

## **MANAGEMENT, MONITORING AND EVALUATION OF THE CRADLE OF HUMANKIND FOSSIL SITES**



**UPDATED FOSSIL SITE MANAGEMENT PLAN  
FOR**

**GONDOLIN**

**2009 - 2013**



**GONDOLIN FOSSIL SITE:  
SITE MANAGEMENT PLAN  
UPDATED FOR PERIOD 2009 - 2013**

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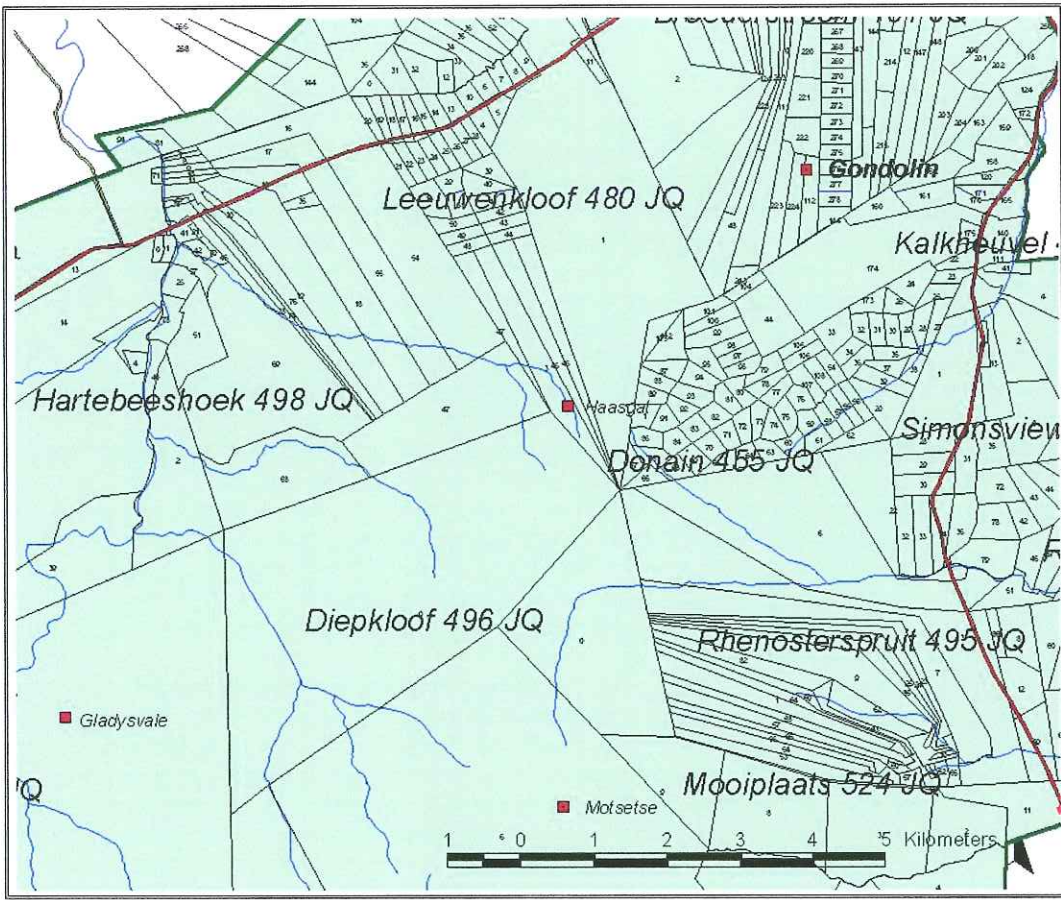


## SUMMARY OF KEY ISSUES

- The fact that the site is in North West Province causes several administrative challenges.
- Access to this site on a regular basis – as in a regular excavation lasting many months - would impact on the fragile condition of the poorly-engineered access road. The trajectory of this road runs straight up a steep hill, and loose gravel on the unpaved surface causes loss of traction and wheel spins. There are multiple users of the road, and residents are sensitive about how the road is used and by whom.
- The landowner of Gondolin has a registered servitude across the land of his neighbor, Mr. M Wright, and the right to use this access road.
- Alternative access via the old wagon road (suggested in an earlier planning document) now presents problems – it crosses private properties and its condition has deteriorated. Insensitive upgrading of this road would destroy the authenticity of an historical trace: there are few other wagon roads either as long as or in such a good state of preservation as this one. The wagon road branches off from the communal access road 600-700m before its terminus at the Gondolin fossil site.
- If the mining relics at Gondolin including the wagon route are to be conserved, steps will have to be taken to alert adjacent landowners to their significance lest they be inadvertently destroyed.
- The site has no fence and unauthorized access (pedestrian) is a problem. There are many exposed and quite obvious fossils, both in situ and in dumps, and the possibility of scavenging remains high. The owner is not in favour of a fence around the fossil site
- The site preserves by far the best relics of lime-mining of any of the sites in the Cradle of Humankind. Here are the remains of 6 or 7 lime-burning kilns and an upper and lower loading ramp. One of the kilns has an intact draw hole, a rarity amongst the Cradle of Humankind fossil sites.
- There are the remains of two South African War 'skanse' nearby. The ruin of a Boer blockhouse or substantial skans on the hill opposite to the south east overlooks the site.
- The site is also impressive in terms of its size and the richness of preserved in situ fossil bones. The site has a huge scientific potential (over 90 000 fossils recovered already) and its breccias have hardly been explored
- It has an open subterranean system (which is collapsing) and many features of dolomitic caves and their sedimentary fills can be demonstrated.
- Increase in groundwater abstraction due to considerable development in the area in recent years and an increase in the number of houses requiring water for domestic and agricultural use, is causing subterranean chambers to become dewatered and unstable. It is obvious that the roof of the Gondolin cave is busy collapsing, and several dangerous boulder chokes have opened up on the surface above the cave.
- Alien and indigenous vegetation is causing the remaining kilns to deteriorate, and the fossil site is heavily infested with *Opuntia*, in particular
- Provision of basic services to the site, should an excavation to take place, would be problematic – there is no water, energy or toilet.



- The viewshed at Gondolin is extremely sensitive and two threats to this as yet unspoiled asset are 1) residential development on ridge lines and hillcrests, and 2) the construction of roads up drainage lines to gain access to hilltop properties. Both development types need ongoing surveillance because of their large potential to impact on this site
- There is no plaque announcing the status of the site. In view of the lack of control at Gondolin, a prominently situated site plaque might draw attention to the fact that there is something important worth looking for, and this might not be desirable.
- The landowner does not favour tourism, but is willing to allow educational visits, scientists and their visitors providing that prior arrangements are made.



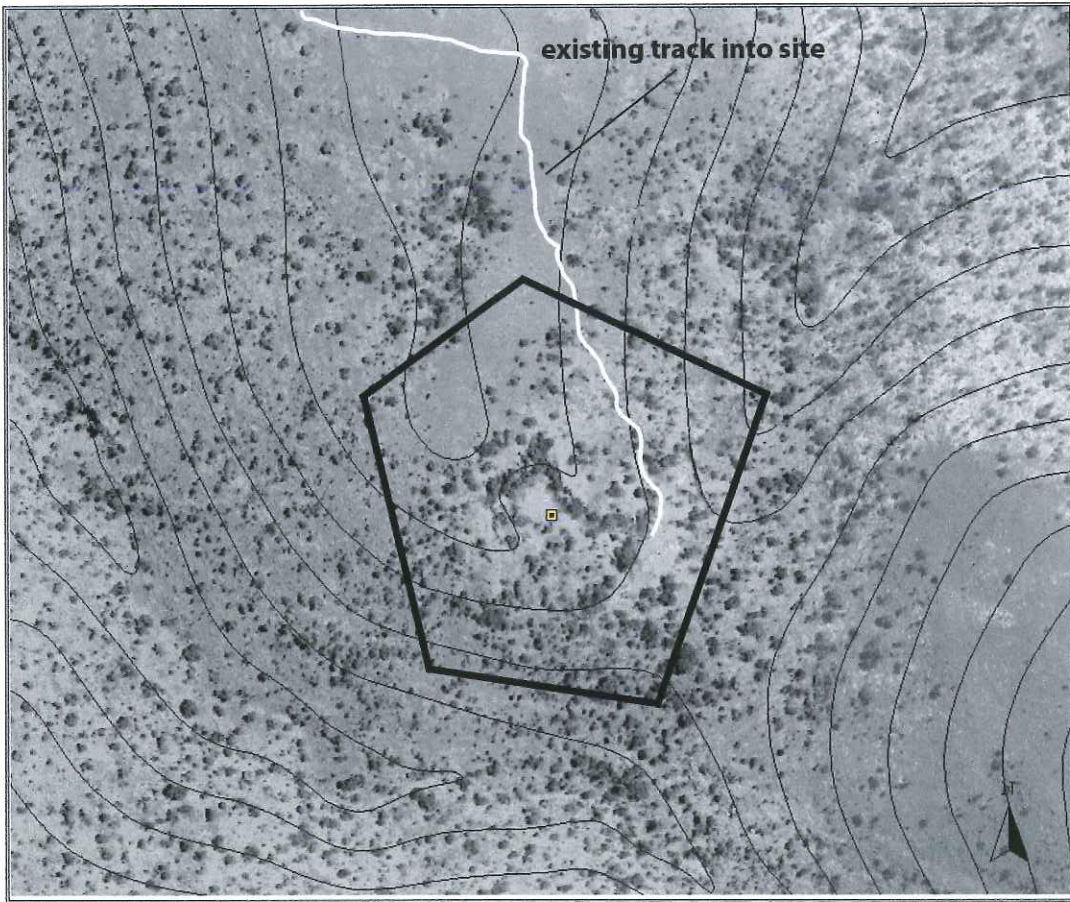
**GONDOLIN SITE  
MANAGEMENT  
PLAN**

**Legend**

- Fossil sites
- Arterial Road
- National Road
- Secondary Road
- Farm boundaries
- ~ River
- World Heritage Site




**GONDOLIN**

Figure 1  
Locality map



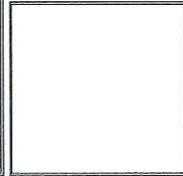
existing track into site

**GONDOLIN SITE  
MANAGEMENT  
PLAN**

- Legend**
-  approximate position of site boundary
  -  contours
  -  palaeontological site

**GONDOLIN**

Figure 2  
Aerial view  
of site





PROCLAMATION DIAGRAM

REGISTRATION COPY

SIDES metres	ANGLES OF DIRECTION	CO-ORDINATES			
		Y	System: WG.27° X		
		Constants	+0.00	+2 800 000.00	
A B	156.10	296.41.00	A	-86 505.78	+58 245.74
B C	179.47	20.34.50	B	-86 645.25	+58 315.84
C D	129.14	97.58.40	C	-86 582.16	+58 483.85
D E	159.13	166.51.40	D	-86 454.27	+58 465.93
E A	109.27	233.21.10	E	-86 418.10	+58 310.96

SG No.  
2295/2004

Approved

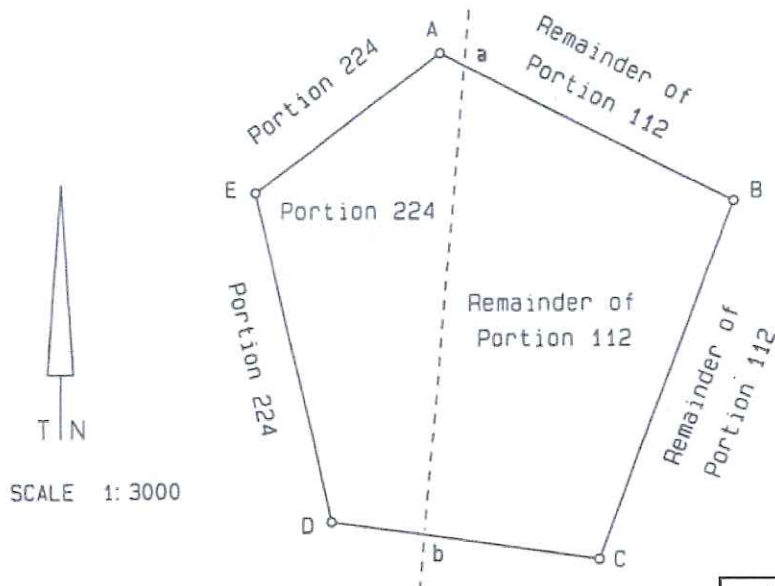
J.S. WEYERS  
for

SURVEYOR-  
GENERAL  
2004-04-16

TRIGONOMETRICAL BEACONS				
BRIT 83	123 Δ	-86 245.57	+55 867.43	
BRIT 87	299 Δ	-80 098.13	+68 249.49	

BEACON DESCRIPTIONS  
A, B, C, D, E .. 20mm iron peg

GONDOLIN PALAEOANTHROPOLOGICAL SITE



**Figure 3**  
Proclamation  
diagram

The figure A B C D E A represents 3,6442 hectares of land being a declared area over Portion 224 and the Remainder of Portion 112 of the farm BROEDERSTROOM No. 481-JQ Province of North West Framed for National Heritage Site declaration purposes in terms of the National Heritage Resources Act No 25 of 1999

Surveyed in January 2004 by me P.H. KOHRS Professional Land Surveyor PLS0314

This diagram is annexed to No. d.d. i.f.o.	The original diagrams are No. A5517/1970 & T17205/1971 Transfer and No. A3905/1951 Grant & T759/1953 C.C.T. respectively	File -/63
		S.R. No. 922/2004 T.P. Comp. JQSU - 14

PTA  
Registrar of deeds

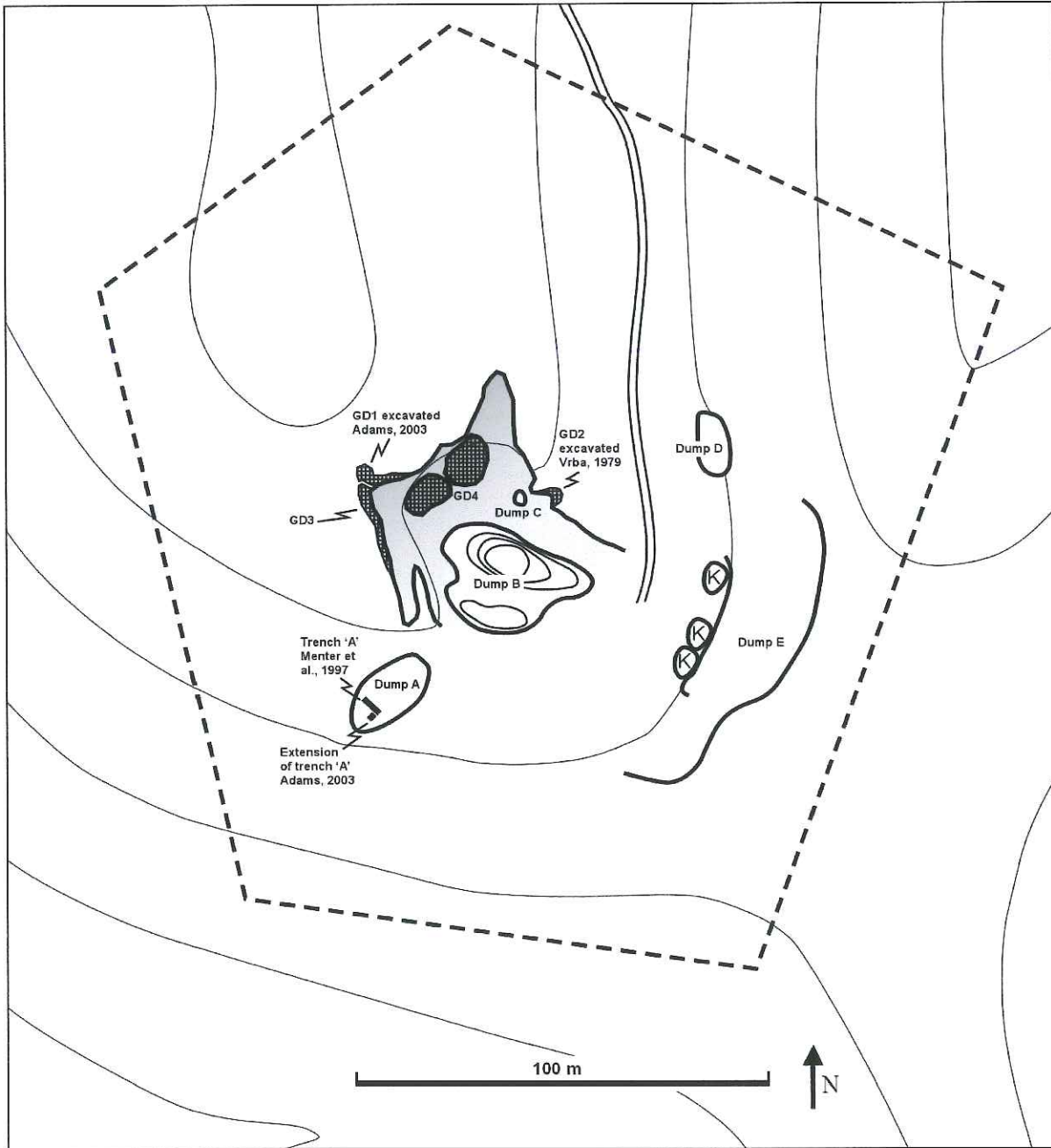


Fig 4 Site plan of Gondolin showing excavation areas, dumps and proclamation boundary

## 1 INTRODUCTION

The Gondolin Fossil Site is one of two National Heritage Sites in the North West Province sector of the Cradle of Humankind World Heritage Site, the other being Haasgat. A third permitted fossil site is Luleche, which as yet has no protected status and its scientific value and site significance are poorly understood. There are of course numerous other fossiliferous sites both known and as yet undiscovered. Gondolin is the most northerly of the declared fossil sites in the Cradle of Humankind and is situated in attractive wooded hilly country overlooking the valley settlement of Broederstroom and the Hartebeestpoort Dam, about 20 kms north-east of Sterkfontein close to the northern boundary of the World Heritage Site (Fig.1).

The Gondolin fossil site is on privately owned ground and can only be reached using a 4x4 on account of the very steep access road to the property. The proclaimed area spans two separate erven, Portion 224 and remainder of Portion 112 of the farm Broederstroom 481-JQ (Figs 1,2 and 3). The boundary between the two passes right through the fossil site. The larger part of the proclaimed World Heritage Site falls into Portion 112.

The site was fairly extensively mined for calcite in the early part of the last century and excellent sources, in the form of travertine, must have been available because there are the remains of at least seven lime-burning kilns, the highest number remaining at any site in the Cradle of Humankind. An old wagon road leads away from its terminus at the kilns, and out of the property in the direction of Broederstroom. The road is now no longer negotiable as it crosses several privately owned properties and the road condition has deteriorated over the years. Until the early 1980's, at least, this road could still be used to reach the site.

The fossils were first noted by L. MacKenzie in 1977. In 1979, Dr Elisabeth Vrba, then on the Transvaal Museum staff, conducted excavations and recovered about 90 000 fossils from the miners' dumps and *in situ* breccia (at GD2, see site plan Fig 4)), but no hominids were reported at the time. The first hominin specimen was recovered from Gondolin Dump A (Fig 4) in November 1997 by Dr André Keyser. It is a fragmented permanent left mandibular molar and may belong to an individual of early *Homo* sp. A second tooth, found by L. Dikhuysen, is a complete permanent left mandibular second molar and because of its large size it has been assigned to *Paranthropus cf. robustus*. This evidence suggests that the breccia at the site from which it came could be in the range of 1.5-1.9 my. Palaeomagnetic dating places the site between 1.77 and 1.95 my (Herries et al. 2006).

The fauna comprises 27 different mammal species including antelopes, hyaenas, a species belonging to the dog (canid) family, porcupines, hyraxes, hares, horses, pigs, hippopotamus and rhinoceros, which suggest the presence of a rocky, contoured environment with good tree cover and with more open grassland plains in the vicinity than at present.

### 1.1 Objectives

- To preserve the full range of natural and cultural heritage values, the site significance and authenticity of the Gondolin fossil site
- To identify and understand the issues that threaten site significance and to provide management measures and monitoring to address them
- To balance opportunities for research, education and tourism without compromising the integrity of the site or the aspirations of the landowner, and considering the needs of residents on or near the site
- To recommend appropriate infrastructure and management strategies to achieve the above goals



- To preserve as much as possible of site context and sense of place in an area that is subject to unprecedented development. Gondolin is an interesting hillside property (the steepest of all except Haasgat) with a number of collapsed caves and sinkholes, which were exploited for lime in the early part of the last century.
- To foster and maintain communication links between management bodies, landowners and researchers as partners in management and conservation of the fossil site.

## **1.2 Method**

- Consultation with landowners, researchers, repository institutions and support institutions to reveal concerns, contentious issues, requirements and future plans
- Research and understand the full range of natural, cultural, scientific, educational and ecological values of the site. Collation of information gained from a series of fossil site inspections has been incorporated.
- Provide an updated list of site values
- Refresh statement of site significance, in consultation with scientists
- Provide an illustrated status quo report against which change can be assessed
- Update the list of risks and threats
- Identify and record desired management outcomes, and devise management strategies to achieve these
- Provide a new management table with management strategies backed, where possible, by operational guidelines for use in the field
- Monitor and evaluate progress at each fossil site inspection, review management strategies where necessary

## **1.3 Administrative information and legal status**

<b>Site:</b>	Gondolin
<b>Farm Name &amp; No.:</b>	Portions 224 and remainder of Portion 112 of Broederstroom 481- JQ (Fig.1,2)
<b>Owner:</b>	Mr. Peter Fleming 12 Wantage Road Parkwood 2193 Has owned half the property since 1988 and the remainder was purchased at around 2004/5
<b>Contact details:</b>	Peter Fleming 011 788 9819 011 403 2247 (W)
<b>Legal status:</b>	National Heritage Site, November 2004; World Heritage Site 1999
<b>Servitude:</b>	Owner has servitude across the land of his neighbour, Mr Michael Wright. Mr Fleming has contributed R4 000 towards the original cost of the R20 000 access road
<b>NHS Boundary:</b>	A polygon A,B,C,D,E framing 3.6442 ha, marked with 20 mm iron pegs (Fig 3,4)
<b>Co-ordinates:</b>	25 49 49 S 27 51 49 E (See proclamation diagram, Fig 3)
<b>Area:</b>	3.6442 ha

<b>Permit Holder:</b>	Kevin Kuykendall was last permit holder
<b>Designated Repository:</b>	?Transvaal Museum
<b>Access to Public</b>	

#### 1.4 Existing site management

- There appear to be no formal site management arrangements at present. Researchers have been only sporadically present since 1979, and the site is overgrown and infested with alien plants and encroaching indigenous vegetation. There are several management functions that are normally the domain of the landowner, such as rangeland management, erosion and fire management, alien vegetation clearance, etc.
- There is no perimeter fence around the heritage site and fencing around the boundary of the host property apparently does not stop unauthorized persons from entering. Inadequate fencing leads to trespass
- There is no access to the general public but educational tours are occasionally organized by local landowners and researchers involved with the site. Visits are by appointment only and the general public is unaware of the whereabouts of the Gondolin fossil site. Its entrance is not signposted. However, pedestrian explorers and hikers have easy access to the site which is out of sight from the nearest house. The unauthorized access poses a threat to the large piles of fossiliferous breccia lying around as well as the fossils exposed and easily visible in the excavation wall. This has implications for erecting a site plaque which might draw attention to site values and invite closer inspection and tampering. The advisability of erecting a site plaque when there is no site supervision or full control of unauthorized access requires further debate.
- Landowners are concerned that hikers could start fires. The Gondolin site is at the bottom of a fire corridor and the long grass (no game and no cattle to reduce fuel load) causes a high fuel build-up. There are several luxury country homes with thatched roofs in the vicinity and uncontrolled fires are a great risk to property. It is not known whether or not there is a community fire management policy.
- The high level of infestation with *Opuntia* and other invasive alien species suggests that alien vegetation is not controlled. The subterranean caves are almost impenetrable because of *Opuntia*. The old kilns are choked with *Pyracantha*. Weed growth in the cavern precinct appears to be uncontrolled. Vegetation is slowly destroying the brick-lined kilns.

Additional existing site management includes:

- A SAHRA Permit Committee member inspects the excavation site and any ongoing excavations on a twice-annual basis, particularly with a view to assessing compliance with terms and conditions of the permit. At the moment, there is no active excavation (July 2008, date of the status quo site inspection).
- The site inspection team, including COH WHS MA, SAHRA and GDACE officials, plus a contracted specialist service provider, inspects the entire site on a twice-annual basis, monitoring the management criteria noted in the generic site management plan (see Table 1, generic management plan) and particularly the monitoring criteria in Table 1 of this document. Inspections are carried out regardless of whether or not there is an active excavation in progress.
- The COH WHS MA monitors development within the surrounding COH WHS properties with a view to protecting heritage values such as sense of place and visual aesthetics.
- A site safety inspection has been provided for. This is meant to take place annually. The subterranean environment at Gondolin is unstable and dangerous. The cave was probably



made even more unsafe by blasting operations in the quest for travertine by lime miners, and the roof is collapsing over a wide area. Cracks and chasms are visible on surface. The subterranean part of the cave is not at present being excavated and for safety reasons should be off-limits to researchers and site visitors.

- GDACE is available for advice to landowners regarding rangeland management, erosion control, fire management, alien vegetation and weed clearance, and preservation of biodiversity. The Gondolin site, like many fossil sites in the COH WHS, is infested with many invasive species, notably *Opuntia* and *Pyracantha*.
- The landowner and surrounding landowners burn firebreaks from time to time, but uncontrolled fires sometimes occur and these have the potential to cause extensive and expensive damage. Wooden and thatched structures are not advisable
- The Heritage Agreement and appended MOU between landowners and permitted scientists addresses issues of mutual management concern and is an important management tool. The terms of the SAHRA permit require that such an agreement be implemented, and the management issues that need to be covered by such an agreement have been discussed in the Generic Management Plan.

## 2 SITE DESCRIPTION: PHYSICAL FEATURES, VALUES AND SIGNIFICANCE

### 2.1 General site description

The site is against the side of a fairly steep hill, one of many in an area of broken hilly dolomitic country covered with Carletonville Dolomite Grassland (Gh 15) as designated by Mucina and Rutherford (2006). The fossil site is the weathering remains of an ancient cave, which today has an elongated slit-like partially choked lateral entrance facing east-south-east. As is the case with Gladysvale, there are areas 'outside' the present subterranean system which are fossiliferous and some of these have been partially explored and excavated (see section 2.3 below). The subterranean system is difficult of access because of collapsed roof blocks and fill, and the dense infestations of weeds and invasive alien species which choke the entrances.

The site was extensively mined for its travertine deposits. The lateral-type entrance would have made access to the subterranean cave relatively easy, and there is an extensive flat area outside the entrance covered in a thick layer of white limestone chips. That the interior of the cave was supplied with rich calcite deposits is attested by the fact that there are the remains of 6, possibly 7 top-loading lime-burning kilns below the artificially-constructed platform outside the cave entrance area. The remnants of a lime-workers' 'drive' or corridor passes between the north-eastern extremity of the deposit (marked GD2 on the plan, Fig 4) and the very large and potentially exciting Dump B (see plan, Fig 4) discarded by lime workers whilst developing the quarry. This dump comprises many blocks of potentially fossiliferous breccia and is covered in small calcite chips (Fig 5).





*Fig 5: Dump B, adjacent to the entrance to the Main Quarry, containing thousands of limestone chips as well as fairly uniform blocks of discarded fossil-bearing breccia*

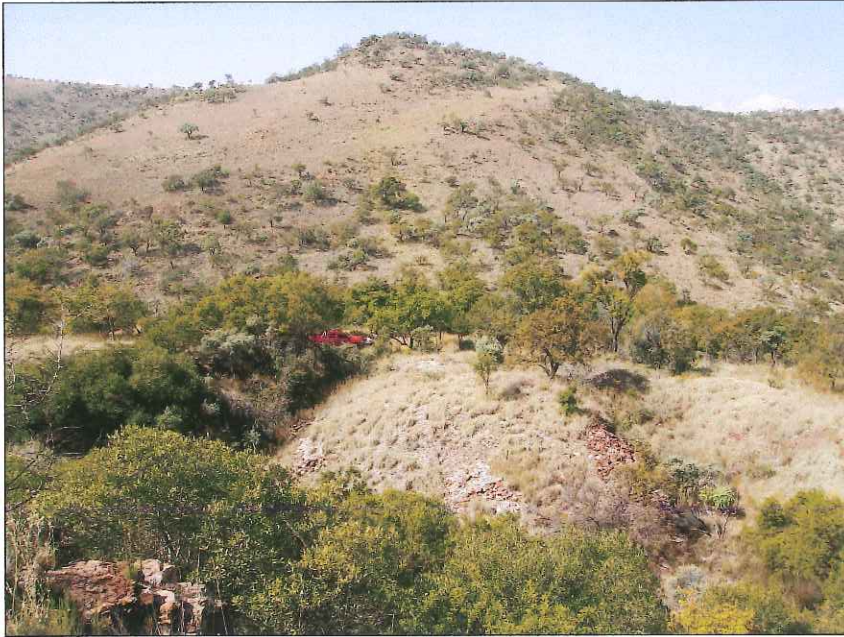
Outside the main quarry area is a large flat upper loading area in part comprising the flattened surface of deliberately dumped material, not named on the site plan, forming a platform with a steep edge against which the series of top loading mixed feed kilns have been constructed. A mixture of sized ore (probably hand-cobbed to approximately 11-16 cm) and local hardwood fuel, would have been fed into the kilns in alternating layers from the top. The dump against which the kilns have been built also contains fossil material. The better preserved kilns are fire-brick lined and it is possible that the others, which have collapsed, were of a more primitive construction. Adjacent to the base of the kilns is the lower extraction and loading area, a broad platform which formed the terminus and turning point of the wagon road. One of the kilns still has an intact extraction door or drawhole preserved at its base (Fig 6). The surface of the lower loading platform is made up almost exclusively of small calcite chips and is surfaced in places with calcined (burned) lime. It appears as Dump E on the plan.



*Fig 6: Remains of an arched, brick-constructed drawhole through which calcined lime could be extracted from the kiln*

The present 4 X 4 access road ends (in a 'dead end') in front of the passage-like entrance to the quarry (Fig 7), immediately opposite which are three or four small dumps of material originally lying on blue plastic; this has since disintegrated. The dumps were placed here by K Kuykendall and are marked 'K' on the site plan (Fig 4). Their source and ultimate fate is unknown as yet (Fig 8).





*Fig 7: View over Gondolin showing passage-like entrance to main Quarry and well-preserved contextual landscape and vegetation. The crest of the hill in the background sports the ruins of a substantial 'scherm' or small blockhouse.*



*Fig 8: The remnant Kuykendall Dumps (marked 'K' on site plan) abandoned on site, still underlain by disintegrating blue plastic sheeting (2006)*



## **2.2 Site values**

The fossil site management plan adopts a values-based approach and seeks to ensure that the many and various values of the site are conserved. Site values extend beyond those formally recognized as being of 'universal value' and this section seeks to provide an updated list of old, new and previously unrecorded or unrecognized values (2.2). Section 2.3 provides an updated statement of site significance which was prepared in consultation with permitted scientists working on site.

Certain values, particularly the World Heritage values are well documented but others have not been sufficiently recognized until now. Six sets of values have been identified: landscape values, palaeontological and archaeological values, mining and historical values, research values, biodiversity and ecological values and finally, educational and tourism values. The relative importance of these values differ – there are several that have allowed for World Heritage status and National Heritage Site status while others are of a more regional or local value.

### **2.2.1 Landscape: Geological and geomorphological values**

- Gondolin has numerous geological and geomorphological or landscape values. On a broader scale, the tilting of the Transvaal Supergroup, basined by the massive weight of the Bushveld Igneous Complex to the north of the Magaliesberg, can be demonstrated by showing visitors the series of homoclinal tilted quartzite beds (including the Magaliesberg range itself), with the series of parallel valleys representing the weathered-out shale horizons of the Transvaal Supergroup in between.
- Nearby outcrops preserve wonderful specimens of stromatolites, mainly domes, biscuit forms, and 'pallisade structures' representing stromatolites which have formed at different depths. There are ripple marks and interesting surface-weathered dolomite outcrops with chert bands, and layers of oolites.
- The geology, mode of origin and sedimentation within dolomitic caves can be beautifully demonstrated on this site. The sequence of formation, fill, collapse and weathering can also be shown
- Bone accumulating agents can be realistically discussed and some of these agents, notably porcupines and barn owls, are still present on site.
- There are excellent examples of in situ fossils and much that is aesthetically pleasing about the cavern environment

### **2.2.2 Palaeontological and archaeological values**

- The original excavation at Gondolin by E.Vrba in 1979 yielded 90 000 fossils, from in situ deposits and from dumps. The in situ portion of the cave that was explored is referred to as GD2 on the plan (Fig. 9)
- Preservation is generally excellent and even foetal and neonatal fossil bones have been found, some of them still articulated
- The fossil sample recovered from the approximately 3m<sup>2</sup> excavated by Vrba and Panagos (Vrba 1982) was partially described by Watson (1993) and later by Adams (2006).
- The fossil fauna includes extinct species of hyaena, a species of dog (canid), a fossil hippo and rhino as well as several antelope species. The commonest fossil antelope by far is the reedbuck, followed by the klipspringer.
- There are palaeomagnetic and faunal dates for GD2. The faunal date suggests about 2.0 million years
- The remnants of the extremely rich breccia can still be seen in situ (Fig 9)

- A single isolated tooth of *Homo* was discovered, but this is probably much more recent than the material from the in situ deposit.
- In 1997, an isolated extremely robust *Paranthropus robustus* tooth was discovered by Kevin Kuykendall on a dump (Dump A), but its origins are as yet unclear
- Fossils dating to about 1.2 – 1.3 million years old are indicated by this find. In other places of the cave, fossils may be older
- An interesting fauna has more recently been recovered from the GD1 areas of the site and has been , and probably date to about 1.76 million years before present, or a little younger, published (Adams, 2006,2007)
- The results of newer excavations are still outstanding



Fig 9: Extremely bone-rich breccia at the site of the Vrba excavation (marked GD2 on the site plan Fig 4) showing numerous drill holes. Portion of this exposure at least should be preserved as a witness section.

### 2.2.3 Mining and historical values

- As mentioned in an earlier section, this site preserves the best relics of the mining phase of the history of the Cradle of Humankind. The cave must have had considerable quantities of travertine because there are more old lime-burning kilns here than at any of the other fossil sites.
- There are the relics, within the quarry, of how the miners set to work extracting the calcite, and how ore was tipped into the lime-burning kilns. One of the latter still has an intact extraction door, where burned lime was scraped out (Fig 6, 10). The terminus of the old wagon road is preserved as well as a considerable piece of track leading out of the valley towards Broederstroom. The prickly pears are in all likelihood a relic of miner's meals: such infestations are typically focused on the old lime mines and occur less frequently elsewhere.
- There are a number of dumps and blast holes in the remaining in situ travertine
- There are at least 2 South African War 'schanses' and the area is thinly littered with War relics such as rusty tins and other metal fragments, one of which was identified as a Bird's (of Bird's Custard fame) Dried Egg Powder tin. Such relics are protected and



should be collected under a permit. Rescued material should be reported to SAHRA and accessioned at the Transvaal Museum.



*Fig 10: Lime-burning kiln showing refractory brick and vegetation which is causing damage to the brick lining*

#### **2.2.4 Research values**

- The breccias are unusually rich, the fossils are well preserved and there is still a great deal of potential in the form of unsorted dumps and unexcavated in-situ material

#### **2.2.5 Biodiversity and ecological values**

- The site is small (somewhat over 3 hectares) and there is no particular ecological importance that can be attached to the site per se, as opposed to the relatively unspoilt setting in which it occurs. One of the most valuable assets is the undeveloped nature of the contextual setting of the site and the open hilly country which still has excellent open views all round, which asset is an increasingly scarce commodity in the densely developed Gauteng Province where most of the fossil sites occur.
- Small game is still reported from time to time

#### **2.2.6 Educational, tourism and economic values**

- The above features confer a considerable number of educational and tourism opportunities, should the landowner at any stage wish to extend into this area. The landowner does not envisage tourism which is open to the general public at this time

### **2.3 Original statement of site significance (J Deacon, 2002)**

In the absence of an updated statement of site significance, the original statement, prepared for nomination of the site as a national Heritage Site, is given verbatim:



*"Gondolin is the northern-most hominin fossil site in the Cradle of Humankind. Apart from twenty seven mammalian species, the fossils from breccias in several ancient caverns include teeth of at least two hominins placing it in the same time range as Kromdraai, Drimolen and Swartkrans.*

*It was recommended by ICOMOS in 1999 that the fossil sites in the Cradle of Humankind be declared a World Heritage Site because they "contain an exceptionally large and scientifically significant group of sites which throw light on the earliest ancestors of humankind. They constitute a vast reserve of scientific information, the potential of which is enormous."*

*In terms of the criteria set out in Section 3(3) of the National Heritage Resources Act (Act No. 25 of 1999), and specified for Grade I national heritage resources in the draft SAHRA Regulations on Grading System and Heritage Resources Assessment Criteria, Gondolin qualifies for national heritage status because of its:*

- (a) **Importance in the pattern of South Africa's history.** The hominin fossils from Gondolin demonstrate that this part of South Africa was home to some of our earliest human ancestors between about 1.5 and 2.0 million years ago.
- (b) **Possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.** Hominin fossils are rare worldwide because of their limited geographical distribution and the rarity of natural conditions for fossilisation and preservation. The *Paranthropus robustus*, *Homo sp.* and associated mammalian remains from Gondolin are therefore of national and international significance.
- (c) **Potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.** The detailed analysis of the fossil animal species found at Gondolin has provided valuable information about environmental conditions between 1.5 and 2.0 million years ago.
- (d) **Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects.** The fossils from Gondolin demonstrate the principal characteristics of the range of mammals that inhabited this region between 1 and 2 million years ago.
- (e) **Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.** The aesthetic qualities of Gondolin's limestone caves were largely destroyed by lime mining activities in the early twentieth century, but the rural setting and natural vegetation are still intact.
- (f) **Importance in demonstrating a high degree of creative or technical achievement at a particular period.** No stone or bone tools have been found at Gondolin.
- (g) **Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.** Gondolin is important to all South Africans who are interested in the history of our species.
- (h) **Strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.** No special association has yet been established.
- (i) **Significance relating to the history of slavery in South Africa.** The age of the deposits at Gondolin places it well before the time period of slavery in South Africa." (J Deacon, 2002)

### 3 SITE ANALYSIS: STATUS QUO, THREATS AND RISKS, JULY 2008

In order to provide a basis against which change can be assessed, a status quo report is necessary. Ideally, change is assessed by means of comparison of 'fixed point photography' and such fixed points are in the process of being selected and installed. For the purposes of the status quo report for this site, fixed point photography is almost unnecessary at the present time:

there is no active work on site and little changes from year to year. The only exception is the alien vegetation, which occurs in some heavy infestations and fixed point monitoring will be set up to assess changes to the situation.

In order to assess the management strategies that may be necessary to preserve site values, threats and risks to site values have been analysed as part of the status quo, and the next section (Section 4) describes desired states and management outcomes.

### **3.1 Physical Environment: Surface**

This section addresses the status quo of seven elements of the physical environment, namely physical and legal access to the property, rangeland or veld condition, erosion, fire management, rare plants and animals, alien invasive species and visual aesthetics.

#### **3.1.1 Access**

##### Status Quo

- Access is not always effectively controlled. The host property has a fence, but the site itself does not. There is no locked boom, and vehicles could access the site unnoticed if adjacent landowners are out.
- Unauthorized visitors have been a problem in the past. They bring with them the increased risk of fire (from picnics). There are many fossils that can be readily extracted from de-calcifying breccia or scavenged from dumps.
- Physical access by means of the steep road is also problematic because of damage by inexperienced 4 x 4 drivers. The lower 'shared' part of the access track is also not well maintained. There are multiple users of the road. The Gondolin landowner has a registered servitude across the land of his neighbour. The neighbour rightly insists that only 4x4 vehicles may use the road as failed attempts by other vehicles to make the steep hill cause a great deal of damage to the road
- Should excavation re-open, this situation would be exacerbated by daily use of the road
- The landowner has no objection to scientists working on his property provided that they notify him in advance of planned visits.
- There are a number of considerations regarding access which should be included in the researcher-landowner agreements required in terms of the Heritage Agreement, at such time as a permitted scientist seeks to excavate or explore deposits on the property. Most of these are generic considerations common to access arrangements throughout the Cradle of Humankind fossil sites and they are listed in the generic part of the fossil site management plan.

##### Risks and Threats:

- Increased risk of fires
- Risk that exposed fossils may be removed

#### **3.1.2 Rangeland**

The rangeland in the contextual area around the Gondolin fossil site appears to be in good condition and there are no signs of over-utilization by domestic animals or game, or patches of erosion. Rangeland management for the property as a whole is a landowner responsibility. GDACE can offer valuable expertise and advice.



Rangeland management within the fossil site itself is not an issue because at 3.6442 ha it represents only a tiny portion of a much larger property. Whatever happens in this greater area will impact on the fossil site.

An outstanding aspect of rangeland management is the compilation of a list of plants and animals still occurring at Gondolin, or in its immediate environs. For plant species, it should be noted which of the species are edible, which medicinal or magical, and which are of economic importance.

Such lists are in any case basic data important to recording the status quo, especially as pressures regarding traditional plant medicines and their collection are likely to increase. Target edible and medicinal species should be mapped and monitored and checks should be made to assess the impact of collection, if any.

Monitoring of rangeland by means of fixed point photography does not appear to be necessary for this site

Status quo:

- Rangeland in good condition, managed as part of main property by the landowner
- No plant species list available
- No faunal lists available
- Edible, medicinal and economically significant species need to be recorded and monitored
- There are a number of well-grown trees, many of them opportunistically growing on top of the old dumps.

Risks and Threats:

- Biological values of the site poorly or at best incompletely understood
- No means of assessing impacts of fire and plant utilization
- Indigenous tree growth is damaging old kilns

### **3.1.3 Erosion**

Status quo:

- Although the access road is an erosion problem, erosion within the fossil site itself is not problematic. What is problematic is the gradual but inexorable collapse of the roof onto the floor of the underground chamber. This has produced several cracks and sinkholes on surface and is discussed further under site safety

Risks and Threats:

- Natural erosion, exacerbated by the impact of blasting and other mining activity, is causing collapse in the subterranean cavern system. This impacts on site safety.

### **3.1.4 Fire management**

Status quo:

- Fire management is a landowner management issue. It would appear that burning of fire breaks around properties does occur and there may be a resident community fire management organisation. (Landowner input requested here)
- Fires are not a direct threat to the heritage values of the site. The stony nature of the ground means that there is little fuel to burn.



Risks and Threats:

- No framework for assessing the impact of fire as yet exists. This is a generic issue relevant to the whole of the COH WHS.
- Uncontrolled fires entering the property from outside continue to pose a threat to property and rangeland.
- Uncontrolled access increases the risk of fires started by picnickers

### 3.1.5 Red Data Species, rare plants and animals

Status quo:

- There are no botanical or faunal lists for Gondolin and no record of medicinal, edible or poisonous plants. Such lists, and a record of the whereabouts of particular species, are essential to baseline studies of, for example, the impact of fire or collection by traditional users.
- Rare species have not yet been mapped. Rare plants and animals are difficult to protect if their whereabouts are unknown. A likely rare species is the bat *Miniopterus natalensis*, whose numbers are declining. The status of bats in the cave is unknown.
- It is recommended that species lists of plants and animals be drawn up and the occurrence of economically significant species as well as medicinal and poisonous plants recorded on a map. Impact of collection and use should be noted.

Risks and Threats:

- There is no up-to-date faunal or plant species list or mapping of vegetation – over 500 species of plants are known to occur in the Sterkfontein area (Mogg 1975) in this type of Highveld grassland. Rare and endangered species cannot be protected if not located and mapped.
- Edible, medicinal and toxic plant species not recorded – full values of site not clearly understood

### 3.1.6 Alien vegetation and weeds

Status quo

- The entire cave entrance area is infested with the prickly pear, *Opuntia*. For researchers and the site inspection team, the *Opuntia* obscures key stratigraphic sections and makes access to the cave entrances impossible. There is standing legislation regarding the eradication of invasive species, but on the other hand, the dense infestation does discourage entry to the caves by unauthorized visitors (Fig 11). A second consideration is that prickly pears are in all likelihood 'historical plantings' in that they were favoured by lime workers for their fruit, and undemanding willingness to grow.
- It is recommended that the landowner discuss their eradication with the management authorities, including GDACE.
- Weeds are a similar problem and the entire precinct of the fossil site is infested.
- Vegetation which is destroying the lime kilns, however, should be judiciously and carefully eradicated so as not to destroy their fabric. (Note: A permit from SAHRA would be required.) Some of the vegetation that is troublesome is indigenous (Fig 10).

Risks and Threats:

- There is no list of invasive alien species present, or of weeds, available for this site.
- Occurrence and density of invasive alien species has not been mapped or prioritized, making management and control difficult

- There is no agreed plan of management or budget for the control and/or clearance of invasive species within the fossil site
- Field operational guidelines for appropriate eradication treatments for different species of invasive species are not yet available
- There is no comprehensive or integrated action plan to address the problem of invasives within the broader COH WHS – re-infestation from outside sources is a problem
- Fixed point photography still needs to be set up on site
- Vegetation growth is destroying the lime kilns.



*Fig 11: Opuntia growing close to the entrance of the Gondolin cave*

### **3.1.7 Visual aesthetics, site context**

#### **Status quo:**

- The viewshed of this site is particularly vulnerable, being set at the focal point of an almost closed amphitheatre of overlooking hills, which are at present mostly undeveloped and pristine (Fig 7). Being almost totally enclosed by higher landforms in itself provides a feeling of remoteness – ‘embraced by the empty hills’ This quality is of great value to town dwellers.
- Plans for developing houses are meant to be forwarded by the North West authorities to the COH WHS MA, which screens all development plans and assesses them for visual impact. The fact that hilltop sites are so popular for residential development makes it problematic, as the site is overlooked from many vantage points, and locals have a propensity to select hilltop locations for development.

#### **Risks and Threats:**

- The location of the site makes it particularly vulnerable to visual impact of any development..
- Local landowners tend to build on the tops of hills or on ridgelines creating a strong visual impact.



### **3.2 Physical Environment: Subterranean**

**Status quo:**

- There is an extensive subterranean system at Gondolin, one which in the past provided sufficient supplies of calcite to warrant seven lime-burning kilns. Undoubtedly much of the accessible travertine would have been removed and access points into the subterranean caves can still be seen, as well as drill holes and other evidence of mining. The blasting associated with mining appears to have weakened the fabric of the cave and ongoing collapse has been noted. The cave and its environs are in need of a site safety inspection prior to any further work there being permitted. The lip of the cave entrance is particularly dangerous and large blocks have recently become detached (Fig 12, 13).

**Risks and Threats:**

- Collapse of the cave both underground and on surface in the form of sinkholes and boulder chokes creates a safety risk to site users



*Fig 12: Collapse of lip of cliff edge above Gondolin cave entrance*





Fig 13: Large fallen block of collapsed material from cliff top partially blocks cave entrance

### 3.3 Infrastructure

#### 3.3.1 Access roads, culverts, bridges, etc.

Status quo:

The poor condition of the access road has already been discussed elsewhere. The most vulnerable portion is not within the fossil site itself, and is therefore not a management issue

The short section of access road that actually enters the fossil site (Fig 4) presents as follows:

- The road is an informal 'jeep track' across country
- It has an extremely rough and rocky surface
- It is not accessible, except to 4 X 4 vehicles
- There are no humps to direct run-off or mitre drains where the road is steep
- The road is fortunately oblique to the slope of the land and steep sections are not yet eroded
- The road sees little use and deterioration due to sustained use is not a factor at present
- There is no proper or visually defined turning circle, encouraging drivers to choose their own piece of veld. This unnecessarily ruins vegetation
- It is actually possible to drive down to the old wagon road. Should this route ever be reopened, judicial and sensitive restoration of the historic road is recommended

Risks and Threats:

- Erosion of road verges and tracks due to poor engineering and drainage interventions

#### 3.3.2 Fencing and gates

Status quo:

- There is a boundary fence around the host property (Landowner info required)

- There is no boom and with the correct vehicle anyone can enter the site
- There is no locked gate which controls access
- The landowner is not particularly in favour of a fence around the proclaimed heritage site
- Unauthorized access has been a problem and fires, disturbance and scavenging of fossils are risks associated with this

Risks and threats:

- Scavenging of fossils

### **3.3.3 Parking**

Status quo:

- There is no defined parking area; drivers turn around as best they can.
- It is recommended that a suitable place to turn be defined and visually marked out with strategically placed stones

Risks and threats:

- Unnecessary damage to vegetation unless an area is defined

### **3.3.4 Built environment**

Status quo:

- Sheds and storage: none
- Accommodation: none
- Pathways, walkways and viewing platforms: none
- Tourist-related, including signage: none
- Ablutions and storage: none

Risks and threats:

- Not an issue at present

### **3.3.5 Waste Management**

Status quo:

- Sewage: There is no toilet on site. This is a prerequisite before sustained excavation can take place. An Enviroloo would be required, because it would be impossible for a Portaloo to be installed, on account of the difficulty of access. Even an Enviroloo would be difficult to bring on to site. There are no workers on site at present, but this does not remove the issue of sanitation. Pit toilets and septic tanks are not recommended, but might be the only solution on this particular site.
- Litter: the management and disposal of litter is an item on the list of considerations to be built into the agreement between the landowner and permitted scientists – see generic management plan for list.

Risks and threats:

- Pollution of the environment. Not an issue at present.

### **3.3.6 Energy**

Status quo:



- There is no energy supply to the fossil site, or one which could be tapped into close by.

Risks and threats:

- Not an issue at present

### **3.3.7 Water**

Status quo:

- There is no water supply to the site. All water has to be brought in. There is no easy solution to this problem because a water bowser is extremely heavy and the access road truly problematic.

Risks and threats:

- Not an issue at present

### **3.3.8 Telecommunications**

No formal telecommunications

Cellphone?

Risks and threats:

- Not an issue at present

## **3.4 Research Environment**

There is no current permit on this site. The last permit was held by Kevin Kuykendall but this has expired.

### **3.4.1 Previous and ongoing research and excavations**

Status quo:

#### ***In Area GD2:***

The presence of fossils was first noted by Mr L. MacKenzie in 1977.

- In 1979, E Vrba and D Panagos conducted excavations and recovered some 90 000 fossils from dumps and in-situ material at GD2 (Fig 9).
- Some dumps were apparently left on site after this excavation (Fig 14). Their status and content is unknown – probably the dump marked as D C on site plan. These could have resulted from the Vrba excavation or from collections resulting from the K Kuykendall Field School, which emphasizes the need for recording status quo of sites.
- The remnant fossiliferous deposit rests on a basal flowstone layer, and is capped by a layer of travertine.
- The intervening layer of richly fossiliferous breccia is about 1.3 m thick. Approximately 2-3 cubic metres were removed – the breccia ‘was harvested using electric drills and chisels’ (Watson 1993) and this probably explains many of the holes in the fossiliferous face (Fig 9).
- The 43 blocks of fossiliferous breccia harvested was prepared in the Transvaal museum using acetic acid, and the resulting collection of material partially described by Watson (op.cit.)

- The sample was re-analysed by Adams (2006) and samples were taken for dating: palaeomagnetic and faunal dates (Herries 2006; and Adams & Conroy 2005). This probably explains a few more of the many holes.
- Figs 9 and 14 express the status quo.
- The repository for this material: Transvaal Museum, Department of Palaeontology and the current curator is Ms Stephany Potze
- Collections: G1 – G41 195



Fig 14: Abandoned dumps close to the Vrba excavation at GD2 – probably Dump DC on site plan, Fig 4

#### **Excavations in Dump A:**

- Dump A (Fig 4) is an extensive dump of *ex situ* breccias and decalcified sediments discarded during the early lime working phase of the site's history.
- The first hominin specimen was recovered from Gondolin Dump A (Fig 4) in November 1997 by Dr Andre Keyser. It may belong to an individual of an early species of *Homo*.
- A second tooth, found by L. Dikhasu, is a complete permanent left mandibular second molar and because of its large size it has been assigned to *Paranthropus cf. robustus*.
- A 2m by 1m trench was excavated by Menter et al. (1999).
- A second 1m<sup>2</sup> excavation trench was put in by Adams in 2003 (see Adams, 2006), who removed 50 calcified blocks and decalcified sediments.
- Both breccia in the form of inclusions in this dump and the decalcified material probably comes from multiple sources in the cave.
- The Menter excavation has been partially backfilled
- The Adams excavation has not been backfilled and a small tree is growing in the trench.
- Figs.15 and 16 summarise the status quo.



- Repository is the Transvaal Museum, for Dump A, Excavation1: Menter 1999 (current curator: Stephany Potze). Collections: 50 breccia blocks, various sizes, from Dump A, partially described by Adams (2006)
- Repository for the material from the extension trench of Adams (2003) is the Bernard Price Institute (current curator: Bernhard Zipfel). Collections: loose fossil specimens, housed with rest of material from GDA – see below.
- Sterile dumps resulting from this exercise have been piled next to the approach road, again highlighting the need for scientists to declare their intentions regarding the different types of material excavated. Their position, content and source need to be annotated on site plan. There is no plan to remove these dumps from site.

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#### **Excavations in GDA**

- The sample of fossils from GDA was removed during a short field season in 1997, at the time of the discovery of the two hominin teeth from Dump A
- Repository: Bernard Price Institute, school of Anatomical sciences, hominin material (current Curator: Bernhard Zipfel). Collections: GA 1 – GA 2 225

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#### **Excavations in GD1:**

- The GD1 sediments represent interstratified travertine, colluviums and residual talus cone material representing the time period 1.76 million years and later.
- The GD1 material comes from decalcified material near the GD 1 datum Point established by Menter (see Menter et al. 1999)
- A fossil sample was excavated in 2003 and described by Adams in 2006, Adams et al. 2007.
- A sample was exported for analysis and dating by A Herries of the University of Liverpool and residues are stored at this University. (Bernard Price Institute: current curator: Bernhard Zipfel) Collections: GD 1 – GD 5695

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#### **Excavations in GD3**

- The GD3 deposits consist of a fine reddish calcified silt still adhering to the wall of the mined cave system
- The deposits have been sampled for palaeomagnetic dating (Herries, Liverpool University, see above) – no results available at time of writing
- The deposits have not been palaeontologically explored.

#### **Risks and Threats:**

- Lack of funding inhibits research and site potential remains locked
- Lack of dedicated heritage officer in Management Authority prevents follow-through after site inspections and management issues remain unattended – a problem generic to all the fossil sites in the COH WHS.



*Fig 15: Dump A showing partial backfill*



*Fig 16: Dump A showing new sapling growth*



### **3.4.2 Excavation edges**

Dump A:

The excavation edges are stable

GD1:

The edges are stable but the area is prone to collapse

Risks and threats:

- Collapse of friable excavation edges

### **3.4.3 Excavation walls**

Dump A

Excavation walls are stable but need watching. The scientists needs to be advised on whether or not to complete the backfill exercise Figs 15 and 16 provide a status quo situation

GD2: Vrba area. The excavation wall is heavily calcified and stable.

Risks and Threats:

- Collapse of friable excavation walls

### **3.4.4 Access to excavations: steps, ladders, lifts etc.**

There are man-made interventions by means of which the excavations are accessed. All are accessible by stepping down into them.

Risks and Threats;

- None at present

### **3.4.5 Erosion**

The only natural 'erosion' is the natural collapse of the cavern system which is ongoing (see Subterranean Environment). There are some erosion features which have been caused by former excavations such as the creation of sumps and trenches which act as conduits for surface run-off. This emphasizes the need for a consistent approach towards post-excavation stabilization and closure procedures.

Threats and risks:

- Excavations change surface topography and cause erosional problems by re-directing surface run-off.

### **3.4.6 Compliance with conditions of excavation permit**

The present permit has expired and a new permit application would be required for any further work.

Status quo:

The following items are checked on a biannual basis:

- Recording method (a lazer theodolite or 'Total Station' is used)

- Check that the position of all excavations has been committed to plan
- Check that lodging of standard site record form with the Cultural History Museum has taken place.
- Review status of progress report and final report
- Check that copies of all published papers listed in the Bibliography hereunder have been lodged with SAHRA
- Check accessioning and preparation backlogs with the repository
- Check that witness sections have been appropriately selected and committed to plan

**Risks and threats:**

- Excavation is inevitably a destructive process. Inappropriate excavation techniques, recording techniques, recovery techniques, preparation techniques, inadequate subsequent publication and indifferent conservation of artefacts recovered is perhaps the greatest threat to fossil site significance. This is an issue generic to all the sites in the COH WHS, hence the SAHRA twice-yearly inspections. Non-compliance is not an issue at this site.
- There is a risk that far more breccia than can ever be processed could be removed, and that research proceeds regardless with still more breccia being removed from in situ, creating impossible bottlenecks and storage problems

### **3.4.7 Witness sections**

**Status quo:**

- Excavation has scarcely commenced in the in situ material and the only 'witness section' is that at the Vrba excavation area at GD2
- The Dump A has been sectioned by excavation but its stratigraphy provides only a history of material discarded, the oldest at the bottom. This provides clues as to its source or sources. There are arguments for and against re-filling dump sites.
- Fig 9 identifies an area where a witness section should be declared (the bone exposure at the Vrba site).

**Risks and threats:**

- Stratigraphic conclusions reached should be independently verifiable. If no witness sections are preserved, this would not be possible
- Dating results need to be independently verifiable. If witness sample sections are not preserved, this will not be possible
- New techniques and analytical procedures are perpetually coming to light. These need to be applied to sites from which earlier conclusions were obtained, in order to verify and expand understanding. If there are no witness sections, this cannot be accomplished.

### **3.4.8 Dumps**

**Status quo:**

Dumps can be divided into two; those dumps which were already there before scientific exploration of the site began and which were discarded by lime workers, and those which have been created by the activities of scientists.

**Old dumps**

Dump A: Richly fossiliferous. Source of 2 hominin teeth. Excavated by Menter and Adams.

Dump B: A huge unexplored dump created by lime miners during quarry development

Dump C: was there at the time of the Menter exploration. Source and maker of the Dump unknown, possibly dates from Vrba excavation



Dump D: unexplored and contents unknown. Vegetated, adjacent to entrance road

Dump E: below kilns, composed of collapsing kiln material and limestone chips. Apparently sterile

Kiln dumps – the dumped material which supports the lime-burning kilns. There are many fossiliferous blocks in amongst sterile material.

#### **New dumps**

Dump C: was there at the time of the Menter exploration. Source and maker of the Dump unknown, possibly dates from Vrba excavation – see above. Time period of this dump unknown  
Dumps marked K – Collected by K Kuykendall. Source and status unknown. Placed on blue plastic sheeting and possibly scheduled for removal.

Adam dumps: - originate from the extension dig in Dump A and have been stacked against the entrance road.

#### **Risks and Threats:**

- Loss of information concerning the source, author and content of dumps
- Loss of or languishing information, because dumps are not processed for fossil content

### **3.4.9 Repositories**

#### **Status quo:**

- Full details of the different repositories for the different areas of the excavation have been given above.
- The three repositories are the Transvaal Museum, Bernard Price Institute and the School of Anatomical Sciences at the University of the Witwatersrand

#### **Risks and threats:**

- Loss of, or deterioration of artefacts
  - Loss of information concerning artefacts
  - Lack of publicized information about artefacts
- These threats are not an issue at present.

### **3.5 Site safety and security**

Site Safety and security needs to be considered from a number of perspectives: Firstly, the physical stability of the valuable site fabric itself, and then from the perspective that site stability (or instability) impacts on the safety of researchers and those visiting the site. The safety of surface features, infrastructure and the special safety risks of subterranean environments all need special consideration.

Site Stability is affected by two different threat sources: Firstly, by natural causes which include the ongoing weathering and decalcifying processes, and secondly from man-made influences such as the alteration of surface drainage and poor excavation techniques, or by mining activities which create unstable voids, and blasting, which shatters rock and created fractures. However, it is only by the inherently destructive twin processes of mining and excavation that site significance was or can be realised.

Site security refers to man-made threats to personal and property safety, such as crime.

#### **3.5.1 Physical safety**

##### **Status quo:**

- The area is remote and there is no preferred pathway through the site. Not being 'on the way' to anywhere, or on a favoured pedestrian route, the site is probably safe.

Risks and Threats:

- None at present

### **3.5.2 Safety of surface and built environment**

Status quo:

- There is no built environment on site.
- There are several dangerous collapsed 'boulder chokes' (rubble-filled deep crevices) which have resulted from the collapse of the underlying cavern, and which are mostly concealed in the long grass. These pose a danger to site users.
- There are a number of unprotected drops at the cliff-like edge to the cave entrance below
- The excavation area above the cave is dangerous because it has created a rough surface, and, because people would need to frequent this area, it is especially dangerous.

Risks and Threats:

- The surface environment has several places which constitute a risk to the safety of site users

### **3.5.3 Safety of excavation area**

Status quo:

- The site has not received a site safety inspection for many years
- A number of collapsed boulder chokes pose a safety hazard in and around the site
- There are a number of steep or vertical drops that would require safety railings in the event of tourism
- There are a number of dangerous overhangs created by decalcification by tree roots; these can collapse at any time and some very large blocks already have (Figs 12 ,13)
- Appropriate prohibition signage should be posted

Risks and threats:

- Site safety is becoming a risk

### **3.5.4 Subterranean safety**

Status quo:

- There are several caves in the area, with three in the main site. None of them is recommended for tourist entry except perhaps the cave with the walkway. The latter runs for about 40m into the cave, terminating at a small hole which extends into the furthest reaches of the subterranean system
- This small entrance should be barricaded off and access granted to professional or experienced cavers only
- There has been no site safety inspection for several years and one is due shortly. This section will need to be amplified after the site safety officer had submitted a report
- The cave is unsafe for a number of reasons:
- It was weakened by blasting in the course of the removal of the flowstone deposits
- It is being progressively decalcified by vegetation
- Natural lines of weakness are being enlarged by erosion



- Excessive abstraction of groundwater in the rapidly developing area around the site is causing dewatering of the subterranean chambers, which renders the overlying caverns unstable
- The caves are unsafe and should be declared no-go areas

Risks and threats:

- Subterranean site safety is becoming a risk

### **3.6 Presentation of site values**

#### **3.6.1 Site interpretation**

Status quo:

- There is no site interpretation either on site or elsewhere in the Cradle of Humankind

Risks and threats:

- Lack of site interpretation diminishes tourist experience – tourism is limited to special groups at present
- Lack of site interpretation restricts dissemination of knowledge concerning the site and inhibits its presentation to a wider audience as required in terms of the WHC
- Lack of presentation of site values to a wider audience prevents information concerning site significance from reaching public psyche
- Potential funders might not know about site significance
- Public not educated about full range of COH WHS values

#### **3.6.2 Visitor numbers**

Status quo:

- There is no formal tourism operating on the site
- There are scientific visitors and field schools but as yet, no procedure to record the number of persons visiting the site

Risks and threats:

- Planning is affected by lack of visitor number figures

## **4 MANAGEMENT OBJECTIVES AND DESIRED OUTCOMES**

This section notes management objectives and desired states or outcomes, and the section and Table that follow (Section 5) describe the management strategies required to achieve such outcomes. The management objectives have the preservation all site values as a goal.

### **4.1 Physical environment, surface**

Management objectives include the following:

*Rangeland:*

- To ensure that contextual veld conditions and rangeland in immediate vicinity of fossil site is maintained in as good a condition as possible, with regard to appropriate land use and management.

*Erosion:*

- To ensure that the fossil site and its environs are free of active erosional problems and that existing areas of erosion are analysed, remedied, rehabilitated and monitored for follow-up action if necessary

*Fire management:*

- To ensure that a proper fire regime appropriate to Bankenveld is maintained on the fossil site.
- To ensure that fossil site users (when the site is active) are aware of fire hazards and can control on-site fires.
- To ensure that the fossil site does not harbor or create fire hazards
- To ensure that the necessary fire-fighting equipment is on hand in the event of a runaway 'internal' fire (rubber flails and beaters)
- To ensure that the basic data necessary to assess the long-term impact of frequent fires is available, which information is necessary to feed back into appropriate fire management

*Biodiversity, rare plants and animals:*

- To ensure that a database of plant and animal species present on site is available, because biological values are as yet poorly understood
- To assess which of these are target species for use as food, medicines, economic reasons, etc., and to what extent they are being collected
- To identify, record and map special species in order to ensure their protection

*Alien vegetation:*

- Desired outcome is a fossil site which is free from alien invasive species, and , as far as possible, from weeds that are troublesome

*Visual aesthetics:*

- Desired outcome is protection of viewshed and contextual visual environment.

## **4.2 Physical environment, subterranean**

- Desired outcome is a subterranean environment which, if it is being visited or excavated, is safe for all site users.
- A further desired outcome is a subterranean environment in which the cave atmosphere, substrate, geological features and micro- and macrobiota are properly conserved. This implies a thorough understanding of the subterranean environment.

## **4.3 Infrastructure, built environment**

Desired outcomes include the following:

- The installation of humps and mitre drains to correct erosional problems on the access road down to the site
- The erection of the site plaque, if deemed appropriate after further discussion
- The erection of interpretative signage if regular tourism is to take place
- The installation of an environmentally acceptable toilet if new excavations or increased tourism should become a reality



#### **4.4 Research environment**

Desired outcomes include the following:

- To ensure that the activities of scientists on site are perceived as 'adding value' rather than those of mere 'site users' and that authorities take cognizance of this, particularly with regard to funding items which are not directly research or science-orientated, such as the purchase of storage containers, which items have little hope of being funded by the NRF or other funding bodies
- To ensure that lack of funding does not inhibit research opportunities and prevent site potential from being realised
- To ensure that the Management Authority has in-house heritage expertise which allows for the follow-up of fossil site inspection observations and recommendations
- To ensure that all dumps, old and new, are committed to plan, with appropriate annotations
- To ensure that new dumps are appropriately sited and properly constructed
- To ensure that excavations are safely executed and compliant with permit terms and conditions
- To ensure that appropriate witness sections are left and stabilized
- To ensure that sample sites are properly recorded and that results are independently verifiable
- To ensure safe excavation edges, walls and bases, and that these are stabilized when work ceases.
- The excavations in Dump A are still not backfilled and a decision is necessary as to whether or not this is necessary. The closure of the excavations at GD1 and GD3 need further discussion. The dumps of breccia left by K Kuykendall need discussion as to their fate. Dumps left by Adams excavation in Dump A need discussion. Dumped material from Vrba excavation also need discussion
- To ensure that dump management becomes part of the permit application; such as indications as to dump site selected, details concerning dump construction method, long-term future of dump.
- To ensure that fossils are carefully and properly prepared, catalogued, curated and housed in a safe repository
- To ensure that regular site safety inspections take place
- To plan for a proper inspection of the nearby but difficult to reach Luleche site.

#### **4.5 Site safety and security**

- Desired outcomes include the provision of safety interventions recommended by the professional site safety officer after inspection of the surface and subterranean environment has taken place to ensure safe working and visiting conditions

#### **4.6 Presentation of site values**

Desired outcomes include:

- To ensure that the many heritage and natural values of the site are interpreted and made available to as wide a public as possible

## **5 MANAGEMENT AND MONITORING TASKS**

The following are operational management tasks and issues that need to be addressed now or in the future as part of on-going management actions in order to achieve the desired outcomes recorded above.. Their funding is still problematic.

The development of research at the fossil sites has been limited by the unfortunate perceptions that the State may not fund development on privately owned property and that the scientists are 'site-users'. This needs to change as it must be seen as the responsibility of the authorities to foster research and necessary associated development on these sites. It is recommended that in future, scientists be viewed rather as 'value adders' and thus eligible for some easement for the funding of heritage site management interventions which they are currently expected to fund, for example, fencing. In effect, the state has been expecting others to finance the protection of the COH WHS fossil sites.

Sites which have no active scientist are generally neglected – this is an indication of the positive influence which scientists have on fossil sites.

The following table has been drawn up with the specific aim of clarifying who should do what, and when, on the heritage site. The Table also provides some indication of priority ratings. It has been constructed in such a way as to incorporate all the key management issues, strategies and monitoring criteria so that it may be used independently of the text.

The relative priority of the management measures has been identified based on ICCROM definitions as follows:

- Immediate - to be attended to urgently as it constitutes a danger to the public or a resource;
- Urgent - to be attended to urgently to protect the resource;
- Necessary - to be attended to, to protect the resource;
- Desirable - to be attended to from a development perspective;
- Keep watch – to be monitored to see if the problem is serious.

TABLE 1 MANAGEMENT AND MONITORING ISSUES FOLLOWS



**Table 1 : MANAGEMENT AND MONITORING ISSUES**

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
<b>Surface environment</b>						
Access - legal access to property	<ul style="list-style-type: none"> <li>• Pedestrian access is a sensitive issue</li> <li>• Adjacent landowners are particular about access</li> <li>• Puts cordial relations at risk</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Maintenance of cordial relations with landowners regarding access (*)</i></li> <li>• Ensure that properly negotiated and preferably written letters are obtained by all site users and permit holders</li> </ul>	Future concern	Permitted scientist	<ul style="list-style-type: none"> <li>• Check if access issue has been addressed in MOU's between landowner and research scientists</li> <li>• Check if scientific tour operator and tourist guides have same permissions</li> </ul>	Ongoing
Unauthorised access	<ul style="list-style-type: none"> <li>• Removal of rock, fossils breccia and artefacts</li> <li>• Removal of Palindaba stone</li> <li>• Removal of edible and medicinal plants</li> </ul>	<ul style="list-style-type: none"> <li>• <i>No unauthorised visitation to site (*)</i></li> <li>• Research and field staff to maintain surveillance</li> </ul>	Necessary	Landowner, Heritage Inspectors	<ul style="list-style-type: none"> <li>• Check stockpiled breccia</li> <li>• Check for signs of digging out of plants</li> </ul>	Ongoing
Rangeland condition	<ul style="list-style-type: none"> <li>• Deterioration of rangeland due to too frequent fires</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Rangeland in optimum condition (*)</i></li> <li>• GDACE can advise</li> <li>• Plan for acquiring baseline data against which fire impacts can be assessed</li> <li>• Plant species list required</li> </ul>	Desirable	Landowner	<ul style="list-style-type: none"> <li>• Check for loss of palatable grasses and forbs</li> <li>• Check for increase in fire favoured species</li> <li>• Check for decrease in fire threatened species</li> </ul>	Ongoing
Retention of topsoil, surface drainage, surface erosion	<ul style="list-style-type: none"> <li>• Loss and dispersal of topsoil makes re-vegetation difficult</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Fossil site free of erosion (*)</i></li> <li>• Check all tracks and car park area</li> <li>• Check for surface drainage and distribution of runoff over surface</li> <li>• Check for signs of surface erosion</li> <li>• Road is landowner responsibility at present</li> </ul>	Necessary	Landowner, Research scientists when active on site	<ul style="list-style-type: none"> <li>• Check for worn patches of vegetation where cars habitually park</li> <li>• Check for erosion gulleys in tracks</li> <li>• Check for patches of exposed soil</li> </ul>	Ongoing

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Fire Management	<ul style="list-style-type: none"> <li>• Too frequent fires have a negative effect on vegetation</li> <li>• Fire is a threat to nearby houses and to moveable property</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Proper fire regime for Bankenveld maintained (*)</b></li> <li>• Implement a fire management policy, such as regular burn and management of firebreaks</li> <li>• Record fire frequency and intensity</li> <li>• Take precautionary measures to contain fires started on site</li> <li>• Be equipped with suitable beaters for research staff and field assistants</li> </ul>	desirable	Landowner, research scientist, GDACE	<ul style="list-style-type: none"> <li>• Set up rangeland study for base data against which fire impact can be assessed</li> <li>• Set up a fire frequency recording programme</li> <li>• Ensure that beaters are always on hand</li> </ul>	Ongoing
Red data species, rare and economically significant plants	<ul style="list-style-type: none"> <li>• Loss of edible and medicinal plants</li> <li>• Many important plant species are not on RED DATA list.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Preservation of biodiversity (*)</b></li> <li>• Surveillance of indigenous plant use</li> <li>• Draw up a species list of medicinal, poisonous, edible and economically significant species on property</li> <li>• Map occurrence and preferred microhabitats</li> <li>• Monitor collection and utilization</li> </ul>	desirable	Landowner, researchers and their staff can provide surveillance when on site	<ul style="list-style-type: none"> <li>• Check for signs of digging geophytes out by the roots</li> <li>• Check local roadside vendors for plants on sale</li> </ul>	Ongoing



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Invasive alien plant species.	<ul style="list-style-type: none"> <li>• Invasion of avens and other habitats by alien species</li> <li>• Invasions are impeding site inspections and access to caves</li> <li>• Loss of biodiversity</li> <li>• Unattractive landscape</li> <li>• Kilns being invaded by alien plants – destructive effect</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fossil site free of invasive aliens(*)</b></li> <li>• Make a list of all invasive plant species</li> <li>• Map and prioritise infestations</li> <li>• Determine best eradication or control programme. GDACE available for assistance</li> <li>• Assess costs and find budget</li> <li>• Begin control according to guideline provided in generic management plan</li> <li>• Enlist expertise of GDACE</li> <li>• Implement control and clearance programme</li> <li>• Monitor and follow up as required</li> <li>• Remove alien plants from kilns (SAHRA Permit required)</li> </ul>	necessary	Landowner, research scientists (in work environment) GDACE and SAHRA	<ul style="list-style-type: none"> <li>• Visual checks for infestations and incidence density</li> <li>• Monitor with fixed point photography</li> </ul>	Ongoing
Weeds & shrub growth in excavation sites	<ul style="list-style-type: none"> <li>• Roots destabilize breccias in time</li> <li>• Plants reduce visibility of noteworthy sections</li> <li>• Weeds give a negative visual experience and project an air of dereliction</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Weed-free fossil site (*)</b></li> <li>• Pull weeds by hand, or 'skoffel'</li> <li>• Destroy in a manner that does not spread seed further</li> </ul>	desirable	Landowner, research scientists (in excavation environment)	<ul style="list-style-type: none"> <li>• Visual checks for weed infestations</li> <li>• Fixed point photography for controls</li> </ul>	Ongoing
Development in 'viewshed'	<ul style="list-style-type: none"> <li>• Negative visual impact</li> <li>• Spoils 'sense of place'</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Preservation of sense of place and natural qualities of viewshed (*)</b></li> <li>• COH WHS to monitor all new development plans</li> </ul>	Necessary	COH WHS MA	<ul style="list-style-type: none"> <li>• Check plans for visual impact on viewshed of site</li> </ul>	Ongoing

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Habitat protection: Removal of stromatolites.	<ul style="list-style-type: none"> <li>Loss of Heritage material and site significance.</li> <li>Loss of micro-habitats (mosaic of sunny and shady areas).</li> </ul>	<ul style="list-style-type: none"> <li><b>Preservation of Painsdaba Stone and fossil stromatolites and associated microhabitats (*)</b></li> <li>Landowner, Research scientists and field staff to maintain surveillance</li> <li>Heritage Monitors to be alerted</li> <li>This problem is not specific to site but widespread</li> </ul>	Necessary	Landowner, permitted scientists, field staff, Heritage Inspectors	<ul style="list-style-type: none"> <li>Check for signs of disturbed soil, exposed patches of soil, overturned and disturbed rock</li> </ul>	Ongoing
<b>SUBTERRANEAN ENVIRONMENT</b>						
Presence of possible breeding colonies of bats: status of colony is unknown at present	<ul style="list-style-type: none"> <li>Loss of colony – sensitive to human interference</li> <li>Species involved (<i>Miniopterus natalensis</i>) is declining in numbers</li> </ul>	<ul style="list-style-type: none"> <li><b>Preservation of breeding colonies of <i>Miniopterus</i> (*)</b></li> <li>Take care when extending excavations into areas where bats are present</li> <li>Ensure that excavation only takes place when risk of disturbing breeding season is low</li> <li>Ensure that bats have free access into and out of cave</li> <li>GDACE can offer advice</li> </ul>	Future concern	Research scientists when they become active on site, GDACE to monitor	<ul style="list-style-type: none"> <li>GDACE to establish monitoring criteria for breeding colony</li> <li>Check for presence and numbers of bats</li> </ul>	Ongoing, breeding season
Porcupine lairs and owl roosts	<ul style="list-style-type: none"> <li>Disturbance and displacement of animals</li> <li>Porcupine lairs are important as modern analogues for taphonomic processes of the past</li> </ul>	<ul style="list-style-type: none"> <li><b>Preservation of porcupine lairs and owl roosts for actualistic studies (*)</b></li> <li>Protect any porcupine lairs and owl roosts on site</li> <li>Encourage that their behavior and lair contents are studied without disturbing animals</li> </ul>	necessary	All site users	<ul style="list-style-type: none"> <li>Check that porcupine lairs remain active – note presence of quills, droppings, gnawed bones</li> </ul>	Ongoing
<b>INFRASTRUCTURE</b>						
Access road	<ul style="list-style-type: none"> <li>See erosion above</li> </ul>	<ul style="list-style-type: none"> <li>See above</li> </ul>			•	



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Perimeter fence	<ul style="list-style-type: none"> <li>Landowner is opposed to perimeter fence</li> <li>Lack of fence allows unauthorized visitation</li> </ul>	<ul style="list-style-type: none"> <li>N/A. landowner is opposed to perimeter fence</li> <li>Perimeter fences curb unauthorized access, tampering with fossils or equipment, vandalism and theft</li> </ul>	N/A	N/A	<ul style="list-style-type: none"> <li>N/A</li> </ul>	N/A
Toilets, ablation	<ul style="list-style-type: none"> <li>Inadequate or improper sewage disposal could pollute groundwater</li> <li>Lack of a toilet is important when excavations are in progress</li> </ul>	<ul style="list-style-type: none"> <li><b>Site free from pollution (*)</b></li> <li>VIP or Enviroloo to be installed in time</li> </ul>	Future concern	Researcher, (for excavators and site visitors, field schools)	<ul style="list-style-type: none"> <li>Check that toilet is installed</li> <li>Check type of toilet</li> <li>Check efficacy, odours, flies</li> </ul>	Future concern
Waste management and disposal	<ul style="list-style-type: none"> <li>Litter</li> <li>Cattle and wild animals die from ingesting plastic bags</li> <li>Water pollution</li> </ul>	<ul style="list-style-type: none"> <li><b>Site free from litter (*)</b></li> <li>Provide litter bins, more when extra people are expected</li> <li>Collect and remove all litter regularly</li> <li>Best practice would require sorting and recycling litter</li> </ul>	Future concern	All site users	<ul style="list-style-type: none"> <li>Check for left litter</li> <li>Check for dumped litter in kilns and avens which are favourite places</li> <li>Check that litter bins have been installed</li> <li>Check removal schedule</li> <li>Check that litter stored on site cannot be wind distributed</li> <li>Encourage recycling</li> </ul>	Future concern
Pathways for site users and visitors	<ul style="list-style-type: none"> <li>Pathways too close to excavations can cause excavation edges to collapse</li> <li>Visitors/children falling into excavations, avens or miners' excavations</li> <li>Pathways can cause erosion</li> </ul>	<ul style="list-style-type: none"> <li><b>Pathways and excavation edges that are safe and stable (*)</b></li> <li>Capping with thin layer of gravel reinforcement</li> <li>Psychological barriers to be put in place, even if temporary</li> <li>Use safe retaining area for visitors</li> <li>Provide anti-erosion measures at sensitive areas</li> </ul>	Future concern	Researchers	<ul style="list-style-type: none"> <li>Check visitor pathways, boardwalks, viewing platforms for safety - of visitors and of site fabric</li> <li>Check pathways for wear and tear and channeling/erosion</li> </ul>	Future concern

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Site plaque recognizing World Heritage Site status and National Heritage Site Status	<ul style="list-style-type: none"> <li>Required in terms of the WHC Act and NHRA.</li> <li>Enhances site status</li> </ul>	<ul style="list-style-type: none"> <li><b>Site plaque appropriately installed if deemed appropriate(*)</b></li> <li><i>If so, then:</i></li> <li>Select appropriate position, agreed by researchers and landowner (Done)</li> <li>Ensure wording is appropriate and agreed, checked by SAHRA</li> <li>Ensure that both SAHRA and WHS logos appear</li> <li>Acquire budget</li> <li>SAHRA to install</li> </ul>	Necessary	SAHRA	<ul style="list-style-type: none"> <li>Check plaque condition and safety (brass plaques liable to theft)</li> </ul>	Ongoing
Signage: adequacy	<ul style="list-style-type: none"> <li>Poor tourist experience if site not adequately interpreted</li> </ul>	<ul style="list-style-type: none"> <li><b>Interpretative signage adequate (*)</b></li> <li>Site not open to general public, does not apply at present. Specialist tour operator and permitted scientist provide site interpretation</li> </ul>	Future concern	Researchers	<ul style="list-style-type: none"> <li>Check quality of signage</li> <li>Check quality of site interpretation</li> </ul>	Ongoing
Visitor impacts	<ul style="list-style-type: none"> <li>Littering</li> <li>Pollution</li> <li>Erosion of pathways</li> <li>Disturbance of excavations</li> <li>Theft of fossils</li> <li>Graffiti</li> </ul>	<ul style="list-style-type: none"> <li><b>Visitor impacts eliminated or minimized by appropriate interventions (*)</b></li> <li>These potential impacts do not apply to Gondolin at present.</li> <li>Toilet facilities are non-existent</li> <li>Responsible tourism cannot take place without toilets</li> </ul>	Future concern	Researchers, tour operator	<ul style="list-style-type: none"> <li>Check for littering</li> <li>Check for pollution of site</li> <li>Check all walkways for wear and tear</li> <li>Check for visitor disturbance of excavations or equipment</li> <li>Check for tampering with and removal of stored fossils</li> <li>Check for graffiti</li> <li>Check that a toilet is available and a place to wash hands</li> </ul>	Future concern



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Infrastructure : water	<ul style="list-style-type: none"> <li>Inadequate water supply inhibits excavation</li> <li>Lack of water slows down breccia preparation</li> <li>Water needed for ablutions</li> <li>Water needed to control dust</li> </ul>	<ul style="list-style-type: none"> <li>Consider all options for storing water on site (*)</li> </ul>	Future concern	researchers	<ul style="list-style-type: none"> <li>Concealed/screened storage tank, if that option is selected</li> </ul>	Future concern
Infrastructure : Energy	<ul style="list-style-type: none"> <li>Lack of energy reduces excavation speed and efficiency</li> </ul>	<ul style="list-style-type: none"> <li>If brought to site, bury cable underground (*)</li> <li>Note need for buried cable at planning stage</li> </ul>	Future concern	Landowner, researchers	<ul style="list-style-type: none"> <li>Ensure that cable is buried</li> </ul>	Future concern
Telecommunications	<ul style="list-style-type: none"> <li>Telephone necessary for responsible tourism</li> <li>Poor cellphone signal</li> <li>No landline</li> </ul>	<ul style="list-style-type: none"> <li>Negotiate with cellphone companies</li> </ul>	Future concern	COH WHS MA	<ul style="list-style-type: none"> <li>Check that telecommunications are satisfactory if new excavations and tourism ever takes place</li> </ul>	Future concern
<b>RESEARCH ENVIRONMENT</b>						
Alteration of surface topography, drainage	<ul style="list-style-type: none"> <li>Excavation has created a series of sumps, into which water is directed</li> <li>Collapse of the footwall is a risk – material could be channeled into subterranean cave.</li> </ul>	<ul style="list-style-type: none"> <li>Excavations that do not cause or exacerbate erosional problems (*)</li> <li>Create appropriate drainage in area peripheral to excavation area if this is possible which directs runoff away from sump</li> <li>Situation appears to be in hand at the site</li> </ul>	Ongoing	Researcher, SAHRA	<ul style="list-style-type: none"> <li>Monitor sump for floodwater and ponding (usually drains underground)</li> </ul>	Ongoing

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Safety of heritage material, pathways	<ul style="list-style-type: none"> <li>• Trampling by site visitors</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Site which is safe from the effects of repeated trampling, wheelbarrow use and pedestrian traffic (*)</i></li> <li>• Check a suitable route around Main Quarry for exposed fossils and mark out a suitable pathway that can be relocated as excavation develops</li> </ul>	Future concern	Researchers, SAHRA	<ul style="list-style-type: none"> <li>• Monitor site for trampling, particularly in pathway areas</li> </ul>	Future concern
Excavation edges	<ul style="list-style-type: none"> <li>• Decalcifying breccia results in the excavation walls having friable edges</li> <li>• Unstable edges collapse</li> <li>• This poses a risk of physical danger as well as of information loss</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Safe and stable excavation edges (*)</i></li> <li>• Excavation sites at Gondolin are small and minor, but in future,</li> <li>• Provide physical barrier or psychological barrier to prevent visitors getting too close</li> <li>• Do not site pathways too close to excavation edges</li> <li>• cap unstable edges with lime cement</li> </ul>	Future concern	Researcher, SAHRA	<ul style="list-style-type: none"> <li>• Researchers to monitor every time they are digging</li> <li>• Monitor for fallen and slumped wall deposit. Check footwall for fallen debris.</li> <li>• Annual professional assessment</li> </ul>	Future concern



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Excavation walls	<ul style="list-style-type: none"> <li>Unstable walls, particularly if decalcified tend to slump and collapse</li> <li>Collapse poses a threat to site users below unstable areas</li> <li>Collapse poses a threat to site significance because of mixing</li> <li>Very high walls are difficult to stabilize when excavation is terminated or completed</li> <li>Very high walls are susceptible to problems noted above</li> </ul>	<ul style="list-style-type: none"> <li><b>Safe and stable excavation walls (*)</b></li> <li>Excavation walls at Gondolin are acceptable at present</li> <li>Deep excavations should be "benched", quarry-style.</li> <li>Unstable walls should be stabilised - geotextile or sandbagging with 10% cement</li> <li>Manage unstable excavation walls appropriately</li> </ul>	Future concern	SAHRA, researchers	<ul style="list-style-type: none"> <li>Check degree of calcification of breccia – hard breccia can take higher walls than decalcified material</li> <li>Check unsupported wall height and recommend benching out if it appears unstable</li> <li>Check wall for loose rocks and boulders and bar down if necessary</li> <li>Decalcified excavations should not have walls in excess of 2 m</li> </ul>	Future concern
Access to bottom of excavation	<ul style="list-style-type: none"> <li>Steps, ladders, etc. must be safe and stable</li> </ul>	<ul style="list-style-type: none"> <li><b>Safe access to excavation base (*)</b></li> <li>Make benching shallow enough to use as steps</li> <li>Create and cap steps with protective layer</li> <li>Ensure ladders are safe</li> </ul>	Future concern	Researchers, SAHRA	<ul style="list-style-type: none"> <li>Check access routes to excavation base for safety and stability</li> </ul>	Future concern
Compliance with terms and conditions of permit	<ul style="list-style-type: none"> <li>Loss of information and site significance</li> </ul>	<ul style="list-style-type: none"> <li><b>Excavations in accord with conditions of permit (*)</b></li> <li>Check all permit terms and conditions</li> </ul>	necessary	SAHRA, researchers	Check all terms and conditions written into the permit such as:	At each site inspection

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Witness sections	<ul style="list-style-type: none"> <li>• Loss of information and site significance</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Defined and stabilized witness sections (*)</b></li> <li>• Ensure that selection of appropriate witness sections are a requirement in terms of the permit</li> <li>• Ensure that the researcher provides adequate criteria for the selection of witness sections</li> <li>• Ensure that all significant features are covered by or included in witness sections proposed</li> <li>• Ensure that witness sections are not prone to collapse and that they are stabilized on closure of excavation</li> <li>• Ensure that witness section is committed to plan</li> </ul>	Future concern	Researcher, SAHRA	<ul style="list-style-type: none"> <li>• Check for designated witness sections</li> <li>• Check for stability of witness sections</li> </ul>	Future concern



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Dumps	<ul style="list-style-type: none"> <li>• Loss of information concerning source and contents of dumped material (NB)</li> <li>• Footprint site of dumps not checked for significant plants</li> <li>• Position unacceptable to landowner</li> <li>• Position obscures significant part of deposit</li> <li>• Dump built over cave infill</li> <li>• No proper toe to dump or careless containment</li> <li>• Dump is cascading due to incorrect angle of repose</li> <li>• Dump is eroding</li> <li>• Dump origin not recorded</li> <li>• Dump contents not recorded</li> <li>• Duration of dump on site not recorded</li> <li>• Dump built over or too close to drainage line</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Mapped and recorded dumps, on site plan. Properly constructed dumps (*)</b></li> <li>• SAHRA to request that the scientist explain how dumped material – whether sterile or fossiliferous and 'in transit' – is to be managed. This dump management plan to become part of permitting requirement</li> </ul>	Necessary	SAHRA, researchers	<ul style="list-style-type: none"> <li>• Check placement of dump on landscape</li> <li>• Ensure that positioning is acceptable to landowner</li> <li>• Check planned position and ultimate size for possible problems with visibility of significant site features</li> <li>• Check to ensure dump is not planned to be situated over cave fill</li> <li>• Check that dump has containment toe</li> <li>• Check footprint area in relation to planned height – cascading must not happen</li> <li>• Check that dump is not eroding</li> <li>• Check that source of material is recorded</li> <li>• Check that contents of dump are recorded</li> <li>• Check that dump does not slump or erode into drainage line</li> <li>• Check that all dumps are recorded and annotated on a plan of the site</li> <li>• Monitor all the products of excavation, their recording (3D) and storage</li> </ul>	Ongoing

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Sieved residues, sterile	<ul style="list-style-type: none"> <li>• Could be placed where they will inconvenience landowner</li> <li>• Placed where they will constitute a visual impediment</li> <li>• Built in such a way that they will erode or become unstable</li> <li>• See points recorded for dumps above</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appropriate disposal of sieved waste (*)</b></li> <li>• Could be used for road and erosion repair if really sterile and in places suited to nature of sieved waste residues</li> <li>• Sieved material EIA to become part of permit application – see recommendation regarding dumps above</li> </ul>	Future concern	SAHRA, researchers	<ul style="list-style-type: none"> <li>• Check location of sieved waste material</li> <li>• Check for stability and erosion</li> <li>• Apply same monitoring criteria as noted for dumped breccia above</li> </ul>	Future concern
Security of breccia piles	<ul style="list-style-type: none"> <li>• Exposed fossiliferous breccia is at risk to scavenging by souvenir hunters, many small pieces lying about</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fossils safe from theft and tampering (*)</b></li> <li>• Portable blocks should be removed if significant</li> <li>• Tourist groups should not free-range: provide site guide</li> <li>• Keep groups to a size than can be properly supervised</li> <li>• Importance of every fossil should be taught – signage that outlines appropriate behaviour</li> <li>• Control access to excavation area strictly</li> </ul>	Future concern	Researchers	<ul style="list-style-type: none"> <li>• Monitor for security of fossiliferous breccia. Only non-portable blocks should be left in accessible places</li> <li>• Monitor site for vulnerable pieces and remove for safe keeping</li> </ul>	Future concern
Repository	<ul style="list-style-type: none"> <li>• Poor repository policies can result in information loss</li> <li>• Poor repository policy can result in problems of locating fossils</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Safe long-term repository (*)</b></li> <li>• Monitor repositories according to 'Minimum Standards for Repositories' guideline as prepared by SAHRA</li> </ul>	necessary	SAHRA	<ul style="list-style-type: none"> <li>• SAHRA to monitor repositories according to SAHRA 'Minimum Standards for Repositories' guideline</li> </ul>	Ongoing
<b>Site safety, security and stability</b>						



Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
cooking fires	<ul style="list-style-type: none"> <li>On site cooking fires are a potential source of uncontrolled fire</li> </ul>	<ul style="list-style-type: none"> <li><b>Fossil site which does not constitute a fire hazard (*)</b></li> <li>Provide appropriate beaters in the event of a grass fire</li> <li>Burn suitable firebreaks around fossil site</li> </ul>	Future concern	Landowner, researchers	<ul style="list-style-type: none"> <li>Check that there are sufficient beaters on site</li> <li>Check what had been arranged concerning site fire breaks</li> </ul>	Future concern
Signage, site safety and warnings	<ul style="list-style-type: none"> <li>Lack of appropriate signage can expose visitors to unexpected hazards, e.g. that there is a bees' nest</li> </ul>	<ul style="list-style-type: none"> <li><b>Compliance with Public Health and Safety requirements (*)</b></li> <li>Install appropriate behavior modifiers and site safety signage as and when this becomes necessary</li> <li>Appropriate safety signage is a requirement of Public (Occupational Health and Safety Act</li> <li>Maropeng even warns against possible presence of snakes</li> </ul>	Future concern	Researchers, landowner, tour operators	<ul style="list-style-type: none"> <li>Check for installation and appropriate wording</li> <li>Check for appropriate location of signs, design and durability</li> </ul>	Future concern
Subterranean environments at Gondolin : "Main Quarry" area and adjacent caves	<ul style="list-style-type: none"> <li>Instability due to previous mining activities and blasting</li> <li>Natural instability</li> </ul>	<ul style="list-style-type: none"> <li><b>Subterranean areas safe or off-limits (*)</b></li> <li>No-go areas for tourists; specialist caving groups only</li> <li>Subterranean site no-go until outcome of site safety inspection has been received</li> </ul>	Necessary	Researchers, tour operators	<ul style="list-style-type: none"> <li>Check that no-go instruction is being obeyed</li> </ul>	Ongoing

Issues	Threats or Risks	Desired Outcomes (*) and Management Measures	Priority	Responsibility	Monitoring Criteria	Monitoring frequency
Bees, "Kransbye", Wasps	<ul style="list-style-type: none"> <li>The numerous cavities and hollows are home to several bee hives and wasps' nests. Many people are allergic to bee stings in particular.</li> </ul>	<ul style="list-style-type: none"> <li><b>Site safe for all site users (*)</b></li> <li>Ensure that the necessary antihistamines are on hand.</li> <li>Destroy or have hives removed if these are where people frequently work.</li> <li>Post warning signage</li> <li>Provide first aid post</li> </ul>	Future concern	Researcher, Educational Tour Operator	<ul style="list-style-type: none"> <li>Monitoring should include checking the route for insect problems.</li> <li>Monitor speed at which an emergency case could reach appropriate medical help</li> <li>Check on site superintendent (usually the principal investigator) first aid expertise and policy</li> </ul>	Ongoing
Theft, crime	<ul style="list-style-type: none"> <li>The isolated situation makes the site particularly prone to petty theft of excavation and other equipment.</li> </ul>	<ul style="list-style-type: none"> <li><b>Site safety (*)</b></li> <li>Control on all persons entering the area</li> <li>Consider security fence around heritage site if situation becomes untenable</li> </ul>	Future concern	Researchers, landowner, site residents	<ul style="list-style-type: none"> <li>Security checks</li> </ul>	Ongoing

**GENERIC ISSUES RELATING TO FOSSIL SITE EXCAVATIONS: Not specific to Gondolin at present but necessary when excavations are in progress – see Generic Management Plan**

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## **7 MAPS AND FIGURES**

Fig. 1 Locality map

Fig. 2 Aerial view of Gondolin showing heritage boundary

Fig. 3 Proclamation Diagram for Gondolin

Fig. 4 Site plan for Gondolin showing dumps

Fig. 5 Dump B adjacent to the entrance to the Main Quarry, containing thousands of limestone chips

Fig. 6 Remains of drawhole at kiln base, through which calcined or burnt lime was removed

Fig. 7 Entrance area to Gondolin showing well preserved contextual vegetation and viewshed

Fig. 8 The remnant Kuykendall Dumps abandoned on site, still underlain by disintegrating blue plastic sheeting

Fig. 9 The site of the Vrba excavation showing extraordinary richness and numerous drill holes

Fig. 10 Lime-burning kiln showing refractory brick and vegetation which is causing damage to the heritage asset

Fig. 11 *Opuntia* infestations

Fig. 12 Collapse area at lip of cliff above subterranean cave entrance

Fig. 13 Large fallen collapsed blocks from cliff lip

Fig .14 Abandoned dumps near to the Vrba excavation

Fig. 15 Dump A showing partial backfill

Fig. 16 Dump A showing new sapling growth