

ENGLISH HERITAGE

ENGLISH HERITAGE ADVISORY COMMITTEE

MEETING: 24 SEPTEMBER 2003

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THE CONSERVATION OF SILBURY HILL

EHAC 2003/28

1 EXECUTIVE SUMMARY

- 1.1 There is a history of antiquarian and archaeological investigation at Silbury which have left some areas of the Hill inadequately supported. Following a collapse at the top of the Hill, English Heritage, after completing temporary works, commissioned a series of investigations into the geophysical composition of the Hill.
- 1.2 The investigations have revealed that the Hill is basically stable but a shaft sunk to the centre of the Hill, during the eighteenth century, and two tunnels driven into it, in 1849 and again in the late 1960s by Atkinson, were inadequately back-filled.
- 1.3 The report asks Committee to note the progress made to date in temporarily protecting the Hill and in investigating the present stability of the Hill and all aspects of its history. The Committee is also asked to support further investigations into the feasibility of the possible option of re-excavating the tunnels and associated laterals with a view to properly backfilling them.

2 RECOMMENDATIONS

The Committee is invited to:

- a) **NOTE progress to date in temporarily protecting the top of Silbury Hill and investigating the Hill's stability; and**
- b) **SUPPORT the carrying out of further investigations into the feasibility, benefits and disadvantages of re-excavating the tunnels to the centre of Silbury Hill and properly backfilling them.**

3 INTRODUCTION

- 3.1 Silbury Hill is a Neolithic monument mound constructed in a number of distinct phases. The earliest was a stacked turf mound some 40M in diameter. The final phase is some 160M in diameter and constructed of chalk rubble with some clayey deposits. During the recent works, finds from the summit of the Hill have been securely dated to between 2490 and 2340 B.C. (at 95% confidence).
- 3.2 Silbury Hill is a Scheduled Monument which has been in guardianship since 1883 and is currently in the care of English Heritage. It is the largest artificial

prehistoric mound in Western Europe and lies within the Avebury World Heritage Site. The Hill is also a Site of Special Scientific Interest.

- 3.3 The purpose of Silbury Hill has always been an enigma; it was commonly thought to be a burial mound. A number of antiquarian and archaeological investigations were carried out from the eighteenth century onwards to try to determine the purpose of the Hill's construction.
- 3.4 The most pertinent of these investigations, in relation to the present condition of the Hill, were the vertical shaft sunk by the Duke of Northumberland in 1776 and the tunnel and laterals dug under the direction of the Reverend Merewether in 1849 and more recently the tunnel and laterals dug by Professor Atkinson in 1968-70 (see **Appendix 2**).
- 3.5 The eighteenth century shaft was sunk from the top down to the centre of the Hill. It was common practice at that time, on abandonment, to cap such shafts with timber blocking roughly a third of the way down, with the shaft left empty below and back-filled above. It is believed that this was the practice at Silbury. Examination by English Heritage's Centre for Archaeology (CfA) of the sides of the collapse at the head of the shaft has led to the detection of previous backfilling. This has been confirmed by further study of aerial photography which has shown cratering to the head of the shaft in 1925 and again in 1934 and has also shown evidence of backfilling works.
- 3.6 The tunnel excavated by the Reverend Merewether penetrated to the centre of the Hill from the south. On completion this was not backfilled but was sealed at its entrance. In 1915 the outer part collapsed and shallow depressions can be seen where the collapse has worked its way to the surface (see appendices 2 and 3).
- 3.7 The Atkinson tunnel, sponsored by the BBC, bypassed the old entrance to the Merewether tunnel before following the same line to the centre. Two lateral tunnels were excavated to either side. Assurances were given at the time that the tunnel would be comprehensively backfilled but this, following recent investigations, is now known not to have been the case.

4 RECENT HISTORY

- 4.1 In 2000 there was the first of a small number of collapses to ground above the shaft sunk in 1776 by the Duke of Northumberland. At that time English Heritage was not aware of the history of collapses above the shaft and very little was known about the condition of the various earlier interventions in the Hill and the extent of their backfilling. Concerns were raised that by backfilling the collapse at the top of the shaft with a substantial weight of chalk that this might destabilise material either above earlier interventions or elsewhere in the Hill. Whilst English Heritage considered what action to take, public concern, especially amongst the local archaeological community, led to Silbury Hill being placed on the World Heritage in Danger List.
- 4.2 In the following year temporary works were carried out to the collapse around the head of the shaft, the void being lined with a geomembrane, filled with polystyrene blocks and capped with a layer of chalk. The purpose of these

works was to stabilise the sides of the collapse in a way which was completely reversible once the causes of the collapse had been investigated and long-term work decided upon.

- 4.3 To attempt to understand the causes of the collapse and to determine the condition of the interior of the mound, English Heritage asked a number of firms to submit proposals for the geophysical surveying of the Hill. After evaluating submissions, Skanska Cementation was appointed to carry out a seismic tomographic survey.
- 4.4 The method adopted was to drill four boreholes from the plateau at the top of the Hill down to original ground level and place in them sounding devices and hydrophones. Strings of geophones were also positioned up the sides of the Hill. The recording of the resistance to the passage of sound waves between the boreholes and between the boreholes and the geophones would then be used to draw up a 3D picture of the density of the Hill.
- 4.5 Silbury Hill is a unique structure and the employment of tomographic techniques to determine the composition of the Hill was seen, to a certain extent, as experimental and at the cutting edge of available technology albeit a method with potentially very interesting possibilities.
- 4.6 At the same time, work was carried out to draw together evidence from archival sources, air photography, topographical surveys and archaeological studies. The purpose of this work was to:
 - a) collate information relating to the original construction of the Hill and its later development and adaption;
 - b) gather information on previous antiquarian and archaeological investigations; and
 - c) assess available knowledge as to the geophysical behaviour of the Hill and changes to its topography.
- 4.7 Skanska Cementation produced a report on their tomographic investigations. These revealed areas of voiding or weak fill along the lines of the Merewether and Atkinson tunnels and to the shaft. One of the boreholes which had been sunk by Skanska penetrated the western lateral tunnel dug by Atkinson and a subsequent camera survey demonstrated that it had been inadequately backfilled. The investigations also highlighted a number of other areas of slightly anomalous results.
- 4.8 The Skanska report was subject to rigorous assessment. This was done by English Heritage through the use of our own independent expert consultants who tested the conclusions Skanska had drawn from their data. CfA also carried out further investigations in one of the areas of slightly anomalous results. In addition, we required Skanska to sink a further two boreholes to test the infilling of the shaft by collapsed material.
- 4.9 Drawing on the results of all our investigations including those using Skanska, there is now a much better understanding of the Hill's geophysical condition.

From archival researches, the Skanska tomography and camera surveys when boreholes hit voids in the Atkinson western lateral and at the bottom of the shaft, it is now known that the Merewether tunnel was not backfilled and that the Atkinson tunnel was inadequately backfilled. The borehole investigations to the shaft (see **Appendix 4**) show that it is completely filled with material although there are zones where it is poorly compacted which are liable to lead to further settlement. Further researches also showed that the slightly anomalous results from areas away from the vicinity of earlier intrusive archaeology were due, in all probability, to slight changes in the composition of original material and moisture content.

5 FUTURE CONSERVATION STRATEGIES

5.1 At the outset, English Heritage documented in 'Silbury Hill – Brief for Project to Stabilise the Monument' the conservation principles which would guide any work of the Hill (see **Appendix 1**). In summary these were that any work to conserve the Hill:

- i) would only be considered following the fullest possible investigation and understanding of the archaeology of the Hill and its geophysical properties;
- ii) should cause no, or if strictly necessary the minimum, damage to the archaeology of the Hill and be the minimum necessary to conserve the Hill;
- iii) should be reversible;
- iv) should be distinguishable from the old; and
- v) should not adversely affect the long-term conservation of the monument.

Strategies for conserving the Hill could then be tested against these principles.

Option 1 - Do Nothing

5.2 English Heritage could decide not to carry out further work but just monitor the situation. We know that the head of the shaft has collapsed before and that movement arising from the collapse of one section of the Merewether tunnel has already worked its way to the surface. The process could therefore be seen as a natural one with the Hill gradually readjusting to past interventions.

5.3 However, with the temporary capping to the shaft in place, it will not be possible to assess whether there has been further settlement below. It is also possible that voids in the tunnels will exacerbate the instability of the shaft infill. The Hill is a robust structure and while further settlement in the area of the shaft and the working out to the surface of the tunnels will affect the centre and a segment of the Hill, the bulk of the mound would be unaffected. However, although more is now understood about the archaeology of the Hill, there is still much that is not known. The fear is that any collapse may destroy irreplaceable archaeology of international importance.

Option 2 - Re-Excavation

- 5.4 The tunnels could be re-excavated and then properly backfilled with a compacted material such as chalk. This would have the advantage of consolidating the tunnels and preventing further collapses which could possibly destabilise the shaft infill.
- 5.5 CfA have commented that the cores from the boreholes have shown that there is excellent preservation of biological material within the primary mound, a resource of considerable significance. The reason for this is, as yet, not fully understood but may be due to the sealing of deposits as the result of iron panning. There are concerns as to the effects on these deposits of re-opening the tunnels and refilling them. If Committee supports recommendation b) then this would be a matter for further investigation.
- 5.6 Once the tunnels had been consolidated then the temporary filling to the collapse at the head of the shaft could be removed, the void filled with chalk and the area monitored for any further possible slumping. English Heritage has been advised that it is unlikely that the fill to the shaft would compact down by more than one to two metres and that such settlement would be gradual. At the same time the depressions above the collapsed entrance to the Merewether tunnel could be filled to reduce water penetration to the centre of the Hill.
- 5.7 The reprofiling of the tunnels to allow for their temporary support during re-excavation would provide further opportunities for examining material from the centre of the Hill. In addition, records from the Atkinson excavations are poor by modern-day standards. Re-excavation would allow for re-recording of the evidence provided by the tunnel walls and enable the buried ditch system to be properly excavated. A possible project outline is included as **Appendix 5**.

6 CONCLUSION

- 6.1 Advice and guidance from the Committee would be welcome as to the conservation principles which have been adopted and their application to the options under consideration. Committee might also wish to express views on the research opportunities presented by the new work.
- 6.2 A project outline for archaeological works, which would need to accompany any proposal to re-excavate the tunnels, is attached (see **Appendix 5**). Again, the Committee's views on the proposed works would be welcome.

7 CROSS REFERENCE TABLE

Implications:	Where raised within the report:
Legal implications	Proposals in accordance with English Heritage's guardianship duties.
Financial/staffing implications	Cost of further investigations can be met within existing budgets. There will be staff time involved in further evaluating possible options.
Health & Safety implications	There is a temporary capping in place to the area of the collapse above the shaft,

	surrounded by a fence. There are no known areas where in the short term there is a danger of further collapse.
PR implications	We will continue to update our position statement and web site.
Risk Management implications	Our PR will seek to counter possible criticism of the further delay in deciding whether to execute longer term conservation works.
Other professional implications?	None identified at this stage.
Relevant past decisions	None.
Compliance with EH Environmental Policy /Issues	Silbury Hill is a SSSI, no work which will affect its status proposed at present.
Compliance with EH Education/Training Issues	Not relevant.
Compliance with EH Social inclusion Issues	Not relevant.
Issue to be considered by another meeting?	No

8 ATTACHMENTS

8.1 The following documents are attached to this report:

- a) Appendix 1 - Silbury Hill – Brief for Project to Stabilise the Monument.
- b) Appendix 2 - Plan of the Hill showing location of earlier interventions and location of geotechnical investigations.
- c) Appendix 3 - Schematic partial section through Hill showing tunnelling and previously recorded voids and recently recorded collapses and voids.
- d) Appendix 4 - Graph of borehole penetration rates for borehole 7 (shaft) and borehole 6 (control).
- e) Appendix 5 - Project outline for archaeological works.

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