

MEMORANDUM

Date: January 22, 2020

Project #: 23377

To: Jim Hodges & Curleigh "Jim" Carothers
City of Camas
616 NE 4th Avenue
Camas, WA 98607

From: Hermanus Steyn, PE & Jamestaun Kraupp, EI

CC: Greg Jellison, PE & Cory Kratovil, PE

Project: Lake Road/Everett Street Intersection Project

Subject: NE 35th Avenue Intersection Operations Analysis

An analysis of the NE Everett Street/NE 35th Avenue intersection operations was prepared to assess how alternative traffic control options at the NE Lake Road/SR500 (NE Everett Street) intersection impact left-turns from NE 35th Avenue onto NE Everett Street¹. The supplemental analysis determined that installation of a roundabout at the NE Lake Road/NE Everett Street will result in less delay for NE 35th Avenue left-turns as compared to operation of the NE Lake Road/NE Everett Street with a traffic signal.

This memorandum supplements the March 2019 Intersection Control Memorandum prepared for the NE Lake Road/NE Everett Street intersection, providing additional background information as well as the supplemental analysis methodology, assumptions and findings related to NE 35th Avenue.

Background

Community members had voiced concerns how traffic control at the NE Lake Road/NE Everett Street intersection will impact drivers completing westbound left turns from NE 35th Avenue onto southbound NE Everett Street in the near-term and long-term future. It was noted that left-turn drivers on NE 35th Avenue have to simultaneously find both 1) a sufficient gap in northbound gap traffic on NE Everett Street (impacted by platoons from the signalized intersection at NE Lake Road today) and 2) a sufficient gap in southbound queues on NE Everett Street approaching the NE Lake Road signal to complete their turning movement. Noting that finding a sufficient number of simultaneous gaps in both the northbound and southbound traffic can be challenging today, questions were posed regarding the potential implications of long-term traffic growth.

¹ NE 35th Avenue is located approximately 500 feet north of the NE Lake Road/NE Everett Street intersection

Analysis Assumptions

A supplemental analysis was prepared to assess future operations at the NE Everett Street/NE 35th Avenue intersection. Year 2040 weekday AM and PM peak hour turning movement volumes were developed for the NE Everett Street/NE 35th Avenue intersection consistent with the methodology outlined in the March 2019 report. Projected future traffic volumes on NE 35th Avenue were estimated considering travel demand projections obtained from the Southwest Washington Regional Transportation Council (RTC) travel demand model and considering potential future land development along vacant properties on the NE 35th Avenue corridor.

The 2015/2040 RTC travel demand model presents link volumes for the NE 38th Avenue corridor but does not include the NE 35th Avenue corridor (refer to the attached Appendix A). Lacking data specific to NE 35th Avenue, future AM and PM peak hour turn movements to/from the NE 35th Avenue corridor at NE Everett Street were estimated assuming residential development of the area between NE 38th Avenue and NE 35th Avenue effectively doubles current turn movement demand at the intersection.

Analysis Findings

Appendix D summarizes the existing 2020 and projected future 2040 weekday AM and PM peak hour traffic volumes, respectively. Appendix B provides the existing traffic counts.

Table 1 and Exhibit 1 summarize the Total Delay per Vehicle in seconds and Max Queue in feet for the existing and projected future traffic conditions for the critical movement, westbound left, of the NE Everett and NE 35th intersection. It should be noted that these results are the operational outcomes from the signal analysis, assuming southbound queues on NE Everett Street and NE Lake Road reach and block NE 35th Avenue left turn movements. As shown, with southbound queues blocking NE 35th Avenue, the westbound left-turn on NE 35th Avenue is projected to experience lengthy delays and queues. The comparatively highest demand and corresponding longest delays are projected during the weekday AM peak hour (when most residents are leaving their homes). The stop controlled westbound left-turn is projected to experience a delay of 1,907 seconds (over 30 minutes) during the typical 2040 weekday AM peak hour.

Table 1. NE 35th Avenue/NE Everett Street Intersection Performance

Analysis Year	Critical Movement	Weekday AM Peak Hour		Weekday PM Peak Hour	
		Total Delay / Veh (s) (mins)	Max Queue (ft)	Total Delay / Veh (s) (mins)	Max Queue (ft)
Existing	Westbound left-turn	310 (approx. 5 mins)	135	169 (approx. 3 mins)	50
2040	Westbound left-turn	1,907 (approx. 31 mins)	355	919 (approx. 15 mins)	200

Appendix C provides the analysis worksheets for the existing and 2040 weekday AM and PM peak hour conditions. The worksheets show the maximum queues and delay that vehicles are projected to experience in the existing and 2040 conditions based on the average of five (5) simulations per condition. It should be noted that the southbound movement for all conditions show max queues

lengths greater than 500 feet. This is the result of queues for the NE lake and Everett intersection, in the signal condition, backing up past the intersection of NE Everett and NE 35th.

NE Lake Road/NE Everett Street Intersection Traffic Control Implications

The March 2019 report studied both future signal and roundabout configurations at the NE Lake Road/NE Everett Street intersection. The traffic control device implemented at NE Lake Road will have implications for operations at NE 35th Avenue as outlined below in Table 2.

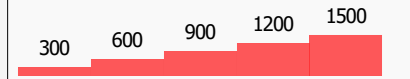
Consideration		Traffic Signal at Lake Road	Roundabout at Lake Road
Gaps in northbound NE Everett Street traffic	Conclusion	Results in comparatively fewer gaps	<i>Results in comparatively more gaps</i>
	Rationale	Traffic signal phasing required to operate the NE Lake Road intersection efficiently will result in near continuous northbound traffic flow through the intersection (e.g., protected eastbound left-turn followed by northbound through movement) with only a few seconds between signal phases	The circular configuration of a roundabout in combination with volume patterns similar to the NE Lake Road intersection will slow vehicles through the roundabout, creating more gaps and reducing platooning compared to a signal while increasing yielding behavior. In this way a roundabout is similar to a four-way stop
Gaps in southbound NE Everett Street queues waiting for NE Lake Road signal	Conclusion	Longer southbound queues result in fewer gaps	<i>Shorter southbound queues result in more gaps</i>
	Rationale	Southbound vehicle queues waiting for the signal are likely to block the NE 35 th Avenue intersection comparatively more often	Southbound vehicle queues using the roundabout are shorter than those associated with signalization
Overall Finding		Comparatively fewer gaps for NE 35 th Avenue westbound left-turn	<i>Comparatively more gaps for NE 35th Avenue westbound left-turn</i>

The findings presented in Table 2 document how installation of a roundabout at the NE Lake Road/NE Everett Street intersection will benefit turns from NE 35th Avenue onto NE Everett Street as compared to a signalization. This was one of many considerations that led to identification of a roundabout as the preferred project option.

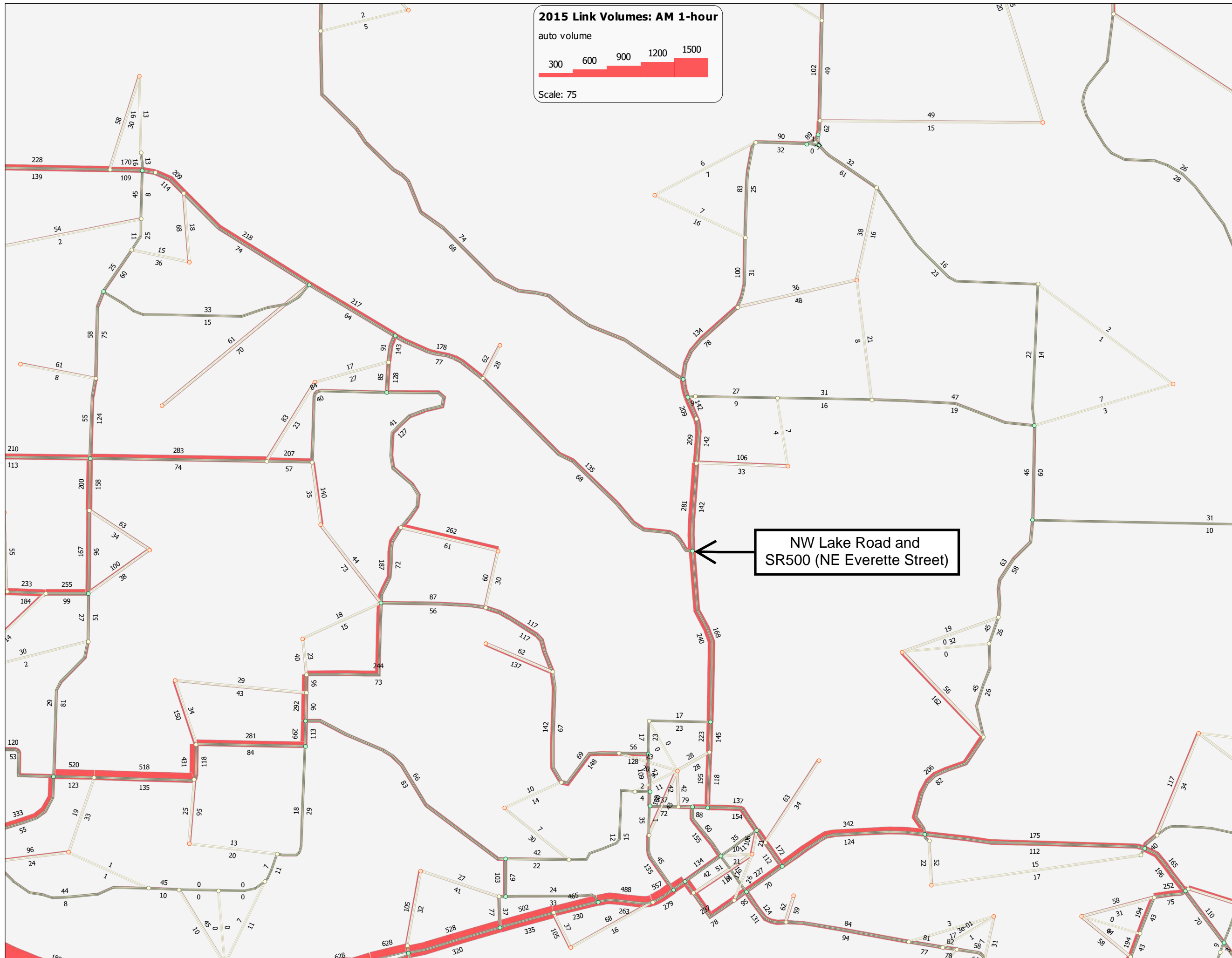
APPENDIX A
2015/2040 REGIONAL TRANSPORTATION COUNCIL (RTC)
LINK VOLUMES

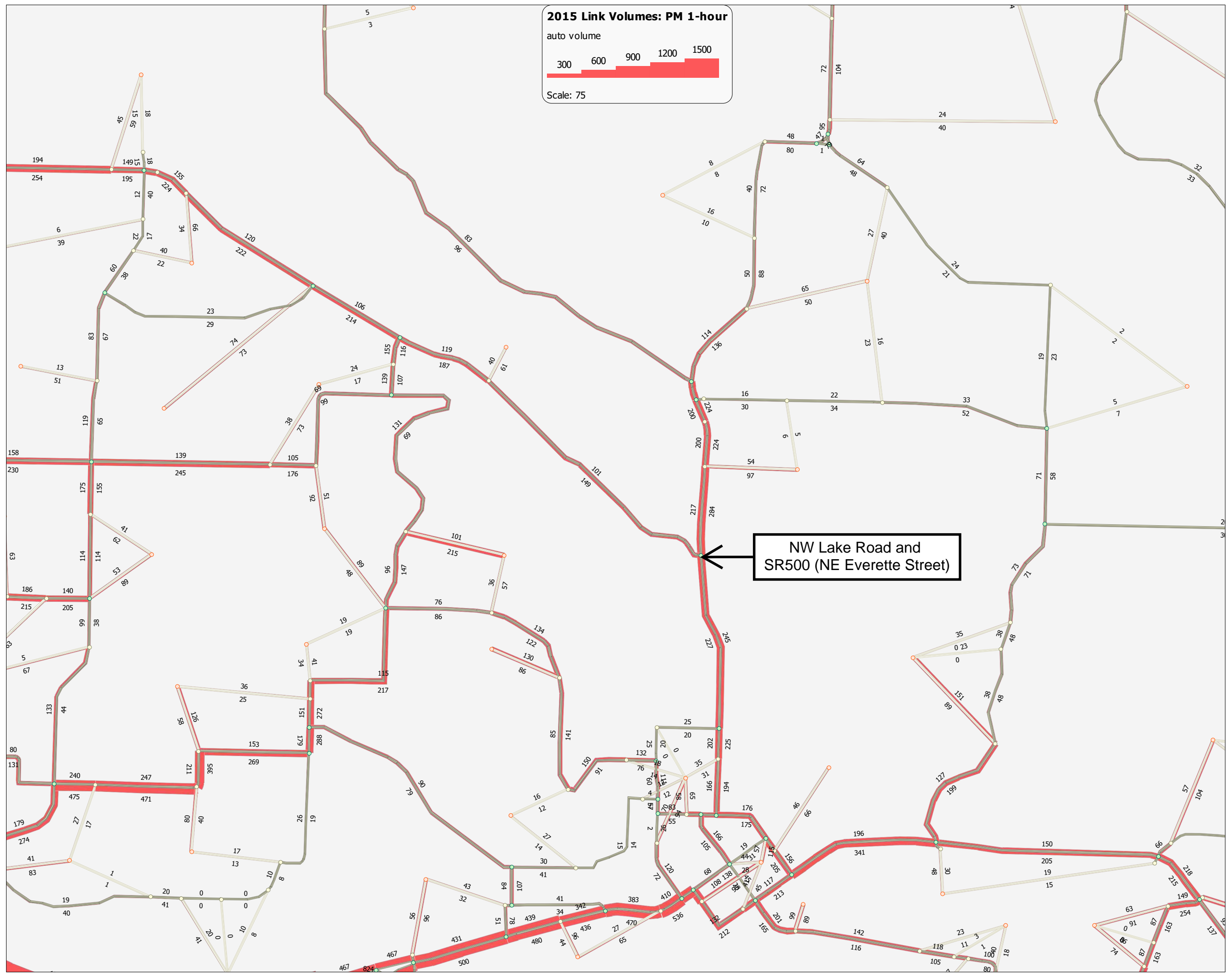
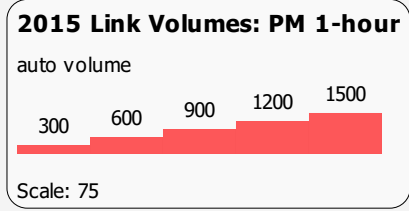
2015 Link Volumes: AM 1-hour

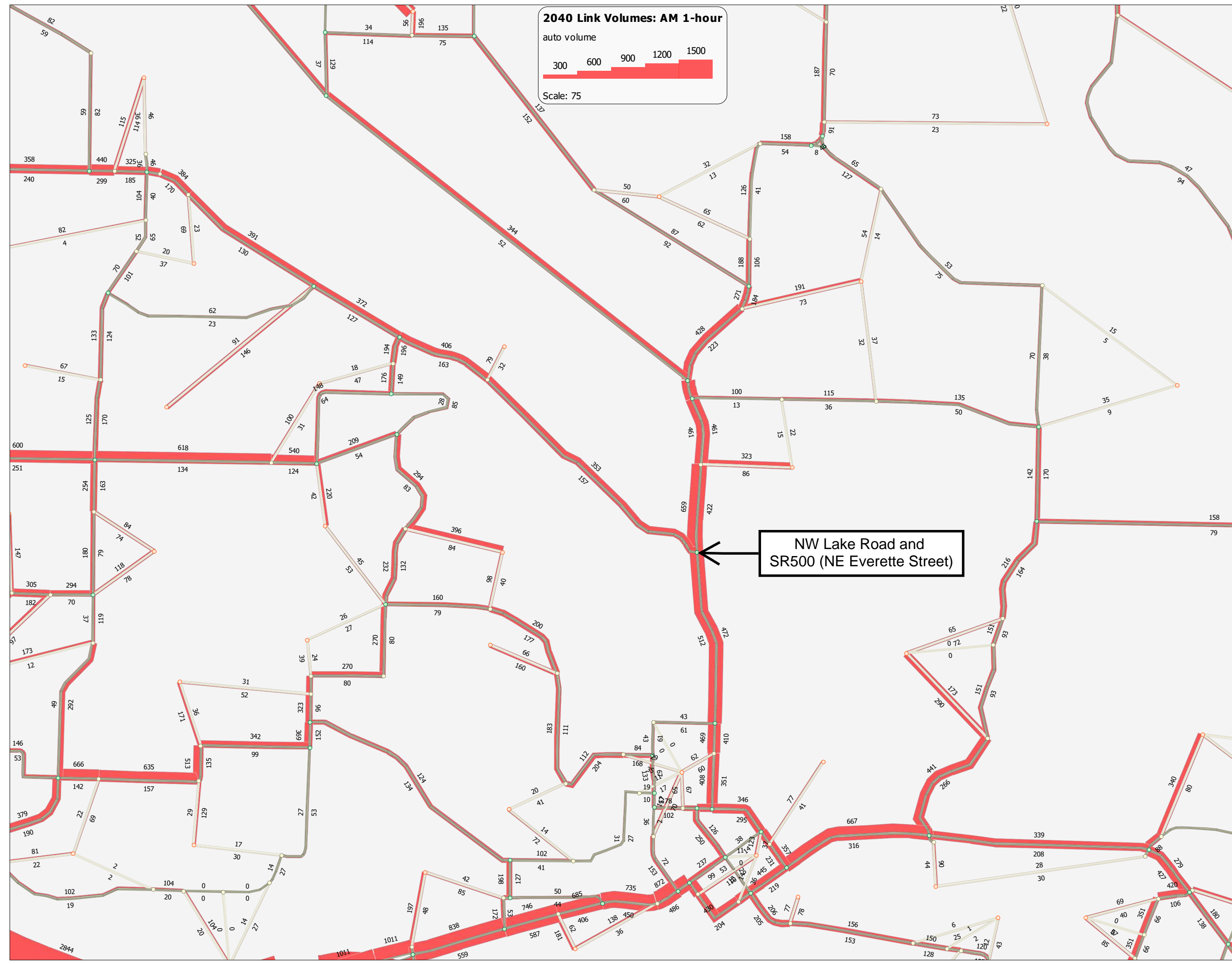
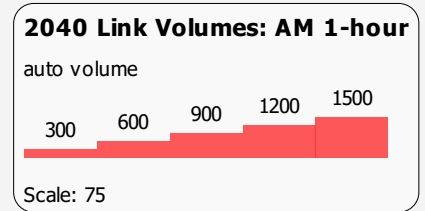
auto volume



Scale: 75



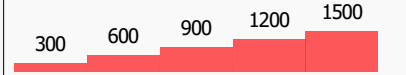




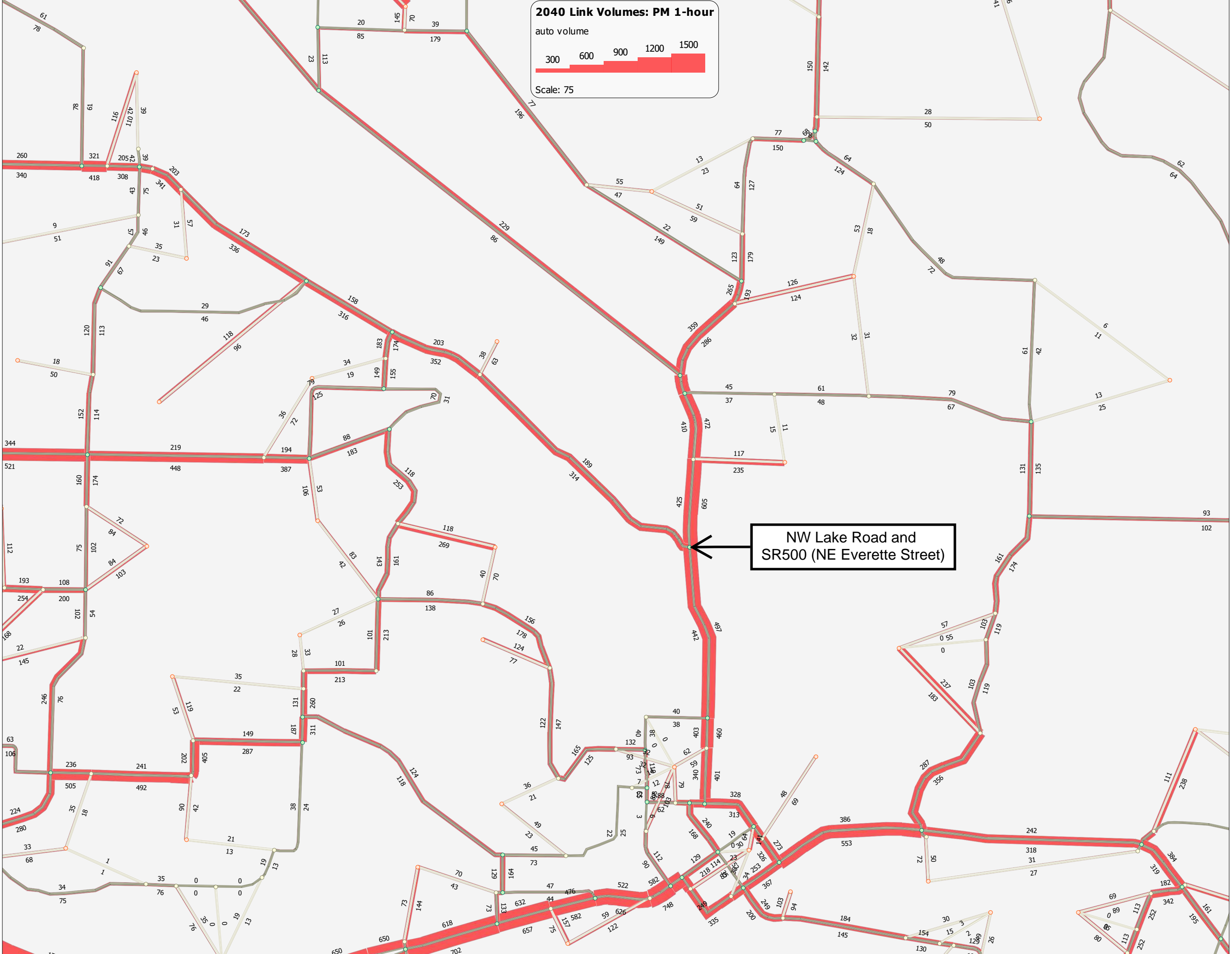
NW Lake Road and
SR500 (NE Everett Street)

2040 Link Volumes: PM 1-hour

auto volume



Scale: 75



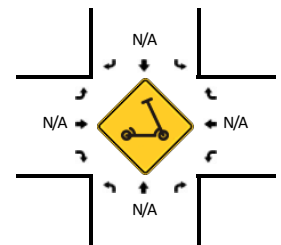
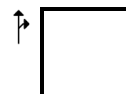
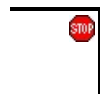
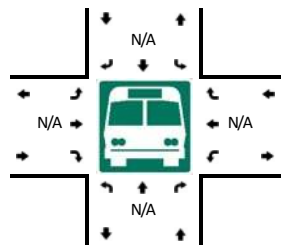
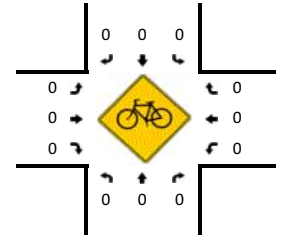
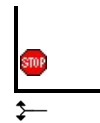
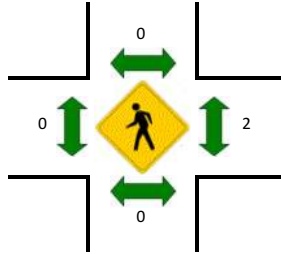
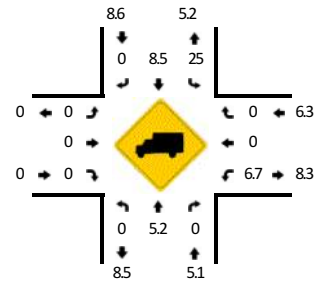
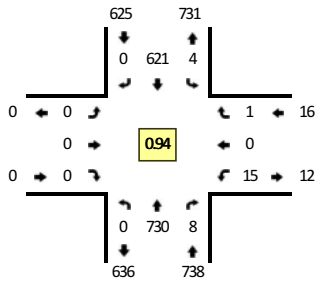
NW Lake Road and
SR500 (NE Everett Street)

APPENDIX B
QUALITY COUNT VOLUMES FOR NE 35TH AVENUE

LOCATION: NE Everett St -- NE 35th Ave
CITY/STATE: Camas, WA

QC JOB #: 15155601
DATE: Thu, Jan 9 2020

Peak-Hour: 7:55 AM -- 8:55 AM
Peak 15-Min: 7:55 AM -- 8:10 AM



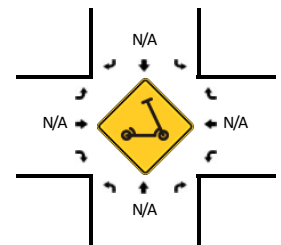
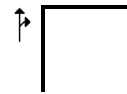
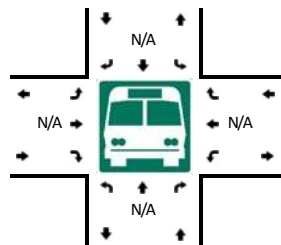
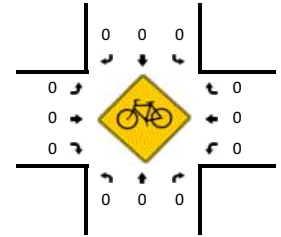
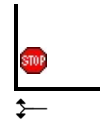
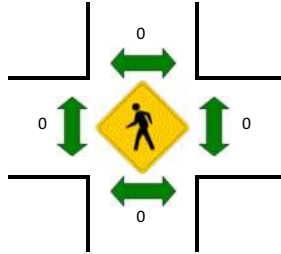
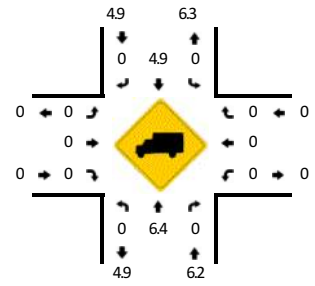
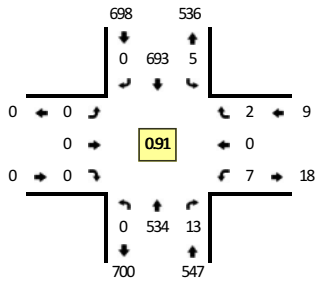
5-Min Count Period Beginning At	NE Everett St (Northbound)				NE Everett St (Southbound)				NE 35th Ave (Eastbound)				NE 35th Ave (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	23	0	0	0	20	0	0	0	0	0	0	1	0	0	0	44	
7:05 AM	0	26	0	0	0	34	0	0	0	0	0	0	1	0	0	0	61	
7:10 AM	0	36	0	0	0	21	0	0	0	0	0	0	0	0	0	0	57	
7:15 AM	0	35	1	0	0	31	0	0	0	0	0	0	0	0	0	0	67	
7:20 AM	0	54	0	0	0	35	0	0	0	0	0	0	2	0	1	0	92	
7:25 AM	0	29	1	0	0	27	0	0	0	0	0	0	2	0	0	0	59	
7:30 AM	0	20	0	0	0	38	0	0	0	0	0	0	0	0	0	0	58	
7:35 AM	0	30	1	0	0	36	0	0	0	0	0	0	1	0	0	0	68	
7:40 AM	0	26	0	0	0	23	0	0	0	0	0	0	0	0	0	0	49	
7:45 AM	0	38	1	0	0	33	0	0	0	0	0	0	2	0	0	0	74	
7:50 AM	0	54	0	0	0	31	0	0	0	0	0	0	2	0	1	0	88	
7:55 AM	0	72	2	0	0	48	0	0	0	0	0	0	0	0	0	0	122	839
8:00 AM	0	88	1	0	0	35	0	0	0	0	0	0	2	0	0	0	126	921
8:05 AM	0	71	0	0	0	44	0	0	0	0	0	0	3	0	1	0	119	979
8:10 AM	0	67	1	0	0	44	0	0	0	0	0	0	1	0	0	0	113	1035
8:15 AM	0	71	0	0	1	51	0	0	0	0	0	0	1	0	0	0	124	1092
8:20 AM	0	61	1	0	0	66	0	0	0	0	0	0	2	0	0	0	130	1130
8:25 AM	0	58	0	0	0	47	0	0	0	0	0	0	0	0	0	0	105	1176
8:30 AM	0	63	0	0	0	60	0	0	0	0	0	0	0	0	0	0	123	1241
8:35 AM	0	65	0	0	2	56	0	0	0	0	0	0	3	0	0	0	126	1299
8:40 AM	0	44	1	0	1	46	0	0	0	0	0	0	1	0	0	0	93	1343
8:45 AM	0	31	0	0	0	55	0	0	0	0	0	0	2	0	0	0	88	1357
8:50 AM	0	39	2	0	0	69	0	0	0	0	0	0	0	0	0	0	110	1379
8:55 AM	0	40	0	0	0	52	0	0	0	0	0	0	2	0	0	0	94	1351
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	924	12	0	0	508	0	0	0	0	0	0	20	0	4	0	1468	
Heavy Trucks	0	32	0	0	0	44	0	0	0	0	0	0	0	0	0	0	76	
Buses																		
Pedestrians		0				0					0			0			0	
Bicycles	0	0	0		0	0	0			0	0	0	0	0	0		0	
Scoters																		

Comments:

LOCATION: NE Everett St -- NE 35th Ave
CITY/STATE: Camas, WA

QC JOB #: 15155602
DATE: Thu, Jan 9 2020

Peak-Hour: 3:00 PM -- 4:00 PM
Peak 15-Min: 3:20 PM -- 3:35 PM



5-Min Count Period Beginning At	NE Everett St (Northbound)				NE Everett St (Southbound)				NE 35th Ave (Eastbound)				NE 35th Ave (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
2:30 PM	0	29	0	0	0	12	0	0	0	0	0	0	0	0	0	0	41	
2:35 PM	0	31	2	0	0	22	0	0	0	0	0	0	0	1	0	0	56	
2:40 PM	0	53	3	0	0	31	0	0	0	0	0	0	0	2	0	0	89	
2:45 PM	0	39	1	0	0	34	0	0	0	0	0	0	0	4	0	1	79	
2:50 PM	0	55	1	0	0	29	0	0	0	0	0	0	0	0	0	0	85	
2:55 PM	0	55	0	0	0	38	0	0	0	0	0	0	0	2	0	0	95	
3:00 PM	0	49	2	0	1	34	0	0	0	0	0	0	0	1	0	0	87	
3:05 PM	0	49	0	0	0	77	0	0	0	0	0	0	0	0	0	0	126	
3:10 PM	0	40	0	0	0	53	0	0	0	0	0	0	0	0	0	0	93	
3:15 PM	0	48	0	0	0	53	0	0	0	0	0	0	0	1	0	0	102	
3:20 PM	0	48	0	0	0	68	0	0	0	0	0	0	0	2	0	0	118	
3:25 PM	0	37	0	0	0	74	0	0	0	0	0	0	0	1	0	0	112	1083
3:30 PM	0	48	1	0	1	64	0	0	0	0	0	0	0	0	0	1	115	1157
3:35 PM	0	50	3	0	0	48	0	0	0	0	0	0	0	1	0	0	102	1203
3:40 PM	0	38	2	0	0	49	0	0	0	0	0	0	0	0	0	1	90	1204
3:45 PM	0	37	0	0	0	64	0	0	0	0	0	0	0	0	0	0	101	1226
3:50 PM	0	32	3	0	2	56	0	0	0	0	0	0	0	1	0	0	94	1235
3:55 PM	0	58	2	0	1	53	0	0	0	0	0	0	0	0	0	0	114	1254
4:00 PM	0	47	2	0	0	29	0	0	0	0	0	0	0	1	0	0	79	1246
4:05 PM	0	39	2	0	0	24	0	0	0	0	0	0	0	1	0	0	66	1186
4:10 PM	0	52	1	0	0	31	0	0	0	0	0	0	0	1	0	0	85	1178
4:15 PM	0	49	2	0	0	35	0	0	0	0	0	0	0	1	0	0	87	1163
4:20 PM	0	35	2	0	0	36	0	0	0	0	0	0	0	2	0	0	75	1120
4:25 PM	0	30	3	0	0	33	0	0	0	0	0	0	0	3	0	0	69	1077
4:30 PM	0	37	0	0	0	30	0	0	0	0	0	0	0	1	0	0	68	1030
4:35 PM	0	34	2	0	0	31	0	0	0	0	0	0	0	1	0	0	68	996
4:40 PM	0	39	1	0	0	18	0	0	0	0	0	0	0	0	0	0	58	964
4:45 PM	0	39	0	0	0	29	0	0	0	0	0	0	0	0	0	0	68	931
4:50 PM	0	45	0	0	0	25	0	0	0	0	0	0	0	3	0	1	74	911
4:55 PM	0	31	2	0	0	32	0	0	0	0	0	0	0	1	0	0	66	863
5:00 PM	0	48	3	0	0	30	0	0	0	0	0	0	0	1	0	1	83	867
5:05 PM	0	36	1	0	0	24	0	0	0	0	0	0	0	1	0	0	62	863
5:10 PM	0	28	0	0	0	14	0	0	0	0	0	0	0	1	0	0	43	821
5:15 PM	0	52	1	0	0	26	0	0	0	0	0	0	0	1	0	0	80	814
5:20 PM	0	35	1	0	0	31	0	0	0	0	0	0	0	1	0	0	68	807
5:25 PM	0	36	1	0	0	24	0	0	0	0	0	0	0	0	0	0	61	799
5:30 PM	0	43	1	0	0	25	0	0	0	0	0	0	0	1	0	0	70	801
5:35 PM	0	33	0	0	0	22	0	0	0	0	0	0	0	1	0	0	56	789

5-Min Count Period Beginning At	NE Everett St (Northbound)				NE Everett St (Southbound)				NE 35th Ave (Eastbound)				NE 35th Ave (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
5:40 PM	0	59	2	0	0	32	0	0	0	0	0	0	1	0	0	0	94	825
5:45 PM	0	50	1	0	0	29	0	0	0	0	0	0	1	0	0	0	81	838
5:50 PM	0	61	2	0	0	25	0	0	0	0	0	0	0	0	0	0	88	852
5:55 PM	0	60	1	0	0	26	0	0	0	0	0	0	0	0	0	0	87	873
6:00 PM	0	39	0	0	0	33	0	0	0	0	0	0	2	0	1	0	75	865
6:05 PM	0	32	2	0	0	35	0	0	0	0	0	0	1	0	0	0	70	873
6:10 PM	0	40	3	0	1	30	0	0	0	0	0	0	0	0	0	0	74	904
6:15 PM	0	31	0	0	0	23	0	0	0	0	0	0	1	0	1	0	56	880
6:20 PM	0	22	0	0	0	18	0	0	0	0	0	0	0	0	0	0	40	852
6:25 PM	0	49	0	0	0	16	0	0	0	0	0	0	0	0	0	0	65	856
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	532	4	0	4	824	0	0	0	0	0	0	12	0	4	0	1380	
Heavy Trucks	0	16	0		0	28	0		0	0	0		0	0	0		44	
Buses																		
Pedestrians		0				0				0				0			0	
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0	
Scooters																	0	

Comments:

Report generated on 1/15/2020 3:20 PM

SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

APPENDIX C
2019/2040 OPERATIONS OUTPUT REPORTS

1: NE 35th Ave & NE Everett St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1	19.8	20.0
Denied Del/Veh (s)	0.1	0.1	0.3	0.0	127.5	115.6	54.4
Total Delay (hr)	1.5	0.2	0.3	0.0	0.1	10.6	12.7
Total Del/Veh (s)	313.9	374.3	1.6	1.2	47.4	70.4	36.5
Stop Delay (hr)	1.5	0.2	0.0	0.0	0.0	9.3	11.1
Stop Del/Veh (s)	312.3	373.0	0.0	0.0	39.6	61.8	31.8

Queuing and Blocking Report
Weekday AM Peak Hour

01/22/2020

Intersection: 1: NE 35th Ave & NE Everett St

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	135	512
Average Queue (ft)	51	369
95th Queue (ft)	133	669
Link Distance (ft)	478	461
Upstream Blk Time (%)		45
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

1: NE 35th Ave & NE Everett St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.2	28.7	28.9
Denied Del/Veh (s)	0.1	0.1	0.1	0.0	144.6	147.8	80.9
Total Delay (hr)	0.3	0.0	0.1	0.0	0.1	15.1	15.7
Total Del/Veh (s)	169.5	49.0	0.7	0.3	93.6	82.0	45.2
Stop Delay (hr)	0.3	0.0	0.0	0.0	0.1	13.1	13.5
Stop Del/Veh (s)	168.0	48.0	0.0	0.0	85.6	71.2	39.1

Queuing and Blocking Report
Weekday PM Peak Hour

01/22/2020

Intersection: 1: NE 35th Ave & NE Everett St

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	51	520
Average Queue (ft)	13	477
95th Queue (ft)	42	574
Link Distance (ft)	478	461
Upstream Blk Time (%)		73
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

1: NE 35th Ave & NE Everett St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	5.2	0.9	0.0	0.0	1.3	170.4	177.7
Denied Del/Veh (s)	662.6	846.9	0.0	0.0	501.2	578.7	315.8
Total Delay (hr)	10.1	0.7	2.0	0.0	0.2	14.0	27.0
Total Del/Veh (s)	1907.2	1289.7	7.8	6.4	88.3	63.8	55.6
Stop Delay (hr)	10.1	0.7	0.2	0.0	0.2	10.7	21.8
Stop Del/Veh (s)	1907.6	1289.9	0.7	0.8	75.4	48.8	45.0

Queuing and Blocking Report
Weekday AM Peak Hour

01/22/2020

Intersection: 1: NE 35th Ave & NE Everett St

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	355	5	574
Average Queue (ft)	268	0	541
95th Queue (ft)	420	3	642
Link Distance (ft)	329	341	514
Upstream Blk Time (%)	58		66
Queuing Penalty (veh)	0		0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

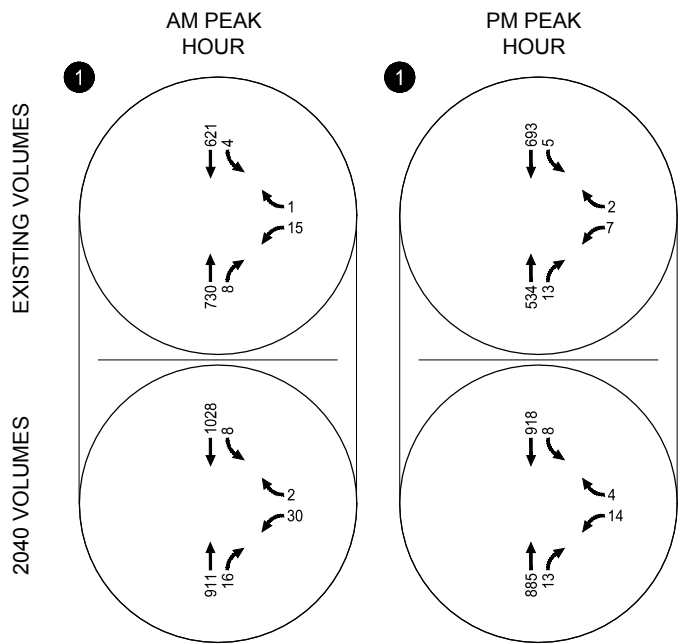
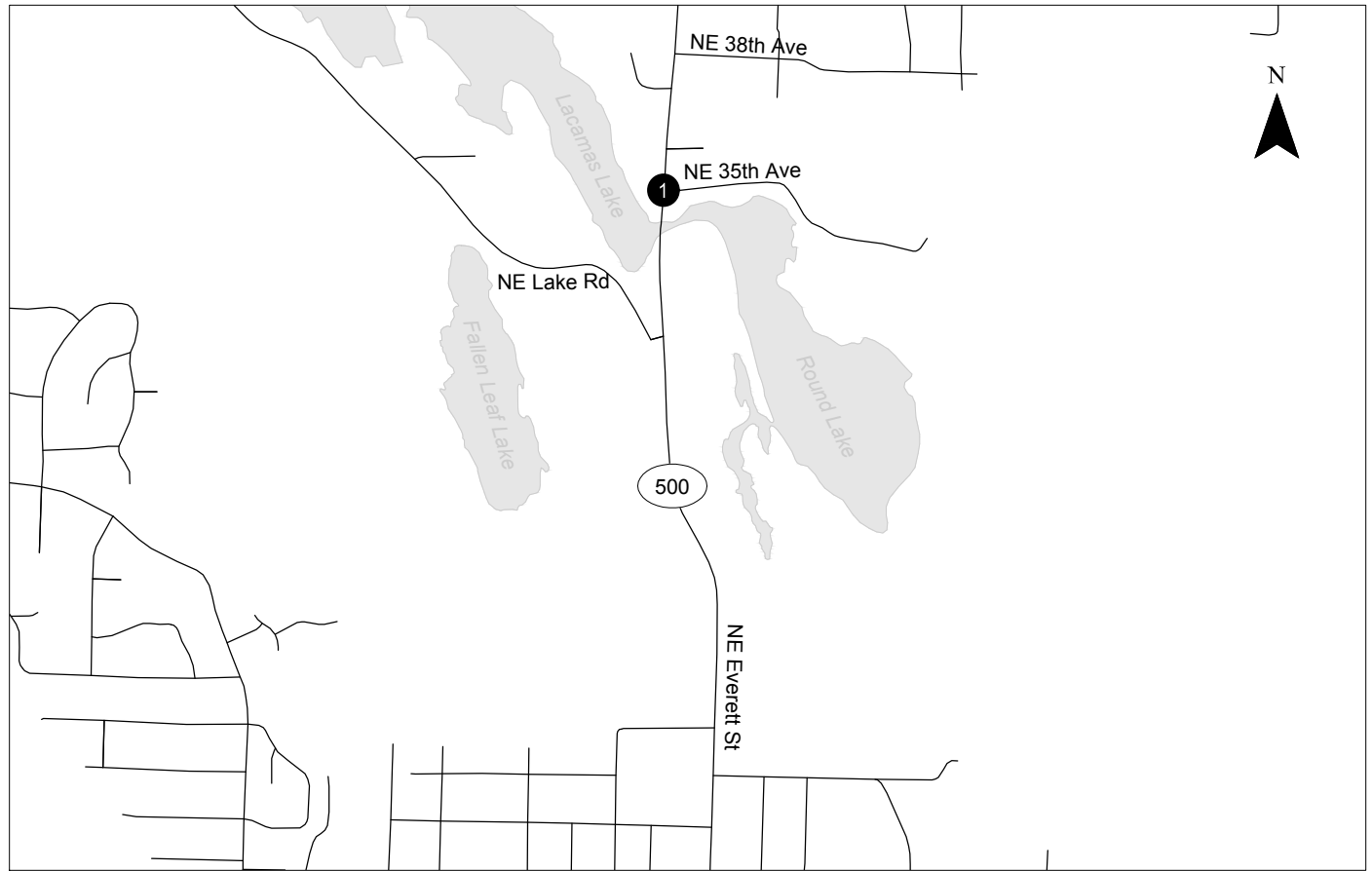
1: NE 35th Ave & NE Everett St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1	4.6	4.7
Denied Del/Veh (s)	0.1	0.2	0.1	0.0	20.4	18.6	9.1
Total Delay (hr)	3.6	0.8	2.0	0.0	0.2	5.5	12.1
Total Del/Veh (s)	919.3	693.9	7.9	7.0	59.5	22.1	23.4
Stop Delay (hr)	3.6	0.8	0.2	0.0	0.2	3.0	7.6
Stop Del/Veh (s)	918.8	693.8	0.7	0.9	49.1	11.9	14.8

Intersection: 1: NE 35th Ave & NE Everett St

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	200	4	557
Average Queue (ft)	102	0	229
95th Queue (ft)	232	3	624
Link Distance (ft)	329	341	514
Upstream Blk Time (%)	0		15
Queuing Penalty (veh)	0		0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

APPENDIX D
2020 / 2040 TRAFFIC VOLUME FIGURE



Year 2020 & 2040 Traffic Conditions
 Weekday AM & PM Peak Hours
 Camas, Washington

Figure 1

LOS = INTERSECTION LEVEL OF SERVICE
 Del = INTERSECTION AVERAGE CONTROL DELAY
 V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

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