A428 Black Cat to Caxton Gibbet improvements

TR010044

Volume 9

9.7 Economic Sensitivity Test Technical Note

Planning Act 2008

Rule 8(1)(k)

Infrastructure Planning (Examination Procedure) Rules 2010

August 2021

Deadline 1

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A428 Black Cat to Caxton Gibbet improvements

Development Consent Order 202[ ]

9.7 Economic Sensitivity Test Technical Note

Regulation Reference:	Rule 8(1)(k)
Planning Inspectorate Scheme Reference	TR010044
Application Document Reference	TR010044/EXAM/9.7
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Version	Date	Status of Version
Rev 1	31 August 2021	Final for Deadline 1

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1 Introduction

1.1.1 In the document Strategy for Dealing with Uncertain Outcomes Arising from COVID-19 (APP-257), Highways England (HE) set out their approach to addressing the uncertainty arising from the COVID-19 pandemic with respect to the A428 Black Cat to Caxton Gibbet improvements (the Scheme).

1.1.2 The approach adopted by HE follows the guidance in the document prepared by the Department for Transport (DfT) 'A route map for updating Transport Analysis Guidance (TAG) during uncertain times' issued in July 2020. (Referred to for simplicity as the DfT route map). This sets out how the appraisal framework should adapt and take account of these future trends in relation to the evidence base or methods used within TAG.

1.1.3 The route map identified two changes introduced by the DfT in July 2020, these were:

a. Interim carbon values advice provided by the Department for Business, Energy and Industrial Strategy (BEIS).

b. The latest Office for Budget Responsibility (OBR) long-term economic growth forecasts.

1.1.4 The forecasts and economic appraisal for the Scheme, reported in the Combined Modelling and Appraisal Report[1] **[APP-250]**, were completed in mid-2020 prior to publication of the DfT route map. These forecasts therefore predate the revised economic growth projections. However, a sensitivity test using the interim carbon values, as recommended in the DfT route map, was subsequently undertaken. This resulted in a reduction of the adjusted Benefit to Cost Ratio from 1.9 to 1.8 and is reported in Table 5-21 of the Combined Modelling and Appraisal Report.

1.1.5 However, given the timing of the release of the OBR projections, it was not possible to complete a sensitivity test to assess the impact of the projections of economic growth issued with the DfT route map in July 2020, in advance of the submission of the DCO application.

1.2 Purpose of Document

1.2.1 The purpose of this document is to describe and present the results of a sensitivity test adopting the July 2020 Transport Analysis Guidance (TAG) Sensitivity Test Data Book (v1.14) economic parameters.

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010044/TR010044-000418-TR010044_A428_Black_Cat_to_Caxton_Gibbet_Improvements_7-10_Combined_Modelling_and_Appraisal_Report_Appendix_D.pdf

1.2.2 The assessment has been undertaken using the A428 strategic traffic model, upon which the traffic forecasts and economic appraisal for Development Consent Order (DCO) submission were based. This traffic model was based upon the 2018 Uncertainty Log and the May 2019 version of the TAG Data Book, which was current at the time of the completion of the forecasts in late 2019.

1.2.3 For the DCO submission, the Scheme traffic forecasts were produced for a 2025 opening year, 2040 design year and 2051 horizon year. These three modelled years were used for the economic assessment that is detailed in the Economic Assessment Report (EAR), which forms Appendix D of the Combined Modelling and Appraisal Report **[APP-250]**.

1.2.4 **Table 1-1** summarises the Scheme benefits as presented in Table ES-1 of the EAR Executive Summary. Over 90% of the Scheme benefits are attributable to just two elements: the **transport economic efficiency** (TEE) benefits that include time savings account for over 60% of total Scheme benefits and **wider economic impacts** which account for another 30% of overall benefits. This note reviews the impact on just these two elements when applying the July 2020 Sensitivity Test parameters.

1.2.5 The TEE benefit total also accounts for £35M of dis-benefits incurred during construction of the Scheme due to extended journey times. As this forms a relatively small proportion of the TEE total, the construction delay dis-benefits have not been re-calculated using the July 2020 Sensitivity Test parameters. The impact of the Sensitivity Test changes compared to the May 2019 Data Book would also be relatively limited as construction delays are based on the 2025 models and the changes in this year are relatively small with dis-benefits expected to reduce by around 4%.

1.2.6 The Scheme costs reported in this technical note are the same as those presented in the EAR.

Table 1-1: Transport related benefits summary (£M)*

Benefit Component	Amount £M
TEE Benefits (including construction)	**554**
Indirect Tax Revenue	84
Accident Benefits	30
Carbon Benefits (Greenhouse Gas)	-127
Monetised Noise Benefits	2
Monetised Air Quality Benefits	-1
Initial Present Value of Benefits (PVB)	**541**

Benefit Component	Amount £M
Wider Economic Impacts	259
Journey Time Reliability Benefits	83
Adjusted PVB	**883**
Present Value of Costs (PVC)	**463**
Adjusted Benefit to Cost Ratio (BCR)	**1.9**

1. *2010 prices and values discounted to 2010, rounded to nearest million.

2 DfT Route Map

2.1.1 In July 2020 the DfT released two TAG Data Books, the first (version 1.13) being a correction to the 'standard' Data Book originally released in May 2020. The second (version 1.14) being a 'sensitivity testing' Data Book. This was released to coincide with publication of the DfT route map.

2.1.2 The differences in the updated May 2020 Data Book (referred to as the July 2020 'standard' Data Book) compared to the May 2019 Data Book were relatively minor and therefore the differences in the outcomes between these two sets of data would also be expected to be relatively minor. The model and economic assessment was therefore updated to version 1.14.

2.1.3 The 'sensitivity testing' Data Book was produced in response to a downgrade of the forecast long term growth of the UK economy, following projections released by the OBR in March 2020. This was followed in July 2020 by the release of the OBR Fiscal Sustainability Report, which was produced after the outbreak of COVID-19 and the subsequent impacts on expected growth. The result was that growth projections were further downgraded, and the overall changes were of a magnitude significantly greater than previous changes to economic forecasts.

2.1.4 The DfT route map recommends that sensitivity tests should be carried out adopting the Sensitivity Test Data Book values, together with a test on the high carbon values, in order to determine the impact on the economic appraisal.

2.1.5 For the purposes of this assessment only the core growth scenario of the traffic forecasts has been reviewed, as the impacts on the low and high growth scenarios would be expected to be proportionally similar, given only economic inputs are being changed.

3 TAG Data Book Comparisons

3.1.1 The differences between the May 2019 (adopted for the forecasts and economic appraisal described in the Combined Modelling and Appraisal Report **[APP-250]**) and July 2020 Sensitivity Test Data Books were significant. In terms of impacts on Scheme economics, the most significant was the reduction in forecast Gross Domestic Product (GDP) growth, which directly affects traveller's value of time. Another significant difference was the forecast changes in population and households, with the growth in these also expected to be significantly lower.

3.1.2 The lower population growth forecast in the Sensitivity Test Data Book compared to the May 2019 Data Book is presented in **Table 3-1**. The change in population and household growth will be reflected in the next release of the National Trip End Model (NTEM), but as this is not yet available, the impacts of these changes in respect of the projections in forecast growth, cannot be assessed.

Table 3-1 : Population Growth Comparison – May 2019 and July 2020 Sensitivity Test Data Books

Year	May 2019 Data Book (2015 = 100)	July 2020 Sensitivity Test Data Book (2015 =100)
2025	105.8	104.9
2040	111.6	108.1
2051	115.0	109.5
2084	123.0	110.5

3.1.3 The change in GDP growth rates is quite significant, reducing from a long term annual growth rate of around 2% to around 1.5%. The impact of this change is summarised in **Table 3-2**, which compares the July 2020 'standard' Data Book value of time indices, with those from the Sensitivity Test Data Book, where the 2015 values are 100. This clearly demonstrates how the long-term reduction has a more significant impact in later years.

Table 3-2 : Value of Time Comparison – July 2020 Data Books

Year	July 2020 Standard Data Book (2015 = 100)	July 2020 Sensitivity Test Data Book (2015 =100)
2025	111.2	107.2
2040	146.7	132.7
2051	180.8	153.3
2084	354.8	247.7

3.1.4 The difference of value of time (VoT) between the May 2019 and July 2020 Sensitivity Test is shown in **Table 3-3**, and this demonstrates that the differences are very similar to those compared to the July 2020 Standard values presented in **Table 3-2**.

Table 3-3 : Value of Time Comparison – May 2019 and July 2020 Sensitivity Test Data Books

Year	May 2019 Data Book (2015 = 100)	July 2020 Sensitivity Test Data Book (2015 =100)
2025	110.9	107.2
2040	146.2	132.7
2051	180.2	153.3
2084	353.6	247.7

3.1.5 There are also changes within the Sensitivity Test Data Book that have an impact on vehicle operating cost (VOC) outcomes. There are changes in respect of historic and forecast vehicle kilometre (vkm) splits, fleet fuel efficiency growth projections and base year electric vehicle consumption. These reflect recently implemented European Union (EU) legislation on tailpipe emissions, and updated input data on diesel sales, ultra-low emission vehicles (ULEV) take-up and new vehicle fuel efficiency. However, these VOC changes are much less significant in terms of economic benefits than the changes to the VoT.

4 TUBA Assessments Undertaken

4.1.1 For the assessment of the July 2020 Sensitivity Test Data Book two approaches were taken:

a. Using the existing forecasts within the Sensitivity Test version of the transport users benefit appraisal (TUBA) software (that incorporates the July 2020 Sensitivity Test Data Book).

b. Re-running the demand and assignment models, using the updated VoT and VOC prior to input to using the Sensitivity Test version of TUBA.

4.1.2 The first approach was relatively straightforward, which simply required inputting of existing matrices of trips, travel time and travel distance into version 1.9.14 of the TUBA program. For this version there are two alternative economic parameter files, one that adopts standard July 2020 Data Book values and one that adopts the Sensitivity Test values.

4.1.3 **Table 4-1** compares the TUBA only Sensitivity Test outcomes with those based on the May 2019 Data Book. These outputs are "masked" in the same way as detailed in section 2.5.6 of the Appendix D to the Combined Modelling and Appraisal Report (Economic Appraisal Report **[APP-254]**). The masking was carried out to exclude sector to sector benefits and dis-benefits that were considered unrepresentative of the scheme's impacts.

4.1.4 Table 4-1 shows that total operational TEE benefits reduce by 19% from £589M to £477M. The reduction in time benefits is the primary cause of this reduction, given that VOC dis-benefits reduce slightly. The reduction of 15.8% in time benefits over the 60 year assessment period is consistent with the VoT reductions presented in **Table 3-3**.

Table 4-1 : Comparison of TEE outcomes –May 2019 and July 2020 Sensitivity Test Data Books (only TUBA re-run)

	Time Benefit	*Fuel VOC Benefit*	*Non-fuel VO Benefit*	**Total VOC**	**Total TEE**
May 2019 Data Book	**711,670**	*-7,308*	*-115,797*	**-123,105**	**588,566**
July 2020 (Sensitivity Test) TUBA Only	**599,356**	*-5,837*	*-116,881*	**-122,718**	**476,638**
Difference	-112,314	*1,471*	*-1,084*	387	-111,928
Proportional Change	**-15.8%**	*+20.1%*	*-0.9%*	**+0.3%**	**-19.0%**

4.1.5 The second assessment required the re-running of the transport demand and assignment models, to incorporate the sensitivity test Data Book parameters relating to VoT and VOC updates. These were applied to both the DIADEM (Dynamic Integrated Assignment and DEmand Modelling) demand model parameter files and within the SATURN (Simulation and Assignment of Traffic to Urban Road Networks) assignment files. The outcome of the re-forecast models in terms of changes in flows is shown in **Figure 4-1 to Figure 4-3**.

4.1.6 Figure 4-1 shows the impact of the sensitivity parameters on the 2040 AM peak with Scheme assignment. This shows the difference in flows, in Passenger Car Units (PCUs), compared to the assignments using the May 2019 VoT and VOC values, with blue indicating a decrease and green an increase.

4.1.7 There are relatively few changes of significance, with only some re-assignment effects along the A14/A1 and M1 corridors. These changes are around 50 PCUs per hour or less and the majority of changes are less than 10 PCUs per hour on roads across the Scheme area and including the Scheme.

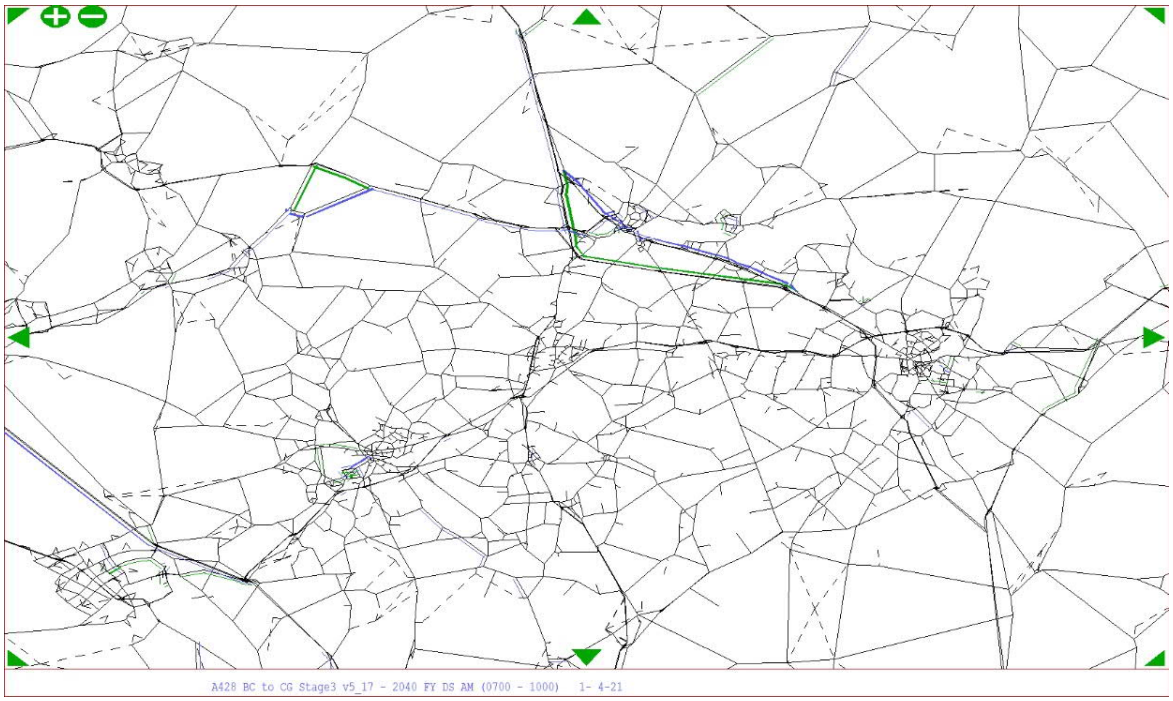

Figure 4-1: 2040 DS AM Flow Difference – July 2020 Sensitivity Test less May 2019

4.1.8 **Figure 4-2 and Figure 4-3** show the impacts of the sensitivity parameters in the inter-peak and PM peak respectively in 2040 also for the with Scheme assignment. The outcome in both is very similar to the change occurring in the AM peak with relatively few changes of significance and only some re-assignment effects along the A14/A1 and M1 corridors. These changes are under 50 PCUs per hour or less and the majority of changes are less than 10 PCUs per hour on roads across the Scheme area and including the Scheme.

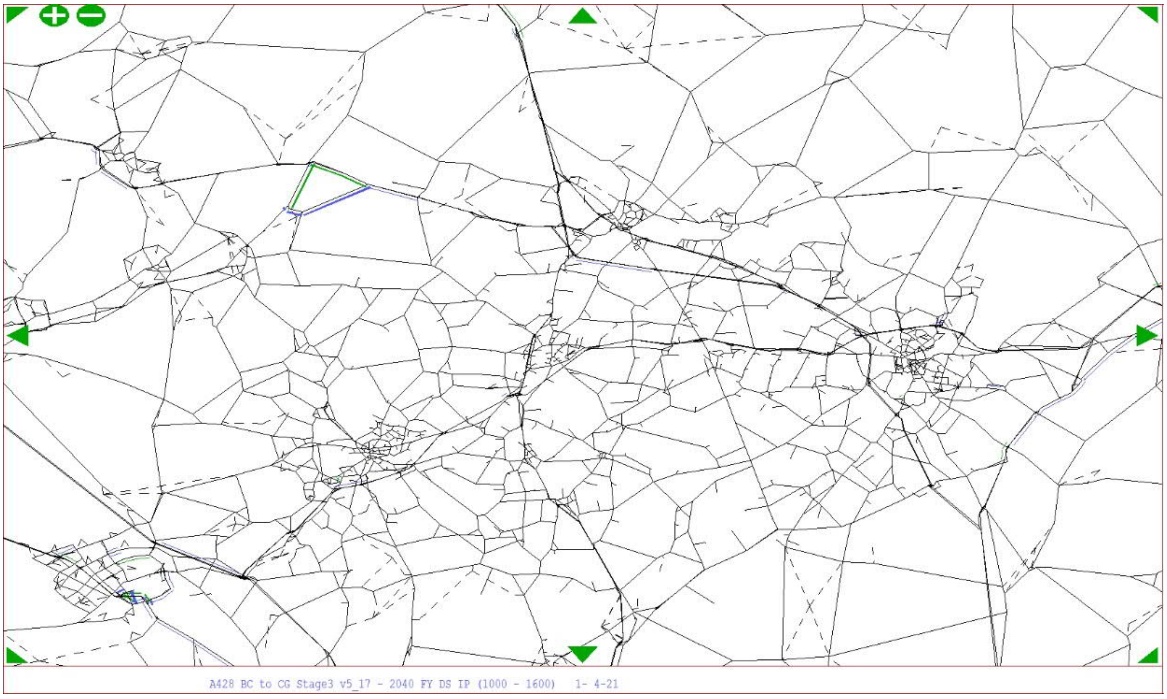

Figure 4-2 : 2040 DS IP Flow Difference – July 2020 Sensitivity Test less May 2019

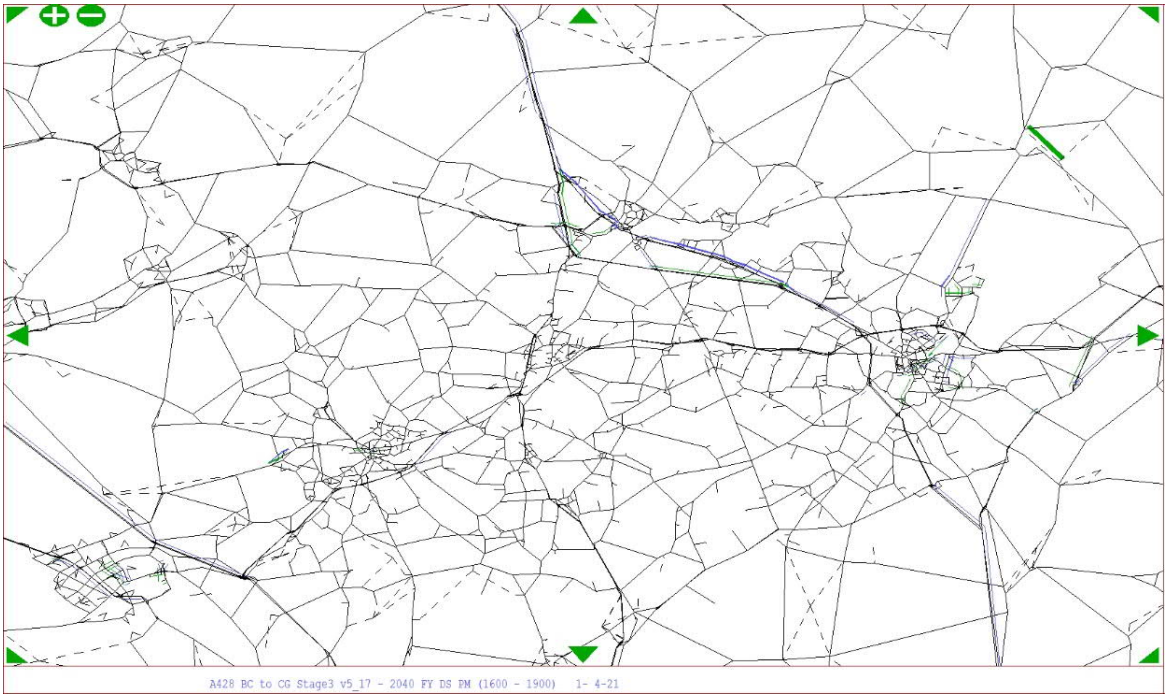

Figure 4-3 : 2040 DS PM Flow Difference – July 2020 Sensitivity Test less May 2019

4.1.9 The analysis of flow changes indicates that the impacts of the Sensitivity Test parameters on the demand model outcomes and on the traffic assignment is relatively small. There is very little change in traffic volumes and journey times and hence the impacts of these changes in terms of economic assessment would also be expected to be relatively minor.

4.1.10 The results of the TUBA assessment are presented in **Table 4-2**. This compares the TEE values for the full model re-run, and also the TUBA only assessment (that is using the July 2020 Sensitivity Test values based upon the existing forecasts), with the May 2019 TEE values that are reported in the Combined Model and Appraisal Report **[APP-250]**.

4.1.11 **Table 4-2** shows that the impact of re-running the full model with the Sensitivity Test economic parameters is very similar with the overall TEE benefits being 19.2% lower compared to 19.0% for the TUBA only outcome presented in **Table 4-1**. The last two rows of Table 4-2 show the change from the TUBA only run and this indicates only marginal impacts, with overall TEE benefits reducing by just 0.3%. This is credible given the impacts of adopting the Sensitivity Test parameters on the forecast flows resulted in relatively minor flow changes.

Table 4-2 : Comparison of TEE outcomes – TAG May 2019 and July 2020 Sensitivity Test Data Books

	Time Benefit	*Fuel VOC Benefit*	*Non-fuel VOC Benefit*	**Total VOC**	**Total TEE**
May 2019 Data Book	711,670	*-7,308*	*-115,797*	-123,105	588,566
July 2020 (Sensitivity Test) TUBA Only	599,356	*-5,837*	*-116,881*	-122,718	476,638
July 2020 (Sensitivity Test) Full Model Run	**596,820**	*-6,103*	*-115,287*	**-121,390**	**475,430**
Actual Difference From May 2019	**-114,851**	*1,205*	*510*	**1,715**	**-113,136**
Proportional Change	**-16.1%**	*+16.5%*	*+0.4%*	**+1.4%**	**-19.2%**
Actual Difference From TUBA only	**-2,536**	*-266*	*1,594*	**1,328**	**-1,209**
Proportional Change From TUBA only	**-0.4%**	*-4.6%*	*+1.4%*	**+1.1%**	**-0.3%**

4.1.12 Given that the majority of the change in benefits is due to changes in the value of time, **Table 4-3** presents a comparison of time benefits for specific years, over the 60 year assessment period, at around 10 year intervals.

4.1.13 This clearly demonstrates that the reduction in time benefits increases over time in line with the reduction in VoT over this period. In 2025 the reduction is 5.3%, by 2051 this increases to 14.6% and by 2084 the reduction is 29.7%. This is also demonstrated in **Figure 4-4** which compares the time benefits and clearly shows the values diverging over time.

Table 4-3 : Comparison of Time Benefits by Year (£ million) – TAG May 2019 and July 2020 Sensitivity Test Data Books (full model re-run)

	2025	2031	2040	2051	2061	2071	2084
May 2019 Data Book	11,121	12,242	13,544	13,014	11,777	10,789	9,631
July 2020 (Sensitivity Test) Full VDM	10,532	11,442	12,150	11,114	9,481	8,192	6,769
Actual Difference from May 2019	-590	-800	-1,394	-1,900	-2,296	-2,597	-2,861
Proportional Difference	-5.3%	-6.5%	-10.3%	-14.6%	-19.5%	-24.1%	-29.7%

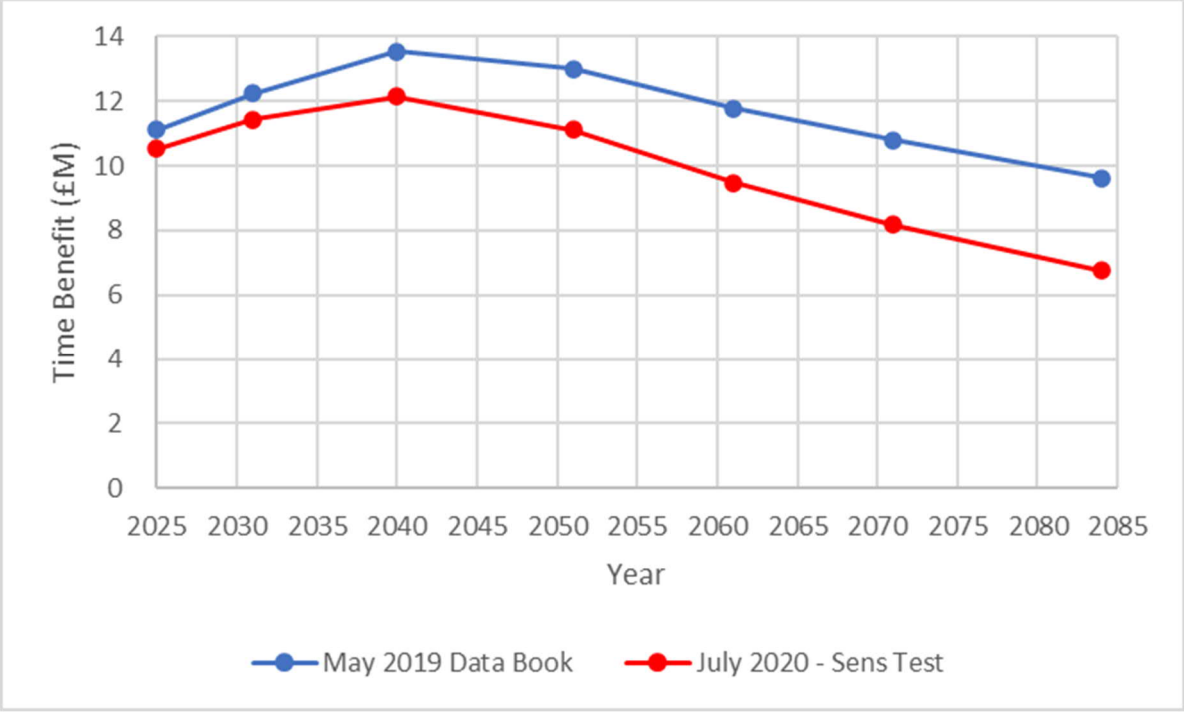

Figure 4-4 : Comparison of TEE Time Benefits by Year

5 Wider Economic Impacts

5.1.1 The other major component of Scheme benefits is wider economic impacts which account for about 30% of overall benefits. These benefits are calculated using the Wider Impacts in Transport Appraisal (WITA) program.

5.1.2 As part of the July 2020 Sensitivity Test Data Book, updates to the input files used by the WITA program were released. This included the Wider Impacts Dataset July 2020 Fiscal Sustainability Report Sensitivity version 3.2.1, which have been used in this Sensitivity Test assessment.

5.1.3 Updates have been applied to the following datasheets that are of significance in the WITA assessment undertaken:

a. Local GDP per Worker – By 2051 this is 14% less overall and by 2081 24% lower.

b. Total Employment/Employment by Sector – By 2051 there is no difference in the forecasts but by 2081 there is a 7% reduction.

c. National GDP per Worker – From 2030 onwards there are reductions in growth of between 0.4% and 0.6% per annum.

5.1.4 One notable point from the above changes, is that up to 2051, there is no change in forecast employment, even though population growth is lower.

5.2 Previous WITA Results

5.2.1 The WITA outputs reported in sections 4.8.3 to 4.8.8 of Appendix D to the Combined Modelling and Appraisal Report (Economic Appraisal Report APP-254) are based on version 2.0 of the WITA program and a summary of the outputs are presented in **Table 5-1**. These are the benefits attributable to the six local authority areas local to the Scheme, these being:

a. Huntingdonshire.

b. South Cambridgeshire.

c. Bedford.

d. Cambridge.

e. Central Bedfordshire.

f. Milton Keynes.

Table 5-1 : WITA Results reported in the DCO EAR – based on May 2019 Dataset

Category	2010 Prices discounted to 2010 (£000s)
Agglomeration - Manufacturing	8,592
Agglomeration – Construction	11,269
Agglomeration - Consumer Services	47,622
Agglomeration - Producer Services	162,973
Agglomeration – Total	**230,456**
Increased output in imperfectly competitive markets	26,257
Labour supply impact	1,960
Total	**258,673**

5.2.2 The majority of the wider economic benefits are due to agglomeration which accounts for 89% of total wider benefits, with most of the remainder accounted for by the benefits in increased output, which is based on 10% of the TUBA TEE business benefits.

5.2.3 Of the agglomeration benefits, around 70% are attributable to producer services and 20% attributable to consumer services, with manufacturing and construction attributable for the remaining 10%.

5.2.4 The breakdown of agglomeration benefits by the six local authorities is shown in **Table 5-2**. South Cambridgeshire and Huntingdonshire account for the two highest proportions at just under 30% each. Bedford and Cambridge account for a third of benefits between them, whilst Central Bedfordshire and Milton Keynes combined account for 10%. These proportions are considered credible when taking into account the location of the Scheme and forecast changes in journey times and relative population, workers and employment within these areas.

5.2.5 For some journeys, travel times are actually forecast to increase, due to additional traffic that the Scheme causes on some routes, such as the A421 west of Black Cat. Therefore, for some workers travelling between Milton Keynes and Bedford, the Scheme results in some increases in travel times, which limits the wider economic impacts for these areas.

Table 5-2 : WITA Agglomeration by Local Authority – based on May 2019 Wider Impacts Dataset

District	Benefits over 60-year appraisal period (£000's, 2010 prices discounted to 2010)	
	Stage 3 Core	Proportion of Total
South Cambridgeshire	66,695	29%
Huntingdonshire	62,060	27%
Bedford	39,034	17%
Cambridge	37,668	16%
Central Bedfordshire	14,783	6%
Milton Keynes	10,216	4%
Total*	**230,456**	**100%**

2. *Totals may differ due to rounding

5.3 Updated WITA Results

5.3.1 **Table 5-3** presents the results of WITA using the July 2020 Sensitivity Test forecasts, based upon the updated WITA economics and data input files. Table 5-3 shows that the agglomeration changes are similar to those occurring with the TEE benefits with a reduction of £38.7M equivalent to 16.8%. There is also a reduction of £4.3M in 'increased output' benefits, which are based on changes to business purpose benefits in TUBA, with a proportional change of 16.5%. There is a small decrease in labour supply impacts of £0.3M, which results in an overall reduction of £43.3M in overall wider economic impacts, from £259M to £215M or a reduction of 16.7%.

Table 5-3 : WITA Results Comparison – May 2019 v July 2020 Sensitivity Test

Category	May 2019 Data Book	July 2020 Sensitivity Test	Change	Change%
Agglomeration - Manufacturing	8,592	7,143	-1,449	-16.9%
Agglomeration – Construction	11,269	9,354	-1,915	-17.0%
Agglomeration - Consumer Services	47,622	39,656	-7,966	-16.7%
Agglomeration - Producer Services	162,973	135,622	-27,352	-16.8%
Agglomeration – Total	**230,456**	**191,774**	**-38,682**	**-16.8%**
Increased output in imperfectly competitive markets	26,257	21,926	-4,331	-16.5%
Labour supply impact	1,960	1,676	-283	-14.5%
Total	**258,673**	**215,377**	**-43,296**	**-16.7%**

* 2010 Prices discounted to 2010 (£000s)

5.3.2 **Figure 5-1** compares the agglomeration benefits, reported in the EAR, with those from the Sensitivity Test outputs for the six local authority areas. The difference in profiles is similar to that presented in **Figure 4-4** for the TEE time benefits, with reductions being greater in later forecast years. In 2025 the difference is around 7% increasing to 16% in 2051 and 27% in 2084.

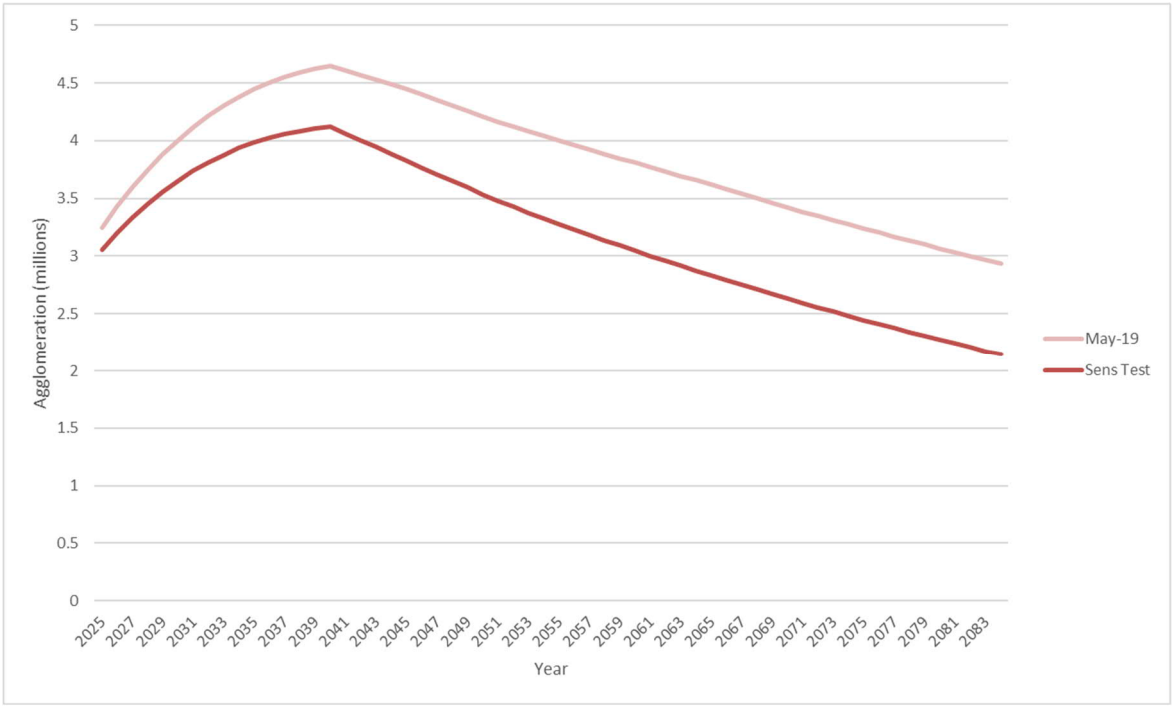

Figure 5-1 : WITA Agglomeration Benefits – May 2019 and July 2020 Sensitivity Test

5.3.3 **Table 5-4** presents the agglomeration benefits by local authority. This shows that South Cambridgeshire and Huntingdonshire contribute the two highest proportions of agglomeration benefits, at 29% and 27% respectively which is consistent with the results of the original assessment presented in **Table 5-2**. The proportional contributions by local authority are very similar to the outcome using the May 2019 datasets with only Milton Keynes changing from 5% to 6%.

Table 5-4 : WITA Agglomeration by Local Authority – based on Sensitivity Test Wider Impacts Dataset

District	Benefits over 60-year appraisal period (£000's, 2010 prices discounted to 2010)	
	Sensitivity Test	Proportion of Total
South Cambridgeshire	55,562	29%
Huntingdonshire	51,473	27%
Bedford	32,493	17%
Cambridge	31,207	16%
Central Bedfordshire	11,880	6%

District	Benefits over 60-year appraisal period (£000's, 2010 prices discounted to 2010)	
	Sensitivity Test	Proportion of Total
Milton Keynes	9,159	5%
Total*	191,774	100%

*Totals may differ due to rounding

6 Summary and Conclusions

6.1.1 As part of the strategy addressing the uncertainty arising from the COVID-19 pandemic, sensitivity tests were carried out to analyse the impact of the revised forecasts of economic growth on the economic benefits of the Scheme.

6.1.2 This note has presented the TUBA and WITA results based on the July 2020 Sensitivity Test economic parameters that were issued with the DfT route map. These account for the majority of benefits and therefore updates have only been undertaken to re-calculate the operational TEE and WITA benefits. Although the traffic models have been updated to incorporate revised values of time and vehicle operating cost parameters in the three future years modelled, this makes very little difference to traffic volumes on or around the Scheme.

6.1.3 Table 6-1 presents a summary of the transport related benefits and compares the outcome of the original results presented in the Combined Modelling and Appraisal Report **[APP-250]**. TEE benefits reduce by 20% compared to those reported at DCO submission and wider economic impacts reduce by 17%. It also shows that the Sensitivity Test parameters result in the adjusted BCR reducing by 0.36 from 1.91 to 1.55.

Table 6-1 : Transport related benefits summary (£M)* - May 2019 and July 2020 Sensitivity Test

Benefit Component	May 2019 Data Book	July 2020 Sensitivity Test Data Book	% change
TEE Benefits (including construction)	**554**	**441**	**-20%**
Indirect Tax Revenue	84	75	-10%
Accident Benefits	30	30	
Carbon Benefits (Greenhouse Gas)	-127	-127	
Monetised Noise Benefits	2	2	
Monetised Air Quality Benefits	-1	-1	
Initial Present Value of Benefits (PVB)	**541**	**420**	**-22%**
Present Value of Costs (PVC)	**463**	**463**	
Initial Benefit to Cost Ratio (BCR)	**1.17**	**0.91**	

Benefit Component	May 2019 Data Book	July 2020 Sensitivity Test Data Book	% change
Wider Economic Impacts	259	215	-17%
Journey Time Reliability Benefits	83	83	
Adjusted PVB	**883**	**718**	**-19%**
Adjusted Benefit to Cost Ratio (BCR)	**1.91**	**1.55**	

*2010 prices and values discounted to 2010, rounded to nearest million.