East Reading Mass Rapid Transit

Economic Assessment Report

COMMERCIALLY SENSITIVE DATA REDACTED

On behalf of **Reading Borough Council**

Project Ref: 28791/5513 | Rev: AA | Date: September 2017

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Document Control Sheet

Project Name: **East Reading Mass Rapid Transit**

Project Ref: **28791/5513**

Report Title: **Economic Assessment Report**

Doc Ref: **28791-5513-EAR**

Date: **September 2017**

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Revision	Date	Description	Prepared	Reviewed	Approved
-	19-12-16	First Issue	NM	PG	SM
A	27-06-17	Updates to ITA comments	NM	SM	SM
B	29-09-17	Updates to ITA comments	NM	PG	SM
C	20-10-17	Updates to ITA comments	NM	PG	SM
D	01-11-17	Updates to ITA comments	NM	PG	SM

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1 Introduction

1.1 Background

1.1.1 This document has been produced in support of a bid to the Thames Valley Berkshire Local Enterprise Partnership to secure the funds available to the Local Transport Body and allocated to the East Reading Mass Rapid Transit (ERMRT) Scheme.

1.1.2 Decisions on transport investment are informed by evidence set out in a business case. The Business case has been developed in line with Treasury's advice on evidence-based decision making as set out in the Green Book and uses its best practice five case model approach.

1.1.3 This document sets out the economic assessment that informs the Economic Case for the Business Case.

1.2 Scheme Description

1.2.1 The ERMRT scheme is a segregated fast track public transport, pedestrian and cycle route that will support enhanced accessibility and continued sustainable growth in Reading, Wokingham Borough and the wider area.

1.2.2 The MRT route is proposed to link the A3290 at Thames Valley Park, from the proposed new Park & Ride facility, to Napier Road, Reading town centre and the railway station.

1.2.3 The purpose of the scheme is to improve the attractiveness of travelling more sustainably, therefore reducing private car trips, easing forecast congestion and air quality along the existing highway network, particularly on the heavily congested A4 London Road corridor. Further background detail, scheme objectives etc. are provided with the main business case document.

1.3 Economic Assessment Overview

1.3.1 The modelling work used to inform the economic assessment was undertaken using the Reading Transport Model and a Passenger Transport spreadsheet based demand model. Outputs from the models were used within the economic assessment, which was undertaken using TUBA (Transport User Benefit Appraisal). The economic assessment informs the Economic Case, as one of the five cases within the Business Case.

1.3.2 Additional benefits of the scheme, such as walking and cycling benefits, bus reliability benefits and benefits for users of the Thames Valley Park Business Park shuttle bus, Heathrow RailAir and other bus services have been undertaken outside of the TUBA. These are detailed further in Section 2.8.

1.4 Structure of Report

1.4.1 Following this introduction, the report is set out in the following structure:

- Section 2 – Economic Benefits
- Section 3 – Public Accounts
- Section 4 – Sensitivity Tests
- Section 5 – Summary and Conclusion

2 Economic Benefits

2.1 Overview

2.1.1 The economic assessment methodology has been undertaken in line with the Department for Transport (DfT) guidance set out in WebTAG.

2.1.2 Monetised benefits for the ERMRT scheme are assumed to include:

i. Additional revenue as a result of increased patronage on bus services and park and ride from both Thames Valley Park and Winnersh due to journey time savings introduced by the scheme

ii. User benefits for existing bus and park and ride users – equivalent to the journey time saving with scheme introduced

iii. User benefits for new users – assumed to have switched from car and hence have a saving in generalised cost equivalent to the generalised cost of previously travelling by car without the scheme and new generalised cost with the scheme

iv. Decongestion benefits as a result in reduction of highway trips through mode switch to bus and park and ride

v. User benefit for Thames Valley Park business park bus users as a result of journey time savings when the scheme is introduced

vi. Benefits accrued from benefits for public transport users at weekends – no weekend model exists so it has not been possible to estimate these

vii. Bus journey time reliability – buses are likely to be far more reliable when the scheme is developed. This is due to selected services avoiding the main pinch point on London Road between the A3290 and Cemetery junction.

viii. Additional Non-User Benefits or marginal external costs arising from a reduction in highway trips, which are likely to be relatively small in the case of this scheme. These include;

- Accident benefits;
- Noise; and
- Air Quality – greenhouse benefits that would accrue as a result of the scheme are captured within the TUBA assessment. These benefits are associated with changes in highway trips (reduction and reassignment), as well as a result of some buses switching from the congested highway network around London Road/Cemetery junction to ERMRT, where they will operate with lower emissions.

ix. Benefits from additional cyclists as a result of provision of an off-road cycle scheme

2.1.3 The following benefits have not been quantified and therefore, the assessment is seen as a conservative estimate of the benefits of the ERMRT:

i. Wider transport benefits such as agglomeration and Gross Value Added (GVA) benefits that would arise as a result of the scheme.

ii. GVA benefits – the scheme will derive GVA benefits in the form of new jobs created in both the construction period of the scheme and within the operation of the scheme, as improved access to/from Reading will attract investment.

iii. Benefits linked to increase usage of rail and potential increased revenues to the train operating companies – Reading is a major rail hub and many people commute into and out of Reading by train. The scheme will offer improved access to the rail network. The success of the Thames Valley Park shuttle bus from the Northern Interchange at Reading Station demonstrates that there is demand to access rail. Surveys undertaken on buses form Woodley showed there are in the region of 7% of bus users from Woodley onward travel by train. The ERMRT will improve the bus journey more attractive and is therefore likely to increase patronage on rail – some of these trips would be newly generated trips and therefore derive revenue benefits that have not been calculated.

iv. The demand to access rail in Reading is likely to increase in the future with Crossrail coming forward and the likely Western Access to Heathrow. This has not been monetised.

v. The ERMRT scheme is only part of a much wider scheme to improve public transport use in Reading and surrounding area. This is likely to see additional benefits over and above those monetised when looking at this scheme in isolation.

vi. Journey quality benefits for bus users have also not been monetised and these will include smoothness of ride and reduction in the fear of accidents, because of the scheme being a segregated route for buses only and removing conflict with other vehicles on a congested network.

2.1.4 The economic assessment has predominantly been undertaken using DfT's TUBA (Transport User Benefit Appraisal) software. In this instance items i to iv above are calculated within TUBA.

2.1.5 TUBA is matrix based software that requires inter-zonal matrices of trips, distance, time and charges such as tolls, fares and parking charges. TUBA calculates the financial costs and benefits in respect of time, fuel and non-fuel Vehicle Operating Cost (VOC), charges, investment and operational costs and revenues. TUBA calculates user benefits from the differences in travel times, VOC and user charges between the Do Minimum and the Do Something scenarios.

2.1.6 Assessment of cycle benefits is undertaken using guidance within WebTAG.

2.2 Study Area

2.2.1 The modelled study area, shown in Figure 2-1.

Figure 2-1: Modelled Study Area

2.3 Modelled Years

2.3.1 The forecast modelled years are 2021, used to represent opening year and 2031, ten years post opening. Models have been produced for a Do-minimum (DM) and Do-something (DS) scenario. The only difference between these two sets of models is that the DS includes the scheme that is the subject of the Business Case.

2.4 Assumptions

2.4.1 The following assumptions have been made with regard to level of service within the main core case for the ERMRT:

- It has been assumed that the demand at the TVP park and ride is capped to the capacity of the park and ride site, which is estimated at 277 spaces;
- The TVP park and ride bus and the TVP shuttle service will utilise the same buses
- The assumed bus service frequencies for buses using the ERMRT are;
  - TVP park and ride – 15-minute frequency in all time periods
  - Winnersh park and ride – 15-minute frequency in all time periods
  - Woodley Service – 15-minute frequency in all time periods
  - 4/X4 – 15-minute frequency in all time periods
  - Heathrow RailAir bus – as current timetable across day
  - Thames Valley Park Shuttle bus – as well as services using ERMRT, two services per hour will run via London Road
- It has been assumed that the park and ride demand trips in the PM peak period are return trips and have been taken to be the transpose of the AM peak period trips. Inbound demand trips in the Inter Peak period are assumed to make the return trips in the Inter Peak period.
- As the scheme will be constructed off line, no delays during construction have been assumed.

2.5 TUBA Assessment

2.5.1 TUBA Version 1.9.9 has been used for the economic appraisal of the scheme. This is the current and latest version of TUBA. At its most basic, TUBA requires two input files as follows:

i. A standard economic parameter file which contains data such as values of time, VOC coefficients, tax rates and economic growth. It also contains standard categories for mode, vehicle type, trip purpose etc. The economic file can be modified by users where appropriate. The file has been modified in order to define park and ride in line with TUBA guidance when assessing park and ride in the software.

ii. A scheme specific file which contains data specific to the modelled scheme. This includes data such as scheme costs, trip, distance, time and charge matrices from the transport model that are required by TUBA.

2.6 TUBA Scheme Inputs

2.6.1 The following sections outline the scheme specific TUBA inputs that have been selected in this assessment. This includes key assumptions on the Scheme Parameter data, time slices and annualisation factors, user classes/vehicle sub modes and scheme costs.

Scheme Parameters

2.6.2 The following scheme parameters have been defined in this assessment:

iii. The First Year of the appraisal period has been entered as 2021. This is the first year for which user benefits are calculated.

iv. The Horizon Year of the appraisal period has been defined as 2080 (normally First Year + 59 for a 60-year appraisal as has been undertaken here).

v. The Modelled Years for which model data is available are 2021 and 2031 as noted in paragraph 2.4.1. TUBA requires that if the first and horizon years are not the same, then at least two modelled years be defined and that these should lie between the first and horizon years (inclusive).

vi. The Current Year has been defined as 2016 and is the year in which the TUBA run is being made.

vii. The detailed results option has been selected to enable detailed analysis of the TUBA results.

viii. The number of warnings has been set to 'All', the default selection for TUBA. This allows TUBA to write or output all serious warnings and error messages to the output file for further analysis.

Time Slices

2.6.3 The outputs from the models represent a single hour for each of the AM peak, inter Peak and PM peak modelled periods. The model has the following modelled hours (referred to as time slices in TUBA).

i. AM Peak Hour 0800 – 0900

ii. PM Peak Hour 1700 – 1800

iii. Average Inter Peak Hour representing 1000 -1600

2.6.4 Time Periods have standard definitions in TUBA as defined in the TUBA economics file. The standard TUBA time periods are defined below.

i. AM Peak (weekday 0700 -1000) – Time Period 1

ii. PM Peak (weekday 1600 – 1900) – Time Period 2

iii. Inter Peak (weekday 1000 – 1600) –Time Period 3

iv. Off Peak (weekday 1900 – 0700) – Time Period 4

v. Weekend – Time Period 5

2.6.5 For each time slice, TUBA requires the duration of the time slice, the annualisation factor, to convert from benefits/time slice to annual benefits.

Annualisation Factors

2.6.6 As noted in Section 2.8, the outputs from the model represent a single hour for each of the AM peak, inter Peak and PM modelled periods. Annualisation factors are used to convert benefits per time slice to annual benefits. The annualisation factor reflects how many of the particular time slices there are in a whole year and is discussed further in Section 2.9. TUBA also requires the time period to which the time slice belongs.

2.6.7 Local ATC data was used to determine the factors required to convert the AM and PM peak hours to TUBA AM and PM time periods respectively. In line with TUBA guidance, factors have been determined from ATC data and these have been used to model the shoulder time slices 0700-0800, 0900-1000 in the AM peak; and 1600-1700 and 1800-1900 in the PM peak within TUBA. This in addition to the peak hours 0800-0900 and 1700-1800 respectively. These factors have been applied as appropriate to the AM and PM peak hour matrices used to inform the TUBA. The peak hour cost skims have been reduced by the same factors used to factor down the matrices hence this relies on the assumption that the relationship between trip numbers and costs is linear. The applied factors range between 0.9 and 0.96 as noted below.

2.6.8 An annualisation of 253 has been assumed for the AM and PM peak periods given that there are 253 weekdays in a year. This led to the following annualisation factors being adopted.

i. 253 hours of AM peak hour (0800 – 0900) (1*253);

ii. 253 hrs of AM Shoulder (0700 – 0800) (1*253);

iii. 253 hrs of AM Shoulder (0900 – 1000) (1*253);

iv. 253 hours of PM peak hour (1700 – 1800) (1*253);

v. 253 hrs of PM Shoulder (1600 – 1700) (1*253);

vi. 253 hrs of PM Shoulder (1800 – 1900) (1*253)

vii. 1518 hours of Inter Peak (6*253).

viii. 312 hours of the Saturday Peak (6*52)

2.6.9 As modelling outputs for the off-peak (19:00 – 07:00), weekends and bank holidays are not available; these periods were not included in the TUBA analysis. Therefore, the actual benefits are likely to be greater than those calculated in this analysis.

User Classes

2.6.10 Sixteen user classes have been defined within the TUBA which covers the modes and journey purposes used within the modelling process. These are detailed in Table 2-1. User classes 1 to 7 pertain to the SATURN highway element of the TUBA while user classes 8 to 16 pertain to the Bus, Winnersh park and ride and TVP park and ride user classes. The later 9 user classes therefore refer to the Public Transport (PT) element of the TUBA as shown in Table 2-1.

Table 2-1: TUBA User Classes

TUBA User Class	Vehicle Type/Sub mode	Journey Purpose	Proportion of Trips
1	Car	Commute	1.000
2	Car	Other	1.000
3	Car	Business	1.000
5	LGV (personal)	Commute	0.120
5	LGV (freight)	Business	0.880
6	OGV1	All	(0.620/2.3) = 0.2700
7	OGV2	All	(0.380/2.3) =0.1700
8	Bus	Commute	1.0000
9	Bus	Other	1.000
10	Bus	Business	1.0000
11	P&R Winnersh	Commute	1.000
12	P&R Winnersh	Other	1.0000
13	P&R Winnersh	Business	1.000
14	P&R TVP	Commute	1.0000
15	P&R TVP	Other	1.000
16	P&R TVP	Business	1.0000

2.6.11 The SATURN model has a single stack matrix each for LGV and HGV trips respectively. Proportions stated in the COBA manual were used to convert the LGV and HGV vehicle matrices into the TUBA vehicle types of LGV (personal) and LGV (freight) and OGV1 and OGV2. These are 12 % LGV (personal) and 88% LGV (freight) for the LGV stacked matrix. For HGV, the splits were 62% OGV1 and 38% OGV2. For the HGV matrix the SATURN model assumes a PCU factor of 2.3 for each HGV. Therefore, the final factors entered into TUBA for OGV1 and OGV2 were (0.62/2.3) = 0.2700 and (0.38/2.3) = 0.1700 respectively. No further factoring was required for LGV as the SATURN model assumes that an LGV vehicle is equivalent to 1 PCU. Note that the SATURN model operates at hour level.

2.6.12 The PT trips are informed by the demand model which operates at peak period level. The TUBA was run at peak hour level, therefore the peak period PT matrices were divided by the peak period factors of 2.8 for the AM peak, 6 for the Inter Peak and 3 for the PM peak to convert the peak period matrices to peak hour for input to TUBA. This gave the flexibility to run the highway and PT elements of the TUBA within the same scheme file using the annualisation factors stated in paragraph 2.6.7.

Matrix Factoring

2.6.13 Time matrices were factored from seconds into hours for the highway model by multiplying each by 0.00028 (1/3600). Distance matrices were factored from metres into kilometres by multiplying each matrix by 0.00100 (1/1000).

2.7 60-Year Appraisal Results - TUBA

2.7.1 A summary of the Transport Economic Efficiency (TEE) results from TUBA is provided in Table 2-2. This excludes benefits associated with generated fare income, environmental benefits, Gross Value Added (GVA) benefits and indirect taxation.

Table 2-2: TEE Benefits (£000s) 60 Year Appraisal

Sector		Travel Time	Vehicle Operating Costs	Total(£000s)
Non Business	Commuting	16,032	356	16,338
	Other	4,688	112	4,800
Business		5,173	1,961	7,135
Total		25,893	2,429	28,323

2.7.2 The analysis shows that the majority of benefits are attributed to non-business users. These results are considered to be realistic as they reflect the fact that the majority of benefits from the scheme are attributable to the higher trip numbers of commuter and other trips compared to business trips.

2.7.3 As part of the verification of TUBA outputs, sector analysis of the highway benefits was undertaken to check that benefits were accruing from logical sector to sector movements. Benefits that were deemed to accrue from sectors to sector movements not expected to be impacted by the scheme were not included in the scheme benefits.

2.7.4 Table 2-3 shows the benefits by time period. Significant benefits accrue across all three time periods.

Table 2-3: TEE Benefits (£000s) by Time Period

Time Period	Travel Time Benefits	Total Benefits
AM Peak	7,207	7,923
PM Peak	8,074	9,284
Inter Peak	11,223	11,036
Total	26,504	28,244

2.8 Benefits from Thames Valley Park Business Park Shuttle Bus

2.8.1 The current shuttle bus which runs from Reading Station and Reading Town Centre, will be able to utilise the ERMRT route and thus, accrue the journey time benefits from the scheme. These have not been assessed explicitly within the model, but have been calculated separately.

2.8.2 Patronage data has been provided by the operator the service for 2015. This provides a total annual trip number from the Northern Interchange as follows:

i. To Thames Valley Park – 99,105

ii. From Thames Valley Park – 117,627

2.8.3 An uplift in passengers has been calculated using an elasticity factor based in the journey time saving made. The elasticity factor has been taken from '*The Demand for Public Transport, A Practical Guide'*, TRL Report TRL593. The elasticity value used is -0.04.

2.8.4 The formula used to provide the uplift is as follows:

Increase in passengers = (JT Before intervention – JT after Intervention) $^{-e}$

Where e is the elasticity factor for change in journey time

2.8.5 Applying this gives the new total passengers:

i. To Thames Valley Park – 100,342

ii. From Thames Valley Park – 119,095

2.8.6 As most of the trips to Thames Valley Park, using the shuttle bus are commute trips, a value of time for commute has been used. This may be a slight under estimate of the benefits, as some trips may well be employer's business trips, with a higher value of time, but no data is available for trip purpose for the buses.

2.8.7 Applying a 4-minute time saving in the AM and PM peak periods, when trips are made. The total annual time saving is 14,629 hours. With a value of time £7.63 per hour (2018 value), this gives a total annual monetised time saving of £111,628.

2.8.8 Assuming no additional passenger growth over time (again a conservative estimate), the total benefit over the 60-year appraisal period is £2.829m.

2.9 Heathrow RailAir Bus Benefits

2.9.1 It was assumed that with the ERMRT in place, the Heathrow RailAir bus would re-route via the scheme and this has been supported by First Bus who operate the service. Data on current usage of the bus service was obtained from the operator. It was assumed the service would enjoy similar journey time reductions as those from scheduled bus services depending by time of day and direction of travel as a result of the scheme. No passenger uplift was assumed as a result of the journey time savings, hence the benefits assumed are a conservative estimate and come from the existing user benefits as a result of the journey time saving. The benefit accrued from this has been calculated as £1.7m.

2.10 Cycle Benefits

2.10.1 As part of the scheme, an off-line new cycle and pedestrian link will be provided. This is likely to result in a potential increase in cyclists and journey time benefits for existing cyclists. Other benefits will be a result of health and absenteeism benefits, which are included within the next section.

2.10.2 Health and absenteeism benefits have been calculated for new cyclists, expected as a result of provision of a new cycle lane adjacent to the East Reading MRT. The methodology to assess the health and absenteeism benefits followed the methodology set out in WebTAG A5.1 Active Mode Appraisal.

2.10.3 Base cycle numbers have been taken from surveys undertaken at the Horseshoe Bridge. Elasticity values from WebTAG to reflect the slightly shorter and improved route have been used. This is felt to be a conservative and pragmatic estimate to determine cycle benefits from the scheme.

2.10.4 The total benefit over the 60-year appraisal period has been calculated to be £1.99m.

2.11 Bus Journey Time Reliability Benefits

2.11.1 A reliability assessment was undertaken for bus passenger journeys that will benefit from the scheme as a result of the bus priority measures. The assessment was informed by WebTAG guidance A1.3. Local data was used for key services to establish the Do-Minimum level of reliability. Using this as a base, the levels of congestion avoided through the use of the new priority lanes and reduced delays at junctions was used to forecast the expected reduction in levels of un-timetables journey time variability.

2.11.2 Real time data for routes 12 and 13 along the A4 in east Reading was analysed for October 2015 data. The data enabled the variation in bus journey time variability to be estimated. A proportion of this variability will be avoided as a result of the scheme, with bus priority measures enabling reduced congestion on the approach to certain congested junctions. This data was also used to inform the reliability benefits of services 4/X4.

2.11.1 The reliability benefits were estimated by trip purpose (commute, other and business) for each of AM IP and PM peaks. A reliability ratio of 1.4 was assumed in line with guidance in TAG Unit A1.3 paragraph 6.5.3. Annual reliability benefits of £277,287 were estimated. The benefits were evaluated and discounted over the 60-year appraisal period to give the reported estimated bus journey time reliability benefits of £6.159m.

2.12 Weekend Saturday only benefits

2.12.1 In order to estimate the Saturday benefits, it was assumed that the benefits would accrue over 6 hours of each day over 52 Saturdays per year or an annualisation of 312 hours. The Saturday travel conditions were assumed to be similar to weekday Inter Peak period which accrue over an annualisation of 1518 hrs. The Saturday benefits were then estimated as a proportion (312/1518) of the weekday IP benefits, giving an estimated Saturday benefits of £2.816m over the appraisal period. It is considered that this is a conservative estimate as peak Saturday travel conditions may be more congested than weekday IP conditions.

2.13 Summary

2.13.1 The above section has outlined the source of scheme benefits using TUBA undertaken for this work. TUBA warnings were analysed and where necessary remedial measures undertaken to check that the benefits were authentic and attributable to the scheme. The scheme is considered to generate considerable user benefits and is therefore beneficial and viable.

2.13.2 In summary, the Total Present Value of Benefits (PVB) over the 60-year appraisal period have been estimated to be £44.22m with the Present Value of Costs (PVC) of £24.48m.

2.13.3 The calculation of benefits has been compared with the scheme costs over a 60-year appraisal period and results in a **BCR of 1.81** for the East Reading MRT, and includes estimates of journey time reliability, noise, journey ambience and estimates of weekend Saturday public transport benefits as well as air quality benefits estimated by TUBA's greenhouse assessment. Social inclusion benefits are not included. A breakdown of the scheme benefits is shown in Table 2-4. As shown in Table 2-4, benefits of £0.456m have been estimated for WI2 (Output change in imperfectly competitive markets) using the guidance in WebTAG Unit 2.1 (Wider Impacts). These benefits have been calculated as a 10% uplift to business user benefits as per paragraph 4.1.9 of TAG Unit 2.1.

2.13.4 COBALT has been used to estimate the accident benefits and these have been estimated at £0.72m. The COBALT has been informed by flows from the SATURN model. Default accident rates have been assumed. The COBALT analysis suggests that 14.3 accidents will be saved by the scheme. In terms of casualties, the analysis suggests that 0.2 fatal, 2.2 serious and 16.7slight casualties will be saved by the scheme.

Table 2-4: Summary of Scheme Benefits in £m (2010 prices)

Benefit	Present Value of Benefits £m (2010 prices)
Highway Benefits	7.89
Public Transport Benefits	26.53
WI2 benefits (Output change in imperfectly competitive markets)	0.46
Cycle Benefit	1.99
Bus Journey Time reliability	6.16
Greenhouse Gases	0.47
Accidents	0.72
Total	**44.22**

Consideration of Other Benefits

2.13.5 The value of benefits accrued of £44.22m will result in a Switching Value of £4.74m to take the project to the high VfM category.

2.13.6 The ERMRT scheme will unlock some dependent developments. The benefit associated with the dependent development has been calculated using the TAG Workbook *'Valuing Housing Impacts'* and several sensitivity tests have been undertaken. The core scenario assumes that the number of dependent dwellings that can be directly associated with the transport scheme is 168, which is a conservative estimate. Table 2-5 shows the sensitivity results and the Net Social Value of the additional housing.

Table 2-5: Dependent Development Benefits

Dependent Housing Numbers	Net Social Value of housing (£'000)
168	11,963
300	21,360
210	14,954
120	8,549
90	6,405

2.13.7 The benefits from dependent development have been calculated at £11.9m in the core scenario, with the lowest level of dependent development showing a benefit of £6.4m and an upper value of £21.4m.

2.13.8 Even at the lowest level, the benefit from the dependent development will exceed the switching value, given this, the proposal should be assigned to the **High VfM category**.

3 Public Accounts

3.1 Overview

3.1.1 The scheme costs have been included within the TUBA assessment. These are converted within TUBA to 2010 prices and values as is consistent with DfT current guidance.

3.2 Scheme Costs and Whole Life Costs

3.2.1 Capital costs for the implementation of the scheme have been calculated at £27.570m in 2010 values and prices. It is assumed that £4.913m at 2010 prices or 20% will come from developer funding. Developer funding is a cost to the private sector and therefore appears as a dis-benefit under other business impacts for the purpose of the economic appraisal. Land costs of the [redacted] have also been included in the assessment.

3.2.2 The scheme costs have been subject to the application of optimism bias that is appropriate for the business case stage as well as reflect the level of knowledge of risks to the project construction. All the risks have been identified and quantified. Following analysis of the risks, it is considered that 67% of the identified quantified risks have been mitigated following detailed design and consideration thus enabling the level of optimism bias assumed, to be consistent with the level of knowledge of risks to the project construction. Consideration has also taken into account that 52% of scheme costs relate to bridge costs and so a higher level of optimism bias has been applied to the bridge elements. Based on the above considerations it has been estimated that a 15% optimism bias was appropriate for the proportion of scheme costs (48%) pertaining to road/civils elements and an optimism bias of 23% was appropriate for the bridge scheme costs. These uplifts are higher than the 3% and 6% applicable to road and bridge elements respectively at Stage 3 or Full approval documented in Table 8 of TAG Unit A1.2. As stated, the optimism bias applied reflects the level of knowledge of risks to the project construction.

3.2.3 Additionally, whole life costs of highway maintenance for the scheme, have been estimated at £3.095m and at £4.154m for structures maintenance over the 60-year appraisal period. This gives whole life costs of £7.249m in 2016 prices. Conversion to 2010 prices including discounting, has been undertaken within TUBA. The resultant PVC of costs have been estimated at £24.48m.

3.3 Expenditure Profile

3.3.1 The profile of expenditure is incorporated into the TUBA model. The profile used is shown in Table 3-1. Default TUBA profiles have been assumed for Preparation and Supervision costs as defined in the standard TUBA economics file. The profile adopted is that assuming a Works Commitment (WC) scheme stage.

Table 3-1: Cost Profile for TUBA

Cost	2017/18	2018/19	2019/20	Total
Construction	7%	59.7%	33.3%	100%
Preparation	default	default	default	default
Supervision	default	default	default	default

3.4 Broad Transport Budget

3.4.1 TUBA uses the input costs and expenditure profiles to calculate costs in 2010 prices and in the 2010 base year. This is a two-stage process which involves the following:

i. Convert costs to 2010 prices through the application of a GDP deflator for 2016 (108.83) obtained from the WebTAG data book (July 2017-v1.8); and

ii. Discount costs to 2010 by applying a discount factor of 3.5% per annum.

3.4.2 The resulting costs as calculated by TUBA are the Present Value of Costs (PVC) which in this instance are £24.48m (in 2010 prices discounted to 2010).

3.5 Indirect Taxation

3.5.1 The TUBA output shows that the scheme will result in Indirect Tax Revenues of -£0.942m The negative value implies that this appears as a dis-benefit in the overall scheme's Present Value of Benefits (PVB) and implies a loss of revenue to Central Government.

3.5.2 The Indirect Tax revenue is a negative largely due to a reduction in fuel consumption as a result of those car users who switch to bus and to park and ride.

4 Sensitivity Tests

4.1 Introduction

4.1.1 There will always be uncertainty about future consumer behaviour and circumstances when predicting so far into the future. It is therefore good practice for economic and transport assessments to include a set of sensitivity tests to explore the relationship between the assumptions and the robustness of the value for money of the scheme, in this case the BCR.

4.1.2 The tests that were undertaken for the proposed scheme are described below. The economic case considers the following tests:

- Scenario 1 – Core scenario detailed within the earlier sections of this report. An optimism bias of 5% for road elements and 8% for structures is assumed in all the tests.
- Scenario 2 – This is a TUBA run which assumes a pessimistic scenario in which PT patronage is assumed to be 10% less than that in Scenario 1. This tests the sensitivity and robustness of the scheme to low PT patronage usage.
- Scenario 3 – As in Scenario 1 above, but the scenario assumes a pessimistic developer contribution of 50% (i.e. a pessimistic Community Infrastructure Levy -CIL contribution of 50%). Therefore, in this scenario, the costs to the public sector are higher than in Scenario 1.

4.2 Sensitivity Test Results

4.2.1 The results of the tests are reported in Table 4-1. As noted above, Scenario 1 refers to the main test in which the TVP park and ride demand has been capped to the parking spaces available. i.e. 277 parking spaces. An optimism bias of 15% for road elements and 23% for structures is assumed in all the tests. These uplifts are higher than the 3% and 6% applicable to road and bridge elements respectively at Stage 3 or Full approval documented in Table 8 of TAG Unit A1.2. As stated, the optimism bias applied reflects the level of knowledge of risks to the project construction.

Table 4-1: Sensitivity Test Results – 15% Roads and 23% Structures Optimism Bias: Costs in £m

Benefit Type	Scenario 1 (Main)	Scenario 2 (Low Demand)	Scenario 3 (50% CIL)
PVB	44.22	39.89	44.41
PVC	24.48	24.48	26.93
BCR	1.81	1.63	1.65
NPV	19.74	15.41	17.48

4.2.2 The results show that in all three scenarios, the scheme benefits exceed the scheme costs giving a positive Net Present Values (NPV). The Benefit to Cost Ratio (BCR) is in the Medium Value for Money (VfM) range of 1.5 to 2.0 for the three scenarios. This means that for every £1 invested in the scheme, the return is of the order of £1.81 for the core Scenario 1. This reduces to £1.63 and £1.65 for Scenarios 2 and 3 respectively, which represent more pessimistic scenarios. The scheme will unlock dependent development. It has been demonstrated that when dependent development benefits are taken into account, the scheme can be seen to be in the **High** Value for Money category. In Scenario 2, demand is lower while in Scenario 3 the scheme costs to the public sector are higher as a result of reduced developer contributions. The increased PVB for Scenario 3 is that as developer contributions are reduced, this is a cost to the public sector, but it is a benefit for business.

4.2.3 Economic worksheets have been created for the main Scenario 1. These include the Economic Efficiency of the Transport System (TEE) table (Appendix A), the Public Accounts (PA) table (Appendix B), the Analysis of Monetised Costs and Benefits (AMCB) table (Appendix C) and the Appraisal Summary Table (AST) (Appendix D).

Appendix A TEE Table

Appendix B PA Table

Appendix C AMCB Table

Appendix D AST