

**From:** [REDACTED]  
**To:** [A303 Stonehenge](#)  
**Subject:** Written summary of submissions made by Consortium of Archaeologists and the Blick Mead Project at Issue Specific Meetings on 5 & 6 June 2019  
**Date:** 21 June 2019 22:43:00  
**Attachments:** [REDACTED]  
**Importance:** High

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Dear Sirs,

We attach above a written summary of our submissions in 4 parts to the panel at meetings on 5 and 6 June 2019. The first attachment includes parts 1-3, prepared by Victoria Hutton of Counsel, and the second attachment is part 4, prepared by Dr Chris Bradley and Professor Tony Brown.

Yours faithfully,

**Mark Bush**

On behalf of the Consortium of Archaeologists and the Blick Mead Project Team



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**Written Summary of submissions made at oral hearings on 5 and 6 June 2019 and the implications of this evidence for the HIA, the Heritage Assessment and the decision**

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**WRITTEN SUMMARY ON BEHALF  
OF THE CONSORTIUM OF ARCHEOLOGISTS  
AND THE BLICK MEAD PROJECT TEAM**

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**Introduction**

1. This written summary is set out as follows:

**Part 1** – General Points

- a) note on expertise of those giving evidence on behalf of the consortium of archaeologists
- b) the implications of the evidence given by the consortium
- c) position of Historic England and the National Trust with regards to the DAMS
- d) further information requested

**Part 2** – Notes of evidence and submissions in the following order:

- a) Inadequacy of survey techniques and information – evidence of Paul Garwood
- b) Evidence of Professor Parker-Pearson with regards to the significance of the areas of the proposed eastern and western approaches and portals and the inadequacy of the DAMS
- c) Evidence of Paul Garwood with regards the positioning of the western portal and its severing of the relationship between groups of barrows together with harm to the topography and visual and spatial relationships
- d) Additional comments on the DAMS
- e) Blick Mead
  - a. Its significance
  - b. Its extent
  - c. Harm already caused
  - d. Harm to setting

e. Risk to preservation of remains and lack of adequate assessment

**Part 3** – Legal Submissions Given on 5 June 2019 with regards to breach of the WHC

**Part 4** – Note from Dr Chris Bradley and Professor Tony Brown on adequacy of the tiered assessment and potential impacts of the scheme

## **Part 1**

- a. Note on expertise of witnesses on behalf of consortium of archaeologists and Blick Mead Project
  
2. The consortium is made up of 22 archaeologists who are leading experts in their fields. At the hearings on 5 and 6 June evidence was presented on behalf of the consortium by:
  - a. Professor Parker-Pearson;
  - b. Paul Garwood;
  - c. Dr Chris Bradley; and
  - d. Professor Jacques.
  
3. CVs of each of the above experts has been presented to the examination. Professor Parker-Pearson's CV reveals that his expertise in relation to Stonehenge is perhaps unparalleled. He has written 5 books and over 70 scientific papers relating to his Stonehenge research. He has led numerous archaeological projects in the Stonehenge WHS having received significant grant-funding for those projects.
  
4. Paul Garwood is Senior Lecturer in Archaeology in the School for History and Cultures, University of Birmingham. He is a specialist in the Neolithic and Bronze Age of Britain and northwest Europe, and is currently co director of the *Stonehenge Hidden Landscapes* and *Stonehenge Landscapes EMI* fieldwork projects.
  
5. Dr Chris Bradley is an environmental hydrologist and senior lecturer at the School of Geography, Earth and Environmental Science at the University of Birmingham. He has published around 45 peer reviewed articles and has 20 years' research experience working in Europe, North and South America.

6. Professor Jacques is a professorial research fellow in Archaeology at the University of Buckingham. He is the director of the Blick Mead project having published monographs, book chapters and articles on the project. His expertise in relation to the Mesolithic period is undoubtable.
7. It is unclear who wrote the HIA and heritage chapter of the ES on behalf of Highways England ('HE'). The consortium asks that the panel considers whether its author/s can be said to be experts in the particular eras with which most of the issues are concerned, in particular the Mesolithic, Neolithic, and Bronze Age.

b. Implications of evidence/submissions

8. As summarised below Professor Parker-Pearson set out an assessment of the material which has been found through the 1% sampling at the eastern and western portals. He stated that the concentrations of material at the western portal demonstrate that it is not a scatter of casually dropped material. It is the result of concentrated activity, consistent with being the remains of a large settlement. He stated that we have sufficient information from some of the diagnostic material and from the trial trenching which uncovered features associated with the early Bronze Age at the time of the Beaker People, 2450-1800bc (Copper into early Bronze Age).
9. He highlighted that when one looks at this within the larger WHS this is an area that was identified in a publication in 2017 by Josh Pollard and colleagues. In that they identified not only the area adjacent to the western approach but also a substantial area to the north which is several km long. A remarkable density of Beaker associated material. Professor Parker-Pearson stated he knew of no Beaker settlement in Britain or in Europe on that scale.
10. With regard to the Eastern Portal Professor Parker-Pearson stated that the finds suggested that one is looking at a funerary zone which may assist in understanding the relationship between the eastern and western parts of the WHS.

11. Significantly, following these submissions, Chris Moore for HE stated: ‘with regard to the significance of that material we have heard theories and at this stage our position is that those theories are inevitably untested and the suggestions are therefore possibilities.’ No contrary theory/rebuttal was put forward by Mr Moore.<sup>1</sup>
  
12. Paul Garwood’s evidence to the Panel emphasised the importance of the location of the Western Portal in terms of the spatial and visual relationships among the linear barrow groups which are situated around Stonehenge, and their significance as key components of the highly structured Early Bronze Age ceremonial and funerary landscape that is still visible today. He highlighted that the siting of the portal in this location would disrupt those relationships resulting in significant harm to the landscape settings and sensory qualities of those barrow groups and the WHS. He also emphasised that the tunnel portal, 4-lane road cutting, and vast 'Longbarrow Junction' would have an especially adverse impact on the setting of the Winterbourne Stoke Crossroads barrow group, the best preserved Early Bronze Age funerary monument complex in north-west Europe, and an integral part of the wider prehistoric landscape. No evidence to the contrary was presented by HE.
  
13. The evidence of Professor Parker-Pearson and Paul Garwood which has not been countered by HE demonstrates that the sites of both the western and eastern portals make a significant contribution to the OUV of the WHS.
  
14. This evidence therefore fundamentally undermines a number of material conclusions within the HIA. The HIA relies upon the assertion that the ‘scheme has been developed to avoid known concentrations of archaeological remains that make a significant

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<sup>1</sup> His comment in any event misses the point. Prof Parker-Pearson was highlighting a major future archaeological research question, one that will only be answered if the relevant areas inside the WHS are either not destroyed or if they are thoroughly investigated to the highest research standards.

contribution to the OUV of the WHS' in order to downplay the harm to the attributes of OUV (comment in relation to attribute 2 on p23).

15. The HIA's conclusions relating to the following criteria are now unsafe:

- a. Criterion 2: 'The physical remains of the Neolithic and Bronze Age funerary and ceremonial sites and monuments in relation to the landscape' – conclusion of only a slight adverse impact heavily based upon assertion that the portals 'avoid known concentrations of archaeological remains that make a significant contribution to the OUV of the WHS'; the western portal evaluations do 'not appear to indicate substantive funerary, ceremonial or settlement activity in this location' (see pp23 and 24)
- b. Criterion 6: 'The disposition, physical remains and settings of the key Neolithic and Bronze Age funerary, ceremonial and other monuments and sites of the period, which together form a landscape without parallel' – conclusion of slight beneficial effect based upon the fact that the scheme 'has been designed to avoid major known concentrations of archaeological remains that contribute to the OUV of the WHS' (p.28);
- c. Integrity: the HIA has failed to take into account the permanent loss of the significant archaeological remains at the western and eastern portals; the conclusion of 'slight beneficial' effect cannot be relied upon (p30);
- d. Authenticity: the HIA has failed to take into account the permanent loss of significant archaeological remains at the western and eastern portals and also the disruption of the spatial and visual relationship between the barrow groups surrounding Stonehenge (pp30-31)

16. With regard to impacts upon other aspects of the WHS, the undervaluing of the archaeological remains at the western and eastern portals means that the conclusion that the effects on archaeological remains within the scheme's footprint as 'neutral to moderately adverse' cannot be relied upon.

17. When considering the harm caused by the scheme it is necessary to consider the loss to this generation and to those of the future who will almost certainly have available to them advanced archaeological techniques which will be able to answer questions which today's researchers haven't even considered asking.
  
18. Further, as Professor Parker-Pearson stated, 'settings are experienced but settings depend on the assets themselves'. At Part 3 of this written summary the consortium has provided its legal submissions with regard to the lawfulness, under the World Heritage Convention, of balancing benefit to the setting/experience of part of the WHS with destruction of physical assets in other parts. Quite apart from the operation of the convention and even if those submissions are not accepted, the HIA's approach is clearly illogical. To elevate purported enhancements to the setting of parts of the WHS and to enable this to counterbalance physical destruction is inappropriate. The physical destruction is permanent. The improvements to settings/experience could come forward as part of an alternative scheme in the near future or through alternative measures in the more distant future. It is clear that on no basis can improvements to settings/experience be seen as carrying anywhere near as much weight as permanent harm by physical destruction.
  
19. When the impacts of the eastern and western portals are properly understood there can be no doubt that the scheme will: (a) cause significant harm to the WHS in breach of the WHC, (b) cause significant harm to the WHS in breach of paragraph 5.131 NPS, (c) result in adverse impact to the WHS and its attributes of OUV in breach of policy 1d of the management plan, (d) fail to manage the WHS to protect the physical remains which contribute to its attributes of OUV and improve their condition in breach of policy 3a of the management plan, (e) fail to maintain and enhance the setting of monuments and sites in the landscape and their interrelationships, in breach policy 3c of the management plan, (f) fail to reduce significantly the negative impacts of roads and traffic on the WHS and its attributes of OUV in breach of policy 6a of the management plan, (g) fail to encourage sustainable archaeological research of the highest quality in the WHS in breach of policy 7a of the management plan.



c. Position of Historic England and the National Trust in relation to the DAMS

20. Professor Parker-Pearson and Paul Garwood on behalf of the Consortium highlighted that academic research within the WHS had been held to standards of 100% recovery and that this had been insisted upon by both Historic England and the National Trust. This was not denied by those bodies.
  
21. No credible reason has been given for Historic England and the National Trust not insisting on the same standards of Highways England. As the Council for British Archaeology stated, this is ‘topsy turvey’ where we are considering a major project which will permanently destroy significant amounts of material and which is not being required to work to the 100% standard.

d. Missing information

22. The consortium has requested the following information:
  - a. exact numbers of finds/lithics discovered in the trial trenching in the areas of the western and eastern portals;
  - b. the exact area which will be archaeologically sterilised as part of the scheme including under roads, cuttings, haulage roads, works areas etc.
  
23. It is concerning that this information has not been readily available not least in informing HE’s own assessment of the heritage impact.

## **Part 2 – Summary of evidence and submissions:**

### *a) Inadequacy of survey techniques and information – evidence of Paul Garwood and Professor Parker-Pearson*

1. Paul Garwood highlighted that the only major geophysical technique which has been used extensively by HE to survey the WHS is magnetometry. He emphasised that one of the main outcomes of all of the major very large scale geophysical survey projects in the Stonehenge landscape shows that magnetometry gives only one picture of what is beneath the surface. It doesn't take account of all kinds of data which one can extract. He highlighted that one could and should use ground penetrating radar, electrical conductivity, electromagnetic induction. All magnetic data will tell you is what is and is not magnetic but what the EMI project has demonstrated is that there are a host of features which can be seen in electrical conductivity data which are invisible in magnetic data.
2. Paul Garwood further emphasised that with regards to sampling regimes a report by Hay and Lacey stated that a 2-4% sampling regime (as used by HE) does not work as a means of being assured of finding early prehistoric and early medieval sites. The report's recommendation was 10% sampling in order to have a chance of identifying the full range of all periods. He stated that the level of sampling which has been done is no serious basis for judging exactly what is there and that he was not confident that we have a firm and convincing picture of areas of impact.
3. Mike Parker-Pearson agreed with Paul Garwood further stating that he was disappointed to see that trial trenching had gone ahead before they had been sampled with two different sieve measures, which had removed the possibility of working out densities.
4. It was concerning that when asked HE was not able to give the total area of the WHS which as a result of the scheme would be archaeologically sterilised (on 5 June).

### *b) Evidence of Professor Parker-Pearson with regard to the significance of the areas of the proposed eastern and western approaches and portals and the DAMS*

5. The Panel's attention is drawn to Professor Parker Pearson's CV. His specialist expertise with regard to the Stonehenge WHS, and in particular the Neolithic and Bronze Age archaeology, is not contested and indeed is undeniable. Further, his analysis and conclusions were not disputed by HE; his analysis must therefore be given full weight. The following is a summary of his evidence. This goes to both the principle of the development

and the DAMS. The evidence was given in presentations on both 5 and 6 June and should be read together with his slide deck.

### *5 June*

6. Settings are experienced but settings depend upon the survival of the remains themselves and therefore the proposal has to be viewed in that context.
7. What has been seen in the last decade or so is heavy development outside of the boundaries of the WHS, hundreds of hectares, this has led to some remarkable discoveries but large areas have been sterilised. This puts more pressure on areas within the WHS. It is necessary to protect those because we are losing so much in the hinterland around.
8. The main areas of damage within the scheme are the Eastern and Western approaches within the WHS. It is estimated that somewhere around 10ha will be archaeologically sterilised. Thanks to the investigations relating to this scheme we now know that the initial statement that there are few remains in those areas are no longer correct. Many remains will be affected. We have learned, especially from the artefacts in the plough soil and their sheer quantity, is that there is a richness and significance of cultural aspects in E and W approaches. Standard mitigation strategy is to ensure as full a recovery as possible. Preservation by record. So that although the land is sterilised we come away with records of what was there and artefacts which have been recovered. We allow destruction by excavation.
9. This is a concept which has been around for a long time. The problem is that it is only ever partial. It is impossible to recover 100% and in the vast majority of cases we end up with percentage samples of the total resource. Whether the resource is in the form of archaeological pits, natural features which may hold remains (e.g. tree hollows), whether in the plough soil itself - once that excavation is done what is not collected/recorded is gone forever. There is no going back.
10. Unlike a research excavation which we might conduct within WHS where soil goes back and we leave remains for future researchers this is a once and only opportunity. I can vouch for excavating holes dug by archaeologists 100 years ago we were able to recover and leave for the future.

11. What we have learned with regards to the Western approach , with the discovery of two new longbarrows, is there is a remarkable concentration of monuments from before the construction of Stonehenge, possibly 5-600 years earlier than the first stage at Stonehenge. This is the densest concentration of Neolithic longbarrows anywhere in Britain.
12. Further, rather than these being placed at random, they are forming some kind of circle sitting around top of a dry valley which the western approach would be going through. They are built as a collectivity. That potentially enhances their integrity as a group. What it is that they are encircling within the valley, we don't know. It may just be natural features in the landscape (we know Neolithic societies did this). It may be series of deep solution shafts. I am unhappy about the prospect that this group might be severed by western approach. It damages the complex's integrity as well as associated remains.
13. One of the really important results of ploughsoil evaluation is to see we have many thousands of artefacts from both east and west. But the western approach has greater density. We know that from the diagnostic artefacts we have a palimpsest of activity – goes back to Mesolithic, early Neolithic – that is same period as the long-barrows. The period that is most striking in terms of its representation is the transition from Neolithic into early bronze – (copper age) – which saw the arrival of the curiously-named Beaker People in the region of Stonehenge at time of 3<sup>rd</sup> and 4<sup>th</sup> phases of construction. What we know from the ploughsoil sampling is that there are some remarkably dense concentrations. This is potentially part of a large and very significant settlement complex within western end.
14. The eastern end has a lesser density – some of us were happy to see it as not terribly important until the analysis showed that the western part of it contains a large number of lithics from the early Neolithic. This raises important issues particularly because one of the aspects we have discovered from our own sampling (we were 100% sampling topsoil) was that we were seeing entire phases of activity – early Neolithic and Mesolithic - which were only represented in the topsoil. You have to sample at 100%. We were indeed required by the agencies in question – National Trust, English Heritage to carry out that level of 100% sampling.
15. I do not accept HE's assessment that the scheme has been designed to avoid known concentrations of archaeological remains. We are learning from the evaluation that there are known concentrations particularly in the western approach and also the eastern. HE has seriously underestimated the harm caused by the proposal. We now know that the Cultural Value Assessment and the HIA were based on incomplete and flawed information

about buried remains in the approaches, remains that constitute assets contributing to OUV.

*Responses to Inspector's questions on 5 June*

16. With regard to the date of the large number of lithics from the eastern portal, diagnostic blade flakes were found which are believed to be early Neolithic, the period in which the first farmers were moving into Britain with their new way of life.

*6 June*

17. We are all familiar with the fact that there is a huge archaeological resource, primarily flints but also worked artefacts, in the WHS ploughsoil. Julian Richards' survey shows us densities, but also shows certain fields with low densities, and indeed from surface collection. More than 90% of remains from Neolithic and early Bronze Age are in the ploughsoil.
18. For more than 10 years research excavations have ensured that there is up to 100% retrieval of those finds as part of our investigations. Not simply for the Stonehenge part but also Avebury. Archaeologists researching within the WHS have achieved 100% retrieval by hand-digging and sieving the ploughsoil to recover finds and plot spatial distributions and densities, to reveal how prehistoric people lived and worked in this landscape.
19. That is something that has been required by curators from English Heritage and National Trust. My last major intervention here was 10 years ago. In the area we dug which was most comparable to the western approach, we excavated 100 square metres with 100 students for a month. We learned from that there are entire periods, particularly the Neolithic and the period before that – the Mesolithic, represented in the plough soil where there was no remaining evidence beneath it.
20. The scientific committee has said there should be equivalent standards from university teams and commercial contractors. What that means is that we pay maximum attention to the ploughsoil within the WHS.
21. I am very pleased that contractors did the 1% test pit sample. The difficulty is where we take it from here. If that project is to go ahead, it is no good to do 4%, 10%, 50% or 80%. The reason it is necessary to do 100% is partly because we don't want to be bulldozing artefacts. On the current draft DAMS and subsequent document prepared on 17 May, if

we take the implications of what is in that report we are looking at half a million artefacts being bulldozed without record or recovery by the proposed mitigation strategy within the WHS. That is an unacceptable level of damage to the resource and loss of information about Stonehenge's prehistoric past.

22. The reason that 100% sieving is important is that what is found are largely undiagnostic lithics. Only a tiny proportion constitute tools or artefacts such as axe fragments and arrow heads. Amongst these are diagnostic items. Items we can date to within a particular prehistoric period. The 100% sample gives us some measure of the chronology of an otherwise un-datable scatter.
23. Although these have been churned by a plough we are looking at minimal spatial dispersal of that material. We have potential to recover the spatial arrangement of activities as well as their chronological distribution. We can identify where there might be midden/rubbish areas, and where we may have occupation areas. We have a blue print of the sort of pattern we would find from the excavation of Durrington Walls village. That was preserved under the subsequent henge. We had an undisturbed Neolithic surface. You can take that pattern and perceive doughnuts of emptiness where there were remains of a prehistoric house. The activities of and how people lived at different moments in this landscape can be reconstructed.
24. Looking at the Western Approach Flint Distributions plan, which has been made available – each of the little bubbles represents a certain quantity of lithics. [Highlighting scales on slide]
25. I haven't been able to get hold of the actual numbers but trying to work from this, within the footprint of the development marked in green one can gauge by taking midpoint of these bubble plots – average number per test pit - and from that we can calculate the distribution. Within the proposed development area something like 7 worked flints per square metre. It varies quite dramatically.
26. When we look at some distributions we see marked drop offs. Big bubbles to small bubbles. If we are looking at well homogenised sample we expect to see fewer sharp contours.

27. There are certain key areas – those ringed in black have been identified in the ploughzone document to suggest that maybe we should go beyond 1% to 4%. Whilst that is to be commended to some degree, it is not enough.
28. They have said if they think it's worth it they might get to 10% or possibly 100%. However, we need to treat this assemblage systematically. Anything less than 100% will see vast destruction of artefacts. That will still lead to the loss of about 0.5 million artefacts.
29. Areas of high concentration – we can compare with the distributions we have been getting from ploughsoil assemblages where we have been doing very high proportions of sieving.
30. In some parts of the western approach somewhere around 30 worked flints per square metre were found – comparable to similar concentrations as found at Durrington Walls.
31. That is not a scatter of casually dropped material. This is the result of concentrated activity, consistent with being the remains of a large settlement. We have sufficient information from some of the diagnostic material and from the trial trenching which uncovered features associated with the early Bronze Age at the time of the Beaker People, 2450-1800bc. This period spans Copper into early Bronze Age.
32. When we look at that within the larger WHS, this is an area that was identified in a publication in 2017 by Josh Pollard and colleagues. In that they identified not only the area adjacent to the western approach but also a substantial area to the north. You can see from the scale (referring to slide) that this is several km long. A remarkable density of Beaker associated material. I know of no Beaker settlement in Britain or in Europe on that scale.
33. The question is what was it that made this aggregation a site of such significance? Possibly from radio carbon dates and diagnostic ceramics we are looking at an occupation settlement which might go with one of the two later stages of Stonehenge. This is also the time as Paul Garwood explained yesterday that this landscape filled up with cemeteries of round-barrows. The settlement may be associated with that activity as opposed to ceremonial activity.
34. Whether such questions can be answered within the existing project I doubt. We should not go ahead lightly with removing these artefacts. Ideally we ought to be aiming to preserve or no one will ever be able to answer these questions. If the project goes ahead, this will not be possible.

35. The western approach also crosses through an area where we have an unusual concentration of Neolithic longbarrows – first half of 4<sup>th</sup> millennia BC. 5-600 years before first stage of building Stonehenge.
36. Some 9 of them in an area just slightly more than 4 square km. This is unmatched. It is not simply the density. They are not doing what longbarrows normally do - they are all concentrated along top of the Wilsford dry valley. Orientations hint at the sense that they are lying with their sides facing towards the middle. In the middle we have Wilsford G30 (longbarrow) and what is known as Normanton Down Mortuary enclosure. In this upper valley we also have the Wilsford Shaft. At the bottom of it we found Neolithic waterlogged remains. Question whether it might be one of a number of natural or manmade deep shafts that may be part of the landscape.
37. This group position immediately to the west of Stonehenge makes me wonder what is in this region that this group may be referencing which may be related to why Stonehenge was placed where it was. There are important research questions which can be asked of this. What is the best means of answering those?
38. Turning to the results of the diagnostic material – what we see is that this is an area where a number of flint blades were found from 1% sample sieving, thought to belong to the earlier Neolithic period. Within this transect there is the remains of activity which may relate to the use of those longbarrows. If one simply machines that off one will not find any hints. The evidence is only in the ploughsoil.
39. Eastern Approach – overall a lower density of artefacts. I haven't been able to find a plan on which the actual road alignment is marked.
40. On same principle of working out average numbers – we are looking around 3.6 worked flints per square metre. About half the density found on average in the western approach. First thoughts were that it is a bit low.
41. What we were then able to do is see some of the finds that Wessex Archaeology have made. Interestingly here in this part of the landscape small numbers of likely Early Neolithic blades were found. . What is important about this area is it offers the chance to ask a question about the relationship of that early Neolithic activity between east and west. There is a general question. Is it a series of small focussed clusters or a general spread across the area? You can only answer that question if you increase the sampling intensity to 100%.



42. Are we looking at funerary zone as opposed to where ceramics were found? One has potentially got a distinction between funerary zone and a settlement focus. We suspect from our own research in this area there is a major development. What we are finding from ploughsoil and within buried features is that you get a higher proportion of tool types on this side of the WHS. This is something that ploughsoil analysis if conducted to sufficiently rigorous level will allow us to cast light on.
43. Document presented to scientific committee set out sampling of features. In the proposal there are percentages of the sample to be taken in each case. Certain ditches not looking at 100%. Similarly for tree hollows, proposed to be sampled at 12.5%. Excavation of all sub-ploughsoil features in the WHS should be at 100%.
44. We know that many of these tree hollows have produced significant cultural material. If you only dig 12.5% you are missing a large number.
45. These are important features not only because they are repositories of cultural material – comparing hollows will allow us to establish whether the theory fits. Are ceramics confined to settlement zone in the east compared with funerary zone in the west?
46. We know from pollen collected from bed of river Avon, and from types of snail found under Neolithic monuments we are looking at a period of woodland clearance in the century leading up to construction of Stonehenge. If we can date tree hollows going out of use and hollows being used as traps for artefacts we can build up a picture which fills in the gaps.
47. Ploughsoil is one of the most important archaeological resources in the WHS. In it is the residue of most day to day activity of the prehistoric peoples who were involved in using this ceremonial and funerary complex. The site is complex because it is a long term palimpsest, 1000s of years mixed up together. That is why 100% is so important in order to gather sufficient distribution and quantity of diagnostic artefacts to be able to tease out the different layers. These are standards which we have been obliged to work to and are happy to work to, and we would like to see the same rules apply to commercial archaeologists working in the WHS. Otherwise we are looking at perhaps 0.5million artefacts lost forever.

*Response to Inspector's Question regarding 100% excavation*

48. We need to be clear about which areas are going to see topsoil destroyed and built upon. Severe compression. Where else is that ploughzone assemblage liable to be damaged? What I have confined my comments to are the areas where the cutting of the road will take place – broadly 40m wide corridor with variations. There could be more areas that are involved – construction of re-routing, compounds, haul roads. The 100% excavation has to apply to where we are seeing the destruction of the relevant deposits. In the main that is going to be within the road-take.
49. Having done a lot of this myself it is time-consuming and labour intensive. Given that it took us a month to excavate an area of 700 square metres with a team of 100. My estimate is team of 300 could do it within 2 long annual seasons. It will take at least another year and probably two years.
50. If you are dry-sieving there is a point where soil is too wet for the sieve to work. There are other techniques; we can use smaller mesh sizes for wet screening, going down to 2mm mesh to pick up the really small stuff. That helps us identify the Mesolithic period. Microliths will drop through standard 10mm mesh – don't find them unless at finer level.
51. The Scientific committee advised secondary sieving at 4mm – that produced desired results and Mesolithic microliths were found.

*Response to Inspector's Question regarding types of flints found*

52. At Durrington Walls we have discovered large scale napping of flint across the settlement. Not primary discard. Not where the flint-napper was making an axe or an arrowhead. Shovelled up and dumped somewhere else. Put on a rubbish heap.
53. Within the houses we find material has ended up in the corners of the houses. Most of it is in a secondary discard context. Relates to the organisation of their inhabited space.
54. At Durrington Walls – where you get empty gaps we were lucky enough to find the floors of Neolithic houses. We can use that as predictive tool – where we find empty spaces we can speculate that there might have been houses. This gives us a chance of making up for

the damage caused by ploughing, using those two dimensional patterns to understand spatial dimension of daily life.

*Paul Garwood's comments following those of Mike Parker-Pearson*

55. Wet sieve techniques are being used as part of the Stonehenge Landscapes EMI project – including sampling of topsoil deposits (a 10% sample as an experimental exercise). We are collecting material from the flint knapping process. Wet sieving can be done in a variety of ways – with 4 and 2mm sieves for example – the aim being to wash out very fine sediments in order to collect very fine material such as tiny lithic artefacts, ceramic fragments, bone, and charcoal, some of which will be important for dating and understanding site functions.
56. Certainly for excavating features this ought to be standard. It is providing very significant additional and detailed information. There are some periods where very fine lithic material may not be recovered through dry sieve techniques. To undertake wet sieving on an intensive and systematic basis gives us the opportunity to look at the Mesolithic era especially in more detail - something that in the WHS we should be doing.

*c) Evidence of Paul Garwood with regard to the positioning of the western portal and its severing of the relationship between groups of barrows together with harm to the topography and to the visual and spatial relationships*

57. Again, the panel is referred to Paul Garwood's C.V. and the above comments as regards his expertise. This note should be read together with his Powerpoint presented on 5 June. Notably, his evidence was not contested by HE.
58. There are two facets in relation to the Winterbourne Stoke Crossroads barrow group, itself as a heritage asset and its wider context and how it relates to OUV.
59. They have been the subject of recent large scale geophysical projects where one deals with the site as an entirety.
60. The WSC barrow group is quite unique, the best preserved funerary complex in Europe. It includes all of the types of funerary monuments e.g. longbarrow, bowl, pond, bell, disc, and saucer barrows all located together as part of one complex. It is a fabulous and

exceptional site from the Early Bronze Age. One needs to understand it in its context, one group amongst a number of complexes e.g. the New and Old King Barrows, the Cursus, Winterbourne Stoke Crossroads, and Normanton Down groups. All of these groups are intervisible and are located broadly in cardinal points by reference to Stonehenge. They all developed in the period 1900-1600bc. There is a very consistent rule articulated in the landscape. You can't look at these in isolation, you need to understand them one against another.

61. It is striking that chronologically the Cursus group developed east to west, the WSC group from north-east to south-west, and the Normanton Down group from west to east: i.e. all [broadly in an anti-clockwise direction with respect to Stonehenge at the centre].
62. The large-scale spatial distribution of elite funerary monuments across the Early Bronze Age landscape and their physical development over time, both in relation to Stonehenge at the centre and to one another, reveal a highly organised sacred landscape. This articulated - and integrated - deep concerns with celestial cycles embodied in Stonehenge and religious and political ideals expressed through the aristocratic funerary rituals conducted at the funerary monument complexes located at strategic points in the landscape around Stonehenge.
63. The visual relationships are very striking and exceptionally important in thinking about their wider place.
64. The road scheme portal roughly cuts clean through the south western zone of the Early Bronze Age landscape, directly impacting on its totality, the landscape setting of the WSC group, and interfering with views not only between WSC and the Normanton Down and King Barrow ridge barrow groups, but also between WSC and the major outlying Wilsford and Lake barrow groups to the south. It is very difficult to see this as anything other than a profoundly detrimental impact on this unique prehistoric landscape. It is so clear to view today that one is concerned with an articulated whole. The portal interferes with this in a profound way.
65. The laser scan gives a view of the terrain, this is a very intrusive scheme.
66. We have managed to do a little amount of view-shed work, mapped onto a terrestrial laser scan and this shows what you can see across the landscape. This should have been done as a matter of course for this project, looking at the effect of what can be seen in the landscape from known points. It is easy to do.

67. The claim that the scheme protects OUV is wrong: the scheme is highly intrusive and affects the integrity and wholeness of the prehistoric landscape, which is fundamental to our understanding and appreciation of it, and will create a damaging permanent impact. If the road scheme goes ahead there needs to be a significant shift of the western tunnel portal to a point outside the WHS.
68. Refer to slide: The Stonehenge Hidden Landscapes Project (SHLP) is the largest archaeological geophysical survey ever conducted, setting the gold standard for work of this kind internationally. It comprises 15sq km of survey data across 10 square kms of contiguous land surface within the WHS, which is treated as a single site. The survey work has revealed tens of thousands of features that are invisible on the surface. The surviving monuments we see today scattered across the landscape are just the 'tips of the icebergs' in relation to the subsurface evidence. They exist in a sea of archaeological features and deposits that extend seamlessly across the entirety of the WHS. In this light, the WHS should be treated as a single site, where damage to one part is damage to the whole.
69. Just on the basis of the SHLP magnetic survey results it is possible to identify numerous new monuments and provide significant new interpretations of others, all of which - equally significantly - should be seen situated among the many other features revealed in the data.
70. Refer to slide: the *Stonehenge Landscapes Electro-Magnetic Induction* (SLE) project has included excavation of 20 trenches across the landscape. Although some of these have produced important cultural evidence, the project is not intended to elaborate understanding of cultural heritage per se. Instead, the purpose is to ascertain what produces the EMI geophysical data in the first place by undertaking systematic analysis of sediments, soils and features, both anthropogenic and natural. Most geophysical survey maps are essentially 'pictures' that archaeologists interpret, yet little has been done to determine what actually produces these or account for what is visible/invisible in such data. There are a number of significant impacts. One needs to be very cautious about the use of geophysical survey results, and certainly not assume that a magnetometry survey will produce a comprehensive picture of the subsurface evidence because it only records one property of the soil (magnetic variation) only to a shallow depth, and is potentially ineffective where processes of demagnetization have occurred. One of the main conclusions of both the SHLP and the SLE project is that integration of multiple geophysical survey methods is critical for the fullest possible recovery of subsurface information.

71. It is clear that an intensive approach, with 100% topsoil sampling, should be de rigeur. The type of research work we are currently doing involves applying as wide a range of viable methods as possible for site investigation. The results are worth that extra effort and investment.
72. The finite character of the WHS demands the highest possible research-led recovery and recording, not just routine commercial methods.
73. By far the preferred option is no damage or destruction that would in any way impede visual relationships or affect the integrity and wholeness of the Early Bronze Age ceremonial and funerary landscape, and the prehistoric landscapes within and around the margins of the WHS more generally.

#### *Response to Inspector Questions*

74. With regard to how the proposed road scheme would interfere with the visual relationship – I can comment in broad terms but the view-shed analyses have not been done. Examples are partial, and based on what one can see from one particular barrow group. The line of the road would create the new western approach – this would increase the fissure line already marked by the A303, the landscape imprint of which would not disappear. The new cutting would compound this pre-existing constraint, creating a visual barrier between Winterbourne Stoke and the area across to the East – including Normanton Down. It would intrude into that landscape setting, damaging the Early Bronze Age landscape as a coherent whole, and the visual and spatial relationships of the linear barrow groups. Deliberate attempts were made by Early Bronze Age groups to control that landscape in very particular ways that took account of visual connectivities. To insert a massive road cutting in such a blatant way – compromising these visual and spatial relationships - would be extremely damaging.
75. The concerns are two-fold with regard to changes in levels, embankments and cuttings:
  - Spatial impact is very great indeed. This is difficult to calculate from the plans, (as the exact extent of cutting, movement of earth and its impact on the road line and roundabouts are not clear), but within those areas there would be total loss of archaeology over extensive areas.

- The visual intrusion of what will become a vastly greater road junction just outside the WHS (the Longbarrow Junction) would be very great. This would be visible directly from the Winterbourne Stoke barrows, and although in a cutting the feeder road (and considerable traffic) just to the west would run very close to the barrow group., This must affect the setting and OUV attributes. The wider coherence of the landscape within and without the current boundaries will be damaged.

76. Mr Garwood agreed that there will also be a detrimental effect on the landscape from above.

*Response to HE's contention that it will be a benefit to move the junction 600m from the WSC barrow group*

77. The figure of 600m can only refer to the centre-point of the junction; the nearest point of the groundworks comprising the junction is only about 250 m from the WS Long barrow at the south-east of the WSC barrow group, while the A303 road cutting leading to the junction would only be c.100 m to the south. The junction is something like 20ha in extent, with two roundabouts. It is a massive hole in the landscape within the sight of the linear barrow group.

78. The wider setting of the WSC barrow group includes the area outside of the WHS. The lie of the land is such that the barrow group is built on a slight slope that runs down to southwest – that is the viewing direction to some respects. It is notable that the chronological development of the barrow group also proceeds towards the long barrow and down to the south west – to the area of the proposed very significant and large-scale junction works. There is no question that the impact will be very considerable however deeply cut the road is.

*Further comments made during discussion*

79. Despite the suggestion that it will be possible to conceal the cutting and do various landscaping, you can't hide a 1.1km-long, 50m-wide chasm across the landscape, with additional fencing and other kinds of works. As soon as you approach that routeway, at any point close to it, it will be in your face and unmistakable. Concealment and mitigation

is illusory, as soon as you approach that part of the WHS, within a few hundred metres it will be very visible.

*d) Additional comments on the DAMS*

80. The Consortium agrees that HE cannot reserve final authority for itself with regard to matters such as unexpected discoveries. The County Council, in consultation with Historic England, should have detailed oversight of the implementation/operation of the DAMS.

81. The proposal that topsoil which has been removed would be stockpiled and stored within the scheme boundaries for the purposes of landscape restoration demonstrates an extraordinary lack of regard for the archaeological significance of the WHS. Such an operation would clearly disrupt the provenance of (or, in other words, contaminate) the existing material in areas where the topsoil had been placed for future research. If this is to occur then there will inevitably be harm to the archaeological resource in those areas beneath the dumped topsoil. This must be factored in as significant harm to the WHS and to the various relevant criteria of OUV.

82. As emphasised by the CBA on 6 June the ability to record that which has been destroyed is not a factor to be taken into account in the balance of the decision (para 5.139 NPS). The scheme must therefore be weighed against the total loss of the archaeological remains.

*e) Blick Mead*

*i. Its significance*

*ii. Its extent*

*iii. Harm already caused*

*iv. Harm to setting*

*v. Risk to preservation of remains and lack of adequate assessment*

*i. Significance of Blick Mead*



83. Whilst Blick Mead and other Mesolithic sites/remains do not fall squarely within the criteria for which the WHS was designated, Mesolithic sites/remains (and in particular Blick Mead) are fundamental to the significance of the WHS. As stated by the Council for British Archaeology, the Mesolithic era is clearly fundamental to understanding the context in which many ceremonial sites developed and therefore the attributes of OUV displayed by the WHS. At the hearing on 5 June HE accepted that the Mesolithic remains illuminate consideration of matters which are part of OUV and activities of other civilisations.
84. That significance is wider than OUV is clear from the WHS management plan, see for example paragraph 1.3.1.
85. As Paul Garwood, Senior Lecturer in Archaeology at Birmingham University and member of the consortium of archaeologists stated, the OUV of the WHS picks out the integrity of its landscape and the interconnectedness of it. It is a huge mistake to approach the whole issue as a collection of heritage assets. The entirety of the WHS from an archaeological point of view is one single site. He stated that there were a number of dimensions to that landscape, one dimension is the topsoil which is choc-a-block with material and to damage part of that damages the whole of the landscape. He emphasised that the Mesolithic remains are a clear part of this. He stated that it was already very clear that the landscape is unusual and quite exceptional and that some of these features have been known about for a long time and some are coming to light only very recently. He stated that only 2 years ago the single largest Mesolithic dug feature in north-western Europe was excavated, a large pit feature 3m across 2m deep with an exceptionally fine run of dating evidence back to the 8<sup>th</sup> millennium BC.
86. The heritage assessments of HE, including the HIA and chapter 6 of the ES, have therefore proceeded on a false basis. The HIA purports to address the significance and impact upon the WHS as a whole, however this is limited largely only to OUV, integrity and authenticity. It does not consider other features of the WHS which also contribute to its significance. The failure to include Mesolithic remains, and in particular the remains at Blick Mead, are one example of failing to understand and assess the significance of the

WHS as being broader than simply the OUV criteria, integrity and authenticity (see para 5.10.29 of the HIA for asset groups scoped out of the HIA).

87. Blick Mead's significance must also be understood as a heritage asset in its own right. It is patently a non-designated asset of archaeological interest that is demonstrably of equivalent significance to Scheduled Monuments and therefore should be subjected to NPS policies relating to designated heritage assets (para 5.124 NPS).

88. The significance of Blick Mead as a site of international importance does not appear to be disputed and has been set out in the submission of Professor Jacques to the Inquiry. At the hearing on 5 June the Council described the site as highly significant and exceptionally exciting and hoped that onward investigations would shed even more light on the site. Professor Jacques updated the inquiry with recent finds including animal bones which reveal much about the socio-economic basis and cultural practice of the time. In particular the high proportion of Aurochs. Underscoring the significance of the artefacts Professor Jacques highlighted the latest results on pollen. Now 40 different types of pollen coming from Mesolithic layers around the auroch footprints – c.6500BC. What they show is that grasses are 45% of the assemblage. This points to there being few trees and possibly a clearing of trees. There are 20 types of spores as well which is highly diverse. There is also potentially DNA evidence from Aurochs.

### *ii. Extent of Blick Mead*

89. The extent of the site of Blick Mead is currently unknown. As Professor Jacques stated only 1/3 of a football pitch penalty area has been excavated and therefore it cannot be said how far the site extends. This has to be taken into account in the heritage assessment.

### *iii. Harm already caused to Blick Mead*

90. The proposed scheme has already caused significant harm to Blick Mead through the siting of 2 water meters within the site. One of these is sited in an unexcavated area which lies directly in the path of the Auroch footprints. The other is in another unexcavated area 1m from the most productive trench at the site. These were installed on site by HE, without consent, on 27 November 2018. Contemporary emails regarding the installation can be found at numbered pages 52-55 of APP Rep 2-063. No recovery of artefacts/remains was carried out and the soil was disposed of.
91. These installations can be seen as nothing other than substantial harm to Blick Mead, which is to be treated as a designated heritage asset in its own right and also as part of the WHS. This harm must be weighed in the planning balance against the scheme. Notably, it has not been considered by HE in any of its assessments.

*iv. Harm to the setting of Blick Mead*

92. It is suggested by HE that the assessment of the setting of Blick Mead was covered by the assessment of the registered park and garden at Amesbury Abbey. This misunderstands how setting is to be assessed. The issue is how the surroundings contribute to the appreciation and understanding of the significance of the asset. Without starting first with an assessment of the significance of the asset (which is clearly different for a Mesolithic archaeological site as opposed a registered park and garden) there has clearly been no adequate assessment of its setting.
93. Latterly, in its responses to the Panel's questions, HE has attempted to remedy the situation by conducting a purported assessment. It argues that due to the tree cover at Blick Mead there will be no impact. This assessment is misconceived for the following reasons:
- a. the trees which are currently in situ do not screen traffic from the A303 either visually or aurally, they clearly will not do so in relation to the new road and flyover; and, in any event,
  - b. the trees are outwith the control of HE, there is no assessment of how likely they are to be maintained nor is there any assessment of their longevity and as to

whether they are likely to survive/or be replaced during the period of the proposal's operation.

94. There is a lack of appropriate evidence (for example photomontages) for any adequate settings assessment to take place in any event. Where photomontages have been provided in the vicinity of Blick Mead these appear to be inaccurate (see photo with commentary provided by Andy Rhind-Tutt in REP 3 089 compared with drawing APP-010 sheet 9 of 24 where the current road and the proposed flyover has been drawn too low). This is concerning on two levels:

- a. if this photomontage has been used in assessments of heritage impacts then those assessments are necessarily undermined (no response was given to this by HE); and
- b. this image appears to have been used to try to assuage the fears of objectors to the scheme, in particular the elderly residents of the Amesbury Abbey Care Home; if it is wrong then this calls into question whether there has been adequate consultation.

95. Despite this lack of evidence, given the proximity and extent of the scheme, the likely volumes of traffic, and the construction period, it can reasonably be assumed that the impact on Blick Mead's setting will be negative. This weighs against the scheme in the planning balance.

*iv. Risk to preservation of remains and inadequacy of assessment*

96. Below is a summary of the evidence and submissions given at the hearing on 6 June 2019. At the invitation of the Inspectorate Dr Chris Bradley and Professor Tony Brown have produced a separate note (see Part 4 below) which clearly sets out why (i) the scheme risks impacting the water environment at Blick Mead, (ii) why the tiered assessment is inadequate, and (iii) what needs to be understood before it can be said that the scheme will not damage the water environment at Blick Mead. That note demonstrates that HE's

impact assessment is entirely inadequate and not compliant with regulation 14 Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Further, the Inspectorate can have no confidence that the proposal will not cause further significant harm to this internationally significant Mesolithic site.

97. It became clear at the hearing on June 6<sup>th</sup> that Historic England was of the view that the assessment of whether or not the scheme would impact the watery environment of Blick Mead was not within their remit. Therefore, any consultation response by Historic England on this issue has to be regarded with extreme caution. Indeed, when pressed by the Inspector as to the adequacy of the assessment HE responded ‘we have not been closely involved in the Blick Mead site itself...’.
98. The Environment Agency was asked to comment. The EA stated that it has its own boreholes nearby Blick Mead and that the data shows that there is upward flow from deep to shallow. The data showed that there could be perched groundwater and that there is a driving head going downwards into the area with Mesolithic remains. The EA stated that it has not been quantified which is the dominant process and that more information on the bore hole would help to clarify that. They agreed that there was potential for the remains to be wetted by groundwater from the chalk.
99. When asked what additional work would be helpful the EA responded that one could monitor boreholes at different levels to help tell where the water is coming from. Also when boreholes are installed there should be records which show the lithology which they have gone through and which horizons are screened. They also stated that groundwater quality testing would help tell whether it has come from chalk or superficial deposits.
100. The EA stated that with regard to the tunnel the potential is for a tunnel to lower the head in the chalk by dewatering. If the deposits rely upon being wetted by the chalk then that could have an impact. Whereas, if they are more reliant upon the groundwater infiltrating from the surface from above then lowering waters in the chalk isn’t going to have so much of an impact.
101. It was clear that the EA did not display any confidence that HE was correct that the wetting of the deposits was solely reliant upon the presence of a spring which would not be affected by the scheme. Further, whilst the EA referred to the impacts of the tunnel they made no comment with regard to the construction of the road and its operation immediately adjacent to the site and in particular road run-off/drainage patterns.

102. Further, in response to a complaint from HE as to the EA's position the EA replied that the reason they had picked up on the fact that there are different water bodies is because the HE had some monitoring points in deep chalk and those heads recorded in the shallow deposits are higher than the levels in the chalk and this suggests two different water bodies with low permeability horizons holding up the water which was included in the risk assessment. The reason why this didn't form part of a previous comment by the EA was because they haven't commented on this site in the past. The modelling so far suggests minimal impact on groundwater heads in chalk. If Blick Mead is dependent on it remaining unchanged then that suggests minimal risk of any impact. But if through further more detailed risk assessment it appears that changes to groundwater levels are going to be more significant, then there is potential that the scheme could impact the site.
103. The EA therefore appear to be of the view that there is at least a possibility that further modelling in relation to detailed design may reveal a greater impact upon groundwater than is currently predicted. With regard to the perched groundwater, the EA did not make any comment as to the impact of the road construction adjacent to Blick Mead. Further, the EA emphasised that construction methods may cause a change to the groundwater.
104. It is concerning that HE appear to be reluctant to be bound to the use of the particular closed bore tunnelling machine which is the equipment which has been assessed for the purpose of their hydrological modelling. It is understood that this machinery, as opposed to other types, would not require de-watering at the eastern end. If this machinery has formed the basis for the assessments and conclusions then clearly its use must be required within the DCO itself. In this regard the consortium agrees with the concerns expressed by the Council.
105. Before turning to the evidence of Dr Bradley, the Panel are requested to note that the Blick Mead project has engaged on this issue with HE for over a year and a half (see summary at APP-Rep 2-063). Their arguments have been based upon genuine expert opinions from archaeologists and hydrologists and should therefore be considered extremely carefully.
106. Further, HE had previously agreed that a 12 month monitoring period in line with tier 4 of Historic England's Guidance was required. This can be seen explicitly from, for example, the email from Chris Moore dated 2 May 2018 at p33 of APP- Rep 2 -063 and also the minutes of the scientific committee meeting on 10 May 2018, p30 of the same

document and the meeting minutes of 3 August on p40. This clearly supports the validity of the consortium's concerns

*EH's Guidance*

107. The relevant guidance is 'Preserving Archaeological Remains' (Historic England) and in particular appendix 3 'Water Environment Assessment Techniques'. Key paragraphs state:

*'Underpinning all water environment system assessments is the need for the development of a hydrogeological conceptual model...*

*The information that is required in order to inform the conceptual model includes:*

- *the identification and hydrogeological characteristics of different aquifers, ie lithology, thickness, permeability and geological structure;*
- *the principal groundwater flow mechanism in each aquifer unit, for example intergranular or fracture*
- *the extent to which groundwater is able to flow between the different aquifers; this may be influenced by intervening lower permeability strata or structural features such as faults*
- *the nature of interactions between groundwater and surface water, ie discharge points*
- *the identification of sources of recharge: rainfall infiltration, regional groundwater input, artificial infiltration sources or a combination of mechanisms.'* p.11

*'The investigation should continue up the tiers until the reliability of the conceptual model has reached an acceptable level. The level that is considered acceptable depends on what the conceptual model is being used for, although in practice it is also influenced by the funds and time available for further investigation and assessment....'* p13

*In some more complex water environment settings Tier 4 assessments are potentially worthwhile. These might include sites where mitigation is considered necessary to facilitate long-term preservation (eg*

*through installation of low permeability barriers/ recharge measures to isolate a system); or where there are concerns of water environment responses to development....' p19*

108. It is concerning that on 6 June HE and Historic England stated that the test for moving up the tiers in the guidance was whether significant effects were established at each level. That test appears nowhere in the guidance. As the excerpt on p19 states, tier 4 may be required where 'there are concerns of water environment responses to development'. That is exactly the case here.

109. Further, the EA's representations to the examination demonstrate that there can be absolutely no certainty with regard to how the water environment at Blick Mead operates. This makes clear that HE's assessment is inadequate.

110. Finally, given the significance of Blick Mead and the potential for interruption in its water environment to lead to substantial harm, this is patently a case where a plan of mitigation is required in order to ensure that the scheme mitigates any impacts. That plan, which may include re-watering the site, requires a tier 4 assessment to have been undertaken so as to inform this mitigation (see p.19 of the guidance).

*Note of Dr Chris Bradley's evidence*

111. Dr Chris Bradley, an expert hydrologist, presented evidence on behalf of the consortium. A note of his evidence follows:

112. I have worked with Prof Brown on floodplain wetlands. I have worked with Prof Brown on Starr Car where we had two year monitoring study which successfully characterised the hydrology .

113. We are asking about the baseline – I completely concur with comments of EA – there is a possibility for movements down or up. Depending on water levels or the hydraulic head. The key thing is then how that translates to understanding the water table. The local boreholes that we have just heard about – there are two monitoring points. They are at depths of 3m. My understanding of the archaeology is that it is



significantly closer to the surface where the water table regime will be influenced by clay and putty chalk. We were talking this morning about geological processes. Conditions through ice age - the chalk can be heavily weathered or it can be impermeable. What we can see in some areas is that the water table is isolated in some instances from the underlying groundwater. We don't know how particular the areas of clay are. They can be very spatially diverse.

114. We don't know about the near surface stratigraphy and alluvial gravels.

115. 3m boreholes are problematic because they are going into the chalk at 3m, from the exposed archaeology/deposits it is possible to identify areas of clay that look like putty chalk. Whilst I wouldn't expect that to be completely uniform across the whole surface it leads to a situation where the shallow water table may be isolated. There is a need for a four dimensional picture. Our proposal 18months ago would have been to investigate the local water table relationship to chalk groundwaters, model the buried archaeology, and the isotopic composition to see if it is precipitation or groundwater. If there were areas of groundwater close to surface then if rainwater was substituting that – change in pH which may affect preservation.

116. The focus of this is not on groundwaters, it is where the archaeology is. The point that the EA was making, in some cases the groundwater is coming up to the surface but at other times of year it may not be. At the moment we don't have the data to characterise what is happening.

117. Any change in water quality could be quite significant to the archaeology. For example the substitution of rainwater for groundwater. We need to know much more about what is happening at a local site. The putty chalk could be of significance.

118. Where we have dry valleys we could have enhanced permeability and subsurface flow could be quite important in maintaining subsurface conditions.

119. If a 12 month monitoring program were undertaken we would develop a local numerical model which predicts what the water table would be. Local fieldwork through geophysical survey would help to look at how the water level would respond through hypothetical extreme events and how it responds to changes in rainfall. Therefore the fact that a 12 month period might not pick up extremes would not limit the effectiveness of the monitoring.

120. In order to properly monitor and assess the potential impact upon Blick Mead there is a need for:
- a. shallow piezometers in areas which have been excavated,
  - b. a model of flownet,
  - c. geophysics to look at extent of weathered clay,
  - d. look at the soil moisture characteristics, peaty or organic substrate,
  - e. look at drought patterns.
121. Tony Brown sent a basis for monitoring/modelling water environment at Blick Mead in 2018.
122. The key points are that if we don't understand the hydrology of the site, without sufficient monitoring in place then we are unable to say whether any subsequent remedial work can be fit for purpose. One of the points of doing the tier 4 assessment would be to have confidence so that we can understand the hydrology at a sub 10m resolution. This is one of the issues of the catchment approach. The regional model of the EA is working in 200mx200m grid. Areas of archaeological interest are at sub-meter resolution. How you translate this?
123. We don't know enough about spatial extent of Blick Mead - if the site extends across the floodplain then there may be other areas of significance or concern.
124. Professor Jacques responded to the Inspector's questions regarding the impact of variations in the past and whether there are any implications for what that might mean in the future. He stated that the character and extent of the site is not very well known. This works in its favour. What can be seen is that peat levels have shrunk considerably along the line of the A303 – this might be for various reasons. It might be because it was upgraded in the late 1960s.
125. The site is protected by about 10cm of water. We know that the Auroch footprints date before 6500 BC because we have secured dates from a layer immediately over them. We have to assume that they have been in permanently saturated conditions. They are right on the edge of the dry, they would be particularly delicate site artefacts. In any event we

have only opened up the Auroch footprints to a tiny extent. We know that the laid surface extends for 30m there may well be other animal prints and ecological artefacts below it.

**Part 3 - Whether the appropriate test of acceptability turns on the overall balance of harm against benefit, or on whether adverse impact on ‘outstanding universal value’ (OUV) should be avoided whatever the benefit.**

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**WRITTEN SUMMARY OF  
LEGAL SUBMISSIONS ON BEHALF OF  
CONSORTIUM OF ARCHEOLOGISTS AND  
THE BLICK MEAD PROJECT TEAM**

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1. The concept of outstanding universal value (“OUV”) is a creature of the World Heritage Convention 1972 (“WHC”). Its obligations bite on this decision by virtue of s104(3) and (4) of the Planning Act 2008<sup>2</sup>. In order to understand how it is to be approached one needs to start with the WHC itself.
2. Article 1 sets out the scope of the WHC, it applies to cultural heritage which are divided into three groups: monuments, groups of buildings and sites. Each of these must be of OUV in order to be covered by the Convention. Articles 4 and 5 set out the duties on State Parties. It is worth setting them out in full:

***Article 4***

*Each State Party to this Convention recognizes that the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage referred to in Articles 1 and 2 and situated on its territory, belongs primarily to that State. It will do all it can to this end, to the utmost of its own resources and, where appropriate, with any international assistance and co-operation, in particular, financial, artistic, scientific and technical, which it may be able to obtain.*

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<sup>2</sup> Note that it is implicit in these subsections that compliance with the NPS will not necessarily mean that all international obligations have been complied with. Otherwise, the legal provisions would be redundant.

## **Article 5**

*To ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory, each State Party to this Convention shall endeavour, in so far as possible, and as appropriate for each country:*

- (a) to adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programmes;*
- (b) to set up within its territories, where such services do not exist, one or more services for the protection, conservation and presentation of the cultural and natural heritage with an appropriate staff and possessing the means to discharge their functions;*
- (c) to develop scientific and technical studies and research and to work out such operating methods as will make the State capable of counteracting the dangers that threaten its cultural or natural heritage;*
- (d) to take the appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage; and*
- (e) to foster the establishment or development of national or regional centres for training in the protection, conservation and presentation of the cultural and natural heritage and to encourage scientific research in this field.*

3. Article 31 of the Vienna Convention on the Law of Treaties 1969 requires a treaty to be interpreted in good faith and in accordance with the ordinary meaning of the words in their context and in light of the treaty's object and purpose. One can see that the duties are clear. Any harm to a World Heritage Site ('WHS') has the potential to breach either or both of these Articles. There is no support for a cost-benefit horse-trade approach in the WHC itself.

4. Although it is not understood that there is any dispute that articles 4 and 5 lead to international obligations upon the United Kingdom<sup>3</sup> it is worth highlighting the majority

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<sup>3</sup> At the hearing on 5 June, the representative from DCMS stated that the minimum obligation under the WHC was to protect OUV.

decision of Australia's High Court in the Tasmanian Dam<sup>4</sup> case which found the articles to amount to international obligations on Australia which is a signatory to the WHC. As to the strength of the obligation and the level of discretion it is worth noting the judgment of Brennan J at para.41:

*'41. The obligation under Art. 4 of the Convention leaves no discretion in a party as to whether it will abstain from taking steps in discharge of the "duty" referred to in that Article. Each party is bound to "do all it can .. to the utmost of its own resources" and the question whether it is unable to take a particular step within the limits of its resources is a justiciable question. No doubt the allocation of resources is a matter for each party to decide and the allocation of resources for the discharge of the obligation may thus be said to be discretionary, but the discretion is not at large. It must be exercised "in good faith", as Art.26 of the Vienna Convention requires. If a party sought exemption from the obligation on the ground that it had allocated its available resources to other purposes, the question whether it had done so in good faith would be justiciable. An analogy in the law of contract can be found in Meehan v. Jones [1982] HCA 52; (1982), 56 A.L.J.R. 813 where it was held that a contract did not fail for uncertainty when a "subject to satisfactory finance" clause was construed as requiring the purchaser to act honestly and reasonably. Mason J. said, at p. 820:*

*"There is in this formulation no element of uncertainty - the courts are quite capable of deciding whether the purchaser is acting honestly and reasonably. The limitation that the purchaser must act honestly, or honestly and reasonably, takes the case out of the principle . . .", that is, out of the principle stated by Kitto J. in Placer Development Ltd. (at p531)'*

5. In this case the British Government has not made any representation or produced any evidence that it is unable to comply with its obligations under the WHC due to its having allocated resources elsewhere.
  
6. The Operational Guidelines of the WHC ('OGs') shed further light upon this issue. Paragraph 49 defines OUV as:

*'49. Outstanding Universal Value means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all*

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<sup>4</sup> *Australia v. Tasmania* [1983] HCA 21; (1983) 158 CLR <sup>4</sup>

*humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole. The Committee defines the criteria for the inscription of properties on the World Heritage List.’ (emphasis added).*

7. The full title of the OGs are the ‘Operational Guidelines for the Implementation of the World Heritage Convention’ (July 2012). They are produced by the Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage. As stated in paragraph 1 they (amongst other matters) set forth the procedure for the protection and conservation of World Heritage Properties. They are therefore the sole authoritative guidance on the implementation of the WHC in this regard. Full weight should be given to them.
  
8. In order to qualify as having OUV potential WHSs need to display one or more of certain criteria (listed in pra.77) together with meeting conditions of integrity and/or authenticity. It can be noted that integrity is a measure of wholeness or intactness (para 88). The OG is absolutely clear that the protection and management of WH properties means ensuring that all aspects of the OUV including conditions of integrity and authenticity at the time of inscription are sustained and enhanced over time. Paragraphs 96 and 112 are highly relevant:

*‘96. Protection and management of World Heritage properties should ensure that their Outstanding Universal Value, including the conditions of integrity and/or authenticity at the time of inscription, are sustained or enhanced over time. A regular review of the general state of conservation of properties, and thus also their Outstanding Universal Value, shall be done within a framework of monitoring processes for World Heritage properties, as specified within the Operational Guidelines’*

*112. Effective management involves a cycle of short, medium and long-term actions to ‘protect, conserve and present the nominated property. An integrated approach to planning and management is essential to guide the evolution of properties over time and to ensure maintenance of all aspects of their Outstanding Universal Value. This approach goes beyond the property to include any buffer zone(s), as well as the broader setting. The broader setting, may relate to the property’s topography, natural and built environment, and other elements such as infrastructure, land use patterns, spatial organization, and visual relationships. It may also include related social and cultural practices, economic processes and other intangible dimensions of*

*heritage such as perceptions and associations. Management of the broader setting is related to its role in supporting the Outstanding Universal Value.*' (emphasis added).

9. Therefore the OG is clear that:
  - a. harm to any of the criteria making up its OUV will breach the Convention; and
  - b. harm to integrity – i.e. to the wholeness or intactness of the WHS will breach the Convention.
  
10. These harms cannot be balanced/traded off against benefits to other criteria or benefits to other parts of the WHS. With regards to the latter, 'integrity', it is clear that there cannot be a geographical trade off i.e. harm to one area and benefit to another. Harm to the wholeness or intactness of one area of the WHS will cause harm to the entirety of the WHS. Interestingly on 5 June during discussions regarding the significance of Blick Mead, HE expressed the view that if one were to harm the Stonehenge component of the WHS that would amount to harm to the whole (including Avebury), the phrase used was 'harm to one component is harm to all'. We entirely agree.
  
11. At the hearing on 5 June ICOMOS UK clearly expressed why the site must be considered as a whole. Ms Denyer stressed that the Stonehenge WHS is one single entity not just the main monument, which is the 'icing on the cake', which was in fact constructed much later than the earlier monuments and within which it forms a network of sites. She stressed that this landscape is not just a landscape of random sites but a landscape of sites that have planned interrelationships of various sorts which are both visual and spatial. This was emphasised by Paul Garwood, senior lecturer in Archaeology at Birmingham University and member of the consortium of archaeologists.
  
12. That this is the correct interpretation of the application of Articles 4 and 5 of the WHC is strongly supported by the continuing objection of the World Heritage Committee and also ICOMOS which acts as an adviser to the committee. The repeated and explicit submissions of ICOMOS in relation to how the WHC is to be applied are forceful and should be given full weight.



13. At the hearing on 5 June, HE sought to place weight on ICOMOS' 'Guidance on Heritage Impact Assessments for Cultural World Heritage Properties' (January 2011). This guidance concerns methodology of impact assessments and, contrary to the OGs, is not authoritative guidance with regards to the implementation of the WHC. In any event nowhere in that guidance is it stated that one can trade off harm to one criterion of OUV against purported benefit to another nor does it state that one can trade off harm to one area of a WHS against purported benefit to another. The fact that ICOMOS UK has repeatedly stated to this examination that HE's approach is incorrect clearly indicates that HE's interpretation of this guidance is wrong.
14. Turning to national policy. There is no provision in the NPPF, NPS, PPG or the World Heritage Site Management Plan 2015 (the latter of which the HIA states is part of the Government's implementation of the WHC p.32) which supports the view that one can:
- a. balance harm to a criterion of OUV against benefit to another criterion to arrive at a neutral or net positive impact and thereby avoid breaching the convention; or
  - b. that, similarly, one can balance harm to part of the WHS against benefit to another part.
15. Rather, the Management Plan which is the most detailed and relevant document in terms of the application of the WHC to the WHS, clearly indicates that such an approach is not permissible. Paragraph 1.3.1 states that: *'To sustain the OUV, it is necessary to protect and manage all the attributes of OUV which contribute towards it.'* Further the policies within the Management Plan indicate that the trade-off approach is inappropriate:
- a. policy 1d states *'Development which would impact adversely on the WHS, its setting and its attributes of OUV should not be permitted.'*
  - b. policy 3a states *'Manage the WHS to protect the physical remains which contribute to its attributes of OUV and improve their conditions'*
  - c. policy 3e states *'Conserve and/or make more visible buried, degraded or obscured archaeological features within the WHS without detracting from their intrinsic form and character'*

16. There is no suggestion throughout the entirety of the Management Plan that a trade-off approach is acceptable under the terms of the WHC obligations.
17. Any contention that the NPS implements the WHC and therefore if the terms of the NPS are complied with then so too is the convention is fundamentally flawed for the following reasons:
- a. First, there is no statement in the NPS or outwith the NPS that states that it is the Government's view that it complies with the WHC/represents the transposition of the WHC into UK policy;
  - b. the NPS, like the NPPF, applies the same policy restriction to WHS' as it does to other designated heritage assets (see para 5.131) there is no indication that their international status and protection by the WHC has appropriately been recognised/taken into account;
  - c. there is no recognition of the OGS which state that all criteria of OUV must be maintained;
  - d. The relevant provisions of the NPS do not, in any event, support the trade-off approach.
18. Finally, common sense militates against a trade-off approach to the convention for the following reasons:
- a. the WHS has been deliberately designated in its entirety and the protections of the WHC apply to the whole area;
  - b. the operational development relating to the road scheme will result in the permanent and irreversible destruction and sterilisation (in archaeological terms) of approximately 10ha<sup>5</sup> area of the WHS;

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<sup>5</sup> HE has been asked to confirm the exact area

- c. if HE's position is to be accepted then the larger the WHS the more scope there would be for harm to certain areas so long as other areas were improved; that is nonsensical;
- d. further, the more attributes of OUV which a WHS possesses the more harm could potentially be done so long as other of the attributes were benefitted. Again, that would be nonsensical;
- e. the result of HE's argument is to state that it is permissible to wipe out the heritage significance of one area of the WHS and concentrate the benefits elsewhere. This fundamentally misunderstands the point that the entirety of the WHS benefits from protection and that one of the reasons it is designated is its integrity (or its wholeness or intactness). It is no answer to this point to state that because the existing A303 would be removed the impact of the operational development would be counterbalanced. The removal of the A303 does not replace the artefacts which were once in the ground in the scheme footprint, indeed it cannot; and
- f. HE's approach leads to the very real potential for a 'death by 1000 cuts' with development permissibly destroying physical elements within the WHS and purporting to balance this against the improvement of the setting/experience of other parts. This approach is antithetical to the designation of the site as a whole on the basis of specific and fixed criteria.

19. In conclusion, it is clear that the cost-benefit approach of HE to the attributes, integrity and authenticity of the WHS is unlawful under the WHC. Therefore, notwithstanding the fact that HE has underestimated the harm caused by the scheme and overstated the benefits, even on its own analysis it is in breach of the WHC due to its reporting of harm to the following elements of OUV:

- a. the physical remains of the Neolithic and Bronze Age funerary and ceremonial sites and monuments in relation to the landscape (pp32 and 24 HIA);
- b. the siting of Neolithic and Bronze Age funerary and ceremonial sites and monuments in relation to the landscape (pp24 and 25 HIA)
- c. the siting of Neolithic and Bronze Age funerary and ceremonial sites and monuments in relation to each other (p.27 HIA)

- d. the disposition, physical remains and settings of the key Neolithic and Bronze Age funerary, ceremonial and other monuments and sites of the period, which together form a landscape without parallel (p.27 HIA);
- e. integrity (see p.29 HIA); and
- f. authenticity (p.30 HIA).

**Victoria Hutton**

**39 Essex Chambers**

**81 Chancery Lane**

**on behalf of:**

**The Consortium of Archaeologists and the Blick Mead Project Team**

**Part 4** Note from Dr Chris Bradley and Professor Tony Brown on adequacy of the tiered assessment and potential impacts of the scheme:

See attached Note

## **The Hydrology of Blick Mead.**

This submission complements the paper previously submitted by Professor Tony Brown, and has been prepared following oral evidence presented at the hearing in Salisbury on June 6<sup>th</sup>. The document first summarises our current conceptual understanding of the hydrology of Blick Mead, it then indicates a number of specific areas of concern relating to the impacts of the A303 development on the hydrology of Blick Mead. Finally, the document outlines, in brief, a hydrological monitoring strategy for Blick Mead, which we argue should be similar to that successfully applied at Star Carr (Brown et al. 2011). Our rationale in suggesting the latter, is not that the hydrology of the two sites are similar, but rather the comparison emphasises the necessity of additional, site-specific, information, to understand the wider hydrological context to areas of buried archaeology.

Our understanding is that all parties accept the importance and significance of the Mesolithic site, Blick Mead, which is situated on the northern margin of the River Avon floodplain and which extends to within metres of the A303. It is very rare to find settlement sites of this nature within the World Heritage Site, and the buried archaeology has enormous research potential (see archaeological submission).

### **1. Conceptual understanding**

The nature of the archaeology, which includes bone and plant remains, at Blick Mead is such that its preservation over the past 7,000 years is quite remarkable in that it indicates the maintenance of saturated conditions throughout this period of time. By inference this suggests that there has been a lack of effective drainage in the vicinity of the site, and a relatively stable hydrological regime (Brown 1995). The latter suggests that the acknowledged seasonal fluctuations in chalk groundwater levels, and in surface saturation, are not evident at depths of ~1m below the surface where the archaeology is found.

Despite the acknowledged importance of Blick Mead, we believe that at present there is insufficient understanding of the hydrology of the site given that opportunities to implement an effective hydrological monitoring regime, under a tier 4 assessment (Historic England 2016) have not been pursued. With this caveat, however, it is possible to infer the likely patterns of water movement to, and through, Blick Mead in the context of the surrounding groundwater catchment as summarised in the following paragraphs.

Blick Mead is likely to (currently) receive water from a variety of shallow and deep water pathways including:

- i. through the chalk matrix. These waters are thought to have a residence time of ~55 years, they are understood to contribute up to 80% of the baseflow of the River Avon; and are characterised by a direction of water movement towards the surface in areas of low topography as the valley-bottom (evidenced by groundwater levels in boreholes in / near the floodplain which indicate upward groundwater movement);
- ii. shallow subsurface waters which follow water flow pathways through interconnected fractures near the surface of the chalk which provide areas of enhanced permeability. These are particularly likely to be present in the vicinity

of dry valleys in the chalk, and may account for a significant proportion of the inflow to Blick Mead given the presence of a dry valley immediately to the North of the site (although the A303 lies directly between the dry valley and Blick Mead). Although at present, we do not know how much of the spring flow into the pool at the site is derived from waters that have followed shallow vs deeper flow pathways;

- iii. Blick Mead is also likely to receive drainage water from the A303 (either through a filter drain or as a result of seepage from road-side ditches). This will be directly impacted by the road reconstruction and re-engineering (as noted in Section 2). It may also receive overbank flow but this is a negligible input on chalk stream floodplains except where there has been water meadow construction

The water-table regime in Blick Mead will be strongly influenced by the extent to which water is able to move from the site, across the floodplain to the River Avon. The alluvial deposits of the floodplain will be moderately to highly permeable, although without a local monitoring network (e.g. shallow piezometer nests), the rate and direction of water movement is unclear. For example, previous work on the floodplain of the River Lambourn (a chalk catchment in the Berkshire Downs) identified a range of processes that controlled the shallow groundwater table and the direction of groundwater movement through the Chalk was found to differ from that through the alluvial aquifer (Grapes et al. 2006). A comparable situation is likely to exist on the Avon floodplain near Blick Mead.

These wider controls on the hydrology of Blick Mead are summarised in Prof. Browns' paper which emphasises the importance of regarding the site as a 'four dimensional' system in which the pattern of water movement varies horizontally and vertically over time through the catchment upstream of the Blick Mead, and which is further affected by the characteristics of the river and associated alluvial deposits (as the latter controls drainage from the site).

Further complexity is introduced at Blick Mead by the stratigraphy of the site, and particularly the distribution of horizons of markedly varying permeability, which are likely to include weathered chalk (highly permeable where fractured); alluvial sands and gravels (highly permeable); putty chalk (Younger 1989; see Annex); head deposits (variable permeability). As discussed in Dr Chris Bradley's oral evidence, the patchy distribution of putty chalk at Blick Mead may impede drainage locally, and reduce some of the water-table variability at points of significant archaeological interest.

### **Discussion.**

In summary, the hydrology of Blick Mead is significantly more complex than presented in the documentation by Highways England (11.4 Annex 3 Blick Mead). The water table regime in the vicinity of the buried archaeology is likely to be maintained by waters that have followed a variety of flow pathways including deep and shallow groundwater, drainage, and local precipitation. The importance of these distinct water sources to the total water budget of Blick Mead will vary seasonally, but there are also likely to be marked spatial variations in patterns of saturation (reflecting differences in water inflow, and the distribution of relatively impermeable units such as the putty chalk). Consequently, in some places,

groundwater may be 'perched' above the regional water-table, while elsewhere, the different water types may be well mixed.

It is pertinent to point out that, for the reasons outlined above, an offer was made to Highways England, with the support of Historic England, first in February of 2018 and repeated in April 2018 that a site-specific monitoring programme be instigated, which could by now have gathered at least 12 months of valuable data.

## **2. Implications of the A303 development.**

Blick Mead is situated within metres of the current line of the A303, and within 500m of the proposed tunnel's eastern portal. In their submission Highways England have discounted the likelihood of any impact of the development on the hydrology of Blick Mead, notwithstanding the recognition in Chapter 11 of the ES:

'Due to the interaction between groundwater and surface water in the area, there may be impacts on surface water features beyond 1km and these should be considered as part of an integrated water environment assessment. Impacts on groundwater may also extend beyond 5km, so the zone of consideration should be determined through calculation of the radius of influence of the proposed activities and based on site specific hydrogeological data. Where necessary further water interest surveys may need to be undertaken in any locations, identified as being impacted by the proposals.'

We believe that there has been insufficient evaluation of the interaction between groundwater and surface water at Blick Mead and this section builds upon the conceptual understanding of the site (presented above) to outline a number of areas of concern:

### **i. Evaluation of groundwater flow to Blick Mead.**

Highways England suggest that there will be no impact on groundwater flow following construction of the tunnel. However, there are several shortcomings with the modelling work that is used to support this conclusion:

- a. Individual model cells have dimensions of 250 x 250 m and at this scale, the model is unable to replicate the observed patterns of groundwater flow to Blick Mead (e.g. the effects of water flow from a dry valley to the north). For comparison this cell size is far larger than the entire archaeological site at Blick Mead.
- b. The groundwater model considers the chalk and surficial deposits to comprise one hydrogeological layer. Hence it is not possible to distinguish between deep groundwater flow (through the chalk matrix) and shallow groundwater flow (through near-surface fractures). Moreover it is not possible to represent the effects of the putty chalk on the hydrology of Blick Mead (and hence investigate the hydrology of any areas of perched groundwater). Coring by members of the Blick Mead team from the University of Southampton and previously by the University of Reading have shown there are at least three sedimentary units underlying the site which have variable permeability.
- c. Given the scale, the representation of the valley bottom / floodplain hydrogeology will be inadequate. This limits the utility of the model to replicate spring flow, and



quantify the effects of any changes in base flow (which affects drainage from Blick Mead).

- d. There is insufficient field data to evaluate model results: as noted below, at present there is only one monitoring point at Blick Mead, and no information is provided on the accuracy of model output.

In earlier discussions with Highways England we indicated the importance of understanding the hydrology of Blick Mead at a sub 10m<sup>2</sup> scale: this requires a modelling approach that is an order of magnitude more detailed than that currently available.

- ii. Road drainage to Blick Mead.

As noted above (in Section 1), it is very likely that seepage of road drainage represents a significant proportion of the current water inflow to Blick Mead. The importance of this inflow is not discussed in 11.4 Annex 3. Moreover at the hearing on June 6<sup>th</sup>, it was suggested that drainage (to Blick Mead) might be reduced following construction of new infiltration basins. This depends upon the exact drainage layout from the new road surface and should be included in the modelling. Given the proximity of Blick Mead to the A303, a detailed assessment of near surface drainage is needed to quantify the current significance of this inflow and to ensure that the contribution of drainage to the site is maintained (during construction and subsequently).

- iii. Effects of road construction on shallow groundwater flow.

The extent of any substantive engineering works (e.g. road realignment) in the immediate vicinity of Blick Mead is unclear. This is potentially important as the site most probably relies upon shallow groundwater flow along an axis of higher permeability in the Chalk in the dry valley to the North (which the current line of the A303 transects). A full Tier 4 assessment of Blick Mead could have established the importance of water flow via this pathway (e.g. using stable isotopes to distinguish between shallow and deep groundwater flow paths, as was done at Star Carr). In the absence of this assessment, a full evaluation of the effects of any ground engineering work on shallow groundwater flow should be completed as we believe that losing this water would lead to a lowering of the water table, particularly in areas where the putty chalk prevents the upward movement of 'deeper' chalk groundwater.

There is a further concern with respect to the possible dewatering in the vicinity of the eastern portal to enable access for the tunnel boring machine. Our understanding is that it is at present unclear whether drainage will be required, but given the proximity of Blick Mead, the potential for water table drawdown at the site should not be discounted.

### **3. Current monitoring.**

To-date, there has been no hydrological monitoring in the areas of greatest archaeological interest at Blick Mead (while one borehole has been installed to a depth of 5m, this is 4m below the area of archaeological interest, and the value of this data from this observation point is limited by the putty chalk which significantly limits groundwater interaction in this area).

We believe that monitoring of the site should include the installation of shallow piezometer nests (to quantify water movement in the area of archaeological interest), monthly sampling to determination isotopic composition of shallow groundwater (to indicate the seasonal interaction between deep and shallow groundwater), and the development of a local groundwater model (at 10m<sup>2</sup>). We successfully used monitoring of this nature in our investigation of Star Carr (Brown et al. 2011).

In the absence of appropriate monitoring information, some of the points raised here are inevitably speculative, but equally we believe that it is impossible to suggest that the A303 development will have no impact on the hydrology of Blick Mead given the lack of this information (which would form part of a Tier 4 assessment).

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Dr Chris Bradley  
Prof. Tony Brown

### Annex. Abstract from Younger (1989); Devensian periglacial influences on the development of spatially variable permeability in the Chalk of southeast England

In unconfined parts of the Chalk aquifer in southeast England, permeability generally varies laterally with the lowest permeabilities occurring beneath interfluvial areas, and the highest beneath river valleys and dry valleys. Furthermore, the Chalk in the river valleys is normally in excellent hydraulic continuity with the overlying highly permeable Quaternary gravels. However, recent field of permeability development in the Chalk of southern investigations in the Thames Valley have demonstrated the existence of zones of anomalously low Chalk permeability associated with the development of thin discontinuous confining layers of low permeability 'putty chalk' at the gravel-chalk interface. Hitherto putty chalk in the Middle Thames Valley has mostly been reported from interfluvial areas where it can occur as a periglacially frost-weathered mantle on the upper surface of the Chalk. The true extent and hydraulic significance of putty chalk in valley bottom positions is only now being realised. Existing models for the lateral variation in Chalk permeability cannot explain these new observations. A new model is therefore proposed in which it is envisaged that, during the Devensian, carbonate dissolution in perennial taliks (unfrozen zones) beneath the major channels of the braided palaeo-Thames caused the high-permeability zones, while permafrost beneath the interfluvial areas restricted dissolution at those sites. Freeze-thaw action in seasonal taliks beneath minor channels would account for the formation of putty chalk at the gravel-chalk interface, and the persistence of permafrost beneath these seasonal taliks would lead to a restriction of dissolution, and thus to a zone of low permeability.