Chiltern Society

Samantha Lumb
Deputy Director, Corporate Affairs
Environmental Agency
Alchemy
Bessemer Road
Welwyn Garden City
Herts AL7 1HE

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Dear Sam

High Speed 2 and the Chiltern Tunnel

Thank you for your letter of 1st November.

Question 1
Thank you for confirming that Schedule 33 permits have been issued for dewatering activities at the vent shafts and for the discharge of water from the slurry treatment plant back to the environment.

This question related to the risk of diversion of water away from PWSs. You stated that this was dealt with in '200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04', section 6.3.
In our letter of 6thOctober we set out a number of paragraphs from 6.3 which indicated that the assessment was open to question. These points were not addressed.

Question 2
Thank you for confirming that the pipeline is to enable treatment of turbid water from Chalfont St Giles PWS.

Question 3
You state that the tunnels will pass under the river in competent chalk at a depth at which any vibration from the TBMs will not spread to the base of the river.
Unfortunately, this is not the case, as shown by the cross sections in HS2's paper (**Chiltern Tunnel Construction Water Environment Assessment Document no: 1MC05-ALJ-EV-REP-CS02_CL04-000142; Appendix 3**). At both Chalfont St Giles and Little Missenden there will be at least 2m of the tunnel exposed to structureless chalk. This represents an increased risk of settlement in the structureless chalk.
What actions are Align/HS2 proposing to take to ensure that this does not happen?

Question 4
You state that Align JV have demonstrated that the construction method used by the TBMs can mitigate for major settlement within the chalk. Please explain what this methodology is and where it is documented.

We are aware that Align JV is monitoring settlement along the route. However this is an after-the-event solution. We understand that the impact on unstructured chalk of the vibration from the TBMs is likely to cause greater settlement (in excess of the 30 mm allowed by HS2 documentation) than tunnelling through competent chalk.

Question 5

The HS2 Phase One Environmental Statement does not set out a definition of significant effect on water quality and river flows. The most common statement is

'Water resources and flood risk assessment

Construction works such as tunnelling and piling could affect groundwater quality which has the potential to temporarily affect public water supply. HS2 Ltd will agree a management strategy with the Environment Agency in consultation with the water company to manage this potential effect.'

This clearly identifies a risk to PWSs but says nothing about the impacts on rivers. The Chiltern Tunnel Construction Water Environment Assessment 1MC05- ALJ-EV-REP-CS02_CL04-000142_C02, 28.04.2021'. makes a comment that should flow be affected, there is the possibility of relining the riverbed. We would appreciate it if you would share your agreed management strategy with us.

Question 6 & 7

4.2.6 of Chiltern Tunnel Construction Water Environment Assessment Document no: 1MC05-ALJ-EV-REP-CS02_CL04-000142 recognises that the greatest risks are to the Amersham and Chalfont St Giles PWS for impacts from turbidity and slurry. Table 4 sets out a number of recognitions of the fractured nature of the chalk.

4.2.8 to 4.2.12 deal with the impact of cement grout defining the risk to groundwater quality as low. However nowhere in this section does it deal with pumping grout into fast flowing water, where there is a significant risk of the gelling grout being washed away and not having time to set. This risk is recognised elsewhere in the HS2 papers.

4.3.6 states that the impact of tunnelling on lateral flow is set out in Report 1 and assesses that there is a risk of localised blockage at some points but will not have a significant impact on PWS. It also sets out that the strike of the chalk is southwest to northeast.

4.3.8 states 'Any changes that do occur in the aquifer are likely to be far more localised than those associated with quality changes and so the risk assessment only considers a 50m zone around the tunnel for changes to groundwater movement rather than the 500m considered for groundwater quality.'
Is this satisfactory?

We would point out that when the tunnels cross the Misbourne Valley at Little Missenden the risk of creating lateral flows is increased as the strike of the chalk will be in the same direction as the tunnels thus increasing the risk of faults / fissures for the water to follow.

The assessment produced relies on Report 1. However Report 1 was produced before the latest GI results were available. As we have pointed out in our previous letter the latest GI results show:

- MWH have identified that there is evidence of fast flowing water through faults/fissures along the Misbourne Valley in the area between Gt Missenden and Amersham.
- MWH estimate that the 'karst' system runs to 3.7km north of Amersham PWS. (This goes beyond the tunnel crossing point at Little Missenden.)
- MWH estimate that a significant amount of the water for the Amersham PWS comes from the Misbourne Valley

We suggest that this indicates that there is a significant risk of water being diverted from the Amersham PWS. As such tunnelling should be halted until sufficient Ground Investigations (GI) are completed to establish the degree of risk.

Question 8

While Bentonite forms a small amount of the tunnel grout, there is still the risk of the grout being washed away when it meets fast flowing water, which the latest GI has established occurs quite often in the aquifer.

The greater concern relates to the Bentonite slurry being used to create the D-walling at the Vent Shafts. At Little Missenden, HS2 identified a dry valley running next to the Little Missenden Vent Shaft (LMVS), which connects to the River Misbourne and Shardeloes Lake. Should there be a loss of slurry like that at Chalfont St Peter Vent Shaft (CSPVS), there is a severe risk of polluting the River Misbourne. Most of the dry valleys in this immediate area are regarded as following fault lines, as identified in the British Geological Survey proprietary mapping study, carried out for and funded by the EA. Incidentally, at the time of the Chalk Bloom in Shardeloes Lake last year, there were pressure tests being carried out at the LMVS (BH RC400 & BH RC402). We understand that this and the intense subsurface fracturing in the local chalk (see BH RC402) combined with the identified dry valley to the east of the LMVS led to that incident.

Statement 1

200504 - GW Assessment for Construction Tasks - Tunnel & Cross Passages 1MC05-ALJ-EV-NOT-CS02_CL04-400048_C04'

8.1.1 sets out potential impacts on the River Misbourne, including

'an increase in river flows at the tunnel crossing points due to increases in hydraulic heads up gradient of the tunnels'

8.1.3 sets out that there is no evidence for springs in the Misbourne valley.

However, as we pointed out in our last letter, there were a substantial number of springs in the Little Missenden area. These were significantly reduced when the main sewer to Maple Cross was constructed. However, there are still at least 2 springs at Little Missenden. Also,

the groundwater there is no more than 1 metre below ground. This indicates that there is significant risk of flooding in the valley.

We believe that it is necessary for there to be a reassessment, as the assumptions on which the assessment is based are clearly incorrect.

Statement 2

As demonstrated above, the risk of diversion of water away from the Amersham PWS has clearly not been fully assessed.

7.1.7 states that MWH conclude that there is strong evidence for a karst conduit that extends more than 3.7km both upstream and downstream from the Amersham site. Further that 'Nevertheless, it was considered likely that the PWS would draw most of its water from this "karst conduit"'

7.1.1 (p44) states 'the tunnel would cross beneath the River Misbourne 2.8km northwest of the Amersham PWS. At this location the tunnel is in SPZ1 for the PWS and crosses the high transmissivity horizons that supply the majority of water to abstraction. The current base of the abstraction borehole is at some 25m AOD so the tunnel would pass through the flow zone that supplies the Amersham PWS.'

7.1.2 to 7.1.5 assesses the risk of loss of water to the abstraction but only considers a change in hydraulic pressure.
There are no assessments of the risk of diversion.

As 3.7m north of the site takes us well beyond the tunnels crossing on the perpendicular, it is clear that the tunnels will have an impact on the fissures / fractures leading to the Amersham PWS. The assumptions made in Section 7 are that the water will find its way around the tunnel. There is no assessment of the risk of diversion along the tunnel perpendicular to the flow of water in the Valley. It is clear from the geological mapping that the strike of the chalk runs from Northeast to Southwest, which increases the potential for fractures running in that direction. Should such a diversion take place this would not only have a substantial impact on the Amersham PWS, it risks the flow of water down the valley to the Chalfont St Giles PWS.

We believe that further GI is needed to quantify this risk. An alternative would be for the tunnels to be deeper underground to avoid the flow of water down the valley and to be below the main part of the aquifer.

Statement 3

It has been demonstrated above there is a potential risk to the Amersham PWS from diversion. As such the fact that neither the EA or Affinity have raised the issue is irrelevant and the situation should be reassessed.

Figure 15 makes no statement that the Misbourne Valley immediately north of the CSG abstraction runs North to South. If one looks at ordnance survey maps it is clear that the Valley runs Northwest to Southeast and is therefore perpendicular to the predominant geological strike.

4.2.15 (Groundwater Assessment for Construction Tasks) states 'Groundwater movement is generally in a Northwest to Southeast direction (see Figure 9 in Section 6 of this report)

Statement 4

4.2.20 states 'Areas potentially at risk from groundwater flooding have been identified in the vicinity of the tunnel, primarily within the valley of the River Misbourne. However, it must be recognised that this is based on a national level assessment and therefore provides relatively coarse information.

This statement indicates that no further assessment was carried out. We would point out that over the past few years there have flooding incidents in both Little Missenden and Great Missenden.

Statement 5

We agree that Bentonite is a naturally occurring substance. However, it contains a number of heavy metals including lead and arsenic. As such it is hazardous when introduced to a water environment. That is why it is very strictly controlled when used in construction processes. Please see attached link to a standard document issued by Network Rail.

https://safety.networkrail.co.uk/wp-content/uploads/2016/05/Bentonite.pdf

Statement 6

As you state the grout will gel in 12 to 15 seconds. It then takes 20 – 30 min to set. However as also recognised by HS2, if grout is introduced to fast running water it will not set and will be washed into the groundwater or surface waters.

6.2.7 states 'Cement / grout tends to be highly alkaline and can pollute water supplies if it gets into them with a pH of 10 to 12 not being uncommon. Drinking water has a pH limit of 9.5. There is a risk of migration of cement or grout (e.g. from the tunnel annular space or from ground improvement at cross passages) could impact water quality in the Chalk, although their viscosity limits their potential to move within the aquifer, providing they are not released into rapidly flowing turbulent water. This is unlikely to be the case in the Chalk aquifer as although rapid flows are known, they are not ubiquitous.'

Here HS2 clearly recognise the risk of pollution from grout /cement, but choose to ignore it, although elsewhere in the reports they clearly identify that there is strong evidence of fast flowing water in the Misbourne Valley. Particularly where the tunnel crosses under the MIsbourne. Further this is recognised as a major source of water for the Amersham PWS. This suggests that either:

- More ground investigations are needed to determine where the fast-flowing water is, or
- The tunnels need to be deeper so that they are in competent chalk below the New Pit & Holywell formation aquifers, where fast flows are unlikely.

Summary

We believe that there is sufficient evidence provided above to show:

- The Tunnels will be in up to 3.5m into the unconsolidated/structureless chalk where they cross under the River Misbourne at both Chalfont St Giles and Little Missenden
- There is a significant risk at both areas, that subsidence will be greater than the 10 mm to 30mm forecast by HS2
- Such subsidence risks the loss of the River Misbourne, a WFD water body, to groundwater
- There are significant risks of grout entering the groundwater as the TBMs tunnel through the fractured parts of the aquifer thus adversely impacting the quality of the groundwater.

We believe that as HS2 / Align have failed to investigate these matters sufficiently to reduce the potential impacts either:

- Significantly more Ground Investigation is needed to establish how the tunnels will impact both the flow of water through the aquifer and its quality, and how the impact can be mitigated.
- The tunnels are tunnelled at a greater depth, ensuring that they are in competent rock, with a reasonable head above the tunnels.

The second alternative is reasonably achievable by going deeper from Chalfont St Peter Vent Shaft. It would require an extension of the tunnel at the North Portal to maintain a proper operational gradient for the trains. There is a potential benefit here in that this could enable the tunnels to go below the North Portal clay deposit currently require substantial piling.

Yours sincerely

Simon Kearey
Chair - Chiltern Society
Campaigning for, Conserving and Promoting the Chilterns: see what we do here!
Direct Dial: 07956 183262
Registered Charity 1085163 Co. Reg. No. 4138448
White Hill Centre, White Hill, Chesham, Bucks, HP5 1AG

Cc Tom Beeston – Chief Officer, John Gladwin – Trustee, Affinity Water