The Canberra community is passionate about transport and has shown great interest in the proposed rapid transit way down our iconic Northbourne Avenue. I am therefore very pleased to provide the third update for the Gungahlin to City Rapid Transit project, which has been underway for the past 12 months. A rapid transit investment on this corridor would be transformational for Canberra and an important first step in a city-wide rapid transit system.

This update includes more detail on cost estimates for LRT and BRT. Some trade-offs in the proposed redesign of Northbourne Avenue have led to lower estimated costs – $614m for LRT and $276m for BRT. These estimates will be further refined as the project moves from feasibility into detailed design in the coming year.

To help us progress this important work to the next stage of design, the ACT Government has provided a detailed business case to Infrastructure Australia, seeking $15m of funding through the Nation Building II program. The submission includes the benefit-to-cost ratios and a detailed economic assessment for both LRT and BRT options.

The ACT Government will match the proposed Australian Government contribution. This project would not have progressed as far as it has without the support of the National Capital Authority, the Chief Executive of which has written to Infrastructure Australia in support of the ACT’s submission, and continues to work closely with ACT planners on Gungahlin to City Rapid Transit.

This update also includes information on how the Gungahlin to City corridor project is being considered as part of an eventual city wide network of rapid transit linking all of our key centres. Possible staging and options are included for the community’s information.

I thank the Canberra community for your continued interest in this project, and I look forward to seeing the project progress to the next stage under the guidance of the newly established Gungahlin to City project office.

Simon Corbell MLA
Minister for the Environment and Sustainable Development
September 2012
Gungahlin to City Transit Corridor

Introduction

The Gungahlin to City Transit Corridor project is exploring the feasibility of developing Bus Rapid Transit (BRT) or Light Rail Transit (LRT) between Gungahlin, Canberra’s fastest growing district, and the City, Canberra’s major employment centre.

To date the project has included the following work: engineering concept design, pre-feasibility cost estimates which have been further refined in this update, public transport modelling, economic and financial evaluations, community consultation and an Infrastructure Australia submission.

In April and May 2012, the ACT Government asked the community for comments on which mode (LRT or BRT) they preferred, whether they preferred a median or kerbside transit on Northbourne Avenue, and for any other comments that would help inform the project. More than 1500 people had a say on this important project. See page 6 for a summary of what we have heard from the community so far.

This project update provides further information about the cost estimates and economic evaluation for LRT and BRT, outlines the feedback from the community consultation, and details the next steps for the project.

- Project commenced September 2011
- Project Update 1 December 2011
- Project Update 2 April 2012
- Community consultation April to May 2012
- Establishment of Gungahlin to City project office May 2012
- Infrastructure Australia Submission lodged August 2012
- Gungahlin to City Project Office projects ongoing
Public transport network context

The Gungahlin to City Transit Corridor is part of wider improvements to Canberra’s public transport network established through Transport for Canberra and the ACT Planning Strategy.

Transport for Canberra establishes how transport will develop in Canberra for the next 20 years. It introduces the Frequent Network, which identifies a rapid network of high frequency public transport services across Canberra. This will be the backbone of Canberra’s public transport system.

Rapid transit can range from bus priority lanes (like the lane on Barry Drive) with priority signals at intersections, to public transport corridors that are separated from the roads (like the high quality LRT or BRT proposed for the Gungahlin to City corridor). Figure 1 shows the Rapid network where these services will be built and operated.

The Gungahlin to City Transit Corridor is the first stage of a rapid transit roll-out across Canberra. Options for investigation for the second stage of the rapid transit network are Kingston (East Lake) to the City via Barton, and Woden to the City. Future stages would include Belconnen, Lanyon, Kippax, Weston Creek, Molonglo, and Queanbeyan in the network (see Figure 1).

In the meantime, the Government is implementing major public transport improvements across Canberra with a range of projects underway including upgrades to Constitution Avenue, the Belconnen to City transit way, Canberra Avenue bus priority, Adelaide Avenue bus stops investigation and Gungahlin to Belconnen improvements.
Land use context

The ACT Planning Strategy highlights opportunities for locating more people and employment around Canberra’s town and group centres and along the rapid transit corridors identified in Transport for Canberra. These opportunities capitalise on the existing structure of the centres and transport connections as shown in Figure 2.

Studies show that there is capacity in the Gungahlin to City corridor for more people to live and work. The transport modelling tested the feasibility of BRT and LRT using two possible scenarios based on how many people and jobs could be located in the corridor over time.

**Scenario 1:** Business as usual population projections assume the normal growth of the corridor population based on the ACT Government’s official population projections.

**Scenario 2:** Higher residential and employment populations: 38% more people and 21% more employment are possible within the corridor by 2031. This is in line with the ACT’s total population projections and the ACT Planning Strategy. The increased development is within the provisions of the existing Territory Plan and recent planning projects, such as the Dickson Group Centre and Gungahlin Town Centre Master Plans.

The ACT Government will do further work in consultation with the community before determining the optimum population and employment numbers for the Gungahlin to City corridor.
Community consultation
The community was consulted during April and May 2012 about:

- overall level of support for transit improvements in the corridor
- preferred transit mode – LRT or BRT
- preferred transit alignment for Northbourne Avenue – median or kerbside and
- other aspects to be considered in the concept design of the corridor.

To reach the greatest number and diversity of Canberrans, the study used a range of consultation methods, including:

- community information sessions at Civic, Dickson and Gungahlin
- workshops with business, industry and community groups
- online survey
- phone survey and
- requests for written submissions.

Key messages
Survey respondents showed strong support for the long-term approach to transport planning in the proposed changes in the Gungahlin to City Corridor that seek to cater for future population growth.

The consultation gauged varying levels of support for a transit improvement in the corridor (either LRT or BRT), with 98% support from online survey respondents and 65% support from participants in a cross-Canberra phone survey.

The majority of consultation participants preferred light rail. In the telephone survey, there was more than 65% support for LRT initially, but after people were informed of the initial cost estimates, the support for LRT and BRT was equal at 46%.

Responses in submissions, online comments and at public workshops illustrated a strong public view that light rail could improve and transform Canberra and that environmental impact was the most important reason for preferring LRT.

Many survey respondents were undeterred by the higher cost estimates for LRT, believing it to be an investment in the future of Canberra.

Respondents preferred the option for a median alignment for the transit corridor. There was also strong support for the inclusion of segregated cycleways along the corridor.

What is light rail transit?
Light rail transit (LRT) is a rail mode, similar to trams, which operates at road level and uses electrically powered vehicles. LRT vehicles can receive power through overhead wires, known as catenary, or can be catered for and recharged when braking using a rapid-charge accumulator system. LRT can operate at low speeds in higher density urban areas with closer spaced stops or at high speeds in segregated corridors. LRT systems operate primarily in their own lane but can also share lanes with other vehicles and share space with pedestrians. LRT can operate at low and high speeds depending on urban environment and stop spacing. LRT is a popular mode choice due to its comfort, speed, reliability and high capacity.

Advantages
- Popular and attractive form of public transport.
- High capacity vehicles.
- Permanent transport infrastructure.
- Can operate at low and high speeds depending on urban environment and stop spacing.
- Energy efficient and can use cleaner power options (hybrid, electric).

Disadvantages
- Expensive in both capital and operational expenditure.
- Requires purpose built depot for stabling and maintenance, adding to cost.
- Inflatable as fleet cannot be used outside of the City to Gungahlin corridor, unlike BRT, unless it is extended throughout the whole network.

What is bus rapid transit?
Bus Rapid Transit (BRT) is a high quality bus system which operates in its own segregated space. This allows for higher speeds, frequency and reliability than normal bus services. BRT systems are more flexible than LRT by being able to transition into general traffic and can use existing fleet. BRT vehicles can be purpose designed to achieve similar passenger comfort and quality as LRT, carrying up to 200 passengers.

Advantages
- Cost-effective alternative to light rail.
- More flexible than LRT with integration to existing bus fleet and network.
- Operates at low and high speeds depending on urban environment and stop spacing.
- Can have similar passenger comfort and quality as LRT for less cost.
- Flexibility to convert to light rail corridor in future.
- No overhead catenary lines as in the case of light rail.

Disadvantages
- Perception that a bus based system has lower amenity than LRT.
- Passenger capacity per BRT vehicle is half of LRT vehicles.
Economic evaluation of LRT and BRT

Cost benefit analysis is a way of calculating and comparing the total expected benefits and costs of a project to determine its feasibility. This analysis is expressed as a benefit cost ratio (BCR) which indicates the overall value for money of a project. For example, a BCR of 2.0 indicates that every dollar invested returns a benefit of two dollars.

Benefits and costs of the project

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
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<tbody>
<tr>
<td>• Public transport travel time savings</td>
</tr>
<tr>
<td>• Highway travel time savings</td>
</tr>
<tr>
<td>• Incremental fare revenue</td>
</tr>
<tr>
<td>• Unperceived vehicle operating costs</td>
</tr>
<tr>
<td>• Environmental externalities</td>
</tr>
<tr>
<td>• Avoided accident costs</td>
</tr>
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<td>• Avoided road damage costs</td>
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</table>

<table>
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<tr>
<th>Costs</th>
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<tr>
<td>• Planning and design</td>
</tr>
<tr>
<td>• Enabling works</td>
</tr>
<tr>
<td>• Road infrastructure</td>
</tr>
<tr>
<td>• Signalling</td>
</tr>
<tr>
<td>• Transit vehicles</td>
</tr>
<tr>
<td>• Electrification and tracks (LRT)</td>
</tr>
<tr>
<td>• Stations and stops</td>
</tr>
<tr>
<td>• Cycle lanes</td>
</tr>
<tr>
<td>• Landscaping</td>
</tr>
</tbody>
</table>

Cost estimates

Since the release of initial cost estimates in April 2012, work has been continuing on refining the design of the corridor which has led to a reduction in cost estimates.

The previous cost estimates were $700–860m for LRT, and $300–360m for BRT. The revised estimates are $614m for LRT and $276m for BRT. Changes to the design have reduced costs, improving the overall viability of the project by:

- using a median alignment for the BRT or LRT along the entire length of the corridor reflecting the community preference during consultation; the previous costs were based on kerbside LRT or BRT on Northbourne Avenue
- retaining the existing verge and median widths of Northbourne Avenue; the previous proposal relocated the road to reduce the width of the median and increase the width of the verges to provide improved public realm and cycle lane upgrades
- maintaining the 3 metre-wide segregated cycle lanes previously proposed but with a 0.6 metre rather than 4 metre separation from the roadway
- retaining existing pedestrian crossing distances on Northbourne Avenue
- maintaining the existing public realm on the verges; and
- the possible removal of some trees in the median and verge to allow for transit operation and 3m-wide cycle lanes.

The existing, previous, and revised proposals for Northbourne Avenue are shown in Figure 3 for both LRT and BRT.
Previous LRT median alignment for Northbourne Avenue

Previous BRT median alignment for Northbourne Avenue

Current alignment for Northbourne Avenue

New median alignment for LRT on Northbourne Avenue

New median alignment for BRT on Northbourne Avenue
These changes to the concept for the Northbourne Avenue section have resulted in the revised cost estimates shown below.

**Table 1: Revised cost estimates**

<table>
<thead>
<tr>
<th>Asset</th>
<th>Cost Component</th>
<th>Cost Type</th>
<th>Assumed Life (Years)</th>
<th>LRT: Median Alignment</th>
<th>BRT: Median Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabling works</td>
<td>Planning</td>
<td>Direct costs</td>
<td>0</td>
<td>$13.355</td>
<td>$13.355</td>
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<tr>
<td>Other general planning and management</td>
<td>Planning</td>
<td>Direct costs</td>
<td>0</td>
<td>$9.713</td>
<td>$9.713</td>
</tr>
<tr>
<td>Traffic management / temporary works</td>
<td>Planning</td>
<td>Direct costs</td>
<td>0</td>
<td>$5.095</td>
<td>$5.095</td>
</tr>
<tr>
<td>Track work</td>
<td>Below rail infrastructure</td>
<td>Direct costs</td>
<td>30</td>
<td>$101.984</td>
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<tr>
<td>Road infrastructure</td>
<td>Bridges</td>
<td>Direct costs</td>
<td>30</td>
<td>$13.520</td>
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<tr>
<td>Road infrastructure</td>
<td>Segregated Rapid Transport Lanes</td>
<td>Direct costs</td>
<td>30</td>
<td>$25.440</td>
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<tr>
<td>Road infrastructure</td>
<td>Road works / footpaths and cycle lanes</td>
<td>Direct costs</td>
<td>30</td>
<td>$8.937</td>
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<td>Road infrastructure</td>
<td>Medians / Landscaping</td>
<td>Direct costs</td>
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<td>Road infrastructure</td>
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<td>Road infrastructure</td>
<td>Utilities</td>
<td>Direct costs</td>
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<td>Signalling</td>
<td>Electrical</td>
<td>Direct costs</td>
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<td>$9.713</td>
<td>$9.713</td>
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<tr>
<td>Power supply, transformers and sub-stations</td>
<td>Electrical</td>
<td>Direct costs</td>
<td>40</td>
<td>$72.000</td>
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<td>Other electrical and mechanical systems</td>
<td>Electrical</td>
<td>Direct costs</td>
<td>15</td>
<td>$15.589</td>
<td>$12.821</td>
</tr>
<tr>
<td>Passenger ticketing</td>
<td>Passenger interface and communications</td>
<td>Direct costs</td>
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<tr>
<td>Passenger information displays and Platform control systems</td>
<td>Passenger interface and communications</td>
<td>Direct costs</td>
<td>10</td>
<td>$10.927</td>
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<td>Vehicle monitoring systems</td>
<td>Passenger interface and communications</td>
<td>Direct costs</td>
<td>10</td>
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<tr>
<td>Bus stops</td>
<td>Existing stops relocated from kerb</td>
<td>Direct costs</td>
<td>20</td>
<td>$3.642</td>
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<tr>
<td>Bus / Light rail stations</td>
<td></td>
<td>Direct costs</td>
<td>50</td>
<td>$27.317</td>
<td>$18.212</td>
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<td>Other buildings and structures</td>
<td>Depots</td>
<td>Direct costs</td>
<td>100</td>
<td>$91.058</td>
<td>$48.000</td>
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<tr>
<td>Bus fleet</td>
<td>Fleet</td>
<td>Direct costs</td>
<td>20</td>
<td>$11.250</td>
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<tr>
<td>Light rail rolling stock</td>
<td>Fleet</td>
<td>Direct costs</td>
<td>35</td>
<td>$54.635</td>
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<td><strong>Subtotal: Direct Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td>$501.594</td>
<td>$225.651</td>
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<tr>
<td>Preliminaries and design 20% of direct costs</td>
<td>Preliminaries and design</td>
<td>Indirect costs</td>
<td>0</td>
<td>$100.319</td>
<td>$45.130</td>
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<td>Government costs 2.5% of direct costs</td>
<td>Project delivery costs</td>
<td>Indirect costs</td>
<td>0</td>
<td>$12.540</td>
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<td><strong>Subtotal: Indirect Costs</strong></td>
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<td>$112.859</td>
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<tr>
<td><strong>TOTAL ($mil)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$614.452</td>
<td>$276.423</td>
</tr>
</tbody>
</table>

The cost estimates recognise that the level of design is at a pre-conceptual or ‘concept screening’ phase. In these circumstances, the typical range of accuracy 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.
Figure 4 shows that project costs become more certain as a project progresses from feasibility to design and construction. This means that the cost estimates for the Gungahlin to City Corridor will be further refined in the next stage of forward design, which would start in 2013-14 subject to Federal Government funding.

Cost estimates were prepared in accordance with the Department of Infrastructure, Transport, Regional, Development and Local Government – Best Practice Cost Estimation for Publicly Funded Road and Rail Construction, 2008.

Benefit – cost ratios

The economic assessment completed by Deloitte Australia for the ACT Government’s Infrastructure Australia Submission has produced the following benefit-cost ratios for the project options:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Population and employment over time</th>
<th>Benefit – cost ratio (BCR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRT</td>
<td>Business as usual</td>
<td>1.98</td>
</tr>
<tr>
<td></td>
<td>Higher population and employment in the corridor</td>
<td>4.78</td>
</tr>
<tr>
<td>LRT</td>
<td>Business as usual</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>Higher population and employment in the corridor</td>
<td>2.34</td>
</tr>
</tbody>
</table>

The economic appraisal was undertaken in accordance with Australian Transport Council and Infrastructure Australia investment appraisal guidelines. The results show that both BRT and LRT are feasible projects, and that feasibility increases as the residential and employment population increases over time.

The economic assessment uses the methodology prescribed by Infrastructure Australia which includes only the traditional transport benefits like travel time savings, carbon emission reductions, vehicle operating costs and road accident costs. Intangible or newer economic benefits like the health benefits of increases in public transport, walking and cycling are not yet able to be included in Infrastructure Australia assessments, even though these sorts of improvements would produce significant benefits to the Canberra community from the Gungahlin to City Transit Corridor improvements.

Infrastructure Australia submission

A submission was lodged with Infrastructure Australia for Nation Building II funding from the Federal Government in early August 2012. The submission seeks $15m from the Federal Government for feasibility and forward design during 2013–14 to 2014–15. If successful, a dollar for dollar matching contribution would be required from the ACT Government.

The forward design and feasibility work would provide the basis for seeking further funding from the Federal Government and would explore options for private investment. The announcement of any funding from Infrastructure Australia would occur in conjunction with next year’s Federal Budget. In the meantime, work will continue on this project.

Gungahlin to City Project Office

The Gungahlin to City Project office has been established to coordinate delivery of transit corridor projects and corridor redevelopment opportunities. The ACT Government recognises there is significant potential for the redevelopment and renewal of the corridor. The ACT Government is the planning and transport authority and the owner of a significant amount of land along the corridor. As such, the ACT Government is uniquely positioned to not only plan for but also implement and realise the opportunities and benefits of the transit oriented corridor redevelopment and renewal, in a way that no other Australian jurisdiction can.
## Gungahlin to City Transit Corridor Timeline

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commencement of study</td>
<td>September 2011</td>
</tr>
<tr>
<td>Background analysis and internal consultation</td>
<td></td>
</tr>
<tr>
<td>Project Update 1</td>
<td>December 2011</td>
</tr>
<tr>
<td>Concept design evaluation and economic assessment</td>
<td></td>
</tr>
<tr>
<td>Community consultation and Project Update 2</td>
<td>April – May 2012</td>
</tr>
<tr>
<td>Concept design and cost estimate refinement</td>
<td></td>
</tr>
<tr>
<td>Gungahlin to City Project Office</td>
<td>May 2012</td>
</tr>
<tr>
<td>Infrastructure Australia (IA) submission</td>
<td>August 2012</td>
</tr>
<tr>
<td>Project Update 3</td>
<td>September 2012</td>
</tr>
<tr>
<td>Announcement of IA funding Federal 2013–14 Budget</td>
<td></td>
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</tbody>
</table>
Report

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

Prepared for
ACT Environment and Sustainable Development Directorate

43316037
<table>
<thead>
<tr>
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<th>URS Australia Pty Ltd</th>
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<tr>
<td></td>
<td>F: 61 3 8699 7550</td>
</tr>
<tr>
<td>Principal-In-Charge:</td>
<td></td>
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<tr>
<td>Alex Iljin</td>
<td></td>
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<tr>
<td>Senior Principal – Transport</td>
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<td>Author:</td>
<td></td>
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<tr>
<td>Amanda Tobin</td>
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<tr>
<td>Senior Transport Planner</td>
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<td>Reviewer:</td>
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<td>26 March 2012</td>
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<td>Status:</td>
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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 and Barton Highways which are the main approach routes 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.

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.

![Image of Griffin's tram network and pedestrian catchments]

Figure 2 Griffin’s tram network and pedestrian catchments

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.²

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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.

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 boulevarde. 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).

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

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

<table>
<thead>
<tr>
<th>Ceremonial</th>
<th>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.</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>Canberra’s key commercial address for apartments, professional and service businesses.</td>
<td>Perception of improved accessibility—a clear presence in the street with a known route and destination.</td>
</tr>
<tr>
<td>Activity</td>
<td>A mixed-use relatively high density activity corridor, with residential and other development in addition to and complementing the commercial role identified above.</td>
<td>Provides a high capacity linear public transport service, the 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.</td>
</tr>
<tr>
<td>Travel</td>
<td>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.</td>
<td>Dedicated public transport lanes and cycleway provide a defined route and public and active transport spine from Gungahlin to City.</td>
</tr>
</tbody>
</table>
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](image)

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.

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

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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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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

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

\textsuperscript{5} Gold Coast Rapid Transit Corridor Study, Hassell, Gold Coast City Council, August, 2011 \\
\textsuperscript{6} The Rebirth, Sunday Plain Dealer, 10\textsuperscript{th} February, 2008 \\
\textsuperscript{7} Eastern Corridor Renewal Strategy Final Draft Executive Summary, Brisbane City Council, August 2009
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](image)

![Figure 10 Northbourne Ave BRT Kerbside plan](image)

![Figure 11 Northbourne Ave BRT Kerbside cross section showing dimensions](image)
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 LRT 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

<table>
<thead>
<tr>
<th>Characteristics to be achieved</th>
<th>Median—narrow</th>
<th>Verges—wide</th>
<th>Bus lanes/light rail—kerbside</th>
</tr>
</thead>
<tbody>
<tr>
<td>National significance – main avenue</td>
<td>Symmetry, 4 rows of trees</td>
<td>Must include at least one row of trees</td>
<td>Does not interfere with median trees</td>
</tr>
<tr>
<td>Northbourne – main avenue</td>
<td>Enhanced perceived value as the primary address in Canberra</td>
<td>N/A</td>
<td>Concentrates activity and reinforces perception of easy access to addresses along Northbourne Ave</td>
</tr>
<tr>
<td>Activity</td>
<td>Wider footpath, dedicated cycleway, space for street activity, proximity of PT to activity, connect the shopfront to the PT, safety and security</td>
<td>Under utilised</td>
<td>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</td>
</tr>
<tr>
<td>Travel</td>
<td>Clear delineation, ease of access</td>
<td>N/A</td>
<td>Direct access from public transport to activity along the boulevard like corridor, encourages hop on/ hop off use</td>
</tr>
</tbody>
</table>

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](image)

The alignment designs have been workshopped 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 workshopped 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:

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Harms</th>
</tr>
</thead>
<tbody>
<tr>
<td>★ Negligible</td>
<td>★ Negligible</td>
</tr>
<tr>
<td>★★ Minor Benefit</td>
<td>★★ Minor Harm</td>
</tr>
<tr>
<td>★★★ Moderate Benefit</td>
<td>★★★ Moderate Harm</td>
</tr>
<tr>
<td>★★★★ Major Benefit</td>
<td>★★★★ Major Harm</td>
</tr>
<tr>
<td>★★★★★ Extreme Benefit</td>
<td>★★★★★ Extreme Harm</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Transport travel time benefits</td>
<td>★★</td>
<td>Minor benefit</td>
</tr>
<tr>
<td>Changes in vehicle operating costs</td>
<td>★★★</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>Incremental fare revenue</td>
<td>★★</td>
<td>Low benefit</td>
</tr>
<tr>
<td>Changes in accident costs</td>
<td>★★★</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>Road decongestion</td>
<td>★★★★</td>
<td>Major benefit driven by loss of car trips</td>
</tr>
<tr>
<td>Construction</td>
<td>★★★★★</td>
<td>Significantly high, $300 – $360 million</td>
</tr>
<tr>
<td>Operating &amp; maintenance</td>
<td>★</td>
<td>Limited difference</td>
</tr>
</tbody>
</table>

#### Social

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Design &amp; Landscape</td>
<td>★★★</td>
<td>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.</td>
</tr>
</tbody>
</table>
3. Concept Design

<table>
<thead>
<tr>
<th>Social</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Transport Options</td>
<td>Bicycles &amp; Pedestrians—provides safe and accessible access for cyclists and pedestrians</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Fit with planning and policy strategies including the Griffin Legacy, and support of future land use</td>
<td>Local and City wide Planning and Policy Strategies</td>
<td>★★</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on Noise/Vibration</td>
<td>Noise and Vibration</td>
<td>★★</td>
<td>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 into 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.</td>
</tr>
<tr>
<td>Impacts on air quality</td>
<td>Air quality and climate change pollutants</td>
<td>★★</td>
<td>Providing a traditional fleet is used (i.e. petrol/diesel), buses will generate the highest individual emissions.</td>
</tr>
<tr>
<td>Impacts on water and soil</td>
<td>Surface and groundwater quality and quantity, Contamination &amp; Biological/chemical/physical functions</td>
<td>★</td>
<td>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.</td>
</tr>
<tr>
<td>Impacts on Natural Resources</td>
<td>Ecosystem function, habitat, flora and fauna, endangered species</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Efficient use of Resources</td>
<td>★★★</td>
<td>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.</td>
</tr>
</tbody>
</table>
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

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

#### Social

<table>
<thead>
<tr>
<th>Social</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Design &amp; Landscape</td>
<td>Qualitative, Social, Structural and Functional considerations, landscape character e.g. symmetry of corridor, activating building frontages</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Sustainable Transport Options</td>
<td>Bicycles &amp; Pedestrians - provides safe and accessible access for cyclists and pedestrians</td>
<td>★★★</td>
<td>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.</td>
</tr>
</tbody>
</table>
## 3. Concept Design

<table>
<thead>
<tr>
<th><strong>Social</strong></th>
<th><strong>Evaluation Criteria</strong></th>
<th><strong>Score</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit with planning and policy strategies including the Griffin Legacy, and support of future land use</td>
<td>Local and City wide Planning and Policy Strategies</td>
<td>★★★</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Environmental</strong></th>
<th><strong>Evaluation Criteria</strong></th>
<th><strong>Score</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on Noise/Vibration</td>
<td>Noise and Vibration</td>
<td>★</td>
<td>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.</td>
</tr>
<tr>
<td>Impacts on air quality</td>
<td>Air quality and climate change pollutants</td>
<td>★</td>
<td>Emissions with trams are likely to be minimal, notwithstanding the remote point source emissions required to generate the electricity to power the trams.</td>
</tr>
<tr>
<td>Impacts on water and soil</td>
<td>Surface and groundwater quality and quantity, Contamination and Biological/chemical/physical functions</td>
<td>★</td>
<td>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.</td>
</tr>
<tr>
<td>Impacts on Natural Resources</td>
<td>Ecosystem function, habitat, flora and fauna, endangered species</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Efficient use of Resources</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Heritage and Culture</td>
<td>Indigenous &amp; European</td>
<td>★★</td>
<td>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.</td>
</tr>
<tr>
<td>Operating &amp; maintenance</td>
<td>Driver and vehicle maintenance costs and road maintenance costs associated with new transitway</td>
<td>★</td>
<td>Limited difference</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Economic</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT travel time benefits</td>
<td>Reduction in travel time for transit passengers</td>
<td>**</td>
<td>Minor benefit</td>
</tr>
<tr>
<td>Changes in vehicle operating costs</td>
<td>Vehicle operating cost savings and bus fleet capital savings</td>
<td>***</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>Incremental fare revenue</td>
<td>Based on change in PT trips</td>
<td>**</td>
<td>Low benefit</td>
</tr>
<tr>
<td>Changes in accident costs and</td>
<td>Based on accident cost rates per passenger km</td>
<td>***</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>environmental externalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road decongestion</td>
<td>Reduction in car trips</td>
<td>****</td>
<td>Major benefit driven by loss of car trips</td>
</tr>
<tr>
<td>Construction</td>
<td>Upfront capital expenditure</td>
<td>*****</td>
<td>Extremely high, TBA ($700+ million)</td>
</tr>
<tr>
<td>Operating &amp; maintenance</td>
<td>Driver and vehicle maintenance costs and road maintenance costs associated with new transitway</td>
<td>*</td>
<td>Limited difference</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Design &amp; Landscape</td>
<td>Qualitative, Social, Structural and Functional considerations, landscape character e.g. symmetry of corridor, activating building frontages</td>
<td>**</td>
<td>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.</td>
</tr>
<tr>
<td>Sustainable Transport Options</td>
<td>Bicycles &amp; Pedestrians—provides safe and accessible access for cyclists and pedestrians</td>
<td>***</td>
<td>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.</td>
</tr>
<tr>
<td>Fit with planning and policy strategies including the Griffin Legacy, and support of future land use</td>
<td>Local and City wide Planning and Policy Strategies</td>
<td>**</td>
<td>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.</td>
</tr>
<tr>
<td>Changes in accident costs and</td>
<td>Based on accident cost rates per passenger km</td>
<td>***</td>
<td>Moderate benefit</td>
</tr>
<tr>
<td>environmental externalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road decongestion</td>
<td>Reduction in car trips</td>
<td>****</td>
<td>Major benefit driven by loss of car trips</td>
</tr>
<tr>
<td>Operating &amp; maintenance</td>
<td>Driver and vehicle maintenance costs and road maintenance costs associated with new transitway</td>
<td>*</td>
<td>Limited difference</td>
</tr>
</tbody>
</table>
3. Concept Design

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Evaluation Criteria</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on Noise/Vibration</td>
<td>Noise and Vibration</td>
<td>★</td>
<td>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.</td>
</tr>
<tr>
<td>Impacts on air quality</td>
<td>Air quality and climate change pollutants</td>
<td>★</td>
<td>Emissions with trams are likely to be minimal, notwithstanding the remote point source emissions required to generate the electricity to power the trams.</td>
</tr>
<tr>
<td>Impacts on water and soil</td>
<td>Surface and groundwater quality and quantity, Contamination &amp; Biological/chemical/physical functions</td>
<td>★</td>
<td>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.</td>
</tr>
<tr>
<td>Impacts on Natural Resources</td>
<td>Ecosystem function, habitat, flora and fauna, endangered species</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Efficient use of Resources</td>
<td>★★★</td>
<td>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.</td>
</tr>
<tr>
<td>Heritage and Culture</td>
<td>Indigenous &amp; European</td>
<td>★★</td>
<td>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.</td>
</tr>
</tbody>
</table>

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
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.

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.

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

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.
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.
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 would overcome this conflict.

Figure 36 LRT along Hibberson Street

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

The concept design identifies retaining transit services (both BRT or LRT) on Nothbourne Avenue valuing the time benefits of not diverting into Challis St higher than the closer proximity of rapid services connecting with local services. Further work on quantifying the benefits and cost of operating options is required to be undertaken in the next phase of design. The site identified as most suitable in this study is Block 2 section 33, the current Motor Registry site. Conceptual short and long term layouts are identified.

Short Term Solution

![Figure 39 Station site layout and design principles](image)

Design option layouts have been developed that retain the existing building and its vehicle inspection function allowing short term development of a station. The potential for full redevelopment of the site in the short or longer term has the benefit of considering the opportunities of a comprehensive integrated development. An integrated design would allow high quality passenger and facilities to be incorporated into a mixed use development. The full redevelopment opportunity can also address safe and secure access for travellers to rapid services if rapid stops are located on the western (northbound) side of the Avenue. Options could include a convenience retail arcade under the Avenue, a bridge connection with stairs and elevators providing access or a signalised at grade crossing. The location presents a significant urban design possibility of Dickson commercial activity meeting the activity of the Avenue.
**Long Term Opportunities for Dickson**

The site layout option below is for BRT operation. It relocates the BRT stops to the RTA site for a closer connection to the local bus interchange. For the BRT to access these stops, signalised entry and exit would be required for the BRT vehicles from Northbourne Avenue.

![Diagram of BRT Station at Dickson](image)

*Figure 40 BRT Station at Dickson*

Similar to the site layout option above the option below is the same arrangement but for LRT. Due to the fact that LRT vehicles require a larger turning radius, the space required to enter and exit the RTA site would be larger, as shown in the diagram below.
3. Concept Design

Whilst these long term options overcome the issue of a long passenger connection between BRT or LRT and the local bus interchange, they result in additional signals on Northbourne Avenue and a diversion from the road that conflicts with the symmetry of Northbourne Avenue. The decision about whether or not to bring the rapid stops closer to the bus interchange at the Motor Registry site should take into account whether the benefits of bringing the passenger connection closer together is outweighed by the affects of additional signals on Northbourne Avenue and detracting from its boulevard character.

City

Short Term Design

Proposals for City Station will be considered in a separate study; however this proposal assumes that the existing City Bus Station will remain in its current location. In the case of BRT replacing the Red Rapid, it would simply enter and exit the City Station area as the Red Rapid bus currently does. As for the LRT option, the LRT vehicles would continue down Northbourne Avenue and terminate at Alinga Street in the central median. The plan below shows this arrangement and the pedestrian connection to the City Station. Whilst this may be considered a long connection for passengers to make by foot between LRT and local bus services, this leaves the southern connection of the LRT service open to integrate with any of the alternative future southern connections to Constitution Avenue discussed previously.

For the LRT vehicles to transition from kerbside to the central median to access a terminus south of Bunda Street, a separate LRT phase would be required for the transition at Cooyong Street. The success of the connection for passengers between the LRT terminus and the City Bus Station would depend on whether the pedestrian phase at the Bunda Street intersection would work in favour of the passengers arriving at the terminus and crossing Northbourne Avenue to interchange between services. This is a design solution that can be accommodated in the detailed design stage for the traffic signals at this intersection.
3.9 Vehicle options

The LRT Vehicles

Light rail vehicles suitable for operation would be modern, high speed, low-floor articulated vehicles. Low floor articulated trams allow wheelchair accessibility, fast loading and unloading of passengers and an ease of movement from any part of the tram to any other, spreading passenger loading evenly. Transverse seating is suggested which provides comfortable seated journeys over the medium distances with ample standing space for standing on shorter journeys in aisles and two vestibule areas. As an example, the Bombardier Flexity 2 is capable of carrying 220 passengers and has a top speed of 70km/h. The Gold Coast Rapid Transit system has selected a slightly larger, 7-module variant of this tram. The Flexity 2 vehicle is pictured below.
3. Concept Design

**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 depot 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.
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. 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.


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 being 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

<table>
<thead>
<tr>
<th>Medium Growth Land Use Scenario</th>
<th>BRT with Medium Growth Land Use</th>
<th>LRT with Medium Growth Land Use</th>
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<tbody>
<tr>
<td>Low Growth Land Use Scenario</td>
<td>BRT with Low Growth Land Use</td>
<td>LRT with Low Growth Land Use</td>
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<tr>
<td>Base Case Land Use Scenario</td>
<td>Base Case</td>
<td>BRT with Base Case Land Use</td>
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<td></td>
<td>LRT with Base Case Land Use</td>
</tr>
<tr>
<td>'No Build' Scenario</td>
<td>BRT</td>
<td>LRT</td>
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</table>

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 in the final technical report.

Preliminary results indicate that both LRT and BRT are feasible under the low growth land use scenario.
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 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.
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.
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
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 footpath or cycleway, and integrates all these activities with the businesses along 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.
6. Conclusion

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.
Limitations

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.
The ACT Government is currently 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, 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.

The corridor

Northbourne Avenue is an important approach route and future transport planning for Canberra over the next 30 years. 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.

Northbourne Avenue

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.

The options considered for the study are:

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

If we had LR or BRT now, the 16 minute travel time would be reduced to less than 8 minutes (BRT) and travel delay in the morning peak hour for general traffic.

For more information about the study and is available from www.mitremsact.act.gov.au.

There are many ways to encourage people to use public transport, which has multiple benefits for the environment and ability to reduce congestion on our roads.

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For more information about the study and is available from www.mitremsact.act.gov.au.
The LRT or BRT terminus would be located on Hibberson Street between Hinder and Gungahlin Park Drs. The study recommends transit only in this part of Hibberson Street to increase transit reliability and pedestrian focus.

**Northbourne Avenue kerbside alignment**—BRT

Kerbside alignment along Northbourne Avenue is recommended by the consultants between Bunda Street and Barton Highway. A narrower median and wider verge allowing for wider cycleways and footpath is a feature of this option.

**Northbourne Avenue kerbside alignment**—LRT

Alternative LRT or BRT median alignment on Northbourne Avenue

BRT and LRT are also being considered for the central median along Northbourne Avenue. This option retains the widened verges and cycleways and footpath proposed for kerbside operation.

**STUDY CORRIDOR**

The boulevard character of Northbourne Avenue would be maintained by retaining the symmetry of the corridor and significant plantings and landscaping in the median and verges.

**Gungahlin Town Centre**

Hibberson Street alignment—BRT

Both LRT and BRT would enter Gungahlin Town Centre on Hibberson Street with a median alignment.

**Hibberson Street alignment**—LRT

Both LRT and BRT would enter Gungahlin Town Centre on Hibberson Street within a median alignment.

**Flemington Road alignment**—BRT

BRT or LRT would operate in the central median along the length of Flemington Road between Hibberson Street and Northbourne Avenue and along Northbourne Avenue between Flemington Road and Barton Highway.

**Flemington Road alignment**—LRT

- LRT median at Macarthur Ave intersection
- LRT median at Macarthur Ave intersection
- LRT kerbside at Antill St intersection
- LRT kerbside at Antill St intersection
- LRT City Terminus

- LRT would transition from kerbside to median at city limits.

**Median to kerbside transition at Barton Highway**

Flemington Road would transition from kerbside to median at Barton Highway.

- Kerbside to median transition at Antill St intersection
- Kerbside to median transition at city limits

- BRT or LRT would operate in the central median along the length of Flemington Road between Hibberson Street and Northbourne Avenue and along Northbourne Avenue between Flemington Road and Barton Highway.

- BRT or LRT would operate kerbside on Northbourne Avenue, it would transition to the central median at Cooyong Street for a terminus at Alinga Street as shown at the right. BRT would terminate near the existing City Bus Station.

**Dickson major station**

As well as being a major destination in the corridor, Dickson is a significant location in the public transport network. A station at Dickson would allow rapid transit services to connect with other frequent and local services. Future opportunities for the station to be integrated with a comprehensive development include passenger conveniences such as passenger lounge and retail as part of a mixed use development. Rapid transit services could divert into Dickson or remain on Northbourne Avenue saving diversion time.

- Possible extension west to Belconnen

- Possible extension south to Woden

**Kerbside to median transition at city**

- LRT would transition from kerbside to median alignment.

- Medain to kerbside transition at Barton Highway

- BRT or LRT would operate in the central median along the length of Flemington Road between Hibberson Street and Northbourne Avenue and along Northbourne Avenue between Flemington Road and Barton Highway.

- BRT or LRT would operate kerbside on Northbourne Avenue, it would transition to the central median at Cooyong Street for a terminus at Alinga Street as shown at the right. BRT would terminate near the existing City Bus Station.
**WHAT IS LIGHT RAIL TRANSIT?**

Light rail transit (LRT) is a rail mode, similar to trams, which operates at road level and uses electrically powered vehicles. LRT vehicles can receive power through overhead wires, known as catenary, or can be catenary free and recharge when braking utilising a rapid charge accumulator system. LRT can operate at slow speeds in higher density urban areas with closer spaced stops or at higher speeds in segregated corridors. LRT systems operate primarily in their own lane but can also share lanes with other vehicles and share space with pedestrians. Widely spaced stops are also common as LRT has a broader walking catchment than local bus services. LRT is a popular mode choice due to its comfort, speed, reliability and high capacity.

**Advantages**
- Popular and attractive form of public transport.
- High capacity vehicles.
- Permanent transport infrastructure.
- Can operate at low and high speeds depending on urban environment and stop spacing.
- Energy efficient and can use cleaner power options (hybrid, electric).

**Disadvantages**
- Expensive in both capital and operational expenditure.
- Requires purpose built depot for stabling and maintenance, adding to cost.
- Inflexible as fleet cannot be used outside of the City to Gungahlin corridor, unlike BRT, unless extended throughout the rapid network.

**WHAT IS BUS RAPID TRANSIT?**

Bus Rapid Transit (BRT) is a high quality bus system which operates in its own segregated space. This allows for higher speeds, frequency and reliability than normal bus services. BRT systems are more flexible than LRT by being able to transition into general traffic and can use existing fleet.

BRT vehicles can be purpose designed to achieve similar passenger comfort and quality as LRT, carrying up to 200 passengers.

BRT includes high quality stops and stations, providing a light-rail-like experience for significantly lower cost.

**Advantages**
- Cost-effective alternative to light rail.
- More flexible than LRT with integration to existing bus fleet and network.
- Operates at low and high speeds depending on urban environment and stop spacing.
- Can have similar passenger comfort and quality as LRT for less cost.
- Flexibility to convert to light rail corridor in future.
- No overhead catenary lines as in the case of light rail.

**Disadvantages**
- Perception that a bus based system has lower amenity than LRT.
- Passenger capacity per BRT vehicle is half of LRT vehicles.

**Network integration**

Introduction of rapid transit into Canberra’s public transport network requires high levels of integration due to Canberra’s multi-centre structure. Many trips that start in one corridor have destinations in another. Less transfer is required where buses operate through more than one corridor. Where LRT is implemented in one corridor, transfer to allow connections to other corridors is required.

**Have your say**

Now that you know more about the costs and benefits, tell us whether you would prefer LRT or BRT for the corridor at www.timetotalk.act.gov.au.
ALIGNMENT

Alignment refers to the location of the transit lane for either light rail or bus transit in relation to the corridor. The study investigates kerbside and median alignments.

Flemington Road

Flemington Road will have a median alignment as it was originally designed to accommodate median transit with space for cycle and pedestrian lanes and parallel streets for local access and parking. Refer to the corridor map for Flemington Road median alignment plan.

Northbourne Avenue

There are two options for Northbourne Avenue, median or kerbside, both with advantages and disadvantages. Further information about the alignment options and evaluation can be obtained from the concept report at www.timetotalk.act.gov.au.

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.

BRT/LRT kerbside Northbourne Avenue plan

BRT/LRT kerbside Northbourne Avenue section

### Advantages
- Concentrates activity at the kerb and provides better access and safety for kerbside stops
- Wider landscaped verges provide greater level of amenity
- Supports nationally significant approach route and main avenue boulevard role of Northbourne Avenue as the primary national gateway

### Disadvantages
- Need to cross full width of Northbourne Avenue to access transit stops on other side of road
- Requires transition from median alignment on Flemington Road and to median LRT terminus in City
- Greater frictions exists between the transit and other vehicles

Cycling and pedestrian benefits

There are also benefits from this project for cyclists and pedestrians. Changes in the corridor layout will provide segregated 3 metre wide cycle lanes on both sides of the road and more space for landscaping and wider footpaths for pedestrians.

BRT/LRT median Northbourne Avenue plan

BRT/LRT median Northbourne Avenue section

### Advantages
- Do not need to cross full width of Northbourne Avenue to access transit stops in opposite direction
- Wider verges for landscaping and improved amenity than currently exists
- Greater frictions exists between the transit and other vehicles
- Maintains consistent median alignment for length of corridor

### Disadvantages
- Always need to cross to the median to access transit stops
- Verge is not as wide as kerbside alignment
- Concentrates transit stop activity in median

Trees

This project will require the removal of median trees however trees will be replanted in the reduced median with suitable species. The increase in verge allows for additional trees to be planted on either side of the road.

Have your say

Now that you know more about the alignments, tell us whether you prefer kerbside or median for Northbourne Avenue at www.timetotalk.act.gov.au.
What would rapid transit mean for the corridor?

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. In Australia, stage one of the Gold Coast Light Rail Transit is currently being implemented and is expected to stimulate the Gold Coast economy and reduce traffic congestion.

The Brisbane Busways are another example of where the provision of new public transport infrastructure renews the area and is expected to boost commercial, retail and residential activity at each of the nodes along the network.

Examples of urban regeneration, new development and increased ridership can be found all over the world associated with BRT and LRT implementation. However cities often choose BRT or LRT for other reasons like capacity, cost, flexibility, suitability and the public’s preferred mode of travel.

LAND USE

A two way relationship exists between sustainable transport improvement and higher land use activity. The level of development located close to public transport routes supports and enhances the use of public transport.

IMPLEMENTATION

If the project proceeds, there is a significant amount of work that needs to be undertaken prior to construction and operation of the system. Above is an indicative timetable for works. This is a similar timeframe to comparable projects like Gold Coast Light Rail and Brisbane Busways.

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 sustainable transport modes.

This project includes consideration of 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 the transport modelling for the project. Detailed land use planning would be required to implement any variation to current planning policy. Refer to the concept report for further detail.

Project team

The project is being managed by the Environment and Sustainable Development Directorate and is being undertaken by URS Australia Pty Ltd (transport planning, infrastructure and rail), Deloitte (economics) and Denton Corker Marshall (urban design and landscape architecture).

Further information about the study, including a concept report which provides further technical detail, is available from www.timetotalk.act.gov.au. Feedback on the project and its options can be submitted online or via email to transportplanning@act.gov.au. The feedback period will close on 25 May 2012.

Community information events will be held at shopping centres in Gungahlin, Dickson and City during the consultation period. Please check www.timetotalk.act.gov.au for details of events. The feedback you submit will assist the ACT Government in selecting a preferred option.

WHERE TO FROM HERE

Study process

- SEPTEMBER 2011 Project commenced
- DECEMBER 2011 Project update #1
- APRIL TO MAY 2012 Feedback on concepts from community
- JUNE 2012 Selection of preferred option by ACT Government
- 2012 Business case to Infrastructure Australia for co-funding of design and/or construction

HAVE YOUR SAY