

CASE FILE LIST

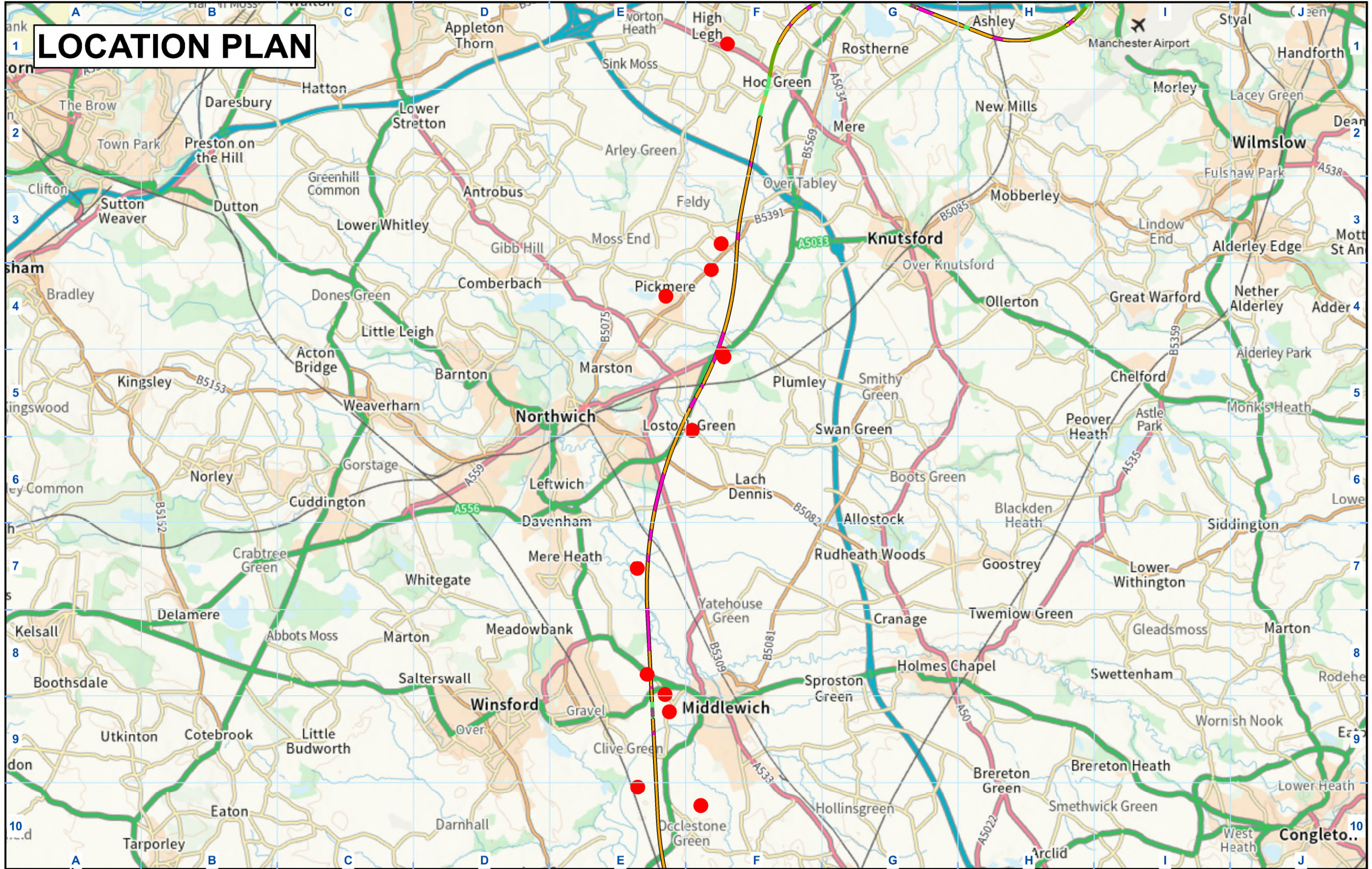
Case: HS2-117.

Title: HS2-117 HS2 Cheshire Residents Group - Promoter.

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LOCATION PLAN



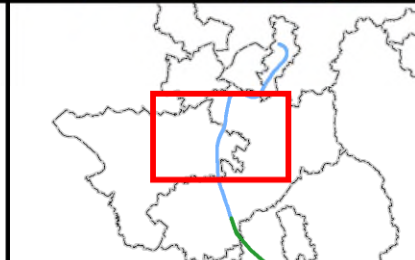
P391

Legend

Phase 2b Western Leg Bill alignment February 2022

- Box Structure
- Cutting
- Embankment
- Retaining Wall
- Underground Box
- Viaduct

● Petitioner Postcode



High Speed Two
Petitioner Location Plan
Reference Drawing

Petitioner
Slater Cheshire Residents Group

Petition number
P2B-HS2-117

HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill Queensway Birmingham B4 6GA
OS 100049160
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Scale at A3: 1:90,250

0 920 1,840 2,760 3,680
Metres

Doc Number: P2B-HS2-HY-MAP-B000-000022

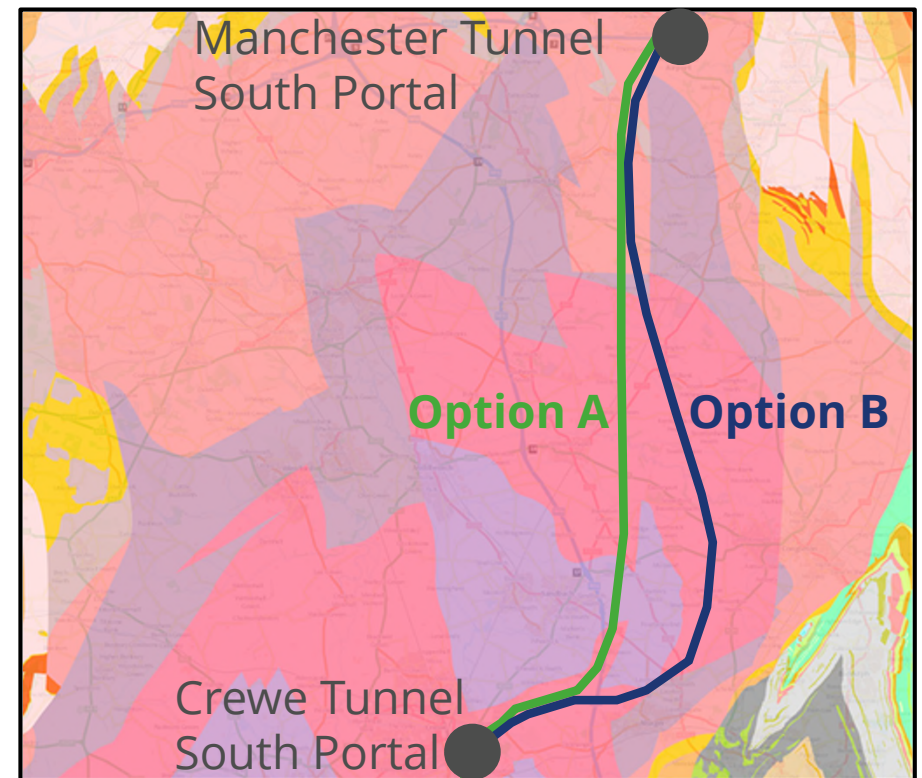
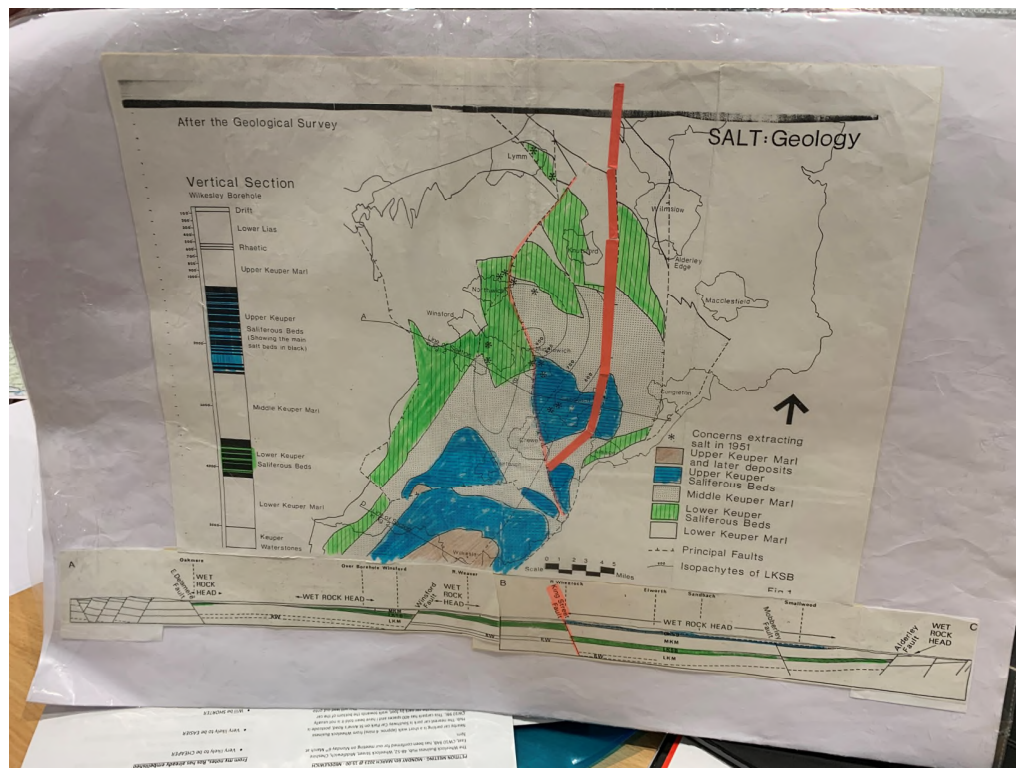
Date: 08/12/22

Petitioner's Crewe - Manchester Tunnel Request

HS2 Cheshire Residents Group proposes that HS2 should be tunnelled from Crewe to Manchester

On 6 March 2023, the petitioner proposed an amendment to their original tunnel proposal. They proposed starting the tunnel at the connection with the 'southern portal of the Crewe Tunnel' and turning east so that, instead of being a straight route to the Manchester South Tunnel portal, it would take a route which avoids 'wet rockhead'.

HS2 has therefore reviewed two tunnel alignments: **Option A** following the petitioner's new request and **Option B** reducing the crossing of 'wet rockhead area' by going further east.



Impact to Strategic Objectives

The Petitioner's proposals do not meet HS2 strategic objectives and preclude the ability to achieve the strategic goals for wider connectivity in The North, through West Coast Mainline (WCML) and NPR connections.

Proposed Scheme would support:

- Services to Manchester (3tph from Euston, 2tph from Curzon Street).
- Services to Scotland, following delivery of a future WCML link.
- NPR services to Liverpool, Manchester, Leeds etc.

Petitioner's proposal Option A and B would preclude:

- A junction for a future WCML link.
- A junction for NPR (London – Liverpool, Liverpool – Manchester services) and for future NPR services to re-use HS2 infrastructure.
- A Crewe Northern Connection which allows high speed services to call at Crewe Station and go back on to high speed infrastructure.
- A new rolling stock depot between Crewe and Manchester – would likely require an alternative location on Phase 2a for a direct surface connection to HS2 mainline, negatively impacting operations. Phase 2b cannot operate the planned future services without an additional train maintenance and stabling facility.
- The Petitioner requests removal of Manchester Airport High Speed Station. This would reduce access to a major population area for HS2. A tunnelled solution could theoretically accommodate a station, but it would be much deeper and thus more challenging to deliver, as well as carrying a much higher cost.

Outline Constructability, Programme and Cost

	Hybrid Bill	Petitioner's proposal Option A	Option B
Total Distance Crewe to Manchester	57km / 35.5miles	50.1km / 31.2miles	54.2km / 33.7miles
TBMs required	6	12	12
Avoids 'wet rockhead' areas	No	No	No
Maximum approximate tunnel depth	40m	>150m	>150m
Total shafts (approx. 3km intervals)	6 shafts	17 shafts Shaft Depth: 42m to 162m	18 shafts Shaft Depth: 42m to 162m
Shaft Location Classification	6 Urban Shafts	6 Urban Shafts 11 Rural Shafts	6 Urban Shafts 12 Rural Shafts
Emergency intervention / Crossover Box required (max. 20km intervals to meet Fire Life Safety Requirements)	0	2 (shaft 8 + Manchester South location)	2 (shaft 8 + Manchester South location)
Additional tunnel material to dispose	Baseline	6.23million m3	7.01million m3
Delay to Delivery into Service Date (approximate)	Baseline	plus 11.5 years (inc. 4 years to resubmit a hybrid Bill)	plus 12.5 years (inc. 4 years to resubmit a hybrid Bill)
Approximate additional costs	Baseline	plus £4.7billion	plus £5.8billion

Cost Assumptions and Risks

Both Options A and B cost estimates do not include provision for:

- Underground public Manchester Airport High Speed Station.
- NPR provision.
- WCML link junction provision.
- A connection back to HS2/NPR infrastructure north of Crewe.
- Inflation pressure from delays to construction and operation.
- Additional costs to overcome unknown ground conditions at depth.
- Third service tunnel if required for Fire Life Safety reasons.
- Both options present construction and operational cost risks for stabling and maintaining trains and HS2 infrastructure.

Construction, Operation and Maintenance Challenges of Petitioner's Proposal

Introduces challenges in respect of managing high water pressures and the need to undertake ground improvement works at depth, thus increasing tunnelling complexity.

A train stabling facility would still be required but would be much further from start/end of service location. This would mean shorter operational time due to much longer empty stock movements.

Infrastructure maintenance requirements likely to need to be provided from the Phase 2a Stone IMB-R location. This would mean a deterioration in maintenance regime as the maintenance window would reduce due to longer travel times to maintenance locations on Phase 2b.

Includes the removal of Manchester Airport High Speed Station, but an emergency evacuation station as a minimum would likely be required in this location for Fire Life Safety reasons.

Despite being reduced in length compared to the Proposed Scheme, Options A and B would not likely result in shorter journey times. This is due to additional ventilation requirements for longer and deeper tunnels and additional power consumption, as well as two curves east of Crewe requiring trains to slow down for them earlier on Phase 2a all contributing to a likely lower average running speed on Phase 2a and Phase 2b than the Proposed Scheme alignment.

Further design development may also identify that more robust Fire Life Safety measures are required for a long, deep tunnel such as a third service tunnel similar to the Channel Tunnel.

Summary of consideration of Petitioner's proposal

Would not enable the needs of the HS2 Phase 2b Strategic Business Case to be fulfilled and would thus preclude the provision of wider connectivity through the connections for Northern Powerhouse Rail and the West Coast Mainline, and for a Crewe Northern Connection.

Would displace the site of Crewe North Rolling Stock Depot, which is a critical strategic facility required for HS2 rolling stock maintenance and fleet stabling.

Removes the provision of the Manchester Airport High Speed Station, which would likely significantly impact passenger numbers as a result of the reduction in access for a large population centre in south Manchester and adversely impact business case benefits associated with the delivery of the Phase 2b Crewe to Manchester Proposed Scheme.

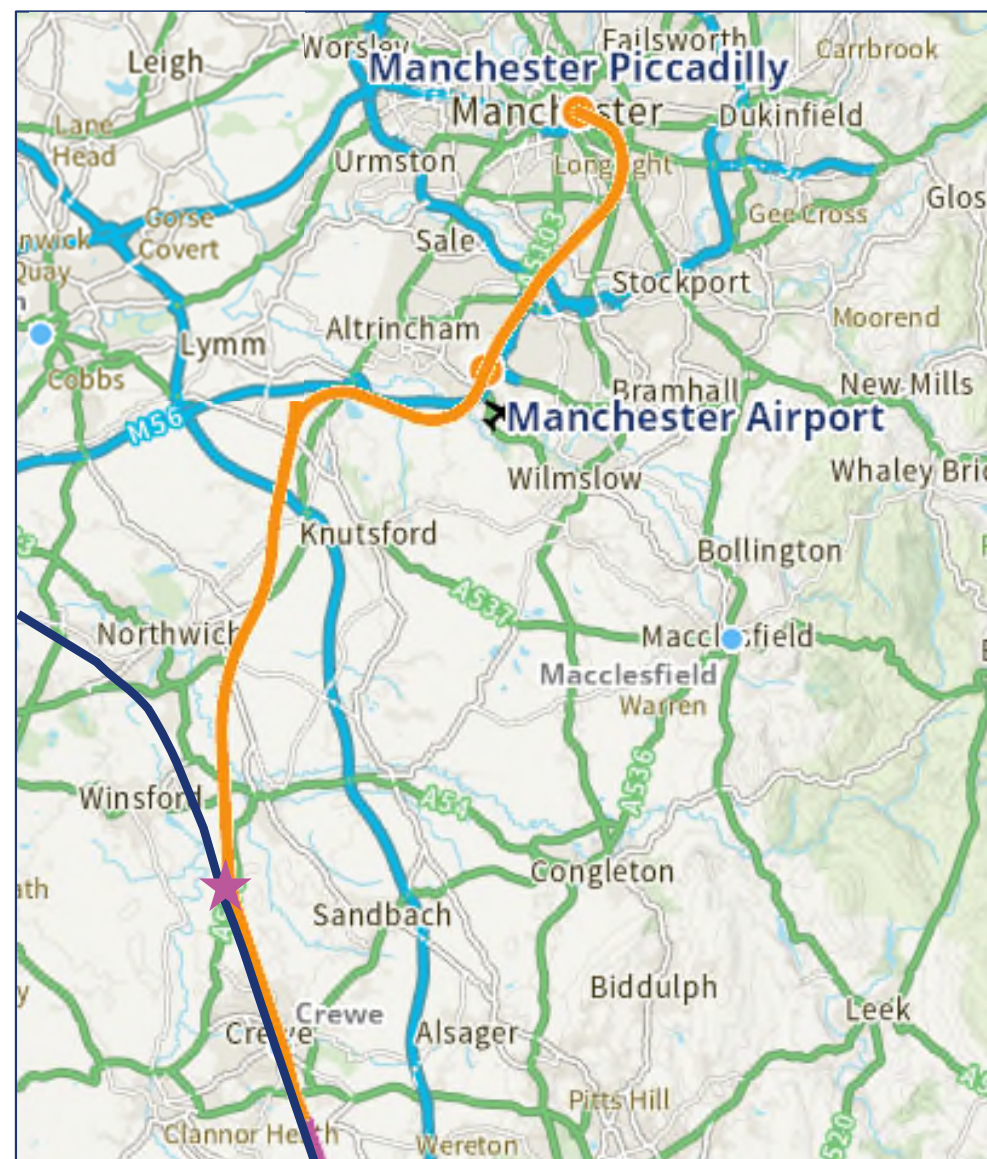
Would be an increase in excess of £4.5billion compared with the Proposed Scheme.

Would likely result in over 11 years of delay to a delivery into service date for the Crewe to Manchester Proposed Scheme.

Crewe North Rolling Stock Depot – Manchester Route Overview

- West Coast Mainline (WCML)
- High Speed Rail Crewe-Manchester Bill

- ★ Crewe North Rolling Stock Depot:
 - 5 miles (8km) north of Crewe
 - Located near Wimboldsley, Cheshire
 - At point where Proposed Scheme and WCML diverge



Route Evolution 2013 - 2016

Phase 2b rolling stock depot locations review

In 2013 HS2 Ltd opened a consultation on Phase 2b scheme refinements. In the consultation, the decision to relocate the Western Leg Depot from the original Golborne site was considered.

Final locations considered as part of the review of the depot included:

- Alternative at Golborne (with alternative footprints and junction configurations);
- Location near Knutsford; and
- Location at Crewe (near Wimboldsley).

Considerations of options on the basis of:

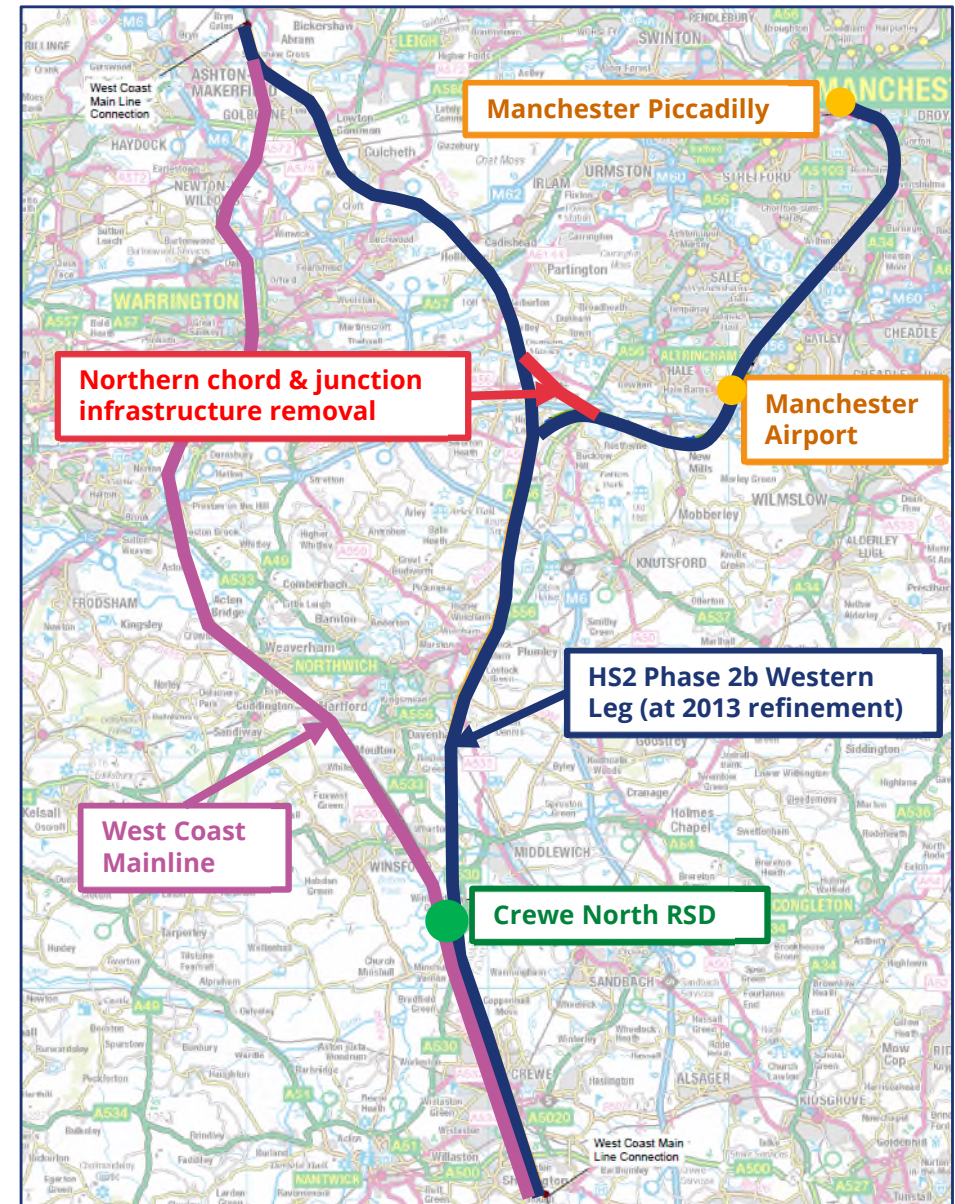
- Constructability;
- Environmental and sustainability impacts;
- Operational performance;
- Journey time;
- Comparative cost; and
- Demand/Business case.

Route Evolution 2013 - 2016

Relocation to Crewe North

In 2017, HS2 Ltd published 'Phase 2b Route Refinements advice to government', including the decision to locate the Western Leg depot to Crewe North.

- Crewe North was considered to be the best performing option, as a result of its central location, ideal for empty coaching stock movements to Manchester, Liverpool and Preston.
- Crewe North has easy access to both the WCML and HS2.
- Crewe North location means 4.5 mile long 'northern chord' and associated grade separated junction infrastructure can be removed, otherwise required to reach a location at Golborne from Manchester (significant cost saving and reduced receptor impacts).



Route Evolution 2013 - 2016

Other Rolling Stock Depot considerations

Crewe North is considered to have lower environmental impacts (listed buildings, landscape and visual) than Golborne and Knutsford options.

Environment Agency and Wildlife Trust preferred the Crewe North location against Golborne due to lower environmental impacts.

Complicated access and egress arrangements to the Knutsford option because of the M6 crossing and proximity to Hoo Green junction.

Knutsford option would require a back shunt move further complicating an M6 crossing (two track to five).

Knutsford option also has no direct connection to the classic network, increasing the length empty of stock movements.

Rolling Stock Depot Requirements

Requirements of a depot for Phase 2b:

- To have direct access to HS2 mainline into Manchester;
- Stabling and maintenance requirements to operate the Train Service Specification (TSS);
- Capability to receive wider gauge captive network trains; and
- Ability to stable up to 53 x 200m long train sets.

This is in addition to using spare stabling at Edge Hill (HS2 Liverpool services), Longsight (HS2 Macclesfield services) and Polmadie (HS2 Scotland services) where HS2 replaces existing WCML services.

Advantages of the Crewe North Rolling Stock Depot

Operationally optimal location as has access to WCML and HS2.

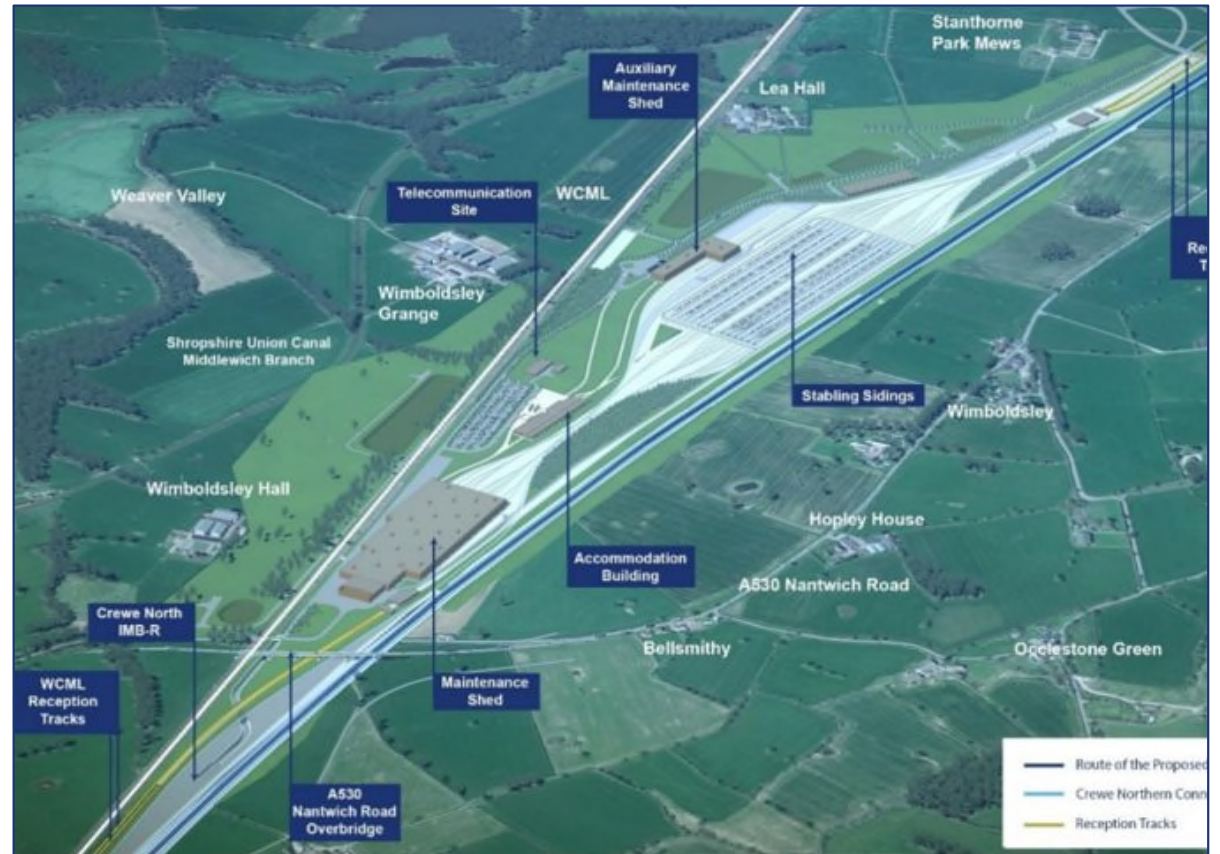
North facing access for services starting and finishing in Manchester and other locations in North West England.

Reduces empty stock movement lengths.

Reduces train path conflict risks.

Visual impact of the depot lessened due to location between WCML and the HS2 mainline.

Most of the land required for other construction works in the Proposed Scheme.



Basford Freight Yard (1)

Petitioner Alternative

Heavily utilised existing rail freight yard, critical to national freight operations.

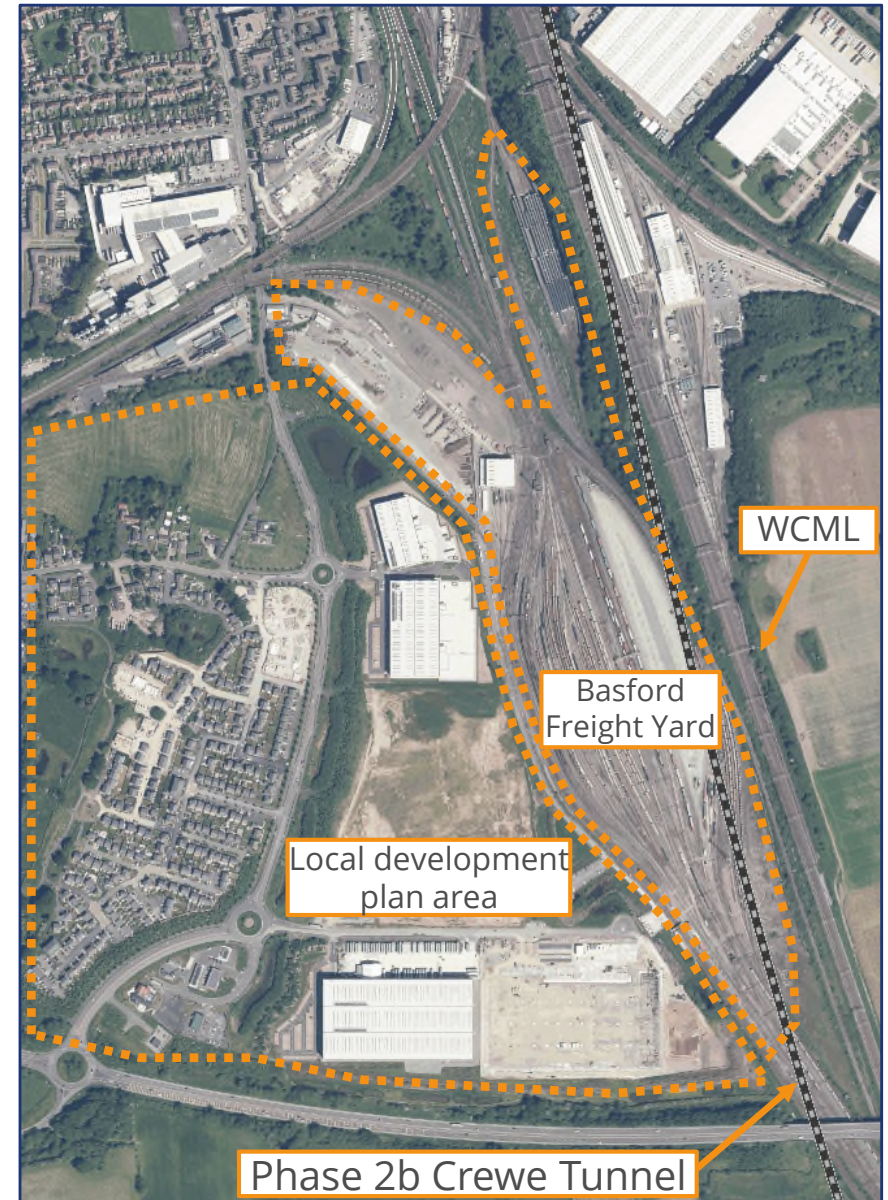
HS2 would be required to re-provide an equivalent freight yard elsewhere on the WCML.

Therefore would need to construct a new freight yard for Network Rail before decommissioning existing, both activities significantly increasing capital cost.

Freight yard relocation would reduce performance of existing freight operations and Basford is sub optimal location for planned HS2 operations.

Land to the west of the freight yard that would also be needed for the size of HS2 Rolling Stock Depot is allocated for other development in Cheshire East Council local development plan and has existing commercial development and residential properties.

Previously considered and discounted in Phase 2a for an alternative location of Stone IMB-R, due to additional impacts and sub optimal performance.



Basford Freight Yard (2)

Required connection to HS2 mainline and WCML

Additional land take for required connection to HS2 mainline.

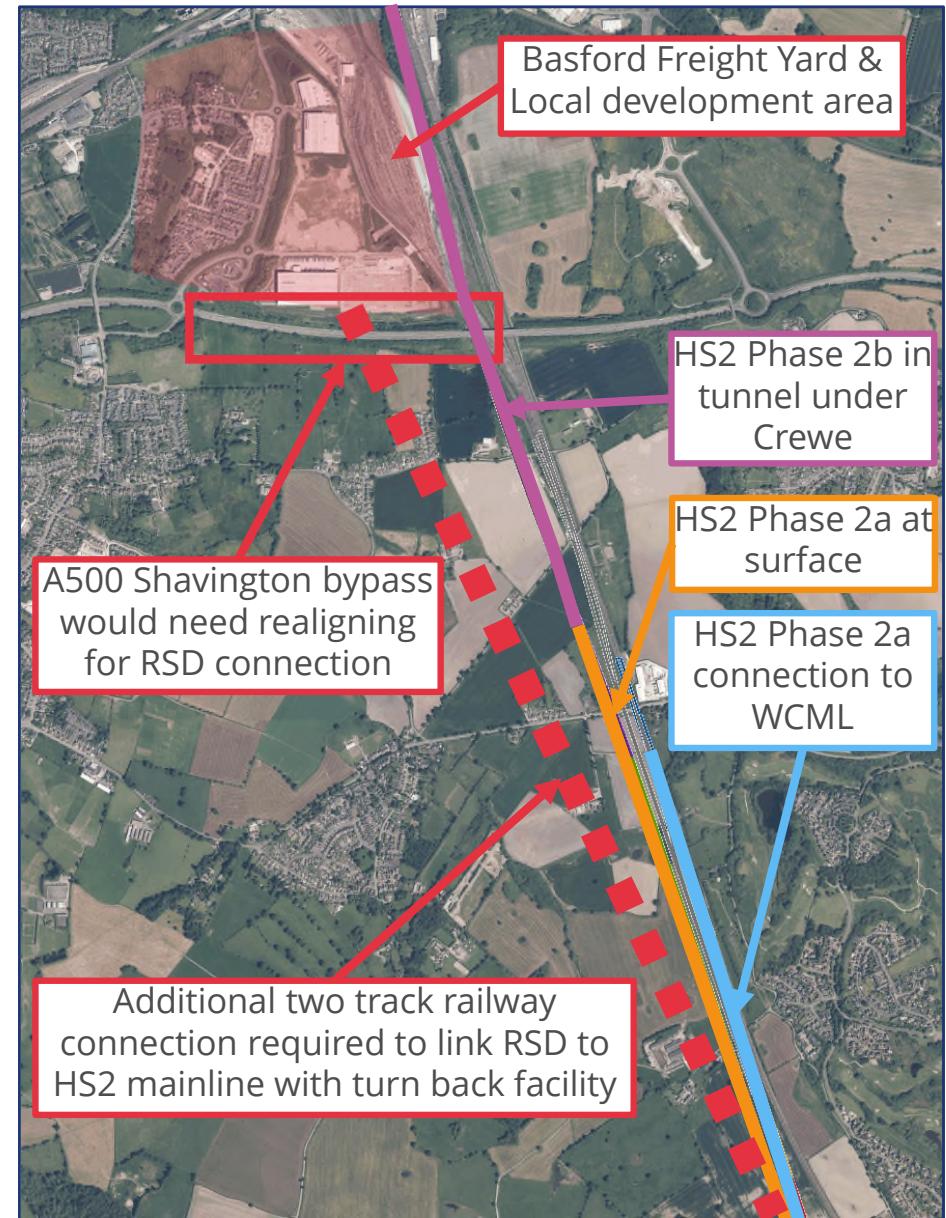
Approximately 3-4 miles of additional infrastructure and junction redesign to tie into HS2 and WCML south of Crewe.

Increased local disruption to road network including the A500 Shavington Bypass.

South facing only - not meeting HS2 requirements.

Significant train turn back facility required south of Crewe Tunnel portal for trains to be able to head north.

Longer empty stock movements for start and end of services from Crewe, Manchester, Liverpool etc.



Network Rail's view on Basford Rail Freight Yard

Current Use

"The majority of Basford Hall Yard is owned by Freightliner, with some of the through lines managed by Network Rail. The yard is probably one of the busiest on the network and is certainly the busiest on North West & Central because of its close proximity with the West Coast Main Line and other key freight artery routes across the network; Scotland, Liverpool, Manchester, West Midlands, South Coast and London.

"The yard currently sees a significant amount of activity being a major inter-connecting hub for intermodal (container) trains. These trains use Basford Hall to split and join with other services in forming long distance trains between the deep sea ports of Felixstowe, London Gateway and Southampton and the inland terminals across the North West and Scotland. The Yard is also used to keep freight away from Crewe station and that section of the West Coast Main Line as a large number of our freight services change drivers, which is done away from the station to improve capacity and performance. The Yard is also a major hub for our engineering haulage contracts which sees ballast trains loaded and the returning materials from worksites being recycled on site.

Network Rail's view on Basford Rail Freight Yard

Future plans and growth for freight traffic

“Over the years the Yard area has got busier, with aggregate and intermodal services either passing through, or calling into the Yard for operational activities; loco changes, attaching and detaching wagons or where services start and terminate and form other trains. All our freight operating companies use the yard in some way, as its position with routes into and out of Crewe makes it a prime location for the services using it.

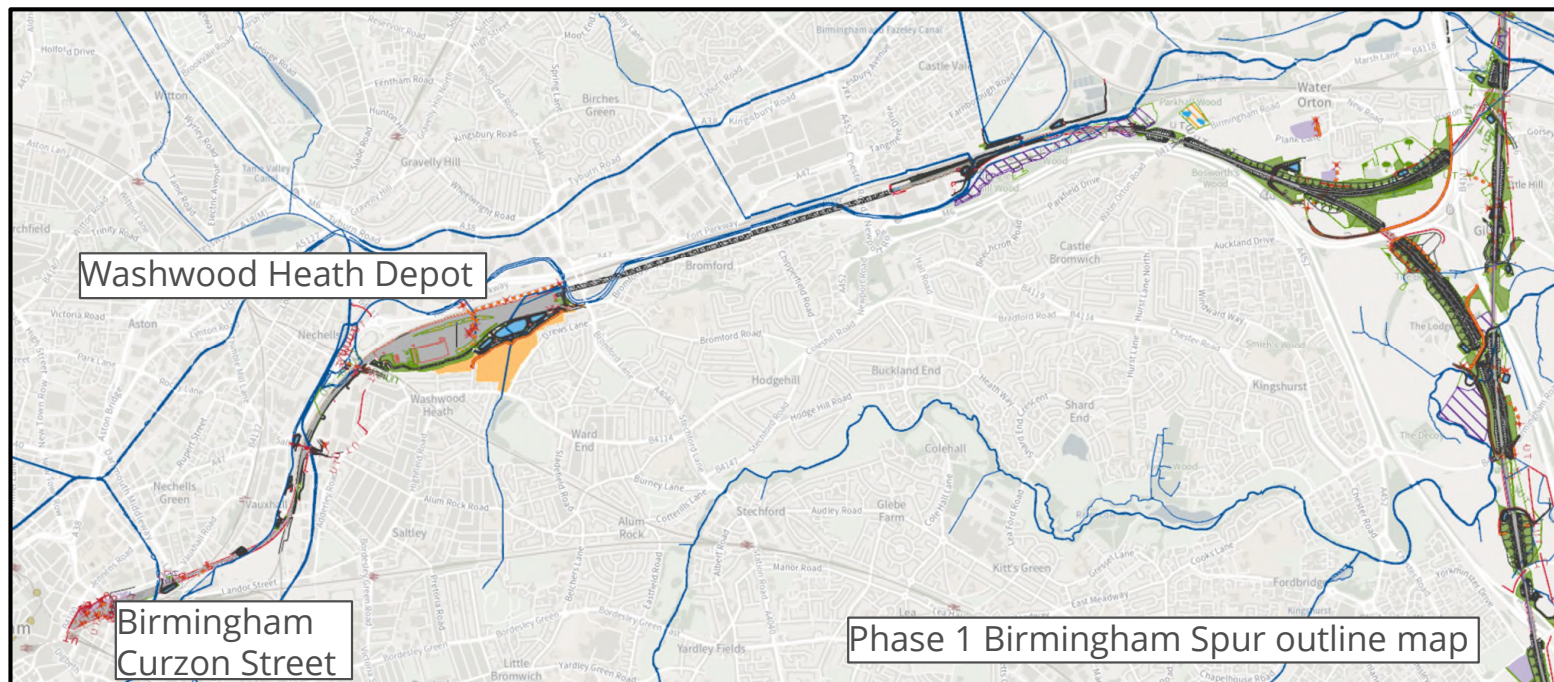
“The predicted growth for intermodal and aggregate traffic over the next 25 years (and beyond) will see Basford Hall increase its operational use and needs to serve the freight industry. The Intermodal sector is predicted to grow significantly in this period and Basford Hall will be a key part of this growth. With the pathing over the WCML, Basford Hall is needed to create capacity on the network and is the only location where multiple trains can be held before departing onto the network.”

Network Rail Senior Route Freight Manager NW&C

Washwood Heath Rolling Stock Depot

Petitioner's request for consideration of alternative locations

- Washwood Heath Rolling Stock Depot located on the Birmingham spur of HS2 Phase 1.
- Stabling and maintenance capacity for 32 x 200m long train sets.
- Capacity is to meet the train service requirements for Phase 1 and Phase 2a.
- It is also capable of some limited stabling for new Phase 2b (Western Leg and East) services that would terminate in Birmingham.
- The Depot reception tracks connect to HS2 mainline facing Birmingham Curzon Street.
- The stabling requirements for Crewe North are in addition to the stabling capabilities of Washwood Heath.



Phase 2b Use of Borrow Pits

Volume 1 of main Environmental Statement (Section 6.11) identifies that:

- Suitable engineering material is required to build embankments on this section of the route.
- There is a significant deficit of acceptable engineering material in the Wimboldsley to Lostock Gralam (MA02) area to construct these embankments.
- To avoid importing material, and the associated increased community and traffic impacts, Borrow Pits are proposed as a source of suitable engineering material.
- Borrow Pits will be backfilled using surplus material (e.g. tunnel arisings) from the Scheme.

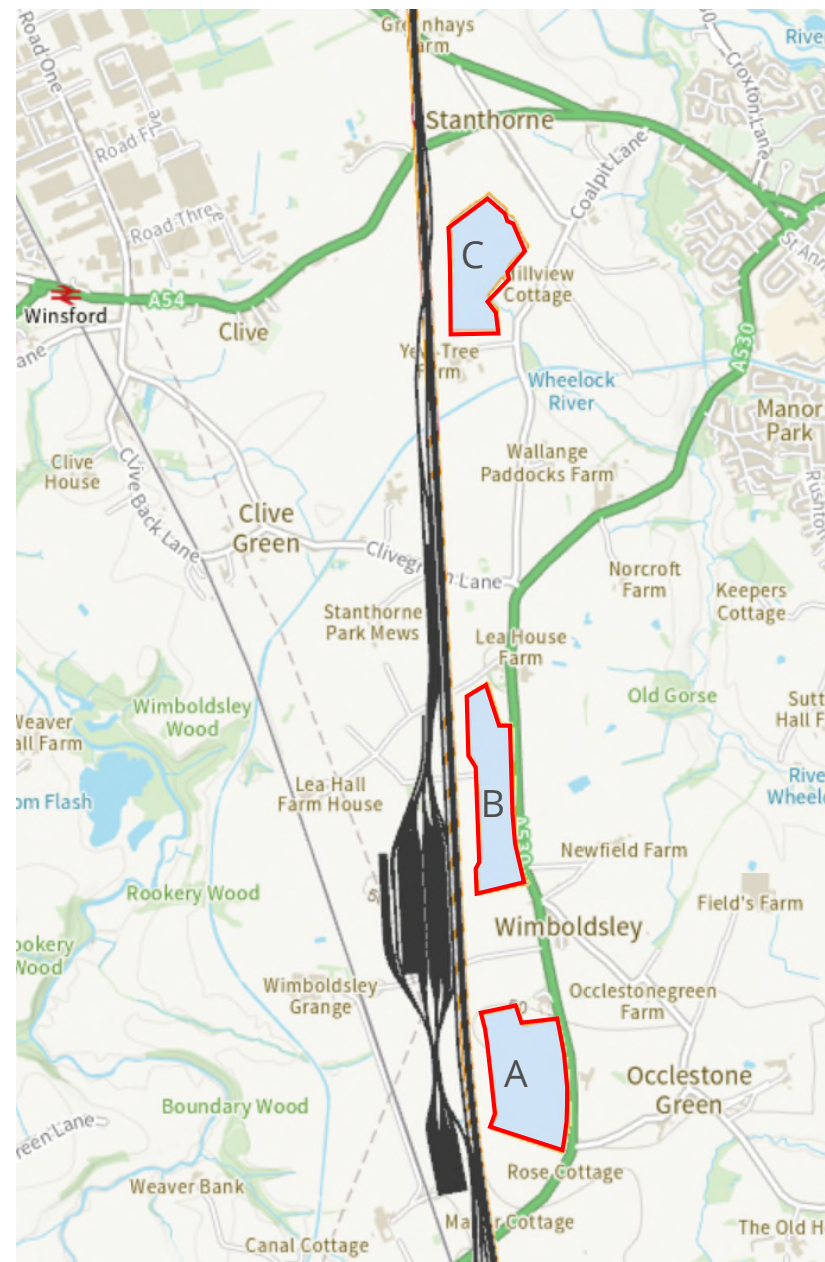
The AP1 Environmental Statement Borrow Pit Report (Section 5) identifies:

- 23 potential borrow pit locations within or near the works.
- 3 shortlisted borrow pits in MA02 which –
 - Contain significant volumes of suitable material.
 - Are located directly adjacent to the trace and in the area where material is required, reducing construction traffic movements.
 - Planned to be backfilled with tunnel arisings transported by conveyor, reducing environmental impacts by removing need to transport material by road and then restored.

MA02 Borrow Pits - Locations

If borrow pits A, B & C were to be removed from the Proposed Scheme, this would mean:

- **An extra 280,000 HGV movements** (140,000 inbound, 140,000 outbound) on local roads to import material.
- **An increase in the distance travelled by 52,000 HGV movements** (26,000 inbound, 26,000 outbound) on local roads to import material.
- **Up to 2,400 additional train paths** (1,200 inbound, 1,200 outbound) on an already busy West Coast Mainline to export material that would have been used to fill the borrow pits.



Borrow Pits – Material

Material from the borrow pits will be used to construct embankments in community area MA02 for the HS2 mainline.

The borrow pit locations have been identified as they contain the required volumes of acceptable engineering material to make up the deficit for required material without needing to import from further afield and increasing HGV movements on local roads.

The suitability of the material has been confirmed from initial ground investigation works.

Borrow Pits - Environmental Controls

Phase 2b Code of Construction Practice - controls include agriculture and soils, construction noise, dust and air quality, working hours, ground settlement, landscape and visual, waste and materials, water resources and flood risk, traffic and transport.

Schedule 17 (Planning Conditions) paragraph 7 – planning authority's approval required for plans or specifications for the excavation of bulk materials from borrow pits.

Information Paper D12: Borrow Pits – the planning authority can refuse approval or impose conditions on grounds of the design or external appearance of the borrow pits, the methods by which they are worked and arrangements as to noise, dust, vibration or screening during their operation.

The planning authority's approval is required for Proposed Scheme of restoration before borrow pit excavation commences.

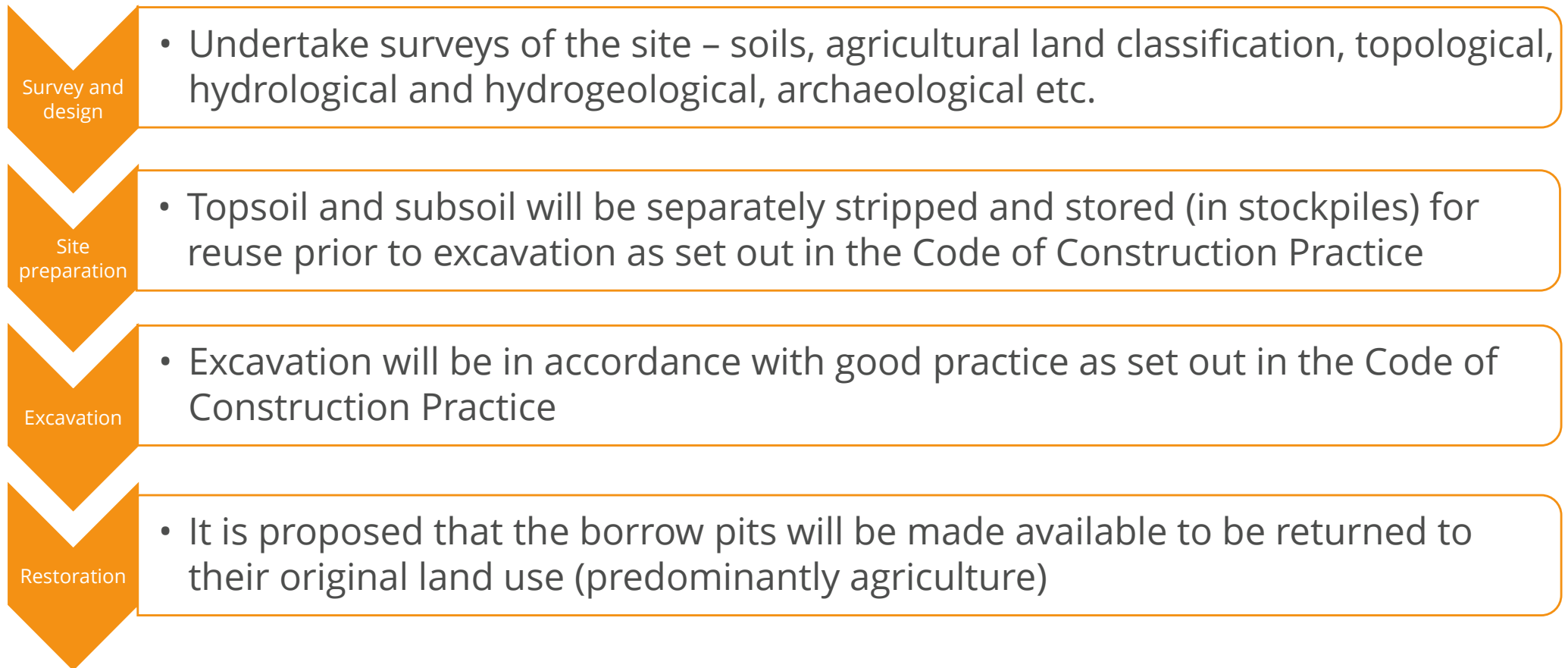
Protective provisions, included at Part 4 of Schedule 32 to the Bill, require approval for details of works likely to affect flood risk, water quality, or groundwater by the appropriate body, prior to undertaking works.

Borrow Pits – Restoration Principles

Section 9.2.2 of the ES Volume 5 Borrow Pit report states:

- the borrow pits will be backfilled using natural, uncontaminated material from the Proposed Scheme excavations and restored using subsoil and topsoil stripped and stored from the site of the borrow pit and, if required, from other areas of the Proposed Scheme;
- it is intended that the borrow pits will be restored to the original ground level and to a condition suitable for their previous land use;
- where agricultural uses are to be resumed on land used for borrow pits, the objective will be to avoid reductions in long-term capability which would downgrade the quality of the disturbed land, through the adoption of good practice in handling, storing and reinstating soils to provide a sufficiently deep soil profile; and
- it is anticipated that there will be no requirement to import additional materials from outside the Proposed Scheme for backfilling of the borrow pits.

Borrow Pits – Restoration Process



Flood risk management

The borrow pits have been located to avoid watercourses.

None of the borrow pits is located within a flood zone risk area.

On restoration, existing baseflow and runoff characteristics will be maintained for surface water features and groundwater will maintain connectivity with the surface water regime.

Drainage systems will be designed to control groundwater as well as sustain baseflow to appropriate nearby watercourses.

Flood risk from multiple sources of flooding (i.e. fluvial, surface water, groundwater, artificial sources) has been considered within the Flood risk assessment appended to the main ES (Volume 5, Appendix WR-005-0MA02) including climate change.

Controlled water management of borrow pit excavation

HS2 Understanding the ground risk across the Cheshire plain, March 2023 report

“4.5.6. The forming of borrow pits in the upper 5 m or so of ground is not predicted to give rise to the risk of aggravating any background salt solution process due to its temporal nature and limited depth. The construction stage specifications shall dictate that surface rainwater runoff into borrow pits is to be properly managed via collector drains and accumulating rainwater shall be assisted by pumping. The water shall be directed via pipework and not disposed via soakaways.

4.5.7. The permissible extent and duration of any temporary diverted water course will be managed as detailed in the draft CoCP. This will protect the quality of surface water and groundwater resources from other adverse effects, including significant changes to the hydrogeological regime. All permanent diverted courses will be permanently lined so as to minimise the leakage of surface water into the ground.”

Emyr Thomas
Sharpe Pritchard LLP
Elm Yard
10-16 Elm Street
London
WC1X 0BJ

By email to: ethomas@sharpepritchard.co.uk

6 April 2023

Dear Emyr,

HIGH SPEED RAIL (CREWE – MANCHESTER) BILL – HOUSE OF COMMONS SELECT COMMITTEE: PETITION HS2-P2B-HOC-110 & HS2-P2B-AP1-116 CHESHIRE WEST AND CHESTER COUNCIL

I am writing to you in my capacity as the Director of Hybrid Bill Delivery at HS2 Ltd, which is acting on behalf of the Promoter of the High Speed Rail (Crewe - Manchester) Bill ('the Bill') currently before Parliament. I understand that your client has a number of concerns about the impact of Phase 2b of HS2 (known as 'the Proposed Scheme') and have submitted petitions on that basis against the Bill and Additional Provision 1 in the House of Commons.

I am writing to you, on behalf of the Secretary of State for Transport, to offer Cheshire West and Chester Council the following assurances to address some of those concerns which have also been raised by Minshull Vernon and District Parish Council and Stanthorne and Wimboldsley Parish Meeting in their respective petitions against the Bill.

Part A - Wimboldsley Primary School

1. In these assurances:-

"Additional Provisions" means any amendment to the Bill requiring further or additional powers to be conferred and which are deposited after the introduction of the Bill in Parliament;

"the Act limits" has the same meaning as given by clause 63(2) to the Bill;

"the Authorised Works" means the works authorised by the Bill;

“the Bill” means the High Speed Rail (Crewe – Manchester) Bill as introduced into Parliament on 24 January 2022 and incorporating the Additional Provisions, and references to “the Bill” include any Act of Parliament enacting the Bill. References in these assurances to clauses and provisions of, and works authorised by, the Bill are taken from the Bill as introduced in the House of Commons on 24 January 2022 but shall be modified as far as may be necessary to reflect changes in any Act of Parliament enacting the Bill;

“the Borrow Pit” means the borrow pit identified as MA02-Borrow Pit B on sheet CT-05-05-309 in the Environmental Statement, Volume 2 (Community Area Map Book) MA02: Wimboldsley to Lostock Gralam;

“the Code of Construction Practice” means the draft Code of Construction Practice for the Proposed Scheme included in Volume 5 of the Environmental Statement deposited in January 2022 in connection with the Bill that is intended to control the construction of the works authorised by the Bill, the final version of which will be produced on Royal Assent;

“the Construction Period” means the period from commencement of any works for construction and delivery of the Proposed Scheme until completion of those works;

“the Deposited Plans” has the meaning given by clause 54 to the Bill;

“the Environmental Statement” means the environmental statement deposited in Parliament in connection with the Bill and includes any additional environmental statement deposited in Parliament in connection with an Additional Provision to the Bill or supplementary environmental statement deposited in connection with the Bill;

“Large Goods Vehicles” has the same meaning as in Part 4 of the Road Traffic Act 1988;

“the nominated undertaker” means the person who is, at the relevant time, the nominated undertaker under clause 42 of the Bill for the purposes of the works to which this assurance relates. The nominated undertaker may be HS2 Ltd, or it may be another body or bodies appointed to oversee the construction and operation of the Proposed Scheme or, in default of any such appointment, the Secretary of State;

“the Petitioner” means Cheshire West & Chester Council of 58 Nicholas Street, Chester, Cheshire CH1 2NP;

“the Promoter” means the Secretary of State for Transport (or any successor Secretary of State or Minister holding the Transport portfolio) in his capacity as promoter of the Bill and includes, so far as relevant, any nominated undertaker exercising any powers or functions under the Bill once enacted;

“the Proposed Scheme” means Phase 2b (Crewe-Manchester) of High Speed 2 as defined in the Bill;

“Royal Assent” means the date upon which Royal Assent is given to the Bill; and

“the School” means Wimboldsley Community Primary School, Nantwich Road, Wimboldsley, Middlewich, Cheshire CW10 0LN.

2. **CONSTRUCTION AIR QUALITY MONITORING**

- 2.1 The Promoter will require the nominated undertaker to treat the construction worksites for the Authorised Works that are situated within the administrative area of the Petitioner as "medium risk" as set out in best practice methodology, currently the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction 2014 ("IAQM, 2014"), as revised from time to time, for the purposes of worksite boundary construction dust monitoring unless and until it is demonstrated by the nominated undertaker's appointed contractor that such construction worksites for the Authorised Works do not meet the criteria to be classed as medium risk under that best practice methodology.
- 2.2 For those construction worksite(s) for the Authorised Works located in the immediate vicinity of the School, worksite boundary automatic continuous construction dust monitoring as set out in Section 7.3 of the draft Code of Construction Practice will be undertaken for any period that such construction worksite(s) are treated as medium risk under paragraph 2.1, and the results will be reported back to the Petitioner in the manner described in Section 7.3 of the draft Code of Construction Practice.

3. **BORROW PIT SCREENING**

- 3.1 The Promoter will, subject to the conditions in paragraph 3.2, require the nominated undertaker where reasonably practicable to create a reasonable and proportionate landscape screening bund to mitigate the visual impact on the School of works to excavate the Borrow Pit (**“the Screening Works”**) subject to the approval of the Screening Works by the relevant local planning authority under Schedule 17 of the Bill.
- 3.2 The conditions referred to in Paragraph 3.1 are that:-
 - 3.2.1 the Screening Works can be provided within the existing powers of the Bill and within the Act limits without the need for any additional land from that identified on the Deposited Plans;
 - 3.2.2 the provision of the Screening Works will not create any new or different environmental effects than those assessed in the Environmental Statement; and
 - 3.2.3 the provision of the Screening Works will not prejudice the safe, timely and economic delivery of the Proposed Scheme.

4. **SCHOOL LANE CONSTRUCTION TRAFFIC**

- 4.1 The Promoter will require the Nominated Undertaker to restrict HS2 Large Goods Vehicles from using School Lane between its junction with Nantwich Road (A530) and Chapel Lane / Forge Mil Lane during the Construction Period, except:-
- 4.1.1 in circumstances where the Authorised Works can only be accessed by Large Goods Vehicles via School Lane;
 - 4.1.2 in circumstances where the Nominated Undertaker is required to use School Lane by the relevant local planning authority under powers conferred on it by paragraph 6 of Schedule 17 to the Bill;
 - 4.1.3 in the case of emergency or if the nominated undertaker is directed to do so by the police or emergency services; or
 - 4.1.4 where not using School Lane for access by Large Goods Vehicles would prejudice the safe, timely and economic delivery of the Proposed Scheme.

Part B - Engagement

1. In this assurance:-

“Additional Provisions” means any amendment to the Bill requiring further or additional powers to be conferred and which are deposited after the introduction of the Bill in Parliament;

“the Bill” means the High Speed Rail (Crewe – Manchester) Bill as introduced into Parliament on 24 January 2022 and incorporating the Additional Provisions, and references to “the Bill” include any Act of Parliament enacting the Bill. References in these assurances to clauses and provisions of, and works authorised by, the Bill are taken from the Bill as introduced in the House of Commons on 24 January 2022 but shall be modified as far as may be necessary to reflect changes in any Act of Parliament enacting the Bill;

“the Code of Construction Practice” means the draft Code of Construction Practice for the Proposed Scheme included in Volume 5 of the Environmental Statement deposited in January 2022 in connection with the Bill that is intended to control the construction of the works authorised by the Bill, the final version of which will be produced on Royal Assent;

“HS2 Community Engagement Framework” means the community engagement framework to be developed by the nominated undertaker in accordance with Section 5.1 of the Code of Construction Practice;

“the nominated undertaker” means the person who is, at the relevant time, the nominated undertaker under clause 42 of the Bill for the purposes of the works to which this assurance relates. The nominated undertaker may be HS2 Ltd, or it may be another body or bodies appointed to oversee the construction and operation of the Proposed Scheme or, in default of any such appointment, the Secretary of State;

“the Promoter” means the Secretary of State for Transport (or any successor Secretary of State or Minister holding the Transport portfolio) in his capacity as promoter of the Bill and includes, so far as relevant, any nominated undertaker exercising any powers or functions under the Bill once enacted;

“the Proposed Scheme” means Phase 2b (Crewe-Manchester) of High Speed 2 as defined in the Bill;

“Royal Assent” means the date upon which Royal Assent is given to the Bill; and

“the School” means Wimboldsley Community Primary School, Nantwich Road, Wimboldsley, Middlewich, Cheshire CW10 0LN.

2. **SPECIAL MANAGEMENT ZONE**

- 2.1 In accordance with the Code of Construction Practice, the Promoter will require the nominated undertaker to ensure that appropriately experienced community engagement personnel are appointed to manage stakeholder and community relationships during the development of the Proposed Scheme within the areas of Minshull Vernon and District Parish Council and Stanthorne & Wimboldsley Parish Meeting Council (**“the Designated Areas”**).
- 2.2 The community engagement team will include:-
 - 2.2.1 A single point of contact for local authorities within the Designated Areas;
 - 2.2.2 A single point of contact for the School;
 - 2.2.3 Named individual points of contact for affected property owners within the Designated Areas; and
 - 2.2.4 A senior manager accountable for the effective implementation of the Code of Construction Practice within the Designated Areas.
- 2.3 The broad duties of the individuals specified in Paragraph 2.2 will include, but will not be limited to:-
 - 2.3.1 Being the first point of contact for communities and local authorities along the line of route of the Proposed Scheme in the Designated Areas;
 - 2.3.2 Managing relationships with local communities, businesses, local authorities and other stakeholders within the Designated Areas;
 - 2.3.3 Raising issues from the community in the Designated Areas within HS2 Ltd for escalation, resolution or clarification;
 - 2.3.4 Monitoring the progress of each item raised and keeping stakeholders within the Designated Areas informed of progress;

- 2.3.5 Ensuring the HS2 Community Engagement Framework is appropriately implemented within the Designated Areas;
- 2.3.6 Attending regular meetings with the lead contractors, local authorities, local communities and other stakeholders within the Designated Areas to discuss construction issues and the forthcoming programme of works for the Proposed Scheme within the Designated Areas;
- 2.3.7 Advising on the appropriate support mechanisms to be provided by the nominated undertaker which will be available to local businesses, property owners and voluntary and community organisations within the Designated Areas that may be affected by the construction of works for the Proposed Scheme; and
- 2.3.8 Liaison with the School, Minshull Vernon and District Parish Council and Stanthorne & Wimboldsley Parish Meeting.

Part C - Footpath Winsford 3/1

1. In this assurance:-

“Additional Provisions” means any amendment to the Bill requiring further or additional powers to be conferred and which are deposited after the introduction of the Bill in Parliament;

“the Act limits” has the same meaning as given by clause 63(2) to the Bill;

“the Bill” means the High Speed Rail (Crewe – Manchester) Bill as introduced into Parliament on 24 January 2022 and incorporating the Additional Provisions, and references to “the Bill” include any Act of Parliament enacting the Bill. References in these assurances to clauses and provisions of, and works authorised by, the Bill are taken from the Bill as introduced in the House of Commons on 24 January 2022 but shall be modified as far as may be necessary to reflect changes in any Act of Parliament enacting the Bill;

“the Footpath” means that part of the existing footpath known as Footpath Winsford 3/1 within the Act limits;

“the nominated undertaker” means the person who is, at the relevant time, the nominated undertaker under clause 42 of the Bill for the purposes of the works to which this assurance relates. The Nominated Undertaker may be HS2 Ltd, or it may be another body or bodies appointed to oversee the construction and operation of the Proposed Scheme or, in default of any such appointment, the Secretary of State;

“the Promoter” means the Secretary of State for Transport (or any successor Secretary of State or Minister holding the Transport portfolio) in his capacity as promoter of the Bill and includes, so far as relevant, any nominated undertaker exercising any powers or functions under the Bill once enacted;

“the Proposed Scheme” means Phase 2b (Crewe-Manchester) of High Speed 2 as defined in the Bill; and

“the Relevant Authority” has the same meaning as given by paragraph 8(14) of Schedule 5 to the Bill.

2. **TEMPORARY STOPPING UP OF FOOTPATH WINSFORD 3/1**

- 2.1 The Promoter will require the nominated undertaker during the construction of the Proposed Scheme to use reasonable endeavours in exercising the powers conferred by paragraph 8 of Schedule 5 of the Bill to temporarily stop up the Footpath to limit the duration of any period of temporary stopping up of the Footpath to a duration for each period of not more than four (4) weeks.
- 2.2 The Promoter will require the nominated undertaker to use reasonable endeavours to provide the Relevant Authority with notice of each proposed period of temporary stopping up of the Footpath under the Bill powers in advance of the nominated undertaker commencing the consultation with that Relevant Authority that is required by paragraph 8(4) of Schedule 5 to the Bill to be undertaken before the nominated undertaker exercises the Bill powers to temporarily stop up the Footpath.

If accepted, these assurances will be included in the Register of Undertakings and Assurances, which is held by the Department for Transport. Drafts of the Register will be published regularly during the passage of the Bill and it will be finalised after Royal Assent. A nominated undertaker will be contractually obliged to comply with all relevant undertakings and assurances set out in the Register. The assurance process is set out in Annex A.

If you have any further queries please don't hesitate to contact Alan Phelan, Petition Manager, on **07780 227796** or alan.phelan@hs2.org.uk.

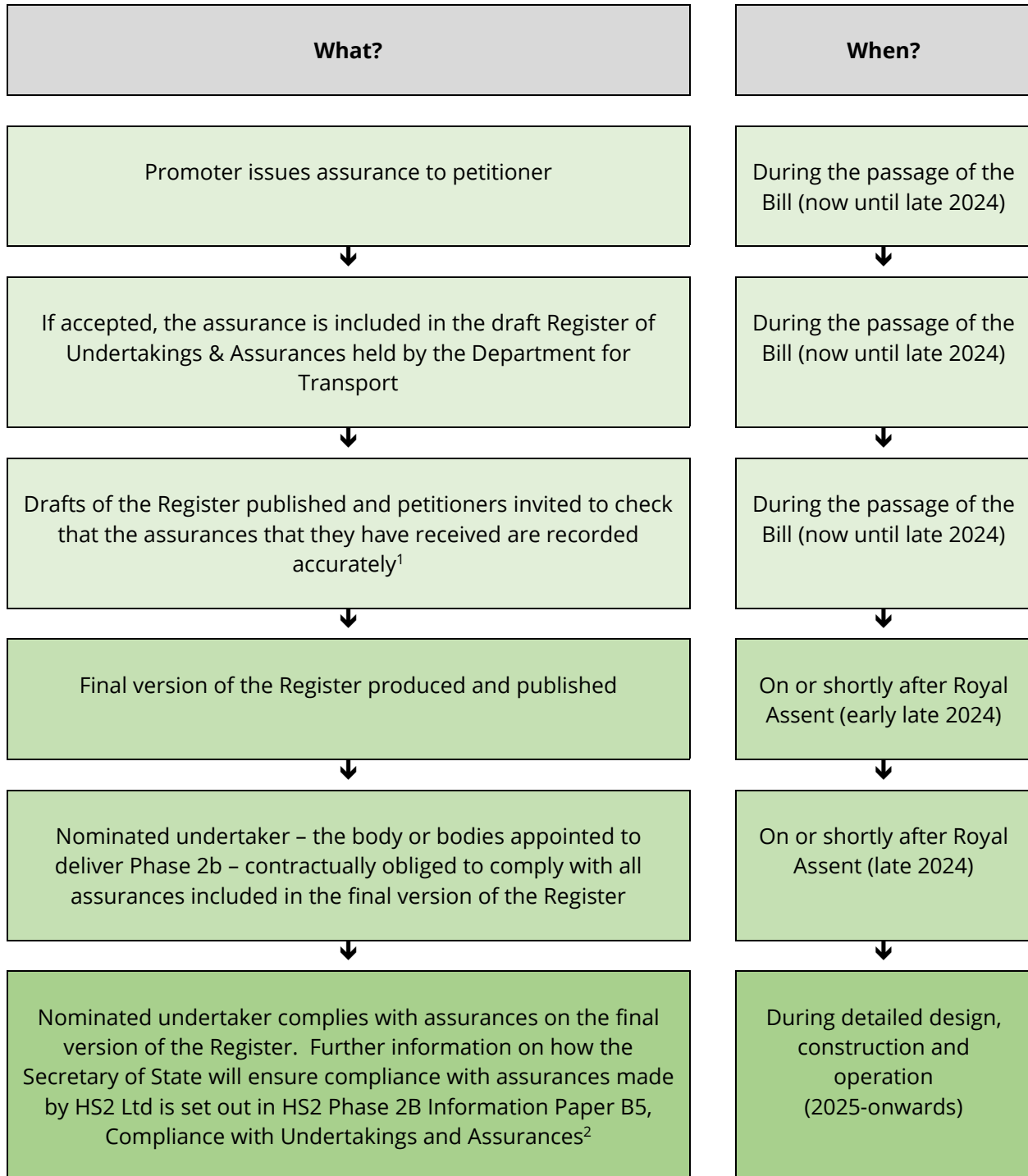
Yours sincerely



Lucy Lagerweij
Director, Hybrid Bill Delivery
High Speed Two (HS2) Limited

Annex A

ASSURANCES: STEPS AND TIMING



¹ The latest draft of the Register can be found at <https://www.gov.uk/government/publications/hs2-phase-2b-crewe-manchester-register-of-undertakings-and-assurances>

² A copy can be found at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1048801/B5_Compliance_with_undertakings_and_assurances_v1.pdf

Sent by email to: grahamdellow@hotmail.com

25 May 2023

Dear Mr Dellow,

HIGH SPEED RAIL (CREWE – MANCHESTER) BILL: PETITION HS2-117- HS2 CHESHIRE RESIDENTS GROUP

I am writing to you in my capacity as Director of Hybrid Bill Delivery at HS2 Ltd, which is acting on behalf of the Promoter of the High Speed Rail (Crewe-Manchester) Bill (the Bill) currently before Parliament.

I understand that you have concerns about the impact of HS2 Phase 2b (known as the Proposed Scheme) and have submitted a petition on behalf of HS2 Cheshire Residents Group on that basis against the Bill in the House of Commons.

A Promoters Response Document was sent to you on the 28 February 2023 setting out our position in relation to the issues you have raised. I understand my colleagues met with you on the 6 March 2023 to further discuss your petition.

I understand that it remains your intention to raise the following petition issues before the Select Committee and our final position is set out below.

Route Alignment

The Promoter's response remains as set out in pages 5 to 18 of the Promoter's Response Document regarding your petition against the Bill sent to you on 28 February 2023.

I am advised that at the meeting on 6 March 2023 between HS2 representatives and members of the HS2 Cheshire Residents Group my colleagues explained our position regarding your proposal for a tunnel that connects the northern portal of the Crewe tunnel with the southern portal of the Manchester tunnel.

During this meeting you provided new information in relation to the proposal in your petition, which you subsequently provided by email to my colleague. In summary you set out that your tunnel proposal would start at the southern portal of the Crewe Tunnel, rather than the

northern portal. The alignment would move east of Crewe and would no longer be as straight as possible to connect to the Manchester Tunnel.

I subsequently wrote to you on 13 March 2023 to request further details on your proposal to place the alignment of the Proposed Scheme in tunnel that you intend to raise as part of the proceedings in relation to your petition. I note that you have not provided any further details on your proposal.

We have reviewed the new information you provided in March 2023 in the time available. This alternative tunnel alignment still crosses areas of Cheshire salt geology similar to your original alternative straight tunnel alignment.

Following further consideration of these alternative tunnel alignments the Promoter's position remains that placing the alignment of the Proposed Scheme in tunnel is inferior relative to the deposited Proposed Scheme for several reasons, including the following:

- Your proposal for a tunnel alignment would not enable the needs of the HS2 Phase 2b Strategic Business Case to be fulfilled and would thus preclude the provision of wider connectivity through the connections for Northern Powerhouse Rail and the West Coast Mainline, and for a Crewe Northern Connection.
- Your proposal would displace the site of Crewe North Rolling Stock Depot, which is a critical strategic facility required for HS2 rolling stock maintenance and fleet stabling.
- Your proposal removes the provision of the Manchester Airport High Speed Station, which would likely significantly impact passenger numbers as a result of the reduction in access for a large population centre in south Manchester and adversely impact business case benefits associated with the delivery of the Phase 2b Crewe to Manchester Proposed Scheme.
- Your proposal also suggests an underground Manchester Piccadilly Station. As per previous correspondence, the Promoter remains of the view that a combined HS2/NPR surface station is the right solution.

Notwithstanding all the issues mentioned above, the cost of your proposal would be an increase in excess of £4.5billion compared with the Proposed Scheme. The proposal would also likely result in over 11 years of delay to a delivery into service date for the Crewe to Manchester Proposed Scheme. This is based on a delay of approximately four years for additional design and scheme development, environmental assessment submission and then approval of a new hybrid Bill. Construction would then take at least an additional seven years compared with the Proposed Scheme.

Crewe North Rolling Stock Depot

The Promoter's response remains as set out in pages 19 – 26 of the Promoter's Response Document regarding your petition against the Bill sent to you on 28 February 2023.

In your petition you mention “other, far more suitable brownfield sites” for the rolling stock depot. The Promoter is not aware of any such sites. Despite our request in paragraph 22 on page 23 of the Promoter’s Response Document that you provide details of the sites you are referring to, I understand you have not done so. We would encourage you to provide this information now so that it can be considered by the Promoter. Late disclosure of information on which you rely may well cause delay to the consideration of your petition and/or a waste of the Select Committee’s time, which are outcomes the Promoter is keen to avoid.

The Promoter has provided several assurances to Cheshire West and Chester Council in respect of the communities in the immediate vicinities of the Crewe North Rolling Stock Depot and mitigating the effects of the Proposed Scheme during construction on Wimboldsley Community Primary School. These assurances have been included in Annex A for your information.

Ground Conditions

As you will be aware, further to the Promoter’s response on ground conditions as set out in pages 26 - 28 of the Promoter’s Response Document, a report was published on 3 March 2023 which provides a review of the ground conditions, the associated risks, and the mitigation measures for the Crewe-Manchester Proposed Scheme. This report titled “Crewe to Manchester - Understanding the Ground Risk across the Cheshire Plain” can be viewed from the following link:

<https://www.gov.uk/government/publications/hs2-phase-2b-select-committee-crewe-to-manchester-understanding-the-ground-risk-across-the-cheshire-plain>

The concerns over ground conditions have been raised by other petitioners and debated during the House of Commons Select Committee hearings for petitioners on the 20 March, 27 March and 17 April 2023. The recordings of these hearing can be accessed on Parliament TV, here: <https://www.parliamentlive.tv/Commons> .

I hope that the information set out above and through our earlier correspondence and discussion gives the HS2 Cheshire Residents Group the reassurance you were seeking in response to the issues raised in your petition.

The Select Committee have emphasised their desire that the Promoter and Petitioners seek to narrow down the issues between them as far as possible in advance of the hearing so that they can focus on issues which remain in dispute.

Therefore, in order to assist with the efficient running of the Committee process, we would be grateful if you could clarify whether, in light of the information set out above and through our earlier engagement with you, you have any outstanding concerns in relation to the issues raised in your petition and if so, identify what those issues are.

Please provide this clarification by return of email or letter to Rachna.Shah@hs2.org.uk by 30 May 2023.

For any further queries please don't hesitate to contact Rachna Shah, Senior Petition Manager, at Rachna.Shah@hs2.org.uk or 07881 792217.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Lucy Lagerweij', with a large, stylized initial 'L'.

Lucy Lagerweij

Director, Hybrid Bill Delivery
High Speed Two (HS2) Limited

Annex A – Assurances issued to Cheshire West and Chester Council regarding Wimboldsley Community Primary School and engagement with Parish Council's

Please note the paragraph numbers in the assurances below are as per the assurances provided through separate correspondence with Cheshire West and Chester Council.

Wimboldsley Community Primary School

In these assurances:-

“Additional Provisions” means any amendment to the Bill requiring further or additional powers to be conferred and which are deposited after the introduction of the Bill in Parliament;

“the Act limits” has the same meaning as given by clause 63(2) to the Bill;

“the Authorised Works” means the works authorised by the Bill;

“the Bill” means the High Speed Rail (Crewe – Manchester) Bill as introduced into Parliament on 24 January 2022 and incorporating the Additional Provisions, and references to “the Bill” include any Act of Parliament enacting the Bill. References in these assurances to clauses and provisions of, and works authorised by, the Bill are taken from the Bill as introduced in the House of Commons on 24 January 2022 but shall be modified as far as may be necessary to reflect changes in any Act of Parliament enacting the Bill;

“the Borrow Pit” means the borrow pit identified as MA02-Borrow Pit B on sheet CT-05-05-309 in the Environmental Statement, Volume 2 (Community Area Map Book) MA02: Wimboldsley to Lostock Gralam;

“the Code of Construction Practice” means the draft Code of Construction Practice for the Proposed Scheme included in Volume 5 of the Environmental Statement deposited in January 2022 in connection with the Bill that is intended to control the construction of the works authorised by the Bill, the final version of which will be produced on Royal Assent;

“the Construction Period” means the period from commencement of any works for construction and delivery of the Proposed Scheme until completion of those works;

“the Deposited Plans” has the meaning given by clause 54 to the Bill;

“the Environmental Statement” means the environmental statement deposited in Parliament in connection with the Bill and includes any additional environmental statement deposited in Parliament in connection with an Additional Provision to the Bill or supplementary environmental statement deposited in connection with the Bill;

“IP E13” means the HS2 Phase 2b Western Leg Information Paper E13: Control of construction noise and vibration;

“Large Goods Vehicles” has the same meaning as in Part 4 of the Road Traffic Act 1988;

“the nominated undertaker” means the person who is, at the relevant time, the nominated undertaker under clause 42 of the Bill for the purposes of the works to which this assurance relates. The nominated undertaker may be HS2 Ltd, or it may be another body or bodies appointed to oversee the construction and operation of the Proposed Scheme or, in default of any such appointment, the Secretary of State;

“the Petitioner” means Cheshire West & Chester Council of 58 Nicholas Street, Chester, Cheshire CH1 2NP;

“the Promoter” means the Secretary of State for Transport (or any successor Secretary of State or Minister holding the Transport portfolio) in his capacity as promoter of the Bill and includes, so far as relevant, any nominated undertaker exercising any powers or functions under the Bill once enacted;

“the Proposed Scheme” means Phase 2b (Crewe-Manchester) of High Speed 2 as defined in the Bill;

“Royal Assent” means the date upon which Royal Assent is given to the Bill; and

“the School” means Wimboldsley Community Primary School, Nantwich Road, Wimboldsley, Middlewich, Cheshire CW10 0LN.

2. **CONSTRUCTION AIR QUALITY MONITORING**

- 2.1 The Promoter will require the nominated undertaker to treat the construction worksites for the Authorised Works that are situated within the administrative area of the Petitioner as "medium risk" as set out in best practice methodology, currently the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction 2014 ("IAQM, 2014"), as revised from time to time, for the purposes of worksite boundary construction dust monitoring unless and until it is demonstrated by the nominated undertaker's appointed contractor that such construction worksites for the Authorised Works do not meet the criteria to be classed as medium risk under that best practice methodology.
- 2.2 For those construction worksite(s) for the Authorised Works located in the immediate vicinity of the School, worksite boundary automatic continuous construction dust monitoring as set out in Section 7.3 of the draft Code of Construction Practice will be undertaken for any period that such construction worksite(s) are treated as medium risk under paragraph 2.1, and the results will be reported back to the Petitioner in the manner described in Section 7.3 of the draft Code of Construction Practice.

3. **BORROW PIT SCREENING**

- 3.1 The Promoter will, subject to the conditions in paragraph 3.2, require the nominated undertaker where reasonably practicable to create a reasonable and proportionate

landscape screening bund to mitigate the visual impact on the School of works to excavate the Borrow Pit ("**the Screening Works**") subject to the approval of the Screening Works by the relevant local planning authority under Schedule 17 of the Bill.

3.2 The conditions referred to in Paragraph 3.1 are that:-

- 3.2.1 the Screening Works can be provided within the existing powers of the Bill and within the Act limits without the need for any additional land from that identified on the Deposited Plans;
- 3.2.2 the provision of the Screening Works will not create any new or different environmental effects than those assessed in the Environmental Statement; and
- 3.2.3 the provision of the Screening Works will not prejudice the safe, timely and economic delivery of the Proposed Scheme.

4. **SCHOOL LANE CONSTRUCTION TRAFFIC**

4.1 The Promoter will require the Nominated Undertaker to restrict HS2 Large Goods Vehicles from using School Lane between its junction with Nantwich Road (A530) and Chapel Lane / Forge Mil Lane during the Construction Period, except:-

- 4.1.1 in circumstances where the Authorised Works can only be accessed by Large Goods Vehicles via School Lane;
- 4.1.2 in circumstances where the Nominated Undertaker is required to use School Lane by the relevant local planning authority under powers conferred on it by paragraph 6 of Schedule 17 to the Bill;
- 4.1.3 in the case of emergency or if the nominated undertaker is directed to do so by the police or emergency services; or
- 4.1.4 where not using School Lane for access by Large Goods Vehicles would prejudice the safe, timely and economic delivery of the Proposed Scheme.

4. **CONTROL OF CONSTRUCTION NOISE**

4.1 The Promoter will require the Nominated Undertaker in designing the construction of any of the HS2 Works which may be forecasted to cause adverse construction noise effects which could adversely affect the carrying out of educational activities from within the Wimboldsley School's existing buildings to take reasonable steps to seek to control such construction noise effects within Wimboldsley School's existing buildings to the construction noise impact levels set out in Table 2 of Appendix A of IP E13 for non-residential school buildings.

4.2 In the event that notwithstanding the steps taken in accordance with paragraph 4.1 above the noise effects from the construction of any of the HS2 Works are forecasted

by the Nominated Undertaker to exceed within Wimboldsley School's existing buildings the construction noise impact levels set out in Table 2 of Appendix A of IP E13 for non-residential school buildings, then taking account of the special circumstances of the educational activities carried out from within the Wimboldsley School's existing buildings, the Promoter will require the Nominated Undertaker to treat Wimboldsley School as a special case for the purposes of IP E13 and to either:

- 4.2.1 offer to install such appropriate noise insulation measures for Wimboldsley School's existing buildings as may be identified by the Nominated Undertaker in accordance with Appendix B of IP E13 ("**the Identified Measures**") prior to the start of the construction of any of the HS2 Works which are forecasted to exceed within Wimboldsley School's existing buildings the construction noise impact levels set out in Table 2 of Appendix A of IP E13 for non-residential school buildings, subject to all necessary approvals being obtained for the installation of the Identified Measures and the Nominated Undertaker being granted such access to Wimboldsley School as is required by the Nominated Undertaker to install the Identified Measures; or
- 4.2.2 offer in accordance with Appendix B of IP E13 a grant to the Wimboldsley School in order for the Wimboldsley School to install the Identified Measures.

Engagement

1. In this assurance:-

"Additional Provisions" means any amendment to the Bill requiring further or additional powers to be conferred and which are deposited after the introduction of the Bill in Parliament;

"the Bill" means the High Speed Rail (Crewe – Manchester) Bill as introduced into Parliament on 24 January 2022 and incorporating the Additional Provisions, and references to "the Bill" include any Act of Parliament enacting the Bill. References in these assurances to clauses and provisions of, and works authorised by, the Bill are taken from the Bill as introduced in the House of Commons on 24 January 2022 but shall be modified as far as may be necessary to reflect changes in any Act of Parliament enacting the Bill;

"the Code of Construction Practice" means the draft Code of Construction Practice for the Proposed Scheme included in Volume 5 of the Environmental Statement deposited in January 2022 in connection with the Bill that is intended to control the construction of the works authorised by the Bill, the final version of which will be produced on Royal Assent;

"HS2 Community Engagement Framework" means the community engagement framework to be developed by the nominated undertaker in accordance with Section 5.1 of the Code of Construction Practice;

“the nominated undertaker” means the person who is, at the relevant time, the nominated undertaker under clause 42 of the Bill for the purposes of the works to which this assurance relates. The nominated undertaker may be HS2 Ltd, or it may be another body or bodies appointed to oversee the construction and operation of the Proposed Scheme or, in default of any such appointment, the Secretary of State;

“the Promoter” means the Secretary of State for Transport (or any successor Secretary of State or Minister holding the Transport portfolio) in his capacity as promoter of the Bill and includes, so far as relevant, any nominated undertaker exercising any powers or functions under the Bill once enacted;

“the Proposed Scheme” means Phase 2b (Crewe-Manchester) of High Speed 2 as defined in the Bill;

“Royal Assent” means the date upon which Royal Assent is given to the Bill; and

“the School” means Wimboldsley Community Primary School, Nantwich Road, Wimboldsley, Middlewich, Cheshire CW10 0LN.

2. **SPECIAL MANAGEMENT ZONE**

2.1 In accordance with the Code of Construction Practice, the Promoter will require the nominated undertaker to ensure that appropriately experienced community engagement personnel are appointed to manage stakeholder and community relationships during the development of the Proposed Scheme within the areas of Minshull Vernon and District Parish Council and Stanthorne & Wimboldsley Parish Meeting Council (**“the Designated Areas”**).

2.2 The community engagement team will include:-

2.2.1 A single point of contact for local authorities within the Designated Areas;

2.2.2 A single point of contact for the School;

2.2.3 Named individual points of contact for affected property owners within the Designated Areas; and

2.2.4 A senior manager accountable for the effective implementation of the Code of Construction Practice within the Designated Areas.

2.3 The broad duties of the individuals specified in Paragraph 2.2 will include, but will not be limited to:-

2.3.1 Being the first point of contact for communities and local authorities along the line of route of the Proposed Scheme in the Designated Areas;

2.3.2 Managing relationships with local communities, businesses, local authorities and other stakeholders within the Designated Areas;

- 2.3.3 Raising issues from the community in the Designated Areas within HS2 Ltd for escalation, resolution or clarification;
- 2.3.4 Monitoring the progress of each item raised and keeping stakeholders within the Designated Areas informed of progress;
- 2.3.5 Ensuring the HS2 Community Engagement Framework is appropriately implemented within the Designated Areas;
- 2.3.6 Attending regular meetings with the lead contractors, local authorities, local communities and other stakeholders within the Designated Areas to discuss construction issues and the forthcoming programme of works for the Proposed Scheme within the Designated Areas;
- 2.3.7 Advising on the appropriate support mechanisms to be provided by the nominated undertaker which will be available to local businesses, property owners and voluntary and community organisations within the Designated Areas that may be affected by the construction of works for the Proposed Scheme; and
- 2.3.8 Liaison with the School, Minshull Vernon and District Parish Council and Stanthorne & Wimboldsley Parish Meeting.

HS2 CREWE TO MANCHESTER

**A Note on Ground Risk across the
Cheshire Plain**

**A Report Prepared by GCG, led by
Professor Lord Robert Mair
CBE FREng FICE FRS**

5th April 2023

HS2

Crewe to Manchester

A Note on Ground Risk across the Cheshire Plain

5th April 2023

1. Introduction

1.1 This Note has been prepared by Professor Lord Robert Mair and Dr Chris Menkiti of Geotechnical Consulting Group (GCG). The purpose of the Note is to comment on the following documents:

- *Briefing Statement: HS2 2B route across the Cheshire Salt District North of Crewe*. Report by Dr Rosalind Todhunter, dated 6 July 2022 (hereinafter referred to as the ‘Todhunter report’)
- *Crewe to Manchester, Understanding the Ground Risk across the Cheshire Plain*. Report by HS2, dated 3rd March 2023 (hereinafter referred to as the ‘HS2 report’)

2. Background

2.1 The proposed HS2 line will cross the Cheshire Plain, an area of relatively flat topography, comprising mainly rural pasture and crop fields. The alignment of the Proposed Scheme crosses the Cheshire Plain in areas of former salt mining and other areas where salt mining is ongoing.

2.2 Throughout this Area of Interest, there are flashes and meres. Flashes are existing water bodies which have formed in depressions in the ground surface resulting from ground settlement, which has been induced by either historic mining collapse or salt dissolution processes. Meres are shallow lakes, likely to have originated at depressions formed from glacial scouring.

2.3 The HS2 Proposed Scheme will be on low embankments and, in some locations, on viaducts and bridge structures. There is a history of ground settlement in the area, arising from historic mining and from salt dissolution processes. The scheme is therefore likely to experience longer term ground settlements in its operational mode. This is addressed later in this Note.

3. Ground conditions and geotechnical risks

3.1 The HS2 report comprehensively describes the geology and ground conditions, including the hydrology (surface water) and hydrogeology (sub-surface groundwater). This information has been gained from detailed desk studies comprising reviews of published data sources, including borehole information held by the British Geological Survey (BGS), and consultations with mining companies operational within the area.

3.2 Geomorphological mapping (i.e. mapping the landforms and their development) has also been undertaken to identify higher priority locations in respect of potential salt dissolution hazard.

Advanced ground investigations, comprising boreholes and cone penetration tests (CPTs) have been undertaken at these targeted locations in 2020 and 2021. Currently, a time history of LiDAR¹ and InSAR² surveys are being studied by HS2 to identify locations of settlement within the alignment corridor.

- 3.3 LiDAR means Light Detection and Ranging and refers to a remote sensing technique that uses pulsed radar to survey a zone of ground.
- 3.4 InSAR stands for Interferometric Synthetic Aperture Radar. It is a satellite-based remote sensing method that can generate high-resolution images using radio and microwaves.
- 3.5 Appendix C of the HS2 report describes both LiDAR and InSAR techniques and associated data already gathered for the proposed alignment by HS2.

4. Further investigations

- 4.1 At this stage of a scheme, it is reasonable not to have undertaken fully comprehensive ground investigations in the form of many more boreholes and CPTs. HS2 is now planning for more ground investigations to further understand the ground conditions. Further supplementary investigations will be essential for the detailed design of the scheme; these will be at a later stage. However, there is sufficient geotechnical information at present on which to base the horizontal and vertical alignment of the Proposed Scheme.
- 4.2 Further investigations informing the detailed design development will also include collection and analysis of LiDAR and InSAR data to obtain information on surface depressions and settlements of the ground in the Area of Interest, as described above. Further comments on the value of LiDAR and InSAR are made in section 7.

5. Potential geotechnical risks

- 5.1 The Todhunter report identifies the complex geological issues in the Area of Interest, highlighting the influence of rock salt dissolution on potential future ground subsidence. Other concerns expressed in the report relate to artesian groundwater pressures in some superficial layers. However, this does not appear to be directly related to salt dissolution; it is a different and more common geotechnical problem associated with the impact of elevated porewater pressures in cohesionless deposits.

¹ From 1998 to present

² From 1995 to 2020

- 5.2 The HS2 report also addresses natural salt dissolution, controlled brine extraction and the potential effects at the ground surface. It notes that, with the cessation of wild brining more than four decades ago, ongoing dissolution along brine runs is expected to be at a slow rate. It also discusses the specific geological conditions leading to collapse at the ground surface, known as ‘sink holes’, noting that there have been no reported instances of sink hole formation arising from salt dissolution across the Area of Interest. This includes a review of data from the Cheshire Brine Compensation Board, for which HS2 report that “The Cheshire Brine Compensation Board stated that in the decade following 2006³ they had received [only] one notice of damage within 1km of the HS2 route” and for this “compensation [was] rejected as [it was] not attributable to salt dissolution”.
- 5.3 The Todhunter report also identifies the need for careful drainage design and this is recognised by HS2. We agree with this.
- 5.4 In summary, we agree with the broad mechanisms of potential salt dissolution hazards identified both in the Todhunter report and the HS2 report, and that there is likely to be future ground subsidence. This must be allowed for in the detailed design of the Proposed Scheme. The Todhunter report refers to “extensive ground instability” in several places. This is potentially misleading, implying that these mechanisms at depth will be manifested at the ground surface as extensive instability in terms of their interaction with the proposed embankments and structures. Whereas long-term surface ground movements that occur can be managed, as discussed in this Note.

6. Proposed scheme response

- 6.1 Although future ground subsidence is to be expected, the HS2 report outlines how this can be safely accommodated by the detailed design of the Proposed Scheme. Bridges and viaducts will be on piled foundations, with the piles taken down to adequate depths; the decks of these structures will be designed to have jacking facilities if there is a need to adjust them in the future.
- 6.2 The Proposed Scheme will be mainly on low embankments, which will probably incorporate geogrid reinforcement; these stiffer embankments will mitigate against effects of ground subsidence, but there may also be a need to adjust the rails to allow for ongoing settlement. The settlement development is likely to be slow and such adjustment is feasible.
- 6.3 A key to the approach outlined in the HS2 report is to mitigate the risk of ongoing settlement (including incipient sinkholes at the ground surface) by firstly adopting engineering solutions, such

³ after cessation of the last known brine operation - the New Cheshire Salt Works, situated in Wincham 2km from the route alignment, which ceased trading in June 2006

as those discussed in paragraphs 6.1 to 6.2 above, and then dealing with any further settlement by means of comprehensive monitoring and appropriate maintenance interventions.

- 6.4 The combination of further ground investigations, risk assessments, use of engineered solutions, detailed monitoring of movements of both the ground and the railway, and a detailed response plan for both anticipated and unexpected ground movement (termed ‘adaptive interventions’ in the HS2 report) will ensure that the Proposed Scheme can be operated safely.

7. Monitoring and surveillance technologies

- 7.1 The HS2 report refers to the use of LiDAR and InSAR for remote sensing of the settlement of the Proposed Scheme. We fully agree with this. Following the tragic train derailment near Carmont (west of Stonehaven), Scotland in August 2020 after a period of intense rainfall, Network Rail appointed Lord Mair to chair a Task Force Review of their management of earthworks (i.e., cuttings and embankments) across the whole Network Rail system. The Review focused on Network Rail’s capability and methodology for the management of railway cuttings and embankments, particularly in the light of climate change. The Task Force report, published in February 2021 (ref[1]), contained a total of 54 recommendations, including the need for significant investment in the updating of monitoring and surveillance methods.

- 7.2 Chapter 10 of the Task Force report focused on the importance of monitoring and surveillance technologies and drew attention to the considerable value of InSAR, using satellite technology. An application of InSAR for railways is shown in Figure 10.5 from the Task Force report (extract below) in which the technology was applied to the entire railway network of the Netherlands, more than 3000 km long, using hundreds of Radarsat-2 acquisitions between 2010 and 2015, leading to the first satellite-based nationwide railway monitoring system. The resulting deformation map for the Netherlands railways is shown in Figure 10.5 (a) of the Network Rail report, and a more detailed “flagging system” risk map is shown in Figure 10.5(b). The risk map, based on the satellite measurements combined with expert judgement, shows areas with < -10 mm/year (indicating a settlement rate exceeding 10mm/year), and those with $> +8$ mm/year (indicating a heave rate exceeding 8mm per year); these are highlighted by the red and blue flags, respectively.

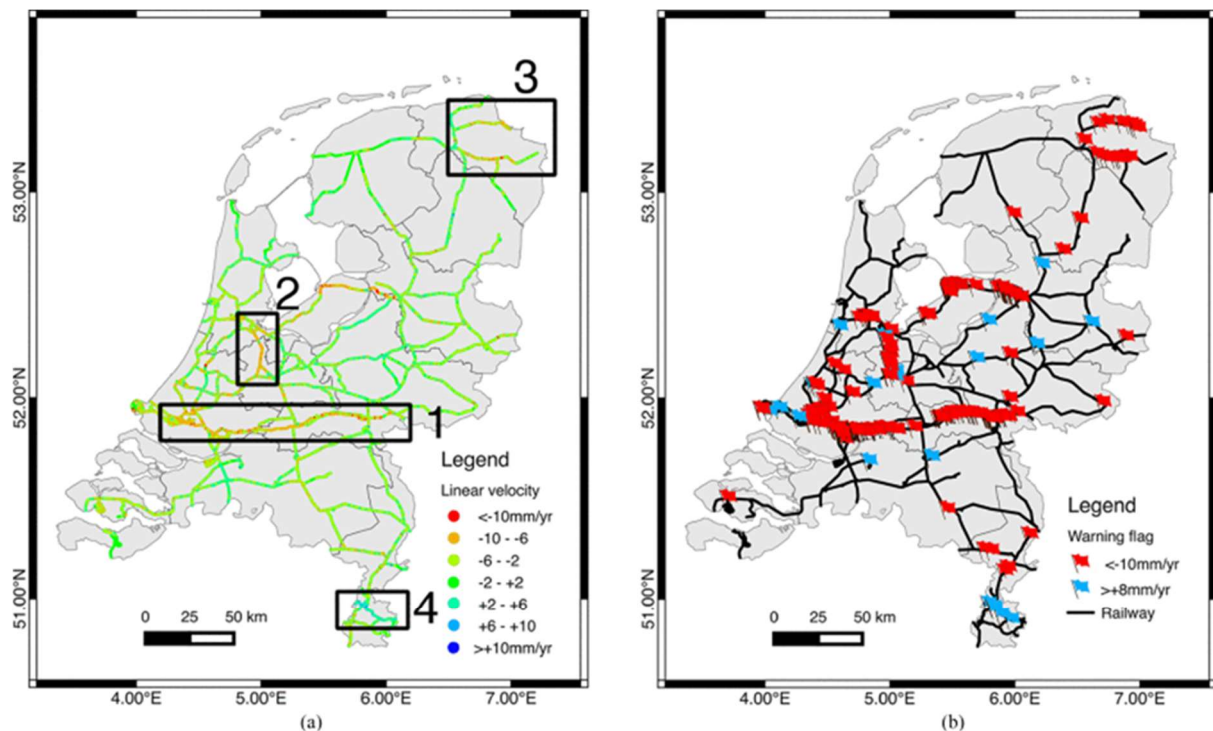


Figure 10.5: (a) Deformation map for Netherlands railway network derived from satellite observations. (b) Risk map, in which the coloured flags indicate the severity of the deformation (negative means settlement, positive means heave). Ling Chang et al (2018)

Extract from ref [1]

7.3 The recent experience for the Netherlands railway network illustrates the potential for InSAR to be used to monitor and control the performance of the HS2 Proposed Scheme. InSAR is clearly a promising technology which is developing rapidly, particularly with rapid developments in AI and machine learning.

7.4 InSAR is also capable of providing warning of impending instability. An example of its potential use for providing warning of bridge foundation scour is illustrated in Figure 10.4 from the Task Force report (see below). On 29th December 2015, following a period of intense rainfall and flooding, the masonry bridge at Tadcaster suffered a partial collapse into the River Wharfe due to scour of its foundations. Figure 10.4 shows subsequent analysis of InSAR data indicating settlement of the bridge being a precursor to failure; measurements several weeks before the failure indicate rapidly increasing settlement, almost certainly caused by earlier flooding and scour. This is a good example of the potential for InSAR technology for providing evidence of settlement as a precursor to subsequent instability and failure. It is highly relevant to providing warning of a possible, although unlikely, development of a sink hole beneath the HS2 Proposed Scheme.

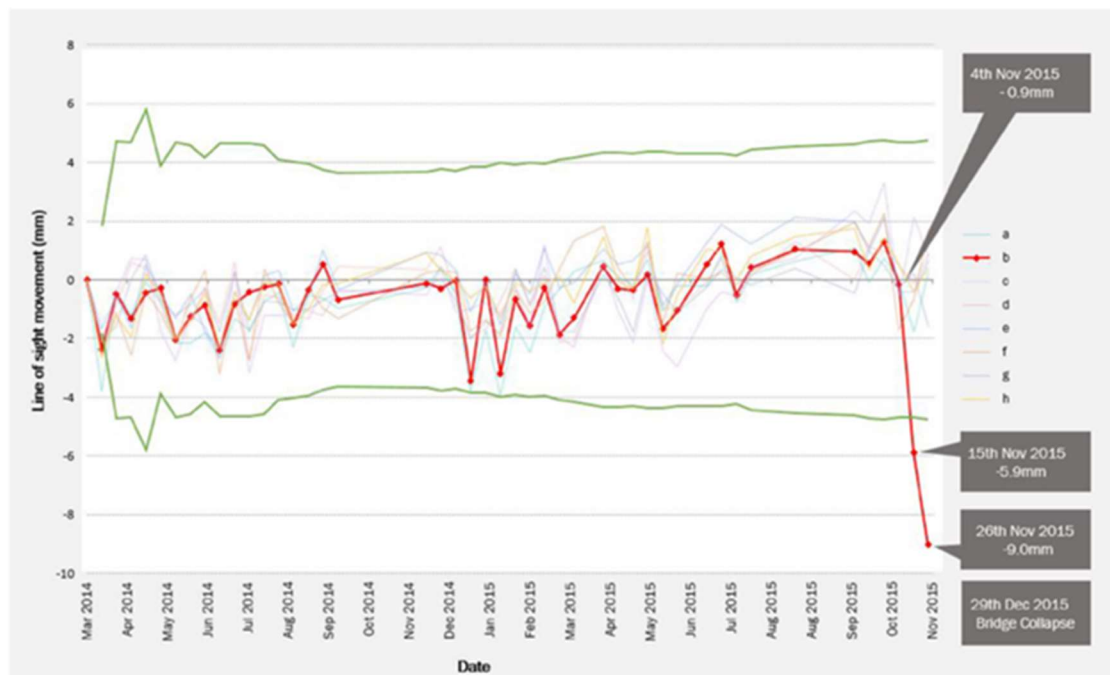


Figure 10.4: Vertical movements of masonry bridge at Tadcaster inferred from InSAR data, indicating rapidly increasing settlement several weeks before bridge failure occurred due to scour of its foundations during flooding of the River Wharfe (Selvakumaran, S et al, 2018)

Extract from ref [1]

7.5 Chapter 10 of the Task Force report also highlights a number of other new technologies for monitoring, including wireless tiltmeter systems recently trialled by Network Rail (see Figure 10.3 below, which has been extracted from the Task Force report). The tiltmeters transmit their measurements through a wireless communications network to a gateway, and thereby are loaded onto the internet. Readings can be taken every five minutes or at even higher frequencies, and alert levels set to give suitable warnings. These are an extremely promising application of innovative sensor development to the management of infrastructure such as the HS2 Proposed Scheme.

7.6 The roles of monitoring and mitigation are recognised in the Todhunter report⁴.

⁴ e.g., Section 4 paragraph 3



Figure 10.3: Wireless tiltmeters around a tunnel portal (Network Rail presentation, 9 October 2020)

Extract of ref [1]

7.7 Distributed fibre optic sensing (DFOS) provides a powerful technique for measurement of deformation and for advance warning of adverse ground movements. Controlled field experiments for early detection of sink hole development have recently been undertaken by HS2, Cambridge University and others (Xu et al, 2022). These were designed to assess the use of a newly developed geogrid for early warning of localised ground movement – see Fig.1 below. The geogrid is integrated with DFOS strain cables during the manufacturing process (referred to as a Sensorgrid). The trial results showed that the Sensorgrid configuration is highly sensitive to strain and can detect very small vertical displacement.

7.8 This innovative technology has considerable relevance to the HS2 Proposed Scheme, in which geogrids are likely to be incorporated in embankments in certain areas.

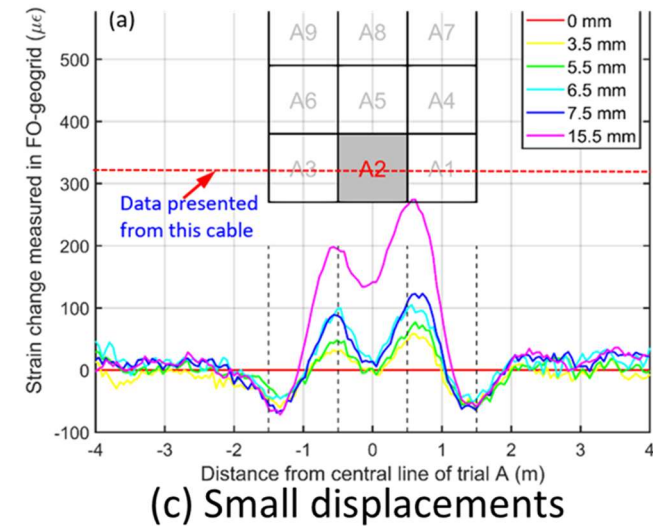
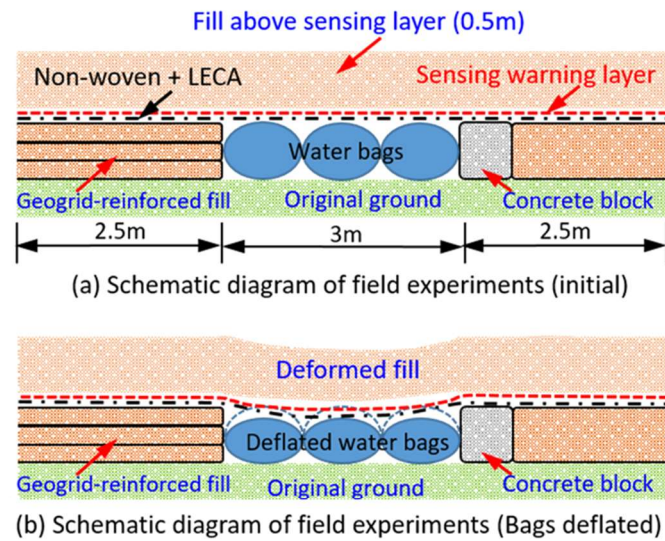


Fig.1 Field simulation of ground movement: (a) Schematic diagram of field experiments at the initial stage; (b) Schematic diagram of field experiments when bags deflated; (c) results for deflation of cell A2, small displacements results, (d) Construction of field experimental setup (after Xu et al, 2022)

8. Conclusions

- 8.1 Since the refined alignment was published in 2016 (ref [2]), additional surveys and studies have been undertaken by HS2 in the Cheshire Plain area, including desk studies of BGS boreholes, data harvesting from salt mine operators, geomorphological mapping and risk categorisation for salt solution landforms, new InSAR and LiDAR surveys, and new ground investigations comprising boreholes and CPTs.
- 8.2 Therefore, it appears, at this stage, that there is sufficient ground investigation information for HS2 to define the vertical and horizontal alignment in the Cheshire Plain area.
- 8.3 Nevertheless, further extensive ground investigation and surveys will be undertaken to fully develop the design and to inform construction planning.
- 8.4 Complex geological mechanisms apply in the Area of Interest, related to the influence of rock salt dissolution. These are well recognised in both the Todhunter report and the HS2 report and we agree that these potential geological hazards are important and applicable. These geological mechanisms will result in ongoing surface settlement that must be accommodated by the HS2 project, both during construction and in the operational life of the railway. The HS2 report discusses many engineering techniques for addressing such challenges.
- 8.5 It is common in infrastructure engineering for structures to be designed to tolerate ground movements. The techniques referenced in the HS2 report are well-established engineering methods that have been successfully used many times. We see no reason why they cannot be successfully used in the Cheshire Plain for the HS2 Proposed Scheme.
- 8.6 Indeed, for the efficient and safe operation of a high speed train, track maintenance with level corrections is a reality, regardless of any underlying time-dependent ground movements.
- 8.7 The ongoing settlements in the Cheshire Plain would be addressed by HS2 by risk categorisation and engineered solutions during design and construction, and in the operational life of the railway by monitoring, surveillance and appropriate maintenance interventions.
- 8.8 There have been significant advances in monitoring and surveillance technologies in recent years, e.g. LiDAR, InSAR, wireless tiltmeters and fibre optic sensing, most of which are being implemented by Network Rail. Adoption of such technologies will be of considerable benefit to the HS2 Proposed Scheme in ensuring safe construction and operation of the railway.
- 8.9 It is noteworthy that the West Coast Main Line railway and other railways have successfully operated in the same area for a long period.

8.10 Based on the information we have reviewed, we see no insurmountable obstacle to the successful construction and operation of the HS2 Proposed Scheme.

8.11 Climate change might promote faster salt solution mechanisms resulting in quicker rates of surface settlement. A climate change resilience assessment was undertaken by HS2 as part of its Environmental Impact Assessment. The result was that “All climate change related risks during operation have been assessed to be ‘low’ or ‘medium’ due to the range of mitigation measures”. We are satisfied that the proposed HS2 construction stage mitigations, as well as the monitoring and surveillance strategies for the operational stage jointly provide resilience to potential climate change impacts.

9.0 References

- [1] A Review of Earthworks Management, prepared by a Task Force led by Professor Lord Robert Mair for Network Rail, February 2021 <https://www.networkrail.co.uk/wp-content/uploads/2021/03/Network-Rail-Earthworks-Review-Final-Report.pdf>
- [2] High Speed Two Phase 2b, Crewe to Manchester West Midlands to Leeds, Route Refinement Consultation 2016 – Consultation document, November 2016.
- [3] Xiaomin Xu, Cedric Kechavarzi, David Wright, Graham Horgan, Hartmut Hangen, Nicholas De Battista, Dave Woods, Edgar Bertrand, Sarah Trinder, Nick Sartain (2022) “Fibre optic instrumented geogrid for ground movement detection”, 11th International Symposium on Field Monitoring in Geomechanics ,London, 4th – 8th September, 2022

Ground conditions

Promoter's response

On 3rd March 2023 the Promoter published a report entitled "Crewe to Manchester - Understanding the Ground Risk across the Cheshire Plain".

The March Report can be viewed at the following link: [HS2 Phase 2b Select Committee: Crewe to Manchester - Understanding the Ground Risk across the Cheshire Plain - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/114444/HS2_Phase_2b_Select_Committee_Crewe_to_Manchester_-_Understanding_the_Ground_Risk_across_the_Cheshire_Plain.pdf)

The March Report provides a review of the ground conditions, the associated risks, and the mitigation measures for the Crewe to Manchester Proposed Scheme.

HS2

Crewe to Manchester

Understanding the Ground Risk across the Cheshire Plain

3rd March 2023

Overview of the March Report

Ground conditions

The alignment of the Proposed Scheme passes across the Cheshire Plain in areas of former salt mining and other areas where salt mining is ongoing. The March Report addresses geological concerns in this area and sets out:

- HS2 Ltd's understanding and interpretation of the existing ground conditions;
- How the route alignment and developed design has taken account of those ground conditions; and
- How HS2 Ltd plans to gather further information, develop the design, construct, and operate the Proposed Scheme.

Based on interpretation of information obtained to date and the derived engineering approach, HS2 Ltd, in conjunction with its designers and technical advisors, considers that the route alignment is appropriate for the intended purpose, and that geological challenges can be both managed and mitigated during detailed design and construction so as to provide a safe operational railway.

Conclusion of the March Report

Ground conditions

The scale of the ground related challenges and their solutions are commensurate with the purpose of the Proposed Scheme as key national infrastructure, and comparable to the scale of other ground related challenges that can be encountered in the operation of other high-speed railways.

The Proposed Scheme has been designed with sufficient inbuilt resilience, along with practical measures for routine maintenance and adaptive design, which can be put in place in achievable timeframes, to mitigate against climate change during operation.

Route Alignment

Ground conditions

The Proposed Scheme was selected to minimise the risks posed by ground conditions in the Cheshire plain. In particular, the route selected:

- Avoids major areas of former high subsidence as marked by flashes, with the one exception of Billinge Flash;
- Avoids a line of Meres that broadly align southeast of Rostherne Mere;
- Avoids areas of ground subsidence such as those which the Cheshire Brine Compensation Board defines as requiring statutory consultation in relation to any new development;
- Does not pass within 2 km of any known former locations of historical wild brine well pumping sites, with one possible exception, a suspected brine well in the vicinity of Clive Green Lane;
- Avoids clusters of subsidence features as historically mapped by BGS;
- Avoids historical and controlled salt mines, whether remediated or not, with the exception of Winsford Rock Salt mine; and
- Avoids existing brining extraction and gas storage caverns, passing just west and northwest of Warmingham and Holford brinefields respectively.

It is not possible to select a route which avoids entirely all possible sources of risk posed by the ground conditions.

Design response

General risk mitigation by design

The Proposed Scheme has been designed to account for the risks posed by ground conditions in the Cheshire plain as outlined below.

Adapted precautionary mitigation measures are proposed against the risk of subsidence, which are typical for the construction of infrastructure in these types of ground condition, or for high-speed rail systems in general including:

- The viaducts will be supported by piers on piled foundations because of the potentially relatively low strength of the near-surface soils. The piles can be lengthened into more stable ground.
- Surface rainwater run-off from embankments, and viaducts to be collected by lined drainage systems and held temporarily in lined balancing ponds, before discharge to river courses. Rainwater not concentrated and not percolating through the ground to give rise to the risk of salt dissolution.
- The track forms can have built in design features to allow for corrections of vertical rail geometry in operation.
- Differential settlements arising from the ground can be addressed through the design and routine maintenance aspects of the track form.

Design response

General risk mitigation by design of vertical horizontal and vertical alignment

The selection of structural infrastructure including viaducts and bridges is driven by the need to cross over existing natural features such as rivers and existing major infrastructure. The viaducts are sufficiently high so as to provide necessary headroom. This infrastructure will be designed to account for the risks posed by ground conditions.

Where the Proposed Scheme continues north and has passed beyond the area of wet rockhead, long cuttings can be incorporated without risk of salt dissolution. At Hoo Green Lane and Rostherne the design has lowered the alignment to pass under the A556 and M56.

Design response

Site Specific Risk Mitigation Design

Solutions are proposed at Clive Green Lane and Billinge Flash. The final choice of mitigation solution will be based on interpretation of further ground investigation.

Winsford Rock Salt mine - viaduct structures and embankment are proposed. The piles of the viaduct structures will not reach the wet rockhead level, nor any of the salt layers. The mine is not materially impacted by the Proposed Scheme.

Construction Stage Response

The draft CoCP references measures to be implemented which include undertaking ground investigation, risk assessments, monitoring of ground movement, groundwater and ground gas.

Ground movement will be monitored using a master network of positional and level datums which would be tied into national level bedrock datums. INSAR and LiDAR surveys would be used during the construction stage to monitor ground movements in direct response to construction stage activities.

Operational Stage Response

Risk mitigating measures by adaptive interventions

Operation and maintenance of the railway will make use of digital information and monitoring techniques to detect:

- ground movements from the legacy effects of former salt brining activity
- salt dissolution from climate change impacts.

Due to the transient nature of ground surface settlements, the operational safety of the railway will need solutions which are able to make corrections for settlements which are outside of expectation.

Adaptive measures can include provisions for track raising, OCS raising, bridge deck raising, and interventions to the foundations, and future 'new technology' that will occur during the 120 year lifetime of the railway.

The monitoring data will allow early decisions on the application of the adaptive design elements accommodated for, or built into the infrastructure, and hence avoid unnecessary interruptions to operations.

Ground investigation works

Ground conditions

Under the process of desktop study, a significant amount of data gathering has been undertaken to inform the Proposed Scheme design with specific reference to the geology, hydrogeology and ground conditions.

HS2 Ltd has carried out detailed reviews of published data sources and a series of consultations with mining companies operational within the area so as to establish the ground conditions in the area.

Subsequently, advanced ground investigations were undertaken at targeted locations in 2020 and 2021. The data from these investigations has been used to reinforce the understanding from the desktop study, refine risk assessments, and will contribute to informing the detailed design development.

Further ground investigations will be carried out as the Proposed Scheme is taken forward.

Alternative alignment following the M6

Ground conditions

The proposed route via Crewe with a connection with the WCML near Crewe provides greater strategic benefit including connectivity to northwest England (including Chester, Liverpool and Warrington) and north Wales. This route also performs more favourably from a sustainability perspective compared with the other alternative routes including the M6 corridor, as it will require fewer demolitions and will be further away from a number of settlements across the Cheshire plain.

Routes following the M6 corridor would have similar impacts and geological challenges associated with passing over the Cheshire plain but would require a less favourable location for the junction of the HS2 WCML connection and the HS2 Manchester spur.

The decision to serve Crewe was confirmed by the Secretary of State in 2015. Neither of the alternative corridors (via the M6 or Airport) would serve Crewe.

HS2

Phase 2b (Crewe – Manchester)

A Note on Ground Risk across the Cheshire Plain

A Report Prepared by GCG, led by Professor Lord Robert Mair

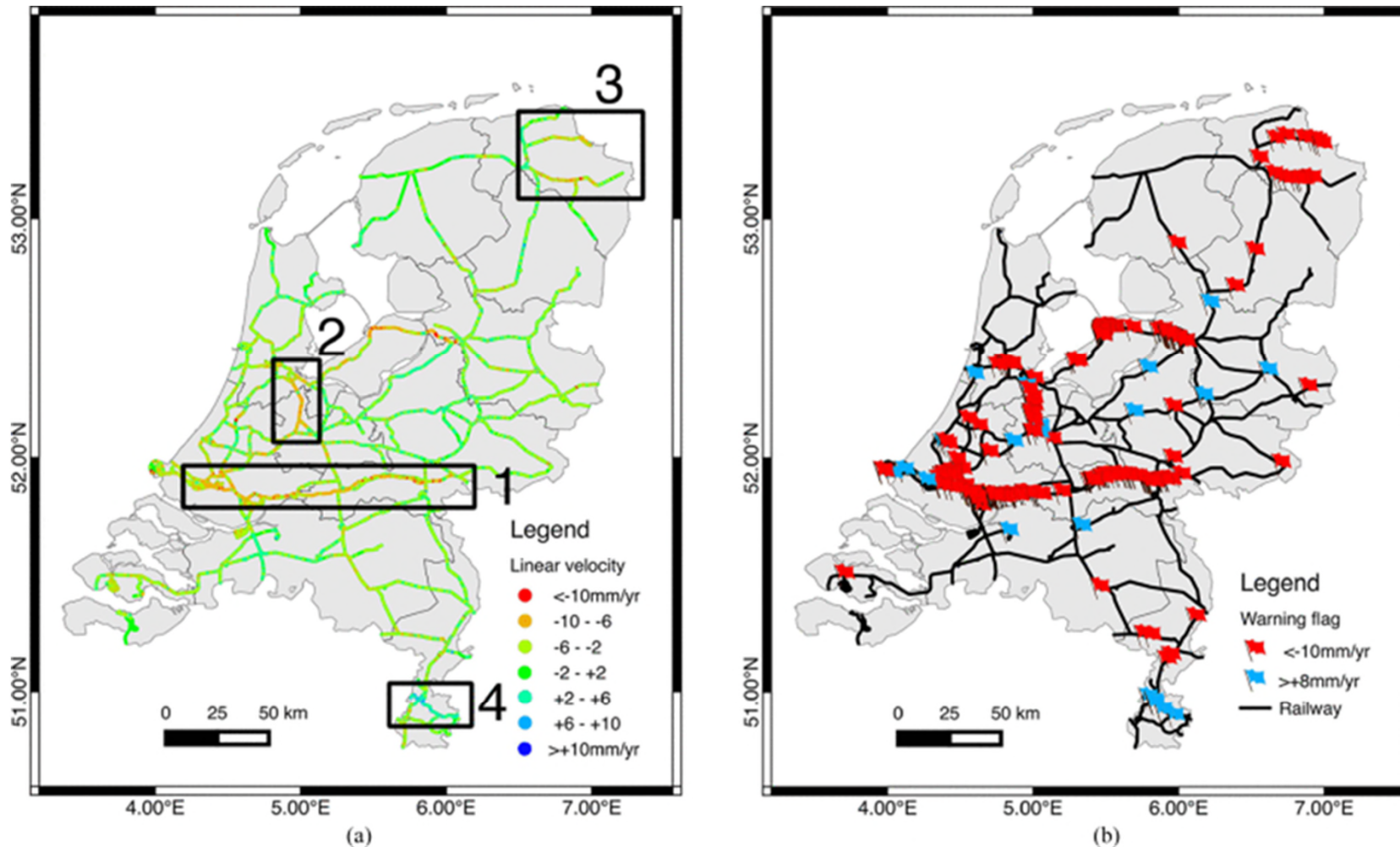


Figure 10.5: (a) Deformation map for Netherlands railway network derived from satellite observations. (b) Risk map, in which the coloured flags indicate the severity of the deformation (negative means settlement, positive means heave). Ling Chang et al (2018)

Extract of Network Rail Report "A Review of Earthworks Management", Mair et al (February 2021)

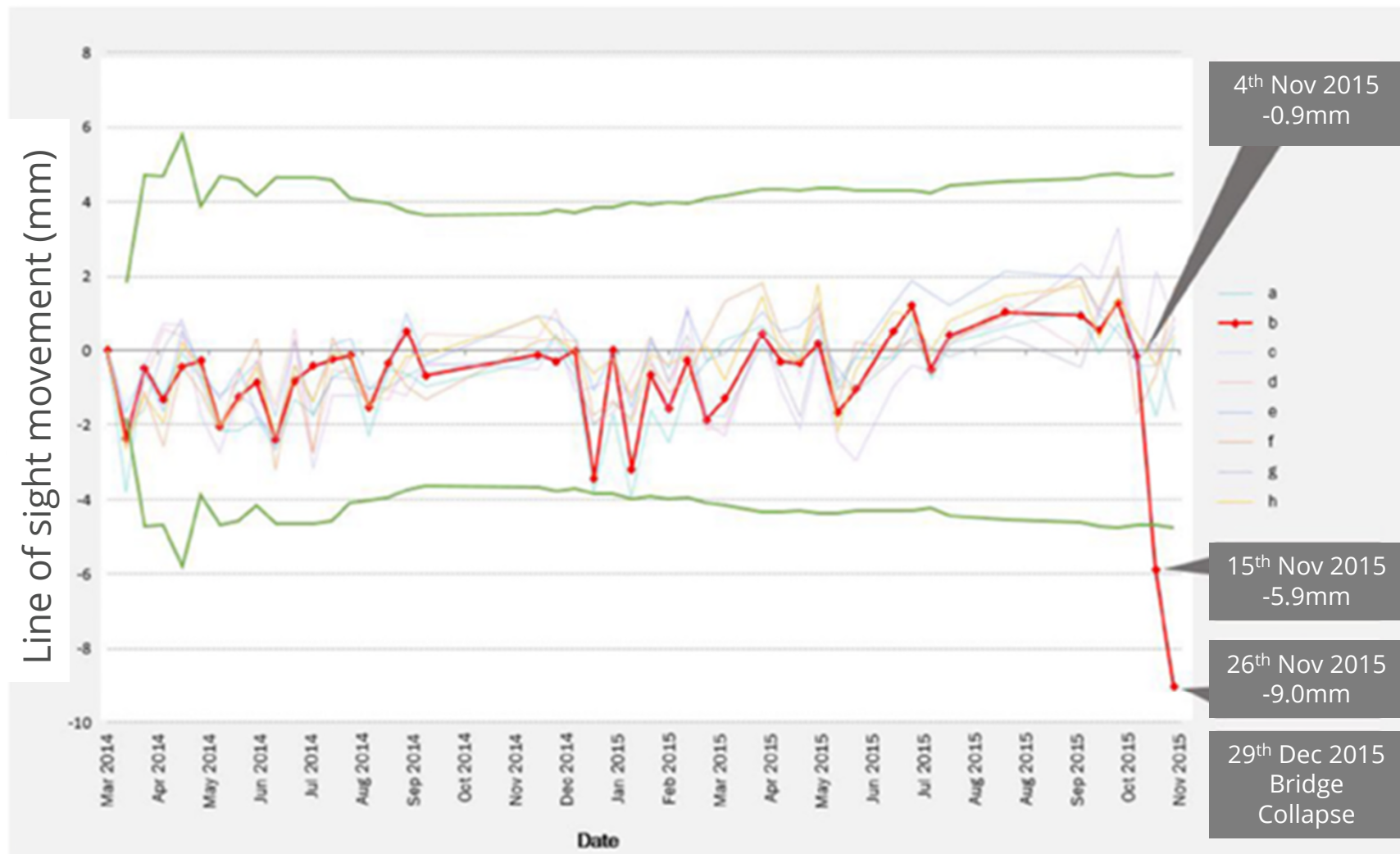


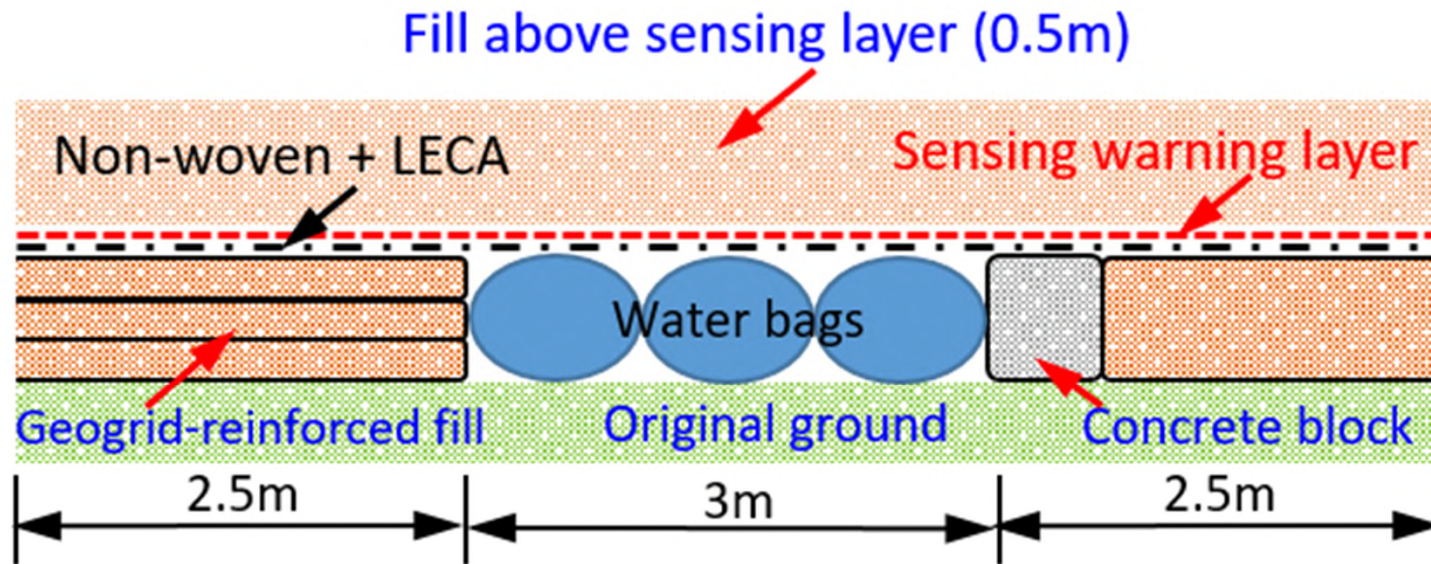
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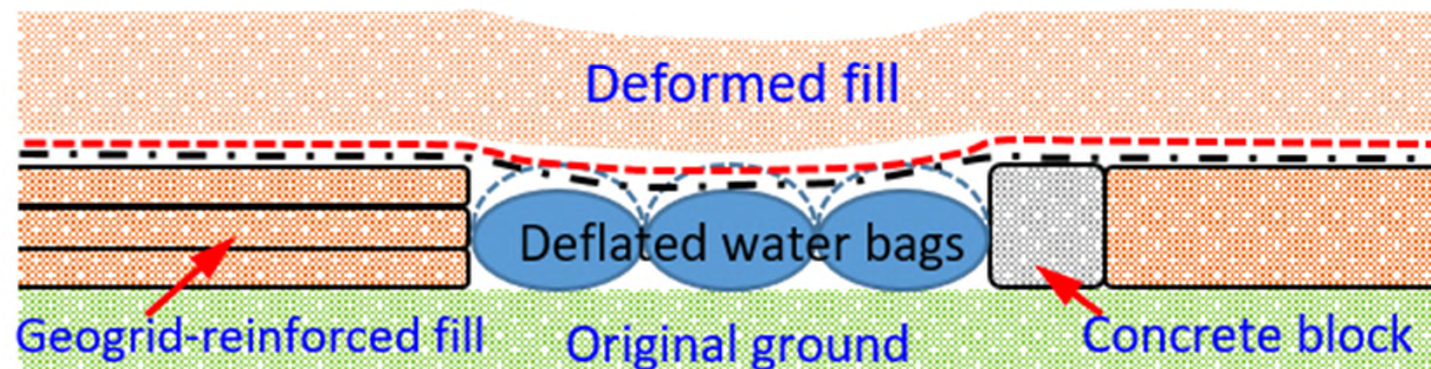


Figure 10.3: Wireless tiltmeters around a tunnel portal (Network Rail presentation, 9 October 2020)

Extract of Network Rail Report “A Review of Earthworks Management”, Mair et al (February 2021)

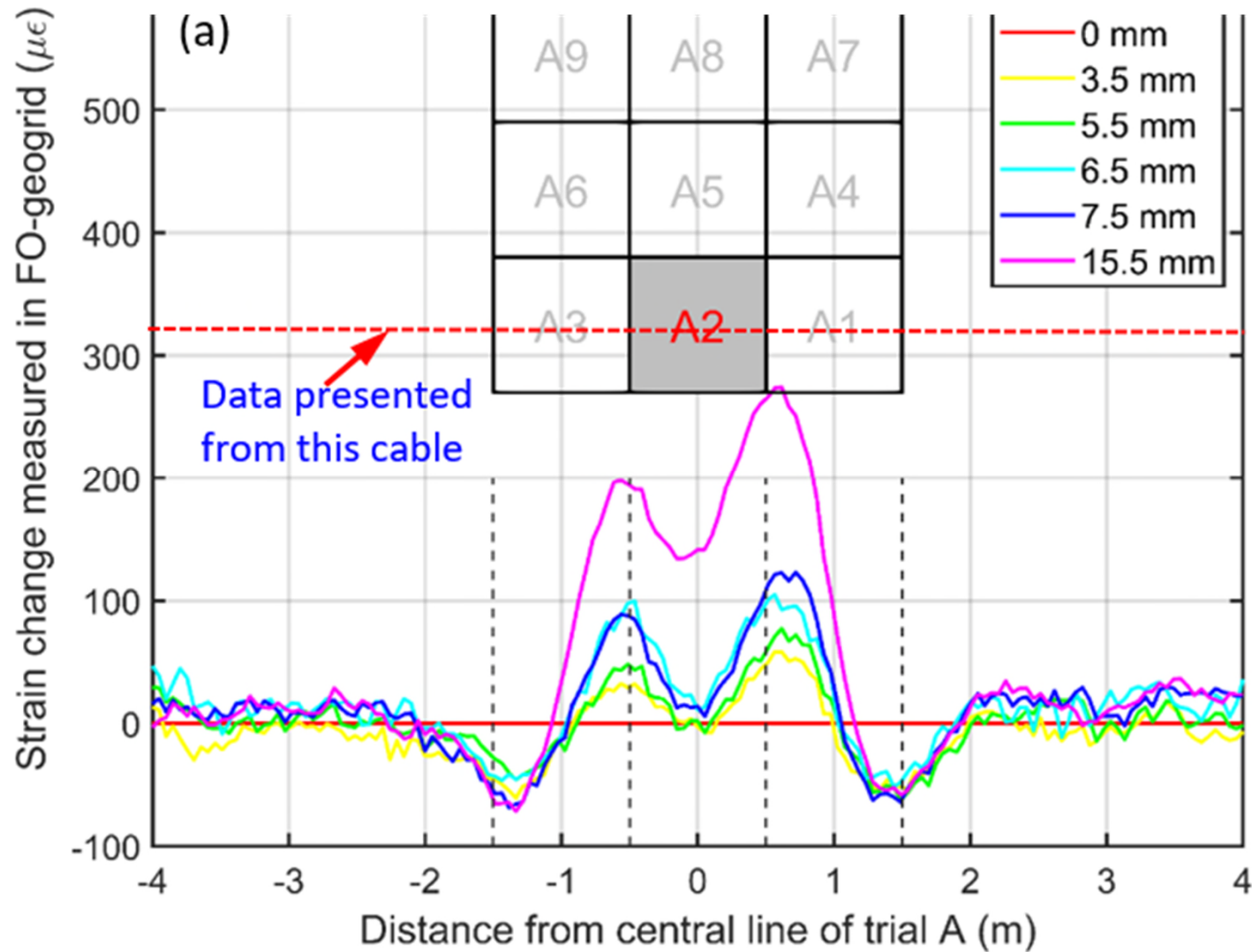


(a) Schematic diagram of field experiments (initial)



(b) Schematic diagram of field experiments (Bags deflated)

Fig.1 Field simulation of ground movement: (a) Schematic diagram of field experiments at the initial stage; (b) Schematic diagram of field experiments when bags deflated; (c) results for deflation of cell A2, small displacements results, (d) Construction of field experimental setup (after Xu et al, 2022)



(c) Small displacements

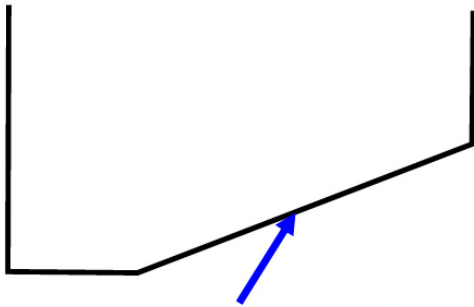
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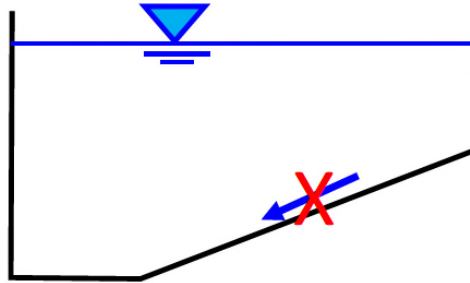
(c) Construction of site trial – Sensorgrid over water bags with backfill above

Fig.1 Field simulation of ground movement: (a) Schematic diagram of field experiments at the initial stage; (b) Schematic diagram of field experiments when bags deflated; (c) results for deflation of cell A2, small displacements results, (d) Construction of field experimental setup (after Xu et al, 2022)

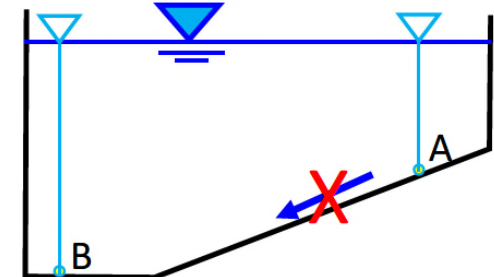
Illustration in response to Dr Todhunter's presentation of driving head at salt rockhead



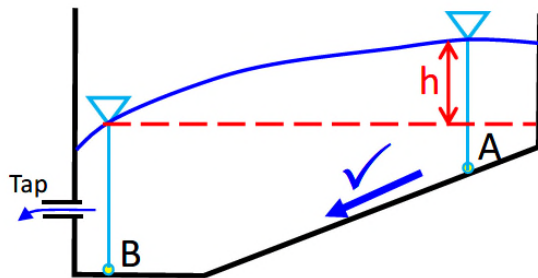
Container with sloping base, mimicking inclined salt rockhead



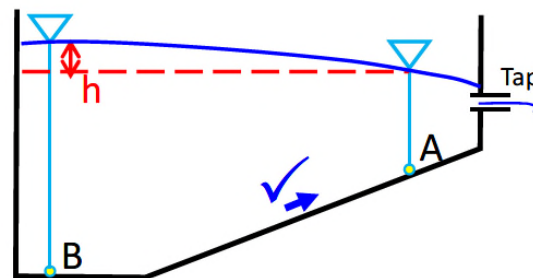
Container filled with water; there is no flow even though the base is inclined



This is because there is no driving head – e.g. see pressure head at points A & B which are equal



If you open a tap on the left, then a head difference “h” is generated and this drives flow.



Indeed if you open a tap on the right, then flow at the base would seem to be “uphill” with respect to the slope of the container base.

Fibre optic instrumented geogrid for ground movement detection

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Abstract

The serviceability of transportation infrastructure, and other civil engineering assets, can be adversely affected by post-construction ground movements. Potential sources of these movements include loss of material from dissolution features, differential movements at earthwork/structure transitions and movements associated with mining legacy features. Post-construction ground movements are mitigated through engineering design, which may be supported through the inclusion of monitoring systems within the earthworks at locations of particular interest.

The number of available methods capable of monitoring sufficiently large areas and providing early warning of the onset/development of ground movement is limited. The incorporation of distributed fibre optic sensing (DFOS) systems into earthworks could provide important information on the commencement, location, origin and magnitude of ground movements in near real-time for critical infrastructure over areas at risk.

HS2 is the new high-speed railway connecting London, Birmingham and the north of England. This paper presents field monitoring trials on the HS2 Phase One route using a newly developed sensing solution consisting of a DFOS instrumented geogrid for ground movement detection. Controlled field tests were first performed on two simulated sinkholes using 3x3m pits in which water-filled bags were placed and covered with stabilised chalk and granular soils, respectively. By deflating the bags in varying sequences, the captured strain signature profiles from the instrumented geogrid were compared with displacement measurements from conventional instrumentation, to assess the instrumented geogrid's sensitivity to millimetre-scale settlements. Robustness and resilience were also evaluated through in-situ durability tests. Finally, as a result of these trials, this technology is being deployed over a 100 m-long, 10 m-wide stretch of the mainline alignment on the HS2 site at Tilehouse Lane Cutting to demonstrate its viability within a live construction environment. During the remaining construction period, continuous monitoring, near real-time data processing and visualisation will offer the opportunity to detect any incipient ground movement below the temporary haul road surface.

Keywords: Distributed fibre optic sensing, Ground movement, Geogrid, Sensorgrid, Early warning

1. Introduction

Nearly all of the UK's critical infrastructure is placed on, or situated in soil. Therefore, ground movement can have a significant social, economical and physical impact on infrastructure provision both at present and in future years. Such ground movements are commonly induced from shallow geohazards like sinkholes, subsidence, landslides, etc., often resulting in both long-term degradation and, ultimately, structural failure of particular assets. Climate change projections suggest that these geohazards, which are themselves often driven by antecedent weather conditions, are likely to increase in magnitude and frequency for certain areas of the UK through the 21st century. Implementing early warning systems by measuring and monitoring spatio-temporal movements may be used as part of a coordinated design and risk management approach to mitigate these increasing risks posed to critical infrastructure (Ast et al. 2001). This was also emphasised by the task force appointed by Network Rail to carry out a review of earthworks management following the fatal train derailment at Carmont, Scotland on 12th August 2020 (Network Rail, 2021).

The number of available methods that are capable of monitoring sufficiently large areas and providing early warning of the onset/development of ground movement, is limited. Conventional instrumentation, such as

borehole extensometers, are often constrained by discretely instrumented ‘measuring points’. Remote sensing technologies like interferometric synthetic aperture radar (InSAR) are commonly used to detect ground surface elevation changes and have proved effective in mapping large-scale ground motions. However, these do not allow for the capture of subsurface deformation, which is often a precursor and early warning of surface ground movement, and their effectiveness in highly vegetated infrastructure corridors is often limited. Distributed fibre optic sensing (DFOS) technology has emerged as a powerful tool for continuous, high temporal and spatial resolution mapping of subsurface ground movement. DFOS enables measurement of temperature, strain, and acoustic energy distributions along the entire length of a fibre optic sensing cable (Kechavarzi et al. 2016; Xu et al. 2021). The incorporation of DFOS cables into the ground could provide significantly improved information on the location and magnitude of subsurface ground movement and subsidence (Möller et al., 2022). To date, this technology has been trialled in some field monitoring campaigns, with DFOS cables embedded in trenches on the ground surface and back-filled by in-situ soil to monitor ground cracks, horizontal displacements and ground settlements. Many have reported that the quality of fibre optic sensing data is highly reliant on the mechanical coupling between fibre optic cables and their surrounding soils, which is dependent on both the cable construction and its installation (Iten et al., 2011; Klar et al. 2014; Zhang et al. 2016; Winters et al. 2020).

This paper reports on controlled field experiments designed to assess the use of a newly developed geogrid, integrated with DFOS strain cables during the manufacturing process (referred to as a Sensorgrid), for early warning of localised ground movement. This innovative Sensorgrid was developed in collaboration between Huesker, the Centre for Smart Infrastructure and Construction (CSIC) at the University of Cambridge and Epsimon Ltd. The performance and practical implications of the new sensing solution were explored through real-world trials simulating the type, scale and rate of ground movement that could be experienced by earthworks assets in areas of unmitigated ground movements.

2. Field-scale controlled experiments

2.1 Experimental setup

Two 3 x 3m voids constructed at the HS2 site at Tilehouse Lane Cutting (TLC) to simulate the ground movement from shallow geohazards and explore the behaviour and response of the Sensorgrid against two different types of overburden fills commonly found and used on the South Portal at TLC: stabilised chalk (trial A) and granular fill (trial B). As illustrated in Figure 1, nine heavy-duty water-filled bags were laid in the base of each, with a maximum inflation height of 0.5m. On one end of the pit, concrete modular blocks were used to form a hard edge, simulating the transition between earthwork and structure (e.g. bridge abutment). At the other end a soft edge was formed by using a geogrid and a non-woven wrap-around on compacted fill (Figures 1(a) and (c)). On one side of the pit, four modular blocks could be removed at the end of the trial to inspect the condition and profile of the Sensorgrid. When all the bags were fully inflated, a layer of non-woven geotextile was placed loosely on top of them to support a lightweight expanded clay aggregate (LECA) fill. This was then followed by the installation of the Sensorgrid, and a 500mm layer of overburden fill above the sensing layer.

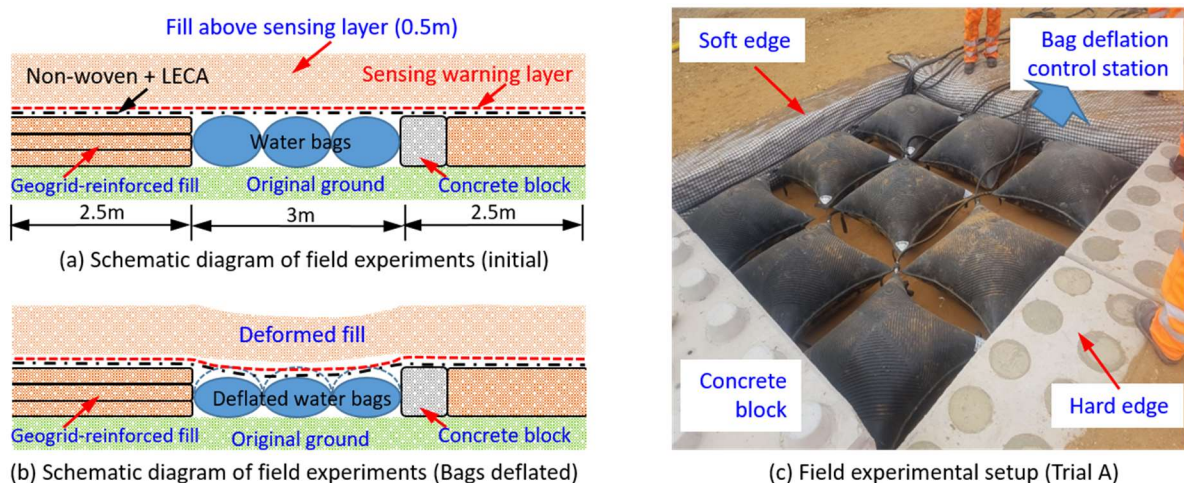


Figure 1: Field simulation of ground movement: (a) Schematic diagram of field experiments at the initial stage; (b) Schematic diagram of field experiments when bags deflated; (c) Field experimental setup (Trial A).

2.2 Field instrumentation

The strain fibre optic (FO) cable integrated into the Sensorgrid used in these two trials was 2.5 mm in diameter and consisted of single-mode optical fibre with a 0.9mm Hytrel coating embedded in an elastic 2.5 mm polyurethane outer sheath. It was knitted into a geogrid by Huesker by substituting it for yarns of similar size. The Sensorgrid used in these two trials was 0.5m wide and carried three individual FO cables, a central fibre, a redundant fibre positioned next to it and an offset fibre.

Prior to the trials, the performance of the Sensorgrid was evaluated through extensive testing at CSIC. In particular, the strain transfer function was evaluated using a bespoke universal testing machine to carry out tensile tests (Figure 2(a)). As illustrated by one of the test results presented in Figure 2(b), the strain transfer function of this very elastic cable showed good linearity, no hysteresis, good repeatability to high strains and high sensitivity (high strain coefficient or gauge factor, which is the slope of the linear relationships shown).

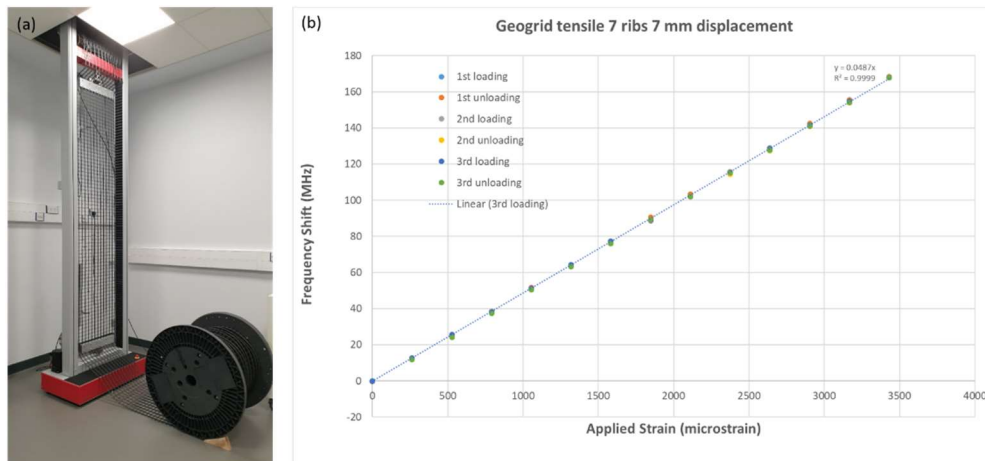


Figure 2: Laboratory tensile tests on the Sensorgrid: (a) Tensile test at CSIC; (b) Testing results.

Figure 3 shows an overview of the field instrumentation set-up. The grid was positioned on top of the bags in a way that the offset fibre was running over the middle of each bag, as illustrated in Figures 3(a) and (b). The anchored length of Sensorgrid was 2.5m on either sides of the pit.

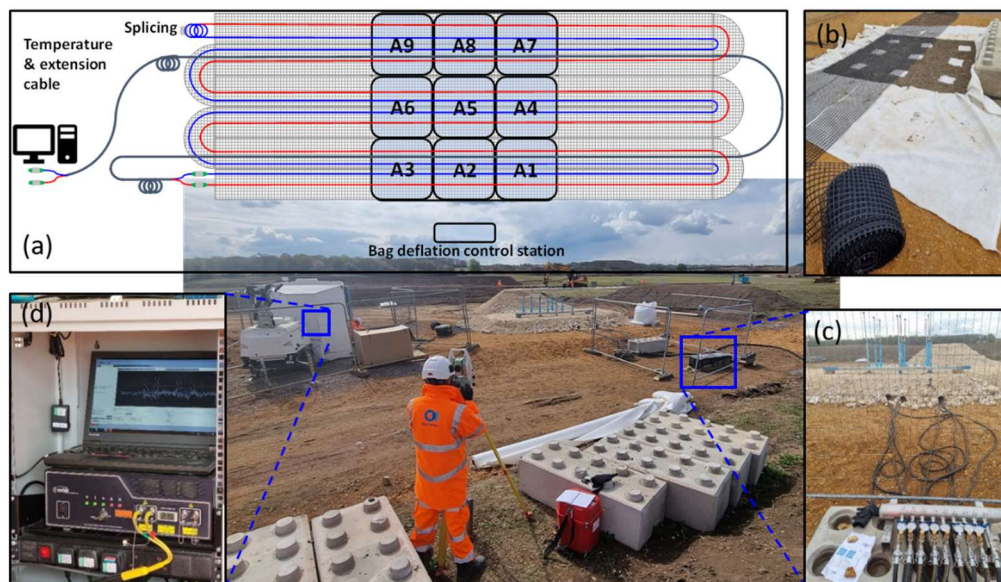


Figure 3: Field experimental setup at trial A: (a) Sensorgrid layout; (b) Sensorgrid installation; (c) Water bag control station; (d) Fibre optic sensing analyser operating in real-time.

A conventional total station monitoring system was employed to capture the displacement on the crown of each bag, created by deflation, as well as the resulting displacement experienced by the Sensorgrid. One circular metallic plate was sitting on the centre of each bag and a second plate was sitting on top of the Sensorgrid above the bags. These two plates were connected to rods and tubes that extended over the overburden fill. Prisms

were attached to the rods and tubes and monitored using a total station, as shown in Figure 3. This allowed the movement of the bags (void) and the geogrid to be recorded in real-time, with an accuracy of $\pm 1\text{mm}$.

To simulate ground movement, water was released from the bags through a control station (as pictured in Figure 2(c)), causing the fill above to move downwards and strain the mesh, which in turn caused a change in the characteristics of the spectrum of the back-scattered light pulsing through the FO sensing cable captured in real-time by a Brillouin Optical Time Domain Analysis (BOTDA) analyser (OZ Optics Ltd, Canada) (Figure 2(d)). After full completion of testing on trial A, the overburden fill, the monitoring tubes and the Sensorgrid were removed to recover the bags from the pit and reuse them for trial B.

3. Results and Observations

3.1 Early warning strain signatures

The strain signature profiles measured in the Sensorgrid at the very early stage of sinkhole formation are illustrated in Figure 4. These represent a change in strain with respect to a baseline measurement taken following the installation and prior to starting the tests. By convention, positive strain change corresponds to an increase in tension while negative strain change represents compression or loss of tension. The strain profiles shown are those obtained with the FO cable centred on the water bags in the row with red numbering, as indicated in the schematic inset in the figures. The grey shading illustrates the bags that have been (grey numbering) or are being (red numbering) deflated at the time of the measurement.

In both trials A and B, the Sensorgrid was sensitive to millimetre scale subsurface vertical settlement (not necessarily the ground surface settlement) over the relatively small spatial scale of 1m (deflated bag width). The strain generated was several times higher than the system's measurement resolution. At this early stage, the strain profile in Trial A exhibited a double-peak shape associated with the central dip across the A2 section and negative strain at the edge of the trial area. The strain profile is wider than that of the deflated water bag as the deformation across A2 generated axial strain in the grid. For Trial B, the strain profile displays a different pattern with a negative strain change in the centre line of the fibre optic trial pit B9, as shown in Figure 4 (b). This artefact is due to the different construction procedures used in Trial B where the soil over the water bags was compacted. This compaction forced the geogrid down in the dips in between the bags, creating tension in the FO cable over the centre of the curved bags. As the bags were deflated this tension was released, resulting in a negative strain change (loss of tension). This would not happen in a site installation when the geogrid is installed over a flat surface. Nevertheless, both trials demonstrate the sensitivity and effectiveness of the Sensorgrid system in detecting relatively small movements over a small spatial scale.

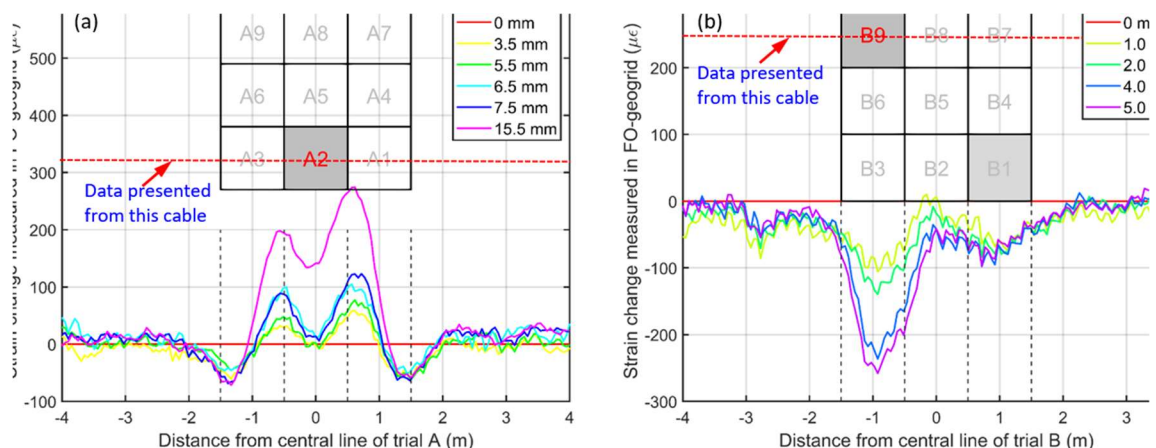


Figure 4: Early warning strain signature profiles: (a) Trial A - deflation of bag A2; (b) Trial B - deflation of bag B9 (following the deflation of B1).

3.2 Strain signatures at large ground deformations

The evolution of the measured strain profiles as sinkholes propagate was investigated by deflating bags in sequence. As displayed in Figure 5(a), the strain profile gradually became wider as the single bag A2 was deflated; i.e. the positive peaks remained around the edges of A2 but strain propagated up to about 1m into the anchorage length on both sides of the trial pit. Similar behaviour was observed in trial B, as shown in Figure 5(b). The

propagation of strain, as the bags were deflated, can also be visualised using contour plots, as highlighted in Figure 5(c) and (d). This type of two-dimensional plot on a larger scale installation is essential to allow for rapidly pinpointing the location of problem areas. Following completion of each trial, the lateral modular blocks were removed for inspection, as shown in Figure 6.

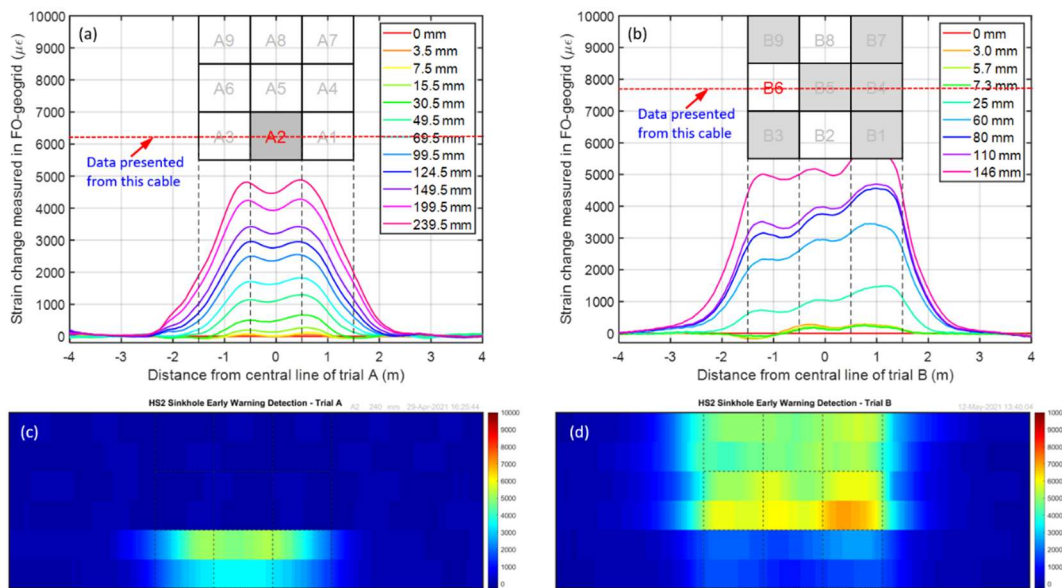


Figure 5: Strain profiles at large ground deformations: (a) Trial A – deflation of bag A2; (b) Trial B - deflation of bag B6 (following the deflation of B1, B9, B3, B7, B5, B4 and B6 in sequence); (c) Strain contour at trial A deflating A2 to 239.5mm; (d) Strain contour at trial B deflating B6 to 146mm.

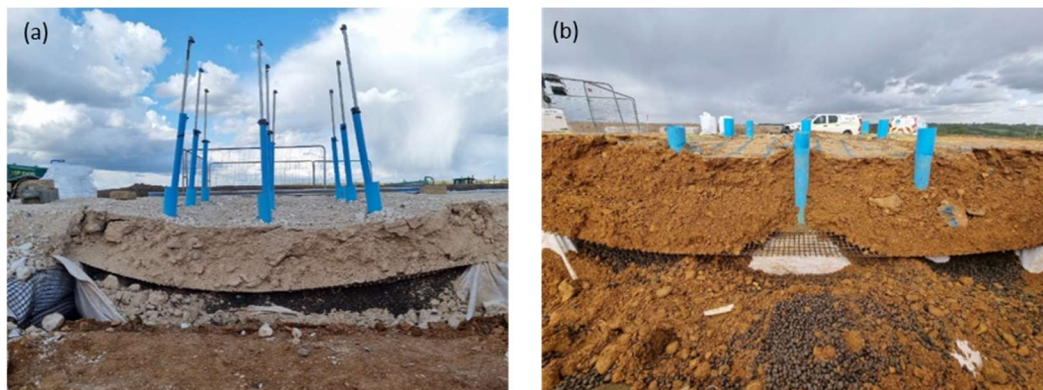


Figure 6: Deformed profiles of Sensorgrid after all bags were fully deflated: (a) Trial A; (b) Trial B.

During the trials, a FO temperature cable was installed above the Sensorgrid to assess potential temperature effects. The largest temperature changes occurred on 29 April 2021 due to sun exposure, with rapid changes and an increase of almost 25°C, which was picked up by part of the cable located outside of the soil. However, in the cable covered by the soil in the trial pit, the changes were not significant and in the order of the precision of the analyser (i.e. ± 1 °C).

4. In-situ durability assessment

Separate tests were conducted in order to assess the robustness of the Sensorgrid used in these preliminary trials, where no significant problems had occurred, under more realistic field conditions representative of the temporary haul road and final pavement construction process at TLC. Two separate Sensorgrid circuits were laid on the ground in a single loop over a length of approximately 50m in order to apply four different treatments: (1) T1 with one protection layer of non-woven geotextile (NW20) above and below the Sensorgrid, (2) T2 with two layers of NW20 above and below the Sensorgrid, (3) T3 with three layers of NW20 above and below the Sensorgrid; (4) T4 with three layers of NW20 above and two layers of NW20 below the Sensorgrid; The non-woven geotextile (NW20) used here had a weight of 235 grams/m², and was the same product used to cover the

water bags in the trial areas. After placing the Sensorgrid and NW20 protections, a series of construction activities were carried out, including placement and levelling of a stabilised chalk fill over the Sensorgrid, and compaction of that fill with eight passes of a 20-tone vibratory roller. For all treatments, both strain and optical power were measured with a Neubrex NBX-5000 Brillouin Optical Time Domain Reflectometry (BOTDR) analyser all along the FO cables integrated in the Sensorgrid. The data showed that, whereas acceptable localised losses were generated during soil placement, soil levelling and soil compaction resulted in significant losses at several locations along the optical fibres. These were likely due to excessive localised bending in the fibres generated by sharp aggregates, but as the losses are cumulative they eventually exceeded the optical budget available (dynamic range of the analyser), leading to erroneous strain data.

Since the manufacturing of the Sensorgrid by Huesker is realised through a knitting process, different grid designs can be achieved by using FO strain cables of different sizes and stiffness and therefore robustness. As such, a stiffer Sensorgrid (Fortrac® R 220/100-30 GSGTA) was produced with a much more robust cable for the larger scale ground movement monitoring scheme deployed at TLC, as described below.

5. Large-scale trial of ground movement monitoring at Tilehouse Lane Cutting

TLC is approximately 710m long in total and up to 11m deep, and it connects the North Approach Embankment and Colne Valley Viaduct to the south-east with the West Hyde embankment and the 10.6 mile-long twin-bore Chiltern Tunnel passing under the M25 to the north-west, as indicated in Figure 7. The ground investigation (48 CPTs) and cutting excavation has revealed dissolution features ranging from 0.5 to 2m in diameter to be present along the cutting (Figure 7(a)). The condition of the infill material varies, and voids are occasionally present. Engineered mitigation has been constructed at these locations and a geogrid-reinforced mattress will also be installed over the area. This has provided the opportunity to prove the viability of the technology in a live construction environment and 5m-wide Sensorgrid with FO strain sensing cables at a 0.5m spacing is being deployed to monitor potential ground movement beneath a 100m-long, 10m-wide stretch of the mainline alignment on the HS2 site at TLC.

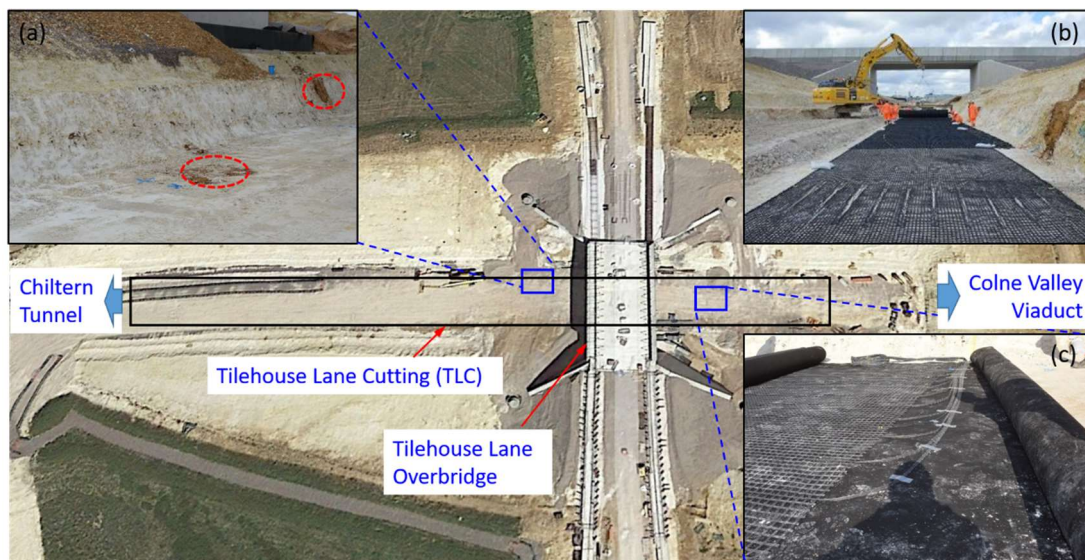


Figure 7: Large-scale monitoring of ground movement at Tilehouse Lane Cutting (TLC): (a) Solution features at TLC (as circled); (b) Field deployment of Sensorgrid; (c) Sensorgrid in-situ.

To protect against construction damage, the Sensorgrid is sandwiched between layers of Non-woven geotextile (HPS14) (Figure 7 (b) and (c)). Above this is a layer of geogrid Fortrac 600 MDT forming the base of the reinforced mattress, overlain by chalk mixed with 2% cement. Strain will be monitored continuously along the Sensorgrid for two years during the construction of HS2. This represents 10,000 monitoring points over 1000m². Temperature cables are also being embedded with the Sensorgrid to assess any (unexpected) temperature effect. The data acquired from the FO cables will be automatically processed and displayed in real-time on a web-based visualisation dashboard developed by Epsimon Ltd. This will enable the project engineers to detect any incipient ground movement, enabling them to take timely preventative action if necessary.

6. Conclusions

Controlled field experiments were performed to explore the performance of a newly developed DFOS instrumented geogrid (Sensorgrid) for ground movement detection. Water-filled bags were placed in the ground and deflated in a pre-determined sequences to replicate vertical ground movements which demonstrated the sensitivity and effectiveness of the Sensorgrid system as an early warning detection solution for local ground movements beneath earthworks. The Sensorgrid sensing system is sensitive to millimetre scale vertical settlement at depth. It is also sensitive to settlement at the sub-metre spatial scale. For large ground movements, the Sensorgrid is likely to experience large strains but, in the trials, these did not exceed the capacity of the system (both in terms of tensile strength and measurement range/limit).

As shown by the trial results, the current Sensorgrid configuration is highly sensitive to strain and can detect very small vertical displacement. Its low stiffness is likely to lead to good strain transfer in soils, which also makes it ideal for application where horizontal movement and axial strain occurs, such as for slope movements and embankment retaining walls. For applications in harsh construction environments, the Sensorgrid design is highly configurable and it can be integrated with more robust strain cables as required.

Developing a capability for early detection of ground movement which leads to appropriate preventative or precautionary measures could prove a valuable tool for the maintenance of infrastructure earthworks. These technologies may become more valuable in future because of the increasing frequency of extreme weather events and their potentially adverse impact on ground conditions and earthwork assets.

Acknowledgements

The authors are grateful to HS2 Innovation for funding and supporting this work. They are thankful to Roadbridge Ltd, SOCOTEC UK Ltd and Mr Kyriakos Kaskiris (formerly at Jacobs UK Ltd) for their support with field construction and Sensorgrid deployment. The authors would also like to thank CSIC (EPSRC (EP/N021614/1) and Innovate UK (920035)) for supporting this research.

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House of Commons

High Speed Rail (Crewe - Manchester) Bill

1. Petitioner information

In the box below, give the name and address of each individual, business or organisation submitting the petition.

Michael Slater - Lea Head, Nantwich Road, Wimboldsley, Middlewich, CW10 0LL
Jenni Slater - Lea Head, Nantwich Road, Wimboldsley, Middlewich, CW10 0LL
Geoff Edwards - Stanthorne Mill House, Coalpit Lane, Stanthorne, CW10 9JS
Leanne Edwards - Stanthorne Mill House, Coalpit Lane, Stanthorne, CW10 9JS
Ewen Simpson - Canal Cottage, Whatcroft Hall Lane, Davenham CW9 7SQ
Susan Simpson - Canal Cottage, Whatcroft Hall Lane, Davenham CW9 7SQ
Chris Wilson - Hollingwood, Cranage Villas, Manchester Road, Plumley, WA16 0UB
Lorna Wilson - Hollingwood, Cranage Villas, Manchester Road, Plumley, WA16 0UB
Ros Todhunter - 81A Birches Lane, Lostock Green, Northwich, CW9 7SN
Sarah Flannery - 15 Clover Drive, Pickmere, Knutsford, WA16 0WF
Mike Flannery - 15 Clover Drive, Pickmere, Knutsford, WA16 0WF
Kathy O'Donoghue - 83 Birches Lane, Lostock Green, Northwich, CW9 7SN
Barry O'Donoghue - 83 Birches Lane, Lostock Green, Northwich, CW9 7SN
Karina Armstrong - Lodge Cottage, Coalpit Lane, Stanthorne, CW10 9JS
Derek Armstrong - Lodge Cottage, Coalpit Lane, Stanthorne, CW10 9JS
Nigel Hennerley - 3 Shulldham Close, High Legh, WA16 6UE
Mrs Hennerley - 3 Shulldham Close, High Legh, WA16 6UE
John Keleher - School Farm, School Lane, Pickmere, WA16 0JF
Pat Mather - School Farm, School Lane, Pickmere, WA16 0JF
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Karl Jones - 2 Ascol Drive, Plumley, Knutsford, WA16 0UD
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Philip Gough - Yew Tree Cottage, Pickmere Lane, Pickmere, WA16 0JL
Andrea Gough - Yew Tree Cottage, Pickmere Lane, Pickmere, WA16 0JL
Peter Walker - Occleston Green Farm, School Lane, Occleston, CW10 0LZ
Jayne Walker - Occleston Green Farm, School Lane, Occleston, CW10 0LZ
M W Finney, MBE - The Laurels, Birch Lane, Stanthorne, Middlewich, CW10 9JR
A J Finney - The Laurels, Birch Lane, Stanthorne, Middlewich, CW10 9JR
James Hague - Bank Farm Cottage, Stanthorne, Middlewich, CW10 9JE

In the box below, give a description of the petitioners. For example, "We are the owners/tenants of the addresses above"; "My company has offices at the address above"; "Our organisation represents the interests of..."; "We are the parish council of..."

With the exception of four tenants, we are all owners of the addresses above.

2. Objections to the Bill

In the box below, write your objections to the Bill and why your property or other interests are **directly and specially affected**. Please number each paragraph.

Only objections outlined in this petition can be presented when giving evidence to the Committee. You will not be entitled to be heard by the Committee on new matters not included in your written petition.

(1) We are a mixed (age and occupation) 'group of individuals' living in Cheshire - from Wimboldsley in the south to High Legh in the north who, over the past few years, have come together through our mutual concerns about HS2. We and especially those who will come after us and our families in the coming decades will be directly and specially affected by HS2 during its construction and in its operation. The threat and knowledge of what is to come is already having a seriously detrimental effect on our leisure and working lives, any sense of well-being and community spirit, our happiness and without exaggeration for many of us, our mental health. Since 2013 the HS2 project has gone from being, 'a new railway no wider than a three-lane motorway', (as promoted by HS2 Ltd), to a massive and destructive mega project the impact of which will, one way or another, affect the whole County of Cheshire. We are not against railways, most of us use trains and believe that railways are better than roads. We want to see much better public transport as THE priority through better rail connections and better integration of rail and bus services etc. HS2 Phase 2b however is a duplication of what we have already got, i.e. the West Coast Main Line, which serves all our needs perfectly. HS2 Phase 2b, will completely and totally unnecessarily, destroy hundreds of acres of fertile farmland, destroy wildlife habitats, destroy ancient woodlands and create massive air and noise pollution. Most of us have lived in Cheshire all of our lives and therefore we have a real affinity with the County. It is a beautiful place to live, even though it has been exploited for hundreds of years mainly by mining for salt and other minerals. This industrial activity has inevitably left numerous scars on the land above the workings. Adding a massive scar of concrete and steel – and several monumental embankments which will literally divide this part of Cheshire and specifically more than one community with an impenetrable barrier causing distress, disruption, unacceptable inconvenience, time and money - in the name of HS2 is just unbearable to contemplate or accept. Over the last three years we have watched in horror what is going on in Buckinghamshire on Phase 1, in many ways there is a synergy between Cheshire and Buckinghamshire. We therefore object to the Bill and therefore the construction of HS2 Phase 2b, in its entirety - in its current form. If the project cannot be stopped, we believe that there has to be, and-we-propose, a better solution.

(2) Some of our group will also be severely impacted by the proposed HS2 Rolling Stock Depot at Wimboldsley, again during both construction and operation. It is absolutely unbelievable, to even think, that building a rolling stock depot on 65 hectares of fertile farmland, is a good idea. We fully understand why the rolling stock depot was re-located from a brownfield site in Golborne, however to then move it to a greenfield site, directly opposite and less than 250 metres from Wimboldsley Primary School, is outrageous. As well as the loss of 65 hectares of fertile farmland, as with the alignment there is a massive loss of wildlife habitats, air, noise and also light pollution, twenty-four hours a day, 365 days a year and all this less than 250 metres from a school. We

therefore object to the Bill with reference to the building of the HS2 Rolling Stock Depot at Wimboldsley. Once again there has to be, and-we-propose, a better solution.

(3) Whilst HS2 Ltd have claimed that the environment has been central to selecting the route and developing the design of HS2, we are all very concerned about the railway being built over the salt district of mid Cheshire. This area is notoriously unstable, subject to subsidence/collapse, (both unexpected and gradual), making we believe the project seriously flawed and potentially dangerous to passengers and to the communities that live on, or near the alignment. We believe that HS2 Ltd have done very little meaningful research into the ground conditions prior to the deposition of the Bill (a complacent and extremely serious omission) and their only response to the inevitable and hugely expensive engineering challenges they face, is to declare that the alignment through Cheshire will be built on viaducts and embankments, with of course the consequences for us residents, as referred to above. We think that climate change, more frequent extreme weather events and rapidly rising sea-level, leading to rises in the water table and therefore more flood risk, are going to make any infrastructure built above ground level, very vulnerable to movement with potentially disastrous consequences, particularly given the very fine, 5mm vertical deflection tolerance, that HS2 requires.

3. What do you want to be done in response?

In the box below, tell us what you think should be done in response to your objections to the Bill. You do not have to complete this box if you do not want to.

You can include this information in your response to the section 'Objections to the Bill' if you prefer. Please number each paragraph.

(1) Our proposal is that HS2 is put in a tunnel through Cheshire. A tunnel that connects the northern portal of the Crewe tunnel with the southern portal of the Manchester tunnel. The rationale for this is what is happening in Buckinghamshire on Phase 1, right at this moment in time. The Chiltern tunnel appears to be a huge success story for HS2 Ltd and will save at least part of Buckinghamshire from annihilation. We believe that Cheshire deserves to be treated in exactly the same way as Buckinghamshire.

NOTE (a): Our proposal assumes that ultimately there will not be an HS2 station at Manchester airport.

NOTE (b): An 'Estimate of Expense' for our tunnel proposal, which is being carried out by two members of our group, is based on a through, subterranean station, at Manchester Piccadilly. A full costing will only be possible when the Ground Investigations (GI's), (to be carried out by HS2 Ltd), are complete and are in the public domain. It is assumed, that the lack of GI information is the reason why only an 'Estimate of Expense' at third quarter 2019 prices, has been published by HS2 Ltd to date. Therefore we can see no reason why all options should not be explored by HS2 Ltd, including a tunnel. As soon as the GI information is available, we assume that full and proper costings will be done, for all of HS2 Phase 2b.

(2) Regardless of what happens vis a vis the HS2 alignment, the HS2 Rolling Stock Depot at Wimboldsley MUST be relocated to a more suitable (and essentially), a brownfield site. Our proposal would obviously be at the now redundant Network Rail sidings at Basford, just south of Crewe station, however we have also established that there are other, far more suitable brownfield sites.

(3) No further comment is required.

4. Petitioner details

Organisation/group name (if relevant)

First name(s)

Last name

Address line 1

Address line 2

Post code

County

Email

Phone (landline or mobile)

Who should be contacted about this petition?

- ☒ Individual above
- ☐ Another contact (for example, Roll A Agent or other representative)

If another contact, complete the 'Main contact's details' section below.

5. Main contact's details

First name(s)

Last name

Address line 1

Address line 2

Post code

County

Email

Phone (landline or mobile)

February 2023

**HIGH SPEED RAIL (CREWE -
MANCHESTER) BILL**

**HOUSE OF COMMONS
SELECT COMMITTEE**

**Petition No. HS2-P2B-117:
Slater Cheshire Residents Group**

Promoter's Response Document

INTRODUCTION

This Promoter's Response Document (PRD) forms the Promoter's response to Petition No. HS2-P2B-117, from Slater Cheshire Residents Group.

In this PRD, 'the Promoter' means the Secretary of State and HS2 Ltd acting on their behalf.

The purpose of the PRD is to advise you and the Select Committee of the Promoter's position in relation to the petitioning points raised. It is intended that the PRD will alleviate many of the concerns raised in the petition.

The Table of Contents overleaf lists the page number, petitioning points in the order they appear in the petition, and a summary statement of the issue(s) contained in the petition for quick reference. Other supporting material (e.g., reports, drawings, and photographs) referred to in the response are attached where applicable.

Copies of the HS2 Phase 2b Information Papers referred to in the response can be found at

HS2 Phase 2b (Crewe – Manchester) Information Papers - GOV.UK (www.gov.uk).

Department for Transport
High Speed Two (HS2) Limited

BACKGROUND

The Slater Cheshire Residents Group are 40 residents across areas of the Proposed Scheme. The following individuals are named as the Petitioners:

- Michael Slater - Lea Head, Nantwich Road, Wimboldsley, Middlewich, CW10 0LL
- Jenni Slater - Lea Head, Nantwich Road, Wimboldsley, Middlewich, CW10 0LL
- Geoff Edwards - Stanthorne Mill House, Coalpit Lane, Stanthorne, CW10 9JS
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- Jayne Walker - Occleston Green Farm, School Lane, Occleston, CW10 0LZ
- M W Finney, MBE - The Laurels, Birch Lane, Stanthorne, Middlewich, CW10 9JRA
- J Finney - The Laurels, Birch Lane, Stanthorne, Middlewich, CW10 9JR
- James Hague - Bank Farm Cottage, Stanthorne, Middlewich, CW10 9JE

Of these petitioners named as part of the Slater Cheshire Residents Group, the following have submitted a separate petition in respect of their land interests:

- Michael Slater - Lea Head, Nantwich Road, Wimboldsley, Middlewich, CW10 0LL (HS2-003 Michael and Ruby Slater)
- Karina Armstrong and Derek Armstrong - Lodge Cottage, Coalpit Lane, Stanthorne, CW10 9JS (HS2-125 Dr Derek and Mrs Karina Armstrong)
- John Keleher and Pat Mather - School Farm, School Lane, Pickmere, WA16 0JF (HS2-002 Patricia Mather and John Keleher)

PETITION NO. HS2-P2B-117

SLATER CHESHIRE RESIDENTS GROUP

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HOUSE OF COMMONS SELECT COMMITTEE

HIGH SPEED RAIL (CREWE - MANCHESTER) BILL

PROMOTER'S RESPONSE TO PETITION OF: Slater Cheshire Residents Group

PETITION NO: HS2-P2B-117

PARAGRAPH NO: 1, Request 1

ISSUE RAISED: Route alignment

PETITION PARAGRAPH: 1. We are a mixed (age and occupation) 'group of individuals' living in Cheshire - from Wimboldsley in the south to High Legh in the north who, over the past few years, have come together through our mutual concerns about HS2. We and especially those who will come after us and our families in the coming decades will be directly and specially affected by HS2 during its construction and in its operation. The threat and knowledge of what is to come is already having a seriously detrimental effect on our leisure and working lives, any sense of well-being and community spirit, our happiness and without exaggeration for many of us, our mental health. Since 2013 the HS2 project has gone from being, 'a new railway no wider than a three-lane motorway', (as promoted by HS2 Ltd), to a massive and destructive mega project the impact of which will, one way or another, affect the whole County of Cheshire. We are not against railways, most of us use trains and believe that railways are better than roads. We want to see much better public transport as THE priority through better rail connections and better integration of rail and bus services etc. HS2 Phase 2b however is a duplication of what we have already got, i.e. the West Coast Main Line, which serves all our needs perfectly. HS2 Phase 2b, will completely and totally unnecessarily, destroy hundreds of acres of fertile farmland, destroy wildlife habitats, destroy ancient woodlands and create massive air and noise pollution. Most of us have lived in Cheshire all of our lives and therefore we have a real affinity with the County. It is a beautiful place to live, even though it has been exploited for hundreds of years mainly by mining for salt and other minerals. This industrial activity has inevitably left numerous scars on the land above the workings. Adding a massive scar of concrete and steel – and several monumental embankments which will literally divide this part of Cheshire and specifically more than one community with an impenetrable barrier

causing distress, disruption, unacceptable inconvenience, time and money - in the name of HS2 is just unbearable to contemplate or accept. Over the last three years we have watched in horror what is going on in Buckinghamshire on Phase 1, in many ways there is a synergy between Cheshire and Buckinghamshire. We therefore object to the Bill and therefore the construction of HS2 Phase 2b, in its entirety - in its current form. If the project cannot be stopped, we believe that there has to be, and we propose, a better solution.

Request

1. Our proposal is that HS2 is put in a tunnel through Cheshire. A tunnel that connects the northern portal of the Crewe tunnel with the southern portal of the Manchester tunnel. The rationale for this is what is happening in Buckinghamshire on Phase 1, right at this moment in time. The Chiltern tunnel appears to be a huge success story for HS2 Ltd and will save at least part of Buckinghamshire from annihilation. We believe that Cheshire deserves to be treated in exactly the same way as Buckinghamshire.

NOTE (a): Our proposal assumes that ultimately there will not be an HS2 station at Manchester airport.

NOTE (b): An 'Estimate of Expense' for our tunnel proposal, which is being carried out by two members of our group, is based on a through, subterranean station, at Manchester Piccadilly. A full costing will only be possible when the Ground Investigations (GI's), (to be carried out by HS2 Ltd), are complete and are in the public domain. It is assumed, that the lack of GI information is the reason why only an 'Estimate of Expense' at third quarter 2019 prices, has been published by HS2 Ltd to date. Therefore we can see no reason why all options should not be explored by HS2 Ltd, including a tunnel. As soon as the GI information is available, we assume that full and proper costings will be done, for all of HS2 Phase 2b.

PROMOTER'S RESPONSE:

Development of the Crewe – Manchester Proposed Scheme

1. The Promoter has carried out extensive stakeholder and public consultation in advance of the submission of the Bill. HS2 Phase 2b Western Leg Information Paper

G1: Consultation and Engagement provides the details of the consultation and engagement carried out during the development of both the strategy for high speed rail in the UK and the route between London and the West Midlands of HS2 (Phase One).

2. The Crewe – Manchester Environmental Statement published in January 2022 (main ES) in section 3.2, Volume 1 and table 3 provide key engagement and consultation to date for the Phase 2b Proposed Scheme.

3. Consultation and engagement has been carried out in compliance with relevant guidance and legislation, including:

- the second provision of the Aarhus Convention (June 1998);
- Cabinet Office guidance on Consultation, published in July 2012;
- prior to July 2012, the Cabinet Office's Code of Practice on Consultation issued in July 2008; and
- the Gunning Principles, which are a set of criteria for assessing the fairness of a public consultation.

4. Consultation has been a major influence on the development of the Proposed Scheme, particularly in helping to identify and mitigate local impacts. Initial consultation on High Speed Rail was undertaken from February 2011 to July 2011, and the subsequent announcement of the decision to pursue the Y network in two phases was announced in January 2012.

5. In January 2013 the initial preferred route for Phase Two was announced which allowed an early opportunity to engage with key stakeholders on potential key issues and concerns about the route and its impacts ahead of consultation. This included the publication of background material used to inform the initial preferred route, including an Appraisal of Sustainability (AoS) options report setting out the environmental performance of alternative route options. Consultation on the Phase Two route between July 2013 and January 2016 sought comments on the proposed route and the approach to the environmental appraisal carried out by the Promoter.

6. On 11 October 2018, HS2 Ltd launched two parallel consultations on the working draft Environmental Statement (ES) and the working draft Equality Impact Assessment (EQIA) Report for the full Phase 2b scheme (including both Eastern Leg and Western Leg).

7. On 6 June 2019, the Government launched a national consultation on 11 proposed design refinements to the full Phase 2b scheme. These refinements included proposed infrastructure for HS2 to accommodate future potential Northern Powerhouse Rail (NPR) services.

8. In August 2019, the Government announced that Douglas Oakervee would chair an independent review of HS2, referred to as the 'Oakervee Review'. The review was

asked to assemble and test all the existing evidence in order to allow the Government to make properly informed decisions on the future of all phases of the HS2 project.

9. The Oakervee Review, published on 11 February 2020, concluded that the HS2 project should proceed, based on a number of recommendations. These included the need for Phase 2b to be considered as part of an Integrated Rail Plan (IRP) for the North and Midlands and for the full Phase 2b scheme to be split into smaller sections.

10. In February 2020 the Government recommitted to providing better rail connectivity between London, the Midlands and the North, ensuring all parts of the country benefit from opportunities for economic development and prosperity. The Government committed to preparing an IRP (including consideration of the Eastern and Western Legs), informed by a 'Rail Needs Assessment' undertaken by the National Infrastructure Commission (NIC).

11. At that time the Government also announced its decision to proceed with the legislation to allow for the development of the Phase 2b Western Leg (the Proposed Scheme) separately and that, subject to the IRP, the full Phase 2b scheme could be legislated for in two or more hybrid Bills. This ensured work on the HS2 project continued whilst the IRP was being developed, to reduce delay.

12. On 7 October 2020, the Government provided a Western Leg route-wide update and launched a national consultation on four further proposed design refinements that were relevant to the Phase 2b Western Leg. This included changes to allow the HS2 route to be used by future NPR trains to link cities across the North of England.

13. The NIC published the Rail Needs Assessment for the Midlands and the North in December 2020. The NIC developed a menu of options for a programme of rail investments in the Midlands and the North, using three different illustrative budget options: focussing on upgrades (baseline budget only); prioritising regional rail links; and prioritising long distance links. The Proposed Scheme was included in the scope of all options.

14. The IRP was published in late 2021. In terms of the Proposed Scheme, the IRP confirmed that the HS2 Crewe – Manchester hybrid Bill should proceed to deposit in Parliament. The outcomes of the IRP are being taken into account in the on-going development of the Proposed Scheme.

15. The Proposed Scheme, as deposited in Parliament in January 2022, comprised:

- the HS2 Western Leg from Crewe to Manchester, including:
 - new stations at Manchester Airport and Manchester Piccadilly;
 - a depot north of Crewe;
 - maintenance facilities north of Crewe and at Ashley; and
 - a connection onto the WCML near Bamfurlong;
- the Crewe Northern Connection, connecting the route of the Proposed Scheme with the WCML and enabling future NPR services to connect with HS2;

- provision for the NPR London to Liverpool, Manchester to Liverpool, and Manchester to Leeds junctions, to enable these future NPR routes to connect with HS2; and
- a number of works at locations beyond the Western Leg route corridor, referred to as 'off-route works' which include:
 - works to enable HS2 trains to call at existing stations further north on the WCML; and
 - construction of depots to provide overnight stabling for HS2 trains serving the north of England and Scotland.

Route corridor alternatives

16. The route corridor of the Proposed Scheme has developed through a refinement process referred to as sifting. The sifting process consisted of a sequentially more detailed appraisal of route options. At the end of each appraisal stage or sift sustainability performance was considered alongside cost, operational and engineering considerations. Preferred options were identified to progress to the next level of sift for a more detailed appraisal.

17. The following environmental factors were considered as part of the appraisal of sustainability performance: climatic factors and adaptability; greenhouse gases; landscape; townscape and cultural heritage; biodiversity and geodiversity; water resources; flood risk; air quality; noise and vibration; community integrity; accessibility; health and well-being; security and safety; economic prosperity; economic welfare; soil and land resources; waste generation; and resource use.

18. The sequence of sifts were aimed at considering a progressively smaller number of options at increasing levels of detail (e.g., by avoiding centres of population and/or key environmental features). In the later sifts, the predicted impacts of the remaining options were further mitigated by refining the vertical and/or horizontal alignments and by introducing certain structures such as viaducts or cuttings with retained walls, where appropriate. In this way, the route development process has ensured that mitigation, so far as reasonably practicable, is inherent within the design from the outset.

The benefits of the Proposed Scheme

19. The WCML is one of the busiest mixed-use railways in Europe, with passenger and freight, fast and slow services sharing the same lines, slowing all traffic and causing congestion. Constructing new lines to remove fast services allows for more frequent, faster and reliable services on dedicated lines. This simultaneously releases capacity on existing lines for commuter, semi-fast services and freight. Constructing new lines can unlock demand and boost growth through new and faster connectivity. The combination of new and released capacity also provides the opportunity to deliver growth through the provision of new and/or different local services.

20. The Proposed Scheme offers the potential for more commuter services to run on some of the key routes into and out of Manchester. The combination of new HS2 services alongside changes to conventional rail services has the potential to more than double evening peak seats on conventional rail services from Manchester Piccadilly on the Stoke and Crewe corridors.

21. The Proposed Scheme improves access to Manchester Airport, the important South Manchester and North Cheshire markets, and creates major regeneration opportunities through Manchester Airport High Speed station.

22. The Proposed Scheme would also significantly improve opportunities for rail connectivity between London and Scotland and provides a necessary segment of the proposed NPR scheme for the Liverpool – Manchester corridor via Manchester Airport which would improve connectivity across the North.

23. Greater Manchester and the North have seen significant rail passenger growth in recent years; Office of Road and Rail (ORR) data shows that daily passenger journeys within the Northwest have quadrupled from just over 25,000 in 1995/96 to over 100,000 in 2019/20, leading to poor performance and crowding. Physical capacity to run more trains on the network is constrained in the Northwest and particularly on the approaches to Manchester, with a bottleneck in the Stockport area. This creates reliability issues, and also means that many local stations in the South Manchester and Cheshire East area have a poor frequency of service due to lack of capacity on this corridor.

24. Alternatives considered failed to fully meet the Government's strategic objectives. They provided limited flexibility for additional rail services and significantly lower performance and reliability. This is especially true for the WCML into Manchester Piccadilly where the alternatives provide no capacity release and would do little to address long standing performance issues given the complexity of the network via Stockport.

The environmental effects of the Proposed Scheme

25. The purpose of the Environmental Statement and subsequent Supplementary Environmental Statements (SES) that accompanies the High Speed 2 (Crewe to Manchester) Bill and Additional Provisions (APs), is to identify the likely significant effects of a proposed development on people and the environment. It does this by identifying the current baseline conditions, anticipating how these may change in the future when the development is assumed to begin construction, and predicting the potential impacts of constructing and operating the development across a range of environmental topics. where the assessment has identified the likely significant effects, the main ES sets out measures proposed to mitigate adverse effects, and the likely significant residual effects (including agriculture, biodiversity, air quality and sound noise and vibration).

26. The environmental assessment within the ES and SESs takes account of a broad evidence base. This includes existing data obtained, for example, from local biological record centres and local experts and aerial photography, as well as surveys and professional judgement. An appropriate baseline was therefore developed to enable assessment to a sufficient level in the ES. As such, the main ES and SES1 and AP1 ES are compliant with the requirements of the Environmental Impact Assessment and Parliamentary Standing Order 27A.

27. As explained in paragraph 9.2 of the main ES, Volume 5, Scope and Methodology Report (SMR) - Addendum report, in order to ensure that all likely significant effects of the Proposed Scheme were identified, a precautionary approach of assuming a 'reasonable worst-case' valuation has been adopted where baseline information was incomplete. This approach was utilised to assign precautionary values to both known receptors and potential receptors based on the best available information.

28. The environmental effects have been assessed on the basis of the Proposed Scheme deposited in Parliament in January 2022. Where an Environmental Impact Assessment is legally required, works would not take place unless they have been assessed already as part of the ES or are subject to a further EIA and consent process. Any nominated undertaker will be contractually bound to comply with the controls set out in the Bill and the Environmental Minimum Requirements, as described in HS2 Phase 2b Western Leg Information Paper E1: Control of environmental impacts and as may be developed during the passage of the Bill through Parliament.

Public transport connections

29. The Proposed Scheme between Crewe-Manchester would include the development of two new stations and complete the line into Manchester city centre, freeing up much needed capacity for commuter services into the city.

30. HS2 would also create better connections between HS2 services and conventional trains at Crewe, enabling more people to access high speed, long distance services, even though their local stations may not be served directly by HS2 trains. The IRP made a commitment to build the Crewe Northern Connection, so that HS2 trains that have stopped at Crewe Station can re-join the HS2 line to Manchester. This could allow up to 5-7 HS2 trains to call at Crewe per hour.

31. Moving long distance services onto the HS2 network could free up space on the WCML for additional passenger stopping services and for freight.

32. The IRP outlined the biggest ever Government investment in the rail network - a £96bn strategy of new lines (including HS2), electrification and upgrades over the next 30 years. IRP is a strategy focused on bringing communities in the North and Midlands closer together, boosting inter-city connections and improving east-west links. It includes:

- The completion of the Western Leg of HS2 from Crewe to Manchester

- A new high-speed line from Birmingham to the East Midlands that would cut the journey time between Birmingham and Nottingham to around 30 mins.
- A comprehensive package of upgrades on the East Coast Main Line.
- Electrification of the Midland Main Line to Chesterfield and Sheffield.
- A new Northern Powerhouse Rail network connecting Liverpool, Manchester, and Leeds, with more frequent, faster, and more reliable services.
- Work on designing a new West Yorkshire mass transit system.

33. The 'core' NPR programme that was announced in the IRP comprised upgrades between Liverpool and Warrington, a 40 mile section of brand-new high speed line between Warrington and West Yorkshire via Manchester using a section of the HS2 Western Leg, and a significantly enhanced scope of the Trans Pennine Rail Upgrade (TRU), trebling capacity between Manchester and Leeds and cutting journey times to just over 30 minutes. It also included a commitment to upgrading and electrifying the Calder Valley Line between Bradford Interchange and Leeds that would reduce journey times by roughly half.

34. The HS2 Crewe – Manchester Proposed Scheme works include a significant amount of infrastructure to allow the delivery of NPR. These works include: the Crewe Northern Connection, passive provision for junctions towards Liverpool at Hoo Green, additional platforms at both Manchester Airport and Manchester Piccadilly high speed stations, and passive provision for a junction towards Leeds in Ardwick. Building these as part of the HS2 scheme would minimise delays to both the HS2 and NPR networks once construction begins.

35. Both Cheshire East and Cheshire West and Chester Councils have received a combined £1.3million through the Rural Mobility Fund. This fund aims to trial on-demand bus services to see whether they can serve communities more effectively than traditional public transport solutions. If successful, these schemes may be run on a permanent basis.

36. Support for local transport initiatives has also been provided from the Local Growth Fund, the Active Travel Fund, and from Bus Capacity Revenue Funding. These schemes will help improve local bus services across Cheshire East and Cheshire West and Chester council areas, enhance key transport routes, and support the growth of housing and employment opportunities.

37. Whilst the station designs are yet to be finalised, the station at Crewe would provide opportunities for interchange between bus and high speed rail services.

38. In July 2019, in their Second Special Report of Session 2017 to 2019, the Phase 2a Select Committee directed the Promoter to commission an ongoing epidemiological health study into the potential effects on mental health and wellbeing of building the railway. The intention is that the findings of this study would provide the Phase 2b Select Committee with a clearer overview of potential effects, and also inform future development of other major infrastructure projects.

39. The Promoter is committed to learning from the actual effects of Phase One construction and has agreed to commission a survey to consider health impacts experienced by Euston residents that are attributed to noise from the construction of the Proposed Scheme. The methodology for the survey has been developed in consultation with external parties such as Public Health England and Imperial College London. The results of the survey may then be used to review the criteria of noise mitigation, noise thresholds and construction hours.

40. The Promoter has examined the responses to the 2017 route and property, the 2018 working draft Environmental Statement and the 2020 Design Refinement consultations. The assessors looked for the use of words such as stressed, upset or worried within the responses. Mental wellbeing was mentioned in association with the perceived environmental, social and economic impacts of the Proposed Scheme. More detail on the issues identified can be found in the 2b Environmental Statement Volume 3 Section 7.5.

Assessment of the Petitioner's proposal

41. The Promoter has undertaken a high-level assessment of what it understands to be the Petitioner's request for a tunnel through Cheshire to connect the proposed HS2 Phase 2b tunnels at Crewe and Manchester. Where detail from the Petitioner has been provided in the petition and subsequent correspondence relating to specifics, these have been considered in the assessment. This assessment has been, for the purposes of responding to the Petitioner's proposal, grouped into the following categories of assumptions: impact to the strategic business case, programme, constructability operational and cost.

Proposed Scheme

42. The route of the Promoter's Proposed Scheme will run from Crewe to Manchester. As reported in table 26 of the AP1 SES, volume 3 route wide effects, combined impacts table, the total length would be approximately 62km (39 miles). The route would begin to the south of the existing Crewe Station, and to the south of the A500 Shavington Bypass, where it would connect to the HS2 Phase 2a route. The Proposed Scheme would pass beneath Crewe in a tunnel. The route would then re-surface to the north of Parkers Road. The Proposed Scheme would connect with the WCML to the north of Crewe tunnel. This connection would enable future Northern Powerhouse Rail (NPR) services to connect with HS2. A rolling stock depot and maintenance facility would be located between the route of the Proposed Scheme and the WCML where they diverge to the south of Winsford. The rolling stock depot would serve as an operational and maintenance hub for HS2 trains on Phase One, Phase 2a and the Proposed Scheme.

43. Reception tracks would connect the rolling stock depot with the WCML, the route of the Proposed Scheme and the Crewe North HS2 infrastructure maintenance facility. Continuing north, the route would pass between the towns of Winsford and Middlewich, then on a series of embankments and viaducts to the west of Lostock Green and east of Higher Shurlach, Rudheath, Lostock Gralam and Higher Wincham

and over the Mid-Cheshire line. The route would then travel further north crossing over the A556 and M6 on a viaducts. The Proposed Scheme also includes a junction near Hoo green. This junction, the NPR London to Liverpool junction, would enable a future NPR route between London and Liverpool to connect to HS2. The HS2 Manchester spur would continue towards Manchester. Bearing east, the spur would pass to the north-west of Rostherne Mere and run broadly parallel to the M56. The Proposed Scheme includes a junction at this location to enable future NPR services between Manchester and Liverpool to connect to HS2. A maintenance base near Ashley would also be located adjacent to the route of the Proposed Scheme. This facility would be used to support railway maintenance.

44. Continuing in an easterly direction, the HS2 Manchester spur would cross the Mid-Cheshire Line for a second time on a viaduct. It would then head northwards before passing beneath the M56 to the east of Warburton Green. The spur would then continue towards the proposed Manchester Airport High Speed station. The station would be located adjacent to the M56 and to the north-west of Manchester Airport. Just beyond this proposed station, the route of the Proposed Scheme would enter a tunnel passing beneath south Manchester.

45. The route would re-emerge in the Ardwick area. A junction would be provided at this location to enable a future NPR route between Manchester and Leeds to connect to HS2. The HS2 Manchester spur would rise onto an embankment before transitioning onto a viaduct terminating at the proposed Manchester Piccadilly High Speed station. The proposed station would be a new six-platform terminus for HS2 and future NPR services.

HS2 Phase 2b Strategic Business Case

46. In June 2019, the Government opened a national consultation on 11 proposed design refinements to the full Phase 2b scheme, including infrastructure to accommodate future Northern Powerhouse Rail (NPR) services. In August 2019 the Government initiated an independent review of HS2 by Douglas Oakervee, in order to test all the evidence for the Government to make informed decisions on the future of all phases of HS2. The 'Oakervee Review', published in 2020, signalled that HS2 Ltd should proceed based on a number of recommendations, including for Phase 2b to be considered as part of the Integrated Rail Plan (IRP) for the North and the Midlands and to be split into smaller sections. The IRP assesses the ability for the Government to deliver on its strategic aims for levelling up in the North of England and the Midlands and to deliver benefits of infrastructure investments to the regions sooner.

47. As such, for future schemes to benefit from the delivery of the Phase 2b Crewe to Manchester scheme, provision has been provided. Key elements include:

- Crewe Northern Connection which would enable services calling at Crewe to use the HS2 Crewe – Manchester infrastructure;
- Hoo Green Junction, which enables future rail link improvements to Liverpool and the North of England and Scotland; and

- Manchester to Liverpool junction which would enable a future NPR scheme as outlined in the IRP.

48. The IRP outlines a strategic use of 22km of the Proposed HS2 Crewe to Manchester infrastructure, for future NPR services that would travel from Liverpool to Manchester and onwards into the Yorkshire and the Northeast. The Proposed Manchester Airport High Speed Station would provide a key new station to the south Manchester conurbation. This would mean a significant boost in rail capacity for the region, alleviating some constraints on the existing network. It would also provide additional capacity to serve Manchester Airport, encouraging the use of public transport to the airport.

Petitioners' proposal

49. The Promoter notes the Petitioner's proposal to remain in tunnel north of Crewe and to follow a straight alignment through to an underground Manchester Piccadilly station, with the removal of Manchester Airport high speed station. The Promoter has assumed, as per the Petitioner requests in respect to a straight-line tunnel through Cheshire, that the strategic business case benefits outlined above would be significantly delayed and require separate delivery or become impracticable to realise through the Petitioner's proposal. The absence of a Manchester Airport High Speed Station would remove access to new rail capacity for hundreds of thousands of people. A straight-line tunnel would require significant additional infrastructure to be built through Cheshire to enable the same benefits as the Proposed Scheme. The Promoter assumes removal of the Crewe Northern Connection as a result of the Petitioner's alternative proposal, removing the ability for train services calling at Crewe to use the Proposed HS2 infrastructure as outlined in the IRP.

Programme consideration of the Petitioner's proposal

50. The Petitioners proposed alternative for a tunnel to connect the proposed HS2 Crewe and Manchester Tunnels, would require powers currently not included within the Phase 2b (Crewe to Manchester) Bill. Given the magnitude of the proposed alternative, it would likely require the Bill currently deposited in parliament, to be withdrawn from parliament and a new environmental impact assessment to be undertaken.

51. It is predicted that this would add at least 5 years of delay before a revised Bill could be brought back before parliament.

52. The Promoter considers that the Petitioners' proposed alternative is a significant change in the alignment of the Proposed Scheme as set out on the Parliamentary Plans deposited in January 2022 in connection with the Bill. The Promoter considers the Petitioner's proposal to be against the principle of the Bill established at Second Reading and retains the right to argue that the issue is outside the remit of the Select Committee should the Petitioner seek to raise this issue before the Select Committee.

53. The principle of the Bill was voted on during Seconding Reading of the Bill in the House of Commons in June 2022. The Bill passed its Second Reading by 205 votes to 6.

Constructability considerations of the Petitioner's proposal

54. To ensure the safe construction of the proposed alternative and to meet the Petitioner's request for as straight-line route as possible, it is assessed that the tunnels may need to be in excess of 100m deep in places, which would make a vent shaft proposal challenging to deliver leading to a more costly alternative design and elongating the construction period. This is further addressed in the Operational considerations category under the heading Safety.

55. For the straight-line tunnel, there would still be significant surface interventions, with associated land take for TBM launch sites, excavated material stockpile areas and site set up and lay down areas for machinery, similar to the land take at the south portal for the Chilterns Tunnel on Phase One. Also due to the straight line tunnel alignment request, the ability to avoid impacting communities, infrastructure, large settlements and environmentally sensitive areas is also diminished. Tunnelling over this length will generate a significant volume of surplus excavated material which, due to there being no embankments in which to use it, would need to be exported for disposal to landfill. The project would therefore still generate significant volumes of traffic, and a much greater volume of waste than a conventional overland route.

56. In addition, the construction programme would be predicted to increase by seven years due to the Petitioner's proposal requiring such extensive tunnelling, which in the Promoter's view could result in a 12 year delay into service in comparison with the Proposed Scheme.

Operational considerations of the Petitioner's proposal - Rolling stock depot facility

57. A rolling stock depot is required to store and maintain the fleet for the additional service provision projected as part of the strategic aims in the IRP. By placing the scheme in tunnel, the rolling stock depot would still be required but would need placing on an alternative site, that would either not have a direct connection to HS2 infrastructure or be much further from locations where trains are planned to start and end their journeys. This could have the impact of increasing empty stock movements, using more train paths on the existing network and increasing train path conflicts around at grade junctions. This would result in train services starting later and finishing earlier, reducing efficiency and capacity of both the existing rail network and the Proposed HS2 route.

Operational considerations of the Petitioner's proposal - Safety

58. A continuous, long and deep tunnel would have safety implications that would need to be considered. In an emergency, passengers and staff would need to be safely evacuated from a tunnel to the surface or to refuges underground in a timely manner. The emergency services would also need to gain access quickly and effectively to reach the incident. Deep vent shafts would need to have additional ways for people to move in and out of the tunnels at much greater depths in the times required. Alternatives include having a third service tunnel similar to the Channel Tunnel scheme or to build fire evacuation cross passages with more sparsely spaced but larger intervention shafts similar to the Gotthard Base Tunnel. In a long tunnel there are additional ventilation needs to reduce the impact of the 'tunnel heat effect' to maintain operation of the high speed railway. This would mean either more ventilation shafts, wider diameter fans, a third tunnel to assist with ventilation, larger running tunnel diameters or a combination to meet the same desired operational requirements in the Promoter's Proposed Scheme.

59. The Petitioner's alternative proposal would also require the relocation of the Crewe and Ashley IMB-Rs and thus would require longer periods to carry out maintenance due to the increased distances required to travel for alternative IMB-R locations, shortening the operational window of the railway. A tunnel of this length and depth would also require long, sustained gradients to descend and climb through the tunnel, increasing power consumption and maintenance requirements of the railway.

Cost Considerations of the Petitioner's proposal

60. The Promoter has in the time available carried out a high-level cost analysis of the Petitioner's alternative alignment. The assessment has identified that despite the reduction in length compared to the Promoter's Proposed Scheme, the Petitioner's proposal carries a cost increase as a result of the need for additional tunnel boring machines (TBM) and constructing deep vent shafts and a deep crossover box that could also act as an additional TBM recovery site during construction. The civils costs associated with the Petitioner's proposal is assumed to be in excess of £9 billion which would be an increase of well over £1 billion from the Promoter's Proposed Scheme. It should be noted that the Promoter has assessed the cheapest possible parameters.

61. As a result, the civils assessment excludes features such as a Manchester Airport Station as per the Petitioner's proposal to remove it from the scheme. Also removed is the provision for three grade separated junctions, as it wouldn't be entirely possible to understand at this stage where those connections would be in a new vertical and horizontal alignment underground, or how much additional infrastructure would be required and delivered as part of the Petitioner's proposal. The Promoter notes however to deliver three underground grade separated junctions in conjunction with an alignment further east than the present location in the Proposed Scheme would either further increase the cost of the Petitioner's proposal significantly or the cost of any future scheme that would follow the Phase 2b Crewe-Manchester hybrid Bill. The Promoter also has retained costs in the Petitioner's alternative for provision of a rolling stock depot and two IMB-Rs as per the Proposed Scheme for operational and

maintenance necessity, though an alternative location for these features has not been identified.

62. The Promoter notes the Petitioners request to also place the Manchester Piccadilly proposed high speed station underground. Based on evidence currently available, the Promoter remains of the view that a combined HS2/NPR surface station is the right solution. Further rationale to support this position can be found in Sections 3.16 to 3.20 of the Integrated Rail Plan for the North and Midlands, which can be viewed here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1062157/integrated-rail-plan-for-the-north-and-midlands-web-version.pdf

HOUSE OF COMMONS SELECT COMMITTEE

HIGH SPEED RAIL (CREWE - MANCHESTER) BILL

PROMOTER'S RESPONSE TO PETITION OF: Slater Cheshire Residents Group

PETITION NO: HS2-P2B-117

PARAGRAPH NO: 2, Request 2

ISSUE RAISED: Crewe North Rolling Stock Depot

PETITION PARAGRAPH: 2. Some of our group will also be severely impacted by the proposed HS2 Rolling Stock Depot at Wimboldsley, again during both construction and operation. It is absolutely unbelievable, to even think, that building a rolling stock depot on 65 hectares of fertile farmland, is a good idea. We fully understand why the rolling stock depot was re-located from a brownfield site in Golborne, however to then move it to a greenfield site, directly opposite and less than 250 metres from Wimboldsley Primary School, is outrageous. As well as the loss of 65 hectares of fertile farmland, as with the alignment there is a massive loss of wildlife habitats, air, noise and also light pollution, twenty-four hours a day, 365 days a year and all this less than 250 metres from a school. We therefore object to the Bill with reference to the building of the HS2 Rolling Stock Depot at Wimboldsley. Once again there has to be, and-we-propose, a better solution.

Request

2. Regardless of what happens vis a vis the HS2 alignment, the HS2 Rolling Stock Depot at Wimboldsley MUST be relocated to a more suitable (and essentially), a brownfield site. Our proposal would obviously be at the now redundant Network Rail sidings at Basford, just south of Crewe station, however we have also established that there are other, far more suitable brownfield sites.

PROMOTER'S RESPONSE:

1. The Proposed Scheme includes the Crewe North infrastructure maintenance base – rail (IMB-R), located on 4ha of land between the route of the Proposed Scheme and

the WCML, north-east of Walley's Green. The Crewe North IMB-R would be a maintenance facility and storage area for the Proposed Scheme. It would support the main maintenance base at Stone, which is part of the Phase 2a scheme. Crewe North Rolling Stock Depot (RSD) would be located just to the north of the IMB-R and would serve as an operational and maintenance hub for HS2 rolling stock.

2. Section 2.2 of the Environmental Statement (ES) Volume 2, Community Area report: Wimboldsley to Lostock Gralam (MA02), sets out details of the Crewe North Rolling Stock Depot ("RSD"). Paragraphs 2.2.33 to 2.2.36 of that section set out the purpose and use of the Crewe North RSD. It also covers the length of the facility along with the extent of land that would be occupied, its height in comparison with the existing landscape, road and rail connections, and lighting arrangements (including the heights of the lighting columns).

3. Figure 5 of that document shows a visualisation of the RSD, and paragraphs 2.2.39 - 2.2.43 goes on to list the area and (where relevant) the maximum heights of the key features of the depot along with other information, such as the lengths of the trains that can be accommodated in each siding. Also included in these paragraphs are details of the landscape mitigation planting and the works to accommodate the site.

4. Finally, paragraphs 2.2.44-2.2.50 provide details of the reception tracks serving the RSD, including information on their operation, and the lengths, depths and heights of the relevant associated engineering features. The design of the Proposed Scheme to date provides the level of detail necessary for the purposes of the Phase 2b Bill and the requirements of the Standing Orders of Parliament. Once the detailed design of the Proposed Scheme is complete the nominated undertaker will need to apply to local authorities along the route for approval of the detailed design of a range of elements of the Proposed Scheme in accordance with the planning regime established under Schedule 17 to the Bill.

Rolling Stock Stabling and Depot – Operational Requirements

5. HS2 Ltd define rolling stock stabling and depot requirements using an agreed Train Service Specification (TSS) and maintenance frequency needs of the fleet. Rolling stock depots and stabling must be viewed as part of an operational system, to consider the need to stable trains at night, starting and finishing points for services, as well as cleaning and maintenance requirements.

6. The operational requirements for the Phases One and 2a are met through the provision of Washwood Heath Rolling Stock Depot in Birmingham, as well as stabling at existing sites, Edge Hill in Liverpool, Longsight in Manchester, and Polmadie in Glasgow. Washwood Heath Depot in Birmingham also has some additional capacity designed in for Phase 2b services that circulate back to Birmingham.

7. The Phase 2b TSS requires further stabling facilities in addition to those identified for Phase One and Phase 2a so that the increased number of services can operate.

8. HS2 Ltd plan to continue stabling some trains at existing Network Rail (NR) facilities at Edge Hill, Longsight and Polmadie where HS2 rolling stock is planned to replace current West Coast Main Line (WCML) services. However, the additional stabling required for Phase 2b operations far exceeds the limited spare and/or released capacity at NR depots. Additionally, Longsight at Manchester cannot be accessed from the new HS2 Station at Manchester, so is only expected to be used by HS2 Macclesfield trains, and the released capacity used for other conventional rolling stock.

9. The TSS also specifies that HS2 Ltd is required to make accommodation for the operation of HS2 captive network trains between Birmingham, Manchester and Euston. This rolling stock is wider than the existing British rolling stock gauge, similar to European high speed trains and with different maintenance needs. These captive trains therefore, could not stable at existing NR facilities, without substantial modification works to those facilities, or indeed be able to access them using the existing network. In any event, as well as having to make significant modification for regauging existing NR depots, the existing conventional rail network would also require expensive and very disruptive gauge widening in order for such trains to be able to reach the existing depots, which in some areas may not be practicable.

10. Additional rolling stock required once Phase 2b is in operation, would be for providing two new Birmingham to Manchester services per hour.

11. Services between London Euston and Manchester from Phases One and 2a would also be made longer through the provision of two 200m rolling stock sets operating together to form 400m trains. There would also be passive provision for an additional London Euston to Manchester train per hour in the future. It would not be possible for these trains to access the existing NR Longsight depot.

Proposed Scheme development

12. Please see the Promoters response in relation to the development of the Crewe – Manchester Proposed Scheme in response to paragraph 1 of the petition earlier in this document. This sets out the extensive stakeholder and public consultation in advance of the submission of the Bill.

Crewe North Rolling Stock Depot - location

13. A new Rolling Stock Depot (RSD) is required to run the planned train services (to meet the TSS requirements for Phase 2b). The RSD size is identified from the requirement to stable up to 53 units in addition to the stabling at Washwood Heath Depot and at existing NR depots.

14. Depot locations were assessed and reviewed against multiple criteria with public consultations. No brownfield sites were available that met the requirements of the RSD on the current line of route. Crewe North site was deemed optimal due primarily to having direct access to both the WCML and HS2 route and for the smallest environmental impact. The WCML access is needed for services to Liverpool, the

Northwest and Scotland, whereas the HS2 access is needed for services to Manchester.

15. While the RSD site is not a brownfield site prior to construction, the land would become more difficult to access and farm, due to being situated between the WCML and the proposed HS2 mainline. There are still significant construction activities that would require land in this area irrespective of the RSD. The presence of these two pieces of infrastructure would also largely screen the RSD from public viewpoints on either side. Alternatives assessed at locations along the Phase 2b route require additional infrastructure to be built, with additional environmental impacts, land take and cost to the scheme while possibly reducing the operational efficiency of the proposed Phase 2b service provision.

Phase 2b Western Leg Rolling Stock Depot – alternative sites considered

16. Section 5.2.113 to 5.2.128 of the main Environmental Statement Volume 5: Appendix CT-003-00000 Alternatives report sets out the alternative rolling stock depot locations between Crewe, Manchester and the WCML connection near Golborne.

17. For further information on the alternatives that were tested for the Crewe North RSD, please see the High Speed Two Phase 2b Crewe to Manchester West Midlands to Leeds Route refinements - HS2 Ltd's advice to Government report (July 2017).

18. The Promoter has previously considered a range of alternative sites for the location of the RSD, including brownfield sites. However, no brownfield sites were available that met the requirements of the RSD on the current line of route. While the RSD site to the north of Crewe is not a brownfield site, the site would have become sterilised, situated as it is between the West Coast Main Line (WCML) and the HS2 mainline.

Petitioners' proposal to relocate Crewe North Rolling Stock Depot to site at Basford

19. The government's response to the HS2 Phase 2b Western Leg Design Refinement Consultation (January 2022) set out that Basford Hall Rail Yard had previously been considered as a location for the Crewe North Rolling Stock Depot and had been discounted as being unsuitable. This is because of their location, size, or lack of connections to the existing rail network. The site at Basford Hall Rail Yard is currently an operational freight yard. Locating an HS2 depot at Basford Hall Rail Yard would mean moving the existing freight operation elsewhere and therefore would not remove the issue of land take. Basford Hall Rail Yard is further away from the line of route than the site at Crewe. Using this site would lead to increased empty train movements with sound, noise, and vibration impacts. It would affect existing railway operations and affect planned development in the area.

20. In addition to the existing freight depot, the land adjacent to the existing Basford depot is currently under development. Notwithstanding, due to the location of Phase 2a, the Proposed Scheme and the associated connections with the WCML, a depot in a location to the south of Crewe would be operationally challenging to meet the

requirements of the TSS and would perform worse than the proposed location of the Crewe North RSD.

21. The HS2 Phase 2b Western Leg Design Refinement Consultation Response document can be viewed here:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1049091/dft-hs2-phase-2b-western-leg-design-refinement-consultation-web-version.pdf#page=22&zoom=100,0,0

22. The Promoter requests that the Petitioner provides details of the '*far more suitable brownfield sites*' referred to in Section 3 paragraph (2) of the petition. This would allow the Promoter to consider and engage with the Petitioner on these sites in a greater degree of detail

Crewe North RSD – mitigation

23. The design of the Proposed Scheme includes a mixture of landscape earthworks and planting to screen views from nearby receptors and assist in integrating the railway infrastructure over time into the surrounding landscape.

24. The operations of the Rolling Stock Depot would include the cleaning and maintenance of trains and also for overnight stabling. The depot would therefore operate 24 hours a day, 7 days a week, with a significant proportion of work taking place overnight.

25. As stated within paragraph 7.5.6 of the MA2 Community Area Report, Volume 2, of the main Environmental Statement (ES), where reasonably practicable, lighting type, column height and location will be selected to reduce light spill and glare. A control management system will be used to dim and control each light and accessories such as baffles, hoods and louvres will be used where required to direct light and reduce light spill.

26. Paragraph 13.5.15 of the MA2 Community Area Report, Volume 2, of the main ES details noise mitigation measures for Crewe North RSD including: limiting the sounding of train horns; control of noise from train movements along tightly curved tracks including wheel squeal; control of train equipment such as heating, ventilation and air conditioning (HVAC) units while vehicles are stabled; control of noise from maintenance and cleaning through the design of the maintenance sheds; enclosures for the carriage wash and wheel lathe; and boundary noise barriers as necessary.

Wimboldsley Community Primary School – air quality

27. The MA02 Wimboldsley to Lostock Gralam Community Area Report, Volume 2, of the main Environmental Statement (ES) identifies the likely significant effects of the construction and operation of the Proposed Scheme and identifies the range of mitigation measures that could be used to reduce or eliminate effects. The assessment is based on a number of assumptions about design and construction practices.

28. The conclusion of the Environmental Impact Assessment reported within the ES is that at the Wimboldsley Community Primary School there would be no significant adverse effects from dust-generating activities during construction, after the provisions of the draft Code of Construction Practice (CoCP) have been applied, as reported in section 5.4 of MA02 Report, Volume 2 of the ES. Furthermore, as noted in paragraph 7.3.5 of the draft CoCP, at an appropriate stage a dust risk assessment, in line with best practice guidance, would be completed to determine the level of monitoring required to assure the effectiveness of onsite mitigations. Where the need for dust monitoring is identified (i.e., Medium, or High dust risk) indicative monitoring for particulate matter would also be carried out. This monitoring includes a site action level, which if triggered, action would be undertaken as detailed in paragraph 4.3.8 – 4.3.10 of the draft CoCP. Where monitoring is carried out monthly monitoring reports would be published detailing locations of monitoring per local authority area.

29. Due to the linear nature of the Proposed Scheme and its associated dust generating activities, the construction dust assessment has been undertaken in detail for distinct assessment areas in the Wimboldsley to Lostock Gralam area. Wimboldsley Community Primary School is included in the area around Wimboldsley, see 3.2.1, Volume 5: Appendix AQ-001-0MA02, MA02 Air quality report. With the application of the established national best practice mitigation measures contained in the draft CoCP, no significant effects linked to dust generating activities are anticipated.

30. As noted, dust mitigation measures, in line with Best Practical Means (as set out in Chapter 7 of the draft CoCP) will be applied to all HS2 sites. National Best Practice Guidance (Institute of Air Quality Management) notes these measures are sufficient for managing any dust impacts linked to demolition and construction works. Furthermore, at Medium and High-Risk sites (as determined through National Best Practice Guidance), continuous indicative dust monitoring will be undertaken on the boundaries of the site as a means to ensure the effectiveness of the on-site mitigation measures. Dust controls will be implemented on a site-by-site basis in line with best practice guidelines and draft CoCP which is sufficient in minimising and controlling dust associated with HS2 works. Therefore, there is no evidence to suggest that emissions from dust and air quality as a result of the construction of the Proposed Scheme would have any implications on the access or use of the school's outdoor areas, or requirements for a cleaning regime for the school.

31. The Promoter notes that the proposed rolling stock depot is on the western side of the proposed HS2 mainline. The rolling stock depot therefore has the proposed mainline between it and Wimboldsley School. The Promoter also notes that the proposed rolling stock depot is in excess of 300m from the school at its closest point.

Local Wildlife Sites

32. Section 7 of the MA02 Area Report, Volume 2, of the main ES, reports significant adverse effects at the county/metropolitan level on the following Local Wildlife Sites (LWS) in Cheshire West and Cheshire.

33. Where a significant adverse effect on the integrity of a LWS has been assessed, sufficient compensation has been incorporated into the Proposed Scheme to address effects on the conservation status of the habitats and species for which that LWS was designated. As far as possible, and in accordance with the mitigation hierarchy, compensation is provided in locations that are close to and have connectivity with the affected LWS. For example, the loss of 0.8ha of woodland habitat from River Dane, Bostock LWS will be compensated by 3.6ha of woodland habitat creation adjacent to The Willowbeds LWS which is approximately 970m to the east of the line of route, as well as further planting to link intervening woodlands and grassland habitat creation along the River Dane. Similarly, 7.9ha of woodland planting in at five locations between the A556 Shurlach Road east of Lostock Gralam and Plumley Lime Beds SSSI would compensate for 2.4ha of woodland from Long Wood LWS (and other areas of undesignated woodland) to maintain the integrity and enhance ecological connectivity between the complex of existing nearby woodlands. Loss of wetland habitat at Whatcroft Lane Wetlands LWS is addressed through creation of reedbed habitat within 1.4ha of wetland habitat creation areas immediately to the east of the LWS along the Trent and Mersey Canal and to the south and south-west of the LWS.

34. It is not possible to directly compensate for the effect on designation status (as the responsibility for designating lies with external bodies). However, it is expected that when mature, that the proposed compensatory habitats to be created are likely to meet relevant LWS criteria. The Volume 2: MA02, Section 7.4, and the Ecological Principles of Mitigation, Scope and Methodology Report (SMR) (Part 2), Volume 5, in the main ES, confirms that the target condition for areas of ecological habitat creation as will be set in order for them to meet the criteria of the corresponding habitat of principal importance (such as lowland meadow and lowland mixed deciduous woodland) as defined under Section 41 of the Natural Environment and Rural Communities Act (2006). The target condition for each area of ecological habitat creation will be site out within an Ecological Site Management Plan. The Local Wildlife Site Selection Criteria for the Cheshire region⁶ also use habitats of principal importance as a basis for LWS section, which provides further confidence that created habitats would be of a comparable standard to LWS.

35. In some instances, LWS in Cheshire West and Chester that are directly affected by the scheme contain habitat that is considered irreplaceable such as ancient woodland, ancient and veteran trees, and orchards. Where these situations occur, proposed compensation measures are included within the scheme design in addition to the mitigation measures described above, to partially compensate significant residual adverse effect. The design and extent of these compensation measures are made on a site by site basis and based on professional judgement.

HOUSE OF COMMONS SELECT COMMITTEE

HIGH SPEED RAIL (CREWE - MANCHESTER) BILL

PROMOTER'S RESPONSE TO PETITION OF: Slater Cheshire Residents Group

PETITION NO: HS2-P2B-117

PARAGRAPH NO: 3, Request 3

ISSUE RAISED: Ground conditions

PETITION PARAGRAPH: 3. Whilst HS2 Ltd have claimed that the environment has been central to selecting the route and developing the design of HS2, we are all very concerned about the railway being built over the salt district of mid Cheshire. This area is notoriously unstable, subject to subsidence/collapse, (both unexpected and gradual), making we believe the project seriously flawed and potentially dangerous to passengers and to the communities that live on, or near the alignment. We believe that HS2 Ltd have done very little meaningful research into the ground conditions prior to the deposition of the Bill (a complacent and extremely serious omission) and their only response to the inevitable and hugely expensive engineering challenges they face, is to declare that the alignment through Cheshire will be built on viaducts and embankments, with of course the consequences for us residents, as referred to above. We think that climate change, more frequent extreme weather events and rapidly rising sea-level, leading to rises in the water table and therefore more flood risk, are going to make any infrastructure built above ground level, very vulnerable to movement with potentially disastrous consequences, particularly given the very fine, 5mm vertical deflection tolerance, that HS2 requires.

Request

3. No further comment is required.

PROMOTER'S RESPONSE:

Preferred Route

1. Consideration of sustainability (including environmental impacts) has been integral to the development of the preferred alignment of the Proposed Scheme throughout the appraisal process. Since its initial development, the Promoter has continued to develop route and station proposals that seek to avoid or reduce environmental and community impacts within the engineering and cost considerations of Phase 2b.

2. The proposed routes presented for public consultation in 2013/2014 and in 2016/2017 have emerged from many combinations of route options. The 2017 preferred route to Manchester, and subsequently the route that emerged from the design development and Design Refinement Consultation processes is, on balance, considered to best meet objectives for passenger demand, ease of construction, journey time, sustainability and cost.

3. A full summary of the route development process is reported within the Alternatives Report, Volume 5, of the main ES.

Ground conditions

4. HS2 is in consultation with the operators of the Salt Industry infrastructure and discussions are ongoing with the business owners/operators to ensure public safety and their safe continued business operations during constructing and operating the Proposed Scheme.

5. HS2 has undertaken a significant amount of data gathering to inform the design with specific reference to the geology and ground conditions. HS2 has held discussions with relevant agencies that have significant knowledge and information on existing infrastructure assets within the area and captured data on the interaction between their activities and the ground conditions. These agencies include Network Rail, The Canal and Rivers Trust, the relevant Salt Industry companies and the Cheshire Brine Subsidence Compensation Board. In addition, HS2 has listened to local communities who have knowledge of the local geology and take note of their observations and opinions.

6. A comprehensive desk study has been compiled for the Phase 2b Western Leg route. Following a review of desk study information, two phases of ground investigations have already been carried out.

7. It is industry practice to undertake Ground Investigation in a phased manner, with each phase building on the next. HS2 has planned a routewide Ground Investigation activity which is proposed to start in 2023. This proposed routewide Ground Investigation would involve closely spaced exploratory sampling points along the full route from Crewe to Manchester, with more frequent and site-specific exploration at specific locations, where the ground risk may be greater due to the local geological conditions. Future contractors would normally also deploy additional ground

investigations in the later stages of design and the early stages of construction to finalise design elements that could be sensitive to ground conditions along the HS2 corridor. This ensures the engineering solutions proposed are verified and the safety of the Proposed Scheme is validated and assured.

8. The Promoter has previously given commitments on the design of the Proposed Scheme in Phase 2b Western Leg Information Paper D1: Design, in particular the Promoter would highlight Sections 3.1 of this publication, which states:

“The Promoter the nominated undertaker will seek to ensure that:

- the design is safe, efficient, and meets with the requirements of whole life operation and maintenance alongside initial buildability and will integrate with the local setting;
- the design is developed through engagement to seek peoples' views and including integration with setting design of the visible buildings and permanent structures”

9. HS2 continues to work with its design partners to optimise the Proposed Scheme with respect to engineering design and cost as more information relating to the ground conditions emerges.

Flood risk and climate change

10. A high-level climate change risk and resilience assessment has been undertaken to identify the potential risks of climate change on the Proposed Scheme, and to assess the Proposed Scheme's resilience and capacity to cope with these potential risks. In addition, a comprehensive flood risk assessment has been carried out for each community area in consultation with the Environment Agency and can be found in the Volume 2 and supporting Volume 5: Community Area collections of the main ES. A route-wide flood risk assessment has also been carried out and can be found in the Volume 3 and supporting Volume 5: Route-wide reports of the main ES.

11. The assessment included the identification and assessment of potential climate change risks for HS2 assets within the Proposed Scheme. The assessment has considered risks posed by climate related hazards such as extreme hot and cold weather, heavy rain, high winds and storms to the infrastructure and assets associated with the railway including tracks, tunnels, overhead line equipment, rolling stock, stations, and earthworks. The likelihood and consequences of climate hazards have been considered based upon the trends within the UK climate projections.

12. Climate change resilience assessments will continue to take place throughout the design, construction, and operation stages of the Proposed Scheme.