Have all the travel time savings on Melbourne' road network been achieved?

A GAMUT Discussion Paper

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Abstract

The foremost economic benefit postulated and claimed for all road network investments is the value of travel time saved. This paper's aim is to empirically test whether the very substantial economic resources that have been consumed over the last two or so decades in the construction and use of major road network additions in Melbourne have helped to achieve the travel time savings which formed the main foundation of their economic justification. The study uses the annual traffic system monitoring data prepared by VicRoads for the monitored urban road network, and compares these actual data against the results for Melbourne's urban road system that were projected by various traffic modelling experts in the 1990s. In particular this study uses City Link as the case study to enable the comparison between such projections and actual traffic volumes and traffic behaviour.

One of the key findings of this study is that the average whole of day speed on Melbourne's freeways overall has stayed at around the same level (78+ kms /hour) apart from 2000-01 (83.5 kms/ hour) and 2001-02 (79.5 kms' hour). Second, the average speed in kilometres per hour in both the morning and evening peak periods for the whole monitored urban network in the most recent year for which data are available — the year ended June 30 2007 — is the lowest it has been since 1994-95. Third, average travel speeds in inner Melbourne post the opening of City Link have reduced in both the morning and evening peaks. Even more concerning is the fact that average speeds across the whole day for both freeways and all types of arterial roads in the inner Melbourne region have all similarly dropped over the years 2001-02 to 2006-07. Fourth, the projected volume of freeway traffic of 331,000 DVH by 2011 looks unlikely based on the reduced speed of freeway traffic volumes since 2003-04 and a total freeway volume of 244,700 DVH in 2006-07. Finally, the Net Present Value (NPV) of the extra travel time in actual daily vehicle hour equivalents over the years 1997-98 to 2006-07 as compared to the projected total saving in DVH of 161.2 million is -$349.4 million. Given this dissaving, the NPV of travel time savings on Melbourne's' urban road network from 2007-08 to 2030-31 inclusive would have to amount to $1.834.4 billion, as opposed to the projected NPV of $957.1 million by Allen consulting group and Cox (1996).

In sum, the results from this study suggest that the core of travel times savings benefits, which is an increase in average travel speeds, has not to date eventuated in Melbourne's urban road network during the years under review. Indeed, based on the evidence presented and analysed in this paper, one could be led to the conclusion that investments in Melbourne's urban road network have resulted in more time being used by Melbourne's motorists rather than less time. Hence major road infrastructure initiatives and the consequent economic investments have not yet delivered a net economic benefit to either Melbourne's motorists or the Victorian community. Equally concerning is the plausible conclusion from this analysis that over their remaining economic life such major urban road network investments are unlikely to result in major travel time savings.

Introduction

> ‘We might ask whether researchers have in fact been able to measure the travel time savings expected to be associated with infrastructure investment, such as a new or widened road that has been built with the intention of generating such savings. When I searched the literature – specialist books, journals and data bases – I was very surprised to draw a blank’ (Metz, 2008, p. 30)

David Metz was chief scientist to the UK Department of Transport and is now visiting professor of transport studies at University College London. The total kilometres of road that comprise the urban road network of Melbourne has increased substantially over the last fifteen or so years. This paper takes up Metz’s challenge. Its aim is to shed some empirical light on whether the enormous economic resources that have been consumed in the construction and use of these major road network additions have achieved the travel time savings which formed the main foundation of their economic justification.

The substance of this paper comprises the following sections:

- Overview of Melbourne’s urban road network;
- Projections and economic justifications for major network projects;
- Comparison and analysis of projected performance against actual performance;
- Conclusions.

Overview of Melbourne’s urban road network

Melbourne’s urban road network is extensive and constantly being modified and expanded. Its major elements are managed for the Victorian government by VicRoads. Its extent as at June 2007 is shown in Figure 1.

Map of urban monitored network

Figure 1 Melbourne's Urban Monitored Road Network (Source: VicRoads, 2008, Traffic System Performance Monitoring 2006-07, p. 11)

VicRoads classifies the metropolitan road network in two main ways: first by distinguishing between freeways and arterials, and also by type of arterial (divided, undivided, with or without tram lines), second by distinguishing between inner and outer areas.

Melbourne is served by a number of freeways. The first section of Melbourne's first freeway system — the South Eastern Freeway — was opened in 1962 (Lay and Daley, 2002, page 261). In 1965 the Victorian State Government announced a ten-year program of freeway building (Melbourne Transportation Committee, undated). The 1969 Melbourne Transport Plan further developed this plan; it recommended some 510km of freeway for metropolitan Melbourne as its ultimate solution (Lay, 2003). Following strong community and local government protest, the Premier of the day, Rupert Hamer cancelled some of the proposed inner city freeways and their road reservations (the F1, F6, F9 and F18 which were included in the 1954 MMBW Plan, and later the F2 along Merri Creek, see Lay, 2003, p. 202). Lay comments:

> In hindsight, the plan was unacceptable in terms of cost (it would have meant a trebling of the then-current expenditure rate on freeways), its effect on the environment and the urban form, and its general inappropriateness for a city like Melbourne that already had a good arterial road system'.(ibid. p.200)
>
> Figure 7.3 of the plan shows a grid of inner city freeways that would have destroyed much of the ring of inner suburbs from Carlton clockwise to South Richmond (ibid. p. 201).

Construction work on both the Lower Yarra Freeway (now known as the West Gate freeway) and the Tullamarine Freeway started in the late 1960s. The Lower Yarra Freeway opened in April 1971 (Laybutt, undated). Work on the Eastern freeway started soon afterwards. Its first phase was characterised at times by strong local community opposition. Phase 1 of the Eastern freeway opened to traffic in December 1977 (Laybutt (b), undated).

At the end of the 1980s, however, none of Melbourne's freeways were directly connected. To partly overcome this, construction of Melbourne's outer ring road began in 1989, with work on its first section —the Western Ring Road — being completed in 1999. This section costs a total of $631 million, $555 million of which was provided by the Federal government (VicRoads, nd).

The Victorian government in 1994 released a paper setting out a strategy for enhancing Melbourne's urban road network. One of its key recommendations was a major expansion of Melbourne's freeway system by substantial traffic capacity additions to both the existing Tullamarine freeway and the South Eastern Arterial, and by 'developing freeway standard links between the South Eastern arterial, the West Gate freeway and the Tullamarine Freeway (Transurban City Link Limited, 1996, p. 13)'. Collectively this new freeway-linking project was named City Link. It is a Build-Own-Operate-Transfer (BOOT) type of freeway initiative, incorporating fully electronic, user-pays tolling. The total expenditure on City Link's construction over the years 1995-96 to 1999-2000 was valued in 1993 dollars at $1.5 billion (ACG and Cox, 1996: p. 3). Of this amount, the Victorian government contributed around $230 million. In current dollar terms the actual pre-opening expenditure was in excess of $1.8 billion. City Link was fully opened to traffic in December 2000. Ownership of City Link transfers to the Victorian Government at the end of the thirty four year Concession Deed period in 2034. In July 2007 the Calder-Tullamarine interchange project, the aim of which was to reduce congestion at the intersection of the Calder and Tullamarine freeways, was opened. Its construction cost was $150 million.

In May 2002 construction of the Craigieburn Bypass, linking the Hume Freeway near at Craigieburn, to the Metropolitan Ring Road at Thomastown commenced. The completed Bypass was open to traffic in December 2005. The bypass cost $305 million and was funded by the Australian government (VicRoads, 2006, p.46)

In May 2006 the Government announced a major freeway project to widen the section of toll road south of the CBD between the Westgate Bridge and the Monash freeway The Monash-City Link-West Gate upgrade is 'a key project and will improve traffic flow and safety along Melbourne's busiest freeway corridor (VicRoads 2007-08 p. 5)'. . This project termed the Monash –Westgate corridor or the M1 project was budgeted in 2006 at $1 billion (DOI, 2006). The project is funded by the Victorian Government and Transurban for CityLink works (VicRoads 2007-08 p. 35). By the end of fiscal year 2007-08 the total cost of this initiative was revised upward to a new figure of $1.4 billon (VicRoads 2007-08 p. 35). At around the same time funding of $331 million was secured from the Victorian and Australian governments for the Deer Park By Pass aimed at providing a link between the Western ring Road and the Western freeway (VicRoads 2007-08 p. 36). This project is expected to be complete in mid 2009 VicRoads 2007-08 p. 36)..

Yet another very large freeway project undertaken in Victoria is the East Link freeway initiative. East Link, formerly known as the Mitcham-Frankston (or Scoresby) Freeway, is Melbourne's second fully-electronic tollway, comprising about 39kms of freeway-standard road connecting the city's eastern and south-eastern suburbs. Construction of it began in March 2005 and the freeway was opened for traffic at the end of June 2008. Total construction costs for East Link were $2.5 billion (Department of Transport, 2008). The private sector organisation, ConnectEast was chosen by the state government to 'finance, design, construct and operate East Link. The contract was for a period of approximately 39 years (the Allen Consulting Group., 2006). The cost benefit analysis claims that the great majority (87.5%) of East Link's total economic benefits of $12.9 billion would derive from the value of travel time savings (ACG, 2006). Ownership of the East Link freeway transfers to the Victorian Government at the end of the Concession Deed period in 2043.

In 2008, the Victorian government released a new transport vision and long-term plan for Victoria. One of its key projects is the construction of a new tunnel 'which will relieve Melbourne's dependence and reduce traffic congestion on the West Gate Bridge' at a cost of more than $2.5 billion .This plan also signalled its intention to 'start the Peninsula Link – a 25 kilometre four-lane connection between EastLink at Carrum Downs and Mount Martha – next year in partnership with the Commonwealth'. Additionally, the Victorian government proposed completing the 'missing link' between the Metropolitan Ring Road and the Eastern Freeway at Bulleen (*The Victorian Transport Plan*, 2008). The cost of this project is stated as 'more than $6 billion'. A third major road project announced in this 2008 transport plan is the 'truck action plan' aimed at removing trucks from residential areas and improving freight access to the Port of Melbourne. Stage 1 of this plan 'will cost $380 million. Collectively the cost of these three new road transport components of this ambitious transport plan amounts to in excess of $9.25 billion out of a total investment of $38 billion 'to significantly increase the capacity of our transport network with more services, more often, to more places (*The Victorian Transport Plan*, 2008, p.3)..'

Given the magnitude of both the historical costs of additions to Melbourne's urban road network and the just mentioned major new investment plans, it seems both timely and highly appropriate to compare the projected economic benefits of such major infrastructure investments with the actual results achieved over the last fifteen or so years. The next two sections of this paper aim to do just that by using the City Link motorway system as a case study.

Projections and economic justifications for major network projects

The Victorian government in the early 1990s commissioned two separate road network traffic models for the whole of Melbourne's major road networks: one by VicRoads, the other by Veitch Lister. The objective of both network models was to compute the future traffic volumes under two contrasting circumstances: namely (i) the Base Case in which no change to the major road network occurs within a specified time horizon, and (ii) the Project case in which a new road project is funded, constructed and opened for use.

The results of both of these road network traffic studies were quite similar as shown in table 2. The simple average project case of vehicle hours of travel per day in 2001 is 1,928,400; the simple average projected savings in daily vehicle hours in 35,800; by inference, the simple average base case daily vehicle hours is 1,964,200 (i.e. 1,928,000 plus 35800).

The Victorian government consequently commissioned two economic analysis studies of the potential costs and benefits of City Link's construction and operation. Both were conducted by The Allen Consulting Group and Cox. The Allen Consulting Group will hereafter be referred to as ACG.

Outcome type	Veitch Lister	VicRoads
Change in vehicle kilometres of travel if project case were implemented (million kms per day)	0.14	0.35
Vehicle hours travel per day (000 VHT)	1927.6	1930.2
Change in vehicle hours of travel/ day (base case- project case) (000 VHT)	-31.8	-37.9
Average travel speed urban network whole day (project case) (km/h)	44.9	43.8
Change in average travel speed (Project case- base case) (km/h)	1.1	1.0

Table 2: Comparison between project case forecast outcomes and base case for year 2001
Source: Extracted from ACG and Cox, 1995, Table 2.6, p. 19.

In both these cost-benefit studies, five types of economic savings were proposed and valued: travel time savings, reduced vehicle operating costs, accident cost savings, fleet mix savings, and off-road benefits. Of these five types of savings, travel time savings are by far the largest, representing 63% of the total forecast future value of all benefits accruing over the 36 years ending June 2031 (ACG and Cox, 1996: table 2.5, p. 14). The stated assumption is that such travel time benefits will be 'gained from the freer and faster flow of traffic in Melbourne' should City Link be constructed and subsequently used (ACG and Cox, 1996: 9). In particular, City Link 'will have a dramatic effect on the efficiency of travel movements within the central core of Melbourne' (ACG and Cox, 1995: 4).

The 1996 benefit-cost study of City Link presents a comparative forecast drawn on the modelling by Veitch Lister Pty Ltd for use by the Melbourne City Link Authority (MCLA) in evaluating the project tenders for City Link (ACG and Cox, 1995: 17). It is presented here as table 3. It is important to note that the projections set down in table 3 are made on the basis that Transurban had actually been awarded the BOOT tender and that 'a number of other projects are deemed to have been completed by 2011 (e.g. the F2 freeway, the Scoresby Freeway – now East Link, and the Mornington Peninsula Freeway (ACG and Cox, 1996: 2). The two latter have now been completed.

Road type	Vehicle type	Base case :City Link not built (000s daily vehicle hours)	Project case: City Link built (000s daily vehicle hours)	CL minus base case: (000s daily vehicle hours)
Freeways	Private	229,000	236,000	7,000
	Commercial	97,000	95,000	-2,000
	Total Freeway DVH	326,000	331	5
Arterial	Private	1348	1320	-28
	Commercial	453	446	-7
	Total arterial DVH	1801	1766	-35
	Grand total DVH	**2127**	**2097**	**-30**

Table 3:
Projected daily vehicle hour time savings from City Link: year 2011 (Source: ACG & Cox 1996, Table 2.1, p. 11estimates by Veitch Lister Pty Ltd for MCLA)

In sum, table 3 indicates that the construction of City Link was projected to reduce total daily vehicle hours (DVH) on Melbourne's urban road network by 30,000 hours — or around 1.4% — per day, as compared with the 'base case' if the freeway system were not expanded.

Mathematically, the specific value of three variables must be determined before daily vehicle hours (DVH) can be computed:

(i)number of trips per day (T)
(ii) average distance per trip (kms) (D); and
(iii)average speed per hour (kms/ hr). (S)

The product of variables (i) and (ii) equals vehicle kilometres travelled (VKT). VKT divided by speed per hour (S) = DVH

These variables are now considered:

Number of trips per day

The projected number of trips per day on either freeways or arterial roads is not explicitly stated. As noted in table 3 ACG and Cox (1996) contend that the total number of vehicular trips taken on Melbourne's freeways will increase by around 1.5%, presumably due to reduced freeway congestion resulting from a significant expansion of total freeway carrying capacity and a corresponding increase in the attractiveness of freeway travel to Melbourne's motorists. The reduction in total daily vehicle hours travelled on Melbourne's arterial roads of just under 2% detailed in Table 3 presumably is the result of both the just mentioned growth of trips per day on Melbourne's expanded freeways that in turn would reduce the number of trips per day on the arterial roads and thus enable faster average travel speeds overall. The only explicit comment offered in the 1996 cost-benefit analysis of City Link was that annual growth in traffic volume is assumed to be 2 % per year (ACG and Cox, 1996:13).

Average distance per trip

The second variable determining daily vehicle hours is average distance per trip. Again, no specific data on this variable were disclosed in either cost-benefit study. One is probably entitled to assume, however, that the expansion of Melbourne's freeway system that the City Link project would provide would result in a reduction in distance per trip for motorists who moved from travelling on arterial roads to travelling on the expanded freeway network, since freeways are generally more direct in route than arterial roads.

Average speed per trip

As already noted, the third variable needed to compute daily vehicle hours is average speed per trip taken. The achievement of this projected total reduction in travel times across Melbourne's road network was claimed to result directly from a corresponding projected increase in average speed, especially within inner Melbourne.

> *Most of the travel time savings (74 per cent) are located in an 8kms x 8 kms grid close to the CBD even though this area has only 7 per cent of the total travel in the metropolitan area. The average travel speed in this inner city area will rise significantly from 29.7 km / hr to 36.1 km/hr compared to a minor increase of 0.3 km/hr outside of this grid* (ACG and Cox, 1995: 19).

Value of travel time savings

The next value proposed in the City Link benefit cost study was the most important one: the hourly value of travel time savings. ACG and Cox (1996) argued for the use of a composite hourly rate of $19.15. This composite derives from the addition of two thirds of an hourly rate of $21.50 for the value of time saved in inner Melbourne, and one third of an hourly rate of $14.42. This valuation was based on analysis by Thorensen, Thorensen and Taylor (as cited in ACG and Cox, 1995: 20). The justification for the use of a considerably higher dollar value than that used by other analysts for travel time saved was that the bulk of the (projected time) 'savings are located in the inner Melbourne urban area where there is more commercial travel and which should lead to a significantly higher value of time than for an average vehicle distribution around Melbourne (ACG and Cox, 1995: 21)'.

Annual average time savings

Two other metrics are needed in order to compute annual travel time savings. Without substantive justification, the assumption was made that 330 days a year was appropriate in order to 'aggregate annual values' (ACG, 1995: 21). The final metric required is the average annual rate of growth of travel time savings over the economic life of City Link. Without supporting justification it was also stated that 'time benefits grow at 4.25 per cent per year (ACG, 1996: 13).' Such a projected annual growth in travel time savings is used even though the assumed annual growth in traffic volume is less than half of that percentage: i.e. 2 % per year (ACG, 1996:13).

The resultant projected annual dollar values of time benefits computed (see ACG 2006 Table 2.5, p. 14) have been converted into equivalent daily vehicle hours saved by applying the following formula.

$$DVH_s = 1000*(\$b/\ \$t_s/n)$$

where:

DVH_s = Implicit daily vehicle hours saved ('000 hrs)

$\$b$ = projected value of travel time savings (million $)

$\$t_s$ = hourly value of travel time saved

n = number of days/ year savings achieved.

Table 4 presents the ACG & Cox (1996) forecast of DVH that would be saved per year form 1997-08 to 2011-12. It is most surprising however that time savings were projected for the years 1997-98 through to 1999-2000 given that City Link's construction would not be complete until the middle part of the year 2000. The consequent disruption of traffic flows especially on the Tullamarine freeway was specifically noted:.

> *Since mid 1996, construction works on City Link, coupled with the staged opening of the Western Ring road, (in June 1997) in particular were negatively affecting travel speed trends on the Tullamarine freeway* (Vic Roads, 2001).

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Comparison and analysis of projected performance against actual performance

Table 5 presents the main projections that underpinned the quantification of the value of the annual travel time savings presented in table 4, and a comparison with publicised actual results over the years 1994-5 to 2006-7.

As shown in table 5 there was a negative variance of 2.3 kms / hour (or 6.4%) between the projected and the actual average travel speeds on all roads in inner Melbourne in 2001. Analysing traffic patterns on a whole of day basis in major metropolitan centres like Melbourne however obscures the quite variable nature of road usage by hours across a typical weekday. Figure 2 shows clearly this time-of-day road use variability. It highlights the clearly bi-modal nature of 'traffic distribution' in Melbourne for both freeways and for arterial roads. On Melbourne's freeways morning traffic volumes spike sharply from around 5 am to about 7.30 am. After that, traffic volumes drop until around 11 am and then rise gradually until about 2.30 pm. The afternoon peak commences around 3.30 pm and ends around 6.30 pm. As noted in Figure 2, traffic volumes per fifteen minute intervals fall very sharply after that. The other notable feature depicted in Figure 2 is that the morning peak for freeways both starts and finishes earlier than that for arterial roads.

Table 5:
Basic propositions underpinning projected City Link travel time savings

Propositions			Actual
Variable	Year	Specific value projected	Actual value reported [6]
1. Average travel speed inner Melbourne; all roads whole of day (km /hr)[1]	2001	36.1	33.8
2. Average travel speed across urban road network (km/ hr) [2]	2001	44.3	42.6 (2000-01)
3. Total daily vehicle hours of travel urban road network (000 hrs) [3]	2001	1929.8	1991.8 (1999-00) 2087.2 (2000-01)
4. Total daily vehicle hours of travel urban road network (000 hrs) [4]	2011	2097.0	2157.2 (2006-7)
5. Melbourne's freeways total daily vehicle hours (000s)[4]	2011	331.0	244.7 (2006-07)
6. Melbourne's arterial roads total daily vehicle hours (000s)[4]	2011	1766.0	1866.8 (2006-07)
7. Freeway travel's share of total vehicle kms of across urban network [4]	2001	(i) 17.3% (ii) 20.3%	21.9%
8. Total cumulative change in daily vehicle hours (DVH) [5]	1997-8 to 2006-07	-162	328.7

Sources:
1. ACG and Cox, 1995, p. 19.
2. VicRoads as cited in ACG and Cox, 1995, p. 19. Note 44.3 is simple average of 43.8 km projected by Veitch Lister and 42.8 kms projected by VicRoads.
3. VicRoads as cited in ACG and Cox, 1995, p. 19. Note 1927.6 is simple average of 1959.4 projected by Veitch Lister and 1930.2 projected by VicRoads
4. Veitch Lister as cited in ACG and Cox, 1996, p. 11. 17.3% projected by Veitch

Lister; 20.3% projected by VicRoads.

5. ACG and Cox (1996)
6. All actual results obtained from VicRoads (2009) Annual Traffic System Performance Monitoring; longitudinal data from 1994/5 to 2006/7 provided to author by Vic Roads April 2009.

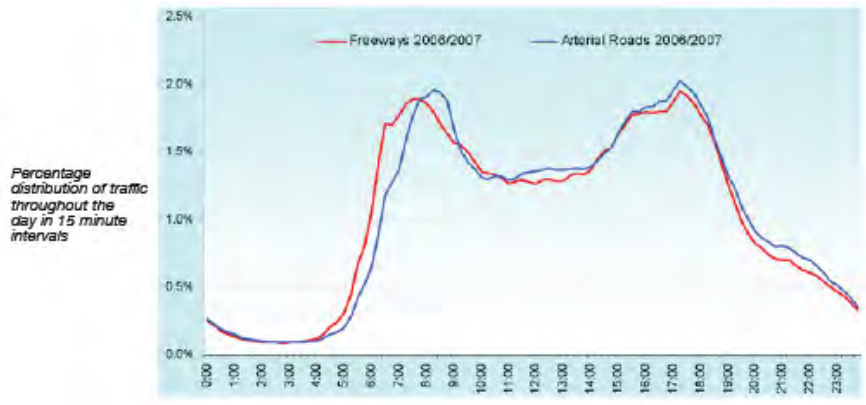

Figure 2: Variability of road usage over a 24 hour cycle: Typical week day (Source: VicRoads (2008): Traffic System Performance Monitoring 2006-07, p. 12)

The average speeds for the freeways during both the morning and the evening peaks in the inner Melbourne region over the year 1994-95 to 2006-07 have increased: from 46.8 km /hr to 58. 8 km/ hour for the morning peak and from 67.8 km/ hour to 73.5 km/ hour for the afternoon peak (Vic Roads, 2009). However, for the period 2001-02 to 2006-07, the average freeway speed per hour in the inner Melbourne region has dropped markedly, both in the morning peak (from 67. 4 km/ hr to 58.8 km/ hr) and in the evening peak (from 80.2 km/ hr to 73.5 km /hr). Given the fact that City Link was fully operational in the second half of 2000-01, and the very substantial economic investment that it represents, one must be concerned about this quite substantial drop in average speed per hour on the busiest usage periods of the day. The average speeds on Melbourne's freeways for the entire urban network overall have also dropped in the years following City Link's full opening. Figure 3 illustrates this drop in comparison to a steady increase in total vehicle kilometres travelled per year across Melbourne's urban road network.

One possible explanation for this overall reduction in average speed on Melbourne's freeways is that the morning peak period is now 30 minutes longer than in 2001/02 and the afternoon peak is up to 30 minutes longer (Vic Roads, 2007). Another plausible explanation is that freeway travel in the evenings as a proportion of the whole day is lower than for arterial roads (Vic Roads 2006)'. In other words the bulk of the increased total freeway VKT noted in Figure 3 is occurring at times when the freeway's capacity to absorb extra traffic (whilst allowing vehicles to maintain higher average speeds) is at its lowest.

The average speeds on Melbourne's inner arterial roads during both the morning and the afternoon peak periods have also fallen over the period 1994-5 to 2006-7. For instance the average speed in the morning peak on inner Melbourne's divided arterials fell from 34.3 km /hour in 1994-5 to 29.5 km/ hour in 2006-07 (Vic Roads, 2009). The same trend applies in the evening peak that has experienced a fall in average speed per hour from 34.9 kms to 30.9 kms over the same period. Admittedly the year by year pattern is volatile with some years seeing an increase (1996-7 and 2002-03 the most notable). A similar reduction in average speeds in both the morning and evening peaks is observable for inner Melbourne's undivided arterial roads.

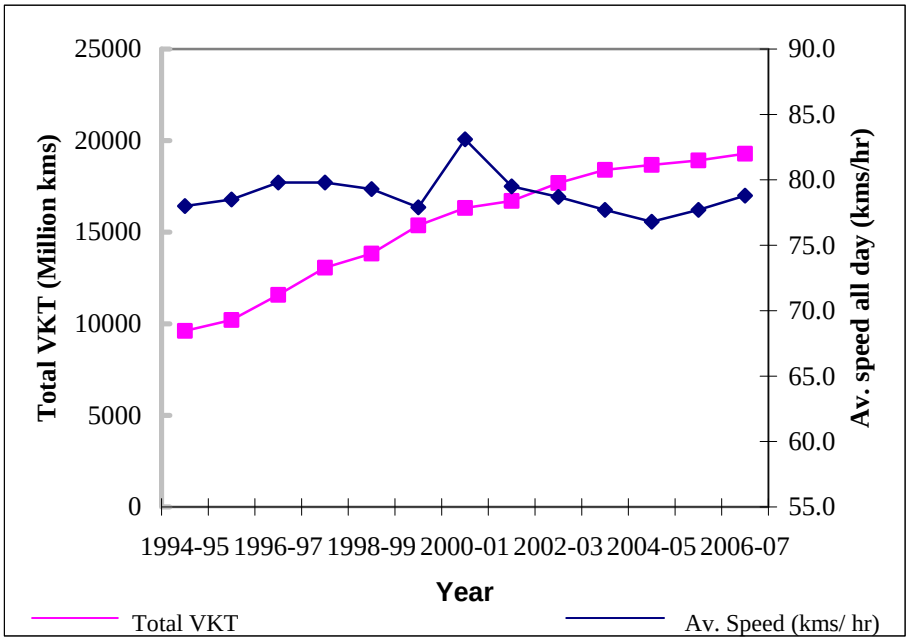

Figure 3: Whole of day average speed / kilometre on Melbourne's freeways compared to total kilometres travelled on freeways

In summary, average travel speeds in inner Melbourne post the opening of City Link have reduced in both the morning and evening peaks. Even more concerning is the fact that average speeds across the whole day for both freeways and all types of arterial roads in the inner Melbourne region have all similarly dropped over the years 2001-02 to 2006-07. Figure 4 represents the simple average speed per kilometre for inner urban arterial roads over the tears 1994-5 to 2006-7 plotted against total VKT on these roads.

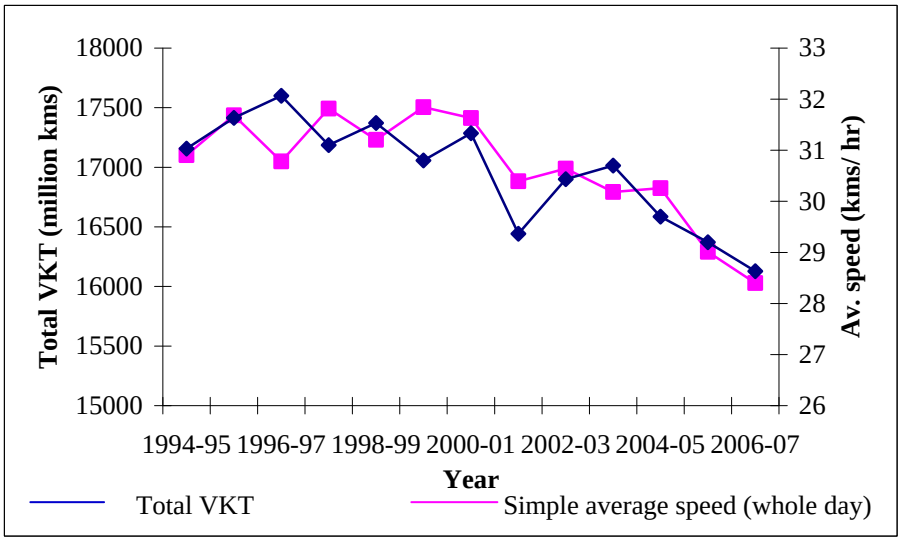

Figure 4: Melbourne's inner arterials: Total VKT and simple average speed all day

The second variable specified in Table 5 is the average travel speeds for the whole of day across the whole urban network. In 2001, the prediction was for an average speed of 44.3 kms/ hour. The actual average speed for the year 2000-01 was 42.6 kms/ hour. Over the years 1994-95 to 2006-07 this average speed per hour across whole of day for the urban road network has dropped by one kilometre per hour. Over the years 2001-02 to 2006-07 it has fallen by 0.6 kilometres per hour from 41.4 in 2001-2 to 40.8 in 2006-7.

The claim that traffic will flow more freely after City Link was completed has been tested by examining the reported changes in traffic time variability across the urban road

network. Figure 5 presents the reported data for the years 1996-97 to 2006-07 for the urban road network monitored by Vic Roads. Based on these data the projected increase in flow of traffic does not appear to have been achieved.

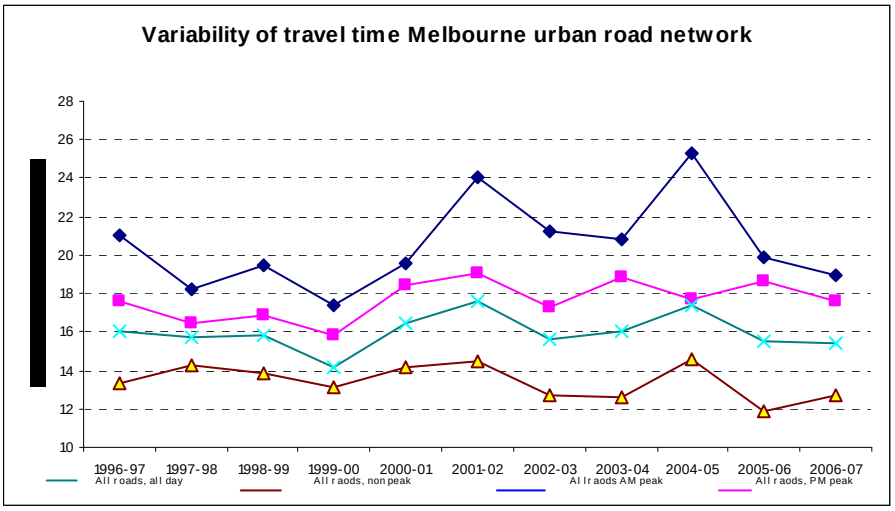

Figure 5: Trend in variability of travel time by time period 1996-7 to 2006-7

(Source: Vic Roads Traffic System Performance Monitoring reports: Series 1: AM peak; Series 2: PM peak Series 3: off peak Series 4: all day.)

Another piece of evidence disputing the claim that City Link would result in freer flowing traffic is presented as table 6. It indicates that congestion (as measured by traffic delay in minutes per kilometre travelled) has not decreased over the nine years to 2005-06. VicRoads (2008) itself notes that 'the the aim is for the rate of increase in traffic delay to be less than the rate of increase in road travel.(…) On average over the past five years this aim has not been met, with delay growing at a higher rate than road travel (VicRoads, 2007—08 p. 43)'.

Table 6: Traffic Levels and Congestion (At urban monitored locations, all times)

Year	Vehicle kilometres travelled	Traffic delay in minutes per km travelled1
1997-98	78,318	0.53
1998-99	80,785	0.50
1999-00	82,803	0.50
2000-01	85,030	0.51
2001-02	86,412	0.55
2002-03	86,460	0.53
2003-04	88,301	0.52
2004-05	88,688	0.57
2005-06	88,041	0.53

Source: VicRoads, *Annual Report 2006-06*, page 57.

Given the observed negative disparity between projected and actual speed in both the inner Melbourne area, and in the urban road network overall, urban network travel time savings would be possible only if the actual percentage traffic volume using Melbourne's inner roads fell during the relevant time period and at the same time the average speed on Melbourne's outer roads increased. As just noted, the average speeds have not increased. Between 1994-5 and 2006-07, the percentage of total vehicle kilometres travelled (VKT) in the urban Melbourne road network represented by inner Melbourne traffic has actually fallen from 27.5% (1994-95) down to 23.9% (2006-07). This decline has been a gradual

and relatively steady one. Moreover the simple average speed achieved on Melbourne's outer urban roads for the whole day has actually declined from around 44.1kms/hr in 1995 to 40.8 kms /hour in 2006-7, as illustrated in figure 6.

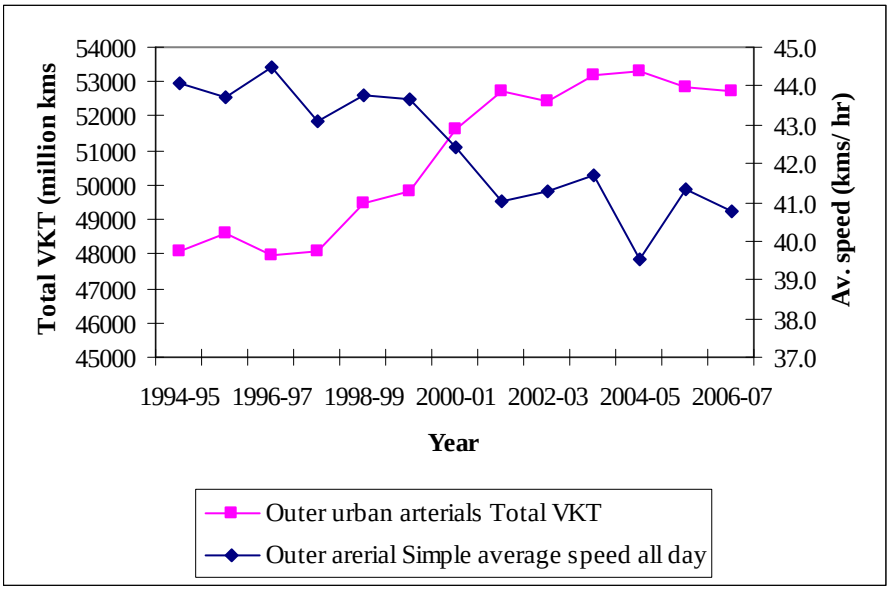

Figure 6: Melbourne's outer arterials: Total VKT and simple average speed all day

The third to seventh variables specified in table 5 all involve total daily vehicle hours travelled. Table 7 presents actual data for the period 1994- 95 to 2006-07. This table shows that the projected total DVH with City Link in year 2001 of 2,097,000 hours (see Table 5) was actually exceeded in the year 2004-05 and was above the City Link forecast level in both 2005-06 and 2006-07.

The projected volume of freeway traffic of 331,000 DVH (table 2) by 2011 looks unlikely based on the reduced speed of freeway traffic volumes since 2003-04 and a total freeway volume of 244700 DVH in 2006-07 (Table 7). Despite this, the growing popularity of Melbourne's freeways is clearly evident. Indeed the actual share of total kilometres travelled within Melbourne's' urban road network in 2006-7 accounted for by freeways has exceeded the projections by Veitch Lister and by Vic Roads (see table 5).

The last comparison presented in Table 5 is between the projected amount of travel time saved — as measured by reduced daily vehicle hours — through the introduction of additional freeway capacity in Melbourne and the actual annual increment to daily vehicle hours recorded and reported by Vic Roads. Table 8 and Figure 6 address this comparison

Table 7: Actual Daily vehicle hours (dvh) Melbourne urban road network

Year	Est. total daily vehicle hours all freeways (000hrs)	Non freeway urban network est. total dvh (000 hrs)	Est. total daily vehicle hours (000 hrs)	% of total daily vehic hours travelled or freeways	Est. total vehicle km travelled
1994-95	123.3	1674.6	1797.9	12.8%	75153
1995-96	130.0	1688.6	1818.7	13.3%	76384
1996-97	145.1	1663.1	1808.2	15.0%	77030
1997-98	163.7	1705.5	1869.2	16.7%	78318

1998-99	174.4	1700.0	1874.4	17.1%	80785
1999-00	197.3	1729.7	1927.0	18.55%	82862
2000-01	196.5	1795.3	1991.8	19.24%	84850
2001-02	210.2	1877.1	2087.2	19.3%	86412
2002-03	227.1	1842.3	2069.4	20.4%	86913
2003-04	236.9	1848.2	2085.1	20.8%	88408
2004-05	243.2	1923.0	2166.2	21.1%	88598
2005-06	243.5	1893.4	2136.9	21.5%	88041
2006-07	244.7	1912.5	2157.2	21.9%	88015

Source: 1994-95 to 2006-07 data supplied by VicRoads electronically on 8 April 2009.

The lack of travel time savings that were projected and used to justify the economic benefits that would result from both City Link and more recently East Link is clearly evident in both table 8 and in figure 7.

Table 8:
Comparison of actual and projected changes in Daily vehicle hours Melbourne urban road network 1997-8 to 2006-07

Year	Est. total DVH Urban Melbourne network (000 hrs)	Annual change in total DVH (000	Imputed project case DVH -base case DVH (000 hours)	Annual change Actual DVH - Base case change DVH
1996-97	1808.2			
1997-98	1869.2	61.0	-1.9	62.9
1998-99	1874.4	5.2	-1.9	7.1
1999-2000	1927.0	52.6	-9.4	62.0
2000-01	1991.8	64.8	-18.7	83.5
2001-02	2087.2	95.4	-19.5	114.9
2002-03	2069.4	-17.8	-20.3	2.5
2003-04	2085.1	15.7	-21.2	36.9
2004-05	2166.2	81.1	-22.1	103.2
2005-06	2136.9	-29.3	-23.0	-6.3
2006-07	2157.2	20.3	-24.0	44.3
Total		349.0	-162.0	511

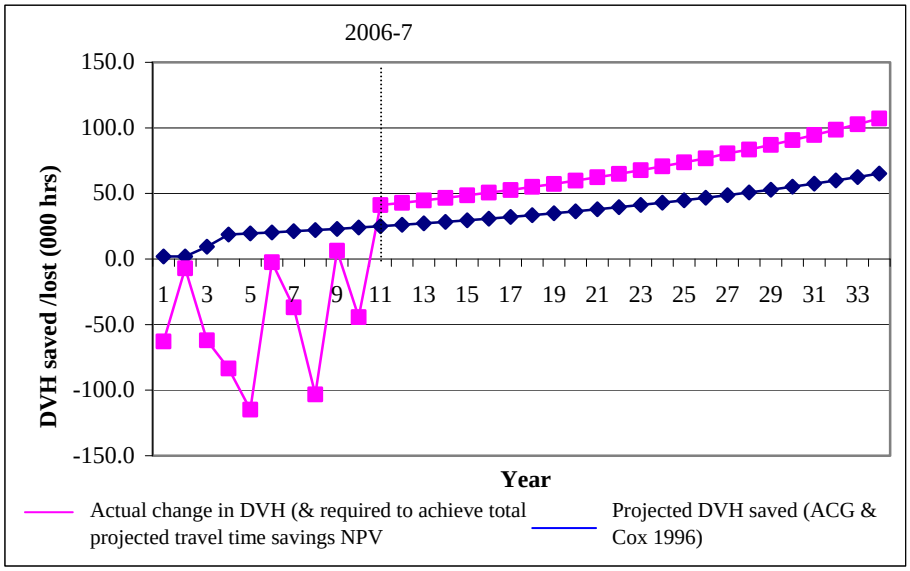

Figure 7 Melbourne urban road network: projected and actual travel time savings: 1997-8 to 2006-7

The Net present Value (in 1993 dollars) of time savings projected for City Link over thirty six years was $1.4851 billion (ACG and Cox, 1996). Of this total amount, $528.1 million were projected to be saved during the years 1997-8 to 2006-07. With the same discount rate of 8% the NPV of the extra travel time in daily vehicle hour equivalents over the years 1997-98 to 2006-07 shown in table 8 is -$349.4 million (in 1993 dollars). Given this net cost (dissaving) to the Victorian community, computations reveal that in order for the total projected travel time savings NPV of $1.485 billion to be achieved, the NPV of travel time savings on Melbourne's' urban road network from 2007-08 to 2030-31 inclusive would have to amount to $1.834.4 billion., as opposed to the projected NPV of $957.1 million.

Given the actual shortfall in travel time savings already noted future travel time savings would have to increase in value by more than 64% per year faster than they were forecast to grow post 2011 by ACG and Cox (1996). As noted earlier, time savings were forecast by ACG and Cox (1996) to grow by 4.5 per year. They would need to grow year-on-year consistently at almost double this rate for the total NPV of time savings to be achieved. Based on the above analysis of actual urban network performance such an outcome seems highly unlikely, at least in the absence of an extremely benevolent *deus ex machina.*

Conclusions

Several conclusions can be drawn from this empirical analysis:
(i) the actual volume of traffic on Melbourne's urban road network in the years 2000-1 to 2006-7 , measured on both total vehicle kilometres and daily vehicle hours, exceeds the volume forecast in the early nineteen nineties;
(ii) the rate of growth in daily total vehicle kilometres travelled slowed to 0.6% per year during the years 2001-02 to 2006-07, compared to 2.1% per year from 1994-5 to 200-01;
(iii) whole of day average travel speeds per hour have increased on Melbourne's inner freeways; however, the average whole of day speed on Melbourne's freeways overall has stayed at around the same level (78+ kms /hour) apart from 2000-01 (83.5 kms/ hour) and 2001-02 (79.5 kms' hour). However, over the years 2001—02 to 2006-07, the average kilometre per hour speed on Melbourne's inner freeways in the morning peak has dropped from 67.4 kms/ hr to 58.8 kms/ hr; in the afternoon period the fall has been from 80.2 kms/ hr to 73.5 kms /hr.

(iv) the whole of day average speed per hour across the monitored urban road network in 2006-7 was 1 kilometre per hour slower than in 1994-5;
(v) reductions in daily vehicle hours travelled on Melbourne's arterial road network have occurred; but the corresponding increase in average speed per hour has not: for instance, the average whole of day speed on inner divided arterials has dropped from 39.8 kms/ hour in 2000-1 to 34 kms/ hour in 2006-7; and for outer area undivided arterials it has dropped from 41.4 kms/ hour in 200-1 to 39.5 kms/hr in 2006-7.
(vi) the average speed in kilometres per hour in both the morning and evening peak periods for the whole monitored urban network in the most recent year for which data are available — the year ended June 30 2007 — is the lowest it has been since 1994-95.

In sum, these results suggest that the core of travel times savings benefits, which is an increase in average travel speeds, has not eventuated in Melbourne's urban road network during the years under review. Indeed, based on the evidence presented and analysed in this paper, one could be led to the conclusion that investments in Melbourne's urban road network have resulted in more time being used by Melbourne's motorists rather than less time. On the basis of the assumptions conventionally used to justify road building , major road infrastructure initiatives have resulted in net economic disbenefits.

We may acknowledge that people derive benefit from freeways, as Metz (2008) points out, in opening up new opportunities for interaction further afield. He writes, 'My argument is that the benefits of new transport infrastructure are taken by travelers in the form of greater access, not time saving' (Metz, 2008 p.31). But, as he continues, 'The transport economists have led us badly astray'. A more dispersed, car dependent city benefits some, but also has serious costs in terms of greenhouse emissions and oil dependence.

This conclusion is most concerning, given the very substantial amounts of public funds that have been directed at Melbourne's urban road network over the last several decades, coupled with the dominance of claimed travel time savings in the economic cost-benefit justifications that have preceded the approval of such very large scale additions to Melbourne's freeway stock. They are even more troubling when one acknowledges the comparatively higher length of freeway per capita that Melbourne enjoyed over numerous comparable cities both in Australia and overseas (Kenworthy and Newman 2002) , even before East Link and the other planned expansions to our freeways came or will come on stream.

This analysis clearly raises very real doubts about the validity of using the projected value of travel time savings as the basis for estimating the social economic benefits of building new road projects, at least within established and complex urban road networks. Even if this validity were accepted, there is a very strong need for far more rigorous and empirically based methods to be used when projecting the quantum of travel time most likely to result from the road project being evaluated at the time.

In closing, perhaps the German word *schlimmbesserung* — meaning an improvement that makes things worse — is an apt descriptor for the massive program of new road construction that has marked Melbourne's 'solution' to its transport challenges over the last several decades.

References

Anon (2008): 'Melbourne freeways upgrade to cost $1.4 billion", *Drive* Fairfax Digital, May 1. http://www.drive.com.au/Editorial/ArticleDetail.aspx?ArticleID=52057&vf=26 accessed 28 April 2009
Davidson, K. (2008) 'Wrong turn - freeway funds a waste', *The Age*, May 8. http://business.theage.com.au/business/wrong-turn--freeway-funds-a-waste-20080504-2avj.html accessed 29/04/09.
Department of Infrastructure (2006) *Annual Report 2005-06*, Melbourne, Victorian Government.
Department of Transport Annual Report 2007-08, Melbourne, Victorian Government 29 October 2008.

Ironmonger, D. 2008, *A System of Time Accounts for Melbourne, Second Edition*, Report Commissioned by The Department of Transport, Victoria, Australia, Households Research Unit, The University of Melbourne, Melbourne, Victoria. Australia.
Kenworthy, J. & P. Newman, P. "Melbourne in an International Comparison of Urban Transport Systems: Marvellous or Mediocre", *Institute for Sustainability and Technology Policy*, Murdoch University, 2002. p.19
Lay, M. and Daley, K. 2002 'The Melbourne City Link Project, *Transport Policy*, 9, pp. 261-67.
Lay, M.G. (2003) *Melbourne Miles* Melbourne: Australian Scholarly Publishing
Laybutt, S. 'History of the M3 Eastern Freeway' (http://mrv.ozroads.net.au/SRNS/M%20Routes/M3%20Eastern/history.htm) 25/04/09.
Melbourne City Link Authority, 2001, *Annual Report*, Victorian Government, Melbourne.
Melbourne Transport Committee (undated): *Melbourne's Transport Task – an overview*. Open, working document.
Metz, D (2008) *The Limits to Travel, How far will you go?* London: Earthscan
Minister for Transport (2002) 'BRACKS GOVERNMENT ANNOUNCES MITCHAM-FRANKSTON FREEWAY PROJECT Media Release, September 23. http://www.dpc.vic.gov.au/domino/Web_Notes/MediaRelArc02.nsf/fce5683f42af57f04a256b36001bd4df/d00505afe9c35a32ca256c3d007c472c?OpenDocument accessed 28 April 2009.
Parsons Brinkerhoff (2008): "TCI' http://www.pb.com.au/PBAU/Projects/Tullamarine%E2%80%93Calder+Interchange/ACCESED 26/04/09.
Public Transport Users Association (2008) 'Common Urban Myths About Transport'
Salt, B. (2008): *The EastLink Imperative*, report commissioned by ConnectEast Group, July.
The Allen Consulting Group and Cox, J. 1995 *The Economic Impact of City Link*, Consultancy Report to the Melbourne City Link Authority, May, Melbourne.
The Allen Consulting Group and Cox, 1996, *The Economic Impact of City Link: Transurban Project* Consultancy Report to the Melbourne City Link Authority, April, Melbourne.
The Allen Consulting Group (2006): *The Economic Impacts of East Link* Report to the Southern and Eastern Integrated Transport Authority, 21 August.
Transurban City Link Limited, 1996, *The Melbourne City Link Prospectus*, 1996
Victorian Department of Transport, 1991: *Central Area Transport Strategy*, Melbourne, Victoria, AU, March.
VicRoads (2001): *Traffic System Performance Monitoring 1999-2000*, Melbourne.
VicRoads *2000-2001 Traffic System Performance Monitoring Report*.
VicRoads *2001 -2002 Traffic System Performance Monitoring Report.*
VicRoads *2002-2003 Traffic System Performance Monitoring Report.*
VicRoads (2006) *2005-06 Annual Report*, Melbourne.
VicRoads (2008): *Traffic System Performance Monitoring 2006-07*, Melbourne, Vic, AU.
VicRoads (nd). 'History of VicRoads' http://www.vicroads.vic.gov.au/Home/AboutVicRoads/HistoryOfVicRoads1.htm 25/04/09
VicRoads: *History of Western Ring Road* '(http://www.vicroads.vic.gov.au/Home/AboutVicRoads/HistoryOfVicRoads1.htm 25/04/09)
VicRoads (2007) VicRoads Annual Report 2007-08
VicRoads (2009) Annual Traffic System Performance Monitoring; longitudinal data from 1994/5 to 2006/7 provided to author by Vic Roads April 2009.
VicRoads (2009b): '*Craigieburn Bypass Community Opening Event* http://www.vicroads.vic.gov.au/Home/RoadsAndProjects/RoadProjects/Expired+Project+Pages/Craigieburn+Bypass+Project.htm, accessed 23 August 2009.
Victorian Government, 2008, *The Victorian Transport Plan*, Treasury Place, Melbourne, Victoria
Wikipedia: Western Ring Road (http://en.wikipedia.org/wiki/Western_Ring_Road 25/04/09)
Williams, P. J. 1992, *Swanston Street Closure Travel Time Surveys* RACV, Melbourne, Victoria, AU.