TTI: 0-6940

Guides for System to Render M-E Traffic Data for Pavement Design: Instructor's Guide

Product 0-6940-P4

Cooperative Research Program

TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS

in cooperation with the
Federal Highway Administration and the
Texas Department of Transportation
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GUIDES FOR SYSTEM TO RENDER M-E TRAFFIC DATA FOR PAVEMENT DESIGN

Instructor's Guide

by

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Report 0-6940-P4
Project 0-6940
Project Title: Develop System to Render Mechanistic-Empirical Traffic Data for Pavement Design

Performed in cooperation with the
Texas Department of Transportation
and the
Federal Highway Administration

Published: October 2020

TEXAS A&M TRANSPORTATION INSTITUTE
College Station, Texas 77843-3135

DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

This report is not intended for construction, bidding, or permit purposes. The researcher in charge of the project was Lubinda F. Walubita.

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

ACKNOWLEDGMENTS

This project was conducted in cooperation with TxDOT and FHWA. The authors thank Wade Odell, the project manager, Hua Chen and Enad Mahmoud, the TxDOT technical leads, and members of the project team for their participation and feedback: Gisel Carrasco, Daniel Garcia, Brett Haggerty, Miles Garrison, Sergio Cantu, Lacy Peters, and Chris Didear.

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LIST OF SYMBOLS AND NOTATIONS

AADTT	Average annual daily truck traffic
ADT	Average daily traffic
ALD	Axle load spectra data
ALDF	Axle load distribution factor
ATHWLD	Average ten heaviest wheel loads daily
CRCP	Continuously reinforced concrete pavement
DC	Dry-cold
DW	Dry-wet
EB	Eastbound
HDF	Hourly distribution factor
ESAL	Equivalent single axle load
FPS	Flexible pavement system
Gr	Growth rate
GVW	Gross vehicle weight
LEF	Load equivalency factor
LS	Load spectra
M	Moderate
MAF	Monthly adjustment factor
M-E	Mechanistic empirical
NB	Northbound
OV	Overlay
OW	Overweight
PTT	Pneumatic traffic tube
SB	Southbound
T-DSS	Traffic data storage system
TP&P	Transportation planning and programming
TTI	Texas A&M Transportation Institute
TxACOL	Texas asphalt concrete overlay design
TxDOT	Texas Department of Transportation
TxME	Texas Mechanistic-Empirical pavement design
VCD	Vehicle classification distribution
WB	Westbound
WC	Wet-cold
WIM	Weigh-in-motion
WW	Wet-warm

SECTION I. INSTRUCTION

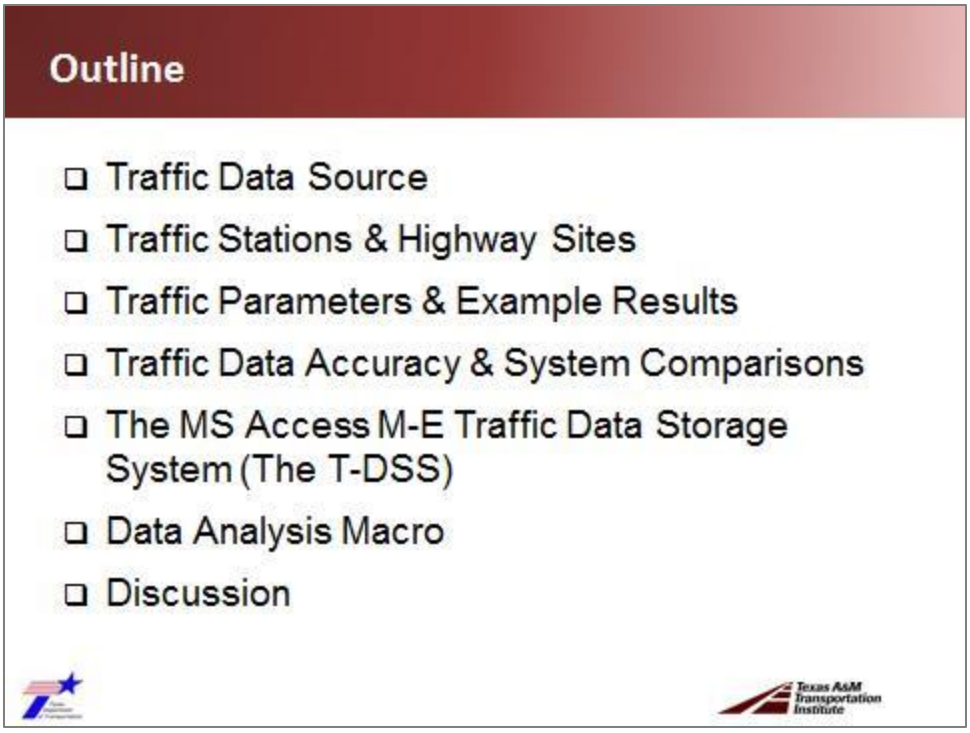
This guideline is to demonstrate the key findings of Texas Department of Transportation (TxDOT) Project 0-6940 *Develop System to Render Mechanistic-Empirical Traffic Data for Pavement Design*. It can be used as an instructor guide to provide in-depth understanding of site-specific ME-compatible traffic data for pavement design.

The training workshop is a half-day course intended to provide the methodologies for generating and utilizing site-specific ME- compatible traffic data for flexible and rigid pavement designs. The course is designed to cover:

- Traffic data sources to obtain the applicable M-E traffic data
- Traffic data parameters calculated and generated using the collected traffic data such as traffic volume, speed, classification, and weight data
- Traffic data inputs required for pavement design (for FPS and ME design software)
- The traffic data storage system (The T-DSS) to store and provide ME-compatible traffic data support
- Data analysis macros and clustering algorithms to automatically analyze and generate the ME-compatible traffic data

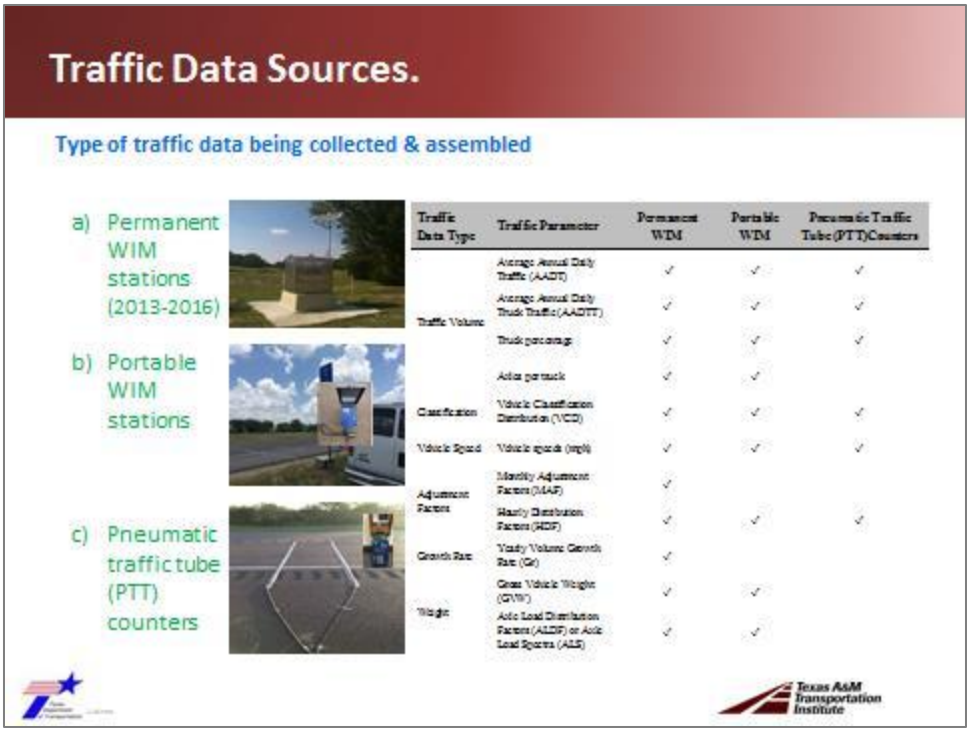
SECTION II. COURSE MODULE

Key Message	Training title
Interactive	In this workshop, we will review mainly the methodologies for generating and utilizing site-specific ME- compatible traffic data for pavement design.
Notes	N/A

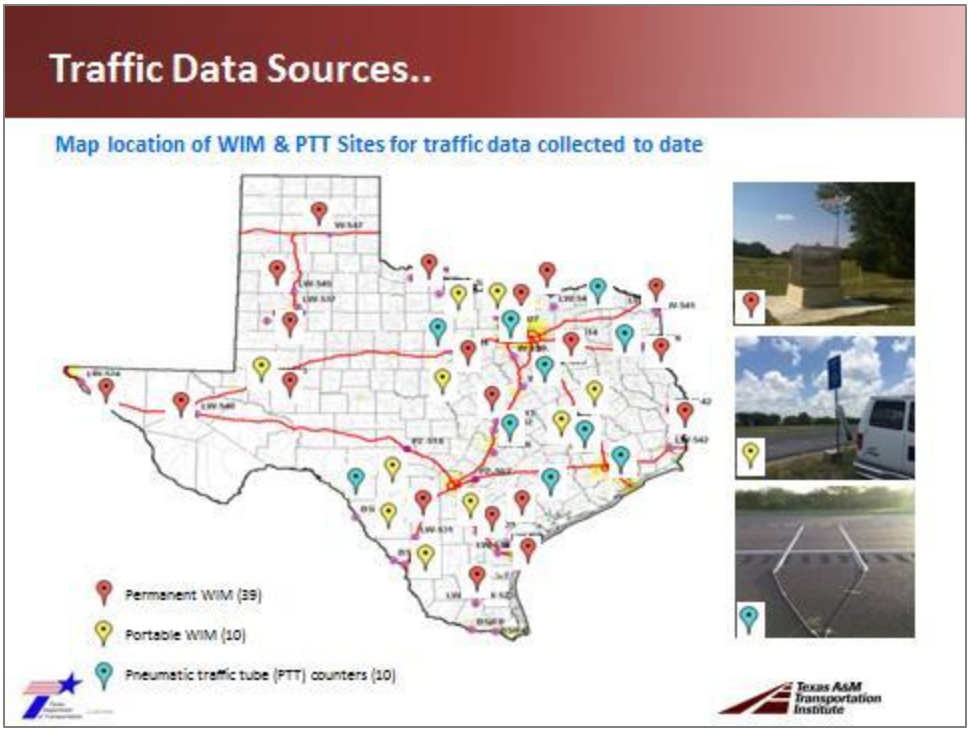


Key Message	Agenda
Interactive	This workshop includes mainly 7 parts: • Traffic data source • Traffic stations and highway sites to collect traffic data • Traffic parameters and example results • Traffic data accuracy and system comparisons • The MS Access M-E traffic data storage system (The T-DSS) • Data analysis macro • Discussion
Notes	N/A

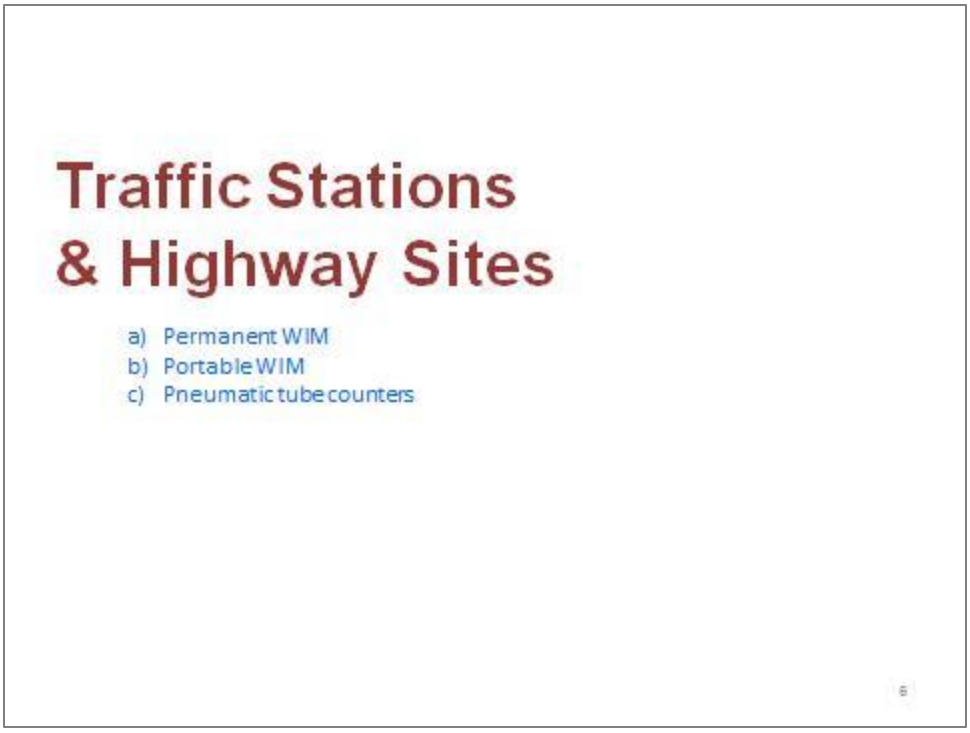
Key Message	Traffic data sources
Interactive	In this section, we are going to review the traffic data source to measure, collect, and assemble various types of traffic data.
Notes	N/A



Key Message	Type of traffic data being collected and assembled.
Interactive	For the Project 0-6940, various types of traffic data were measured, collected, and assembled using three traffic data sources, (a) permanent weigh-in-motion (WIM) stations, (b) portable WIM units, and (c) pneumatic traffic tube (PTT) counters. The permanent WIM data are obtained continuously during the years while the portable WIM data are obtained during the short-term deployment periods. The PTT is installed to collect only traffic volume counts, vehicle speed, and vehicle classification for at least 48 hours up to 7 days, but with no vehicle weight data.
Notes	The permanent and portable WIM systems provide the following minimum type of traffic data: • Traffic volume counts • Vehicle classification and speed • Axle spacing • Vehicle weights, i.e., gross vehicle weight (GVW) • Individual axle loads • Axles per truck Among them, the PTT can collect only the first three traffic data.



Key Message	Map location of WIM and PTT sites for traffic data collated to date
Interactive	The traffic data were collected from 39 permanent WIM, 10 portable WIM, and 10 pneumatic traffic tube counter sites as presented in the map.
Notes	All the permanent WIM data were obtained from TxDOT's Transportation Planning and Programming (TPP) division. The portable WIM data were measured and collected by Texas A&M Transportation Institute (TTI) through the short-term (minimum 7 days thru to 1 year) deployment of portable WIM units on selected highway sites around the State. Likewise, the pneumatic traffic tube data were also measured and collected by TTI through the short-term (minimum 48 hours thru to 7 days) deployment of pneumatic traffic tube counters.



Key Message	Traffic stations and highway sites
Interactive	The next section is on the information of traffic stations and highway sites where the traffic data were collected.
Notes	N/A

Traffic Stations & Hwy Sites.

Example permanent WIM stations

#	Station ID#	District (County)	Climatic Region	Hwy	Lane Direction	Mile Marker	GPS Coordinates
1	W513	WAC(Bell)	Moderate	IH 35	All (NB & SB)	276-280	N 30° 51' 36" W 97° 35' 18"
2	W523	PHR(Hidalgo)	Moderate	US 281	All (NB & SB)	750-748	N 26° 41' 09" W 98° 06' 53"
3	W524	ELP(El Paso)	Dry-Warm	IH 10	All (EB &WB)	40-41	N 31° 37' 59" W 106° 13' 08"
4	W527	FTW(Wise)	Wet-Cold	SH 114	All (NB & SB)	582	N 33° 02' 11" W 97° 25' 56"
5	W531	LRD(La Salle)	Dry-Warm	IH 35	All (NB & SB)	50-55	N 28° 13' 05" W 99° 18' 10"
6	W534	CRP(Corpus Christi)	Moderate	IH 69	All (NB & SB)	145	N 27° 50' 23" W 97° 37' 59"
7	W541	ATL(Cass)	Wet-Cold	FM3129	NB (L1) & SB(L1)	232-230	N 33° 13' 32" W 94° 05' 56"
8	W542	BMT(Western Orange	Wet-Warm	IH 10	All (EB &WB)	860-865	N 30° 07' 35" W 94° 01' 25"
9	W547	AMA (Potter)	Dry-Cold	IH 40	All (EB & WB)	110-120	N 35° 11' 39" W 101° 04' 26

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Key Message	Example of permanent WIM stations
Interactive	The table lists the information of 9 stations where permanent WIM installed to obtain the traffic data by the TxDOT TPP among 39 sites around Texas.
Notes	Clicking the GPS coordinates open the permanent WIM location on the Google map

Traffic Stations & Hwy Sites..

Example portable WIM sites

#	Site ID#	District (County)	Climatic Region	Hwy	Lane Direction	Mile Marker	GPS Coordinates
1	TS001	LRD (Webb)	Dry-warm	US 83	NB (Outside)	678-680	N 28° 02' 37.4", W 099° 32' 59.8"
2	TS002	BRY (Robertson)	Wet-Warm	SH7	All (EB & WB)	618-616	N 31° 15' 27.1" W 96° 21' 09.5"
3	TS003	BRY(Leon)	Wet-Warm	SH7	WB-L1	658-660	N 31° 18', W 95° 35'
4	TS007	FTW (Wise)	Wet-Cold	SH 114	EB-L1	582-584	N 33°02; W 97°25'
5	TS004	LRD (Dimmit)	Dry-Warm	FM 468	EB-L1	432-434	N 28°33'; W 99°30'
6	TS005	CRP (Live Oak)	Moderate	US 281	NB-L1 & SB-L1	620-622	N 28°27'59.0", W 98°10'50.7"
7	TS006	BWD (Comanche)	Dry-Warm	SH 6	NB-L1	386-384	N 32°13; W 98°57'W
8	TS008	ODA (Midland)	Dry-Warm	FM 1787	All (EB & WB)	280	N 31°41'; W 102°07'
9	TS009	LRD (Webb)	Dry-Warm	US 83	NB (Outside)	696-698	N 27° 46' 46.2", W 099° 27' 0.2"

Key Message	Example of permanent WIM stations
Interactive	The portable WIM data were measured and collected through the short-term deployment to supplement traffic data from 10 highways sites where the permanent WIM data are not available. The table lists the information of 9 of 10 portable WIM sites around the Texas.
Notes	The portable WIM data are obtained during the short-term deployment periods, which is at minimum seven consecutive days up to 1-year with routine periodic service maintenance.

Traffic Stations & Hwy Sites…

Example PTT sites

#	Site ID#	District (County)	Climatic Region	Hwy	Lane Direction	Mile Marker	GPS Coordinates
1	TTI00001	ATL (Panola)	Wet-Cold	US 59	SB (Outside)	308-310	N 32° 12' 05.3" W 94° 20' 35.5"
2	TTI00051	AUS (Bastrop)	Moderate	SH 304	SB	450-452	N 30° 06' 06.8" W 97° 21' 08.5"
3	TTI00024	YKM(Lavaca)	Wet-Warm	SH 95	SB	522-524	N 29° 22' 34.6" W 97° 09' 52.0"
4	TTI00002	FTW (Wise)	Wet-Cold	SH 114	EB (Outside)	582-584	N 33° 02' 12.1" W 97° 25' 34.5"
5	TTI00005	LRD (Maverick)	Dry-Warm	Loop 480	SB & NB (Outside)	570-567	N 28° 40' 58.9" W 100° 30' 10.5"
6	TTI00016	HOU(Harris)	Wet-Warm	FM 2100	NB & SB	456-454	N 29° 55' 32.6" W 95° 04' 18.2"
7	TTI00007	PAR(Lamar)	Wet-Cold	US 271	NB & SB	187-188	N 33° 51' 06.50" W 95° 30' 33.20"
8	TTI00019	SAT(Comal)	Dry-Warm	IH 35	SB (Outside)	190-189	N 29° 42' 34.8" W 98° 05' 23.8"
9	TTI00009	WAC(Bell)	Moderate	IH 35 (Frontage)	NB & SB	269-268	N 30° 58' 25.90" W 97° 30' 55.2"

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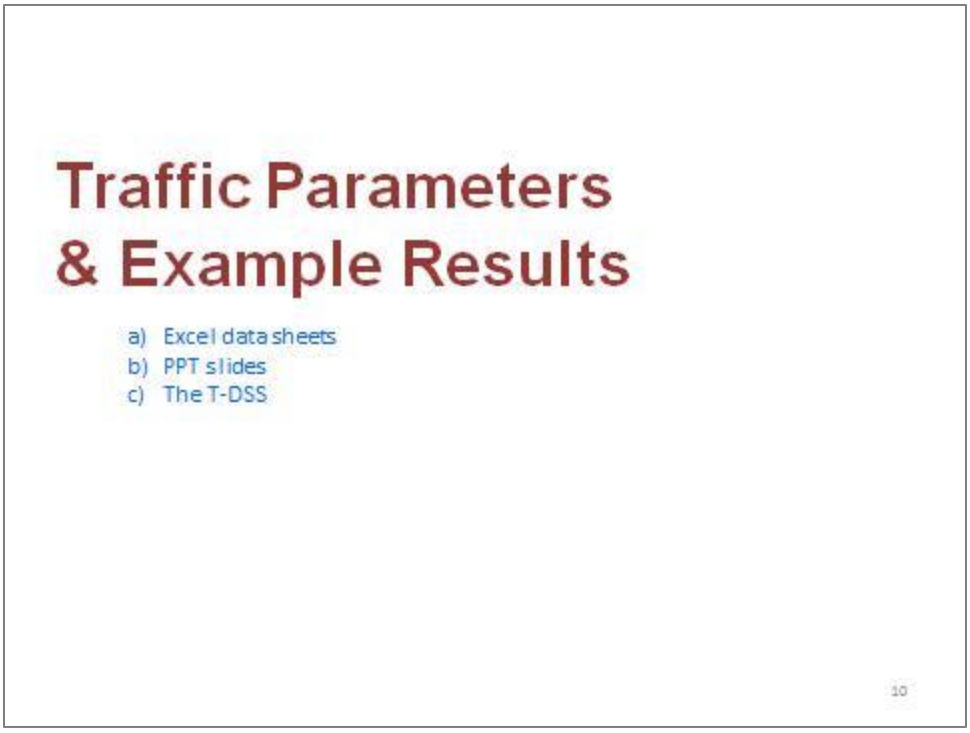
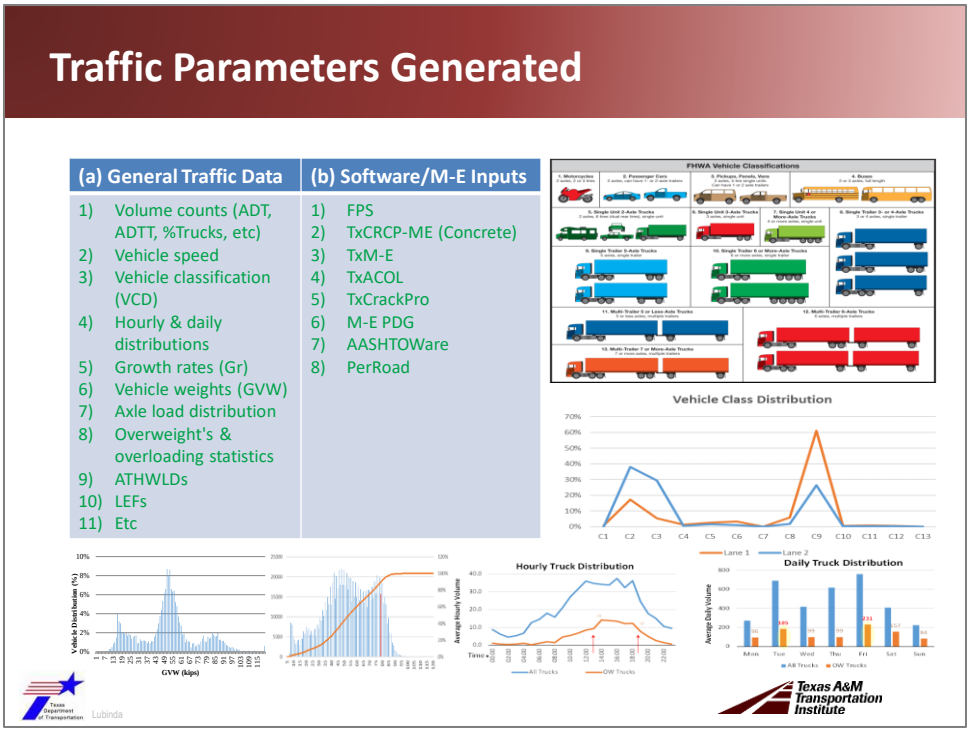
Key Message	Example of pneumatic traffic tube (PTT) counter stations
Interactive	Unlike the WIM systems that measures vehicle weights, the pneumatic traffic tube (PTT) counters were installed at 10 stations to measure and collect only traffic volume counts, vehicle speed, axle spacing, and vehicle classification for at least 48 hours up to 7 days but with no vehicle weight data. The table lists the information of 9 of 10 PTT stations around the Texas.
Notes	N/A



Key Message	Traffic parameters and example results
Interactive	In this part, we are going to discuss on the traffic parameters and some example results calculated using the traffic data collected using the WIM systems.
Notes	N/A



Key Message	Traffic parameters: general traffic data and M-E software
Interactive	Based on the WIM traffic volume, speed, classification, and weight data, the pertinent traffic parameters were calculated as listed in the table: • Traffic volume data: ADT, ADTT, %Truck • FHWA vehicle classification • Hourly and daily vehicle distribution • Growth rate • Gloss vehicle weights (GVW) • Axle load distribution • Overweight and overloading statistics • Average ten heaviest wheel loads daily (ATHWLD) • Load efficiency factor (LEF), etc. These computed/generated traffic parameters are used as traffic inputs for the flexible and rigid pavement design programs, like FPS, TxCRCP, and other M-E design software.
Notes	N/A

Example Traffic Results.

Permanent WIM – Volume & FPS inputs (Example Station W531)

FPS Parameter	NB-L1 (Outside)	NB-L2 (Inside)	SB-L1 (Outside)	SB-L2 (Inside)	Comment
ADT-Beginning	6,113	2,699	6,213	2,656	ADT at the beginning of the design period
ADT-END 20 Year	23,001	10,155	23,377	9,994	ADT at the end of the design period (20 yrs)
18 kip ESALs 20 Years (millions)	39.08	5.49	40.11	5.76	@ 6.85% Gr
Avg. vehicle speed (mph)	~65	~65	~65	~65	Approach speed assumed to be equal to operational speed
% Trucks in ADT	47%	13%	51%	14%	
ATHWLD (kips)	14.3	11.8	12.3	12.7	
%Tandem axles	55.5%	51.1%	57.9%	54.9%	

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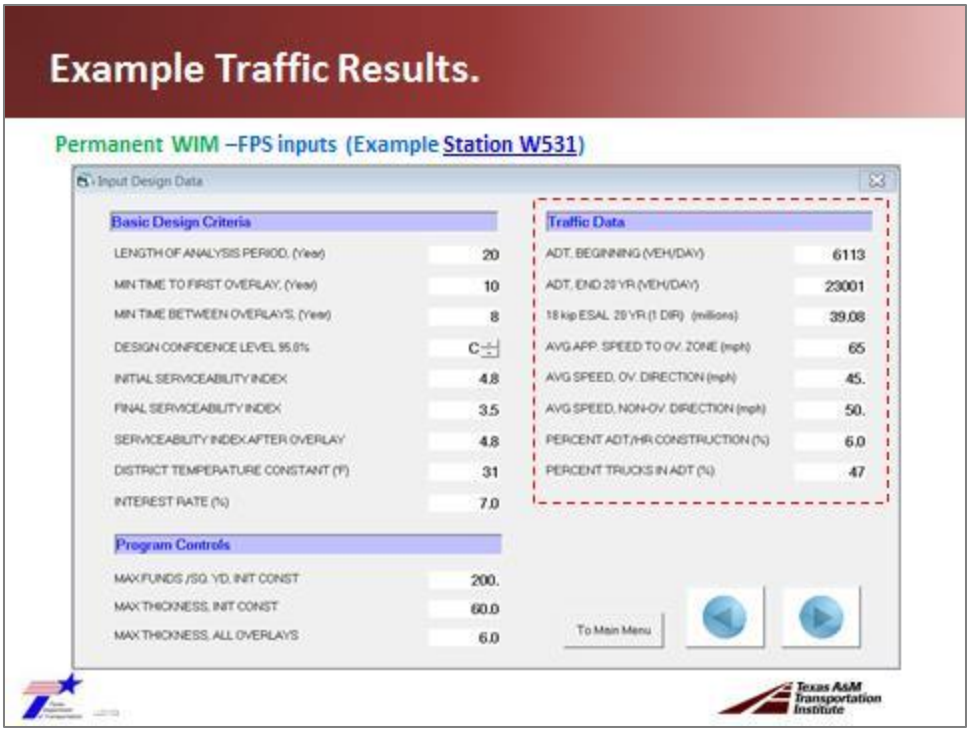
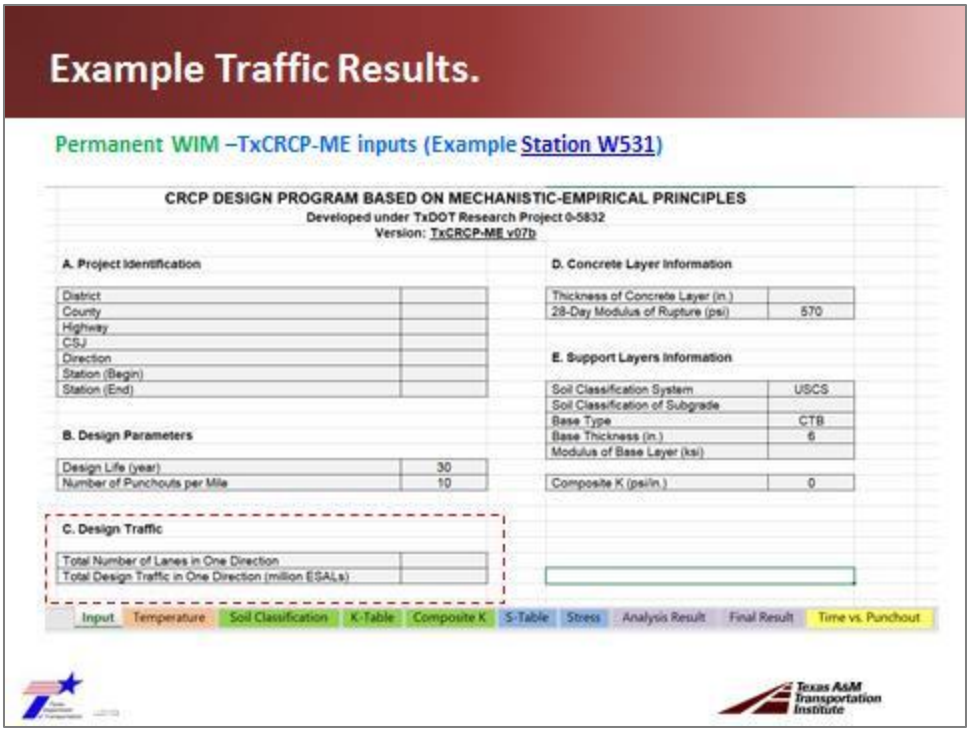
Key Message	FPS inputs calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	From now, I will show the examples of traffic parameters and results calculated using the permanent WIM data. First, this table shows the example of all traffic inputs required for the flexible pavement design using the FPS program. These traffic parameters were calculated using the traffic data collected from the W531 permanent WIM station on IH 35 at Laredo district, La Salle county. The growth rate was calculated as 6.85% from 3 consecutive years, from 2014 to 2016, in this highway.
Notes	N/A



Key Message	FPS traffic data inputs (IH 35, Laredo district, La Salle county, NB L1)
Interactive	The slide shows the screenshot of FPS traffic data input. The users can enter the traffic parameters including ADT at beginning and end 20 years, 18-kips ESAL, and % truck using the traffic data calculated using the permanent WIM data, as listed at the previous slide.
Notes	N/A



Key Message	TxCRCP-ME traffic data inputs
Interactive	The slide shows the screenshot of TxCRCP-ME input. In the Design Traffic box highlighted with red-dot line, the users can enter the design traffic in one direction (million ESALs) using the traffic data calculated using the permanent WIM data.
Notes	N/A

Example Traffic Results..

Permanent WIM – Truck overweight & overloading statistics

Station#	Most Overload Lane	ADTT	Daily OW Trucks (> 80 kips)	%OW
W523 (US 281)	SB outside	1 968	98	5.0%
W524 (IH 10)	EB outside	3 432	77	2.2%
W527 (SH 114)	EB outside	1 670	333	19.9
W531 (IH 35)	NB outside	2 400	144	6.0%
W541 (FM 3129)	NB outside	192	70	36.5%
W547 (IH 40)	WB outside	2 676	159	5.9%

Station#	%age Number/Count of Overweight Axles			
	Single (20 kips)	Tandem (> 34 kips)	Tridem (> 42 kips)	Quad (> 50 kips)
W523 (US 281)	2.0%	8.0%	21.3%	40.0%
W524 (IH 10)	0.5%	7.8%	16.9%	0.0%
W527 (SH 114)	1.0%	33.0%	90.5%	58.3%
W531 (IH 35)	0.8%	7.9%	20.0%	34.8%
W541 (FM 3129)	0.5%	41.5%	4.9%	0.0%
W547 (IH 40)	1.3%	12.0%	91.8%	0.0%

A truck maybe within legal GVW limit, but due to uneven loading, the axles may overloaded as shown above with higher %age overweight on the axles than the GVW, i.e., W523 = 5% (GVW) vs 8% (tandem)

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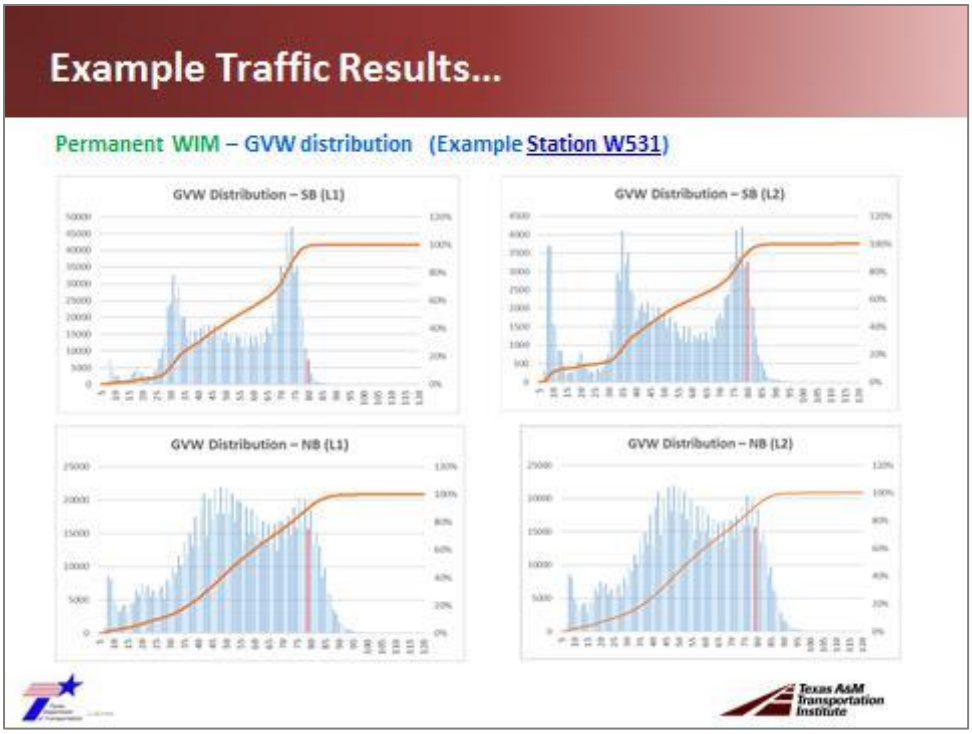
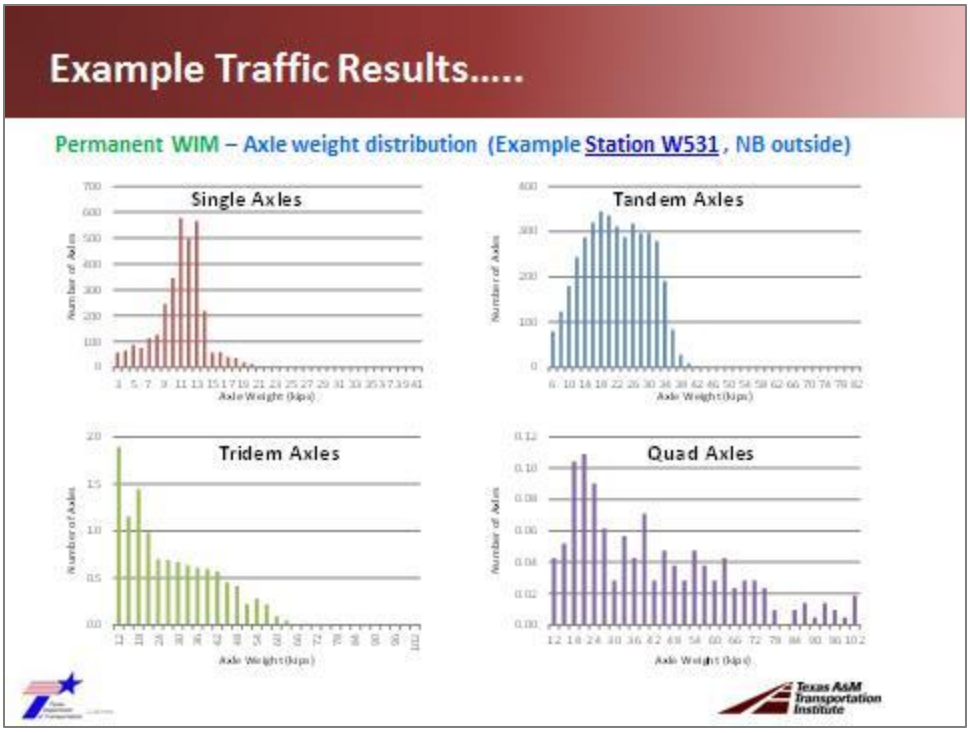
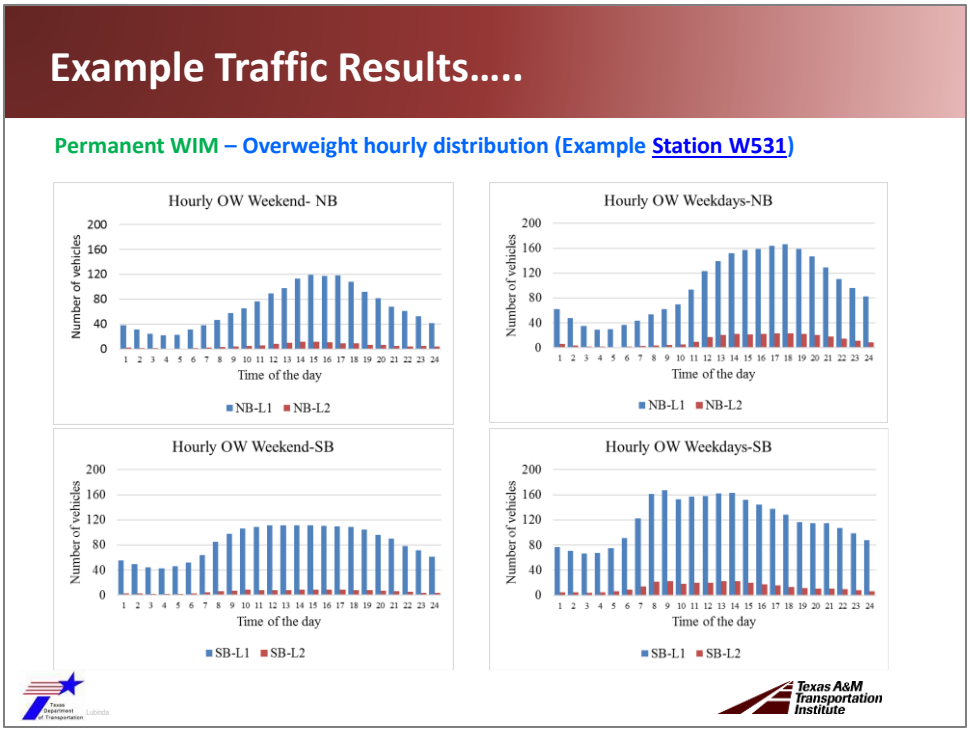
Key Message	Overweight trucks and axles collected from permanent WIM
Interactive	This table exemplifies the number and rate of daily overweight trucks and the percentage of overweight axles of 6 permanent WIM stations. In some cases, a truck may be within legal gross vehicle weight (GVW) limit, but due to uneven loading, the axles may overloaded as shown in the table with higher %age overweight on the axles than the GVW, i.e., W523 = 5% (GVW) vs 8% (tandem).
Notes	Limit of vehicle and axle weights • Gross vehicle: 80 kips • Single axle: 20 kips • Tandem axle: 34 kips • Tridem axle: 42 kips • Quad axle: 50 kips



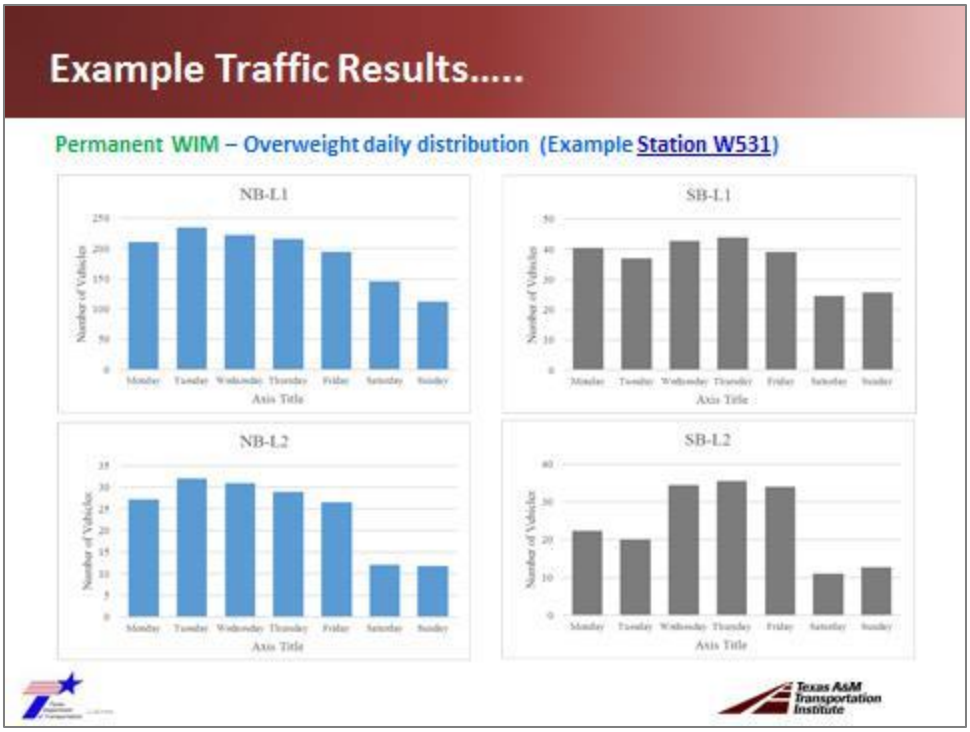
Key Message	Gross vehicle weight (GVW) distribution calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	These plots show the distribution of GVW of each lane from the permanent WIM data collected at IH 35, Laredo district, La Salle county. The orange line in each plot presents the cumulated distribution of GVW.
Notes	N/A



Key Message	Axle weight distribution calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	These plots show the example of axle weight distribution calculated using the permanent WIM data. The data were collected on the outside lane of IH 35, Laredo district.
Notes	N/A



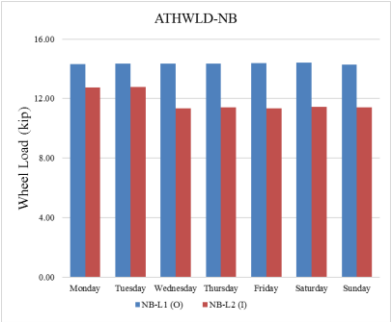
Key Message	Overweight hourly distribution calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	These plots exemplify the hourly distribution of overweight vehicles at both weekend and weekdays calculated with the permanent WIM data.
Notes	N/A

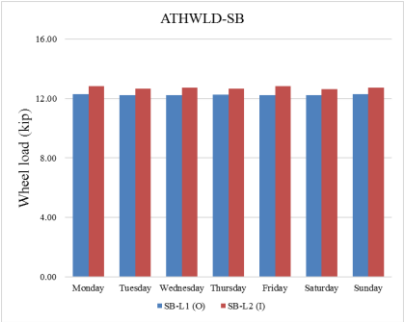


Key Message	Overweight daily distribution calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	These plots show the daily distribution of overweight vehicles on both directions of IH 35 Laredo district. As expected, more overweight vehicles were counted at weekdays on outside lanes.
Notes	N/A

Example Traffic Results……

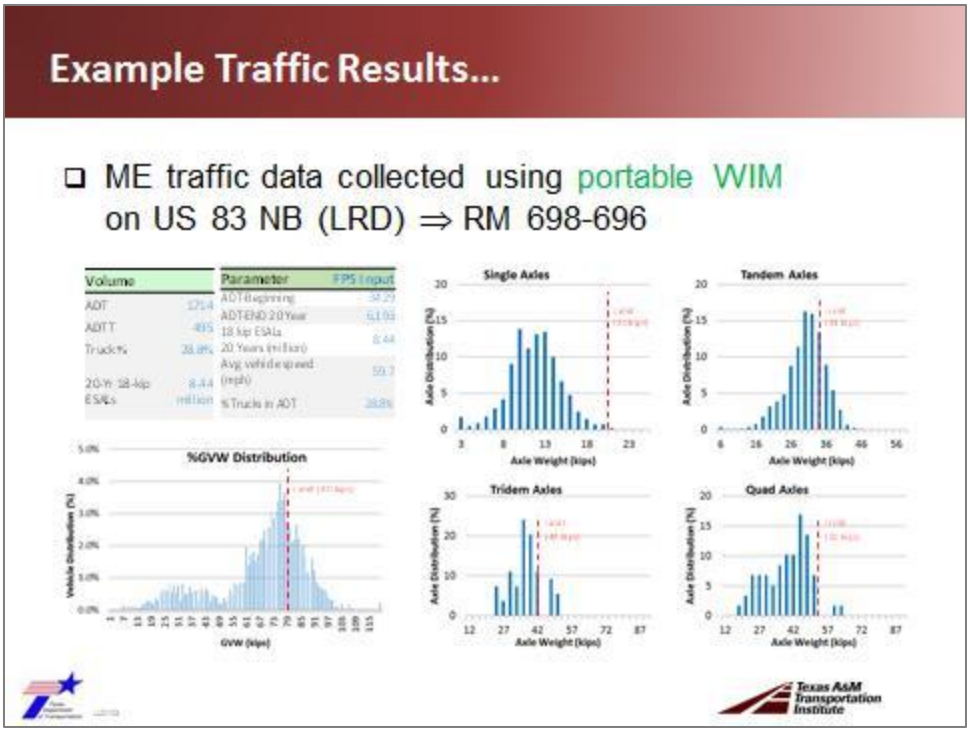
Permanent WIM – Daily ATHWLD Distribution (Example Station W531)



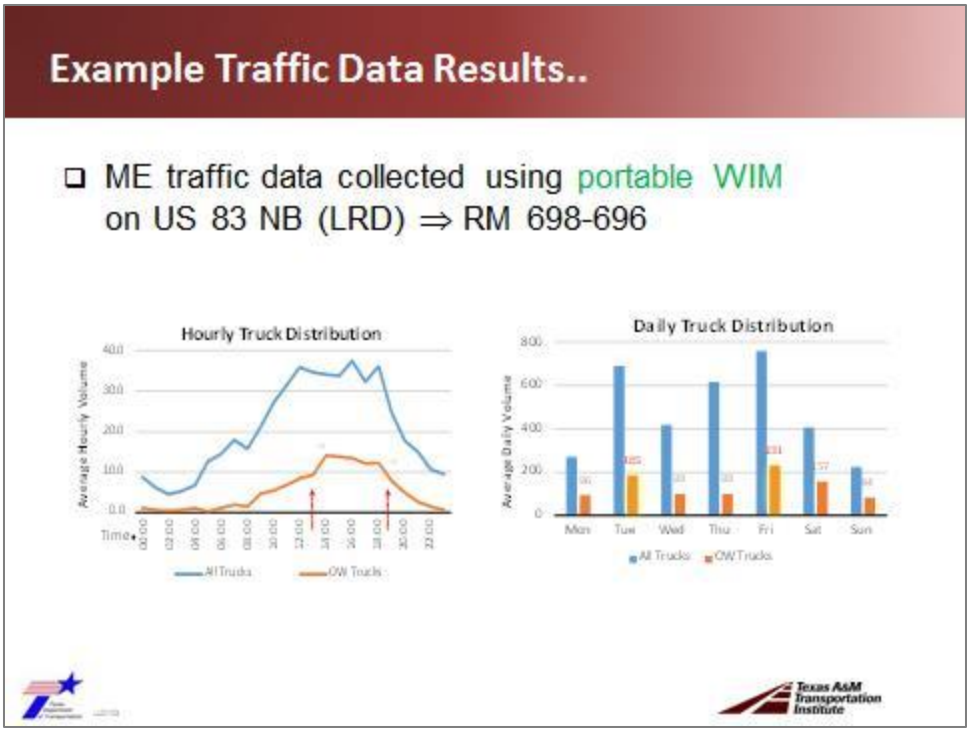


	ATHWLD	%Tandem Axles
NB-L1 (O)	14.34 kips	55.5%
NB-L2 (I)	11.78 kips	51.1%
SB-L1 (O)	12.25 kips	57.9%
SB-L2 (I)	12.74 kips	54.9%

Key Message	ATHWLD distribution calculated using permanent WIM data (IH 35, Laredo district, La Salle county)
Interactive	These plots show the ATHWLD distribution of IH35 in Laredo district, which is required for the pavement design check in the FPS. The common ATHWLD is around 12 kips, but the outside lane of northbound on this highway shows higher value (14.34 kips). It means that this section has higher overweight vehicle traffic than any other highways.
Notes	ATHWLD: Average ten heaviest wheel loads daily



Key Message	ME traffic data collected using Portable WIM system
Interactive	In this slide, I will show the examples of traffic parameters and results calculated using the portable WIM data. This volume and ME traffic parameters were calculated using the traffic data collected from a portable WIM installed on US83 northbound in Laredo district, such as traffic volume, gross vehicle weight (GVW) distribution, and axle load distributions.
Notes	N/A

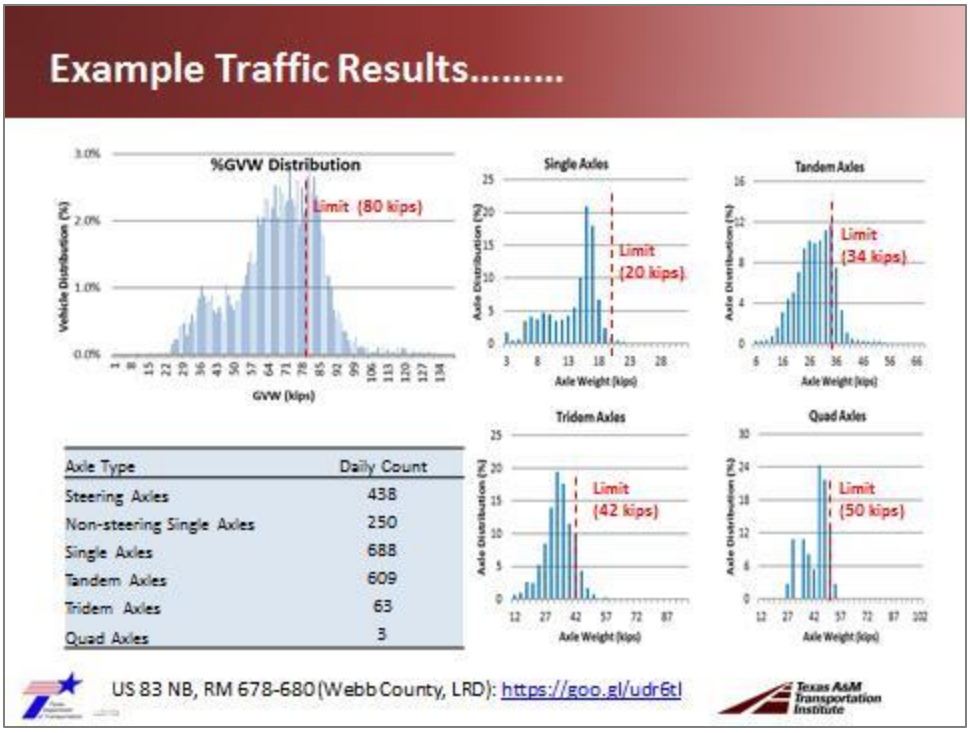


Key Message	Hourly and daily truck distributions calculated using portable WIM data (US 83 NB, Laredo district, Webb County)
Interactive	These plots exemplify the hourly and daily truck distributions on US 83 northbound in Laredo district using the portable WIM. As indicated in the plots, most overweight trucks are passing the highway mainly between 1PM to 7PM. Also, 60% of overweight trucks (573/951) were counted on Tuesday, Friday, and Saturday.
Notes	N/A

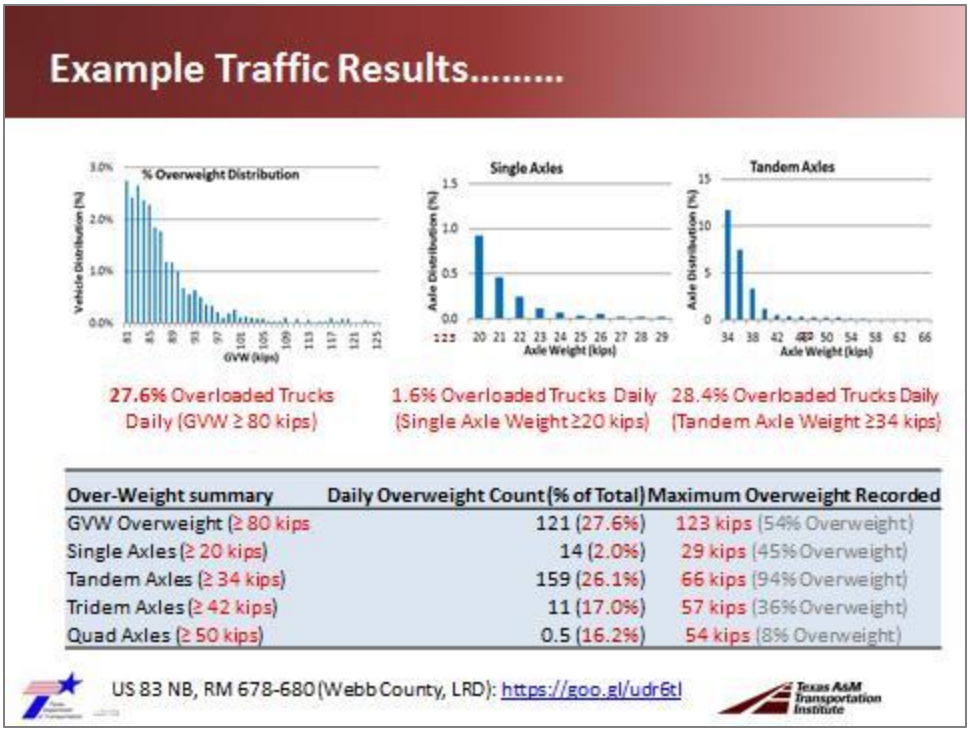
Example Traffic Data Results…

US 83	Location 1	Location 2
County	Webb	Dimmit
Nearest RM	698 (0.8 miles to North)	654 (0.6 miles to North)
ADT	1 877	2 344
ADTT	610	911
Avg. Truck Speed	59.4 mph	58.7 mph
20-year ESAL	**9.33 million**	**21.21 million**
ATHWLDs	11.39	15.9 kips
Class9 Front Axle Wt. COV	7.5 %	13.4%
Daily GVW overweight	127 (24.8%)	366 (40.2%)
Daily Tandem Axle Overweight	230 (28.4%)	802 (52.5%)

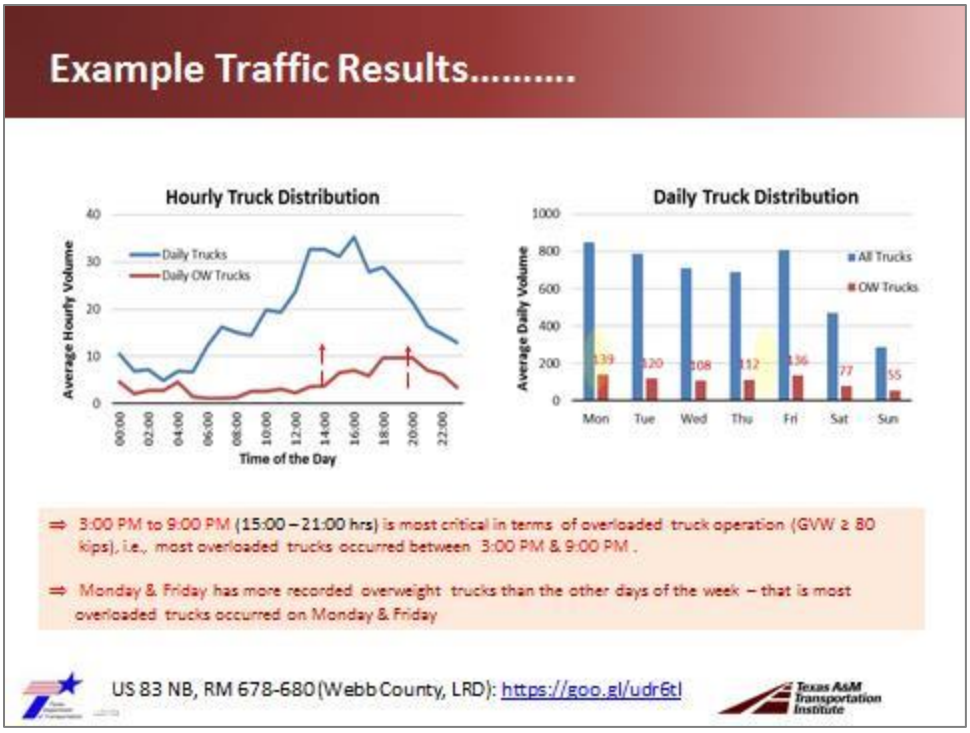
Key Message	Traffic data collected at 2 different portable WIM stations on the same highway
Interactive	This table presents the traffic data collected at two different portable WIM stations on the same highway: one in Webb county and another in Dimmit county at US 83 Laredo district. Two portable WIM sensors and counters were installed those two different stations on US 83 northbound; Location 1 stays about 44 miles away from Location 2. Although those portable WIM systems were deployed at the same highway, the traffic data collected at Location 2 showed higher traffic volume, %truck, and overweight trucks traffics than Location 1. Even, the ESAL of Location 2 is more than twice than one of Location 1. These results indicate that the traffic data should be collected or estimated properly to avoid excessive or insufficient pavement structure designs.
Notes	N/A



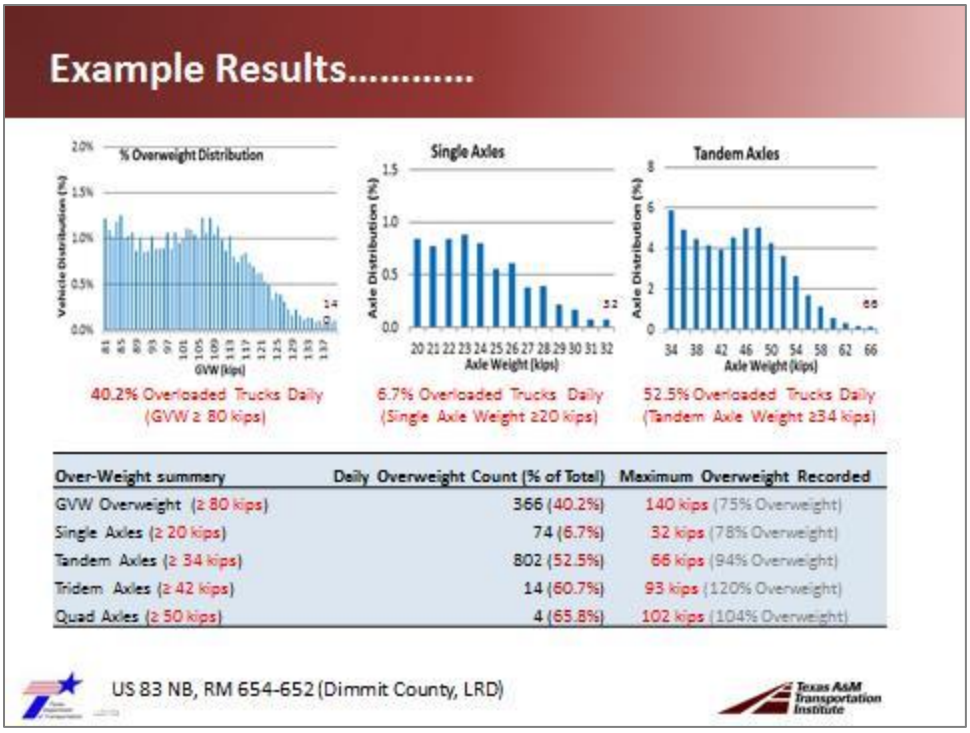
Key Message	GVW and axle load distributions calculated using portable WIM data (US 83 NB, Laredo district, Webb county)
Interactive	This slide shows the distributions of GVW and each axle type on US 83, Webb county at Location 1 having lower traffic loads and %truck. Also, the plots present the overweight GVW and axle load distributions as well.
Notes	N/A



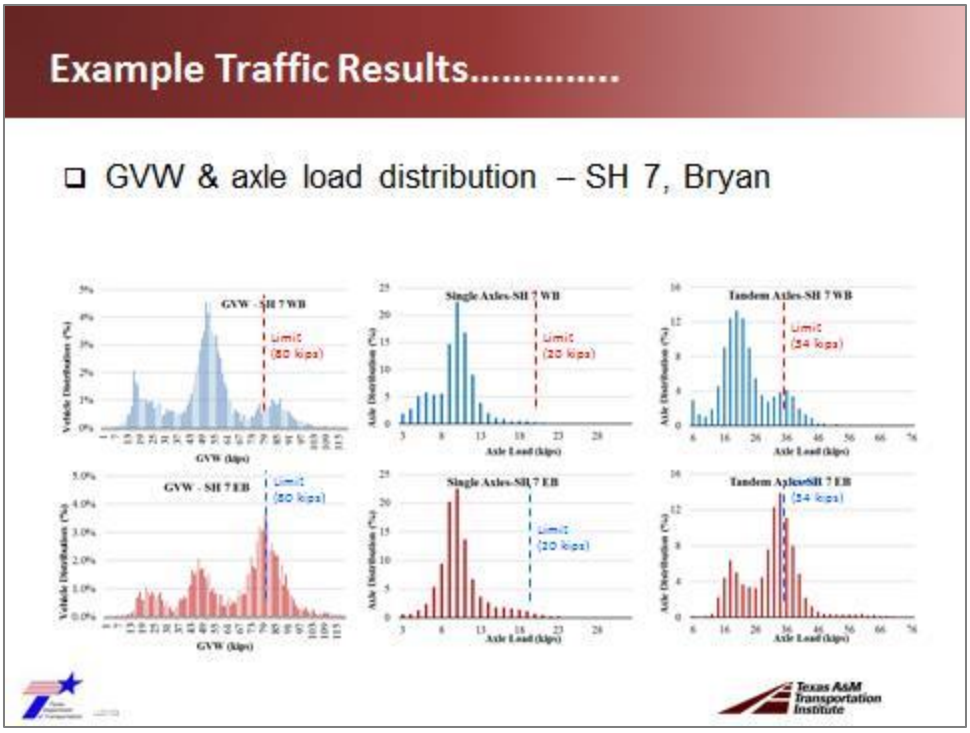
Key Message	Overweight GVW and axle load distributions calculated using portable WIM data (US 83 NB, Laredo district, Webb county)
Interactive	The plots show the overweight distributions of GVW, single axle, and tandem axle on US 83, Webb County at Location 1. As listed in the table, over 27% of vehicles were overweigh trucks, and the portable WIM recorded 123 kips of the heavies truck weight on the highway.
Notes	N/A



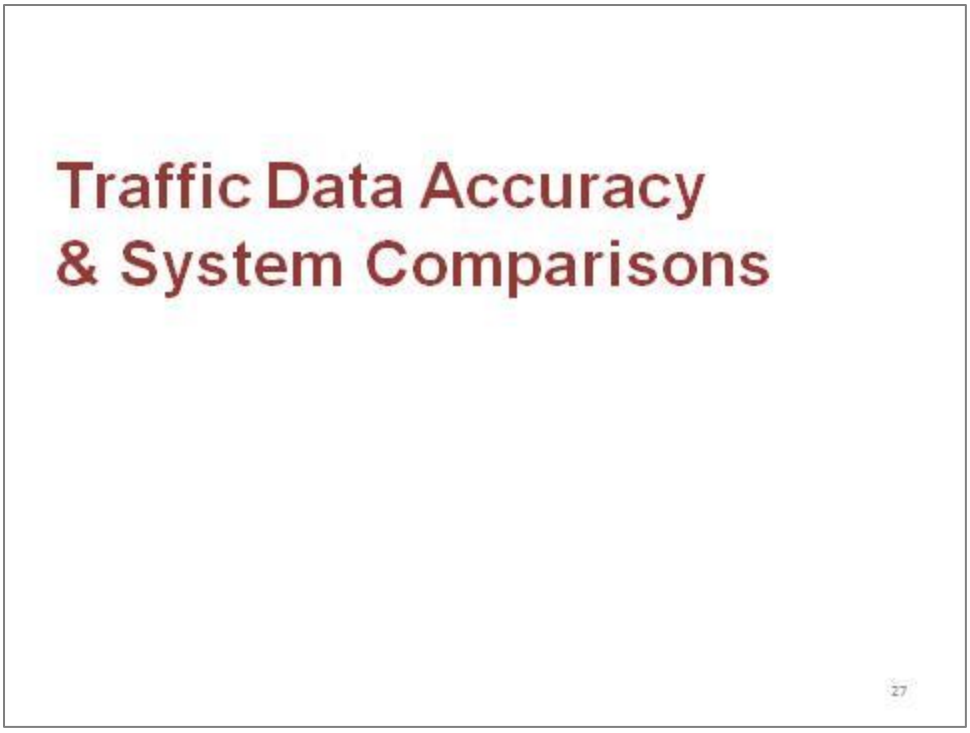
Key Message	Hourly and daily truck distributions of US 83 NB, Laredo district, Webb county
Interactive	These plots exemplify the hourly and daily truck distributions on US 83 northbound in Laredo district, Webb county. As indicated in the plots, 3PM to 9PM (15:00 – 21:00 hrs) is most critical in terms of overloaded truck operation (GVW ≥ 80 kips). Also, Monday & Friday has more recorded overweight trucks than the other days of the week.
Notes	N/A



Key Message	Overweight GVW and axle load distributions calculated using portable WIM data (US 83 NB, Laredo district, Dimmit county)
Interactive	The plots show the overweight distributions of GVW, single axle, and tandem axle on US 83 Dimmit county at Location 2 having higher traffic loads and %truck than Location 1. As listed in the table, 40% of vehicles were overweigh trucks, and the portable WIM recorded 140 kips of the heavies truck weight on the highway. Also, more than half of tandem, tridem, and quad axles were overweight on the US83 in the Dimmit county (Location 2).
Notes	N/A



Key Message	Gross vehicle weight distributions of SH 7 in Bryan district
Interactive	The plots exemplify other GVW, single, and tandem axle load distributions measured on SH 7 in Bryan district. The eastbound shows higher overweight GVW distribution than the westbound.
Notes	N/A



Key Message	Traffic data accuracy and system comparisons
Interactive	In this part, we are going to discuss on the traffic data accuracy and system comparisons between portable and permanent WIM systems.
Notes	N/A

System & Traffic Data Comparison.

Permanent WIM – ADT Comparison with TPP

Station#	District	TTI	TPP
W523 (US 281)	PHR	14, 527	14, 403
W524 (IH 10)	ELP	24, 445	25, 027
W527 (SH 114)	FTW	15, 260	15, 869
W531 (IH 35)	LRD	17, 681	17, 685
W541 (FM 3129)	ATL	1, 121	1, 150
W547 (IH 40)	AMA	11, 976	12, 187

Texas A&M Transportation Institute

Key Message	Comparison of ADT processed by TTI and TxDOT TPP using the same permanent WIM data
Interactive	The table is to compare the ADT calculated from TTI and TxDOT TPP using the same permanent WIM data. The ADT values from TTI and TPP looks very similar; the differences are within 5%.
Notes	N/A

System & Traffic Data Comparison..

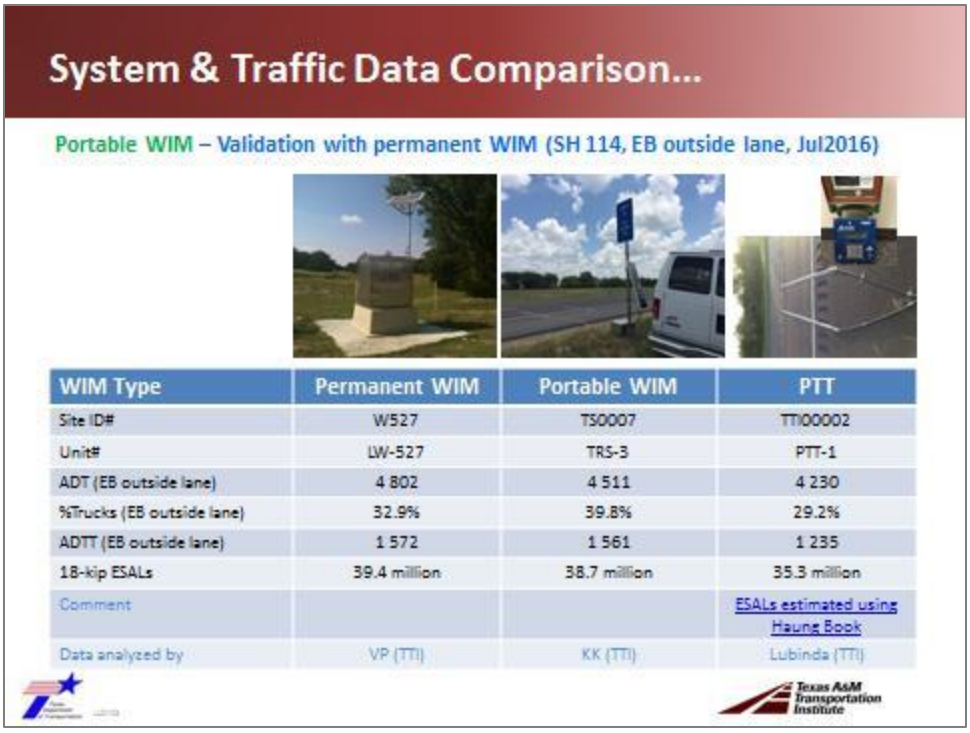
Portable WIM – ADT comparison with permanent WIM, TPP website, & PTT

Site#	Hwy	District	Portable WIM (TTI)	Permanent WIM (TTI)	Nearest Site (s) on TPP Website	PTT (TTI)
TS001	US 83	LRD	4 687	-	5 130	4 619
TS002	SH 7	BRY	2 692	-	2 518	2 525
TS003	SH 7	BRY	2 050	-	1 913	2 118
TS007 (Jul2016)	SH 114 (EB-L1)	FTW	4 511	4 802	4 873	4 230
TS005	US 281	CRP	10 310	-	10 239	
TS006	SH 6	BWD	2 118	-	2 085	
TS004	FM 468	LRD	1 976	-	1 757	
TS008	FM 1787	ODA	2 521	-	2 552	
TS009	US 83	LRD	3 520	-	3 769	3 506

Station/sites for TTI portable & TP&P website are not exactly the same

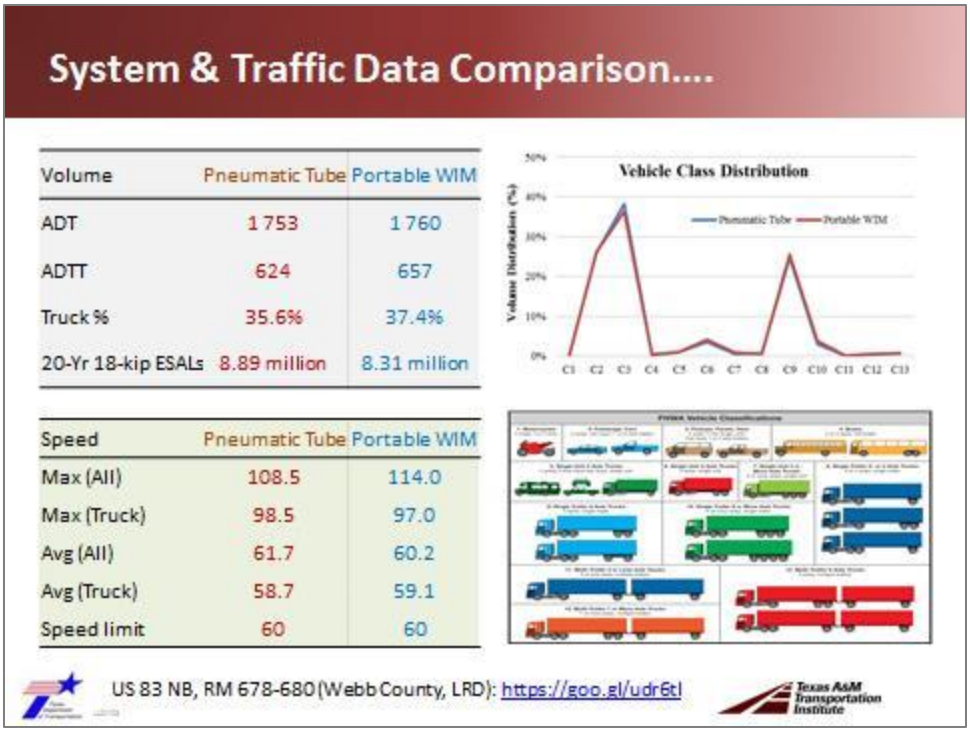
Texas A&M Transportation Institute

Key Message	Comparison of ADT obtained from permanent WIM, TPP website, and pneumatic tube traffic counter
Interactive	This table is to compare the ADT obtained from the TxDOT Statewide Planning Map (by TPP) with the ADT measured using portable WIM and pneumatic tube traffic (PTT) counter. Although the station or sites for TTI portable WIM/PTT and TPP website are not exactly the same, the TPP's ADT values are similar with ones of portable WIM and PTT systems.
Notes	N/A



WIM Type	Permanent WIM	Portable WIM	PTT
Site ID#	W527	TS0007	TTI00002
Unit#	LW-527	TRS-3	PTT-1
ADT (EB outside lane)	4 802	4 511	4 230
%Trucks (EB outside lane)	32.9%	39.8%	29.2%
ADTT (EB outside lane)	1 572	1 561	1 235
18-kip ESALs	39.4 million	38.7 million	35.3 million
Comment			ESALs estimated using Haung Book
Data analyzed by	VP (TTI)	KK (TTI)	Lubinda (TTI)

Key Message	Validation of portable WIM with permanent WIM
Interactive	The portable WIM system was validated with the permanent WIM data collected on SH114 eastbound in Fort Worth district. The portable WIM and PTT were installed at the same location near the permanent WIM. The ADT, ADTT, and ESAL of portable WIM are similar with those of permanent WIM. The portable WIM data were collected only for 1 week (7 days) while the permanent WIM data were for one year (2015).
Notes	N/A



Key Message	Validation of portable WIM with PTT
Interactive	The portable WIM system was validated with the pneumatic traffic tube (PTT) data, which were installed at the same location at US 83 northbound in Laredo district. The traffic volume data, such as ADT and ADTT, of the portable WIM system are nearly identical to those of the PTT counter.
Notes	N/A

System & Traffic Data Comparison.....

FPS Inputs	Pneumatic Tube	Portable WIM	Comment
ADT-Beginning	3 506	3 520	ADT (both direction) at the beginning of the design period
ADT-END 20 Year	6 332	6 357	ADT (both direction) at the end of the design period (20 yrs)
18 kip ESALs 20 Years (million)	6.89	8.31	Assuming 3% growth rate
Avg. vehicle speed (mph)	61.7	60.2	Approach speed assumed to be equal to operational speed
% Trucks in ADT	35.6%	37.4%	

US 83 NB, RM 678-680 (Webb County, LRD): https://goo.gl/udr6tl

Texas A&M Transportation Institute

Key Message	Validation of portable WIM with PTT
Interactive	This table compares the FPS traffic inputs calculated using PTT and portable WIM data at US 83 northbound as previous slide.
Notes	N/A

System & Traffic Data Comparison……

FPS Parameter	Pneumatic Tube	Portable WIM	Comment
ADT-Beginning	4 619	4 687	ADT (both direction) at the beginning of the design period
ADT-END 20 Year	8 343	8 466	ADT (both direction) at the end of the design period (20 yrs
18 kip ESALs 20 Years (million)	17.85	21.21	Assuming 3% growth rate
Avg. vehicle speed (mph)	61.7	60.2	Approach speed assumed to be equal to operational speed
% Trucks in ADT	38.3%	38.9%	

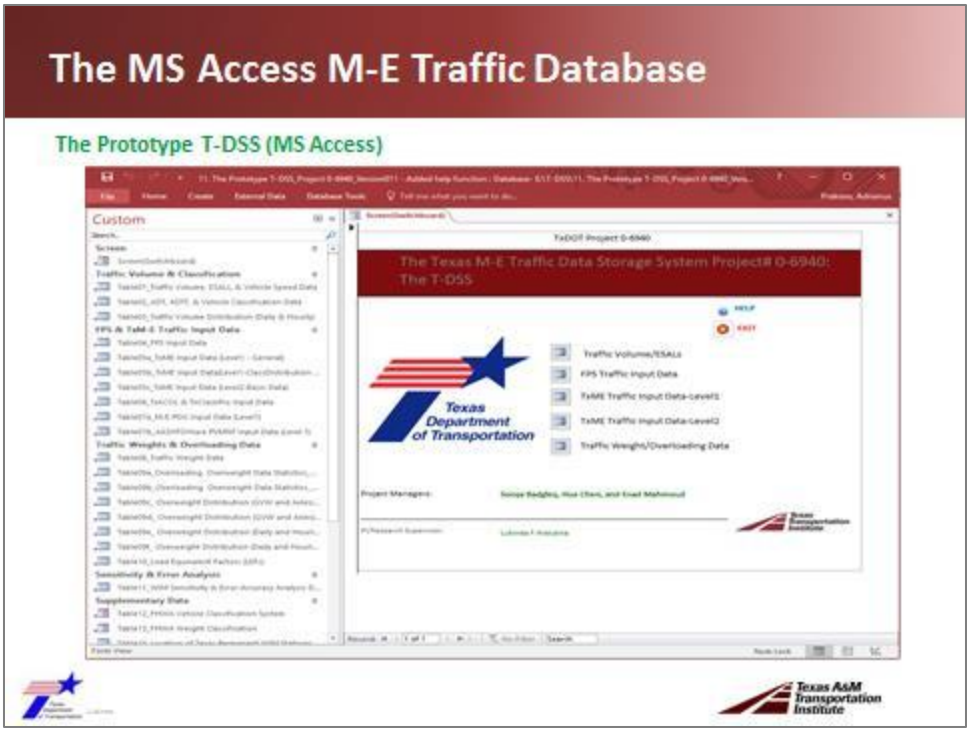
US 83 NB | LRD, Webb County | (Between FM 133 and FM 2688)
RM 654 & 652 | GPS: N 28° 21' 37.5" W 099° 37' 55.9"

https://www.google.com/maps/place/28%C2%B021'37.5%22N+99%C2%B037'55.9%22W/@28.3603951,-99.63379,16.5z/data=!4m5!3m4!1s0x0:0x0!8m2!3d28.360428!4d-99.632204

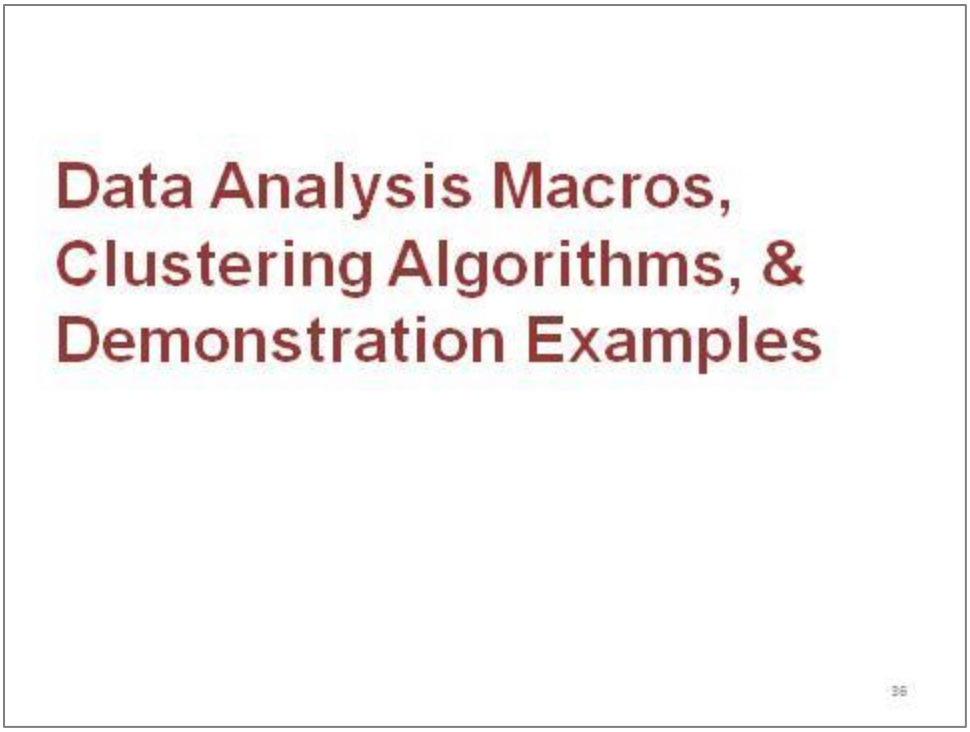
Texas A&M Transportation Institute

Key Message	Validation of portable WIM with PTT
Interactive	Here is another comparison between the portable WIM and PTT systems installed at another site on US83 highway. As similar with the previous comparison, the traffic volume data of portable WIM and PTT system are very similar.
Notes	N/A

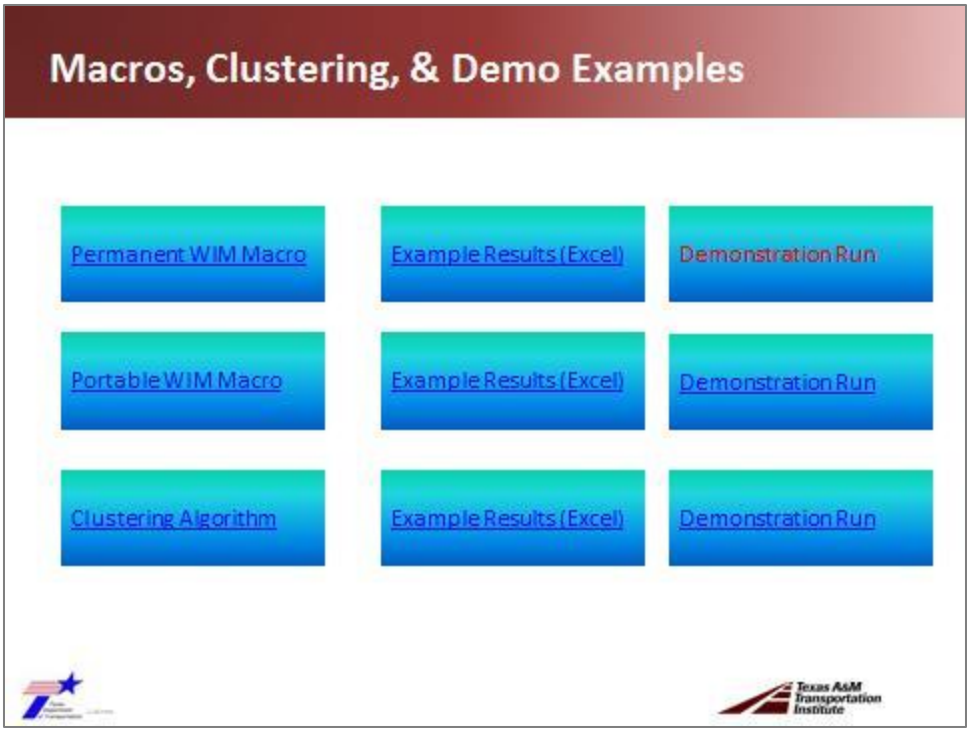
Key Message	The Traffic Data Storage System
Interactive	
Notes	N/A



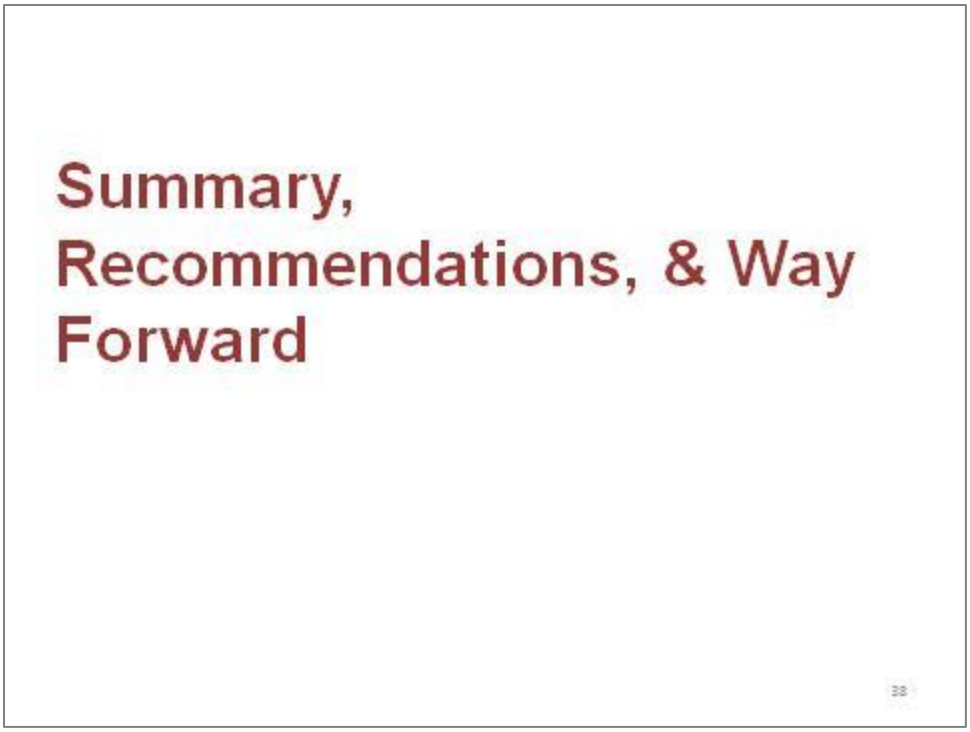
Key Message	The Traffic Data Storage System (The T-DSS)
Interactive	The M-E traffic data storage system (The T-DSS) was developed, being maintained and managed in the user-friendly MS Access platform to provide M-E traffic data support for the FPS and other M-E software. The Microsoft Access was selected as the platform for the T-DSS because the Access is compatible with most computer machines and the engineers are conversant with MS office package. The data are arranged and stored in tabular format along with zipped attachments such as MAF and ALD files. The main traffic data tables are: • Tables 01-03: Traffic volume and classification data (TxCRCP-ME input data). • Table 04: FPS input data. • Table 05: TxME input data. • Table 06: TxACOL and TxCrackPro data. • Table 07: M-E PDG and AASHTOWare input data.
Notes	Open the T-DSS attached in the slide.



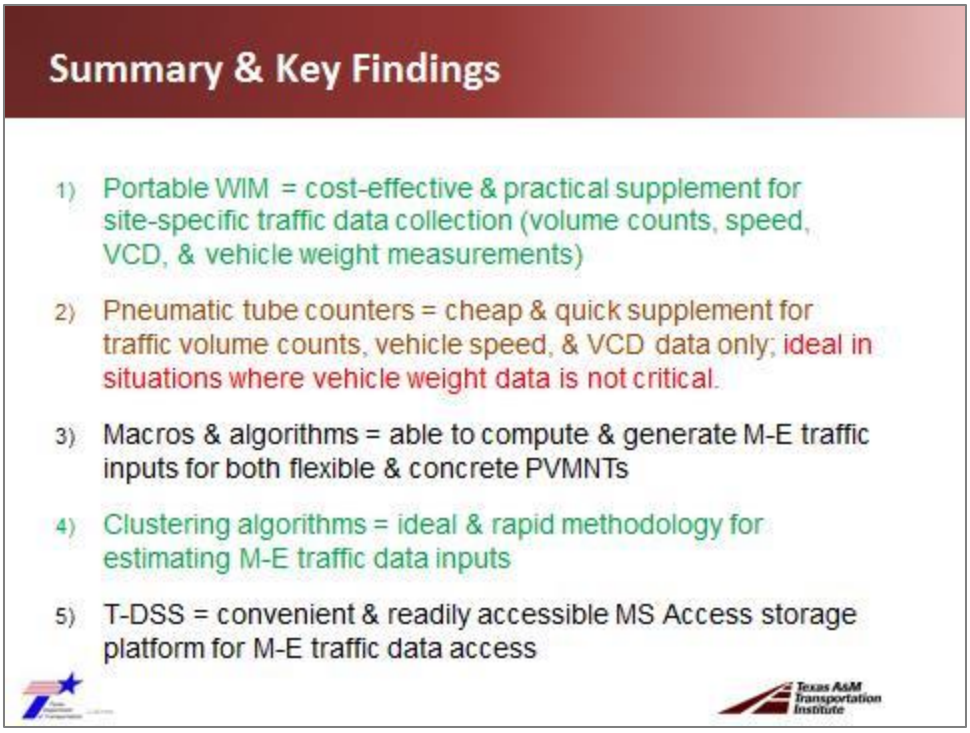
Key Message	Data analysis macros, clustering algorithms, and their demonstration examples
Interactive	
Notes	N/A



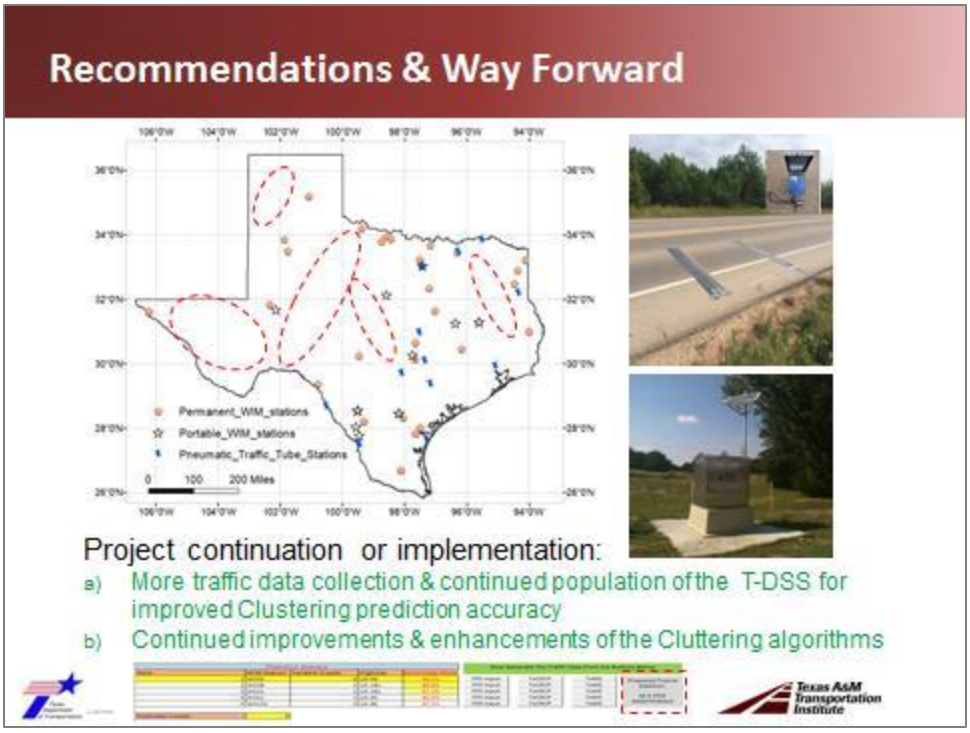
Key Message	Macro, clustering, and demo examples
Interactive	Three types of data analysis macros were developed to ensure consistent and efficient data analysis procedure as: • Portable WIM data analysis macro • Permanent WIM data analysis macro • Clustering analysis macro These macros were developed in the Microsoft Excel VBA platform because the Microsoft Excel is able to support various computing methodologies required for the data analysis and is compatible with most computer machines.
Notes	Click each button to run each macro or demonstrate its example.



Key Message	Summary and Conclusion
Interactive	
Notes	N/A



Key Message	Summary and key findings
Interactive	1) The portable WIM is a cost-effective, practical system to supplement site-specific traffic data, including traffic volume, vehicle classification distribution (VCD), and vehicle and axle weights, where the permanent WIM is not available. 2) Pneumatic tube counter is a cheap, quick supplement to collect the traffic volume, VCD, and speed data only. Actually, the PTT is ideal in situation where the vehicle and axle weight data are not critical. 3) The analysis macro and algorithms developed in this project allow users to compute and generate easily the ME-compatible traffic data for flexible and concrete pavement designs. 4) The clustering algorithm is an ideal, rapid methodology for estimating the ME-compatible traffic data with the minimum traffic data like ADT. 5) The T-DSS will provide a data storage platform to access ME-compatible traffic data conveniently and readily.
Notes	N/A



Key Message	Recommendations and way forward
Interactive	In this study, the clustering algorithm was developed based on the permanent and portable WIM data collected from limited districts/areas in Texas. As shown in the map, more data need from north, west, and central Texas, such as Amarillo, El Paso, Abilene, San Angelo, etc. Thus, the project continuation or implementation of the portable WIM system will bring the valuable benefits to TxDOT, CST, MNT, and the districts as the following: • More traffic data collection and continued population of the T-DSS, serving as an ongoing traffic data source and improving clustering prediction accuracy. • Improvement and enhancement of the clustering algorithms. Overall, it will provide accurate site-specific traffic data for optimal pavement design, particularly in areas where permanent WIM stations are not existent.
Notes	N/A

Key Message	Discussion
Interactive	
Notes	

TRAINING EVALUATION FORM

for participants in the Workshop for TxDOT Project 0-6940
Develop System to Render Mechanistic-Empirical Traffic Data for Pavement Design

Date:

Training Location:

Trainer:

Instructions: Please indicate your level of agreement with the statements listed below in Q#1–7.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	O	O	O	O	O
2. The topics covered were relevant to me.	O	O	O	O	O
3. The materials were helpful.	O	O	O	O	O
4. This training experience will be useful in my work.	O	O	O	O	O
5. The trainer was knowledgeable about the training topics.	O	O	O	O	O
6. The time allotted for the training was sufficient.	O	O	O	O	O
7. The meeting room and facilities were adequate and comfortable.	O	O	O	O	O

8. What did you like most about this training?

9. What aspects of the training could be improved?

10. Please share other comments here:

Thank you for your feedback!