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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

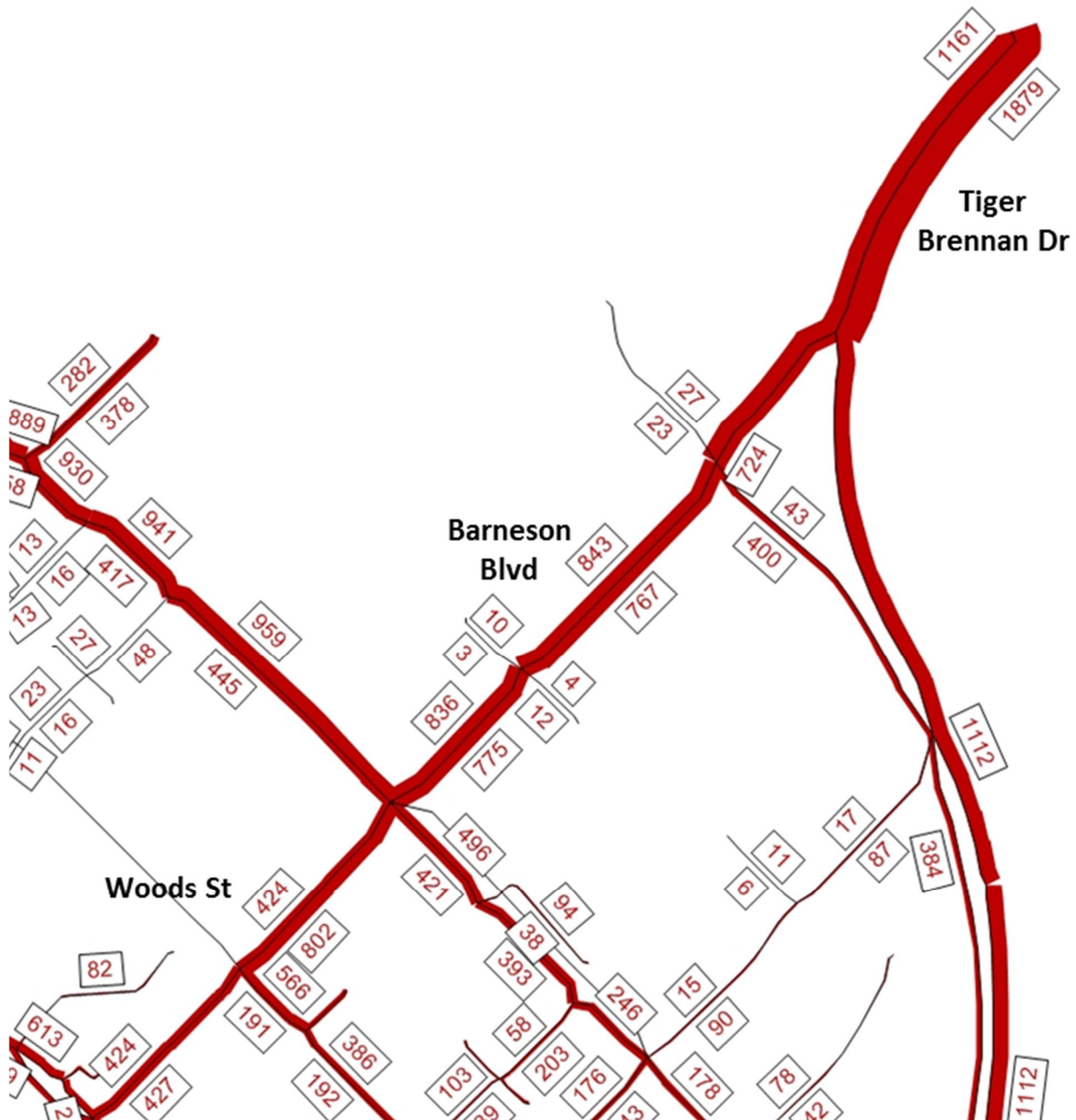
Intersection	AM peak overall LOS	PM peak overall LOS
Barneson Blvd/ Tiger Brennan Dr	C	D
Barneson Blvd/ Harvey St	A	A
Barneson Boulevard/ McMinn St	D	D
Barneson Blvd/ Woods St	A	A
Barneson Blvd/ Cavanagh St	D	D

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.

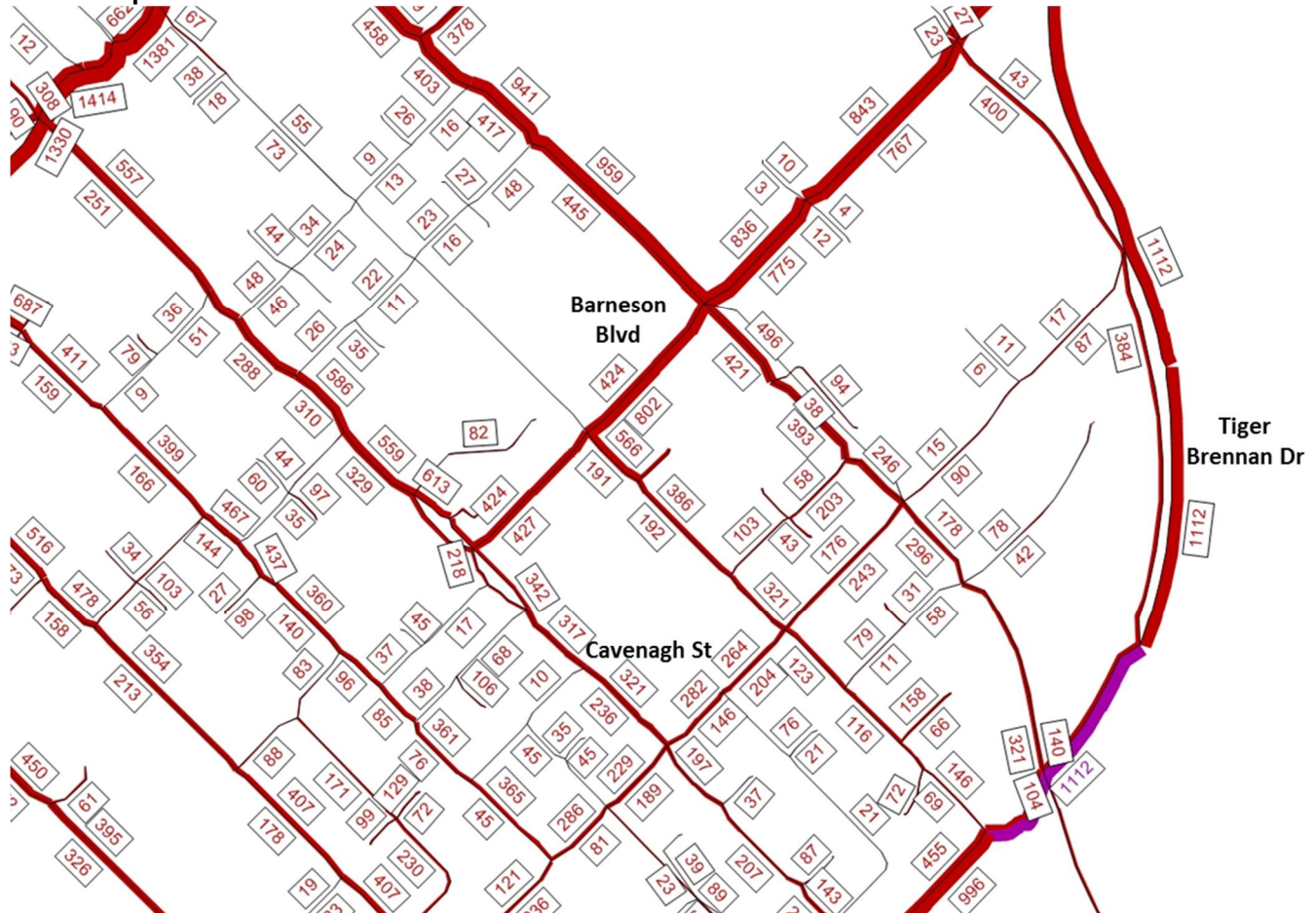
All movements at all of the intersection in both peak periods are forecast to operate with a Degree of Saturation (DOS) of below 0.9 and with a reasonable 95% queue length. It can be concluded therefore that the concept design for Barneson Boulevard should operate at an acceptable level of service in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

Appendix A – VISSIM model assignment plots

AM peak Barneson Boulevard northern end



AM peak Barneson Boulevard central



AM peak Barneson Boulevard inbound



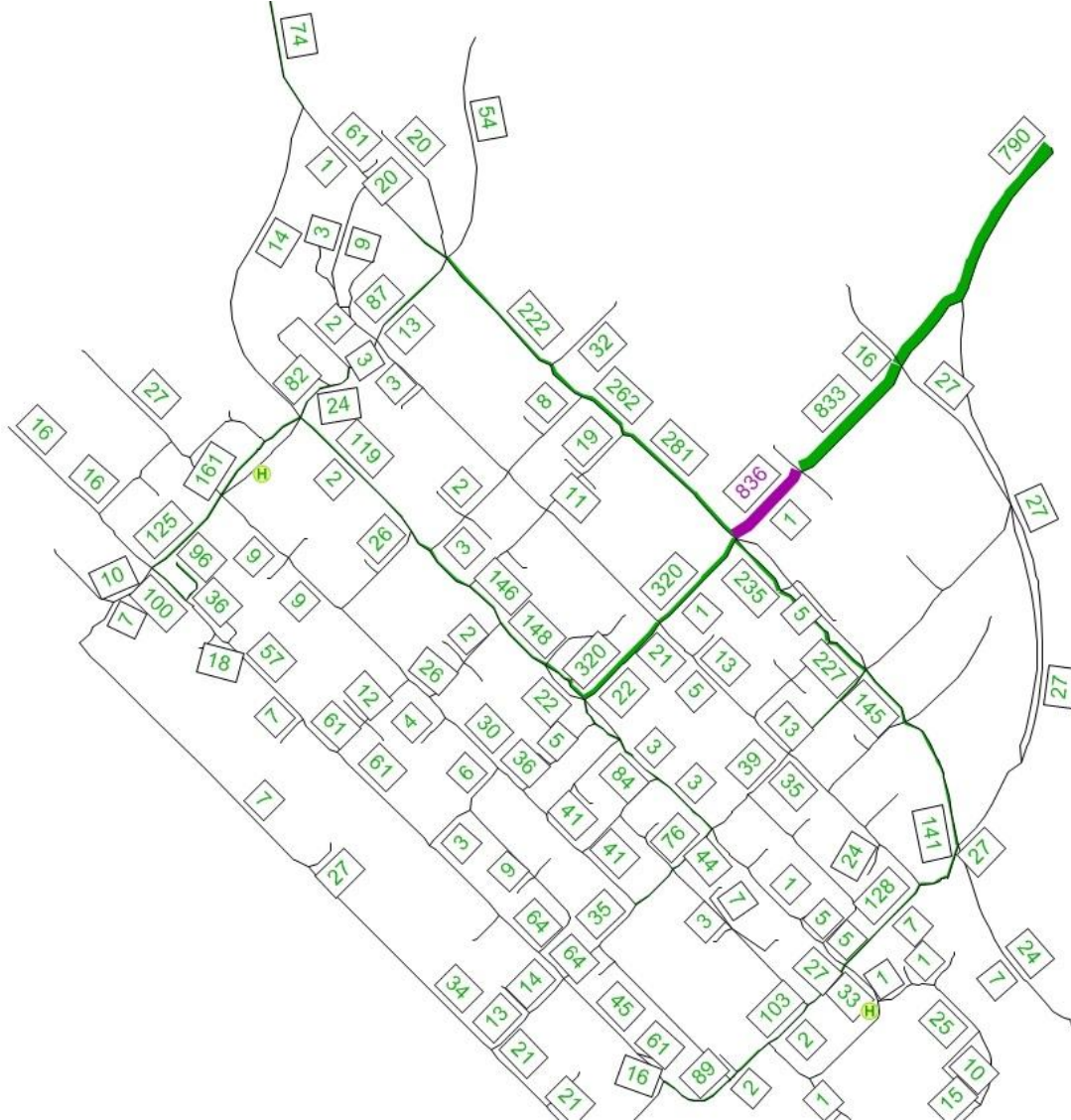
AM peak Tiger Brennan Drive inbound



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



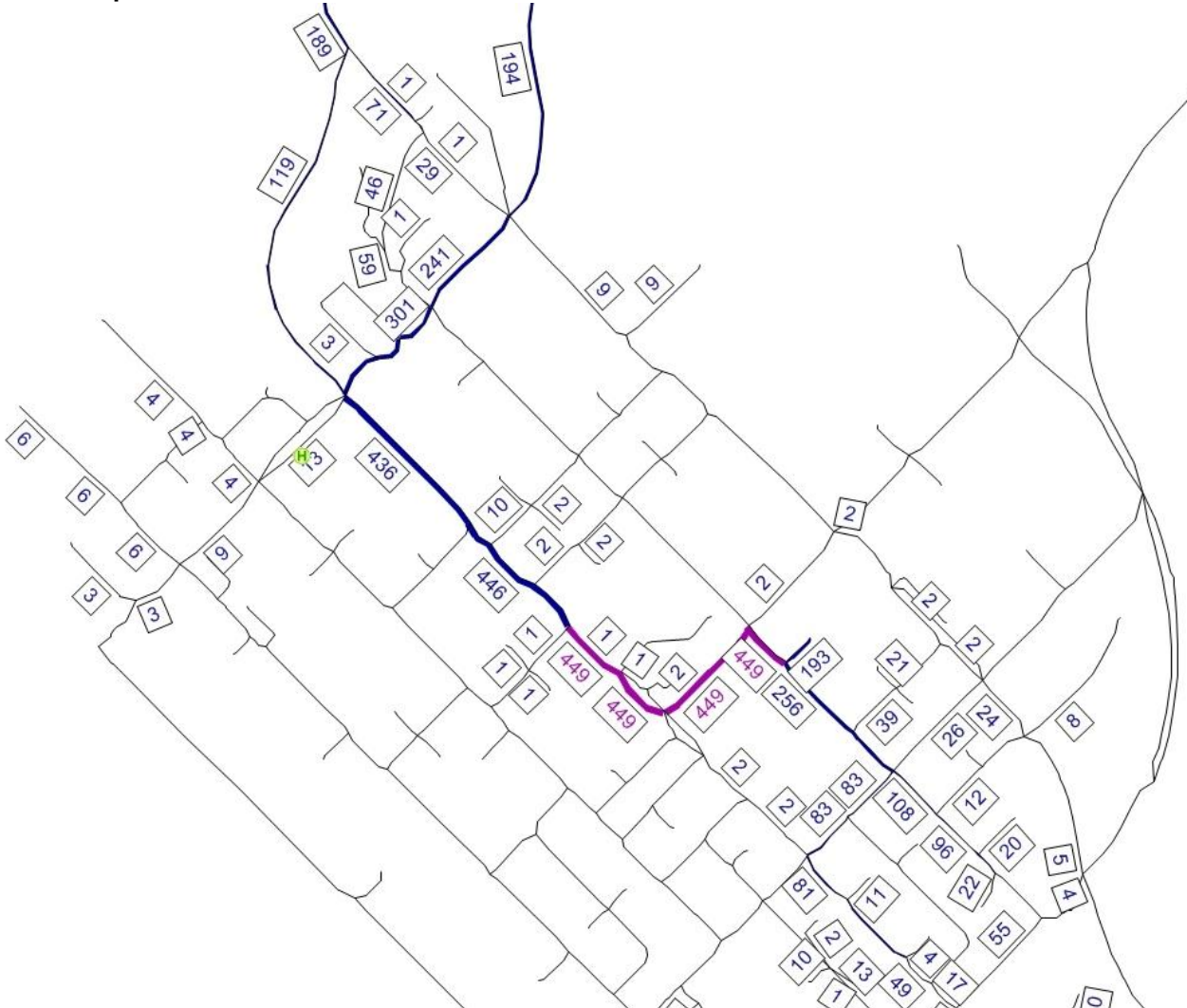
PM peak Barneson Boulevard central section



PM peak Barneson Boulevard inbound to Cavenagh Street



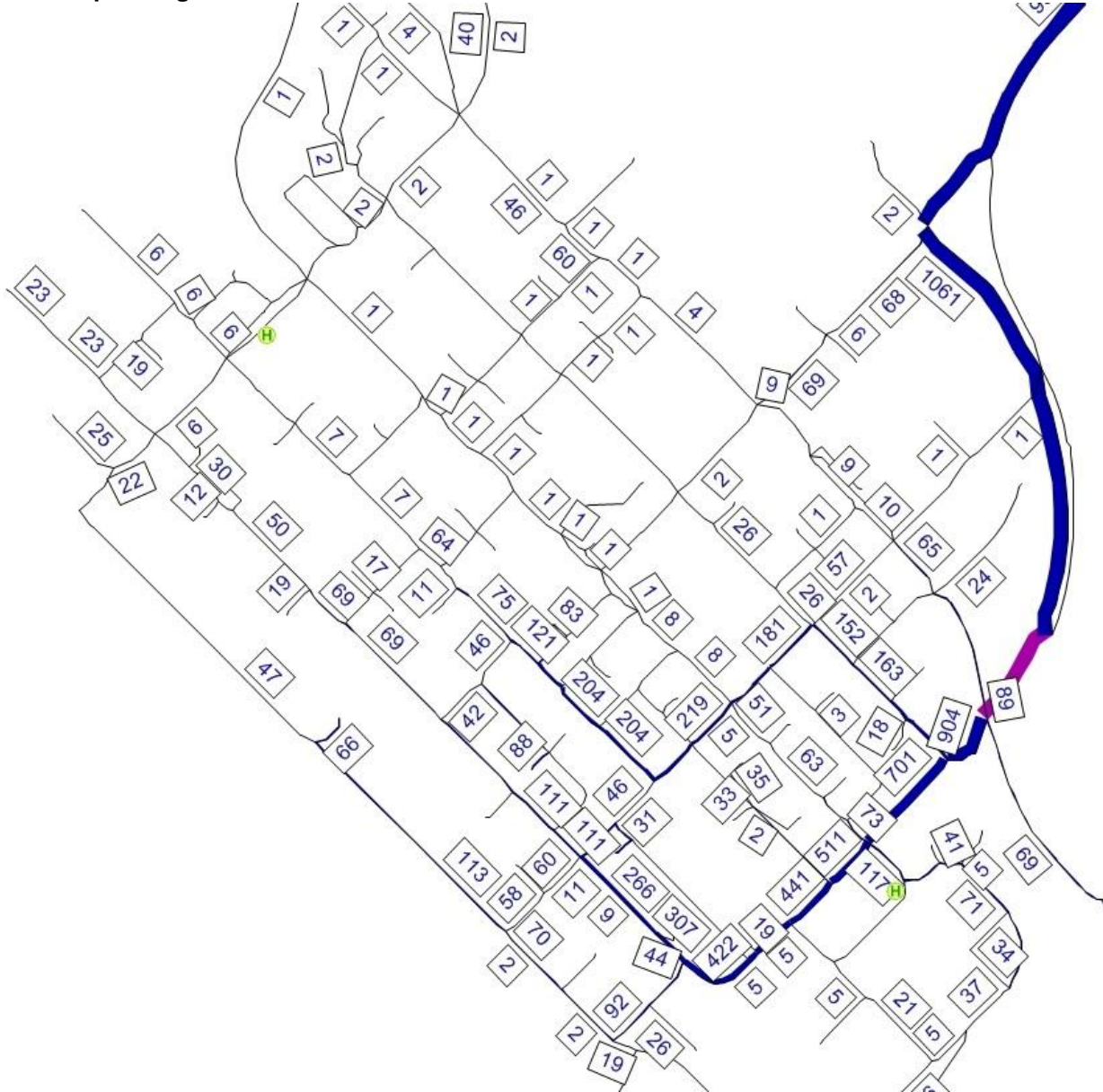
PM peak left turn from Woods Street onto Barneson Boulevard



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

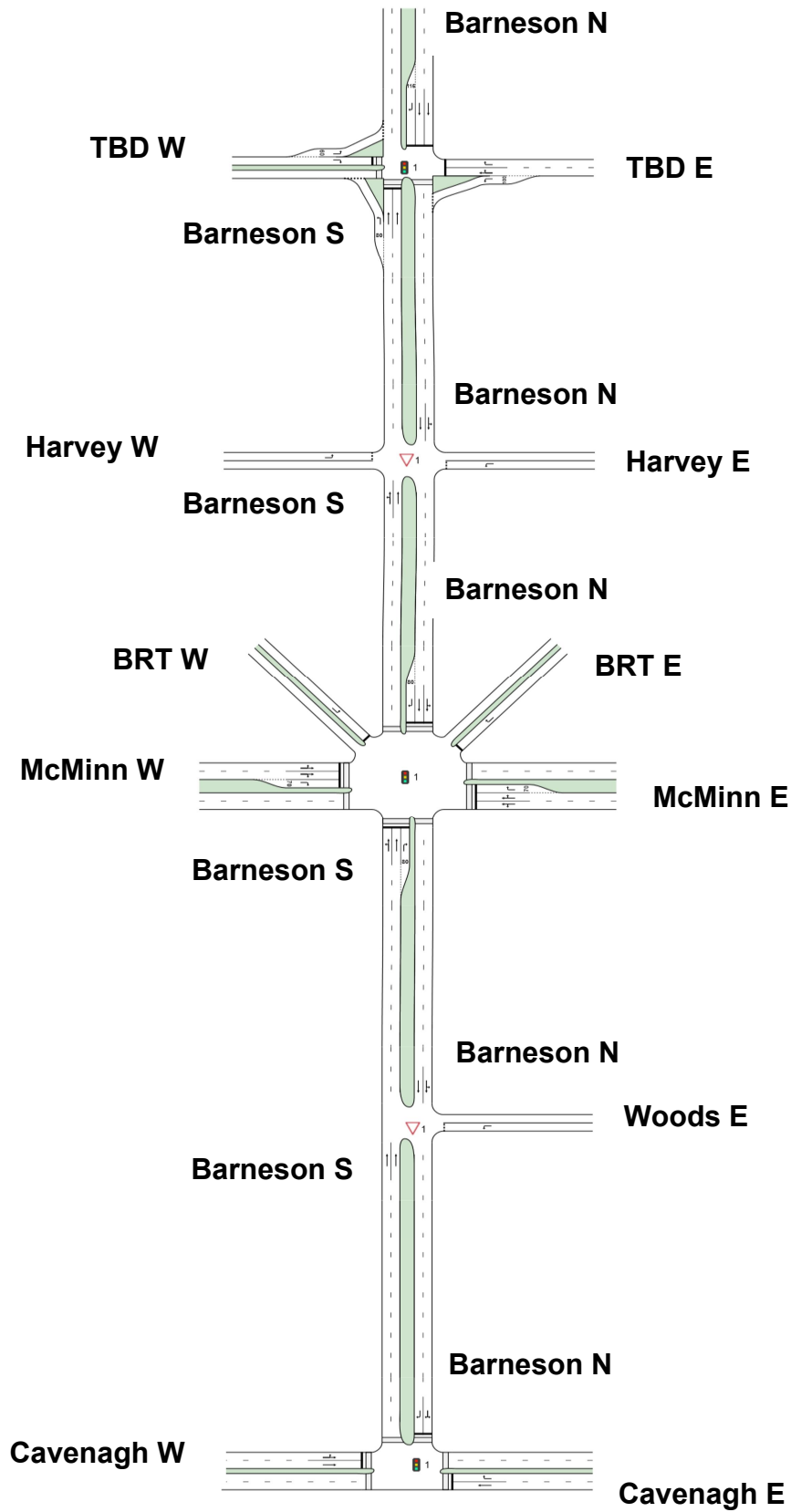
Movement	Vehicles	Ave Delay (s)	LOS	Ave Q	Max Q
Stuart Highway/ McMinn Street/ Daly Street					
Daly St left	25	20	B	2	20
Daly St through	764	23	B	18	130
Daly St right	251	30	C	11	96
McMinn St W left	37	60	E	10	52
McMinn St W through	55	56	D	10	52
McMinn St W right	41	63	E	11	55
Stuart Hwy left	142	31	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	Arrival Flows HV %	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	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	Distance m	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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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 AM Peak - SIDRA Analysis Rev2.sip6

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

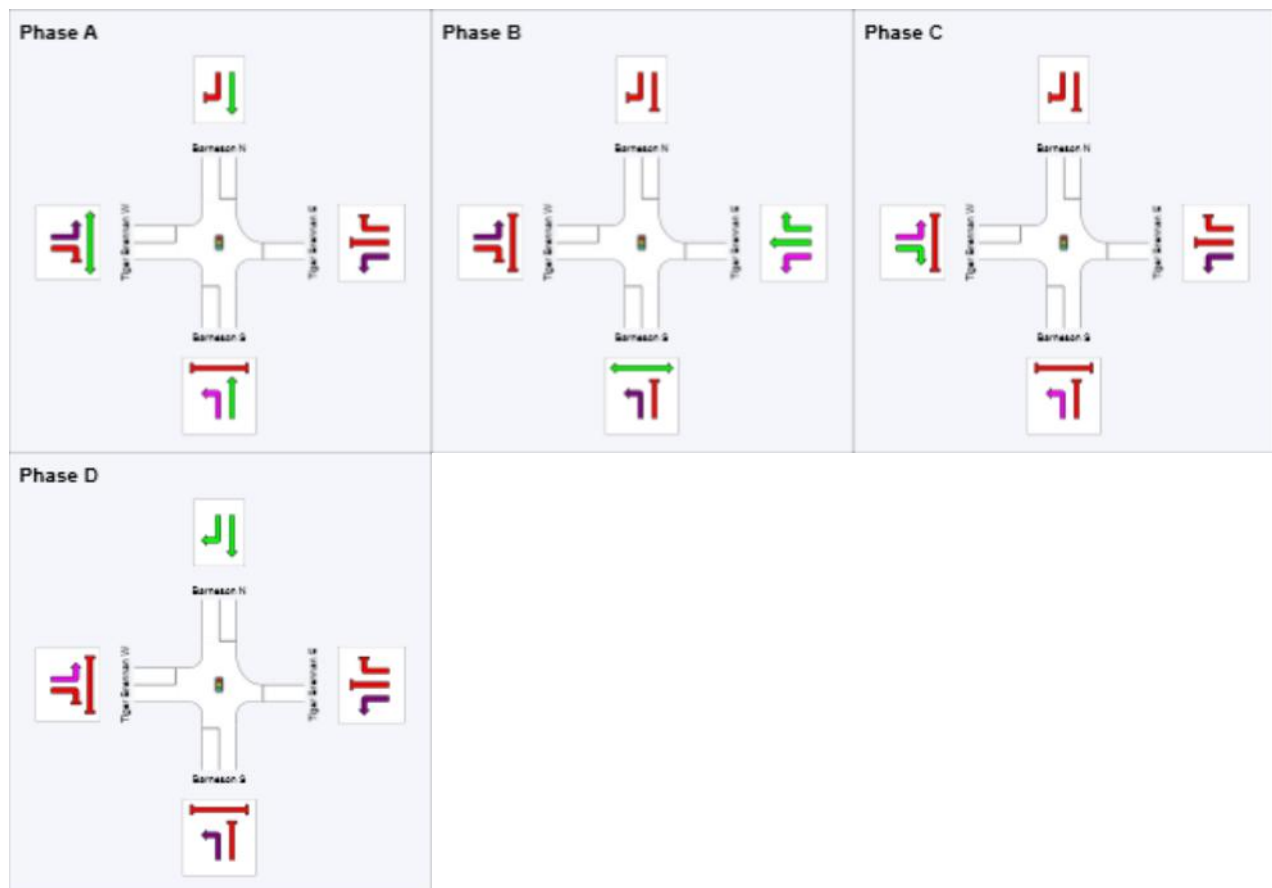
Movement Class: All Movement Classes












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	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	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	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	Average Back of Queue 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

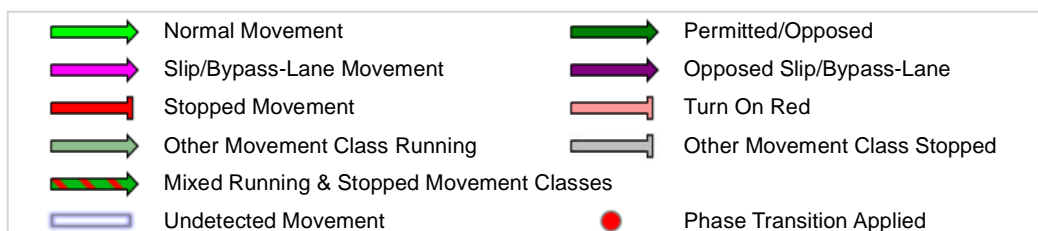
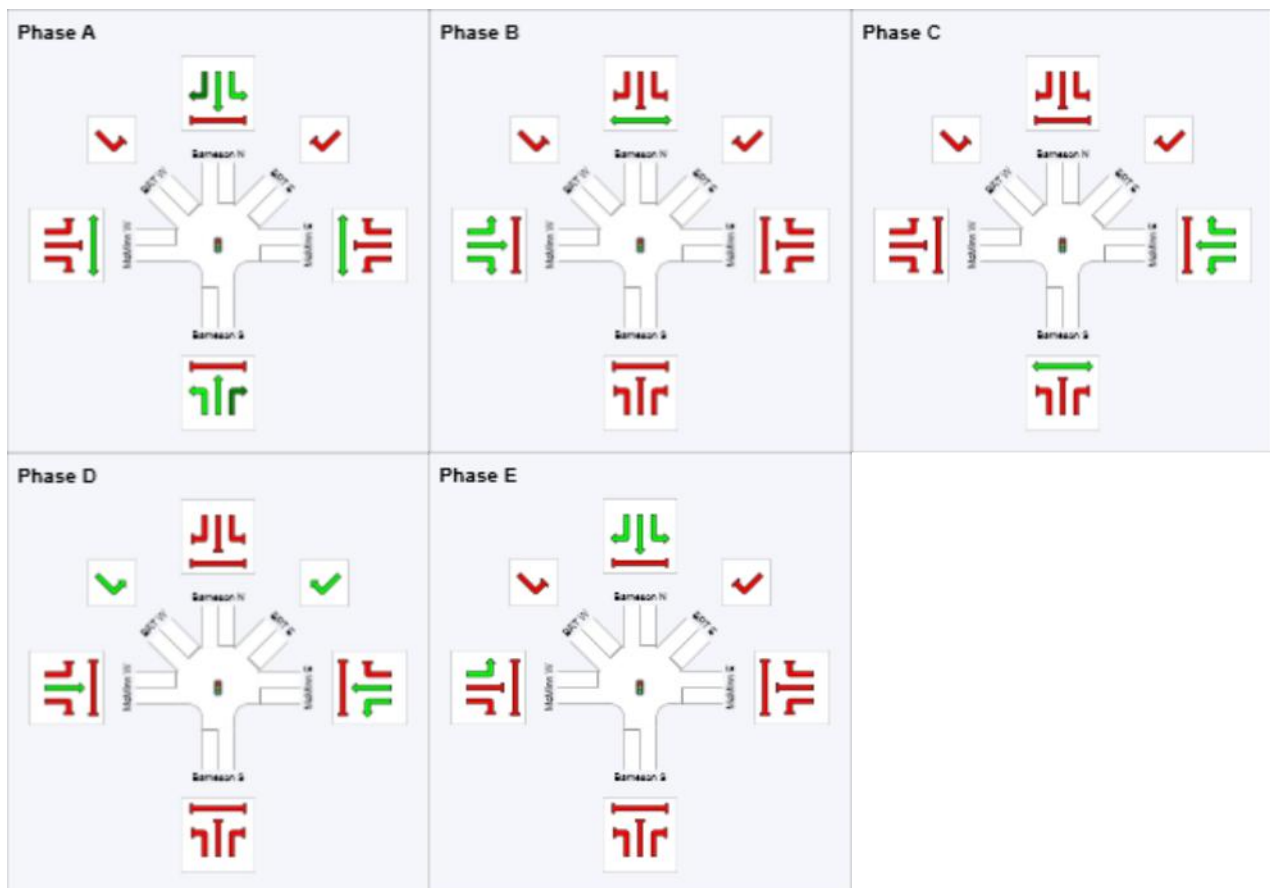
Movement Class: All Movement Classes

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 %



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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Organisation: JACOBS GROUP (AUSTRALIA) PTY LTD | Processed: Tuesday, 3 May 2016 10:48:37 AM

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

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

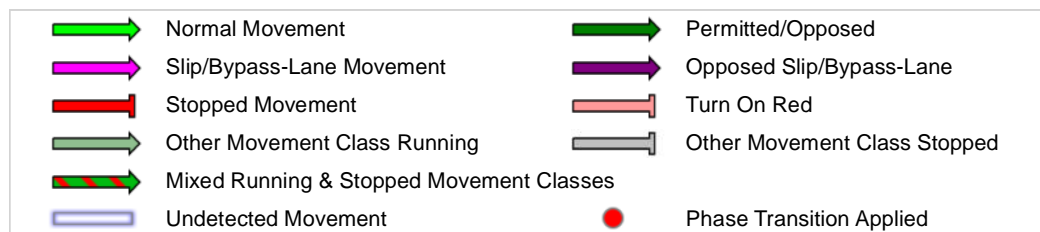
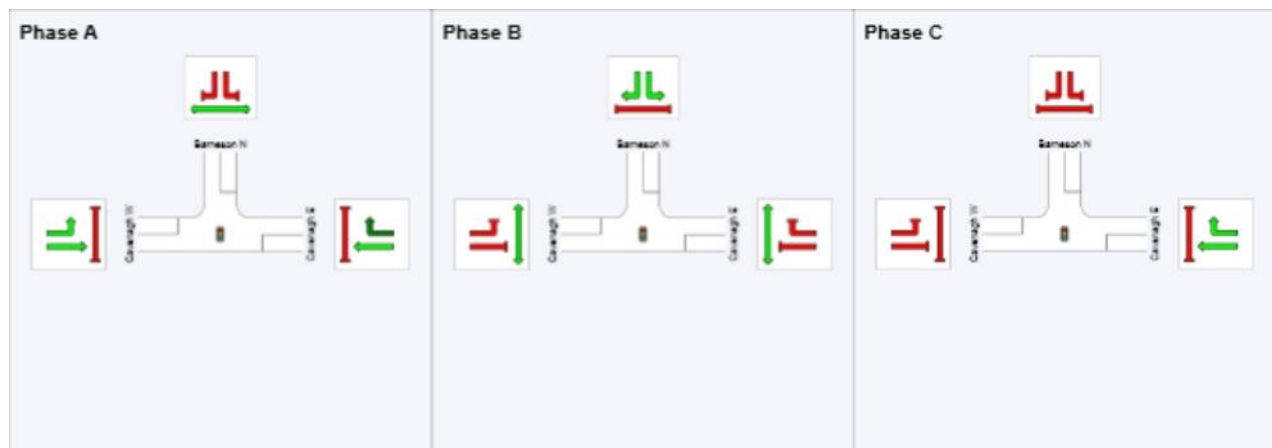
Movement Class: All Movement Classes

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	Arrival Flows HV %	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	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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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 PM Peak - SIDRA Analysis Rev2.sip6

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

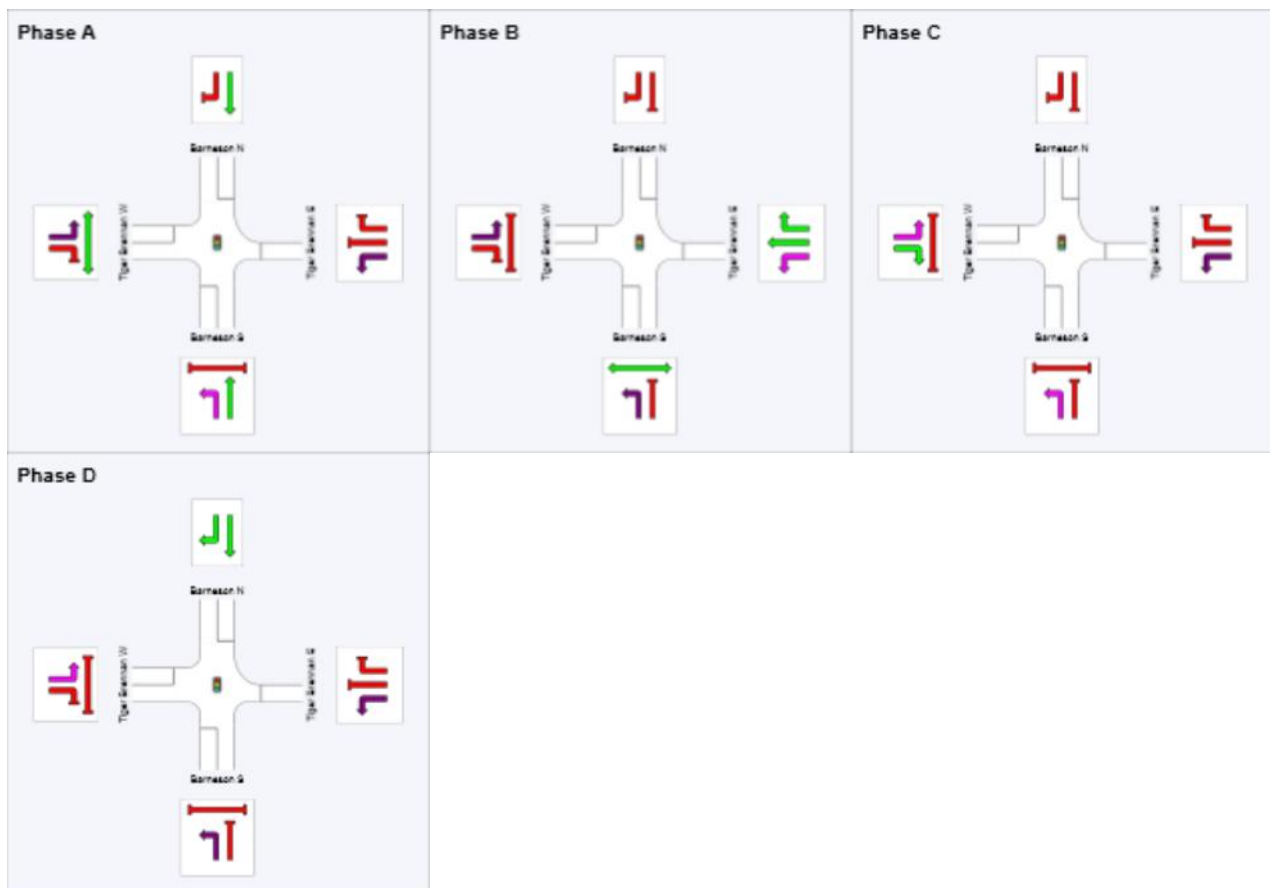
Movement Class: All Movement Classes











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		Phase Transition Applied
	Undetected Movement		

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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 PM Peak - SIDRA Analysis Rev2.sip6

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

MOVEMENT SUMMARY

New Site
 Signals - Fixed Time Coordinated Cycle Time = 120 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	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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Project: J:\IE\Projects\06_Central West\IW110300\IW103200 - Barneson Boulevard\SIDRA\Barneson Link 2031 PM Peak - SIDRA Analysis Rev1.sip6

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

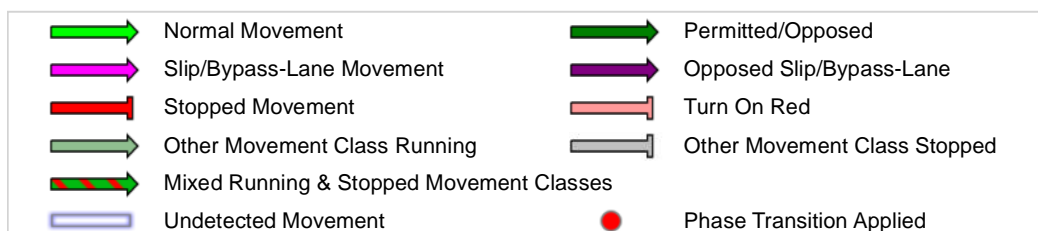
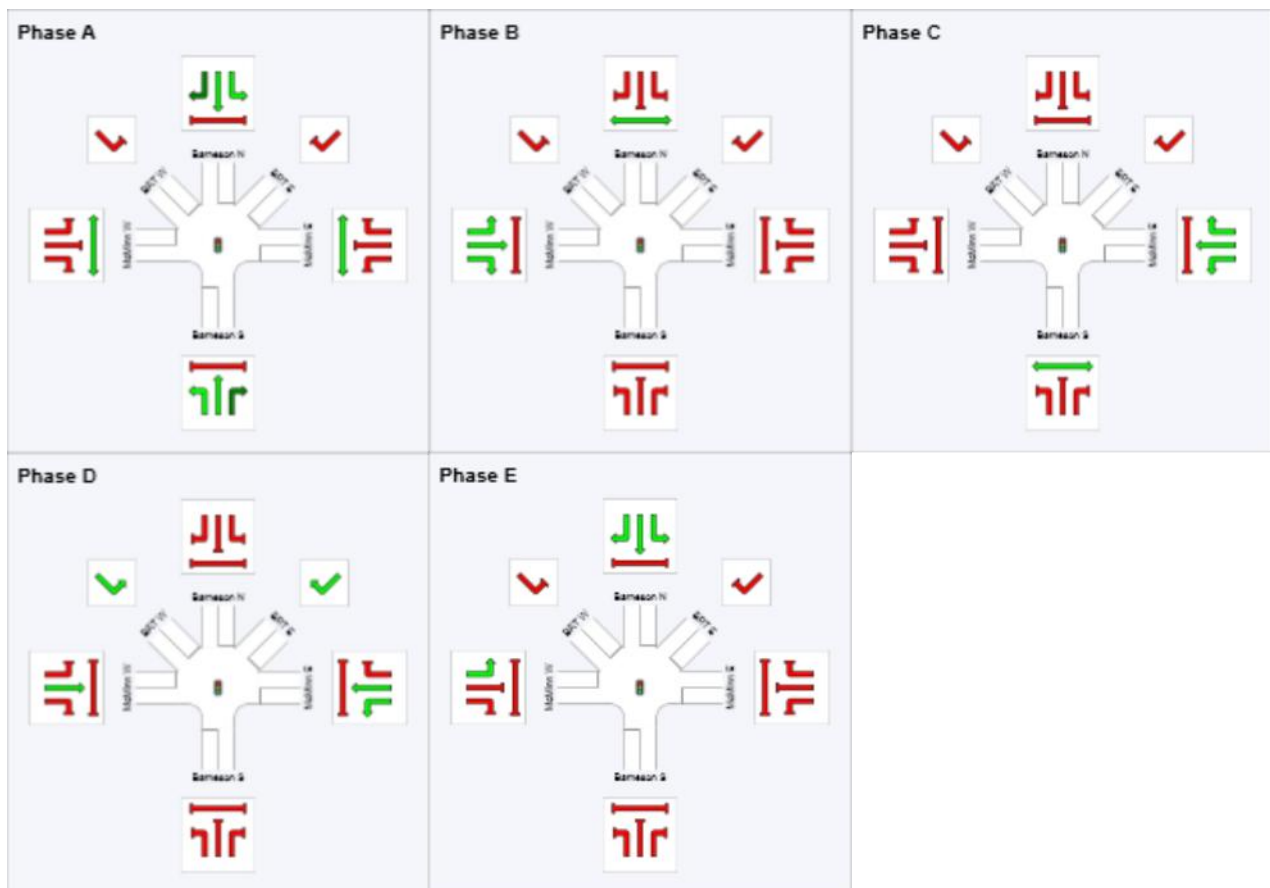
Movement Class: All Movement Classes

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 %



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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/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	Distance m	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

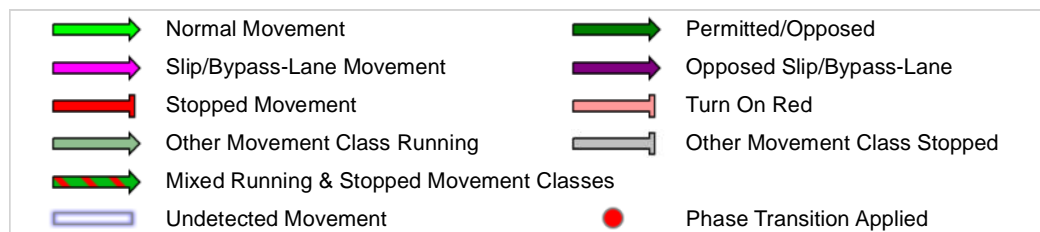
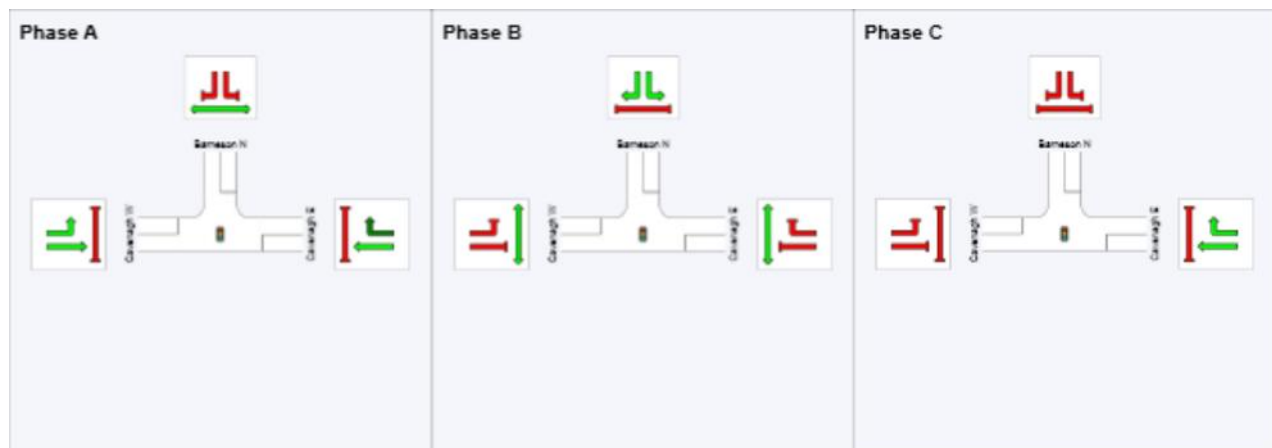
Movement Class: All Movement Classes

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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