CANBERRA PUBLIC TRANSPORT FUTURES FEASIBILITY STUDY

Final Report: Economic and Financial Implications of Transport Options

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CONTENTS

Section		Page
	EXECUTIVE SUMMARY	
1	**INTRODUCTION – TERMS OF REFERENCE**	
2	**EXISTING SITUATION**	
2.1	Introduction	2-1
2.2	Recent changes	2-1
2.3	Existing bus routes	2-5
2.4	Levels of service	2-22
2.5	Trends in usage	2-27
2.6	funding constraints	2-30
2.7	ACTION customer survey (October 2002)	2-33
2.8	Planned changes to ACTION Buses	2-36
3	**LAND USE DEVELOPMENT**	
3.1	Land use, population and employment assumptions	3-1
3.2	Growth trends in travel demand	3-1
3.3	Employment trends	3-2
3.4	Land use options	3-4
3.5	Factors necessary to make land use changes happen	3-6
4	**CONSULTATION**	
4.1	Community and stakeholder consultation	4-1
4.2	Transport Summit, June 2003	4-1
5	**SUSTAINABILITY**	
5.1	Introduction	5-1
5.2	Definitions of sustainable transport	5-1
5.3	Sustainability indicators	5-2
5.4	Sustainability indicators for Canberra study	5-3
5.5	Accessibility (Travel cost)	5-4
5.6	Travel demand	5-4
5.7	Mode split to public transport	5-5
5.8	Road traffic noise	5-5
5.9	Total transport emissions	5-5
5.10	Public health and safety	5-6
5.11	Transport system related land value benefits capture	5-8
5.12	Infrastructure benefits from reduced urban sprawl	5-11
5.13	Job creation	5-14
6	**TRANSPORT TECHNOLOGY**	
6.1	Introduction	6-1
6.2	Light rail and bus: Making the right choice	6-1
6.3	Bus	6-3
6.4	Light rail	6-4
6.5	Future technologies	6-6
7	**DEVELOPMENT OF OPTIONS**	
7.1	Development of short-term public transport system improvement options	7-1
7.2	General short term measures for Canberra	7-2
7.3	Development of long-term public transport System improvement options	7-5
7.4	Definition of alternatives	7-9
7.5	Optimum extent of network	7-11
7.6	Suitable first stage	7-11
8	**THE TRANSPORT MODEL**	
8.1	The Transtep Transport Model	8-1
8.2	The Transport Network	8-2
8.3	Sensitivity test	8-5
9	**ASSESSMENT OF SHORT-TERM OPTIONS**	
9.1	Introduction	9-1
9.2	Parking policies	9-1
9.3	Transit priority at intersections	9-2
9.4	Real time information	9-3
9.5	Exclusive bus lanes for civic–gungahlin route	9-3
9.6	Conclusion	9-4

CONTENTS

Section		Page
10	**ASSESSMENT OF LONG-TERM OPTIONS**	
10.1	Introduction	10-1
10.2	Fare earnings	10-1
10.3	Effects on road congestion	10-2
10.4	Predicted LRT fare revenue	10-3
10.5	Effect on ACTION Bus Services	10-5
10.6	Effect on car parking demand	10-6
11	**DETAILS OF ROUTE DESIGN AND CONSTRUCTION COSTS**	
11.1	Introduction	11-1
11.2	Network layout	11-1
11.3	Routes	11-4
11.4	Vehicle requirements	11-6
11.5	Stations/stops	11-6
11.6	Special structures	11-7
11.7	Overall cost estimate	11-8
12	**ECONOMIC AND FINANCIAL PERFORMANCE**	
12.1	Economic evaluation	12-1
12.2	Financial evaluation	12-6
12.3	Sensitivity analysis	12-10
12.4	Recommended policy for funding and implementation	12-11
12.5	Private sector involvement	12-13
12.6	Project delivery risk assessment	12-21
13	**SUMMARY AND RECOMMENDATIONS**	
13.1	Land use development scenarios	13-1
13.2	Recommended long-term system improvements	13-2
13.3	Interim improvement measures	13-3
14	**REFERENCES**	

Section		Page
APPENDICES		
A	ACTION Bus Operations 2002	
B	Stakeholder and Community Consultations	
C	Land Value Benefits Capture	
D	Route Design and Costings	
E	Economic and Financial Analysis Spreadsheets	

Executive Summary

THE STUDY

KBR were commissioned to undertake the Canberra Public Transport Futures Feasibility Study by PALM (now ACTPLA), who managed the study on behalf of the ACT Government. The overall objective of the study is to make recommendations for the planning and implementation of improvements to public transport services for Canberra which will increase the public transport share of journeys. These recommendations are consistent with the principles of environmental sustainability and improving the quality of living in Canberra.

This summary contains the following sections:

- The study
- Current and future situation
- Medium to long term recommendations
- Preferred Routes
- Vehicle types
- The transport model
- Recommendations of the transport model
  - Transport efficiency
  - Reduction in road user costs and accidents
  - Reductions in transport emissions
- Urban consolidation
- Economic evaluation
- Financial evaluation
- Sensitivity tests
- Supporting measures
  - Land sales
  - Car parking

- Reduced urban sprawl
- Project delivery
  - Key risks.

CURRENT AND FUTURE SITUATION

Public transport in Canberra is currently exclusively bus based and operated by ACTION buses. The ACTION fleet consists of 347 buses operating 65 bus routes across the ACT region, with approximately 2800 bus stops.

On a typical school term weekday, ACTION provide 2,424 different services. Approximately 67,000 passenger journeys are made each weekday (Parsons Brinckerhoff, 2002). Assuming that each bus user typically makes one return journey per day, approximately 30,000 people use ACTION buses everyday, which is approximately 10% of the ACT population. For journey to work trips, based on the 2001 Census, 6% were by public transport in Canberra, compared to approximately 20% in Sydney and 14% in Melbourne.

This study addresses the declining mode share for public transport at a time of continuing population growth in Canberra. The population of Canberra (excluding Queanbeyan) was 322,000 in 2002 and is now forecast to rise to 389,000 by 2032, an increase of 67,000 (21%) people in 30 years (Demographic Unit, 2003, ACT Population Projections).

Over the same 30 year period the number of households is anticipated to rise by 37%, reflecting decreasing household sizes. Population growth and trip rates per household are the key determining factors for future growth in demand for public transport in Canberra.

MEDIUM TO LONG TERM RECOMMENDATIONS

The recommended solutions seek to provide a new or improved public transport system in Canberra that, whilst based upon the existing system, is developed progressively over time and will offer a more radical alternative to journeys by car, significantly improving public transport's mode share.

One of the aims of this study has been to investigate the various public transport corridors which currently serve travel demand in Canberra. The solutions proposed for the development of long term public transport system improvements in Canberra are a product of both the international literature review and extensive local consultations. The study has considered all potential transport corridors and also reviewed the different types of public transport vehicles which could operate on these corridors.

PREFERRED ROUTES

The first stage of route development should be based upon the following four dedicated transport corridors:

Belconnen Route – will run from Northbourne Avenue/Alinga Street, City to Benjamin Way/Emu Bank, Belconnen, via the Bruce Stadium and The University of Canberra. The route will have 20 station/stop platforms (10 either side) and a terminus and would have a total length of 9.5 km and a travel time of 18 minutes each way.

Gungahlin Route – will run from Northbourne Avenue/Alinga Street, City to a terminus in Anthony Rolfe Avenue, Gungahlin. The route is to have 28 station/stop platforms (14 either side), and a terminus at either end. The city terminus would also act as the terminus for the Kingston/Manuka to Civic route. The route would have a total length of 13 km and a travel time of 24 minutes each way.

Woden/Tuggeranong Route – will run from Northbourne Avenue/Alinga Street to the southern end of Anketel Street, Tuggeranong. The route will proceed via Athlon Drive to a terminus in Anketel Street. The route is to have 40 station/stop platforms (20 either side), and a terminus at each end plus three intermediate track cross-overs to allow early return of vehicles in emergencies and six power substations. The City terminus will also act as the City terminus for the Belconnen route. This route would have a total length of 21.3 km and a travel time of 38 minutes each way.

Manuka/Civic Loop – will run from Northbourne Avenue/Alinga Street, City to Burke Crescent, Kingston. The route is via Alinga Street, Constitution Avenue and Kings Avenue to State Circle. From State Circle the route runs as a one way single track along Brisbane Avenue and Wellington Avenue to Burke Crescent. The route is to have 18 station/stops platforms, nine in each direction and would have a length of 8.1 km in each direction and journey time of 15 minutes each way.

The collective length of this network is 54.43 km (Figure 1).

VEHICLE TYPES

The study has also considered a range of different vehicle types to operate the network. The review included current conventional modes, and also current trials of public transport options of the future. To decide which modes to consider, KBR referred to highly regarded text *Light rail and bus: making the right choice* by Professor Hass-Klau (2000), which summarises the results of a worldwide study of buses and light rail with the aim of evaluating the success of past schemes for the benefit of future schemes.

The Hass-Klau study found that vehicle operating speed is similar for either mode in most operating environments. Furthermore the study found that whilst noise and pollution issues tend to favour light rail over buses at the moment, changes in diesel fuel technology towards zero emissions is reducing the difference. The cost of the two modes is also remarkably similar, although studies into operating costs have shown that light rail is slightly cheaper than buses on a lifetime basis.

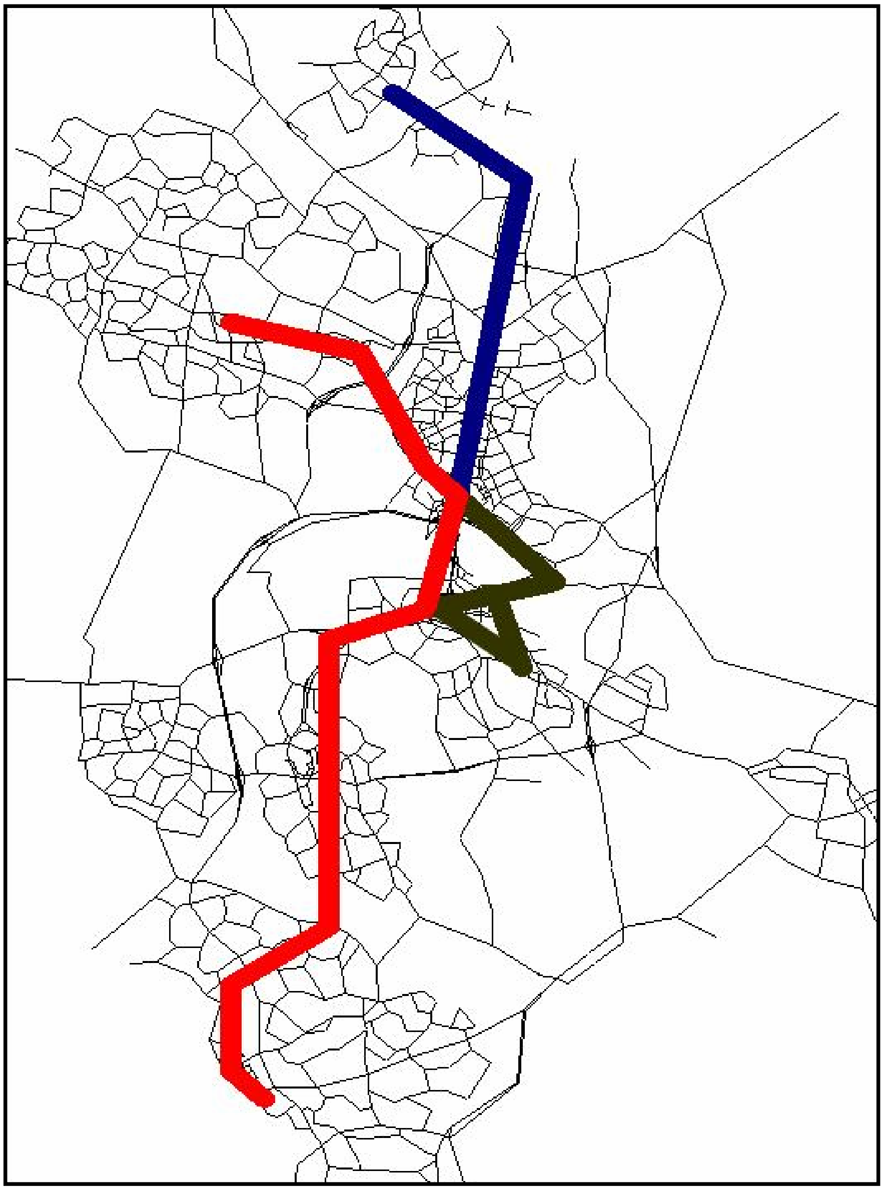


Figure 1 Preferred routes

Also, the Hass-Klau study considered the important issue of public perception and concluded that light rail tends to receive a higher level of political and public support than bus schemes. Furthermore, the higher degree of support for light rail tends to ensure that other complimentary measures are implemented which assists the success of the scheme *but that such support and commitment would also assist bus based schemes*. The study makes the important observation from a user's point of view:

> "Light rail is an inflexible, fixed route mode but this is perceived as an advantage over a bus as it means the service has a degree of permanency. The very flexibility of bus becomes a disadvantage as services can be readily changed." (Hass-Klau 2000).

What is clear from Hass-Klau study is that there are a range of dedicated public transport systems functioning around the world but there is not just one formula or approach for success. Indeed, success it would seem, is a result of commitment. As such this study does not recommend a particular vehicle type and concludes that these routes should be serviced with either light rail or buses. Both should use dedicated infrastructure to achieve fast journey speeds and a high quality interchange environment. Furthermore, the vehicle type could change over time.

THE TRANSPORT MODEL

The four different corridors have been tested as networks in the Scott Wilson Nairn travel model. The travel simulation model consists of:

- a suite of software, that controls operations of the model and performs calculations;
- a network database, describing the road and public transport infrastructure characteristics of the modelled system;
- land-use files, containing forecasts of travel-related land use variables; and,
- a set of files describing the travel characteristics of Canberra residents.

The computer modelling process is an iterative one, in which highway congestion alters travel costs, and this in turn is fed back into the trip generation, trip distribution and mode choice computations. This ensures that the travel costs effectively influence the whole travel simulation process.

Travel demand is composed of different elements such as trip generation rates, travel purposes, destination patterns and choice of mode. These components are themselves influenced by a number of variables such as:

- land use patterns;
- the level of street congestion;
- travel cost including fares and parking charges;

- social-economic factors such as income age groups;
- the pattern and frequency of public transport services; and
- housing density, prices and accessibility factors.

Travel demand is derived directly from the land-use data, socio-economic data and travel characteristics so that the model is fully responsive to land-use changes and options. Future travel demand is responsive to the ageing population and to rising future incomes.

RECOMMENDATIONS OF THE TRANSPORT MODEL

Transport efficiency

Road congestion is a key transport efficiency indicator. Measures to improve transport efficiency, such as a Corridor Transit system, benefit not only the transit system users but also road users too. Providing an alternative means of travel that is as attractive as travel by car, frees road space for other economically important journeys that can only be made by road.

Road congestion is frequently expressed as a volume to capacity ratio (V/C), which is the amount of traffic using/wanting to use the road compared to its theoretical maximum. As this ratio moves towards one, congestion gets progressively worse, resulting in low speeds and unreliable journey times.

The effect of the Corridor Transit system on road congestion over time is shown in Table 1. In 2011, the systems inception, 135km of road will have a V/C ratio greater than 0.75 – the point which speeds begin to drop and journey times become unreliable. However, with the introduction of the Corridor Transit system, the length of road with a V/C ratio over 0.75 is forecast to fall to 93km. In 2031, the situation is much worse without the transit system, 238km of road will have a V/C ratio greater than 0.75 compared to 207km of congested road with the system. This reduction in roads with a V/C ratio over 0.75 is 13% in 2031.

Table 1 Estimated length of congested roads, 2011, 2021 and 2031

V/C ratio	Year 2011		Year 2021		Year 2031	
	No change	With improvements	No change	With improvements	No change	With improvements
0.75-0.85	44	31	59	55	76	73
0.85-0.9	21	22	25	25	36	26
0.9-0.95	18	11	30	17	33	31
0.95-1.0	17	12	18	14	31	20
>1.0	35	27	45	40	62	57

Source: Scott Wilson Nairn's travel model of Canberra

Just considering the worst sections of congested road, 52 km of road will have a V/C over 0.95 in 2011. In the year 2031, 93 km of road will have a V/C ratio over 0.95. However, the introduction of the Corridor Transit System reduces the length of roads with a V/C ratio over 0.95 to 39km in 2011 and 77km in 2031. This is a decrease of 21% in 2011 and 17% in 2031.

Reduction in road user costs and accidents

These non-user benefits, are gained by motorists who do not use the transit corridor system. Non-user benefits for highway users cover the following elements:

- reduced vehicle travel times
- reduced vehicle operating costs.
- reduced accident costs.

Highway travel time savings are also a function of traffic flow. As traffic flow decreases, the remaining traffic is able to travel faster and therefore experience reduced journey times. Compared to the base case there are considerable savings from both fewer car travellers and faster journey times. At a 5% discount rate these benefits would be $1092 million. Details of all of the discounted savings are shown in Table 2.

Vehicle operating costs are a function of road geometry and traffic flow. As traffic flow decreases so does the vehicle operating cost. At a 5% discount rate these benefits would be $1921 million. Details of all of the discounted savings are shown in Table 2.

Road traffic accident costs also reduce over the period from 2011 to 2031. The reduction is a response to fewer vehicles on the road as more people switch to public transport as a result of the Transit Corridor System. At a 5% discount rate these benefits would be $211 million. Details of which are shown in Table 2.

Table 2 20-year Highway cost savings ($/million) Year 2011 start

Discount rate	Vehicle operating costs	Journey time savings	Accident costs
5%	$1921	$1092	$211
7%	$1558	$881	$169
9%	$1274	$716	$137

Reductions in transport emissions

The transport model could not explicitly model public transport emissions and as such they have not been included in the main appraisal of the options. However, in most Australian cities, as much as 60% of air pollution is generated by cars. Therefore measures which reduce the number of cars on the roads in Canberra should also reduce air pollution.

Whilst the overall levels of air pollution in Canberra are expected to fall with an improved public transport corridor system, different public transport modes would produce different results. Light rail systems would produce near zero levels of emissions at source compared to buses. However, light rail systems would increase the burden on power generation plants and would increase pollutants at these sites.

Urban consolidation

Urban consolidation is the opposite of urban sprawl, which is generally regarded as the increase in the urban footprint at the urban fringe as a result of low density housing. Urban sprawl is commonly associated with low public transport provision and increased reliance upon the private car for all trips, which means more roads, both locally and elsewhere. The principle of urban consolidation therefore has been identified whereby more compact cities increase sustainability (Bunker et al, 2002).

There is no simple model that describes either the costs of urban sprawl or the benefits of urban consolidation. One major argument for consolidation is that higher densities are required to reduce infrastructure costs per household. However, the amount of infrastructure required is also dependent upon the topography of the land and the ability of the new development to connect to existing supplies (Urban Frontiers Program, UWS, 2001). A similar argument could be made for consolidating existing urban areas, but the cost of disturbance and re-connection to existing services prevents a simplified model being developed.

A study outlined in *Sydney - the urban sustainability challenge*, by Gillespie Economics reveals how the ACT Government examined the comparative costs of two options for accommodating growth. One option was greenfield development in Gungahlin of 2500 households per year with only 500 infill households per year. The second option balanced the development with infill of eventually 1500 households for both new development and infill per year. The study concluded that with greater urban consolidation, the ACT Government could defer over $58 million in capital expenditure over five years and also save $6 million in recurrent costs.

The relationship between urban consolidation and transport costs/benefits is complex (Gillespie Economics). If the consolidation is on a small scale, and there is existing transport capacity based around a public transport node, then any extra travel demand could be absorbed without any further transport infrastructure or public transport service costs. However, if the consolidation were to take place over a large area not only may there be an increase in the amount of parking space required, but also in the number of journeys made by car to a wide variety of destinations.

There is a growing body of research that is linking urban sprawl to ill health, in particular obesity, chronic disease, and car accidents. This follows on from the research that has been undertaken in recent years promoting the health benefits of physical activity. The Smart Growth America project commissioned research titled "*Measuring the Health Effects of*

Sprawl" (McCann and Ewing, 2003) which discovered a strong link between sprawl index and obesity. A further study in America (Ewing et al, 2003) into the risk of road traffic accidents and sprawl found similar correlations. For every 1% increase in sprawl (as measured using a sprawl index identified in the McCann and Ewing study) there was a 1.49% increase in road traffic accident risk.

In this study we have not been able to accurately quantify the economic and public health benefits of urban consolidation. It appears from the literature review that public transport options and land use scenarios that have greater urban consolidation and subsequently less car use will have better economic and health outcomes than other scenarios and options.

ECONOMIC EVALUATION

The economic evaluation compares the costs of the public transport corridor system against the benefits to both users and non-users. The comparison is made between each of the options and a base case. The results of the economic analysis in each case show the difference between the option and the base case. In this instance a horizon year of 2031 has been used to establish costs and benefits and an equal value of time for private and public transport system users, which is $10 per hour.

The analysis has compared the following benefits and costs:

- Benefits
  - construction and maintenance savings;
  - journey time savings;
  - vehicle operating cost savings; and
  - road accident savings
- Costs
  - corridor system track and rolling stock capital costs;
  - corresponding savings in future ACTION Bus Fleet purchases;
  - transit system operating costs (corridor transit – saving in bus system); and
  - transit system travel time costs (increases with additional users)

Highway travel time savings are also a function of traffic flow. The effect of the public transport corridor system is to increase the mode share of public transport and reduce traffic flow. As traffic flow decreases, the remaining traffic is able to travel faster and therefore motorists experience reduced journey times. Compared to the base case there are considerable savings from both fewer car travellers and faster journey times.

Over time, bus fleet acquisition costs reduce compared to the base case, reflecting the growing importance of the public transit corridor service. The overall transit system (bus and corridor transit) continues to experience greater operating costs compared to the base case up until 2022. After this time, operating costs decrease compared to the base case as the transit corridor system becomes more efficient. However, the increased number of transit user users causes the transit time costs to rise compared to the base case.

The economic benefits for year 2006 start are shown in Table 3. Scheme costs range from $525 million for a bus based system discounted at 9% to $764 million for a light rail system discounted at 5%.

The highways related economic benefits are the same for both modes and are based upon reduced traffic flow. At 7% discount rate, construction and maintenance savings will be $23 million each. Accident savings will exceed $150 million, vehicle operating benefits will exceed $1500 million and travel savings are $822 million.

Transit system benefits are the same for both modes and are not all savings. There are savings associated with replacing the existing ACTION services, which amount to $114 million at 7% discount rate. However, operating costs and time costs together are $560–$615 million at 7% discount rate.

Table 3 Economic analysis in year 2006 start ($M)

		Light Rail			Busway		
System	Element	PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted total costs		**-$764.26**	**-$725.77**	**-$691.62**	**-$574.00**	**-$548.47**	**-$525.38**
Highway Savings	Const. Cost	$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
	Maint. Cost	$27.70	$22.54	$18.49	$27.70	$22.54	$18.49
	Accident Cost	$189.27	$152.80	$124.43	$189.27	$152.80	$124.43
	V.O.C. Cost	$1,868.90	$1,520.25	$1,247.04	$1,868.90	$1,520.25	$1,247.04
	Time Cost	$1,015.50	$822.02	$671.08	$1,015.50	$822.02	$671.08
Transit System	Fleet Cost	$152.23	$113.55	$85.30	$152.23	$113.55	$85.30
	Operating Cost	-$59.39	-$52.46	-$46.15	-$128.95	-$108.36	-$91.47
	Time Cost	-$623.59	-$506.48	-$414.81	-$623.59	-$506.48	-$414.81
Discounted total benefits		**$2,596.51**	**$2,095.60**	**$1,706.53**	**$2,526.95**	**$2,039.70**	**$1,661.21**
Net Flow		**$1,832.25**	**$1,369.83**	**$1,014.91**	**$1,952.95**	**$1,491.23**	**$1,135.84**

The results of the economic analysis for a start to construction in 2006 show that the benefits of the schemes do significantly outweigh the costs. The bus based option, which costs less but produces similar benefits as the light rail option, has the most favourable economic results. At 7% discount, the bus based option would return a net present value benefit of $1,491 million compared to $1370 million for the light rail. This is an 8% improvement.

The economic benefits for a start to construction in 2011 are shown in Table 4. The highways based economic benefits are the same for both modes and result from reduced traffic flow. At 7% discount, construction and maintenance savings will be $23 million each. Accident savings will both be $170 million, vehicle operating savings will exceed $1,550 million and travel savings will be $880 million. These are marginally higher benefits than commencing the scheme in 2006.

Transit system benefits are generally the same for both modes. There are savings associated with replacing the existing ACTION services, which amount to $245 million at 7% discount with light rail, operating costs are also a net benefit at a discount rate of 7% ($1.5 million) as more of the demand is transferred on to the more efficient corridor system compared to the conventional bus routes. However, time costs are still over $500 million additional cost at 7% discount rate.

Table 4 Economic analysis for year 2011 start ($M)

		Light Rail			**Busway**		
System	Element	PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		**-$764.26**	**-$725.77**	**-$691.62**	**-$574.00**	**-$548.47**	**-$525.38**
Highway Savings	Const. Cost	$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
	Maint. Cost	$28.31	$23.00	$18.83	$28.31	$23.00	$18.83
	Accident Cost	$211.15	$169.33	$136.92	$211.15	$169.33	$136.92
	V.O.C. Cost	$1,920.96	$1,558.48	$1,274.33	$1,920.96	$1,558.48	$1,274.33
	Time Cost	$1,091.50	$880.76	$716.39	$1,091.50	$880.76	$716.39
Transit System	Fleet Cost	$330.74	$245.42	$183.01	$330.74	$245.42	$183.01
	Operating Cost	$14.61	$1.51	-$6.71	-$66.03	-$62.88	-$58.56
	Time Cost	-$645.84	-$523.94	-$428.34	-$645.84	-$523.94	-$428.34
Discounted Total Benefits		**$2,977.32**	**$2,377.97**	**$1,915.57**	**$2,896.68**	**$2,313.58**	**$1,863.72**
Net Flow		**$2,213.06**	**$1,652.20**	**$1,223.95**	**$2,322.67**	**$1,765.10**	**$1,338.34**

The result of the economic analysis for commencement of construction in 2011 shows that the benefits of the schemes do significantly outweigh the costs. The bus based option, which again costs less but produces similar benefits as the light rail option, produces the most favourable economic results. At 7% discount rate, the bus based option would return a net present value benefit of $1,765 million compared to $1652 million net for the light rail. These benefits are 15–20% greater than if the scheme commences in 2006.

FINANCIAL EVALUATION

The financial evaluation compares the costs of the public transport corridor system against different revenue streams. The comparison is made between each of the options and a base case. Again a time horizon of 2031 has been used to establish all revenue streams.

The analysis has compared the following costs:

- Corridor transport system
  - Capital costs
  - Operating costs
  - Fare revenue
- Action
  - Fleet savings
  - Operating cost savings
  - Fare revenue
- Other items
  - Car park construction
  - Road construction
  - Road maintenance

The financial assessment for commencement of construction in 2006 is shown in Table 5. Scheme capital costs range from $525 million for a bus based system discounted at 9% to a light rail system costing $764 million if discounted at 5%.

The main differences between the two modes are that the light rail is expected to have lower operation costs than the bus based system, which at 7% discount costs are $112 million for light rail compared to $168 million for the bus based system. The revenue is $164 million for both modes.

The financial impact upon ACTION is also the same for both modes. Fleet replacement and operations savings will be $114 million and $59 million respectively at 7% discount. There will be a loss in revenue for ACTION which is estimated as $18 million over the time horizon to 2031, discounted at 7%.

The other financial savings, from reduced road and car park maintenance and construction are the same for both modes. At 7% discount, car park construction savings total almost $19 million, road construction and maintenance savings total $23 million each.

Table 5 Financial analysis for year 2006 start ($M)

		Light Rail			Busway		
System	Element	PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor Transit System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		**-$764.26**	**-$725.77**	**-$691.62**	**-$574.00**	**-$548.47**	**-$525.38**
Corridor Transit System	Operating Cost	-$139.00	-$111.69	-$90.53	-$208.50	-$167.53	-$135.80
	Fare Revenue	$205.57	$163.51	$131.16	$205.57	$163.51	$131.16
ACTION	Fleet Savings	$152.25	$113.56	$85.32	$152.25	$113.56	$85.32
	Operating Cost Saving	$79.55	$59.17	$44.33	$79.55	$59.17	$44.33
	Fare Revenue	-$25.73	-$17.84	-$12.26	-$25.73	-$17.84	-$12.26
Car park Const. Saving		$20.36	$18.73	$17.30	$20.36	$18.73	$17.30
Road Maint. Saving		$27.70	$22.54	$18.49	$27.70	$22.54	$18.49
Road Const. Saving		$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
Discounted Revenue & Savings		$346.60	$271.37	$214.95	$277.10	$215.53	$169.68
Net Cash Flow		**-$417.66**	**-$454.40**	**-$476.67**	**-$296.90**	**-$332.94**	**-$355.69**

The overall net financial cost of commencing construction of the scheme in 2006 depends upon the chosen mode and discount rate. At 7% discount, the bus based system will cost $333 million overall, compared to $454 million for the light rail option. At 5% discount the costs reduce somewhat to $417 million for light rail and $297 million for the bus system.

The financial assessment for a start in 2011 is shown in Table 6. Scheme capital costs range from $525 million for a bus based system discounted at 9% to a light rail system costing $764 million if discounted at 5%.

The light rail system is expected to have lower operation costs than the bus based system. Light rail at 7% discount rate costs $128 million compared to $193 million for the bus based system. The revenue is the same at $200 million for both modes.

The financial impact upon ACTION is also the same for both modes. Fleet replacement and operations savings will be $245 million and $130 million respectively at 7% discount. There will be a loss in revenue of $53 million over the time horizon to 2031, if discounted at 7%.

The other financial savings, from reduced road and car park maintenance and construction are the same for both modes. At 7% discount, car park construction savings reach $21 million, road construction and maintenance savings total $26 million and $23 million respectively.

The overall net financial cost of starting construction of the scheme in 2011 depends upon the chosen mode and discount rate. At 7% discount rate, the bus based system will cost $149 million, compared to $261 million for the light rail option. At 5% discount the net cost falls to $159 million for light rail and $50 million for the bus system.

Table 6 Financial analysis for year 2011 start ($M)

		Light Rail			**Busway**		
System	Element	PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor Transit System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		**-$764.26**	**-$725.77**	**-$691.62**	**-$574.00**	**-$548.47**	**-$525.38**
Corridor Transit System	Operating Cost	-$161.29	-$128.79	-$103.69	-$241.93	-$193.19	-$155.54
	Fare Revenue	$251.90	$200.42	$160.75	$251.90	$200.42	$160.75
ACTION	Fleet Savings	$330.77	$245.45	$183.02	$330.77	$245.45	$183.02
	Operating Cost Saving	$175.90	$130.31	$96.98	$175.90	$130.31	$96.98
	Fare Revenue	-$73.07	-$53.50	-$39.25	-$73.07	-$53.50	-$39.25
Carpark Const. Saving		$23.09	$21.41	$19.95	$23.09	$21.41	$19.95
Road Maint. Saving		$28.31	$23.00	$18.83	$28.31	$23.00	$18.83
Road Const. Saving		$28.77	$25.99	$23.50	$28.77	$25.99	$23.50
Discounted Revenue and Savings		$604.38	$464.29	$360.09	$523.74	$399.89	$308.24
Net Cash Flow		**-$159.88**	**-$261.48**	**-$331.53**	**-$50.27**	**-$148.58**	**-$217.13**

SENSITIVITY TESTS

There are considerable savings to be achieved with deferring commencement of the scheme until 2011 compared to 2006 primarily associated with the increased fleet savings and greater revenue anticipated from 2011 onwards compared to 2006. Furthermore, road and car park savings will also be greater in the years from 2011 compared to 2006. However, even in the best case for year 2011 commencement, the scheme still makes a net $50 million loss at 5% discount rate. The annualised cost of the deficit for each year is shown in Table 7.

Table 7 Net annualised cost of scheme ($M)

Start	Light Rail			Busway		
year	PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
2006	31.7	38.7	49.8	22.5	28.4	37.1
2011	12.1	22.3	34.6	3.8	12.7	22.7

The light rail scheme, even with the year 2011 start, would cost Treasury between $12 million and $35 million per year depending upon a discount rate of 5% or 9% respectively. The bus options would cost Treasury considerably less, between $4 million and $28 million for the same discount rates. For the year 2011 start lower population growth scenario (not shown in Tables 3, 4, 5, 6, and 7), the light rail would cost between $29 million and $47 million per annum compared to $20 million and $34 million per year for the bus based system. Under this year 2011 start, lower growth scenario, the financial results are generally similar to year 2006 commencement scenario.

SUPPORTING MEASURES

This study also considered the impact and benefits of a range of short-term measures that should be implemented in advance of the Corridor Transit System. These short-term measures would not only start the process but remain in place as supporting measures for the Corridor Transit System. The supporting measures include:

- car parking policies;
- transit priority at intersections;
- real time information; and
- exclusive bus lanes.

Preliminary analysis of these options in isolation from each other revealed more bus passengers and an increased mode share to public transport. A co-ordinated adoption of these measures would have even greater effect.

Parking policies have a large role to play in encouraging motorists to switch to public transport for at least some trips whilst also maintaining a revenue stream and freeing existing or future proposed parking spaces for alternative, and more economically beneficial land uses.

Transit priority at intersections and bus lanes would have a much smaller effect on public transport mode share but would generate substantial travel time savings for existing public transport users and would be a step in the right direction to improve the operation and perception of public transport in advance of the corridor system being introduced.

The effect of real time information could not be quantified by the Scott Wilson Nairn Travel Mode but would improve confidence of the present bus network in existing bus users whilst also improving the perception of public transport for non-users.

Land sales

KBR instructed Colliers International to provide an independent and objective valuation of enhancement to current government owned land values as a result of a new light rail route. The valuation was undertaken by Paul Powderley AAPI of Colliers International on 10 June 2003, and enclosed in a report titled *Valuation Advice for Canberra Public Transport Futures ACT* dated 12 June 2003. This section is a précis of that report.

Colliers International have provided value estimates for all land that would change value as a result of a light rail network. Colliers International only considered land currently in government ownership and value gains for new developments and changes of use resulting from the light rail network. They have excluded further benefits that may accrue to existing privately held land or developments in close proximity (c500m radius) to the light rail network nodes. Such changes in value would not benefit the ACT Government first hand, but would benefit the ACT later through increased rateable values. Furthermore, gains in property value, when ever realised, would feed back into the economy at some point.

The study undertaken by Colliers International on behalf of KBR for this study has identified that land value benefit capture as a result of the scheme could be in excess of $40 million. Further land sales could increase this amount.

Car parking

Future car parking revenues from Civic and other town centre car parking areas have not been quantified in this analysis. These revenues from approximately 15,000–17,000 car parking spaces at $7 per day for 250 days per year would represent $26–30 million per year at current prices.

The elasticities established by Booze, Allen and Hamilton, 2003, *ACT Transport Demand Elasticities Study* also show that although demand for parking would decrease if prices increased, revenue would not decrease. A $1 increase for these 22,000 customers per day would generate a further increase in car parking revenues of $5 million over a year (over 250 days).

Reduced urban sprawl

The typical additional infrastructure cost for all infrastructure, e.g. sewer, water, stormwater, electricity, gas, telephone, local roads, sub-arterial roads, has been estimated in studies in 1991/2 as approximately $17,000 per dwelling, higher for new urban fringe residential areas compared to urban consolidation residential development.

This cost differential is now likely to be significantly higher, e.g. $30,000 per dwelling at current valuations.

Over a 25–30 year future period, the potential for urban consolidation in suburbs such as North Canberra, South Canberra and the town centres of Civic, Woden, Belconnen and Tuggeranong could accommodate an additional 40,000 persons according to the difference between the urban development Scenarios 1 and 2 in this report.

These 40,000 persons would represent approximately 16,000–17,000 new dwellings by means of urban consolidation, with an effective infrastructure saving of $495 million in comparison to urban fringe development over a 25–30 year future period.

PROJECT DELIVERY

Key risks

Risk refers to the level of uncertainty on a project. Failure to understand these uncertainties can lead to project cost increases and under-performance. These are generally not acceptable outcomes for project proponents (owners).

In some project delivery strategies the Owner retains the risk throughout the duration of the project. In others the risk is passed to another party (or parties) at either the start of a project or at specific stages during the project. There is no single risk allocation strategy.

Assessing which of the alternative project delivery strategies will be the least cost strategy is an essential part of risk management. Most projects are unique and only ever executed once. Hence there has been few opportunities to make satisfactory historical comparisons. There are, however, a number of general observations that can be made and these do provide a guide to a least cost strategy:

- Scope uncertainty is the major cause of cost risk;
- Most opportunity for cost saving is during the design phase;
- Transferring risk to a contractor (via a lump sum bid) may provide reassurance to the owner but it may be paid for via additional contingency in the contractor's price or qualified out in a way that allows the contractor to claim variations;
- A more hierarchical contracting organisation will result in a higher total of mark-ups;
- Contractors are in general more commercially aware then engineering consultants, and therefore tend to take greater advantage of scope uncertainties;
- There is no substitute for good project management (planning) whichever way the project is delivered.

- *The Owner* owns the project and has responsibility to define it and also to decide how the project will be delivered.

- The *Owner's engineer* is assigned the task of assisting with the scoping and feasibility study and often acts as a superintendent for the work.

- *Design consultants* are appointed primarily to provide concept and detail design and documentation services, in line with their design expertise.

- *Suppliers* design, fabricate and deliver equipment and materials but generally do not install.

- *Fabrication and construction contractors* are used where the work is of a routine fabrication or construction nature (and generally single discipline skills are required, e.g. civil works, mechanical and piping). Fabrication drawings may be included in the contractors' scope, especially for structural steel or pipework.

- *Design and construction contractors* (D &C) are used where work can be readily specified and packaged into stand-alone multi-disciplinary packages, with minimal interface with other works, and design work is the responsibility of the contractor. Process guarantees are not normally offered. Industry norms for design and construction work standards are acceptable.

- *Vendor turnkey or Engineering, Procurement, Construction (EPC) contractors* are used where the work includes a high proportion of proprietary equipment, and/or has a requirement for a process or performance guarantee. As for D & C, they are used where the work can be performance-specified and packaged into stand-alone packages, with minimal interface with other works, and industry norms for design and construction work standards again are acceptable.

- *Engineering, procurement, and construction management consultants (EPCM)* are appointed when the Client requires expert support in areas of design, procurement, construction management and commissioning. It allows the Owner to reduce involvement in the detail management of a project whilst retaining the ability to influence outcomes of all critical issues.

- *BOO/BOOT (build, own, operate and transfer) companies* are used when the Owner does not have the resources or requirement to construct and operate the facility.

1 Introduction – Terms of Reference

KBR were commissioned to undertake this Public Transport Futures Feasibility Study by PALM (now ACTPLA), who managed the study on behalf of the ACT Government. The overall objective of the study is to identify the future planning and implementation of improvements to public transport services in the ACT and the corresponding increases to the public transport share of journeys. These recommendations are to be consistent with the principles of environmental sustainability and improving the quality of living in Canberra.

This report presents the final economic and financial analysis results for the study. The report contains the following chapters:

- Chapter 2: Existing Situation
- Chapter 3: Land Use Development
- Chapter 4: Consultation
- Chapter 5: Sustainability
- Chapter 6: Transport Technology
- Chapter 7: Development of Options
- Chapter 8: Transport Model
- Chapter 9: Assessment of Short-term Options
- Chapter 10: Assessment of Long-term Options
- Chapter 11: Details of Route Design and Construction Costs
- Chapter 12: Economic and Financial Performance
- Chapter 13: Summary and Recommendations
- Chapter 14: References.

The study terms of reference are summarised below, along with the approach taken and the section of the report which addresses each term:

- **Development of performance indices to assess potential improvements and monitor post-improvement progress against the economic, social and environmental goals that underlie public transport investment.**

  KBR have researched and devised seven key sustainability indicators to address this term of reference. The indicators cover economic, social and environmental goals (Chapter 5).

- **Identification of data needs to adequately inform public transport planning and decision making.**

  KBR have liaised with ACTION buses and PALM to collect sufficient patronage and census data to inform public transport planning. The bus data includes bus service information, revenues and market sector details. The required census data includes the journey to work data and forecasts at the same level to apply to future situations (Chapters 2 and 3).

- **Analysis of travel demand, behaviour and attitudes to public transport to determine the barriers to its use and the opportunities for strategic improvements.**

  Travel demand, behaviour and attitudes to public transport have been assessed using ACTION customer survey data collected in October 2002 (Chapter 2).

- **Identification of the likely range of patronage levels that the future public transport system should be designed to carry. The study will also recommend appropriate targets for public transport usage and system performance.**

  The transport model is used to estimate future demand for private car and public transport services. The model takes land use, employment and population assumptions and existing travel patterns to produce new demand forecasts which are then assigned to their respective highway and public transport networks. The model inputs and assumptions are described (Chapters 3 and 8) for current and future base cases and (Chapters 9 and 10) for the public transport options.

- **Specification of the desirable future public transport system in terms of characteristics, capacity and route structure.**

  A comprehensive description of route design and construction issues and costs iscontained in Chapter 11. The work includes a description of the route, including concept drawings, a description of vehicle requirements, station requirements and special structural changes required for the system to operate in Canberra. All of this has been costed and described in detail (Appendix D).

- **Assessment of existing and possible future public transport technologies to determine the best solution to Canberra's needs.**

  KBR have used their experience and involvement in public transport projects in Australia and other parts of the world to describe the latest developments in public transport. An assessment of their applicability to Canberra is included (Chapter 6).

- **Resolution of the role and characteristics of the inter-town sectors of the network and resolution of the undetermined segments of the inter-town route reservations.**

  This report has investigated and assessed the future role and characteristics of inter-town sections. In general the inter-town sections should be further developed as part of the process of urban consolidation and become transit oriented corridors.

- **Specific investigation of public transport options for Gungahlin.**

  The analysis of future public transport solutions have been undertaken for all selected corridors in Canberra and the report describes the impacts for Gungahlin in isolation to each of the other corridors (Chapter 9).

- **Investigation of land use changes to improve public transport viability.**

  The report describes the necessary changes to land use to improve public transport viability. The process will be that of urban consolidation and moving towards the 'smart city' concept (Chapter 3).

- **Identification of transport demand measures and other policy changes to improve public transport viability.**

  The study has assessed a range of short-term public transport options that were a combination of transport demand measures and public transport improvements. The transport demand measures include changing car park policies and changing traffic signals to favour public transport. The public transport options include transit priority at intersections and exclusive bus lanes. The longer term measures are exclusively aimed at developing a public transport corridor (Chapter 7).

- **Assessment of options for funding for capital expenditure and operating costs.**

  The study describes the economic and financial implications of the long term public transport corridor options based upon scheme benefits described in chapter eight and costs of the scheme identified in chapter eleven. A policy for funding is also provided (Chapter 12).

- **Development of an implementation strategy which identifies the priorities and staging of recommended improvements.**

  Chapter 12 also describes the recommended approach to funding and implementation. It describes the short and long term implementation approach.

2 Existing Situation

2.1 INTRODUCTION

Volume public transport in Canberra is currently exclusively bus based and operated by ACTION buses. The ACTION fleet consists of 347 buses operating 65 bus routes across the ACT region, with approximately 2,800 bus stops.

On a typical school term weekday, ACTION provide 2,424 different services. Approximately 67,000 passenger journeys are made each weekday (Parsons Brinckerhoff, 2002). Assuming that each bus user typically makes one return journey per day, approximately 30,000 people use ACTION buses everyday, which is approximately 10% of the ACT population. For journey to work trips, based on the 2001 Census, 6% were by public transport in Canberra, compared to approximately 20% in Sydney and 14% in Melbourne.

This study addresses the declining mode share for public transport at a time of continuing population growth in Canberra. The population of Canberra (excluding Queanbeyan) was 322,000 in 2002 and is now forecast to rise to 389,000 by 2032, an increase of 67,000 (21%) people in 30 years (Demographic Unit, 2003, *ACT Population Projections*).

Over the same 30 year period the number of households is anticipated to rise by 37%, reflecting decreasing household sizes and a resultant increase in trips. Population growth is therefore a key determining factor for future growth in demand for public transport in Canberra.

The majority of the transport network analysis which has been undertaken for future public transport options in this report has been based on earlier slightly higher population growth projections whereby the population of the ACT would reach 390,000 to 400,000 by the year 2026 (six years earlier). However, a sensitivity analysis of the economic and financial results for the project has also been undertaken for this lower population growth rate.

2.2 RECENT CHANGES

There have been significant changes in public transport provision in Canberra over the past ten years. In 1997 Roger Graham & Associates were commissioned to review ACTION bus services. Their main findings and recommendations were:

- The philosophy of self-containment of commuter and other travel within centres has not been achieved;
- 30% potential bus patronage is probably lost with enforced transfers (overseas experience);
- Through routing at interchanges wherever feasible;

- Greater use of mini buses/separate routes for the elderly;
- Zone fare system;
- More signage and information at stops;
- Relocation of Belconnen and Tuggeranong Interchanges;
- Redesign of Woden and Civic Interchanges;
- Review of school bus service provision and funding arrangements;
- Review current bus scheduling work practices;
- More scope for timetable reviews when needed; and
- Design review for midi vs mini buses.

This study has considered each of these aspects with the assistance of Mr Richard Filewood of KLA Consultants and reported within sub-headings below.

2.2.1 Network design

Graham recommended through routing of services as an alternative to interchange feeder services and separate trunk services. Through routing is now an important feature of the ACTION bus network in the North-West Belconnen and South-East Tuggeranong areas.

Route design

Secondary routes continue to operate in suburban enclaves providing 2nd tier services to local shopping centres.

As recommended by Graham, daytime and night-time routes now follow the same network pattern and route numbers.

Airport services

Graham recommended an airport service. A regular passenger service from the City to the Airport was attempted by ACTION but abandoned through lack of patronage. A private operator now provides a limited stop contracted service to Canberra Airport.

Tourist Services

Graham recommended tourist services. Most tourist attractions are now serviced by ACTION's regular network. Tourist only services, i.e. to Black Mountain and the Aquarium, are not commercially sustainable and do not operate.

The network is now under constant review as recommended.

2.2.2 Fares

Following the Graham Report, ACTION introduced a time-based zonal ticketing system.

A recent Government initiative abandoned zone-based ticketing and returned ACTION to a flat fare system in an attempt to improve patronage.

2.2.3 Infrastructure

Responsibility for infrastructure now rests with the ACT Department of Urban Services (DUS). Interchanges are owned by DUS but operated by ACTION. Bus stops, shelters, terminal facilities and street furniture are provided by DUS through centralised funding arrangements.

The City interchange has, over the last 4 years, undergone major upgrading to improve its aesthetics and to enhance the environment for the benefit of retailers.

Whilst improving the 'useability' of interchanges, widespread criticism has been levelled at the choice of shelter selected by DUS for the City Interchange. These shelters were neither selected nor funded by ACTION.

The Belconnen Interchange has been under detailed review for some four years, as has the Woden Interchange for 2–3 years. In both cases these interchange reviews are part of wider Town Centre redevelopment studies, hence the substantial project lead-times. No final outcomes are yet established, however ACTION is supporting redevelopment models which:

- place the interchanges as close as possible to shopping precincts,
- provide ready 'at grade' pedestrian access,
- improve safety and security for passengers,
- improve the aesthetic appeal of public transport, and
- improve modal transfer (park & ride, kiss & ride, cycle storage as well as pedestrian access).

Tuggeranong Interchange is not under review at this time.

2.2.4 Marketing

Following the Graham Report, ACTION has introduced a range of effective marketing strategies including:

- an extended hours call centre;
- a 13 17 10 number for all customer information and inquiries;
- effective network information at Interchanges;
- en-route passenger information;
- display cases at bus stops;
- bus stop specific timetable information en-route;
- print and electronic media advertising;
- timetable and route map brochures;
- introduction of electronic destination signs and more relevant signage; and
- special event services.

Planned improvements in the future include GPS tracking of buses and real time passenger information at key nodal points.

2.2.5 Timetabling

Post Graham there have been major improvements to timetabling, rostering and scheduling.

ACTION upgrades, on an on-going basis, its HASTUS computerised rostering and scheduling tool.

A variety of improvements in driver work practices have improved the productivity of drivers and reduced dead running.

2.2.6 School bus services

ACTION employs a dedicated Schools Officer in the Service Planning section to ensure the effective planning of school special services.

There is a significant expectation in the ACT community that ACTION will provide a robust, dedicated school bus network, for children. Some 80 ACTION buses are dedicated in the morning and afternoon school peak periods to providing school bus services.

The Department of Urban Services chairs the School Transport Advisory Committee upon which ACTION is a permanent member.

2.2.7 Enterprise bargaining agreements (EBAs)

In the last new EBAs ACTION achieved significant improvements in driver productivity and now, with approximately 92% driver productivity being achieved, this is considered close to, if not at, best practice.

A further EBA is to be negotiated in the immediate future and a range of business improvements is again identified for negotiation.

2.2.8 Management structure and commerciality

Since the Graham Report ACTION has made major changes to its management structure. These changes have streamlined the organisation structure, reduced costs and improved managerial accountability.

In 2002 ACTION (the ACT Internal Omnibus Network), an agency of the Department of Urban Services become a Statutory Authority. It now operates under a commercially focused board and which is accountable directly to the Minister.

2.2.9 Use of mini-buses/smaller buses

High frequency mini bus services for local area routes have not been introduced and are not planned for introduction.

It is noteworthy that since the Graham Report national accessibility standards for Public Transport were introduced in August 2002, under the Disability Discrimination Act 1992. These standards require bus operators to achieve 100% wheelchair accessibility of buses over the next 20 years in the following stages:

- 25% buses accessible by December 2007;
- 55% by December 2012;

- 80% by December 2017; and
- 100% by December 2022.

At this stage low floor technology to accommodate wheelchairs is not available on mini buses. At the time of the Graham Report mini buses such as the 'Nepean Nipper' operated by Westbus used a chassis similar to the Mercedes Benz 812. These buses had three steep steps which passengers had to negotiate to access the bus. Such bus design is no longer permissible under DDA standards.

In addition to full size buses, ACTION operates the following:

- 25 Dennis Dart MIDI buses
- 16 MINI buses.

The Dennis Dart Midi buses are fully integrated into, and form part of, the ACTION regular passenger service fleet.

These buses are wheelchair accessible and provide accessible services (particularly the designated wheelchair accessible bus routes).

The 16 mini buses operated by ACTION do not form part of the regular passenger service network. ACTION is the beneficiary of a separate 7-year commercial contract for the provision of dedicated accessible services for people with disabilities, in particular, the provision of school transport services for children with disabilities.

These buses are wheelchair accessible and the service also provides an attendant/carer in addition to the driver. Separate staff are employed for the provision of these contracted accessible services for people with disabilities.

There are no proposals to increase the number of smaller buses in the ACTION fleet.

The ACTION fleet of 347 buses operates on a target of 10% spare bus ratio. This is best practice and is only achievable through full integration of all vehicle types (regular bus, midi-bus and articulated bus).

It is appreciated that regular-sized buses are under-utilised at night time, however it is not possible to integrate further midi/mini into the ACTION fleet without increasing fleet size to accommodate midi/mini buses for the following reasons:

- The demand for larger buses during peak periods:
- The extent of through running in the network, that is through-routed suburban services contributing to high frequency on the inter-town trunk routes, where demand is heavy.
- The high percentage of heavily loaded school services that operate directly before and after regular passenger services.

2.3 EXISTING BUS ROUTES

2.3.1 Route analysis

A detailed assessment of the current nature of ACTION's bus operation in Canberra has been compiled to provide an up to date description of the current operations of the

ACTION route network, typical bus service frequencies at different times of the day and current patronage levels for full fare (adult), school and concession travellers.

This analysis has been based on information contained in ACTION's HASTUS computerised rostering and scheduling database.

The current typical bus service frequencies on the trunk corridor routes (18 sections) and local feeder services are illustrated by Figures 2.1 to 2.7 for five different periods of the day on weekdays and Saturdays and Sundays.

The detailed trunk corridor route analysis is also included as Appendix A to this report and shows:

- route linkages;
- bus routes servicing each link;
- journey time (in minutes per link);
- average speed per link;
- direction of service (a and b representing outbound and inbound);
- period of the day by time (AM, AM Peak, day, PM Peak, PM), and
- weekday, Saturday and Sunday services.

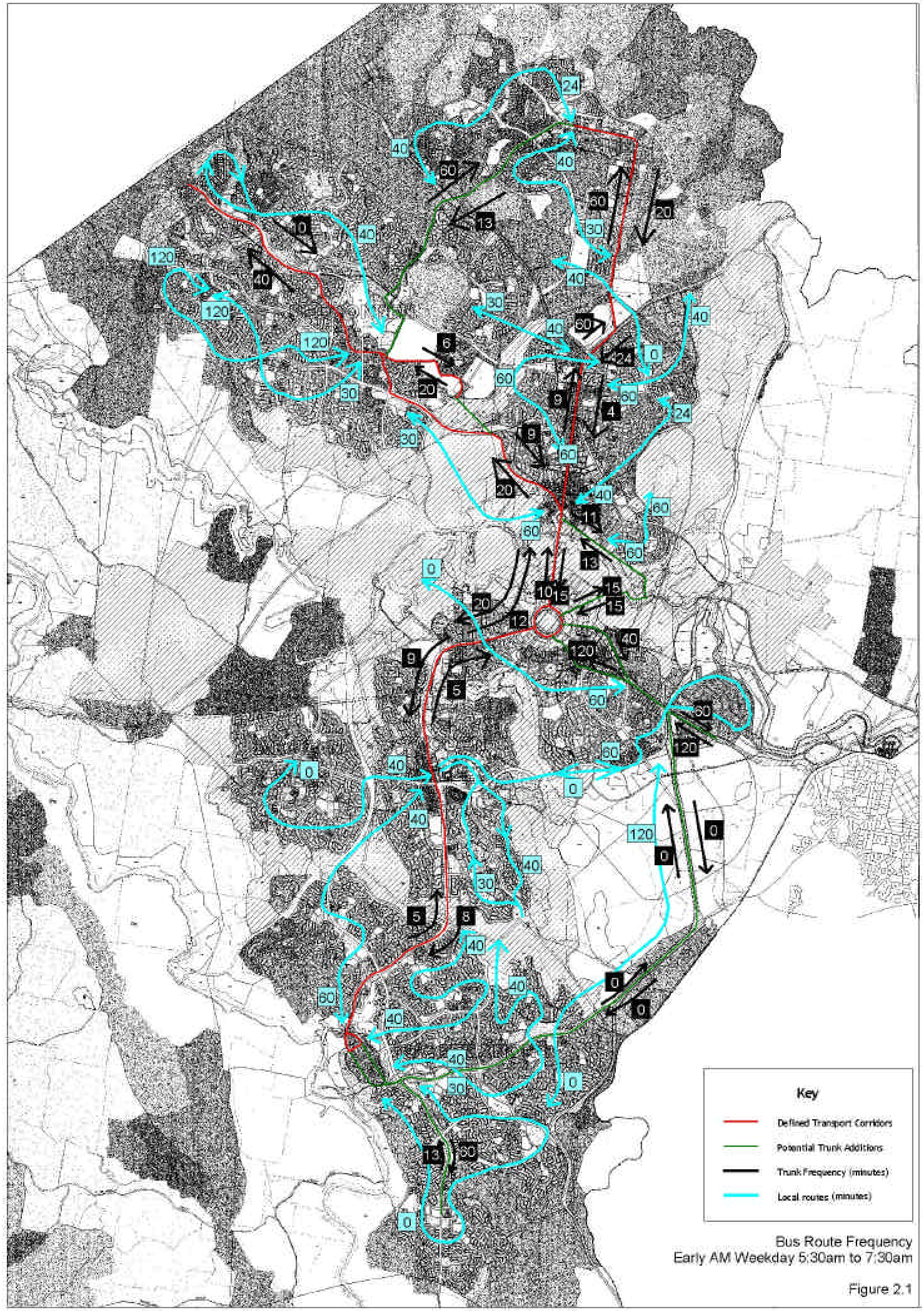
2.3.2 Patronage

A detailed description of current ACTION patronage has been obtained by interrogating ACTION's ticketing database; which provides details of ACTION patronage for every month between January and October 2002 (Figures 2.8 to 2.15).

Total monthly patronage on ACTION buses varied from approximately 843,000 in January 2002 to approximately 1,607,000 in May 2002. The average monthly patronage for the 10 months from January to October 2002 was approximately 1,340,000 and is heavily influenced by school terms, when school passenger demand represents 41–43% of all passenger journeys.

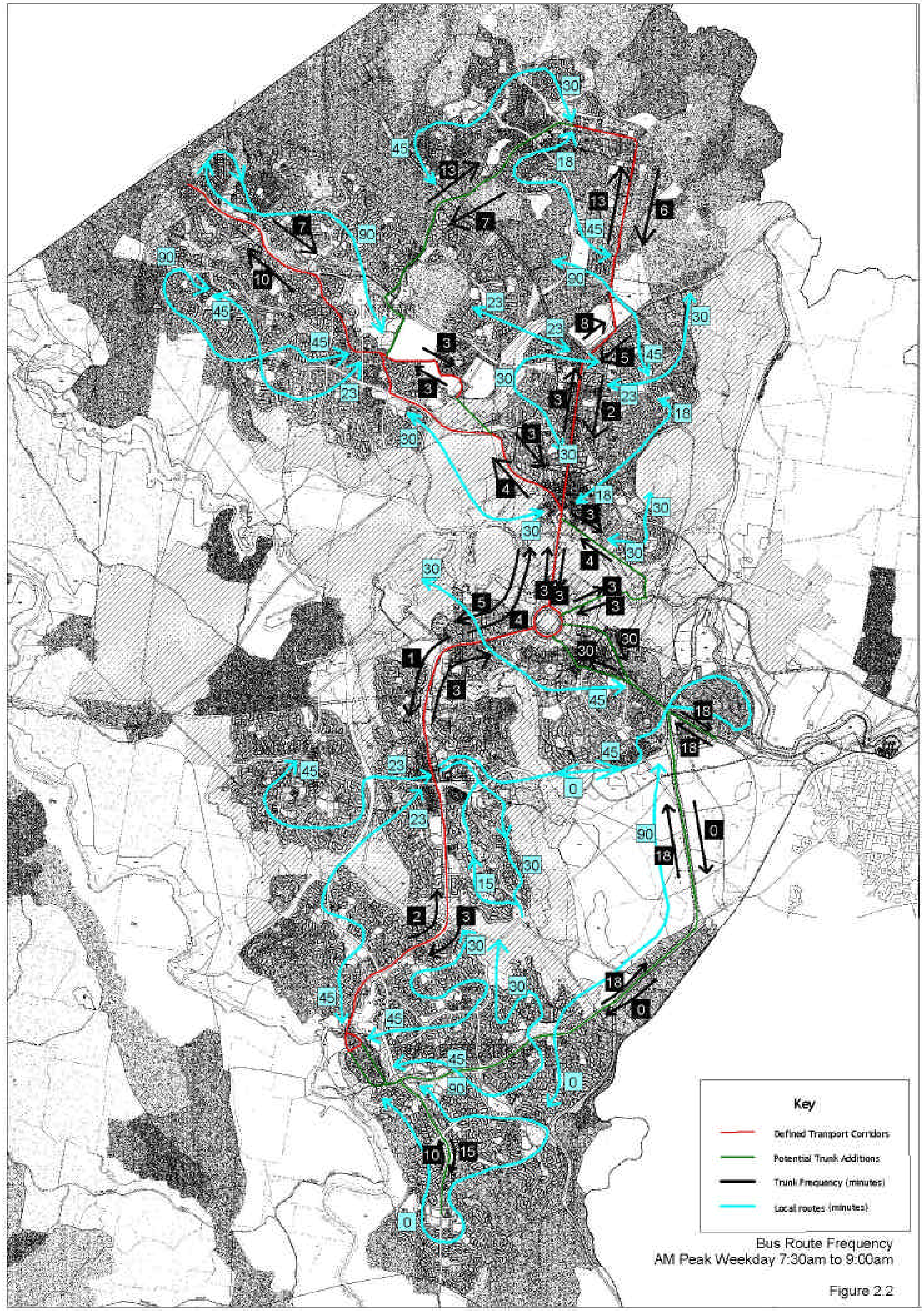
Approximately 1,250,000 passenger trips are made during the weekdays and 100,000 passenger trips are made during the weekends of an average month. The busiest time of day, based upon monthly passenger data is the PM peak period, which has 35% of day time demand during a 3½ hour period. The inter-peak period also has 35% of demand, but this is over a period of 6 hours. By comparison, the AM peak has 20% of demand over a 1½ hour period and the early morning and evening periods have 5% of demand each.

The PM peak is busier overall as it attracts passengers whose journey began in both the morning peak and throughout the day but the peak of passenger activity is actually more concentrated during the 1½ hour AM peak.



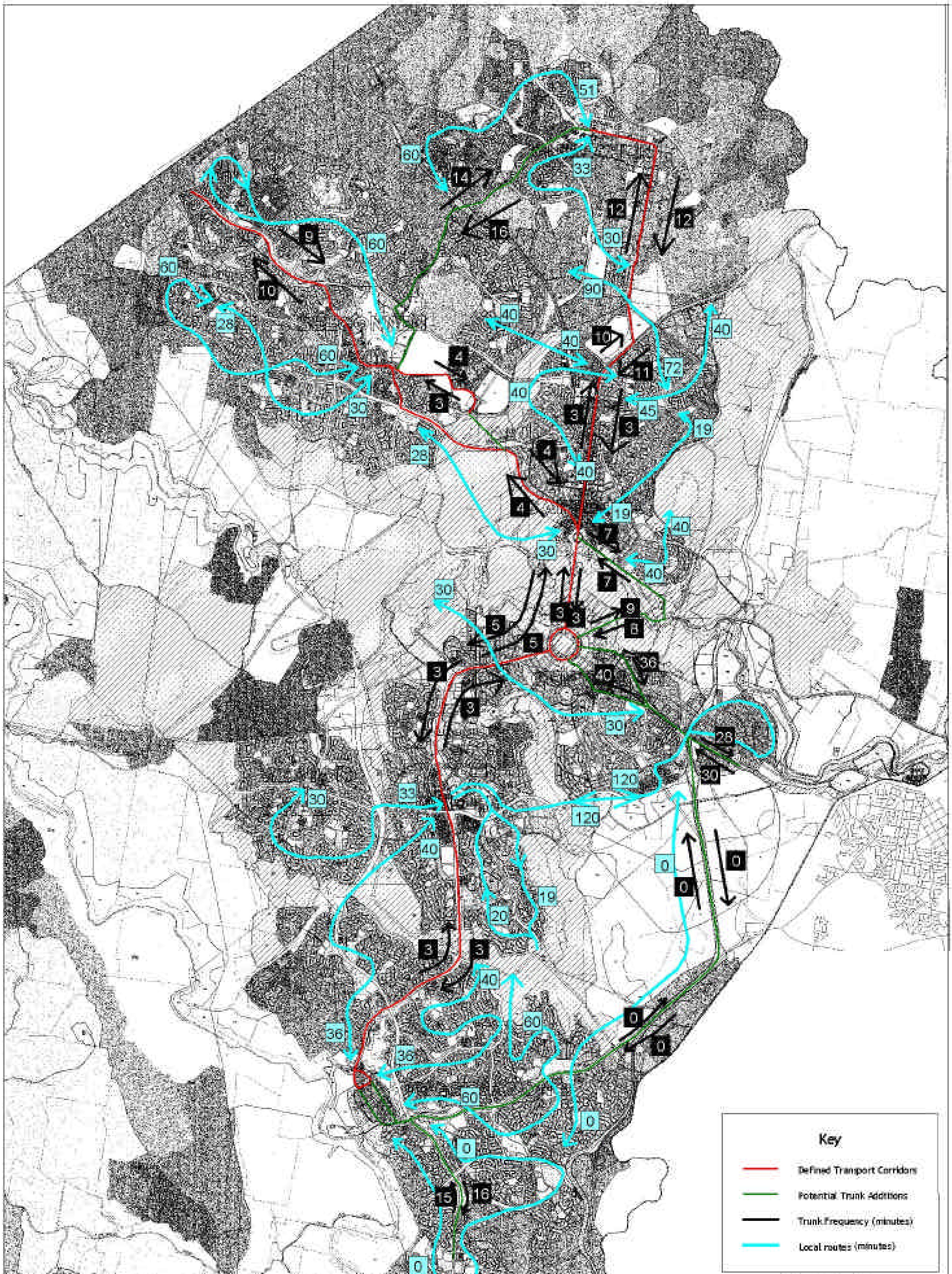
Bus Route Frequency
Early AM Weekday 5:30am to 7:30am

Figure 2.1



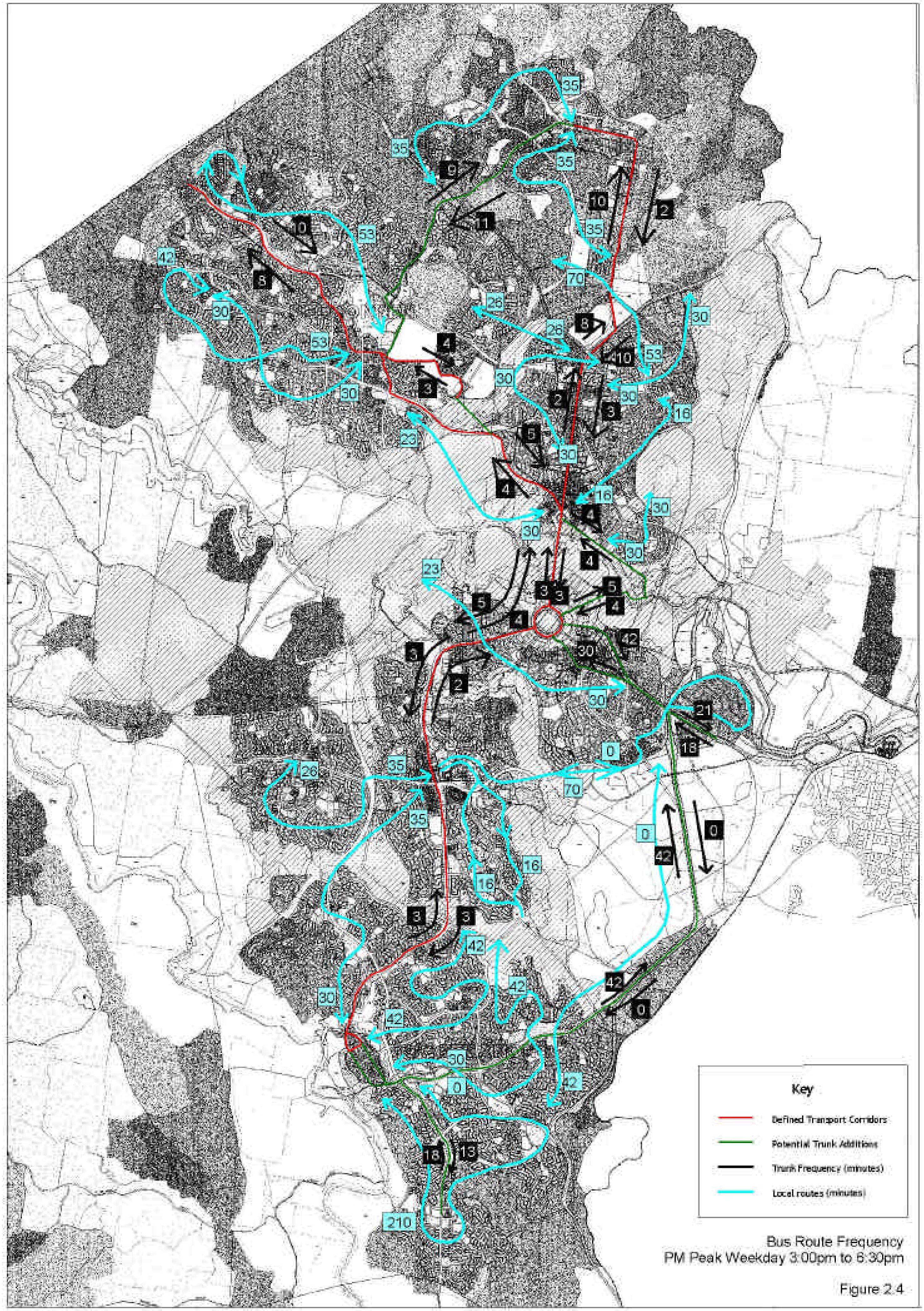
Bus Route Frequency
AM Peak Weekday 7:30am to 9:00am

Figure 2.2



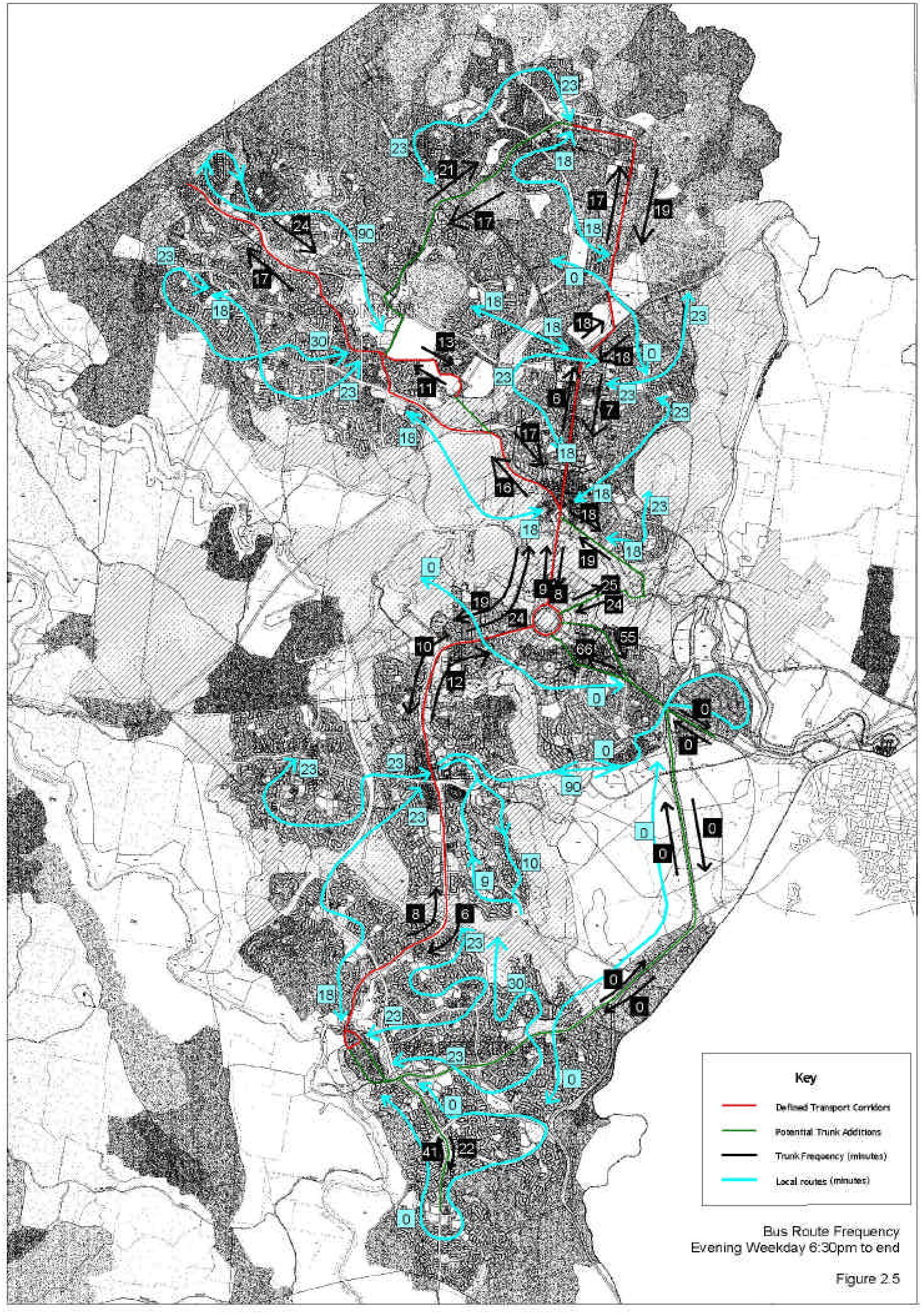
Bus Route Frequency
Daytime Weekday 9.00am to 3:00pm

Figure 2.3



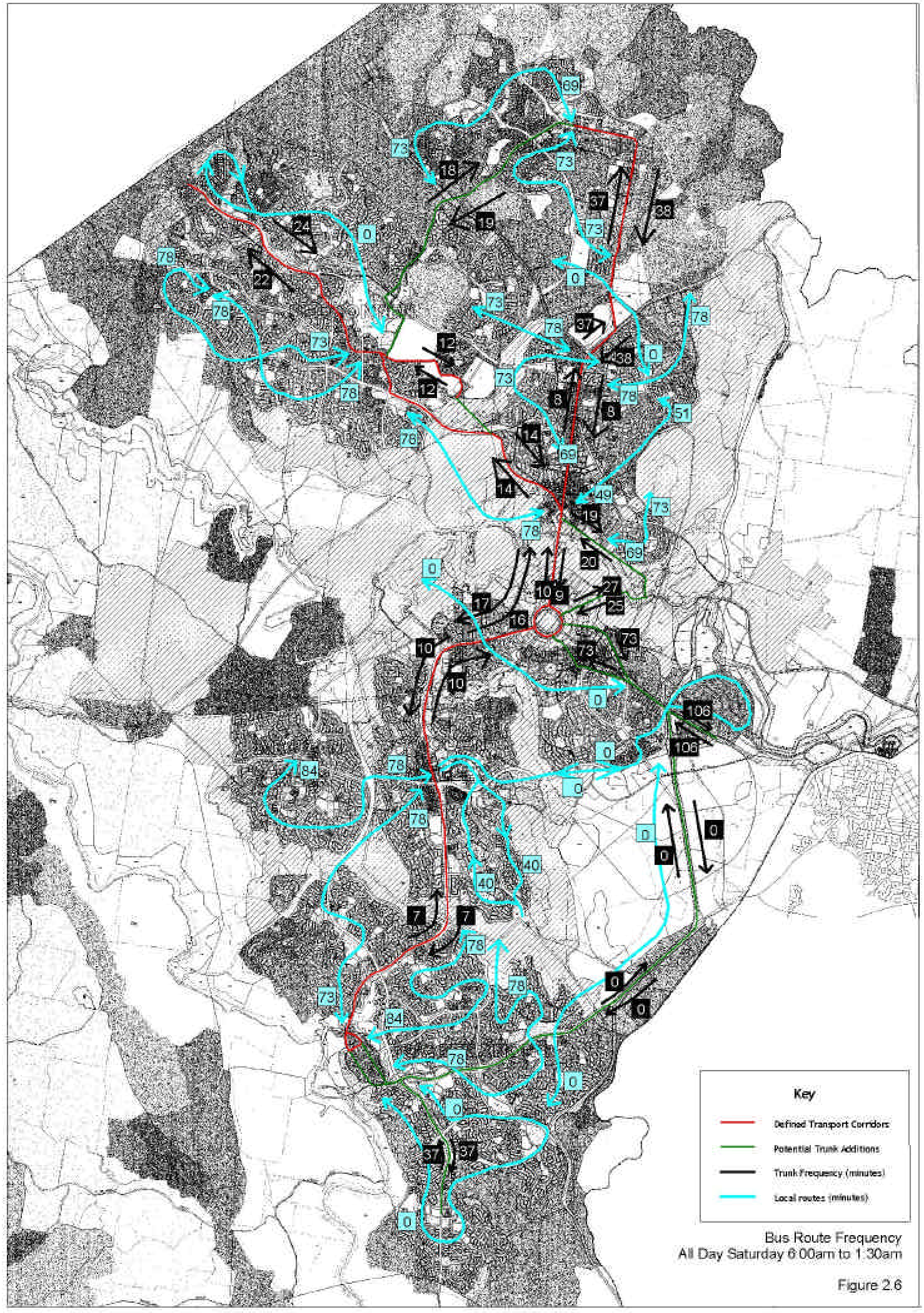
Bus Route Frequency
PM Peak Weekday 3:00pm to 6:30pm

Figure 2.4



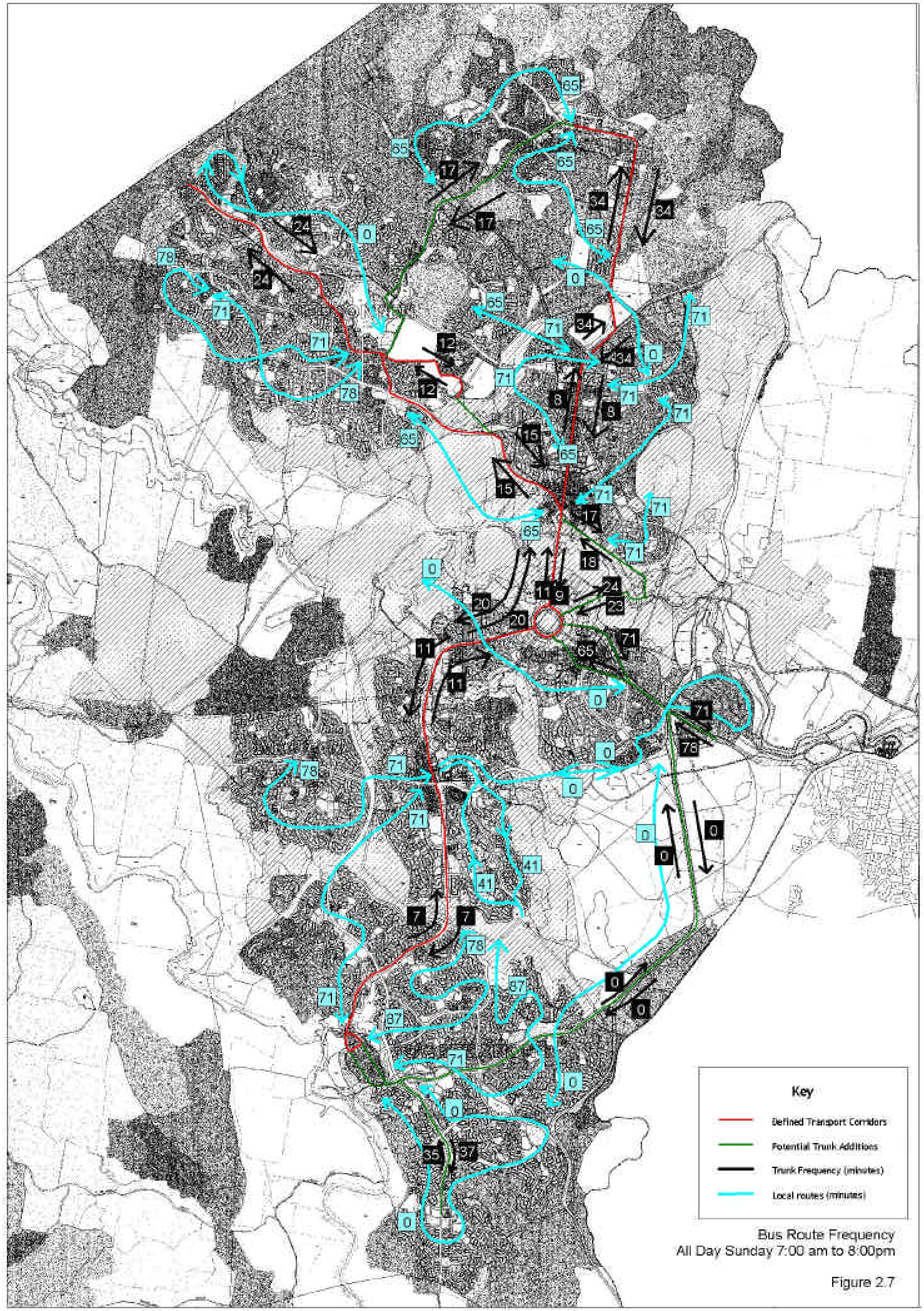
Bus Route Frequency
Evening Weekday 6:30pm to end

Figure 2.5



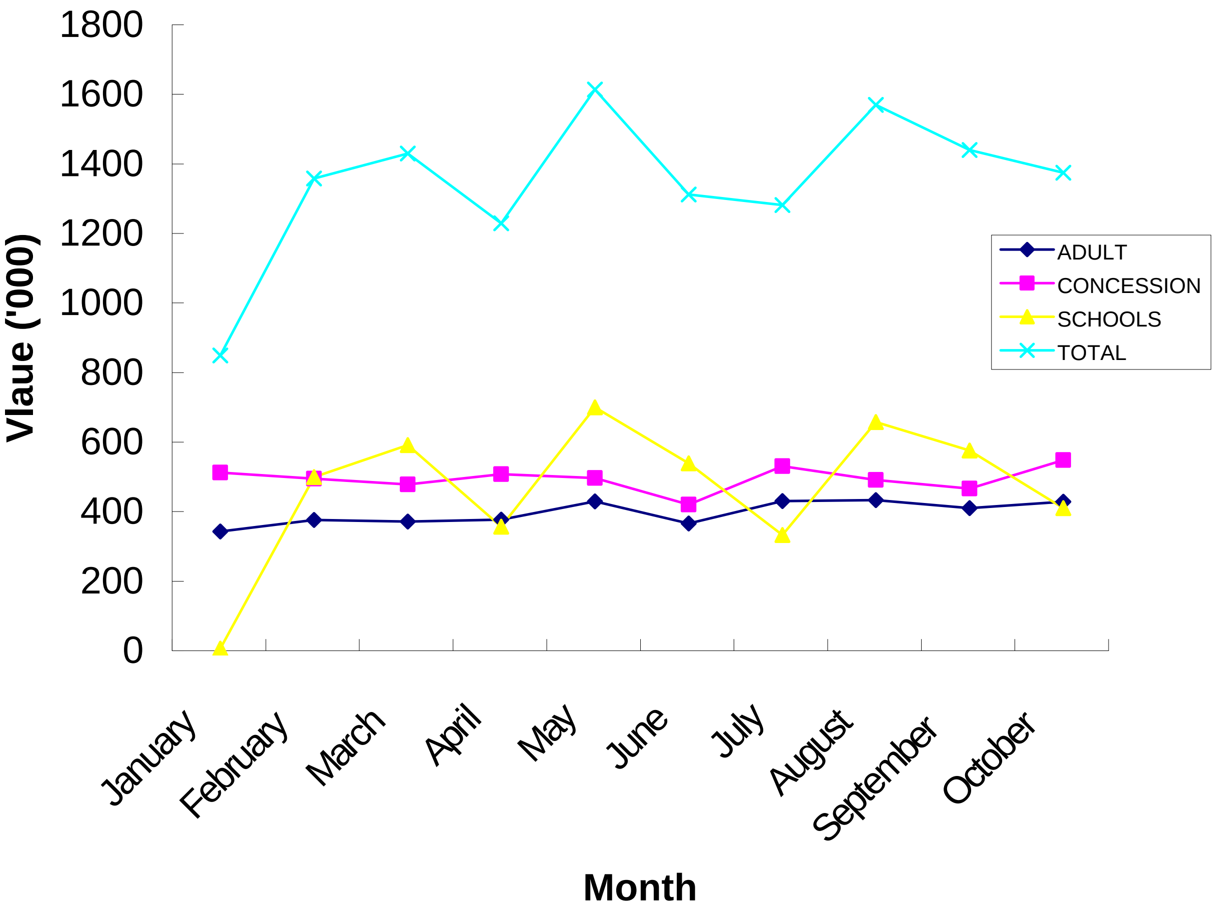
Bus Route Frequency
All Day Saturday 6:00am to 1:30am

Figure 2.6



Bus Route Frequency
All Day Sunday 7:00 am to 8:00pm

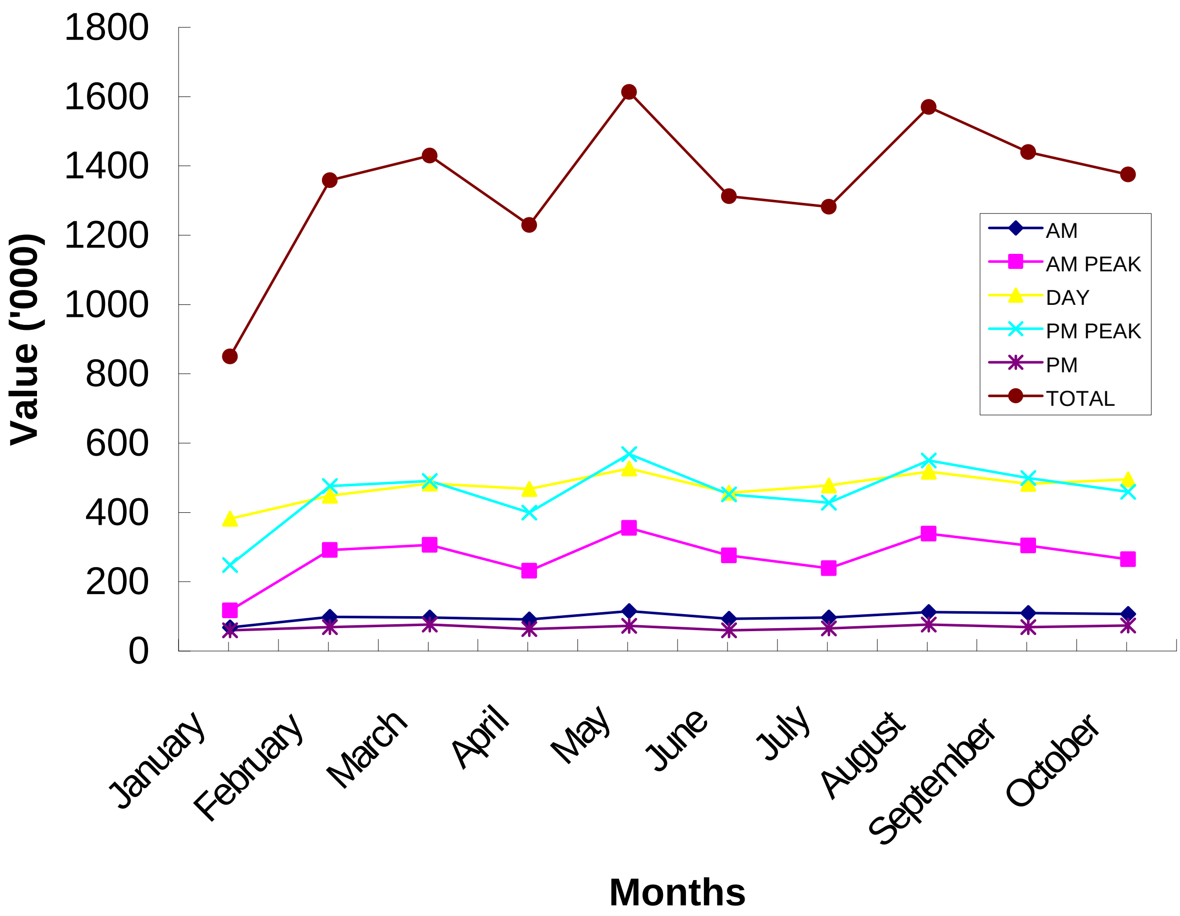
Figure 2.7



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	337191	506075	3	843269
February	370190	488307	493597	1352094
March	365796	471846	585720	1423362
April	370499	501441	350853	1222793
May	422884	490144	694281	1607309
June	359745	413825	532461	1306031
July	424032	524354	327031	1275417
August	426609	485122	651799	1563530
September	403899	460051	569968	1433918
October	422785	542217	403650	1368652

Data

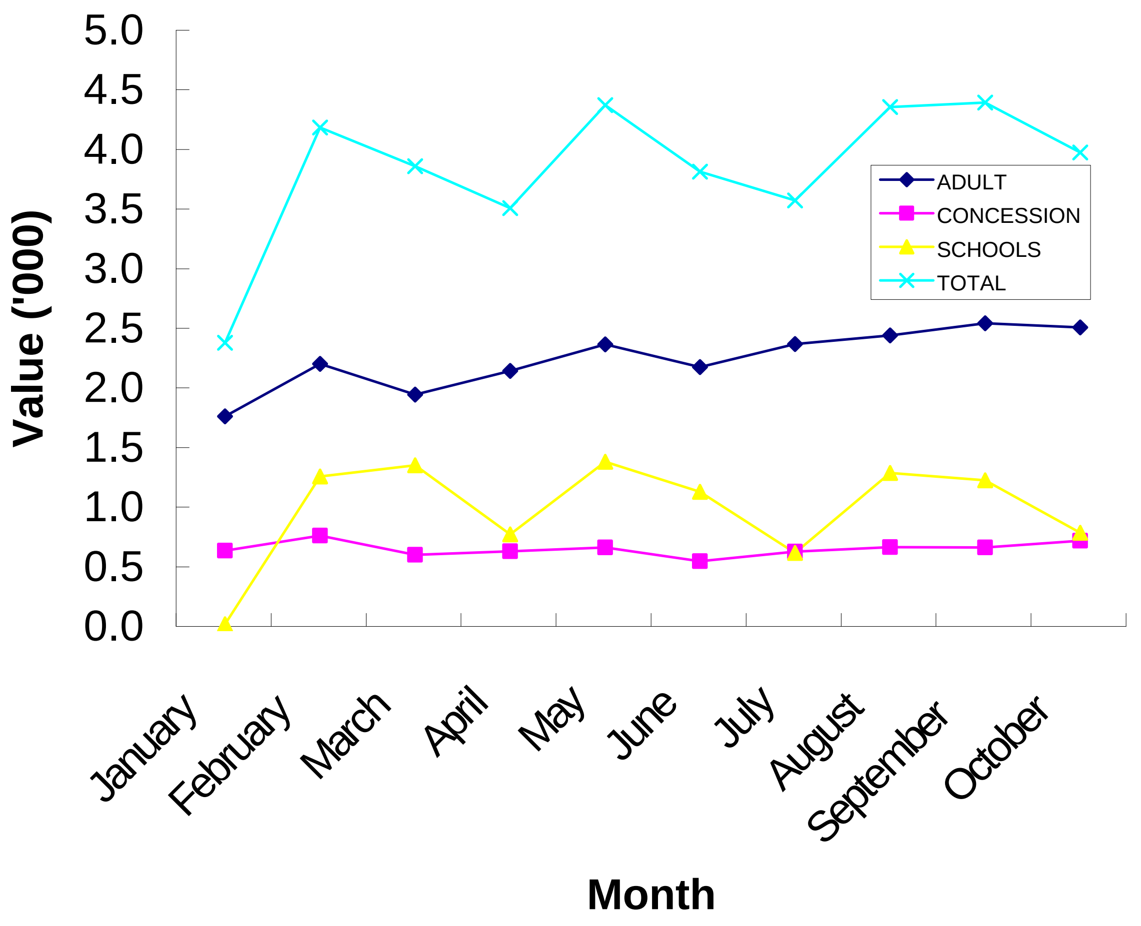
Figure 2.8 Total Monthly Patronage by Travel Class 2002



	AM	AM PEAK	DAY	PM PEAK	PM	TOTAL
January	61405	110430	375818	242068	53548	843269
February	92076	284786	442502	470226	62504	1352094
March	90699	300060	477043	484977	70583	1423362
April	85013	225438	461776	393538	57028	1222793
May	109136	349275	520260	562246	66392	1607309
June	86663	269088	450435	446052	53793	1306031
July	90644	232792	471475	421617	58889	1275417
August	106170	332514	511107	543239	70500	1563530
September	102978	298245	476593	493073	63029	1433918
October	100554	258676	488944	452832	67646	1368652

Data

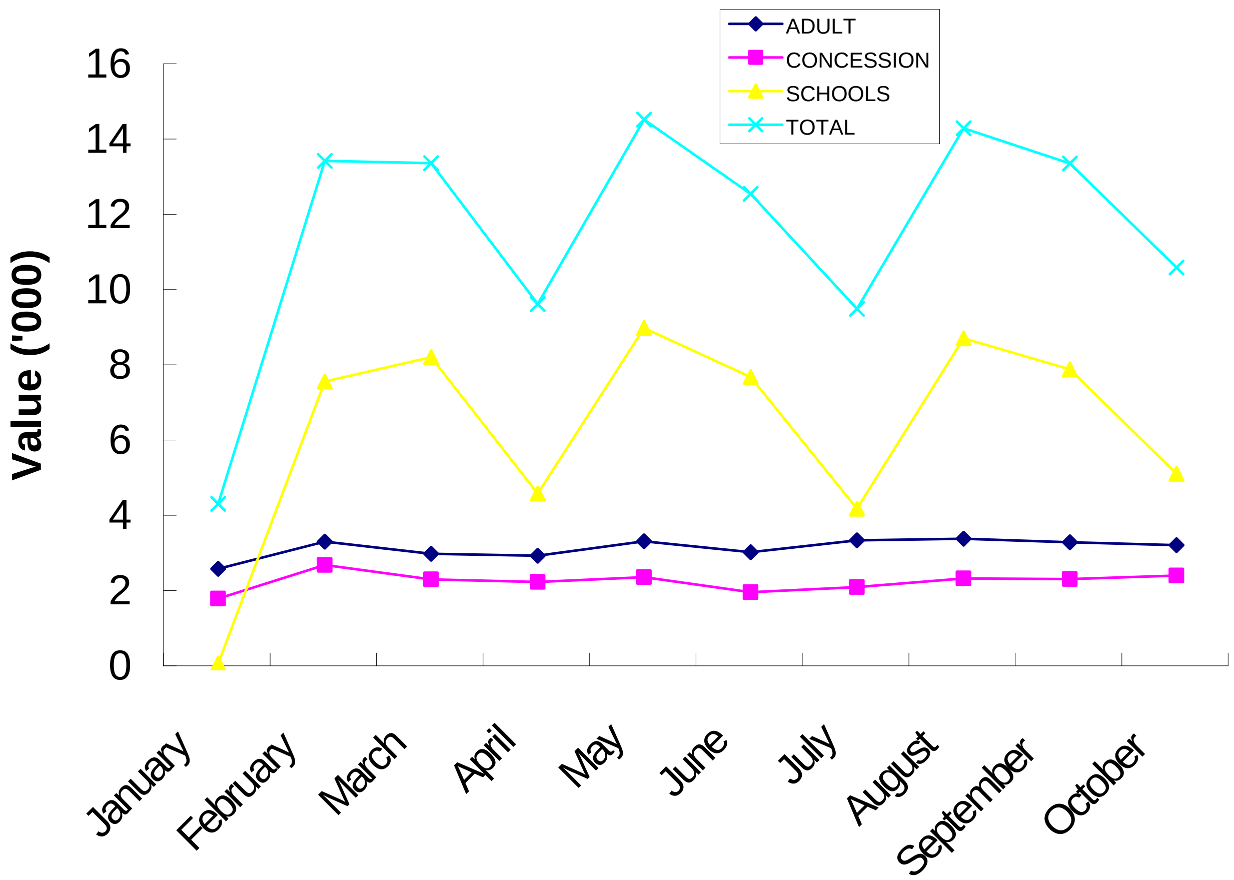
Figure 2.9 Total Monthly Patronage by Time Period 2002



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	1744.0	617.7	0.0	2361.7
February	2183.3	741.7	1240.1	4165.1
March	1926.1	583.0	1332.0	3841.1
April	2125.0	612.1	753.9	3491.0
May	2346.4	645.0	1363.4	4354.9
June	2156.7	529.2	1110.1	3796.0
July	2350.0	607.8	597.5	3555.3
August	2422.1	645.7	1270.0	4337.8
September	2524.4	643.5	1207.9	4375.7
October	2488.1	701.0	766.8	3955.9

Data

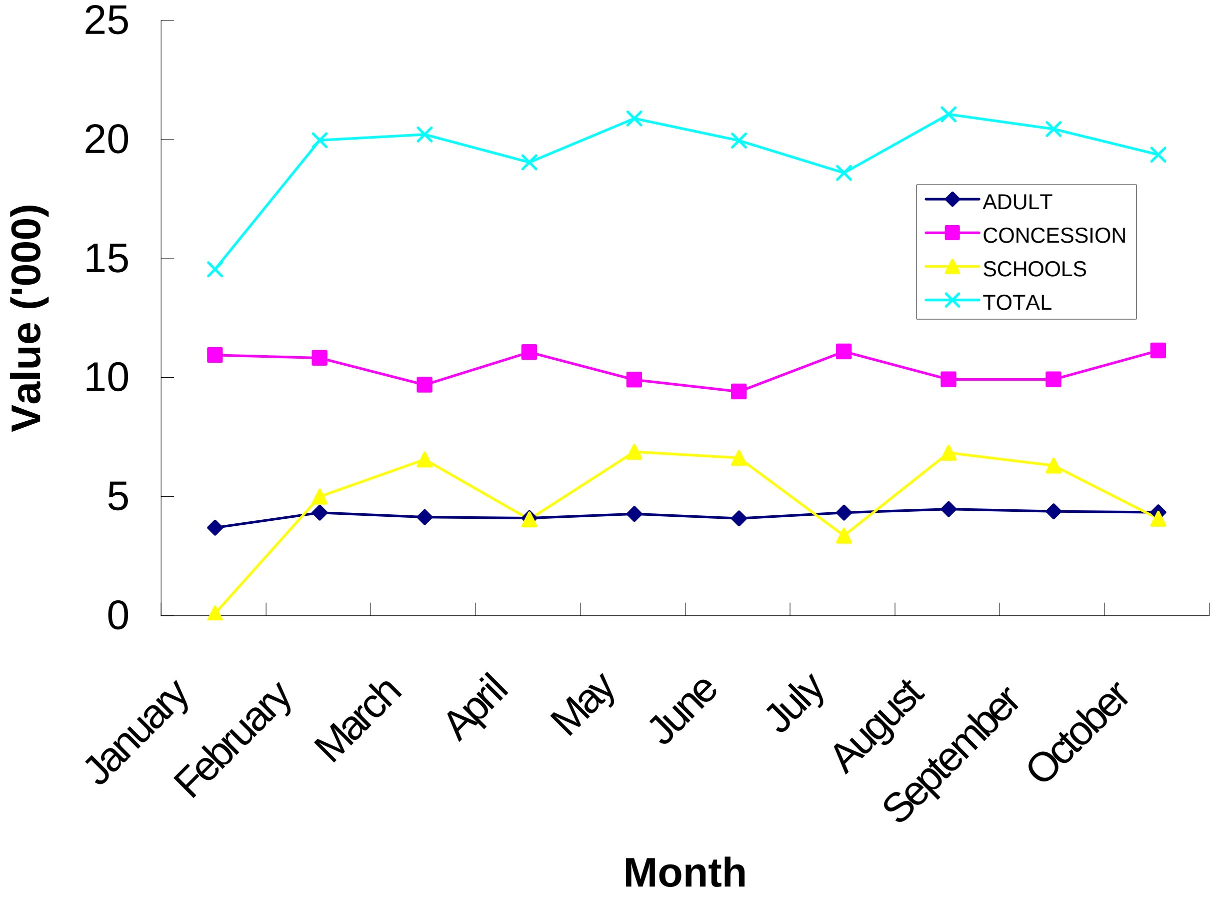
Figure 2.10 Typical Weekday Early AM Patronage 2002



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	2515.4	1731.9	0.0	4247.3
February	3240.6	2619.8	7499.9	13360.2
March	2917.9	2240.5	8147.6	13306.0
April	2871.2	2168.8	4520.0	9559.9
May	3247.5	2298.2	8916.8	14462.5
June	2963.3	1902.0	7616.2	12481.4
July	3274.7	2035.7	4118.3	9428.7
August	3316.5	2261.2	8649.3	14226.9
September	3223.8	2248.4	7817.9	13290.1
October	3144.8	2339.4	5047.2	10531.4

Data

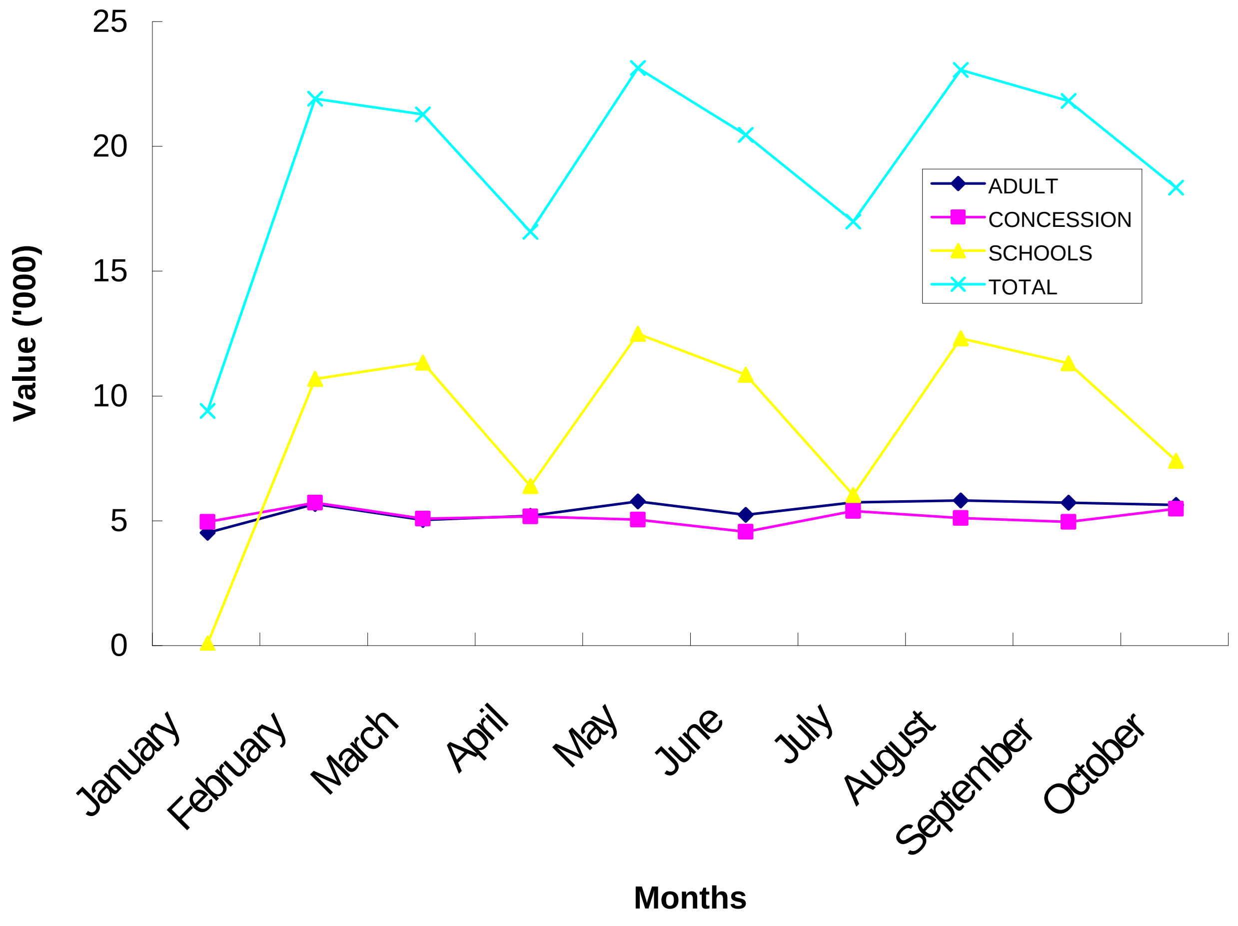
Figure 2.11 Typical Weekday AM PEAK Patronage 2002



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	3603.5	10851.0	0.1	14454.5
February	4238.8	10729.1	4912.0	19879.9
March	4050.2	9597.6	6469.0	20116.8
April	4012.3	10979.2	3954.0	18945.5
May	4181.2	9821.7	6790.7	20793.5
June	3999.7	9325.4	6531.6	19856.7
July	4240.2	11003.4	3267.0	18510.6
August	4379.0	9835.9	6755.7	20970.7
September	4287.7	9836.4	6216.8	20340.9
October	4248.8	11036.6	3979.3	19264.7

Data

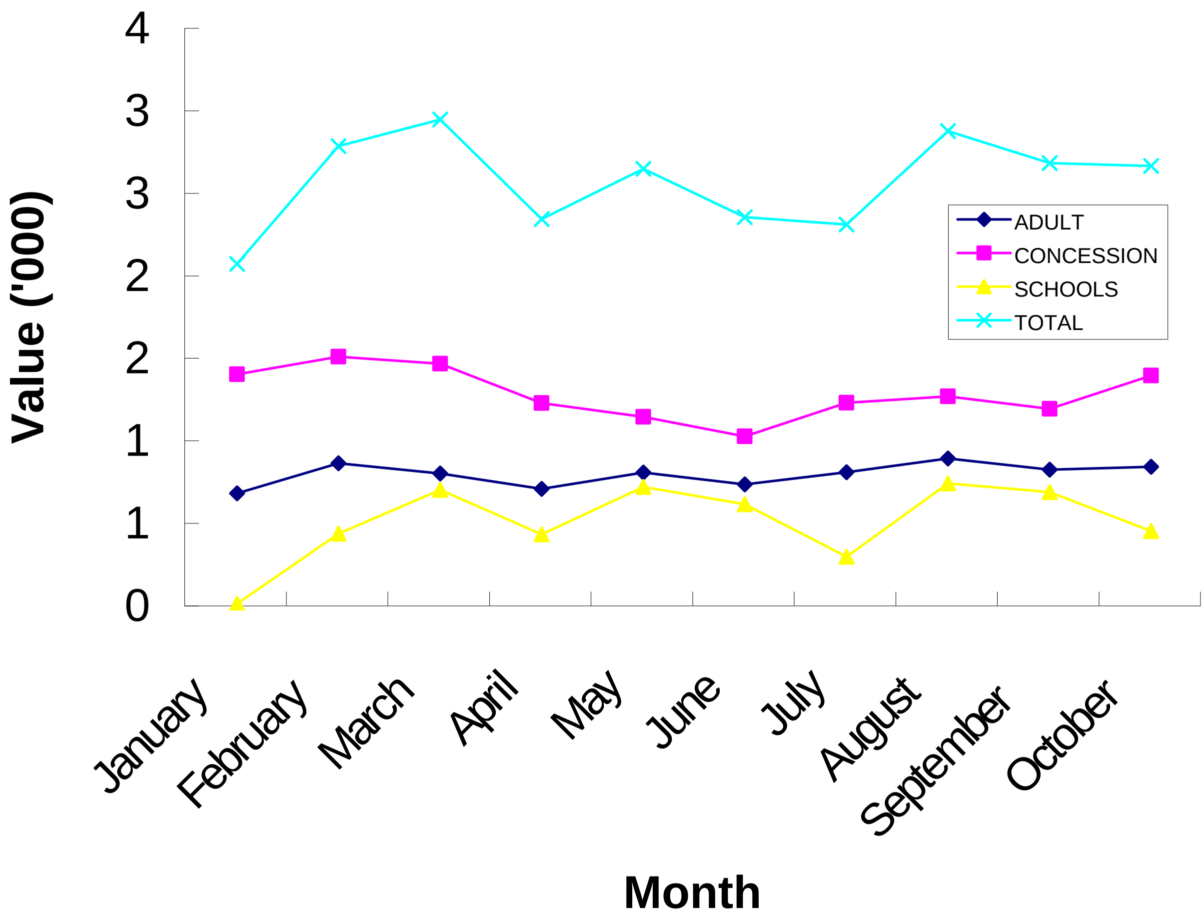
Figure 2.12 Typical Weekday Inter-Peak Patronage 2002



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	4436.8	4873.5	0.0	9310.3
February	5581.0	5643.7	10603.0	21827.6
March	4948.4	4998.8	11252.2	21199.4
April	5115.9	5081.9	6299.6	16497.5
May	5694.3	4954.4	12407.8	23056.5
June	5145.5	4471.2	10762.5	20379.3
July	5647.8	5303.4	5951.5	16902.7
August	5731.8	5026.0	12223.5	22981.2
September	5637.8	4868.9	11221.8	21728.5
October	5550.0	5394.5	7316.3	18260.8

Data

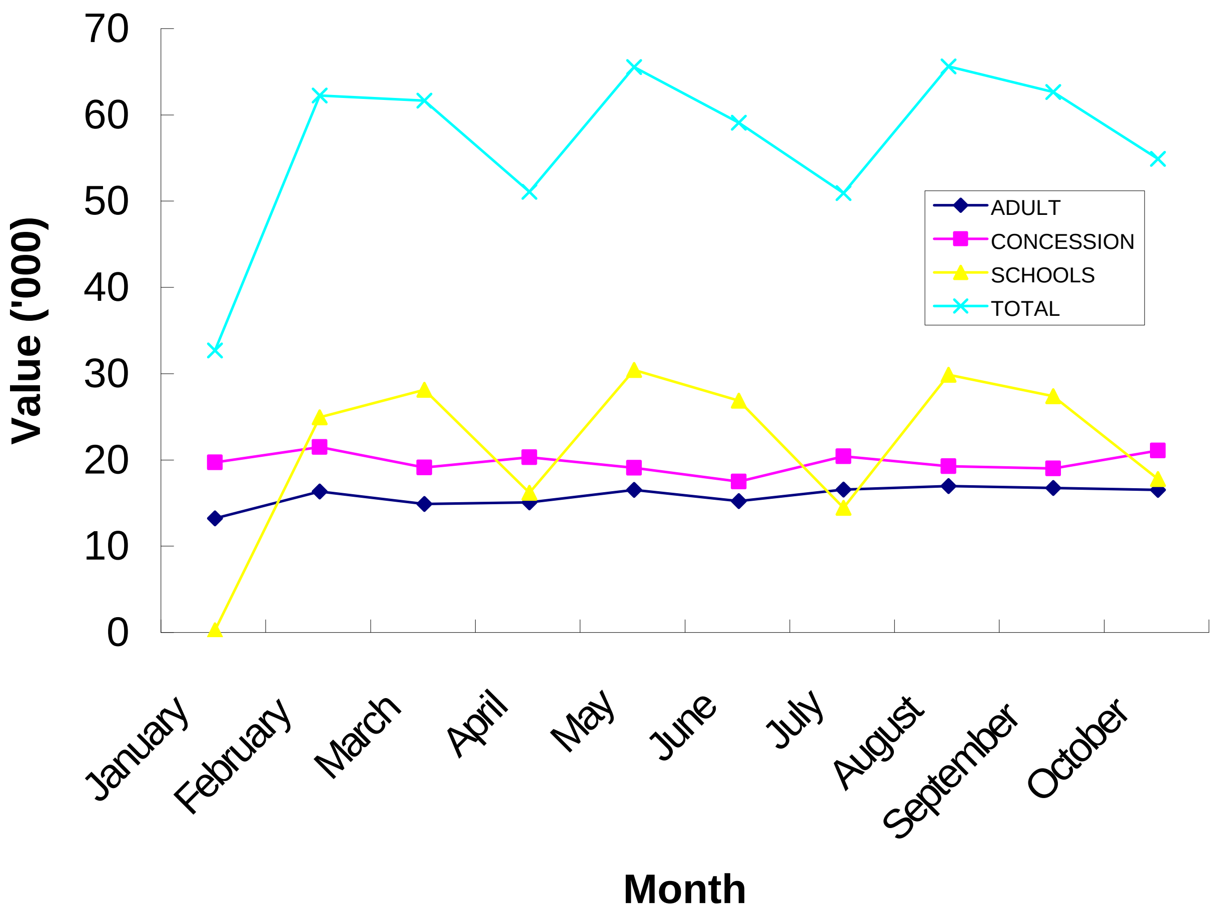
Figure 2.13 Typical Weekday PM PEAK Patronage 2002



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	669.2	1390.3	0.0	2059.5
February	851.5	1496.5	425.0	2773.0
March	789.3	1454.0	690.6	2933.8
April	695.5	1215.7	420.3	2331.6
May	795.3	1132.4	707.4	2635.2
June	724.2	1014.9	602.8	2341.8
July	796.3	1217.2	284.3	2297.8
August	880.4	1255.6	728.7	2864.7
September	812.0	1180.4	677.0	2669.3
October	829.2	1383.0	440.4	2652.6

Data

Figure 2.14 Typical Weekday Evening Patronage 20



	ADULT	CONCESSION	SCHOOLS	TOTAL
January	12968.9	19464.4	0.1	32433.4
February	16095.2	21230.7	24679.9	62005.8
March	14631.8	18873.8	27891.4	61397.1
April	14820.0	20057.6	15947.9	50825.5
May	16264.8	18851.7	30186.1	65302.6
June	14989.4	17242.7	26623.1	58855.1
July	16308.9	20167.5	14218.7	50695.1
August	16729.8	19024.4	29627.2	65381.4
September	16485.7	18777.6	27141.3	62404.6
October	16261.0	20854.5	17550.0	54665.5

Data

Figure 2.15 Total Typical Weekday Patronage 2002

2.3.3 Fare types

There are many ticket types available for passengers to board an ACTION bus, but they can all either be described as either an adult fare, a concession fare or a school fare. During the course of a weekday, adult fares and school fares each represent 30% of the daily total whilst concessions represent 40% of the daily total.

For a weekday on an average month, during the early morning and morning peak time periods (5.30–9.00 am), 40% of tickets are adults fares, 20% are concessions and 40% are school fares. During the inter-peak period (9.00 am–3.00 pm) on an average month, the proportion of concession fares rises to approximately 60%, with 20% each for adult fares and school fares. During the evening peak and evening periods (3.00 pm–8.00 pm) on an average month, adult fares comprise 30% of the total, concessions 30% of the total and school fares 40% of the total.

Comparison with State Transit and private buses in Sydney shows that the situation in Canberra is somewhere between these two forms of operator. In Sydney State Transit attract almost half of their passengers paying full fare compared to only 19% paying full fare on the privately operated network (Transport Data Centre, 2000). Of the remaining fares, on State Transit, 31% of trips are concession fares and 19% are school fares compared with 22% concession fares and 43% school fares on the privately operated buses.

2.4 LEVELS OF SERVICE

There are two main measurements of service level when describing public transport. Firstly, and most importantly given the way customers value their time, is journey frequency. The other main measurement is journey time. A frequent bus service reduces waiting time and anxiety, which is generally valued much more highly by passengers than on-board journey time. However, circuitous routes do begin to frustrate passengers on board. Another level of service issue is the cost of travel. Whilst the fare inevitably reflects the frequency and journey time, passengers tend to object to paying too much for a service that does not justify its perceived cost.

2.4.1 Bus frequency

The current route frequencies per day on weekdays and weekends (August 2002 timetable) on all ACTION public bus routes are listed in Table 2.1.

Ideal bus frequencies for passengers should be a minimum of four buses per hour and up to 12 buses per hour. At 12 buses per hour passengers treat the service as turn up and go; having the confidence not to worry whether they have missed a bus or not, as one will be along shortly. At four buses per hour, assuming random arrival times at the bus stop, passengers will wait for an average of 7.5 minutes to catch a bus which is the reasonable minimum level of service.

During 12 hours of operation, four buses per hour equates to 48 buses. In Canberra, only one route (Route 38) provides this many buses during a weekday

Table 2.1 ACTION Bus route frequencies, August 2002

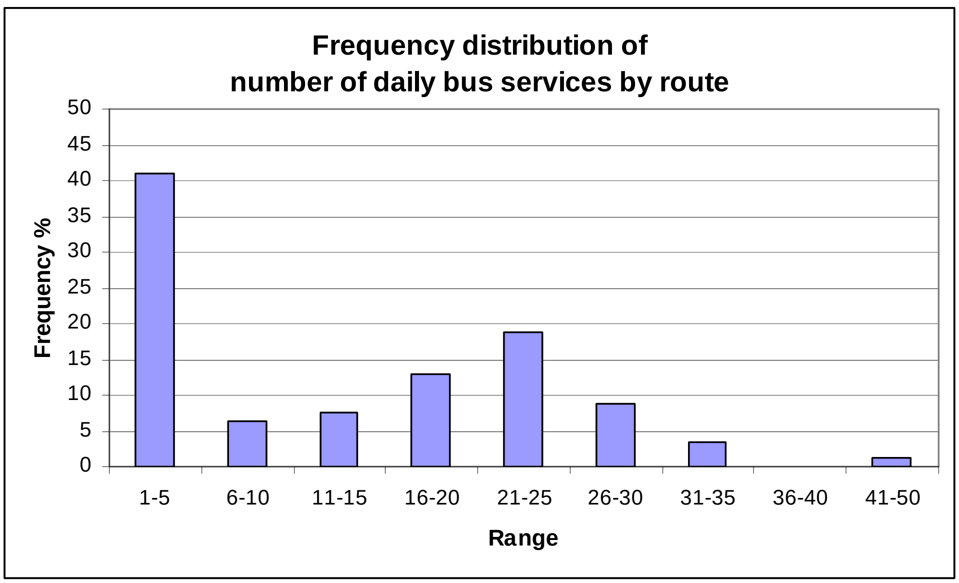
Route No.	Trips per day					
	Weekday		Saturday		Sunday	
	To	To				
12	Spence 10	Theodore 7	9	9	4	1
13	Fraser 2	Lanyon 2	3	1	2	0
14	Fraser 2	Lanyon 1	1	1	0	0
15	Spence 5	Theodore 13	13	13	2	3
16	Kippax 9	Belconnen 7	9	9	10	10
17	Kippax 9	Belconnen 11	8	8	11	10
20	City 4	Mawson 3	0	0	0	0
21	Mawson 20	Woden 20	0	0	0	0
22	Mawson 21	Woden 21	0	0	0	0
23	Farrer 25	Woden 25	14	14	9	9
24	Farrer 26	Woden 26	15	15	10	10
25	Woden/City 24	Cooleman Court 22	16	15	12	12
26	Woden/City 24	Cooleman Court 26	14	14	11	11
27	Woden/City 24	Cooleman Court 23	15	14	11	11
28	Woden/Campbell 17	Cooleman Court 17	0	0	0	0
29	City 1	Cooleman Court 1	0	0	0	0
30	Giralang 19	City/Woden 21	0	0	0	0
31	Giralang 21	City/Woden 22	0	0	0	0
32	Belconnen 9	Woden 8	6	15	12	11
33	Campbell 25	Dickson 26	16	17	11	12
34	City/Belconnen 34	City/Woden 33	15	5	12	12
35	Dickson 27	Narrabundah 28	16	16	11	11
36	Watson 28	Narrabundah 26	15	15	11	11
37	City 4	Woden 3	0	0	0	0
38	Dickson 46	City/Woden 48	23	25	11	11
39	Watson 26	City/Causeway 27	16	16	12	11
40	City/Campbell Park 21	Belconnen 20	0	0	0	0
41	City 18	Belconnen 17	0	0	0	0
42	City 5	Belconnen 7	0	0	0	0
43	Charnwood 17	Belconnen 17	0	0	0	0
44	Belconnen 16	Kippax 17	16	15	11	10
45	Dunlop 15	Belconnen 15	0	0	0	0
46	Belconnen 3	Fraser West 4	15	15	11	11
47	Belconnen 17	Giralang 17	0	0	0	0
48	Belconnen 11	Mitchell 11	0	0	0	0
49	Belconnen 5	Woden 5	0	0	0	0
51	City 23	Belconnen 22	Gung 16	Belc 16	Gung 12	Belc 11
52	City 23	Belconnen 20	Gung 17	Belc 16	Gung 12	Belc 12
55	City/Woden 19	Belconnen 19	16	17	11	11
56	City/Woden 26	Belconnen 25	16	16	12	12
60	Woden/City 23	Tuggeranong 24	15	15	11	11

Route No.	Trips per day					
	Weekday		Saturday		Sunday	
	To	To				
61	Woden/City 19	Tuggeranong 19	14	14	9	9
62	Woden/City 23	Tuggeranong 23	15	16	11	11
63	Woden/Campbell Park 24	Tuggeranong 24	15	14	10	9
64	Woden 19	Tuggeranong 21	14	14	10	10
65	Woden/City 24	Tuggeranong 23	15	15	9	9
66	Woden 20	Tuggeranong 22	15	15	9	11
67	Woden/City 22	Tuggeranong 22	15	15	9	9
72	City 2	Turner Snr Citizen Centre 2	0	0	0	0
73	Hawker 3	Belconnen 3	0	0	0	0
74	Hawker 3	Belconnen 3	0	0	0	0
75	Woden 3	Coleman Centre 3	0	0	0	0
80	Belconnen 29	Fyshwick 30	15	15	11	13
81	Campbell Park/Russell 1	Belconnen 1	0	0	0	0
83	Fyshwick 13	Woden 13	0	0	0	0
84	Railway 11	Woden 11	0	0	0	0
85	City 2	Lanyon 1	0	0	0	0
86	Fyshwick 7	Woden 7	0	0	0	0
91	Mawson 0	Woden 0	7	7	5	5
92	Mawson 0	Woden 0	8	8	6	6
100	Belconnen 3	City 1	0	0	2	2
112	Belconnen 0	Spence 1	0	0	0	0
115	Belconnen 0	Spence 1	0	0	0	0
116	Kippax 15	Tuggeranong 16	7	7	0	0
117	Holt 15	Tuggeranong 15	7	7	0	0
126	Woden/City 4	Chapman 2	0	0	0	0
155	City/Woden 4	Belconnen 2	0	0	0	0
156	City/Woden 2	Belconnen 2	0	0	0	0
160	Woden/City 3	Tuggeranong 3	0	0	0	0
161	Woden/City 1	Tuggeranong 1	0	0	0	0
162	Woden/City 3	Tuggeranong 3	0	0	0	0
170	City 2	Monash 1	0	0	0	0
216	Kippax 4	Tuggeranong 5	0	0	0	0
217	Woden 4	Kippax 6	0	0	0	0
225	Woden/City 3	Cooleman Centre 3	0	0	0	0
227	Woden/City 3	Cooleman Centre 2	0	0	0	0
243	Charnwood 5	Barton 5	0	0	0	0
244	Barton 4	Kippax 2	0	0	0	0
251	Barton 2	Belconnen 0	0	0	0	0
252	Barton 2	Belconnen 1	0	0	0	0
256	City 2	Belconnen 2	0	0	0	0
265	Woden/City 2	Tuggeranong 2	0	0	0	0
267	Woden/City 2	Tuggeranong 2	0	0	0	0

Route No.	Trips per day					
	Weekday		Saturday		Sunday	
	To	To				
268	City 2	Gordon 2	0	0	0	0
269	City 3	Banks 3	0	0	0	0
300	Tuggeranong 0	Belconnen 0	1	2	0	0
312	Spence 25	Theodore 28	12	12	8	10
313	Fraser West 32	Lanyon 32	17	16	10	11
314	Fraser West 32	Lanyon 31	16	16	11	10
315	Spence 28	Theodore 25	11	10	10	9
Total all routes	**1136**	**1134**	**539**	**535**	**372**	**368**

Source: ACTION Bus timetables 2002

The number of buses per route in Canberra is summarised by Figure 2.16. Over 40% of bus routes have between 1 and 5 buses on them per weekday. Two-thirds of bus routes have fewer than 20 buses per day. Nearly 90% of bus routes have fewer than 25 buses per day. The five routes with over 30 buses per day are: 34, 38, 80, 313, and 314.



Source: ACTION bus timetables 2002

Figure 2.16 Frequency distribution of number of daily bus services by each route, Year 2002

However when looking at the number of buses by trunk route corridor where several routes combine, Table 2.2 shows that there are over 200 buses (each way) per day on the four primary trunk route corridors between the following centres, and there are approximately 170 buses (each way) per day between Civic and Russell/Campbell:

- Woden to Parkes/Barton
- Tuggeranong to Woden

- Civic to Parkes/Barton
- Belconnen to Civic.

The data indicates that whilst there are a significant number of buses per day between some of the main centres, there are several different routes between the centres. This increases route penetration at the expense of frequent and direct services.

Table 2.2 Number of buses per trunk route corridor, Year 2002

Route	Number of buses per day in each direction
Russell/Campbell to Parkes/Barton	135–154
Civic to Russell/Campbell	165–174
Canberra Railway to Fyshwick	30–30
Mitchell to North Canberra	92–98
Civic to Woden	161–168
Civic to Parkes/Barton	272–278
Belconnen to Gungahlin	75–83
Gungahlin to Mitchell	80–87
Tuggeranong to Woden	298–302
Belconnen to Civic	233–238
Woden to Parkes/Barton	294–312
Charnwood to Belconnen	96–99

Source: ACTION bus timetables 2002

2.4.2 Bus journey time

Bus journey times need to be more compatible with car journey times to encourage car users to switch mode. Bus journey time data have been acquired from the data contained in ACTION's HASTUS computerised rostering and scheduling database.

Mean bus journey speeds in Canberra on the local area routes range from 22.4km/h on route 83 (Fyshwick to Woden) to 45.3km/h on route 85 (City to Lanyon). On the trunk transit corridor routes, journey speeds range from 22 km/h on route 39 (Watson to City/Causeway) to 56km/h on route 268/269 (City to Gordon/Banks).

2.4.3 Bus fares

There are a range of current fares available, based on pre-paid tickets or pay on board (Table 2.3). The ticket system is based upon a single flat fare, which can be transferred to a one hour transfer ticket available on request, at no extra charge. The adult on-board fare is $2.40 compared to $2.10 if bought in advance in the Faresaver book of ten tickets.

Table 2.3 Ticket types and cost, effective 1st July 2002

Pre-purchased Tickets	On-Bus Fares
Adult faresaver 10 – $21.00	Adult single trip (1 hour transfer ticket available on request, at no extra charge) $2.40
Weekly $23.50	Shopper’s off peak daily* $3.50
Monthly $80.50	Daily $6.00
Shopper's off peak daily* $3.50	
Daily $6.00	
Concession	Concession and school student
Faresaver 10 – $10.50	Single trip (1 hour transfer ticket available on request, at no extra charge) $1.30
Weekly $11.75	Pensioner off peak daily *~ $1.30
Monthly $40.20	Daily $3.00 – 1 Hour transfer option available at no extra charge
Daily² $3.00	
School student	
Faresaver 10 – # $7.50	
School term $55.00	

Source: ACTION Bus website 2003, http://www.action.act.gov.au/fares.cfm

Key

* *Off Peak: Weekdays 9am - 4.30pm and after 6pm, and all day weekends and public holidays.*
~ *Students are not eligible to use the Pensioner Off Peak Daily tickets.*
\# *This ticket provides ten individual bus trips that can be used on school days.*

2.5 TRENDS IN USAGE

2.5.1 1997 Household travel survey

This survey, which was carried out in 1997, is the most recent comprehensive survey of all travel for all purposes in the Canberra/Queanbeyan region. The most comparable previous survey was undertaken in 1976.

The survey recorded the weekday travel patterns of 1791 households representing 5,011 persons, a 1.8% sample size from the total Canberra/Queanbeyan population of 330,000 in 1996.

The survey recorded a total of 19,875 trips at all times of the day for all trip purposes, i.e. work, school, shopping, social/recreation/other (Table 2.4). Approximately 55% of trips in Canberra were as a car driver and a further 19% of trips were made as a car passenger. Approximately 4.6% of trips were by local bus in the whole of Canberra, but there was some regional variation. In Civic and Woden, approximately 7.2% of trips were made by bus, whilst only 4.4% of trips were made by bus in neighbouring Queanbeyan. The proportion of walk trips was highest in Civic, at approximately 34%. Improvements in public transport usually attract more walk trips.

Table 2.4 Choice of travel mode for all travel and for centres, 1997

Trip mode	All Canberra region (%)	To/from Civic (%)	To/from Woden (%)	To/from Queanbeyan (%)
Walk	16.72	34.07	27.35	23.05
Bike	3.04	2.37	2.66	1.37
Bus	4.64	7.17	7.19	4.39
Train	0.11	0.19	0.34	0.00
Car driver	54.55	45.35	45.41	52.95
Car passenger	19.44	9.70	15.74	15.85
Taxi	0.47	0.40	0.51	0.79
Motorcycle	0.56	0.45	0.68	0.72
Other	0.46	0.30	0.11	0.86
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Note: Linked trips - all day. Source: 1997 Household Travel Survey

The 1997 travel data illustrate the current base case for travel demand and for the initial assessments of future public transport system improvement. These base data are then expanded by appropriate residential and employment zone growth factors to provide future base case travel demand matrices for the years 2002 and 2022 with typical person and household trip generation rates (Table 2.5):

Table 2.5 Daily trip generation rates by mode, 1997

Travel mode	Trips/person	Trips/house
Walk	0.77	1.73
Bike	0.14	0.32
Bus	0.21	0.48
Train	0.01	0.01
Car driver	2.52	5.65
Car passenger	0.90	2.02
Taxi	0.02	0.05
Motorcycle	0.03	0.06
Other	0.02	0.05
Total	**4.62**	**10.37**

Note: Linked trips - all day. Source: 1997 Household Travel Survey

2.5.2 Census travel data 1991, 1996 and 2001

The journey to work travel data provides a complete assessment of travel patterns for the journey to work component of travel. Although it does not represent total travel, it is important in identifying trends in public transport usage and peak demand.

A comparison of the ACT and Queanbeyan residents census journey to work travel results for 1991 and 1996 shows a long-term decline in the proportion of bus usage for journey to work travel from 8.0% in 1991 to 6.6% in 1996 (Table 2.6). Similar results for combined travel modes are not yet available from the most recent 2001 census but the proportion of bus usage (including bus/car driver and bus/car passenger travel) is known to have declined further to 5.7%.

Table 2.6 Journey to work, 1991 and 1996—travel modes including bus access modes

Travel mode	ACT	ACT	Queanbeyan	Queanbeyan
	1991	1996	1991	1996
Car as driver	59.1	62.5	67.2	68.8
Car as passenger	9.5	8.9	9.4	8.2
Bus only	7.0	5.7	0.7	0.5
Walked only	3.3	3.3	5.1	4.1
Worked at home	2.8	3.0	3.7	3.4
Bicycle	1.5	1.8	0.5	0.6
Bus, including car as driver	0.4	0.4	0.1	0.0
Bus, including car as passenger	0.6	0.5	0.1	0.1
Did not go to work	9.3	10.7	8.2	9.7
All other*	2.7	2.7	3.7	3.8
Not stated	3.8	0.4	1.1	0.6
Total	**100.0**	**100.0**	**100.0**	**100.0**

** Includes 'other (combinations).' Source: 1991 and 1996 Census Data*

In 2001, there were approximately 156,000 journey to work trips by ACT residents compared to approximately 134,000 in 1996, an increase of 16%. However, the number of bus trips fell from 9137 in 1996 to 8827 in 2001 (Table 2.7). This is an overall decrease in the number of bus trips of 3% and decrease in the mode share from 6.8% in 1996 to 5.7% in 2001. A similar decline occurred in both the ACT and Queanbeyan between the two census years.

A more detailed breakdown of the journey to work travel patterns from each of suburb of Canberra shows that the highest bus usage in 2001 was from North Canberra with approximately 7% of journeys to work by bus (Table 2.7). Lowest bus usage was from Gungahlin and Tuggeranong, with less than 5% of journey to work trips by bus in 2001.

Only North and South Canberra and Gungahlin have increased the number of bus trips to work but only North Canberra has managed to maintain its mode share for bus journeys to work between 1996 and 2001. There has been a dramatic increase in the number of trips to work from Gungahlin between 1996 and 2001(almost double) but although the number of bus journeys to work has risen, it has only risen by 37%. This increase in bus journeys still represents a declining mode share. All other suburbs have both lost the number of bus trips to work and mode share.

Table 2.7 Trends in township public transport usage levels, 1996 to 2001

	1996 Census Journey to Work			2001 Census Journey to Work		
Origin Zone	All trips	Bus trips	% By bus	All trips	Bus trips	% By bus
N. Canberra	15068	1115	7.4	17725	1316	7.4
S. Canberra	8446	587	7.0	10519	660	6.3
Belconnen	37829	2763	7.3	42573	2596	6.1
Tuggeranong	39494	2361	6.0	44581	2050	4.6
Woden/Weston	25715	1878	7.3	26977	1621	6.0
Gungahlin	6461	411	6.4	12773	563	4.4
Other ACT	712	22	3.1	761	21	2.8
Total ACT	133725	9137	6.8	155909	8827	5.7
Queanbeyan (C) NSW	11768	285	2.4	13826	267	1.9
Total ACT/ Queanbeyan	145493	9422	6.5	169735	9094	5.4

Source: 1996 and 2001 Journey to work Census data

2.5.3 Journey to Work and Other Public Transport Usage

A comparison of public transport usage levels for journey to work and all travel in Canberra, Sydney and Melbourne, based on the 1997 household travel survey data and 1999 and 2001 data indicates that the proportion of journeys to work by public transport in Canberra is far less than in either Sydney or Melbourne (Table 2.8). The proportion of trips made by public transport in Canberra (6%) is similar to that in Melbourne, but approximately half that of Sydney (11%).

Table 2.8 Comparison of trends in public transport usage

City	% Public transport for journeys to work	% Public transport for all travel
Canberra (1997/2001)	6%	6%
Sydney (1999/2001)	20%	11%
Melbourne (1999)	14%	6%

Source: Journey to work – Census and Household Travel data in Canberra, Melbourne and Sydney for the years indicated

2.6 FUNDING CONSTRAINTS

2.6.1 Past, present and future budgets

ACTION buses have in the past required significant government financial support, especially as fare revenue has fallen. In 1996/7 the Government provided approximately $42 million in revenue support whilst in 2001/2, this revenue support rose to approximately $47 million. During this same time period, fare revenue decreased from approximately $18.9 million in 1996/7 to $15.7 million in 2001/2 (Table 2.9). Employee costs have remained relatively stable between 1996/7 and 2001/2 whilst total expenses have fluctuated between approximately $67 million – $71 million. Depreciation and borrowing have both fallen between 1996/7 and 2001/2 but operating costs have risen from $14.9 million to $17.2 million over this time.

Table 2.9 Financial performance of ACTION Buses between 1996/7 and 2002/3

Financials Performances Indicators	1996/7 $000	1997/8 $000	1998/9 $000	1999/00 $000	2000/01 $000	2001/02 $000
Government and other funds	45,964	38,178	41,787	47,965	47,434	47,010
Fare revenue	18,877	17,871	17,478	17,702	18,501	15,445
Total revenue	**64,841**	**56,049**	**59,265**	**65,667**	**65,935**	**62,455**
Employees	37,790	38,014	41,678	39,909	36,536	37,485
Superannuation	4,683	4,644	4,602	4,726	4,846	5,089
Admin/Operations	14,930	13,924	15,027	17,341	17,455	17,204
Depreciation	7,368	7,041	4,418	5,181	4,719	4,734
Borrowing/other	6,381	3,441	3,947	3,968	3,059	2,765
Total expenses	**71,152**	**67,064**	**71,672**	**71,125**	**66,615**	**67,277**
Total assets	111,812	101,433	75,997	72,124	68,495	74,394
Property/plant/equipment	107,131	97,023	73,534	67,513	62,752	62,242
Cash/investments/other	4,681	4,410	2,463	4,611	5,743	12,152
Provision for employee entitlement	11,942	11,672	10,708	11,781	11,673	10,884

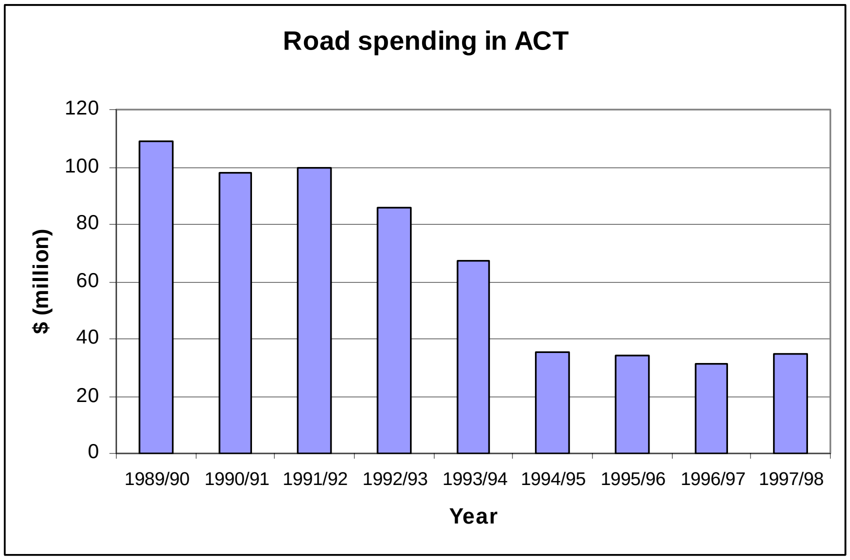
Source: ACTION Buses Annual Reports for the years indicated

The future situation, as forecast in the 2001-02 Annual Report: Department of Urban Services, predicts that until 2005/6 Government funding will remain at approximately $48 million annually whilst fare revenue will rise to approximately $17.2 million. Total operating expenses during this period are forecast to rise marginally to approximately $69.9 million.

2.6.2 Road spending trends

Road related spending in the ACT fell from a high of $109.2 million in 1989/90 to approximately $35 million in 1994/5 (Figure 2.17). The funding then remained at this general level up to the year 1997/8 (Bureau of Transport Economics, 1999).

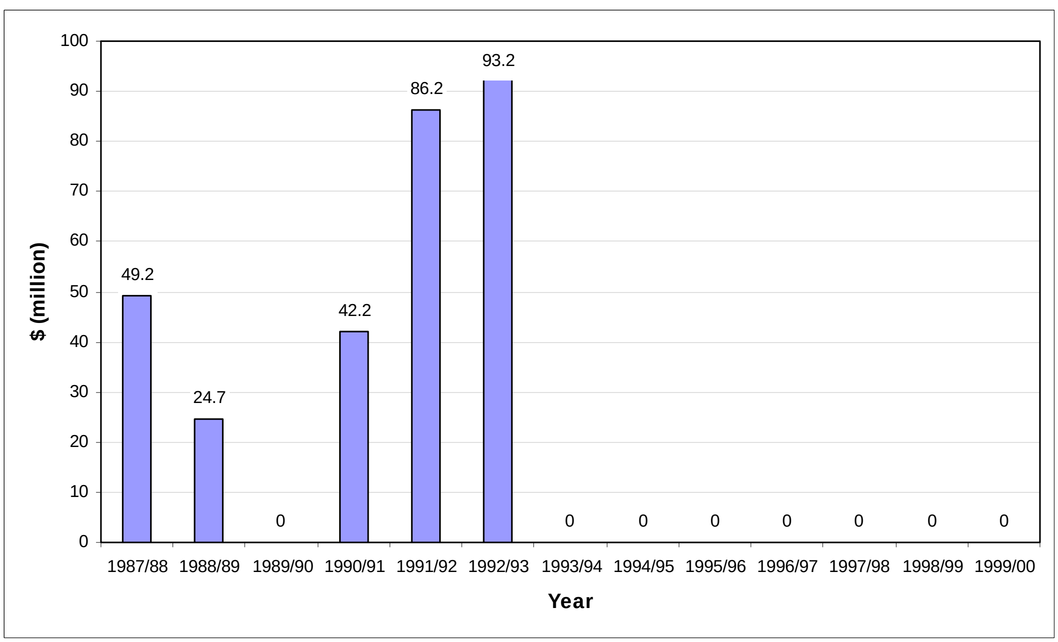
These spending levels indicate that the ACT Government has in the past been able to spend an additional $70 million per annum on roads. A similar level of money could potentially be made available to spend on public transport system capital works improvements.



Source: Bureau of Transport Economics, 1999

Figure 2.17 Road spending in the ACT

Historically, the Commonwealth Government has played a contributory role in funding capital works for urban public transport primarily through programs such as the Building Better Cities program which funded the major portion of the Sydney Light Rail project. However, the Commonwealth funding ceased effectively in 1992/3. Prior to this time, it averaged approximately $49 million per annum as indicated by Figure 2.18 below.



Source: Bureau of Transport Economics, 1999

Figure 2.18 Commonwealth funding for Urban Public Transport, 1987/88 to 1999/2000

2.7 ACTION CUSTOMER SURVEY (OCTOBER 2002)

This survey was undertaken by TNS Consultants for DUS/PALM in October 2002. Overall 82% of survey respondents were satisfied with ACTION's performance.

Additionally, survey respondents gave ACTION a satisfaction score to the following three questions:

- Is ACTION doing a good job?
  - = 48% Agree 15–24 age group
  - = 64% Agree 24–55 age group
  - = 71% Agree Over 55 age group
- Does ACTION provide a valuable community service?
  - = 70% Agree 15–24
  - = 84% Agree 25–54
  - = 80% Agree Over 55
- Are ACTION fares are value for money?
  - = 54% Agree 15–24
  - = 71% Agree 24–55
  - = 77% Agree Over 55.

The survey analysis was based on a 200 person random survey plus a 299 person bus user survey. Overall, 29% of respondents said buses were their primary form of transport for commuting. This is high in comparison to the actual 5–7% bus usage level for journey to work from Census Data. The overall combined survey sample was more representative of existing bus users rather than the Canberra population as a whole.

The survey results are summarised in Table 2.10 for a total of 51 attributes of the existing ACTION Bus System. There were some small differences between the satisfaction levels recorded between different age groups with the elderly users (over 55) being generally more tolerant of issues such as bus service frequency and having more concern with matters such as:

- explained difference of tickets
- ticket agent knowledge of tickets

and the younger users (15–24) having more concern with issues such as:

- directness of bus routes
- frequency of buses
- buses running to time
- friendliness of bus drivers
- comfort of the ride

- comfort of seating.

However, 10 out of 51 of the existing bus system attributes recorded very low satisfaction levels (less than 33% of respondents satisfied with the service and a further 7 out of 51 attributes scored relatively low satisfaction levels (less than 50% of respondents satisfied with the service). The attributes that are currently of greatest concern are in order of significance.

- 19% satisfied ticket office opening hours at interchanges
- 22% satisfied public behaviour at interchanges
- 26% satisfied comfort of seating at interchanges
- 26% satisfied cleanliness at interchanges
- 26% satisfied lighting at night of interchanges
- 27% satisfied access for disabled at bus stops
- 27% satisfied lost property system
- 30% satisfied provision of timetables at bus stops
- 32% satisfied staff availability at interchanges
- 33% satisfied protection from weather at interchanges
- 39% satisfied personal safety at interchanges
- 42% satisfied air conditioning on buses
- 42% satisfied ticket agent knowledge of tickets
- 44% satisfied frequency of buses
- 46% satisfied customer service line
- 47% satisfied bus drivers knowledge of other routes
- 48% satisfied cleanliness of bus stops and shelters.

Table 2.10 Satisfaction levels with ACTION Service elements

		% Persons who gave a Satisfaction Level of 7/10 or more			
		All Ages	**15–24**	**24–55**	**Over 55**
Fare elements	Range of tickets	58	55	62	56
	Value for money	66	56	67	78
Ticketing system	Convenience	74	71	72	80
	Explained difference of tickets	51	55	51	47
	Staff knowledge	66	71	70	60
	Ticket agent knowledge of tickets	42	52	42	31
	Helpfulness of staff	67	59	70	75
	Ease of validation	85	84	86	86
	Ticketing machines working	66	66	66	66
Bus routes	Coverage	66	62	66	70

		% Persons who gave a Satisfaction Level of 7/10 or more			
		All Ages	15–24	24–55	Over 55
	Directness	56	47	54	71
	Need to transfer	64	60	64	70
	Through interchange journeys	53	55	49	59
Legibility	Route maps	69	73	67	68
	Route numbers	74	80	73	67
Timetable	Running to time	56	44	57	68
	Frequency	44	30	47	57
	Ease of understanding	71	66	72	76
Bus drivers	Ability	75	72	72	82
	Safety	80	76	80	85
	Passenger comfort	68	63	66	77
	Courtesy	68	58	68	79
	Friendliness	61	43	67	76
	Helpfulness	64	50	68	78
	Knowledge of other routes	47	47	44	50
Bus design	Comfort of ride	57	49	57	68
	Comfort of seating	50	40	48	66
	Ease of getting on and off	73	72	76	68
	Ease of getting to seats	66	60	67	70
	Availability of seats	61	51	65	69
	Cleanliness	62	53	61	75
	Heating	67	61	69	72
	Air conditioning	42	43	35	50
	Ventilation	53	51	54	57
Bus interchanges	Signposting	57	55	52	66
	Comfort of seating	26	20	24	38
	Protection from weather	33	37	31	32
	Cleanliness	26	23	25	32
	Lighting at night	26	39	23	15
	Ticket office opening hours	19	20	15	25
	Staff availability	32	29	31	38
	Personal safety	39	38	37	45
	Public behaviour	22	20	19	28
Bus shelters and stops	Easy to find	63	63	64	62
	Located conveniently	68	67	73	63
	Cleanliness	48	51	49	42
	Provision of timetables	30	23	28	43
	Accessibility	62	61	65	60
	Access for disabled	27	28	24	32
Bus system	Customer service line	46	46	47	45
	Lost property	27	26	32	21

Source: ACTION customer survey (October 2002

2.8 PLANNED CHANGES TO ACTION BUSES

The ACTION Strategic Plan 2002-2005 highlights the four key strategies that ACTION will target during the plan timeframe. They are:

- customer focus
- people focus
- systems and resources
- business development and innovation.

The customer focus strategy will focus upon the following service, fares and fleet changes (ACTION, 2002):

- review services provided at interchanges
- finalise process for introduction of new air-conditioned, ultra low floor, compressed natural gas vehicles
- implement Government initiatives in relation to fares and concessions
- implement service changes twice a year
- review night time operation of services.

The people focus strategy will aim to create a more open and communicative workforce, with improved training and development. A key element of this strategy will be a review of the enterprise bargaining agreement.

The systems and resources strategy will aim to improve the efficiency of management, operations and maintenance. This will be achieved through benchmarking and a range of programs. Other aims of the strategy include establishing a funding model for ACTION buses and to identify and manage risk.

The business development and innovation strategy will focus upon the following areas to develop the business (ACTION 2002):

- to increase the usage of route services
- to improve the finance and business performance of the organisation
- identification of new markets
- improve customer service
- extend environmental focus of the business
- make public transport more competitive with private transport.

To develop this and other strategies further, ACTION, with other Government agencies are working towards implementing the following initiatives (ACTION communication 2003):

- a busway system, using bus priority lanes and ‘B’ signals;
- a town centre traffic management review;
- interchange upgrade;

- real time information;
- smart card ticketing;
- bike racks on buses;
- travel smart;
- park and ride;
- mobile phone information technology;
- a fleet replacement strategy;
- new communications system; and
- service changes, additional express services and route straightening.

3 Land Use Development

3.1 LAND USE, POPULATION AND EMPLOYMENT ASSUMPTIONS

During the course of this study, ongoing development work on the future land use options for Canberra and the ACT has been undertaken by PALM (now ACTPLA), with the result that a range of alternative future population growth scenarios have been determined for a 25–30 year future period.

These scenarios represent various combinations of urban consolidation and new urban fringe development including to varying degrees.

- Completion of the planned development of Gungahlin
- Urban consolidation within the major town centres and along transport corridors
- Development of new urban fringe residential areas.

3.2 GROWTH TRENDS IN TRAVEL DEMAND

The market for passenger travel in the ACT region (Canberra/Queanbeyan) can be divided in market sectors in a number of ways. However, the principle definitions of market sectors for public transport are based upon ticket types and the statistics of passenger boardings. The travel demand market sector definitions which are maintained by ACTION are:

- adults, i.e. full fare paying passengers;
- concessions, aged pensioners and other concession ticket; and
- schools, i.e. school children travelling on either school buses or general bus services.

The primary determinants of these travel demands are the locations of residential and employment areas and community facilities/services (including retail and commercial/industrial areas). The locations of schools and places of further education are also a highly significant factor influencing overall travel demand; in particular, the recent trend towards larger than less locally based schools. A further significant factor is the location of recreational type facilities including both cultural and sporting facilities, for example, the Bruce Stadium, which can on occasions general major peaks of travel demand.

Population growth in combination with declining household sizes is continuing to generate a significant demand for new dwellings in Canberra by a combination of new urban developments in fringe areas, e.g. Gungahlin, Dunlop in Belconnen and Gordon in Tuggeranong and redevelopment in urban areas, in particular close to the Northbourne Avenue Corridor in Civic, Braddon, O’Connor, Lyneham and Watson.

During the recent three year period, June 1998 to June 2001, which does not include the most recent major developments in the Kingston area of South Canberra, there were a total of +5,782 additional dwellings created by residential development in the ACT. An increase of +1,927 dwellings per year (+2,000 approximately).

The geographic distribution of the net additional dwellings is identified by Figure 3.1. Approximately 90% of the additional dwellings, +5,194 have been constructed in 32 identified localities with the remaining 67 localities having had relatively minor levels of residential development, on average less than 10 additional dwellings each over the three year period.

3.3 EMPLOYMENT TRENDS

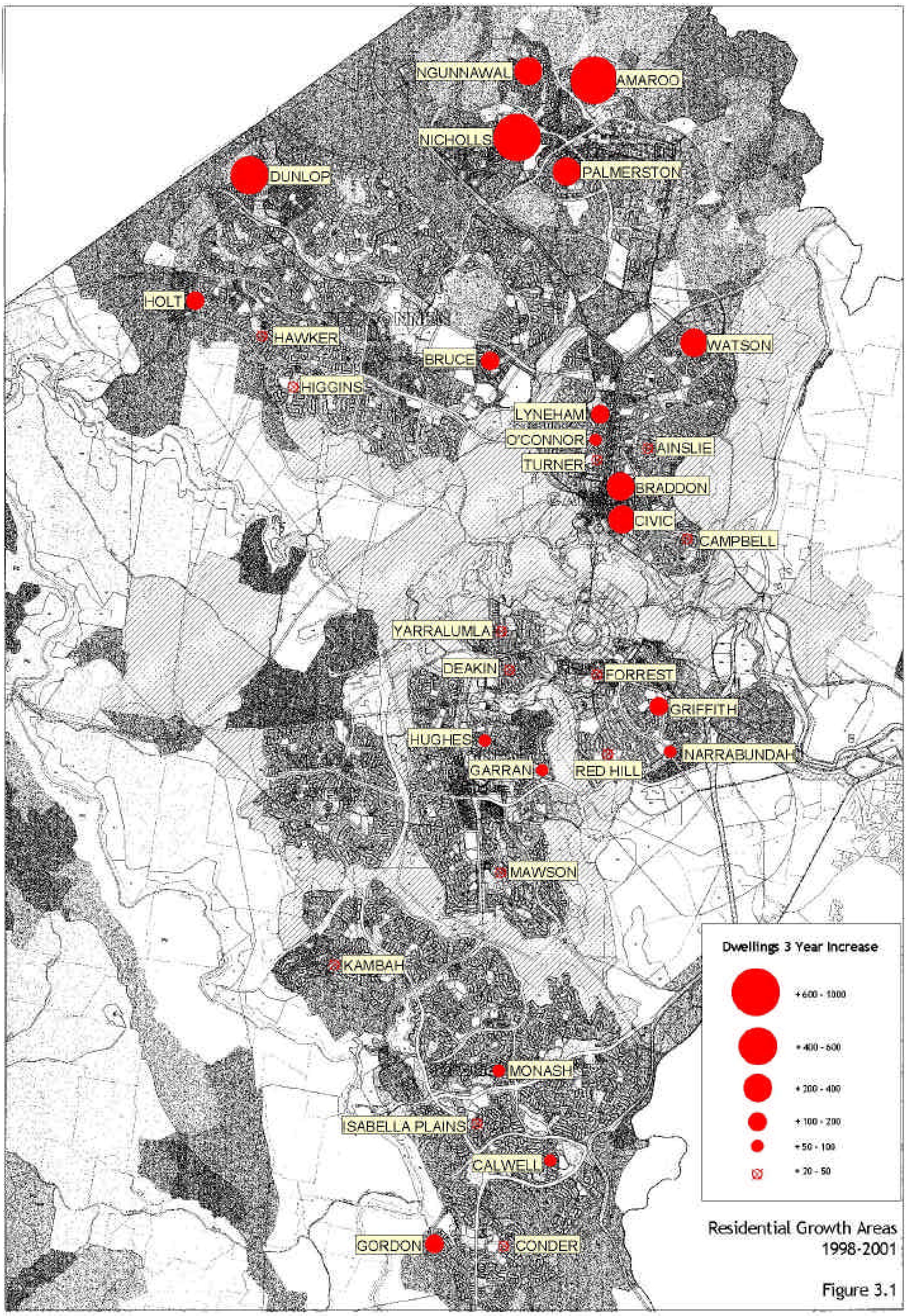
A similar graphical presentation of the relative size of the key employment locations in Canberra is illustrated by Figure 3.2, based on IBECON projections for the year 2004, extrapolated from year 1996 base data.

There are a total of 45 identifiable employment centres in Canberra/Queanbeyan with 92.6 percent of the projected total year 2004 employment of 188,786 persons being located within these centres.

The following hierarchy of centres is evident from this employment distribution.

Table 3.1 Hierarchy of Employment Centres in Canberra/ACT

Category of Centre	Name of Centres
Level 1	Civic
Level 2	Fyshwick Woden (Phillip) Town Centre Belconnen
Level 3	Queanbeyan Town Centre Greenway Parkes Barton Russell
Level 4	Deakin Acton Bruce Braddon Kingston Dickson Mitchell Griffith Garran Duntroon Majura
Level 5	11 other centres including Gungahlin Town Centre
Level 6	14 other centres



Residential Growth Areas
1998-2001

Figure 3.1

The centres which are currently exhibiting the strongest employment growth (projected increases during the 8 year period 1996-2004) are as follows:

- Civic +4,400 jobs, from 22,345 to 26,753
- Queanbeyan +1,700 jobs, from 8,077 to 9,786
- Gungahlin Town Centre +1,700 jobs, from 0 to 1,702
- Russell +1,700 jobs, from 4,155 to 5,837
- Fyshwick +1,600 jobs, from 12,981 to 14,592
- Kingston +1,400 jobs, from 2,507 to 3,891
- Woden +1,200 jobs, from 12,865 to 14,106
- Belconnen +1,100 jobs, from 11,502 to 12,647

3.4 LAND USE OPTIONS

Three land use scenarios were defined by the Department of Urban Services for use in this study. The third scenario contains three different derivatives, making a total of five distinct land use options for testing. The details of employment and population for each land use scenario is shown in Table 3.2.

3.4.1 Scenario 1

The guiding principle behind scenario one is to follow the Y-plan and continue the development of Gungahlin as a priority.

3.4.2 Scenario 2

This scenario places greater emphasis on infill development, dual occupancy and higher dwelling densities. This scenario follows the established principles of planning for public transport.

3.4.3 Scenario 3

This scenario contains three sub elements:

- develop Stromlo for urban use and take up land in North Belconnen;
- place greater emphasis on the development of Kowen, Googong and Tralees to Canberra's south east; and
- place emphasis on the development of Gooromon and Jeir to Canberra's north west.

Table 3.2 Future population and employment forecasts for each land use option, 2011 and 2026

District	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c	
	Pop	Emp	Pop	Emp	Pop	Emp	Pop	Emp	Pop	Emp
Forecast year 2011										
Belconnen	90,881	27,081	90,981	26,619	90,946	28,262	90,946	28,262	90,946	28,262
Gungahlin	37,001	13,150	37,203	6,949	37,001	6,947	37,001	6,947	40,001	7,257
N Canberra	44,125	51,363	44,573	54,533	41,656	53,282	41,656	53,282	41,656	53,282
S Canberra	25,677	41,590	26,380	44,328	24,693	41,870	24,693	41,870	24,684	32,114
21,684	32,504	20,307	33,004	21,366	32,114	21,684	32,114	21,684	32,114	21,684
Westen/Stromlo	22,452	4,259	22,600	4,407	27,223	5,389	22,323	4,489	22,323	4,489
Tuggeranong	90,650	18,019	91,150	17,225	89,895	17,988	89,895	17,988	89,895	17,988
Googong/Tralee	427	2,733	427	3,053	2,961	3,021	5,911	3,421	3,961	3,221
Queanbeyan	36,525	9,385	36,525	9,392	33,991	9,199	33,991	9,199	33,991	9,199
External towns	3,147	959	547	872	3,147	996	3,147	996	3,147	996
Kowen	220	-	220	-	20	356	1,550	300	520	206
Total	**383,609**	**188,846**	**383,610**	**188,744**	**383,647**	**188,994**	**383,227**	**188,438**	**383,247**	**188,454**
Forecast year 2026										
Belconnen	91,958	31,649	102,641	30,301	88,458	32,984	88,457	32,984	88,457	32,984
Gungahlin	75,750	22,511	37,162	8,188	47,682	8,188	34,182	8,188	37,782	8,528
N Canberra	51,021	57,134	62,515	65,229	36,627	61,534	36,627	61,534	36,627	61,534
S Canberra	26,576	43,819	37,071	49,407	22,524	44,439	22,254	44,439	22,254	44,439
Woden	33,650	21,242	40,700	24,084	30,505	24,611	30,505	24,611	30,505	24,611
Westen/Stromlo	22,450	4,494	25,952	4,982	78,281	8,494	20,401	5,494	20,401	5,494
Tuggeranong	86,441	20,761	96,688	18,987	80,003	21,016	80,003	21,016	80,003	21,016
Googong/Tralee	427	2,775	427	3,147	3,439	2,989	30,789	3,859	11,939	3,359
Queanbeyan	38,325	10,695	38,335	10,708	35,256	10,481	35,256	10,481	35,256	10,481
Gooroomon	-	-	-	-	-	-	0	0	64,500	0
External towns	8,447	991	547	879	2,906	969	2,906	969	2,906	969
Kowen	220	-	230	-	9,538	606	53,650	2,370	4,270	376
Total	**435,265**	**216,071**	**442,268**	**215,912**	**435,219**	**216,311**	**435,300**	**215,945**	**435,170**	**213,791**

The effective population growth from 2001 to 2026 and the locations of this population growth in each scenario are summarised by Table 3.3.

Table 3.3 Distribution of Future Population Growth for Canberra/ACT 2026

Location	Base year population (2001)	Future Predicted Population Growth to Year 2026				
		Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 3C
Belconnen	78,261	+13,697	+24,380	+10,197	+10,196	+10,196
Gungahlin	27,020	+48,730	+10,142	+20,662	+7,162	+10,762
North Canberra	43,097	+7,924	+19,418	-6,470	-6,470	-6,470
South Canberra	28,010	-1434	+9,061	-5,486	-5,486	-5,486
Woden	31,200	+2,450	+9,500	-695	-695	-695
Weston/Stromlo	28,340	-5,890	-2,388	+49,941	-7,939	-7,939
Tuggeranong	85,640	+801	+11,048	-5,637	-5,637	-5,637
Googong/Tralee	40	+387	+387	+3,399	+30,749	+11,899
Queanbeyan	27.680	+10,645	+10,655	+7,576	+7,576	+7,576
Gooromon	0	0	0	0	0	+64,500
Kowen	0	+220	+230	+9,538	+53,650	+4,270
Other towns	2,200	+6,247	-1,653	+706	+706	+706
Total	**351,488**	**+83,777**	**+90,780**	**+83,731**	**+83,812**	**+83,682**

Source: Department of Urban Services

3.5 FACTORS NECESSARY TO MAKE LAND USE CHANGES HAPPEN

The previous report on this project, *Stage 1 Study Working Paper – "Scoping Report"* provided a range of examples of the necessary elements to improve public transport usage. These are summarised in Appendix B of this report. The key issue is integration of transport and land use planning to make the move towards a higher density urban form which is more capable of sustaining efficient public transport.

To make the leap from car dependence to increased public transport usage, Canberra should adopt the principles of greater urban consolidation as a move towards being a Smart City. Smart cities are turning their back against urban sprawl. (International City/County Management Association with Geoff Anderson, 1998.) Smart cities recognise that quality of life and economic gain can go hand in hand. A key element of a smart city is a vision and a plan and a community that wants to achieve that vision (International City/County Management Association with Geoff Anderson, 1998).

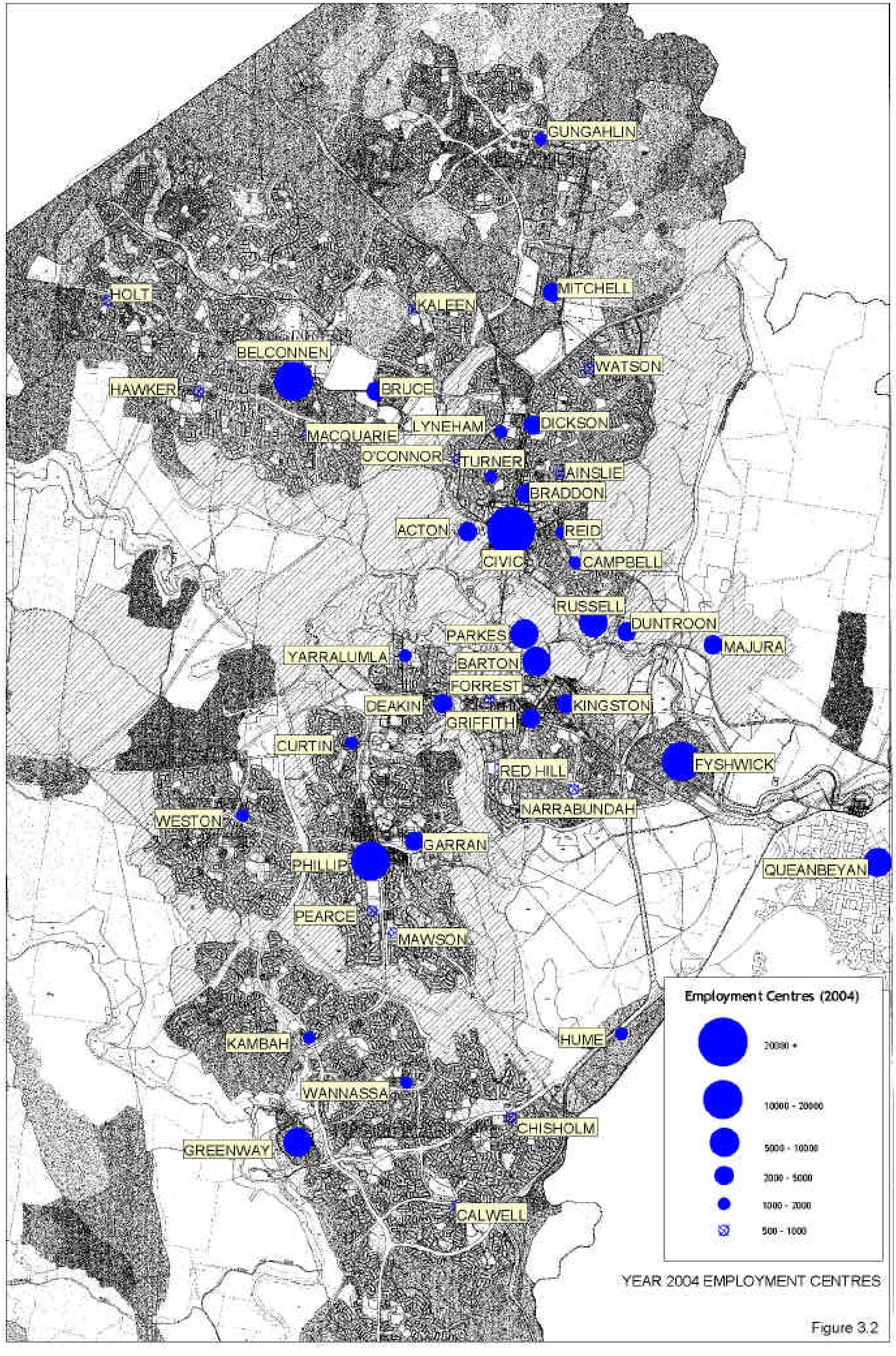
Later chapters of this report describe the critical public transport corridors that must be pursued to achieve the objectives for transit oriented development in Canberra, they are:

- Belconnen to Civic – with a focus around Bruce Stadium;
- Gungahlin to Civic;
- Woden to Tuggeranong and
- Kingston, Fyshwick and Manuka.

The cities listed below due to scale and location could all be considered similar to Canberra on an economic and political basis. In addition, the list highlights where rail-based modes of urban public transport are provided. All of the cities listed below can be considered as Smart Cities:

- Europe
  - Dublin, Ireland — Heavy sub-urban rail
  - Edinburgh, Scotland — None
  - Cambridge, England — None
  - Bonn, Germany — Tram and light rail and bus
  - Lucerne, Switzerland — Light rail and bus
  - Strasbourg, France — Tramway and bus
  - Brussels, Belgium — Metro, tramway and bus
- North America
  - Baltimore USA — Light rail
  - Austin, USA — None
  - Providence, USA — None
  - Fort Worth, USA — Light rail
  - Ottowa, Canada — Light rail
  - Victoria, Canada — None
- Asia Pacific
  - Fremantle, Australia — Light rail to Perth
  - Christchurch, New Zealand — None

Should Canberra move towards similar population densities then improved public transport provision could be sustained. Should the population densities in the right places and with the right public transport not be achieved, then Canberra would face a transport problem. That problem could be one of road congestion and spiralling public transport provision costs.



YEAR 2004 EMPLOYMENT CENTRES

Figure 3.2

4 Consultation

4.1 COMMUNITY AND STAKEHOLDER CONSULTATION

There were a total of five community workshop and stakeholder consultation meetings during the course of this study:

- 14/10/02 Initial Community Workshop, issues and vision for the future
- 27/11/02 Community Workshop Feedback and Government Agency briefings
- 8/04/03 Preliminary Presentation of Route Options and Costs
- 5/05/03 ACT Government Stakeholder Discussion Workshop to review short-term Strategies and Interim Bus Network Improvements
- 11/06/03 Transport Summit.

A summary of the issues raised and consensus reached by the two consultation workshop meetings in October and November 2002 is presented in Appendix B to this report.

The final version of the community views and preferences regarding land use development issues in Canberra and the public transport system is summarised by the 11 June 2003 transport summit at the National Convention Centre, as follows.

4.2 TRANSPORT SUMMIT, JUNE 2003

4.2.1 Issues relating to land use development and future transport planning

The most frequently mentioned idea from the Summit was for increasing residential and employment densities around transport nodes and corridors so as to encourage the viability of public transport services and to make Canberra more compact. There was recognition that having more people living and working near transport nodes and along the main transport corridors would facilitate greater use of the public transport system. It would also encourage greater use of sustainable transport modes like walking and cycling.

These ideas were expressed in several ways:

- a more compact city / more urban infill / less urban sprawl
- higher population and employment densities
- higher densities in town centres
- more transit oriented development
- more development along transport corridors
- developing transit systems prior to urban development

- more integrated transport and land use.

There was discussion of what ‘density’ meant. Many participants acknowledge that Canberra has very low densities at present. The following definitions were proposed:

- Medium density: 36 dwelling/hectare
- High density: 72 dwellings/hectare
- Very high density: 144 dwellings/hectare

The scale of development and the location of the development was also seen as important in determining attitudes to density. Several ideas were offered on this issue:

- high density would be acceptable/suitable in town and group centres
- up to 15 storeys in town centres
- medium density is acceptable/desirable at transport nodes and at key points along transport corridors
- medium density may not be desirable along some parkways (Adelaide Avenue was mentioned) in order to protect the green belts and natural character of parkways
- protecting the views of the hills and the skyline is important.

A full understanding of the density issue needs to include analysis of the traffic impacts of density and also analysis of other infrastructure and resources impacts of density particularly on energy and water use.

There was strong endorsement of the need to keep the transit options open for the future. In particular there is a need to ensure that the transit corridors are protected for future transit systems. There was also recognition that early development of these corridors for transit would encourage land use to orient itself towards the transit system.

4.2.2 Issues relating to the existing public transport system

Some participants warned about having too much development along corridors as this will reduce transit speeds if there are too many stops.

Many participants recognised the need to improve the quality of public transport services to encourage greater use of the system. They identified a wide range of initiatives to achieve this including:

- more services (frequency and service coverage)
- faster and more frequent services on the trunk corridor
- dedicated / exclusive transit right-of–way on trunk corridors
- more direct routes
- demand-responsive feeder services
- better scheduling of services
- better information including real-time information systems
- better interchanges

- greater use of technology (smart cards, etc)
- free buses
- bus passes as part of salary packaging
- improved park and ride facilities
- improve the image and attitudes towards buses
- focus on short local trips
- allow bikes on buses

There was significant interest in ensuring that feeder services were better used and provided better service. More demand-responsive feeder services were seen as important. Some participants indicated that there may be a need to reduce the service coverage of the bus system in order to improve service frequency on key direct routes.

A major issue identified by many participants was the need for a pricing system that would encourage people to make appropriate travel choices, including appropriate use of public transport. Related to this is the need for sources of funding for improving public transport and other projects to achieve a more sustainable transport system. Participants identified the possible use of electronic road pricing and congestion pricing systems that are being adopted in other cities as an option for Canberra as the system of arterial roads in Canberra would lend itself to such as system. Ideas mentioned in this regard include:

- electronic road pricing
- congestion pricing
- car parking charges to encourage greater use of public transport
- discouragement of city centre car parking
- allocating / diverting more funds towards public transport.

Some participants support the development of a light rail system for Canberra. This is based on the belief that light rail is more attractive to travellers and that because it is a fixed system it generates benefits for surrounding land use and some of this value can be captured to help fund the system.

There was some support for measures to encourage more walking and cycling including:

- car-free precincts
- higher densities around transport nodes/ More transit-oriented development
- promoting and improving safety of walking and cycling
- safe routes walking and cycling

Some other issues/ opportunities raised at the Summit were:

- vary school opening hours to reduce peak problems
- encourage more car pooling

- more use of taxis for demand-responsive services
- encourage employment in Gungahlin and other areas
- encourage more home-based employment
- need to develop a shared strategy with NSW Government
- need to encourage population growth
- need to consider the aging of the population and the impact on transport
- need to consider the future requirements of the school population for transport.

5 Sustainability

5.1 INTRODUCTION

The aim of this section is to describe the transport related sustainability impacts of each of the land use scenarios and the effects that the corridor transit system improvements will have on these indicators. Five different land-use scenarios were defined, by the Department of Urban Services, for use in this assessment. They can be described as follows:-

- **Scenario 1**: Follow the Y-plan and continue the development of Gungahlin as a priority
- **Scenario 2**: Place greater emphasis on infill development, dual occupancy and higher densities
- **Scenario 3A:** Develop Stromlo for urban use and take up the land in North Belconnen
- **Scenario 3B**: Place greater emphasis on the development of Kowen, Googong and Tralee to Canberra's South-East
- **Scenario 3C:** Instead place emphasis on the development of Gooromon and Jeir to Canberra's North-West.

5.2 DEFINITIONS OF SUSTAINABLE TRANSPORT

There is no accepted definition of sustainability, sustainable development or sustainable transport (Victoria (Canada) Transport Policy Institute, 2003). It is increasingly accepted, as measured by its use in sustainability literature, that sustainable development "should meet the needs of the present without compromising the abaility of future generations to meet their own needs" (Brundtland Commission, 1987 quoted in Victoria (Canada) Transport Policy Institute, 2003).

The Canadian Centre for Sustainable Transport definition of a sustainable transportation system (Centre for Sustainable Transport, 2003) is one that:

- allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations
- is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.
- limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.

5.3 SUSTAINABILITY INDICATORS

A study by PIARC (2002) of 18 world cities aimed to discover the relative significance of 26 transport indicators that are frequently used in transport assessments (Figure 5.1). The study found that the five most significant indicators, all of which were ranked equally highly, were:

- air quality
- employment
- business attraction and growth
- accessibility
- mode share.

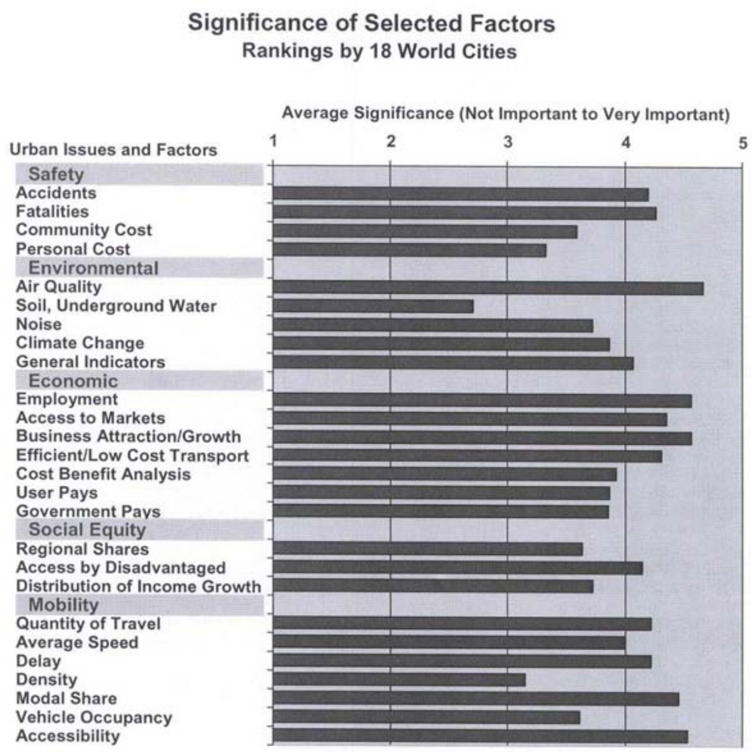


Figure 5.1 PIARC Sustainability Indicators

5.4 SUSTAINABILITY INDICATORS FOR CANBERRA STUDY

The first stage of the Canberra Public Transport Futures Feasibility Study identified a total of 18 key indicators (yielding a sub-set of 55 indicators) after a literature search of international best practice. One of the major factors in determining which indicators to use will be the availability of data. After considering the ability to measure the indicators and the findings from PIARC, KBR refined the 18 indicators to seven (Table 5.1).

The table shows the new indicators along the left hand column and shows how the previous 18 indicators relate to the seven new ones on the right hand side. For example, the new mode split indicator is composed of the former mode utilisation and telecommuting and demand for public transport indicator, whilst the former transport supply indicator has been split to cover both the new accessibility and supply and demand indicators.

Table 5.1 Progression of sustainability indicators

<table>
<tr><th>New indicators</th><th colspan="6">Previous indicators that have been grouped into a new set of sustainable indicators</th></tr>
<tr><td>Accessibility</td><td>Accessibility</td><td rowspan="2">Transport Supply</td><td rowspan="2">Mobility</td><td rowspan="2">Transport Effective-ness</td><td rowspan="2">Transport Efficiency</td><td rowspan="2">Social Equity</td></tr>
<tr><td>Supply and Demand</td><td>Travel Demand</td></tr>
<tr><td>Mode split</td><td>Mode Utilisation</td><td colspan="5">Telecommuting and Demand for Public Transport</td></tr>
<tr><td>Noise</td><td colspan="3" rowspan="2">Environmental</td><td colspan="3" rowspan="3">Health</td></tr>
<tr><td>Emissions</td></tr>
<tr><td>Health and safety</td><td colspan="3">Transport Safety</td></tr>
<tr><td>Land value</td><td>Increasing Land Values</td><td colspan="2">Infrastructure Support</td><td colspan="3">Job Creation</td></tr>
</table>

Previously defined indicators not covered by the above seven sustainability indicators, are biodiversity implications, customer satisfaction and use of natural resources. The Corridor Transit system runs almost exclusively within existing urban corridors and therefore does not directly affect biodiversity. Customer satisfaction is difficult to measure until the Corridor Transit system is implemented whilst the use of natural resources could be considered neutral as car drivers switch modes and therefore use less fuel. Land value is shown below as it was a component of the 18 original indicators and is now discussed in more detail later in the chapter.

As mentioned, this study has selected from a list of international best practice sustainable indicators seven key indicators that are used for assessing options, which are described below. The indicators allow each of the options to be quantitatively assessed for comparison between each other. The transport model is the key tool for providing inputs to the sustainability assessment.

5.5 ACCESSIBILITY (TRAVEL COST)

Accessibility can be measured in several ways, including distance, time, mode, and number of interchanges or a combination of all. A travel model works upon the principal of generalised travel cost, which can be a function of journey time and distance for car journeys or the combination of walking, waiting, interchange and in-vehicle times for public transport journeys. Furthermore, the model can include public transport fares and also parking charges to fully reflect the cost of travel. A journey that is accessible will have a low travel cost, reflecting a short journey distance and time, along with either low parking charges or direct and cheap public transport. An inaccessible journey will tend to be long in both time and distance, with either high parking charges or require at least one public transport interchange, which further increases journey time and therefore journey cost.

The transport model is able to produce an average trip cost for each assignment. That is the average cost for all trips from each option on the network with and without public transport improvements.

Whilst the public transport improvements increase accessibility by car by reducing congestion and therefore decreasing journey time, the effect of parking charge increases in town centres has caused an increase the cost of car travel and therefore decreased mobility by car. The public transport improvements have reduce journey times along the corridors' and therefore increase accessibility by public transport.

This study will measure accessibility as:

- highway network average travel speed – obtainable from the transport model
- average travel cost per trip (car and PT trips) – obtainable from the transport model.

5.6 TRAVEL DEMAND

Travel demand is measured in trip rates. These rates can be the number of trips per person or per time period (typically year) or per person per time period. Progression towards increased sustainability within cities involves reducing the number of trips made by car and replacing them with trips by public transport, cycling or walking.

Each land use scenario will generate demand for travel based upon the specific land use options of the scenario. Trip rates within the model are usually heavily influenced by where people chose to live and where they work. Scenarios with more people and more jobs will generate more trips and the length of these trips are determined by the distance between these origins and destinations.

- This study will measure travel demand as:
- trip rates/person – obtainable from the transport model
- highway network VKT – obtainable from the transport model
- road congestion as measured by length of roads >V/C 0.95 – obtainable from the transport model.

5.7 MODE SPLIT TO PUBLIC TRANSPORT

Multi-modal travel models assign trips to each mode based upon changes in travel costs between each mode. A public transport scheme, which makes public transport journey times more comparable with car journey times will increase travel demand for the service at the expense of travel demand by car. The model outputs travel demand for each mode.

This study will measure mode choice as:

- proportion of travel by each mode – obtainable from the transport model.

5.8 ROAD TRAFFIC NOISE

Road traffic noise is a function of traffic volume, speed and composition and is complicated further by road pavement, road geometry and individual vehicle noise (NSW Department of Main Roads, 1987). Noise is measured in decibels, and is weighted to reflect to loudness, hence the unit measurement of noise being dB(A). Common noise levels are shown in Table 5.2.

Table 5.2 Noise levels of different activities

Activity/object	dB(A)
Quiet Bedroom	20 - 30
Daytime levels in quiet residential area	35 - 45
Busy Central Office	50 - 60
Lawn Mower at 15 metres	70
Jack Hammer at 1 metre	100
Jet Aircraft Taking Off at 25 metres	140

Source: Environment ACT, 2003, Noise Fact Sheet

It is considered that noise of an intensity level of over 63dBA requires mitigation, such as greater separation from adjacent land uses, barriers or other noise amelioration measures.

Unlike traffic pollution, which effects both people and the atmosphere, road noise effects only people. Using a traffic model it is not possible to accurately predict the number of people affected by road noise, as such information is not contained in the model and is not readily transferred to a means of estimating the number of people in proximity to the road network. Instead, this study will measure road traffic noise as the length of road where road noise exceeds 63dB(A).

5.9 TOTAL TRANSPORT EMISSIONS

Transport is on of the largest sources of greenhouse gases and other emissions in cities around the world. In the ACT the transport sector is responsible for approximately 27% of greenhouse gas emissions, with 85% of the those emissions due to road transport (PALM, 2003, *Sustainable Transport for the ACT - an issues paper*). Whilst new fuels (such as natural gas), and fuel and engine technology is helping to reduce emissions, traffic growth is overriding any technological benefits and emissions continue to rise.

The travel model considers only emissions from vehicles in the model, such as cars, trucks and buses. An electrically powered corridor transit system would not produce emissions that could be registered in the model as these would be produced as part of a greater release of emissions from a power station. However, the corridor transit system, as demonstrated above, encourages a greater shift from cars to public transport and emissions are reduced as a result.

This study will measure transport emissions:

- Pollutants for car network – obtainable from the transport model
- Pollutants for PT network – obtainable from the transport model
- Emissions hotspots – obtainable from the transport model.

5.10 PUBLIC HEALTH AND SAFETY

Traffic causes public health and safety problems in several forms; some easily measurable and some less so. Road traffic accidents are the most easily measurable and can be forecast using transport models. Other traffic related health issues include the direct effects of transport-generated atmospheric pollution and the indirect effects of obesity, aggravated by sedentary, car based lifestyles. These later two are much harder to quantify, especially in a transport model, but are gaining more significance as Governments around the world consider the full costs of transportation.

5.10.1 Traffic accidents

Car accidents have been estimated at costing $15 billion per year in Australia based upon 1996 data (Australian Transport Safety Bureau, 2002). Road traffic accidents account for 93% of all transport related accidents in Australia whilst rail accounts for 2% (Australian Bureau of Statistics, 2002).

Road traffic accidents are a problem around the world and accounted for 1630 deaths in Australia in the year 2000, 16 of which are in the ACT (Table 5.3). The ACT has the lowest accident rates both per person and per registered vehicle in Australia and is one of the lowest rates in the world, but approximately 200 people are injured on Canberra's roads each year, 10% fatally injured.

Table 5.3 Road traffic accidents involving fatalities

Year	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
1994	552	345	364	143	195	52	36	15	**1,702**
1995	563	371	408	163	194	53	56	14	**1,822**
1996	538	382	338	162	220	53	58	17	**1,768**
1997	525	346	322	123	184	29	56	17	**1,602**
1998	491	348	257	152	199	47	59	20	**1,573**
1999	506	345	273	132	188	47	44	17	**1,552**
2000	543	373	276	151	185	38	48	16	**1,630**

Source: ABS 2002

In this study road accidents are measured as the number car accident injuries - obtainable from the transport model.

5.10.2 The human effects of air pollution

There is a growing concern over the health effects of travel, in particular the effects of transport pollution. There is a growing body of research into the effects of pollution on human health around the world that is beginning to establish the size and scale of the problem. It is thought that in some Western countries, it is estimated that car emissions kill twice as many people as car crashes (Kunzli *et al* 2000).

A recent study by Kunzli et al, entitled *Public-health impact of outdoor and traffic-related air pollution: a European assessment* (Kunzli et al, 2000) outlined some of the effects of air pollution. The study estimated the impact of outdoor (total) and traffic-related air pollution on public health in Austria, France, and Switzerland. The study found that air pollution caused 6% of total mortality or more than 40000 attributable cases per year. About half of all mortality caused by air pollution was attributed to motorised traffic, accounting also for more than 25000 new cases of chronic bronchitis (adults); more than 290000 episodes of bronchitis (children); more than 0·5 million asthma attacks; and more than 16 million person-days of restricted activities (Kunzli et al, 2000).

In a letter to Mr Kugathas at PALM, dated 18th May 2003, Professor Tord Kjellstrom of the National Centre for Epidemiology and Population Health raised the same concerns outlined above about health externalities and begins to quantify some of the costs. Research by Professor Tord Kjellstrom has discovered that in New Zealand, an estimated 900 deaths per year are attributable to air pollution (2% of all deaths), of which nearly half are due to motor vehicle emissions (Kjellstrom et al, 2002). These deaths (450) are more than the number of road traffic fatalities in New Zealand (395) in 2001 (Land Transport Safety Authority, 2002).

5.10.3 The effects of urban sprawl

There is a growing body of research that is linking urban sprawl to ill health, in particular obesity and chronic disease. This follows on from the research that has been undertaken in recent years promoting the health benefits of physical activity. The Smart Growth America project commissioned research titled "*Measuring The Health Effects of Sprawl"* (McCann and Ewing, 2003).

The research found that people living in counties in the US marked by sprawling development are likely to walk less, weigh more and suffer from hypertension more than those in less sprawling counties. The study developed a sprawl index, based upon:

- population density;
- percentage of population living in low densities (less than 1500 people per square mile);
- percentage of population living in high densities (more than 12,500 people per square mile and characterised by transit development);
- net population density of urban land;
- average block size; and
- percentage of small blocks (0.01 square miles or less).

There was a strong link between sprawl index and obesity. People living in the most sprawled county weighed an average of 2.7kg more than those in the least sprawled county (McCann and Ewing, 2003).

A further study by Reid et al into the risk of road traffic accidents and sprawl found similar correlations. For every 1% increase in the same sprawl index as identified above (that is becoming less sprawled) there was a 1.49% increase in road traffic accident risk.

In this study we have not been able to quantify the health effects of transport in numerical terms. Each option is tested against a range of land use scenarios and we can conclude from the evidence presented above, that options and scenarios that have high population densities and less car use will have better health implications than other scenarios and options.

5.11 TRANSPORT SYSTEM RELATED LAND VALUE BENEFITS CAPTURE

5.11.1 Land value benefits

Introduction

The aim of this section is to provide an assessment of the likely land value capture benefits related to a light rail scheme for Canberra. KBR instructed Colliers International to provide an independent and objective valuation of land values as a result of a new light rail route. The valuation was undertaken by Paul Powderley AAPI of Colliers International on 10 June 2003, and enclosed in a report titled *Valuation Advice for Canberra Public Transport Futures ACT* dated 12 June 2003. This section is a précis of that report.

Method

Colliers International were commissioned to assess the land value capture benefits of a Stage 1 network light rail scheme. The first line runs between Belconnen and Civic via Bruce Stadium. The second line runs between Gungahlin and Civic and continues via Barton/Parkes to Kinston/Manuka. The third line runs between Tuggeranong, Woden and Civic. Along each of these three lines, KBR identified key sites which could accommodate the stations and opportunities from further development. In their report *Valuation Advice for Canberra Public Transport Futures ACT*, Colliers International have quantified the indicative land values that can be derived from a change of use and increased access to these locations as a result of the rail system.

Colliers International have applied the fundamental principles of valuation:

> "…. if something positive happens in an area then property values increase and vice versa if something does not have public support." (Powderley, 2003).

They believe that a well located and strategically staged transport route would have a positive affect in almost all cases of nearby property.

To undertake the valuation, Colliers International have identified the value capture of the following categories:

- Improvement in existing property values which will result in a greater rating base and greater revenue for the Government.
- Creation of new sites and development opportunities along routes and adjacent to stations/platforms.
- Reduction in the number of public car parks owned by the Government which are generally in town centre locations and would have much higher order land values.

Results

Colliers International have provided value estimates for all land that would change value as a result of a light rail network. The items of land that are believed to gain in value are listed in Table 5.4. Colliers International only considered land value gains for new developments and changes of use resulting from the light rail network. They have excluded further benefits that may accrue to existing developments in close proximity (c500m radius) to the light rail network nodes. Such changes in value would not benefit the ACT Government first hand, but would benefit the ACT later through increased rateable values. Furthermore, gains in property value, when ever realised, would feed back into the economy at some point.

Table 5.4 Land value gains

Section	Location	Development	Value
City to Belconnen	3 stations before Bruce Stadium	50-60 residential units	$3,000,000
	Haydon Drive/Battye Street intersection	50-60 residential units	$2,000,000
	Opposite bus interchange	Residential/commercial	$3,000,000
	Florey Drive - Ginninderra Drive section	Residential	$1,000,000
Parliamentary triangle loop	National Convention Centre car park	Residential/office	$5,000,000
	10000 sqm of Kings Avenue car park	Residential/commercial	$4,500,000
Northbourne Avenue corridor	Antill Street	100 residential units	$3,000,000
	Mitchell and Gungahlin town centre	Residential/commercial	$4,250,000
Inner South loop	Kingston Oval railway	Residential	$5,000,000
	Fyshwick loop	Commercial	$2,000,000
Woden	Curtin crossover	40-60 residential units	$2,000,000
Woden to Tuggeranong	Athllon Drive between Mawson and Torrens	Residential	$3,000,000
	Athllon Drive opposite Greenway	Residential	$4,000,000
Total			**$41,750,000**

Comparisons with other studies

There have been many pioneering studies undertaken in North America and Europe to quantify the benefits to adjoining land owners served by new road and public transport systems as summarised by Table 5.5 and Table 5.6 below (Smith, J.J., 2001). Most commonly, the travel time-savings achieved by new road and public transit projects are capitalised into higher home prices in the benefiting residential areas. However, for some schemes the land capture value has funded part of the scheme or continues to contribute to the operating costs.

Conclusions

The land valuation undertaken objectively and independently by Colliers International reveals that a light rail scheme could contribute over $40million to the ACT, plus on going benefits associated with increased land values in close proximity to the light rail stations. It is understood that such benefits are unlikely to be gained from any mode other than rail-based transit.

Table 5.5 Examples of other cities where Land Value Benefit Capture has been implemented for transit systems

City	Description
Toronto, Canada	Existing property tax revenue increased by US$5 million annually along the route of the Yonge Street Subway.
Los Angeles, USA	The Metro-Rail Special Benefit Assessment District survived a court challenge and is contributing US$130 million per year towards retiring LA Metro Bonds.
London, UK	Approximately $250 million of the total capital cost ($700 million) of the Docklands Light Railway was contributed by developers.
Milan, Italy	The first 35 km of Metro Routes were funded by a levy on properties within 500 m of stations. It raised a total of 36 billion lira.
Hong Kong, China	The mass transit railway receives no subsidy and recovers costs from rent, from land development around stations.
Miami, USA	Site rents cover 25% of the total capital cost of the Miami Metrorail.
Copenhagen, Denmark	A new transit line to a new suburb is being funded by selling public land for development.

Table 5.6 Examples of other cities where Land Value Benefit Capture have been identified by researchers but not implemented

City	Description
Lindenwold, USA	$4,580 (Year 1987). Estimate of the increase in value of a family home in a transit corridor.
London, UK	£1.3 billion increase in the annual rental value of commercial and residential property along the route of the Jubilee Line Extension, project cost of £3.5 billion.
Portland, USA	10% increase in value for homes within a 500 m zone of a LRT station.
Boston, USA	6.7% increase in value for homes being located within a community with a commuter rail station.

City	Description
San Francisco, USA	$8,000–$9,000 (Year 1997). Typical increase in the value of homes within 300m of a Bay Area Rapid Transit (BART) station stop.
Orange County, USA	House values $599,400 (Year 1998) for inner areas vs $320,000 for outer areas (equivalent to $11,200 per additional minute of commuting time).
Atlanta, USA	In neighbourhoods with low values, a transit stop raised values but in neighbourhoods with high values a transit stop lowered values.
Tyne and Wear, UK	In a relatively short two month period, a 1.7% increase in property values occurred for properties near the newly opened Metro Stations.

5.12 INFRASTRUCTURE BENEFITS FROM REDUCED URBAN SPRAWL

5.12.1 Introduction

This section considers the infrastructure benefits from reducing urban sprawl. In this context, infrastructure includes not only transport infrastructure but also water and utility infrastructure. Urban sprawl is generally regarded as the increase in the urban foot print at the urban fringe with low density housing. Urban sprawl is then associated with low public transport provision and increased reliance upon the private car for all trips, which means more roads locally and elsewhere.

The principle of urban consolidation has been present in most States within Australia for the past 20 years, following the notion that more compact cities increase sustainability (Bunker et al, 2002). Urban consolidation was first endorsed by a Special Premiers' Conference in 1991 and support grew during the early 1990's with a range of reviews and initiatives endorsed during this period (Bunker et al 2002).

5.12.2 Issues

There is no simple model that describes either the costs of urban sprawl or the benefits of urban consolidation. One major argument for consolidation is that higher densities are required to reduce infrastructure costs per household (Urban Frontiers Program, UWS, 2001). Whilst there is a clear logic to this argument, it is too simple to be widely applied to all developments. For a new release area, higher densities will reduce the amount and length of infrastructure required. However, the amount of infrastructure required is dependent upon the topography of the land and the ability of the new development to connect to existing supplies (Urban Frontiers Program, UWS, 2001).

A similar argument could be made for consolidating existing urban areas, but the cost of disturbance and re-connection to existing services prevents a simplified model being developed. Indeed, the direct costs infrastructure for infill compared to new release areas on the urban fringe depend greatly on excess capacity in the existing system (Gillespie Economics). There is often excess capacity for water and sewerage, but less frequently capacity for storm water or roads.

The relationship between urban consolidation and transport costs/benefits is complex (Gillespie Economics). If the consolidation is small scale, and there is existing transport capacity and based around a public transport node, then any extra travel demand could be absorbed without any further transport infrastructure of public transport service costs. However, if the consolidation were to take place over a large area not only may there be an increase in the amount of parking space required but also in the number of journeys made by car to a wide variety of destinations.

There have been few studies into the transport impacts of urban consolidation. As reported in *Sydney - the urban sustainability challenge*, by Gillespie Economics the RTA undertook a study causing the Department of Planning to conclude that the urban consolidation generates efficiencies, especially in public transport compared to fringe development. Other studies by UITP, mentioned in *Sydney - the urban sustainability challenge*, by Gillespie Economics confirm that higher density cities have much greater public transport participation and reduced private vehicle km.

5.12.3 Case studies

There have been several studies into the costs of urban sprawl both in Australia and beyond. Some of the examples involve real world situations whilst others rely entirely or in part on theoretical studies.

Parklea Precinct of Rouse Hill Development Area

A study was undertaken by Travers Morgan and Applied Economics in 1991 in Sydney to compare the costs and benefits of developing the Parklea Precinct of Rouse Hill Development Area to urban consolidation in Parramatta, Ryde and Hornsby (Sydney - the urban sustainability challenge, by Gillespie Economics). The study discovered that there was sufficient spare capacity in infrastructure in the existing areas for infill to be considerably cheaper than fringe development, which would require all of this infrastructure from new. The cost of savings was between $205,000-$216,000 per hectare. Table 5.7, equivalent to approximately $15,000 to $20,000 per detached dwelling (11–13 dwellings per hectare).

Table 5.7 Cost savings per hectare from infill in Parramatta, Ryde and Hornsby compared to developing the Parklea Precinct

Item	Cost saving per Ha ($1991)
Water	$10,000
Sewerage	$14,000-$25,000
Stormwater	$17,000
Electricity	$16,400
Gas	$7,500
Telephone	$18,700
Sub-arterial roads	$121,500
Total	**$205,100 to $216,100**

Source: Sydney - the urban sustainability challenge, by Gillespie Economics

Erskine Park/St Clair and Rouse Hill

A similar theoretical study was undertaken for the NSW Department of Planning which compared fringe development in Sydney's Erskine Park/St Clair and Rouse Hill suburbs with urban consolidation of different densities, based on land around

Bankstown and Hurstville stations. The aim of this study was to provide a methodology which allow cost to be compared between various fringe developments and locations of urban consolidation.

Whilst the costs were easy to identify for the new development areas, as outlined in the issues section above, the costs for the infill varied upon local capacity. Despite these differences the study found that there were significant cost savings for urban consolidation compared to fringe development (Table 5.8). Savings ranged from over \$17,000 per dwelling when comparing 450m^2 lots in the fringe with 18 dwellings/ha to over \$30,000 per dwelling when comparing 840m^2 lots in the fringe with 50 dwellings/ha.

Table 5.8 Cost differences between infrastructure provision in the urban fringe and urban consolidation

Fringe Consolidation	Saving per dwelling ($ 1989/90 prices)			
	840m^2 lot 50dw/ha	840m^2 lot 18dw/ha	450m^2 lot 50dw/ha	450m^2 lot 18dw/ha
Sewer	8422	7752	4551	3881
Water	4171	3601	3411	2841
Stormwater	7276	7276	3898	3898
Gas	1753	1492	1369	1108
Power	2248	2152	1885	1789
Telecom	1031	795	659	423
Local roads	4635	4635	2483	2483
Miscellaneous	1148	1148	615	615
Total saving	**30684**	**28851**	**18871**	**17038**

Source: NSW Department of Planning, 1991, Public Sector Cost Savings of Urban Consolidation

ACT Government

A study outlined in *Sydney - the urban sustainability challenge*, by Gillespie Economics reveals how the ACT Government examined the comparative costs of two options for accommodating growth. One option was greenfield development in Gungahlin of 2500 households per year with only 500 infill households per year. The second option balanced the development with infill of eventually 1500 households for both new development and infill per year. The study concluded that with greater urban consolidation, the ACT Government could defer over \$58 million in capital expenditure over five years and also save \$6 million in recurrent costs.

New Jersey

A recent study in New Jersey was done during the master plan process, which compared the infrastructure costs of conventional sprawl based growth against a mix of infill, high density new development and some traditional sprawl. To highlight that the approach was neither new or radical, the alternative to sprawl was considered by Mogravero as "..not a revolutionary plan but rather modest tweaking of existing patterns." (Mogavero, 2003). However, the results were dramatic.

The alternative approach produce US$1.18 billion savings in roads, water and sewer construction, which was equivalent to US$12,000 per new home. In addition, it was calculated that the local government would save US$400 million per year (Mogavero, 2003). These costs exclude the reductions in spending on storm drainage, school transport and travel time savings for the emergency services.

5.13 JOB CREATION

Transport is beneficial to the economy. Cities without a sustainable transport system will not be able to compete economically (UITP 2003). Transport enables goods to be delivered to markets and people to both get to work and get places of consumption (National Institute of Economic and Industry Research, 2002). As populations increase public transport becomes more viable and a more desirable alternative to road congestion. Public transport schemes around the world are being introduced to facilitate further economic growth.

In Smart Cities, good public transport is a must. Good public transport is seen by many of the international city surveys to improve living standards and improve the liveability of a city. Poor public transport reduces the liveability of a city as it restricts access to those who either do not have a car or chose not to use one. In a city the size of Canberra, to neglect public transport in the future would either require an expansion of the road network or an increase in congestion and resultant pollution.

Public transport concentrates land use and infrastructure within the transport corridor, especially at the stations/nodes. This concentration of development, rather than peripheral urban sprawl, is more cost effective and generates synergies between different land uses to the benefit of the economy and further reinforcing the viability of the transport corridor.

Investment in public transport increases the net worth of land/property values. Considerate public transport will reduce blight so that the land around the public transport node will increase in value by as much as 20% as witnessed along the Brisbane bus lane (UITP, 2003) whilst the land away from the node is unaffected. Furthermore, investment in adequate, dedicated public transport infrastructure is a one off cost, just like a road. However, increasing the frequency of service and size of vehicles can accommodate passenger growth much more sustainably than additional road development.

Public transport is considered attractive by employers as it provides access for employees to work (Kenyon, P. and Wills-Johnson, N., 1999). Town centre development is both attractive for the employer, as other amenities are closely located, and the public transport operator. Furthermore, an extensive public transport system reduces the need for employers to provide land or structures for car parking, which is very costly in town centres.

6 Transport Technology

6.1 INTRODUCTION

An extensive literature review has been undertaken of existing cities with similar populations and bus based public transport systems to Canberra to identify examples of initiatives, which either have increased or are anticipated to increase levels of public transport usage. These have been described in fully in the KBR report *Canberra public transport futures feasibility study - Stage 1 Study Working Paper "Scoping Report"*.

6.2 LIGHT RAIL AND BUS: MAKING THE RIGHT CHOICE

Light rail and bus: making the right choice by Professor Hass-Klau (2000) summarises the results of a worldwide study of buses and light rail with the aim of evaluating the success of past schemes for the benefit of future schemes. What becomes clear from the paper is that there is a range of dedicated public transport systems functioning around the world but there is no one formula or approach for success.

In general, the study found that light rail required less space than bus based schemes and had the greatest carrying capacity. A scheme in Ottawa carried the same number of people by bus-ways as could be transported by light rail. A similar, high capacity, guided and unguided bus system in Nancy has yet to generate successful patronage. Also, some of the unguided sections have recently been converted to guided operation (Transit Australia, September 2003).

Operating speed is governed by stopping frequency. Buses and bus-ways tend to have fewer stops than light rail and as a result run faster than light rail in such conditions. However, where light rail shares road space with other traffic, light rail tends to be quicker than buses as it has a dedicated route. This dedicated route tends to remain free of traffic compared to bus lanes, which still suffer from other road traffic illegally using the bus lane.

Noise and pollution issues tend to favour light rail over buses, although changes in diesel fuel technology towards zero emissions is reducing the difference. Light rail has better running comfort than buses, but ride quality of buses can be good.

Scheme costs vary enormously, with buses running on existing roads being much cheaper than any other option. However, the cost of dedicated infrastructure for light rail, bus-ways and guided bus are much more similar than often assumed. Vehicle costs vary much more significantly, with light rail costing much more than buses, but also lasting much longer than a bus. Studies into operating costs have shown that light rail is slightly cheaper than buses on a lifetime basis.

Details of scheme costs and performance, as listed in *Light rail and bus: making the right* are shown below (Table 6.1).

Table 6.1 Comparison of bus and light rail systems

Light rail speed, mixed traffic	15-36km/h (Geneva and Los Angeles)
Light rail speed, right of way	23-57km/h (Denver and Los Angeles)
Bus speed, mixed traffic	11-28km/h (Dublin and Aarhus)
Bus speed, right of way	25km/h in bus lane and 50km/h in bus-way (Southampton and Pittsburgh)
Infrastructure	Too location specific to allow meaningful comparisons
Light rail vehicles	$2.5-$5 million per unit (Manchester and Strasbourg)
Bus	$312,000 single deck $460,000 articulated (Leeds)

Source Haas Klau, 2000 Light rail and bus: making the right choice

Newly created public transport infrastructure generates significant growth in the number of passengers using public transport. Light rail infrastructure tends to generate much greater passenger numbers than most bus based systems (Table 6.2).

Table 6.2 Growth in trips for cities comparable in size to Canberra

Town	Population	Mode	Trips per resident	Trip growth over 10 years
Augsburg	250,000	Light rail and bus	207.6	23.2%
Freiburg	202,000	Light rail and bus	323.8	38.0%
Gent	260,000	Light rail and bus	179.2	50.5%
Karlsruhe	268,000	Light rail and bus	310.8	29.9%
Zurich	342,000	Light rail and bus	786.5	24.4%
Aachen	250,000	Bus only	224.0	74.2%
Southampton	214,000	Bus only	82.2	19.4%
Cardiff	300,000	Bus only	98.3	-10.3%
Leicester	285,000	Bus only	101.4	-19.7%
Nice	360,000	Bus only	99.4	-14.9%
Canberra	320,000	Bus only	50	

Source Haas Klau, 2000 Light rail and bus: making the right choice

The table shows a range of European cities of similar size to Canberra, the varying trip rates per resident and growth rate over time. Aachen, as a bus based town, has a high trip rate for bus only towns, but most light rail towns have trip rates from half to four times in excess of that. All light rail towns have experienced a growth in the number of trips per resident during the past decade compared to a mixed reaction in bus only towns.

The reason for the dramatic increase in trip rates in towns with light rail is unclear. Cities that adopt light rail do however have a tendency to implement traffic restraint measures more effectively. Furthermore, light rail is indicative of a higher level of political support for public transport than bus schemes. Haas Klau argues that it is the political support behind light rail that is its prime driver for improved public transport. Light rail is an inflexible, fixed route mode but this is perceived as an advantage over a bus as it means the service has a degree of permanency. The very flexibility of bus becomes a disadvantage as services can be readily changed.

6.3 BUS

Curitiba

One of the world's most successful public transport examples can be found in Curitiba, Brazil. Curitiba's Master Plan integrated transportation with land use planning, with the latter being the dominant driver. The bus system itself is composed of a hierarchical system of services. Five main arteries leading into the centre of the city carry express buses and include:

- exclusive bus lanes;
- traffic signal priority for buses;
- pre-boarding fare collection;
- level bus boarding from raised platforms in tube stations;
- free transfers between lines;
- large capacity articulated and bi-articulated wide-door buses; and
- overlapping system of bus services.

A zoning and land-use policy requires mixed-use high-density development along the major north-south structural axes in order to create the necessary population to support profitable use. It is this **integrated land use, road network and transport strategy** that sees around 70% of Curitiba's commuters use the transit system for daily travel to work.

Transit-way in Sydney

The Liverpool to Parramatta transit-way opened in Sydney in February 2003. The cost of the 31 km Liverpool–Parramatta route was $258 million ($8.32 million/km). It has 21 km along dedicated transit-way and uses bus lanes when running on-carriageway.

The State Transit Authority operates CNG buses along the transit-way. The transit-way is ultimately proposed to be used by a mix of trunk services, which travel exclusively along the transit-way and feeder bus services, which travel along the transit-way for small sections. Service frequency is 10 minutes during peak hours and 15-20 minutes off-peak. Travel time for the whole 31 km route is planned to be 64 minutes, giving an average speed of 29km/h.

There are proposals for two more transit-ways in Sydney, one from Blacktown to Castle Hill and the other from Parramatta to Rouse Hill. The schemes will add a further 32km of transit-way to Sydney. They have a combined estimated cost of $540 million ($16.875 million/km) and completion of both is not expected until 2010 (Transit Australia, April 2003).

Brisbane SE Busway

The Brisbane South East busway, which provides 16km of dedicated bus-way from City to Mount Gravatt and Eight Mile Plains, opened in two stages. The first stage opened in October 2000 and the second stage in April 2001. The scheme was a high profile project used for Olympic events and built to a high standard, costing $500 million ($37 million per km).

The system has relatively few widely spaced stations (over 2 km in outer section). and lacks park & ride facilities. Both of which have lead to some criticism. However, buses using the bus-way can continue to Beenleigh and Gold Coast via the Pacific Motorway. Both BCC and private buses use the network.

The system has a high bus frequency in-bound in the AM peak, i.e. 70 buses in the peak half hour 7.30 to 8.00 am and offers significant travel times savings compared to existing bus services.

Adelaide O-Bahn

The O-Bahn was completed in Adelaide in 1989 to serve the north east corridor from Adelaide. The 12 km route is mainly via a bushland corridor (River Torrens Valley), although buses use existing road for final 2 km into the city.

Park & ride is a very popular use of the O-Bahn and a new park & ride facility at Golden Grove opened in 2002. However, a proposed 10 km SE corridor O-Bahn project has been abandoned. The cost of $182 million ($18 million per km) was considered too high.

6.4 LIGHT RAIL

6.4.1 Light Rail in Sydney

The Sydney LRT was a conversion of an existing freight rail line plus a short section of on street running from Haymarket to Central (initial objections from the NSW RTA were overcome).

The initial section opened in 1997 with extension to Lilyfield in 2001. The third stage, the crucial extension from Central through the core CBD, i.e. via Pitt and Castlereagh Streets is still in the planning stage. These are some concerns from retailers in affected streets in the CBD. The NSW State government has indicated this would not occur before the opening of the Cross City Road Tunnel in 2006. There is also developing community pressure for other extensions, i.e. via Anzac Parade to UNSW, and La Perouse and the former F6 Freeway Corridor from Arncliffe to Caringbah and from the CBD north across the Harbour to Brookvale.

6.4.2 Gold Coast

There is currently a major planning study to establish the feasibility of light rail on the Gold Coast. The aim is to have the scheme completed in mid–late 2003. During the planning stage the mode assessment workshop considered the following vehicle modes:

- light rail

- bus (diesel, electric, guided, non-guided)
- PRT (personal rapid transit)
- monorail.

During the workshop project teams scored each of these modes against the agreed evaluation criteria to identify a preferred mode. In scoring each mode, an assessment was made on each mode's performance. For each subcategory, the mode(s) performing most highly were scored five points (five out of five) with lower levels of performance by other modes scored lower marks. To ensure a robust assessment sensitivity tests were carried out by varying the weightings attributed to each criteria.

Indicative Operating Strategies

In scoring each mode against each attribute, certain operating patterns for each mode were assumed:

- Services would operate along the proposed alignment between Parkwood and Pacific Fair via Southport, Main Beach and Broadbeach.
- Services would stop quite frequently to pick up and set down passengers.
- Services would be frequent: at least every 10 minutes at busy times.
- Vehicles would be identifiably different from other public transport services to clearly differentiate between these and other services.
- Integrated ticketing would be in place and fare levels would be the same for each mode (i.e. the fare component would not impact on the mode selection).
- Existing urban public transport services would remain unchanged within the project area, or would be improved. In other words, there would be no deliberate ‘downscaling’ of these services to the detriment of existing passengers.

Mode Evaluation

Table 6.3 shows the summary evaluation of each mode against each of the five main criteria.

The workshop outcomes revealed that:

- Light rail scores more highly than any other mode, both in terms of the simple sum of scores and the weighted sum.
- Light rail scores highest for all attributes except for 'transport function' (buses score more highly on sub-attributes of extendibility and flexibility) and ‘deliverability’ (buses score more highly on sub-attributes of financial viability and construction impacts).
- Overall, bus-based systems and PRT score lowest. Buses perform least well against the ‘built and natural environment’ and ‘economic catalyst’ attributes.
- Monorail performs about midway between bus and light-rail, scoring higher than light rail in the transport function attribute due to its higher score on reducing congestion (light rail would operate at surface, taking up/sharing traffic space whereas mono-rail would be above ground, not competing for road space). Monorail, and PRT, score poorly against the deliverability attribute, neither being

considered to score well against the sub-attributes of ‘political acceptability’ or ‘community acceptance’.

Table 6.3 Summary Mode Evaluation (Gold Coast Study), 2002

Attribute	Mode					
	Light Rail	Bus Guided	Bus Diesel	Bus Electric	PRT	Monorail
Meet and shape community travel and lifestyle into the future						
20%	26	18	10	10	21	23
Economic catalyst						
10%	18	13	8	10	12	15
Built and natural environment						
35%	24	14	8	15	21	21
Transport function						
10%	17	20	22	21	12	15
Deliverability						
25%	15	12	14	14	6	5
Sum of Scores	100	77	62	70	72	79
Weighted Sum	20.9	15.8	11.3	13.9	15.5	16.2

Note: Weighted sum is score for each attribute multiplied by percentage weighting for each attribute, summed.

Source: Parson’s Brinkerhoff, 2002, Gold Coast Light Rail Feasibility Study

6.5 FUTURE TECHNOLOGIES

6.5.1 Automated People mover

The concept of the automated people mover is to provide passengers with a dedicated vehicle to undertake their journey, on demand and with low energy consumption. The service would not operate to a timetable. Passengers would arrive at a station and either use a waiting vehicle or wait for the next available vehicle. The aim of such systems is to minimise waiting times and to provide a relatively high speed journey to the occupants specific destination.

The system is very much like a taxi on rails. The individual vehicles would each seat less than ten people, or even less to accommodate wheelchairs, strollers, cycles or luggage. However, the range of origins and destinations served would still be governed by station location. There are a range of alternatives in differing degrees of readiness:

- Austrans – work was initiated on the Austrans system in July, 1998 on a 0.5 km test track located in Chullora (http://www.austrans.com.au)
- ULTra – the system is being tested in Cardiff Bay before expansion to link the city to the bay (http://www.atsltd.co.uk)
- Skyweb – work has begun on the first stage of prototyping and was unveiled in April 2003 and the Minnesota Fair (http://www.skywebexpress.com)
- City Mobility – for concept details see the following web pages

- http://www.advancedpassengervehicles.com/brochures/citymobility.pdf

Austrans

The Austrans system, devised by Bishop Austrans Limited, claims to challenge the problem to provide public transport alternatives that can service low-density urban areas, and provide the convenience, flexibility and comfort offered by the car, without its penalties (http://www.austrans.com.au). The system includes using driverless vehicles capable of carrying 9 people in loop configurations. Each looped configuration could carry approximately 10,000 passengers per hour at reasonable speeds (http://www.austrans.com.au).

The system, although confined to tracks is unlike conventional light rail in many ways:

- capacity (exceeding 10,000 passengers per hour per direction dependent on network configuration);
- grade climbing ability (up to 20% grades);
- braking (up to 0.8 g acceleration);
- switching operating times (high speed 1 second switch);
- switch transit times (vehicle maintains high velocity);
- high speeds (up to 120km/hr);
- low infrastructure costs (street level stations for superior access; low cost structures; smallest right of way); and
- design efficiency.

The key to the flexibility of the Austrans system is that the stations are off-line, allowing other vehicles to pass stations without the need to stop. The system is also highly automated. The vehicles are driver-less and are designed to run at headways of only 3 seconds, which is made possible by the switching gear and superior braking compared to other forms of public transport. The typical wait time would be 2.5 minutes

The system is completely electrically powered by a third rail. Furthermore, the system uses less land than most other forms of transport, having a width of under 2m and a turning radius of 8m (http://www.austrans.com/frames-spec.htm).

Ultra System

Other automated people movers, such as the ULTra system currently being tested in Cardiff, UK operate on battery power due to their smaller size (4 passengers) (Lowson 2002). The light weight and electrical operation reduce noise and vibration and requires considerably less power to run then any conventional public transport system (Lowson, 2002). The ULTra system claims to use 80% less energy than conventional trams and 75% less energy than a car (http://www.atsltd.co.uk).

In Canberra

The ULTra system in Cardiff is perhaps the closest to fruition, with hopes for completion in 2005. If the concept proved popular in Cardiff, with a population similar to Canberra, then KBR would suggest that the applicability of a system to Canberra be investigated.

The concept of the automated people mover could be applied to Canberra to connect the airport to Civic. It could provide a cheaper alternative to light rail whilst also providing an innovative solution to public transport access to the airport.

However, the typical APM systems work on a loop, with the aim of connecting several centres within a city, not connecting to points on a linear route.

7 Development of Options

7.1 DEVELOPMENT OF SHORT-TERM PUBLIC TRANSPORT SYSTEM IMPROVEMENT OPTIONS

7.1.1 Common themes

The literature review revealed that public transport improvement schemes generally require a set of common elements which lead to successful operation. Few schemes are a complete success without combining most of the following elements. Many of the schemes reviewed contain all of the elements, whilst other schemes contained most of the elements as follows:

- an integrated, hierarchical network of public transport;
- stations that are integrated with adjacent development and the surrounding transportation network to maximise accessibility;
- integrated land-use zoning and development in transport corridor;
- infrastructure improvements, including platform rather than curb loading and bus shelters, etc.;
- implementation considerations, including exclusive rights stations instead of stops, bus-only corridors ,etc.; and
- customer satisfaction values, including reliability, service frequency, ease of access and travel time, real-time information, shortened headways, etc.

The common elements form three distinct groups, firstly, land use and transport integration, secondly infrastructure improvements and thirdly service improvements.

It has long been recognised that integrated transport and land use planning is both essential and self-reinforcing for public transport. Planning for public transport includes higher densities and mixed land uses around transport interchanges and key nodes. Such densities and mixed uses provide the combination of both passengers for the network and a range of destinations for passengers. However, such densities take time to form, so although integrated land use and transport planning must begin early, the benefits are often not felt for many years. However, bad transport and land use planning can often be felt much sooner through the rise of car traffic.

Some infrastructure improvements can be made relatively quickly and are relatively inexpensive compared to dedicated infrastructure. Such measures include bus priority at intersections, bus lanes, bus only access and better boarding and alighting facilities. All of these measures benefit existing users and improve the position of buses relative to cars. Bus only access can be used in the CBD or at attractions such as the Bruce Stadium. Allowing buses better access than cars to major attractions, again reinforces the image of public transport and creates a benefit unavailable to car users. Better boarding and alighting facilities improve conditions for bus users and elevates the quality of the public transport system. All of these measures will ensure that existing users continue to use public transport whilst encouraging car users to switch modes for some trips.

7.2 GENERAL SHORT TERM MEASURES FOR CANBERRA

The literature review and consultations highlighted a range of short-term measures that would be suitable for Canberra. Short-term measures cover the period up to 2011; which is the time before which long term measures would be most likely to be introduced. They could all be implemented within a year or two without large financial requirements and they all apply tried and trusted approaches:

- Improve peak hour frequency to 10–15 minutes on all ACTION routes;
- employee incentives, i.e. employer provided travelpasses;
- real time information at major bus stops and interchanges;
- improved pedestrian connections to bus stops (network wide basis);
- increased cost of parking in centres (examine sensitivity to more than 1 option);
- bus priority now on existing roads, Tuggeranong to Belconnen trunk corridor;
- demand responsive operation for feeder services (in particular evening services);
- better combinations of fast, stopping and semi-fast services Woden to Civic;
- total reconstruction and amenity improvements to 4 interchanges;
- improved bus stop design with shelters in outer areas; and
- one week free trial for potential new public transport customers.

However, not all of these items can be modelled using the Scott Wilson Nairn transport model of Canberra. The modelling, which is described in more detail in the following chapter, considered the following short term public transport improvements:

- car parking policies
- transit priority at intersections on Northbourne Avenue
- real time information
- exclusive bus lanes on Northbourne Avenue.

A workshop meeting was held on 5 May 2003 with KBR and representatives of PALM, Urban Services and ACTION to review the short-term public transport system improvement options for Canberra under the following agenda.

1. Improve travel time and speed
   - Bus priority measures at intersections and congestion points and transit lanes
   - Straighten bus routes
   - Express buses/routes
   - Optimised corridor approach (balance speed with coverage)

2. Improve inter-modal operations
   - Park & ride, kiss & ride and bike & ride
3. Improve frequency and reliability
   - Real time information
4. Improve ‘Nodes’ and accessibility
   - Improvements to interchanges and bus stops
   - Farside terminus concept
5. Segment market and market focussed approach
   - By trip purpose
   - By peak/off peak usage
   - Choice users vs captives

The following provisional solutions were determined from the workshop discussions.

7.2.1 Network operations

- Gungahlin Drive extension (opportunities for simultaneous introduction of bus priority—Northbourne Avenue)
- Need “corridor approach” to combine measures to maximise benefits, e.g. real time information at interchanges and along routes
- (700 series) Old Express Services use to run into city from various suburbs (were well used)
- As population ages peak tends to spread
- ACTION is developing new GPS System (5 towers—100% coverage) Panic Button Response
- Need to change frequency on inter-town—5 minutes throughout the day

7.2.2 Park & Ride

- Belconnen
  - College Street future potential site with bus layovers
  - Advertise Park & Ride in with increased parking charges)
- Brisbane examples
  - Park & Ride with Childcare Centres

7.2.3 Bike & Ride

- Bike lock-up areas, e.g. Woden hard to find
- Loading bikes on front of bus or inside (time vs pedestrian safety tradeoffs)

7.2.4 Passenger Information Systems

- Real time information, vision impaired and hearing impaired persons also need to be considered
- 1,000 Bus stops—out of 2,800, will have timetables in “blades”
- Christchurch—4 or 5 stops have real time system, e.g. local Canberra industry R&D Electronics could be involved. (Many systems already in other cities–ACTION could buy “off the shelf”)
- Deanes Bus lines Queanbeyan may also be included in system
- Dial-a-bus in Weston many years ago did not work.
  - May be tried again later this year, i.e. after 7.00 pm
  - Typically 5–6 persons per bus, individual drop off or pick up may work
- Shellharbour minibus – trial did work well
- Clubs and shopping centres – some use paratransit, self-run services to take patrons home.

7.2.5 Issues affecting future growth in passenger demand

- Future PALM Urban strategy
  - Likely more urban consolidation in Civic
  - Medium density—Belconnen/Woden/Tuggeranong (Town Centres)
- 20% assumption PT usage in Gungahlin (needs improved PT Service provision)
- SCATS/Traffic signals in Canberra
  - System for adjusting green phases for buses – SCATS 6, ACT Government may have this
- PALM Website has latest planning densities
- Public scrutiny most likely for Gungahlin route costs
- 2006 Opening date Gungahlin Drive Extension (Eastern route)
- Stop PT users being considered as 2nd class citizens
- Intertown Buses need different colours plus bike storage provision, e.g. not local buses
- Interchange redesigns should ensure future provision is left for Light Rail
- Need more quality Bus Stops in outer areas, e.g. where high passenger demand. High standard pedestrian access infrastructure and shelters, seatings, real time information, safe pedestrian crossings of major roads
- Each suburb needs a 15 minute service frequency to Civic/Barton Parkes in peak hour, except if direct route leads through an interchange, e.g. Woden, Belconnen, Tuggeranong

- Need Value Capture Strategy for all routes for development opportunities for ACT government land.

7.2.6 Suburbs needing new peak hour express services

An analysis has been undertaken by KBR of the most recent trends in the bus usage levels (% Journey to work) for each of the 80–90 individual suburbs in Canberra. The year 2001 usage levels for each suburb are summarised by Figure 7.1. Additionally the trend in the usage between the 1996 Census and the 2001 Census is illustrated by Figure 7.2.

The areas identified by the dark blue zones in Figure 7.2 are the areas where the public transport usage decline has been greatest during the period 1996–2001. In these 20 suburbs, the level of public transport usage has typically declined by at least one third (from 6 percent generally to less than 4 percent) during the period 1996–2001.

These 20 suburbs are the areas where the need for improved peak hour bus services is greatest. An indicative future route network for these improved peak hour services (limited stop trips at a minimum 15 minute frequency inbound during 7.30 to 9.00 am and outbound from 3.30 to 6.30 pm) is illustrated by Figure 7.3. These new route networks are required independently of the existing inter-town express route network which currently does not provide adequately frequent or direct services to these areas.

7.3 DEVELOPMENT OF LONG-TERM PUBLIC TRANSPORT SYSTEM IMPROVEMENT OPTIONS

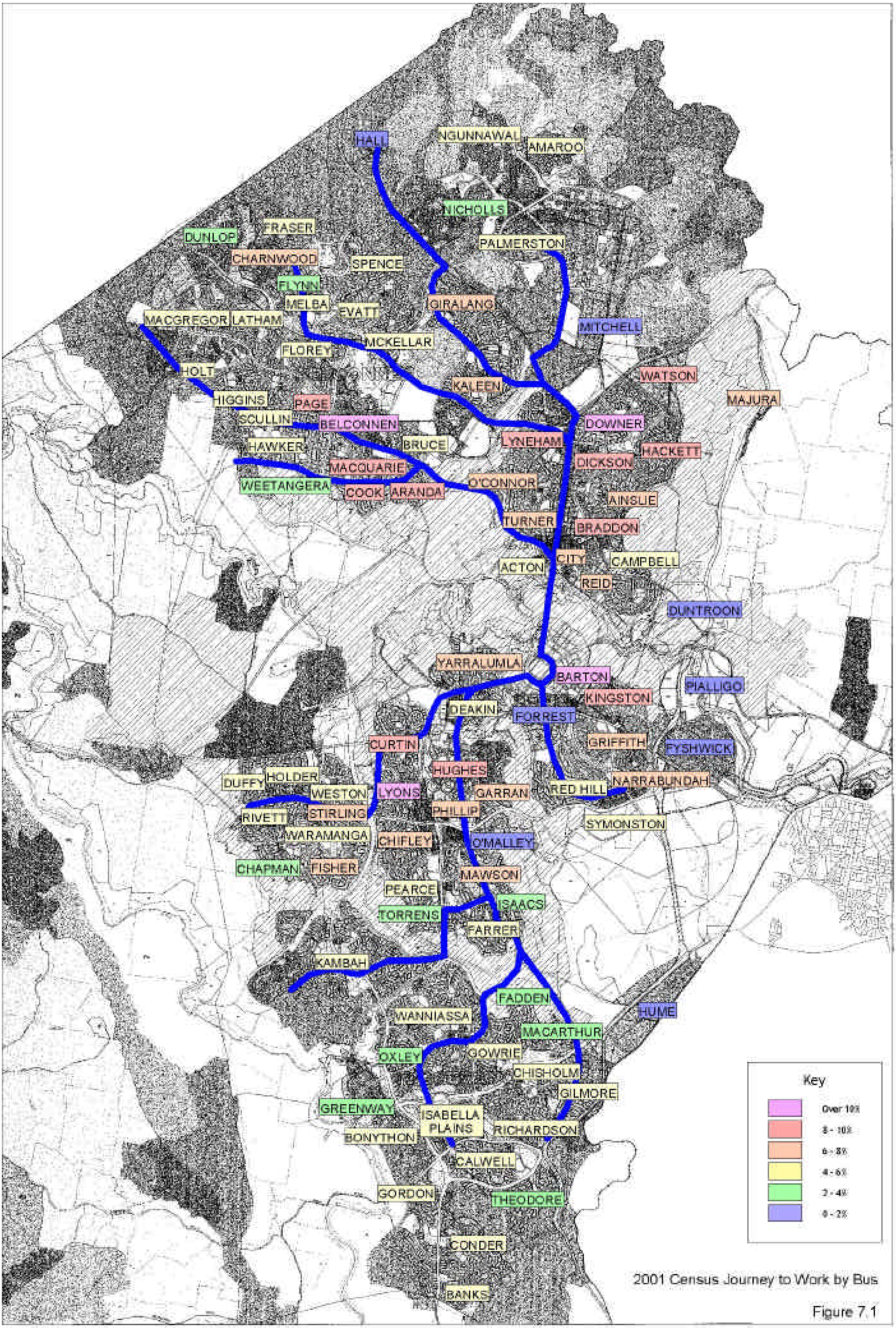
The long-term public transport system improvements are the sustainable solution to transport problems in Canberra. The solutions seek to provide a new or improved public transport system in Canberra that, whilst based upon the existing system and the short-term measures identified above, will offer a radical alternative to journeys by car and significantly improve public transport's mode share.

7.3.1 Range of modes of transport

The solutions proposed for the development of long term public transport system improvements in Canberra are a product of both the international literature review and also the consultations described above. The study considered at an early stage the following range of options:

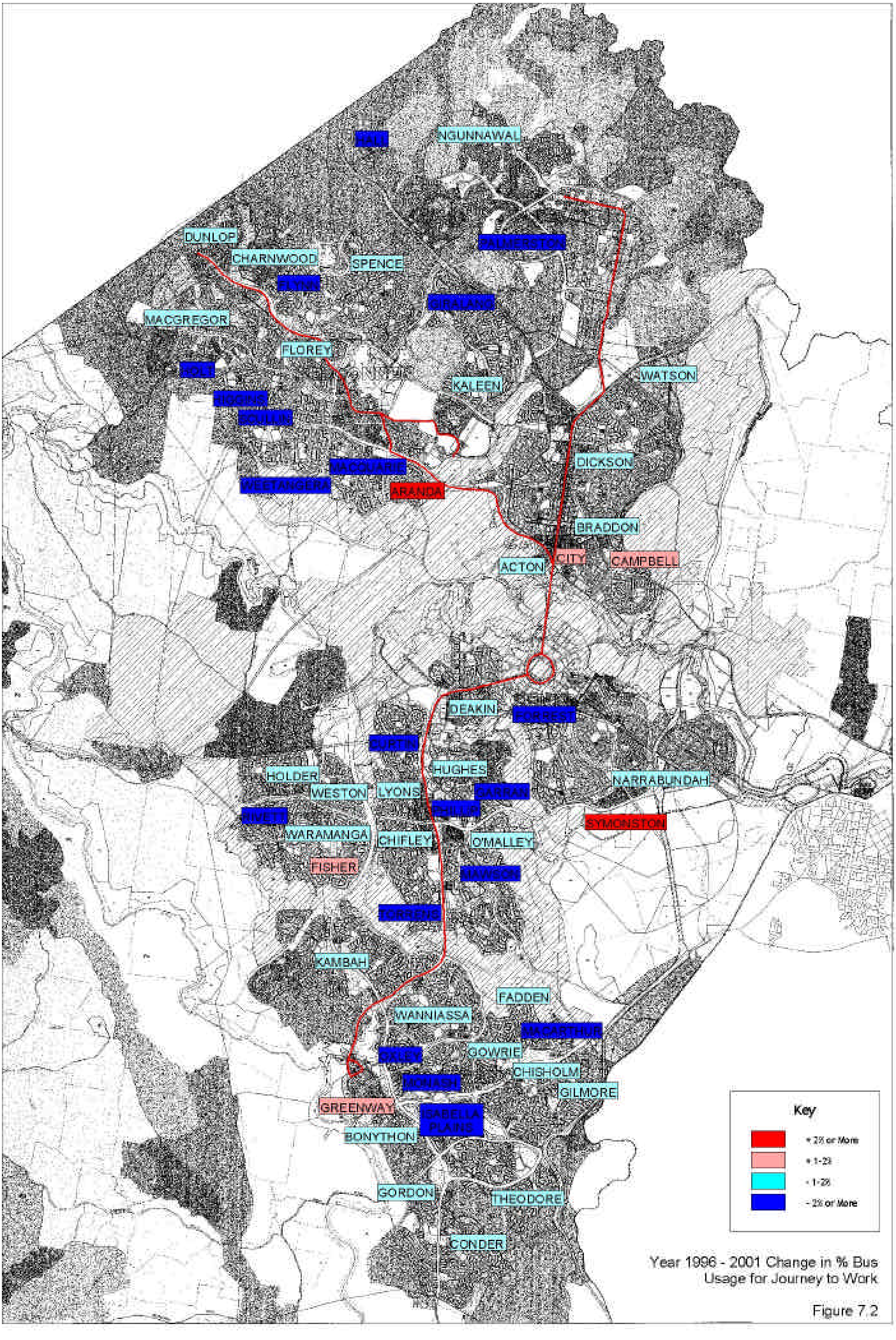
- light rail in a dedicated corridor
- tram (on-road light rail)
- off-road busway
- on-road busway.

These are all present in some form in Australian cities, and have been described in Chapter six.



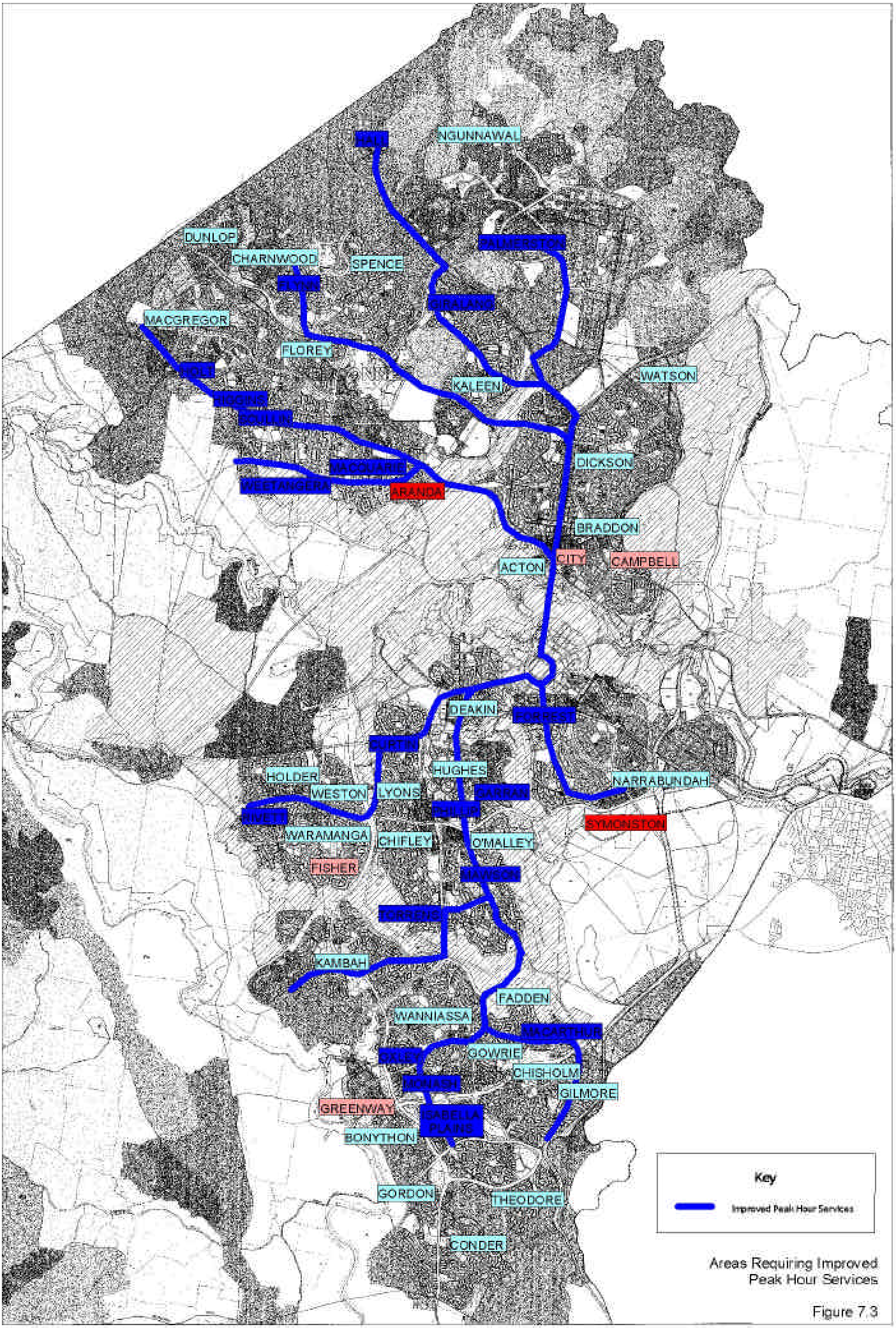
2001 Census Journey to Work by Bus

Figure 7.1



Year 1996 - 2001 Change in % Bus Usage for Journey to Work

Figure 7.2



Areas Requiring Improved Peak Hour Services

Figure 7.3

7.3.2 Practical considerations

Modelling studies allow all of the future scenarios to be tested relatively simply, and allow the impact of options to be tested in different stages before progressing any further. An early test was to consider the possibility of a within-carriageway bus option and what impact this would have upon the road network. Preliminary tests revealed that the levels of congestion within Canberra would be intolerably high if part of the existing highway capacity was devoted to the new transport system. As such, the within carriageway bus system was dropped in favour of modes that could operate within their own dedicated infrastructure.

Transport models, however complex, are simplifications of a reality that is capable of being tested within the computer software package. After detailed consideration, the modelling implications of the other, off-carriageway forms of public transport was such that they would all perform more or less the same in the model. Literature reviews confirmed that bus-based public transport systems on dedicated infrastructure could have similar journey speeds and capacities as some light rail systems.

7.4 DEFINITION OF ALTERNATIVES

A large number of options were initially considered for detailed analysis, but many were screened to select a smaller number of options that would involve a least-cost network and would reach financial viability and could be staged. This study eventually proposed four basic transit corridor options, which could function as either a network or a collection of individual corridors, depending upon staging. The four corridors are shown in Figure 7.4 and listed below:

- Belconnen to Civic;
- Gungahlin to Civic;
- Woden/Tuggeranong to Civic; and
- The Manuka/Civic Loop.

The collective length of this network is 54.4 km.

7.4.1 Belconnen Route

The Belconnen route is proposed to run from Northbourne Avenue/Alinga Street, City to Benjamin Way/Emu Bank, Belconnen, via the Bruce Stadium and The University of Canberra. The route could have 20 station/stop platforms (10 actual stops), and a terminus.

The route would have a total length of 9.5 km and a travel time of 18 minutes each way.

7.4.2 Gungahlin route

The Gungahlin route is proposed to run from Northbourne Avenue/Alinga Street, City to a terminus in Anthony Rolfe Avenue, Gungahlin. The route could have 28 station/stop platforms (14 actual stops), and a terminus at either end. The city terminus would also act as the terminus for the Kingston/Manuka to Civic route.

The route would have a total length of 13 km and a travel time of 24 minutes each way.

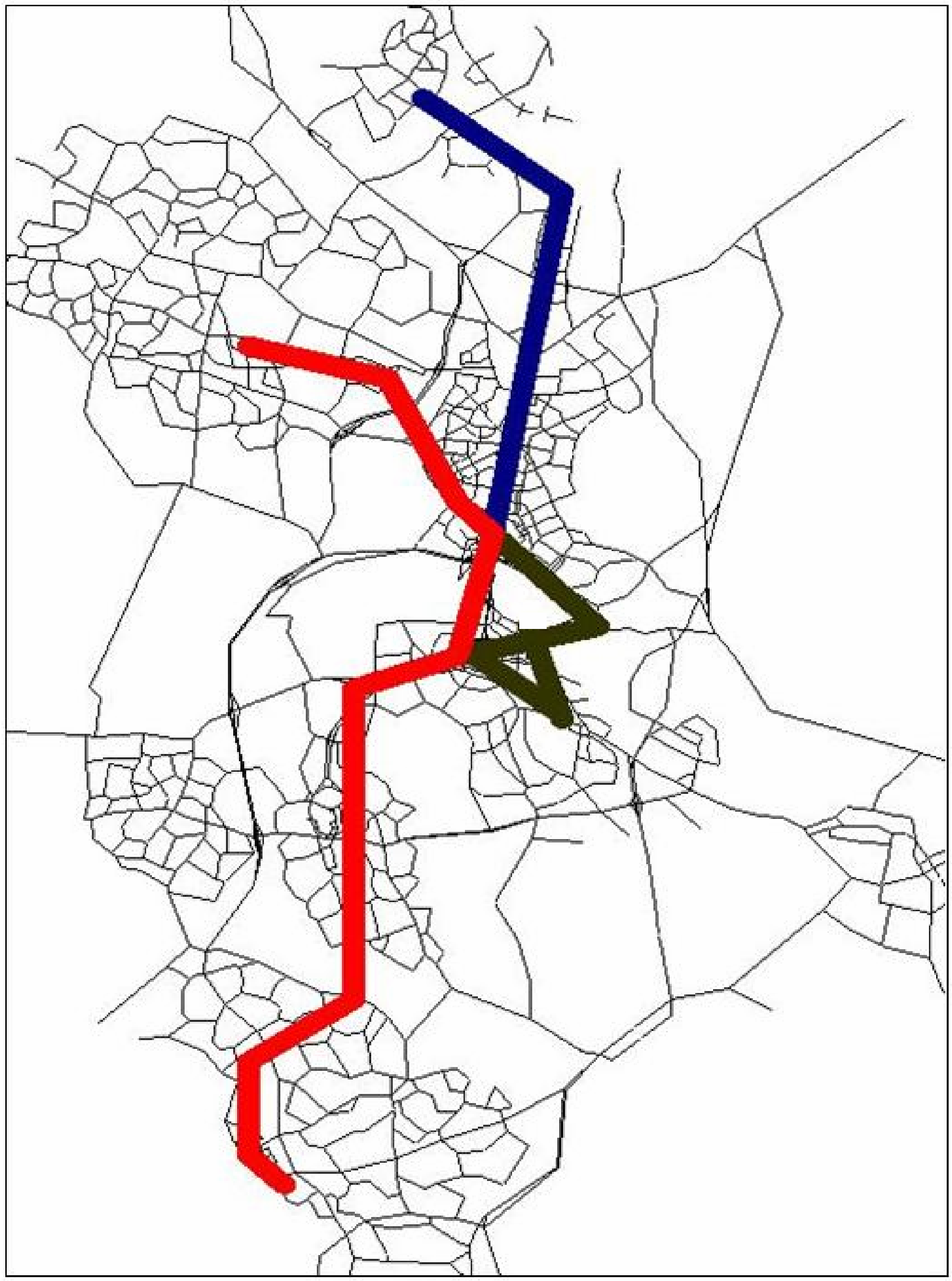


Figure 7.4 Four Primary Corridor Transit Route Options

7.4.3 Woden/Tuggeranong route

The Woden/Tuggeranong route is to run from Northbourne Avenue/Alinga Street to the southern end of Anketel Street, Tuggeranong. The route will proceed via Athlon

Drive to a terminus in Anketel Street. The route could have 40 station/stop platforms (20 actual stops), and a terminus at each end plus three intermediate track cross-overs to allow early return of vehicles in emergencies and six power substations. The City terminus will also act as the City terminus for the Belconnen route.

This route would have a total length of 21.3 km and a travel time of 38 minutes each way.

7.4.4 Manuka/Civic Loop

The Manuka/Civic loop is proposed to run from Northbourne Avenue/Alinga Street, City to Burke Crescent, Kingston. The route is via Alinga Street, Constitution Avenue and Kings Avenue to State Circle. From State Circle the route runs as a one way single track along Brisbane Avenue and Wellington Avenue to Burke Crescent. The route could have 18 station/stop platforms, twelve actual stops, six of which would be around the one-way loop section.

This route would have a length of 8.1 km each way and journey time of 15 minutes each way.

7.5 OPTIMUM EXTENT OF NETWORK

There are two ways to extend the proposed network for Canberra. The first option is to consider extra routes/corridors that could be added to the network. The second option is to extend the initially identified corridors. This study primarily considered extending the initial route options as these were the most viable corridors and adding extra corridors would not be as efficient as developing the existing routes further.

The basic network covered most of the north-south axis of Canberra, leaving only extensions to the north-west, south east and easterly out to the airport. This study did not restrict itself to the ACT boundaries, but also considered an extension to Queanbeyan. There were five main extensions to the routes evaluated as listed below:

- Gungahlin to Belconnen;
- Extension to Airport;
- Extension to Fyshwick;
- Extension to Queanbeyan; and
- Extension to Dunlop.

7.6 SUITABLE FIRST STAGE

The first stage of the network development should ideally include all four of the following routes, and would have a length of 54.4 km:

- Belconnen to Civic;
- Gungahlin to Civic;
- Woden to Civic; and
- The Manuka/Civic Loop.

8 The Transport Model

8.1 THE TRANSTEP TRANSPORT MODEL

The travel simulation model consists of:

- a suite of software, that controls operations of the model and performs calculations;
- a network database, describing the road and public transport infrastructure characteristics of the modelled system;
- land-use files, containing forecasts of travel-related land use variables; and,
- a set of files describing the travel characteristics of Canberra residents.

Scott Wilson Nairn's TRANSTEP suite of travel simulation software was used. The computer modelling process is an iterative one, in which street congestion alters travel costs, and this in turn is fed back into the trip generation, trip distribution and mode choice computations. This ensures that the travel costs effectively influence the whole travel simulation process.

Travel demand is composed of different elements such as trip generation rates, travel purposes and destination patterns and choice of mode. These components are themselves influenced by a number of variables such as:

- land use patterns
- the level of street congestion
- travel cost including fares and parking charges
- social-economic factors such as income age groups
- the pattern and frequency of public transport services
- housing density, prices and accessibility factors.

Travel demand is derived directly from the land-use data, socio-economic data and travel characteristics so that the model is fully responsive to land-use changes and options. Future travel demand is responsive to the ageing population and to rising future incomes.

Buses are pre-loaded onto the street network so that they contribute to congestion and, conversely, congested street speeds help to determine the on-street public transport speeds. The public transport models seek to balance service frequencies with travel demand for each bus or corridor transit service. This ensures the most efficient planning of future public transport facilities.

The TRANSTEP suite also provides comprehensive, integrated environmental and economic evaluation facilities.

8.2 THE TRANSPORT NETWORK

The patronage forecasts have been derived using a computerised travel simulation model, which has been developed for Canberra, Queanbeyan and surrounding areas. The overall modelling process is shown in the following diagram.

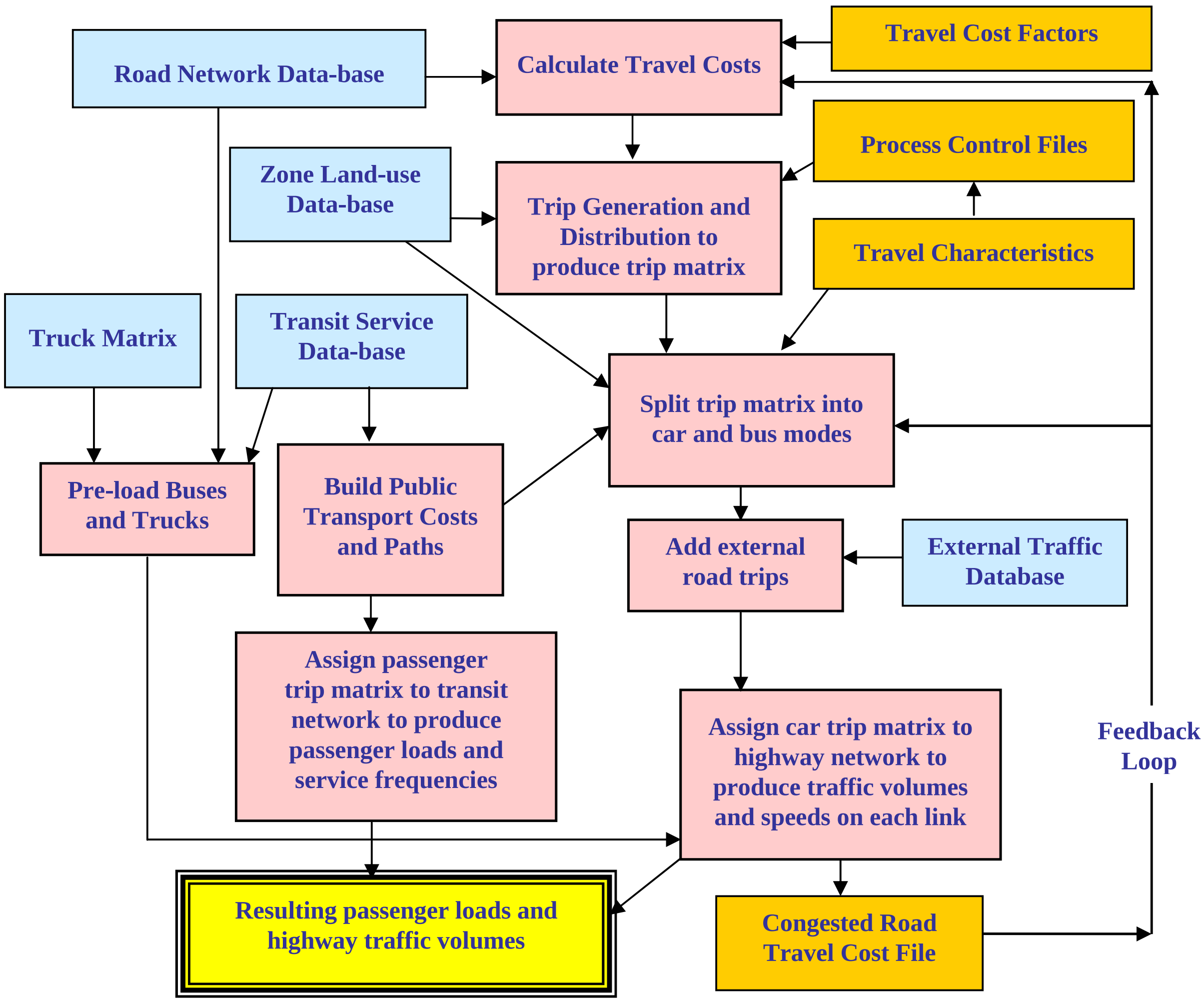


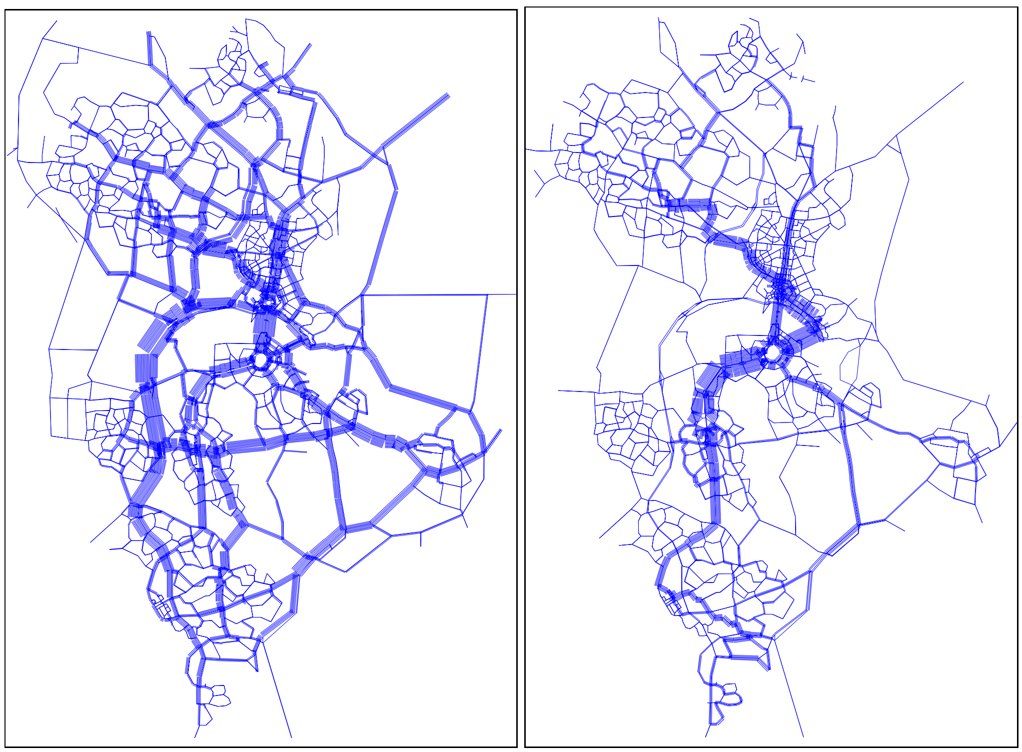
Figure 8,1 The Overall Modelling Sequence

The network for the study consists of an inventory of major roads and streets in Canberra and surrounding areas, including their numbers of lanes, length, their speed and their capacity/delay characteristics. Future planned roadworks have been included in the networks for future years and all current ACTION bus services are included in the public transport base network.

The current and forecast future land-use files were derived directly from files provided by the ACT Department of Urban Services and they were based on the ABS Census of 2001. The travel characteristics of Canberra residents were derived from the Canberra/Queanbeyan Household Interview Travel Survey of 1997.

The pattern of road traffic movements follows the major arterial roads and spreads in a diverse manner throughout Canberra's suburbs. The pattern of bus passenger flows, however, is largely determined by the pattern of bus services. While the buses serve most areas of Canberra, the intensity of their movements is more pronounced in certain corridors and less diverse than the road traffic patterns.

The diversity of the road traffic pattern in Canberra is compared with that for bus passengers in the diagrams in Figure 8.2. The line thickness represents the number of cars or public transport passengers but the two diagrams are illustrative only and not of the same scale.



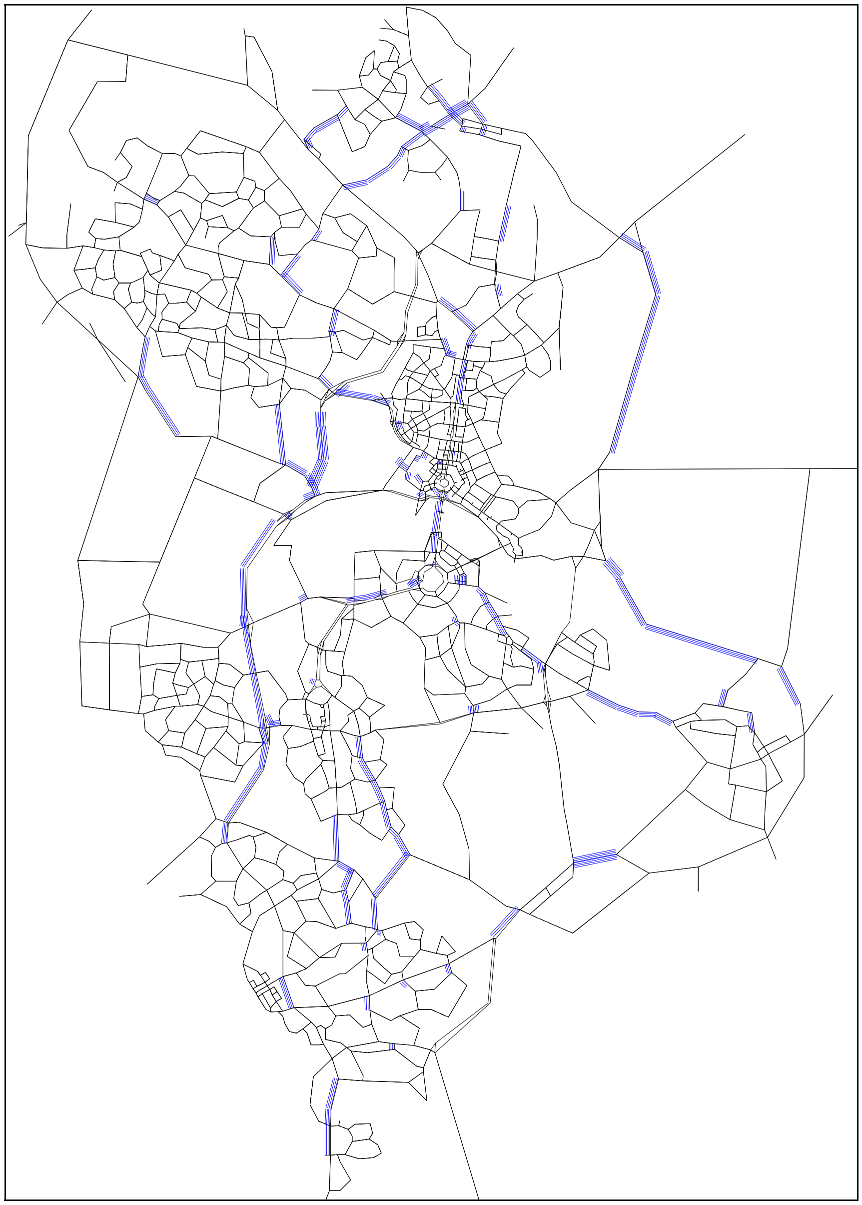
Road Traffic Pattern 2011 **Bus Passenger Pattern 2001**

Source: Scott Wilson Nairn's travel simulation model of Canberra

Figure 8.2 Patterns of Road Traffic and Bus Passengers

A very significant influence on several aspects of travel demand is the growing level of street congestion in Canberra. Congestion increases travel costs and thereby limits travel generation. Increasing street congestion will be a major influence on improving choice for public transport.

The sections of road, which are estimated to carry peak hour traffic volumes of more than 95% of their capacity by the year 2021 if only currently committed roadworks are completed, are shown in Figure 8.3.



Source: Scott Wilson Nairn's travel simulation model of Canberra

Figure 8.3 Sections of Congested Road in 2021 (Volume/Capacity Ratios >0.95)

8.3 SENSITIVITY TEST

The transport model is capable of providing outputs for a range of forecast years at 5-year intervals from 2001 to 2031. The need for and potential benefits to be gained by public transport improvements in Canberra is shown in Table 8.1. The table shows results for the travel model for the year 2021 and Scenario 1–Land Use Development, with the corridor system.

Table 8.1 Comparison of transport system results for different (forced) mode splits, 2021

Criterion / Target Mode Split	7.5%	10%	12.5%	15%	17.5%	20%
Road Maint. Cost $mill/annum	$68.60	$67.60	$66.80	$65.70	$64.80	$63.90
Accid Costs $millions/Annum	$813.00	$804.50	$799.50	$782.20	$774.10	$770.30
Veh Op Costs $Millions/Annum	$1,040.40	$1,013.40	$993.70	$966.10	$945.80	$925.90
Km of Roads V/C>0.95	68.9	61.59	57.7	53.9	51.9	49.2
Ave. AM Peak Trip Length Km	13.7	13.6	13.5	13.5	13.4	13.4
Average AM Peak Trip Time Min	20.4	19.8	19.4	19.1	18.8	18.6
Average AM Peak Speed Km/h	40.1	41.1	41.8	42.3	42.8	43.4
AM Peak Public Transport Trips	11,005	15,548	19,954	24,829	29,735	34,965
Corridor System AM Peak Trips	2,907	4,320	5,724	7,372	9,062	10,929
Corridor System Revenue $Mill	$16.28	$24.01	$31.39	$40.03	$48.78	$58.39
Km of Roads Noise > 68 dBa	406.8	405.6	400.8	398.9	393.3	388.9
Hydro-Carbons kg	16.29	15.83	15.47	15.01	14.65	14.29
Carbon-Monoxide kg	92.8	89.54	86.96	83.93	81.43	79.09
Nitrogen-Oxides kg	31.25	30.62	30.16	29.43	28.91	28.37
Sulphur-Dioxide g	618	602	590	573	561	549

Source: Scott Wilson Nairn's travel model of Canberra

As the mode share of public transport increases, the cost of maintaining roads and operating vehicles decreases, whilst public transport revenue increases. A doubling of the public transport mode share from 7.5% to 15% would save almost $74 million per annum in car operating costs, $37 million per annum in car accident costs and $3 million in road maintenance costs per annum whilst generating almost $24 million in extra public transport system revenue.

There are other benefits from increasing the mode share of public transport. The proportion of roads with noise in excess of 63dBa would also decrease and the amount of pollutant gases released to the atmosphere would decrease. Remaining motorists would also benefit from typically shorter and faster journeys.

9 Assessment of Short-term Options

9.1 INTRODUCTION

The aim of this section is to provide an assessment of a range of short-term options that could improve the environment in which public transport operates. The short-term options include:

- car parking policies
- transit priority at intersections
- real time information
- exclusive bus lanes.

These measures both provide encouragement for the bus operator - ACTION, and also disincentives to motorists, which should encourage a switch to bus for some journeys.

9.2 PARKING POLICIES

Parking policies in Canberra's main centres have a strong influence on the demand for bus services. Car parking charges are typically the only element of a car journey with a direct and readily comparable fee attached. Car journeys without a parking fee are often regarded by motorists as free, as they are at the point of use and the cost of fuel is comparatively low in Australia compared to most developed nations. However, public transport (and taxi) journeys involve a fee for use and so the car becomes the cheapest mode of transport at the point of use. However, a journey that involves car-parking charges involves a fee that can be readily compared to public transport.

A short-term policy option, which will influence a driver's choice of mode, is to increase car-parking charges to make a journey by car comparable with a journey by bus. Such a policy needs to be enacted thoughtfully. A town centre within Canberra would need to adopt a similar parking policy to avoid drivers increasing journey lengths to avoid paying the parking fee. The extent of the charged parking area needs to be sufficiently large to dissuade motorists from parking freely and walking to their preferred destination. Enforcement also needs to be robust to ensure that motorists pay to park or are encouraged to switch to public transport.

To increase public transport ridership the following car parking policies are currently proposed by the ACT Government:

- extend the areas in which car parking charges are levied into Belconnen Centre and Parkes and Barton; and
- gradually increase car parking charges to double their current real value.

The estimated effect of these policies in the year 2011 is shown in Table 9.1. The policies increase bus mode share from 8.4% to 10.4%, which increases bus loadings by 22.6%. The policies increases trip costs by over 3% whilst reducing trip generation by over 2%, which had the effect of reducing car trips by over 5.1%.

The improved bus patronage will increase revenue whilst the decreased number of car trips reduces highway maintenance and vehicle operating costs. The other impact of the two polices is to reduce the total demand for car parking spaces by almost 30%. This could result in changed land use, which in itself could yield better financial returns. Furthermore, the transport elasticity study by Booz, Allen & Hamilton (2003) revealed that for every 10% increase in parking charges demand only fell by 1.1%. As such, whilst the demand for parking falls, revenue still increases.

Table 9.1 Estimated impact of proposed car parking policy changes in 2011

Measurable	Base	With policy	Change %
Total Trips Generated	198,015	193,816	-2.12%
Average Trip Cost	$4.38	$4.53	3.29%
Trip Generation Rate	0.513	0.502	-2.14%
Total Car Trips	87,909	83,417	-5.11%
Mode Split	8.42%	10.36%	23.06%
Total Bus Loadings	11,694	14,337	22.60%
Annual Road Maintenance ($Millions)	$64	$62	-2.98%
Road Accident Costs ($Millions)	$718	$705	-1.81%
Annual Car Veh Op Costs ($Millions)	$917	$869	-5.16%
Average Car Trip Length (Km)	13.28	13.29	0.07%
Average Car Trip Duration (Minutes)	18.86	18.16	-3.71%
Ave Car Speed (Km/h)	42.2	43.9	3.93%
Total Car Park Requirements	22,149	15,705	-29.09%

Source: Scott Wilson Nairn's travel model of Canberra

The policy of increasing parking charges is unlikely to be successful or popular if undertaken in isolation. Public transport must improve, especially if the increased charges are linked to public transport improvements. However, parking policies can improve the effectiveness of transport corridors whilst improving revenue.

9.3 TRANSIT PRIORITY AT INTERSECTIONS

Improving transit priority at intersections is an important element in increasing both the real and perceived travel speed of public transport. Furthermore, bus priority at intersections improves bus journey time reliability, which assists both the operator - ACTION, and also the passengers who have a more reliable bus service.

Buses are perceived to be much slower than travel by car especially when a bus has to stop to pick up and set down passengers. Bus priority at intersections allows buses opportunities to make up time lost at bus stops and possibly overtake cars at these intersections. This can reverse the poor perception of bus travel.

The priority measures that could be adopted include bus lanes in close proximity to intersections, to allow buses to advance to the front of a queue at an intersection.

Other options include fitting buses with a device, either GPS or a transponder, which will alter the traffic light phase to give the bus priority at an intersection. Such improvements are common in other cities in Australia and around the world.

As a short-term measure, bus priority at intersections would start to raise the profile of public transport in key corridors ahead of major public transport improvements. The overall effect of such measures on patronage and mode split are limited. In tests using the Scott Wilson Nairn travel simulation model of Canberra for 2011, mode split changed by 0.63% and bus loadings increased by only 0.25%. This is not to say that the improvements are not worth while, but that the effect of the improvements in the model (which excludes peoples perceptions and behavioural choices) is small.

9.4 REAL TIME INFORMATION

It is well documented that both existing and potential bus users dislike the uncertainty of waiting for a bus. Uncertainty is compounded by unreliable journey times and long headways. Real time information could reduce this uncertainty, as it has done for suburban rail operations in Sydney.

The short-term measures proposed include real time information systems at station termini, adjacent shopping malls and even at bus stops. Such measures have been used to good effect in cities around the world. The impact of real time information cannot be modelled, so its impacts for Canberra have not been quantified. However, such information may at least help reduce the decline in bus patronage before the long term measures are introduced.

9.5 EXCLUSIVE BUS LANES FOR CIVIC–GUNGAHLIN ROUTE

Dedicated on-road bus lanes already exist at some locations in Canberra. This report has assessed the early construction of a section of the proposed corridor transit system (from Gungahlin to Civic) as an additional exclusive on-road bus lane in advance of the introduction of the main scheme. This proposal will also provide impetus to the development of higher density developments along these routes. Higher densities along the route will in turn provide sufficient passenger demand to support the proposed corridor system.

A preliminary investigation into the impacts of an exclusive bus lane in each direction from Civic to Gungahlin has been undertaken using the Scott Wilson Nairn travel simulation model of Canberra for 2011 (Table 9.2).

Table 9.2 Estimated impact of Gungahlin exclusive bus lane project 2011

Measurable	Base	With policy	Change %
Total Trips Generated	198,015	198,057	0.02%
Average Trip Cost	$4.38	$4.38	-0.05%
Total Car Trips	87,909	87,869	-0.05%
Mode Split	8.42%	8.47%	0.63%
Total Bus Loadings	11,694	11,723	0.25%
Annual Road Maintenance Costs ($Millions)	$64	$64	-0.06%
Annual Road Accident Costs ($Millions)	$718	$716	-0.22%
Annual Car Veh Op Costs ($Millions)	$917	$916	-0.09%
Ave Car Trip Duration (Minutes)	18.86	18.85	-0.10%
Ave Car Speed (Km/h)	42.2	42.3	0.04%
Total Car Park Requirements	22,149	22,121	-0.13%

Source: Scott Wilson Nairn's travel model of Canberra

The exclusive bus lane would have only a limited affect upon mode split and passenger numbers. However, it would provide significant economic benefits to public transport users. The scheme would cost approximately $15.3 million in each direction but over a 20 year period would deliver almost $110 million in benefits (net present value, discounted at 7%) from reduced road maintenance, reduced accidents, reduced vehicle operating costs and reduced journey times. This is a benefit to cost ratio of 3.5:1 if discounted at 7%.

9.6 CONCLUSION

- The short-term options considered included four measures that could readily be implemented in advance of the corridor transit scheme but would boost public transport demand in advance of its introduction. The four measures include car parking policies; transit priority at intersections; real time information; and exclusive bus lanes. Preliminary analyses of these options in isolation from each other reveal more bus passengers and an increased mode share to public transport. A co-ordinated adoption of these measures could have even greater effect.
- Parking policies have a large role to play in encouraging motorists to switch to public transport for at least some trips whilst also maintaining their revenue stream and freeing parking spaces for alternative, and more lucrative, land uses.
- Transit priority at intersections and bus lanes would have a much smaller effect on mode share but would generate substantial travel time savings for existing public transport users and would be a step in the right direction to improve the operation and perception of public transport in advance of the corridor system being introduced.
- The effect of real time information could not be quantified but would improve confidence of the present bus network in existing bus users whilst also improving the perception of public transport in no-users.

10 Assessment of Long-term Options

10.1 INTRODUCTION

The aim of this section is to provide an assessment of the long-term options of the proposed Corridor Transit system. The options for consideration are either an LRT or busway Corridor Transit system. The short-term options described in the previous chapter are all a precursor to these longer-term options. The longer-term operations are unlikely to commence until 2011, so that is considered a start date for all of these options, although in reality some options may be ready before then.

This section considers a whole range of alternative options and stages. The assessment for this range of options is based upon just four criteria:

- effects on road congestion;
- effects on ACTION buses;
- predicted revenue; and
- effects on parking demand.

10.2 FARE EARNINGS

The Scott Wilson Nairn travel model of Canberra has assumed this four route network as the first stage for its tests. However, it would also be possible to stage these initial four routes according to demand. Based on revenue performance the first stage should be the Belconnen to Civic line. In model tests, this route generates an opening year revenue of $1.71 million and a 20 year present value, if discounted at 7%, of $3.89/km, which is the best performing line using this measure (Table 10.1). This is however substantially lower, by approximately 50% than the $7.65 million per kilometre revenue performance of the four routes combined.

Table 10.1 Estimated fare earnings for first stage options

	Gungahlin to Civic $(Million)	Belconnen to Civic $(Million)	Woden to Civic $(Million)	Manuka Loop $(Million)	Full Network (All 4 routes)
Fare revenue 2011	$0.99 M	$1.71 M	$1.96 M	$1.41 M	$24.35 M
Fare revenue 2021	$2.05 M	$3.33 M	$3.51 M	$2.72 M	$40.83 M
Fare revenue 2031	$3.65 M	$5.71 M	$6.19 M	$4.54 M	$58.67 M
20 year net present value	$20.3 M	$33.1 M	$35.8 M	$26.9 M	$401.79 M
20 year net present value ($M/km)	1.69	3.89	2.76	2.99	7.65

Source: Scott Wilson Nairn's travel model of Canberra

In order to maximise the project economic benefit, the sequencing of the initial route stages should be the Belconnen to Civic route, then the Woden–Tuggeranong to Civic route and then the Kingston–Manuka Loop. These routes all attract comparable revenues per kilometre with the Belconnen to Civic line and good returns per kilometre.

However, alternatively the network could be developed in a different order, giving priority to the Belconnen–Civic via Bruce, the Gungahlin–Civic and Kingston–Manuka–Civic sections as these are the sections which exhibit the greatest potential for integration of land use and transport development in the short to medium term. Also these routes do not currently have as well developed bus services as the Woden–Tuggeranong to Civic route.

10.3 EFFECTS ON ROAD CONGESTION

Road congestion is a key transport scheme performance indicator as measures to reduce congestion, such as a Corridor Transit system can benefit not only the transit system users but also road users too. Providing an alternative means of travel that is as attractive as travel by car frees road space for economically important journeys that can only be made by road.

Road congestion is frequently expressed as a volume to capacity ratio (V/C), which is the amount of traffic using/wanting to use the road compared to its theoretical maximum. As the result of this ratio moves towards one, congestion gets progressively worse, resulting in low speeds and unreliable journey times. For volume to capacity ratios below 0.7, traffic speeds and journey time reliability will generally be good. Between 0.75 and 0.85 journey speeds begin to decrease and journey times can become unreliable as congestion can quickly grow. At these levels, traffic incidents tend to have a significant role in exasperating congestion. Once the volume to capacity (V/C) ratio exceeds 0.95 road speeds slow significantly, even to temporary stand stills and accidents become more frequent.

The effect of the Corridor Transit system on road congestion over time is shown in Table 10.2. In 2011, the systems inception, 135km of road will have a V/C ratio greater than 0.75 – the point which speeds begin to drop and journey times become unreliable. However, with the introduction of the Corridor Transit system, the length of road with a V/C ratio over 0.75 is forecast to fall to 93km. In 2031, the situation is much worse without the transit system, 238km of road will have a V/C ratio greater than 0.75 compared to 207km of congested road with the system. This is a reduction in roads with a V/C ratio over 0.75 of 13% in 2031.

Table 10.2 Estimated length of congested roads, 2011, 2021 and 2031

V/C ratio	Year 2011		Year 2021		Year 2031	
	No change	With improvements	No change	With improvements	No change	With improvements
0.75-0.85	44	31	59	55	76	73
0.85-0.9	21	22	25	25	36	26
0.9-0.95	18	11	30	17	33	31
0.95-1.0	17	12	18	14	31	20
>1.0	35	27	45	40	62	57

Source: Scott Wilson Nairn's travel model of Canberra

Just considering the worst sections of congested road in 2011, 52 km of road will have a V/C over 0.95. In the year 2031, 93 km of road will have a V/C ratio over 0.95. However, the introduction of the Corridor Transit system reduces the length of roads with a V/C ratio over 0.95 to 39km in 2011 and 77km in 2031. This is a decrease of 21% in 2011 and 17% in 2031.

10.4 PREDICTED LRT FARE REVENUE

Revenue is heavily influenced by passenger loadings. A successful LRT scheme would ideally have even loadings along the entire route, in both directions and throughout the day. Such loading patterns ensure a good revenue stream and a high level of service for customers. If loadings are more peak direction based, revenue would be lower as too would be journey comfort.

Loading patterns in 2031 have been modelled using the Scott Wilson Nairn's travel model of Canberra. The line from Belconnen to Tuggeranong is not evenly loaded along its length or in both directions but has a reasonably consistent loading pattern and its peak load is for a short duration (Figure 10.1). The Gungahlin to Civic line is consistently loaded in both directions, although one direction is highly loaded and the other direction has much lighter load (Figure 10.2). The Manuka Loop has a peak boarding point from which demand gradually declines (Figure 10.3).

The predicted future total AM peak hour passengers on the corridor transit system is 10,951 (Year 2031). The predicted peak line loadings in the AM peak hour (Year 2031) for the corridor transit system are:

- Belconnen–Civic–Woden 2,100/hr southbound and 1,000/hr northbound
- Gungahlin–Civic 2,500/hr southbound and 500/hr northbound
- Kingston/Manuka–Civic 900/hr northbound and 500/hr southbound.

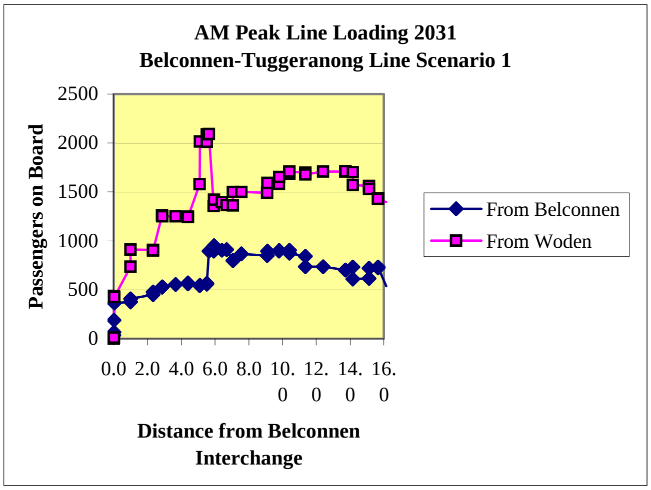


Figure 10.1 Loading pattern on the Belconnen to Tuggeranong Line, 2031

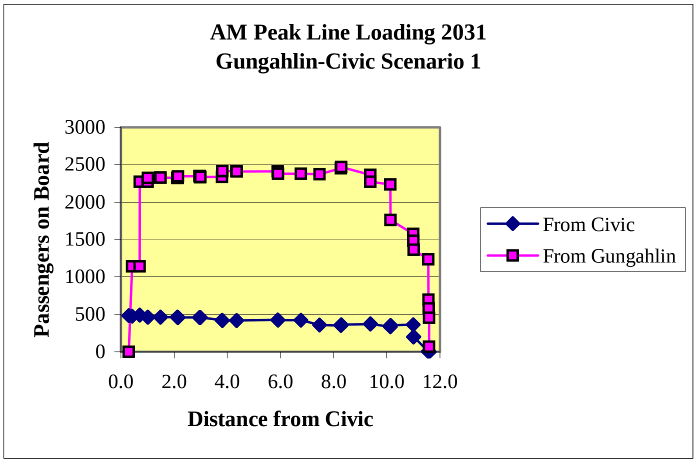


Figure 10.2 Loading pattern on the Gungahlin to Civic Line, 2031

Source: Scott Wilson Nairn's travel model of Canberra

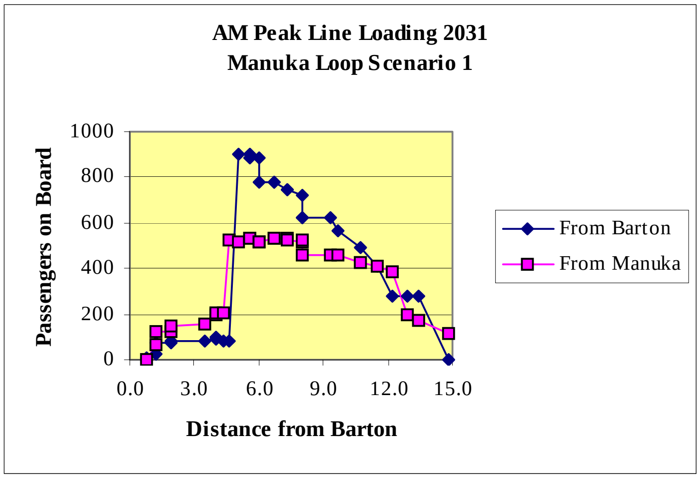


Figure 10.3 Loading pattern on the Manuka Loop, 2031

The revenue collected depends on both loadings and fares charged. The current bus fares charged are a flat fee of $2.50, with season tickets and concessionary fares available. The light rail fare would be distance based, with a $1.50 flagfall and $0.08 per kilometre after the first kilometre. The model has not tested season tickets or concessionary fares. The average fare for journeys on the Corridor Transit system would be $2.09.

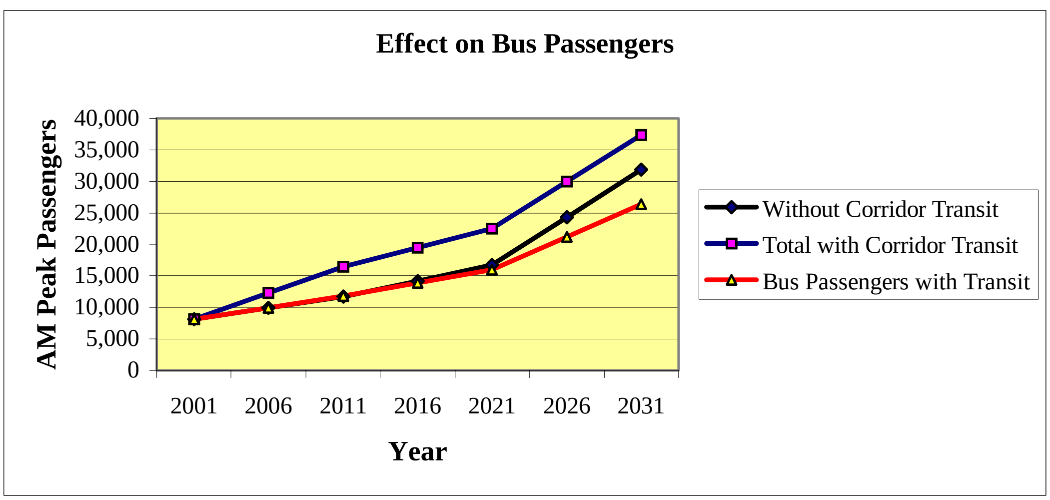
The revenue from the preferred network would be $24.35 million if implemented in 2011, rising to $58.67 million in 2031. The present value of the revenue, if discounted by 7%, is $401.79 million, which equates to $7.65 million/km. This would more than cover operating costs, which over the same time period would be approximately $126.64 million. The network would therefore over a 20 year period, generate an operating surplus of approximately $275.15 million when discounted at 7%.

10.5 EFFECT ON ACTION BUS SERVICES

The short-term measures proposed in the previous chapter should have a positive effect on ACTION bus services. Naturally the development of a corridor transit network would have a considerable effect on bus services. There would be reduction in those bus services that compete with the corridor transit scheme. There would also be rerouting to provide feeder services to the corridor transit network.

Initially the number of passengers carried by ACTION buses will increase with the introduction of the Transit Corridor system such that the average load on a bus will be 8% higher. Eventually the ACTION buses will carry fewer passengers than they would have done without the Transit Corridor system (Figure 10.4).

Despite the reduction in passenger numbers, there would be benefits in terms of fleet reductions. The reduction in ACTION bus revenue is forecast to be approximately $90 million over 20 years if discounted at 7% compared to fleet replacement and related savings over the same time period after discounting of approximately $245 million.



Source: Scott Wilson Nairn's travel model of Canberra

Figure 10.4 Change in bus passenger demand, 2001–2031

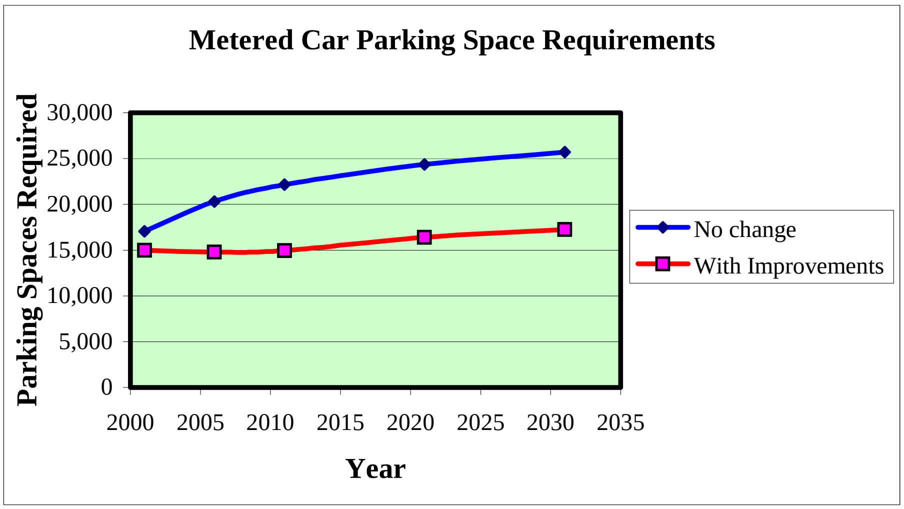
10.6 EFFECT ON CAR PARKING DEMAND

Car parking demand is a function of car demand and parking availability. Public transport improvements should reduce demand for travel by car and therefore reduce car parking demand. The benefits of reducing this demand for car parking is to free this land, which is very well located, for more profitable land uses. The following short-term parking measures were proposed in the previous chapter:

- extend the areas in which car parking charges are levied into Belconnen Centre and Parkes and Barton; and
- gradually increase car parking charges to double their current real value.

The effect of the short-term measures was to reduce parking demand by 29%.

The Corridor Transit system should reduce parking demand further. The effect of this was modelled using the Scott Wilson Nairn's travel model of Canberra and forecast a 32% reduction in parking demand in 2031 (Figure 10.5).



Source: Scott Wilson Nairn's travel model of Canberra

Figure 10.5 Metered parking space requirements, 2001–2031

As mentioned, the main benefit of reducing parking demand is to release land for other uses. The Scott Wilson Nairn's travel model of Canberra forecast that in 2021 24.8ha of parking land would be freed for other uses (Table 10.3).

Table 10.3 Potential parking area saved in 2021

Area	Reduction in demand	Area saved (ha)
Civic	-21%	6.3
Woden	-34%	3.5
Belconnen	-40%	7.4
Barton/Parkes	-49%	5.5
Other	-41%	2.1

Source: Scott Wilson Nairn's travel model of Canberra

11 Details of Route Design and Construction Costs

11.1 INTRODUCTION

The aim of this section is to provide a preliminary level of definition regarding some of the engineering aspects of introducing light rail vehicles (LRV's) to Canberra's City Centre and suburbs. It also addresses issues such as routes, stop/station locations and costing with respect to a two stage introduction.

11.2 NETWORK LAYOUT

The proposed light rail vehicle network is shown in Figure 11.1 and typical station/stop construction details are shown in Figure 11.2. Network introduction is to take place in two stages, on each of the Belconnen, Tuggeranong, Gungahlin and Kingston routes. Chainage datum for the various routes has been taken as the intersection of Northbourne Ave. and Alinga St. Wherever possible the routes will run in a dedicated reserve either on one side of the roadway or in the median. Traffic lights will be installed to aid crossing of busy intersections and roundabouts. Route staging and lengths are shown in Table 11.1 below.

Table 11.1 Route length by stage

Stage 1 Routes	Distance (km)
Belconnen	9.49
Tuggeranong	21.34
Gungahlin	13.00
Kingston/Manuka	10.60
Total Stage 1 route distance	**54.43**

Stage 2 Route Extensions	Distance (km)
Belconnen Extension to Dunlop	8.66
Tuggeranong Extension to Conder	4.54
Gungahlin Extension to Moncrieff	3.74
Kingston/Manuka Extension to Fyshwick	8.25
Russell to Airport Extension	4.78
Total Stage 2 route distance	**29.97**

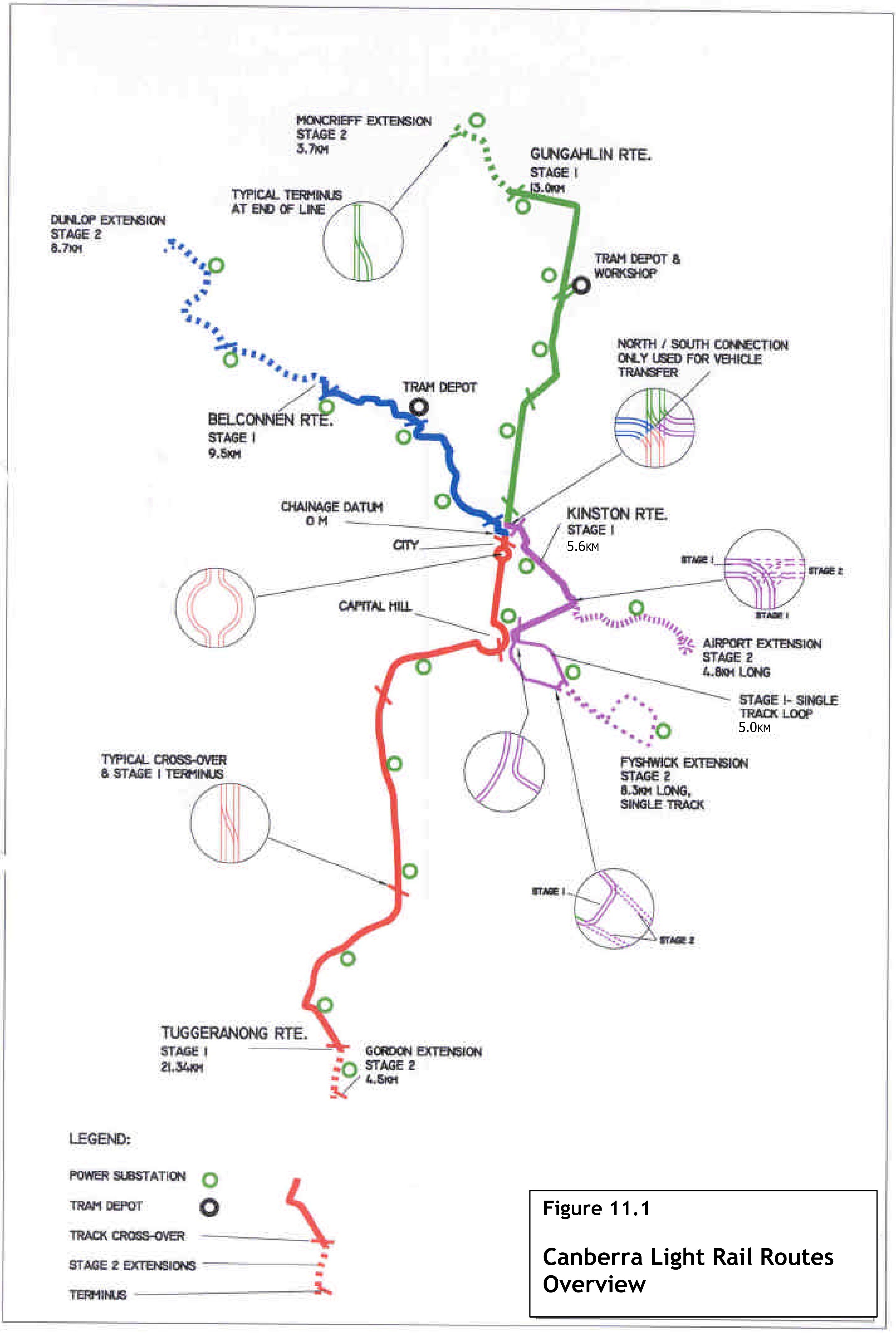
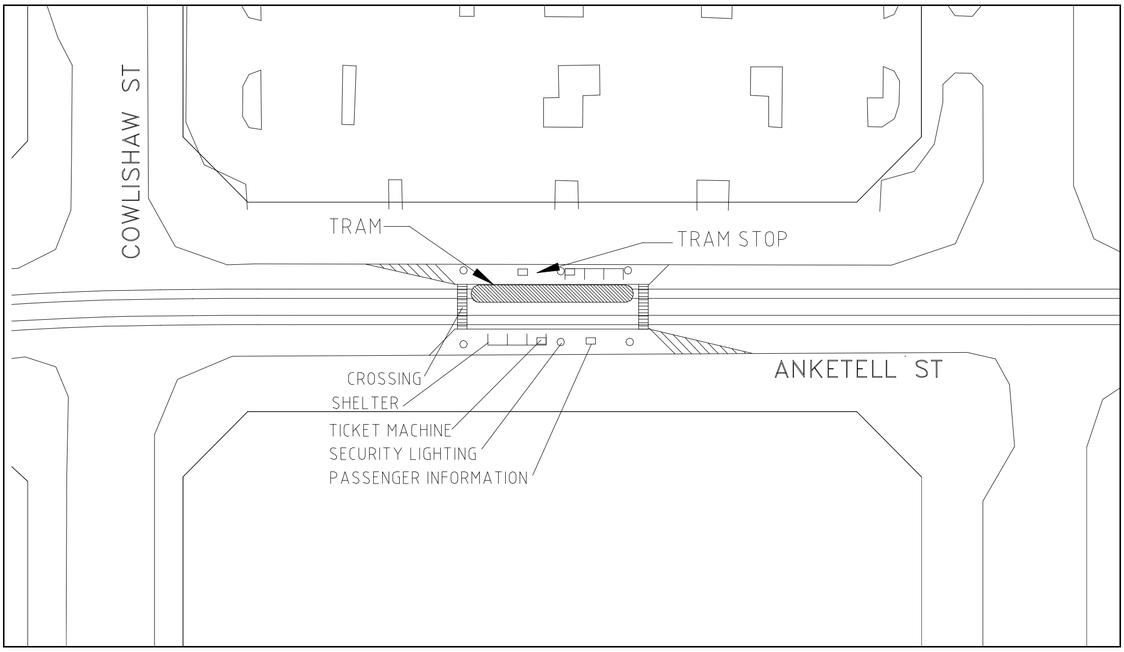
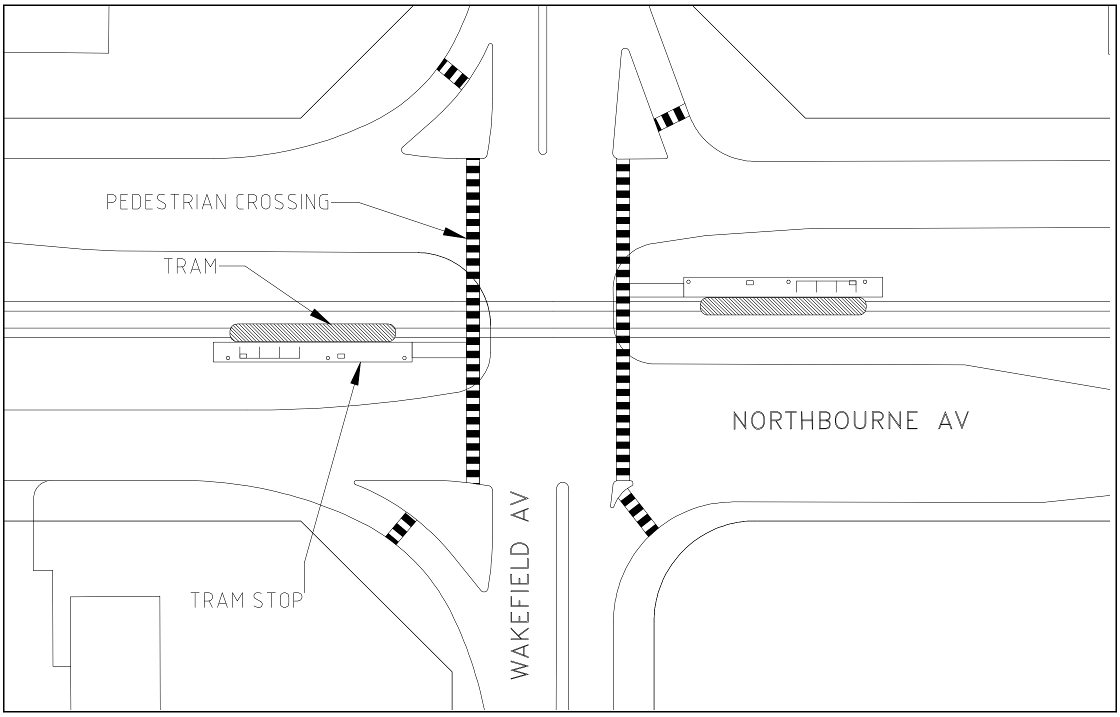


Figure 11.1

Canberra Light Rail Routes Overview



Typical road centre stop with extended curbs to form low platforms



Typical road median departure side stations with low platforms and passenger facilities.

Figure 11.2

Typical station/stop Configurations

11.3 ROUTES

11.3.1 Belconnen route

Belconnen Route, Stage 1

Stage 1 of the Belconnen route is proposed to run from Northbourne Avenue/Alinga Street, City to Benjamin Way/Emu Bank, Belconnen. As the route up Barry Drive near David Street is too steep for conventional LRV's it is proposed to divert the route under Barry Drive to run along side Dryandra Street and through the Bruce/O'Connor Ridge Nature Reserve to the Bruce Stadium. The route will also run via Bimbimbie Street at The University of Canberra to avoid the grade in College Street. The approach to Belconnen is to be via the future transport corridor with the stage 1 terminus in Benjamin Way. The route will have 20 stations/stops (10 either side), a terminus plus two intermediate track cross-overs to allow early return of vehicles in emergencies and three power substations. Typical station/stop details and details of the route are shown in Appendix D of this report.

Belconnen Route, Stage 2

Stage 2 of the Belconnen route is proposed to run from Benjamin Street via a new bridge up to Southern Cross Drive. The tracks will initially occupy the road median and then diverge to the east side near Ginninderra Creek. At this location a new bridge and cuttings will be used to modify ruling grades. The route will terminate near Lance Hill Avenue, Dunlop. The route extension is to have 22 station/stops (11 either side), a terminus plus one intermediate track cross-over to allow early return of vehicles in emergencies and two power substations.

11.3.2 Gungahlin route

Gungahlin Route, Stage 1

Stage 1 of the Gungahlin route is proposed to run from Northbourne Avenue/Alinga Street, City to a terminus in Anthony Rolfe Avenue, Gungahlin. The route is via the median of Northbourne Avenue to Antill Street where it will run under the intersection and continue along the east side of Federal Avenue to Flemington Road. Route continuation will be along the east side of Fleminton Road to Harrison Street, where it will diverge to the median of Anthony Rolfe Avenue. The route is to have 28 station/stops (14 either side), a terminus at each end plus two intermediate track cross-overs to allow early return of vehicles in emergencies and four power substations. Details of the route are shown in Appendix D.

Gungahlin Route, Stage 2

Stage 2 of the Gungahlin route is proposed to run from Anthony Rolfe Avenue via Mirrabei Drive to a terminus at Moncrief. The tracks will essentially run on the west side of the roadway. The route extension is to have 12 stations/stops, (6 either side) including a terminus and one power substation.

11.3.3 Woden–Tuggeranong route

Tuggeranong Route, Stage 1

Stage 1 of the Tuggeranong route is to run from Northbourne Avenue/Alinga Street, City to the southern end of Anketel Street, Tuggeranong. LRV's will run via the median of Commonwealth Avenue, around the inside of State Circle and leave along the median of Adelaide Avenue. The route will proceed via Athlon Drive to a terminus in Anketel Street. Wherever possible the route is to run in a dedicated reserve either on one side of the roadway or in the median. The route is to have 40 station/stops (20 either side), a terminus at each end plus three intermediate track cross-overs to allow early return of vehicles in emergencies and six power substations. The City terminus will also act as the City terminus for the Belconnen route. Details of the route are shown in Appendix D.

Tuggeranong Route, Stage 2

Stage 2 of the Tuggeranong route is proposed to run from Anketel Street via Drakeford Drive and Tharwa Drive to a terminus at Box Hill Avenue in Gordon. Wherever possible the route is to run in a dedicated reserve either on one side of the roadway. The route extension is to have 16 station/stops (8 either side) including a terminus and one power substation.

11.3.4 Kingston–Fyshwick – Manuka Loop

Kingston Route, Stage 1

Stage 1 of the Kingston route is proposed to run from Northbourne Avenue/Alinga Street, City to Burke Crescent, Kingston. The route is via Alinga Street, Constitution Avenue and Kings Avenue to State Circle. From State Circle the route runs as a one way single track along Brisbane Avenue and Wellington Avenue to Burke Cresent. The single track returns to State Circle via Canberra Avenue and a right of way to the rear of St Andrews Presbyterian Church. The route is to have 18 station/stops, (9 either side) plus one intermediate track cross-over to allow early return of vehicles in emergencies and three power substations. Details of the route are shown in Appendix D.

Kingston Route, Stage 2 – Fyshwick

Stage 2 of the Kingston route is to include a single track loop extension to Fyshwick. The tracks will follow Canberra Avenue to Ipswich Street, around Newcastle Street and Hindmarsh Drive, back to Canberra Avenue. Through the heart of Fyshwick it is expected that the LRV's will share centre of road with motor vehicles as is the case in Melbourne. The route extension is to have eight station/stops, and one power substation.

11.3.5 Additional Route – Stage 2 – Airport

Stage 2 of the Kingston route is also to include a double track extension to the Canberra Airport. The route will extend from Kings Avenue, Russell, via Russell Drive, Moorshead Drive and Pialligo Avenue to the Airport, with a loop through the Airport proper. The route extension is to have eight stations/stops, and one power substation.

11.4 VEHICLE REQUIREMENTS

11.4.1 Vehicle types

It is envisaged that light rail vehicles similar to the ALSTOM Citadis low floor tram would be operated on the system. These are able to pickup passengers from street level or from low platforms. These vehicles can seat 40 passengers and can carry a crush load of 197. The vehicles come in a variety of configurations which governs the purchase price, which can range from $2.5 million to $3.5 million. We are assuming a configuration similar to that supplied for Melbourne and a price of $3 million each.

11.4.2 Vehicle numbers

Based on a peak service headway of three minutes and an average travelling speed between stations of 45 km/h with 30 seconds per stop, the network will require 71 LRV's for Stage 1 and 35 LRV's for Stage 2. This includes four spare LRV's for stage 1 and 2 spares for Stage 2.

11.5 STATIONS/STOPS

11.5.1 Features and Accessibility

All stations/stops are to provide LRV access for disabled persons. The stations are to be equipped with low platforms approximately 200mm to 300mm high, together with ramp access to the platform. A high level of lighting and shelters will provide a secure waiting area for passengers. Ticket machines, automatic passenger information displays, route directories and emergency telephones will combine to provide an enhanced travelling experience (Figure 11.3).

Figure 11.3 Typical passenger facilities at terminus, including ticket machine and information screen

11.5.2 Station/stop Locations

Stations are to be located at approximately 1km spacings along the route. Actual locations would be optimised for local requirements. Depending on the track location, stations may be located in the road median, in the track reserve or in a motor vehicle traffic lane, where the road may be narrowed at the station to one shared lane between motor vehicles and LRV's. Typical station configurations are shown in Figure 11.4.

At locations where the LRV track is deviated under the roadway, stations may be installed at the lower level of the LRV line. At these locations passenger elevators would be provided for disabled use.

Where stations are located at major junctions without existing traffic lights, pedestrian lights would be provided for safe access to the LRV system.

Figure 11.4 Typical road centre stop with low platform and passenger facilities

11.6 SPECIAL STRUCTURES

11.6.1 Stations and bridges

A number of major structures will be required for the introduction of the proposed LRV route. These include:

- bridges across Lake Burley Griffin at Commonwealth Avenue and Kings Avenue
- a rail under road crossing at Barry Drive near David Street, with an LRV station
- a bridge across Macarthur Avenue at Dryandra Street
- an underpass beneath the Gungahlin Drive Extension, South East of Bruce Stadium
- a rail under road crossing at the intersection of Northbourne Avenue and Antill Street, also with a station
- a ramp down from Commonwealth Avenue (between the road bridges) on to State Circle
- a ramp down from Adelaide Avenue (between the road bridges) on to State Circle.

A number of other smaller bridges and cuttings are also required to control track gradients.

11.6.2 LRV Depots

Belconnen Route Depot

A proposed LRV depot in the East Belconnen area would be used to stable 41 vehicles. These would be housed on eight roads with appropriate track and overhead provision. The depot would provide light maintenance facilities and secure storage. The depot would include a maintenance building containing two roads for undercover maintenance and a third road in the open to be used as a test track. In addition the depot would be used as a staff amenities centre and administration offices. Major depot features include access platforms, overhead crane, moveable overhead wiring, bogie jacks, sand delivery system, environmentally friendly tram washing plant and automatic points throughout the depot. Depot provisions do not include small tools, consumables and spare parts.

Gungahlin Route Depot

A second LRV depot in the Mitchell area would be used to stable 30 vehicles. The depot would provide heavy maintenance, workshop facilities and secure storage. The depot would also house the LRV traffic control system, the LRV power control system, administration offices and staff amenities. Major depot features are similar to those supplied for the Belconnen Depot, but also include a wheel lathe. Depot provisions do not include small tools, consumables and spare parts.

11.7 OVERALL COST ESTIMATE

11.7.1 Light rail scheme

The costs have generally been determined using previously known standard rates due to the many variable factors impinging on system costs. Costs have been established for each route and for both stages. Costs have also been established for the two depots that will be required to house and maintain the vehicles. Base date for the estimate is mid June 2003 and it is subject to rise and fall with inflation and currency exchange rates. GST is not included in the cost estimate.

For each route, the following items were estimated:

- Road works
- Track works (in concrete & rubber)
- Track works (in ballast)
- Special works (switches)
- Automatic points
- Service relocations
- Street & landscaping
- Bridge structures

- Traffic management
- Station/stop facilities
- Traffic signals
- Extra ordinary earth works
- Power substations (1000kVA)
- Overhead traction wiring.

For each individual item contingencies have been applied in line with the variability of the base costs and this has averaged 20%. Details of the costs for each item of each route are included in Appendix D.

Items that have not been included in the cost estimates include:

- ticket machines/ticketing system
- driver training
- land acquisition costs (all land assumed in government ownership)
- government/client costs
- maintenance/warranty period costs
- operations costs.

Costing summaries for each route and each stage are shown in Table 11.2. The total routes costs (trackwork and infrastructure) for stage one are approximately $426 million.

In addition to the route costs, are depot costs, vehicle costs, survey, urban design and project management costs, which total approximately $464 million. This results in a total cost for Stage 1 of approximately $890 million. Stage 2 would cost a total of approximately $413 million extra.

Table 11.2 Cost summaries for transit routes as light rail

Stage 1		Stage 2	
Belconnen Route	$ 96,448,350	Belconnen Route	$ 70,809,600
Tuggeranong Route	$154,191,200	Tuggeranong Route	$ 26,902,700
Gungahlin Route	$ 85,898,000	Gungahlin Route	$ 22,793,700
Kingston Route	$ 89,816,400	Kingston Route	$ 54,477,500
		Airport Route	$ 33,690,300
Additional costs*	$463,869,356	Additional costs*	$204,245,978
Total Project costs	**$890,223,306**	**Total Project costs**	**$412,919,778**

*Note: * Additional costs include depot costs and vehicle costs*

The cost of providing each route in isolation to each other is shown in Table 11.3. The costs include the cost of providing depot stabling for each option. Although the amount of space required for each depot decreases, the costs of stabling rise if considered separately as there is a certain amount of equipment that is required for each stable. Only two depot stabling locations are proposed, at Belconnen and

Mitchell which presumes that the Belconnen–Civic or Gungahlin–Civic routes must be constructed before the equivalent Woden/Tuggeranong–Civic and Kingston/Manuka–Civic routes, otherwise additional stabling locations will be required.

Table 11.3 Cost summaries for each light rail options as separate installations

Route	Route and vehicle costs ($)	Stable costs ($)	Total cost ($)
Belconnen to Civic	169,219,000	10,470,000	179,689,000
Tuggeranong to Civic	313,326,000	11,130,300	324,456,000
Gungahlin to Civic	185,584,000	18,530,000	204,114,000
Kingston to Civic	170,791,000	6,669,000	177,460,000

11.7.2 Bus based scheme

Using the detailed light rail scheme costs, a similar exercise was undertaken to establish the costs of a bus based scheme, full details of which are provided in Appendix D.

This approach requires similar costs as the light rail scheme for road and track works, structures and all of the traffic management. The cost of the electrical elements of the light rail scheme would however be saved including much lower vehicle costs, $400,000 per bus on average. Similar contingencies were also used in this exercise.

Costing summaries for each route and each stage for a bus based scheme are shown in Table 11.4. This exercise was undertaken for both stages and estimates approximately $670 million in stage 1 and a further $330 million in stage 2.

Table 11.4 Cost summaries for transit routes as busway (CNG Buses)

Stage 1		Stage 2	
Belconnen Route	$ 80,626,450	Belconnen Route	$ 58,554,500
Tuggeranong Route	$117,878,300	Tuggeranong Route	$ 22,059,700
Gungahlin Route	$ 64,560,000	Gungahlin Route	$ 17,238,800
Kingston Route	$ 73,285,600	Kingston Route	$ 54,477,500
		Airport Route	$ 26,479,500
Additional costs*	$331,458,992	Additional costs*	$151,525,978
Total Route costs	**$667,809,342**	**Total Route costs**	**$330,335,978**

*Note: * Additional costs include depot costs and vehicle costs.*

12 Economic and Financial Performance

12.1 ECONOMIC EVALUATION

12.1.1 Net transport user benefits

With the implementation of the proposed corridor transit scheme, users of the enhanced public transport receive benefits that are in excess of the benefits of the existing public transport system.

These benefits arise from reduced journey times that are made possible because of the faster, more direct and more frequent transit corridor service. Furthermore, the transit corridor service operates at greater frequencies along the corridor, and therefore provides users with reduced waiting and interchange times.

User benefits, expressed in the model in units of time, are converted to monetary values for economic evaluation. The means used to convert time to money is the value of time. This study has used equal value of time for private and public transport system users, which is $10 per hour. Full details of the economic analysis cash flows for each year of the project are shown in Appendix E of this report.

In the central case for the project, a year 2011 start is assumed with a four-year construction period leading to full operations from the year 2015 onwards. Additional sensitivity cases are also examined for an earlier, year 2006, start and a year 2011 start with lower population growth, that represent variations to the central case.

12.1.2 Transit system costs and benefits

Changes to costs for the combined corridor transit and existing bus-based system have been assessed under the following heading:

- Corridor System Track and Rolling Stock Capital Costs
- Corresponding savings in future ACTION Bus Fleet purchases
- Transit System Operating Costs (Corridor Transit – saving in bus system)
- Transit System Travel Time Costs (increases with additional users)

The whole public transport system will experience changes, as outlined in section 5.7. The changes affect the bus fleet, bus operations and bus time costs. These changes are compared to the base case situation, which would still provide a public transport service to users into the future and which would continue to grow to meet increasing demand in years to 2031 as shown in Table 12.1.

Table 12.1 Estimated future ACTION Bus Fleet requirements

Year	No Corridor Transit	With Corridor Transit	Bus Fleet Savings
2011	557	545	12
2021	744	709	35
2031	1,330	1,101	229

Over time, bus fleet acquisition costs reduce compared to the base case, reflecting the growing transit corridor fleet. This is recorded as a benefit. The overall transit system (bus and corridor transit) continues to experience greater operating costs compared to the base case up until 2022. After this time, the operating costs decrease compared to the base case as the transit corridor system becomes more efficient.

Highway travel time savings are also a function of traffic flow. As traffic flow decreases, the remaining traffic is able to travel faster and therefore experience reduced journey times. Compared to the base case there are considerable savings from both fewer car travellers and faster journey times. However, the increased number of transit users causes the transit time costs to rise compared to the base case.

12.1.3 Non-user benefits

Transport economic analysis considers both the users and non-users of the scheme. The user benefits, in this case relating to passengers on the corridor transit system, have been calculated above. The non-user benefits, in this case relate to motorists who do not use the transit corridor system.

Non-user benefits for highway users cover the following elements (reduced future travel time costs for highway users are assessed as part of overall transport system user benefits):

- reduced construction costs
- reduced maintenance costs
- reduced accident costs
- reduced vehicle operating costs.

Over the 20 year period from 2011 to 2031 the transit corridor system will permit a reduction in highway construction costs as traffic volumes do not increase at the same rate as the base case as more journeys are made by public transport. The savings are expected to save 17km of widening to arterial roads. Over the same time period there will also be a reduction in road maintenance costs. This reduction is two fold. Firstly there is less traffic causing damage to the road and secondly there is less new road space to maintain compared to the base case.

Road traffic accident costs will also reduce over the period from 2011 and 2031. The reduction is a response to less vehicles on the road as more people switch to public transport as a result of the transit corridor system. Details of these savings are shown in Table 12.2.

Vehicle operating costs are a function of road geometry and traffic flow. As traffic flow decreases so does the vehicle operating cost. Details of discounted savings are shown in Table 12.2.

Table 12.2 20-year Highway cost savings ($/million)

Discount rate	Construction costs	Maintenance costs	Accident costs	Vehicle operating costs
5%	$25.90	$27.70	$189.27	$1,868.90
7%	$23.40	$22.54	$152.80	$1,520.25
9%	$21.15	$18.49	$124.43	$1,247.04

12.1.4 Transit system capital and vehicle costs

The capital and vehicle costs have been discussed in detail in Chapter 11. The scheme costs total approximately $890.2 million for all stage one design, construction and vehicles. These costs are all considered as costs compared to the base case, which would not develop a corridor transit system.

The construction phase takes places during the years 2011 to 2014 whilst rolling stock costs (which includes operations, acquisition and stabling) continues to rise as the transit corridor scheme develops over time. The system costs are shown in Table 12.3 for discount rates 5%, 7% and 9%.

Table 12.3 20-year Scheme costs ($/million)

Discount rate	Construction costs (LRT)	Vehicle costs (LRT)	Construction costs (Busway)	Vehicle costs (Busway)
5%	$574.67	$189.59	$472.90	$101.11
7%	$557.39	$168.38	$458.67	$89.80
9%	$540.53	$151.08	$444.80	$80.57

12.1.5 Economic results

The detailed economic analysis has been undertaken and described above for each of the four key benefit areas of:

- corridor system costs
- highway costs
- transit system costs
- net transport user benefits (travel time).

Each element has been compared to the base case. As such, the corridor transit system incurs construction and vehicle costs that would not occur in the base case and these are regarded as a cost. Compared to the base case, the highway system experiences less traffic and congestion as a result of the transit corridor system, which results in savings. The ACTION bus system experiences a reduction in fleet size compared to the base case and an overall operating cost saving as the fleet decreases; which equates to a saving. Overall, the transit system experiences more users and these incur travel time costs. Users also experience travel time savings and this is is regarded as a benefit.

The economic analysis results are presented in detail in Table 12.4 for the three cases of year 2006 start, year 2011 start and year 2011 start, low population growth.

Table 12.4 Summary of Economic Analysis Results

2006 Start		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Highway Savings	Const. Cost	$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
	Maint. Cost	$27.70	$22.54	$18.49	$27.70	$22.54	$18.49
	Accident Cost	$189.27	$152.80	$124.43	$189.27	$152.80	$124.43
	V.O.C. Cost	$1,868.90	$1,520.25	$1,247.04	$1,868.90	$1,520.25	$1,247.04
	Time Cost	$1,015.50	$822.02	$671.08	$1,015.50	$822.02	$671.08
Transit System (Inc Buses)	Fleet Cost	$152.23	$113.55	$85.30	$152.23	$113.55	$85.30
	Operating Cost	-$59.39	-$52.46	-$46.15	-$128.95	-$108.36	-$91.47
	Time Cost	-$623.59	-$506.48	-$414.81	-$623.59	-$506.48	-$414.81
Discounted Total Benefits		$2,596.51	$2,095.60	$1,706.53	$2,526.95	$2,039.70	$1,661.21
Net Flow		$1,832.25	$1,369.83	$1,014.91	$1,952.95	$1,491.23	$1,135.84

2011 Start		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Highway Savings	Const. Cost	$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
	Maint. Cost	$28.31	$23.00	$18.83	$28.31	$23.00	$18.83
	Accident Cost	$211.15	$169.33	$136.92	$211.15	$169.33	$136.92
	V.O.C. Cost	$1,920.96	$1,558.48	$1,274.33	$1,920.96	$1,558.48	$1,274.33
	Time Cost	$1,091.50	$880.76	$716.39	$1,091.50	$880.76	$716.39
Transit System (Inc Buses)	Fleet Cost	$330.74	$245.42	$183.01	$330.74	$245.42	$183.01
	Operating Cost	$14.61	$1.51	-$6.71	-$66.03	-$62.88	-$58.56
	Time Cost	-$645.84	-$523.94	-$428.34	-$645.84	-$523.94	-$428.34
Discounted Total Benefits		$2,977.32	$2,377.97	$1,915.57	$2,896.68	$2,313.58	$1,863.72
Net Flow		$2,213.06	$1,652.20	$1,223.95	$2,322.67	$1,765.10	$1,338.34

2011 - Low Growth		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Highway Savings	Const. Cost	$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
	Maint. Cost	$28.20	$22.97	$18.87	$28.20	$22.97	$18.87
	Accident Cost	$195.90	$158.45	$129.28	$195.90	$158.45	$129.28
	V.O.C. Cost	$1,901.64	$1,548.61	$1,271.70	$1,901.64	$1,548.61	$1,271.70
	Time Cost	$1,082.50	$875.65	$714.31	$1,082.50	$875.65	$714.31
Transit System (Inc Buses)	Fleet Cost	$178.25	$134.77	$102.77	$178.25	$134.77	$102.77
	Operating Cost	-$48.65	-$43.58	-$38.74	-$125.23	-$105.72	-$89.62
	Time Cost	-$638.28	-$519.25	-$425.96	-$638.28	-$519.25	-$425.96
Discounted Total Benefits		$2,725.47	$2,201.01	$1,793.38	$2,648.88	$2,138.87	$1,742.50
Net Flow		$1,961.21	$1,475.24	$1,101.77	$2,074.88	$1,590.40	$1,217.12

The benefit to cost ratios for the scheme are in the range 2.77 to 3.90 for light rail and 3.55 to 5.05 for busway as shown in Tables 12.5 and 12.6.

Table 12.5 20-year Economic performance summary (Light Rail) Year 2011 start

Discount rate	Net costs $/M (NPV Year 2011)	Net benefits $/M (NPV Year 2011)	Benefit to cost ratio
5%	764.26	2,977.32	3.90
7%	725.77	2,377.97	3.28
9%	691.62	1,915.57	2.77

Table 12.6 Economic Performance Summary (Busway) Year 2011 start

Discount rate	Net costs $/M (NPV Year 2011)	Net benefits $/M (NPV Year 2011)	Benefit to cost ratio
5%	574.00	2,896.68	5.05
7%	548.47	2,313.58	4.22
9%	525.38	1,863.72	3.55

12.2 FINANCIAL EVALUATION

The financial evaluation, whilst similar to the economic evaluation, focuses only on fiscal expenditures and revenues. In this case, all expenditure is negative and all gains are positive. The items used in the financial evaluation include:

- transit system construction costs
- transit system vehicle costs
- transit system operating costs
- transit corridor system fare revenue
- ACTION Bus fleet acquisition costs
- ACTION Bus operating costs
- ACTION Bus system revenue
- carpark construction cost savings
- road maintenance cost savings
- road construction cost savings.

Additional items which are not specifically considered here but are also relevant to the overall funding package for the project are:

- revenue from government land sales enhanced by the project
- revenue from the expansion of paid car parking
- reduced infrastructure cost from reduced urban sprawl with more urban transit oriented development.

12.2.1 Corridor transit system

The corridor transit system contains four elements: construction costs, vehicle costs, operating costs and fare revenue. The construction vehicle and operating costs have been described in detail in other parts of this report.

The fare scale for the Corridor Transit system would be a $1.50 flagfall plus $0.08/km after the first kilometre. In reality there would be various discounted tickets for season tickets and concessions. The effect of such tickets are represented in the financial analysis by discounting the projected fare revenue stream by a factor x 0.5815.

The 20-year discounted total costs for the actual transit system are shown in Tables 12.7 and 12.8. The net operating revenue for the scheme, that is the difference between vehicle and operating costs and revenue, is summarised over 20 years at a 7% discount rate.

Table 12.7 Financial details for corridor transit system (Light Rail) Year 2011 start ($M)

Discount rate	Construction costs	Vehicle costs	Operating costs	Revenue
PV @ 5%	$574.67	$189.59	$161.29	$251.90
PV @ 7%	$557.39	$168.38	$128.79	$200.42
PV @ 9%	$540.53	$151.08	$103.69	$160.75

Table 12.8 Financial details for corridor transit (Busway) Year 2011 start ($M)

Discount rate	Construction costs	Vehicle costs	Operating costs	Revenue
PV @ 5%	$472.90	$101.11	$241.93	$251.90
PV @ 7%	$458.67	$89.80	$193.19	$200.42
PV @ 9%	$444.80	$80.57	$155.54	$160.75

12.2.2 Existing transit system

The existing transit network, operated by ACTION has three components for the economic analysis. They include fleet costs, operating costs and fares. Fleet and operating costs have been described in previous sections and chapters and, when compared to the base case, both experience reduced expenditure. This is regarded as a financial benefit.

The current ACTION normal fare for bus travel is a flat fare of $2.50. There are also seasonal fares and concession fares available for school travel and senior citizens. This evaluation assumes that this ACTION fare system would be retained in future (in 2003 prices but escalated according to the Consumer Price Index). In reality various discounted tickets would apply and these are represented by a fare discount of x0.5815 in the financial analysis.

The financial effects on the existing transit system are shown in Table 12.9. There will be significant savings in fleet (bus replacement) and operating costs and there will also be a reduction in revenue. Despite this loss in revenue over the period from 2011 to 2031, the existing transit system will have accrued net savings at $283.76 million when discounted at 7%.

Table 12.9 20-year Financial savings for existing transit system ($M)

Discount rate	Fleet savings	Operating cost savings	Lost revenue
PV @ 5%	$330.77	$175.90	-$73.07
PV @ 7%	$245.45	$130.31	-$53.50
PV @ 9%	$183.02	$96.98	-$39.25

12.2.3 Highways network

The existing highway network has three components for the financial analysis; car parking, construction savings, road maintenance savings and road construction savings. Road maintenance and construction costs have been discussed in previous sections and chapters. Both road maintenance and construction costs will reduce as a result of the transit corridor scheme. This reduction translates into a financial benefit.

12.2.4 Parking space construction savings

The implementation of the Corridor Transit system, together with its supporting parking and preferred right-of-way policies, will lead to a reduction in car-parking demand. The total changes in demand for car-parking in Civic, Woden, Belconnen, Barton, Parkes, Manuka, Deakin, Dickson and Kingston, where car parking charges will apply under the proposed new policies, is shown in Table 12.10.

Table 12.10 Effect on parking demand (number of parking spaces utilised)

Year	No change	With Improvements	Saving
2006	20,304	14,797	5,507
2011	22,149	14,937	7,212
2021	24,350	16,391	7,959
2031	25,699	17,237	8,462

The detailed financial implications for future parking construction cost and the highway network is shown in Table 12.11. All three elements show savings over the time period of 2011 to 2031.

Table 12.11 20-year Financial savings for highway network ($M)

Discount rate	Car park construction savings	Road maintenance cost savings	Road construction cost savings
PV @ 5%	$23.09	$28.31	$28.77
PV @ 7%	$21.41	$23.00	$25.99
PV @ 9%	$19.95	$18.83	$23.50

12.2.5 Financial appraisal

The financial appraisal describes the costs and benefits of the transit corridor system under the following three main elements:

- corridor transit system
- existing transit system
- highway network.

The transit corridor scheme cumulative discounted costs are detailed in Appendix E over the period from 2011 to 2031. Details of the discounted cash flow assessment are shown in Table 12.12.

The schemes generally have positive cash flow immediately following opening of the full Stage 1 network in 2015. However, over 20 years the schemes nevertheless have a discounted net revenue shortfall.

Table 12.12 Summary of Financial Analysis Results ($M)

2006		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor Transit System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Corridor Transit System	Operating Cost	-$139.00	-$111.69	-$90.53	-$208.50	-$167.53	-$135.80
	Fare Revenue	$205.57	$163.51	$131.16	$205.57	$163.51	$131.16
ACTION	Fleet Savings	$152.25	$113.56	$85.32	$152.25	$113.56	$85.32
	Operating Cost Saving	$79.55	$59.17	$44.33	$79.55	$59.17	$44.33
	Fare Revenue	-$25.73	-$17.84	-$12.26	-$25.73	-$17.84	-$12.26
Carpark Const. Saving		$20.36	$18.73	$17.30	$20.36	$18.73	$17.30
Road Maint. Saving		$27.70	$22.54	$18.49	$27.70	$22.54	$18.49
Road Const. Saving		$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
Discounted Revenue & Savings		$346.60	$271.37	$214.95	$277.10	$215.53	$169.68
Net Cash Flow		-$417.66	-$454.40	-$476.67	-$296.90	-$332.94	-$355.69

2011		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor Transit System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Corridor Transit System	Operating Cost	-$161.29	-$128.79	-$103.69	-$241.93	-$193.19	-$155.54
	Fare Revenue	$251.90	$200.42	$160.75	$251.90	$200.42	$160.75
ACTION	Fleet Savings	$330.77	$245.45	$183.02	$330.77	$245.45	$183.02
	Operating Cost Saving	$175.90	$130.31	$96.98	$175.90	$130.31	$96.98
	Fare Revenue	-$73.07	-$53.50	-$39.25	-$73.07	-$53.50	-$39.25
Carpark Const. Saving		$23.09	$21.41	$19.95	$23.09	$21.41	$19.95
Road Maint. Saving		$28.31	$23.00	$18.83	$28.31	$23.00	$18.83
Road Const. Saving		$28.77	$25.99	$23.50	$28.77	$25.99	$23.50
Discounted Revenue & Savings		$604.38	$464.29	$360.09	$523.74	$399.89	$308.24
Net Cash Flow		-$159.88	-$261.48	-$331.53	-$50.27	-$148.58	-$217.13

2011 - Low Growth		Light Rail			Busway		
		PV @ 5%	PV @ 7%	PV @ 9%	PV @ 5%	PV @ 7%	PV @ 9%
Corridor Transit System	Track Cost	-$574.67	-$557.39	-$540.53	-$472.90	-$458.67	-$444.80
	Rolling Stock	-$189.59	-$168.38	-$151.08	-$101.11	-$89.80	-$80.57
Discounted Total Costs		-$764.26	-$725.77	-$691.62	-$574.00	-$548.47	-$525.38
Corridor Transit System	Operating Cost	-$145.76	-$117.46	-$95.48	-$218.64	-$176.19	-$143.22
	Fare Revenue	$222.24	$177.81	$143.49	$222.24	$177.81	$143.49
ACTION	Fleet Savings	$178.25	$134.77	$102.77	$178.25	$134.77	$102.77
	Operating Cost Saving	$93.41	$70.46	$53.60	$93.41	$70.46	$53.60
	Fare Revenue	-$33.95	-$24.59	-$17.83	-$33.95	-$24.59	-$17.83
Carpark Const. Saving		$20.36	$18.73	$17.30	$20.36	$18.73	$17.30
Road Maint. Saving		$28.20	$22.97	$18.87	$28.20	$22.97	$18.87
Road Const. Saving		$25.90	$23.40	$21.15	$25.90	$23.40	$21.15
Total Revenue & Savings		$388.64	$306.09	$243.87	$315.76	$247.36	$196.13
Net Cash Flow		-$375.61	-$419.68	-$447.75	-$258.24	-$301.11	-$329.25

12.3 SENSITIVITY ANALYSIS

Sensitivity analysis has been undertaken for the project economic and financial analysis for the two alternative staging/timing scenarios of either:

- an early start in 2006 with construction over a four year period and commencement of full operations in 2010
- a year 2011 start but lower population growth with the future total Canberra population reaching 390,000 by 2031.

The summary of the variation in the economic and financial results is projected in Table 12.13 and Table 12.14. The additional economic analysis spreadsheets are included as Appendix E. The sensitivity analysis shows very little change in the economic performance of the project but the net financial cashflow (at the 7% discount rate) is reduced by approximately $150–$200 million dollars for either a year 2006 start or year 2011 low growth.

Table 12.13 Sensitivity Analysis Results ($M) for Light Rail Options

Discount rate	Economic result	Economic evaluation			Financial evaluation		
		Year 2006 start	Year 2011 start	Year 2011 low growth	Year 2006 start	Year 2011 start	Year 2011 low growth
5%	NPV costs	764	764	764	764	764	764
	NPV benefits	2597	2977	2725	347	604	389
	NPV net	1832	2213	1961	-417	-160	-375
	Benefit: Cost ratio	**3.40**	**3.90**	**3.57**	**0.45**	**0.79**	**0.51**
7%	NPV costs	726	726	726	726	726	726
	NPV benefits	2096	2378	2201	271	464	306
	NPV net	1370	1652	1475	-455	-261	-420
	Benefit: Cost ratio	**2.89**	**3.28**	**3.03**	**0.37**	**0.64**	**0.42**
9%	NPV costs	692	692	692	692	692	692
	NPV benefits	1707	1916	1793	215	360	244
	NPV net	1015	1224	1102	-477	-332	-448
	Benefit: Cost ratio	**2.47**	**2.77**	**2.59**	**0.36**	**0.52**	**0.36**

Table 12.14 Sensitivity Analysis Results ($M) for Busway Options

Discount rate	Economic result	Economic evaluation			Financial evaluation		
		Year 2006 start	Year 2011 start	Year 2011 low growth	Year 2006 start	Year 2011 start	Year 2011 low growth
5%	NPV costs	574	574	574	574	574	574
	NPV benefits	2,527	2,897	2,649	277	524	316
	NPV net	1,953	2,323	2,075	-297	-50	-258
	Benefit: Cost ratio	**4.40**	**5.05**	**4.61**	**0.48**	**0.91**	**0.55**
7%	NPV costs	548	548	548	548	548	548
	NPV benefits	2,040	2,314	2,139	216	400	247
	NPV net	1,492	1,766	1,591	-333	148	-301
	Benefit: Cost ratio	**3.72**	**4.22**	**3.90**	**0.39**	**0.73**	**0.45**
9%	NPV costs	525	525	525	525	525	525
	NPV benefits	1,661	1,864	1,743	170	308	196
	NPV net	1,136	1,339	1,218	-355	-217	-329
	Benefit: Cost ratio	**3.16**	**3.55**	**3.32**	**0.32**	**0.59**	**0.37**

12.4 RECOMMENDED POLICY FOR FUNDING AND IMPLEMENTATION

In addition to the future corridor transit system revenue income, the recommended policy for funding and implementing the transit corridor system requires a combination of the following funding options to make up the net scheme cost after discounting of approximately $261 million at the 7% discount rate. Annual top up funding of $22.3 million would be required to fund this net scheme cost:

- parking charges
- land sales

- savings from infrastructure with urban consolidation
- loans
- Commonwealth Government funding.

In addition to the above options, private sector involvement in the construction and implementation phase would permit a review of the cost estimates with potential further savings likely to be identified.

12.4.1 Parking charges

Future car parking revenues from Civic and other town centre carparking areas have not been included in this analysis. The revenues from approximately 15,000–17,000 car parking spaces at $7 per day for 250 days per year would generate $26–$30 million per year at current prices.

The elasticities established by Booz, Allen and Hamilton, 2003, *ACT Transport Demand Elasticities Study* also showed that although demand for parking would decrease if prices increased, revenue would not decrease. A $1 increase for these 22,000 customers per day would return a further funding increment of $5 million over a year (over 250 days).

12.4.2 Land sales

The study undertaken by Colliers International on behalf of KBR for this study has revealed that land value capture sales as a result of the scheme could be in excess of $40 million over an initial 5-year period. Further land sales could increase this amount.

12.4.3 Savings from infrastructure with urban consolidation

The typical additional infrastructure cost for all infrastructure, e.g. sewer, water, stormwater, electricity, gas, telephone, local roads, sub-arterial roads, has been estimated in studies in 1991/2 as approximately $17,000 per dwelling, higher for urban fringe compared to urban consolidation residential development.

This cost differential is now likely to be significantly higher, e.g. $30,000 per dwelling at current valuations.

Over a 25–30 year future period, future potential urban consolidation in suburbs such as North Canberra, South Canberra and the town centres of Civic, Woden, Belconnen and Tuggeranong could accommodate an additional 40,000 persons according to the difference between the urban development Scenarios 1 and 2 in this report.

These 40,000 persons would represent approximately 16,000–17,000 dwellings by means of urban consolidation, with an effective infrastructure saving of $495 million in comparison to urban fringe development over a 25–30 year future period.

12.4.4 Loans

With current interest rates at historically low levels, loans for capital investment could provide an opportunity to fund the capital costs of the transit corridor scheme.

12.4.5 Federal Government funding

Research into previous spending by the Federal Government on public transport shows that in part this has been as high as $93 million in the year 1992/3 (BTE, 1999). The research shows that there has been no public transport funding by the Federal Government since this date (Figure 12.1).

Re-establishing national funding for public transport infrastructure on a comparable scale to the previous budgets would considerably assist some of the development costs of the transit corridor system and provide additional benefits to the nation's capital that would improve its international competitiveness.

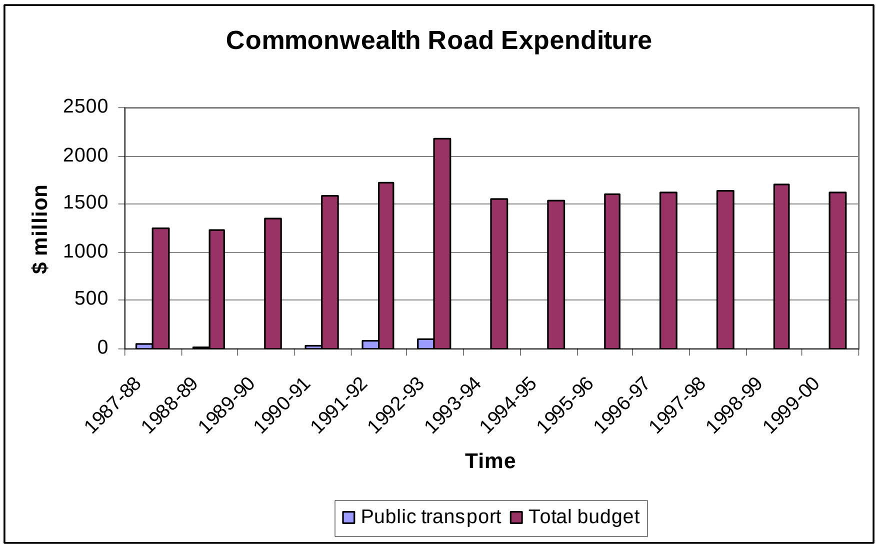


Figure 12.1 Commonwealth Road Expenditure – total budget and public transport spending

12.5 PRIVATE SECTOR INVOLVEMENT

An alternative approach for the project capital funding is assistance from the private sector. There are many alternative schemes which could be implemented for private sector assistance in either construction or operation of the project.

The private sector now operates light rail systems in both Sydney and Melbourne and has considerable global experience in this sector. This expertise could be utilised by means of a public tender process for either construction and/or operation of the future system. The transit corridor system could be financed through PPP or the private sector could own the infrastructure and charge the operator for use.

The future options for delivery of the project are as follows:

1. In-house project
2. Design and construct project
3. Vendor turnkey or Engineer, Procure, Construct (EPC) project
4. EPCM (manage) project

5. Alliance project

6. BOO/BOOT (build, own, operate, transfer) project.

These alternative strategies all offer different combinations of control, risk and likely project cost efficiency. The general processes and risks involved with each option are summarised by the process flowcharts in Figures 12.2 to 12.7 of this report.

In-house Project

Description:
Internal Owner resources (augmented by consultants) used for engineering and procurement. Physical construction by maintenance or outside contractors. Commissioned by operating personnel.

Comments:
Normally limited to small plant upgrades or reconfigurations where Owner skills are appropriate or can be easily augmented and the added workload does not impact ongoing operations.

Points for consideration:

Maximum flexibility of design and schedule.	Scope and costs difficult to control.
Optimum interface with operations.	Operational priorities often ahead of project's.
Excellent process appreciation.	In-house resources strained.
Local knowledge and generally strong communications.	Documentation not always a priority.

Risk:
Stays with Owner for duration of project.

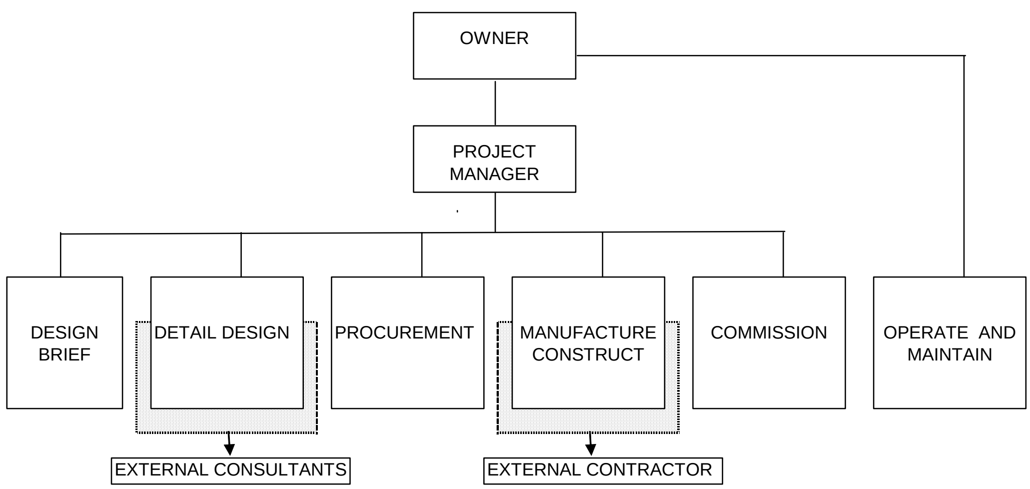


Figure 12.2 In-house Project

Design and Construct Project

Description:

Process design and some specialised design services retained in-house. Most work issued as a single (or sometimes multiple) design and construct package . Responsibility for design, procurement and construction included in this D & C contract.

Comments:

Normally limited to projects where process design is not a significant element (e.g. warehouse) or is a contractor speciality (e.g. package boiler) and where each D & C package is stand-alone. Variations to scope or schedule would typically incur significant penalty.

Points for consideration:

Single party responsible for design and construction interface.	Limited ability for Owner to control quality and schedule.
Requires firm scope and agreed design criteria.	Contractor may not have strength in all areas of scope.
Takes advantage of industry standards.	Contractor's price includes risk mark-up

Risk:

Majority of construction risk transferred to contractor early in project, subject to appropriate contract terms and agreed design criteria.

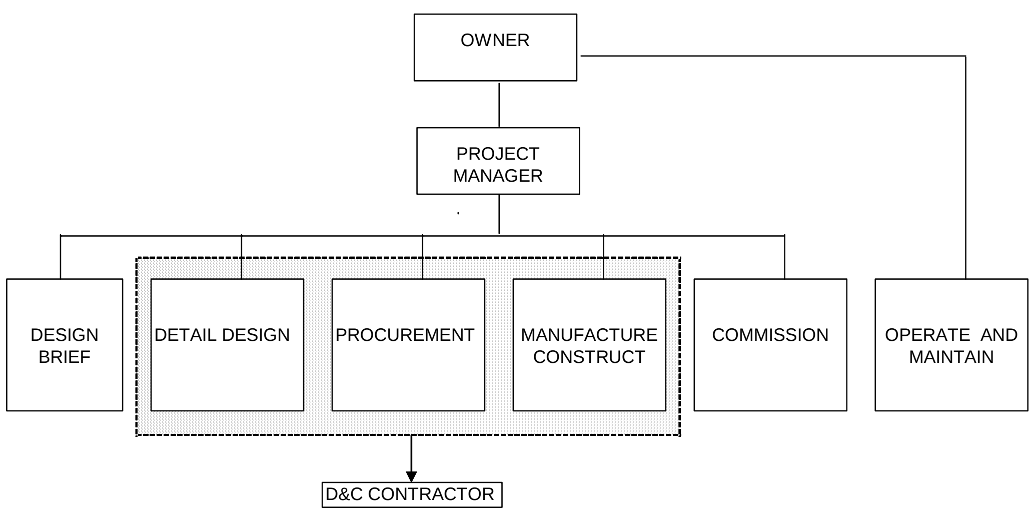


Figure 12.3 Design and Construct Project

Vendor Turnkey or EPC Project

Description:

A specialised equipment vendor or process engineer takes responsibility for all aspects of a project, including process guarantees, detailed design, procurement, installation and commissioning.

Comments:

Most suitable for projects requiring a large proportion of specialised equipment or proprietary processes. Possible variation is a design and supply only contract, with installation by a local contractor.

Points for consideration:

Access to current technology	Limited ability for Owner to control quality and schedule.
Minimal support from owner required, and possibly vendor financed.	Price includes significant contingency.
One organisation responsible for all aspects of work.	Installation may not be a core business of vendor.

Risk:

Construction and performance risk transferred to contractor on award, subject to appropriate contract terms and agreed performance criteria.

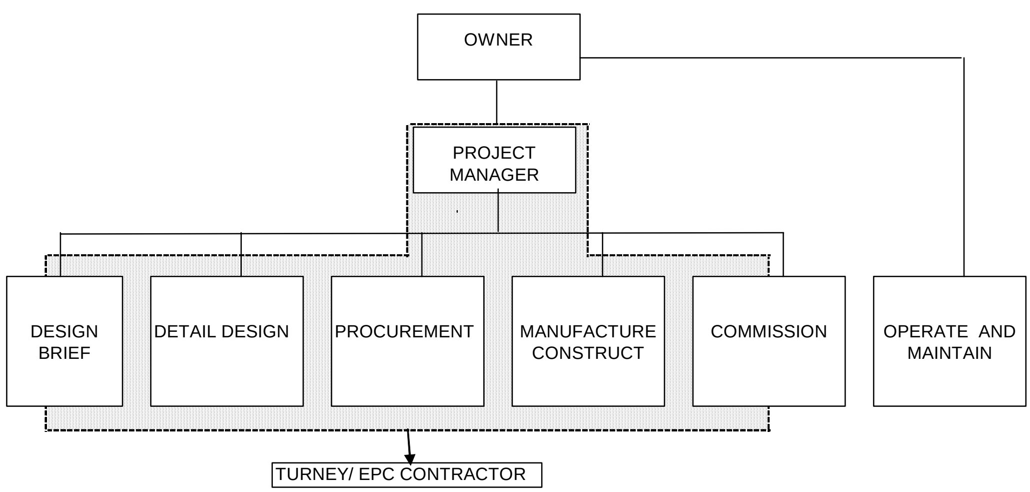


Figure 12.4 Vendor Turnkey or EPC Project

EPCM Project

Description:
A professional project management organisation, acting on the Owner's behalf, undertakes all engineering, procurement and management of construction, (using contractors). Sometimes limited to Construction Management only.

Comments:
This approach differs from previous strategies in that an engineering and management team is sourced from an outside organisation. This team runs the the project on behalf of the Owner. Packages of work are identified and competitively tendered.

Points for consideration:

Experienced project management team with multi-disciplinary skills.	Procedures and documentation need to be maintained to high level.
Selection of best contractors for each package of work.	Owner maintains control over project to degree desired.
Flexibility to change both design and schedule without major cost impact.	Professional management of delivery.

Risk:
Most risk remains with Owner until contracts are awarded - progressive throughout the project. However critical interface issues are able to be directly managed.

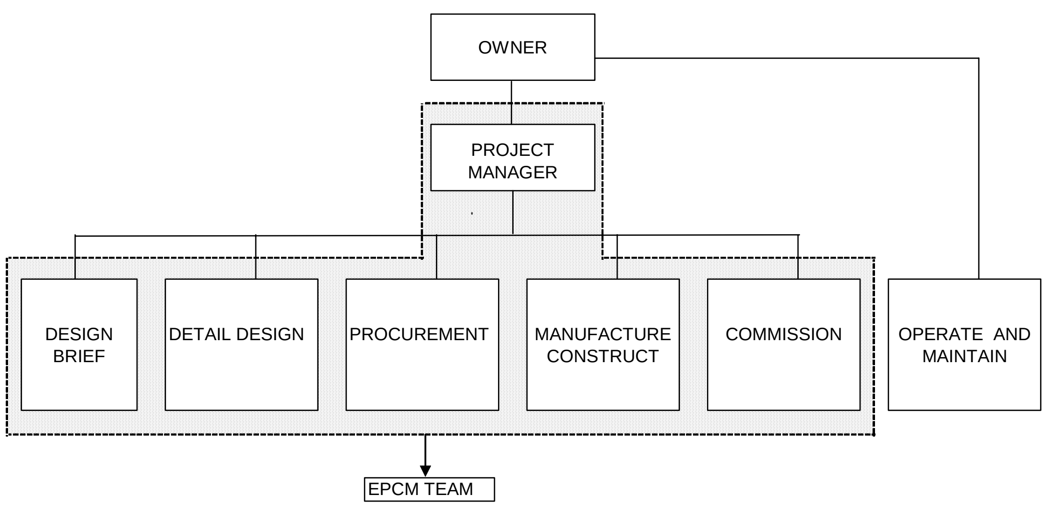


Figure 12.5 EPCM Project

Alliance Project

Description:
This strategy is in many ways similar to the EPCM approach except that the management team includes personnel from the Owner's organisation. It can also extend to include a head contractor who would direct construct a large proportion of the work.

Comments:
An alliance can call upon the expert knowledge of all alliance members. With proper alignment, the alliance is able to focus on optimum solutions for the Owner. However the effort required to put in place an alliance generally restricts its use to larger or long-term projects.

Points for consideration:

Wide pool of project experience able to be called upon.	Big effort required to set up and educate personnel in alliancing ways.
High degree of flexibility in scope and schedule	Scope "creep'" needs strong control.
All team members aligned on project objectives thru risk/reward share.	New benchmarks for performance measurement required.

Risk:
Generally all risk stays with Owner throughout the project. However alliancing arrangements ensure all parties maintain focus on key issues.

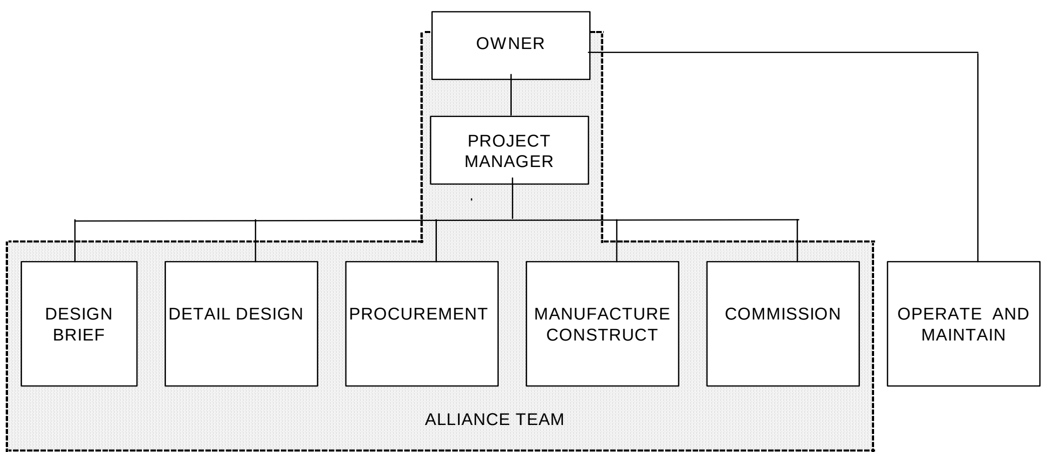


Figure 12.6 Alliance Project

BOO/BOOT Project

Description:

Build, Own, Operate (BOO) and Build, Own, Operate, Transfer (BOOT) strategies provide for a party independent of the Owner organisation to build the facility and also to operate it on behalf of the Owner, (and possibly transfer ownership at a later date).

Comments:

Typically used for non-core business activities. Usually some sort of take-or-pay arrangement with Owner. Very little direct involvement by Owner other than specifying outcome in terms of product or service.

Points for consideration:

Non-core business activity.	No detail design or operational control.
Generic in nature.	Lowest standard to meet requirement.
No capital requirement on Owner.	May require a take-or-pay arrangement.

Risk:

No direct risk to owner, subject to appropriate contract terms and product criteria. Long-term risk on use of product or service.

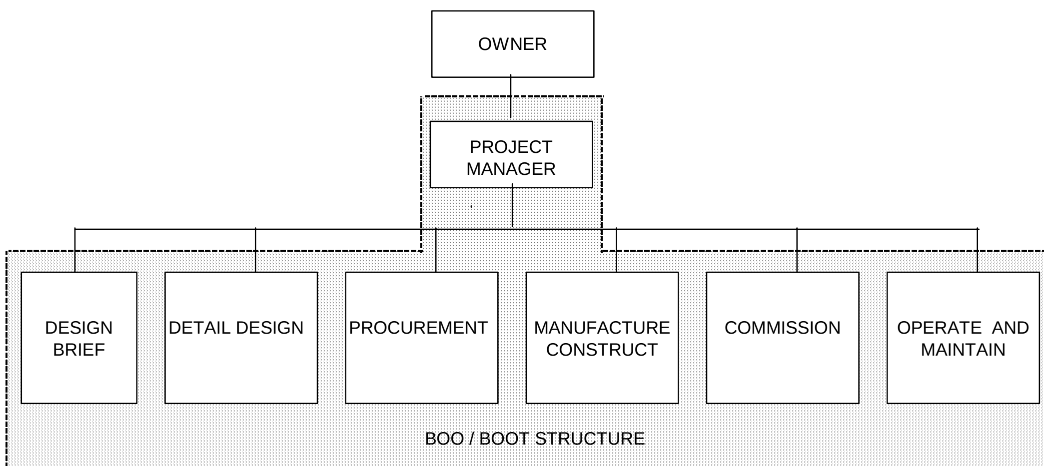


Figure 12.7 BOO / BOOT Project

12.6 PROJECT DELIVERY RISK ASSESSMENT

Risk refers to the level of uncertainty on a project. Failure to understand these uncertainties can lead to project cost increases and sometimes under-performance. These are generally not acceptable outcomes for Owners.

In some project delivery strategies the Owner retains the risk throughout the duration of the project. In others the risk is passed to another party (or parties) at either the start of a project or at specific stages during the project. There is no single risk allocation strategy.

Assessing which of the alternative project delivery strategies will be the least cost strategy is an essential part of risk management. Most projects are unique and only ever executed once. Hence there has been few opportunities to make satisfactory historical comparisons. There are, however, a number of general observations that can be made and these do provide a guide to a least cost strategy:

- Scope uncertainty is the major cause of cost risk;
- Most opportunity for cost saving is during the design phase;
- Transferring risk to a contractor (via a lump sum bid) may provide reassurance to the owner but it may be paid for via additional contingency in the contractor's price or qualified out in a way that allows the contractor to claim variations;
- A more hierarchical contracting organisation will result in a higher total of mark-ups;
- Contractors are in general more commercially aware then engineering consultants, and therefore tend to take greater advantage of scope uncertainties;
- There is no substitute for good project management (planning) whichever way the project is delivered.
- *The Owner* owns the project and has responsibility to define it and also to decide how the project will be delivered.
- The *Owner's engineer* is assigned the task of assisting with the scoping and feasibility study and often acts as a superintendent for the work.
- *Design consultants* are appointed primarily to provide concept and detail design and documentation services, in line with their design expertise.
- *Suppliers* design, fabricate and deliver equipment and materials but generally do not install.
- *Fabrication and construction contractors* are used where the work is of a routine fabrication or construction nature (and generally single discipline skills are required, e.g. civil works, mechanical and piping). Fabrication drawings may be included in the contractors' scope, especially for structural steel or pipework.
- *Design and construction contractors* (D &C) are used where work can be readily specified and packaged into stand-alone multi-disciplinary packages, with minimal interface with other works, and design work is the responsibility of the contractor. Process guarantees are not normally offered. Industry norms for design and construction work standards are acceptable.

- *Vendor turnkey or Engineering, Procurement, Construction (EPC) contractors* are used where the work includes a high proportion of proprietary equipment, and/or has a requirement for a process or performance guarantee. As for D & C, they are used where the work can be performance-specified and packaged into stand-alone packages, with minimal interface with other works, and industry norms for design and construction work standards again are acceptable.
- *Engineering, procurement, and construction management consultants (EPCM)* are appointed when the Client requires expert support in areas of design, procurement, construction management and commissioning. It allows the Owner to reduce involvement in the detail management of a project whilst retaining the ability to influence outcomes of all critical issues.
- *BOO/BOOT companies* are used when the Owner does not have the resources or requirement to construct and operate the facility.

13 Summary and Recommendations

13.1 LAND USE DEVELOPMENT SCENARIOS

This study has investigated future public transport (Corridor Transit) system improvements for Canberra and the ACT sub-region in the context of five future land use development scenarios. These five land use scenarios are defined as follows:

- Scenario 1: Follow the Y-Plan and continue the development of Gungahlin as a priority
- Scenario 2: Place greater emphasis on infill development, dual occupancy and higher densities
- Scenario 3A: Develop Stromlo for urban use and take up the land in North Belconnen
- Scenario 3B: Place greater emphasis on the development of Kowen, Googong and Tralee to Canberra's South East
- Scenario 3C: Instead place emphasis on the development of Gooromon and Jeir to Canberra's North West.

The scenarios are conceptually similar to the range of four growth concepts for Canberra which are being considered for the Canberra Spatial Plan, as presented at the 11–12 June 2003 Forum, namely:

- Growth Concept 1 – Base case/current trends: This is very similar to Scenario 1 in this report with a future total Canberra/Queanbeyan population of 418,000 in the period 2026/31.
- Growth Concept 2 – A City Beyond the Border: This is similar to a combination of Scenarios 3B and 3C in this report with significant urban development in Gooroman–Jeir to the north west and Googong–Tralee in the south east with an ultimate Canberra/Queanbeyan population of 500,000 in the period 2026/31.
- Growth Concept 3 – A City within the Border: This is similar to a combination of Scenarios 3A and 3B in this report with new urban development areas east in Kowen, west in Stromlo and south in West Murrumbidgee. The ultimate Canberra/Queanbeyan population is also 500,000.
- Growth Concept 4 – A City Contained: This is similar to Scenario 2 in this report with the development of urban consolidation along the identified Y-Plan public transport corridors in Canberra and also within the corridor east to the Airport. The ultimate Canberra/Queanbeyan population is also 500,000.

The transport sustainability analysis which has been undertaken has compared the performance of the range of land use development scenarios, primarily in the full development year 2031 timeframe.

In almost all the performance indicators considered, the performance of the two land use scenarios which minimise urban fringe development in new areas, (Scenario 1 and Scenario 2) is superior, indicating that these are the two preferred land use development scenarios for the future. If new urban fringe areas are to be considered, the Stromlo area, by virtue of its close distance to the existing central city employment, retail and entertainment precincts is preferable to the alternative locations, where the relative isolation and reduced accessibility act to suppress travel demand.

The preferred future land use scenario for Canberra should in principle combine elements of Scenario 1 and Scenario 2. From a public transport operating revenue perspective, Scenario 1 is preferable in that it results in a higher transit user mode share and greater revenue for the corridor transit system

Scenario 2 however provides more opportunity for locally based walking and cycling trips with transit oriented development whereby areas within a 500 m walking distance of designated transit stops. Figures 13.1 and 13.2 show future land development zones which can act as the future focal points for increased development densities (transit oriented development) for both residential and local commercial/ entertainment facilities, including suitable housing for the elderly.

This policy would however represent a significant divergence from past land use policies, whereby, with the exception of Northbourne Avenue, higher density developments are encouraged within the vicinity of local commercial centres which are generally located away from the major transport corridors.

13.2 RECOMMENDED LONG-TERM SYSTEM IMPROVEMENTS

The study has examined both longer term and interim improvements to the public transport system including in the longer term the development of either or all of the Civic to Belconnen, Gungahlin, Kingston/Manuka and Woden/Tuggeranong transport corridors as either light rail or dedicated off-road busway routes.

The major constraint to improved public transport usage in Canberra has been identified as excessive travel times by public transport in comparison to car travel, which is a combination of poor service frequency (on most routes other than inter - town routes) and the indirect routing of many bus services.

This study has tested and assessed the systematic introduction of a stage 1 corridor transit system over 54 route kilometres serving all the core inter-town routes, commencing in either 2006 or 2011. Future Stage 2 extensions giving a further total of 30 route kilometres have also been identified for further consideration when funds become available.

This study has identified the future capital cost of the stage 1 (54 kilometres) corridor transit system as either $890 million for a light rail or $670 million for an equivalent bus based system. Despite these high costs, the study has identified significant net economic benefit to the future community of Canberra from a corridor transit system with a benefit to cost ratio of 3.28:1 at a 7% discount rate (light rail) and 4.22:1 (busway).

Although a bus based inter-town corridor transit system would be approximately 25% cheaper to construct than the equivalent light rail system, it would have significantly higher annual operating costs and energy usage and the longer term durability of the vehicles would be generally lower leading to higher replacement cost in future years.

The future fare structure for the corridor transit network would however need to be fully integrated with the ACTION buses in order to avoid disadvantaging any passengers who need to interchange from feeder bus services onto the corridor transit system.

Although the existing bus based inter-town network in Canberra has through routing of some bus services from Belconnen and Tuggeranong at both ends of the main inter-town route, in practice this only benefits a small proportion of the total Canberra population that live or work in either the north west sector of Belconnen or the south east Sector of Tuggeranong. There is currently no through routing of Gungahlin or Fyshwick–Kingston-Manuka services.

The project community benefits will arise from increased accessibility, reduced traffic congestion, reduced motor vehicle pollution and reduced traffic accidents. In addition to these benefits, ACTION buses will have fleet and operating cost savings whilst road construction and maintenance savings will also be able to be realised. Other key benefits, which are not quantified in the economic and financial analysis include being able to make better use of existing car parking land and the improved land values that will come from higher densities and better access to public transport. With the inclusion of these factors, the longer term financial performance of the system will be close to break even but will require additional top up funding from either car parking revenues or government land sales.

A critical factor in comparing the future attractiveness of alternative bus and light rail systems to the travelling public in Canberra is the improved ride quality which occurs with light rail. Light Rail vehicles are also more inherently suitable for carriage of larger objects such as bicycles, which is an important consideration for many potential users of public transport in Canberra.

Additionally, the highly visible investment in rail tracks signifies a degree of permanence for the future system which will lead to land value capture benefits for numerous government owned sites in the vicinity of rail stations where increased levels of development would occur.

A light rail system would generally provide the type of spark necessary to improve the image of public transport in Canberra which has deteriorated in the past decade towards a disproportional reliance on the school children and welfare recipient based "non-choice" user market.

Additionally, extensive research in Europe (Haas Klau, 2002), indicates that for cities of comparable population to Canberra, the cities which have light rail systems have approximately three times as many journeys by public transport per resident per annum than the cities which have bus only systems.

13.3 INTERIM IMPROVEMENT MEASURES

The economic and financial analysis which has been undertaken for this report indicates that the recommended year to commence the construction of the corridor transit system would be 2011 with a likely four year construction period.

Sensitivity analysis for financial performance with commencement in 2006 indicates a significantly lower revenue basis at that time.

In the interim period, car parking revenues from the expansion of pay parking could be accrued to provide seed funding for the project in 2011.

In the interim period, it will however be appropriate to act to secure the public transport system route corridors, which are virtually all contained within existing road reserves by the development of low cost surface busway systems operated by ACTION buses.

It is recommended that within the next 2 years, the Belconnen to Civic and Gungahlin to Civic routes should be established as bus based public transport corridors with a limited life sealed road pavement (cost $1.6 million per kilometre plus traffic signal modifications) on the future light rail alignment. These routes will be the easiest to establish in the short-term as they would not require widening of either the Kings Avenue or Commonwealth Avenue Bridges over Lake Burley Griffin.

It is important to begin work on the transit corridors at the earliest possible opportunity. This will allow routes to become established and the identification of station locations will provide an opportunity for urban development in Gungahlin to focus around these transport nodes. This early development will maximise the potential for the success of the corridor transit system as an alternative to private car journeys.

For the Belconnen route, the crossing point of the Gungahlin Drive Extension roadway near the south east corner of the AIS/Bruce Stadium complex, need to be included in the construction plans for that project.

Other interim solutions to improve existing public transport which should be implemented by ACTION and the Department of Urban Services are:

- the provision of direct 15 minute peak hours frequency bus services from at least one point in every suburb in Canberra to Civic, and/or the nearest town centre if that lies on a direct route towards Civic
- a major review of ACTION bus routes based on the principle of directness such that at no point on its journey should a bus be travelling away from its ultimate destination
- improvements to passenger information systems with the provision of real time information at the interchanges and selected major bus stops (2 or 3 on each of the intertown corridors) and basic minimum timetable information showing the bus route and timetable at at least 50% all bus stops on the network
- the current level of provision of bus route and map information at bus stops as observed in the outer suburbs of Belconnen, Gungahlin and Tuggeranong is less than 10 percent (February 2003)
- the removal of local road traffic control measures and street furniture which adversely affect bus operations and passenger comfort on local roads. A high priority should be given to the removal of the numerous small roundabouts on McClelland and Kellaway Streets through North Gungahlin which have a major adverse effect on passenger comfort for buses travelling along these roads.

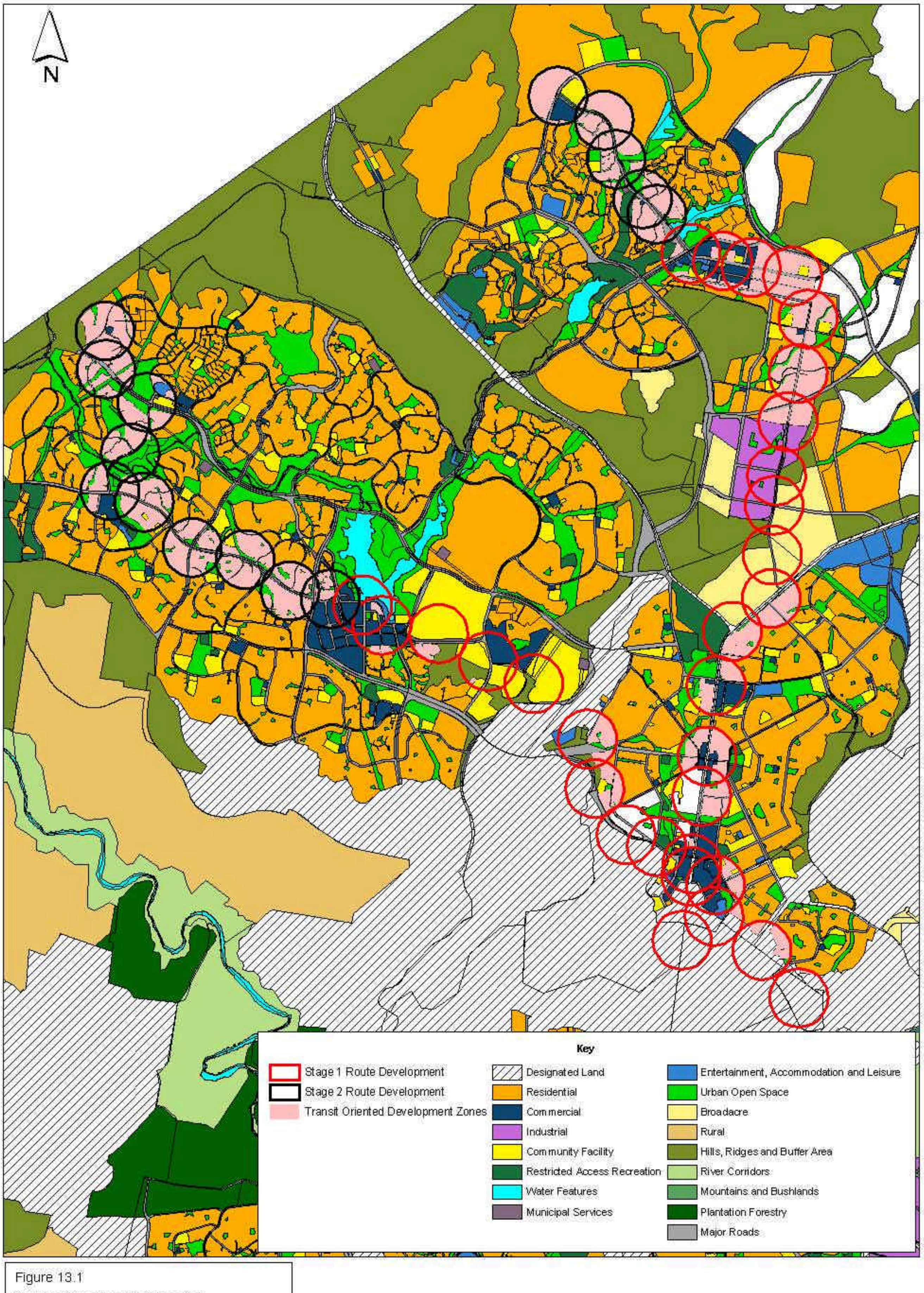


Figure 13.1

Station Catchment Zones for Transit Oriented Development -Northern ACT

Base Map: ACTPLA (2003)

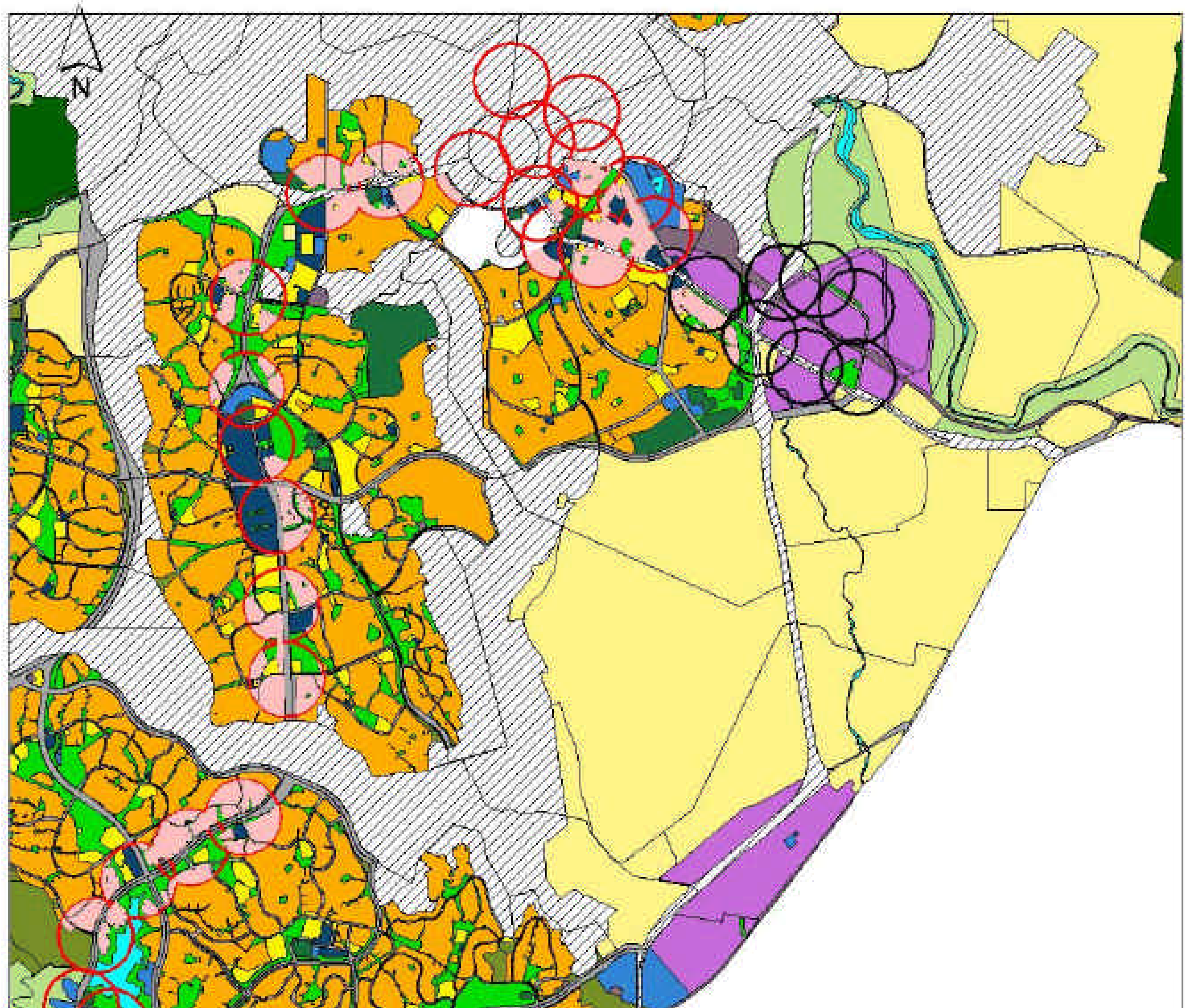


Figure 13.2

Station Catchment Zones for Transit Oriented Development -Southern ACT

Base Map: ACTPLA (2003)

0 750 1,500 3,000 4,500 6,000 Metres

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