## EXHIBIT LIST

Reference No: HOC/00119  
Petitioner: Frederick Smith  
Published to Collaboration Area: Monday 02-Jul-2018

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</table>
Colonel David John Hindle  BSc., MSc., DIC., MICE., MInstRE., ARSM., VR.

Qualifications:
Colonel, Engineer & Logistics Staff Corps RE(V) – HM Armed Forces Volunteer Reserve.
BSc (Hons, 1st class) Mining Geology - University of Wales, University College Cardiff.
MSc (Distinction) Engineering Geology – University of London, Imperial College.
Member of the Institution of Civil Engineers.
Member of the Institution of Royal Engineers.
Member of the British Tunnelling Society.
Member of the International Tunnelling Association.

Experience:
Over 40 years in mining, tunnelling and ground engineering in the UK and Worldwide, Including over 100 tunnelling projects in over 20 countries.
Advisor to HM Armed Forces on ground engineering matters (via the Staff Corps).
Co-founder of OTB Engineering Limited, a civil and mining engineering consultancy.
Co-founder of Innovative Support Systems Ltd., a specialist manufacturer of ground & tunnel support systems.
Visiting MSc lecturer in Tunnelling Technology to University College London, Warwick University, Exeter University – Camborne School of Mines & the British Tunnelling Society’s Tunnel Design & Construction Course.

Selected Projects:
A55 North Wales Coast Road Penmaenbach and Pen-y-Clip tunnels. Project management of the design and construction supervision of 1.5km.
Jubilee Line Extension, London Bridge Station. Project management of the shafts, tunnels and cavern designs and construction supervision.
Brunel’s Thames Tunnel. Project management of the design of the refurbishment of the historic railway tunnel in East London
Thames Tideway tunnels. Peer reviewer of the original scheme comprising 30 km of tunnels and 35 shafts.
Deep Tunnel Sewerage System, Singapore. Design advice to a Japanese contractor for a 7.7km long tunnel in soil and rock.
VIAMADEIRA project. Adviser to the operating consortium on the construction of 24 highway rock tunnels totalling over 20km in Madeira.
Thirre Tunnel project. Advisor to the contractor on the construction of a 5.5km long, twin bore highway rock tunnels in Albania.
BETWEEN THE SINGLE TUNNEL PORTALS THE ONLY VISIBLE STRUCTURES WOULD BE THE TWO SHAFT HEAD HOUSES PLUS SURROUNDING AREAS OF HARDSTANDING AND AN ACCESS ROAD TO SHAFT 2. THESE COULD BE EASILY SCREENED BY TREES AND SHRUBS IF REQUIRED.
The HS2 proposed scheme envisages tunnelling from the portals towards the shafts, which would be perfectly feasible for the single tunnel scheme. However, if access to the West Coast Main Line can be obtained through negotiations with Network Rail there is the opportunity to move all bulk materials into and out of the site by rail, thereby greatly reducing road traffic movements and confining the construction site to the Lea Valley.
SINGLE TUNNEL
SCHEME POTENTIAL
LAND TAKE DURING
CONSTRUCTION

MADELEY CHORD

WCML JUNCTION
(could be re-established)

OVERBRIDGE

STOKE TO MARKET DRAYTON RAILWAY (DISUSED)

HAUL ROAD

WORKSITE 1

WORKSITE 2

LAY DOWN AREA

LAY DOWN AREA

TUNNEL 1

TUNNEL 2

TUNNEL 3

TUNNEL 4

SHAFT 1

SHAFT 2

TEMPORARY HAUL ROAD

A255 (4)

HOC/00119/0005
By moving the tunnel low point to directly below the WCML crossing the southern gradient out of the tunnel can be reduced to 0.95% (maximum viaduct gradient 0.96%). Tunnels will be in soft rock throughout and in low permeability rock below the water table.
Mechanised Open-face Shield
(Can be manufactured in UK)

Closed Face Earth Pressure Balance TBM
(There are currently no UK manufacturers)

£5 million
£15 to £25 million
ADVANTAGES OF MECHANISED OPEN FACE SHIELDS

• Cost a fraction of the price of closed face EPBM or Slurry TBM.
• Can be manufactured in UK.
• Relatively quick delivery time.
• Relatively easy to transport to site and around the site.
• Simple to assemble and dismantle on site.
• Simple to operate and maintain.
• Readily obtainable spare parts.
• Easily interchangeable excavation devices: backhoe, rock breaker, roadheader.
• Relatively low power consumption.
• Produces clean, uncontaminated spoil.
# Preliminary Construction Programme

| TASKS:                                      | MONTHS: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---------------------------------------------|---------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Mobilise to site                            | Months  | 1 |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Procure and deliver 3No TBMs                |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Procure and deliver PCC segments            |         |   |   |   |   |   |   |   |   |   | 12  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Setup worksites                             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Form WCML junction                          |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Shaft 1                           |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Shaft 2                           |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Install dewatering & surface monitoring     |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Portals                           |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 1 from Shaft 1             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 2 from Shaft 1             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 3 from Shaft 1             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 4 from Shaft 2             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 5 from Shaft 2             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Tunnel 6 from Shaft 2             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Construct Cross Passages                    |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fit-out tunnels                             |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fit-out shafts & headhouses                 |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Reinstate worksites and lay-down areas      |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Demobilise from site                        |         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**Assumptions:**

- Average TBM advance rate 6 metres per day (conservative).
- 3No TBMs 24/7 working.
- TBM move & maintenance between drives - 1 month.
- All bulk materials in and out by rail.
THE SINGLE TUNNEL SCHEME AIMS TO REDUCE COST AND RISK BY:

• Reducing the number of construction elements.

• Reducing the number of construction interfaces.

• Simplifying the design and construction methodology.

• Selection of appropriate construction equipment.

• Improving the efficiency of materials handling and muckshifting.

• Reducing land take and local disruption both during and post-construction.
OVERALL ADVANTAGES OF THE SINGLE TUNNEL SCHEME:

• Greatly reduced environmental effects and land-take both during and post-construction (discussed previously).
• Reduced interference with the local traffic layout.
• Reduced number of construction methodologies and interfaces, thereby reducing risk and overall cost.
• Capability of completion in 3 years.
• Elimination of majority of surface enabling works.
• Capability of UK involvement in tunnel boring machine manufacture.
• Possibility of utilising the abandoned Stoke to Market Drayton railway and the Madeley Chord to transport bulk materials to and from site via the WCML.
• Suitable spoil arisings from open face shield tunnelling for use elsewhere on HS2 or for local landfill, landscaping and building projects.
• Confining construction activities to a small portion of the Lea valley.
• Track gradients similar or better than the proposed scheme.
• Reduced long-term maintenance and improved security to the railway.
<table>
<thead>
<tr>
<th>Item</th>
<th>Proposed Scheme (£ million)</th>
<th>Single Tunnel (£ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tunnels</td>
<td>170.64</td>
<td>314.59</td>
</tr>
<tr>
<td>Spoil disposal from single tunnel scheme (tunnel only)</td>
<td></td>
<td>28.40</td>
</tr>
<tr>
<td>Civil engineering (including earthworks)</td>
<td>208.30</td>
<td>50.55</td>
</tr>
<tr>
<td>Rail Systems</td>
<td>69.66</td>
<td>103.55</td>
</tr>
<tr>
<td>Indirect Costs</td>
<td>65.37</td>
<td>84.92</td>
</tr>
<tr>
<td><strong>Sub-total: Construction &amp; Indirect Costs:</strong></td>
<td><strong>513.97</strong></td>
<td><strong>582.01</strong></td>
</tr>
<tr>
<td><strong>Sub-total difference:</strong></td>
<td></td>
<td><strong>68.04</strong></td>
</tr>
<tr>
<td>Earthworks (reduction against Proposed Scheme)</td>
<td></td>
<td>not used</td>
</tr>
<tr>
<td>Land &amp; Property (reduction against Proposed Scheme)</td>
<td></td>
<td>-15.94</td>
</tr>
<tr>
<td>Efficiency Adjustment</td>
<td></td>
<td>5.38</td>
</tr>
<tr>
<td>Avoided design improvements required for Proposed Scheme)</td>
<td></td>
<td>-1.20</td>
</tr>
<tr>
<td><strong>Total Difference:</strong></td>
<td></td>
<td><strong>56.28</strong></td>
</tr>
<tr>
<td>Contingency (40%)</td>
<td></td>
<td>22.51</td>
</tr>
<tr>
<td><strong>Total cost difference from Proposed Scheme:</strong></td>
<td></td>
<td><strong>78.79</strong></td>
</tr>
</tbody>
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**Notes:**
- Tunnels cost estimate assumes bored tunnelling cost reduction from £28.2 million to £24 million per kilometer for a 10.2m diameter bored tunnel in line with HM Treasury Cost Review lower bound figures using a cheaper TBM in a “greenfield” site.
- Earthworks for proposed scheme previously excluded in HS2 estimate.
- Earthworks and spoil disposal costs taken from Spons Civil Engineering & Highways Price Book, Series 600: Earthworks
- Cost excludes resale value of spoil and assumes exemption from landfill tax.
- Haulage distances assumed to be 7 kilometers for 1 million cubic metres (local disposal sites identified) and the remainder to be within 20 km.
- All costs adjusted to 2015 prices.
- Items in red denote changed values from HS2 table.
HS2 Phase 1
Independent Determination of Cost

Commentary to be read in conjunction with the independent determination of cost prepared by mbpc Infrastructure Limited, based on prices ruling at 4th Quarter 2015, 31st December 2015

mbpc Infrastructure Limited

31st July 2017
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Introduction to the July 2017 Revision

Having compared the drawings on which the original commentary was based, there appeared to be several significant alterations to Phase 1 of the HS2 Project, which are shown on the drawings posted on the website of the Department for Transport in 2016. The cost of these alterations and their effect on the construction programme, including the acquisition of land, required to facilitate the opening of the railway in 2026.

Project programme

The principles changes in mbpc estimate of cost for Phase 1 of the HS2 Project, at the prices ruling at 4th Quarter 2015, are the additional costs of acquiring approximate 12,000 property interests along the route, whether they be freehold, leasehold or rented, and the cost of providing alternative accommodation for those displaced.

At the meeting held on 18th January 2017, attended by Lord Ahmad of Wimbledon, Michael Hurn of the DfT, John Stretch, representing HS2 Limited, Lord Berkeley and M H Byng, on behalf of petitioner, Sam Price, MHB raised the issue of the power supply required for the railway and the capital cost of generating it and the cost of alterations to the supply network to deliver it to the new railway at the power levels required and in appropriate places along the route. Mr. Stretch stated that these costs would be met by enhanced energy supply costs.

National Grid have stated that no application for a supply has been received from HS2 Limited so it is unable to confirm the costs of generating and providing the supply nor the programme for their provision. This has a major effect on project programme and cost, which are taken into account in the determination of cost included with this commentary.

Ground conditions

The ground conditions identified towards the north end of the route, from Colne Valley to Quainton, Calvert to Burton Green and from Balsall Common to Curdworth and Curzon Street, increase the costs of foundations to the track and to the structures along the line so appropriate allowances have been included for these additional works.

Commentary to the July 2017 revision

This commentary should be read in conjunction with the summary of the priced determination of cost produced by mbpc of Phase 1 of HS2 railway and the spreadsheet summary prepared by HS2 Limited and presented at the meeting held on 18th January 2017.

Comparative costs and budgets

The total of mbpc determination is £51.23 billion and the total of the summary offered by HS2 Limited is £17.58 billion, to which has been added an allowance of 35% for risk, bringing the total to £23.73 billion.

The monies allocated to the project by DfT are £23.50 billion, written answer to Parliamentary Question HL4189 dated 21st December 2016; the figure was later increased to £27.18 billion in July 2017, written answer to Parliamentary Question HL1048.

All costs are based on prices ruling at 4th Quarter 2015, 31st December 2015.

Origin of MHB estimate

M H Byng gave evidence, on behalf of Mr Sam Price (petitioner), a resident of the London Borough of Camden (Petition HoL 691) under oath to the HS2 Select Committee in The House of Lords on 11th October 2016 on the cost and the effects of disruption of the Project AP03 proposed by HS2 Limited for the section of the line from Old Oak Common to London Euston Station, including the rebuilding of the station.
Mr Price submitted in evidence an alternative scheme, mitigating disruption to the residents and providing a station design within the footprint of the current Euston Station, known as “Euston Express”

In the absence of any detailed estimates from HS2 Limited, with which the petitioner had been in contact since February 2016, to prepare a comparative estimate of cost for the deposited scheme and petitioned alternative, MHB prepared a notional estimate of the HS2 proposal and, on the same basis, prepared an estimate of cost for the petitioned alternative.

The costs submitted in evidence were:

- HS2 Limited AP03 scheme £5.747 billion
- Euston Express scheme £3.647 billion

Both estimates were prepared using the principles set out in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning published by Network Rail in July 2014; the RMM suite is use throughout the rail industry in Great Britain and internationally and provides a "common language" for the comparative measurement, valuation and analysis of railway engineering construction projects.

Both estimates are based on the prices ruling at 4th Quarter 2015.

HS2 Limited did not challenge MHB evidence to the Select Committee, nor his methodology used to prepare then or the totals of either estimate.

Immediately before MHB appeared before the Select Committee, the petitioner received from the Department for Transport, further details of HS2 Limited’s proposals for the redevelopment of London Euston Station, which increased the scope of the work proposed by HS2 Limited AP03 project, which were not included in the estimate used in evidence before the Select Committee.

Revised MHB estimate

On the instruction of the petitioner, MHB prepared a revised estimate of the cost of both schemes using the additional information provided by the DfT on 11th October 2016; the amounts of the revised estimates are:

- HS2 Limited AP03 scheme £8,248 billion
- Euston Express scheme £6,752 billion

The petitioner having considered the technical proposals put forward by HS2 Limited to mitigate the effects of the extensive construction works required for the tunnelled high-speed railway approaches to London Euston Station, instructed MHB to prepare a further estimate of cost of the same basis as those previously published for a scheme combined the revised approaches with the petitioner’s station scheme; the version is entitled, “The Euston Express Amalgam” scheme; the estimate cost of this scheme is:

- Euston Express Amalgam scheme £7,495 billion

Both the "Euston Express" scheme and the subsequent "Euston Express Amalgam" scheme can be delivered in considerably less time than the HS2 Limited AP03 scheme, with far less disruption to the residents and the area around London Euston Station at considerably less cost.

The totals of each of these estimates has been submitted to the Department for Transport and they have been referred to in a recent debate in the House of Lords.

Effects on the cost of the entire HS2 Phase 1 project

The length of section of the route covered by the HS2 AP03 proposal is less than 5% of the total project route from London to the West Midlands and is estimated to cost, by MHB, a minimum of £7,495 billion; by
interpolation the cost of the entire project is likely to be very much greater than that previously reported to the public or given in a written answer to Parliamentary Questions.

These concerns have been echoed by other petitioners along the route who have contacted the petitioner and MHB for advice on the cost of sections of the work adjacent to them.

The petitioner has raised these concerns with the DfT and with HS2 Limited and offered to share further evidence of cost with both organisations.

**Independent Estimate of the Cost of HS2 Phase 1**

In accordance with the petitioner’s instructions, MHB prepared an independent estimate of the entire project cost of HS2 Phase 1; the total of the estimate, using the principles set out in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

The estimate is based on the measurement of the Group Elements contained in RMM Phase 1 - Cost Planning and is taken from the drawings posted on the DfT website in 2013 and in August 2016.

The total of the original independent estimate of cost was £53.6 billion, subsequently revised in January 2017 to £47.98 billion and revised once more, with the July 2017 edition of the commentary to £51.25 billion. The reasons driving these changes are set out in the sections that follows.

All prices are those at prices ruling at 4th Quarter 2015.

**Comparison with published estimates**

The large increase in cost over the totals published by DfT need explanation; in the time available there have been no meetings between the petitioner and DfT or HS2 Limited. MHB has reviewed the estimate with the sparse details available from HS2 Limited and its advisors and has prepared a list of key differences and areas in which the overall cost might be reduced.

For the ease of comparison with the estimate, the items are listed in the order of the Group Element referred to in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Railway Control Systems – Group Element 1.01**

The estimates produced by HS2 Limited are for a sophisticated yet-to-be designed signalling system. HS2 Limited is intended to be entirely independent of the “classic railway” and therefore will neither have access to or share the existing signalling centres on the “classic railway”.

- The cost of these signalling centres appears to be omitted from these estimates offered by HS2 Limited.
- In the independent estimate, allowance is made for 2 (two) major signalling centres, one at London end and the other close to the diverging junction in West Midlands.

mbpc estimate is based on the use ETMS Level 2 signalling system in which movement authority and other signal aspects are displayed in the cab for the driver. Apart from a few indicator panels, trackside signalling is largely dispensed with. The train detection and the train integrity supervision still remain in place at the trackside.

**Train Power Systems – Group Element 1.02**

The estimates produced by HS2 Limited are based on the original cost data from the Great Western Mainline Electrification project, the outturn cost of which appears to be 7 (seven) times greater than that originally
approved, and the original estimated cost of the initial phases of the North-West Electrification Project, which has overspent considerably in its initial delivery phases.

In the independent estimate, allowance is made to considering the costs of delivered projects, within Great Britain and internationally.

**Electric Power and Plant – Group Element 1.03**

The estimates produced by HS2 Limited appear to assume that there is sufficient electric power available from the grid without the creation of new generating capacity; this assumption has caused problems with the later phases of the North-West Electrification Project, which find themselves short of adequate power east of Manchester.

National Grid state that, as at July 2017, it had not received an application from HS2 Limited for a power supply for Phase 1 of the project or indeed any other phases.

NG requires an application to advise HS2 of

i. The capital cost of providing increased generating capacity to ensure the integrity of existing supplies to industrial, commercial and industrial users as well as to the "classic" railway.

ii. The capital cost of alterations to the electricity supply network to provide sufficient, reliable power in the correct locations to allow HS2 to operate

iii. NG programme for completing these works to allow HS2 to plan its construction works accordingly.

During the meeting held on 18th January 2017, Mr. Stretch, representing HS2 Limited, stated that the electricity generators would accept payment for these works in the forma of enhanced energy charges.

NG emphatically denies this statement or that any application or agreement has been reached over power supply, and asserts that the generators and NG will require capital contributions from HS2 Limited for the items listed above.

In the independent estimate, allowance is made for the capital cost contributions for these works and the effect on the project delivery programme for the time required by NG for their delivery.

**Buildings and Property – Group Element 1.06**

HS2 Phase 1 called for 4 (four) major station buildings, which are in City Centres or form parts of complicated transport interchanges; they are:

1. London Euston
2. Old Oak Common
3. Birmingham Interchange
4. Birmingham Curzon

Building on the costs included in the unchallenged estimates offered in evidence to the House of Lords Select Committee on 11th October 2016, the independent estimate make allowance for the higher level of cost of these iconic buildings so that their appearance is in keeping with structure associated with a modern high-tech high-speed railway, similar to those constructed along the TGV network in France and on high-speed lines in China.

In addition, there are four traction or infrastructure maintenance facilities along the route; these are required to provide bespoke facilities for HS2 Phase 1, to avoid the need to share with the "classic railway".

The independent estimate includes for these facilities and the fixed plant contained in them.
HS2 is an independent railway and is not expected to share offices or facilities with "the classic railway" so its needs it own administrative office to run its business. The cost of renting administrative offices is included in Group Element 3.03, Other Project Costs.

Civil Engineering – Group Element 1.07

The author of the independent estimate, M H Byng has, since July 2014, delivered teaching events to introduce the "Rail Method of Measurement" (RMM) suite of documents, including Volume 1 - Cost Planning. In these events, the dearth of measurement, valuation and estimating competencies available to the British railway industry has become very apparent. The lack of these competencies is shown by the errors in preparing estimates for many structure, as demonstrated by the cost problems faced by Network Rail in its Control Period 5 and Control Period 6 programmes.

On average the estimates for many structures, including new ones, are as low as 66% of the sums of contracts placed with contractors after the design is complete and the works delivered.

There is currently no cost database available to the industry to make commercial managers aware of these outturn costs to consider when preparing estimates for new works.\(^1\)

The independent estimate is based on out-turn elemental costs from projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

Enabling Works – Group Element 1.08

From the drawings deposited on the DfT website in 2013, there appear to be 561 (five hundred and sixty one) enabling works packages that must be delivered before the major construction works can begin on Phase 1 of the project.

Many of the enabling works contracts are major contracts in their own right and can only be designed and delivered by third party statutory authorities of utilities providers before the major works required for HS2 Phase 1 may be stated. As at the date of this edition of the commentary, HS2 Limited has not agreed the scope of these works with the statutory or utility bodies nor the programme for their completion.

mbpc has made allowance for these works in Group Element 1.08 Enabling Works; in addition to the cost of these works, mbpc estimate includes in Group Element 3.03 - Other Project Cost, the costs of disruption and disturbance caused by them.

The independent estimate of cost is based on an assessment of the programme required for these works and its "knock-on" effect on the design and construction programme for the major works contracts.

Preliminaries and General Conditions – Group Element 2.01

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of the contractor’s preliminaries and of complying with the General Conditions of Contract currently in use in the British railway industry. The allowance covers each and every enabling works package as well as the Major Works packages, required along the route.

These allowances are relatively high, when compared with international best practice because of the procurement strategy employed in Great Britain, mirroring Network Rail practice, which involves “framework contracting”. The process involves several more layers of management than is normally seen internationally.

The independent estimate is based on out-turn elemental costs from similar British projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

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\(^1\) Working with RICS, ICE and the RIA (Rail Industry Association), mbpc is developing the "Railway Cost Information Service" (RCIS), which, it is intended, will fill the gap.
Overheads and Profit – Group Element 2.02

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of the contractor’s overheads and mark-up (profit) based on the General Conditions of contract currently in use in the British railway industry.

The allowances included in mbpc determination are based on the levels of these items required by contractors engaged in similar major construction works internationally and not on the extremely low levels of mark up for commercial risk (not project risk - see Group Element 4.01 - Risk) and of profit imposed on the industry by the current approach of Network Rail and HS2 Limited.

Potential contractors for the major works within HS2 Phase 1 believe that the current pricing trends, if sustained for the length of the project, will place one or several of them under considerable risk of financial failure.

Design fees – Group Element 3.01

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of design fees for designers employed “in-house” by HS2 Limited or for external consultants, employed under “design framework contracts” based on the procurement strategy adopted by HS2 Limited with its suppliers.

The procurement involves the preparation of the preliminary and concept design by designers acting for HS2 Limited, from which the initial estimates of cost are derived. The designs and those responsible for them are then novated to the contractor, who is required to accept legal responsibility for them under design and build contracts.

The process is used internationally but the amount of design work done before novation is considerably less than that done in Britain. The result in Britain is that design costs are higher because of “double-dipping” (duplicate charging) by designers who frequently insist and are paid for correcting any errors or omission made in the conceptual design before novation. This trend is evident from projects executed on the “classic railway” for Network Rail in Control Periods 4, 5 and 6.

The independent estimate is based on out-turn elemental costs from similar British projects analysed in accordance with the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning.

Project Team Fees – Group Element 3.02

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of project management, including design management, for project managers employed “in-house” by HS2 Limited or for external consultants based on the procurement strategy made available by HS2 Limited to its potential suppliers.

The allowance made in the independent estimate is, of necessity, high, because of the complex nature of the project interaction between various parts of it and the divided responsibility approach towards design development and production, referred in Group Element 3.01.

The independent estimate draws on the experience of similar large infrastructure projects in Britain, such the former Birmingham Northern Relief Road (M6 Toll Road) and takes cost data from on out-turn elemental costs from similar British projects analysed in accordance with the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning.

Other Project Costs – Group Element 3.03

No information is available from HS2 Limited other than a schedule attached to a written answer to a Parliamentary Question regarding the costs of acquitting property and making good disruption to adjacent
owners in the London Borough of Camden. The schedule, signed by Simon Kirby (Commercial Director HS2 Limited) is dated 4th September 2015, amounts to £97.80 million.

In a meeting with HS2 Limited immediately prior to Mr. Price’s petition being heard by the Select Committee on 11th October 2016, Professor Andrew McNaughton advised the petitioner that HS2 had already incurred more than £1 billion in compulsory purchase costs in the Camden area alone.

This figure is 10 (ten) times greater than that included in the earlier schedule but appears credible when considered considering the revised (increased) scope of the work in London Euston Station and shown on the drawings forwarded to the petitioner on 11th October 2016.

The higher figure referred to by Professor McNaughton is credible when one considers the high value of property in London and the cost of buying commercial property held as investments by pension funds and the like; in these cases, to acquire the land required for the project, HS2 Limited has to buy the investment and, where the displaced landlord has tenancies that do not include development break clause and is unable to relocate tenants, HS2 Limited is faced with meeting all of the relocation and associated disruption costs.

MHB is also aware of claims made by registered valuers, acting for landowners and users along the proposed route, entitled to compensation, and the amounts of those claims to which is added the considerable cost of acquiring land in the more populated part of the route between Balsall Common and Curdworth/Curzon Street. Where business premises or sports facilities must be acquired for the route, the cost of loss of profits and increased costs incurred in the movement of the business or the cost of providing temporary and permanent facilities for the landowners or users is included.

There are properties that have been acquired by HS2 Limited and leased back to their original owners, properties that do not comply with current occupational standards. The cost of making good the deficiencies in standards are falling on HS2 Limited as the landlord.

The Property Cost Estimate (PCE) for HS2 Phase 1 was suggested, prior to December 2016 by HS2 Limited to be £1.8 billion, whereas the schedule of costs offered by Mr. Stretch, on behalf of HS2 Limited, at the meeting held on 18th January 2017, states it is £2.285 billion; this figure is taken directly from mpcb original determination of costs, details of which have never been requested or seen by HS2 Limited, so the accuracy of HS2 Limited figures is uncertain.

Between January and July 2017, mpcb became aware, when acting for clients along the route and from sources within HS2 Limited that fewer than 25% of the 12,000 property interests along the route had been acquired. The failure to acquire these land interests, other by resorting to the powers of General Vesting Declarations, has the following effect on the project programme and cost.

i. Delays to site access for site and ground investigations works leading to delays in the completion of design works.

ii. Delays in the time for commencement of enabling works and major works thus increasing project cost and time to deliver.

iii. Provision of land packages in a haphazard manner causing out-of-sequence construction works, increasing construction cost and the time to deliver the project.

iv. Greatly increased costs of land acquisition, which, at July 2017, is expected to increase the PCE from £1.80 billion to £5.10 billion.

mbpc determination of cost takes account of the effect of delayed land acquisition on construction cost, design cost and Other Project Costs for land acquisition and the costs associated therewith.

Costs included in this section also include:-

v. The acquisition of temporary rights of ways, wayleaves for construction activities, including making good on the completion of works, all fees and professional charges associated with obtaining Royal
Assent to the HS2 Bill, Transport and Works Act Orders required for parts of the works and planning consents are also included.

vi. Works to protect flora/fauna and wildlife, either temporarily and permanently, affected by the project are included.

vii. Where the HS2 Phase 1 project makes connections to the “classic railway”, the costs of any disruption caused to the operation of the latter is included.

viii. HS2 is an independent railway and is not intended to share facilities with “the classic railway” and requires its own administrative offices. The cost of renting these office for the period of construction of Phase 1 is included in this element.

Included in the independent estimate and similar related estimates is the cost of project finance, as described in Components 3.03.01.07.01 – 03 of the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning. In the absence of any innovative funding proposals from HS2 Limited, the finance costs have been assessed as debt financing, obtained by HM Treasury, charged at LIBOR rates of interest, over the period required to complete the project. No allowance is made for amortising or capitalising it on the completion of the project.

The independent estimate draws on the experience of similar large infrastructure projects in Britain, such as the East West Railway Phase 1 and takes cost data from on out-turn elemental costs from similar British projects analysed in accordance with the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning.

Risk – Group Element 4.01

MHB understands that HS2 Limited has included an uplift of 35% to its base cost estimate to cover contingencies and risk.

The independent estimate is based on the methodology set out in the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning in which risk dealt on a quantitative basis as set out in Group Element 4.01; given the design development carried out by HS2 Limited to date, the allowance included in the independent estimate is 7.5%.

Inflation – Group Element 5.01

The estimate given for HS2 Phase 1 by HS2 Limited is at 4th Quarter 2015 prices with an allowance for risk but without any obvious allowance for future inflation.

The independent estimate, similarly, makes no allowance for either tender or construction inflation as defined in RMM Volume I sub-element 4.01; however when preparing those elements within the estimate for direct construction works and for design and project team fees, it became apparent that the supply chain believes that the volume of work on such a high profile project, underway concurrently with other major rail infrastructure projects will lead to rises in the prices of labour, materials and plant over and above normal inflation.

Under the methodology referred to in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning, these additional costs should be allocated to component 5.01.01.02, in the section covering “Construction inflation” as component 02 – Exceptional inflation.

The estimate provided by HS2 Limited makes no reference to effects of the possibility of exceptional inflation in accordance with the RMM suite.
Taxation and Grants – Group Element 6.01

The estimate given for HS2 Phase 1 by HS2 Limited is not in sufficient details to address items of “Taxation and Grants” that make affect the outturn cost of the project.

The independent estimate, similarly, makes no allowance for the effects of either “taxation or grants” on the final project cost, although along its proposed route, HS2 Phase 1 may require work carrying in conservation areas or adjacent to sites of special scientific interest (SSSI), which may afford the project with either taxation relief or grant aid on the cost of work required.

Conclusion

HS2 Phase 1 can delivered for a lower price than that stated in the independent estimate if HS2 Limited streamlines its project procurement strategy and follows international best practice. The effect of this streamlined procurement and delivery strategy is reflected in the proportions of costs offered by HS2 Limited, although the totals offered in the IBS estimate is insufficient to overcome the geographical and statutory obstacles faced with construct the new railway in Great Britain.

These problems have long been understood, as early as June 1920, the (then) Minister of Transport told Parliament:-

"that the cost of building railways per mile, was UK : £34,000, France : £31,000, Prussia : £26,000, USA : £14,000"

[Hansard vol.130, col 2453]

Even then the cost of building in the UK was 29.52% higher then the international average and 242.85% higher than the optimum price. On this basis, the cost of HS2 Phase 1, if it was 242.85% greater per mile than IBS, would be £57.07 billion, at 4th Quarter 2015 prices, inclusive of allowances for risk and contingencies

The manner in which the project appears to have been set up and run for the past 9 years, mirrors the practice employed by Network Rail, and threatens to transfer all of NR’s past and present problems over meeting cost and delivery targets to the new project.

The effect of these practices further threatens any attempt to deliver the project within IBS cost parameters, as adjusted to meet the parameters of building the railway in Great Britain, and thus the amount of the Government Funding Envelope, £27.18 billion is wholly inadequate.

Michael Byng
31st July 2017
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### Project Title: HS2 Phase 1 - London to the West Midlands

#### Date of Estimate: 31st July 2017

#### Pricing base date: 31st December 2015 - 4th Quarter 2015

#### Currency: GB Pounds (£)

### Summary of Group Element Costs - Rail Method of Measurement - Volume 1 - Cost Planning

<table>
<thead>
<tr>
<th>Group Element</th>
<th>Total Cost</th>
</tr>
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<tbody>
<tr>
<td>Direct Construction Works</td>
<td>£</td>
</tr>
<tr>
<td>1.01 Railway Control Systems</td>
<td>4,528,657,716.42</td>
</tr>
<tr>
<td>1.02 Train Power Systems</td>
<td>3,523,454,275.00</td>
</tr>
<tr>
<td>1.03 Electric Power and Plant</td>
<td>2,194,009,083.89</td>
</tr>
<tr>
<td>1.05 Operational Telecommunication Systems</td>
<td>2,314,738,406.41</td>
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<td>1.06 Buildings and Property</td>
<td>7,946,205,919.41</td>
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<tr>
<td>1.08 Enabling Works</td>
<td>838,913,865.50</td>
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<tr>
<td>2 INDIRECT CONSTRUCTION WORKS</td>
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<tr>
<td>2.01 Preliminaries</td>
<td>4,566,939,622.12</td>
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<tr>
<td>2.02 Contractor’s Overheads &amp; Profit</td>
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<tr>
<td>3 PROJECT/DESIGN TEAM &amp; OTHER PROJECT COSTS</td>
<td>£</td>
</tr>
<tr>
<td>3.01 Design Team</td>
<td>5,967,964,888.07</td>
</tr>
<tr>
<td>3.02 Project Team</td>
<td>2,467,223,630.35</td>
</tr>
<tr>
<td>3.03 Other Project Costs</td>
<td>3,529,550,650.00</td>
</tr>
<tr>
<td>4 RISK</td>
<td>£</td>
</tr>
<tr>
<td>4.01 TOTAL RISK ALLOWANCES</td>
<td>2,716,188,801.24</td>
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<tr>
<td>5 INFLATION</td>
<td>£</td>
</tr>
<tr>
<td>5.01 Tender and construction inflation</td>
<td>0.00</td>
</tr>
<tr>
<td>6 TAXATION</td>
<td>£</td>
</tr>
<tr>
<td>6.01 Tax allowances &amp; grants</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Total Costs**

- **Direct Construction Costs (A)**: £27,678,421,952.24
- **Indirect Construction Works (B)**: £6,870,875,871.09
- **Construction Cost (A+B)**: £34,549,297,823.33
- **Employer’s Indirect Costs (D)**: £13,964,739,168.42
- **Construction, Project/Design Team & Other Project Costs (C+D)**: £48,514,036,991.76
- **Total Risk Allowances (F)**: £2,716,188,801.24
- **Cost Limit (Excluding Inflation) (E+F)**: £51,230,225,793.00
- **Total Cost Limit (G+H)**: £51,230,225,793.00
- **Total Taxation Assessment**: £0.00
Expert Witness Statement of Michael Byng
Petition No: - HS2-PA-000119

High Speed Rail (West Midlands - Crewe Bill
Petition of Frederick Ewart Smith

Michael Byng
2nd July 2018
HOUSE OF COMMONS SELECT COMMITTEE

HIGH SPEED RAIL (WEST MIDLANDS - CREWE) BILL

PETITIONER:- FREDERICK EWART SMITH

PETITION NO:- HS2-P2A-000119

EXPERT WITNESS STATEMENT OF:- MICHAEL HOWARD BYNG

1. Introduction
1.1. This statement has been prepared by Michael Howard Byng, Quantity Surveyor on behalf of the Petitioner, Frederick Ewart Smith; the statement is prepared in accordance with the RICS practice statement and guidance note "Surveyors acting as expert witnesses", 4th Edition 2014.
1.2. This statement is prepared in accordance with section PS 1 Application of practice statement on page 8 of the practice statement

2. Acting as an expert witness and instructions
2.1. I am instructed by the Petitioner to provide my professional advice and comment on the response made by HS2 Limited to the Petition and to comment on the basis of the estimates of cost provided by HS2 Limited included in the Cost Assessment Breakdown on page 93 of the Whitmore Heath to Madeley Tunnel Report prepared for HS2 Limited
2.2. My statement is confined to the basis of the cost estimates provided by HS2 Limited, which I am advised are based on a "Cost Model" derived from "International Best Standards" (IBS), with which I am aware and have knowledge
2.3. In my statement, I make reference to my experience of analysing the costs of HS2 Phase 1 and the impact of estimating costs for future Phases; In appendices B - D, I use contemporary documents in illustrate and support my professional opinion

3. Duty in providing expert evidence
3.1. This statement sets out the facts, as presented to me by the Petitioner, is truthful, impartial and independent; I have neither sought nor have I been offered any instructions to act for HS2 Limited, its advisors or consultants or its contractors. After considering the RICS guidance note on Conflicts of Interest, I confirm that I am not conflicted in giving evidence on behalf of the Petitioner.

4. Relevant experience
4.1. In appendix A to this statement is my curriculum vitae. I have over 40 years post-qualification experience in providing quantity surveying and expert witness services to clients in connection with building and civil engineering projects in the United Kingdom and internationally.
4.2. Between 1998 and 2012, I drafted and developed the "Rail Method of Measurement" (RMM) suite of documents, which provide the basis of the measurement and valuation of railway engineering projects through all stages of their life cycle.
4.3. In addition to drafting and completing the RMM suite, I have used in extensively in the United Kingdom and internationally to prepare estimates of cost for projects of railway engineering construction, where required, these estimates of cost have been used as "valuations for loan security" or for "first mortgage".
4.4. I am currently instructed to advise on the cost of a series railway engineering projects in Great Britain with a value in excess of £2.5 billion at 4th Quarter 2017 prices.

1 RICS, The Royal Institution of Chartered Surveyors, 12 Great George Street, Parliament Square, LONDON SW1P 3AD
5. Application of the RMM suite to the HS2 Project

5.1. The RMM suite was published by Network Rail (NR) in July 2014 and is now in regular use in the rail industry in Great Britain, including within HS2 Limited, which is represented on the Industry Development Group established by NR in July 2014 to continue the development of the suite and widen its application.

5.2. The RMM suite has been used to prepare an independent estimate of cost for HS2 Phase 1, London to the West Midlands Railway, and has been used in whole and in part to provide evidence on behalf of petitioners opposing the Bill for that project before it received Royal Assent on 23rd February 2017.

5.3. A commentary on the independent estimate of cost and a summary of the estimate is included in appendix B to this statement.

5.4. Where I have given evidence in connection with sections or Phases of the HS2 Project, HS2 Limited did not refute the facts on which my estimate was based nor did the company challenge its methodology nor the quantum of estimates produced using the RMM suite.

6. HS2 Limited approach to estimates of cost

6.1. At a meeting held on 18th January 2018, I attended a meeting arranged by Lord Ahmad of Wimbledon, then Parliamentary Under Secretary of State for Transport to discuss my independent estimate of cost for HS2 Phase 1, which then totalled, at 4th Quarter 2015 prices, £47.98 billion; HS2 Limited was represented at the meeting as was the Department for Transport (DfT).

6.2. Neither HS2 nor DfT challenged my estimate. However when asked by Lord Ahmad to provide details of HS2 Limited’s estimate of cost, the representative of HS2 Limited provide a single page spreadsheet, which claimed to support the Government’s finding envelope for the project as known at the time, £23.5 billion.²

6.3. HS2 Limited estimate summary is stated as being based on International Best Standards (IBS). IBS is stated as being the "Cost Model" on which HS2 Limited is calculating its target costs for all Phases of the project.

6.4. A copy of the summary of the cost of Phase 1 provided by HS2 Limited at the meeting is included in Appendix C to this statement.

6.4.1. Given the statement made in note 3 on 94 of the "Whitmore Heath to Madeley Tunnel Report dated 25th March 2018, I have drawn the Petitioner’s attention to the inclusion by HS2 Limited in its summary of the exact figure for Indirect Costs included in my commentary and estimate of cost, shown in appendix B

6.4.2. I have advised the Petitioner that HS2 Limited is able to provide details of these costs and should reply in percentage additions to cover the...

6.5. In the documents supplied to me by the Petitioner, there is an extract from "Hansard" dated 23rd April 2018, which records the evidence of Mr. Tim Smart of HS2 Limited, giving a Select Committee Hearing to hear other petitions against the Whitmore Heath to Madeley Tunnel. In paragraphs 101 and 137 of the extract Mr. Smart refers to "Cost Models" in use by HS2 Limited. In paragraph 137, Mr. Smart states that HS2 Limited knows what the cost is of the various work activities in this section. I include the extract from "Hansard" at appendix D.

6.6. In appendix E to this statement, I include a copy of a letter written by the Secretary of State for Transport, Rt Hon Chris Grayling MP to Lord Berkeley, a member of the Institution of Civil Engineers and of the House of Lords, the letter is reproduced by permission of Lord Berkeley, in which the Secretary of State states that the "Target Costs" for Phase 1 will not be known until 2019; I therefore challenge the statement made by Mr. Smart on 23rd April 2018 to the Select Committee, as recorded in paragraph 137.

² Written answer to a Parliamentary Question HL4189 dated 21st December 2016
7. **M H Byng professional opinion of the cost advice given in the "Whitmore Heath to Madeley Tunnel Report"**

7.1. The Petitioner has provided me with a copy of the report. I comment on the section "Cost Assessment Breakdown" as follows:

7.2. The table at page 93 of the report is not set out in accordance with the provisions of RMM Suite - Volume 1 - Cost Planning

7.2.1. Based on the evidence given by Mr. Smart at an earlier hearing of the Select Committee on 23rd April 2018, the costs are based on the use of a Cost Model, which, in the absence of any advice from HS2 Limited, is assumed to be IBS

7.2.2. The assumption for the rate of tunnelling does not reconcile with the findings of the report by the British Tunnelling Society prepared for HM Treasury

7.2.3. Indirect costs are detailed and defined in Group Elements 3.01, 3.02 and 3.03 of RMM Volume 1 Cost Planning and include, inter alia, the items listed in note 3 on page 94 of the report; Group Element 3.03 includes land acquisition and fees associated with it; the cost of these items is not calculated on a percentage basis

7.2.4. Earthworks cost can be isolated for this section of the works by using the RMM suite - Volume 1 Cost Planning and the drawings deposited by HS2 Limited and the alternative proposals offered by the petitioner; a similar exercise has been carried out in respect of tunnels on HS2 Phase 1; details of the measured exercise have been lodged by Wendover Parish Council with DfT via the MP for the constituency, Rt Hon David Lidington.

7.2.5. Without access to the Property Cost Estimate (PCE) held by HS2 Limited, I cannot comment on the statement made in note 5 in respect of Land and Property

7.2.6. Without access to the contents of a detailed estimate of cost of the project prepared by HS2 Limited, I am unable to accept HS2 Limited assessment of an "efficiency adjustment" nor, based on my relevant professional experience of similar projects of this size, do I believe that any such adjustment may be achieved.

7.2.7. The contingency allowance made by HS2 of 40% is at variance with the allowance made in the estimate summary offered for HS2 Phase 1, see appendix C, which is shown under "Risk" as being 25%

7.2.8. During the Committee Stages of the Phase 1 Bill, all costs were requested by DfT to be shown at 4th Quarter 2015 prices.

7.3. I have addressed how each of these issues may be ascertained and reconciled in the summary of my statement

8. **Summary**

8.1. On the contents of the documents provided to me by the Petitioner, I will say that:-

8.1.1. I do not accept the accuracy of the estimates of costs set out on page 93 of the Whitmore Heath to Madeley Tunnel Report dated 25th March 2018

8.1.2. From my experience of dealing with HS2 Limited to conclude the costs of Phase 1 of the project, HS2 Limited, using RMM Volume 1 - Cost Planning, is able to provide detailed calculations of indirect costs, notwithstanding the statement made in note 3 on page 94 of the Whitmore Heath to Madeley Tunnel Report dated 25th March 2018

8.1.3. Based on my experience elsewhere and from the preparation of the independent estimate for HS2 Phase 1, I do not accept the statement made by HS2 Limited in note 4 on page 94 of the Whitmore Heath to Madeley Tunnel Report dated 25th March 2018 that the costs of earthworks for this section cannot be isolated

8.1.4. The report makes no statement in respect of the programme of works for this section, if HS2 Limited has no structured estimate of costs for Phase 2A, then assessment can be made of the environmental impact on the Petitioner’s property, until a programme is available.
8.1.5. From information provided by and statements made by representatives of HS2 Limited, I do not accept that it has an accurate estimate of costs or a valid project programme to consider the merits of the Petitioner’s proposal.

8.1.6. The Petitioner should seek leave of the Select Committee to defer any decision on the Petitioner’s application until such time as detailed estimates of all costs and a detailed project programme of the deposited proposal and the alternative are ascertained using the principles of the RMM Suite.

8.2. Subject to the determination of this Select Committee, I can provide a report setting out the detailed determination of cost for the alternatives; the report can be completed within 4 (four) weeks of the date of instruction to commence.

8.3. The report will comply with and be prepared in accordance with section PS 5 "Reports and oral evidence" in the RICS practice statement and guidance note "Surveyors acting as expert witnesses", 4th Edition 2014.

9. Statement of truth

9.1. I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinion I have expressed represent my true and complete professional opinions on the matters to which they refer.

10. Declaration

10.1. I confirm that my report has drawn attention to all material facts which are relevant and have affected my professional opinion.

10.2. I confirm that I understand and have complied with my duty to the Select Committee as an expert witness which overrides any duty to those instructing or paying me, that I have given my evidence impartially and objectively and that I will comply with that duty as required by the Select Committee.

10.3. I confirm that I am not instructed under any conditional or other success-based fee arrangement.

10.4. I confirm that I have no conflicts of interest.

10.5. I confirm that I am aware of and have complied with the requirements of the rules, protocols and directions of the Select Committee.


Signed

Name:- Michael Howard Byng

Date:- 2nd July 2018

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3 RICS, The Royal Institution of Chartered Surveyors, 12 Great George Street, Parliament Square, LONDON SW1P 3AD
Appendix A

Michael Howard Byng

Curriculum Vitae
MICHAEL BYNG

PROFILE

A Quantity Surveyor and Arbitrator with extensive post qualification experience of identifying, creating business case solutions to major infrastructure projects and providing cost and project management services to bring them to satisfactory conclusions to time and to budget on heavy civil engineering and infrastructure projects throughout the United Kingdom and Overseas.

PROFESSIONAL QUALIFICATIONS

- Professional Associate of the Royal Institution of Chartered Surveyors - Quantity Surveyor’s Division (ARICS) - 1974; Elected Fellow of the Royal Institution of Chartered Surveyors (FRICS) - 1985.
- Associate of the Australian Institute of Quantity Surveyors – 2006.
- Elected Associate of the Chartered Institute of Arbitrators (A CI Arb) - 1974.
- Member of the Permanent Way Institution – 1999.
- Elected honorary cost advisor to the China Rail Transit Promotion Union – 2008
- Elected honorary cost advisor to the Jiangsu Tram Transit Institute (People’s Republic of China) – 2008

PROFESSIONAL EXPERIENCE

Providing additional added value services to clients of the Quantity Surveying Practice and developing a stand-alone project control business.

- Project Control from feasibility study to completion of schemes procured by traditional third party methods, design and build, management contracting, construction management and joint venture arrangements.
- Developing project control services, cost and project management on a “Whole Life Cycle Cost” basis for projects procured by traditional and PFI/PPP processes in the UK, Europe and Overseas.
- Providing Expert Witness assistance, giving evidence Select Committees in the Houses of Commons and Lords on behalf of petitioners to the HS2 Phase 1 Hybrid Bill process, 2015 to 2015 including sections from London Euston to Old Oak Common, £8.248 billion, Wendover Area, £525 million and the entire HS2 Phase 1 Project, £47.98 billion; all price at 4th Quarter 2015.
- Providing Expert Witness assistance in connection with a major railway signal engineering dispute in the Republic of Ireland, value of claims and counterclaims in excess of €100 million.
- Preparing detailed estimates of cost by measured elemental measurement for the East West Railway Phase 1 between Oxford and Bicester, value £315 million at 2nd Quarter 2013 prices.
- Advising Cambridgeshire County Council on the capital cost of reinstating the March to Wisbech Railway, £115 million at 3rd Quarter 2017 prices; advising the Peninsula Rail Task Force (PRTF) on the cost of reinstating railways in Devon and Cornwall, including the provision of new stations.
- Advising Transport New South Wales (TSW) on railway enhancements on main and suburban lines.
OTHER PROFESSIONAL EXPERIENCE

- Leading a cost study comparison for a variety of infrastructure projects, road, rail, marine and power for the Construction Directorate of the European Union in Brussels in conjunction with CEEC (Comité Européen des Economistes de la Construction); the study includes an assessment of comparable costs together with a review of alternative procurement routes including traditional and PFI/PPP type methods.

- Providing expert witness services in connection with litigation and arbitration matters arising from building and civil engineering contracts including advising on legal pleadings and drafting responses to claims and counterclaims. Services provided in accordance with the Practice Statement entitled “Surveyors Acting As Expert Witnesses – 2nd Edition 2000” published by the Royal Institution of Chartered Surveyors.

- Lead author for the "Rail Method of Measurement" (RMM) suite of documents published in three volumes by Network Rail in July 2014 to provide a "common cost language" for the railway industry in Great Britain and internationally.

- Owner and developer of the "Railway Cost Information Service" (RCIS) to provide elemental cost analysis data to the railway industry; Rail Cost Information Service Limited (company registered in England and Wales No 08600675)


- Creating training programmes for use in Great Britain and internationally covering the use of the suites of documents referred to above and for the teaching of Whole Life Construction Economics of railway infrastructure.

CONTINUING PROFESSIONAL DEVELOPMENT

- Development and creation of a standard method of measurement and valuation for works of railway engineering construction for international application; work sponsored by Network Rail and London Underground in the UK

- Computer induction and application courses in all Microsoft Applications; Working knowledge of use, development and maintenance of quantity surveying measurement management and estimating systems such as RIPAC & ICEPAC.

- Working knowledge of CANDY construction estimating systems.

- Working knowledge of Primavera © project management software.
Appendix B

HS2 Phase 1 Commentary and Independent Estimate of Cost 18th January 2017

Priced at 4th Quarter 2015 Prices
Commentary

This commentary should be read in conjunction with the priced determination of cost produced by mbpc of Phase I of HS2 railway totalling £53.6 billion and the schedule of rates provided to HS2 Limited to allow a like-for-like comparison of the scope of works between mbpc determination and the estimate of cost produced by HS2 Limited as held by the Department for Transport (DfT) published in a written answer to a Parliamentary Question (HL4189) on 21st December 2016 in the sum of £23.5 billion.

Origin of MHB estimate

M H Byng gave evidence, on behalf of Mr Sam Price (petitioner), a resident of the London Borough of Camden (Petition HoL 691) under oath to the HS2 Select Committee in The House of Lords on 11th October 2016 on the cost and the effects of disruption of the Project AP03 proposed by HS2 Limited for the section of the line from Old Oak Common to London Euston Station, including the rebuilding of the station.

Mr Price submitted in evidence an alternative scheme, mitigating disruption to the residents and providing a station design within the footprint of the current Euston Station, known as “Euston Express”

In the absence of any detailed estimates from HS2 Limited, with which the petitioner had been in contact since February 2016, to prepare a comparative estimate of cost for the deposited scheme and petitioned alternative, MHB prepared a notional estimate of the HS2 proposal and, on the same basis, prepared an estimate of cost for the petitioned alternative.

The costs submitted in evidence were:

- HS2 Limited AP03 scheme £5.747 billion
- Euston Express scheme £3.647 billion

Both estimates were prepared using the principles set out in the “Rail Method of Measurement” (RMM) suite of documents, Volume 1 - Cost Planning published by Network Rail in July 2014; the RMM suite is use throughout the rail industry in Great Britain and internationally and provides a ”common language” for the comparative measurement, valuation and analysis of railway engineering construction projects.

Both estimates are based on the prices ruling at 4th Quarter 2015.

HS2 Limited did not challenge MHB evidence to the Select Committee, nor his methodology used to prepare then or the totals of either estimate.

Immediately before MHB appeared before the Select Committee, the petitioner received from the Department for Transport, further details of HS2 Limited’s proposals for the redevelopment of London Euston Station, which increased the scope of the work proposed by HS2 Limited AP03 project, which were not included in the estimate used in evidence before the Select Committee.

Revised MHB estimate

On the instruction of the petitioner, MHB prepared a revised estimate of the cost of both schemes using the additional information provided by the DfT on 11th October 2016; the amounts of the revised estimates are:

- HS2 Limited AP03 scheme £8.248 billion
- Euston Express scheme £6.752 billion

The petitioner having considered the technical proposals put forward by HS2 Limited to mitigate the effects of the extensive construction works required for the tunnelled high-speed railway approaches to London Euston Station, instructed MHB to prepare a further estimate of cost of the same basis as those previously published for a scheme combined the revised approaches with the petitioner’s station scheme; the version is entitled, “The Euston Express Amalgam” scheme; the estimate cost of this scheme is:-
Both the "Euston Express" scheme and the subsequent "Euston Express Amalgam" scheme can be delivered in considerably less time than the HS2 Limited AP03 scheme, with far less disruption to the residents and the area around London Euston Station at considerably less cost.

The totals of each of these estimates has been submitted to the Department for Transport and they have been referred to in a recent debate in the House of Lords.

**Effects on the cost of the entire HS2 Phase 1 project**

The length of section of the route covered by the HS2 AP03 proposal is less than 5% of the total project route from London to the West Midlands and is estimated to cost, by MHB, a minimum of £7,495 billion; by interpolation the cost of the entire project is likely to be very much greater than that previously reported to the public or given in a written answer to Parliamentary Questions.

These concerns have been echoed by other petitioners along the route who have contacted the petitioner and MHB for advice on the cost of sections of the work adjacent to them.

The petitioner has raised these concerns with the DfT and with HS2 Limited and offered to share further evidence of cost with both organisations.

**Independent Estimate of the Cost of HS2 Phase 1**

In accordance with the petitioner’s instructions, MHB prepared an independent estimate of the entire project cost of HS2 Phase 1; the total of the estimate, using the principles set out in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

The estimate total is £53.6 billion at prices ruling at 4th Quarter 2015.

**Comparison with published estimates**

The large increase in cost over the totals published by DfT need explanation; in the time, available there have been no meetings between the petitioner and DfT or HS2 Limited. MHB has reviewed the estimate with the sparse details available from HS2 Limited and its advisors and has prepared a list of key differences and areas in which the overall cost might be reduced.

For the ease of comparison with the estimate, the items are listed in the order of the Group Element referred to in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Railway Control Systems – Group Element 1.01**

The estimates produced by HS2 Limited are for a sophisticated yet undersigned signalling systems. HS2 Limited is intended to be entirely independent of the “classic railway” and therefore will neither have access to or share the existing signalling centres on the “classic railway”.

The cost of these signalling centres appears to be omitted from these estimates offered by HS2 Limited.

In the independent estimate, allowance is made for 2 (two) major signalling centres, one at London end and the other close to the diverging junction in West Midlands.

**Train Power Systems – Group Element 1.02**

The estimates produced by HS2 Limited are based on the original cost data from the Great Western Mainline Electrification project, the outturn cost of which appears to be 7 (seven) times greater than that originally
approved, and the original estimated cost of the initial phases of the North-West Electrification Project, which has overspent considerably in its initial delivery phases.

In the independent estimate, allowance is made to considering the costs of delivered projects, within Great Britain and internationally.

**Electric Power and Plant – Group Element 1.03**

The estimates produced by HS2 Limited appear to assume that there is sufficient electric power available from the grid without the creation of new generating capacity; this assumption has caused problems with the later phases of the North-West Electrification Project, which find themselves short of adequate power east of Manchester.

The London end of the HS2 Phase 1 route is in an already high demand area for electric power, where existing sources may be stretched beyond capacity if the needs of Crossrail 1 and 2 are to be satisfactorily met.

In the independent estimate, allowance is made for 2 (two) major additional electricity generating sources, one at London end and the other close to the diverging junction in West Midlands.

**Buildings and Property – Group Element 1.06**

HS2 Phase 1 called for 4 (four) major station buildings, which are in City Centres or form parts of complicated transport interchanges; they are:

1. London Euston
2. Old Oak Common
3. Birmingham Interchange
4. Birmingham Curzon

Building on the costs included in the unchallenged estimates offered in evidence to the House of Lords Select Committee, the independent estimate make allowance for the higher level of cost of these iconic buildings so that their appearance is in keeping with structure associated with a modern high-tech high-speed railway, similar to those constructed in China.

In addition, there are four traction or infrastructure maintenance facilities along the route; these are required to provide bespoke facilities for HS2 Phase 1, to avoid the need to share with the "classic railway".

The independent estimate includes for these facilities and the fixed plant contained in them.

HS2 is an independent railway and is not expected to share offices or facilities with "the classic railway" so its needs its own administrative office to run its business. The cost of renting administrative offices is included in Group Element 3.03, Other Project Costs.

**Civil Engineering – Group Element 1.07**

The author of the independent estimate has M H Byng has, since July 2014, delivered teaching events to introduce the "Rail Method of Measurement" (RMM) suite of documents, including Volume 1 - Cost Planning.

In these events, the dearth of measurement, valuation and estimating competencies available to the British railway industry has become very apparent. The lack of these competencies is shown by the errors in preparing estimates for many structure, as demonstrated by the cost problems faced by Network Rail in its Control Period 5 and Control Period 6 programmes.

On average the estimates for many structures, including new ones, are as low as 66% of the sums of contracts placed with contractors after the design is complete and the works delivered.
There is currently no cost database available to the industry to make commercial managers aware of these out0turn costs to consider when preparing estimates for new works.

The independent estimate is based on out-turn elemental costs from projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Enabling Works – Group Element 1.08**

There is a very large amount of enabling works required along the route, works diverting roads, rivers and watercourse and service mains; these falls within the Group Element 1.08 Enabling Works

In preparing the independent estimate, MHB has examined all the plans and sections for the deposited bill as shown on the DfT website. The estimates pay attention to works required in the Balsall Common – Curdworth/Curzon Street and Balsall Common – Handsacre sections of the route and to similar works required in the section immediately before the route reaches Balsall Common, between Coventry and Kenilworth.

The route in this area crosses and are which is, geologically, part of the Trent Valley, and is formed of sand, gravel and aggregates; the area poses real difficulty in finding suitable foundations for permanent way and the structures carrying it.

The estimates produced by HS2 Limited do not appear to have taken account of these difficulties whereas the independent estimate draws on elemental analyses of costs of projects completed in areas with similar geological conditions.

**Preliminaries and General Conditions – Group Element 2.01**

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of the contractor’s preliminaries and of complying with the General Conditions of contract currently in use in the British railway industry. This allowance is relatively high, when compared with international best practice because of the procurement strategy employed here, which involves “framework contracting”. The process involves several more layers of management than is normally seen internationally.

The independent estimate is based on out-turn elemental costs from similar British projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Overheads and Profit – Group Element 2.02**

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of the contractor’s overheads and mark-up (profit) based on the General Conditions of contract currently in use in the British railway industry.

**Design fees – Group Element 3.01**

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of design fees for designers employed “in-house” by HS2 Limited or for external consultants based on the procurement strategy made available by HS2 Limited to its potential suppliers.

The procurement involves the preparation of the preliminary and concept design by designers acting for HS2 Limited, from which the initial estimates of cost are derived. The designs and those responsible for them are then novated to the contractor, who is required to accept legal responsibility for them under design and build contracts.

The process is used internationally but the amount of design work done before novation is considerably less than that done in Britain. The result in Britain is that design costs are higher because of “double-dipping” (duplicate charging) by designers who frequently insist and are paid for correcting any errors or omission made
in the conceptual design before novation. This trend is evident from projects executed on the “classic railway” for Network Rail in Control Periods 4, 5 and 6.

The independent estimate is based on out-turn elemental costs from similar British projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Project Team Fees – Group Element 3.02**

In the absence of any estimate from HS2 Limited, the independent estimate has made allowance for the cost of project management, including design management, for project managers employed “in-house” by HS2 Limited or for external consultants based on the procurement strategy made available by HS2 Limited to its potential suppliers.

The allowance made in the independent estimate is, of necessity, high, because of the complex nature of the project, interaction between various parts of it and the divided responsibility approach towards design development and production, referred in Group Element 3.01.

The independent estimate draws on the experience of similar large infrastructure projects in Britain, such as the former Birmingham Northern Relief Road (M6 Toll Road) and takes cost data from on out-turn elemental costs from similar British projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

**Other Project Costs – Group Element 3.03**

No information is available from HS2 Limited other than a schedule attached to a written answer to a Parliamentary Question regarding the costs of acquitting property and making good disruption to adjacent owners in the London Borough of Camden. The schedule, signed by Simon Kirby (Commercial Director HS2 Limited) is dated 4th September 2015, amounts to £97.80 million.

In a meeting with HS2 Limited immediately prior to Mr. Price’s petition being heard by the Select Committee on 11th October 2016, Professor Andrew McNaughton advised the petitioner that HS2 had already incurred more than £1 billion in compulsory purchase costs in the Camden area alone.

This figure is 10 (ten) times greater than that included in the earlier schedule but appears credible when considered considering the revised (increased) scope of the work in London Euston Station and shown on the drawings forwarded to the petitioner on 11th October 2016.

The higher figure referred to by Professor McNaughton is credible when one considers the high value of property in London and the cost of buying commercial property held as investments by pension funds and the like; in these cases, to acquire the land required for the project, HS2 Limited has to buy the investment and, where the displaced landlord has tenancies that do not include development break clause and is unable to relocate tenants, HS2 Limited is faced with meeting all of the relocation and associated disruption costs

MH8 is also aware of claims made by registered valuers, acting for landowners and users along the proposed route, entitled to compensation, and the costs of acquiring property in the more populated part of the route between Balsall Common and Curdworth/Curzon Street. Where business premises or sports facilities must be acquired for the route, the cost of loss of profits and increased costs incurred in the movement of the business or the cost of providing temporary and permanent facilities for the landowners or users is included.

There are properties that have been acquired by HS2 Limited and leased back to their original owners, properties that do not comply with current occupational standards. The cost of making good the deficiencies in standards are falling on HS2 Limited as the landlord.

The acquisition of temporary rights of ways, wayleaves for construction activities, including making good on the completion of works, all fees and professional charges associated with obtaining The Royal Assent to the
HS2 Bill, Transport and Works Act Orders required for parts of the works and planning consents are also included.

Works to protect flora/fauna and wildlife, either temporarily and permanently, affected by the project are included.

Where the HS2 Phase 1 project makes connections to the "classic railway", the costs of any disruption caused to the operation of the latter is included.

HS2 is an independent railway and is not intended to share facilities with "the classic railway" and requires its own administrative offices. The cost of renting these office for the period of construction of Phase 1 is included in this element.

Included in the independent estimate and similar related estimates is the cost of project finance, as described in Components 3.03.01.07.01 – 03 of the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning. In the absence of any innovative funding proposals from HS2 Limited, the finance costs have been assessed as debt financing, obtained by HM Treasury, charged at LIBOR rates of interest, over the period required to complete the project. No allowance is made for amortising or capitalising it on the completion of the project.

The independent estimate draws on the experience of similar large infrastructure projects in Britain, such the East West Railway Phase 1 and takes cost data from on out-turn elemental costs from similar British projects analysed in accordance with the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning.

Risk – Group Element 4.01

MHB understands that HS2 Limited has included an uplift of 35% to its base cost estimate to cover contingencies and risk.

The independent estimate is based on the methodology set out in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning in which risk dealt on a quantitive basis as set out in Group Element 4.01; given the design development carried out by HS2 Limited to date, the allowance included in the independent estimate is 7.5%.

Inflation – Group Element 5.01

The estimate given for HS2 Phase 1 by HS2 Limited is at 4th Quarter 2015 prices with an allowance for risk but without any obvious allowance for future inflation.

The independent estimate, similarly, makes no allowance for either tender or construction inflation as defined in RMM Volume I sub-element 4.01; however when preparing those elements within the estimate for direct construction works and for design and project team fees, it became apparent that the supply chain believes that the volume of work on such a high profile project, underway concurrently with other major rail infrastructure projects will lead to rises in the prices of labour, materials and plant over and above normal inflation.

Under the methodology referred to in the "Rail Method of Measurement" (RMM) suite of documents, Volume 1 - Cost Planning, these additional costs should be allocated to component 5.01.01.02, in the section covering “Construction inflation” as component 02 – Exceptional inflation.

The estimate provided by HS2 Limited makes no reference to effects of the possibility of exceptional inflation in accordance with the RMM suite.
Taxation and Grants – Group Element 6.01

The estimate given for HS2 Phase 1 by HS2 Limited is not in sufficient details to address items of “Taxation and Grants” that make affect the outturn cost of the project.

The independent estimate, similarly, makes no allowance for the effects of either “taxation or grants” on the final project cost, although along its proposed route, HS2 Phase 1 may require work carrying in conservation areas or adjacent to sites of special scientific interest (SSSI), which may afford the project with either taxation relief or grant aid on the cost of work required.

Conclusion

HS2 Phase 1 can delivered for a lower price than that stated in the independent estimate if HS2 Limited streamlines its project procurement strategy and follows international best practice. The effect of this streamlined procurement and delivery strategy is reflected in the proportions of costs offered by HS2 Limited, although the totals offered in the IBS estimate is insufficient to overcome the geographical and statutory obstacles faced with construct the new railway in Great Britain.

These problems have long been understood, as early as June 1920, the (then) Minister of Transport told Parliament:-

"that the cost of building railways per mile, was UK : £34,000, France : £31,000, Prussia : £26,000, USA : £14,000"

[Hansard vol.130, col 2453]

Even then the cost of building in the UK was 29.52% higher then the international average and 242.85% higher than the optimum price. On this basis, the cost of HS2 Phase 1, if it was 242.85% greater per mile than IBS, would be £57.07 billion, at 4th Quarter 2015 prices, inclusive of allowances for risk and contingencies

The manner in which the project appears to have been set up has been set up and run for the past 5 years, mirrors the practice employed by Network Rail, and threatens to transfer all of NR’s past and present problems over meeting cost and delivery targets to the new project.

The effect of these practices further threatens any attempt to deliver the project within IBS cost parameters.

Michael Byng
30th January 2017
## Summary of Group Element Costs - Rail Method of Measurement - Volume 1 - Cost Planning

<table>
<thead>
<tr>
<th>Group Element</th>
<th>Total Cost (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Construction Costs (A)</strong></td>
<td></td>
</tr>
<tr>
<td>1.01 Railway Control Systems</td>
<td>3,817,710,802.39</td>
</tr>
<tr>
<td>1.02 Train Power Systems</td>
<td>2,892,110,713.97</td>
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<tr>
<td>1.03 Electric Power and Plant</td>
<td>2,620,975,334.54</td>
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<tr>
<td>1.04 Permanent Way</td>
<td>4,250,904,109.76</td>
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<tr>
<td>1.05 Operational Telecommunication Systems</td>
<td>2,648,849,705.00</td>
</tr>
<tr>
<td>1.06 Buildings and Property</td>
<td>6,622,559,555.16</td>
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<tr>
<td>1.07 Civil Engineering</td>
<td>3,911,205,760.81</td>
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<tr>
<td>1.08 Enabling Works</td>
<td>4,400,496,043.24</td>
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<tr>
<td><strong>Total Direct Construction Costs (A)</strong></td>
<td>31,164,812,024.88</td>
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<tr>
<td><strong>Indirect Construction Works (B)</strong></td>
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</tr>
<tr>
<td>2.01 Preliminaries</td>
<td>5,142,222,713.41</td>
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<tr>
<td>2.02 Contractor's Overheads &amp; Profit</td>
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<td><strong>Total Indirect Construction Works (B)</strong></td>
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<td><strong>Construction Cost (A+B)=(C)</strong></td>
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<tr>
<td><strong>Project/Design Team &amp; Other Project Costs (D)</strong></td>
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<tr>
<td>3.01 Design Team</td>
<td>6,829,385,985.68</td>
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<tr>
<td>3.02 Project Team</td>
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<td>3.03 Other Project Costs</td>
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<td><strong>Total Project/Design Team &amp; Other Project Costs (C+D)=(E)</strong></td>
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<td><strong>Employer's Indirect Costs (E)</strong></td>
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<tr>
<td><strong>Construction, Project/Design Team &amp; Other Project Costs (E+D)=(F)</strong></td>
<td>49,878,916,909.77</td>
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<td><strong>Risk (G)</strong></td>
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<td>4.01 Total Risk Allowances</td>
<td>3,740,931,827.01</td>
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<td><strong>Total Risk Allowance (F)</strong></td>
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<tr>
<td><strong>Cost Limit (excluding Inflation) (F+G)</strong></td>
<td>53,619,848,736.78</td>
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<tr>
<td><strong>Inflation (H)</strong></td>
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<tr>
<td>5.01 Tender and Construction Inflation</td>
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<td><strong>Total Inflation Allowance (H)</strong></td>
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<tr>
<td><strong>Total Cost Limit (G+H)</strong></td>
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<td><strong>Taxation (J)</strong></td>
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<tr>
<td>6.01 Tax Allowances &amp; Grants</td>
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<td><strong>Total Taxation Allowance (J)</strong></td>
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<td><strong>Total Cost Limit (J)</strong></td>
<td>53,619,848,736.78</td>
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Appendix C

HS2 Phase 1

HS2 Limited Summary Estimate of Costs

18th January 2017
### Computation Between mmbc Infrastructure Cost Plan and Industry Benchmark Data

<table>
<thead>
<tr>
<th>Key Quantity</th>
<th>Group Element Unit</th>
<th>£ 40k</th>
<th>% of Total Cost Limit</th>
<th>£/unit</th>
<th>Group Element £/unit</th>
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</thead>
<tbody>
<tr>
<td>1.00 Direct Construction Works</td>
<td>487</td>
<td>Single Track km</td>
<td>5,182,328,000</td>
<td>9.7%</td>
<td>10,641,331</td>
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<tr>
<td>1.03 Railway Control Systems</td>
<td>487</td>
<td>Single Track km</td>
<td>5,847,966,655</td>
<td>10.9%</td>
<td>12,098,149</td>
</tr>
<tr>
<td>1.03 Electric Power and Plant</td>
<td>487</td>
<td>Single Track km</td>
<td>3,523,345,275</td>
<td>6.6%</td>
<td>7,234,795</td>
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<td>1.04 Permanent Way</td>
<td>487</td>
<td>Single Track km</td>
<td>2,510,694,210</td>
<td>4.7%</td>
<td>5,155,430</td>
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<tr>
<td>1.05 Operational Telecommunication Systems</td>
<td>487</td>
<td>Single Track km</td>
<td>2,648,849,705</td>
<td>4.9%</td>
<td>5,439,116</td>
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<td>1.06 Buildings and Property</td>
<td>356,767</td>
<td>Gross Floor Area m²</td>
<td>9,093,168,000</td>
<td>17.0%</td>
<td>22,918</td>
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<td>1.07 Civil Engineering</td>
<td>221</td>
<td>Route km</td>
<td>990,003,425</td>
<td>1.8%</td>
<td>4,343,907</td>
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<td>1.08 Enabling Works</td>
<td>221</td>
<td>Route km</td>
<td>2,088,828,872</td>
<td>2.6%</td>
<td>6,328,637</td>
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<td>DIRECT CONSTRUCTION COSTS (A)</td>
<td></td>
<td></td>
<td>31,166,586,142</td>
<td>48.1%</td>
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<td>INDIRECT CONSTRUCTION WORKS (B)</td>
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<td>6,776,047,122</td>
<td>12.6%</td>
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<tr>
<td>TOTAL CONSTRUCTION WORKS (A+B)</td>
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<td>37,941,033,264</td>
<td>70.7%</td>
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<td>3.00 PROJECT/DESIGN TEAM &amp; OTHER PROJECT COSTS</td>
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<tr>
<td>3.01 Preliminary</td>
<td>% on Direct Cost</td>
<td>5,142,222,173</td>
<td>9.6%</td>
<td>16.5%</td>
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<td>3.02 Contractor’s Overheads &amp; Profit</td>
<td>% on Direct Cost</td>
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<td>EMPLOYER’S INDIRECT COSTS (D)</td>
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<td>6,776,047,122</td>
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<td>CONSTRUCTION, PROJECT/DESIGN TEAM &amp; OTHER PROJECT COSTS (C+D+E)</td>
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<td>4.00 RISK</td>
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<td>49,879,091,027</td>
<td>£ 226m per route km</td>
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<td>4.01 TOTAL RISK ALLOWANCES</td>
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<td>3,740,911,827</td>
<td>7.0%</td>
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<td>TOTAL RISK ALLOWANCE (F)</td>
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<td>3,740,911,827</td>
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<td>COST LIMIT (EXCLUDING INFLATION) (E+F+G)</td>
<td>53,620,022,854</td>
<td>100.0%</td>
<td>£ 243m per route km</td>
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Excludes:
- Rolling Stock and Traincare Depot
- Schedule 4 / Asset Protection
- On Network Works

**MB E Benchmark Data From HBS & Periodic Update**

<table>
<thead>
<tr>
<th>Source</th>
<th>Key Quantity</th>
<th>£/Unit</th>
<th>Total £</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBS</td>
<td>487 track km</td>
<td>2,900,000</td>
<td>1,412,300,000</td>
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<tr>
<td>IBS</td>
<td>487 track km</td>
<td>2,070,000</td>
<td>998,350,000</td>
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</table>

Included in train Power
- Included
- 1.5%

Included in Control Systems
- Included
- 0.5%

Included in Summit
- Included
- 10.6%

Tunneling
- 41 route km
- 42,000,000
- 1,722,000,000

Vehiclux
- 19 route km
- 23,000,000
- 437,000,000

Surface Route
- 161 route km
- 5,600,000
- 901,000,000

Booth & Utility norms
- 221 route km
- 6,300,000
- 1,392,300,000

**H52 Current Baseline**

<table>
<thead>
<tr>
<th>Source</th>
<th>£/Unit</th>
<th>Total £</th>
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<tbody>
<tr>
<td>HBS</td>
<td>487 track km</td>
<td>1,900,000</td>
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<tr>
<td>IBS</td>
<td>487 track km</td>
<td>1,100,000</td>
</tr>
</tbody>
</table>

Included in output rates
- Included
- 8.5%

Included in output rates
- Included
- 3.0%

- 11.5%

- 48.4%

Client Design & Surveys
- 10.0%
- 957,420,150

Macclesfield Review
- 13.0%
- 1,244,659,195

As mmbc estimate - carryover coverage
- 9.4%
- 2,285,327,012

- 27.4%

Based on ‘Reference Class’ study
- 25.0%
- 3,515,429,464

Client risk for programme of H52 complexity and lifecycle stages

Blended Data
- 221 route km
- £ 80m per route km
- 37,577,132,322

IBS Study
- 221 route km
- £ 65m per route km
- 34,365,000,000

PREPARED BY HIGH SPEED 2 LIMITED FOR MEETING WITH LORD BERKLEY ON 18 JANUARY 2017. ALL INFORMATION SHOULD BE TREATED IN CONFIDENCE PURALLY FOR THIS PURPOSE OF THE MEETING.
Appendix D

Extract from "Hansard" for 23rd April 2018

Evidence of Earthworks Costs given to the HS2 House of Commons Select Committee

Mr. Tim Smart HS2 Limited
Mr Smart gives Evidence:

99. MR MOULD QC (DfT): Yes. 100. There’s one other point, which is the point that was raised by Mr Martin in relation to the allowance that is made on this schedule – on our schedule – for earthworks. As you will recall, we have made an allowance on the second line for civil engineering excluding earthworks for both the twin-tunnel scheme and for the single tunnel alternative. The numbers are there set out. The point was made earlier that there should on the face of it be a significant saving in earthworks over and above the structural elements of the civil – that is to say, viaducts and so forth. We’re here dealing really with cut and fill elements – that is to say embankments, cuttings and so forth. There ought to be a significant saving by going underground as opposed to on the surface. And the figure that is shown in this schedule for that is £8.82 million. Mr Martin, understandably if I may say so, raised a concern as to whether that looked like a sufficient sum. Mr Smart, I’d like to deal with that point if we may, just to explain how HS2 have arrived at that figure. And for that purpose, we go to the next slide, which is P34(3). And we look at note 4 there.

101. MR SMART: Yes. Note 4 is the key one there, sir, which is earthworks costs represent the cost saving in adopting the single tunnel. ‘The earthworks model considers re-use of excavated’ – well, you can read it, sir. But what we are saying is that when we look at the earthworks, we don’t look at a simple add and omit – you know, take out an embankment, add in a cutting, or take it out – it’s at grade. As we are excavating and creating embankments all along the route, we have what is known as a ‘mass haul’ calculation because we try to do the most sustainable solution which is reuse as much material as we can. And also, that looks at hauling and trying to minimise haul distances – moving it along the route. So, it is quite a complicated model which looks at where we move material from – either from a cutting which might go into an embankment or whether it’s surplus and has to go off site completely or maybe moved somewhere else down the route and re-used. Now, all of that is quite a complicated exercise and we do that on the route basis. So, that results in the figure that is shown on our costings, if we go back to P34(2). That results in the £8.82 million reduction to the twin-bored single tunnel. Now, that means that when you come to look at a cost comparison that Mr Hindle has done, you would not add back in those earthworks because they are already accounted for in our figures.

Mr Booth QC cross questioning Mr Smart:

134. MR BOOTH QC: – to a short series of questions that I have for Mr Smart. Mr Smart, picking up on your last point and dealing with that first. The Committee has been shown your cost analysis table and you have – it’s slide P34(2) – thank you very much. What you’ve done, as you’ve confirmed, you’ve credited the twin-bored single tunnel with an £8.2 million saving in terms of earthworks.

135. MR SMART: Correct.

136. MR BOOTH QC: But what we’ve agreed – I think what you’ve indicated to the Committee – is you do not know what the saving in earthwork costs will be for this stretch because you do not know how much the embankments and the cuttings for this stretch of route, which will lie above the tunnel, so to speak – you do not know what that cost is?

137. MR SMART: No, not quite. We know what that cost is, which comes out of the model, but what we can’t do from this – I’m not saying we can’t do it – but not from this – is an add and omit which say, ‘This embankment adds that much and that much and this cutting saves that much’. So, what we’ve got is that is the cost over this section of route but it is derived from properly looking at what happens to where we take material from and to.
138. MR BOOTH QC: I understand it is the output from your model. But you see what you’ve said in the slide is precisely what Marian Boater of HS2 responded to us when we raised this issue with her earlier in the month. She said in terms, ‘The 18 earthworks costs cannot be isolated for a specific section’. If you can’t isolate them – i.e., you don’t know what they are – you’re not in a position to dispute Mr Hindle when he says, ‘Well, actually, the costs inherent in the scale and extent of cuttings and embankments for this section’ – 21 metres high in places – you’re not in a position to dispute his querying of your £8 million figure. And he, with his experience, places a £60 million figure on that.

139. MR SMART: Yes. What I’m saying is we can dispute it because that is the figure. Now, I think what you’re saying is we haven’t been able to – in the time available – interrogate the model and come up with an accurate way of looking at Mr Hindle’s like for like in terms of add and omit, as you would do in a bill of quantities. If it would be helpful to the Committee we can do that.

140. MR BOOTH QC: Well, it may be helpful to the Committee. It’s a matter for the Committee. We asked for that material and it wasn’t provided to us. Next point is this. As regards technology, we heard Mr Mould put questions and indeed answer questions from the Committee as regards the cost of the boring machines which you propose to rely upon. And what was said was that you have assumed a cost of £15 million per tunnel boring machine.
Appendix E

Letter from The Secretary of State for Transport - Rt Hon Chris Grayling MP to Lord Berkeley
 dated 6th April 2018

"Target Costs" for Phase 1 - 2019
Thank you for your letter of 15 March, about HS2 Phase One costs.

As you know from previous correspondence on this issue from both Lord Ahmad and Paul Maynard MP, HS2 Ltd and the Department do not agree with the cost, schedule and engineering assertions made by Michael Byng. The Phase One funding envelope (without rolling stock) is £24.3bn.

The drawings published in August 2016 reflect the updated scope positions for the Phase One railway following completion of the House of Commons Select Committee’s consideration of petitions. As you would expect, the funding envelope for Phase One contains a significant contingency allowance. During progression through Parliament, this allowance included a specific fund to cater for the Select Committee’s recommendations having cost implications, so the overall funding envelope therefore remained unchanged following Select Committee consideration. The updated designs were published through GOV.UK and any member of the public can sign up to receive email alerts to let them know each time new HS2 information is published.

HS2 Ltd regularly updates its cost estimate for Phase One, to reflect bottom up re-assessment and specific add and omit revision as cost understanding is matured. Going forward, they will also update their cost estimates to reflect the latest market feedback as contractors undertake detailed design work and more contracts are awarded.

HS2 Ltd do not publicly share their detailed cost estimates as they are commercially sensitive, and they are only supplied to successful bidders who become contracting partners. This is a position I fully support, as it is an important element in maintaining a healthy and competitive market and
making sure that tenders submitted prior to contract award represent value for money.

Thus far, HS2 Ltd market engagement has not indicated that their estimates are significantly at odds with contractors' views, and certainly not to the extent that Michael Byng has proposed, which at £51bn would be an increase of over 100% upon the HS2 Ltd estimate. Please therefore be assured that the combined cost estimate for Phase One remains within the funding envelope.

Although the final target price for HS2 Phase One will be agreed in 2019 when notice to proceed is intended to be authorized to the Main Works Civil contractors for Phase One (as set out in the published Development Agreement) the suggestion that HS2 Ltd are waiting for contractors to tell them how much the railway will cost as you have previously implied is wide of the mark. HS2 Ltd will continue to update its cost estimates in order to incentivize innovation, drive efficiency and maintain cost control, and I will continue to be appraised of developments as the estimate is matured and developed over the coming years.

You may be aware that I have already agreed with David Lidington MP to pass all of the correspondence relating to the Wendover mined tunnel proposal, including the mbpc report supplied by Michael Byng and the HS2 Ltd responses to it, to the Infrastructure Projects Authority (IPA) for their consideration when they next review the HS2 programme later in the year (currently scheduled for June or July, though precise dates are still to be confirmed).

Should the IPA's consideration of Michael Byng's Wendover scheme raise concerns about HS2 Ltd's assessment of their own costs in that area, then this will of course precipitate further action to look at the validity of HS2 Ltd cost estimates along the rest of the route. I will communicate the outcome of the IPA's consideration of Michael Byng's proposals and assertions in relation to Wendover with you when it becomes available later in the year.

In the meantime I remain confident that the Phase One railway will be delivered within the funding envelope.

With best wishes,

Rt Hon Chris Grayling MP
SECRETARY OF STATE FOR TRANSPORT

A255 (51)