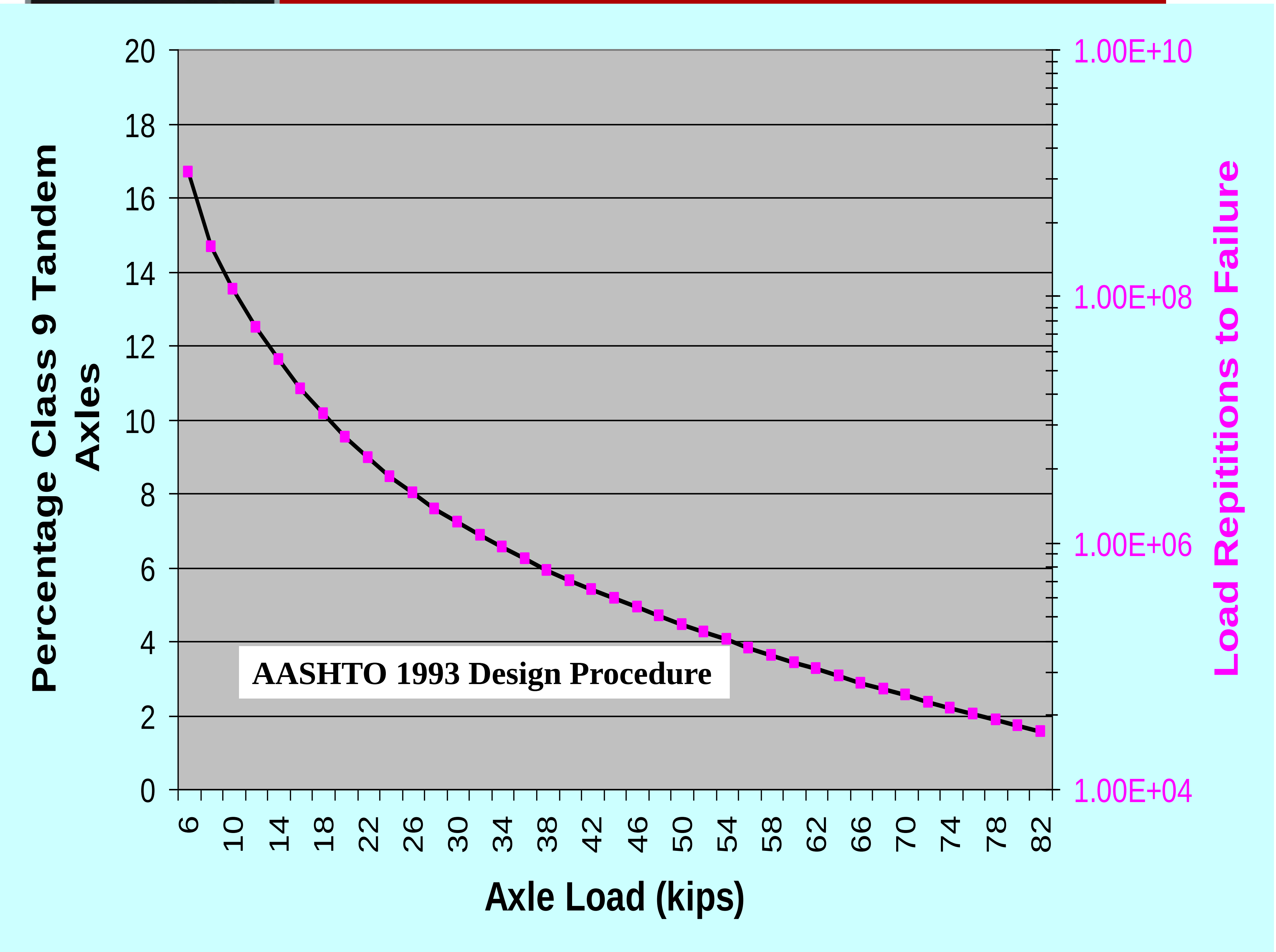
AASHTOWare Pavement ME Design

AASHTO

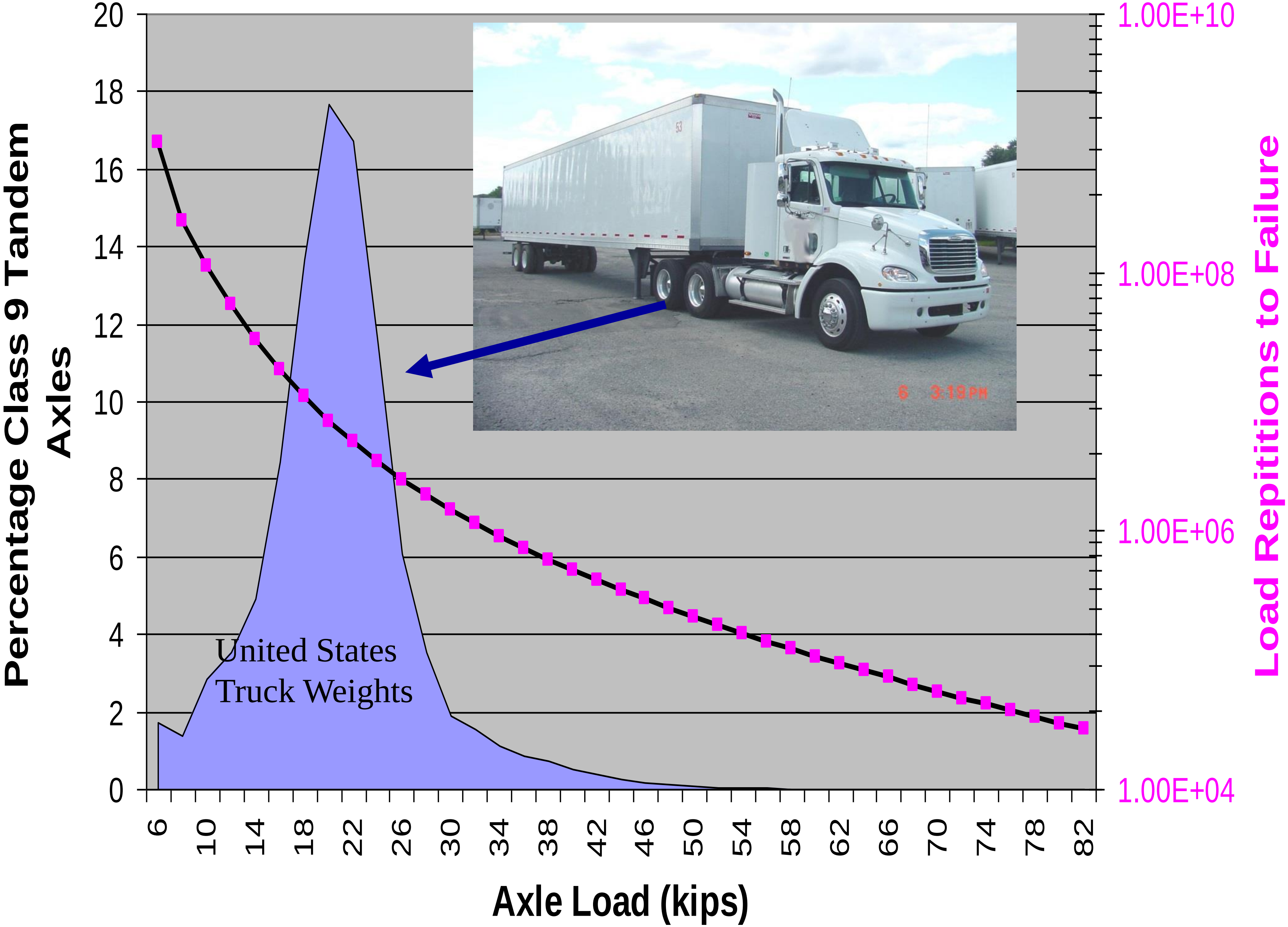
Traffic in ME Design

Chris Wagner, P.E.
FHWA Pavement & Materials TST
dgit@dot.gov

Why is traffic important to pavement design?

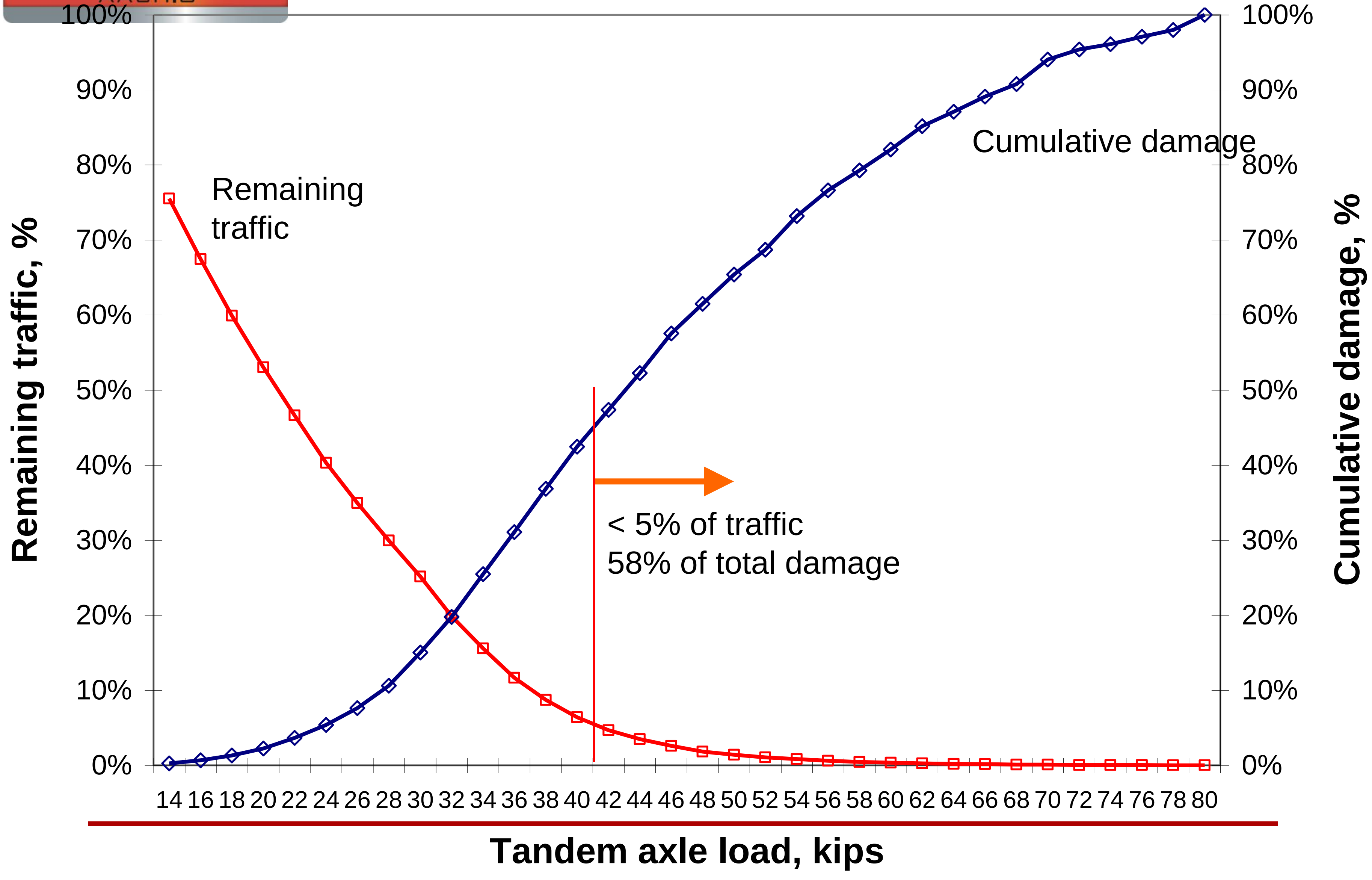


AASHTO 1993 Design Procedure
Percentage Class 9 Tandem Axles
Load Repititions to Failure
Axle Load (kips)
0
2
4
6
8
10
12
14
16
18
20
1.00E+04
1.00E+06
1.00E+08
1.00E+10
6
10
14
18
22
26
30
34
38
42
46
50
54
58
62
66
70
74
78
82



Percentage Class 9 Tandem Axles
Load Repititions to Failure
Axle Load (kips)
United States
Truck Weights
20
18
16
14
12
10
8
6
4
2
0
1.00E+10
1.00E+08
1.00E+06
1.00E+04
6
10
14
18
22
26
30
34
38
42
46
50
54
58
62
66
70
74
78
82

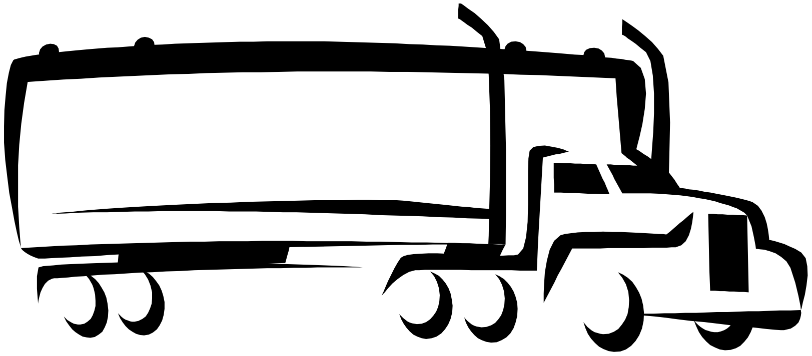
Damage vs. axle weight



What information do we need ?

Information we need:

- **Volume**
- **Classification**
- **Weight**

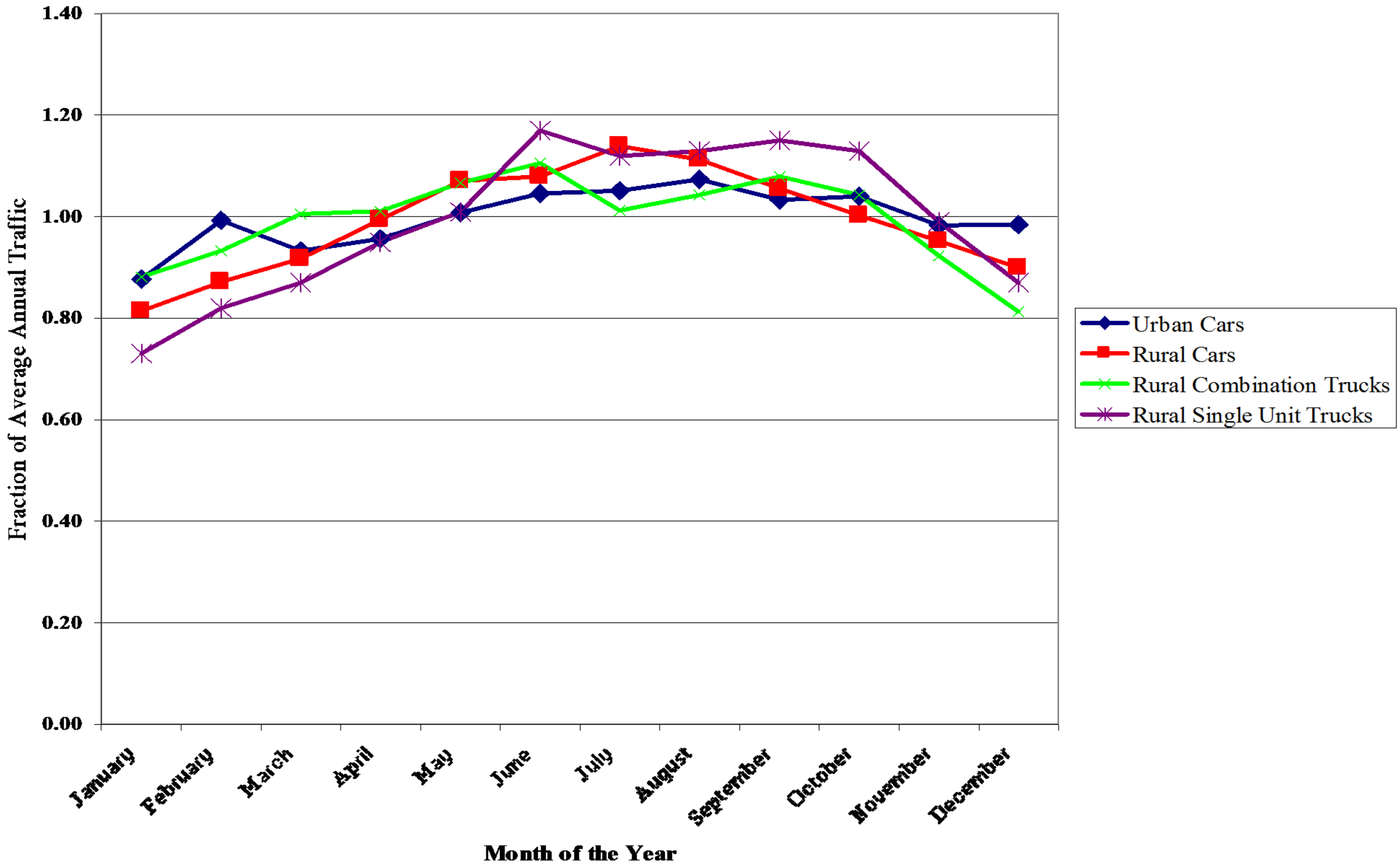


Design lane only
Heavy vehicles only

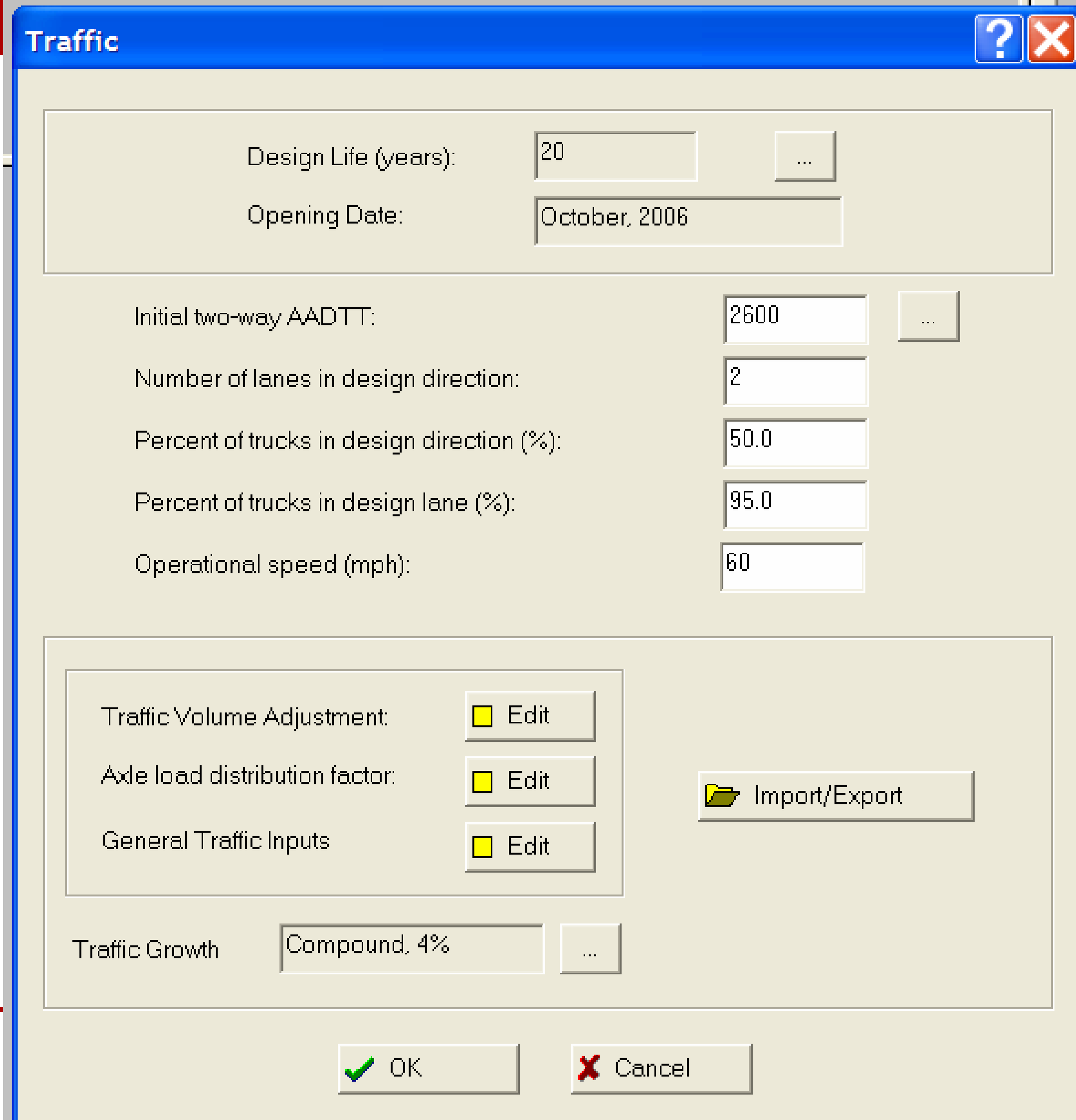
Truck Volume

- Lane Distribution
- Direction Distribution
- Growth Factors
- Seasonal
- Hourly distribution (PCC only)

Seasonal Truck Volume Variation



Screen Inputs

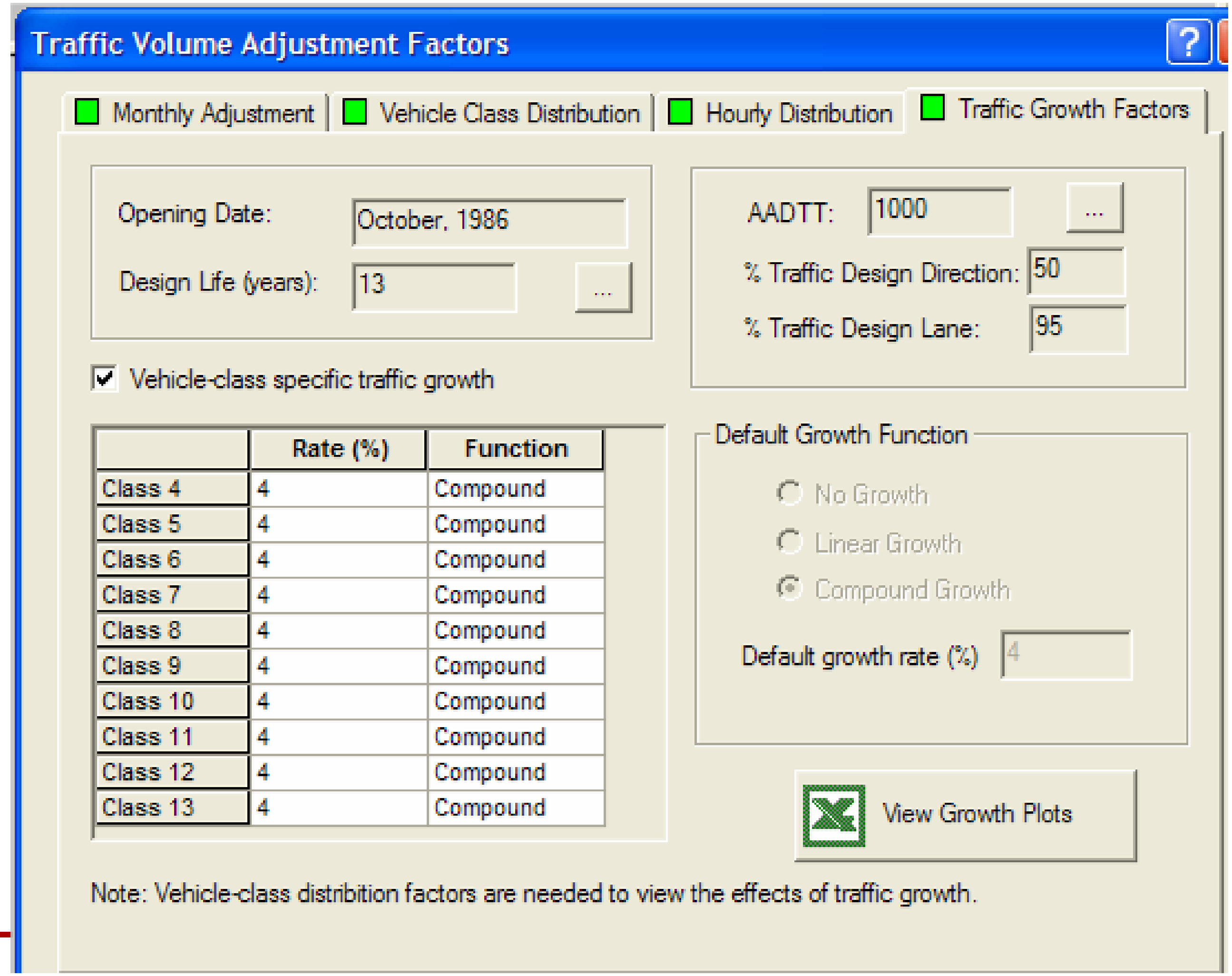


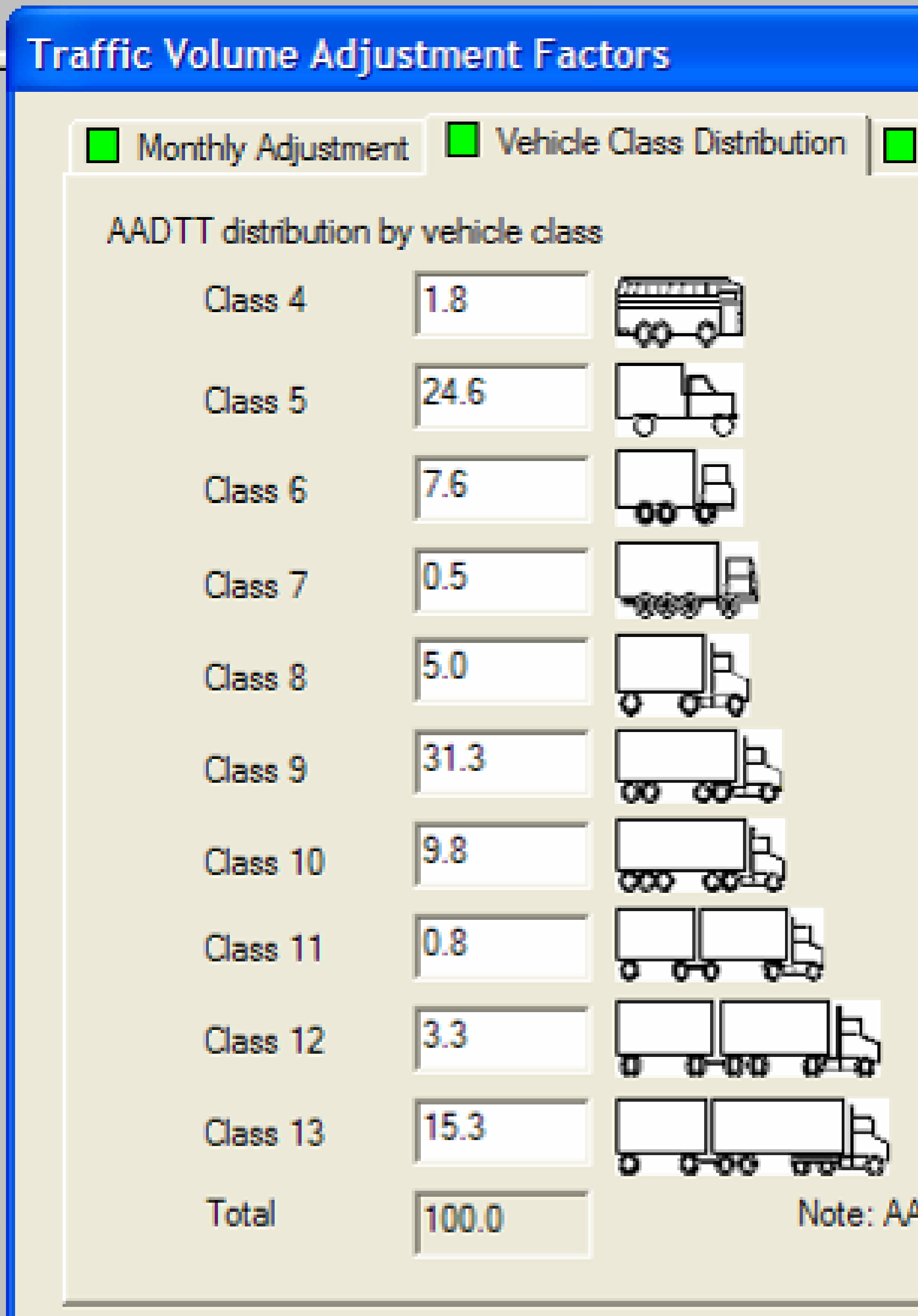
Truck Growth

Monthly

Traffic Growth

- By class
- Liner
- Compound





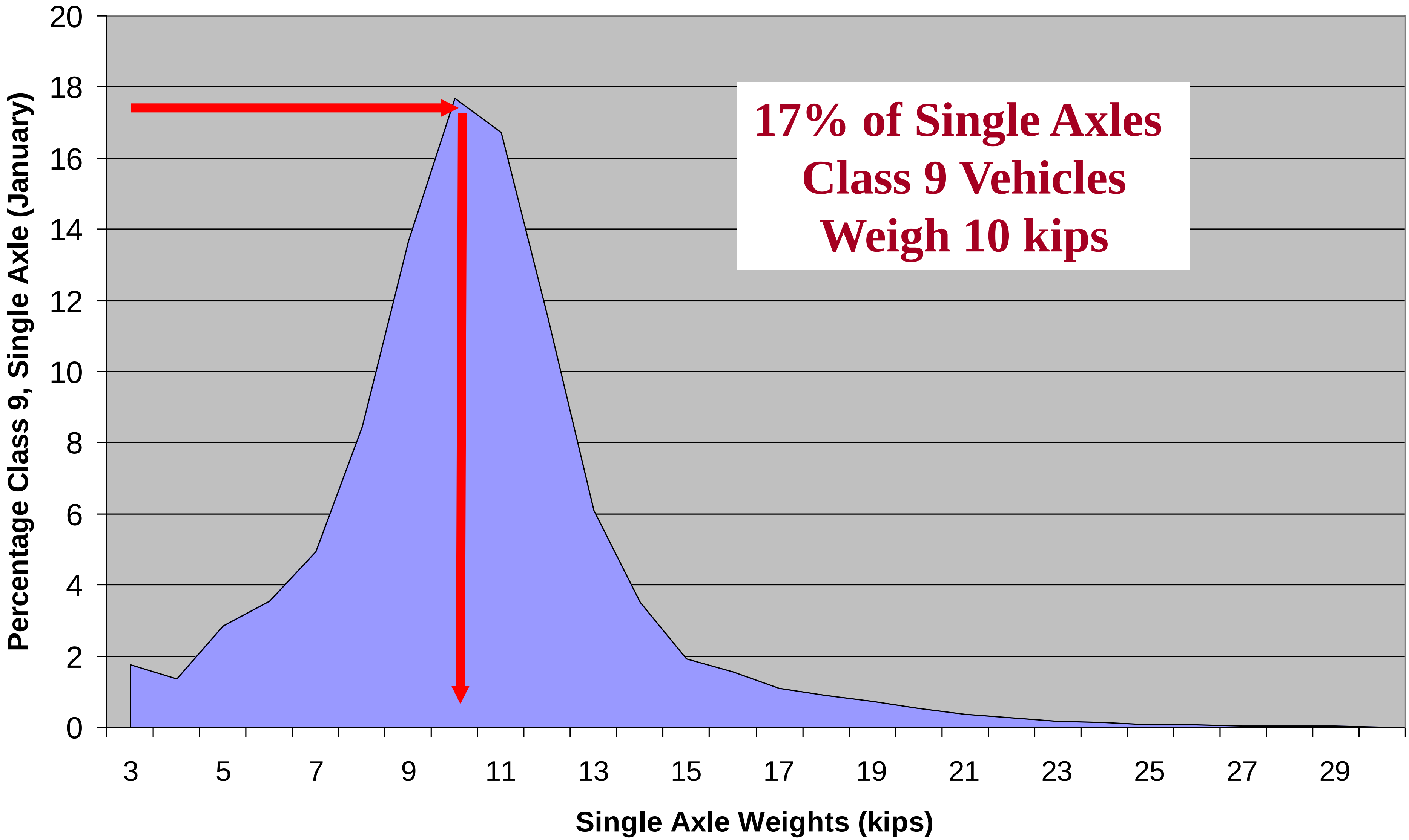
Vehicle Class Distribution

13 FHWA Classifications

Only concerned with trucks

Vehicle Weight

Vehicle Weight (Axle Load Spectra)



MEPDG Input screen

Axle Load Distribution Factors

Axle Load Distribution

- Level 1: Site Specific
- Level 2: Regional
- Level 3: Default

Export Axle File

Open Axle File

View

- Cumulative Distribution
- Distribution

View Plot

Axle Types

- Single Axle
- Tandem Axle
- Tridem Axle
- Quad Axle

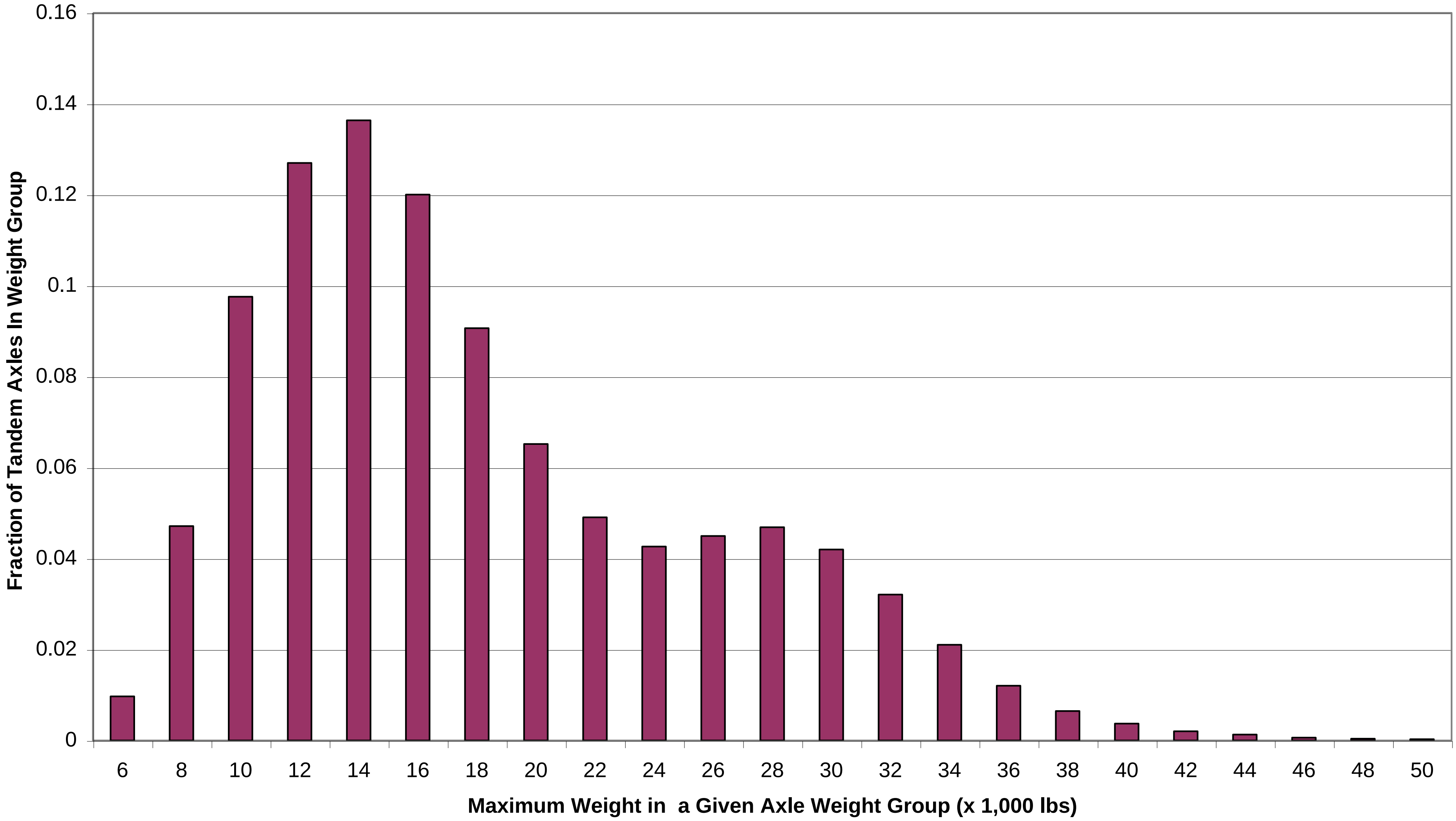
Axle Factors by Axle Type

Season	Veh. Class	Total	3000	4000	5000	6000	7000
January	4	100.00	1.8	0.96	2.91	3.99	6.8
January	5	100.00	10.05	13.21	16.42	10.61	9.22
January	6	100.00	2.47	1.78	3.45	3.95	6.7
January	7	100.00	2.14	0.55	2.42	2.7	3.21
January	8	100.00	11.65	5.37	7.84	6.99	7.99
January	9	100.00	1.74	1.37	2.84	3.53	4.93
January	10	100.00	3.64	1.24	2.36	3.38	5.18
January	11	100.00	3.55	2.91	5.19	5.27	6.32
January	12	100.00	6.68	2.29	4.87	5.86	5.97
January	13	100.00	8.88	2.67	3.81	5.23	6.03
February	4	100.00	1.8	0.96	2.91	3.99	6.8

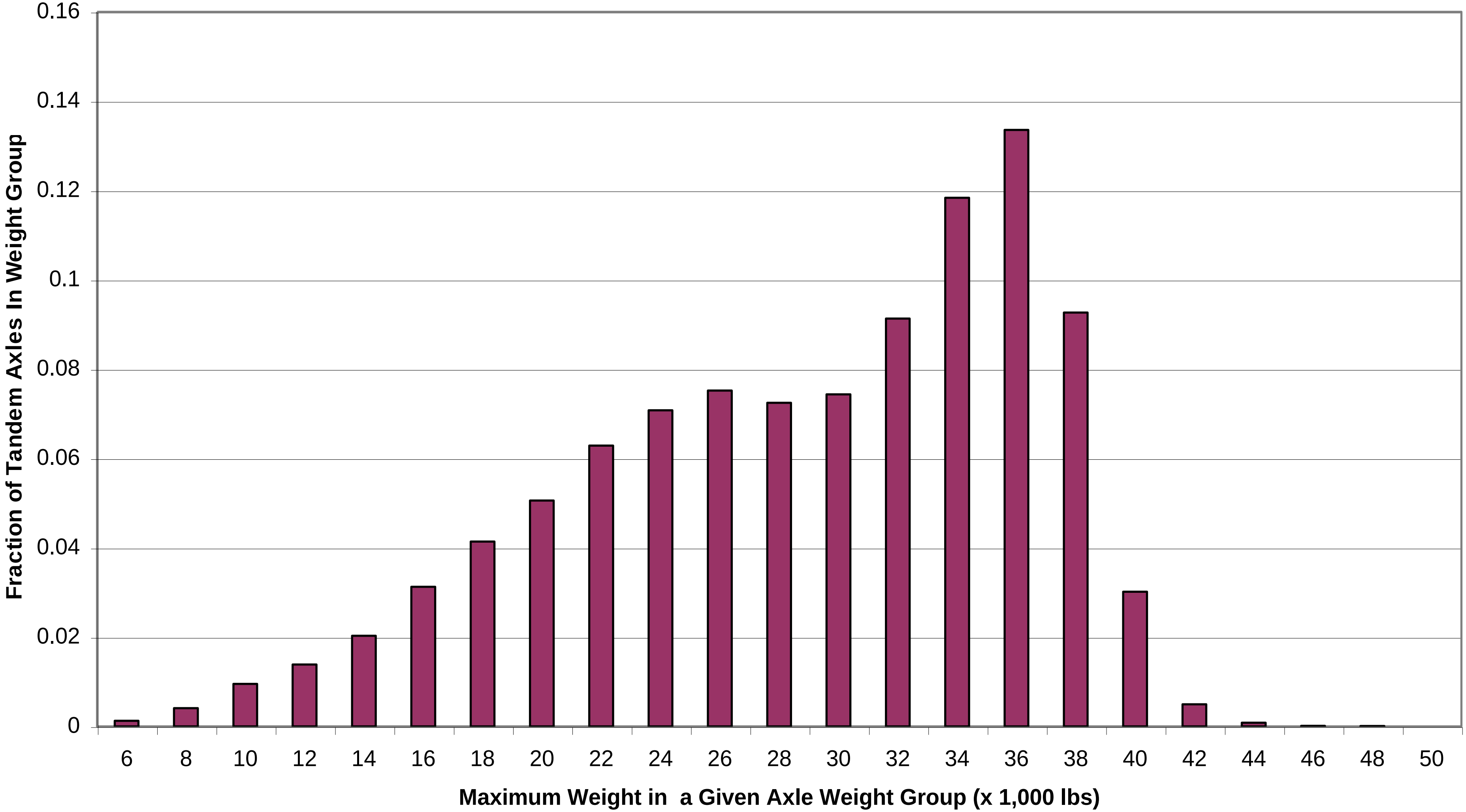
OK

Cancel

Tandem Axle Load Distribution
Lightly Loaded Trucks



Tandem Axle Load Distribution
Heavily Loaded Trucks



ESAL Comparison

Lightly Loaded = 0.186 (flexible)

Moderately Loaded = 0.355

Heavily Loaded = 0.666

Conclusion:

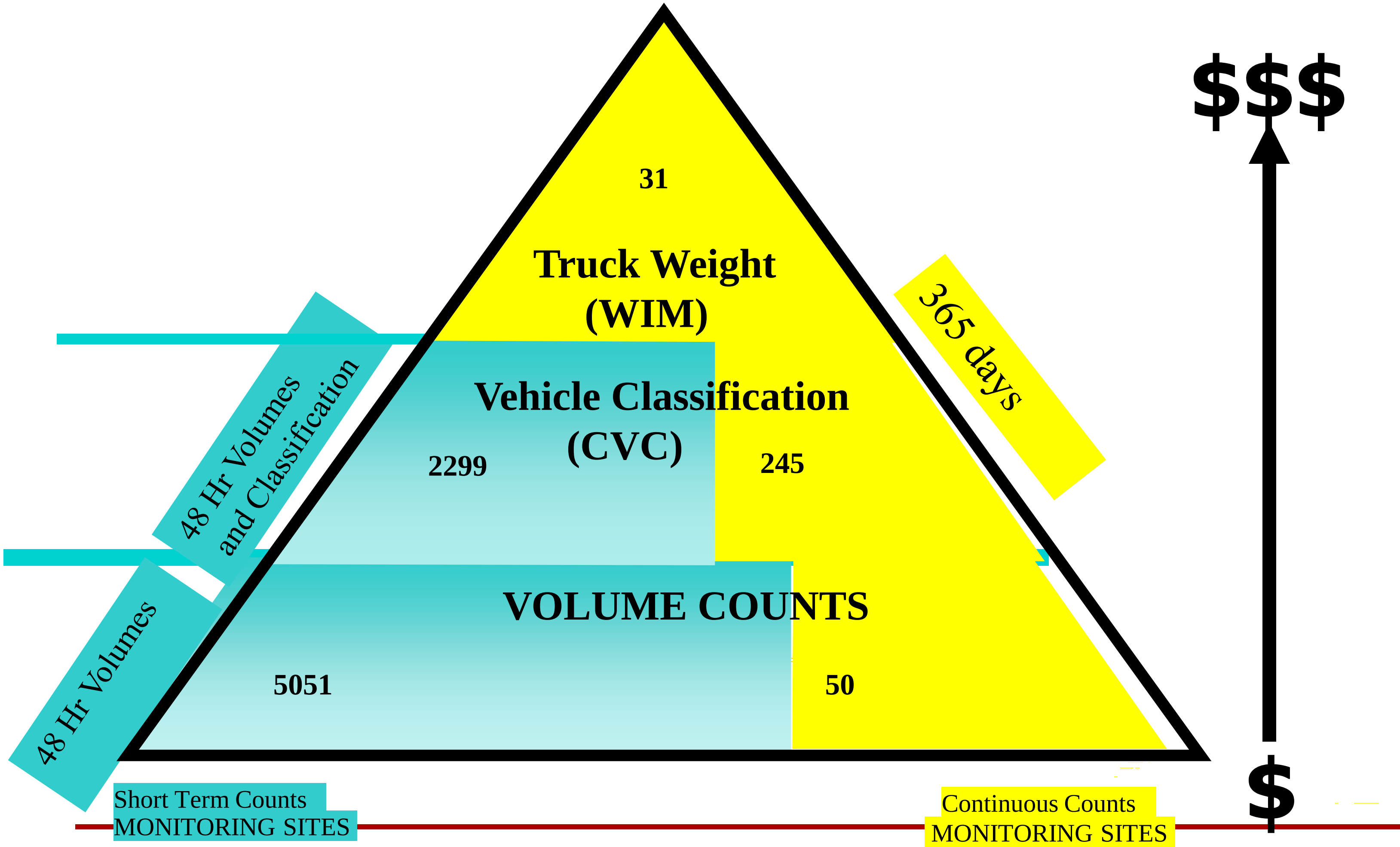
Not knowing the loaded/unloaded condition can equal a 3X error in life expectancy

Tools to gather Volume, Weight and Classification Data ?

Tube counters

Weigh in Motion Station

Data Collection Framework



Traffic

- Quality Control on WIM data
- Develop WIM input files
- Cluster analysis in identifying homogeneous traffic patterns.

- LTTP Plug program
  - Improved default traffic files
  - Improved user derived traffic data

Key Fact ………..

- The default data in ME Design is a great start

- A small amount of good data is better than a large amount of poor quality data…..

- Typically only 25% of WIM data is has been found to contain quality data.

Focus

- Information on most prevalent vehicles
- Overweight, permit vehicles
- Make it practical for design
  - Catalog traffic files

Questions ???


DIESEL
w/ PUC
ARM 9
UNLEADED
353 9
PREMIUM UNLEADED
LEG 9
THIRD ST

Florida Department of Transportation Project Traffic Forecasting

NATMEC 2014

Classification Workshop

Steven Bentz

The Project Traffic Forecasting Handbook offers guidelines and techniques on the Design Traffic Forecasting Process, and supplements the **Project Traffic Forecasting Procedure**.

The PTF Handbook is a continuation of FDOT’s effort to develop an improved traffic forecasting procedure.

To standardize methodologies, a statewide survey of engineers and planners who produce or use traffic forecasts was conducted to determine the actual methods in use throughout the Districts.

A task team was formed to draft a compilation and explanation of the standardized design traffic forecasting methodologies.

The result was the Project Traffic Forecasting Handbook.

It represents a consensus approach to traffic forecasting.

Project Traffic Forecasting 101
Web-based Training Course

http://www.transportal.org

The new PTF 101 training course is on-line and operational.

It is comprised of 17 modules which include a Fundamental Introduction, an Overview, and Basic, Advanced, and Assessment modules for Preservation, Operational Improvement, Capacity Improvement and New Alignment type projects.

The course can be simply viewed or users may enroll in order to receive a certificate upon successful completion and receive 16 PDH's. The course numbers are:

FDOT Course Number: PE-04-0008
FBPE Course Number: 0009291

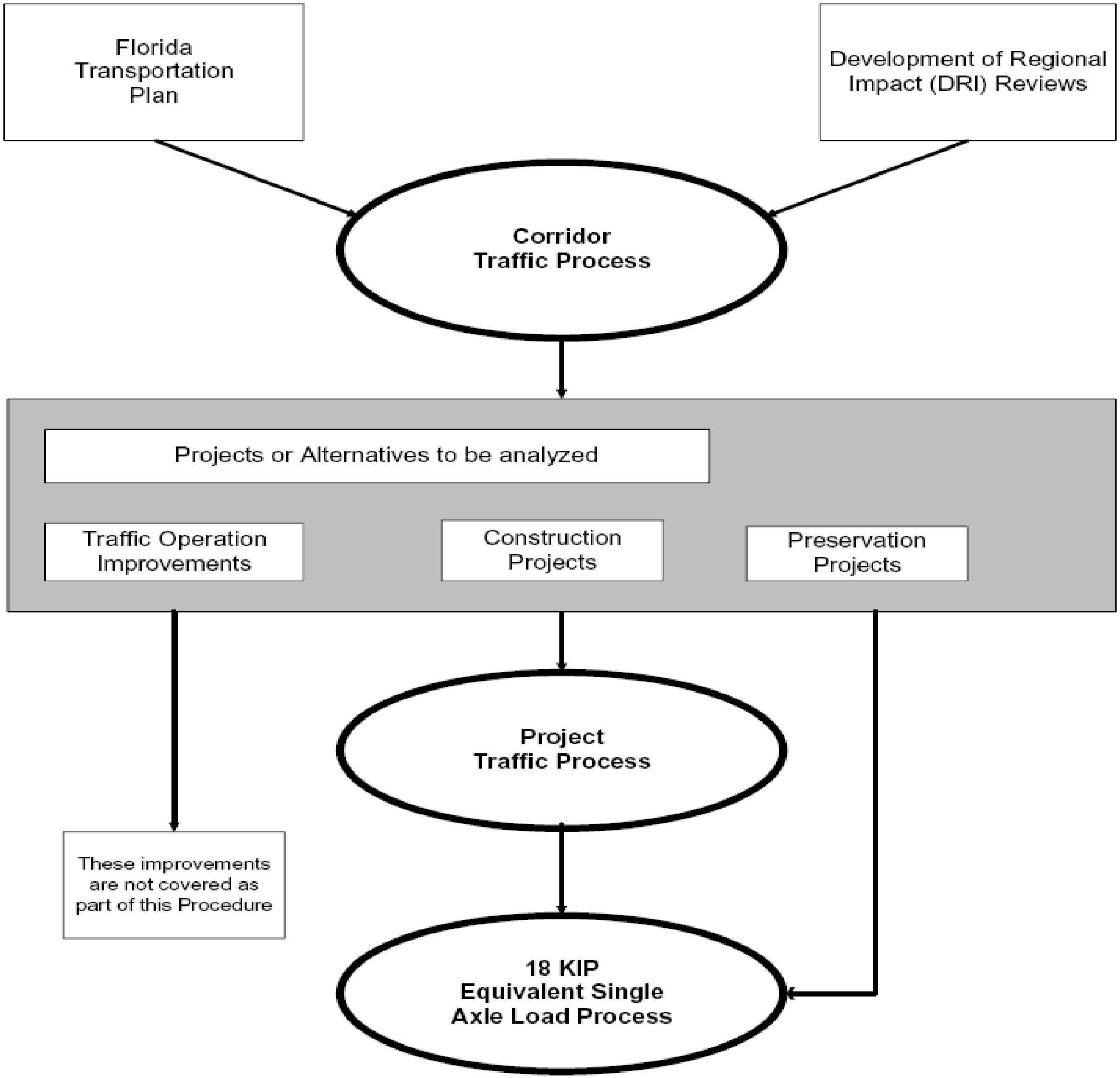
PROJECT TRAFFIC FORECASTING (PTF)

The process to estimate traffic conditions used for determining the geometric design of a roadway and/or intersection and the number of 18-KIP ESALs that pavement will be subjected to over the design life.

Project Traffic Forecasting estimates are needed for Planning and Project Development and Environmental (PD&E) studies and construction plans which lead to construction, traffic improvements, and pavement design projects.

A Project Traffic Report is routinely developed as part of most Project Development and Environmental Studies.

FDOT's Roadway Plans Preparation Manual requires Project Traffic and its major parameters to be posted on the Typical Section sheets.



Florida Transportation Plan
Development of Regional Impact (DRI) Reviews
Corridor Traffic Process
Projects or Alternatives to be analyzed
Traffic Operation Improvements
Construction Projects
Preservation Projects
Project Traffic Process
These improvements are not covered as part of this Procedure
18 KIP Equivalent Single Axle Load Process

Corridor projects usually require the development of travel projections which are used to make decisions which have important capacity and capital investment implications.

The traffic forecasting is required before establishing a new alignment or widening of an existing facility.

The Project Traffic projections are commonly used to develop laneage requirements for intersection designs, and to evaluate the operational efficiency of proposed improvements.

Project Traffic Forecasting is also required for reconstruction, resurfacing, adding lanes, bridge replacement, new roadway projects, and major intersection improvements.

This process differs from Corridor Traffic Forecasting in that it is site specific and covers a limited geographic area.

The Equivalent Single Axle Loading (ESAL) Forecasting Process is necessary for pavement design for new construction, reconstruction, or resurfacing projects.

Truck traffic and damage factors are needed to calculate axle loads expressed as ESALs.

The four major types of construction projects are :

•Preservation (resurfacing)

•Intersection Operational Improvements (add turns lanes)

•Roadway Capacity Improvements (add through lanes)

•New Alignment Projects.

Traffic operations projects such as signal timing, signal phasing and other non-construction type projects are not covered under this procedure.

Construction projects require both the Project Traffic Forecasting Process and the Equivalent Single Axle Load (ESAL) Process to be performed.

Preservation Projects, which are usually resurfacing projects, only require the ESAL process to determine the appropriate Load Equivalency Factor for the pavement to be laid.

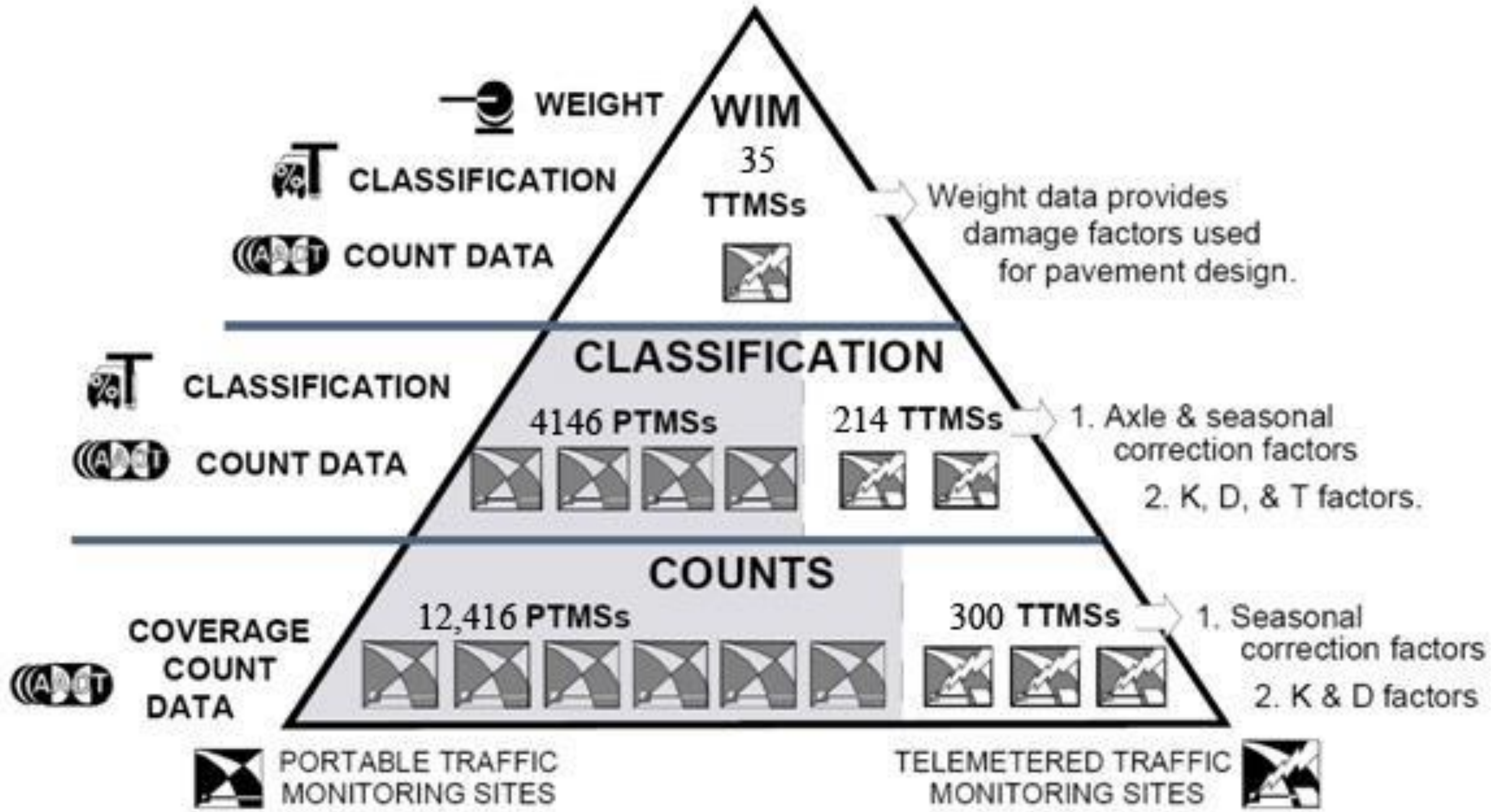
Corridor Traffic Forecasting and Project Traffic Forecasting projects require forecasts of Annual Average Daily Traffic (AADT) and Design Hour Volumes (DHV).

TRUTH IN DATA PRINCIPLE

The goal of the principle is to provide the user with the information needed to make appropriate choices regarding the applicability of the forecast for particular purposes.

For the producer of the traffic forecast, it means clearly stating the input assumptions and their sources, and providing the forecast in a form that the user can understand and use.

TRAFFIC MONITORING SITES IN FLORIDA



STANDARD K FACTORS

FDOT has decided to replace the K30 factors with **Standard K factors.**

This has occurred because it has been widely recognized that roadways in urbanized areas cannot be cost effectively designed based on the 30th highest hour demand volumes.

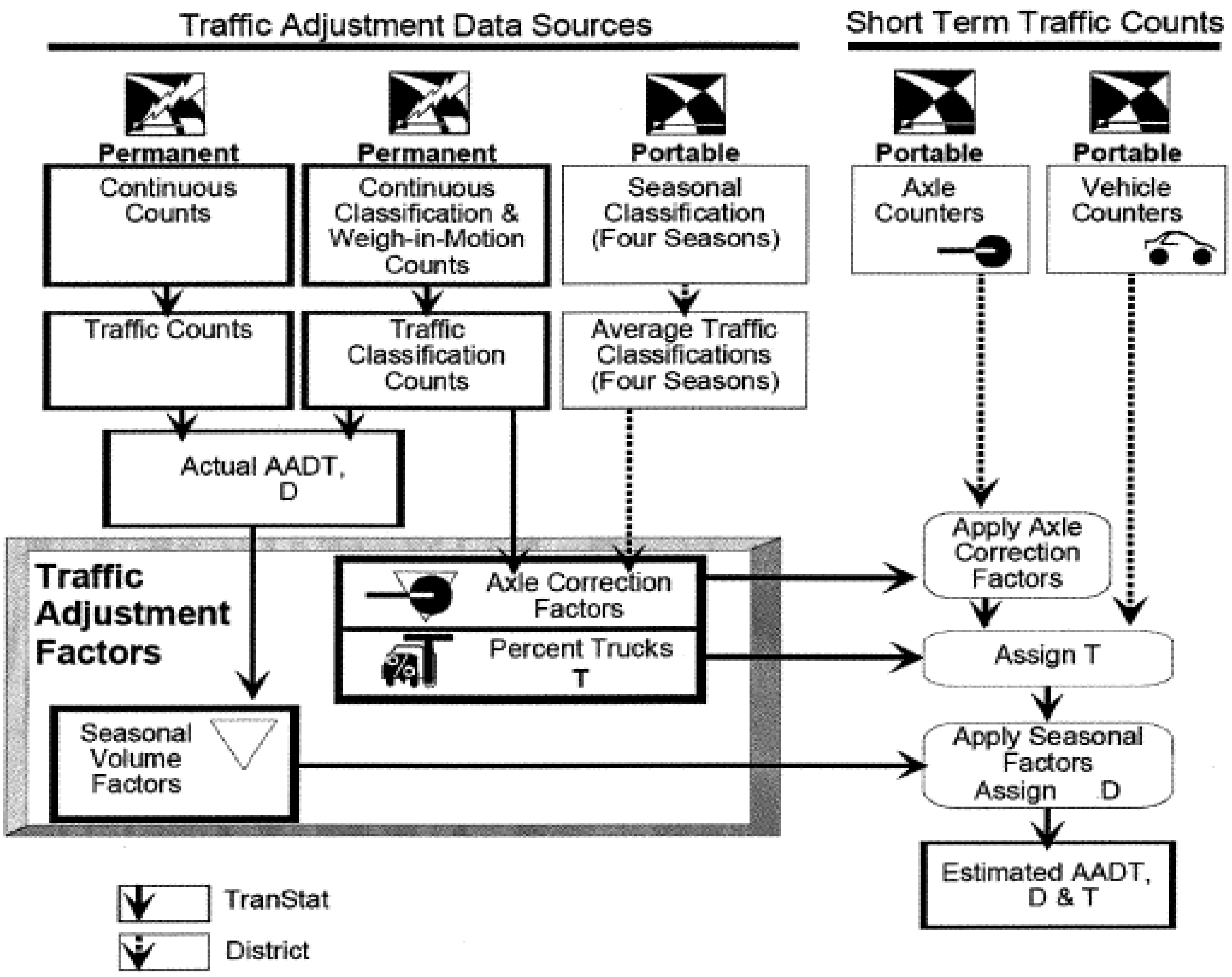
Standard K factors have been established statewide by using the data measured at the continuous count sites.

The Standard K factors are based on area type and facility type with consideration to typical peak periods of the day.

FDOT Standard K Factors

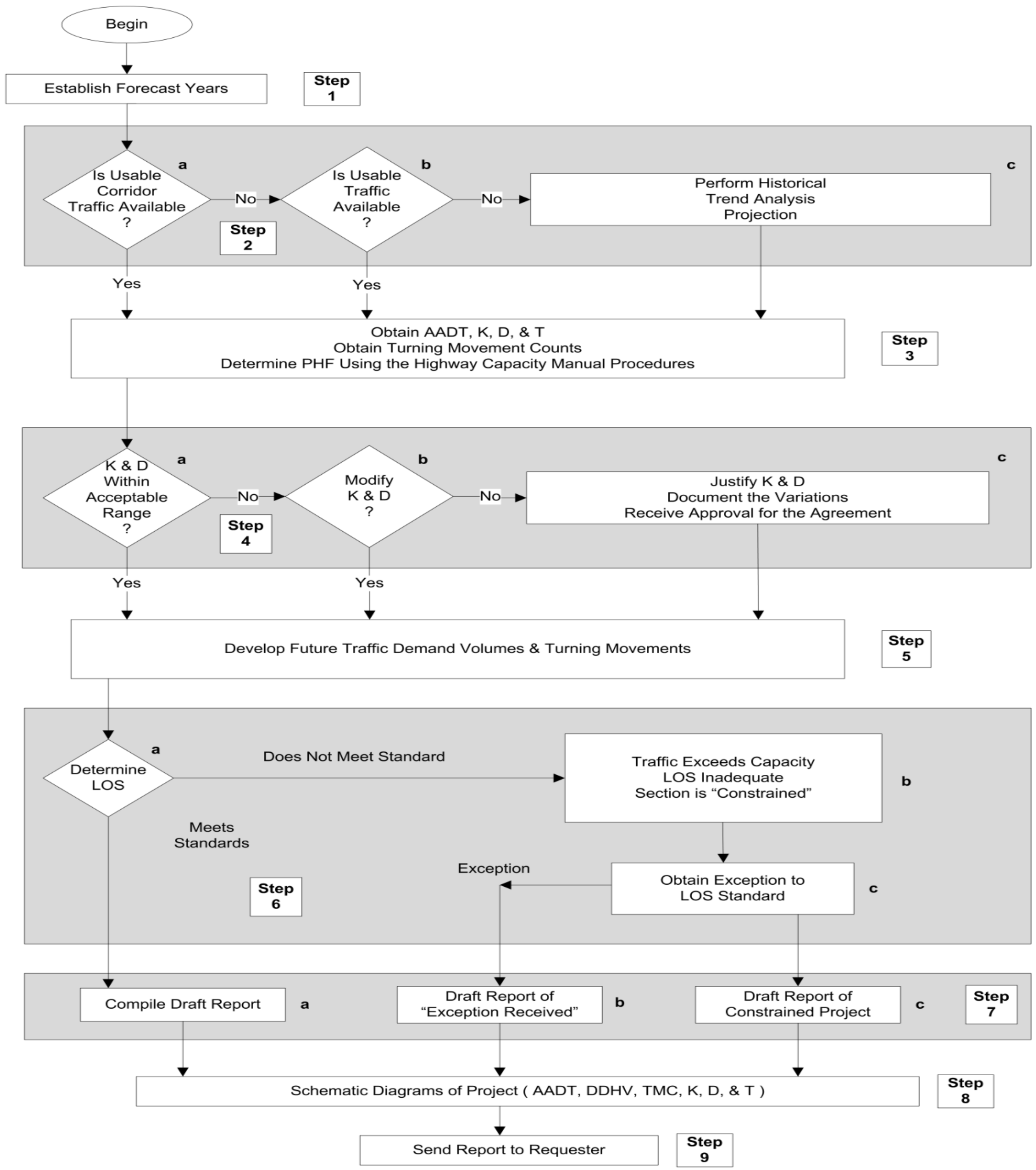
Area (Population) [Examples]	Facility Type	Standard K Factors* (%AADT)	Representative Time Period
Large Urbanized Areas with Core Freeways *(1,000,000+) [Jacksonville, Miami]*	Freeways	8.0 - 9.0 ***	Typical weekday peak period or hour
	Arterials & Highways	9.0**	Typical weekday peak hour
Other Urbanized Areas *(50,000+) [Tallahassee, Ft. Myers]*	Freeways	9.0 **	Typical weekday peak hour
	Arterials & Highways	9.0 **	Typical weekday peak hour
Transitioning to Urbanized Areas *(Uncertain) [Fringe Development Areas]*	Freeways	9.0	Typical weekday peak hour
	Arterials & Highways	9.0	Typical weekday peak hour
Urban *(5,000-50,000) [Lake City, Key West]*	Freeways	10.5	100th highest hour of the year
	Arterials & Highways	9.0 **	Typical weekday peak hour
Rural *(<5,000) [Chipley, Everglades]*	Freeways	10.5	100th highest hour of the year
	Arterials	9.5 **	100th highest hour of the year
	Highways	9.5	100th highest hour of the year

*	Some smoothing of values at area boundaries/edges would be desirable.
**	Value is 7.5% in approved Multimodal Transportation Districts where automobile movements are deemphasized. Essentially, this lower value represents an extensive multi-hour peak period rather than a peak hour.
***	Value is 8.0% for FDOT-designated urbanized core freeways and may be either be 8.5% or 9.0% for non-core freeways. Values less than 9% essentially represent a multi-hour peak period rather than a peak hour.



Traffic Adjustment Data Sources
Short Term Traffic Counts
Permanent
Continuous Counts
Permanent
Continuous Classification & Weigh-in-Motion Counts
Portable
Seasonal Classification (Four Seasons)
Portable
Axle Counters
Portable
Vehicle Counters
Traffic Counts
Traffic Classification Counts
Average Traffic Classifications (Four Seasons)
Actual AADT, D
Traffic Adjustment Factors
Axle Correction Factors
Percent Trucks T
Seasonal Volume Factors
Apply Axle Correction Factors
Assign T
Apply Seasonal Factors Assign D
Estimated AADT, D & T
TranStat
District

Project Traffic Forecasting Process



The End

steven.bentz@dot.fl.us

(850) 414-4738

IDOT CLASSIFICATION

William Morgan
Data Management Unit Chief

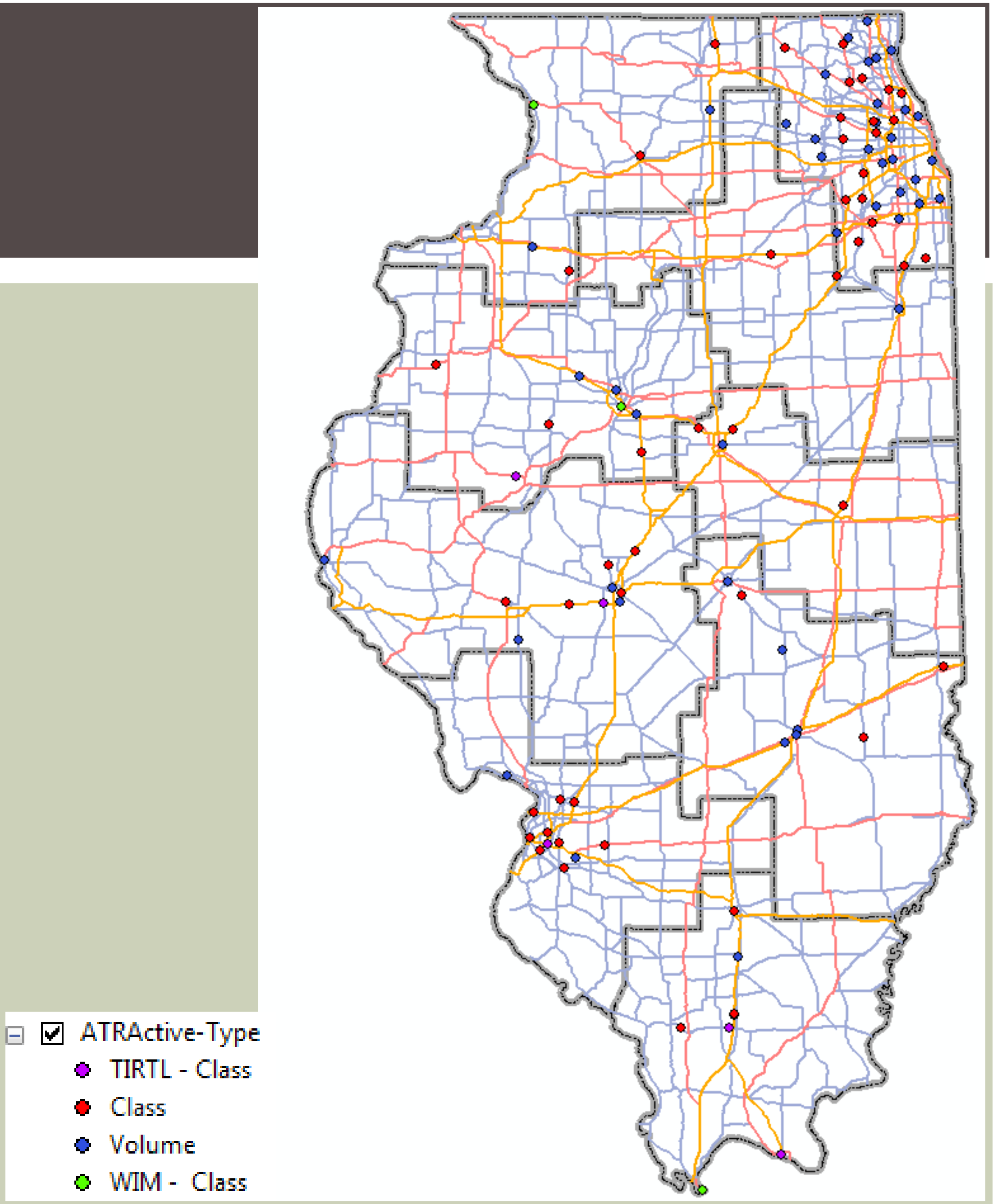
CLASSIFICATION

- Collection
- Quality Control
- Factoring
- Users of Data
- How we report

COLLECTION

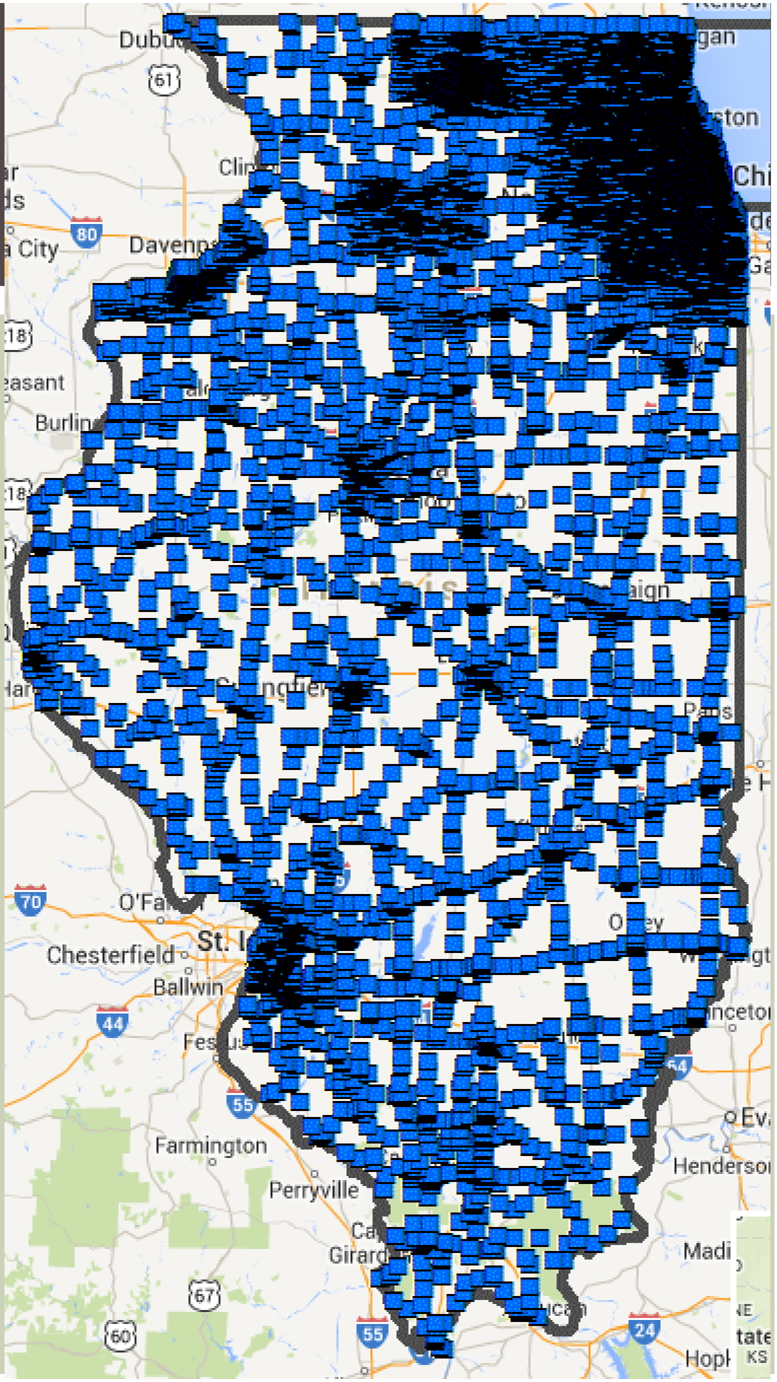
ATR Sites

- Total - 111
  - Classification - 66
  - Volume - 45
- Types
  - TRS - 97
  - WIM - 3
  - TIRTL - 11



COLLECTION

- Short Term Counts
  - District Staff
  - Consultant Contracts



QUALITY CONTROL - ATR

- ATR Sites
  - Sites polled twice a week.
  - Review numbers and look for issues and missing data
  - On our TIRTL sites, we also review the specific beam levels and angles, and current live status to see current traffic numbers.

QUALITY CONTROL – SHORT TERM

- Review historical counts for SU & MU
- Look at traffic flow of current counts along route
- Drastic changes in AADT can warrant new breaks in count segments due to new traffic generators (New shopping centers, subdivisions, etc.)

FACTORING

- Utilize monthly and day of week factors (Seasonal).
- Broken down into 4 groups based on roadway type (Interstate/Other) and rural/urban classification.
- Create growth factors based on last two years worth of data.
- Seasonal factors are based on 4 year rolling average.

IDOT USERS OF DATA

- AADT, SU & MU breakout – used by Design & Bridges
- AADT/VMT – used by Traffic Safety and Safety Engineering when reviewing crash data.
- AADT – Planning uses during annual program cycle.

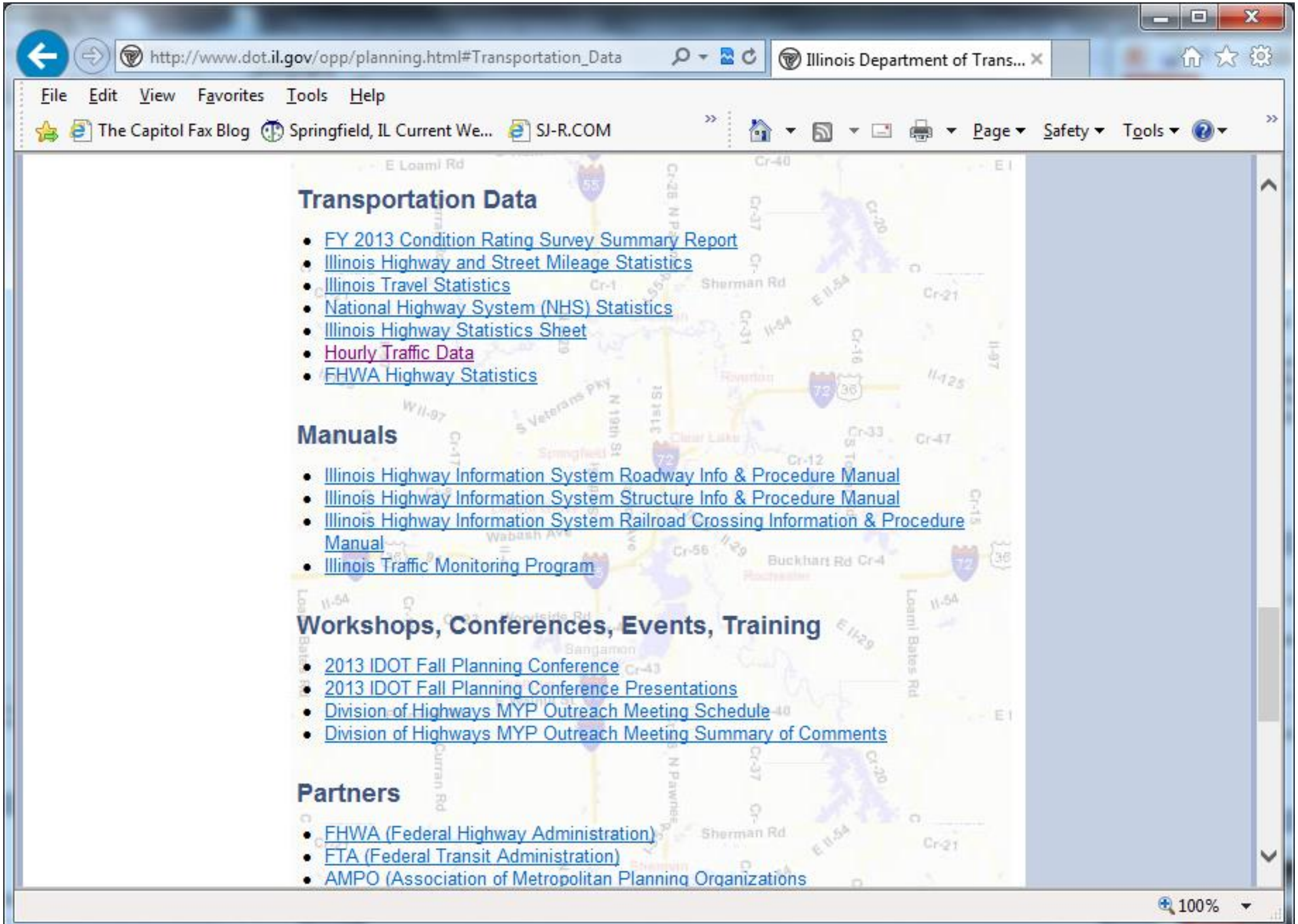
OTHER USERS OF DATA

- AADT – County, City, MPOs, Legislature, Governors office, researchers, businesses, etc. Many of these use for planning purposes, analysis patterns.

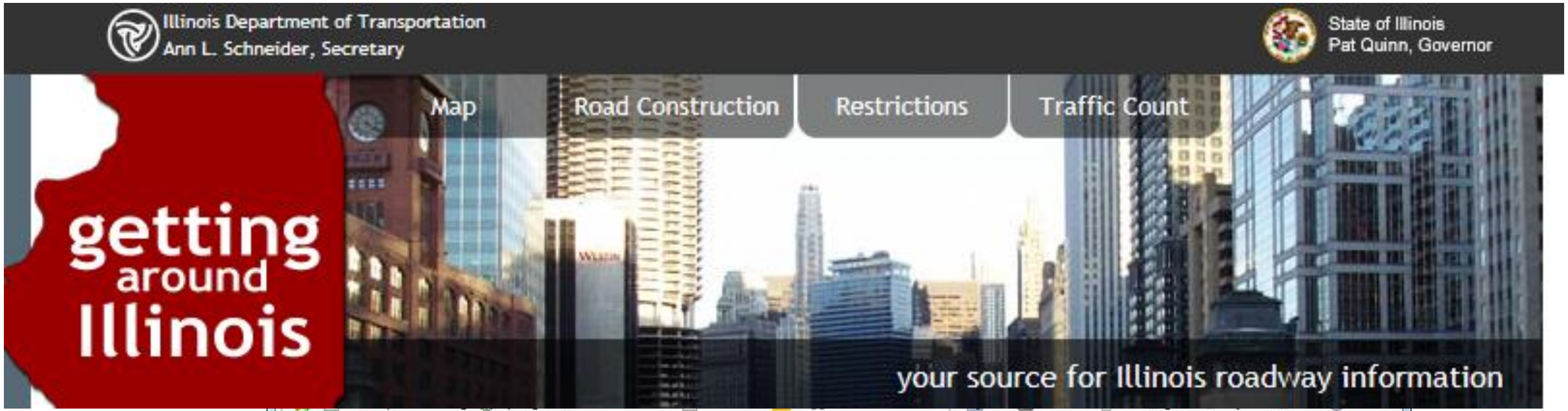
HOW WE REPORT DATA

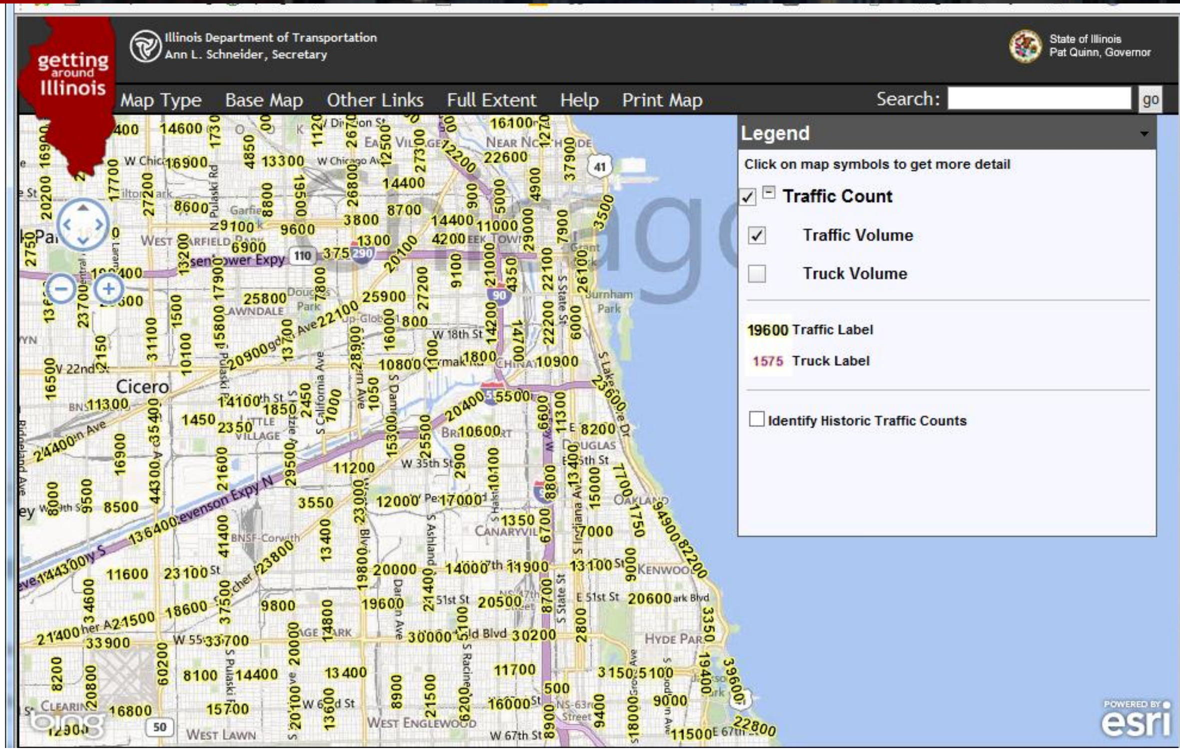
- External Websites
  - http://www.dot.il.gov/opp/planning.html#Transportation_Data
  - http://www.gettingaroundillinois.com
  - http://gis.dot.illinois.gov/gist2/
  - http://idot.ms2soft.com/tcds/
- Internal web site
  - IRoads

http://www.dot.il.gov/opp/planning.html#Transportation_Data



http://www.gettingaroundillinois.com





http://gis.dot.illinois.gov/gist2/

ILLINOIS TECHNOLOGY
TRANSFER CENTER

1.Select a year

2013

2.Select geographic area

STATEWIDE
ADAMS
ALEXANDER
BOND
BOONE
BROWN
BUREAU
CALHOUN
CARROLL
CASS

Select Area

3. Select data to download

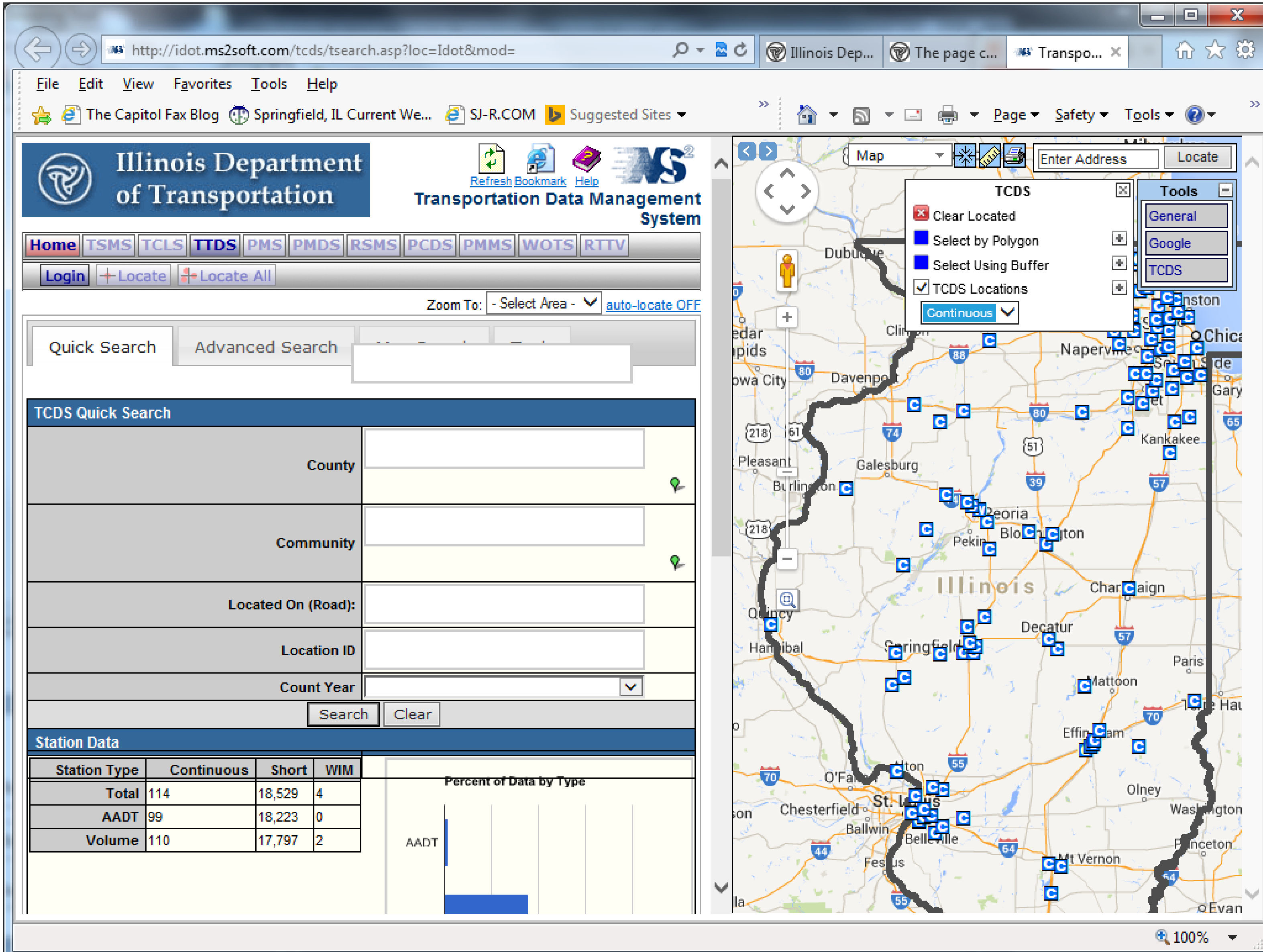
All
Highway
Railroad
Structure

4. Download Data

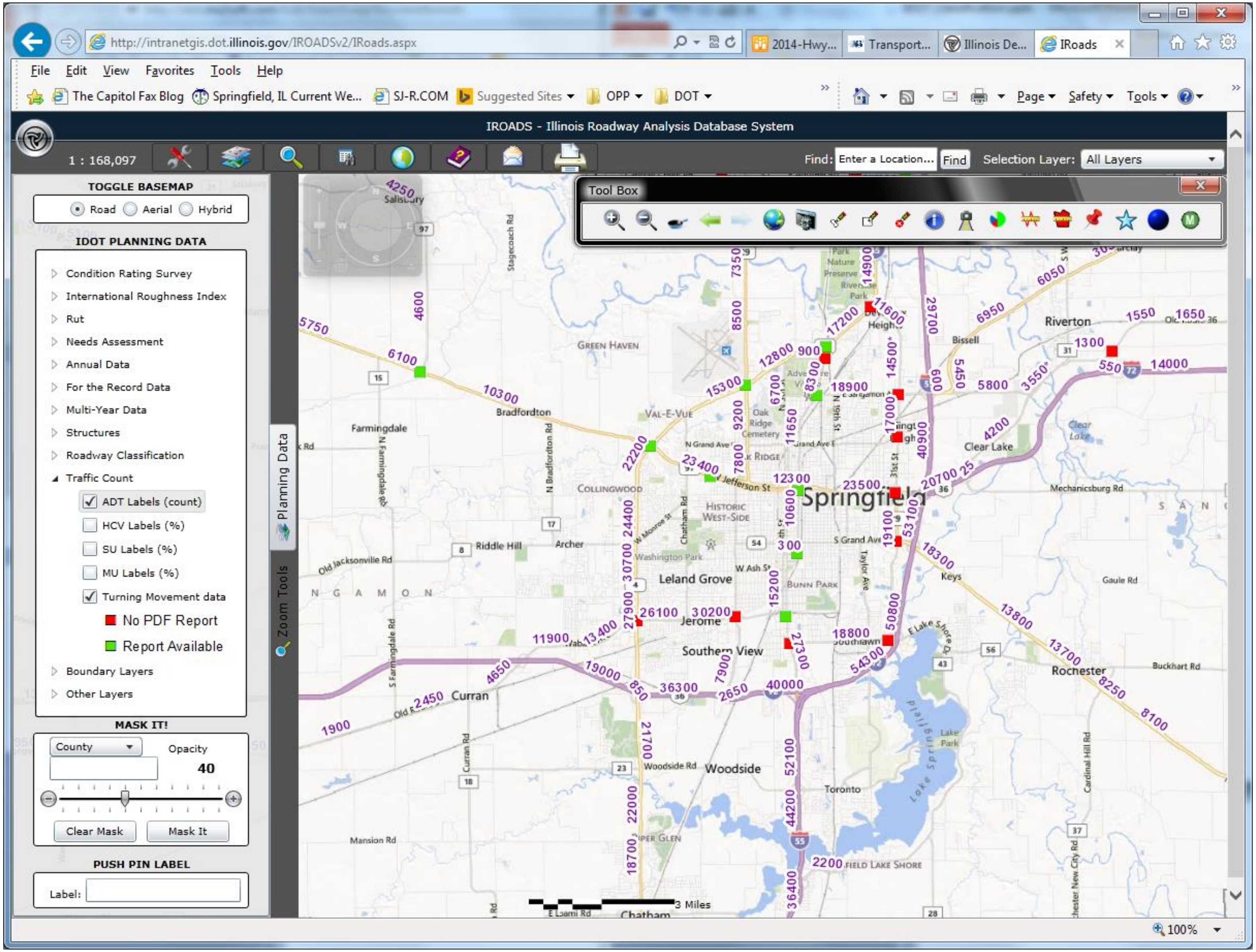
OTHER LINKS OF INTEREST

- Illinois Highway System File Metadata
- Illinois Geospatial Data Clearinghouse

IDOT MS2 Hosted site/



IRoads



http://intranetgis.dot.illinois.gov/IROADSv2/IRoads.aspx
File Edit View Favorites Tools Help
IROADS - Illinois Roadway Analysis Database System
1 : 168,097
Find: Enter a Location... Find
Selection Layer: All Layers
Tool Box
TOGGLE BASEMAP
Road Aerial Hybrid
IDOT PLANNING DATA
Condition Rating Survey
International Roughness Index
Rut
Needs Assessment
Annual Data
For the Record Data
Multi-Year Data
Structures
Roadway Classification
Traffic Count
ADT Labels (count)
HCV Labels (%)
SU Labels (%)
MU Labels (%)
Turning Movement data
No PDF Report
Report Available
Boundary Layers
Other Layers
MASK IT!
County
Opacity
40
Clear Mask
Mask It
PUSH PIN LABEL
Label:
Planning Data
Zoom Tools
Springfield
Leland Grove
Jerome
Southern View
Curran
Woodside
Rochester
Riverton
Clear Lake
Bradfordton
Farmingdale
3 Miles
100%

Michigan – our fit in the department

Classification data short term

Continuous vehicle classifications axle and weights

Equipment and sites configuration

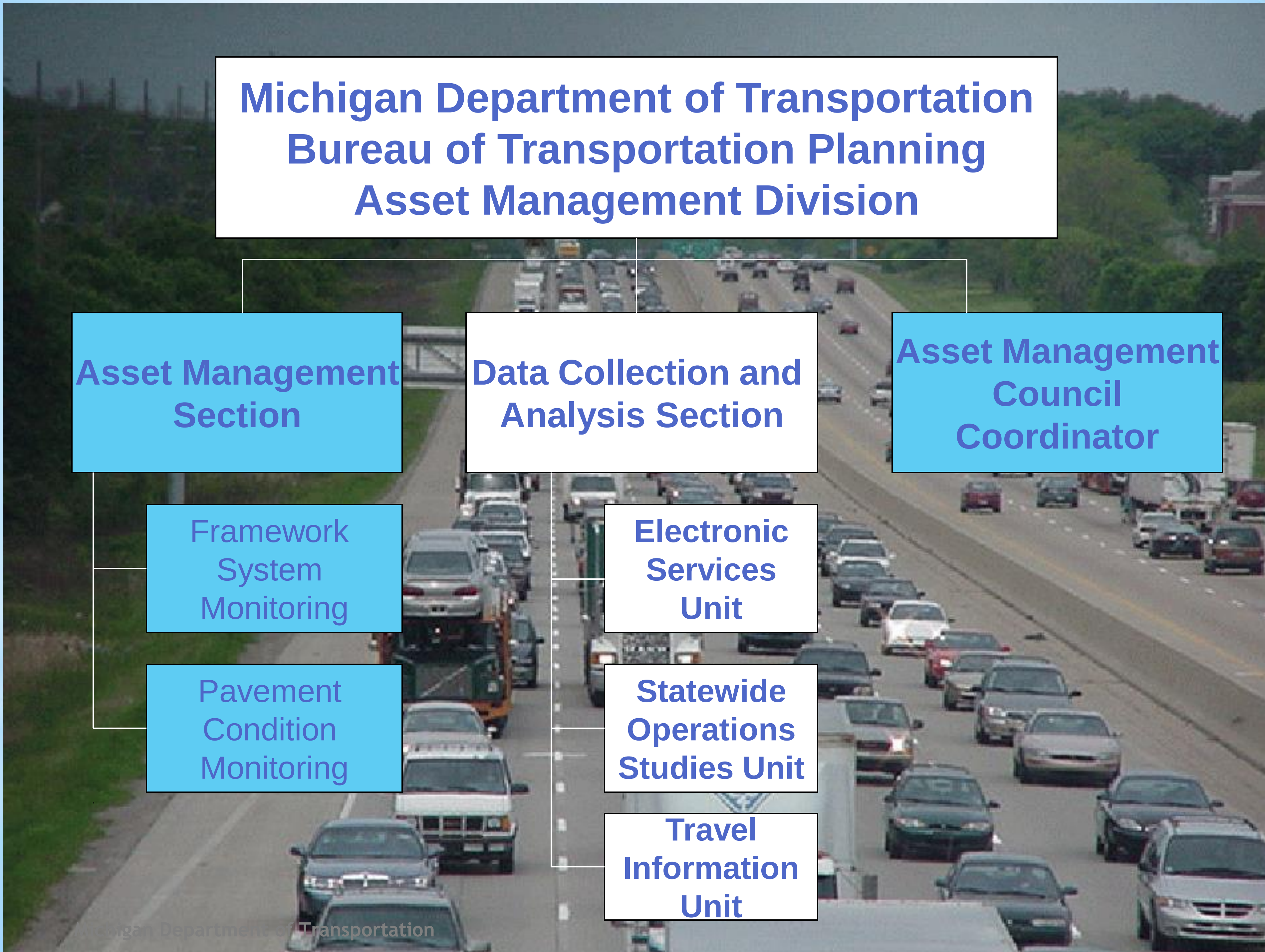
Sites

Use of data

Limited length classification

NATMEC Classification Workshop

June 29, 2014 Sunday 9am-12 noon


Michigan Department of Transportation
Bureau of Transportation Planning
Asset Management Division
Asset Management Section
Framework System Monitoring
Pavement Condition Monitoring
Data Collection and Analysis Section
Electronic Services Unit
Statewide Operations Studies Unit
Travel Information Unit
Asset Management Council Coordinator

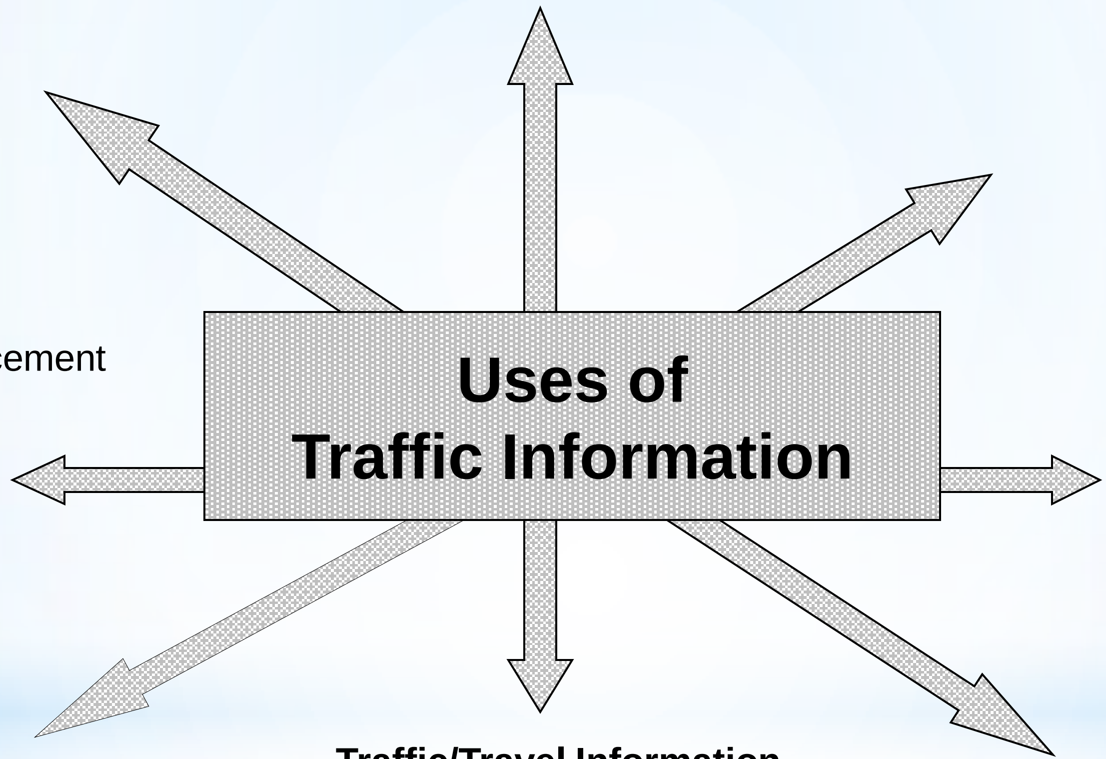
$$$ Million Federal Aid

Operations/Safety

- Signals
- Stop signs
- Intersection improvements
- Speed limits
- Weight enforcement

Pavement

- Design
- Management



Project Level Planning

- Traffic Analysis

Legislative Analysis

- Revenue
- Size & weight

Models

- Travel Demand Forecasting
- Air Quality

Traffic/Travel Information

- Public
- Gov. agencies
- Universities
- Private companies

Multi-Modal

- Air
- Rail
- Bus

Overview

- Short Term Class (13 bin hose, 3 bin video, 4 bin radar)
- We don’t collect length classification data at our continuous count station (CCS) sites
- State crew performs maintenance/upgrades
- Contractors for new pavement installations
- In-house monitoring suite of tools including polling program/traffic processing software
- WIM analyst reviewing data/equipment weekly

State Crew – Repair and Upgrades

Loop Sensor Classification Configuration

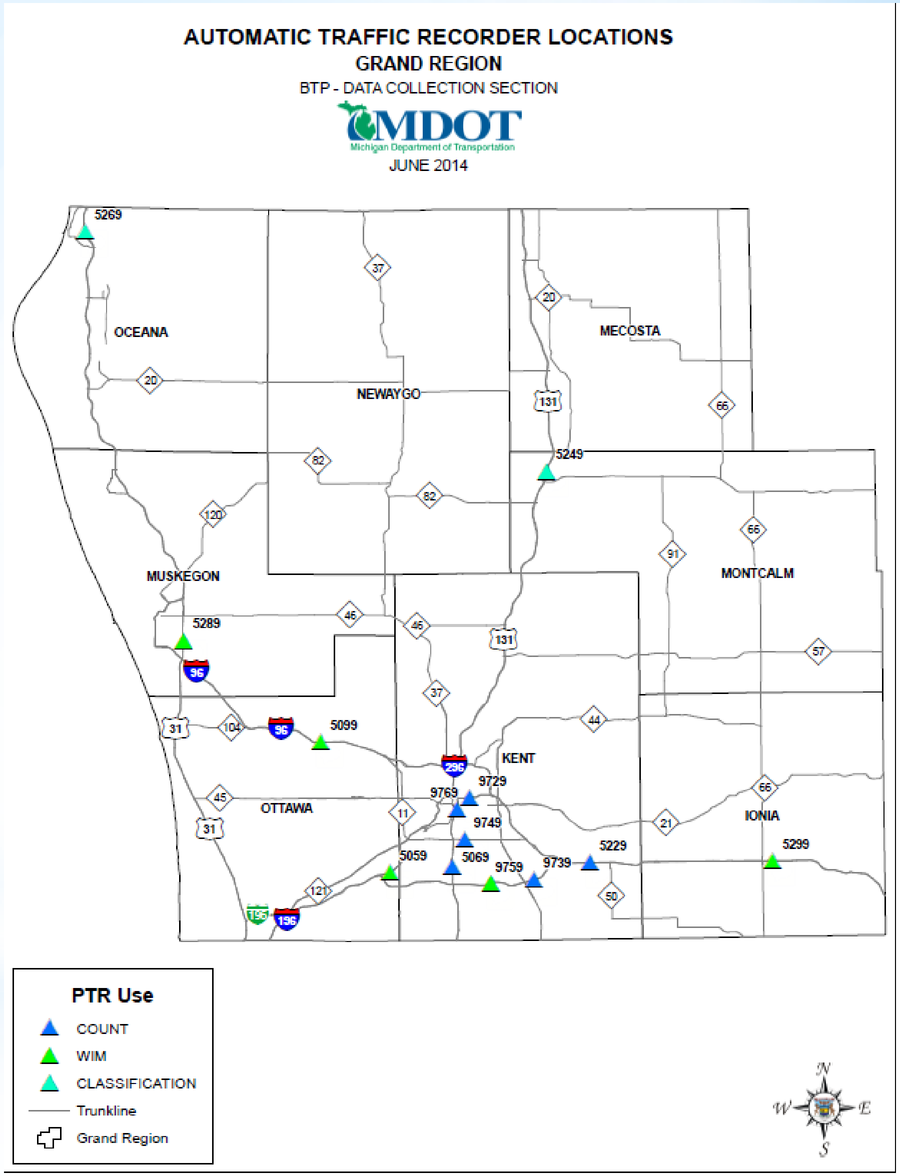
Sites selection

Collaboration for the placement of new WIM site installations and upgrades:

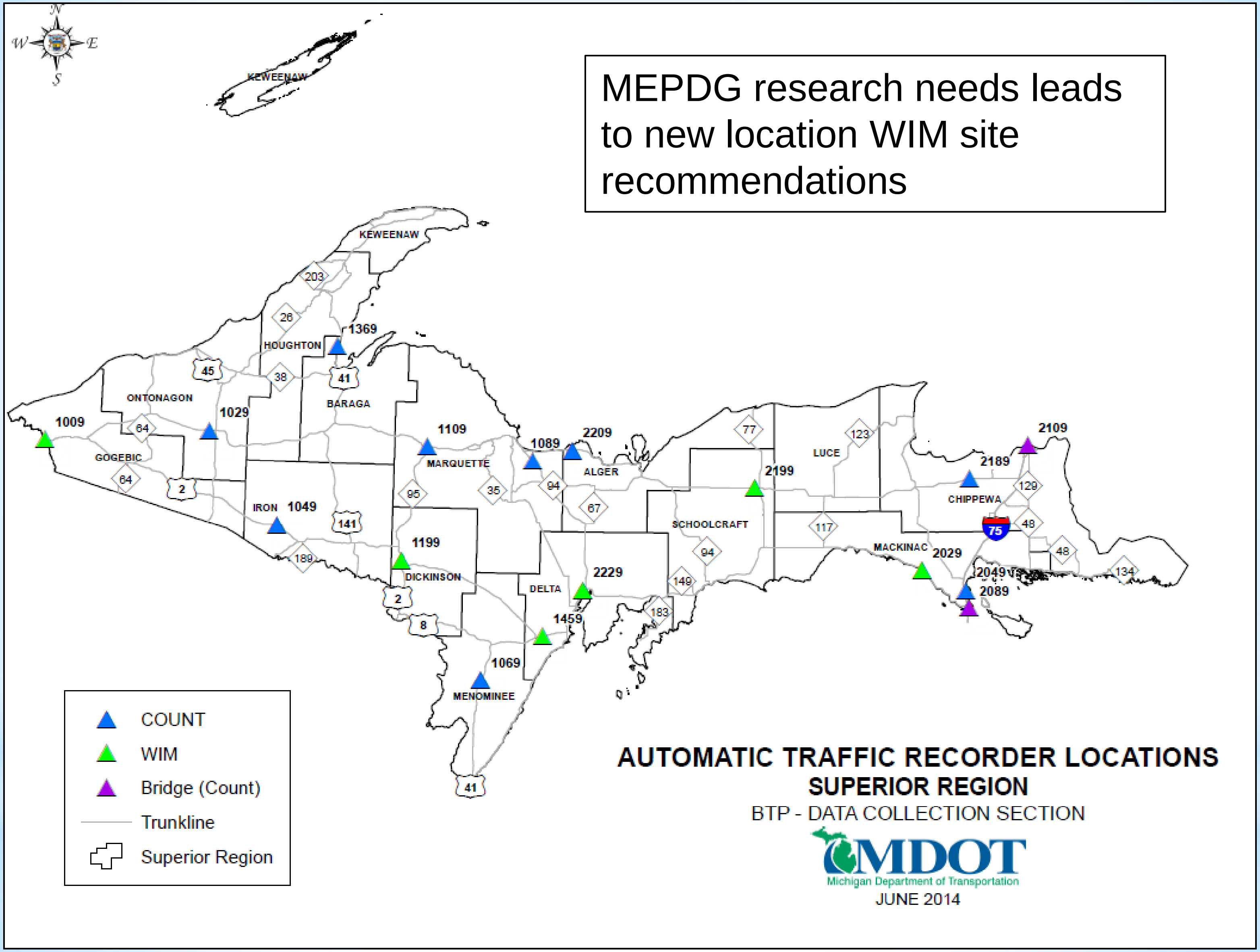
-Working with State Commercial Vehicle Enforcement, Transportation Planners and Pavement Design Teams

-Freight community and Third party vendors (PrePass and DriveWyze)

.



MEPDG research needs leads to new location WIM site recommendations



Equipment

Use 6 by 6 loops with 45 angles for counting (Phoenix)

15 Piezo BL for class (PAT)

41 Quartz WIM axle (PAT)

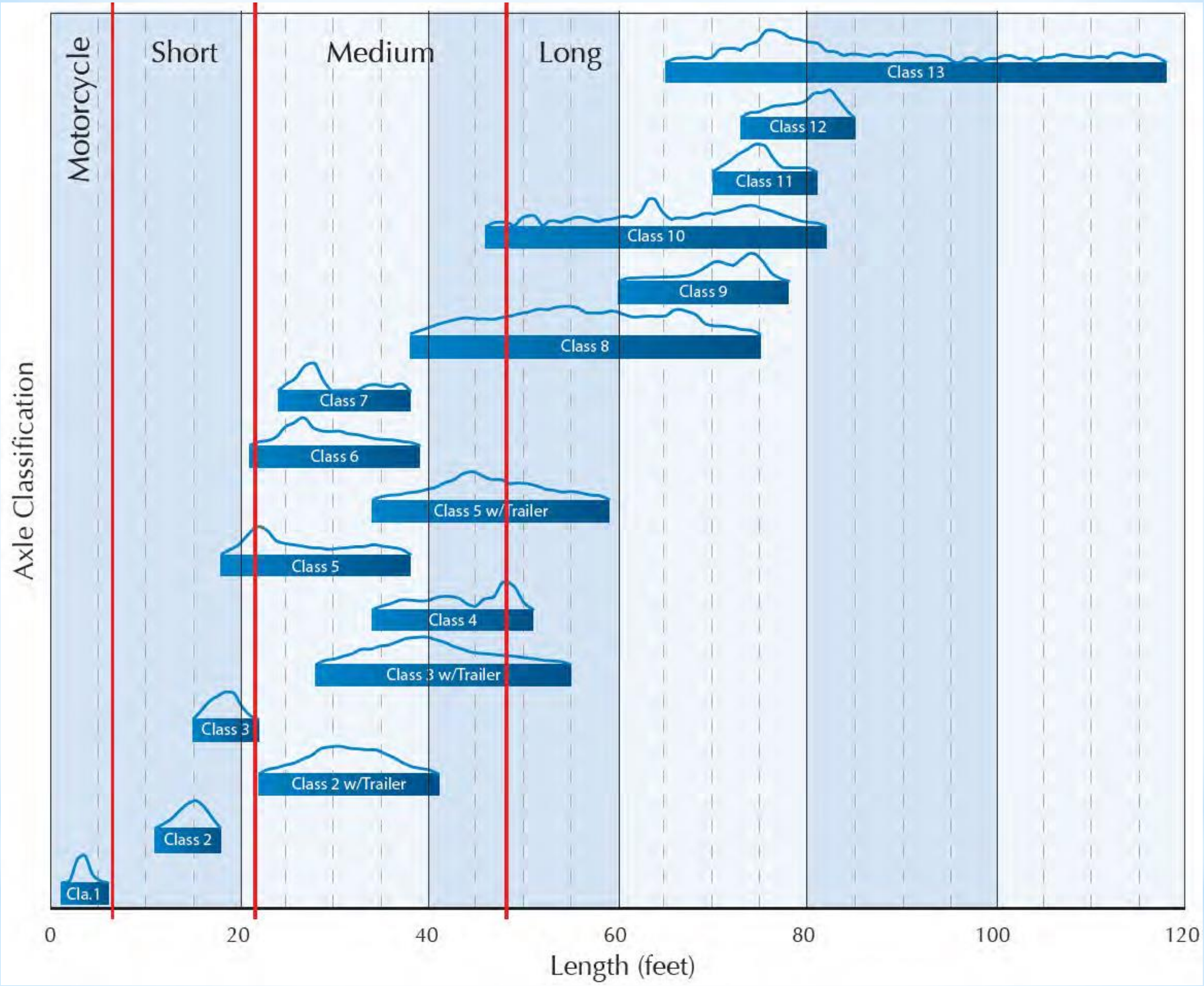
2 3M Micro loop Classifications

141 sites overall, of which 58 sites reporting class

Classification Data usage

- Planning
  - 13 Bin, 3 bin, 4 bin for project,
  - AADTT reporting, HPMS
  - Air Quality
- Overweight analysis
  - Axle WIM data for enforcement strategies
  - Truck Vehicle Registration/Policy
- Axle and WIM
  - Pavement Design
  - PREP-ME inputs
  - Bridge Loadings
  - Commercial Vehicle Enforcement (Virtual WIM sites)
  - PrePass and DriveWyze
- Project and future plans
  - Equivalent Single Axle Load (ESAL)
- Class data to MPO’s

Software issues include needed upgrades



Loop- and Length-Based Vehicle Classification, Federal Highway Administration – Pooled Fund Program [TPF-5(192)]

Vehicle length issues

- Overlapping or gray areas with types vehicles
- Axle based (WIM) for Enforcement
- Length (accuracy issues using defaults) for Pavement Design
- MOVES (Air Quality)
- Information provided to:
  - MDOT staff and other state agencies
  - FHWA
  - MPO's and RPO's
  - Public/Consultants
  - Researchers (weights, truck parking, pavement design, bridge design)
- Michigan Axle Loadings

Michigan has a unique system of truck-weight law based on maximum axle loadings, not gross vehicle weight (GVW). *Gross vehicle weight* includes the weights of the truck, cargo, fuel, and driver; *axle loading* is the weight on a single axle. Maximum allowable axle loadings are the same for a standard truck in all states, but Michigan allows use of more axles in combination with lower axle loadings, for a greater gross vehicle weight than other states.

Michigan Axle Loading

The maximum gross vehicle weight allowed on a “federal-weight-law truck” is 80,000 pounds, with four of its five axles carrying 17,000 pounds each and the steering axle carrying 12,000 pounds.

The maximum allowable gross vehicle weight on the heaviest “Michigan-weight-law truck” is 164,000 pounds, which can only be achieved by use of eleven properly-spaced axles. Most of these axles carry only 13,000 pounds each.

Michigan Axle Loading

Most of these axles carry only 13,000 pounds each. The alternative to a single Michigan combination carrying 160,000 lbs. on 11 axles is two standard trucks carrying 160,000 lbs. on 10 axles

Michigan's axle loading system has a critical dependence with the FHWA Scheme F classification criteria.

Michigan Axle Loading

ATTACHMENT 1

VEHICLE TYPE CLASSIFICATION
CLASSIFICATION CRITERIA

(FHWA SCHEME F)

CLASS	DESCRIPTION	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
1	MOTORCYCLE	0.1-6									
2	CAR	6.1-10.29									
2	CAR W/TRAIL	6.1-10.29	6-25								
2	CAR W/TRAIL	6.1-10.29	6-25	1-11.99							
2	CAR W/TRAIL	6.1-10.29	6-25	1-11.99	1-11.99						
3	VAN - TRUCK	10.1-14.5									
3	V/T W/TRAIL	10.1-14.5	6-25								
3	V/T W/TRAIL	10.1-14.5	6-25	1-11.99							
3	V/T W/TRAIL	10.1-14.5	6-25	1-11.99	1-11.99						
4	BUS	23.1-40									
4	BUS	23.1-40	3.5-6.0								
4	BUS	23.1-40	0.1-6	0.1-6							
5	TRUCK 2/AXL	14.5-23.09									
6	TRUCK 3/AXL	6.1-23	2.5-6.3								
7	TRUCK 4/AXL	6.1-23	2.5-6.3	2.5-13							
7	TRUCK 5/AXL	6.1-23	2.5-6.3	2.5-6.3	2.5-6.3						
8	SEMI 3/AXLE	6.1-23	11-40								
8	SEMI 4/AXLE	6.1-23	1-11.99	6.1-44							
8	SEMI 4/AXLE	6.1-23	11-38	2.5-11.99							
9	SEMI 5/AXLE	6.1-26	2.5-6.3	6.1-46	2.5-27						
9	SEMI 5/AXLE	6.1-26	18.1-46	2.5-6.3	2.5-6.3						
10	6/AXL 1/TRL	6.1-23	11-46	2.5-6.3	2.5-6.3	2.5-6.3					
10	6/AXL 1/TRL	6.1-26	2.5-6.3	6.1-46	0.1-16	0.1-11					
10	7/AXL 1/TRL	6.1-26	2.5-6.3	2.5-46	2.5-12	2.5-6.3	2.5-6.3				
10	7/AXL 1/TRL	6.1-26	2.5-6.3	10-20	6-12	6-12	6-12				
10	8/AXL 1/TRL	6.1-26	2.5-6.3	3.5-46	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3			
10	9/AXL 1/TRL	6.1-26	2.5-6.3	2.9-46	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3		
10	10/AX 1/TRL	6.1-26	2.5-6.3	2.9-46	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	
10	11/AX 1/TRL	6.1-26	2.5-6.3	2.9-46	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3
11	5/AX MUL/TR	6.1-26	1.1-26	6.1-20	11.1-26						
12	6/AX MUL/TR	6.1-26	2.5-6.3	11.1-26	6.1-24	1.1-26					
13	7/AX MUL/TR	6.1-26	2.5-6.3	2.5-45	2.5-45	2.5-45	2.5-45				
13	8/AX MUL/TR	6.1-26	2.5-6.3	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45			
13	9/AX MUL/TR	6.1-26	2.5-6.3	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45		
13	10/AX ML/TR	6.1-26	2.5-6.3	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	
13	11/AX ML/TR	6.1-26	2.5-6.3	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45	2.5-45

For More information:

Lawrence Whiteside

Travel Information Unit, Asset Management Division

Michigan Department of Transportation

whitesidel@michigan.gov

Phone: 517-373-2272

www.michigan.gov\adtmaps

www.michigan.gov\mdot-tmis

Using Vehicle Class Data for Pavement Deterioration and Other Purposes

Roger D. Mingo, P.E.

R.D. Mingo and Associates

People Interested in Class Data

- Data Providers– Collectors and Compilers Who Strive Constantly for More and Better Data

- Data Users– Analyze Trends, Plan Highways, or Formulate Policies Based on Trends

People Interested in Class Data

- Data Providers– Collectors and Compilers Who Strive Constantly for More and Better Data
- Data Users– Analyze Trends, Plan Highways, or Formulate Policies Based on Trends
- Data Dabblers– Every So Often, Gather and Analyze as Much Data as Possible for Some Specific Purpose

Examples of Why We Dabble

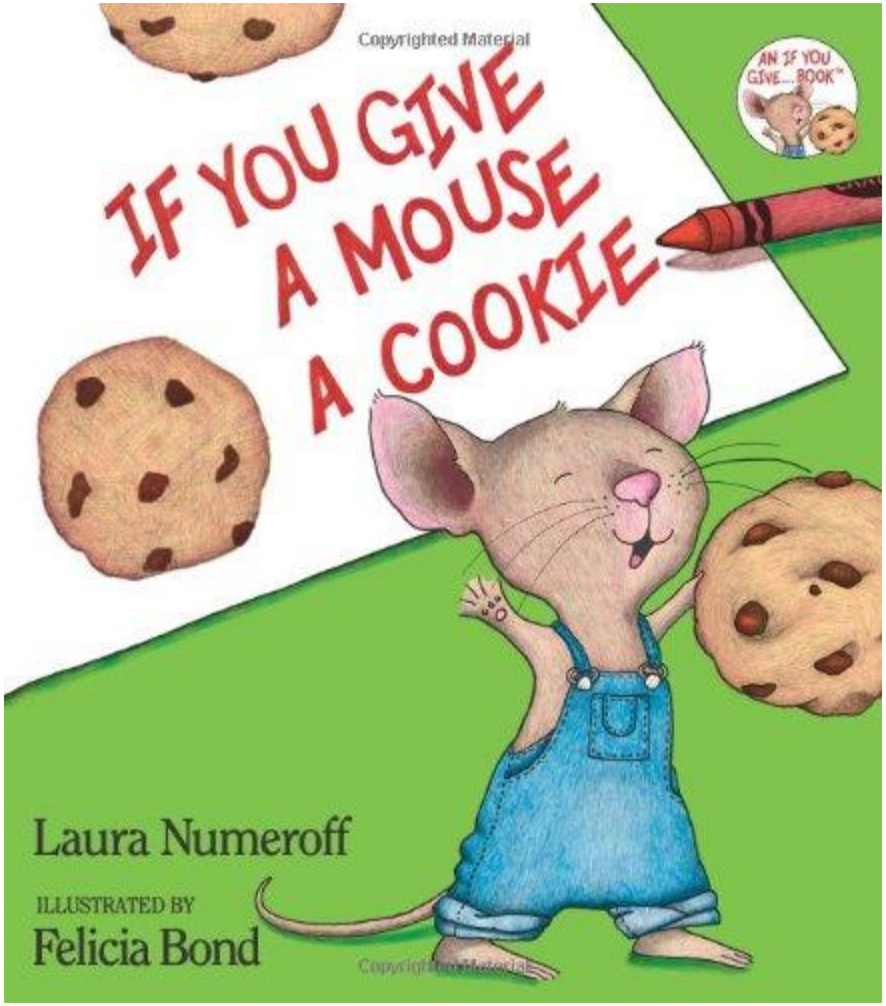
- Highway Cost Allocation (HCAS)– How much highway resource does each class of highway user consume?
- Truck Size and Weight (TSW) Policy– If we allow bigger trucks / heavier trucks / heavier axle loads, what happens to our highways and highway users?

Simple Questions, Simple Needs

- Travel by Vehicle Class– Typical HCAS or TSW studies need more than 13 vehicle classes
- Vehicles on Various Highway Types– Vehicles have different travel patterns and impacts on different types of highways
- Vehicle Weights and Axle Weights– Pavement, bridge, and interference impacts vary by vehicle weight, axle weights, and axle spacings.

Bottom Line: Insatiable Demand

- VMT Array Needed– Travel by 28 vehicle classes, 12 highway classes, and 51 states / colonies
- More Detail– Break down vehicle class travel by 100 operating weight groups, and develop a characteristic array of 120 axle weights / types for each
- Quality Compromise– Better data allows better analysis, and therefore better decisions.


Copyrighted Material
IF YOU GIVE
A MOUSE
A COOKIE
AN IF YOU GIVE... BOOK™
Laura Numeroff
ILLUSTRATED BY
Felicia Bond

Path from VM1 and VM2 Tables

- VM2 Tables– Contain FHWA estimates of travel by all vehicles in each state and highway type
- Classification Data– If complete and accurate, would get us half way to the large VMT array we need
- WIM Data– Allows finer breakdown of vehicle types and provides operating weight and axle weight details

Role of Class Data

- More Detail than Counts– Traffic counts alone provide limited value to studies of trucks
- More Spatial Coverage than WIM– In the latest (December 2013) sweep of data compiled by FHWA, we got nearly 2400 class stations, only 451 WIM stations (plus 19 LTPP WIM stations).
- Can Work with WIM– Weights of axles, combined with spacings, provide opportunity for improved classification accuracy

Limitations of Class Data

- Difficult to Compile and Extract– VTRIS, TMAS, dbf formats, file name variety
- Incomplete Coverage–2400 compiled class stations cover only 220 of cells in the state / functional-class (612 needed)
- High Error Rate for Some Classes– Catchall class 13 has been a historic problem (better, though, when class 14 is used)

Improvements?

- 13 Classes?– Get rid of "catchall classes". Don't overreach.
- Aggregate / Disaggregate?– Maybe, but much value comes from the raw data
- Length Based?– What else is there?
- Critical Needs of Dabbler Community?–More data, more accessibility, more housekeeping

LOOP and LENGTH based vehicle classification

TPF - 5(192)

2014 NATMEC Conference – Classification Workshop

Scott Petersen, P.E.

June 29, 2014

Project Team

- Gene Hicks, Mn/DOT Project Manager
- Steven Jessberger, FHWA
- Erik Minge, SRF Consulting Group
- Scott Petersen, SRF Consulting Group
- Herb Weinblatt, Cambridge Systematics
- Benjamin Coifman, Ohio State University
- Earl Hoekman, EL Enterprises

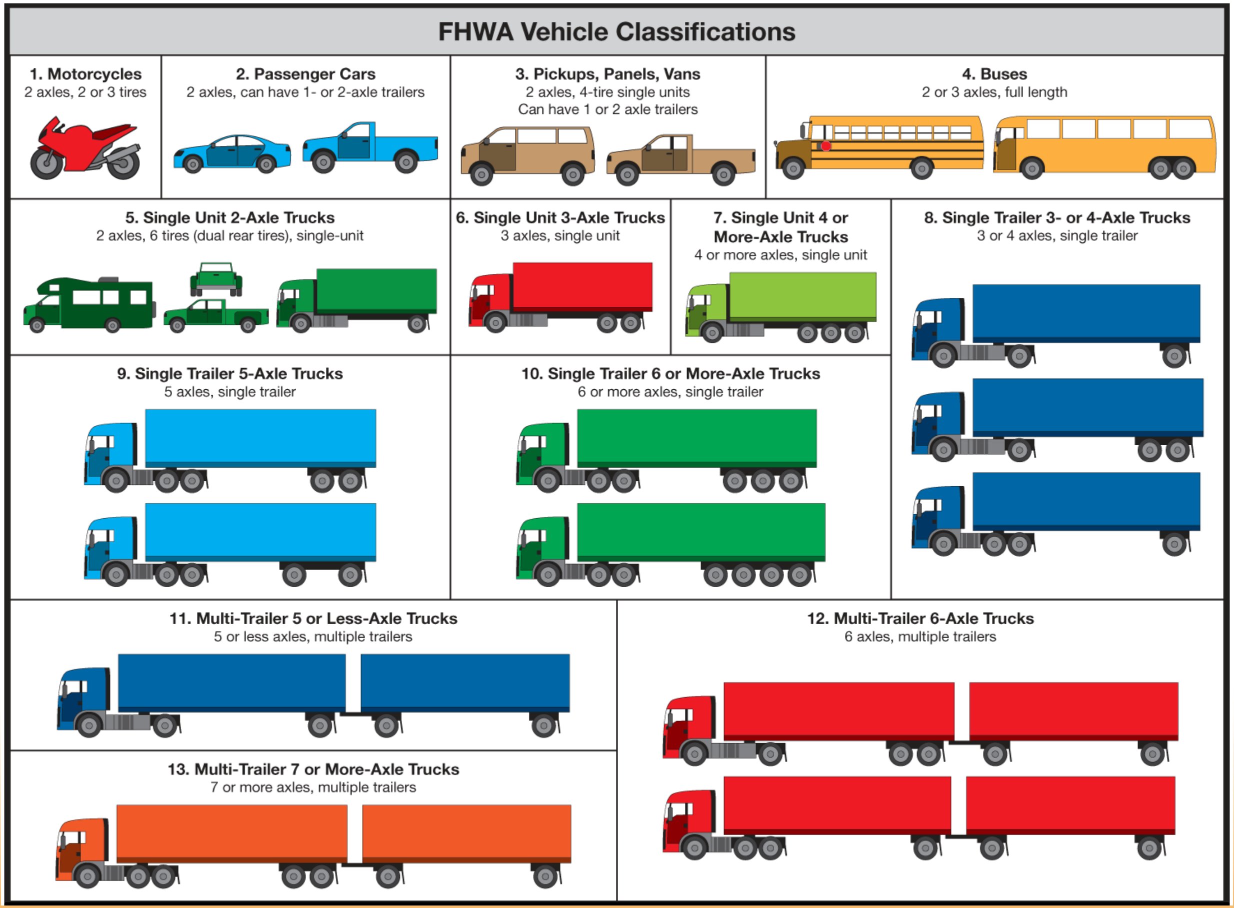
Participating Agencies/TAC

- Maryann Dierckman, Alaska
- Aaron Moss, Colorado
- Anne-Marie McDonnell, Connecticut
- Steven Bentz, Florida
- Jack Helton, Idaho
- Rob Robinson, Illinois
- Jim Kramer, Michigan
- Gene Hicks, Minnesota
- Kurt Matias, New York
- Dave Gardner and Lindsey Pflum, Ohio
- Andrea Bahoric, Pennsylvania
- Bill Knowles, Texas
- Ken Lakey, Washington
- John Williamson, Wisconsin
- Mark Wingate, Wyoming

Literature Review

- Loop Characteristics
- Loop Detector Errors
- Length Classification Issues
- Inductive Signature-Based Detectors
- Non-Loop Detectors
- Uses for Length-Based Classification

Traditional Classification Method
FHWA 13 Class Scheme



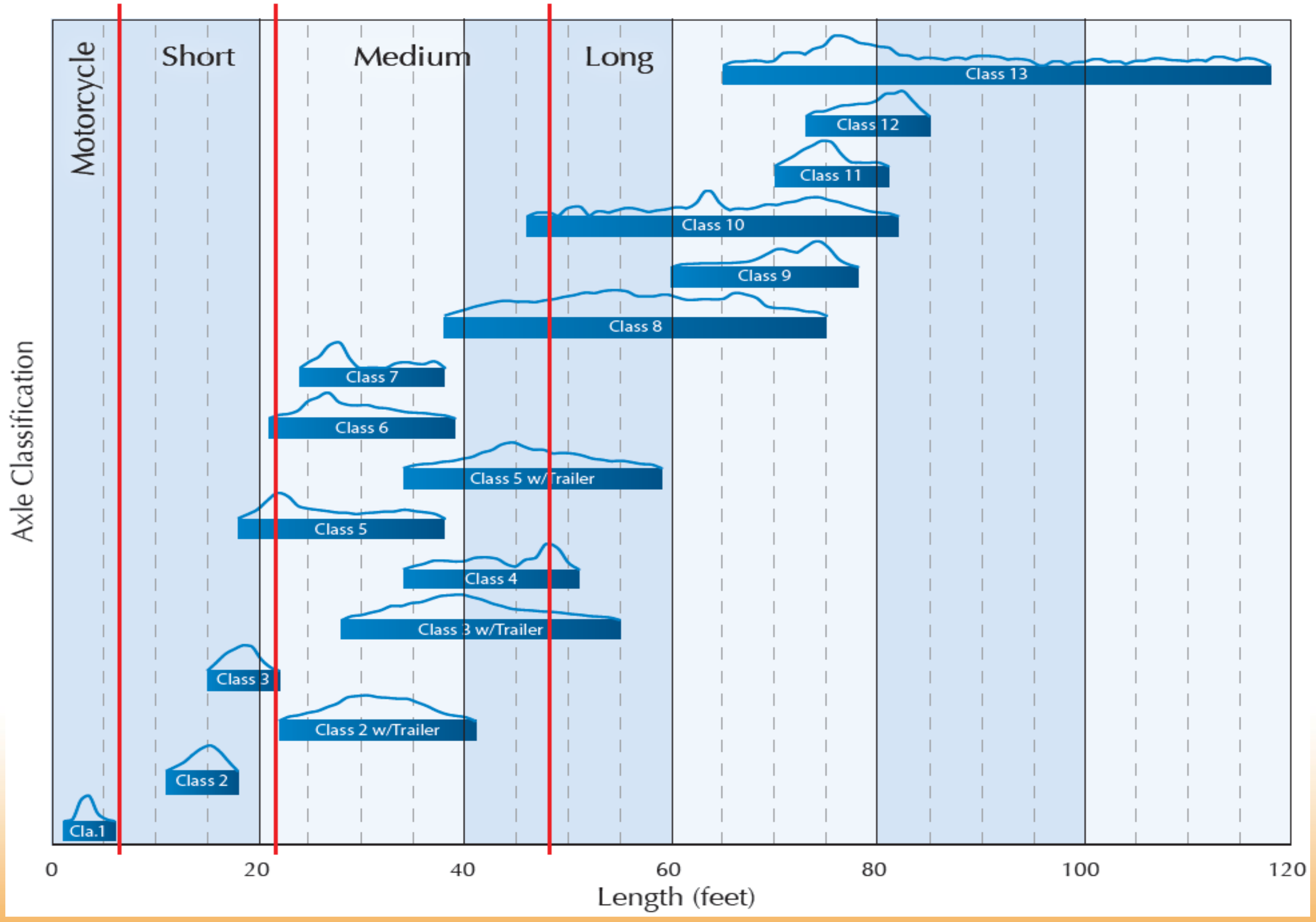
Proposed Length Bins
What length thresholds should be used?

<table>
<tr><th colspan="6">LBVC Scheme</th><th rowspan="2">Corresponding Axle Classes</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>MC</td><td>MC</td><td>MC</td><td>MC</td><td>MC</td><td>MC</td><td>1</td></tr>
<tr><td rowspan="2">S</td><td rowspan="2">S</td><td rowspan="2">S</td><td rowspan="2">S</td><td>A</td><td>A</td><td>2</td></tr>
<tr><td>LT</td><td>LT</td><td>3</td></tr>
<tr><td rowspan="2">M</td><td rowspan="2">M</td><td>M</td><td>M</td><td>M</td><td>M</td><td>3T, 5-7</td></tr>
<tr><td>ML</td><td>ML</td><td>ML</td><td>ML</td><td>4</td></tr>
<tr><td rowspan="2">L</td><td>L</td><td rowspan="2">L</td><td>L</td><td rowspan="2">L</td><td>L</td><td>8-12</td></tr>
<tr><td>VL</td><td>VL</td><td>VL</td><td>13</td></tr>
</table>

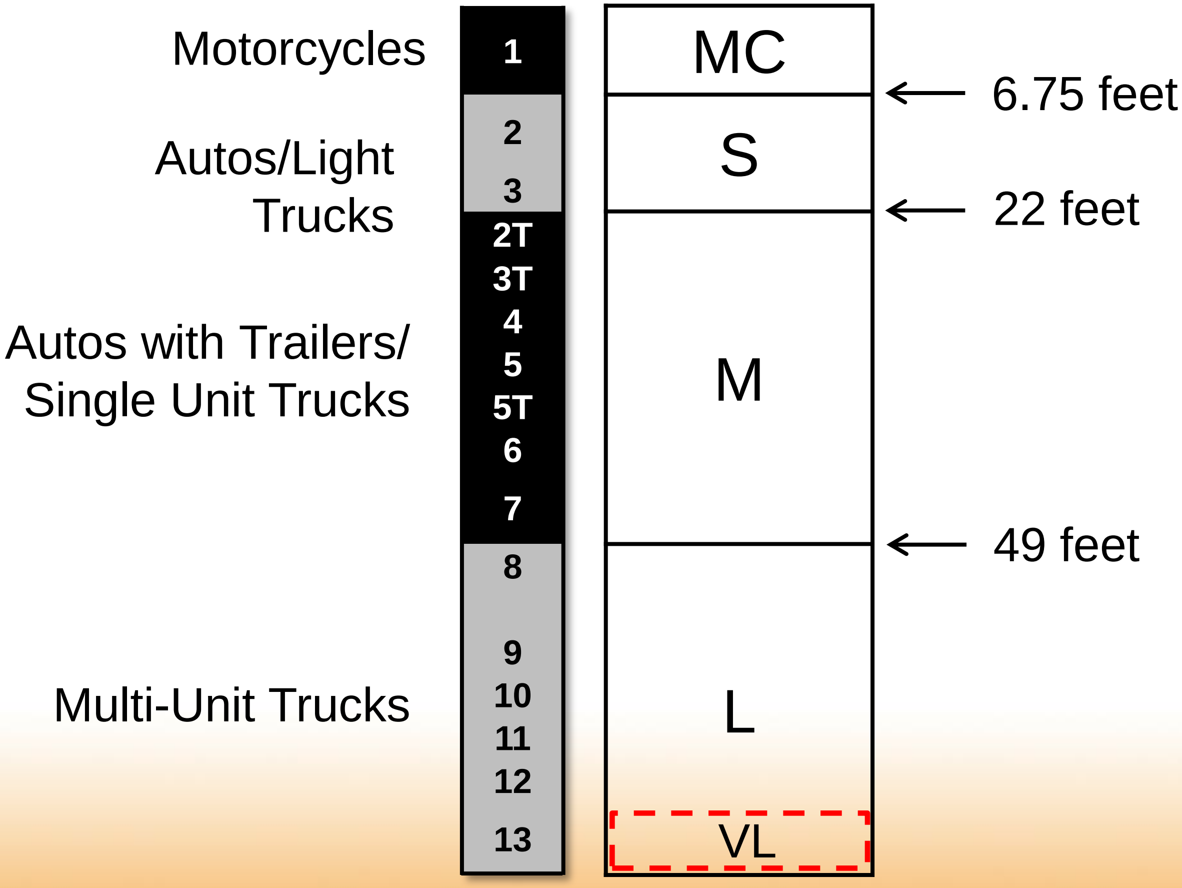
Proposed Length Bins
What length thresholds should be used?

LBVC Scheme 1	2	3	4	5	6	Corresponding Axle Classes
MC	MC	MC	MC	MC	MC	1
S	S	S	S	A	A	2
				LT	LT	3
M	M	M	M	M	M	3T, 5-7
		ML	ML	ML	ML	4
L	L	L	L	L	L	8-12
	VL		VL		VL	13

Vehicle Length Distribution by Class



Proposed Length Bins
What length thresholds should be used?



Proposed Length Bins
What length thresholds should be used?

Motorcycles — 1 — MC

← 6.75 feet

Autos/Light Trucks — 2, 3 — S

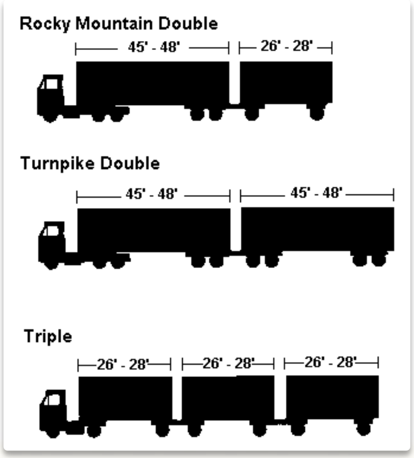
← 22 feet

Autos with Trailers/ Single Unit Trucks — 2T, 3T, 4, 5, 5T, 6, 7 — M

← 49 feet

Multi-Unit Trucks — 8, 9, 10, 11, 12, 13 — L

VL ← 85 feet?



Length Classes MC and S Threshold Results – LTPP Data

Axle Class	Length Bin				Total	Total
	MC	S	M	L		
1	6,047 92.8%	472 7.2%	0 0.0%	0 0.0%	6,518 100.0%	6,518
2	365 0.0%	2,047,028 100.0%	0 0.0%	0 0.0%	2,047,393 100.0%	2,647,020
3	0 0.0%	576,945 96.2%	22,683 3.8%	0 0.0%	599,627 100.0%	

Length Class M Threshold Results – LTPP Data

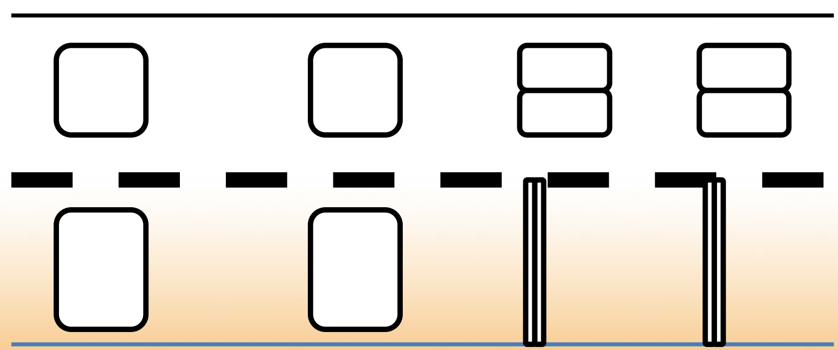
Axle Class	Length Bin				Total	Total
	MC	S	M	L		
2T	0 0.0%	460 1.9%	23,820 97.6%	114 0.5%	24,393 100.0%	250,991
3T	0 0.0%	34 0.0%	66,975 88.9%	8,315 11.0%	75,323 100.0%	
4	0 0.0%	1 0.0%	10,945 89.3%	1,304 10.6%	12,250 100.0%	
5	0 0.0%	21,747 24.0%	68.682 76.0%	0 0.0%	90,429 100.0%	
5T	0 0.0%	1 0.0%	11,130 65.0%	6,005 35.0%	17,135 100.0%	
6	0 0.0%	876 3.3%	25,554 96.6%	34 0.1%	26,463 100.0%	
7	0 0.0%	41 0.8%	4,951 99.1%	7 0.1%	4,998 100.0%	

Length Class L
Threshold Results – LTPP Data

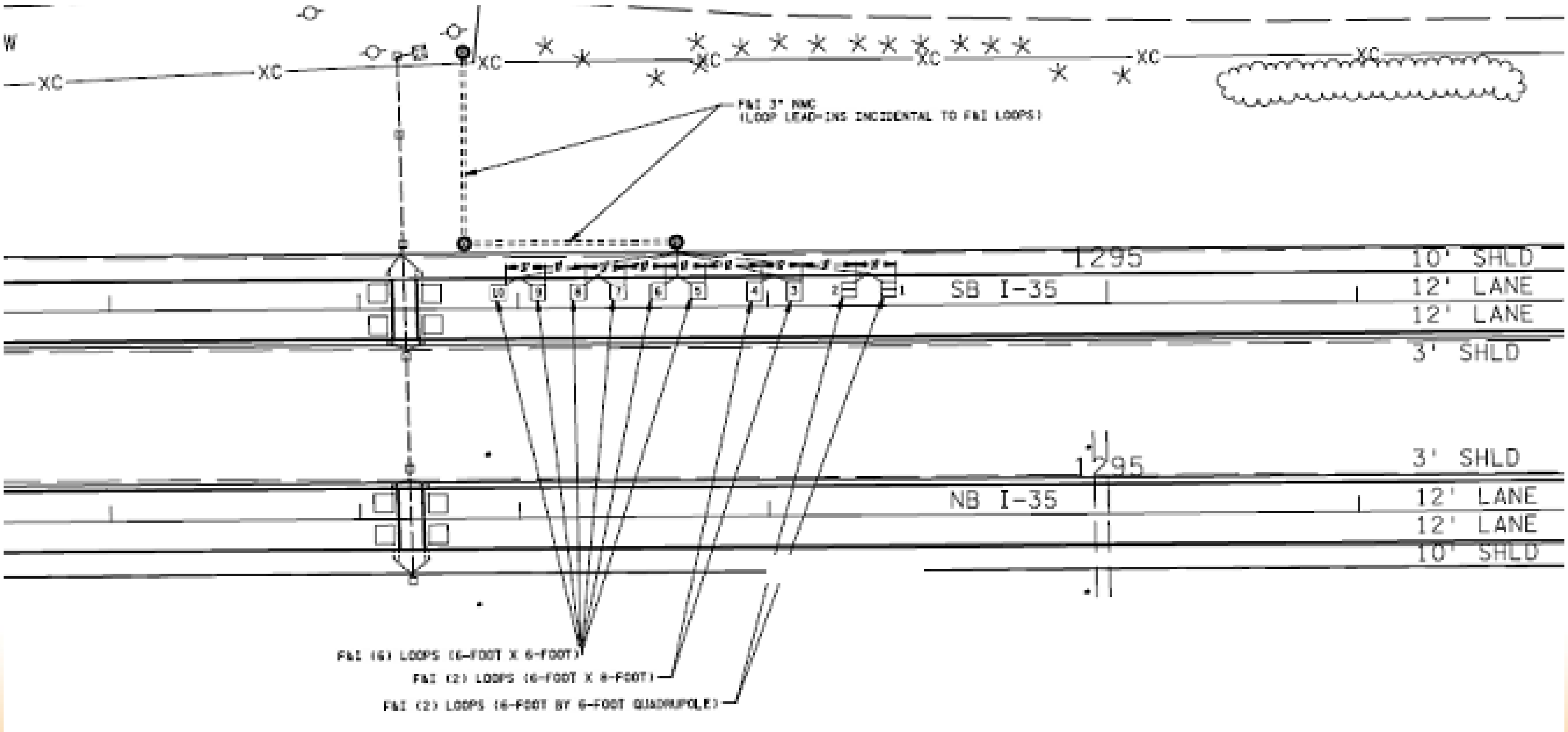
Axle Class	Length Bin				Total	Total
	MC	S	M	L		
8	0 0.0%	1 0.0%	9,982 22.1%	35,133 77.8%	45,116 100.0%	1,136,402
9	0 0.0%	0 0.0%	4,946 0.5%	997,264 99.5%	1,002,209 100.0%	
10	0 0.0%	0 0.0%	317 3.1%	10,003 96.9%	10,319 100.0%	
11	0 0.0%	0 0.0%	0 0.0%	52,263 100.0%	52,263 100.0%	
12	0 0.0%	0 0.0%	0 0.0%	23,923 100.0%	23,923 100.0%	
13	0 0.0%	0 0.0%	104 4.0%	2,468 96.0%	2,572 100.0%	

Field Test: How Accurate Are Length-Based Sensors?

- Detector Model
- Loop shape
  - 6’x6’
  - 6’x8’
  - Quadrupole
  - “Blade” Loop
- Loop lead-in length



I-35 Test Site Loop Layout (Wyoming, MN)



Field Test - Detectors

Loop Detectors	
Manufacturer	**Model**
Diamond	Phoenix I
Diamond	Phoenix II
GTT	Canoga C944
IRD	TCC-540
IRD	TRS
PEEK	ADR 3000

Non-Loop Detectors	
Manufacturer	**Model**
GTT	Canoga Microloops (C944 Card)
Vaisala/Nu-Metrics	Hi-Star NC200 ION
Vaisala/Nu-Metrics	Hi-Star NC300
Wavetronix	SmartSensor HD

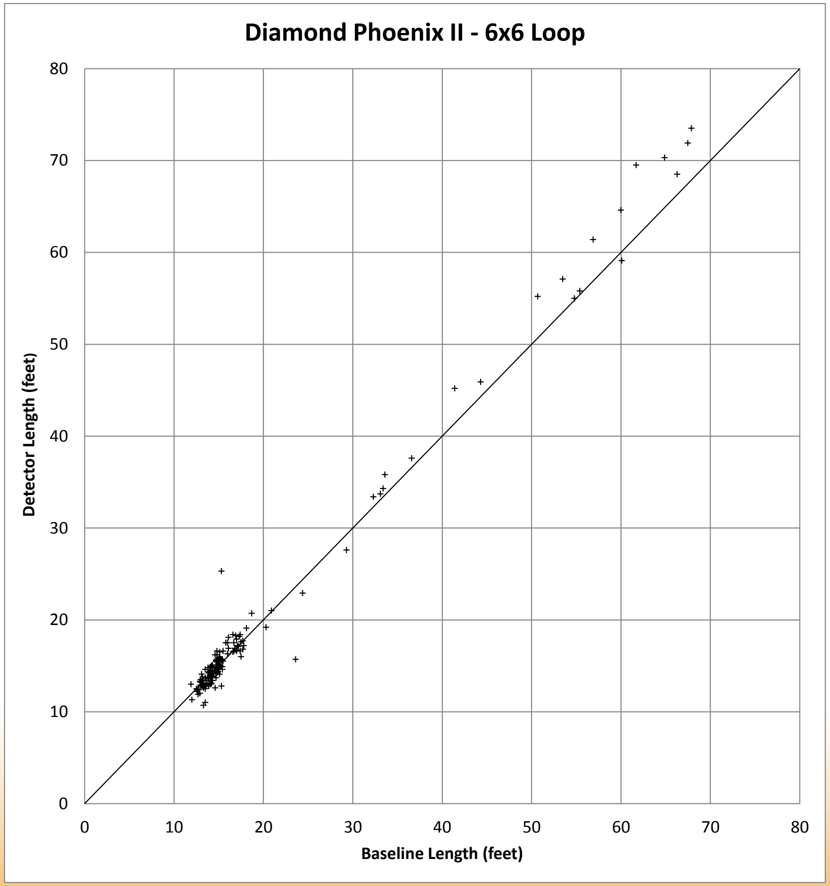
Field Test - Detectors

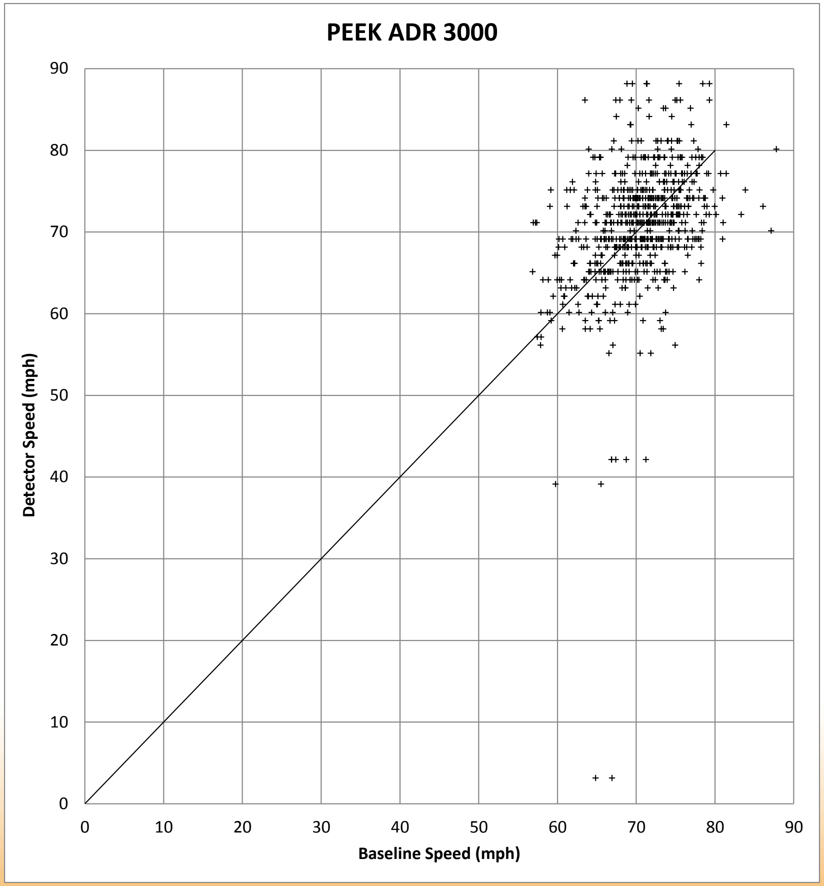
Inductive Signature Detectors	
Manufacturer	**Model**
Diamond	iLoop
IST	IST-222
PEEK	ADR 6000

Video Ground Truth

- High-resolution video screenshots
- Pixel-measurement
- Average absolute error 0.43 ft
- Errors generally within one foot

Loop Detector Field Test Results
Length and Speed





Loop Detector Field Results Normal Lead-In (200'-300')

Manufacturer	Model	6'x6' loops (feet)	6'x8' loops (feet)	Quadrupoles (feet)
Diamond	Phoenix I	1.24	1.79	3.5
Diamond	Phoenix II	1.74	1.09	Not Tested
GTT	Canoga C944	1.98	1.85	3.4
IRD	TCC-540	1.31	1.42	3.9
IRD	TRS	1.64	1.44	Did Not Function
PEEK	ADR 3000	1.34	2.05	3.8

Loop Detector Field Results
Long Lead-In (1,500')

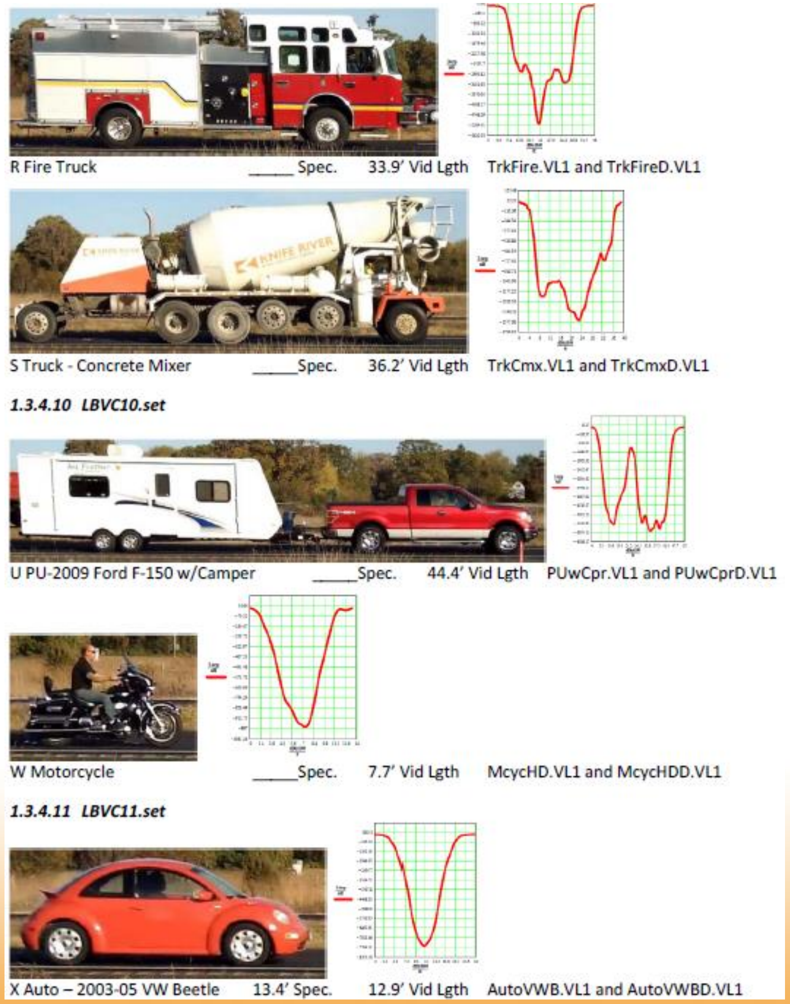
Manufacturer	Model	Average Absolute Length Error (feet)
Diamond	Phoenix I	0.97
Diamond	Phoenix II	1.18
GTT	Canoga C944	1.41
IRD	TCC-540	1.51
IRD	TRS	Not Tested
PEEK	ADR 3000	1.80

Inductive Signature Detector Results

Manufacturer/Model	Loop Configuration Tested	Average Absolute Error (feet)
Diamond iLoop	6'x6' Loops	1.61
IST IST-222	6'x6' Loops	1.32
PEEK ADR 6000	6'x6'/Quadrupole Combination	1.36

Laboratory Test Objectives

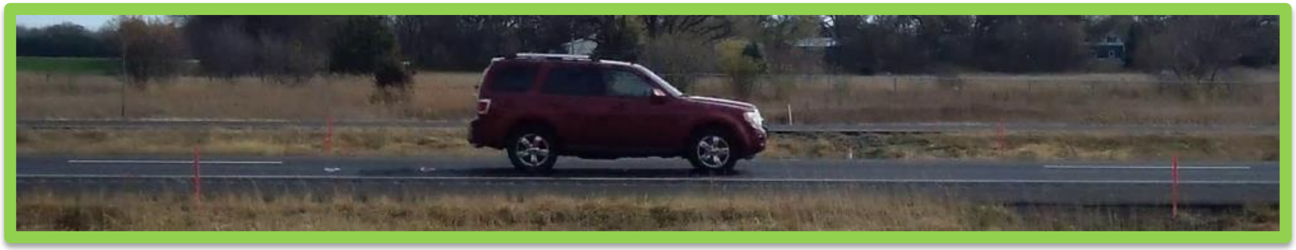
- Determine repeatability of detector data
- Directly compare detector results with same vehicle signatures



Laboratory Results - Length

Laboratory Results - Speed

Calibration Procedure
Probe Vehicle Selection and Procedure



Conclusions

- Length classification is less precise than classification by axle spacing and/or weight
- Significant overlap between lengths among various axle classes
  - Passenger vehicles with trailers classified as Medium
  - Selected length scheme thresholds designed to balance misclassification

Conclusions

- When calibrated, loop detectors report accurate vehicle lengths
  - Average absolute error less than two feet across all vehicles
- Calibration is an important step
  - Select a calibration vehicle that has a magnetic length that is close to the physical length (auto, semi w/lowboy)
- 6'x6' and 6'x8' loops offer excellent length detection performance and should continue to be installed
  - Benefit to motorcycle detection with 6'x8' loops

Contact

Scott Petersen, SRF Consulting Group

spetersen@srfconsulting.com

Gene Hicks, Mn/DOT Project Manager,

gene.hicks@state.mn.us

Erik Minge, SRF Consulting Group

eminge@srfconsulting.com

Herb Weinblatt, Cambridge Systematics

hweinblatt@camsys.com

2014 NATMEC Classification Workshop

June 29, 2014

Chicago, IL

Overview Class Data Collection, Usage and Issues

NATMEC 2014

Improving Traffic Data Collection, Analysis, and Use

Tianjia Tang, PE, Ph.D.

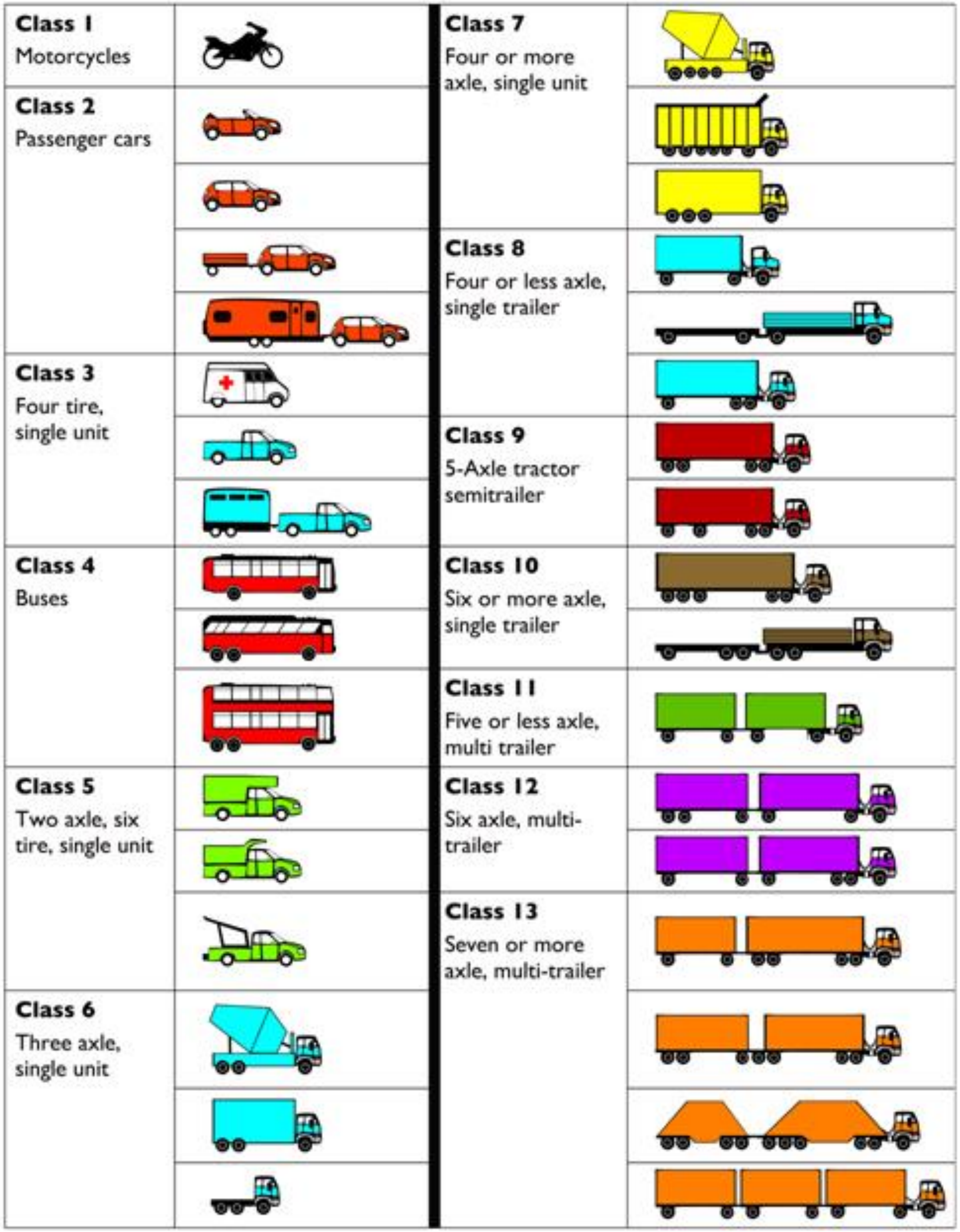
Chief, Travel Monitoring and Surveys Division

Office of Highway Policy Information, Federal Highway Administration

Tianjia.Tang@DOT.GOV

Objective

1) To review whether the current system still meets the needs,
2) How to take advantage of current data capturing technology ,
3) What new technology and policy program and initiatives both the private and public sectors should focus on.



Class 1
Motorcycles
Class 2
Passenger cars
Class 3
Four tire, single unit
Class 4
Buses
Class 5
Two axle, six tire, single unit
Class 6
Three axle, single unit
Class 7
Four or more axle, single unit
Class 8
Four or less axle, single trailer
Class 9
5-Axle tractor semitrailer
Class 10
Six or more axle, single trailer
Class 11
Five or less axle, multi trailer
Class 12
Six axle, multi-trailer
Class 13
Seven or more axle, multi-trailer

Data Reported to FHWA

I. **HPMS** - 6 Vehicle Groups:
   MC, Bus, LD-SWB, LD-LWB, SUV, and CT

2. **WIM** – all 13 Vehicle Types

3. **Volume** – 1

4. **Class** – 13 vehicle types

FHWA Usage

- Fund Apportionment – actual apportionment and legislative scenario analysis
- Safety analysis
- Cost allocation analysis
- Trending analysis
- Fuel consumption
- Greenhouse gas emission
- Fuel efficiency
- Others

Highway Noise Modeling

Five vehicle types

1. automobiles,
2. medium trucks,
3. heavy trucks,
4. buses,
5. motorcycles

Air Quality Modeling

EPA's MOVES Model

SourceType ID	SourceType
11	Motorcycles
21	Passenger Cars
31	Passenger Trucks (primarily personal use)
32	Light Commercial Trucks (other use)
41	Intercity Buses (non-school, non-transit)
42	Transit Buses
43	School Buses
51	Refuse Trucks
52	Single Unit Short-haul Trucks
53	Single Unit Long-haul Trucks
54	Motor Homes
61	Combination Short-haul Trucks
62	Combination Long-haul Trucks

Air Quality Modeling

SourceType ID	SourceType	HPMS Vehicle Class
11	Motorcycles	Motorcycles
21	Passenger Cars	Passenger Cars
31	Passenger Trucks (primarily personal use)	Other Two-Axle/Four Tire, Single Unit
32	Light Commercial Trucks (other use)	Other Two-Axle/Four Tire, Single Unit
41	Intercity Buses (non-school, non-transit)	Buses
42	Transit Buses	Buses
43	School Buses	Buses
51	Refuse Trucks	Single Unit
52	Single Unit Short-haul Trucks	Single Unit
53	Single Unit Long-haul Trucks	Single Unit
54	Motor Homes	Single Unit
61	Combination Short-haul Trucks	Combination
62	Combination Long-haul Trucks	Combination

Transportation Demand Modeling

System wide – POV, bus and truck most likely

Project level – may be as "automobiles, medium trucks, heavy trucks, buses, and motorcycles."

Roadway Geometric Design

- # of lane - volume only
- Lane width – POV and truck %
- Horizontal curvature – volume only and design vehicle
- Vertical curve – % of truck only.

Roadway Pavement Design

- **AASHTO ESAL method** (1993 AASHTO Design Guide): single axles, Tandem axles, and Triple Axles
- **Asphalt Institute Handbook** – same as AASHTO
- **AASHTO Mechanistic and Empirical Design** – FHWA 13 vehicle types

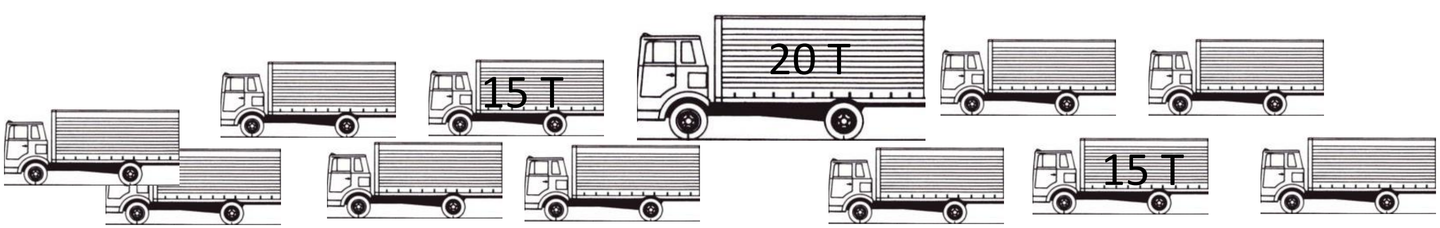
Bridge Design (2 types)

Standard Specifications for Highway Bridges AASHTO - three types of design vehicles loads.

1: H Truck - two axle 20-ton configuration and 15 – ton Configuration

2: HS Truck - conventional semi- or tractor-trailer vehicle

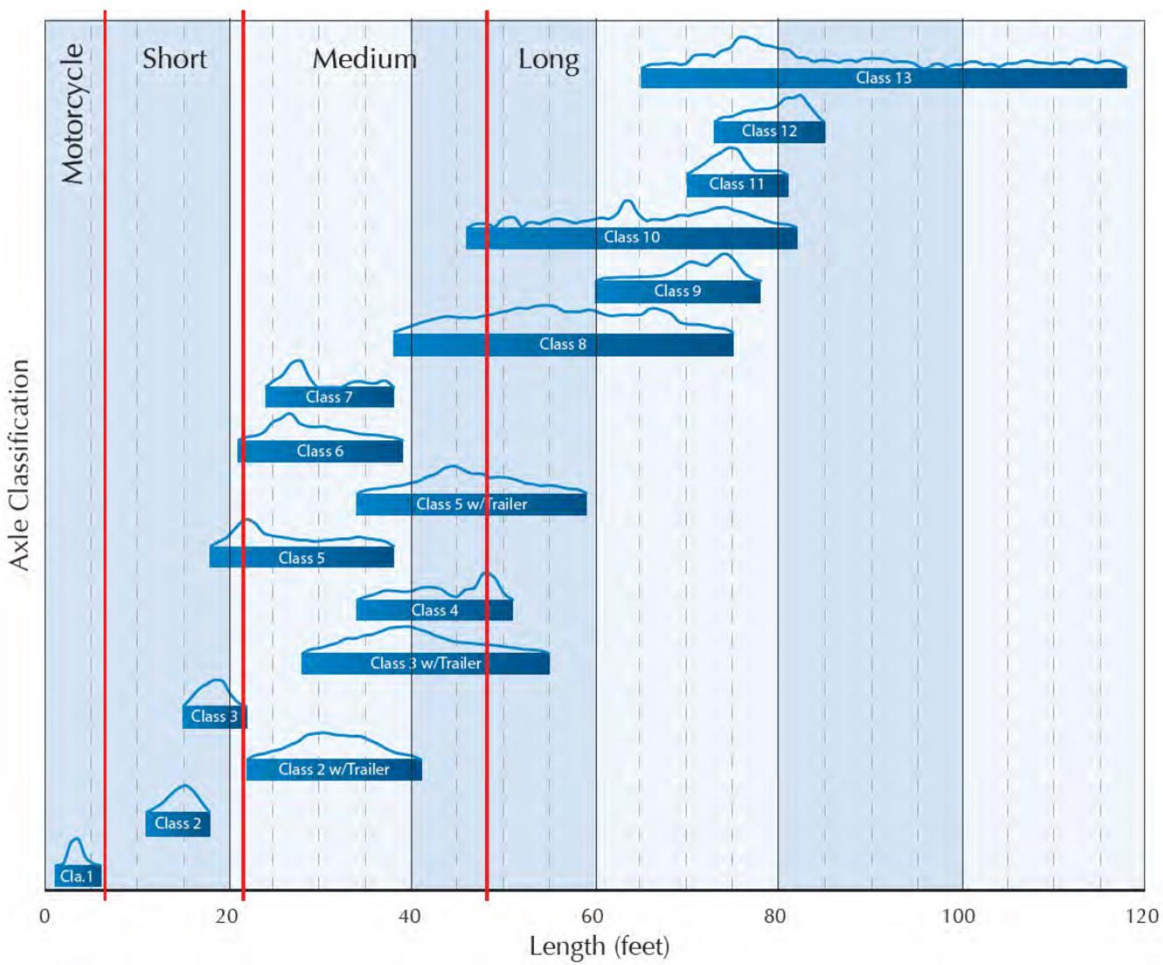
3: String arrangement vehicle groups



Pavement/Bridge Deterioration Analysis

No fixed number of vehicle categories. In theory, the more class, and the more class with both axle weight and gross vehicle weight, the more precise correlations can be drawn.

New Phenomena TPF5192 MN DOT Pool Fund Study



Vehicle Length by Axle Classification

What We Should Do

Classification Expert Panel Natmec Workshop

Overview of Wisconsin's Continous Count Program

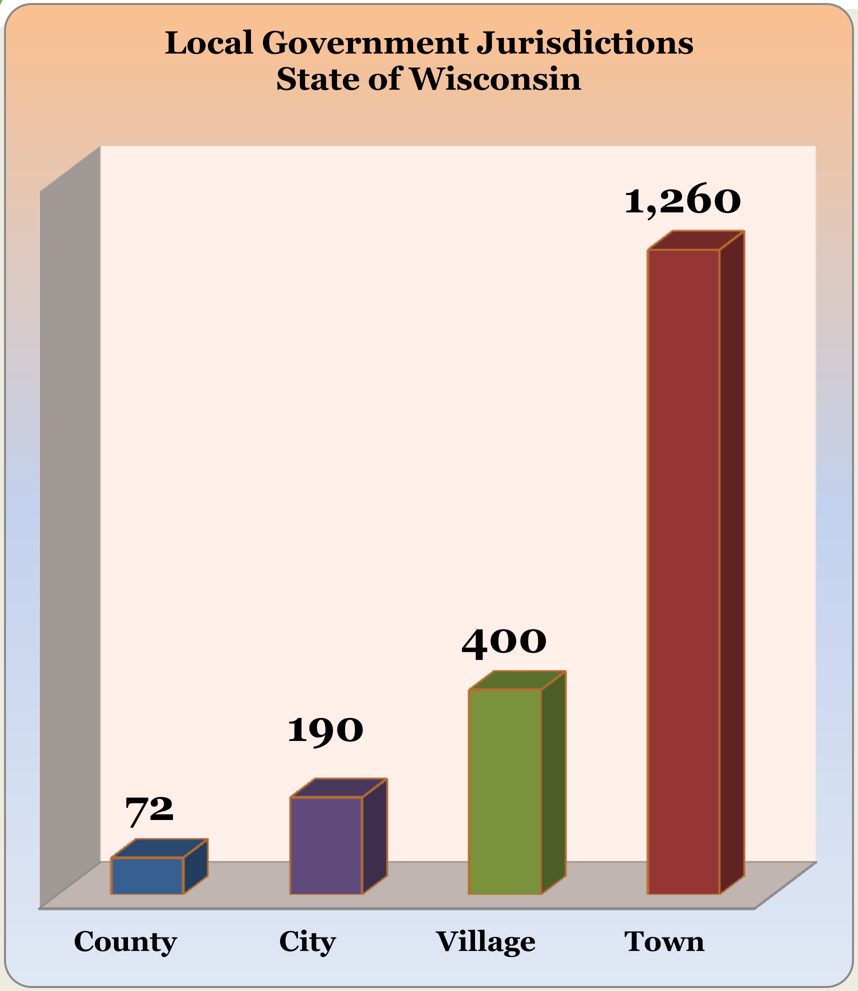
SUSIE FORDE, SECTION CHIEF OF DATA MANAGEMENT
WISCONSIN DEPARTMENT OF TRANSPORTATION

RHONDA MCDONALD, TRAFFIC DATA ANALYST
WISCONSIN DEPARTMENT OF TRANSPORTATION

STATE OF WISCONSIN PROFILE

System	Miles
Interstate	743
PA Freeway Expressway	573
PA Other	4903
Minor Arterial	7436
Major Collector	14879
Minor Collector	8621
Local	77.990
Total	**115,145**

Local / County Roads = 100,000+ miles



Data Management Section

Bureau of State Highway Programs

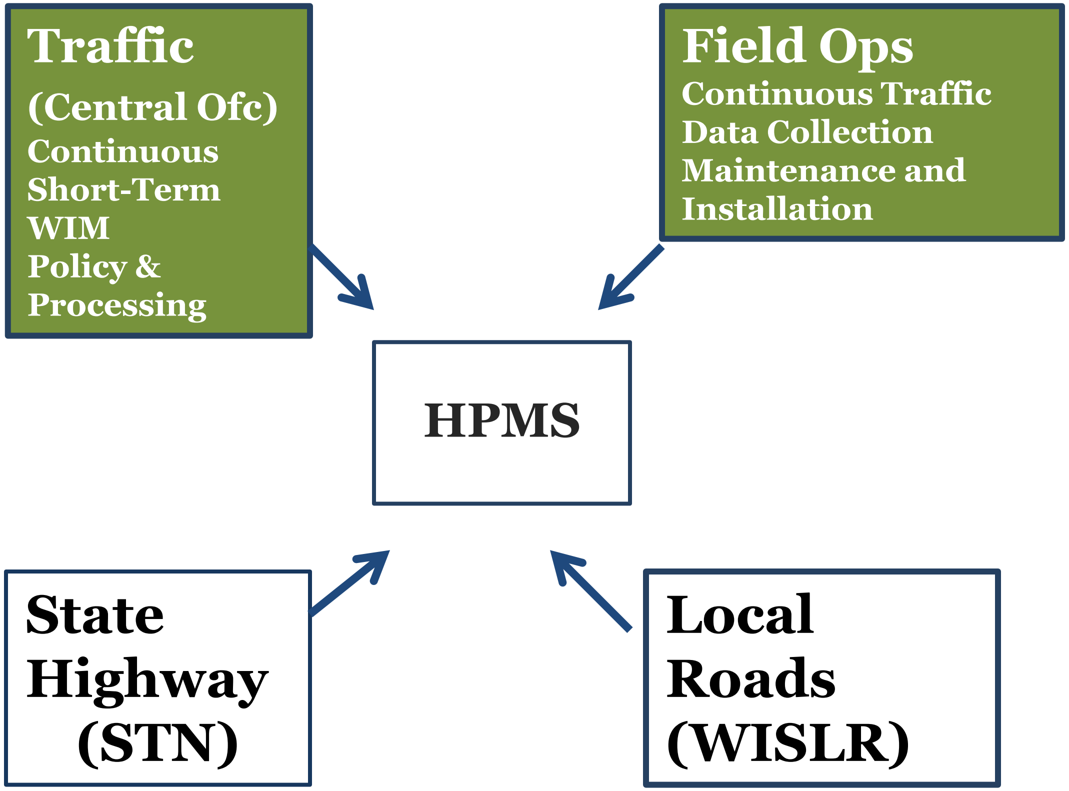
Roadway and Traffic Data Programs

Administer Statewide Policy and Guidelines for Roadway Data

Meet Federal & State Mandates

Process|Share Linework and Data

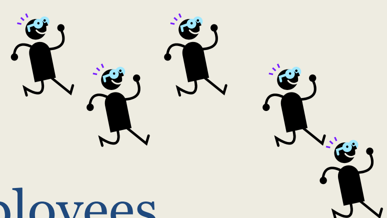
Submit Roadway Data to Federal Highways



WISDOT Traffic Data Staffing Levels

Central Office

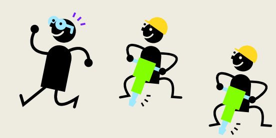
- Responsibilities
  - Administer Policy and Federal Guidelines
  - Oversee Contracts, Budgets
  - Process Continuous, Video, Short-Duration, WIM, and Special Counts



- Staffing Level
  - 4 Full Time Employees
  - 1 Seasonal Employee

Field Operations

- Responsibilities
  - Maintenance ATR Sites
  - Oversee Installation ATR and WIM Sites
  - Maintain Short-Term Equipment
  - Manage Materials and Supplies
- Staffing Level



  - 2 Full Time Employees
  - 1 Seasonal Employee

WisDOT Traffic Program Overview

Installation / Maintenance

- **Equipment**
  - Wavetronix
  - Diamond
  - Peek
  - Timemark (S-T)
- **Communications**
  - Data Remote
  - Sierra
- **Contract Oversight**

Data Collection

- **Short-Term**
  - 3-6-10 Cycle
  - (Even/Odd)
  - Download – VIAS
- **Continuous**
  - 24/7 – 365 Days/yr
- **WIM**
- **Specials**
  - Upon Request

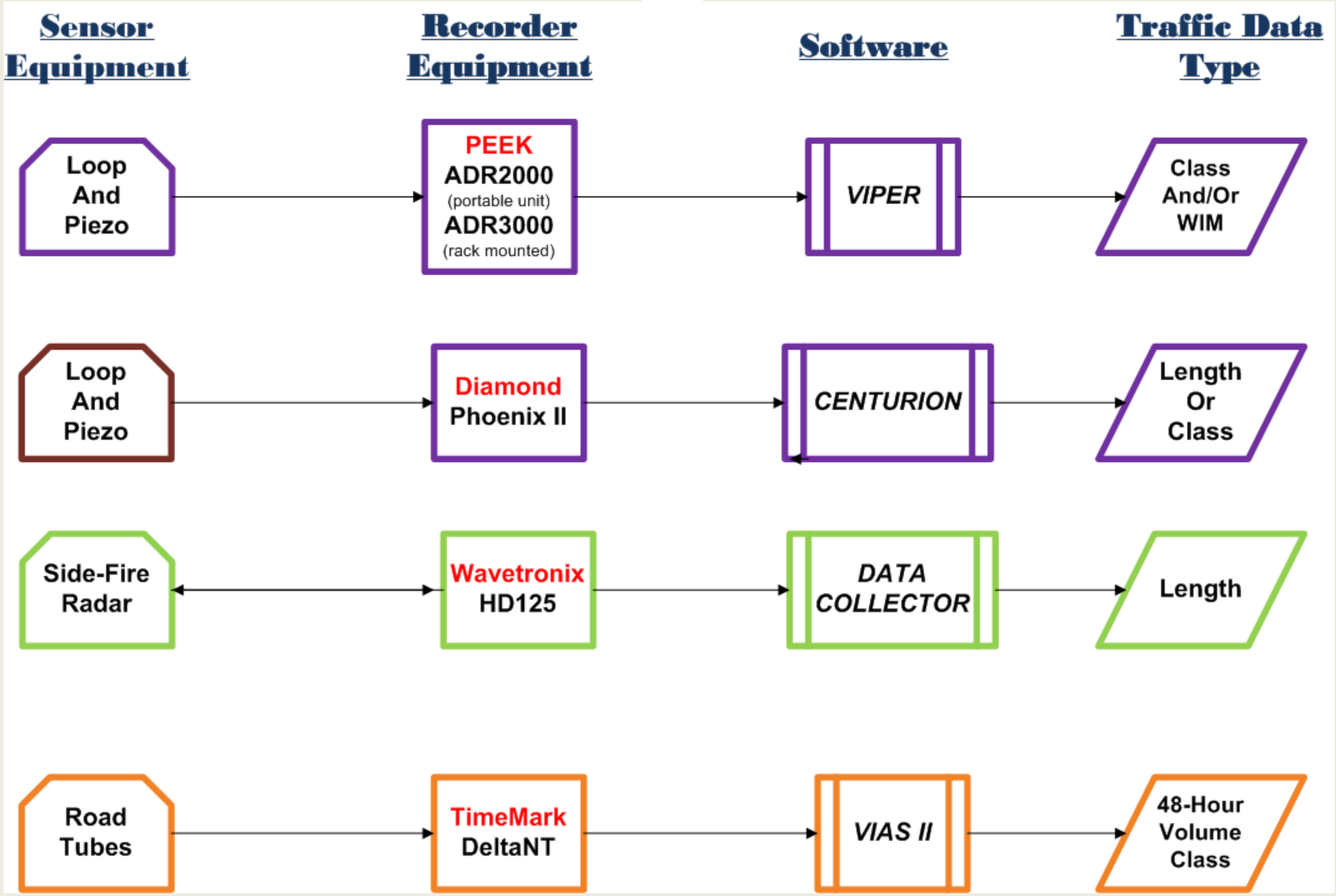
Production Processing

- **Autopolling**
  - Datacollector
  - Centurion
  - Viper
- **TRADAS Process**
  - Daily
  - Troubleshoot
  - Reprocessing
  - Monthly
  - Annual
- **Quality Control**
  - Preliminary AADT to Prior Final AADT
  - Corridor
  - TRADAS Edits

Outputs

- **Federal**
  - TMAS
  - HPMS
- **Internal**
  - Local Road System
  - Forecasting VMT
  - Pavement Design
  - Hwy Programming
  - Regional Planners
  - Safety Engineers
- **External**
  - Tribal
  - MPOs
  - RPCs
  - Public
  - Consultants

Data Equipment Schematic



WISDOT QUALITY CONTROL PROCESS

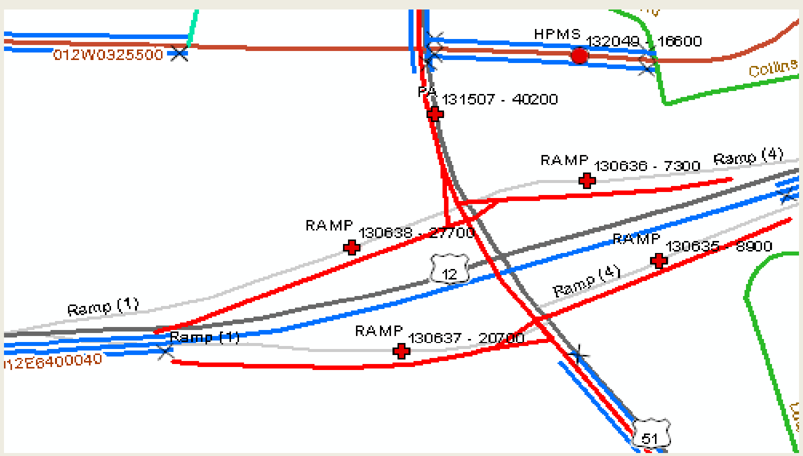
% Change report

Wisconsin Department of Transportation

% Change for Counts Taken between 06/13/2013 and 06/13/2014

Region	County	Station ID	Count Cycle	Location	Cnt Date	CAADT	Prev Yr	Prev AADT	Pct Chg
SW	La Crosse	321000	A-6E-V-MA	CTH DH BTWN CTH HD & CTH V HOLMEN	5/19/14	362	2011	3700	-90.22
SW	La Crosse	322062	A-3-V-HPMS	ENTERPRISE AVE NORTH OC COMMERCE ST ONALASKA - HPMS	6/2/14	1557	2011	8232	-81.09

GIS – PLOTTING (corridor)

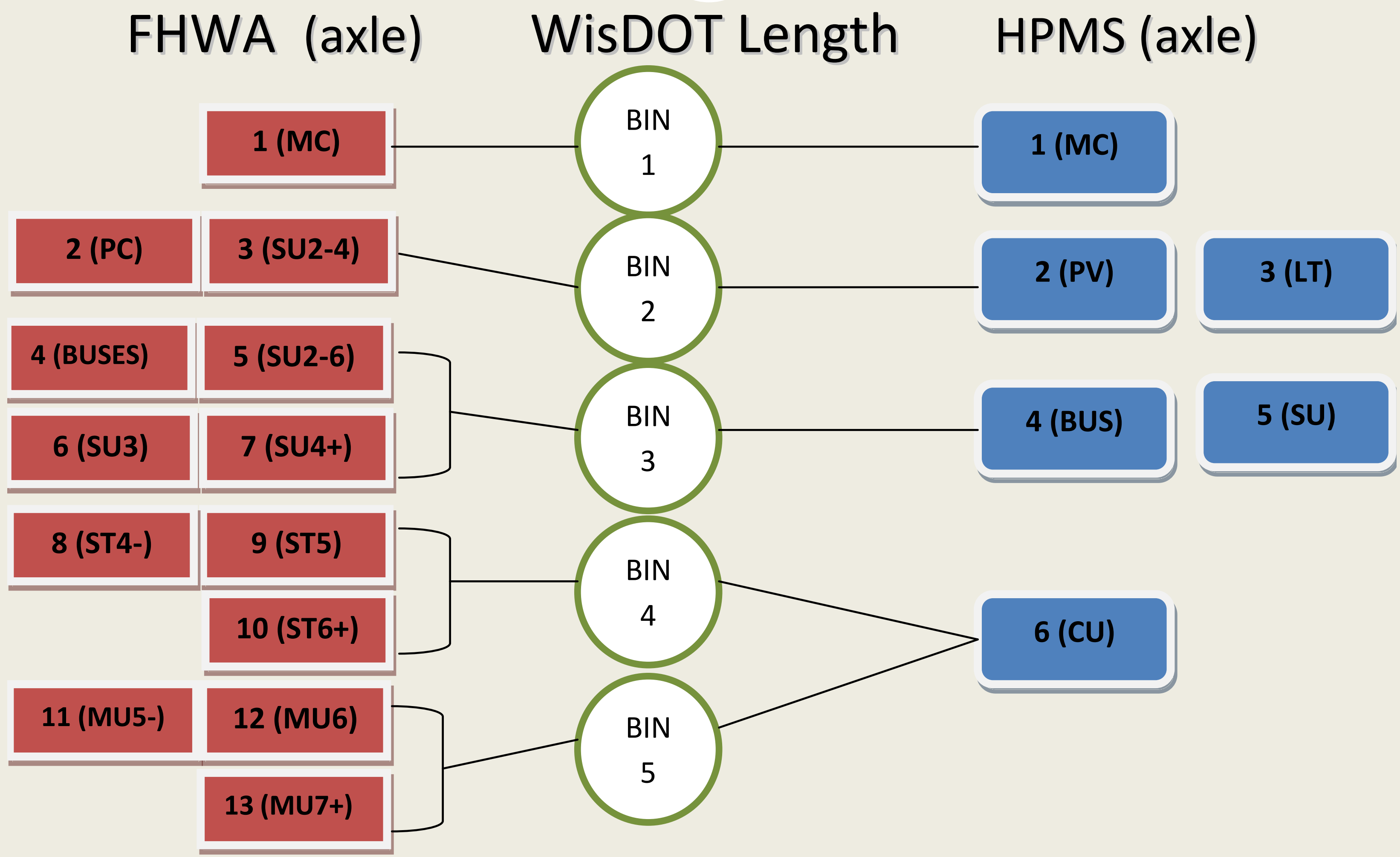


PROCESS DOCUMENTATION

Bureau of State Highway Programs
Data Management Section

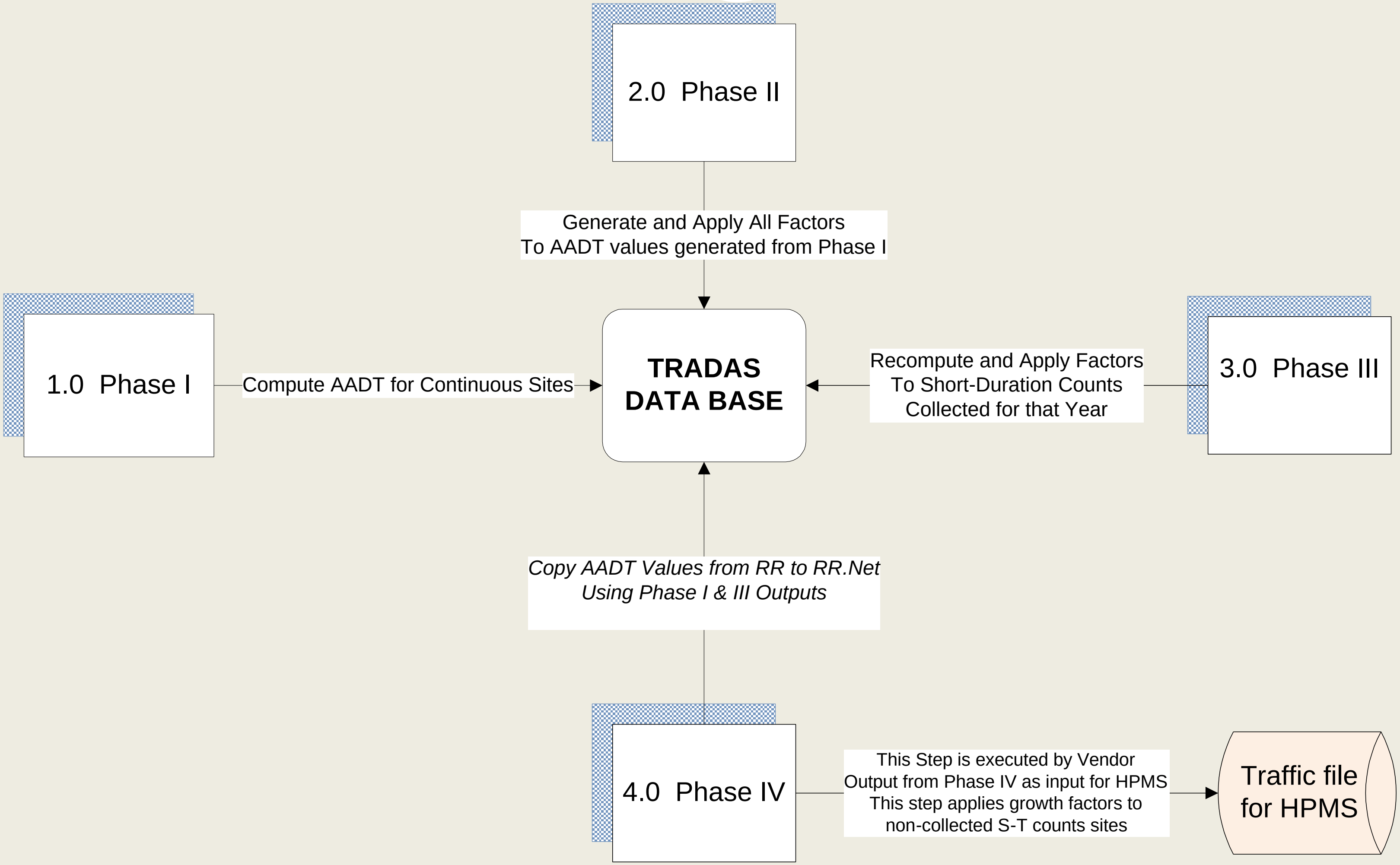
Process Documentation
Traffic Data System (TRADAS)

WisDOT Continuous Axle & Length Schemes



FACTORS APPLIED

TRADAS Annual Processing



Reporting Of WisDOT Traffic Data

MONTHLY

- TMAS
- REGION REPORTS

Quarterly

- TAFIS
- Meta

ANNUAL

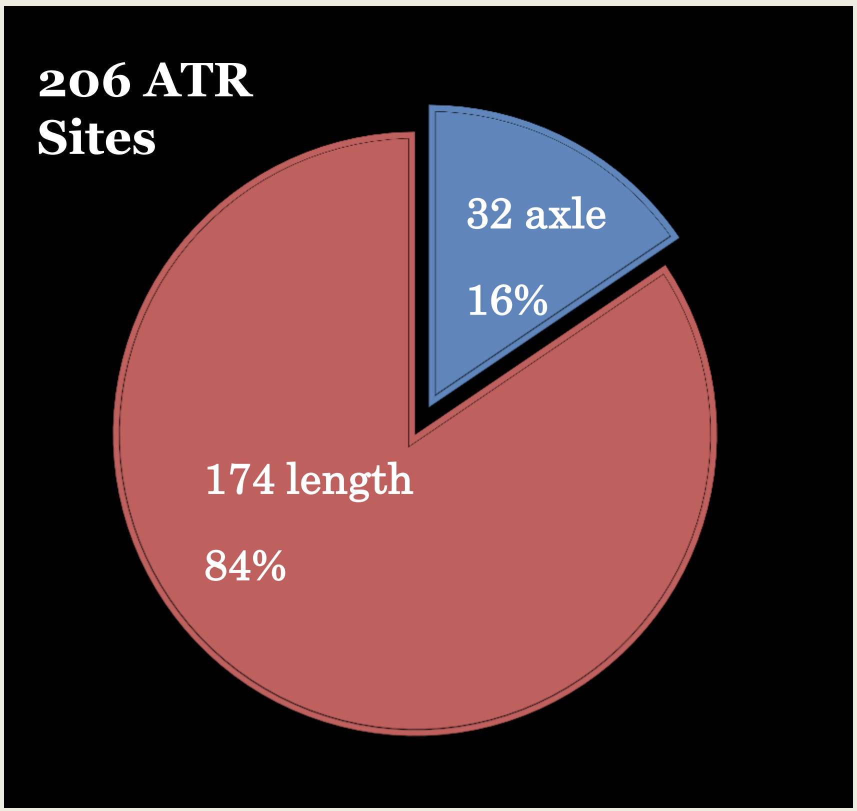
- RR WEB (short-term)
- Continuous Count Data
- HPMS
- WISLR (LR)
- CLASSIFICATION BOOK

Traffic Data Users

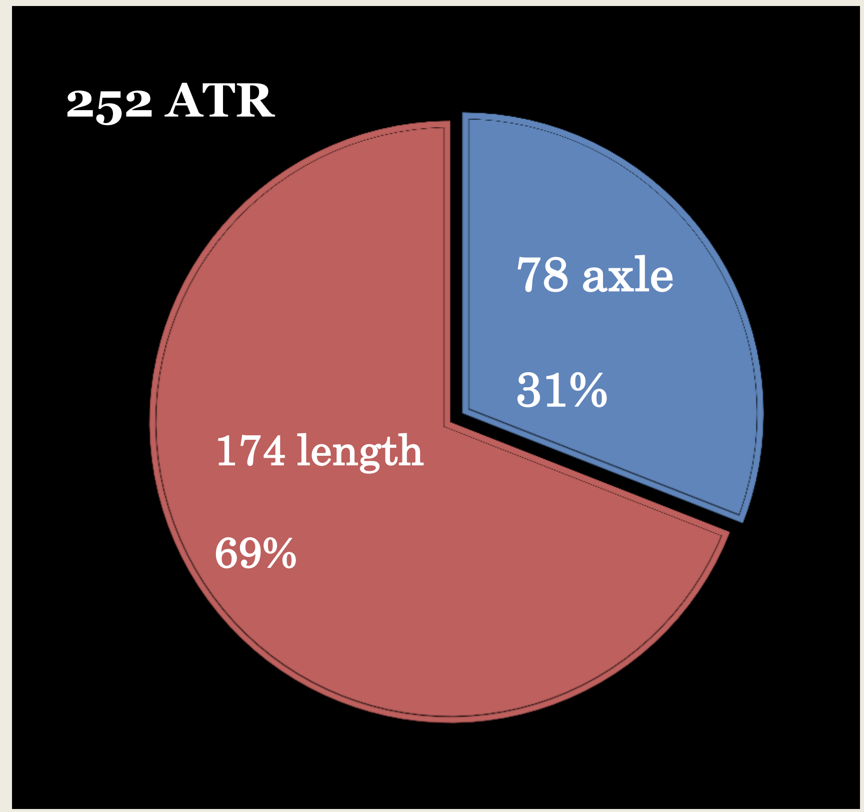
- **Uses**
  - Design
  - Safety
  - Operations
  - Expansion
- **Department**
  - Pavement Designers
  - Safety Engineers
  - Forecasting
  - Planning
- **External**
  - Federal Highways
  - Local Agencies
  - Developers

WISDOT Continuous Count Program

Current View of Axle to Length Percent Comparison



2016 Axle to Length Percent Comparison



Axle to Length Cost Comparison

	Average COST Install New 4-lane Site				
Type of Station	Contract Install	Materials	Recorder	Total	Net Difference
Axle	$24,000	$ 9,000	$ 2,200	$ 35,200	$ 16,900
Length	$7,000	$ 5,900	$ 5,400	$ 18,300	

	Average REPAIR COST 4-lane Site				
Type of Station	Contract / DOT Maint	Materials	Total	Net Difference	Total Net Diff Install + Maint Per Site
Axle	$21,500	$ 3,600	$ 25,100	$ 24,350	$41,250
Length	$500	$ 250	$ 750		

Axle

- Higher resolution (MC, Cars, Pickups, etc)
- Higher installation and maintenance costs
  - Lane closures
  - Timeliness of maintenance

Length

- Lower resolution (Passenger, Single-Unit, Combos)
- Lower installation and maintenance costs
  - Non-intrusive technologies reduce costs
  - Very few maintenance needs

Steps To Tune Continuous Count Program
Commitment to Quality Traffic Data

3. Review Traffic Program
- Increase Axle / Length Ratio: 31% / 69%
- By 2016 78 Axle / 174 Length

2. Contract with industry traffic data expert
- Analyze Wisconsin's Length to Axle data
- Recommendations to fine tune

2013	2014	2016

1. FHWA TMG Training
- Wisconsin Hosted: Iowa, Minnesota, Kansas
- *July 2013, La Crosse, Wisconsin*

Monday, 10:30 – Noon
Room: Montreaux 1

HOW GOOD ARE MY DATA?

WISCONSIN DOT CASE STUDY AND FINDINGS:

"UNDERSTANDING THE SIGNIFICANCE *OF CLASS VERSUS LENGTH ON AXLE FACTORS* AND ITS EFFECT ON *AADT* TO ENSURE RELIABLE TRAFFIC DATA"