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

<table>
<thead>
<tr>
<th>#</th>
<th>Main Street</th>
<th>Cross Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Gateway Drive</td>
<td>N 47th St</td>
</tr>
<tr>
<td>33</td>
<td>Gateway Drive</td>
<td>I-29 West Ramps</td>
</tr>
<tr>
<td>34</td>
<td>32nd Ave S</td>
<td>S 24th St</td>
</tr>
<tr>
<td>35</td>
<td>32nd Ave S</td>
<td>I-29 East Ramps</td>
</tr>
<tr>
<td>37</td>
<td>32nd Ave S</td>
<td>I-29 West Ramps</td>
</tr>
<tr>
<td>37</td>
<td>S Columbia Rd</td>
<td>11th Ave S</td>
</tr>
<tr>
<td>38</td>
<td>S Washington St</td>
<td>47th Ave S</td>
</tr>
</tbody>
</table>

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*

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

*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
- \(V_{15}\) = 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.

![Screenshot of Rail Preemption Reporting Tool](image)

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.

![Rail Preemption Report](image)

**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 Appendix 1.

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

<table>
<thead>
<tr>
<th>Volume/Factor</th>
<th>Source</th>
<th>Southbound</th>
<th>Westbound</th>
<th>Northbound</th>
<th>Eastbound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>Thru</td>
<td>Left</td>
<td>Total</td>
</tr>
<tr>
<td>15-min Volume</td>
<td>Manual</td>
<td>11</td>
<td>19</td>
<td>27</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>13</td>
<td>22</td>
<td>22</td>
<td>57</td>
</tr>
<tr>
<td>15-min Volume</td>
<td>Manual</td>
<td>12</td>
<td>9</td>
<td>21</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>15</td>
<td>9</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td>15-min Volume</td>
<td>Manual</td>
<td>13</td>
<td>15</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>16</td>
<td>20</td>
<td>29</td>
<td>65</td>
</tr>
<tr>
<td>15-min Volume</td>
<td>Manual</td>
<td>15</td>
<td>14</td>
<td>32</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>18</td>
<td>14</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>Hourly Volume</td>
<td>Manual</td>
<td>51</td>
<td>57</td>
<td>108</td>
<td>216</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>62</td>
<td>65</td>
<td>102</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>GEH</td>
<td>1.5</td>
<td>1.0</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>PHF</td>
<td>Manual</td>
<td>0.85</td>
<td>0.75</td>
<td>0.84</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Autoscope</td>
<td>0.86</td>
<td>0.74</td>
<td>0.80</td>
<td>0.88</td>
</tr>
</tbody>
</table>

#36, 32nd Ave S @ I-29 West Ramps
APPENDIX 1: Phase IIIa Data Accuracy Tables