

January 21, 2014

OUR REF: TO3131TOZ EMAIL TO: <u>greg.leblanc@sympatico.ca</u>

Greg Leblanc 1963 Old Carp Road Carp, ON K0A 1L0

Dear Greg:

Re: 3119 Carp Road Plan of Subdivision Transportation Brief

1.0 INTRODUCTION

From the information provided it is our understanding that you wish to submit a Plan of Subdivision application for a proposed rural commercial/industrial subdivision of approximately 300,000 ft² at the above-noted address. From the concept plan provided, the site is located on the west side of Carp Road and will be accessed by a single site driveway that cul-de-sacs at the west boundary of the property. It appears that no other lands/development will be connected to this site driveway. The site in its local context is depicted in Figure 1 and the subdivision's Concept Plan is shown on Figure 2.

2.0 SCOPE OF WORK

As the proposed development will generate more than 75 vph and a Plan of Subdivision approval is being sought, the City's Transportation Impact Assessment Guidelines indicate that a Community Transportation Study is the required level of traffic study. However, given the somewhat isolated location of the proposed subdivision and that it has only one proposed driveway connection to Carp Road, we discussed the scope of work with Amira Shehata of the City of Ottawa. Through discussions it was agreed that a Traffic Brief that focussed on the site specific transportation issues and requirements would be sufficient. Within this context, it was agreed that the study area would extend to and include the Carp Road intersections with each of March Road, the Site Driveway and the McGee Side Road. Accordingly, the Traffic Brief is provided herein.

3.0 Existing Transportation Conditions

3.1 Carp Road

Carp Road is a two-lane arterial road with a posted speed of 80 kph through the study area. It has a rural cross-section with a right-of-way protection policy of 30 m. Its intersection with March Road is traffic signal controlled with left-turn lanes provided on all four approaches.

Its intersection with McGee Side Road is STOP sign controlled on the east-west approaches only, and there are no turn lanes. Adjacent to the site, Carp Road is two lanes wide with gravel shoulders.



Figure 1: Site Context

3.2 Peak Hour Volumes and Intersection Operation

With regard to peak hour traffic volumes, these are depicted on Figure 3 and included as Appendix A. The Carp/March count was provided by the City of Ottawa and Delcan conducted the Carp/McGee intersection in December 2013. Peak direction volumes total approximately 400 with the two-directional total being approximately 550 vph during the morning peak hour and 650 vph during the afternoon peak hour. As shown in Table 1, the study area's two main intersections currently operate at a very good level of service (LoS 'A' to 'C'), with there being significant spare capacity.



Figure 2: Concept Plan

Figure 3: Existing Peak Hour Traffic



Table 1 provides a summary of existing traffic operations at key study area intersections, based on the Synchro (V8) traffic analysis software. The subject intersections were assessed in terms of the volume-to-capacity (v/c) ratio/delay and the corresponding Level of Service (LoS) for the 'critical movement(s)'. The signalized Carp/March intersection 'as a whole' was assessed based on a weighted v/c ratio and the Synchro model output of existing conditions is provided within Appendix B.

		W	eekday AM P	eak (PM Pe	ak)	
		Critical Mov	ement	Intersec	tion'as	a whole'
Intersection	LoS	max.v/c or avg. delay (s)	Movement	Delay (s)	LoS	v/ c
Carp/March	C(B)	0.73(0.69)	EBT(WBT)	16.0(14.9)	A(A)	0.54(0.53)
Carp/McGee Side	B(B)	11.3(14.9)	WBT(EBT)	1.3(1.5)	-	-
Note: Analysis of signalized i	ntersecti	ons assumes a l	PHF of 0.95 and a	saturation flow	rate of 180	00 veh/h/lane.

Table 1: Existi	ng Performance	e at Study	Area	Intersections
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As shown in Table 1, the signalized Carp/March intersection 'as a whole' is currently operating at an excellent LoS 'A' during both the weekday morning and afternoon peak hours, with respect to the City of Ottawa operating standards of LoS 'D' or better (0.90 > v/c > 0.00). This is indicative of significant spare capacity at this intersection.

With regard to 'critical movements' at study area intersections, they are currently operating at an acceptable LoS 'C' or better during both the weekday morning and afternoon peak hours.

3.3 Background Traffic Growth

Five City of Ottawa traffic counts at the Carp/March Road intersection, between 2006 and 2013, were used to estimate background traffic growth. The analysis results are provided in Appendix C and based on this analysis, a 1% growth rate for 10 years is assumed appropriate for the horizon year of the proposed subdivision. As such, the existing 2013 volumes depicted in Figure 3 were increased by a factor 1.1 to estimate 2023 horizon year background volumes as depicted in Figure 4.

Figure 4: 2023 Horizon Year Background Traffic Volumes



4.0 Project Site Traffic Generation

The proposed development is best described as a rural commercial/industrial subdivision comprised of 12 lots and totalling of 300,000 ft^2 of floor area. The ITE Trip Generation Manual (9th Edition) was used to derive the appropriate peak hour vehicle trip rate. As there is no directly equivalent land use, a number of land uses within the Manual were considered. These uses, and their peak hour vehicle trip rates per 1000 ft^2 of development area, are provided in Table 2.

	170	Veh/ 1000 ft ² and	Directional Split
Use	Cotogory	Morning Peak	Afternoon Peak
	Category	Hour	Hour
Light Industrial	110	0.92 (88/12)	0.97(12/88)
Industrial Park	130	0.82(82/18)	0.85(21/79)
Warehouse	150	0.42(65/35)	0.48(19/81)
Construction Equipment Rental	811	-	0.99(28/72)
Tractor Supply Store	810	0.7	1.4(45/55)

Table 2:	Sample	ITE	Vehicle	Trip	Rates
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Based on the Table 2 rates, and as the subdivision will likely be comprised of a combination of light industrial, warehouse and rural commercial uses, the following rates and directional splits were considered appropriate for analysis purposes.

- Morning peak hour: 0.9 veh/1000 ft², with an 85% in/15% out directional split
- Afternoon peak hour: 0.9/veh 1000 ft² with a 25% in/75% out directional split

Applying these volumes to the proposed $300,000 \text{ ft}^2$ of development results in the peak hour site-generated traffic as summarized in Table 3.

			vehicle p	per hour)		
Use	Morn	ing Peak	Hour	Aftern	oon Peal	(Hour
	١n	Out	Total	١n	Out	Total
Industrial / rural commercial (300,000 ft ²)	230	40	270	70	200	270

With regard to distribution and assignment of these site-generated vehicle trips, the morning and afternoon peak hour traffic flow on the adjacent section of Carp Road was considered, as were the existing turning volumes at the March and McGee intersections. The resultant assignment of projected peak hour traffic is depicted on Figure 5.



Figure 5: Assignment of Projected Site-Generated Traffic

Figure 6: Total Projected Horizon Year Traffic Volumes



Integrated Systems and Infrastructure Solutions

5.0 Assessment of Projected Conditions

The combination of site-generated traffic plus 2023 horizon year background traffic volumes is depicted in Figure 6. The results of the intersection capacity analysis of the three study area intersections for these total projected conditions are provided in Table 4.

Table 4 provides a summary of projected performance of the study area intersections and the Synchro model output of projected conditions is provided within Appendix D.

		W	eekday AM P	eak (PM Pe	ak)	
		Critical Mov	ement	Intersec	tion 'as	a whole'
Intersection	LoS	max.v/c or avg. delay (s)	Movement	Delay (s)	LoS	v/ c
Carp/March	C(C)	0.77(0.71)	EBT(WBT)	18.4(16.5)	B(A)	0.62(0.58)
Carp/Site	C(C)	16.2(16.7)	EBL(EBL)	2.2(4.0)	-	-
Carp/McGee Side	B(C)	12.8(20.1)	WBT(EBT)	1.5(1.8)	-	-
Note: Analysis of signalized i	ntersecti	ons assumes a l	PHF of 0.95 and a	saturation flow	rate of 180	00 veh/h/lane.

Table 4: Projected Performance at Study Area Intersections

As shown in Table 4, with no signal timing plan modifications, the signalized Carp/March intersection 'as a whole' is projected to continue operating at an excellent LoS 'B' or better during both peak hours. With regard to 'critical movements' at study area intersections, they are projected to operate at an acceptable LoS 'C' or better during both the weekday morning and afternoon peak hours. This is similar to the existing conditions summarized in Table 1.

With regard to the Carp/McGee intersection, it too will continue to operate at an excellent LoS B'/C', with no modification required.

With regard to the proposed development's new driveway connection to Carp Road, it is projected to operate at a very good LoS 'C' during both peak periods, however, the total projected volumes do require turn lanes on Carp Road at this location (Appendix E).

Based on projected horizon traffic volumes and using a 90 km/h highway design speed, an northbound left-turn lane and southbound right-turn auxiliary lane are warranted/recommended on Carp Road at the site driveway. The recommended storage lengths and taper lengths are 70 m and 75 m respectively for the right-turn lane and 60 m and 145 m for the left-turn lane. These lanes are not needed initially, but only when a certain turn movement threshold is reached. These thresholds are 60 vph for the southbound right-turn lane and approximately 20 to 30 vph for the northbound left-turn lane. Therefore, with regard to timing of implementation, they could be provided initially if desired by the proponent, or traffic conditions could be monitored as development proceeds, and implementation could occur when warranted.

With regard to throat length on the site driveway connection to Carp Road, it is well over 100 m long before any of the subdivision lots are reached, therefore there is no throat length issue.

6.0 Findings, Conclusions and Recommendations

Based on the foregoing analysis, the findings, conclusions and recommendations of this Transportation Overview are as follows.

- The proposed development on the west side of Carp Road has the potential for approximately 300,000 ft² of commercial/industrial uses spread out over a number of lots;
- The adjacent section of Carp Road has a two-lane rural cross-section with a posted speed of 80 kph and a right-of-way protection policy of 30 m;
- The study area intersections of Carp/March and Carp/McGee currently operate at very good levels of service in the LoS 'B' to 'C' range;
- A 10-year horizon and a background growth rate of 1% per year was used for analysis of projected conditions at full site build-out;
- The proposed commercial/industrial subdivision is estimated to generate approximately 270 vph two-way total at full build-out;
- With the combination of existing traffic plus background traffic growth plus sitegenerated traffic, the three study area intersections of Carp/March, Carp/McGee and Carp/Site Driveway are projected to operate at an acceptable LoS 'C' during peak hours;
- As the site driveway is a minimum of 100 m long before there is an on-site connection to any lot, there is no throat length issue;
- The site-generated traffic does not require any modifications to off-site intersections, however, turn lanes are required on Carp Road at the Carp/Site Driveway intersection. Due to the design speed of Carp Road, a southbound right-turn lane with 70 m of storage and 75 of taper is required. For the northbound left-turn movement, 60 m of storage and 145 m of taper are required; and
- The above-noted turn lanes at the Carp/Site Driveway intersection are not required initially, but will be warranted when the southbound right-turn reaches approximately 60 vph and the northbound left-turn reaches approximately 30 vph. Monitoring of site-generated traffic is recommended to determine when these thresholds are met and the turn lanes are required.

Based on the foregoing, and assuming the identified turn lanes are implemented at the appropriate time, the proposed development is recommended from a transportation perspective.

Please call if you have any questions.

Sincerely,

Ronald M. Jack, P.Eng.

Vice President Manager, Transportation Division

Attachments

Appendix A

Current 2013 Traffic Counts

- Carp/MarchCarp/McGee Side



Survey Date: Tuesday 20 August 2013

DRY

AADT Factor

CARP RD and MARCH RD

Total Observed U-Turns

(ULRS Listing RR- 5 & RR- 49)



DIRECTIONAL TRAFFIC FLOW



DIRECTIONAL TRAFFIC FLOW

Intersection:	Carp		at McGee Side	
DATE: Day:	4 Month:	December Year:	 Day of Wee	k: Wednesday
Observer:	Cathie Lytle	Weath	er: Clear	
		Chkd	by: Date	
TIME PERIO Instr	D: From: <u>4</u> : actions: 1) Use tally ma 2) Use one she	00 To: rks to indicate vehicle eet for each 15-minute	5 : 00 es. e period.	N
Street Name: McGee Side Bus Trks Pass, Vehicles		362 S	Bass. Vehicles	21
			() (
) с	S	г , Г R	
4				Street Name: McGee Side
Delcan	Street Name: Carp Bus Trks Pass Ve			

Appendix B

SYNCHRO Analysis: Existing Conditions

Existing AM 1: Carp & March

Lane Group EBL EBT WBL WBT NBL NBT SBL SBT Lane Configurations 5 7 7 31 117 20 178 Lane Group Flow (vph) 55 446 76 84 33 170 21 215 Tum Type Perm NA Perm		≯	+	4	+	-	1	1	Ļ
Lane Configurations No. Perm NA Perm	Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Volume (vph) 52 325 72 72 31 117 20 176 Lane Group Flow (vph) 55 446 76 84 33 170 21 215 Tum Type Perm NA Permited Phases 4 8 2 6 Detector Phase 4 4 8 2 6 6 Detector Phase 4 4 8 8 2 2 6 6 Switch Phase 4 4 8 8 2 27.2 <td< td=""><td>Lane Configurations</td><td>×</td><td>1⊾</td><td>*</td><td>1</td><td>×</td><td>1⊾</td><td>*</td><td>1</td></td<>	Lane Configurations	×	1⊾	*	1	×	1⊾	*	1
Lane Group Flow (vph) 55 446 76 84 33 170 21 215 Tum Type Perm NA Perm NA Perm NA Perm NA Protected Phases 4 8 2 6 6 Detector Phases 4 4 8 2 2 6 6 Detector Phase 4 4 8 8 2 2 6 6 Minimum Split (s) 10.0 10.0 10.0 21.0 21.0 21.0 21.0 21.0 21.2 21.2 27.2 </td <td>Volume (vph)</td> <td>52</td> <td>325</td> <td>72</td> <td>72</td> <td>31</td> <td>117</td> <td>20</td> <td>178</td>	Volume (vph)	52	325	72	72	31	117	20	178
Turn Type Perm NA Perm	Lane Group Flow (vph)	55	446	76	84	33	170	21	215
Protected Phases 4 8 2 6 Permitted Phases 4 8 2 6 6 Detector Phase 4 4 8 2 2 6 6 Switch Phase - - 21.0 <t< td=""><td>Turn Type</td><td>Perm</td><td>NA</td><td>Perm</td><td>NA</td><td>Perm</td><td>NA</td><td>Perm</td><td>NA</td></t<>	Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Permitted Phases 4 8 2 6 Detector Phase 4 4 8 8 2 2 6 6 Minimum Initial (s) 10.0 10.0 10.0 21.0	Protected Phases		4		8		2		6
Detector Phase 1 4 8 8 2 2 6 6 Switch Phase Minimum Initial (s) 10.0 10.0 10.0 21.0	Permitted Phases	4		8	-	2	_	6	-
Switch Phase Image Image <thimage< th=""> Image</thimage<>	Detector Phase	4	4	8	8	2	2	6	6
Minimum Initial (s) 10.0 10.0 10.0 10.0 21.0 </td <td>Switch Phase</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Switch Phase								
Minimum Split (s) 27.2 27	Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Total Split (%) 51.2	Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (%) 50.0%	Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Yellow Time (s) 4.6	Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
All-Red Time (s) 1.6 <td>Yellow Time (s)</td> <td>4.6</td> <td>4.6</td> <td>4.6</td> <td>4.6</td> <td>4.6</td> <td>4.6</td> <td>4.6</td> <td>4.6</td>	Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Lost Time Adjust (s) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Total Lost Time (s) 6.2 <td>All-Red Time (s)</td> <td>1.6</td> <td>1.6</td> <td>1.6</td> <td>1.6</td> <td>1.6</td> <td>1.6</td> <td>1.6</td> <td>1.6</td>	All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Total Lost Time (s) 6.2	Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lead/Lag None None None None Min Min <t< td=""><td>Total Lost Time (s)</td><td>6.2</td><td>6.2</td><td>6.2</td><td>6.2</td><td>6.2</td><td>6.2</td><td>6.2</td><td>6.2</td></t<>	Total Lost Time (s)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Lead-Lag Optimize? Recall Mode None None None None Min Min Min Min Act Effet Green (s) 18.0 18.0 18.0 18.0 21.2 21.5 20.0 21.5 21.5 21.5 21.5 21.5	Lead/Lag								
Recall Mode None None None None Min Sign Sign	Lead-Lag Optimize?								
Act Effct Green (s) 18.0 18.0 18.0 18.0 21.2 Actuated g/C Ratio 0.35 0.35 0.35 0.41 </td <td>Recall Mode</td> <td>None</td> <td>None</td> <td>None</td> <td>None</td> <td>Min</td> <td>Min</td> <td>Min</td> <td>Min</td>	Recall Mode	None	None	None	None	Min	Min	Min	Min
Actuated g/C Ratio 0.35 0.35 0.35 0.41 0.41 0.41 0.41 v/c Ratio 0.13 0.73 0.33 0.14 0.07 0.24 0.04 0.30 Control Delay 11.5 21.5 16.3 10.7 11.9 11.0 11.7 12.6 Queue Delay 0.0	Act Effct Green (s)	18.0	18.0	18.0	18.0	21.2	21.2	21.2	21.2
vic Ratio 0.13 0.73 0.33 0.14 0.07 0.24 0.04 0.30 Control Delay 11.5 21.5 16.3 10.7 11.9 11.0 11.7 12.6 Queue Delay 0.0 <td< td=""><td>Actuated g/C Ratio</td><td>0.35</td><td>0.35</td><td>0.35</td><td>0.35</td><td>0.41</td><td>0.41</td><td>0.41</td><td>0.41</td></td<>	Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.41	0.41	0.41	0.41
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Queue Delay 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Total Delay 11.5 21.5 16.3 10.7 11.9 11.0 11.7 12.6 LOS B C B S	Control Delay	11.5	21.5	16.3	10.7	11.9	11.0	11.7	12.6
Total Delay 11.5 21.5 16.3 10.7 11.9 11.0 11.7 12.6 LOS B C B C B B C C B B C <td>Queue Delay</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td>	Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOS B C B C B B C B	Total Delay	11.5	21.5	16.3	10.7	11.9	11.0	11.7	12.6
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Approach LOS C B B B B Queue Length 50th (m) 3.3 33.0 5.0 4.7 1.7 8.1 1.1 11.8 Queue Length 95th (m) 8.8 57.7 13.2 11.3 7.1 22.5 5.2 30.0 Internal Link Dist (m) 511.9 443.6 2852.2 206.9 Turn Bay Length (m) 115.0 90.0 115.0 100.0 Base Capacity (vph) 1100 1515 576 1545 977 1505 1018 1537 Starvation Cap Reductn 0	Approach Delay		20.4		13.4		11.2		12.5
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Internal Link Dist (m) 511.9 443.6 2852.2 206.9 Turn Bay Length (m) 115.0 90.0 115.0 100.0 Base Capacity (vph) 1100 1515 576 1545 977 1505 1018 1537 Starvation Cap Reductn 0 10 14 14 14	Queue Length 95th (m)	8.8	57.7	13.2	11.3	7.1	22.5	5.2	30.0
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Starvation Cap Reductin 0 <td>Base Capacity (vph)</td> <td>1100</td> <td>1515</td> <td>576</td> <td>1545</td> <td>977</td> <td>1505</td> <td>1018</td> <td>1537</td>	Base Capacity (vph)	1100	1515	576	1545	977	1505	1018	1537
Spillback Cap Reductn 0	Starvation Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn 0	Spillback Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio 0.05 0.29 0.13 0.05 0.03 0.11 0.02 0.14 Intersection Summary Cycle Length: 102.4 Actuated Cycle Length: 51.6 Natural Cycle: 55 Control Type: Actuated-Uncoordinated Maximum v/c Ratio: 0.73 Intersection Signal Delay: 16.0 Intersection LOS: B Intersection Capacity Utilization 75.4% Intersection Capacity Utilization 75.4% ICU Level of Service D Analysis Period (min) 15 Splits and Phases: 1: Carp & March Intersection Capacity C	Storage Cap Reductn	0	0	0	0	0	0	0	0
Intersection Summary Cycle Length: 102.4 Actuated Cycle Length: 51.6 Natural Cycle: 55 Control Type: Actuated-Uncoordinated Maximum v/c Ratio: 0.73 Intersection Signal Delay: 16.0 Intersection Capacity Utilization 75.4% ICU Level of Service D Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Reduced v/c Ratio	0.05	0.29	0.13	0.05	0.03	0.11	0.02	0.14
Cycle Length: 102.4 Actuated Cycle Length: 51.6 Natural Cycle: 55 Control Type: Actuated-Uncoordinated Maximum v/c Ratio: 0.73 Intersection Signal Delay: 16.0 Intersection Capacity Utilization 75.4% Intersection Capacity Utilization 75.4% Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Intersection Summary								
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Natural Cycle: 55 Control Type: Actuated-Uncoordinated Maximum v/c Ratio: 0.73 Intersection Signal Delay: 16.0 Intersection LOS: B Intersection Capacity Utilization 75.4% ICU Level of Service D Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Actuated Cycle Length: 51.6								
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Maximum v/c Ratio: 0.73 Intersection Signal Delay: 16.0 Intersection Capacity Utilization 75.4% Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Control Type: Actuated-Uncoordinated								
Intersection Signal Delay: 16.0 Intersection LOS: B Intersection Capacity Utilization 75.4% ICU Level of Service D Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Maximum v/c Ratio: 0.73								
Intersection Capacity Utilization 75.4% ICU Level of Service D Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Intersection Signal Delay: 16.0				In	tersection L	OS: B		
Analysis Period (min) 15 Splits and Phases: 1: Carp & March	Intersection Capacity Utilization 75.4%	,			IC	U Level of S	Service D		
Splits and Phases: 1: Carp & March	Analysis Period (min) 15								
Splits and Phases: 1: Carp & March									
	Splits and Phases: 1: Carp & March								

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
Volume (veh/h)	2	0	6	11	6	27	5	240	4	4	215	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	0	6	12	6	28	5	253	4	4	226	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	534	505	229	509	505	255	232			257		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	534	505	229	509	505	255	232			257		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	99	98	99	96	100			100		
cM capacity (veh/h)	433	466	810	468	466	784	1336			1308		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	8	46	262	236								
Volume Left	2	12	5	4								
Volume Right	6	28	4	5								
cSH	665	621	1336	1308								
Volume to Capacity	0.01	0.07	0.00	0.00								
Queue Length 95th (m)	0.3	1.8	0.1	0.1								
Control Delay (s)	10.5	11.3	0.2	0.2								
Lane LOS	В	В	А	А								
Approach Delay (s)	10.5	11.3	0.2	0.2								
Approach LOS	В	В										
Intersection Summary												
Average Delay			1.3									
Intersection Capacity Utilization			26.7%	ICI	U Level of S	ervice			А			
Analysis Period (min)			15									

Existing AM 2: Carp & McGee Side

Existing PM 1: Carp & March

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	5	۴.	N	۴.	N	1.	3	۵.
Volume (vph)	45	78	44	366	137	220	17	150
Lane Group Flow (vph)	47	118	46	400	144	291	18	209
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	16.4	16.4	16.4	16.4	21.2	21.2	21.2	21.2
Actuated g/C Ratio	0.33	0.33	0.33	0.33	0.42	0.42	0.42	0.42
v/c Ratio	0.19	0.21	0.12	0.69	0.30	0.39	0.04	0.28
Control Delay	13.6	10.1	11.9	21.1	13.4	12.6	10.9	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.6	10.1	11.9	21.1	13.4	12.6	10.9	11.1
LOS	В	В	В	С	В	В	В	В
Approach Delay		11.1		20.1		12.9		11.1
Approach LOS		В		С		В		В
Queue Length 50th (m)	2.9	5.5	2.8	29.7	7.7	15.3	0.9	10.0
Queue Length 95th (m)	8.6	13.7	7.9	52.1	23.0	39.1	4.6	27.3
Internal Link Dist (m)		511.9		443.6		2852.2		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	671	1539	1097	1602	1010	1564	937	1553
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	0.08	0.04	0.25	0.14	0.19	0.02	0.13
Intersection Summary								
Cycle Length: 102.4								
Actuated Cycle Length: 50.1								
Natural Cycle: 55								
Control Type: Actuated-Uncoordinated	b							
Maximum v/c Ratio: 0.69								
Intersection Signal Delay: 14.9				Int	tersection L	OS: B		
Intersection Capacity Utilization 85.2%	0			IC	U Level of S	Service E		
Analysis Period (min) 15								
Solits and Phases: 1: Caro & March	1							
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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			\$			\$	
Volume (veh/h)	5	8	4	11	3	21	7	222	16	28	362	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	5	8	4	12	3	22	7	234	17	29	381	7
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	724	709	385	709	704	242	388			251		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	724	709	385	709	704	242	388			251		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	99	97	99	97	99			98		
cM capacity (veh/h)	322	349	663	333	351	797	1170			1315		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	18	37	258	418								
Volume Left	5	12	7	29								
Volume Right	4	22	17	7								
cSH	382	515	1170	1315								
Volume to Capacity	0.05	0.07	0.01	0.02								
Queue Length 95th (m)	1.1	1.7	0.1	0.5								
Control Delay (s)	14.9	12.5	0.3	0.8								
Lane LOS	В	В	А	А								
Approach Delay (s)	14.9	12.5	0.3	0.8								
Approach LOS	В	В										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			44.1%	ICI	U Level of S	ervice			А			
Analysis Period (min)			15									

Existing PM 2: Carp & McGee Side

Appendix C

Background Traffic Growth Analysis

Carp/ March <u>8 hrs</u>

Voor	Data	Nort	h Leg	South	n Leg	East	Leg	Wes	t Leg	Total		
rear	Date	SB	NB	NB	SB	WB	EB	EB	WB	Total		
2006	Monday 8 May	1381	1377	1944	1897					6599		
2008	Tuesday 3 June	1185	1397	1951	1720							
2009	Tuesday 16 June 2009	1286	1801	2220	1552					6859		
2011	Thursday 30 June	1184	1359	1810	1580					5933		
2013	Tuesday 20 August	1730	1770	2216	2078					7794		
-			•				•		•			
		Voar		Cou	nts		% Change					
	North Leg	Teal	NB	SB	NB+ SB	INT	NB	SB	NB+ SB	INT		
		2006	1377	1381	2758	6599						
		2008	1397	1185	2582	0	1.5%	-14.2%	-6.4%	-100.0%		
		2009	1801	1286	3087	6859	28.9%	8.5%	19.6%			
		2011	1359	1184	2543	5933	-24.5%	-7.9%	-17.6%	-13.5%		
		2013	1770	1730	3500	7794	30.2%	46.1%	37.6%	31.4%		
	Regression Estimate	2006	1402	1207	2610							
	Regression Estimate	2013	1687	1508	3195							
	Average Annual Change		2.68%	3.23%	2.93%							
			•									
		Year		Cou	nts			% Cł	nange			
	West Leg		EB	WB	EB+ WB	INT	EB	WB	EB+ WB	INT		
		2006				6599						
		2008				0				-100.0%		
		2009				6859						
		2011				5933				-13.5%		
		2013				7794				31.4%		
		0000										
	Regression Estimate	2006										
	Regression Estimate	2013										
	Average Annual Change											
			r	Cou	nto			2222				
	Faatlag	Year	EP	UUD COU		INT	ED	% CI				
	East Leg	2006	ED	VV D	ED+ VV D	6500	ED	VV D		1 IN 1		
		2006				0299				100.0%		
		2000				6950				-100.0%		
		2009				5000				10 50/		
		2011				5933 7704				-13.5%		
		2013	1			//94	1	1	1	31.4%		
	Regression Estimate	2006										
	Regression Estimate	2000										
	Average Appuel Change	2013										
	Average Annual Change											
			1	Cou	nte			% ()	ande			
	Southlea	Year	NP	00u	NR, CD	INT	NP	~ 01 €₽	NR, CD	INIT		
	South Ley	2006	1011	1807	28/1	6500	IND	30	ND+ 3D	1111		
		2000	1944	1720	3641	0399	0.49/	0.2%	4 4 9/	100.0%		
		2008	1921	1/20	30/1	0	0.4%	-9.3%	-4.4%	-100.0%		
		2009	1910	1552	3/12	0009 5022	10.0%	-9.0%	2.0%	12 50/		
		2011	1010	1560	3390	5933	-10.5%	1.0%	-10.1%	-13.5%		
		2013	2210	20/8	4294	//94	22.4%	31.5%	20.1%	31.4%		
	Pogragaion Estimate	2006	1050	1704	2657							
		2000	1953	1/04	305/							
	Regression Estimate	2013	2108	1031	3938							
	Average Annual Change		1.09%	1.03%	1.07%							

Carp/ March <u>AM Peak</u>

Vest Uate SB NB NB <t< th=""><th></th><th></th><th>Nort</th><th>h Leg</th><th>South</th><th>n Leg</th><th>East</th><th>Leg</th><th>Wes</th><th>Tatal</th></t<>			Nort	h Leg	South	n Leg	East	Leg	Wes	Tatal		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Year	Date	SB	NB	NB	SB	WB	EB	EB	WB	Total	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	2006	Monday 8 May	261	141	194	396					992	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	2008	Tuesday 3 June	214	167	182	366					929	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	2009	Tuesday 16 June 2009	235	193	182	320					930	
2013 Tuesday 20 August 225 177 193 349 944 North Log Year Counts North Log	2011	Thursday 30 June	205	150	181	293					829	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	2013	Tuesday 20 August	225	177	193	349					944	
North Leg Vear Counts % Change 2006 141 261 141 261 187 18 38 NB+SB 117 2009 193 235 428 932 18.4% -18.0% -5.2% -6.4% 2009 193 225 428 930 15.6% 9.8% 12.3% 0.1% 2011 150 225 402 944 18.0% 9.8% 17.1% -10.9% 2013 177 225 400 387 -22.3% -12.8% -17.1% -10.9% Regression Estimate 2013 176 210 387 -22.3% -10.9% 13.2% 13.9% West Leg Vear Counts % Change -6.4% -0.49% -6.4% -0.9% 10.9% -6.4% -0.9% -0.4% -0.9% -0.4% -0.9% -0.4% -0.9% -0.4% -0.9% -0.4% -0.4% -0.9% -0.4% -0.4% -0.4% <td>2010</td> <td>Tuesday 20 August</td> <td>LLO</td> <td></td> <td>100</td> <td>010</td> <td></td> <td>ł</td> <td></td> <td></td> <td>011</td>	2010	Tuesday 20 August	LLO		100	010		ł			011	
North Leg Year NE SE (NT) NB SE (NT) 2006 167 211 402 992 18.4% -11.0% -5.2% -6.4% 2011 150 225 428 930 15.6% 9.8% 12.3% 0.1% 2013 175 245 428 930 15.6% 9.8% 13.2% 10.9% Pegression Estimate 2013 175 245 400 387 Average Annual Change 1.81% -2.13% -0.49%					Cou	nte			% Cł	ande		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		North Lea	Year	NR	SR		INT	NB	SB		INT	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			2006	141	261	402	992		00	1101 00		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			2000	167	214	381	929	18 4%	-18.0%	-5.2%	-6.4%	
$East Leg \qquad \begin{array}{ c c c c c c c c c c c c c c c c c c c$			2000	107	225	429	020	15 6%	0.00/	10.2%	0.4/0	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			2009	150	205	420	930	10.0%	9.0 /o 10 00/	17.0%	10.0%	
Vest Leg			2011	177	205	300	029	-22.3/0	-12.0/0	-17.1%	-10.9%	
Regression Estimate Regression Estimate Average Annual Change 200 201 155 1.81% 245 2.00 400 387 West Leg Year Counts % Change 2008 929 0 6.4% 2009 929 0 6.4% 2011 0 929 0 0.1% 2011 0 929 0 0.1% 2011 0 920 0 0.1% 2011 0 920 0 0.1% 2011 0 920 0 0.1% 2013 2013 1.1.1% 7.0.9% 13.9% Regression Estimate Regression Estimate Average Annual Change Vear Counts % Change 2006 2013 1.1.1% 1.9.9% Regression Estimate Regression Estimate Regression Estimate Average Annual Change South Leg Year Counts SB NR+SB INT 2008 182 366 548 929 -6.2% <td></td> <td>1</td> <td>2013</td> <td>177</td> <td>225</td> <td>402</td> <td>544</td> <td>10.0 %</td> <td>9.0%</td> <td>13.2 /0</td> <td>13.9%</td>		1	2013	177	225	402	544	10.0 %	9.0%	13.2 /0	13.9%	
Negression Estimate 2006 135 243 3400 Average Annual Change 1.81% -2.13% -0.49% West Leg Year Counts % Change 2006 2008 922 -0.49% 2008 929 -0.49% 2009 920 -0.49% 2009 920 -0.49% Regression Estimate 2006 929 2011 829 -0.1% 2013 930 -0.1% Average Annual Change 2015 East Leg Year Counts % Change 2008 929 -0.4% 2009 930 -0.1% 2001 929 -0.4% 2003 929 -0.1% 2004 929 -0.4% 2005 2001 929 2013 924 -0.1% Regression Estimate 2006 2009 2013 829 Average Annual Change 2013 <td></td> <td>Degrappion Estimate</td> <td>2006</td> <td>155</td> <td>045</td> <td>400</td> <td></td> <td></td> <td></td> <td></td> <td></td>		Degrappion Estimate	2006	155	045	400						
Hegression Estimate Regression Estimate 2013 178 210 337 1.81% -2.13% -0.49% West Leg Year Counts % Change 2006 2008 929 -6.4% 2009 930 0.1% 0.1% 2001 930 0.1% 0.1% 2011 944 -1.0.9% 1.3.9% Regression Estimate Regression Estimate 2013 2014 944 -1.0.9% Regression Estimate 2006 Regression Estimate 2013 Average Annual Change Year Counts % Change 2006 2008 929 -6.4% 2011 829 -10.9% 13.9% Regression Estimate Regression Estimate 2013 Average Annual Change South Leg Year Counts Year <td colsp<="" td=""><td></td><td>Regression Estimate</td><td>2006</td><td>155</td><td>245</td><td>400</td><td></td><td></td><td></td><td></td><td></td></td>	<td></td> <td>Regression Estimate</td> <td>2006</td> <td>155</td> <td>245</td> <td>400</td> <td></td> <td></td> <td></td> <td></td> <td></td>		Regression Estimate	2006	155	245	400					
Average Annual Change 1.81% -2.13% -0.49% West Leg Year Counts % Change 2006 2008 922 -6.4% 2009 930 0.1% 2013 944 -10.9% 2013 944 13.9% Regression Estimate Regression Estimate 2006 2008 929 -6.4% 2013 944 13.9% Regression Estimate 2006 2009 930 0.1% Average Annual Change 0.1% East Leg Year Counts % Change 2009 930 0.1% 2011 1.8.9% 992 -6.4% 2013 944 0.1% 2014 992 -10.9% 2015 992 -6.4% 2016 2008 929 0.1% 2013 944 13.9% Regression Estimate 2006 2013 2013 944 13.9% Regression Estimate 2006 2006 191 82.9 -0.5% 2006 192 -6.2% -7.6% -7.1% 2006 192 <td< td=""><td></td><td>Regression Estimate</td><td>2013</td><td>1/6</td><td>210</td><td>387</td><td></td><td></td><td></td><td></td><td></td></td<>		Regression Estimate	2013	1/6	210	387						
West Leg Vear Counts % Change 2006 EB WB EB+WB INT EB WB EB+WB INT 2008 929 929 -6.4% -0.1% -0.1% -0.1% -0.1% -0.4% -0.1% 0.1%		Average Annual Change		1.81%	-2.13%	-0.49%						
West Leg Year Counts % Change 2006 B B EB+WB INT EB B B EB+WB INT 2008 992 992 992 B B EB+WB INT 2009 992 992 992 -6.4% 0.1% 0.1% 2011 2013 944 13.9% -10.9% 2013 -10.9% Regression Estimate Regression Estimate 2013 Average Annual Change KB WB EB+WB INT EB <wb< td=""> EB+WB INT 2009 929 -6.4% 0.1% -10.9% 2013 -10.9% 2013 -10.9% 2014 13.9% -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013 -10.9% 2013</wb<>				1	0				a/ 0			
West Leg Leb WB LB+WB INT LB WB LB+WB INT 2006 2008 929 929 -6.4% 0.1%<			Year	55	Cou			50	% Cr	nange	/ N/ T	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		West Leg		EB	WB	EB + WB	INI	EB	WB	EB+WB	INI	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			2006				992					
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			2008				929				-6.4%	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			2009				930				0.1%	
Vear Counts % Change 2013 944 13.9% Regression Estimate Regression Estimate 2013 Average Annual Change Year Counts % Change 2006 992 992 6.4% 2008 929 -6.4% 2013 930 0.1% 2013 944 13.9%			2011				829				-10.9%	
Regression Estimate Regression Estimate Average Annual Change 2006 2013 East Leg Year Counts % Change 2006 992 - -6.4% 2009 930 932 - 2009 9330 0.1% - 2013 944 - - Regression Estimate Regression Estimate 2013 2016 - - South Leg Year Counts % Change - Year Counts % Change - - Average Annual Change 2013 - - - - Begression Estimate 2013 2016 2013 -			2013				944				13.9%	
East Leg Year Counts % Change 2006 EB WB EB+WB INT EB WB EB+WB INT 2008 929 929 -6.4% 0.1% 0.1% 0.1% 2009 930 929 -10.9% 13.9% -10.9% 13.9% Regression Estimate 2011 944 13.9% 13.9% 13.9% Average Annual Change 2013 2014 992 -6.2% -7.6% -7.1% -6.4% South Leg Year Counts % Change 13.9% 13.9% 13.9% South Leg Year Counts % Change -6.4% 13.9% 2006 194 396 590 992 -6.2% -7.6% -7.1% -6.4% 2013 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% 0.1%		Regression Estimate Regression Estimate Average Annual Change	2006 2013									
East Leg Int EB WB EB+WB INT EB WB EB+WB INT 2006 2008 929 929 1 6.4% 0.1% -6.4% 0.1% -10.9% 0.1% -10.9% 0.1% -10.9% 13.9% -10.9% 14.3% 13.9% -10.9% 14.3% 13.9% -10.9% 14.3% 13.9% -10.9% 13.9% -10.9% -10.9% 13.9% -10.9% -10.9% <td< td=""><td></td><td></td><td>Year</td><td></td><td>Cou</td><td>nts</td><td></td><td></td><td>% Cł</td><td>nange</td><td></td></td<>			Year		Cou	nts			% Cł	nange		
2006 992 929 -6.4% 2009 930 0.1% 2011 829 11.9% 2013 944 11.9% Regression Estimate Regression Estimate Average Annual Change South Leg Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% 0.1% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%		East Leg		EB	WB	EB+WB	INT	EB	WB	EB+WB	INT	
2008 929 -6.4% 2009 930 0.1% 2011 2013 944 2013 944 13.9% Regression Estimate Regression Estimate Average Annual Change South Leg Year Counts % Change 2006 194 396 590 992 2006 194 396 590 992 2006 194 396 590 992 2008 182 366 548 929 -6.2% 2009 182 320 502 930 0.0% 2011 181 293 474 829 -0.5% 2013 193 349 542 944 6.6%			2006				992					
2009 930 0.1% 2011 2013 944 -10.9% 2013 944 13.9% Regression Estimate Regression Estimate Average Annual Change South Leg Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%			2008				929				-6.4%	
2011 2013 Segression Estimate Regression Estimate Average Annual Change 2006 2013 -10.9% 13.9% South Leg Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%			2009				930				0.1%	
2013 944 13.9% Regression Estimate Regression Estimate Average Annual Change 2006 2013 South Leg Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%			2011				829				-10.9%	
Regression Estimate Regression Estimate Average Annual Change 2006 2013 South Leg Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%			2013				944				13.9%	
Year Counts % Change 2006 194 396 590 992 2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%		Regression Estimate Regression Estimate Average Annual Change	2006 2013									
South Leg NB SB NB+SB INT NB SB NB+SB INT 2006 194 396 590 992 -			Vear		Cou	nts			% Cł	nange		
2006 194 396 590 992 -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9%		South Leg	rear	NB	SB	NB+ SB	INT	NB	SB	NB+ SB	INT	
2008 182 366 548 929 -6.2% -7.6% -7.1% -6.4% 2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9% Regression Estimate 2006 187 375 562 Regression Estimate 2013 186 313 499 499			2006	194	396	590	992					
2009 182 320 502 930 0.0% -12.6% -8.4% 0.1% 2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9% Regression Estimate 2006 187 375 562 Regression Estimate 2013 186 313 499 499			2008	182	366	548	929	-6.2%	-7.6%	-7.1%	-6.4%	
2011 181 293 474 829 -0.5% -8.4% -5.6% -10.9% 2013 193 349 542 944 6.6% 19.1% 14.3% 13.9% Regression Estimate Regression Estimate 2006 187 375 562 562 513 186 313 499 542 562 <td></td> <td></td> <td>2009</td> <td>182</td> <td>320</td> <td>502</td> <td>930</td> <td>0.0%</td> <td>-12.6%</td> <td>-8.4%</td> <td>0.1%</td>			2009	182	320	502	930	0.0%	-12.6%	-8.4%	0.1%	
2013 193 349 542 944 6.6% 19.1% 14.3% 13.9% Regression Estimate 2006 187 375 562 Regression Estimate 2013 186 313 499			2011	181	293	474	829	-0.5%	-8.4%	-5.6%	-10.9%	
Regression Estimate 2006 187 375 562 Regression Estimate 2013 186 313 499			2013	193	349	542	944	6.6%	19.1%	14.3%	13.9%	
Regression Estimate 2006 187 375 562 Regression Estimate 2013 186 313 499					-							
Regression Estimate 2013 186 313 499		Regression Estimate	2006	187	375	562						
		Regression Estimate	2013	186	313	499						
Average Annual Change -0.05% -2.58% -1.70%		Average Annual Change		-0.05%	-2.58%	-1.70%						

Carp/ March <u>PM Peak</u>

		Nort	h Leg	South	n Leg	East	Leg	Wes	Total	
Year	Date	SB	NB	NB	SB	WB	EB	EB	WB	lotal
2006	Monday 8 Mav	171	255	407	200					1033
2008	Tuesday 3 June	214	167	182	366					929
2009	Tuesday 16 June 2009	170	407	547	202					1326
2011	Thursday 30 June	192	235	362	230					1019
2013	Tuesday 20 August	215	279	413	228					1135
			ļ <u> </u>				1		Į	
				Cou	nts			% Cł	nange	
	North Leg	Year	NB	SB	NB+ SB	INT	NB	SB	NB+ SB	INT
	5	2006	255	171	426	1033				
		2008	167	214	381	929	-34.5%	25.1%	-10.6%	-10.1%
		2009	407	170	577	1326	143.7%	-20.6%	51.4%	42.7%
		2011	235	192	427	1019	-42.3%	12.9%	-26.0%	-23.2%
		2013	279	215	494	1135	18.7%	12.0%	15.7%	11.4%
				-						
	Regression Estimate	2006	255	177	432					
	Regression Estimate	2013	283	209	492					
	Average Annual Change		1.50%	2.38%	1.87%					
				Cou	nts			% Cł	nange	
	West Leg	Year	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
		2006				1033				
		2008				929				-10.1%
		2009				1326				42.7%
		2011				1019				-23.2%
		2013				1135				11.4%
	Regression Estimate Average Annual Change	2013						o/		
	Fact / cr	Year	CD	Cou		INT	50	% Cr	nange	
	East Leg	2006	EB	W B	EB+WB	1022	EB	WB	EB+WB	1 N 1
		2006				1033				10 19/
		2008				929				-10.1%
		2009				1010				42.7 /0
		2011				1125				-23.2%
	l	2013				1135				11.4%
	Regression Estimate	2006								
	Regression Estimate	2000								
	Average Appual Change	2013								
	Average Annual Ghange									
	ſ			Cou	nte			% Cł	ande	
	South Lea	Year	NB	SR		INT	NR	SR SR	NR+SR	INT
	Courn Log	2006	407	200	607	1033	ND	50	ND+ 5D	11111
		2000	182	366	548	920	-55 3%	83.0%	-9.7%	-10 1%
		2000	547	202	749	1326	200.5%	-44.8%	36.7%	42 7%
		2003	362	230	592	1019	-33.8%	13.9%	-21.0%	-23.2%
		2013	413	230	641	1125	- 33.0 %	-0.9%	- 2 1.0 /o 9 30/	-20.2%
	l	2013	413	220	041	1133	14.170	-0.9%	0.3%	11.4%
	Regression Estimate Regression Estimate Average Annual Change	2006 2013	358 408 1.89%	255 235 -1.17%	613 643 0.68%					

Appendix D

SYNCHRO Analysis: Projected Conditions

Projected AM 1: Carp & March

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	×	Δ.	×	1.	×	1.	×	Δ.
Volume (vph)	58	358	105	80	38	141	22	260
Lane Group Flow (vph)	61	524	111	93	40	206	23	306
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	22.0	22.0	22.0	22.0	22.1	22.1	22.1	22.1
Actuated g/C Ratio	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
v/c Ratio	0.13	0.77	0.54	0.14	0.10	0.30	0.05	0.45
Control Delay	11.3	22.8	23.8	10.5	14.6	13.7	14.1	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.3	22.8	23.8	10.5	14.6	13.7	14.1	16.7
LOS	В	С	С	В	В	В	В	В
Approach Delay		21.6		17.7		13.8		16.6
Approach LOS		С		В		В		В
Queue Length 50th (m)	3.7	41.3	8.1	5.3	2.5	11.9	1.4	21.3
Queue Length 95th (m)	10.3	78.0	23.2	13.2	9.8	32.7	6.5	52.3
Internal Link Dist (m)		511.9		443.6		1943.8		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	1006	1387	432	1423	797	1387	908	1422
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	0.38	0.26	0.07	0.05	0.15	0.03	0.22
Intersection Summary								
Cycle Length: 102.4								
Actuated Cycle Length: 56.7								
Natural Cycle: 60								
Control Type: Actuated-Uncoordinated								
Maximum v/c Ratio: 0.77								
Intersection Signal Delay: 18.4				In	tersection L	OS: B		
Intersection Capacity Utilization 86.1%				IC	U Level of S	Service E		
Analysis Period (min) 15								
Splits and Phases: 1: Carp & March								

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
Volume (veh/h)	4	0	7	12	7	44	6	365	5	6	255	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	4	0	7	13	7	46	6	384	5	6	268	7
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	734	687	272	692	688	387	276			389		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	734	687	272	692	688	387	276			389		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	99	96	98	93	100			99		
cM capacity (veh/h)	305	366	767	352	365	661	1287			1169		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	12	66	396	282								
Volume Left	4	13	6	6								
Volume Right	7	46	5	7								
cSH	494	526	1287	1169								
Volume to Capacity	0.02	0.13	0.00	0.01								
Queue Length 95th (m)	0.5	3.3	0.1	0.1								
Control Delay (s)	12.5	12.8	0.2	0.2								
Lane LOS	В	В	А	А								
Approach Delay (s)	12.5	12.8	0.2	0.2								
Approach LOS	В	В										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			34.7%	ICI	J Level of S	ervice			А			
Analysis Period (min)			15									

Projected AM 2: Carp & McGee Side

Projected AM 9: Carp & Site

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Movement FRI FRR NRI NRT SRT SRP
Lane Configurations
Volume (veh/h) 20 20 115 214 386 115
Sign Control Stop Free Free
Grade 0% 0% 0%
Peak Hour Factor 0.95 0.95 0.95 0.95 0.95 0.95
Hourly flow rate (vph) 21 21 121 225 406 121
Pedestrians
Lane Width (m)
Walking Speed (m/s)
Percent Blockage
Right turn flare (veh)
Median type None None
Median storage veh)
Upstream signal (m)
pX, platoon unblocked
vC, conflicting volume 934 467 527
vC1, stage 1 conf vol
vC2, stage 2 conf vol
vCu, unblocked vol 934 467 527
tC, single (s) 6.4 6.2 4.1
tC, 2 stage (s)
tF (s) 3.5 3.3 2.2
p0 queue free % 92 96 88
cM capacity (veh/h) 261 596 1040
Direction, Lane # EB 1 NB 1 SB 1
Volume Total 42 346 527
Volume Left 21 121 0
Volume Right 21 0 121
cSH 363 1040 1700
Volume to Capacity 0.12 0.12 0.31
Queue Length 95th (m) 3.0 3.0 0.0
Control Delay (s) 16.2 3.9 0.0
Lane LOS C A
Approach Delay (s) 16.2 3.9 0.0
Approach LOS C
Intersection Summary
Average Delay 2.2
Intersection Capacity Utilization 60.8% ICU Level of Service
Analysis Period (min) 15

Projected PM 1: Carp & March

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	×	Δ.	×	1.	×	Δ.	×	Δ.
Volume (vph)	50	86	53	402	175	278	19	182
Lane Group Flow (yph)	53	135	56	440	184	369	20	248
	Perm	NΔ	Perm	NΔ	Porm	NΔ	Perm	NΔ
Protected Phases	1 Onn	4	1 0111	8	1 Onn	2	1 01111	6
Permitted Phases	4	-	8	0	2	-	6	0
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase	-	-	0	0	٢	-	0	0
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Solit (s)	27.2	27.2	27.2	27.2	21.0	21.0	21.0	21.0
Total Split (s)	51.2	51.2	51.2	51.2	51.2	£1.2 51.0	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Vellow Time (s)	16	1 6	1 6	1 6	1 6	16	16	1 6
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lost Time Adjust (s)	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Lost Time (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Leau/Lay								
	None	None	None	None	Min	Min	Min	Min
Act Effet Croop (a)	19.0	19.0	19.0	19.0	10111	10111	10111	10111
Act Elici Green (S)	18.9	18.9	18.9	18.9	22.7	22.7	22.7	22.7
Actualed g/C Rallo	0.35	0.35	0.35	0.35	0.42	0.42	0.42	0.42
V/C Rallo	0.23	0.22	0.13	0.71	0.41	0.50	0.05	0.34
Control Delay	15.2	10.8	12.7	22.1	16.3	15.5	12.4	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	10.8	12.7	22.1	16.3	15.5	12.4	12.9
LUS	В	B	В	0	В	B	В	B
Approach Delay		12.0		21.1		15.7		12.9
Approach LOS		В	<u>.</u>	C		B		B
Queue Length 50th (m)	3.3	6.5	3.4	33.7	11.1	22.1	1.0	13.2
Queue Length 95th (m)	11.3	18.2	10.7	69.8	33.4	57.8	5.4	36.9
Internal Link Dist (m)	445.0	511.9	60 0	443.6	445.0	2479.8	100.0	206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vpn)	558	1445	1016	1506	916	1470	753	1466
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	0.09	0.09	0.06	0.29	0.20	0.25	0.03	0.17
Intersection Summary								
Cycle Length: 102.4								
Actuated Cycle Length: 54.3								
Natural Cycle: 55								
Control Type: Actuated-Uncoordinated								
Maximum v/c Ratio: 0.71								
Intersection Signal Delay: 16.5				In	tersection L	US: B		
Intersection Capacity Utilization 89.9%				IC	U Level of S	Service E		
Analysis Period (min) 15								
Splits and Phases: 1: Carp & March								
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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			\$			\$			\$	
Volume (veh/h)	7	9	5	12	4	29	8	285	18	39	518	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	7	9	5	13	4	31	8	300	19	41	545	13
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	993	969	552	970	966	309	558			319		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	993	969	552	970	966	309	558			319		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	96	99	94	98	96	99			97		
cM capacity (veh/h)	206	243	534	216	244	731	1013			1241		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	22	47	327	599								
Volume Left	7	13	8	41								
Volume Right	5	31	19	13								
cSH	261	403	1013	1241								
Volume to Capacity	0.08	0.12	0.01	0.03								
Queue Length 95th (m)	2.1	3.0	0.2	0.8								
Control Delay (s)	20.1	15.1	0.3	0.9								
Lane LOS	С	С	А	А								
Approach Delay (s)	20.1	15.1	0.3	0.9								
Approach LOS	С	С										
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utilization			59.4%	IC	U Level of S	ervice			В			
Analysis Period (min)			15									

Projected PM 2: Carp & McGee Side

Projected PM 3: Carp & Site

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EBR	NBL	NBT	SBT	SBR
		4	Ţ.	
130	45	443	252	25
		Free	Free	
		0%	0%	
0.95	0.95	0.95	0.95	0.95
137	47	466	265	26
		None	None	
278	292			
278	292			
6.2	4.1			
3.3	2.2			
82	96			
760	1270			
NB 1	SB 1			
514	292			
47	0			
0	26			
1270	1700			
0.04	0.17			
0.9	0.0			
1.1	0.0			
A				
1.1	0.0			
	4.0			
	65.4%	ICI	U Level of Servi	ice
	15			
	EBR 130 0.95 137 278 278 6.2 3.3 82 760 NB 1 514 47 0 1270 0.04 0.9 1.1 A 1.1	EBR NBL 130 45 0.95 0.95 137 47 137 47 278 292 278 292 6.2 4.1 3.3 2.2 82 96 760 1270 NB1 SB1 514 292 47 0 0 26 1270 1700 0.04 0.17 0.9 0.0 1.1 0.0 4.0 65.4% 15 4.0	EBR NBL NBT 130 45 443 Free 0% 0.95 0.95 0.95 137 47 466 278 292 1 278 292 1 278 292 1 3.3 2.2 82 96 760 1270 NB1 SB 1 1 514 292 47 47 0 0 1270 1700 0.04 0.17 0.9 0.0 1.1 0.0 A 1.1 0.0 15	EBR NBL NBT SBT 130 45 443 252 Free Free Free 0% 0% 0 0.95 0.95 0.95 0.95 137 47 466 265 278 292 278 292 278 292 278 292 6.2 4.1 3.3 2.2 282 82 96 760 1270 1270 NB 1 SB 1 514 292 47 0 0 0.04 0.17 0.0 0.0 1.1 0.0 4.0 1.1 0.0 4.0 1.1 0.0 1.1 0.0 1.1 1.0 1.1 1.1 0.0 1.1 1.1 0.0 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1

Appendix E

Left-Turn Lane Warrant Analysis

				Design Speed	Advancing Traffic Volume (V _A)		Opposing Traffic Volume (V _o)		Left Turn Traffic Volume (V _L)		% of Left Turning Traffic		Warrant Left Turn
					AM	PM	AM	PM	AM	PM	AM	PM	Lane
Existing													
Carp/Site				90	329	488	501	277	115	45	35%	9%	Yes
		4	t	r	Ļ	t		_	→	-		←	▲
_	Peak	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
		Warrant?											
	AM	115	214			386	115	20		20			
	PM	45	443			252	25	70		130			

