Laredo Urban Transportation Study Travel Time and Delay Survey

TECHNICAL SUMMARY

Laredo Urban Transportation Study (LUTS) Travel Survey Program
Interagency Contract
With
Texas Department of Transportation

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Introduction

The purpose of this technical summary is to describe the results of the analysis of data collected as part of the travel time and delay survey conducted in Laredo, Texas in February of 2002. This summary is organized into four sections. The first provides an overview of the study area. The second presents the survey data collection methodology. The third section discusses the results of the data analysis, and the final section provides summary information.

Area Description

The Laredo Urban Transportation Study (LUTS) survey area is contained within Webb County, Texas. According to the 2000 Census[1], approximately 193,000 people lived within the over 3,330 square miles that comprise Webb County. The U.S. Census Bureau also reports that Webb County had a growth in population of nearly 45% between the 1990 and 2000 census.

Methodology

To the general public, travel time, or the amount of time required to traverse a route between two points, is a fairly fundamental concept. To transportation engineers and planners, travel times can provide valuable information on the operating characteristics of a roadway network within an urbanized area. Results obtained from travel time and delay studies can assist in the validation of not only travel demand models, but also, in air quality models and emission estimates.

The primary objective of collecting travel time and delay data was to measure average speeds during peak and off-peak periods for roadways in Laredo classified by the functional classification of the roadway and the area type that the roadway traversed. The functional classification of roadways is based on the importance of movement and the access functions assigned to that facility. The different functional classes analyzed in Laredo are:
  1 – Freeway (limited access to property with traffic movement and mobility as primary function)
  2 – Arterial (highly continuous roads with inter-community and intra-metropolitan traffic movement as primary function)
  3 – Collector (primary function is to distribute traffic between arterial and local streets)
  4 – Local (primary function is to provide access to property)
  5 – Frontage (provide transition off of and on to freeways)

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[1] http://quickfacts.census.gov/qfd/states/48/48479.html

Urban areas are typically divided into small geographic sections called traffic analysis zones (TAZ). Each zone is normally bound by transportation facilities and/or geographic features (e.g. bodies of water, parks, etc), and the activity that occurs within that area is typically somewhat homogenous. Zones are categorized by the density of activity associated with them. The zonal density is measured in terms of population and employment relative to the area in acres. The following formula is utilized in determining the density of activity.

$$\text{Activity Density} = \text{Population} + (X * \text{Employment}) / \text{Area}$$

In this formula, "X" is the population/employment ratio for the entire study area. This density categorization is referred to as area type, and typically there are five to six area types in an urban area. It is important to note that the activity densities for each area type, as well as the number of area types, vary from urban area to urban area. In Laredo, there are six area types and they are as follows:
- 1 – Central Business District (CBD) – (high activity density)
- 2 – CBD Fringe (moderate to high activity density)
- 3 – Urban (moderate activity density)
- 4 – Suburban (moderate to low activity density)
- 5 – Industrial (special category determined by the MPO, based primarily on function rather than density)
- 6 – Rural (low activity density)

Route Scheduling

In Laredo, a total of five routes were selected for data collection purposes. The routes were structured to cover as many of the functional classification and area types as possible in an efficient manner. The routes are described in Table 1. The table provides the segments for each route with the accompanying functional class and area type. The determination on where one segment ended and another began was based on three factors. A new segment began when there was a change in the functional classification of the roadway along a route as well as when there was a change in the area type being traversed by the route. The final criterion for when a new segment began was determined in the development of the routes. New segments were often created when the route went though a major intersection or when the route path changed from one street to another.

A graphical representation of the routes is shown in Figure 1. For each route, a total of twelve runs were conducted using the floating car method. This method involves traveling at speeds that are consistent with other vehicles on the roadway. Of those twelve runs, three were during the peak periods (7-9 a.m. and 4-6 p.m.) and three more were during the off-peak periods (9 a.m.-12 p.m. and 1-4 p.m.). The remaining six runs were conducted in the reverse direction (three during the peak period and three during the off-peak period).

Table 1. Laredo Travel Time Route Description.

|	Roadway	From	To	Functional Class	Area Type
Route 1	Loop 20	McPherson	ATC	Arterial	5
	Loop 20	ATC	Del Mar	Arterial	6
	Del Mar	Loop 20	Winfield	Arterial	6
	Del Mar	Winfield	McPherson	Arterial	4
	McPherson	Del Mar	Fenwick	Arterial	3
	Fenwick	McPherson	Del Mar	Collector	3
	Del Mar	Fenwick	Springfield	Arterial	3
	Springfield	Del Mar	Sunset	Collector	3
	Sunset	Springfield	Brand	Collector	3
	Brand	Sunset	Stratford	Local	3
	Stratford	Brand	END ROUTE	Local	3
Route 2	IH 35	Las Cruces	International	Frontage	5
	IH 35	Las Cruces	International	Freeway	5
	IH 35	International	Del Mar	Freeway	4
	IH 35	Del Mar	Mann	Freeway	3
	IH 35	Mann	Calton	Freeway	2
	IH 35	Mann	Calton	Frontage	2
	Calton	IH 35	McPherson	Arterial	2
	McPherson	Calton	Saunders	Arterial	2
	Saunders	McPherson	IH 35	Arterial	2
	Saunders	IH 35	Santa Maria	Arterial	2
	Santa Maria	Saunders	Victoria	Collector	2
	Victoria	Santa Maria	Convent	Local	1
	Convent	Victoria	END ROUTE	Local	1
Route 3	US 59	Heritage	Loop 20	Arterial	4
	Loop 20	US 59	ATC	Arterial	4
	Loop 20	ATC	Clark	Arterial	6
	Clark	Loop 20	ATC	Arterial	4
	Clark	ATC	Bartlett	Arterial	3
	Bartlett	Spur 400	US 59	Collector	3
	Bartlett	US 59	Hillside	Collector	2
	Hillside	Bartlett	McPherson	Local	2
	McPherson	Hillside	Calle del Norte	Arterial	3
	Calle del Norte	McPherson	St James	Collector	3
	St James	Calle del Norte	Winchester	Local	3
	Winchester	St James	Merlin	Local	3
	Merlin	Winchester	Del Mar	Collector	3
	Del Mar	Merlin	Lindenwood	Arterial	3
	Lindenwood	Del Mar	Timber	Collector	3
	Timber	Lindenwood	END ROUTE	Local	3

ATC = Area Type Change

Table 1. Laredo Travel Time Route Description (continued)

	Roadway	From	To	Functional Class	Area Type
Route 4	SH 359	Larga Vista	Loop 20	Arterial	6
	SH 359	Loop 20	US 83	Arterial	4
	US 83	SH 359	Meadow	Arterial	2
	Meadow	US 83	Corpus Christi	Collector	2
	Meadow	Corpus Christi	Clark	Collector	3
	Meadow	Clark	Lyon	Collector	3
	Lyon	Meadow	IH 35	Collector	3
	IH 35	Lyon	Mann	Frontage	2
	IH 35	Lyon	Mann	Freeway	2
	IH 35	Mann	Del Mar	Freeway	3
	IH 35	Del Mar	International	Freeway	4
	IH 35	Del Mar	International	Frontage	4
	IH 35	International	Las Cruces	Frontage	5
	Las Cruces	IH 35	FM 1472	Collector	5
	FM 1472	Las Cruces	Lowry	Arterial	5
	Lowry	FM 1472	Acadia Loop	Local	5
Route 5	US 83	Southgate	Loop 20	Arterial	3
	Loop 20	US 83	ATC	Arterial	3
	Loop 20	ATC	SH 359	Arterial	4
	Loop 20	SH 359	Clark	Arterial	4
	Loop 20	Clark	ATC	Arterial	4
	Loop 20	ATC	US 59	Arterial	6
	US 59	Loop 20	Arkansas	Arterial	3
	Arkansas	US 59	Fremont	Collector	3
	Fremont	Arkansas	Springfield	Local	3
	Springfield	Fremont	Clark	Local	2
	Clark	Springfield	IH 35	Collector	2
	Clark/Park	IH 35	Santa Isabel	Collector	2
	Santa Isabel	Park	Jefferson	Local	2
	Jefferson	Santa Isabel	ATC	Collector	2
	Jefferson	ATC	San Ignacio	Collector	4
	San Ignacio	Jefferson	Ugarte	Collector	4
	Ugarte	San Ignacio	Eagle Pass	Local	4
	Eagle Pass	Ugarte	Chicago	Local	4
	Chicago	Eagle Pass	Maya	Local	4

ATC = Area Type Change

After determining the number of runs that were needed per route, a file naming convention was developed. The file naming structure was implemented so that the file name for each run would contain enough information to identify the route number, whether the run was collected during the peak or off-peak period, and in which direction the data for the route was collected. After estimating the amount of time needed to traverse a route, a schedule was devised. In Laredo, all data was collected between the hours of 7 a.m. and 6 p.m. Tuesday through Thursday.

Figure 1. Laredo Travel Time and Delay Routes
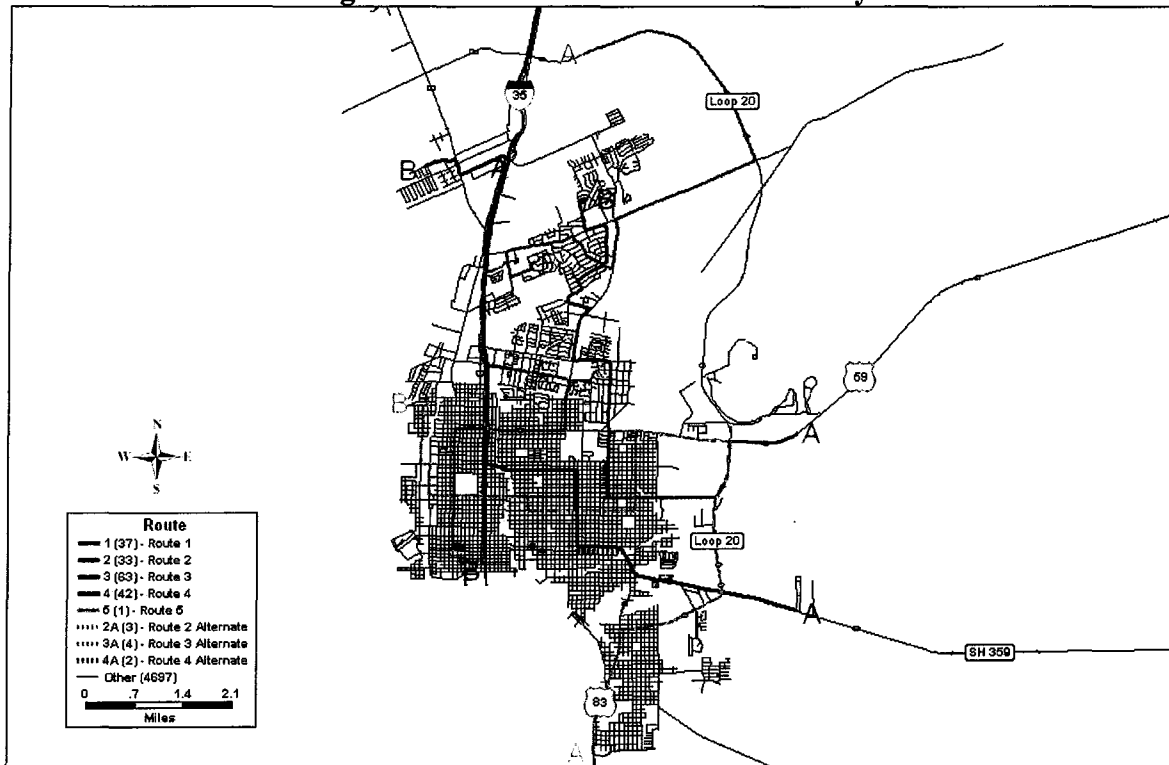
Data Collection Set-up

Data was collected over a two-week period in February 2002. The method for collecting the data involved using three main components; a vehicle, a Global Positioning Satellite (GPS) receiver, and a laptop computer. For this data collection, a GPS 35/36 TracPak^{TM} antenna manufactured by the Garmin Corporation was used. This particular GPS antenna collects various streams of data, including longitude, latitude, and speed, on a second-by-second basis. In order for the GPS data to be collected, annotated, and archived, specific pieces of software were used.

The laptop computer was loaded with software programs that allowed for data archiving as well as for data entry. Maptitude®, a geographic information system (GIS) software, has a feature that allows for the archiving the GPS data received from the antenna. NMEATime® was utilized to update the laptop computer's internal clock to the atomic time standard so that it would be consistent with the time associated with the GPS antenna. The final program incorporated into the data collection was a FORTRAN program called Runstart. This program allowed the user to identify the start and end points for the data collection by typing in text statements. In addition to noting the start and end points, information such as segment endpoints, posted speed limits for segments, and events that contributed to unusually low speeds could be entered. Each time a comment was entered, the information was time-stamped. This time-stamp provided a correlation between a particular event and the GPS data.

After the data collection process was completed, measures were taken to process the raw data into a format that allowed for the analysis of the data. The data collected using the GPS receiver and Maptitude® included more information than was needed for the analysis. Therefore, the raw GPS data was processed through a Fortran program that removed all extraneous lines of data from the individual files. At this point, the data was imported into a Microsoft Excel® spreadsheet and the longitude and latitude values were converted to a decimal degree format. The Excel® GPS files were then imported into a Microsoft Access® database. The X-Y coordinate information in the Access® database was then loaded into ArcGIS®. Using ArcGIS®, a determination was made of the X-Y coordinates of the segment endpoints. Polygons were constructed around the segment endpoints to take into consideration any stop time or delay associated with traffic signals. An example of the polygons is provided in Figure 2.

Figure 2. Data Processing in ArcGIS®.
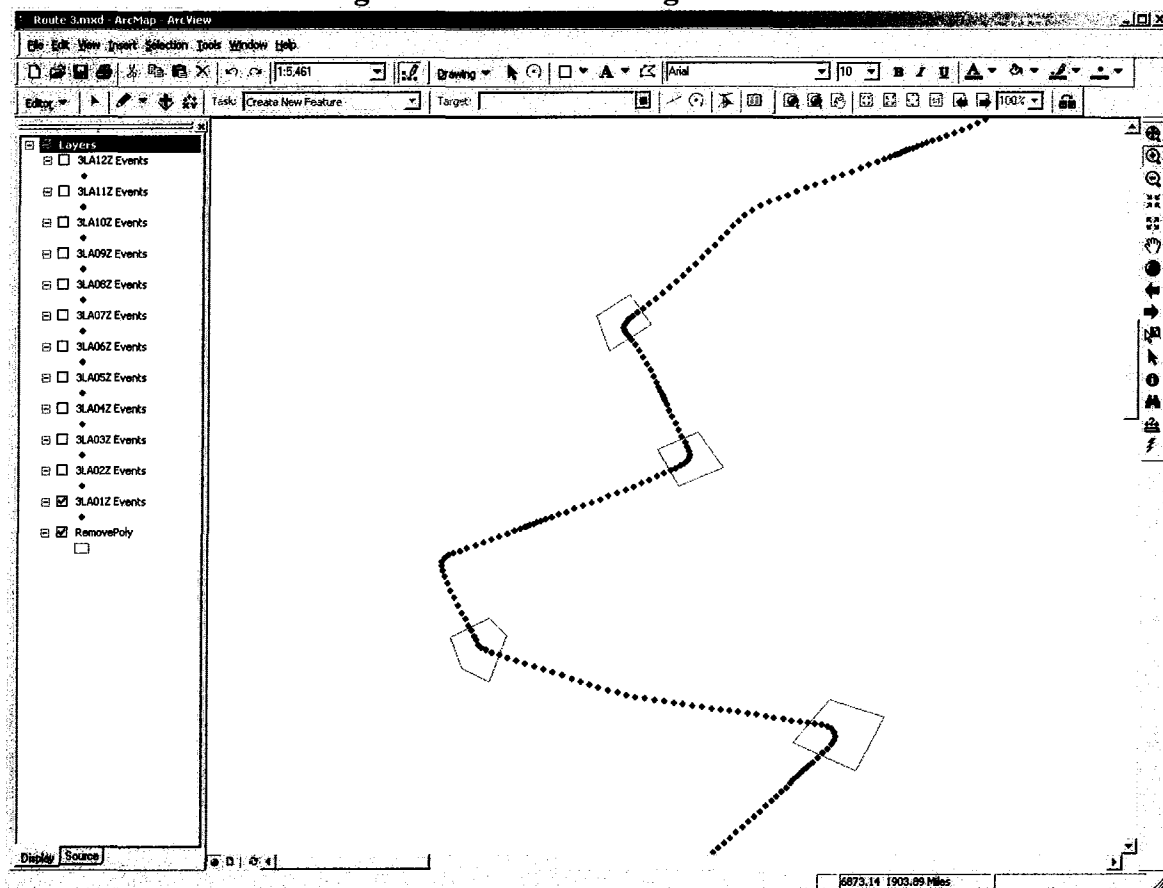
As shown in Figure 2, the polygons (shaded areas) represent segment endpoints. The size of the polygons were dependent on the amount of delay or stop time at a particular intersection. The polygons were constructed to cover the run that had the largest amount of delay time at a given segment endpoint. The longitude and latitude readings (per second) are shown as a small square. Areas where there are higher concentrations of readings represent a decrease in speed.

Data Analysis

After the raw data was reduced and imported into ArcGIS®, it was then analyzed in order to obtain the average speed for each segment along a given route. Using the polygons developed for each route, the distance between the individual polygons was measured. Additionally, the time required to traverse the distance between polygons was determined. Using distance and time values, the speed was determined for each segment using the formula:

$$\text{Speed (mph)} = \frac{\text{Distance (miles)}}{\text{Time (seconds)}/3600}$$

The data that resulted from these calculations is provided in Tables 2 through 6. The time per segment (in seconds) and the average speed per segment along an individual route are shown in the columns. The segment endpoints are provided in the left-hand column. As shown in these tables, in addition to the average speed for each run the functional classification (FUNCL), area type (ATYPE), and length was provided on a per segment basis. Segment averages were determined on a peak or off-peak basis and by direction. After compiling the segment average speeds, a review of the data within the tables was conducted to identify speeds that were unusually low or high. For those segments with speeds that were considered outside the normal range of values, a determination was made as to why the speed varied. This determination was made by reviewing the Runstart file for the run in question and ascertaining if the unusual speed was a result of a recurring or non-recurring event.

If the unusual speed reading was the result of recurring events such as a traffic control devices (e.g. traffic signal, stop sign, school zone) or trains, then the data was not excluded from the analysis. However, if the low speed was the result of an event that was not recurring, then the data was excluded. Examples of non-recurring events include construction, traffic incidents, and disabled vehicles. In Tables 2-6, cells that contain "bad data" are instances where non-recurring event were present during the data collection.

Table 2a. Average Speed per Segment – Route 1 (Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 1 Time (sec)	Run 1 Avg. Speed	Run 2 Time (sec)	Run 2 Avg. Speed	Run 3 Time (sec)	Run 3 Avg. Speed	Segment Average
McPherson to Area Type Chg.	2	5	0.65	52	44.8	59	39.5	56	41.6	42.0
Area Type Change to Del Mar	2	6	2.59	209	44.6	206	45.3	207	45.1	45.0
Del Mar to Winfield	2	6	0.53	60	32.0	59	32.5	60	32.0	32.2
Winfield to McPherson	2	4	1.50	211	25.5	218	24.7	195	27.6	26.0
McPherson to Fenwick	2	3	0.66	99	24.0	72	33.0	88	27.0	28.0
Fenwick to Del Mar	3	3	0.74	150	17.7	147	18.1	151	17.6	17.8
Del Mar to Springfield	2	3	0.94	130	26.2	115	29.6	116	29.3	28.4
Springfield to Sunset	3	3	0.29	37	28.3	37	28.3	35	29.9	28.8
Sunset to Brand	3	3	0.27	36	27.5	37	26.7	39	25.4	26.5
Brand to Stratford	4	3	0.06	12	18.1	11	19.7	11	19.7	19.2
Stratford to Linden	4	3	0.04	8	20.2	8	20.2	7	23.1	21.2

Table 2b. Average Speed per Segment – Route 1 (Off-Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 4 Time (sec)	Run 4 Avg. Speed	Run 5 Time (sec)	Run 5 Avg. Speed	Run 6 Time (sec)	Run 6 Avg. Speed	Segment Average
McPherson to Area Type Chg.	2	5	0.65	56	41.6	57	40.9	65	35.9	39.4
Area Type Change to Del Mar	2	6	2.59	208	44.8	209	44.6	192	48.6	46.0
Del Mar to Winfield	2	6	0.53	58	33.1	60	32.0	58	33.1	32.7
Winfield to McPherson	2	4	1.50	164	32.9	149	36.2	131	41.1	36.7
McPherson to Fenwick	2	3	0.66	79	30.1	64	37.1	66	36.0	34.4
Fenwick to Del Mar	3	3	0.74	150	17.7	151	17.6	133	20.0	18.4
Del Mar to Springfield	2	3	0.94	111	30.6	112	30.4	105	32.4	31.1
Springfield to Sunset	3	3	0.29	37	28.3	35	29.9	36	29.1	29.1
Sunset to Brand	3	3	0.27	37	26.7	35	28.2	36	27.5	27.5
Brand to Stratford	4	3	0.06	11	19.7	11	19.7	11	19.7	19.7
Stratford to Linden	4	3	0.04	8	20.2	8	20.2	10	16.2	18.9

Table 2c. Average Speed per Segment – Route 1 (Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 7 Time (sec)	Avg. Speed	Run 8 Time (sec)	Avg. Speed	Run 9 Time (sec)	Avg. Speed	Segment Average
Stratford to Linden	4	3	0.04	8	20.0	9	17.7	8	20.0	19.2
Brand to Stratford	4	3	0.06	11	19.0	12	17.4	11	19.0	18.5
Sunset to Brand	3	3	0.27	34	29.0	34	29.0	34	29.0	29.0
Springfield to Sunset	3	3	0.29	37	28.3	34	30.8	41	25.6	28.2
Del Mar to Springfield	2	3	0.95	110	31.0	126	27.0	113	30.2	29.4
Fenwick to Del Mar	3	3	0.74	155	17.1	150	17.7	163	16.3	17.0
McPherson to Fenwick	2	3	0.67	65	37.2	67	36.1	66	36.6	36.6
Winfield to McPherson	2	4	1.50	138	39.1	164	32.9	147	36.7	36.2
Del Mar to Winfield	2	6	0.53	54	35.6	71	27.1	55	35.0	32.6
Area Type Change to Del Mar	2	6	2.60	224	41.7	210	44.5	206	45.4	43.9
McPherson to Area Type Chg.	2	5	0.65	50	46.8	53	44.2	52	45.0	45.3

Table 2d. Average Speed per Segment – Route 1 (Off-Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 10 Time (sec)	Avg. Speed	Run 11 Time (sec)	Avg. Speed	Run 12 Time (sec)	Avg. Speed	Segment Average
Stratford to Linden	4	3	0.04	7	22.8	8	20.0	8	20.0	20.9
Brand to Stratford	4	3	0.06	10	20.9	12	17.4	10	20.9	19.8
Sunset to Brand	3	3	0.27	34	29.0	36	27.4	34	29.0	28.5
Springfield to Sunset	3	3	0.29	35	29.9	35	29.9	34	30.8	30.2
Del Mar to Springfield	2	3	0.95	124	27.5	122	27.9	168	20.3	25.2
Fenwick to Del Mar	3	3	0.74	156	17.0	153	17.4	152	17.5	17.3
McPherson to Fenwick	2	3	0.67	68	35.5	67	36.1	66	36.6	36.1
Winfield to McPherson	2	4	1.50	140	38.5	142	38.0	147	36.7	37.7
Del Mar to Winfield	2	6	0.53	54	35.6	56	34.3	52	37.0	35.6
Area Type Change to Del Mar	2	6	2.60	204	45.8	211	44.3	208	45.0	45.0
McPherson to Area Type Chg.	2	5	0.65	52	45.0	54	43.3	54	43.3	43.9

Table 3a. Average Speed per Segment - Route 2 (Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 1 Time (sec)	Run 1 Avg. Speed	Run 2 Time (sec)	Run 2 Avg. Speed	Run 3 Time (sec)	Run 3 Avg. Speed	Segment Average
Las Cruces to Intl. Blvd (FR)	5	5	0.22	22	35.6	18	43.5	18	43.5	40.9
Las Cruces to Intl. Blvd (ML)	1	5	0.16	11	53.1	9	65.0	9	65.0	61.0
Intl. Blvd. to Del Mar	1	4	0.84	52	58.0	48	62.8	49	61.5	60.8
Del Mar to Mann	1	3	0.46	28	59.7	26	64.3	28	59.7	61.3
Mann to Calton (ML)	1	2	0.55	32	62.2	33	60.3	33	60.3	61.0
Mann to Calton (FR)	5	2	0.38	30	45.4	34	40.1	29	47.0	44.2
Calton to McPherson	2	2	1.13	144	28.1	195	20.8	200	20.3	23.1
McPherson to Saunders	2	2	0.61	118	18.7	194	11.4	138	16.0	15.3
Saunders to I-35	2	2	0.88	114	27.9	131	24.3	107	29.7	27.3
I-35 to Santa Maria	2	2	0.53	93	20.6	109	17.6	102	18.8	19.0
Santa Maria to Victoria1	3	2	0.83	123	24.2	158	18.9	152	19.6	20.9
Santa Maria to Victoria2	3	2	0.53	143	13.3	149	12.8	110	17.3	14.5
Victoria to Salinas	4	1	0.08	57	5.4	55	5.5	62	4.9	5.3
Salinas to Matamoros	4	1	0.06	23	8.7	12	16.8	22	9.1	11.6

Figure 3b. Average Speed per Segment - Route 2 (Off-Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 4 Time (sec)	Run 4 Avg. Speed	Run 5 Time (sec)	Run 5 Avg. Speed	Run 6 Time (sec)	Run 6 Avg. Speed	Segment Average
Las Cruces to Intl. Blvd (FR)	5	5	0.22	17	46.1	17	46.1	15	52.2	48.1
Las Cruces to Intl. Blvd (ML)	1	5	0.16	11	53.1	10	58.5	9	65.0	58.8
Intl. Blvd. to Del Mar	1	4	0.84	50	60.3	48	62.8	45	67.0	63.4
Del Mar to Mann	1	3	0.46	28	59.7	25	66.9	25	66.9	64.5
Mann to Calton (ML)	1	2	0.55	33	60.3	30	66.4	29	68.6	65.1
Mann to Calton (FR)	5	2	0.38	31	44.0	32	42.6	27	50.5	45.7
Calton to McPherson	2	2	1.13	205	19.8	195	20.8	191	21.2	20.6
McPherson to Saunders	2	2	0.61	226	9.8	131	16.8	107	20.6	15.7
Saunders to I-35	2	2	0.88	129	24.7	127	25.0	89	35.7	28.5
I-35 to Santa Maria	2	2	0.53	135	14.2	253	7.6	bad data	bad data	10.9
Santa Maria to Victoria1	3	2	0.83	bad data	bad data	121	24.6	125	23.8	24.2
Santa Maria to Victoria2	3	2	0.53	bad data	bad data	99	19.2	257	7.4	13.3
Victoria to Salinas	4	1	0.08	57	5.4	48	6.4	63	4.8	5.5
Salinas to Matamoros	4	1	0.06	17	11.8	39	5.2	10	20.1	12.4

Table 3c. Average Speed per Segment – Route 2 (Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 7 Time (sec)	Run 7 Avg. Speed	Run 8 Time (sec)	Run 8 Avg. Speed	Run 9 Time (sec)	Run 9 Avg. Speed	Segment Average
Convent to Matamoros	2	1	0.13	24	18.8	76	5.9	18	25.1	16.6
Houston to Convent	3	1	0.14	22	22.4	43	11.4	28	17.6	17.1
Santa Maria to Houston2	3	2	0.45	105	15.6	97	16.9	86	19.0	17.2
Santa Maria to Houston1	3	2	0.83	160	18.6	145	20.5	123	24.2	21.1
I-35 to Santa Maria	2	2	0.54	148	13.0	260	7.4	223	8.7	9.7
Saunders to I-35	2	2	0.88	161	19.7	113	28.0	99	32.0	26.6
McPherson to Saunders	2	2	0.61	109	20.2	89	24.7	121	18.2	21.0
Calton to McPherson	2	2	1.09	250	15.7	165	23.7	199	19.7	19.7
Mann to Calton (FR)	5	2	0.41	35	42.6	33	45.2	28	53.3	47.0
Mann to Calton (ML)	1	2	0.55	35	56.6	32	61.9	32	61.9	60.1
Del Mar to Mann	1	3	0.47	28	60.1	29	58.0	29	58.0	58.7
Intl. Blvd. to Del Mar (ML)	1	4	0.37	25	53.4	24	55.6	25	53.4	54.1
Intl. Blvd. to Del Mar (FR)	5	4	0.41	27	54.5	28	52.6	28	52.6	53.2
Las Cruces to Intl. Blvd (FR)	5	5	0.43	32	48.6	29	53.7	33	47.2	49.8

Table 3d. Average Speed per Segment - Route 2 (Off-Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 10		Run 11		Run 12		Segment Average
				Time (sec)	Avg. Speed	Time (sec)	Avg. Speed	Time (sec)	Avg. Speed	
Convent to Matamoros	2	1	0.13	37	12.2	bad data	bad data	26	17.4	14.8
Houston to Convent	3	1	0.14	64	7.7	bad data	bad data	26	18.9	13.3
Santa Maria to Houston2	3	2	0.45	87	18.8	bad data	bad data	106	15.4	17.1
Santa Maria to Houston1	3	2	0.83	126	23.6	bad data	bad data	135	22.1	22.9
I-35 to Santa Maria	2	2	0.54	196	9.8	135	14.3	bad data	bad data	12.1
Saunders to I-35	2	2	0.88	142	22.3	130	24.4	87	36.4	27.7
McPherson to Saunders	2	2	0.61	101	21.8	122	18.0	131	16.8	18.9
Calton to McPherson	2	2	1.09	213	18.4	193	20.3	227	17.2	18.6
Mann to Calton (FR)	5	2	0.41	32	46.6	32	46.6	38	39.2	44.2
Mann to Calton (ML)	1	2	0.55	36	55.0	31	63.9	32	61.9	60.3
Del Mar to Mann	1	3	0.47	28	60.1	25	67.3	27	62.3	63.2
Intl. Blvd. to Del Mar (ML)	1	4	0.37	29	46.0	23	58.0	20	66.7	56.9
Intl. Blvd. to Del Mar (FR)	5	4	0.41	29	50.7	31	47.5	27	54.5	50.9
Las Cruces to Intl. Blvd (FR)	5	5	0.43	34	45.8	34	45.8	29	53.7	48.4

Table 4a. Average Speed per Segment - Route 3 (Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 1 Time (sec)	Run 1 Avg. Speed	Run 2 Time (sec)	Run 2 Avg. Speed	Run 3 Time (sec)	Run 3 Avg. Speed	Segment Average
Heritage to Loop 20	2	4	1.01	80	45.2	89	40.7	83	43.6	43.2
Loop 20 to Area Type Change	2	4	0.23	17	49.2	18	46.4	18	46.4	47.3
Area Type Change to Clark	2	6	0.43	32	48.6	36	43.2	35	44.4	45.4
Clark to Area Type Change	2	4	0.27	21	46.4	24	40.6	23	42.3	43.1
Area Type Change to Bartlett	2	3	1.16	183	22.9	214	19.6	192	21.8	21.4
Bartlett to US 59	3	3	0.92	139	24.0	264	12.6	248	13.4	16.7
US 59 to Hillside	3	2	0.92	182	18.1	171	19.3	189	17.4	18.3
Hillside to Mcpherson	4	2	0.47	77	22.1	58	29.3	65	26.1	25.8
Mcpherson to Calle del Norte	2	3	0.75	124	21.9	125	21.7	132	20.6	21.4
Calle del Norte to St James	3	3	0.26	34	27.9	36	26.3	39	24.3	26.1
St James to Winchester	4	3	0.27	44	22.2	44	22.2	46	21.2	21.8
Winchest to Merlin	4	3	0.10	20	18.5	28	13.2	23	16.1	16.0
Merlin to Del Mar	3	3	1.01	172	21.1	158	23.0	172	21.1	21.7
Del Mar to Linden.	2	3	0.21	35	22.1	119	6.5	40	19.3	15.9
Linden. to Timber	3	3	0.41	85	17.3	79	18.7	91	16.2	17.4
Timber to Beverly	4	3	0.09	13	23.7	15	20.5	15	20.5	21.6

Table 4b. Average Speed per Segment - Route 3 (Off-Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 4 Time (sec)	Run 4 Avg. Speed	Run 5 Time (sec)	Run 5 Avg. Speed	Run 6 Time (sec)	Run 6 Avg. Speed	Segment Average
Heritage to Loop 20	2	4	1.01	79	45.8	92	39.3	77	47.0	44.1
Loop 20 to Area Type Change	2	4	0.23	18	46.4	18	46.4	19	44.0	45.6
Area Type Change to Clark	2	6	0.43	35	44.4	35	44.4	34	45.7	44.8
Clark to Area Type Change	2	4	0.27	23	42.3	22	44.3	24	40.6	42.4
Area Type Change to Bartlett	2	3	1.16	148	28.3	143	29.3	179	23.4	27.0
Bartlett to US 59	3	3	0.92	217	15.3	186	17.9	175	19.0	17.4
US 59 to Hillside	3	2	0.92	157	21.0	132	25.0	141	23.4	23.1
Hillside to Mcpherson	4	2	0.47	65	26.1	57	29.8	56	30.3	28.8
Mcpherson to Calle del Norte	2	3	0.75	116	23.4	102	26.6	114	23.8	24.6
Calle del Norte to St James	3	3	0.26	31	30.5	31	30.5	30	31.6	30.9
St James to Winchester	4	3	0.27	47	20.7	46	21.2	43	22.7	21.5
Winchest to Merlin	4	3	0.10	27	13.7	23	16.1	22	16.9	15.6
Merlin to Del Mar	3	3	1.01	168	21.6	159	22.8	154	23.6	22.7
Del Mar to Linden.	2	3	0.21	33	23.4	26	29.7	28	27.6	26.9
Linden. to Timber	3	3	0.41	83	17.8	87	16.9	88	16.7	17.1
Timber to Beverly	4	3	0.09	14	22.0	15	20.5	14	22.0	21.5

Table 4c. Average Speed per Segment - Route 3 (Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 7 Time (sec)	Run 7 Avg. Speed	Run 8 Time (sec)	Run 8 Avg. Speed	Run 9 Time (sec)	Run 9 Avg. Speed	Segment Average
Timber to Beverly	4	3	0.08	14	21.8	14	21.8	15	20.4	21.3
Linden. to Timber	3	3	0.41	83	17.8	92	16.0	78	18.9	17.6
Del Mar to Linden.	2	3	0.21	43	17.8	30	25.5	24	31.9	25.1
Merlin to Del Mar	3	3	1.01	170	21.3	161	22.5	178	20.3	21.4
Winchest to Merlin	4	3	0.10	23	16.0	24	15.3	23	16.0	15.8
St James to Winchester	4	3	0.28	68	14.6	43	23.0	49	20.2	19.3
Calle del Norte to St James	3	3	0.26	33	28.4	32	29.3	34	27.6	28.5
Mcpherson to Calle del Norte	2	3	0.76	137	19.9	73	37.4	104	26.3	27.9
Hillside to Mcpherson	4	2	0.47	56	30.4	58	29.4	60	28.4	29.4
US 59 to Hillside	3	2	0.92	274	12.0	185	17.8	132	25.0	18.3
Bartlett to US 59	3	3	0.95	140	24.5	133	25.7	127	27.0	25.7
Area Type Change to Bartlett	2	3	1.23	193	23.0	178	24.9	195	22.7	23.5
Clark to Area Type Change	2	4	0.27	26	37.4	24	40.5	24	40.5	39.5
Area Type Change to Clark	2	6	0.43	35	44.1	35	44.1	30	51.5	46.6
Loop 20 to Area Type Change	2	4	0.23	19	43.9	20	41.7	19	43.9	43.2
Heritage to Loop 20	2	4	1.01	73	49.7	76	47.7	70	51.8	49.8

Table 4d. Average Speed per Segment - Route 3 (Off-Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 10 Time (sec)	Run 10 Avg. Speed	Run 11 Time (sec)	Run 11 Avg. Speed	Run 12 Time (sec)	Run 12 Avg. Speed	Segment Average
Timber to Beverly	4	3	0.08	14	21.8	15	20.4	15	20.4	20.9
Linden. to Timber	3	3	0.41	82	18.0	88	16.7	70	21.1	18.6
Del Mar to Linden.	2	3	0.21	24	31.9	27	28.4	22	34.8	31.7
Merlin to Del Mar	3	3	1.01	156	23.2	157	23.1	169	21.4	22.6
Winchest to Merlin	4	3	0.10	23	16.0	23	16.0	22	16.7	16.2
St James to Winchester	4	3	0.28	46	21.5	47	21.1	57	17.4	20.0
Calle del Norte to St James	3	3	0.26	32	29.3	34	27.6	40	23.5	26.8
Mcpherson to Calle del Norte	2	3	0.76	110	24.8	100	27.3	105	26.0	26.0
Hillside to Mcpherson	4	2	0.47	60	28.4	55	31.0	52	32.7	30.7
US 59 to Hillside	3	2	0.92	169	19.5	197	16.7	156	21.1	19.1
Bartlett to US 59	3	3	0.95	125	27.4	203	16.9	161	21.3	21.8
Area Type Change to Bartlett	2	3	1.23	150	29.5	184	24.1	149	29.7	27.8
Clark to Area Type Change	2	4	0.27	24	40.5	24	40.5	21	46.3	42.5
Area Type Change to Clark	2	6	0.43	34	45.4	37	41.7	31	49.8	45.6
Loop 20 to Area Type Change	2	4	0.23	20	41.7	21	39.7	18	46.4	42.6
Heritage to Loop 20	2	4	1.01	76	47.7	77	47.1	86	42.2	45.7

Table 5a. Average Speed per Segment - Route 4 (Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 1 Time (sec)	Run 1 Avg. Speed	Run 2 Time (sec)	Run 2 Avg. Speed	Run 3 Time (sec)	Run 3 Avg. Speed	Segment Average
Larga Vista to Loop 20	2	6	0.98	111	31.7	115	30.6	93	37.8	33.4
Loop 20 to US83	2	4	1.28	109	42.2	116	39.7	229	20.1	34.0
US83 to Meadow	2	2	0.76	165	16.5	179	15.2	193	14.1	15.3
Meadow to Corpus Christi	3	2	0.19	26	25.9	25	26.9	24	28.0	26.9
Corpus Christi to Clark	3	3	0.33	44	26.7	59	19.9	76	15.4	20.7
Clark to Lyon	3	3	0.31	38	29.4	41	27.3	37	30.2	29.0
Lyon to I-35	3	3	1.31	195	24.3	224	21.1	237	20.0	21.8
I-35 to Mann (FR)	5	2	0.81	87	33.5	118	24.7	83	35.1	31.1
I-35 to Mann (ML)	1	2	1.54	94	59.1	90	61.7	92	60.3	60.4
Mann to Del Mar	1	3	0.62	37	60.6	39	57.4	39	57.4	58.5
Del Mar to Intl Blvd (ML)	1	4	0.27	22	43.8	21	45.9	18	53.5	47.7
Del Mar to Intl Blvd (FR)	5	4	0.37	29	46.1	29	46.1	31	43.1	45.1
Intl. Blvd to Las Cruces (ML)	1	5	0.28	22	45.1	21	47.2	22	45.1	45.8
Intl Blvd to Las Cruces (FR)	5	5	0.14	14	35.6	15	33.3	30	16.6	28.5
Las Cruces to Mines	3	5	0.65	71	33.1	86	27.3	91	25.8	28.8
Mines to Lowery	2	5	0.19	42	16.3	57	12.0	46	14.8	14.4
Lowery to Acadia Loop	4	5	0.39	56	25.1	56	25.1	55	25.6	25.3

Table 5b. Average Speed per Segment - Route 4 (Off-Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 4 Time (sec)	Run 4 Avg. Speed	Run 5 Time (sec)	Run 5 Avg. Speed	Run 6 Time (sec)	Run 6 Avg. Speed	Segment Average
Larga Vista to Loop 20	2	6	0.98	80	44.0	83	42.4	122	28.8	38.4
Loop 20 to US83	2	4	1.28	151	30.5	145	31.8	115	40.0	34.1
US83 to Meadow	2	2	0.76	151	18.0	133	20.5	164	16.6	18.4
Meadow to Corpus Christi	3	2	0.19	25	26.9	24	28.0	25	26.9	27.3
Corpus Christi to Clark	3	3	0.33	60	19.6	78	15.0	61	19.2	17.9
Clark to Lyon	3	3	0.31	36	31.1	37	30.2	37	30.2	30.5
Lyon to I-35	3	3	1.31	231	20.5	166	28.5	202	23.4	24.1
I-35 to Mann (FR)	5	2	0.81	85	34.3	65	44.8	135	21.6	33.6
I-35 to Mann (ML)	1	2	1.54	90	61.7	82	67.7	101	55.0	61.4
Mann to Del Mar	1	3	0.62	42	53.3	38	59.0	37	60.6	57.6
Del Mar to Intl Blvd (ML)	1	4	0.27	21	45.9	18	53.5	20	48.2	49.2
Del Mar to Intl Blvd (FR)	5	4	0.37	27	49.5	26	51.4	29	46.1	49.0
Intl. Blvd to Las Cruces (ML)	1	5	0.28	22	45.1	18	55.1	21	47.2	49.2
Intl Blvd to Las Cruces (FR)	5	5	0.14	11	45.4	14	35.6	12	41.6	40.9
Las Cruces to Mines	3	5	0.65	73	32.2	80	29.4	85	27.7	29.8
Mines to Lowery	2	5	0.19	20	34.1	17	40.2	61	11.2	28.5
Lowery to Acadia Loop	4	5	0.39	54	26.1	53	26.6	55	25.6	26.1

Table 5c. Average Speed per Segment - Route 4 (Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 7 Time (sec)	Run 7 Avg. Speed	Run 8 Time (sec)	Run 8 Avg. Speed	Run 9 Time (sec)	Run 9 Avg. Speed	Segment Average
Lowery to Acadia Loop	4	5	0.39	55	25.6	53	26.6	49	28.8	27.0
Mines to Lowery	2	5	0.19	21	32.4	48	14.2	58	11.7	19.4
Las Cruces to Mines	3	5	0.58	61	34.1	74	28.1	70	29.7	30.7
Intl Blvd to Las Cruces (FR)	5	5	0.19	18	37.2	17	39.4	18	37.2	37.9
Intl. Blvd to Las Cruces (ML)	1	5	0.28	18	55.1	16	62.0	17	58.4	58.5
Del Mar to Intl Blvd (FR)	5	4	0.37	21	63.9	20	67.1	20	67.1	66.0
Del Mar to Intl Blvd (ML)	1	4	0.27	15	65.5	14	70.1	15	65.5	67.0
Mann to Del Mar	1	3	0.62	34	65.8	36	62.2	32	69.9	66.0
I-35 to Mann (ML)	1	2	1.54	95	58.5	102	54.4	86	64.6	59.2
I-35 to Mann (FR)	5	2	0.80	194	14.9	140	20.6	90	32.1	22.5
Lyon to I-35	3	3	1.38	230	21.5	257	19.3	221	22.4	21.1
Clark to Lyon	3	3	0.31	39	28.9	42	26.8	35	32.2	29.3
Corpus Christi to Clark	3	3	0.33	85	13.8	41	28.7	50	23.5	22.0
Meadow to Corpus Christi	3	2	0.19	26	25.8	26	25.8	31	21.7	24.5
US83 to Meadow	2	2	0.72	110	23.6	105	24.7	75	34.6	27.7
Loop 20 to US83	2	4	1.28	110	41.8	107	43.0	106	43.4	42.7
Larga Vista to Loop 20	2	6	0.98	73	48.2	82	42.9	85	41.4	44.1

Table 5d. Average Speed per Segment - Route 4 (Off-Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 10 Time (sec)	Run 10 Avg. Speed	Run 11 Time (sec)	Run 11 Avg. Speed	Run 12 Time (sec)	Run 12 Avg. Speed	Segment Average
Lowery to Acadia Loop	4	5	0.39	57	24.7	56	25.2	59	23.9	24.6
Mines to Lowery	2	5	0.19	20	34.0	21	32.4	19	35.8	34.1
Las Cruces to Mines	3	5	0.58	61	34.1	61	34.1	70	29.7	32.7
Intl Blvd to Las Cruces (FR)	5	5	0.19	17	39.4	18	37.2	19	35.3	37.3
Intl. Blvd to Las Cruces (ML)	1	5	0.28	19	52.2	17	58.4	19	52.2	54.3
Del Mar to Intl Blvd (FR)	5	4	0.37	22	61.0	21	63.9	24	55.9	60.3
Del Mar to Intl Blvd (ML)	1	4	0.27	16	61.4	15	65.5	16	61.4	62.7
Mann to Del Mar	1	3	0.62	37	60.5	35	63.9	37	60.5	61.6
I-35 to Mann (ML)	1	2	1.54	102	54.4	96	57.8	102	54.4	55.6
I-35 to Mann (FR)	5	2	0.80	146	19.8	52	55.6	129	22.4	32.6
Lyon to I-35	3	3	1.38	239	20.7	260	19.0	226	21.9	20.6
Clark to Lyon	3	3	0.31	38	29.6	43	26.2	37	30.4	28.7
Corpus Christi to Clark	3	3	0.33	78	15.1	47	25.0	41	28.7	22.9
Meadow to Corpus Christi	3	2	0.19	22	30.5	47	14.3	24	28.0	24.3
US83 to Meadow	2	2	0.72	165	15.7	121	21.5	110	23.6	20.3
Loop 20 to US83	2	4	1.28	110	41.8	113	40.7	113	40.7	41.1
Larga Vista to Loop 20	2	6	0.98	79	44.5	80	44.0	81	43.4	44.0

Table 6a. Average Speed per Segment - Route 5 (Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 1 Time (sec)	Run 1 Avg. Speed	Run 2 Time (sec)	Run 2 Avg. Speed	Run 3 Time (sec)	Run 3 Avg. Speed	Segment Average
Southgate to Loop 20	2	3	1.76	172	36.7	208	30.4	276	22.9	30.0
Loop 20 to Area Type Change	2	3	0.65	53	43.9	53	43.9	85	27.4	38.4
Area Type Change to SH 359	2	4	0.69	60	41.7	107	23.4	55	45.4	36.8
SH 359 to Clark	2	4	1.18	92	46.4	81	52.7	87	49.0	49.4
Clark to Area Type Change	2	4	0.41	30	49.7	29	51.4	30	49.7	50.3
Area Type Change to US 59	2	6	0.27	22	44.5	20	49.0	97	10.1	34.5
US 59 to Arkansas	2	3	1.31	108	43.6	110	42.8	115	40.9	42.4
Arkansas to Fremont	3	3	1.08	164	23.8	262	14.9	214	18.2	18.9
Fremont to Springfield	4	3	1.48	367	14.6	383	13.9	358	14.9	14.5
Springfield to Clark	4	2	0.14	30	17.0	18	28.3	26	19.6	21.6
Clark to I-35	3	2	0.54	92	21.0	91	21.2	101	19.1	20.4
I-35 to Santa Isabel	3	2	0.80	183	15.7	200	14.3	208	13.8	14.6
Santa Isabel to Jefferson	4	2	0.38	45	30.4	41	33.4	125	10.9	24.9
Jefferson to Area Type Change	3	2	0.03	5	21.3	7	15.2	12	8.9	15.1
Area Type Change to San Ign.	3	4	0.03	4	24.6	5	19.7	6	16.4	20.2
San Ignacio to Ugarte	3	4	0.80	172	16.7	154	18.6	153	18.7	18.0
Ugarte to Eagle Pass	4	4	0.05	9	18.0	8	20.3	8	20.3	19.5
Eagle Pass to Chicago	4	4	0.10	70	5.3	16	23.3	15	24.9	17.9
Chicago to Maya	4	4	0.05	12	13.8	11	15.0	10	16.5	15.1

Table 6b. Average Speed per Segment - Route 5 (Off-Peak Period).

Segment	FUNCL	ATYPE	Length (miles)	Run 4 Time (sec)	Run 4 Avg. Speed	Run 5 Time (sec)	Run 5 Avg. Speed	Run 6 Time (sec)	Run 6 Avg. Speed	Segment Average
Southgate to Loop 20	2	3	1.76	205	30.8	227	27.8	204	31.0	29.9
Loop 20 to Area Type Change	2	3	0.65	53	43.9	62	37.5	80	29.1	36.9
Area Type Change to SH 359	2	4	0.69	57	43.8	60	41.7	110	22.7	36.1
SH 359 to Clark	2	4	1.18	94	45.4	102	41.8	92	46.4	44.5
Clark to Area Type Change	2	4	0.41	34	43.8	32	46.6	29	51.4	47.3
Area Type Change to US 59	2	6	0.27	26	37.7	151	6.5	23	42.6	28.9
US 59 to Arkansas	2	3	1.31	119	39.5	120	39.2	116	40.6	39.8
Arkansas to Fremont	3	3	1.08	181	21.5	140	27.8	202	19.3	22.9
Fremont to Springfield	4	3	1.48	323	16.5	322	16.6	397	13.5	15.5
Springfield to Clark	4	2	0.14	25	20.4	50	10.2	19	26.8	19.1
Clark to I-35	3	2	0.54	99	19.5	70	27.5	58	33.2	26.8
I-35 to Santa Isabel	3	2	0.80	165	17.4	bad data	bad data	bad data	bad data	17.4
Santa Isabel to Jefferson	4	2	0.38	49	27.9	42	32.6	37	37.0	32.5
Jefferson to Area Type Change	3	2	0.03	6	17.8	4	26.6	4	26.6	23.7
Area Type Change to San Ign.	3	4	0.03	5	19.7	5	19.7	4	24.6	21.3
San Ignacio to Ugarte	3	4	0.80	154	18.6	149	19.2	152	18.9	18.9
Ugarte to Eagle Pass	4	4	0.05	8	20.3	8	20.3	7	23.1	21.2
Eagle Pass to Chicago	4	4	0.10	17	22.0	16	23.3	15	24.9	23.4
Chicago to Maya	4	4	0.05	11	15.0	10	16.5	14	11.8	14.5

Table 6c. Average Speed per Segment - Route 5 (Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 7 Time (sec)	Run 7 Avg. Speed	Run 8 Time (sec)	Run 8 Avg. Speed	Run 9 Time (sec)	Run 9 Avg. Speed	Segment Average
Chicago to Maya	4	4	0.05	13	12.6	12	13.7	16	10.3	12.2
Eagle Pass to Chicago	4	4	0.10	15	24.7	18	20.6	17	21.8	22.4
Ugarte to Eagle Pass	4	4	0.04	8	20.1	9	17.9	8	20.1	19.4
San Ignacio to Ugarte	3	4	0.79	132	21.6	170	16.8	167	17.1	18.5
Area Type Change to San Ign.	3	4	0.03	3	32.0	13	7.4	5	19.2	19.6
Jefferson to Area Type Change	3	2	0.03	4	26.5	6	17.7	6	17.7	20.6
Santa Isabel to Jefferson	4	2	0.38	44	31.1	49	27.9	44	31.1	30.0
I-35 to Santa Isabel	3	2	0.80	272	10.5	283	10.1	293	9.8	10.1
Clark to I-35	3	2	0.54	61	31.6	121	15.9	66	29.2	25.6
Springfield to Clark	4	2	0.14	30	17.2	41	12.6	22	23.4	17.7
Fremont to Springfield	4	3	1.48	338	15.8	386	13.8	350	15.3	15.0
Arkansas to Fremont	3	3	1.08	269	14.5	270	14.4	237	16.4	15.1
US 59 to Arkansas	2	3	1.31	110	42.8	132	35.6	124	37.9	38.8
Area Type Change to US 59	2	6	0.27	20	49.1	21	46.8	26	37.8	44.6
Clark to Area Type Change	2	4	0.42	29	51.7	35	42.9	35	42.9	45.8
SH 359 to Clark	2	4	1.19	106	40.3	97	44.0	100	42.7	42.3
Area Type Change to SH 359	2	4	0.70	70	35.8	123	20.4	68	36.9	31.0
Loop 20 to Area Type Change	2	3	0.64	75	30.9	82	28.3	77	30.1	29.8
Southgate to Loop 20	2	3	1.76	210	30.2	178	35.6	162	39.1	35.0

Table 6d. Average Speed per Segment - Route 5 (Off-Peak Period, Reverse Direction).

Segment	FUNCL	ATYPE	Length (miles)	Run 10 Time (sec)	Run 10 Avg. Speed	Run 11 Time (sec)	Run 11 Avg. Speed	Run 12 Time (sec)	Run 12 Avg. Speed	Segment Average
Chicago to Maya	4	4	0.05	12	13.7	12	13.7	11	14.9	14.1
Eagle Pass to Chicago	4	4	0.10	18	20.6	16	23.2	14	26.5	23.4
Ugarte to Eagle Pass	4	4	0.04	9	17.9	9	17.9	8	20.1	18.7
San Ignacio to Ugarte	3	4	0.79	156	18.3	196	14.6	142	20.1	17.7
Area Type Change to San Ign.	3	4	0.03	4	24.0	4	24.0	3	32.0	26.7
Jefferson to Area Type Change	3	2	0.03	4	26.5	5	21.2	5	21.2	22.9
Santa Isabel to Jefferson	4	2	0.38	37	37.0	42	32.6	37	37.0	35.5
I-35 to Santa Isabel	3	2	0.80	203	14.1	272	10.5	245	11.7	12.1
Clark to I-35	3	2	0.54	105	18.4	70	27.5	113	17.1	21.0
Springfield to Clark	4	2	0.14	35	14.7	23	22.4	45	11.5	16.2
Fremont to Springfield	4	3	1.48	331	16.1	386	13.8	372	14.4	14.8
Arkansas to Fremont	3	3	1.08	160	24.4	246	15.8	148	26.3	22.2
US 59 to Arkansas	2	3	1.31	111	42.4	115	40.9	102	46.1	43.1
Area Type Change to US 59	2	6	0.27	21	46.8	22	44.7	21	46.8	46.1
Clark to Area Type Change	2	4	0.42	28	53.6	33	45.5	29	51.7	50.3
SH 359 to Clark	2	4	1.19	82	52.1	91	46.9	82	52.1	50.4
Area Type Change to SH 359	2	4	0.70	60	41.8	65	38.6	56	44.8	41.7
Loop 20 to Area Type Change	2	3	0.64	51	45.4	84	27.6	51	45.4	39.5
Southgate to Loop 20	2	3	1.76	161	39.4	150	42.2	150	42.2	41.3

After the data for each route was compiled into tables similar to the one provide in Tables 2 through 6, the information was aggregated further into tables that provided a summary for all of the routes. Aggregated summary data is provided in Table 7. As shown in the table, the average speeds (bold value in the bottom row of each table) for each functional classification (FUNCL) are shown by area type (ATYPE) and by peak (P) and off-peak (OP) periods.

Table 7a. Aggregated Speed Summary (Freeway)

FUNCL	1	1	1	1	1	1	1	1	1	1	1	1
ATYPE	1	1	2	2	3	3	4	4	5	5	6	6
P or OP	P	OP	P	OP	P	OP	P	OP	P	OP	P	OP
			61.0	65.1	61.3	64.5	60.8	63.4	61.0	58.8		
			60.1	60.3	58.7	63.2	54.1	56.9	45.8	49.2		
			60.4	61.4	58.5	57.6	47.7	49.2	58.5	54.3		
			59.2	55.6	66.0	61.6	67.0	62.7				
	N/A	**N/A**	**60.1**	**60.6**	**61.1**	**61.7**	**57.4**	**58.0**	**55.1**	**54.1**	**N/A**	**N/A**

Table 7b. Aggregated Speed Summary (Arterial)

FUNCL	2	2	2	2	2	2	2	2	2	2	2	2
ATYPE	1	1	2	2	3	3	4	4	5	5	6	6
P or OP	P	OP	P	OP	P	OP	P	OP	P	OP	P	OP
	16.6	14.8	23.1	20.6	28.0	34.4	26.0	36.7	42.0	39.4	45.0	46.0
			15.3	15.7	28.4	31.1	36.2	37.7	45.3	43.9	32.2	32.7
			27.3	28.5	29.4	25.2	43.2	44.1	14.4	28.5	32.6	35.6
			19.0	10.9	36.6	36.1	47.3	45.6	19.4	34.1	43.9	45.0
			9.7	12.1	21.4	27.0	43.1	42.4			45.4	44.8
			26.6	27.7	21.4	24.6	39.5	42.5			46.6	45.6
			21.0	18.9	15.9	26.9	43.2	42.6			33.4	38.4
			19.7	18.6	25.1	31.7	49.8	45.7			44.1	44.0
			15.3	18.4	27.9	26.0	34.0	34.1			34.5	28.9
			27.7	20.3	23.5	27.8	42.7	41.1			44.6	46.1
					30.0	29.9	36.8	36.1				
					38.4	36.9	49.4	44.5				
					42.4	39.8	50.3	47.3				
					38.8	43.1	45.8	50.3				
					29.8	39.5	42.3	50.4				
					35.0	41.3	31.0	41.7				
	16.6	**14.8**	**20.5**	**19.2**	**29.5**	**32.6**	**41.3**	**42.7**	**30.3**	**36.5**	**40.2**	**40.7**

Table 7c. Aggregated Speed Summary (Collector)

FUNCL	3	3	3	3	3	3	3	3	3	3	3	3
ATYPE	1	1	2	2	3	3	4	4	5	5	6	6
P or OP	P	OP	P	OP	P	OP	P	OP	P	OP	P	OP
	17.1	13.3	20.9	24.2	17.8	18.4	20.2	21.3	28.8	29.8		
			14.5	13.3	28.8	29.1	18.0	18.9	30.7	32.7		
			17.2	17.1	26.5	27.5	18.5	17.7				
			21.1	22.9	29.0	28.5	19.6	26.7				
			18.3	23.1	28.2	30.2						
			18.3	19.1	17.0	17.3						
			26.9	27.3	16.7	17.4						
			24.5	24.3	26.1	30.9						
			20.4	26.8	21.7	22.7						
			14.6	17.4	17.4	17.1						
			15.1	23.7	17.6	18.6						
			20.6	22.9	21.4	22.6						
			10.1	12.1	28.5	26.8						
			25.6	21.0	25.7	21.8						
					20.7	17.9						
					29.0	30.5						
					21.8	24.1						
					21.1	20.6						
					29.3	28.7						
					22.0	22.9						
					18.9	22.9						
					15.1	22.2						
	17.1	13.3	19.1	21.1	22.7	23.6	19.1	21.1	29.7	31.2	N/A	N/A

Table 7d. Aggregated Speed Summary (Local)

FUNCL	4	4	4	4	4	4	4	4	4	4	4	4
ATYPE	1	1	2	2	3	3	4	4	5	5	6	6
P or OP	P	OP	P	OP	P	OP	P	OP	P	OP	P	OP
	5.3	5.5	25.8	28.8	19.2	19.7	19.5	21.2	25.3	26.1		
	11.6	12.4	29.4	30.7	21.2	18.9	17.9	23.4	27.0	24.6		
			21.6	19.1	19.2	20.9	15.1	14.5				
			24.9	32.5	18.5	19.8	12.2	14.1				
			30.0	35.5	21.8	21.5	22.4	23.4				
			17.7	16.2	16.0	15.6	19.4	18.7				
					21.6	21.5						
					21.3	20.9						
					15.8	16.2						
					19.3	20.0						
					14.5	15.5						
					15.0	14.8						
	8.4	8.9	24.9	27.1	18.6	18.8	17.7	19.2	26.1	25.3	N/A	N/A

Table 7e. Aggregated Speed Summary (Frontage)

FUNCL	5	5	5	5	5	5	5	5	5	5	5	5
ATYPE	1	1	2	2	3	3	4	4	5	5	6	6
P or OP	P	OP	P	OP	P	OP	P	OP	P	OP	P	OP
			44.2	45.7			53.2	50.9	40.9	48.1		
			47.0	44.2			45.1	49.0	49.8	48.4		
			31.1	33.6			66.0	60.3	28.5	40.9		
			22.5	32.6					37.9	37.3		
	N/A	N/A	36.2	39.0	N/A	N/A	54.8	53.4	39.3	43.7	N/A	N/A

After these tables were created, the information was then input into two matrices: one for peak period average speeds and another for off-peak period average speeds. These matrices are provided below in Tables 8 and 9.

Table 8. Peak Period Average Speeds

	Frontage	Freeway	Arterial	Collector	Local
CBD	N/A	N/A	16.6	17.1	8.4
CBD Fringe	36.2	60.1	20.5	19.1	24.9
Urban	N/A	61.1	29.5	22.7	18.6
Suburban	54.8	57.4	41.3	19.1	17.7
Industrial	39.3	55.1	30.3	29.7	26.1
Rural	N/A	N/A	40.2	N/A	N/A

Table 9. Off-Peak Period Average Speeds

	Frontage	Freeway	Arterial	Collector	Local
CBD	N/A	N/A	14.8	13.3	8.9
CBD Fringe	39.0	60.6	19.2	21.1	27.1
Urban	N/A	61.7	32.6	23.6	18.8
Suburban	53.4	58.0	42.7	21.1	19.2
Industrial	43.7	54.1	36.5	31.2	25.3
Rural	N/A	N/A	40.7	N/A	N/A

The data was further aggregated by combining the peak and off-peak values into one matrix. The results are provided in Table 10.

Table 10. Combined Average Speeds

	Frontage	Freeway	Arterial	Collector	Local
CBD	N/A	N/A	15.7	15.2	8.7
CBD Fringe	37.6	60.4	19.9	20.1	26.0
Urban	N/A	61.4	31.1	23.2	18.7
Suburban	54.1	57.7	42.0	20.1	18.5
Industrial	41.5	54.6	33.4	30.5	25.7
Rural	N/A	N/A	40.5	N/A	N/A

In order to assess the significance of the average speeds obtained in the data collection, the posted speed limits for the roadways are needed. Table 11 provides the posted speed limits for each cell of the matrix. Due to the geographic size of certain area types, some cells had various speed limits. In those instances, the speed limit is given as a range.

Table 11. Posted Speed Limits

POSTED SPEED LIMIT

	Frontage	Freeway	Arterial	Collector	Local
CBD	N/A	N/A	30	30	30
CBD Fringe	30	65	30-35	30	30
Urban	N/A	65	30-45	30	30
Suburban	45	65	35-50	30	30
Industrial	45	65	30-45	35	30
Rural	N/A	N/A	30-45	N/A	N/A

In addition to the average speeds for each matrix cell, a determination was made as to the total number of observations and average segment length per category. Table 12 provides this information. In this table, the first value in a cell is the total number of observations, and the value in parentheses is the average length (in miles) of each observation.

Table 12. Number of Observations and Average Segment Length

	Frontage	Freeway	Arterial	Collector	Local
CBD	N/A	N/A	2 (0.13)	2 (0.14)	4 (0.07)
CBD Fringe	8 (0.60)	8 (1.05)	20 (0.78)	28 (0.53)	12 (0.33)
Urban	N/A	8 (0.52)	32 (0.90)	44 (0.71)	24 (0.30)
Suburban	6 (0.39)	8 (0.49)	32 (0.81)	8 (0.54)	12 (0.06)
Industrial	8 (0.24)	6 (0.22)	8 (0.42)	4 (0.62)	4 (0.39)
Rural	N/A	N/A	20 (1.23)	N/A	N/A

Average segment length (in miles) in parentheses

Additionally, to further illustrate the data that was collected, speed profiles are provided in the Appendix. The speed profiles are shown for all five routes, and are disaggregated by the period (peak or off-peak) and by the direction (AB for the normal direction and BA for the reverse direction). The profiles provide the recorded speed of the vehicle as provided by the GPS antenna (y-axis) over time (x-axis). Notations have been included that indicate the general area of intersections along the route.

Incomplete Cells

There were instances when certain cells were not filled. This occurred for various reasons. Frontage roads were not initially incorporated in the design of the routes. Due to the impact that frontage roads had on the freeway segment speed averages, it was necessary to separate that information. There were no freeways and frontage roads in the CBD area type. Due to construction at the IH-35 and Loop 20 interchange, there was no efficient manner to connect routes south of Loop 20 with IH-35 north of the interchange. IH-35 north of Loop 20 was the only location which would have provided values for rural freeway. The remaining two incomplete cells (rural-collector and rural-local) were not collected due to the difficult nature of incorporating these locales into the routes.

Summary

The travel time and delay information collected in Laredo, Texas in February 2002 provides a general overview of the operating conditions of various functionally classified roadways in the area. The data was collected in a fashion to account for peak and off-peak operating conditions as well as to account for the direction of travel along a particular corridor. When examining the results, there are several issues that are worth mentioning. First, with the exception of local streets, the posted speed limits for the FUNCL groups varied. The largest disparity existed in the arterial group, where there was a difference of 15 MPH between the highest and lowest posted speed limit. A second issue to consider is the impact that traffic control devices, traffic calming measures, and recurring events have on the averages. Traffic signals, stop and yield signs, and signs indicating school zones are all devices that were encountered while traversing the various

routes. Also encountered in residential areas were speed humps. This calming measure was very effective in reducing the average speed. In Laredo, there are a significant number of trains that travel through the area. Although it did not occur along any of the selected routes during the data collection process, it is not uncommon for trains to stop for extended periods in certain areas of Laredo (particularly in the suburban and Industrial area types in the eastern portion of the city). Another issue is the size and location of the various area types. The CBD area type was relatively small and not centrally located relative to the rest of the urban area. The Industrial area type was similar in that it was primarily located in one section of the city. These factors limited the number of opportunities to include different functionally classified roads in the selected routes. This is made apparent in Table 12 by reviewing the arterial, collector, and local roads in the CBD and Industrial area types. The number of observations for these cells is typically fewer than other cells in their respective functional class.

The point of mentioning these issues is to illustrate that there are factors that impact the average speeds that were obtained for the individual cells. Therefore, these factors should be considered when utilizing the cell values for planning purposes.

Appendix

Laredo Travel Time and Delay Speed Profiles

Route 1- Peak (AB Direction)

Del Mar/Loop

McPherson/Del Mar

Del Mar/Fenw ick

Route 1 - Off-Peak (AB Direction)

Del Mar/Loop 20

McPherson/Del Mar

Del Mar/Fenw ick

Route 1 - Peak (BA Direction)

Route 1 - Off-Peak (BA Direction)

Route 2 - Peak (AB Direction)

Route 2 - Off-Peak (AB Direction)

Route 2 - Peak (BA Direction)

Route 2 - Off-Peak (BA Direction)

Route 3 - Peak (AB Direction)

Route 3 - Off-Peak (AB Direction)

Route 3 - Peak (BA Direction)

Route 3 - Off-Peak (BA Direction)

Route 4 - Peak (AB Direction)

US 83/Meadow

IH 35/Las Cruces

Route 4 - Off-Peak (AB Direction)

US 83/Meadow

Route 4 - Peak (BA Direction)

Y-axis: (MPH), scale 0 to 80

Labels: US 83/Meadow, IH 35/Lyon, IH 35/Las Cruces

Route 4 - Off-Peak (BA Direction)

Y-axis: (MPH), scale 0 to 70

Labels: US 83/Meadow, IH 35/Lyon

Route 5 - Peak (AB Direction)

Route 5 - Off-Peak (AB Direction)

Route 5 - Peak (BA Direction)

Loop 20/Sh 359

IH 35/Clark

Route 5 - Off-Peak (BA Direction)

Loop 20/SH 359

IH 35/Clark