Technical Memo 2

Date:	Wednesday, March 01, 2017
Project:	Northeast Pierre Transportation Plan
To:	Steve Gramm, SAT participants
From:	Rick Laughlin, Jason Kjenstad
Subject:	Origin/Destination information

The purpose of this memorandum is to provide an overview of the draft origin-destination study results for the Northeast Pierre Transportation Plan. Two primary sources of origin-destination survey data were used for this study:

- A StreetLight dataset for the study area we received from StreetLight Data, Inc.
- A video-based license plate survey.

There are pros and cons of each survey, and the background sections provide an overview of each. Each survey approach used a consistent set of survey stations, shown in Figure 1.

The following sections provide some background on methodology and results.

StreetLight Data Background

StreetLight Data's product analyzes data from anonymous mobile devices (phones, GPS systems in vehicles, etc.) and takes that time and location data, analyzes it, and provides commercial or all vehicle mobility patterns for a place.

For this study, the StreetLight data provided were a summary of origin-destination patterns in the Pierre area for personal vehicle and commercial truck trips. The data provided were summarized from the most recent year of available data (July 2015 through June 2106) in a format of *Origin Zone – Middle Filter Zone – Destination Zone*. This allowed us to understand personal vehicle and commercial vehicle patterns through the study area. The data analyzed were from average weekdays (Monday through Thursday). Our data were specifically set up to report which major roadways the trips originated from when entering the study area and which of our key "middle filter" zones of interest those trips passed through.

The origin-destination zones were located at:

- **Station 1**: US 14 West of Highway 1806
- **Station 2**: US 83 South of 1st Street (south of Fort Pierre City Limits)
- **Station 3**: Highway 1804 North of US 14
- **Station 4**: US 14 Northeast of William Street / 293rd Avenue

- **Station 5**: Highway 34 Southeast of 293rd Avenue

The middle filter / internal zones were located at:

- **Station 6**: The US 14 bridge over the Missouri River
- **Station 7**: Highland Avenue at the railroad tracks northeast of Sioux Avenue
- **Station 8**: Euclid Avenue south of 4th Street
- **Station 9**: US 83 Truck Bypass (Garfield Avenue) just north of 4th Street

This is similar to a "selected link" analysis in travel demand modeling, where the origins and destinations of travel flow through a designated select link are analyzed. Unique features of the StreetLight data include:

- Data represent an entire year of travel patterns (July 2015 to June 2016).
- A sample of travel in Pierre was collected based on vehicles using a variety of GPS services.
- Vehicles were classified as Heavy Commercial Trucks, Medium Commercial Trucks, or Personal Vehicles. For our analysis, we focused on commercial truck patterns in the study area. The percentage of the sampled personal vehicle trips that traveled through the study area was also evaluated from this dataset, and compared to the license plate data.

Video License Plate Background

Video cameras were placed in the same locations as those recorded for the GPS-based StreetLight data. The cameras were positioned to record license plates at our data collection stations that would allow the study team to determine defined routes. The cameras were set up so each individual lane was assigned a camera. The data were collected so that each station where video cameras were set up recorded the license plate number of the passing vehicle, the time the vehicle passed, and the direction it headed. A program was developed to match license plates between two locations, evaluating the time that passed between the vehicle passing between the two stations, and from that data we summarized the number of observed vehicles between stations. We were then able to estimate the patterns of traffic entering the city and which station that they left. The time component was added for each vehicle match to screen for those trips that stopped in Pierre or passed directly through Pierre.

Unique features of the video license plate survey:

- All data were collected over a 24-hour period on November 15, 2016.
- The video attempted to record the license plates of all vehicles during the survey period (not just a sample).
- No vehicle classification data were available.
- A small percentage of plates were not recorded (approximately 10 to 30 percent) due to obstructed views from closely-spaced vehicle platoons or non-standard license plate placement.

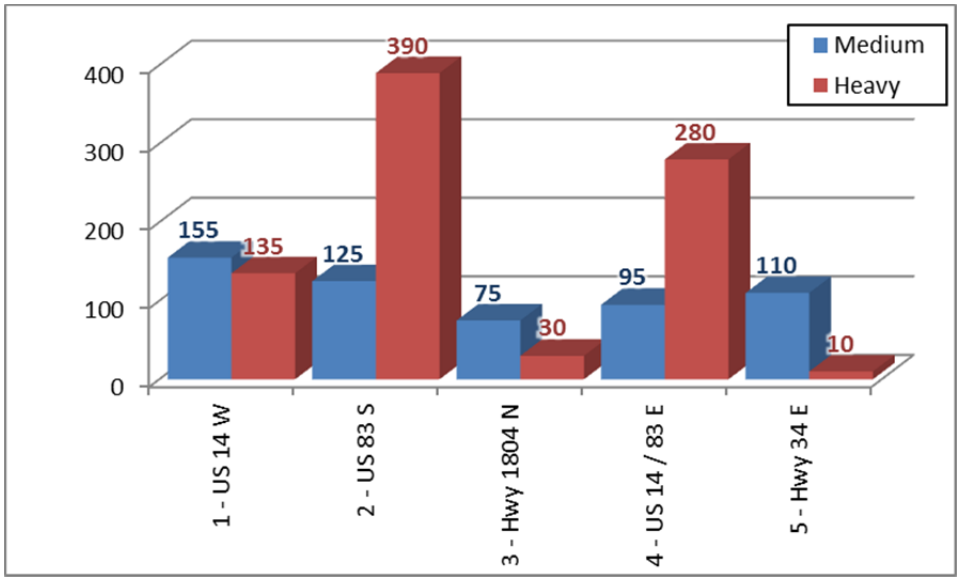
Origin-Destination Results

StreetLight Truck Data

Some differences are expected in the results for each of the two different origin-methodologies, since each uses different technology, sample rates, vehicle classification, and survey periods. The StreetLight data are provided in a format so that the frequency of travel between stations can be interpreted, which allows us to estimate the percentage of trips that show up at Station A and are destined for Station B. Based on the StreetLight data, travel patterns were identified for the major Pierre O-D stations.

To convert the flow percentages identified by the StreetLight data into numbers of trucks traveling between stations, we combined the StreetLight frequency data with 2015 South Dakota Department of Transportation (SDDOT) daily truck count data. The SDDOT daily count data are shown in **Figure 2**, with the survey stations highlighted in blue. **Chart 1** below shows the result of combining those two data sources.

Chart 1. Estimates of Daily and Medium Heavy Truck Volumes at Origin-Destination Zones



Sources: SDDOT, 2015 South Dakota Traffic Flow Map; StreetLight Data, Inc.

Based on a combination of the StreetLight data and the SDDOT truck counts on the study area boundary, **Table 1** and **Table 2** provide origin-destination estimates of daily truck travel (for both heavy trucks and medium trucks) between the five primary origin-destination stations.

Table 1. Estimated Daily Heavy Trucks Traveling Between Origin-Destination Stations

		Destination Station				
	Station Description	**Station 1 – US 14 West**	**Station 2 – US 83 South**	**Station 3 - Highway 1804 North**	**Station 4 - US 14 Northeast**	**Station 5 - Highway 34 Southeast**
Origin Station	**Station 1 - US 14 West**		15	*	20	5
	Station 2 - US 83 South	15		5	165	*
	Station 3 - Highway 1804 North	*	5		10	*
	Station 4 - US 14 Northeast	20	165	10		*
	Station 5 - Highway 34 Southeast	5	*	*	*	

* Less than 5 heavy trucks daily

Table 2. Estimated Daily Medium Trucks Traveling Between Origin-Destination Stations

		Destination Station				
	Station Description	**Station 1 – US 14 West**	**Station 2 – US 83 South**	**Station 3 - Highway 1804 North**	**Station 4 – US 14 Northeast**	**Station 5 - Highway 34 Southeast**
Origin Station	**Station 1 - US 14 West**		5	*	10	*
	Station 2 - US 83 South	5		5	20	5
	Station 3 - Highway 1804 North	*	5		5	10
	Station 4 - US 14 Northeast	10	20	5		5
	Station 5 - Highway 34 Southeast	*	5	10	5	

* Less than 5 medium trucks daily

Video License Plate Matching Data

The objective of the video license plate data was to identify non-truck (personal vehicle) patterns. Similar to our approach with the StreetLight data, we combined the percentages identified by the video license plate data with the SDDOT traffic counts. **Table 3** provides origin-destination estimates of daily personal vehicle travel between the five primary origin-destination stations.

Table 3. Estimated Daily Personal Vehicles Traveling Between Origin-Destination Stations

		Destination Station				
	Station Description	**Station 1 - US 14 West**	**Station 2 - US 83 South**	**Station 3 - Highway 1804 North**	**Station 4 - US 14 Northeast**	**Station 5 - Highway 34 Southeast**
Origin Station	**Station 1 - US 14 West**		200	45	75	50
	Station 2 - US 83 South	200		25	60	45
	Station 3 - Highway 1804 North	45	25		20	5
	Station 4 - US 14 Northeast	75	60	20		10
	Station 5 - Highway 34 Southeast	50	45	5	5	

Route Choice Through Pierre

For both the StreetLight and video license plate data, the "middle filter / internal zones" were evaluated to see which routes through traffic were using. The critical concern here was what route traffic from the Fort Pierre side (US 14 West and US 83 South) used to pass through Pierre to the east (US 14 / US 83 East, and to a lesser extent SD 1804). **Table 4** provides a summary of the estimated route, whether via Euclid Avenue or via Garfield Avenue / Truck Bypass.

Table 4. Estimated Routes for Through Traffic, by Vehicle Type

Vehicle Type	West Side Origin-Destination Station	East Side Origin-Destination Station	Proportion Via Euclid	Proportion Via Garfield / Bypass
Personal Vehicle	US 14 / US 83 West of Missouri River	US 14 East	54%	46%
	US 14 / US 83 West of Missouri River	SD 1804	92%	8%
Medium Trucks	US 14 / US 83 West of Missouri River	US 14 East	28%	72%
	US 14 / US 83 West of Missouri River	SD 1804	82%	18%
Heavy Trucks	US 14 / US 83 West of Missouri River	US 14 East	3%	97%
	US 14 / US 83 West of Missouri River	SD 1804	33%	67%