

**PHASE 1 PALAEOLOGICAL  
ASSESSMENT OF THE PROPOSED SPAR  
PERSEVERANCE WAREHOUSE  
DEVELOPMENT NORTH OF PORT  
ELIZABETH IN THE NELSON MANDELA  
METROPOLITAN MUNICIPALITY, EASTERN  
CAPE PROVINCE.**

**FOR**

**SPAR Perseverance Warehouse  
Development**

**HIA CONSULTANTS**

**SiVEST Environmental Division**

**DATE: 20 February 2017**

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## EXECUTIVE SUMMARY

Gideon Groenewald was appointed by SiVEST Environmental Division to undertake a Phase 1 Palaeontological Survey, assessing the potential palaeontological impact of the proposed SPAR Perseverance Warehouse Development north of Port Elizabeth in the Nelson Mandela Metropolitan Municipality, Eastern Cape Province. The study was recommended following a Desktop Palaeontological Impact Assessment that indicated the requirement of a Phase 1 site visit.

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. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The study area the proposed SPAR Perseverance Warehouse Development north of Port Elizabeth in the Nelson Mandela Metropolitan Municipality, Eastern Cape Province, is mainly underlain by Cretaceous aged sedimentary rocks of the Sundays River Formation, Uitenhage Group and Tertiary to Quaternary aged Intermediate and Low Level Fluvial Gravel of the Swartkops River (Figure 2).

These Cretaceous to Quaternary aged sedimentary rocks weather into very clay rich soils, that characterize the study area, with very high groundwater levels in the gravel beds.

Several possible mineralized (expected to be “fossilized”) bones occur with hundreds of clearly defined much younger bones in the study site that seems to be used as a dumping site by local inhabitants of the area. A Very High Palaeontological sensitivity is allocated to areas underlain by the Fossiliferous Cretaceous aged marine deposits of the Sundays River Formation and a High Palaeontological sensitivity to areas underlain Low Level Gravels of Tertiary to Quaternary age.

### Recommendations:

- The ECO and EOs must be informed of the fact that a Very High Palaeontological sensitivity was allocated to the areas of the development underlain by rocks of the Uitenhage Group and a High Palaeontological sensitivity is allocated to areas underlain by rocks of the Low Level fluvial gravels on site. Although suspiciously fossiliferous, bone material found associated with Tertiary aged gravels might be related to recent (1968-69 flooding in the area and the HIA will take note of this fact.
- A protocol for the chance find of fossils must be compiled and forms part of an Addendum to this Phase 1 PIA study. This report must be discussed with the ECO on site as soon as clearing of topsoil starts for this project.

- These recommendations as well as the recommended actions mentioned in the “Chance Find Protocol” must be included in the EMPr of this project.

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## INTRODUCTION

### Background

Gideon Groenewald was appointed by SiVEST Environmental Division to undertake a Phase 1 Palaeontological Survey, assessing the potential palaeontological impact of the proposed SPAR Perseverance Warehouse Development north of Port Elizabeth in the Nelson Mandela Metropolitan Municipality, Eastern Cape Province. The study was recommended following a Desktop Palaeontological Impact Assessment that indicated the requirement of a Phase 1 site visit.

### Legal Requirements

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. 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; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

### Aims and Methodology

A Phase 1 investigation is often the last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

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 identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assessing 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.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (3324 Port Elizabeth) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage was 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 minimal extent of bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

<b>PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS</b>	
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).	
<b>RED</b>	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.
<b>ORANGE</b>	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.
<b>GREEN</b>	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.
<b>BLUE</b>	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

	<p>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. Minimum requirement is a Phase 1 site inspection and/ or a “Chance Find Protocol” Report. Collection of a representative sample of potential fossiliferous material is recommended.</p>
<p style="text-align: center;"><b>GREY</b></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. Minimum requirement is a Phase 1 field investigation and/or a “Chance Find Protocol” Report.</p>

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

### Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area’s stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged);
- where feasible, location and examination of any fossil collections from the study area (e.g. museums); and



- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation focussed on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

### Locality and Proposed Development

The locality of the proposed development falls within the industrial development area north of Port Elizabeth (Figure 1) and a description of the proposed development is taken directly from the information as supplied by SiVest. Environmental Division.



**Figure 1 Locality of the SPAR Perseverance Warehouse Development**

Due to the growing market demands, the SPAR Group (Pty) Ltd (hereafter referred to as 'SPAR') are proposing to construct a new SPAR Distribution Centre on Erf 1092 at Red House in Port Elizabeth, Eastern Cape Province (hereafter referred to as the 'proposed development' indicated in Figure 1). The proposed development will be a self-sustainable facility which includes a new Dry Goods

Warehouse with an internal Returns Area and Workshop/Charging Bay. In addition, the proposed development will also include the following:

- Conference Facility (including Entrance Foyer, IT Centre, Training Rooms, Bar Facility, Conference Ablutions & Entertainment Area);
- Security Entrance & Staff Ablution;
- Canteen;
- Guardhouse / Entrance Canopy;
- Truck Workshop & Truck Wash;
- Services Room (accommodating electrical, transformer and generator);
- Municipal Sub-station;
- Truck Entrance & Guard House;
- Fire Pump House; and
- Site services such as internal roads, stormwater systems, water reticulation systems and sewage systems.

The following information should also be noted:

- The site is undeveloped but is located within an industrial area;
- The site does not fall within any National Threatened Ecosystems;
- Surface water features are present on site. The 'waterbody' on the site is delineated as a wetland on the National Freshwater Ecosystem Priority Areas map and the NMBM's Fine-Scape Wetland Map;
- The site is within 5 km of a Formal Protected Area – i.e. the Swartkops Valley Local Authority Nature Reserve;
- The site falls within a Terrestrial Critical Biodiversity 2 Area in terms of the Eastern Cape Biodiversity Conservation Plan (2007);
- The site falls within an Aquatic Critical Biodiversity 2 Area in terms of the Eastern Cape Biodiversity Conservation Plan (2007);
- The site is not within a CBA or riverine process area in terms of the NMBM's Bioregional Plan (2015);
- Pre-transformation vegetation types mapped on the site are Motherwell Karroid Thicket and Sundays Doringveld Thicket (NMBM Bioregional Plan, 2015); and
- The Ecosystem Status of the site is rated as 'endangered' on a metropolitan scale (NMBM Bioregional Plan, 2015).

The proposed project site currently belongs to the Nelson Mandela Bay Metropolitan Municipality (NMBMM). However, the ownership of the property is in the process of being transferred to SPAR and thus ultimately the property will

belong to SPAR. The proposed project site will be accessed primarily via Kohler Road which will need to be extended as part of the proposed development. Additionally, the proposed development will also include the upgrade of the Kohler/Chelsea Roads intersection.

As mentioned above, the proposed development involves the construction of a new SPAR Distribution Centre, with the purpose of housing the increase in SPAR's operational demands due to national and regional growth. It should be noted that the new project site makes provision for future expansion according to the SPAR 20 year expansion plan. In addition, the project site is a 146 000m<sup>2</sup> undeveloped erf and is in close proximity to an existing SPAR Distribution Centre.

## GEOLOGY

The study area is mainly underlain by Cretaceous aged sedimentary rocks of the Sundays River Formation, Uitenhage Group and Tertiary to Quaternary aged Intermediate and Low Level Fluvial Gravel of the Swartkops River (Figure 2). These Cretaceous to Quaternary aged sedimentary rocks weather into very clay rich soils that characterize the study area, with very high groundwater levels in the gravel beds.

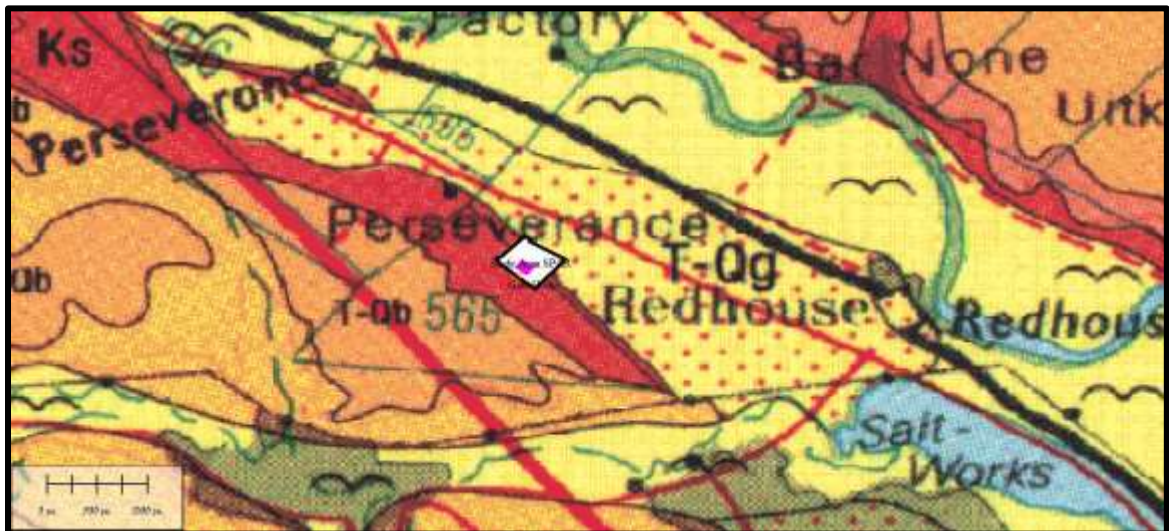


Figure 2 Geology underlying the development is mainly Cretaceous aged Sundays River mudstone (Ks) and Tertiary to Quaternary aged fluvial gravels (T-Qg)

### **The Sundays River Formation (Ks)**

The Sundays River Formation (Ks) is interpreted as a sequence of mostly green to grey coloured marine mudrocks with near-shore interbedded sandstone that in some places have the characteristic herringbone cross-bedding that is indicative of a tidal environment (Johnson *et al*, 2006).

### **Fluvial, Low Level Gravels (T-Qg)**

The Low Level Fluvial Gravels (T-Qg) is interpreted as fluvial sediments probably associated with Low Sealevel stands associated with a fluvial environment of an ancient Swartkops River. It is possible that this area can be subjected to flooding in the future as sea-level rise due to Global Warming. The associated higher water tables will result in permanent water bodies such as the one found on site, where the water in the man-made lake is most probably seepage of groundwater and not necessarily rainwater. Due to the closeness of the sea, the water level in this water body will rise during the present rise in sea-levels as a result of Global Warming.

## **PALAEONTOLOGY**

### **PRELIMINARY ASSESSMENT RESULTS**

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself (Desktop PIA). The palaeontological sensitivity was predicted as highly significant, due to the potential abundance of Cretaceous to Quaternary aged fossils, including trace, plant, invertebrate and vertebrate fossils, in the Uitenhage Group as well as the Low Level Fluvial Gravels on site.

## **FIELD INVESTIGATION**

Dr. Gideon Groenewald, experienced fieldworker, visited the site of the proposed SPAR Perseverance Warehouse Development north of Port Elizabeth in the Nelson Mandela Metropolitan Municipality, Eastern Cape Province on 20 February 2017. The topography of the area is dominantly footslope landscape associated with a terrace gravel to the north, where large parts of the land surface is in some way or another altered by human development. This includes very old road infrastructure (possibly wagon trails or sandy roads, informal burrow pit excavations, as well as completely unaltered vegetation with natural habitats intact despite the closeness of formal housing and industrial sites.

The soil cover seems to be very deep clay-rich, Hutton soil forms with very high clay content. The burrow-pit excavation reveals a very high water table in the gravel beds on site.

Excavations for the new development will expose mostly mudstone and shale of the Sundays River Formation (southern part of the proposed development) and most probably gravel beds of the Lower Level Gravels in the northern part of the development.

The presence of the well-defined mudstone layers as well as confirmation of the exposure of green mudstone, will be a clear indication of the possible presence of fossil remains and the “Chance Find Protocol” must be included the procedures that the contractor must follow to record these important finds. The “Chance Find Protocol” Report must be included in the EMPr for the project.

### Field Survey

Observations were recorded at different GPS stations (Figure 3 and Table 2).

**Figure 3 GPS Stations with photographic records (Table 2) of observations that revealed significant finds in terms of the Palaeontological Heritage of the development site**



For reference to observation points the study area is enlarged to allow for numbers of GPS stations to be revealed in the figures. The GPS points indicate specific points where either present day bones of cattle and large vertebrates (unknown age) were recorded. At some points the observations are related to other fields of the present day Ecology of the area, but might be once-off





sightings (for example tortoises that might be illusive and not easy to see during site investigations by ecologists. The reason for including these sightings in this report is purely for the sake of recording the sightings for the benefit of the entire EIA team.




The recording of bone material that was buried for some time (very heavy material, indicating some mineralization since burial) is recorded in this report, mainly as an indication of the possible presence of the remains of animals that occurred in the study area at least more than 100 years ago. It must be stressed that thousands of bones (very light compared to the fossilized bones), present in the study area, are purely the remains of present day cattle, goats and possibly wildlife that perished or were consumed by humans (bones clearly cut by butcher saw). The presence of excretions of an animal that clearly eats mainly bones (highly bone-enriched excretions) indicates that these carnivores (maybe dogs) and other bone-eaters (such as porcupines) are very actively eating the bones that are dumped in the study area.

Weathering is not very deep (>1.5m) and outcrops of suitable rocks for finding of fossils are not well preserved. It is however important to note that the areas indicated as having a Very High to High potential to reveal significant Palaeontological Heritage need to be noted by the ECO. Detailed inspection of all excavations (soil survey excavation sites) as well as the burrow pit sides did not reveal any significant marine fossils. Due to the very high water table level, it is an assumption of this survey, that the development of this terrain will most probably include much more a process of land filling than excavation of foundations. If excavation of deeper than 1.5m is planned, the ECO must follow the proposals in the "Chance Find Protocol" document that is provided as a separate document, but read as an Addendum to this Phase 1 PIA.




Table 2 attempts to give the reader an overview of the outcrop characteristics of the inspection points discussed. The most important points for inspection by the ECO will be discussed in the "Chance Find Protocol" report, with photographic illustrations of the kind of outcrop that might reveal significant plant, trace, insect as well as vertebrate fossils in this extremely sensitive geological terrain for Palaeontological Heritage.




**Table 2 Record of Photographic Observations. For GPS points see Figure 3.**




Photo	(GPS station) Coordinates	Comments	Photographic Record
1	(1530) S33° 50.210' E25° 32.292'	General view of the study area towards the west. No significant outcrops of Sunday River Formation, with very deep red highly clay-rich soils. No fossils observed.	
2	(1531) S33° 50.195' E25° 32.300'	Highly sensitive geological formations are deeply weathered and no fossils were observed in the areas where highly clay-rich soils are exposed.	
3	(1532) S33° 50.156' E25° 32.353'	Lower Level Gravels resulting in areas with numerous cobblestones in a clay-rich soil that have very high water tables. Fossils of vertebrates are present, but these must not be confused with numerous bones of recent animals dumped at the site	
4	(1532) S33° 50.156' E25° 32.353'	Excavation into deep soils on the Sundays River Formation. Small vertebrate bones are present in the soils, but it is not clear if these bones are the remains of animals that still live in this habitat today. As is clear from this image, the area is highly disturbed by human intervention	




5	(1532 S33° 50.156' E25° 32.353'	Deep soils are present, with broken bones, not cut by humans, but clearly broken and mineralized as they are much heavier than the present day bones also present on site. These bones were recorded as fossils during the field investigation but after discussions with other scientists the bones are seen as most probably indicative of animals that lived in the area less than 200 years ago. The bones are therefore of Archaeological interest.	
6	(1533) S33° 50.138' E25° 32.367'	Highly weathered bone material present in the excavations for geotechnical investigation on site. The deeply weathered highly clay-rich sediments might contain some vertebrate fossils and the ECO must be made aware of the possible presence of significant fossil finds if excavation will exceed 1.5m in depth.	
7	(1534 S33° 50.131' E25° 32.371'	Very high water table at the site resulted in a human made "lake" on site. The excavation into the substrate exposed a rich clay, that might contain significant fossils of land-living animals, mostly associated with human activities during recorded history in this area. No marine fossils were observed and it is assumed that the burrow pits were exposing gravels that were used for road building.	








8	(1535) S33° 50.114' E25° 32.384'	Highly suspicious looking bones, with a very high density were recorded on site. These bones differ completely from the majority of bone fragments on site that clearly are present day bones resulting from the slaughtering of domestic animals. The bones recorded in this picture are morwe dense and might be associated with cattle that were used for domestic purposes and were then covered for some time, causing mineralization.	
9	(1535) S33° 50.114' E25° 32.384'	Suspiciously well-preserved bone material present on site. These bones differ from the common bones on site and were initially thought to represent Tertiary aged material. Following discussions with other scientists it is accepted that these remains might be of a younger age and belongs more in the field of Archaeology where the remains might be associated with recorded human history of the site.	
10	(1535) S33° 50.114' E25° 32.384'	Not very clear in the photograph, but present at the tip of the geological pick, a bone was recovered from the gravel bed that is clearly cut by a butcher saw. This implies that some of the bone material on site is very young and, although embedded in the gravel beds, are not older than recorded history on site. This also places the age of the river gravels at a relatively young age, indicating that this study site might be inundated with flood waters during high rainfall cycles, such as the flood cycle of 1969 in this region. With the present rise in sea level as a result of Global Warming, the development of infrastructure must be planned accordingly.	

11	(1536) S33° 50.075' E25° 32.424'	Natural fluvial levies are present on site. These small but important natural barriers will prevent rises in water levels of the Swartkops River to flood this region. Bones associated with this site is much younger than the bones recorded at GPS site 1532 and are most probably part of normal human dumping of remains of meals.	
12	(1538) S33° 50.043' E25° 32.398'	Modern bones are discarded and must not be confused with the mineralized bone remains recorded at GPS site 1532. The presence of highly bone-rich excretion dumps of a carnivorous animal (GPS ) indicates that the area is frequented by bone eating animals that might include porcupines that are known to eat bones for the some reason.	
13	(1541) S33° 50.006' E25° 32.317'	Significant shelly remains of either land-living present day snails or marine animals are present on site. The ECO must be on the lookout for the fossilized remains of marine invertebrates that might be present in the mudstones of the Sundays River Formation.	

14	(1542) S33° 49.985' E25° 32.272'	Relatively deep soils on highly clay-rich sediments abounds with the presence of ground-living animals, including moles. These animals might be responsible for the fact that bones of different ages abound on the surface in the study area. Petrified bones will be sorted with boulders and might be present as a result of the burrowing animals bringing these "rocks" to the surface.	
15	(1543) S33° 49.988' E25° 32.245'	Significant linear depression on site, associated with the remains of mineralized bones of cattle, most probably indicate the presence of an ox wagon trail on site. Although highly speculative, the explanation for the presence of so many mineralized bone remains of large cattle species, mixed with the present day bones of butchered animals, can only be explained if the older animals are seen as animals that died along these very sandy routes where trekking must have been a deadly business.	
16	(1545) S33° 50.005' E25° 32.234'	Recording of a rare sighting of a tortoise. It is only recorded in this report to assist the Ecologist of the project to ensure that the area be "swept" for these creatures at the onset of construction and clearing of the bushy vegetation.	

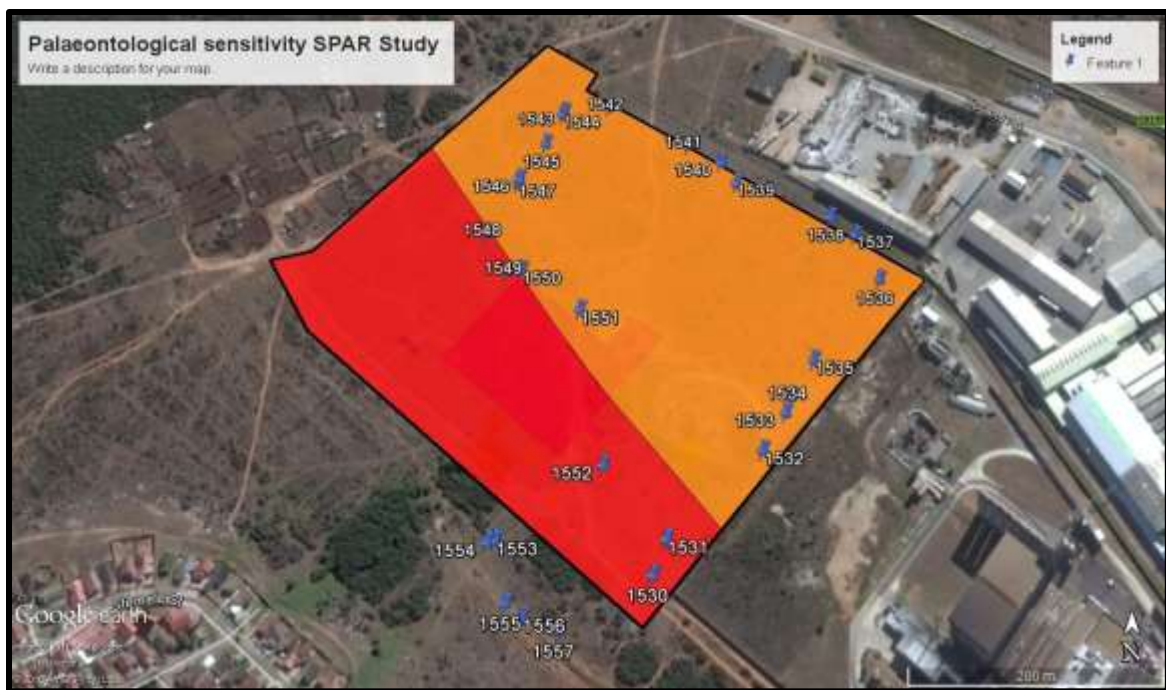
17	(1547) S33° 50.027' E25° 32.218'	Very bone-rich excretions abound in the study area, indicating that bone material are frequently dumped in the study site.	
18	(1550) S33° 50.071' E25° 32.221'	Deep excavation (>1.5m) during geotechnical investigation indicates that the soils are very deep, highly clay-rich and no fossils were observed at this specific excavation site. If excavation of deeper than 1.5m is planned, the ECO must follow the recommendations made in the "Chance Find Protocol" document to ensure recording of fossils if present in this soil profile.	
19	(1552) S33° 50.163' E25° 32.267'	Very high water table levels causes groundwater seepage in the study area. The high water tables will lead to difficulty in excavation of foundations. Fossils will be difficult to see and no fossils were observed during this field investigation.	

20	(1554) S33° 50.197' E25° 32.206'	View to the south of the study area where the main development will take place. The area is underlain by very deep soils and no fossils were observed.	
21	(1555) S33° 50.222' E25° 32.217'	Observations towards the north of the study area. The site is covered in very deep soils and no fossils were recorded in this part of the site.	
22	(1555) S33° 50.222' E25° 32.217'	Observations towards the south of the study area. The area is underlain by deep soils and no fossils were observed.	
23	(1555) S33° 50.222' E25° 32.217'	Observation towards the east. The impact of human development is clearly visible and no fossils were observed in the deep soils on site.	

24	(1555) S33° 50.222' E25° 32.217'	Observation towards the west. The impact of human development is clearly visible and no fossils were observed in the deep soils on site	
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## PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation.



**Figure 4 Palaeontological Sensitivity of the southern part of the study area is Very High and that of the northern region High. For explanation of colour coding, see Table 1.**

The field investigation confirms that the study area is underlain by deep red coloured clay-rich soils that forms on both the Sundays River Formation as well as the Low Level shale of the Tierberg Formation, Ecca Group as well as green-grey shale and yellow-brown sandstone of the Abrahamskraal Formation, fluvial Gravel Beds. All areas have deeply weathered soils and significant bone remains were recorded from the gravel beds. Some of the bones are clearly very young remains

of bones that were cut by modern butcher activities, whereas other bones are mineralized and probably represent age old deaths of animals along the linear zone in the study area that might represent an old ox wagon trail that lead from the sea into the interior of the Eastern Cape during the late 1700 to 1800's. Some areas have shallow weathering and fossils might be discovered during excavation of deeper than 1.5m.

## **IMPACT ASSESSMENT METHODOLOGY**

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the Basic Assessment (BA). The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

### **Determination of Significance of Impacts**

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 4.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

### **Impact Rating System**

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

- Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 3 Description of terms

<b>NATURE</b>		
<p>Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.</p> <p>Palaeontological Heritage is a key component in the EIA process and must be addressed during the initial stages of the development as part of the EMP of the project.</p> <p>Planning: Must form part of the EMP document</p> <p>Construction: Follow "Chance Find Protocol" recommendations</p> <p>Operational: No Impact</p> <p>Decommissioning: Report any deep excavation during decommissioning – normally No Impact</p>		
<b>GEOGRAPHICAL EXTENT</b>		
<p>This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.</p>		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	<p>Will affect the entire country Planning and Construction – Pre-mitigation Very High Negative International, loss of fossils is permanent and irreversible</p> <p>Post-mitigation Very High Positive International – finding of new fossils in this site will have Very</p>



		High Positive implications for the status of research in the Eastern Cape Province and South Africa
<b>PROBABILITY</b>		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence). <b>Fossils are present in all the geological formations on site and chance find during excavation is Very High. Both Planning and Construction Phase. Operational Phase and Decommissioning – no impact</b>
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
<b>REVERSIBILITY</b>		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required. <b>The proper planning of mitigation and inclusion into the EMP will reduce damage to fossils. Excavation during construction will unfortunately always destroy some significant fossils but the proper planning and collection of fossils will eventually have a positive impact if correctly mitigated for.</b>
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.

IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources without mitigation, but unique find of fossils with properly planned mitigation during construction	<b>The impact will result in a complete loss of all resources. Excavation will result in complete loss of access to fossils in the study area for ever. The collection of a representative sample of fossils will however be a unique opportunity to find the fossils as no excavation will also be a negative impact as no fossils will be exposed and possible “chance finds” will be lost to science.</b>
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).

4	Permanent negative without mitigation Permanent positive with properly planned mitigation	The only class of impact that will be non-transitory. Without Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite). Positive with mitigation, according to the "Chance Find Protocol" EMP arrangements.
<b>CUMULATIVE EFFECT</b>		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact without mitigation in planning and construction phase High Cumulative Impact with mitigation during planning and construction phase	The impact would result in significant negative cumulative effects if not mitigated Mitigation will result in High positive cumulative impacts
<b>INTENSITY / MAGNITUDE</b>		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation. Probably applicable for fossils as mitigation will be expensive but can lead to permanent recovery of significant fossils and mitigation will result in positive outcome.
4	Very high negative if not mitigated Very high positive if mitigated according to "Chance Find Protocol"	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
Significance		
<b>SIGNIFICANCE</b>		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:		
$(\text{Extent } (4) + \text{probability } (-3) + \text{reversibility } (2) + \text{irreplaceability } (4) + \text{duration } (4) + \text{cumulative effect } (4)) \times \text{magnitude/intensity}(4).$		
The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
<b>Points</b>	<b>Impact Significance Rating</b>	<b>Description</b>
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.

6 to 28	Positive impact	Low	The anticipated impact will have minor positive effects.
29 to 50	Negative impact	Medium	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive impact	Medium	The anticipated impact will have moderate positive effects.
51 to 73	Negative impact	High	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive impact	High	The anticipated impact will have significant positive effects.
74 to 96	Negative impact	Very high	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive impact	Very high	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report.

Table 4 Rating of impacts

IMPACT TABLE FORMAT	
Environmental Parameter	<i>A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water <b>Palaeontological Heritage</b></i>
Issue/Impact/Environmental Effect/Nature	<i>A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water <b>During planning and construction phase – actions without mitigation according to “Chance Find Protocol” will lead to destruction of and permanent loss of fossils.</b></i>

IMPACT TABLE FORMAT	
	<i>With mitigation Palaeontological Heritage will benefit by the fact that areas with no outcrop will become available for scientific investigation, albeit for a very limited time.</i>
<i>Extent</i>	<p>A brief description indicating the chances of the impact occurring</p> <p><i>The Phase 1 field assessment revealed the presence of possible vertebrate fossils and it is a known fact that excavation into the Sundays River Formation has a Very High likelihood of exposing significant marine invertebrate palaeofauna</i></p>
<i>Probability</i>	<p>A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity</p> <p><i>Without mitigation according to the "Chance Find Protocol" no recovery of the Palaeontological Heritage will be possible</i></p> <p><i>With mitigation, the new fossil finds will be a unique opportunity to discover new fossils in South Africa</i></p>
<i>Reversibility</i>	<p>A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water</p> <p><i>Palaeontological Heritage will be affected permanently and irreversibly during this development</i></p>
<i>Irreplaceable loss of resources</i>	<p>A brief description of the degree in which irreplaceable resources are likely to be lost</p> <p><i>Any excavation will either provide a unique opportunity to find new fossils if properly mitigated, or lead to permanent loss of information if not mitigated according to the "Chance Find Protocol"</i></p>
<i>Duration</i>	<p>A brief description of the amount of time the proposed activity is likely to take to its completion</p> <p><i>No recovery of the loss of fossils is possible after irresponsible activity without mitigation.</i></p> <p><i>Following mitigation, the information gathered by finding new fossil data will have a permanent</i></p>

IMPACT TABLE FORMAT		
	<i>impact in our understanding of the Natural Environment during the Cretaceous to Quaternary ages in Southern Africa</i>	
<i>Cumulative effect</i>	<i>A brief description of whether the impact will be exacerbated as a result of the proposed activity</i> <i>Irresponsible development without mitigation in the entire region of the Swatkops River has resulted on the loss of thousands of items that could contribute significantly to the Palaeontological Heritage of the Country.</i> <i>Responsible mitigation during the planning and construction phases of the project will result in unique opportunities to discover new fossils in Southern Africa.</i>	
<i>Intensity/magnitude</i>	<i>A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily</i> <i>Loss of Palaeontological Heritage is permanent and the system can never recover lost information due to irresponsible actions in this development</i> <i>Responsible actions and mitigation according to the "Chance Find Protocol" will lead to unique opportunities to discover new information for the first time, with a permanent impact on the future generations of students in South Africa</i>	
<i>Significance Rating</i>	<i>A brief description of the importance of an impact which in turn dictates the level of mitigation required</i> <i>Without mitigation, the significant negative impact on Palaeontological Heritage will be Very High during the planning and construction phases. There will be no impact on Palaeontological Heritage during operational and decommissioning phases.</i>	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	-4	+4
Probability	-4	-3

IMPACT TABLE FORMAT		
Reversibility	-4	+2
Irreplaceable loss	-4	+4
Duration	-4	+4
Cumulative effect	-4	+4
Intensity/magnitude	-4	+4
Significance rating	-96 (high negative)	+70 (high positive)
Mitigation measures	<p><i>Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMPR.</i></p> <p><i>Please refer to the "Chance Find Protocol" Report attached to the Phase 1 PIA Report</i></p>	

## CONCLUSION

The study area the proposed SPAR Perseverance Warehouse Development north of Port Elizabeth in the Nelson Mandela Metropolitan Municipality, Eastern Cape Province, is mainly underlain by Cretaceous aged sedimentary rocks of the Sundays River Formation, Uitenhage Group and Tertiary to Quaternary aged Intermediate and Low Level Fluvial Gravel of the Swartkops River (Figure 2).

These Cretaceous to Quaternary aged sedimentary rocks weather into very clay rich soils that characterize the study area, with very high groundwater levels in the gravel beds.

Several possible mineralized (expected to be "fossilized") bones occur with hundreds of clearly defined much younger bones in the study site that seems to be used as a dumping site by local inhabitants of the area. A Very High Palaeontological sensitivity is allocated to areas underlain by the Fossiliferous Cretaceous aged marine deposits of the Sundays River Formation and a High Palaeontological sensitivity to areas underlain Low Level Gravels of Tertiary to Quaternary age.

### Recommendations:

- The ECO and EOs must be informed of the fact that a Very High Palaeontological sensitivity was allocated to the areas of the development



underlain by rocks of the Uitenhage Group and a High Palaeontological sensitivity is allocated to areas underlain by rocks of the Low Level fluvial gravels on site. Although suspiciously fossilsiferous, bone material found associated with Tertiary aged gravels might be related to recent (1968-69 flooding in the area and the HIA will take note of this fact.

- A protocol for the chance find of fossils must be compiled and forms part of an Addendum to this Phase 1 PIA study. This report must be discussed with the ECO on site as soon as clearing of topsoil starts for this project.
  - These recommendations as well as the recommended actions mentioned in the “Chance Find Protocol” must be included in the EMP of this 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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