2013 El Paso Travel Time and Delay Survey
Technical Summary

Texas Department of Transportation

Prepared by the
Texas A&M Transportation Institute
July 2014

2013 El Paso Travel Time and Delay Survey

TECHNICAL SUMMARY

Texas Department of Transportation Travel Survey Program

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July 2014

Acknowledgements

A number of individuals contributed to and assisted with this study and preparation of the technical summary. Charlie Hall, the TxDOT project director, provided guidance and assistance throughout the duration of the study. Gary Lobaugh, of the Texas A&M Transportation Institute, helped with preparation of the report. The contributions of these individuals are acknowledged and appreciated.

EXECUTIVE SUMMARY

Speed information collected in Travel Time and Delay surveys provides an overview of the operating characteristics of functionally classified roadways as they pass through different area types in a region. In the 2013 El Paso Travel Time and Delay Survey, data were collected in a fashion that also allowed for analysis of the data by peak and off-peak period and morning and afternoon travel.

Various factors can affect the measures of travel time and delay presented in this report. First, posted speed limits on roadways that have the same functional classification and area type often vary. When interpreting the study results, consideration must be given to signage variability within individual area type-functional class groupings, the size of the study area, and practical limitations with respect to the sample collected.

Another consideration is the impact that traffic control devices, traffic calming measures and non-vehicular impediments to travel can have on travel speeds. Traffic signals, stop signs, yield signs and school-zones were among the many impediments to travel encountered during the data collection effort. These, along with parked vehicles, pedestrians, and cyclists, have the potential to influence travel times and the perceived level of congestion on a given functional class and area type.

Analysis of the travel time data by peak and off-peak period revealed a relatively small peak versus off-peak speed discrepancies on the roadways studied. This suggests that, in general, El Paso-area functional classes are not severely impacted by the effects of peak-period congestion.

The degree to which speeds on individual functional classes fluctuate with changes in activity density provides another indication of the nature and scale of congestion within an urban area. The greatest variation in speeds was observed on arterials, which ranged from approximately 10 mph in the CBD to 40 mph in the Rural area type. Speeds on locals through the CBD were approximately 10 mph. They then increased and stayed relatively consistent around the 20 mph range through the CBD Fringe, Urban, Suburban, and Rural area types. Freeway speeds exhibited a gradual increase from approximately 45 mph in the CBD to approximately 60 mph in the Suburban area type, and then increased to around 70 mph in the Rural area type. Collector speeds were consistently in the 20-25 mph range through the CBD, CBD Fringe, Urban, and Suburban area types, and then increased to approximately 30 mph in Rural areas.

Overall, (peak and off-peak) weighted averages for travel speeds on the various functional classes generally increased from the CBD to the Rural area type with the exception of collectors. When measured across functional classes, average peak-period speeds tended to drop off sharply between freeways and arterials, then continued to decline moderately across arterials, collectors, and local streets.

Finally, a comparison of average AM and PM speeds was undertaken for each functional classification-area type combination. This comparison indicated that afternoon travel speeds on El Paso-area freeways were slightly higher than morning speeds through the CBD Fringe area type. Conversely, morning freeway speeds through the Suburban area type were slightly higher than afternoon speeds. All of the other area types had approximately the same freeway travel speeds in the morning and afternoon periods. Arterials and locals also exhibited very similar morning and afternoon speeds through all area types. Morning speeds on collectors were slightly higher than afternoon speeds in the CBD Fringe, Urban, Suburban, and Rural area types, and slightly lower through the CBD.

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INTRODUCTION AND STUDY AREA DESCRIPTION

The purpose of this technical summary is to describe the methodology and results for the travel time and delay survey conducted in El Paso, Texas during February 2013. The report is organized into four sections. The first section includes an introduction and overview of the study area. The second explains the route development and data collection procedures. The third section describes the data processing and analysis methods employed, and the fourth presents the study results.

The El Paso study area is located in El Paso County in west Texas. According to U.S. Census Bureau figures, the county area covers approximately 1,013 square miles and had an estimated population of 827,718 in 2013. Between 2010 and 2013, the population of El Paso County grew by 3.4 percent[1]. Figure 1 shows the study area and road network.

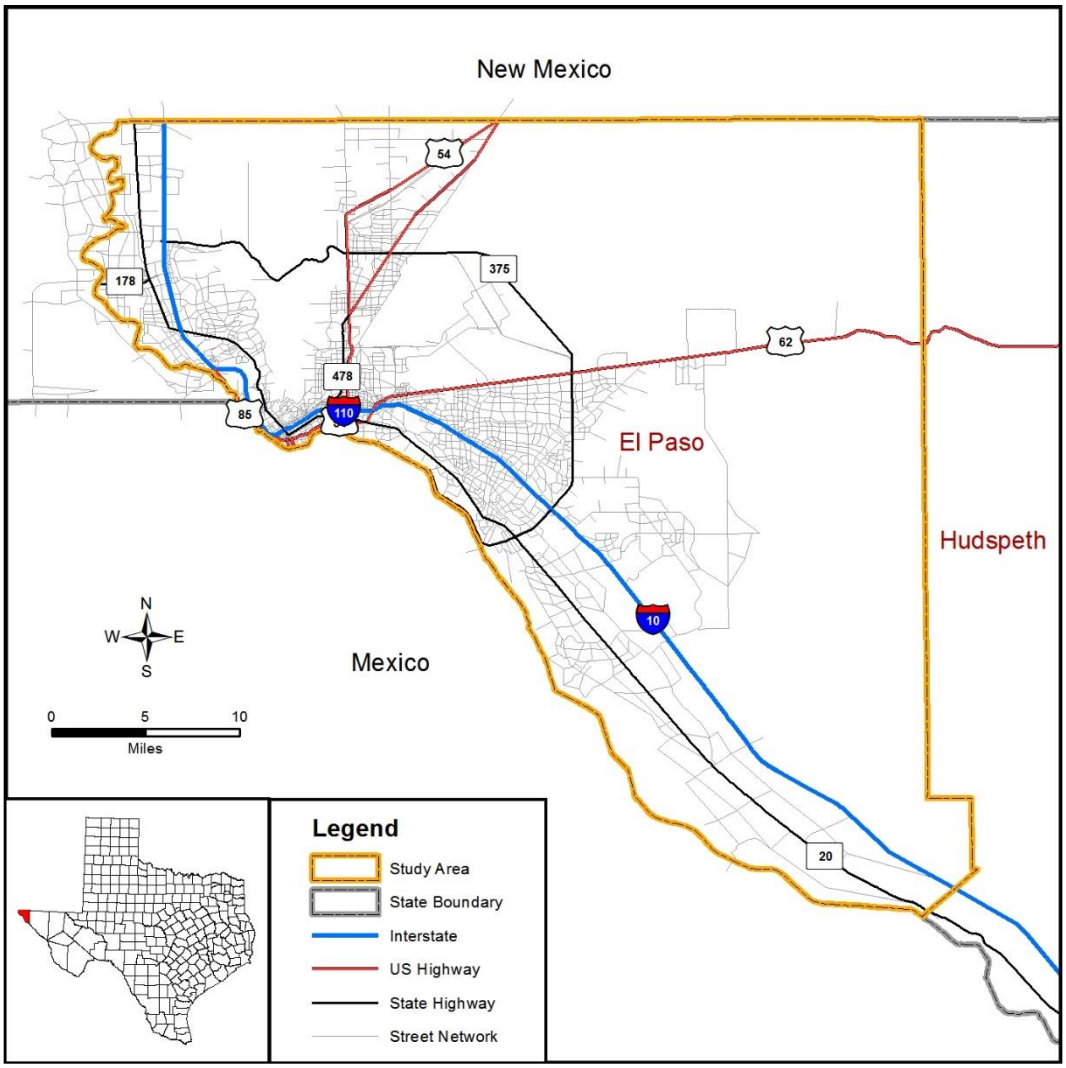

Figure 1. El Paso Study Area.

[1] http://quickfacts.census.gov/qfd/states/48000.html

ROUTE DEVELOPMENT AND DATA COLLECTION

To the general public, travel time, or the amount of time required to traverse a route between two points, is a basic concept that influences their daily lives. To transportation engineers, planners and analysts, precise field-measured travel times and speeds have a wide range of potential uses. They can provide insights into the operating characteristics and levels of service for a roadway network within an urbanized area, assist in the calibration and validation of travel demand models, permit capacity and historical trend analyses, and enable air quality modeling and emissions estimates. Results from Travel Time and Delay studies may also be considered in focused applications such as signal timing and school zone projects, the planning and prioritization of transportation of network maintenance and improvement work, and other tasks.

The collection of travel time data entails the measurement of speeds during peak and off-peak periods for a variety of roadways in a study area. Each segment of roadway examined is stratified by its functional classification and the area type it traverses. The functional classification of a roadway is based on the importance of movement and access functions assigned to it. The functional classes examined in the 2013 El Paso Travel Time and Delay Study were:

1 – Freeway (limited access to property with traffic movement/mobility as primary function);

2 – Arterial (highly continuous roads with inter-community and intra-metropolitan traffic movement as primary function, as well as roads that carry a mix of local and through traffic but give priority to traffic movement over access to property);

3 – Collector (distribution of traffic between arterial and local streets as primary function);

4 – Local (access to property as primary function).

Urban areas are divided into small geographic parcels called traffic analysis zones (TAZ). Each TAZ is normally bounded by transportation facilities and/or geographic features such as bodies of water or parks. The activity that occurs within that zone is typically homogenous. Zones are categorized by the activity density associated with them. This is measured in terms of the zone's population and employment relative to its size in acres. The following formula is used to determine activity density:

$$Activity\ Density\ = \frac{Population + (X \times Employment)}{Area}$$

In this formula, X denotes the population/employment ratio for the entire study area. The activity density categorization for each TAZ is referred to as area type, and there are typically five to six area types within a given urban area. The number of area types and their activity density ranges vary from one urban area to another.

The following area types correspond to the El Paso region:

1 – Central Business District (CBD);

2 – CBD Fringe;

3 – Urban;

4 – Suburban; and

5 – Rural.

Route Development and Scheduling

ESRI ArcGIS software was used to identify area types and functional classifications and to develop the routes used to measure travel time and delay. The paths of most routes were randomly devised and covered a variety of functional classification and area type combinations. Four of the 14 routes examined were designed specifically to reflect travel patterns between study-area activity centers.

Each route was comprised of several route segments of varying lengths. One route segment ended and another began when either of the following conditions existed:

- Change in the functional classification of the roadway; or
- Change in the area type being traversed.

Traveling onto a new street did not constitute a segment change unless one or more of the above criteria were met. Table 1 shows a breakdown of the number of route segments examined in the El Paso study (by area type and functional class combination).

Table 1. Number of Segments Studied per Area Type – Functional Class Combination.

Functional Class / Area Type	Freeway	Arterial	Collector	Local	Total
Central Business District	2	2	1	2	7
CBD Fringe	6	11	4	5	26
Urban	2	5	3	5	16
Suburban	2	7	3	3	15
Rural	1	3	3	3	10
Total	13	29	14	18	74

The goal in developing routes for this travel time and delay survey was not to ensure the equal distribution or length of area type and functional class segments, but to generally reflect the coverage of various area types and functional classes within the metropolitan region. Small sample sizes occasionally resulted from the scarcity of certain area type-functional classification groupings in the study area, ongoing construction or maintenance projects, scheduling requirements, and other considerations.

El Paso travel time data were collected over a one-week period in February 2013. Route paths were plotted using ESRI ArcGIS software. The length of the routes was controlled so that two routes could be completed each day. This schedule provided sufficient time for each route be driven 12 times at a speed consistent with that of surrounding traffic, without passing or being passed by the majority of other vehicles on the roadway (average-car method of data collection). When no other vehicles were present on the roadway, field technicians maintained the posted speed limit. A total of 14 routes were developed and data were collected between 7:00 a.m. and 6:00 p.m., Monday through Friday. Routes with freeway segments were avoided on Friday due to anomalies that can severely impact freeway travel times on that day of the week. No data were collected on school holidays or during periods with adverse weather conditions such as heavy/prolonged rain. When construction, maintenance, utility work or traffic incidents disrupted travel on a prescribed route/run, the data were recollected that day or on another day during the same time period.

The 12 runs conducted for each route were split equally by direction. Six were in the A-to-B direction and six were in the B-to-A direction. For each group of six runs, three were conducted during peak travel periods (7:00-9:00 a.m. and 4:00-6:00 p.m.) and three during the off-peak periods (9:00 a.m.-11:00 p.m. and 1:00-3:00 p.m.). The number of runs was balanced so that equal amounts of peak and off-peak data were collected during the AM and PM periods. Table 2 shows a sample daily data collection schedule.

Table 2. Sample Daily Travel Time Data Collection Schedule.

Period	Route-Run	Direction	Scheduled Time Slot
Peak Morning (7:00 a.m.- 9:00 a.m.)	5-1	5A > 5B	7:00 AM - 7:20 AM
	5-2	5B > 5A	7:20 AM - 7:40 AM
	5-3	5A > 5B	7:40 AM - 8:00 AM
	6-1	6A > 6B	8:00 AM - 8:20 AM
	6-2	6B > 6A	8:20 AM - 8:40 AM
	6-3	6A > 6B	8:40 AM - 9:00 AM
If finished early, redo problematic AM peak runs			
Off-Peak Morning (9:00 a.m.- 11:00 p.m.)	6-4	6B > 6A	9:00 AM - 9:20 AM
	6-5	6A > 6B	9:20 AM -9:40 AM
	6-6	6B > 6A	9:40 AM - 10:00 AM
	5-4	5B > 5A	10:00 AM - 10:20 AM
	5-5	5A > 5B	10:20 AM - 10:40 AM
	5-6	5B > 5A	10:40 AM - 11:00 AM
11:00 a.m. - 12:00 p.m. Buffer (redo any a.m. off-peak runs affected by incidents)			
12:00 p.m. - 1:00 p.m. Lunch			
Off-Peak Afternoon (1:00 p.m.- 3:00 p.m.)	5-7	5A > 5B	1:00 PM - 1:20 AM
	5-8	5B > 5A	1:20 PM - 1:40 PM
	5-9	5A > 5B	1:40 PM - 2:00 PM
	6-7	6A > 6B	2:00 PM - 2:20 PM
	6-8	6B > 6A	2:20 PM - 2:40 PM
	6-9	6A > 6B	2:40 PM - 3:00 PM
3:00 p.m. - 4:00 p.m. Buffer (redo any p.m. off-peak runs affected by incidents)			
Peak Afternoon (4:00 p.m.- 6:00 p.m.)	6-10	6B > 6A	4:00 PM - 4:20 PM
	6-11	6A > 6B	4:20 PM - 4:40 PM
	6-12	6B > 6A	4:40 PM - 5:00 PM
	5-10	5B > 5A	5:00 PM - 5:20 PM
	5-11	5A > 5B	5:20 PM - 5:40 PM
	5-12	5B > 5A	5:40 PM - 6:00 PM
6:00 p.m. - 6:30 p.m. Buffer (redo any p.m. peak runs affected by incidents)			

Route Description

Of the 14 routes developed, 10 were "traditional" routes, with randomly-chosen beginning and end points. These were devised to incorporate a diversity of functional class and area type combinations and were not intended to replicate local trips or provide the shortest or quickest route between start and end points. The four remaining routes were developed with activity centers as their origin and destination.

Activity centers (ACs) are areas that have unique trip generating capabilities. While similar land use types typically generate similar levels of traffic, activity centers have the ability to produce relatively large and varying amounts of traffic. Activity centers selected for analysis in the El Paso Travel Time and Delay Study included the El Paso CBD, El Paso International Airport, University of Texas at El Paso, Northwest El Paso, Fort Bliss, El Paso Community College, Cielo Vista Mall, and Zaragoza Border Crossing. Figure 2 shows all 14 study routes overlaid on a map with area type and functional class information.

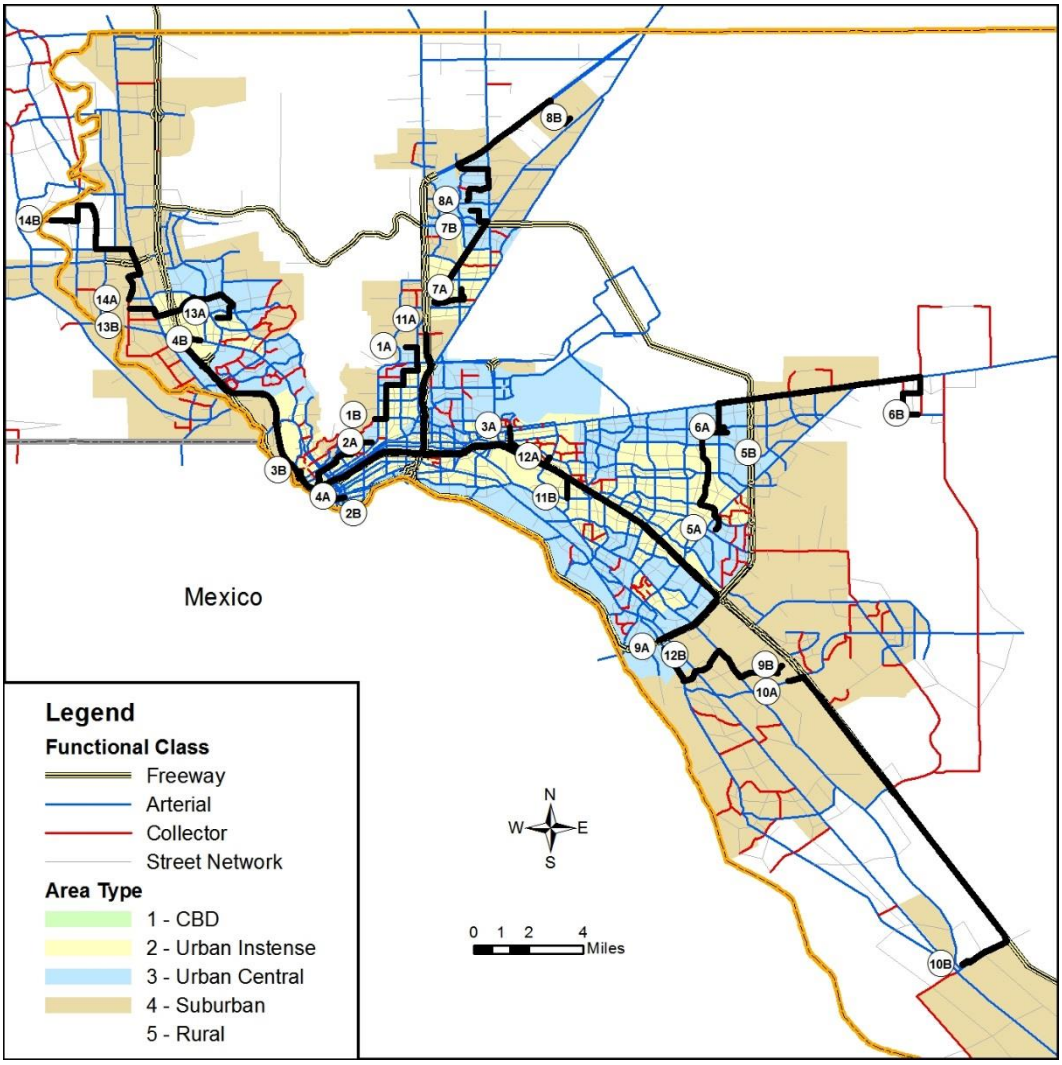

Figure 2. Study Routes.

Table 3 provides detailed descriptions of each route in the study, including functional class (FUNCL) and area type (ATYPE) information. For ease of comprehension, individual lines in the route descriptions represent distinct roadways as opposed to route segments. However, the travel time and delay analyses presented in the remainder of the report are based primarily on the various combinations of functional class-area type segments, rather than individual roadways.

Table 3. Route Descriptions by Roadway Name.

	Roadway	From	To	ATYPE	FUNCL
Route 1	*Begin route at intersection of Kemp Ave and Russell St (1A)*				
	Kemp	Russell	Dyer	3	4
	Dyer	Kemp	Hayes	2	2
	Hayes	Dyer	Byron	2	3
	Byron	Hayes	Harrison	2	4
	Harrison	Byron	N Piedras	2	4
	N Piedras	Harrison	Richmond	2	2
	Richmond	N Piedras	Alabama	2	2
	Richmond	N Piedras	Kentucky	3	3
	End route at intersection of Kentucky St and Richmond Ave (1B)				
Route 2	*Begin route at intersection of Magnolia St and Murchison Dr (2A)*				
	Murchison	Magnolia	Medical Center	2	2
	Medical Center	Murchison	Cliff/Los Angeles	2	3
	Cliff	Medical Center	Brown	2	3
	Cliff/Los Angeles	Brown	W Missouri/W Franklin	2	4
	W Missouri/W Franklin	Los Angeles	I-10	2	4
	W Franklin	I-10	Durango	1	3
	Durango	W Franklin	Overland	1	2
	Overland	Durango	Santa Fe	1	4
	End route at intersection of Overland Ave and Santa Fe St (2B)				
Route 3 AC	*Begin route at intersection of Boeing Dr and Airway Blvd (3A - AC rotue Airport)*				
	Airway	Boeing	I-10	2	2
	I-10	Airway	N Virginia	2	1
	I-10	N Virginia	W Franklin	1	1
	I-10	W Franklin	W Schuster	2	1
	Sun Bowl	Schuster	Electric	2	2
	End route at intersection of Sun Bowl Rd and W Electric Rd (3B - AC route UTEP)				

Table 3. El Paso Area Route Descriptions by Roadway Name (Continued).

Roadway	From	To	ATYPE	FUNCL
Route 4 AC	*Begin route at intersection of Kansas St and 4th Ave (4A - AC route CBD)*			
4th	Kansas	Santa Fe	1	4
Santa Fe	4th	W Yandell/I-10	1	2
I-10	Santa Fe	W Franklin	1	1
I-10	W Franklin	Sunland Park	2	1
I-10	Sunland Park	S Resler	3	1
I-10	S Resler	N Mesa	2	1
N Mesa	I-10	Desert Trail	2	2
End route at intersection of N Mesa St and Desert Trail Dr (4B - AC route NW El Paso)				
Route 5	*Begin route at intersection of Michelangelo Dr and Pullman Dr (5A)*			
Pullman	Michelangelo	Vista del Sol	3	3
Vista del Sol	Pullman	Leroy Bronse/Lee	2	2
Leroy Bronse/Lee	Vista del Sol	Montwood	2	3
Leroy Bronse/Lee	Montwood	Pebble Hills	2	4
Lee	Pebble Hills	Edward James/Snow Hawk	3	4
Edward James/Snow Hawk	Lee	Old Castle	3	4
End route at intersection of Snow Hawk Dr and Old Castle St (5B)				
Route 6	*Begin route at intersection of Oxcart Run and Edgemere Blvd (6A)*			
Edgemere	Oxcart Run	Saul Kleinfeld	3	2
Saul Kleinfeld	Edgemere	Montana	3	2
Montana	Saul Kleinfeld	Loop 375	3	2
Montana	Loop 375	Flager	4	2
Montana	Flager	Krag	5	2
Krag	Montana	Buffalo Bill	5	3
Buffalo Bill	Krag	Vista del Este	5	4
Vista del Este	Buffalo Bill	Greg	5	3
Greg	Vista del Este	Vandeveer	5	2
End route at intersection of Vandeveer Dr and Greg Rd (6B)				
Route 7	*Begin route at intersection of Pikes Peak Dr and Mt Whitney Dr (7A)*			
Mt Whitney	Pikes Peak	Tetons	2	4
Tetons	Mt Whitney	Dryer	2	3
Dryer	Tetons	Rushing	2	2
Dryer	Rushing	Fairbanks	3	2
Fairbanks	Dryer	Alcan	3	2
Alcan	Fairbanks	Prince Edward	3	4
Prince Edward	Alcan	Vancouver	3	4
End route at intersection of Prince Edward Ave and Vancouver St (7B)				

Table 3. El Paso Area Route Descriptions by Roadway Name (Continued).

Roadway	From	To	ATYPE	FUNCL
Route 8	*Begin route at intersection of Capistrano Dr and Makinaw St (8A)*			
Makinaw	Capistrano	Salem	3	4
Salem	Makinaw	McCombs	3	3
McCombs	Salem	Sean Haggerty	3	2
Sean Haggerty	McCombs	Gateway	3	2
Gateway	Sean Haggerty	McCombs	3	2
Gateway	McCombs	Mesquite Hill	4	2
Mesquite Hill	Gateway	Auburn Sand	4	4
Auburn Sand	Mesquite Hill	Mesquite Sun	4	4
	End route at intersection of Mesquite Sun Ln and Auburn Sand Dr (8B)			
Route 9	*Begin route at intersection of Oscar Alvarez Ct and Socorro Rd (9A)*			
Socorro	Oscar Alvarez	Isaiah	3	2
Socorro	Isaiah	Moon	4	2
Moon	Socorro	Alameda	4	4
Moon	Alameda	Old Hueco Tanks	4	3
Old Hueco Tanks	Moon	North Loop	4	3
North Loop	Old Hueco Tanks	Rio Vista	4	2
Rio Vista	North Loop	Thunder	4	4
Thunder	Rio Vista	Valley Ridge	4	4
Valley Ridge	Thunder	Stockyard	4	4
	End route at intersection of Valley Ridge Dr and Stockyard Rd (9B)			
Route 10	*Begin route at intersection of Robin Rd and Horizon Blvd (10A)*			
Horizon	Robin	I-10	4	*2*
I-10	Horizon	Darrington	4	1
I-10	Darrington	Fabens	5	1
Fabens	I-10	NW I	4	2
NW I	Fabens	1st	5	4
1st	NW I	NW Eubanks	5	4
	End route at intersection of 1st St and NW Eubanks St (10B)			
Route 11 AC	*Begin route at intersection of Ellerthorpe Ave and US 54 (11A - AC route Fort Bliss)*			
US 54	Ellerthorpe	Kaspar	4	1
US 54	Kaspar	I-10	2	1
I-10	US 54	Hunter	2	1
Hunter	I-10	Phoenix	2	2
	End route at intersection of Hunter Dr and Phoenix Ave (11B - AC route El Paso Community College)			
Route 12 AC	*Begin route at intersection of Hawkins Blvd and Viscount Blvd (12A - AC Route Cielo Vista Mall)*			
Hawkins	Viscount	I-10	2	2
I-10	Hawkins	Loop 375	2	1
Loop 375	I-10	S Americas	3	1
	End route at intersection of Loop 375 and S Americas Ave (12B - AC route Zaragoza Border Crossing)			

Table 3. El Paso Area Route Descriptions by Roadway Name (Continued).

Roadway	From	To	ATYPE	FUNCL
Route 13	*Begin route at intersection of El Parque Dr and Villa Hermosa Dr (13A)*			
Villa Hermosa	El Parque	Belvidere	2	4
Villa Hermosa	Belvidere	West Wind	3	4
West Wind	Villa Hermosa	Redd	3	2
Redd	West Wind	Resler	3	2
Redd	Resler	Thorn	2	2
Thorn	Redd	Doniphan	2	2
Doniphan	Thorn	Mulberry	2	2
Mulberry	Doniphan	East River	4	3
End route at intersection of Mulberry Ave and East River Ln (13B)				
Route 14	*Begin route at intersection of Montoya Dr and Mamie Rd (14A)*			
Montoya Dr	Mamie	Montoya Rd	4	3
Montoya Rd	Montoya Dr	Doniphan	4	3
Doniphan	Montoya Rd	Borderland	4	2
Borderland	Doniphan	Morill	4	2
Morill	Borderland	Gato	5	4
Gato	Morill	Westside	5	4
Westside	Gato	Gardner	5	2
Gardner	Westside	Gato	5	3
End route at intersection of Gardner Rd and Gato Rd (14B)				

Data Collection Equipment, Setup and Training

The equipment used for the field work included a data collection vehicle, Global Positioning System (GPS) data logger, in-vehicle GPS navigation device, and mini voice recorder. The GPS data logger employed was the iBlue 747 Trip Recorder manufactured by TranSystem Inc. Positioning data were captured on a second-by-second basis and included longitude, latitude, speed, heading, time, date and other variables. The in-vehicle GPS navigation system assisted with safe and accurate route reconnaissance and data collection by the field technicians. A small digital voice recorder enabled the data collectors to record speed-limit signage along the routes and safely log the time, location, and duration of any incidents requiring recollection of data.

Prior to collecting travel time and speed data in the field, technicians received orientation on the study objectives, methodology, and use of the GPS data loggers, navigation devices and voice recorders. Instruction on how to interpret and revise route information and study area functional class-area type maps was also provided in the event that unexpected construction or maintenance required route revisions in the field. Finally, extensive safety training and trial runs were conducted to ensure that the data were collected properly and safely.

DATA PROCESSING AND ANALYSIS

Following the fieldwork, the raw GPS data files were downloaded from the loggers in comma-separated variable format and imported into PostgreSQL, an open source Relational Database Management System (RDMS).

Data processing utilized the PostgreSQL spatial extension PostGIS. In addition to the GPS data collected from the field work, a GIS travel time route file was utilized for data analysis. This route file was developed based on the master travel time route map provided to the data collection team. For analysis purposes, the route file was segmented based on the functional classification and area type of the roadways that made up the route. Segmentation of the route was concluded using the travel demand model network layer with the functional classification of each link, a TAZ layer containing the area type attribute, and aerial/satellite imagery. The study area network layer was used as the default boundary for determining segment transitions. When roadways that straddled two different area types were traversed, the area type with the higher activity density was assigned.

Utilizing a PostgreSQL/PostGIS data processing algorithm, per-second GPS recordings were mapped to their respective routes and assigned the appropriate functional classification and area type based on the route segmentation. This assignment involved a two-step process. First, each route was buffered and GPS points were assigned a route if they fell within that buffer. This was done to remove extraneous travel data collected during the day of data collection such as travel to/from the route. Second, each point was assigned its final functional classification and area type based on a "nearest neighbor" analysis using the study area route file. After each GPS point was appropriately assigned, it was then ordered by route based on its time stamp. Additional calculations were performed which included calculating a generalized heading, generalized speed, and flags for locations where the vehicle was stopped.

Once the initial calculations were made, the algorithm then assessed whether each GPS point belonged to a partial run (associated with route reconnaissance, for example) or a complete run. Complete runs were those that traveled along the entire route without reversing direction or deviating from the route. After processing the complete runs, the data were visually inspected using QGIS, an open source GIS visualization and editing platform. In some cases, extraneous data were identified and excluded from further analysis based on the data collection schedule and/or field notes. These extraneous runs often represented scouting runs or those disrupted by heavy rain or traffic incidents, which had to be recollected by the field technicians. Finally, when all routes were judged to have complete travel time runs per the data collection plan, each individual run was assigned an AB (first segment -> last segment)/BA (last segment -> first segment) travel direction and either peak or off-peak period depending on the time of day.

Figure 3 is a screenshot from the GIS software showing an example of a portion of a travel time and delay run along a route (segment begin and end points are shown as bars bisecting the route path at segment transitions). Points that appear increasingly close together represent slowing. Points that are further apart represent higher speeds and less delay.

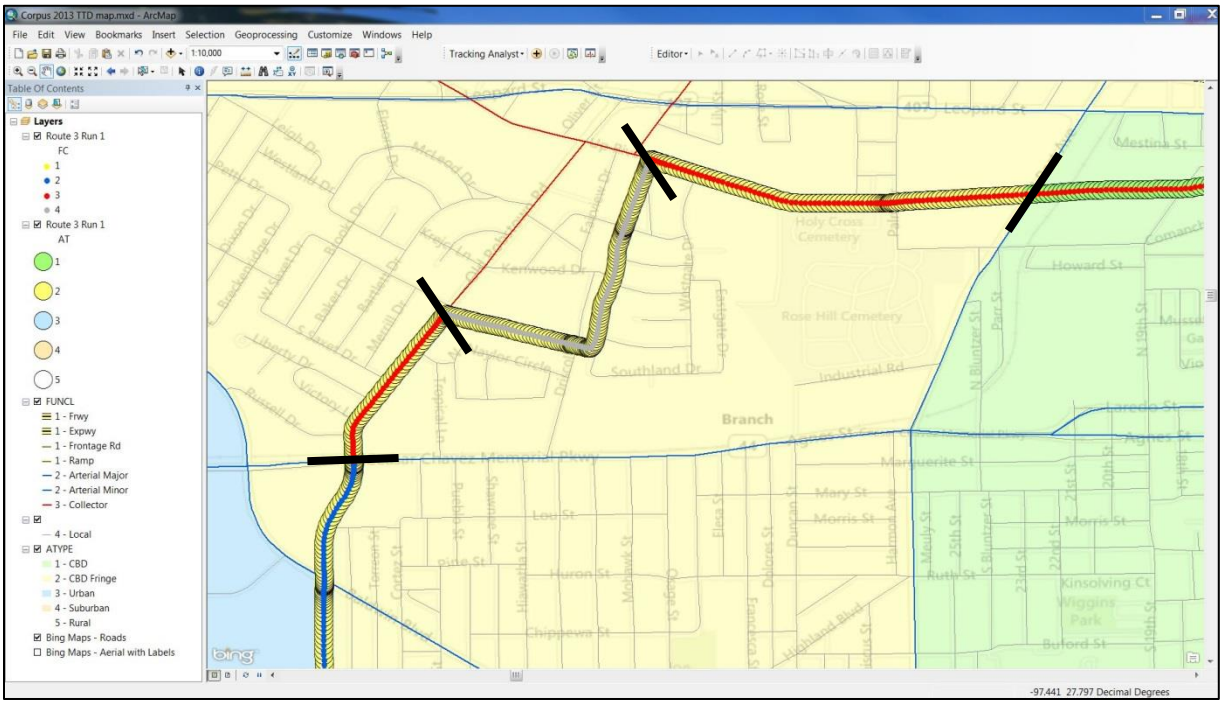

Figure 3. Example of Segmented GPS Data Shown in ArcGIS.

Using the final data of complete travel time, average speeds were then calculated using PostgreSQL based on the second-by-second GPS and route, functional classification, area type, travel direction, and period.

The average travel speeds presented in this report were calculated based on the time mean speed (or mean spot speed) method of measurement. This is the average of all second-by-second GPS spot speed readings for each functional class-area type combination. It is the sum of the spot speeds divided by the total number of spot speed measurements and is represented by the formula below:

$$Average\ Travel\ Speed\ for\ Each\ FUNCL/ATYPE\ Combination\ (mph) = \frac{\sum^{p} S}{P}$$

Where S is the travel speed in miles-per-hour for each data point, totaling the number of data points denoted by P and p.

The data were also analyzed to obtain the average segment length (miles) for each functional class-area type combination based on the following formula:

$$Average\ Length\ for\ Each\ FUNCL/ATYPE\ \ Combination\ (miles) = \frac{\sum^{p}\left(\frac{T}{3600} \times S\right)}{P}$$

Where *T* is travel time in seconds and *S* is the travel speed in miles per hour for each data point, totaling the number of data points denoted by *P* and *p*.

The data were then exported to Microsoft Excel for table and chart generation.

Results from the 2013 El Paso Travel Time and Delay Study are presented in the following section of the report.

RESULTS

The methodology employed for analyzing the travel time data incorporated all regular delays encountered while traveling along a route. Slowdowns associated with occurrences such as queuing at traffic control devices and turning at intersections were not excluded from the dataset during analysis. Table 4 provides a summary of average speeds for each route, in both directions, by peak and off-peak period.

Table 4. Summary of Average Speeds for Each Route.

Route	Peak Period			Off-Peak Period		
	Average Speed			Average Speed		
	A → B	B → A	Overall	A → B	B → A	Overall
1	21.8	20.7	21.2	21.8	20.2	21.0
2	15.1	17.0	16.0	15.9	17.3	16.5
3 AC	40.3	31.5	35.3	40.2	44.2	42.1
4 AC	33.8	30.8	32.2	36.4	33.8	35.0
5	18.6	18.5	18.5	20.5	19.9	20.2
6	36.4	27.4	31.3	38.8	33.3	35.8
7	23.5	26.4	24.9	26.0	27.8	26.9
8	33.5	33.9	33.7	35.6	35.4	35.5
9	21.5	20.6	21.1	21.9	22.9	22.4
10	56.9	54.6	55.7	57.9	54.9	56.3
11 AC	45.8	44.3	45.0	51.2	45.5	48.2
12 AC	47.4	42.1	44.6	48.6	46.9	47.7
13	21.5	22.4	21.9	22.9	21.4	22.2
14	27.5	29.5	28.4	28.7	30.0	29.4

Figures in miles per hour.

Speed limit signs posted along the data collection routes can be helpful for interpreting the travel time data collected. Table 5 shows the posted speed limit or range of speed limits for each functional classification and area type combination in the 2013 El Paso Travel Time and Delay Study. Due to variability in route paths and segment lengths, certain speed-limit ranges are larger than others. An asterisk denotes functional class-area type combinations whose speed limits were affected by the presence of school zones.

Table 5. Posted Speed Limits.

Area Type \ Functional Class	Freeway	Arterial	Collector	Local
Central Business District	50-60	30-30	30-30	30-30
CBD Fringe	50-60	30-45 (*25)	30-35 (*15)	30-30 (*15)
Urban	50-60	30-60 (*20)	25-35 (*15)	30-30
Suburban	60-75	40-65	30-35	25-50
Rural	75-75	30-55	30-40	25-30

Figures in miles per hour. * - School Zone.

The total number of segment runs and the average segment length of each functional class-area type combination is shown in Table 6.

Table 6. Average Length of Each Functional Class-Area Type Segment Combination.

Area Type \ Functional Class	Freeway		Arterial		Collector		Local	
	Number of Segment Runs	Average Segment Length (mi)	Number of Segment Runs	Average Segment Length (mi)	Number of Segment Runs	Average Segment Length (mi)	Number of Segment Runs	Average Segment Length (mi)
CBD	24	0.55	24	0.41	12	0.30	24	0.25
CBD Fringe	72	3.00	132	0.65	48	0.64	60	0.51
Urban	24	1.60	60	0.74	36	0.45	60	0.43
Suburban	24	2.70	84	1.57	36	0.63	36	0.58
Rural	12	6.70	36	0.77	36	0.74	36	0.58

Speed data for the individual routes examined were compiled and aggregated into tables showing summary information for each functional class-area type cohort. Figures 4 through 8 show the aggregate speed results by functional classification and peak and off-peak period for each area type.

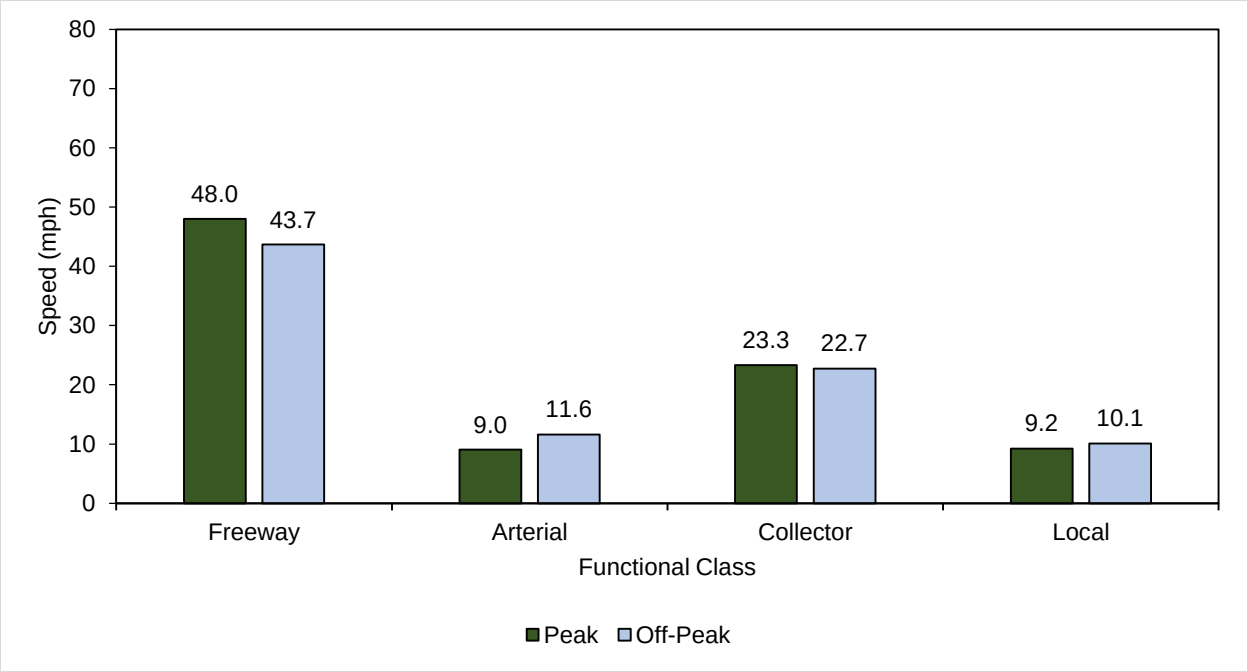

Figure 4. CBD - Average Peak vs. Off-Peak Speeds.

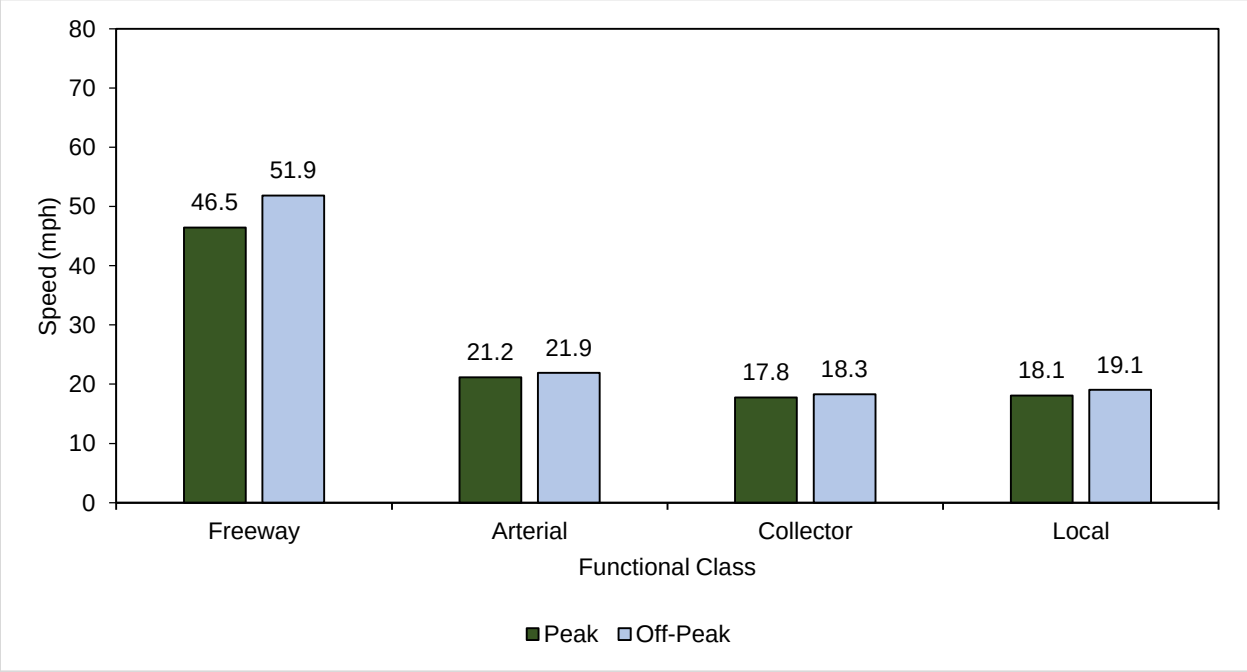

Figure 5. CBD Fringe - Average Peak vs. Off-Peak Speeds.

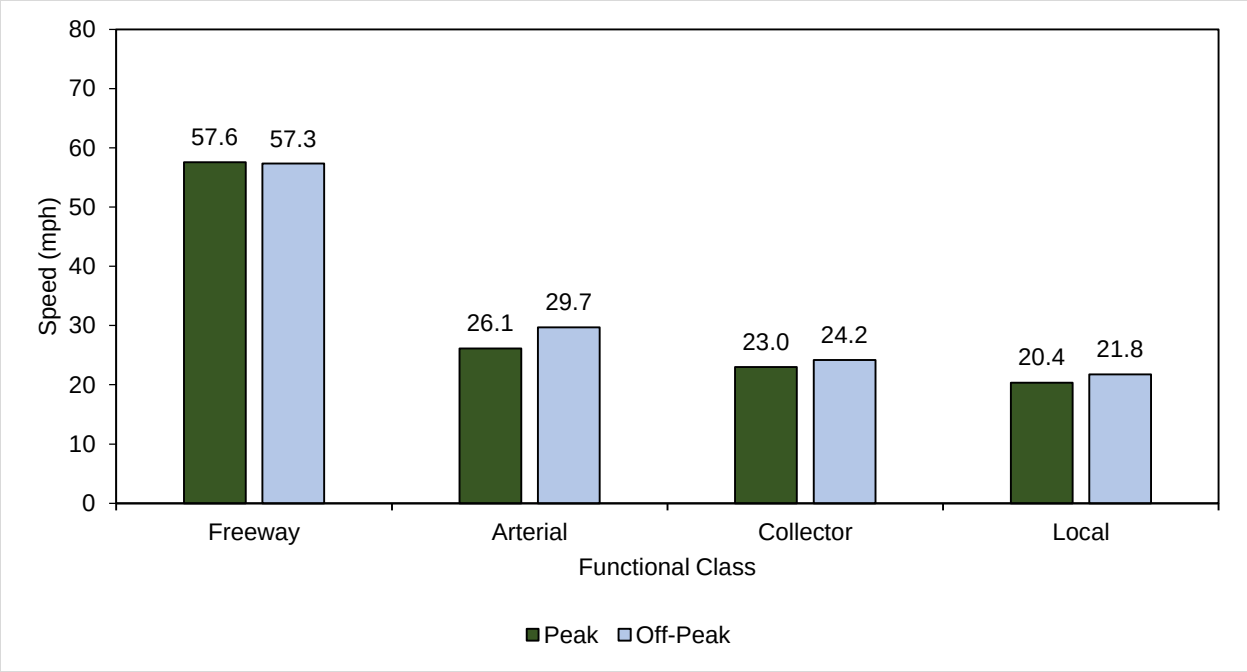

Figure 6. Urban - Average Peak vs. Off-Peak Speeds.

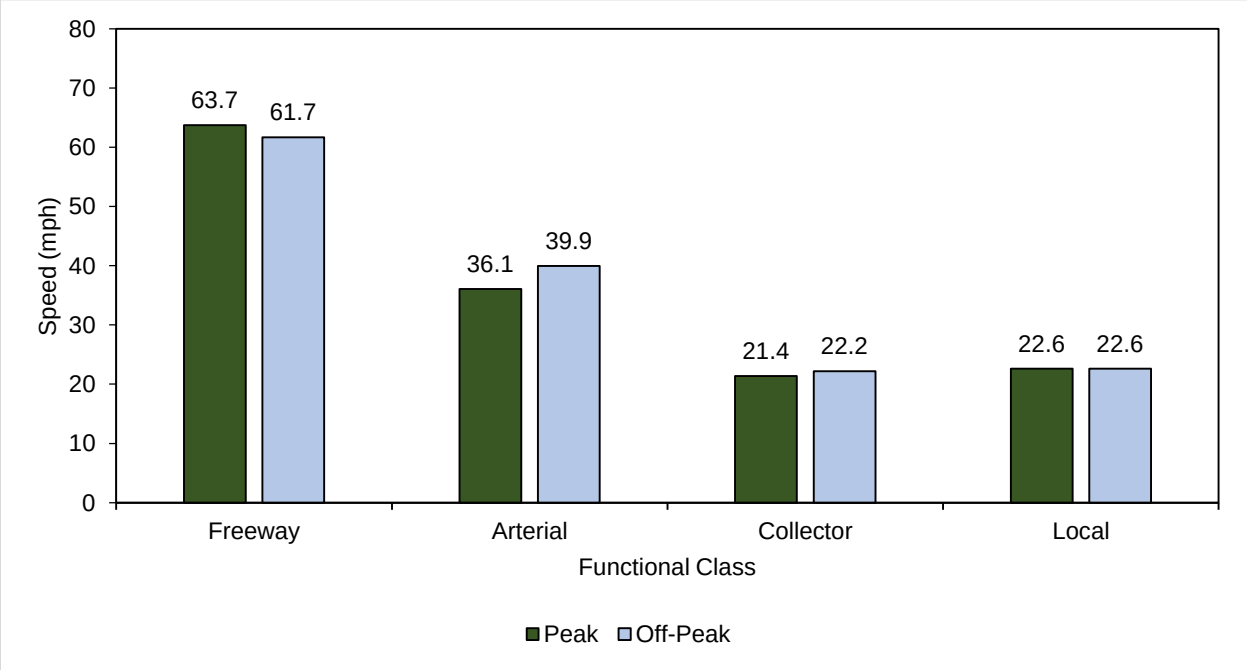

Figure 7. Suburban - Average Peak vs. Off-Peak Speeds.

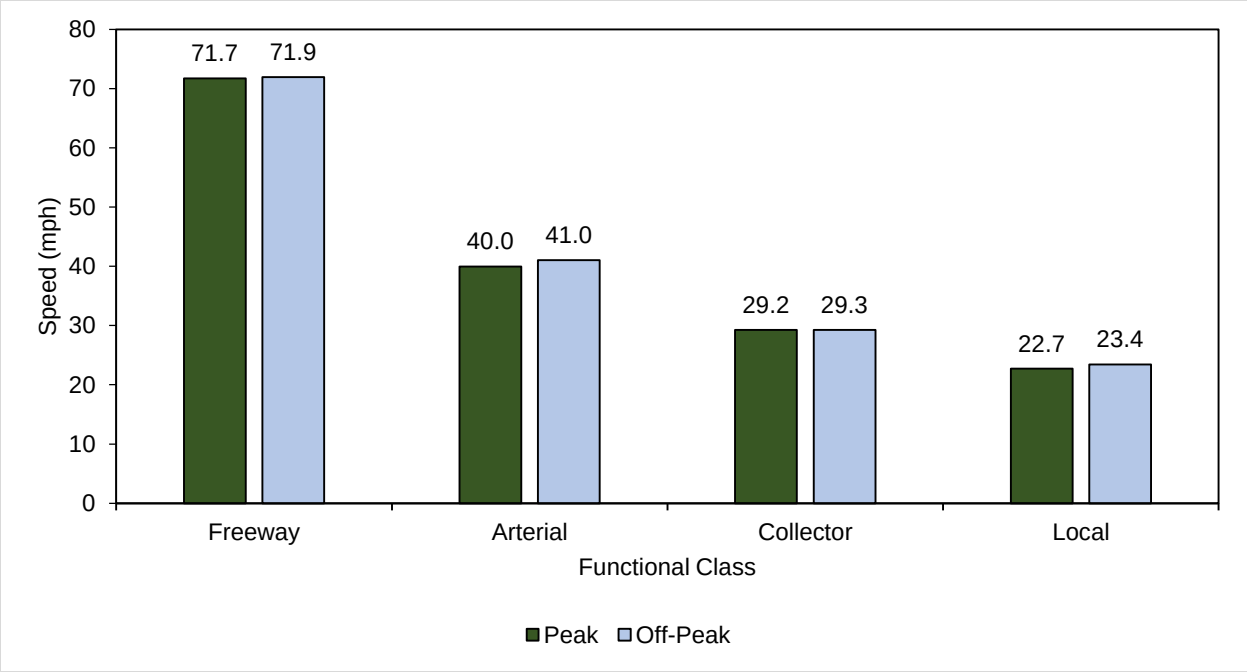

Figure 8. Rural - Average Peak vs. Off-Peak Speeds.

Figures 4 to 8 illustrate the relatively small peak versus off-peak speed discrepancies observed on the roadways studied. This suggests that, in general, El Paso-area functional classes are not severely impacted by the effects of peak-period congestion.

The degree to which speeds on individual functional classes fluctuate with changes in activity density provides another indication of the nature and scale of congestion within an urban area. The greatest variation in speeds was observed on arterials, which ranged from approximately 10 mph in the CBD to 40 mph in the Rural area type. Speeds on locals through the CBD were approximately 10 mph. They then increased and stayed relatively consistent around the 20 mph range through the CBD Fringe, Urban, Suburban, and Rural area types. Freeway speeds exhibited a gradual increase from approximately 45 mph in the CBD to approximately 60 mph in the Suburban area type, and then increased to around 70 mph in the Rural area type. Collector speeds were consistently in the 20-25 mph range through the CBD, CBD Fringe, Urban, and Suburban area types, and then increased to approximately 30 mph in Rural areas.

The overall (peak and off-peak) weighted averages for travel speeds for every functional class and area type combination are shown in Table 7. In general, speeds on all roadways increased from the CBD to the Rural area type with the exception of collectors.

Table 7. Summary of Average Speeds for Each Functional Class-Area Type Combination.

Area Type \ Functional Class	Freeway	Arterial	Collector	Local
Central Business District	45.7	10.2	23.0	9.7
CBD Fringe	49.0	21.5	18.0	18.6
Urban	57.4	27.8	23.6	21.0
Suburban	62.7	37.9	21.8	22.6
Rural	71.8	40.5	29.3	23.1

After disaggregating the travel time data and examining it by functional class, area type, and peak and off-peak period, an aggregate comparison of El Paso speeds was performed. Figure 9 presents the average peak-period speeds for each functional class across all area types. The results show speeds dropping off sharply between freeways and arterials, then continuing to decline moderately across arterials, collectors, and local streets.

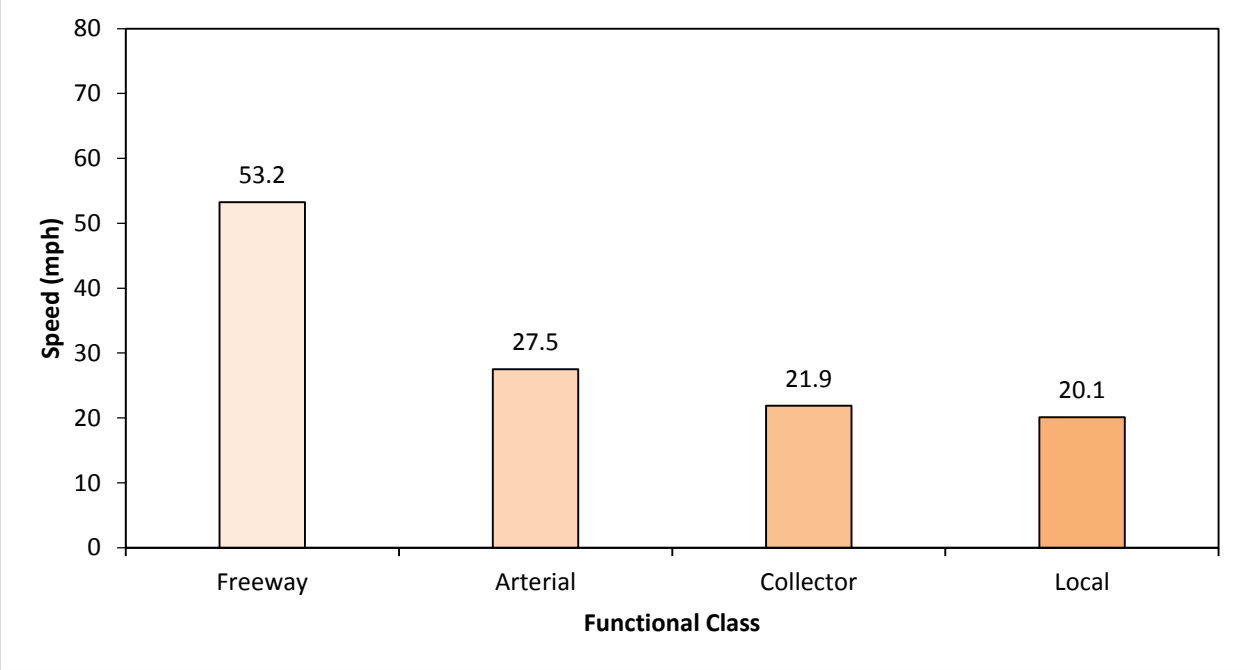

Figure 9. Average Peak-Period Speeds for All Area Types.

Finally, a comparison of average AM and PM speeds was undertaken for each functional classification-area type combination. This comparison indicated that afternoon travel speeds on El Paso-area freeways were slightly higher than morning speeds through the CBD Fringe area type. Conversely, morning freeway speeds through the Suburban area type were slightly higher than afternoon speeds. All of the other area types had approximately the same freeway travel speeds in the morning and afternoon periods. Arterials and locals also exhibited very similar morning and afternoon speeds through all area types. Morning speeds on collectors were slightly higher than afternoon speeds in the CBD Fringe, Urban, Suburban, and Rural area types, and slightly lower through the CBD.

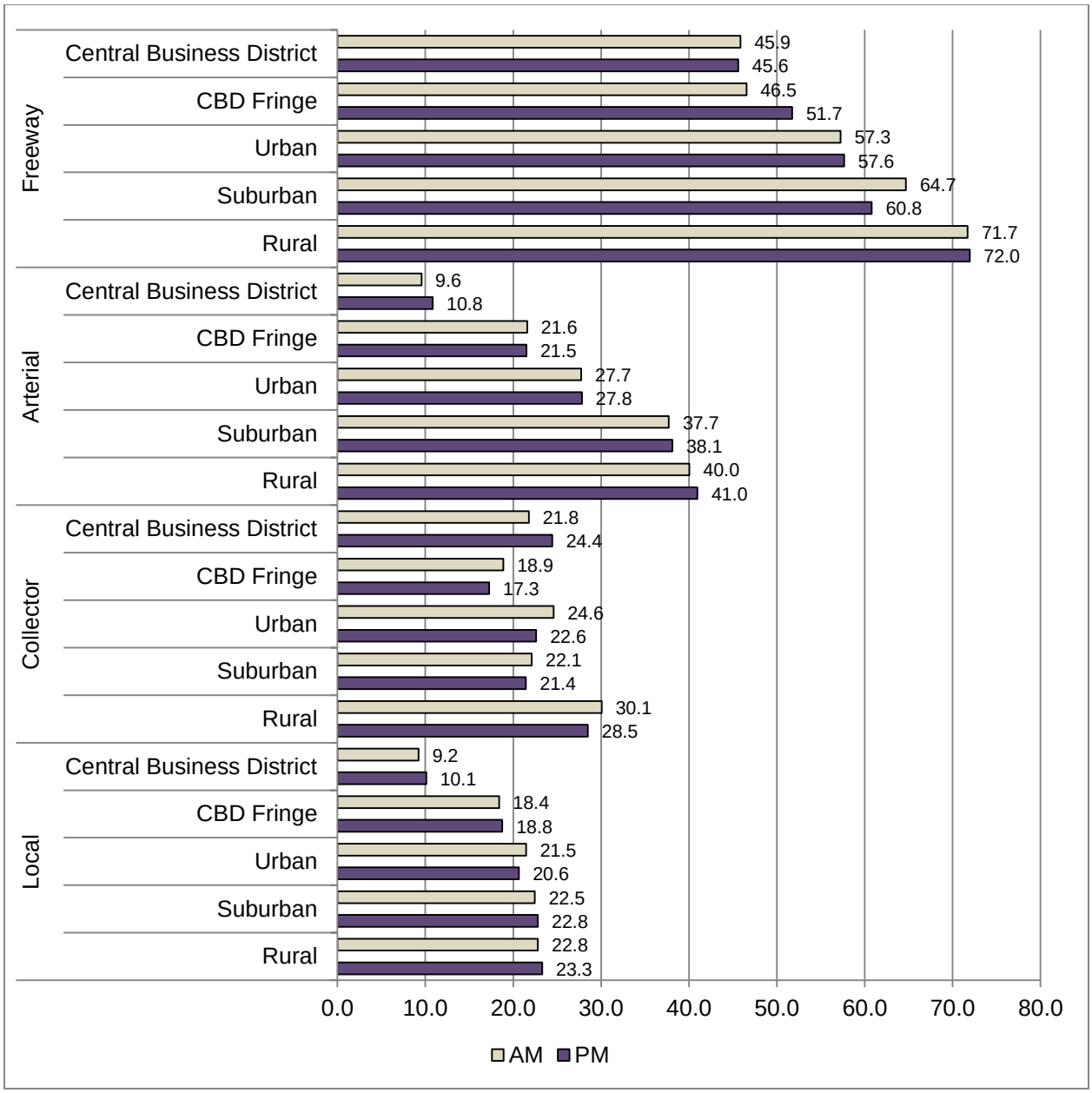

Figure 10. Average AM vs. PM Speeds.