MEYRICK AND ASSOCIATES

Economic assessment of some of the larger projects in the Victorian Transport Plan

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EXECUTIVE SUMMARY

Purpose of this report

The economic costs and benefits of some of the larger projects in the package of initiatives in the Victorian Transport Plan (VTP) have been quantified by the economic advisers of Meyrick and Associates, Steer Davies Gleave and EconSearch Pty Ltd.

The economic analysis of potential developments was constructed around three work streams:

1. A benefit cost analysis (BCA), focusing on the direct impact of the proposed interventions
2. An assessment of the wider economic benefits (WEBs) that flow from improving the functioning of the transport sector.
3. An assessment of the impact on gross state product and employment in Victoria using an equilibrium modelling framework.

This report details the method and outcomes of these work streams. It also identifies the major differences between this analysis and the one undertaken for the Eddington East West Link Needs Assessment in 2007-08 for the Department of Infrastructure (DoI). This previous analysis was detailed in *East West Needs Assessment Economic Analysis: Technical Report* (Meyrick and Associates, Steer Davies Gleave and EconSearch, 2008)

Package assessed

For the purposes of this assessment a package of transport initiatives was assessed. These projects are outlined in Table 1.

TABLE 1: PROJECTS INCLUDED IN THE VTP INITIATIVES AND MODELLED FOR ECONOMIC ASSESSMENT

Regional Rail Link Melbourne Metro -(Stage 1) Melbourne Metro-(Stage 2) Sunbury Electrification South Morang Extension	Alternative to Westgate-Port to Geelong Road Alternative to Westgate- Geelong Road to Western Ring Road Truck Action Plan Stage 1 Peninsula Link North East Link Dingley Arterial Outer Metropolitan Ring Transport Corridor

Outcomes of Analysis

Table 2 and Table 3 outlines the summary of the three works streams of economic assessment for the package of projects.

TABLE 2: OUTCOMES OF ECONOMIC BENEFIT COST ASSESSMENT

Present value of conventional benefits ($m)	21,349
Present value of Wider Economic Benefits ($m)	3,002
Present value of costs ($m)	18,010
Conventional benefit/cost ratio	1.18
Benefit/cost ratio including Wider Economic Benefits	1.35

TABLE 3: IMPACT ON GROSS STATE PRODUCT AND EMPLOYMENT

Victorian Economic Effects	**Average Annual Impact During Construction**	**Impact in 2036**
	Average Annual 2009 – 2028	**2036**
Gross State Product ($m)	643	1,898
Gross State Product (%)	0.25%	0.74%
Employment (no. FTE)	5,879	9,696
Employment (%)	0.27%	0.45%

1. INTRODUCTION

1.1 Purpose of this report

The economic costs and benefits of some of the larger projects in the package of initiatives in the Victorian Transport Plan (VTP) have been quantified by the economic advisers of Meyrick and Associates, Steer Davies Gleave and Econsearch Pty Ltd.

The economic analysis of potential developments was constructed around three work streams:

1. A benefit cost analysis (BCA), focusing on the direct impact of the proposed interventions
2. An assessment of the wider economic benefits (WEBs) that flow from improving the functioning of the transport sector.
3. An assessment of the impact on gross state product and employment in Victoria using a general equilibrium modelling framework.

This report details the method and outcomes of these work streams. It also identifies the major differences between this analysis and the one undertaken for the Eddington East West Link Needs Assessment in 2007-08 for the Department of Infrastructure (DoI). This previous analysis was detailed in *East West Needs Assessment Economic Analysis: Technical Report* (Meyrick and Associates, Steer Davies Gleave and Econsearch, 2008).

The revisions to the approach from that undertaken for the Eddington East West Link Needs Assessment in 2007-08 have been driven by an internal review of the conventional benefit cost assessment model by Steer Davies Gleave and an external review undertaken by PricewaterhouseCoopers. Additional advice to enhance the robustness of the approach was provided by the Public Transport Division of the Department of Transport, VicRoads and Veitch Lister Consulting. Changes to the approach between the two assessments have been discussed and agreed to with the broader government project team.

1.2 Structure of this report

The report comprises two main sections.

Section 2 is a presentation of the method and results of the Benefit Cost Analysis (BCA) undertaken to assess the impact of the package of initiatives that forms part of the VTP. It details the approach to both the conventional benefit cost analysis and the inclusion of the Wider Economic Benefits.

Section 3details the assessment of the impact on gross state product and employment in Victoria using an equilibrium modelling framework.

The report's appendices detail the outcomes of some sensitivity analysis on the BCA results as well as sectoral definitions utilised in the equilibrium modelling framework.

2. BENEFIT COST ASSESSMENT

2.1 Background

The information provided to the economic consultants allowed the estimation of the following benefits that flow from the transport intervention:

1. Reduced private and commercial vehicle operating costs
2. Travel time savings for private vehicle operators, commercial vehicle operators and public transport users as well as for freight travelling on the network.
3. Reduced crash costs incurred by private and commercial vehicles
4. A change in the level of valued externality costs from changes in greenhouse gas and other emissions from private and commercial vehicles
5. Residual value of the initiatives
6. Wider economic benefits in terms of agglomeration, labour supply and imperfect competition.

2.2 Input Information

The main input data that informs both the conventional benefit cost assessment and the assessment of wider economic benefits comes from the whole of Melbourne transport model developed by Veitch Lister Consulting (the Veitch Lister model). This model provided inputs for the base case and the project case.

Summary and more detailed indicators which were used to determine the wider economic benefits were provided for the base and project case for the year 2036. For the base case 2011 summary indicators were also provided.

2.3 Parameter Values

The parameter values for such items as value of travel time and emissions are summarised in Table 4.

TABLE 4: MODEL PARAMETERS

Parameter	Measure	Source / Notes
Base Year	2012	Agreed between economic consultants and Government project team
Time period	30 years from base year	Consistent with Infrastructure Australia guidelines
Discount rate	6.5% real	As required by Victorian guidelines
Number of days per annum	300	Agreed between economic consultants and Government project team
Value of time savings per hour for non-business travel (2008 prices)	$11.54	Austroads 2007 Road User Costs inflated to 2008
Value of time savings per hour for business travel	$37.50	Austroads 2007 Road User Costs inflated to 2008
Value of time savings for business travel in commercial vehicles (2008 prices)	$24.16	The median of Austroads 2007 Road User Costs for commercial vehicles inflated to 2008
Value of time savings for freight	$24.77	The median of Austroads 2007 Road User Costs for commercial vehicles freight travel time inflated to 2008
Proportion of commercial vehicle travel that is for business purposes	100%	From Veitch Lister Model outputs
Proportion of private vehicle travel that is for business purposes	20%	Advice from VicRoads
Proportion of public transport travel that is for business purposes	3.4%	From Veitch Lister Model outputs
Inflation Rate (CPI) per annum	2.00%	Agreed between economic consultants and East West Team
Net Present Value	January 08 dollar terms	Agreed between economic consultants and East West Team
Externality Valuations	**$/tonne**	
NO_x	$1,750	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
NMVOC	$850	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
SO_x	$ 11,380	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
CO_2	$10	Calculation provided by Caroline Evans,
CH4	**$10**	sources include Watkiss, Cosgrove (2003)

Parameter	Measure	Source / Notes
N_2O	$10	Urban Pollutant Emissions from Motor Vehicles, BTRE (2005) Greenhouse Gas Emissions from Australian Transport.
CO	$3	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
Particulate Emissions	$341,650	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia

2.4 Project Assessed

For the purposes of this assessment a package of transport initiatives was assessed. For the remainder of this report this package will be referred to as some of the larger projects in the package of initiatives contained in the Victorian Transport Plan. These projects are outlined in Table 5.

TABLE 5: TRANSPORT INITIATIVES INCLUDED IN THE VTP AND MODELLED FOR ECONOMIC ASSESSMENT

Regional Rail Link	Alternative to Westgate-Port to Geelong Road
Melbourne Metro -(Stage 1)	Alternative to Westgate- Geelong Road to Western Ring Road
Melbourne Metro-(Stage 2)	Truck Action Plan Stage 1
Sunbury Electrification	Peninsula Link
South Morang Extension	North East Link
	Dingley Arterial
	Outer Metropolitan Ring Transport Corridor

2.5 Capital and Operating Cost Profiles

Capital expenditure (CAPEX) and operating expenditure (OPEX) profiles for each of the initiatives were developed with input from the Victorian Department of Treasury and Finance, VicRoads, the Public Transport Division of the Department of Transport and further advice from the Government project team.

2.6 Extending the performance indicators from 2011-2063

As discussed earlier, the input material from the Veitch Lister Model was provided to the economic consultants for one year (2036) for the project cases and for two years for the base case (2011 and 2036). For intermediate years, values were estimated by a process of interpolation, using a compound annual growth rate based on the two known data points (2011 base case and 2036 base case or project case). A worked example is outlined in Box 1.

BOX 1: CALCULATING GROWTH RATES IN THE BENEFIT COST MODEL

Private Vehicle Operating Costs $'000 per day	2011	$30,023
Private Vehicle Operating Costs $'000 per day	2036	$42,471
Number of years (n)	25	
Per annum growth rate applied to vehicle operating costs 2006-2011 in base case	$(42,471/30,023)^{(1/n)} - 1$	1.40%

To extend the performance indicators from the last year of data (2036) to the end of the assessment period (2063), the respective growth rates determined for 2011-2036 was applied to the performance indicator.

2.7 Conventional Benefit Cost Assessment

Meyrick and Associates undertook the conventional BCA to estimate the direct impact of the project on those immediately affected by it: those who use the project, those who supply it, and those who are subject to various external effects directly traceable to the project.

The phase of the study was concerned with changes in economic activity only in so far as these have specific implications for the level of utilisation of the project. In undertaking this analysis, we were guided by the National Guidelines for Transport System Management (2nd Edition) as endorsed by the Australian Transport Council and the Council of Australian Governments (February 2006).

2.8 Inclusion of Wider Economic Benefit

The cost benefit analysis following conventional guidance largely concentrates on counting direct impacts on transport users, which are principally time and cost savings. It has long been recognised that these direct impacts will have wider economic benefits in addition to the time and costs savings that are assessed in the conventional appraisal.

Inclusion of WEBs combines outputs from conventional transport appraisal, such as time savings and changes in demand, with economic data, such as output and employment, to produce estimates of changes to productivity, over and above productivity impacts accounted for in the conventional BCA. For this assessment Steer Davies Gleave has quantified productivity and wider economic benefits as far as possible. These Wider Economic Benefits include:

1. Agglomeration economies
2. Imperfect competition effects and
3. Additional labour supply effects

2.9 Conventional Benefit Assessment

2.9.1 Consideration of uptake of benefits

The method outlined above provides an exponential growth pattern of benefits between the commencement of a new initiative and the performance of the network in 2036. However, it does not take into account the likely early uptake of the benefits in the early years of the intervention. In order to ensure that early uptake was considered appropriately the following steps were undertaken.

The basis of the benefit uptake rate is the value of capital works completed each year as a proportion of the total amount of capital expenditure for the project case.

Beginning in 2008, a cumulative figure of completed-to-date projects was calculated for each year. The number comprises of the sum of capital expenditures generated in all the previous years, which was then added to the amount of works completed during the year considered.

This to-date figure is then divided by the projected amount of total capital expenditure for the package of initiatives throughout the construction period.

The yearly cumulative percentage of capital is then used as the time profile of benefits uptake as detailed in Table 6.

2.9.2 Travel Time Savings

The present value of time savings for private vehicle operators, commercial vehicle operators and public transport users as well as the freight travelling on the network is outlined in Table 7.

TABLE 6: TIME PROFILE OF BENEFITS UPTAKE

Year	Time profile of benefits uptake (in relation to the benefit achieved in 2036)	Year	Time profile of benefits uptake (in relation to the benefit achieved in 2036)
2008	0.0%	**2019**	49.2%
2009	0.0%	**2020**	49.2%
2010	0.0%	**2021**	49.6%
2011	0.0%	**2022**	49.6%
2012	2.2%	**2023**	49.6%
2013	4.4%	**2024**	54.4%
2014	6.3%	**2025**	74.2%
2015	19.2%	**2026**	82.4%
2016	19.2%	**2027**	98.7%
2017	29.3%	**2028**	98.7%
2018	29.3%	**2029**	100.0%

TABLE 7: PRESENT VALUE OF TRAVEL TIME SAVINGS

	Time savings for private vehicles ($m)	Time savings for commercial vehicles ($m)	Time savings public transport ($m)	Time savings freight ($m)	Total time savings ($m)
VTP package assessed	11,487	909	2,026	1,118	**15,541**

Value of time is dependent on the opportunity costs involved.

2008 dollar values of time per hour were determined for business and non-business travel by inflating the 2007 Austroads values of private and business car use and inflating the median of the per occupant value for the different commercial vehicles in the fleet. These values are outlined in Table 4.

Parameter values of the proportion of modal travel time dedicated to business and non-business travel were determined by Steer Davies Gleave who utilised detailed origin-destination information and purpose of trips provided by Veitch Lister Consulting. These values were crosschecked with representatives of VicRoads who have utilised the Veitch Lister model for other modelling purposes. These proportions are outlined in Table 4.

The parameter values detailed in Table 4 were used to determine travel time savings for each option through the following method:

1. For the year 2036, total journey time in minutes for each mode was calculated by multiplying the Veitch Lister summary performance indicator of in vehicle 'person hours per day' by the number of minutes in an hour and by an uplift factor for each mode of travel to account for total journey time (in vehicle time as well as waiting and transfers)
2. For each mode, a minute per kilometre estimate was derived by dividing the total journey time in minutes by the Veitch Lister summary performance indicator of 'person kilometres'
3. For each mode, travel time savings in minutes in 2036 was calculated by summing the person kilometers in the base and project cases and multiplying the outcome by the difference between the total journey time in minutes for the base and project cases. This result was divided by 2 to take into account of the rule of a half.
4. To determine the value of travel time savings per annum for each mode, travel time savings in minutes were multiplied by the proportion of travel by private, commercial or public transport undertaken for business purposes and the value of travel time for business purposes this was summed with the proportion of travel by private, commercial or public transport undertaken for non-business purposes and the value of travel time for non-business purposes. See Table 4 for these parameter values.
5. It should be noted that as Victoria's wealth increases over the course of the next twenty five years the value of time for business and leisure purposes increases as well. Therefore, the value of time in the model increases over the appraisal period at 2% per annum for business travel and 1.8% per annum for leisure time.

2.9.3 Crash Costs

The present value of crash cost savings is outlined in Table 8.

TABLE 8: PRESENT VALUE OF CRASH COSTS

	Present value crash costs savings total vehicles ($m)
VTP package assessed	194

The level of crashes over the transport network differs as a result of the intervention. The Veitch Lister performance indicators provide data on number of crashes per day and the cost of these crashes (in 2001 dollars).

To determine the present value of reduction in accident costs as a result of the interventions the following steps were undertaken:

1. For the base case and for each option assessed, the Veitch Lister performance indicator 'Accidents Costs ($ per Day)' was inflated using the long term inflation rate to 2008 dollars.
2. For the base case and for each option assessed, 'the accident costs $ per' day figure for each year of the assessment period was determined through the process outlined in section 2.6.
3. To determine an aggregate cost, the per day figure was multiplied by the number of days in the year (300).
4. Each annual figure was discounted to 2008 values
5. Finally this profile of difference between crash costs in the option less the base case was summed to get the present value.

2.9.4 Reduction in vehicle operating costs

The present value of vehicle operating costs savings for each option is listed in Table 9.

TABLE 9: PRESENT VALUE OF VEHICLE OPERATING COST BENEFITS

	PV operating costs savings private vehicle ($m)	PV operating costs savings commercial vehicles ($m)	PV operating costs savings total vehicles ($m)
VTP Package assessed	594	431	**1,025**

The present value of vehicle operating cost savings for each option was determined by:

1. Vehicle operating cost figures provided by Veitch Lister Consulting were reported in 2005 dollars. These values were inflated by the long term inflation rate to 2008 dollars.
2. Operating costs per day for private and commercial vehicles for the base case and options were derived from the Veitch Lister model.
3. These costs were divided by the number of kilometres travelled per day (sourced from the Veitch Lister model) to derive an operating cost per kilometre travelled.
4. To determine a vehicle operating cost saving per day in the project cases , the operating cost per kilometre travelled for the base case was taken from the operating cost per kilometre travelled for the base case in each option to determine a vehicle operating cost saving per day.
5. The outcome of the previous step was multiplied by the number of days per annum to get annual value of vehicle operating cost savings.

2.9.5 Reduction in externalities

The present value of reduced externality costs for each option is listed in Table 10.

TABLE 10: PRESENT VALUE OF EXTERNALITY SAVINGS

	Present value of externality savings ($m)
VTP Package Assessed	-125

The Veitch Lister transport model provides summary indicators for private and commercial vehicle emissions (tonnes per day) for NO_x, NMVOC, SO_x, CO_2, CH_4,N_2O, CO and particulate emissions

To determine externality cost savings, the following steps were involved:

1. Tonnes per day for emissions from the Veitch Lister model were multiplied by the number of days and the respective externality valuations outlined in Table 4.
2. The base case valuations were taken from the option valuations to determine externality savings for each option.

2.10 Residual benefit

TABLE 11: PRESENT VALUE OF RESIDUAL BENEFIT

	Residual benefits ($m)
VTP Package Assessed	4,714

The Infrastructure Australia Guidelines (Infrastructure Australia, 2008) acknowledge that there is a need for residual value calculations where the economic life of the assets exceeds the 30 year appraisal period. This is the case for all the projects in this assessment, with the major elements of the investment in these options having economic lives of between 50-120 years (ATC, 2005).

Rather than a straight line depreciation approach to calculating the residual value of the assets the benefits and costs involved in each option were extended for a further twenty years post the appraisal period. A present value of the net benefits (for years 31 to 50) was determined as the residual value. A 20 year extension period was chosen to provide a consistent methodology between projects; however it is likely to underestimate the residual value of projects whose major asset lives are greater than 50 years.

2.11 Wider economic benefits

Wider Economic Benefits (WEBs) for the same package of initiatives were developed by Steer Davies Gleave using the outputs of the conventional benefit cost assessment as well as parameter values and other data as listed in Table 12. Table 13 outlines the wider economic benefits as a result of agglomeration, imperfect competition and labour supply impact for each option.

TABLE 12: WIDER ECONOMIC BENEFIT DATA SOURCES

Parameter	Source
Origin – Destination journey costs	Veitch Lister model
Origin – Destination travel demand	Veitch Lister model
Employment by sector	EconSearch
Employment by location	Veitch Lister model
Employment forecasts	Veitch Lister model
Agglomeration elasticities	Dan Graham/ UK guidance
Labour supply elasticity	UK guidance, Australian literature
Productivity of new entrants	Johnson (et al)/ UK guidance
Values of Time	Meyrick and Associates benefit cost model
Productivity by location and sector	EconSearch
Wages by location	ABS
Tax wedges	UK guidance, and Australian literature
Imperfect competition up-rate	UK guidance

TABLE 13: PRESENT VALUE OF WIDER ECONOMIC BENEFITS OF THE VTP PACKAGE ASSESSED

	PV Agglomeration Benefit $m	PV Imperfect Competition $m	PV Labour Supply $m	PV Total Wider Economic Benefits
VTP Package Assessed	2,661	174	167	**3,002**

2.11.1 Agglomeration economies

Agglomeration economies are productivity gains that businesses derive from being located close to other firms and to labour markets. Agglomeration effects tend to be significant for schemes that improve links between cities – especially links heavily used by business travellers, freight and commuters.

Agglomeration economies are derived from the clustering of economic activity. Better access to other firms and to workers enables many sectors to be more efficient. This type of accessibility is measured by 'effective density' – a measure that weighs the activity (jobs, workers etc) accessible to a location by proximity measured in journey costs, where nearby activity gets a higher weight than activity further away.

An increase in the effective density of a location can, according to evidence, lead to an increase in productivity. Recent advances in the literature have provided with detailed elasticities that enable the conversion of changes of effective density into a change in productivity for different locations and individual sectors.

Effective density for each location in a study area is calculated using evidence on average generalised costs (across all modes) for work-related journeys from and to all other locations. This data is extracted from transport models. For the application to this Study a zoning system based on Statistical Local Areas (SLAs) has been used and transport costs data have been extracted from the VLC transport model.

Data on employment by location was sourced from ABS data on employment by SLAs.

Once effective densities were determined for the base and project cases relative changes in effective density were calculated for each location.

Evidence available internationally on agglomeration economies enables us to translate such increases in effective density to productivity gains. These 'agglomeration elasticities' can be quantified by individual sectors and locations. Jobs in a particular sector in a location where a transport project leads to a 5% increase in effective density, and where the agglomeration elasticity is 0.1, will become 0.5% more productive (5%*0.1) because of increased integration. The impact is summed across sectors and locations and the total agglomeration benefits are reported as an additional benefit attributable to the project.

2.11.2 Imperfect Competition

Firms that benefit from transport improvements tend to experience increased turnover as a result. Evidence shows that firms, on average, are able to charge more for additional sales than what it costs them to produce/ provide. Conventional benefit cost appraisal, however, values the benefits to firms based on cost savings which, for these additional sales, underestimates their value. These additional productivity benefits can be assessed as a proportion of conventional time and cost savings to business travellers, in accordance with the modelled outcomes of the conventional benefit cost assessment.

According to the UK Department for Transport,for a typical developed economy, the missing elements of appraisal due to imperfect competition are in the order of 10% of user benefits to in-work travel normally quantified in appraisal. This proportion has been applied in Melbourne/ Victoria. The wider economic benefit of imperfect competition has therefore been calculated as 10% of the user benefits to in-work journeys.

2.11.3 Labour Supply

Individuals are generally faced with the decision about whether to or how much to work. The time and cost of getting to a place of work can act as a disincentive to working. Therefore, if transport costs were lower, it is likely that more people would decide to participate in the labour market (a labour market participant is one who is either in work or seeking work). Where a transport scheme does encourage additional labour supply, there are gains in productivity. Moreover, the additional taxation associated with the increased labour supply is additional to the welfare benefits estimated in conventional appraisal, albeit usually small in magnitude.

The extent of this effect relies on increased output caused by higher participation in the labour market Typically labour supply is considered to be sensitive to the going wages rates. Each individual has a 'reservation wage' – the lowest wage the person considers taking. For the purposes of economic appraisal this reservation wage is net of taxes on income as well as commuting costs. A reduction in the cost of commuting will therefore increase the 'take-home' wage offer and this may encourage more individuals to join the labour market.

Labour supply response to changes in wages is typically modelled using labour supply elasticities. Extensive literature has attempted to quantify this elasticity, but the area is fraught with problems of estimation and the range of elasticities is therefore wide. Dandie and Mercante (2007) review the evidence for Australia and their results suggest a labour supply elasticity that is larger than the 0.1 found in the UK. However, due to the large spread of elasticities, an elasticity of 0.1 was utilised as a conservative estimate.

The labour supply effect is calculated by considering the average change in commuting costs for workers in a location against the average wage earned by these. Doing so both for the project and base cases provides an understanding of the relative change in take-home pay caused by the intervention. The labour supply elasticity of 0.1 was used to convert the change in wage to a change in the number of people in work.

However, the output produced by new entrants is likely to be lower than that of existing workers. Johnson et al (2001) provide evidence that new entrants are 31% less productive than the average existing worker. Therefore each additional worker is considered to increase output by 69% of average output per worker.

The labour supply effect is not in itself additional to benefits in transport appraisal, but the proportion of the additional output that is captured in taxation is. For the UK the tax authority captures on average 30% of marginal output in taxation (taxes on income, production and profits plus contribution to pensions and insurances). In addition, new entrants to the labour market give up government support (such as job seeker's allowance and incapacity benefits) worth in the order of 10% of average output. Since the market only receives 60% of the output of a new entrant, the remainder is not considered by individuals when making decisions and 40% of the additional output is additional to benefits in transport appraisal.

However, the tax wedge in Australia is significantly lower than in the UK. Evidence from the Australian Treasury finds the UK and Australian tax wedges to be 33% and 28%, respectively. We therefore apply a tax wedge for our analysis of 35%; 5% lower than in the UK.

2.11.4 Developing a benefit stream for WEBs

The outputs of the Steer Davies Gleave Analysis were undiscounted value of each wider economic benefit in 2036. These outputs are detailed in Table 14. To develop a benefit stream for the wider economic benefits it was assumed that percentage of WEBs to conventional benefits was constant across the assessment period. The proportion of WEBs ascribed to each of the agglomeration, imperfect competition and labour supply benefits was also held constant.

TABLE 14: SUMMARY OUTPUTS FOR WIDER ECONOMIC BENEFIT ASSESSMENT

	VTP Package Assessed	
Wider Benefits	**$m**	**% of WEBs**
Agglomeration (2036 value)	462	89%
Imperfect Competition (2036 value)	30	6%
Labour Supply (2036 value)	29	6%
Total Wider Benefits (2036 value)	591	
Discounted Wider Economic Benefits in 2036	89	
Total Discounted Conventional Benefits in 2036	495	
% of WEB to Conventional Benefits	**18%**	

2.12 Summary of Benefits

Table 15 outlines a summary of all the benefits and the proportion that each benefit stream provides to total projects for all of the projects analysed.

TABLE 15: SUMMARY OF BENEFITS

	Travel time savings	Reduction in crash costs	Reduction in vehicle operating costs	Reduction in externalities	Residual value	Wider economic benefits
Present Value of Benefit ($m)	15,541	194	1,025	-125	4,714	3,002
Percentage of total benefit (%)	64%	1%	4%	-1%	19%	12%

2.13 Outcomes of Benefit Cost Assessment

Table 2 summarises the outcomes of the benefit cost assessment for the package of projects.

TABLE 16: OUTCOMES OF ECONOMIC BENEFIT COST ASSESSMENT

Present value of conventional benefits ($m)	21,349
Present value of Wider Economic Benefits ($m)	3,002
Present value of costs ($m)	18,010
Conventional benefit/cost ratio	1.18
Benefit/cost ratio including Wider Economic Benefits	1.35

3. IMPACT ON THE VICTORIAN ECONOMY: CGE ANALYSIS

3.1 Introduction

Economic impact analysis based on an input-output approach takes into account the direct impact of the project on regional economic activity, and some of the downstream effects of the induced demand for goods and services elsewhere in the economy. But it does not take into account structural adjustments brought about by the project. For this, the economic consultants have developed a Computable General Equilibrium (CGE) model to examine the flow-on effects arising from transport development on the broader economy. Estimates of indirect impacts of the preferred option have been made for key economic indicators including gross state product and employment.

Flow-on impacts to other industries at the regional and state levels, where significant, have been estimated using the CGE modelling framework. This has provided the best approach to directly estimate the indirect impacts arising from improving the transport sector through investment in the some of the larger projects in the VTP Package, developing the modelling framework in this way has enabled the economic consultant to better link the various components and phases of the project to ensure a comprehensive analysis of the preferred option.

3.1.1 Region definition

The multi-region CGE model, developed from an input-output database, has three regions:

- Melbourne
- Rest of Victoria
- Rest of Australia.

For presentational purposes, the results for Melbourne and Rest of Victoria have been aggregated and provided for Victoria in total.

3.1.2 Sector definition

The aggregation of industries from the 109 sector national sector definitions to the 30 commodities/industries is provided in Appendix B.

- 30 Sectors: Uniform definition of sectors for all regions.
- 109 Sectors: National input-output table sectors. The base data and control data for the input-output database have been collected and collated at this level of disaggregation.

3.1.3 Transport sectors

As detailed in Appendix B, there are five transport sectors specified in the model:

- Road transport
- Rail transport
- Water transport
- Air transport
- Services to transport and storage.

3.2 General model structure

The model recognises:

- producers classified by industry and domestic region
- investors similarly classified
- multiple region-specific household sectors
- aggregate foreign purchaser of the domestic economy's exports.

The model contains explicit representation of intraregional and interregional trade flows based on the EconSearch in-house input-output database. As each region has been modelled separately, the model captures the changes in economic activity resulting from a reduction in transport costs. Second and subsequent round effects are captured via the model's input-output linkages and account for economy-wide and international constraints.

The core input-output database of the three region CGE model is presented in Figure 1. It is based on the Monash MRF model (MMRF), a multi-region model of the Australian economy. Figure 1 shows the basic structure of the model using the MMRF notation. The seven columns identify the principal categories of demand:

1. Domestic producers – there are 30 industries (I) in each of the 3 regions (R)
2. Investors – there are 30 industries (I) in each of the 3 regions (R)
3. Households – there is one aggregate household sector in each of the 3 regions (R)
4. Purchaser of exports – a single aggregate foreign entity
5. Regional government demand – one set of regional government demands in each of the 3 regions (R)
6. Federal government demand – one set of federal government demands in each of the 3 regions (R)
7. Change in stocks – inventory accumulation in each of the three regions (R).

The nine rows show the supply of commodities to each category of demand, the margins associated with those sales, various forms of taxes applied to those sales and the supply of primary inputs to the production sector. These are specified as:

(1) Basic flows – each of the 30 commodities (C) identified in the model can be obtained from the four sources (S), i.e. the region itself, the other two regions or imported from overseas. The commodities are used as inputs into current production (V1BAS), inputs to capital formation (V2BAS), consumed by households (V3BAS), are exported (V4BAS), consumed by governments (V5BAS and V6BAS) and accumulate as inventories (V7BAS).

(2) Margins – there are nine domestically produced 'goods' (M) that are defined as margin services. These services are necessary to transfer commodities from their sources to the various users (V1MAR, V2MAR, etc.). The most significant margins specified in the model are the services provided by the trade and transport sectors.

(3 - 5) Taxes – there is a range of commodity taxes that are payable on the purchase of commodities from each source. These include regional and federal commodity taxes, as well as GST. For example, the cell V3GST represents a 3-dimensional array showing the cost of GST paid on the flows of 30 goods (C), from four sources both domestically and imports (S), in three regions (R).

(6 – 8) Primary factors – as well as intermediate inputs and the margins and taxes paid on those inputs, current production requires three types of primary inputs: labour (V1LAB), capital (V1CAP) and land (V1LND).

(9) Other costs – this category covers various miscellaneous industry expenses.

The equations that comprise the core of the three region CGE model are based on the Monash MRF model and can be classified according to the following broad sets:

- producers' demands for intermediate inputs and primary inputs
- demands for inputs to capital creation
- household demand
- export demands
- government demands
- demands for margins
- zero pure profits in production and distribution
- indirect taxes
- market clearing conditions for commodities and primary factors
- regional and national macroeconomic variables and price indices (CoPS 2007, p. 21).

FIGURE 1 THE THREE REGION CGE INPUT-OUTPUT DATABASE

		ABSORPTION MATRIX						
		1	2	3	4	5	6	7
		Producers	Investors	Households	Exports	Regional Govt	Federal Govt	Stocks
	Size	I x R	I x R	R	1	R	R	R
Basic Flows	C x S	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS	V7BAS
Margins	C x S x M	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	V6MAR	
Taxes: Regional	C x S	V1TAXS	V2TAXS	V3TAXS	V4TAXS			
Taxes: Federal	C x S	V1TAXF	V2TAXF	V3TAXF	V4TAXF			
Taxes: GST	C x S	V1GST	V2GST	V3GST	V4GST			
Labour	O	V1LAB						
Capital	1	V1CAP						
Land	1	V1LND						
Other Costs	1	VIOCT						

C = Number of commodities = 30
I = Number of Industries = 30
O = Number of occupation types = 8
M = Number of commodities used as margins = 9
R = Number of regions = 3
S = Number of sources = R+1: Domestic regions plus foreign imports = 4

	MAKE MATRIX	
Size	I x R	Total
C x R	MAKE	Sales
Total	Costs	

Source: Derived from CoPS (2007, Figure 4.1)

3.3 Aggregate outputs

The types of economic stimulus that are expected to result from the options were divided into the following categories:

- capital costs associated with the preferred option
- operating costs associated with the preferred option
- productivity improvements in form of time savings
- improved net revenue for the rail system
- reduced vehicle operating costs
- reduced crash costs.

The impacts of capital expenditure have been estimated on the basis of the average annual expenditure expected over the construction period 2009 - 2028. Adjustments were made for the proportion of expenditure on land purchases and imported capital items. In total 30% of capital expenditure was omitted.

Operating expenses are assumed to consist entirely of expenditure on the transport industry.

Productivity improvements in the form of commercial time savings are assumed to reduce labour costs in the road transport sector. This is measured as labour costs per unit of output. Private time savings are ignored as they are assumed to have no significant economic impact (increased leisure time).

Reduced vehicle operating costs (which includes reduced fuel consumption), reduced crash costs and reduced depreciation are modelled as reduced inputs for the machinery and equipment (includes cars and car parts), trade (includes motor vehicle repairs), financial and business services and capital costs.

The drivers of the economic impacts, derived directly from the cost benefit analysis, are shown in Table 17. These data show the dollar value (2008 dollars) of capital expenditure, operational expenditure and each category of productivity change.

TABLE 17 DIRECT IMPACT $ MILLION

	Difference from Base Case	
	2009 - 2028	2036
Capital expenditure (average annual)	$1,528	
Operational expenditure		$200
Road transport labour productivity		$442
Road transport operating cost savings		$173
Reduced crash costs		$31

The economic drivers shown in Table 17 are represented in CGE model (Table 18) as percentage changes in various activities and productivity measures. These changes are simulated in combination as shocks to the economy to estimate the difference between the base case and the preferred option in terms of a number of key economic indicators.

TABLE 18: DIRECT IMPACT % CHANGE

	Difference from Base Case	
	2009 - 2028	**2036**
Final capital expenditure (average annual)	1.535%	
State government final cons exp: transport		17.480%
Road transport labour productivity		20.793%
Trade sector cost saving		0.576%
Petroleum sector cost saving		8.044%
Motor vehicle & parts sector cost saving		0.246%
Finance & business sector cost saving		0.249%
Capital cost saving		2.114%

The results generated for each model simulation are presented at the state level for the key economic indicators of GSP and employment in Table 19.

TABLE 19: IMPACT ON GROSS STATE PRODUCT AND EMPLOYMENT: DURING CONSTRUCTION AND IN 2036

Victorian Economic Effects:	**Average Annual Impact During Construction**	**Impact in 2036**
	Average Annual 2009 - 2028	**2036**
Gross State Product ($m)	643	1,898
Gross State Product (%)	0.25%	0.74%
Employment (no. FTE)	5,879	9,696
Employment (%)	0.27%	0.45%

The analysis assumes that the increase in the demand for labour in Victoria will not impact national employment levels. It was also assumed that labour is mobile and can move between states. Together these assumptions imply that the increased employment in Victoria will be offset by falls in other states and territories.

As detailed in Table 19, the construction activity associated with some of the larger projects in the VTP Package is projected to generate annual average employment of over 5,700 jobs during the 2009-2028 construction period. This is equivalent to a 0.27 per cent increase relative to the baseline. The relative impact on gross state product is similar, projected to add around 0.25 per cent annually over the 20 year construction period. This is equivalent to around $600 million per annum.

The impacts of the operating phase of the projects assessed are also presented in Table 19. The projections are provided for the year 2036. Under this option, gross state product is projected to increase by $1,898 million above the baseline, an increase of 0.74 per cent. The relative impact on employment is somewhat less, projected to be 0.45 per cent, which is equivalent to almost 9,700 jobs.

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A. SENSITIVITY ANALYSIS

Sensitivity analysis was undertaken on the economic assessment of the VTP projects assessed. The discount rate was increased to 10% (Table 20) and decreased to 4% (Table 21).

TABLE 20: OUTCOMES OF ECONOMIC ASSESSMENT SENSITIVITY ANALYSIS 1: 10% DISCOUNT RATE

	Present value of benefits ($m)	Present value of costs ($m)	Benefit/cost ratio
VTP Package Assessed	**11,677**	**13,265**	**0.88**

TABLE 21: OUTCOMES OF ECONOMIC ASSESSMENT SENSITIVITY ANALYSIS 2: 4% DISCOUNT RATE

	Present value of benefits ($m)	Present value of costs ($m)	Benefit/cost ratio
VTP Package Assessed	**45,800**	**23,303**	**1.97**

B. SECTOR DEFINITIONS[1]

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
1. Animals	0101 Sheep 0103 Beef cattle 0104 Dairy cattle 0105 Pigs 0106 Poultry
2. Crops	0102 Grains 0107 Other agriculture 0200 Services to agriculture; hunting and trapping
3. Forestry and fishing	0300 Forestry and logging 0400 Commercial fishing
4. Coal, oil and gas	1100 Coal, 1201 Oil and gas
5. Mining NEC	1301 Iron ores 1302 Non-ferrous metal ores 1400 Other mining 1500 Services to mining
6. Food, drinks and tobacco	2101 Meat and meat products 2102 Dairy products 2103 Fruit and vegetable products 2104 Oils and fats 2105 Flour mill products and cereal foods 2106 Bakery products 2107 Confectionery 2108 Other food products 2109 Soft drinks, cordials and syrups 2110 Beer and malt 2113 Wine, spirits and tobacco products

[1] Concordance between the national input-output sectors and the Australian and New Zealand Standard Industrial Classification (ANZSIC) 4-digit classification can be found in ABS Cat No. 5209.0.55.001 Australian National Accounts: Input-Output Tables - Electronic Publication, *Input-Output Industry Classification: 2001-02 edition in terms of 1993 ANZSIC*.

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
7. Textiles, clothing and footwear	2201 Textile fibres, yarns and woven fabrics 2202 Textile products 2203 Knitting mill products 2204 Clothing 2205 Footwear 2206 Leather and leather products
8. Wood products	2301 Sawmill products 2302 Other wood products
9. Paper and publishing	2303 Pulp, paper and paperboard 2305 Paper containers and products 2401 Printing and services to printing 2402 Publishing; recorded media and publishing
10. Petrochemicals	2501 Petroleum and coal products
11. Other chemical products	2502 Basic chemicals 2503 Paints 2504 Medicinal and pharmaceuticals products; pesticides 2505 Soap and other detergents 2506 Cosmetic and toiletry preparations 2507 Other chemical products 2508 Rubber products 2509 Plastic products
12. Non-metallic mineral products	2601 Glass and glass products 2602 Ceramic products 2603 Cement, lime and concrete slurry 2604 Plaster and other concrete products 2605 Other non-metallic mineral products
13. Metals and metal products	2701 Iron and steel 2702 Basic non-ferrous metals and products 2703 Structural metal products 2704 Sheet metal products 2705 Fabricated metal products

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
14. Machinery and equipment	2801 Motor vehicles and parts; other transport equipment 2802 Ships and boats 2803 Railway equipment 2804 Aircraft 2805 Photographic and scientific equipment 2806 Electronic equipment 2807 Household appliances 2808 Other electrical equipment 2809 Agricultural, mining and construction machinery, lifting and material handling equipment 2810 Other machinery and equipment
15. Manufacturing NEC	2901 Prefabricated buildings 2902 Furniture 2903 Other manufacturing
16. Electricity	3601 Electricity supply
17. Gas and water	3602 Gas supply 3701 Water supply; sewerage and drainage services
18. Construction	4101 Residential building construction 4102 Other construction 4201 Construction trade services
19. Trade services	4501 Wholesale trade 4502 Wholesale mechanical repairs 4503 Other wholesale repairs 5101 Retail trade 5102 Retail mechanical repairs 5103 Other retail repairs
20. Accommodation, cafes and restaurants	5701 Accommodation, cafes and restaurants
21. Road transport	6101 Road transport
22. Rail transport	6201 Rail, pipeline and other transport
23. Water transport	6301 Water transport
24. Air transport	6401 Air and space transport
25. Transport NEC	6601 Services to transport; storage

Uniform Regional Sectors (30 sectors)	**Database Sectors: national input-output table sectors (109 sectors)**
26. Communication services	7101 Communication services
27. Finance, insurance and business services	7301 Banking 7302 Non-bank finance 7401 Insurance 7501 Services to finance, investment and insurance 7702 Other property services 7801 Scientific research, technical and computer services 7802 Legal, accounting, marketing and business management services 7803 Other business services
28. Ownership of dwellings	7701 Ownership of dwellings
29. Government services	8101 Public administration 8201 Defence 8401 Education 8601 Health services 8701 Community services
30. Services NEC	9101 Motion picture, radio and television services 9201 Libraries, museums and the arts 9301 Sport, gambling and recreational services 9501 Personal Services 9601 Other services