Basic Heritage Impact Assessment for the proposed upgrades to the Maropeng Interpretive Centre

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Submitted to: NuLeaf Planning & Environmental (Pty) Ltd.

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DECLARATION OF INDEPENDENCE

This report has been compiled by Dominic Stratford. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the project.

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1. Project Description

1.1. Introduction

The Maropeng property is located in the Cradle of Humankind UNESCO world heritage site in the Gauteng. Extensive infrastructure upgrades are planned to remodel several established areas of the property and build new facilities in other areas. The upgrades include significant extensions to the hotel, renovating of the dormitory (Hominid House)[1] and the development of the amphitheatre to include a fixed stage and associated ablution facilities. The new developments on the property include three picnic areas (Africa Forms, Human Impact and Triassic Period), which incorporate standing and landscape sculpture and a small lake (Triassic Period picnic area). All of these upgrades require varying levels of subsurface disturbance and potentially extensive soil removal and movement. In accordance with the Department of Environmental Affairs, the South African Heritage Resource Agency and UNESCO, a Heritage Impact Assessment is required to ensure that cultural heritage resources are identified, assessed for sensitivity and protected if required. During the initial phases of construction of the museum and market place at Maropeng, a rich Earlier Stone Age-bearing deposit was exposed and partially destroyed. It is therefore necessary to conduct not only surface survey of the property to identify exposed archaeological material, but also subsurface survey through the excavation of test pits to identify buried archaeological remains that may be destroyed by the construction of the proposed upgrades.

1.2. Purpose of the Basic Assessment Report

The purpose of the below Basic Assessment Report is to identify, describe and assess the sensitivity of archaeological materials that may be damaged or destroyed by the proposed infrastructure upgrades to take place across the Maropeng property. The process of the assessment has been conducted in accordance with the guidelines set out by the relevant authorities. The following report provides information about the nature and sensitivity of the cultural heritage resources found on the Maropeng property in the vicinity of the proposed infrastructure upgrades. It also includes recommendations for preserving the cultural heritage resources. The identified archaeology found on the property through previous EIA reports

[1] Specific renovations of the Hominid House dormitories are not included in this BA, however the associated Human Impact Picnic Area is included.

and archaeological research warrants careful exploration for both surface and buried archaeological materials at Maropeng.

1.3. Abbreviations

Abbreviations	***Description***
A.D.	Common Era (the past 2000 years)
ASAPA	Association of South African Professional Archaeologists
BA	Basic Assessment
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DGPS	Differential Global Positioning System
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
ICOMOS	International Council on Monuments and Sites
LCT	Large Cutting Tool
Ma	Million years ago
MSA	Middle Stone Age
msl	Meters above sea level
NHRA	National Heritage Resources Act
OUV	Outstanding Universal Value
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WHCA	World Heritage Convention Act
WHS	World Heritage Site

1.4. Terms and Definitions

Oldowan	The oldest stone tool technology recognised and found between 2.2 and 1.7 Ma in South Africa.
Acheulean	A stone tool technology found between 0.3 and 1.7 Ma in Africa and characterised by LCTs production and use e.g. handaxes, cleavers and picks.
Colluvium	An accumulation of stones and sediments deposited downwards by gravity.
Lithic	A stone tool or anthropogenically modified stone.

Primary context	A context which preserves in situ archaeological evidence exhibiting little or no post-depositional modification through biogenic, geogenic or anthropogenic processes.
Spit level	An arbitrary horizontal unit of depth excavated from a deposit or layer e.g. 10cm.
Secondary context	A context in which the archaeological evidence has been moved, accumulated, dispersed or modified from its primary context by post-depositional processes.
Shovel test pit	A 1m x 1m square excavated to an arbitrary depth (bedrock or depth significant enough to be sterile of archaeological remains) with the intention of exploring the extent and nature of buried archaeological evidence.
Winnowed	The selective removal of smaller sediments and stones by water.

2. Legal and Administrative Requirements

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

2.1. National Heritage Resources Act (NHRA) (Act No. 25 of 1999)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA.

2.2. World Heritage Convention Act (Act N. 49 of 1999)

Within areas of OUV, the identification, description and protection of sites and artefacts are governed by the World Heritage Convention Act (Act N. 49 of 1999). In this study, the guidelines established by the International Council on Monuments and Sites (ICOMOS) Guideline on Heritage Impact Assessments for Cultural World Heritage Properties are followed closely to ensure methodological consistency and thorough protection is afforded to the heritage of the Maropeng site.

3. Background to the Study Area

3.1. Description of study locality

The Maropeng site (GPS: 25°58'02.72''S, 27°39'44.86''E) is located in the core area of the UNESCO World Heritage Site known as the Cradle of Humankind, Gauteng. The Cradle of Humankind is classified as an area of Outstanding Universal Value (OUV) due to the preservation of up to 3.5Ma of landscape, faunal and hominid evolution in the dolomite caves found in the area. The deposits of the Sterkfontein Caves, which is located 9km south east of Maropeng, have yielded the largest assemblage of *Australopithecus* fossils in the world (Clarke, 2013) as well as the most complete single hominid skeleton ever found (Clarke, 1998) and the oldest hominid fossils found in southern Africa (Partridge et al., 2003). In addition to these remarkable finds, Sterkfontein, and nearby Swartkrans, have yielded two of the largest and most complete assemblages of Oldowan stone tools in southern Africa (Kuman & Field, 2009).

The geological context of the Maropeng site is very different to that which characterises the fossil-bearing areas of the Cradle of Humankind. The property is situated on a combination of lithologies which overlie the cave-bearing dolomites, in this case both Timeball Hill Formation and Hekpoort Formation (Obbes, 2000). These formations are not fossiliferous and therefore have no palaeonthological value. Although this specific geological context of the site precludes Maropeng from preserving any palaeontological fossil material (See Geological Map in Appendix 1), the site is of increasing archaeological interest due to the preservation of a rich ESA stone tool assemblage buried just below the landscape surface across the site. The archaeological context and lithic assemblage has been the subject of both initial research (Pollarolo et al., 2010) and continuing research under the direction of the author. This stone tool assemblage represents the best preserved and largest ESA LCT-

bearing assemblage yet discovered in the Cradle of Humankind in an open-air context. It must therefore be considered to be an important component within the World Heritage Site OUV. An outline of the attributes, condition, integrity and research value of this assemblage is described in section 3.3.

An initial EIA report (Van Riet and Louw, 2003) filed prior to the construction of the Maropeng Interpretive Centre conducted basic assessments of geology, soils, hydrology, topography and flora. Maps of their respective distributions on the site can be found in Appendix 1. Figure 1, shows the Maropeng site and the areas of proposed infrastructure upgrades together with the locations of archaeological sampling.

3.2. Description of proposed infrastructure upgrades

Five areas have been identified in the proposed infrastructure upgrades. Each area, and the nature of the upgrade, is described briefly below and can be seen in Figure 1. Service capacity assessment indicates that water and sewerage upgrades will not be necessary in any of the areas. These upgrades will be localised to the immediate area of the infrastructure and are not likely to inflict additional subsurface disturbance across the Maropeng property

Hominid House & Human Impact Picnic Area

The Hominid House area (Figure 1; GPS: 25°58'15.33''S, 27°39'32.35''E) was being upgraded as this report was being written. This building is not part of this BA application but the proximity of the building to the Huma Impact Picnic Area mean that it is relevant to the HIA assessment. Originally, Hominid House consisted of three buildings, two dormitories and associated teacher accommodation, and one kitchen and communal area. These buildings covered an area of approximately 2000m^2. Extending 25m south from the building was a lawn play area. To the north of Hominid House is a small picnic area. All these areas can be considered disturbed.

Human Impact Picnic Area

The newly proposed upgrades include the development of a 'Human Impact Picnic Area' which will be located directly to the north of the current Hominid House buildings and

expand the current picnic area. Development of the picnic area will include extensive landscaping, installation of seating area, a small pond and 'eco-friendly' toilet facilities. Excavations for foundation in this area expect to extend to a maximum depth of 600mm.

Africa Forms Picnic & Play Area

This area (Figure 1; GPS: 25°58'03.31''S, 27°39'34.64''E) is currently dominated by grass and within a 'Moot Plains Bushveld' vegetation cover (Vegetation map in Appendix 1) with open woodland found around the rocky outcrops.. The vegetation in the area is considered sensitive. The area has several dolorite outcrops which have generally been undisturbed by the modern development. Stone walling structures have been found here and given a conservation priority. This area is located on a small ridge that dominates the western part of the Maropeng site (Map 12, Appendix 1). Soil cover here can be thin (<20cm).

The proposed picnic area development focusses on landscaping and installation of a sequence of 'enclosed spaces with suspended shade structures'. These will be located around the natural grassland and outcrops which will remain undisturbed. No bathroom facilities are planned for this area and so subsurface disturbance will be limited to the planting of trees for windbreaks.

Triassic Period Picnic and Play Areas

This area (GPS: 25°57'59.63''S, 27°39'42.04''E) is located just to the west of the Maropeng Tumulus (Figure 1). The area is dominated by natural grassland of the Moot Plains Bushveld vegetation type (Vegetation map in Appendix 1). Shallow south to north orientated drainage ditches can be found close to the Tumulus.

Proposed developments include extensive landscaping and the installation of sculptures, trees and a small lake. These will be built into a framework of manicured lawns and natural grassland. An extensive dirt ('aggregate') path will lead visitors around the area and trees will provide shade near the lawns and picnic locations. No toilet facilities are planned and so disturbance of the subsoils should be limited to the planting of trees and the excavation of the small lake.

Maropeng Hotel

The Maropeng Hotel (Figure 1; GPS: 25°57' 2.65''S, 27°39'51.41''E) is located on a north westerly slope in the far north of the Maropeng property. Here, erosion has exposed the

bedrock and overlying colluvium and there is little to no topsoil cover. Quartzites, Shales and Dolorite can be seen exposed on the landscape surface (Map 10 in Appendix 1). The vegetation is classified as a mixture of disturbed and invasive vegetation, protea caffra savanna and grassland (Vegetation map in Appendix 1) although concentrated development of the area has disturbed much of the natural vegetation in the area. To the south east of the hotel, a large spoil heap has been built up to hide the water treatment plant on the adjacent property. This spoil heap was built out of the sediments excavated during the construction of the Market Place and Tumulus and although it contains artefacts they have been completely removed from their original context and therefore have very limited value.

The reception of the existing hotel will be converted into a new spa and wellness centre and will be contained within the current hotel infrastructure footprint. The current 24 rooms of the hotel will also be redeveloped and contained within the original footprint. New buildings will include a new 28 executive rooms, 4 VIP suites, a 24 room cluster, a 23 room cluster and a 22 room cluster. All buildings are to be developed to the north and east of the current hotel. These buildings will be built into the existing north-west slope. The hotel will keep the current 30 bay carp park and offer a 'Park and Ride' service from the main Maropeng car park. From a heritage perspective this poses no issue as no archaeological material has been found in this vicinity. The large spoil heap is to be raised to further limit the visual impact of the water treatment facility directly to the southeast of the Hotel.

Amphitheatre

The Maropeng Amphitheatre (Figure 1; GPS: 25°58'10.43''S; 27°39'48.37''E) represents a large excavated site with a maximum depth of 2.5m below the landscape surface. A gently south westerly sloping grass surface constitutes the area for the audience, while a flat base and steep southern wall represent the back of the site and the performance area. Currently there are limited services in the amphitheatre and that present focus on drainage. This can clearly be a problem when the dominant and underlying sediments are fine-grained and restrict vertical water movement. The vegetation around the amphitheatre is classified as grassland (Vegetation map in Appendix 1), which has formed on massive lateritic sediments. The initial excavation of the amphitheatre exposed a laterally extensive artefact-bearing layer which had not been recognised during construction. This has resulted in the removal and

relocation of considerable quantities of archaeological material. The presence of an artefact-bearing layer in this area was only realised recently during research at Maropeng.

Upgrades to the amphitheatre are extensive and include the construction of a large concert stage, including dressing rooms, storage and associated large bathroom facilities. Beyond the local disturbance of archaeological remains associated with the immediate site, current local service infrastructure capacity has been deemed suitable for the upgrade with the exception of a sewerage pipe that will extend from the southern area of museum overflow car park and a road that will be extended around the eastern extremity of the amphitheatre. The road will follow an existing gravel track (seen in Figure 2) and will be contained within the existing footprint. The current architect's plans are to build the stage and associated buildings into the southern and back wall of the amphitheatre while keeping the gently sloping spectator area to the north. Any proposed additional service trench excavation but will need to be discussed with reference to the identified artefact-bearing layer.

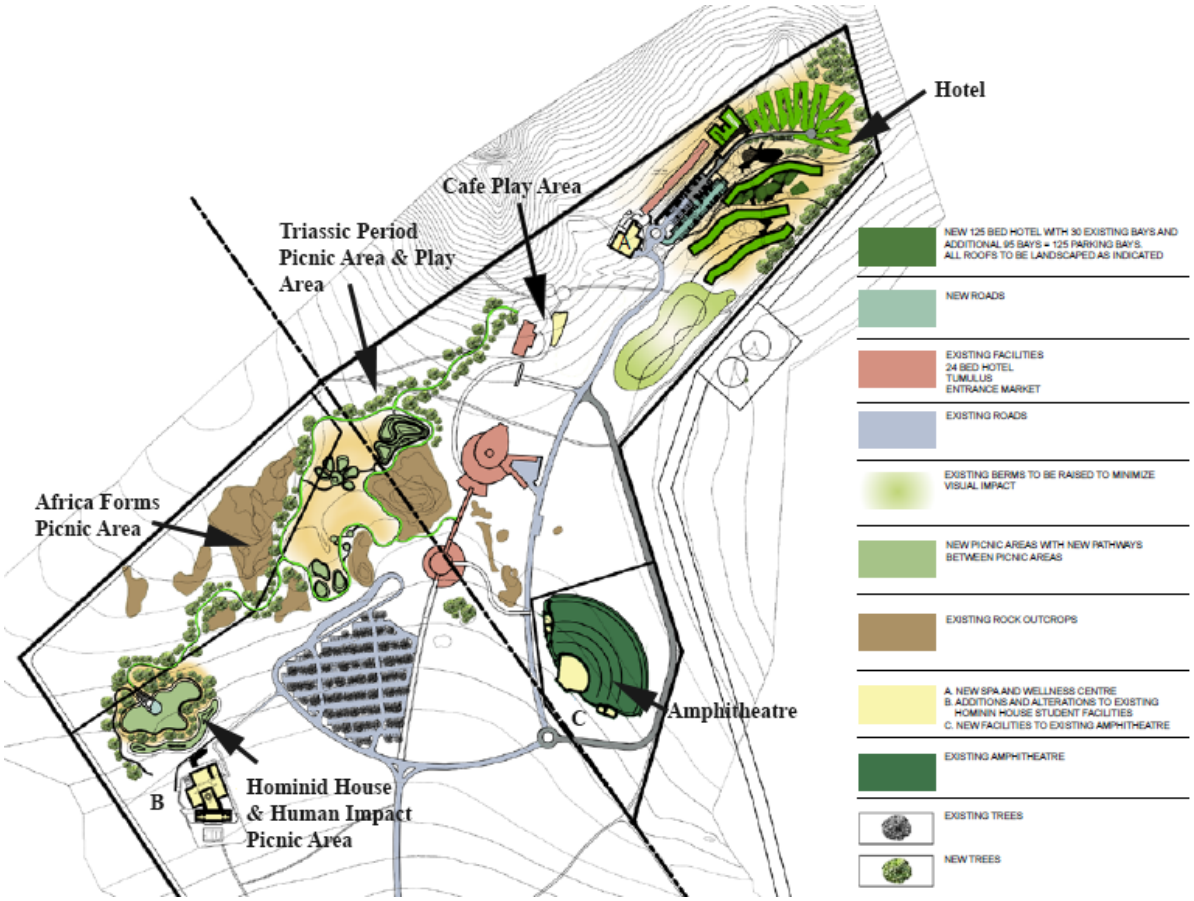

Figure 1. Proposed infrastructure upgrades to the Maropeng property

3.3. Review of previous palaeontological and archaeological studies within the study area

Previous studies have identified several archaeological contexts on the Maropeng site. The stone walling structures identified at the African Forms Picnic Area, have not been the subject of dedicated study but has been attributed to an Early Iron Age settlement. The Earlier Stone Age-bearing deposit identified in the Market Place excavations were the subject of preliminary research. Below I briefly describe both archaeological contexts.

Stone walling structures

Stone walling attributed to the Early Iron Age has been identified in the Magaliesburg area since the early 1970's (e.g. Mason, 1974). These sites are significant for archaeological research as they represent the earliest phases of Iron Age occupation in the Gauteng (previously central Transvaal) area (Huffman, 1990). Several sites have received a great deal of attention including the Iron Age settlements of Broederstroom (e.g. Mason, 1974, 1981; Friede, 1977; Huffman, 1990; Wadley, 1996) and Olifantspoort (e.g. Mason, 1974; Wadley, 1996). These rich settlements document relatively long sequences of occupation and contact between different cultures (Wadley, 1996) and are of key importance to understanding changing subsistence strategies, trade and cultural identities in the Iron Age. Early Iron Age settlements in the Magaliesburg area are dated to between about 225 (Jubilee Shelter [Wadley, 1996]) and 600 A.D (Broederstroom [Mason, 1981]). Open air Early Iron Age settlements can be identified on the landscape by stone walling structures of varying sizes and distributions, although the Central Cattle Pattern has been proposed as the main model for the spatial organisation of structures within settlements (e.g. Huffman, 2001). The stone walling structures found at Maropeng represent a village-sized settlement and it is clear that although several structures of different sizes are present, the settlement is small and contained to an area of about 2000m^2 (described in section 5.2). To date, no excavations have been carried out on the Maropeng stone wall structures and this may be an area of future research by Early Iron Age specialists. This is an important archaeological feature on the Maropeng archaeological landscape and its preservation should therefore be a priority, as was identified by Van Riet and Louw (2003).

Earlier Stone Age-bearing deposits

Earlier Stone Age deposits were not discovered on the Maropeng property until initial construction of the Museum and Market Place in 2003. The original EIA conducted by Van Riet and Louw (2003), focused on archaeological features exposed on the landscape surface and did not investigate the possibility of buried archaeological material being present at the site. This procedure is in accordance with current HIA guidelines. In 2005, visiting archaeologists from the University of the Witwatersrand identified an artefact-bearing layer exposed by the earthworks excavations at the market place (Pollarolo et al., 2010). The stone tools found within the artefact-bearing layer were initially identified by the visiting scientists as Earlier Stone Age (ESA) in type with several typologically diagnostic LCT (Large Cutting Tools) artefacts (handaxes, cleavers and picks) being identified. Controlled excavations were then conducted under Dr. Pollarolo and the Department of Archaeology at the University of the Witwatersrand with support of Maropeng a'Afrika Leisure Ltd. Results of the lithic analysis from initial test pits and excavation around the Market Place and collection of stone tools from the construction spoils heaps can be found in Pollarolo et al. (2010). Very briefly, Pollarolo et al. (2010) proposed that the artefact-bearing layer was formed through the gradual accumulation of colluvium from the nearby quartzite ridge to the east of the Maropeng property. This colluvium was then slowly winnowed and deflated until it formed a 'pavement' covering the landscape. This was then buried. A techno-typological analysis of the Maropeng assemblage revealed close comparisons to other ESA assemblages from Sterkfontein (Kuman & Field, 2009), Swartkrans (Kuman, 1998) and Rietputs Formation (Leader, 2009) in the Vaal River Basin and prompted Pollarolo et al. (2010) to tentatively attribute the assemblage to an Early Acheulean industry. Early Acheulean assemblages from Sterkfontein and Swartkrans in the Cradle of Humankind are dated to between about 1.4 to 1.0 Ma (Kuman & Clarke, 2000; Pollarolo et al., 2010).

Ongoing research at Maropeng under the author's direction has yielded a large and informative stone tool assemblage from in situ excavations (as opposed to construction spoil heaps) which is currently being analysed. The archaeological importance of this assemblage is in its context. Despite the secondary context of the assemblage, the site does preserve the largest and most complete ESA assemblage found in an open air context in the Cradle of Humankind and therefore has the potential to significantly augment our understanding of

hominid distribution and technological behaviour in the Cradle of Humankind between one and two million years ago.

4. Methodology

4.1. Survey and Test Pits

Following the standards recommended by the ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties, this HIA was tasked with considering the Maropeng site in a more comprehensive fashion than is often conducted, "applying the lens of OUV to the overall ensemble of attributes" (ICOMOS, 2010; pp.1). To this end, it was decided that all possible components of heritage value should be considered in this report. This includes more intrusive methods like test pitting and trial trenching as per the recommendations of the above document (*ibid*; pp. 6).

Two basic archaeological survey and sampling techniques were conducted for this HIA. The first involved a standard walking survey of the focus areas of the HIA. These areas (Figure 2) are Hominid House and the Human Impact Picnic Area, Africa Forms Picnic Area, Triassic Period Picnic Area and Play Area, the Hotel and the Amphitheatre. These areas have previously been surveyed as a part of the ongoing archaeological research project at the site under my direction. They were, however, surveyed again. The areas mentioned above were walked in a grid by the author and assistants with any heritage features, artefact scatters noted. The low grass level was beneficial to the survey. Surveys around Hominid House, Triassic Period Picnic Area and Play Area, the Hotel and the Amphitheatre identified only isolated artefacts that had been relocated through the initial construction and landscaping phases at the Maropeng site.

The second technique was shovel test pitting. Although this is not a conventional method used in HIA Basic Assessments (HIA BA), which generally focus on walking surveys, it is considered necessary in an area where a buried artefact-bearing layer is known to be present and potentially extend across the site. The relatively shallow nature of the artefact-bearing layer means that it is easily disturbed and the context destroyed through basic construction practices. This potential has been well demonstrated by the original construction of the Tumulus and Market Place and Amphitheatre, where possibly the richest concentration of

artefacts was removed and dumped in large spoil heaps to the south west of the hotel. Before any of the initial excavations of the Tumulus, Market Place and Amphitheatre, it was unlikely that the artefact-bearing layer was exposed on the landscape surface and perhaps only isolated ESA-type tools were identified (LCTs). Now that we know about the presence of an important ESA-bearing layer buried just below the landscape surface at Maropeng, it is crucial that infrastructure upgrades are sensitive to this archaeological context. It was therefore considered important to test for the presence of a buried artefact-bearing layer in each of the proposed upgrade locations.

Shovel test pitting involves the excavation of a small (1 x 1m) square for basic sampling of the area. In this case, all test pits were excavated until the bedrock (either dolorite or quartzite) was exposed, thereby guaranteeing that no deeper archaeological contexts were missed. The upper 20cm of the excavation was considered potentially mixed through turbative processes. Any and all artefacts were recovered, documented and stored separately. Below 20cm, test pits were excavated in 10cm 'spit levels'. All excavated sediments were dry sieved through 2mm mesh sieves. Artefacts recovered in the sieves were documented and stored by spit depth below the landscape surface. As changes in sediments were encountered, excavations paid particular care to recover artefacts in situ. In this case, artefacts were documented to exact depth below the landscape surface.

Once the test pit had reached bedrock or a depth of 2m, walls were cleaned and prepared for documentation. Basic descriptions are given here of the artefacts and sediments found in the test pits of each of the sites in following with the ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties (2010) which encourages HIA reports to describe not only the asset but "the physical features which embody them" (pp. 6).

Figure 2. Plan view of the Maropeng site. Major areas for proposed upgrades are Human Impact Picnic Area, Africa Forms Picnic & Play Area, Triassic Period Picnic Area and Play Area, the Hotel and the Amphitheatre.

4.2. Framework for assessing heritage value

It is important that HIAs conducted on World Heritage Properties provide a defendable system for assessing and evaluating value and impact and that the HIA reports "deliver an evaluation that is helpful to States Parties, the advisory bodies and the World Heritage Committee" (ICOMOS, 2010; pp.11). To this end, this report follows the evaluation framework recommended with the Guidance on Heritage Impact Assessments for Cultural World Heritage Properties. A two stage model is followed. The first provides a framework for assessing the value of heritage assets and is measured on a scale of Very High, High, Medium, Low, Negligible and Unknown Potential. The definitions of each category can be found in ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties (2010). The second provides a framework for assessing the magnitude of the impact of the proposed development and is evaluated on a scale of Major, Moderate, Minor, Negligible and No Change. Definitions of each category can be found in ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties (2010). In addition to these evaluations, recommendations are provided to help mitigate any direct or indirect impacts on the identified heritage asset. Methods for quantifying the assessed impact can be found in Appendix 2 (Page 44).

Three main mitigation processes are recommended in this HIA. The first focuses on the avoidance of any disturbance and destruction of the identified heritage resources. In the case of this BA, this involves the limiting of excavations below 600mm depth. This approach is followed in order to maintain the integrity of the OUV as much as possible across the whole site. The second involves the supervision of limited deep excavations for services by an archaeologist. This will enable artefacts to be recovered and their context documented, thereby limiting major loss of OUV integrity. The third focuses on controlled archaeological excavations be carried out prior to construction of larger areas requiring deep (>600mm) excavations where development may cause significant disturbance of identified archaeological evidence. Controlled excavations will allow archaeologists to recover artefacts and record detailed contextual data, thereby preserving the integrity and limiting damage to the OUV.

Those heritage resources recovered prior to major disturbance and possible destruction will be utilised in the current research program being conducted at Maropeng. The scientific and cultural value of the site and the importance of the OUV will be increased through this research. Through this research, local and international awareness of the OUV can be increased through museum displays and guide training.

5. Results and Impact Assessment

5.1. Hominid House & Human Impact Picnic Area

Two areas were tested at the Hominid House construction site and can be considered relevant to the development of the Human Impact Picnic Area to the north. The first was located inside the current construction site and examined the exposed sediment profiles still open as construction continues. The second area was located 20m south west of the current construction site. This test pit was excavated in order to clarify the lateral and vertical variability of the artefact-bearing layer over relatively short distances. Identifying potential lateral and vertical variability allows one establish a benchmark of potential variability which can be extended to the other sites investigated for this HIA.

Location: Hominid House Construction Site – Open Excavations at the 'Fire Pit'.

GPS Location: 25°58'15.49''S, 27°39'32.42''E

Results Description:

Most of the foundations for the construction had already been filled by the time the site was visited for initial inspection. Two excavations were still open. The first was for services and was located in the middle of the Hominid House construction site two meters to the west of the site office, the second was for a 'Fire Pit'. The first service related excavation measured to a depth of 700mm. No artefacts or sedimentary features associated with the artefact-bearing layer could be seen in the excavation profiles. Ten meters to the north of the services excavation, was the 1200mm deep excavation for the 'Fire Pit'. The large intricate excavation of several concentric circles exposed a gently easterly dipping artefact-bearing horizon with a

depth of 300mm below the ground surface at the westerly exposure and 350mm eastern extremity of the excavation. Here, larger clasts of quartz and quartzite were found in the upper levels of a well decayed and pelletised dolorite (Figure 3). Clast proportions were very low and generally restricted in size to <100mm. Although the sedimentary layer associated with the artefacts was relatively thick (200mm at thickest) in this exposure, only one artefact could be identified in situ (Figure 4). No artefacts were found when construction spoil heaps were inspected and I can, therefore, conclude that although a stratigraphically and sedimentologically continuation of the main artefact-bearing layer was exposed at Hominid House, this part of that layer has a **very low artefact density** and is therefore cannot be deemed a heritage high impact risk area.

Figure 3. Panoramic photograph of the artefact-bearing layer and associated sedimentary features exposed in the 'Fire Pit' excavation at the Hominid House Construction Site.

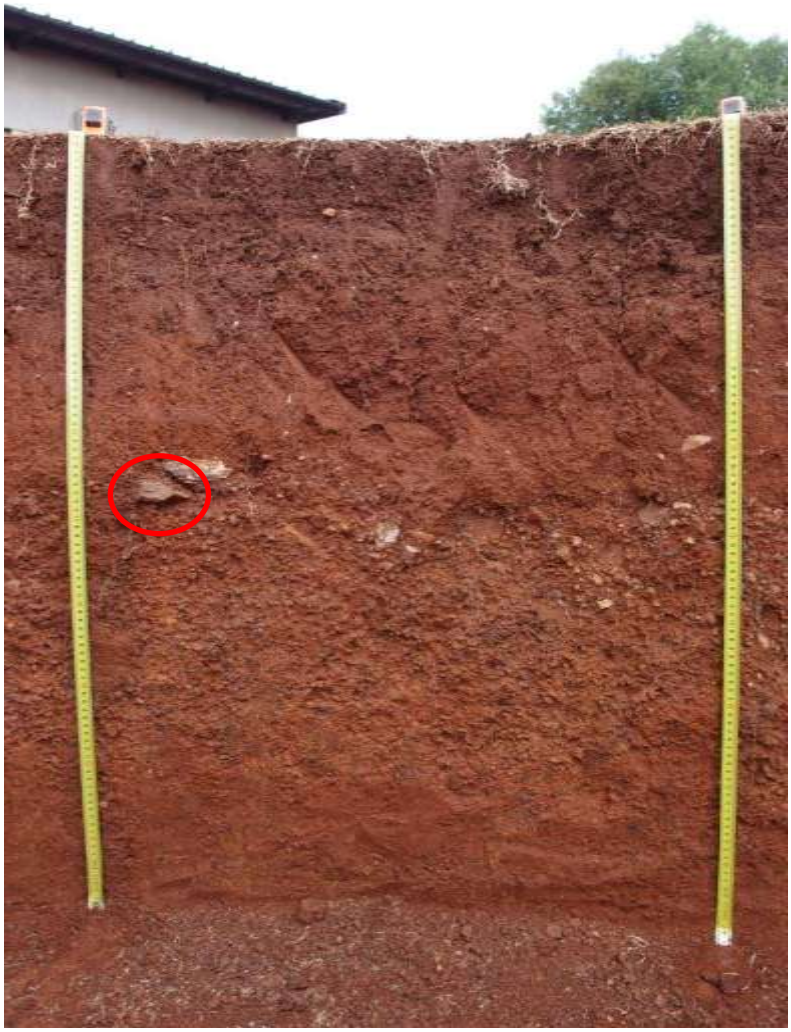

Figure 4. Profile photograph of the northern face of the 'Fire Pit'. An in situ stone tool can clearly be seen exposed in the profile (red circle). Tape measures are both extended 90cm.

Test Pit: Hominid House Test Pit

Test Pit Location: Twenty meters south west of the main Hominid House building.

GPS Location: 25°58'17.14''S, 27°39'31.85''E

Results Description:

This 1 x 1m test pit was excavated to identify the westerly extent of the artefact-bearing layer identified in the Hominid House 'Fire Pit' excavations. Given the gentle westerly slope of the above described layer, it was unclear if this continued further west and was possibly closer to the landscape surface or terminated. The test pit was excavated to the dolorite bedrock which

was exposed at a depth of 90cm. Several artefacts matching the type and raw material found in the main excavations at the Market Place, were found at a depth of between 78-80cm are were associated with the same artefact-bearing layer as was exposed in the Market Place excavations and in Hominid House 'Fire Pit'. In this location, the layer thickness is highly variable and 120mm at its thickest. As in the 'Fire Pit' excavation, the larger clasts and artefacts were associated with the upper levels of the pelletised decayed dolorite layer, were of low density and generally restricted to <100mm in maximum dimension. The direct association of the lower surface of this artefact-bearing unit with the highly irregular upper decayed surface of the dolorite bedrock (Figure 5) suggests that the depth of the artefact-bearing layer is not uniform or predictable across the larger Maropeng property. This irregularity is demonstrated in the relatively shallow depth of the artefact-bearing layer found in the Hominid House 'Fire Pit'. Artefact density in this area is also low and has a low heritage impact risk.

Figure 5. The western wall of the Hominid House Test Pit. The same pelletised decayed dolorite level can be seen towards the base of the test pit at a depth of between 70cm and 90cm. On the western wall this layer is discontinuous. Both tape measures are extended 90cm.

Heritage Value and Recommendations for this location:

It was clearly not expected that an artefact-bearing layer would be encountered at this distance from the main archaeological excavations (near the Market Place) when the current Hominid House construction was initiated. It is clear that not only does the artefact-bearing layer extend over a much larger area than previously thought, but also that this layer is highly

variable and its presence is at least partially controlled by the morphology of the underlying dolorite. The depth of the artefact-bearing layer at the test pit (over 700mm), protects it from disturbance by foundations reaching 600mm.

Despite the low artefact density, as a mitigation process, I would recommend that services and foundations are not excavated to a depth of over 600mm in this area. This restriction includes the small pond, eco-friendly toilet facilities and the water pump which are proposed for the Human Impact Picnic Area to the north.

This area which includes the Human Impact Picnic Area can be classified as having a low heritage value, and the proposed developments can be considered to have a Neutral to Slight detrimental impact on the asset or Minor scale impact. In terms of the OUV integrity, the recommended mitigation will limit major disturbance or damage to the heritage resources. See summary (Section 6) for quantification of potential impact.

5.2. Africa Forms Picnic & Play Area

This proposed picnic area is located close to the north western fence of the Maropeng property and close to several of the larger dolorite outcrops. A current 'walking trail' runs through the dolorite outcrops and information boards point out flora and some Early Iron Age stone walling structures that are found directly associated with the dolorite outcrops. A 1 x 1m test pit was excavated 2m west of the 'walking trail' and 15m from the closest stone walling. Because two contexts (Earlier Stone Age and Early Iron Age) with potential archaeological sensitivity are present at this site, both are briefly described.

Location: Africa Forms Picnic and Play Area

GPS Location: 25°58'02.75''S, 27°39'34.37''E

Results Description:

Stone walling

The stone wall structures (described as ‘packed stone wall kraals’ in the original EIA) found in this area cover an approximate area of 2000m^2 and are restricted in location to the dolorite outcrops in the western area of the site. The stone walling is of Early Iron Age style and take the form of large and small stone walled circles in varying states of preservation (Figure 6). The structures are not continuous and represent isolates structures of different sizes. In the cases of larger circles, natural dolorite outcrops are integrated into the wall. The walling is made up of large blocky quartzite clasts. This area was given a high conservation status and sensitive to development. It remains as such and this area should not be disturbed.

Figure 6. Stone walling structures preserved near the proposed African Forms picnic area.

Test Pit

The 1 x 1m test pit was excavated until the dolorite bedrock was reached. The abundance and proximity of the nearby dolorite outcrops suggested that the dolorite would be shallow. This

has various implications for the preservation and integrity of buried archaeological artefacts. The test pit was excavated to a depth of 50cm before dolorite was exposed (Figure 7). No discrete artefact-bearing layer was present but several artefacts were recovered from all depths of the excavation. Diagnostic ESA artefacts, like a quartzite Acheulean handaxe, were recovered from close to the base of the excavation, and were directly associated with the irregular surface of the dolorite surface. Several quartz flakes were found from upper levels but were generally smaller in size (<50mm). The lithic artefacts cannot be associated with the stone walling and represent distinct archaeological phases on the Maropeng property. The shallow nature of the artefacts and the presence of roots, dessication cracks and animal burrows indicate that turbative processes have modified the archaeological context and limited the assemblage integrity in this area.

Figure 7. Western wall of the Africa Forms Picnic and Play Area Test Pit. Larger clasts and artefact are seen directly associated with the irregular surface of the dolorite, while smaller clasts can be seen throughout the profile and are often directly associated with root structures and dessication cracks indicating turbation processes. Tape measure is extended 50cm.

Heritage Value and Recommendations for this location:

The preservation of multiple archaeological contexts in this area contributes to a higher sensitivity. The higher integrity of the stone walling structures means that these should be prioritised for preservation and management. The poor integrity of the ESA and potentially MSA assemblages found buried in the area means that although artefacts should be recovered during any construction process, their analytical or interpretive value is limited to basic typological comparisons. These artefacts are, however, of some value and I recommend that given the relatively shallow nature of the artefacts, an archaeologist is present during the construction of infrastructure or the planting of trees (as planned for this site) to recover artefacts uncovered.

Due to the combination of different heritage assets being present, this area (which includes the picnic and play areas) can be classified as having a high heritage value. If the proposed developments take into account preservation of the stone walling, the impact can be considered to have a slightly detrimental impact on the buried lithic assemblage – a Minor scale impact. If the stone wall structures are not considered within a conservation plan, then development will have a major impact on the overall OUV. See summary (Section 6) for quantification of potential impact.

5.3. Triassic Period Picnic Area

The proposed upgrades to this area involve extensive landscaping and interactive sculptures and a small lake. This area has never been tested for buried archaeological remains and so a 1 x 1m test pit was excavated to assess the presence of the artefact-bearing layer found in more western areas of the Maropeng site.

Location: Triassic Period Picnic Area

GPS Location: 25°57’59.68’’S, 27°39’41.89’’E

Results Description:

This test pit was placed about 50m west of the Maropeng Museum Tumulus and play area. The location is as close to the centre of the Triassic Period Picnic area as I could identify from the available plans. The test pit was excavated until dolorite was exposed at a depth of 80cm in the eastern profile and 55cm in the western profile. The dolorite, partially decayed and with a upper pelletised layer was irregular in surface morphology. A convex surface dipping from west to east was exposed. Gravels containing well-rounded clasts and a medium density of ESA-type artefacts (up to 100mm in maximum dimension), including cores and flakes in quartzite, rested directly and conformably on the decayed, pelletised dolorite surface (Figure 8). The artefact-bearing layer ranged in thickness from 10cm to 35cm and can be described as a clast-supported, regularly graded and poorly sorted deposit with a sharp lower contact and diffuse upper contact. Pellets from the underlying decayed dolorite are incorporated into the artefact-bearing layer. Numerous discontinuous lenses, dominated by smaller gravels, were excavated at shallower depths (20cm from the landscape surface). These lenses also yielded smaller artefacts (20mm – 50mm), mainly flakes with sharp edges. The artefact-bearing layer in this area appears to have been through several phases of reworking including fluvial and colluvial processes. The secondary context assemblage may be significantly time-averaged which does limit any potential behavioural interpretation of the assemblage beyond typo-technological analysis.

More artefacts were yielded from this test pit than any other in this assessment and I would describe the artefact density as medium. The artefact-bearing layer itself is thicker in this site than has been seen in any of the archaeological work at Maropeng, and although the clasts and artefacts are generally smaller than found at the Market Place excavations, the density, artefact type and raw material proportions are comparable.

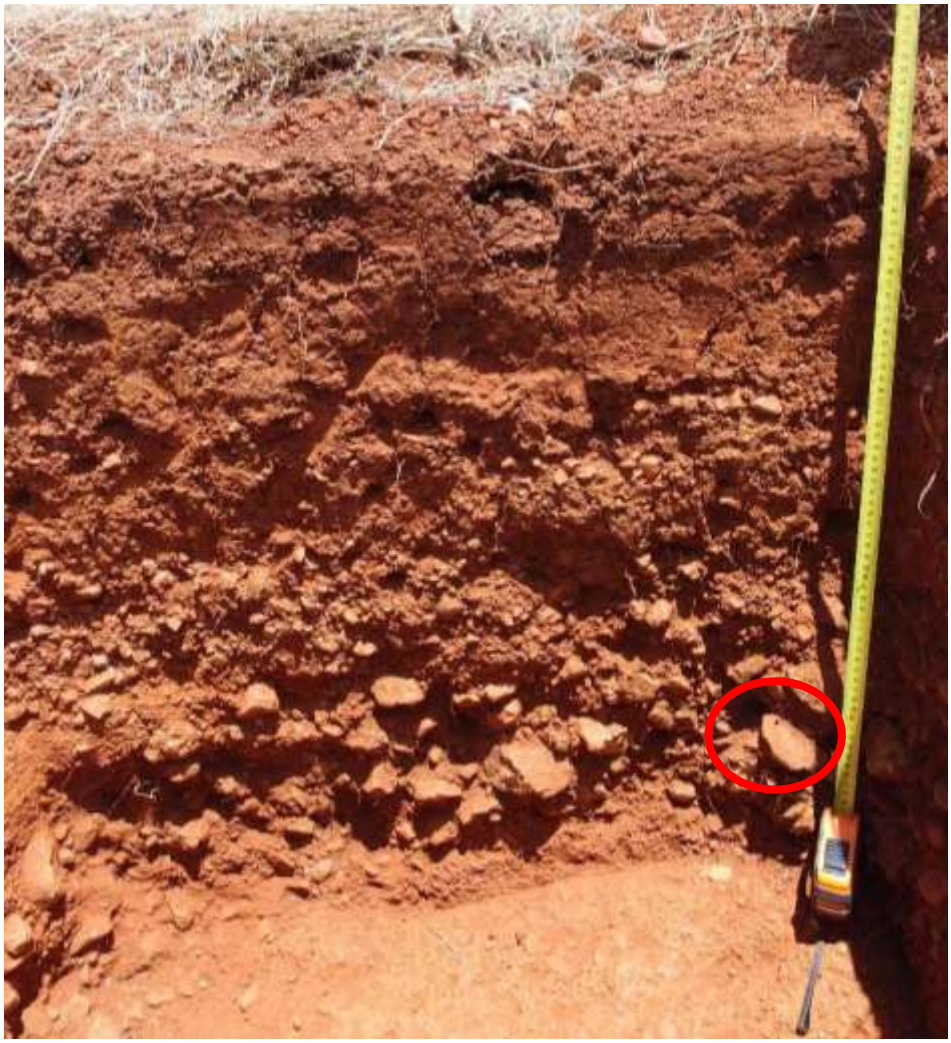

Figure 8. Southern wall of the Triassic Period Picnic Area Test Pit. The west - east gradient of the exposed underlying dolorite can be seen. A single platform core can also be seen in situ (red circle). Tape measure is extended 90cm.

Heritage Value and Recommendations for this location:

The increased thickness of the artefact-bearing layer in this location and the higher density of ESA-type artefacts mean that this area is more sensitive and efforts should be made not to excessively disturb this context. The nature of the proposed upgrades to this area should allow this preservation as only very limited excavations are planned. The exception to this is the proposed 'Triassic Sculpture Lake'. If excavations are planned to reach beyond 50cm in depth then I recommend that an archaeologist be present to excavate a controlled sample of artefacts and ensure the recovery of artefacts and documentation of sediment features in this area during construction. This should include planting of trees – an activity that is in the current upgrade proposal.

This area can be classified as having a medium heritage value, and the proposed developments can be considered to have a moderately to largely detrimental impact on the asset or Medium scale impact. See summary (Section 6) for quantification of potential impact.

5.4. Triassic Period Playground Area

This area is located between the proposed Triassic Period Picnic Area and the Museum Tumulus. The results for this area extend to the café play area located 125m to the north east.

Location: Triassic Period Play Area

GPS Location: 25°58'00.13''S, 27°39'42.64''E

Results Description:

Testing the presence, density and thickness of an artefact-bearing layer was important in this area, given the findings of the Triassic Period Picnic Area Test Pit. Ground survey of the proposed location for the play area revealed a low density of small flake artefacts scattered on the landscape surface, undoubtedly a result of the earlier construction phases and subsequent landscaping. A diffuse artefact-bearing layer was also identified eroding from the walls of a shallow drainage ditch which runs north - south and is located about 10m west of the paved path which circumnavigates the Tumulus building (Figure 9). This layer was discontinuous and disappears 15m to the north of the thickest exposure. A geotrench-style test pit was excavated to clarify the nature of the layer.

Figure 9. Western slope of the drainage ditch in the vicinity of the proposed Triassic Period Play Area. The diffuse and eroding artefact-bearing layer can clearly be seen. Several quartzite artefacts were recovered from the surface prior to excavation.

Upon excavation of the test pit, an artefact-bearing layer very similar to that found in the Triassic Period Picnic Area was exposed. The layer shares most of the sedimentological characteristics of the Period Picnic Area Test Pit but is generally thinner (maximum thickness 25cm) (Figure 10), has a lower density of smaller artefacts, and has a sharper upper deposit contact. The layer also partially directly overlies exfoliating dolorite and blocks can be seen incorporated into the artefact-bearing layer. An in situ irregular dolorite surface can be seen in the south western corner of the test pit. Artefacts and gravels have filled the irregular surface morphology. Away from the exfoliating dolorite, decayed dolorite pellets are found

and the artefact-bearing layer lies conformably on this. Clasts in the artefact-bearing layer are unorganised and poorly sorted.

Figure 10. Western wall of the Triassic Period Play Area Test Pit.

Heritage Value and Recommendations for this location:

The artefact-bearing layer in this area is close to the landscape surface (25cm), but discontinuous and is generally low in artefact density. It therefore has medium heritage sensitivity. I would, however, recommend that an archaeologist be present during any excavations for services so that artefacts can be recovered and added to the comparative assemblage for the whole Maropeng site. This recommendation is extended to the café play area to the north east.

This area can be classified as having a low/medium heritage value, and the proposed developments can be considered to have a moderately to largely detrimental impact on the asset or Medium scale impact. See summary (Section 6) for quantification of potential impact.

5.5. Hotel

The Hotel area is the most northern location tested in this assessment. Here the landscape surface slopes to the north and exposures of shales, dolorite, laminated sandstones and poorly metamorphosed quartzite can be seen in the deep cuttings made for the construction of the Hotel. Expansion plans are described in detail above (Section 3.2) additional facilities to the north and east of the current hotel. A ground survey of the area revealed no artefacts and only shallow exposures of dolorite, sandstone and quartzite. I consider it likely that any artefact-bearing layer found at higher elevations to the south have been eroded away. To test this, a 1 x 1m test pit was excavated approximately 35m to the east of the current hotel where most of the current expansion plans focus.

Location: Maropeng Hotel

GPS Location: 25°57'53.55''S, 27°39'52.64''E

Results Description:

An in situ bedded and poorly metamorphosed quartzite with interbedded finely laminated sandstone strata was exposed approximately 50cm below the landscape surface. Overlying this was a clast-supported poorly organised colluvium consisting of large (up to 300mm), decaying blocks of the same stone (Figure 11). The organic horizon is thin and the land surface is dominated by eroding quartz, and dolorite pebble-sized clasts. Dolorite can be found outcropping 10m to the east of the test pit. Localised rivulets spread fine sediments and occasional artefacts from the very large construction spoil heap located 40m to the south east. This spoil heap consists of material relocated from the construction of the Market Place and Museum. It is rich in artefacts but the material has no remaining context and therefore has no scientific value beyond general ESA typological enquiries.

Figure 11. Southern wall of the Maropeng Hotel Test Pit. Tape measure is extended 60cm.

Heritage Value and Recommendations for this location:

The absence of an artefact-bearing layer in this location is expected given the lower elevation of the area in comparison to the southern sites and the increasingly steep north and west slope the Hotel is built onto. There is, therefore, no concern in this area from a heritage management point of view.

This area can be classified as having a negligible heritage value, and the proposed developments can be considered to have a neutral detrimental impact on the asset or No Change scale impact. See summary (Section 6) for quantification of potential impact.

5.6. Amphitheatre

The initial excavation of the amphitheatre exposed a laterally extensive artefact-bearing layer which had not been recognised during construction. This has resulted in the removal and relocation of considerable quantities of archaeological material. The presence of an artefact-bearing layer in this area was only realised recently during my research at the Maropeng. The exposure is described below.

Location: Maropeng Amphitheatre

GPS Location: 25°58'10.32''S, 27°39'48.29''E

Results Description:

The amphitheatre artefact-bearing layer is of particular interest for the site formation history of this extensive deposit because it shares sedimentological characteristics with the Hominid House 'Fire Pit' site, and the artefactual density, type and abundance of the Market Place excavations. Figure 12 shows a geotrench-style test pit which was excavated into the southern wall of the amphitheatre. The layer, which is exposed at a depth of about 1m (1640 msl.) below the landscape surface across the entire southern wall (134m of sediments exposed to 1m depth), is continuous and associated with a relatively thin (<200mm) pelletised decayed dolorite layer that has been fluvially deposited (Figure 12). Large clasts and artefacts (>80mm) are found associated with the upper surface of this layer and are generally well preserved with cores and flaked showing sharp edges. The pellet layer lies conformably on the horizontal surface of a massive matrix-supported laterite layer which contains occasional medium sized (50-150mm) decayed dolorite clasts towards the base of the test pit. The maximum thickness of the artefact-bearing layer in the amphitheatre is 100mm, and the upper contact with the overlying massive laterite layer (with the same sedimentological characteristics as the basal layer) is sharp. Artefacts are of striking similarity in preservation, raw material proportions, type proportions, and size profile to the Market Place excavations.

Figure 12. Southern wall of the Amphitheatre Test Pit. Upper laterite layer is approximately 1m thick. Mr Aub is taking DGPS points from the exposed artefact-bearing layer to assess the relative elevation of this layer across the Maropeng property.

Heritage Value and Recommendations for this location:

This area is of particular concern from a heritage management point of view. The exposure of an artefact-rich layer across an extensive space is rare and requires further study. The generally good preservation of the artefacts also warrants careful sampling and excavation. The artefacts are in a secondary context but represent one of the better preserved ESA assemblages in the Cradle of Humankind. I recommend that this exposed artefact-bearing layer is disturbed as little as possible and that discussions are held with the consulting architects to find ways to ensure minimal disturbance is caused. I also recommend the

supporting subterranean services (sewerage, water and electricity) are kept shallower than 1m and that an archaeologist is present during the excavation of service-related trenches. Given the irregular depth of this artefact-bearing layer, it is important to collect any artefacts that are accidentally excavated. If disturbance of the in situ artefact-bearing layer is unavoidable then I recommend that discussions are held to locate an area of least potential impact and that the area identified for disturbance is excavated by an archaeologist to ensure appropriate contextual preservation and access of the assemblage for analysis.

This area can be classified as having a medium/high heritage value, and the proposed developments can be considered to have a largely detrimental impact on the asset or Major scale impact. See summary (Section 6) for quantification of potential impact.

6. Recommendations and Conclusions

Table 1 shows a summary of the proposed upgrades and heritage impact for the Maropeng site. The two areas that require greatest consideration for the proposed upgrades are the African Forms Picnic area and the Triassic Period Picnic and Play area. In the Africa Forms Picnic and Play area, the presence of multiple types and temporal periods of archaeological evidence mean that both the surface and subsurface of this area should be preserved. The Triassic Period Picnic area test pit indicated that one of the richest parts of the ESA-bearing layer is located 70cm below the land surface. Picnic area upgrades are not of great concern for the preservation of this layer because soil disturbance is proposed to be minimal. The building of small lake in this area is, however, more concerning and I would recommend that if the lake cannot be moved, an archaeologist is asked to excavate a representative sample of archaeological material from this area prior to the lake being built. The more major upgrades of the Amphitheatre also require detailed discussions with the architect to ensure that disturbance of the artefact-bearing layer is limited to the smaller possible area. In almost all areas to be upgraded, extensive landscaping is proposed. This is especially the case in the picnic areas where sculpted banks will be built into grassed seating areas. Due to the world heritage status of this site and the abundance of stone tools on the landscape, I would

recommend that landscaping use sediments from the Maropeng site. This will limit contamination of the archaeological evidence and help ensure the integrity of the site.

Due to the broad distribution of the artefact-bearing layer across the Maropeng site at a depth of between 40 and 80cm, I suggest that no service infrastructure or building infrastructure is excavated to a depth of greater than 60cm without an archaeologist being consulted and on site. This should be considered a blanket recommendation for the infrastructure upgrades proposed in 2015 and in the future anywhere on the Maropeng property.

If all recommendations regarding mitigation of the heritage resources identified in this report are followed then it is likely that minimal damage will be inflicted on the heritage resources of the area. The mitigation measures recommended focus on the protection of archaeological contexts as much as possible. In some cases, controlled recovery of artefacts buried below the landscape surface will be necessary. These artefacts must be recovered in a controlled manner in order to allow them to be studied by archaeologists in a research environment. If the recommended mitigation processes are not followed, potentially large numbers of artefacts, and their context will be destroyed to the detriment of South African and world archaeology.

As an overall evaluation of the significance of the total impact of the proposed upgrades, if the mitigation measures are followed, impact should be low. Where impact is probable through deeper excavations, planned pre-emptive excavation by qualified archaeologists is necessary to ensure the preservation of the OUV integrity. Sensitivity to heritage resources and their scientific value is amplified in internationally acknowledged areas. This includes the Cradle of Humankind and all properties within those boundaries. The World Heritage Site status of the Cradle of Humankind, including the Maropeng property, means that the preservation, research and distribution of cultural heritage resources need to be prioritised and conducted in a responsible fashion under international guidelines. As a result of the internationally recognised importance of the Cradle of Humankind, the processes of development and associated heritage mitigation are scrutinised on a local and international scale by land owners, developers, scientists, politicians and tourists.

Pre-mitigation impact summary

Impact Assessment	Human Impact Picnic Area	Africa Forms Picnic Area	Triassic Period Picnic Area	Triassic Period Play & Café Play Area	Hotel	Amphitheatre
Development type	Development & Landscaping	Landscaping	Landscaping	Landscaping	Development & Landscaping	Development & Landscaping
Extent of Service Instalation	Major	Minor	Minor	Minor	Major	Major
Nature of Impact	Destruction through excavation	Destruction through excavation	Destruction through excavation	Destruction through excavation	Destruction through excavation	Destruction through excavation
Nature of Mitigation	Minor - limited excavations below 600mm depth	Moderate - avoidance of stone wall structures and limited excavation below 300mm	Major - limited of excavation below 600mm; controlled archaeological excavation in vicinity of lake	Moderate - limited excavation below 300mm	Zero	Moderate - limited excavation below 600mm
Extent[1]	1	1	1	1	1	1
Duration	5	5	5	5	5	5
Magnitude	8	10	10	8	0	8
Probability	5	5	5	4	1	5
Sum of impact	*70*	*80*	*80*	*56*	*6*	*70*

Post-mitigation impact summary

Impact Assessment	Human Impact Picnic Area	Africa Forms Picnic Area	Triassic Period Picnic Area	Triassic Period Play & Café Play Area	Hotel	Amphitheatre
Development type	Development & Landscaping	Landscaping	Landscaping	Landscaping	Development & Landscaping	Development & Landscaping
Extent of Service Instalation	Major	Minor	Minor	Minor	Major	Major
Nature of Impact	Negligable disturbance	Minor disturbance	Low level disturbance	Minor disturbance	Zero	Minor disturbance
Nature of Mitigation	Minor - limited excavations below 600mm depth	Moderate - avoidance of stone wall structures and limited excavation below 300mm	Major - limited of excavation below 600mm; controlled archaeological excavation in vicinity of lake	Moderate - limited excavation below 300mm	Zero	Moderate - limited excavation below 600mm
Extent[1]	1	1	1	1	1	1
Duration	1	1	1	1	1	1
Magnitude	2	2	4	2	0	2
Probability	1	2	3	2	1	3
Sum of impact	*4*	*8*	*18*	*8*	*2*	*12*

[1] The Artefact-bearing layer extents beyond the property boundaries. This report only considers the Maropeng property.

Table 1. Summary of potential impact at the identified sites.

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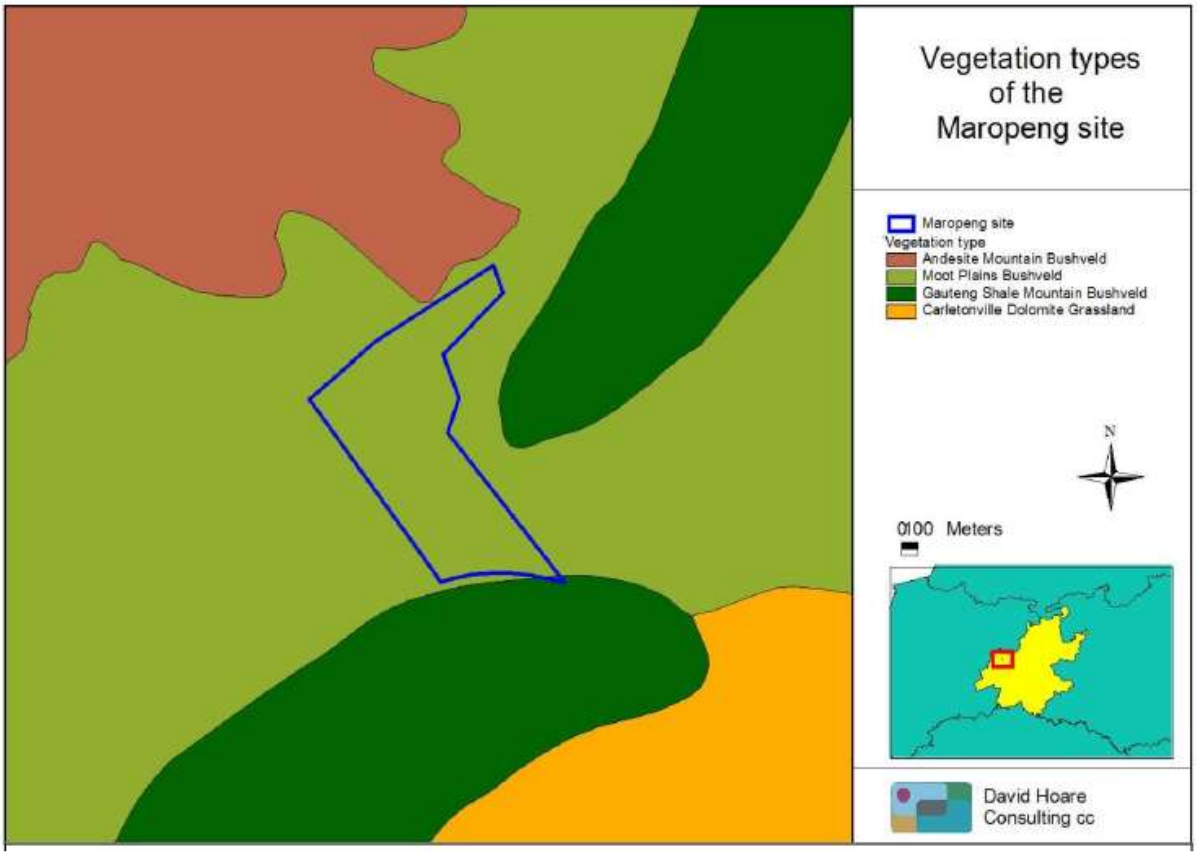
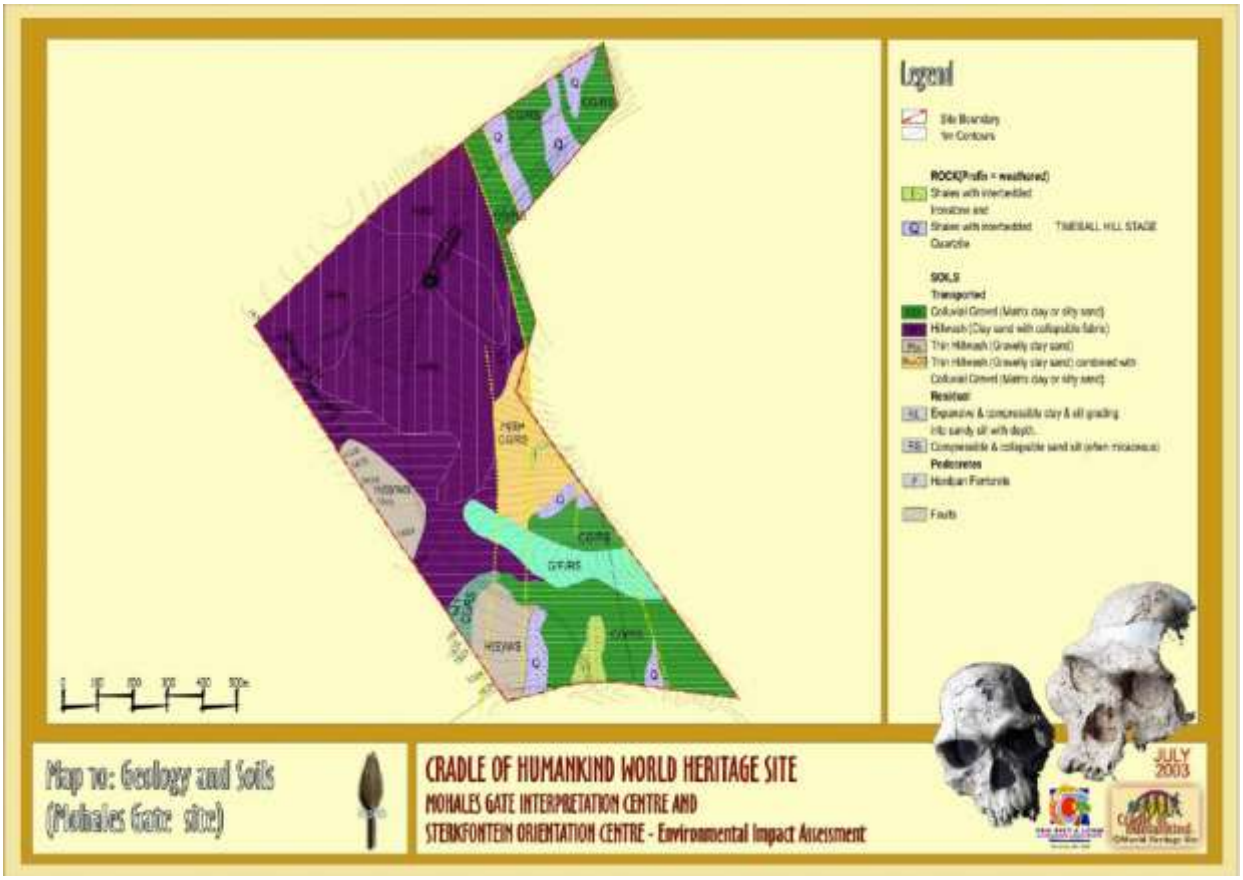
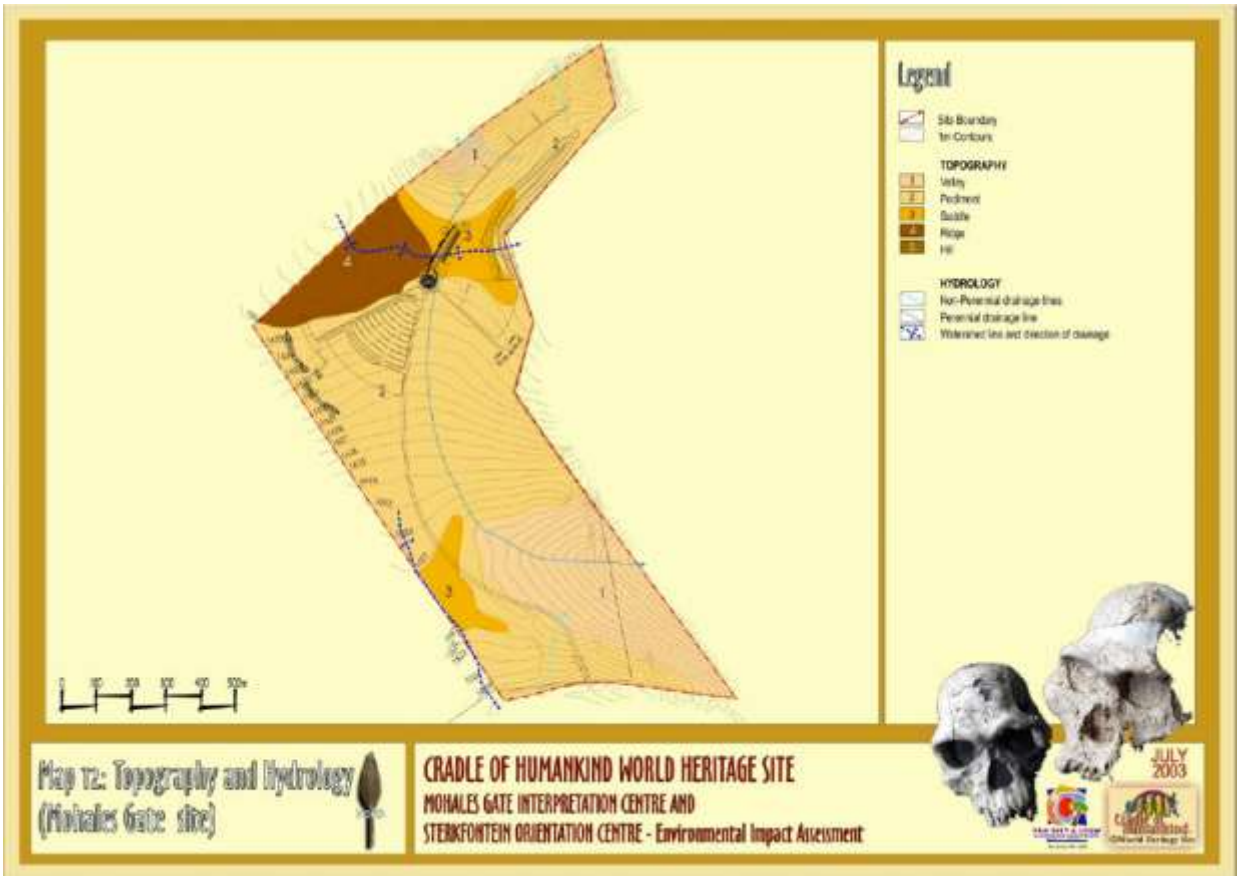
Appendix 1 - Maps



Maropeng Property vegetation distribution. From Van Riet & Louw (2003).



Maropeng Property geology and soils distribution. From Van Riet & Louw (2003).



Maropeng Property topography and hydrology. From Van Riet & Louw (2003).

Appendix 2 – Required methodology for assessment of impacts.

The methodology for the assessment of potential environmental impacts states the nature of the potential impact (i.e. a description of the cause of the impact, the affect and how it will be affected) and includes a table quantifying the impact according to the following criteria:

Extent (how far the impact extends):
(1) Very low: within the site only
(2) Low: within the local neighbourhoods
(3) Medium: within the region
(4) High: Nationally
(5) Very high: Internationally

Duration (the timeframe over which the effects of the impact will be felt):
(1) Very short: 0-1 years
(2) Short: 2-5 years
(3) Medium: 5-15 years ○ (4) Long: >15 years
(5) Permanent

Magnitude (the severity or size of the impact): ○
(0) None
(2) Minor
(4) Low
(6) Moderate
(8) High
(10) Very High

Probability (the likelihood of the impact actually occurring):
(1) Very improbable: Less than 20% sure of the likelihood of an impact occurring
(2) Improbable: 20-40% sure of the likelihood of an impact occurring
(3) Probable: 40-60% sure of the likelihood of an impact occurring
(4) Highly probable: 60-80% sure of the likelihood of that impact occurring
(5) Definite: More than 80% sure of the likelihood of that impact occurring

The significance of the potential visual impact is determined by the sum of the individual scores for extent, duration and magnitude multiplied by the probability of the impact occurring i.e. significance = (extent + duration + magnitude) x probability. The significance rating scale is interpreted as follows:

(2-12) Negligible: Impact would be of a very low order. In the case of negative impacts, almost no mitigation and or remedial activity would be needed, and any minor steps, which might be needed, would be easy, cheap, and simple. In the case of positive impacts, alternative means would almost all likely be better, in one or a number of ways, than this means of achieving the benefit.

(13-30) Low: Impact would be of a low order and with little real effect. In the case of negative impacts, mitigation and / or remedial activity would be either easily achieved or little would be required, or both. In case of positive impacts alternative means for achieving this benefit would likely be easier, cheaper, more effective, less time-consuming, or some combination of these.

(31-56) Moderate: Impact would be real but not substantial. In the case of negative impacts, mitigation and / or remedial activity would be both feasible and fairly easily possible. In the case of positive impacts, other means of achieving these benefits would be about equal in time, cost, and effort.

(57-90) High: Impacts of a substantial order. In the case of negative impacts, mitigation and / or remedial activity would be feasible but difficult, expensive, time-consuming or some combination of these. In the case of positive impacts, other means of achieving this benefit would be feasible, but these would be more difficult, expensive, time-consuming or some combination of these.

(91-100) Very High: Of the highest order possible. In the case of negative impacts, there would be no possible mitigation and / or remedial activity and in the case of positive impacts, there is no real alternative to achieving the benefit.