Broughton Bypass
Economic Assessment Report

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	Originated by	Checked by	Reviewed by	
ORIGINAL	**Sergey Makov**	**Daragh Foley**	**Leighton Cardwell**	
Approved by	**Sophie Kelly**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS **SEK**	
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Executive Summary

This Economic Assessment Report has been prepared to support the Full Business Case for the proposed Broughton Bypass scheme. It details how the economic appraisal of the scheme has been undertaken, followed by the related results.

Broughton Bypass is one of the key highway interventions of a wide-ranging, complementary set of transport infrastructure investments, set out and agreed with Government as part of the Preston City Deal. The bypass is expected to solve the congestion, severance, environmental and safety problems experienced in and around Broughton village. These problems are largely generated by significant volumes of through traffic between Broughton Crossroads and Junction 1 of the M55.

The proposed bypass is approximately 2km in length and has been designed as two sections running north and south of the existing B5269 Whittingham Lane. It will be constructed as one scheme.

The assessment has been based on industry-standard economic appraisal methodology which has been agreed with the client and the Lancashire Enterprise Partnership's independent assurer. Scheme costs have been estimated for both construction and maintenance of the bypass. Scheme benefits and disbenefits have been calculated using Department for Transport (DfT) recommended tools and software packages.

The result of the assessment shows that the scheme is forecast to generate a Benefit Cost Ratio (BCR) of 5.8. It is therefore classified as representing very high value for money based on DfT guidance criteria. It is also very high value for money when set against the funding criteria of the Transport for Lancashire (TFL) Assurance Framework.

In addition, two sensitivity tests have been undertaken to take into account uncertainty regarding future traffic growth and to demonstrate the impact on the Value for Money if the scheme's dependent development was included in the Core scenario.

Results of these sensitivity tests demonstrate that the scheme's Value for Money is robust to lower levels of traffic growth in the future and is not altered in the context of development otherwise dependent on the scheme.

Therefore, Broughton Bypass has been assessed as representing very high value for money.

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1 Introduction

1.1 Background and Purpose of Report

This report details the economic assessment undertaken for the Broughton Bypass Full Business Case. It presents monetised costs and benefits of the scheme, and describes the methodologies used to derive these impacts.

The monetised impacts presented in this report are used to inform the overall Value for Money assessment of the scheme.

This report should be read alongside the Broughton Bypass Full Business Case (September 2015) with supporting information provided in the Appraisal Specification Report (July 2014), the Local Model Validation Report (August 2015), and the Model Forecasting Report (September 2015).

1.2 Structure of the Report

The remainder of this report is structured as follows:

- ***Chapter 2 – Scheme Overview****: provides an overview of the proposed scheme and its objectives;*
- ***Chapter 3 – Economic Assessment Approach****: provides a general description of the economic assessment methodology;*
- ***Chapter 4 – Traffic Modelling Inputs for Economic Assessment****: provides a summary of the traffic model, which produces the majority of the inputs into economic analysis;*
- ***Chapter 5 – Estimation of Costs****: provides a detailed description of the various components that make up the scheme costs;*
- ***Chapter 6 – Estimation of Benefits****: provides a detailed description of the various components that make up the scheme benefits;*
- ***Chapter 7 – Economic Assessment Results****: provides a detailed description of the results of the economic analysis;*
- ***Chapter 8 – Low Growth and Dependent Development Sensitivity Tests****: provides a general description of the sensitivity tests undertaken and the associated results;*
- ***Chapter 9** – **GVA Benefits:** provides a description of GVA benefits of the scheme; and*
- ***Chapter 10 – Summary and Conclusions****: provides a summary and conclusions to all the above.*

2 Scheme Overview

2.1 Proposed Scheme

The proposed Broughton Bypass is 2 km long and its approximate alignment is shown in Figure 2.1. The bypass is scheduled to open in 2017 and will have a speed limit of 40mph.

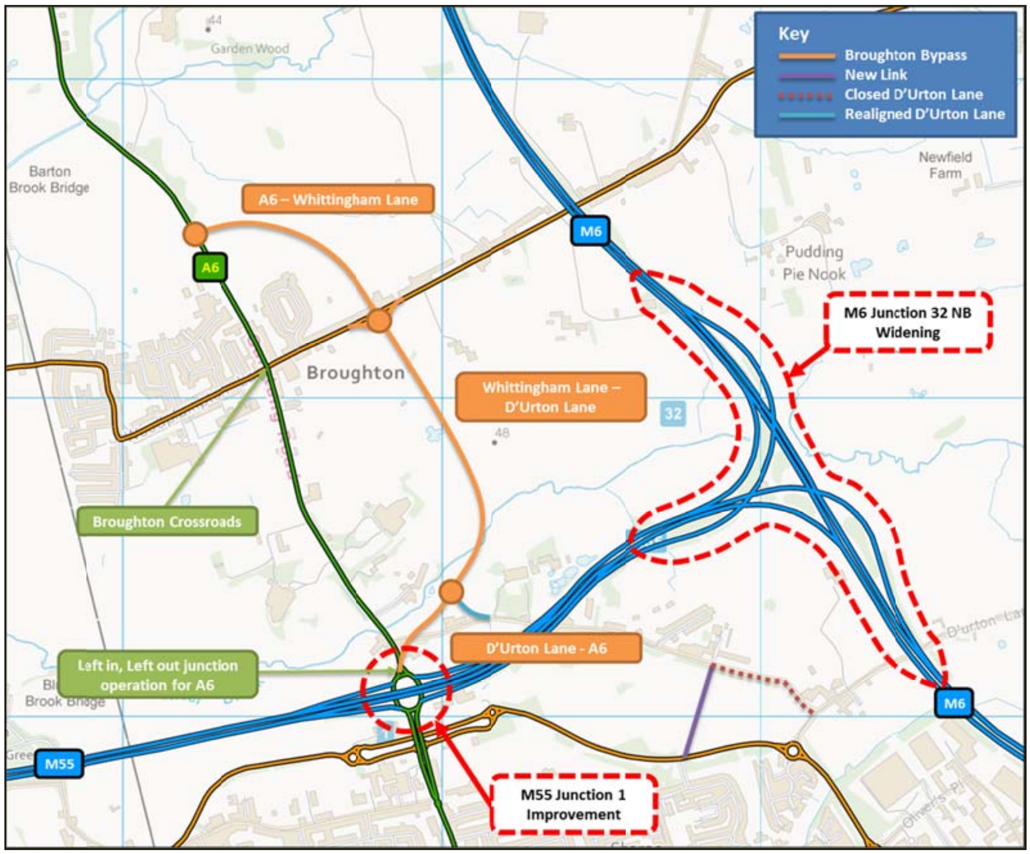

Figure 2.1: Scheme Location

The bypass will replace the part urban/part rural single carriageway road currently passing through Broughton with a rural classified road. It will avoid the village, removing through traffic from Broughton Crossroads.

The bypass is to be constructed on the east side of the village. From north to south it can be considered to have three sections:

- From A6 Garstang Road north of Broughton to Whittingham Lane;
- From Whittingham Lane to D'Urton Lane; and
- From D'Urton Lane to A6 Garstang Road just north of M55 Junction 1

The sections between Whittingham Lane and D'Urton Lane, and D'Urton Lane and A6 Garstang Road are dual carriageway, and the remaining section to the north between Whittingham Lane and the A6 is single carriageway.

Roundabout junctions are provided along the bypass with the exception of the southern tie in which is a left in left out priority junction.

D'Urton Lane has been realigned at its western end to tie in with the bypass. D'Urton Lane is also closed to vehicular traffic close to the junction with the section of D'Urton Lane that leads to Haighton Green Lane. A link will be provided from D'Urton Lane to Eastway through a proposed development site, though this link will not open until after the opening year of the bypass. The speed limit along the existing A6 through Broughton village will be reduced from 40mph to 20mph with gateway signs and reduced carriageway width for motorists. Facilities for bus users and non-motorised users will be enhanced with additional crossing points, wider footways and shared use cycle tracks and a general improvement of the public realm.

2.2 Scheme Objectives

The published objectives of the proposed scheme are as follows:

- To improve the environment, particularly that of the bypassed community;
- To provide better conditions for public transportation, cyclists and pedestrians, which facilitates and encourages the increased use of transport options other than private vehicles;
- To enhance road safety;
- To assist economic growth through an efficient and sustainable transport system and maintenance of accessibility to the trunk network for the efficient transport of goods; and
- To bring additional capacity to the network and improve accessibility and journey times into and out of Preston and better connectivity to the wider strategic road network, with additional benefit to the delivery of new development and economic growth in the area.

3 Economic Assessment Approach

3.1 Introduction

Economic Assessment involves the determination of costs and benefits of a scheme using travel demand, traffic flows, journey times and other inputs from a traffic model.

By comparing the costs with the benefits of a scheme over a 60 year assessment period, a Benefit Cost Ratio (BCR) can be calculated, which represents the value for money of the scheme.

This chapter provides a general description of the economic appraisal approach adopted for the Broughton Bypass scheme.

The DfT Advice Note on Value for Money Assessment for Local Transport Decision Makers (December 2013) suggests a flexible approach to economic appraisal to ensure time and resources spent on the development of a business case are proportionate to the size of the investment. Having considered the nature of the scheme and its potential impacts on the economy, environment, and social well-being and having taken into account lessons learnt from previous projects, it has been accepted and agreed with LCC and the Independent Assurer that the key benefits of the bypass are likely to be derived from a reduction in delays to traffic and subsequently significant travel time savings around Broughton and across the wider study area. Therefore, travel time benefits have been identified as the main contributor to the scheme value for money and TUBA analysis of user benefits as the key element of economic assessment.

The other benefits and disbenefits which are usually associated with a bypass scheme include:

- Vehicle operating cost (VOC) benefits
- Accident benefits
- Greenhouse gases emission
- Air Quality and Noise benefits
- Changes in Indirect Taxes
- Changes in delays during maintenance
- Delays during construction (N.B. This is always a disbenefit and is therefore recorded as a negative benefit).

VOC benefits and changes in indirect taxes are calculated in TUBA together with travel time benefits. Therefore they have been included in the analysis and calculation of the BCR.

Given that the accident rates in and around Broughton are lower than the national average rates (with the exception of Broughton Crossroads) and to ensure proportionate approach to the appraisal COBALT analysis of accident benefits is not required. Instead a qualitative assessment of safety benefits has been undertaken to support the Business Case.

In line with WebTAG environmental impact assessment has been undertaken which includes quantification and monetisation of air quality and noise benefits for the areas where a relatively large change in traffic flows is expected. In addition assessment of greenhouse gas emissions has been undertaken as part of the economic appraisal.

According to WebTAG impacts during construction and maintenance should be assessed and recorded where they are likely to be significant. The construction of the Broughton Bypass scheme is not expected to create significant delays to the local road network as the scheme is being constructed off-line (away from the existing road).

Consequently, a QUADRO (QUeues And Delays at ROadworks) based economic assessment of disbenefits associated with delays during construction has not been included in the analysis.

Maintenance delay benefits are expected to have a more significant effect than construction delay: delays during maintenance are likely to decrease with the scheme in place particularly if the bypass and the existing A6 are used as diversion routes for each other. However, the proportion of maintenance delay benefits to the total benefits of the scheme is likely to be very small and unlikely to have an impact on the value for money of the scheme.

Therefore it has been agreed with LCC that unless the TUBA assessment of the scheme showed that the BCR is close to the boundary of a Value for Money category, the assessment of the maintenance benefits is not required.

Given one of the key objectives of the scheme is to assist economic growth and support delivery of new development in the wider area the analysis of GVA benefits of the scheme is required to support the business case submission, aligned with the principles of the TfL assurance framework. GVA analysis seeks to complement the standard economic appraisal and therefore it is not included in the calculation of the BCR of the scheme. However, it provides an indication of the total GVA that could be realised if a transport scheme is implemented.

The approach to assessment of potential benefits of the scheme is summarised in Table 3-1 below.

Element of Assessment	Assessment method
Travel Time Benefits	TUBA
VOC Benefits	TUBA
Accident Benefits	Qualitative assessment
Maintenance Delay Benefits	Not required unless TUBA BCR is near the threshold
Construction Delay Disbenefits	Not required
Environmental Impacts (Air Quality, Noise, Greenhouse Gases)	Standard WebTAG Spreadsheets
Indirect Tax	TUBA
GVA Benefits	Unlocked development and GVA Assessment

Table 3-1: Approach to Elements of Economic Assessment

Along with the estimation of benefits the costs are also required for the economic assessment of the scheme.

Costs can be defined as the total amount of money spent on constructing and maintaining the scheme. The costs are therefore referred to as Scheme costs and Maintenance costs:

- Scheme costs are construction costs, land costs, preparation costs (planning and designing the scheme) and supervision costs during the scheme construction.
- Maintenance costs are the cost of people, machinery and materials required to maintain the highway network. These costs are also known as the Capital Costs of Maintenance.

3.2 Assessment Tools

Transport User Benefit Appraisal (TUBA) - Latest Version 1.9.5 (November 2014) has been used to derive travel time benefits, VOC and indirect tax benefits of the scheme. The use of TUBA in economic appraisal is discussed in more detail in Chapter 6.

3.3 Appraisal Period

To assess the economic benefits over the life cycle of the scheme, there is a need for at least two forecast years: the opening year of the scheme (2017) and the design year (2032). No interim year has been produced for use in the economic assessment as detailed in the Appraisal Specification Report (Section 12.2).

In accordance with TAG Unit A1.1 (Paragraph 2.1.1), the economic assessment period should extend to 60 years after the scheme Opening Year. Therefore the economic assessment was carried out up to a future year of 2076.

3.4 Discounting of Benefits and Costs

Costs and benefits occur in different years throughout the assessment period e.g. the construction costs occur before the scheme opens, whilst the benefits occur in the 60 years afterwards.

In addition, it is considered that benefits that accrue now are considered to be more valuable than those that accrue further into the future.

Given the above, in order to compare benefits and costs, it is therefore essential that they are all converted to a common base and a common value (known as the Present Value Year).

The process used is called discounting, and the Present Value Year is currently 2010.

Discounting is undertaken internally within the computer programs mentioned above, using the standard DfT discount rates of 3.5% per year for the first 30 years of appraisal and 3.0% per year thereafter.

Costs can also be in different price bases. In order to enable comparisons to be made between such costs they need to be adjusted so that they are all in a common price base.

The combination of having costs and benefits in a standard price base and discounted to a common year means that all result costs and benefits are in 2010 prices, discounted to 2010 (unless explicitly stated).

The unit of account must also be consistent between costs and benefits in order to allow comparison between the two.

There are two different units of accounts:-

- Market price unit of account – this refers to the prices paid by consumers for goods and services and therefore includes indirect taxation (e.g. VAT); and
- Factor cost unit of account – this excludes indirect taxation. Prices paid by Government bodies are usually quoted in the factor cost unit of account as any tax paid is recovered by the Government and is therefore ignored.

While scheme benefits are calculated in market prices, scheme costs are usually quoted as factor costs.

The scheme costs must therefore be adjusted to market prices for economic assessment purposes – this is done within economic assessment software.

3.5 Economic Assessment Methodology

Figure 3.1 shows the diagram which provides details of the methodology for the economic assessment and calculation of the BCR of Broughton Bypass scheme.

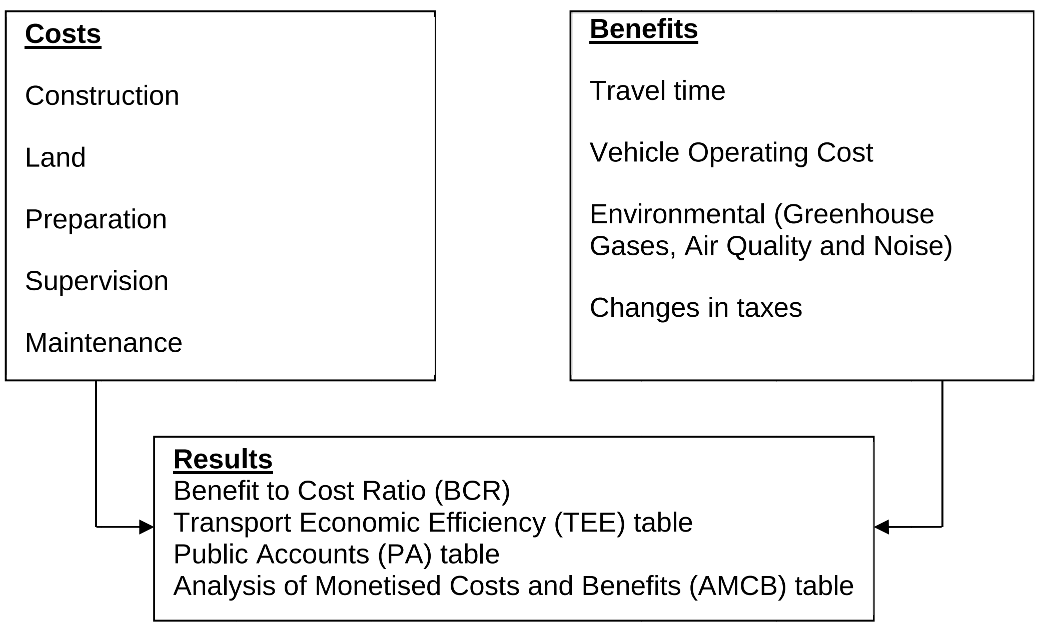

Figure 3.1: Economic Assessment Methodology

3.6 Design Standards

The economic assessment has been undertaken in accordance with the following Transport Analysis Guidance (TAG):-

- TAG Unit A1.1: Cost Benefit Analysis

- TAG Unit A1.2: Scheme Costs
- TAG Unit A1.3: User and Provider Impacts
- TAG Unit A2.1: Wider Impacts
- TAG Unit A2.3: Transport Appraisal in the Context of Dependent Development
- TAG Unit A4.1: Social Impact Appraisal

4 Traffic Modelling Inputs for Economic Assessment

4.1 Introduction

The vast majority of the inputs to economic assessment (such as future traffic flows, journey times and journey distances) are obtained from the Broughton Transport Model.

This chapter provides a summary of the traffic modelling that has been used as the basis of this economic assessment.

Full details of the Broughton Transport Model can be found in the Local Model Validation Report (August 2015) and Model Forecasting Report (September 2015).

4.2 Modelled Area

The study area of the full Broughton Transport Model extends over a wide area, modelled in varying degrees of detail (See Figure 4.1).

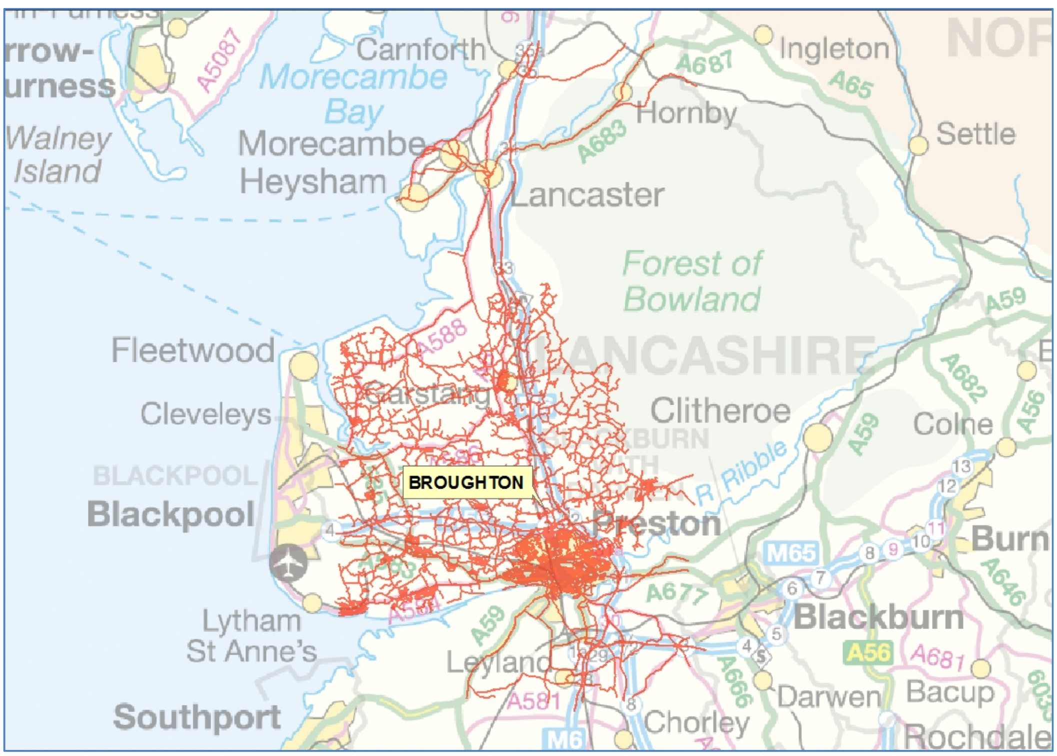

Figure 4.1: Broughton Transport Model Network

For the purpose of economic appraisal and in order to ensure the scheme benefits are robust and only attributable to the impacts of the Broughton Bypass a cordon of the model was produced.

The cordoned network was defined on the basis of the changes in traffic flows and changes in delays in the design year of the scheme. The cordoned network has been agreed with the LEP independent assurer and is demonstrated in Figure 4.2.

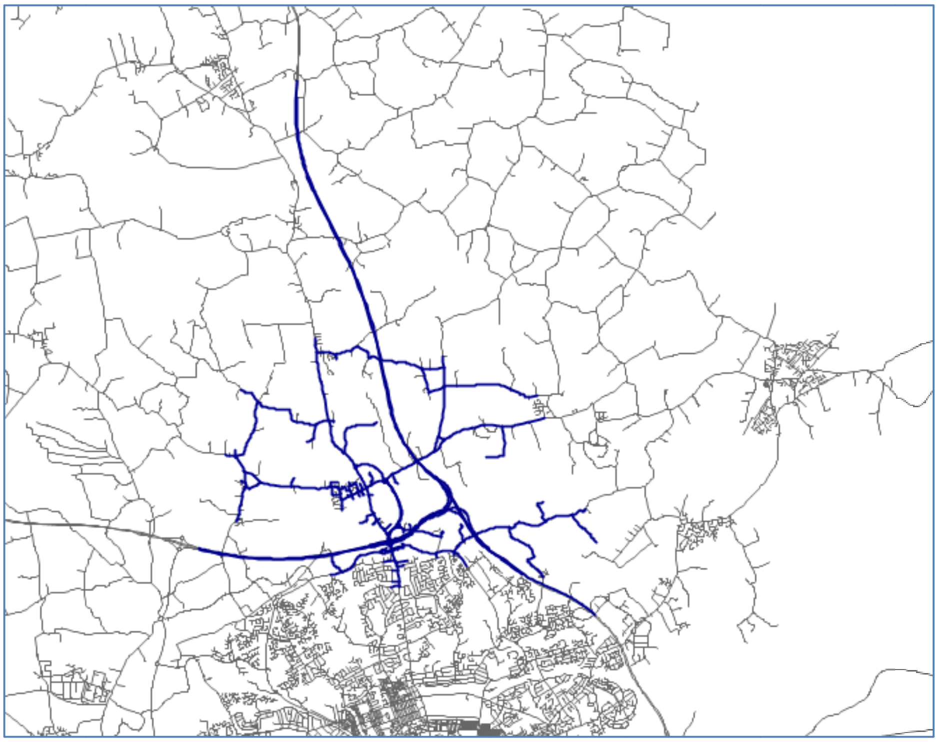

Figure 4.2: Cordoned network

4.3 Modelled Years, User Classes and Time Periods

The traffic model derived future year traffic flows both with and without the scheme in place for the Opening Year (2017) and 15 years after opening, known as the Design Year (2032).

Following TAG guidance, the traffic model splits traffic flows into different vehicle categories and different journey purposes for each modelled year. The future year matrices consist of five 'User Classes':

- User Class 1: Car – Commute
- User Class 2: Car – Employers Business
- User Class 3: Car – Other (Leisure, Education etc.)
- User Class 4: Light Goods Vehicles (LGVs)
- User Class 5: Heavy Goods Vehicles (HGVs)

The traffic model uses the following time periods:

- AM weekday peak (08:00 - 09:00)
- Inter-peak (IP) (an average weekday hour 10:00 - 16:00);
- PM weekday peak (17:00 - 18:00).

4.4 Forecast Scenarios

The economic assessment of the Broughton Bypass is based on the "most likely" traffic forecast scenario known as Core Scenario. It has been produced in line with WebTAG guidance and does not include trips associated with the scheme dependent development. More details on the Core forecasting scenario can be found in the MFR (September 2015).

In addition to the Core Scenario and in line with WebTAG a Low Growth traffic forecast scenario has been developed to take into account a reduced demand as a result of national uncertainty regarding forecasts of population, households, employment, GDP growth and fuel price trends and their impact on future traffic growth.

An additional sensitivity test has been undertaken to assess the impact of “dependent development”. Without the introduction of the scheme, the level of development surrounding Broughton is constrained due to the lack of highway capacity. Once the proposed scheme is in place, additional development may be permitted.

To understand the impact of dependent development on the total benefits of the scheme travel demand associated with the dependent development was added to the Core scenario and the model was re-run with and without the scheme. The benefits were then recalculated based on the new model outputs to produce the BCR for With Dependent Development scenario.

5 Estimation of Costs

5.1 Introduction

The derivation of scheme costs is a crucial part of the scheme appraisal.

Economic assessment considers both the actual cost of the scheme, together with any changes in the capital cost of maintenance in future years.

The costs used in scheme appraisal differ from the outturn costs used for funding decisions. Costs for scheme appraisal are adjusted to the DfT's standard present value year for appraisal (2010) to allow direct comparison with the monetised benefits, and the costs are in calendar years. Scheme costs used for funding submissions are the outturn costs in the expected years of expenditure, and are in financial years.

The derivation of scheme costs for use in appraisal is illustrated in Figure 5.1.

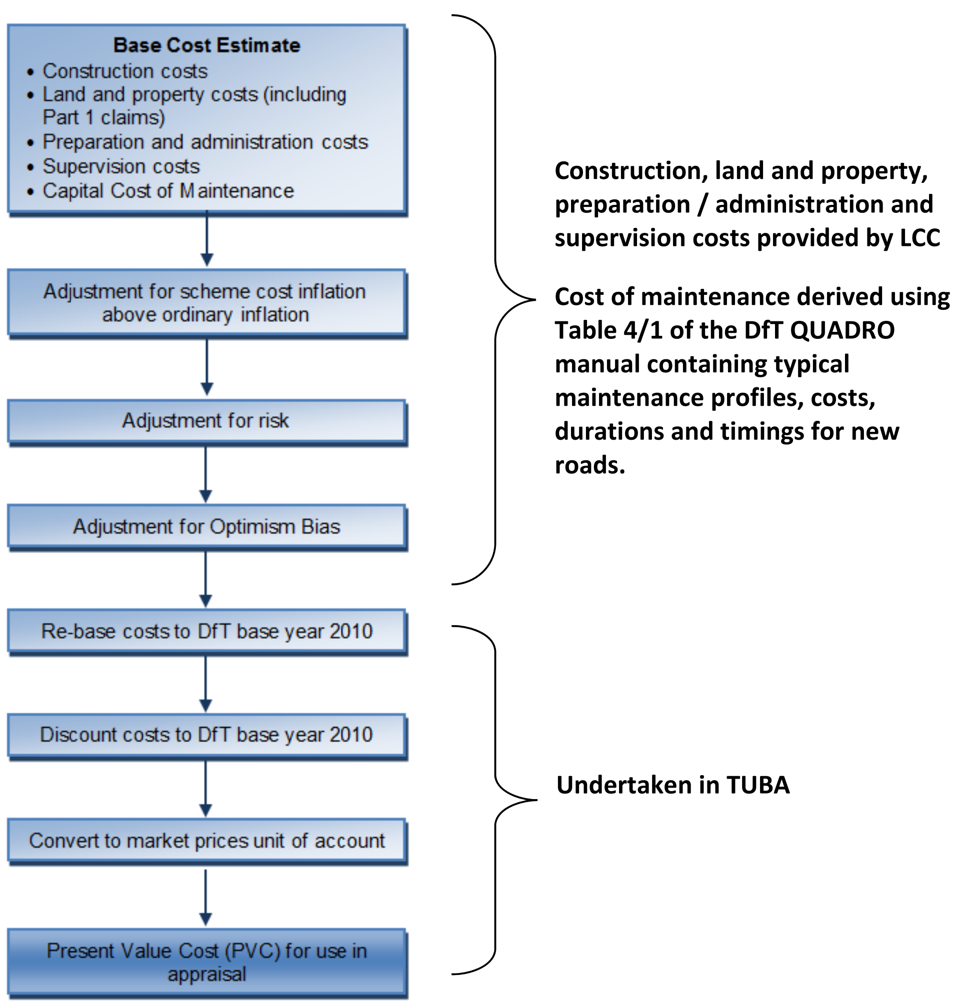

Figure 5.1: Estimation of Costs for Appraisal

5.2 Scheme Costs

Base cost estimates for construction, land / property, preparation / administration and supervision, including adjustment for risk have been provided by the Lancashire County Council and are presented in Appendix A. Costs have been provided in 2014 prices.

The base cost estimates derived by LCC met the following criteria:

- Costs are based on the latest scheme design;
- Expenditure in calendar years;
- Exclude both recoverable and non-recoverable VAT; and
- Exclude any costs that are present in both the Do-Minimum and the Do-Something scenarios.

To ensure that only the costs which will be incurred subsequent to the economic appraisal and the decision to go ahead the costs which have been incurred to date were excluded from the total scheme costs as shown in Appendix A.

The cost estimates were prepared in 2014 prices and then inflated to outturn costs (i.e. expected costs in the actual years of expenditure). These costs were then rebased to 2010 prices using the GDP-deflator series as published in the November 2014 WebTAG databook.

These adjustments have been undertaken by Jacobs, and ensure that the costs account for real changes above or below general inflation (a construction-related inflation of 5% per annum was used).

In accordance with TAG guidance (Unit A1-2), quantified risk assessment (QRA) has been undertaken to consider those risks that may have impact upon scheme costs, their likelihood and the associated financial impact. The QRA was undertaken by LCC. With much of the land required for the construction of the scheme already owned by the LCC only 9% risk has been allowed for from the QRA which was added to the Base Costs to derive risk-adjusted cost estimates, required by the guidance.

Lastly, Optimism Bias adjustments have been made. Optimism Bias is the tendency for scheme appraisers to be overly optimistic about key parameters, including scheme costs. As risk analysis improves during the development of the scheme, the level of Optimism Bias adjustment will decrease. Given the final scheme cost is not expected to be available until the tender procedure in September 2015 for the purpose of this economic assessment the 15% Optimism Bias adjustment was applied to the scheme cost as recommended by WebTAG for the second stage of scheme appraisal (TAG Unit A1.2: Table 8).

In line with DfT guidance and the input requirements of TUBA, the detailed scheme costs have been broken down into the following items:

- Construction
- Land
- Preparation
- Supervision

A summary of scheme costs including Optimism Bias and QRA is shown in Table 5-1 and the cost profile is presented in Appendix A.

Category	Scheme Cost (£m)
Construction	£17.3m
Land and property	£3.4m
Preparation and administration	£0.8m
Supervision	£2.1m
Total	**£23.5m**

Table 5-1: Scheme Costs (in 2014 prices, undiscounted)

5.3 Maintenance Costs

The capital cost of maintenance is the cost of people, machinery and materials to maintain the new highway network.

When the scheme is in place, the bypass will require additional maintenance that would not occur if the scheme was not built. The maintenance cost estimate has been produced using Table 4/1 of the DfT QUADRO manual containing typical maintenance profiles, costs, durations and timings for new roads.

As the costs in QUADRO manual are in 2002 prices they have been converted to 2010 prices using the GDP deflator series.

Similarly to scheme costs an Optimism Bias adjustment of 15% has been made to maintenance costs.

The summary of additional maintenance cost is shown in Table 5-2 and the profile of maintenance costs used is presented in Appendix A.

Section	Additional Maintenance Cost (£m)
Bypass Northern Section	£0.5m
Bypass Southern Section	£2.5m
Total	**£3.0m**

Table 5-2: Maintenance Cost over 60 years (in 2010 prices, undiscounted)

The maintenance cost of the bypass is likely to be partially off-set by a reduction in the maintenance required on the A6 due to a reduction in traffic. However, this effect is likely to be negligible and has not been included in the analysis.

5.4 Present Value of Costs

The costs above were entered into TUBA to be summed over the 60 year appraisal period, converted to 2010 prices, discounted to 2010, and converted to the market price unit of account. A summary of the Present Value of Costs (PVC) output by TUBA is provided in Table 5-3.

	Discounted Costs (£m)
Scheme Costs	£21.1m
Additional Costs of Maintenance	£1.0m
Total PVC	**£22.1m**

Table 5-3: Present Value of Costs

5.5 Public Accounts (PA) Table

A summary of the scheme costs are reported in a standard table known as the Public Accounts (PA) table. The PA table for this scheme is presented in Appendix B.

Note that the PA table includes the effect of the scheme on indirect tax revenues.

This reflects the fact that the Government receives less indirect tax revenues with the scheme in place due to a decrease in fuel consumption – the assessment of this is discussed in detail in Chapter 6.

6 Estimation of Benefits

6.1 Introduction

As discussed previously, a key part of economic appraisal is to determine the benefits of the scheme.

The costs experienced by road users in the situation without the scheme (Do Minimum) are compared to costs in the situation with the scheme (Do Something), which should be a net benefit i.e. following the improvement, costs should be lower.

The different types of benefit which are being assessed as part of the economic analysis are shown below in Figure 6.1.

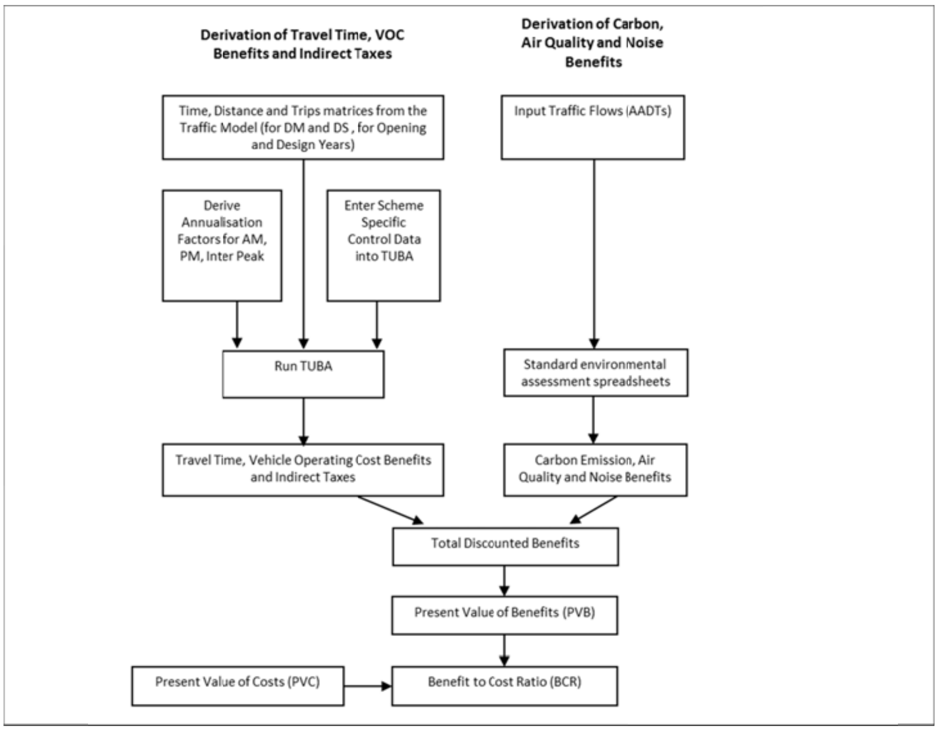

Figure 6.1: Flow Diagram Showing the Process for the Derivation of Benefits

6.2 Transport Economic Efficiency benefits

The Transport Economic Efficiency (TEE) benefits consist of three key components, set out below:

- Travel time and Vehicle Operating Costs (VOC) benefits as a result of the scheme;
- Travel time and Vehicle Operating Costs (VOC) disbenefits as a result of construction activities; and
- Travel time and Vehicle Operating Costs (VOC) benefits as a result of maintenance activities.

As discussed in Chapter 3 Construction and Maintenance delay benefits are not expected to have significant effect on the scheme BCR and Value for Money and therefore construction delay benefits have not been included in the analysis while maintenance delay benefits would only be assessed if the BCR was close to the boundary of a VfM category.

Conversely travel time and VOC benefits are expected to constitute the biggest part of the scheme benefits. Therefore, the analysis of TEE benefits for the Broughton Bypass scheme was driven by Travel time and VOC benefits which were calculated with the use of TUBA.

TUBA is the industry-standard software used to derive the travel time, VOC and Indirect Taxes benefits/ disbenefits of a scheme. It considers the Business and Consumer Traveller Impacts, the Private Sector Provider Revenues and Costs, and the Indirect Taxes elements of the WebTAG requirements.

Travel time saving benefits are derived by comparing the overall travel times in the Do Minimum situation with travel times in the Do Something scenarios.

It will typically take a shorter time to travel through the study area when the scheme is implemented and these time savings are converted into a monetary value. For the appraisal of travel time and Vehicle Operating Cost (VOC) benefits, matrices (tables of trips, travel times and distances between all origins and destinations) from the traffic model are entered into TUBA, along with other scheme specific data.

TUBA assesses travel time savings over the modelled area and then applies monetary values (known as Values of Time (VOT)) to derive the monetary benefits of those time savings.

TAG guidance VOT parameters and forecast changes in their values over future years are included in the standard TUBA economic file (as used within TUBA version 1.9.5).

TUBA also calculates Vehicle Operating Cost (VOC) changes which occur due to changes in costs associated with such items as fuel, maintenance, and wear and tear. These occur due to changes in speed and distance when the scheme is implemented and can include both positive and negative values depending upon the scheme's impact upon traffic flows and routing.

In accordance with best practice, the results of the TUBA assessments have been checked at a sector level (as it would be difficult to do this assessment at a zonal level). The results of those checks are shown in Appendix C.

6.2.1 Annualisation Factors

In accordance with the TUBA guidance, annualisation factors are required to expand the daily modelled time periods to those that occur within a full year.

The model has 3 time periods that represent single hours for a typical average, neutral month weekday:

- AM Peak: 0800 – 0900
- Inter peak (Average hour): 1000 – 1600
- PM Peak: 1700 – 1800

To produce a robust assessment, the annualisation factors need to factor modelled hours to be representative of those periods with similar flows and journey purposes.

The annualisation factors have been calculated based on the standard procedures outlined in the TUBA manual and were derived using Automatic Traffic Count (ATC) data on the A6 Garstang Road north of Broughton cross-roads as a representative road carrying the traffic which will be expected to benefit from the scheme.

The average weekday traffic flow profile was examined to identify time intervals which would be included in the AM, PM and Inter-peak time slices for the TUBA analysis. The criteria was set up so that that if the time interval had a flow within 7.5% of the modelled peak hour flow it would be added to the modelled peak to derive the annualisation factor.

The resultant annualisation factors are shown in Table 6-1. The average day flow profile is presented in Appendix D.

Time Slice	Time	Model Matrix Used	Hours	Days	Annualisation Factor
AM Peak	08:00 to 09:00	AM	1	253	253
Inter-peak	10:00 to 16:00	Inter-peak	6	253	1518
PM Peak	16:00 to 18:00	PM	2	253	506

Table 6-1: TUBA Time Slices

It should be noted that the annualisation factors for AM and PM peaks presented in Table 6-1 as used for the TUBA analysis of the Broughton Bypass scheme are lower than the expected maxima (759) suggested in the TUBA General Guidance and Advice (November 2014), thus proving a suitably conservative approach in calculation of the scheme benefits.

The weekday off-peak (19:00-07:00), weekends and Bank Holidays have been specifically excluded.

Exclusion of off-peak and weekend benefits therefore also confirms a conservative estimate of the scheme benefits.

This is also consistent with latest TAG guidance, which recommends not including benefits from non-modelled time periods.

6.2.2 TUBA Input Parameters

The TUBA input for each assessment consists of a standard TUBA scheme file. The common parameters within the scheme files for all of the TUBA runs including sensitivity tests are shown in Table 6-2 below.

Parameter	Value
TUBA Version	1.9.5 (current version)
First Year	2017
Horizon Year	2076
Modelled Years	2017, 2032
Current Year	2015 (defines the first year in which the discount rate is applied)

Time Slices	3 Time Slices as shown in Table 6-1
Scheme Mode	Road
1st Construction Year	2015
Opening Year	2017
Do Something Costs	As Shown in Tables 5-1 – 5-2
Price	Factor Prices
GDP Deflator	107.65 (deflation factor for 2014 applied to all costs except Maintenance which is in 2010 prices)
Do Something Scheme Cost Profile	As Shown in Appendix A
User Classes	As Shown in Section 4.3
Input Matrices	Time, Distance and Trip Skims

Table 6-2: TUBA Input Parameters

TUBA input file for the Core Scenario is presented in Appendix E.

6.2.3 User Classes and Matrix Input

The 2017 and 2032 matrices have been obtained from the cordoned VISUM model. The following matrices were taken from the model for each future year, vehicle type, journey purpose and time period:

- Trip matrices (in vehicles)
- Time matrices (in hours)
- Distance matrices (in km)

The LGV trip matrices have been split into Commuting/Other trips which account for 12% and Business trips which account for 88% of LGV trips.

As the Broughton transport model does not differentiate between OGV1 and OGV2, the HGV trip matrices have been split by 47% and 53% respectively, based on national average splits.

6.2.4 Assessment of TUBA Warnings

TUBA performs a series of checks on the input data to assess whether the input appears sensible. The checks generally involve comparing the Do Minimum and Do Something input time and distance skim matrices to observe any large differences between values within the matrices. If the ratio of the values is above a specified threshold, TUBA displays a warning message in the output file.

The warning messages were closely checked to ensure that the results were logical. It was decided that warnings affecting a very small demand (less than 5 trips) would not need to be investigated as they are unlikely to have a material impact on the results. Therefore, they were filtered out before the analysis was undertaken.

The remaining three warnings were investigated to make sure that the output was suitable and sensible in relation to the impacts of the scheme.

The analysis of TUBA warnings is presented in Table 6-3 below.

Zone Origin	Zone Destination	Reason for TUBA Warning
Ratio of DM to DS travel time lower than limit		
151	1007925	Ratio < 0.33. Affects demand between two zones north of Broughton. Result of extra delay at minor arm of priority junction in DS due to increase in traffic volume along A6
Ratio of DM to DS travel time higher than limit		
28	1010057	Ratio > 3.33. Significant reduction in JT as a result of the scheme. Affects trips between the zones east of Broughton and Preston
50	1014065	Same as above but different direction

Table 6-3: TUBA Warnings Assessment

6.3 Changes in Indirect Tax

Indirect taxes relate to the taxation levied on goods and services and therefore include excises, duties and VAT. TUBA calculates the changes in Indirect Taxes as a result of changes in speed and distance. These changes affect the amount of fuel being used and therefore affect the amount of taxes the Government receives.

According to the TAG guidance changes in indirect tax revenues are included as part of the Present Value of Benefits (PVB). Therefore, change in Indirect Taxes, as a monetary value in 2010 prices discounted to 2010, is included within the AMCB and PA tables and form part of the BCR.

6.4 Greenhouse Gas Emissions, Noise and Air Quality Benefits

Changes in traffic flows caused by the introduction of the scheme result in changes in greenhouse gas emissions from vehicles, depending on changes in flows, speeds and distance travelled.

The standard Greenhouse Gases Spreadsheet from TAG Unit A3 has been used to calculate the total carbon dioxide emissions (tonnes) for the life of the scheme.

The spreadsheet outputs information on carbon dioxide emissions per year. Benefits are output in tonnes and as a monetary value (PVB).

The standard Air Quality Worksheet from TAG Unit A3 has been used to calculate the change in Air Quality for the life of the scheme. The spreadsheet outputs information on PM10 (Particulate Matter < 10μm) concentrations and NOx (Nitrogen oxides) in tonnes per year. Benefits are also output as a monetary value (PVB).

Changes in traffic flows can also result in changes in noise, depending on whether properties are located adjacent to affected roads or not. The standard Noise Spreadsheet from TAG Unit A3 has been used to calculate the change in noise levels during the life of the scheme, the change in numbers of people “annoyed” and the monetary value of those changes (PVB).

The monetary values of the results are also reported in Chapter 7 of this report.

The results are also included within the AMCB table and the BCR, but not the TEE table.

7 Economic Assessment Results

7.1 Introduction

The different types of benefits and costs, as well as the methodology for deriving them, have been discussed in Chapters 5 and 6.

This chapter presents the results of these assessments and how they have been used to derive the Benefit to Cost Ratio (BCR) for the scheme.

All results in this Chapter relate to the Core Scenario. The Core scenario has been produced in line with WebTAG guidance and does not include trips associated with Dependent Development. More details on the Core forecasting scenario can be found in the MFR (September 2015).

The results for the Low Growth Scenario and scenario which includes dependent development are presented in Chapter 8.

All costs and benefits presented in this chapter have been assessed over a 60-year project lifetime. As discussed in Chapter 3, all costs and benefits are shown in 2010 prices, discounted to 2010.

The final outputs of the appraisal are the Transport Economic Efficiency (TEE) table, the Analysis of Monetised Cost and Benefit (AMCB) table and the Public Account (PA) table, which are enclosed in Appendix B.

7.2 TEE – Travel Time Savings and Vehicle Operating Costs

It will take a shorter time to travel through the study area when the scheme is implemented, resulting in significant decreases in journey times. For Vehicle Operating Costs (VOC), there is likely to be a mixture of increases and decreases in VOC, however, the overall impact of the scheme on VOC is positive.

The results of the travel time assessment show that, as expected, there are significant benefits resulting from journey time savings, amounting to £129.5m.

The scheme also produces a net benefit of £2.7m from a decrease in VOC.

The results are included within the TEE table, as well as within the AMCB table and the BCR. The following paragraphs look at the travel time results in more detail.

Analysis of the travel time benefits by trip purpose, shown in Table 7-1 below, indicates that 42% of the benefits come from Business trips, 22% are associated with Commuting trips and 36% with Other trips.

Purpose	Benefits (£m)
Business	£54.7m
Commuting	£27.8m
Other	£47.0m
Total	**£129.5m**

Table 7-1: Travel Time Benefits by Journey Purpose
(PVB, 2010 prices, discounted to 2010)

Analysis of the travel time benefits by time period, as shown in Table 7-2 indicates that 25% of the benefits are associated with AM trips, 21% with IP trips and 54% with PM trips.

The high proportion of PM trip benefits is due to two hours of PM peak benefits compared to one hour of AM benefits defined from the analysis of traffic flows used to inform the annualisation results.

Time Period	Benefits per Period (£m)
Weekday AM	£32.4m
Weekday Interpeak	£27.2m
Weekday PM	£69.9m
Total	**£129.5m**

Table 7-2: Travel Time Benefits by Time Period
(PVB, 2010 prices, discounted to 2010)

The travel time benefits have been also assessed against the level of time saved, as shown in Table 7-3 below.

Net journey time changes (£m)	0 to 2 mins	2 to 5 mins	More than 5mins
Business	£6.8m	£14.8m	£33.2m
Commuting	£2.2m	£8.0m	£17.6m
Other	£6.8m	£12.5m	£27.8m
Total	**£15.7m**	**£35.3m**	**£78.5m**

Table 7-3: Monetised Time Benefits by Size of Time Saving
(PVB, 2010 prices, discounted to 2010)

The table shows that as expected the majority of benefits are associated with journeys with a decrease in travel time of more than 5 minutes which represents the highest thresholds provided by DfT for travel time savings analysis. Travel time savings of up to 8-9 minutes are noted in the Model Forecasting Report (September 2015).

Travel time savings of greater than 5 minutes account for £78.5m of benefits which is more than 60% of the total travel time benefits of the scheme. As demonstrated in Table 5-3 the pattern is similar across all journey purposes.

The benefit profile over a scheme's life is used to determine whether the benefits of the scheme occur earlier or later in the scheme's life. The benefit profile over the 60-year assessment periods is shown in Figure 7.1. The benefit profile indicates that, as expected, the benefits increase between the Opening Year and the Design Year (last modelled year) and steadily decline after that. The two main reasons for the shape of this profile are:

a. Increasing congestion in future years without the scheme in place, resulting in increased benefits once the scheme is in place; and
b. The impact of discounting over time.

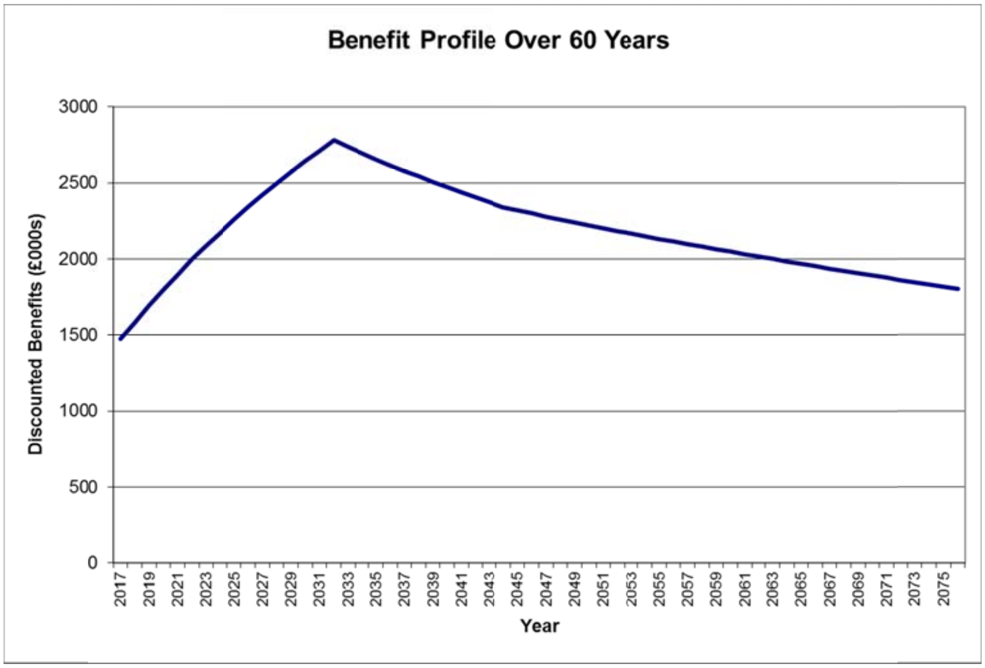

Figure 7.1: Travel Time Benefits - 60 year profile

The geographical distribution of the travel time and VOC benefits is shown in the sector-to-sector analysis contained in Appendix C.

Figure 7.2 shows the total TUBA benefits by sector across the cordoned model.

The sector-to-sector analysis shows that the largest benefits occur between the following sectors which experience reductions in travel time as a result of the bypass:

- A6 South to A6 North
- M6 South to A6 North
- West of Broughton to North of Broughton

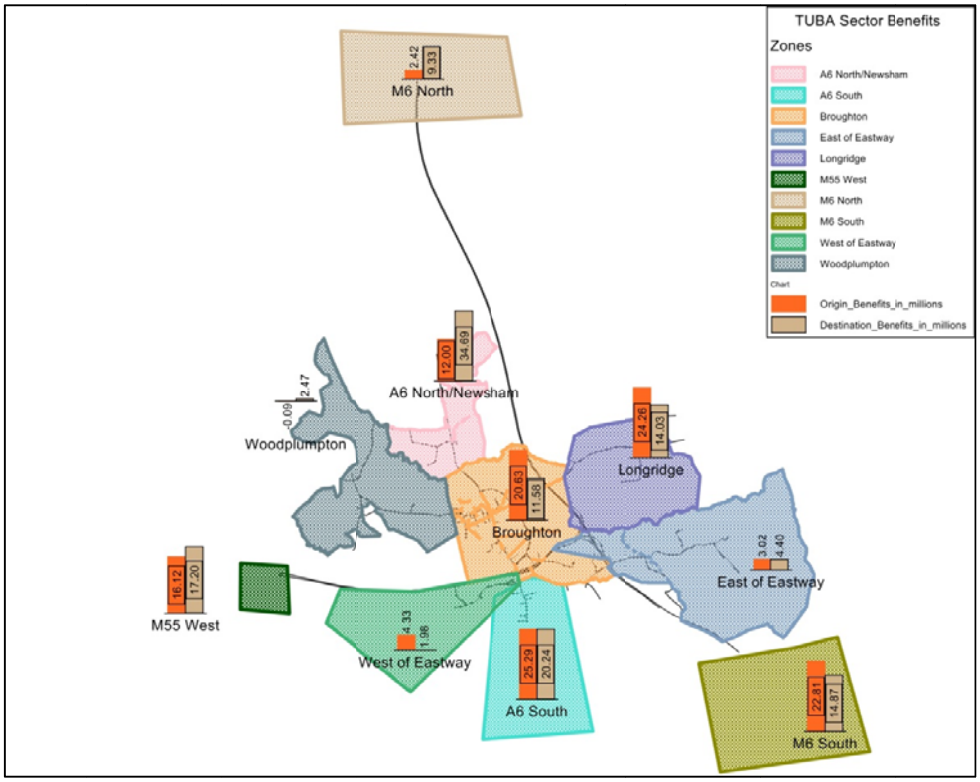

Figure 7.2: Sector Benefits

There are small disbenefits for some traffic movements as a result of increase in traffic on certain roads when the scheme is in place.

In particular, due to a slight increase in the amount of traffic travelling in NW direction along M6 and M55 those trips will experience a slight increase in journey time with the scheme in place.

7.3 Greenhouse Gas Emissions, Air Quality and Noise Results

As described previously Greenhouse Gas Emissions, Air Quality and Noise benefits have been recalculated to reflect the changes to the forecast model.

The results output from the Greenhouse Gas emissions spreadsheet for the study area predict an increase in carbon dioxide emissions in the opening year of 1,626 tonnes and an increase of 64,618 tonnes over the 60 year appraisal period. These changes are due to an increase in distance travelled once the scheme is in place despite there being a decrease in overall travel times. There is no change in traded carbon dioxide emissions as a result of the scheme. The monetary value of the increase in carbon dioxide emissions over the 60 years appraisal period is a dis-benefit of -£3.0m.

The scheme is anticipated to lead to an improvement in air quality overall as well as within the existing AQMA in Broughton, with 16 properties removed from exceedance of the annual mean Air Quality Objective. The decrease in concentrations of PM10 provides a monetary benefit over 60 years of £253k. An increase in regional NOx emissions of 528 tonnes over the 60 year appraisal period is predicted, with an associated monetary disbenefit of -£33k. The total value of the change in Air Quality is therefore a benefit of £0.2m.

The results output from the Noise spreadsheet show that there is predicted to be a benefit from changes in noise levels, equating to £1.2m over the 60 year appraisal period. There will be 24 less people ‘annoyed’ by noise after the scheme is built.

The summary of environmental results is shown in Table 7-4 below.

	Total
Greenhouse Gas PVB	-£3.0m
Air Quality PVB	£0.2m
Noise PVB	£1.2m

Table 7-4: Summary of Environmental Assessment Results
(PVB, 2010 prices, discounted to 2010)

7.4 Changes in Taxes

As discussed in Chapter 6, changes in indirect tax revenues are included as part of the Present value of Benefits (PVB) of the scheme.

The results output from TUBA for the entire study area predict a slight decrease in indirect tax revenues of -£1.4m. This is added to the benefits, as shown in Appendix B.

7.5 Summary

The results of analysis of monetised costs and benefits for the Core scenario are presented in AMCB table (Appendix B). The two commonly known metrics used to compare the benefits and costs of a scheme are the benefit-cost ratio (BCR) which represents benefits divided by the costs and the net present value (NPV) which is calculated as the sum of benefits minus the sum of costs.

The total Present Value of Benefits (PVB) of the scheme exceeds the Present Value of Cost (PVC) by more than £107m. The BCR of the scheme is 5.8 which indicates that the scheme offers Very High Value for Money.

8 Sensitivity Tests

8.1 Introduction

The economic assessment results described in Chapter 7 were calculated using the “most likely” traffic forecasts known as Core Scenario.

As discussed in Chapter 3, a Low Growth forecast scenario has been developed to take into account uncertainty regarding forecasts of population, households, employment, GDP growth and fuel price trends and their impact on future traffic growth.

The Low Growth sensitivity test has been undertaken to investigate what effect the use of the Low Growth traffic forecasts would have on the BCR. To create Low Growth scenario in line with WebTAG Unit M4 a proportion of base year demand has been subtracted from the Core scenario and trips associated with future ’More Than Likely’ developments have been excluded.

An additional scenario has been created to assess the impact of “dependent development”.

Without the introduction of the scheme, the level of development surrounding Broughton is constrained due to the lack of highway capacity. This is evidenced by a lack of planning consents for several developments in Whittingham in recent years without the Broughton bypass scheme.

Once the proposed scheme is in place, additional development may be permitted. For the purpose of the sensitivity test, the travel demand generated by the dependent development planned for the former Whittingham Hospital has been added to the demand modelled in the Core scenario.

It should be noted that the assessment of the impacts of low growth and inclusion of dependent development has only been undertaken in TUBA. All other assessment results (such as accidents and environmental benefits) in the calculation of the PVB and BCR figures are consistent between the Core and the sensitivity test scenarios.

8.2 Economic Assessment Results – Sensitivity Tests

The results of the sensitivity tests are presented in Table 8-1, together with those for the Core Scenario for comparison purposes.

As expected, the Low Growth scenario predicts a moderately lower BCR than the Core Scenario.

The Low Growth scenario resulted in a BCR of 3.9, which is within the High Value for Money category.

The Sensitivity test shows that even with the low growth of economy and traffic in future the Broughton Bypass scheme is expected to continue to have high value for money set against DfT guidance, and that of the Transport for Lancashire assurance framework.

	Low Growth Scenario Forecast	Inclusion of "Dependent Development"	Core Scenario Forecast
TUBA Benefits (Travel time, VOC and Indirect Tax benefits)	£86.9m	£157.1m	£130.8m
Greenhouse Gas, Noise & Air Quality Benefits	-£1.6m	-£1.6m	-£1.6m
TOTAL PVB	**£85.3m**	**£155.5m**	**£129.2m**
TOTAL PVC	**£22.1m**	**£22.1m**	**£22.1m**
Benefit to Cost Ratio (BCR)	**3.9**	**7.0**	**5.8**

Table 8-1: Core, Low Growth and Dependent Development Test Results

The dependent development sensitivity test scenario produced a BCR of 7.0. This proves that as a result of adding extra network capacity with the bypass in place the dependent development trips can be accommodated without causing the same level of delays they would otherwise cause if the scheme is not built.

9 GVA Benefits

9.1 Overview

Gross Value Added (GVA) is an output and productivity metric, measuring the contribution of each individual producer, industry or sector and is generally considered as a measure of economic activity within an area. The GVA analysis seeks to complement the standard economic appraisal and provide an indication of the total GVA that could be realised if a transport scheme is implemented.

Jacobs have undertaken the GVA analysis for the Broughton Bypass based on the methodology developed for the TfL Major Schemes prioritisation work but using the updated transport model results and the most recent planning data received from LCC.

9.2 Methodology

In the absence of a singly recognised and adopted methodology for estimating GVA impacts, the GVA analysis has been undertaken using an evidence-led, theoretically consistent framework approach, based on available studies and parameters, as well as collaborative working with LCC.

This framework of potential GVA benefits has been previously used by Jacobs for the TfL Major Schemes prioritisation work and is shown in Figure 9.1. It defines GVA as Transport-induced changes in jobs, multiplied by GVA per job, adjusted for changes in productivity (agglomeration and labour), plus savings in direct transport costs.

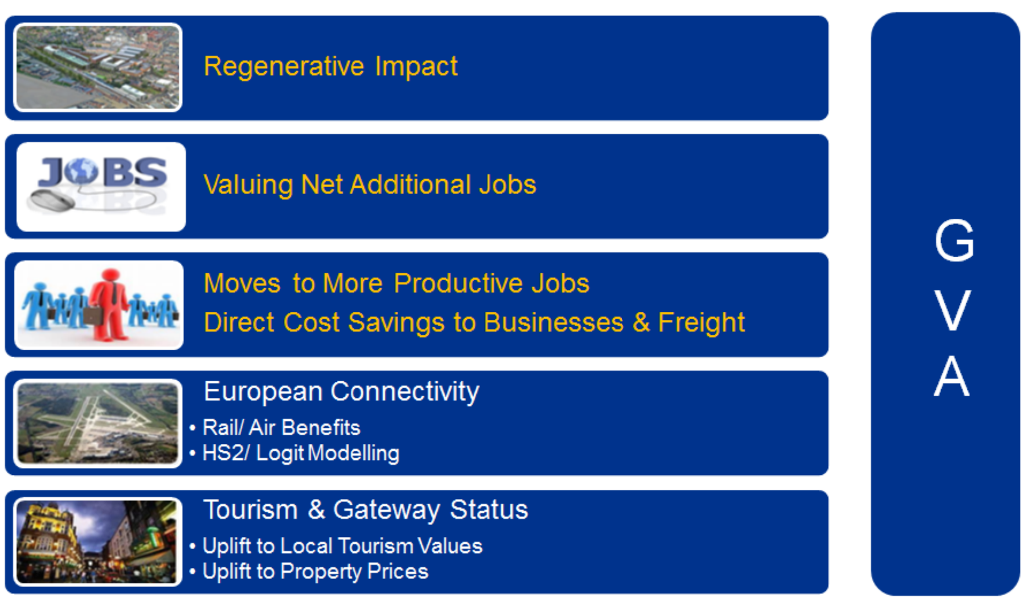

Figure 9.1: GVA Framework of Potential Benefits

Having considered the nature of the scheme, as well as the conclusions of local reviews and workshops, Jacobs identified which sources of GVA benefit are most prominent with respect to the Broughton Bypass.

The bypass is expected to significantly enhance labour connectivity to/from Preston. It is also a precondition for the development in Whittingham in place of the former Whittingham Hospital and it supports a proportion of potential future development in Longridge. Therefore, it was determined that two types of the potential GVA benefits would be relevant for the Broughton Bypass: Unlocking development and Productivity uplifts.

Unlocked development and employment have been quantified by multiplying the number of jobs expected to be generated by the Whittingham Hospital development by GVA per employee. GVA per employee is calculated as a weighted average of employment by industry and GVA per employee in each industry.

As GVA is not only generated by direct, net employment but can also arise through the completion of residential development being unlocked the number of indirect jobs in the local economy generated by this mechanism was also forecast based on HCA appraisal guidance methodologies (2013).

The Longridge development is expected to provide new homes. It was assumed that 20% of them are going to benefit from the Broughton bypass scheme. Therefore 200 dwellings have been converted to number of jobs. The factor employed in this analysis corresponds to 0.15 and has been obtained from the National Housing Federation report The Labour Needs of Extra Housing (2005).

A further proportion of the estimated direct and indirect employment has also been "netted off" by taking current and future transport capacity into account in both the Do Minimum and Do Something scenarios to actually identify which jobs will be unlocked by the transport scheme.

The processes employed in undertaking the above calculations make use of the Broughton Transport model, DMRB and WebTAG2 guidance on the assessment and forecasting of dependent development (WebTAG2 Unit A2-3).

The second type of GVA benefits, which arise from productivity benefits as a result of reduced journey times, is quantified by estimating productivity uplifts for the affected transport users. The data for transport users has been obtained from the transport model. Transport users have been divided into two categories: freight and car users. A different methodology is used for each category.

Productivity benefits from reduced journey times for vehicles transporting freight have been obtained by applying the reduction in journey time to a national average productivity value of time for freight obtained from a study published by AECOM[1]. This value has only been applied to heavy good vehicles.

Productivity benefits for cars have been obtained using a different methodology. In this case, productivity elasticity for reductions in journey time has been used to estimate percentage productivity uplift. This elasticity is derived from a study published by the Institute of Transport Studies (ITS) in Leeds across all relevant journey purposes[2]. This uplift is then applied to existing car users affected by the scheme and the GVA they currently generate by industry.

[1] Wider Economic Benefits- Humber Bridge Study AECOM (2012)
[2] Review of methodologies to assess transport's impacts on the size of the economy (ITS 2010)

The annual benefits obtained in the GVA analysis have been forecast over a 60 year period to be consistent with WebTAG guidance.

As results are streamed over 60 years, a 2% per annum GVA growth rate up to 2036 has been applied in line with WebTAG2 and the WebTAG2 databook guidance on forecast real increases in productivity over time.

The benefits over the 60 year period have then been discounted using a 3.5% discount rate for the first 30 years and then a 3% discount rate as defined in WebTAG, and in line with Treasury Green Book guidance.

9.3 GVA Analysis Results

The results of the GVA analysis for the scheme are summarised in Table 9-1 below.

	Total
GVA benefit from Unlocked development over 60 years	£151.5m
GVA benefits from Productivity increase over 60 years	£1.5m
Total GVA Benefits over 60 years	£153.0m
Benefits per year	£2.5m
Benefits per Employee (in 2030)	£0.003m

Table 9-1: GVA Benefits
(PVB, 2010 prices, discounted to 2010)

The total benefit is derived through unlocked development, employment and productivity impacts which show that the Broughton Bypass would have positive impacts by strongly supporting local economic activity.

It is worth noting that 99% of the GVA benefits come from unlocked residential development and the creation of employment opportunities associated with the two development sites in Longridge and Whittingham which are currently constrained by the available transport capacity – rather than productivity impacts that are more a function of travel time savings.

As GVA analysis is not a mandatory requirement within WebTAG transport scheme appraisal the GVA benefits have not been included in the calculation of the BCR and Value for Money of the scheme. However, it offers a monetised evaluation of the benefits of unlocked growth to the Lancashire economy and is of importance to the LEP and the achievement of its Strategic Economic Plan in particular.

10 Summary and Conclusion

10.1 Summary

The report set out the economic assessment of the proposed Broughton Bypass.

The economic analysis of the monetised costs and benefits of a scheme forms a key element in the overall value for money assessment as prescribed within WebTAG appraisal guidance, and the Appraisal Summary Table framework.

It aims to quantify in monetary terms, over a 60 year appraisal period, as many of the costs and benefits of a proposal as is feasible.

As has been agreed with LCC the economic assessment of the Broughton Bypass is based on the industry standard approach tailored to the specific benefits of the scheme and includes the analysis of travel time and vehicle operating cost benefits, changes in tax and environmental benefits (air quality, noise and greenhouse gases).

To ensure that the travel time benefits of the scheme do not include benefits associated with external trips and/or background noise in the model the cordoned model has been produced which was agreed with the independent assurer.

Construction delay benefits are not expected to be significant due to the nature of the scheme and therefore have not been assessed.

It has been agreed with the client that maintenance delay benefits would only need to be assessed if following the TUBA analysis the BCR was close to the boundary of Value for Money category. As TUBA only BCR was well above the Value for Money category threshold maintenance delay benefits analysis has not been undertaken.

It has been agreed that monetisation of accident benefits is not required and instead a qualitative assessment of accident benefits would be undertaken to support the Business Case.

According to the WebTAG there may be other social and environmental benefits and disbenefits of the scheme such as landscape, historic environment, security etc. that cannot be presented in monetised form. These impacts are beyond the scope of the Economic Assessment Report. However, they are summarised in the Economic Case and Appraisal Summary Table (AST) of the scheme.

10.2 Conclusion

The economic assessment demonstrates that the Broughton Bypass scheme will deliver significant benefits, especially in terms of travel time savings which amount to £129.5m.

The total benefits of the scheme reported in the AMCB table are £129.2m (PVB, 2010 prices, discounted to 2010). The total costs of the scheme are £22.1m (PVC, 2010 prices, discounted to 2010). The Benefit to Cost Ratio (BCR) is therefore 5.8.

Within this the environmental impacts account for -£1.6m of disbenefit over 60 years. There will also be some small disbenefits from a reduction in Indirect Tax revenues.

In accordance with WebTAG guidance, a sensitivity test has been undertaken to understand the economic impact of lower levels of future traffic growth, known as the Low Growth scenario, on the scheme Value for Money. In addition a scenario With Dependent Development was created to test the impact of “dependent development” on the scheme BCR.

The Low Growth scenario resulted in BCR of 3.9 and the dependent development test in BCR of 7.0. This demonstrates that the scheme Value for Money is robust to lower levels of traffic growth in the future as the bypass is still within High Value for Money category, and creates additional benefits if dependent development is coming forward.

The scheme can potentially generate additional £153m of GVA benefits through unlocked development, employment and productivity impacts. The GVA benefits have been estimated using the most advanced methodology available. In the absence of WebTAG guidance for assessment of GVA benefits they have not been included in the calculation of the BCR and Value for Money of the scheme. However, they demonstrate the level of economic growth to be unlocked by the scheme and are of importance to the LEP and the achievement of its Strategic Economic Plan in particular.

Appendix A Scheme Costs and Spend Profile

	Description
A-1	LCC Cost Estimate
A-2	Scheme Cost Profile
A-3	Capital Cost of Maintenance

Appendix B TEE, AMCB and PA Tables

Appendix C Sector-to-Sector Analysis of TUBA Benefits

Figure/Table	Description
Table C-1	Total Benefits
Table C-2	Time Benefits
Table C-3	Fuel VOC Benefits
Table C-4	Non-Fuel VOC Benefits

Appendix D Flow Analysis for TUBA Annualisation Factors

Appendix E TUBA Input File