



# Transportation Pooled Fund Program

To create Web-based Traffic Data Visualization and Analysis Tools

## DRAFT Task 4 Report

Prepared for the Federal Highway Administration

By

Albany Visualization And Informatics Lab (AVAIL)

Lewis Mumford Center, University at Albany, SUNY

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*Catherine T. Lawson, Ph.D.*

*Chair, Geography and Planning Department*

*Director, Lewis Mumford Center*

*Director, Masters in Urban and Regional Planning (MRP) Program*

*AS 218 1400 Washington Avenue*

*Albany, New York 12222*

*(518) 442-4775*

*lawsonc@albany.edu*

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# INTRODUCTION

The Task 4 Report of the FHWA Transportation Pooled Fund Program, *To create Web-based Traffic Data Visualization and Analysis Tool*, is structured to solicit feedback on the web based tools being developed at AVAIL. This report includes a complete list of proposed tools and visualizations as well as images with links of those that are in the beta testing phase.

## 2 TASK 4: PROCESSES AND REQUIREMENTS

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- Scope of Work: The contractor shall deliver a functional requirement document that defines all functions of the proposed system and its components.

The Task 4 Report:

1. Presents an overview of various Client Modules (tools and visualizations) in development or proposed;
2. Creates a framework for discussion about optimal tools and visualizations;
3. Defines a final set of Client Modules;
4. Identifies all optimal tools and visualizations for development; and
5. Facilitates AVAIL’s effort to build the most informed and cutting-edge tool.

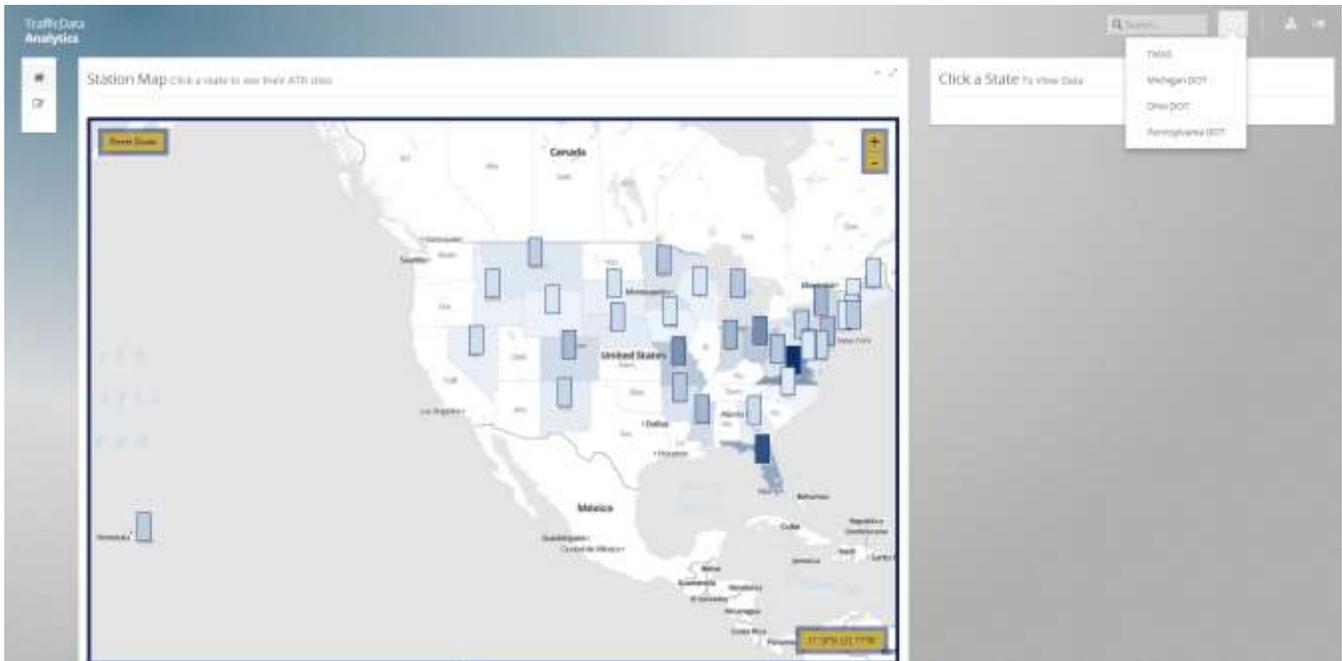


Figure 1 Web-Tool Landing Page

### 3 CLIENT MODULES

The Client Modules outlined in this report are in beta testing phase. The maps, visualizations, and web user interface designs are highly detailed approximations. All designs are open for discussion. Modules are currently at various stages of completeness. Some are in conceptualization mode, while others are fully programmed and web ready.

#### 3.1 DASHBOARD

The Dashboard allows the user to select a state and get an overview of the traffic monitoring system in that state.

##### 3.1.1 National Map

The National Map shows the current data set<sup>1</sup>, zooms to show all states with data available. States are choropleth shaded based on number of stations producing data, with darker states having more stations. This is a “slippy” map, with zooming and sliding capabilities.

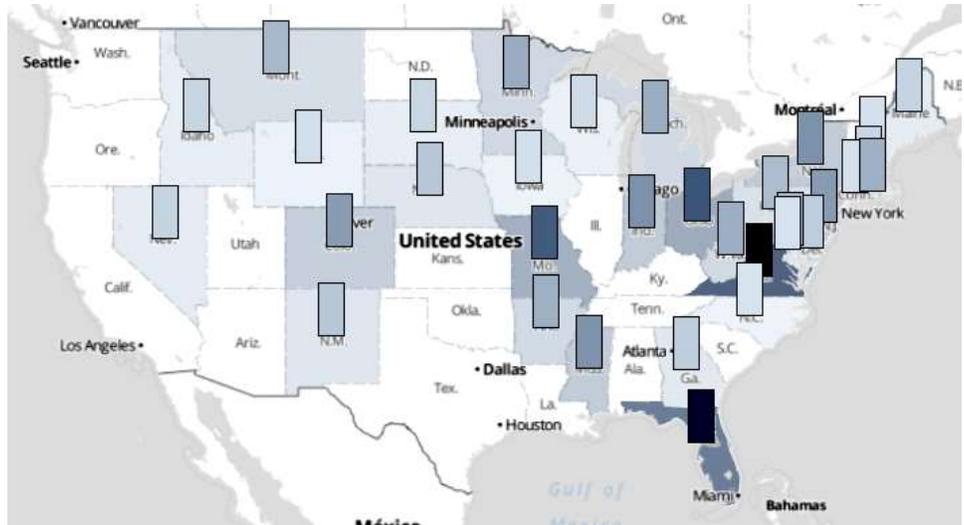


Figure 2 US Map of State Data Availability

*Questions you can answer: How many of my neighboring states have data available? How does my state compare nationally in terms of number of stations providing data?*

<sup>1</sup> Information about TMS can be found in the Task 3 Report.

### 3.1.2 State Map

To view state-level data, users must click on the rectangle that corresponds with the state of interest. In this case, we clicked on Michigan.

The squares now represent types of stations in the state: Blue squares are WIM Stations and Orange squares are Class Stations.

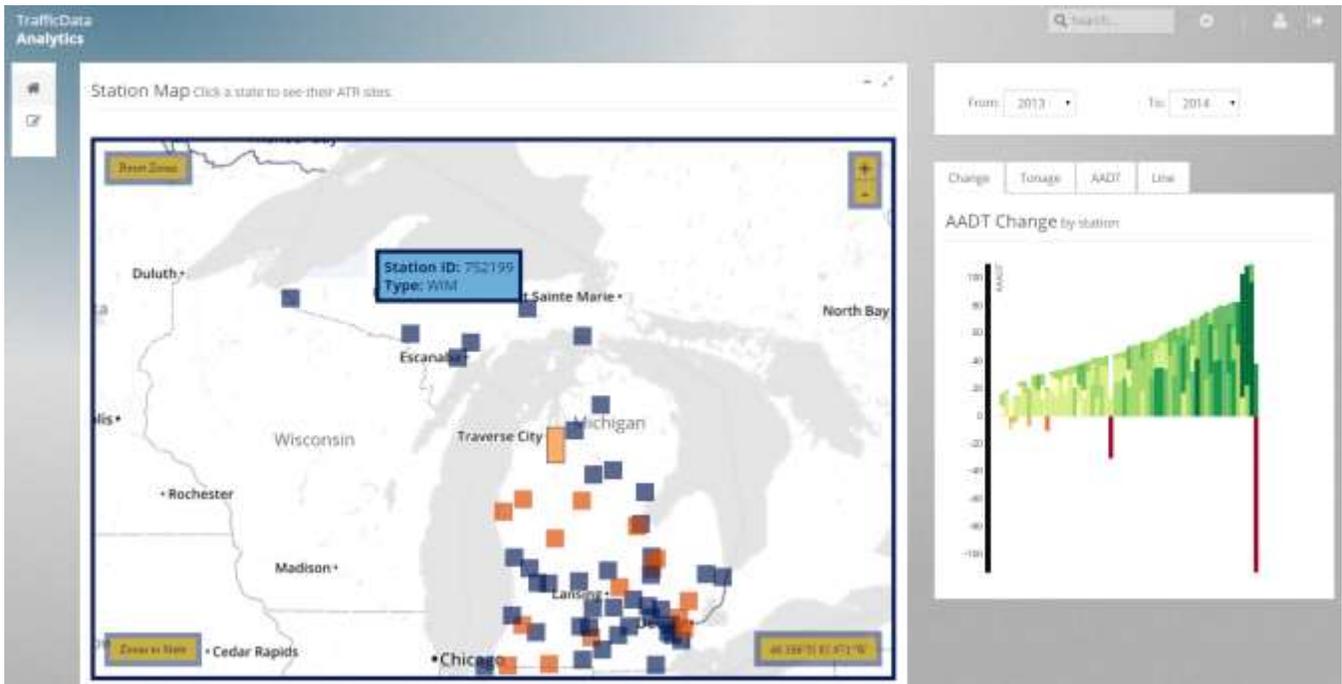


Figure 3 State Level Map Indicating Station Distribution and Type

Questions you can answer: What is the spatial distribution of WIM Stations compared to Class Stations? What types of stations are available near state borders?

### 3.1.3 AADT Overview Panel

The AADT Overview Panel has a map on the left-hand side and a set of data visualizations on the right. The map in the center shows WIM and Class stations across the state. As you scroll over the stations, the data to the right is highlighted, showing the bar that corresponds to each station. Likewise, when you scroll on the bars, the WIM or Class site square turn yellow, to show the station associated with the bar.

#### 3.1.3.1 Bar Chart to show year over year change in AADT of all Stations

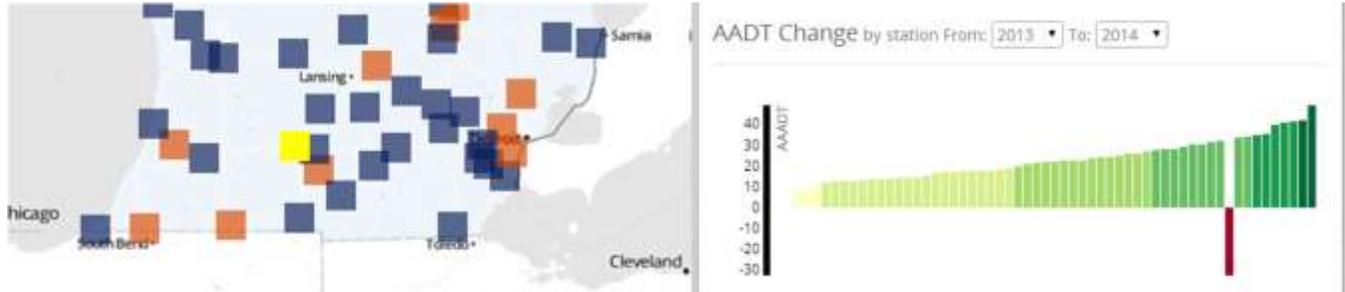


Figure 4 Illustration of Interactivity between State Map and Yearly Comparison Bar Chart for AADT for All Stations

Questions you can answer: Are traffic volumes in my state increasing or decreasing over the last year? Were these changes occurring in previous years?

#### 3.1.3.2 Bar Chart to show AADT of all stations (by Avg of All years, or individual year) (by Vehicle Class)

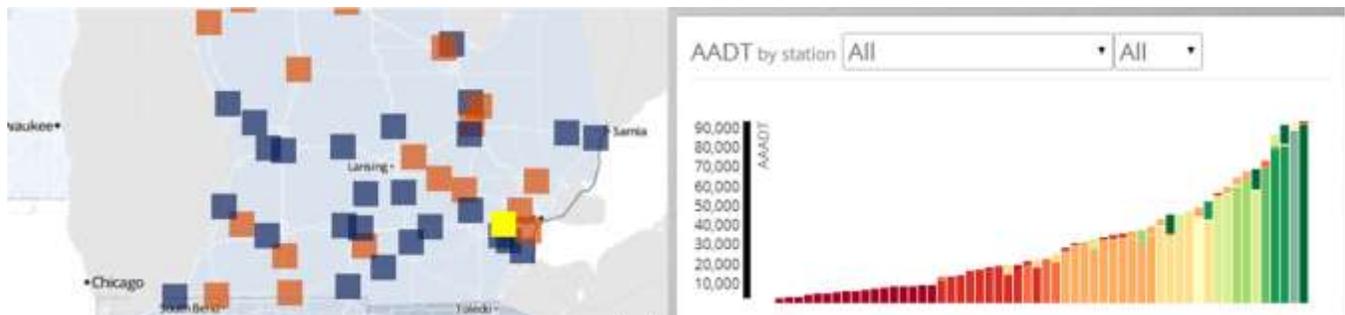


Figure 5 Illustration of Interactivity between State Map and AADT Traffic Volume by Station

Questions you can answer: Which stations in my state are experiencing the heaviest volumes on average for all years of data available? Which stations in my state are experiencing the heaviest volumes on average last year?

### 3.1.3.3 Line Chart to show MADT (average, by year) (by Class)

The line chart shows volume of traffic by class by month and can be filtered by station.

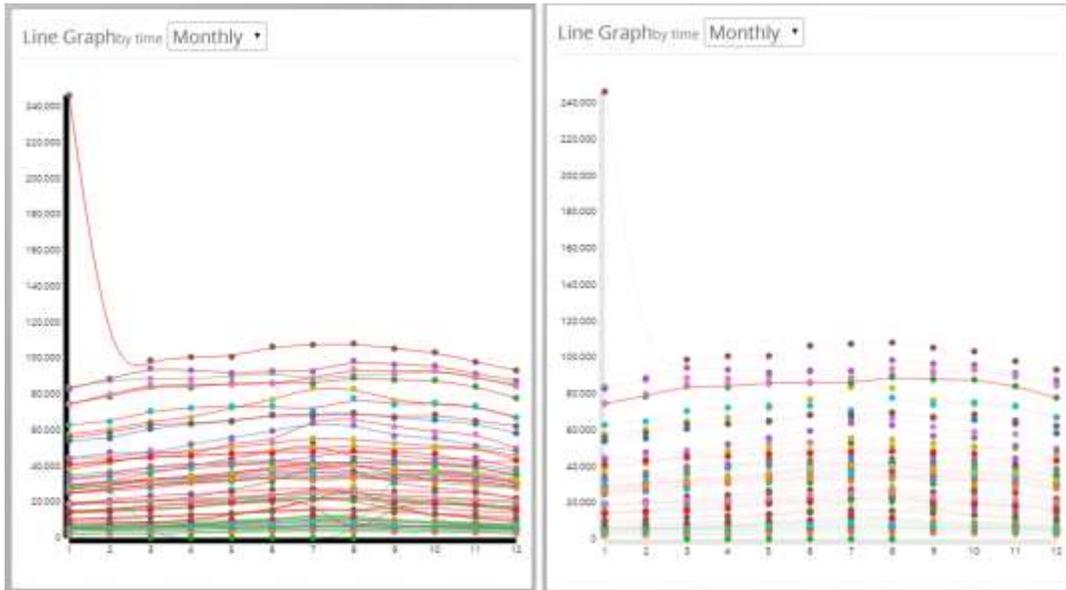


Figure 6 Illustration of Line Chart Showing Monthly Traffic Volume of All Stations or a Single Station

Questions you can answer: What are the monthly volume trends at all stations across my state? What are the seasonal volume variations for any one single station in my state?

### 3.1.3.4 Line Graph to show Average Daily Traffic Distribution

This Graph is based on a twenty-four hour period and shows traffic trends by class and station.

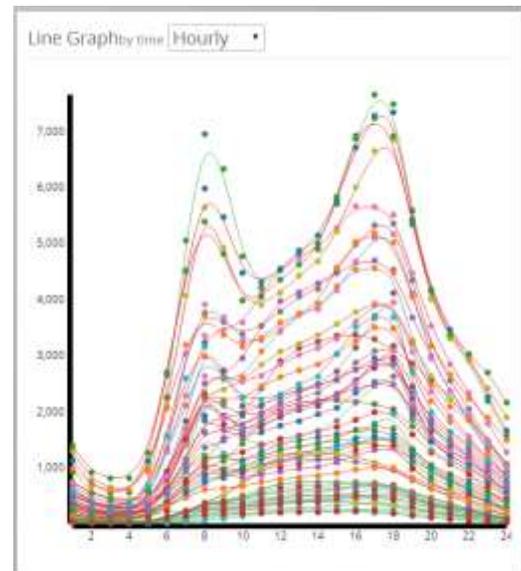


Figure 7 Line Graph Showing Distribution of Traffic by Time of Day for All Stations

Questions you can answer: What are the hourly volume trends at all stations across my state? What are the peaking characteristics of any one single station in my state?

### 3.1.4 Interconnected Visualizations

Each of the bar graphs and line graphs interact with the map. As you can see in Figure 8, the yellow square shows the geographic location of the station that corresponds with selected line in the line graph at right. The line graph shows volume by month for that station.

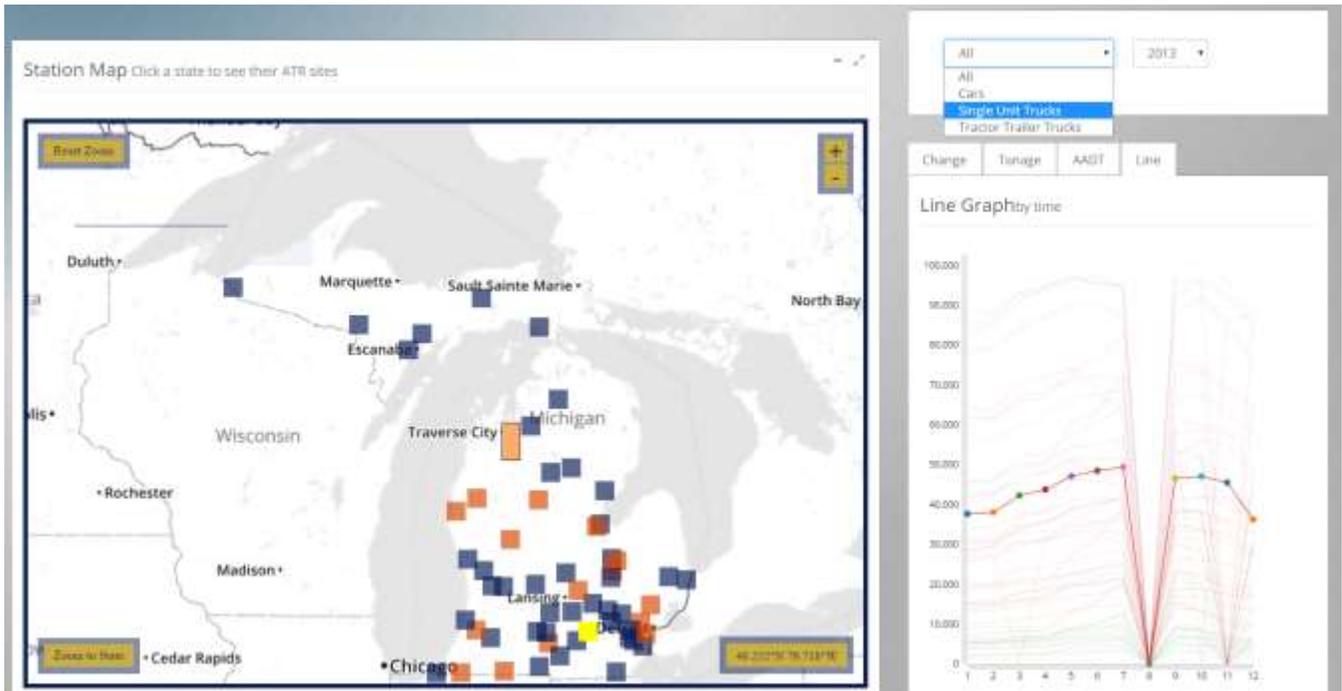


Figure 8 Screen Shot of Web-Tool, Illustrating Interactivity of Multiple Graphics

Questions you can answer: At the station closest to Detroit, what month had the highest volume of a vehicle type (Car, Single Unit Truck, or Tractor Trailer)? Was this pattern the same at my other sites?

### 3.2 SINGLE STATION OVERVIEW

By clicking on the box that corresponds with a given station, you can access information specific to that station. The Single Station Overview page displays a comprehensive overview of raw data available for single station.



Figure 9 Screenshot of Single Station Overview

#### 3.2.1 Single Station Tabs

On each station page, the graphs, reports and station info are now organized by tab. The image below shows the tabs for a typical WIM station.



Figure 10 WIM Station Tabs

### 3.2.2 Truck Volume Tab

#### 3.2.2.1 Volume by Time Graph (filterable by weight & class and time (year, month, day))

The Single Station Overview is a dynamic data visualization page. The right-hand side of the page (Figure 3) shows basic information about the site, (e.g., the number of lanes, the WIM method, the WIM Calibration, etc.). The graph in the center of the page is interactive. The X-Axis shows the year, the Y axis volume of traffic. Class types are broken out by color in each bar, and respond when you mouse-over the bar by turning red, showcasing the exact data. In Figure 10, you can see the mouse-over information for class 5 vehicles at station 829209, in the year 2009.

By clicking on the bar for the year 2009, you can access the month by month view (Figure 3) displaying traffic volume by class for this station.

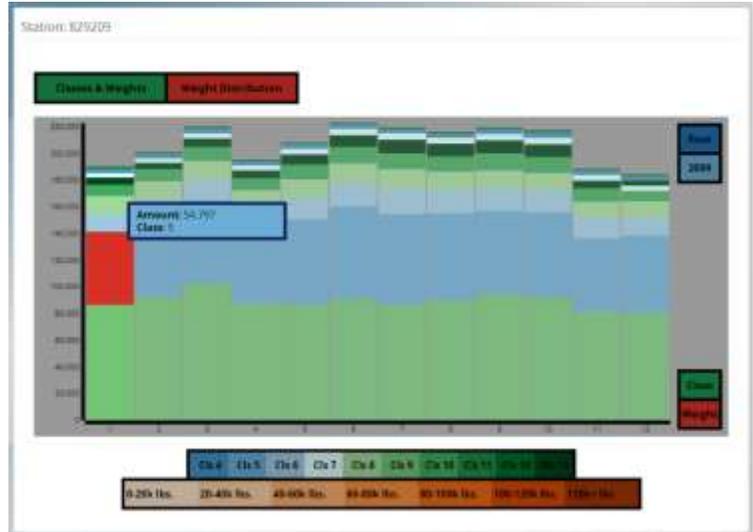


Figure 11 Monthly Graph of Traffic Volume by Class

Questions you can answer: In March, how many Class 9 vehicles were counted at this station? Has the number of Class 9 vehicles been increasing or decreasing over the year?

#### 3.2.2.2 Weight by Time Graph (filterable by weight & class and time (year, month, day))

Similar to the Volume by Time Graph is the Weight by Time Graph. You access this graph by clicking on the red box labeled Weight, in the bottom right of this pane (toggle for class or weight.) This Weight by Time Graph behaves exactly the same way as the Volume by Time Graph, with mouse-overs and drill-downs into monthly information by clicking on the desired year.

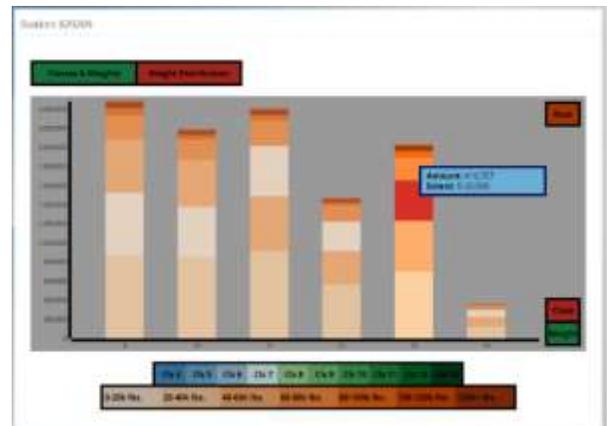


Figure 12 Yearly graph of traffic volume by weight

Questions you can answer: Which year had the highest percentage of overweight (> 80,000 lbs.) vehicles at this station? For how many years did this pattern of overweight vehicles persist?

Another functionality of these Volume by Time and Weight by Time Graphs is the ability to turn vehicle and weight classes on and off by clicking on the horizontal color bars below the graph. You'll notice in Figure 12 that classes 4-9 and 11-13 have been turned off. The bar graph in Figure 12 now shows only the traffic volumes of class 10 by weight and year.

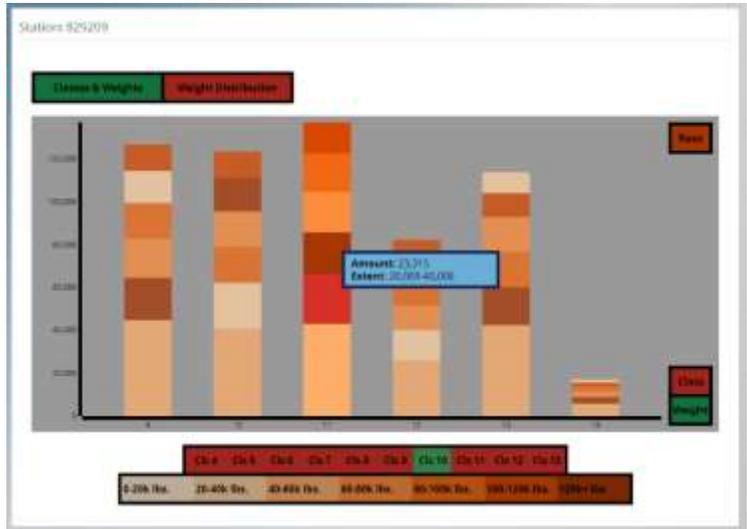


Figure 13 Yearly Graph of Traffic Volume by Weight of Class 9 Vehicles

Questions you can answer: Looking only at Class 9 vehicles, which year had the highest number of 80,000 lbs + vehicles? What trends can be detected over the years or months of available data?

### 3.2.2.3 Weight Distribution Graph

The Weight Distribution Graph is filterable by weight & class by time (year, month, day) by total weight and by tandem axle weight. It is colored in quartiles with lightest color indicating the empty or near-empty hauls. The darker colors indicating heavier trucks. Overweight is indicated by the darkest color on the right-hand side of the graph.

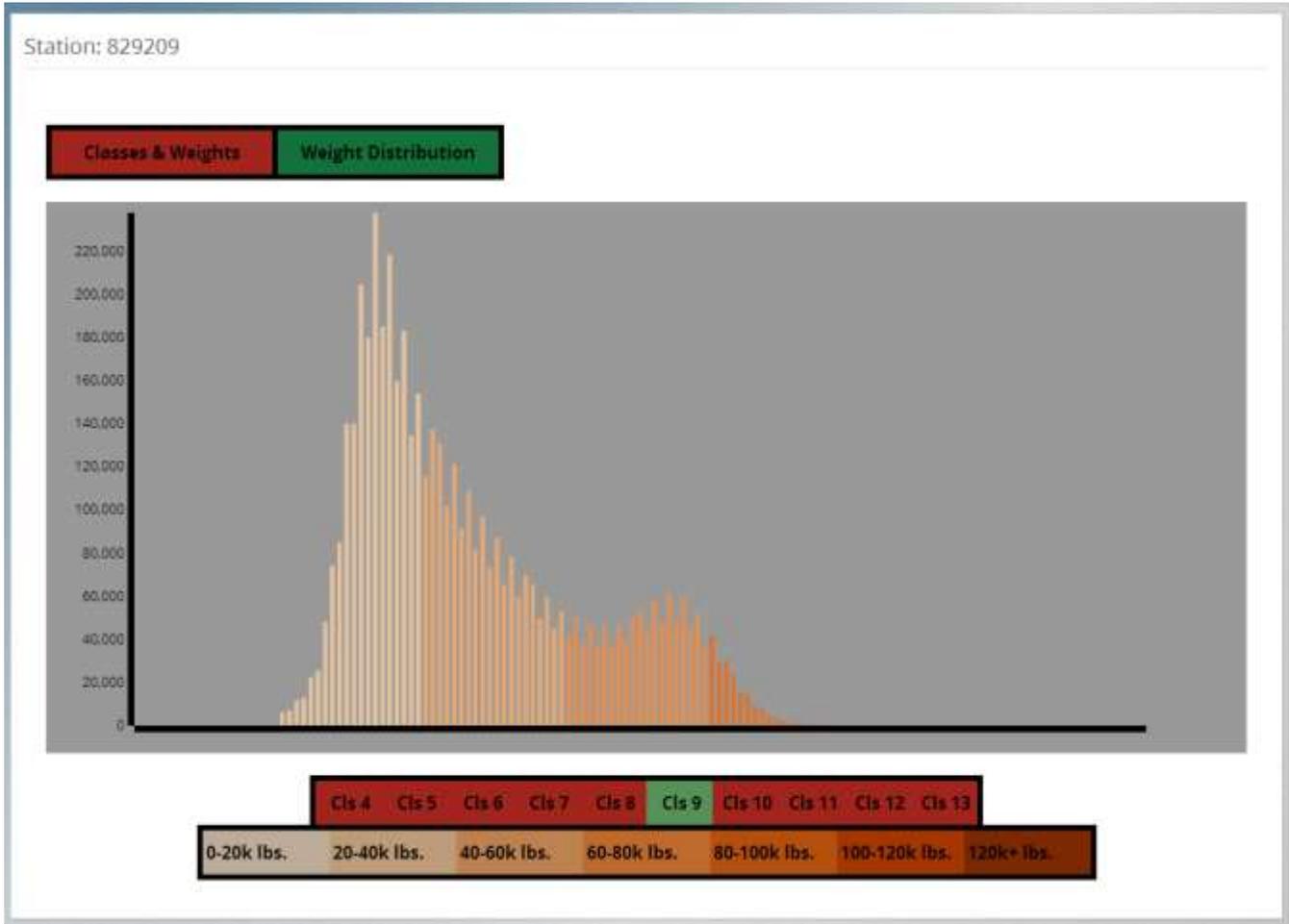


Figure 14 Distribution of Weight by Class at a Single Station

Questions you can answer: For Class 9 vehicles, what were the hauling patterns with respect to empties (<20,000 lbs) at this station over the year? What is the distribution of overweight vehicles at this site?

### 3.2.3 Seasonality Tab

The Seasonality tab is set up to give you large volume data over time in various visualizations. The purpose of the seasonality section is to give the user an idea of how a station behaves over the course of a year.

#### 3.2.3.1 Yearly Volume Graphs

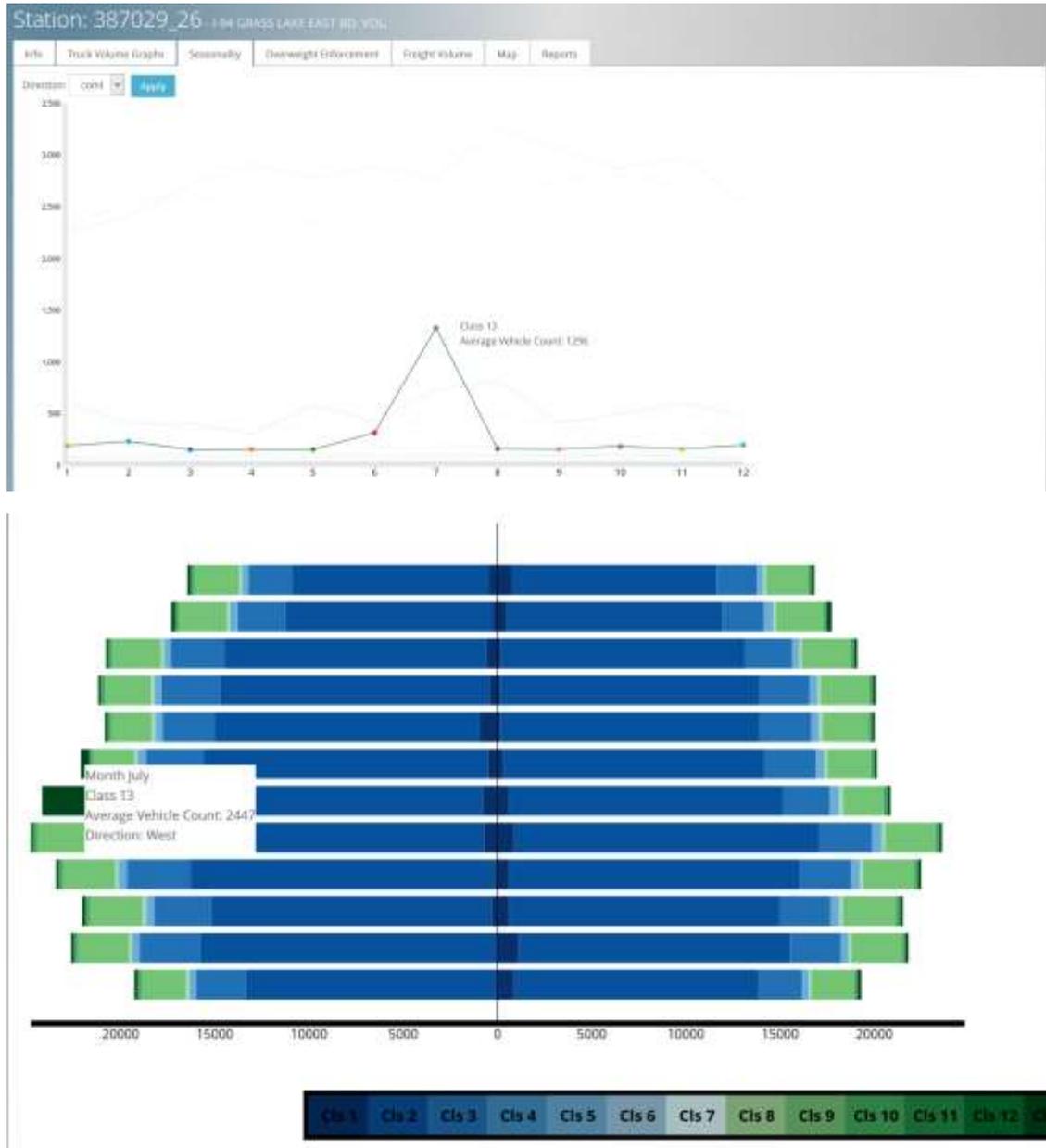


Figure 15 Single Station Page, Yearly Volume Graphs

Questions you can answer: How does overall traffic volume change through the seasons? How does traffic volume for each class change seasonally by direction?

### 3.2.3.2 Calendar View - shows Daily Traffic Totals (by class)

The Calendar Visualization is a heat map that shows volume of traffic by day, week, month and year. Peak volume is dark green. This calendar also reveals gaps in data and highlights trends across calendar years. The distribution of red clearly indicates weekend behaviors.

This graph is a visualization of yearly highest days.

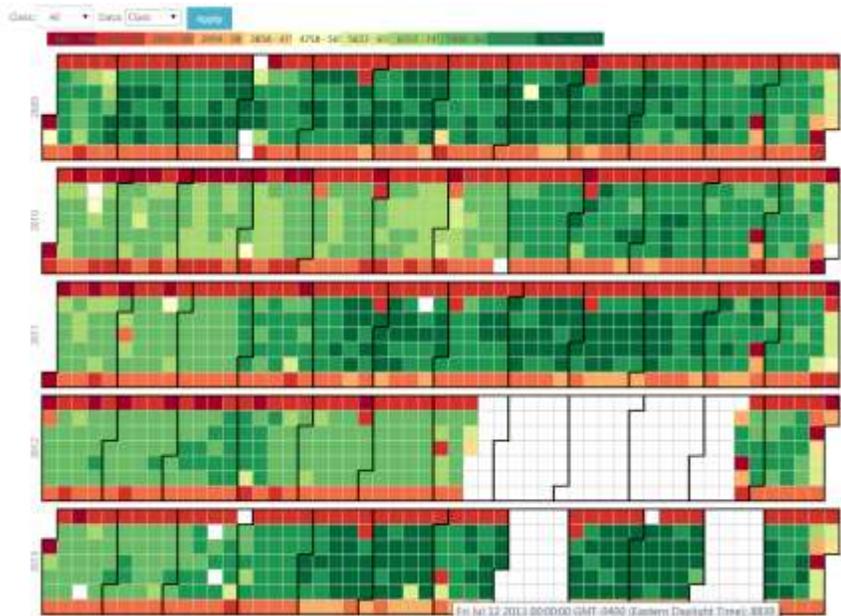


Figure 16 Calendar Heat Map Illustrating Distribution of Traffic by Class or All

Questions you can answer: How many days was this station not reporting data? What were the heaviest traffic totals by day of the week and month at this station?

### 3.2.4 Calibration Chart - show front axle weight / Axle A spacing

The purpose of the Calibration Chart is to determine the quality of the data. The chart in figure 15 is an example illustration showing the ability to determine how much of the data falls within acceptable boundaries.

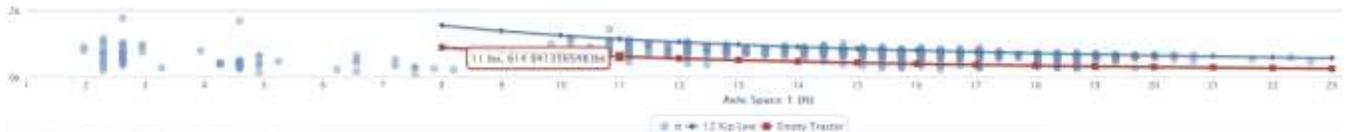


Figure 17 Example of Calibration Illustration

Question you can answer: What is the quality of the data from this station?

### 3.2.5 Single Station Enforcement

Show visualizations relevant to overweight enforcement at a single site.

#### 3.2.5.1 Deployment Grid

This grid shows the number and percent of overweight trucks (total weight or tandem axle) by day or week and time of day (filter by year, month).



Figure 18 Example of Enforcement Deployment Tool

Questions you can answer: What time of day and day of week are the highest percentages of overweight trucks at this station? Which direction are those overweight trucks traveling?

#### 3.2.5.2 Calendar View

This Calendar is similar to the Calendar View of Daily Traffic Totals as seen in Figure 14 except this calendar shows variation in overweight trucks by day, week and month. This tab will soon allow the user to set the overweight limit for each vehicle class.



### 3.2.6 Reports

AVAIL is developing a reports section for the web-tool. The report below is based on two reports submitted by Ohio DOT: Yearly Highest Days and Yearly Highest Hours.

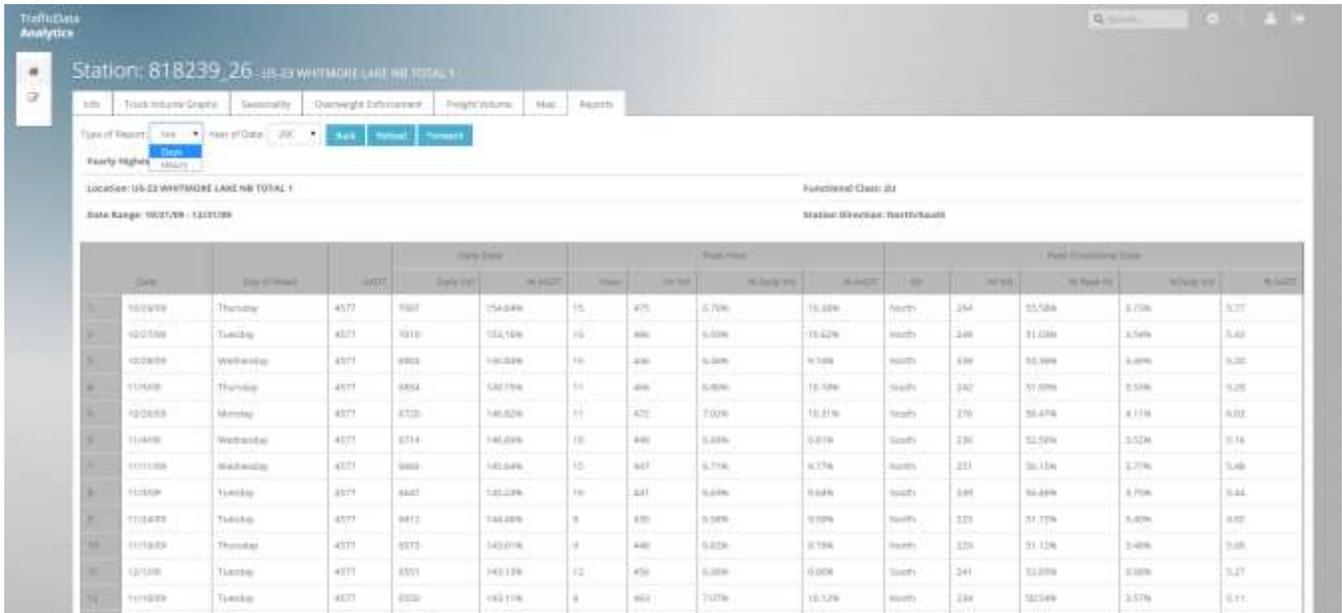


Figure 19 Yearly Highest Days Report

The report ranks the highest days for a single station for total volume and displays that volume as a percent of AADT. A report like this could also be generated as a comparative report between stations.

Location: US-23 WHITMORE LAKE NB TOTAL 1

Date Range: 10/21/09 - 12/31/09

Date	Day of Week	AADT	Daily Data		Peak Hour		
			Daily Vol	% AADT	Hour	Hr Vol	% Daily Vol
10/29/09	Thursday	4577	7087	154.84%	15	475	6.70%
10/27/09	Tuesday	4577	7010	153.16%	13	486	6.93%

### 3.3 ROAD NETWORK ANALYSIS

The Road Network Analysis section of the Web-Tool visualizes the road network based on HPMS<sup>2</sup>, short counts and a number of derived sources.

#### 3.3.1 HPMS Road Network Map

To access the HPMS Road Network Map click on the dropdown menu on the top left side of the map.

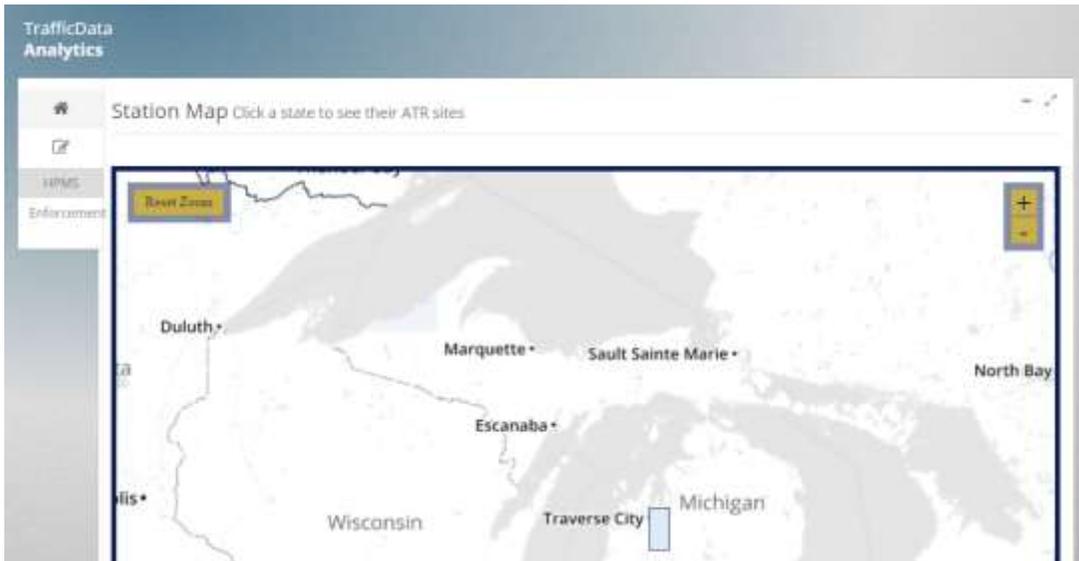


Figure 20 Dashboard, Illustrating HPMS Dropdown Menu at Left

The HPMS Map has a menu on the top left corner of the map that allows a user to choose a state, set of states, or interstate roadways.



Figure 21 HPMS Map, Illustrating HPMS Menu at Left

<sup>2</sup> Information about HPMS can be found in the Task 3 Report.

After the user chooses a state or interstate, the map will populate with count data. The user can hover over a roadway segment to display the data for that segment of road.



Figure 22 HPMS Map, Zoomed Out with New York State Selected

As the user zooms in to the map, next level road types appear on the map. First type 2, then type 3, and so on. Each segment of road displaying HPMS data has data specific to that segment.



Figure 23 HPMS States Tab, Illustrating Zooming Feature of HPMS Map

Questions you can answer: Which road segments experience the highest volume? How does traffic volume disperse from one road segment to others?

AVAIL is developing this HPMS map to include road segments by HPMS AADT & Truck AADT (by Year), by calculated AADT & Truck AADT, Vehicle Tonnage & Payload Tonnage (by year, by month), by FAF Vehicle Tonnage (& other FAF variables) (by year).

### 3.3.2 HPMS Data Tab

The Data tab visualizes HPMS data into bar graphs by state by road segment type. These graphs will soon allow the user to dive deeper into state HPMS data by segment type as well as comparing selected road segments.

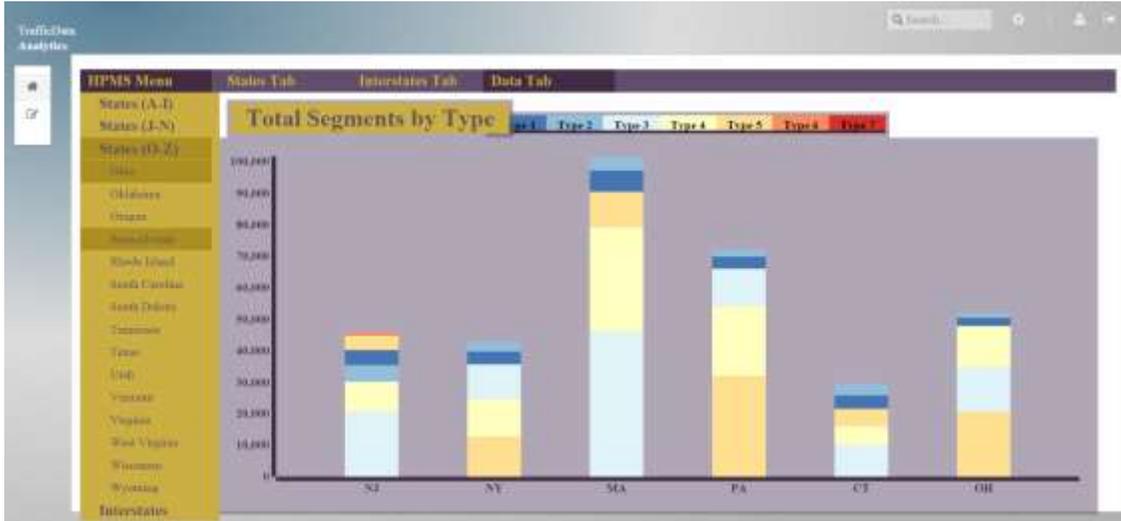


Figure 24 HPMS Data Tab Illustrating State HPMS Data by Road Segment Type

The graph is interactive. Each state bar segment you click on opens a data box on the right that shows the road type, the AADT, and the number of segments in the state.



Figure 25 HPMS Data Tab Illustrating Data Box on Right

Questions you can answer: How is volume by road segment distributed in my state compared to other states? What road segment types are being used most often?

### 3.3.3 HPMS Interstates Tab

The first draft of this road segment map is illustrated by the figure below.



Figure 26 HPMS Interstate Tab

*Questions you can answer: How much volume and weight is traveling on the interstate system between states?*

## 3.4 CORRIDOR ANALYSIS

The concept for Corridor Analysis is still being fleshed out. It will combine HPMS and class and weight station information with customizable corridor linkages.

## 3.5 ENFORCEMENT DASHBOARD

The enforcement Dashboard is still being developed. The idea is to build a dashboard that provides an overview of statewide overweight trucks. All visualizations are filterable by month and year. The Enforcement Dashboard is a future features mock up. None of the Enforcement suite of tools are functional in the current Web-Tool.

### 3.5.1 Rank Stations by forecasted overweight percent and count

The ranking of stations by overweight behaviors will allow the user you to see which stations have the most heavy truck traffic by day of the week across the state. This can be used in planning deployment scheduling in

advance. This graph ranks each station by a customizable composite index based on historical data.



Figure 27 Example of station ranking tool

Questions you can answer: At which stations should overweight truck enforcement staff be deployed on Mondays? What day of the week is most important for enforcement at a given station?

### 3.5.2 Maps of corridors showing most likely overweight segments.

This map is currently under construction. It will be a composite of HPMS and weight records by highway corridor.

### 3.5.3 Map of stations visualized by overweight percent or count

This map is currently under construction. It will be similar to the State Overview Map (Figure 3) but with overweight percentages and counts shown in choropleth shading and customizable to state weight regulations.

## 3.6 DATA MANAGEMENT

Tools for managing the website will be constructed at the end of the tool building phase. Below are a list of planned admin tools. Please suggest any desired tool functions.

### 3.6.1 Settings Page

#### 3.6.1.1 Set visualizations color scheme

#### 3.6.1.2 Overweight limit (total weight & axle weight)

#### 3.6.1.3 Set bridge weight limits