

Barneson Boulevard and Tiger Brennan Drive Stage 3

Report to City of Darwin

October 2017

1. Introduction	3
2. Concept Development	7
2.1. Why Barneson Boulevard?	7
2.2. Other options explored	9
2.2.1. Why not stop at McMinn Street?	9
2.2.2. Why not extend Knuckey Street instead?	10
2.2.3. Other options.....	11
3. Design Development	12
3.1. Design Project Objectives.....	12
3.2. Geometric challenges.....	12
3.3. Intersection treatments.....	12
3.4. Community consultation or road concept design	12
3.5. Clearances & Approvals	13
4. Current Project Status.....	15
4.1. Green Infrastructure Community Consultation.....	15
4.2. Timelines	15
5. Specific Responses to Council Decision No. 22/0038	15
6. Appendices.....	19
Appendix A – City of Darwin Council's Decision No.22/0038	19
Appendix B - Jacobs Report – Barneson Boulevard Traffic Modelling and Public Summary	19
Appendix C - Frequently Asked Questions	19
Appendix D – Final Concept Design	19
Appendix E – Green Infrastructure and Public Art Examples	19
Appendix F – Darwin Regional Transport Plan.....	19

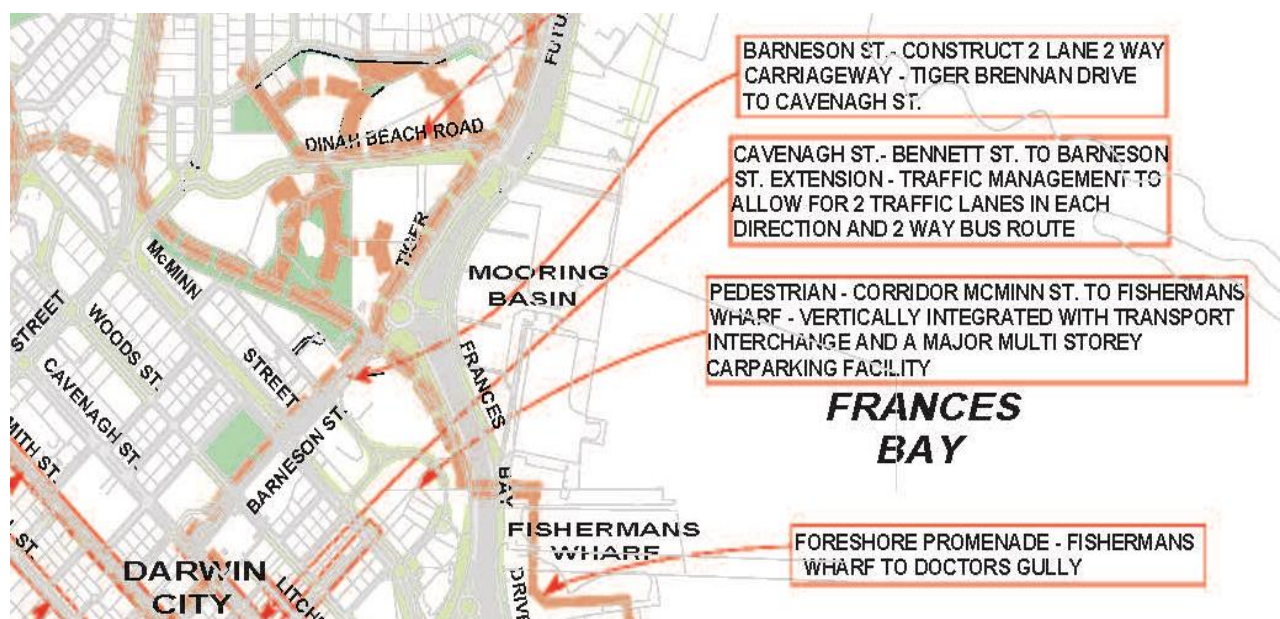
1. Introduction

The purpose of this report is to provide City of Darwin clarity and sufficient information to be able to confidently support the Barneson Boulevard project as an iconic, green infrastructure project that will breathe life into this part of the CBD. A significant body of work has been undertaken and is summarised in this report. The report also provides a response to specific questions from City of Darwin council members as per Council's Decision No.22/0038 highlight in **Appendix A**. This report should not be used for anything other than the intended purpose.

Barneson Boulevard and Tiger Brennan Drive Duplication Stage 3 is a tri-party agreement between all levels of government. The Australian Government is contributing \$29.53 million and both the Northern Territory Government and City of Darwin are contributing \$5 million each.

Barneson Boulevard has been in planning since 1996 and was part of the Central Darwin Planning Concepts and Development Opportunities. Figure 1 below provides the excerpt from the planning document.

Figure 1 – Excerpt from Central Darwin Planning Concepts and Development Opportunities.



As a result of this work the land was set aside for the Barneson Boulevard corridor. Note it was known as "Barneson Street" at this point in time. The land is currently zoned as PM – Proposed Main Road. All of the land is managed by the Northern Territory Government. Figure 2 provides a map of the current land zoning.

More recently, Barneson Boulevard was proposed to be an urban boulevard as a major part of the Darwin CBD Master Plan. An excerpt is provided below. Figure 3 also provide the Darwin CBD Master Plan land use map and proposed cross section.

"The Darwin City Centre suffers from a lack of links and connections midway between Daly and Bennett Streets. This has the effect of causing congestion along these two streets, especially at intersections

For many years a connection into the city centre along the Barneson Street alignment has been planned. Proposals included a tunnel linking from Tiger Brennan Drive to Cavenagh Street. Initial economic and financial evaluation shows that not only is a tunnel a very expensive option (four to six times the cost of a

street), but it does little to open up the development potential of land to the north-east of McMinn Street. The former oil tank farms clearly have great development potential which will go unrealised without better access to these sites.

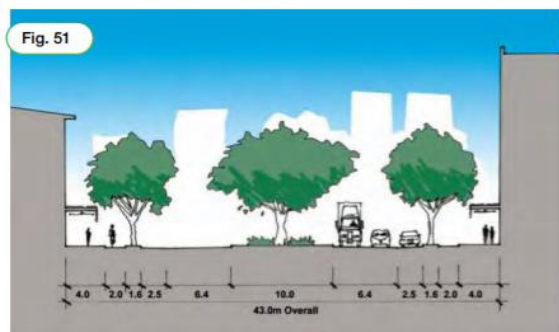
For this reason a new urban boulevard is proposed, one which not only creates a four-lane link for vehicles, but which supports pedestrians and encourages walking. It is proposed to have dedicated cycle paths and on-street parking to support potential economic activity such as shops and showrooms.

A new boulevard link at Barneson could allow for dispersal of traffic while providing access to development. Significant tree planting could be used to express the tropical Darwin landscape. The aim should be to create a great urban street, not just a transport route. A cross section of the proposed urban is shown. ”

Figure 2 – CBD fringe land zoning.



Figure 3 – Barneson Boulevard as identified in the Darwin CBD Master Plan.



The corridor of land reserved for the Barneson Boulevard alignment passes between Frog Hollow Park and the Frog Hollow Centre for the Arts, also known as the old Darwin Primary School. Frog Hollow Park is heritage listed and protected under the *Heritage Act*. The Old Darwin Primary School is not heritage listed. The Frog Hollow Park and Old Darwin Primary School will not be affected by the construction of the road. This green infrastructure project will activate the area and enhance the public space adjacent to Frog Hollow Park. The following figures provide a detailed overview of the Frog Hollow area.

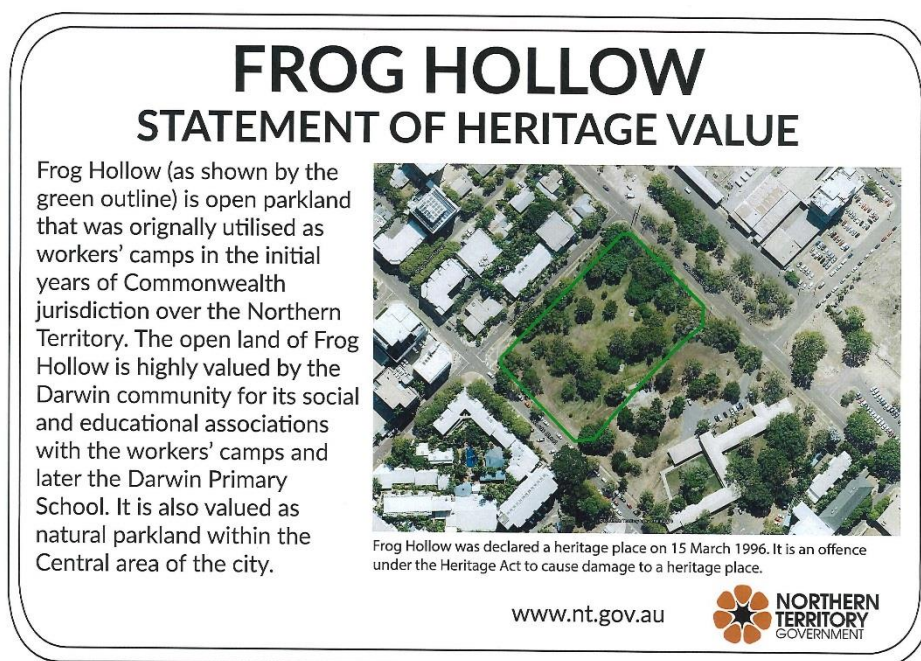
Figure 4 provide an aerial photo of the lot boundaries. Lot 5665 is the heritage listed Frog Hollow Park, managed by City of Darwin. Lot 5672 is owned by the Northern Territory Government and has a mixed zoning for PM proposed main road and CB central business.

For clarity, and in consultation with Heritage Branch, signs have been erected about the boundaries of the Frog Hollow Park. Figure 5 provides the sign layout.

Figure 4 – Lot boundaries in Frog Hollow.



Figure 5 – Signs erected at Frog Hollow Park



Figures 6 and 7 provide photos of the current status of where the Barneson Boulevard is going to be located. There are a number of trees, the Arts Centre car park and a toilet block that will be affected. The toilet block and car park will be relocated as part of the project. The location is being decided in consultation with the Frog Hollow Centre for the Arts tenants. The Department of Infrastructure, Planning and Logistics is seeking advice from an arborist as to the health of the trees and whether it is feasible to relocate any of the trees into the park. This advice is expected in the coming weeks.

Figure 6 and 7 – Photos of where Barneson Boulevard is located between the Park and the Arts Centre.



2. Concept Development

2.1. Why Barneson Boulevard?

The Department of Infrastructure, Planning and Logistics regularly undertakes network wide modelling as far as Cox Peninsula Road. The basis of this model is as follows:

- The model is based on current land uses and population data.
- Future traffic predictions are made based on population growth projections and any known developments.
- Land uses determine the “attraction” of a location in traffic modelling. For example, a light commercial land use will attract higher volumes of traffic when compared with something that is zoned rural residential.
- A “Do nothing” scenario is always used to test and calibrate the model outputs against measured, real traffic numbers.
- How quickly land uses develop and population increases governs how quickly traffic grows – i.e. building new roads does not increase traffic.

A major update of this model was undertaken in 2014 and revised in 2017. The last version of this model indicated issues with entry/exit points to the CBD. As such, it was investigated whether it was now time to construct Barneson Boulevard.

The traffic model specific to Barneson Boulevard was based on the network strategic model. **Appendix B** - Jacobs Report – Barneson Boulevard Traffic Modelling and Public Summary provides the full report and a summary of the results is provided in the following tables.

It should be understood that Level of Service is measure of network performance used across Australia. The definition of the Level of Service can be found the Austroads Road Design guidelines in Table 4.1, which is provided below for reference.

Table 4.1 Level of service road performance criteria

Level of Service	V/C Range	Comments
A/B	≤ 0.44	Stable, free flow conditions where drivers are able to select desired speeds and to easily manoeuvre within the traffic stream.
C	0.45 – 0.64	Stable flow, but where most drivers are restricted to some extent in their ability to select their desired speed and to manoeuvre within the traffic stream.
D	0.65 – 0.84	Close to the limit of stable flow. All drivers are restricted in their ability to select their desired speed and to manoeuvre within the traffic stream. Small increases in traffic flow may cause operational problems.
E	0.85 – 1.04	Traffic volumes are close to capacity, and there is virtually no freedom to select desired speeds. Flow is unstable and minor disturbances within the traffic stream will cause breakdown, leading to long queuing and delays.
F	≥ 1.25	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass. Flow breakdown occurs, and extensive queuing and delays result.

Source: AustRoads 2009

Table 1 – Level of Service - Traffic Scenario – 2017 Base Case (Without Barneson Boulevard)

	Tiger Brennan Drive – McMinn Street to Dinah Beach	Stuart Highway – McMinn Street to Duke Street	Bennett Street – McMinn Street to Cavenagh Street	Daly Street – McMinn Street to Cavenagh Street	McMinn Street – Stuart Highway to Tiger Brennan Drive	Knuckey Street – McMinn Street to Cavenagh Street
	AM Peak					
Inbound	A	C	D	D	D	C
Outbound	A	A	A	A	A	C
	PM Peak					
Inbound	A	A	C	C	C	A
Outbound	A	C	D	D	D	A

Table 2 – Level of Service – Traffic Scenario – 2027 with Barneson Boulevard

	Tiger Brennan Drive – McMinn Street to Dinah Beach	Stuart Highway – McMinn Street to Duke Street	Bennett Street – McMinn Street to Cavenagh Street	Daly Street – McMinn Street to Cavenagh Street	McMinn Street – Stuart Highway to Tiger Brennan Drive	Knuckey Street – McMinn Street to Cavenagh Street
	AM Peak					
Inbound	A	A	C	D	C	A
Outbound	A	A	A	A	A	A
	PM Peak					
Inbound	A	A	A	C	A	A
Outbound	A	A	A	D	C	A

The model shows that Bennett, Daly and McMinn Street are currently at level of service D. What this means is that if an incident occurs on the network, the CBD becomes gridlocked. This is also an issue for emergency management.

Barneson Boulevard relieves this and provides a much higher level of service across a number of roads until 2027. In 2027, Barneson Boulevard level of service is predicted to reduce to level of service D. However, due to the high level of service on a number of other roads, traffic will redistribute and service the CBD beyond the predicted 10 years.

The main reason Barneson Boulevard achieves this so efficiently is due to the geographic location. It is the midway point between Daly and Bennett Street and connects to Cavenagh Street, which in itself is a central connection road. (Refer Figure 8)

Figure 8 – Barneson Boulevard connects to the geographical centre of the city.



2.2. Other options explored

2.2.1. Why not stop at McMinn Street?

If Barneson Boulevard stops at McMinn Street, the traffic attracted to use Barneson Boulevard will have to feed up local streets such as Lindsay, Shepherd and McLachlan Streets. To cater for traffic into the future if Barneson Boulevard is not constructed, these local streets will mean loss of parking (they currently function as one way with parking on one side), loss of amenity for residents and possible land acquisition.

Figure 9 provides an aerial map of the local streets that would be affected and Figure 10, 11 and 12 provide photos of what would be affected.

Additionally, McMinn Street duplication would also need to be duplicated sooner to ensure a bottleneck did not develop at the Barneson Boulevard /McMinn Street intersection.

Figure 9 – Local streets affected by stopping Barneson Boulevard at McMinn Street

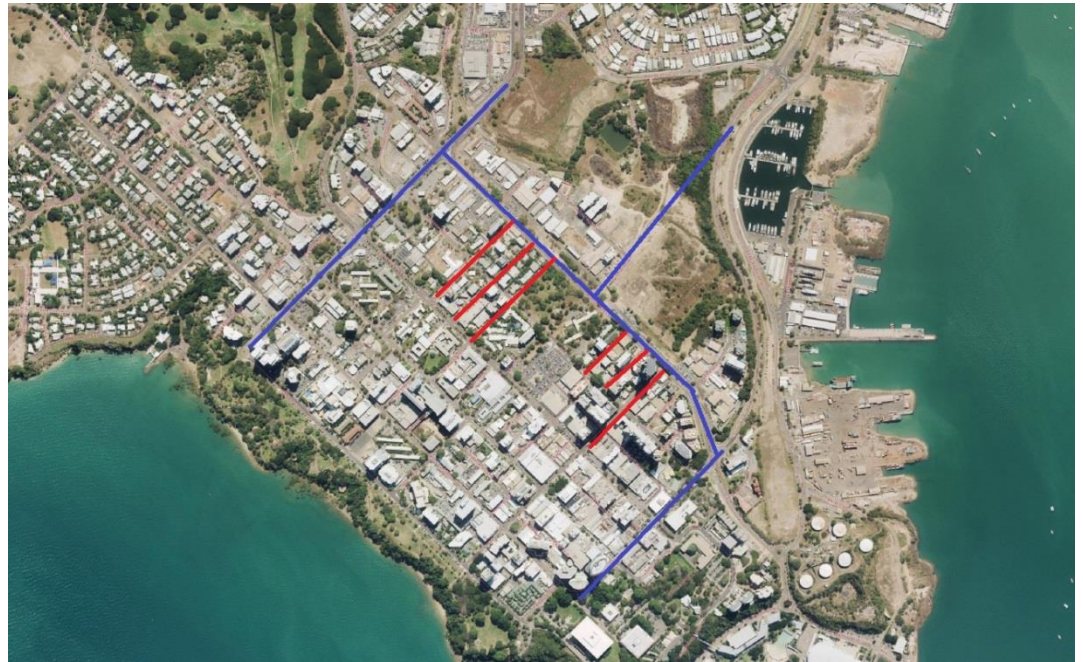
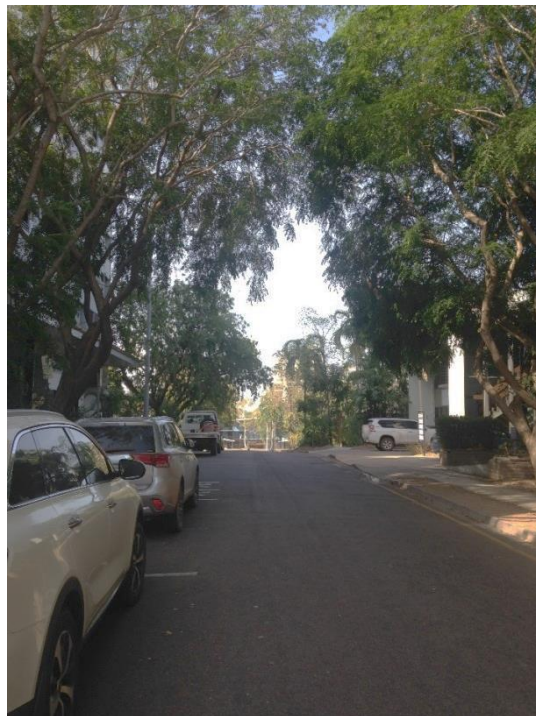


Figure 10, 11 & 12 – Shepherd, Lindsay and McLachlan Streets

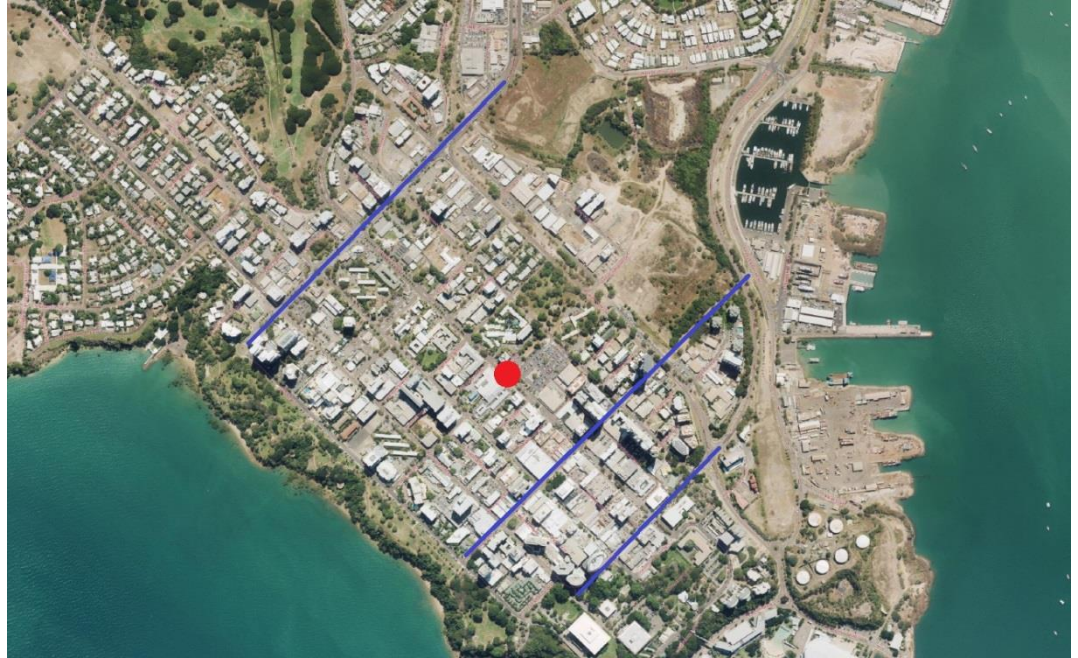


2.2.2. Why not extend Knuckey Street instead?

At this point in time, the business end of the Darwin CBD is generally bounded by Bennett and Knuckey Streets. As such, Knuckey Street extension was investigated as part of the Barneson Boulevard traffic modelling. To comply with Austroads guidelines, Knuckey Street can connect to Tiger Brennan Drive as a left-in-left-out only due to the proximity of other traffic signals. The traffic modelling confirmed the traffic is not likely to be attracted to Knuckey Street as it did not take traffic

as quickly to their destination as Barneson Boulevard does. (Refer Figure 13). Extension of Knuckey Street would also traverse across private land, limiting opportunities for a significant development on this site.

Figure 13 – Knuckey Street extension.



2.2.3. Other options

Three other options were considered instead of the Barneson Boulevard project as follows:

- Stuart Highway bypass through Stuart Park (on the old rail alignment). This investigation was undertaken prior to considering Barneson Boulevard. However, it was found that Barneson Boulevard negates the needs for this for project into the longer term (20+ years). The Stuart Highway bypass does not provide the same traffic benefits as Barneson Boulevard..
- Review of public transport – no significant benefits realised due to traditionally low use of public transport. However, increased use of public transport will continue to be pursued.
- Review of traffic signal improvements - no significant benefits realised as most of the optimisation has already been implemented.

3. Design Development

3.1. Design Project Objectives

Once the need for Barneson Boulevard had been established, design development was approved with the objectives of the project as follows:

- Provide an iconic entry into the CBD and alleviate traffic issues
- Open up the eastern fringe of the city
- Complete the duplication of Tiger Brennan Drive
- Provide a better connection for pedestrians and cyclists
- Contribute to the revitalisation of the CBD

The final concept design is provided in **Appendix C**.

3.2. Geometric challenges

There are some geographical challenges for the design of Barneson Boulevard. In particular, Wood Street height differences with a substation on one corner presented challenges. Three options were put to the community including:

- A culdesac
- Left in/Left out
- Left out only.

A culdesac was the only option that maintained access to the Mirrambeena Resort and did not affect the heritage space in Frog Hollow Park. There was strong community feedback about maintaining the heritage space in Frog Hollow Park and the culdesac option being the preferred option.

3.3. Intersection treatments

Intersection treatments were investigated and traffic signals chosen for the following reasons:

- Roundabouts are designed for fast and efficient traffic flow. They only achieve this if the volumes of traffic on all legs of the roundabout are equal. Otherwise, smaller side streets will find it difficult to find safe gaps in traffic, increasing the risk of crashes.
- Traffic signals provide an opportunity for all legs of the intersection to safely access the direction of travel.
- Traffic signals are also much safer for pedestrians and cyclists.

3.4. Community consultation or road concept design

Formal community consultation on the road layout was undertaken from mid December 2016 to the end of February 2017. There were 4 stalls in the Smith Street mall, 2 community forums and numerous online touch points including our 40,000 membership on Facebook. Figure 14 below summarises the consultation work. **Appendix D** provides a copy of the Frequently Asked Questions from this process.

Figure 14 – Community consultation summary

What was done?

2- staged
community
consultation



Part 1 – November to December 2016

Part 2 – January to February 2017

1



Presentation to City of Darwin Council



Launched website



Wrote to stakeholders



Media Release and Ads



Letterbox drop



Held a community workshop

2



Met one-on-one with stakeholders



Held info booths in Smith St Mall



Updated website



Launched online survey



Ads



2nd Letterbox drop

Facebook ads and updates



Held a 2nd community workshop



152 surveys completed

11 written submissions

21 meetings

304 people attended
info booths

80 attended workshops

3,200 letterbox drop

500 webpage views

40,000 reach on Facebook

Community feedback we were able to incorporate into the design included not moving the bus stops at the front of Woolworths, leaving the Frog Hollow Heritage Park, provision for public art, a bus stop for older residents in One Mile Dam, a pedestrian crossing between the Frog Hollow Park and the Old Darwin Primary School and having a flexible construction timeline so as not to affect Darwin Festival. Some of the feedback that could not be included was a flyer over at the Tiger Brennan Drive / Barneson Boulevard intersection (can be looked at in future, but this does not achieve unlocking the whole of the eastern fringe), roundabouts, provision of on street parking due to safety issues.

3.5. Clearances & Approvals

The Department has obtained all relevant clearances and approvals for the project, including Aboriginal Area Protection Authority certificates. The certificates noted three sacred tree behind the old Darwin Primary School. (Figure 15)

Figure 15 – Sacred trees behind the buildings in Frog Hollow.



Due to the proximity of the old Shell site, the Department of Infrastructure, Planning and Logistics engaged a consultant to investigate areas of concern and to determine the extent of soil and water contamination for the area of earthworks required for the Barneson Boulevard and Tiger Brennan Drive Stage 3 project. The findings included:

- Low levels of contamination were found in soil and groundwater which present a low but acceptable risk to the project.
- There is minimal excavation on the project to meet the design heights and Management Plans will be required. Material that contains contamination may be used in non-sensitive areas (i.e. as fill under the roadway).
- Potential acid sulphate soils were identified in the mangrove area of the site which will be treated if mangrove muds are removed. Acid sulphate soils are a naturally occurring substance in coastal zones and as such encountered regularly for any works in coastal areas.
- Small quantities of asbestos are present at three locations. There is a low potential for it to be uncovered, and it will be handled in accordance with a Management Plan which will be developed for the construction phase of the project. This is a common occurrence on road reserves where illegal dumping has occurred.

Management plans will be in place for these aspects during construction.

4. Current Project Status

4.1. Green Infrastructure Community Consultation

Consultation is currently underway for the urban space and public art aspects of the project. **Appendix E** provides a copy of the information on the “Have Your Say” webpage.

4.2. Timelines

The following are the proposed delivery timelines:

- Detail Design and Documentation Complete - October 2017
- Construction Tender Advertised - November 2017
- Construction commencement - Early 2018
- Barneson Boulevard Works Complete - December-2018
- Tiger Brennan Drive Works Complete - December 2019.

5. Specific Responses to Council Decision No. 22/0038

The questions and answers are provided below (**Appendix A**).

(Niblock/Knox)

- A. THAT Council request that the Northern Territory Government prepare a report for council outlining alternative options for Barneson Boulevard that do not dissect the Frog Hollow precinct, comprising Lots 5665 and 5672.

As is outlined in this report, extensive work has been undertaken to determine that the current alignment design for Barneson Boulevard is the best solution. Other options that have been explored are outlined in Part 2.2 of this report.

- B. THAT Council request that the report also consider the following:

B.1 Transport mode design

B.1.1 Can one lane be dedicated to a rapid bus lane?

The Department of Infrastructure, Planning and Logistics is investigating alternative locations for the existing Darwin bus interchange. This has an impact on the entire bus network and Barneson Boulevard is a logical route for bus services. However, a dedicated bus route is not warranted at this point in time and would result in one lane not being used very often.

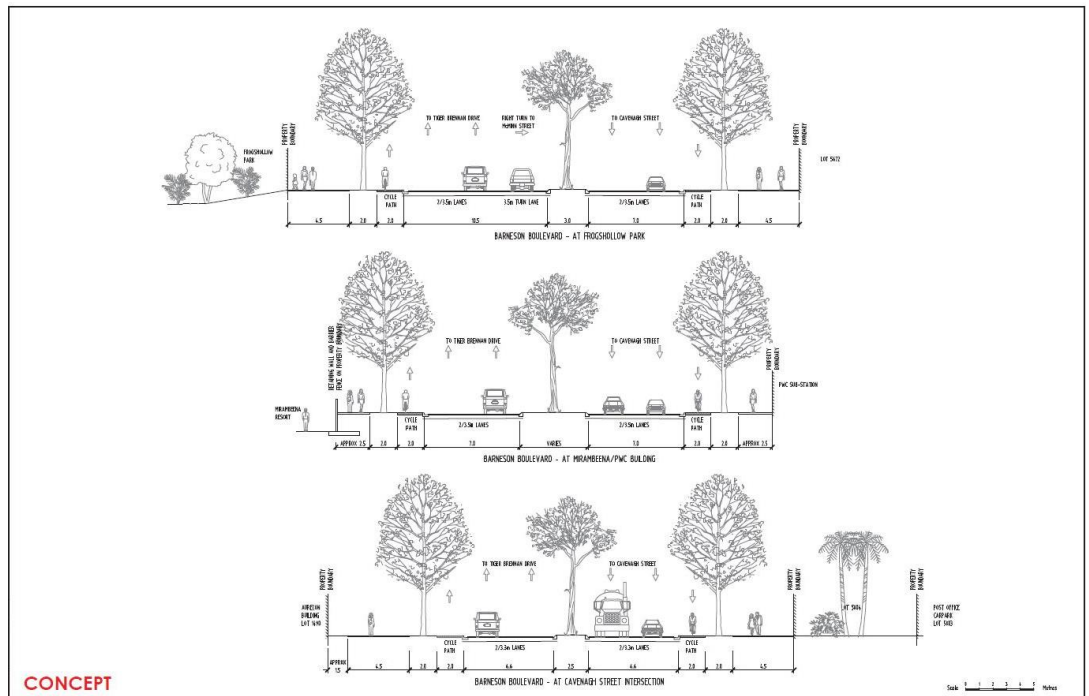
B.1.2 What is Transport’s strategic plan or goals for mode shift over the next ten years?

A copy of the Darwin Regional Transport Plan is provided in **Appendix F**. The Public Transport goal is to increase usage of public transport services by having a service that is fast, frequent, reliable, accessible and comfortable.

B.2 Landscaping

B.2.1 How wide will the median strip in the middle of the four lanes be?

The median strip, on average, is 3 metres wide. The road width is two lanes wide, which is 7 metres. There are also dedicated cycle lanes and very wide shared paths (3 to 4.5 metres wide)



B.2.2 Will there be other elements to landscaping such as ground covers?

This part of the project is currently being consulted on with the community. However, ground covers have been incorporated into the concepts and are expected to be requested as part of the final design.

B.2.3 Does the plan include an irrigation system? Can this utilise grey water?

Yes, irrigation will be included to ensure the cool green feel is maintained. The Department of Infrastructure, Planning and Logistics has investigated grey water use for other landscaped areas on the network, however it is not currently available due to no access to grey water systems. Grey water could be retrofitted should it become available.

B.3 Heat mitigation

B.3.1 Will the road surface be treated with any coatings to reduce surface temperature?

This will continue to be looked into, however solutions for our environment are yet to be proved, are very expensive and create additional glare. The best opportunity for cooling at this time will be provided through very large shade trees.

B.3.2 Will pedestrian paths use 'cool pavement' textiles that are reflective?

There are a number of ways of achieving this and pedestrian path treatments are yet to be determined. However, attractive, cooling surfaces could be accommodated within the budget.

B.4 Street lighting

B.4.1 Can any proposed streetlights utilise these technologies so that we aren't wasting money upfront?

The project has incorporated street lighting in accordance with City of Darwin requirements. The design team is currently reviewing street lighting as the effectiveness is likely to be diluted by the large shade trees. Additionally, pedestrian, verge and artistic (eg fairy lights or up lighting on trees) lighting is being explored.

B.4.2 Further to this, will pedestrian lighting be provided along the verge in landscaped areas, and street furniture?

Inclusion of this lighting is currently being investigated within the design.

B.5 Art

B.5.1 Can we provide areas of pavement that schools or local artists can contribute with mosaics – promoting ownership amongst the community?

Yes. The steps in the amphitheatre in Frog Hollow would provide a great canvas for many contributions.

There are also opportunities in a number of other locations on the project for artworks.

B.6 Iconic Entrance to the City

B.6.1 From a place making and tourist perspective, what can be done at the intersection on Cavenagh Street in front of Woolworths so the Boulevard still has that wow factor that says "welcome to Darwin"?

This provides a brilliant opportunity to present something spectacular and cement Barneson Boulevard as the entry to Darwin. The Department of Infrastructure, Planning and Logistics has already spoken with the Uniting Church who own the land and building which is opposite the Barneson Boulevard intersection and they are happy to work with the project to create a memorable space.

Ideas are being canvassed through the community consultation at present. As outlined earlier in the report examples on what can be achieved can be referenced at **Appendix E** .

6. **Appendices**

Appendix A - City of Darwin Council's Decision No.22/0038

Appendix B - Jacobs Report – Barneson Boulevard Traffic Modelling and Public Summary

Appendix C - Final Concept Design

Appendix D - Frequently Asked Questions

Appendix E - Green Infrastructure and Public Art Examples

Appendix F - Darwin Regional Transport Plan

Appendix. A

13. NOTICE(S) OF MOTION

13.4 Barneson Boulevard
Common No. 2116605

(Niblock/Knox)

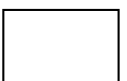
- A. THAT Council request that the Northern Territory Government prepare a report for council outlining alternative options for Barneson Boulevard that do not dissect the Frog Hollow precinct, comprising Lots 5665 and 5672.
- B. THAT Council request that the report also consider the following:
- Transport mode design
 - Can one lane be dedicated to a rapid bus lane?
 - What is Transport's strategic plan or goals for mode shift over the next 10 years?
 - Landscaping
 - How wide will the median strip in the middle of the four lanes be
 - Will there be other elements to landscaping such as ground cover?
 - Does the plan include an irrigation system? Can this utilise grey water?
 - Heat mitigation
 - Will the road surface be treated with any coatings to reduce surface temperature?
 - Will pedestrian paths use 'cool pavement' textiles that are reflective?
 - Street lighting
 - Can any proposed streetlights utilise these technologies so that we aren't wasting money upfront?
 - Further to this, will pedestrian lighting be provided along the verge in landscaped areas, and street furniture?
 - Art
 - Can we provide areas of pavement that schools or local artists can contribute with mosaics – promoting ownership amongst the community?
 - Iconic Entrance to the City
 - From a place making and tourist perspective, what can be done at the intersection on Cavenagh Street in front of Woolworths so the Boulevard still has that wow factor that says "welcome to Darwin"?

DECISION NO.22\0038

(26/09/17)

Carried

ACTION: GM CITY OPS



Appendix. B

32 Cordelia Street
PO Box 3848
South Brisbane QLD 4101 Australia
T +61 7 3026 7100
F +61 7 3026 7300
www.jacobs.com

Date 27 May 2016
Attention Chris Pick
From John Bennett
Subject **Barneson Boulevard Detailed Design – Traffic Modelling Assessment**

1. Introduction

As part of the detailed design for Barneson Boulevard and concept design for McMinn Street and Tiger Brennan Drive, Jacobs undertook a traffic modelling assessment to inform the design process and to estimate the operation of key intersections in the 2031 design horizon year. The study area for the assessment included Barneson Boulevard between Tiger Brennan Drive and Cavanagh Street; McMinn Street between Daly Street and Bennett Street; and Tiger Brennan Drive between Dinah Beach Rd and McMinn Street.

The objectives of the modelling assessment were to:

- Truth the existing concept plan for Barneson Boulevard and provide guidance on the required configurations for intersections along the link road. An existing concept for Barneson Boulevard was produced by Jacobs in 2015 and a key objective of the modelling was to re-assess this design using the latest future traffic forecasts and to identify any necessary refinements.
- Assist in the development of a concept plan for duplication of McMinn Street between Daly Street and Bennett Street; and the duplication of Tiger Brennan Drive between Dinah Beach Road and McMinn Street. Modelling for these streets was required to assess preliminary concept designs and provide advice on intersection configurations and access arrangements.

The traffic modelling was undertaken using a modified version of the Darwin CBD VISSIM microsimulation model that was developed for the Barneson Boulevard Business Case Study, which was undertaken by Jacobs on behalf of the City of Darwin in 2015. Modification to the Darwin CBD VISSIM model were undertaken to reflect the proposed road configuration for the horizon year of 2031.

The VISSIM model was used to provide outputs for the key intersections along Barneson Boulevard, McMinn Street and Tiger Brennan Drive. SIDRA analysis was also undertaken for Barneson Boulevard to provide a comprehensive assessment of the link road performance for input into the detailed design process.

The coverage of the Darwin CBD model is shown in **Figure 1**.

Figure 1: VISSIM model extents



Imagery Source: Bing Maps

2. VISSIM modelling methodology and assumptions

2.1 Network assumptions

An initial concept for Barneson Boulevard was assessed using the Darwin CBD VISSIM model as part of the Barneson Boulevard Business Case Study, which was undertaken by Jacobs on behalf of the City of Darwin in 2015. A copy of the VISSIM model developed for the business case, which represented the 2031 horizon year, was used as a starting point for the analysis undertaken for the detailed design. The network layout assumed for Barneson Boulevard is shown in Figures 2 and 3.

Figure 2 : Barneson Boulevard northern section modelling configuration



Figure 3 : Barneson Boulevard southern section modelling configuration



The initial configurations for duplication of Tiger Brennan Drive and McMinn Street were assumed based on previous planning studies undertaken for the CBD and Stuart Park including the Stuart Park Transport Study (Parson Brinkerhoff 2014) and Jacobs' Inner Suburbs Traffic Study 2015.

The configurations were agreed in consultation with Department of Transport (DoT) and included:

- Two lanes along McMinn Street in each direction between Daly Street and Tiger Brennan Drive.
- Completion of the Stuart Highway Bypass and associated re-configuration of the Stuart Highway/ McMinn Street intersection including:
 - 3 lanes in each direction on the Bypass.
 - Removal of the bus lanes and permission of the right turn from Daly St to McMinn St for all traffic which is currently a barred movement. This was included to facilitate access to the existing Stuart Hwy from the western part of the CBD as the connection between the Bypass and the existing Stuart Hwy at Geranium St needed to be removed as the connection was causing significant congestion.
 - Buses accessing the existing Stuart Hwy via Day St using a signalised intersection of McMinn Street and Day Street
 - Dedicated left and right turn pockets on Daly St
 - Extension of the right turn pocket on McMinn St west and through movements permitted from both lanes.
- Segregated bus lanes (Bus Rapid Transit) running between Day Street to the intersection of McMinn Street/ Knuckey Street, with bus movements included at the McMinn Street/ Barneson Boulevard intersection.
- Two lanes for each of the Tiger Brennan Drive carriageways

Other modifications to the model included the following:

- The extension of Knuckey St from McMinn ST to Tiger Brennan Drive with left-in and left-out provision only at the intersection with Tiger Brennan Drive
- Left-in and left-out provision for the intersection of Barneson Boulevard with:
 - Wood St South
 - Harvey St North
 - Harvey St South – future extension into the former Shell Tank Farm site
- Removal of the intersection of Barneson Boulevard and Wood St North

The assumed configurations for McMinn Street and Tiger Brennan Drive are shown in Figures 4 and 5.

Figure 4 : McMinn Street western section modelling configuration



Figure 5 : McMinn Street eastern section modelling configuration



2.2 Traffic demand development

Since the completion of the business case modelling in 2015, an updated version of the Darwin Strategic Model (DSM) was produced by the DoT. The updated DSM contained revised land use and peak hour traffic forecasts for the CBD road network in 2027. These forecasts were used to refine the VISSIM model demands to make sure that the traffic volumes in the VISSIM model are representative of the latest land use and traffic volume estimates for the study area.

Refinement of the existing VISSIM model demands for 2031 was undertaken using the following procedure:

1. Calculate the zone equivalence between the DSM and VISSIM models. There are eight strategic model zones with the VISSIM model extents. These zones were matched to the 71 zones contained within the VISSIM model.
2. Compare the DSM zone demands for 2027 to the existing 2031 VISSIM model zone demands. These comparisons showed that the VISSIM model demands were 34% higher in the AM peak and 21% higher in the PM peak.
3. Factor the internal VISSIM model zones to reduce the demands to be comparable to that of the equivalent DSM model zone demands on a zone by zone basis.
4. Assign the new VISSIM model demands in VISUM using static assignment to provide a quick comparison between the new VISSIM model volumes and the DSM volume plots for 2027 at the major entry points to the CBD. These comparisons revealed some significant differences in volumes at the major external entry points to the network.
5. Factor the trips going to/ from the major external points to be more comparable to the DSM model volume plots to finalise the revised VISSIM model demands for 2027.
6. Factor the new VISSIM model 2027 demands by 1.5% per annum (roughly 16%) to calculate the new VISSIM model demands for 2031.

Comparisons between the new VISSIM model demands for 2027 and the DSM model demands for 2027 are shown in the following tables. The comparisons show that the revised VISSIM model demands for 2027 are highly comparable to that of the DSM 2027 demands on a zone-by-zone basis and that the inbound/ outbound volumes at the major model entry points are very similar.

Table 1 : AM peak 2027 DSM and VISSIM zone demand comparisons

DSM zone	2027 DSM		2027 VISSIM		Difference	
	In	Out	In	Out	In	Out
1	313	198	253	156	-60	-42
2	402	184	441	191	39	8
3	1678	820	1398	667	-280	-152
4	1064	446	1001	556	-64	110
5	1374	572	1181	577	-193	5
6	83	222	258	168	175	-54
8	557	653	904	795	347	142
Total	5471	3094	5435	3111	-36	17

DSM zone	2027 DSM		2027 VISSIM		Difference	
	In	Out	In	Out	In	Out
Directional split	64%	36%	64%	36%	-	-

Table 2 : AM peak 2027 DSM and VISSIM major network entry point demand comparisons

Entry point	2027 DSM		2027 VISSIM		Difference	
	In	Out	In	Out	In	Out
Tiger Brennan Dr	1750	1080	1735	1073	-15	-7
Stuart Hwy	1680	790	1710	792	30	2
Gardens Rd	400	160	447	165	47	5

Table 3 : PM peak 2027 DSM and VISSIM zone demand comparisons

DSM zone	2027 DSM		2027 VISSIM		Difference	
	In	Out	In	Out	In	Out
1	237	294	204	275	-33	-19
2	263	394	278	408	14	15
3	1092	1616	788	1340	-304	-276
4	632	1008	806	1098	174	90
5	808	1300	732	1259	-76	-40
6	183	89	181	227	-2	138
8	612	542	944	854	331	312
Total	3828	5242	3933	5462	105	220
Directional split	42%	58%	42%	58%	-	-

Table 4 : PM peak 2027 DSM and VISSIM major network entry point demand comparisons

Entry point	2027 DSM		2027 VISSIM		Difference	
	In	Out	In	Out	In	Out
Tiger Brennan Dr	1140	1710	1137	1710	-3	0
Stuart Hwy	1060	1480	1068	1485	8	5
Gardens Rd	200	360	221	361	21	1

2.3 Traffic demand assignment

The final traffic demands for 2031 were assigned to the VISSIM model using Dynamic Assignment. The Dynamic Traffic Assignment process undertaken was in line with the process adopted for the original base year VISSIM model development, which included the following steps:

1. Undertake VISUM assignment from within the VISSIM model to quickly produce all available paths within the model network.

2. Run the Dynamic Assignment starting from 70% of traffic demands; incrementing by 1% of traffic demand for each iteration up to 100% of traffic demands.
3. Undertake Dynamic Assignment at 100% of traffic demands for 10 iterations to achieve convergence in the assignment.

Following completion of the Dynamic Assignment process, the VISSIM model was run over 5 seed values to obtain average performance results for the network.

Plots showing the assigned volumes across the model network study area for the 2031 AM and PM peak hours are provided in **Appendix A**. Select link analysis has been provided to demonstrate where traffic is travelling from and to for some of the key movements. The purple line indicates the movement chosen for select link analysis. Volumes shown upstream of the purple line indicate where traffic originates from; traffic downstream of the purple line indicates where traffic is travelling to.

It should be noted that the volumes shown in the assignment plots represent actual demand during the whole peak hour, rather than served (stop line) flow and are therefore slightly higher than the volumes shown in the VISSIM/ SIDRA model outputs.

Key findings from the AM peak assignment plots include:

- Of the 1,879 vehicles travelling inbound into the model from Tiger Brennan Drive, 60% continue along Tiger Brennan Drive and 40% turn onto Barneson Boulevard. Select link analysis for these movements shows that the traffic using Tiger Brennan Drive travels to destinations in the eastern areas of the CBD; whilst the traffic using Barneson Boulevard travels to destinations in the central and western areas of the CBD.
- Of the traffic travelling inbound along Barneson Boulevard; 40% turn onto McMinn St (the majority turning right), 37% turn left onto Woods Street and 23% continue to Cavenagh Street (the majority turning right).

This indicates that a large proportion of the traffic using Barneson Boulevard will do so to access areas off McMinn Street and development off Woods Street (including the new car park). Woods Street may also represent quite an attractive route in the model as vehicles are able to avoid signals along Cavenagh Street.

- Of the 1,161 vehicles exiting the network at the Tiger Brennan Drive model zone, 65% do so via Barneson Boulevard and 35% via Tiger Brennan Drive. Select link analysis for these movements shows a logical pattern of route choice, with outbound traffic along Barneson Boulevard largely originates from areas in the west of the CBD, while traffic using Tiger Brennan Drive largely originates in the east..

The heavy use of Barneson Boulevard relative to Tiger Brennan Drive is due to the planned CBD development pattern, where the majority of new high-density residential development will be located in the western and central areas of the CBD (refer **Figure 6**).

Key findings from the PM peak assignment plots include:

- Of the 1,838 vehicles exiting the network at the Tiger Brennan Drive model zone, 60% do so via Tiger Brennan Drive and 40% via Barneson Boulevard. Similar to the AM peak outbound, select link analysis for these movements show that the traffic using Barneson Boulevard originates primarily from the western and central areas of the CBD while traffic using Tiger Brennan Drive primarily originates from areas in the east of the CBD.

The greater use of Tiger Brennan Drive is most likely the result of higher levels of employment in the east of the CBD and that Stuart Highway provides an alternate route of exit for the western areas of the CBD.

- There is a relatively high volume of traffic turning right from Barneson Boulevard onto Cavenagh Street (around 700 vehicles). Of this traffic, around 60% originates from Woods Street (developments off Woods Street and areas to the east of Woods Street) and the remainder from areas north of Barneson Boulevard.

The traffic originating from Woods Street primarily travels to Stuart Highway and McMinn Street west of Daly Street. Half of this traffic originates from development located off Woods Street (which includes the new car park), with the remainder originating from areas in the east of the CBD. Again, Wood Street may be a desirable route as vehicles are able to avoid signals along Cavenagh Street.

The inbound CBD traffic along Barneson Boulevard onto Cavenagh Street generally travels to destinations in the west and central CBD. This traffic can be associated with the planned high density residential developments in these areas.

Figure 6 : Locations of future developments in the Darwin CBD



2.4 Modelling limitations

The 2012 Base Year Darwin CBD VISSIM model was calibrated and validated to a high level against observed traffic data and conditions, providing a robust base for the future scenario assessment undertaken for this study. The good level of calibration achieved gives confidence that the model provides good replication of travel conditions and driver behaviour, and that the traffic assignment through the network is sensible.

The 2031 forecast model was developed based on known planned development for the CBD as well as travel demands from the Darwin Strategic Traffic model, which itself is based on up-to-date land use and planning data forecasts for Greater Darwin.

The VISSIM models developed for this project have been built from the most up to date land use forecasts available and a base model calibrated well against observed conditions. However, the following limitations should be considered when interpreting the model results:

- The model zone system is relatively coarse in comparison to the number of individual developments and car parks in the CBD. Design of a microsimulation model zone system requires balancing the size of zone catchments against data availability (traffic and planning) and model development resources. It is generally not practical to create a fully disaggregated zone system with individual representation of all access points to the road network. Rather, the study area is divided up into traffic catchments (in this case, typically the size of a block) aggregating areas with roughly equivalent access to the road network. For example, the developments located off Woods Street (east of Barneson Boulevard) are represented by a single zone, when in reality vehicles may travel to a number of smaller destinations (zones) in that area. The trade-off with this approach is the potential for unrealistic traffic patterns at the zone catchment extremes.
- Travel demand associated with the proposed new car park south of Woods Street is assigned to the zone with coverage of the car parks physical location. This zone is accessed off Woods Street, however in reality, the car park will be accessed directly off Barneson Boulevard via an access between Woods Street and Cavenagh Street. As such, the model will somewhat over-estimate the volume of traffic turning in/ out of Woods Street at its intersection with Barneson Boulevard.
- The modelling considers a design horizon of 2031 and does not consider developments that may take place in the CBD in the longer term. This includes developments that may take place in the land adjacent to Barneson Boulevard. Beyond 2031, traffic volumes along Barneson Boulevard may increase.
- The attractiveness of Barneson Boulevard as a route into/ out of the CBD is a function of the traffic assignment parameters used in the 2012 Base Year model and the simulated operational performance of the road. Changes to the road environment 20 years into the future may alter this attractiveness and subsequently the future volumes forecast for Barneson Boulevard.

The limitations described above are not atypical for a microsimulation model and Jacobs considers that the Darwin CBD VISSIM model provides a robust basis for analysis and is the best tool available for the assessment at present. The model has been used for a number of previous planning studies for the CBD (including the Barneson Boulevard business case), so a good level of consistency has been maintained by using the model.

3. Intersection performance outputs

3.1 VISSIM results

A summary of the overall intersection Level of Service (LOS) for the key intersections in the AM and PM peak hours is provided in the following table. Detailed intersection outputs from the VISSIM model are provided in **Appendix B**.

Table 5 : VISSIM model overall intersection LOS summaries

Intersection	AM peak overall LOS	PM peak overall LOS
Stuart Hwy/ McMinn St	C	C
McMinn St/ Day St	B	A
McMinn St/ McLachlan St	A	A
McMinn St/ Shepard St	A	A
McMinn St/ Barneson Blvd	D	D
McMinn St/ Gardiner St	A	A
McMinn St/ Knuckey St	C	B
McMinn St/ Foelsche St	A	A
McMinn St/ Carey St	A	B
McMinn St/ Tiger Brennan Dr	B	B
Barneson Blvd/ Cavanagh St	B	A
Barneson Blvd/ Woods St	A	A
Barneson Blvd/ Harvey St	A	A
Barneson Blvd/ Tiger Brennan Dr	C	C
Tiger Brennan Dr/ Knuckey St	A	A
Knuckey St/ Harvey St	A	A

The results in the table above indicate that all of the key intersections along Barneson Boulevard, McMinn Street and Tiger Brennan Drive operate at LOS D or better overall in both peak hours.

Individual movements at a number of the intersections are forecast to operate at LOS E or F. These movements are either left or right turn movements with relatively low traffic volumes. The poorer LOS forecast for these movements is due to a relatively small allocation of green time at signals, rather than excessive levels of delay or congestion.

For example, the right turn from Barneson Boulevard north to McMinn Street west has an average delay of 88 seconds due to the small amount of green time this movement is allocated out of the whole signal cycle, yet has an average queue length of only 40 metres.

3.2 SIDRA results

As discussed in **Section 1**, SIDRA analysis was undertaken in addition to VISSIM modelling for the intersections along Barneson Boulevard to inform the detailed design process and confirm the required intersection configurations and turn pocket lengths.

Volumes for the SIDRA analysis were extracted from the VISSIM model. The SIDRA analysis was undertaken in SIDRA V6.1, which enables assessment of Barneson Boulevard as a connected network of intersections.

A summary of the overall intersection LOS for the key intersections in the AM and PM peak hours is provided in the following table. Detailed intersection outputs from the SIDRA model are provided in **Appendix C**.

Table 6 : SIDRA model overall intersection LOS summaries

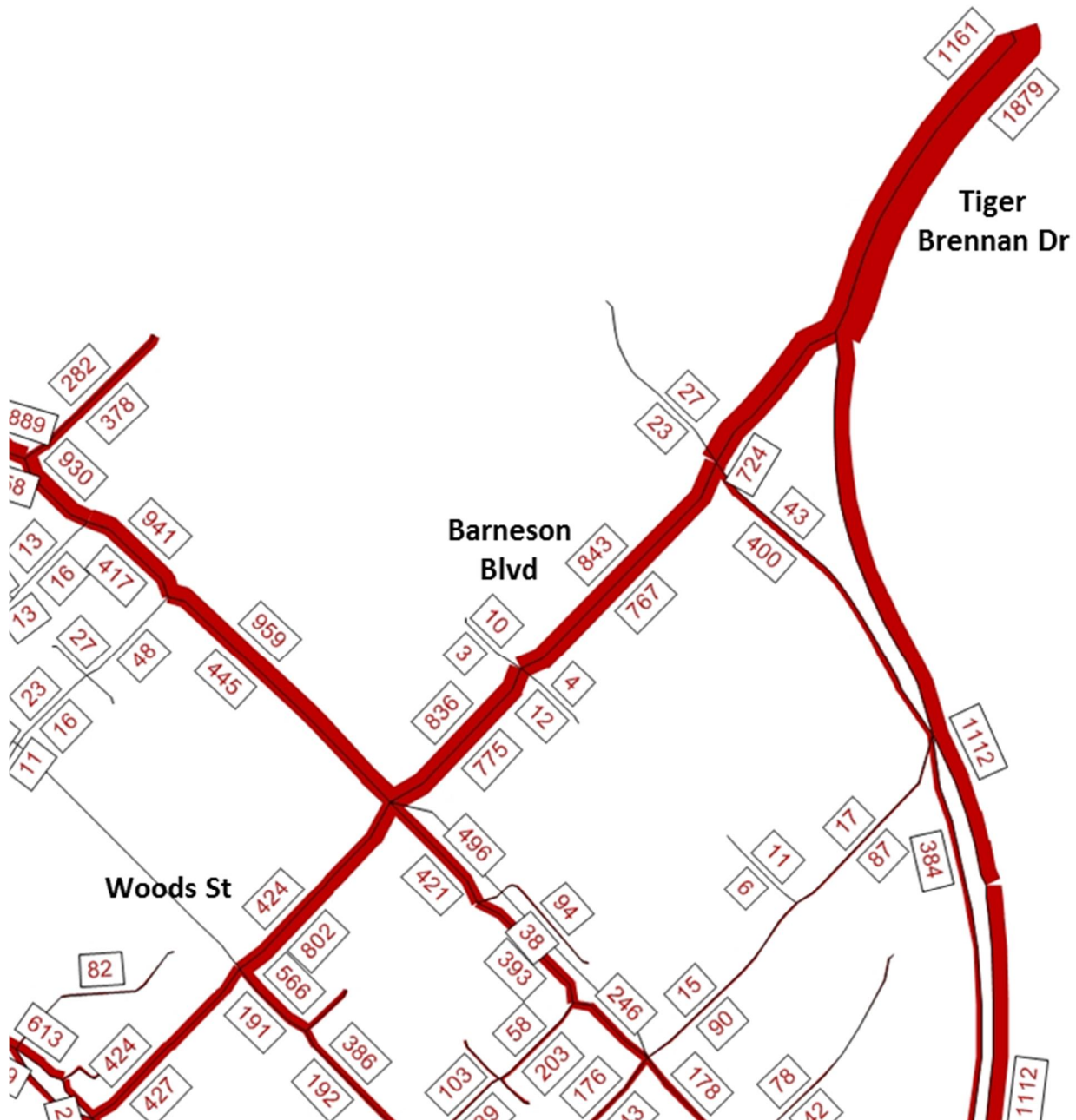
Intersection	AM peak overall LOS	PM peak overall LOS
Barneson Blvd/ Tiger Brennan Dr	C	D
Barneson Blvd/ Harvey St	A	A
Barneson Boulevard/ McMinn St	D	D
Barneson Blvd/ Woods St	A	A
Barneson Blvd/ Cavanagh St	D	D

The SIDRA results show that the intersections along Barneson Boulevard are forecast to operate at LOS D or better overall in both peak periods. The SIDRA results show slightly higher levels of delay in comparison to the VISSIM outputs. SIDRA is likely to provide a more conservative estimate of intersection performance as the software does not model vehicle interactions and traffic flow profiles in as much detail as VISSIM.

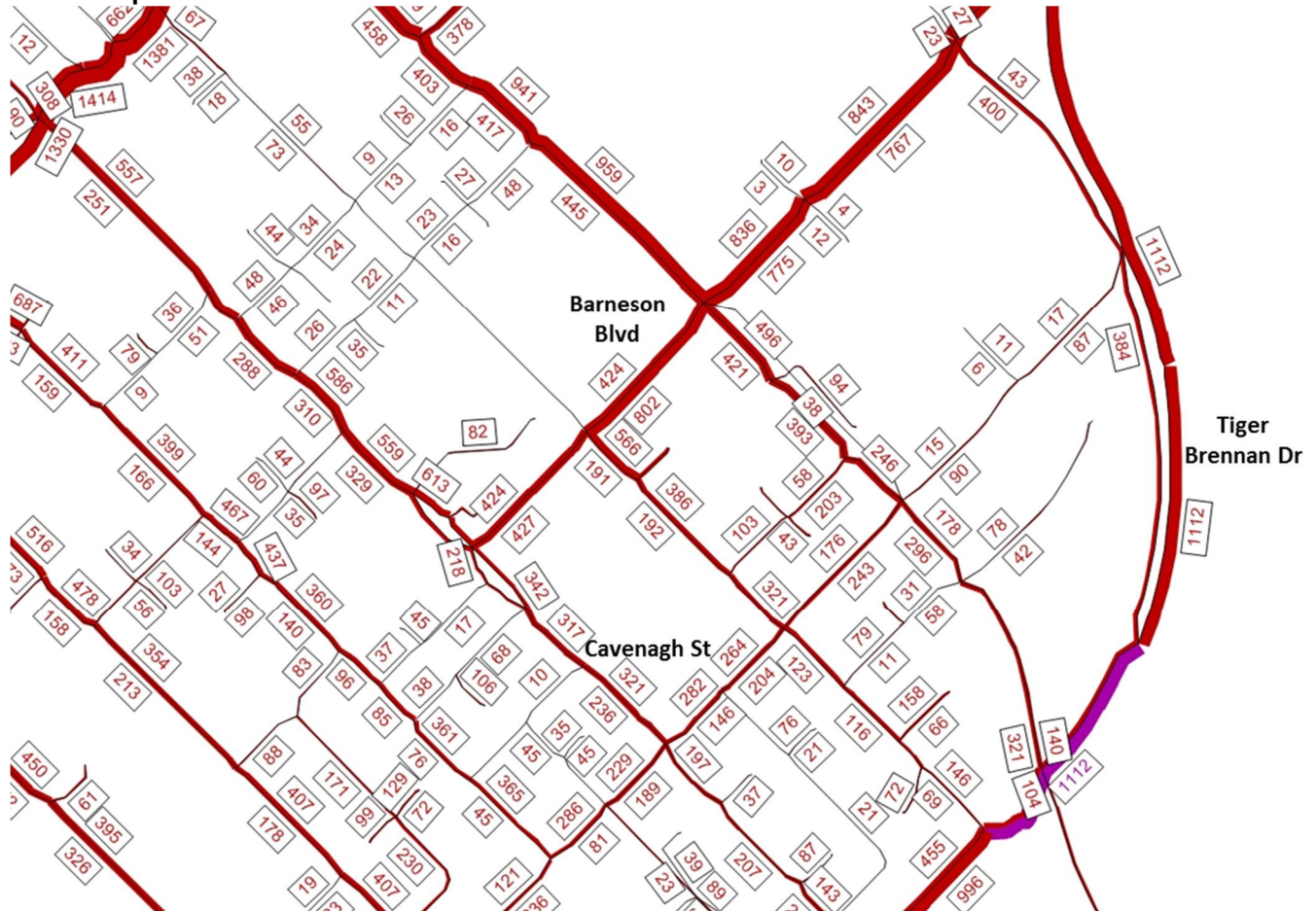
All movements at all of the intersection in both peak periods are forecast to operate with a Degree of Saturation (DOS) of below 0.9 and with a reasonable 95% queue length. It can be concluded therefore that the concept design for Barneson Boulevard should operate at an acceptable level of service in 2031.

Appendix A – VISSIM model assignment plots

AM peak Barneson Boulevard northern end



AM peak Barneson Boulevard central



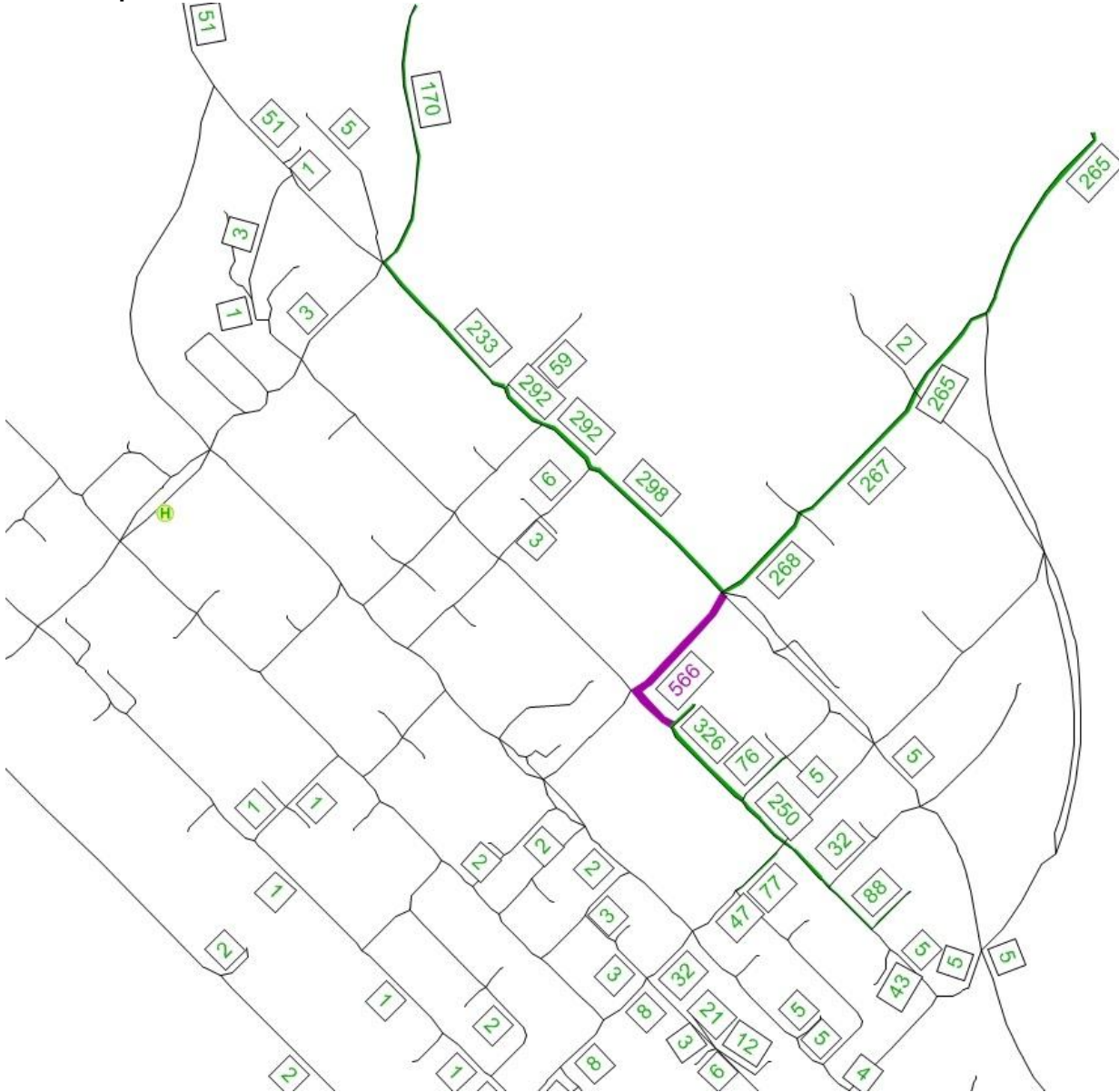
AM peak Barneson Boulevard inbound



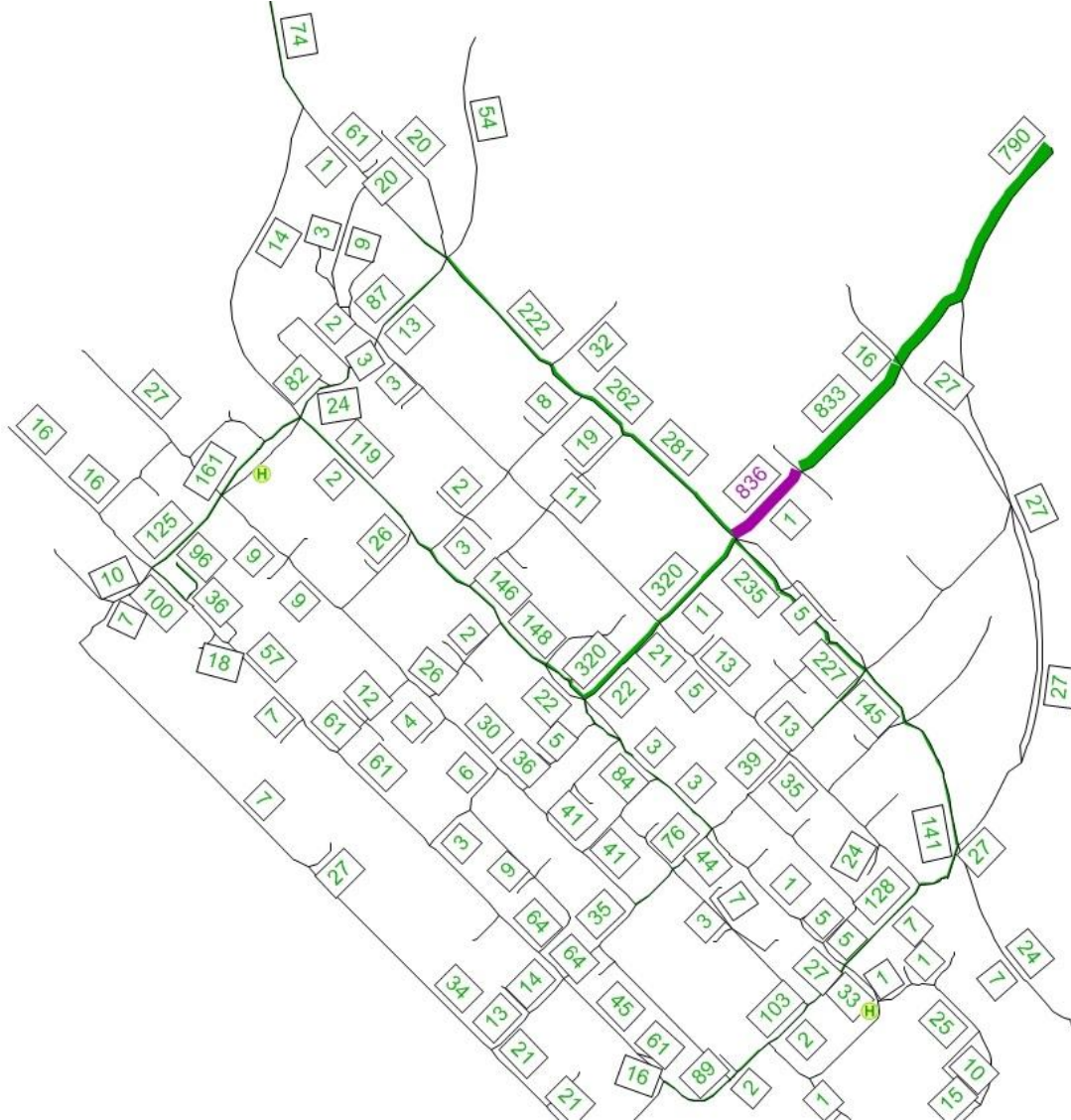
AM peak Tiger Brennan Drive inbound



AM peak Barneson Boulevard left turn onto Woods Street



AM peak Barneson Boulevard outbound



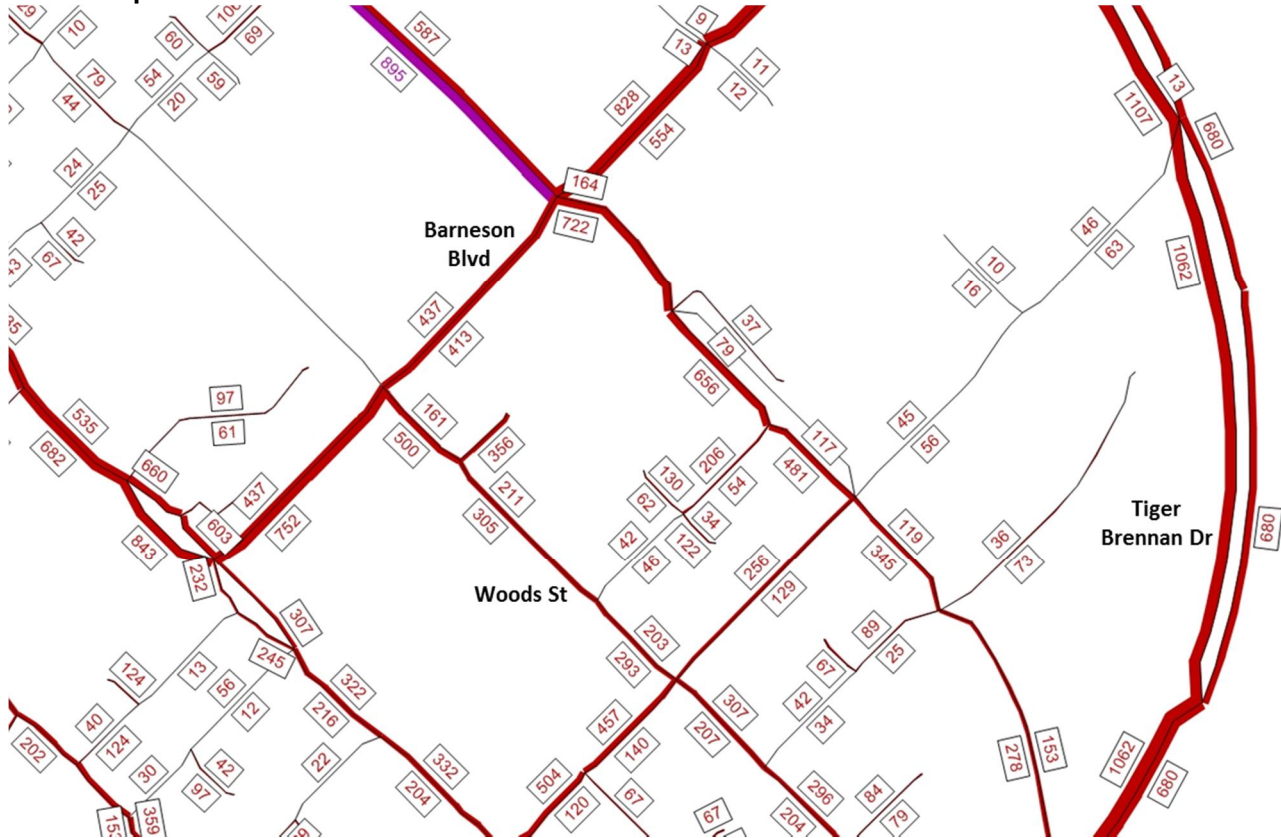
AM peak Tiger Brennan Drive outbound



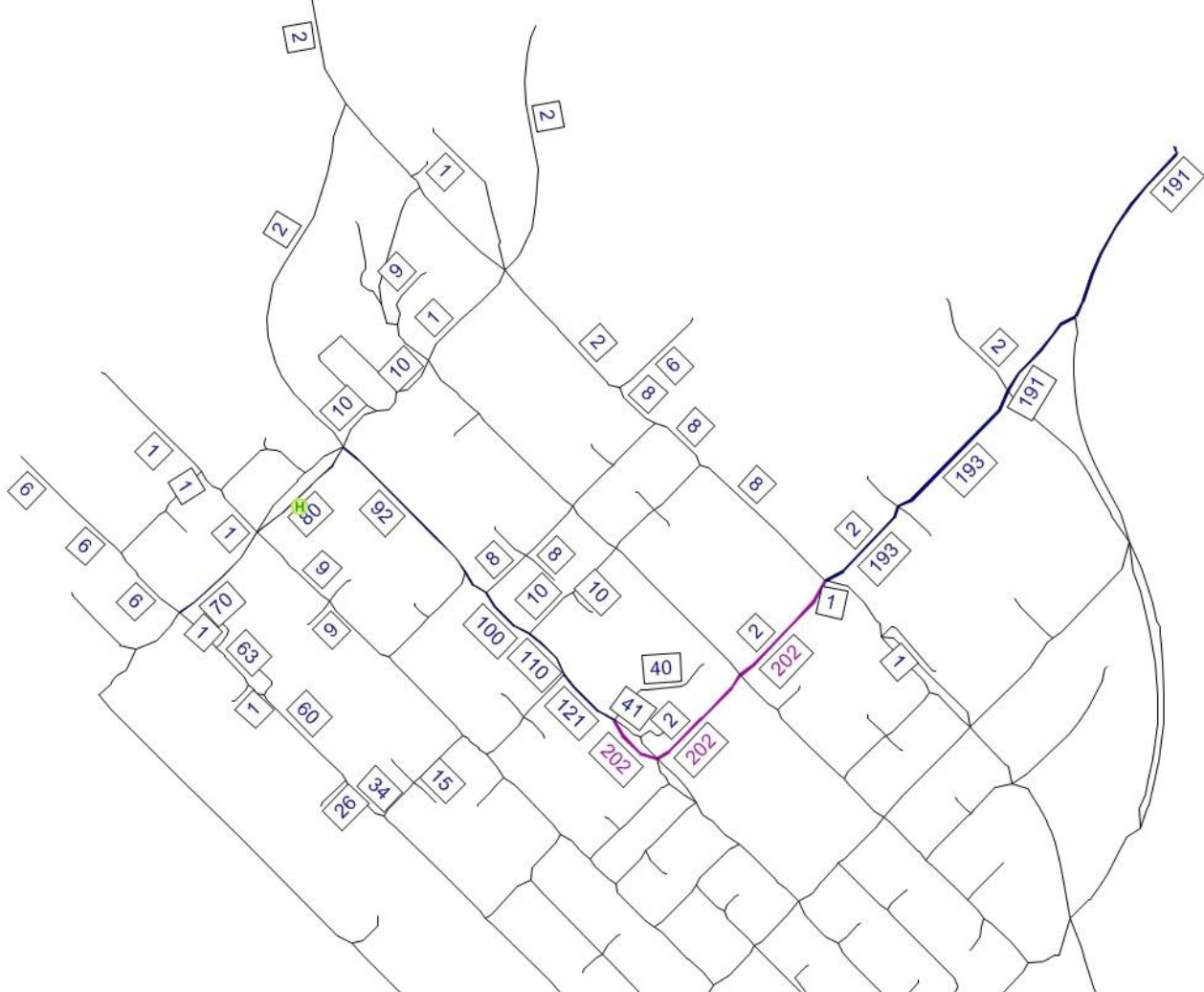
PM peak Barneson Boulevard northern end



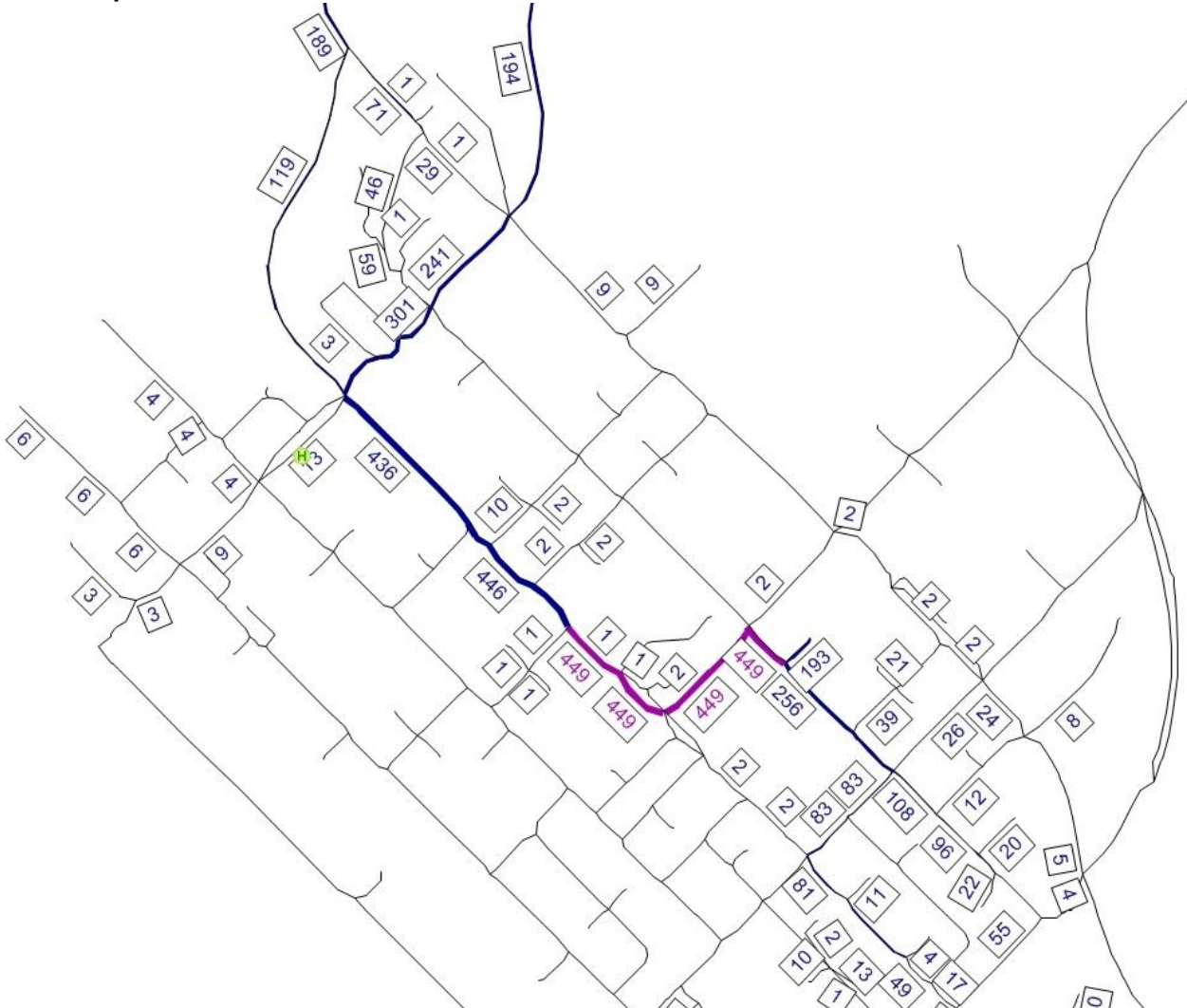
PM peak Barneson Boulevard central section



PM peak Barneson Boulevard inbound to Cavenagh Street



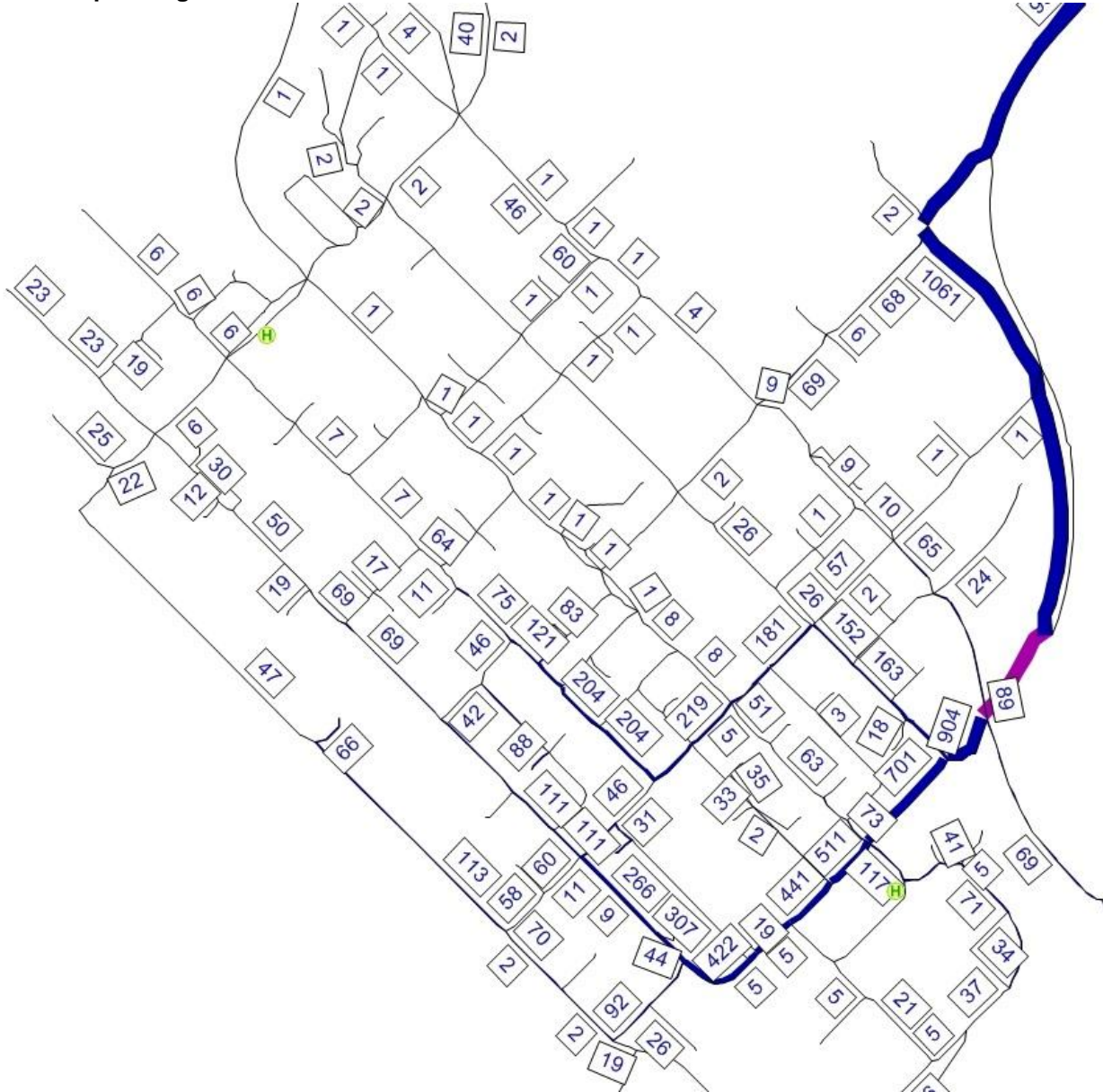
PM peak left turn from Woods Street onto Barneson Boulevard



PM peak Barneson Boulevard outbound



PM peak Tiger Brennan Drive outbound



Appendix B – VISSIM model intersection outputs

AM peak

Movement	Vehicles	Ave Delay (s)	LOS	Ave Q	Max Q
Stuart Highway/ McMinn Street/ Daly Street					
Daly St left	5	27	B	1	13
Daly St through	387	23	B	9	65
Daly St right	204	37	C	11	72
McMinn St W left	36	56	D	22	101
McMinn St W through	106	58	E	22	101
McMinn St W right	91	53	D	25	105
Stuart Hwy left	420	44	D	44	160
Stuart Hwy through	852	42	C	44	160
Stuart Hwy right	219	44	D	16	131
McMinn St E left	240	7	A	1	50
McMinn St E through	26	45	D	9	46
McMinn St E right	185	38	C	9	46
Overall LOS	2771.4		C		
McMinn Street/ Day Street					
McMinn St W left	148	4	A	0	5
McMinn St W through	728	15	B	10	92
Day St left	197	16	B	11	96
Day St right	186	30	C	13	100
McMinn St E through	293	10	A	3	33
McMinn St E right	134	9	A	2	29
Overall LOS	1686		B		
McMinn Street/ McLachlan St					
McMinn St W through	728	15	B	10	92
McMinn St W right	1	0	A	0	0
McLachlan St left	1	1	A	0	0
McLachlan St right	14	3	A	0	0
McMinn St E left	10	0	A	0	0
McMinn St E through	293	10	A	3	33
Overall LOS	1047		A		
McMinn Street/ Shepard Street					
McMinn St W through	728	15	B	10	92
McMinn St W right	12	3	A	0	12
Shepard St left	12	1	A	0	5
Shepard St right	32	4	A	0	5
McMinn St E left	30	1	A	0	2
McMinn St E through	293	10	A	3	33
Overall LOS	1107		A		
McMinn Street/ Barneson Boulevard					

Barneson Blvd N left	143	44	D	29	94
Barneson Blvd N through	403	41	C	29	94
Barneson Blvd N right	173	53	D	14	53
McMinn St W left	253	49	D	50	197
McMinn St W through	321	49	D	50	197
McMinn St W right	379	52	D	50	197
Barneson Blvd S left	67	34	C	14	51
Barneson Blvd S through	314	40	C	14	51
Barneson Blvd S right	34	58	E	3	19
McMinn St E left	5	47	D	19	79
McMinn St E through	214	54	D	19	79
McMinn St E right	222	54	D	19	79
BRT W	15	25	B	1	14
BRT E	8	53	D	1	28
Overall LOS	2551		D		
McMinn Street/ Carpark Link					
McMinn St W left	93	0	A	0	0
McMinn St W through	405	1	A	0	0
Carpark Link left	7	1	A	0	18
Carpark Link right	29	5	A	0	18
McMinn St E through	414	2	A	0	2
McMinn St E right	6	2	A	0	2
Overall LOS	954		A		
McMinn Street/ Gardiner Street					
McMinn St W through	242	2	A	0	16
McMinn St W right	169	3	A	0	16
Gardiner St left	68	1	A	0	0
Gardiner St right	2	3	A	0	0
McMinn St E left	38	0	A	0	0
McMinn St E through	352	0	A	0	0
Overall LOS	871		A		
McMinn Street/ Knuckey Street					
Knuckey St N left	2	28	C	7	66
Knuckey St N through	76	44	D	7	66
Knuckey St N right	24	43	D	7	66
McMinn St W left	2	8	A	3	41
McMinn St W through	242	2	A	0	16
McMinn St W right	125	29	C	5	47
Knuckey St S left	108	47	D	15	84
Knuckey St S through	11	51	D	15	84
Knuckey St S right	70	35	C	15	84
McMinn St E left	52	5	A	5	60
McMinn St E through	352	0	A	0	0

McMinn St E right	2	11	A	7	62
BRT in	15	43	D	2	42
BRT out	8	55	D	15	84
Overall LOS	1089		B		
McMinn Street/ Foelsche Street					
McMinn St E left	61	1	A	0	0
McMinn St E through	240	1	A	0	3
Foelsche Street right	36	0	A	0	0
Overall LOS	337		A		
McMinn Street/ Carey Street					
McMinn St W left	41	0	A	0	0
McMinn St W through	242	2	A	0	16
Carey St left	4	0	A	0	3
Carey St right	37	3	A	0	3
McMinn St E through	240	1	A	0	3
McMinn St E right	36	2	A	0	3
Overall LOS	601		A		
McMinn Street/ Tiger Brennan Drive/ Bennett Street					
TBD N left	82	13	A	17	92
TBD N through	960	18	B	17	92
TBD N right	114	13	A	17	92
McMinn St W left	57	1	A	0	0
McMinn St W through	50	43	D	4	26
McMinn St W right	46	44	D	4	26
Bennett St S left	198	6	A	7	66
Bennett St S through	329	51	D	26	72
Bennett St S right	53	61	E	26	72
McMinn St E left	34	4	A	0	2
McMinn St E through	27	49	D	5	32
McMinn St E right	27	49	D	5	32
Overall LOS	1976		B		
Barneson Boulevard/ Cavenagh Street					
Barneson Blvd NE left	108	22	B	9	50
Barneson Blvd NE right	277	24	B	9	50
Cavenagh St NW left	120	10	A	3	35
Cavenagh St NW through	203	1	A	0	0
Cavenagh St SE through	296	0	A	0	0
Cavenagh St SE right	294	15	B	20	29
Overall LOS	1299		A		
Barneson Boulevard/ Woods Street					
Barneson Blvd NE left	572	2	A	0	12
Barneson Blvd NE through	215	2	A	0	12
Woods Street left	171	4	A	0	17

Overall LOS	957		A		
Barneson Boulevard/ Harvey Street					
Barneson Blvd NE left	6	1	A	0	0
Barneson Blvd NE through	713	1	A	0	0
Harvey St SE left	9	1	A	0	0
Barneson Blvd SW left	5	0	A	0	0
Barneson Blvd SW through	783	0	A	0	0
Harvey St NW left	10	0	A	0	0
Overall LOS	1527		A		
Barneson Boulevard/ Tiger Brennan Drive Western Intersection					
Barneson Blvd NE through	675	29	C	19	87
Barneson Blvd NE right	0	0	A	19	87
TBD SE left	25	1	A	0	0
TBD SE through	6	63	E	19	80
TBD SE right	420	48	D	19	80
Barneson Blvd SW left	13	1	A	0	0
Barneson Blvd SW through	743	30	C	20	85
Barneson Blvd SW right	36	42	C	2	29
TBD NW left	0	0	A	0	0
TBD NW through	8	32	C	1	16
TBD NW right	20	31	C	1	16
Overall LOS	1947		C		
Barneson Boulevard/ Tiger Brennan Drive Eastern Intersection					
TBD through	1204	0	A	0	0
TBD to Barneson	678	1	A	0	0
Overall LOS	1882		A		
Tiger Brennan Drive/ Knuckey Street					
TBD NW through	1154	0	A	0	3
TBD NW right	94	2	A	0	3
TBD SW left	0	0	A	0	0
TBD SW through	434	0	A	0	0
Knuckey St left	15	2	A	0	0
Overall LOS	1697		A		
Knuckey Street/ Harvey Street					
Knuckey St NE through	94	0	A	0	0
Knuckey St NE right	1	0	A	0	0
Knuckey St SW left	5	0	A	0	0
Knuckey St SW through	10	0	A	0	0
Harvey St left	5	0	A	0	0
Harvey St right	7	0	A	0	0
Overall LOS	122		A		

PM peak

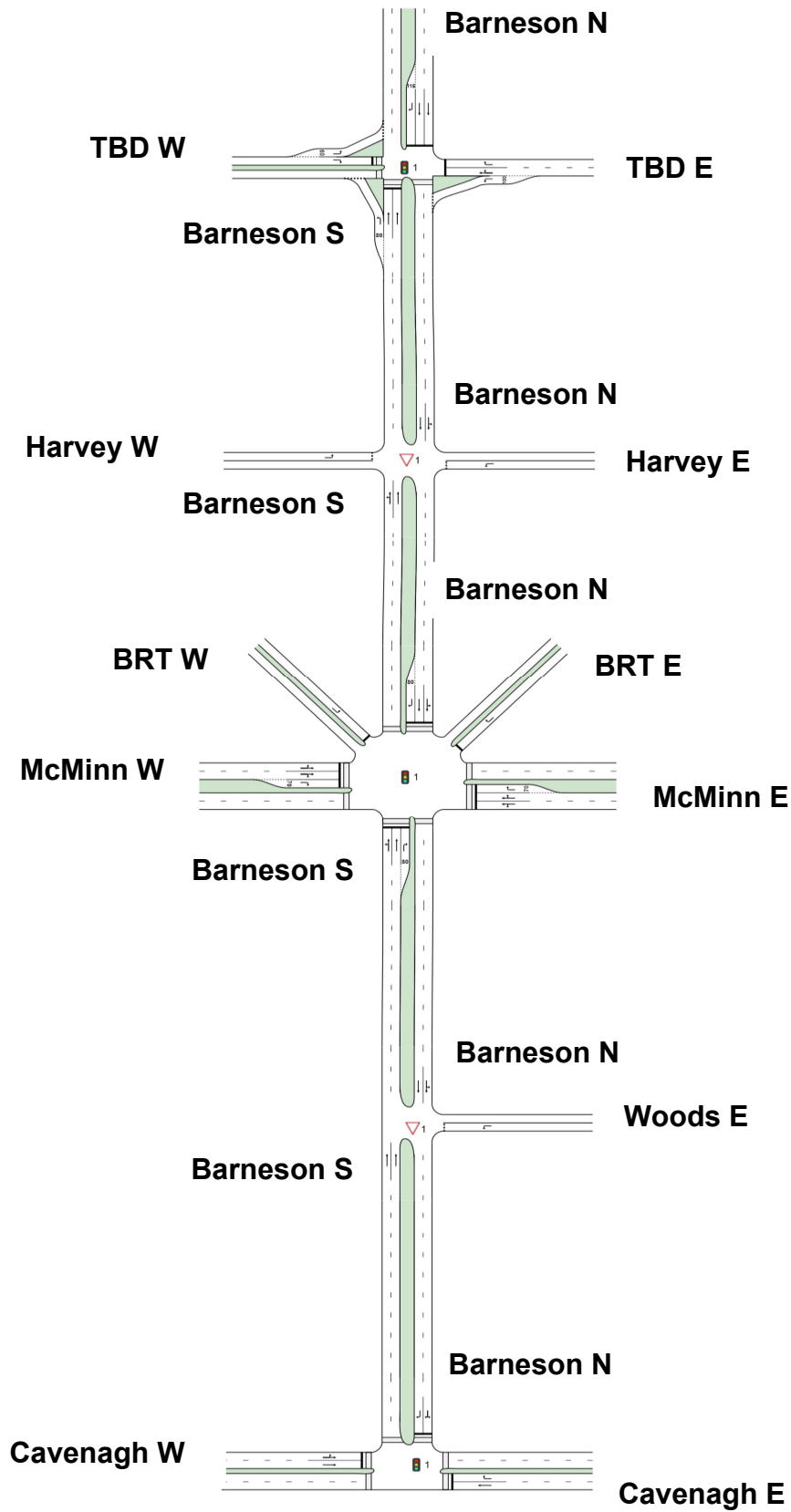
Movement	Vehicles	Ave Delay (s)	LOS	Ave Q	Max Q
Stuart Highway/ McMinn Street/ Daly Street					
Daly St left	25	20	B	2	20
Daly St through	764	23	B	18	130
Daly St right	251	30	C	11	96
McMinn St W left	37	60	E	10	52
McMinn St W through	55	56	D	10	52
McMinn St W right	41	63	E	11	55
Stuart Hwy left	142	31	C	22	110
Stuart Hwy through	551	38	C	22	110
Stuart Hwy right	183	54	D	16	106
McMinn St E left	273	7	A	0	29
McMinn St E through	39	52	D	25	131
McMinn St E right	462	43	D	25	131
Overall LOS	2823		C		
McMinn Street/ Day Street					
McMinn St W left	137	2	A	0	3
McMinn St W through	367	13	A	5	68
Day St left	113	13	A	7	77
Day St right	193	27	B	10	80
McMinn St E through	661	9	A	6	71
McMinn St E right	213	8	A	3	62
Overall LOS	1684		A		
McMinn Street/ McLachlan St					
McMinn St W through	367	13	A	5	68
McMinn St W right	0	2	A	0	3
McLachlan St left	1	0	A	0	8
McLachlan St right	35	5	A	0	8
McMinn St E left	18	2	A	0	25
McMinn St E through	661	9	A	6	71
Overall LOS	1081		A		
McMinn Street/ Shepard Street					
McMinn St W through	367	13	A	5	68
McMinn St W right	5	6	A	0	6
Shepard St left	19	2	A	0	15
Shepard St right	86	4	A	0	15
McMinn St E left	59	1	A	0	13
McMinn St E through	661	9	A	6	71
Overall LOS	1197		A		
McMinn Street/ Barneson Boulevard					
Barneson Blvd N left	63	21	B	8	41

Barneson Blvd N through	275	20	B	8	41
Barneson Blvd N right	260	88	F	41	137
McMinn St W left	356	41	C	27	118
McMinn St W through	74	36	C	27	118
McMinn St W right	162	35	C	27	118
Barneson Blvd S left	115	44	D	14	64
Barneson Blvd S through	331	26	B	14	64
Barneson Blvd S right	19	17	B	0	9
McMinn St E left	1	58	E	36	109
McMinn St E through	555	51	D	36	109
McMinn St E right	274	54	D	36	109
BRT W	13	42	C	1	22
BRT E	17	60	E	3	34
Overall LOS	2514		D		
McMinn Street/ Carpark Link					
McMinn St W left	31	1	A	0	0
McMinn St W through	124	0	A	0	0
Carpark Link left	4	1	A	0	17
Carpark Link right (1)	35	7	A	0	17
Carpark Link right (2)	38	8	A	0	17
McMinn St E through	342	4	A	2	69
McMinn St E right	7	6	A	2	69
Overall LOS	582		A		
McMinn Street/ Gardiner Street					
McMinn St W through	124	0	A	0	0
McMinn St W right	32	3	A	0	2
Gardiner St left	205	1	A	0	11
Gardiner St right	8	2	A	0	11
McMinn St E left	15	0	A	0	5
McMinn St E through	564	1	A	0	5
Overall LOS	948		A		
McMinn Street/ Knuckey Street					
Knuckey St N left	2	16	B	4	29
Knuckey St N through	52	38	C	4	29
Knuckey St N right	14	34	C	4	29
McMinn St W left	8	23	B	1	19
McMinn St W through	124	0	A	0	0
McMinn St W right	49	34	C	2	28
Knuckey St S left	208	40	C	22	107
Knuckey St S through	23	44	D	22	107
Knuckey St S right	51	41	C	22	107
McMinn St E left	35	13	A	11	73
McMinn St E through	564	1	A	0	5

McMinn St E right	4	25	B	12	75
BRT in	13	27	B	1	26
BRT out	17	40	C	22	107
Overall LOS	1164		B		
McMinn Street/ Foelsche Street					
McMinn St E left	25	1	A	0	0
McMinn St E through	269	2	A	0	0
Foelsche Street right	88	0	A	0	0
Overall LOS	381		A		
McMinn Street/ Carey Street					
McMinn St W left	10	0	A	0	0
McMinn St W through	124	0	A	0	0
Carey St left	36	0	A	0	1
Carey St right	38	3	A	0	1
McMinn St E through	269	2	A	0	0
McMinn St E right	24	1	A	0	0
Overall LOS	501		A		
McMinn Street/ Tiger Brennan Drive/ Bennett Street					
TBD N left	44	18	B	12	65
TBD N through	558	20	B	12	65
TBD N right	31	42	D	12	65
McMinn St W left	67	3	A	0	0
McMinn St W through	47	50	D	3	15
McMinn St W right	11	47	D	3	15
Bennett St S left	215	4	A	17	68
Bennett St S through	809	17	B	37	72
Bennett St S right	80	44	D	37	72
McMinn St E left	63	3	A	0	0
McMinn St E through	70	49	D	8	42
McMinn St E right	70	49	D	8	42
Overall LOS	2067		B		
Barneson Boulevard/ Cavenagh Street					
Barneson Blvd NE left	66	36	C	14	79
Barneson Blvd NE right	677	19	B	14	79
Cavenagh St NW left	103	22	B	10	38
Cavenagh St NW through	223	1	A	0	0
Cavenagh St SE through	317	0	A	0	0
Cavenagh St SE right	364	7	A	10	29
Overall LOS	1750		A		
Barneson Boulevard/ Woods Street					
Barneson Blvd NE left	149	1	A	0	2
Barneson Blvd NE through	290	1	A	0	2
Woods Street left	455	3	A	0	40

Overall LOS	893		A		
Barneson Boulevard/ Harvey Street					
Barneson Blvd NE left	12	1	A	1	46
Barneson Blvd NE through	593	4	A	1	46
Harvey St SE left	10	1	A	0	0
Barneson Blvd SW left	16	0	A	0	0
Barneson Blvd SW through	944	0	A	0	0
Harvey St NW left	11	0	A	0	0
Overall LOS	1585		A		
Barneson Boulevard/ Tiger Brennan Drive Western Intersection					
Barneson Blvd NE through	503	34	C	17	75
Barneson Blvd NE right	22	56	E	17	75
TBD SE left	83	1	A	0	0
TBD SE through	2	29	C	27	120
TBD SE right	890	35	C	27	120
Barneson Blvd SW left	14	2	A	0	0
Barneson Blvd SW through	931	31	C	26	113
Barneson Blvd SW right	9	44	D	1	12
TBD NW left	0	0	A	0	0
TBD NW through	5	50	D	2	14
TBD NW right	17	48	D	2	14
Overall LOS	2475		C		
Barneson Boulevard/ Tiger Brennan Drive Eastern Intersection					
TBD through	691	0	A	0	0
TBD to Barneson	524	1	A	0	0
Overall LOS	1215		A		
Tiger Brennan Drive/ Knuckey Street					
TBD NW through	632	0	A	0	2
TBD NW right	72	4	A	0	2
TBD SW left	1	0	A	0	0
TBD SW through	932	0	A	0	0
Knuckey St left	37	2	A	0	0
Overall LOS	1673		A		
Knuckey Street/ Harvey Street					
Knuckey St NE through	65	0	A	0	0
Knuckey St NE right	8	0	A	0	0
Knuckey St SW left	5	0	A	0	0
Knuckey St SW through	30	0	A	0	0
Harvey St left	7	0	A	0	0
Harvey St right	2	0	A	0	0
Overall LOS	117		A		

Appendix C – SIDRA outputs



SiDRA Analysis Layouts

MOVEMENT SUMMARY

 **Site: Barneson/Tiger Brennan**

 **Network: Barneson Boulevard**
2031 AM

New Site

Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Arrival Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
1	L2	14	1.0	14	1.0	0.009	6.0	LOS A	0.0	0.3	0.10	0.57	53.9
2	T1	785	1.0	785	1.0	0.447	22.4	LOS C	18.1	127.7	0.65	0.57	43.8
Approach		799	1.0	799	1.0	0.447	22.1	LOS C	18.1	127.7	0.64	0.57	44.0
East: Tiger Brennan E													
4	L2	26	1.0	26	1.0	0.026	7.5	LOS A	0.3	1.8	0.21	0.59	48.4
5	T1	6	1.0	6	1.0	0.452	42.5	LOS D	11.9	83.8	0.88	0.81	33.6
6	R2	443	1.0	443	1.0	0.452	48.1	LOS D	11.9	83.8	0.88	0.81	33.0
Approach		476	1.0	476	1.0	0.452	45.8	LOS D	11.9	83.8	0.85	0.80	33.3
North: Barneson N													
8	T1	718	1.0	718	1.0	0.339	17.3	LOS B	12.4	87.7	0.60	0.52	38.4
9	R2	16	1.0	16	1.0	0.186	73.7	LOS E	1.0	7.2	0.99	0.69	26.8
Approach		734	1.0	734	1.0	0.339	18.5	LOS B	12.4	87.7	0.61	0.53	37.7
West: Tiger Brennan W													
10	L2	16	1.0	16	1.0	0.016	11.7	LOS B	0.3	2.0	0.36	0.61	49.8
12	R2	20	1.0	20	1.0	0.235	74.0	LOS E	1.3	9.2	0.99	0.70	17.7
Approach		36	1.0	36	1.0	0.235	46.5	LOS D	1.3	9.2	0.71	0.66	29.2
All Vehicles		2044	1.0	2044	1.0	0.452	26.8	LOS C	18.1	127.7	0.68	0.61	38.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	53	45.8	LOS E	0.2	0.2	0.84	0.84	
P4	West Full Crossing	53	22.9	LOS C	0.1	0.1	0.59	0.59	
All Pedestrians		105	34.3	LOS D			0.72	0.72	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

 **Site: Barneson/Tiger Brennan**

 **Network: Barneson Boulevard
2031 AM**

New Site

Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Phase times specified by the user

Sequence: Split Phasing

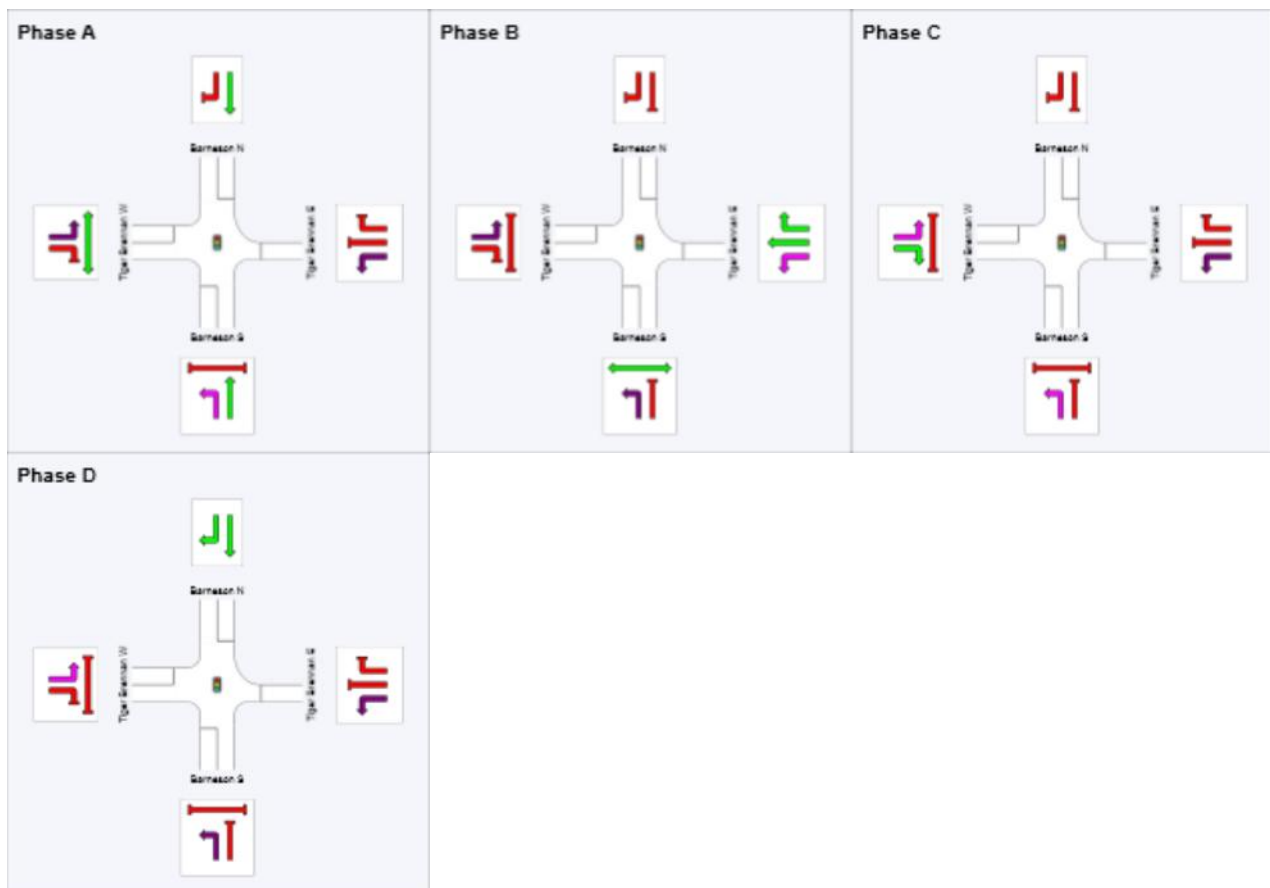
Movement Class: All Movement Classes












Input Sequence: A, B, C, D

Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	65	0	41	53
Green Time (sec)	59	35	6	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	65	41	12	12
Phase Split	50 %	32 %	9 %	9 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

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MOVEMENT SUMMARY

 Site: Barneson/Harvey

 Network: Barneson Boulevard
2031 AM

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
1	L2	16	1.0	16	1.0	0.216	5.5	LOS A	0.0	0.0	0.00	0.02	58.1
2	T1	820	1.0	820	1.0	0.216	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		836	1.0	836	1.0	0.216	0.1	NA	0.0	0.0	0.00	0.01	59.7
East: Harvey E													
4	L2	16	1.0	16	1.0	0.017	7.1	LOS A	0.1	0.4	0.40	0.59	48.7
Approach		16	1.0	16	1.0	0.017	7.1	LOS A	0.1	0.4	0.40	0.59	48.7
North: Barneson N													
7	L2	16	1.0	16	1.0	0.198	5.6	LOS A	0.0	0.0	0.00	0.02	58.1
8	T1	752	1.0	752	1.0	0.198	0.0	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		767	1.0	767	1.0	0.198	0.1	NA	0.0	0.0	0.00	0.01	59.7
West: Harvey W													
10	L2	16	1.0	16	1.0	0.017	7.3	LOS A	0.1	0.5	0.42	0.59	48.6
Approach		16	1.0	16	1.0	0.017	7.3	LOS A	0.1	0.5	0.42	0.59	48.6
All Vehicles		1635	1.0	1635	1.0	0.216	0.2	NA	0.1	0.5	0.01	0.02	59.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

New Site
 Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %	Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m	per veh	km/h	
South: Barneson S													
1	L2	69	1.0	69	1.0	0.824	77.9	LOS E	10.8	76.0	1.00	0.88	26.7
2	T1	323	1.0	323	1.0	0.824	71.1	LOS E	15.6	109.8	1.00	0.88	18.3
3	R2	35	1.0	35	1.0	0.277	71.9	LOS E	2.3	16.1	1.00	0.75	27.3
Approach		427	1.0	427	1.0	0.824	72.3	LOS E	15.6	109.8	1.00	0.87	20.8
East: McMinn E													
4	L2	5	1.0	5	1.0	0.513	53.5	LOS D	12.2	86.0	0.93	0.78	23.8
5	T1	226	1.0	226	1.0	0.513	48.5	LOS D	12.2	86.0	0.93	0.78	33.4
6	R2	236	1.0	236	1.0	0.513	63.3	LOS E	7.6	53.6	0.98	0.79	19.8
Approach		467	1.0	467	1.0	0.513	56.0	LOS E	12.2	86.0	0.95	0.79	27.0
NorthEast: BRT E													
26	R2	8	100.0	8	100.0	0.168	76.5	LOS E	0.6	7.3	0.99	0.68	26.1
Approach		8	100.0	8	100.0	0.168	76.5	LOS E	0.6	7.3	0.99	0.68	26.1
North: Barneson N													
7	L2	147	1.0	147	1.0	0.390	54.5	LOS D	16.4	115.8	1.00	0.85	31.9
8	T1	417	1.0	417	1.0	0.390	47.6	LOS D	18.0	126.9	1.00	0.86	23.6
9	R2	178	1.0	178	1.0	0.501	48.1	LOS D	9.1	63.9	1.00	0.81	33.1
Approach		742	1.0	742	1.0	0.501	49.1	LOS D	18.0	126.9	1.00	0.85	28.3
NorthWest: BRT W													
27	L2	16	100.0	16	100.0	0.316	77.7	LOS E	1.1	14.0	1.00	0.71	26.0
Approach		16	100.0	16	100.0	0.316	77.7	LOS E	1.1	14.0	1.00	0.71	26.0
West: McMinn W													
10	L2	266	1.0	266	1.0	0.715	34.2	LOS C	13.7	96.8	0.97	0.84	29.0
11	T1	342	1.0	342	1.0	0.715	35.0	LOS D	18.1	128.1	0.96	0.86	37.4
12	R2	407	1.0	407	1.0	0.715	51.2	LOS D	18.1	128.1	0.96	0.85	23.0
Approach		1016	1.0	1016	1.0	0.715	41.3	LOS D	18.1	128.1	0.96	0.85	30.0
All Vehicles		2677	1.9	2677	1.9	0.824	51.3	LOS D	18.1	128.1	0.98	0.84	27.2

Level of Service (LOS) Method: Delay (HCM 2000).
 Vehicle movement LOS values are based on average delay per movement
 Intersection and Approach LOS values are based on average delay for all vehicle movements.
 SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
 Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
 The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	49.2	LOS E	0.2	0.2	0.87	0.87
P4	West Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96

All Pedestrians	211	56.8	LOS E	0.93	0.93
-----------------	-----	------	-------	------	------

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

 Site: Barneson/McMinn

 Network: Barneson Boulevard
2031 AM

New Site

Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Phase times specified by the user

Sequence: Split Phasing

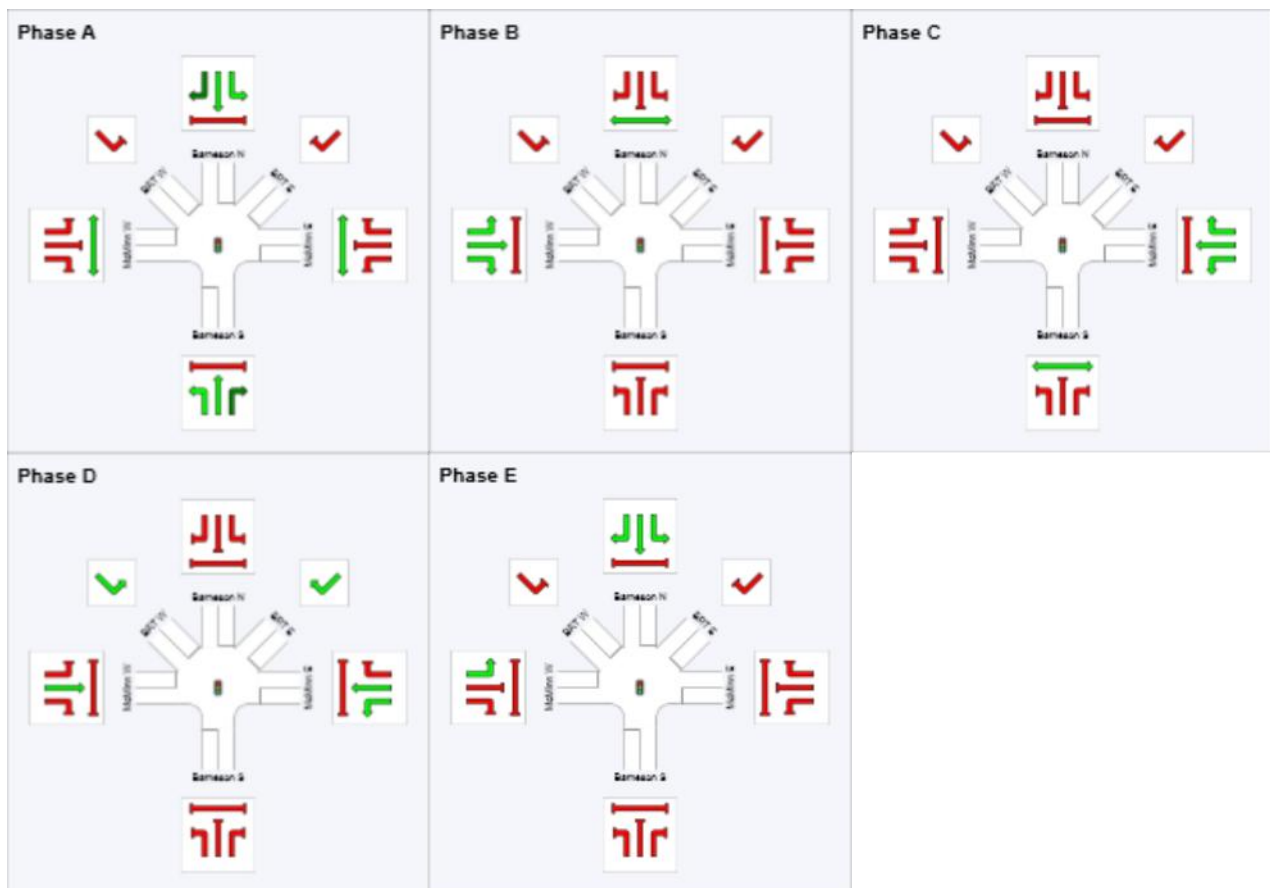
Movement Class: All Movement Classes












Input Sequence: A, B, C, D, E

Output Sequence: A, B, C, D, E

Phase Timing Results

Phase	A	B	C	D	E
Reference Phase	No	Yes	No	No	No
Phase Change Time (sec)	105	0	38	61	73
Green Time (sec)	19	32	17	6	26
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	25	38	23	12	32
Phase Split	19 %	29 %	18 %	9 %	25 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

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MOVEMENT SUMMARY

 Site: Barneson/Woods

 Network: Barneson Boulevard
2031 AM

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Arrival Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
2	T1	436	1.0	436	1.0	0.112	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		436	1.0	436	1.0	0.112	0.0	NA	0.0	0.0	0.00	0.00	60.0
East: Woods E													
4	L2	182	1.0	182	1.0	0.137	5.6	LOS A	0.0	0.0	0.00	0.58	50.9
Approach		182	1.0	182	1.0	0.137	5.6	LOS A	0.0	0.0	0.00	0.58	50.9
North: Barneson N													
7	L2	600	1.0	600	1.0	0.325	5.5	LOS A	0.0	0.0	0.00	0.58	53.5
8	T1	231	1.0	231	1.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		831	1.0	831	1.0	0.325	4.0	NA	0.0	0.0	0.00	0.42	54.5
All Vehicles		1448	1.0	1448	1.0	0.325	3.0	NA	0.0	0.0	0.00	0.31	55.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 **Site: Barneson/Cavenagh**

 **Network: Barneson Boulevard**
2031 AM

New Site

Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Cavenagh E													
5	T1	312	1.0	312	1.0	0.276	14.1	LOS B	9.6	67.6	0.53	0.46	48.8
6	R2	309	1.0	309	1.0	0.489	25.7	LOS C	10.8	75.9	0.82	0.80	32.8
Approach		621	1.0	621	1.0	0.489	19.9	LOS B	10.8	75.9	0.67	0.63	41.9
North: Barneson N													
7	L2	119	1.0	119	1.0	0.430	48.1	LOS D	10.8	76.6	0.88	0.80	33.0
9	R2	295	1.0	295	1.0	0.430	48.4	LOS D	10.8	76.6	0.84	0.79	32.9
Approach		414	1.0	414	1.0	0.430	48.3	LOS D	10.8	76.6	0.85	0.80	32.9
West: Cavenagh W													
10	L2	125	1.0	125	1.0	0.425	56.7	LOS E	8.0	56.3	0.93	0.79	21.3
11	T1	211	1.0	211	1.0	0.425	45.6	LOS D	10.5	74.3	0.90	0.75	34.2
Approach		336	1.0	336	1.0	0.425	49.7	LOS D	10.5	74.3	0.91	0.76	30.0
All Vehicles		1371	1.0	1371	1.0	0.489	35.8	LOS D	10.8	76.6	0.78	0.71	35.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	53	38.5	LOS D	0.1	0.1	0.77	0.77
P3	North Full Crossing	53	50.1	LOS E	0.2	0.2	0.88	0.88
P4	West Full Crossing	53	38.5	LOS D	0.1	0.1	0.77	0.77
All Pedestrians		158	42.4	LOS E			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 AM Peak - SIDRA Analysis Rev1.sip6

PHASING SUMMARY

 **Site: Barneson/Cavenagh**

 **Network: Barneson Boulevard
2031 AM**

New Site

Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Network Cycle Time)

Phase times specified by the user

Sequence: Split Phasing

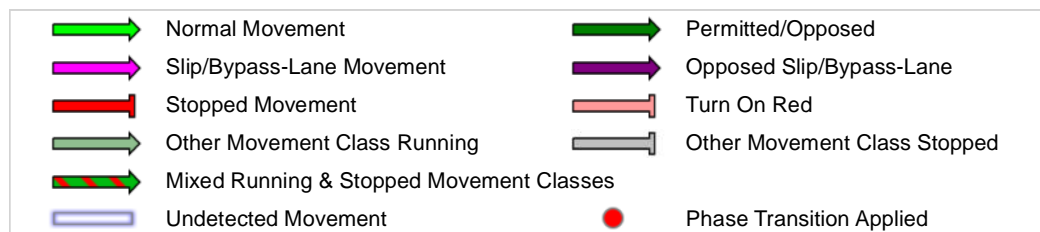
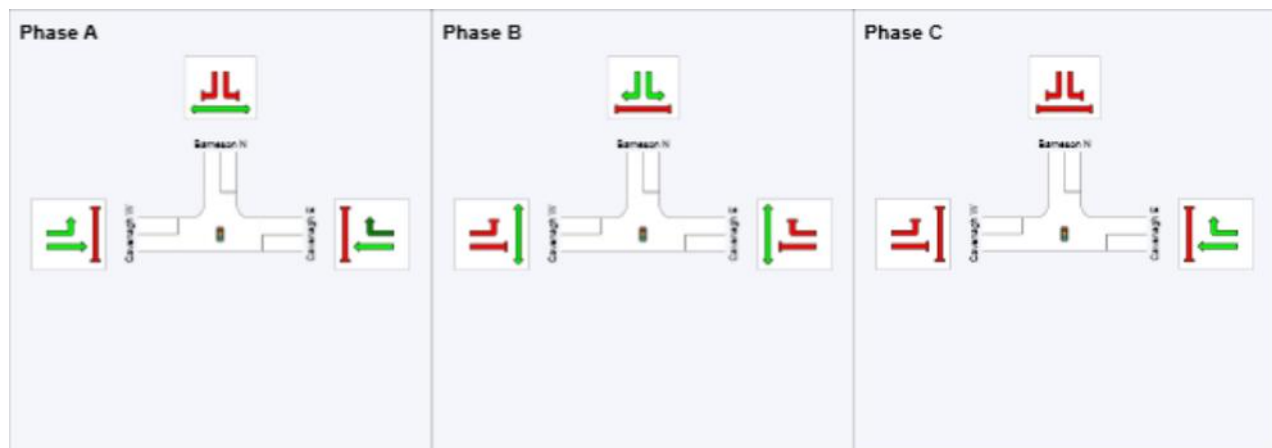
Movement Class: All Movement Classes

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	37	85
Green Time (sec)	31	42	39
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	37	48	45
Phase Split	28 %	37 %	35 %



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MOVEMENT SUMMARY

 **Site: Barneson/Tiger Brennan**

 **Network: Barneson Boulevard
2031 PM**

New Site

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Arrival Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles Distance veh m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: Barneson S													
1	L2	14	1.0	14	1.0	0.009	6.2	LOS A	0.1	0.5	0.18	0.58	53.6
2	T1	973	1.0	973	1.0	0.719	41.9	LOS D	27.1	191.5	0.97	0.86	35.5
Approach		986	1.0	986	1.0	0.719	41.4	LOS D	27.1	191.5	0.96	0.85	35.7
East: Tiger Brennan E													
4	L2	88	1.0	88	1.0	0.076	7.2	LOS A	0.8	5.6	0.22	0.61	48.7
5	T1	2	1.0	2	1.0	0.722	36.5	LOS D	23.7	167.5	0.93	0.86	35.5
6	R2	931	1.0	931	1.0	0.722	42.0	LOS D	23.7	167.5	0.93	0.86	34.9
Approach		1021	1.0	1021	1.0	0.722	39.0	LOS D	23.7	167.5	0.87	0.84	35.4
North: Barneson N													
8	T1	529	1.0	529	1.0	0.304	22.3	LOS C	9.7	68.7	0.68	0.58	34.8
9	R2	22	1.0	22	1.0	0.240	68.4	LOS E	1.3	9.4	0.99	0.70	27.9
Approach		552	1.0	552	1.0	0.304	24.1	LOS C	9.7	68.7	0.69	0.59	34.2
West: Tiger Brennan W													
10	L2	1	1.0	1	1.0	0.002	22.1	LOS C	0.0	0.2	0.57	0.59	43.6
12	R2	18	1.0	18	1.0	0.194	68.1	LOS E	1.1	7.5	0.99	0.70	18.8
Approach		19	1.0	19	1.0	0.194	65.5	LOS E	1.1	7.5	0.97	0.69	20.0
All Vehicles		2578	1.0	2578	1.0	0.722	36.9	LOS D	27.1	191.5	0.87	0.79	35.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	35.3	LOS D	0.1	0.1	0.77	0.77
P4	West Full Crossing	53	29.5	LOS C	0.1	0.1	0.70	0.70
All Pedestrians		105	32.4	LOS D			0.73	0.73

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

 **Site: Barneson/Tiger Brennan**

 **Network: Barneson Boulevard
2031 PM**

New Site

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Phase times specified by the user

Sequence: Split Phasing

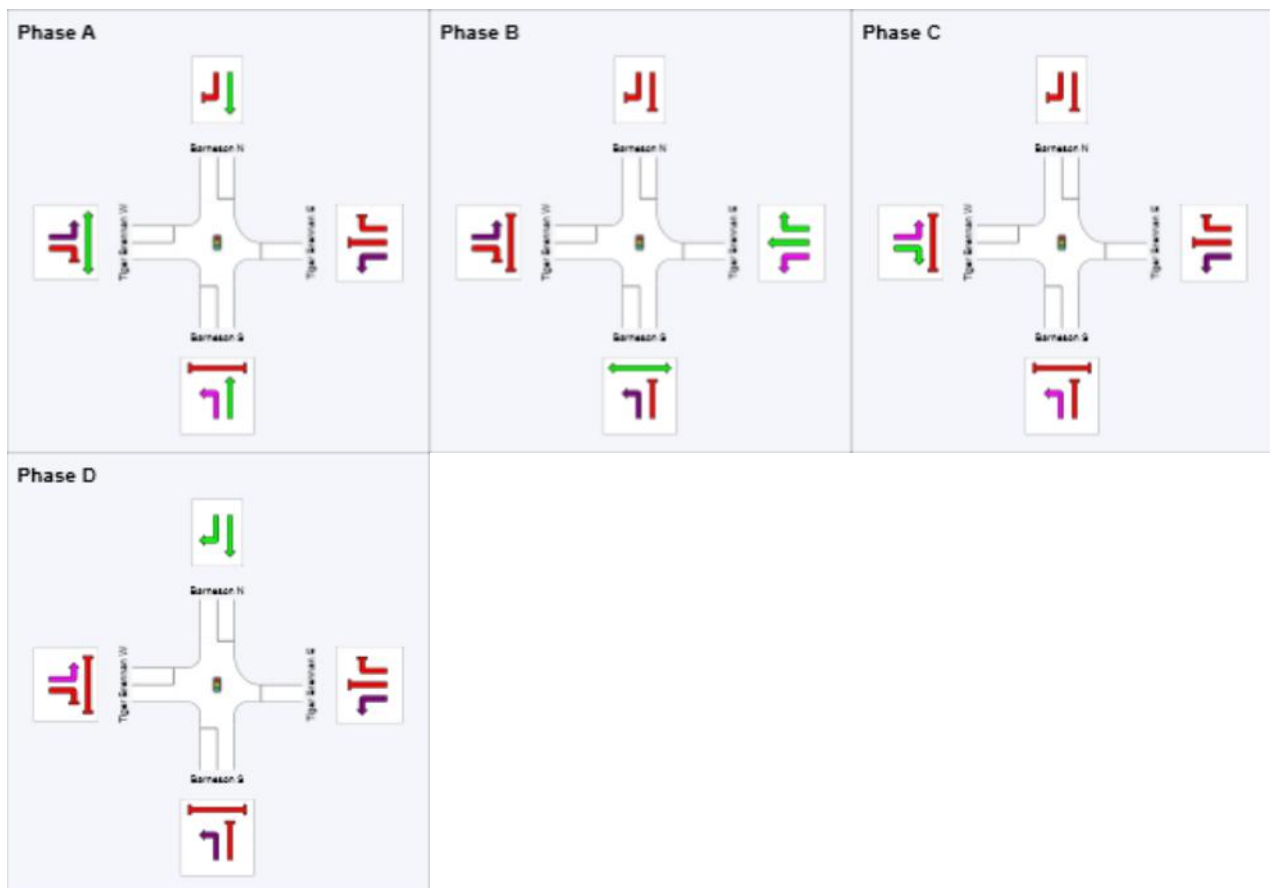
Movement Class: All Movement Classes












Input Sequence: A, B, C, D

Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	72	0	48	60
Green Time (sec)	42	42	6	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	48	48	12	12
Phase Split	40 %	40 %	10 %	10 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

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MOVEMENT SUMMARY

 Site: Barneson/Harvey

 Network: Barneson Boulevard
2031 PM

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
1	L2	17	1.0	17	1.0	0.259	5.5	LOS A	0.0	0.0	0.00	0.02	58.1
2	T1	986	1.0	986	1.0	0.259	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		1003	1.0	1003	1.0	0.259	0.1	NA	0.0	0.0	0.00	0.01	59.7
East: Harvey E													
4	L2	11	1.0	11	1.0	0.011	6.8	LOS A	0.0	0.3	0.36	0.57	48.9
Approach		11	1.0	11	1.0	0.011	6.8	LOS A	0.0	0.3	0.36	0.57	48.9
North: Barneson N													
7	L2	13	1.0	13	1.0	0.164	5.6	LOS A	0.0	0.0	0.00	0.02	58.1
8	T1	623	1.0	623	1.0	0.164	0.0	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		636	1.0	636	1.0	0.164	0.1	NA	0.0	0.0	0.00	0.01	59.7
West: Harvey W													
10	L2	12	1.0	12	1.0	0.014	7.8	LOS A	0.1	0.4	0.46	0.61	48.0
Approach		12	1.0	12	1.0	0.014	7.8	LOS A	0.1	0.4	0.46	0.61	48.0
All Vehicles		1661	1.0	1661	1.0	0.259	0.2	NA	0.1	0.4	0.01	0.02	59.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY


Site: Barneson/McMinn


Network: Barneson Boulevard
2031 PM

New Site
 Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Arrival Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
1	L2	120	1.0	120	1.0	0.881	50.3	LOS D	10.4	73.7	0.99	0.86	32.9
2	T1	342	1.0	342	1.0	0.881	49.4	LOS D	17.3	121.8	1.00	0.93	23.1
3	R2	18	1.0	18	1.0	0.109	48.9	LOS D	0.8	5.8	0.78	0.69	32.9
Approach		480	1.0	480	1.0	0.881	49.6	LOS D	17.3	121.8	0.99	0.90	26.6
East: McMinn E													
4	L2	1	1.0	1	1.0	0.822	57.0	LOS E	22.9	161.9	1.00	0.95	22.9
5	T1	585	1.0	585	1.0	0.822	53.3	LOS D	22.9	161.9	1.00	0.95	32.0
6	R2	292	1.0	292	1.0	0.822	65.1	LOS E	17.2	121.1	1.00	0.92	19.7
Approach		878	1.0	878	1.0	0.822	57.2	LOS E	22.9	161.9	1.00	0.94	28.4
NorthEast: BRT E													
26	R2	18	100.0	18	100.0	0.330	71.9	LOS E	1.1	14.6	1.00	0.71	27.0
Approach		18	100.0	18	100.0	0.330	71.9	LOS E	1.1	14.6	1.00	0.71	27.0
North: Barneson N													
7	L2	66	1.0	66	1.0	0.214	34.1	LOS C	7.6	53.9	0.84	0.74	39.2
8	T1	280	1.0	280	1.0	0.214	30.3	LOS C	8.6	60.4	0.86	0.73	30.1
9	R2	273	1.0	273	1.0	0.711	38.1	LOS D	12.1	85.2	1.00	0.85	36.4
Approach		619	1.0	619	1.0	0.711	34.1	LOS C	12.1	85.2	0.92	0.78	34.6
NorthWest: BRT W													
27	L2	14	100.0	14	100.0	0.252	71.4	LOS E	0.9	11.1	0.99	0.70	27.3
Approach		14	100.0	14	100.0	0.252	71.4	LOS E	0.9	11.1	0.99	0.70	27.3
West: McMinn W													
10	L2	367	1.0	367	1.0	0.703	27.1	LOS C	10.6	74.5	0.95	0.84	32.0
11	T1	73	1.0	73	1.0	0.363	28.6	LOS C	4.9	34.5	0.91	0.76	39.8
12	R2	177	1.0	177	1.0	0.363	46.8	LOS D	6.1	43.3	0.92	0.77	24.3
Approach		617	1.0	617	1.0	0.703	32.9	LOS C	10.6	74.5	0.94	0.81	30.7
All Vehicles		2625	2.2	2625	2.2	0.881	44.9	LOS D	22.9	161.9	0.96	0.86	29.8

Level of Service (LOS) Method: Delay (HCM 2000).
 Vehicle movement LOS values are based on average delay per movement
 Intersection and Approach LOS values are based on average delay for all vehicle movements.
 SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
 Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P2	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95

All Pedestrians	211	54.3	LOS E	0.95	0.95
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Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY


Site: Barneson/McMinn

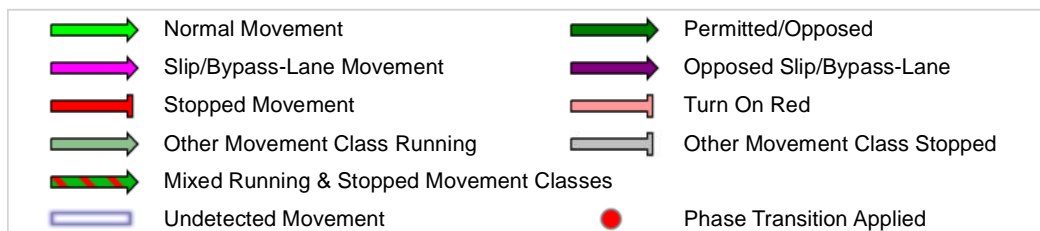
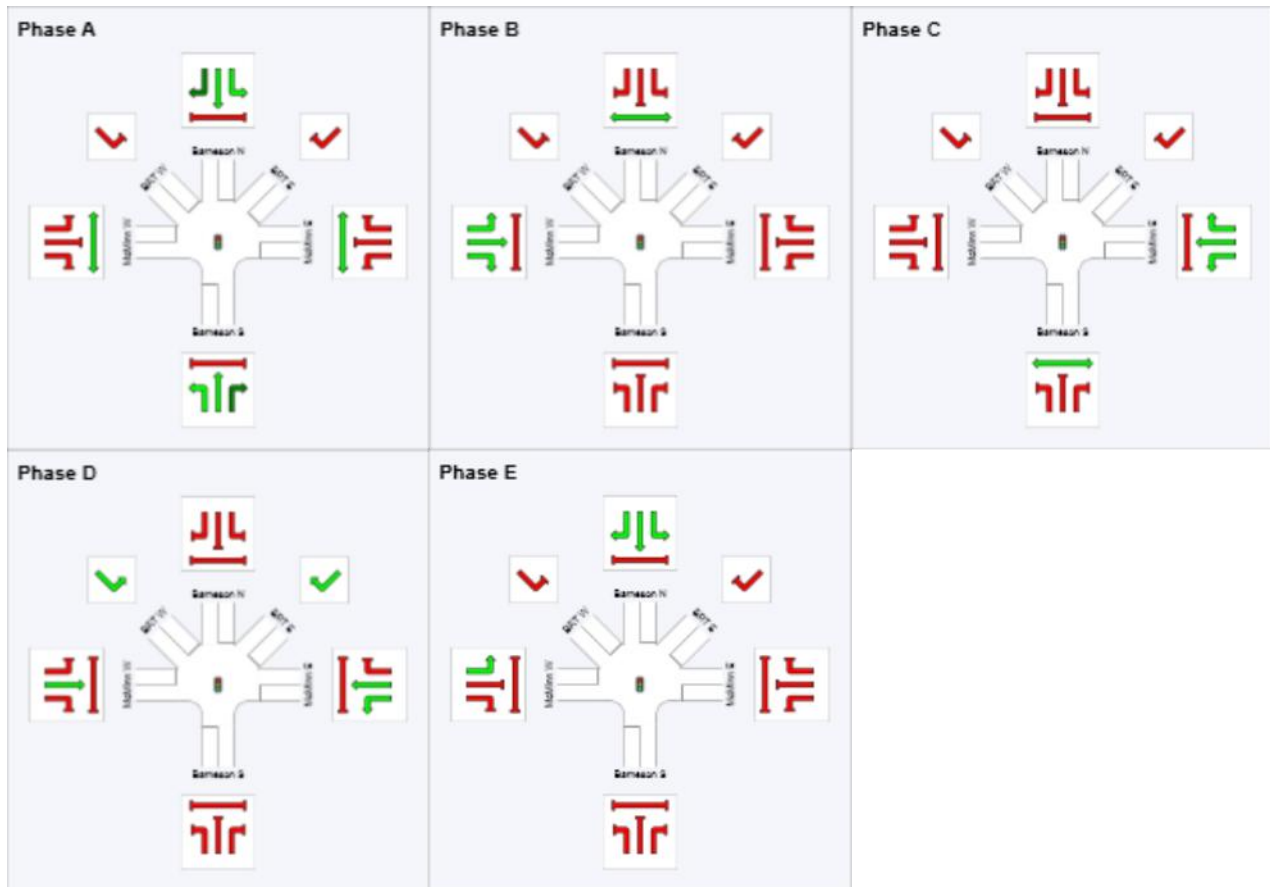

Network: Barneson Boulevard
2031 PM

New Site
 Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Phase times specified by the user
Sequence: Split Phasing
Movement Class: All Movement Classes
Input Sequence: A, B, C, D, E
Output Sequence: A, B, C, D, E

Phase Timing Results

Phase	A	B	C	D	E
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	67	93	0	23	35
Green Time (sec)	20	21	17	6	26
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	26	27	23	12	32
Phase Split	22 %	23 %	19 %	10 %	27 %



MOVEMENT SUMMARY

 Site: Barneson/Woods

 Network: Barneson Boulevard
2031 PM

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Arrival Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barneson S													
2	T1	485	1.0	485	1.0	0.125	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		485	1.0	485	1.0	0.125	0.0	NA	0.0	0.0	0.00	0.00	60.0
East: Woods E													
4	L2	479	1.0	479	1.0	0.382	5.9	LOS A	2.2	15.7	0.21	0.54	49.7
Approach		479	1.0	479	1.0	0.382	5.9	LOS A	2.2	15.7	0.21	0.54	49.7
North: Barneson N													
7	L2	158	1.0	158	1.0	0.120	5.6	LOS A	0.0	0.0	0.00	0.41	54.9
8	T1	300	1.0	300	1.0	0.120	0.0	LOS A	0.0	0.0	0.00	0.09	58.3
Approach		458	1.0	458	1.0	0.120	1.9	NA	0.0	0.0	0.00	0.20	56.5
All Vehicles		1422	1.0	1422	1.0	0.382	2.6	NA	2.2	15.7	0.07	0.25	55.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 PM Peak - SIDRA Analysis Rev1.sip6

MOVEMENT SUMMARY

 Site: Barneson/Cavenagh

 Network: Barneson Boulevard
2031 PM

New Site

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles													
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Arrival Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Cavenagh E													
5	T1	329	1.0	329	1.0	0.347	19.8	LOS B	11.6	82.2	0.66	0.57	45.3
6	R2	374	1.0	374	1.0	0.650	29.5	LOS C	14.1	99.3	0.92	0.84	30.7
Approach		703	1.0	703	1.0	0.650	25.0	LOS C	14.1	99.3	0.80	0.71	38.6
North: Barneson N													
7	L2	67	1.0	67	1.0	0.622	41.1	LOS D	19.1	134.8	0.89	0.84	35.2
9	R2	714	1.0	714	1.0	0.622	41.0	LOS D	19.1	134.8	0.89	0.84	35.2
Approach		781	1.0	781	1.0	0.622	41.0	LOS D	19.1	134.8	0.89	0.84	35.2
West: Cavenagh W													
10	L2	112	1.0	112	1.0	0.646	62.6	LOS E	7.8	55.1	1.00	0.82	20.0
11	T1	240	1.0	240	1.0	0.646	51.1	LOS D	12.1	85.4	0.99	0.82	32.5
Approach		352	1.0	352	1.0	0.646	54.7	LOS D	12.1	85.4	0.99	0.82	29.1
All Vehicles		1836	1.0	1836	1.0	0.650	37.5	LOS D	19.1	134.8	0.87	0.79	34.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Prop. Queued	Effective Stop Rate per ped		
P2	East Full Crossing	53	28.8	LOS C	0.1	0.1	0.69	0.69	
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95	
P4	West Full Crossing	53	28.8	LOS C	0.1	0.1	0.69	0.69	
All Pedestrians		158	37.3	LOS D			0.78	0.78	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

 **Site: Barneson/Cavenagh**

 **Network: Barneson Boulevard
2031 PM**

New Site

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Phase times specified by the user

Sequence: Split Phasing

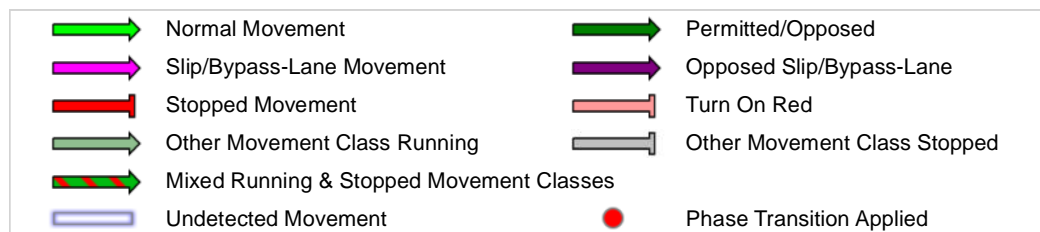
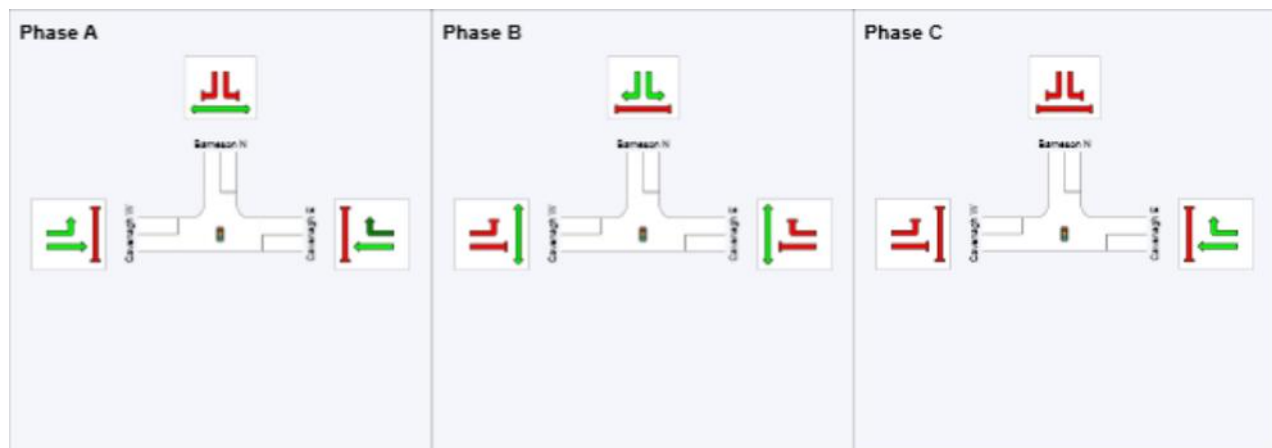
Movement Class: All Movement Classes

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	27	82
Green Time (sec)	21	49	32
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	55	38
Phase Split	23 %	46 %	32 %



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Appendix. C

Appendix. D



Frequently Asked Questions

Barneson Boulevard & Tiger Brennan Drive Duplication Project

Table of Contents

1.	General	3
2.	Construction	5
3.	Neighbourhood and surrounding environment	7
4.	Consultation process	8
5.	Landscaping and Public Art.....	9
6.	Cyclists and Pedestrians	10
7.	Bus stops.....	11
8.	Intersections	12
9.	Woods Street.....	14
10.	Parking.....	16
11.	Frog Hollow Park.....	16
12.	Old Darwin Primary School	18
13.	Frog Hollow Centre for the Arts.....	18
14.	Other.....	20
15.	More questions?	20

1. General

1.1. *Why is the road being built?*

Tiger Brennan Drive currently receives high traffic volumes, which will grow as the population of greater Darwin increases, placing further strain on the current entry points to the narrow peninsula. The construction of Barneson Boulevard and duplication of Tiger Brennan Drive will help to reduce peak period congestion by dispersing traffic entering and exiting the CBD.

Construction of Barneson Boulevard will provide an important third arterial link into the centre of the CBD, improving the distribution of traffic and relieving pressure on the existing TBD and Stuart Highway routes. The link will also provide access for future land development on the periphery of the city. Barneson Boulevard is consistent with the 10 year infrastructure plan.

1.2. *What evidence is there to indicate that the road will be beneficial?*

Economic analysis carried out as part of the business case showed that the project is estimated to result in a number of benefits, including improved travel times for commuters entering and exiting the CBD.

Additionally, the project will open up a substantial area of high value city centre land for development increasing the effective catchment area of the city through reduced travel times.

1.3. *Where will the road be built?*

The Boulevard will provide a new link between Tiger Brennan Drive and Cavenagh Street, intersecting McMinn Street and Woods St. The Boulevard follows a corridor that was established for this purpose many years ago.

The corridor to accommodate Barneson Boulevard was identified 20 years ago in the Central Darwin Planning Concepts and Development Opportunities (1996) and was subsequently preserved through a Proposed Main Road zoning. Services in the area have been future-proofed to facilitate it. This corridor was identified as the best route to meet future planning objectives, including to better disperse traffic entering and exiting Darwin CBD.

1.4. *Why is the road being built there?*

The corridor to accommodate Barneson Boulevard was identified 20 years ago in the Central Darwin Planning Concepts and Development Opportunities (1996) and was subsequently preserved through a Proposed Main Road zoning. This corridor was identified as the best route to meet future planning objectives, including to better disperse traffic entering Darwin CBD as the road connects to the Centre of the CBD, thus helping in efficient movement of traffic.

1.5. *Were other routes considered for the dispersal of traffic?*

Yes. A previous planning study in 2014 by the Department of Transport examined options to construct a new realigned section of the Stuart Highway at Stuart Park. The results of the planning study showed that although it would assist in alleviating the currently congested section of the Stuart Highway through Stuart Park and increase capacity at the Stuart Highway/Daly Street/McMinn Street intersection, it

would not relieve the Tiger Brennan Drive/Bennett Street/McMinn Street intersection. Traffic approaching the CBD would still be concentrated at the two entry points.

1.6. *Was Knuckey Street considered as an alternative to Barneson Boulevard?*

The proposed future extension of Knuckey Street to Frances Bay is a separate project to the development of Barneson Boulevard. Both projects are identified in the Darwin City Master Plan as improving connections and links to Darwin city centre.

The point at which Barneson Boulevard connects with Cavenagh Street is ideally situated at an equal distance from Tiger Brennan Drive on the eastern side of Darwin peninsular, and the Stuart Highway on the western side of the peninsular. This strategic position means that it is ideally located to evenly disperse traffic which is the primary objective of Barneson Boulevard.

1.7. *Why was the original tunnel option disregarded?*

A tunnel option was originally considered for Barneson Boulevard, however it was not feasible due to multiple drawbacks including:

- High cost exceeding \$80 million plus as opposed to \$20 million for current proposed design.
- High construction impact such as the excavation, treatment and disposal of a large quantity of acid sulphate and soils.
- Large volume of undispersed traffic delivered to Cavenagh St, creating congestion and amenity issues
- Lower accessibility and network connectivity, with inferior street level visibility making it undesirable for pedestrians.

1.8. *What factors determined the entry point for the road?*

Factors included:

- land availability for future road reserve
- an entry point which delivered traffic to the centre of Darwin CBD
- a point that was equal distance from Tiger Brennan Drive and the Stuart Highway
- a suitable entry point that would meet the objective to disperse traffic and ease congestion.

1.9. *How much of a reduction in travel time can commuters expect when the construction of Barneson Boulevard and duplication of Tiger Brennan Drive are complete?*

The construction of Barneson Boulevard and duplication of Tiger Brennan Drive will help to ease congestion entering and exiting the Darwin CBD and is focussed on dispersing traffic, rather than increasing or speeding up traffic. Time savings will primarily be realised in the future when higher traffic volumes are expected. Commuters will benefit in the immediate term by having an alternate route if other roads to the CBD become blocked as a result of incident management.

1.10. *How will this project be funded?*

The project is worth \$39.5 million and is made up of funding from the Australian Government (\$29 million), NT Government (\$5 million) and City of Darwin Council (\$5 million). The funding will be broken

into two major components - the construction of a new iconic entry into the city through Barneson Boulevard worth \$20 million and the duplication of Tiger Brennan Drive from Dinah Beach Road to McMinn St worth \$19.53 million.

1.11. *What will be the speed limit along Barneson Boulevard?*

50km per hour.

1.12. *What will be the speed limit along Tiger Brennan Drive from Dinah Beach Road to the city?*

50km per hour.

2. Construction

2.1. *When will construction begin and how long will it take?*

It is expected that construction on this project will commence later in 2017 and finish by end of 2019 subject to various project approvals.

Construction will take place over two key stages:

- Stage 1 – Barneson Boulevard from Dinah Beach Road to Cavenagh Street
- Stage 2 – Divert all traffic on the completed Barneson Boulevard and then duplicate Tiger Brennan Drive from Dinah Beach Road to McMinn Street intersection and the Cross Road to link Barneson Boulevard and Tiger Brennan Drive.

The construction sequencing will help reduce the risk of working under traffic and the need for extensive traffic management.

2.2. *What is the timeline?*

The planning phase is expected to be completed in 2017. Subject to project approvals, construction is expected to commence soon after.

2.3. Will construction of the Boulevard impact traffic entering and exiting the CBD from Tiger Brennan Drive?

Construction works on the duplication of Tiger Brennan Drive are expected to take approximately six months. During this time, traffic will be diverted on to the newly constructed Barneson Boulevard.

DURING CONSTRUCTION:



Graphic 1. Construction staging and road closures

Barneson Boulevard will be built as stage one. This means that when it comes time to widen Tiger Brennan Drive, traffic can be diverted onto Barneson Boulevard to allow works to take place. Once the duplication of Tiger Brennan Drive is complete, both arterial routes will be opened for operation.

At all times during construction, one major road will be in operation facilitating movement in and out of the south-eastern side of the city.

A Traffic Management Plan will be developed to minimise the impact of construction on existing traffic flow and construction will take place in a staged approach.

2.4. How will the construction of Barneson Boulevard impact existing peak hour congestion issues?

Major works will be conducted outside of peak times. A Traffic Management Plan will be developed to minimise the impact of construction on existing traffic flow.

2.5. Will construction to Barneson Boulevard and the widening of Tiger Brennan Drive happen at the same time?

No. Barneson Boulevard will be constructed first and when it is completed the duplication of Tiger Brennan Drive will commence. Traffic will be diverted to the completed Barneson Boulevard while construction on Tiger Brennan Drive takes place.

2.6. Will power and water services in the area be affected?

Barneson Boulevard will follow a corridor that was established for this purpose many years ago, and services in the area have been positioned to facilitate it. The Department is working with Power and Water to plan and construct future services in the area.

The road will run adjacent to the Power and Water Control Box at Woods Street. It will not be impacted by the road works. During construction there may be some temporary disruption to services. Notification will be provided to affected residents as per Power and Water processes.

2.7. How can I find out about jobs/contracts?

The construction project will deliver jobs in the civil construction and supporting sectors. The construction tender will be advertised in the last quarter or the 2016/17 financial year, with work planned to begin in the second half of 2017 subject to approvals.

2.8. Will any local companies benefit from a project this big?

The construction of the project will deliver hundreds of jobs in the civil construction and supporting sectors during the duration of the project and is expected to go to public tender in September 2017.

3. Neighbourhood and surrounding environment

3.1. Will trees be removed as part of the project?

Yes, some trees will be removed to create space for the road, footpaths, drains and other associated infrastructure. This includes some mangroves. As part of the construction of the road, new landscaping and tree planting will occur to create shade and a sense of place.

3.2. What about sacred trees/trees of significance?

DIPL has obtained an Authority Certificate from the Aboriginal Areas Protection Authority (AAPA). The Authority Certificate identifies registered sacred sites and sacred trees. A search of the NT Heritage Register has also been conducted. The results include three sacred trees on the site of the Frog Hollow Centre for the Arts and a boab tree located in the middle of the Post Office Car Park. No registered sacred sites (including trees) or trees listed on the NT Heritage Register are anticipated to be impacted by the planned works.

3.3. Will One Mile Dam be affected?

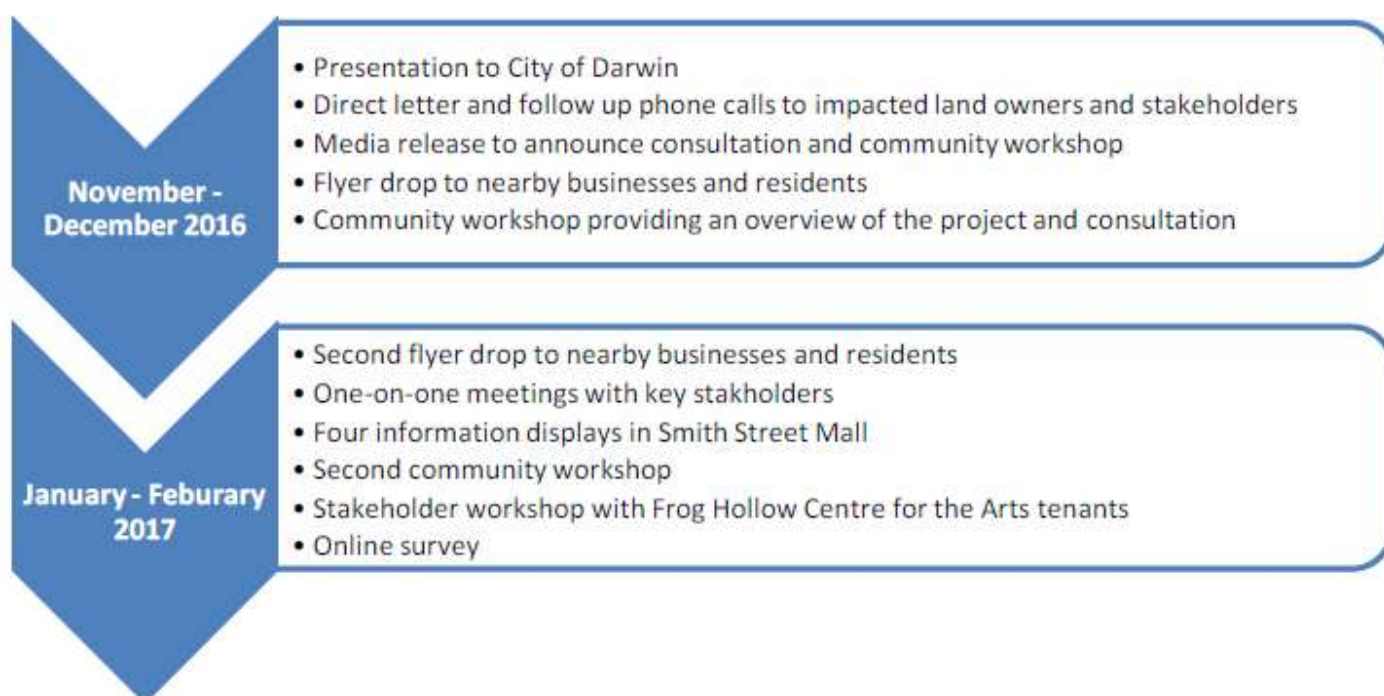
No works are proposed within Lot 5027 Town of Darwin (the lot in which One Mile Dam is located). During construction, residents at One Mile may experience temporary noise, vibration and dust impacts. Potential impacts and management measures are being assessed in accordance with the Environmental Assessment Act and Waste Management and Pollution Control Act. A Communication Plan is being developed to inform One Mile and other potentially impact stakeholders of potential works, timing, measures in place to reduce potential impacts, complaints procedures and the like.

4. Consultation process

4.1. What is the consultation process for this project?

Consultation regarding the project occurred in 2013 as part of the Darwin City Master Plan process. In 2015 the Department of Infrastructure, Planning and Logistics met with a limited group of key stakeholders to discuss the vision of the project and potential impacts. In December 2016, a broader consultation program commenced, inviting feedback on the concept design from key stakeholders and the broader community.

This consultation program ran over three months from December 2016 to February 2017. It involved:



Graphic 2. Consultation program December 2016 – February 2017 inviting feedback on the concept design.

Concept designs are now being reviewed to incorporate feedback from the consultation program. Final designs will be announced for a further round of public consultation prior to construction commencing later in 2017.

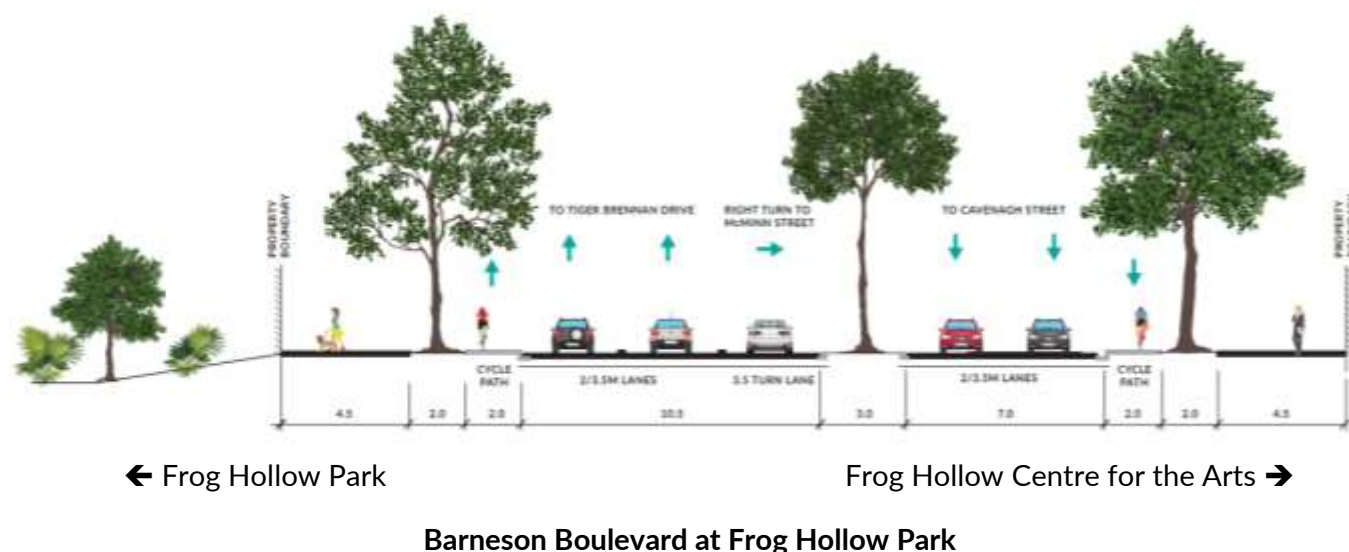
4.2. How will the Frog Hollow Centre for the Arts tenants be engaged in the consultation process?

The consultation process included meetings and a dedicated workshop with the tenants of the Frog Hollow Centre for the Arts, identifying issues and solutions to impact at this site. The next stage will include the development of a communication plan to inform tenants and other impacted stakeholders about construction timelines.

5. Landscaping and Public Art

5.1. What will the streetscape look like?

Barneson Boulevard will be wider than most Darwin streets, and will feature landscaping and provide a leafy shaded entry to Darwin's CBD.



Graphic 3. Cross section drawing Barneson Boulevard near Frog Hollow Park

5.3. What sort of trees will be used?

Landscaping will take place after the road has been constructed. The species of flora will be in keeping with the surrounding area. Trees will include natives selected to respond to the particular environment such as Milkwood, Rain Tree, Yellow Flame Tree, White Bush Apple, Mataranka Palms, Beach Hibiscus, Paperbark, Pongamia and Pandanus.

Final species selection subject to detailed design and in particular the space available for both canopy and root system development.

5.4. Are there any environmental risks?

Potential environmental risks are being considered in accordance with:

- The Northern Territory Environment Protection Authority (NT EPA) environmental assessment processes, and;
- Department of Infrastructure, Planning and Logistics policies.

A Notice of Intent is being prepared for referral to the NT EPA.

5.5. I live nearby; will I be affected by dust and noise pollution during construction?

During construction, machinery will generate noise during operation and dust may be generated from activities such as clearing, excavation, and stockpiling (particularly in the Dry Season). Potential noise and dust impacts will be assessed in accordance with the NT EPA environmental assessment process and DIPL policies. Management measures will be implemented such as use of water carts, restricting works at night where possible, an Erosion and Sediment Control Plan and a Noise Management Plan.

5.6. Residents, businesses, commuters and visitors will receive targeted communications during the construction phase informing them of the progress of works and updates such as any proposed works are night. I live nearby; will I be affected by traffic noise when the road is completed?

Traffic generated noise is anticipated to impact nearby residents. A noise mitigation measure is incorporated into the road design i.e. the road surfacing will be dense graded asphalt. Dense graded asphalt combined with a low speed limit will assist to minimise noise impacts.

5.7. Will there be opportunities for community art around the site of Barneson Boulevard?

A new entry statement public art project to Darwin will be created in conjunction with the project. The Darwin arts community and the public will have an opportunity to provide input into the planning for this element of the project.

5.8. Why are Cafes and Shops included in the artist impressions of the road?

The construction of Barneson Boulevard and completion of the full duplication of Tiger Brennan Drive is a landmark project that will help unlock the potential of the city's eastern end. The Boulevard's cool and shady ambience will incorporate urban landscaping and amenities to support activities such as al fresco dining and other potential commercial developments in the future.

6. Cyclists and Pedestrians**6.1. Will there be provisions for pedestrians and cyclists?**

Yes. Barneson Boulevard will contain wide footpaths and segregated cycle ways for pedestrians and cyclists. To ensure planning is carried out in the interests of cyclists, the Northern Territory Government will continue to liaise with the Bicycle Network as a key stakeholder in this project.

6.2. How will existing bike paths connect to the bike paths on Barneson?

The segregated cycle way which runs along Barneson Boulevard from Cavenagh Street to Tiger Brennan Drive connects with the existing shared path on Tiger Brennan Drive. See below image:

Please refer to the *Darwin Region Cycling and Walking map* and also the Barneson Boulevard concept design on our webpage at dipl.nt.gov.au.

6.3. Will the pathways be sheltered?

No. Trees which are prominent in the design of the Boulevard will grow to provide shade along the route, however hard structure shade or rain shelters are not included.

6.4. *What safety measures have been put in place for pedestrians using Barneson Boulevard?*

Intersections along Barneson Boulevard will be signalised, this has been identified as the safest and most effective traffic management approach to intersection especially for pedestrians, cyclists and disabled people.

6.5. *What will be the cyclist and pedestrian connectivity from Woods Street on to and across Barneson?*

Following community consultation on the concept designs, the draft plans will be reconsidered to provide for pedestrian connectivity at Woods St.

7. Bus stops

7.1. *Will any existing bus routes or timetables be affected?*

During construction of the Cavenagh Street / Barneson Boulevard intersection, the Cavenagh Street bus stop may be temporarily relocated elsewhere in the CBD for safety and congestions reasons.

Upon completion of construction, no changes to current bus routes are planned as part of this project.

Bus timetables will need to be varied slightly following completion of the project to accommodate the reduction in available bus bays at the reconfigured Cavanagh Street bus stop outside Woolworths. The community will be notified of the changes to bus services related to the project.

7.2. *Will buses run along the new road?*

Currently, there are no services planning to run along Barneson Boulevard. However, the road will have the capacity to accommodate both commercial and public buses if required in the future.

7.3. *Will there be a bus stop on Barneson Boulevard?*

A bus stop is not proposed along Barneson Boulevard at this stage.

The current bus network does not run along Barneson Boulevard, therefore there is no need to make provision for any bus bay. There is capacity to include Barneson Boulevard into the existing bus network in the future should demand warrant it.

7.4. *What will happen to the Woolworths bus stop?*

During construction of the Cavenagh Street / Barneson Boulevard intersection, the Cavenagh Street bus stop may be temporarily relocated elsewhere in the CBD for safety and congestions reasons.

The Woolworths Bus Stop will be redesigned to accommodate the new intersection with Barneson Boulevard and the number of bus bays will be reduced by one. This will require changes to the allocation of bus stops and adjustments to the departure times of some services. The changes to departure times will only be by a couple of minutes. This will assist in managing bus traffic at the reconfigured bus stop. Passengers will be advised of the necessary changes as part of the move back to Cavanagh Street following construction.

8. Intersections

8.1. *Are any intersections being upgraded or changed as part of the project?*

Yes. There will be three new intersections along Barneson Boulevard at Cavenagh St, McMinn St and Tiger Brennan Drive.

8.2. *Will the new intersections be signalised?*

Yes. Traffic signals have been identified as the most effective and safest traffic management approach to these intersections, especially for pedestrians, cyclists and disabled people.

8.3. *Were roundabouts considered as an alternative to signals?*

Yes. Roundabouts work well when there are even amounts of traffic approaching on all arms. In the case of Barneson Boulevard, traffic studies have indicated that roundabouts will adversely impact the traffic flow on the roads with lower traffic volumes.

Barneson Boulevard presents potential for new mixed use development along the corridor. The success of such development will be dependent on attracting sufficient foot traffic, something which roundabouts will not encourage.

Roundabout intersections pose greater safety risks for pedestrians and cyclists, particularly when traffic volumes are high, and are thus generally not suitable for a CBD environment. High pedestrian activity is a necessity for a successful and vibrant CBD.

8.4. *Why is McMinn Street being signalised?*

The Barneson Boulevard / McMinn Street intersection is part of long term planning for the eventual duplication of McMinn Street.

Other options, such as a roundabout at this intersection would also encroach on the boundaries of the heritage listed Frog Hollow Park.

8.5. *Are there any intersection treatments options other than signals and roundabouts?*

Not that will meet the objectives of this project to disperse traffic and ease congestion in a safe manner.

8.6. *Why aren't roundabouts being used?*

Traffic signals have been identified as the safest and most effective traffic management approach to these intersections, especially for pedestrians, cyclists and disabled people. Roundabouts work well when there are even amounts of traffic approaching on all arms. In the case of Barneson Boulevard, traffic modelling has indicated that roundabouts will adversely impact the traffic flow on the roads with lower traffic volumes.

8.7. *Will this project mean more traffic lights to slow us down on the road?*

The signalised intersections are planned on major intersections only at Cavenagh, McMinn and Tiger Brennan Drive. These signals will read the demand of each of the approaches and ensures there is a continuous flow of traffic. This system operates on a priority basis dictated by demand, which limits waiting time.

8.8. *How will the exit onto Cavenagh Street be handled – will there be a bottleneck?*

Traffic modelling indicates, with the construction of Barneson Boulevard, Darwin's CBD will have a third entry point and therefore will disperse traffic and ease congestion. It will also provide direct access to the Cavenagh Street Car Park from Cavenagh and Woods Streets.

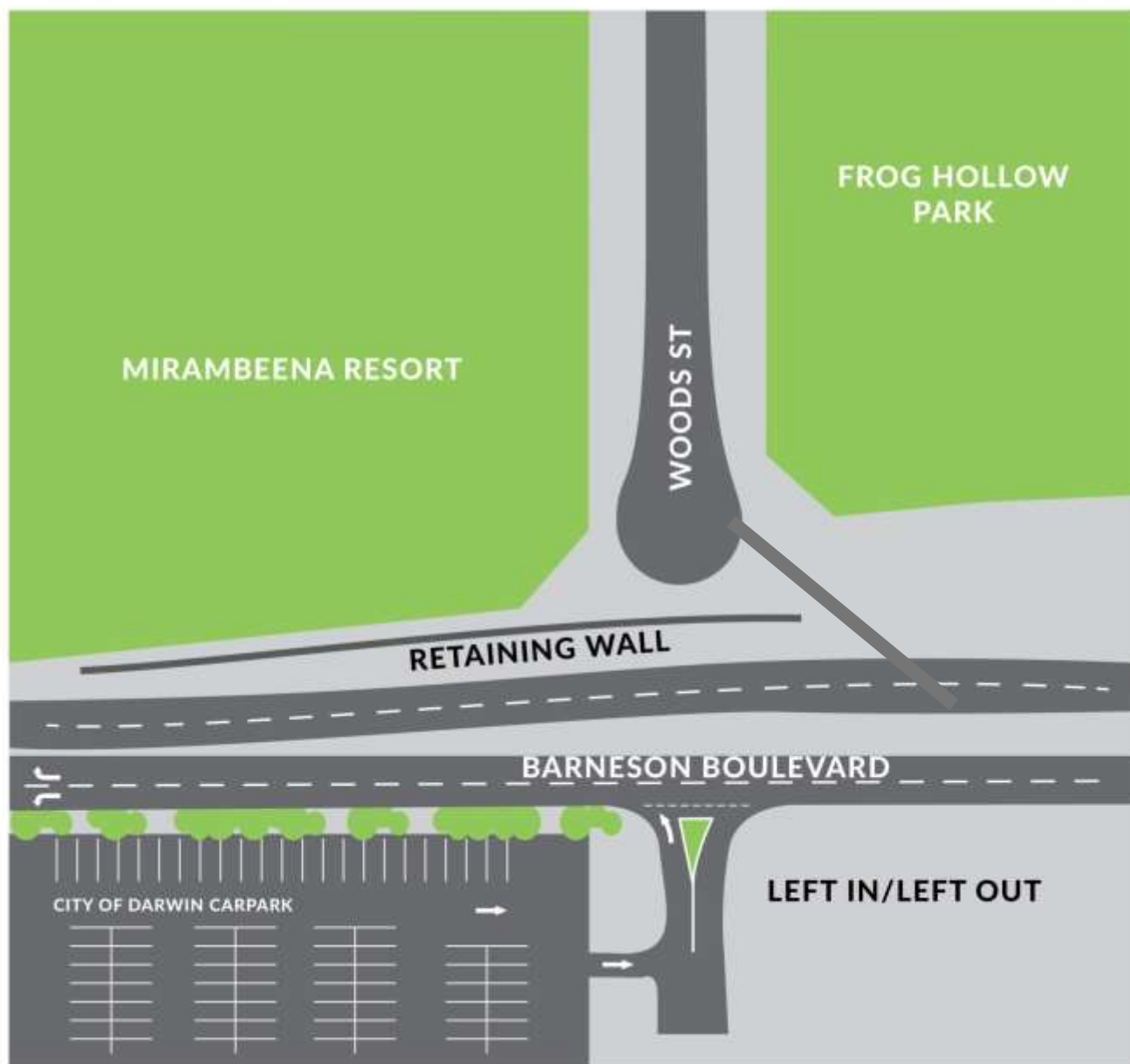
8.9. *Will there be right turn access from Harvey Street?*

No. Left-in Left-out only. This is for safety reasons. The proximity to other intersections is too close to warrant any other type of traffic treatment at Harvey Street. Residents will have access to McMinn Street from Day Street.

8.10. *Was a fly over bridge considered instead of signalised lights at the Tiger Brennan Drive and Barneson Boulevard intersection?*

Yes, however this type of intersection treatment was determined as cost prohibitive at this stage due to the limited benefits it offered. A grade separated option in proximity of an existing signalised intersection did not offer any benefits to justify high capital cost investment.

9. Woods Street



Graphic 4. Proposed design for Woods Street including pedestrian connectivity to Barneson Boulevard

9.1. Why is Woods Street proposed as cul-de-sac in the designs?

There are a number of reasons that a cul-de-sac is proposed at Woods Street as the optimal treatment for this intersection. These include:

a) Gradient issues:

- The current design of Barneson Boulevard follows a gradual incline when travelling city-bound toward Cavenagh Street. The level at which Woods Street would be required to be built-up to match the road level of Barneson Boulevard would require significant earthworks affecting the rear access to Travelodge Mirambeena.

- There are a range of other controlling factors which determined the proposed road level for Barneson Boulevard. These include:
 - The existing road level at Cavenagh Street
 - The existing levels along the adjacent Cavenagh Street Car Park
 - The levels adjacent to the existing Power and Water Corporation switching station building in Woods St
 - The levels adjacent to the existing Arts Centre buildings (Frog Hollow).

b) Against AustRoads Guidelines:

- If Barneson Boulevard was to be constructed to a level that would allow Woods St to remain as a cross road, Barneson Boulevard would need to be constructed with a one way cross fall in excess of 5% which exceeds the 3% recommended by AustRoads Guidelines.

c) Maintaining rear-access to Woods Street for Travellodge Mirambeena

- There is a need to maintain Mirambeena's existing rear access to Woods Street. Adjustments to the level of Woods Street will impact this; therefore an at-grade solution is the most suitable alternative.

d) Avoiding impact on heritage-listed Frog Hollow Park

- Two alternative at-grade solutions were considered for the intersection at Woods Street and Barneson Boulevard. These catered for:
 - left-in (from Barneson) and left-out (from Woods St); and
 - left-out (of Woods St) only.
- Both of these options would impact on the heritage listed Frog Hollow Park and therefore were undesirable design alternatives.

e) Limited impact on traffic flow in this area

- Road-traffic that is generated along Woods Street is generated beyond Lindsay Street (there are no properties that front Woods Street between Lindsay Street and Barneson Boulevard). Traffic that might opt to travel along Woods Street will have access to alternative options along McMinn or Cavenagh Streets.
- In the Cul-de-sac option for Woods Street, pedestrian and bicycle access from Woods Street to Barneson Boulevard will be catered for as part of the proposed design.

9.2. If Woods Street is made into a cul-de-sac, how will it affect the nearby road network?

Effects on the local road network are expected to be minimal. Woods Street does not carry significant volumes of through traffic and primarily serves as access to abutting property.

9.3. How will pedestrian and cycle access be maintained?

A pedestrian and cyclist crossing will be provided where Woods Street meets Barneson Boulevard. This will include a ramp to provide access at the retaining wall.

9.4. How long/tall will the retaining wall be?

Approximately 50m long and 1.5metres high.

10. Parking

10.1. *Will Barneson Boulevard include on street parking?*

No, Barneson Boulevard will not include on street parking. One reason for this is to ensure safety of cyclists using the adjacent segregated cycle paths. On street parking was considered as part of preliminary designs however the small number of bays that could be included had a negligible effect on the overall design benefits.

Barneson Boulevard is designed to provide a streamlined entry and exit to the city for motorists and shared path users. Car parking on the arterial route would slow traffic and not be compatible with the segregated cycle paths.

10.2. *Will there be a loss of parking spaces?*

Approximately 188 of existing formal and informal parking spaces will be affected by the construction of Barneson Boulevard. City of Darwin projections show there is capacity in existing parking sites to meet demand.

10.3. *Is there capacity for parking in the CBD if these car parks are taken away?*

Yes. Provision and management of parking facilities in the CBD is monitored by City of Darwin.

City of Darwin projections show there is capacity in all day parking sites at the China Town car park, West Lane and within Zone C to meet the parking demand.

10.4. *Does this mean there are less free parking spaces in Darwin CBD?*

Approximately 80 informal, free-parking spots along the current Barneson Street will be affected. All day parking in Zone C still available in Darwin CBD. Refer to the *Parking in Darwin's City Centre* brochure available for download from www.darwin.nt.gov.au.

10.5. *What will be the impact to parking on Cavenagh Street?*

Approximately ten existing car parks on Cavenagh Street will be impacted. These are currently located in front of the Cavenagh Street Car Park.

Entry/exit to the Cavenagh Street Post Office Car Park will be relocated for safety reasons and to ease traffic congestion and queuing in close proximity to the Cavenagh Street / Barneson Boulevard intersection.

11. Frog Hollow Park

11.1. *Will Frog Hollow Park be affected?*

No road infrastructure or associated works are planned within Frog Hollow Park (Lot 5665 Town of Darwin).

In 1996, the Minister for Lands, Planning and Environment declared Frog Hollow a heritage place with cultural significance. Utilised as worker camps in the initial years of Commonwealth jurisdiction over the Northern Territory, Frog Hollow is valued as natural parkland within the central area of the city.

The road reserve for Barneson Boulevard runs adjacent to Frog Hollow in Lot 5672 Town of Darwin. The proposed new road will be located between the Frog Hollow Park on the north-western side of the Boulevard, and the Frog Hollow Centre for the Arts on the south-eastern side of the Boulevard.

While the corridor for the Boulevard will travel between these two important historical sites, design has been devised with preserving the heritage values of this space as a key priority. Sacred trees and areas of historical significance have been identified as part of planning works and will be preserved.

The project may also result in improved community access to Frog Hollow with a dedicated pedestrian and cyclist paths and a landscaped strip running alongside the Park from Woods to McMinn Streets.



Graphic .5 Standing at intersection of McMinn Street and Barneson Boulevard looking towards Cavenagh Street at Frog Hollow Park.

11.2. What is the size of the Frog Hollow Park before and after works?

Frog Hollow Park (Lot 5665) is, and will remain, approximately 1.13 hectares.

11.3. Was there an idea to build a tunnel under Frogs Hollow to protect it from a road going through the park?

A tunnel option was considered however as per Section 1.7 it was not economically feasible and would limit network connectivity and pedestrian accessibility with inferior street level visibility making it undesirable for pedestrians.

12. Old Darwin Primary School

12.1. *Will the old Darwin Primary School Building be impacted?*

A number of arts organisations which make up Frog Hollow Centre for the Arts occupy the building which is the old Darwin Primary School. See section 13.

13. Frog Hollow Centre for the Arts

13.1. *Will the Frog Hollow Centre for the Arts building be affected?*

The Centre for the Arts is an important historical landmark with cultural ties to the old Darwin primary school. The site has also been discussed in an urban planning context as a possible future location for a new, multi-storey school. Preserving the cultural value of this site is important to some sectors of the Darwin community and the current building tenants.

The proposed works will require relocation of the Arts Centre's toilet block, external stairwell and carpark access from McMinn Street. The infrastructure will be relocated elsewhere within the same Lot.

Tenants and user groups have been consulted with one-on-one meetings and workshops and we listened to their ideas and concerns. Construction will be carried out in a way that mitigates noise and dust impacts and will be timed outside of Darwin Festival period.

13.2. *What will happen with the external staircase?*

In the current plans, external stairs will be removed to make room for the pedestrian path on Barneson Boulevard. This will not impact the attached storage block.

13.3. *Where will the toilet block be moved to?*

This is being considered in consultation with current tenants.

13.4. *How long construction will take, specifically along the section which runs along Frog Hollow Centre for the Arts?*

At least six months. The overall project is expected to be completed by 2019, weather permitting.

13.5. *How many car parks will be taken and added to compensate for the lost car parks on McMinn St?*

Approximately 17 car parks will be relocated from the car park on the McMinn St side of the Centre for the Arts. The Woods St car park will be redesigned to compensate this loss.

13.6. *Will the Frog Hollow Centre for the Arts tenants be relocated during construction?*

There is no plan to relocate the tenants of Frog Hollow Centre for the Arts. The tenants of the Centre for the Arts are being consulted to identify how this project will affect them and what can be done to minimise impact during the construction period.

13.7. *How will people access the Frog Hollow Art Centre*

Staff and visitors will access the Centre for the Arts via Woods Street. This central access point will improve site security and traffic/pedestrian safety.

13.8. *How will pedestrians cross from Frog Hollow Park to the Frogs Hollow Centre for the Arts?*

While provisions hadn't been made for pedestrian access between these sites, the Department is now reviewing the concept designs to provide this access. It will likely be a pedestrian island in the median strip near the intersection of Barneson Boulevard and Woods Street.

13.9. *Will the works impact the security of the Centre for the Arts site?*

Security of the site is expected to be enhanced with improved fencing running along the site adjacent to Barneson Boulevard.

13.10. *What will be done about potential asbestos on site?*

DIPL is aware of asbestos being present in the outside toilet block. Works will be undertaken in accordance with DIPL standard specifications and legislation.

13.11. *What improvements will be made to the site?*

As well as creating a third arterial entry and exit point to the city, Barneson Boulevard will open up the development potential of surrounding land and enhance the style and amenity of the city centre and the area immediately surrounding Frog Hollow. Provision of fencing and pedestrian access is expected to contribute to the overall improvement and positive flow on effect for the Frog Hollow site. There may also be opportunities for community art around the site as a result of the works.

13.12. *During and after the construction phase, will the current access system between the main buildings be impacted and / or changed?*

This is yet to be determined as concept designs are still underway.

13.13. *Will construction works cause noise pollution, and if so, what are the identified mitigation measures?*

During construction, machinery will generate noise during operation and dust may be generated from activities such as clearing, excavation, and stockpiling (particularly in the Dry Season). Potential noise and dust impacts will be assessed in accordance with the NT EPA environmental assessment process and

DIPL policies. Management measures will be implemented such as use of water carts, restricting works at night where possible, an Erosion and Sediment Control Plan and a Noise Management Plan.

Residents, businesses, commuters and visitors will receive targeted communications during the construction phase informing them of the progress of works and updates such as any proposed works at night.

13.14. *How will the road traffic generated noise pollution be mitigated? Will the mitigation measures detrimentally impact the Frog Hollow tenancies?*

Traffic generated noise is anticipated to impact nearby residents'. A noise mitigation measure is incorporated into the road design i.e. the road will be dense graded asphalt. Dense graded asphalt combined with a low speed limit will assist to minimise noise impacts. Noise mitigation will be in accordance with the NTG Road Traffic Noise on NT Government Controlled Roads. Roads (DoT 2014). No mitigation/action is required for land uses adjacent to arterial roads where existing roads, exiting road upgrades or future road currently planned roads are.

14. Other

14.1. *What is happening to the old tank farm?*

Barneson Boulevard does not affect the old tank farm.

14.2. *Does this project affect the proposed light rail alignment?*

The potential corridor for light rail does not follow the Barneson Boulevard alignment.

The Darwin City Master Plan identifies McMinn Street as a potential corridor option for light rail, tram or rapid bus transit system.

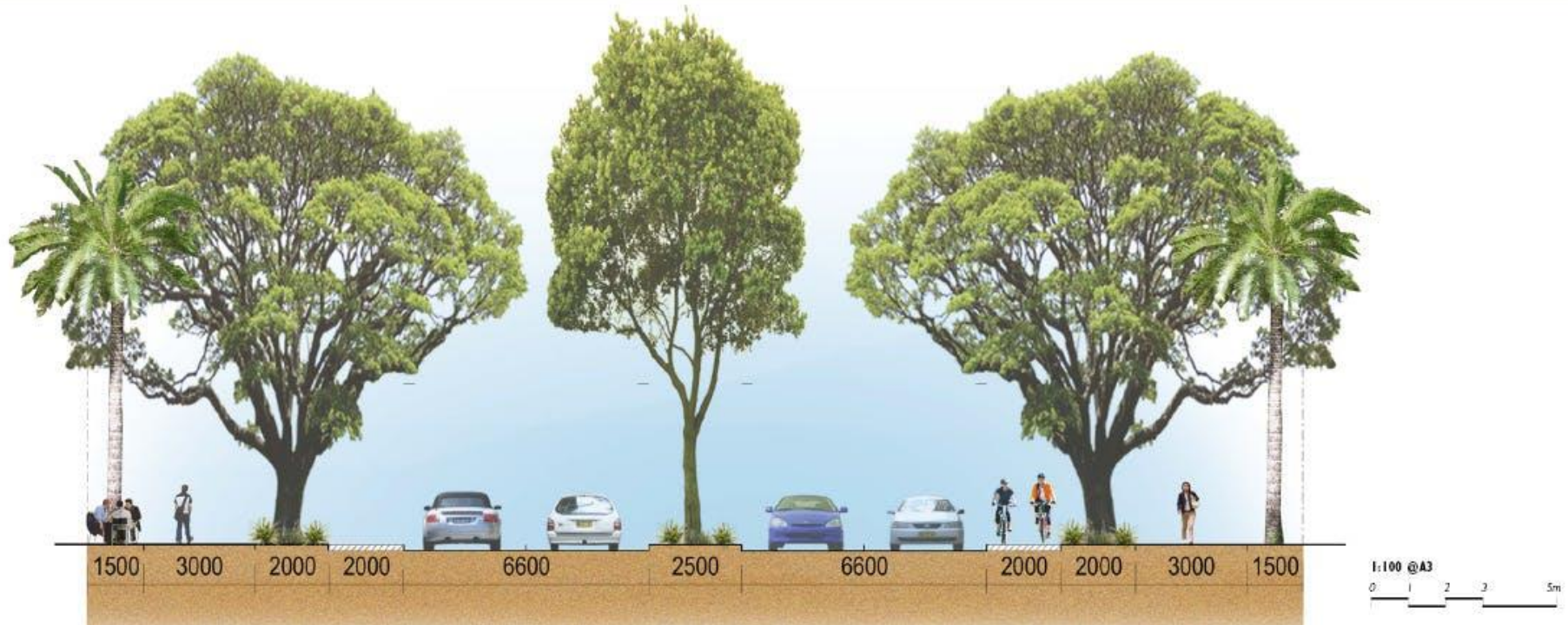
15. More questions?

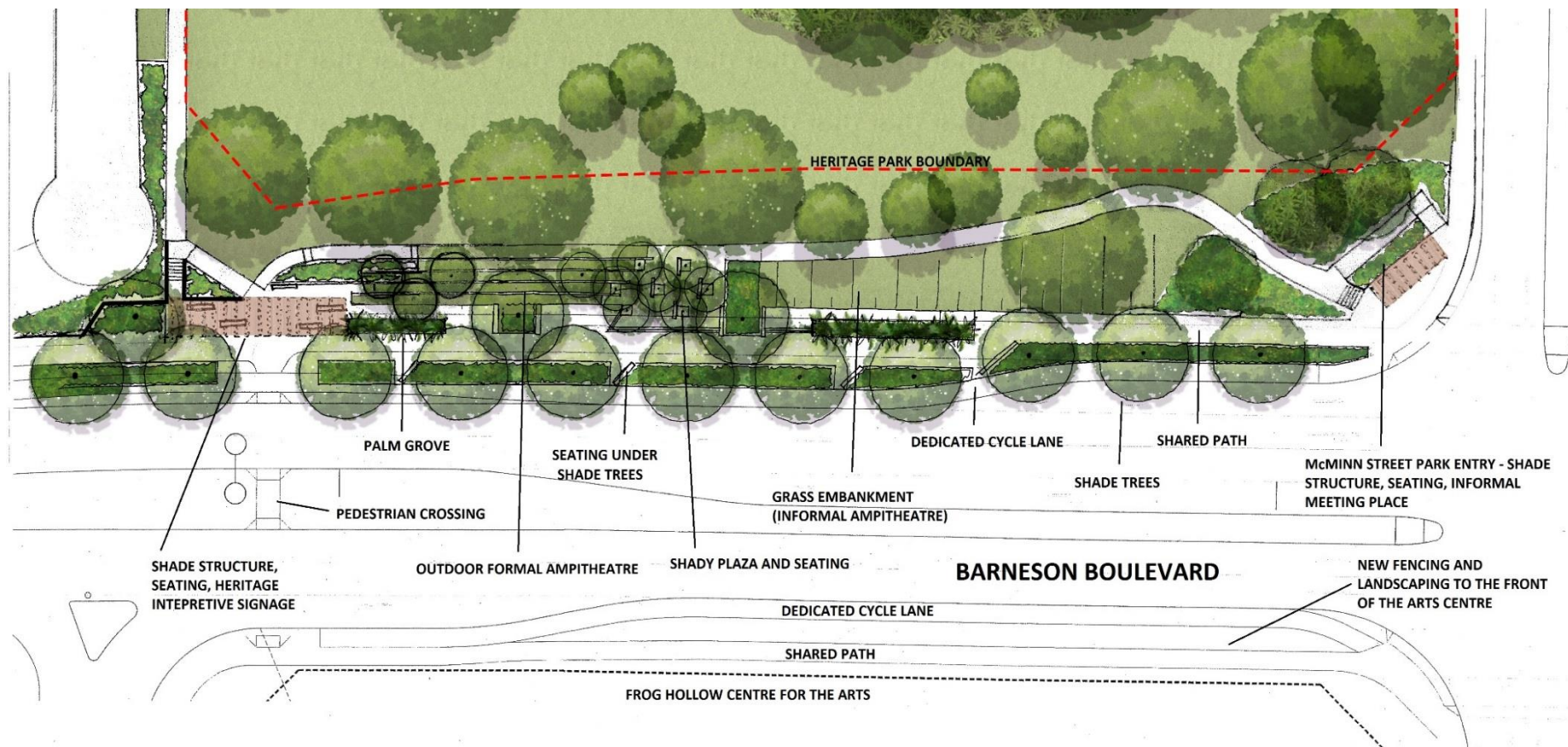
Please contact the project team on 8924 7118 or projects.tipd@nt.gov.au for more information.

Appendix. E



Barneson Boulevard Link - McMinn Street, Cavenagh Street concept. (Subject to approvals)





- The size of the trees are indicative and will depend on the type of species.
- The species type is subject to further community consultation and landscaping design.
- The time marker is from the project completion date (not the age of the tree).













Project Report

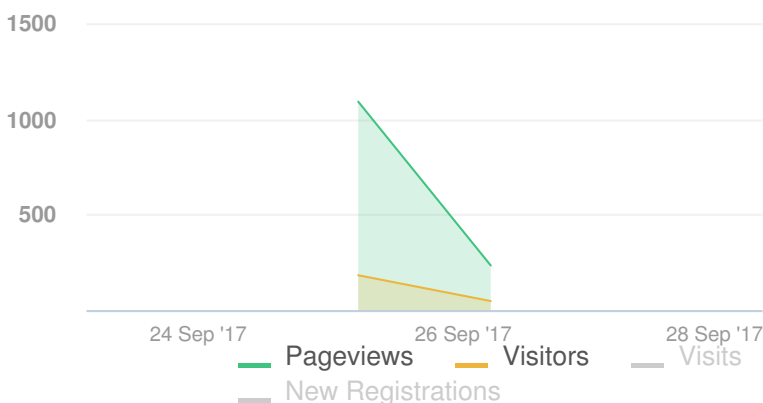
25 September 2017 - 26 September 2017

Have Your Say Northern Territory

Greening the CBD: Barneson Boulevard and Tiger Brennan Drive Stage 3 public consultation on landscaping and public space enhancement



Visitors Summary

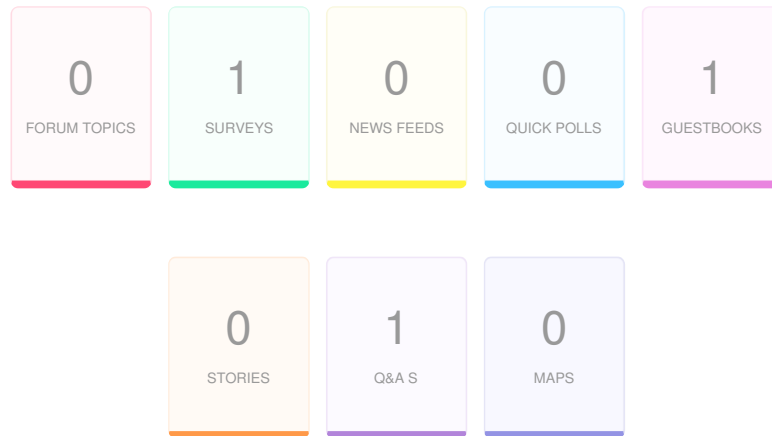


Highlights

TOTAL VISITS	248	MAX VISITORS PER DAY	182
NEW REGISTRATIONS	1		
ENGAGED VISITORS	69	INFORMED VISITORS	155
		AWARE VISITORS	227

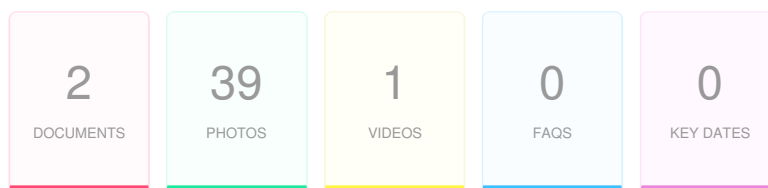
Aware Participants	227	Engaged	69
Aware Actions Performed	Participants	Engaged Actions Performed	RegisteredUnverifiedAnonymous
Visited a Project or Tool Page	227	Contributed on Forums	000
Informed Participants	155	Participated in Surveys	2067
Informed Actions Performed	Participants	Contributed to Newsfeeds	000
Viewed a video	0	Participated in Quick Polls	000
Viewed a photo	127	Posted on Guestbooks	000
Downloaded a document	19	Contributed to Stories	000
Visited the Key Dates page	0	Asked Questions	000
Visited an FAQ list Page	0	Placed Pins on Maps	000
Visited Instagram Page	0	Contributed to Brainstormers	000
Visited Multiple Project Pages	88		
Contributed to a tool (engaged)	69		

ENGAGEMENT TOOLS SUMMARY



Tool Type	Engagement Tool Name	Tool Status	Visitors	Contributors		
				Registered	Unverified	Anonymous
Survey Tool	Online survey	Published	107	2	0	67

INFORMATION WIDGET SUMMARY



Widget Type	Engagement Tool Name	Visitors	Views/Downloads
Photo	Frog Hollow Concept	90	91
Photo	Barneson map	68	69
Photo	Cross Section	43	43
Photo	Perspective With Street Sign	38	38
Photo	Barneson Boulevard Signage	34	35
Photo	Big art	33	34
Photo	Big flame tree red orange blooming	30	30
Photo	Ampitheatre	28	28
Photo	Sculptures	22	22
Photo	2 YO White Bush Apple	19	19
Photo	Mataranka Palm	18	18
Photo	Milkwood	17	17
Photo	Big Street Art	16	16
Photo	Mural art	16	16
Photo	Shade raintrees along scenic road	16	16
Photo	Paperbark	15	15
Photo	Sculptures	15	15
Photo	Flamboyant tree red bloom parac brisbane	15	15

INFORMATION WIDGET SUMMARY

Widget Type	Engagement Tool Name	Visitors	Views/Downloads
Photo	Flamboyant tree red bloom parac brisbane	15	15
Photo	Pongamia	13	13
Photo	Ampitheatre	12	12
Photo	Yellow Flame	12	12
Photo	Img 1683	11	11
Photo	Shutterstock 146060600 (1)	11	11
Photo	Urban art	11	11
Photo	Rain Tree	10	10
Photo	Wall art	9	9
Photo	Raintree	9	9
Photo	Raintree	8	8
Photo	Raintrees along main road	8	8
Photo	Mural art	7	7
Photo	Mural art	6	6
Photo	Wall art	5	5
Photo	Mural art	5	5
Photo	Sculptures	4	4
Photo	Mural art	3	3
Photo	Mural art	3	3
Photo	Sculptures	2	2

INFORMATION WIDGET SUMMARY

Widget Type	Engagement Tool Name	Visitors	Views/Downloads
Photo	Sculptures	2	2
Photo	Sculptures	1	1
Document	Traffic Modelling	14	16
Document	Greening Barneson Q&A	14	15
Faqs	faqs	0	0
Video	Greening Barneson	0	0

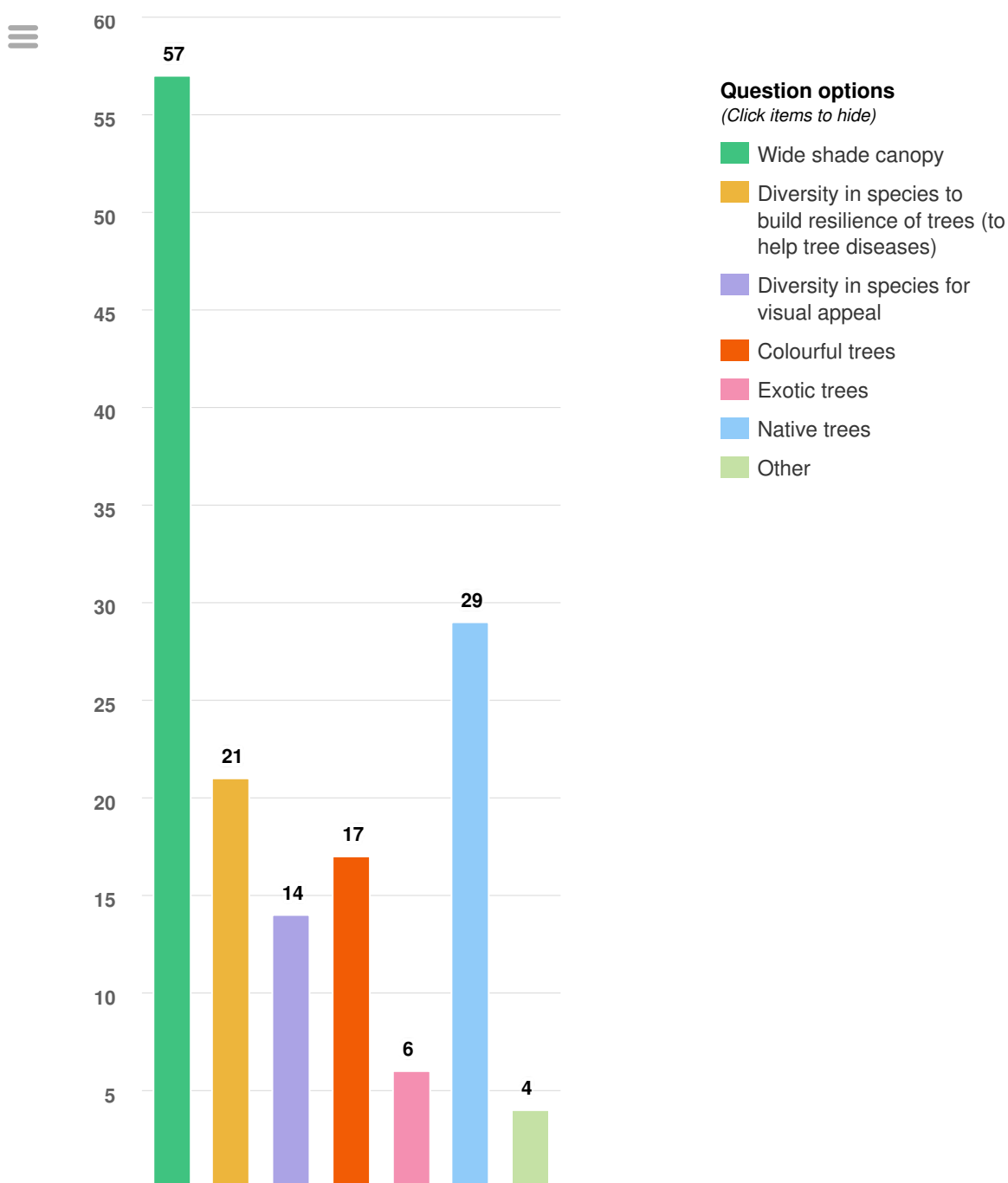
ENGAGEMENT TOOL: SURVEY TOOL

Online survey

VISITORS	107	CONTRIBUTORS	69	CONTRIBUTIONS	75
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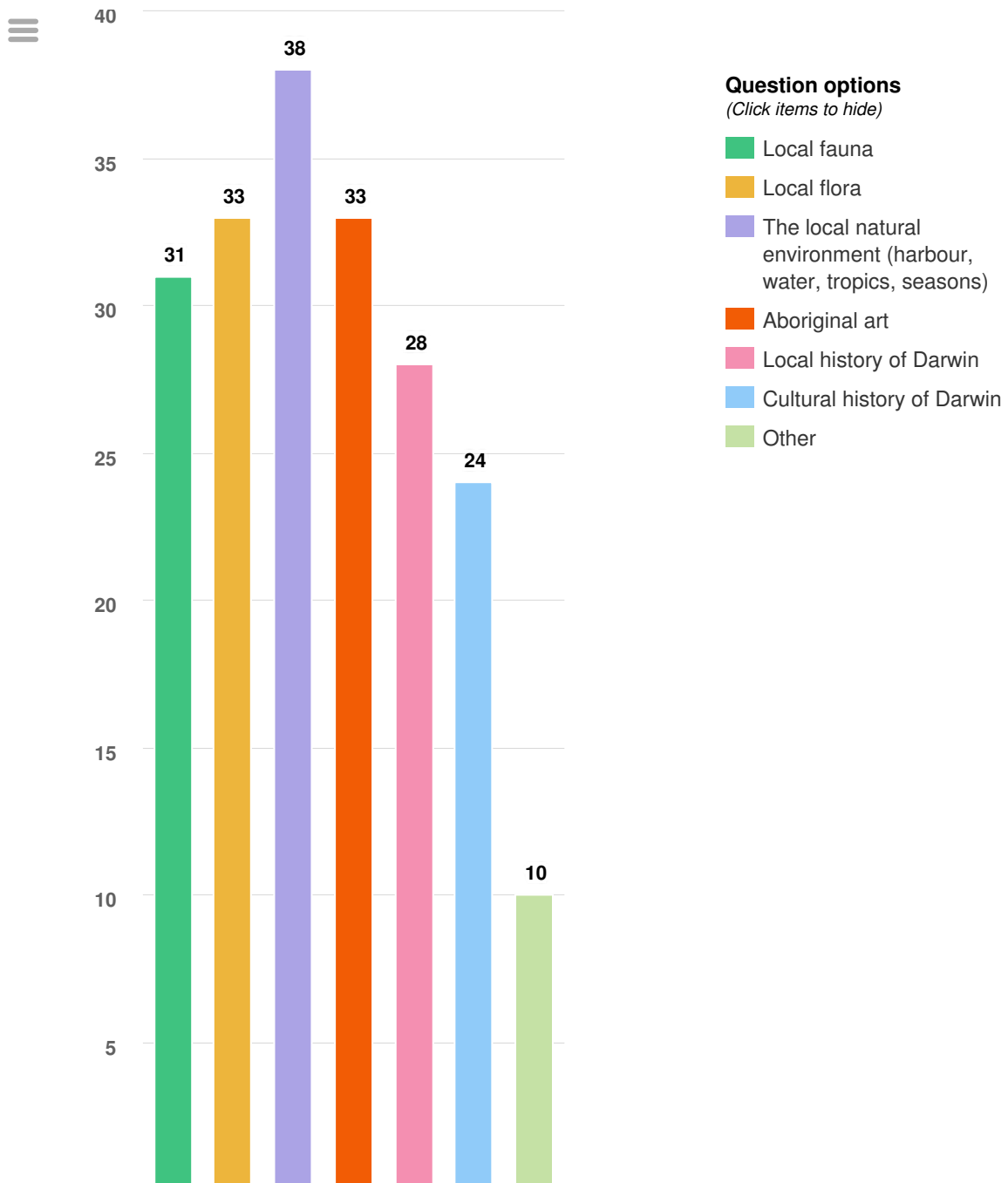
1. What is important to you in the consideration of types of trees to be planted along the Boulevard? (Choose your top 3 options)

Optional question (responses / skipped)



3. We want to create an iconic entry way into Darwin City that Territorians can be proud of and visitors can enjoy. Creative use of urban art along the route is a fantastic way to achieve this. What...

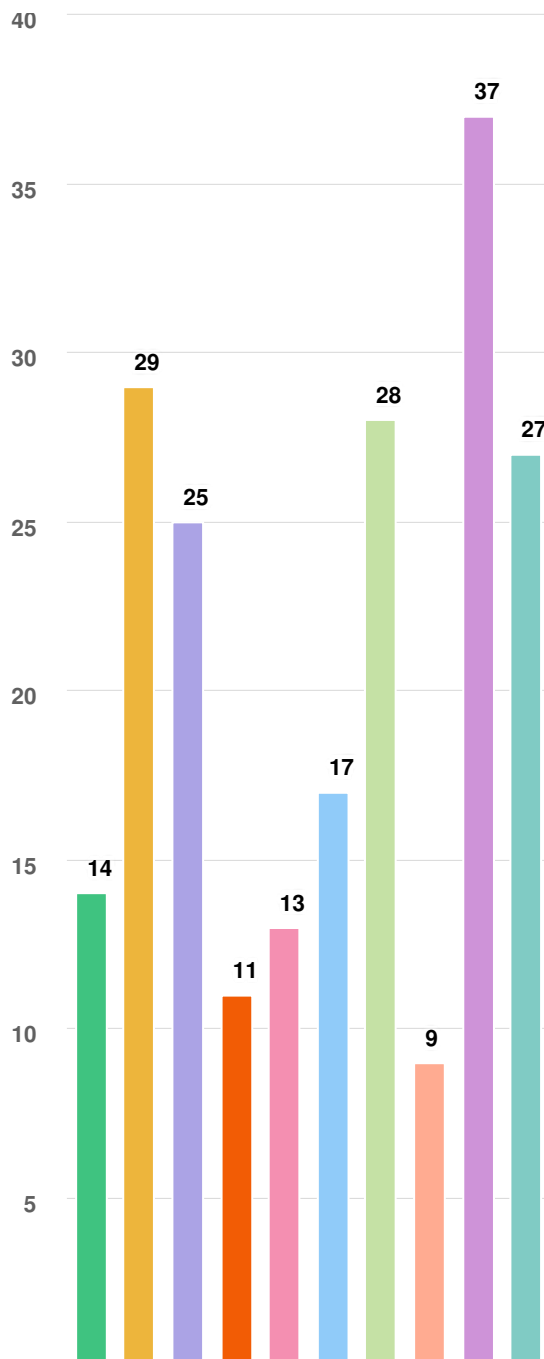
Optional question (responses / skipped)



4. There are many examples of innovative and creative urban artwork. See the gallery for some examples. What types of artwork would you like to see used along the route?

(Choose all that apply)

Optional question (responses / skipped)



Question options

(Click items to hide)

- ☒ Moveable art (art that moves to create an affect, see Brisbane airport example; Singapore airport example)
- ☒ Big street art (large statement pieces, easy to see, see example)
- ☒ Interactive art (that people can pose with/on or play in/on, see example)
- ☒ Subtle art (small and unobtrusive pieces, sometimes used at regular intervals)
- ☒ Electronic art (use of lighting, television or other electronics)
- ☒ Murals (painted on a wall, see example)
- ☒ Sculptures (similar to a statue, see example)
- ☒ Graffiti Art (artistic spray painting usually painted on flat structure like a wall, see example)
- ☒ Wayfinding Art (i.e. built into the practical elements of the project such as seating, shade structures etc.)
- ☒ Practical art (that people can use like tiered seating of an amphitheatre, see example)

Appendix. F

DEPARTMENT OF TRANSPORT



Darwin Regional Transport Plan 2016



CONTENTS

Introduction	2
Vision and Objectives	3
Background	4
Regional Transport Challenges and Drivers	7
Trends and Opportunities	7
The Strategic Context	8
Plan Development Process	10
Integrating Transport and Land Use	11
Strategic Road Network and Freight	14
Public Transport	17
Active Transport	21
Plan Implementation Monitoring and Reporting	25

Planning for efficient and sustainable transport is an essential element of the ongoing development of a liveable and economically vibrant Darwin Region.

MESSAGE FROM THE MINISTER

The Northern Territory is developing with unprecedented opportunities across the agriculture, mining, energy and tourism sectors. Transport networks and logistics are essential enablers of our strategic goals of a prosperous economy, strong society, confident culture and balanced environment. A strong, dynamic economy delivers jobs, income and opportunities for our people; it ensures Government can invest in essential economic and social infrastructure; and it is the foundation of our great Territory lifestyle.

Darwin is a vibrant, growing city and region, and planning for transport is essential in responding to the diverse opportunities available through Darwin's proximity to Asia and the Developing the North agenda.

The Darwin Regional Transport Plan is one of the key strategies which make up the Northern Territory Government's Integrated Transport Planning and Investment Roadmap. The Transport Plan sets out Government's strategic vision, key issues and priorities for transport within the Darwin Region.

The Transport Plan has been developed following consultation and feedback from key stakeholders and the community. Submissions on the draft Plan indicated strong support for the Plan's overall vision and raised a range of issues for further consideration. The Transport Plan has been updated to acknowledge and reflect the issues raised through consultation.

The Plan will be monitored with formal reviews at five, 10 and 15 year timeframes and a framework will be established to track and report on the implementation of the Transport Plan.

It is with pleasure that I release the Darwin Regional Transport Plan which will contribute to the ongoing development of the region and ensure Darwin's transport networks are integrated, efficient, accessible, safe and sustainable.



The Hon Peter Chandler MLA
Minister for Transport



INTRODUCTION

Movement and access are fundamental to all cities. Planning for efficient and sustainable transport is an essential element of the ongoing development of a liveable and economically vibrant Darwin Region.

The Darwin Regional Transport Plan (the Transport Plan) sets out the NT Government's strategic vision, key issues and priorities for transport within the Darwin Region. For the purposes of the Transport Plan, the boundaries of the Darwin Region mirror the boundaries of the Darwin Regional Land Use Plan 2015, incorporating the administrative boundaries of Darwin, Palmerston, Litchfield, Coomalie, Cox Peninsula and Finniss.

The NT Government's *Framing the Future* strategic plan outlines overarching policy priorities and desired outcomes for economic and social development. *Framing the Future's* vision is based on the key strategic goals of a prosperous economy, strong society, confident culture and a balanced environment. The Darwin Regional Transport Plan contributes directly to growing the Territory and the key principles of economy, society, culture and environment.

The Transport Plan has been developed following consultation and feedback from key stakeholders and the community.

SCOPE

The Transport Plan focusses on integrating transport and land use and planning for public transport, roads, cycling and walking across the Darwin Region. Although other modes of transport such as aviation, rail and sea transport are key components of the regional transport system, planning for these modes extends across the Territory, interstate and internationally and is being addressed in detailed mode specific strategies.

Vehicle parking is an integral component of most urban transport systems. Within the Darwin Region, local government manages parking on Council land and within Council road reserves. Elsewhere, parking is managed by the Northern Territory Government or the private sector. This Plan acknowledges the interaction of regional transport planning and local parking strategies. The Northern Territory Government will continue to work with local government to manage the strong links between parking, reducing the reliance on private vehicles and increased use of cycling, walking and public transport.

There has been a long history of transport planning for the Darwin region and this Plan acknowledges past events and planning which have influenced the development of the region's transport networks. It is expected that further regional transport plans will be developed to coordinate transport planning for other regions and major regional centres across the Territory.

VISION

An integrated regional transport system which is safe, reliable and sustainable, connects people and places and supports the continuing economic growth of the region, the Territory and Northern Australia.

GOALS AND ACTIONS

These guiding objectives shape four key strategic goals, with a number of actions identified under each goal:

- 1 Integrating Transport and Land Use
- 2 Strategic Road Network and Freight
- 3 Public Transport
- 4 Active Transport

OBJECTIVES

To provide a regional transport network which responds to economic and residential growth strategies over the next 10-15 years and is:

Integrated

Strengthening the integration of land use and transport planning and integration of transport modes to manage and respond to transport demand.

Efficient, to support economic development

Ensuring the transport system and transport infrastructure is efficient and supports economic and future growth opportunities.

Accessible and provides choice

Ensuring the region's transport system provides a range of transport options to meet community, business and industry demands while supporting economic and social inclusion.

Safe

A safe systems approach across all modes of transport (including public transport) which prioritises the safety of vulnerable road users.

Sustainable and active

A sustainable transport system which is responsive to the environment and innovative technologies and encourages walking, cycling and public transport use, creating a liveable, people-focussed city.

BACKGROUND

WHAT IS A TRANSPORT SYSTEM?

A transport system includes infrastructure (such as roads), services (such as public transport) and modes of transport (such as bicycles and vehicles) which enable people and goods to move from one point to another.

WHY DO WE NEED A REGIONAL TRANSPORT PLAN?

The Darwin Region is growing and with the shared Northern Territory and Australian Government visions to develop Northern Australia, there is a need to effectively plan now for land use and infrastructure to support this growth. Transport infrastructure and services are an essential component of planning for city and regional growth.

This Transport Plan represents a transport framework for the long term development of transport networks to support future population, employment and economic growth in Darwin over the next 10 to 15 years. The Plan is fundamentally linked to and integrated with, the Darwin Regional Land Use Plan 2015 which provides a foundation for long term land use and development of the Darwin Region.

The Darwin Regional Land Use Plan has identified land requirements to accommodate a short term population of 150 000 and a longer term (40-50 year) population of 250 000. This Transport Plan provides a framework for the efficient planning of transport networks to meet the demands of economic, industrial and residential growth strategies in the short term, over the next 10-15 years.

REGIONAL TRANSPORT ROLES AND RESPONSIBILITIES

The regional transport system is complex, with a mix of roles and responsibilities between the Northern Territory Government, local governments and private operators. The NT Government manages and maintains the arterial road network (including the arterial cycle path network) throughout the Darwin Region, while local government manages the local road network. The NT Government is also responsible for managing transport infrastructure assets within the region such as boat ramps and ferry terminals.

The public bus service, Darwinbus, and the school bus network are managed by the NT Government which contracts private operators to provide services. Bus infrastructure including bus interchanges and bus stops are managed by the NT Government. The Mandorah ferry service is provided by a private operator, although the NT Government contracts the ferry operator to provide services for transporting school children.

The NT Government has a policy and regulatory role in other transport issues and modes of transport including vehicle registration and compliance, taxis, long distance coaches, freight, rail, air and sea transport. However, these services are provided by private operators.

Land use planning is integral to the management and development of regional transport and the NT Government and the independent NT Planning Commission have a key role in planning for urban land use and design.

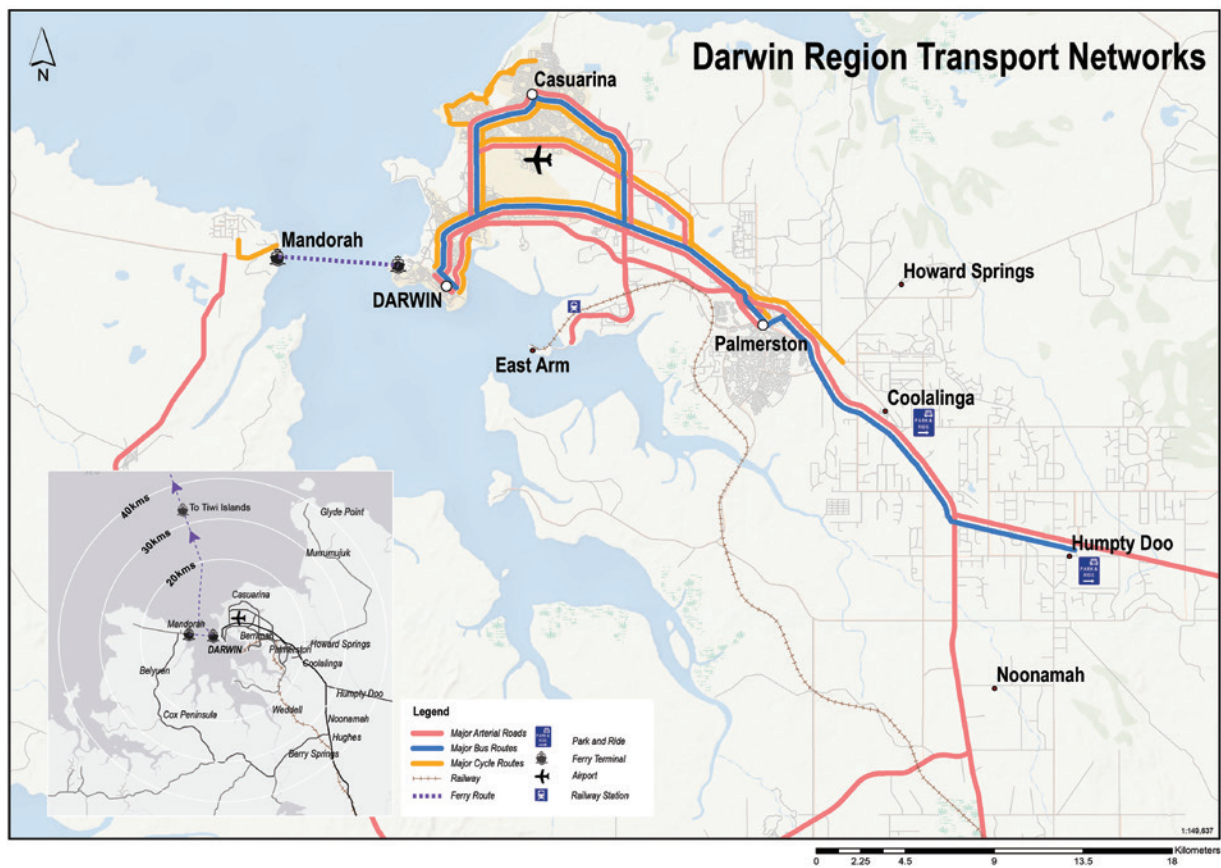


Figure 1: Darwin Regional Transport Networks

HOW WE TRAVEL - AN OVERVIEW OF THE CURRENT REGIONAL TRANSPORT SYSTEM

The Darwin Region covers an area of 419 500 ha and in 2015 has a total population of around 130 000 people, just over half of the total Northern Territory population.

The existing regional transport network includes a network of major (arterial) roads and shared paths, the Adelaide to Darwin Railway, Darwin International Airport, Port of Darwin's East Arm Wharf and the Cruise Ship facility at Fort Hill Wharf. Transport services include a modern and efficient public and school bus service and passenger ferry services to Mandorah and the Tiwi Islands from Cullen Bay. Commercial passenger vehicles including taxis, minibuses

and private hire cars contribute to regional transport options as well as community transport and specialised commercial transport services. Figure 1 shows existing regional transport networks.

Current traffic volumes in the region peak on Bagot Road (34 986 annual average daily traffic in 2013).

Transport in the Darwin Region is dominated by motor vehicles, particularly for key trips such as the journey to work. Australian Bureau of Statistics 2011 census data (the most recent census data available) indicates that private vehicles dominate the journey to work in Darwin (Figure 2).

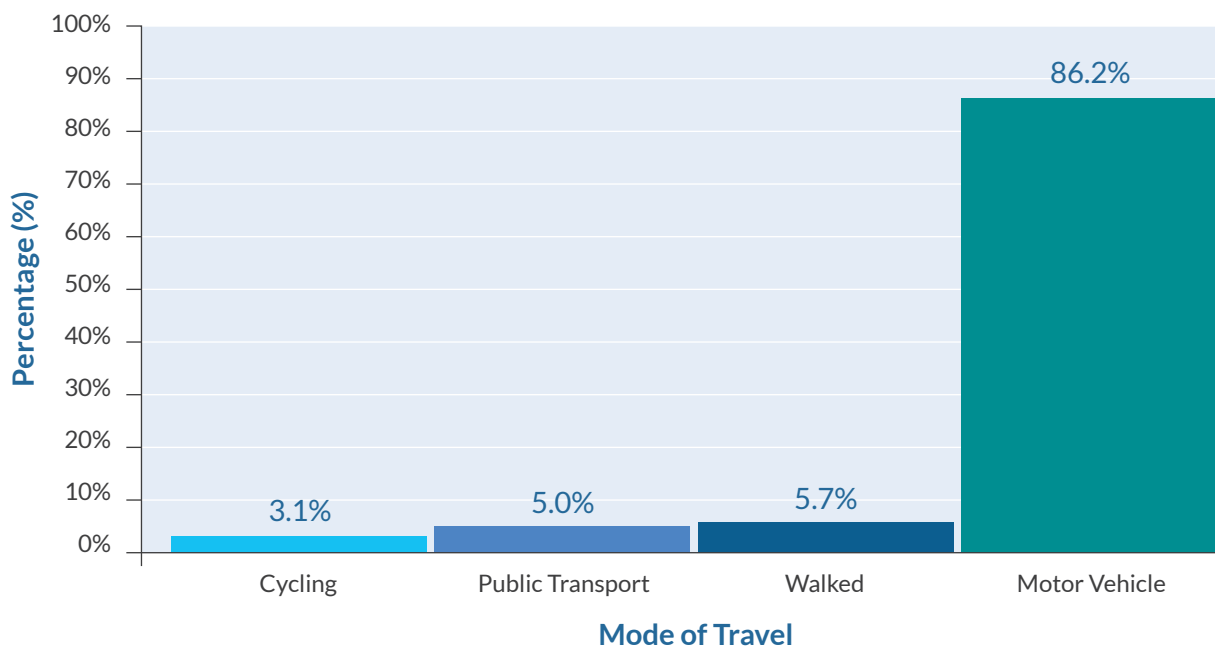


Figure 2: Darwin Journey to Work (2011 Census – Australian Bureau of Statistics)

Although mode share for the journey to work by motor vehicle is high in Darwin, levels of cycling and walking for the journey to work are relatively high compared with other Australian capital cities.

There are around 5.2 million boardings on the Darwin Bus network per year. However, at 5 percent mode share, public transport use is relatively low in the Darwin Region for the journey to work compared with other Australian capital cities.



REGIONAL TRANSPORT CHALLENGES AND DRIVERS

A growing population and increased economic development provide challenges for transport planning. As the Darwin Region moves from a regional centre to a major urban area, the demand for travel will increase and the way people and vehicles move around the region will change.

Major new greenfield residential sites beyond Palmerston identified in the Land Use Plan will increase the demand for travel on the Stuart Highway and Tiger Brennan Drive. Development of identified infill sites in the inner urban suburbs is likely to increase demand for, and support the development of, improved public transport services. Development of the Middle Arm Industrial Area will require development of supporting

transport infrastructure including arterial road connections. Key regional transport challenges and drivers include:

- > Regional geography
- > Congestion
- > Freight demand
- > Transport Safety
- > Long term regional land use
- > Changing demographics
- > Housing and transport affordability
- > Social inclusion
- > Community health and wellbeing
- > Environment and sustainability

TRENDS AND OPPORTUNITIES FOR CHANGE

Like most Australian cities, Darwin has developed as a relatively low density, car dependant city. Australian Bureau of Statistics 2011 census data indicates more people drive to work in Darwin than in any other Australian capital city (86% compared to a national capital city average of 82%). However, the region is changing and evolving with increasing residential densities in the Darwin CBD, Casuarina and Palmerston that change the demands for transport infrastructure and services. Although it can be difficult to envision a future where there is a significant mode shift in the region's transport, planning now for alternative transport choices in the future could help to avoid some of the transport challenges currently faced by larger, more established Australian cities.

There is evidence internationally that amongst younger people, there is a shift away from driving and an increasing demand for walkable neighbourhoods with a range of alternative transport options including walking, cycling and public transport. There

is also an increasing interest in flexible work practices and working remotely. While these trends may not be evident as yet in Australian cities, the potential for alternative transport in Darwin is evidenced by the relatively high levels of walking and cycling for the journey to work indicated in 2011 census data (figure 2).

The Transport Plan considers future transport demand including a potential decline in car use, technological innovation in transport and improved communications reducing the need for travel. Planning for transport in the future needs to be flexible and respond to changing and uncertain scenarios.

While very significant shifts in mode of transport may not occur in Darwin within the timeframe of the Transport Plan (10 – 15 years), it is important to monitor shifting transport demand, remain flexible, plan ahead and encourage and support future travel behaviour change.

THE STRATEGIC CONTEXT

This Transport plan sits within a framework of national, regional and local plans and strategies which influence the Plan and which the Plan will be linked to.

THE NATIONAL CONTEXT

The Darwin Region holds a strategic position of national and international importance. Close proximity to the South-East Asian economic and transport hubs of Singapore and Jakarta continues to support the expansion of the region's role as a major service, tourism and trade centre. The region has a growing strategic role in national and regional defence.

This Transport Plan has been developed within the context of national strategic policy agendas which have been adopted by all jurisdictions such as the National Port Strategy, the National Land Freight Strategy, the National Road Safety Action Plan and the National Cycling Strategy.

The Northern Territory and Australian Governments' share a vision to develop Northern Australia to boost Australia's prosperity by increasing exports and employment. Northern Australia has a geographical advantage given its proximity to Asia along with natural advantages relating to agriculture, mining, energy and tourism. The Northern Territory Government has established a North Australia Development Office to work with the Australian Government to unlock the full potential of Northern Australia.

FRAMING THE FUTURE

Framing the Future is the NT Government's policy framework for service delivery and maximising opportunities within the Territory, Northern Australia and with Asia. Four strategic goals underpin Government's policy and decision-making to drive economic and social development:

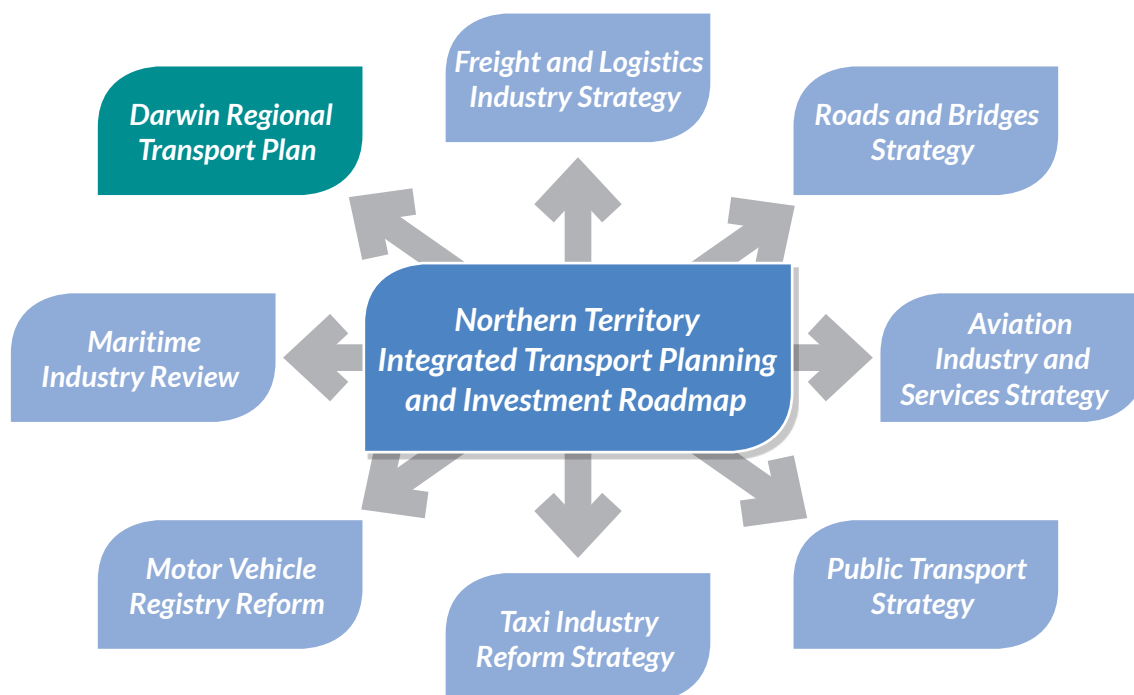
- > prosperous economy
- > strong society
- > balanced environment
- > a confident culture

These four policy objectives have influenced and informed the development of the Transport Plan. Framing the future provides broad goals for the region's transport, including a transport system which is accessible to everyone, sustainable and supportive of a well-functioning economy and society.

INTEGRATED TRANSPORT PLANNING AND INVESTMENT ROADMAP

In December 2013, the NT Government announced a framework for an Integrated Transport Planning and Investment Roadmap to guide the development of the Territory's transport infrastructure and services and drive economic growth. The Roadmap provides a long term, over-arching plan for the delivery of transport links through a suite of planning strategies. A number of detailed strategies and plans sit under the Roadmap umbrella, including this Transport Plan and several policy documents and reform processes.

Figure 3: Integrated Transport Planning and Investment Roadmap



DARWIN REGIONAL LAND USE PLAN

The NT Government has released a Darwin Regional Land Use Plan to provide a broad foundation for the long term use and development of land within the region. Ensuring effective integration of transport and land use planning, the Transport Plan is informed by, and will inform, ongoing implementation of the Land Use Plan.

REGIONAL CONTEXT

At the regional level, the Transport Plan links with key strategic local government policy documents including urban Master Plans and mode specific plans and strategies, such as:

- > Darwin City Centre Master Plan
- > City of Darwin CBD Parking Strategy
- > City of Darwin Bike Plan
- > Palmerston City Centre Master Plan
- > Palmerston City Centre Parking Strategy
- > Palmerston City Centre Public Realm Strategy

PLAN DEVELOPMENT PROCESS

A comprehensive transport study was undertaken by the Department of Transport during 2012/13. The Study aimed to develop a strategic framework for managing future transport network development in the Darwin Region and to inform on going land use planning for the region. A key outcome of the Study was the development of a regional multi modal travel demand model. The model was integrated with land use planning for the Darwin Region including population and employment projections and provided the basis for the development of the Transport Plan.

A broad community consultation process was undertaken during late 2013/2014 to inform the NT Government's Transport Roadmap. The consultation process attracted feedback and submissions from a wide range of stakeholders and several submissions raised transport issues relevant to the Darwin Region. This feedback informed the development of a draft Transport Plan.

A consultation draft Transport Plan was exhibited for consultation in November 2015. 28 written submissions were received with strong support for the Plan's overall vision and general support for many of the Plan's goals and actions.

Submissions raised a wide range of issues for consideration including:

- > Public transport and road access in rural areas
- > Freight routes and haulage of extractive materials
- > Public transport connections for health facilities and tourist destinations
- > Support for reservation of corridors for future rapid transit (including potentially light rail)
- > Integrating bike and bus travel
- > Support for developing cycling and walking networks, particularly around the inner suburbs and extension of networks in the rural area

Where appropriate, the Transport Plan has been updated to acknowledge and reflect the issues raised through consultation. Some of the feedback received concerned detailed operational comments rather than higher level issues relevant to the strategic directions outlined in the Transport Plan. However, the feedback received included many valid comments and suggestions and these more detailed comments are being considered at an operational level by the Department of Transport as well as in mode specific strategies and plans.

Transport and land use planning involves many complex variables which are fundamentally linked. Ongoing planning for transport and land use will be an evolving process and the NT Government's regional transport and land use plans will continue to influence and be influenced by each other.

INTEGRATING TRANSPORT AND LAND USE

GOAL: LAND USE SUPPORTING SHORTER TRIPS AND SUSTAINABLE TRANSPORT CHOICES

Land use and transport are fundamentally linked and the Transport Plan responds to the *Darwin Regional Land Use Plan 2015*. The Land Use Plan provides an indication of where growth in population, jobs and other key elements of urban structure will be in the shorter and longer term. The Transport Plan responds by highlighting key transport routes and corridors which will serve the expected land use pattern. The Land Use Plan may subsequently be reviewed to further reflect the transport network, for example, concentrating higher density land uses closer to frequent public transport.

Land use significantly influences transport networks by determining where homes, jobs and other destinations are located, potentially reducing the need to travel, increasing the ease of travelling between these destinations and providing access to affordable travel choices. The Darwin Regional Land Use Plan presents a land use structure which provides a range of future residential development opportunities. This includes meeting continued demand for traditional low density housing on individual lots, while increasing housing choice both on higher density, more compact urban lots and a range of rural lifestyle options. The land use structure provides for infill development which supports higher frequency public transport and shorter trips achievable by cycling and walking, urban and peri-urban development and more remote greenfield sites which will require longer travel times and be more dependent on private vehicle travel.



Supporting the Darwin Regional Land Use Plan, the Northern Territory Compact Urban Growth Strategy encourages higher density residential development and integration with public transport and cycling and walking networks in urban areas.

At the sub regional level, the NT Planning Commission is developing a number of Area Plans within the Darwin Region, such as the *Darwin Inner Suburbs Area Plan*, which provide a land use framework for the future development of an area. Consideration of transport issues and planning for transport corridors is a fundamental element of the area planning process.

Integrating public transport and land use planning is essential to ensure that residents and workplaces have a reasonable level of access to public transport. The *Darwin Regional Land Use Plan* highlights that the demand for public transport is likely to grow in the region which is expected to increase the viability of introducing new modes of

public transport in the longer term, including potentially bus rapid transit and light rail, along established bus routes. In the short to medium term, it will be important to identify and plan for future rapid transit corridors where public transport priority is likely to be required.

A recent review of Darwin's public transport network recommended providing public transport services to the majority of the region's urban population within a 600 metre walk of residences and jobs (400 m in the Darwin CBD). However, more remote and rural greenfield residential sites in the Darwin Region such as Hughes, Noonamah and Murrumujuk (which have been identified in the Land Use Plan) are unlikely to support frequent, all day, public transport services. It is likely that rural park and ride facilities on key public transport routes (serviced during peak periods) would provide the most efficient public transport services in these greenfield locations. At the local level,

good urban design can support connectivity, shorter trips, walking, cycling and access to public transport. There is also potential for innovative local transport solutions, such as car share schemes, to contribute to the transport options in the region. It is essential that the arterial and local transport networks are effectively integrated to provide a seamless connection between communities.

Looking to the future, should opportunities for development of the Cox Peninsula emerge, improving transport connections to the Peninsular in consultation with local communities will be an essential enabler of development. Potential for the development of a vehicle ferry, including the development of supporting infrastructure and reservation of suitable land will need to be investigated.



ACTIONS

Continue to integrate Regional Land Use and Transport Plans – the Transport Plan responds to the Darwin Regional Land Use Plan. The Transport Plan will be reviewed as the current land use plan evolves and Darwin's population increases.

Update the Darwin Region Transport Model to reflect current population, employment and land use projections – the existing multi-modal transport model is being updated to reflect the Darwin Regional Land Use Plan to provide a basis for ongoing planning of transport networks.

Investigate and plan for future transport connections – guided by the Darwin Regional Land Use Plan, development of infill and greenfield sites will require new and upgraded transport connections. Transport corridors will be investigated and planned to support land use planning objectives including a potential future Stuart Highway rapid transport corridor (for bus rapid transit or potentially light rail) and future passenger and vehicle ferry infrastructure sites.

Support the development of safe, healthy and liveable communities – transport networks can shape communities by providing well connected and accessible transport options. Good urban design and streetscapes can encourage more walking and cycling for short trips and contribute to the development of well connected, liveable neighbourhoods. Area planning for new and existing suburbs and communities will include provision for transport choice, with good connections for cycling, walking and public transport.

Improve the regional public transport network to support land use objectives – frequent, reliable and comfortable public transport can support the transformation of urban areas into vibrant, mixed use activity centres. Improvements to the existing regional public transport network has the potential to significantly improve transport choice and affordability in identified urban infill sites and the rural area.



STRATEGIC ROAD NETWORK AND FREIGHT

GOAL: DEVELOPING THE ROAD NETWORK TO SUPPORT A DYNAMIC ECONOMY AND THE REGION'S PIVOTAL ROLE IN DEVELOPING THE NORTH

Private and freight vehicles are an integral part of the Region's transport system and will continue to be the primary mode of transport in the region in the short, medium and most likely, longer term. With a growing population and a vibrant economy, the number of vehicle trips will continue to increase. Transport modelling has been undertaken to utilise land use, population and employment projections to predict where there is likely to be increased traffic demand and the capacity of the road network to respond to this demand. The model assists in identifying areas in the road network where there may be a need for additional road capacity.

Although at present road congestion is limited in the region, levels of congestion are increasing at key points across the network. Congestion on Tiger Brennan Drive will be addressed by duplication between Berrimah Road and Woolner. Emerging congestion issues have been identified on the Stuart Highway through Stuart Park, Bagot Road, Stuart Highway through Pinelands, Berrimah Road and Elrundie Avenue.

Potential for future congestion has also been identified on Chung Wah Terrace, McMillans Road, Wishart Road, Vanderlin Drive, Trower Road, Lambrick Avenue, Stuart Highway through Livingstone, Channel Island Road, McMinn Street and Goyder Road.

The growth in traffic rates varies on different roads and traffic modelling has applied different growth scenarios for arterial roads across the Darwin region. Without careful planning and consideration of alternative transport options, congestion is likely to become an increasing feature of Darwin's transport network.

Although the dominant role of private and freight vehicles in the transport system is recognised, prioritisation of alternative modes including walking, cycling and public transport potentially reduces the number of individual private trips and improves access to the transport system for all modes.

The Darwin Region transport model forecasts future patterns of travel demand across the Region and is based on land use planning for the Darwin Region. Transport modelling can be used to identify incremental improvements to road network capacity to reduce network congestion and accommodate growth in residential and economic development. The regional network is designed to enable efficient traffic movements at most times of the day, with low to moderate levels of congestion. The road network is designed to a high level of service with sufficient road capacity to accommodate forecast traffic demand.

The modelling process has also included a number of incident management scenarios to better plan for major incidents, such as serious accidents and flooding events and reduce the short term impacts on the road network.

The draft NT Roads and Bridges Strategy Investment Plan nominates a number of priority road projects for the Darwin Region. Planned improvements to the road network will focus on:

- > Incremental network capacity improvements.
- > Extensions in the network to improve network connectivity and accessibility.
- > Strategic new road links to support new residential and mixed use developments, economic activity and rural lifestyle and greenfield developments.

Longer term arterial transport corridors identified in the Darwin Regional Land Use Plan include links to the Middle Arm Industrial Area, links around the harbour and the Weddell arterial.

More detailed transport planning will be required at the sub-regional level, particularly in rapidly growing areas such as Palmerston and the NT Government is working with local government to effectively integrate the arterial and local road networks.

A recent transport study of the Stuart Highway corridor through Stuart Park has investigated transport capacity on the approaches to the Darwin CBD from Bagot Road to McMinn Street. The Study included an investigation of the feasibility of using the former rail corridor through Stuart Park as a transport corridor. Deviating the Stuart Highway through the rail corridor in the future would have potential to allow Stuart Park to develop as a lower speed, mixed use environment, supporting walking, cycling and public transport. A number of potential shorter term improvements to the Stuart Highway corridor were also considered during the Study including potentially signalling the Goyder Road intersection and improvements to public transport.

The Department of Transport has worked with the NT Planning Commission to integrate transport options for the Stuart Park with land use planning investigations in the area.

A separate Territory wide Freight and Logistics Industry Strategy is in development. Within the Darwin region, a transport industry precinct is proposed between Wishart Road, Berrimah Road and Tiger Brennan Drive. Plans for the precinct include 86 lots and a nine hectare site for a 'Truck Central' transport hub. Truck Central will be a major road transport facility for refuelling, fatigue management and servicing. The precinct will provide large lots to accommodate transport depots and vehicle servicing with easy access to major road transport links and the East Arm Logistics Precinct.

Darwin International Airport is expected to maintain its role as a primary international and domestic passenger terminal into the future, however, increasing cargo transport and general aviation demands may see the need for a second airport within the region to cater specifically for this demand.

The Darwin Regional Land Use Plan identifies a site for a second airport on the Blackmore Peninsula to the west of Middle Arm. The identification of this site for future use as an airport will assist with ongoing land use planning and enable the site to be protected from the potential encroachment of incompatible land use in surrounding areas.

Planning for the region's road and freight networks will need to be continually responsive to emerging technologies and innovations including intelligent transport systems and driverless vehicles.

ACTIONS

Working with local government, continue to maintain and develop the region's road infrastructure - the existing road network is essential to the social and economic development of the region. Effective operation of the system requires ongoing maintenance of the network and planning for new and upgraded infrastructure and effective integration with the local road network.

Update transport modelling for the Darwin Region - in response to the Darwin Regional Land Use Plan, update transport modelling for the region to confirm short to medium term road network improvements and develop incident management scenarios.

Consistent with the Roads and Bridges Strategy use updated transport modelling to confirm forecasts for improving the road network including -

- > Duplicate and upgrade Tiger Brennan Drive (TBD) from Berrimah to Darwin CBD to improve connectivity and accessibility between Palmerston and the Darwin CBD.
- > Develop Barneson Street link between TBD and Cavenagh Street to provide an additional entry point to the Darwin CBD.
- > Improve the capacity of Berrimah Road between Berrimah and East Arm Port.
- > Extend Roystonea Avenue to Elrundie Avenue and Weddell Freeway to support population growth and economic development.
- > Duplicate Elrundie Avenue from University Avenue to Tilston Avenue and Roystonea Avenue.
- > Improve the network capacity of Vanderlin Drive and McMillans Road to improve links between Casuarina and Berrimah.

- > Progressively duplicate Amy Johnson Avenue.
- > Duplicate the Stuart Highway from Cox Peninsula Road to Acacia Hills.

Support freight movements on key arterial routes - the movement of goods and produce is essential to the ongoing development of the region and the Northern Territory. Road connections to the major East Arm logistics precinct (including the Port, Rail terminal and Business Park), Darwin International Airport and the Transport Industry Precinct will facilitate and support freight movement.

Consider all transport modes in the allocation of road space - recognising private and freight vehicles as the primary transport mode in the region, consider how increases in capacity may also be achieved by improvements to alternative modes of transport.

Integrate transport and land use planning on the approaches to the Darwin CBD and preserve freight corridors

- monitor transport and traffic demand on the approaches to the CBD and along freight corridors and integrate with land use planning.

Deliver the Transport Industry Precinct

- the Land Development Corporation will oversee the development of this major transport facility incorporating a proposed 'Truck Central' transport hub.

Deliver a Freight and Logistics Industry Strategy for the Territory - including freight and logistics strategies for the Darwin Region.

PUBLIC TRANSPORT

GOAL: FAST, FREQUENT, RELIABLE, ACCESSIBLE AND COMFORTABLE PUBLIC TRANSPORT

Public transport has the potential to contribute significantly to the region's transport network. A fast, frequent, reliable, comfortable and safe public transport network, supported by urban planning and design, can contribute to an efficient transport system. For the purposes of the Transport Plan, public transport is restricted to bus and ferry services. Commercial passenger vehicles, sometimes considered as a form of public transport (including taxis, mini-buses and private hire vehicles) are being planned for separately through the NT taxi industry reform process.

Framing the Future provides broad goals for the Darwin transport system. The system should be accessible, supportive of an efficient economy, promote a healthy community and operate within a sustainable environment.

Public Transport is a critical enabler for many in the community including seniors and Indigenous people for access to health services, education and employment.

Currently public transport use for the journey to work in the Darwin Region is relatively low. At 5 percent, Darwin has the lowest public transport mode share of any Australian capital city.

The existing public transport network in Darwin is based on the Darwinbus service with a privately operated ferry service providing a link between Darwin and Mandorah. The existing bus network (figure 4) has grown incrementally and in response to changing demands over time. Although residential densities are relatively low in many areas of Darwin (like most Australian urban areas), densities are high enough in some areas of Darwin, Casuarina and Palmerston to support efficient public transport. The relatively dense mix of residential and employment land uses on

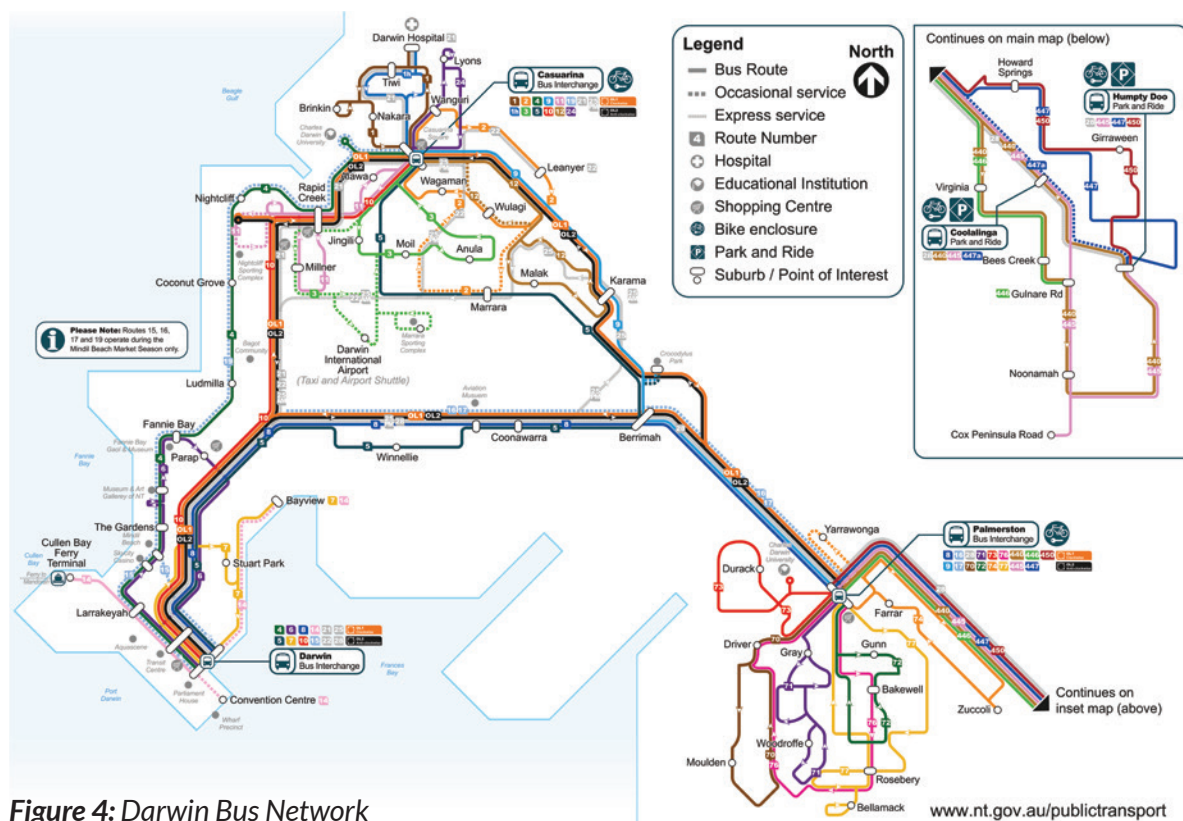


Figure 4: Darwin Bus Network

the Darwin peninsular, in Casuarina and in Palmerston have potential to support mixed use, commercial-retail-residential precincts which are typically strong drivers of public transport patronage.

Bus patronage varies considerably across the region and ranges from relatively high levels in Darwin, Casuarina and Palmerston, and along the corridors between these centres to minimal boardings on some rural routes.

The Department of Transport has been reviewing the current Darwin bus network. Issues investigated include improvements in the frequency, span of service and function of the bus system. Options for improvement include the introduction of 30 minute bus services throughout the day, seven days a week, improvements to timetabling to further improve the reliability of connections and reduce waiting and travel times and 15 minute services in higher density residential areas on the approaches to the Darwin CBD. There are also opportunities to improve services to major destinations such as Royal Darwin Hospital and introduce connections to the new Palmerston Regional Hospital.

Investigations have confirmed that buses are likely to remain a key feature of public transport in the Darwin Region in the short to medium term. Although the Darwin City Centre Master Plan envisions the development of light rail and feedback from consultation has also expressed a community aspiration for light rail, it is likely that light rail or other forms of rapid transit will be longer term options for regional public transport. However, it is important to plan for future rapid transit now by investigating and reserving public transport corridors as part of the land use planning process.

Bus access in and around the Darwin CBD currently uses Mitchell Street inbound and

Cavenagh Street outbound. The existing CBD bus network is constrained by competing road and land uses in Mitchell Street and is not easily legible to users. A detailed study of bus movements in and around the Darwin CBD has been undertaken and this will inform planning for CBD bus and passenger access including potential city loop services.

In December 2014, a new ticketing regime was introduced across the bus network which provides greater flexibility for passengers and provides an incentive to purchase multi-ride tickets. A new 'bus tracker' app has also been introduced to provide 'real time' arrival and departure times and assist in journey planning.

Rural communities have highlighted local demand for public transport services to connect rural centres such as Batchelor and Adelaide River with urban activity centres including Palmerston, Casuarina and Darwin. Efficiently servicing rural, low density populations with regular public transport services can be challenging. The Department of Transport will continue to work with local communities to explore opportunities for improving transport connections for rural centres.

Enabling access to public transport requires integration with other modes, particularly cycling and walking. Well connected pedestrian access to bus stops is essential to the operation of the bus network. Good cycling connections and bike parking at public transport nodes can expand the catchment of bus stops and interchanges to more than a kilometre. Major bus interchanges and park and ride facilities in the Darwin Region provide secure bicycle parking to support bike/bus commuting. In the rural area, park and ride facilities at Coolalinga and Humpty Doo support combined car and public transport

commuting. A new policy has recently been introduced which allows folding bikes to be carried on the buses in the Northern Territory.

National standards prescribe requirements for improving public transport accessibility. The Northern Territory is progressively complying with accessibility standards with 100 percent of the Darwin and Alice Springs public bus fleet now meeting accessibility standards. There is an ongoing program to upgrade bus stops to reach full compliance. Bus stop information has also been significantly improved with the introduction of compliant bus totems which are gradually being implemented across the network. The totems provide timetable information and maps and braille section provides a phone number for further information. Significant improvements have been made to major bus interchanges in the region and 100 percent compliant park and ride facilities have been developed at Coolalinga and Humpty Doo. An interactive voice response system for bus information is also available.

The current passenger ferry between Cullen Bay and Mandorah is privately operated and is expected to continue to provide an alternative transport route between the Darwin CBD and the Cox Peninsula. The Darwin Regional Land Use Plan has highlighted that longer term, there may be potential for further development of harbour ferry services, depending on the ability of these services to compete with alternative modes of commuter transport. The viability of additional harbour ferry services will increase with population growth.

In the future, it is likely that additional or alternative ferry terminal infrastructure will be required in addition to the existing Cullen Bay facilities. Planning for potential additional infrastructure is required in the medium to long term to support the development of harbour ferry services.

There are a number of passenger transport terminals in the region including the Ghan railway station, the Darwin International Airport and the Cruise Ship Passenger Terminal. These key tourism and travel destinations are currently serviced by the commercial passenger industry rather than scheduled public transport services. The irregular demand for services from these destinations will continue to be best serviced by taxis, mini-buses and shuttle services in the short to medium term.

An Aviation Industry and Services Strategy is being developed to support the sustainability and growth of the Territory's aviation sector and develop the Territory's emerging role as an aviation gateway for northern Australia.

ACTIONS

Improve the Darwin public transport network -

- > **Consult with the community regarding potential improvements to the Darwin Bus network:** including potential improvements to frequency, span of service and timetabling.
- > **Engage with key stakeholders** such as Seniors groups, Accessibility groups and Indigenous communities regarding specific needs and services to major destinations such as health facilities.
- > **Provide easily accessible public transport information:** improve the legibility of the public transport network by providing clear and accessible timetabling and journey planning information.
- > **Review CBD Public Transport Access:** to investigate improvements in CBD public transport access and movement including a potential city loop service.
- > **Investigate demand and potential for public transport priority on the arterial road network:** to maintain the frequency and reliability of public transport, priority measures for public transport (such as queue jumps, signal priority and bus lanes) will be investigated at specific locations.
- > **Improve public transport accessibility:** continue to improve network accessibility through the ongoing bus stop and shelter replacement program and ensure all new infrastructure is compliant with national accessibility standards.
- > **Integrate public transport with other modes:** continue to integrate bus stop and interchange facilities with a well- connected shared path network and provide bicycle parking at major stops and interchanges. Continue to develop park and ride facilities in rural areas as demand develops.

Integrate public transport and land use planning -

Planning for infill and greenfield residential development will continue to support easy access to public transport, aiming for a walk of no more than 600 metres from residences and jobs to public transport for majority of the urban population and 400 metres in the Darwin CBD.

Plan for future public transport corridors

- The Department of Transport will continue to work with the Department of Lands, Planning and the Environment to identify and reserve future transport corridors for rapid transit and transport orientated development opportunities along these corridors.

Work with local government to integrate parking policies and public transport planning -

the NT Government will continue to work with local government to manage the strong links between parking, reducing the reliance on private vehicles and increased use of public transport.

Respond to local demand for public transport connections between rural and urban activity centres -

the NT Government will continue to work with local communities to explore opportunities for improving rural transport connections.

Plan for future ferry facilities -

the NT Government will continue to identify opportunities to support the future development of ferry services.

Work with tourism groups to investigate transport options -

work with Tourism NT and key stakeholders to investigate transport options to support tourism development.

ACTIVE TRANSPORT

GOAL: SAFE, CONVENIENT CYCLING AND WALKING TO SUPPORT HEALTHY, CONNECTED COMMUNITIES

Darwin has the potential to be a great walking and cycling city. The region is already leading the way in relation to many other Australian cities and there is significant scope to go much further.

Active transport refers to all forms of transport which include some form of physical activity, particularly cycling and walking. Public transport is often included as a form of active transport as most public transport journeys involve some form of active transport at the start and end of a trip.

There is substantial evidence regarding the potential for active transport to provide significant health and environmental benefits and to contribute to more liveable, connected communities. At the national level, the National Cycling Strategy provides high level, strategic guidance for increasing the number of people cycling.

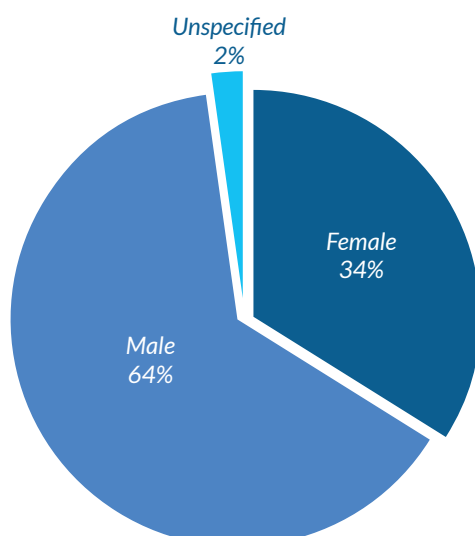
Cycling and walking have enormous potential to contribute to the transport system in the Darwin Region. The Region has an extensive network of off road cycling and walking

paths. With generally flat terrain, relatively short distances between activity centres and a good climate for most of the year, cycling and walking provide realistic options for local short trips. In addition, cycling and walking can easily be combined with public transport for longer distance journeys.

Levels of walking and cycling in the Darwin Region for the journey to work are relatively high compared to other Australian capital cities. Australian Bureau of Statistics 2011 census data indicates that at 3.1 percent, more people cycle to work in Darwin (per capita) than in any other capital city. Walking is even higher at 5.7 percent, and second only to levels of walking in Hobart (6.6 percent). These mode share figures are a good basis to work from in the Australian context, but are still far below international examples in Europe, such as in the Netherlands and Denmark where cycling mode share consistently exceeds 40 percent.

The Department of Transport is monitoring levels of cycling throughout the region through a series of annual visual bike counts which have been undertaken since 2011.

Figure 5: 'Super Tuesday' bike count results Darwin 2014



**At 53 sites 3505
bike trips in 2 hours**

In addition to visual bike counts, two permanent bike counters were installed at two key locations on the path network in July 2014, to provide continuous data on where and when people are cycling in the Darwin Region. Subject to effective operation of the counters, additional permanent counters will be installed to assist in planning and developing the network.

Increasing safety and convenience for pedestrians and cyclists and realising the potential for active transport requires a comprehensive approach across multiple areas including infrastructure, urban design, policy, road safety, behaviour change, education and awareness. The most successful walking and cycling cities have focussed on providing separated, well connected cycling and walking path networks. In the Northern Territory, all paths are shared paths which means that cyclists and pedestrians can use all paths. 'Footpaths' can be used by cyclists and 'cycle paths' can be used by pedestrians, effectively extending the active transport network of paths. Except for a restricted number of high use, recreational paths, the shared path network currently meets existing levels of demand. However, as Darwin's population grows and the number of people cycling and walking increases, the shared path network may need to evolve to provide separately for cyclists and pedestrians.

The extensive off road shared path network across the Darwin Region is reviewed and upgraded in response to community identified priorities. The NT Government has committed over \$1 million a year over five years to develop new and upgraded cycle paths across the Territory. In the Darwin Region, priorities have included widening and resealing the high use path from Rapid

Creek to Trower Road in Brinkin, providing cycle access to major employment and study destinations at Charles Darwin University, Royal Darwin Hospital and Casuarina. Several major new paths are nearing completion in the region including a new path on Lambrick Avenue in Palmerston to connect existing paths on Roystonea Avenue with Farrar Boulevard and continuing across the Stuart Highway to the existing Howard Springs path. A new off road path on Henry Wrigley Drive will provide access to airport workplaces and the Marrara sporting complex and duplication of Tiger Brennan Drive between Berrimah Road and Woolner Road includes a new 9 km off road path.

Other short and medium term cycling infrastructure priorities for the region include:

- > Improving provision for cyclists on Bagot Road and Trower Road to link the northern suburbs with the Stuart Highway
- > Extending the existing Howard Springs path to Coolalinga

Effective wayfinding and signage is an essential element of active transport networks. Following the development of national guidelines and a new Australian standard, wayfinding and signage within the Darwin region is being reviewed and coordinated across the arterial and local networks.

Cycling and walking infrastructure needs to be supported with good end of trip facilities which includes secure bicycle parking, showers and lockers for residents, visitors and employees. The NT Planning Scheme requires the provision of end of trip facilities for major new commercial and CBD

developments, and national guidelines are being developed to provide guidance on the type of facilities provided.

Many new development applications for commercial developments now routinely include provision of bicycle parking facilities conveniently located near major access points. The NT Government has worked with a number of key employment work places within the Darwin region to plan for and encourage active transport for the journey to work.

To ensure connectivity between local and arterial cycling networks, the NT Government has contributed to the City of Darwin Bike Plan. The five year Bike Plan identifies priorities for infrastructure, education, encouragement and evaluation actions. The importance of cycling and walking to the Darwin Region has been recognised in other local government plans and strategies including the Darwin City Centre Master Plan, the City of Darwin's Community Wellbeing Plan and the City of Palmerston Master Plan.

In addition to infrastructure provision, education and awareness can support cycling and improve safety. The NT Government provides bicycle education to school and other community groups through the Parap Road Safety Centre in Darwin, which is a unique community resource for promoting cycling and road safety skills. In 2014, over 1000 students and other participants attended cycling safety sessions at the Centre. A partnership has been established with the NT cycling alliance, Pedals NT which is also based at the Road Safety Centre.

With increasing numbers of cyclists using the road network, there has been community feedback from all road users regarding the need to share the road. The NT Road Users' Handbook was updated in 2014, including a new section 'Sharing the road with cyclists'. The Handbook highlights that bicycles are classed as vehicles, have the same rights and responsibilities as all road users and deserve the same respect and courtesy. At the same time, cyclists are required to abide by all the relevant rules and regulations that govern the drivers of other vehicles.



ACTIONS

Ensure all new major road infrastructure includes provision for cyclists and pedestrians - design and construction of all new arterial roads and major upgrades in the region will include consideration of cyclist and pedestrian demand and provision of appropriate infrastructure.

Continue to maintain and develop the shared path network - responding to community priorities, continue to develop the shared path network in consultation with local government to ensure integration of local and arterial networks.

Review and update wayfinding and signage across the region's active transport networks - working with the City of Darwin, City of Palmerston and other key stakeholders, review and enhance wayfinding and signage in accordance with national guidelines and standards.

Continue to promote the provision of end of trip facilities - provide guidance and advice for the provision of end of trip facilities in major new developments.

Monitor and analyse cycling across the region - continue to implement annual visual bike counts and expand the permanent counter network to measure and analyse regional cycling demand and assist in planning and prioritising cycle network upgrades and development.

Continue to implement walking and cycle safety education programs - continue to deliver pedestrian, road safety and bicycle education programs through the Parap Road Safety Centre, in schools and at other venues.

Implement a vulnerable road user awareness campaign - guided by the Australian Bicycle Council and peak cycling advocacy groups, work with local cycling and other interest groups and local government to deliver a road safety campaign to raise awareness of vulnerable road users.

Integrate cycling and walking with other modes of transport - continue to integrate bus stop and bus and ferry interchange facilities with well-connected shared path networks and provide bicycle parking at major stops and interchanges.

Work with major employers to encourage active transport - continue to work with major employers and industry groups to develop Work Place Travel Plans and other tools to encourage the uptake of active transport for the journey to work.

PLAN IMPLEMENTATION, MONITORING AND REPORTING

The Transport Plan will guide the ongoing development of the Darwin Regional transport network over the next 15 years. Working with key stakeholders and the community, the NT Government will implement the Transport Plan progressively.

Many of the actions identified in the Transport Plan require further investigation and development. Other actions demonstrate an ongoing commitment to guiding principles and priorities. The Transport Plan is flexible. It identifies priorities for investment in transport infrastructure and services, however these priorities will change and evolve over the next 15 years reflecting the availability of funding and the local, regional, national and international climate.

Integration of transport and land use planning is a key goal. The Transport Plan responds to the Darwin Regional Land Use Plan and will inform ongoing development and implementation of the Land Use Plan.

The Transport Plan is not a static document. The goals, priorities and actions will continue to evolve in response to changing social and economic demands.

Implementation of the Transport Plan will be monitored, with formal reviews and public reports at the five, 10 and 15 year timeframes. A monitoring and evaluation framework will be established to track and report on the implementation of the Transport Plan.

The Darwin Regional Transport Plan has been produced by the NT Department of Transport.

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