NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Grand Forks Data Collection and Archival Study – Phase IIIa

Final Report

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Prepared for:
Grand Forks-East Grand Forks MPO

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INTRODUCTION

The Grand Forks – East Grand Forks MPO contacted ATAC with regards to expanding the use of existing traffic detection cameras for traffic data collection. Prior to this project, the City of Grand Forks had 31 intersections comprising of 122 cameras set for traffic data collection purposes. As part of the current project, 7 intersections comprising of 24 cameras are to be setup for traffic data collection.

Additionally, the MPO had requested a feasibility study to include rail preemption event data in the archival databases similar to those created during Phase II of the study. It is envisioned that if feasible, all intersections with rail preemption will be setup (under a separate study) such that Traffic Analysis web interface may be used to run rail preemption event reports.

OBJECTIVES

As part of this study, a total of 7 intersections (numbered 32-38) were to be set to count traffic volumes. The intersections included in this phase of the study are listed in table 1.

Table 1. Study intersections

#	**Main Street**	**Cross Street**
32	Gateway Drive	N 47th St
33	Gateway Drive	I-29 West Ramps
34	32nd Ave S	S 24th St
35	32nd Ave S	I-29 East Ramps
37	32nd Ave S	I-29 West Ramps
37	S Columbia Rd	11th Ave S
38	S Washington St	47th Ave S

METHODOLOGY

This study was divided into two major tasks:

- Data Collection Setup
- Rail Preemption Feasibility Check

The steps involved in both of these tasks are discussed below:

DATA COLLECTION SETUP

In this task, intersections were set to collect turning movement counts and mean speeds. This task comprised of intersection setup, data quality audits, and camera re-calibration. Each of these steps are discussed as below.

Intersection Setup

Each of the intersections was setup to count traffic one approach at a time. All of intersections had one camera per approach. Within each approach, setup was based on factors such as geometrics, lane assignment, and lane groups. For a camera, all lane groups with exclusive movements were counted separately using corresponding detector stations. However, in cases of shared lanes, two or more movements were combined and counted together in a single detector station. For example, at the northbound approach of S Columbia Rd @ 11th Ave S, the rightmost lane is shared by through and right-turning movements. Therefore, in this case, the right-turn movement has been set to be counted with the through movement and is reported to the same detector station. Refer to Table 2 for detailed information on lane assignments and detector stations set per approach.

Table 2. Intersection lane assignments and detector setup per approach*

Main Street	Cross Street	EB			NB			SB			WB		
		L	T	R	L	T	R	L	T	R	L	T	R
Gateway Drive	N 47th Street	•	•	•	•	•	•	•	•	•			
													
Gateway Drive	I-29 West Ramps	N/A	•	•	N/A	N/A	N/A	•	N/A	•	N/A	•	•
													
32nd Ave S	S 24th Street	N/A	•	•	•	N/A	•	N/A	N/A	N/A	•	•	N/A
													
32nd Ave S	I-29 East Ramps	•	•	N/A	•	•	•	N/A	N/A	N/A	N/A	•	•
													
32nd Ave S	I-29 West Ramps	N/A	•	•	N/A	N/A	N/A	•	N/A	•	•	•	N/A
													
S Columbia Rd	11th Ave S	•	•	•	•	•		•	•	•	•	•	•
													
S Washington St	47th Ave S	•	•	•	•	•	•	•	•	•	•	•	•
													

* Notes:

1. Each arrow corresponds to a lane group and may represent multiple lanes.
2. Each dot represents a separate detector station that counts the corresponding movement(s).

Similar to Phase II of the study, the updated detector configuration files were saved on the external drive connected to the Communications Server.

Data Quality Audits

Similar to Phase II of the study, for each of the cameras setup, random data quality audits were performed and traffic volumes were collected manually in 15-minute intervals. The manually collected traffic counts were then compared to camera output. Hourly traffic volumes (manual vs camera) were compared using GEH statistic which is computed as follows:

$$GEH = \sqrt{\frac{(A-M)^2}{(A+M)/2}}$$

Where:

A = Autoscope camera traffic count
M = Manual traffic count

Also, lane group peak hour factors (PHF) were compared for hourly traffic volumes. For intersection turning movement counts, PHF is computed as follows:

$$PHF = \frac{V}{4 \times V_{15}}$$

Where:

V = hourly volume
V15 = volume during the peak 15 minutes of flow

Camera Re-calibration/Re-aiming

It was found out that camera calibration at a couple of the approaches forced the detectors set near the edges of the view to be crooked. The calibration appeared to be crooked such that the calibration lines were not parallel to the direction of travel. This necessitated tweaking of calibration at the following approaches:

1. 32nd Ave S @ I-29 East Ramps EB, NB
2. 32nd Ave S @ I-29 West Ramps SB, WB
3. S Columbia Rd @ 11th Ave S EB, WB, NB

The improved calibration at these cameras is expected to improve not only the traffic counts but also presence and passage detection.

Note that the following camera needs to be re-aimed before it could be set for traffic data collection. The current view of the camera does not cover all of the lanes at the stop bar. It may also be necessary to set the zoom on this camera to a lower level.

1. Gateway Dr @ N 47th St WB

RAIL PREEMPTION FEASIBILITY CHECK

This task started with the sample signal event data received from the City of Grand Forks. This was followed by database building, Graphical User Interface (GUI) creation, and creation of reporting capabilities. Each of these steps are discussed as below.

Database Building

A script has been created that reads individual data entries in the raw data file into an intersection based Preemption database table. This table is in addition to the ADT and 15-minute tables, which were created during the Phase II of the study.

GUI Creation

A temporary Graphical User Interface has been created to enable running of the rail preemption report. Figure 1 below shows a screenshot of the same.

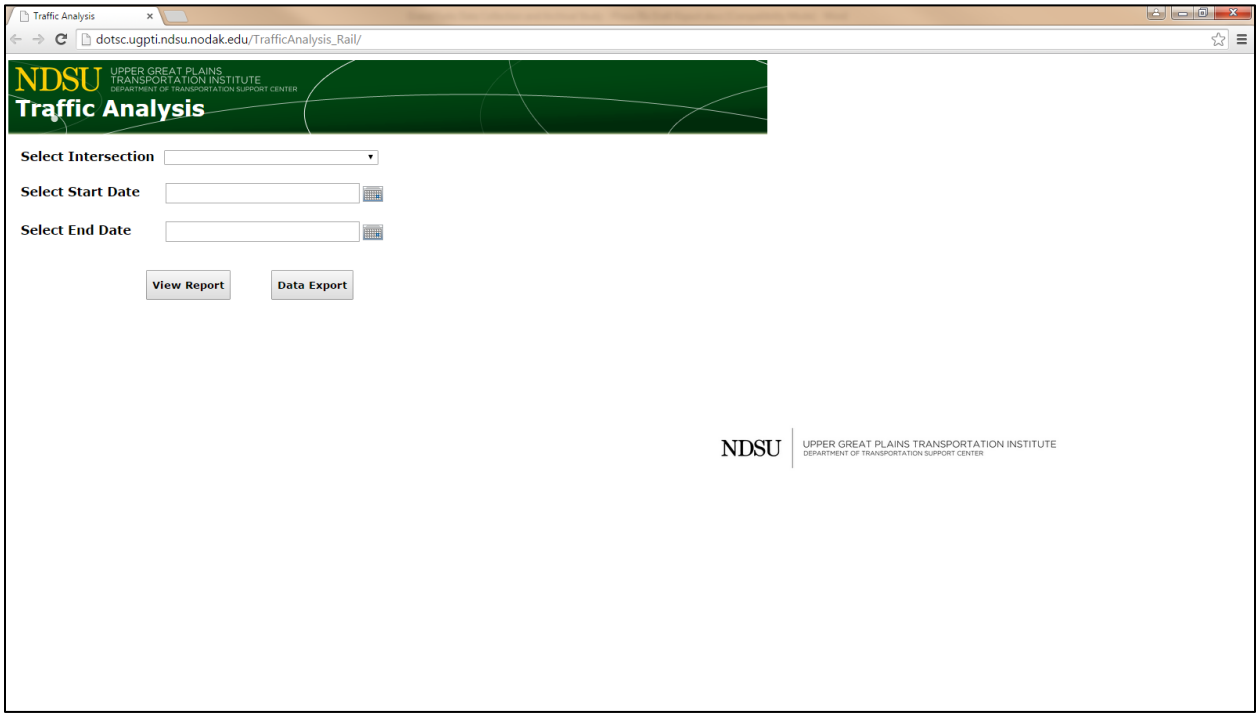

Figure 1. Screenshot of Rail Preemption Reporting Tool

Reporting Capabilities

The temporary GUI can be used to query the Traffic Analysis database and to subsequently create the following report:

- Signal Event Reports
  - Rail Preemption Report

The report is briefly discussed below.

Rail Preemption Report

The Rail Preemption report analyses the Signal Event database to create a table under the following categories:

1. Weekdays and Weekends
2. Weekdays Only
3. Weekend Only

For each of these categories, the report calculates the following statistics:

1. Total Events
2. Average Number of Events
3. Average Duration
4. Minimum Duration
5. Maximum Duration

Figure 2 below shows a sample Rail Preemption Report as created using the temporary GUI. As is evident from the sample report, this report can be created for one or multiple days. In case of multiple days, the reported statistics are averaged over the selected number of days.

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Rail Preemption Report

42nd St N @ University Ave
April 01, 2015 - May 01, 2015 (31 Days)
10/1/2015

Rail Preemption		Weekdays and Weekends (31 Days)	Weekdays Only (23 Days)	Weekends Only (8 Days)
24 hr	Total Events:	91	73	18
	Average Number of Events:	3	3.2	2.2
	Average Duration:	00:08:52	00:10:10	00:03:35
	Minimum Duration:	00:00:33	00:00:33	00:01:03
	Maximum Duration:	08:37:34	08:37:34	00:10:08
AM Peak Period (7am - 9am)	Total Events:	1	0	1
	Average Number of Events:	0	0	0.1
	Average Duration:	00:10:08	00:00:00	00:10:08
	Minimum Duration:	00:10:08	00:00:00	00:10:08
	Maximum Duration:	00:10:08	00:00:00	00:10:08
PM Peak Period (4pm - 6pm)	Total Events:	6	5	1
	Average Number of Events:	0.2	0.2	0.1
	Average Duration:	00:03:45	00:04:12	00:01:32
	Minimum Duration:	00:00:33	00:00:33	00:01:32
	Maximum Duration:	00:09:22	00:09:22	00:01:32

The information generated by this calculator is for estimation uses only. The Upper Great Plains Transportation Institute and North Dakota State University make no representation or warranty, expressed or implied, regarding the accuracy or reliability of the results.

Figure 2. Sample Rail Preemption Report

RESULTS

A sample comparison of the traffic volumes at the intersection of 32nd Ave S and I-29 West Ramps is shown in table 3. It shows turning movement counts reported by the cameras as compared to manual counts. The traffic counts are compared as set by lane group per approach. As mentioned, GEH values were computed for individual hourly total volumes per lane group as well as for hourly approach total volumes. Similar to Phase II of the study, a GEH of 2.0 or less is considered good and results show less than 5% of the detector stations are greater than this value.

Peak hour factor values by each lane group and approach are also computed for comparison. For 85% of the PHF comparisons, the values as computed from traffic counts reported by the cameras were within 0.04 of those computed from manual traffic counts. For detailed comparison of data from all the intersections, refer to the Appendix.

All of the intersections with the exception of Gateway Dr @ N 47th St have been added to the Traffic Analysis webpage and are ready for reporting purposes.

CONCLUSION/NEXT STEPS

The data accuracy observed in the current setup and camera output is comparable to that of Phase II and falls well within acceptable ranges for accuracy. Along with other reports generated by Traffic Analysis Tool, the Rail Preemption Report can be used for more realistic transportation network modeling. Consequently, the modeling output would be more reliable and should be able to generate more accurate measures of effectiveness such as travel time and average travel speeds within various segments of the modelled network.

If desired, other intersections may be setup for rail preemption reporting. As a result, rail preemption reports may be independently created for intersections running parallel to a rail corridor. This would make it easy to compare how rail preemption affects signal and traffic operations along a highway. However, an automatic email needs to be setup for data transfer (via attachment) between the City of Grand Forks's CENTRACS server and the DOTSC IT contact that will place the data transfer file on the DOTSC server so that the data can be inserted into the Traffic Analysis database. Also, the preemption reporting can be further expanded to other signal events. For example, preemption reports could be created for Police, EMS, and Transit etc.

It is envisioned that, if pursued further, the rail based preemption reporting will be integrated into the existing Traffic Analysis Tool. This would simplify the GUI and would not require separate URL for rail preemption reporting.

It is expected that any further changes to detector configuration (at intersections #1 through #38) would be based on the updated detector configuration files (as saved on external drive connected to the City's Communications Server). A process should be developed to account for and to document any changes made by the City employees or contractors to detectors, to ensure traffic counting is not adversely affected.

The setup for the intersection of Gateway Dr @ N 47th St would be completed once the City had had a chance to re-aim the WB camera.

Network-wide setup of intersections for traffic data collection has the potential to provide detailed insight into traffic characteristics of various roadway segments that form the transportation network. It is recommended that the rest of the network in Grand Forks that already has Autoscope camera based detection be set to count traffic. As the City grows, new signalized intersection warranted in the area should be setup using similar technologies to maintain compatibility with the Traffic Analysis Tool.

Table 3. Traffic Volume comparison between Autoscope and Manual Turning Movement Counts

#36. 32nd Ave S @ I-29 West Ramps																
Volume/ Factor	Source	Southbound				Westbound				Northbound				Eastbound			
		Right	Thru	Left	Total	Right	Thru	Left	Total	Right	Thru	Left	Total	Right	Thru	Left	Total
15-min Volume	Manual	11	19	27	57	25	47	31	103	N/A	N/A	N/A	N/A	23	34	67	124
	Autoscope	13	22	22	57	27	48	33	108	N/A	N/A	N/A	N/A	23	34	67	124
15-min Volume	Manual	12	9	21	42	11	40	30	81	N/A	N/A	N/A	N/A	10	37	41	88
	Autoscope	15	9	19	43	11	39	30	80	N/A	N/A	N/A	N/A	10	38	44	92
15-min Volume	Manual	13	15	28	56	21	34	28	83	N/A	N/A	N/A	N/A	14	38	68	120
	Autoscope	16	20	29	65	21	35	33	89	N/A	N/A	N/A	N/A	14	39	68	121
15-min Volume	Manual	15	14	32	61	26	49	44	119	N/A	N/A	N/A	N/A	9	43	53	105
	Autoscope	18	14	32	64	29	53	46	128	N/A	N/A	N/A	N/A	8	44	55	107
Hourly Volume	Manual	51	57	108	216	83	170	133	386	N/A	N/A	N/A	N/A	56	152	229	437
	Autoscope	62	65	102	229	88	175	142	405	N/A	N/A	N/A	N/A	55	155	234	444
	GEH	1.5	1.0	0.6	0.9	0.5	0.4	0.8	1.0	N/A	N/A	N/A	N/A	0.1	0.2	0.3	0.3
PHF	Manual	0.85	0.75	0.84	0.89	0.80	0.87	0.76	0.81	N/A	N/A	N/A	N/A	0.61	0.88	0.84	0.88
	Autoscope	0.86	0.74	0.80	0.88	0.76	0.83	0.77	0.79	N/A	N/A	N/A	N/A	0.60	0.88	0.86	0.90

APPENDIX: Phase IIIa Data Accuracy Tables

#32. Gateway Dr @ N 47th St																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	5	2	19	26	-	-	-	-	24	1	7	32	11	115	2	128
	Autoscope	5	1	23	29	-	-	-	-	24	2	7	33	16	116	2	134
15-min interval	**Manual**	8	1	13	22	-	-	-	-	24	2	6	32	12	107	2	121
	Autoscope	6	2	13	21	-	-	-	-	26	2	6	34	16	104	2	122
15-min interval	**Manual**	9	1	19	29	-	-	-	-	38	1	4	43	18	96	0	114
	Autoscope	8	0	23	31	-	-	-	-	39	1	4	44	17	101	0	118
15-min interval	**Manual**	3	1	18	22	-	-	-	-	34	2	3	39	8	111	3	122
	Autoscope	4	2	23	29	-	-	-	-	28	2	2	32	9	113	4	126
Hourly Totals	**Manual**	25	5	69	99	-	-	-	-	120	6	20	146	49	429	7	485
	Autoscope	23	5	82	110	-	-	-	-	117	7	19	143	58	434	8	500
	GEH	**0.4**	**0.0**	**1.5**	**1.1**	**-**	**-**	**-**	**-**	**0.3**	**0.4**	**0.2**	**0.2**	**1.2**	**0.2**	**0.4**	**0.7**
PHF	**Manual**	0.69	0.63	0.91	0.85	-	-	-	-	0.79	0.75	0.71	0.85	0.68	0.93	0.58	0.95
	Autoscope	0.72	0.63	0.89	0.89	-	-	-	-	0.75	0.88	0.68	0.81	0.85	0.94	0.50	0.93

#33. Gateway Dr @ I-29 West Ramps																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	4	0	5	9	27	85	110	222	N/A	N/A	N/A	N/A	37	69	53	159
	Autoscope	4	0	6	10	29	93	110	232	N/A	N/A	N/A	N/A	37	74	55	166
15-min interval	**Manual**	7	0	7	14	37	82	127	246	N/A	N/A	N/A	N/A	57	74	69	200
	Autoscope	8	0	7	15	35	82	128	245	N/A	N/A	N/A	N/A	61	75	69	205
15-min interval	**Manual**	17	0	4	21	31	88.0	110	229	N/A	N/A	N/A	N/A	62	79	74	215
	Autoscope	14	0	4	18	35	91	110	236	N/A	N/A	N/A	N/A	60	83	70	213
15-min interval	**Manual**	16	0	6	22	34	75	112	221	N/A	N/A	N/A	N/A	51	83	66	200
	Autoscope	18	0	7	25	40	76	111	227	N/A	N/A	N/A	N/A	50	85	66	201
Hourly Totals	**Manual**	44	0	22	66	129	330	459	918	N/A	N/A	N/A	N/A	207	305	262	774
	Autoscope	44	0	24	68	139	342	459	940	N/A	N/A	N/A	N/A	208	317	260	785
	GEH	**0.0**	**N/A**	**0.4**	**0.2**	**0.9**	**0.7**	**0.0**	**0.7**	**N/A**	**N/A**	**N/A**	**N/A**	**0.1**	**0.7**	**0.1**	**0.4**
PHF	**Manual**	0.65	N/A	0.79	0.75	0.87	0.94	0.90	0.93	N/A	N/A	N/A	N/A	0.83	0.92	0.89	0.90
	Autoscope	0.61	N/A	0.86	0.68	0.87	0.92	0.90	0.96	N/A	N/A	N/A	N/A	0.85	0.93	0.93	0.92

#34. 32nd Ave S @ S 24th St																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	N/A	N/A	N/A	N/A	N/A	235	14	249	39	27	18	84	12	80	0	92
	Autoscope	N/A	N/A	N/A	N/A	N/A	253	10	263	37	29	19	85	11	95	0	106
15-min interval	**Manual**	N/A	N/A	N/A	N/A	N/A	162	3	165	34	25	22	81	40	213	0	253
	Autoscope	N/A	N/A	N/A	N/A	N/A	174	4	178	30	26	26	82	38	219	0	257
15-min interval	**Manual**	N/A	N/A	N/A	N/A	N/A	155	22	177	5	5	3	13	45	192	0	237
	Autoscope	N/A	N/A	N/A	N/A	N/A	162	26	188	5	5	3	13	44	209	0	253
15-min interval	**Manual**	N/A	N/A	N/A	N/A	N/A	151	33	184	9	6	6	21	37	178	0	215
	Autoscope	N/A	N/A	N/A	N/A	N/A	151	33	184	8	7	8	23	39	190	0	229
Hourly Totals	**Manual**	N/A	N/A	N/A	N/A	N/A	703	72	775	87	63	49	199	134	663	0	797
	Autoscope	N/A	N/A	N/A	N/A	N/A	740	73	813	80	67	56	203	132	713	0	845
	GEH	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**1.4**	**0.1**	**1.3**	**0.8**	**0.5**	**1.0**	**0.3**	**0.2**	**1.9**	**N/A**	**1.7**
PHF	**Manual**	N/A	N/A	N/A	N/A	N/A	0.75	0.55	0.78	0.56	0.58	0.56	0.59	0.74	0.78	N/A	0.79
	Autoscope	N/A	N/A	N/A	N/A	N/A	0.73	0.55	0.77	0.54	0.58	0.54	0.60	0.75	0.81	N/A	0.82

#35. 32nd Ave S @ I-29 East Ramps																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	N/A	N/A	N/A	N/A	34	83	0	117	30	1	4	35	68	63	13	144
	Autoscope	N/A	N/A	N/A	N/A	34	87	0	121	29	1	4	34	69	62	17	148
15-min interval	**Manual**	N/A	N/A	N/A	N/A	33	96	0	129	23	0	7	30	59	55	16	130
	Autoscope	N/A	N/A	N/A	N/A	33	100	0	133	25	0	8	33	62	55	16	133
15-min interval	**Manual**	N/A	N/A	N/A	N/A	43	75	0	118	40	0	7	47	65	66	9	140
	Autoscope	N/A	N/A	N/A	N/A	43	79	0	122	48	0	8	56	66	68	9	143
15-min interval	**Manual**	N/A	N/A	N/A	N/A	35	100	0	135	48	0	8	56	87	98	10	195
	Autoscope	N/A	N/A	N/A	N/A	35	104	0	139	45	0	8	53	87	98	10	195
Hourly Totals	**Manual**	N/A	N/A	N/A	N/A	145	354	0	499	141	1	26	168	279	282	48	609
	Autoscope	N/A	N/A	N/A	N/A	145	370	0	515	147	1	28	176	284	283	52	619
	GEH	**N/A**	**N/A**	**N/A**	**N/A**	**0.0**	**0.8**	**N/A**	**0.7**	**0.5**	**0.0**	**0.4**	**0.6**	**0.3**	**0.1**	**0.6**	**0.4**
PHF	**Manual**	N/A	N/A	N/A	N/A	0.84	0.89	N/A	0.92	0.73	0.25	0.81	0.75	0.80	0.72	0.75	0.78
	Autoscope	N/A	N/A	N/A	N/A	0.84	0.89	N/A	0.93	0.77	0.25	0.88	0.79	0.82	0.72	0.76	0.79

#36. 32nd Ave S @ I-29 West Ramp																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	11	19	27	57	25	47	31	103	N/A	N/A	N/A	N/A	23	34	67	124
	Autoscope	13	22	22	57	27	48	33	108	N/A	N/A	N/A	N/A	23	34	67	124
15-min interval	**Manual**	12	9	21	42	11	40	30	81	N/A	N/A	N/A	N/A	10	37	41	88
	Autoscope	15	9	19	43	11	39	30	80	N/A	N/A	N/A	N/A	10	38	44	92
15-min interval	**Manual**	13	15	28	56	21	34	28	83	N/A	N/A	N/A	N/A	14	38	68	120
	Autoscope	16	20	29	65	21	35	33	89	N/A	N/A	N/A	N/A	14	39	68	121
15-min interval	**Manual**	15	14	32	61	26	49	44	119	N/A	N/A	N/A	N/A	9	43	53	105
	Autoscope	18	14	32	64	29	53	46	128	N/A	N/A	N/A	N/A	8	44	55	107
Hourly Totals	**Manual**	51	57	108	216	83	170	133	386	N/A	N/A	N/A	N/A	56	152	229	437
	Autoscope	62	65	102	229	88	175	142	405	N/A	N/A	N/A	N/A	55	155	234	444
	GEH	**1.5**	**1.0**	**0.6**	**0.9**	**0.5**	**0.4**	**0.8**	**1.0**	**N/A**	**N/A**	**N/A**	**N/A**	**0.1**	**0.2**	**0.3**	**0.3**
PHF	**Manual**	0.85	0.75	0.84	0.89	0.80	0.87	0.76	0.81	N/A	N/A	N/A	N/A	0.61	0.88	0.84	0.88
	Autoscope	0.86	0.74	0.80	0.88	0.76	0.83	0.77	0.79	N/A	N/A	N/A	N/A	0.60	0.88	0.86	0.90

#37. S Columbia Rd @ 11th Ave S																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	36	105	10	151	7	4	11	22	50	51	16	117	11	2	14	27
	Autoscope	36	116	10	162	7	7	11	25	50	50	17	117	13	2	14	29
15-min interval	**Manual**	44	148	3	195	6	2	7	15	43	53	11	107	18	3	11	32
	Autoscope	42	147	3	192	6	2	8	16	43	53	11	107	19	3	11	33
15-min interval	**Manual**	32	131	15	178	7	4	9	20	73	55	16	144	17	3	15	35
	Autoscope	31	130	16	177	8	4	9	21	72	55	15	142	17	3	17	37
15-min interval	**Manual**	26	256	10	292	15	6	8	29	100	99	20	219	28	6	10	44
	Autoscope	25	256	10	291	21	6	5	32	100	99	20	219	29	7	11	47
Hourly Totals	**Manual**	138	640	38	816	35	16	35	86	266	258	63	587	74	14	50	138
	Autoscope	134	649	39	822	42	19	33	94	265	257	63	585	78	15	53	146
	GEH	**0.3**	**0.4**	**0.2**	**0.2**	**1.1**	**0.7**	**0.3**	**0.8**	**0.1**	**0.1**	**0.0**	**0.1**	**0.5**	**0.3**	**0.4**	**0.7**
PHF	**Manual**	0.78	0.63	0.63	0.70	0.58	0.67	0.80	0.74	0.67	0.65	0.79	0.67	0.66	0.58	0.83	0.78
	Autoscope	0.80	0.63	0.61	0.71	0.50	0.68	0.75	0.73	0.66	0.65	0.79	0.67	0.67	0.54	0.78	0.78

#38. S Washington St @ 47th Ave S																	
Volume/ Factor	**Source**	**Southbound**				**Westbound**				**Northbound**				**Eastbound**			
		Right	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**	**Right**	**Thru**	**Left**	**Total**
15-min interval	**Manual**	13	44	36	93	22	13	1	36	8	41	4	53	6	3	3	12
	Autoscope	11	46	36	93	22	14	1	37	8	41	3	52	6	3	3	12
15-min interval	**Manual**	30	39	38	107	17	13	6	36	5	35	7	47	6	8	2	16
	Autoscope	27	38	38	103	18	14	6	38	5	32	7	44	6	8	2	16
15-min interval	**Manual**	20	38	37	95	20	11	5	36	6	48	2	56	4	9	2	15
	Autoscope	17	38	36	91	20	13	7	40	6	36	2	44	4	9	2	15
15-min interval	**Manual**	17	40	32	89	17	17	3	37	9	32	6	47	6	8	5	19
	Autoscope	16	39	35	90	17	18	3	38	9	26	4	39	8	9	6	23
Hourly Totals	**Manual**	80	161	143	384	76	54	15	145	28	156	19	203	22	28	12	62
	Autoscope	71	161	145	377	77	59	17	153	28	135	16	179	24	29	13	66
	GEH	**1.0**	**0.0**	**0.2**	**0.4**	**0.1**	**0.7**	**0.5**	**0.7**	**0.0**	**1.7**	**0.7**	**1.7**	**0.4**	**0.2**	**0.3**	**0.5**
PHF	**Manual**	0.67	0.91	0.94	0.90	0.86	0.79	0.63	0.98	0.78	0.81	0.68	0.91	0.92	0.78	0.60	0.82
	Autoscope	0.66	0.88	0.95	0.92	0.88	0.82	0.61	0.96	0.78	0.82	0.57	0.86	0.75	0.81	0.54	0.72