Victoria Road upgrade

Environmental Assessment - Economic Evaluation

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Bridge to Bay Alliance

Victoria Road Upgrade – Economic Evaluation

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Final Report

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Table of Contents

Executive Summary

Background and Objectives

Victoria Road is a major arterial road connecting the Parramatta and Sydney central business districts. Around 200,000 bus passengers travel on Victoria Road each week. Up to 170 buses, with more than 8,000 passengers, travel between Gladesville Bridge and The Crescent at Rozelle during typical weekday morning peak periods.

The Roads and Traffic Authority (RTA) has a proposal to improve the efficiency and reliability of bus services and assist general traffic flow through Drummoyne and Rozelle. The proposal involves the construction of a new bridge across Iron Cove, the introduction of tidal flow arrangements to Drummoyne, new traffic arrangements for Rozelle, and new bus lanes and bus bays. The RTA proposes a new bridge to the west of the current Iron Cove Bridge.

As a further stage in the analysis, the RTA requires an economic evaluation of the proposal. Saha International (Saha) was commissioned by the Bridge to Bay Alliance (the Alliance), on behalf of the RTA, to undertake such an evaluation.

Project Option and Costs

For the purposes of this evaluation, only two options were considered:

- Base Case – maintaining the current arrangements along Victoria Road between Gladesville Bridge and The Crescent
- Proposed Option – constructing a new bridge west of the current Iron Cove Bridge and the provision of peak hour bus lanes

Table ES-1 outlines the construction cost estimates for the proposed new bridge and associated works.

Table ES-1: Victoria Road Upgrade Project Capital Costs

Years Ending June	Total Capital Costs ($ million)
Phase 1: EA, Scope and TOC Development	13
Phase 2: Detailed design, EA and communications Rozelle road works Drummoyne road works Bridge works ITS Utility adjustments Escalation RTA internal costs and project delivery costs	 10 9.5 18 66.5 8 6 5 20
Cost Plan Total Outturn Estimate	**156**

Source: Bridge to Bay Alliance

Project Benefits

We have derived conventional transport benefits from the traffic modelling results provided by the Alliance, covering the following:

- Change in consumer surplus:
  - Savings in travel time for existing bus passengers, including improved reliability
  - Savings in travel time for general traffic users
  - User benefits attributable to induced bus passengers
- Change in producer surplus:
  - Change in net bus revenue for additional passengers (additional revenue less additional costs)
- Change in third–party effects:
  - Reduced road costs as a result of car users diverting to bus
  - Reduced externalities as a result of car users diverting to bus

In addition, the unexpired capital value of the new asset has been taken up as a benefit.

Economic and Financial Evaluation Results

Table ES-2 summarises the results of the economic and financial evaluations.

Table ES-2: Results of Economic Evaluation at 7% Real Discount Rate

Criteria	Victoria Road Upgrade Incremental to Base Case
Undiscounted Capital Cost ($000)	156,000
Project Costs (Present Value $000):	
Capital costs	150,897
Recurrent costs	11,480
Total Project Costs	**162,377**
Project Benefits (Present Value $000):	
Existing user benefits	92,483
Generated user benefits	6,960
Incremental bus revenue	4,820
Reduced road costs	29,510
Other externality benefits	13,295
Residual value	5,715
Total Project Benefits	**152,784**
Evaluation Measures:	
Net Benefits (NPV $000)	**(9,594)**
NPV/Capital Costs	**(0.06)**
Benefit-Cost Ratio	**0.94**
Internal Rate of Return	**6.4%**

Conclusions

Based on the analysis described in this report, the following conclusions are derived from the economic evaluation:

- The project as defined produces marginal economic outcomes where the base evaluation produces a marginal negative outcome, with a BCR of 0.94.
- The majority of benefits (60%) are enjoyed by both bus and car users in terms of estimated travel time savings and improved bus reliability, consistent with the traffic model estimates. Another 20% of benefits reflect the broader third-party road decongestion benefits as a result of passengers diverting to bus because of the improved bus trip times.
- Based on the most recent RTA unit values of environmental impacts, including reduced pollution and greenhouse gas emissions, such benefits represent just under 10% of total benefits.
- Very small variations in almost all parameters produce significant swings either side of the breakeven position.
- In terms of the base evaluation, the shortfall of $9.6 million in NPV terms is the equivalent of around $770,000 per annum throughout the evaluation period. For the project to break even, the amenity benefit affecting pedestrians and cyclists which has not been separately valued would need to be valued at $770,000 per annum.

1 Introduction

1.1 Background and Objectives

Victoria Road is a major arterial road connecting the Parramatta and Sydney central business districts. Around 200,000 bus passengers travel on Victoria Road each week. Up to 170 buses, with more than 8,000 passengers, travel between Gladesville Bridge and The Crescent at Rozelle during typical weekday morning peak periods.

The Roads and Traffic Authority (RTA) has a proposal to improve the efficiency and reliability of bus services and assist general traffic flow through Drummoyne and Rozelle. The proposal involves the construction of a new bridge across Iron Cove, the introduction of tidal flow arrangements to Drummoyne, new traffic arrangements for Rozelle, and new bus lanes and bus bays. The RTA proposes a new bridge to the west of the current Iron Cove Bridge.

In the light of previous investigations, the RTA has undertaken community consultation and traffic modelling.

As a further stage in the analysis, the RTA requires an economic evaluation of the proposal. Saha International (Saha) was commissioned by the Bridge to Bay Alliance (the Alliance), on behalf of the RTA, to undertake such an evaluation.

1.2 Structure of the Report

The remainder of the report contains the following sections:

- Chapter 2 – Evaluation Approach
- Chapter 3 – Assessment of Costs and Benefits
- Chapter 4 – Economic Evaluation
- Chapter 5 – Conclusions

The Appendix contains a detailed spreadsheet of the economic evaluation.

2 Evaluation Approach

The overall evaluation approach has followed conventional transport evaluation principles and procedures in accordance with NSW Treasury and RTA Economic Analysis Manual investment appraisal guidelines. The most recent RTA 2007 parameters were used (Appendix B, issued July 2008).

For the purposes of this evaluation, only two options were considered:

- Base Case – maintaining the current arrangements along Victoria Road between Gladesville Bridge and The Crescent
- Proposed Option – constructing a new bridge west of the current Iron Cove Bridge and the provision of peak hour bus lanes

Estimates of capital and maintenance costs for the project and for the Base Case were provided to Saha by the Alliance.

As always, the fundamental determinant of transport project benefits is the traffic and demand modelling. In this evaluation, the benefits of the proposal were based on traffic modelling results provided to Saha by the Alliance. These traffic numbers were based on traffic movements exclusively on Victoria Road itself between Gladesville Bridge and The Crescent. The results were not part of a wider metropolitan network traffic model and therefore did not purport to reflect broader impacts on the network as a result of the project proceeding (project option) or not (base case). Given that behavioural responses of passengers to changes in transport activities are generally driven by impacts on the whole origin-destination trip, these more limiting traffic-modelled outcomes might not fully reflect what might happen with the project. For example, increasing congestion on the Victoria Road corridor might lead to changed trip routings based on expected travel times across the whole network rather than necessarily increased queues on the corridor itself – presumably, if users divert, we can assume that in generalised cost terms they are better off, otherwise they would have remained on the corridor. However, in the absence of broader network impacts of the proposed improvements, we have reviewed the corridor-specific traffic data and made simplifying assumptions as to how to relate potential impacts on the Victoria Road corridor itself to wider origin-destination trip patterns.

We have derived conventional transport benefits from the available data, covering the following:

- Change in consumer surplus:
    - Savings in travel time for existing bus passengers, including improved reliability
    - Savings in travel time for general traffic users
    - User benefits attributable to induced bus passengers
- Change in producer surplus:
    - Change in net bus revenue for additional passengers (additional revenue less additional costs)
- Change in third–party effects:
    - Reduced road costs as a result of car users diverting to bus
    - Reduced externalities as a result of car users diverting to bus

In addition, the unexpired capital value of the new asset has been taken up as a benefit.

The costs and benefits of the Victoria Road upgrade option were compared with the Base Case of maintaining current arrangements using a discounted cash flow technique on the basis of a real discount rate of 7% in accordance with NSW Treasury and RTA investment appraisal guidelines.

Project capital expenditure was assumed to take effect from 2008/09 and all values were expressed in 2008 dollars. The evaluation period was 32 years, with two years for implementation and 30 years of operation.

A number of sensitivity tests were undertaken to test the robustness of the results to changes in the original assumptions.

3 Assessment of Costs and Benefits

3.1 Introduction

This chapter discusses the component costs and benefits for the Victoria Road Upgrade project and how they were derived.

3.2 Project Capital Costs

Table 3-1 summarises the construction cost estimates for the proposed new bridge and associated works.

Table 3-1: Victoria Road Upgrade Project Capital Costs

Years Ending June	Total Capital Costs ($ million)
Phase 1:	
EA, Scope and TOC Development	13
Phase 2:	
Detailed design, EA and communications	10
Rozelle road works	9.5
Drummoyne road works –	
Road works to remove median	11.5
Quick movable barrier	6.5
Bridge works	66.5
ITS:	
Bus lane cameras, CCTV, VMS, pavement lights	3
New ITS ducts	2
Traffic management for ITS works	1
Traffic signal adjustments	2
Utility adjustments:	
Telstra and AGL adjustment at bridge abutments	3
Structural adjustments to bridge concept	2
Other service adjustments	1
Escalation	5
RTA internal costs and project delivery costs	20
Cost Plan Total Outturn Estimate	**156**

Source: Bridge to Bay Alliance

We were advised that the construction program would take two years. For the purposes of this evaluation, we have assumed that the total amount of $156 million is expended equally over two years, $78 million in each of the first two years.

For the purposes of this evaluation, we assumed that the only capital expenditure which would be subject to a residual value calculation would be the bridge works. All other costs would be fully expended by the end of the 30-year evaluation period. Bridge works were assumed to have a 100-year life. After 30 years, the residual value for the $66.5 million bridge works in 2040 would be $46.55 million.

3.3 Recurrent Costs

Both the Base Case and the option involve recurrent maintenance and system operating costs. These are summarised in Table 3-2.

Table 3-2: Project Recurrent Costs

	Base Case	Project Option
Tidal flow system	$50,000 per annum	$600,000 per annum
Bridge maintenance	$13,000 per annum	$26,000 per annum(1)
Total	$63,000 per annum	$626,000 per annum

Note: (1) assumes that the costs of maintaining two bridges is twice that of one bridge

Source: Bridge to Bay Alliance

Further costs would be incurred in substantive maintenance work on the existing Iron Cove Bridge. These costs would occur under both options although the timing is uncertain. For the purposes of this evaluation, we have assumed that the timing would be the same in both options and, with the maintenance costs being the same, there would be no incremental cost difference between the options. However, the traffic impacts would differ significantly between the options and these are discussed in section 3.4.2 below.

As part of the project's recurrent costs, additional bus operating costs as a result of the project attracting more bus passengers are discussed in section 3.6 below.

3.4 Reduced Travel Times

Existing bus and car passengers could expect to receive travel time savings as a general result of the project throughout the evaluation period as well as additional travel time benefits while substantive maintenance is undertaken on the existing Iron Cove Bridge. In addition, bus passengers could expect to enjoy improved reliability assessed as a reduction in unexpected delays.

3.4.1 General Time Savings

The Alliance provided estimates of unit time savings, of the number of buses and bus passengers, and of cars in the respective time periods. We then applied the following parameters to derive estimates of annual time savings:

- General traffic distribution: 80% private car, 5% business car, 11% light commercial, 4% heavy commercial (RTA Economic Analysis Manual, Appendix B, Table 7)
- General traffic vehicle occupancy: 1.12 private car, 1.2 business car, 1.3 light commercial, 1.0 heavy commercial (ibid. Table 8)
- In-vehicle travel time (IVT): $11.55 per hour for private travel and public transit passengers, based on the latest RTA estimate (ibid. Table 9). Other peak hour RTA travel time values were used: business car ($36.95 per person hour), light commercial ($22.64 per person hour and $1.23 per

freight hour) and heavy commercial ($24.04 per person hour and $21.49 per freight hour), as found in Appendix B, Table 9.

- Gross-up factor from AM and PM peaks to annual figures: 240 (48 weeks x 5 days)

The assumed improvements in actual times offered by the project are outlined in Table 3-3 below. The variability of actual bus times over scheduled times suggests that there is likely to be an element of unexpected delays in passengers' travel times, constituting a measure of unreliability. However, given the well-established traffic patterns along Victoria Road, it would be unreasonable to define all times in excess of timetabled schedules as unexpected delays as passengers adjust to regular delays. If we consider that unexpected delays occur more at random and that they represent actual times in excess of the expected delays, we would conventionally value the associated time savings more highly than the standard unit in-vehicle travel time. For the purposes of this evaluation, we have calculated an additional unexpected delay saving based on the following assumptions:

- This benefit only applies to AM peak citybound bus passengers between 0730 and 0900
- Only average times in excess of 25 minutes are considered unexpected delays
- Unexpected delays are valued at 3.7 times in-vehicle time, based on recent RailCorp parameters which ranged between 2.5 and 8.7 times IVT depending on the overall speed of services (stopping and fast services) and the average lateness

The effect of incorporating this estimate of unexpected delays is to increase the total value of annual travel time savings for AM peak buses city bound by just over 20%, from $4.70 million to $5.72 million.

Table 3-3 summarises the annual travel time savings for bus and car users in the AM and PM peaks for each year of the evaluation period, except for the two years when maintenance work on the existing Iron Cove Bridge was undertaken.

Table 3-3: Project General Annual Travel Time Savings

	Unit Saving (min/vehicle)	No. Vehicles per day	Passengers per day(1)	Total Value of Annual Travel Time Savings(2)
General traffic:				
AM peak – citybound	1.18	5,608		$524,828
AM peak – outbound	(1.68)	4,590		($611,061)
PM peak – citybound	2.17	5,772		$989,055
PM peak – outbound	0.10	5,715		$45,198
Sub-total		**21,685**		**$948,020**
Buses:				
AM peak – citybound	13.39	162	7,596	$5,721,763
AM peak – outbound	1.48	52	820	$56,195
PM peak – citybound	1.83	58	1,349	$114,260
PM peak – outbound	(0.37)	123	5,626	($95,304)
Sub-total		**395**	**15,391**	**$5,796,913**
Total				**$6,744,933**

Notes: (1) General traffic passengers included car passengers as well as occupants in light and heavy commercial vehicles, excluding buses
(2) Travel time savings for general traffic included savings for passengers and freight
Source: Bridge to Bay Alliance and Saha estimates

3.4.2 Time Savings during Bridge Maintenance

While the cost of bridge maintenance was assumed to be the same for both options, the traffic impacts were expected to differ significantly between the two options. For the purposes of the evaluation, we assumed that the Iron Cove Bridge maintenance would involve two years of disruptions but, because of the additional lanes provided by the project, there would be no material impact of traffic flows in the project option.

Table 3-4 summarises the additional travel time savings which the project would provide over the Base Case in the two years of bridge maintenance, assumed to be 2015 and 2016. The unit assumptions were the same as those used in the calculations in Table 3-3.

Table 3-4: Additional Project Annual Travel Time Savings during Bridge Maintenance

	Additional Unit Saving (min per vehicle)	No. Vehicles per day	Passengers per day	Total Value of Additional Annual Travel Time Savings	
				Unadjusted	Adjusted
General traffic:					
AM peak – citybound	5.77	5,608		$2,557,613	
AM peak – outbound	11.70	4,590		$4,247,179	
PM peak – citybound	6.47	5,772		$2,951,949	
PM peak – outbound	1.77	5,715		$798,496	
Sub-total		**21,685**		**$10,555,238**	**$5,277,619**
Buses:					
AM peak – citybound	29.07	162	7,596	$10,200,516	
AM peak – outbound	8.53	52	820	$323,277	
PM peak – citybound	7.20	58	1,349	$448,731	
PM peak – outbound	2.30	123	5,626	$597,819	
Sub-total		**395**	**15,391**	**$11,570,343**	**$5,785,172**
Total				**$22,125,581**	**$11,062,791**

Source: Bridge to Bay Alliance and Saha estimates

Because of the corridor-specific traffic modelling, the amount in the "unadjusted" column assumes that traffic users would not adjust their travel behaviour during the bridge maintenance period and potentially find alternative routes which might minimise the adverse travel times. In practice, it is likely that increased travel times in the Base Case would be less than these estimates. For the purposes of this evaluation, we have therefore assumed that only 50% travel time costs would be saved, which are then added to the totals from Table 3-3 for the two years of bridge maintenance.

3.5 Induced Traffic Benefits

Transport improvements customarily lead to increased usage, with the greater the level of improvements leading to a higher the number of induced passengers. For the purpose of this evaluation, the significant improvements are recorded for AM peak city bound bus passengers, and as a result we have confined our estimate of additional transport trips on this corridor to this group of passengers.

Table 3-5 summarises the travel time benefits attributable to induced AM peak city bound bus passengers.

Table 3-5: Induced Transport Benefits

Parameters	Values
Current AM peak city bound bus passengers	7,596 per day
Generalised journey time (GJT) elasticity	-0.3
Assumed trip time reduction	25%
Derived new bus passengers	569.7 per day
Travel Time Benefit:	
Average trip saving	13.39 minutes
Value of in-vehicle time	$11.55 per person hour
Annual Travel Time Benefit	**$176,227**
Car Park Costs Avoided:	
Car trips avoided	508.7 per day
% car trips using multi-storey car parks	50%
Capital costs of multi-storey car park space	$50,000
Annual Car Park Costs Avoided	**$423,884**

Source: Saha estimates

The above table was based on the following assumptions:

- Number of AM peak bus passengers from Table 3-3 above
- GJT elasticity based on RailCorp estimate for short rail trips in Sydney of around -0.5. Given the generally lower modal attractiveness of bus over rail, we assumed that a lower elasticity was appropriate – in this case, we have applied a more conservative elasticity of -0.3.
- Modal choice would be influenced not only by what happens on a particular part of the trip but the contribution such improvements make in relation to the total trip. We assumed that the derived time saving of 13.39 minutes represented around 25% time saving of the total trip
- Conventionally, generated traffic attracts 50% of the unit benefits of existing traffic – the "rule of a half", represented by the triangle under the demand curve
- Peak hour car occupancy: 1.12
- Assumed conservatively that not all diverted car users are heading for CBD requiring multi-storey car park spaces – in this case, assumed only 50%
- Capital cost of a multi-storey car park space based on RailCorp estimate for 2005 for North West rail study ($45,000), increased to $50,000 to reflect 2008 estimates
- Assumed that freed-up car spaces would be progressively taken up by other users over time and therefore savings are averaged over 30-year evaluation period

3.6 Changed Bus Producer Surplus

Table 3-6 summarises the estimates of annual changes to bus revenues and costs as a result of the project.

Table 3-6: Incremental Bus Revenues and Costs

Revenue:	
Additional daily AM peak city bound bus passengers	569.7
Additional daily bus passengers	1,139.4
Average bus fare per trip	$1.52
Total annual incremental bus revenue	**$415,653**
Costs:	
Average AM peak city bound bus occupancy	47
Additional AM peak bus services	12.2
Average round trip distance	50 kms
Average operating cost per bus km	$3
Total annual incremental bus costs	**$437,400**

Source: Saha estimates

The above table was based on the following assumptions:

- Bus revenue assumes that passengers make two one-way trips or one roundtrip per day. Thus, new AM peak city bound bus passengers make return trips later on the same days.
- Average bus fare was based on work undertaken for Ministry of Transport, as provided by TDC
- Average bus occupancy was derived from modelling data in Table 3-3 above: 7,596 passengers on 162 buses
- Average bus operating cost of $3 per bus vehicle kilometre excludes capital costs. With capital costs, operating costs are around $6 per bus vehicle km, as advised by Ministry of Transport. However, we were advised that the time savings provided by this project would enable these additional bus trips to be achieved with existing buses, i.e. no additional buses would be required. To the extent that this assumption might not hold, the incremental bus costs could be up to double the above figure of $3 per bus vehicle kilometre.

This table indicates that expected additional revenue would cover around 95% of expected additional costs provided no additional capital costs were incurred.

In the accompanying spreadsheet, the additional costs are included under “recurring costs” while the incremental bus revenue is included under “benefits”.

3.7 Reduced Road Costs

Table 3-7 summarises the estimates of reduced road costs as a result of the project.

Table 3-7: Reduced Road Costs

	Values
Road Decongestion Benefits:	
Additional daily AM peak city bound bus passengers	569.7
Car vehicle occupancy for private AM peak movements	1.12
Number of additional AM city bound car trips avoided	508.7
Average round trip distance	40 kms
Total daily vehicle kilometres saved	20,346
Unit road decongestion rate	37.36 cents per diverted km
Total Annual Road Decongestion Benefits	**$1,824,342**
Resource Cost Correction:	
Unit resource cost correction	14.75 cents per diverted km
Total Annual Resource Cost Correction	**$720,225**
Total Annual Reduced Road Costs	**$2,544,567**

Source: RailCorp and Saha estimates

The above table was based on the following assumptions:

- Road congestion would be reduced on average in the AM peak city bound direction and in the PM peak outbound direction because the same passengers are using buses in both directions – therefore, if we assume that an average one-way car trip was 20 kilometres, total vehicle kilometres in the peak periods covering a wider network than the Victoria Road corridor alone would amount to 40 kilometres.
- The unit decongestion value of 37.36 cents per diverted vehicle kilometre was derived from recent work undertaken for RailCorp in which they measured the road effects of car passengers diverting to rail. This value represents an estimate of the benefit enjoyed by remaining road users because of the diversion of some users to other modes (in this case buses), reflecting increases in average speed flows with fewer vehicles on the road.
- An additional resource cost correction has been made. While the perceived costs of car travel (fuel) were assumed in the decision to divert to bus, an additional resource cost saving occurs representing the difference between the full resource VOC and the perceived VOC. According to the RTA Manual, Appendix B, Table 1, this cost in December 2007 for cars was estimated at 13.45 cents per vehicle kilometre. To derive equivalent estimates for other vehicles, we applied the VOC ratios from Table 5 at 30kph: this provided estimates for light commercials of 17.09 cents per vehicle kilometre and for heavy commercials (rigid) 35.92 cents per vehicle kilometre.

3.8 Reduced Externality Costs

Table 3-8 summarises the unit values of a range of externalities to derive an annual estimate of externality savings.

Table 3-8: Reduced Externality Costs

	General Traffic			Bus	Total
	Car	Light Commercial[1]	Heavy Commercial[1]		
Unit values (cents/km):					
Total:	**14.53**	**99.71**	**59.66**	**74.63**	
Air pollution	*2.58*	32.31	21.54	*29.08*	
Greenhouse gases	*2.03*	10.06	4.79	*11.98*	
Noise pollution	*0.83*	5.51	3.60	*2.03*	
Water	*0.39*	4.85	3.23	*4.36*	
Nature/landscape	*0.05*	3.59	0.36	*0.13*	
Urban separation	*0.60*	5.27	2.40	*1.92*	
Upstream/downstream	*3.48*	33.54	19.17	*17.97*	
Accidents	*4.57*	4.57	4.57	*7.16*	
Average unit value (cents/km)	25.70			74.63	
Change in daily incremental vkt	(20,346)			608	
Total Externality Savings	**$1,255,201**			**($108,811)**	**$1,146,390**

Notes: [1] Estimates expressed in $ per tonne-kilometres in Table 18, Appendix B were converted to $/vehicle kilometre based on an average loading of 2 tonnes for a light vehicle and 10 tonnes for a heavy vehicle

Source: RTA Manual, Appendix B, Tables 13 and 18 and Saha estimates

The proposed scheme comprises significant expenditure to address pedestrian safety issues. However, no clear estimate has been made of the likely reduction in incidence and consequence on pedestrian safety. While a network-wide average estimate of the impacts of accident reduction is included in the above table, with the impact of reduced car kilometres marginally offset by the expected increase in bus kilometres, it is possible that these estimates may still understate the project's safety improvements, particularly as the RTA Manual indicates that the average cost for a "pedestrian, crossing carriageway" accident in December 2007 was $156,300.

3.9 Intangible Benefits

The above analysis has focused on the quantitative aspects of the project. However, the project is also expected to provide additional benefits to cyclists and pedestrians in terms of traffic separation. Also, there may be some amenity benefit to users and residents although these may be in dispute: hence, no attempt has been made to assign any values to them.

4 Economic Evaluation

4.1 Introduction

The Victoria Road upgrade option was compared with the Base case of maintaining current arrangements using a discounted cash flow technique on the basis of a real discount rate of 7% in accordance with NSW Treasury and RTA investment appraisal guidelines.

Project capital expenditure is assumed to take effect from 2008/09 and all values are expressed in 2008 dollars. The evaluation period was 32 years, with two years for implementation and 30 years of operation. Only the bridge works component of the total investment has been assigned a residual value at the end of the evaluation period.

A number of sensitivity tests were undertaken to test the robustness of the results to changes in the original assumptions.

4.2 Base Evaluation

Table 4-1 summarises the economic evaluation at 7% real discount rate and indicates the results for the Victoria Road upgrade option incremental to the Base Case.

A more detailed presentation of the results is given in the spreadsheet in Appendix A.

Table 4-1: Results of Economic Evaluation at 7% Real Discount Rate

Criteria	Victoria Road Upgrade Incremental to Base Case
Undiscounted Capital Cost ($000)	156,000
Project Costs (Present Value $000):	
Capital costs	150,897
Recurrent costs	11,480
Total Project Costs	**162,377**
Project Benefits (Present Value $000):	
Existing user benefits	92,483
Generated user benefits	6,960
Incremental bus revenue	4,820
Reduced road costs	29,510
Other externality benefits	13,295
Residual value	5,715
Total Project Benefits	**152,784**
Evaluation Measures:	
Net Benefits (NPV $000)	**(9,594)**
NPV/Capital Costs	**(0.06)**
Benefit-Cost Ratio	**0.94**
Internal Rate of Return	**6.4%**

The following points emerge from the above table:

- Under the base assumptions, the project produces a marginally negative outcome, with a negative NPV of $9.6 million.
- Given the BCR equals 0.94 to two decimal places, the results are only marginally short of producing a break-even outcome.
- Just over 60% of the gross benefits comprise travel time savings to existing bus passengers and car users.
- A further 20% of benefits consist of reduced road user costs and congestion

4.3 Sensitivity Tests

A number of sensitivity tests were undertaken to assess the robustness of the results to changes in the key variables. These are summarised in Table 4-2. Except for the two explicit sensitivities at alternative discount rates, all other sensitivity tests were undertaken at 7% real discount rate.

Table 4-2-: Economic Evaluation Sensitivity Tests

Sensitivity Test	Victoria Road Upgrade Incremental to Base Case	
	NPV ($000)	BCR
Discount Rate: 4%	51,846	1.31
Discount Rate: 10%	(44,876)	0.72
Higher Capital Costs (+20%)	(38,630)	0.80
Lower Capital Costs (-20%)	19,443	1.15
Higher Total Benefits (+20%)	18,837	1.12
Lower Total Benefits (-20%)	(38,024)	0.77
Higher Total Benefits (+2% per annum real increase)	20,715	1.13
Changed Unexpected Delays (base evaluation: 25 minutes):		
20 minutes	29,941	1.18
24 minutes	(1,687)	0.99
26 minutes	(16,273)	0.90
Alternative GJT elasticities (base evaluation: -0.3):		
-0.2	(26,098)	0.84
-0.4	6,910	1.04
Changed Delay Impacts of Bridge Maintenance (base evaluation: 50% impact):		
100% impact	4,667	1.0
Changed bus time savings as % of total trip time (base evaluation: 25%):		
20% of trip time	(19,496)	0.88
30% of trip time	309	1.00
Increased car trip lengths (base evaluation: 40 kms):		
50 kms	1,423	1.01
Higher value of in-vehicle time (base evaluation: $11.55 person hour):		
$11.88 per person hour (as used in recent RailCorp evaluations)	(6,890)	0.96

The range of sensitivity tests indicates that small changes in different variables lead to significant swings above and below the breakeven point. For example, changing the threshold assumption of bus trip times in excess of expected delays by one minute can change the NPV by $8 million.

5 Conclusions

Based on the analysis described in this report, the following conclusions are derived from the economic evaluation:

- The project as defined produces marginal economic outcomes where the base evaluation produces a marginal negative outcome, with a BCR of 0.94.
- The majority of benefits (60%) are enjoyed by both bus and car users in terms of estimated travel time savings and improved bus reliability, consistent with the traffic model estimates. Another 20% of benefits reflect the broader third-party road decongestion benefits as a result of passengers diverting to bus because of the improved bus trip times.
- Based on the most recent RTA unit values of environmental impacts, including reduced pollution and greenhouse gas emissions, such benefits represent just under 10% of total benefits.
- Very small variations in almost all parameters produce significant swings either side of the breakeven position.
- In terms of the base evaluation, the shortfall of $9.6 million in NPV terms is the equivalent of around $770,000 per annum throughout the evaluation period. For the project to break even, the amenity benefit affecting pedestrians and cyclists which has not been separately valued would need to be valued at $770,000 per annum.

Appendix A - Spreadsheet

SAHA

Hyder Consulting/Bridge to Bay Alliance

Victoria Road Economic Evaluation

Option 1 Incremental

($'000)	Costs		Total Costs	Residual Value	Benefits						Total Benefits	Net Benefits
	Capital Costs	Recurring Costs			Existing Pax		New Passengers		Non Passenger Benefits			
Years	*Project*	*Maint. + OPEX*			*General Traffic*	*Bus*	*User Benefits*	*Incr. Revenue*	*Decongestion*	*Externalities*		
2009	$ 78,000	-$ 63	$ 77,937	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 77,937
2010	$ 78,000	-$ 63	$ 77,937	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 77,937
2011	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2012	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2013	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2014	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2015	$ -	$ 1,000	$ 1,000	$ -	$ 6,226	$ 11,582	$ 600	$ 416	$ 2,545	$ 1,146	$ 22,514	$ 21,514
2016	$ -	$ 1,000	$ 1,000	$ -	$ 6,226	$ 11,582	$ 600	$ 416	$ 2,545	$ 1,146	$ 22,514	$ 21,514
2017	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2018	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2019	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2020	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2021	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2022	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2023	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2024	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2025	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2026	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2027	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2028	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2029	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2030	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2031	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2032	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2033	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2034	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2035	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2036	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2037	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2038	$ -	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2039	-$	$ 1,000	$ 1,000	$ -	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 11,452	$ 10,451
2040	-$	$ 1,000	$ 1,000	$ 46,550	$ 948	$ 5,797	$ 600	$ 416	$ 2,545	$ 1,146	$ 58,002	$ 57,001
Undisc.	**$ 156,000**	**$ 29,886**	**$ 185,886**	**$ 46,550**	**$ 38,996**	**$ 185,478**	**$ 18,003**	**$ 12,470**	**$ 76,337**	**$ 34,392**	**$ 412,225**	**$ 226,339**
PV @ 4%	**$ 153,000**	**$ 16,510**	**$ 169,510**	**$ 13,800**	**$ 23,944**	**$ 105,353**	**$ 9,978**	**$ 6,911**	**$ 42,308**	**$ 19,061**	**$ 221,356**	**$ 51,846**
PV @ 7%	**$ 150,897**	**$ 11,480**	**$ 162,377**	**$ 5,715**	**$ 17,798**	**$ 74,686**	**$ 6,960**	**$ 4,820**	**$ 29,510**	**$ 13,295**	**$ 152,784**	**-$ 9,594**
PV @ 10%	**$ 148,909**	**$ 8,453**	**$ 157,362**	**$ 2,425**	**$ 13,812**	**$ 55,913**	**$ 5,143**	**$ 3,562**	**$ 21,807**	**$ 9,824**	**$ 112,487**	**-$ 44,876**

	4%	7%	10%
NPV	$ 51,846	-$ 9,594	-$ 44,876
NPV/I	0.34	-0.06	-0.30
BCR	1.31	0.94	0.71
IRR		6.40%	

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