NDSU | UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
ADVANCED TRAFFIC ANALYSIS CENTER

Fargo-Moorhead Metro Traffic Data Collection and Reporting

Final Report

September 2021

Prepared for:
Fargo-Moorhead Metro COG

Prepared by:
Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Reliable intersection-traffic data is essential for transportation planning, operations, and safety. Recently, all agencies within the Fargo-Moorhead Metro Council of Governments responsible for signalized intersections were using technology capable of collecting continuous traffic data. These agencies included:

- North Dakota Department of Transportation
- Minnesota Department of Transportation
- City of Fargo
- City of Moorhead
- City of West Fargo

Some of these agencies had collected such data already. For example, the City of Fargo used in-pavement detection loops and a SQL database to collect and store data. NDDOT's Fargo District collected turning movement counts at all of its ramp termini, but did not import it into a database. Moreover, all of NDDOT's decades-old equipment that was used to collect data was recently replaced. Other agencies, e.g. West Fargo, had video-based detection equipment, such as Autoscope cameras, which are capable of data collection but were not set up to do so. Most of the agencies relied on targeted short counts which is the predominant, albeit outdated, type of intersection traffic data collection, given the modern capabilities of transportation infrastructure.

The Upper Great Plains Transportation Institute (UGPTI) has built a web-based traffic data analysis tool. This Traffic Analysis Tool uses existing traffic signal control devices to collect data 24 hours per day, 7 days per week, and 365 days per year. The primary purpose of this project was to develop the agency-to-UGPTI connections and build a Traffic Analysis Tool-compatible database for the FM Metro COG to collect data from intersections operated by each of the agencies listed above.

OBJECTIVES

For this project, 28 intersections were set up for data analysis. The number of intersections broken down by agency are listed in Table 1.

Agency	#	Main Street	Cross Street
City of Fargo	1	1st Ave N	3rd St N
	2	32nd Ave S	32nd St S
	3	45th St S	23rd Ave S
	4	4th St N	7th Ave N
	5	Main Ave	4th St
	6	Main Ave	8th St
	7	Main Ave	Broadway
	8	University Dr	19th Ave N
	9	University Dr	Main Ave
	10	Veterans Blvd	40th Ave S
City of West Fargo	1	Main Ave	15th St NW
	2	13th Ave E	9th St E

	3	13th Ave E	14th St E
	4	13th Ave E	17th St E
	5	Sheyenne St	7th St W
	6	Sheyenne St	19th Ave
	7	Sheyenne St	21st Ave
	8	Sheyenne St	26th Ave
	9	Sheyenne St	29th Ave
	10	Sheyenne St	32nd Ave
	11	Sheyenne St	38th Ave
	12	Sheyenne St	40th Ave
	13	9th St E	4th Ave E
NDDOT	1	S University Dr	WB I-94 ramps
	2	Sheyenne St	WB I-94 ramps
City of Moorhead	1	15th Ave N	11th St N
	2	20th St	30th Ave S
MnDOT	1	US 75	15th Ave N

Table 1. Study intersections

METHODOLOGY

This study was divided into five major tasks:

- Remote connections/import setup
- Equivalency table/data collection setup
- Reporting capabilities setup
- Login credential setup
- Data quality audits

These tasks are discussed in detail below:

REMOTE CONNECTIONS/IMPORT SETUP

In this task, UGPTI worked with respective Information Services and Information Technology departments within Fargo, West Fargo, and NDDOT to set up remote connections and to facilitate import of the traffic data into the existing web-based application.

For Moorhead and MnDOT, UGPTI worked with the agencies to determine the capabilities of existing infrastructure.

EQUIVALENCY TABLE/DATA COLLECTION SETUP

In this task, intersections were set to collect turning movement count data. Wherever the existing infrastructure allowed, traffic speed data was also collected. Based on available devices and their existing setup, this task comprised of steps such as creating an equivalency table, intersection setup, data quality audits, and camera re-calibration. Each of these steps are discussed as below.

Creating an Equivalency Table

UGPTI worked with the cities of Fargo and Moorhead and MnDOT District 4's traffic engineering personnel to create an equivalency table of detector-to-lane relationships. The detectors were then grouped into turning movements per lane-group, per approach, per intersection. This equivalency table was only needed for loop-based signalized intersections operated by the City of Fargo and MnDOT.

Intersection Setup

The intersections for all agencies were set up to count traffic one approach at a time. Loop-based intersections were set up based on the loop-to-movement equivalency table. At any given approach, all lane groups with exclusive lanes and loops present were counted separately. However, in the case of shared lanes, movements were combined and counted together from a single loop detector. Similarly, camera-based intersections were set up based on factors such as geometrics and lane assignment. At any given approach, all lane groups with exclusive lanes were counted separately using corresponding detector stations and zones. However, in case of shared lanes, movements were combined and counted together in a single detector station. Table 2 provides detailed information on lane assignments and counting capabilities set per approach. Note that in the table, each arrow corresponds to a lane group and may represent multiple lanes. Also, each dot represents a separate detector station that counts the corresponding movement(s).

Once lane configurations were set up and remote connections were established, UGPTI created tools to make the now-collectable data compatible with the Traffic Analysis Tool.

For the North Dakota DOT, UGPTI worked to update its data collection parameters to current manufacturer recommendations. After that, UGPTI made this data compatible with the Traffic Analysis Tool.

LOGIN CREDENTIALS SETUP

UGPTI created secure login credentials for the Traffic Analysis Tool. In addition to the MPO staff, these credentials will be provided to each of the agencies.

REPORTING CAPABILITIES SETUP

UGPTI created reporting and exporting capabilities for each agency's traffic data using the newly created database.

*Table 2. Set up of intersection lane assignments and detectors per approach**

Agency	#	Main Street	Cross Street	NB			EB			SB			WB		
				L	T	R	L	T	R	L	T	R	L	T	R
City of Fargo	1	1st Ave N	3rd St N												
	2	32nd Ave S	32nd St S												
	3	45th St S	23rd Ave S												
	4	4th St N	7th Ave N												
	5	Main Ave	4th St												
	6	Main Ave	8th St												
	7	Main Ave	Broadway												
	8	University Dr	19th Ave N	N/A											
	9	University Dr	Main Ave	N/A											
	10	Veterans Blvd	40th Ave S												
City of West Fargo	1	Main Ave	15th St NW												
	2	13th Ave E	9th St E												
	3	13th Ave E	14th St E												
	4	13th Ave E	17th St E												
	5	Sheyenne St	7th St W												
	6	Sheyenne St	19th Ave												
	7	Sheyenne St	21st Ave												
	8	Sheyenne St	26th Ave												
	9	Sheyenne St	29th Ave			N/A		N/A		N/A			N/A		
	10	Sheyenne St	32nd Ave												
	11	Sheyenne St	38th Ave												
	12	Sheyenne St	40th Ave												
	13	9th St E	4th Ave E												
NDDOT	1	S University Dr	WB I-94 ramps	N/A			N/A			N/A			N/A		
	2	Sheyenne St	WB I-94 ramps			N/A		N/A		N/A			N/A		
City of Moorhead	1	15th Ave N	11th St N												
	2	20th St	30th Ave S												
MnDOT	1	US 75	15th Ave N												

* Notes:

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

DATA QUALITY AUDITS

Random data quality audits were performed, and traffic volumes were collected manually in 15-minute intervals at each of the approaches. The manually collected traffic counts were then compared to data collected by cameras. Hourly traffic volumes were then compared using GEH statistic which is computed as follows:

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

Where:

A = autoscope or loop traffic count
M = manual traffic count

Also, 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

TRAFFIC ANALYSIS TOOL CAPABILITIES

The NDSU Traffic Analysis Tool, which the aforementioned agencies now have access to, has the following reporting capabilities:

- Graphs
  - Volume Profile
  - Speed Profile
  - Monthly Seasonal Factors
  - Day-of-the-Week Seasonal Factors
- Turning Movement Counts
  - Peak Hour Volume/Factor
  - Annual Average Daily Traffic (AADT)
  - Monthly Average Daily Traffic (MADT)
  - Average Daily Traffic (ADT)

These reports are briefly discussed below.

Volume Profile

The Volume Profile report provides an analysis of 15-minute traffic counts to create a line chart of 15-minute volumes for the selected intersection. This report can be created for one or multiple days. In the case of multiple days, the reported traffic volumes are averaged over the selected number of days. The pdf report includes three charts – one for the entire intersection and the other two for the intersecting corridors. Sample charts showing the entire intersection is shown in Figures 1 and 2.

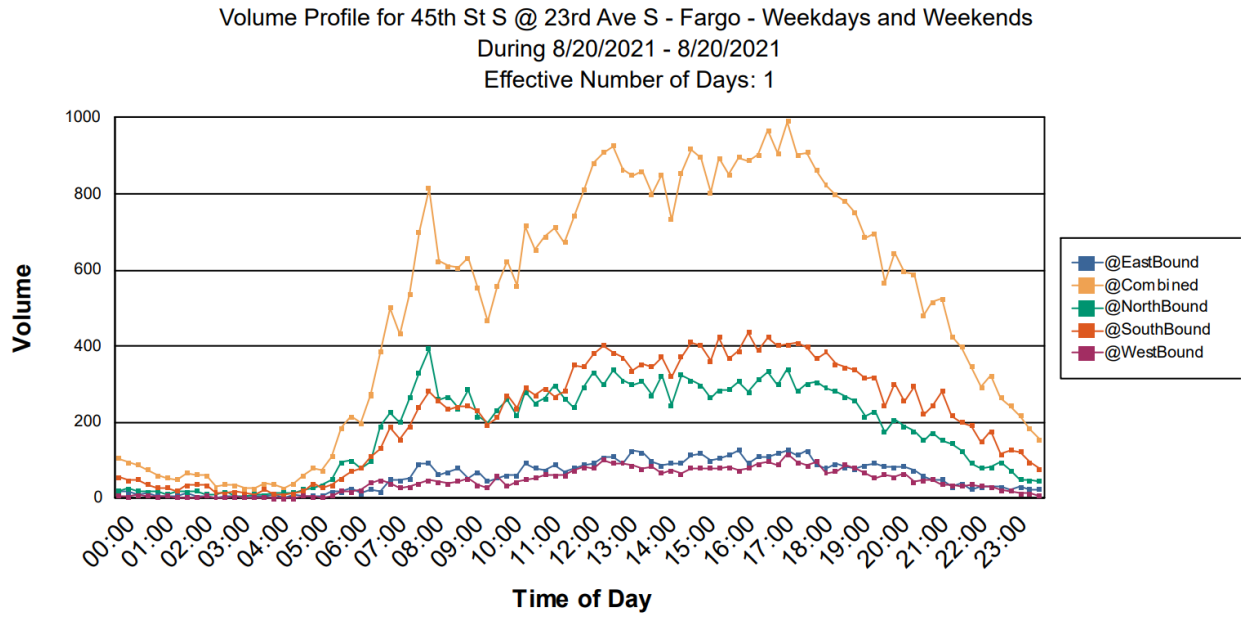


Figure 1. Sample Volume Profile report for 45th St S @ 23rd Ave S, Fargo

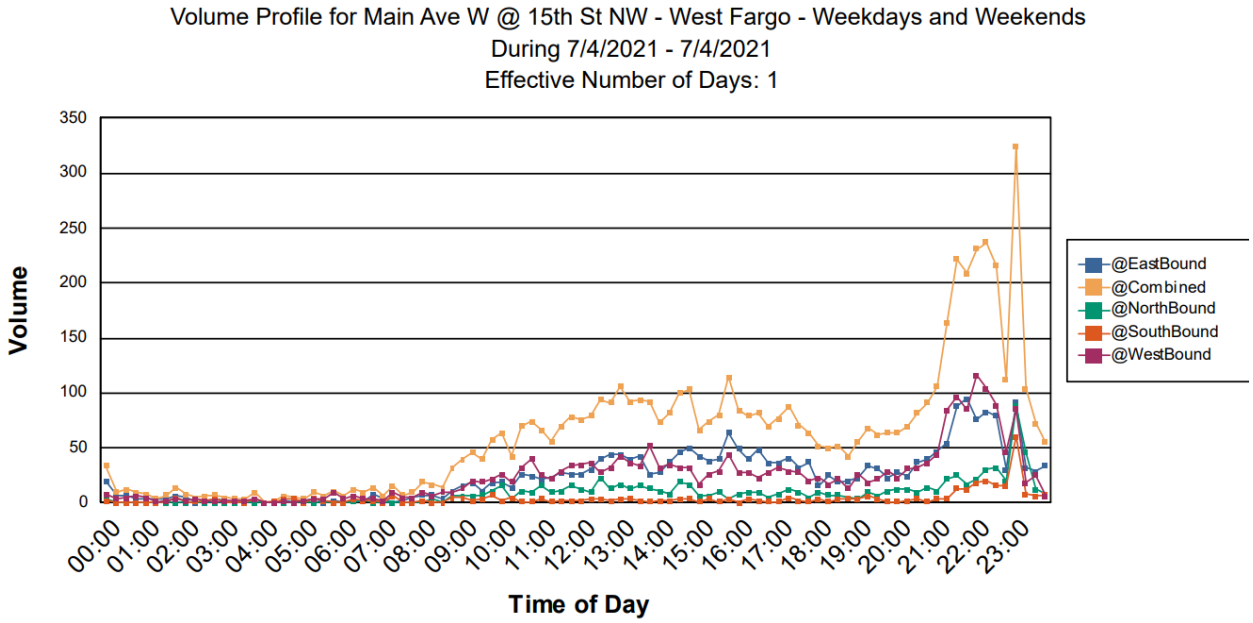


Figure 2. Sample Volume Profile report for Main Ave W @ 15th St NW, West Fargo

This report can be used to determine the beginning and end of peak/off-peak periods and to visualize their level of dispersion over time. This information is helpful in deciding implementation schedules of time-of-day plans including flash modes.

In addition to the pdf report with charts, an Excel export of the underlying data can also be performed.

Speed Profile Report

Similar to Volume Profile, Speed Profile plots 15-minute average speed data over a 24-hour period. When multiple days are selected for analysis, the speeds for individual 15-minute periods

are averaged over the days. Note that only through-lane speeds are considered for analysis in this report. The pdf report includes three charts – one for the entire intersection and the other two for the individual intersecting corridors. A sample chart showing the series for entire intersection is shown in Figure 2.

This report can be used to identify problem spots/times where drivers commonly speed, such as around bar closing, where coordinated efforts between engineering and law enforcement may be required. Time periods with zero detected vehicles are not plotted in this chart.

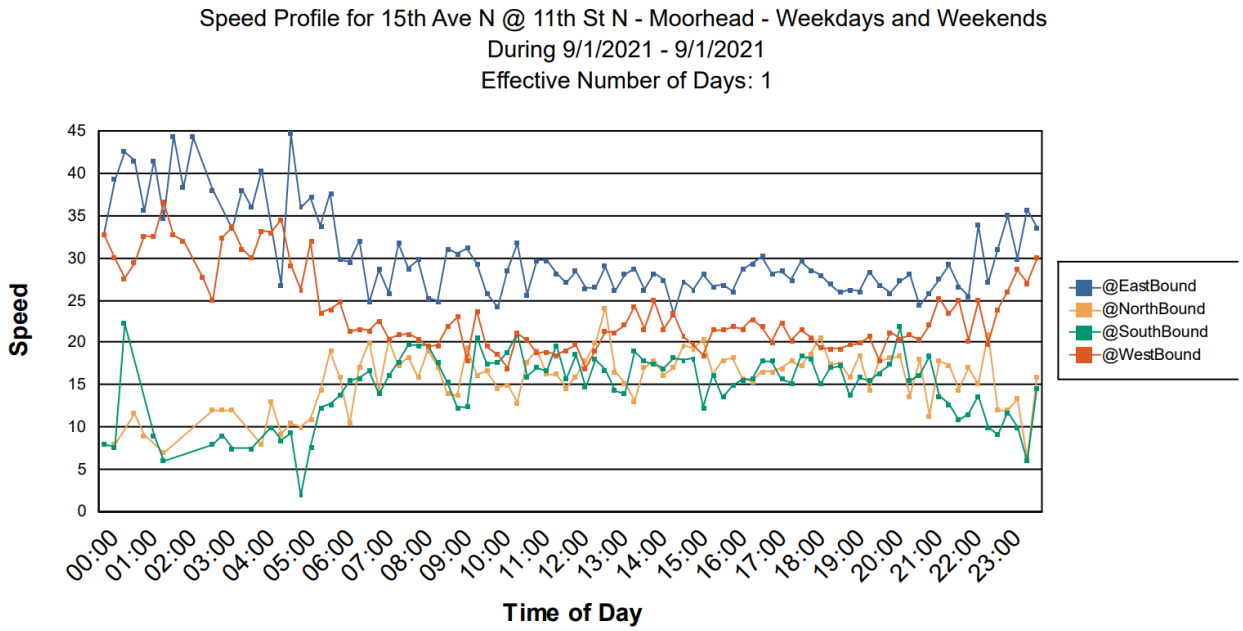


Figure 3. Sample Speed Profile report for 15th Ave N @ 11th St N, Moorhead

Monthly Seasonal Factors

The Monthly Seasonal Factors report provides an analysis of daily traffic count data to create a bar chart of monthly average daily traffic volumes and corresponding factors (in comparison to AADT) for the selected intersection. The report can be created for a selected year or for the immediate past 12 months if desired. This report consists of two charts – one for the entire intersection and another based on bi-directional totals at all legs of the intersection. A sample chart for the entire intersection is shown in Figure 3.

This report can be used to identify locations where variations in seasonal ADT are high enough to warrant a seasonal signal timing plan. This report can also show how a combination of various seasonal factors such as school sessions, harvest seasons, etc. affect ADT.

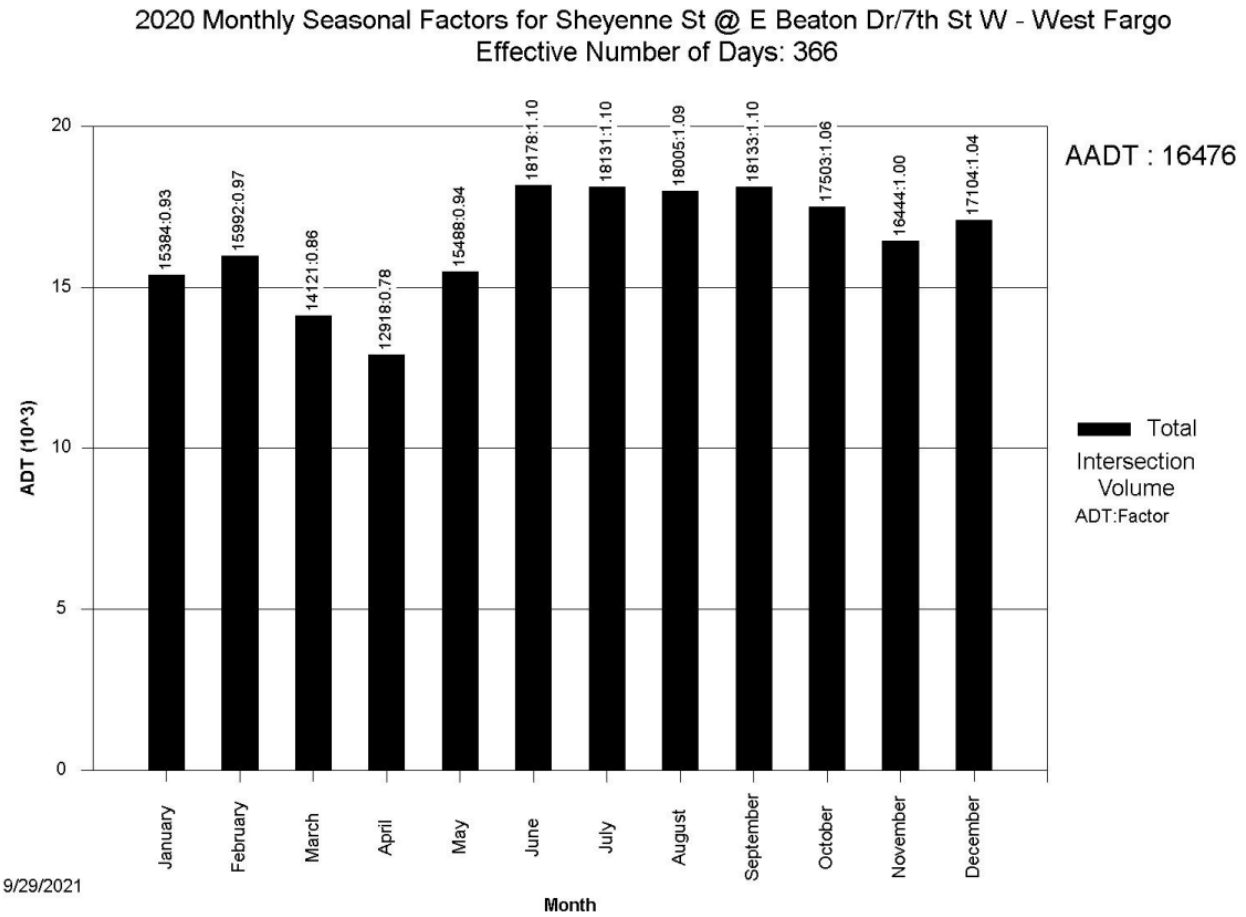


Figure 4. Sample Monthly Seasonal Factors report for Sheyenne St @ Beaton Dr/7th St W, West Fargo

Day-of-the-Week Seasonal Factors

The Day-of-the-Week Seasonal Factors report provides an analysis of daily traffic counts to create a bar chart showing ADT for each day of the week for a given month. Additionally, it also shows bi-directional ADT volumes by each approach at the intersection. The report can be created for any month/year for which data is available.

This report can be used to identify fluctuations in ADT across the week that may be a result of changing demand or special events etc. Further, this report would help to determine locations that may require a special time-of-day plan for the weekends.

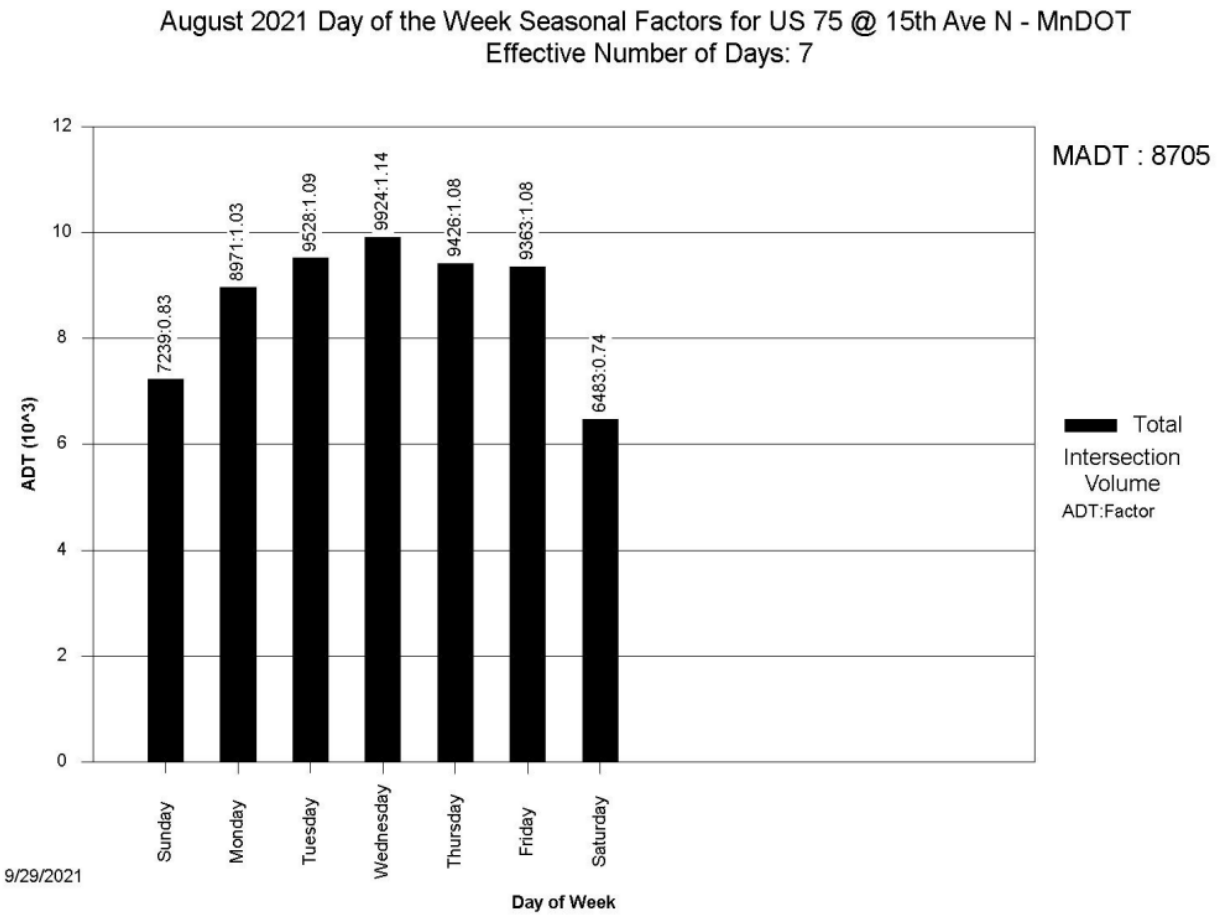


Figure 5. Sample Day-of-the-week Seasonal Factor report for US 75 @ 15th Ave N, Moorhead (MnDOT)

Peak Hour Volume/Factors

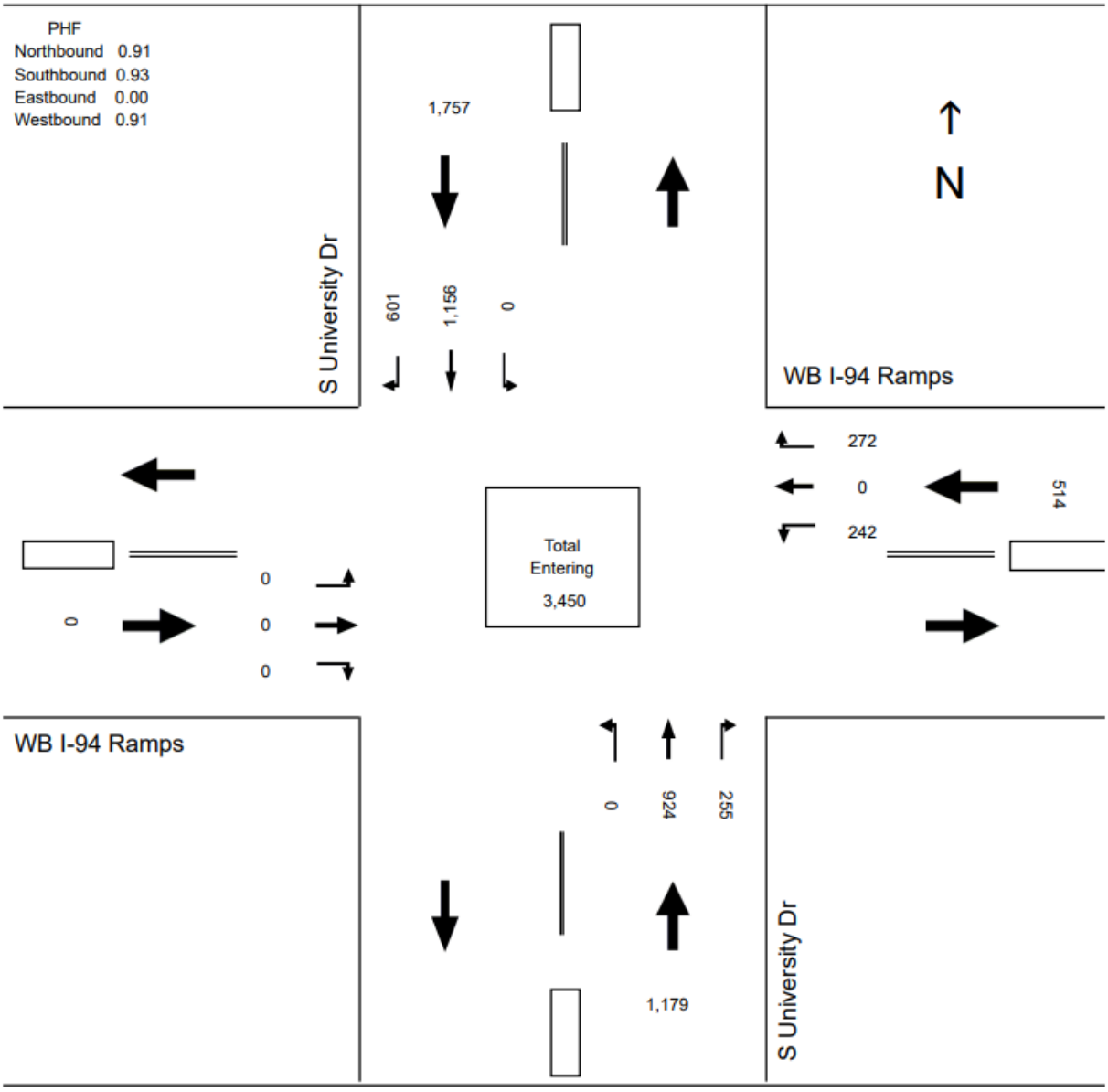
The Peak Hour Volume/Factors report provides an analysis of 15-minute traffic count data to create an intersection turning movement count diagram for selected peak period(s). This report can be created for a custom date range. By default, AM, mid-day, and PM peak periods can be analyzed. The peak-hourly traffic volumes reported are averaged over the selected date range. Note that the peak hour for each day included in the analysis period may be unique in that it may have occurred at a different time. This uniqueness of traffic demand is taken into consideration during the analysis, and only the peak hour traffic for each day is considered for averaging the hourly volumes. Also, peak hour factors are calculated for each of the approaches at the selected intersection. A sample report is shown in Figure 5. An Excel export of the underlying data can also be performed.

This turning movement counts generated in this report can be directly used as an input for phasing design, signal retiming, and progression design. Reports can be generated based on information presented in the Monthly Seasonal Factors report, therefore adding the ability to create seasonal time-of-day plans (e.g. September – April weekday plan, May – August weekday plan).

In addition to the built in capability to create AM, mid-day, and PM peak period reports, a custom time period may also be selected for analysis. This functionality would enable agencies to create custom time-of-day plans for repetitive special events such as games etc.

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

Peak Hour Volume/Factor for S University Dr @ WB I-94 Ramps - NDDOT Fargo - Weekdays
During 2020-09-01 - 2021-04-30
Effective Number of Days: 174
PM (3 - 7 PM)



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.

9/29/2021

1

Figure 6.Peak Hour Volume/Factor Report for S University Dr @ WB I-94 Ramps, Fargo (NDDOT)

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

AADT TMC Diagram for Sheyenne St @ 32nd Ave W - West Fargo - Weekdays and Weekends
During 01/01/2020 - 12/31/2020
Effective Number of Days: 366

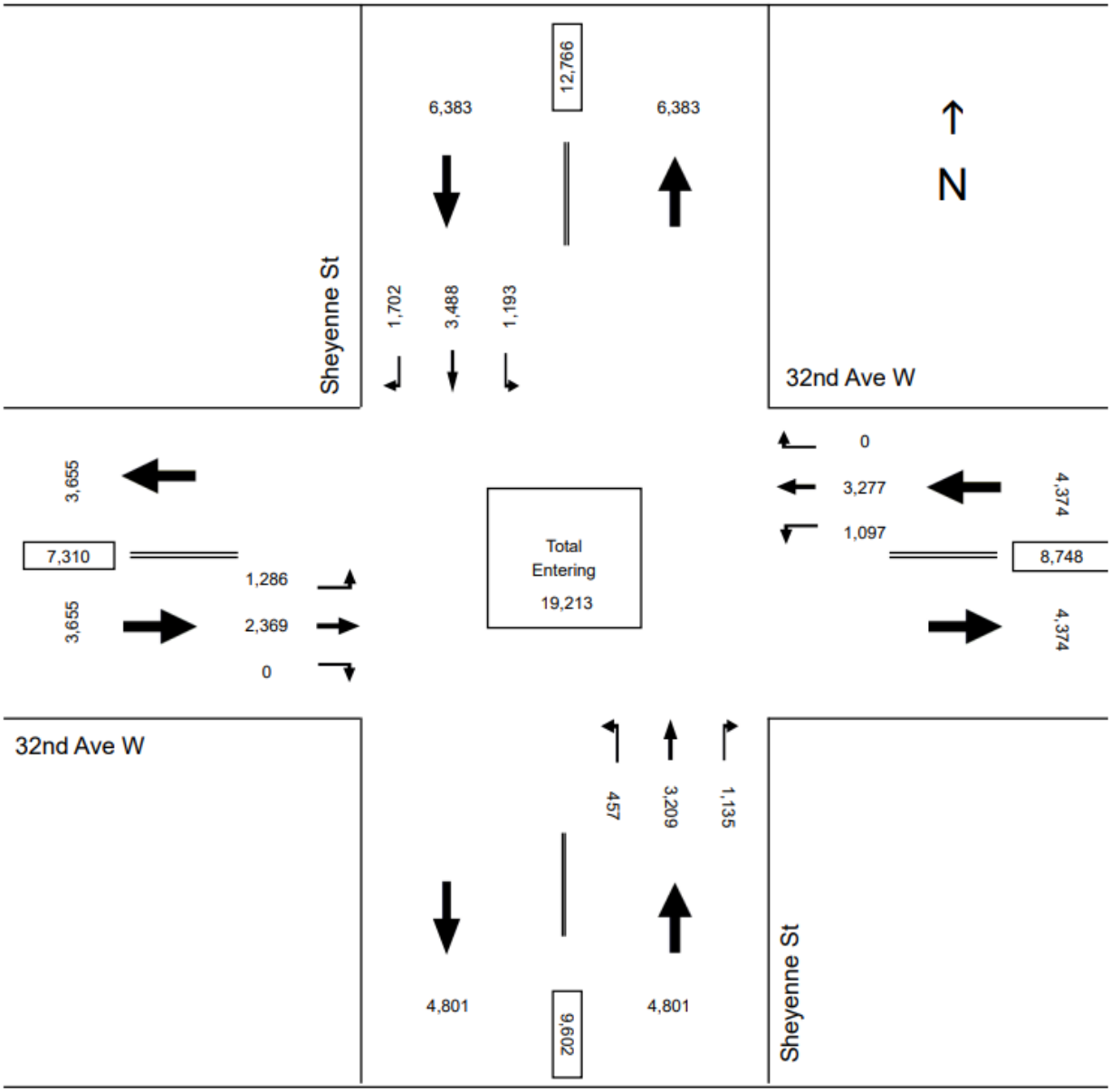


Figure 7. Annual Average Daily Traffic report for Sheyenne St @ 32nd Ave W, West Fargo

AADT

The AADT report provides an analysis of ADT traffic counts to calculate the annual ADT volumes for the selected intersection. Similar to the Peak Hour Factor/Volume report, the information is provided in a turning movement count diagram format. In addition to the intersection AADT, the report also provides AADT values per approach/direction as well. This report can be created for a selected year or the immediate past 12 months. The traffic volumes reported are averaged over the entire year (based on days with available data). A sample report is shown in Figure 6. An excel export of the underlying data can also be performed.

The AADT values calculated in this report can be used for traffic safety, traffic operations, as well as transportation planning purposes. The regional travel demand model can be calibrated using these AADT reports in addition to ATR counts/short counts.

MADT

Similar to AADT, the MADT report provides an analysis of the ADT database to calculate the MADT volumes for the selected intersection and month. In addition to the MADT value for the intersection, the report also provides MADT values per approach/direction as well. This pdf report can be created for any selected month/year. The reported traffic volumes are averaged over the number of days based on available data within the selected month. An excel export of the underlying data can also be performed. A sample report is shown in Figure 7.

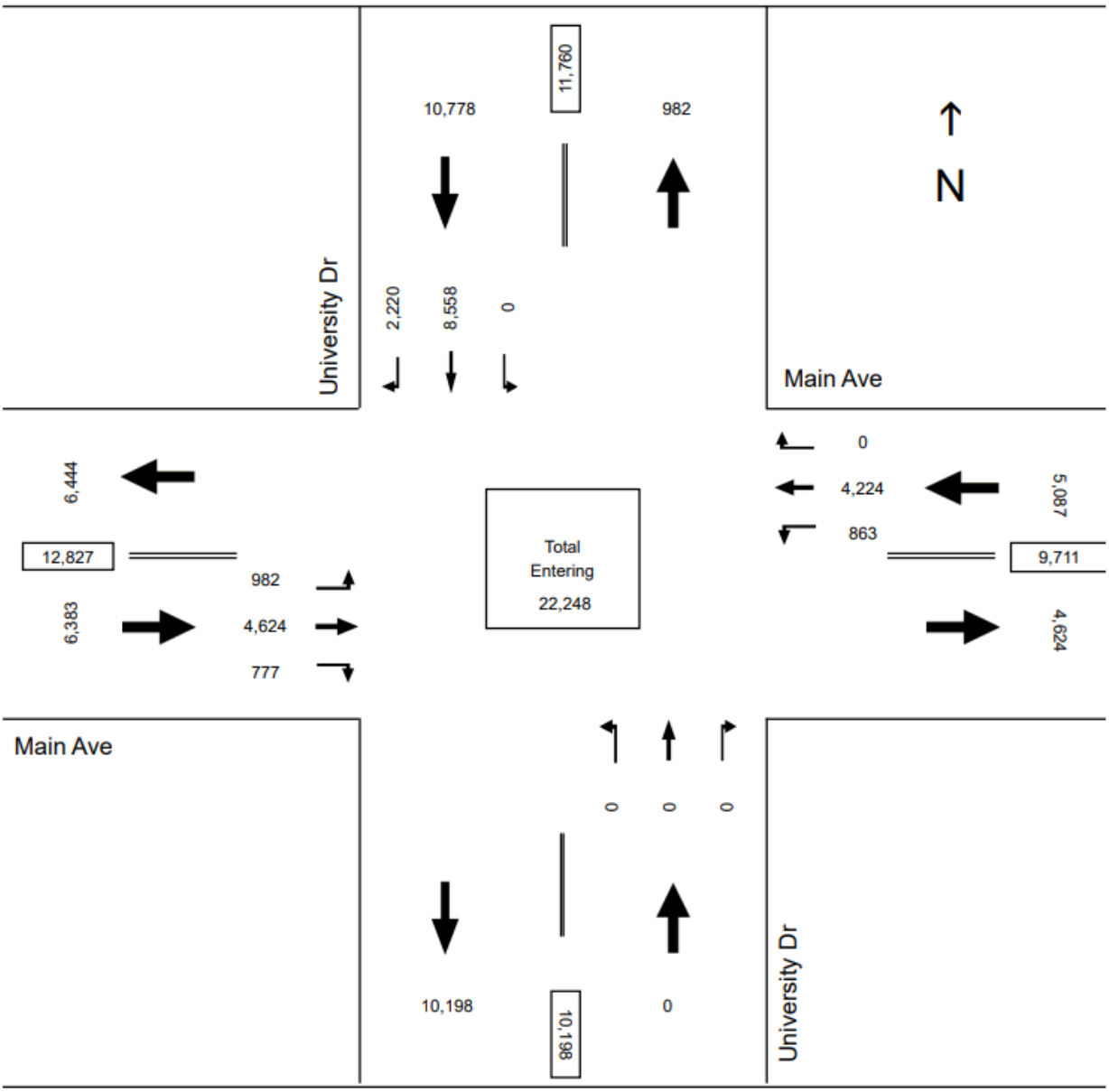
This report can be used to determine monthly average traffic volumes by each movement and approach at the selected intersection.

ADT

Similar to AADT and MADT, the ADT report provides an analysis of the ADT database to calculate average daily traffic for custom durations. The traffic volume information is also presented in a similar manner. This report can be created for any number of days. The ADT report can be used to determine how certain special events may affect traffic demand and patterns.

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

January MADT TMC Diagram for University Dr @ Main Ave - Fargo - Weekdays and Weekends
During 1/01/2021 - 1/31/2021
Effective Number of Days: 31



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.

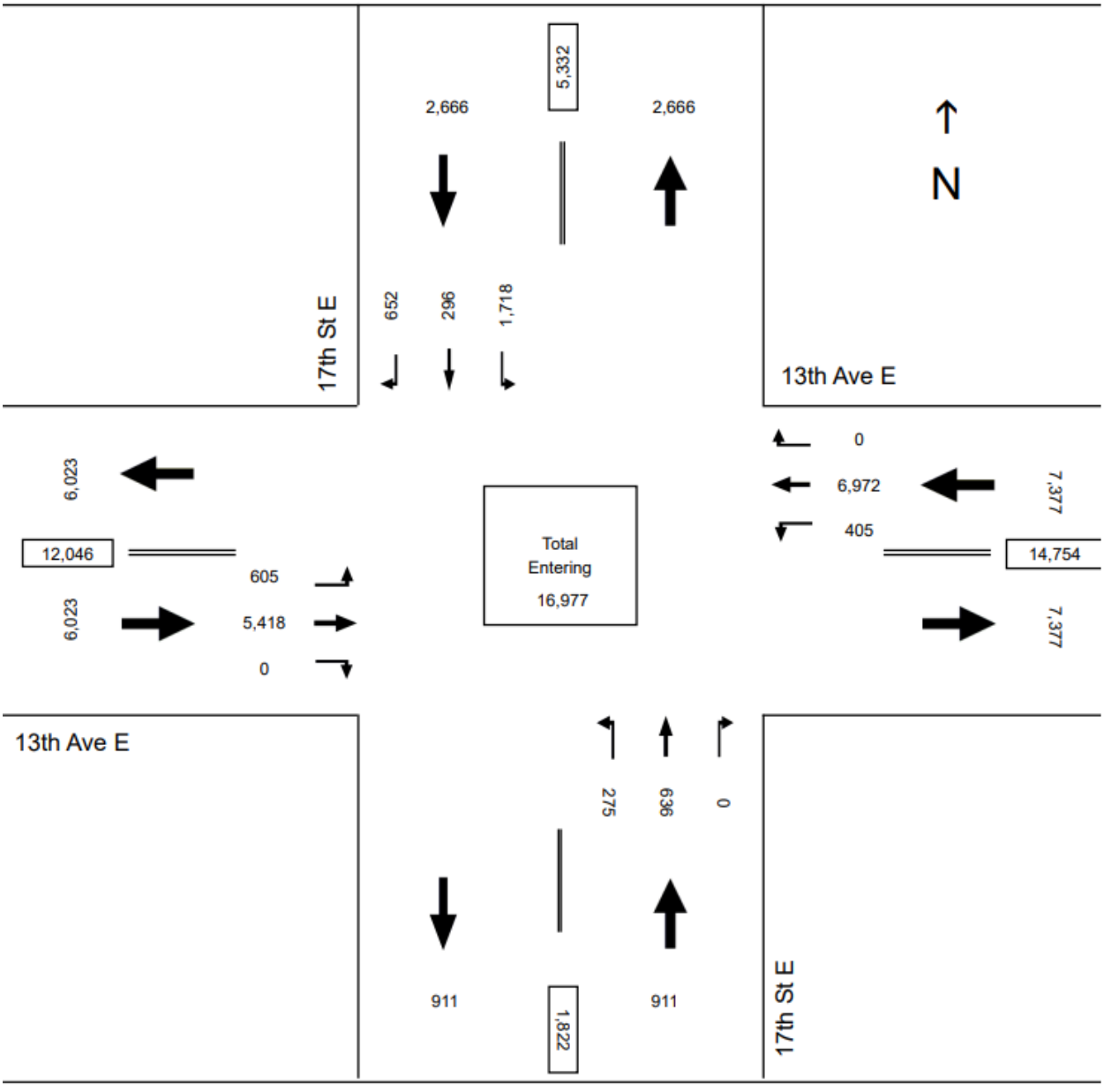
9/29/2021

1

Figure 8. January 2021 MADT report for University Dr @ Main Ave, Fargo

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

ADT TMC Diagram for 13th Ave E @ 17th St E - West Fargo - Weekdays and Weekends
During 1/1/2021 - 1/1/2021
Effective Number of Days: 1



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.

9/29/2021

1

Figure 9. Sample ADT report for 13th Ave E @ 17th St E, West Fargo

NORTH DAKOTA TRAFFIC DASHBOARD

ATAC has created a GIS-based web dashboard for traffic data collected from state-owned Automatic Traffic Recorders (ATRs) as well as the signalized intersections in the NDSU Traffic Analysis Tool database. The signalized intersections include those in the Grand Forks and Fargo metro regions. The dashboard can be found at:

https://www.ugpti.org/r/trafficdb/

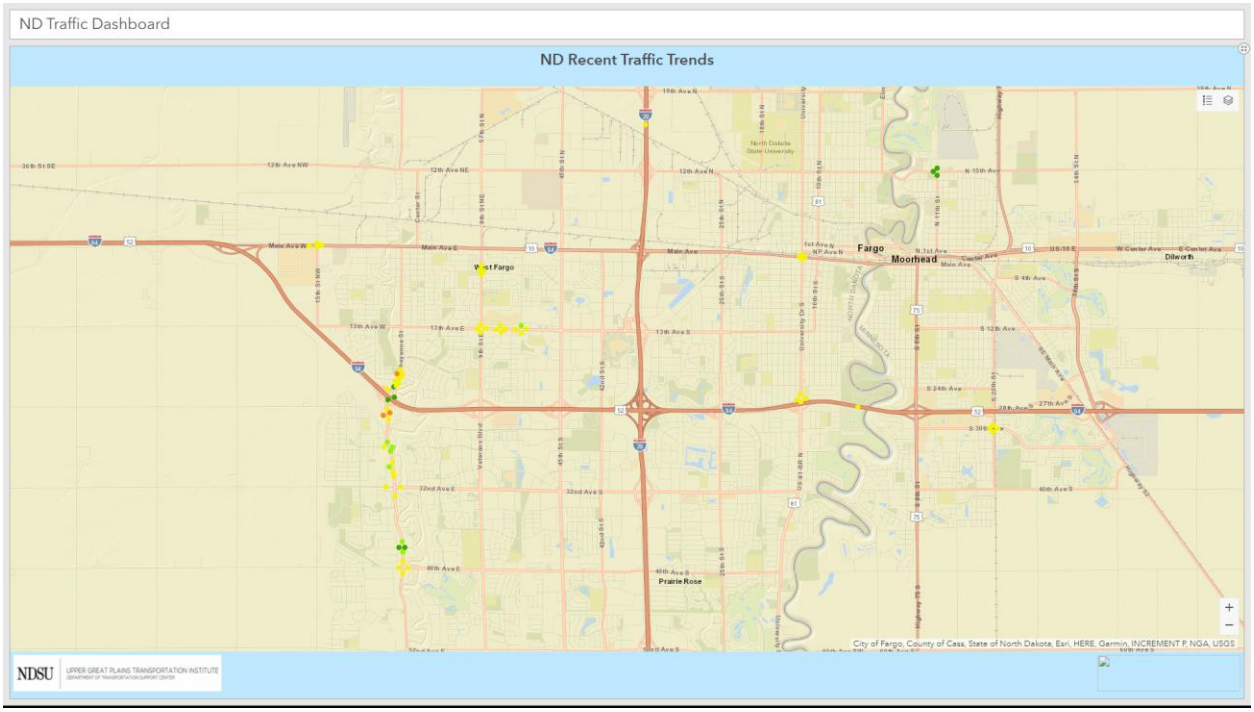


Figure 10. North Dakota Traffic Dashboard displaying Fargo metro area intersections

Figure 10 shows each leg of intersection data collection locations set up under this project that have more than a year's worth of data in the database. For this COG/MPO signalized intersection data, three type of traffic growth/decay metrics can be displayed based on the "stations" displaying within the map window in Figure 10:

1. Weekly ADT
   Week-by-week trend line plot of weekly ADT.
2. Growth Rate
   Bar chart comparing weekly ADT to that of the same week in the previous year.
3. Daily ADT
   Day-to-day trend line plot of daily ADT

Note that even though the ATR's showing within the map are displayed (e.g. ATR on I-29 between 12th Ave N & 19th Ave N in Figure 10), the data from them is not part of the metrics calculated based on COG/MPO data. Figures 11 and 12 show Weekly ADT and Growth Rate plots for the locations shown in Figure 10.

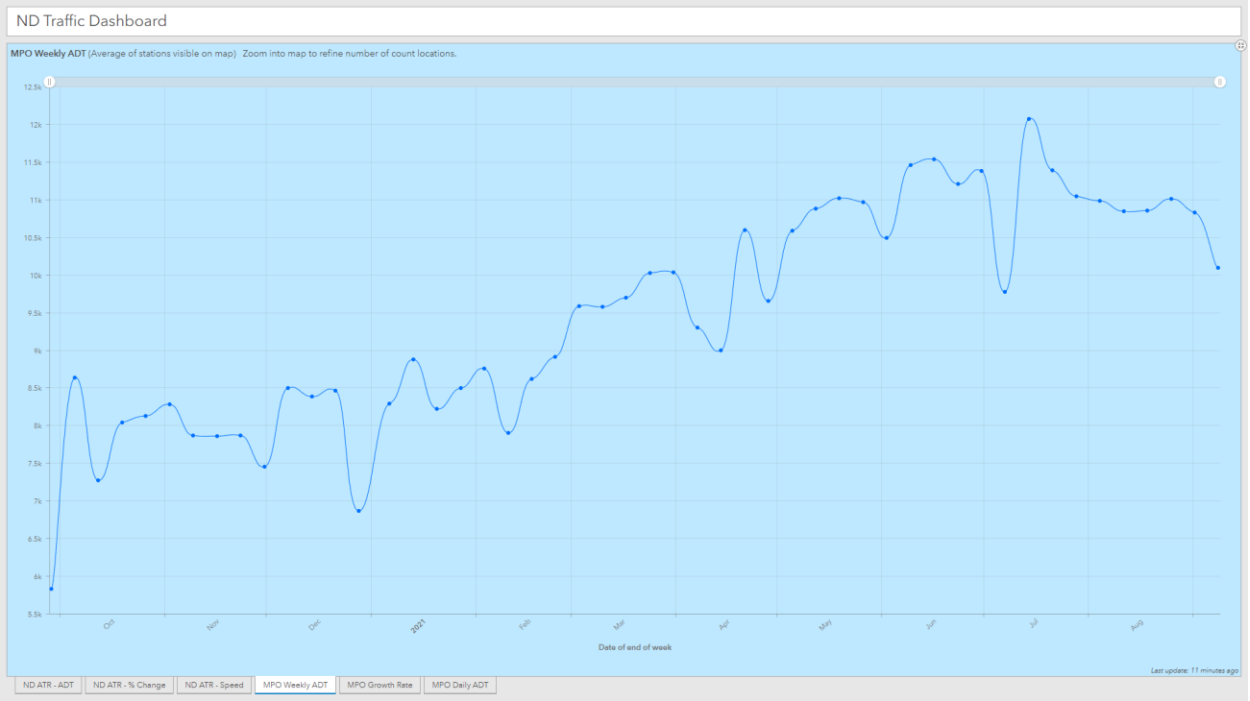


Figure 11. Weekly ADT plot for FM Metro COG's intersections

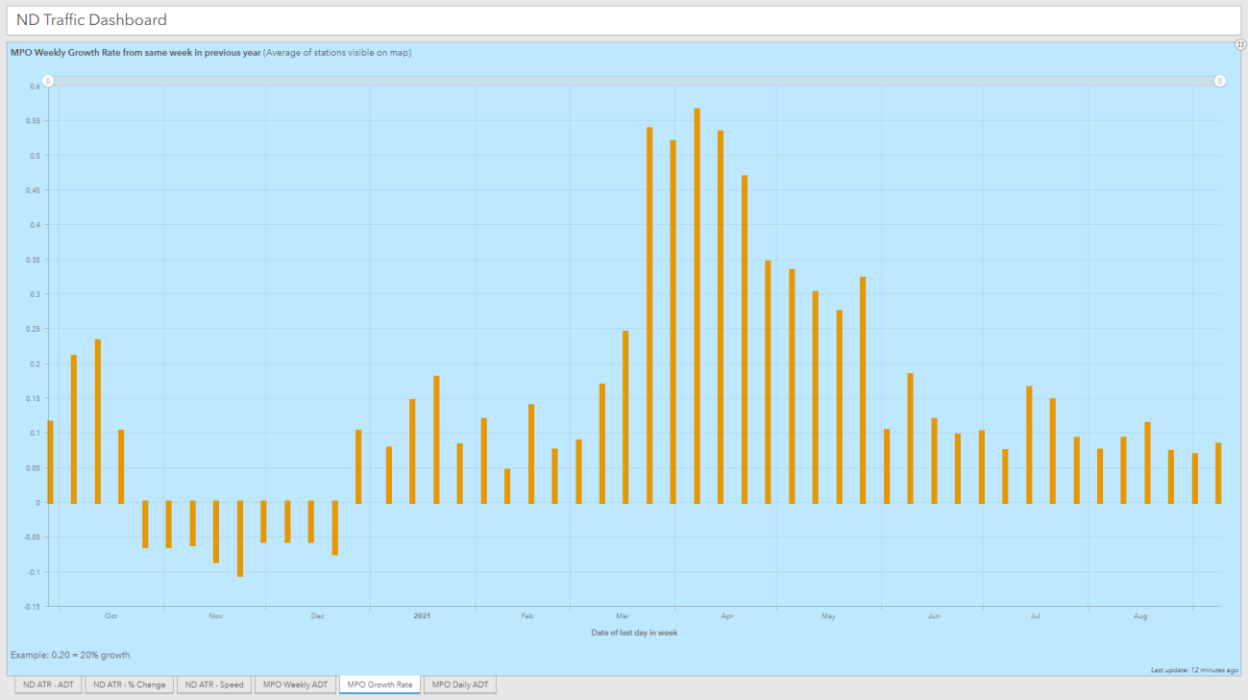


Figure 12. Weekly Growth Rate plot for FM Metro COG's intersections

The creation of this traffic dashboard was not undertaken as part of this project. Information about the dashboard is shared here as an example of useful application of the valuable data being collected.

EMAIL NOTIFICATIONS

These emails are sent to stakeholders, engineers, and developers to notify them of potential outages which may have been caused by power disruptions, communication loss etc. These would facilitate prompt troubleshooting of any issues, thereby minimizing data loss. Currently, weekly emails are sent to stakeholders to reassure them that the data is not more than a week old. UGPTI staff, including engineers and developers, receive these emails daily so any issues may be tackled as soon as possible.

UGPTI engineers and developers also receive notifications regarding the availability of data from intersections newly set for traffic data collection. This facilitates timely setting up of intersections within the traffic analysis database.

Corridor reports

The Graphical User Interface (GUI) of the traffic analysis website and the supporting programming enables collective reporting of a group of intersections along a corridor. So far, this feature is available for AADT, MADT, and ADT reports. The homepage of the traffic analysis website now presents the user with an option to either select a single intersection or a corridor using separate drop-down menu items. In the case of corridor reports, the website creates a compressed folder containing individual pdf reports. Note that major intersections along intersecting corridors are included in groups of both intersecting streets. For example, the intersection of Main Ave @ University Dr in Fargo would be part of both Main Ave and University Dr corridors.

RECOMMENDATIONS

Based on the findings of this pilot project for the area agencies, several next steps have been identified and the corresponding recommendations are discussed below.

North Dakota Department of Transportation

Consider:

- Setting up more intersections for traffic data collection. These would include I-94 and I-29 ramp termini within the Fargo District's jurisdiction.
- Using API commands and scripts to automate the data download process.
- Providing a dedicated machine for traffic data.
- Providing user credentials for the agency's ATMS.

Minnesota Department of Transportation

Consider:

- Setting up more intersections for traffic data collection, mainly to include intersections along US 75 and US 10 within District 4's jurisdiction.
- Adding detectors wherever turning traffic cannot be captured due to lack of detection.

    - Alternatively, other available detection technologies such as video may be considered.

- Creating an import script to automate high-res data translation and inserts into the traffic database.

City of Fargo

Consider:

- Setting up more intersections for traffic data collection mainly to include other signalized intersections within Fargo's jurisdiction.
- Using API commands and scripts to automate the data download process.
- Adding detectors wherever turning traffic cannot be captured due to lack of detection.
    - Alternatively, other available detection technologies such as video may be considered.
- Creating an import script to automate ATMS output data into the traffic database.

City of Moorhead

Consider:

- Setting up more intersections for traffic data collection mainly to include other signalized intersections within Moorhead's jurisdiction.
- Providing a dedicated machine for traffic data.
- Using API commands and scripts to automate the data download process.
- Setting up of automated traffic data transfer between City and UGPTI servers

City of West Fargo

Consider:

- Setting up more intersections for traffic data collection mainly to include other signalized intersections within West Fargo's jurisdiction.
- Using API commands and scripts to automate the data download process.