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Preston Western Distributor Full Business Case

Economic Assessment Report

April 2019

Lancashire County Council

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Executive Summary

This Economic Assessment Report (EAR) has been prepared to support the Full Business Case for the Preston Western Distributor road scheme in Lancashire. It details how the economic appraisal of the scheme has been undertaken, followed by the related results.

The Preston Western Distributor scheme is one of the four major highways schemes set out in the Preston, South Ribble and Lancashire City Deal and is in Transport for Lancashire's (TfL) agreed and prioritised Investment Programme.

The preferred option consists of construction of a new 4.3km dual carriageway road connecting the M55 and A583. It will support delivery of the North West Preston strategic housing development (more than 5,000 dwellings) and improve access to both the Strategic Road Network in Northwest Preston, and to/from the Enterprise Zone at Warton. It will also provide direct links into Cottam development areas, Cottam Parkway Rail Station, and direct connection to the East West Link.

The PWD scheme is designed to promote economic growth whilst simultaneously delivering transport user benefits and business competitive advantage. Therefore, the focus of the economic assessment has been on capturing the wider economic benefits as reported in the Economic Impacts Report (Appendix A of this document); whilst also making sure that the industry standard methodology for deriving transport related benefits was followed as reported in this EAR (this document).

Using the principles of cost-benefit analysis in line with WebTAG and Department for Transport (DfT) recommended tools and software packages the scheme benefits and costs have been calculated over the 60 year appraisal period.

The Initial Benefit Cost Ratio (BCR) of the Preston Western Distributor Preferred Option is 2.09 which represents high Value for Money based on DfT criteria and the criteria of the TfL Assurance Framework.

The scheme will also generate £55.4m of wider economic benefits which have been included in the adjusted BCR (2.49) and £54.7m of dependent development benefits, not included in the calculation of the BCR, but offering a monetised evaluation of land value uplift as a result of the North West Preston strategic site unlocked by the scheme.

In addition to the Core scenario a series of sensitivity tests have been undertaken to take into account uncertainty regarding future traffic growth, and to demonstrate the impact on the Value for Money with the Cuerden Strategic Sites included in the forecast scenario.

Results of the sensitivity tests demonstrate that the scheme Initial BCR represents High Value for Money in High Growth Scenario and Medium Value for Money in Low Growth Scenario. With the wider economic benefits included, the adjusted BCR's of Low Growth Scenario will be in High Value for Money category. The inclusion of the Cuerden strategic site has a minor positive impact on the BCR and Value for Money.

1. Introduction

1.1 Background and Purpose of Report

This report details the economic assessment undertaken as part of the Preston Western Distributor (PWD) Full Business Case. It presents monetised costs and benefits of the scheme, and describes the methodologies used to estimate 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 PWD Full Business Case (TBC) with supporting information provided in the Local Model Validation Report (December 2018) and the Traffic Forecasting Report (December 2018).

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 – Sensitivity Tests:** provides a general description of the sensitivity tests undertaken and the associated results.
- **Chapter 9 – Summary and Conclusions:** provides a summary and conclusions to all the above.

2. Scheme Overview

2.1 Proposed Scheme

The Preston Western Distributor (PWD) is a key component of the programme of measures set out in the Central Lancashire Transport Masterplan (CLTM) that collectively will support the scale of development set out in the approved Central Lancashire Core Strategy and will mitigate its impact on the transport network.

The PWD consists of construction of a new 4.3km dual carriageway road to support delivery of the North West Preston strategic housing development (more than 5,000 dwellings) and improve access to both the Strategic Road Network in Northwest Preston, and to/from the Enterprise Zone at Warton.

The scheme includes a new full access junction with the M55 (Junction 2). It also provides direct links into existing Cottam development areas, the potential Cottam Parkway Rail Station, and direct connection to the East West Link Road. The PWD scheme will also include a combined cycleway footway along the eastern side of the proposed scheme between the A583 and the proposed East West Link (EWL) Road which would tie into existing footpaths and cycle facilities.

As part of the scheme several minor roads (e.g. Lea Road, Sidgreaves Ln) will be altered in the provision of a new roundabout to connect north/south and to/from the East West Link Road. The East West Link Road provides the spine through the Strategic Housing Development and therefore providing connectivity to the PWD of the 5000+ houses proposed. Additionally, it connects the PWD scheme directly with existing highway network at Lightfoot Lane.

The scheme is one of the four major highways schemes in the Preston, South Ribble and Lancashire City Deal and is in TfL’s agreed and prioritised Investment Programme.

A map showing the location of the scheme is included in Figure 2-A below.

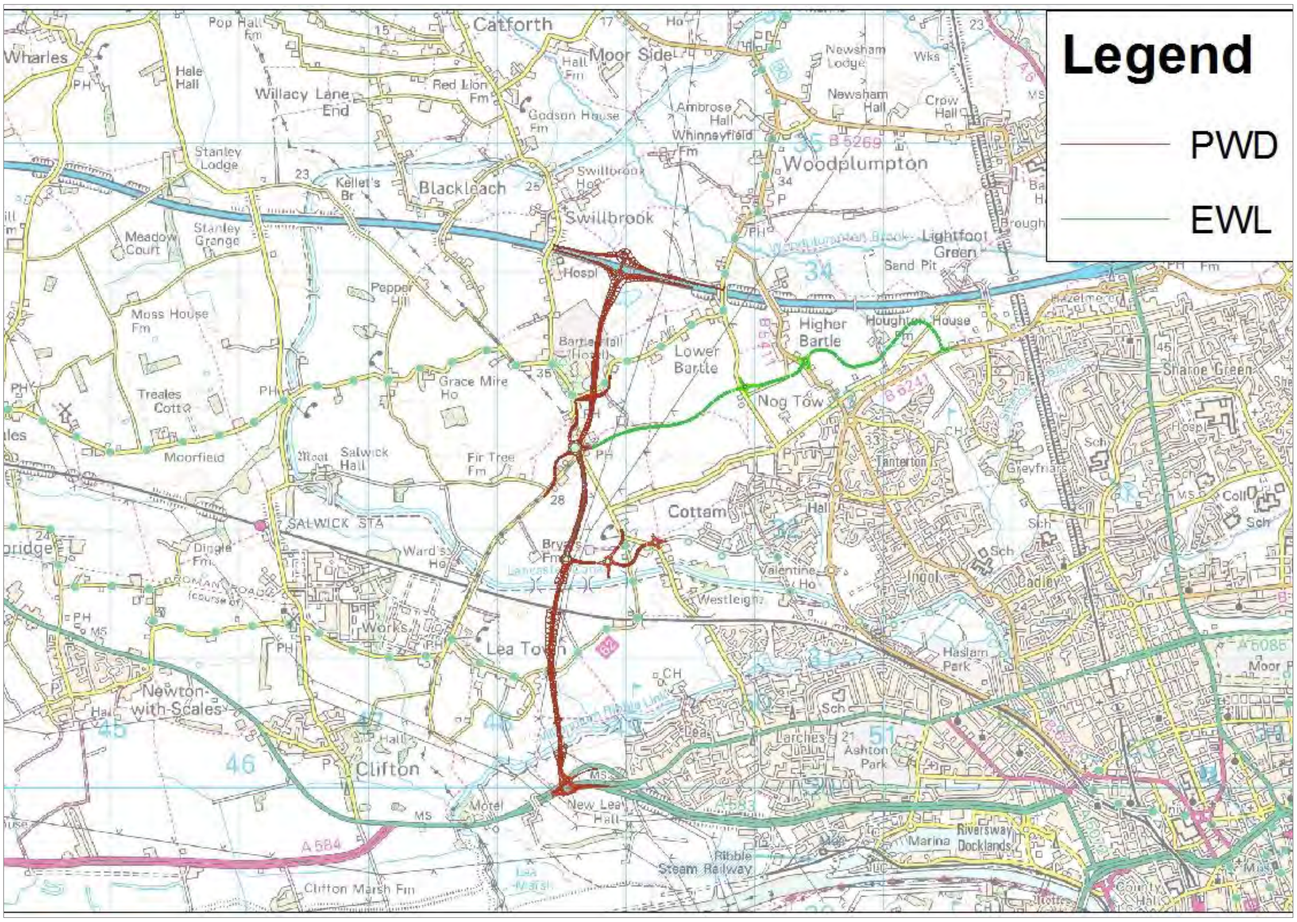

Figure 2-A: Scheme location

2.2 Scheme Objectives

The confirmed scheme objectives as defined in the Option Assessment Report (June 2017) and the PWD Strategic Case are split into two tiers. The three primary objectives are critical to delivery of the Core Strategy and are identified within the CLHTM. The eight supporting objectives relate to the current and future problems within the PWD area of impact. The full set of objectives is listed below:

A. Primary Objectives

1. Unlock capacity for 5,000+ dwellings and their residents in North West Preston;
2. Improve access to the Warton Enterprise Zone site; and
3. Reduce congestion on arterial and radial routes to/from Preston.

B. Supporting Objectives

1. Facilitate access to the proposed Cottam Parkway rail station;
2. Facilitate the implementation of bus priority measures;
3. Facilitate the provision of enhanced walking and cycling networks;
4. Facilitate enhancement of the public realm and local centres;
5. Improve road safety;
6. Improve air quality and reduce noise pollution;

7. Support further housing and employment growth potential in Central Lancashire; and
8. Support the future delivery of a new Ribble Crossing joining with the A582 and A59 routes west of Penwortham.

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.

This chapter provides a general description of the economic appraisal approach adopted for the PWD Full Business Case.

The nature of the scheme, its objectives and potential impacts, as well as lessons learnt from previous projects have been considered in defining the economic appraisal approach. In line with WebTAG recommendation, it was also aimed to ensure that time and resources spent on the economic assessment are proportionate to the size of the investment.

The PWD scheme is designed to promote economic growth whilst simultaneously delivering transport user benefits and business competitive advantage. Therefore, the focus of the economic assessment has been on capturing both traditional sources of scheme benefits, alongside wider economic benefits.

A WebTAG standard assessment requires consideration of the following impacts:

- **Transport Economic Efficiency (TEE) benefits**, consisting of two elements:
  - Travel time and Vehicle Operating Cost (VOC) benefits and disbenefits;
  - Travel time and VOC benefits and disbenefits as a result of construction and maintenance activities;
- Changes in **taxes**;
- The impacts of the scheme on **Accidents**;
- The **Environmental Impacts** (air quality, noise, greenhouse gases) calculated as part of Environmental Impact Appraisal;
- The impacts of the scheme on **Journey Time Reliability**;
- The **Wider Economic Impacts** of the scheme;
- The **Costs** of the scheme, consisting of two elements:
  - Construction, land and compensation, preparation and supervision costs; and
  - Changes in maintenance costs.

Each of the above elements informs the overall Value for Money of the scheme and is considered within the Appraisal Summary Table (AST). However, only some of these elements are currently included within the Analysis of Monetised Costs and Benefits (AMCB) and the calculation of the Initial Benefit to Cost Ratio (BCR).

There are also impacts that can be monetised, but the evidence relating to their appraisal is less developed and therefore there is less certainty about the robustness of their results. These elements contribute to the Value for Money of the scheme but are not part of the AMCB or BCR. In the context of the PWD economic appraisal journey time reliability benefits have been derived but not included in the BCR.

Analysis of the wider impacts of the scheme is reported in the Economic Impact Report (Appendix A). In line with WebTAG some of the wider impacts can be included in the Adjusted BCR. The wider economic benefits that are used to calculate the adjusted BCR are:

- *labour supply impacts;*

- *productivity (static clustering); and*
- *output change in imperfectly competitive markets.*

Land value uplift benefits from unlocking dependent developments, i.e. from North West Preston housing development, are also monetised but not included in the adjusted BCR. They are used as indicative monetised impacts to support the Value for Money conclusions of the scheme.

The relationship between each of the economic impacts, the AMCB, BCR and VfM is illustrated in Figure 3-A.

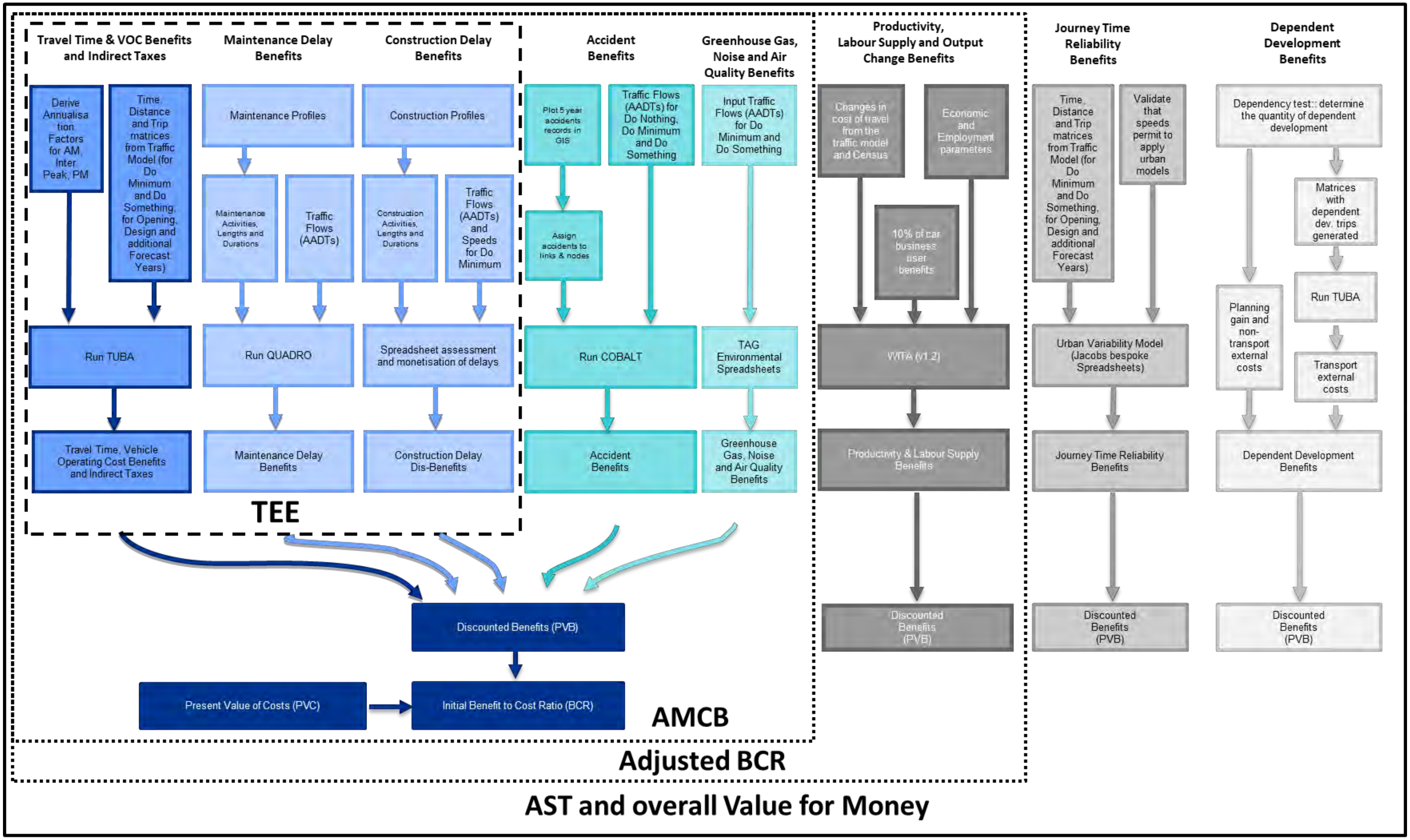

Figure 3-A: Economic assessment approach and relationship between each of the economic impacts, the AMCB, BCR and VfM

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) – version 1.9.11 (June 2018) has been used to derive travel time benefits, VOC and indirect tax benefits of the scheme, as well as the impacts on the transport network of unlocking new development.

COst and Benefit to Accidents – Light Touch (COBA-LT) – version 2013.2 with parameter file 2018.1 (May 2018) has been used to derive the expected change in number of accidents and their associated cost to the economy.

QUeues And Delays at ROadworks (QUADRO) – version 4R16.0 has been used to derive the cost of delay due to construction and maintenance works.

Jacobs bespoke Spreadsheets Analysis Tool has been used to determine journey time reliability impacts of the scheme.

The use of assessment tools 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 minimum two forecast years to demonstrate the long term benefits of the scheme. In line with WebTAG the two forecast years should represent the Opening year and the Design Year of the scheme.

The Opening year of the scheme is forecast to be 2022 and therefore the traffic forecasting was undertaken for 2022 and 2037 (fifteen years after the opening).

Given the cost of the scheme, and recognising the importance of an intermediate year, a third forecast year (2042) has been developed for the appraisal of the PWD scheme.

This approach adds a further level of confidence and support to the Value for Money results of the appraisal. The 2042 final year ensures that:

a) an intermediate year (2037) is available for forecasting, ensuring guidance is met from that respect for major schemes and enhancing robustness of the Value for Money of the scheme, but also that

b) the BCR is in line with 2042 forecasts for the rest of the 60 year appraisal period.

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 2081.

3.4 Discounting of Benefits and Costs

Costs and benefits occur in different years throughout the assessment period, for example 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 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 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 A3: Environmental Impact Appraisal; and
- 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 Central Lancashire Highway Transport Model (CLHTM) which was revalidated with the latest WebTAG values of time specifically for the purpose of the PWD FBC and used the latest TEMPRO 7.2 growth factors to estimate future year traffic demand.

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

Full details of the CLHTM can be found in the Local Model Validation Report (December 2018) and Traffic Forecasting Report (December 2018).

4.2 Modelled Area

The study area of the CLHTM extends over a wide area, modelled in three degrees of detail outlined below and in Figure 4-A:

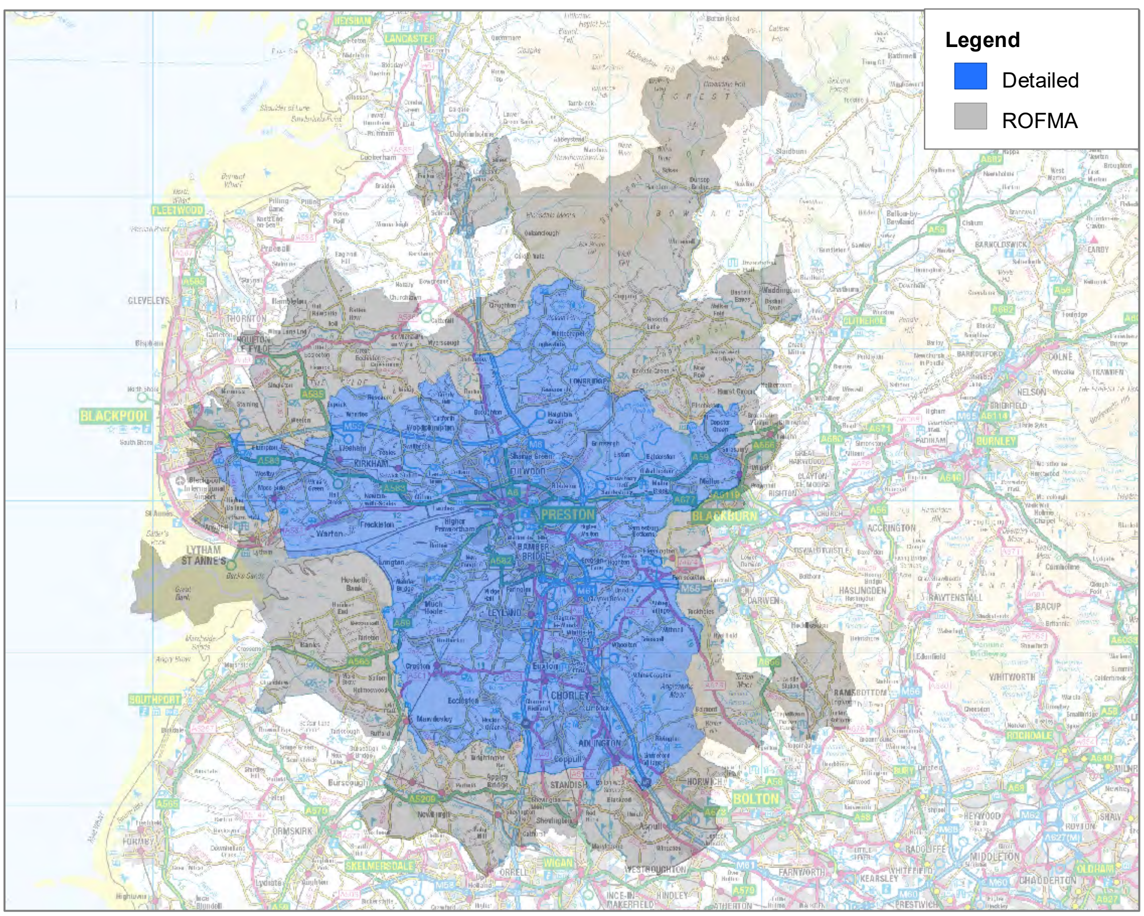

Figure 4-A: Model network structure

- Fully modelled area:

- Area of detailed modelling (Detailed); and
- Rest of fully modelled area (ROFMA).

- External Area (the rest of Great Britain).

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 (2022), 15 years after opening, known as the Design Year (2037) and for 2042.

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); and
- 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); and
- PM weekday peak (17:00 - 18:00).

4.4 Forecast Scenario

The economic assessment of the PWD 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 TFR (December 2018).

In line with WebTAG, an additional 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.

Similarly, a High growth traffic forecast scenario has been developed to take into account an increased demand due to national uncertainty in population and economic forecasts.

A further forecast scenario, referred to as Core+ scenario, has been developed which includes the traffic demand generated by the committed Cuerden Strategic site that had to be excluded from the Core scenario to ensure the traffic growth was constrained to TEMPRO. The test aims to assure the robustness of BCR to such potential changes.

The outputs of the above scenarios are from post Variable Demand Model runs, which have been used to undertake the economic assessment of the PWD.

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-A.

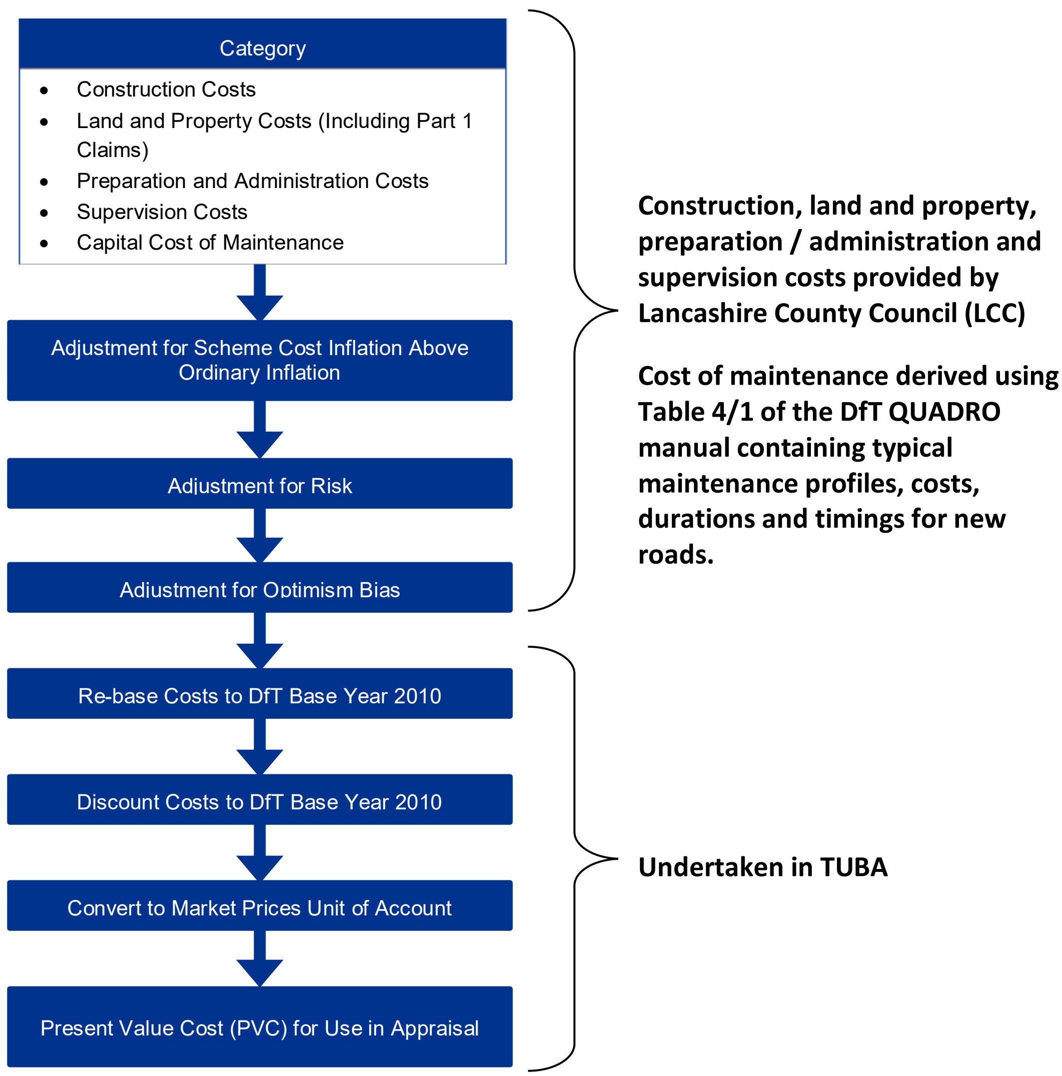

Figure 5-A: Estimation of costs for appraisal

5.2 Scheme Costs

Base cost estimates for construction, land / property, preparation / administration and supervision, including adjustment for risk have been provided by Lancashire County Council (LCC) and are presented in Appendix B. Costs have been provided in 2019 Quarter 1 prices.

The base cost estimates derived by LCC in collaboration with Early Contractor Involvement (ECI) contractor met the following criteria:

- Target construction costs are based on the detailed 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 for the purpose of VfM assessment.

The cost estimates were prepared in 2019 Quarter 1 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 May 2018 WebTAG databook.

These adjustments have been undertaken by Jacobs, and ensured that the costs account for real changes above or below general inflation (a construction-related inflation of 5.5% per annum was used for construction cost and 2.5% for land, preparation and supervision cost).

In accordance with TAG guidance (Unit A1-2), a quantified risk assessment (QRA) has been undertaken to consider those risks that may impact upon scheme costs, with an assessment made of their likelihood and the associated financial impact. The QRA was undertaken by LCC and the ECI Contractor and is reported in the Financial Case. In addition, a Monte Carlo risk probability analysis has been undertaken and the 80% likelihood value was carried forward and 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 will not be known until the construction contract is awarded in 2019, for the purposes of this economic assessment the 3% Optimism Bias adjustment was applied to the scheme cost as recommended by WebTAG for the final stage of scheme appraisal (TAG Unit A1.2: Table 8).

The table below summarises the adjustment made to the base cost for the purpose of economic appraisal.

Scheme Cost Adjustment Breakdown	Scheme Cost (£m)
Base Cost	£153.3 m
QRA Adjustment	£15.6 m
OB (3%)	£5.4 m
Construction Inflation above General Inflation Adjustment	£10.8 m
TOTAL	**£185.1 m**

Table 5-1: Scheme Cost Adjustment Breakdown (in 2019 Q1 prices, undiscounted)

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; and
- Supervision.

A summary of scheme costs including only QRA and construction inflation above general inflation adjustment is shown in Table 5-2 and the cost profile is presented in Appendix B.

Category	Scheme Cost (£m)
Construction	£163.4 m
Land and Property	£12.8 m
Preparation and Administration	£1.3 m
Supervision	£2.3 m
Total	**£179.7 m**

Table 5-2: Scheme Costs (in 2018 Q1 prices, undiscounted)

Table 5-3 shows the costs adjusted to include 3% Optimism Bias.

Category	Scheme Cost (£m)
Construction	£168.3 m
Land and Property	£13.2 m
Preparation and Administration	£1.3 m
Supervision	£2.3 m
Total	**£185.1 m**

Table 5-3: Construction Related Inflation Adjusted Scheme Costs (in 2018 Q1 prices, undiscounted)

5.3 Maintenance Costs

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

When the scheme is in place, the PWD 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 QUADRO manual 2017 (DMRB Volume 14 Sec 1 Part 2 Chapter 4) containing typical maintenance profiles, costs, durations and timings for new roads.

Similarly to scheme costs an Optimism Bias adjustment of 3% has been made to maintenance costs.

The summary of additional maintenance cost is shown in Table 5-4, with the definition of each maintenance section and corresponding assumptions demonstrated in Figure 5-B. The detailed profile of maintenance costs used is presented in Appendix C.

Section	Additional Maintenance Cost (£m)
PWD – Full Route	£8.15 m
PWD – Slip Roads	£1.1 m
Access Roads	£0.56 m
Total	**£9.81 m**

Table 5-4: Maintenance cost over 60 years (in 2010 prices, undiscounted)

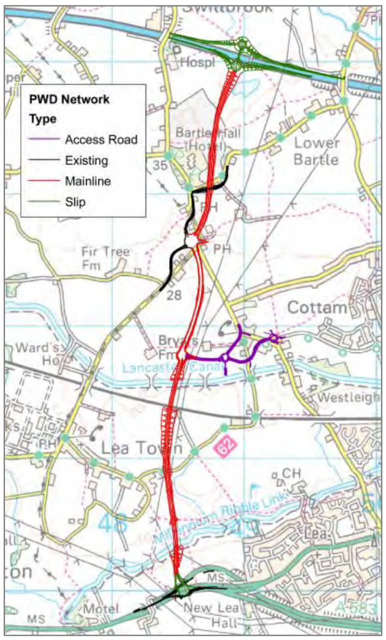

Figure 5-B: Sections defined for maintenance costs appraisal

The maintenance cost of the PWD is likely to be partially off-set by a reduction in the maintenance required on the local road network due to a reduction in traffic, particularly on A6. 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 5-5.

	Discounted Costs (£m)
Scheme Costs	£130.90 m
Additional Costs of Maintenance	£2.73 m
Total PVC	**£133.63 m**

Table 5-5: Present Value of Costs (2010 prices, discounted to 2010)

5.5 Public Accounts (PA) Table

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

Note that the PA table includes the effect of the scheme on indirect tax revenues, which is reported as -£8.24m.

6. Estimation of Benefits

6.1 Introduction

As discussed previously the economic assessment of the PWD was driven by the objectives of the scheme which include standard transport scheme objectives (improving journey times, journey time reliability, safety etc.) as well as providing wider economic benefits for Central Lancashire as identified in the Core Strategy (unlocking housing growth, improving labour supply and augmenting agglomeration and productivity).

This chapter provides a detailed description of how the identified transport impacts of the PWD have been estimated. The methodology and results of appraising wider economic impacts are detailed in the Economic Impact Report (Appendix A). A summary of Wider Impact Benefits results is provided in Chapter 7.

The different types of benefit being assessed for the PWD which can be monetised and are included within the calculation of the Initial Benefit to Cost Ratio (BCR) are summarised in Figure 6-A and detailed in sections 6.2, 6.3, 6.4, 6.5 and 6.6.

The rest of the elements which contribute to the VfM of the scheme but are not part of the BCR are detailed in section 6.7.

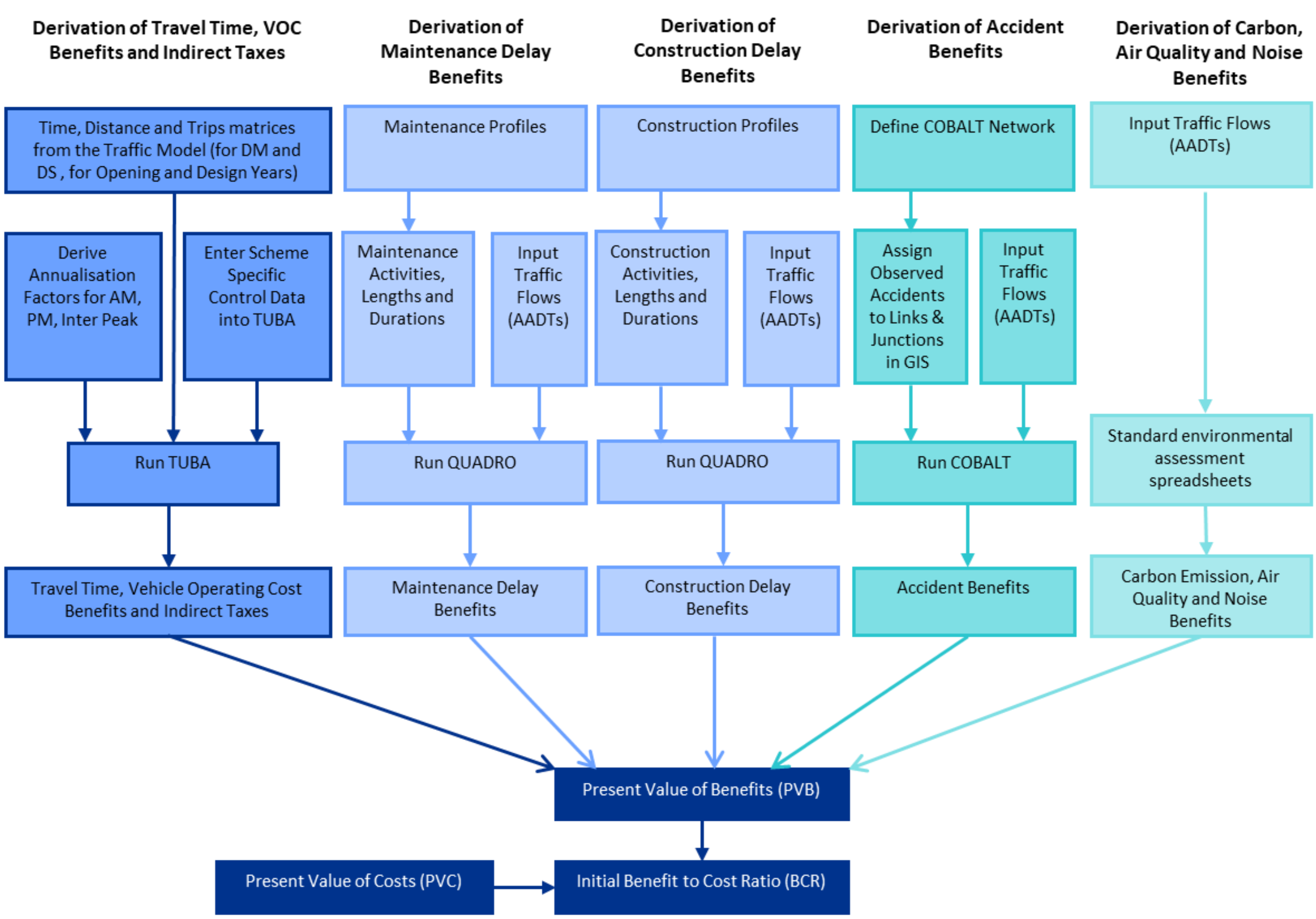

Figure 6-A: The Process for the Derivation of Benefits

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;
- VOC disbenefits as a result of construction activities; and
- VOC disbenefits as a result of maintenance activities.

Traditionally travel time and VOC benefits as a result of the scheme are expected to constitute by far the largest proportion of the scheme benefits used in BCR calculation.

The TEE benefits as a result of the scheme are calculated with the use of TUBA. Along with travel time and VOC TUBA considers other Business and Consumer impacts (e.g. user charges), the private sector provider revenues and costs, and the Indirect Taxes elements of the WebTAG requirements. In the absence of tolled roads, the PWD is not expected to have any impact on user charges or private sector provider revenues. The assessment of changes in Indirect Tax is discussed in one of the subsequent sections of this Chapter.

Travel time saving benefits are derived within TUBA 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.

TUBA also calculates 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.

For the appraisal of travel time and 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 entire 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 1.9.11).

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).

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; and
- 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 permanent Automatic Traffic Count (ATC) data for the A6 Garstang Rd (South of Beech Drive) and A583 (West of Riversway) as representative roads 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 criterion was set up so that that if the time interval had a flow within 10% of the modelled peak hour flow it would be added to the modelled peak to derive the annualisation factor.

The analysis of the traffic flow profile at the permanent count sites on the A6 and A583 showed that the AM and PM each contained 2 hours of traffic within 10% of the modelled peak hour flow. To best represent the modelled area, the AM and PM peak annualisation factors were taken as 506 (253 x 2). In addition, it was concluded that the traffic flow in AM between 09:00 and 10:00 and in PM between 18:00 and 19:00 were comparable with the inter-peak flow and therefore impacts of the scheme in those hours, referred to as AM and PM peak shoulders, could be estimated using travel demand and time and distance skims taken from the interpeak model.

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

Time Slice	Time	Model Matrix Used	Hours	Days	Annualisation Factor
AM Peak	07:00 to 09:00	AM	2	253	506
IP Peak	10:00 to 16:00	Inter-peak	6	253	1518
PM Peak	16:00 to 18:00	PM	2	253	506
AM Peak Shoulder	09:00 to 10:00	Inter-peak	1	253	253
PM Peak Shoulder	18:00 to 19:00	Inter-peak	1	253	253

Table 6-1: TUBA Time Slices

The weekday off-peak (19:00-07:00), weekends and Bank Holidays have been excluded from TUBA analysis. This is consistent with TAG guidance, which recommends not including benefits from non-modelled time periods.

Given that the PWD is not only expected to reduce congestion in peak hours but also provides a faster route between a number of zones in uncongested situation the off-peak benefits or the scheme would be positive and therefore exclusion of off-peak and weekend benefits confirms a conservative estimate of the scheme benefits.

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	1.9.11
First Year	2022
Horizon Year	2081
Modelled Years	2022, 2037 and 2042
Current Year	2018 (defines the first year in which the discount rate is applied)
Time Slices	5 time slices as shown in Table 6-1
Scheme Mode	Road

Parameter	Value
1st Construction Year	2019
Opening Year	2022
Do Something Costs	As shown in Table 5-2 to Table 5-4
Price	Factor Prices
GDP Deflator	113.88 (deflation factor for 2018 applied to all costs except Maintenance which is in 2010 prices) – based on May 2018 TAG Databook
Do Something Scheme Cost Profile	As shown in Appendix B
User Classes	As shown in Section 4.3
Input Matrices	Time, Distance and Trip skims

Table 6-2: TUBA Input Parameters

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

6.2.3 User Classes and Matrix Input

The 2022, 2037 and 2042 matrices have been obtained from the CLHTM SATURN model. The following matrices were taken from the model for each future year, vehicle type, journey purpose and time period:

- Trip matrices (in PCUs);
- Time matrices (in Seconds); and
- Distance matrices (in m).

Appropriate factors were applied in TUBA input file to convert the trip, time and distance matrices to vehicles (only to HGV user class), hours, and kilometer, respectively. 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 CLHTM 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 from COBA Manual Part 4 Chapter 8 ("Table 8/1. Annual Average Category Proportions by Class of Road").

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.

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.

Table 6-3 shows the warnings affecting more than 5 trips and their analysis. It should be noted that none of them was a serious warning, confirming the robustness of the forecasting model.

The TUBA output file for the Core scenario is available upon request.

Warning type	Origin	Destination	Time period	Vehicle type	Purpose	Year	Number of trips	Comment
Ratio of DM and DS travel time higher than the limit	388	312	IP	LGV	All	2022	6.013	Results are logical. Significant journey time saving for the trips going from the zone 388 (next to the PWD southern roundabout) to the north of model. Traffic shift from the route via Tom Benson Way/A6 and Preston city centre to PWD and M55.
					All	2037	7.933	
					All	2042	8.405	
	536	322	PM	Car	Other/ Commuting	2037	5.107/ 9.942	Results are logical. Significant journey time saving for the trips going from the zone 536 (Blackpool) to North-West of Preston. Traffic shift from the route via A583 to M55 and PWD.
					Other/ Commuting	2042	5.181/ 9.965	
Ratio of DM and DS travel distance is lower than the limit	386	528	AM	LGV	All	2037	5.009	Results are logical. Trips from Lea area to M65 switch to PWD instead of going through central Preston which is significantly longer distance but a shorter JT.
						2042	5.307	
	528	387	PM	LGV	All	2037	6.287	Results are logical. Opposite movement of the above.
						2042	6.662	
Ratio of DM and DS travel distance is higher than the limit	429	481	PM	Car	Other	2042	6.5	Results are logical. Trips from the zones north of Lightfoot Lane to the zones east of A6 travel a longer route in DM scenario to avoid the congestion at Lightfoot Lane/A6 junction. In the DS, they choose the shorter route via this junction given the relief of traffic on A6 as a result of the PWD.
	430	481	PM	Car	Other	2042	23.338	
	430	478	AM	Car	Other	2042	14.359	
	398	175	PM	LGV	All	2037	8.507	Results are logical. Trips from the zones south of A59 New Hall Lane to the zones near M6 and M61 junction re-route to the A59 New Hall Lane and M6 junction 31 instead of the longer route within Preston. This is due to congestion relief on the A59 New Hall Lane with the PWD in place.

Table 6-3: TUBA Warnings

6.3 Construction and Maintenance Delays

6.3.1 Construction Delays

During the construction of the scheme, delays will be experienced by road users. These delays can be kept to a minimum through the use of effective traffic management but are unlikely to be removed altogether. This results in travel time and VOC dis-benefits on the existing network that should be considered as part of the TEE assessments.

QUADRO is the industry-standard software used to derive the construction and maintenance delay elements of the TEE benefits of a scheme.

Traffic management arrangements provided by the contractor have been coded into QUADRO for each of the construction activities. QUADRO then calculates the impact upon travel times and applies VOT to derive the monetary value of the changes in travel times.

The preferred traffic management systems as confirmed by LCC for the on-line construction of the PWD connections with the M55 and A583 / A5085 are shown in Table 6-4. The remainder of the construction will be off-line. i.e. away from the existing road network.

Description	Site Length (Km.)	Traffic Management Type	Usual speed limit (Km/h)	Year of work	Duration
Construction of works access on M55	2.6	2 lanes open, 50mph speed limit, 24hrs	113	2019	6 weeks
Use of works access and barriers in hard shoulder to protect Becconsall Bridge and Hodder Diversion works at M55	2.6	Narrow lanes - 3 lanes maintained through works area	113	2020-2022	52 weeks * 2 years
Construction of new junction slip roads, gantries and MS4 signs at M55	2.6	2 lanes open, 50mph speed limit, 24hrs	113	2022	9 months
Install interrupter cable for motorway communications at M55	11.3	1 lane closure	113	2019	3-4 nights
Install MS1 signs and barrier works at M55	11.3	1 lane closure	113	2019	2-3 weeks at nights
Installation of Becconsall Bridge beams at M55	11.3	Full closure	113	2021	5 nights
Removal of existing footbridge at M55	11.3	Full closure	113	2022	1 weekend
Changes of Traffic Management at M55	11.3	Full closure	113	2020-2022	5-6 nights over the 3 years
Construction and removal of temporary alignment at Riversway	1.5	1 lane closure	80	2022	2 weekends
Full closure of junction to undertake surface course and lining works at Blackpool Road	3.5	Full Closure	96	2022	5 nights
Overnight single lane running on westbound to accommodate tie in works at Blackpool Road	3.5	Single lane running on westbound	96	2021-2022	5 nights
Construction of works access at Blackpool Road	0.67	1 lane closure and speed restriction- eastbound	96	2019	3 weeks
Use of works access at Blackpool Road	0.67	Speed restriction - eastbound	96	2019-2021	20 months
Construction of new junction at Blackpool Road	0.67	Eastbound: Lane closure and speed restriction Westbound: 2 lanes open and speed restriction	96	2021-2022	16 months

Table 6-4: Construction Traffic Management Systems

Preparation work commences in 2019 and construction is due for completion in 2022. Traffic flows for the calculation of construction delay disbenefits have been taken from the CLHTM 2022 model.

The monetary values of the disbenefits, based in 2010 prices and discounted to 2010 within QUADRO, are included within the AMCB table and the BCR as well as the TEE table.

6.3.2 Maintenance Delays

Delays will be experienced by road users during periods of maintenance in the future situations both with and without the scheme. With the scheme in place, it is likely that less traffic will be affected by the delays due to maintenance, particularly on the A6 within Preston urban area, given that some of the traffic will shift to the PWD.

Also, less maintenance is required on a new road (i.e. the “maintenance holiday” effect) and therefore the present value of cost of delays due to maintenance of the PWD will be reduced by the effect of discounting.

The Preston Western Distributor and A6 have been split into several sections as shown in Figure 6-B. The maintenance delay is calculated separately for each section in each of the Do Minimum and Do Something scenarios.

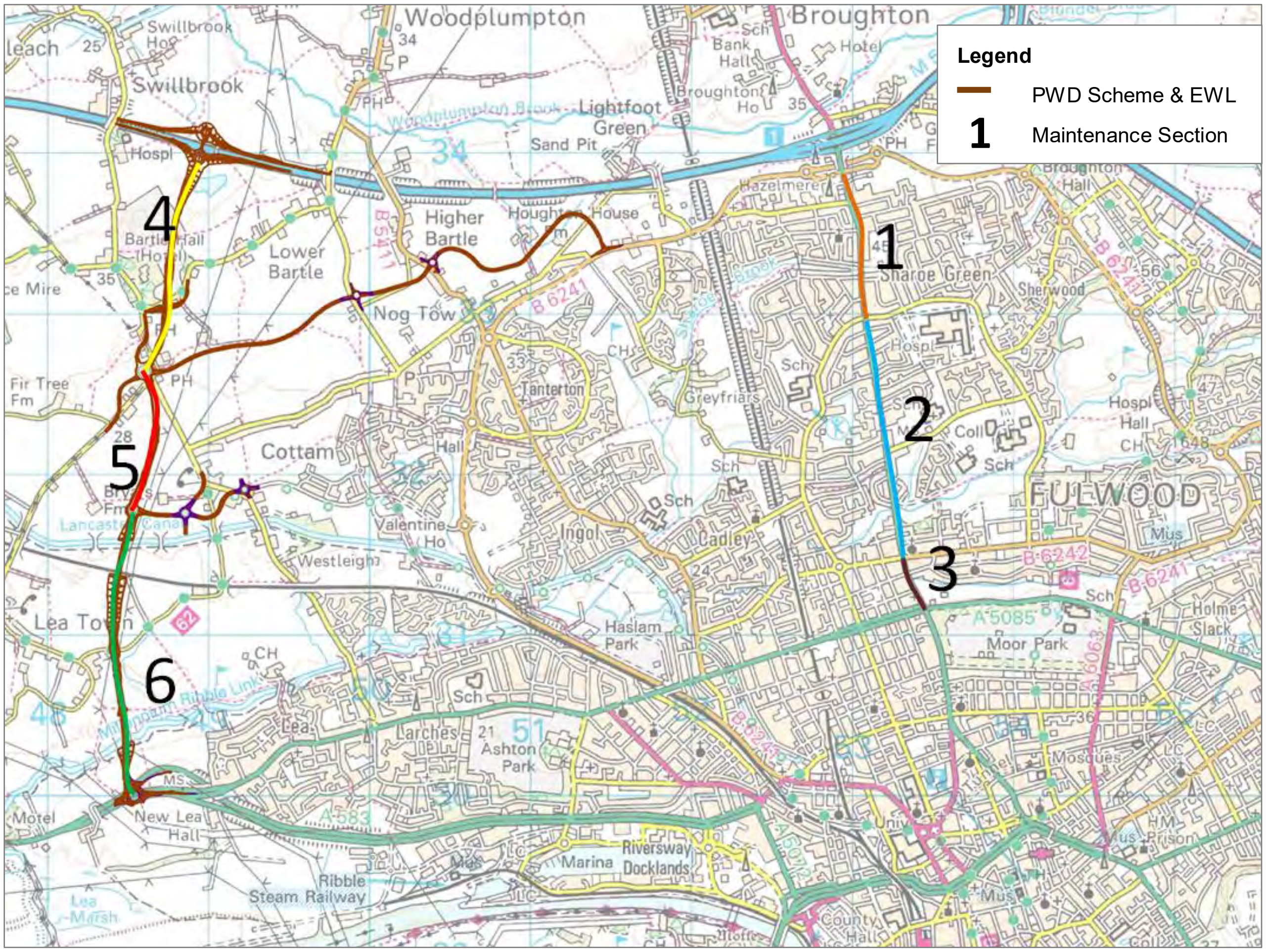

Figure 6-B: Maintenance Sections

Table 6-5 provides a summary of the preferred traffic management systems and roadwork / streetwork assumptions as confirmed by LCC for the maintenance of each section.

Section	Description	Site Length (km)	Traffic Management Type	Diversion Length (km)	Usual speed limit (km/h)	Year of work	Duration (days)
1	A6 Garstang Rd from Eastway to Black Bull Lane	0.3	Shuttle working lane closure Full day	6.28	48	2022 2032 2044 2054 2064 2074	11 3 11 3 11 3
2	A6 Garstang Rd from Black Bull Lane to Lytham Rd	0.25	Shuttle working lane closure Full day	2.16	48	2022 2033 2044 2054 2064 2074	18 6 18 6 18 6

Section	Description	Site Length (km)	Traffic Management Type	Diversion Length (km)	Usual speed limit (km/h)	Year of work	Duration (days)
3	A6 Garstang Rd from Lytham Rd to Blackpool Rd (A5085)	0.25	Shuttle working lane closure Full day	3.11	48	2022 2033 2044 2054 2064 2074	3 1 3 1 3 1
4	PWD from M55 J2 to EWL	1.38	Contraflow with 1 lane open	9.0	113	2033 2044 2054 2064 2074	8 10 17 10 10
5	PWD from EWL to Cottam Link Rd	0.9	Contraflow with 1 lane open	5.1	113	2033 2044 2054 2064 2074	5 6 11 6 6
6	PWD from Cottam Link Rd to Blackpool Rd (A583)	1.82	Contraflow with 1 lane open	4.25	113	2033 2044 2054 2064 2074	11 13 22 13 13

Table 6-5: Maintenance Traffic Management Systems

Forecast year flows are taken as the 2037 design year flows from the CLHTM model.

The QUADRO results are summed separately for the Do Minimum and Do Something scenarios, and the difference between the two is the maintenance benefit/disbenefit.

QUADRO produces output in terms of costs i.e. negative PVB. The results are reported in Chapter 7. The results are also included within the AMCB table and the BCR, as well as the TEE table.

6.4 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.

6.5 Accident Benefits

In line with WebTAG the DfT COBA-LT software (version 2013.2 with parameter file 2018.1 (May 2018) was used to derive the accident benefits of the scheme.

COBA-LT calculates numbers of accidents with and without the scheme, and converts them into monetary values by applying cost of accident prevention. The difference in cost of accidents between the Do Minimum and Do Something scenarios forms the accident benefit of the scheme.

The benefits are discounted to 2010 and summed over the 60-year assessment period.

COBA-LT uses nodes and links to represent the Base, Do Minimum and Do Something highway networks.

The COBA-LT study area for the PWD was defined in such a way that it would include all roads where a significant change in flow between Do Minimum and Do Something scenarios is predicted (taken to be a change in flow of 10% or more). There is no clear guidance on how to identify a study area for COBA-LT analysis. Therefore the 10% criterion was used as it is consistent with how WebTAG defines significant change in traffic flow for distributional impact assessment of accident benefits.

The extent of the COBA-LT network is demonstrated in Figure 6-C. Furthermore, Table 6-6 provides the total number of junctions and links assessed in Do Minimum and Do Something scenarios as part of accident assessment.

Element	Do Minimum	Do Something
Number of Junctions	148	154
Number of Links in Separate Mode	342	380
Number of Links in Combined Mode	752	745

Table 6-6: Number of Junctions and Links Assessed in COBA-LT

Coding of links and nodes was carried out in accordance with the COBA-LT User Manual, and used the CLHTM model as its basis.

Link and junction parameters including speed limits, distances, road class and junction type were obtained from GIS and Google Earth Street View.

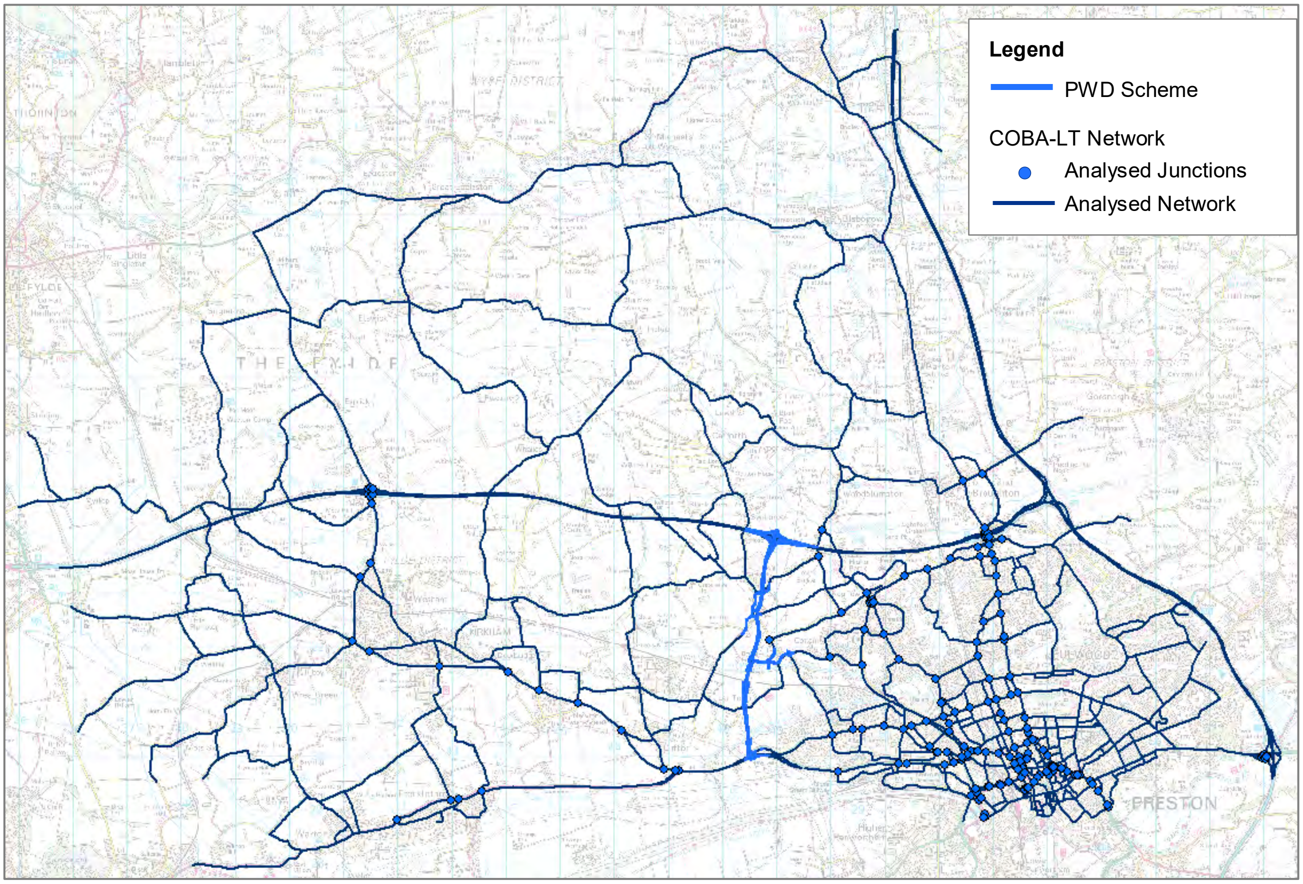

Figure 6-C: COBA-LT Network

COBA-LT calculates the number of accidents from either default (national average) or observed (local) accident rates.

Observed accident rates were calculated from PIA data for the latest available complete five year period at the time of the PWD OBC (2010-2014). It is recognised that a more up-to-date data has been released since then. However, the analysis of the 2015-2016 accident statistics in the study area has demonstrated that the change in numbers of accidents since 2014 is generally consistent with the accident rate decrease inbuilt in COBA-LT and therefore recalculating accident rates using more recent data was deemed disproportionate. Appendix G shows the locations of all PIAs occurring between 2010 and 2014 within the main study area.

The PIA data was plotted in GIS and assigned to the COBA-LT links and junctions in the 2013 Base year scenario to derive the observed accident rates. For the links and junctions that represented the Scheme or parts of the forecast network which are not present in the Base year scenario (e.g. the Preston Western Distributor, East-West Link, etc.), default accident rates were used.

Where a link had no accidents over the five year period, either 0.5 accident per 5 year assumption was applied or the link was joined with an adjacent link with at least one accident over the 5 year period provided that type, speed and AADT flow is the same for the amalgamated links.

The similar principle was applied to any links with unusually high observed accident rates (> 3 PIAs per million veh-km). Any link with an unusually high accident rate was joined with an adjacent link if it satisfied the criteria above, or else the default accident rate was used.

The traffic flows used for accident analysis are the modelled flows derived in the LMVR and the TFR, and are consistent with all other elements of economic analysis contained within this report.

The warning messages within the output files were closely checked to understand their impact on the results of the COBALT analysis. It was concluded that the warning messages mainly related to the observed accident rates being too high. Further checks were carried out to ensure that the inputs for observed accidents rates calculation were correct and the resulting rates were representative of the actual situation on the ground.

COBA-LT outputs the number of accidents and casualties, and their associated costs, discounted over the 60-year assessment period for the future situations with and without the scheme, together with the net changes in accidents and casualties.

The results are shown in Chapter 7.

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

6.6 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 reported in Chapter 7 of this report.

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

6.7 Journey Time Reliability

The term reliability is referred in TAG Unit A1.3 guidance as variation in journey times that individuals are unable to predict. Such variation could come from recurring congestion at the same period each day (day-to-day variability, or DTDV) or from non-recurring events, such as traffic collisions. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects which travellers are assumed to be aware of.

Different methods to estimate reliability impacts have been developed for private vehicle trips on urban roads, interurban motorways and dual carriageways and other roads.

In urban roads, TAG guidance proposes a model that calculates journey reliability benefits as a function of the standard deviation of travel time. In turn, standard deviation is estimated based on changes in journey time and distance due to the scheme:

$$\Delta\sigma_{ij} = 0.0018({t_{ij2}}^{2.02} - {t_{ij1}}^{2.02}){d_{ij}}^{-1.41}$$

Where:

$\Delta\sigma_{ij}$	is the change in standard deviation of journey time from zone i to zone j (seconds)
t_{ij1} *and* t_{ij2}	are the journey times, with and without the scheme, from zone i to zone j (seconds)
d_{ij}	is the journey distance from zone i to zone j (kilometres)

In order to express changes in journey time standard deviation in monetary terms, TAG guidance proposes an estimation based on the rule of a half (see TAG A1.3 section 2.1) and a monetary value of reliability:

$$Benefit = -\frac{1}{2}\sum_{ij}\Delta\sigma_{ij} * (T_{ij1} + T_{ij2}) * VOR$$

The value of reliability (VOR) is obtained by multiplying the value of time by a reliability ratio, estimated as 0.4 and T_{ij1} and T_{ij2} are number of trips with and without the scheme.

This model can be applied under the assumption that alternative routes are readily available to divert away from incidents and was derived on areas on which average free flow speeds were between 37 and 47 kph.

Trips between pairs of zones that are both within Preston and north of South Ribble urban area (see Figure 6-D) fit the alternative routes assumption. Minimal routes and free-flow times have been obtained from the opening year model (AM period) for each pair of zones within this area, dividing them to estimate free-flow speed. The average free-flow speed for all pairs of zones within the study area falls within the required range.

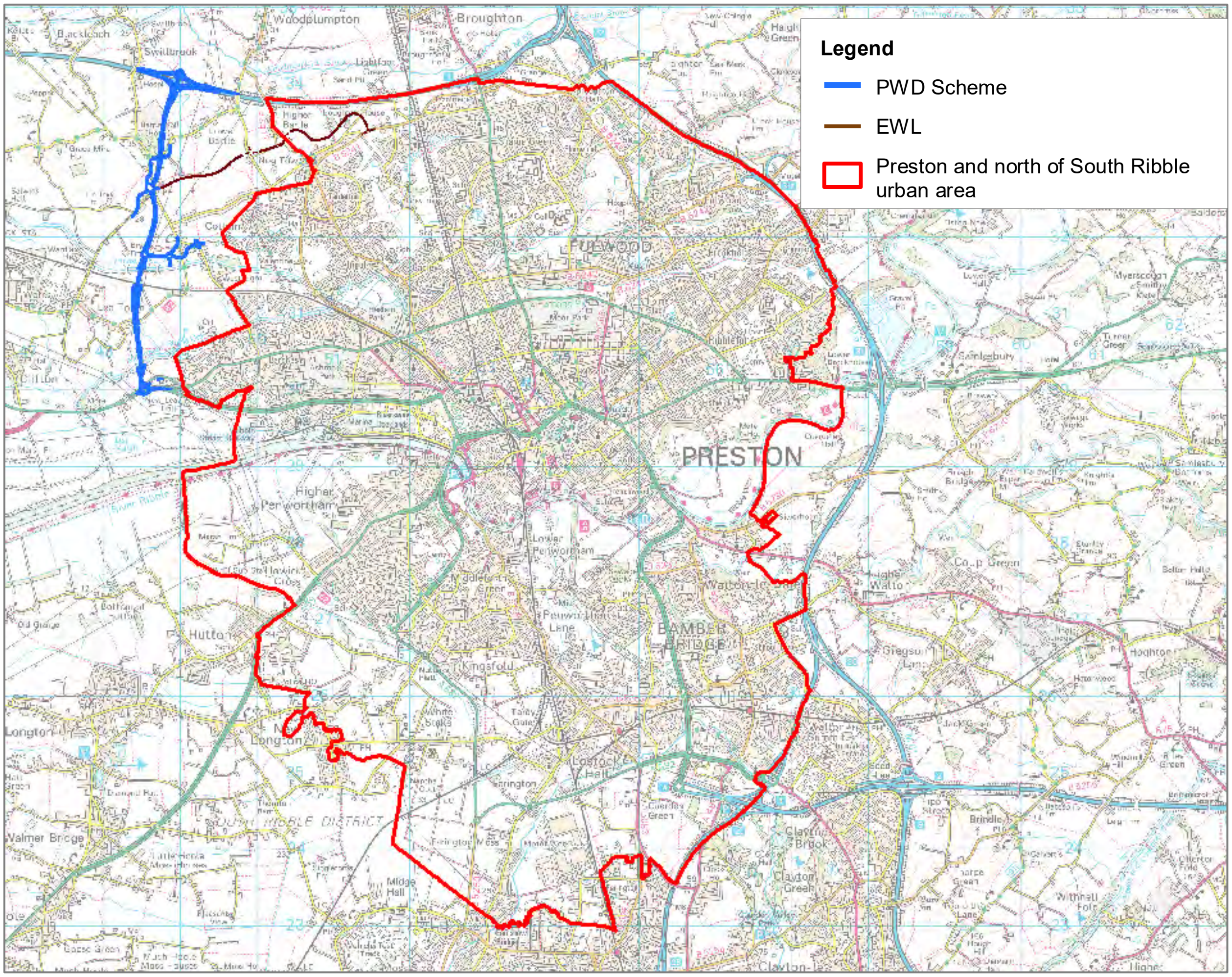

Figure 6-D: Model zones within the urban area of Preston and north of South Ribble considered for Journey Time Reliability in urban roads

Monetised impacts of the scheme on journey time reliability for trips starting and ending within Preston and north of South Ribble urban area have been estimated for modelled years by applying the benefit formula per each year, user class and time period. Results by time period have been annualised to obtain an overall benefit per year.

In order to estimate a monetized impact for the 60-year appraisal period, impacts in seconds have been interpolated for later applying the corresponding value of reliability. Obtained values have been discounted to 2010 and expressed in 2010 prices.

For journeys predominantly on single carriageway roads outside urban areas (other roads), TAG guidance states that it is not currently possible to estimate monetised reliability benefits. However, it states that reliability of road journey times is believed to decline as flows approach capacity.

Based on the predictions of the CLHTM model, for any of the modelled years, annual average daily traffic (AADT) flows on most arterial and radial routes around Preston are expected to decrease due to the introduction of the PWD scheme, improving journey time reliability on these roads.

For motorways and dual carriageways, TAG guidance states that, as alternative routes avoiding particular sections usually have limited capacity, it makes it difficult for large numbers of drivers to divert if they encounter delays due to an incident. In the absence of significant "transient excess demand" (temporary periods of demand exceeding capacity), it may be sufficient to assume that incidents are the main source of unpredictable variability.

The CLHTM predicts a moderate increase on the flows in the motorways and dual carriageways (M55, M6 and M61, with an overall increase of AADT lower than 5% in all modelled years), and consequently a moderate increase of incidents. Impacts on reliability are, hence, expected to be negative but not significant, and can potentially be balanced by positive impacts in single carriageway non-urban roads.

Thus, monetised impacts of the scheme in journey time reliability were calculated considering only the effects on urban roads and are reported in Chapter 7. Given the limitations of the applied approach detailed above and uncertainty regarding the impact of the scheme on journey time reliability across the wider network the monetary value of reliability impact is not included within the AMCB and BCR. It nevertheless provides a valuable indication of the scale of additional benefits of the PWD for the trips within the Preston urban area.

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) and Value for Money of 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 TFR (December 2018).

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 D.

7.2 TEE – Travel Time Savings and Vehicle Operating Costs

It will take a shorter time to travel certain routes through the study area when the scheme is implemented, resulting in significant decreases in overall journey times.

The results of the travel time assessment show that, as expected, there are significant monetised benefits resulting from travel time savings, amounting to £279.7m.

The scheme also produces a net disbenefit of -£15.9 from an increase in VOC. An overall VOC disbenefit, is small in comparison to travel time benefits, is logical as the total travel distance across the network is slightly higher with the scheme than without the scheme. In addition, the impact of Variable Demand Modelling on the travel pattern also contributed to longer journey distances, as described in TFR (December 2018).

The TUBA results are included within the TEE table, as well as 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 31% of the benefits come from Business trips, 34% are associated with Commuting trips and 35% with Other trips.

Purpose	Time Benefits (£m)
Business	£85.3m
Commuting	£95.9m
Other	£98.5m
Total	**£279.7m**

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

Analysis of the travel time benefits by time period, as shown in Table 7-2 indicates that 31% of the benefits are associated with AM trips, 32% with PM trips and 37% with IP trips. The significant proportion of IP benefits is logical. Although journey time savings are higher during peak hours the annualisation factor for IP benefits is higher than for AM and PM benefits.

Time Period	Time Benefits (£m)
Weekday AM	£87.6m
Weekday Interpeak	£103.4m
Weekday PM	£88.7m
Total	**£279.7m**

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

The travel time benefits have been also disaggregated into the three bands of time saved per vehicle, as shown in Table 7-3 below.

Net journey time changes (£m)	0 to 2 mins	2 to 5 mins	More than 5 mins
Business	£14.1m	£22.0m	£49.2m
Commuting	£30.7m	£30.9m	£34.3m
Other	£38.3m	£30.5m	£29.6m
Total	£83.1m	£83.4m	£113.1m

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

Although the table shows that time benefits slightly favour short time savings (up to 5mins), 40% of the total travel time benefits derive from savings of more than 5 minutes. In general, the smaller time savings are due to a reduction in congestion in Preston and the arterial roads accessing it, while larger time savings are experienced by vehicles using the scheme.

The travel time 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-A. The benefit profile indicates that, as expected, the benefits increase between the Opening Year and 2042 (last modelled year) and steadily decline afterwards. The two main reasons for the shape of this profile are:

a) Increasing congestion in future years without the scheme, resulting in increased benefits once the scheme is in place; and

b) The impact of discounting over time.

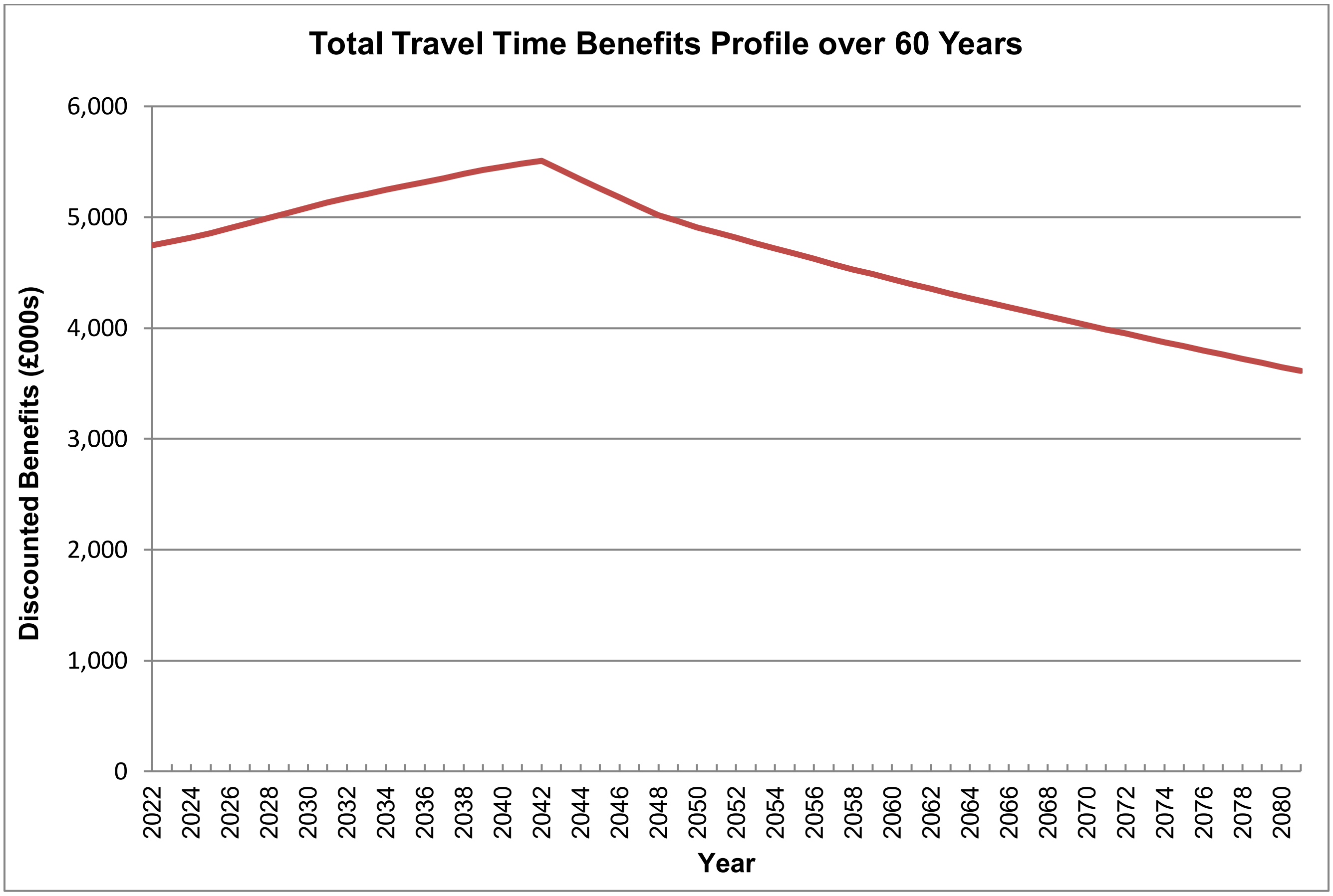

Figure 7-A: Travel Time Benefits - 60 year profile (2010 prices, discounted to 2010)

The trips which account for the largest proportions of travel time benefits are listed below:

- Trips within Preston and between Preston and areas in the north, east and south-east of Lancashire. These trips will benefit from the scheme due to a reduction in congestion on roads accessing or going through Preston, mainly the A6 and the A5085 Blackpool Road. While the unitary benefits per trip are moderate, the high trip demand between these areas relevantly scales the total amount of benefits.

- Trips between Preston and Blackpool, that can use PWD instead of travelling longer journeys through M55 junction 1 or leaving the M55 at junction 3 and accessing Preston through Kirkham and local roads.

- Trips between the Warton Enterprise Zone site and East Lancashire, South-East Lancashire/Bolton and GB south. With the scheme, vehicles can access Warton through M6, M55 and PWD, instead of going through Preston or using local roads.

The sector-to-sector analysis also shows that there could be dis-benefits for some movements mainly those affected by a slight increase in journey time on the strategic road network. The highest disbenefits are expected to come from trips between Blackpool and east Lancashire, the south-east of Lancashire/Bolton and GB south. While unitary dis-benefits per trip are insignificant, high demand scales down the impact on total benefits.

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

7.3 TEE – Construction and Maintenance Delay Results

7.3.1 Construction Delay Results

The PWD scheme is partly being constructed on-line (at junctions with the M55 and A583 / A5085) and partly off-line (away from the existing road network). Delays to existing traffic will be kept to a minimum through the use of effective traffic management, as described in Chapter 6, but it is inevitable that there will be some delays to traffic due to the use of temporary speed and lane restrictions during the construction period.

The construction delay dis-benefits are estimated to be -£2.04m (2010 prices, discounted to 2010). The disbenefit was split between different journey purposes using the same proportions as the TUBA results as presented in Table 7-1. The resulting construction delay dis-benefits to Business, Commuting and Other users are therefore -£0.62m, -£0.70m, and -£0.72m respectively.

7.3.2 Maintenance Delay Results

As discussed in Chapter 6, delays will be experienced by road users during periods of maintenance in the future situations both with and without the scheme.

With the transfer of traffic from Preston urban roads to the PWD fewer trips will be affected by the delays due to maintenance, particularly on the A6. However, the new road will also need to be maintained, and over the 60 year period the overall impact on travel time as a result of maintenance activities is expected to be negative, with a net disbenefit of -£0.69m.

Similarly to the construction delay disbenefits the maintenance delay dis-benefits of £0.69m were split between different journey purposes using the same proportions as the TUBA results. The resulting maintenance delay dis-benefits to Business, Commuting and Other users are therefore -£0.21m, -£0.24m and -£0.24m respectively.

Results of construction and maintenance delay analysis are summarised in Table 7-4. The results are also included in the TEE and AMCB tables and are used in calculating the scheme BCR.

	With Scheme	Without Scheme	Benefit/Disbenefit
Construction delay	£2.04m	N/A	-£2.04m
Maintenance delay	£5.06m	£5.75m	-£0.69m
Total	£7.10m	£5.75m	-£2.73m

Table 7-4: QUADRO analysis results (2010 prices, discounted to 2010)

7.4 Changes in Indirect Tax Revenues

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

Change in indirect tax revenue equates to a net benefit of £8.24m, which is the result of higher distances-travelled with the scheme in place. This is added to the benefits, as shown in Appendix D.

7.5 Accident Results

COBA-LT was used to estimate numbers of accidents, and their associated costs, for the situations both with and without the scheme. The results of the analysis show that there would be an overall decrease in accidents within the COBA-LT study area.

The majority of safety benefits are expected along the A585/A583 corridor and on A6 within Preston which will experience a significant reduction in traffic with the PWD in place. Benefits and disbenefits across the whole COBA-LT network are presented in Appendix I, colour-coded by the size of benefit.

Table 7-5 below shows the decrease in the predicted number of accidents and casualties over the 60-year assessment period for the area of interest. There are predicted to be 8 fewer fatal accidents over this period with the scheme in place. The monetary value of the overall change in accidents would be a benefit of £33.74m (2010 prices, discounted to 2010).

Type	Total
Reduction in number of accidents	**632**
Reduction in number of casualties	
Fatal	8
Serious	100
Slight	732
Total	**840**

Table 7-5: Predicted Accident Reductions over the 60 year Appraisal Period

The accident results are included within the AMCB Table and the calculation of BCR.

7.6 Greenhouse Gas Emissions, Air Quality and Noise Results

As described in Chapter 6 Greenhouse Gas Emissions, Air Quality and Noise benefits have been derived using standard environmental spreadsheets recommended by WebTAG.

The results output from the Greenhouse Gas emissions spreadsheet for the study area predict an increase in carbon dioxide emissions of 393,094 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 -£17.6m.

The scheme is anticipated to lead to a marginal improvement in air quality overall. The decrease in concentrations of PM10 provides a monetary benefit over 60 years of £0.95m. An increase in regional NOx emissions over the 60 year appraisal period is predicted, with an associated monetary disbenefit of -£0.37m. The total value of the change in Air Quality is therefore a benefit of £0.58m.

The results output from the Noise spreadsheet show that there is predicted to be a benefit from changes in noise levels, equating to £6.22m over the 60 year appraisal period. There will be 1,173 less households 'annoyed' by noise after the scheme is built. The results of environmental impacts of the scheme are summarised in Table 7-6 below.

PVB	Core Assessment
Greenhouse Gas	-£ 17.6m
Air Quality	£ 0.58m
Noise	£ 6.22m

Table 7-6: Environmental Benefits (2010 prices, discounted to 2010)

7.7 Journey Time Reliability

The monetised impacts of the scheme on the journey time reliability have been estimated for trips between zones within Preston and north of South Ribble urban area, as detailed in Chapter 6.

As a result of the reduction in congestion and accidents in the urban area of Preston, the scheme is estimated to improve the journey time reliability for trips between the zones within Preston, which is estimated to be a total benefit of £5.0m (2010 prices, discounted to 2010). Table 7-7 shows the results of the journey time reliability analysis by trip purpose:

Purpose	Journey Time Reliability Benefits (£m)
Business	£1.5m
Commuting	£1.2m
Other	£2.3m
Total	**£5.0m**

Table 7-7: Journey Time Reliability Benefits (2010 prices, discounted to 2010)

Given that the journey time reliability analysis was limited to the urban area and there is an uncertainty regarding the impact of the scheme on journey time reliability across the wider network and in line with WebTAG guidance, this element of appraisal is not considered within the AMCB and therefore has not been included in the calculation of the BCR.

7.8 Summary of Wider Economic Benefits

The appraisal of the wider economic benefits of the PWD is reported in the EIR (Appendix A). In line with WebTAG, methods available to capture the wider impacts are not as robust as the traditional transport user benefits presented in this report. Therefore, only some of the wider economic impacts can be included within the scheme's BCR, which will be referred to as adjusted BCR.

A summary of the results of these impacts, extracted from EIR is provided in Table 7-8.

	Benefits (£m, 2010 prices discounted to 2010)
Labour supply impacts	£1.8m
Productivity: Static Clustering	£45.5m
Output change in imperfectly competitive markets	£8.1m
TOTAL	**£55.4m**

Table 7-8: Wider Economic Impacts for Inclusion in Adjusted BCR

Other wider economic benefits will be reported as indicative monetised impacts solely to support the Value for Money conclusions of the scheme as reported in the Economic Case. In this study, benefits from land value uplift as a result of Dependent Developments have been monetised but not included in the adjusted BCR in line with WebTAG.

The benefits from 3,575 dwellings at the North West Preston residential development which have been identified as Dependent Developments on the PWD are £54.7m (2010 prices discounted to 2010.

8. Sensitivity Tests

8.1 Introduction

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

As discussed in Chapter 4, sensitivity tests have been undertaken to investigate the effect on the scheme BCR of travel demand variation.

This chapter describes each sensitivity test and their results in the following order:

- *Low and High Growth;*
- *Core+ Scenario - Inclusion of Cuerden development trips;*
- *Unforeseen Impacts.*

It should be noted that to ensure a proportionate approach the assessment for each sensitivity test has been undertaken in TUBA only. 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 Low and High Growth Sensitivity Tests

Low Growth and High Growth forecast scenarios have 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 and High Growth sensitivity tests have been undertaken to investigate what effect the use of the Low and High Growth traffic forecasts would have on the BCR.

To create a 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.

Similarly, to create a High Growth scenario a proportion of base year demand has been added to the Core scenario along with trips associated with ‘Reasonably Foreseeable’ developments.

Results

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

	Low Growth Forecast	High Growth Forecast	Core Scenario Forecast
TUBA Benefits (Travel Time, VOC and Indirect Tax benefits)	£205.5m	£327.6m	£272.0m
Total PVB	£225.6m	£347.7m	£292.1m
Total PVC	**£133.63m**	**£133.63m**	**£133.63m**
NPV	**£91.97m**	**£214.07m**	**£158.47m**
Initial Benefit to Cost Ratio (BCR)	**1.69**	**2.60**	**2.19**
Total PVB including £55.4m of Wider Economic Impact	£281.0m	£403.1m	£347.5m
Adjusted Benefit to Cost Ratio (BCR)	**2.10**	**3.02**	**2.60**

Table 8-1: Low and High Growth Scenarios **Test Results (£000's, 2010 prices, discounted to 2010)**

As expected, the Low Growth scenario predicts moderately lower TUBA benefits than the Core Scenario, while the High Growth scenario predicts moderately higher benefits. The Low Growth scenario resulted in an initial BCR of 1.69 which represents medium Value for Money, while the High Growth and Core scenarios resulted in a high value for money initial BCR of 2.60 and 2.19, respectively. When considering the wider economic benefits, the proposed scheme presents high Value for Money in all scenarios.

8.3 Core+ Scenario - Inclusion of Cuerden Development Trips

The Core traffic forecasts used in the economic assessment of the PWD have been developed without explicitly modelling trips generated by the Cuerden strategic site in South Ribble. This was to ensure that the level of growth in the core scenario is consistent with TEMPRO forecasts and is further explained in Chapter 4 and the TFR (December 2018).

However, given that the Cuerden development has been granted planning permission and is therefore a more than likely site, a Core+ scenario has been developed to understand the impact of inclusion of Cuerden traffic on the value for money of the scheme.

Results

The results of the Core+ sensitivity test are presented in Table 8-2, together with those for the Core Scenario for comparison purposes.

	Core+ (With Cuerden traffic) Forecast	Core Scenario Forecast
TUBA Benefits (Travel Time, VOC and Indirect Tax benefits)	£275.6m	£272.0m
Total PVB	£295.7	£292.1m
Total PVC	**£133.63 m**	**£133.63 m**
NPV	**£162.07m**	**£158.47m**
Initial Benefit to Cost Ratio (BCR)	**2.21**	**2.19**
Total PVB including £55.4m of Wider Economic Impact	£351.2m	£347.5m
Adjusted Benefit to Cost Ratio (BCR)	**2.63**	**2.60**

Table 8-2: Core+ Scenario Test Results **(£000's, 2010 prices, discounted to 2010)**

Traffic to and from Cuerden will receive benefits from improved journey times due to the PWD and therefore the impact of the inclusion of the Cuerden development site on the VfM is positive. However, despite the size of the development (4,000 jobs) the change from the Core forecast results is relatively minor which may be explained by the fact that the site is located far from the scheme.

8.4 Unforeseen Impacts Sensitivity Test

The above sensitivity tests investigate the impacts of known economic, planning and modelling uncertainty and constraints. This test demonstrates further the economic robustness of the scheme given unforeseen impacts to benefits and costs.

The unforeseen impacts have been represented by 10% changes to benefits or costs to show the value for money of the core scenario in the worst case.

Results

The results of the sensitivity test are presented in Table 8-3.

	Core Scenario Forecast	10% Benefits Reduction	10% Cost Increase	10% Benefits Reduction & Cost Increase
Total PVB	£292.10m	£262.90m	£292.10m	£262.90m
Total PVC	**£133.63m**	**£133.63m**	£146.99m	£146.99m
NPV	**£158.47m**	**£129.27m**	**£145.11m**	**£115.91m**
Initial Benefit to Cost Ratio (BCR)	**2.19**	**1.97**	**1.99**	**1.79**
Total PVB including £55.4m of Wider Economic Impact	£347.5m	£318.3m	£347.5m	£318.3m
Adjusted Benefit to Cost Ratio (BCR)	**2.60**	**2.38**	**2.36**	**2.17**

Table 8-3: Unforeseen Impacts Results (£000's, 2010 prices, discounted to 2010)

The results show that either a 10% decrease to benefits or a 10% increase in costs over the core scenario will drop the initial BCR to 1.97 and 1.99, respectively, which are just under the lower limit of high value for money category. A 10% decrease in benefits with a 10% increase in costs causes the initial BCR to fall to 1.79 into the medium value for money category. Similar to other sensitivity tests, the £55.4m of wider economic benefits will result in adjusted BCR's in high Value for Money category.

9. Summary and Conclusion

9.1 Summary

The economic assessment of the PWD scheme includes consideration of the following impacts, in line with WebTAG guidance:

- **Transport Economic Efficiency (TEE) benefits**, consisting of two elements:
  - Travel time and Vehicle Operating Cost (VOC) benefits and disbenefits; and,
  - Travel time and VOC benefits and disbenefits as a result of construction and maintenance activities.
- Changes in **taxes**;
- The impacts of the scheme on **Accidents**;
- The **Environmental Impacts** (air quality, noise, greenhouse gases) calculated as part of Environmental Impact Appraisal;
- The impacts of the scheme on **Journey Time Reliability**;
- **Wider Economic Impacts** as a result of the proposed scheme:
  - Labour supply impacts;
  - Productivity - Static Clustering;
  - Output change in imperfectly competitive markets;
  - Dependent Development benefits (land value uplift).
- The **Costs** of the scheme, consisting of two elements:
  - Construction, land and compensation, preparation and supervision costs;
  - Changes in maintenance costs.

A summary of the economic assessment results is provided in Table 9-1.

Impact			Benefits (£m)
Costs	Investment Costs		-£130.9m
	Operating Costs (Capital Costs of Maintenance)		-£2.7m
	Total PVC		**£133.6 m**
Benefits within Initial BCR	TEE Benefits	Commuting Travel Time Benefits	£95.9m
		Other User Travel Time Benefits	£98.5m
		Business User Travel Time Benefits	£85.3m
		VOC Benefits	-£15.9m
		Construction Delay Benefits	-£2.0m
		Maintenance Delay Benefits	-£0.7m
	Indirect Tax Revenues		£8.2m
	Accident Benefits		£33.7m
	Greenhouse Gas Emissions		-£17.6m
	Air Quality		£0.6m

Impact		Benefits (£m)
	Noise	£6.2m
	Total PVB	**£292.1m**
Net Present Value (NPV)		**£158.5m**
Initial Benefit to Cost Ratio (BCR)		**2.19**
Wider Economic Impacts for Inclusion in Adjusted BCR	Labour supply impacts	£1.8m
	Productivity: Static Clustering	£45.5m
	Output change in imperfectly competitive markets	£8.1m
	TOTAL	**£55.4m**
Total PVB (including Wider Economic Impacts)		**£347.5m**
Adjusted BCR		**2.60**
Benefits not included in BCR	Journey Time Reliability Benefits	£5.0m
	Dependent Development benefits (land value uplift)	£54.7m

Table 9-1: Summary of Economic Assessment Results (2010 prices, discounted to 2010)

A set of sensitivity tests has been undertaken to investigate the effect on the scheme BCR of travel demand variation, and the inclusion of trips generated by the Cuerden Strategic site, which is excluded in the Core scenario. To ensure a proportionate approach the assessment has been limited to TUBA analysis. All other assessment results were assumed to be consistent between the Core and the sensitivity test scenarios. The results are provided in Table 9-2.

	Core Scenario	Low Growth Scenario	High Growth Scenario	Core + Scenario
TUBA Benefits (Travel Time, VOC and impacts on taxation)	£272.0m	£205.5m	£327.6m	£275.6m
Total PVB	£292.1m	£225.6m	£347.7m	£295.8m
Total PVC	£133.63m	£133.63m	£133.63m	£133.63m
NPV	**£158.47m**	**£91.97m**	**£214.07m**	**£162.07m**
Initial Benefit to Cost Ratio (BCR)	**2.19**	**1.69**	**2.60**	**2.21**
Total PVB including £55.4m of Wider Economic Impact	£347.5m	£281.0m	£403.1m	£351.2m
Adjusted Benefit to Cost Ratio (BCR)	**2.60**	**2.10**	**3.02**	**2.63**

Table 9-2: Summary of Sensitivity Tests Results (2010 prices, discounted to 2010)

9.2 Conclusion

Economic assessment of the PWD demonstrated that the scheme delivers significant travel time benefits, together with a reduction in accidents in the local and urban roads surrounding the scheme. The total benefits of the scheme reported in the AMCB table are £292.1m (PVB, 2010 prices, discounted to 2010). The total costs of the scheme are £139.6m (PVC, 2010 prices, discounted to 2010). The initial Benefit to Cost Ratio (BCR) is therefore 2.19, which demonstrates high value for money.

The scheme also delivers wider economic benefits from labour supply, productivity (static clustering) and output change in imperfectly competitive markets, which equate to £55.4m (2010 prices, discounted to 2010) and results in adjusted BCR of 2.60. Other impacts which have been monetised but not included in the BCR calculations are journey time reliability (£5m; 2010 prices, discounted to 2010) and land value uplift as a result of unlocking dependent development (£54.7m; 2010 prices, discounted to 2010).

The results from sensitivity tests resulted in a lower initial BCR for the Low Growth traffic demand scenario (1.69), a higher initial BCR for the High Growth scenario (2.60) and slightly higher initial BCR of 2.21 for the Core+ scenario. With the inclusion of the wider economic benefits, the adjusted BCR's in all scenarios will be in high Value for Money category based on DfT criteria and the criteria of the TfL Assurance Framework.

Appendix A. Economic Impact Report