

# 3288 Greenbank Road – Phase 1 Transportation Impact Assessment

Step 1 Screening Report

Step 2 Scoping Report

Step 3 Forecasting Report

Step 4 Strategy Report

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March 2020

PN: 2020-16

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## 1 Screening

This study has been prepared according to the City of Ottawa’s 2017 Transportation Impact Assessment (TIA) Guidelines. Accordingly, a Step 1 Screening Form has been prepared and is included as Appendix A, along with the Certification Form for TIA Study PM. As shown in the Screening Form, a TIA is required including the Design Review component and the Network Impact Component.

## 2 Existing and Planned Conditions

### 2.1 Proposed Development

The proposed development, located at 3288 Greenbank Road Phase 1, is currently zoned as [Development Reserve \(DR\)](#). The existing lands include a mix of farm fields and a private dwelling. The proposed Phase 1 of development includes Blocks 4 and 8-15 and are part of the previous zoning by-law amendment and plan of subdivision application that included a total of 328 apartment units and 429 townhome units. The Phase 1 includes a total of 116 units in Block 4 (72 stacked townhome units and 44 back-to-back townhome units), and 42 rear lane townhomes in Block 8-15. Street B will be constructed along the southern limits of the property with extensions of Street A, Street C, Street E and Jockvale Road along the frontages of each Block. A single intersection is proposed at Greenbank Road and Street B. The anticipated full build-out and occupancy horizon is 2022. The development is located within the Nepean Towncentre Design Priority and Community Design Plan area, and the Nepean Area 7 Secondary Plan area. Figure 1 illustrates the Study Area Context. Figure 2 and Figure 3 illustrates the proposed concept plan.

Figure 1: Area Context Plan



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: March 25, 2020

# SOUTH NEPEAN TOWN CENTRE

## Concept Option 3A

City of Ottawa

DWELLING TYPE	UNIT COUNT
Stacked Towns	72
Back To Back Towns	44
<b>TOTAL</b>	<b>116</b>

### Stacked Towns Parking:

Residents: 79 (1.1 spaces/unit)\*  
 Visitor: 7 (0.1 spaces/unit)  
 Total: 86 spaces

\*Reduced width parking stalls: 32 spaces

### Stacked Total Amenity Area:

Required: 432m<sup>2</sup> (6m<sup>2</sup> per unit)  
 Provided: ±612m<sup>2</sup> (±8.5m<sup>2</sup> per unit)

Communal Amenity Area:  
 Required: 216m<sup>2</sup> (50% of total required amenity area)  
 Provided: 216m<sup>2</sup>

### Landscaped Area:

4,781m<sup>2</sup> (30%)

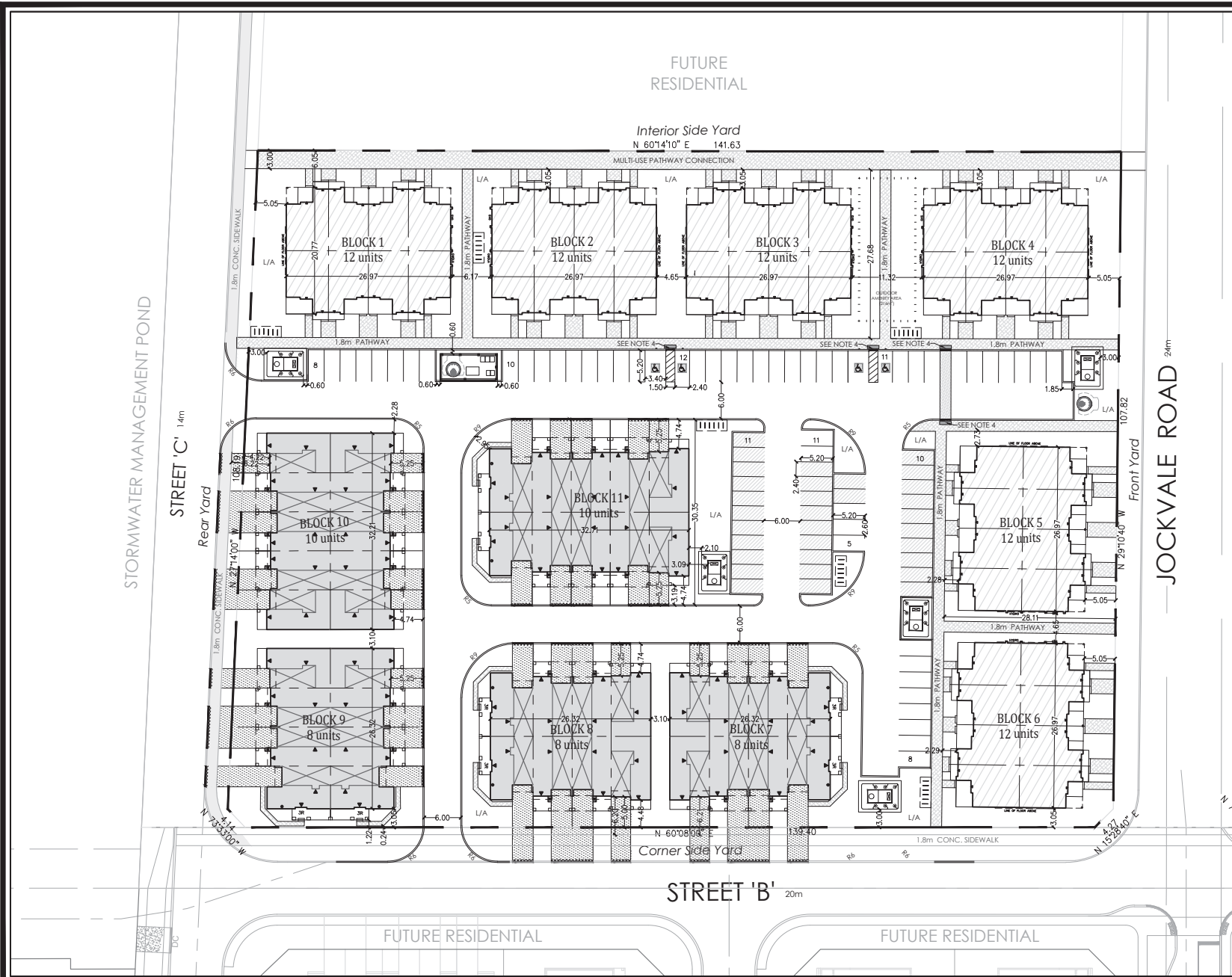
Scale 1:600

March 19, 2020



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STORMWATER MANAGEMENT POND

STREET 'C' 14m

JOCKVALE ROAD 24m

STREET 'B' 20m

FUTURE RESIDENTIAL

FUTURE RESIDENTIAL





## 2.2 Existing Conditions

### 2.2.1 Area Road Network

*Greenbank Road:* Greenbank Road is a City of Ottawa arterial road with a four-lane urban cross-section, transitioning to two-lanes south of Jockvale Road. Sidewalks are provided on the east side of the road and transition to a paved shoulder on the east side. The posted speed limit is 60 km/h. The Ottawa Official Plan reserves a 37.5 metre right of way between Strandherd Drive and future Chapman Mills Drive, and 44.5 metre south of Chapman Mills Drive. Greenbank Road is a truck route north of Jockvale Road.

*Jockvale Road (rural):* Jockvale Road, adjacent to Greenbank Road, is a City of Ottawa local road with a two-lane cross-section that transitions between an urban cross section and a rural cross section, with gravel shoulders. The posted speed is 60 km/h and the right-of-way is 26.0 metre west of Greenbank Road and 20.0 metre to the east. Jockvale Road is a truck route.

*Strandherd Drive:* Strandherd Drive is a City of Ottawa arterial road with a four-lane urban cross-section. Sidewalks are provided to the west of Greenbank Road on both sides of the road and a multi-use pathway is located on the north side to the west of Greenbank Road. On-street bike lanes are provided on both sides of the road. The posted speed limit is 60 km/h and the Ottawa Official Plan reserves a 44.5 metre right of way. Strandherd Drive is a truck route.

*Marketplace Avenue:* Marketplace Avenue is a City of Ottawa collector road with a two-lane urban cross-section, including sidewalks and on-street parking. The posted speed limit is 50 km/h and the right-of-way is 20.0 metre.

*Chapman Mills Drive:* Chapman Mills Drive is a City of Ottawa major collector road with a divided two-lane urban cross-section and centre median bus rapid transit. Sidewalks and on-street parking are provided on both sides of the roadway, and buffered bike lanes are provided on blocks east of Beatrice Drive. The posted speed limit is 40 km/h during school days/hours, otherwise an unposted 50km/h speed limit, and the right-of-way is 41.0 metres.

### 2.2.2 Existing Intersections

#### *Greenbank Road / Jockvale Road*

The intersection of Greenbank Road and Jockvale Road is a signalized intersection with shared all movement lanes on the north and east bound approaches. The southbound approach consists of an auxiliary left-turn lane and a shared through/right-turn lane, and the westbound approach consists of a shared left-turn/through lane and an auxiliary right-turn lane. No turn restrictions were noted.

#### *Greenbank Road / Marketplace Avenue*

The intersection of Greenbank Road and Marketplace Avenue is a signalized intersection. The east and west bound approaches consist of an auxiliary left-turn lane and a shared through/right-turn lane. The southbound approach consists of dual auxiliary left-turn lanes, a through lane, a shared through/right-turn lane, and a bike lane. The northbound approach consists of an auxiliary left-turn lane, a through lane, and a shared through/right-turn lane. No turn restrictions were noted.

#### *Strandherd Drive / Greenbank Road*

The intersection of Strandherd Drive and Greenbank Road is a signalized intersection. The east and west bound approaches consist of an auxiliary left-turn lane, two through lanes, an auxiliary channelized right-turn lane, and a pocket bike lane. The northbound approach consists of dual auxiliary left-turn lanes, a through lane, a



shared through/right-turn lane and a bike lane. The southbound approach consists of dual auxiliary left-turn lanes, two through lanes, an auxiliary channelized right-turn lane, and a pocket bike lane. No turn restrictions were noted.

### 2.2.3 Existing Driveways

Along Greenbank Road, there are two accesses to the Barrhaven Towncentre, two accesses to the Loblaws site in the Chapman Mills Marketplace, and a residential driveways and St Joseph High School accesses are south of the Jockvale Road intersection. The Barrhaven Towncentre accesses are both right-in/right-out, the Loblaws access to the parking lot is right-in/right-out, and the loading access at the back of Loblaws permits full movements.

Along Strandherd Drive, there are an additional three right-in/right-out accesses and a signalized intersection for the Barrhaven Towncentre.

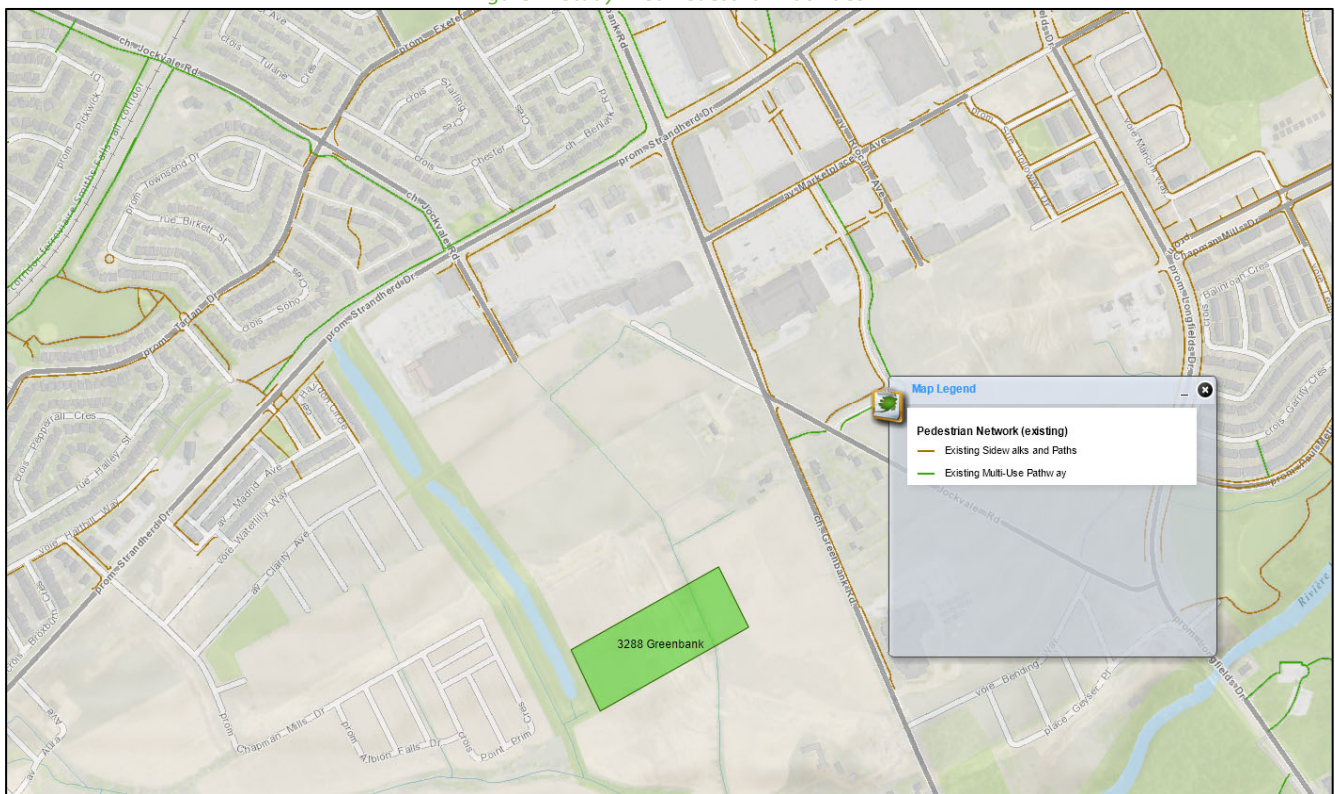
The On The Green golf range and mini putt access is located on Jockvale Road, west of Greenbank Road.

### 2.2.4 Cycling and Pedestrian Facilities

Figure 4 illustrates the pedestrian facilities in the study area and Figure 5 illustrates the cycling facilities.

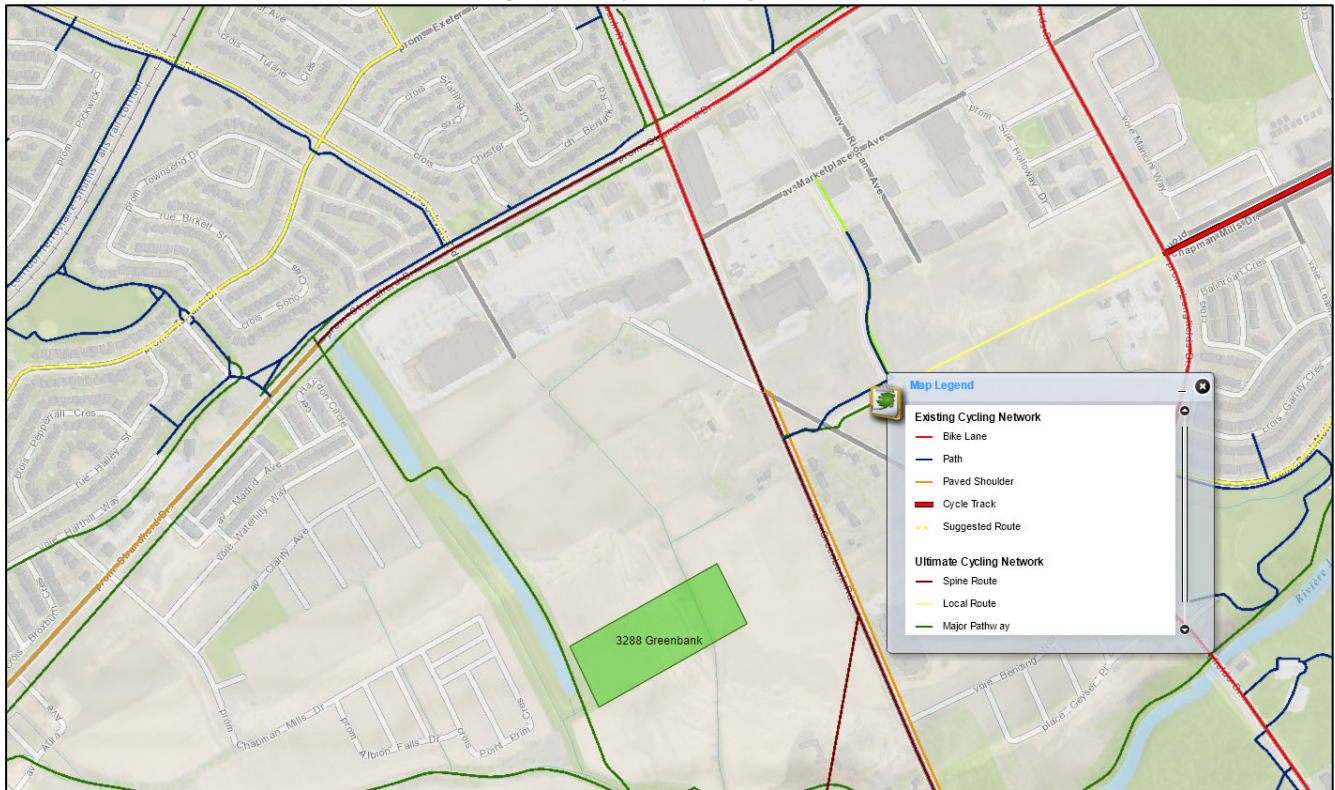
Sidewalks are provided along both sides of the roadways in the study area with a multi-use pathway on the north side of Strandherd Drive and along the Southwest Transitway. The cycling network consists of the bike lanes north and east of the Greenbank Road and Strandherd Drive intersection, the multi-use pathways and a path along the east side of Greenbank Road, south of Jockvale Road.

Figure 4: Study Area Pedestrian Facilities



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: March 25, 2020

Figure 5: Study Area Cycling Facilities



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: March 25, 2020

### 2.2.5 Existing Transit

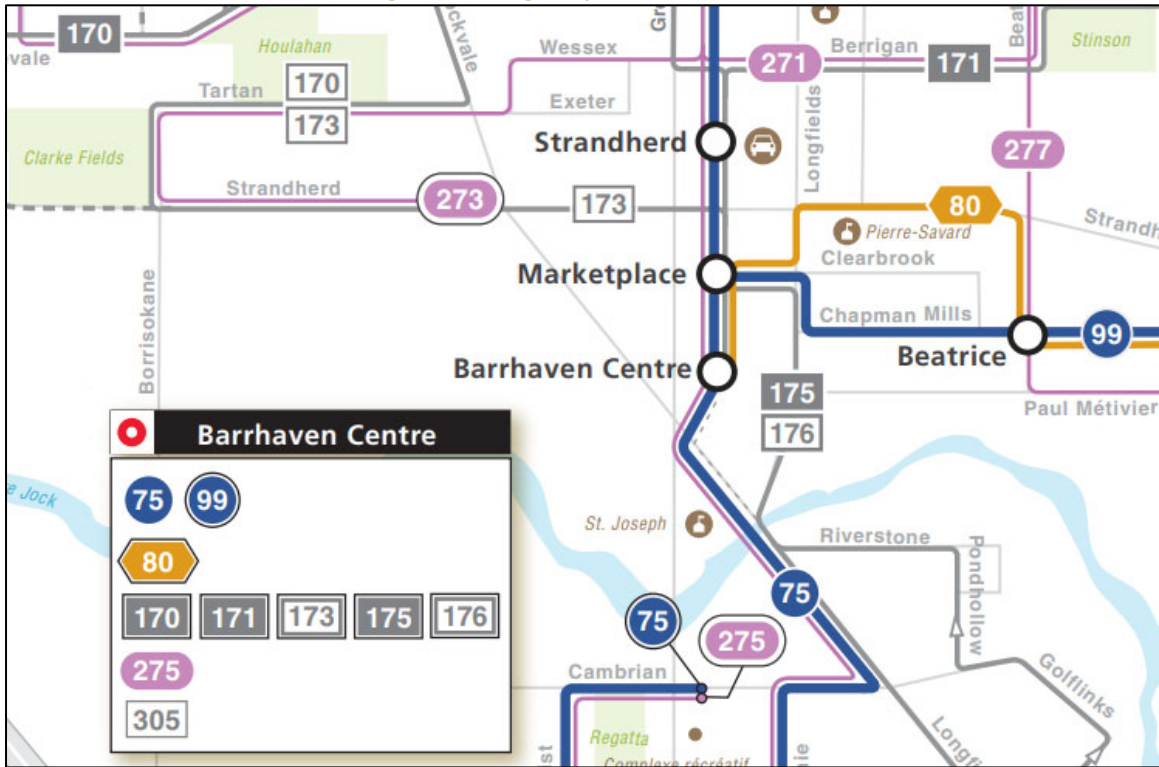
Within the study area, the Southwest Transitway ends at the Barrhaven Towncentre Station, and includes Marketplace and Strandherd Stations. Routes #75, 80, 99, 170, 171, 173, 175, 176, 275 and 305 stop at the Marketplace and Barrhaven Towncentre Stations, with routes #75, and 275 travelling south on Jockvale Road the Transitway. The frequency of these routes within proximity of the proposed site currently are:

- Route #75 – 5-10 minutes in the peak direction, and 10-15 minutes in the off-peak direction and 15-30 minutes during off-peak times
- Route #275 – every 15-30 minutes to Tunney’s Pasture during the AM peak, and every 15-30 minutes to Minto Recreation Centre during the PM peak

Figure 6 illustrates the transit system map in the study area and Figure 7 illustrates the walking distance for the Southwest Transitway. The existing Transitway stations are within the 600m walk distance for half the site, and the future Greenbank-St Joseph station will be directly adjacent to the proposed site.



Figure 6: Existing Study Area Transit Service



Source: <http://www.octranspo.com/> Accessed: March 25, 2020

Figure 7: Study Area Transit Stations



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: March 25, 2020

2.2.6 Existing Area Traffic Management Measures

Greenbank Road has a school zone south of Jockvale Road for St. Joseph Highschool. The posted speed limit is 40km/h between the hours of 7:00-9:00AM, 11:30AM-1:00PM and 2:00-3:30PM on school days.

2.2.7 Existing Peak Hour Travel Demand

Existing turning movement counts were acquired from the City of Ottawa for the existing Study Area intersection. Table 1 summarizes the intersection count dates.

Table 1: Intersection Count Date

Intersection	Count Date
Greenbank Road and Jockvale Road	August 16, 2016
Greenbank Road and Marketplace Avenue	February 10, 2016
Strandherd Drive and Greenbank Road	August 16, 2016

Figure 8 illustrates the existing traffic counts and Table 2 summarizes the existing intersection operations. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections. Detailed turning movement count data is included in Appendix B and the synchro worksheets are provided in Appendix C.

Figure 8: Existing Traffic Counts

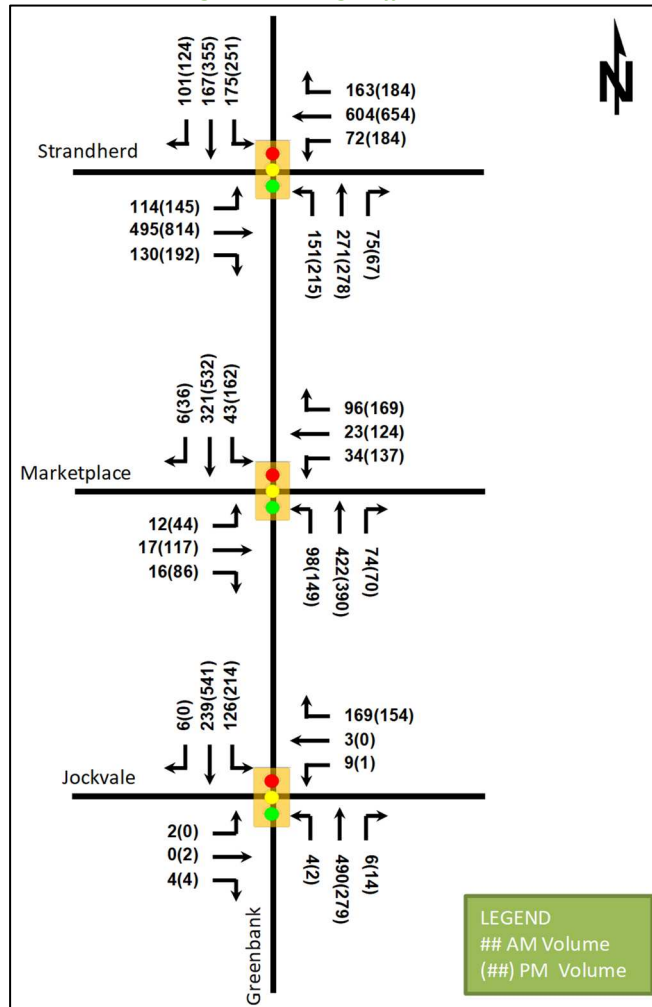


Table 2: Existing Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Jockvale Road Signalized</b>	EB	A	0.03	0.2	0.0	A	0.04	37.0	4.9
	WBL/T	A	0.10	48.5	8.8	A	0.01	51.0	2.1
	WBR	A	0.57	12.0	17.0	A	0.58	14.7	18.1
	NB	A	0.43	9.3	115.1	A	0.24	4.9	47.4
	SBL	A	0.20	3.5	6.6	A	0.26	1.6	11.7
	SBT/R	A	0.17	1.9	11.1	A	0.36	1.9	37.8
	<b>Overall</b>	<b>A</b>	-	<b>7.7</b>	-	<b>A</b>	-	<b>4.4</b>	-
<b>Greenbank Road &amp; Marketplace Avenue Signalized</b>	EBL	A	0.07	35.1	6.9	A	0.27	31.1	17.3
	EBT/R	A	0.19	29.2	13.0	B	0.65	46.4	69.8
	WBL	A	0.19	38.7	14.7	B	0.62	44.3	44.5
	WBT/R	A	0.45	17.2	21.9	D	0.84	56.2	#109.1
	NBL	B	0.61	65.0	#63.1	D	0.84	86.0	#84.3
	NBT/R	A	0.27	13.0	51.1	A	0.36	22.2	48.4
	SBL	A	0.25	61.4	13.1	A	0.58	62.4	m33.2
	SBT/R	A	0.20	15.0	30.5	A	0.46	22.3	m49.9
<b>Overall</b>	<b>C</b>	-	<b>21.6</b>	-	<b>D</b>	-	<b>39.3</b>	-	
<b>Greenbank Road &amp; Strandherd Drive Signalized</b>	EBL	A	0.46	25.8	31.7	B	0.64	34.1	40.0
	EBT	A	0.49	34.6	79.5	E	0.95	61.3	#157.7
	EBR	A	0.25	5.7	14.5	A	0.37	6.3	18.4
	WBL	A	0.25	21.9	21.4	E	0.95	80.3	#84.9
	WBT	B	0.67	40.8	100.4	C	0.75	44.3	110.2
	WBR	A	0.32	6.3	17.2	A	0.35	6.2	18.2
	NBL	A	0.54	70.4	35.0	B	0.63	71.2	m45.1
	NBT/R	A	0.41	29.9	34.5	A	0.43	24.9	m28.5
	SBL	A	0.58	57.9	35.3	B	0.69	58.9	48.4
	SBT	A	0.19	32.7	29.0	A	0.42	37.2	59.6
	SBR	A	0.21	3.1	6.9	A	0.26	5.9	13.9
<b>Overall</b>	<b>C</b>	-	<b>33.8</b>	-	<b>D</b>	-	<b>44.3</b>	-	

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 0.90

m = metered queue  
# = queue exceeds storage or mid-block length

The existing intersection operations generally operate satisfactorily during the peak hours.

The northbound left-turn movement at the Greenbank Road and Marketplace Avenue intersection may experience extended queues during the AM and PM peak hours, with high delays during the PM peak. Additionally, the westbound through/right-turn may experience extended queues during the PM peak as well. Greenbank Road provides space for a dual left-turn movement, but this will require modification to the Barrhaven Town Centre access, limiting the feasibility of this modification until redevelopment occurs.

At the Greenbank Road and Strandherd Drive intersection, high delays are noted for the westbound left-turn movement and may experience extended queues for the eastbound through and westbound left-turn movements during the PM peak.

### 2.2.8 Collision Analysis

Collision data has been acquired from the City of Ottawa open data website (data.ottawa.ca) for five years prior to the commencement of this TIA for the surrounding study area road network. Table 3 summarizes the collisions types and conditions in the study area, Figure 9 illustrates the intersections and segments analyzed, and Table 4 summarizes the total collisions for each of these locations. Collision data is included in Appendix D.

Table 3: Study Area Collision Summary, 2014-2018

		Number	%
<b>Total Collisions</b>		<b>227</b>	<b>100%</b>
<b>Classification</b>	<b>Fatality</b>	0	0%
	<b>Non-Fatal Injury</b>	40	18%
	<b>Property Damage Only</b>	187	82%
<b>Initial Impact Type</b>	<b>Approaching</b>	8	4%
	<b>Angle</b>	11	5%
	<b>Rear end</b>	112	49%
	<b>Sideswipe</b>	30	13%
	<b>Turning Movement</b>	42	19%
	<b>SMV Unattended</b>	1	0%
	<b>SMV Other</b>	20	9%
	<b>Other</b>	3	1%
<b>Road Surface Condition</b>	<b>Dry</b>	144	63%
	<b>Wet</b>	45	20%
	<b>Loose Snow</b>	17	7%
	<b>Slush</b>	2	1%
	<b>Packed Snow</b>	6	3%
	<b>Ice</b>	13	6%
<b>Pedestrian Involved</b>		1	0%
<b>Cyclists Involved</b>		1	0%

Figure 9: Study Area Collision Records – Representation of 2014-2016

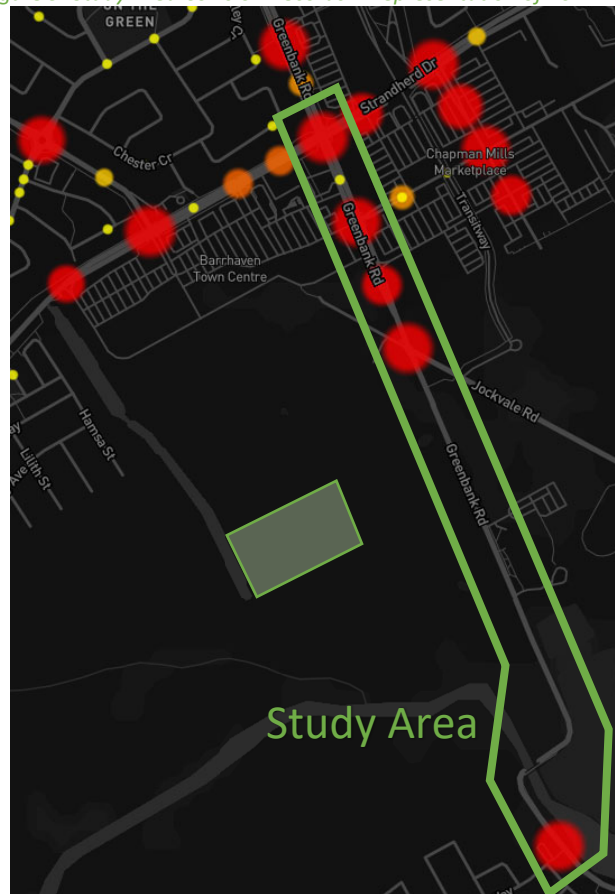




Table 4: Summary of Collision Locations

	Number	%
<b>Intersections / Segments</b>	<b>227</b>	<b>100%</b>
Greenbank Rd @ Jockvale Rd	30	13%
Greenbank Rd @ Marketplace Ave	21	9%
Greenbank Rd @ Strandherd Dr	131	58%
Greenbank Rd btwn Jockvale Rd & Cambrian Rd	34	15%
Greenbank Rd btwn Marketplace Ave & Jockvale Rd	8	4%
Greenbank Rd btwn Strandherd Dr & Marketplace Ave	3	1%

Within the study area, the intersection of Greenbank Road at Strandherd Drive is noted to have significantly higher collision rates than the other study area intersections. Table 5 summarizes the collision types and conditions for each of the Greenbank Road at Strandherd Drive intersection.

Table 5: Greenbank Road at Strandherd Drive Collision Summary

		Number	%
<b>Total Collisions</b>		<b>131</b>	<b>100%</b>
Classification	Fatality	0	0%
	Non-Fatal Injury	24	18%
	Property Damage Only	107	82%
Initial Impact Type	Angle	4	3%
	Rear end	70	53%
	Sideswipe	16	12%
	Turning Movement	36	27%
	SMV Other	3	2%
	Other	2	2%
Road Surface Condition	Dry	88	67%
	Wet	27	21%
	Loose Snow	8	6%
	Slush	2	2%
	Packed Snow	2	2%
	Ice	4	3%
Pedestrian Involved		1	1%
Cyclists Involved		0	0%

The Greenbank Road at Strandherd Drive intersection had a total of 131 collisions during the 2014-2018 time period, with 107 involving property damage only, and the remaining 24 having non-fatal injuries. The high volume of rear end and turning movement collisions would indicate congestion being a major factor in the cause for the high collision rates. Combined with the predominantly property damage classification, these are low speed impacts. The turning movement collisions typically present a potential hazard to pedestrians and cyclists, in which the only documented a single pedestrian collision during this period in 2018. Weather conditions are not considered to have a major impact on the collisions.

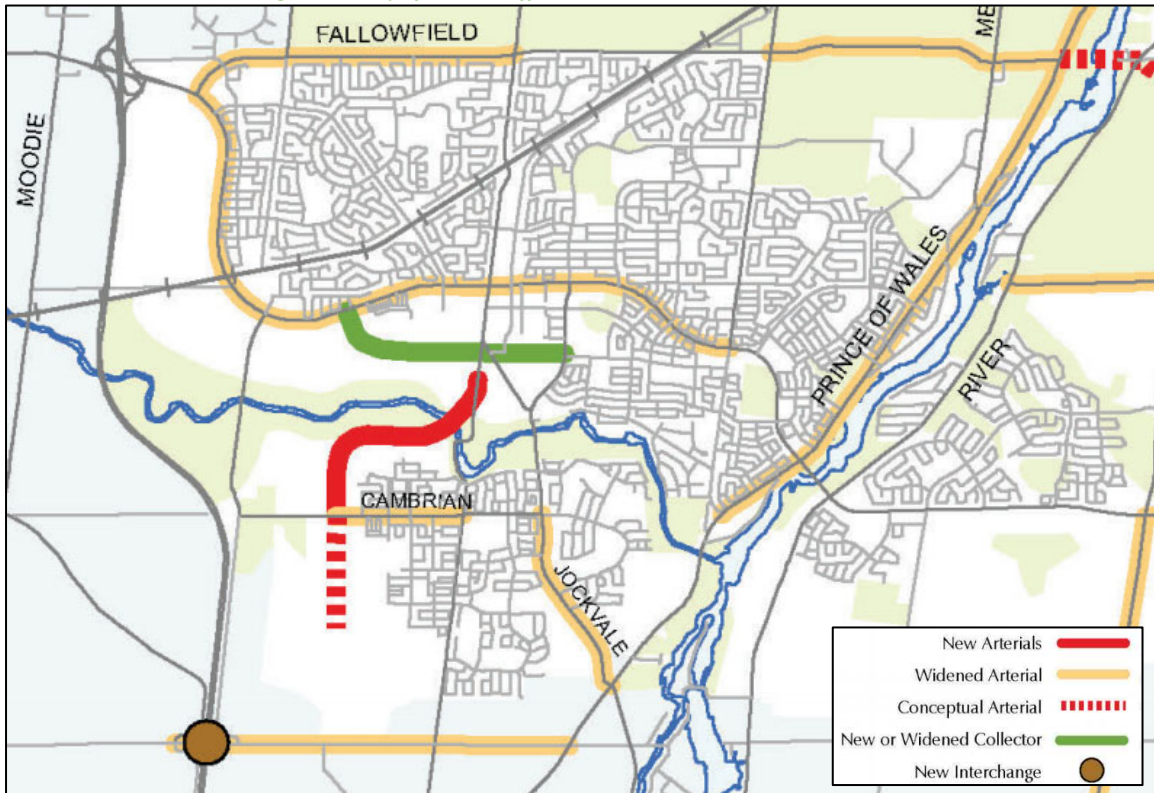
### 2.3 Planned Conditions

#### 2.3.1 Changes to the Area Transportation Network

The subject development is within the South Nepean Towncentre (SNTC) Community Design Plan (CDP) and the Nepean South Area 7 Secondary Plan. A revision to the SNTC CDP is currently underway and this development is being proposed within the context of these revisions. The following projects are currently included within the 2031 Affordable Network and illustrated in Figure 10:

- Strandherd Drive Widening is in the process of being designed and constructed between Kennevale Road and Jockvale Road, including a 4-lane cross-section, and is estimated to be completed by 2023
- Chapman Mills Drive Extension from Longfields Drive to Strandherd Drive, including the extension of the bus rapid transit (BRT) corridor to the Southwest Transitway/Greenbank Road within the centre median
- Greenbank Road Re-Alignment, south of Chapman Mills Drive, to loop west around the existing Half Moon Bay development and connect to Cambrian Road, and will include cycle tracks and a future BRT extension within the centre median

Figure 10: City of Ottawa Affordable Network – Barrhaven Context



Beyond the 2031 Affordable Network horizon, the following network improvements are planned for the study area:

- Chapman Mills Drive BRT extension from Greenbank Road to Borrisokane Road
- Greenbank Road Re-Alignment extension south of Cambrian Road that will ultimately connect to Barnsdale Road and include connectivity improvements to Manotick

### 2.3.2 Other Study Area Developments

#### 3195 Jockvale Road (Richcraft)

The development is proposed to be a mix of 210 stacked townhome units and approximately 200,000 sq. ft. of retail space, located between the Barrhaven Towncentre and the On The Green golf range. The development will extend Jockvale Road south of the Barrhaven Towncentre and include a new signalized intersection on Greenbank Road. It is estimated that the development will be constructed by 2026.

### *3311 Greenbank Road*

A residential subdivision has been proposed south of St Joseph High School by Minto Communities, in conjunction with the City of Ottawa. A total 144 townhome units (119 Minto and 25 City), and 64 mid-rise units (City) will ultimately be constructed within the proposed lands.

### *3201 Greenbank Road*

Currently under construction, approximately 11,000 ft<sup>2</sup> of retail and an 8,000 ft<sup>2</sup> restaurant space will be incorporated into the existing retail development of the Loblaws and Home Sense.

### *Barrhaven Towncentre – 3777 Strandherd Drive*

A new retail pad is proposed for the Barrhaven Towncentre, with a total of 5,025 ft<sup>2</sup>. This new pad is located south of the existing BMO building.

### *Burnett Lands – 3370 Greenbank Road (Claridge)*

The Burnett Lands are located south of the 3288 Greenbank Road development and is proposed to include 177 townhomes in Phase 1, 70 townhomes in Phase 2 and 720 condo units in Phase 3. Originally proposed to be completed by 2020, the plan of subdivision application is currently pending, and the Official Plan and Zoning By-Law Amendment have been adopted.

### *Barrhaven South – South of the Jock River*

Beyond the study area, Barrhaven South includes various developments from Caivan, Mattamy, Minto, and Tamarack. These lands will be considered within the background growth percentage applied to the study area.

## 3 Study Area and Time Periods

### 3.1 Study Area

The study area will include the intersections of Greenbank Road and Street 'B', Greenbank Road and Jockvale Road, Greenbank Road and Marketplace Avenue, Greenbank Road and Strandherd Drive, and Strandherd Drive and Jockvale Road. Greenbank Road is noted as the boundary road.

The TIA guidelines requirement for all signals within a 1.0km radius of the site to be analyzed is recommended to be waived for this site at the signalized intersections located at:

- Strandherd Drive and Barrhaven Town Centre Access 210 metres west of Greenbank Road
- Strandherd Drive and Riocan Avenue
- Strandherd Drive and Jockvale Road
- Strandherd Drive and Andora Avenue
- Greenbank Road and Village Square Access
- Marketplace Avenue and SW Transitway
- Future Chapman Mills Drive signals:
  - At Strandherd Drive
  - On west side of Kennedy Burnett SWM Pond
  - Between Greenbank Road and Longfields Drive

The impact to these intersections is to be minimal (e.g. south of the site), will not be impacted by the site trips (e.g. Marketplace Avenue), or have through traffic only and with no turning movements having an undue effect on signal operations (e.g. Greenbank Road north of Strandherd Drive, or Strandherd Drive east and west of Greenbank Road).

The TRANS screenline SL-9 is located to the north at Fallowfield Road and SL-49 is located to the south along the Jock River and will not be reviewed as part of this study.

### 3.2 Time Periods

The AM and PM peak hours will be examined for the proposed development.

### 3.3 Horizon Years

The anticipated build-out year is 2022. As a result, the full build-out plus five years horizon year is 2027.

## 4 Exemption Review

Table 6 summarizes the exemptions for this TIA.

*Table 6: Exemption Review*

Module	Element	Explanation	Exempt/Required
<b>Design Review Component</b>			
<b>4.1 Development Design</b>	4.1.2 Circulation and Access	Only required for site plans	Exempt
	4.2.3 New Street Networks	Only required for plans of subdivision	Required
<b>4.2 Parking</b>	4.2.1 Parking Supply	Only required for site plans	Exempt
	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	Exempt
<b>Network Impact Component</b>			
<b>4.5 Transportation Demand Management</b>	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	Required
<b>4.6 Neighbourhood Traffic Management</b>	4.6.1 Adjacent Neighbourhoods	Only required when the development relies on local or collector streets for access and total volumes exceed ATM capacity thresholds	Exempt
<b>4.8 Network Concept</b>		Only required when proposed development generates more than 200 person-trips during the peak hour in excess of equivalent volume permitted by established zoning	Exempt

## 5 Development-Generated Travel Demand

### 5.1 Trip Generation and Mode Shares

This TIA has been prepared using the vehicle and person trip rates for the residential components using the TRANS Trip Generation Study Report (2009). Table 7 summarizes the person trip rates for the proposed land use.

Table 7: Trip Generation Person Trip Rates

Dwelling Type	Land Use Code	Peak Hour	Vehicle Trip Rate	Person Trip Rates
Townhomes	224 (TRANS)	AM	0.54	0.98
		PM	0.71	1.16

Using the above Person Trip rates, the total person trip generation has been estimates. Table 8 below illustrates the total person trip generation for the Townhomes dwelling type.

Table 8: Total Person Trip Generation

Land Use	Units / GFA	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Townhomes	158	57	98	155	97	86	183

Using the most recent National Capital Region Origin-Destination survey (OD Survey), the existing mode shares for South Nepean have been determined and compared to various modes share breakdowns identified by City Staff as potential interpretations of the data. Table 9 summarizes these modal shares.

Table 9: Mode Shares

Travel Mode	South Nepean (average)	South Nepean (AM from/within)	South Nepean (PM to/within)	BRT Area
Auto Driver	65%	62%	60%	45%
Auto Passenger	15%	12%	15%	15%
Transit	15%	18%	15%	30%
Cycling	0%	1%	0%	1%
Walking	5%	7%	10%	9%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Using the above mode share targets for a BRT area and person trip rates the person trips by mode have been projected. Table 10 summarizes the trip generation by mode.

Table 10: Trip Generation by Mode

Travel Mode	Mode Share	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Auto Driver	40%	23	39	62	39	34	73
Auto Passenger	15%	9	15	23	15	13	27
Transit	35%	20	34	54	34	30	64
Cycling	1%	1	1	2	1	1	2
Walking	9%	5	9	14	9	8	16
<b>Total</b>	<b>100%</b>	<b>57</b>	<b>98</b>	<b>155</b>	<b>97</b>	<b>86</b>	<b>183</b>

As shown above, 62 AM and 73 PM new peak hour two-way vehicle trips are projected as a result of the proposed development.

## 5.2 Trip Distribution

To understand the travel patterns of the subject development the OD Survey has been reviewed to determine the travel for the residential component patterns were applied based on the build-out of Barrhaven. Table 11 below summarizes the distributions.

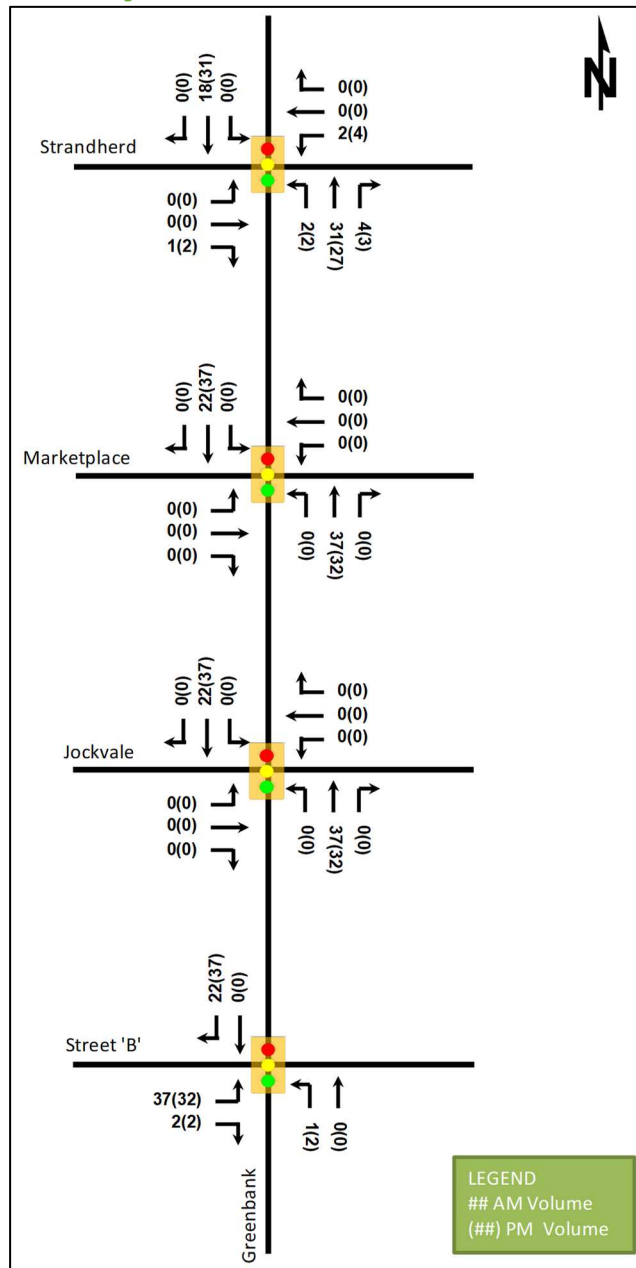
Table 11: OD Survey Existing Mode Share – South Nepean

To/From	Residential % of Trips
North	80%
South	5%
East	10%
West	5%
Total	100%

### 5.3 Trip Assignment

Using the distribution outlined above, turning movement splits, and access to major transportation infrastructure, the trips generated by the site have been assigned to the Study Area road network. Figure 11 illustrates the new site generated volumes.

Figure 11: New Site Generation Auto Volumes





## 6 Background Network Travel Demands

### 6.1 Transportation Network Plans

The transportation network plans were discussed in Section 2.3. The widening of Strandherd Drive (west of the study area) is the only confirmed project within the study horizons and is not considered to have any notable impact on the study area traffic volumes and travel patterns.

### 6.2 Background Growth

The adjacent area transportation studies have used a 2-3% traffic growth in the area. This background growth is considered low by City staff and a 5% will be applied to the mainline volumes in the area. This may overburden the existing road network but does represent the lack of transportation infrastructure in Barrhaven.

### 6.3 Other Developments

The background developments explicitly considered in the background conditions (Section 6.2) include:

- 3195 Greenbank Road
- 3201 Greenbank Road
- 3311 Greenbank Road
- 3370 Greenbank Road (Phase 1)
- 4005 Strandherd Drive

The development within the Barrhaven Towncentre (3777 Strandherd Drive) is for a 5,000 sq. ft. pad and is anticipated to be negligible within the existing trips within the Towncentre.

The background development volumes within the study area have been provided in Appendix G.

## 7 Demand Rationalization

### 7.1 2022 Future Background Operations

Figure 12 illustrates the 2022 background volumes and Table 12 summarizes the 2022 background intersection operations. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections.

The synchro worksheets for the 2022 future background horizon are provided in Appendix E.

Figure 12: 2022 Future Background Volumes

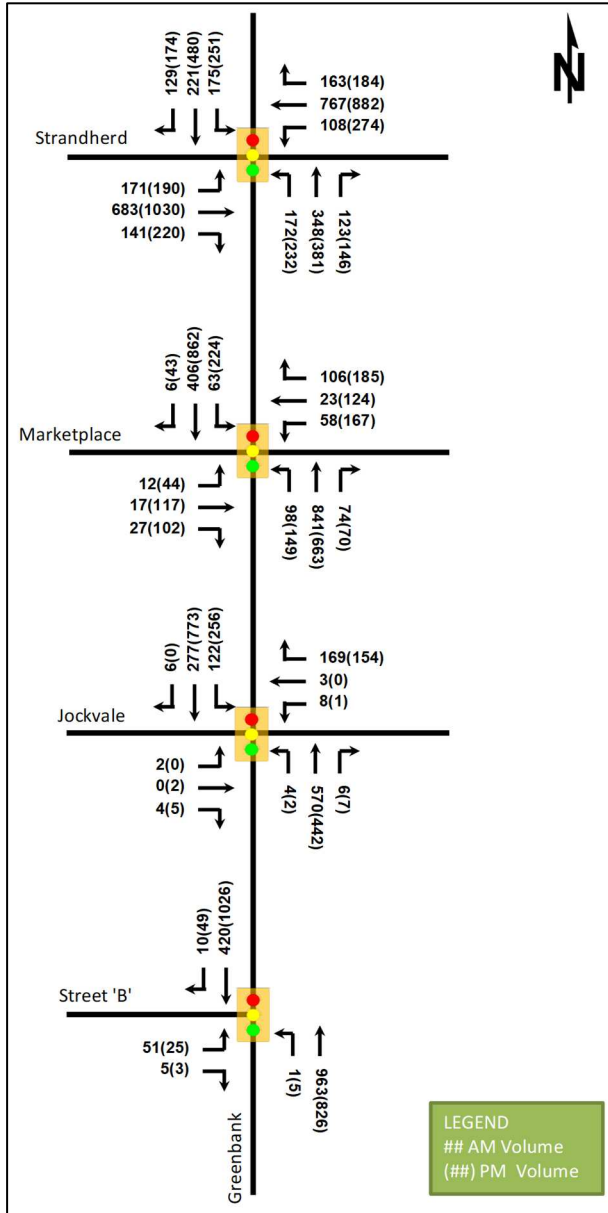


Table 12: 2022 Future Background Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
Greenbank Road & Jockvale Road <i>Signalized</i>	EB	A	0.03	0.2	0.0	A	0.04	37.0	4.9
	WBL/T	A	0.09	48.2	8.4	A	0.01	51.0	2.1
	WBR	A	0.55	12.0	16.1	A	0.56	14.8	17.4
	NB	A	0.47	9.8	133.6	A	0.26	4.9	51.4
	SBL	A	0.19	2.9	4.9	A	0.24	1.3	8.6
	SBT/R	A	0.18	1.6	9.5	A	0.40	2.0	33.2
<b>Overall</b>		<b>A</b>	-	<b>7.8</b>	-	<b>A</b>	-	<b>4.2</b>	-

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Marketplace Avenue</b> <i>Signalized</i>	EBL	A	0.06	34.8	6.6	A	0.24	30.8	16.0
	EBT/R	A	0.17	29.2	12.1	B	0.61	44.6	62.1
	WBL	A	0.18	38.6	14.0	A	0.56	41.5	41.5
	WBT/R	A	0.44	16.8	21.0	D	0.82	53.6	#93.5
	NBL	B	0.61	65.9	#54.8	C	0.78	80.5	#72.0
	NBT/R	A	0.32	14.1	62.8	A	0.45	24.1	68.4
	SBL	A	0.32	61.5	16.7	B	0.61	60.8	m33.3
	SBT/R	A	0.23	15.2	35.3	A	0.57	23.4	m59.2
	<b>Overall</b>	<b>C</b>	-	<b>21.4</b>	-	<b>D</b>	-	<b>36.5</b>	-
<b>Greenbank Road &amp; Strandherd Drive</b> <i>Signalized</i>	EBL	B	0.69	36.4	#44.0	E	0.90	71.1	#75.6
	EBT	B	0.67	40.4	102.2	F	1.08	94.3	#192.8
	EBR	A	0.26	5.7	13.8	A	0.38	6.3	18.8
	WBL	A	0.41	25.0	27.6	F	1.27	182.0	#127.1
	WBT	C	0.78	45.8	117.4	E	0.92	56.3	#151.5
	WBR	A	0.30	6.5	16.4	A	0.33	6.3	17.2
	NBL	A	0.55	72.0	35.4	B	0.62	74.7	m44.9
	NBT/R	A	0.49	29.4	37.6	A	0.57	22.5	30.6
	SBL	A	0.55	57.9	32.7	B	0.65	58.3	44.0
	SBT	A	0.23	33.3	33.9	A	0.51	38.6	72.8
	SBR	A	0.24	4.8	11.2	A	0.32	6.8	17.8
	<b>Overall</b>	<b>D</b>	-	<b>36.8</b>	-	<b>E</b>	-	<b>62.2</b>	-
<b>Greenbank Road &amp; Street "B"</b> <i>Unsignalized</i>	EBL/R	D	0.24	25.0	6.8	E	0.25	47.5	6.8
	NBL	A	0.00	8.2	0.0	A	0.01	10.0	0.0
	NBT	-	-	-	-	-	-	-	-
	SBT/R	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	-	<b>1.2</b>	-	<b>A</b>	-	<b>0.8</b>	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

The intersection operations for the 2022 future background horizon generally operate satisfactorily during the AM peak hour with potential extended queues in the northbound left-turn movement at the Marketplace Avenue intersection and eastbound left-turn movement at the Strandherd Drive intersection. During the PM peak hour, extended queues are noted at the westbound shared through/right-turn and northbound left-turn movements at the Marketplace Avenue intersection and high delays for the northbound left-turn. At the Strandherd Drive intersection, the eastbound through and westbound left-turn movements will be over capacity with high delays and extended queuing. The eastbound left-turn and westbound through movements are also noted to have extended queuing.

### 7.2 2027 Future Background Operations

Figure 13 illustrates the 2027 background volumes and Table 13 summarizes the 2027 background intersection operations. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections.

The synchro worksheets for the 2027 future background horizon are provided in Appendix F.

Figure 13: 2027 Future Background Volumes

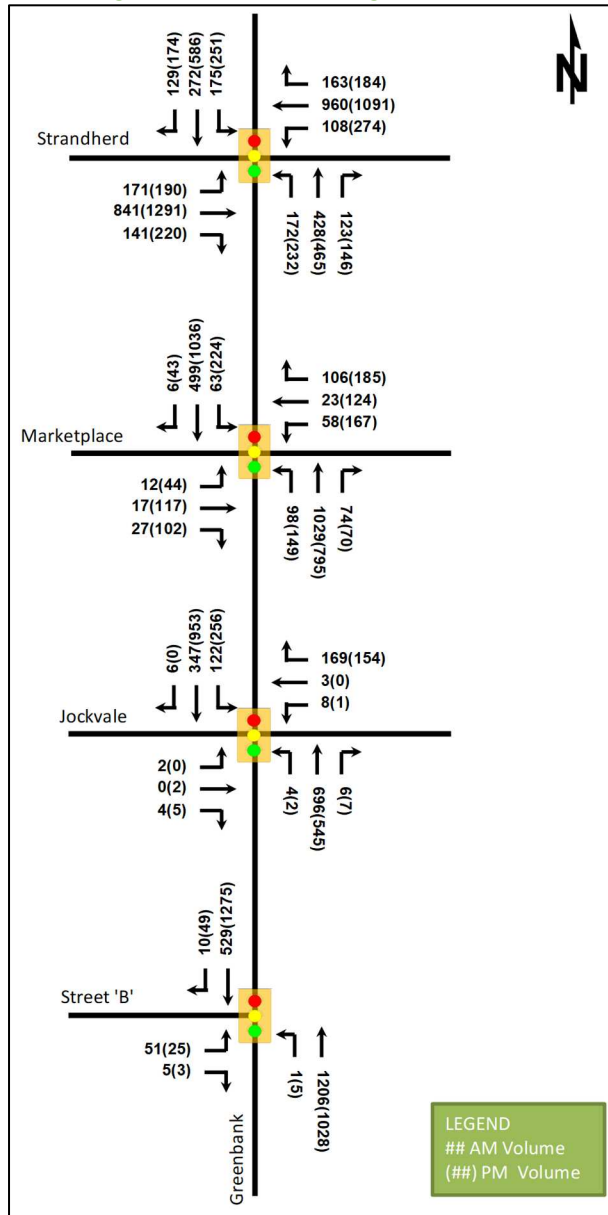


Table 13: 2027 Future Background Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Jockvale Road</b> <i>Signalized</i>	EB	A	0.03	0.2	0.0	A	0.04	37.0	4.9
	WBL/T	A	0.09	48.2	8.4	A	0.01	51.0	2.1
	WBR	A	0.55	12.0	16.1	A	0.56	14.8	17.4
	NB	A	0.47	9.8	133.6	A	0.32	5.3	64.9
	SBL	A	0.19	2.9	4.9	A	0.26	1.2	7.3
	SBT/R	A	0.18	1.6	9.5	A	0.49	4.9	120.6
<b>Overall</b>		<b>A</b>	-	<b>7.8</b>	-	<b>A</b>	-	<b>5.6</b>	-

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Marketplace Avenue Signalized</b>	EBL	A	0.06	34.8	6.6	A	0.24	30.8	16.0
	EBT/R	A	0.17	29.2	12.1	B	0.61	44.6	62.1
	WBL	A	0.18	38.6	14.0	A	0.56	41.5	41.5
	WBT/R	A	0.44	16.8	21.0	D	0.82	53.6	#93.5
	NBL	B	0.61	65.9	#54.8	C	0.78	81.4	#72.6
	NBT/R	A	0.32	14.1	62.8	A	0.53	25.3	85.2
	SBL	A	0.32	61.5	16.7	B	0.61	60.7	m34.0
	SBT/R	A	0.23	15.2	35.3	B	0.67	23.8	m71.4
	<b>Overall</b>	<b>C</b>	-	<b>21.4</b>	-	<b>D</b>	-	<b>35.8</b>	-
<b>Greenbank Road &amp; Strandherd Drive Signalized</b>	EBL	B	0.69	36.4	#44.0	D	0.88	66.9	#75.6
	EBT	B	0.67	40.4	102.2	F	1.35	201.4	#265.3
	EBR	A	0.26	5.7	13.8	A	0.40	9.8	27.4
	WBL	A	0.41	25.0	27.6	F	1.27	183.4	#127.0
	WBT	C	0.78	45.8	117.4	F	1.14	116.9	#209.9
	WBR	A	0.30	6.5	16.4	A	0.35	10.3	25.0
	NBL	A	0.55	72.0	35.4	B	0.62	75.9	m45.1
	NBT/R	A	0.49	29.4	37.6	B	0.66	24.8	36.8
	SBL	A	0.55	57.9	32.7	B	0.65	58.3	44.0
	SBT	A	0.23	33.3	33.9	B	0.62	41.1	90.4
	SBR	A	0.24	4.8	11.2	A	0.32	6.8	17.8
	<b>Overall</b>	<b>D</b>	-	<b>36.8</b>	-	<b>F</b>	-	<b>103.3</b>	-
<b>Greenbank Road &amp; Street "B" Unsignalized</b>	EBL/R	E	0.35	39.2	11.3	F	0.43	97.0	12.8
	NBL	A	0.00	8.6	0.0	B	0.01	11.0	0.0
	NBT	-	-	-	-	-	-	-	-
	SBT/R	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	-	<b>1.5</b>	-	<b>A</b>	-	<b>1.3</b>	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

The intersection operations for the 2027 future background horizon are similar to the 2022 future background horizon at the Jockvale Road and at the Marketplace Avenue intersections. The Strandherd Drive and Street B intersections will also operate similarly during the AM peak hour.

During the PM peak, the Strandherd Drive intersection will see a decrease in operations with the westbound through movement becoming over capacity due to the background growth. The overall intersection will experience high delays. At the Street B intersection, the eastbound shared left-turn/right-turn movement will experience high delays as a stop-control.

### 7.3 Modal Share Sensitivity

Capacity constraints have been noted at the Strandherd Drive intersection during the PM peak and increased demand along Greenbank Road will impact side street operations. These constraints are due to the delay of higher-level transportation improvements required within Barrhaven by the City which would provide alternative regional transportation options and shift the existing modal shares. As this development is targeted for a transit focus and meets the planned context of this area, rationalization for adjusted demand is not required for this TIA.

## 8 Development Design

### 8.1 Design for Sustainable Modes

The proposed development is a residential subdivision and the auto parking areas for block 4’s stacked townhomes will be located adjacent to the stacked townhomes with a total of 79 resident parking spaces, or 1.1 per unit, and 7 visitor spaces. The back-to-back townhomes of block 4 and rear lane townhomes of blocks 8-15 will each include a driveway and garage. Bicycle parking for the back-to-back townhomes is assumed to be within the individual units and six bicycle racks are interspersed around the stacked town homes.

Figure 14 illustrates the planning context of the pedestrian and cycling network for the surrounding subdivision, as outlined in the previous TIA (CGH 2019)

Figure 14: Concept Pedestrian and Cycling Network



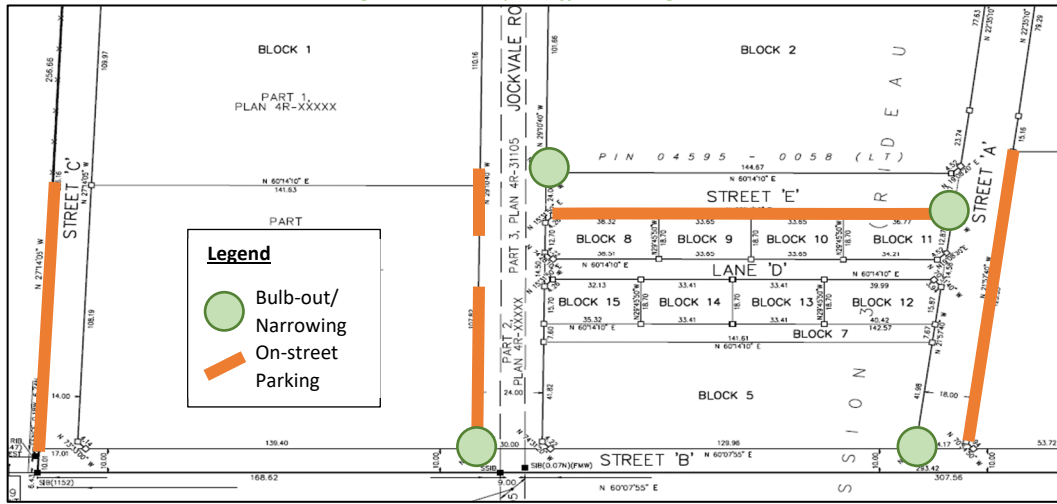
Beyond the active mode network, the existing transit system stop is provided at Barrhaven Centre (future Chapman Mills station) is a maximum of approximately 900 metres walking distance away.

### 8.2 New Street Networks

Traffic calming elements are recommended at the internal intersections, including bulb-outs to narrow each approach to the intersection (e.g. reduced crossing distance). Figure 15 illustrates the proposed locations.



Figure 15: Concept Traffic Calming Plan



## 9 Boundary Street Design

Table 14 summarizes the MMLOS analysis for the boundary road of existing Greenbank Road and the future collector road Street B. The MMLOS targets are based on the policy area of within 600m of a rapid transit station and 300m of a school. The MMLOS worksheet has been provided in Appendix G.

Table 14: Boundary Street MMLOS Analysis

Segment	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target
<b>Greenbank Road</b> (existing)	<b>E</b>	A	<b>F</b>	C	D	D	A	E
<b>Street B</b> (future)	<b>B</b>	A	B	B	D	D	-	N/A

Existing Greenbank Road does not meet the pedestrian and cycling MMLOS targets. The current cross-section is a two-lane rural cross-section, and as such, it is understandable why these targets are not met in this location. The future extension of the urban cross-section of Greenbank Road, the bicycle target will be met, and the pedestrian target will continue to not be met. The travel speed and volumes along Greenbank Road are the primary influence on the pedestrian LOS and will not be met along any arterial.

Street B is not expected to meet the pedestrian LOS targets. Traffic volumes and speed (between 30 and 50 km/h) are the primary influence on the LOS B level of service and sidewalks on Street B would need to be increased to 3 metres to achieve the target LOS A. Therefore, a pedestrian LOS B is deemed satisfactory.

## 10 Access Intersections Design

### 10.1 Location and Design of Access

The residential accesses will connect to the adjacent arterial road network via local roads and adjacent collector road Street B. Within the subdivision. No turn lanes are proposed for the internal intersections and will be controlled by minor stop control. Street B will be free-flow between the Kennedy-Burnett SWM Pond and Greenbank Road, with stop-control on Jockvale Road and Street A.

### 10.2 Intersection Control

Street B intersection is assumed to be a minor stop control as per the approved RMA (Novatech 2018), although operational constraints may require signalization as demands along Greenbank Road increase due to background growth.

### 10.3 Access Intersection Design

#### 10.3.1 2022 Future Total Access Intersection Operations

The 2022 future total intersection volumes are illustrated above in Figure 16 and the access intersection operations are summarized below in Table 15. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections. The synchro worksheets have been provided in Appendix H.

Figure 16: 2022 Future Total Volumes

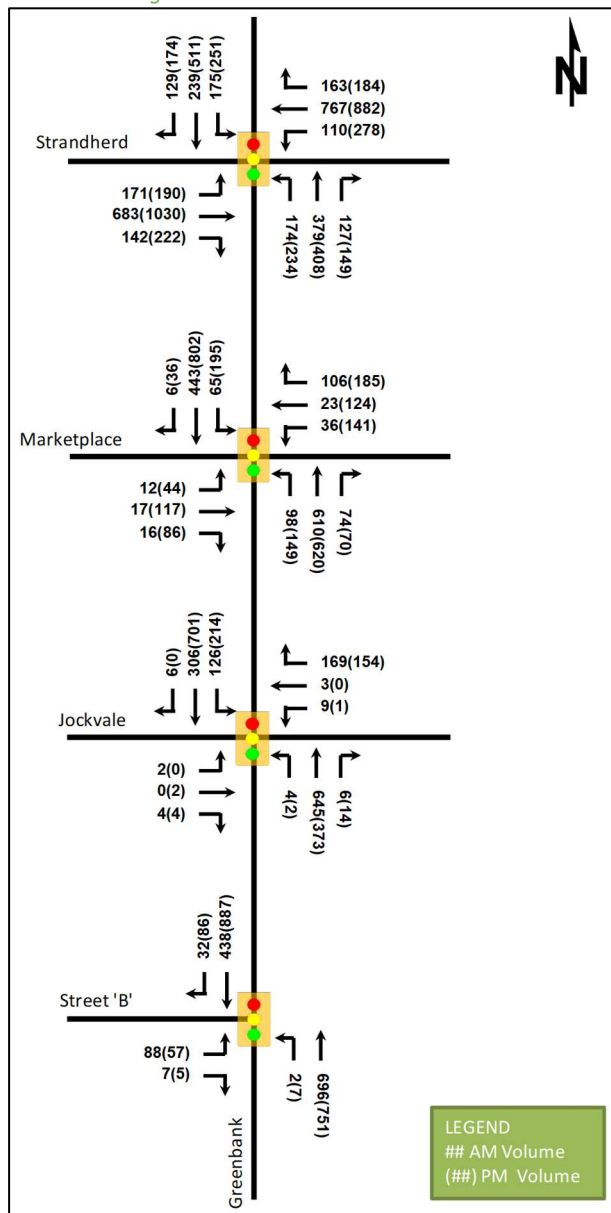


Table 15: 2022 Future Total Access Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
Greenbank Road & Street "B" Unsignalized	EBL/R	D	0.42	31.4	14.3	F	0.58	77.2	21.0
	NBL	A	0.00	8.3	0.0	B	0.01	10.1	0.0
	NBT	-	-	-	-	-	-	-	-
	SBT/R	-	-	-	-	-	-	-	-
	Overall	A	-	2.4	-	A	-	2.7	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

As a minor stop-controlled intersection, Greenbank Road and Street B will experience high delays during the PM peak in the shared eastbound left/right-turn movement.

Should the intersection become signalized, Table 18 summarizes the mitigated intersection operations. There may be extended queues in the northbound direction during the AM peak and in the southbound direction during the PM peak.

Table 16: 2022 Future Total Access Intersection Operations – Signalized

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
Greenbank Road & Street "B" Signalized	EBL/R	A	0.35	21.3	17.9	D	0.39	52.7	27.1
	NBL	A	0.00	6.0	0.8	A	0.02	3.3	1.4
	NBT	A	0.55	10.1	#96.8	A	0.52	6.0	89.0
	SBT/R	A	0.37	7.0	48.4	A	0.69	9.2	156.0
	Overall	A	-	9.8	-	A	-	9.4	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

10.3.2 2027 Future Total Access Intersection Operations

The 2027 future total intersection volumes are illustrated above in Figure 17 and the access intersection operations are summarized below in Table 17. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections. The synchro worksheets have been provided in Appendix I.

Figure 17: 2027 Future Total Volumes

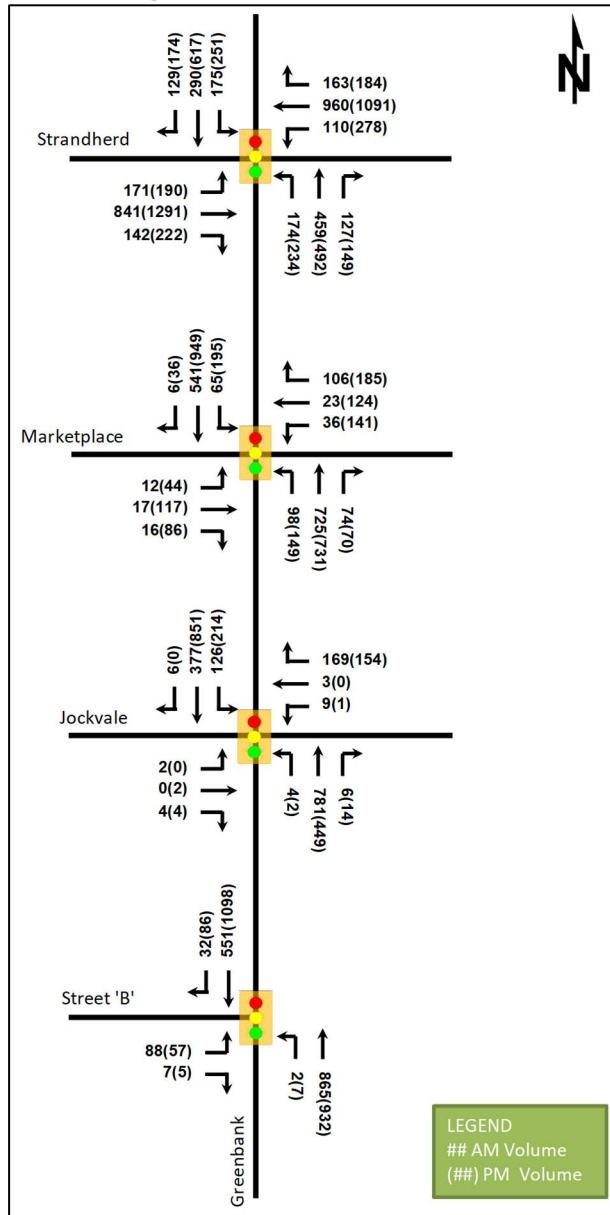


Table 17: 2027 Future Total Access Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
Greenbank Road & Street "B" Unsignalized	EBL/R	F	0.61	59.4	24.8	F	1.02	232.0	36.8
	NBL	A	0.00	8.6	0.0	B	0.01	11.2	0.0
	NBT	-	-	-	-	-	-	-	-
	SBT/R	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	-	<b>3.7</b>	-	<b>A</b>	-	<b>6.6</b>	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

If Street B remains a minor stop-controlled intersection, the shared eastbound left/right-turn lane will experience high delays in both peak hours by 2027.

Should the intersection become signalized, Table 18 summarizes the mitigated intersection operations. There may be extended queues in the northbound direction during the AM peak and in the southbound direction during the PM peak.

Table 18: 2027 Future Total Access Intersection Operations – Signalized

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
Greenbank Road & Street "B" Signalized	EBL/R	A	0.28	19.3	17.9	A	0.39	52.8	27.1
	NBL	A	0.00	6.0	0.8	A	0.03	3.6	1.5
	NBT	B	0.69	15.1	#148.6	B	0.65	8.2	138.9
	SBT/R	A	0.47	8.5	66.2	D	0.82	13.5	258.9
	<b>Overall</b>	<b>B</b>	-	<b>12.9</b>	-	<b>B</b>	-	<b>12.3</b>	-

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

### 10.3.3 Access Intersection MMLOS

Table 19 summarizes the MMLOS analysis for the site access intersections of Greenbank Road and Street B, should it become a signalized intersection. The intersection analysis is based on the policy area of within 600m of a rapid transit station and 300m of a school. The MMLOS worksheets has been provided in Appendix G.

Table 19: Access Intersection MMLOS Analysis

Intersection	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS		Auto LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target	ALOS	Target
Greenbank Road & Street B	<b>B</b>	A	<b>D</b>	C	<b>E</b>	D	E	E	B	E

The MMLOS targets for the pedestrian, bicycle and transit LOS will not be met at a signalized intersection for Greenbank Road and Street B. The pedestrian level of service would require a maximum of two lanes at a crossing to meet a LOS A. The mixed traffic approaches for cyclists and speeds along the arterial roads drive the LOS D and would require bike lanes or higher order facilities with operating speeds under 50 km/h to meet the LOS C or better. The transit LOS will be met in the north and south bound directions but the higher delays on the eastbound approach will not. A larger intersection would be required to increase signal timing to the eastbound approach to reduce the delay for local service.

### 10.3.4 Recommended Design Elements

The design elements for the site intersections are consistent with the CDP and various EA study recommendations.

## 11 Transportation Demand Management

### 11.1 Context for TDM

The mode shares used within the TIA represent a shift from auto modes to transit modes, although not as high as anticipated once the BRT network is extended. Overall, the modal shares are likely to be achieved and supporting TDM measures should be provided.

The subject site is within a design priority area.

Total bedrooms within the development is subject to the final unit count for blocks 8-15. No age restrictions are noted.



## 11.2 Need and Opportunity

The subject site has been assumed to rely predominantly on auto travel with an increase in transit ridership with the proximity to the Southwest Transitway and future BRT corridors, and those assumptions have been carried through the analysis. The study area intersections are anticipated to have residual capacity and the increase in transit ridership is achievable.

## 11.3 TDM Program

The “suite of post occupancy TDM measures” has been summarized in the TDM checklists for the residential land uses. The checklist is provided in Appendix J.

The key TDM measures recommended include:

- Enhanced connectivity of pedestrians and cyclists to the adjacent network and transit
- Bike parking locations at each building in proximity to the entrances
- Inclusion of a 1-month Presto card for first time new townhome purchase and apartment rental, with a set time frame for this offer (e.g. 6-months) from the initial opening of the site
- Unbundle parking cost from purchase or rental costs

## 12 Transit

### 12.1 Route Capacity

Overall, the forecasted new transit trips would result in the need for approximately 1-2 single buses (55-person capacity) during the AM and PM peak hours for local service.

### 12.2 Transit Priority

No transit priority is required explicitly for this study.

## 13 Network Intersection Design

### 13.1 Network Intersection Control

No change to the existing signalized control is recommended for the network intersections.

### 13.2 Network Intersection Design

#### 13.2.1 2022 Future Total Network Intersection Operations

The 2022 future total network intersection operations are summarized below in Table 20. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections. The synchro worksheets have been provided in Appendix H.

Table 20: 2022 Future Total Network Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Jockvale Road Signalized</b>	EB	A	0.03	0.2	0.0	A	0.04	37.0	4.9
	WBL/T	A	0.09	48.2	8.4	A	0.01	51.0	2.1
	WBR	A	0.55	12.0	16.1	A	0.56	14.8	17.4
	NB	A	0.50	10.3	146.1	A	0.28	5.1	57.0
	SBL	A	0.20	3.0	4.6	A	0.25	1.3	8.2
	SBT/R	A	0.20	1.7	9.7	A	0.42	2.3	33.9
	<b>Overall</b>	<b>A</b>	-	<b>8.0</b>	-	<b>A</b>	-	<b>4.4</b>	-
<b>Greenbank Road &amp; Marketplace Avenue Signalized</b>	EBL	A	0.06	34.8	6.6	A	0.24	30.8	16.0
	EBT/R	A	0.17	29.2	12.1	B	0.61	44.6	62.1
	WBL	A	0.18	38.6	14.0	A	0.56	41.5	41.5
	WBT/R	A	0.44	16.8	21.0	D	0.82	53.6	#93.5
	NBL	B	0.61	65.3	#55.4	C	0.78	80.9	#73.2
	NBT/R	A	0.34	14.6	68.3	A	0.48	24.3	71.9
	SBL	A	0.32	61.8	16.8	B	0.61	60.7	m33.3
	SBT/R	A	0.24	14.9	35.8	B	0.60	23.1	m60.2
<b>Overall</b>	<b>C</b>	-	<b>21.2</b>	-	<b>D</b>	-	<b>36.2</b>	-	
<b>Greenbank Road &amp; Strandherd Drive Signalized</b>	EBL	B	0.69	36.3	#43.7	D	0.88	66.9	#75.6
	EBT	B	0.67	40.5	102.2	F	1.08	94.3	#192.8
	EBR	A	0.26	5.8	14.0	A	0.38	6.3	18.6
	WBL	A	0.41	25.2	27.9	F	1.29	190.5	#129.1
	WBT	C	0.78	45.8	117.4	E	0.93	57.8	#151.5
	WBR	A	0.30	6.5	16.4	A	0.33	6.3	17.2
	NBL	A	0.55	72.2	35.8	B	0.63	75.1	m45.2
	NBT/R	A	0.53	30.1	39.0	B	0.60	23.0	31.5
	SBL	A	0.55	57.9	32.7	B	0.65	58.3	44.0
	SBT	A	0.24	33.6	36.3	A	0.54	39.4	78.0
	SBR	A	0.24	4.8	11.2	A	0.32	6.8	17.8
<b>Overall</b>	<b>D</b>	-	<b>36.9</b>	-	<b>E</b>	-	<b>62.6</b>	-	

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

The network intersection operations for the 2022 future total horizon operate similar to the 2022 future background conditions.

13.2.2 2027 Future Total Network Intersection Operations

The 2027 future total network intersection operations are summarized below in Table 21. The level of service for signalized intersections is based on the TIA Guidelines for volume to capacity ratio of the lane movements and HCM average delay for the overall intersection, and HCM average delay for unsignalized intersections. The synchro worksheets have been provided in Appendix I.

Table 21: 2027 Future Total Network Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	V/C	Delay	Q (95 <sup>th</sup> )	LOS	V/C	Delay	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Jockvale Road Signalized</b>	EB	A	0.03	0.2	0.0	A	0.04	37.0	4.9
	WBL/T	A	0.09	48.2	8.4	A	0.01	51.0	2.1
	WBR	A	0.55	12.2	16.3	A	0.56	14.8	17.4
	NB	B	0.61	12.5	203.5	A	0.34	5.5	71.1
	SBL	A	0.23	3.4	6.0	A	0.27	1.2	m6.9
	SBT/R	A	0.24	1.8	9.6	A	0.51	5.8	94.3
	<b>Overall</b>	<b>A</b>	-	<b>9.2</b>	-	<b>A</b>	-	<b>6.1</b>	-
<b>Greenbank Road &amp; Marketplace Avenue Signalized</b>	EBL	A	0.06	34.8	6.6	A	0.24	30.8	16.0
	EBT/R	A	0.17	29.2	12.1	B	0.61	44.6	62.1
	WBL	A	0.18	38.6	14.0	A	0.56	41.5	41.5
	WBT/R	A	0.44	16.8	21.0	D	0.82	53.6	#93.5
	NBL	B	0.61	63.0	m#52.8	C	0.78	81.7	#72.4
	NBT/R	A	0.39	15.7	86.4	A	0.55	25.7	88.8
	SBL	A	0.32	62.5	16.4	B	0.61	60.5	m34.0
	SBT/R	A	0.29	13.8	40.2	C	0.70	24.1	m76.0
<b>Overall</b>	<b>C</b>	-	<b>20.5</b>	-	<b>D</b>	-	<b>35.8</b>	-	
<b>Greenbank Road &amp; Strandherd Drive Signalized</b>	EBL	C	0.79	52.6	#62.0	D	0.88	66.9	#75.6
	EBT	D	0.82	46.9	#139.8	F	1.35	201.4	#265.3
	EBR	A	0.26	5.8	14.0	A	0.40	9.8	27.1
	WBL	A	0.51	28.9	27.9	F	1.29	190.5	#129.1
	WBT	E	0.98	67.2	#173.2	F	1.14	116.9	#209.9
	WBR	A	0.31	8.3	19.2	A	0.35	10.3	25.0
	NBL	A	0.55	72.3	36.0	B	0.63	76.1	m45.4
	NBT/R	B	0.61	32.0	43.0	C	0.70	25.9	40.2
	SBL	A	0.55	57.9	32.7	B	0.65	58.3	44.0
	SBT	A	0.30	34.3	43.5	B	0.65	42.1	95.8
	SBR	A	0.24	4.8	11.2	A	0.32	6.8	17.8
<b>Overall</b>	<b>D</b>	-	<b>45.5</b>	-	<b>F</b>	-	<b>103.1</b>	-	

Notes: Saturation flow rate of 1800 veh/h/lane  
PHF = 1.00

m = metered queue  
# = queue exceeds storage or mid-block length

The network intersection operations for the 2027 future total horizon operate similar to the 2027 future background conditions.

### 13.2.3 Network Intersection MMLOS

Table 22 summarizes the MMLOS analysis for the network intersections along Greenbank Road. The existing and future conditions for both intersections will be the same and are considered in one row. The analysis is based on the policy area of within 600m of a rapid transit station. The MMLOS worksheets has been provided in Appendix G.

Table 22: Study Area Intersection MMLOS Analysis

Intersection	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS		Auto LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target	ALOS	Target
Greenbank Road & Jockvale Road	F	A	F	C	D	D	F	E	A	E
Greenbank Road & Marketplace Avenue	F	A	F	C	E	D	B	E	B	E
Greenbank Road & Strandherd Drive	F	A	F	C	F	D	B	E	D	E

The MMLOS targets will not be met for the pedestrian and bicycle LOS at all three intersections, transit LOS at Marketplace Avenue and Strandherd Drive, and truck LOS at Jockvale Road. The pedestrian level of service would require a maximum of two lanes at a crossing to meet a LOS A. The mixed traffic approaches for cyclists and left-turn arrangements at the study area intersections govern the bicycle LOS, requiring alternative left-turn configurations and/or bike lanes without shifting across right-turn lanes to meet the targets. The transit LOS will not be met due to the intersection delays at Strandherd Drive and on the westbound approach of the Marketplace Avenue intersection. The truck LOS is not met at Jockvale Road due to the north and southbound turning radii and would require 2 receiving lanes on both the east and west legs.

#### 13.2.4 Recommended Design Elements

No study area intersection design elements are proposed as part of this study. Higher level transportation improvements are required within Barrhaven by the City to provide alternative regional transportation options and shift the existing modal shares.

## 14 Summary of Improvements Indicated and Modifications Options

The following summarizes the analysis and results presented in this TIA report:

### Proposed Site and Screening

- The proposed site includes 158 townhome units
- Accesses will be provided along the internal road network, connecting to Street B out to Greenbank Road
- The development is proposed to be completed as a single phase by 2022
- The Trip Generation and Location triggers were met for the TIA Screening

### Existing Conditions

- Greenbank Road, Jockvale Road and Strandherd Drive are arterial roads, and Marketplace Avenue is a collector road in the study area
- Future roadways include Street B as collector roads
- Sidewalks/MUPS are generally provided on both sides of the study area roadways, and on-street bike lanes on both sides of the roadway on Greenbank Road north of Marketplace Avenue and on Strandherd Drive, east of Greenbank Road
- The high volumes roadways have produced a high number of collisions at the study area intersections, primarily at the Greenbank Road and Strandherd Drive intersection
- The collisions are predominantly rear end and turning movement collisions indicating that they are lower speed and a result of congestion

- Some high delays are noted at the Marketplace Avenue and at the Strandherd Drive intersections during both peaks, but generally the intersections operate satisfactorily

#### **Development Generated Travel Demand**

- The proposed development is forecasted produce 155 two-way people trips during the AM peak hour and 183 two-way people trips during the PM peak hour
- Of the forecasted people trips, 62 two-way trips will be vehicle trips during the AM peak hour and 73 two-way trips will be vehicle trips during the PM peak hour based on a BRT transit modal share target
- Of the forecasted trips, 80% are anticipated to travel north, 10% to the east, and 5% to both the west and south

#### **Background Conditions**

- The background developments were explicitly included in the background conditions, along with a total background growth of 5% per annum along the mainline volumes
- The study area intersections at Jockvale Road and at Marketplace Avenue will operate similar to the existing conditions
- The Strandherd Drive intersection will begin to experience capacity constraints during the PM peak, including high delays and extended queuing
- Higher level transportation improvements are required within Barrhaven by the City to provide alternative regional transportation options and shift the existing modal shares

#### **Development Design**

- The bike and auto parking areas are to be located near the main entrances for the stacked town home and apartment units
- Pedestrian connections will be made along the internal roads and Street B, with a multi-use pathway connection along the north side of Block 4
- Traffic calming elements are recommended at the future internal road intersections including bulb-outs to narrow each approach to the intersection and reduce pedestrian crossing distances and on-street parking ultimately alternative sides to the north of the existing phases

#### **Boundary Street Design**

- The boundary streets will not meet pedestrian MMLOS targets, due to lack of facilities along Greenbank Road and auto volumes and/or posted speed limits
- Due to the issues limiting the ability to meet the MMLOS targets, and future improvements along Greenbank Road, no improvements are recommended as part of this study

#### **Access Intersections Design**

- Townhome accesses are proposed as private approach, the access will require a depressed curb and sidewalk through the access
- The intersections along Street B are assumed to be minor stop-controlled, with Street B operating as a free flow corridor
- The intersection of Greenbank Road and Street B will be signalized due operational constraints from background growth along Greenbank Road
- No specific recommendations or design elements are required outside of typical site design



- The MMLOS targets for pedestrians, bicycles and transit cannot be met at the signalized access intersection at Street B due to the nature of arterial roadways or restrictions on limiting transit delay

#### TDM

- Supportive TDM measures to be included within the proposed development should include:
  - Enhanced connectivity of pedestrians and cyclists to the adjacent network and transit
  - Bike parking locations at each building in proximity to the entrances
  - Inclusion of a 1-month Presto card for first time new townhome purchase and apartment rental, with a set time frame for this offer (e.g. 6-months) from the initial opening of the site
  - Unbundle parking cost from purchase or rental costs

#### Transit

- No transit service is currently provided on the boundary road network
- To meet forecasted transit use, a single bus, or equivalent capacity, would be required for peak hour service on local routes
- No specific transit priority measures were considered as part of this development

#### Network Intersection Design

- Generally, the network intersections will operate similar to the background conditions
- Higher level transportation improvements are required within Barrhaven by the City to provide alternative regional transportation options and shift the existing modal shares
- The MMLOS targets will not be met for the pedestrian and bicycle LOS at all three intersections, transit LOS at Marketplace Avenue and Strandherd Drive, and truck LOS at Jockvale Road
- Improved cycling facilities, including left-turn configurations out of mixed flow could meet the LOS targets but due to the nature of arterials roadways, the pedestrian and transit LOS cannot be met

## 15 Conclusion

It is recommended that, from a transportation perspective, the proposed development applications proceed.

Prepared By:

Reviewed By:



Andrew Harte, P.Eng.  
Senior Transportation Engineer

A handwritten signature in blue ink, appearing to read "Chris Gordon".

Christopher Gordon, P.Eng.  
Senior Transportation Engineer

# Appendix A

TIA Screening Form and PM Certification Form

City of Ottawa 2017 TIA Guidelines  
Step 1 - Screening Form

Date: 06-Feb-20  
Project Number: 2019-06  
Project Reference: Caivan Barrhaven Town Centre

1.1 Description of Proposed Development	
Municipal Address	3288 Greenbank Road
Description of Location	CON 3RF PT LOT 14
Land Use Classification	Development Reserve - DR
Development Size	24 townhomes
Accesses	One local connection to Jockvale, one local connection to Chapman Mills
Phase of Development	Two Phase
Buildout Year	2023
TIA Requirement	Full TIA Required

1.2 Trip Generation Trigger	
Land Use Type	Townhomes or apartments
Development Size	147 Units
Trip Generation Trigger	Yes

1.3 Location Triggers	
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?	No
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?	Yes South Nepean Town Centre
Location Trigger	Yes

1.4. Safety Triggers	
Are posted speed limits on a boundary street 80 km/hr or greater?	No
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?	No
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?	No
Is the proposed driveway within auxiliary lanes of an intersection?	No
Does the proposed driveway make use of an existing median break that serves an existing site?	No
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?	No
Does the development include a drive-thru facility?	No
Safety Trigger	No



## **TIA Plan Reports**

On 14 June 2017, the Council of the City of Ottawa adopted new Transportation Impact Assessment (TIA) Guidelines. In adopting the guidelines, Council established a requirement for those preparing and delivering transportation impact assessments and reports to sign a letter of certification.

Individuals submitting TIA reports will be responsible for all aspects of development-related transportation assessment and reporting, and undertaking such work, in accordance and compliance with the City of Ottawa's Official Plan, the Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines.

By submitting the attached TIA report (and any associated documents) and signing this document, the individual acknowledges that s/he meets the four criteria listed below.

### **CERTIFICATION**

1. I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;
2. I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;
3. I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and
4. I am either a licensed<sup>1</sup> or registered<sup>2</sup> professional in good standing, whose field of expertise [check  appropriate field(s)] is either transportation engineering  or transportation planning .

**1,2 License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works.**


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Tél. : 613-580-2424  
Télécopieur: 613-560-6006

Dated at Ottawa this 20 day of September, 2018.  
(City)

Name: Andrew Harte  
(Please Print)

Professional Title: Professional Engineer

  
\_\_\_\_\_  
Signature of Individual certifier that s/he meets the above four criteria

<b>Office Contact Information (Please Print)</b>
Address: 13 Markham Avenue
City / Postal Code: Ottawa / K2G 3Z1
Telephone / Extension: (613) 697-3797
E-Mail Address: Andrew.Harte@CGHTransportation.com





# Appendix B

Turning Movement Counts



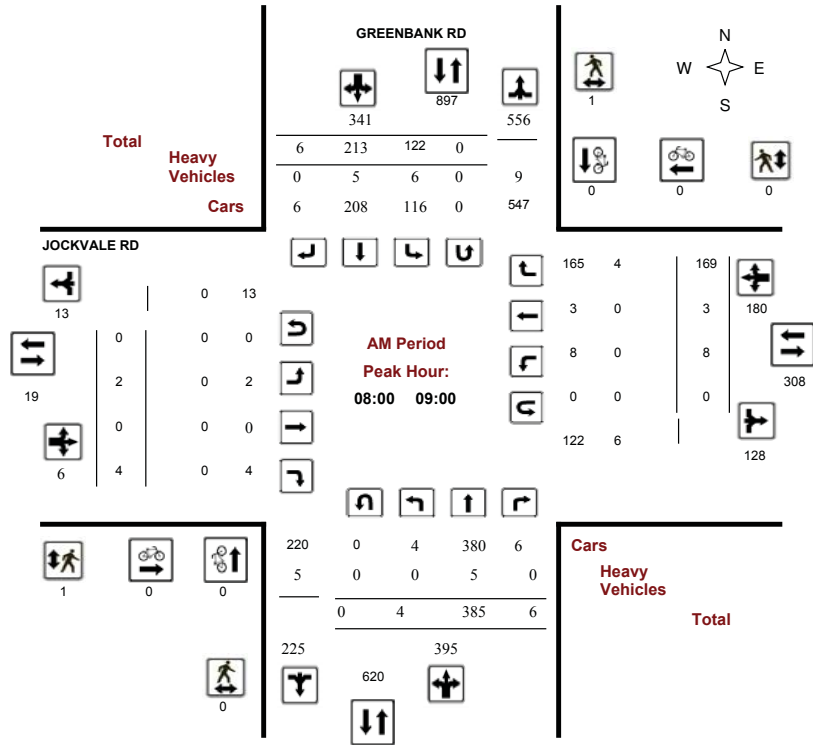
### Transportation Services - Traffic Services

#### Turning Movement Count - Full Study Peak Hour Diagram

#### GREENBANK RD @ JOCKVALE RD

Survey Date: Tuesday, August 16, 2016  
Start Time: 07:00

WO No: 36178  
Device: Miovision



Comments



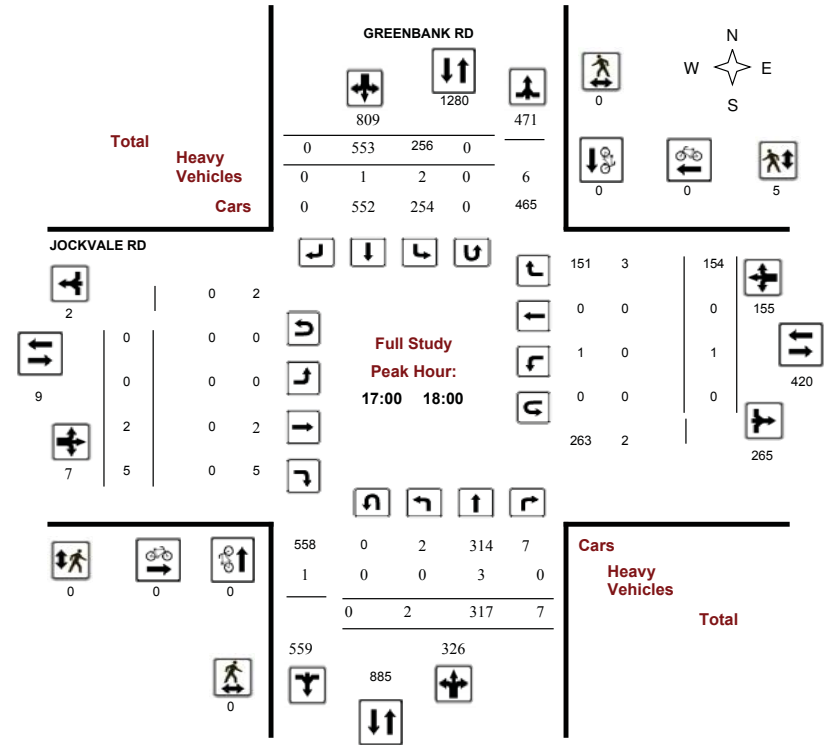
### Transportation Services - Traffic Services

#### Turning Movement Count - Full Study Peak Hour Diagram

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WO No: 36178  
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Comments



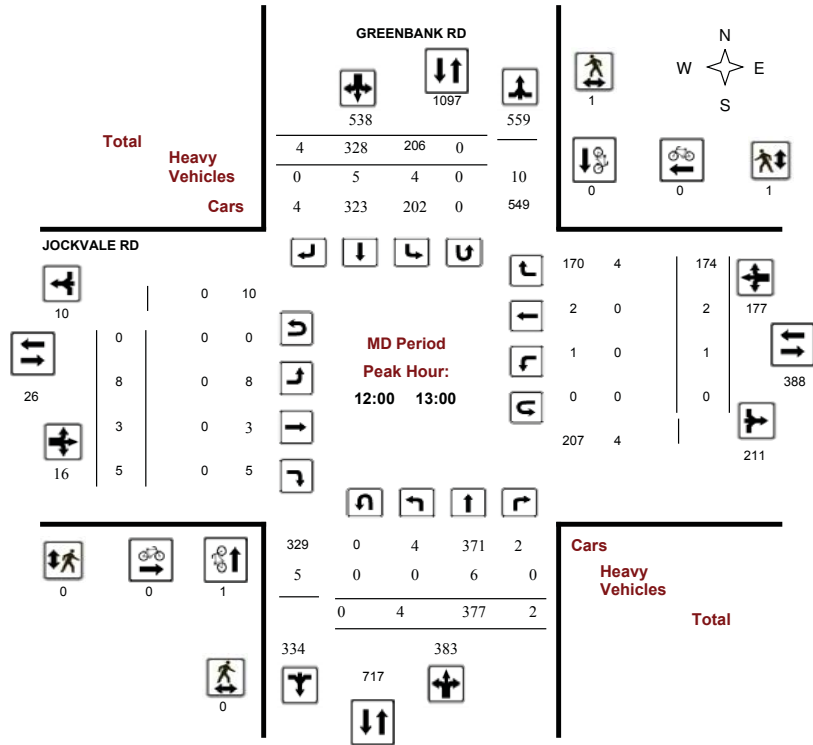
### Transportation Services - Traffic Services

#### Turning Movement Count - Full Study Peak Hour Diagram

#### GREENBANK RD @ JOCKVALE RD

Survey Date: Tuesday, August 16, 2016  
Start Time: 07:00

WO No: 36178  
Device: Miovision



Comments



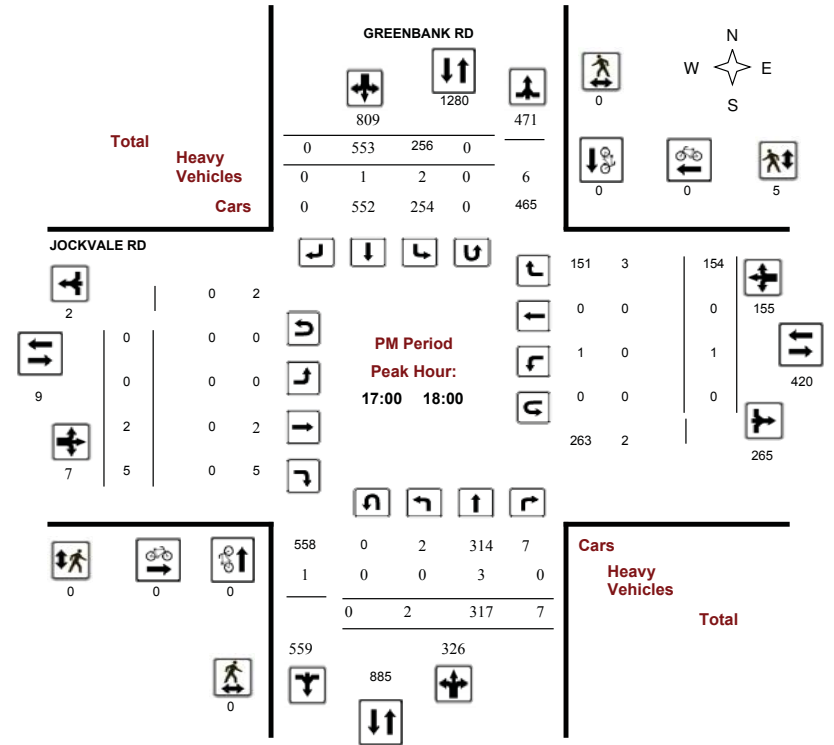
### Transportation Services - Traffic Services

#### Turning Movement Count - Full Study Peak Hour Diagram

#### GREENBANK RD @ JOCKVALE RD

Survey Date: Tuesday, August 16, 2016  
Start Time: 07:00

WO No: 36178  
Device: Miovision



Comments

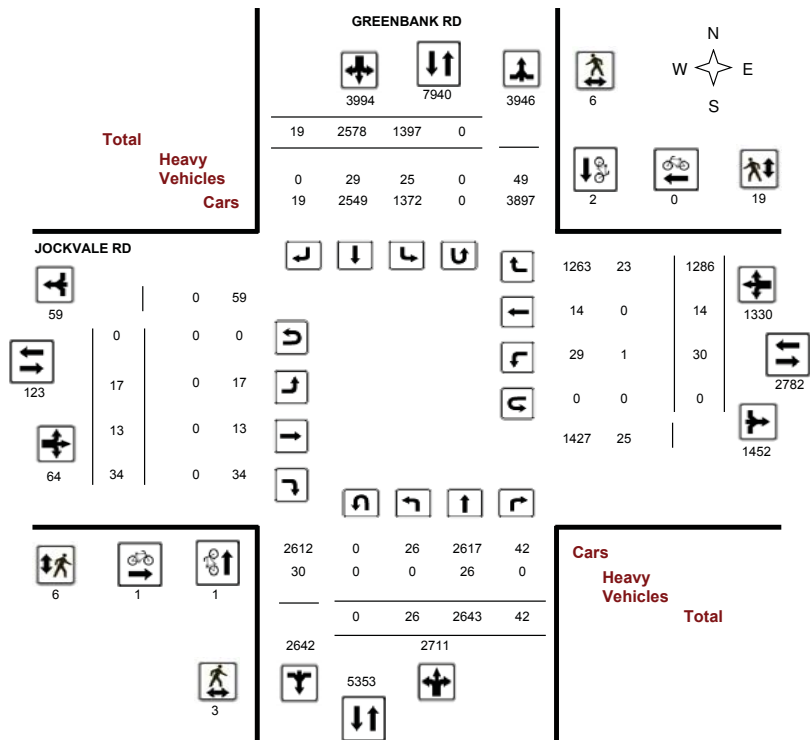


**Transportation Services - Traffic Services**  
**Turning Movement Count - Full Study Diagram**

**GREENBANK RD @ JOCKVALE RD**

Survey Date: Tuesday, August 16, 2016

WO#: 36178  
 Device: Miovision



Comments



**Transportation Services - Traffic Services**

Work Order  
36178

**Turning Movement Count - Full Study Summary Report**

**GREENBANK RD @ JOCKVALE RD**

Survey Date: Tuesday, August 16, 2016

Total Observed U-Turns

AADT Factor

Northbound: 0 Southbound: 0  
 Eastbound: 0 Westbound: 0

.90

**Full Study**

Period	GREENBANK RD								JOCKVALE RD								WB TOT	STR TOT	Grand Total	
	Northbound				Southbound				Eastbound				Westbound							
	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT				
07:00 08:00	4	415	2	421	85	162	0	247	668	0	1	3	4	5	1	160	166	170	838	
08:00 09:00	4	385	6	395	122	213	6	341	736	2	0	4	6	8	3	169	180	186	922	
09:00 10:00	8	313	5	326	109	197	2	308	634	6	2	1	9	4	1	179	184	193	827	
11:30 12:30	7	328	7	342	193	317	9	519	861	8	4	5	17	0	3	155	158	175	1036	
12:30 13:30	0	318	2	320	210	316	2	528	848	1	3	6	10	2	3	201	206	216	1064	
15:00 16:00	0	238	1	239	194	363	0	557	796	0	0	4	4	5	0	140	145	149	945	
16:00 17:00	1	329	12	342	228	457	0	685	1027	0	1	6	7	5	3	128	136	143	1170	
17:00 18:00	2	317	7	326	256	553	0	809	1135	0	2	5	7	1	0	154	155	162	1297	
Sub Total	26	2643	42	2711	1397	2578	19	3994	6705	17	13	34	64	30	14	1286	1330	1394	8099	
U Turns	0								0								0		0	
Total	26	2643	42	2711	1397	2578	19	3994	6705	17	13	34	64	30	14	1286	1330	1394	8099	
EQ 12hr	36	3674	58	3768	1942	3583	26	5552	9320	24	18	47	89	42	19	1788	1849	1938	11258	
Note: These values are calculated by multiplying the totals by the appropriate expansion factor.																<b>1.39</b>				
AVG 12hr	33	3306	53	3391	1748	3225	24	4996	8387	21	16	43	80	38	18	1609	1664	1744	10131	
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.																<b>.90</b>				
AVG 24hr	43	4331	69	4443	2289	4225	31	6545	10988	28	21	56	105	49	23	2108	2180	2285	13273	
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.																<b>1.31</b>				

**Comments:**

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.



**Transportation Services - Traffic Services** W.O. 36178  
**Turning Movement Count - 15 Minute Summary Report**

**GREENBANK RD @ JOCKVALE RD**

Survey Date: Tuesday, August 16, 2016

Total Observed U-Turns

Northbound: 0 Southbound: 0  
 Eastbound: 0 Westbound: 0

Time Period	GREENBANK RD Northbound			GREENBANK RD Southbound			JOCKVALE RD Eastbound			JOCKVALE RD Westbound			Grand Total						
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT		E TOT	LT	ST	RT	W TOT	STR TOT
07:00 07:15	0	112	0	112	22	39	0	61	173	0	0	0	0	1	0	27	28	28	201
07:15 07:30	0	107	0	107	18	36	0	54	161	0	1	0	1	0	1	46	47	48	209
07:30 07:45	2	108	0	110	16	40	0	56	166	0	0	1	1	0	0	40	40	41	207
07:45 08:00	2	88	2	92	29	47	0	76	168	0	0	2	2	4	0	47	51	53	221
08:00 08:15	1	107	3	111	29	46	1	76	187	0	0	1	1	4	0	46	50	51	238
08:15 08:30	2	96	2	100	30	44	1	75	175	0	0	2	2	0	0	37	37	39	214
08:30 08:45	1	85	0	86	25	60	0	85	171	0	0	0	0	0	0	40	40	40	211
08:45 09:00	0	97	1	98	38	63	4	105	203	2	0	1	3	4	3	46	53	56	259
09:00 09:15	3	88	1	92	23	43	2	68	160	3	1	0	4	0	0	41	41	45	205
09:15 09:30	1	77	1	79	29	51	0	80	159	1	0	0	1	3	1	38	42	43	202
09:30 09:45	4	81	2	87	29	55	0	84	171	1	1	0	2	1	0	40	41	43	214
09:45 10:00	0	67	1	68	28	48	0	76	144	1	0	1	2	0	0	60	60	62	206
11:30 11:45	1	73	5	79	44	66	2	112	191	1	0	2	3	0	1	36	37	40	231
11:45 12:00	2	76	1	79	52	76	3	131	210	0	2	1	3	0	2	39	41	44	254
12:00 12:15	3	86	1	90	56	87	2	145	235	3	2	0	5	0	0	40	40	45	280
12:15 12:30	1	93	0	94	41	88	2	131	225	4	0	2	6	0	0	40	40	46	271
12:30 12:45	0	112	1	113	51	88	0	139	252	1	1	2	4	1	1	50	52	56	308
12:45 13:00	0	86	0	86	58	65	0	123	209	0	0	1	1	0	1	44	45	46	255
13:00 13:15	0	60	1	61	44	79	1	124	185	0	0	3	3	0	1	54	55	58	243
13:15 13:30	0	60	0	60	57	84	1	142	202	0	2	0	2	1	0	53	54	56	258
15:00 15:15	0	50	1	51	44	86	0	130	181	0	0	0	0	0	0	34	34	34	215
15:15 15:30	0	46	0	46	58	74	0	132	178	0	0	1	1	3	0	39	42	43	221
15:30 15:45	0	63	0	63	47	95	0	142	205	0	0	2	2	0	0	27	27	29	234
15:45 16:00	0	79	0	79	45	108	0	153	232	0	0	1	1	2	0	40	42	43	275
16:00 16:15	0	65	2	67	59	120	0	179	246	0	0	0	0	0	2	31	33	33	279
16:15 16:30	1	79	3	83	64	111	0	175	258	0	0	3	3	1	0	30	31	34	292
16:30 16:45	0	93	4	97	55	119	0	174	271	0	0	2	2	2	0	28	30	32	303
16:45 17:00	0	92	3	95	50	107	0	157	252	0	1	1	2	2	1	39	42	44	296
17:00 17:15	0	91	3	94	53	145	0	198	292	0	1	2	3	1	0	34	35	38	330
17:15 17:30	1	73	1	75	70	135	0	205	280	0	0	1	1	0	0	36	36	37	317
17:30 17:45	1	77	2	80	66	140	0	206	286	0	0	2	2	0	0	46	46	48	334
17:45 18:00	0	76	1	77	67	133	0	200	277	0	1	0	1	0	0	38	38	39	316
<b>TOTAL:</b>	<b>26</b>	<b>2643</b>	<b>42</b>	<b>2711</b>	<b>1397</b>	<b>2578</b>	<b>19</b>	<b>3994</b>	<b>6705</b>	<b>17</b>	<b>13</b>	<b>34</b>	<b>64</b>	<b>30</b>	<b>14</b>	<b>1286</b>	<b>1330</b>	<b>1394</b>	<b>8099</b>

Note: U-Turns are included in Totals.

Comment:



**Transportation Services - Traffic Services**  
**Turning Movement Count - Cyclist Volume Report**

Work Order  
36178

**GREENBANK RD @ JOCKVALE RD**

Count Date: Tuesday, August 16, 2016

Start Time: 07:00

Time Period	GREENBANK RD			JOCKVALE RD			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	0	1	1	1	0	1	2
08:00 09:00	0	0	0	0	0	0	0
09:00 10:00	0	1	1	0	0	0	1
11:30 12:30	1	0	1	0	0	0	1
12:30 13:30	0	0	0	0	0	0	0
15:00 16:00	0	0	0	0	0	0	0
16:00 17:00	0	0	0	0	0	0	0
17:00 18:00	0	0	0	0	0	0	0
<b>Total</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>4</b>

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.



# Transportation Services - Traffic Services

W.O.  
36178

## Turning Movement Count - Heavy Vehicle Report

### GREENBANK RD @ JOCKVALE RD

Survey Date: Tuesday, August 16, 2016

GREENBANK RD										JOCKVALE RD										Grand Total
Northbound					Southbound					Eastbound					Westbound					
Time Period	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT		
07:00 08:00	0	2	0	2	0	5	0	5	7	0	0	0	0	0	0	7	7	7	14	
08:00 09:00	0	5	0	5	6	5	0	11	16	0	0	0	0	0	0	4	4	4	20	
09:00 10:00	0	5	0	5	4	8	0	12	17	0	0	0	0	0	0	2	2	2	19	
11:30 12:30	0	5	0	5	5	4	0	9	14	0	0	0	0	0	0	2	2	2	16	
12:30 13:30	0	6	0	6	6	3	0	9	15	0	0	0	0	0	0	4	4	4	19	
15:00 16:00	0	0	0	0	2	2	0	4	4	0	0	0	0	1	0	1	2	2	6	
16:00 17:00	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
17:00 18:00	0	3	0	3	2	1	0	3	6	0	0	0	0	0	0	3	3	3	9	
<b>Sub Total</b>	<b>0</b>	<b>26</b>	<b>0</b>	<b>26</b>	<b>25</b>	<b>29</b>	<b>0</b>	<b>54</b>	<b>80</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>23</b>	<b>24</b>	<b>24</b>	<b>104</b>	
<b>U-Turns (Heavy Vehicles)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>Total</b>	<b>0</b>	<b>26</b>	<b>0</b>	<b>26</b>	<b>25</b>	<b>29</b>	<b>0</b>	<b>54</b>	<b>80</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>23</b>	<b>24</b>	<b>24</b>	<b>104</b>	

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.



# Transportation Services - Traffic Services

Work Order  
36178

## Turning Movement Count - Pedestrian Volume Report

### GREENBANK RD @ JOCKVALE RD

Count Date: Tuesday, August 16, 2016

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	0	0	0	0
07:15 07:30	0	0	0	0	1	1	1
07:30 07:45	0	0	0	0	0	0	0
07:45 08:00	0	0	0	0	0	0	0
07:00 08:00	0	0	0	0	1	1	1
08:00 08:15	0	0	0	1	0	1	1
08:15 08:30	0	0	0	0	0	0	0
08:30 08:45	0	1	1	0	0	0	1
08:45 09:00	0	0	0	0	0	0	0
08:00 09:00	0	1	1	1	0	1	2
09:00 09:15	0	2	2	3	5	7	7
09:15 09:30	0	0	0	0	0	0	0
09:30 09:45	0	2	2	3	3	5	5
09:45 10:00	0	0	0	1	1	1	1
09:00 10:00	0	4	4	2	7	9	13
11:30 11:45	0	0	0	1	1	1	1
11:45 12:00	0	0	0	0	0	0	0
12:00 12:15	0	1	1	1	1	2	2
12:15 12:30	0	0	0	0	0	0	0
11:30 12:30	0	1	1	0	2	2	3
12:30 12:45	0	0	0	0	0	0	0
12:45 13:00	0	0	0	0	0	0	0
13:00 13:15	0	0	0	0	0	0	0
13:15 13:30	3	0	3	3	0	3	6
12:30 13:30	3	0	3	3	0	3	6
15:00 15:15	0	0	0	2	2	2	2
15:15 15:30	0	0	0	0	0	0	0
15:30 15:45	0	0	0	0	0	0	0
15:45 16:00	0	0	0	1	1	1	1
15:00 16:00	0	0	0	3	3	3	3
16:00 16:15	0	0	0	0	0	0	0
16:15 16:30	0	0	0	0	0	0	0
16:30 16:45	0	0	0	0	0	0	0
16:45 17:00	0	0	0	1	1	1	1
16:00 17:00	0	0	0	0	1	1	1
17:00 17:15	0	0	0	0	0	0	0
17:15 17:30	0	0	0	2	2	2	2
17:30 17:45	0	0	0	0	0	0	0
17:45 18:00	0	0	0	3	3	3	3
17:00 18:00	0	0	0	5	5	5	5
<b>Total</b>	<b>3</b>	<b>6</b>	<b>9</b>	<b>6</b>	<b>19</b>	<b>25</b>	<b>34</b>

Comment:





**Transportation Services - Traffic Services**  
**Turning Movement Count - Pedestrian Volume Report**

Work Order  
36178

**GREENBANK RD @ JOCKVALE RD**

Count Date: Tuesday, August 16, 2016

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	0	0	0	0
07:15 07:30	0	0	0	0	1	1	1
07:30 07:45	0	0	0	0	0	0	0
07:45 08:00	0	0	0	0	0	0	0
07:00 08:00	0	0	0	0	1	1	1
08:00 08:15	0	0	0	1	0	1	1
08:15 08:30	0	0	0	0	0	0	0
08:30 08:45	0	1	1	0	0	0	1
08:45 09:00	0	0	0	0	0	0	0
08:00 09:00	0	1	1	1	0	1	2
09:00 09:15	0	2	2	3	2	5	7
09:15 09:30	0	0	0	0	0	0	0
09:30 09:45	0	2	2	0	3	3	5
09:45 10:00	0	0	0	0	1	1	1
09:00 10:00	0	4	4	2	7	9	13
11:30 11:45	0	0	0	1	1	1	1
11:45 12:00	0	0	0	0	0	0	0
12:00 12:15	0	1	1	0	1	1	2
12:15 12:30	0	0	0	0	0	0	0
11:30 12:30	0	1	1	0	2	2	3
12:30 12:45	0	0	0	0	0	0	0
12:45 13:00	0	0	0	0	0	0	0
13:00 13:15	0	0	0	0	0	0	0
13:15 13:30	3	0	3	3	0	3	6
12:30 13:30	3	0	3	3	0	3	6
15:00 15:15	0	0	0	2	0	2	2
15:15 15:30	0	0	0	0	0	0	0
15:30 15:45	0	0	0	0	0	0	0
15:45 16:00	0	0	0	1	1	1	1
15:00 16:00	0	0	0	3	3	3	3
16:00 16:15	0	0	0	0	0	0	0
16:15 16:30	0	0	0	0	0	0	0
16:30 16:45	0	0	0	0	0	0	0
16:45 17:00	0	0	0	1	1	1	1
16:00 17:00	0	0	0	1	1	1	1
17:00 17:15	0	0	0	0	0	0	0
17:15 17:30	0	0	0	2	2	2	2
17:30 17:45	0	0	0	0	0	0	0
17:45 18:00	0	0	0	3	3	3	3
17:00 18:00	0	0	0	5	5	5	5
Total .....	3	6	9	6	19	25	34

Comment:



**Transportation Services - Traffic Services**

Work Order  
36178

**Turning Movement Count - 15 Min U-Turn Total Report**

**GREENBANK RD @ JOCKVALE RD**

Survey Date: Tuesday, August 16, 2016

Time Period	Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00 07:15	0	0	0	0	0
07:15 07:30	0	0	0	0	0
07:30 07:45	0	0	0	0	0
07:45 08:00	0	0	0	0	0
08:00 08:15	0	0	0	0	0
08:15 08:30	0	0	0	0	0
08:30 08:45	0	0	0	0	0
08:45 09:00	0	0	0	0	0
09:00 09:15	0	0	0	0	0
09:15 09:30	0	0	0	0	0
09:30 09:45	0	0	0	0	0
09:45 10:00	0	0	0	0	0
11:30 11:45	0	0	0	0	0
11:45 12:00	0	0	0	0	0
12:00 12:15	0	0	0	0	0
12:15 12:30	0	0	0	0	0
12:30 12:45	0	0	0	0	0
12:45 13:00	0	0	0	0	0
13:00 13:15	0	0	0	0	0
13:15 13:30	0	0	0	0	0
15:00 15:15	0	0	0	0	0
15:15 15:30	0	0	0	0	0
15:30 15:45	0	0	0	0	0
15:45 16:00	0	0	0	0	0
16:00 16:15	0	0	0	0	0
16:15 16:30	0	0	0	0	0
16:30 16:45	0	0	0	0	0
16:45 17:00	0	0	0	0	0
17:00 17:15	0	0	0	0	0
17:15 17:30	0	0	0	0	0
17:30 17:45	0	0	0	0	0
17:45 18:00	0	0	0	0	0
Total	0	0	0	0	0



# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

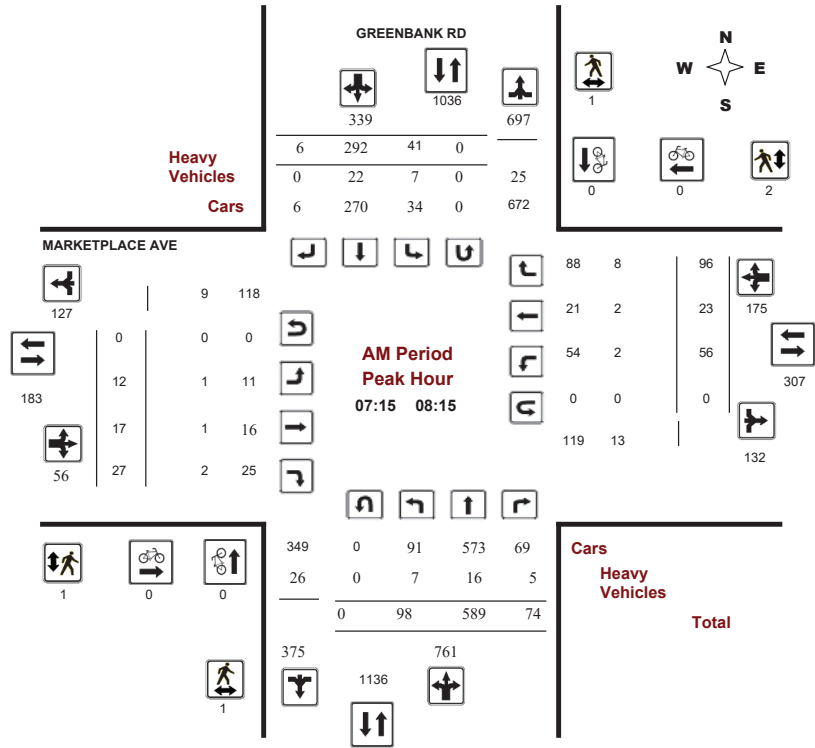
### GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Start Time: 07:00

WO No: 35721

Device: Miovision



Comments



# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

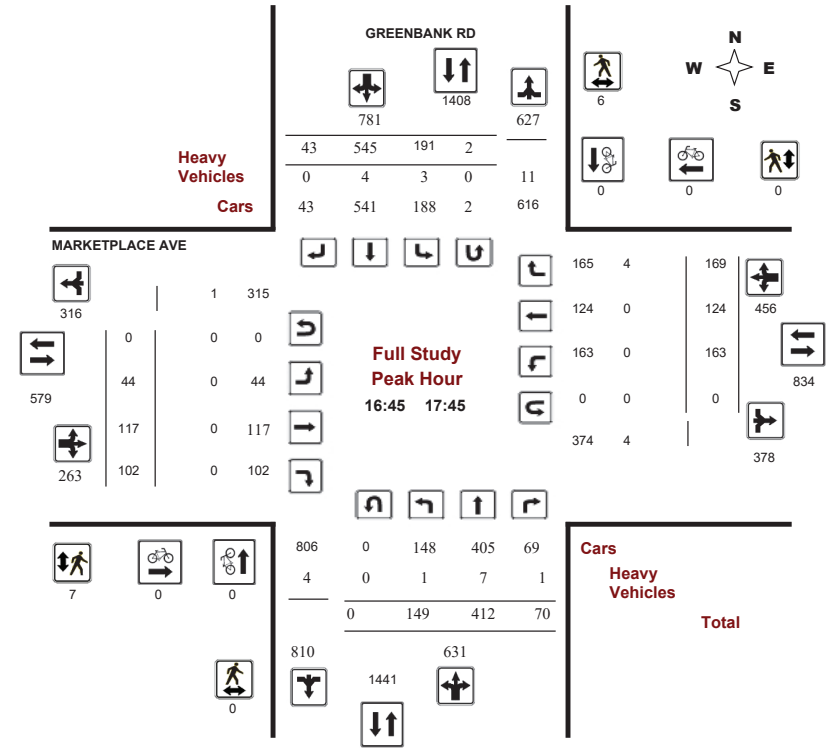
### GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Start Time: 07:00

WO No: 35721

Device: Miovision



Comments



### Transportation Services - Traffic Services

#### Turning Movement Count - Peak Hour Diagram

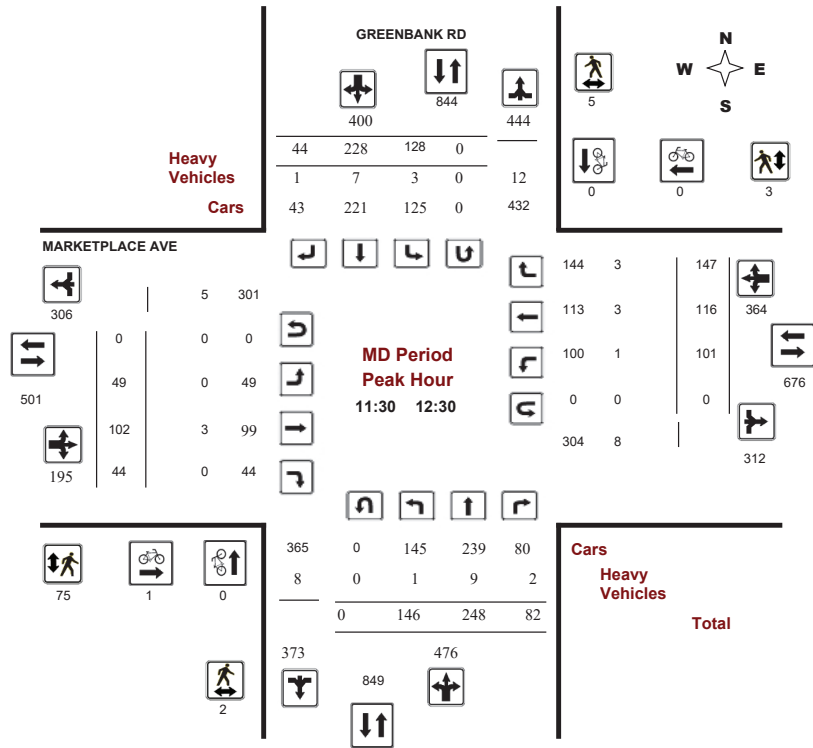
#### GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Start Time: 07:00

WO No: 35721

Device: Miovision



Comments



### Transportation Services - Traffic Services

#### Turning Movement Count - Peak Hour Diagram

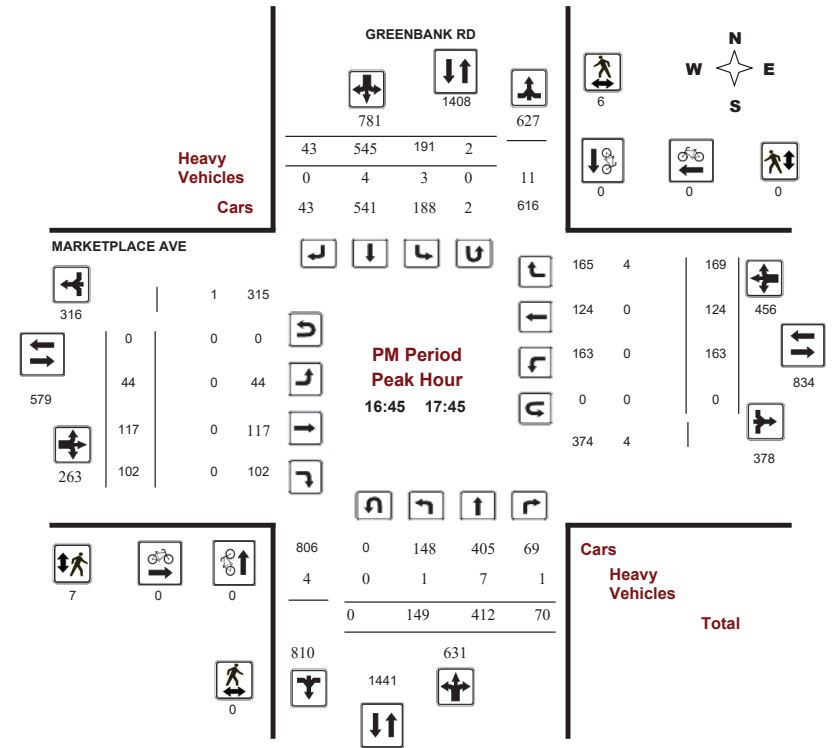
#### GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Start Time: 07:00

WO No: 35721

Device: Miovision



Comments

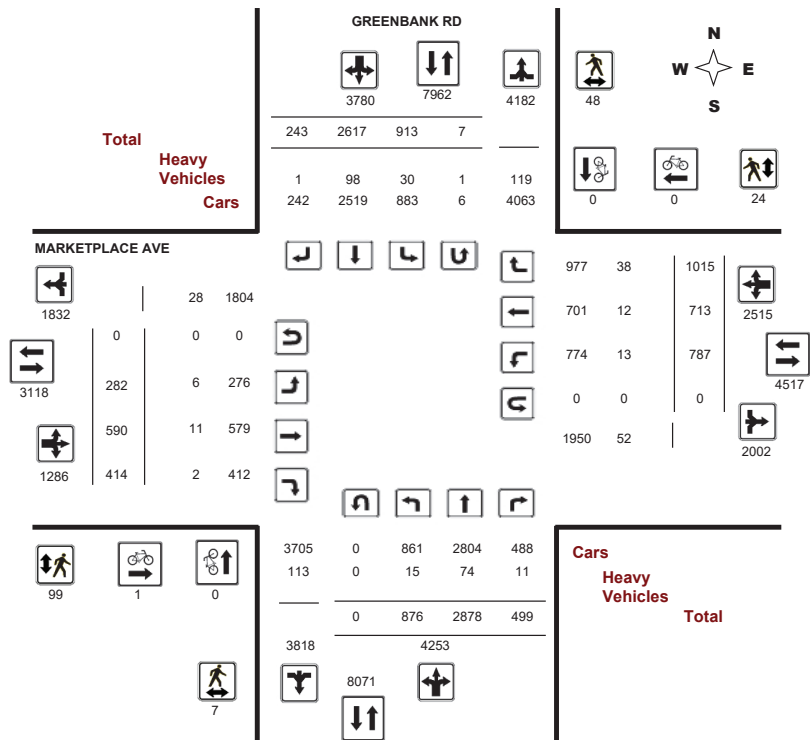


**Transportation Services - Traffic Services**  
**Turning Movement Count - Full Study Diagram**

**GREENBANK RD @ MARKETPLACE AVE**

Survey Date: Wednesday, February 10, 2016

WO#: 35721  
 Device: Miovision



Comments



**Transportation Services - Traffic Services**

Work Order  
35721

**Turning Movement Count - Full Study Summary Report**

**GREENBANK RD @ MARKETPLACE AVE**

Survey Date: Wednesday, February 10, 2016

Total Observed U-Turns

AADT Factor

Northbound: 0 Southbound: 7  
 Eastbound: 0 Westbound: 0  
 1.00

**Full Study**

Period	GREENBANK RD					MARKETPLACE AVE					Grand Total								
	Northbound		Southbound		NB TOT	Eastbound		Westbound		WB TOT		STR TOT							
	LT	ST	RT	RT		LT	ST	RT	LT		ST		RT	RT					
07:00 08:00	75	543	78	696	34	281	6	321	1017	10	18	20	48	53	25	90	168	216	1233
08:00 09:00	90	514	45	649	57	231	11	299	948	8	22	23	53	39	40	118	197	250	1198
09:00 10:00	104	300	62	466	82	226	37	345	811	29	52	27	108	66	69	81	216	324	1135
11:30 12:30	146	248	82	476	128	228	44	400	876	49	102	44	195	101	116	147	364	559	1435
12:30 13:30	93	226	57	376	140	237	39	416	792	52	86	46	184	90	110	144	344	528	1320
15:00 16:00	101	302	45	448	134	385	30	549	997	31	86	72	189	114	111	140	365	554	1551
16:00 17:00	113	324	64	501	149	491	39	679	1180	57	109	81	247	157	128	124	409	656	1836
17:00 18:00	154	421	66	641	189	538	37	764	1405	46	115	101	262	167	114	171	452	714	2119
<b>Sub Total</b>	<b>876</b>	<b>2878</b>	<b>499</b>	<b>4253</b>	<b>913</b>	<b>2617</b>	<b>243</b>	<b>3773</b>	<b>8026</b>	<b>282</b>	<b>590</b>	<b>414</b>	<b>1286</b>	<b>787</b>	<b>713</b>	<b>1015</b>	<b>2515</b>	<b>3801</b>	<b>11827</b>
<b>U Turns</b>				<b>0</b>				<b>7</b>	<b>7</b>				<b>0</b>				<b>0</b>	<b>0</b>	<b>7</b>
<b>Total</b>	<b>876</b>	<b>2878</b>	<b>499</b>	<b>4253</b>	<b>913</b>	<b>2617</b>	<b>243</b>	<b>3780</b>	<b>8033</b>	<b>282</b>	<b>590</b>	<b>414</b>	<b>1286</b>	<b>787</b>	<b>713</b>	<b>1015</b>	<b>2515</b>	<b>3801</b>	<b>11834</b>
<b>EQ 12Hr</b>	<b>1218</b>	<b>4000</b>	<b>694</b>	<b>5912</b>	<b>1269</b>	<b>3638</b>	<b>338</b>	<b>5254</b>	<b>11166</b>	<b>392</b>	<b>820</b>	<b>575</b>	<b>1788</b>	<b>1094</b>	<b>991</b>	<b>1411</b>	<b>3496</b>	<b>5284</b>	<b>16450</b>
Note: These values are calculated by multiplying the totals by the appropriate expansion factor.													<b>1.39</b>						
<b>AVG 12Hr</b>	<b>1218</b>	<b>4000</b>	<b>694</b>	<b>5912</b>	<b>1269</b>	<b>3638</b>	<b>338</b>	<b>5254</b>	<b>11166</b>	<b>392</b>	<b>820</b>	<b>575</b>	<b>1788</b>	<b>1094</b>	<b>991</b>	<b>1411</b>	<b>3496</b>	<b>5284</b>	<b>16450</b>
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.													<b>1.00</b>						
<b>AVG 24Hr</b>	<b>1595</b>	<b>5241</b>	<b>909</b>	<b>7744</b>	<b>1662</b>	<b>4765</b>	<b>442</b>	<b>6883</b>	<b>14627</b>	<b>513</b>	<b>1074</b>	<b>754</b>	<b>2342</b>	<b>1433</b>	<b>1298</b>	<b>1848</b>	<b>4580</b>	<b>6922</b>	<b>21549</b>
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.													<b>1.31</b>						

**Comments:**

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.



Transportation Services - Traffic Services W.O. 35721

Turning Movement Count - 15 Minute Summary Report

GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Total Observed U-Turns

Northbound: 0 Southbound: 7  
Eastbound: 0 Westbound: 0

Time Period	GREENBANK RD									MARKETPLACE AVE									Grand Total
	Northbound			Southbound			Eastbound			Westbound			Eastbound			Westbound			
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT	
07:00 07:15	10	112	18	140	5	46	0	51	191	1	5	1	7	11	6	14	31	38	229
07:15 07:30	17	143	18	178	6	46	2	54	232	2	3	7	12	8	8	21	37	49	281
07:30 07:45	19	152	22	193	10	98	1	109	302	5	6	7	18	22	6	28	56	74	376
07:45 08:00	29	136	20	185	13	91	3	107	292	2	4	5	11	12	5	27	44	55	347
08:00 08:15	33	158	14	205	12	57	0	69	274	3	4	8	15	14	4	20	38	53	327
08:15 08:30	15	97	5	117	6	45	3	54	171	0	8	5	13	8	10	35	53	66	237
08:30 08:45	20	119	16	155	18	75	4	97	252	1	4	6	11	11	12	35	58	69	321
08:45 09:00	22	140	10	172	21	54	4	79	251	4	6	4	14	6	14	28	48	62	313
09:00 09:15	30	109	13	152	21	69	15	105	257	11	11	4	26	10	12	13	35	61	318
09:15 09:30	31	69	18	118	17	52	11	80	198	5	11	9	25	17	17	22	56	81	279
09:30 09:45	22	67	20	109	17	51	4	72	181	7	16	11	34	18	27	31	76	110	291
09:45 10:00	21	55	11	87	27	54	7	89	176	6	14	3	23	21	13	15	49	72	248
11:30 11:45	38	60	14	112	33	53	11	97	209	13	26	12	51	12	30	34	76	127	336
11:45 12:00	32	57	28	117	22	59	9	90	207	11	22	12	45	22	26	38	86	131	338
12:00 12:15	35	60	24	119	36	60	14	110	229	15	29	7	51	29	27	35	91	142	371
12:15 12:30	41	71	16	128	37	56	10	103	231	10	25	13	48	38	33	40	111	159	390
12:30 12:45	21	63	15	99	33	49	12	94	193	11	19	9	39	17	28	43	88	127	320
12:45 13:00	25	55	19	99	36	70	11	118	217	16	13	11	40	19	28	32	79	119	336
13:00 13:15	22	62	10	94	36	63	8	107	201	13	31	13	57	24	14	30	68	125	326
13:15 13:30	25	46	13	84	35	55	8	98	182	12	23	13	48	30	40	39	109	157	339
15:00 15:15	30	84	12	126	34	73	7	114	240	13	23	12	48	21	27	34	82	130	370
15:15 15:30	24	82	4	110	24	104	7	135	245	5	16	20	41	32	32	37	101	142	387
15:30 15:45	26	78	15	119	41	100	7	149	268	7	23	17	47	35	24	30	89	136	404
15:45 16:00	21	58	14	93	35	108	9	153	246	6	24	23	53	26	28	39	93	146	392
16:00 16:15	26	73	20	119	32	124	10	166	285	17	30	28	75	29	30	24	83	158	443
16:15 16:30	24	93	8	125	30	112	12	154	279	15	25	12	52	34	24	26	84	136	415
16:30 16:45	28	69	16	113	42	140	5	187	300	10	30	21	61	51	38	41	130	191	491
16:45 17:00	35	89	20	144	45	115	12	172	316	15	24	20	59	43	36	33	112	171	487
17:00 17:15	42	115	18	175	48	141	9	200	375	11	33	26	70	42	39	45	126	196	571
17:15 17:30	35	106	19	160	48	144	9	201	361	10	28	23	61	38	29	51	118	179	540
17:30 17:45	37	102	13	152	50	145	13	208	360	8	32	33	73	40	20	40	100	173	533
17:45 18:00	40	98	16	154	43	108	6	158	312	17	22	19	58	47	26	35	108	166	478
TOTAL:	876	2878	499	4253	913	2617	243	3780	8033	282	590	414	1286	787	713	1015	2515	3801	11834

Note: U-Turns are included in Totals.

Comment:



Transportation Services - Traffic Services  
Turning Movement Count - Cyclist Volume Report

Work Order  
35721

GREENBANK RD @ MARKETPLACE AVE

Count Date: Wednesday, February 10, 2016

Start Time: 07:00

Time Period	GREENBANK RD			MARKETPLACE AVE			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	0	0	0	0	0	0	0
08:00 09:00	0	0	0	0	0	0	0
09:00 10:00	0	0	0	0	0	0	0
11:30 12:30	0	0	0	1	0	1	1
12:30 13:30	0	0	0	0	0	0	0
15:00 16:00	0	0	0	0	0	0	0
16:00 17:00	0	0	0	0	0	0	0
17:00 18:00	0	0	0	0	0	0	0
Total .....	0	0	0	1	0	1	1

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.



Transportation Services - Traffic Services

W.O. 35721

Turning Movement Count - Heavy Vehicle Report

GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Table with columns for Time Period, GREENBANK RD (Northbound/Southbound), and MARKETPLACE AVE (Eastbound/Westbound). Includes sub-totals for U-Turns and Total.

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.



Transportation Services - Traffic Services

Work Order 35721

Turning Movement Count - Pedestrian Volume Report

GREENBANK RD @ MARKETPLACE AVE

Count Date: Wednesday, February 10, 2016

Start Time: 07:00

Table with columns for Time Period, NB Approach, SB Approach, EB Approach, WB Approach, Total, and Grand Total.

Comment:



# Transportation Services - Traffic Services

Work Order  
35721

## Turning Movement Count - 15 Min U-Turn Total Report

### GREENBANK RD @ MARKETPLACE AVE

Survey Date: Wednesday, February 10, 2016

Time Period	Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0
07:15	07:30	0	0	0	0
07:30	07:45	0	0	0	0
07:45	08:00	0	0	0	0
08:00	08:15	0	0	0	0
08:15	08:30	0	0	0	0
08:30	08:45	0	0	0	0
08:45	09:00	0	0	0	0
09:00	09:15	0	0	0	0
09:15	09:30	0	0	0	0
09:30	09:45	0	0	0	0
09:45	10:00	0	1	0	1
11:30	11:45	0	0	0	0
11:45	12:00	0	0	0	0
12:00	12:15	0	0	0	0
12:15	12:30	0	0	0	0
12:30	12:45	0	0	0	0
12:45	13:00	0	1	0	1
13:00	13:15	0	0	0	0
13:15	13:30	0	0	0	0
15:00	15:15	0	0	0	0
15:15	15:30	0	0	0	0
15:30	15:45	0	1	0	1
15:45	16:00	0	1	0	1
16:00	16:15	0	0	0	0
16:15	16:30	0	0	0	0
16:30	16:45	0	0	0	0
16:45	17:00	0	0	0	0
17:00	17:15	0	2	0	2
17:15	17:30	0	0	0	0
17:30	17:45	0	0	0	0
17:45	18:00	0	1	0	1
Total		0	7	0	7



# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

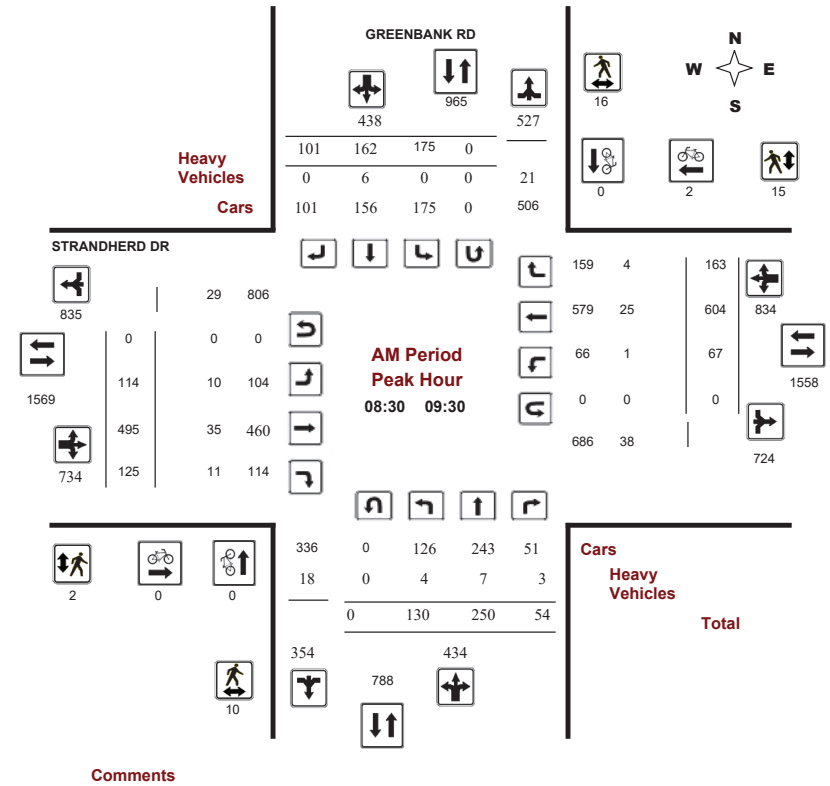
### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016

WO No: 36175

Start Time: 07:00

Device: Miovision







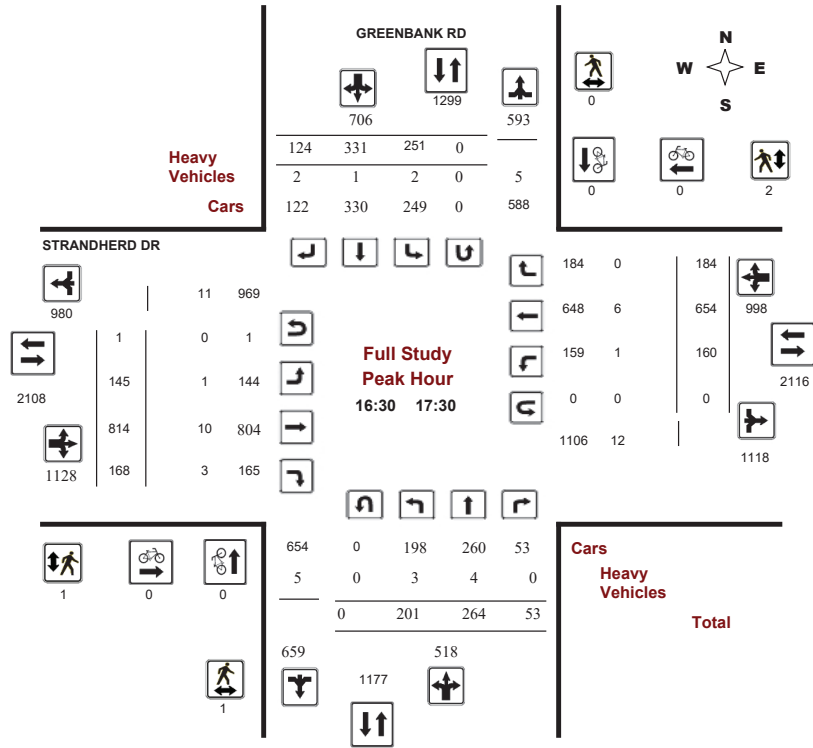
### Transportation Services - Traffic Services

#### Turning Movement Count - Peak Hour Diagram

#### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016  
Start Time: 07:00

WO No: 36175  
Device: Miovision



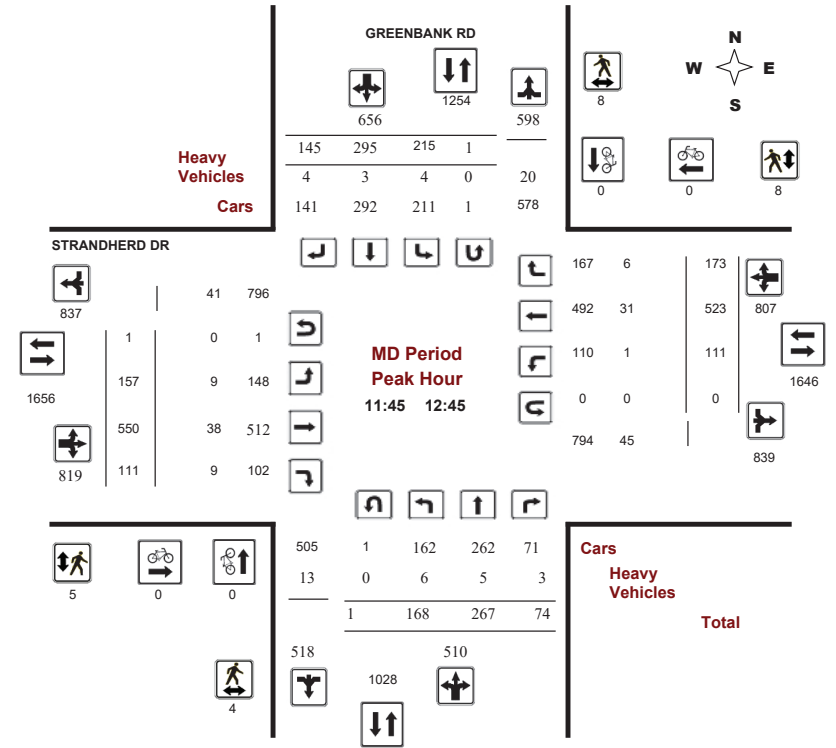
### Transportation Services - Traffic Services

#### Turning Movement Count - Peak Hour Diagram

#### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016  
Start Time: 07:00

WO No: 36175  
Device: Miovision

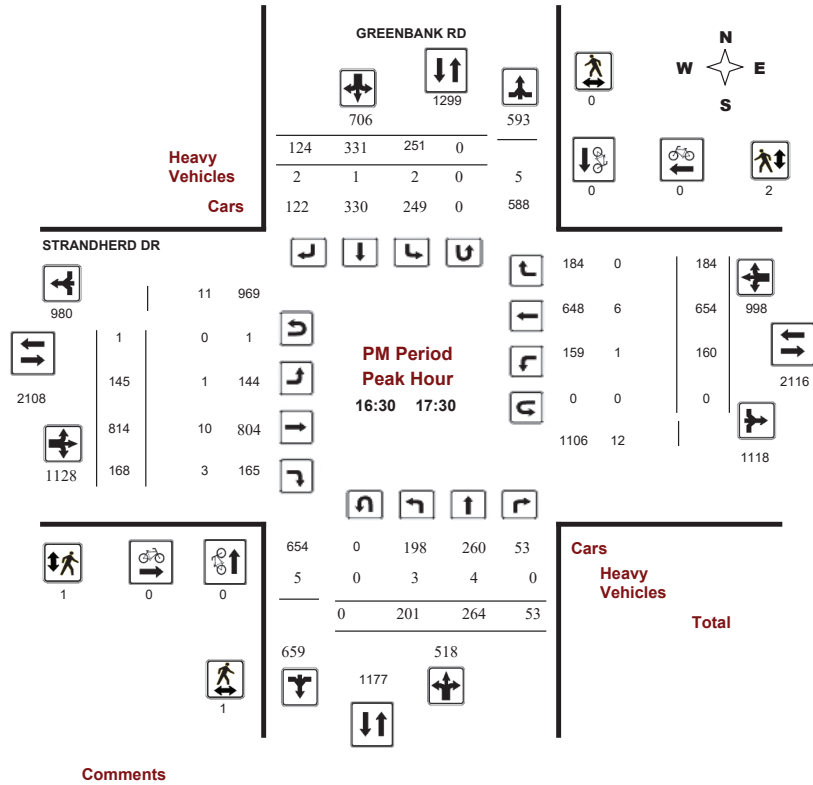




**Transportation Services - Traffic Services**  
**Turning Movement Count - Peak Hour Diagram**  
**GREENBANK RD @ STRANDHERD DR**

**Survey Date:** Tuesday, August 16, 2016  
**Start Time:** 07:00

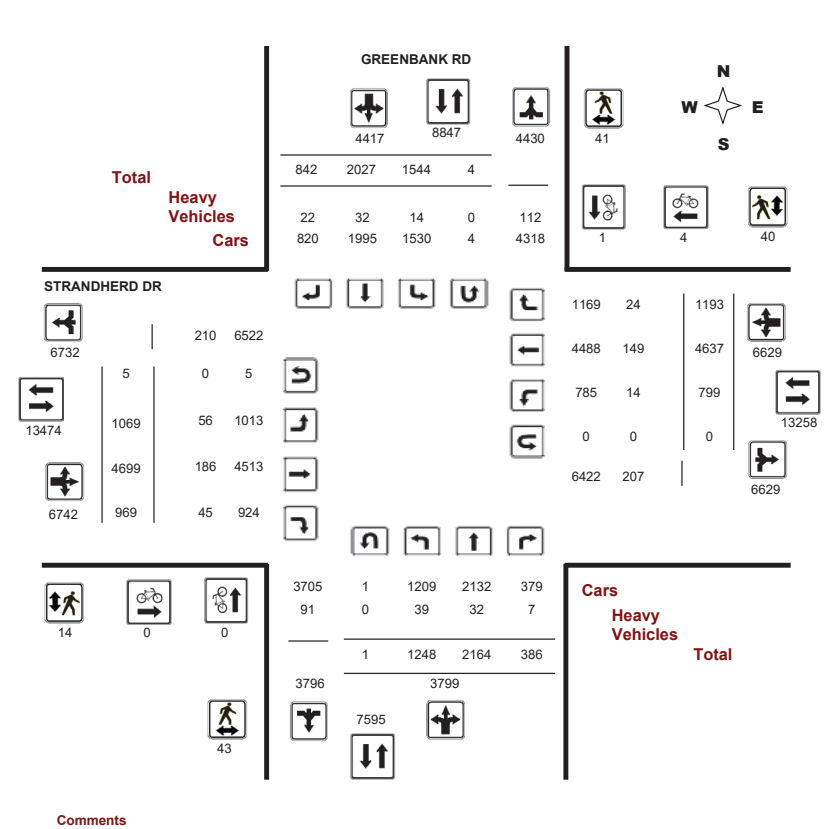
**WO No:** 36175  
**Device:** Miovision



**Transportation Services - Traffic Services**  
**Turning Movement Count - Full Study Diagram**  
**GREENBANK RD @ STRANDHERD DR**

**Survey Date:** Tuesday, August 16, 2016

**WO#:** 36175  
**Device:** Miovision





# Transportation Services - Traffic Services

Work Order  
36175

## Turning Movement Count - Full Study Summary Report

### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016

<b>Total Observed U-Turns</b>		<b>AADT Factor</b>
Northbound: 1	Southbound: 4	.90
Eastbound: 5	Westbound: 0	

#### Full Study

Period	GREENBANK RD										STRANDHERD DR										Grand Total			
	Northbound					Southbound					Eastbound					Westbound								
	LT	ST	RT	NB TOT	SB TOT	LT	ST	RT	STR TOT	STR TOT	LT	ST	RT	EB TOT	WB TOT	LT	ST	RT	WB TOT	STR TOT				
07:00 08:00	108	379	19	506	284	95	120	69	790	790	112	471	77	660	36	526	120	682	1342	2132				
08:00 09:00	129	257	49	435	383	149	139	95	818	818	109	472	116	697	47	684	188	919	1616	2434				
09:00 10:00	146	247	38	431	494	181	207	106	925	925	110	518	99	727	77	512	125	714	1441	2366				
11:30 12:30	181	262	69	512	635	213	287	135	1147	1147	155	581	116	852	101	518	169	788	1640	2787				
12:30 13:30	153	287	58	498	583	198	250	135	1081	1081	170	551	115	836	108	521	172	801	1637	2718				
15:00 16:00	151	222	45	418	659	240	322	97	1077	1077	123	605	123	851	126	590	116	832	1683	2760				
16:00 17:00	190	259	56	505	646	228	322	96	1151	1151	147	708	164	1019	142	658	161	961	1980	3131				
17:00 18:00	190	251	52	493	729	240	380	109	1222	1222	143	793	159	1095	162	628	142	932	2027	3249				
<b>Sub Total</b>	1248	2164	386	3798	4417	1544	2027	842	8211	8211	1069	4699	969	6737	799	4637	1193	6629	13366	21577				
<b>U Turns</b>				1				4				5				5				0			5	10
<b>Total</b>	1248	2164	386	3799	4417	1544	2027	842	8216	8216	1069	4699	969	6742	799	4637	1193	6629	13371	21587				
<b>EQ 12Hr</b>	1735	3008	537	5281	6140	2146	2818	1170	11421	11421	1486	6532	1347	9371	1111	6445	1658	9214	18585	30006				
Note:	These values are calculated by multiplying the totals by the appropriate expansion factor.										1.39													
<b>AVG 12Hr</b>	1561	2707	483	4753	5526	1932	2536	1053	10279	10279	1337	5878	1212	8434	1000	5801	1492	8293	16727	27006				
Note:	These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.										.90													
<b>AVG 24Hr</b>	2045	3546	633	6226	7239	2530	3322	1380	13465	13465	1752	7701	1588	11049	1309	7599	1955	10864	21913	35378				
Note:	These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.										1.31													

#### Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.



# Transportation Services - Traffic Services

W.O. 36175

## Turning Movement Count - 15 Minute Summary Report

### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016

Total Observed U-Turns

Northbound: 1	Southbound: 4
Eastbound: 5	Westbound: 0

Time Period	GREENBANK RD										STRANDHERD DR										Grand Total
	Northbound					Southbound					Eastbound					Westbound					
	LT	ST	RT	N TOT	S TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	W TOT	LT	ST	RT	W TOT	STR TOT	
07:00 07:15	24	87	6	117	60	18	28	14	177	177	26	95	17	138	8	93	23	124	262	439	
07:15 07:30	24	89	4	117	78	25	31	21	195	195	27	115	12	154	9	125	32	166	320	515	
07:30 07:45	33	106	6	145	64	28	23	13	209	209	31	142	15	188	10	153	33	196	384	593	
07:45 08:00	27	97	3	127	83	24	38	21	210	210	28	119	33	180	9	155	32	196	376	586	
08:00 08:15	33	64	14	111	76	29	28	19	187	187	14	130	24	169	10	176	48	234	403	590	
08:15 08:30	33	70	6	109	102	35	38	29	211	211	33	110	20	163	10	163	39	212	375	586	
08:30 08:45	25	68	11	104	76	33	27	16	180	180	34	122	37	193	9	201	52	262	455	635	
08:45 09:00	38	55	18	111	129	52	46	31	240	240	28	110	35	173	18	144	49	211	384	624	
09:00 09:15	37	65	11	113	102	41	41	20	215	215	28	146	23	197	24	119	34	177	374	589	
09:15 09:30	30	62	14	106	131	49	48	34	237	237	24	117	30	171	16	140	28	184	355	592	
09:30 09:45	33	61	2	96	137	40	71	26	233	233	27	118	24	169	15	132	25	172	341	574	
09:45 10:00	46	59	11	116	124	51	47	26	240	240	31	137	22	191	22	121	38	181	372	612	
11:30 11:45	42	77	14	133	130	50	53	27	263	263	37	160	28	226	20	135	32	187	413	676	
11:45 12:00	50	60	16	127	159	50	74	35	286	286	44	142	36	223	32	118	40	190	413	699	
12:00 12:15	43	61	17	121	167	50	87	30	288	288	34	138	29	201	24	141	50	215	416	704	
12:15 12:30	46	64	22	132	179	63	73	43	311	311	40	141	23	204	25	124	47	196	400	711	
12:30 12:45	29	82	19	130	151	52	61	37	281	281	39	129	23	191	30	140	36	206	397	678	
12:45 13:00	45	85	20	150	124	41	45	38	274	274	41	112	33	186	33	129	46	208	394	668	
13:00 13:15	33	60	8	101	144	52	62	30	245	245	46	177	31	254	19	126	47	192	446	691	
13:15 13:30	46	60	11	117	165	53	82	30	282	282	44	133	28	205	26	126	43	195	400	682	
15:00 15:15	43	58	10	111	180	69	80	31	291	291	24	129	30	183	34	118	33	185	368	659	
15:15 15:30	40	54	13	107	179	55	98	26	286	286	44	148	26	218	20	145	25	190	408	694	
15:30 15:45	29	59	10	98	153	54	77	21	251	251	26	177	33	236	35	138	36	209	445	696	
15:45 16:00	39	51	12	102	149	62	67	19	251	251	29	151	34	214	37	189	22	248	462	713	
16:00 16:15	44	60	15	119	162	62	89	11	281	281	28	167	39	234	39	145	45	229	463	744	
16:15 16:30	47	63	14	124	163	46	91	26	287	287	44	149	39	232	30	183	31	244	476	763	
16:30 16:45	51	79	11	141	170	67	76	27	311	311	38	215	41	294	41	159	46	246	540	851	
16:45 17:00	48	57	16	121	151	53	66	32	272	272	37	177	45	260	32	171	39	242	502	774	
17:00 17:15	47	80	19	146	194	65	91	38	340	340	24	197	40	261	40	152	52	244	505	845	
17:15 17:30	55	48	7	110	191	66	98	27	301	301	46	225	42	313	47	172	47	266	579	880	
17:30 17:45	38	72	14	124	176	55	93	28	300	300	39	199	41	279	41	131	27	199	478	778	
17:45 18:00	50	51	12	113	168	54	98	16	281	281	34	172	36	242	34	173	16	223	465	746	
<b>TOTAL:</b>	1248	2164	386	3799	4417	1544	2027	842	8216	8216	1069	4699	969	6742	799	4637	1193	6629	13371	21587	

Note: U-Turns are included in Totals.

Comment:



**Transportation Services - Traffic Services**  
**Turning Movement Count - Cyclist Volume Report**

Work Order  
36175

**GREENBANK RD @ STRANDHERD DR**

Count Date: Tuesday, August 16, 2016

Start Time: 07:00

Time Period	GREENBANK RD			STRANDHERD DR			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	0	1	1	0	0	0	1
08:00 09:00	0	0	0	0	2	2	2
09:00 10:00	0	0	0	0	1	1	1
11:30 12:30	0	0	0	0	1	1	1
12:30 13:30	0	0	0	0	0	0	0
15:00 16:00	0	0	0	0	0	0	0
16:00 17:00	0	0	0	0	0	0	0
17:00 18:00	0	0	0	0	0	0	0
Total .....	0	1	1	0	4	4	5

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.



**Transportation Services - Traffic Services**  
**Turning Movement Count - Heavy Vehicle Report**

W.O.  
36175

**GREENBANK RD @ STRANDHERD DR**

Survey Date: Tuesday, August 16, 2016

Time Period	GREENBANK RD								STRANDHERD DR								Grand Total		
	Northbound				Southbound				Eastbound				Westbound						
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT		W TOT	STR TOT
07:00 08:00	5	1	0	6	0	3	7	10	16	8	22	7	37	3	16	2	21	58	74
08:00 09:00	6	10	3	19	0	3	1	4	23	12	25	7	44	0	26	7	33	77	100
09:00 10:00	6	3	0	9	2	11	4	17	26	12	39	7	58	6	25	4	35	93	119
11:30 12:30	7	2	2	11	3	2	3	8	19	8	34	8	50	1	34	9	44	94	113
12:30 13:30	4	8	1	13	5	7	4	16	29	9	34	7	50	2	19	1	22	72	101
15:00 16:00	4	0	0	4	2	1	1	4	8	1	16	3	20	1	14	0	15	35	43
16:00 17:00	3	3	0	6	0	2	2	4	10	4	10	3	17	0	9	1	10	27	37
17:00 18:00	4	5	1	10	2	3	0	5	15	2	6	3	11	1	6	0	7	18	33
<b>Sub Total</b>	<b>39</b>	<b>32</b>	<b>7</b>	<b>78</b>	<b>14</b>	<b>32</b>	<b>22</b>	<b>68</b>	<b>146</b>	<b>56</b>	<b>186</b>	<b>45</b>	<b>287</b>	<b>14</b>	<b>149</b>	<b>24</b>	<b>187</b>	<b>474</b>	<b>620</b>
<b>U-Turns (Heavy Vehicles)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total</b>	<b>39</b>	<b>32</b>	<b>7</b>	<b>78</b>	<b>14</b>	<b>32</b>	<b>22</b>	<b>68</b>	<b>146</b>	<b>56</b>	<b>186</b>	<b>45</b>	<b>287</b>	<b>14</b>	<b>149</b>	<b>24</b>	<b>187</b>	<b>474</b>	<b>620</b>

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.



### Transportation Services - Traffic Services

Work Order  
36175

### Turning Movement Count - Pedestrian Volume Report

#### GREENBANK RD @ STRANDHERD DR

Count Date: Tuesday, August 16, 2016

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	1	1	0	0	0	1
07:15 07:30	2	0	2	0	2	2	4
07:30 07:45	2	2	4	0	1	1	5
07:45 08:00	1	0	1	0	1	1	2
07:00 08:00	5	3	8	0	4	4	12
08:00 08:15	0	2	2	0	0	0	2
08:15 08:30	0	1	1	0	0	0	1
08:30 08:45	0	4	4	2	0	2	6
08:45 09:00	3	5	8	0	0	0	8
08:00 09:00	3	12	15	2	0	2	17
09:00 09:15	6	2	8	0	7	7	15
09:15 09:30	1	5	6	0	8	8	14
09:30 09:45	4	2	6	0	3	3	9
09:45 10:00	3	0	3	2	1	3	6
09:00 10:00	14	9	23	2	19	21	44
11:30 11:45	3	1	4	0	3	3	7
11:45 12:00	2	1	3	1	1	2	5
12:00 12:15	0	2	2	2	1	3	5
12:15 12:30	0	3	3	1	4	5	8
11:30 12:30	5	7	12	4	9	13	25
12:30 12:45	2	2	4	1	2	3	7
12:45 13:00	3	2	5	0	0	0	5
13:00 13:15	1	1	2	1	1	2	4
13:15 13:30	4	2	6	1	0	1	7
12:30 13:30	10	7	17	3	3	6	23
15:00 15:15	0	0	0	0	0	0	0
15:15 15:30	0	1	1	0	0	0	1
15:30 15:45	1	0	1	0	0	0	1
15:45 16:00	0	1	1	0	0	0	1
15:00 16:00	1	2	3	0	0	0	3
16:00 16:15	2	0	2	0	0	0	2
16:15 16:30	0	1	1	1	1	2	3
16:30 16:45	0	0	0	0	1	1	1
16:45 17:00	0	0	0	0	1	1	1
16:00 17:00	2	1	3	1	3	4	7
17:00 17:15	1	0	1	0	0	0	1
17:15 17:30	0	0	0	1	0	1	1
17:30 17:45	0	0	0	0	2	2	2
17:45 18:00	2	0	2	1	0	1	3
17:00 18:00	3	0	3	2	2	4	7
Total .....	43	41	84	14	40	54	138

Comment:



### Transportation Services - Traffic Services

Work Order  
36175

### Turning Movement Count - 15 Min U-Turn Total Report

#### GREENBANK RD @ STRANDHERD DR

Survey Date: Tuesday, August 16, 2016

Time Period	Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00 07:15	0	0	0	0	0
07:15 07:30	0	1	0	0	1
07:30 07:45	0	0	0	0	0
07:45 08:00	0	0	0	0	0
08:00 08:15	0	0	1	0	1
08:15 08:30	0	0	0	0	0
08:30 08:45	0	0	0	0	0
08:45 09:00	0	0	0	0	0
09:00 09:15	0	0	0	0	0
09:15 09:30	0	0	0	0	0
09:30 09:45	0	0	0	0	0
09:45 10:00	0	0	1	0	1
11:30 11:45	0	0	1	0	1
11:45 12:00	1	0	1	0	2
12:00 12:15	0	0	0	0	0
12:15 12:30	0	0	0	0	0
12:30 12:45	0	1	0	0	1
12:45 13:00	0	0	0	0	0
13:00 13:15	0	0	0	0	0
13:15 13:30	0	0	0	0	0
15:00 15:15	0	0	0	0	0
15:15 15:30	0	0	0	0	0
15:30 15:45	0	1	0	0	1
15:45 16:00	0	0	0	0	0
16:00 16:15	0	0	0	0	0
16:15 16:30	0	0	0	0	0
16:30 16:45	0	0	0	0	0
16:45 17:00	0	0	1	0	1
17:00 17:15	0	0	0	0	0
17:15 17:30	0	0	0	0	0
17:30 17:45	0	0	0	0	0
17:45 18:00	0	0	0	0	0
Total	1	4	5	0	10



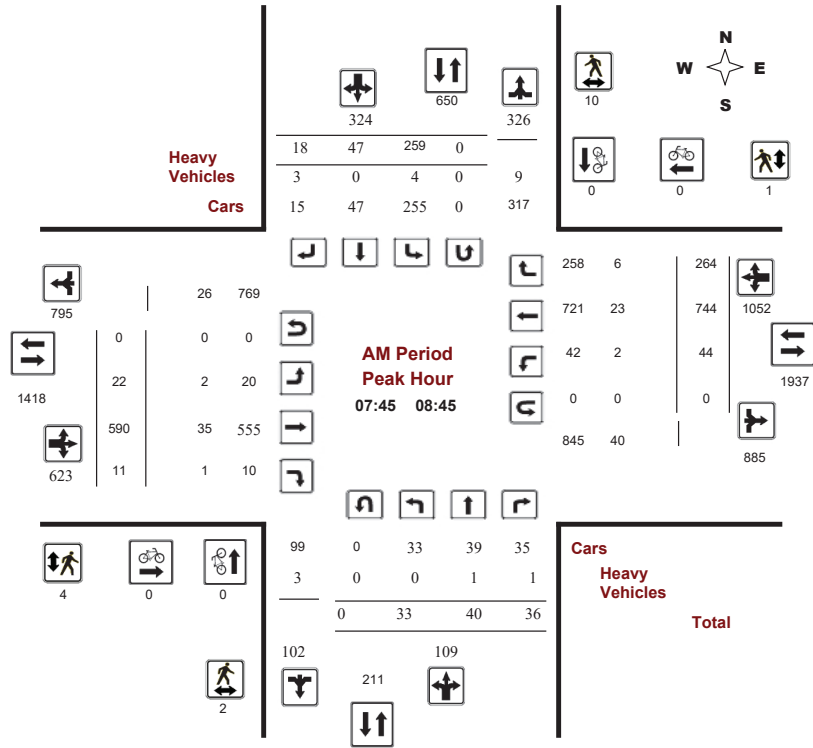
# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018  
Start Time: 07:00

WO No: 37499  
Device: Miovision



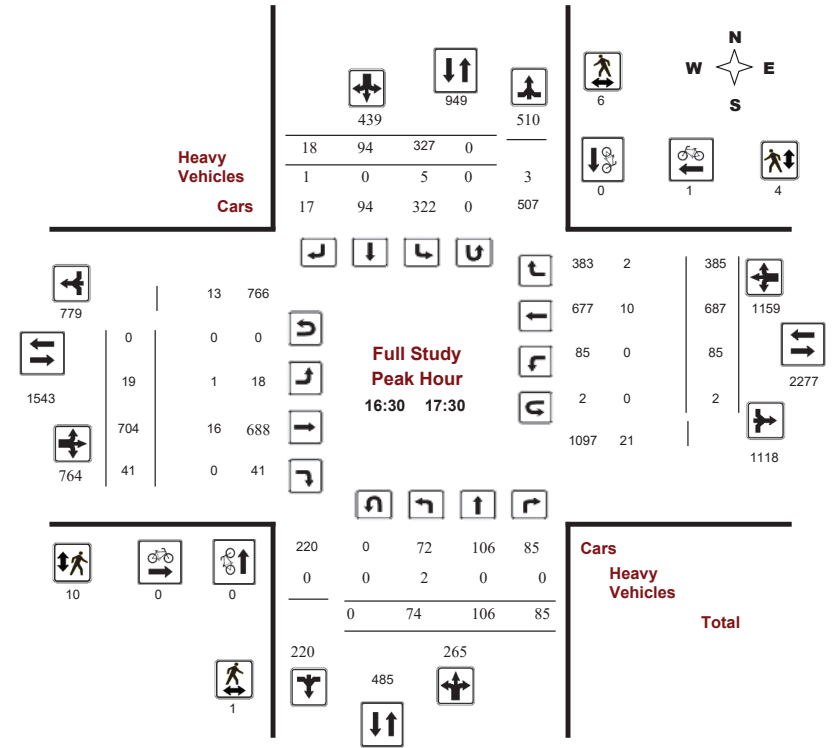
# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018  
Start Time: 07:00

WO No: 37499  
Device: Miovision





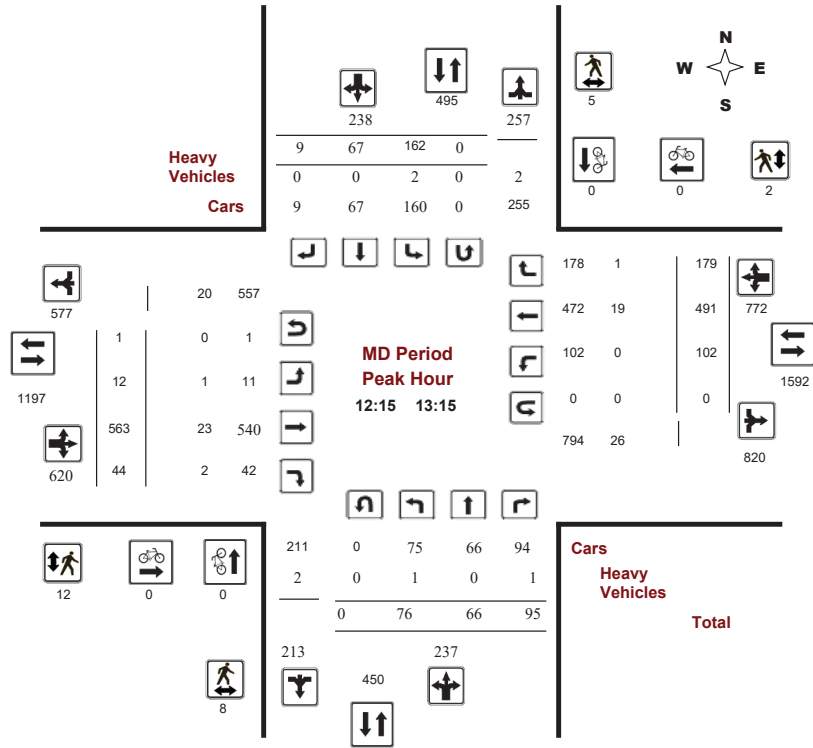
# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018  
Start Time: 07:00

WO No: 37499  
Device: Miovision



Comments



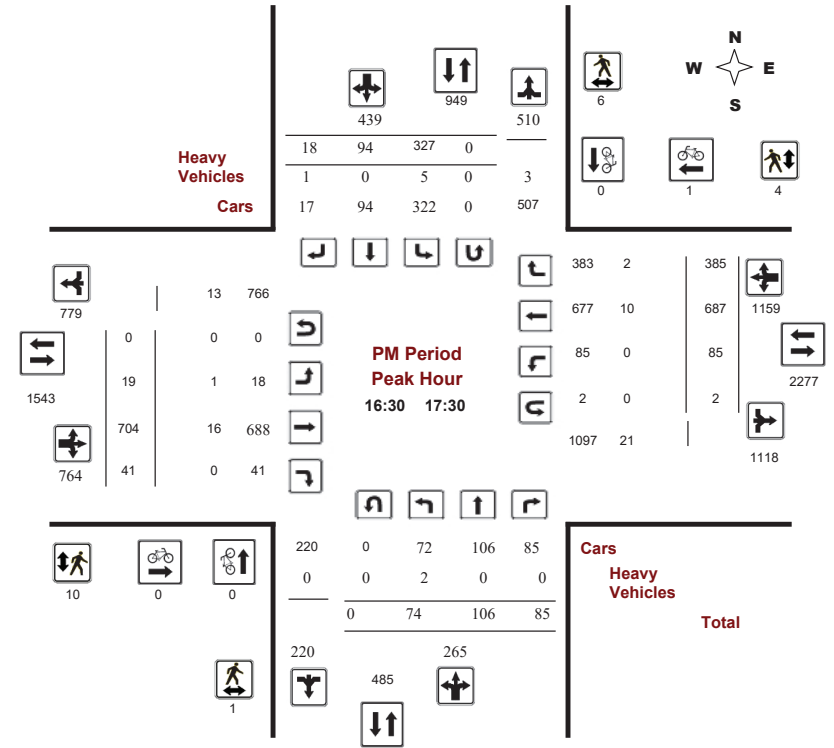
# Transportation Services - Traffic Services

## Turning Movement Count - Peak Hour Diagram

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018  
Start Time: 07:00

WO No: 37499  
Device: Miovision



Comments



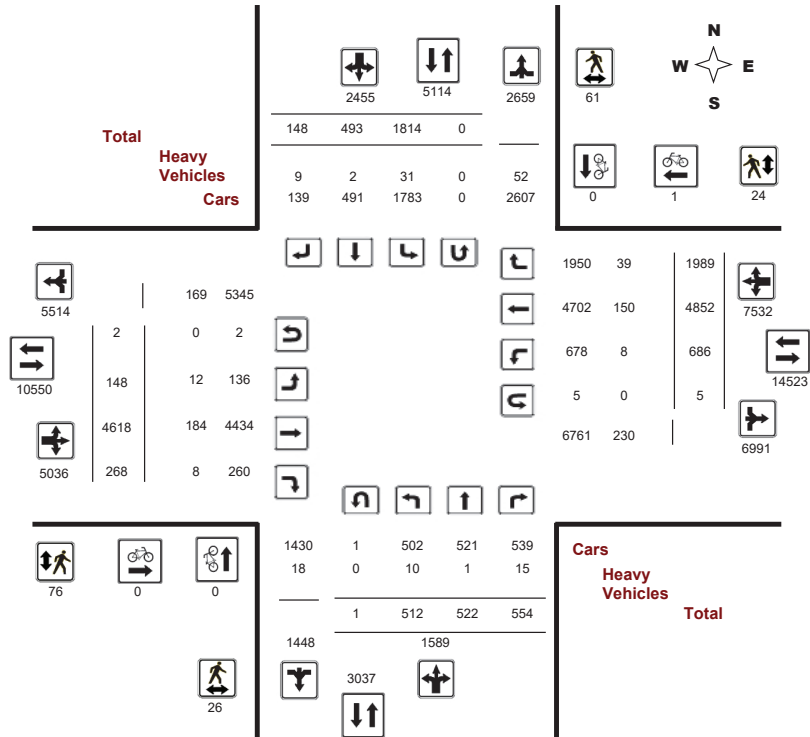


**Transportation Services - Traffic Services**  
**Turning Movement Count - Full Study Diagram**

**JOCKVALE RD @ STRANDHERD DR**

Survey Date: Thursday, January 18, 2018

WO#: 37499  
 Device: Miovision



**Transportation Services - Traffic Services**

Work Order  
37499

**Turning Movement Count - Full Study Summary Report**

**JOCKVALE RD @ STRANDHERD DR**

Survey Date: Thursday, January 18, 2018

**Total Observed U-Turns**  
 Northbound: 1 Southbound: 0  
 Eastbound: 2 Westbound: 5  
**AADT Factor**  
 1.00

**Full Study**

Period	Northbound				Southbound				Eastbound				Westbound				Grand Total		
	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT		WB TOT	STR TOT
07:00 08:00	36	18	20	74	251	42	9	302	376	16	504	9	529	33	599	176	808	1337	1713
08:00 09:00	29	44	43	116	234	42	21	297	413	24	551	11	586	49	756	259	1064	1650	2063
09:00 10:00	65	40	52	157	209	38	14	261	418	15	439	26	480	97	557	153	807	1287	1705
11:30 12:30	77	64	83	224	160	51	13	224	448	5	487	52	544	109	473	179	761	1305	1753
12:30 13:30	82	67	98	247	158	75	12	245	492	13	552	39	604	110	472	186	768	1372	1864
15:00 16:00	69	85	81	235	212	68	27	307	542	23	649	34	706	116	643	330	1089	1795	2337
16:00 17:00	81	101	88	270	297	84	26	407	677	29	727	51	807	88	680	356	1124	1931	2608
17:00 18:00	73	103	89	265	293	93	26	412	677	23	709	46	778	84	672	350	1106	1884	2561
<b>Sub Total</b>	512	522	554	1588	1814	493	148	2455	4043	148	4618	268	5034	686	4852	1989	7527	12561	16604
<b>U Turns</b>				1				0	1				2				5	7	8
<b>Total</b>	512	522	554	1589	1814	493	148	2455	4044	148	4618	268	5036	686	4852	1989	7532	12568	16612
<b>EQ 12Hr</b>	712	726	770	2209	2521	685	206	3412	5621	206	6419	373	7000	954	6744	2765	10469	17469	23090
Note:	These values are calculated by multiplying the totals by the appropriate expansion factor.																1.39		
<b>AVG 12Hr</b>	712	726	770	2209	2521	685	206	3412	5621	206	6419	373	7000	954	6744	2765	10469	17469	23090
Note:	These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.																1.00		
<b>AVG 24Hr</b>	932	951	1009	2893	3303	898	269	4470	7363	269	8409	488	9170	1249	8835	3622	13715	22885	30248
Note:	These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.																1.31		

**Comments:**

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.



Turning Movement Count - 15 Minute Summary Report

JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018

Total Observed U-Turns

Northbound: 1 Southbound: 0  
Eastbound: 2 Westbound: 5

Time Period	Northbound			Southbound			Eastbound			Westbound			Grand Total						
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT		E TOT	LT	ST	RT	W TOT	STR TOT
07:00 07:15	4	2	4	10	45	3	2	50	60	1	97	2	100	4	118	23	145	245	305
07:15 07:30	5	7	1	13	66	12	2	80	93	5	128	3	136	4	139	33	176	312	405
07:30 07:45	18	4	11	33	64	8	3	75	108	4	127	1	132	10	181	45	236	368	476
07:45 08:00	9	5	4	18	76	19	2	97	115	6	152	3	161	15	161	75	251	412	527
08:00 08:15	8	13	10	31	56	13	6	75	106	7	165	2	174	5	174	67	246	420	526
08:15 08:30	8	10	10	28	64	7	3	74	102	6	149	2	157	13	199	65	277	434	536
08:30 08:45	8	12	12	32	63	8	7	78	110	3	124	4	131	11	210	57	278	409	519
08:45 09:00	5	9	11	25	51	14	5	70	95	8	113	3	124	20	173	70	263	387	482
09:00 09:15	16	12	9	37	68	11	3	82	119	4	105	5	114	25	151	45	222	336	455
09:15 09:30	11	11	22	44	61	6	4	71	115	2	102	8	112	31	141	35	207	319	434
09:30 09:45	15	7	12	34	34	12	4	50	84	3	112	4	119	17	139	47	203	322	406
09:45 10:00	23	10	9	42	46	9	3	58	100	6	120	9	135	24	126	26	176	311	411
11:30 11:45	17	18	20	55	36	8	2	46	101	2	132	5	139	18	124	46	188	327	428
11:45 12:00	23	16	19	58	46	11	4	61	119	0	110	20	130	30	102	48	181	311	430
12:00 12:15	20	14	20	54	43	21	6	70	124	1	115	14	130	37	124	42	204	334	458
12:15 12:30	17	16	24	57	35	11	1	47	104	2	130	13	146	24	123	43	190	336	440
12:30 12:45	14	8	27	49	47	22	2	71	120	4	135	12	151	33	128	48	209	360	480
12:45 13:00	20	17	27	64	40	18	4	62	126	3	155	10	168	19	118	46	183	351	477
13:00 13:15	25	25	17	67	40	16	2	58	125	3	143	9	155	26	122	42	190	345	470
13:15 13:30	23	17	27	67	31	19	4	54	121	3	119	8	130	32	104	50	186	316	437
15:00 15:15	14	23	27	64	47	14	4	65	129	3	140	9	152	28	165	76	269	421	550
15:15 15:30	21	23	15	59	42	16	6	64	123	5	185	11	201	32	169	77	278	479	602
15:30 15:45	20	27	19	67	67	15	6	88	155	6	171	7	184	21	145	82	248	432	587
15:45 16:00	14	12	20	46	56	23	11	90	136	9	153	7	169	35	164	95	294	463	599
16:00 16:15	26	22	21	69	65	17	6	88	157	9	192	16	218	25	155	86	266	484	641
16:15 16:30	19	22	30	71	70	22	9	101	172	9	187	16	212	20	187	78	285	497	669
16:30 16:45	14	36	21	71	89	25	5	119	190	7	145	7	159	24	162	95	282	441	631
16:45 17:00	22	21	16	59	73	20	6	99	158	4	203	12	219	19	176	97	292	511	669
17:00 17:15	22	23	30	75	83	24	3	110	185	5	154	11	170	20	182	93	296	466	651
17:15 17:30	16	26	18	60	82	25	4	111	171	3	202	11	216	22	167	100	289	505	676
17:30 17:45	20	27	20	67	65	32	9	106	173	3	174	14	191	24	156	83	263	454	627
17:45 18:00	15	27	21	63	63	12	10	85	148	12	179	10	201	18	167	74	259	460	608
TOTAL:	512	522	554	1589	1814	493	148	2455	4044	148	4618	268	5036	686	4852	1989	7532	12568	16612

Note: U-Turns are included in Totals.

Comment:



JOCKVALE RD @ STRANDHERD DR

Count Date: Thursday, January 18, 2018

Start Time: 07:00

Time Period	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	Grand Total
07:00 08:00	0	0	0	0	0	0	0
08:00 09:00	0	0	0	0	0	0	0
09:00 10:00	0	0	0	0	0	0	0
11:30 12:30	0	0	0	0	0	0	0
12:30 13:30	0	0	0	0	0	0	0
15:00 16:00	0	0	0	0	0	0	0
16:00 17:00	0	0	0	0	1	1	1
17:00 18:00	0	0	0	0	0	0	0
Total .....	0	0	0	0	1	1	1

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.



# Transportation Services - Traffic Services

W.O.  
37499

## Turning Movement Count - Heavy Vehicle Report

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018

Time Period	Northbound			Southbound			Eastbound			Westbound			W TOT	STR TOT	Grand Total				
	LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT				E TOT	LT	ST	RT
07:00 08:00	1	0	2	3	9	0	0	9	12	1	32	1	34	2	25	3	30	64	76
08:00 09:00	0	1	2	3	2	0	3	5	8	2	29	1	32	2	22	10	34	66	74
09:00 10:00	2	0	3	5	3	0	1	4	9	1	26	2	29	1	27	6	34	63	72
11:30 12:30	2	0	5	7	1	0	1	2	9	1	22	1	24	2	22	1	25	49	58
12:30 13:30	2	0	0	2	2	0	2	4	6	2	30	2	34	0	15	6	21	55	61
15:00 16:00	1	0	2	3	4	2	0	6	9	2	10	0	12	0	16	9	25	37	46
16:00 17:00	1	0	1	2	6	0	2	8	10	3	23	0	26	1	18	4	23	49	59
17:00 18:00	1	0	0	1	4	0	0	4	5	0	12	1	13	0	5	0	5	18	23
<b>Sub Total</b>	<b>10</b>	<b>1</b>	<b>15</b>	<b>26</b>	<b>31</b>	<b>2</b>	<b>9</b>	<b>42</b>	<b>68</b>	<b>12</b>	<b>184</b>	<b>8</b>	<b>204</b>	<b>8</b>	<b>150</b>	<b>39</b>	<b>197</b>	<b>401</b>	<b>469</b>
<b>U-Turns (Heavy Vehicles)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total</b>	<b>10</b>	<b>1</b>	<b>15</b>	<b>26</b>	<b>31</b>	<b>2</b>	<b>9</b>	<b>42</b>	<b>68</b>	<b>12</b>	<b>184</b>	<b>8</b>	<b>204</b>	<b>8</b>	<b>150</b>	<b>39</b>	<b>197</b>	<b>401</b>	<b>469</b>

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.



# Transportation Services - Traffic Services

Work Order  
37499

## Turning Movement Count - Pedestrian Volume Report

### JOCKVALE RD @ STRANDHERD DR

Count Date: Thursday, January 18, 2018

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	2	0	2	2
07:15 07:30	0	1	1	1	0	1	2
07:30 07:45	1	2	3	5	0	5	8
07:45 08:00	0	4	4	1	1	2	6
<b>07:00 08:00</b>	<b>1</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>1</b>	<b>10</b>	<b>18</b>
08:00 08:15	0	0	0	0	0	0	0
08:15 08:30	0	3	3	1	0	1	4
08:30 08:45	2	3	5	2	0	2	7
08:45 09:00	0	2	2	2	0	2	4
<b>08:00 09:00</b>	<b>2</b>	<b>8</b>	<b>10</b>	<b>5</b>	<b>0</b>	<b>5</b>	<b>15</b>
09:00 09:15	2	3	5	1	0	1	6
09:15 09:30	1	4	5	1	0	1	6
09:30 09:45	1	0	1	0	1	1	2
09:45 10:00	0	2	2	3	1	4	6
<b>09:00 10:00</b>	<b>4</b>	<b>9</b>	<b>13</b>	<b>5</b>	<b>2</b>	<b>7</b>	<b>20</b>
11:30 11:45	1	2	3	1	1	2	5
11:45 12:00	1	2	3	3	2	5	8
12:00 12:15	0	1	1	5	1	6	7
12:15 12:30	2	3	5	3	0	3	8
<b>11:30 12:30</b>	<b>4</b>	<b>8</b>	<b>12</b>	<b>12</b>	<b>4</b>	<b>16</b>	<b>28</b>
12:30 12:45	3	1	4	3	1	4	8
12:45 13:00	1	0	1	2	1	3	4
13:00 13:15	2	1	3	4	0	4	7
13:15 13:30	1	2	3	1	3	4	7
<b>12:30 13:30</b>	<b>7</b>	<b>4</b>	<b>11</b>	<b>10</b>	<b>5</b>	<b>15</b>	<b>26</b>
15:00 15:15	1	3	4	5	0	5	9
15:15 15:30	1	1	2	2	1	3	5
15:30 15:45	0	0	0	1	0	1	1
15:45 16:00	1	4	5	5	0	5	10
<b>15:00 16:00</b>	<b>3</b>	<b>8</b>	<b>11</b>	<b>13</b>	<b>1</b>	<b>14</b>	<b>25</b>
16:00 16:15	0	2	2	1	1	2	4
16:15 16:30	0	5	5	1	2	3	8
16:30 16:45	0	1	1	2	1	3	4
16:45 17:00	1	4	5	2	3	5	10
<b>16:00 17:00</b>	<b>1</b>	<b>12</b>	<b>13</b>	<b>6</b>	<b>7</b>	<b>13</b>	<b>26</b>
17:00 17:15	0	1	1	3	0	3	4
17:15 17:30	0	0	0	3	0	3	3
17:30 17:45	1	2	3	6	2	8	11
17:45 18:00	3	2	5	4	2	6	11
<b>17:00 18:00</b>	<b>4</b>	<b>5</b>	<b>9</b>	<b>16</b>	<b>4</b>	<b>20</b>	<b>29</b>
<b>Total</b>	<b>26</b>	<b>61</b>	<b>87</b>	<b>76</b>	<b>24</b>	<b>100</b>	<b>187</b>

Comment:



# Transportation Services - Traffic Services

Work Order  
37499

## Turning Movement Count - 15 Min U-Turn Total Report

### JOCKVALE RD @ STRANDHERD DR

Survey Date: Thursday, January 18, 2018

Time Period	Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00 07:15	0	0	0	0	0
07:15 07:30	0	0	0	0	0
07:30 07:45	0	0	0	0	0
07:45 08:00	0	0	0	0	0
08:00 08:15	0	0	0	0	0
08:15 08:30	0	0	0	0	0
08:30 08:45	0	0	0	0	0
08:45 09:00	0	0	0	0	0
09:00 09:15	0	0	0	1	1
09:15 09:30	0	0	0	0	0
09:30 09:45	0	0	0	0	0
09:45 10:00	0	0	0	0	0
11:30 11:45	0	0	0	0	0
11:45 12:00	0	0	0	1	1
12:00 12:15	0	0	0	1	1
12:15 12:30	0	0	1	0	1
12:30 12:45	0	0	0	0	0
12:45 13:00	0	0	0	0	0
13:00 13:15	0	0	0	0	0
13:15 13:30	0	0	0	0	0
15:00 15:15	0	0	0	0	0
15:15 15:30	0	0	0	0	0
15:30 15:45	1	0	0	0	1
15:45 16:00	0	0	0	0	0
16:00 16:15	0	0	1	0	1
16:15 16:30	0	0	0	0	0
16:30 16:45	0	0	0	1	1
16:45 17:00	0	0	0	0	0
17:00 17:15	0	0	0	1	1
17:15 17:30	0	0	0	0	0
17:30 17:45	0	0	0	0	0
17:45 18:00	0	0	0	0	0
Total	1	0	2	5	8

# Appendix C

Synchro Intersection Worksheets – Existing Conditions

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2018 Existing  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	2	0	4	9	3	169	4	490	6	126	239	6
Future Volume (vph)	2	0	4	9	3	169	4	490	6	126	239	6
Satd. Flow (prot)	0	1563	0	0	1681	1483	0	1742	0	1658	1737	0
Fit Permitted		0.884			0.772			0.998		0.420		
Satd. Flow (perm)	0	1403	0	0	1347	1463	0	1738	0	733	1737	0
Satd. Flow (RTOR)		102			188			1		3		
Lane Group Flow (vph)	0	6	0	0	13	188	0	555	0	140	273	0
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	16.7%	60.8%	60.8%		16.7%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		12.0			12.0	13.0		89.9		104.3	108.6	
Actuated g/C Ratio		0.10			0.10	0.11		0.75		0.87	0.90	
v/c Ratio		0.03			0.10	0.57		0.43		0.20	0.17	
Control Delay		0.2			48.5	12.0		9.3		3.5	1.9	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		0.2			48.5	12.0		9.3		3.5	1.9	
LOS		A			D	B		A		A	A	
Approach Delay		0.2			14.3			9.3		2.5		
Approach LOS		A			B			A		A		
Queue Length 50th (m)		0.0			3.1	0.0		25.9		2.2	0.0	
Queue Length 95th (m)		0.0			8.8	17.0		115.1		6.6	11.1	
Internal Link Dist (m)		194.4			396.8			294.1		283.1		
Turn Bay Length (m)												
Base Capacity (vph)		325			231	388		1302		736	1572	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.06	0.48		0.43		0.19	0.17	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	100 (83%), Referenced to phase 2:NBL and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.57	Intersection Signal Delay: 7.7	Intersection LOS: A
Intersection Capacity Utilization 76.1%	ICU Level of Service D	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2018 Existing  
05-27-2020

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↘		↖	↘		↖	↘		↖	↘	
Traffic Volume (vph)	12	17	16	34	23	96	98	422	74	43	321	6
Future Volume (vph)	12	17	16	34	23	96	98	422	74	43	321	6
Satd. Flow (prot)	1658	1607	0	1658	1518	0	1658	3236	0	3216	3304	0
Fit Permitted	0.645			0.678			0.950			0.950		
Satd. Flow (perm)	1124	1607	0	1182	1518	0	1655	3236	0	3209	3304	0
Satd. Flow (RTOR)		18			107			21			2	
Lane Group Flow (vph)	13	37	0	38	133	0	109	551	0	48	364	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (%)	10.0%	29.2%		10.0%	29.2%		12.5%	48.3%		12.5%	48.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	17.1	13.7		18.4	16.1		12.9	75.3		7.2	67.2	
Actuated g/C Ratio	0.14	0.11		0.15	0.13		0.11	0.63		0.06	0.56	
v/c Ratio	0.07	0.19		0.19	0.45		0.61	0.27		0.25	0.20	
Control Delay	35.1	29.2		38.7	17.2		65.0	13.0		61.4	15.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	35.1	29.2		38.7	17.2		65.0	13.0		61.4	15.0	
LOS	D	C		D	B		E	B		E	B	
Approach Delay		30.7			22.0			21.5			20.4	
Approach LOS		C			C			C			C	
Queue Length 50th (m)	2.7	4.5		8.0	5.4		26.8	27.8		6.2	18.2	
Queue Length 95th (m)	6.9	13.0		14.7	21.9		#63.1	51.1		13.1	30.5	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	185	395		203	442		178	2037		235	1851	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.07	0.09		0.19	0.30		0.61	0.27		0.20	0.20	

Intersection Summary

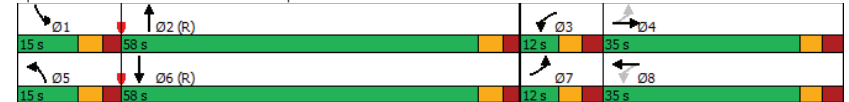
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 89 (74%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.61	Intersection Signal Delay: 21.6	Intersection LOS: C
Intersection Capacity Utilization 51.5%	ICU Level of Service A	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: 2: Greenbank & Marketplace





Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2018 Existing  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	114	495	130	72	604	163	151	271	75	175	167	101
Future Volume (vph)	114	495	130	72	604	163	151	271	75	175	167	101
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3189	0	3216	3316	1483
Fit Permitted	0.236			0.378			0.950			0.950		
Satd. Flow (perm)	409	3316	1446	656	3316	1432	3206	3189	0	3158	3316	1462
Satd. Flow (RTOR)			149			181		28				149
Lane Group Flow (vph)	127	550	144	80	671	181	168	384	0	194	186	112
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (%)	15.8%	34.2%	34.2%	15.8%	34.2%	34.2%	20.0%	30.0%		20.0%	30.0%	30.0%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	49.5	40.6	40.6	45.1	36.4	36.4	11.6	34.7		12.5	35.6	35.6
Actuated g/C Ratio	0.41	0.34	0.34	0.38	0.30	0.30	0.10	0.29		0.10	0.30	0.30
v/c Ratio	0.46	0.49	0.25	0.25	0.67	0.32	0.54	0.41		0.58	0.19	0.21
Control Delay	25.8	34.6	5.7	21.9	40.8	6.3	70.4	29.9		57.9	32.7	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	25.8	34.6	5.7	21.9	40.8	6.3	70.4	29.9		57.9	32.7	3.1
LOS	C	C	A	C	D	A	E	C		E	C	A
Approach Delay		28.2			32.5			42.3			35.9	
Approach LOS		C			C			D			D	
Queue Length 50th (m)	18.5	58.5	0.0	11.3	76.8	0.0	21.9	33.5		24.0	18.0	0.0
Queue Length 95th (m)	31.7	79.5	14.5	21.4	100.4	17.2	35.0	34.5		35.3	29.0	6.9
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	300	1121	587	369	1004	559	474	941		474	984	538
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.42	0.49	0.25	0.22	0.67	0.32	0.35	0.41		0.41	0.19	0.21

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 120

Control Type: Actuated-Coordinated

3288 Greenbank Road AM Peak Hour

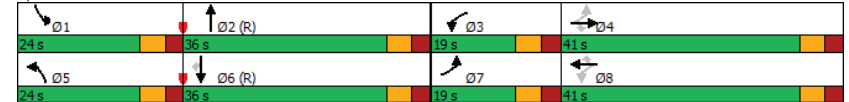
Synchro 10 Light Report  
Page 5

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.67	Intersection LOS: C
Intersection Signal Delay: 33.8	ICU Level of Service D
Intersection Capacity Utilization 80.2%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	

Splits and Phases: 3: Greenbank & Strandherd



3288 Greenbank Road AM Peak Hour

Synchro 10 Light Report  
Page 6

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2018 Existing  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	0	2	4	1	0	154	2	279	14	214	541	0
Future Volume (vph)	0	2	4	1	0	154	2	279	14	214	541	0
Satd. Flow (prot)	0	1588	0	0	1658	1483	0	1730	0	1658	1745	0
Fit Permitted								0.998		0.542		
Satd. Flow (perm)	0	1588	0	0	1745	1483	0	1727	0	941	1745	0
Satd. Flow (RTOR)		4				171		3				
Lane Group Flow (vph)	0	6	0	0	1	171	0	328	0	238	601	0
Turn Type		NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	25.0%	52.5%	52.5%		25.0%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		10.0			10.0	11.2		94.6		109.6	115.3	
Actuated g/C Ratio		0.08			0.08	0.09		0.79		0.91	0.96	
v/c Ratio		0.04			0.01	0.58		0.24		0.26	0.36	
Control Delay		37.0			51.0	14.7		4.9		1.6	1.9	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		37.0			51.0	14.7		4.9		1.6	1.9	
LOS		D			D	B		A		A	A	
Approach Delay		37.0			14.9			4.9			1.8	
Approach LOS		D			B			A			A	
Queue Length 50th (m)		0.5			0.2	0.0		13.2		0.0	6.5	
Queue Length 95th (m)		4.9			2.1	18.1		47.4		11.7	37.8	
Internal Link Dist (m)		194.4			396.8			294.1			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		275			299	457		1362		996	1677	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.00	0.37		0.24		0.24	0.36	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	10 (8%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.58	Intersection Signal Delay: 4.4	Intersection LOS: A
Intersection Capacity Utilization 78.1%	ICU Level of Service D	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2018 Existing  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	44	117	86	137	124	169	149	390	70	162	532	36
Future Volume (vph)	44	117	86	137	124	169	149	390	70	162	532	36
Satd. Flow (prot)	1658	1633	0	1658	1575	0	1658	3239	0	3216	3275	0
Fit Permitted	0.275			0.421			0.950			0.950		
Satd. Flow (perm)	478	1633	0	735	1575	0	1645	3239	0	3216	3275	0
Satd. Flow (RTOR)		29			54			20			7	
Lane Group Flow (vph)	49	226	0	152	326	0	166	511	0	180	631	0
Turn Type	pm-pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (%)	10.8%	29.2%		10.8%	29.2%		16.7%	43.3%		16.7%	43.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	30.4	23.9		31.9	26.5		14.4	52.4		11.7	49.7	
Actuated g/C Ratio	0.25	0.20		0.27	0.22		0.12	0.44		0.10	0.41	
v/c Ratio	0.27	0.65		0.62	0.84		0.84	0.36		0.58	0.46	
Control Delay	31.1	46.4		44.3	56.2		86.0	22.2		62.4	22.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	31.1	46.4		44.3	56.2		86.0	22.2		62.4	22.3	
LOS	C	D		D	E		F	C		E	C	
Approach Delay		43.7			52.4			37.8			31.2	
Approach LOS		D			D			D			C	
Queue Length 50th (m)	8.3	43.7		27.4	65.3		37.7	44.3		23.5	39.3	
Queue Length 95th (m)	17.3	69.8		44.5	#109.1		#84.3	48.4		m33.2	m49.9	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	187	409		246	415		201	1425		367	1359	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.26	0.55		0.62	0.79		0.83	0.36		0.49	0.46	

Intersection Summary

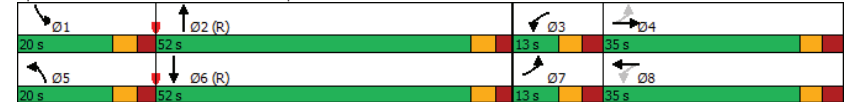
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 117 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.84  
 Intersection Signal Delay: 39.3  
 Intersection Capacity Utilization 74.0%  
 Analysis Period (min) 15  
 Description: As per timing plans provided 26-Nov-2018  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2018 Existing  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	145	814	192	184	654	184	215	278	67	251	355	124
Future Volume (vph)	145	814	192	184	654	184	215	278	67	251	355	124
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3211	0	3216	3316	1483
Fit Permitted	0.205			0.114			0.950			0.950		
Satd. Flow (perm)	358	3316	1464	199	3316	1483	3212	3211	0	3208	3316	1464
Satd. Flow (RTOR)			213			204		23				149
Lane Group Flow (vph)	161	904	213	204	727	204	239	383	0	279	394	138
Turn Type	pm-pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (%)	15.0%	34.2%	34.2%	15.0%	34.2%	34.2%	20.0%	30.8%		20.0%	30.8%	30.8%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	45.1	34.5	34.5	46.5	35.2	35.2	14.1	33.0		15.2	34.1	34.1
Actuated g/C Ratio	0.38	0.29	0.29	0.39	0.29	0.29	0.12	0.28		0.13	0.28	0.28
v/c Ratio	0.64	0.95	0.37	0.95	0.75	0.35	0.63	0.43		0.69	0.42	0.26
Control Delay	34.1	61.3	6.3	80.3	44.3	6.2	71.2	24.9		58.9	37.2	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	34.1	61.3	6.3	80.3	44.3	6.2	71.2	24.9		58.9	37.2	5.9
LOS	C	E	A	F	D	A	E	C		E	D	A
Approach Delay		48.7			43.9			42.7			39.3	
Approach LOS		D			D			D			D	
Queue Length 50th (m)	24.4	115.6	0.0	35.7	86.5	0.0	32.6	21.8		34.4	41.8	0.0
Queue Length 95th (m)	40.0	#157.7	18.4	#84.9	110.2	18.2	m45.1	m28.5		48.4	59.6	13.9
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	260	953	572	215	971	578	474	899		474	942	522
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.62	0.95	0.37	0.95	0.75	0.35	0.50	0.43		0.59	0.42	0.26

Intersection Summary

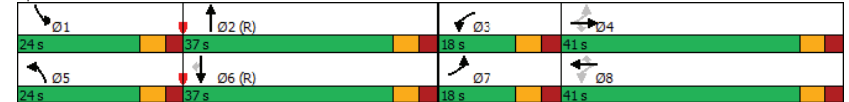
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 7 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2018 Existing  
05-27-2020

Maximum v/c Ratio: 0.95	Intersection Signal Delay: 44.3	Intersection LOS: D
Intersection Capacity Utilization 87.8%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		
m Volume for 95th percentile queue is metered by upstream signal.		

Splits and Phases: 3: Greenbank & Strandherd



# Appendix D

Collision Data

Accident Date	Accident Year	Accident Time	Location	Environment Condition	Light	Traffic Control	Traffic Control Condition	Classification Of Accident	Initial Impact Type	Road Surface Condition
2014-01-11	2014	18:30	GREENBANK RD @ JOCKVALE RD	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	07 - SMV other	02 - Wet
2014-02-01	2014	15:10	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	06 - Ice
2014-02-11	2014	8:25	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	02 - Wet
2014-04-03	2014	13:14	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-07-08	2014	13:54	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-07-12	2014	14:19	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2015-01-16	2015	10:00	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	05 - Packed snow
2015-02-21	2015	15:00	GREENBANK RD @ JOCKVALE RD	03 - Snow	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	03 - Loose snow
2015-03-17	2015	23:57	GREENBANK RD @ JOCKVALE RD	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	02 - Angle	01 - Dry
2015-04-16	2015	20:44	GREENBANK RD @ JOCKVALE RD	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2015-06-11	2015	18:52	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2015-07-10	2015	13:20	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2015-07-26	2015	13:00	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2015-08-01	2015	13:34	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2015-12-21	2015	9:31	GREENBANK RD @ JOCKVALE RD	02 - Rain	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	02 - Wet
2016-03-05	2016	9:00	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2016-05-28	2016	13:29	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2016-08-11	2016	12:54	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	05 - Turning movement	01 - Dry
2016-11-18	2016	17:42	GREENBANK RD @ JOCKVALE RD	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2017-01-21	2017	11:44	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	06 - Ice
2017-02-15	2017	18:31	GREENBANK RD @ JOCKVALE RD	03 - Snow	07 - Dark	01 - Traffic signal		03 - P.D. only	03 - Rear end	05 - Packed snow
2017-05-04	2017	10:10	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2017-06-06	2017	19:50	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2017-06-16	2017	20:54	GREENBANK RD @ JOCKVALE RD	01 - Clear	05 - Dusk	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2017-09-19	2017	17:05	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2017-11-03	2017	16:35	GREENBANK RD @ JOCKVALE RD	02 - Rain	05 - Dusk	01 - Traffic signal		03 - P.D. only	03 - Rear end	02 - Wet
2017-12-07	2017	17:04	GREENBANK RD @ JOCKVALE RD	01 - Clear	07 - Dark	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2018-06-15	2018	11:08	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2018-07-24	2018	19:39	GREENBANK RD @ JOCKVALE RD	02 - Rain	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	02 - Wet
2018-08-10	2018	12:02	GREENBANK RD @ JOCKVALE RD	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-02-21	2014	6:14	GREENBANK RD @ MARKETPLACE AVE	02 - Rain	03 - Dawn	01 - Traffic signal		03 - P.D. only	05 - Turning movement	02 - Wet
2014-03-04	2014	14:07	GREENBANK RD @ MARKETPLACE AVE	03 - Snow	01 - Daylight	01 - Traffic signal		03 - P.D. only	02 - Angle	02 - Wet
2014-03-28	2014	9:00	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	02 - Wet
2015-01-07	2015	15:51	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	05 - Turning movement	01 - Dry
2015-03-02	2015	15:28	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2015-05-18	2015	13:39	GREENBANK RD @ MARKETPLACE AVE	02 - Rain	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	02 - Angle	02 - Wet
2015-10-10	2015	9:38	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	02 - Angle	01 - Dry
2015-10-17	2015	16:15	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	05 - Turning movement	01 - Dry
2015-12-28	2015	19:13	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2016-03-18	2016	18:43	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	05 - Turning movement	01 - Dry
2016-05-05	2016	18:31	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	07 - SMV other	01 - Dry
2016-06-28	2016	23:01	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2016-08-23	2016	12:36	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2016-12-23	2016	14:09	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	02 - Angle	02 - Wet
2017-01-06	2017	11:39	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2017-08-01	2017	9:00	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2017-12-12	2017	15:09	GREENBANK RD @ MARKETPLACE AVE	03 - Snow	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	03 - Loose snow
2018-01-16	2018	9:20	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	03 - Loose snow
2018-01-17	2018	16:47	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	05 - Dusk	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2018-02-24	2018	19:46	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2018-09-30	2018	14:14	GREENBANK RD @ MARKETPLACE AVE	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	99 - Other	01 - Dry
2014-01-11	2014	8:22	GREENBANK RD @ STRANDHERD DR	04 - Freezing Rain	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	06 - Ice
2014-01-23	2014	17:49	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	06 - Ice
2014-01-24	2014	18:15	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-01-31	2014	18:41	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-02-09	2014	10:01	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-02-11	2014	12:35	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	02 - Wet
2014-02-18	2014	7:29	GREENBANK RD @ STRANDHERD DR	03 - Snow	01 - Daylight	01 - Traffic signal		03 - P.D. only	05 - Turning movement	03 - Loose snow
2014-03-12	2014	19:20	GREENBANK RD @ STRANDHERD DR	05 - Drifting Snow	07 - Dark	01 - Traffic signal		02 - Non-fatal injury	05 - Turning movement	03 - Loose snow
2014-04-27	2014	15:15	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-05-03	2014	9:53	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	04 - Sideswipe	01 - Dry
2014-05-09	2014	21:00	GREENBANK RD @ STRANDHERD DR	02 - Rain	07 - Dark	01 - Traffic signal		02 - Non-fatal injury	05 - Turning movement	02 - Wet
2014-06-11	2014	17:27	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal		03 - P.D. only	05 - Turning movement	02 - Wet
2014-06-23	2014	13:50	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	03 - Rear end	01 - Dry
2014-07-14	2014	7:45	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-07-18	2014	13:58	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-07-23	2014	10:47	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	02 - Angle	01 - Dry
2014-07-28	2014	14:30	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry
2014-09-05	2014	11:43	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		02 - Non-fatal injury	07 - SMV other	01 - Dry
2014-09-13	2014	13:55	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	02 - Wet
2014-09-20	2014	16:40	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal		03 - P.D. only	03 - Rear end	01 - Dry



2017-10-28	2017	11:20	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-11-03	2017	15:29	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-11-09	2017	21:44	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	05 - Turning movement	02 - Wet
2017-11-18	2017	15:56	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-11-18	2017	18:44	GREENBANK RD @ STRANDHERD DR	02 - Rain	07 - Dark	01 - Traffic signal	02 - Non-fatal injury	03 - Rear end	02 - Wet
2017-11-30	2017	7:20	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-12-08	2017	17:58	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-12-09	2017	16:15	GREENBANK RD @ STRANDHERD DR	01 - Clear	05 - Dusk	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2017-12-22	2017	12:35	GREENBANK RD @ STRANDHERD DR	03 - Snow	01 - Daylight	01 - Traffic signal	03 - P.D. only	04 - Sideswipe	03 - Loose snow
2018-01-14	2018	13:03	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	04 - Slush
2018-03-02	2018	6:27	GREENBANK RD @ STRANDHERD DR	01 - Clear	03 - Dawn	01 - Traffic signal	02 - Non-fatal injury	03 - Rear end	01 - Dry
2018-03-09	2018	14:33	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	02 - Non-fatal injury	05 - Turning movement	01 - Dry
2018-04-27	2018	14:03	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2018-05-13	2018	14:40	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2018-05-27	2018	11:15	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2018-06-04	2018	13:46	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-06-06	2018	8:49	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-06-28	2018	15:18	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-06-28	2018	21:35	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-07-10	2018	23:26	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	02 - Non-fatal injury	07 - SMV other	01 - Dry
2018-07-11	2018	20:33	GREENBANK RD @ STRANDHERD DR	01 - Clear	05 - Dusk	01 - Traffic signal	02 - Non-fatal injury	05 - Turning movement	01 - Dry
2018-07-19	2018	6:55	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	04 - Sideswipe	01 - Dry
2018-07-24	2018	19:30	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-09-17	2018	11:22	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-09-24	2018	9:09	GREENBANK RD @ STRANDHERD DR	02 - Rain	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-09-28	2018	19:39	GREENBANK RD @ STRANDHERD DR	02 - Rain	07 - Dark	01 - Traffic signal	02 - Non-fatal injury	03 - Rear end	02 - Wet
2018-10-16	2018	18:55	GREENBANK RD @ STRANDHERD DR	01 - Clear	05 - Dusk	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2018-10-25	2018	9:51	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	01 - Dry
2018-11-11	2018	14:00	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	04 - Sideswipe	01 - Dry
2018-11-11	2018	17:47	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-11-21	2018	9:34	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	05 - Turning movement	02 - Wet
2018-11-22	2018	9:35	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	05 - Turning movement	02 - Wet
2018-11-22	2018	19:44	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-11-25	2018	14:10	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-12-07	2018	11:30	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	05 - Turning movement	01 - Dry
2018-12-11	2018	10:15	GREENBANK RD @ STRANDHERD DR	03 - Snow	01 - Daylight	01 - Traffic signal	03 - P.D. only	02 - Angle	05 - Packed snow
2018-12-13	2018	17:40	GREENBANK RD @ STRANDHERD DR	02 - Rain	07 - Dark	10 - No control	03 - P.D. only	03 - Rear end	06 - Ice
2018-12-17	2018	17:00	GREENBANK RD @ STRANDHERD DR	01 - Clear	07 - Dark	01 - Traffic signal	03 - P.D. only	03 - Rear end	02 - Wet
2018-12-22	2018	15:57	GREENBANK RD @ STRANDHERD DR	01 - Clear	01 - Daylight	01 - Traffic signal	03 - P.D. only	03 - Rear end	06 - Ice
2014-02-12	2014	10:37	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	01 - Dry
2014-08-26	2014	16:15	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	07 - SMV other	01 - Dry
2014-09-26	2014	14:20	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	07 - SMV other	01 - Dry
2014-12-12	2014	8:10	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	03 - Loose snow
2015-01-17	2015	8:55	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	01 - Approaching	02 - Wet
2015-01-20	2015	15:12	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	02 - Non-fatal injury	03 - Rear end	01 - Dry
2015-01-30	2015	7:25	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	03 - Dawn	10 - No control	02 - Non-fatal injury	07 - SMV other	05 - Packed snow
2015-04-09	2015	0:50	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	02 - Rain	07 - Dark	10 - No control	02 - Non-fatal injury	07 - SMV other	02 - Wet
2015-05-07	2015	7:51	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	02 - Non-fatal injury	03 - Rear end	01 - Dry
2015-05-07	2015	21:33	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	01 - Dry
2015-09-15	2015	18:27	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	01 - Dry
2015-12-10	2015	1:00	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	02 - Rain	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	02 - Wet
2016-01-29	2016	10:18	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	02 - Non-fatal injury	01 - Approaching	03 - Loose snow
2016-02-19	2016	18:23	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	02 - Rain	07 - Dark	10 - No control	03 - P.D. only	01 - Approaching	03 - Loose snow
2016-04-06	2016	20:26	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	05 - Packed snow
2016-04-28	2016	21:36	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	03 - Rear end	01 - Dry
2016-04-30	2016	11:26	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	02 - Non-fatal injury	6 - SMV unattended vehicl	01 - Dry
2016-06-22	2016	22:43	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	02 - Rain	07 - Dark	10 - No control	03 - P.D. only	01 - Approaching	02 - Wet
2017-01-15	2017	1:14	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	02 - Wet
2017-03-22	2017	11:12	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	01 - Dry
2017-04-23	2017	0:43	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	01 - Dry
2017-06-17	2017	2:58	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	02 - Wet
2017-11-11	2017	12:15	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	02 - Angle	01 - Dry
2017-11-27	2017	8:02	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	05 - Drifting Snow	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	06 - Ice
2017-11-27	2017	8:01	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	02 - Wet
2018-01-01	2018	12:47	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	01 - Daylight	10 - No control	03 - P.D. only	07 - SMV other	06 - Ice
2018-03-08	2018	7:00	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	01 - Daylight	10 - No control	03 - P.D. only	07 - SMV other	03 - Loose snow
2018-03-08	2018	19:25	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	06 - Ice
2018-11-04	2018	14:40	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	07 - SMV other	01 - Dry
2018-11-17	2018	20:12	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	07 - Dark	10 - No control	03 - P.D. only	07 - SMV other	03 - Loose snow
2018-12-12	2018	11:06	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	01 - Approaching	06 - Ice
2018-12-12	2018	18:31	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	03 - Rear end	01 - Dry
2018-12-13	2018	20:05	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	01 - Clear	07 - Dark	10 - No control	03 - P.D. only	01 - Approaching	01 - Dry



2018-12-24	2018	6:16	GREENBANK RD btwn JOCKVALE RD & CAMBRIAN RD	03 - Snow	07 - Dark	10 - No control	03 - P.D. only	03 - Rear end	03 - Loose snow
2014-01-03	2014	8:58	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	01 - Approaching	06 - Ice
2014-01-07	2014	15:45	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	06 - Strong wind	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	06 - Ice
2015-07-29	2015	11:01	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	05 - Turning movement	01 - Dry
2015-08-15	2015	12:00	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	04 - Sideswipe	01 - Dry
2015-08-15	2015	11:40	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	02 - Angle	01 - Dry
2015-10-25	2015	17:44	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	04 - Sideswipe	01 - Dry
2016-06-14	2016	20:53	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	05 - Dusk	10 - No control	03 - P.D. only	04 - Sideswipe	01 - Dry
2018-09-16	2018	16:18	GREENBANK RD btwn MARKETPLACE AVE & JOCKVALE RD	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	01 - Approaching	01 - Dry
2016-03-24	2016	15:44	GREENBANK RD btwn STRANDHERD DR & MARKETPLACE AVE	04 - Freezing Rain	01 - Daylight	10 - No control	03 - P.D. only	03 - Rear end	06 - Ice
2017-01-19	2017	17:50	GREENBANK RD btwn STRANDHERD DR & MARKETPLACE AVE	01 - Clear	07 - Dark	10 - No control	02 - Non-fatal injury	04 - Sideswipe	02 - Wet
2017-05-13	2017	19:15	GREENBANK RD btwn STRANDHERD DR & MARKETPLACE AVE	01 - Clear	01 - Daylight	10 - No control	03 - P.D. only	04 - Sideswipe	01 - Dry

# Appendix E

Synchro Intersection Worksheets – 2022 Future Background Conditions

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	2	0	4	9	3	169	4	608	6	126	284	6
Future Volume (vph)	2	0	4	9	3	169	4	608	6	126	284	6
Satd. Flow (prot)	0	1563	0	0	1682	1483	0	1743	0	1658	1739	0
Fit Permitted		0.884			0.776			0.998		0.393		
Satd. Flow (perm)	0	1403	0	0	1354	1463	0	1740	0	686	1739	0
Satd. Flow (RTOR)		102			169			1		2		
Lane Group Flow (vph)	0	6	0	0	12	169	0	618	0	126	290	0
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	16.7%	60.8%	60.8%		16.7%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		12.0			12.0	12.9		90.1		104.3	108.6	
Actuated g/C Ratio		0.10			0.10	0.11		0.75		0.87	0.90	
v/c Ratio		0.03			0.09	0.55		0.47		0.19	0.18	
Control Delay		0.2			48.2	12.0		9.8		2.9	1.6	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		0.2			48.2	12.0		9.8		2.9	1.6	
LOS		A			D	B		A		A	A	
Approach Delay		0.2			14.4			9.8		2.0		
Approach LOS		A			B			A		A		
Queue Length 50th (m)		0.0			2.8	0.0		30.2		1.5	0.0	
Queue Length 95th (m)		0.0			8.4	16.1		133.6		4.9	9.5	
Internal Link Dist (m)		194.4			396.8			286.3		283.1		
Turn Bay Length (m)												
Base Capacity (vph)		325			232	372		1306		700	1574	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.05	0.45		0.47		0.18	0.18	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	100 (83%), Referenced to phase 2:NBL and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 0.55	Intersection Signal Delay: 7.8	Intersection LOS: A
Intersection Capacity Utilization 82.7%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Background  
05-27-2020

	↖	→	↘	↙	←	↖	↙	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖		↖	↖		↖	↖		↖	↖	↖
Traffic Volume (vph)	12	17	16	36	23	106	98	573	74	65	421	6
Future Volume (vph)	12	17	16	36	23	106	98	573	74	65	421	6
Satd. Flow (prot)	1658	1607	0	1658	1514	0	1658	3254	0	3216	3308	0
Fit Permitted	0.659			0.680			0.950			0.950		
Satd. Flow (perm)	1149	1607	0	1185	1514	0	1656	3254	0	3210	3308	0
Satd. Flow (RTOR)		16			106			15			1	
Lane Group Flow (vph)	12	33	0	36	129	0	98	647	0	65	427	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (%)	10.0%	29.2%		10.0%	29.2%		12.5%	48.3%		12.5%	48.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	17.1	13.6		18.4	16.0		11.7	74.9		7.7	68.5	
Actuated g/C Ratio	0.14	0.11		0.15	0.13		0.10	0.62		0.06	0.57	
v/c Ratio	0.06	0.17		0.18	0.44		0.61	0.32		0.32	0.23	
Control Delay	34.8	29.2		38.6	16.8		65.9	14.1		61.5	15.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	34.8	29.2		38.6	16.8		65.9	14.1		61.5	15.2	
LOS	C	C		D	B		E	B		E	B	
Approach Delay		30.7			21.5			20.9			21.3	
Approach LOS		C			C			C			C	
Queue Length 50th (m)	2.5	4.0		7.5	4.8		24.1	33.4		8.5	22.1	
Queue Length 95th (m)	6.6	12.1		14.0	21.0		#54.8	62.8		16.7	35.3	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	187	393		203	440		161	2036		236	1888	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.08		0.18	0.29		0.61	0.32		0.28	0.23	

Intersection Summary

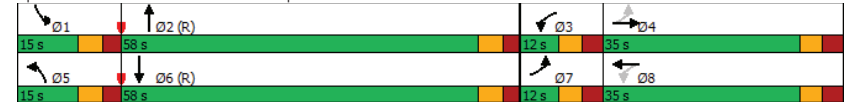
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 89 (74%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 0.61	Intersection Signal Delay: 21.4	Intersection LOS: C
Intersection Capacity Utilization 53.3%	ICU Level of Service A	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	171	683	141	108	767	163	172	348	123	175	221	129
Future Volume (vph)	171	683	141	108	767	163	172	348	123	175	221	129
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3161	0	3216	3316	1483
Fit Permitted	0.170			0.252			0.950			0.950		
Satd. Flow (perm)	295	3316	1446	438	3316	1432	3206	3161	0	3164	3316	1462
Satd. Flow (RTOR)			149			163		39				149
Lane Group Flow (vph)	171	683	141	108	767	163	172	471	0	175	221	129
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (%)	15.8%	34.2%	34.2%	15.8%	34.2%	34.2%	20.0%	30.0%		20.0%	30.0%	30.0%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	48.4	37.0	37.0	45.2	35.4	35.4	11.7	35.4		11.8	35.5	35.5
Actuated g/C Ratio	0.40	0.31	0.31	0.38	0.30	0.30	0.10	0.30		0.10	0.30	0.30
v/c Ratio	0.69	0.67	0.26	0.41	0.78	0.30	0.55	0.49		0.55	0.23	0.24
Control Delay	36.4	40.4	5.7	25.0	45.8	6.5	72.0	29.4		57.9	33.3	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	36.4	40.4	5.7	25.0	45.8	6.5	72.0	29.4		57.9	33.3	4.8
LOS	D	D	A	C	D	A	E	C		E	C	A
Approach Delay		34.8			37.4			40.8			34.5	
Approach LOS		C			D			D			C	
Queue Length 50th (m)	25.7	77.6	0.0	15.6	92.7	0.0	23.0	40.1		21.7	21.7	0.0
Queue Length 95th (m)	#44.0	102.2	13.8	27.6	117.4	16.4	35.4	37.6		32.7	33.9	11.2
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	261	1021	548	299	978	537	474	959		474	980	537
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.66	0.67	0.26	0.36	0.78	0.30	0.36	0.49		0.37	0.23	0.24

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 120

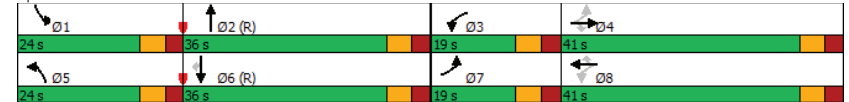
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 0.78	Intersection LOS: D
Intersection Signal Delay: 36.8	ICU Level of Service E
Intersection Capacity Utilization 83.5%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Greenbank & Strandherd



Intersection						
Int Delay, s/veh	1.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↙ ↘ ↗					
Traffic Vol, veh/h	51	5	1	696	438	10
Future Vol, veh/h	51	5	1	696	438	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	51	5	1	696	438	10
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1141	443	448	0	-	0
Stage 1	443	-	-	-	-	-
Stage 2	698	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	222	615	1112	-	-	-
Stage 1	647	-	-	-	-	-
Stage 2	494	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	222	615	1112	-	-	-
Mov Cap-2 Maneuver	222	-	-	-	-	-
Stage 1	646	-	-	-	-	-
Stage 2	494	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	25	0	0			
HCM LOS	D					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1112	-	235	-	-	
HCM Lane V/C Ratio	0.001	-	0.238	-	-	
HCM Control Delay (s)	8.2	-	25	-	-	
HCM Lane LOS	A	-	D	-	-	
HCM 95th %tile Q(veh)	0	-	0.9	-	-	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↙ ↘ ↗ ↗ ↘ ↙ ↘ ↗ ↗											
Traffic Volume (vph)	0	2	4	1	0	154	2	341	14	214	664	0
Future Volume (vph)	0	2	4	1	0	154	2	341	14	214	664	0
Satd. Flow (prot)	0	1588	0	0	1658	1483	0	1734	0	1658	1745	0
Fit Permitted	0.998 0.526											
Satd. Flow (perm)	0	1588	0	0	1745	1483	0	1731	0	914	1745	0
Satd. Flow (RTOR)	4 154 2											
Lane Group Flow (vph)	0	6	0	0	1	154	0	357	0	214	664	0
Turn Type	NA Perm NA pm+ov Perm NA pm+pt NA											
Protected Phases	4 8 1 2 2 1 6											
Permitted Phases	4 8 8 2 6											
Detector Phase	4 4 8 8 1 2 2 1 6											
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	25.0%	52.5%	52.5%		25.0%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)	0.0 0.0 0.0 0.0 0.0 0.0											
Total Lost Time (s)	6.4 6.4 7.1 7.1 7.1 7.1											
Lead/Lag	Lead Lag Lag Lead											
Lead-Lag Optimize?	Yes Yes Yes Yes											
Recall Mode	None None None None None C-Max C-Max None C-Max											
Act Effct Green (s)	10.0 10.0 11.0 94.8 109.6 115.3											
Actuated g/C Ratio	0.08 0.08 0.09 0.79 0.91 0.96											
v/c Ratio	0.04 0.01 0.56 0.26 0.24 0.40											
Control Delay	37.0 51.0 14.8 4.9 1.3 2.0											
Queue Delay	0.0 0.0 0.0 0.0 0.0 0.0											
Total Delay	37.0 51.0 14.8 4.9 1.3 2.0											
LOS	D D B A A A											
Approach Delay	37.0 15.1 4.9 1.8											
Approach LOS	D B A A A											
Queue Length 50th (m)	0.5 0.2 0.0 14.6 0.0 8.1											
Queue Length 95th (m)	4.9 2.1 17.4 51.4 8.6 33.2											
Internal Link Dist (m)	194.4 396.8 297.7 283.1											
Turn Bay Length (m)												
Base Capacity (vph)	275 299 443 1368 976 1677											
Starvation Cap Reductn	0 0 0 0 0 0											
Spillback Cap Reductn	0 0 0 0 0 0											
Storage Cap Reductn	0 0 0 0 0 0											
Reduced v/c Ratio	0.02 0.00 0.35 0.26 0.22 0.40											
Intersection Summary												
Cycle Length: 120												
Actuated Cycle Length: 120												
Offset: 10 (8%), Referenced to phase 2:NBT and 6:SBTL, Start of Green												
Natural Cycle: 120												
Control Type: Actuated-Coordinated												

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 0.56	Intersection Signal Delay: 4.2	Intersection LOS: A
Intersection Capacity Utilization 84.9%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	[Diagrammatic arrows for lane configurations]											
Traffic Volume (vph)	44	117	86	141	124	185	149	588	70	195	765	36
Future Volume (vph)	44	117	86	141	124	185	149	588	70	195	765	36
Satd. Flow (prot)	1658	1633	0	1658	1569	0	1658	3263	0	3216	3287	0
Fit Permitted	0.294			0.458			0.950			0.950		
Satd. Flow (perm)	511	1633	0	799	1569	0	1644	3263	0	3216	3287	0
Satd. Flow (RTOR)		29			59			12			5	
Lane Group Flow (vph)	44	203	0	141	309	0	149	658	0	195	801	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (%)	10.8%	29.2%		10.8%	29.2%		16.7%	43.3%		16.7%	43.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	29.4	22.9		30.9	25.5		13.9	53.1		12.0	51.2	
Actuated g/C Ratio	0.24	0.19		0.26	0.21		0.12	0.44		0.10	0.43	
v/c Ratio	0.24	0.61		0.56	0.82		0.78	0.45		0.61	0.57	
Control Delay	30.8	44.6		41.5	53.6		80.5	24.1		60.8	23.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.8	44.6		41.5	53.6		80.5	24.1		60.8	23.4	
LOS	C	D		D	D		F	C		E	C	
Approach Delay		42.2			49.8			34.5			30.7	
Approach LOS		D			D			C			C	
Queue Length 50th (m)	7.6	38.8		25.9	60.3		33.4	60.4		25.5	52.1	
Queue Length 95th (m)	16.0	62.1		41.5	#93.5		#72.0	68.4		m33.3	m59.2	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	189	409		252	417		200	1449		367	1404	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.23	0.50		0.56	0.74		0.74	0.45		0.53	0.57	

Intersection Summary

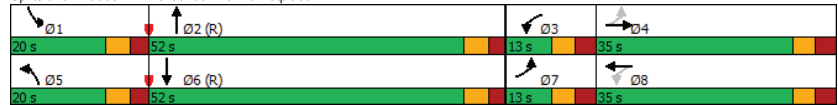
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 117 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 0.82	Intersection LOS: D
Intersection Signal Delay: 36.5	ICU Level of Service D
Intersection Capacity Utilization 77.6%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	190	1030	220	274	882	184	232	381	146	251	480	174
Future Volume (vph)	190	1030	220	274	882	184	232	381	146	251	480	174
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3164	0	3216	3316	1483
Fit Permitted	0.116			0.115			0.950			0.950		
Satd. Flow (perm)	202	3316	1464	201	3316	1483	3212	3164	0	3210	3316	1464
Satd. Flow (RTOR)			220			184		45				174
Lane Group Flow (vph)	190	1030	220	274	882	184	232	527	0	251	480	174
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (%)	15.0%	34.2%	34.2%	15.0%	34.2%	34.2%	20.0%	30.8%		20.0%	30.8%	30.8%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	45.4	34.5	34.5	46.2	34.9	34.9	13.9	33.8		14.4	34.3	34.3
Actuated g/C Ratio	0.38	0.29	0.29	0.38	0.29	0.29	0.12	0.28		0.12	0.29	0.29
v/c Ratio	0.90	1.08	0.38	1.27	0.92	0.33	0.62	0.57		0.65	0.51	0.32
Control Delay	71.1	94.3	6.3	182.0	56.3	6.3	74.7	22.5		58.3	38.6	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	71.1	94.3	6.3	182.0	56.3	6.3	74.7	22.5		58.3	38.6	6.8
LOS	E	F	A	F	E	A	E	C		E	D	A
Approach Delay		77.8			75.1			38.5				38.0
Approach LOS		E			E			D				D
Queue Length 50th (m)	31.3	~150.2	0.0	~71.0	111.6	0.0	31.7	23.9		31.0	52.3	0.0
Queue Length 95th (m)	#75.6	#192.8	18.8	#127.1	#151.5	17.2	m44.9	30.6		44.0	72.8	17.8
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	215	953	577	216	963	561	474	923		474	948	542
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.88	1.08	0.38	1.27	0.92	0.33	0.49	0.57		0.53	0.51	0.32

Intersection Summary

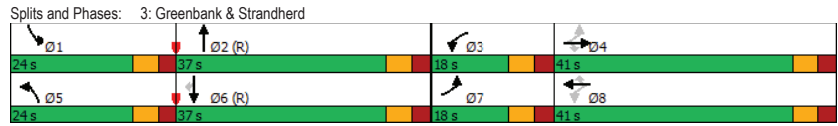
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 7 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 130
Control Type: Actuated-Coordinated



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Background  
05-27-2020

Maximum v/c Ratio: 1.27	Intersection LOS: E
Intersection Signal Delay: 62.2	ICU Level of Service F
Intersection Capacity Utilization 99.4%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	



HCM 2010 TWSC  
6: Greenbank & Street B

2022 Future Background  
05-27-2020

Intersection						
Int Delay, s/veh	0.8					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Vol, veh/h	25	3	5	751	887	49
Future Vol, veh/h	25	3	5	751	887	49
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	3	5	751	887	49

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	1673	912	936
Stage 1	912	-	-
Stage 2	761	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	105	332	732
Stage 1	392	-	-
Stage 2	461	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	104	332	732
Mov Cap-2 Maneuver	104	-	-
Stage 1	389	-	-
Stage 2	461	-	-

Approach	EB	NB	SB
HCM Control Delay, s	47.5	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	732	-	112	-
HCM Lane V/C Ratio	0.007	-	0.25	-
HCM Control Delay (s)	10	-	47.5	-
HCM Lane LOS	A	-	E	-
HCM 95th %tile Q(veh)	0	-	0.9	-

# Appendix F

Synchro Intersection Worksheets – 2027 Future Background Conditions

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	2	0	4	9	3	169	4	744	6	126	355	6
Future Volume (vph)	2	0	4	9	3	169	4	744	6	126	355	6
Satd. Flow (prot)	0	1563	0	0	1682	1483	0	1743	0	1658	1741	0
Fit Permitted		0.884			0.776			0.998		0.340		
Satd. Flow (perm)	0	1403	0	0	1354	1463	0	1740	0	593	1741	0
Satd. Flow (RTOR)		102			169			1		2		
Lane Group Flow (vph)	0	6	0	0	12	169	0	754	0	126	361	0
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	16.7%	60.8%	60.8%		16.7%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag						Lead	Lag	Lag		Lead		
Lead-Lag Optimize?						Yes	Yes	Yes		Yes		
Recall Mode	None	None		None	None	C-Max	C-Max			None	C-Max	
Act Effct Green (s)		12.0			12.0	12.9		90.1		104.3	108.6	
Actuated g/C Ratio		0.10			0.10	0.11		0.75		0.87	0.90	
v/c Ratio		0.03			0.09	0.55		0.58		0.22	0.23	
Control Delay		0.2			48.2	12.0		11.8		3.3	1.7	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		0.2			48.2	12.0		11.8		3.3	1.7	
LOS		A			D	B		B		A	A	
Approach Delay		0.2			14.4			11.8			2.1	
Approach LOS		A			B			B			A	
Queue Length 50th (m)		0.0			2.8	0.0		42.1		1.1	1.0	
Queue Length 95th (m)		0.0			8.4	16.1		186.0		5.3	9.5	
Internal Link Dist (m)		194.4			396.8			286.3			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		325			232	372		1306		630	1576	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.05	0.45		0.58		0.20	0.23	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	100 (83%), Referenced to phase 2:NBL and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 0.58	Intersection Signal Delay: 8.8	Intersection LOS: A
Intersection Capacity Utilization 90.2%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Background  
05-27-2020

	↖	→	↘	↙	←	↖	↙	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↘		↖	↘		↖	↘		↖	↘	
Traffic Volume (vph)	12	17	16	36	23	106	98	688	74	65	519	6
Future Volume (vph)	12	17	16	36	23	106	98	688	74	65	519	6
Satd. Flow (prot)	1658	1607	0	1658	1514	0	1658	3261	0	3216	3308	0
Fit Permitted	0.659			0.680			0.950			0.950		
Satd. Flow (perm)	1149	1607	0	1185	1514	0	1656	3261	0	3211	3308	0
Satd. Flow (RTOR)		16			106			12			1	
Lane Group Flow (vph)	12	33	0	36	129	0	98	762	0	65	525	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (%)	10.0%	29.2%		10.0%	29.2%		12.5%	48.3%		12.5%	48.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	17.1	13.6		18.4	16.0		11.7	74.9		7.7	68.5	
Actuated g/C Ratio	0.14	0.11		0.15	0.13		0.10	0.62		0.06	0.57	
v/c Ratio	0.06	0.17		0.18	0.44		0.61	0.37		0.32	0.28	
Control Delay	34.8	29.2		38.6	16.8		63.8	15.4		62.5	14.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	34.8	29.2		38.6	16.8		63.8	15.4		62.5	14.0	
LOS	C	C		D	B		E	B		E	B	
Approach Delay		30.7			21.5			20.9			19.3	
Approach LOS		C			C			C			B	
Queue Length 50th (m)	2.5	4.0		7.5	4.8		24.1	39.7		8.6	25.4	
Queue Length 95th (m)	6.6	12.1		14.0	21.0		#55.1	81.0		16.4	39.6	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	187	393		203	440		161	2039		236	1888	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.08		0.18	0.29		0.61	0.37		0.28	0.28	

Intersection Summary

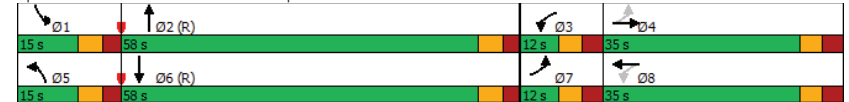
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 89 (74%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 0.61	Intersection Signal Delay: 20.7	Intersection LOS: C
Intersection Capacity Utilization 53.5%	ICU Level of Service A	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	171	841	141	108	960	163	172	428	123	175	272	129
Future Volume (vph)	171	841	141	108	960	163	172	428	123	175	272	129
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3185	0	3216	3316	1483
Fit Permitted	0.108			0.156			0.950			0.950		
Satd. Flow (perm)	188	3316	1446	272	3316	1432	3206	3185	0	3170	3316	1462
Satd. Flow (RTOR)			149			149		29				149
Lane Group Flow (vph)	171	841	141	108	960	163	172	551	0	175	272	129
Turn Type	pm-pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (%)	15.8%	34.2%	34.2%	15.8%	34.2%	34.2%	20.0%	30.0%		20.0%	30.0%	30.0%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	48.4	37.0	37.0	45.2	35.4	35.4	11.7	35.4		11.8	35.5	35.5
Actuated g/C Ratio	0.40	0.31	0.31	0.38	0.30	0.30	0.10	0.30		0.10	0.30	0.30
v/c Ratio	0.79	0.82	0.26	0.50	0.98	0.31	0.55	0.57		0.55	0.28	0.24
Control Delay	52.6	46.8	5.7	28.6	67.2	8.3	72.4	30.8		57.9	34.0	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	52.6	46.8	5.7	28.6	67.2	8.3	72.4	30.8		57.9	34.0	4.8
LOS	D	D	A	C	E	A	E	C		E	C	A
Approach Delay		42.6			56.0			40.7			34.7	
Approach LOS		D			E			D			C	
Queue Length 50th (m)	25.9	101.7	0.0	15.6	-126.8	2.5	23.1	48.4		21.7	27.2	0.0
Queue Length 95th (m)	#62.0	#139.8	13.8	27.6	#173.2	19.2	35.5	39.0		32.7	41.0	11.2
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	229	1021	548	251	978	527	474	959		474	980	537
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.75	0.82	0.26	0.43	0.98	0.31	0.36	0.57		0.37	0.28	0.24

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 120

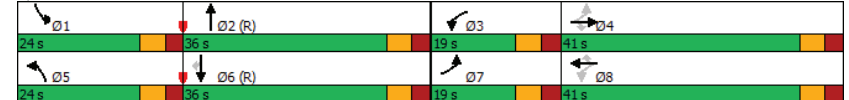
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 0.98	Intersection Signal Delay: 45.5	Intersection LOS: D
Intersection Capacity Utilization 89.0%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
~ Volume exceeds capacity, queue is theoretically infinite.		
Queue shown is maximum after two cycles.		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		

Splits and Phases: 3: Greenbank & Strandherd



Intersection						
Int Delay, s/veh	1.5					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↙ ↘ ↗					
Traffic Vol, veh/h	51	5	1	865	551	10
Future Vol, veh/h	51	5	1	865	551	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	51	5	1	865	551	10
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1423	556	561	0	-	0
Stage 1	556	-	-	-	-	-
Stage 2	867	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	150	531	1010	-	-	-
Stage 1	574	-	-	-	-	-
Stage 2	411	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	150	531	1010	-	-	-
Mov Cap-2 Maneuver	150	-	-	-	-	-
Stage 1	573	-	-	-	-	-
Stage 2	411	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	39.2	0	0			
HCM LOS	E					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1010	-	160	-	-	
HCM Lane V/C Ratio	0.001	-	0.35	-	-	
HCM Control Delay (s)	8.6	-	39.2	-	-	
HCM Lane LOS	A	-	E	-	-	
HCM 95th %tile Q(veh)	0	-	1.5	-	-	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↙ ↘ ↗ ↗ ↘ ↙ ↘ ↗ ↗											
Traffic Volume (vph)	0	2	4	1	0	154	2	417	14	214	814	0
Future Volume (vph)	0	2	4	1	0	154	2	417	14	214	814	0
Satd. Flow (prot)	0	1588	0	0	1658	1483	0	1736	0	1658	1745	0
Fit Permitted	0.998 0.485											
Satd. Flow (perm)	0	1588	0	0	1745	1483	0	1733	0	843	1745	0
Satd. Flow (RTOR)	4 154 2											
Lane Group Flow (vph)	0	6	0	0	1	154	0	433	0	214	814	0
Turn Type	NA Perm NA pm+ov Perm NA pm+pt NA											
Protected Phases	4 8 1 2 2 1 6											
Permitted Phases	4 8 8 2 6											
Detector Phase	4 4 8 8 1 2 2 1 6											
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	25.0%	52.5%	52.5%		25.0%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)	0.0 0.0 0.0 0.0 0.0 0.0											
Total Lost Time (s)	6.4 6.4 7.1 7.1 7.1 7.1											
Lead/Lag	Lead Lag Lag Lead											
Lead-Lag Optimize?	Yes Yes Yes Yes											
Recall Mode	None None None None None C-Max C-Max None C-Max											
Act Effct Green (s)	10.0 10.0 11.0 94.8 109.6 115.3											
Actuated g/C Ratio	0.08 0.08 0.09 0.79 0.91 0.96											
v/c Ratio	0.04 0.01 0.56 0.32 0.26 0.49											
Control Delay	37.0 51.0 14.8 5.3 1.2 4.9											
Queue Delay	0.0 0.0 0.0 0.0 0.0 0.0											
Total Delay	37.0 51.0 14.8 5.3 1.2 4.9											
LOS	D D B A A A											
Approach Delay	37.0 15.1 5.3 4.1											
Approach LOS	D B A A											
Queue Length 50th (m)	0.5 0.2 0.0 18.8 0.0 102.9											
Queue Length 95th (m)	4.9 2.1 17.4 64.9 7.3 120.6											
Internal Link Dist (m)	194.4 396.8 297.7 283.1											
Turn Bay Length (m)												
Base Capacity (vph)	275 299 443 1370 925 1677											
Starvation Cap Reductn	0 0 0 0 0 0											
Spillback Cap Reductn	0 0 0 0 0 0											
Storage Cap Reductn	0 0 0 0 0 0											
Reduced v/c Ratio	0.02 0.00 0.35 0.32 0.23 0.49											
Intersection Summary												
Cycle Length: 120												
Actuated Cycle Length: 120												
Offset: 10 (8%), Referenced to phase 2:NBL and 6:SBTL, Start of Green												
Natural Cycle: 120												
Control Type: Actuated-Coordinated												

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 0.56	Intersection LOS: A
Intersection Signal Delay: 5.6	ICU Level of Service F
Intersection Capacity Utilization 94.9%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	44	117	86	141	124	185	149	699	70	195	912	36
Future Volume (vph)	44	117	86	141	124	185	149	699	70	195	912	36
Satd. Flow (prot)	1658	1633	0	1658	1569	0	1658	3269	0	3216	3291	0
Fit Permitted	0.294			0.458			0.950			0.950		
Satd. Flow (perm)	511	1633	0	799	1569	0	1649	3269	0	3216	3291	0
Satd. Flow (RTOR)		29			59			10			4	
Lane Group Flow (vph)	44	203	0	141	309	0	149	769	0	195	948	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (%)	10.8%	29.2%		10.8%	29.2%		16.7%	43.3%		16.7%	43.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	29.4	22.9		30.9	25.5		13.9	53.1		12.0	51.2	
Actuated g/C Ratio	0.24	0.19		0.26	0.21		0.12	0.44		0.10	0.43	
v/c Ratio	0.24	0.61		0.56	0.82		0.78	0.53		0.61	0.67	
Control Delay	30.8	44.6		41.5	53.6		81.4	25.3		60.7	23.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.8	44.6		41.5	53.6		81.4	25.3		60.7	23.8	
LOS	C	D		D	D		F	C		E	C	
Approach Delay		42.2			49.8			34.4			30.1	
Approach LOS		D			D			C			C	
Queue Length 50th (m)	7.6	38.8		25.9	60.3		33.8	74.2		25.6	59.4	
Queue Length 95th (m)	16.0	62.1		41.5	#93.5		#72.6	85.2		m34.0	m71.4	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	189	409		252	417		200	1451		367	1405	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.23	0.50		0.56	0.74		0.74	0.53		0.53	0.67	

Intersection Summary

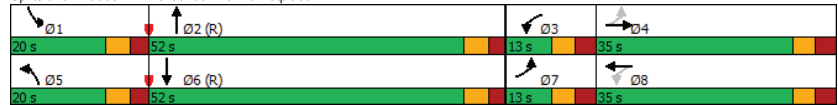
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 117 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 0.82	Intersection LOS: D
Intersection Signal Delay: 35.8	ICU Level of Service D
Intersection Capacity Utilization 81.9%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Background  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	190	1291	220	274	1091	184	232	465	146	251	586	174
Future Volume (vph)	190	1291	220	274	1091	184	232	465	146	251	586	174
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3185	0	3216	3316	1483
Fit Permitted	0.116			0.116			0.950			0.950		
Satd. Flow (perm)	202	3316	1464	202	3316	1483	3213	3185	0	3211	3316	1464
Satd. Flow (RTOR)			184			149		33				
Lane Group Flow (vph)	190	1291	220	274	1091	184	232	611	0	251	586	174
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (%)	15.0%	34.2%	34.2%	15.0%	34.2%	34.2%	20.0%	30.8%		20.0%	30.8%	30.8%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	45.8	34.5	34.5	45.8	34.5	34.5	13.9	33.8		14.4	34.3	34.3
Actuated g/C Ratio	0.38	0.29	0.29	0.38	0.29	0.29	0.12	0.28		0.12	0.29	0.29
v/c Ratio	0.88	1.35	0.40	1.27	1.14	0.35	0.62	0.66		0.65	0.62	0.32
Control Delay	66.9	201.4	9.8	183.4	116.9	10.3	75.9	24.8		58.3	41.1	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	66.9	201.4	9.8	183.4	116.9	10.3	75.9	24.8		58.3	41.1	6.8
LOS	E	F	A	F	F	B	E	C		E	D	A
Approach Delay		161.6			116.0			38.9				39.5
Approach LOS		F			F			D				D
Queue Length 50th (m)	31.3	~221.0	6.5	~70.8	~166.7	6.3	31.8	26.7		31.0	66.3	0.0
Queue Length 95th (m)	#75.6	#265.3	27.4	#127.0	#209.9	25.0	m45.1	36.8		44.0	90.4	17.8
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	215	953	552	215	953	532	474	920		474	948	542
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.88	1.35	0.40	1.27	1.14	0.35	0.49	0.66		0.53	0.62	0.32

Intersection Summary

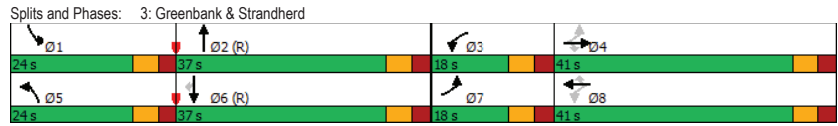
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 7 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Background  
05-27-2020

Maximum v/c Ratio: 1.35	
Intersection Signal Delay: 103.3	Intersection LOS: F
Intersection Capacity Utilization 107.0%	ICU Level of Service G
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	



HCM 2010 TWSC  
6: Greenbank & Street B

2027 Future Background  
05-27-2020

Intersection						
Int Delay, s/veh	1.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Vol, veh/h	25	3	5	932	1098	49
Future Vol, veh/h	25	3	5	932	1098	49
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	3	5	932	1098	49

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	2065	1123	1147
Stage 1	1123	-	-
Stage 2	942	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	60	250	609
Stage 1	311	-	-
Stage 2	379	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	60	250	609
Mov Cap-2 Maneuver	60	-	-
Stage 1	309	-	-
Stage 2	379	-	-

Approach	EB	NB	SB
HCM Control Delay, s	97	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	609	-	65	-
HCM Lane V/C Ratio	0.008	-	0.431	-
HCM Control Delay (s)	11	-	97	-
HCM Lane LOS	B	-	F	-
HCM 95th %tile Q(veh)	0	-	1.7	-

# Appendix G

MMLOS Analysis

# Multi-Modal Level of Service - Intersections Form

Consultant	CGH Transportation	Project	2020-16
Scenario	Existing/Future	Date	27-May-20
Comments			

INTERSECTIONS		Greenbank & Jockvale			
Crossing Side		NORTH	SOUTH	EAST	WEST
Pedestrian	Lanes	5	5	6	5
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Permissive	Permissive	Protected/ Permissive	Permissive
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RTOR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed
	Ped Signal Leading Interval?	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	3-5m	5-10m	15-25m	>25m
	Crosswalk Type	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings
	<b>PETSI Score</b>	<b>39</b>	<b>38</b>	<b>18</b>	<b>34</b>
	<b>Ped. Exposure to Traffic LoS</b>	<b>E</b>	<b>E</b>	<b>F</b>	<b>E</b>
	Cycle Length				
	Effective Walk Time				
	<b>Average Pedestrian Delay</b>				
<b>Pedestrian Delay LoS</b>	-	-	-	-	
<b>Level of Service</b>	<b>E</b>	<b>E</b>	<b>F</b>	<b>E</b>	
		<b>F</b>			
Approach From		NORTH	SOUTH	EAST	WEST
Bicycle	Bicycle Lane Arrangement on Approach	Mixed Traffic	Mixed Traffic	Mixed Traffic	Mixed Traffic
	Right Turn Lane Configuration	≤ 50 m	≤ 50 m	> 50 m	≤ 50 m
	Right Turning Speed	≤ 25 km/h	≤ 25 km/h	>25 km/h	≤ 25 km/h
	<b>Cyclist relative to RT motorists</b>	<b>D</b>	<b>D</b>	<b>F</b>	<b>D</b>
	<b>Separated or Mixed Traffic</b>	<b>Mixed Traffic</b>	<b>Mixed Traffic</b>	<b>Mixed Traffic</b>	<b>Mixed Traffic</b>
	Left Turn Approach	One lane crossed	No lane crossed	No lane crossed	No lane crossed
	Operating Speed	> 50 to < 60 km/h	> 50 to < 60 km/h	> 50 to < 60 km/h	> 40 to ≤ 50 km/h
	<b>Left Turning Cyclist</b>	<b>E</b>	<b>C</b>	<b>C</b>	<b>B</b>
<b>Level of Service</b>	<b>E</b>	<b>D</b>	<b>F</b>	<b>D</b>	
		<b>F</b>			
Transit	Average Signal Delay	≤ 20 sec	≤ 10 sec	≤ 30 sec	≤ 20 sec
	<b>Level of Service</b>	<b>C</b>	<b>B</b>	<b>D</b>	<b>C</b>
		<b>D</b>			
Truck	Effective Corner Radius	< 10 m	< 10 m	> 15 m	> 15 m
	Number of Receiving Lanes on Departure from Intersection	1	1	1	1
	<b>Level of Service</b>	<b>F</b>	<b>F</b>	<b>C</b>	<b>C</b>
		<b>F</b>			
Auto	Volume to Capacity Ratio	0.0 - 0.60			
	<b>Level of Service</b>	<b>A</b>			

Greenbank & Marketplace				Greenbank & Strandherd			
NORTH	SOUTH	EAST	WEST	NORTH	SOUTH	EAST	WEST
6	5	4	4	7	6	6	4
Median > 2.4 m	Median > 2.4 m	No Median - 2.4 m	No Median - 2.4 m	Median > 2.4 m	Median > 2.4 m	Median > 2.4 m	Median > 2.4 m
Permissive	Permissive	Protected	Protected	Permissive	Permissive	Protected	Protected
Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed
No	No	No	No	No	No	No	No
No Channel	No Channel	No Channel	No Channel	Smart Channel	No Channel	Smart Channel	Smart Channel
10-15m	10-15m	10-15m	10-15m	10-15m	15-25m	15-25m	>25m
Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings
<b>25</b>	<b>40</b>	<b>61</b>	<b>61</b>	<b>16</b>	<b>23</b>	<b>37</b>	<b>66</b>
<b>F</b>	<b>E</b>	<b>C</b>	<b>C</b>	<b>F</b>	<b>F</b>	<b>E</b>	<b>C</b>
<b>F</b>	<b>E</b>	<b>C</b>	<b>C</b>	<b>F</b>	<b>F</b>	<b>E</b>	<b>C</b>
<b>F</b>				<b>F</b>			
NORTH	SOUTH	EAST	WEST	NORTH	SOUTH	EAST	WEST
Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Mixed Traffic	Mixed Traffic	Pocket Bike Lane	Curb Bike Lane, Cycletrack or MUP	Pocket Bike Lane	Pocket Bike Lane
Not Applicable	Not Applicable	≤ 50 m	≤ 50 m	> 50 m Introduced right turn lane	Not Applicable	Bike lane shifts to the left of right turn	Bike lane shifts to the left of right turn
Not Applicable	Not Applicable	≤ 25 km/h	≤ 25 km/h	≤ 25 km/h	Not Applicable	>25 to 30 km/h	>25 to 30 km/h
<b>Not Applicable</b>	<b>Not Applicable</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>Not Applicable</b>	<b>F</b>	<b>F</b>
<b>Separated</b>	<b>Separated</b>	<b>Mixed Traffic</b>	<b>Mixed Traffic</b>	<b>Separated</b>	<b>Separated</b>	<b>Separated</b>	<b>Separated</b>
≥ 2 lanes crossed	≥ 2 lanes crossed	No lane crossed	No lane crossed	≥ 2 lanes crossed	≥ 2 lanes crossed	≥ 2 lanes crossed	≥ 2 lanes crossed
≥ 60 km/h	≥ 60 km/h	> 40 to ≤ 50 km/h	≤ 40 km/h	≥ 60 km/h	≥ 60 km/h	≥ 60 km/h	≥ 60 km/h
<b>F</b>	<b>F</b>	<b>B</b>	<b>B</b>	<b>F</b>	<b>F</b>	<b>F</b>	<b>F</b>
<b>F</b>	<b>F</b>	<b>D</b>	<b>D</b>	<b>F</b>	<b>F</b>	<b>F</b>	<b>F</b>
<b>F</b>				<b>F</b>			
≤ 30 sec	≤ 30 sec	≤ 40 sec	≤ 30 sec	≤ 40 sec	≤ 40 sec	> 40 sec	> 40 sec
<b>D</b>	<b>D</b>	<b>E</b>	<b>D</b>	<b>E</b>	<b>E</b>	<b>F</b>	<b>F</b>
<b>E</b>				<b>F</b>			
10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m	> 15 m	10 - 15 m	> 15 m	> 15 m
≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2	≥ 2
<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>A</b>
<b>B</b>				<b>B</b>			
0.61 - 0.70				0.81 - 0.90			
<b>B</b>				<b>D</b>			

<b>Greenbank &amp; Street B</b>			
<b>NORTH</b>	<b>SOUTH</b>	<b>EAST</b>	<b>WEST</b>
3	3		0 - 2
No Median - 2.4 m	No Median - 2.4 m		No Median - 2.4 m
Permissive	No left turn / Prohib.		Permissive
No right turn	Permissive or yield control		Permissive or yield control
RTOR allowed	RTOR prohibited		RTOR allowed
No	No		No
Smart Channel	No Right Turn		No Channel
10-15m	No Right Turn		10-15m
Std transverse markings	Std transverse markings		Std transverse markings
<b>81</b>	<b>91</b>		<b>85</b>
<b>B</b>	<b>A</b>	<b>-</b>	<b>B</b>

<b>B</b>	<b>A</b>	<b>-</b>	<b>B</b>
<b>B</b>			
<b>NORTH</b>	<b>SOUTH</b>	<b>EAST</b>	<b>WEST</b>
Mixed Traffic	Mixed Traffic		Mixed Traffic
≤ 50 m			≤ 50 m
≤ 25 km/h			≤ 25 km/h
<b>D</b>	<b>#N/A</b>	<b>-</b>	<b>D</b>
<b>Mixed Traffic</b>	<b>Mixed Traffic</b>	<b>-</b>	<b>Mixed Traffic</b>
	No lane crossed		No lane crossed
	> 50 to < 60 km/h		> 40 to ≤ 50 km/h
<b>-</b>	<b>C</b>	<b>-</b>	<b>B</b>
<b>-</b>	<b>#N/A</b>	<b>-</b>	<b>D</b>
<b>#N/A</b>			
≤ 20 sec	≤ 20 sec		≤ 40 sec
<b>C</b>	<b>C</b>	<b>-</b>	<b>E</b>
<b>E</b>			
10 - 15 m			10 - 15 m
1			1
<b>E</b>	<b>-</b>	<b>-</b>	<b>E</b>
<b>E</b>			
0.61 - 0.70			
<b>B</b>			

# Multi-Modal Level of Service - Segments Form

Consultant Scenario Comments	CGH Transportation	Project Date	2020-16
	Existing/Future		27-May-20

SEGMENTS		Street A	Greenbank 1	Street B 2	Section 3
Pedestrian	Sidewalk Width	E	1.8 m	≥ 2 m	
	Boulevard Width		0.5 - 2 m	0.5 - 2 m	
	Avg Daily Curb Lane Traffic Volume		> 3000	≤ 3000	
	Operating Speed		> 60 km/h	> 30 to 50 km/h	
	On-Street Parking		no	yes	
	<b>Exposure to Traffic PLoS</b>		<b>E</b>	<b>A</b>	<b>-</b>
	Effective Sidewalk Width		1.5 m	2.0 m	
	Pedestrian Volume		250 ped/hr	250 ped/hr	
<b>Crowding PLoS</b>	<b>B</b>	<b>B</b>	<b>-</b>		
<b>Level of Service</b>	<b>E</b>	<b>B</b>	<b>-</b>		
Bicycle	Type of Cycling Facility	F	Mixed Traffic	Mixed Traffic	
	Number of Travel Lanes		2-3 lanes total	≤ 2 (no centreline)	
	Operating Speed		≥ 60 km/h	>40 to <50 km/h	
	<b># of Lanes &amp; Operating Speed LoS</b>		<b>F</b>	<b>B</b>	<b>-</b>
	Bike Lane (+ Parking Lane) Width				
	<b>Bike Lane Width LoS</b>		<b>-</b>	<b>-</b>	<b>-</b>
	Bike Lane Blockages				
	<b>Blockage LoS</b>		<b>-</b>	<b>-</b>	<b>-</b>
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge	< 1.8 m refuge	
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes	≤ 3 lanes	
	Sidestreet Operating Speed		>40 to 50 km/h	>40 to 50 km/h	
	<b>Unsignalized Crossing - Lowest LoS</b>		<b>B</b>	<b>A</b>	<b>-</b>
<b>Level of Service</b>	<b>F</b>	<b>B</b>	<b>-</b>		
Transit	Facility Type	D	Mixed Traffic	Mixed Traffic	
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8	Vt/Vp ≥ 0.8	
	<b>Level of Service</b>		<b>D</b>	<b>D</b>	<b>-</b>
Truck	Truck Lane Width	A	≤ 3.5 m		
	Travel Lanes per Direction		> 1		
	<b>Level of Service</b>		<b>A</b>	<b>-</b>	<b>-</b>
Auto	<b>Level of Service</b>	<b>Not Applicable</b>			

# Appendix H

Synchro Intersection Worksheets – 2022 Future Total Conditions

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	2	0	4	9	3	169	4	645	6	126	306	6
Future Volume (vph)	2	0	4	9	3	169	4	645	6	126	306	6
Satd. Flow (prot)	0	1563	0	0	1682	1483	0	1743	0	1658	1739	0
Fit Permitted		0.884			0.776			0.998		0.378		
Satd. Flow (perm)	0	1403	0	0	1354	1463	0	1740	0	660	1739	0
Satd. Flow (RTOR)		102			169			1		2		
Lane Group Flow (vph)	0	6	0	0	12	169	0	655	0	126	312	0
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	16.7%	60.8%	60.8%		16.7%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag						Lead	Lag	Lag		Lead		
Lead-Lag Optimize?						Yes	Yes	Yes		Yes		
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		12.0			12.0	12.9		90.1		104.3	108.6	
Actuated g/C Ratio		0.10			0.10	0.11		0.75		0.87	0.90	
v/c Ratio		0.03			0.09	0.55		0.50		0.20	0.20	
Control Delay		0.2			48.2	12.0		10.3		3.0	1.7	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		0.2			48.2	12.0		10.3		3.0	1.7	
LOS		A			D	B		B		A	A	
Approach Delay		0.2			14.4			10.3		2.0		
Approach LOS		A			B			B		A		
Queue Length 50th (m)		0.0			2.8	0.0		33.2		1.4	0.3	
Queue Length 95th (m)		0.0			8.4	16.1		146.1		4.6	9.7	
Internal Link Dist (m)		194.4			396.8			286.3			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		325			232	372		1306		681	1574	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.05	0.45		0.50		0.19	0.20	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	100 (83%), Referenced to phase 2:NBL and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 0.55	Intersection Signal Delay: 8.0	Intersection LOS: A
Intersection Capacity Utilization 84.7%	ICU Level of Service E	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale





Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Total  
05-27-2020

	↖	→	↘	↙	←	↖	↙	↗	↘	↖	↙	↗	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↘		↖	↘		↖	↘		↖	↘	↖	↘
Traffic Volume (vph)	12	17	16	36	23	106	98	610	74	65	443	6	
Future Volume (vph)	12	17	16	36	23	106	98	610	74	65	443	6	
Satd. Flow (prot)	1658	1607	0	1658	1514	0	1658	3257	0	3216	3308	0	
Fit Permitted	0.659			0.680			0.950			0.950			
Satd. Flow (perm)	1149	1607	0	1185	1514	0	1656	3257	0	3210	3308	0	
Satd. Flow (RTOR)		16			106			14			1		
Lane Group Flow (vph)	12	33	0	36	129	0	98	684	0	65	449	0	
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA		
Protected Phases	7	4		3	8		5	2		1	6		
Permitted Phases	4			8									
Detector Phase	7	4		3	8		5	2		1	6		
Switch Phase													
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0		
Minimum Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0		
Total Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0		
Total Split (%)	10.0%	29.2%		10.0%	29.2%		12.5%	48.3%		12.5%	48.3%		
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7		
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5		
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0		
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2		
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag		
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes		
Recall Mode	None	None		None	None		None	C-Max		None	C-Max		
Act Effct Green (s)	17.1	13.6		18.4	16.0		11.7	74.9		7.7	68.5		
Actuated g/C Ratio	0.14	0.11		0.15	0.13		0.10	0.62		0.06	0.57		
v/c Ratio	0.06	0.17		0.18	0.44		0.61	0.34		0.32	0.24		
Control Delay	34.8	29.2		38.6	16.8		65.3	14.6		61.8	14.9		
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0		
Total Delay	34.8	29.2		38.6	16.8		65.3	14.6		61.8	14.9		
LOS	C	C		D	B		E	B		E	B		
Approach Delay		30.7			21.5			20.9			20.8		
Approach LOS		C			C			C			C		
Queue Length 50th (m)	2.5	4.0		7.5	4.8		24.1	35.5		8.5	22.6		
Queue Length 95th (m)	6.6	12.1		14.0	21.0		#55.4	68.3		16.8	35.8		
Internal Link Dist (m)		102.8			148.8			283.1			171.8		
Turn Bay Length (m)	25.0			55.0			60.0			56.0			
Base Capacity (vph)	187	393		203	440		161	2038		236	1888		
Starvation Cap Reductn	0	0		0	0		0	0		0	0		
Spillback Cap Reductn	0	0		0	0		0	0		0	0		
Storage Cap Reductn	0	0		0	0		0	0		0	0		
Reduced v/c Ratio	0.06	0.08		0.18	0.29		0.61	0.34		0.28	0.24		

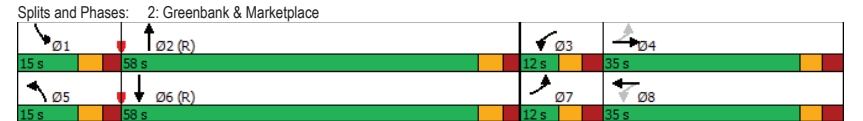
Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 89 (74%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 0.61  
 Intersection Signal Delay: 21.2  
 Intersection Capacity Utilization 53.3%  
 Analysis Period (min) 15  
 Description: As per timing plans provided 26-Nov-2018  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	171	683	142	110	767	163	174	379	127	175	239	129
Future Volume (vph)	171	683	142	110	767	163	174	379	127	175	239	129
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3165	0	3216	3316	1483
Fit Permitted	0.171			0.251			0.950			0.950		
Satd. Flow (perm)	297	3316	1446	436	3316	1432	3207	3165	0	3167	3316	1462
Satd. Flow (RTOR)			149			163			36			149
Lane Group Flow (vph)	171	683	142	110	767	163	174	506	0	175	239	129
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (%)	15.8%	34.2%	34.2%	15.8%	34.2%	34.2%	20.0%	30.0%		20.0%	30.0%	30.0%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	48.3	36.9	36.9	45.3	35.4	35.4	11.8	35.4		11.8	35.4	35.4
Actuated g/C Ratio	0.40	0.31	0.31	0.38	0.30	0.30	0.10	0.30		0.10	0.30	0.30
v/c Ratio	0.69	0.67	0.26	0.41	0.78	0.30	0.55	0.53		0.55	0.24	0.24
Control Delay	36.3	40.5	5.8	25.2	45.8	6.5	72.2	30.1		57.9	33.6	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	36.3	40.5	5.8	25.2	45.8	6.5	72.2	30.1		57.9	33.6	4.8
LOS	D	D	A	C	D	A	E	C		E	C	A
Approach Delay		34.8			37.4			40.9			34.6	
Approach LOS		C			D			D			C	
Queue Length 50th (m)	25.7	77.8	0.0	15.9	92.7	0.0	23.2	43.8		21.7	23.6	0.0
Queue Length 95th (m)	#43.7	102.2	14.0	27.9	117.4	16.4	35.8	39.0		32.7	36.3	11.2
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	262	1020	547	299	978	537	474	958		474	978	536
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.65	0.67	0.26	0.37	0.78	0.30	0.37	0.53		0.37	0.24	0.24

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 120

Control Type: Actuated-Coordinated

3288 Greenbank Road AM Peak Hour

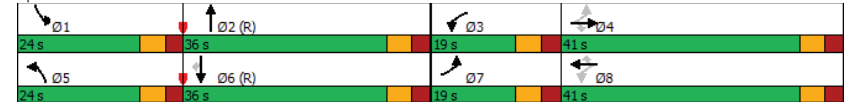
Synchro 10 Light Report  
Page 5

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 0.78	Intersection LOS: D
Intersection Signal Delay: 36.9	ICU Level of Service E
Intersection Capacity Utilization 83.5%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Greenbank & Strandherd



3288 Greenbank Road AM Peak Hour

Synchro 10 Light Report  
Page 6

HCM 2010 TWSC  
6: Greenbank & Street B

2022 Future Total  
05-27-2020

Intersection						
Int Delay, s/veh	2.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Vol, veh/h	88	7	2	696	438	32
Future Vol, veh/h	88	7	2	696	438	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	88	7	2	696	438	32
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1154	454	470	0	-	0
Stage 1	454	-	-	-	-	-
Stage 2	700	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	218	606	1092	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	493	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	218	606	1092	-	-	-
Mov Cap-2 Maneuver	218	-	-	-	-	-
Stage 1	639	-	-	-	-	-
Stage 2	493	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	31.4	0	0			
HCM LOS	D					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1092	-	229	-	-	
HCM Lane V/C Ratio	0.002	-	0.415	-	-	
HCM Control Delay (s)	8.3	-	31.4	-	-	
HCM Lane LOS	A	-	D	-	-	
HCM 95th %tile Q(veh)	0	-	1.9	-	-	

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔		↔	↔	↔	↔	↔
Traffic Volume (vph)	0	2	4	1	0	154	2	373	14	214	701	0
Future Volume (vph)	0	2	4	1	0	154	2	373	14	214	701	0
Satd. Flow (prot)	0	1588	0	0	1658	1483	0	1734	0	1658	1745	0
Fit Permitted							0.998			0.508		
Satd. Flow (perm)	0	1588	0	0	1745	1483	0	1731	0	883	1745	0
Satd. Flow (RTOR)		4			154		2			1	6	
Lane Group Flow (vph)	0	6	0	0	1	154	0	389	0	214	701	0
Turn Type		NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	25.0%	52.5%	52.5%		25.0%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		10.0			10.0	11.0		94.8		109.6	115.3	
Actuated g/C Ratio		0.08			0.08	0.09		0.79		0.91	0.96	
v/c Ratio		0.04			0.01	0.56		0.28		0.25	0.42	
Control Delay		37.0			51.0	14.8		5.1		1.3	2.3	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		37.0			51.0	14.8		5.1		1.3	2.3	
LOS		D			D	B		A		A	A	
Approach Delay		37.0			15.1			5.1			2.1	
Approach LOS		D			B			A			A	
Queue Length 50th (m)		0.5			0.2	0.0		16.3		0.0	9.9	
Queue Length 95th (m)		4.9			2.1	17.4		57.0		8.2	33.9	
Internal Link Dist (m)		194.4			396.8			297.7			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		275			299	443		1368		954	1677	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.00	0.35		0.28		0.22	0.42	
Intersection Summary												
Cycle Length: 120												
Actuated Cycle Length: 120												
Offset: 10 (8%), Referenced to phase 2:NBT and 6:SBTL, Start of Green												
Natural Cycle: 120												
Control Type: Actuated-Coordinated												

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 0.56	Intersection LOS: A
Intersection Signal Delay: 4.4	ICU Level of Service E
Intersection Capacity Utilization 86.9%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	[Diagrammatic symbols for lane configurations]											
Traffic Volume (vph)	44	117	86	141	124	185	149	620	70	195	802	36
Future Volume (vph)	44	117	86	141	124	185	149	620	70	195	802	36
Satd. Flow (prot)	1658	1633	0	1658	1569	0	1658	3266	0	3216	3291	0
Fit Permitted	0.294			0.458			0.950			0.950		
Satd. Flow (perm)	511	1633	0	799	1569	0	1649	3266	0	3216	3291	0
Satd. Flow (RTOR)		29			59			12			4	
Lane Group Flow (vph)	44	203	0	141	309	0	149	690	0	195	838	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (%)	10.8%	29.2%		10.8%	29.2%		16.7%	43.3%		16.7%	43.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	29.4	22.9		30.9	25.5		13.9	53.1		12.0	51.2	
Actuated g/C Ratio	0.24	0.19		0.26	0.21		0.12	0.44		0.10	0.43	
v/c Ratio	0.24	0.61		0.56	0.82		0.78	0.48		0.61	0.60	
Control Delay	30.8	44.6		41.5	53.6		80.9	24.3		60.7	23.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.8	44.6		41.5	53.6		80.9	24.3		60.7	23.1	
LOS	C	D		D	D		F	C		E	C	
Approach Delay		42.2			49.8			34.4			30.2	
Approach LOS		D			D			C			C	
Queue Length 50th (m)	7.6	38.8		25.9	60.3		33.2	64.3		25.5	53.4	
Queue Length 95th (m)	16.0	62.1		41.5	#93.5		#73.2	71.9		m33.3	m60.2	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	189	409		252	417		200	1451		367	1405	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.23	0.50		0.56	0.74		0.74	0.48		0.53	0.60	

Intersection Summary

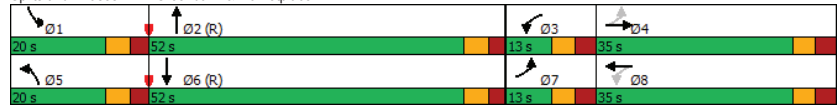
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 117 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 0.82	Intersection LOS: D
Intersection Signal Delay: 36.2	ICU Level of Service D
Intersection Capacity Utilization 78.7%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	190	1030	222	278	882	184	234	408	149	251	511	174
Future Volume (vph)	190	1030	222	278	882	184	234	408	149	251	511	174
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3171	0	3216	3316	1483
Fit Permitted	0.116			0.116			0.950			0.950		
Satd. Flow (perm)	202	3316	1464	202	3316	1483	3213	3171	0	3210	3316	1464
Satd. Flow (RTOR)			222			184		42				174
Lane Group Flow (vph)	190	1030	222	278	882	184	234	557	0	251	511	174
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (%)	15.0%	34.2%	34.2%	15.0%	34.2%	34.2%	20.0%	30.8%		20.0%	30.8%	30.8%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	45.8	34.5	34.5	45.8	34.5	34.5	14.0	33.8		14.4	34.2	34.2
Actuated g/C Ratio	0.38	0.29	0.29	0.38	0.29	0.29	0.12	0.28		0.12	0.28	0.28
v/c Ratio	0.88	1.08	0.38	1.29	0.93	0.33	0.63	0.60		0.65	0.54	0.32
Control Delay	66.9	94.3	6.3	190.5	57.8	6.3	75.1	23.0		58.3	39.4	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	66.9	94.3	6.3	190.5	57.8	6.3	75.1	23.0		58.3	39.4	6.8
LOS	E	F	A	F	E	A	E	C		E	D	A
Approach Delay		77.2			78.2			38.4				38.4
Approach LOS		E			E			D				D
Queue Length 50th (m)	31.3	~150.2	0.0	~73.0	111.6	0.0	32.0	25.0		31.0	56.3	0.0
Queue Length 95th (m)	#75.6	#192.8	18.6	#129.1	#151.5	17.2	m45.2	31.5		44.0	78.0	17.8
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	215	953	579	215	953	557	474	922		474	946	541
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.88	1.08	0.38	1.29	0.93	0.33	0.49	0.60		0.53	0.54	0.32

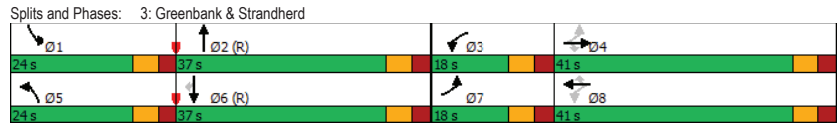
Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 7 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 130
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2022 Future Total  
05-27-2020

Maximum v/c Ratio: 1.29	Intersection LOS: E
Intersection Signal Delay: 62.6	ICU Level of Service F
Intersection Capacity Utilization 99.6%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	



HCM 2010 TWSC  
6: Greenbank & Street B

2022 Future Total  
05-27-2020

Intersection						
Int Delay, s/veh	2.7					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W		W	W	W	W
Traffic Vol, veh/h	57	5	7	751	887	86
Future Vol, veh/h	57	5	7	751	887	86
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	57	5	7	751	887	86

Major/Minor	Minor2	Major1	Major2		
Conflicting Flow All	1695	930	973	0	- 0
Stage 1	930	-	-	-	-
Stage 2	765	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	102	324	709	-	-
Stage 1	384	-	-	-	-
Stage 2	459	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	101	324	709	-	-
Mov Cap-2 Maneuver	101	-	-	-	-
Stage 1	380	-	-	-	-
Stage 2	459	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	77.2	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	709	- 107	-	-
HCM Lane V/C Ratio	0.01	- 0.579	-	-
HCM Control Delay (s)	10.1	- 77.2	-	-
HCM Lane LOS	B	- F	-	-
HCM 95th %tile Q(veh)	0	- 2.8	-	-

Lanes, Volumes, Timings  
6: Greenbank & Street B

2022 Future Total - Signal  
05-27-2020

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	88	7	2	696	438	32
Future Volume (vph)	88	7	2	696	438	32
Satd. Flow (prot)	1652	0	1658	1745	1729	0
Fit Permitted	0.956		0.494			
Satd. Flow (perm)	1652	0	862	1745	1729	0
Satd. Flow (RTOR)	7				8	
Lane Group Flow (vph)	95	0	2	696	470	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Detector Phase	4		2	2	6	
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	
Minimum Split (s)	25.1		25.1	25.1	25.1	
Total Split (s)	25.1		34.9	34.9	34.9	
Total Split (%)	41.8%		58.2%	58.2%	58.2%	
Yellow Time (s)	3.7		3.7	3.7	3.7	
All-Red Time (s)	3.4		3.4	3.4	3.4	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	7.1		7.1	7.1	7.1	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None		Max	Max	Max	
Act Effct Green (s)	8.1		36.8	36.8	36.8	
Actuated g/C Ratio	0.16		0.72	0.72	0.72	
v/c Ratio	0.35		0.00	0.55	0.37	
Control Delay	21.3		6.0	10.1	7.0	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	21.3		6.0	10.1	7.0	
LOS	C		A	B	A	
Approach Delay	21.3			10.1	7.0	
Approach LOS	C			B	A	
Queue Length 50th (m)	7.5		0.1	41.8	22.7	
Queue Length 95th (m)	17.9		0.8	#96.8	48.4	
Internal Link Dist (m)	194.4			76.7	286.3	
Turn Bay Length (m)			15.0			
Base Capacity (vph)	590		624	1264	1255	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	0.16		0.00	0.55	0.37	

Intersection Summary	
Cycle Length:	60
Actuated Cycle Length:	50.8
Natural Cycle:	60
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.55

Lanes, Volumes, Timings  
6: Greenbank & Street B

2022 Future Total - Signal  
05-27-2020

Intersection Signal Delay: 9.8	Intersection LOS: A
Intersection Capacity Utilization 56.1%	ICU Level of Service B
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 6: Greenbank & Street B



Lanes, Volumes, Timings  
6: Greenbank & Street B

2022 Future Total - Signal  
05-27-2020

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	57	5	7	751	887	86
Future Volume (vph)	57	5	7	751	887	86
Satd. Flow (prot)	1650	0	1658	1745	1724	0
Fit Permitted	0.956		0.241			
Satd. Flow (perm)	1650	0	421	1745	1724	0
Satd. Flow (RTOR)	3				11	
Lane Group Flow (vph)	62	0	7	751	973	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Detector Phase	4		2	2	6	
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	
Minimum Split (s)	25.1		25.1	25.1	25.1	
Total Split (s)	25.2		94.8	94.8	94.8	
Total Split (%)	21.0%		79.0%	79.0%	79.0%	
Yellow Time (s)	3.7		3.7	3.7	3.7	
All-Red Time (s)	3.4		3.4	3.4	3.4	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	7.1		7.1	7.1	7.1	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None		Max	Max	Max	
Act Effct Green (s)	10.8		92.2	92.2	92.2	
Actuated g/C Ratio	0.10		0.82	0.82	0.82	
v/c Ratio	0.39		0.02	0.52	0.69	
Control Delay	52.7		3.3	6.0	9.0	
Queue Delay	0.0		0.0	0.0	0.2	
Total Delay	52.7		3.3	6.0	9.2	
LOS	D		A	A	A	
Approach Delay	52.7			6.0	9.2	
Approach LOS	D			A	A	
Queue Length 50th (m)	13.0		0.3	53.3	89.3	
Queue Length 95th (m)	27.1		1.4	89.0	156.0	
Internal Link Dist (m)	194.9			72.2	297.7	
Turn Bay Length (m)			15.0			
Base Capacity (vph)	268		345	1433	1418	
Starvation Cap Reductn	0		0	0	62	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	0.23		0.02	0.52	0.72	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	112.3
Natural Cycle:	80
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.69

Lanes, Volumes, Timings  
6: Greenbank & Street B

2022 Future Total - Signal  
05-27-2020

Intersection Signal Delay: 9.4	Intersection LOS: A
Intersection Capacity Utilization 74.9%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 6: Greenbank & Street B





# Appendix I

Synchro Intersection Worksheets – 2027 Future Total Conditions

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↔		↔		↔	↔	
Traffic Volume (vph)	2	0	4	9	3	169	4	781	6	126	377	6
Future Volume (vph)	2	0	4	9	3	169	4	781	6	126	377	6
Satd. Flow (prot)	0	1563	0	0	1682	1483	0	1743	0	1658	1741	0
Fit Permitted		0.884			0.776			0.998		0.327		
Satd. Flow (perm)	0	1403	0	0	1354	1463	0	1740	0	571	1741	0
Satd. Flow (RTOR)		102			168			1		2		
Lane Group Flow (vph)	0	6	0	0	12	169	0	791	0	126	383	0
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	20.0	73.0	73.0		20.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	16.7%	60.8%	60.8%		16.7%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		12.0			12.0	12.9		90.1		104.3	108.6	
Actuated g/C Ratio		0.10			0.10	0.11		0.75		0.87	0.90	
v/c Ratio		0.03			0.09	0.55		0.61		0.23	0.24	
Control Delay		0.2			48.2	12.2		12.5		3.4	1.8	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		0.2			48.2	12.2		12.5		3.4	1.8	
LOS		A			D	B		B		A	A	
Approach Delay		0.2			14.6			12.5		2.2		
Approach LOS		A			B			B		A		
Queue Length 50th (m)		0.0			2.8	0.3		45.9		1.1	1.6	
Queue Length 95th (m)		0.0			8.4	16.3		203.5		6.0	9.6	
Internal Link Dist (m)		194.4			396.8			286.3			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		325			232	371		1306		613	1576	
Starvation Cap Reductn		0			0	0		0		0	0	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.05	0.46		0.61		0.21	0.24	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	100 (83%), Referenced to phase 2:NBL and 6:SBTL, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 0.61	Intersection Signal Delay: 9.2	Intersection LOS: A
Intersection Capacity Utilization 92.3%	ICU Level of Service F	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		

Splits and Phases: 1: Greenbank & Jockvale



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	12	17	16	36	23	106	98	725	74	65	541	6
Future Volume (vph)	12	17	16	36	23	106	98	725	74	65	541	6
Satd. Flow (prot)	1658	1607	0	1658	1514	0	1658	3265	0	3216	3308	0
Fit Permitted	0.659			0.680			0.950			0.950		
Satd. Flow (perm)	1149	1607	0	1185	1514	0	1656	3265	0	3211	3308	0
Satd. Flow (RTOR)		16			106			11			1	
Lane Group Flow (vph)	12	33	0	36	129	0	98	799	0	65	547	0
Turn Type	pm-pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (s)	12.0	35.0		12.0	35.0		15.0	58.0		15.0	58.0	
Total Split (%)	10.0%	29.2%		10.0%	29.2%		12.5%	48.3%		12.5%	48.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	17.1	13.6		18.4	16.0		11.7	74.9		7.7	68.5	
Actuated g/C Ratio	0.14	0.11		0.15	0.13		0.10	0.62		0.06	0.57	
v/c Ratio	0.06	0.17		0.18	0.44		0.61	0.39		0.32	0.29	
Control Delay	34.8	29.2		38.6	16.8		63.0	15.7		62.5	13.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	34.8	29.2		38.6	16.8		63.0	15.7		62.5	13.8	
LOS	C	C		D	B		E	B		E	B	
Approach Delay		30.7			21.5			20.9			18.9	
Approach LOS		C			C			C			B	
Queue Length 50th (m)	2.5	4.0		7.5	4.8		24.1	41.8		8.4	26.1	
Queue Length 95th (m)	6.6	12.1		14.0	21.0		m#52.8	86.4		16.4	40.2	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	187	393		203	440		161	2041		236	1888	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.06	0.08		0.18	0.29		0.61	0.39		0.28	0.29	

Intersection Summary

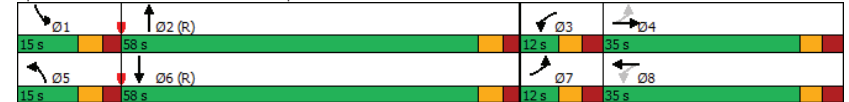
Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 89 (74%), Referenced to phase 2:NBT and 6:SBT, Start of Green  
 Natural Cycle: 120  
 Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 0.61	Intersection Signal Delay: 20.5	Intersection LOS: C
Intersection Capacity Utilization 54.6%	ICU Level of Service A	
Analysis Period (min) 15		
Description: As per timing plans provided 26-Nov-2018		
# 95th percentile volume exceeds capacity, queue may be longer.		
Queue shown is maximum after two cycles.		
m Volume for 95th percentile queue is metered by upstream signal.		

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	171	841	142	110	960	163	174	459	127	175	290	129
Future Volume (vph)	171	841	142	110	960	163	174	459	127	175	290	129
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3185	0	3216	3316	1483
Fit Permitted	0.108			0.155			0.950			0.950		
Satd. Flow (perm)	188	3316	1446	270	3316	1432	3206	3185	0	3172	3316	1462
Satd. Flow (RTOR)			149			149		28				149
Lane Group Flow (vph)	171	841	142	110	960	163	174	586	0	175	290	129
Turn Type	pm-pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (s)	19.0	41.0	41.0	19.0	41.0	41.0	24.0	36.0		24.0	36.0	36.0
Total Split (%)	15.8%	34.2%	34.2%	15.8%	34.2%	34.2%	20.0%	30.0%		20.0%	30.0%	30.0%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	48.3	36.9	36.9	45.3	35.4	35.4	11.8	35.4		11.8	35.4	35.4
Actuated g/C Ratio	0.40	0.31	0.31	0.38	0.30	0.30	0.10	0.30		0.10	0.30	0.30
v/c Ratio	0.79	0.82	0.26	0.51	0.98	0.31	0.55	0.61		0.55	0.30	0.24
Control Delay	52.6	46.9	5.8	28.9	67.2	8.3	72.3	32.0		57.9	34.3	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	52.6	46.9	5.8	28.9	67.2	8.3	72.3	32.0		57.9	34.3	4.8
LOS	D	D	A	C	E	A	E	C		E	C	A
Approach Delay		42.7			56.0			41.2			34.9	
Approach LOS		D			E			D			C	
Queue Length 50th (m)	26.0	101.9	0.0	15.9	-126.8	2.5	23.2	51.6		21.7	29.2	0.0
Queue Length 95th (m)	#62.0	#139.8	14.0	27.9	#173.2	19.2	36.0	43.0		32.7	43.5	11.2
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	228	1020	547	250	978	527	474	958		474	978	536
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.75	0.82	0.26	0.44	0.98	0.31	0.37	0.61		0.37	0.30	0.24

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 120

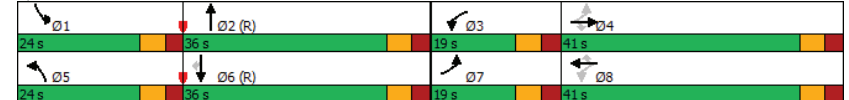
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 0.98	Intersection LOS: D
Intersection Signal Delay: 45.5	ICU Level of Service E
Intersection Capacity Utilization 89.0%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Greenbank & Strandherd



HCM 2010 TWSC  
6: Greenbank & Street B

2027 Future Total  
05-27-2020

Intersection						
Int Delay, s/veh	3.7					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Vol, veh/h	88	7	2	865	551	32
Future Vol, veh/h	88	7	2	865	551	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	88	7	2	865	551	32
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1436	567	583	0	-	0
Stage 1	567	-	-	-	-	-
Stage 2	869	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	147	523	991	-	-	-
Stage 1	568	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	147	523	991	-	-	-
Mov Cap-2 Maneuver	147	-	-	-	-	-
Stage 1	567	-	-	-	-	-
Stage 2	410	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	59.4	0	0			
HCM LOS	F					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	991	-	155	-	-	
HCM Lane V/C Ratio	0.002	-	0.613	-	-	
HCM Control Delay (s)	8.6	-	59.4	-	-	
HCM Lane LOS	A	-	F	-	-	
HCM 95th %tile Q(veh)	0	-	3.3	-	-	

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

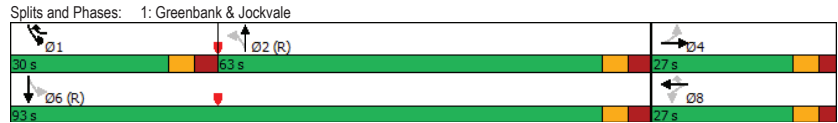
2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔		↔	↔	↔	↔	↔
Traffic Volume (vph)	0	2	4	1	0	154	2	449	14	214	851	0
Future Volume (vph)	0	2	4	1	0	154	2	449	14	214	851	0
Satd. Flow (prot)	0	1588	0	0	1658	1483	0	1737	0	1658	1745	0
Fit Permitted							0.998			0.469		
Satd. Flow (perm)	0	1588	0	0	1745	1483	0	1733	0	815	1745	0
Satd. Flow (RTOR)		4			154			2				
Lane Group Flow (vph)	0	6	0	0	1	154	0	465	0	214	851	0
Turn Type		NA		Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		
Detector Phase	4	4		8	8	1	2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0	5.0	10.0	10.0		5.0	10.0	
Minimum Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (s)	27.0	27.0		27.0	27.0	30.0	63.0	63.0		30.0	93.0	
Total Split (%)	22.5%	22.5%		22.5%	22.5%	25.0%	52.5%	52.5%		25.0%	77.5%	
Yellow Time (s)	3.7	3.7		3.7	3.7	3.7	3.7	3.7		3.7	3.7	
All-Red Time (s)	2.7	2.7		2.7	2.7	3.4	3.4	3.4		3.4	3.4	
Lost Time Adjust (s)		0.0			0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)		6.4			6.4	7.1		7.1		7.1	7.1	
Lead/Lag							Lead	Lag		Lag	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None	None	C-Max	C-Max		None	C-Max	
Act Effct Green (s)		10.0			10.0	11.0		94.8		109.6	115.3	
Actuated g/C Ratio		0.08			0.08	0.09		0.79		0.91	0.96	
v/c Ratio		0.04			0.01	0.56		0.34		0.27	0.51	
Control Delay		37.0			51.0	14.8		5.5		1.2	5.8	
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay		37.0			51.0	14.8		5.5		1.2	5.8	
LOS		D			D	B		A		A	A	
Approach Delay		37.0			15.1			5.5			4.9	
Approach LOS		D			B			A			A	
Queue Length 50th (m)		0.5			0.2	0.0		20.6		0.0	114.0	
Queue Length 95th (m)		4.9			2.1	17.4		71.1		m6.9	94.3	
Internal Link Dist (m)		194.4			396.8			297.7			283.1	
Turn Bay Length (m)												
Base Capacity (vph)		275			299	443		1370		905	1677	
Starvation Cap Reductn		0			0	0		0		0	22	
Spillback Cap Reductn		0			0	0		0		0	0	
Storage Cap Reductn		0			0	0		0		0	0	
Reduced v/c Ratio		0.02			0.00	0.35		0.34		0.24	0.51	
Intersection Summary												
Cycle Length: 120												
Actuated Cycle Length: 120												
Offset: 10 (8%), Referenced to phase 2:NBT and 6:SBTL, Start of Green												
Natural Cycle: 120												
Control Type: Actuated-Coordinated												

Lanes, Volumes, Timings  
1: Greenbank & Jockvale

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 0.56	Intersection LOS: A
Intersection Signal Delay: 6.1	ICU Level of Service F
Intersection Capacity Utilization 98.8%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
m Volume for 95th percentile queue is metered by upstream signal.	



Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	44	117	86	141	124	185	149	731	70	195	949	36
Future Volume (vph)	44	117	86	141	124	185	149	731	70	195	949	36
Satd. Flow (prot)	1658	1633	0	1658	1569	0	1658	3273	0	3216	3295	0
Fit Permitted	0.294			0.458			0.950			0.950		
Satd. Flow (perm)	511	1633	0	799	1569	0	1650	3273	0	3216	3295	0
Satd. Flow (RTOR)		29			59			10				4
Lane Group Flow (vph)	44	203	0	141	309	0	149	801	0	195	985	0
Turn Type	pm+pt	NA		pm+pt	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8								
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	10.0		5.0	10.0		5.0	10.0		5.0	10.0	
Minimum Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (s)	13.0	35.0		13.0	35.0		20.0	52.0		20.0	52.0	
Total Split (%)	10.8%	29.2%		10.8%	29.2%		16.7%	43.3%		16.7%	43.3%	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7		3.7	3.7	
All-Red Time (s)	3.1	3.2		3.1	3.2		2.6	2.5		2.6	2.5	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.4	6.5		6.4	6.5		6.3	6.2		6.3	6.2	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	29.4	22.9		30.9	25.5		13.9	53.1		12.0	51.2	
Actuated g/C Ratio	0.24	0.19		0.26	0.21		0.12	0.44		0.10	0.43	
v/c Ratio	0.24	0.61		0.56	0.82		0.78	0.55		0.61	0.70	
Control Delay	30.8	44.6		41.5	53.6		81.7	25.7		60.5	24.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.8	44.6		41.5	53.6		81.7	25.7		60.5	24.1	
LOS	C	D		D	D		F	C		E	C	
Approach Delay		42.2			49.8			34.4			30.2	
Approach LOS		D			D			C			C	
Queue Length 50th (m)	7.6	38.8		25.9	60.3		34.0	78.2		25.5	60.7	
Queue Length 95th (m)	16.0	62.1		41.5	#93.5		#72.4	88.8		m34.0	m76.0	
Internal Link Dist (m)		102.8			148.8			283.1			171.8	
Turn Bay Length (m)	25.0			55.0			60.0			56.0		
Base Capacity (vph)	189	409		252	417		200	1453		367	1407	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.23	0.50		0.56	0.74		0.74	0.55		0.53	0.70	

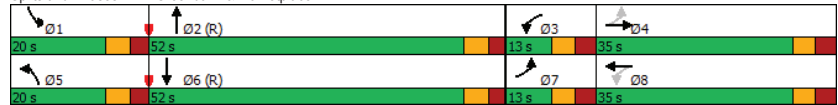
<b>Intersection Summary</b>	
Cycle Length:	120
Actuated Cycle Length:	120
Offset:	117 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle:	120
Control Type:	Actuated-Coordinated

Lanes, Volumes, Timings  
2: Greenbank & Marketplace

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 0.82	Intersection LOS: D
Intersection Signal Delay: 35.8	ICU Level of Service E
Intersection Capacity Utilization 83.0%	
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 2: Greenbank & Marketplace



Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Total  
05-27-2020

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	190	1291	222	278	1091	184	234	492	149	251	617	174
Future Volume (vph)	190	1291	222	278	1091	184	234	492	149	251	617	174
Satd. Flow (prot)	1658	3316	1483	1658	3316	1483	3216	3189	0	3216	3316	1483
Fit Permitted	0.116			0.116			0.950			0.950		
Satd. Flow (perm)	202	3316	1464	202	3316	1483	3213	3189	0	3211	3316	1464
Satd. Flow (RTOR)			186			149		32				174
Lane Group Flow (vph)	190	1291	222	278	1091	184	234	641	0	251	617	174
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Prot	NA	Perm	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8						6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (s)	18.0	41.0	41.0	18.0	41.0	41.0	24.0	37.0		24.0	37.0	37.0
Total Split (%)	15.0%	34.2%	34.2%	15.0%	34.2%	34.2%	20.0%	30.8%		20.0%	30.8%	30.8%
Yellow Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7		3.7	3.7	3.7
All-Red Time (s)	2.9	2.8	2.8	2.9	2.8	2.8	2.6	2.8		2.6	2.8	2.8
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.6	6.5	6.5	6.6	6.5	6.5	6.3	6.5		6.3	6.5	6.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max	Max	None	Max	Max	None	C-Max		None	C-Max	C-Max
Act Effct Green (s)	45.8	34.5	34.5	45.8	34.5	34.5	14.0	33.8		14.4	34.2	34.2
Actuated g/C Ratio	0.38	0.29	0.29	0.38	0.29	0.29	0.12	0.28		0.12	0.28	0.28
v/c Ratio	0.88	1.35	0.40	1.29	1.14	0.35	0.63	0.70		0.65	0.65	0.32
Control Delay	66.9	201.4	9.8	190.5	116.9	10.3	76.1	25.9		58.3	42.1	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	66.9	201.4	9.8	190.5	116.9	10.3	76.1	25.9		58.3	42.1	6.8
LOS	E	F	A	F	F	B	E	C		E	D	A
Approach Delay		161.4			117.5			39.3				40.1
Approach LOS		F			F			D				D
Queue Length 50th (m)	31.3	~221.0	6.5	~73.0	~166.7	6.3	32.1	27.7		31.0	70.7	0.0
Queue Length 95th (m)	#75.6	#265.3	27.1	#129.1	#209.9	25.0	m45.4	40.2		44.0	95.8	17.8
Internal Link Dist (m)		186.3			415.8			171.8			236.6	
Turn Bay Length (m)	70.0		100.0	130.0			60.0			85.0		160.0
Base Capacity (vph)	215	953	553	215	953	532	474	920		474	946	541
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.88	1.35	0.40	1.29	1.14	0.35	0.49	0.70		0.53	0.65	0.32

Intersection Summary

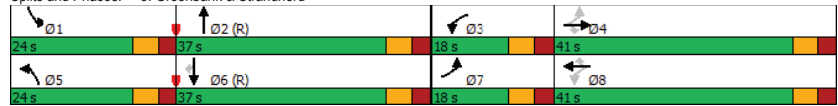
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 7 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Lanes, Volumes, Timings  
3: Greenbank & Strandherd

2027 Future Total  
05-27-2020

Maximum v/c Ratio: 1.35	
Intersection Signal Delay: 103.1	Intersection LOS: F
Intersection Capacity Utilization 107.2%	ICU Level of Service G
Analysis Period (min) 15	
Description: As per timing plans provided 26-Nov-2018	
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 3: Greenbank & Strandherd



Lanes, Volumes, Timings  
6: Greenbank & Street B

2027 Future Total  
05-27-2020

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Traffic Volume (vph)	57	5	7	932	1098	86
Future Volume (vph)	57	5	7	932	1098	86
Satd. Flow (prot)	1650	0	1658	1745	1728	0
Fit Permitted	0.956		0.950			
Satd. Flow (perm)	1650	0	1658	1745	1728	0
Lane Group Flow (vph)	62	0	7	932	1184	0
Sign Control	Stop			Free	Free	

Intersection Summary

Control Type: Unsignalized	
Intersection Capacity Utilization 76.8%	ICU Level of Service D
Analysis Period (min) 15	



HCM 2010 TWSC  
6: Greenbank & Street B

2027 Future Total  
05-27-2020

Intersection						
Int Delay, s/veh	6.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Vol, veh/h	57	5	7	932	1098	86
Future Vol, veh/h	57	5	7	932	1098	86
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	57	5	7	932	1098	86
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	2087	1141	1184	0	-	0
Stage 1	1141	-	-	-	-	-
Stage 2	946	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	58	244	590	-	-	-
Stage 1	305	-	-	-	-	-
Stage 2	377	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	57	244	590	-	-	-
Mov Cap-2 Maneuver	57	-	-	-	-	-
Stage 1	301	-	-	-	-	-
Stage 2	377	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	232	0.1	0			
HCM LOS	F					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	590	-	61	-	-	
HCM Lane V/C Ratio	0.012	-	1.016	-	-	
HCM Control Delay (s)	11.2	-	232	-	-	
HCM Lane LOS	B	-	F	-	-	
HCM 95th %tile Q(veh)	0	-	4.9	-	-	

Lanes, Volumes, Timings  
6: Greenbank & Street B

2027 Future Total - Signal  
05-27-2020

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	88	7	2	865	551	32
Future Volume (vph)	88	7	2	865	551	32
Satd. Flow (prot)	1652	0	1658	1745	1733	0
Fit Permitted	0.956		0.410			
Satd. Flow (perm)	1652	0	715	1745	1733	0
Satd. Flow (RTOR)	7				6	
Lane Group Flow (vph)	95	0	2	865	583	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Detector Phase	4		2	2	6	
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	
Minimum Split (s)	25.1		25.1	25.1	25.1	
Total Split (s)	25.1		34.9	34.9	34.9	
Total Split (%)	41.8%		58.2%	58.2%	58.2%	
Yellow Time (s)	3.7		3.7	3.7	3.7	
All-Red Time (s)	3.4		3.4	3.4	3.4	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	7.1		7.1	7.1	7.1	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None		Max	Max	Max	
Act Effct Green (s)	10.2		36.9	36.9	36.9	
Actuated g/C Ratio	0.20		0.72	0.72	0.72	
v/c Ratio	0.28		0.00	0.69	0.47	
Control Delay	19.3		6.0	15.1	8.5	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	19.3		6.0	15.1	8.5	
LOS	B		A	B	A	
Approach Delay	19.3			15.1	8.5	
Approach LOS	B			B	A	
Queue Length 50th (m)	7.5		0.1	69.5	35.1	
Queue Length 95th (m)	17.9		0.8	#148.6	66.2	
Internal Link Dist (m)	194.4			76.7	286.3	
Turn Bay Length (m)			15.0			
Base Capacity (vph)	583		514	1253	1247	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	0.16		0.00	0.69	0.47	
Intersection Summary						
Cycle Length: 60						
Actuated Cycle Length: 51.4						
Natural Cycle: 75						
Control Type: Semi Act-Uncoord						
Maximum v/c Ratio: 0.69						

Lanes, Volumes, Timings  
 6: Greenbank & Street B

2027 Future Total - Signal  
 05-27-2020

Intersection Signal Delay: 12.9 Intersection LOS: B  
 Intersection Capacity Utilization 68.2% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 6: Greenbank & Street B



Lanes, Volumes, Timings  
6: Greenbank & Street B

2027 Future Total  
05-27-2020

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	57	5	7	932	1098	86
Future Volume (vph)	57	5	7	932	1098	86
Satd. Flow (prot)	1650	0	1658	1745	1728	0
Fit Permitted	0.956		0.156			
Satd. Flow (perm)	1650	0	272	1745	1728	0
Satd. Flow (RTOR)	3				9	
Lane Group Flow (vph)	62	0	7	932	1184	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Detector Phase	4		2	2	6	
Switch Phase						
Minimum Initial (s)	10.0		10.0	10.0	10.0	
Minimum Split (s)	25.1		25.1	25.1	22.7	
Total Split (s)	25.1		94.9	94.9	94.9	
Total Split (%)	20.9%		79.1%	79.1%	79.1%	
Yellow Time (s)	3.7		3.7	3.7	3.7	
All-Red Time (s)	3.4		3.4	3.4	1.0	
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	
Total Lost Time (s)	7.1		7.1	7.1	4.7	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None		Max	Max	Max	
Act Effct Green (s)	10.8		92.3	92.3	94.3	
Actuated g/C Ratio	0.10		0.82	0.82	0.84	
v/c Ratio	0.39		0.03	0.65	0.82	
Control Delay	52.8		3.6	8.2	13.1	
Queue Delay	0.0		0.0	0.0	0.5	
Total Delay	52.8		3.6	8.2	13.5	
LOS	D		A	A	B	
Approach Delay	52.8			8.1	13.5	
Approach LOS	D			A	B	
Queue Length 50th (m)	13.1		0.3	81.1	130.7	
Queue Length 95th (m)	27.1		1.5	138.9	258.9	
Internal Link Dist (m)	194.9			72.2	297.7	
Turn Bay Length (m)			15.0			
Base Capacity (vph)	266		223	1433	1450	
Starvation Cap Reductn	0		0	0	53	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	0.23		0.03	0.65	0.85	

Intersection Summary	
Cycle Length:	120
Actuated Cycle Length:	112.4
Natural Cycle:	90
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.82

Lanes, Volumes, Timings  
6: Greenbank & Street B

2027 Future Total  
05-27-2020

Intersection Signal Delay: 12.3	Intersection LOS: B
Intersection Capacity Utilization 84.7%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 6: Greenbank & Street B





# Appendix J

TDM Checklist

**TDM-Supportive Development Design and Infrastructure Checklist:**  
*Residential Developments (multi-family or condominium)*

Legend	
REQUIRED	The Official Plan or Zoning By-law provides related guidance that must be followed
BASIC	The measure is generally feasible and effective, and in most cases would benefit the development and its users
BETTER	The measure could maximize support for users of sustainable modes, and optimize development performance

TDM-supportive design & infrastructure measures: <i>Residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
<b>1. WALKING &amp; CYCLING: ROUTES</b>		
<b>1.1 Building location &amp; access points</b>		
BASIC	1.1.1 Locate building close to the street, and do not locate parking areas between the street and building entrances	<input checked="" type="checkbox"/>
BASIC	1.1.2 Locate building entrances in order to minimize walking distances to sidewalks and transit stops/stations	<input checked="" type="checkbox"/>
BASIC	1.1.3 Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort	<input checked="" type="checkbox"/>
<b>1.2 Facilities for walking &amp; cycling</b>		
REQUIRED	1.2.1 Provide convenient, direct access to stations or major stops along rapid transit routes within 600 metres; minimize walking distances from buildings to rapid transit; provide pedestrian-friendly, weather-protected (where possible) environment between rapid transit accesses and building entrances; ensure quality linkages from sidewalks through building entrances to integrated stops/stations (see <i>Official Plan policy 4.3.3</i> )	<input checked="" type="checkbox"/>
REQUIRED	1.2.2 Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances through such measures as: reducing distances between public sidewalks and major building entrances; providing walkways from public streets to major building entrances; within a site, providing walkways along the front of adjoining buildings, between adjacent buildings, and connecting areas where people may congregate, such as courtyards and transit stops; and providing weather protection through canopies, colonnades, and other design elements wherever possible (see <i>Official Plan policy 4.3.12</i> )	<input checked="" type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
REQUIRED	1.2.3 Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas, and provide marked pedestrian crosswalks at intersection sidewalks (see <i>Official Plan policy 4.3.10</i> )	<input checked="" type="checkbox"/>
REQUIRED	1.2.4 Make sidewalks and open space areas easily accessible through features such as gradual grade transition, depressed curbs at street corners and convenient access to extra-wide parking spaces and ramps (see <i>Official Plan policy 4.3.10</i> )	<input checked="" type="checkbox"/>
REQUIRED	1.2.5 Include adequately spaced inter-block/street cycling and pedestrian connections to facilitate travel by active transportation. Provide links to the existing or planned network of public sidewalks, multi-use pathways and on-road cycle routes. Where public sidewalks and multi-use pathways intersect with roads, consider providing traffic control devices to give priority to cyclists and pedestrians (see <i>Official Plan policy 4.3.11</i> )	<input checked="" type="checkbox"/>
BASIC	1.2.6 Provide safe, direct and attractive walking routes from building entrances to nearby transit stops	<input checked="" type="checkbox"/>
BASIC	1.2.7 Ensure that walking routes to transit stops are secure, visible, lighted, shaded and wind-protected wherever possible	<input type="checkbox"/>
BASIC	1.2.8 Design roads used for access or circulation by cyclists using a target operating speed of no more than 30 km/h, or provide a separated cycling facility	<input type="checkbox"/>
<b>1.3 Amenities for walking &amp; cycling</b>		
BASIC	1.3.1 Provide lighting, landscaping and benches along walking and cycling routes between building entrances and streets, sidewalks and trails	<input type="checkbox"/>
BASIC	1.3.2 Provide wayfinding signage for site access (where required, e.g. when multiple buildings or entrances exist) and egress (where warranted, such as when directions to reach transit stops/stations, trails or other common destinations are not obvious)	<input checked="" type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
<b>2. WALKING &amp; CYCLING: END-OF-TRIP FACILITIES</b>		
<b>2.1 Bicycle parking</b>		
REQUIRED	2.1.1 Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible (see <i>Official Plan policy 4.3.6</i> )	<input checked="" type="checkbox"/>
REQUIRED	2.1.2 Provide the number of bicycle parking spaces specified for various land uses in different parts of Ottawa; provide convenient access to main entrances or well-used areas (see <i>Zoning By-law Section 111</i> )	<input type="checkbox"/>
REQUIRED	2.1.3 Ensure that bicycle parking spaces and access aisles meet minimum dimensions; that no more than 50% of spaces are vertical spaces; and that parking racks are securely anchored (see <i>Zoning By-law Section 111</i> )	<input type="checkbox"/>
BASIC	2.1.4 Provide bicycle parking spaces equivalent to the expected number of resident-owned bicycles, plus the expected peak number of visitor cyclists	<input type="checkbox"/>
<b>2.2 Secure bicycle parking</b>		
REQUIRED	2.2.1 Where more than 50 bicycle parking spaces are provided for a single residential building, locate at least 25% of spaces within a building/structure, a secure area (e.g. supervised parking lot or enclosure) or bicycle lockers (see <i>Zoning By-law Section 111</i> )	<input type="checkbox"/>
BETTER	2.2.2 Provide secure bicycle parking spaces equivalent to at least the number of units at condominiums or multi-family residential developments	<input type="checkbox"/>
<b>2.3 Bicycle repair station</b>		
BETTER	2.3.1 Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area (or secure bicycle parking area, if provided)	<input checked="" type="checkbox"/>
<b>3. TRANSIT</b>		
<b>3.1 Customer amenities</b>		
BASIC	3.1.1 Provide shelters, lighting and benches at any on-site transit stops	<input type="checkbox"/>
BASIC	3.1.2 Where the site abuts an off-site transit stop and insufficient space exists for a transit shelter in the public right-of-way, protect land for a shelter and/or install a shelter	<input type="checkbox"/>
BETTER	3.1.3 Provide a secure and comfortable interior waiting area by integrating any on-site transit stops into the building	<input type="checkbox"/>

TDM-supportive design & infrastructure measures: <i>Residential developments</i>		Check if completed & add descriptions, explanations or plan/drawing references
<b>4. RIDESHARING</b>		
<b>4.1 Pick-up &amp; drop-off facilities</b>		
BASIC	4.1.1 Provide a designated area for carpool drivers (plus taxis and ride-hailing services) to drop off or pick up passengers without using fire lanes or other no-stopping zones	<input type="checkbox"/>
<b>5. CARSHARING &amp; BIKESHARING</b>		
<b>5.1 Carshare parking spaces</b>		
BETTER	5.1.1 Provide up to three carshare parking spaces in an R3, R4 or R5 Zone for specified residential uses (see <i>Zoning By-law Section 94</i> )	<input type="checkbox"/>
<b>5.2 Bikeshare station location</b>		
BETTER	5.2.1 Provide a designated bikeshare station area near a major building entrance, preferably lighted and sheltered with a direct walkway connection	<input type="checkbox"/>
<b>6. PARKING</b>		
<b>6.1 Number of parking spaces</b>		
REQUIRED	6.1.1 Do not provide more parking than permitted by zoning, nor less than required by zoning, unless a variance is being applied for	<input checked="" type="checkbox"/>
BASIC	6.1.2 Provide parking for long-term and short-term users that is consistent with mode share targets, considering the potential for visitors to use off-site public parking	<input type="checkbox"/>
BASIC	6.1.3 Where a site features more than one use, provide shared parking and reduce the cumulative number of parking spaces accordingly (see <i>Zoning By-law Section 104</i> )	<input type="checkbox"/>
BETTER	6.1.4 Reduce the minimum number of parking spaces required by zoning by one space for each 13 square metres of gross floor area provided as shower rooms, change rooms, locker rooms and other facilities for cyclists in conjunction with bicycle parking (see <i>Zoning By-law Section 111</i> )	<input type="checkbox"/>
<b>6.2 Separate long-term &amp; short-term parking areas</b>		
BETTER	6.2.1 Provide separate areas for short-term and long-term parking (using signage or physical barriers) to permit access controls and simplify enforcement (i.e. to discourage residents from parking in visitor spaces, and vice versa)	<input type="checkbox"/>