List of Chapters

10 Flood risk, groundwater protection, geology and land contamination (Fg.2)

Question Fg.2.1

Flood risk and drainage

i. How has the potential for permanent compaction of underlying chalk from construction activities been assessed?

ii. Should the means to mitigate this risk be clearly stated in the OEMP?

Highways England response

i. How has the potential for permanent compaction of underlying chalk from construction activities been assessed?

1. Paragraph 10.7.4 of the Environmental Statement [APP-048] recognises that construction activities can result in physical damage to soil, mentioning among other things, compaction as a result of heavy construction vehicle movements. Paragraph 10.8.1 describes how mitigation by design has, and will be, implemented to avoid damage to geological, geomorphological and hydrogeological receptors, including any underlying chalk. In other words, rather than attempting to calculate the damage that construction plant can cause to the geology of the site, the design philosophy seeks to avoid and prevent the damage occurring in the first place.
2. For instance, paragraphs 5.2.20 to 5.2.27 of the draft Detailed Archaeological Mitigation Strategy (DAMS) [REP4-024], requires construction traffic to be routed primarily along the footprint of the earthworks, i.e. on areas that will form part of the final Scheme and are not to be returned to agricultural use following construction. Where this is not possible, and the haul route must traverse land that will be returned to agricultural use at a future date, the surface will be protected by a layer of stabilised chalk fill separated from the underlying ground by a geotextile sheet. The document stresses the Contractor's responsibility not only to protect sensitive archaeological remains but also to prevent deformation and therefore damage to the underlying chalk.
3. Elsewhere, in temporary compound or stockpiling areas, any potential damage to the underlying chalk from material stockpiles would be the result of settlement, rather than compaction. It would again be the responsibility of the Contractor to develop working methods to ensure that the underlying chalk is protected from compaction, while also protecting any archaeology which may potentially be present in the overlying topsoil. The approach would be set out in the Soils Management Strategy, which is a requirement of the Outline Environmental Management Plan (OEMP) [REP4-020] in MW-G7 (Management Plans), MW-GEO3 (Soils Management Strategy), MW-

GEO7 (Excavated materials management). The Contractor is required to prepare the Soils Management Strategy (SMS), based on the Outline SMS submitted with the Deadline 6 OEMP, in consultation with Wiltshire Council and the members of HMAG, for approval in advance of the works (MW-GEO3).

ii. Should the means to mitigate this risk be clearly stated in the OEMP?

4. It is important within the framework of a DCO and related control mechanisms to encourage innovation and application of best contractor and practice knowledge at the time of detailed design and implementation. Therefore, to ensure there is opportunity to deliver on this the dDCO and related documentation is designed so that the Applicant defines the performance criteria for all aspects of the design and allow the contractor to develop the measures that will best deliver and achieve them. It may be that the contractor can suggest technologies or methodologies that provide better mitigation than those that Highways England would suggest at this stage. It is the contractor's design, compliant with all aspects of the DCO, the Environmental Statement, DAMS and OEMP, etc., and Highways England does not want to constrain or limit the options. Therefore, Highways England would not expect the specific means to mitigate the risk to be detailed within the OEMP, but expects the relevant Standards, including those referenced in the Outline SMS submitted with the Deadline 6 OEMP, to be achieved or exceeded.

Question Fg.2.2

Flood risk and drainage

i. How would the discharge of any water from the construction phase, including any dewatering of the tunnel arisings slurry be controlled to prevent flood risk and contamination?

ii. Should this be explicitly addressed in the OEMP?

Highways England response

i. How would the discharge of any water from the construction phase, including any dewatering of the tunnel arisings slurry be controlled to prevent flood risk and contamination?

1. MW-WAT3 of the Outline Environmental Management Plan (OEMP) [REP4-020] requires the main works contractor to utilise sustainable methods for construction waste water discharges, including site drainage, surface runoff, and dewatering discharges including waste water generated through the dewatering of the tunnel arisings. This includes discharge to watercourses or groundwater subject to water quality and rate of discharges and scour assessments (for surface watercourses only) in accordance with the provisions of the draft Development Consent Order (dDCO). For discharges to mains foul or combined sewers relevant permissions will be obtained from the statutory undertaker. Discharge to watercourses or groundwater will, insofar as not dealt with in the dDCO Article 13 Discharge of Water [REP4-019], only be permitted where permits or other relevant approval has been obtained.
2. Sufficient time will be made for the Environment Agency to issue permits in accordance with relevant legislation. The main works contractor shall ensure that site drainage meets the effluent and flood risk standards required by the sewerage undertaker and the Environment Agency, as appropriate, in accordance with the relevant permit, and will provide and maintain holding or settling tanks, separators and other measures as may be required to meet those standards. The above methods will also reflect any necessary consultation between the Environment Agency and Wiltshire Council regarding any potential surface water or groundwater flood risk that could arise from regulated discharges of water. This is reflected in the Statement of Common Ground (3.28.16) and OEMP (MW-WAT 2, MW-WAT 3, MW-WAT 7, MW-WAT 10) as submitted at Deadline 6. The main works contractor shall ensure that access is provided to the undertaker and Environment Agency so that samples of discharge can be obtained and analysed, and the flows verified as required. The main works contractor shall incorporate the following measures during the construction works:
3. all temporary land-take will include adequate areas of land set aside for robust control measures, for example sustainable drainage control;

4. any discharge to sewers and controlled waters will be required to be in accordance with the dDCO provisions, having regard to the relevant licensing body's requirements;
5. water flows from sites will be limited during construction to existing runoff rates, unless otherwise agreed with the Environment Agency in accordance with relevant legislation; and
6. the relevant sections of BS 6031: Code of Practice for Earthworks for the general control of site drainage will be followed.
7. The principle behind the dewatering of the tunnel arisings through the Slurry Treatment Plant is to allow for the sustainable recovery and recirculation of the water/bentonite slurry through the tunnelling process for as long as practicable. There will be a limit to this sustainable re-use before fresh slurry is required and the waste water generated will require management in accordance with relevant permissions of the statutory undertaker or Environment Agency as appropriate.

ii. Should this be explicitly addressed in the OEMP?

8. The OEMP as submitted at Deadline 6 includes sufficient provisions to control discharges arising from construction and dewatering. In addition to the references made to the OEMP in the answer to (i), further reference to relevant measures contained in the OEMP was made in the 'Written Summaries of oral submissions at Issue Specific Hearings - Flood risk, Groundwater, Geology and Waste' [REP4-032] held on 11th June and specifically in agenda item 7.3. MW-GEO8 of the OEMP, confirms the measures required to prevent cross contamination from stockpiled materials, and to protect buried services, drainage runs and groundwater source protection zones from potential ingress of contaminants. MW-GEO6 requires contractors to control potential hazardous substances in line with COSHH guidance; MW-WAT4 requires a spill response procedure and pollution incident control plan; MW-WAT6 requires the contractor to establish measures to prevent deposition of silt or other material in any watercourse, lake or aquifer, in accordance within industry guidelines; and MW-WAT7 requires contractors to carry out handling of contaminated material treatment processes and storage that does not affect the chalk aquifer.

Question Fg.2.3

Flood risk and drainage

i. Given the Council's statutory role should MW-WAT3 be expanded to also require consultation and/ or agreement with the Council as well as the Environment Agency?

ii. If so, should this just be in respect of part c or more generally?

Highways England response

1. i and ii: The Applicant has amended the Outline Environmental Management Plan (OEMP) item, MW-WAT3 (c) at Deadline 6 to make reference to Wiltshire Council. Reference to the Council is not needed elsewhere in this item as the other references to the Environment Agency relate to legal powers that are not held by Wiltshire Council, e.g. control of discharges.

Question Fg.2.4

Flood risk and drainage

Please provide an update on the discussions following the Council's peer review of the latest FRA. Please set out any areas of disagreement. Within this response please set out the position in respect of the revised culvert design, the updated modelling outputs and the peak surface water flow onto the River Till flood plain and any associated mitigation.

Highways England response

1. The Applicant received Wiltshire Council's comments on the peer review on 15th July 2019 and these were discussed on 22nd July 2019. There is mutual agreement with the Council that a substantial number of items have been resolved and that it should be possible to reach agreement on all other matters relating to the updated Flood Risk Assessment (FRA) [REP3-008] before Deadline 7 and that this agreement should be confirmed in the Statement of Common Ground to be submitted at that time.
2. The items that are not yet fully agreed are summarised below along with the Applicant's position setting out the response to the matters raised:
   i. Wiltshire Council (WC) request additional understanding of pluvial flood risk to the revised B3083 and surrounding land at Parsonage Down including risk assessment for a 12 hour storm duration.

      Highways England position is: the drainage network has been designed to Design Manual for Roads and Bridges (DMRB) standards; Annex 1B to the FRA, the Pluvial Hydraulic Modelling Report [REP3-008], outlines [para 4.4.10 and Figure 4.8 and 4.9] that a risk assessment for a 12 hour storm duration was undertaken and concludes [para 7.2.5] that with the revised culvert design the flood risk to the B3083 would be substantially decreased. The Council's request for additional information on flood risk comes having already recognised the significant betterment the Applicant is providing to reduce the flood risk to the road as a result of the scheme through its redesign and installation of road drainage measures, which are currently absent from the existing road.

   ii. WC request clarification of any effect upon the River Till from increased pluvial run off from the Parsonage Down area.

      Highways England position is: the EA confirmed during a meeting on 20th June 2019, which WC also attended, that the 85% sensitivity test on fluvial flood risk for the River Till was adequate and appropriate to assess the increase in surface water flow to the River Till. The results of that sensitivity test showed no increase in fluvial flood risk, as reported in paragraph 7.1.5 of the Fluvial Hydraulic Modelling Report, Annex 1A to the FRA [REP3-008].

iii. WC request further clarification of how the scheme's hydraulic models show water on the carriageway and the pathways for this water to enter and/or leave the carriageway in any locations at which it is not intended to.

Highways England position is: the methodologies for the pluvial modelling, which assessed the mitigation provided by the road drainage strategy, were outlined in the updated FRA [REP3-008] and updated Road Drainage Strategy, ES Appendix 11.3 [REP2-009] respectively and further discussed with WC in subsequent meetings e.g. 20th June, 8th July 2019 and 22nd July 2019.

iv. WC has continuing uncertainty about the adequacy of the Drainage Treatment Areas' (DTA)'s capacity to prevent pluvial flood risk

Highways England response is: a road drainage Technical Note was provided to WC on 4th July 2019 which explained the position that there is adequate capacity within the illustrative design of the road drainage treatment areas to manage storm water runoff safely and the exceedance flow routes are not directed towards any sensitive receptors. Namely:

- the drainage treatment areas capacity was tested against an upper end allowance of 40% for climate change and the results show the remaining freeboard is on average more than 250mm at each drainage treatment area;
- to reduce the freeboard to zero the climate change allowance would have to be increased to between 66% and 84%;
- for the highway drainage to overtop the drainage treatment areas the design year return period would have to be greater than a 1 in 1000 year return period storm.
- the exceedance routes have been created within the landscape that reflect existing topography to ensure surface flows would be directed to the current flow routes and would not be directed towards any sensitive receptors.

v. WC has questioned the design of Drainage Treatment Area 1 in relation to its position above the proposed landscaped ground level and height of connecting pipes.

3. Highways England position is: the detail shown on Figure DTA 1 Comparison, Appendix A, of the Technical Note shows a possible pipe route from the road to the DTA; it is intended that this piped route be located below the finished ground level of the landscape area; the DTA edge level is proposed at 86.0 AOD which maintains the DTA level above the surrounding area enabling the provision of exceedance flow routes to either side of the DTA. It is intended

that the outfall construction details, location and level at the discharge point into the infiltration section of DTA are matters to be defined at the detailed design stage.

Question Fg.2.5

Flood risk and drainage

Please provide an update on the discussions in respect of the FRA. In particular please outline any areas of disagreement, where additional information is required, and any consequential implications for other documents such as updates to the OEMP?

Highways England response

1. All matters regarding the flood risk assessment (FRA) have now been agreed with the Environment Agency. This is reflected in the updated Outline Environmental Management Plan (OEMP) submitted at Deadline 6, 26th July 2019 and updated Statement of Common Ground (SoCG) that will be submitted at Deadline 7.

Question Fg.2.6

Flood risk and drainage

i. Should the Flood Risk Management Plan be listed in MW-G7 of the OEMP and should the plan be developed in consultation with Wiltshire Council as well as the Environment Agency?

ii. If not, why?

Highways England response

1. The Applicant can confirm that item MW-G7 of the Outline Environmental Management Plan (OEMP) [REP4-020] has been amended (within the updated OEMP submitted at Deadline 6) to list the Flood Risk Management Plan as part of the Water Management Plan. The Applicant can also confirm that item MW-WAT12 has been amended within the updated OEMP to make reference to the Flood Risk Management Plan being developed in consultation with Wiltshire Council (in so far as relevant to its functions as lead local flood authority).

Question Fg.2.7

Flood risk and drainage

Please provide an update on the discussions about the need for the employment of a full-time drainage engineer during construction:

- What is the current status of the discussions?
- Set-out why this post is considered to be necessary (or not); and
- how this would be secured.

Highways England response

1. Highways England refers the Examining Authority to Appendix B ref. B1.25 within the Comments on Local Impact Reports [REP3-014]. Highways England still holds this position as:
   a. the role is required by Wiltshire Council in order to fulfil their statutory obligations; and
   b. the requirement for Highways England to fund this role would fail the tests for requirements set out in paragraph 4.9 of the National Policy Statement for National Networks, in that it is not necessary to make the authorised development acceptable in planning terms and is not reasonable in all other respects.
2. Highways England does not intend to further discuss this matter with Wiltshire Council.

Question Fg.2.8

Flood risk and drainage

i. Please provide an update on the discussions about the climate change allowance for road drainage.

ii. If the Applicant considers that a 30% allowance (with a 40% sensitivity check) is sufficient please respond to the Council concerns in respect of reliance on the freeboard, lack of allowance for any uncertainty and that climate change allowances may increase in the near future?

iii. Could the Environment Agency set out its position on this matter?

iv. Should MW-WAT12 be updated to include reference to climate change allowances in line with the comments made by the Environment Agency at DL4 [REP4-049]?

Highways England response

i. Please provide an update on the discussions about the climate change allowance for road drainage.

ii. If the Applicant considers that a 30% allowance (with a 40% sensitivity check) is sufficient please respond to the Council concerns in respect of reliance on the freeboard, lack of allowance for any uncertainty and that climate change allowances may increase in the near future?

1. In response to point i and ii: Discussions with Wiltshire Council (WC) and the Environment Agency (EA) have continued. A meeting attended by both parties and Highways England was held on the 20th June 2019, to clarify the rational and background information to the points raised concerning the highway drainage and climate allowance. The items discussed were,
   - The design is based on a 1 in 100 year+30% allowance for climate change with a 300mm freeboard being maintained.
   - The drainage treatment areas capacity was tested against an upper end allowance of 40% for climate change, the remaining freeboard is more than 250mm at each drainage treatment area.
   - To reduce the freeboard to zero the climate change allowance would have to be increased to between 66% and 84%.
   - For the highway drainage to overtop the drainage treatment areas the design year return period storm would have to be greater than a 1 in 1000year return period storm.
2. A Technical Note confirming the above points, providing additional background information and detailing the design rationale being applied was requested by Wiltshire Council. The Technical Note was produced by HE and forwarded to WC and EA on the 4th July 2019. Comments were received from WC on 15th July 2019 and discussed with them on 22nd July

2019. Agreement was reached on the climate change allowances for road drainage and the Applicant expects to be able to confirm this agreement in the Statement of Common Ground to be submitted at Deadline 7. Currently HE are awaiting a response from the EA.

iv. Should MW-WAT12 be updated to include reference to climate change allowances in line with the comments made by the Environment Agency at DL4 [REP4-049]?

3. A change has been made to MW-WAT12 with respect to climate change in the OEMP submitted at Deadline 6, further to the Environment Agency's comments at Deadline 4.

Question Fg.2.9

Flood risk and drainage

In the Relevant Representation from Wiltshire Council [RR-2365] a detailed concern was raised in respect of the Triangular Irregular Networks and the Light Detection and Ranging (paragraph 69 (a)). A specific response to this concern does not appear to have been provided.

Can the Applicant respond to this matter and can the Council set out its current position in respect of this?

Highways England response

1. With respect to the matter of the Triangular Networks and the Light Detection and Ranging, raised by Wiltshire Council in their Relevant Representation [RR-2365], further clarification was given in Section 3.3 of the updated Pluvial Hydraulic Modelling Report, Annex 1B to the updated Flood Risk Assessment [REP3-008] and has been addressed to Wiltshire Council's satisfaction in their meeting with the Applicant on 22nd July 2019.

Question Fg.2.10

Flood risk and drainage

In the Relevant Representation from Wiltshire Council [RR-2365] a detailed concern was raised that the model should be run for a longer simulation time (paragraph 69 (c)). A specific response to this concern does not appear to have been provided.

Can the Applicant respond to this matter and can the Council set out its current position in respect of this?

Highways England response

1. With respect to Wiltshire Council's (WC's) Relevant Representation [RR-2365], paragraph 69(c) this relates to an item that is required to be answered or addressed from the hydraulics study as follows:

   c) The model should be run for a longer simulation time as water levels are still rising at the current end-time of 10 hours. It will be important to test other storm durations, culvert sizes, (and model simulation length) to optimise the scheme.

2. Clarification of the model simulations used in the assessment was given in Section 3.9 of the updated Pluvial Hydraulic Modelling Report, Annex 1B to the updated Flood Risk Assessment [REP3-008] and this concern has been addressed to Wiltshire Council's satisfaction in their meeting with the Applicant on 22nd July 2019.

Question Fg.2.11

Flood risk and drainage

In the Relevant Representation from Wiltshire Council [RR-2365] a query was raised as to the ownership and maintenance responsibilities and regime for the proposed culvert. The long culvert has now been removed from the scheme, however, it is understood that shorter culverts would still be utilised.

What would the ownership, maintenance regime and responsibilities be for any culverts and how would this be secured?

Highways England response

1. Future maintenance procedures for the drainage systems are set out within the Outline Environmental Management Plan (OEMP) [REP4-020(clean)] (See table 3.2b Ref. MW-G11). This provides that a Handover Environmental Management Plan (HEMP) must be drawn up at the end of the construction phase, specifying maintenance obligations. The provisions of the OEMP are secured within Requirement 4 of the draft Development Consent Order (dDCO) [REP4-018] which requires works to be undertaken in accordance with the OEMP.
2. The maintenance proposals in the Drainage Strategy are secured at Requirement 10 of Schedule 2 of the draft DCO [REP4-018], which provides that written details of surface water drainage proposals for each part of the Scheme must be approved by the Secretary of State prior to commencement of development for that part. These details must be based on the mitigation measures included in the Environmental Statement (ES), which includes the Road Drainage Strategy, which is Appendix 11.3[REP2-009] to the ES.
3. As stated in the draft Statement of Common Ground between Highways England and Wiltshire Council [REP4-022], section 3.28.10, the Applicant acknowledges Wiltshire Council's concerns. The parties have agreed that matters relating to the highways that Wiltshire Council would become liable to maintain, as a result of the Scheme, are capable of being resolved through the terms of a legal agreement between the parties. That agreement is anticipated to be concluded before the close of the Examination and discussions are ongoing regarding its precise terms.

Question Fg.2.12

Flood risk and drainage

i. Having regard to the DL4 submission from Wiltshire Council [REP4-039] please could the Applicant address matters of potential flood risk to the B3083?

ii. Could the Council set out its current position on these matters?

Highways England response

1. The matters related to flood risk of the B3083 are clearly addressed at paragraph 10.3.7 of the updated FRA [REP3-008]. The existing (baseline) configuration of the B3083 does not provide provision of conveyance culverts and the existing road level is lower than in the proposed scheme. As the proposed scheme provides both conveyance culverts and raising of the road, this removes the B3083 from the floodplain, providing a significant benefit to the local infrastructure in comparison to the existing scenario.
2. Within Fig 3.2 of Annex 1B of the FRA there is an image with erroneous text. Figure 3.2 has a text box describing a ford crossing of the B3083. The Applicant can confirm that there is no formal ford proposed at this location.

Question Fg.2.13

Flood risk and drainage

Having regard to the provision of the additional evidence submitted to the examination, please set out an updated assessment of the proposed development in respect of the flood risk policy, including the application of the Sequential and Exception Tests, in the NPSNN?

Highways England response

1. At Deadline 3 (DL3), the Applicant submitted an updated Flood Risk Assessment (FRA) to the Examination [REP3-008], which provided updated information which supports the Environmental Statement and its conclusions in relation to flood risk.
2. In particular section 1.4 of the updated FRA explains that:-
3. Key updates to this document are summarised as:
    - Incorporation of confirmatory results from updated hydraulic modelling for the River Avon, with changes to hydrological inflows and changes in indicative areas assigned to highway drainage ponds.
    - Incorporation of confirmatory results from updated surface water hydraulic modelling for the Parsonage Down catchment, including surface water hydrology and updated drainage solutions at Parsonage Down.
4. Details of updates to the hydraulic modelling assessments are contained within Annexes 1 and 2 of this document.
5. The conclusions of FRA Version 2.0 remain unchanged from the version submitted with the DCO application [APP-283]. Importantly, additional hydraulic modelling undertaken confirms and shows that the proposed scheme does not increase flood risk to properties during construction or operation.
6. Benefits were also demonstrated, in particular how the B3083 is at a greatly reduced risk of flooding when compared to the flood risk associated with the same site today.
7. Section 4 of the updated FRA [REP3-008], Policy Context and Consultation, includes consideration of the Sequential and Exception Tests in the NPSNN. Section 4 of this document has not been changed since the original FRA was submitted to the Examination [APP-283]. In addition, these matters are considered in the Applicant's Case for the Scheme [APP-294], in Appendix A, Table 5, paragraphs 5.98 to 5.115. As nothing has changed in terms of flood risk, this review of flood policy including the Sequential and Exception tests in the NPSNN, and its conclusions relating to the Scheme, remain extant.

Question Fg.2.14

Drainage

The road drainage strategy would involve water from a sump within the tunnel being pumped beyond the eastern portal. The water would then either enter the highway drainage system or, if contaminated, be retained in an impounding sump for disposal by tanker. It appears that the switch between discharge or retention could either be automated or manual. The method is not secured (ie within the OEMP).

i. What are the risks and benefits of each approach?

ii. If a manual approach were chosen, would any time delay from a contamination incident to the manual override being initiated result in polluted water entering the wider road drainage system?

iii. If an automated approach were chosen, what measures would be in place in the event that the automated system failed?

iv. In view of the importance of this part of the drainage strategy, is it necessary to provide certainty on this within the OEMP?

Highways England response

1. As noted at the Issue Specific Hearing 4 (ISH4) item 6.5iii [REP4-032] and detailed in the Road Drainage Strategy [Environmental Statement Appendix 11.3, REP2-009], the drainage in the tunnel relies on the provision of two sumps as follows:
   i. a ‘Low-point sump’ for the collection of gravity drainage within the tunnel; and
   ii. an Impounding Sump at the Eastern portal for the discharge of contaminated drainage from the tunnel, fed by a pumping main from the low-point sump.
2. Outside of the tunnel, the surface-water drainage system will capture and direct all water arriving on the road surface away from the tunnel portals. Inside the tunnel, drainage arriving at the low-point sump would typically consist of water being carried into the tunnel on wet vehicles and a nominal allowance for groundwater infiltration through the joints in the tunnel lining. Therefore, the quantity of drainage being captured and handled is not assessed or anticipated to be significant during normal tunnel operation, with the exception of tunnel washing during planned maintenance or in the event of an incident in the tunnel resulting in a pollution incident. It should be noted that the capacity of the low-point sump and the (low) rate of inflow during all but tunnel washing and pollution incidents would be such that the low-point sump pumps will not operate continuously.
3. Drainage arriving at the low-point sump in the tunnel would initially be contained there and then pumped to the high point of the road alignment

beyond the eastern portal. The drainage water would be categorised as "contaminated" if there were tunnel washing and maintenance activities ongoing, or a pollution incident (spillage) or fire-fighting activities in the tunnel. Otherwise, the drainage water would be categorised as "clean". The diverter valve beyond the eastern portal would direct "clean" drainage water to the surface-water drainage system and "contaminated" drainage water to the impounding sump.

4. As described at ISH4, this diverter valve might be manual or automatic. The following bullet points summarise the risks and benefits of each option:

    - **Valve operation** – the diverter valve either requires an operator to activate it from a remote location by using the tunnel control system or a physical button on a control panel (manual operation) or it can be operated by the tunnel control software automatically upon detection of agreed triggers e.g. hydrocarbon sensors in the low-point sump or activation of the vehicle incident detection system. Therefore, both manual and automatic systems are capable of being operated remotely, but automatic activation requires no human intervention.
    - **Availability on demand** – an operating procedure would be developed to exercise the valve periodically. For an automatic valve, this operating procedure could allow the valve to be cycled through its positions without operator intervention, while a manually controlled valve would require human intervention to cycle it. Therefore, an automatic valve would provide enhanced confidence of correct operation on demand.
    - **Potential for error** – a manually operated valve by definition is reliant on a person to operate it. An automatic valve is reliant only on the availability and reliability of the agreed triggers. Therefore, an automatic valve removes the potential for human error but is reliant on the availability and reliability of the triggering devices (i.e. sensors) for its correct operation.
    - **Failsafe operation** – a manually operated valve would remain in the default position unless manually instructed to operate, or unless power were lost and it moved to a previously agreed "safe" position, which would logically direct water to the impounding sump . An automatically operated valve would be able to fail to the safe position for a wide number of reasons including conflicting trigger signals, loss of power or similar. Therefore, an automatic valve provides a more robust failsafe provision. However, unnecessary operation to the failsafe position would result in a more frequent need to empty the impounding sump by tanker.

5. Highways England's Design Manual for Roads and Bridges (Volume 2, Section 2, Part 9 "Design of Road Tunnels" - BD78/99) requires the low point sump to have sufficient capacity to contain a spillage from a full tanker lorry. In addition, because of the very low quantities of tunnel drainage water arriving at the low point sump during normal tunnel operations (compared to the much larger quantities of water required for tunnel washing or fire-

fighting activities), the sump pumps will normally only be required to operate for brief periods at very infrequent intervals during normal tunnel operations. Therefore, if a spillage were to happen (itself an unusual event), by far the most likely scenario is that the spillage would be fully contained within the low point sump and there would be ample time for either a manual or an automatic diverter valve to be operated. Therefore, any delay in operating a manual diverter valve is mitigated by the system design which will include careful consideration of the capacity of the low-point sump in combination with the speed and operation of the pumps. The Contractor will develop the detailed design of the tunnel drainage system holistically to mitigate against the risk of contaminated water entering the surface water drainage system.

6. If an automated approach were chosen, an operating procedure would be developed to determine what condition or triggers should be used to activate the valve to its diverted position. During detailed design development, a “failsafe” protocol would be developed for this automatic operation. Most likely the valve would be programmed to default to the “divert to impounding sump” position on loss of power or on conflict of input signals. However, the details of this operation would be a matter for agreement at the detailed design stage to enable the opportunity for innovation and direct contractor experience input.
7. As noted at the ISH4, design approval of the tunnel drainage system is already secured by Requirements 4 and 10 of Schedule 2 of the draft development consent order (dDCO) [REP4-018]. Requirement 10 requires consultation with the planning authority and the Environment Agency and approval by the Secretary of State while Requirement 4 demands that the authorised development is carried out in accordance with the Outline Environmental Management Plan (OEMP) [REP4-020]. The OEMP includes at requirement MW-WAT14 that the surface water drainage system conforms with Requirement 10 of the dDCO and at requirement MW-G11 the provision of the Handover Environmental Management Plan (HEMP), which will include the drainage maintenance strategy. Therefore, the Applicant does not consider that it is necessary for the OEMP to address directly whether the valve is required to be automatically or manually operated. This will be decided as part of the holistic and detailed design, operation and maintenance of the integrated tunnel system and will provide appropriate systems and operations in all states.

Question Fg.2.15

Drainage

Given its significance should the impounding sump (and related infrastructure) be identified on the work plans and specified in the Works in Schedule 1 of the dDCO?

Highways England response

1. As noted in our response to question Fg2.14, the impounding sump forms part of the tunnel drainage system, itself a part of the Road Drainage Strategy (Environmental Statement Appendix 11.3, [REP2-009]).
2. The impounding sump is intended to be in the vicinity of the Eastern portal, however its precise capacity and location will be determined by the Contractor during the detailed design development of the project and, therefore, it would not be appropriate for it to be listed in one or another individual Work Package within Schedule 1 of the dDCO, nor to show it in a particular position on the Works Plans [APP-008]. A proportionate degree of flexibility is required to develop an appropriate solution as part of the detailed design of the Scheme.
3. The Applicant considered that the authorisation for the impounding sump would fall within the description of the ancillary works in Schedule 1 to the DCO, under paragraph b)(iv) as “drainage works” and “pumping stations”. As a result of the Applicant’s further consideration revision 4 of the DCO for submission at Deadline 6 includes express reference to impounding sumps.
4. It should also be noted that design approval for drainage system, which includes the impounding sump, is secured at Requirement 10 of the dDCO, which specifically requires approval in writing by the Secretary of State, following consultation with the planning authority on matters related to its land drainage functions and the Environment Agency before construction may commence. The written details of the drainage system must be based on the mitigation measures included in the Environmental Statement which includes the Road Drainage Strategy. There are therefore adequate controls on the final position and operation of the impounding sump and related tunnel drainage system.

Question Fg.2.16

Drainage

i. How would any contaminants entering the road drainage ditches be treated/ attenuated to prevent pollution?

ii. How would this be secured?

Highways England response

i. How would any contaminants entering the road drainage ditches be treated/ attenuated to prevent pollution?

1. The Environmental Statement Appendix 11.3 Road Drainage Strategy (APP-281) defines the proposed drainage strategy, Section 3 West of Tunnel and Section 5 East of Tunnel, for the treatment and attenuation of surface water runoff from the highway, namely:

Section 3 West of Tunnel

2. *Runoff collections and conveyance*

Runoff from the carriageway would be collected in road edge channels or gullies which outfall to carrier pipe systems. The use of carrier pipes would ensure that spillages are contained within the drainage system and do not infiltrate to ground close to source. Subsurface drainage would be provided by narrow filter drains throughout all sections of the scheme where necessary. The runoff would be conveyed via the carrier pipes to infiltration basins for treatment.

3. *Attenuation and pollution control*

Five Drainage Treatment Areas (DTAs) are proposed within the preliminary design for this area, as shown in Figure 2.2, (APP-281). The runoff from catchment 1 would outfall to the infiltration basin (DTA1) located within the landscaped Parsonage Down area. All runoff from catchment 2 would be conveyed to the basin (DTA2) located west of the river and to the north of the proposed highway. The runoff from catchments 4 and 5 would be conveyed to the two basins (DTA4 & DTA5) located east of the River Till. Catchment 6 would drain to the basin (DTA6) located between the new junction and the existing highway.

4. The infiltration basins would be grassed and designed with shallow slopes to integrate sympathetically into the landscape. They would include impermeable areas to capture a portion of the runoff and aid biodiversity enhancement. A proprietary treatment system would be provided in the base area within the basin to absorb contaminates before the runoff is discharged via infiltration to ground. A conceptual design of the infiltration basins is shown in Figure 3.1, (APP-281).

Section 5 East of Tunnel

5. *Runoff collections and conveyance*

   The preliminary design proposals include road edge channels along the new highway, new combined kerb drains along the slip roads and fly-over and retention of the existing drainage system around the circulatory carriageway at Countess Roundabout.

6. The surface water channels would outfall into carriage pipe systems which convey the flows to the outfalls. The combined kerb drains for the flyover would also drain to a carrier system before outfalling.

7. *Attenuation and pollution control*

   The proposals include eight new Drainage Treatment Areas in the form of linear ponds located within the highway boundary adjacent to the slip roads at Countess Roundabout. These ponds would replace the existing unlined ditches to which the runoff from the carriageway currently outfalls. The ponds would be lined, planted with reeds and contain permanent water to provide treatment prior to discharge and enhance biodiversity opportunities. The runoff would be attenuated to achieve a minimum 20% betterment of the existing discharge rates as requested by Wiltshire Council during consultation, with the exception of the discharge into the retained drainage ditch at Blick Mead where the existing rate of runoff will remain unchanged. All ponds would outfall to the existing highway ditches which ultimately discharge the runoff to the River Avon. The ponds would be designed to ensure no ingress from flood water in the 1 in 100 year plus climate change event from the adjacent River Avon catchment. Conceptual sections showing the linear ponds and the modelled flood levels are in Figure 5.1, (APP-281).

ii. How would this be secured?

8. Requirement 10 of Schedule 2 of the DCO (Revision 3 submitted at DL4 [REP4 -019]) (APP-020) sets out that written details of surface water drainage proposals for each part of the Scheme must be approved by the Secretary of State, and that these details must be based on the mitigation measures included in the Environmental Statement (ES), which include the Drainage Strategy.

Question Fg.2.17

Flood risk and drainage

At DL4 the Council suggested additions to MW-WAT14 [REP4-039].

i. Given Requirement 10 would secure the details of the drainage system, why does the Council consider it necessary that this detail is set out in MW-WAT14? In responding, please provide a justification for each separate addition proposed.

ii. Can the Applicant and the Environment Agency provide their views on whether the suggested additions are necessary?

Highways England response

1. The Applicant considers that Requirement 10 adequately secures control of the Scheme's drainage design and the Council's requirements could be considered through the approval and consultation process as required; meaning no OEMP amendment is required.

Question Fg.2.18

Flood risk and drainage

Requirement 10 of the dDCO requires that the drainage system is approved by the Secretary of State following consultation with the Council and the Environment Agency.

Notwithstanding the recent addition of Requirement 11, should this be amended to secure the specific approval/ agreement of either or both the Environment Agency and the Council? Please provide detailed reasoning and, if you consider that this is necessary, why the current drafting of Requirements 10 and 11, along with the OEMP, are not adequate.

Highways England response

1. The Applicant considers that such an amendment is not necessary. As discussed at the DCO hearing, the matters that are subject to a DCO requirement have been carefully considered by it; and it is considered appropriate that the Secretary of State approve the 'agenda setting' matters that have Scheme wide, cross cutting (and indeed cross authority) implications.
2. The principles of the drainage system for the authorised development are set out in the Road Drainage Strategy [REP2-009] appended to the Environmental Statement. Requirement 10 requires the details of the drainage system to be based on the mitigation measures set out in the Environmental Statement, which includes the Road Drainage Strategy
3. As the body with responsibility for the operation of the trunk road network under the Infrastructure Act 2015, the Applicant has particular experience and expertise in this area which may not be available to Wiltshire Council or the Environment Agency in respect of the particular considerations applicable to the trunk road network. The contributions that Wiltshire Council and the Environment Agency can make to developing the detailed design of the drainage system for the authorised development is recognised by the obligation to consult. The Applicant's response to DCO.2.44 sets out in more detail the particular statutory roles and duties that apply to Highways England and DCO.2.47(iv) explains the Applicant's concerns regarding the approval function sitting with Wiltshire Council in this respect.
4. The Applicant notes its position on this requirement is reflected in the precedents; see the A19/A184 Testo's Junction Alteration Development Consent Order 2018, the M20 Junction 10a Development Consent Order 2017, the M4 Motorway (Junctions 3 to 12) (Smart Motorway) Development Consent Order 2016, the A14 Cambridge to Huntingdon Improvement Scheme Development Consent Order 2016. Indeed the only instance of a Highways England DCO where the approval of the drainage system function sat with the local planning authority is the A19/A1058 Coast Road (Junction

Improvement) Development Consent 2016, which as noted in the Secretary of State's decision letter at paragraph 37, was an exceptional case arising from the transition of the functions of the former Highways Agency to Highways England.

5. Furthermore, the Applicant notes that where the Scheme drainage system interacts with a 'drainage work' (as defined) that is the responsibility of Wiltshire Council as LLFA and the EA, those bodies will have relevant approval rights pursuant to their protective provisions within the dDCO.

Question Fg.2.19

Flood risk and drainage

i. Could the Environment Agency and the Council set out what, if any concerns remain in respect of the updated Road Drainage Strategy [REP2-009 and REP2-010] and are requirements beyond those set out in DMRB necessary?

ii. Could the Applicant set out its position on this matter and confirm whether a revised version is intended to be submitted?

Highways England response

ii. Could the Applicant set out its position on this matter and confirm whether a revised version is intended to be submitted?

1. Discussions with Wiltshire Council and the Environment Agency have continued. A meeting attended by both Interested Parties and Highways England was held on the 20th June 2019, to clarify the rational and background information to the points raised at the Issue Specific Hearing 4, held on the 11th June 2019 concerning the highway drainage design and climate allowance.
2. A Technical Note providing additional background information detailing the design rationale being applied within the illustrative design was requested by Wiltshire Council. The Technical Note was produced by HE and forwarded to WC and EA on the 4th July 2019; currently HE are awaiting a response from WC and EA. On the basis of the discussions to date HE does not anticipate any need for any additional update to the Environmental Statement Appendix 11.3, Road Drainage Strategy during examination as the control and approval mechanisms offered and secured in the dDCO provide for all necessary and agreed actions.

Question Fg.2.20

Flood risk and drainage

Please provide an update on the discussions in respect of the maintenance responsibilities for the drainage infrastructure?

Highways England response

1. Future maintenance procedures for the drainage systems are set out within the Outline Environmental Management Plan (OEMP) (Updated at DL4 [REP4 -020] (See table 3.2b Ref. MW-G11). This provides that a Handover Environmental Management Plan must be drawn up at the end of the construction phase, specifying maintenance obligations. The provisions of the OEMP are secured within Requirement 4 which requires works to be undertaken in accordance with the OEMP.
2. The maintenance proposals in the Drainage Strategy are secured at Requirement 10 of Schedule 2 of the draft DCO [REP4-018], which provides that written details of surface water drainage proposals for each part of the Scheme must be approved by the Secretary of State prior to commencement of development for that part. These details must be based on the mitigation measures included in the Environmental Statement (ES), which includes the Drainage Strategy, which is Appendix 11.3 (Updated at DL4, [REP-009]) to the ES.
3. As stated in the deadline 4 (DL4) version of the draft Statement of Common Ground (SoCG) between Highways England and Wiltshire Council [REP4-023], section 3.5.17, Highways England acknowledges Wiltshire Council's concerns. The parties agree that matters relating to the highways that Wiltshire Council would become liable to maintain, as a result of the Scheme, are capable of being resolved through the terms of a legal agreement between the parties.
4. The parties intend to conclude such an agreement before the close of the Examination. It is proposed to be addressed by the legal agreement between the parties, but remains under discussion until the precise terms of the agreement have been settled.

Question Fg.2.21

Drainage, groundwater and contamination

Reliance would be placed on natural attenuation of any contaminants that pass through the filtration material in the drainage treatment areas. Groundwater levels are relatively high in the area.

i. What degree of confidence is there that this method is sufficient and how conservative is the design?

ii. What water quality standards would be applied and how would meeting these be monitored?

Highways England response

i. What degree of confidence is there that this method is sufficient and how conservative is the design?

1. The Applicant is confident that the drainage system and natural attenuation are sufficient to protect groundwater. Deadline 2 Road Drainage Strategy [REP2-009] provides details of the proposed methods to attenuate contamination. For ease of reference, key features are summarised below:
2. The existing A303 is predominantly drained by gullies which discharge directly to either filter drains or road side ditches which infiltrate the runoff to ground (paragraph 1.2.1).
3. Runoff from the carriageway would be collected in road edge channels or gullies which outfall to carrier pipe systems. The use of carrier pipes would ensure that spillages are contained within the drainage system and do not infiltrate to ground close to source. Subsurface drainage would be provided by narrow filter drains throughout all sections of the scheme where necessary (paragraph 3.2.1).
4. The infiltration basins would be grassed and designed with shallow slopes to integrate sympathetically into the landscape. They would include impermeable areas to capture a portion of the runoff and aid biodiversity enhancement. A proprietary treatment system would be provided in the base area within the basin to absorb contaminates before the runoff is discharged via infiltration to ground. A conceptual design of the infiltration basins is shown in Figure 3.1 (paragraph 3.2.3).
5. The new sections of the A360, B3083 and Rollestone Cross would utilise a filter drain system with on-line soakaways to intercept and infiltrate runoff from the carriageway at or close to source. This replicates the existing drainage regime for these routes, with enhancements in terms of water quality through the specification of engineered infiltration systems (paragraph 3.2.14).
6. The design is conservative by being based on a conservative estimate of capacity as detailed below. Furthermore, the outline design assumed a water

table at extreme peak levels (based on the levels recorded in the 2014 flood event) and is therefore based on a minimum unsaturated zone thickness. This is conservative given that typical winter high water levels are up to 3 metres lower than the peak levels so there will be additional attenuation in the unsaturated zone.

7. **Conservative Estimate of Capacity.**

   A number of soakaway tests have been undertaken and their results recorded in the Preliminary Ground Investigation Report (6.3 Environmental Statement Appendix 10.1 [APP-273]. These were used to determine the infiltration rate of the ground at the outfall locations. When calculating attenuation storage, to be conservative, the lowest recorded infiltration rate corresponding to the soakaway test closest to the area has been used with an additional factor of safety of 20 applied within the calculations.

8. In addition, the design includes the following features:

   - The basins include a 300mm freeboard (1 in 100 year + 30%)
   - In the event of a rainfall event exceeding the design storm (1 in 100 year +30%) exceedance routes have been identified to ensure excess water does not flow towards vulnerable properties.

9. The illustrative design capacity was subjected to sensitivity tests in relation to global warming, and design storm return period. These tests concluded that the current design is conservative for the following reasons:

   - When the upper global warming allowance of 40 % was applied, the infiltration basins were found to contain the design storm without overtopping. A freeboard of some 250mm was maintained in each basin.
   - For the highway drainage to overtop the drainage treatment areas the design year return period storm would have to be greater than a 1 in 1000 year return period storm.

10. It is Highways England's submission that the precautionary approach is shown to demonstrate a high degree of confidence, that the method and approach is more than sufficient and provides for conservative standards and performance in the required design.

ii. What water quality standards would be applied and how would meeting these be monitored?

11. In its response to item 9.6.1 and 9.6.4 in the Comments received to Deadline 3 [REP4-036]. HE confirmed that its groundwater samples have been compared to the UK Drinking Water Standards (see paragraph 3.10.2 of APP-282 and Table 3.6). HE is not assessing whether the water is fit to drink for water users or proposing to take on the role of the Local Authority or the Drinking Water Inspectorate (DWI) with regard to Private Water Supplies but will continue to compare groundwater quality samples with drinking water

standards as part of the Groundwater Management Plan proposed at item MW-WAT10 of the OEMP [REP4-020]. This is sufficient for the protection of the groundwater resources upon which the private water supplies rely.

12. Highways England has applied a comparison to drinking water quality standards as a highly conservative benchmark approach and this approach to continued sampling and monitoring is secured and delivered through the Groundwater Management Plan within the OEMP.

Question Fg.2.22

Groundwater monitoring

Groundwater monitoring (for water levels and quality) is intended to take place during construction and for 5 years post construction.

i. For the construction phase this is dealt with in MW-WAT10 of the OEMP. Is it intended that the post construction monitoring is secured via the HEMP? Is this sufficiently clear to ensure that adequate post construction monitoring is secured, or should the 5-year period be explicitly stated?

ii. In addition to the Environment Agency, should Wiltshire Council also be consulted on the Groundwater Management Plan?

It appears that the principle of on-going monitoring has been agreed between the Applicant, the Environment Agency and Wiltshire Council, but that specific proposals have not yet been agreed.

iii. To what extent would it be necessary to agree specific details at the pre-consent stage? If this is required, how would this be secured? Are the existing measures in the dDCO, the OEMP and the requirement for the production of a HEMP sufficient to ensure that the detailed proposals would be secured/ agreed appropriately?

iv. What processes would be put in place in respect of landowner consent for the on-going monitoring?

Highways England response

i. For the construction phase this is dealt with in MW-WAT10 of the OEMP. Is it intended that the post construction monitoring is secured via the HEMP? Is this sufficiently clear to ensure that adequate post construction monitoring is secured, or should the 5-year period be explicitly stated?

1. Paragraph 7.2.7 in Appendix 11.4 Groundwater Risk Assessment of the ES [APP-282] states that groundwater monitoring (both level and quality information) will be undertaken during a baseline period, construction, and a minimum 5-year period post construction as requested by Wiltshire Council. However, the detail of monitoring will be discussed with Wiltshire Council and the Environment Agency when developing the Groundwater Management Plan (MW-WAT10 in the OEMP)[REP4-020]. The reference to 5 years in the ES was a record of Wiltshire Council's request at that time and may change as the detail of the monitoring is developed during the consultation that is required by MW-WAT10 (which refers to the monitoring and reporting programme forming part of the plan). The period of monitoring will therefore be able to be determined as part of that consultation process with the EA and Wiltshire Council. Once approved, that commitment will then need to be carried out as agreed.

ii. In addition to the Environment Agency, should Wiltshire Council also be consulted on the Groundwater Management Plan?

2. The updated version of the OEMP to be submitted at Deadline 6 has been updated to provide for consultation with Wiltshire Council as appropriate to their statutory functions. . Other groundwater aspects are the responsibility of the Environment Agency. As noted above, specific monitoring proposals would be developed as part of the Groundwater Management Plan.

iii. To what extent would it be necessary to agree specific details at the pre-consent stage? If this is required, how would this be secured? Are the existing measures in the dDCO, the OEMP and the requirement for the production of a HEMP sufficient to ensure that the detailed proposals would be secured/ agreed appropriately?

3. Specific details are not usually developed at the pre-consent stage. The requirement to develop a Groundwater Management Plan would be sufficient, through the approvals and consultation process, to ensure that detailed monitoring proposals would be secured/ agreed appropriately. The Applicant also notes that item MW-G11 provides that the HEMP will be based on the CEMP at the time, which will include those plans appended to it such as the GMP. Item MW-G11 also sets out that the HEMP will provide the relevant information on existing and future environmental commitments and objectives that would need to be honoured and define on-going actions and risks that need to be managed, e.g. on-going monitoring, Sufficient controls are therefore in place.

iv. What processes would be put in place in respect of landowner consent for the on-going monitoring?

4. Highways England will continue to engage with land owners for their agreement to continue to monitor and to undertake the monitoring requested by them. Article 15 of the dDCO [REP4-018] would permit the Applicant to enter on land to undertake water monitoring in the event of consent to monitor boreholes and other water features not being forthcoming.

Question Fg.2.24

Groundwater monitoring and contamination

A number of private water supplies are used for drinking water.

i. In view of this is it necessary that monitoring is put in place to ensure compliance with drinking water standards (for example by expanding MW-WAT15 in the OEMP)?

ii. If it is the Applicant's view that this is not necessary, please clearly set out the reasons and any risk assessment which has been carried out.

iii. If this is considered to be necessary how should this be secured, for example is the wording suggested by the Council at DL4 to insert into the OEMP appropriate?

iv. If monitoring is necessary, what frequency would be required to mitigate any risks appropriately?

v. In the event that any samples failed to meet drinking water standards what reporting measures would be put in place and how would any remediating action be secured?

Highways England response

i. In view of this is it necessary that monitoring is put in place to ensure compliance with drinking water standards (for example by expanding MW-WAT15 in the OEMP)?

1. Highways England confirms that monitoring is in place and that analytical results are compared to the UK Drinking Water Standards (see paragraph 3.10.2 and Table 3.6 of [APP-282]). Nitrate and turbidity concentrations have exceeded the Drinking Water Standards in some groundwater samples collected and analysed in 2018 (paragraph 11.6.59 of 6.1 Environmental statement Chapter 11 - Road Drainage and the Water Environment [APP-049]). A blanket requirement for compliance with drinking water standards over the whole area would not be a reasonable imposition to put upon the Applicant.
2. The Scheme is underlain by a principal aquifer (the Chalk) and the protection of this aquifer is acknowledged throughout the environmental impact assessment (Environmental Statement Chapter 11 - Road Drainage and the Water Environment [APP- 049]). For example at paragraph 11.2.5 reference is made to policies which require consideration of the impacts of pollution from development on the water environment by assessing water bodies, protected areas under the Water Framework Directive (WFD), safeguard zones, water protection zones, source protection zones around potable groundwater abstractions and ecological sites. These policies also encourage mitigation of pollution on the water environment through careful design to facilitate good pollution control practice.

3. Highways England confirms that its groundwater samples have been analysed for a range of determinands that are sufficient to define the baseline and to be able to assess the effects of the Scheme.
4. With respect to private water supplies Highways England does not consider it to be part of its duties to monitor private users' boreholes and wells with the purpose of compliance with regulations and to establish whether water is fit to drink. This role is carried out by the Local Authority or the Drinking Water Inspectorate (DWI), which acts as the regulator for private water supplies, to fulfil their statutory duties under the Private Water Supplies Regulations. These Regulations place a duty on local authorities to conduct a risk assessment of each private water supply within their area and to undertake monitoring in order to determine compliance with drinking water standards. Clarification on this point was made at paragraph 7.1.3 of Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003] which states that samples are compared to UK Drinking Water Standards but the Applicant is not proposing to take on the statutory duties of others.
5. Measures are in place in the OEMP (Deadline 4 Submission - Appendix 2.2 Outline Environmental Management Plan [REP4-020]) for monitoring groundwater. It is not necessary to expand MW-WAT15. Specific details are not usually developed at the pre-consent stage. The requirement to develop a Groundwater Management Plan (MW-WAT10) would be sufficient, through the approvals and consultation process, to ensure that detailed monitoring proposals would be secured/ agreed appropriately.

ii. If it is the Applicant's view that this is not necessary, please clearly set out the reasons and any risk assessment which has been carried out.

6. Highways England is undertaking monitoring and the results are compared to UK Drinking Water Standards. Highways England does not consider it to be necessary to 'ensure compliance' at private water supply wells and boreholes. This is the role of the Local Authority or the Drinking Water Inspectorate (DWI) with regard to Private Water Supplies for the reasons set out at (i) above. However, MW-WAT11 of the draft OEMP does provide measures for management of impact on abstraction boreholes.
7. As set out in response to item 9.6.1 in the Comments received to Deadline 3 [REP4-036] a Groundwater Risk Assessment has been carried out [APP-282] which predicts no impacts on drinking water supplies. The Scheme therefore is not anticipated to increase the risk of pathogenic contamination as there are no significant changes in sources of pollution or pathway.

iii. If this is considered to be necessary how should this be secured, for example is the wording suggested by the Council at DL4 to insert into the OEMP appropriate?

8. Highways England notes Wiltshire Council's comments with regard to the OEMP amendments requested at Deadline 4, however as explained in Highways England's response to comments received at Deadline 4 on the OEMP also submitted at Deadline 6, it is Highways England's view that sufficient measures to manage impact on abstraction boreholes and private water supplies are already contained within items MW-WAT11 and MW-COM6 of the OEMP.
9. Highways England confirms groundwater quality samples will continue to be compared with drinking water standards as part of the Groundwater Management Plan proposed at item MW-WAT10 of the OEMP [REP4-020] – this will be able to be confirmed as part of the consultation on the monitoring proposals that are required to be set out in the Groundwater Management Plan.

iv. If monitoring is necessary, what frequency would be required to mitigate any risks appropriately?

10. The groundwater level and water quality monitoring and reporting programme will be developed by the Main works contractor in consultation with the Environment Agency and Wiltshire Council (as appropriate) (Item (c) of MW-WAT10 of the OEMP [REP4-020]).

v. In the event that any samples failed to meet drinking water standards what reporting measures would be put in place and how would any remediating action be secured?

11. Development of baseline groundwater conditions and derivation of trigger levels and action levels/mitigation/action plans for exceedances and accidents/incidents will be developed by the Main works contractor in consultation with the Environment Agency and Wiltshire Council (as appropriate) in developing the Groundwater Management Plan (Item (d) of MW-WAT10 of the OEMP [REP4-020]).

Question Fg.2.25

Groundwater

Please provide a response to the matter raised by the National Farmers' Union (paragraph 2.2) [REP4-052] and Howard Smith on behalf of West Amesbury Farm [REP4-059] in respect of pump tests.

In particular is further testing proposed and to what extent is this necessary to inform the baseline evidence?

Highways England response

1. The National Farmers' Union (NFU) deadline 4 submission summarising their representations at the Issue Specific Hearing (Number 4) on Flood Risk, on the 11 June 2019, at (paragraph 2.2) [REP4-052] states the following:-
2. "Highways England when questioned on pumping tests stated that they had carried out three pumping test. This is not strictly true as HE have carried out pumping test on land at West Amesbury Farm at Stonehenge Bottom. Two pumping test from two different boreholes have been carried out which are in very close proximity to each other at Stonehenge Bottom and a further pump test was carried out at King Barrow field. The pumping tests were carried out on June/July2018. The NFU believe that further pumping tests are required but Highways England is failing to engage with the landowner and reach an agreement to pump the water over the land."
3. Highways England responded to this point in its deadline 5 responses to deadline 4 information [REP5-003], paragraph 21.1.15. The response confirmed that three pumping tests were carried out in 2018; that there will be ongoing ground investigations and testing for design purposes; and that engagement with the land owner will take place. For clarity, that response is copied below:-
4. [AS-016] describes the pumping tests undertaken in 2018, which supplement those undertaken in November 2002 and September 2004. In 2018 a pumping test comprising step test, constant rate test, and recovery was conducted in borehole W623 from 7/6 to 22/6, in borehole W601 between 3/7 and 23/7, in borehole W617 between 26/7 and 6/8. Each test measured groundwater level responses at five to seven additional observation wells in an area 100s of metres around the pumped well. The observation wells are in the vicinity of the pumping test well while the pumped well locations are a minimum of 400m apart. The locations were on Coneybury Hill, Stonehenge Down, and Stonehenge Bottom respectively representing the hydrogeological domains across the chalk block where the tunnel would pass.
5. During the ongoing ground investigations to be undertaken by Highways England and the Main Contractor, additional testing at different times of the

year will take place at different locations to provide additional data for the final design. There is sufficient pumping test data for the purposes of the environmental statement and examination and determination of the application.

6. Land access arrangements will be made or powers provided for access in the dDCO for future ground investigations and pumping tests which would be carried out for detailed design purposes.
7. Referring to Howard Smith on behalf of West Amesbury Farm [REP4-059] the comments in relation to pumping tests are as follows:
8. “There appears to be a complete difference in interpretation as to the number of pumping tests carried out at West Amesbury Farm in 2018. At all times whilst in discussions with Highways England and their contractors were told that teats needed to be carried out both hopefully at peak and low flow times of year so updated data is available to influence how the tunnel is constructed. The previous data from Stonehenge Bottom was taken in 2003/ 2004 and we were told if additional tests could not be undertaken there was sufficient data taken then to use in the construction.
9. Highways England were only able to complete one test covering three boreholes in 2018. Two boreholes being located in Stonehenge Bottom and one in King Barrow field, to blatantly state that 3 tests have been carried out is incorrect as the pumping from each of the boreholes continued when the operation was completed at the first borehole.
10. There would therefore appear to be insufficient data to proceed with the construction and if Highways need to undertake more pumping tests they need to advise when this is programmed for so negotiations can start about the entrance requirements.”
11. The Applicant responded to West Amesbury Farm’s concerns about pumping in its deadline 5 responses to deadline 4 information [REP5-003], in sections 13.1.5 and 13.1.6. The response largely replicated the Applicant’s response to the NFU, provided in (i) above and confirmed that three pumping tests were carried out in 2018; that there will be ongoing ground investigations and testing for design purposes; and that engagement with the land owner will take place. The response is copied below:
12. 13.1.5: AS-016 describes the pumping tests undertaken in 2018, which supplement those done in November 2002 and September 2004. They are not described as being on a particular farm. In 2018, a pumping test comprising step test, constant rate test, and recovery was conducted in borehole W623 from 7/6 to 22/6, in borehole W601 between 3/7 and 23/7, in borehole W617 between 26/7 and 6/8. Each test measured groundwater level responses at five to seven additional observation wells in an area 100s of metres around the pumped well (for locations see Drawing 2 in Deadline 3 Submission - 8.22 – Stonehenge Area Pumping Test 2018 Interpretative Report [REP3-017]). The locations were on Coneybury Hill, Stonehenge

Down, and Stonehenge Bottom respectively representing the hydrogeological domains across the chalk block where the tunnel would pass.

13. During the ongoing ground investigations to be undertaken by Highways England and the Main Contractor, additional testing at different times of the year will take place at different locations to provide supporting data for the final design. There is sufficient pumping test data for the purposes of the environmental statement and consideration and determination of the application.
14. 13.1.6: We consider that APP-282, REP3-017, REP3-018, REP3-020 and REP3-021 demonstrate that a considerable amount of data and interpretation has been undertaken. There is sufficient pumping test data for the purposes of the environmental statement and consideration and determination of the application. Land access arrangements will be made for future ground investigations and pumping tests which would be carried out for detailed design purposes by agreement or through the powers proposed within the dDCO.
15. In conclusion and in response to whether further testing is proposed and to what extent this is necessary to inform the baseline evidence, the Applicant stated that: Additional testing at different times of the year will take place at different locations to provide supporting data for the final design. There is sufficient pumping test data for the purposes of the Environmental Statement and consideration and determination of the application.

Question Fg.2.26

Groundwater, Geology and detailed design

In its DL4 submission the Environment Agency has requested that it be consulted on any updated design to the proposed tunnel to consider any impact on groundwater flows [REP4-049]. Requirement 3 in the dDCO requires consultation with the planning authority on matters relating to its functions.

i. Should there be a Requirement to consult the Environment Agency where any changes are proposed to the tunnel? Please provide reasons.

ii. If consultation is required, how should this be secured (for example by amending Requirement 3)?

Highways England response

1. The Applicant considers that this matter is adequately addressed in the OEMP, compliance with which is secured through Requirement 4.
2. Measure MW-WAT10 requires the contractor to produce a Groundwater Management Plan which is required to address, amongst other matters:

   "b) An update to the Groundwater Risk Assessment for the final design and construction Plan.

   c) The groundwater level and water quality monitoring and reporting programme.

   d) Development of baseline groundwater conditions and derivation trigger levels and action levels/mitigation/action plans for exceedances and accidents/incidents."
3. The OEMP requires the main works contractor to consult the Environment Agency during the development of the Groundwater Management Plan.
4. The Applicant has made further amendments to this measure in its update for submission at Deadline 6 to clarify that the plan must address the management of groundwater flood risk and to consult Wiltshire Council in so far as relevant to its functions as lead local flood authority.

Question Fg.2.27

Contamination

At DL4 the Environment Agency has suggested that Article 13 in the dDCO be amended to include reference to ground water and dissolved pollutants [REP4-049].

Please set out your position on this matter with reasons?

Highways England response

1. Please see Highways England's response to SWQ DCO.2.19, which explains why the Environment Agency's proposed amendments to article 13 of the dDCO are not appropriate, given (a) the purpose of article 13; and (b) that the amendments would duplicate regulation under the Environmental Permitting (England and Wales) Regulations 2016.

Question Fg.2.28

Contamination

Requirement 7 deals with contamination found during construction.

i. Is it necessary to also secure pre-commencement investigation and risk assessment of potentially contaminated land to minimise the risk of contamination being discovered during construction? Please provide reasons for your answer.

ii. If this is necessary how should this be secured (ie an additional Requirement)?

iii. It appears that some investigation is ongoing, can the Applicant provide an update on this and whether it is likely to be completed and be able to be reviewed adequately during the examination?

Highways England response

i. Is it necessary to also secure pre-commencement investigation and risk assessment of potentially contaminated land to minimise the risk of contamination being discovered during construction? Please provide reasons for your answer.

1. As the Applicant has maintained in submissions (see DCO.1.99 [REP2-030], responses to the Environment Agency's Written representation [REP3-13] , the Applicant's comments on the Environment Agency's response to the Examining Authority's question DCO.1.100 [REP3-016], response to B1.17 of Wiltshire Council's Local Impact Report [REP3-014] and summary of oral submissions at DCO issue specific hearing agenda item 4.6 [REP4-029]) it considers that it has made appropriate provision to address contaminated land.
2. The Applicant considers that a pre-commencement requirement to carry out further investigations and risk assessment of potentially contaminated land is unnecessary. The Applicant has assessed the risks associated with contaminated land in Chapter 10 (Geology and Soils) of the Environmental Statement [APP-048]. No significant permanent or temporary effects are identified (see paragraph 10.9.15) and a low potential for contamination has been concluded. In the unlikely event that contaminated land is discovered, Requirement 7 of the draft DCO submitted at Deadline 6 makes appropriate provision for a risk-based approach (consistent with the underlying principles of the statutory contaminated land regime) that includes reporting as soon as reasonably practicable to the Environment Agency (EA) and Wiltshire Council (WC); preparation of a risk assessment of the contamination in consultation with them; if remediation is necessary the preparation of a written scheme and programme of remediation in consultation with the EA and WC for approval of the Secretary of State; and thereafter that those remediation measures are carried out in accordance with that approved scheme and programme (which

in itself means that those measures cannot be taken until it is approved). Please see DCO.2.56 for further consideration of the appropriateness of the provisions of Requirement 7.

3. Measures to manage residual risks arising from previously unidentified contaminated land included in the OEMP [REP-039] are PW-GEO2 and MW-GEO2 which provide measures to first assess and, if required, manage/treat unexpected contamination in compliance with CLR11. Measure MW-GEO8 also requires the contractor to develop and implement appropriate measures in respect of land that becomes identified as being contaminated.
4. As far as the prohibition or cessation of work is concerned please see the Applicant's submissions at agenda item 4.6(ii) of [REP4-029]. It is not necessary or proportionate in the circumstances of the Scheme to either prohibit commencement or require cessation of work until further investigation is carried out. The investigation so far is typical of a phased contaminated land assessment and shows the Scheme area to be of low risk. There are comprehensive risk based controls contained in Requirement 7 and the provisions of the OEMP as set out above. To the extent that the actions or omissions of the Applicant between the discovery of contamination and the carrying out of any remediation works are a concern, those are more than adequately controlled in the background statutory regime, and the obligations of the Applicant and the powers of WC and the EA contained within it. The Applicant is a Government owned company, regulated under a licence that prescribes environmental obligations (for further detail of which please see DCO.2.44). In any event, the Applicant intends to carry out surveys prior to the commencement of the main works, as considered further below.
5. On that basis, a pre commencement requirement would be disproportionate – it prescribes a single, overly onerous mechanism which is simply not justified by the low risk already established. In doing so, it could unnecessarily delay the implementation of this nationally significant infrastructure project and the wide public benefits that it will deliver.

ii. If this is necessary how should this be secured (ie an additional Requirement)?

6. The Applicant considers that for the reasons stated above, a pre-commencement requirement would be unnecessary.

iii. It appears that some investigation is ongoing, can the Applicant provide an update on this and whether it is likely to be completed and be able to be reviewed adequately during the examination?

7. An explanation on the Phase 7 ground investigation rationale, schedule and progress to date has been provided in the Applicant's response to comments from the EA on Written question responses received to Deadline 3 [REP4-036], reference item 12.1.7. The Phase 7 ground investigation is a 2-year ground investigation programme split into two phases (Phase 7A and Phase

7B). Phase 7A is further split into phases and Phase 7Ai is currently being undertaken and it includes for ground investigation works at the former RAF Stonehenge and RAF Oatlands Hill sites. There have been no changes to the ground investigation schedule and an approved Factual Report is expected at the end of September 2019 for Phase 7Ai. Whilst the Factual Report will not be submitted during the Examination period, the data will inform subsequent remediation options and strategies (if required) and will be developed in liaison with the EA prior to construction. This work should provide further comfort that the risk of unforeseen contamination being discovered during actual construction works will be low. If these investigations do discover contamination that was not foreseen in the Environmental Statement, the provisions of Requirement 7 and the OEMP will require that it is risk assessed and where required, remediated, in full consultation with the EA and WC, and with the approval of the Secretary of State.

8. To conclude, the Applicant's environmental assessment concludes that the risks associated with contaminated land are not significant and the provisions of Requirement 7, the OEMP, background environmental legislation and Highways England's licence ensure that appropriate measures will be taken in the event that any risk materialises, and so a pre-commencement requirement to carry out such investigation and assessment is not justified on the basis of the evidence available. Nonetheless, the Applicant is carrying out additional investigations as part of the process for developing the detailed design. If these investigations uncover previously unidentified contaminated land the process for addressing it would be as set out in requirement 7 supplemented by OEMP measures cited above.

Question Fg.2.29

Contamination

i. Should Requirement 7 be updated to clarify that, if contaminated land and/ or groundwater is found works in that area should cease until the risk assessment is completed and (if necessary) the remediation is approved?

ii. If not, why?

Highways England response

1. Please see responses in the written summaries of oral submissions put at the Development Consent Order hearing [REP4-029] on 4th June in section 4.6 and the Flood risk, Groundwater, Geology and Waste hearing [REP4-032] on 11th June in section 7.5, in particular the post meeting note referring to the measures in MW-GEO2 of the OEMP issued at Deadline 4 [REP4-029] to address unexpected contamination.
2. Highways England considers that no change to the Requirement is required because:
   a. the remediation itself must be carried out in accordance with the approved scheme under Requirement 7(2), meaning that it can only proceed once the scheme is approved; and
   b. any work not consisting of remediation work and any measures required to be taken pending the approval of the remediation scheme would be adequately controlled by the background statutory obligations applying to the Applicant and the statutory powers held by Wiltshire Council and the EA.

Question Fg.2.30

Contamination

i. Should MW-WAT2 and MW-WAT7 in the OEMP also require consultation with Wiltshire Council in respect of the Water Management Plan?

ii. If not, why?

Highways England response

1. Although this would have already occurred as a result of the inclusion of the Water Management Plan within item MW-G7 and the consultation requirements set out there, for clarity the OEMP has been updated at Deadline 6 to explicitly provide for Wiltshire Council consultation within items MW-WAT-2 and MW-WAT7.

Question Fg.2.31

Contamination

Should MW-GEO1 in the OEMP be amended to also consider human health and environmental impacts of the scheme and contamination [REP4-020]?

Highways England response

1. Changes have been made to item MW-GEO1 of the OEMP in this regard at Deadline 6

Question Fg.2.32

Contamination and groundwater flow

In respect of the tunnel boring methodology and the potential for there to be a risk of pollution or impediment to groundwater flow the Environment Agency notes that OEMP: PW-G1, MW-G5, MW-G7, MW-WAT8, MW-WAT9, MW-WAT 10, MW WAT11, and MW-WAT14 provide some control of these activities (emphasis added) [REP4-020].

Are the controls adequate and, if not, what additional controls are required to mitigate any risks appropriately?

Highways England response

1. The Applicant considers that controls are adequate. The response at Item 18.2.47 of the Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003] states the following:
2. See response to agenda item 5.1 in the oral submission report from ISH4 [REP4-032].
3. Highways England, as the Scheme promoter, is responsible for ensuring that groundwater resources, including the supply and quality of groundwater, are protected during the construction and operation of the Scheme. Potential impacts on water supplies will be mitigated through the implementation of measures included within the Outline Environmental Management Plan (OEMP) [REP4-020] (at references PW-WAT1 and WAT2, and MW-WAT1, WAT2, WAT3, WAT4, WAT5, WAT6, WAT7, WAT9, WAT10, WAT14, and WAT15), which is secured through paragraph 4 of Schedule 2 to the draft Development Consent Order [REP4-018].
4. This therefore provides more than an adequate control framework and delivery mechanism to manage and deliver necessary and appropriate pollution control and limitation and removal of risk for impediment to groundwater flow arising from the tunnel boring activities.

Question Fg.2.33

Dewatering

The OEMP now commits to the use of closed face tunnelling techniques. This should prevent the risk of large-scale dewatering being required [REP4-020].

i. To what extent was small-scale dewatering assessed in the Environmental Statement and does it reflect the worst-case scenario in terms of dewatering?

ii. Should a limit on the level of smaller-scale dewatering be secured as part of the DCO to ensure that dewatering, beyond that assessed, does not take place?

iii. Is the approval/ permitting procedure sufficient to ensure any required dewatering is adequately controlled?

Highways England response

i. To what extent was small-scale dewatering assessed in the Environmental Statement and does it reflect the worst-case scenario in terms of dewatering?

1. Small scale dewatering is not required for the current design and construction methods and therefore there were no potential impacts to be assessed in the Environmental Statement.
2. A response related to dewatering was provided as a post hearing note to Issue Specific Hearing 4, Deadline 4 Submission - 8.30.2 Written Summaries of oral submissions at Issue Specific Hearings - Cultural Heritage [REP4-030] Item 8.1 i) which records that: In respect of the potential for a requirement for dewatering during construction based on the current design and construction methods, no abstraction of groundwater is anticipated. It is possible that temporary and localised groundwater control could be required for the construction of the tunnel portal slab to launch the tunnel boring machine and for some cross passages for mechanical and electrical services at Stonehenge Bottom. Information can also be found in the Applicant's responses to the Examining Authority's first written questions [REP2-031], references Fg.1.11 and Fg.1.41. The Applicant has committed, through the Outline Environmental Management Plan (OEMP) [APP-187], reference MW-WAT8, to adopt construction techniques which minimise, so far as reasonably practicable, the need for and extent of dewatering and groundwater abstraction. Compliance with the OEMP is secured by requirement 4 of the draft DCO.
3. For ease of reference, MW-WAT8 states that the main works contractor shall be responsible for obtaining the necessary approvals and permits to enable and abstraction and discharge of pumped water in an approved manner.

(Deadline 4 Submission - Appendix 2.2 Outline Environmental Management Plan [REP4-020]).

ii. Should a limit on the level of smaller-scale dewatering be secured as part of the DCO to ensure that dewatering, beyond that assessed, does not take place?

4. A limit on the level of small scale dewatering is not necessary as part of the DCO. This is secured through the approvals process and permits referred to in MW-WAT8.

iii. Is the approval/ permitting procedure sufficient to ensure any required dewatering is adequately controlled?

5. The Applicant considers that the approval/permitting procedures set out in the OEMP and secured by requirement 4 of the draft DCO are sufficient to ensure any required dewatering is adequately controlled.

Question Fg.2.35

Disapplication of legislation and protective provisions

i. Please provide an update on discussions in respect of the disapplication of the Land Drainage Act and the related Protective Provisions.

ii. Please outline any areas of disagreement clarifying why any residual concerns remain.

Highways England response

1. Please see the response to question CA.2.23 which brings together one answer on all matters related to disapplications and protective provisions for relevant statutory bodies and statutory undertakers.

Question Fg.2.36

Disapplication of legislation and protective provisions

i. Please provide an update on discussions in respect of the disapplication of legislation and the related Protective Provisions?

ii. Please clarify whether the current proposed wording now satisfies all the relevant comments raised in [RR-2060]?

Highways England response

1. Please see the response to question CA.2.23 which brings together one answer on all matters related to disapplications and protective provisions for relevant statutory bodies and statutory undertakers.

Question Fg.2.37

Soils management strategy

In MW-G7 the OEMP states that the main works contractor will consult with Wiltshire Council, the Environment Agency (and others) on those aspects of the various specified plans relevant to their functions [REP4-020].

In respect of the Soils Management Strategy it appears to be unclear who would be consulted.

Please provide clarity on this, for example would this include Wiltshire Council. Should this be more clearly stated in the OEMP?

Highways England response

1. The OEMP has been amended at Deadline 6 (item MW-GEO3) to make clear that Wiltshire Council and the members of HMAG will be consulted on the Soils Management Strategy.

Question Fg.2.38

Geology and soils

Please provide a response to the comments raised by Dr Reeves on behalf of the Stonehenge Alliance in [REP4-087] and, as necessary, please cross refer to [REP2-131] to ensure all areas of concern have been responded to.

Highways England response

1. Our responses to the comments raised by Dr Reeves on behalf of Stonehenge Alliance at both Deadline 2 [REP2-131] and Deadline 4 [REP4-087] were provided at Deadline 3 [REP3-013] and Deadline 5 [REP5-003] respectively. The comments raised by Dr Reeves at Deadline 4 form part of a suite of materials referred to in the submission of Dr Kate Fielden [REP4-055] and hence were responded to as such.
2. In reviewing our responses to Dr Reeves in [REP4-087] under item 4 '*Inadequacy of Data Investigation, Interpretation, Presentation and Analysis'* we would cross reference to particular items in the Stonehenge Alliance Written Representation response [REP3-013] 17.3.2, 17.3.29 & 17.3.32 in addition to the specific responses given at Issue Specific Hearing 4 confirmed in the Written Summary [REP4-032] item 5.1. To reiterate the Applicant's position:
    a. The professional credentials and expertise of our team is provided for all parts of the ES which has been undertaken and reported by competent and experienced experts.
    b. A proportionate response has been undertaken in the investigations to characterise the variable nature of the geology and hydrology employing experts in these fields including Professor Rory Mortimore.
    c. It is not normal practice to provide a 3D ground model for preliminary design in support of a DCO submission. This is unprecedented and would require significant additional investigation within the World Heritage Site, which is unnecessary for the assessment, examination and determination of the application.
3. Finally, in replying to this question we acknowledge the oversight in not responding specifically to item 11.3.5 [REP4-036] regarding the issue of 3D modelling. This is addressed in our response to ExA's Second Written Question Fg 2.51 and we trust this now fully clarifies and brings up to date the completeness of our previous responses to Dr Reeves on behalf of Stonehenge Alliance.

Question Fg.2.40

Geology and soils

i. Are you aware of any examples where an integrated 3D model (as suggested by Dr Reeves at ISH4 on behalf of the Stonehenge Alliance) has been considered to be necessary at the pre-consent stage?

ii. If so, please provide details of any examples and set out whether these can be considered reasonably comparable with the Proposed Development?

Highways England response

1. A response to the adequacy of modelling was provided during the Issue Specific Hearing 4, Item 5.1 which records that the Applicant is of the view that the information presented in the ES is more than adequate at this stage of the process to identify and assess impacts. Mr Taylor QC pointed out that 3D modelling has not been used at the consents stage on other tunnelling projects through chalk geology such as Crossrail, the Northern Line Extension or Thames Tideway Tunnel. (Deadline 4 Submission - 8 30.4 - Written summaries of oral submissions put at Flood risk, Groundwater, Geology and Waste hearing on 11th June 2019 [REP4-032]).
2. The use of a 3D model at this stage of the preliminary design has also been addressed in response to question Fg 2.51 which confirms the Applicant's view that the information presented in the Environmental Statement is more than sufficient at this stage of the consents process and that a 3D model is not required. This is further covered in the response to Stonehenge Alliance at Deadline 5 [REP5-003] items 11.1.1 & 11.2.56 which confirms as follows:
    a. The Applicant considers that a proportionate approach has been taken to characterise the variable nature of the geology employing experts in this field, including Professor Rory Mortimore, and does not agree that a 3D model is necessary at this stage.
    b. In developing the preliminary design provided in support of the Development Consent Order (DCO), the Applicant has followed best practice as embodied in the Association of British Insurers / British Tunnelling Society Joint Code of Practice for the Risk Management of Tunnel Works (ACOP) to:
        i. Undertake hazard identification and the management of risk to ensure their reduction to a level 'as low as reasonably practicable' as an integral consideration in the design, procurement and construction of the tunnel works.
        ii. Promote and secure best practice for the minimisation and management of risk as part of the Insurance of the works.

iii. Undertaken suitable and sufficient site investigation phased appropriately to the pertaining physical and geological environments.

3. The preliminary design has been prepared in accordance with the ACOP and taking full cognisance of the Construction (Design & Management) Regulations and BS6164 Code of Practice for Safety in Tunnelling. The Applicant considers that it is neither unusual nor is it unacceptable to require the expert Contractor to plan and take responsibility for the continuation of investigations and the detailed design as part of their further risk management and procurement of the works including the development of a 3D model if this is deemed as necessary.
4. To further support this viewpoint, we would refer to the following major infrastructure projects of Crossrail, Thames Tideway and Silvertown tunnels. These projects are comparable to A303 Stonehenge in that they involve tunnelling through varying geology but are significantly more complicated by merit of their urban environment and the complex interactions with other tunnels, underground foundations and utilities:
5. Crossrail

    i. Crossrail has led the development of 3D Building Information Modelling (BIM) as part of the process of generating and managing information throughout the whole life of the asset lifecycle by using model-based technologies. On a practical basis, and in layman's terms, 3D structural models have been developed to show the complex underground interchanges within the highly congested urban environment that have subsequently been used as part of the complex asset management of the network. These 3D structural models were not produced for the consent stage.

    ii. Of the 42km of new tunnels under central London, including 10 new stations involving significant excavation using open-face tunnelling techniques involving Sprayed Concrete Lining (SCL), only Farringdon station warranted the development of a 3D Geology model in conjunction with the 3D structural model. The 3D Geology model was developed at Farringdon due to the complexity and the unknowns of the geology associated with the Lambeth Group in view of the risks relating to the open-face tunnelling techniques being used to construct this underground station. This model was developed by the British Geological Society (2009-2013) and updated as more site investigation information became available before handover to the contractor prior to the start of tunnelling in May 2013. The 3D Geology model at Farringdon was therefore not produced for the consent stage but in subsequent development by the client and contractor to manage the specific risks at this location.

6. Thames Tideway Tunnel

   A 3D Geology model was not submitted as part of the DCO application nor during Examination. During the Detailed design, local 3D ground models were used in specific locations.

7. Silvertown Tunnel

   A 3D Geology model was not submitted at part of the DCO application nor during Examination but was subsequently developed during Detailed design to provide a better understanding of: the significant variations in ground conditions; contaminated land along the route through heavily industrialised areas; presence of buried obstacles (old foundations) particularly at the south portal at the site of a demolished Gas Works; pylon foundations to the Emirates Air Line cable car; the backfilled entrance to the Royal Victoria docks, and demolished warehouses.

8. In summary, whilst the Applicant recognises the risks associated with the geology and hydrogeology at Stonehenge and the unique nature of the archaeology within the WHS, a 3D ground model is not considered necessary at this stage as it will not change the choice of a closed-face Tunnel Boring Machine as part of the risk management of the project. Furthermore, the high density of additional boreholes required to construct a competent 3D Geology model will not make a significant difference to the alignment which is constrained by the Scheme's location within the historic environment, existing topography and road layout. We therefore maintain our view expressed at ISH4 that a 3D geology model would be an academic 'nice to have' but is not necessary to inform the preliminary design as assessed in the Environmental Statement in support of the DCO and has not been considered necessary at the pre-consents stage of comparable major tunnelling infrastructure projects, including in locations with chalk.

Question Fg.2.41

Blick Mead hydrogeology How would general post construction monitoring of water levels alleviate concerns of the potential impact on the Blick Mead site if there is no express requirement to monitor this site explicitly in relation to the impact on archaeological remains?

Highways England response

1. As set out in paragraphs 11.10.1 of the Environmental Statement [APP-049], as no likely significant adverse effects are identified for the water environment at Blick Mead no monitoring of significant effects is required or proposed. The OEMP sets out monitoring to be undertaken during the construction stage to ensure that the mitigation measures embedded in the scheme design are appropriately implemented. It is not necessary to agree specific details at the pre-consent stage and therefore no locations at Blick Mead or elsewhere have an express requirement to monitor. However, there are commitments to monitoring and to the development of action plans as set out in the OEMP (Deadline 4 Submission - Appendix 2.2 Outline Environmental Management Plan [REP4-020]).
2. MW-WAT10 in the Outline Environmental Management Plan allows for monitoring and also for the development of trigger levels and action plans should these be necessary. MW-WAT10 includes the following::
    a. Potential effects on groundwater (resources and quality) that fall outside other regulations such as the Environmental Permitting Regulations.
    b. An update to the Groundwater Risk Assessment for the final design and construction plan.
    c. The groundwater level and water quality monitoring and reporting programme.
    d. Development of baseline groundwater conditions and derivation of trigger levels and action levels/Mitigation/action plans for exceedances and accidents/incidents.
    e. The management of groundwater flood risk.
3. The Groundwater Risk Assessment referred to at item b) includes Blick Mead as demonstrated in Annex 3 of Appendix 11.4 of the Environmental Statement [APP-282]. This will mean that impacts at Blick Mead would be re-assessed and should alleviate concerns of the potential impact on the Blick Mead site.

Question Fg.2.42

Blick Mead hydrogeology

Notwithstanding the Applicant's position that future monitoring of groundwater at the Blick Mead site is not required, it is suggested that the site could/ would be monitored more generally and more widely (with reference to MW-WAT10). The Groundwater Management Plan is proposed to be prepared in consultation with the Environment Agency only who have no heritage responsibility. In the event that groundwater levels are affected at the Blick Mead site it is unclear how any reporting and subsequent remediation would be adequately secured without any requirement to take account of the heritage assets at the site.

In this context, how would any general monitoring adequately take account of the effect on archaeological remains?

Highways England response

1. The Groundwater Management Plan (item MW-WAT10 of the OEMP [REP4-020]) considers the following:
   a. Potential effects on groundwater (resources and quality) that fall outside other regulations such as the Environmental Permitting Regulations.
   b. An update to the Groundwater Risk Assessment for the final design and construction plan.
   c. The groundwater level and water quality monitoring and reporting programme.
   d. Development of baseline groundwater conditions and derivation of trigger levels and action levels/mitigation/action plans for exceedances and accidents/incidents.
2. The Groundwater Risk Assessment referred to at item b) would include Blick Mead and other water dependent heritage assets as demonstrated in Annex 3 of Appendix 11.4 of the Environmental Statement, the Blick Mead Tiered Assessment [APP-282]. The OEMP (and therefore the Groundwater Risk Assessment considering heritage assets) is secured through Schedule 2, Paragraph 4 of the DCO [REP4-018]. In the unlikely event that groundwater levels are affected at Blick Mead, in accordance with standard practice during any necessary consultation on the Groundwater Management Plan, the Environment Agency would engage with other statutory bodies as necessary to ensure that heritage assets are taken fully into account.
3. The Applicant confirms that monitoring of surface water and groundwater is ongoing at Blick Mead even though this is not required to inform or confirm the assessment of the effects of the Scheme because all effects were found to be non-significant at Blick Mead.

4. For additional background see Deadline 1 Submission - Blick Mead - Note regarding proposals for additional monitoring [REP1-007] which explains why additional monitoring is not required to inform or confirm the assessment of the effects of the Scheme. All groundwater effects were found to be non-significant with negligible changes to the hydrogeology of the Blick Mead area (paragraph 1.2.1). Nevertheless, as stated at paragraph 1.2.6, it was agreed at a meeting with Professor Jacques in April 2018 and with the Heritage Monitoring Advisory Group in May 2018 that hydrological monitoring at Blick Mead would take place.
5. Monitoring of surface water and groundwater in and around Blick Mead (covering a greater area than just the low lying area and intermittent spring) has taken place and is continuing (see [AS-015] Additional Submission accepted at the discretion of the Examining Authority - Blick Mead monitoring to March 2019).
6. The existing monitoring regime will continue but the additional monitoring requested by Professor Jacques is not required to inform or confirm the assessment of the effects of the Scheme. See Deadline 1 Submission – Blick Mead - Note regarding proposals for additional monitoring [REP1-007]. As stated at 1.4.2 of that report, “additional piezometers to infill the existing array will not add significantly to the conceptual model of the groundwater flow which is supporting the wetting of the site. The Scheme will have a negligible effect on groundwater levels at the site so there is no mechanism for impacts. As such, this additional monitoring is not required to inform or confirm the assessment of the effects of the scheme”.

Question Fg.2.43

Blick Mead hydrogeology. The period of monitoring did not cover a full 12 months; however, it did collect data from the highs and lows of one calendar year. With this in mind, what practical implications could the shorter monitoring period have?

Highways England response

1. The adequacy of monitoring is discussed in response to point 106 at paragraph 34.1.44 in the Deadline 5 Submission - 8.36 - Comments on any additional information requested by the Examining Authority and received at Deadline 4 [REP5-003]. This refers to paragraph 26.3.8 of Deadline 3 Submission - 8.18 - Comments on Written Representations [REP3-013] which states that:

2. a twelve-month period is commonly used to define a hydrological baseline because it covers the seasonal lows and highs. A low water level and highwater level period have already been recorded (autumn 2018 and spring 2019) at Blick Mead [AS-022] and span the extremes of a typical twelve month period. This is sufficient as a baseline and for correlation and validation with long term records. There is no guarantee that conditions recorded over a typical twelve months will be representative of extremes. Therefore, the effects of the Scheme were assessed under a wider range of conditions rather than those likely to be experienced in a single year and include data from the drought of 1976 and floods of 2014 to ensure the widest range of consideration and therefore there are no practical implications of the shorter monitoring period that are not accounted for on a precautionary and wider scoped basis.

3. The extent of monitoring and the scenarios under which the effects of the Scheme have been assessed are appropriate and acceptable for EIA and for the consideration and determination of the application.

4. The Applicant considers that the shorter monitoring period does not have any practical implications for the Scheme; as described above, due to the wider assessment context that was used, and because any individual twelve-month period is not likely to provide the range of conditions upon which to base the assessment.

Question Fg.2.44

Blick Mead hydrogeology

The extent of the archaeological remains at the Blick Mead site is unknown.

To what extent should this influence any monitoring at the site both in terms of establishing the baseline and then ongoing monitoring?

Highways England response

1. Regarding the extent of archaeological remains it is stated at 34.1.46 of Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003] item 124 that:
2. The Blick Mead site assessed in the Environmental Statement is close to the low-lying area and intermittent spring. Item 123 confirms that: The effects of the Scheme do not extend to the area identified in the assessment as Blick Mead.
3. The Tiered assessment examines a larger area in order to understand the flow processes that maintain the wetting of the Blick Mead area.
4. As stated at paragraph 34.1.67 of Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003]:
5. The relevant hydrological processes at Blick Mead are referred to in the Tiered Assessment (Annex 3 [APP-282]) and Comments on Written Representations paragraphs 60.3.7 to 60.3.13 [REP3-013] and followed up in the Issue Specific Hearing (Deadline 4 Submission - 8.30.2 Written summaries of oral submissions put at Cultural Heritage hearings on 5th and 6th June 2019, Item 8.iii) [REP4-030]). There will be no significant effect on the sources of water contributing to Blick Mead as a result of the Scheme and therefore the detail of the hydrology, whilst of interest to those studying Blick Mead, is not necessary to support the Environmental Statement or examine and determine the application.
6. Nevertheless, monitoring of surface water and groundwater in and around Blick Mead (covering a greater area than just the low lying area and intermittent spring) has taken place and is continuing (see [AS-015] Additional Submission accepted at the discretion of the Examining Authority - Blick Mead monitoring to March 2019). Additional monitoring is not required to inform or confirm the assessment of the effects of the Scheme. See Deadline 1 Submission – Blick Mead - Note regarding proposals for additional monitoring [REP1-007]. As stated at 1.4.2 of that report, “additional piezometers to infill the existing array will not add significantly to the conceptual model of the groundwater flow which is supporting the wetting of the site. The Scheme will have a negligible effect on groundwater

levels at the site so there is no mechanism for impacts. As such, this additional monitoring is not required to inform or confirm the assessment of the effects of the scheme".

7. Regarding ongoing monitoring, as stated in response to Item Fg.2.42 of this document, the Groundwater Management Plan proposed at item MW-WAT10 of the OEMP [REP4-020] includes monitoring which will be secured through the DCO.
8. The precautionary approach to assessment and reporting means that the question about whether the extent of the archaeological remains at the Blick Mead has or should influence the monitoring programme, is already accounted for. The assessment has considered and determined that there are no likely significant effects.

Question Fg.2.45

Blick Mead hydrogeology

Please provide the predicted reduction in groundwater levels down gradient of the tunnel during high ground water level conditions and indicate whether any fall is likely to extend as far as the Blick Mead site and set out whether this would be significant in comparison to the seasonal rise?

Highways England response

1. The fall in levels downstream of the tunnel during high groundwater levels is not significant at Blick Mead. When levels are high there will be at least 0.35m, and more likely 0.7m of saturation above the Mesolithic layer. The predicted reduction in groundwater levels is 0.02m so will not affect the wetting of the layer.
2. Further detail is provided at paragraph 33.2.8 of Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003] which states that: Groundwater levels at Blick Mead are generally above 68m OD and in the winter months can reach at least 0.2m higher at 68.2m OD (see final graph in Blick Mead monitoring report [AS-015]). In a typical year this is therefore 0.7m higher than the upper level of the Mesolithic deposits at 67.5m OD (i.e. 68.2 minus 67.5) and at least 0.35m higher than the archaeological and ecological artefacts found between 67.85 m OD and 66m OD (i.e. 67.85 minus 67.5). This highest level of 67.85 OD is taken from the archaeologist record at paragraph 60.3.4 Deadline 3 Submission - 8.18 - Comments on Written Representations [REP3-013]. Under peak conditions the depth of groundwater above the Mesolithic deposits would be more. There is therefore a ‘freeboard’ of a least 0.35 m when groundwater levels are high which ensures that the Mesolithic deposits remain wetted. The model run results for peak conditions shows that the effects do not spread as far as Blick Mead and if they did they would result in a fall in groundwater levels of less than 0.02m. This is well within the ‘freeboard’. The fall in levels downstream of the tunnel is not significant at Blick Mead.

Question Fg.2.46

Blick Mead hydrogeology

In the Environment Agency's response to DL4 it was advised that any dewatering in the vicinity of the Blick Mead site has the potential to impact on groundwater levels but that this would be subject to regulation by the Environment Agency [REP4-049]. It appears that an assessment of risk to all receptors would be required prior to the issue of any licence.

Would any assessment of risk extend to the effect on archaeological remains and is there sufficient expertise in the process to scrutinise any heritage impacts prior to issuing any licence?

Highways England response

1. With regard to dewatering, the Outline Environmental Management Plan (OEMP), item MW-WAT10 [REP4-020] sets out a commitment to update the Groundwater Risk Assessment for the final design and construction plan. Therefore, if there are refinements to the Scheme as a result of detailed design or construction methods these refinements (including dewatering) will be assessed.
2. The Groundwater Risk Assessment referred to at item b) of MW-WAT10 would include Blick Mead and other water dependent heritage assets as demonstrated in Annex 3 [APP-282]. The risk assessment to be undertaken as part of MW-WAT10 and secured through the dDCO will therefore take account of the effect on archaeological remains.
3. In accordance with standard practice during any necessary consultation on the Groundwater Management Plan the Environment Agency would engage with other statutory bodies as necessary to ensure that heritage impacts are taken fully into account.
4. Expertise in the process would therefore be provided in the form of the risk assessment submissions and compliance with the terms of the dDCO and supporting documentation set out above and from engagement with the relevant statutory bodies.

Question Fg.2.47

Blick Mead hydrogeology

In the Environment Agency's response to DL4 it was noted that there is potential for the final design to deviate from that assessed to date and, if this were to occur, then further assessment of risk in respect of the magnitude and extend of impacts on groundwater would be required [REP4-049].

If this were to occur what measures would there be to ensure that any further risk assessment would take account of the potential to impact on the archaeology at the Blick Mead site?

Highways England response

1. With regard to the final design, the Outline Environmental Management Plan (OEMP), item MW-WAT10 [REP4-020] sets out a commitment to update the Groundwater Risk Assessment for the final design and construction plan. Therefore, if there are refinements to the Scheme as a result of detailed design or construction methods these refinements will be assessed.
2. The Groundwater Risk Assessment referred to at item b) of MW-WAT10 would include Blick Mead and other water dependent heritage assets as demonstrated in Annex 3 [APP-282]. The risk assessment to be undertaken as part of MW-WAT10 and secured through the dDCO will therefore take account of any potential effect on archaeological remains.
3. In accordance with standard practice during any necessary consultation on the Groundwater Management Plan the Environment Agency would engage with other statutory bodies as necessary to ensure that heritage impacts are taken fully into account.estion Response

Question Fg.2.48

Blick Mead hydrogeology

Please provide a detailed response to the submissions made by Mark Bush on behalf of the the Blick Mead Project Team [REP4-047].

Please have particular regard to the tiered assessment and whether it would be necessary for this to be advanced ie to tier 4?

Highways England response

1. A response to the submissions made by Mark Bush on behalf of the Blick Mead Project Team [REP4-047] was provided at Deadline 5 within the 'Deadline 5 Submission - 8.36 - Comments on any additional information requested by the Examining Authority and received at Deadline 4 [REP5-003]. . Key points concerning Blick Mead have been extracted from paragraphs 34.1.63-74 and are presented below for ease of reference.
2. *Significance of Blick Mead*

   Please see the Applicant's written summary of its oral submissions made at ISH 2, with respect to agenda item 4 (i) and item 8 [REP4-030], regarding the significance of Blick Mead and the OUV of the WHS. Highways England agrees with Historic England's comment at ISH 2 item 4 (ii) regarding the significance of Blick Mead and its contribution to the OUV of the WHS. Namely: "[Historic England] *confirmed that regardless of the significance of Blick Mead, it plays no part of the OUV, although regard still has to be had to Blick Mead in order to ensure heritage is properly safeguarded and managed.* [Historic England] *explained that this is the context in which Highways England has properly undertaken its assessment of Blick Mead as well as of the OUV on the whole".*
3. Highways England therefore do not accept that the Mesolithic remains illuminate consideration of matters which are part of OUV. Regarding the significance of Blick Mead, Highways England has always accepted that it is of national (high) value (see Appendix 6.8 – Cultural Heritage - Summary of non-significant effects [APP-217, page 5]) and should be treated as such in terms of the NPSNN. The ES reports No Change and a Neutral Effect on the Blick Mead archaeological site.
4. See also the Applicant's response Comments on Written Representations [REP3-013] in response to the Stonehenge Alliance regarding the WHS inscription and the Mesolithic period [REP3-013, paras. 12.3.103–105]; and to the Blick Mead Archaeology Team regarding the significance of Blick Mead as a heritage asset [REP3-013, paras. 60.2.2 & 60.2.7].

5. Extent of Blick Mead

   The extent of the heritage asset known as Blick Mead is described in Appendix 11.4, Annex 3 Blick Mead Tiered Assessment, Section 2.2 [APP-282], which was reviewed and accepted by Historic England and Wiltshire Council Archaeological Services.

6. *Harm already caused to Blick Mead*

   The applicant does not accept that installation of the two water meters has caused 'significant harm to Blick Mead'. The installation was attended by an experienced archaeologist, who inspected the arisings for artefacts and recorded the deposit sequence. No artefacts were observed in the arisings.

7. The test of substantial or less than substantial harm hinges on the loss of significance of the asset. The applicant acknowledges that the Blick Mead site contains Mesolithic deposits of national importance. As explained by the Applicant at the ISH2 (see written summary of oral submissions [REP4-030], agenda item 8), the EIA and HIA assessed Blick Mead as of national importance, equivalent to it being a designated heritage asset and a scheduled monument but did not afford it OUV status since it is not of the periods for which the WHS is inscribed.

8. The preservational environment, which is suggested by the Blick Mead team to be more or less permanently waterlogged, will not, on the evidence of Dr Sladen for Highways England (as recorded in the written summary of oral submissions made at ISH2, in relation to agenda item 8 (ii) [REP4-030]), have been compromised. In any case, the significance of the site as a heritage asset of national importance has not been in any way diminished by these installations.

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

   A response was provided to the evidence and submissions at the issue specific hearing on 6 June 2019, as recorded in the Applicant's written summaries of oral submissions put at Cultural Heritage hearings on 5th and 6th June 2019 [REP4-030] with respect to Agenda item 8(iii). In those submissions it was explained that the assessment that has been undertaken was entirely appropriate and adequate, and there is no basis for suggesting it does not comply with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. It was also reiterated at the hearing (as recorded in Deadline 4 Submission - 8.30.2 Written summaries of oral submissions put at Cultural Heritage hearings on 5th and 6th June 2019, Item 8.iii) [REP4-030]) that the impact assessment presented in the Environmental Statement Chapter 11 - Road Drainage and the Water Environment [APP- 049] confirmed that no element of the Scheme is likely to have a material effect upon the hydrology of Blick Mead and no mitigation would be required to preserve the significance of Blick Mead.

10. During the hearing it was confirmed that Highways England has followed the required guidance from Historic England in the production of the Blick Mead

assessment, Historic England further confirmed this at the hearing, noting also that the assessment conducted was adequate.

11. The submission from the Consortium seeks to attribute views to the Environment Agency which are unsupported by the evidence. There were no further questions from the Environment Agency in its Deadline 4 submission in relation to Blick Mead and therefore the Applicant refutes the suggestion that the EA has no confidence in the conceptual model and refutes the suggestion that there could be a greater impact than currently predicted. The Environment Agency confirmed at issue specific hearing 2 that “even if water was coming from a perched water table above the site, it is clear that it would not be affected by the scheme. Equally if the water was coming from the aquifer below the site there was no evidence to suggest that the presence of the tunnel would result in any effect on the Blick Mead site”. (Applicant’s Written summaries of oral submissions put at Cultural Heritage hearings on 5th and 6th June 2019, Agenda Item 8.ii) [REP4-030]).

12. In other words, the detail of the hydrology of the site will not affect the findings of the assessment because none of the sources of water (groundwater, rainfall and drainage) which contribute to and maintain the hydrology of Blick Mead will be affected by the Scheme and it therefore follows that the hydrology of Blick Mead will not be affected by the Scheme. Further detail on this point is provided in response to paragraph 34.1.63 (Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003]).

13. The Environment Agency stated the model was a good representation of the Chalk aquifer and shows no change in groundwater levels in the Blick Mead area (REP4-030 8 iii).

14. It is incorrect that Highways England is reluctant to be bound to the use of the closed face tunnel boring machine (TBM). The use of a closed-face TBM for the main bored tunnels has been confirmed in the revised OEMP as submitted at Deadline 4 item D-CH-32 [REP4-020].

15. Highways England met with Professor Brown on 16 April 2018 who stated that he does not have experience of the Avon valley geology at Blick Mead. Prior to the meeting we were led to believe this was the case and expected to be provided with data for use in the assessment. Professor Brown and Dr Bradley’s submissions refer to Star Carr which is not comparable. We have had several meetings with Blick Mead representatives and have had full regard to their views. Their focus on comparison with Star Carr is not appropriate (at the ISH2 Highways England explained that Star Carr was hydrologically not similar to Blick Mead, and Dr Bradley agreed with this – see agenda item 8(iii) in the written summary of oral submissions [REP4-030]) and suggests that they do not have specific expertise in the hydrology at Blick Mead.

16. It is not correct to assert that HE had previously agreed to a 12 month monitoring period. On page 4 of REP4-047 it is recorded that Highways England responded on 26.2.19 [83], denying any agreement to monitor the water table at Blick Mead over 12 months; Highways England maintained the only agreement was to conduct the tiered assessment and to carry out monitoring in accordance with that. On page 11 [REP4-047] Chris Moore confirms on behalf of Highways England that "the intention is to commence monitoring at the earliest opportunity, the monitoring will extend beyond 12 months and continue into the construction phase". This *ongoing* monitoring is being discussed and agreed as part of ongoing monitoring for the Scheme. It is not however required to support the Environmental Statement which has been assessed on a precautionary basis for a range of hydrological conditions that exceeds those that might be recorded on site.

17. By way of further explanation see paragraph 26.3.8 of Deadline 3 Submission - 8.18 - Comments on Written Representations [REP3-013] which states that a twelve-month period is commonly used to define a hydrological baseline because it covers the seasonal lows and highs. A low water level and highwater level period have already been recorded (autumn 2018 and spring 2019) at Blick Mead [AS-022] and span the extremes of a typical twelve month period. This is sufficient as a baseline and for correlation with long term records. There is no guarantee that conditions recorded over a typical twelve months will be representative of extremes. Therefore, the effects of the Scheme were assessed under a wider range of conditions than those likely to be experienced in a single year and include data from the drought of 1976 and floods of 2014.

18. The extent of monitoring and the scenarios under which the effects of the Scheme have been assessed are appropriate and acceptable for EIA and for the consideration and determination of the application.

19. *EH's Guidance*

    Please see the written summary of Highways England's oral submissions made at ISH2 in relation to Agenda Item 8 (iii) [REP4-030] with respect to the Tiered Assessment and how the appropriate level is determined. The assessment, Appendix 11.4, Annex 3 Blick Mead Tiered Assessment [APP-282] was reviewed and accepted by Historic England's Senior Science Advisor and Wiltshire Council Archaeological Services' County Archaeologist.

20. The assertion from the Consortium misrepresents the Applicant's position. As recorded in the written summary of oral submissions made at the ISH2 [REP4-030] with respect to agenda item 8(iii), "*Dr Sladen [on behalf of Highways England] confirmed that the tiered assessment process is not linked to significance of the archaeological site but to the reliability of the conceptual model. Historic England agreed with this, as did the Environment Agency*". The reliability of the conceptual model has reached an acceptable level and has been verified by monitoring. A Tier 4 assessment is only

required where mitigation is considered necessary to facilitate long-term preservation. As no significant effects were identified, no mitigation is necessary and therefore additional tiers of investigation and modelling are not required.

21. It is of note that the first page of the guidance (Historic England 2016 Preserving archaeological remains: Decision-taking for sites under development. Swindon. Historic England) states: “The emphasis throughout is on the benefits gained, both to sustainable development and the archaeological resource from understanding:

    - the significance and current state of preservation of the archaeological material
    - the potential development impacts of the proposed scheme”

    It is therefore important to assess the significance of effects.

22. It is not correct to assert that there is no certainty as to how the water environment at Blick Mead operates in light of the Environment Agency’s representations, nor that the Applicant’s assessment is inadequate. A response to assertions about the Environment Agency’s submissions is provided in response to paragraphs 98 to 103 of the Consortium’s submission (ibid). The Environment Agency has been provided with a response to questions on Blick Mead (paragraphs 33.2.6, 33.2.7 and 33.2.8 in the Environment Agency Deadline 4 comments). These responses confirm that groundwater level monitoring at Blick Mead supports the conceptual model i.e. the groundwater level in the underlying aquifer is such that there will normally be upward pressure that assists in maintaining the wet conditions in the Mesolithic deposits. Rainfall will also provide a further mechanism for wetting of the Mesolithic deposits (Section 2.6 of Annex Appendix 11.4 Annex 3 Blick Mead Tiered Assessment [APP-282]). The assessment has not identified any likely significant effects for Blick Mead and as a result no mitigation plan is required.

23. *Note of Dr Chris Bradley’s evidence*

    The groundwater levels support the conceptual model which shows that the groundwater level in the underlying aquifer is such that there will normally be upward pressure that assists in maintaining the wet conditions in the Mesolithic deposits. Rainfall will also provide a further mechanism for wetting of the Mesolithic deposits (Section 2.6 of Appendix 11.4, Annex 3, Blick Mead Tiered Assessment [APP-282]). Vertical flow components can therefore be up or down depending on the hydrological conditions and the degree of interconnection between layers.

24. Near surface stratigraphy and the geological setting is provided in the Blick Mead Tiered assessment (Annex 2 of the Groundwater Risk Assessment [App-282]).

25. Groundwater levels are provided in [AS-015] and do not demonstrate the presence of a permanent isolated shallow water table. The levels are consistent with the conceptual model of an upward head gradient with the saturated deposits at Blick Mead being fed from the Chalk aquifer beneath. The drilling results do not show any evidence of perched water or of a difference in groundwater level in different strata, and these results are consistent with the findings of the Tiered Assessment presented in Annex 3 of Appendix 11.4 - Groundwater Risk Assessment [APP-282] and the Environmental Statement. Rainfall will also provide a further mechanism for wetting of the Mesolithic deposits. (Section 2.6 of Appendix 11.4, Annex 3, Blick Mead Tiered Assessment [APP-282]).
26. Groundwater level monitoring results are presented in the Blick Mead monitoring report [AS-015]. Groundwater levels in WS09 are generally higher than those in the shallower WS10. This does not demonstrate perched water but does verify the conceptual model of an upward head gradient with the saturated deposits at Blick Mead being fed from the Chalk aquifer beneath. In February 2019 the heads reversed as would be expected at times when rainfall recharge is occurring.
27. The Scheme will not affect the ground surface or infiltration characteristics at Blick Mead. Groundwater in the Chalk aquifer is recharged by rain. No effect on groundwater quality is expected.
28. It is generally accepted that dry valleys are associated with enhanced permeability. The chalk groundwater contours indicate the catchment to Blick Mead is from a dry valley to the north which may be as a result of typical enhanced permeability seen in dry valleys. The tunnel is to the west in a separate groundwater catchment outside this dry valley.
29. A local groundwater model would have boundary conditions of chalk groundwater inflows and runoff inflows from the A303. Neither of these will change under the Scheme and therefore the predictive model would have no changes from baseline conditions. Therefore, a local model would provide no additional insights relevant to the Scheme impacts.
30. There are no significant effects predicted at Blick Mead [APP-282]. Therefore, detailed investigations into the detail of Blick Mead would not change the outcome of the assessment.
31. See Deadline 1 Submission - Blick Mead - Note regarding proposals for additional monitoring [REP1-007] which explains why additional monitoring is not required to inform or confirm the assessment of the effects of the Scheme.
32. The effects of the Scheme do not extend to the area identified in the assessment as Blick Mead.
33. The Blick Mead site assessed in the Environmental Statement is close to the low-lying area and intermittent spring.

34. It is unclear how the ‘edge of the dry’ is being defined. Groundwater levels will fall during drought conditions and will continue to do so. A cycle of drying and wetting currently takes place so the concept of protection by 10cm of water is not necessarily correct. Whether this is the case or not, nothing that supports the water environment at Blick Mead is being altered by the Scheme and therefore no effect on water levels is predicted as a result of the Scheme.
35. As stated in response to item 108 at paragraph 34.1.45 of Deadline 5 Submission - 8.36 - Comments on any further information requested by the Examining Authority and received at Deadline 4 [REP5-003]: The reliability of the conceptual model has reached an acceptable level and has been verified by monitoring. A Tier 4 assessment is only required where mitigation is considered necessary to facilitate long-term preservation. As no significant effects were identified, no mitigation is necessary and therefore additional tiers of investigation and modelling are not required or justified

Question Fg.2.49

Blick Mead hydrogeology

Please provide an assessment/ evidence as to what degree the site is wetted from perched water and what are the implications of this for the effect of the development on the archaeological remains?

Highways England response

1. Whether the Blick Mead site is wetted from perched water or not, the presence of the tunnel will not have an effect at Blick Mead.
2. Paragraph 34.1.74 of Deadline 5 Submission - 8.36 - Comments on any additional information requested by the Examining Authority and received at Deadline 4 [REP5-003] states: There is no evidence of separate deep and shallow groundwater. Even if there was, the Applicant is in agreement with the Environment Agency that “even if water was coming from a perched water table above the site, it is clear that it would not be affected by the scheme. Equally if the water was coming from the aquifer below the site there was no evidence to suggest that the presence of the tunnel would result in any effect on the Blick Mead site” (Deadline 4 Submission - 8.30.2 Written summaries of oral submissions put at Cultural Heritage hearings on 5th and 6th June 2019, Item 8.ii) [REP4-030]).
3. Paragraph 33.2.6 of [REP5-003] refers to the evidence related to perched water as follows:

   The groundwater levels referred to are on the graphs provided in the Blick Mead monitoring report [AS-015]. Borehole WS10 was installed at a higher elevation than WS09 to determine whether there is any evidence of perched water. Groundwater levels in WS09 are generally higher than those in the more shallow WS10 [AS-015]. This does not demonstrate perched water but does verify the conceptual model of an upward head gradient with the saturated deposits at Blick Mead being fed from the Chalk aquifer beneath. The drilling results do not show any evidence of perched water. The borehole drilled depths and installation depths are provided in [REP1-007] Blick Mead - Note regarding proposals for additional monitoring.
4. There is no evidence of a perched water table and, whether the site is wetted from perched water or not, there are no implications for the effect of the development on the archaeological remains.

Question Fg.2.50

Blick Mead hydrogeology

Figure 5.2 in the Road Drainage Strategy [REP2-009] sets out a catchment comparison for Blick Mead. It shows an existing and preliminary proposed peak flow rate.

i. Can you please explain the numbers in this figure and in particular what the second Q number represents and why this rises in the proposed preliminary design?

ii. In addition, please provide a clearer copy of this figure as the text is difficult to read.

Highways England response

i. Can you please explain the numbers in this figure and in particular what the second Q number represents and why this rises in the proposed preliminary design?

1. The drawing, Figure 5.2, ES Appendix 11.3 Road Drainage Strategy, illustrates the catchment areas contributing to the surface water discharge at the peak runoff rate, calculated with the Modified Ration Method, for the existing highway and post construction of the Scheme at a location identified as “A” within the existing ditch at Blick Mead.
2. **Q** is the flow rate, measured in litres per second, based on,

   Q = 2.78CiA where

   C is the Runoff Coefficient - Impermeable Area 1.0

   Permeable Area 0.3

   I is the Rainfall Intensity

   A is the contributing area
3. The flow rate Q is the summation of the flows from the impermeable area (shown hatched blue on Figure 5.2) and the permeable area (shown dense hatched green on Figure 5.2)
4. The first value of Q, shown on the Existing Drainage Catchment Plan, is the discharge rate from the existing highway into the ditch at point A.
5. The second value of Q, shown on the Preliminary Design Drainage Catchment, is the discharge rate post construction of the Scheme, based on a preliminary assessment of the contributing area, highlighted blue and green. This is a preliminary assessment of the contributing area and associated discharge flow at point A into the existing highway ditch.
6. The scale of discharge, existing Q at 292.6 l/s and post construction Q at 328.9 l/s are of the same order of magnitude (a difference of 36.3l/s or +12.4% variance). The increase in discharge rate is due to a slight over

estimate (precautionary approach) of the allocated contributing areas in the proposed Scheme drained by the network which discharges at point A. This preliminary assessment confirms that at detailed design stage, when the highway geometry is fixed, by adjusting the highway area contributing to the drainage network discharging at point A it will be possible to control the discharge rate to replicate the existing condition ensuring the flow rate in the retained ditch adjacent to Blick Mead is not negatively affected by the Scheme.

ii. In addition, please provide a clearer copy of this figure as the text is difficult to read.

7. A copy of ES Appendix 11.3 Road Drainage Strategy [APP – 281], Figure 5.2 Blick Mead Drainage Catchment Comparison, can be found in Appendix A.

Question Fg.2.51

Hydrology/ ground conditions/ vibration

At Deadline 4 (DL4) you respond to comments on the issues raised by the Stonehenge Alliance however no response is given regarding concern raised by the Stonehenge Alliance ref 11.3.5 page 11-99 [REP4-036].

i. Has a response been provided elsewhere to this concern?

If not, what are your views in this respect?

Highways England response

1. The Applicant's comments on Written Representations [REP3-013], Section 17.2 addresses the use of geophysical survey techniques and states that a comprehensive programme of archaeological evaluations, the scope of which was agreed with the Heritage Monitoring and Advisory Group (HMAG) and endorsed by the Scientific Committee, has been completed within the Scheme order limits, which includes land to be used and possessed temporarily and acquired permanently, both within and outside of the World Heritage Site (WHS). The cultural heritage assessment, reported in Chapter 6 of the Environmental Statement (ES) [APP-044], provides detail of the archaeological evaluation surveys and assessments that have been undertaken to inform the design of the Scheme and on which the cultural heritage assessment is based. Please also see Highways England's response to the Second Round of Written Questions CH.2.6.
2. The full Scheme boundary has been covered by non-intrusive archaeological geophysical survey, including detailed magnetometer survey as well as targeted earth resistance and Ground Penetrating Radar (GPR) survey of all areas outside the WHS boundary during Stage 3 of the project, and the results of historic surveys used to provide a robust assessment of likely impacts.
3. The response to these concerns raised by Stonehenge Alliance was also covered in the Written Summary of the Oral Submission from Issue Specific Hearing number 4 (ISH4) regarding Flood risk, Groundwater, Geology and Water under item 5.1 [REP4-032] which confirms the Applicant's view that the information presented in the Environmental Statement is more than sufficient at this stage of the consents process and that a 3D model is not required. This is further covered in the response to Stonehenge Alliance at Deadline 5 [REP5-003] items 11.1.1 and 11.2.56 which confirm as follows:
   a. The Applicant considers that a proportionate approach has been taken to characterise the variable nature of the geology employing experts in this field, including Professor Rory Mortimore, and does not agree that a 3D model is necessary at this stage.

b. In developing the preliminary design provided in support of the draft Development Consent Order (dDCO), the Applicant has followed best practice as embodied in the Association of British Insurers/British Tunnelling Society Joint Code of Practice for the Risk Management of Tunnel Works (ACOP) to:

   i. Undertake hazard identification and the management of risk to ensure their reduction to a level 'as low as reasonably practicable' as an integral consideration in the design, procurement and construction of the tunnel works.

   ii. Promote and secure best practice for the minimisation and management of risk as part of the Insurance of the works.

   iii. Undertaken suitable and sufficient site investigation phased appropriately to the pertaining physical and geological environments.

4. The preliminary design has been prepared in accordance with the ACOP and taking full cognisance of the Construction (Design & Management) Regulations and BS6164 Code of Practice for Safety in Tunnelling. The Applicant considers that it is neither unusual nor is it unacceptable to require the expert Contractor to plan and take responsibility for the continuation of investigations as part of the detailed design and their further risk management and procurement of the works.

5. To support this viewpoint, we would refer to the following major infrastructure projects:

6. **Crossrail**

   Crossrail has led the development of 3D Building Information Modelling (BIM) as part of the process of generating and managing information throughout the whole life of the asset lifecycle by using model-based technologies. On a practical basis, and in layman's terms, 3D structural models have been developed to show the complex underground interchanges within the highly congested urban environment that have subsequently been used as part of the complex asset management of the network. These 3D structural models were not produced for the consent stage.

7. Of the 42km of new tunnels under central London, including 10 new stations involving significant excavation using open-face tunnelling techniques involving Sprayed Concrete Lining (SCL), only Farringdon station warranted the development of a 3D Geology model in conjunction with the 3D structural model. The 3D Geology model was developed at Farringdon due to the complexity and the unknowns of the geology associated with the Lambeth Group in view of the risks relating to the open-face tunnelling techniques being used to construct this underground station. This model was developed by the British Geological Society (2009-2013) and updated as more site investigation information became available before handover to the contractor

prior to the start of tunnelling in May 2013. The 3D Geology model at Farringdon was therefore not produced for the consent stage but in subsequent development by the client and contractor to manage the specific risks at this location.

8. **Thames Tideway Tunnel**

   A 3D Geology model was not submitted as part of the DCO application nor during Examination. During the detailed design, local 3D ground models were used in specific locations.

9. **Silvertown Tunnel**

   A 3D Geology model was not submitted as part of the DCO application nor during Examination, but was subsequently developed during detailed design to provide a better understanding of: the significant variations in ground conditions; contaminated land along the route through heavily industrialised areas; presence of buried obstacles (old foundations) particularly at the south portal at the site of a demolished Gas Works; pylon foundations to the Emirates Air Line cable car; the backfilled entrance to the Royal Victoria docks, and demolished warehouses.

10. In summary, whilst the Applicant recognises the risks associated with the geology and hydrogeology at Stonehenge and the unique nature of the archaeology within the WHS, a 3D ground model is not considered necessary at this stage as it will not change the choice of a closed-face Tunnel Boring Machine as part of the risk management of the project. Furthermore, the high density of additional boreholes required to construct a competent 3D Geology model will not make a significant difference to the alignment which is constrained by our location within the historic environment, existing topography and road layout. We therefore maintain our view expressed at ISH4 that a 3D geology model would be a ‘nice to have’ but is not necessary to inform the preliminary design as assessed in the Environmental Statement Chapter 3 The Proposed Scheme [APP-040] in support of the DCO.

APPENDIX A

ES Appendix 11.3 Road Drainage Strategy [APP – 281], Figure 5.2 Blick Mead Drainage Catchment Comparison,

NOTES

1. THE EXISTING DRAINAGE INFORMATION HAS BEEN GATHERED USING A COMBINATION OF THE HIGHWAYS ENGLAND DRAINAGE DATA MANAGEMENT SYSTEM (HADDMS), PHOTOGRAPHIC DATA AND A SITE WALKOVER.

LEGEND

IMPERMEABLE CATCHMENT (1.0 RUNOFF COEFFICIENT)

PERMEABLE CATCHMENT (0.3 RUNOFF COEFFICIENT)

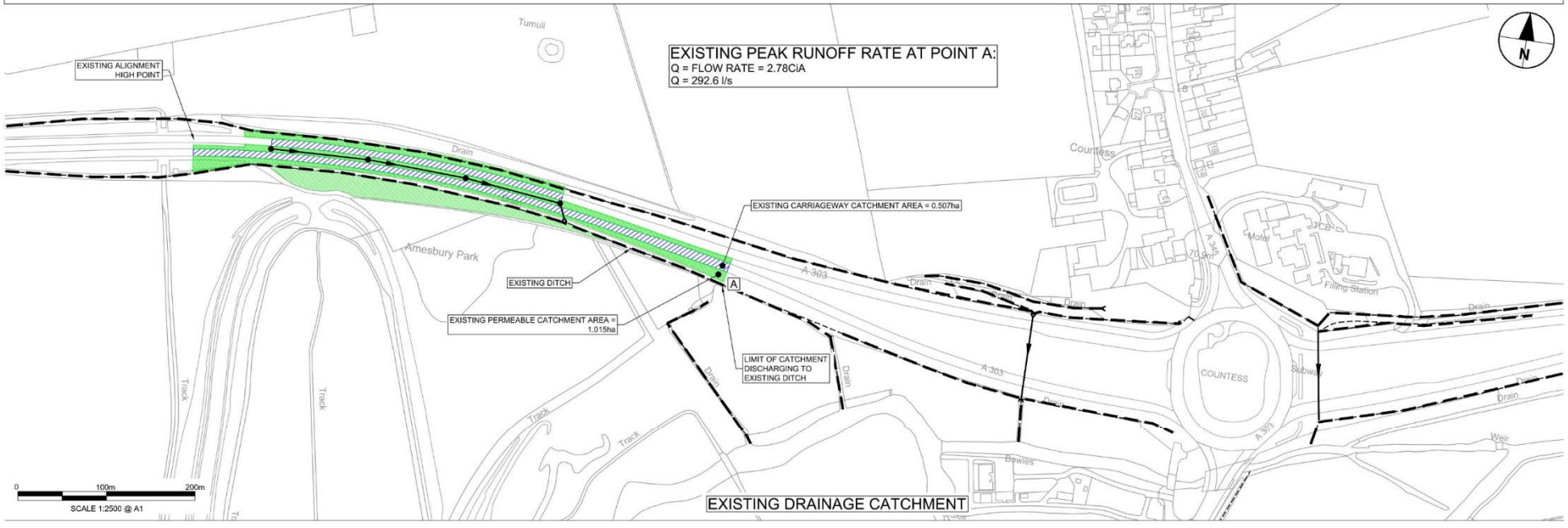
DRAINAGE ANNOTATIONS LEGEND

EXISTING DITCH

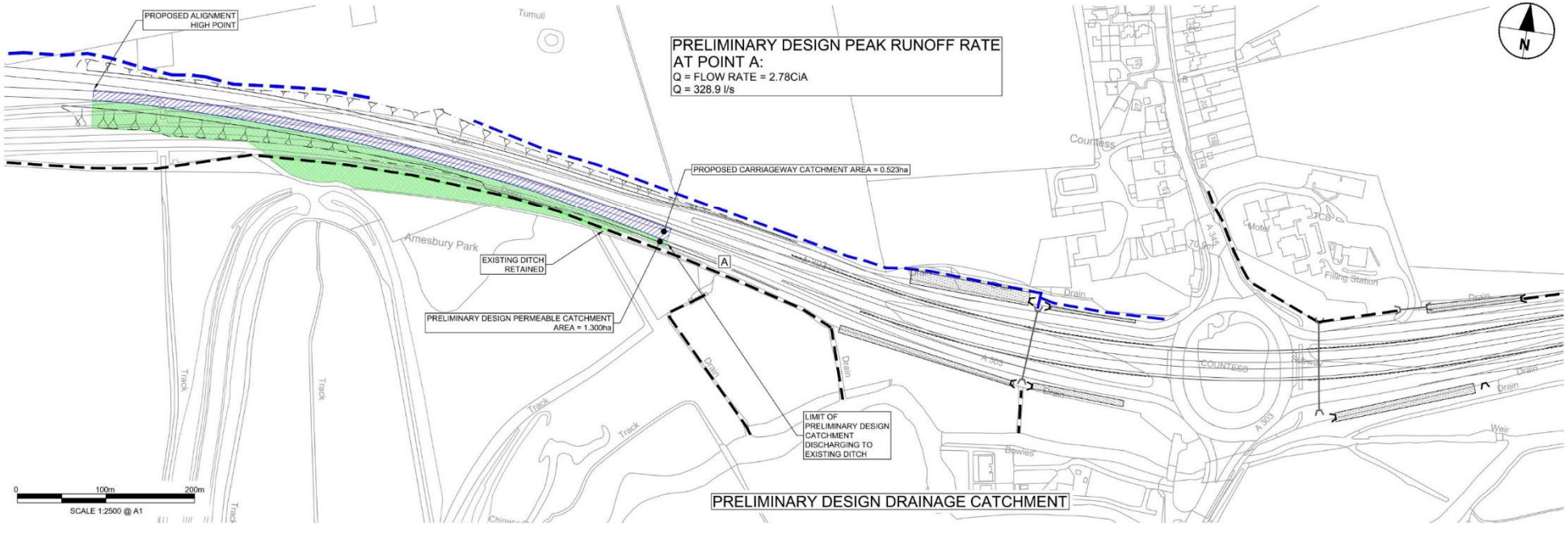
PROPOSED DITCH

EXISTING CULVERT

LINEAR POND

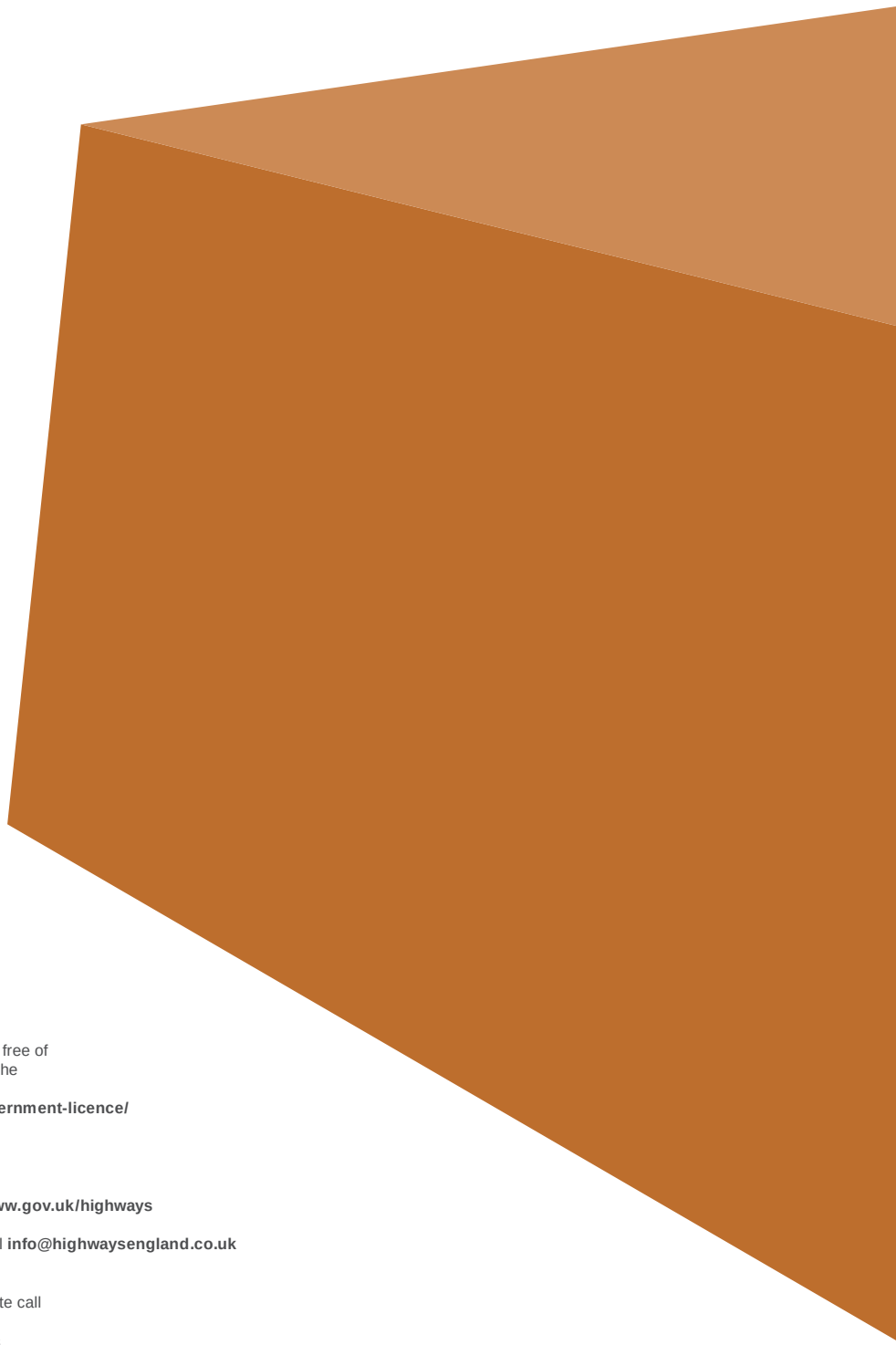


EXISTING DRAINAGE CATCHMENT



PRELIMINARY DESIGN DRAINAGE CATCHMENT

If you need help accessing this or any other Highways England information, please call **0300 123 5000** and we will help you.



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