

Qualitative Commentary on the key benefits under each theme.

The Department has identified some key benefits that may be observable against each theme. For the theme that is most relevant, please rank the priorities – 1 being the most important – and provide a brief description against the number 1 priority. There is no requirement to undertake this task for projects that most strongly align with the Innovation theme.

Connecting People

Benefit	Priority (1 to 4; NA if not relevant)
Increased agglomeration in urban centres	3
Increased urban renewal	4
Improved reliability of routes / passenger services	2
Increased capacity on existing commuter links	1

For the priority 1 benefit outlined above, please provide a short description outlining why this is the key benefit for the project?

The Gungahlin to City Corridor connects Canberra's fastest growing district, Gungahlin with the City and the Parliamentary Triangle, Canberra's focal points for civic and employment activities. Population levels in Gungahlin under a business as usual case are projected to come close to doubling by 2031 and as the district develops, the demand for travel between Gungahlin and the City is expected to grow.

Current road and public transport links are congested and with few alternative corridors available for expansion, the expansion of public transport capacity and associated road congestion relief along Northbourne Avenue-Flemington Road corridor is necessary to increase the efficiency of existing movements and provide capacity to support future developments in the City, along Northbourne Avenue and within the Gungahlin District.

Moving Freight

Benefit	Priority (1 to 3; NA if not relevant)
Increased connectivity of intermodal linkages	Not relevant
Improved reliability of freight routes	Not relevant
Increased capacity of freight routes	Not relevant

For the priority 1 benefit outlined above, please provide a short description outlining why this is the key benefit for the project?

Not applicable

Asset	Cost Component	Cost Type	OPTION 8: LRT Median & Verge Cycle			OPTION 10: BRT Median & Verge Cycle		
			Static Costs	P50	P90	Static Costs	P50	P90
Enabling works	Planning	Direct costs	\$ 11.655	\$ 11.653	\$ 17.350	\$ 11.655	\$ 11.653	\$ 17.350
Other general planning and management	Planning	Direct costs	\$ 9.713	\$ 9.710	\$ 13.316	\$ 9.713	\$ 9.710	\$ 13.316
Traffic Management / Temporary Works	Planning	Direct costs	\$ 4.431	\$ 4.430	\$ 5.272	\$ 4.431	\$ 4.430	\$ 5.272
Track work	Below rail infrastructure	Direct costs	\$ 101.984	\$ 101.940	\$ 155.205	\$ -	\$ -	\$ -
Road Infrastructure	Bridges	Direct costs	\$ 18.011	\$ 17.901	\$ 22.779	\$ 18.011	\$ 17.901	\$ 22.779
Road Infrastructure	Segregated Rapid Transport Lanes	Direct costs	\$ 24.000	\$ 23.999	\$ 34.561	\$ 24.000	\$ 23.999	\$ 34.561
Road Infrastructure	Road works	Direct costs	\$ 4.824	\$ 4.834	\$ 7.440	\$ 4.824	\$ 4.834	\$ 7.440
Road Infrastructure	Medians / Landscaping	Direct costs	\$ 4.875	\$ 4.890	\$ 6.155	\$ 4.875	\$ 4.890	\$ 6.155
Road Infrastructure	Drainage	Direct costs	\$ 4.589	\$ 4.588	\$ 5.527	\$ 4.589	\$ 4.588	\$ 5.527
Road Infrastructure	Cycle Lanes	Direct costs	\$ 4.113	\$ 4.111	\$ 5.067	\$ 4.113	\$ 4.111	\$ 5.067
Road Infrastructure	Footpaths	Direct costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Road Infrastructure	Utilities	Direct costs	\$ 26.800	\$ 27.217	\$ 34.596	\$ 26.800	\$ 27.217	\$ 34.596
Signalling	Electrical	Direct costs	\$ 7.285	\$ 7.283	\$ 9.986	\$ 7.285	\$ 7.283	\$ 9.986
Power supply, transformers and sub-stations	Electrical	Direct costs	\$ 39.000	\$ 39.116	\$ 63.418	\$ -	\$ -	\$ -
Other electrical and mechanical systems	Electrical	Direct costs	\$ 15.589	\$ 15.589	\$ 17.044	\$ 12.821	\$ 12.820	\$ 14.160
Passenger ticketing	Passenger interface and communications	Direct costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Passenger information displays and Platform control systems	Passenger interface and communications	Direct costs	\$ 10.927	\$ 10.925	\$ 12.318	\$ 7.285	\$ 7.284	\$ 8.667
Vehicle monitoring systems	Passenger interface and communications	Direct costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Bus stops		Direct costs	\$ 3.000	\$ 2.996	\$ 5.146	\$ 3.000	\$ 2.996	\$ 5.146
Bus / Light Rail stations		Direct costs	\$ 21.854	\$ 21.848	\$ 28.662	\$ 14.569	\$ 14.562	\$ 21.265
Other buildings and structures	Depots	Direct costs	\$ 60.000	\$ 59.988	\$ 102.953	\$ 35.000	\$ 34.958	\$ 53.260
Bus fleet	Fleet	Direct costs	\$ -	\$ -	\$ -	\$ 11.250	\$ 11.249	\$ 13.792
Light rail rolling stock	Fleet	Direct costs	\$ 54.635	\$ 54.112	\$ 71.129	\$ -	\$ -	\$ -
Subtotal: Direct Costs			\$ 427.284			\$ 204.220		
Preliminaries and design	Preliminaries and design	Indirect costs	\$ 85.457	\$ 88.258	\$ 103.284	\$ 40.844	\$ 41.933	\$ 46.507
Government costs	Project delivery costs	Indirect costs	\$ 10.682	\$ 11.032	\$ 12.911	\$ 5.106	\$ 5.242	\$ 5.813
Subtotal: Indirect Costs			\$ 96.139			\$ 45.950		
TOTAL PROJECT COST (\$mil)			\$ 523.423	\$ 540.578	\$ 632.615	\$ 250.170	\$ 256.842	\$ 284.857

000732

Christie, Joan

From: Corrigan, Jim
Sent: Monday, 14 May 2012 10:26 AM
To: Valdivia, Jamie
Subject: FW: City to Gungahlin Transit Corridor - concept report, project update etc
Attachments: 20120314 Northbourne SC Meeting 6 Minutes 7 March 2012.docx; Final Concept Report_8spread.pdf; ESD_City to Gungahlin transit Update FA_1 page.pdf; 120413 Northbourne Ave Economic Workshop (April).pdf

From: Jurcevic, Suzanne
Sent: Friday, 13 April 2012 2:50 PM
To: Tennent, Simon; Drury, Trish; Tomlins, George; Douglas, Ken; Ahmed, Khalid; Andrew Smith; Collett, David; Corrigan, Jim; Davoren, Pam; Dixon, Brook; Murray, Chris; Papps, David; Peters, Paul; Ponton, Ben; Swayn, Alastair
Cc: Blume, Kristin; Kugathas, Kuga; Walter, Stephan
Subject: City to Gungahlin Transit Corridor - concept report, project update etc

Dear Committee members,

Please find attached the following documents:

- Project update #2 for community consultation (likely to commence Monday)
- URS Concept Report – provides further detail on concept design
- Meeting minutes from 7 March
- Deloitte presentation from today's economics results briefing

Regards,

Suzanne Jurcevic | Senior Project Officer

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Government

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Sustainable Development

Meeting Record

Northbourne Avenue Transport Corridor Study Steering Committee

Level 3 Board Room, Dame Pattie Menzies South, Challis St Dickson

Wednesday 7 March 2011

10.00 – 11.30am

Attendance:

Name & Position	Directorate/Agency
Minister Corbell	
David Papps, Director General and Meeting Chair	ESDD
Gary Rake, Chief Executive	NCA
Andrew Smith, Deputy Chief Executive	NCA
Ben Ponton, A/g DDG, Planning Policy	ESDD
Jim Corrigan, Director, Office of the Coordinator General	EDD
Brook Dixon, A/g Director, Economic, Regional and Planning	CMCD
David Collett, Senior Director, Asset Management	CSD
Ken Douglas, Senior Manager, Economic and Regional	CMCD
Derek Stolz – delegate for Paul Peters, ED, Roads and Public Transport	TAMS
Kuga Kugathas, Senior Manager, Transport Planning & Projects	ESDD
Kristin Blume, Senior Manager, Transport Policy Coordination and Northbourne Project Team Leader	ESDD
Stephan Walter, Manager, Northbourne project	ESDD
Suzanne Jurcevic, Assistant Manager, Northbourne project	ESDD
Consultants: Amanda Tobin Martin Oaten Matthew Yi	URS Deloitte

Apologies:

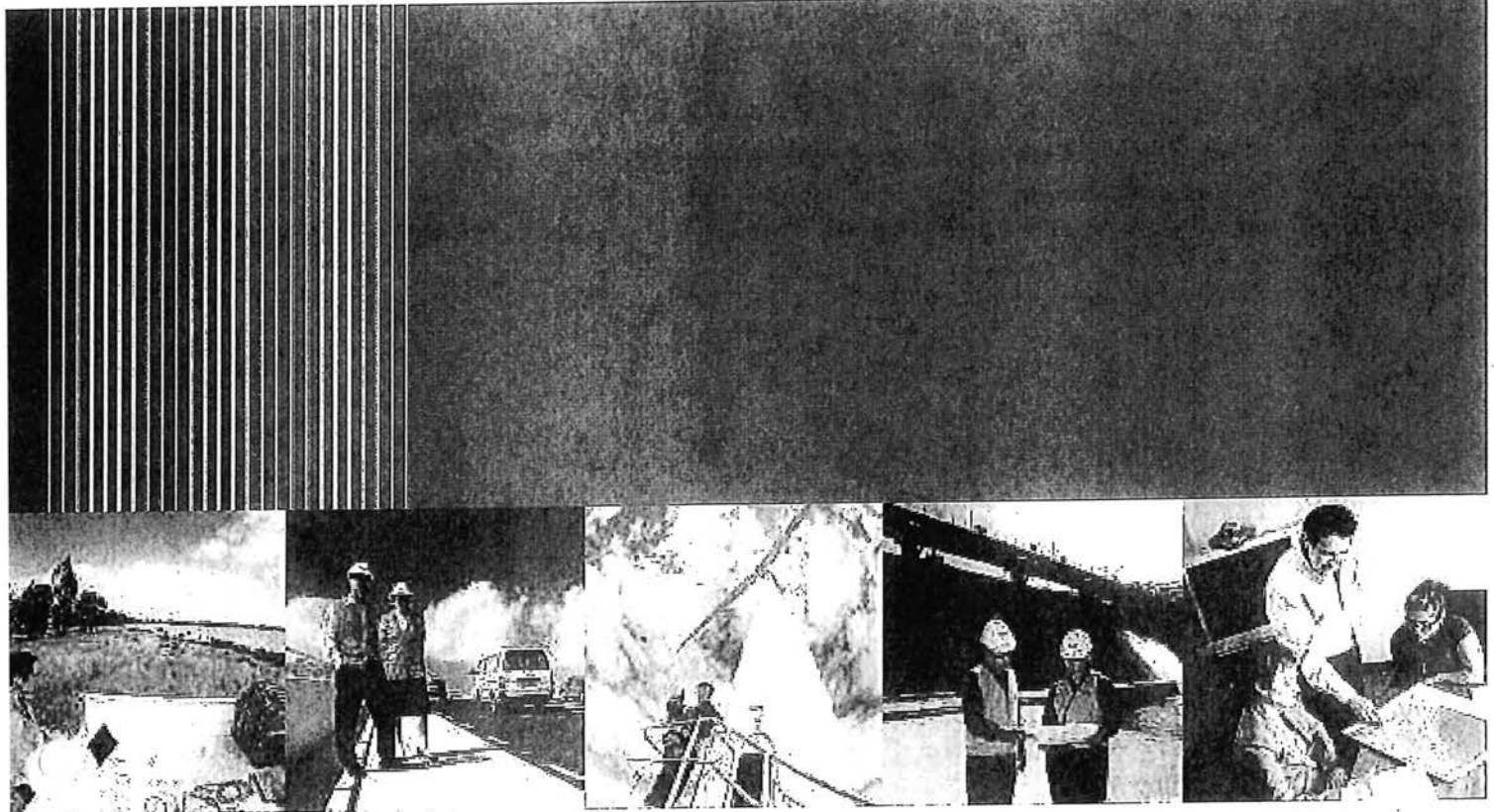
Khalid Ahmed, ED, Policy Coordination and Development	TD
Alastair Swayn	Government Architect
Paul Peters, ED, Roads and Public Transport	

Record of actions and key decisions

No	Item	Summary of discussion	Action	Responsibility
1	Welcome and apologies	Chair welcomed the steering committee and noted apologies.	Noted	
2	Other business	Minutes of the previous meeting were confirmed.		
3	Project Update	<p>Kristin Blume provided update on project, noting:</p> <ul style="list-style-type: none"> • Community consultation was deferred from December 2011 and will occur over March – May 2012. • Business case was distributed to steering committee members and feedback is due on Fri 16 March 2012. 	Noted	
4	Options update	<p>Amanda Tobin (URS) outlined the 5 options which have been modelled in response to feedback from steering committee members,</p> <ul style="list-style-type: none"> • Base case – business as usual • Bus priority measures (BPM) between City and Dickson • BRT • LRT • BPM converting to LRT 	Noted.	
5	Business case	<p>Martin Oaten and Matt Yi (Deloitte) provided an overview of the draft business case. Issues/discussion of note included:</p> <ul style="list-style-type: none"> • BCR for LRT/low land use scenario would be a 	Deloitte presentation to be distributed to steering committee with meeting minutes.	

		<p>suitable comparison to BCR for BRT/base case due to increased development resulting from development of LRT.</p> <ul style="list-style-type: none"> • For Infrastructure Australia to be able rely upon the BCR's that result from including land use uplift benefits it is suggested that a process or mechanism be defined in the IA submission that will deliver the benefits. • Financial modelling uses current ACTION costs, however it was noted that other BRT systems can make significant operational cost efficiencies and savings. 	<p>Business case outlines example delivery models for Cabinet consideration.</p> <p>Deloitte to refine operational costs.</p>	<p>Deloitte</p>
6	Presentation - URS	<p>Amanda Tobin presented: a recap of options considered in the study, a concept report update, Triple bottom line evaluation outcomes and supplementary information requested by stakeholders regarding alternatives to options; including the cost of a reduced capacity option and minimal alignment change option. Next steps in the study were identified.</p>	<p>URS presentation to be distributed to steering committee with meeting minutes.</p>	<p>Project team</p>
	Business case briefing	<p>Briefing to be held with Deloitte following steering committee for the benefit of those unable to attend and to provide opportunity for further discussion on business case.</p>	<p>Invites to be sent to steering committee members</p>	<p>Project team</p>

Next meeting (no. 8): April 2012



Report

City to Gungahlin Transit Corridor:
Concept Design Report (April 2012)

Prepared for
ACT Environment and Sustainable Development
Directorate

43316037



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Principal-In-Charge: Alex Iljin Senior Principal – Transport	T: 61 3 8699 7500 F: 61 3 8699 7550	
Author: Amanda Tobin Senior Transport Planner		
Reviewer: Alex Iljin Senior Principal – Transport	Date:	26 March 2012
		Reference:	43316037/01/A
		Status:	Final Draft

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Executive Summary

This report summarises the outcomes to date of investigating Bus Rapid Transit (BRT) and Light Rail Transit (LRT) options for the City to Gungahlin Transit Corridor.

Introducing rapid transit to the corridor will go towards improving the Frequent Network outlined in the Transport for Canberra plan, and help transform the City to Gungahlin corridor into a more urban, active, attractive boulevard and entry to the ACT. The BRT or LRT options would replace the current Red Rapid service between Gungahlin and City made permanent after successful trials in 2011. Further extensions south and east towards the Parliamentary Zone/Barton, Woden and Belconnen have been considered and are part of current and future transport planning.

The Corridor: Now and Future

Northbourne Avenue is an important approach route and main avenue for Canberra. It links to the Federal Highway which is the main approach route from Sydney and Melbourne and so becomes a visitor's first perception of the city's character.

Flemington Road is a connector road from Canberra City Centre to the town centre of Gungahlin, which links Northbourne Avenue to Hibberson Street, the main shopping and business strip in Gungahlin. Currently, the southbound bus lanes on Flemington road carry nearly 50% of people on the road in the morning peak.

The corridor includes three main nodes/stations at City, Dickson and Gungahlin, which will be both an important part of the public transport network, and locations for changing land use that is already part of current planning policy.

Mode Options

- Bus Rapid Transit (BRT)—AU\$300 – \$360 million
- Light Rail Transit (LRT)—AU\$700 – \$860 million

These cost ranges are estimates which recognise that the level of design is at a pre-conceptual or concept screening phase.

For both options, the same alignment is recommended by applying the principle that each of the mode options should take into account eventual light rail operation: whether it's in the next 5 or 30 years, the appropriate location should be reserved now. In each of the options the service is assumed to run at a 10 minute frequency by 2021 and 8 minutes or less by 2031. Three major stations would exist along the corridor at City, Dickson and Gungahlin, where interchange would occur between frequent and coverage bus services and other transport modes.

Concept Design—Alignment Options

The concept design in this report recommends a kerbside alignment for either LRT or BRT along Northbourne Avenue, transitioning to a median alignment before Barton Highway and running in the median to the Gungahlin Town Centre using the existing median land reservation. The option of a median alignment for the Northbourne Avenue sector is also discussed in this report.

Executive Summary

Land Use

Public transport patronage is influenced by the level of development located in close proximity to the public transport routes. How many residents, jobs and other trip generating activities are located in the transport corridor will impact on the number of trips taken by public transport and other modes. The benefits of public transport improvement projects are measured by how many people are attracted to using the public transport as opposed to taking trips by individual vehicles. A two way relationship exists between transport improvement and efficiency and higher land use activity.

This project assessment includes considering the infrastructure options and mode costs as well as land use variables to identify what provides the greatest benefits. These are assumptions for the purpose of transport modelling. Detailed land use planning would be required to implement any variation to current policy. This study has modelled the potential impacts of theoretical higher population growth under two scenarios:

- "low" growth, based on no changes to existing planning policy but a faster take-up of recent planning changes in Gungahlin, Dickson, and the city;
- "medium" growth, assuming an additional level of growth on top of the base case forecast population in the corridor. This scenario would require planning policy changes over many years in consultation with the community, and is not directly part of this transit study.

Improved transit in the corridor will allow the main avenue to fulfil its role as a nationally significant entry to the Central National Area.

Evaluation Results

Preliminary economic modelling shows that for all options, benefits appear to outweigh costs when growth occurs within the corridor under the "low" growth land use scenario. This higher rate of growth is consistent with LRT and BRT project experiences in Australia and overseas. Greater improvements to the benefit to cost ratio were demonstrated when higher levels of growth are modelled within the corridor. This higher level of growth would require detailed corridor land use planning. This study will be developing detailed benefit to cost ratios for each mode option for the corridor. We note that BRT options tend to attract higher BCRs than LRT due to the higher up-front costs for LRT and similar monetary benefits for each mode.

Introduction

This study proposes Bus Rapid Transit (BRT) and Light Rail Transit (LRT) options for the transport corridor between City and Gungahlin, along Northbourne Avenue and Flemington Road. This important national corridor is subject to trends and factors that will have an increasing impact as population grows over the next 10 to 20 years:

- Growing population
- Growing road congestion
- Public transport being delayed by traffic congestion
- High greenhouse gases as a result of road congestion
- Need for greater social inclusion

The main focus of this concept report is to identify transit improvements that will help transform the corridor, and respond to the pressures identified above. The project is part of the ACT Government's Transport for Canberra policy, released in March 2012.

1.1 Transport for Canberra and the Frequent Network

Transport for Canberra is a plan to achieve a more efficient transport network for Canberra over the next 20 years. It promotes safe and sustainable travel options and the complimentary planning of the transport network and future land use to encourage development in Canberra within easy reach to the transport network.

Replacing and updating the ACT Government's Sustainable Transport Plan released in 2004, Transport for Canberra updates the mode share targets set by this plan to achieve 30% mode share of all journey to work trips by walking, cycling and public transport by 2026.

Transport for Canberra identifies the Frequent Network as part of the strategic network of service types. The Frequent Network comprises rapid and frequent network services. These are the fast and frequent all day services, running at 15 minute or better frequency. Rapid services run along the major corridors that connect Canberra's town centres and major employment areas, and "frequent local" services connect higher density residential areas. The Frequent Network is supported by "coverage" services which act as feeders and access services in the suburbs, and peak express (or "Xpresso") services which connect lower density suburbs to employment locations in peak periods. The frequent network is a 20 year plan to 2031 which aims to achieve (if not exceed) the public transport mode share targets (12.5% of work trips by public transport by 2016), and help guide land use and transport planning decisions.

I. Introduction



Figure 1 shows the planned Frequent Network for 2031 in the study area. It shows that along the transport corridor between City and Gungahlin a rapid service exists, known as the Red Rapid; it is this service that is proposed to be improved through either BRT or LRT. The map also shows an East-West "Frequent Local" which in the next 5 – 7 years will provide a frequent connection between Dickson and Belconnen

Figure 1 Snapshot of the 2031 Frequent Network in the study area

1.2 Planning Context

This study aligns with Commonwealth and ACT Government strategic land use and transport plans and policies which apply to the ACT, including the Transport for Canberra policy (ACT), the National Capital Plan (Commonwealth) and the draft ACT Planning Strategy (ACT).

The draft ACT Planning Strategy was recently released for public consultation and provides the overarching land use strategies for the ACT to 2060. The strategies which this study aligns to specifically include: "creating opportunities for increased density and dispersed employment by capitalising on the existing structure of the centres and inter-town transport connections" and "improving everyone's mobility and creating more choices in travel by integrating investment in Canberra's transport networks with the land use it serves."

The National Capital Plan (NCP) aims to ensure that Canberra is planned and developed in accordance with its national significance. The NCP identifies Northbourne Avenue as a Main Avenue and National Approach Route and as such the objective for its planning and development is to establish and enhance the identity of the approaches to the Central National

Area as roads of national significance and, where relevant, as frontage roads for buildings which enhance the National Capital function and as corridors for a possible future inter-town public transport system.

Walter Burley Griffin's original plan for Canberra envisioned a tram network easily accessed by walkable catchments as shown in Figure 2 below.

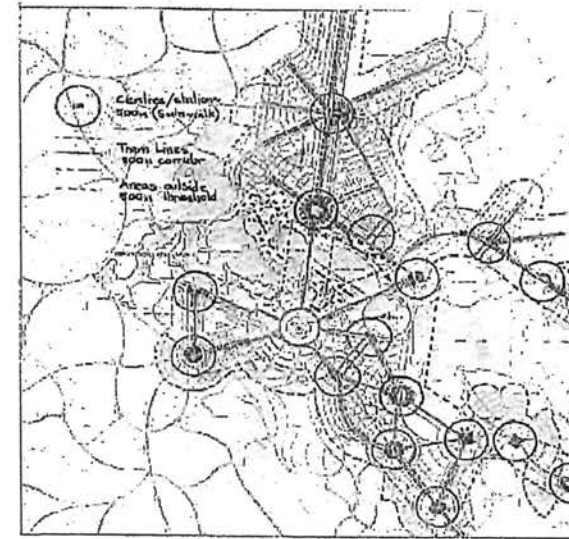


Figure 2 Griffin's tram network and pedestrian catchments¹

His transport vision is described in the *Report Explanatory of the Preliminary Central Plan* and is outlined below:

It is contended that modern and prospective means of street transportation in the tramway and fast vehicle traffic, and of which the great progress up the present is hardly a beginning toward speed, safety, noiseless, and reliability in sight for the near future, mean a very different distribution of trade than where walking range has been the determining factor. During the transformation period terrific congestion has resulted in the large cities, and the lift or "elevator" pressed into service for relieve. An equally well administered tram service possibly supported financially in the same way would certainly assure more convenient as well as far better horizontal alignment, for even in spite of inadequate and costly nature of the street railway accommodation the trend in the larger cities in the United States of America is now obviously that of dispersion in long lines, as witness, Broadway in New York and all the important through lines that accidentally occur in Chicago of a generally unwieldy checker-board pattern.²

¹ The Griffin Legacy: Canberra, the nations's capital in the 21st century, National Capital Authority, 2004.

² Appendix B, Copy of Federal Capital Design No. 20, W. B Griffin, 1912.

I. Introduction

The City to Gungahlin Transit Corridor would also enhance Griffin's vision for Canberra in the following ways:

- National Gateway—reinforces the linear alignment by adding a permanent transit space, consistent with Burley Griffin's original intention for the avenue;
- Commercial address—a clear presence in the street with a known route and destination;
- Mixed-use, high density development—provides a high capacity linear public transport service with routes and destinations that are evident with well defined, accessible stops, which can be used to travel between destinations along Northbourne Avenue (e.g. commuting, business meetings, etc. as the Melbourne tram network is used in the CBD along, say Collins Street, or the Brisbane busway through the Brisbane CBD), and opens up opportunity to extend this along Flemington Road to create a continuous and seamless connection between Gungahlin and Canberra;
- Multi-modal transport route—introducing BRT or LRT will bring a new dimension of transport technology to the corridor thereby increasing its multi-modal character and defining a clear route and public transport spine from Gungahlin to City.

1.3 The Study Corridor

The character of the corridor can be separated into three distinct zones:

1. Northbourne Avenue

Northbourne Avenue is an important approach route and main avenue for Canberra. It links to the Federal Highway which is the main approach route from Sydney and Melbourne and so becomes a visitor's first perception of the city's character. The Federal Highway has a defined landscape policy of establishing a clear and identifiable route from the boundary to the symbolic centre of the city.

According to the National Capital Plan (NCP), the road traverses through different landscape realms from the rural realm, through the open parkland realm and finally to a more formal character as it becomes Northbourne Avenue, so that visitors' expectations are progressively built up along the approach route. Northbourne Avenue is also intended to become progressively formal towards the city end and the National Triangle, with the section between Anthill/Mouat Streets and Barry Drive/Cooyong Street being classified as a Main Avenue under the NCP.

The increase in formality is achieved by the introduction of a large central median which is first planted with sporadic clumps of trees which becomes continuous tree planting closer to the city centre. These trees are planted in staggered rows to avoid a missing or dying tree becoming obvious. Due to soil and species selection issues, many of the trees have required removal. Further loss of trees and deterioration of health is expected in the future.



Figure 3 Northbourne Avenue

2. Flemington Road

Flemington Road is not defined in the NCP. It is a connector road from Canberra City Centre to the town centre of Gungahlin, which links Northbourne Ave to Hibberson Street which is the main shopping and business strip in Gungahlin. Flemington Road is developing and will ultimately be an urban boulevard. There are significant

2-3 level recently constructed and under-construction residential developments closer to Gungahlin.

There are a couple of recently constructed schools along Flemington Road and housing estates are also being planned or under construction. Significant light-poles and traffic poles create visual clutter along the main road, which are yet to be softened by landscaping.

3. Hibberson Street (Gungahlin)

Hibberson Street has developed rapidly as the central shopping and business street of Gungahlin. It currently consists of two lanes of traffic with a combination of parallel parking and wide pedestrian verges along its length. It contains a lot of foot traffic with many pedestrian crossings, mature street trees and covered awnings along the street. Improving the way shoppers and traffic mix on Hibberson Street has been identified as a key issue in the Gungahlin Town Centre Planning Report (Nov 2010).



Figure 4 Shared path and on road cycle lane network in the study corridor

The urban design and landscaping approach for the proposed route would be to maintain the three distinct zones of Northbourne Ave, Flemington Rd and Hibberson Street. Northbourne Ave will have a formal character both in design and planting particularly close to the city. Flemington Road will also be a boulevard characterised by generous tree planting and grassed verges. Hibberson Street will maintain existing mature tree planting while addressing the traffic/pedestrian conflicts.

The road corridor varies between two to three mixed use traffic lanes in each direction, except at the southern end of Flemington Road where it narrows to one lane in each direction with a bus lane southbound. Currently buses share the same lanes as traffic, except some short sections of bus lane at the southern end of Flemington Road and the northern end of Northbourne Avenue. Bus stops are generally at intersections and pedestrian crossings are provided at other locations. There is an on-road cycle lane in each direction for most of the corridor and footpaths. There is an extensive network of shared paths, footpaths and connector streets as shown in Figure 4.

I. Introduction

1.4 Current and future traffic volumes

Currently the peak hour travel time for the Red Rapid route is slightly longer than general traffic. In the morning peak, the average travel time in the peak southbound direction along the corridor is 26 minutes for general traffic and 28 minutes for the Red Rapid service.

Currently 8% of journey to work trips are taken by public transport. Transport for Canberra addresses this low public transport mode share, with improvements to the transport network in response to passenger demand and future land use and ring road upgrades to provide alternative private vehicle routes to alleviate congestion on the Frequent Network.³ This map



shows the public transport network (red) and arterial and parkway road networks (grey) as planned in Transport for Canberra. The Majura Parkway is planned to be complete in the short term, which along with Gungahlin Drive will offer alternative north-south routes to Northbourne Avenue and Flemington Road.

For example in the morning peak southbound in 2031, future transport modelling has shown that Majura Parkway will be carrying up to 6.4% more of the southbound traffic volume and Gungahlin Drive up to 3.4%. This contributes to Northbourne Avenue carrying up to 2.8% less of the overall southbound traffic.

However, with population growth and without transport intervention, overall traffic on the corridor and associated travel times will grow significantly by 2031.

Figure 5 Proportion of Southbound Traffic Travelling via Arterial Roads. 2031

3. Transport for Canberra—Transport for a Sustainable City 2011 – 2031, ACT Government, Environment and Sustainable Development

1.5 Environment

In terms of ecological constraints, online data covering 2 km either side of the existing road corridor were reviewed resulting in the identification of a range of recorded Territory and Commonwealth protected and threatened species and communities. These are reported in Appendix A.

Records included:

- **Threatened Flora**—One threatened flora species has been recorded within the Study Area. There is the potential for suitable habitat for nine additional threatened ACT/ Commonwealth protected flora species to occur in the Study Area.
- **Threatened Fauna**—Thirteen threatened fauna species have been recorded within the Study Area. There is the potential for suitable habitat for twenty-three additional threatened ACT/Commonwealth protected fauna species to occur in the Study Area.
- **Threatened Ecological Communities**—Two Threatened Ecological Communities (TECs) have been recorded within the Study Area. These TECs are protected under ACT and Commonwealth legislation.

1.6 The Proposal

The proposed project integrates transport and land use to capitalise on the attributes of the Northbourne Avenue—Flemington Road corridor between City and Gungahlin to connect these two parts of Canberra.

The project comprises:

- A dedicated public transport connection between City and Gungahlin—provided by either bus or light rail in dedicated lanes separated from other traffic for the full 12 km length;
- Stations at City (in Northbourne Avenue adjacent to the existing bus station), Dickson (utilising the Motor Registry site in between Northbourne Avenue and Challis Street) and Gungahlin (in Hibberston Street in the town centre), where the bus/light rail connects to local bus services;
- Intermediate stops at key locations;
- An off-road cycleway (3 m wide on both sides of the road);
- Wider footpaths (2.4 m wide on both sides of the road);
- A reconfigured streetscape on Northbourne Avenue—the median is narrowed (from 27 m to 6 m) and the verges widened (from 6 m to 14 m);
- Maintaining Northbourne Avenue as the primary National Gateway—the modified road cross-section will maintain symmetry and include 6 rows of trees, two in the median and two in each verge (separating the footpath, cycleway and bus/light rail lane);
- Opportunities to support a more vibrant, urban feel for the corridor;

- Creating activity along the street—people will be able to spread out across the verges from shopfronts right across to kerbside public transport, with stops integrated into this more active space; and
- Improved safety
 - On-road by providing segregated space for cyclists, segregating bus/light rail, and reducing right turn conflicts with the narrower median;
 - For pedestrians by reducing waiting and crossing times with reduced crossing width across Northbourne Avenue; and
 - For people on foot by increasing activity and concentrating it in widened verges that create more useable “people space” and having waiting passengers at stops in this “activity zone”.

This intergration of transport, land use and urban design has been developed to enhance the corridor’s role in Canberra:

Ceremonial	Northbourne Avenue is the primary National Gateway, which elevates its importance, the importance of its urban design and the decision-making for treatments within it	The proposal recognises the Griffin Legacy, reinforcing the linear alignment by maintaining the avenue of trees and adding the permanency of dedicated bus lanes or light rail tracks, consistent with Burley Griffin’s original intention for the Avenue
Commercial	Canberra’s key commercial address for apartments, professional and service businesses	Perception of improved accessibility—a clear presence in the street with a known route and destination
Activity	A mixed-use relatively high density activity corridor, with residential and other development in addition to and complementing the commercial role identified above	Provides a high capacity linear public transport service, who’s route and destinations are evident (from the tracks) with well defined, accessible stops, which can be used to travel between destinations along Northbourne Avenue (eg commuting, business meetings, etc, as the Melbourne tram network is used in the CBD along, say Collins Street), and opens up opportunity to extend this along Flemington Road to create a continuous and seamless connection between Gungahlin and City
Travel	The major north—south multi-modal transport route connecting the northern suburbs to City and beyond, servicing car traffic, commercial vehicles, public transport (currently buses), cycling and pedestrians	Dedicated public transport lanes and cycleway provide a defined route and public and active transport spine from Gungahlin to City

Mode Options

The following section describes the mode options considered in this study, how their frequency and stops would be different to the current Red Rapid bus service operation and what land use change could occur with the implementation of either option.

The mode options being explored to replace the Red Rapid between City and Gungahlin are Light Rail Transit (LRT) and Bus Rapid Transit (BRT). Currently the Red Rapid bus operates along this corridor, however it shares the road with general traffic, with only limited bus priority on Flemington Road southbound between Sandford Street and Northbourne Avenue and on Northbourne Avenue a queue jump lane southbound at Barton Highway.

2.1 Light Rail Transit

LRT is a rail mode that operates at road level using electrically powered vehicles, which receive power from overhead wires known as ‘catenary’. The overhead power supply allows the vehicles to be integrated with other vehicles on the road and pedestrians. It operates primarily in its own right of way with widely spaced stops at high speeds. However it also has the ability to slow down and operate in high density areas with closer spaced stops providing greater access. Such a system would work well along this corridor as it could stop more frequently to capture more passengers in the high density area between City to Dickson and increase speed to connect to Gungahlin in the north only stopping a handful of times to pick up and drop off passengers.

LRT is a popular mode choice for people due to its comfort, speed and reliability; it has the ability to move large numbers of people quickly and easily between activity centres. The vehicle below is a similar size to what is suitable for the passenger demand expected in Canberra, it can carry up to 220 passengers.

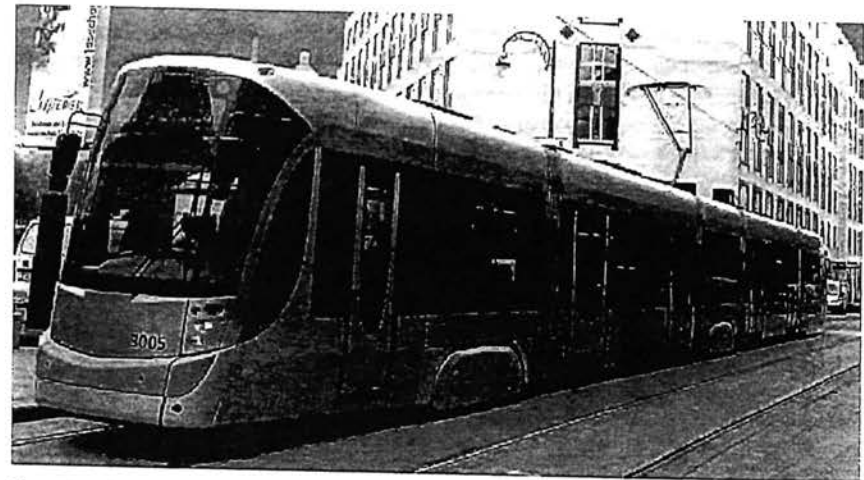


Figure 6 Typical LRT vehicle

2. Mode Options

2.2 Bus Rapid Transit

BRT is a bus system operating in its own right of way at high speeds and frequency. By removing buses from traffic you improve their operating speed and reliability. However they also have the ability to transition into general traffic, eliminating the need for passengers to change vehicles where the transit corridor ends.

BRT vehicles can carry up to 105 passengers if articulated like the one shown below.

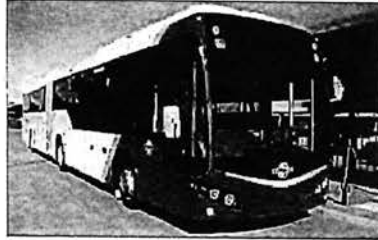


Figure 7 Typical BRT vehicle

2.3 Why BRT or LRT?

The buses currently servicing Canberra's Rapid Transit corridors offer a good frequency service that is reliable and already attracts a strong patronage and demand.

However, BRT and LRT modes, in their own right of way create the potential to elevate this demand further with a more rapid and reliable service. BRT and LRT have been implemented in numerous cities around the world over the last few decades, retro-fitting dedicated rights of way into the existing urban fabric.



Figure 8 Typical streetcar in Portland

The urban development and regeneration outcomes are clearly seen, with Portland, US, demonstrating how LRT and streetcars (trams) can revitalise urban centres. A 2005 study of real estate development within areas served by the Portland streetcar found that after streetcar investment was secured, lots within one block of the proposed corridor captured 55% of all new development.

This development was also found to be much denser than development further from the streetcar line. Post streetcar development within these

blocks achieved 90% of the Floor Area Ratio the zoning allowed. A survey of the developers through this corridor supported these statistics by saying that streetcar investment increased their confidence in bringing investment to the area.⁴

More locally, whilst Australian examples exist of successful implementation of light rail systems, very little data is available about the urban development and regeneration that has occurred along these transport corridors as a result of improved transit service. However, stage one of

⁴ Streetcar-Development Linkage: The Portland Streetcar Loop, E.D. Hovee & Company, LLC, February 2008

the Gold Coast Rail Transit is currently being implemented, which is predicted to stimulate the current medium scenario population and employment projections of Queensland Treasury Planning and Information by 20% for the Gold Coast.⁵

Worldwide examples also exist of how BRT has brought new investment to cities, with a recent example in Cleveland, Ohio, of the Euclid Corridor Project bringing \$US4.3 billion worth of investment to the 6.5 km corridor through spending on museums and hospitals to housing and educational institutions. Furthermore, following its implementation in 2008, ridership increased by an average of 31% the following year.⁶

Again, more locally, Brisbane Busways is another example of where the provision of new public transport infrastructure will renew the area and is expected to boost commercial, retail and residential activity at each of the nodes along the network. The Eastern Busway and the Eastern Corridor Renewal Strategy has been initiated by the Brisbane City Council and the Queensland Government and plans for urban growth and change at six precincts along the Eastern Busway. It recognizes that the improved connectivity provided through the provision of new public transport will provide stimulus for growth along the new transport corridor.⁷

Examples of urban regeneration, new development and increased ridership can be found all over the world associated with BRT and LRT implementation. However, cities also choose BRT or LRT for other reasons, such as capacity, cost, flexibility or the modal preference of the public. Further information about this can be obtained from the ACT Government Transit Options for Canberra fact sheet.

2.4 Costs

Undiscounted cost estimates for BRT and LRT options, which have been benchmarked against ACT and other Australian light rail and BRT projects, are shown in Table 1

Table 1 — Capital Cost Estimates

Cost Component	Proportion of Total Cost	Proportion of Total Cost
Planning and Design	32%	24%
Roadworks		
• Bridges	5%	2%
• Segregated rapid transport lanes	10%	19%
• Pavement	17%	7%
• Utilities	9%	4%
• Drainage	3%	1%
Verges and landscaping	7%	3%
Footpaths and cycleway	2%	1%
Signalling and catenary/electrification systems	8%	14%
Passenger interface, stops and communications	8%	5%
Vehicles & Depots	—	20%
Total Cost (\$ millions)	\$300 – \$360	\$700 – \$860

⁵ Gold Coast Rapid Transit Corridor Study, Hassell, Gold Coast City Council, August, 2011

⁶ The Rebirth, Sunday Plain Dealer, 10th February, 2008

⁷ Eastern Corridor Renewal Strategy Final Draft Executive Summary, Brisbane City Council, August 2009

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2. Mode Options

The cost estimates for each option recognise that the level of design is at a pre-conceptual or concept screening phase. In these circumstances, the typical estimate classification accuracy range is expected to vary between a low range of -15% to -30% to a high range of +20% to +50%. These estimates are at 2011 prices. Escalation has not been included.

Considerations affecting cost that apply to all the options include:

- the introduction of segregated rapid transit lanes, one per direction of travel, generally:
 - kerb-side along Northbourne Avenue, from Alinga Street up to Barton Highway
 - within the median into Flemington Road up to Hibberson Street
- resulting major modification to the existing linear roadway alignment, intersections and median achieving:
 - widening of the footpaths
 - introduction of segregated single direction cycleways
 - modifications to existing and introduction of widened verges
 - relocation of the 3-lanes per direction roadway
 - segregated rapid transit lanes as above
 - relocation of utilities and essential services into a single trench on Northbourne Avenue
- modifications and additions to two bridges on Flemington Road
- modifications to the signalling system in order to maximise the effectiveness of the segregated system

The BRT CAPEX Costs also differ markedly from the LRT option due mainly to the additional LRT requirements of:

- dedicated trackbed and signalled crossovers
- electrification, including substations, overhead wiring and support systems
- slightly larger and more complex stops/stations
- the requirement for a depot to facilitate stabling and maintenance
- inclusive high capacity rolling stock vehicle cost (BRT option excludes bus costs)
- correspondingly higher indirect costs

From the high level evaluation conducted, the overall CAPEX costs for each mode is as follows:

- BRT—AU\$300 – \$360 million
- LRT—AU\$700 – \$860 million

Concept Design

This section describes the concept design for BRT and LRT including the following detail:

- Their alignment along the corridor;
- Potential future extensions of the corridor;
- The service and stop spacing;
- The station designs at City, Dickson and Gungahlin; and
- The vehicles proposed for LRT and BRT operation.

3.1 Alignment

Alignment refers to the location of a transit lane within a corridor. Transit alignments should be responsive to the characteristics of a corridor. International examples of BRT and LRT transit corridors demonstrate that a variety of alignments can be achieved depending on a corridor's physical, social and environmental characteristics and attributes. Further information about this can be obtained from the ACT Government Transit Options for Canberra fact sheet.

Alignment Opportunities

The re-alignment of this corridor presents a significant opportunity to not only develop a transit corridor to assist improve conditions for public transport users and motorists but to also make improvements to benefit cyclists, pedestrians, residents and visitors to the corridor.

These improvements will be a key feature of each alignment option and include:

- Dedicated transit lanes for public transport;
- Segregated cycleway along the length of the corridor (3m wide);
- Wider footpaths (2.4m); and
- Improved landscaping and treatments to create a more attractive public realm.

The project is not just considered a transport infrastructure project but is anticipated to also refocus on people in the corridor environment, making it just as much an urban design improvement. The improvements are expected to drive redevelopment of sites adjacent to the corridor responding to the people focus.

Alignment Options

Two potential alignments, based on the characteristics of the corridor, have been investigated in detail for this study:

- **Median**—transit lane located in the median. This alignment is the recommended alignment for Flemington Rd and the northern segment of Northbourne Ave (from Gungahlin Town Centre to the Barton Highway intersection). Flemington Road was designed to accommodate a transit lane in the median and as BRT or LRT would move at a higher speed with less stops through this section a median alignment was chosen as the most suitable. A median alignment is also an option for the remainder of the corridor.
- **Kerbside**—transit lane kerbside, adjoining the verge. This alignment is the recommended option for the Northbourne Avenue segment of the corridor (between the Barton Highway and Alinga Street).

3. Concept Design

Northbourne Avenue – BRT Kerbside Alignment

The investigated options for Northbourne Avenue (between the Barton Highway and Alinga St) are outlined below.



Figure 9 Existing plan of Northbourne Ave alignment

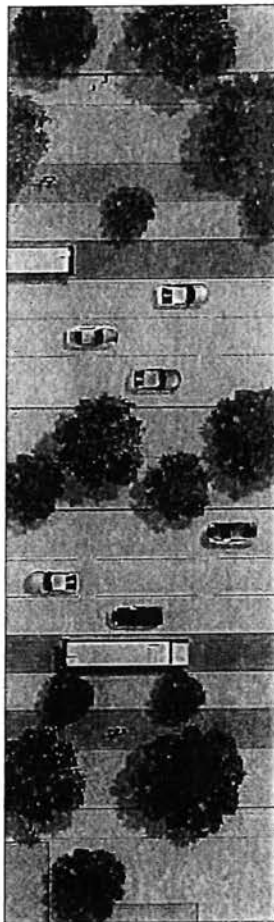


Figure 10 Northbourne Ave BRT Kerbside plan

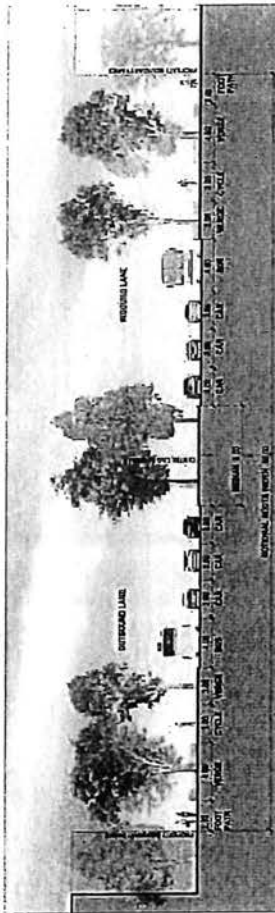


Figure 11 Northbourne Ave BRT Kerbside cross section showing dimensions

Northbourne Avenue – LRT Kerbside Alignment

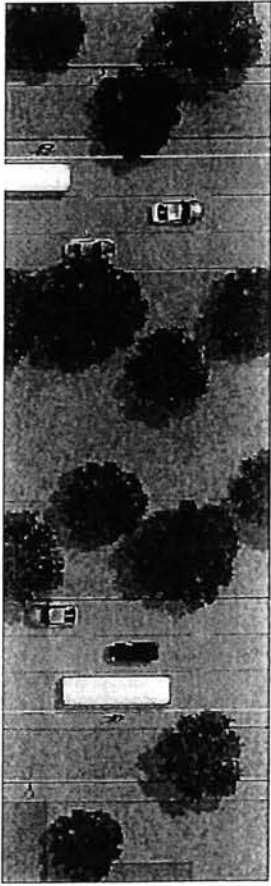


Figure 12 Existing plan of Northbourne Ave alignment

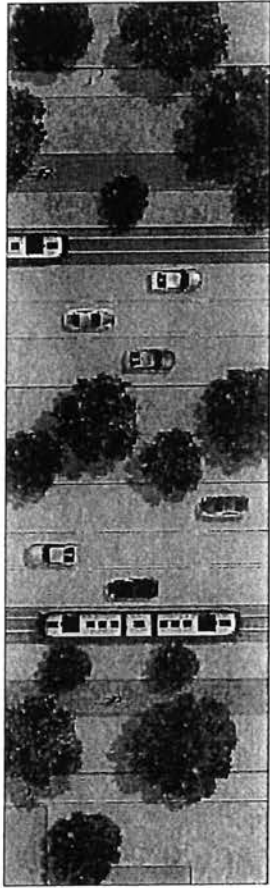


Figure 13 Northbourne Ave LRT Kerbside plan

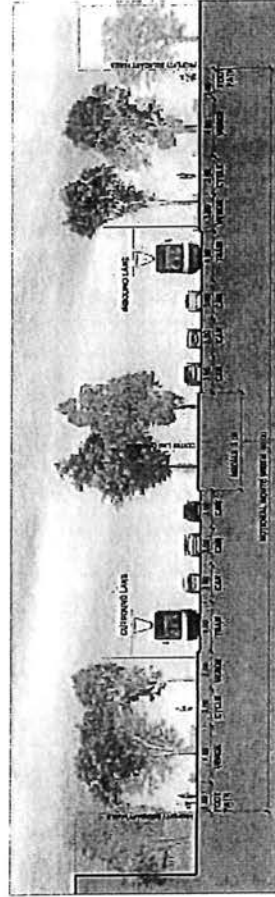


Figure 14 Northbourne Ave LRT Kerbside cross section showing dimensions

3. Concept Design

Northbourne Avenue – BRT Median Alignment

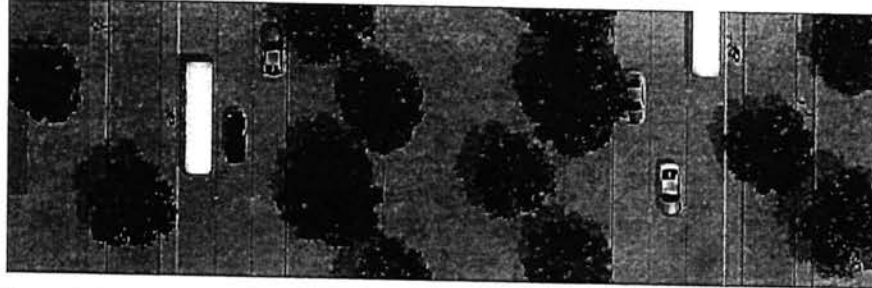


Figure 15 Existing plan of Northbourne Ave alignment

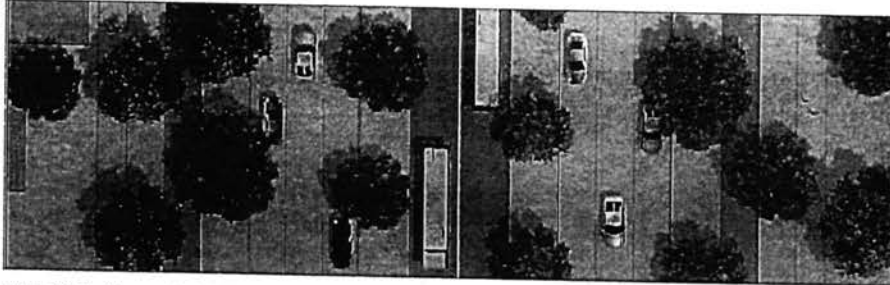


Figure 16 Northbourne Ave BRT Median plan

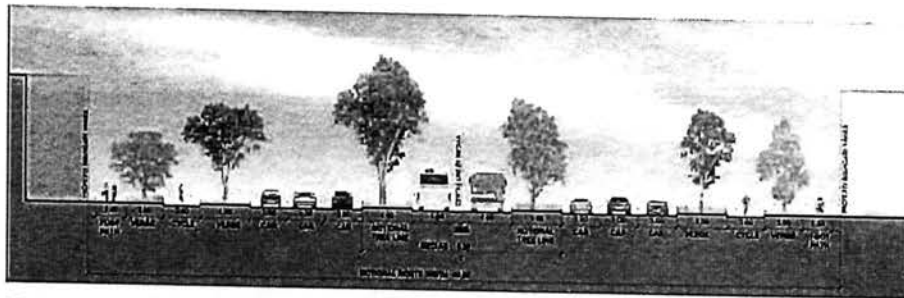


Figure 17 Northbourne Ave BRT Median cross section showing dimensions

Northbourne Avenue – LRT Median Alignment

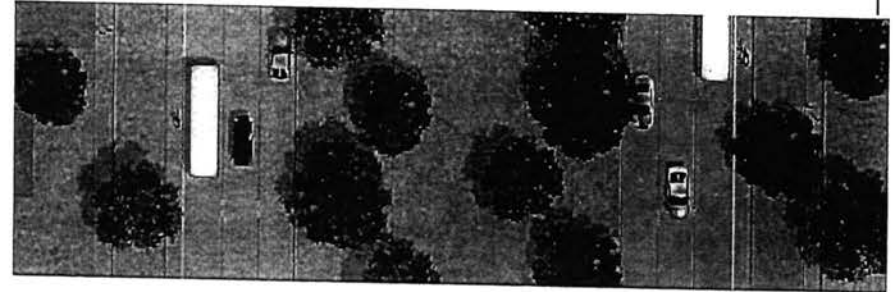


Figure 18 Existing plan of Northbourne Ave alignment

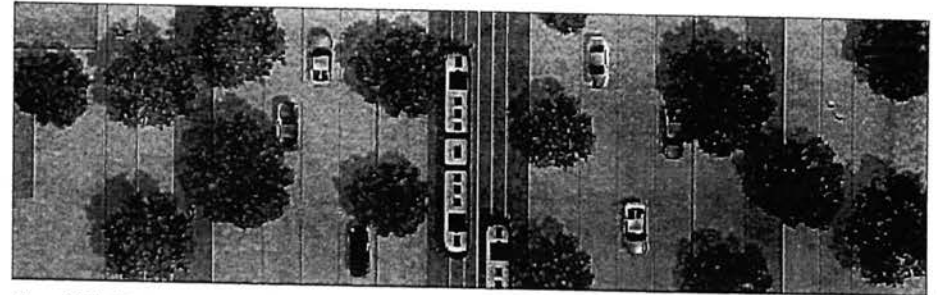


Figure 19 Northbourne Ave LRT Median plan

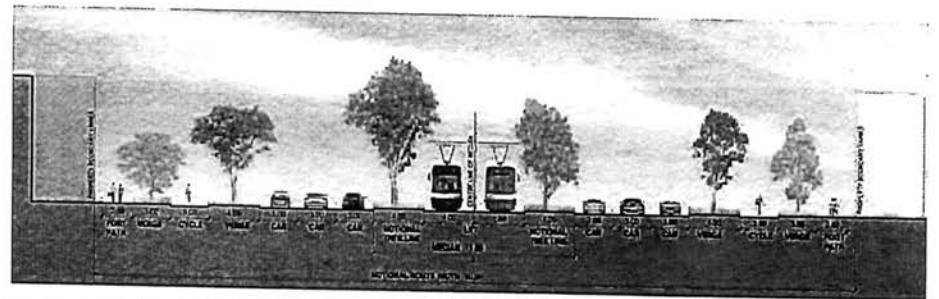


Figure 20 Northbourne Ave LRT Median cross section showing dimensions

3. Concept Design

Recommended Northbourne Avenue Alignment

Selection of kerbside bus lanes/light rail has been deliberate in Northbourne Avenue, specifically between the City terminus (Alinga Street) and Dickson (Antill Street), to best respond to and enhance this unique section of road. It is not carried further north of Barton Highway as the role of Northbourne Avenue changes and the same treatment is not appropriate.

It is recognised that Northbourne Avenue from City to Dickson, where kerbside bus lanes/light rail are proposed, is unique and performs four important roles. Any change to the Avenue must strengthen all of these multi-faceted roles:

- A nationally significant role as the primary National Gateway, elevating its importance, the importance of urban design and the decision-making for treatments within it;
- Canberra's key commercial address for professional and service businesses;
- A mixed-use relatively high density activity corridor, with residential and other development in addition to and complementing the commercial role identified above; and
- The major north—south multi-modal transport route connecting the northern suburbs, including Gungahlin, to City and beyond, servicing car traffic, commercial vehicles, public transport (currently buses), cycling and pedestrians.

The kerbside alignment bus lanes/light rail strengthens all four roles and has the greatest urban design and landscape benefits. The recommendations for kerbside transit lanes recognises the Avenue's urban context and desired future character as a place of activity and vibrancy. It is expected that like the Red Rapid service, future services should promote the hop-on, hop-off use of transit services for short trips in this sector of the corridor.

It is a requirement that as the primary National Gateway symmetry is achieved across the road, with at least 4 rows of trees (two in the median and one in each verge). This sets minimum median widths, which are also influenced by the presence of buses/light rail in or adjacent to the median (due to minimum clearance requirements).

The three key elements of the road space are the median, verges and bus lanes/light rail alignment:

- **Median**—the existing median is not currently well utilised and cannot be readily used by people, so narrowing the median (from 27 m to 6 m) allows the space to be provided next to building frontages and by used by people, and also narrows the road to integrate the two sides of the road rather than isolating them from each other (tram in median requires 12 m median to provide clearance to 2 rows of trees, diluting this outcome; also isolates waiting passengers in the median).
- **Verges**—the wider verge (14 m from 6 m) created by narrowing the median allows a wider footpath (2.4 m from 1.5 m), separate bicycle path (3 m from 1.5 m on-road), open space (two 4 m wide strips, between the footpath and bicycle path and between the bicycle path and kerb, to accommodate activity such as café tables, etc), two rows of trees (one in each of the open space strips), street furniture/art, bus/light rail stop facilities (shelters, signs, etc), and encourages/facilitates development fronting the road.
- **Kerbside bus/light rail**—connects passengers with the activity in the verge and building frontages—encourages hop on/hop off use (i.e. it is an extension of the footpath); it also integrates the stops as part of the activity in the verges.

The outcomes from these arrangements are summarised in the following table.

Role of Northbourne Avenue	Characteristics to be achieved	Median—narrow	Verges—wide	Bus lanes/light rail—kerbside
National significance – main avenue	Symmetry, 4 rows of trees	Must be retained, with two rows of trees	Must include at least one row of trees	Does not interfere with median trees
Northbourne – main avenue	Enhanced perceived value as the primary address in Canberra	N/A	Allows and concentrates activity in front of shopfronts so higher value and community perception as a desirable address/place to visit	Concentrates activity and reinforces perception of easy access to addresses along Northbourne Ave
Activity	Wider footpath, dedicated cycleway, space for street activity, proximity of PT to activity, connect the shopfront to the PT, safety and security	Under utilised	Allows for the wider footpaths and separated, wide, off-road cycleway, improving safety and provides space for high quality stop infrastructure without impinging on the footpath or cycleway, and integrates activity generated by shopfronts (e.g. café tables) in the active, busy public space on the road	The stops are part of the footpath and are not just overlooked, but integrated into the activity, increasing both safety (step straight from the footpath onto the bus/light rail) and security
Travel	Clear delineation, ease of access	N/A	Safer waiting space for passengers in the verge with kerbside operation and wider verges support wider footpaths and cycleway	Direct access from public transport to activity along the boulevard like corridor, encourages hop on/hop off use

Therefore kerbside LRT or BRT operation was considered preferable along the Northbourne Avenue part of the corridor so that it could act more like a tram or streetcar with many stops and integration with verge-side pavements to help create an active cafe and retail strip along Northbourne Avenue.

3. Concept Design

BRT Alignment – Flemington Road (median)

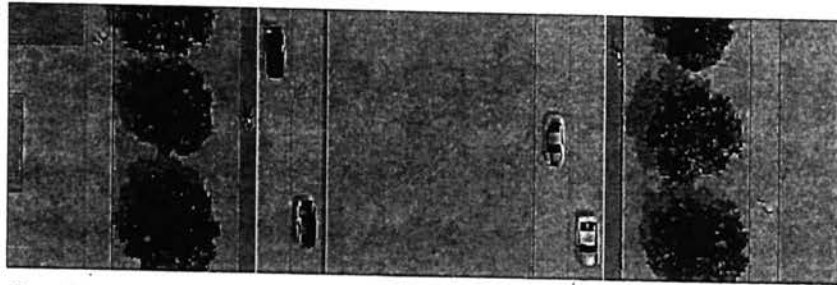


Figure 21 Existing plan view of Flemington Rd

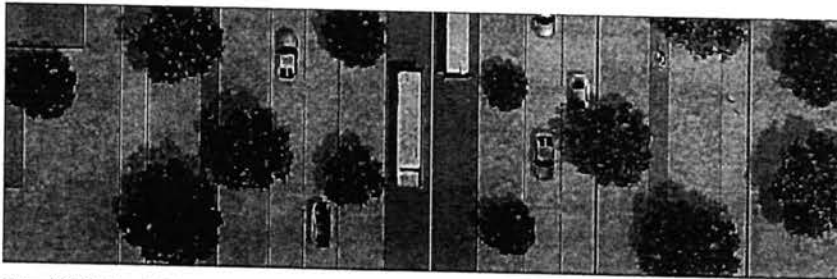


Figure 22 BRT Central Median Flemington Rd

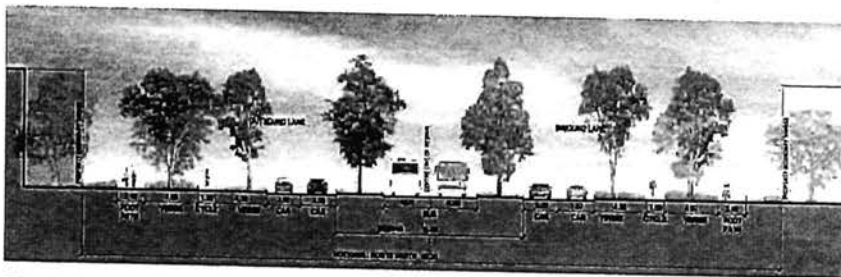


Figure 23 BRT Median Flemington Rd cross section showing dimensions

LRT Alignment – Flemington Road – median alignment

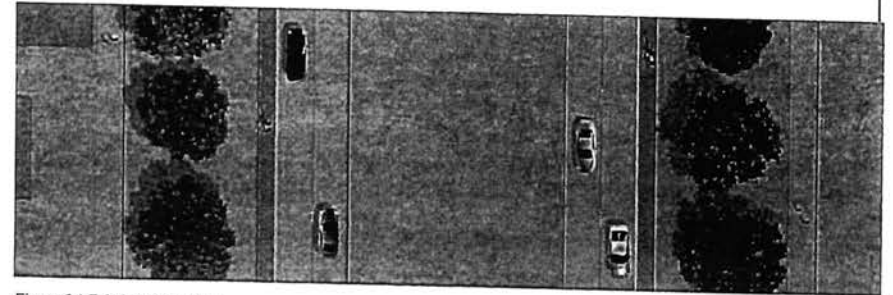


Figure 24 Existing Plan view

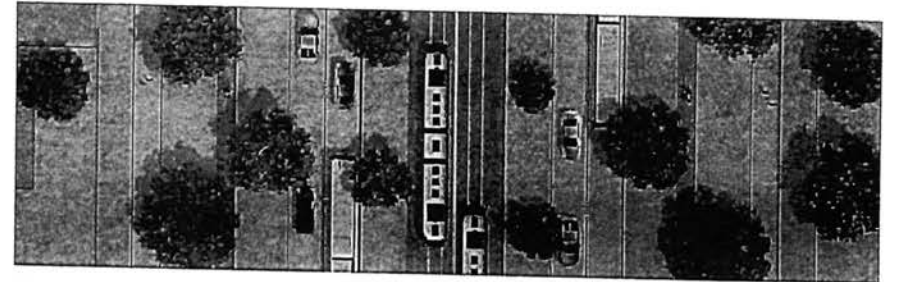


Figure 25 LRT Central Median Flemington Rd

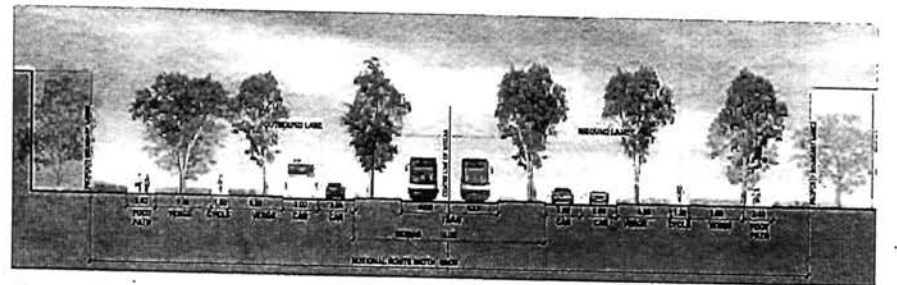


Figure 26 LRT Central Median Flemington Rd showing cross section showing dimensions

3. Concept Design

Flemington Road Alignment

As for Northbourne Avenue it can be seen that the same alignment has been designed for both BRT and LRT by applying the principal that each of the mode options should take into account the potential for eventual light rail operation.

Along Flemington Road the route is more of a light rail or train route with less frequent stopping, potentially higher speeds and more commuter traffic, so a median route is a preferable solution in this location. In contrast, the Northbourne Avenue section is designed to attract local and visitor patronage for a more get-on/get-off scenario. LRT or BRT would transition from kerbside to median at Barton Highway on Northbourne Avenue, where the character of the corridor changes from dense urban environment to semi-rural and therefore a median BRT or LRT operation would be more suitable. The drawing below shows this transition at Barton Highway.

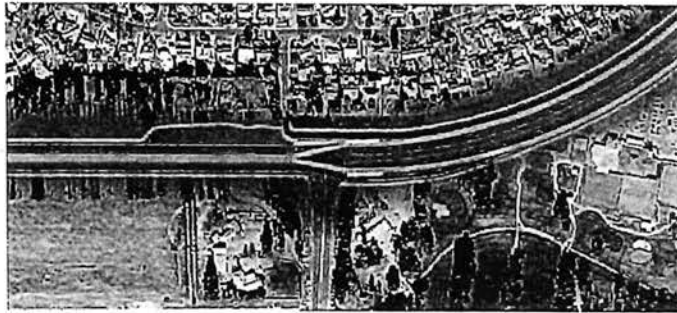


Figure 27 Transition from kerbside operation to median operation at Barton Highway

The alignment designs have been workshoped with stakeholders across the ACT administration and the National Capital Authority (NCA), which has informed the desired cross section of the corridor for each of the mode options.

The placement of the LRT or BRT corridor within the road cross section was dependent on a number of things such as safety, amenity, land use and location of utilities. A number of alternatives were explored and workshoped with stakeholders.

Note the cross sections shown on the preceding pages are indicative only; the number of lanes and landscaping varies along the length of the corridor, and will need to be confirmed in forward design.

3.2 Alignment Evaluation

A high level evaluation of the alignment options was undertaken to assess each option against a range of economic, social and environmental factors in comparison to the base case (existing) alignment.

The following is an evaluation of the options against the 'base case'. The base case in this context assumes that public transport service improvements consistent with population growth are implemented and the current growth expected in ACT planning policy is achieved with no additional land use uplift occurring in the study corridor. No additional infrastructure improvements, which protect public transport reliability, are assumed in this case, such as road widening or transit lanes.

The benefits and harms of the BRT and LRT options when compared to the 'base case' are presented in the following tables. They are based on a set of criteria that take into account a triple bottom line approach, including economic, social and environmental factors. Input from a number of disciplines has informed this evaluation, including engineering (design, construction and operation), transport, community engagement, social impact, environmental management and economics.

A qualitative rating system has been used to evaluate the options based on the following levels:

Benefits	Harms
★ Negligible	★ Negligible
★★ Minor Benefit	★★ Minor Harm
★★★ Moderate Benefit	★★★ Moderate Harm
★★★★ Major Benefit	★★★★ Major Harm
★★★★★ Extreme Benefit	★★★★★ Extreme Harm

The final rating score for each option is the overall score of benefit and harm points. All positive scores represent a net benefit based on economic, social and environmental factors when compared to the base case. All negative scores represent a net harm.

3.3 BRT Option

Economic	Evaluation Criteria	Score	Comments
Public Transport travel time benefits	Reduction in travel time for transit passengers	★★	Minor benefit
Changes in vehicle operating costs	Vehicle operating cost savings and bus fleet capital savings	★★★	Moderate benefit
Incremental fare revenue	Based on change in PT trips	★★	Low benefit
Changes in accident costs	Based on accident cost rates per passenger km	★★★	Moderate benefit
Road decongestion	Reduction in car trips	★★★★	Major benefit driven by loss of car trips
Construction	Upfront capital expenditure	★★★★	Significantly high, \$300 – \$360 million
Operating & maintenance	Driver and vehicle maintenance costs and road maintenance costs associated with new transitway	★	Limited difference

Social	Evaluation Criteria	Score	Comments
Urban Design & Landscape	Qualitative, Social, Structural and Functional considerations, landscape character e.g. symmetry of corridor, activating building frontages	★★★	The wider verges on Northbourne Ave deliver improved pedestrian and cycle routes, immediate access and public amenity to adjacent land use and accessible transit stops on the kerb rather than in the median. Although the avenue profile is altered, it maintains its civic presence, particularly its symmetry and high-quality landscape character. Flemington Rd achieves a slightly beneficial outcome. It scored moderately beneficial for connectivity and slightly beneficial for accessibility and activation. Visual impact due to increase in pavement area resulted in the overall moderately beneficial assessment.

3. Concept Design

Social	Evaluation Criteria	Score	Comments
Sustainable Transport Options	Bicycles & Pedestrians—provides safe and accessible access for cyclists and pedestrians	★★★	Widened cycleway and separation from traffic provides safer and more accessible cycle facilities. Widened pedestrian path and narrower crossing on Northbourne Ave provides improved access for pedestrians.
Fit with planning and policy strategies including the Griffin Legacy, and support of future land use	Local and City wide Planning and Policy Strategies	★★	BRT kerbside lanes are in a more desirable location for businesses on Northbourne Ave, the land use uplift expected with BRT would require changes to current local and city wide planning policies, which is seen as positive additional development along the corridor.

Environmental	Evaluation Criteria	Score	Comments
Impacts on Noise/Vibration	Noise and Vibration	★★	The increased movement of buses along the corridor, although sporadic, has the potential to generate more peak intermittent noise. This is likely to negatively impact fronting and nearby properties and will be greatest in effect where the existing road extends in to the verges as is the case along the majority of Northbourne Avenue. Along Flemington Avenue such impacts are likely to be less notable given the use of the median to accommodate BRT.
Impacts on air quality	Air quality and climate change pollutants	★★	Providing a traditional fleet is used (i.e. petrol/diesel), buses will generate the highest individual emissions.
Impacts on water and soil	Surface and groundwater quality and quantity, Contamination & Biological/chemical/physical functions	*	Providing erosion and sedimentary control measures are in place and bridges and culverts are designed and upgraded to accommodate the corridor widening, the residual impacts are likely to be negligible. The extent and depth of works is likely not to have any significant impact on the geological character or result in effects on base groundwater movements.
Impacts on Natural Resources	Ecosystem function, habitat, flora and fauna, endangered species	★★★	Assumed Moderate Harm as impacts are relatively unknown at this stage, Commonwealth and ACT listed species and Threatened Ecological Communities have been recorded immediately adjacent to the road corridor and may have the potential to be impacted as a result of the scheme's implementation.
Sustainability	Efficient use of Resources	★★★	The alignment for this option uses a large volume of material on Northbourne Ave to change the alignment, i.e. the entire existing road will be excavated and replaced. Also a large volume of truck movements are expected during construction. However the alignment on Northbourne Ave avoids relocation of many services in the central median. Overall expected to be of moderate harm because of construction.

Environmental	Evaluation Criteria	Score	Comments
Heritage and Culture	Indigenous & European	*	Construction noise and vibration have the potential to impact on the structural integrity of the heritage listed buildings. Operationally, there is no additional impact when compared to the existing bus services.

Overall the number of benefits comes to 22★ and harms come to 17★. This represents an overall score of 5★.

3.4 LRT Options

Kerbside LRT

Economic	Evaluation Criteria	Score	Comments
PT travel time benefits	Reduction in travel time for transit passengers	★★	Minor benefit
Changes in vehicle operating costs	Vehicle operating cost savings and bus fleet capital savings	★★★	Moderate benefit
Incremental fare revenue	Based on change in PT trips	★★	Low benefit
Changes in accident costs and environmental externalities	Based on accident cost rates per passenger km	★★★	Moderate benefit
Road decongestion	Reduction in car trips	★★★★	Major benefit driven by loss of car trips
Construction	Upfront capital expenditure	★★★★★	Extremely high, \$700 – \$860 million
Operating & maintenance	Driver and vehicle maintenance costs and road maintenance costs associated with new transitway	*	Limited difference

Social	Evaluation Criteria	Score	Comments
Urban Design & Landscape	Qualitative, Social, Structural and Functional considerations, landscape character e.g. symmetry of corridor, activating building frontages	★★★	The wider verges on Northbourne Ave deliver improved pedestrian and cycle routes, immediate access and public amenity to adjacent land use and accessible transit stops on the kerb rather than in the median. Although the avenue profile is altered, it maintains its civic presence, particularly its symmetry and high-quality landscape character. Flemington Rd achieves a slightly beneficial outcome. It scored moderately beneficial for connectivity and slightly beneficial for accessibility and activation. Visual impact due to increase in pavement area and LRT overhead cabling was considered slightly detrimental which resulted in the overall moderately beneficial assessment.
Sustainable Transport Options	Bicycles & Pedestrians - provides safe and accessible access for cyclists and pedestrians	★★★	Widened cycleway and separation from traffic provides safer and more accessible cycle facilities. Widened pedestrian path and narrower crossing on Northbourne Ave provides improved access for pedestrians.

3. Concept Design

Social	Evaluation Criteria	Score	Comments
Fit with planning and policy strategies including the Griffin Legacy, and support of future land use	Local and City wide Planning and Policy Strategies	★★★	LRT lanes are in a more desirable location for businesses on Northbourne Ave, and LRT is expected to bring the most increase in land use development possible along the corridor, which would require changes to current local and city wide planning policies.
Environmental	Evaluation Criteria	Score	Comments
Impacts on Noise/Vibration	Noise and Vibration	*	The introduction of light rail vehicles along the corridor, has the potential to generate more peak vibration levels. This is likely to negatively impact fronting and nearby properties and will be greatest in effect where the existing road extends in to the verges as is the case along the majority of Northbourne Avenue. Along Flemington Avenue such impacts are likely to be less noticeable given the use of the median to accommodate LRT.
Impacts on air quality	Air quality and climate change pollutants	*	Emissions with trams are likely to be minimal, notwithstanding the remote point source emissions required to generate the electricity to power the trams.
Impacts on water and soil	Surface and groundwater quality and quantity, Contamination and Biological/chemical/physical functions	*	Providing erosion and sedimentary control measures are in place and bridges and culverts are designed and upgraded to accommodate the corridor widening, the residual impacts are likely to be negligible. The extent and depth of works is likely not to have any significant impact on the geological character or result in effects on base groundwater movements.
Impacts on Natural Resources	Ecosystem function, habitat, flora and fauna, endangered species	★★★	Assumed Moderate Harm as impacts are relatively unknown at this stage, Commonwealth and ACT listed species and Threatened Ecological Communities have been recorded immediately adjacent to the road corridor and may have the potential to be impacted as a result of the scheme's implementation.
Sustainability	Efficient use of Resources	★★★	The alignment for this option uses a large volume of material on Northbourne Ave to change the alignment, i.e. the entire existing road will be excavated and replaced. Also a large volume of truck movements are expected during construction. However the alignment on Northbourne Ave avoids relocation of many services in the central median. Overall expected to be of moderate harm because of construction.
Heritage and Culture	Indigenous & European	★★	Construction and operational noise and vibration have the potential to impact on the structural integrity of the heritage listed buildings. Operationally, intermittent passing trams may also have this impact.
Operating & maintenance	Driver and vehicle maintenance costs and road maintenance costs associated with new transitway	*	Limited difference

Overall the total benefits come to 23★ and impacts come to 17★. This represents an overall score of 6★.

Median LRT

Economic	Evaluation Criteria	Score	Comments
PT travel time benefits	Reduction in travel time for transit passengers	★★	Minor benefit
Changes in vehicle operating costs	Vehicle operating cost savings and bus fleet capital savings	★★★	Moderate benefit
Incremental fare revenue	Based on change in PT trips	★★	Low benefit
Changes in accident costs and environmental externalities	Based on accident cost rates per passenger km	★★★	Moderate benefit
Road decongestion	Reduction in car trips	★★★★	Major benefit driven by loss of car trips
Construction	Upfront capital expenditure	★★★★★	Extremely high, TBA (\$700+ million)
Operating & maintenance	Driver and vehicle maintenance costs and road maintenance costs associated with new transitway	*	Limited difference
Social	Evaluation Criteria	Score	Comments
Urban Design & Landscape	Qualitative, Social, Structural and Functional considerations, landscape character e.g. symmetry of corridor, activating building frontages	★★	Less landscaping and grassed area in central median and light rail stops isolated in median. Wider verges activates building frontage however some benefit is lost with passengers in the central median. Overall minor harm.
Sustainable Transport Options	Bicycles & Pedestrians—provides safe and accessible access for cyclists and pedestrians	★★★	Widened cycleway and separation from traffic provides safer and more accessible cycle facilities. Widened pedestrian path and narrower crossing on Northbourne Ave provides improved access for pedestrians.
Fit with planning and policy strategies including the Griffin Legacy, and support of future land use	Local and City wide Planning and Policy Strategies	★★	The land use uplift expected with LRT would require changes to current local and city wide planning policies. Operating LRT in the central median would take passengers away from direct frontage to businesses, considered only minor harm. Overall the land use uplift expected with LRT is considered to be a positive affect on future land use.
Changes in accident costs and environmental externalities	Based on accident cost rates per passenger km	★★★	Moderate benefit
Road decongestion	Reduction in car trips	★★★★	Major benefit driven by loss of car trips
Operating & maintenance	Driver and vehicle maintenance costs and road maintenance costs associated with new transitway	*	Limited difference

3. Concept Design

Environmental	Evaluation Criteria	Score	Comments
Impacts on Noise/Vibration	Noise and Vibration	*	The introduction of light rail vehicles along the corridor, has the potential to generate more peak vibration levels however there is likely to be less impact if LRT is operating in the median, therefore impact considered to be negligible.
Impacts on air quality	Air quality and climate change pollutants	*	Emissions with trams are likely to be minimal, notwithstanding the remote point source emissions required to generate the electricity to power the trams.
Impacts on water and soil	Surface and groundwater quality and quantity, Contamination & Biological/chemical/physical functions	*	Providing erosion and sedimentary control measures are in place and bridges and culverts are designed and upgraded to accommodate the corridor widening, the residual impacts are likely to be negligible. The extent and depth of works is likely not to have any significant impact on the geological character or result in effects on base groundwater movements.
Impacts on Natural Resources	Ecosystem function, habitat, flora and fauna, endangered species	***	Assumed Moderate Harm as impacts are relatively unknown at this stage, Commonwealth and ACT listed species and Threatened Ecological Communities have been recorded immediately adjacent to the road corridor and may have the potential to be impacted as a result of the scheme's implementation.
Sustainability	Efficient use of Resources	***	The alignment for this option uses a large volume of material on Northbourne Ave to change the alignment, i.e. the entire existing road will be excavated and replaced. Also a large volume of truck movements are expected during construction. The alignment will require relocation of almost all services in the central median. Overall expected to be of moderate harm because of construction.
Heritage and Culture	Indigenous & European	**	Construction and operational noise and vibration have the potential to impact on the structural integrity of the heritage listed buildings. Operationally, intermittent passing trams may also have this impact.

Overall the number of benefits come to 19* and impacts come to 19*. Overall the total score comes to 0*, therefore no overall benefit or harm.

3.5 Alternative Options

Further investigation will be undertaken to consider variations to the above options including replacing more than just the Red Rapid with LRT or BRT.

The design of BRT or LRT assumes that either mode will only replace the Red Rapid route between City to Gungahlin as shown in Figure 29. Further investigation will take place into what efficiencies may also be achieved through replacing some of the other existing bus routes with LRT or BRT. Alternatively, LRT or BRT could replace all buses currently travelling on Northbourne Avenue south of Dickson requiring transfers to LRT at Dickson (this is the approach taken for the Gold Coast light rail).

Further investigation will look into the additional cost to operate the LRT system without the overhead catenary wires that are used to supply power to the LRT vehicles. Emerging technology exists to operate LRT systems with electric supply from beneath the track, which increases a city's attractiveness, but adds to capital costs.

A staged approach to implementing BRT or LRT is also being considered, where initially priority measures such as bus lanes may be implemented along the length of Northbourne Avenue in the short term which would eventually be converted to a bus transit or light rail corridor in the long term extending into Flemington Road up to Gungahlin.

Finally, the current options consider the transit lane as an addition to the current road cross section through the entire corridor. Further investigation will look into whether the transit corridor can replace an existing traffic lane in each direction along the corridor to determine the impact to general traffic along the corridor and surrounding road network. The plan view below shows how this would look mid-block on Northbourne Avenue. Previous work indicates that this proposal would impose an unacceptable impact on traffic congestion and rat running through local roads. Further work will be undertaken to ascertain this.

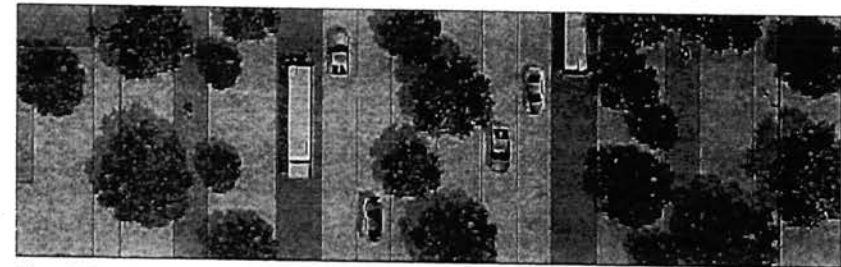


Figure 28 Plan view of option to replace a traffic lane each way with BRT lanes on Northbourne Avenue

3.6 Potential Future Extensions

As noted in Transport for Canberra, the Rapid service routes could be run as either LRT, BRT or a combination in the future, which offers opportunities for expansion of an LRT or BRT network beyond City-Gungahlin in the future, with a southerly extension to Barton and along Canberra Avenue to Fyshwick towards Queanbeyan to complete the Red Rapid route as one of the possible extensions. Other possible future extensions include south to Woden-Tuggeranong, and north-west from City to Belconnen (refer to the red lines on the "Frequent Network" plan, in Figure 29).

Some initial thought has been given to how to extend the current route to Constitution Avenue to allow for future extensions to Barton and beyond to Fyshwick. Figures 30 – 33 show some possible route options with a discussion about each. These options would need to be explored in significant further detail in a future study.

3. Concept Design

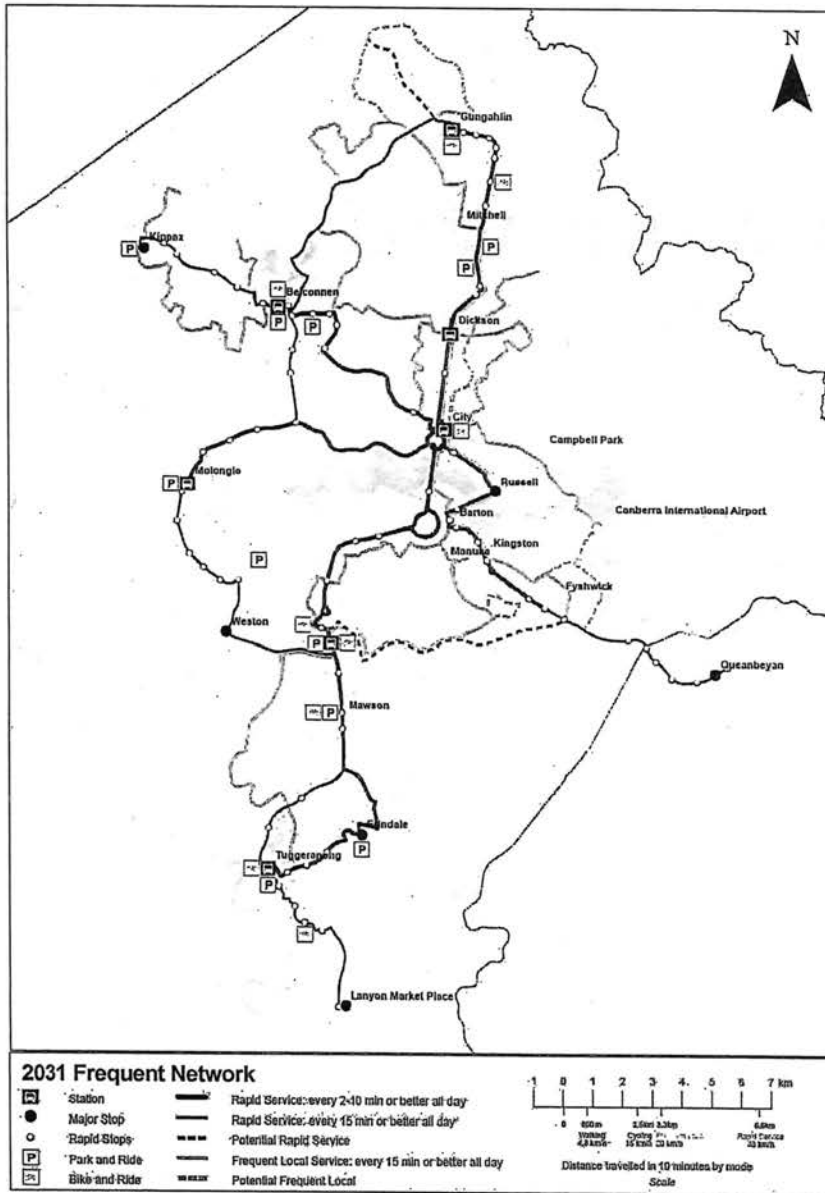


Figure 29 2031 Frequent Network



Figure 30 Option 1 – Via City Walk

Option 1—Extending the LRT or BRT corridor via Alinga Street and City Walk provides direct access between the Red Rapid service and the connecting bus services at City as it takes the service through City Bus Station. Whilst there is adequate width through City Walk to do this, the rapid transit would need to operate at very low speeds to maintain pedestrian safety through this area.



Figure 31 Option 2 – Via London Circuit

Option 2—Continuing the LRT or BRT service along Northbourne Avenue to London Circuit and connecting to Constitution Avenue via this road is a possible option. London Circuit is currently the primary connection for general traffic to Constitution Avenue and further investigation would need to be given to the impact of a transit lane on traffic flow through this area as any expansion of lanes is restricted.



Figure 32 Option 3 – Via London Circuit and City Walk

Option 3—Separating the two directions of transit lines to connect to Constitution Avenue captures a broader patronage for the mode. However some stakeholder feedback has expressed concern that legibility and visibility between both directions for passengers may detract from its usefulness at capturing a broader patronage. This issue can be overcome with suitable urban design solutions ensuring a clear direct path between both lines. Consideration would also need to be given to this option's impact on the symmetry of Northbourne Ave south of Alinga Street where only the southbound service would run. This option could also operate as a one way system

for the light rail service to turn around rather than using a turn-back facility in the central median on Northbourne Avenue.

3. Concept Design



Figure 33 Option 4 – Via City Hill

Option 4—The transit route could be taken directly through City Hill to connect to Constitution Avenue. Above ground the gradient over City Hill would be suitable for either BRT or LRT operation. Vernon Circle around City Hill Park may become the transit station in line with NCA's City Hill National Capital Plan (Griffin legacy) amendments that encourage diversion of traffic via London Circuit improving pedestrian access and safety in the precinct. Alternatively, it could travel underground south of Alinga Street to connect to an underground transit City interchange beneath City Hill Park. As for Option 2, this option could be part of a future stage of the Constitution Avenue upgrade. A design solution that draws together these two boulevards at City Hill would provide a very direct and legible path for BRT or LRT. Further expansion south to Commonwealth Avenue further enhances this legibility.

All options discussed above allow for an extension east to Constitution Avenue and south to Commonwealth Avenue.

3.7 The Service and Stop Spacing

Currently the Red Rapid route runs at a 15 minute frequency or less. In future, it is expected that this frequency would increase and this scenario would become the base case against which the impacts of replacing the service by either BRT or LRT would be compared in terms of the demand increase and service frequency. The options investigated in this study are predicted to run at a 10 minute frequency by 2021 and an 8 minute frequency or better by 2031.

Transport for Canberra defines a number of Bus Stations (which are primarily route hubs that allow service interchanges) along the Northbourne Avenue corridor:

- City
- Dickson
- Gungahlin

In addition, Park and Ride facilities are planned and in place along the corridor. The EPIC park and ride is open and future facilities are planned in Mitchell (near Well Station Drive) and to the west of Gungahlin Town Centre.

The bus stations are appropriate locations for BRT or LRT stations as the primary locations where service and modal interchange would take place between the Frequent Local and Coverage bus routes to the north—south BRT/LRT spine. Intermediate stops would also be provided, consistent with the Rapid Frequent 0.5 km to 2 km spacing, to achieve a high average speed along this north—south public transport spine. Additionally, extra stops are proposed to meet land use growth, as detailed in the Concept Design section of this report.

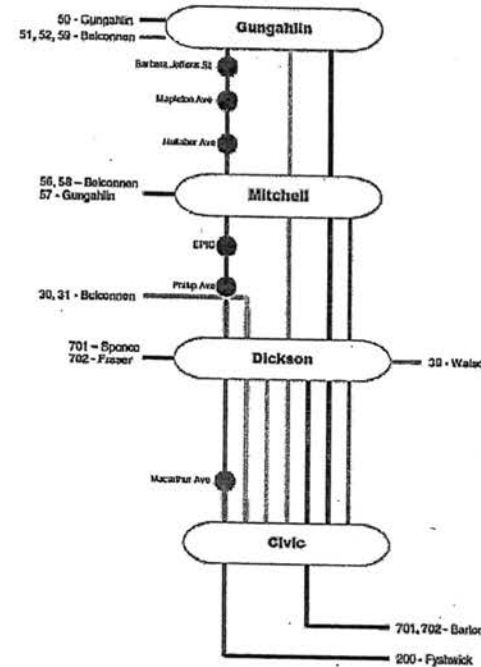


Figure 34 Current Bus Routes Travelling on Northbourne Ave and Flemington Rd

The rapid transit options being investigated in this report are designed to replace the Red Rapid service through the City to Gungahlin corridor, shown as the red line in the diagram adjacent. Initially the service is expected to run at 15 minute frequencies to match the current service and increase to every 10 minutes in 2021 and 8 minutes or less by 2031.

The existing stations at Civic, Dickson and Gungahlin will be a critical element to making this service work efficiently. Providing an efficient and safe interchange for pedestrians between the LRT or BRT service and buses at these points are key to the success of the City—Gungahlin rapid transit corridor. In the case of an LRT service replacing the Red Rapid further investigation will also look at the possibility of all bus services interchanging to this LRT transit mode in the Northbourne Avenue sector and provide a smoother traffic flow. If this were the case, additional stops would need to be provided in this southern sector.

To meet the expected higher short trip demand in this higher density sector of the corridor the service would run more slowly with closely spaced stops. Travelling further north and into Flemington Road, the service speed would increase with fewer stops. The additional stops are indicative locations to respond to the expected land use uplift and increased urban density that can be expected with LRT or BRT consistent with current planning policy as shown in Figure 35.

3. Concept Design

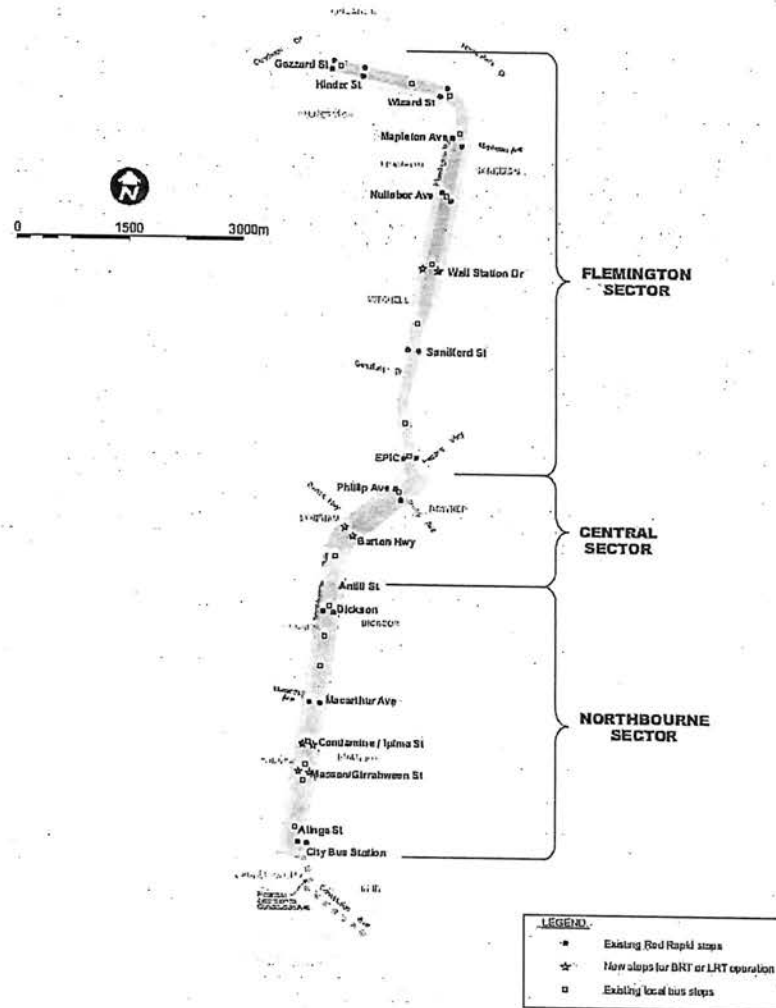


Figure 35 Map of Possible BRT/LRT Stops

In the case of LRT, this service along the corridor can be considered a hybrid between streetcar operation in the Northbourne Sector and LRT operation in the Central and Flemington Road Sector.

Typically streetcar operation is considered an extension of the footpath and moves at slower speeds with closely spaced stops through city areas, on the other hand LRT operation moves at higher speeds with stops spaced further apart. LRT is considered to be more an extension to the roadway that connects to outer suburbs. Therefore along Northbourne Avenue, the LRT option would operate with characteristics closer to a streetcar and along Flemington Road it would operate as an LRT service. This would have no impact on vehicle type or size however it would impact where the LRT depot would be located, which is discussed further in this section.

BRT Option

In this option, BRT replaces the Red Rapid. The remaining bus services, such as Coverage and Local Frequent services, would continue to use the corridor in the general traffic lanes along Flemington Road and share the rapid transit corridor with BRT along Northbourne Ave.

Specifically, the BRT service will come and go from City Station as per the current Red Rapid bus movements and travel in the kerbside BRT lanes until Barton Highway, where they transition from the kerbside lane to the central median. They travel in the central median the remainder of the route to Gungahlin.

This has the potential to be converted to LRT in the future. The BRT option would have the street-car like stops and speeds as a future LRT conversion.

Refer to Appendix B for typical sections along the corridor showing this alignment.

LRT Option

In the LRT option LRT replaces the Red Rapid. The remaining bus services would share the transit lane with LRT along Northbourne Avenue and operate as BRT. Along Flemington Road the bus services would switch to running in the general traffic as there are existing bus lanes on Flemington Road and less bus services serving this section of the corridor and light rail would be operating at a higher speed with fewer stops than the buses in the median.

Similar to the BRT alignment, the LRT alignment moves in the median rapid lane from Gungahlin to Barton Highway and then transitions to the kerbside lane for most of Northbourne Avenue. It transitions back to the median again at Cooyong Street to terminate at the city end.

Transitioning to the median is necessary to enable a turnback facility for light rail vehicles reaching the end of the service line.

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3. Concept Design

3.8 Stations

Gungahlin

Both options are proposed to terminate adjacent to the entrance at Gungahlin marketplace on Hibberson Street. Previous studies have identified this as the preferred public transport corridor in Gungahlin and stakeholders have also supported this in the Design workshop. Therefore in order to maintain the landscaping and successful urban character of this street, it is proposed to remove general traffic from Hibberson Street between Hinder Street and Gozzard Street and devote these two blocks to either the LRT terminus or BRT terminus. It is expected that vehicles will move slowly but reliably through this section and this design will create a pedestrian friendly mall environment in the Gungahlin retail and commercial centre. The image below shows this arrangement with LRT in Hibberson Street

Both the BRT and LRT options would need to provide an efficient interchange to the connecting local bus services, including routes 50, 51, 52, 56, 58 and 59. Currently the arrival of these services combined is approximately every 5 minutes during the AM peak so a suitable layover area for these buses is essential. In the case of the BRT option, the proposed terminus at Gungahlin Marketplace could be shared with BRT and the local bus services, however in the case of the LRT option, the current bus layover location at Gungahlin Marketplace would conflict with the LRT terminus. Either the Western Layover or Eastern Layover Options in the *Gungahlin Town Centre Bus Station Study*⁸ would overcome this conflict.

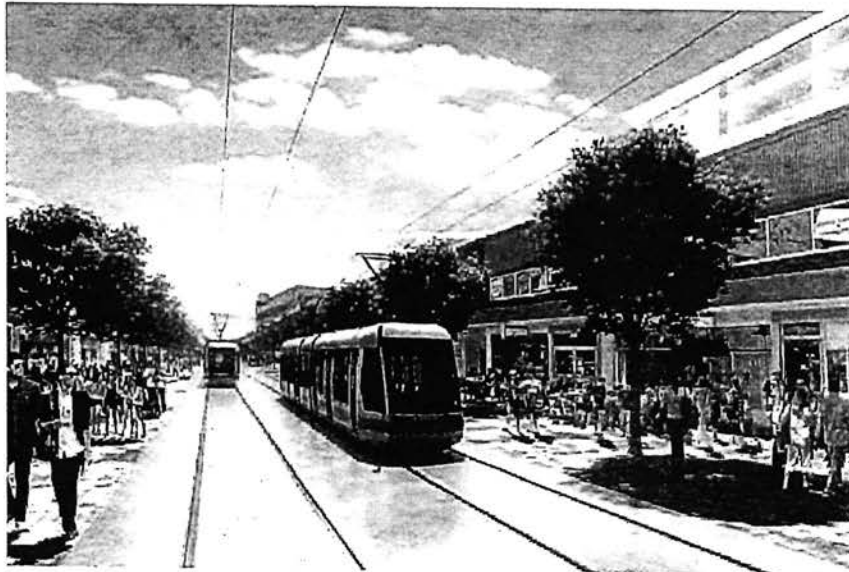


Figure 36 LRT along Hibberson Street

⁸ Gungahlin Town Centre Bus Station Study, Revision No.1 January 2012, SMEC



Figure 37 Recommended Western Layover Option in The Gungahlin Town Centre Bus Station Study⁹



Figure 38 Recommended Eastern Layover Option in The Gungahlin Town Centre Bus Station Study⁹

Dickson

In addition to Dickson being a major destination in the corridor, Dickson is a significant location in the public transport network allowing transfer between rapid services operating along the Avenue and frequent and local services that serve areas east and west of Dickson. Frequent services connect north east Belconnen areas with the corridor at Dickson. A large residential catchment exists east of Dickson. Dickson does not currently operate or serve as an interchange location. This corridor transit project together with Network rework will require a major station to be developed at Dickson.

Suitable operation options were identified in the SPTNP 2009. Options included keeping rapid services on Northbourne, diverting services through Challis Street and a combination of southbound services remaining on Northbourne and Northbound services diverting through Challis Street.

⁹ Gungahlin Town Centre Bus Station Study, Revision No.1 January 2012, SMEC

3. Concept Design

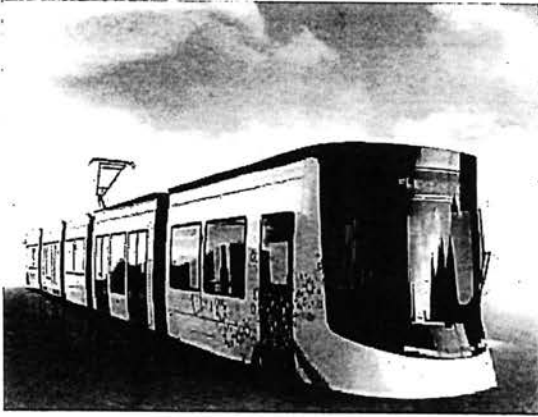


Figure 44 Bombardier Flexity 2 LRT vehicle¹⁰

LRT Traction Distribution

The LRT system would run on standard gauge, and the track bed would consist mainly of flush or embedded rails, to facilitate integration into the roadway, and allow for the option of grassed infill where applicable.

Traction power for the LRT system would be derived from new substations installed along the corridor, spaced approximately 2km apart. These installations would contain transformers, rectifiers and switchgear, housed either in outdoor compounds or integrated within buildings.

The substations would distribute 750-Volt direct current to the rolling stock via an overhead contact system. The contact wires would be supported by poles or from buildings by means of a standard arrangement. The power would be collected by the rolling stock via a pantograph, which remains in constant contact with the overhead wires.

The traction power would be switched and sectioned from a central location by means of Supervisory Control And Data Acquisition (SCADA) links.

LRT Depot

A depot would need to support stabling, light and heavy maintenance of the tram fleet as well as on-site offices and staff facilities. As no stabling is envisaged at the ends of the network it must, as a minimum, be capable of holding all trams with adequate operational track space for maintenance operations to take place.

Importantly future provision must be made to expand the facility to support increased requirements. This means allowing for the potential to stable and maintain enough trams to run longer trams on higher frequency operations over a potentially extended route length. An estimate of 20 x 7-module trams should suffice for the future provision requirements. A 100 x 200m facility should be more than adequate to meet this requirement.

Ideally, the facility should be located near the middle of the route to minimise dead running, where empty services are run to the start or from the finish of the route.

¹⁰ Source: Bombardier Inc, Vienna, Austria

The land use category under the ACT Territory Plan that would apply to the depot is 'Transport Depot' which means the use of land for the parking or storage of motor vehicles used in connection with a commercial or industrial transport undertaking. A Transport Depot is prohibited in all residential zones (RZ1-4), and most commercial zones (CZ1, CZ2, CZ4, CZ5, CZ6), and the transport zone (TZ1), as well as other non-urban and parks/educational/health land use zones.

A Transport Depot is permissible to use in all industrial zones, (IZ1 General Industrial, IZ2 Mixed Use Industrial), one commercial zone (CZ3 – Services), and the secondary transport zone (TZ2).

This means that under existing land use controls, the LRT dept would need to be located in Mitchell.

BRT Vehicles

The current Easy Access buses in the ACTION fleet are considered suitable for BRT operation along the Red Rapid route. The Easy Access fleet are buses designed to meet the needs of all passengers, including those with reduced mobility. They have low floors and therefore no stairs; extendable ramps, a wide entrance and floor space within the buses are provided for wheelchairs or prams.

There are currently 210 Easy Access buses within the ACTION fleet including some that can carry up to 100 passengers. Below is an example of the low floor entry that these buses provide. Higher capacity articulated buses are also being delivered as part of ACTION's fleet replacement program.

This study assumes that existing fleet would initially operate the BRT service and therefore any future depot requirements would be managed within the broader fleet context.

It is noted that BRT systems around the world often use bespoke higher capacity vehicles that are designed to look and feel more like trams and this could be considered in the future.



Figure 45 Existing ACTION bus

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Land Use and Transport in the Study Corridor

Public transport patronage is influenced by the level of development located in close proximity to the public transport routes. How many residents, jobs and other trip generating activities are located in the transport corridor will impact on the number of trips taken by public transport and other modes. The benefits of public transport improvement projects are measured by how many people are attracted to using the public service as opposed to taking trips by individual vehicles. A two way relationship exists between transport improvement and efficiency and higher land use activity.

This project assessment includes considering the infrastructure option and mode costs as well as land use variables to identify what provides the greatest benefits. These are assumptions for the purpose of transport modelling. Detailed land use planning would be required to implement any variation to current policy. This section of the report describes the existing land use conditions of the Northbourne Avenue and Flemington Road corridor in terms of the current land use planning policy context and land use conditions, and compares future land use conditions based on current ACT Government forecasts (the base case) with future land use conditions under the following scenarios:

1. Low Growth Scenario; and
2. Medium Growth Scenario.

4.1 The Base Case

The existing land use policies and controls that apply to the study area are the foundation on which the 'base-case scenario' (or business-as-usual) is calculated. This is then used as a benchmark to compare possible land development scenarios that may be possible as a result of rapid transit infrastructure improvements along the study area corridor.

The 'base case' is founded on the projection of an overall population in the region of approximately 500,000 people in 2031, and assumes that historic development patterns (mainly 'greenfield' development in the districts of Molonglo, Gungahlin and Queanbeyan) will be followed into the future.

Under this scenario there is no significant change to land use policies and planning controls in the study area. The base case utilises these ACT Government population and employment projections to determine the likely population in the future.

4.2 Land Development Scenario Guiding Principles

The project has developed land development scenario guiding principles based on the ACT Planning Strategy and Transport for Canberra policy, with input from ACT Directorates and the National Capital Authority. The principles are as follows:

1. Reduce car dependence and increase sustainable travel choices on the corridor in line with the Transport for Canberra mode share targets.
2. Provide a sustainable and effective level of service for all users anticipating the growing demand of movement in the corridor over the life of the project; ensure ease of movement, safety and reliability.
3. Provide an urban environment within the corridor where higher density development is located adjacent to the transit route and "steps down" to a walkable and cycleable distance.

4. Land Use and Transport in the Study Corridor

4. Broaden and intensify uses and activity generators within the corridor encouraging particularly short trips between housing, employment, services and recreation.
5. Maintain and enhance the role of Northbourne Avenue as a national approach route and main avenue of Canberra. Retain a landscape character and symmetry, including the possible extension of this role from Flemington Road to the existing 'gateway' entrance at Antill Street.
6. Provide a secure, high quality and healthy urban environment recognising the growing importance of the Avenue with its own sense of place as well as its transport movement function.
7. Retain and maintain urban open space, community space and uses within the corridor to support existing and new users.
8. Promote a diverse residential population within the corridor by including a range of housing choices and types allowing a diverse population to benefit from the rapid transport infrastructure and existing services and amenities.
9. Provide efficient public transport transfer /continuity for wider city trips (network integration).
10. Recognise interchange importance and development potential on the "Frequent Local" bus network particularly extending east and west from Dickson. These include crucial connections to Watson, Ainslie, Hackett, Lyneham, Kaleen and especially west to Belconnen via the major destinations in Bruce (Canberra Stadium, Canberra Institute of Technology, University of Canberra).
11. Assumptions about population increase within the corridor will not increase the overall population of the ACT and will reduce greenfield development.
12. Promote mixed use development opportunities appropriate to the urban character of each "segment" of the corridor based on the following hierarchy:
 - a) Northbourne Avenue (City to Antill St)—highest potential, promote active street frontages
 - b) Northbourne Avenue/Flemington Road (Antill St to Flemington Road at EPIC)—some potential
 - c) Flemington Road (Mitchell)—little potential
 - d) Flemington Road (Wells Station Drive to Kate Crace Cr)—some potential
 - e) Gungahlin Town Centre—some potential

4.3 Low Growth Land Use Scenario

The low growth land use scenario assumes realisation of a greater proportion of existing land use development potential under existing land use controls and policies in the Territory Plan than is forecast to occur. This scenario includes the realisation of the following existing policies affecting land use:

- Progressive implementation of the Dickson Centre Master Plan
- Progressive development of Gungahlin Town Centre development based on recent planning variations
- Redevelopment of public housing in Braddon and Turner.

4. Land Use and Transport in the Study Corridor

- Continued medium density housing development within parts of the Inner North Precinct (areas of Braddon, Lyneham and Turner within 500 metres of Northbourne Avenue).
- Progressive Implementation identified in the City Area based on NCA's amendments resulting from Griffin legacy work and also ANU Exchange plans.

4.4 Medium Growth Land Use Scenario

The medium growth land use scenario assumed further land use development opportunities that could occur as a result of a transit project. The scenario assumed that properties within the corridor are developed to the full extent allowable under existing land use controls (in terms of the percentage site coverage, and building heights) and includes the following additional land use features:

- Mixed use development with increase in the height limit along Northbourne Avenue precinct CZ5 zone up to 10 storeys and 12 storeys at major intersections.
- Continued medium density housing development within parts of the Inner North Precinct (areas of Braddon, Lyneham and Turner within 500 metres of Northbourne Avenue) up to 3 storeys.
- Comprehensive development of properties fronting Flemington Road in Gungahlin (under the mixed use zone with 8 storey height limit).
- Variation of broadacre sites adjacent Northbourne Avenue, adjacent the Canberra race course, to CZ5 (Mixed Use Zone with 8 storey height limit).
- Variation of the EPIC site allowing complimentary mixed use development to CZ5 (Mixed Use Zone with 8 storey height limit).
- Expansion of urban housing adjacent to Northbourne Avenue to RZ3 (up to two storey height limit).

4.5 High Growth Land Use Scenario

A high growth land use scenario was initially developed to consider further land use features in addition to those outlined under the medium growth land use scenario. Use of this scenario in modelling was discontinued after the preliminary land use calculations indicated population exceeding those identified as the ACT population forecasts.

4.6 Land use scenarios and preliminary modelling

Each of the options described in the Concept Design section is modeled in the Canberra Strategic Transport Model, which estimates travel demand for different scenarios based on changes to population, employment, retail, road speeds and capacities, and vehicle characteristics.

In total seven scenarios are being modeled to reflect the mode options and their corresponding land use scenarios. The diagram below shows which options were modeled for which land use scenario.

Land Use Scenario	Medium Growth Land Use Scenario		BRT with Medium Growth Land Use	LRT with Medium Growth Land Use
	Low Growth Land Use Scenario		BRT with Low Growth Land Use	LRT with Low Growth Land Use
	Base Case Land Use Scenario	Base Case	BRT with Base Case Land Use	LRT with Base Case Land Use
		'No Build' Scenario	BRT	LRT
	Transport Scenario			

Figure 46 Diagram of options modeled in the Canberra Strategic Transport Model

The Canberra Strategic Transport model covers the ACT and Queanbeyan and its demand matrices are segmented by six journey purposes at the trip generation, trip distribution and mode choice stages maintained periodically by ESDD.

The base case option assumes that changes in future transport and land use continue on business as usual basis, in line with current Government transport commitments and planning strategies.

To demonstrate the impact of these options against the base case, further information will be provided during the community consultation period as transport modeling results are finalised.

Preliminary results indicate that both LRT and BRT are feasible under the low growth land use scenario.

5

Implementation

Implementation of LRT/BRT

If LRT or BRT are identified as a viable transport mode, work may begin to establish the process and the schedule for completing the designs for the approved alignment and maintenance facility. Following the concept design, the sequence of events may be:

- Procure the long lead items for the project, which may include the vehicles. The vehicle procurement specialist would begin interviewing vehicle manufacturers and developing specifications for the procurement process. Decision on the type of technology would have to be completed by the owner to establish design parameters.
- Begin preliminary designs to finalize the project footprint to establish an agreed upon basis of design. This would include a finalised horizontal and vertical alignment, station locations, preliminary utility relocations and urban designs. At the end of this phase a cost estimate would be established to approximately 80% accuracy with 20% contingency in consideration. A 30% design document and basis of design report would be generated for review and acceptance into the next phases of the project. If the owner selects a design firm to conduct the preliminary engineering, they have the option to continue working with the incumbent designers or procure for a new designer that advances the project design to completion.
- Selecting a contracting methodology is a critical decision that has to be made by the owner to identify the next procurement phases. The owner may choose to go with a traditional design-bid-build or a design-build-operate-maintain, or other contracting methods.
- Advance the preliminary designs to 100% completion. Generally, interim packages are produced for review by the owner and the stakeholders. This provides an opportunity for a formalized review process of the design and the scope. In the case of the design-build, the final design may go concurrently with construction. In some cases, the owner may decide to divide the final design into different elements such as systems, utilities and structures, each having a separate contract and schedule. This may result in quicker project implementation by advancing some of the construction elements while design on other elements continues concurrently. A good example is major utilities work would be advanced during the design of the surface features.
- After the final design is completed, the project may be let out to tender and a contractor procured to begin the construction of the major elements. The construction process generally follows a bottom-up approach where subsurface infrastructure, such as earthwork, utilities and foundations are built first. Structures and stations are constructed next followed by roadways elements. The track and system elements for LRT are constructed last. Depending on the size of the project, the contractor may divide the construction into zones or reaches depending on scheduling requirements.
- In terms of LRT, the last phase of system implementation is testing the system and the newly arrived vehicles. During this phase, the owner begins training operators and maintenance staff for operations.

5. Implementation

Generally, light rail projects are implemented in 3-4 years from the beginning of preliminary design to end of testing. Preliminary design and final engineering may take up to 8 -12 months depending on the complexity of the design.

In the case of BRT projects, these are generally built in segments/stages and construction/ bid packages are assembled accordingly. This allows segments of the BRT corridor to be utilized prior to completion of the entire line.

Due to the lower level of sophistication of technology associated with BRT vs. LRT, the time for testing and implementation of the system is significantly reduced and may become operational in a matter of weeks rather than months. Generally, training of operators on the new vehicle and docking at stations is all that is required, assuming that amenities such as TSP, automatic fare vending, variable messaging, etc., are tested as they are installed.

Below is a graphical representation of the potential implementation program for LRT or BRT along the study corridor.

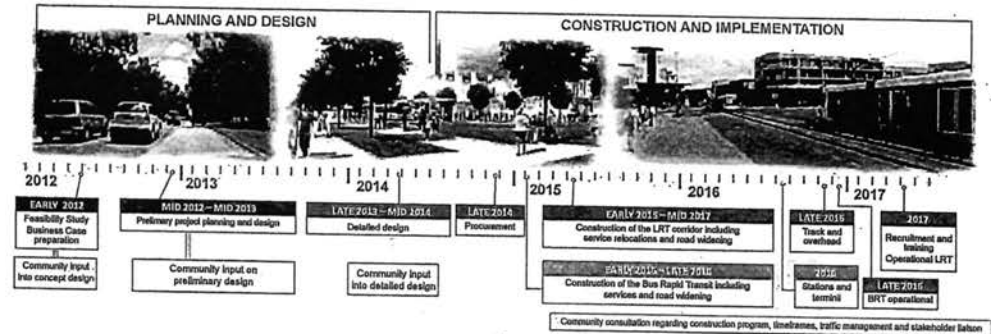


Figure 47 Implementation diagram

6

Conclusion

The City to Gungahlin Transit Corridor Concept Study has identified a number of improvements to the study corridor as part of implementing a BRT or LRT system including:

- A BRT or LRT connection between City to Gungahlin for the full 12km length, replacing the Red Rapid through this corridor;
- Station designs at City, Dickson and Gungahlin that integrate BRT or LRT to the current bus and road network;
- Additional stops and higher frequency for the BRT or LRT service along the transit corridor to respond to higher demand expected for the transit service;
- New dedicated cycleways on each side of Northbourne Avenue and wider footpaths;
- Potential increase in land use development along the corridor in response to the improved service provided by BRT or LRT;
- Enhancements to Northbourne Avenue aimed at strengthening its role as the ceremonial gateway to our nation's capital with enhanced tree planting and encouraging active use of the verges; and
- Potential future extensions to the BRT or LRT network from City to other suburbs or major destinations.

Along the length of the corridor new dedicated public transport lanes have been proposed in the both BRT and LRT concepts. A different alignment for these lanes has been recommended on Northbourne Avenue and Flemington Road due to their contrasting characteristics.

Kerbside bus lanes or light rail lanes have been selected for Northbourne Avenue between City and Barton Highway to enhance its unique character as the primary National Gateway. The sketches below show what the new cross section would look like with BRT or LRT kerbside on Northbourne Avenue.

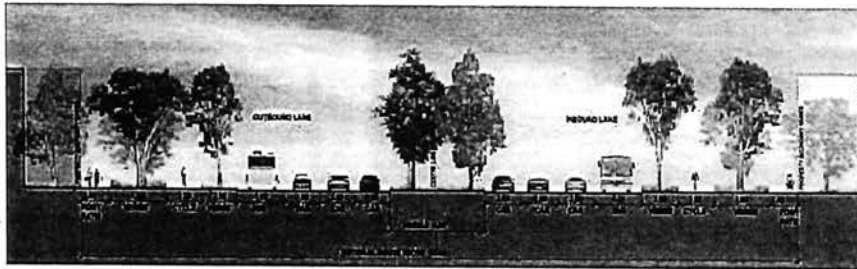


Figure 48 BRT Kerbside on Northbourne Ave

6. Conclusion

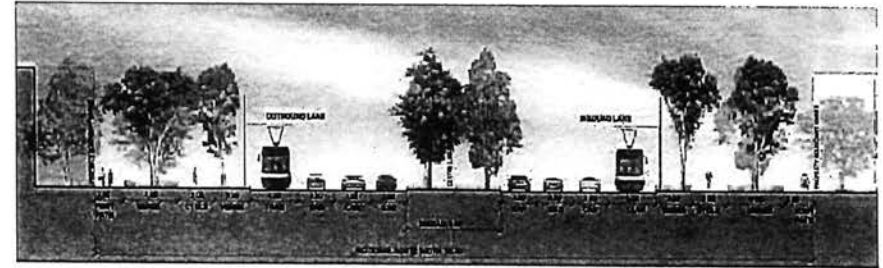


Figure 49 LRT Kerbside on Northbourne Ave

Only transit operation in the kerbside lanes strengthens the multi-faceted role of the Avenue by meeting its ceremonial, commercial, activity and travel roles:

- **Ceremonial:** symmetry is achieved with four rows of trees, two rows in the central median and two rows in the verge;
- **Commercial:** allows and concentrates activity in front of businesses, which enhances Northbourne Avenue's perceived value as the primary address in Canberra;
- **Activity:** a wider verge, including a wider footpath and dedicated cycleway, improves safety and provides space for high quality stop infrastructure without impinging on the Avenue.
- **Travel:** direct access from BRT or LRT to activity along the Avenue, which encourages hop on/hop off use. Also reconfiguration of the Avenue means a shorter crossing distance across the Avenue to what passengers must currently cross to access services in the opposite direction.

Median bus lanes or light rail lanes have been selected for the central sector of the study corridor and Flemington Road, i.e. Barton Highway to Gungahlin. The sketches below show what the new cross section would look like with BRT or LRT operation on Flemington Road.

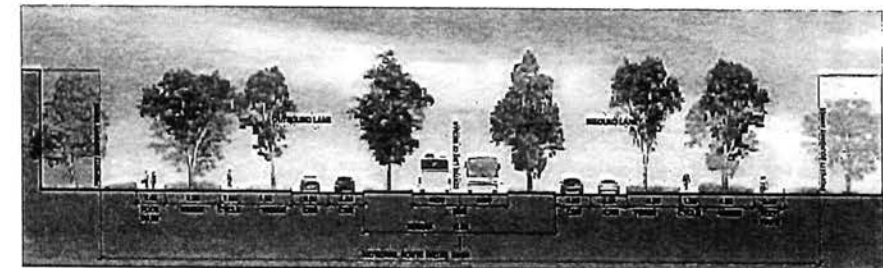


Figure 50 BRT Median on Flemington Road

6. Conclusion

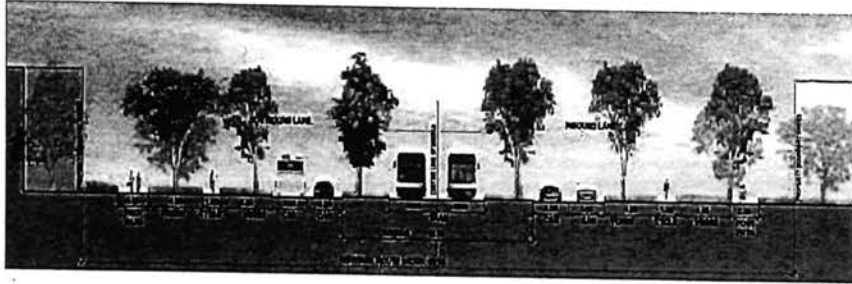


Figure 51 LRT Median on Flemington Road

Median operation is recommended for Flemington Road as the route through here is more of a commuter route with less frequent stopping and higher speeds. The BRT or LRT on Northbourne Avenue would transition from kerbside to the central median at Barton Highway, where the character of the corridor changes from dense urban environment to semi-rural, which is more suited to a median alignment.

Both the BRT and LRT options have been predicted to run at a 10 minute frequency by 2021 and an 8 minute frequency or better by 2031 in the peak periods. This service would replace the Red Rapid in the City to Gungahlin corridor, however further efficiencies along the corridor may be achieved by replacing additional bus routes along the corridor with this service or extending the BRT or LRT network south to Woden-Tuggeranong, and north-west from City to Belconnen.

The estimated capital costs for these two options are \$300 – \$360 million for BRT and \$700 – \$860 million for LRT. The higher LRT capital cost is attributed to additional costs such as track, electrical, a new LRT depot, and new light rail vehicles. Additional costs for LRT also come from the larger and more complex stops/stations required.

A triple bottom line evaluation undertaken of these options, comparing their social, economic and environmental impacts to the 'do-nothing' scenario has shown LRT to provide higher benefits due to its higher social benefits.

Potential variations to the options above are currently being explored; including the use of existing road capacity for the BRT or LRT lanes; less changes to the median and verge widths; and staged options where, for example, bus priority would be implemented initially and converted to LRT or BRT in the future.

In addition to the infrastructure and mode costs considered in this study, potential land use variables have been identified that could occur along the corridor associated with the improvement of public transport. In addition to the forecast population, employment and retail growth along the corridor, a low growth scenario identifying realisation of a greater proportion of existing land use development potential under existing land use controls and policies in the Territory Plan has been identified. Furthermore, additional land use development opportunities that could occur as a result of the transit project were identified to the full extent allowable under existing land use controls which formed a medium growth scenario.

The BRT and LRT options with the different land use scenarios above were modeled in the Canberra Strategic Transport Model, which estimates travel demand for different scenarios based on changes to population, employment, retail, road speeds and capacities, and vehicle characteristics. The results of this modeling indicate that both the BRT and LRT options result in a significant mode shift to public transport along the study corridor when compared to the 'no build' scenario where no infrastructure improvements are made to the transport services in future years.

Overall the study shows that there are significant opportunities to improve the corridor with the implementation of either BRT or LRT, and potentially additional benefits if the corridor were to be extended in the future.

BRT is a cost-effective option, whilst LRT generates the best overall outcome for Canberra.

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City to Gungahlin Transit Corridor

FOREWORD

The ACT Government is constantly looking for ways to encourage more people to use public transport, with its multiple benefits for the environment and ability to reduce congestion on our roads.

The City to Gungahlin Transit Corridor project is an integral part of the 2012 Transport for Canberra policy, which maps out ways to deliver faster, more convenient and more sustainable transport options for Canberra over the next 30 years.

The project aims to deliver high quality, fast public transport down one of the city's busiest corridors, providing more incentive for people to use public transport.

This update is part of our commitment to keep the public informed about the project and involve the community in decisions around what the corridor should look like, the best transit options and the costs.

Do we choose light rail or bus rapid transit? Do we run the transit down the middle of Northbourne Avenue or add extra lanes on the edges of the verges? How do we incorporate bicycle and walking paths to encourage active travel? What are the costs of each option?

Whichever option we choose will have major implications for Northbourne Avenue, the iconic entry into our city. We therefore value wide community input to the project at all levels of its planning and design.

I look forward to hearing your views and incorporating them in further decisions on this large, important project.

Simon Corbell MLA
Minister for the Environment and Sustainable
Development

ABOUT THE PROJECT

The City to Gungahlin Transit Corridor Study is investigating the feasibility of replacing the existing Red Rapid bus service between Gungahlin and City with a light rail transit (LRT) or bus rapid transit (BRT) corridor along Northbourne Avenue and Flemington Road.

Introducing rapid transit to the corridor would contribute to the improvement of the Frequent Network outlined in the Transport for Canberra policy, and help transform the City to Gungahlin corridor into a more urban, active, attractive boulevard and entry to the ACT.

Future extensions to the Parliamentary Zone, Woden and Belconnen have also been considered as a part of current and future transport planning.

The corridor

Northbourne Avenue is an important approach route and main avenue for Canberra. It links to the Federal Highway, the main approach route from Sydney and Melbourne, and so becomes a visitor's first perception of the city's character.

Flemington Road is a connector road from Northbourne Avenue to Gungahlin and directly links to Hibberson Street, the main shopping and business strip in Gungahlin Town Centre. Currently, the southbound bus lanes on Flemington Road carry nearly 50% of people on that road in the morning peak.

The corridor includes three main nodes/stations at City, Dickson and Gungahlin, which will be both an important part of the public transport network, and locations for changing land use that is already part of current planning policy.

April 2012



The options considered for the study are:

- Bus Rapid Transit (BRT)—AU\$300 – \$360 million
- Light Rail Transit (LRT)—AU\$700 – \$860 million

The indication of cost provided is based on pre detailed design estimates. The accuracy of the cost estimate will

be increased as the design is developed. Refer to the concept report for further detail.

In each option the service is proposed to run at a 10 minute frequency by 2021 and 8 minutes or less by 2031. Three major stations would exist along the corridor at City, Dickson and Gungahlin, where modal interchange would occur.



Bus Rapid Transit

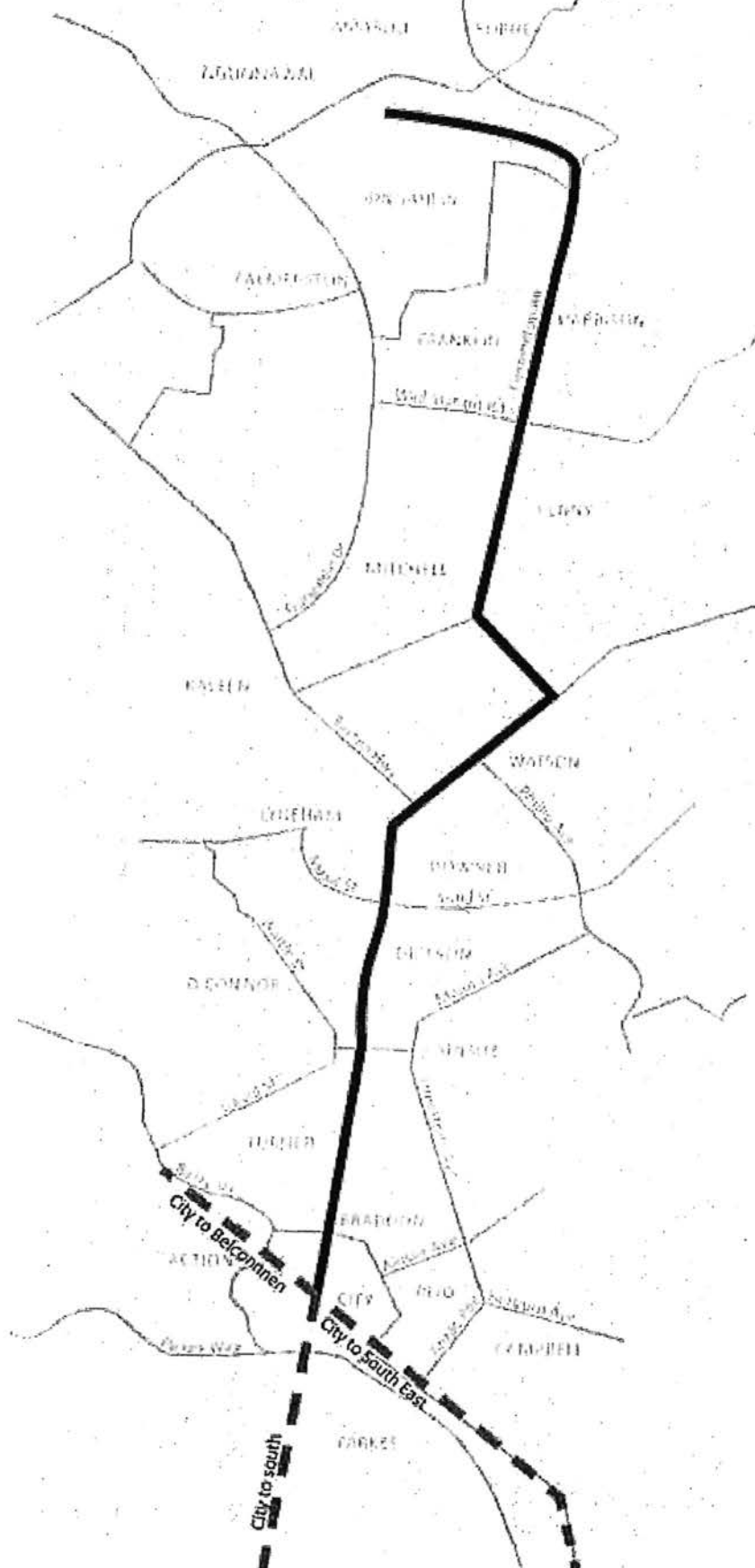


Light Rail Transit



City to Gungahlin Transit Corridor Study Area

Objectives of the study



- **Delivering transport efficiently**—by developing a sustainable transport system along the corridor with greater reliability and capacity to service growing centres and cater for population growth.
- **Managing congestion**—by increasing public and active transport.
- **Developing a resilient system**—by supporting Canberra’s role as the nation’s capital and improving connectivity to key centres.
- **Supporting economic prosperity/employment growth**—by enhancing accessibility to town centres and promoting economic activity in the corridor, supporting mixed use urban development.
- **Creating a low carbon and environmentally responsible transport system**—by maximising the use of public transport and reducing greenhouse gas emissions, noise and air pollution.
- **Improving access to services**—by providing an efficient and reliable public transport system that provides improved access to housing, employment, services and recreational opportunities.

What happens if we do nothing?

Without improvements to public transport infrastructure, road congestion will continue to grow as Canberra’s population increases, impacting on travel times and the overall quality of life that we enjoy in Canberra.

If we had LRT or BRT now, the 16 minute travel delay in the morning peak hour for cars and buses on the corridor would be reduced to less than 8 minutes (BRT) and less than 6 minutes (LRT). Public transport travel times would be over 30% faster than general traffic.

A detailed concept report provides further information about the study and is available from www.timetotalk.act.gov.au.