Economic Appraisal Report

A5WTC Updated Traffic Model

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Contents

Tables

Figures

Appendices

1 Introduction

1.1 Background

Mouchel was appointed in October 2007 by the former Northern Ireland Roads Service, now TransportNI (TNI), to undertake a detailed study for potential dual carriageway upgrades to the A5, to include highways design, traffic and economic appraisal.

The proposals to upgrade the A5 between Londonderry and Aughnacloy have featured prominently in strategy documents produced by the Department for Regional Development (now the Department for Infrastructure). The 'Regional Transportation Strategy for Northern Ireland 2002-2012' defined the A5 Western Transport Corridor (A5WTC) as one of five strategic corridors in Northern Ireland. The corridor starts in the North West of the Province at Londonderry and extends south to the border with the Republic of Ireland (ROI) close to the village of Aughnacloy. At this point, the A5WTC links into the N2 at the border with Co Monaghan.

1.2 Purpose of the Economic Assessment

The Department for Transport (DfT) requires that an economic assessment of a proposed scheme is undertaken using the WebTAG guidance. In Northern Ireland the approach has been agreed with the Department for Infrastructure (DfI). The assessment determines whether the proposed scheme produces a satisfactory cost benefit ratio in economic terms, taking account of costs incurred by government and user benefits.

1.3 Description of Scheme

The A5 Western Transport Corridor (WTC) will be a mainly dual carriageway 85 kilometre long route from Londonderry to the land border just south of Aughnacloy and will be largely constructed offline. The A5 WTC is one of five Key Transport Corridors identified in the Regional Transportation Strategy which is intended to improve the connections between Dublin and Londonderry and Donegal in the North West of Ireland. The route broadly follows the existing A5 corridor and provides access to relevant towns, including Strabane, Newtownstewart, Omagh, and Ballygawley. Its southern end, near the border at Aughnacloy, will connect to proposed improvements to upgrade the N2 route in County Monaghan.

A description of the proposed scheme is given in the Traffic Model Forecasting Report, reference: 718736-2700-R-011.

2 Approach to Economic Appraisal

2.1 Appraisal Methodology

The economic appraisal of a highway project is an assessment of benefits expected to accrue as a result of construction of the road, set against the capital costs incurred by the government to construct it. The economic appraisal of this scheme has been prepared in accordance with the Green Book - Appraisal and Evaluation in Central Government ("the Green Book") (HM Treasury, 2003 – updated July 2011).

A full cost benefit assessment was required to allow the proposed scheme for the A5WTC to be assessed in 'value for money' terms, as well as demonstrating that the scheme offered sufficient economic benefit to be viable.

The calculation of economic benefits to road users (excluding accident benefits) was undertaken using the DfT's TUBA V.1.9.7 (Transport Users Benefit Appraisal) program. TUBA compares the costs for the Do Minimum against the cost for the Do Something scheme to establish the value of the savings in travel time and vehicle operating costs. By comparing all construction and associated costs with the traffic benefits, conventionally over a 60 year period from the opening of the first phase, a **B**enefit to **C**ost **R**atio (BCR) may be calculated.

TUBA does not calculate the accident benefits (the reduction in accident costs as a result of the scheme). This assessment was undertaken using the DfT's COBALT program, which is consistent with the WebTAG recommendations, and the results added to the final calculation. The assessment was undertaken using the current version of the COBALT program, COBALT 2013.2 using COBALT parameter file 2016.1.

2.2 Traffic Modelling

The scheme has a significant impact in terms of its effect on traffic and has been assessed using a highway traffic model. Building and calibrating the traffic model, using the SATURN modelling platform, is described in the Local Model Validation Report ref. 718736-2700-R-010. Forecasts from the traffic model were used as the basis for the Economic Assessment and are reported in the Forecasting Report ref. 718736-2700-R-011.

The A5 WTC traffic model consists of three separate sub-models, each representing a particular time of day, all of which have been validated at the base year of 2013. The sub-models represent an average hour for an average weekday (Monday to Thursday) within the AM peak period (07:30-09:30), PM peak period (16:00-18:00) and Inter peak period (09:30-16:00). The outputs from the traffic model have been expanded to cover the entire year in accordance with conventional modelling practice.

The traffic forecasts have been developed for the opening year of each phase of the scheme (2019, 2023 and 2028) and also for a design year of 2041. The road user

benefits have been established based on these traffic forecasts by comparing the Do-Minimum and the Do-Something scenarios. The appraisal period has been extended to 60 years after the scheme opening year as required by TAG Unit A1.1, with the final year being 2078. The traffic forecasts beyond the last modelled year (i.e. 2042 to 2078) are assumed to remain constant.

2.3 Extent of Study Area

Figure 2-1 shows the extent of the traffic model network, which includes the whole of Northern Ireland and the appropriate parts of the Republic of Ireland to the north and south of Northern Ireland. The location of the A5 WTC, the Do Something scheme, is shown, shaded red extending from Londonderry to Aughnacloy.

The TUBA road user benefits, including the user time and operating costs, were assessed over the whole of the model area.

The COBALT accident cost savings were also assessed over the whole model area. Observed accident data was available for the A5. Over the rest of the model area the assessment assumed national average accident rates by road type.

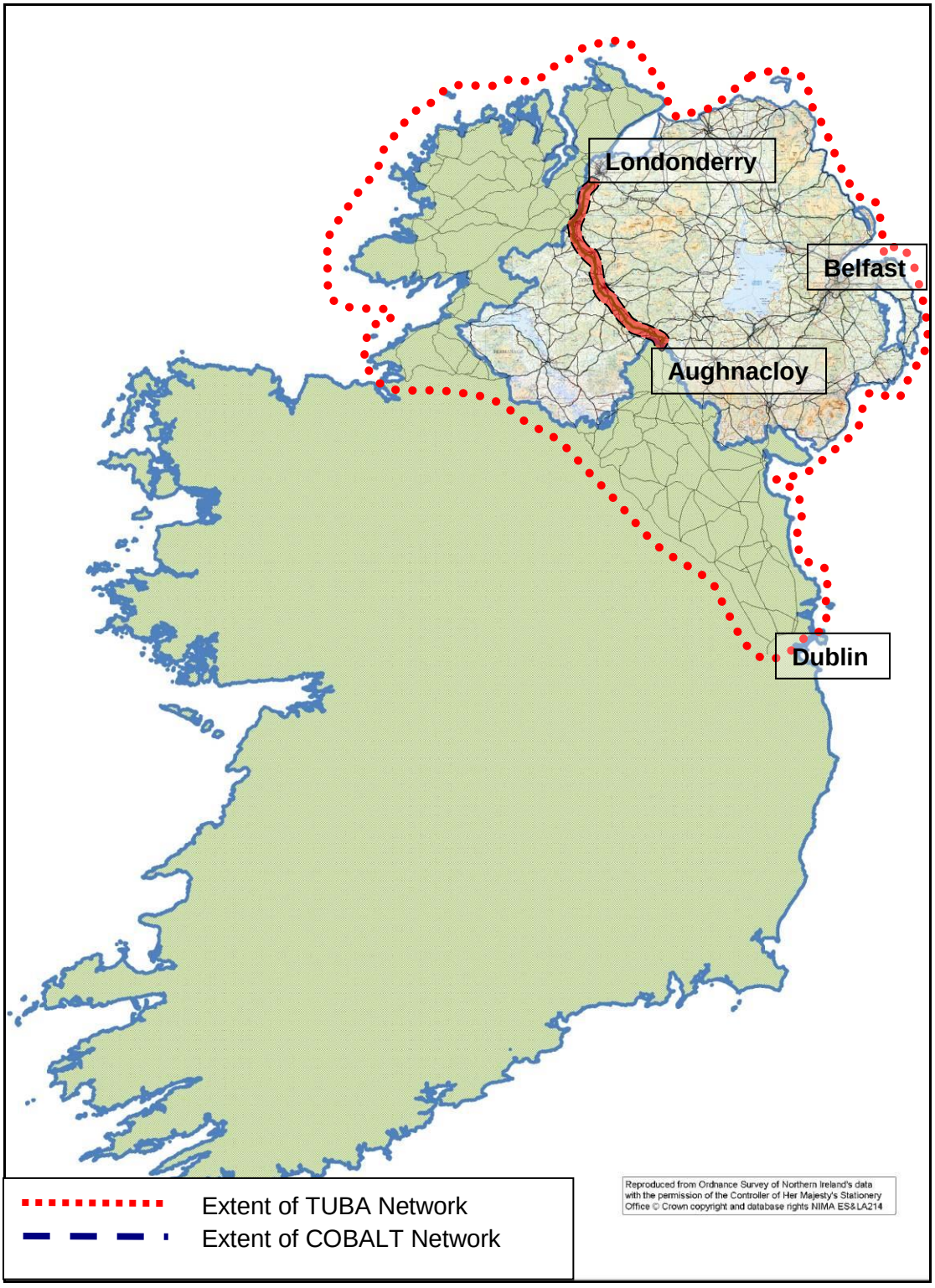

Figure 2-1: Extent of the Traffic Model and Economic Assessment Networks

2.4 TUBA Appraisal

The TUBA program calculates benefits on a year by year basis. The phased construction means that benefits need to be calculated for each year taking account of the completion of each phase. As schemes are opened at a particular time within that opening year, the part of the year before opening will have a different road network available to users than the part of the year after opening. To reflect this, would require Do-Minimum and Do-Something traffic forecasts for both scenarios. However, TUBA does not support more than one Do-Something scenario per year. Therefore, for the purposes of TUBA, it is assumed that the first phase of the scheme is open from 2019 to 2022, the second phase is open from 2023 to 2027 and the third phase is open from 2028 onwards.

2.4.1 Annualisation Factors:

Annualisation factors were calculated to enable the benefits identified for each model time period to be expanded to represent a whole year.

These factors were derived through analysis of long term Automatic Traffic Counters (ATC) and Manual Classified Counts (MCC) data. The process for determining the annualisation factors is set out in Table 2-1 below.

The calculation requires two steps:

i) Expand and combine the AM, Inter, and PM peak periods to represent an average 12-hour weekday (5-days).
ii) Expand the Inter peak period to represent the remaining periods, comprising weekday night time, weekends, and Bank holidays.

Calculation Stages		12 Hour Weekday			Weekday Night time / Weekends / Bank holidays			
1	Model Period	AM (0730 - 0930)	IP (1100 - 1500)	PM (1600 - 1800)	IP (1100 - 1500)			IP (1100 - 1500)
2	Expanded Period	AM (0700 - 1000)	IP (1600 - 1900)	PM (1600 - 1900)	Weekday night	Weekends	Bank Holidays	Combined Weekday Night time / Weekends / Bank holidays
3	Number of Days	253	253	253	253	104	8	-
4	Number of Hours per day	3	6	3	12	24	24	-
5	Total Number of Hours	**759**	**1518**	**759**	3036	2496	192	**5724**
5	Average Hour Factor	0.89	1.008	0.94	-	-	-	0.406
6	Annualisation Factor by period	676	1531	713	-	-	-	2325
7	Combined Annualisation Factors	**AM**	**676**					
		IP	**3856** (1531 + 2325)					
		PM	**713**					

Table 2-1: Determination of Annualisation Factors

2.4.2 User Classes

The economic appraisal (of user time and vehicle operating costs using TUBA) is based on 7 user classes. The 5 user classes which were included in the SATURN traffic model were split into 7 user classes by disaggregating LGVs and HGVs. LGVS were split into non-work and work and, HGVs were split into medium and heavy goods vehicles. The disaggregation factors were derived using WebTAG assumptions for LGV split between work and non-work and, for HGVs, local vehicle composition based on traffic counts. The disaggregation factors are shown in Table 2-2 below.

Time Period	LGVs		HGVs	
	Non-work (commuting and other)	Work (freight)	OGV1	OGV2
AM	12%	88%	43.64%	56.36%
IP	12%	88%	41.46%	58.54%
PM	12%	88%	43.19%	56.81%

Table 2-2: Disaggregation of LGVs and HGVs

The 7 user classes are defined as follows:

- Car – Journey between home and work (“Commute”)
- Car – Employers Business
- Car – Other trip purposes
- Light Goods Vehicle (LGV) (commuting and other)
- Light Goods Vehicle (LGV) (Freight transport)
- Heavy Goods Vehicle (HGV) (OGV1)
- Heavy Goods Vehicle (HGV) (OGV2)

The economic appraisal of accident costs using COBALT was based on all of the user classes combined, which was consistent with WebTAG guidance.

2.4.3 TUBA Scheme Benefits

The TUBA program takes, as its principal input, zone to zone matrices of trip numbers, times taken and distances travelled. TUBA then applies values of time and operating cost and discounts a 60 year stream of benefits to the present value year (defined by the DfT as 2010) and expresses the benefits in 2010 market prices. By subtracting the road user costs for the Do-Something case (i.e. with the scheme in place) from those for the Do-Minimum case (i.e. without the scheme in place) it establishes the net road user benefits.

For the appraisal of road user costs standard values of time, operating cost and other related economic parameters for traffic appraisal were applied, using the standard ‘economic parameter data’ available from the DfT TUBA website.

2.4.4 Journey Time and Vehicle Operating Costs

The journey time and vehicle operating costs represent the economic benefits that accrue to road travellers as a result of the scheme. They include savings in journey time and changes in vehicle operating costs, to Business Users and Consumer Users.

Business Benefits are the benefits accrued by business travellers, including car (and van) occupants travelling on employers business. This group also includes HGV drivers. Consumer Users are non-business travellers, in cars and vans. Importantly 'commuters' are classed as consumers as they are travelling in their own time, not that of their employers.

The TUBA model includes standard values of time, based on average earnings, but the values for time in the course of work (employers business) are much higher than personal time (including commuting).

The vehicle operating costs are both distance and speed related, and include fuel costs and non-fuel costs, e.g. tyres, maintenance and depreciation etc.

The benefits are calculated for all users of the network and include those who travel on the new road (A5 WTC) and those who do not. For example, whilst users of the A5 WTC will enjoy time savings, users of the old A5 may also enjoy benefits as average speeds for journeys increase on the old road as a result of traffic relief.

It is often the case that there are overall time benefits and (overall) operating cost disbenefits. For example, travellers may travel further distances to take advantage of the time savings and hence incur additional vehicle operating costs.

Total transport economic efficiency benefits of the scheme, as discussed above, are shown in Table 2-3

2.4.5 Carbon Disbenefits

As there is an increase in fuel consumption, there is also a net increase in carbon products emitted. TUBA predicts this disbenefit to be £26.6M over the 60 year appraisal period.

Road User	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Consumer User Benefits					
Commuting	125.166	-7.677	-8.396	4.093	113.186
Other	310.893	-20.662	-18.922	11.037	282.346
Net Consumer Benefits	**436.059**	**-28.339**	**-27.318**	**15.130**	**395.532**
Business User Benefits					
Business					
Personal	459.639	-11.295	1.161	6.014	455.519
Freight	300.363	-61.016	11.775	32.356	283.478
Net Business Impact	**760.002**	**-72.311**	**12.936**	**38.370**	**738.997**
Present Value of Transport Economic Efficiency Benefits (PVB)	**1,196.061**	**-100.650**	**-14.382**	**53.500**	**1,134.529**

Table 2-3: A5 WTC Transport User Benefits (£M)

2.4.6 Annual Benefits for the Appraisal Period

Figure 2-2 shows the road user benefits for each year of the economic appraisal period also at 2010 prices, discounted to 2010.

This shows a steady increase in annual benefit up to 2041. Beyond 2041 no further growth has been assumed and annual benefits begin to reduce after discounting, the later they occur in the future.

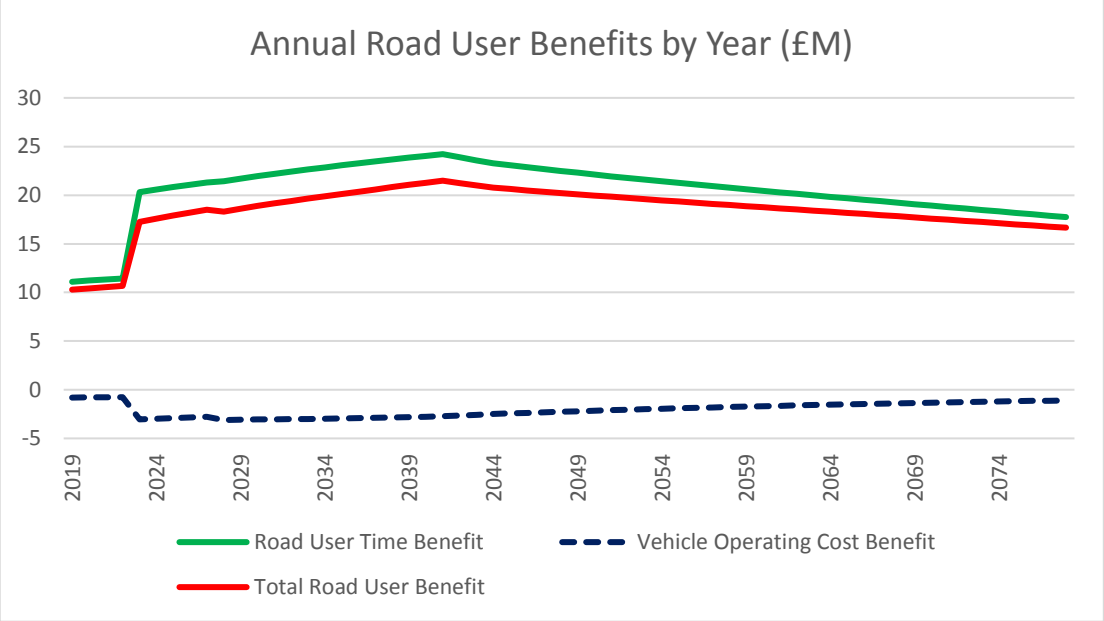

Figure 2-2: Road User Benefits by Year (Discounted to 2010)

2.4.7 Total Benefit by Time Period

Table 2-4 shows a breakdown of the discounted total road user benefits for each time period. This shows that the inter-peak accounts for about 67% of the total benefits, with the AM and PM peak periods being 13% and 20% respectively.

Time Period	Total Road User Benefit (£M)	Benefit Proportion	Annualisation Factor	Proportion of Total Time
AM peak	138.352	13%	676	13%
PM peak	221.170	20%	713	14%
Inter-peak	721.504	67%	3856	73%
Total	**1,081.026**	100%	5245	100%

Table 2-4: Road User Benefits by Time Period

This demonstrates that the benefits are proportionately higher in the PM peak period.

2.5 COBALT Appraisal

An assessment of accident benefits was undertaken separately using COBALT, the DfT's cost benefit analysis program for accident savings. This was run in combined link and junction mode using assignment results from the traffic model as inputs.

The COBALT program was run for the three stages separately. The accident benefits for the first stage needed to be calculated for the 4 years from 2019 to 2023, the accident benefits with the first and second stages in place needs to be calculated for the 5 years from 2023 to 2028 and the accident benefits for the complete scheme needs to be calculated for the remaining 51 years, making a total of 60 subsequent years.

A fixed trip matrix approach has been adopted in accordance with the WebTAG guidance.

2.5.1 Accident Benefits

COBALT calculates the number of accidents on each link in each year of the evaluation period using Average Annual Daily Traffic (AADT), accident rate per km and link length. The numbers of accidents on the A5 through the study area have been collected from recorded accident data over a 5 year period from 2011 to 2015. For other roads, a set of standard rates have been used. COBALT also calculates a severity split using standard factors which estimate the number of accidents classified by injury severity of fatal, serious or slight. COBALT applies the appropriate costs per accident to establish the economic cost of accidents over the appraisal period.

Average Annual Daily Traffic (AADT) flows were taken from the SATURN model assignment for the forecast years used in each model stages. The first stage used 2019 and 2023 flows. The second stage used 2023 and 2028 flows. The third stage used 2028 and 2041 flows. These flows were input into COBALT.

The projected changes in the numbers of accidents, casualties and accident costs over the appraisal period for the proposed scheme are set out in Table 2-5 below.

Scenario	Number of Accidents			Number of Casualties (60 Years)			Present Value of Accident Costs – (£M)
	2028	2041	Total 60 years	Fatal	Serious	Slight	
Do Minimum	631.7	627.1	37923.7	458.3	4855.5	46675.5	2,116.859
Do Something	593.7	586.4	35677	436.2	4524.7	43953.3	1,990.849
Change	38.0	40.7	2246.7	22.1	330.8	2722.2	126.010

Table 2-5: Forecast Accidents over 60 year Appraisal Period

The total number of predicted accidents covers all the roads in the study area and not just in the immediate vicinity of the A5 WTC. The COBALT analysis predicts a reduction of 22.1 fatal accidents and a net cost benefit of £126.0M over the 60 year appraisal period.

3 Scheme Costs

3.1 Scheme Cost

For the economic appraisal the investment and operating costs are adjusted to a 'Present Value Cost' (PVC) for a standard base year of 2010. The costs are converted to market prices and discounted using standard Treasury discount rates. There are three key considerations, as discussed below:

3.1.1 Base Costs

The base costs for the A5 WTC Proposed Scheme include construction, land, and preparation and supervision costs, all at Q3:2016 prices.

The base costs were then converted to the Present Value of Cost (PVC) through discounting to 2010.

3.1.2 Risk and Optimism Bias

It is common practice to include a risk allowance and optimism bias on top of the scheme estimated costs to allow for unexpected costs. This is in accordance with guidance from TAG Unit A1.2.

3.1.3 Present Value of Costs

Table 3-1 sets out the estimated scheme costs for the A5 WTC and shows;

a) the estimated cost at a price base of Q3:2016, and

b) the Present Value Cost (PVC) at a price base of 2010 discounted to 2010. The PVC includes the following adjustment factors:

- An adjustment for inflation using the Retail Price Index from 2016 to 2010
- An adjustment to market prices (gross of indirect tax)
- A discount factor based on the HM Treasury "Green Book" to adjust costs occurring in different periods to a standard base year of 2010.

Cost Element	Scheme Costs	
	Estimated (£M) at 3rd Quarter 2016 Prices	PVC (£M) discounted to 2010 at 2010 Prices
Construction	583.706	429.908
Preparation	75.996	64.105
Supervision	13.100	9.632
Stats Diversions	29.736	22.239
Archaeology	9.564	7.152
Land and Compensation	99.253	73.526
Risk and Optimism Bias	68.312	50.313
Total	**879.667**	**656.875**

Table 3-1: A5 WTC Scheme Costs

The total Present Value Cost of the scheme is £656.9M.

4 Results of Appraisal

4.1 Introduction

As previously reported, all costs and benefits have been expressed in 2010 market prices and discounted to 2010. An appraisal period of 60 years has been used, over the period of 2019 to 2078.

4.2 Results of the Economic Appraisal

The outputs from the economic appraisal for the A5 WTC scheme are given in Table 4-1 below.

	Costs & Benefits	2010 Prices discounted to 2010 (£M)
Benefits	Consumer User Benefits: Commuting	109.1
	Consumer User Benefits: Other	271.3
	Business Benefits	700.6
	Total Economic Efficiency Benefits	1,081.0
	Accident Benefits	126.0
	Carbon Benefits	-26.6
	Indirect Tax Revenue	53.5
	Present Value of Benefits (PVB)	**1,234.0**
Costs	Construction Cost	656.9
	Present Value of Cost (PVC)	**656.9**
Net Present Value	**Net Present Value (NPV)**	**577.1**
Benefit Cost Ratio	**Benefit to Cost Ratio (BCR)**	**1.88**

Table 4-1: Economic Appraisal Summary Table

The above table shows all road user benefits of £1,234.0M, and a marginal carbon disbenefit of £26.6M. The indirect tax, accrued through increased vehicle operating costs amounts to £53.5M.

The Net Present Value (NPV) of the scheme is the difference between Present Value of Benefits (PVB) and Present Value of Cost (PVC). The NPV for the scheme is £577.1M, i.e. the investment provides a positive return.

The calculated Benefit Cost Ratio (BCR) is 1.88.

4.3 WebTAG Tables

This section describes how the results of the economic appraisal of the A5 WTC scheme are presented using standard WebTAG tables.

4.3.1 Transport Economic Efficiency (TEE) Table

The TEE table is shown as Table A.1 in Appendix A. It shows the present value of the TEE benefits as £1,081.0M. The benefits include consumer user benefits of £380.4M and business user benefits of £700.6M.

4.3.2 Public Accounts (PA) Table

The PA table is shown as Table A.2 in Appendix A. It shows the discounted value of the investment cost of the scheme as £656.9M.

4.3.3 Analysis of Monetised Costs and Benefits (AMCB) Table

The AMCB table is shown as Table A.3 in Appendix A. It replicates in the prescribed format the entries in Table 4-1 above and confirms that the BCR of the proposed A5 WTC is 1.88.

It can be seen that the TEE benefit of £1,081.0M is increased to £1,234.0M, by including accident benefits, indirect tax benefits and allowing for the carbon disbenefit.

This produces final values of £1,234.0M for PVB, £656.9M for PVC and £577.1M for NPV.

4.4 Summary

The Economic Appraisal Report has described the process used to assess the economic case for the A5 Western Transport Corridor Scheme and sets out the results in narrative terms and in the standard appraisal tables required by WebTAG.

The proposed scheme has a BCR of 1.88 and provides a substantial accident benefit of £126M.

Appendix A - WebTAG Tables

Economic Efficiency of the Transport System (TEE)

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£125,166,000		£125,166,000			
Vehicle operating costs	-£16,073,000		-£16,073,000			
User charges	£0		£0			
During Construction & Maintenance	Not assessed		Not assessed			
NET NON-BUSINESS BENEFITS: COMMUTING	**£109,093,000**	*(1a)*	**£109,093,000**			

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£310,893,000		£310,893,000			
Vehicle operating costs	-£39,584,000		-£39,584,000			
User charges	£0		£0			
During Construction & Maintenance	Not assessed		Not assessed			
NET NON-BUSINESS BENEFITS: OTHER	**£271,309,000**	*(1b)*	**£271,309,000**			

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£760,002,000		£300,363,000	£459,639,000				
Vehicle operating costs	-£59,375,000		-£49,241,000	-£10,134,000				
User charges	£0		£0	£0				
During Construction & Maintenance	Not assessed		Not assessed	Not assessed				
Subtotal	**£700,627,000**	*(2)*	**£251,122,000**	**£449,505,000**				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue	£0							
Operating costs	£0							
Investment costs	£0							
Grant/subsidy	£0							
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions	£0	*(4)*						
NET BUSINESS IMPACT	**£700,627,000**	*(5) = (2) + (3) + (4)*						

TOTAL		
Present Value of Transport Economic Efficiency Benefits (TEE)	**£1,081,029,000**	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Table A.1: A5 Western Transport Corridor: Economic Efficiency of the Transport System (TEE)

Public Accounts (PA Table)

Local Government Funding	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Revenue	£0		£0			
Operating Costs	Not assessed		Not assessed			
Investment Costs	£656,875,434		£656,875,434			
Developer and Other Contributions	£0		£0			
Grant/Subsidy Payments	£0		£0			
NET IMPACT	£656,875,434	*(7)*	£656,875,434			
Central Government Funding: Transport						
Revenue	N/A		N/A			
Operating costs	N/A		N/A			
Investment Costs	£0		£0			
Developer and Other Contributions	£0		£0			
Grant/Subsidy Payments	£0		£0			
NET IMPACT	£0	*(8)*	£0			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£53,500,000	*(9)*	-£53,500,000			
TOTALS						
Broad Transport Budget	£656,875,434	*(10) = (7) + (8)*				
Wider Public Finances	-£53,500,000	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values in 2010 prices and values

Table A.2: A5 Western Transport Corridor: Scheme Public Accounts

Analysis of Monetised Costs and Benefits

Noise	Not calculated	*(12)*
Local Air Quality	Not calculated	*(13)*
Greenhouse Gases	-£26,567,000	*(14)*
Journey Quality	Not calculated	*(15)*
Physical Activity	Not calculated	*(16)*
Accidents	£126,009,900	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£109,093,000	*(1a)*
Economic Efficiency: Consumer Users (Other)	£271,309,000	*(1b)*
Economic Efficiency: Business Users and Providers	£700,627,000	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£53,500,000	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£1,233,971,900	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£656,875,434	*(10)*
Present Value of Costs (see notes) (PVC)	£656,875,434	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£577,096,466	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.88	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Table A.3: A5 Western Transport Corridor: Analysis of Monetised Costs and Benefits