



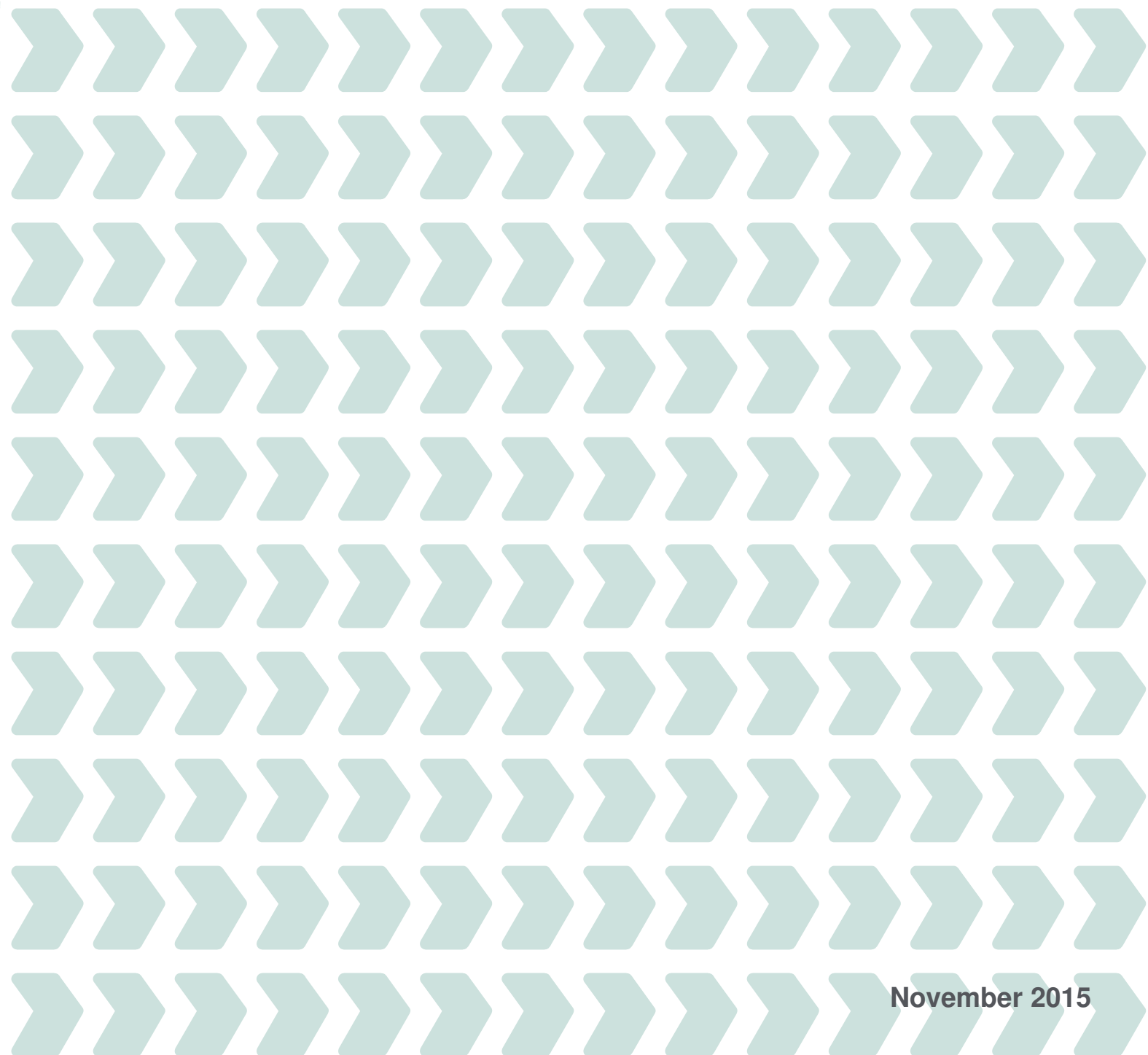
Department
for Transport

HS2 West Midlands to Crewe

Strategic Outline Business Case

Economic Case

Moving Britain Ahead



November 2015

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1. The case for accelerating the HS2 route from the West Midlands to Crewe

Introduction

- 1.1 HS2 is a new high speed rail network for the UK, connecting London with major cities in the Midlands and the North of England. It is a "Y" shaped network that will be delivered in several phases. Trains will also run beyond the "Y" network to serve places such as Liverpool, Warrington, Newcastle and Scotland.
- 1.2 Phase One of HS2 will see a new high speed line constructed from Euston to just north of Birmingham, where it will join the existing West Coast Main Line (WCML), allowing fast, direct services to destinations including Manchester, Liverpool, Crewe, Preston and Glasgow. New high speed trains will serve Birmingham city centre and an interchange station designed to serve the wider West Midlands. At Old Oak Common in West London, a new interchange will be built connecting HS2 with Crossrail and the Great Western Main Line. Phase One will be built and operational by 2026, subject to Parliamentary approval of the High Speed Rail (London-West Midlands) Bill.
- 1.3 The Phase Two proposal is to extend the line to the North-West to Manchester with connections back onto the WCML. It will also extend the line to the North-East to Leeds with a connection back onto the East Coast Main Line. There will be stations in Manchester and Leeds, with intermediate stations in the East Midlands and South Yorkshire. Phase Two will be completed seven years after Phase One in 2033.
- 1.4 This Economic Case is intended to assess the value for money of the route between Fradley in the West Midlands and Crewe, and for accelerating delivery of this section of HS2 Phase Two. This section of the route is referred to as Phase 2a. It also considers a range of alternative options for delivering the strategic objectives.
- 1.5 Phase 2a is a 37 mile (60 km) railway starting at Fradley at its southern end. At the northern end it connects with the WCML south of Crewe to allow HS2 services to join the WCML and serve Crewe.

Assessment principles

- 1.6 The Strategic Outline Business Case (SOBC) – of which this Economic Case forms one part – is intended to support a decision on how to accelerate the delivery of the benefits of HS2, and in particular whether to accelerate the route to Crewe. This represents an investment decision to proceed with the route to Crewe and a decision to do so to the accelerated timescales described. An assessment is therefore presented of both:

- the value for money of accelerating delivery of the route between Fradley and Crewe compared to delivery alongside the entirety of Phase Two in 2033. This is the key policy proposal and is termed 'the base case for acceleration'
 - the value for money of Phase 2a assuming Phase One of the scheme is in place and, hypothetically, the remainder of Phase 2 is not built. This is termed the 'Incremental Case'
- 1.7 The Government still intends to proceed with the full HS2 "Y" network, of which the HS2 route between Birmingham and Crewe is just one part. Therefore, in support of the case for accelerating Phase 2a, we have also updated our analysis of the case for the "Y" network as a whole.
- 1.8 A complete assessment of the value for money of a transport scheme requires the comparison of a range of options. We have therefore looked in detail at the case for alternatives based on enhancements to the existing rail network (defined here as rail alternatives – see section 2). All of these schemes have been compared to a common scenario that allows us to assess the incremental economic, social, environmental and public accounts impacts that each package of transport interventions may bring about.
- 1.9 By bringing together and summarising information on costs, benefits and risks on a number of alternative options, the Economic Case supports and informs decision making. However, it should not be seen as unequivocally providing the 'right' or only answer. The Department for Transport (DfT) carries out investment appraisals following the recommendations in HM Treasury (HMT) guidance on the five case model for public sector business cases¹. Decision makers are presented with evidence against all five cases (strategic, economic, financial, commercial and management) when considering investment decisions such as HS2². Therefore while value for money is a very important consideration, other factors are also considered when selecting options for the next stage in the decision making process.
- 1.10 This value for money assessment adheres to the general guidance on evaluating proposals published by HMT in the Green Book and the more detailed advice provided by the DfT on how to apply Green Book principles to investments in transport (WebTAG)³. In compliance with both the Green Book and WebTAG, it provides a consolidated assessment of the costs and benefits of each of the options considered.
- 1.11 This report draws on modelling and economic analysis undertaken by HS2 Limited.

Our assessment of the Economic Case for HS2

Assessment framework

- 1.12 Our appraisal aims to capture all of the impacts – positive and negative – as well as the associated risks and uncertainty, so that the decision maker is provided with a full assessment of the pros and cons of different courses of action. Where possible, these impacts are expressed in units of money, and it is from these monetary

¹ 'Public Sector Business Cases using the Five Case model: A Toolkit' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190601/Green_Book_guidance_public_sector_business_cases_using_the_Five_Case_Model_guidance.pdf

² See <https://www.gov.uk/transport-analysis-guidance-webtag> for more details

³ Department for Transport, 'Transport Analysis Guidance – WebTAG', <https://www.gov.uk/transport-analysis-guidance-webtag>

valuations that the Benefit Cost Ratio (BCR) – a measure of the return to the investment – is calculated.

1.13 A wide range of benefits are quantified in monetary terms, ranging from direct benefits to transport users from travel time savings, reductions in crowding and improvements in reliability, to Wider Economic Impacts (WEI) and safety and environmental impacts, such as noise and air quality. The table below summarises the most significant impacts monetised in the assessment of benefits.

Figure 1: Key benefits considered in HS2 Economic Case

Impact	Description
Journey Time Savings	Journey times are improved as a result of HS2
Reductions in Crowding	Reduction in levels of crowding meaning passengers experience a more pleasant journey
Greater Journey Reliability	HS2 trains are expected to be more reliable and experience less delays than services on the existing rail network
Agglomeration	HS2 reduces the time (and cost) of travelling between areas and businesses thus leading to greater business interaction
Environmental Impacts	Covers a range of impacts which include localised impacts such as noise and air quality and national impacts such as greenhouse gases

1.14 Our assessment of the costs of the scheme incorporates the entirety of expected costs to Government. This includes the capital costs of building the scheme and the operating costs of running the railway once opened from which the revenue arising from additional rail passengers is deducted. The benefits as described above are subsequently combined with the net costs to Government to derive a BCR.

1.15 There are also a series of impacts which are not monetised in this assessment. Some of these are assessed qualitatively and these are discussed in Section 3. There are other impacts which are not assessed as the techniques to do so need further development and in some cases there is insufficient information on their likely scale. The table below describes those impacts not considered, the majority of which are likely to be additional benefits. These impacts largely constitute second order transformational effects, i.e. those impacts which are not a direct result of the transport investment – such as travel time savings – but rather those which arise as a result of those direct impacts. For example, improvements in connectivity as demonstrated by reduced journey times may affect the business location of firms, causing them to move to higher productivity areas, thus facilitating land use change.

Figure 2: Key impacts not valued

Impact	Description
Regeneration	Land use change is not considered within our modelling. Benefits from regenerating areas of the country most affected by the benefits of HS2 regeneration.
Movements to More Productive Jobs	Land use change is not considered within our modelling. The increase in productivity identified as resulting from jobs relocating into higher productivity areas.
Foreign Direct Investment	The connectivity benefits arising from HS2 may lead to firms overseas being more attracted to invest in the UK.
Freight	HS2 may result in additional capacity available for rail freight. The potential benefits resulting from this have been considered but have not been quantified in the economic case.

- 1.16 An integral element of our appraisal is the approach taken to forecast rail demand. Since the 1990s rail demand growth has been strong, particularly on the routes which HS2 intends to serve. For example, on the WCML intercity passenger numbers have grown by an average of 5.3 per cent each year since 1996/97⁴. Despite this, the HS2 Economic Case assumes that demand is capped once it reaches a certain level – this approach follows the general principle that it is not reasonable to expect rail demand to grow indefinitely. In this Economic Case, the level of demand at which the demand cap applies is reached in 2037. This approach is consistent with previous work, notably the 2013 Economic Case for HS2.
- 1.17 It is considered however, that this application of a demand cap is conservative as it is applied only four years after the full "Y" network is assumed to open. There is no evidence to suggest that demand will stop growing within this timescale and demand growth on our rail network has been strong over the preceding twenty years. Our demand forecasts could also be viewed as conservative given that they only assume 2.2 per cent demand growth each year across the rail network whereas as noted above, historic demand growth has been far stronger.
- 1.18 The PLANET Framework Model (PFM) is the tool used to assess the changes in behaviour as a result of HS2. It assesses the impact of HS2 on the behaviour of existing travellers who may now use a different mode, switch to HS2 or make a different trip. It also assesses the extent to which HS2 and the associated capacity released on the existing network attracts new travel demand. The outputs from PFM therefore form the basis of the majority of monetised impacts.
- 1.19 The exception to this is the calculation of operating and capital costs. In the case of operating costs we combine a series of assumptions on the operational characteristics of HS2 and the existing rail network – such as train timetables – with our knowledge of the cost of operating rail services. Capital cost estimates originate from HS2 Limited (HS2 Ltd) who undertake detailed cost estimation exercises and then supplement this with an allowance to reflect the risks and uncertainties associated with those estimates (including optimism bias). It is important to note that benefits and costs are valued across the British rail network as a whole rather than solely focusing on HS2. For example, the analysis captures the benefits to those

⁴ National Rail Trends

passengers who may not use HS2 services but benefit from the capacity HS2 releases on the existing network.

Standard assessment – key results

Acceleration

- 1.20 The key policy proposal is to accelerate the delivery of the HS2 route from the West Midlands to Crewe. The analysis of this proposal, the 'base case for acceleration', demonstrates that the revenue gain and cost savings which result outweigh both the capital and operating costs of accelerating in Net Present Value (NPV) terms. The revenue gain occurs because journey times are now quicker leading to increased demand for rail services. The NPV cost saving comes from a re-profiling of capital costs. Work on the line from West Midlands to Crewe occurs earlier while some work on the rest of Phase 2 is moved back slightly (though the opening date of the rest of Phase 2 remains the same).
- 1.21 A BCR is calculated as the benefits divided by the net costs to Government (capital costs plus operating costs minus revenue gain). Given that the revenue and cost savings of accelerating Phase 2a outweigh the incremental capital and operating costs a BCR cannot be calculated as the costs (i.e. the denominator) are negative. On this basis the proposal is financially positive and delivers net benefits. It can therefore be concluded that the value for money case for acceleration is very high (also see Figure 3 below).

Incremental and full "Y" BCRs (including higher inflation)

- 1.22 Construction inflation (and growth in other project-specific costs) since 2011 has been higher than background inflation and this may continue over the next 5 years. This was recognised in the Spending Review, and adopting this approach slightly reduces BCRs compared to the 'Reference Case'.
- 1.23 When assessed on a standalone 'incremental' basis, assuming that Phase One of HS2 is already delivered in 2026 but that the rest of Phase 2 is not built, the BCR of Phase 2a is estimated to be 1.3 (including WEI and higher project-specific inflation in line with the Spending Review). This Economic Case also analyses the costs and benefits of the full "Y" network, the BCR for which is estimated to be 2.2 (again including WEI and higher inflation). This represents high value for money. Other than inflation all other assumptions underlying these BCRs are common to the 'Reference Case'.

'Reference Case' BCRs

- 1.24 Much of the analysis that follows in this Economic Case has been conducted in relation to a 'Reference Case'. This has been produced on a comparable basis to the 2013 Economic Case for HS2. In particular, it applies general background inflation rates to the project based on the GDP deflator (in line with standard practice).
- 1.25 In the 'Reference Case' for Phase 2a on a standalone 'incremental' basis the benefits outweigh the costs by a factor of 1.6 (including WEI) and 1.3 without WEI. In the 'Reference Case' the full "Y" has a BCR of 2.5 (including WEI) and 2.0 without WEI.

- 1.26 Leaving inflation to one side these BCRs are likely to be conservative for the reasons relating to demand forecasts (described in paragraphs 1.16-1.17). In addition the Phase 2a BCRs are likely to be conservative because they assume that the train service operated in Phase One continues to operate when this new infrastructure is in place. If HS2 were not to extend beyond Crewe it is expected that a different train service would be implemented to maximise the benefits of the extended high speed line to Crewe.
- 1.27 The table below provides a breakdown of the monetised benefits and costs of each of these assessments:

Figure 3: BCRs for each case

£2011 Prices, PV	Full "Y" Network	'Incremental Case'	Case for Acceleration
Net Benefits (Excl. WEIs)	£58.6bn	£1.9bn	£0.3bn
Net Benefits (Incl. WEIs)	£72.8bn	£2.2bn	£0.4bn
Net Cost to Government 'Reference Case'	£28.8bn	£1.4bn	-£0.6bn
BCR 'Reference Case' (Incl. WEIs)	2.5	1.6	N/A
BCR 'Reference Case' (Excl. WEIs)	2.0	1.3	N/A
BCR Higher Inflation (Incl. WEIs)	2.2	1.3	N/A
BCR Higher Inflation (Excl. WEIs)	1.8	1.1	N/A

- 1.28 The economic analysis in this document is based on the best information available during its completion in October and early November. Subsequently the Spending Review (announced on 25 November 2015) included a slightly revised time profile for the capital costs of HS2. This does not materially affect the BCRs in this Economic Case.
- 1.29 The economic analysis described in this document will be updated again in the future and we will continue to keep the treatment of project-specific inflation and other changes to the BCR methodology under review. In particular the Phase 2b Strategic Outline Business Case is expected in 2016 and the Outline Business Case for Phase 2a is expected in 2017.

Changes in BCRs from 2013

- 1.30 There have been a number of changes to the assessment since the previous update of the HS2 Economic Case in October 2013. Some of these have increased benefits or costs whilst others have decreased benefits or costs. The net effect is that in the 'Reference Case' the benefit cost ratio for the "Y" network increases slightly by 0.2 relative to the previous assessment.

- 1.31 The key factors which have acted to increase the BCR relative to the previous assessment (in the 'Reference Case') include:
- incorporating updated forecasts for the UK economy, including the impact of economic growth
 - improvements to the estimates of the reliability benefits of HS2
 - updated representation of future rail services on the existing network in the do minimum (or the without HS2 scheme case)
 - revisiting our assessment of the benefits arising from agglomeration and increases in labour supply

The robustness of the economic analysis

- 1.32 In line with DfT appraisal guidance, our appraisal of the impacts of HS2 extends for 60 years after scheme completion (and therefore until the 2090s). It is important to take this long term view for infrastructure that will be long-lived and which could continue to deliver benefits well beyond the end of the appraisal period. However, accurately forecasting benefits (and costs) such a long way into the future is inherently challenging and subject to significant uncertainties and unknowns. It is important therefore to understand the robustness of the Economic Case to changes in those factors in the appraisal which have the largest impact on the results. In the case of HS2, as with many transport investments, this means understanding the impact of a range of different assumptions such as economic growth, growth in demand for rail travel, construction costs and the valuation of time savings.
- 1.33 An assessment has been conducted of the resilience of the 'Reference Case' (not including higher inflation) to variations in these factors based on an analysis of the probability of different events occurring and is termed 'risk analysis'. A similar analysis was conducted for the 2013 HS2 Economic Case and this represents an updated version of that work. The outputs of this updated analysis are shown below, demonstrating that for the factors considered there is an 95 per cent chance of the "Y" network representing high value for money (BCR between 2.0 and 4.0) and a 63 per cent chance of the 'Incremental Case' representing medium value for money (BCR between 1.5 and 2.0). This risk analysis and subsequent sensitivity analysis is based on the 'Reference Case'.

Figure 4: Risk analysis for full "Y" network

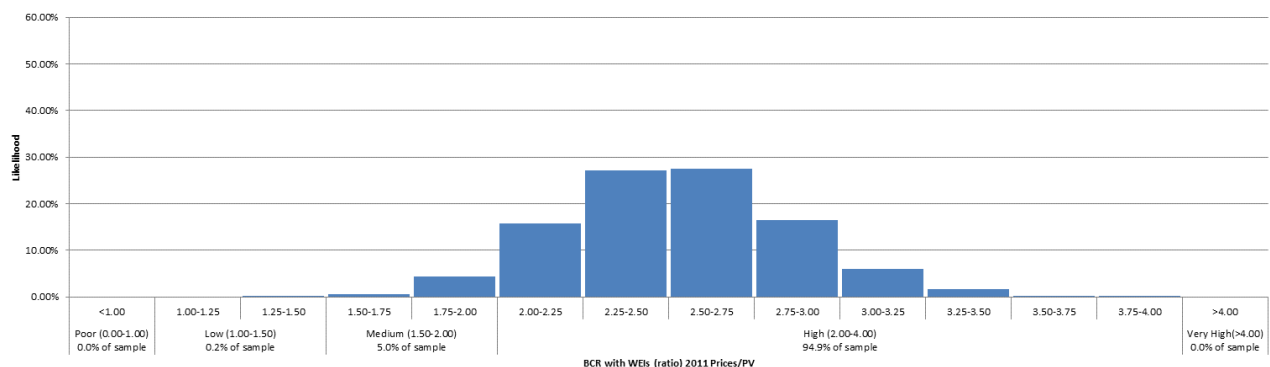
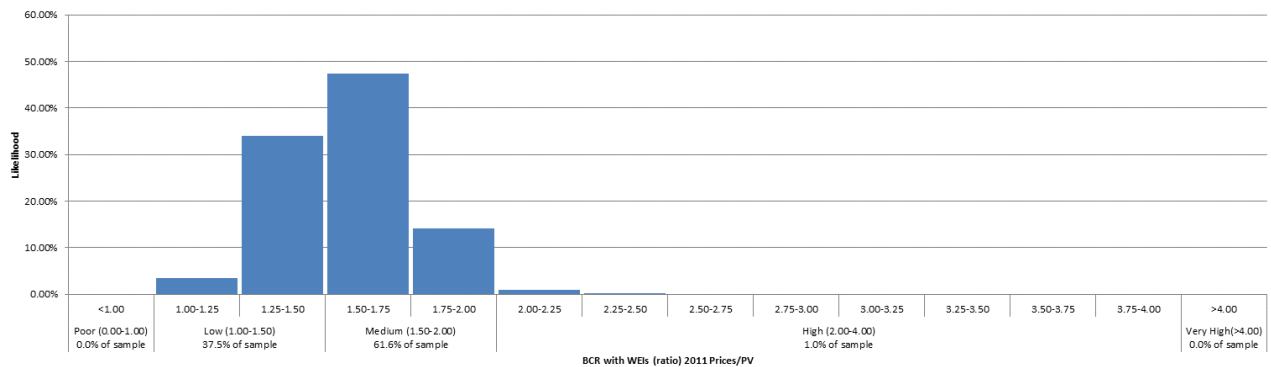


Figure 5: Risk analysis for 'Incremental Case'



1.34 There are two key issues to note with this analysis. Firstly, a similar assessment cannot be conducted for the 'base case for acceleration'; as noted previously the revenues in this instance outweigh the costs so therefore a BCR cannot be calculated. Secondly, this work only considers uncertainty in a select number of exogenous variables for which probability distributions are available and there are other variables important in determining the outputs (such as the journey purposes of passengers) which are not covered. Cost inflation is also one of the uncertainties not included in the risk analysis, although this is included as a sensitivity test (see from paragraph 1.57).

Key sensitivities in the appraisal

1.35 As with any appraisal of a major transport scheme, there are a number of key parameters (such as methodological and policy assumptions) which have a significant influence on the economic analysis. A number of sensitivity tests were therefore conducted on these issues to explore further the robustness of the value for money case for Phase 2a and the full "Y" network.

Demand cap

1.36 The appraisal of HS2 assumes that demand for rail travel stops at a particular level after which it is no longer assumed to grow. This level is currently forecast to be reached in 2037. While it may be considered unreasonable to assume demand grows forever, as noted previously this specific assumption is conservative:

- it is applied only four years after the full "Y" network is assumed to open;
- there is no evidence to suggest that demand will stop growing within this timescale;
- demand growth on our rail network has been significantly stronger over the preceding twenty years than the growth rates implied by our forecasts.

1.37 The charts below illustrate the impact on the "Y" network risk analysis and the risk analysis for the 'Incremental Case' if the level of demand at which the demand cap applies was increased by 20 per cent. In this scenario the demand cap now applies in 2044. In both cases there is now an increased likelihood of high value for money in the 'Reference Case', with the "Y" network having a 99.9 per cent chance of

providing high value for money (accounting for the factors considered in the risk analysis) compared to 95 per cent previously. The 'Reference Case' BCRs increase from 2.5 to 3.8 in the case of the full "Y" network and from 1.6 to 1.8 for the 'Incremental Case'.

Figure 6: Risk analysis for 2044 demand cap for full "Y" network

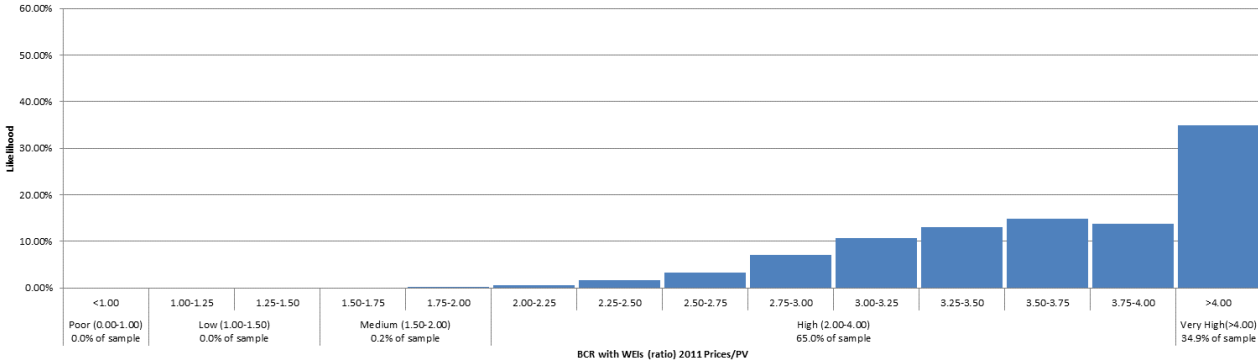
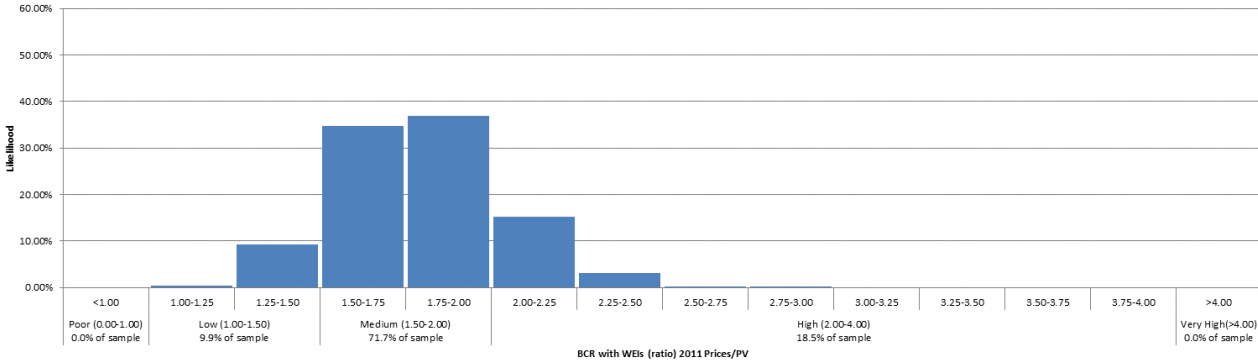


Figure 7: Risk analysis for 2044 demand cap for 'Incremental Case'



- 1.38 The specification of the demand cap itself is subject to uncertainty, with numerous alternatives to the level based approach adopted in the HS2 Economic Case. One alternative may be to implement a demand cap in a specific year but subsequently allow demand to increase in line with population beyond the cap year. This would have the advantage of ensuring that the number of trips per person on rail is assumed to be constant rather than falling, which is what happens when population growth is forecast during the period when demand is fixed. The demand cap is currently forecast to be reached in 2037. If this alternative approach is applied beyond the cap year, then the 'Reference Case' BCR for the "Y" network increases to 2.9 from 2.5.
- 1.39 Given the uncertainty over our long term forecasts it is also prudent to consider the impact of a lower demand cap. The charts below demonstrate the impact on the "Y" network and 'Incremental Case' if the level of demand at which the cap is implemented is 20 per cent lower. In this scenario the demand cap would be reached in 2027 and for the full "Y" network the expected 'Reference Case' BCR would be 1.6.

Figure 8: Risk analysis for 2027 demand cap for full "Y" network

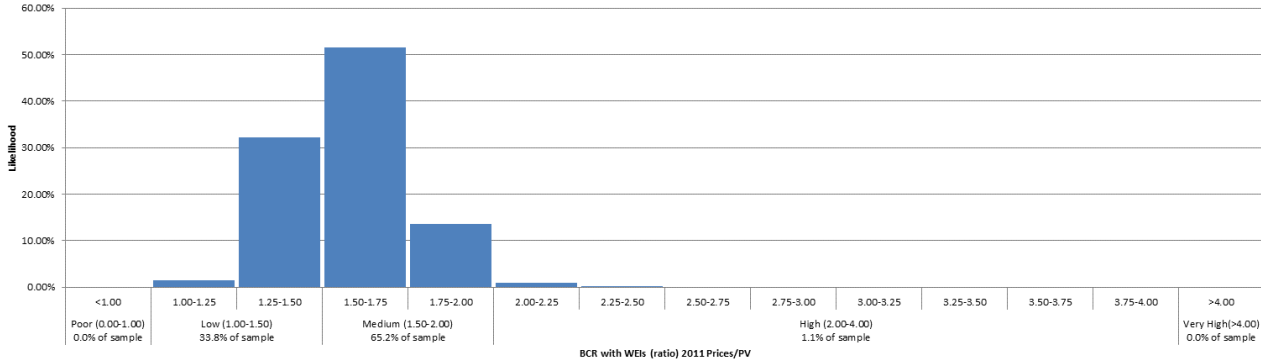
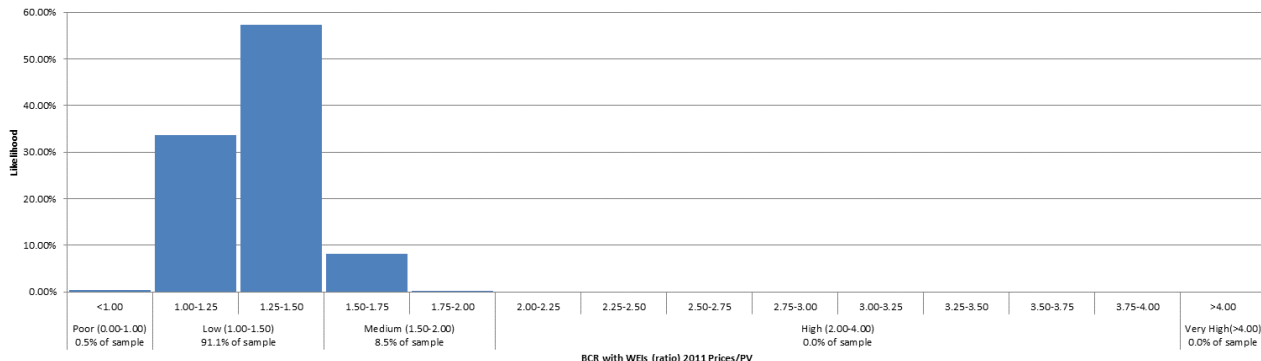


Figure 9: Risk analysis for 2027 demand cap for 'Incremental Case'



Values of time

1.40 The majority of benefits to transport users from HS2 are expressed in units of time which allows subsequent conversion to monetary values using appropriate values of time. The values of time applied in the appraisal are therefore a key driver of the outputs.

1.41 To reflect the importance of values of time, not just to the HS2 Economic Case but all transport appraisals, we commissioned a substantial piece of research aiming to gather primary survey evidence for people’s willingness to pay for travel time savings. This study aimed to reflect any recent changes in behaviour, particularly advances in mobile technology with the objective of this work being to provide values recommended for implementation in WebTAG. The research has been finalised and its findings can be found at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/470998/Understanding_and_Valuing_Impacts_of_Transport_Investment.pdf

1.42 The scale of the potential changes to the values instigated by this research means that before any changes are made to WebTAG and the 'Reference Case' of any appraisal a formal consultation process is required with WebTAG users and practitioners. Nevertheless, to reflect this new evidence tests have been conducted which attempt to assess the impact of the values recommended by the research on the HS2 Economic Case.

1.43 The table below summarises the values recommended as part of the research compared to the values of time that are currently given in WebTAG and used in the 'Reference Case'.

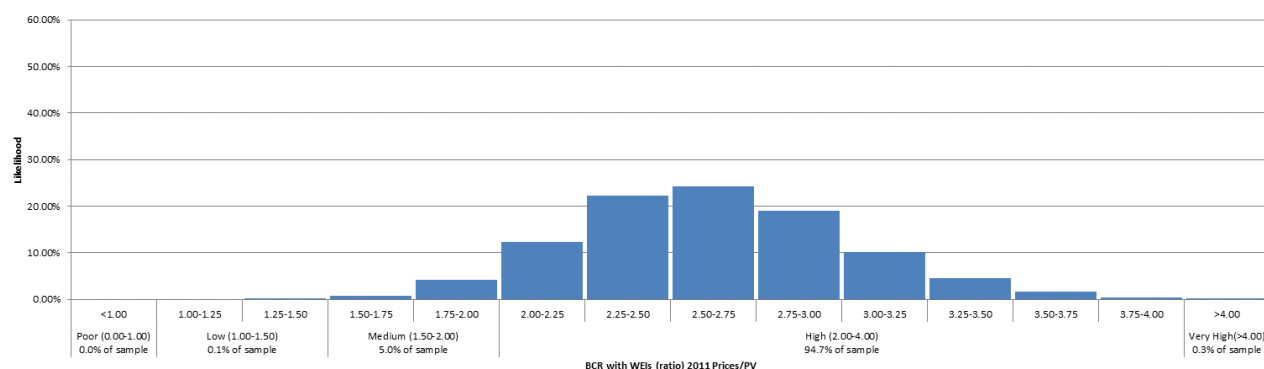
Figure 10: Values of time comparison

	Current Values		Recommended Values
Non-work travel			
Commuter	£6.81		£10.01
Other Non-work	£6.04		£4.57
Business travel			
		Distance band	
Car (driver / Passenger)	£27.06 / £20.52	0-50km	£10.08
		50-100km	£16.30
		100km +	£25.12
Rail Passenger	£31.96	0-50km	£10.08
		50-100km	£16.30
		100km+	£36.19
Bus Passenger	£16.63	0-50km	£10.08
		50-100km	£16.30
Other Public Transport Passenger	£26.28 (London Underground passenger)	0-50km	£10.08
		50-100km	£16.30

1.44 The study demonstrated that values of time vary considerably according to journey purpose with the time of business passengers valued highest. For business travellers it was also found that the length of trip was relevant with passengers travelling on longer trips typically having higher values of time than those travelling on shorter trips. This is logical, as those who are willing to make longer trips clearly value time at their destination highly, as otherwise they would not make the trip. They must therefore value time savings which increase the time available at their destination.

1.45 The benefits of HS2 arise both from long-distance travellers experiencing the journey time savings offered by HS2, but also from short-distance passengers benefiting from HS2 releasing capacity on the existing network. Applying the outputs of this study to the appraisal therefore has a marginal impact on the results with the full "Y" network 'Reference Case' BCR increasing to 2.6 from 2.5 while the stand-alone Phase 2a 'Reference Case' BCR remains constant at 1.6. The chart below shows the impact of these values of time on the BCR distribution for the "Y" network.

Figure 11: Risk analysis for recommended values (Figure 10) of time for the full "Y" network



Train service specification (TSS)

- 1.46 The 'Incremental Case' analysis of Phase 2a assumes an identical train service specification to that of Phase One of the scheme except that journey times are improved as a result of the extended high speed line to Crewe. This is a conservative assumption, particularly as if Phase Two of HS2 was not progressed – as assumed in the 'Incremental Case' – then alternative train service specifications would be optimised to provide higher levels of benefits.
- 1.47 The Phase One train service specification assumes that of the three services per hour each way between London and Manchester, two are routed via Crewe (but do not stop) and so in Phase 2a use the extended high speed line. One is routed via Stoke (again without stopping) and does not therefore utilise the faster journey speeds on offer with the extended high speed line in Phase 2a. The table below outlines the changes in benefits in the 'Incremental Case' that result if this service was re-routed via Crewe.

Figure 12: Change in benefits from re-routing HS2 service

£2011 Prices, PV	'Reference Case'	Manchester Re-route	Difference
Transport User Benefits	£1,978m	£2,123m	£145m
Other Benefits	£5m	£5m	£0m
Loss of Indirect Taxes	-£117m	-£125m	-£8m
Wider Economic Impacts	£366m	£377m	£11m
Net Transport Benefit	£2,227m	£2,375m	£148m
Revenues	£1,376m	£1,490m	£114m
Capital Costs	£2,677m	£2,824m	£147m
Benefit Cost Ratio	1.56	1.63	0.07

- 1.48 This analysis demonstrates that if an additional HS2 service was routed via Crewe then this would lead to an extra £148 million of benefits and £114 million of revenue gain. When the third service is re-routed via Crewe there is an increased chance of possible congestion on the line between Crewe and Manchester, and more detailed work is required to fully understand the impacts. On a conservative basis, we have therefore assumed:

- all three services to Manchester would have a journey time saving of 9 minutes (instead of 13)
- additional infrastructure costs of £200 million (£147m, Net Present Value) to facilitate this routing

1.49 If this was the case then altering the train service in this manner would have a positive value for money case increasing the 'Reference Case' incremental BCR of Phase 2a by almost 0.1. Further work needs to be done to confirm these cost estimates and train service assumptions. This work may conclude that the assumptions listed above are a conservative interpretation of the requirements for three high speed trains to be routed via Crewe.

1.50 As well as altering the route of the high speed trains another option may be to alter their stopping pattern to make services accessible to more people. For example, additional stops could be made at Crewe to exploit its strong rail connectivity with the surrounding area. Additional stops at Crewe have been modelled on two HS2 services, one which terminates at Manchester and another terminating at Glasgow. The table below presents the change in benefits resulting from this train service specification. It demonstrates that stopping two additional high speed trains at Crewe increases net transport benefits by £278 million and revenues by £251 million. A BCR for this train service specification cannot be calculated. This is because if further trains stopped at Crewe this may require additional investment in infrastructure, such as a new station or new platforms, and the scale of these costs have not yet been assessed.

Figure 13: Change in benefits from increasing stops at Crewe

£2011 Prices, PV	'Reference Case'	Crewe Additional Stops	Difference
Transport User Benefits	£1,978m	£2,280m	£302m
Other Benefits	£5m	£5m	£0m
Loss of Indirect Taxes	-£117m	-£141m	-£24m
Net Transport Benefit	£1,866m	£2,144m	£278m
Revenues	£1,376m	£1,627m	£251m

Reliability

- 1.51 It is expected that HS2 will result in an improvement in the reliability of rail services. However until the line is operational and therefore the full extent of the interactions between HS2 services and the existing rail network become known, the scale of reliability benefits is uncertain.
- 1.52 In recognition of this, HS2 Ltd have improved their methods for modelling the reliability benefits resulting from HS2. They have drawn on the latest available historic data on the performance of the existing network and updated their assumptions on the reliability of high speed train services. The assessment compares the reliability of comparable existing rail services to those services operating on the high speed network.
- 1.53 The methodological improvements have resulted in smaller reliability benefits over shorter distance trips but greater reliability benefits over longer distance trips than

previously estimated. The overall impact is to increase net transport benefits for the "Y" network by 3 per cent, and revenues by 4 per cent which leads to a 0.1 increase in the BCR.

1.54 Despite the improved modelling of reliability impacts the scale of the benefits from reliability improvements remains uncertain. This is particularly the case where HS2 interacts with the existing rail network. Removing the reliability benefits altogether (a very conservative assumption) would reduce the BCR for the 'Incremental Case' by 0.1 and the "Y" network by 0.2.

Fares

1.55 The relationship between rail fares and the Economic Case for HS2 is complex. It is relevant to note that the results presented here assume the same fares are charged across both the HS2 network and the existing rail network. The Economic Case for HS2 is not predicated on higher fares being charged for HS2 services.

1.56 The 'Reference Case', assumes that fares rise at a rate equivalent to growth in the Retail Price Index (RPI) until 2020 and thereafter fares are assumed to rise at RPI plus one per cent (an assumption commonly applied in the appraisal of rail schemes). If fares were assumed to be lower than this then demand for rail (and therefore HS2) would increase causing the level of demand at which we assume demand growth to stop to be reached sooner and therefore the demand cap to be applied earlier.

1.57 To test the sensitivity of the results to lower fare assumptions, it has been assumed that fares rise at a rate equivalent to RPI growth until the demand cap is reached. In this case the demand cap is reached in 2032, rather than 2037 in the 'Reference Case'. The charts below for the "Y" network and 'Incremental Case' demonstrate that this assumption depresses the BCR. While the quicker demand growth resulting from lower fares increases benefits, this is more than offset by the associated reduced revenues.

Figure 14: Risk analysis for alternative fare assumptions, "Y" network

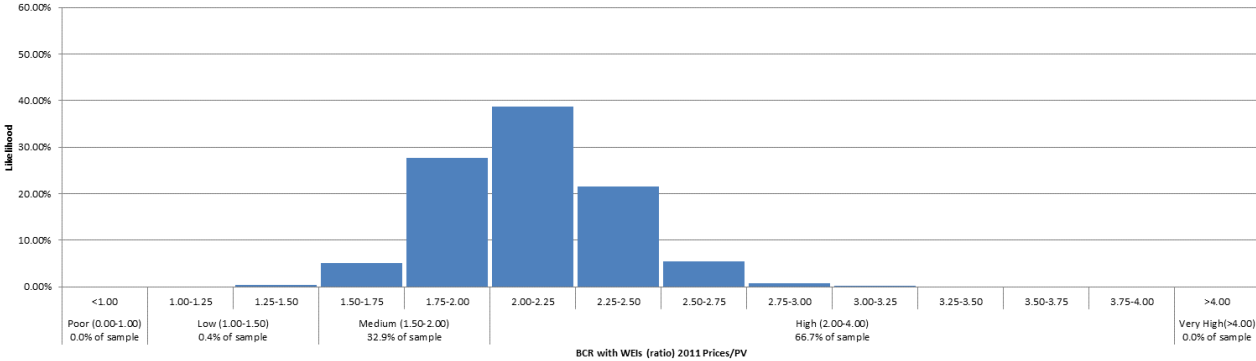
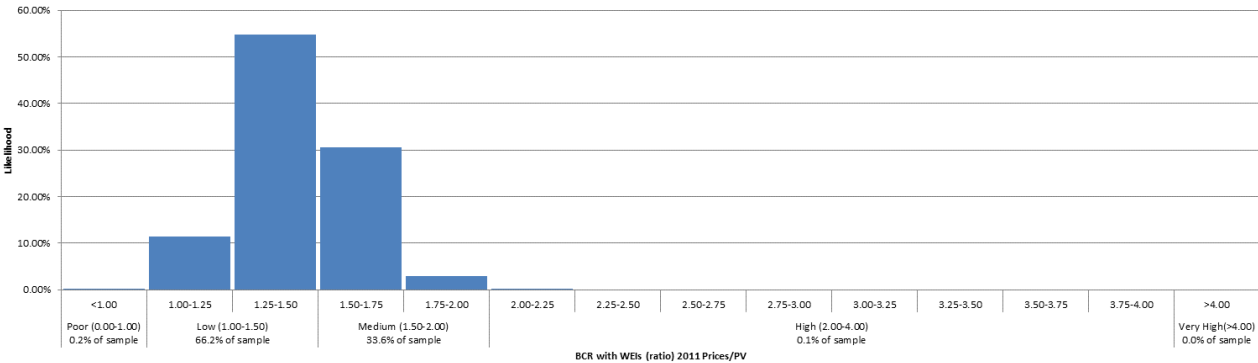


Figure 15: Risk analysis for alternative fare assumptions, 'Incremental Case'



1.58 These tests illustrate the interaction between the demand cap and the alternative fare assumptions. Lower fare assumptions result in a higher rate of demand growth, meaning the level of demand at which the demand cap is applied is reached sooner. They do not therefore imply an increase in absolute demand. If the level at which the demand cap applied was assumed to increase by 15 per cent as a result of the low fares (RPI+ zero per cent until the demand cap), then the demand cap year would move to 2037 (from 2032 as above) and the 'Reference Case' BCR for the "Y" network would increase from 2.5 to 2.8.

Cost sensitivities

1.59 The 'Reference Case' in the Economic Case assumes construction costs increase over time in line with general price inflation i.e. the GDP deflator. In recognition of the fact that infrastructure projects are subject to industry specific inflation factors, we have considered the impact of construction cost inflation which reflects more recent historic trends and applied this to the years up to 2020/21. This is the basis of the headline BCR results at paragraph 1.23 and below.

1.60 The following conclusions can be drawn:

- The full "Y" network continues to deliver high value for money when higher inflation is assumed. The central BCR reduces to 2.2, from 2.5 in the 'Reference Case'.
- The impact on Phase 2a as an increment is more marked and the value for money category shifts from medium to low. The central BCR reduces to 1.3, from 1.6 in the 'Reference Case'.
- The case for acceleration of Phase 2a continues to be financially positive (revenue and cost savings outweigh the incremental capital and operating costs) and benefits to users are brought forward.

1.61 The 'Reference Case' in the Economic Case assumes an optimism bias (OB) factor of 40 per cent added to Phase 2a (and other Phase 2) construction costs. The approach follows the Green Book Supplementary Guidance on OB and reflects a detailed, bottom-up attribution of different assets to different risk categories. DfT appraisal guidance (WebTAG) provides its own advice on OB for conventional rail schemes which require OB between 66 per cent and 40 per cent depending on the project stage⁵. The "greenfield" nature of a large share of HS2 Phase 2 construction

⁵ 66% is suggested at feasibility stage, 40% is suggested at option selection stage, lower rates are suggested for later stages.

makes it rather different from investments on the existing rail network. This, together with the fact that HS2 costs are estimated on a different basis from Network Rail projects, means that it is appropriate for HS2 to follow the Green Book Supplementary guidance. Nevertheless a sensitivity to a higher, 50 per cent OB assumption has also been considered. This found that the full “Y” 'Reference Case' BCR would be 2.4 and the Phase 2a incremental 'Reference Case' BCR would be 1.4, compared to the 'Reference Case' BCRs of 2.5 and 1.6 respectively.

2. Alternatives to HS2

Introduction

- 2.1 The DfT and HS2 Ltd have previously considered a number of alternatives to a high speed network. This work showed that a dedicated high speed "Y" network is the best way to meet the HS2 programme objectives. For example, the 2013 Strategic Case for HS2 considered a number of alternatives to the "Y" network. These were assessed for how well they would deliver the benefits of improved capacity, connectivity and economic growth provided by HS2.
- 2.2 Domestic aviation was ruled out, as it is most economically viable for journeys over 400 miles, which is about the distance from London to Glasgow or Edinburgh. Check – in times mean that for many shorter intercity journeys, road or rail will almost always be a better option than domestic aviation.
- 2.3 We have also looked at whether significantly increasing road capacity would meet the objectives of HS2. The Government is already carrying out the biggest ever upgrade of our strategic road network, and by 2021, spending on road enhancements will have tripled. This will counter the effects of past under-investment, maintain the network and add some extra capacity where it is needed to ease congestion on existing motorways. However, our work found that these enhancements do not provide the additional capacity needed to allow roads alone to cater for the predicted increase in passenger demand. Roads are also not well suited to improving connectivity between city centres, because traffic speeds are limited, or for providing additional commuter capacity into major cities, because of the traffic constraints that exist there.
- 2.4 Utilising rail fares to address capacity problems was ruled out, as in order to be effective, the approach would need to involve very significant and highly undesirable price rises. It would also not meet the objective of improving connectivity between cities, and would also have serious consequences for economic productivity and growth. The report concluded that a new rail line would be the best way to meet the strategic objectives of the scheme.
- 2.5 In line with HMT's 'Managing Public Money' and the 'Green Book', the Government's decision on the HS2 route between the West Midlands and Crewe necessitates further consideration of the alternatives to this particular scheme. A detailed examination of alternative rail options to investment in high speed rail between the West Midlands and Crewe has therefore been undertaken. This assessment has included consideration of the value for money and strategic fit of three alternative options.

Scope of work and approach

2.6 The latest set of alternatives work looks specifically at alternative options to deliver greater capacity and connectivity between the West Midlands and Crewe. This chapter briefly describes the alternative options, the extent to which they have the potential to improve capacity and journey times, as well as outlining the costs and benefits of each. It should be read in conjunction with Chapter 6 of the Strategic Case which assesses in more detail how well the alternatives meet the objectives of HS2, which are:

- to provide sufficient capacity to meet long term demand and to improve resilience and reliability across the network
- to improve connectivity by delivering better journey times and making travel easier

It is required that any solution should:

- minimise disruption to the existing network
- use proven technology that we know can deliver the required results
- be affordable and represent good value to the taxpayer
- minimise impacts on local communities and the environment

Whichever option is chosen also needs to support the delivery of the rest of Phase Two. As a result, the preferred option will also need to meet the following specific objectives of:

- improving connectivity and journey times for cities north of Birmingham
- delivering benefits to northern cities sooner than previously envisaged for Phase Two
- enabling the efficient delivery of the rest of Phase Two

2.7 Further technical detail on the packages and their assessment can be found in a report published by the Department's technical advisors, Atkins⁶. Despite the alternatives being at an earlier stage of development than HS2 they have been assessed using consistent methods and assumptions wherever appropriate.

Shortlisted alternatives

2.8 The Department's technical advisors initially developed nine options, which were sifted down to three options for detailed consideration on the basis that the infrastructure must be capable of:

- enabling the delivery of the Phase 2a train service specification
- delivering a similar level of capacity to Phase 2a
- delivering an environmental impact that is no worse than Phase 2a

⁶ <https://www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester>

2.9 On this basis of the above criteria, three options were shortlisted. These are categorised as low, medium and high depending on the level of ambition each of them involve. The three options which were considered in detail are as follows:

- **Low:** this option is known as the Colwich cut-off and Stafford bypass, which was previously examined by the Department as part of the West Coast Route Modernisation programme which concluded in 2009. This involves a new 140mph (225kph) capable train line for 4.2 miles (6.8km) which joins onto the existing line at Stone via a grade separated junction. This section of the Stone line would be upgraded to allow trains to operate at 140mph (225kph). This would subsequently connect onto 6.7 miles (10.8km) of new 140mph (225kph) alignment which would finally connect into the WCML north of Norton Bridge. This option requires three flat junctions and one grade separated junction with the WCML
- **Medium:** this involves around one-third (9.2 miles or 15.2km) of the Phase 2a alignment from Streethay Junction to Great Haywood. This would then connect to a 3 miles (4.8km) high speed spur to the Stone line. The Stone line would be upgraded to 140mph (225kph) for 4 miles (6.5km) with a new 6.7 miles (10.8km) long 140mph (225kph) alignment to the WCML near Norton Bridge. This option requires construction of three flat junctions
- **High:** this involves around two-thirds (26.4 miles or 42.5km) of the Phase 2a alignment from Streethay Junction joining the West Coast Mainline 11.4 miles (18.3km) south of Crewe at a junction onto the West Coast Mainline. At this point, HS2 trains which are capable of operating on the existing network would then run along the West Coast Mainline (WCML) for 11.4 miles (18.3km) to Crewe.

2.10 The table below summarises the journey time benefits of these options when compared with Phase One of HS2. These journey time savings are all lower than the 13 minutes expected from the HS2 Phase 2a proposal.

Figure 16: Journey time savings from Strategic Alternatives relative to HS2 Phase 2a

Option	Journey Time Improvement
HS2 Phase 2a	13 minutes
High	10.5 minutes
Medium	7.5 minutes
Low	5 minutes

The assessment framework

2.11 Each alternative option has been assessed against two network scenarios that are exactly analogous to how Phase 2a has been assessed (all consistent with the 2a 'Reference Case'):

- The full "Y" network incorporating the alternative option. In this scenario, the alternative option opens in 2027 between then end of Phase One and Crewe, with the rest of the "Y" network north of Crewe then opening in 2033. Under this scenario the alternative option forms part of the long term "Y" network

- The alternative option as an increment to Phase One. Under this scenario the alternative option is examined as an increment to Phase One but not part of the full "Y" network. For appraisal purposes this assumes that the alternative option opens in 2027

2.12 The analytical approach, assumptions and methodology for assessing the alternative options has been kept as consistent as possible with that adopted by HS2 Ltd for the assessment of Phase 2a

Results

Benefits

- 2.13 Forecast benefits are a function of the connectivity improvements. As the alternative options all deliver lower connectivity improvements than Phase 2a this means that the magnitude of benefits for each option is also lower.
- 2.14 The table below sets out the benefits of the full "Y" network with the alternatives between Birmingham and Crewe, assuming that the alternatives become part of the long term "Y" network and the remainder of Phase Two is delivered by 2033. Net transport benefits for the full "Y" including the alternative options are lower than under Phase 2a - by £1.5 billion for the high cost option, £2.3 billion for the medium cost option and £3.3 billion for the low cost option (all including WEIs).

Figure 17: Benefits of the full "Y" network with the rail alternatives between Birmingham and Crewe

£2011, 2011 PV	Full "Y" Incorporating Phase 2a	Full "Y" Incorporating the High Cost Option	Full "Y" Incorporating the Medium Cost Option	Full "Y" Incorporating the Low Cost Option
Transport User Benefits (Business)	£43.2bn	£42.3bn	£41.7bn	£41.0bn
Transport User Benefits (Other)	£18.2bn	£17.9bn	£17.8bn	£17.6bn
Other Quantifiable Benefits	£0.2bn	£0.2bn	£0.2bn	£0.2bn
Loss to Government of Indirect Taxes	-£3.0bn	-£3.0bn	-£2.9bn	-£2.9bn
Net Transport Benefits (PVB)	£58.6bn	£57.3bn	£56.7bn	£55.9bn
Wider Economic Impacts	£14.2bn	£14.0bn	£13.8bn	£13.7bn
Net Benefits Including WEIs	£72.8bn	£71.3bn	£70.5bn	£69.5bn

- 2.15 The table below sets out the incremental benefits of each of the alternative options relative to a baseline where Phase One is built and in the hypothetical scenario that the remainder of Phase Two is not built. The high cost option has £0.5 billion less benefits than Phase 2a, the medium cost option has £0.9 billion less and the low cost option has £1.3 billion less (all including WEIs).

Figure 18: Benefits of rail alternative options

£2011, 2011 PV	Incremental Phase 2A	Incremental High Cost Option	Incremental Medium Cost Option	Incremental Low Cost Option
Transport User Benefits (Business)	£1.5bn	£1.2bn	£0.9bn	£0.6bn
Transport User Benefits (Other)	£0.4bn	£0.3bn	£0.3bn	£0.2bn
Other Quantifiable Benefits	£0.0bn	£0.0bn	£0.0bn	£0.0bn
Loss to Government of Indirect Taxes	-£0.1bn	-£0.1bn	-£0.1bn	£0.0bn
Net Transport Benefits (PVB)	£1.9bn	£1.5bn	£1.1bn	£0.7bn
Wider Economic Impacts (WEIs)	£0.4bn	£0.3bn	£0.2bn	£0.1bn
Net Benefits Including WEIs	£2.2bn	£1.7bn	£1.3bn	£0.9bn

2.16 The decrease in benefits as we move from Phase 2a to the alternative options is proportionately lower under the incremental appraisal than when assessed as part of the full "Y" network for the following reasons:

- in the assumed 'Reference Case' train service specification, five high speed trains per hour use Phase 2a when it opens while ten operate under the full "Y" network. The number of services thus impacted by longer journey times in the alternative scenarios is much less under the incremental assessment than under the full "Y" assessment
- the number of passengers travelling on Phase 2a is much lower than when the full "Y" network opens. This is a result of the lower service level and longer journey times to destinations such as Manchester and Scotland in the standalone scenario. The impact of having longer journey times on these alternatives therefore affects fewer people in the incremental scenario

Cost to government

2.17 As with Phase 2a, each of the alternatives will generate both capital costs and costs from operating and managing the new railway.

2.18 Capital costs are calculated using a consistent methodology to Phase 2a, as far as possible, using 'Reference Case' assumptions (not including higher inflation assumptions mentioned in paragraph 1.22). The construction costs of the alternative options were calculated on a unit rate basis, with the unit rates determined in reference to the costs of HS2 Phase 2a. Further explanation for the capital costs are set out by Atkins in their report⁷.

2.19 Operating costs are calculated using a consistent methodology to Phase 2a and are offset against savings from running a reconfigured train service on the conventional network.

2.20 In estimating the net cost to government of a transport scheme, the capital and operating costs set out above need to be offset by the additional revenues generated by the scheme. Revenues for each of the alternative options have been calculated

⁷ <https://www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester>

using a consistent methodology to HS2. The tables below summarise the capital and operating costs, revenues generated and subsequently the net cost to government.

Figure 19: Costs of rail alternative options, full "Y" network

£2011, 2011 PV	Full "Y" Incorporating Phase 2a	Full "Y" Incorporating the High Cost Option	Full "Y" Incorporating the Medium Cost Option	Full "Y" Incorporating the Low Cost Option
Capital Costs	£39.0bn	£38.1bn	£37.8bn	£37.5bn
Operating Costs	£22.9bn	£22.8bn	£22.8bn	£22.8bn
Total Costs	£61.9bn	£60.9bn	£60.6bn	£60.2bn
Revenues	£33.1bn	£32.3bn	£31.8bn	£31.3bn
Net Costs to Government (PVC)	£28.8bn	£28.6bn	£28.8bn	£28.9bn

Figure 20: Costs of rail alternative options, 'Incremental Case'

£2011, 2011 PV	Incremental Phase 2a	Incremental High Cost Option	Incremental Medium Cost Option	Incremental Low Cost Option
Capital Costs	£2.7bn	£1.7bn	£1.4bn	£1.1bn
Operating Costs	£0.1bn	£0.1bn	£0.0bn	£0.0bn
Total Costs	£2.8bn	£1.8bn	£1.5bn	£1.1bn
Revenues	£1.4bn	£1.1bn	£0.9bn	£0.6bn
Net Costs to Government (PVC)	£1.4bn	£0.7bn	£0.6bn	£0.5bn

Benefit Cost Ratios

2.21 When assessed as part of the full "Y" network, all of the alternative options deliver very similar BCRs to Phase 2a. On an 'incremental' basis, all three alternative options deliver higher BCRs than Phase 2a.

Figure 21: 'Reference Case' BCRs for rail alternative options, full "Y" network

	Full "Y" Incorporating Phase 2a	Full "Y" Incorporating the High Cost Option	Full "Y" Incorporating the Medium Cost Option	Full "Y" Incorporating the Low Cost Option
BCR without Wider Economic Impacts	2.0	2.0	2.0	1.9
BCR with Wider Economic Impacts	2.5	2.5	2.4	2.4

Figure 22: 'Reference Case' BCRs for rail alternative options, 'Incremental Case'

	Incremental Phase 2a	Incremental High Cost Option	Incremental Medium Cost Option	Incremental Low Cost Option
BCR without Wider Economic Impacts	1.3	2.2	1.8	1.5
BCR with Wider Economic Impacts	1.6	2.6	2.2	1.8

2.22 There are two important caveats in the above analysis:

- Atkins have assumed in their options that classic compatible trains travel at the existing line speed for non-tilt rolling stock on the WCML. If allowed to use the higher “tilt speed” on straighter sections of track (which HS2 Limited believe should be possible), the journey times for the alternative options would reduce by between 45 seconds and 1 minute, and benefits would increase accordingly.
- the analysis of costs has been undertaken using standard (GDP deflator) assumptions of inflation. It has not been reworked on the basis of higher project-specific inflation, which would increase the costs of all the options considered (lowering the BCRs).

We do not believe that either of these factors would change the overall conclusion that the alternative options have broadly similar BCRs to Phase 2a as part of the full “Y” network and offer higher BCRs than Phase 2a when considered as a standalone investment.

Conclusions

2.23 The Government has considered strategic alternatives to Phase One, Two and the full "Y" network. We have previously considered that only a dedicated high speed network could deliver a step change in capacity and connectivity that the UK needs. The strategic alternatives also failed to offer a robust solution to the unacceptable levels of poor performance on the WCML and resulted in too much disruption to passengers.

- 2.24 There are no strategic alternatives to Phase 2a because it is an integrated element of a fully high speed network, to which the Government is committed. To ensure we get best value for money for the taxpayer, we have looked at alternative rail investments which could relieve the capacity bottlenecks between West Midlands and Crewe. If we were not building the full "Y" HS2 network, these options could provide a medium to high value-for-money way to alleviate existing capacity bottlenecks on the WCML.
- 2.25 However, Phase 2a is an accelerated part of Phase Two, which Government is committed to, so each alternative should be considered in the context of the full "Y" network. When assessed as part of the full "Y" network (assumed completed in 2033), the alternatives deliver broadly similar BCR to Phase 2a (see table 13).
- 2.26 The Government believes that Phase 2a offers the right solution as none of the alternative options are consistent with our vision for a dedicated high speed network from London to Birmingham, Manchester, Leeds and beyond.
- 2.27 The alternative options also do not meet the Department's objectives in the same way as Phase 2a, namely that they:
- do not provide the same level of connectivity benefits for the major cities of the Midlands and the North due to lower journey time improvements
 - do not provide as much additional or released capacity to meet the long term needs for the north-south railway as Phase 2a
 - offer a less robust solution to the problem of resilience and performance, particularly on the WCML which experiences relatively high levels of unreliability
 - could have a greater impact on services on existing lines as construction work is carried out (medium and low cost options only)

Robustness of results/key issues

- 2.28 As set out above, our technical advisors have examined the impact of each option using a consistent methodology to that used for Phase 2a. This means that the results are estimated with a similar level of robustness and subject to the same risks and limitations as the 'Reference Case' results for Phase 2a (see Chapter 3). While we have thoroughly examined the costs and benefits of alternative ways of meeting our strategic objectives, this analysis has not been tested to the same level of detail as the 2a option.

3. Value for money assessment

Introduction

- 3.1 The Economic Case needs to reach a conclusion on whether the scheme represents value for taxpayers' money. The analysis in Section 1 quantified the economic impacts of Phase 2a against a "without scheme", in order to assess the economic, social, environmental and public account of the transport intervention. This quantified analysis of the impacts forms the basis of any value for money assessment of the scheme proposed.
- 3.2 There are limits to the ability of a single BCR to generate informative conclusions on value for money. To reflect the long-term forecasting horizon required when considering such a project combined with its inherent scale and complexity, it is appropriate therefore, to consider how robust the value for money of Phase 2a remains across a range of possible future scenarios. This analysis was also outlined in Section 1.
- 3.3 In order to allow comparison across schemes, WebTAG specifies value for money categories within which schemes can be placed, and the table below describes these categories. When categorising a scheme it is relevant to not only take account of the BCR but also the associated risks and uncertainty:

Figure 23: Value for Money Categories

Value for Money Category	BCR
Poor	Less than 1.0
Low	Between 1.0 and 1.5
Medium	Between 1.5 and 2.0
High	Between 2.0 and 4.0
Very High	Greater than 4.0

- 3.4 Not all potential scheme impacts can be assessed in monetary terms and of those that can we have more robust evidence for the monetisation of some impacts than others. In assessing value for money, WebTAG recommends using a three stage approach:
 - we start with those impacts where the evidence for the monetisation is robust. We call the resulting BCR the "initial" BCR

- we then add those impacts where monetisation is possible, but where the evidence for doing so may not be as robust. The resulting BCR is called the 'adjusted BCR'
- finally those impacts for which it is not possible to provide monetary values are accounted for in a qualitative manner, and the potential ability for these impacts to shift the value for money category is assessed

3.5 The table below presents the categories within which the assessment of differing impacts are ordinarily placed. Even within these categories the robustness of the analysis can vary, for example the quantification of reliability impacts is considered less robust in this assessment than travel time savings.

Figure 24: Three Stage Approach to Monetisation of Impacts

Initial BCR: robust, monetisable impacts	Adjusted BCR: less robust, but monetisable impacts	Judgement whether non-monetised impacts could shift value for money assessment
Travel Time Savings	Wider Economic Impacts	Townscape
Crowding Benefits		Heritage
Noise		Biodiversity
Air Quality		Water environment
Greenhouse Gases		Security
Physical Activity		Accessibility
Accidents		Personal Affordability
Indirect Tax Revenue		Severance
Reliability		Option Values
		Landscape
		Journey Quality

Notes: In the Economic Case for HS2 the reliability benefits have been recorded in the initial BCR to ensure consistency with previous versions of the economic case. Similarly, landscape impacts have been monetised, however the assessment is considered insufficiently robust to be included in the 'adjusted BCR'.

3.6 Section 1 demonstrated that for the key policy proposal to accelerate the delivery of the HS2 route from the West Midlands to Crewe, the revenue gain and cost savings which result outweigh both the capital and operating costs of accelerating construction. This proposal is expected to be financially positive. When assessed on a standalone basis, assuming that Phase One of HS2 is already delivered in 2026, the benefits of Phase 2a in this 'Incremental Case' outweigh the costs by a factor of 1.6 to 1 (including WEI) and 1.3 to 1 without WEI⁸. Finally for the full "Y" network the BCR is 2.0 excluding WEI and 2.5 including WEI. These BCRs all refer to the 'Reference Case'. However, as discussed in section 1, construction inflation (and growth in other project-specific costs) since 2011 have been higher than background inflation and this may continue over the next 5 years. This was recognised in the

⁸ Wider Economic Impacts have been quantified using the methodology outlined in WebTAG unit A2-1. They encompass benefits from: agglomeration, imperfect competition and labour supply impacts. Benefits arising from movements to more productive jobs may exist but have not been quantified.

Spending Review and slightly reduces the BCR to 1.3 from 1.6 (for the 'Incremental Case') and to 2.2 from 2.5 (for the full "Y").

Non-monetised impacts

3.7 The impacts that cannot be robustly translated into monetary values undergo a qualitative assessment based on the inputs of experts of the relevant fields. The results of this assessment for the route between West Midlands and Crewe are summarised in the table below. This assessment concerns two types of impacts:

- permanent impacts – impacts on townscape and landscape, heritage, biodiversity, water environment, security, accessibility, personal affordability, severance, option values, physical activity and journey quality, for which no sufficiently robust evidence or methodology for monetisation exists
- transient construction impacts – impacts on noise, greenhouse gases and air quality that arise only during construction

Figure 25: Non-monetised Impacts

	Impact	Assessment	Comment
Permanent Impacts	Townscape & Landscape	Moderate adverse	Loss of undeveloped land. Land- and townscape character moderately affected (see sec. 3.8).
	Heritage	Slight adverse	Minor effects on 4 listed buildings, Trent and Mersey Canal affected.
	Biodiversity	Slight adverse	Some loss of ancient woodland, and designated habitats.
	Water Environment	Slight adverse	Minor waterways diverted, minor flood risk, minor potential groundwater impacts.
	Security	Not assessed	No stations or other sensitive environments affected.
	Accessibility	Slight beneficial	Small journey time and quality benefits.
	Personal Affordability	Not assessed	Fares not assumed to change.
	Severance	Slight adverse	15 dwellings isolated. Potential effect on less than 5 public rights of way.
	Option Values	Slight beneficial	Improves HS2 journey option by quickening journeys.
	Physical Activity	Not assessed	Unlikely to be significant.
	Journey Quality	Slight beneficial	More journeys undertaken on new HS2 trains.
Transient Construction Impacts	Noise	Slight adverse	High-level assessment
	Air Quality	Slight adverse	High-level assessment
	Greenhouse Gases	Slight adverse	High-level assessment

- 3.8 The assessment of townscape and landscape impacts is informed by two complementary approaches to appraisal:
- quantitative appraisal of the landscape impacts based on the value to society of the different types of undeveloped land traversed by the line and the current scope of mitigations⁹. This appraisal applies the guidance outlined in the Department's Value for Money Assessment Guidance¹⁰
 - qualitative appraisal based on an understanding of the naturalistic and cultural features, the character of the specific areas and the impact that the line and the current scope of mitigations will have on them. This results in a qualitative assessment of the impacts consistent with the approach outlined in WebTAG.
- 3.9 The first approach has the benefit of providing a monetary assessment. However it is based on very high-level data and limited categorisations of landscape and does not consider townscape. The second approach is based on more detailed and comprehensive information on both townscape and landscape, but cannot result in a monetary assessment. We expect the approaches to overlap in part so the resulting assessment is based on a balanced judgment of both appraisals.
- 3.10 The results of the quantitative landscape assessment are summarised below. This analysis is based on data on the type of landscape either side of HS2's line of route from the West Midlands to Crewe and the potential mitigations of the line's impact on the landscape which reduce the monetary valuation. These mitigations consist of two types, the first being existing infrastructure such as roads and rail and the second being mitigations applied to the HS2 line itself such as tunnels and cuttings.
- 3.11 The two values presented below are the result of different approaches to considering the period over which this impact is subject to appraisal. The methodology to assess the value of undeveloped land has recommended valuing landscape impacts in perpetuity¹¹. However, typically the appraisal period for a transport project is sixty years, beyond which uncertainty around future conditions prevents us from forecasting benefits and costs.

Figure 26: Quantified Assessment of Landscape Impacts

Appraisal Period	Value (2011 prices, PV)
Landscape impact into perpetuity	£408m
Landscape impact over 60-year appraisal period	£213m

3.12 Any valuation of something which is intangible such as landscape is challenging, and while the Department has used the methods outlined in its guidance to quantify landscape impacts there remains inherent uncertainty and subjectivity applied in the assessment. This is why our consideration of landscape impacts relies both on the quantified and non-quantified assessment.

⁹ There are two types of mitigation: the first is designing the route to reduce impacts, for example by following existing transport corridors with the second being to apply mitigations to the railway itself such as tunnels and embankments. It is noted that as the scheme develops the mitigations applied are likely to increase, particularly the second category.

¹⁰ DfT 2013, Value for money assessment: advice note for local transport decision makers, <https://www.gov.uk/government/publications/value-for-money-advice-for-local-transport-decision-makers>

¹¹ ODPM, 2001: "Valuing the external benefits of undeveloped land" Annex 3

3.13 Consideration of these additional environmental and socio-economic impacts is not believed to conclusively alter the case for the proposal. In the case of those impacts which are assessed exclusively in a qualitative manner there both adverse and beneficial impacts. We have attempted to monetise landscape impacts and while they are expected to be negative the extent to which we can incorporate these accurately into our value for money assessment is restricted by the inherent limitations of the methodology applied.

Value for money conclusions

3.14 The available evidence suggests that the value for money of the 'Acceleration Case' is very high given that the proposal results in negative net costs to Government which is also combined with positive benefits, thus a BCR cannot be calculated.

3.15 Taking the adjusted BCR (which includes wider economic impacts) the "Y" network represents high value for money with a BCR of 2.2. This includes the fact that construction inflation (and growth in other project-specific costs) since 2011 have been higher than background inflation and this may continue over the next 5 years, as recognised in the Spending Review. This suggests the full "Y" network represents high value for money and it is unlikely that non-monetised impacts will alter this conclusion.

3.16 This analysis has been subject to an assessment of the risks and uncertainties which could influence the value for money category. Risk analysis has been conducted (around the 'Reference Case') which assesses the resilience of the BCR to a variety of factors based on analysis of the probability of different events occurring. For the factors considered there is a 95 per cent chance of the "Y" network 'reference case' representing high value for money (based on the monetised impacts).

3.17 We have also considered specific risks to the value for money such as its sensitivity to our most recent work on values of time and the fare assumptions adopted. Despite uncertainty in some of these factors potentially worsening value for money, there are also reasons to believe that our assessment is conservative. For example, we apply demand growth forecasts which are lower than recent trends and we cap demand in 2037, only four years after the "Y" network opens. Our overall analysis of uncertainty therefore does not alter the conclusion that the "Y" network is likely to represent high value for money.

3.18 For the 'Incremental Case', the BCR including WEI is assessed at 1.3. This includes the risk of higher project-specific cost inflation as recently recognised in the Spending Review.

3.19 However, as with the "Y" network there are reasons to believe that our assessment is conservative. We apply the same cautious demand forecasts as with the "Y" network. We do not assume any land use change resulting from the improvements in connectivity of Phase 2a (or indeed from the full "Y" network) which may make businesses alter their location decisions, which could lead to further benefits from regeneration and people moving to more productive jobs. Potential opportunities exist to improve the train service specification operating on the HS2 route to Crewe by either re-routing HS2 trains so more take advantage of the extended high speed route or changing the stopping pattern, allowing more people to benefit from HS2. These potential opportunities could improve the BCR for the incremental Phase 2a case.

3.20 The economic analysis described in this document will be updated again in future and we will continue to keep the treatment of project-specific inflation and other changes to the BCR methodology under review. In particular the Phase 2b Strategic Outline Business Case is expected in 2016 and the Outline Business Case for Phase 2a is expected in 2017.

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