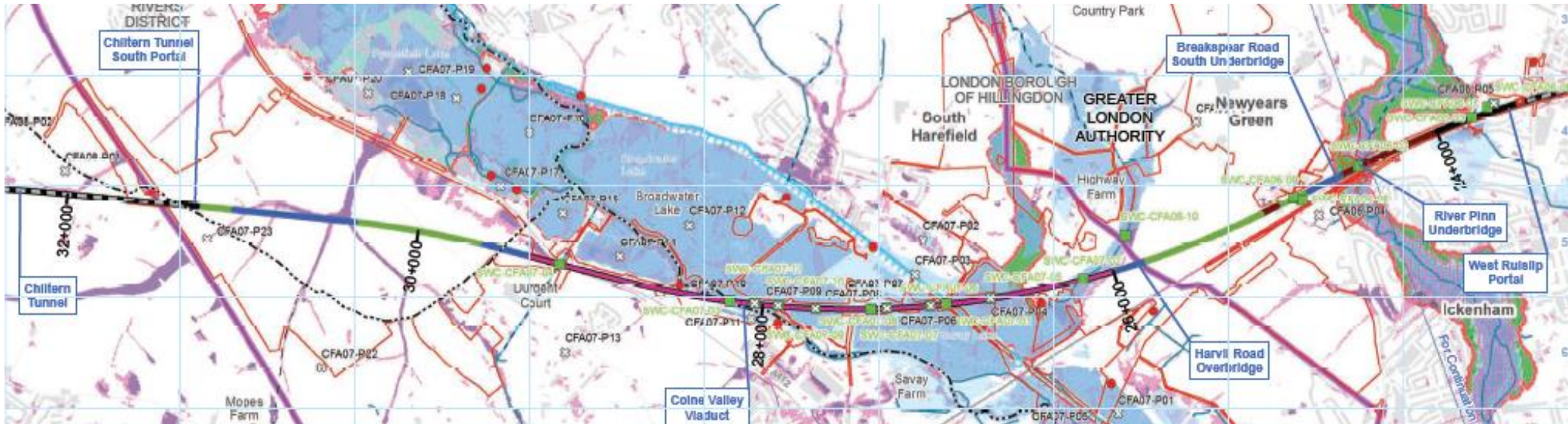


Water resources and flood risk - Overview

June 2016

Water resources and flood risk assessment (1)

- The assessment for the Environmental Statement was based upon the identification of surface water features within 1km of the route of the Proposed Scheme, except where there is clearly no hydraulic connectivity. In urban areas the extent was 500m.
- All groundwater bodies were considered within 1km horizontally of the route of the Proposed Scheme and/or within 10m of the lowest possible construction or dewatering depth.



Water resources and flood risk assessment (2)

- The design of the Proposed Scheme provides the level of detail necessary for the purposes of the Bill and the requirements of the Environmental Impact Assessment Directive.
- The Environment Agency stated the following regarding the assessment in their Environmental Statement Consultation response:

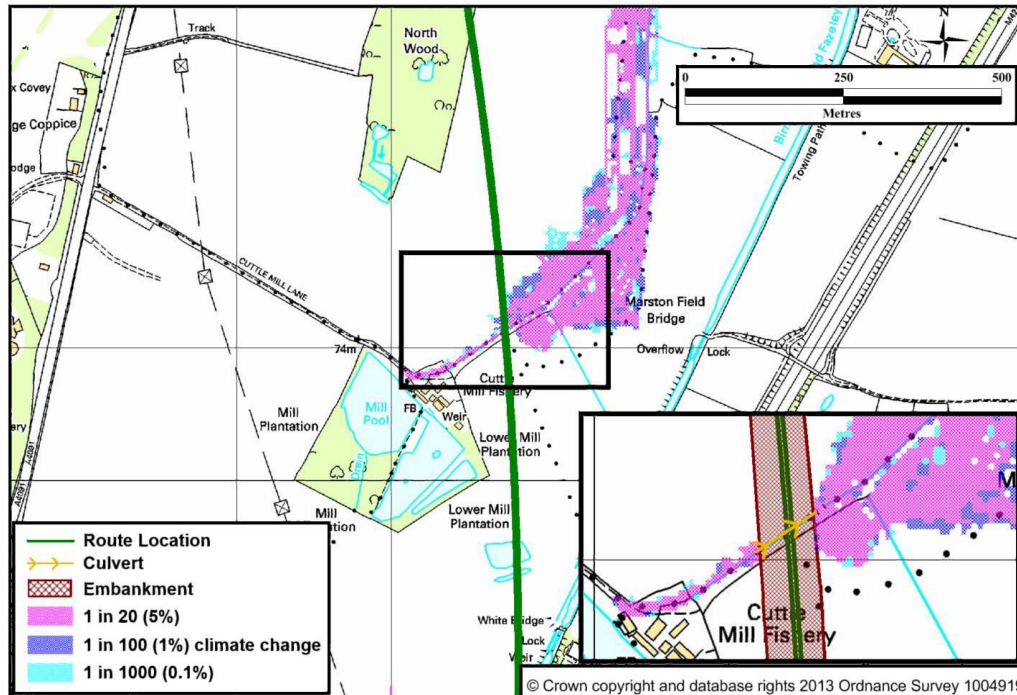
'We have provided a range of environmental information and technical advice to High Speed 2 Ltd. We note the majority of comments made by the Environment Agency in response to the draft Environmental Statement consultation last year have been taken into account. As a result, we believe the potential environmental effects that lie within the remit of our organisation have been appropriately assessed at this stage.'

Protective provisions

- Under protective provisions in Schedule 32 Parts 4 and 5 of the hybrid Bill, the approval of the appropriate body is required prior to carrying out any works likely to affect groundwater or surface water (including canal) flows, level or quality.
- In relation to groundwater, the appropriate body is the Environment Agency. In relation to canals, it is the Canal and River Trust. In relation to watercourses, it is either the Environment Agency, or the Lead Local Flood Authority, or the Internal Drainage Board, as explained within Information Paper E25: Authorising works affecting watercourses.
- Therefore, no works affecting the flow, level or quality of groundwater or surface water can commence until the appropriate body is satisfied that any impacts from construction are properly understood and any required mitigation is adequate.

Flood risk assessment (1)

- The risk of flood impacts has been assessed in the Environmental Statement through a route-wide Flood Risk Assessment as well as on an individual Community Forum Area basis.
- Where the railway and associated works have the potential to increase flood risk, the design avoids or mitigates the risk consistent with the approach in the National Planning Policy Framework and the supporting Technical Guidance.



Example of hydraulic modelling used in route-wide flood risk assessments

Flood risk assessment (2)

- The design aim is for no increase in the risk of flooding for more/highly vulnerable receptors (as defined under the National Planning Policy Framework) during the lifetime of the development. These include residential properties. Where required, the design will mitigate loss of floodplain by creating replacement storage areas for floods up to the 1 in 100 year (1%) annual rainfall probability event, with an allowance for climate change.
- The Environment Agency stated the following as part of their consultation response:

'We note potential flood risk has been assessed in the Environmental Statement through a route-wide Flood Risk Assessment. Volume 5 of the Environmental Statement also includes Flood Risk Assessment reports for the 26 Community Forum Areas also the route. We believe flood risk has been appropriately assessed.'

Replacement flood storage areas

- Replacement flood storage areas are provided to mitigate the impact of the proposed scheme on existing floodplains and to ensure that the Proposed Scheme does not cause an increased flooding risk to vulnerable receptors (e.g. residential property) as a result of its construction or operation.
- Replacement flood storage areas, as with land drainage balancing ponds, will be shallow scrapes in the landscape and will generally be suitable for grazing once the scheme is operational. Arable farming may also be possible on replacement flood storage areas in some locations. There is no requirement to fence these areas, unless needed for land or livestock management purposes.

Balancing ponds (1)

- Balancing ponds are often required for development projects in order to regulate water flows to avoid an increase in flooding from new surface water drainage systems. An example of a balancing pond during dry weather, with land potentially suitable for grazing, is provided below.

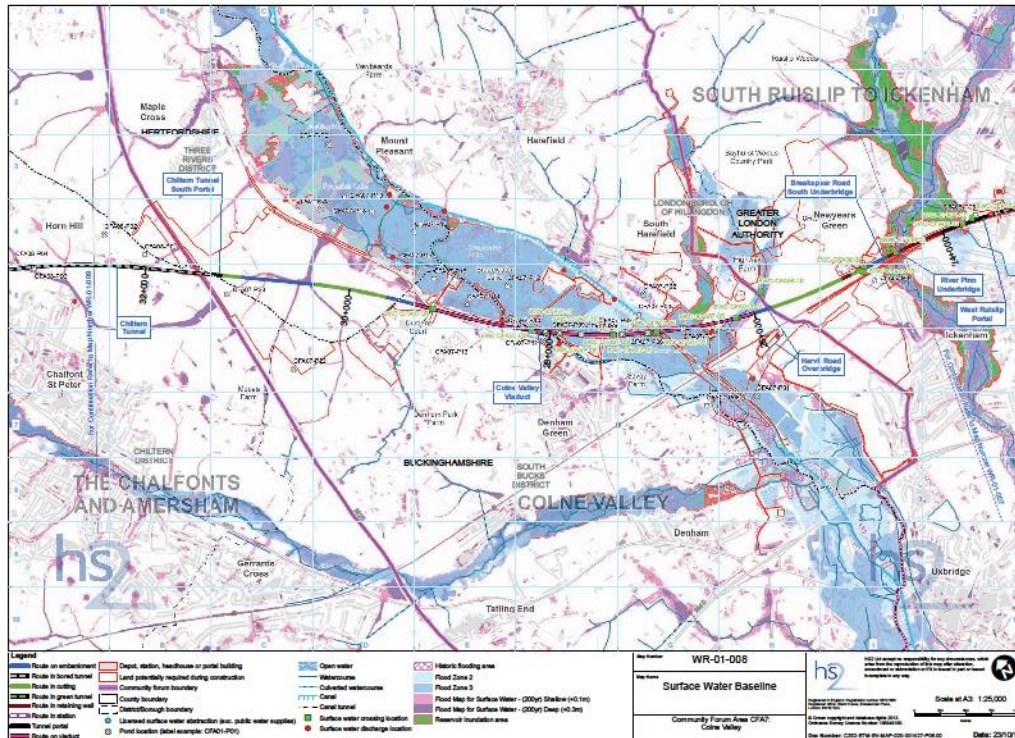


Balancing ponds (2)

- Balancing ponds will typically be unlined and have banks with a varying profile. Those required for land drainage purposes will often resemble depressions in the ground rather than actual ponds, and are often called detention basins.
- The majority will not be designed to hold water permanently, but will be dry most of the time, except following intense rainfall events.
- Although infiltration to ground is the preferred option for sustainable drainage systems, in certain locations ponds may be designed to be permanently wet where there are site specific environmental requirements to retain water.
- In many cases, it is not possible to combine balancing ponds for different types of drainage systems (e.g. railway, highway and land), as they need to be kept separate due to varying ownership, management and maintenance requirements.
- Systems have been designed to drain by gravity where possible; pumping will only be adopted where it is unavoidable.

Surface water

- The railway has been designed to avoid or reduce adverse impacts on rivers, streams, ponds and canals.
- The route crosses rivers and streams either by viaduct, clear span bridges or, where necessary, culverts. Structures have been designed to be sympathetic to their surroundings, to take account of ecological requirements and to help ensure the quality of watercourses is not adversely affected.



Surface Water Baseline Plans show the proposed scheme's alignment in relation to existing surface water features and areas at varying risks of flooding.

Land drainage

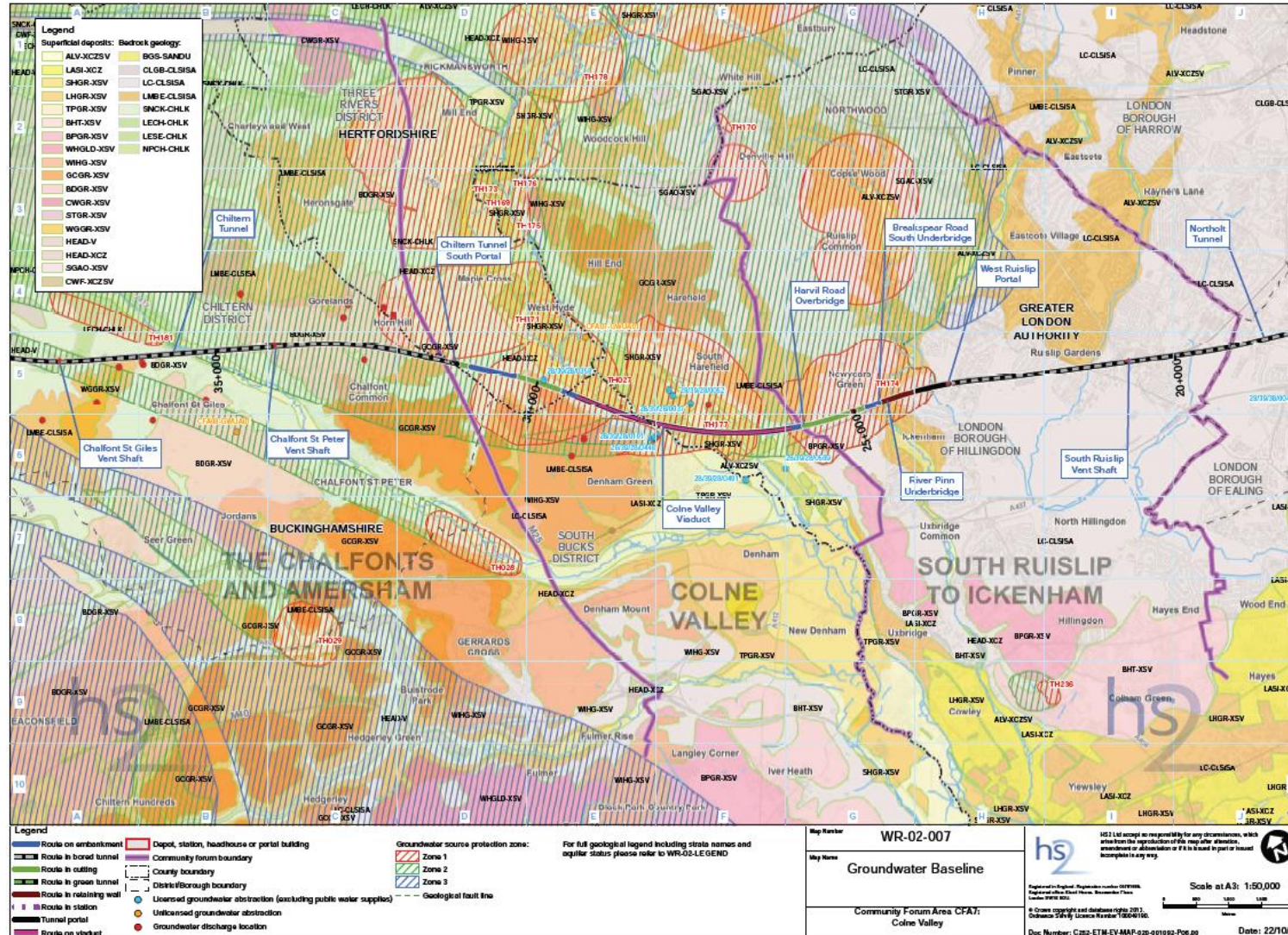
- Surface water bodies will be protected by the measures as set out in draft Code of Construction Practice.
- The Code of Construction Practice requires surveys to record, for reinstatement purposes the presence of drainage, irrigation and water supplies.
- The Secretary of State will require the Nominated Undertaker to work with landowners and farmers whose productive agricultural soils are temporarily affected by the construction of the HS2 works and/or are affected temporarily as a result of land-raising, with the intention to bring agricultural soils back to enable their former use before construction of the HS2 works on the relevant land and shall prepare in consultation with the relevant landowner and relevant planning authority an agricultural soils plan in advance of construction.

Groundwater dewatering

- Groundwater dewatering may be required for construction in aquifers below the water table which can impact upon local springs and water features. The impact of groundwater dewatering on local springs and water features has been assessed in the Environmental Statement.
- The water table elevation and rock permeability is not yet known along much of route. Where that is the case, conservative assumptions have been made in the Environmental Statement to provide a reasonable worst case scenario.
- The ground investigations aim to confirm these assumptions. Ground investigation is currently in progress, guided by the construction programme.
- Mitigation measures for the effects of groundwater dewatering can include, but are not limited to:
 - Re-injection of the dewatered groundwater back into the ground;
 - Local discharge of dewatered groundwater to impacted water features; and
 - Waterproofing excavations, so that groundwater dewatering is not required.

Groundwater baseline plan

Groundwater Baseline Plans show the proposed scheme's alignment in relation to geological bedrock and sources of groundwater and areas of protection.



Tunnelling – impact on watercourses

- The impact of tunnelling under watercourses has been assessed as part of the Environmental Statement.
- In certain geological situations, such as the River Misbourne, risks of subsidence caused by tunnelling affecting loss of river water to the ground will require consideration.
- The following measures were identified within the Environmental Statement to address such risks:
 - The tunnel boring machine will be operated in a closed face mode, which will reduce settlement;
 - The tunnel depth will be such that there is approximately two tunnel diameters of cover above the crown of the tunnel.
- The ground investigation will confirm the present situation and vulnerability to tunnelling.
- Monitoring will be undertaken prior, during, and after construction to identify impacts. Should material impacts be identified then the following mitigation measures could be adopted:
 - River bed sealing; and/or
 - Injection grouting, to seal any pathways created.

Public water supply

- The potential impact of works on public water supplies has been assessed as part of the Environmental Statement.
- The Promoter is in ongoing discussions with Affinity Water and the Environment Agency to agree a package of measures to protect public water supplies during the construction of the Proposed Scheme.
- The draft Code of Construction Practice also sets out that any water supply pipes damaged during construction will be repaired or replaced as quickly as reasonably practicable and normally within 24 hours. Until water supplies are reinstated and tested, drinking water will be provided by bottle and/or tanker as a temporary measure as appropriate to affected parties. Provision of an interim water supply will also apply where supplies to livestock are temporarily interrupted.

Prevention of water pollution

- Section 16 of the draft Code of Construction Practice contains measures to prevent contamination and protect water resources during construction, including (but not limited to):
 - Use of oil interceptors and shut-off valves in drainage systems;
 - Secondary containment measures, such as plant nappies to retain leakage of fuel;
 - Preparation of pollution incident control plans, which will include where appropriate, spill kits and identify specialist response companies who can respond immediately to an incident;
 - Use of non-erodible bunds or silt or sediment fences when adjacent to watercourses;
 - Restrictions or controls with regards to excavation within watercourses to limit effects on water flow, water quality, sedimentation, fisheries or river ecology; and
 - Measures specified within best practice guidance.

Hydrological monitoring

- The draft Code of Construction Practice requires consultation with the Environment Agency regarding water quality, flow and levels monitoring to be undertaken for watercourses and groundwater affected by construction works or discharge or surface water run-off including:
 - Pre-construction, to identify a baseline; and
 - During construction to confirm the effectiveness of mitigation and identify pollution incidents.
- The controls contained in the Environmental Minimum Requirements (EMRs), along with powers contained in the hybrid Bill and the Undertakings given by the Secretary of State, will ensure that impacts which have been assessed in the ES will not be exceeded.

Engagement

- Engagement has been, and will continue to be, undertaken with the Environment Agency, Lead Local Flood Authorities, Internal Drainage Boards, the Canal and River Trust and water companies, to ensure that likely residual significant adverse effects are managed and mitigated appropriately.