

# South Essex Rapid Transit: Best and Final Funding Bid

## Appendix: Cost Benefit Analysis

Report

September 2011

**Prepared for:**  
Essex County Council  
County Hall  
Chelmsford  
Essex  
CM1 1QH

**Prepared by:**  
Steer Davies Gleave  
28-32 Upper Ground  
London SE1 9PD

+44 (0)20 7910 5000  
[www.steerdaviesgleave.com](http://www.steerdaviesgleave.com)



## CONTENTS

1	INTRODUCTION .....	1
	Background.....	1
	*TUBA output files provided separately.....	1
	Document Structure .....	1
2	COST BENEFIT ANALYSIS ASSUMPTIONS .....	3
	Introduction.....	3
	Underlying Assumptions.....	3
	Local Factors.....	4
3	APPRAISAL INPUTS / OUTPUTS.....	7
	Introduction.....	7
	Appraisal Inputs .....	7
	Appraisal Outputs.....	8
	Checking of TUBA warning messages .....	11
	Spatial (Sectoral) Analysis of TEE benefits .....	11
	Maintenance delay costs/savings. ....	11
	Delays during construction. ....	11

## TABLES

Table 1.1	Cost Benefit Analysis.....	1
Table 3.1	Capital Cost Estimates (Current Prices, £).....	7
Table 3.2	Annual Operating Cost Estimates (Current Prices, £).....	8
Table 3.3	TEE Table for sert Network.....	9
Table 3.4	Sensitivity Test Results - sert Network .....	10

## APPENDICES

### A ANALYSIS OF TUBA WARNINGS



# 1 Introduction

## Background

- 1.1 This document has been prepared to present supporting information for the Value for Money (VfM) Case on the modelling and appraisal of *sert*. As identified in **Table 1.1** below it sets out the information requested in Annex A of *Major Scheme Business Cases: Value for Money Guidance for Development Pool Scheme* (May 2011).

**TABLE 1.1 COST BENEFIT ANALYSIS**

Item	Section / Page
A clear explanation of the underlying assumptions used in the Cost Benefit Analysis.	Page 3
Information on local factors used. For example the derivation of growth factors, M factors in COBA and annualisation factors in TUBA(to include full details of any calculations).	Page 4
A diagram of the network (if COBA is used).	n/a
Information on the number of junctions modelled (if COBA is used), for both the do-minimum and the do-something.	n/a
Details of assumptions about operating costs and commercial viability (e.g. public transport, park and ride, etc.).	Page 5
Full appraisal inputs/outputs (when used, COBA and/or TUBA input and output files should be supplied).	Chapter 3*
Evidence that TUBA warning messages have been checked and found to be acceptable.	Page 13
Spatial (sectoral) analysis of TEE benefits.	Page 13
Details of the maintenance delay costs/savings.	Page 13
Details of the delays during construction.	Page 14

\*TUBA output files provided separately

## Document Structure

- 1.2 As indicated in **Table 1.1**, the information has been set out in this document in the order of the checklist.



## 2 Cost Benefit Analysis Assumptions

### Introduction

- 2.1 The Cost Benefit Analysis (CBA) has been undertaken in line with DfT guidance (WebTAG) for economic appraisal, as set out in the April 2011 release.

### Underlying Assumptions

- 2.2 The underlying appraisal assumptions are applied to the forecast benefits presented in the Model Forecasting Report (appended separately to the BAFFB form) and estimated costs summarised in **Chapter 3** to produce annual values for the life of the appraisal period.
- 2.3 The software package TUBA has been employed for the derivation of public transport and highway user journey time benefits. The principal assumptions for the economic appraisal are listed below.

### *Scheme*

- Construction is assumed to start in 2012 with *sert* 1 opening in October 2014 and *sert* 2 opening in April 2014.
- Forecast years are modelled for 2013 and 2028. For the intermediate years, annual values are produced by interpolation. No demand growth is assumed beyond 2028.
- It is assumed in the first 12 months of operation that only 90% of forecast benefits will be realised due to people adapting to the new service and trip opportunities offered.

### *Appraisal*

- The appraisal period for the scheme runs from the commencement of construction to 60 years of benefits.
- A social discount rate of 3.5% real per annum is used for the first 30 years and 3.0% per annum for the next 30 years.

### *Costs*

- Real inflation (above RPI) is applied to the capital cost estimate to uplift values for the construction period. The assumed values are based on estimated construction inflation<sup>1</sup> of:
  - 4.65% (2011-12)
  - 7.55% (2011-13)
  - 9.71% (2011-14)
- Background inflation (RPI) as presented in HM Treasury's medium term forecasts (August 2011) has been stripped out to produce real construction inflation of:
  - 1.25% (2011-12)

---

<sup>1</sup> As advised by the cost consultants

- 0.94% (2012-13)
- -0.41% (2013-14)

- █ Real inflation of 0.5% per annum is applied to operating costs for the scheme until 2028.

#### **Revenue**

- █ An average fare of £1.50 per passenger, in 2009 prices, is assumed. (This is based on an average of all tickets to board a bus in the area up to a maximum of £4, which is the standard cost of a day travel card); and
- █ Real inflation of 0.5% per annum (above RPI) is applied to revenue for the scheme until 2028.

#### **Benefits**

- █ WebTAG values of time, growth in values of time and journey purpose splits are used.

- 2.4 The results of the CBA are presented in Chapter 3.

#### **Local Factors**

##### **Growth Factors**

- 2.5 The Model Forecasting report (also appended separately to the BAFFFB form) presents the assumptions for forecast growth used in the modelling and appraisal.

##### **Annualisation factors**

- 2.6 The transport modelling is based upon an average hour for three time periods:

- █ Morning peak - 7am to 10am
- █ Interpeak - 10am to 4pm
- █ Evening peak - 4pm to 7pm

- 2.7 To expand these single average hours to annual totals, factors have been applied in TUBA.

##### **Morning & evening peak**

- █ Average hour factored to 3 hour peak period \* annual number of Mondays to Saturdays + 50% on Sundays - Bank holidays
- █  $1 * 3 * (312 + (50\% \text{ of } 52) - 8)$
- █  $3 * 330 = 990$

##### **Interpeak**

- █ Average hour factored to 6 hour interpeak period \* annual number of Mondays to Saturdays + 50% on Sundays - Bank holidays
- █  $1 * 6 * (312 + (50\% \text{ of } 52) - 8)$
- █  $6 * 330 = 1980$

##### **Operating Costs**

- 2.8 Operating costs were estimated for both *sert* routes. Cost data included:
- █ An hourly rate for drivers of £16;

- A per mile rate for fuel and tyres (£0.83), Bus Service Operator Grants (£-0.24), and direct (£0.22) and maintenance costs (£0.13); and
  - A peak vehicle requirement (PVR) cost for engineering and overheads of £11,000 and £18,000 respectively.
- 2.9 Values for the above costs were based on commercial operator information for a typical major bus company.
- 2.10 Route data included service frequencies for each route (6 per hour during peak periods and 3 in the off-peak), route length, average speed across the route (30kph), and terminal layover times of 7 minutes for *sert* 1 and 6 minutes for *sert* 2.
- Commercial Viability***
- 2.11 The revenue risk of operating the *sert* services will be taken on by the private sector operators of the services as part of the Quality Partnership Scheme (QPS) through which these will be procured. In discussions with the operators so far, they have shared the promoters' view that the *sert* services should be able to be run on a commercial basis.
- 2.12 Within the terms of the partnership agreement, the operators have indicated that they may alter the configuration of the *sert* services, e.g. by changes to frequency, hours of operation or routing, in order that these can be run on a commercial basis. Indeed, they have indicated that it would be highly unlikely that services simply using the *sert* infrastructure alone would be operated, and that higher returns could be provided by extending the services into areas beyond this.
- 2.13 There would be additional financial benefits for operators for their existing services that will be able to use the *sert* infrastructure (i.e. that these services and the vehicles used to operate them meet the performance standards set out in the QPS agreement).



## 3 Appraisal Inputs / Outputs

### Introduction

- 3.1 The economic appraisal of sert assesses the Value for Money of the proposals. It is based upon the assumptions described in the preceding chapter, the modelled forecasts for demand and benefits and the estimated capital and operating costs for the proposals.

### Appraisal Inputs

#### Capital costs

- 3.2 Capital cost estimates have been prepared for the individual sert routes. The estimates encompass civils work, ITS requirements, utilities diversions, design and supervision. A quantified risk assessment of the design and estimated costs has also been conducted. Table 3.1 presents the estimated values.

**TABLE 3.1 CAPITAL COST ESTIMATES (CURRENT PRICES, £)**

Item	sert 1	sert 2	sert network
Total - Civils	6,857,159	1,030,859	7,888,018
Total - ITS	3,897,338	724,242	4,621,580
Total - Utilities Diversions	8,979,600	1,437,000	10,416,600
Design	1,251,025	210,612	1,461,637
Supervision	537,725	87,755	625,480
Quantified Risk Assessment	3,500,573	592,000	4,092,573
Total	<b>25,023,420</b>	<b>4,082,468</b>	<b>29,105,888</b>

- 3.3 The proposed capital cost expenditure profile assumed is:

■ For **sert 1**

- Design costs - 2012: 80%, 2013: 20%
- Construction costs - 2012: 20%, 2013:60%, 2014:20%

■ For **sert 2**

- Design costs - 2012: 100%
- Construction costs - 2012: 20%, 2013: 80%

#### Operating costs

- 3.4 Operating costs have been estimated using an opex model constructed on the basis of bus industry operating costs and the assumed service levels for sert.

**TABLE 3.2 ANNUAL OPERATING COST ESTIMATES (CURRENT PRICES, £)**

Item	sert 1	sert 2	sert network
Annual operating costs	£2,172,828	£587,222	£2,760,050

***Optimism bias***

3.5 Over and above the base estimated capital cost and QRA values, optimism bias (OB) is included in the capital cost value used in the economic appraisal. The value represents the remaining uncertainty that exists prior to implementation of the project. Reflecting the nature of *sert*, a highway based rapid transit scheme and its conventional construction requirements, the project is categorised as standard. However, given the design work on which the costs have been estimated is at an outline level, there remains a degree of uncertainty. Therefore the OB level of 44% is applied.

3.6 For the operating cost estimates a 1% OB uplift has been applied.

***Demand and benefits***

3.7 The demand and benefits have been forecast by the modelling suite described in the various modelling reports required by DfT that have been appended separately to the BAFFB form.

3.8 These model outputs are used as inputs for TUBA to forecast the travel time, vehicle operating cost and greenhouse gas impacts of the scheme. The modelled forecasts of demand and change in highway kilometres are used for the spreadsheet model forecasting of revenue and externalities.

**Appraisal Outputs**

3.9 The results of the economic appraisal are presented in **Table 3.3**. The results demonstrate the the strong Value for Money Case for the *sert* network.

3.10 The *sert* network demonstrates a BCR of 5.5:1. The main driver for the benefits is travel time savings for public transport users for non-business or commuting purposes. On the basis of the modelling there are some highway disbenefits arising from improving public transport travel, but these are significantly more than offset by the public transport benefits.

3.11 The total travel time and VOC benefits are significantly greater than the estimated capital costs for the network. Applying the outputs from the modelling, the economic results indicate that the incremental revenue generated by the *sert* network will be lower than the incremental operating cost. However, as discussed in **Paragraph 2.11** above, engagement with local bus operators has indicated that they are confident that the services will be commercially viable.

**TABLE 3.3 TEE TABLE FOR SERT NETWORK**

*Figures in 2002 market prices in £000s*

<b>SERT 1 and SERT 2 Combined</b>	TOTAL	HIGHWAY	PT
<b>Consumer - Commuting user benefits</b>			
Travel Time	£45,379	£2,859	£42,520
Vehicle operating costs	(£2,980)	(£2,980)	-
User charges	-	-	-
During Construction & Maintenance	-	-	-
<b>NET CONSUMER - COMMUTING BENEFITS</b> (1)	<b>£42,399</b>		
<b>Consumer - Other user benefits</b>			
Travel Time	£149,561	(£19,799)	£169,360
Vehicle operating costs	£3,948	£3,948	-
User charges	-	-	-
During Construction & Maintenance	-	-	-
<b>NET CONSUMER - OTHER BENEFITS</b> (2)	<b>£153,510</b>		
<b>Business</b>			
Travel Time	£1,247	(£26,499)	£27,746
Vehicle operating costs	£118	£118	-
User charges	-	-	-
During Construction & Maintenance	-	-	-
<b>Subtotal</b> (3)	<b>£1,365</b>		
<b>Private Sector Provider Impacts</b>			
Revenue	£15,378	(£12,994)	£28,373
Operating costs	(£48,297)	-	(£48,297)
Investment costs	(£29,239)	-	(£29,239)
Grant/subsidy	£29,239	-	£29,239
<b>Subtotal</b> (4)	<b>(£32,918)</b>		
<b>Other business impacts</b>			
Developer contributions	-	-	-
<b>NET BUSINESS IMPACT</b> (6)	<b>(£31,554)</b>		
<b>TOTAL PVB</b> (7) = (1)+(2)+(6)	<b>£164,355</b>		

**Public Accounts**

*Figures in 2002 market prices in £000s*

<b>SERT 1 and SERT 2 Combined</b>	TOTAL	HIGHWAY	PT
<b>Local Government Funding</b>			
Revenue	-	-	-
Operating Costs	(£0)	-	(£0)
Investment Costs	-	-	-
Developer Contributions	-	-	-
Grant/Subsidy Payments	£5,848	-	£5,848
<b>NET IMPACT</b> (8)	<b>£5,848</b>		
<b>Central Government Funding: Transport</b>			
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer Contributions	-	-	-
Grant/Subsidy Payments	£23,391	-	£23,391
<b>NET IMPACT</b> (9)	<b>£23,391</b>		
<b>TOTAL PVC</b> (10) = (8)+(9)	<b>£29,239</b>		
<b>Central Government Funding: Non-Transport</b>			
Indirect Tax Revenues	(£5,438)	(£533)	(£4,905)
<b>TOTALS</b>			
Broad Transport Budget	-	-	-
Wider Public Finance	(£5,438)	-	-

**Analysis of Monetised Costs and Benefits**

*Figures in 2002 market prices in £000s*

<b>SERT 1 and SERT 2 Combined</b>	TOTAL	HIGHWAY	PT
Greenhouse Gases	£727	-	£727
Economic Efficiency: Consumer Users (Commuting)	(11)=(1) £42,399		
Economic Efficiency: Consumer Users (Other)	(12)=(2) £153,510		
Economic Efficiency: Business Users and Providers	(13)=(6) (£31,554)		
Wider Public Finances (indirect taxation revenues)	(14) (£5,438)		
<b>Present Value of Benefits (PVB)</b> (15)=(11)+(12)+(13)+(14)	<b>£159,644</b>		
Accident	£1	£1	-
Local Air Quality	£0	-	£0
Noise	£0	-	£0
Congestion	£5	£5	-
<b>Present Value of Benefits (PVB)</b> (12)	<b>£159,650</b>		
<b>Present Value of Costs (PVC)</b> (13)	<b>£29,239</b>		
<b>Net Present Value (NPV)</b> (14) = (12)	<b>£130,411</b>		
<b>Benefit to Cost Ratio (BCR)</b>	<b>5.5:1</b>		

### Sensitivity tests

- 3.12 In addition to the central case results presented above, a range of sensitivity tests have been undertaken to examine the robustness of the proposed scheme and the significance of the modelling and appraisal assumptions to the economic case.
- 3.13 The sensitivity tests have comprised:
- *sert* running speeds reduce by 10% (S1)
  - *sert* and bus fares increased by 1% per annum in real terms (S2)
  - *sert* mode constant increased from 5 to 10 mins (to make it less attractive) (S3)
  - 25% above Temprow demand growth (S4)
  - 25% below Temprow demand growth (S5)
  - High demand test (as per VfM guidance) (S6)
  - Low demand test (as per VfM guidance) (S7)
  - 25% increase in values of time (S8)
  - 25% decrease in values of time (S9)
- 3.14 For the sensitivity analysis the central case highway forecasts have been used to ensure comparability between the *sert* results. As identified in the Local Model Validation Report (also appended separately to the BAFFB form) the central case forecast model runs converged. However, because of the large size of the model, there was still a small amount of instability in the final iterations of the highway assignment, which clouded the benefits calculations as they often resulted in an over-/under-estimate of the highway benefits, which it was felt, was down to model stability and not to the scheme.
- 3.15 Therefore given the assumptions made for the impact of the highway measures, and subsequent proof generated through the modelling which indicated that *sert* had limited impact on the highway traffic, all sensitivity tests assumed the same highway benefits as the central case (a small dis-benefit) so that the sensitivity tests were compared on a like for like basis.
- 3.16 The results of the sensitivity tests are presented below in **Table 3.4**.

**TABLE 3.4 SENSITIVITY TEST RESULTS - SERT NETWORK**

	Central	S1	S2	S3	S4	S5	S6	S7	S8	S9
<b>PVB</b>	159,650	135,980	131,620	88,045	168,623	159,998	171,839	146,980	161,843	156,902
<b>NPV</b>	130,411	106,742	102,381	58,806	139,384	130,759	142,600	117,741	132,604	127,663
<b>BCR</b>	5.5:1	4.7:1	4.5:1	3.0:1	5.8:1	5.5:1	5.9:1	5.0:1	5.5:1	5.4:1

- 3.17 The results of the sensitivity tests demonstrate the strength of the economic benefits for the *sert* network. As expected, the reduction in running speed, increase in fare and reduction in the mode constant all produce a lower benefit total, though the BCR remains above 3:1 in all cases.

- 3.18 Testing the effect of higher and lower TEMPRO growth produces a higher BCR with the higher growth test. When TEMPRO growth is reduced by 25% there is negligible change, indicating that the incremental effect is broadly similar to that in the central case.
- 3.19 The remaining tests of higher and lower growth and values of time all produce BCRs for the network of 5:1 and higher.

#### **Checking of TUBA warning messages**

- 3.20 The TUBA warning messages produced in the TUBA output files have been reviewed, and taken account of in terms of adjustments to the model and re-running these. The consultants are now confident that all issues raised by the TUBA warnings have been fully addressed. More information on this is presented in **Appendix A** to this report

#### **Spatial (Sectoral) Analysis of TEE benefits**

- 3.21 The TEE benefits are derived from the model outputs. The Modelling Reports (appended separately to the BAFFB form) describe the distribution of the results.

#### **Maintenance delay costs/savings.**

- 3.22 The *sert* proposals will introduce priority measures for public transport on the highway network, including segregated lanes and the realignment of some junctions. Maintenance of the highway will be undertaken as part of routine works and the introduced priority measures will not result in a change in the standard regime. If and when highway works are required, the nature of *sert* (i.e. not fixed rail) will allow the services to divert around highway works with minimal disruption to the service.
- 3.23 Maintenance of the *sert* stops and associated facilities, e.g. real time information displays, will be undertaken without creating disruption to the services, as well maintenance of the *sert* vehicle fleet.
- 3.24 The costs of maintaining *sert* infrastructure will be incorporated into the general highways maintenance budgets of the three partner authorities promoting the scheme, and have not been considered in the cost benefit analysis

#### **Delays during construction.**

- 3.25 The construction programme for *sert* has been developed to ensure the efficient implementation of the scheme. Where construction will take place on-line construction codes of good practice will be followed to ensure safe working and minimise disruption. The staging of the construction will ensure that any delays created are isolated and therefore have limited impact on highway users.
- 3.26 Given the small scale of anticipated delays during the construction, no quantified assessment has been included in the economic appraisal.



APPENDIX

A

ANALYSIS OF TUBA WARNINGS



**A1 APPENDIX 1**

**Appendix 2**

A1.1 Appendix list number



