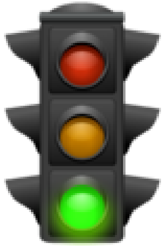


USING PERFORMANCE MEASURES TO JUSTIFY SIGNAL SYSTEMS ON ARTERIALS

May 4, 2017

Georgia Department of Transportation

I-95 CORRIDOR COALITION

pennsylvania
DEPARTMENT OF TRANSPORTATION

Webcast and Audio Information

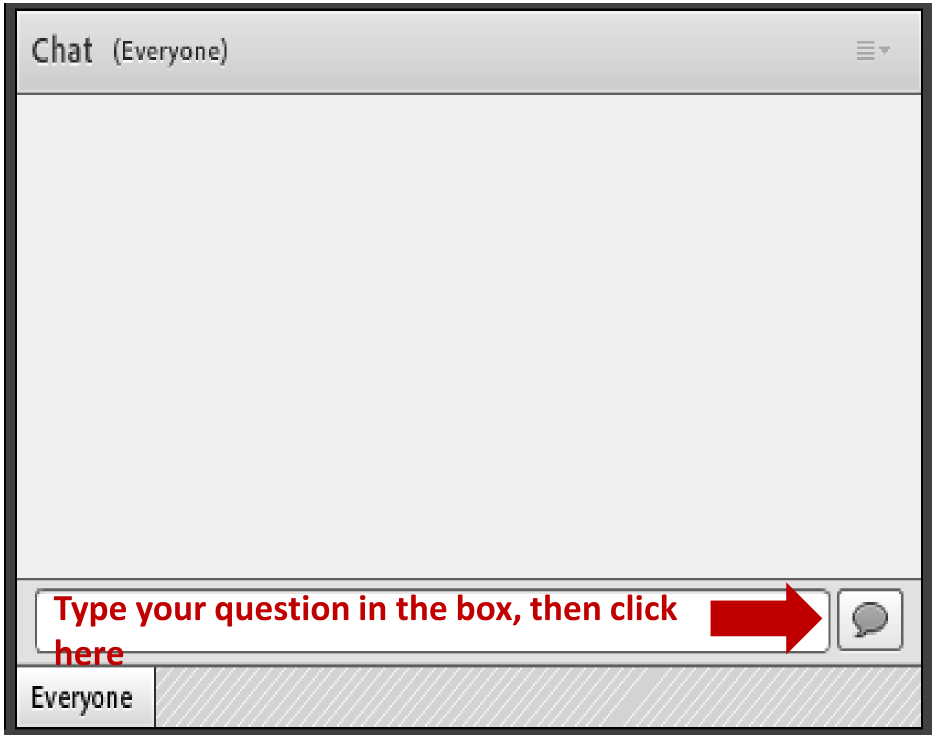
- The call-in phone number is:

1-719-867-1571 & enter 725437# at the prompt

- **Your phone line will be muted throughout the webcast**
- Please press *0 to speak to an operator for questions regarding audio
- Please call 917-974-4810 for difficulties with the web or audio application
- This web meeting is being recorded
- **All materials will be available to participants after the web meeting**

Asking Questions

- Please pose your questions using the chat box
- Questions will be monitored then answered by the speakers during their presentation or at the end of the webinar



Type your question in the box, then click here

Agenda

I-95 CORRIDOR
COALITION

Welcome & Overview	Denise Markow, PE I-95 Corridor Coalition
Outcome Assessment using Probe Vehicle Data to Justify Signal Investments to Decision Makers	Dan Farley Pennsylvania DOT
Focused Operations: Measuring Arterial Performance Using Automated Traffic Signal Performance Measures	Alan Davis, PE, PTOE Georgia DOT

I-95 Corridor Coalition Sponsored Event -

Welcome

179 Registered

36 States

DOTs

MPOs

Federal Agencies

Universities

Vendors

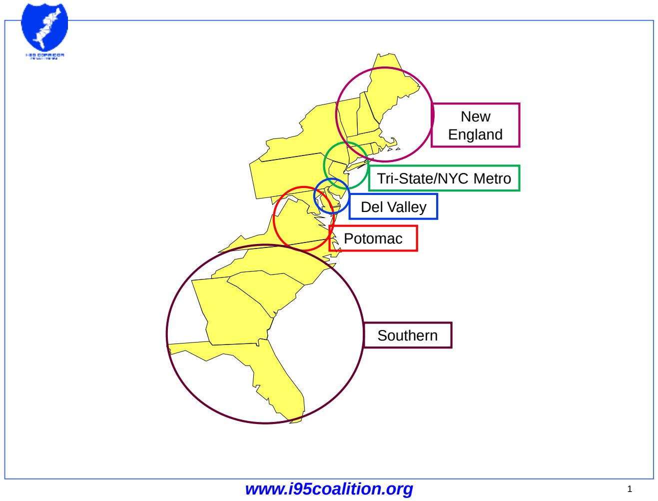
Research Institutes

The Coalition who . . .

I-95 Corridor Coalition

I-95 CORRIDOR COALITION

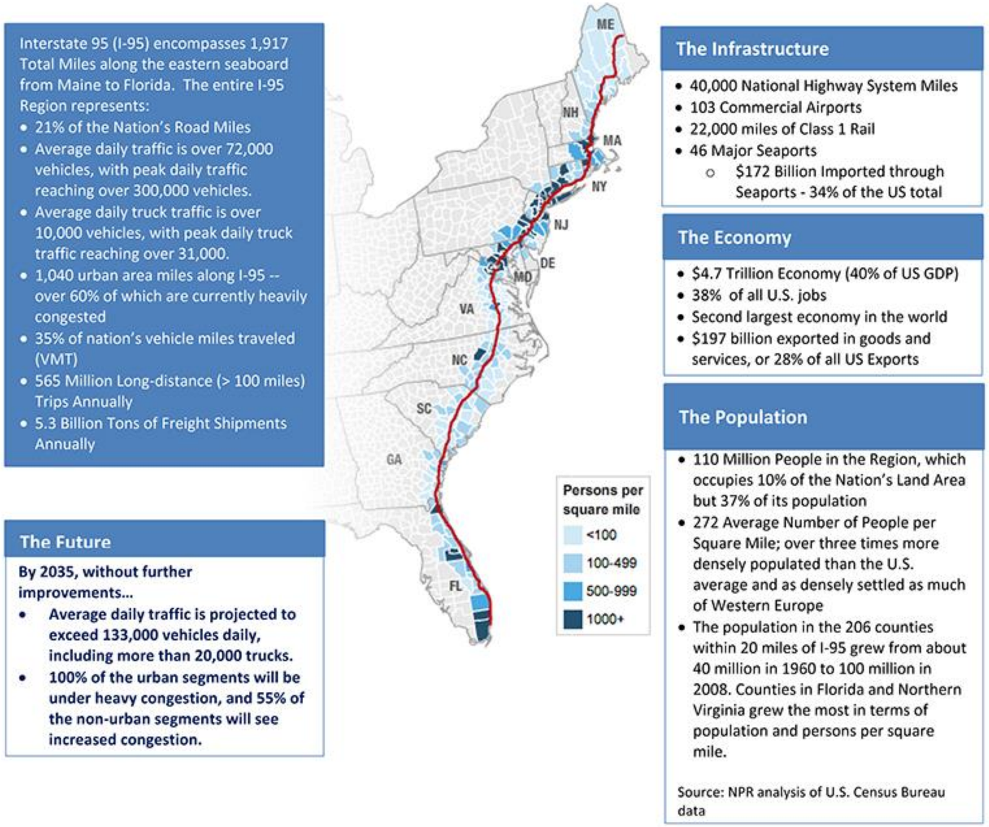
- TSMO Program
- Focusing on Arterial Management
- A Coalition Sponsored Webinar



www.i95coalition.org

1

I-95 Corridor Coalition Website



Interstate 95 (I-95) encompasses 1,917 Total Miles along the eastern seaboard from Maine to Florida. The entire I-95 Region represents:

- 21% of the Nation's Road Miles
- Average daily traffic is over 72,000 vehicles, with peak daily traffic reaching over 300,000 vehicles.
- Average daily truck traffic is over 10,000 vehicles, with peak daily truck traffic reaching over 31,000.
- 1,040 urban area miles along I-95 -- over 60% of which are currently heavily congested
- 35% of nation's vehicle miles traveled (VMT)
- 565 Million Long-distance (> 100 miles) Trips Annually
- 5.3 Billion Tons of Freight Shipments Annually

The Future

By 2035, without further improvements...

- **Average daily traffic is projected to exceed 133,000 vehicles daily, including more than 20,000 trucks.**
- **100% of the urban segments will be under heavy congestion, and 55% of the non-urban segments will see increased congestion.**

Persons per square mile
<100
100-499
500-999
1000+

The Infrastructure

- 40,000 National Highway System Miles
- 103 Commercial Airports
- 22,000 miles of Class 1 Rail
- 46 Major Seaports
  - $172 Billion Imported through Seaports - 34% of the US total

The Economy

- $4.7 Trillion Economy (40% of US GDP)
- 38% of all U.S. jobs
- Second largest economy in the world
- $197 billion exported in goods and services, or 28% of all US Exports

The Population

- 110 Million People in the Region, which occupies 10% of the Nation's Land Area but 37% of its population
- 272 Average Number of People per Square Mile; over three times more densely populated than the U.S. average and as densely settled as much of Western Europe
- The population in the 206 counties within 20 miles of I-95 grew from about 40 million in 1960 to 100 million in 2008. Counties in Florida and Northern Virginia grew the most in terms of population and persons per square mile.

Source: NPR analysis of U.S. Census Bureau data

What is being explored today . . .

Arterial Monitoring Technologies

1. Probe data
2. Re-identification data
3. High resolution controller data

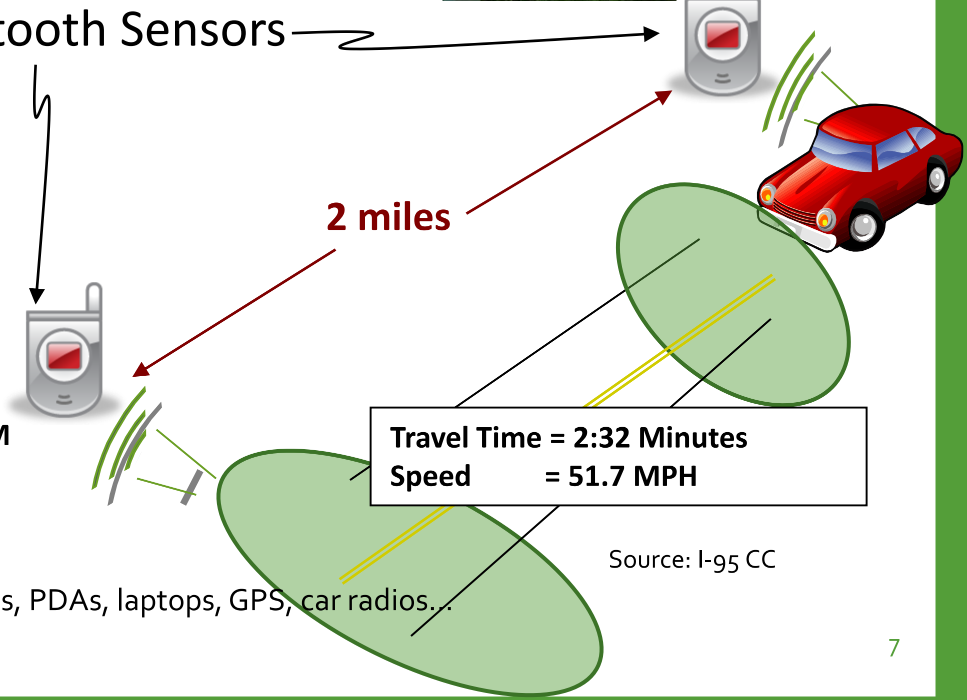
1

Source: INRIX

3

2

Bluetooth Sensors



Bluetooth Signal *

2 miles

Time = 8:05:58 AM

Travel Time = 2:32 Minutes
Speed = 51.7 MPH

Source: I-95 CC

* Bluetooth signals come from cell phones, PDAs, laptops, GPS, car radios…
** Provisional patent received

Introductions

Denise Markow, PE

I-95 Corridor Coalition

TSMO Program Coordinator

Dan Farley

Pennsylvania DOT

Section Chief, Traffic Operations Deployment & Maintenance Section

Alan Davis, PE, PTOE

Georgia DOT

Assistant State Traffic Engineer

Dan Farley
Pennsylvania Department of Transportation

Outcome Assessment using Probe Vehicle Data to Justify Signal Investments to Decision Makers

Daniel P. Farley
Section Chief
Traffic Operations Deployment and Maintenance

dfarley@pa.gov
717-783-0333

Outcome Assessment using Probe Vehicle Data to Justify Signal Investments to Decision Makers

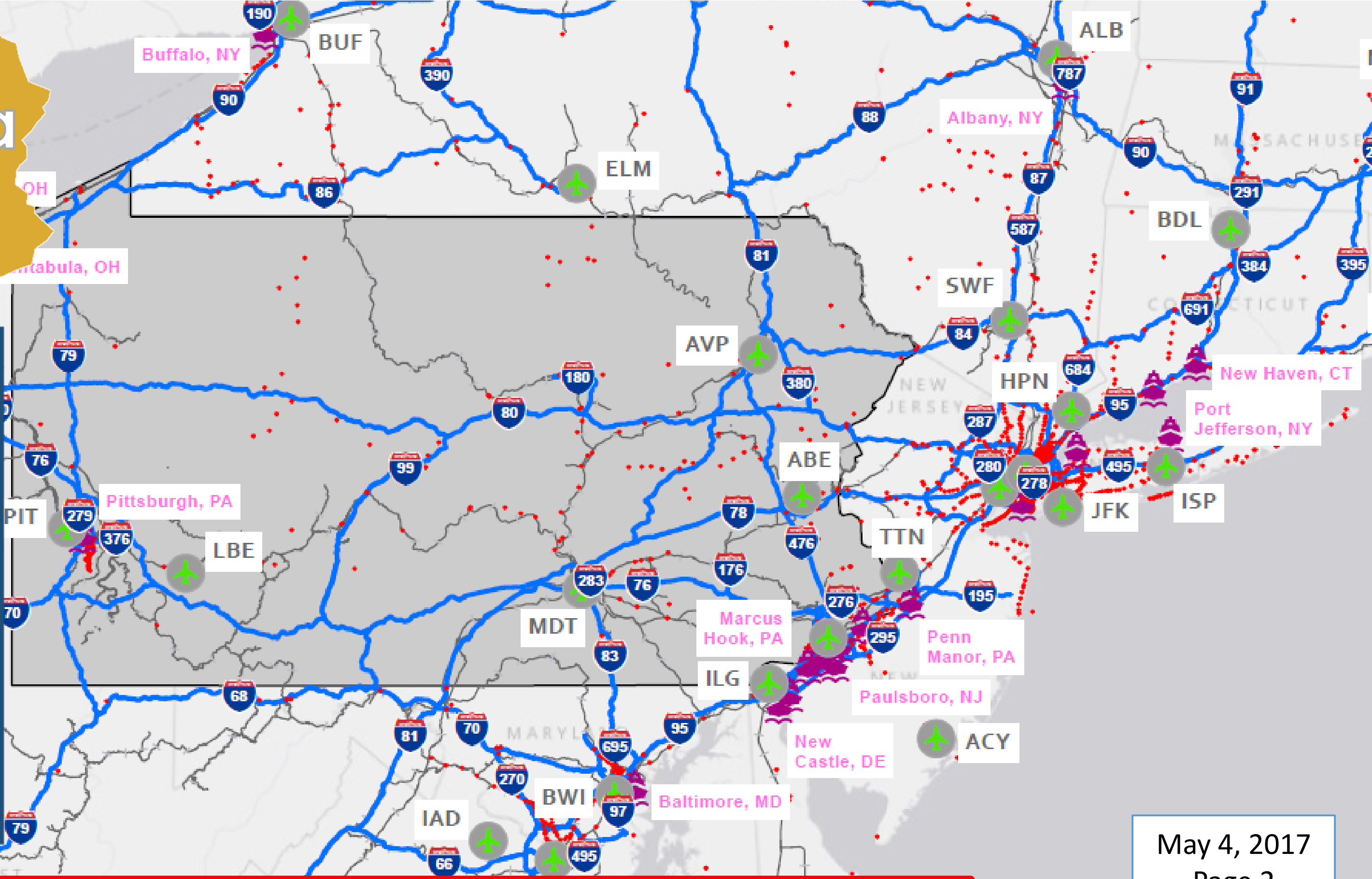
I-95 Corridor Coalition Traffic Signal and Arterial Performance Metric Webinar

May 4, 2017

Pennsylvania Facts

PennDOT

- 11,500 – Employees
- 11 – Engineering Districts
- 4 – Regional TMC's
- 52,000+ Events in 2016
- 1,700+ ITS Devices



PENNSYLVANIA INFRASTRUCTURE	PENNSYLVANIA DEMOGRAPHIC	PENNSYLVANIA MOBILITY	PENNSYLVANIA TRAFFIC	PENNSYLVANIA ENVIRONMENTAL	PENNSYLVANIA CONGESTION
40K mi of state-owned roadway	**12.8M** people	**102B** VMT annually	**264M+** annual hours of delay	**133M+** gallons of wasted fuel	**$6T** annual cost of congestion
5th largest nationally	6th largest state	Circle the world more than 4M times	31.5 hours per driver	11.1 gallons per vehicle	$730 per driver

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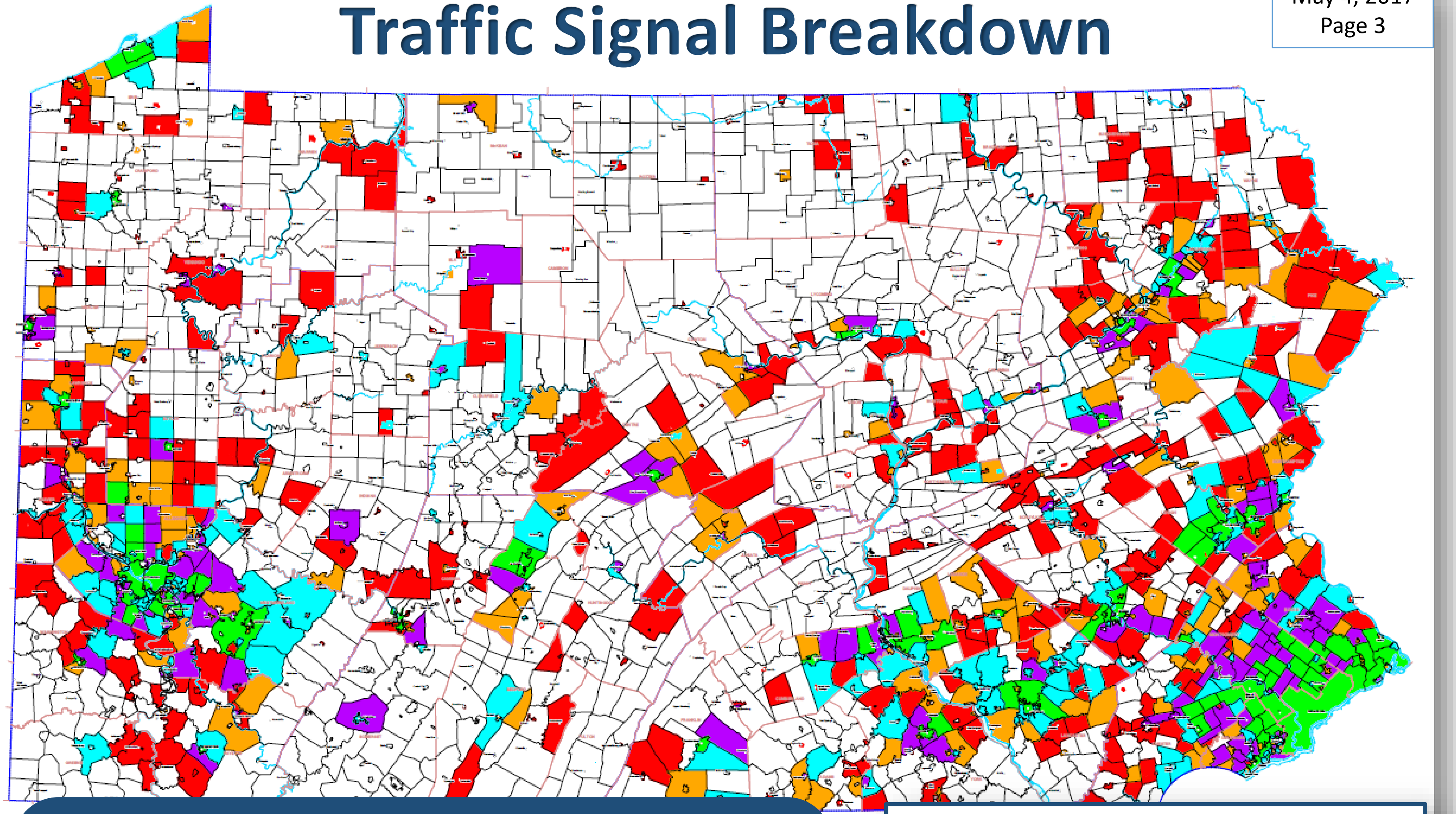
Traffic Signal Breakdown



1,200 municipal traffic signal owners
14,000 traffic signals in Pennsylvania
75% of municipalities own under 10 traffic signals
80%+ of signals are maintained by contractors
10,500 (77%) traffic signals are on state highways

🟥 1 or 2 Traffic Signals
🟧 3 to 5 Traffic Signals
🟦 6 to 10 Traffic Signals
🟪 11 to 25 Traffic Signals
🟩 Greater than 25 Traffic Signals

Green Light-Go Program

www.dot.state.pa.us/signals

PA Act 101 of 2016 (July 20, 2016) - Up to $ 40 Million Annually

Goal: To enhance traffic signal management, maintenance, and operations and make the Commonwealth's signalized corridors more safe and efficient.

Local Grant Program

- Counties, Municipalities, and Planning Partners Eligible Applicants
- All Existing Traffic Signals
- 20% Match All Projects Municipal Managed unless otherwise indicated by PennDOT
- Eligible Activities: LED, regional operations, retiming, special event timing, monitoring, maintenance, and equipment upgrades
- Also added ITS applications such as autonomous connected related technology (DSRC)

PennDOT Management

- PennDOT to assume ownership and maintenance responsibility [Pilot evaluation is 160 signals in 9 municipalities that parallel I-76 (Schuylkill Expressway)]
- Focus on Super-Critical Corridors (AADT above 25,000)
- Communication back to TMC and Signal Performance Measures on all corridors
- One Unified Command and Control Software to Monitor and Manage Signals

Where do we need to be?

- Isolated → **Coordinated**
- Jurisdictional Needs → **Regional Improvements**
- Project Focused → **Customer Impacts**
- Reactive & output-oriented → **Performance Based decision-making**
- Historical → **Real-Time**
- Peak Hour Timing → **24/7 Operations**

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ATSPM

Automated Traffic Signal Performance Measures

FHWA Every Day Counts (EDC-4) Initiative

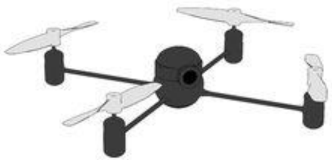
TPF Transportation Pooled Fund Program

TPF-5(258):Traffic Signal Systems Operations and Management

NCHRP

03-122: Performance-Based Management of Traffic Signals

Corridor Level Metrics



- Initial Deployment in Philadelphia Region (5 Counties)
- 138-Super-Critical Corridors
- 2,184 Traffic Signals
- 776 Arterial Miles of INRIX data
- Future Statewide Deployment

Probe Data

Arterial Travel Time Comparison Tool

- Before/After Analysis and corridor reliability utilizing Cumulative Frequency Diagrams (CFDs)

Arterial Ranking

- Ranking by median travel time and interquartile range (IQR) identifying delay, reliability, and variability

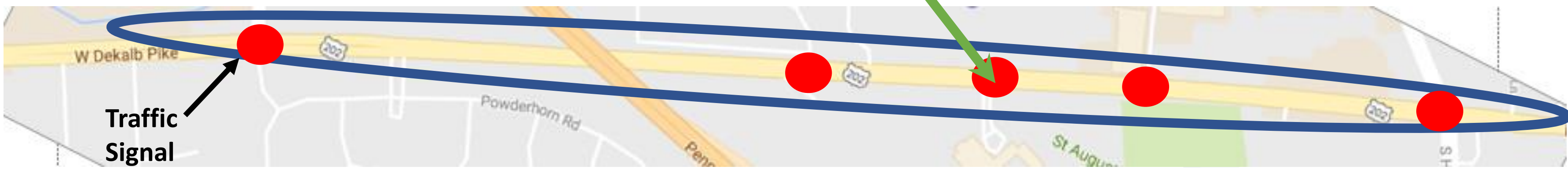
Arterial Congestion Ticker

- Speed profiles of arterial routes

- Continue to Work to Identify Relationships and Use-Cases between Corridor and Intersection Metrics and the Variety of Data Sources
- Clarify when and where each of the Metrics should be used

Intersection Level Metrics (High Resolution Metrics)

- Statewide Approach
- Utilizing the Utah Open Source Code
- Establish as Updates Occur
- Implement where controller and communications are available
- Future statewide Command and Control Software Platform

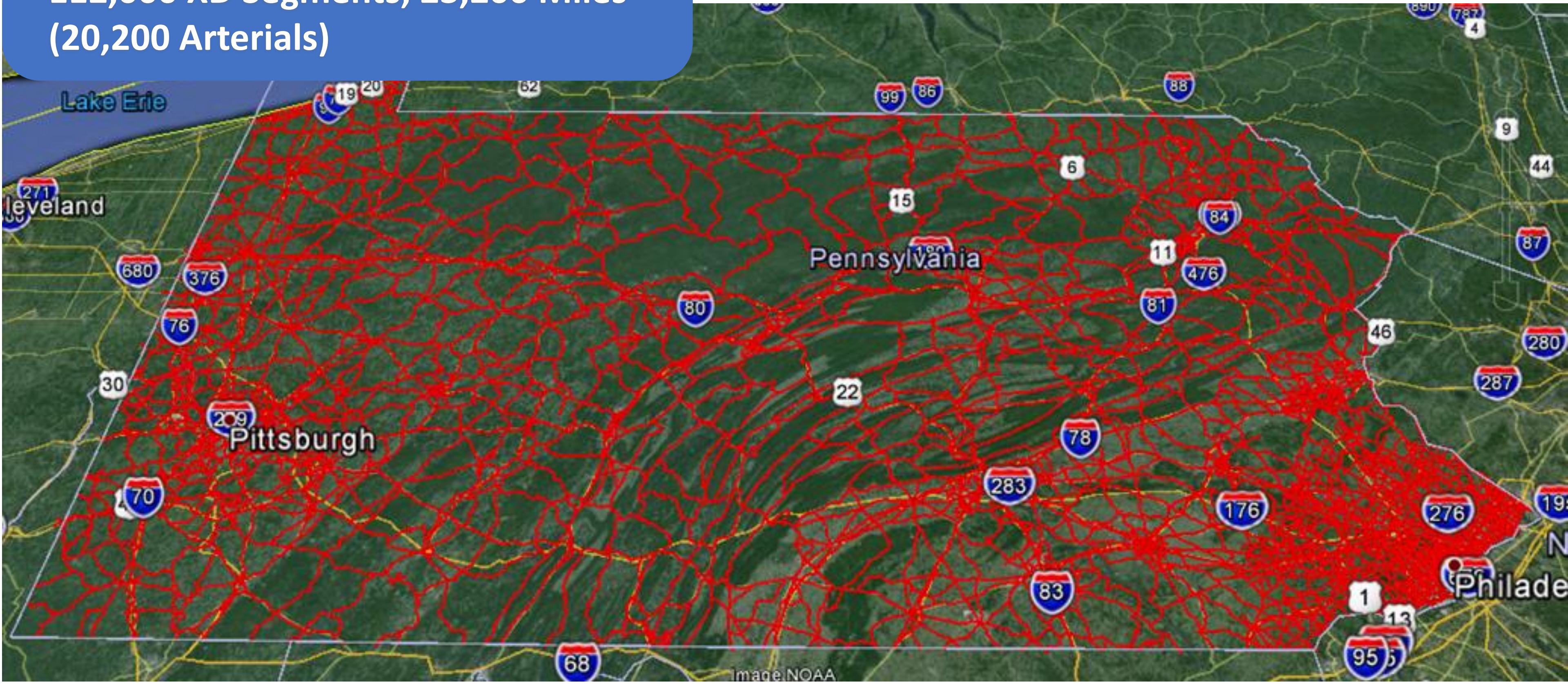


Pennsylvania is an All-In State

- INRIX is the Selected Data Vendor
- Real-Time Data and Achieved Data since 2011
- Data used in 511PA
- Statewide Travel Times when appropriate
- 7 validations completed in PA through I-95 VPP and have generally performed significantly better than contract (AASE < 5 mph, Speed Bias < 3 mph)

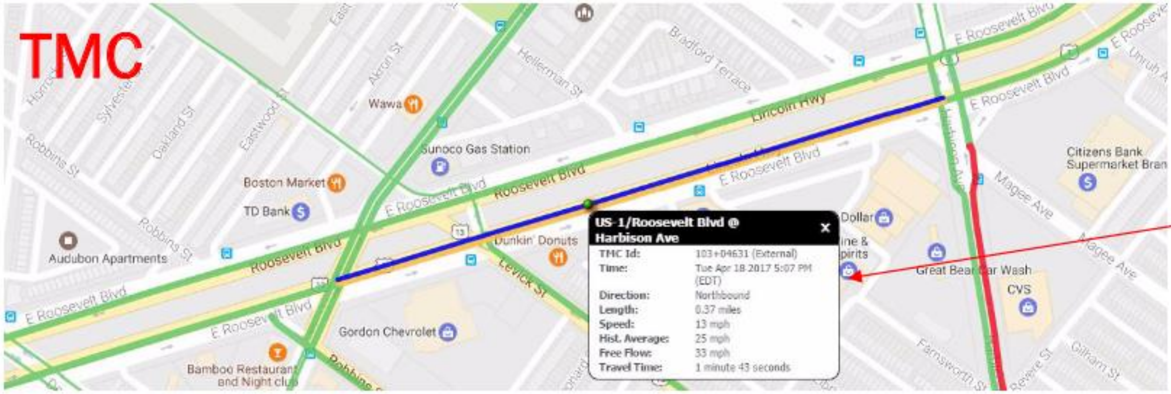
Coverage Area

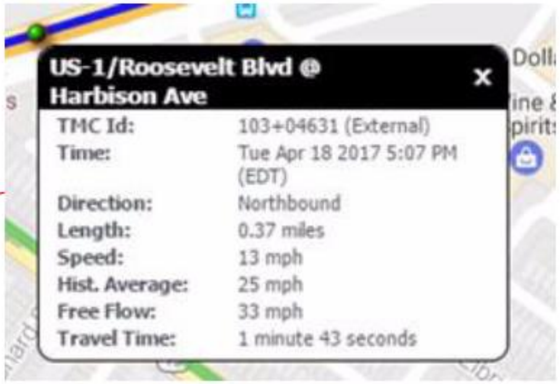
- 25,000 TMC Segments; 16,600 Miles
- 112,000 XD Segments; 23,200 Miles (20,200 Arterials)



US-1 Corridor

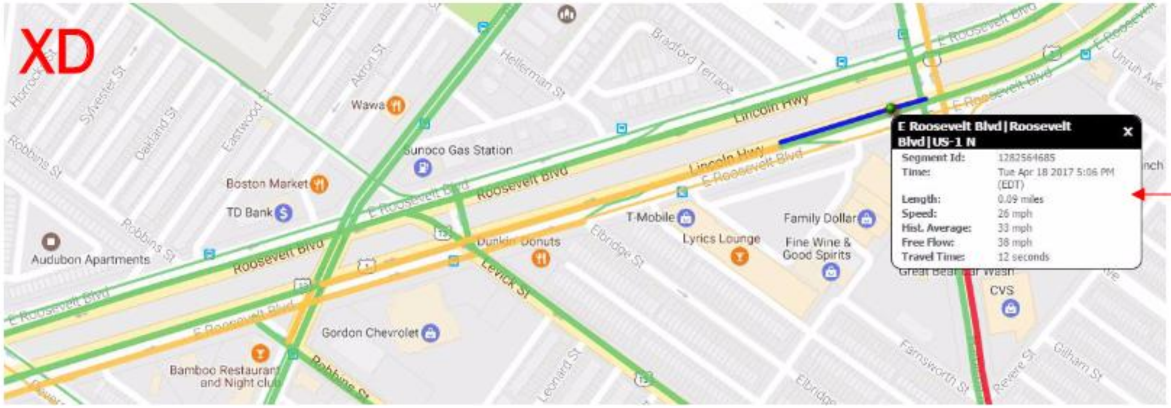
Granularity and Coverage Comparision of TMC and XD Segments





US-1/Roosevelt Blvd @ Harbison Ave

TMC Id:	103+04631 (External)
Time:	Tue Apr 18 2017 5:07 PM (EDT)
Direction:	Northbound
Length:	0.37 miles
Speed:	13 mph
Hist. Average:	25 mph
Free Flow:	33 mph
Travel Time:	1 minute 43 seconds



E Roosevelt Blvd | Roosevelt Blvd | US-1 N

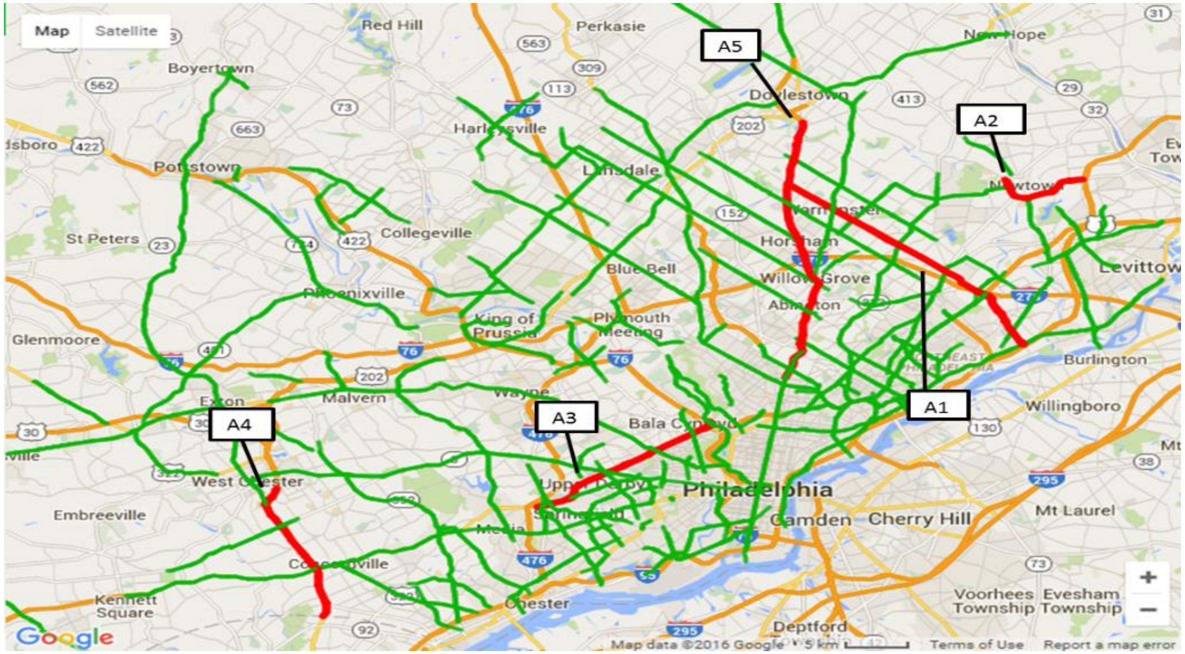
Segment Id:	1282564685
Time:	Tue Apr 18 2017 5:06 PM (EDT)
Length:	0.09 miles
Speed:	26 mph
Hist. Average:	33 mph
Free Flow:	38 mph
Travel Time:	12 seconds

Figures provided by INRIX

- Reflects current traffic conditions
- Reported every minute
- Generally 3-5 minutes behind actual road conditions

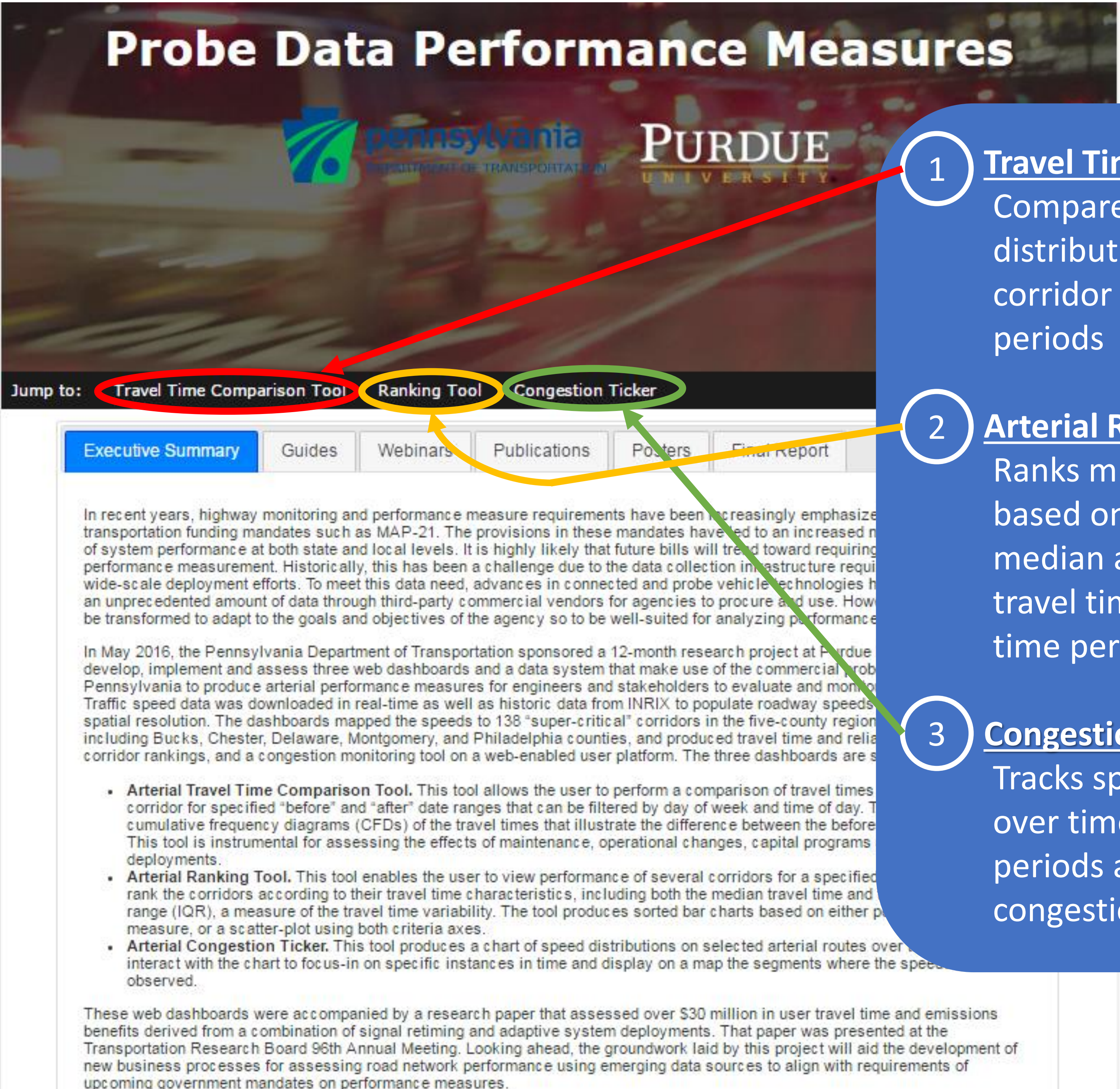
Research Project

<u>Purpose</u>: Develop, implement and evaluate commercial probe data licensed by Pennsylvania to produce arterial performance measures to evaluate user costs (signal retiming, maintenance, adaptive installation and benefit/cost activities), travel time reliability, variability, and corridor prioritization.



<u>Focus Area</u>:

- 138 “Super-Critical” corridors (AADT greater than 25,000)
- Five-county region of PennDOT District 6, including Bucks, Chester, Delaware, Montgomery, and Philadelphia counties
- Total: 2,184 Signals on 766 miles of arterials



In recent years, highway monitoring and performance measure requirements have been increasingly emphasize
transportation funding mandates such as MAP-21. The provisions in these mandates have led to an increased n
of system performance at both state and local levels. It is highly likely that future bills will trend toward requiring
performance measurement. Historically, this has been a challenge due to the data collection infrastructure requi
wide-scale deployment efforts. To meet this data need, advances in connected and probe vehicle technologies h
an unprecedented amount of data through third-party commercial vendors for agencies to procure and use. How
be transformed to adapt to the goals and objectives of the agency so to be well-suited for analyzing performance

In May 2016, the Pennsylvania Department of Transportation sponsored a 12-month research project at Purdue
develop, implement and assess three web dashboards and a data system that make use of the commercial prob
Pennsylvania to produce arterial performance measures for engineers and stakeholders to evaluate and monito
Traffic speed data was downloaded in real-time as well as historic data from INRIX to populate roadway speeds
spatial resolution. The dashboards mapped the speeds to 138 "super-critical" corridors in the five-county region
including Bucks, Chester, Delaware, Montgomery, and Philadelphia counties, and produced travel time and relia
corridor rankings, and a congestion monitoring tool on a web-enabled user platform. The three dashboards are s

- **Arterial Travel Time Comparison Tool.** This tool allows the user to perform a comparison of travel times
corridor for specified "before" and "after" date ranges that can be filtered by day of week and time of day. T
cumulative frequency diagrams (CFDs) of the travel times that illustrate the difference between the before
This tool is instrumental for assessing the effects of maintenance, operational changes, capital programs
deployments.
- **Arterial Ranking Tool.** This tool enables the user to view performance of several corridors for a specified
rank the corridors according to their travel time characteristics, including both the median travel time and
range (IQR), a measure of the travel time variability. The tool produces sorted bar charts based on either p
measure, or a scatter-plot using both criteria axes.
- **Arterial Congestion Ticker.** This tool produces a chart of speed distributions on selected arterial routes over
interact with the chart to focus-in on specific instances in time and display on a map the segments where the spee
observed.

These web dashboards were accompanied by a research paper that assessed over $30 million in user travel time and emissions benefits derived from a combination of signal retiming and adaptive system deployments. That paper was presented at the Transportation Research Board 96th Annual Meeting. Looking ahead, the groundwork laid by this project will aid the development of new business processes for assessing road network performance using emerging data sources to align with requirements of upcoming government mandates on performance measures.

1 **Travel Time Comparison Tool**

Compares travel time distributions on a single corridor over different time periods

2 **Arterial Ranking Tool**

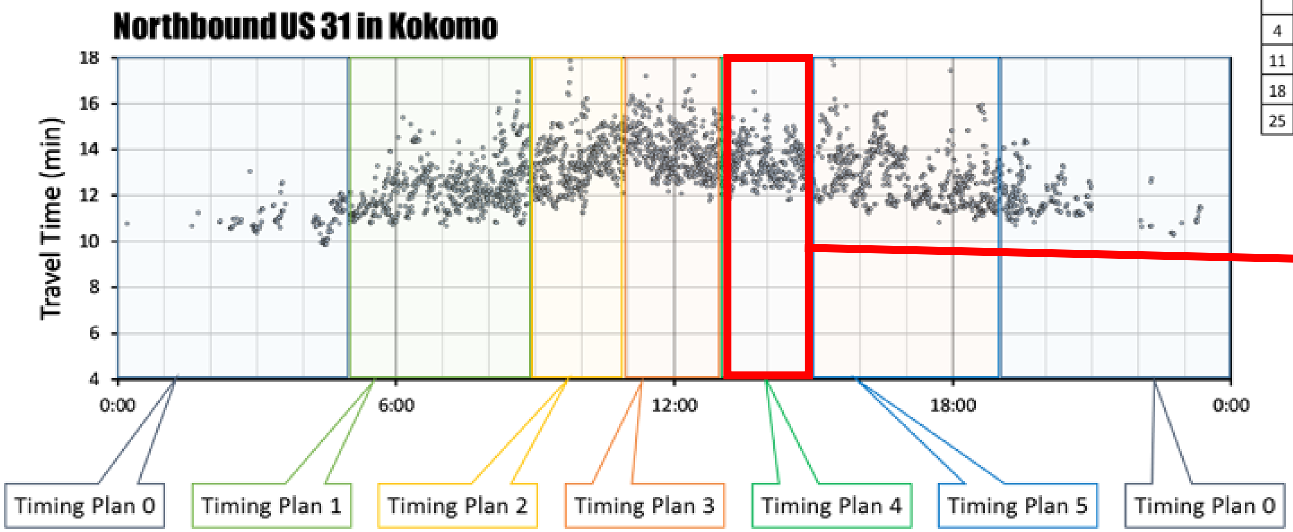
Ranks multiple corridors based on normalized median and interquartile travel times over the same time period

3 **Congestion Ticker**

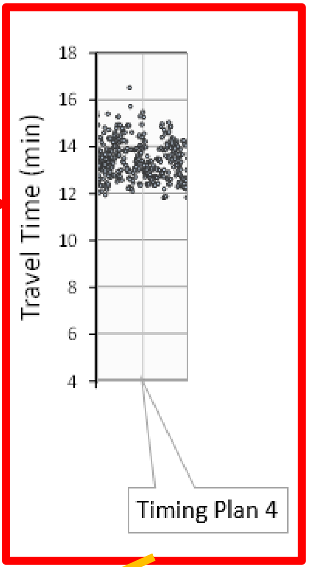
Tracks speeds of corridors over time to identify time periods and locations of congestion

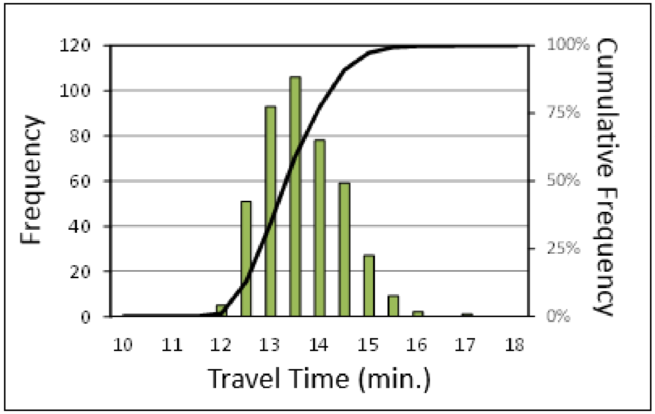
① Travel Time Comparison Tool

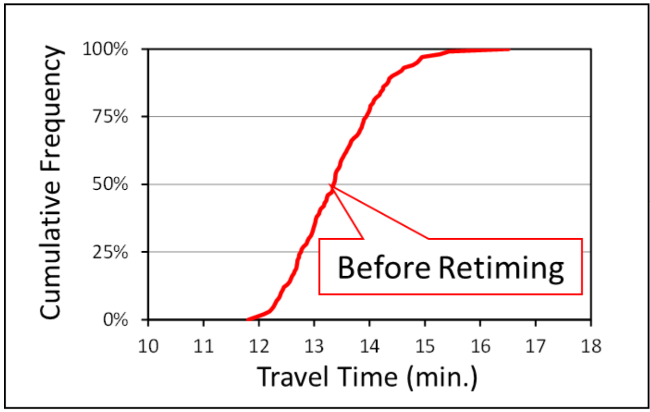
Cumulative Frequency Diagram (CFD)



MARCH 2012						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31







① Travel Time Comparison Tool

Cumulative Frequency Diagram (CFD)

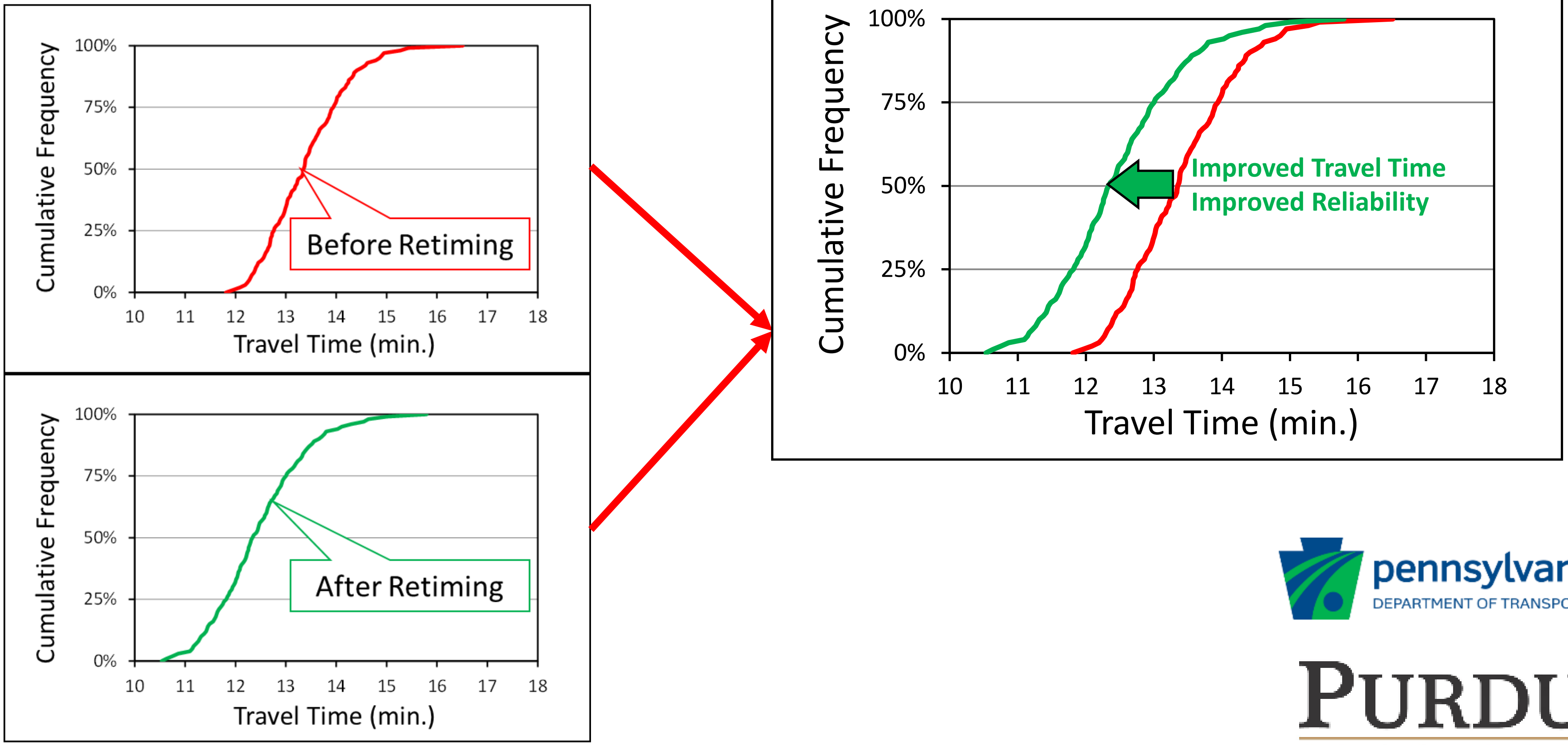
MARCH 2012						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

BEFORE

APRIL 2012						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

AFTER

Retiming Week



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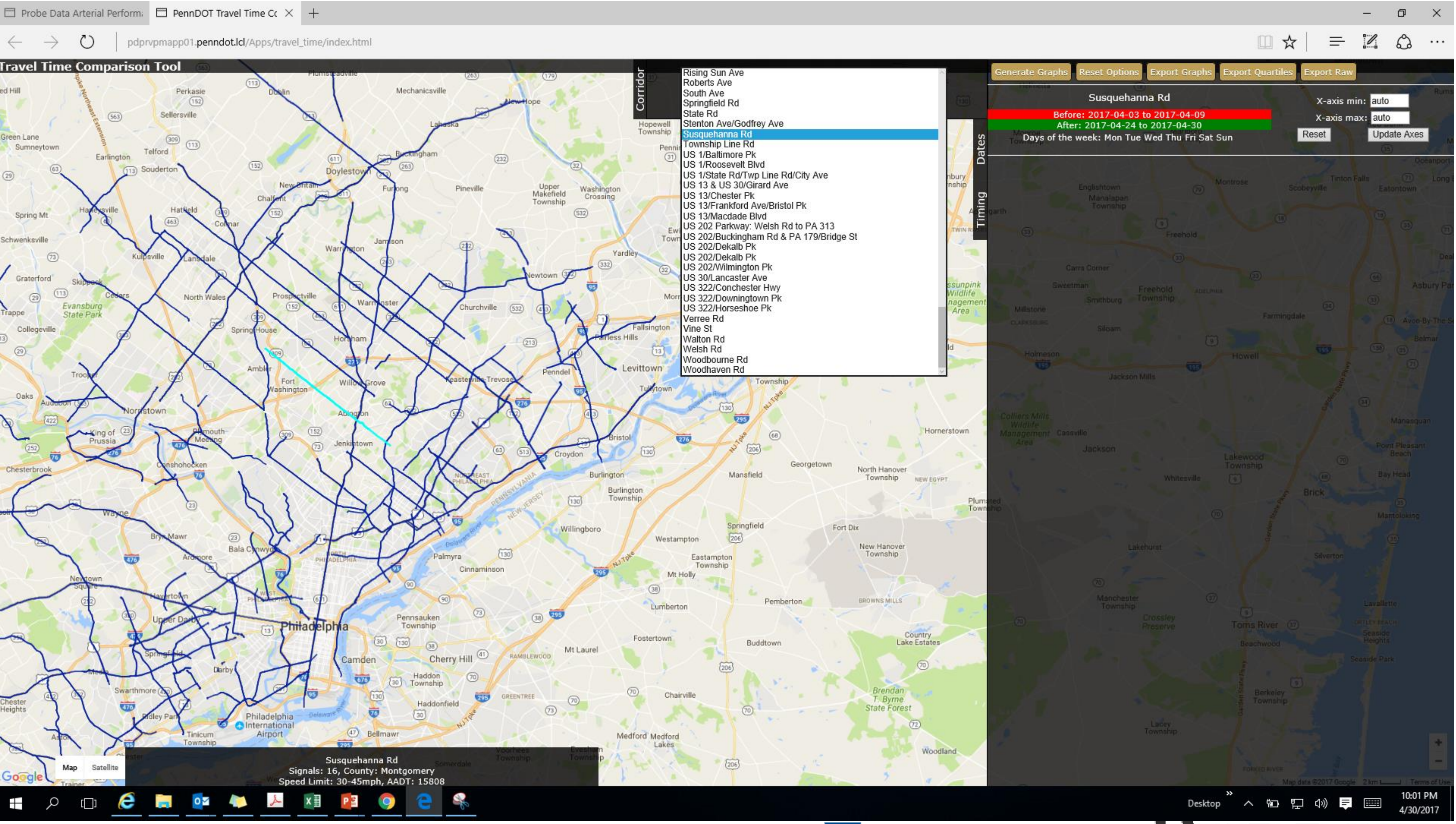
① Travel Time Comparison Tool

Select a Corridor



Rising Sun Ave
Roberts Ave
South Ave
Springfield Rd
State Rd
Stenton Ave/Godfrey Ave
Susquehanna Rd
Township Line Rd
US 1/Baltimore Pk
US 1/Roosevelt Blvd
US 1/State Rd/Twp Line Rd/City Ave
US 13 & US 30/Girard Ave
US 13/Chester Pk
US 13/Frankford Ave/Bristol Pk
US 13/Macdade Blvd
US 202 Parkway: Welsh Rd to PA 313
US 202/Buckingham Rd & PA 179/Bridge St
US 202/Dekalb Pk
US 202/Dekalb Pk
US 202/Wilmington Pk
US 30/Lancaster Ave
US 322/Conchester Hwy
US 322/Downingtown Pk
US 322/Horseshoe Pk
Verree Rd
Vine St
Walton Rd
Welsh Rd
Woodbourne Rd
Woodhaven Rd

Susquehanna Rd
Before: 2017-04-03 to 2017-04-09
After: 2017-04-24 to 2017-04-30
Days of the week: Mon Tue Wed Thu Fri Sat Sun

X-axis min: auto
X-axis max: auto

Susquehanna Rd
Signals: 16, County: Montgomery
Speed Limit: 30-45mph, AADT: 15808

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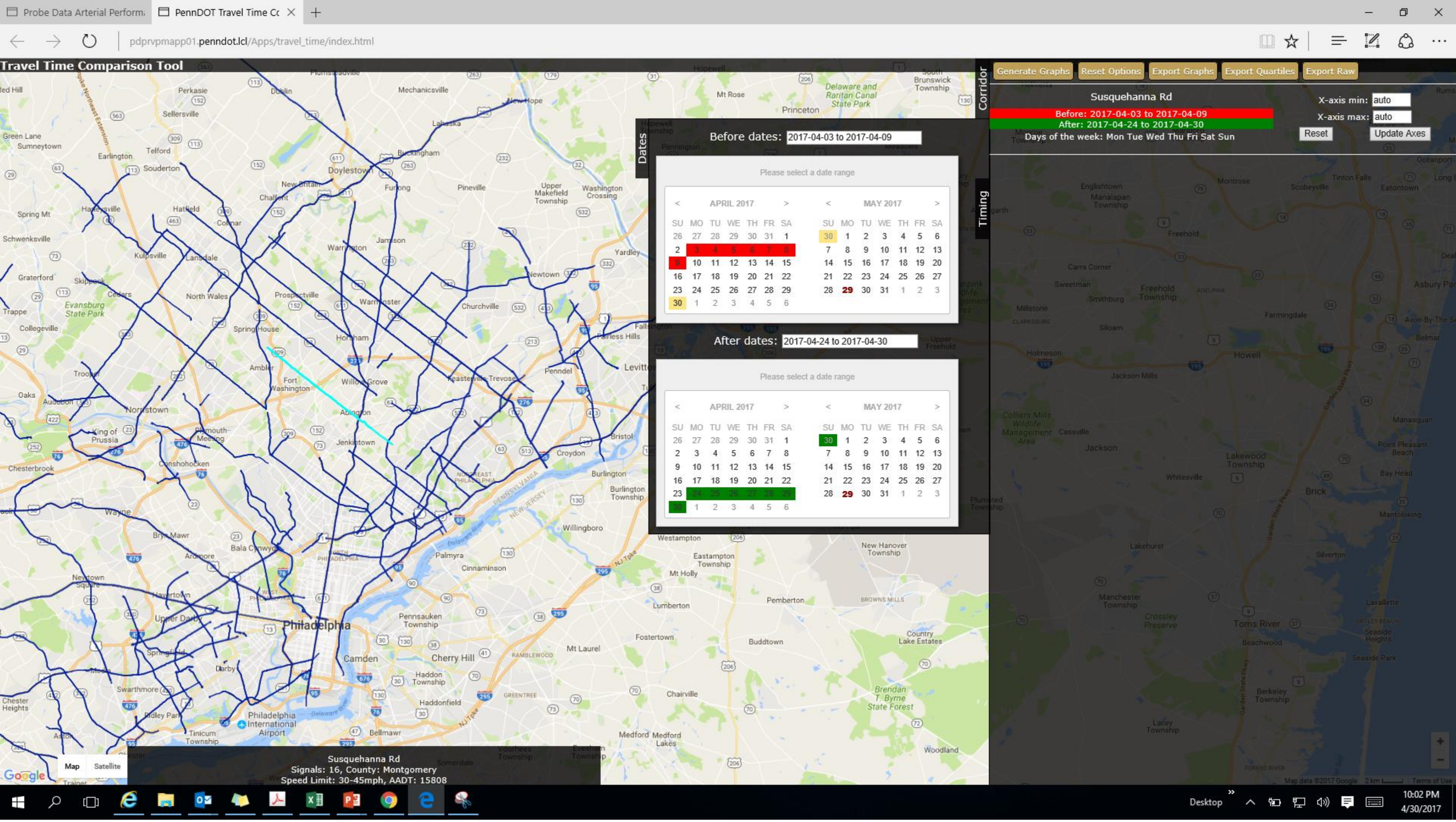
① Travel Time Comparison Tool

Select Before and After Evaluation Dates



Before dates: 2017-04-03 to 2017-04-09

After dates: 2017-04-24 to 2017-04-30

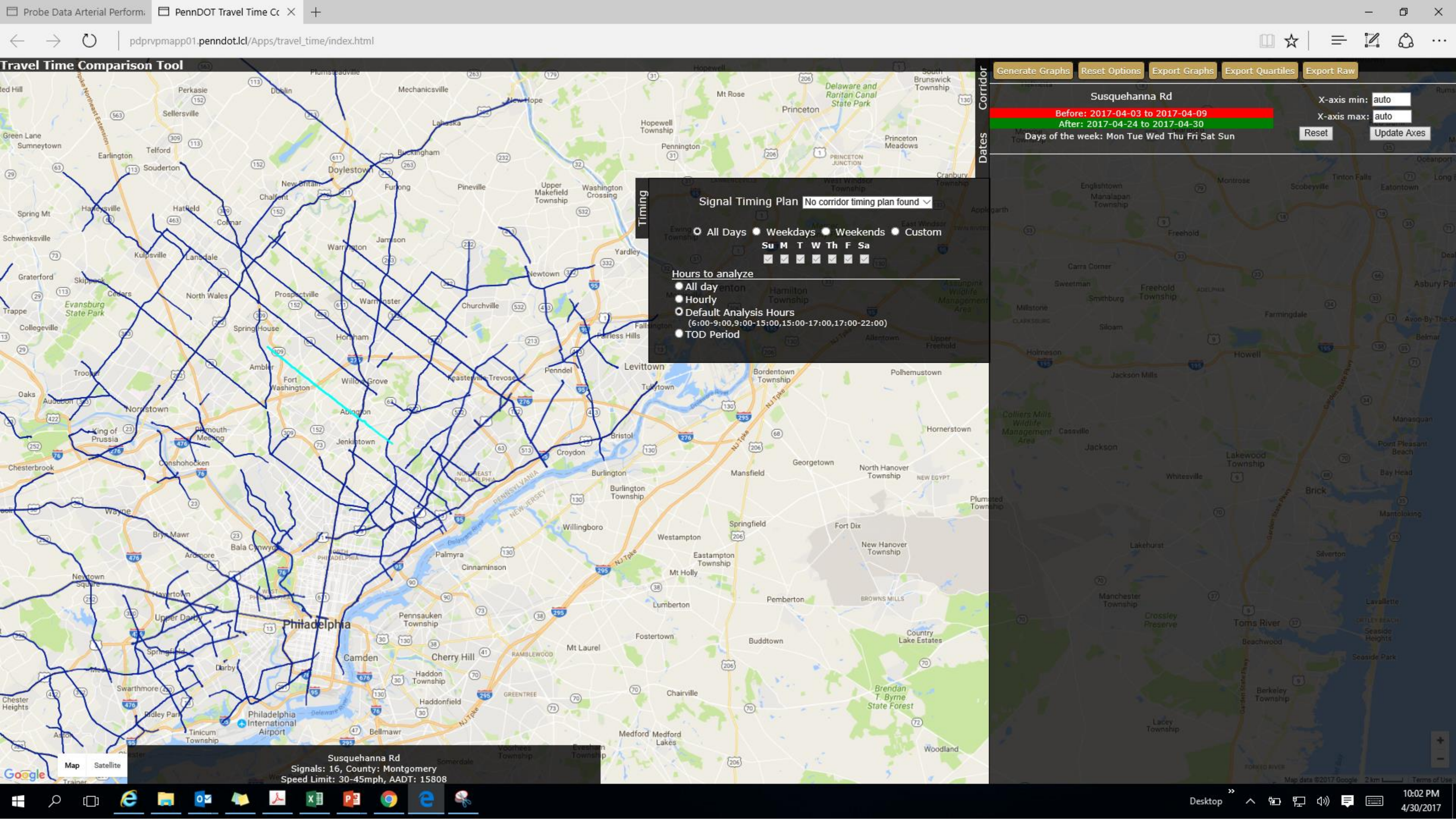
Susquehanna Rd
Before: 2017-04-03 to 2017-04-09
After: 2017-04-24 to 2017-04-30
Days of the week: Mon Tue Wed Thu Fri Sat Sun

X-axis min: auto
X-axis max: auto

Susquehanna Rd
Signals: 16, County: Montgomery
Speed Limit: 30-45mph, AADT: 15808

① Travel Time Comparison Tool

Select the Days and Hours of Evaluation



Susquehanna Rd

Before: 2017-04-03 to 2017-04-09

After: 2017-04-24 to 2017-04-30

Days of the week: Mon Tue Wed Thu Fri Sat Sun

X-axis min: auto

X-axis max: auto

Reset Update Axes

Signal Timing Plan: No corridor timing plan found

● All Days ○ Weekdays ○ Weekends ○ Custom

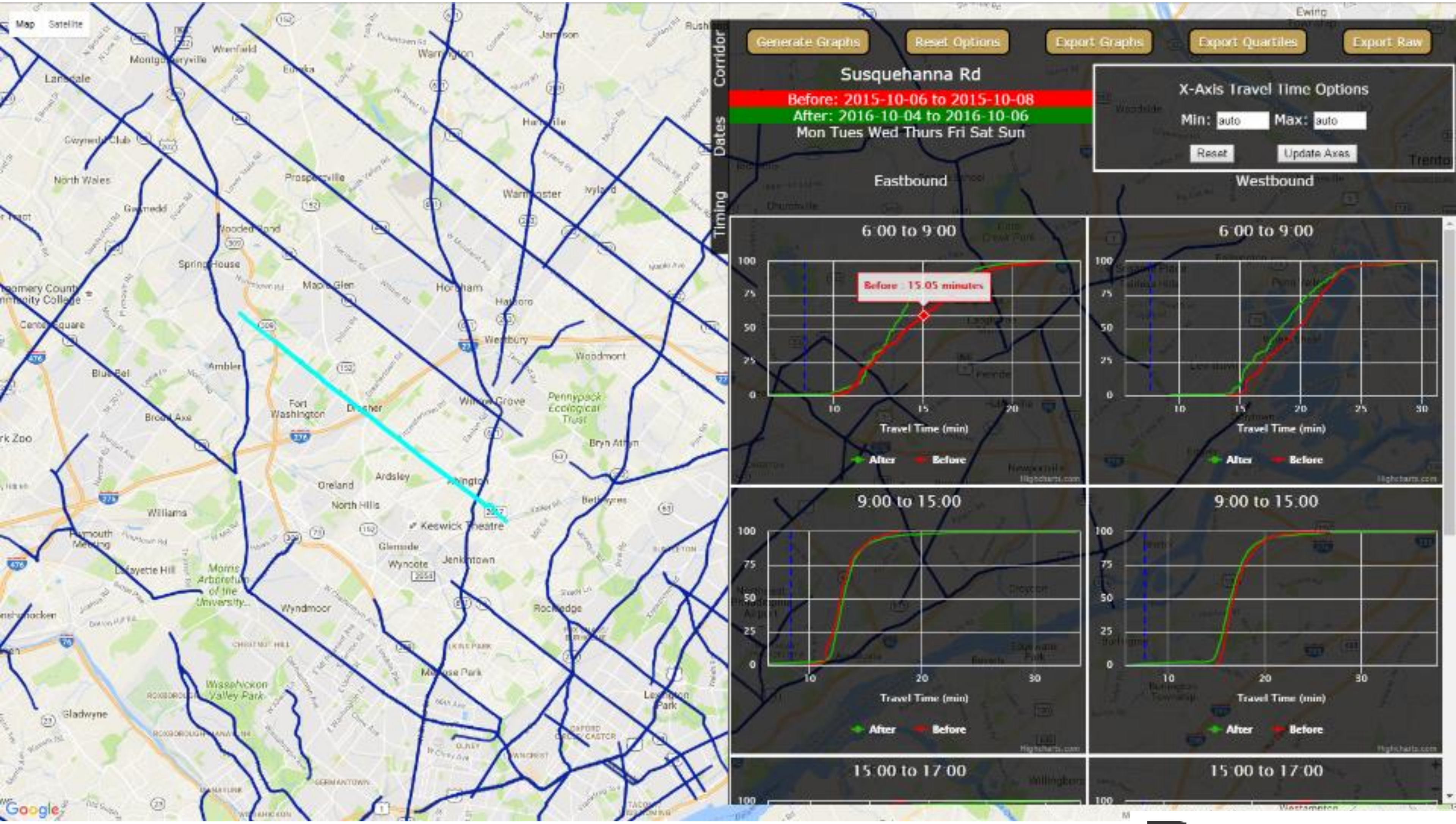
Su	M	T	W	Th	F	Sa
☑	☑	☑	☑	☑	☑	☑

Hours to analyze

- ○ All day
- ○ Hourly
- ● Default Analysis Hours (6:00-9:00,9:00-15:00,15:00-17:00,17:00-22:00)
- ○ TOD Period

Susquehanna Rd
Signals: 16, County: Montgomery
Speed Limit: 30-45mph, AADT: 15808

① Travel Time Comparison Tool



Susquehanna Rd
Before: 2015-10-06 to 2015-10-08
After: 2016-10-04 to 2016-10-06
Mon Tues Wed Thurs Fri Sat Sun

X-Axis Travel Time Options
Min: auto Max: auto

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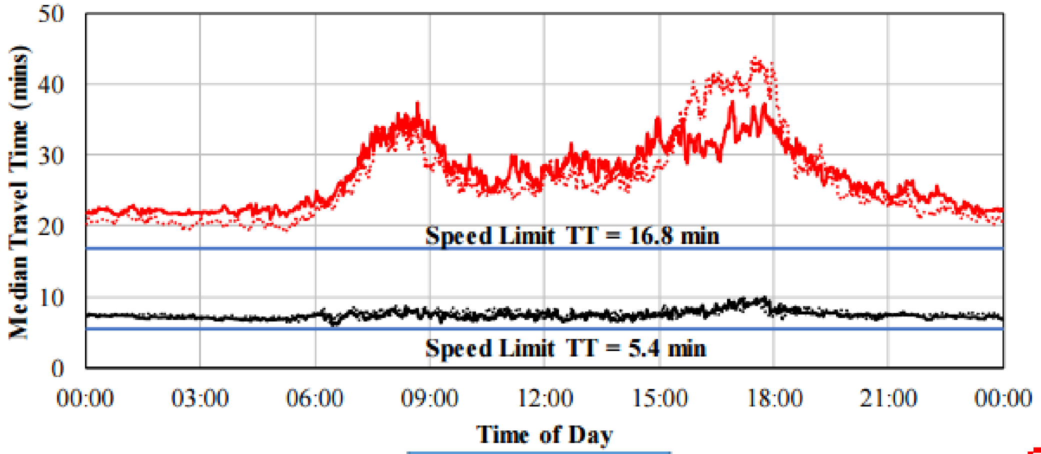
2 Arterial Ranking Tool

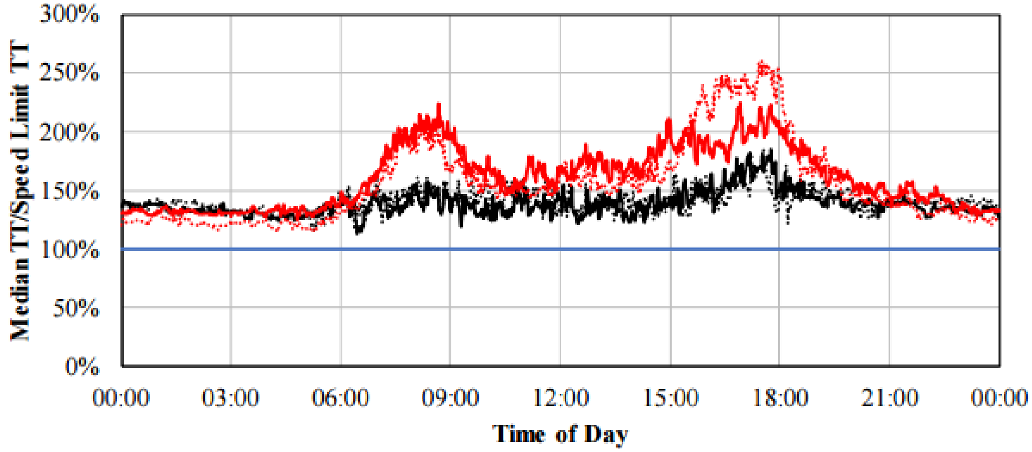
Travel Time Normalization

*Median travel time and speed limit travel time on **Newtown Bypass (shown in black)** and **US-1 (shown in red)** for the study period 12/5/2016 to 12/10/2016*



Normalize

$$\text{Normalized TT} = \frac{\text{Median TT}}{\text{Speed limit TT}}$$



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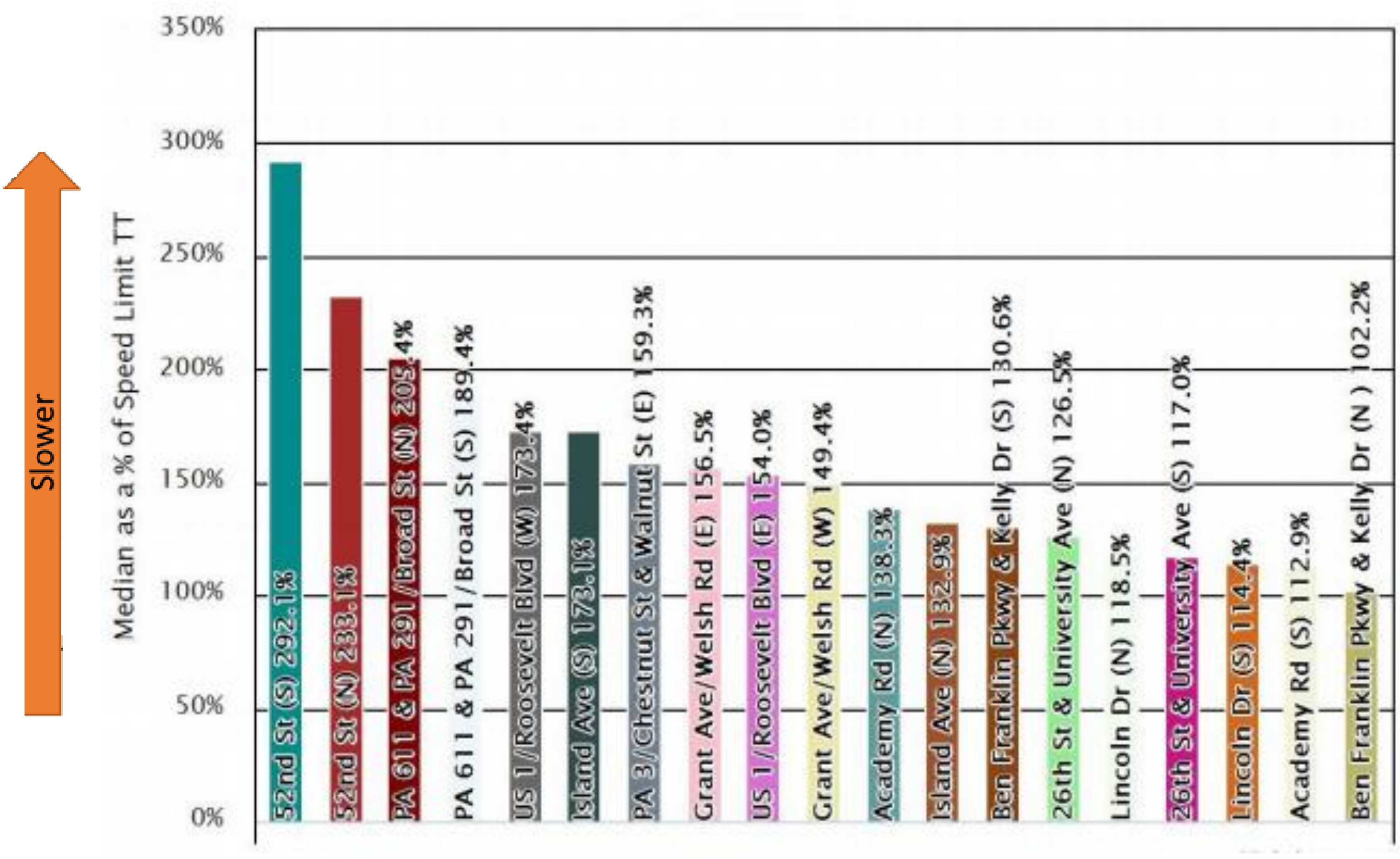
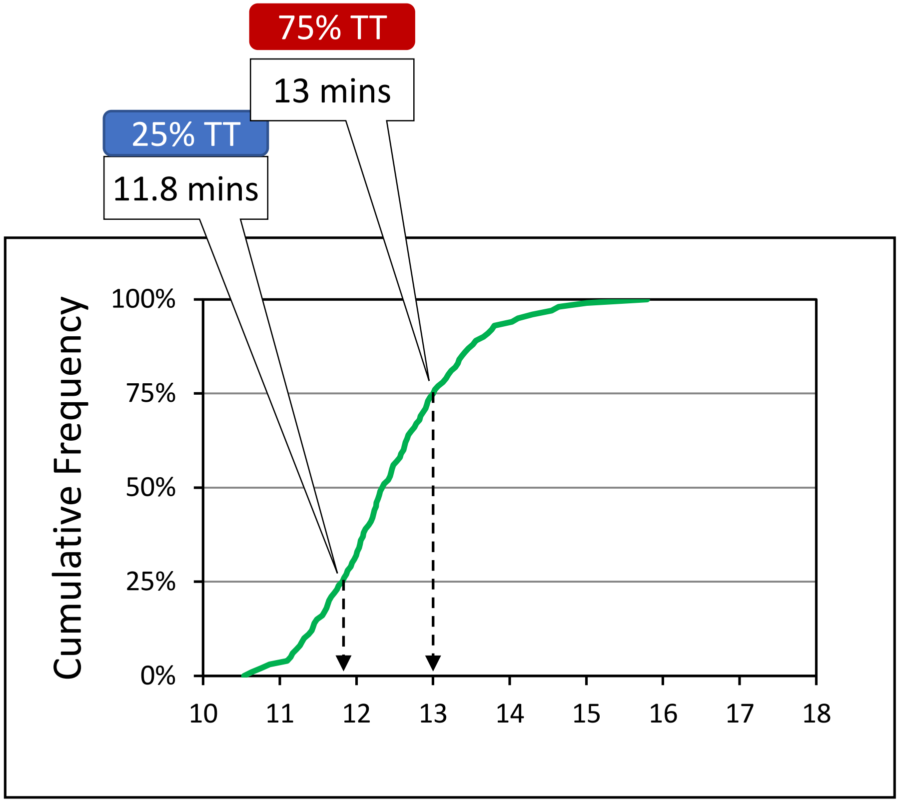
② Arterial Ranking Tool

Travel Time Normalization Ranking



2 Arterial Ranking Tool

Interquartile-Range (IQR) Normalization



APRIL 2012						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	🟩 16	🟩 17	🟩 18	🟩 19	🟩 20	21
22	23	24	25	26	27	28
29	30					

$$\text{Normalized IQR} = \frac{(75\text{th percentile TT} - 25\text{th percentile TT})}{\text{Speed limit TT}}$$

75th TT

25th TT

$$\frac{13\ \text{min}}{9\ \text{min}} - \frac{11.8\ \text{min}}{9\ \text{min}} = 0.13\ (13\%)$$

Spd. Lim TT

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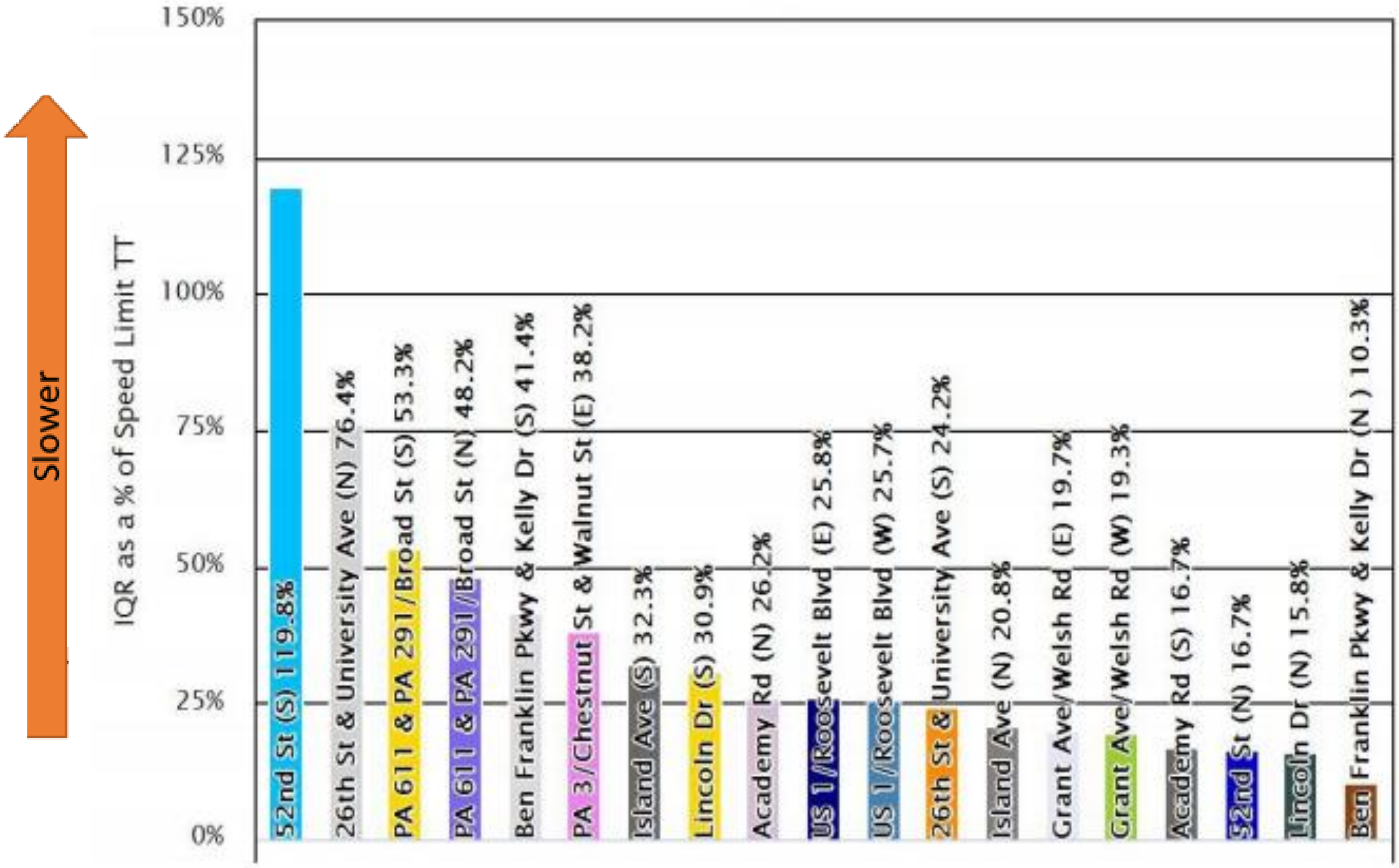
② Arterial Ranking Tool

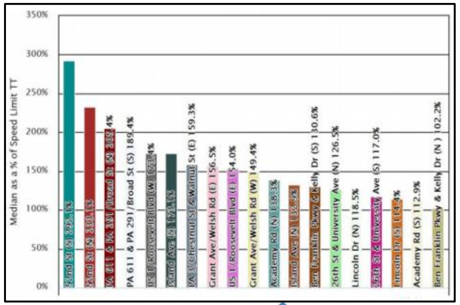
Interquartile-Range (IQR) Normalization Ranking



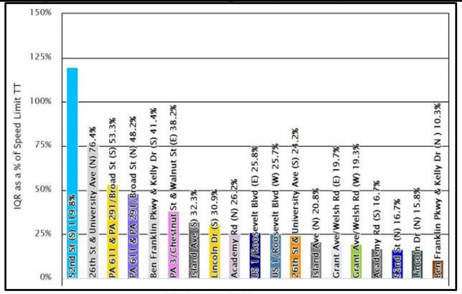
2 Arterial Ranking Tool

Reliability vs Central Tendency

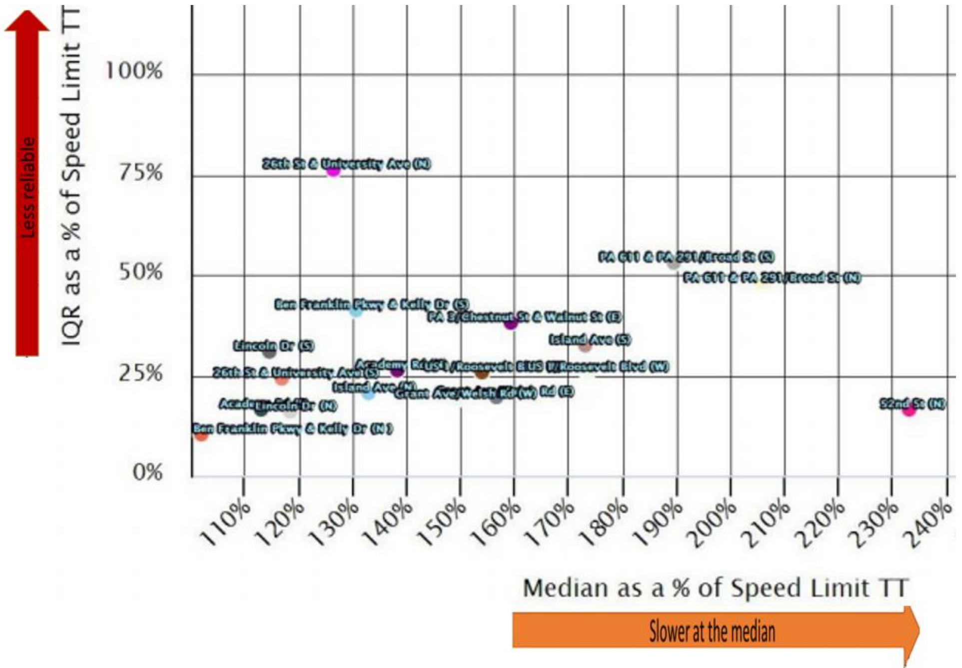
Travel Time Normalization Ranking



Interquartile-Range (IQR) Normalization Ranking

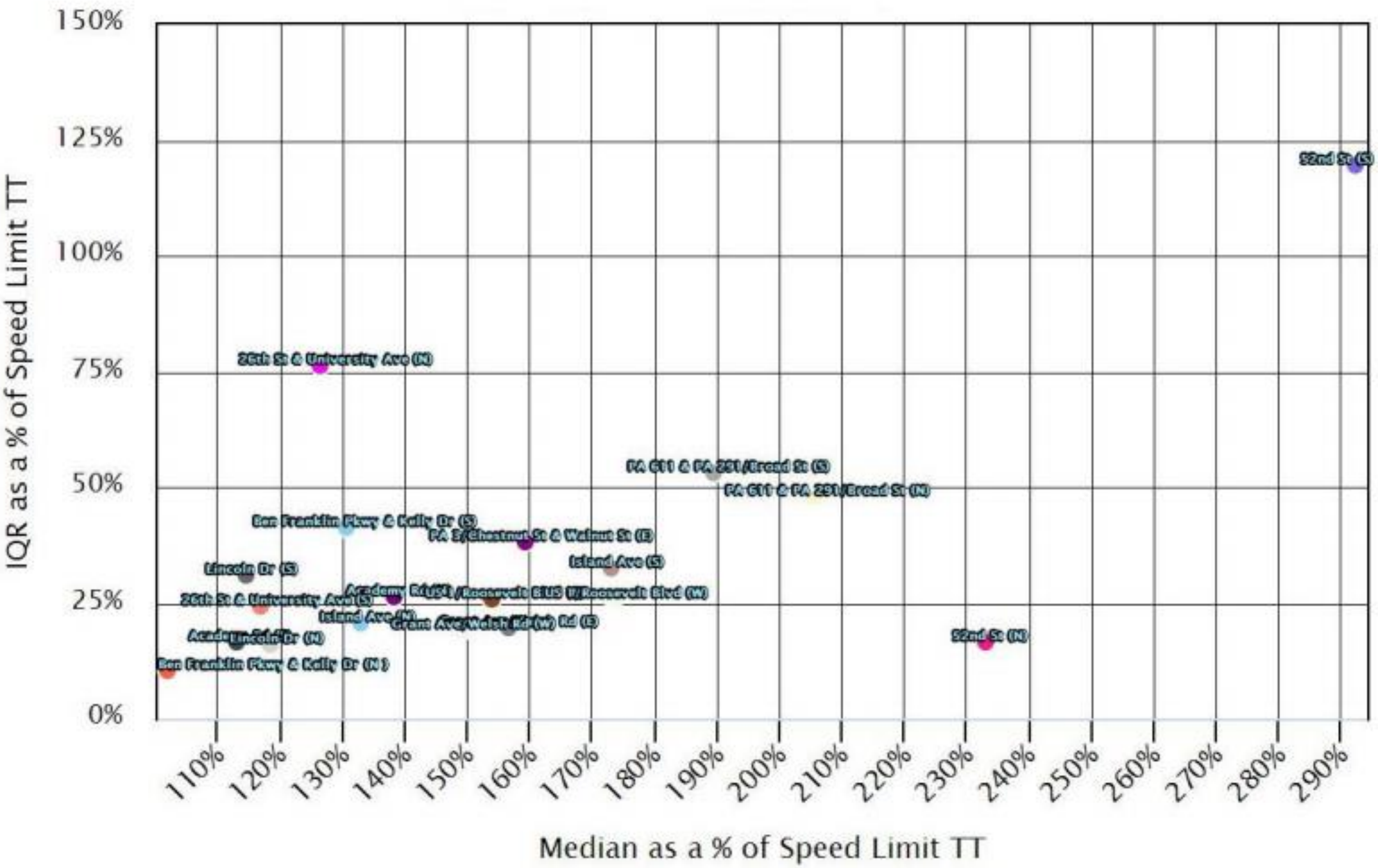


Reliability vs Central Tendency



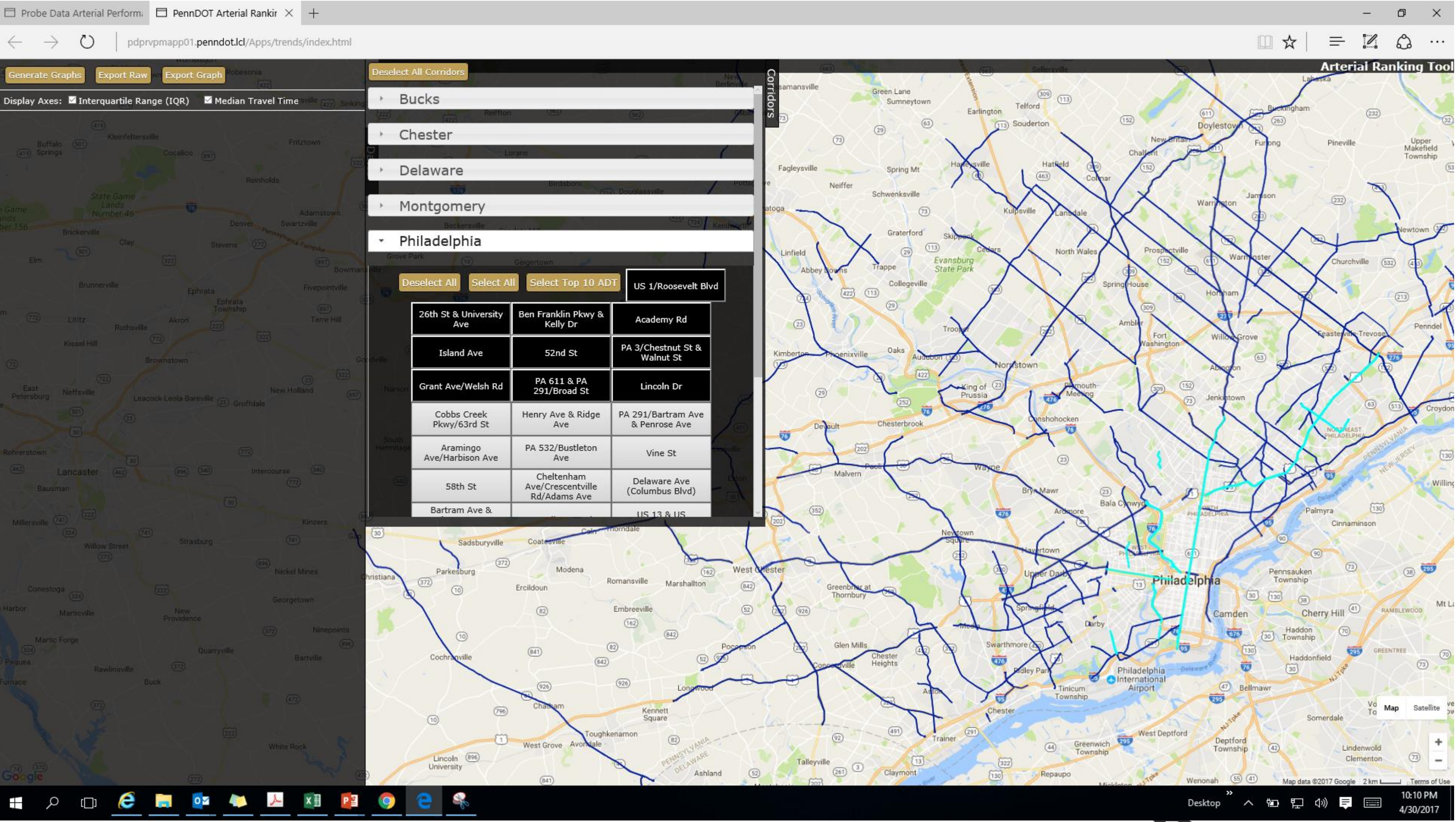
② Arterial Ranking Tool

Reliability vs Central Tendency (Philadelphia County)



2 Arterial Ranking Tool

Select a County and Corridors

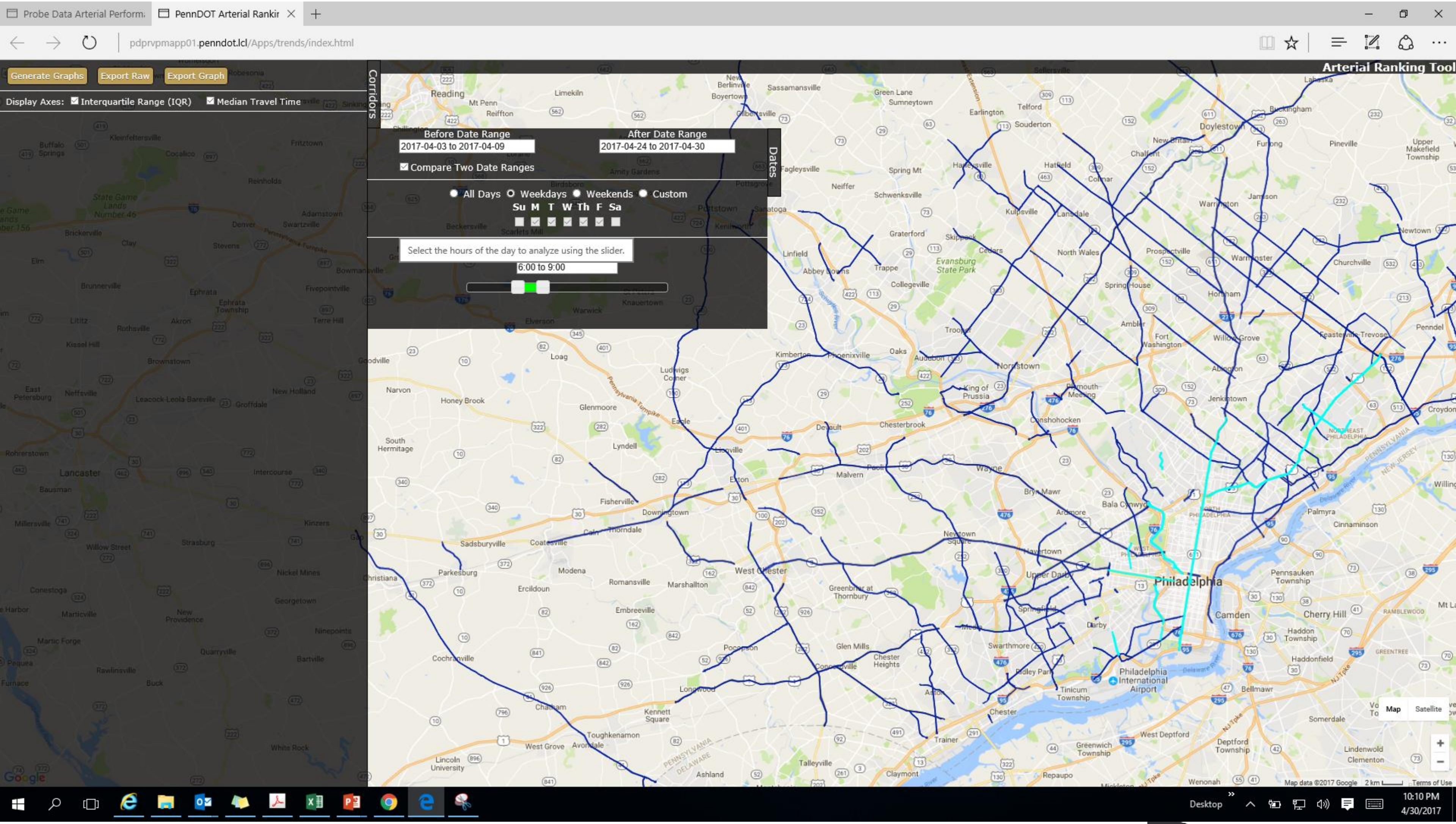


Display Axes: ☑ Interquartile Range (IQR) ☑ Median Travel Time

		US 1/Roosevelt Blvd
26th St & University Ave	Ben Franklin Pkwy & Kelly Dr	Academy Rd
Island Ave	52nd St	PA 3/Chestnut St & Walnut St
Grant Ave/Welsh Rd	PA 611 & PA 291/Broad St	Lincoln Dr
Cobbs Creek Pkwy/63rd St	Henry Ave & Ridge Ave	PA 291/Bartram Ave & Penrose Ave
Aramingo Ave/Harbison Ave	PA 532/Bustleton Ave	Vine St
58th St	Cheltenham Ave/Crescentville Rd/Adams Ave	Delaware Ave (Columbus Blvd)
Bartram Ave &		US 13 & US

② Arterial Ranking Tool

Select a Time Frame, Days, and Hours of Evaluation



Display Axes: ☑ Interquartile Range (IQR) ☑ Median Travel Time

Before Date Range: 2017-04-03 to 2017-04-09

After Date Range: 2017-04-24 to 2017-04-30

☑ Compare Two Date Ranges

○ All Days ● Weekdays ○ Weekends ○ Custom

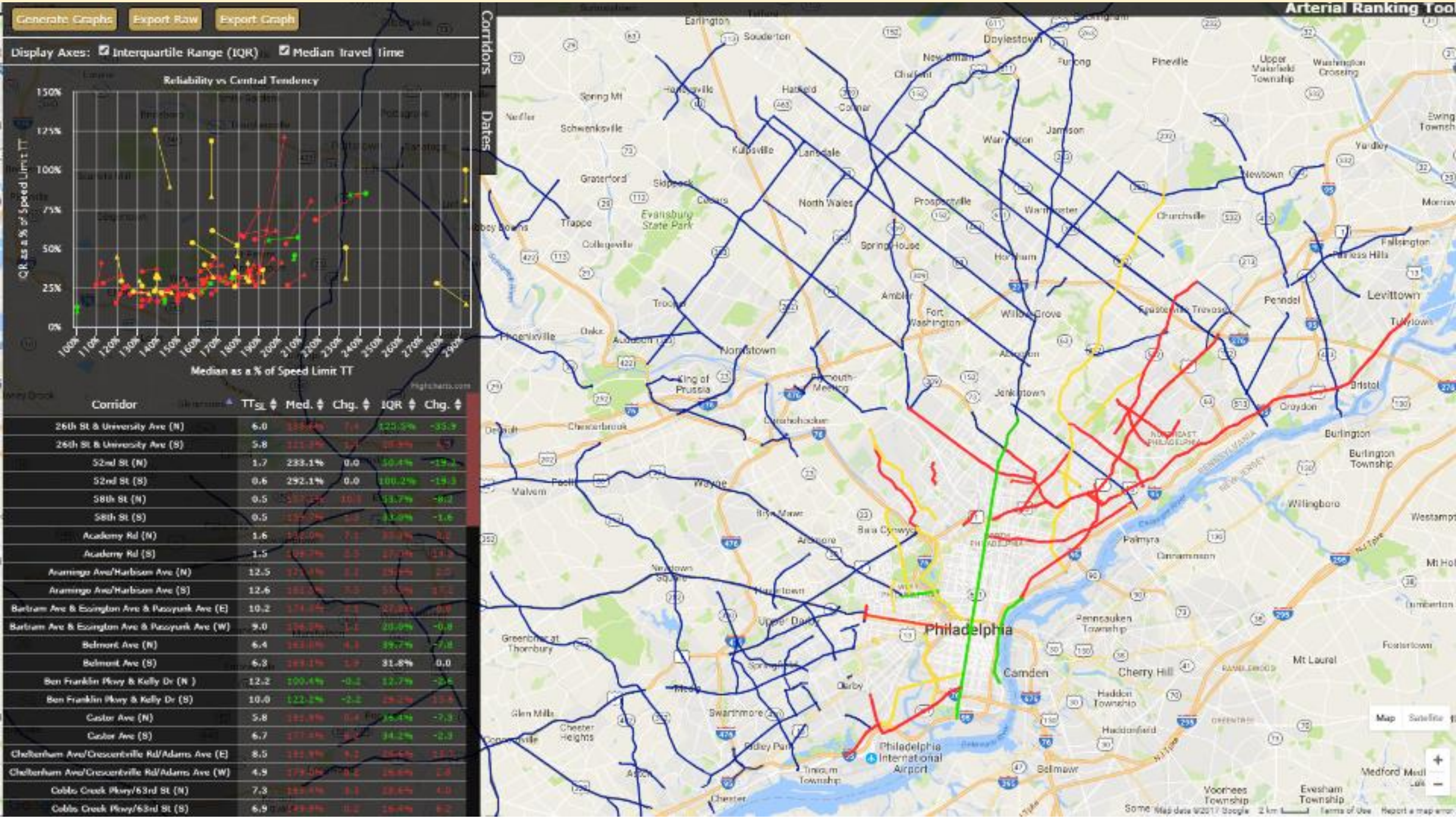
Su	M	T	W	Th	F	Sa
☐	☑	☑	☑	☑	☑	☐

Select the hours of the day to analyze using the slider.

6:00 to 9:00

② Arterial Ranking Tool

Reliability vs Central Tendency

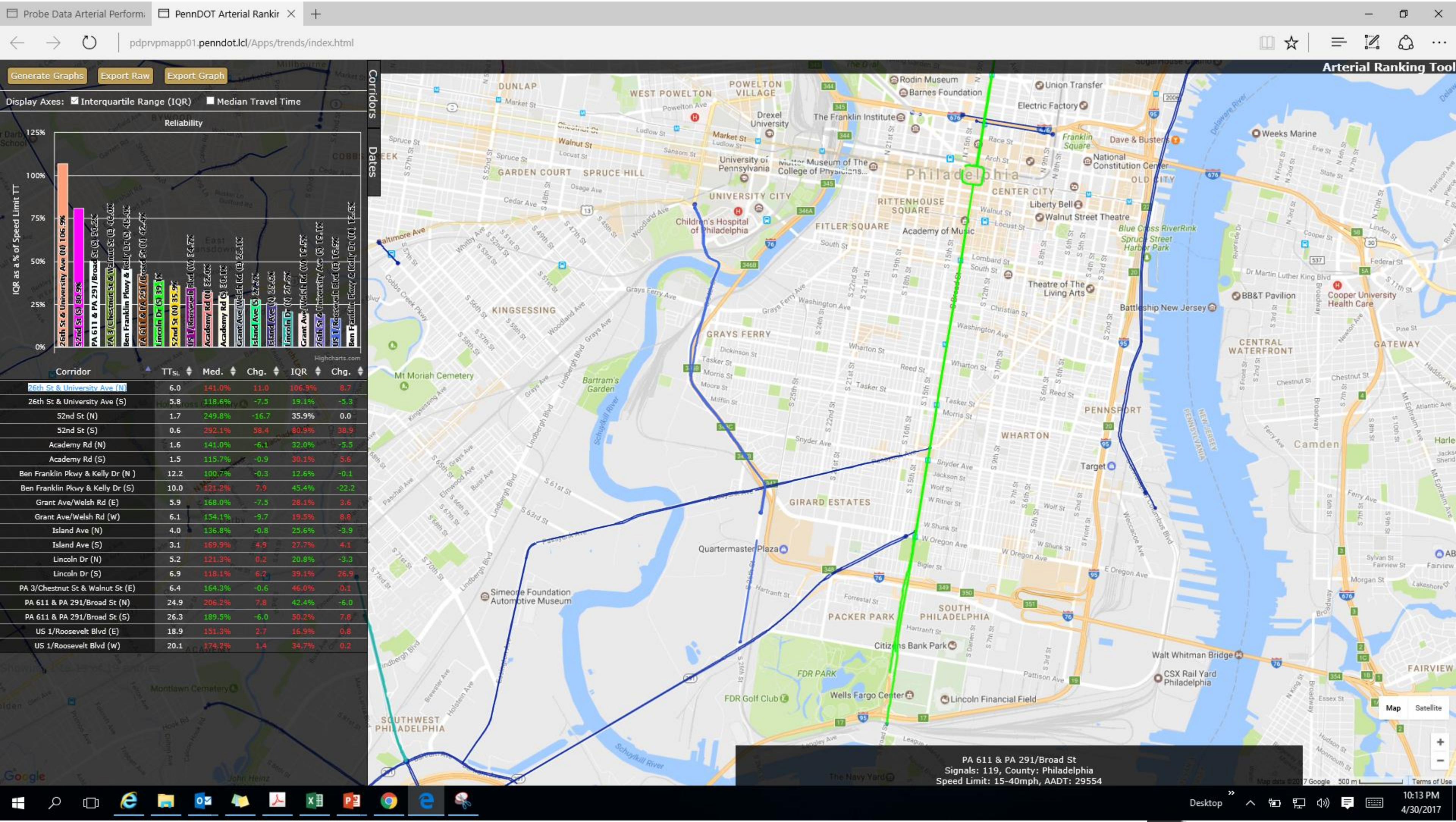


Display Axes: ☑ Interquartile Range (IQR) ☑ Median Travel Time

Corridor	TT_{SL}	Med.	Chg.	IQR	Chg.
26th St & University Ave (N)	6.0	[illegible]	[illegible]	125.5%	-35.9
26th St & University Ave (S)	5.8	[illegible]	[illegible]	[illegible]	[illegible]
52nd St (N)	1.7	233.1%	0.0	50.4%	-19.2
52nd St (S)	0.6	292.1%	0.0	100.2%	-19.3
58th St (N)	0.5	[illegible]	[illegible]	33.7%	-8.2
58th St (S)	0.5	[illegible]	[illegible]	33.0%	-1.6
Academy Rd (N)	1.6	[illegible]	[illegible]	[illegible]	[illegible]
Academy Rd (S)	1.5	[illegible]	[illegible]	[illegible]	[illegible]
Aramingo Ave/Harbison Ave (N)	12.5	[illegible]	[illegible]	[illegible]	[illegible]
Aramingo Ave/Harbison Ave (S)	12.6	[illegible]	[illegible]	[illegible]	[illegible]
Bartram Ave & Essington Ave & Passyunk Ave (E)	10.2	[illegible]	[illegible]	[illegible]	[illegible]
Bartram Ave & Essington Ave & Passyunk Ave (W)	9.0	[illegible]	[illegible]	20.0%	-0.8
Belmont Ave (N)	6.4	[illegible]	[illegible]	39.7%	-7.8
Belmont Ave (S)	6.3	[illegible]	[illegible]	31.8%	0.0
Ben Franklin Pkwy & Kelly Dr (N)	12.2	100.4%	-0.2	12.7%	-2.6
Ben Franklin Pkwy & Kelly Dr (S)	10.0	122.2%	-2.2	[illegible]	[illegible]
Castor Ave (N)	5.8	[illegible]	[illegible]	35.4%	-7.3
Castor Ave (S)	6.7	[illegible]	[illegible]	34.2%	-2.3
Cheltenham Ave/Crescentville Rd/Adams Ave (E)	8.5	[illegible]	[illegible]	[illegible]	[illegible]
Cheltenham Ave/Crescentville Rd/Adams Ave (W)	4.9	[illegible]	[illegible]	[illegible]	[illegible]
Cobbs Creek Pkwy/63rd St (N)	7.3	[illegible]	[illegible]	[illegible]	[illegible]
Cobbs Creek Pkwy/63rd St (S)	6.9	[illegible]	[illegible]	[illegible]	[illegible]

② Arterial Ranking Tool

Interquartile-Range (IQR) Normalization Ranking

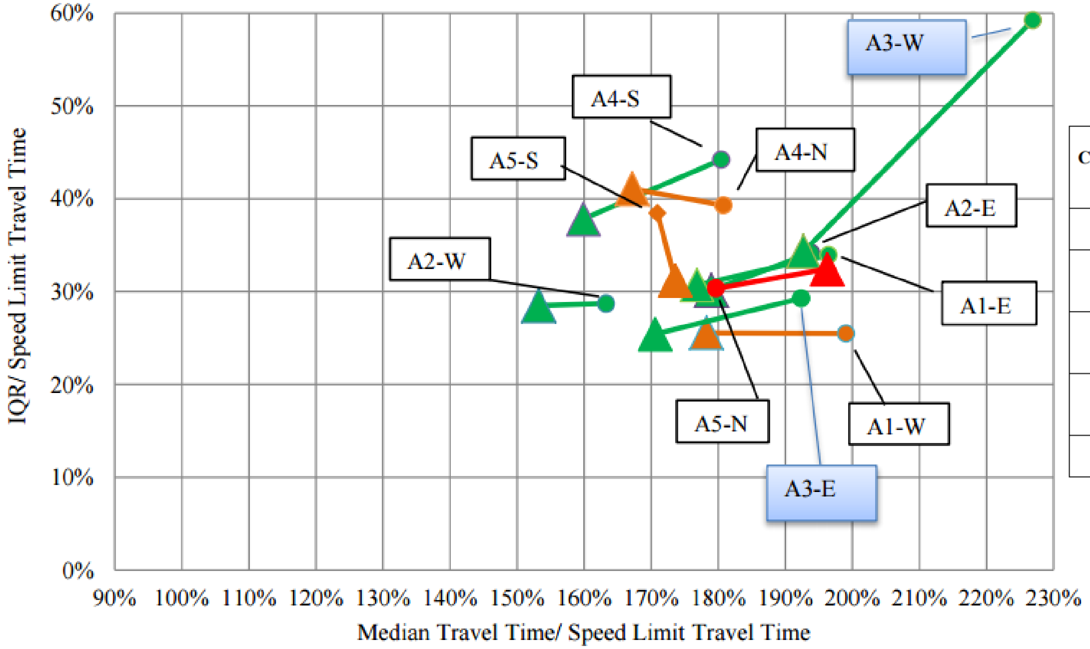


Corridor	TT_{SL}	Med.	Chg.	IQR	Chg.
26th St & University Ave (N)	6.0	141.0%	11.0	106.9%	8.7
26th St & University Ave (S)	5.8	118.6%	-7.5	19.1%	-5.3
52nd St (N)	1.7	249.8%	-16.7	35.9%	0.0
52nd St (S)	0.6	292.1%	58.4	80.9%	38.9
Academy Rd (N)	1.6	141.0%	-6.1	32.0%	-5.5
Academy Rd (S)	1.5	115.7%	-0.9	30.1%	5.6
Ben Franklin Pkwy & Kelly Dr (N)	12.2	100.7%	-0.3	12.6%	-0.1
Ben Franklin Pkwy & Kelly Dr (S)	10.0	121.2%	7.9	45.4%	-22.2
Grant Ave/Welsh Rd (E)	5.9	168.0%	-7.5	28.1%	3.6
Grant Ave/Welsh Rd (W)	6.1	154.1%	-9.7	19.5%	8.8
Island Ave (N)	4.0	136.8%	-0.8	25.6%	-3.9
Island Ave (S)	3.1	169.9%	4.9	27.7%	4.1
Lincoln Dr (N)	5.2	121.3%	0.2	20.8%	-3.3
Lincoln Dr (S)	6.9	118.1%	6.2	39.1%	26.9
PA 3/Chestnut St & Walnut St (E)	6.4	164.3%	-0.6	46.0%	0.1
PA 611 & PA 291/Broad St (N)	24.9	206.2%	7.8	42.4%	-6.0
PA 611 & PA 291/Broad St (S)	26.3	189.5%	-6.0	50.2%	7.8
US 1/Roosevelt Blvd (E)	18.9	151.3%	2.7	16.9%	0.8
US 1/Roosevelt Blvd (W)	20.1	174.2%	1.4	34.7%	0.2

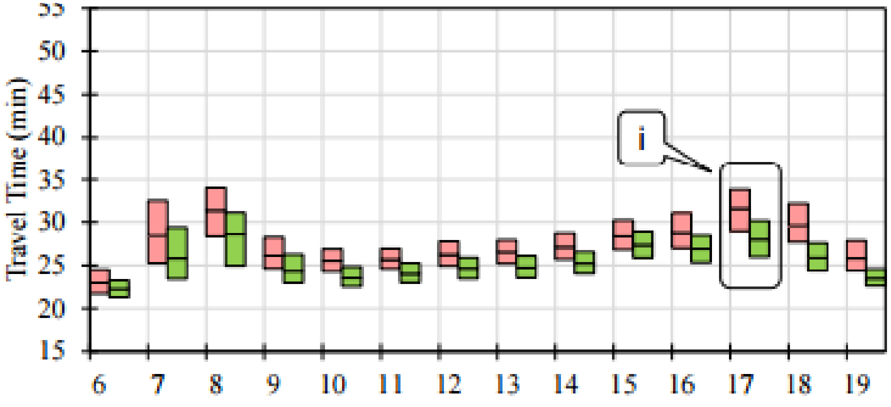
PA 611 & PA 291/Broad St
Signals: 119, County: Philadelphia
Speed Limit: 15-40mph, AADT: 29554

② Arterial Ranking Tool

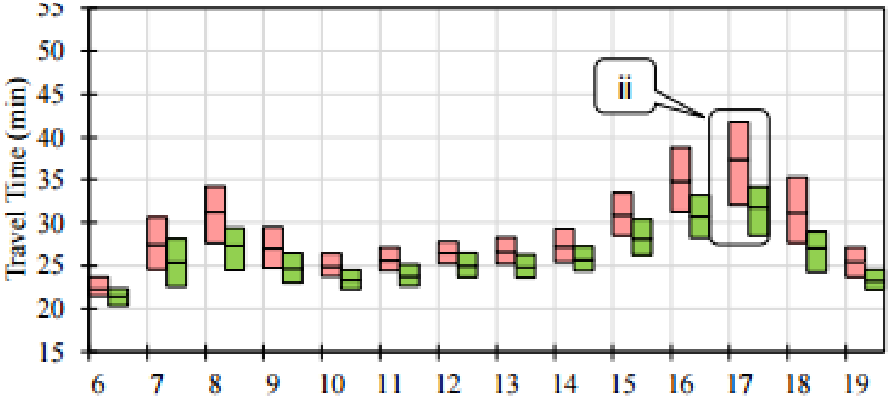
Case Study: US 1/State Rd/Township Line Rd/City Ave



Corridor ID	Corridor Name	AADT	Length (mi)	Average Speed Limit (mph)	Signal Count (Adaptive Signals)	Before Date Range	After Date Range
A1	PA 132 / Street Rd	33,965	15.2	45	50 (21)	10/12/2015–11/23/2015	1/4/2016–2/15/2016
A2	PA 332 (Newtown Bypass)	35,015	4.8	53	12 (12)	2/22/2016–4/4/2016	4/25/2016–6/6/2016
A3	US 1/State Rd/Township Line Rd/City Ave	35,268	10.0	36	40 (4)	10/12/2015 11/23/2015	3/7/2016 4/18/2016
A4	US 202/Wilmington Pkwy	46,553	8.6	45	16 (9)	9/4/2015–10/26/2015	1/4/2016–2/15/2016
A5	PA 611/Old York Rd/ Easton Rd	30,919	16.3	42	68 (15)	4/27/2015–6/8/2015	1/4/2016–2/15/2016

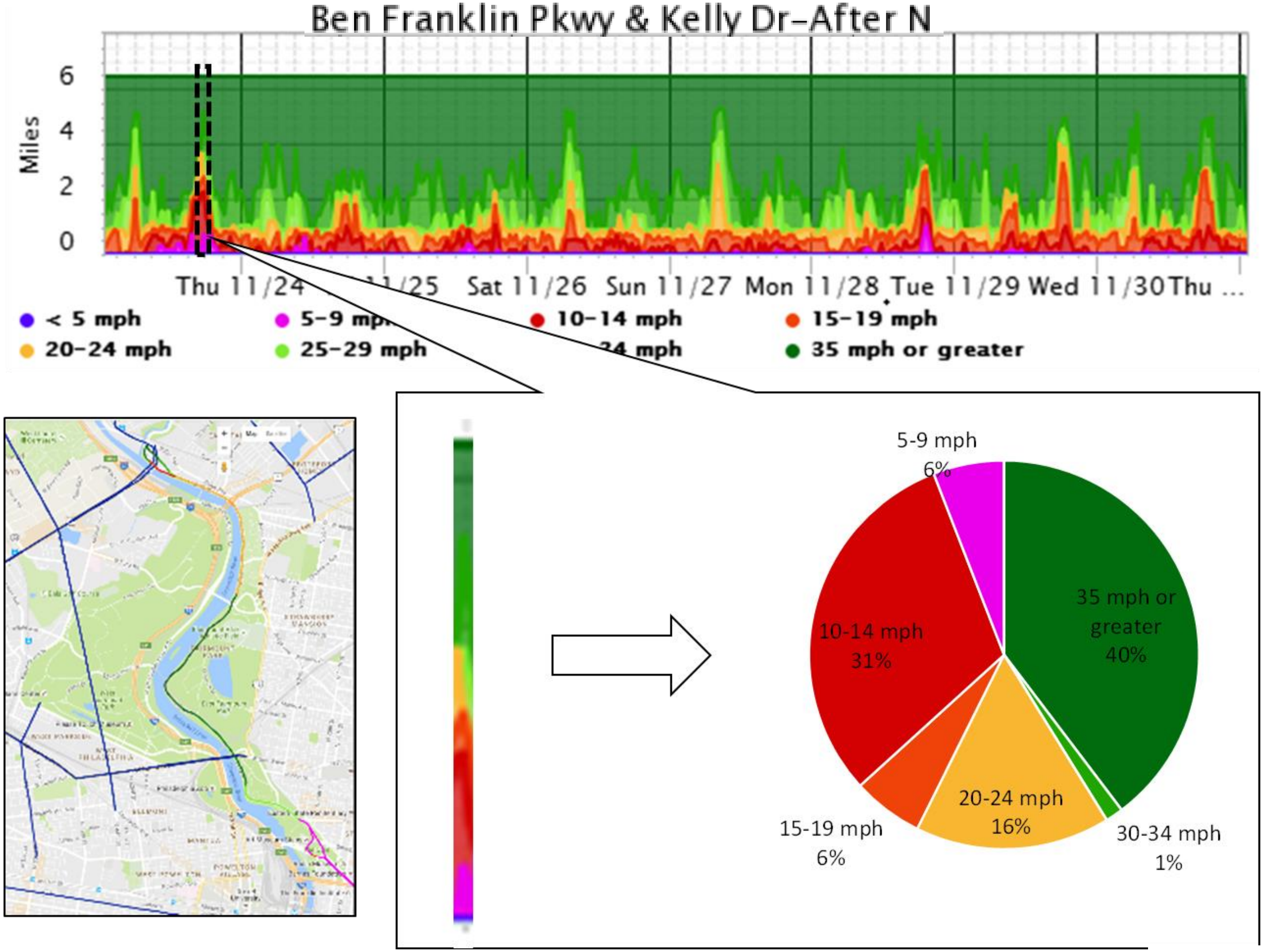


e) Corridor A3, Eastbound



f) Corridor A3, Westbound

3 Congestion Ticker



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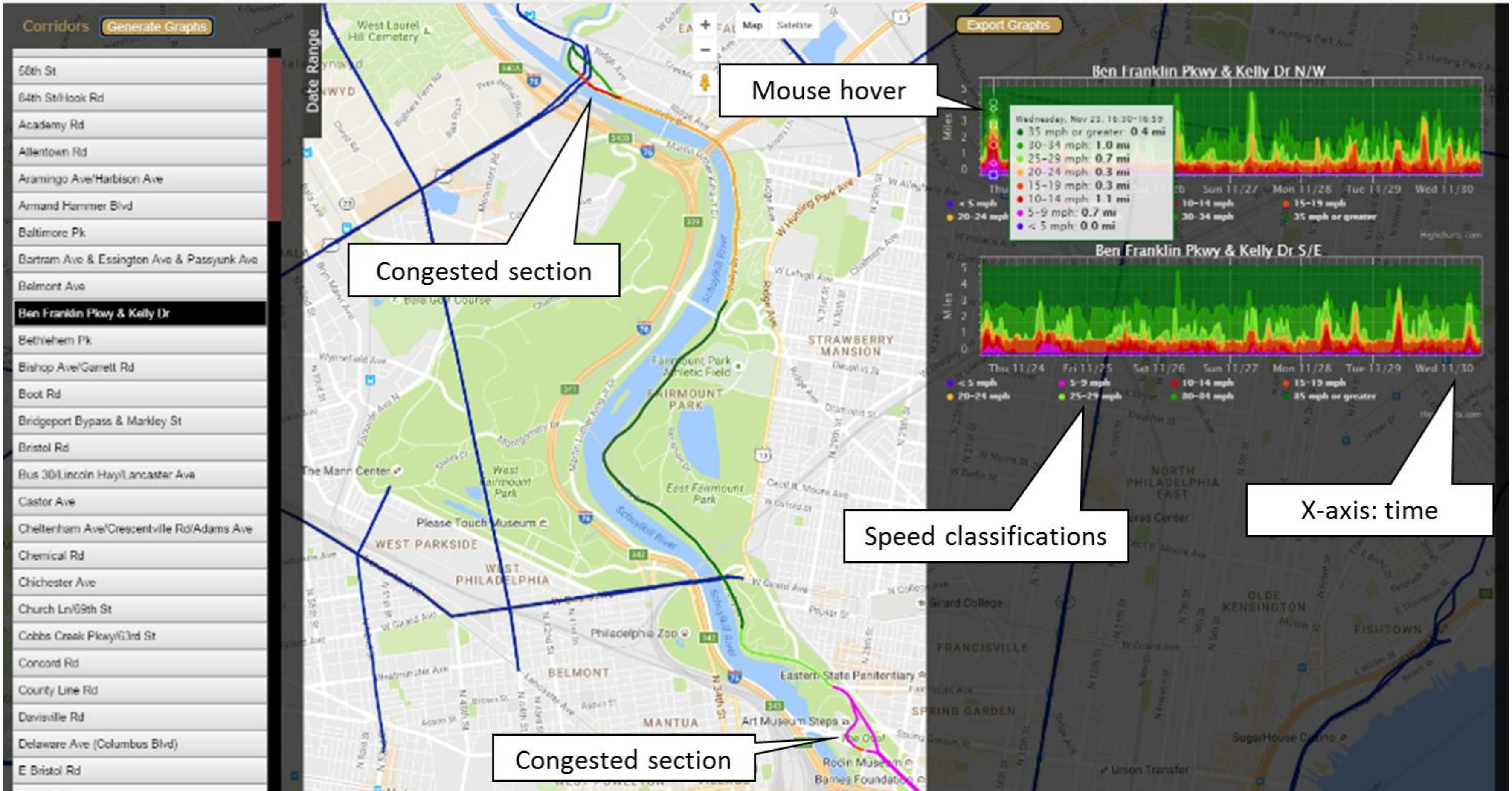
③ Congestion Ticker



Wednesday, Nov 23, 16:30-16:59
- 35 mph or greater: **0.4 mi**
- 30-34 mph: **1.0 mi**
- 25-29 mph: **0.7 mi**
- 20-24 mph: **0.3 mi**
- 15-19 mph: **0.3 mi**
- 10-14 mph: **1.1 mi**
- 5-9 mph: **0.7 mi**
- < 5 mph: **0.0 mi**

Mouse hover

Congested section

Speed classifications

X-axis: time

Congested section

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④ Benefit Evaluation

Case Study: US 1/State Rd/Township Line Rd/City Ave

Corridor ID	Corridor Name	AADT	Length (mi)	Average Speed Limit (mph)	Signal Count (Adaptive Signals)	Before Date Range	After Date Range
A1	PA 132 / Street Rd	33,965	15.2	45	50 (21)	10/12/2015–11/23/2015	1/4/2016–2/15/2016
A2	PA 332 (Newtown Bypass)	35,015	4.8	53	12 (12)	2/22/2016–4/4/2016	4/25/2016–6/6/2016
A3	US 1/State Rd/Township Line Rd/City Ave	35,268	10.0	36	40 (4)	10/12/2015 11/23/2015	3/7/2016 4/18/2016
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A5	PA 611/Old York Rd/ Easton Rd	30,919	16.3	42	68 (15)	4/27/2015–6/8/2015	1/4/2016–2/15/2016

Volume

$$vol_i = AADT * k_i * d$$

Change in median TT

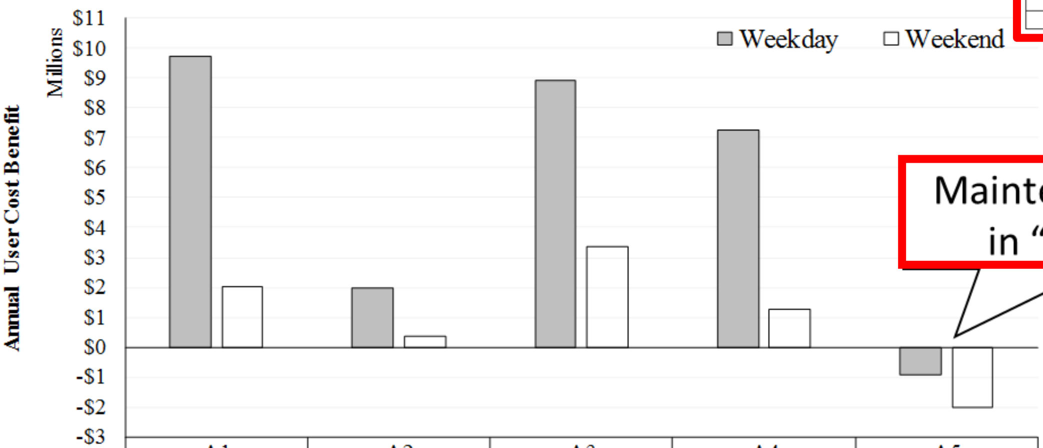
$$\Delta TT_i = TT_{before,i} - TT_{after,i}$$

$$user_{car,i} = vol_i * \Delta TT_i * \%C_i * PPV_c * VOT_c \quad + \quad user_{truck,i} = vol_i * \Delta TT_i * \%T_i * PPV_t * VOT_t$$

User benefits (cars) User benefits (trucks)

Summary of Annual CO_2 Emission Reductions for the Adaptive Signals

Corridor	Weekday CO_2 Savings		Weekend CO_2 Savings	
	Tons	Dollars	Tons	Dollars
A1	3120	$112,000	650	$23,000
A2	640	$23,000	120	$4,000
A3	2890	$104,000	1080	$39,000
A4	2320	$84,000	400	$14,000
A5	-310	-$11,000	-650	-$23,000
Total	**8660**	**$213,000**	**1610**	**$58,000**



Maintenance activities in "after" period

	A1	A2	A3	A4	A5
▨ Weekday	$9,716,000	$1,995,000	$8,917,000	$7,238,000	-$904,000
☐ Weekend	$2,030,000	$378,000	$3,370,000	$1,247,000	-$2,001,000

Over $30M in annualized user benefits

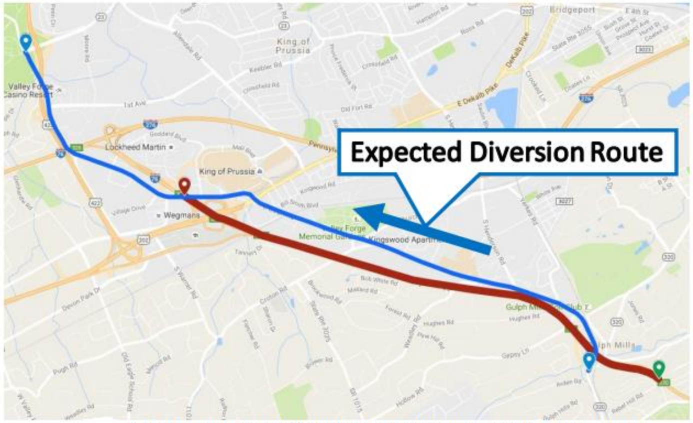
Real-World Evaluations

List of Use Applications

Type of Event	(1) Travel Time Comparison	(2) Arterial Ranking	(3) Congestion Ticker
Signal Timing Plan Degradation	🚦	🚦	
Signal Maintenance and Retiming	🚦	🚦	
Adaptive Installation	🚦	🚦	🚦
Construction Activities	🚦	🚦	🚦
Special Events	🚦		🚦
Crashes	🚦		🚦
Weather Events (Winter Storms)	🚦		🚦
Land Use Changes	🚦	🚦	

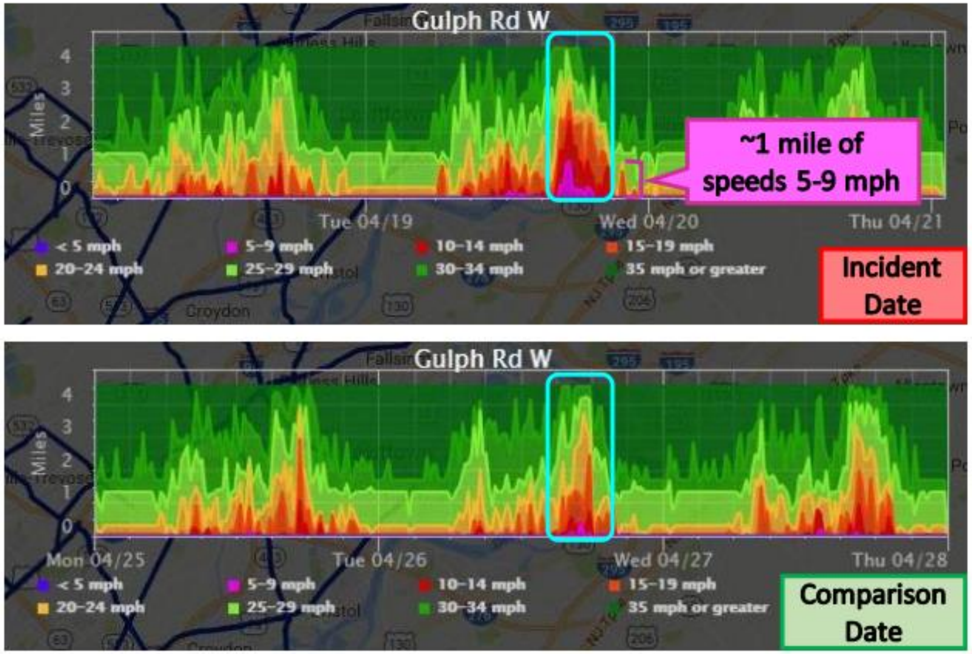
Real-World Evaluations

Incident Impacts



I-76 West accident impact (red) and expected Gulph Rd detour (blue)

Travel time impacts on Westbound Gulph Rd

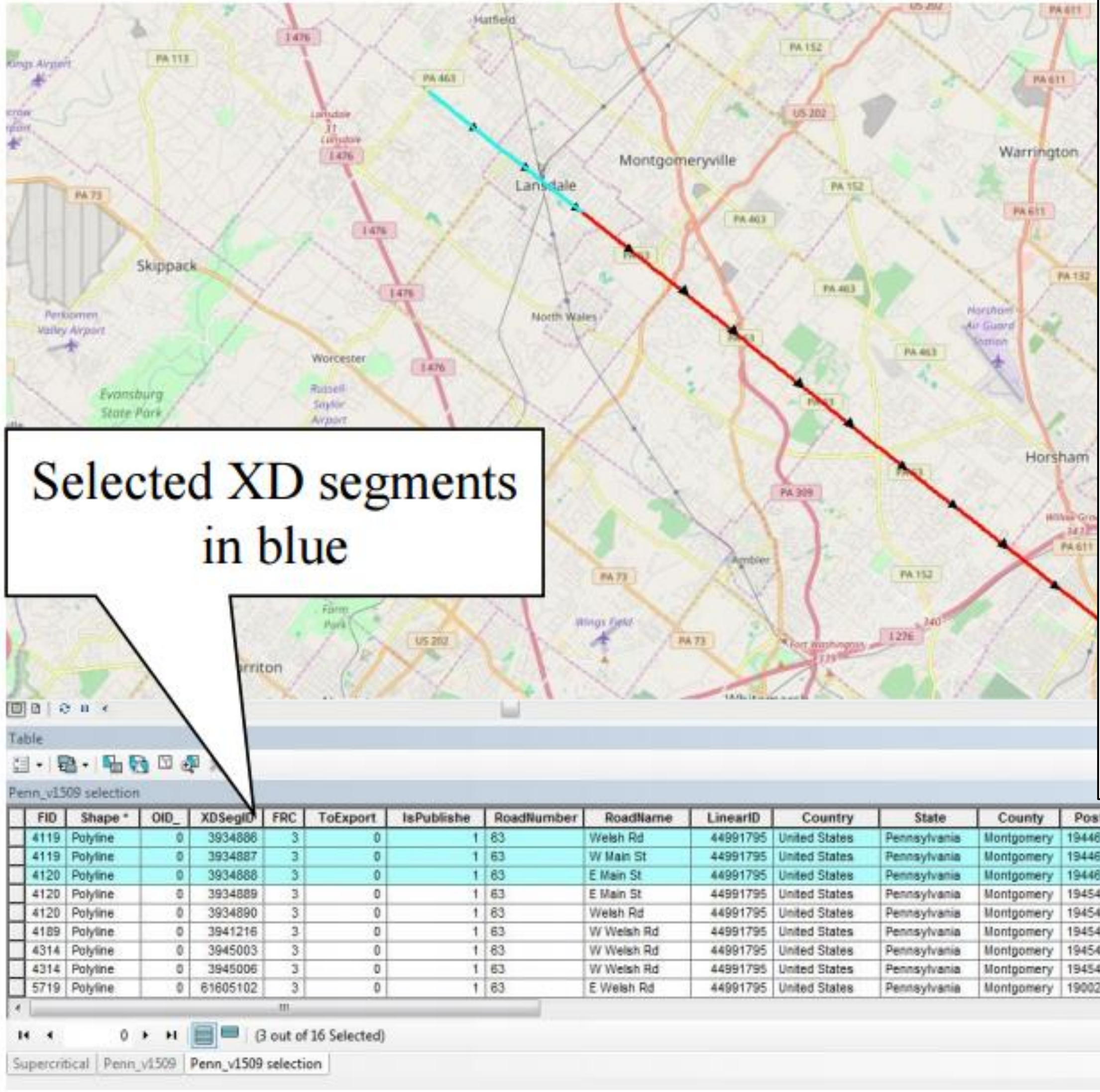


Congestion heat map of Westbound Gulph Rd

How it Works?

Mapping of the Corridors

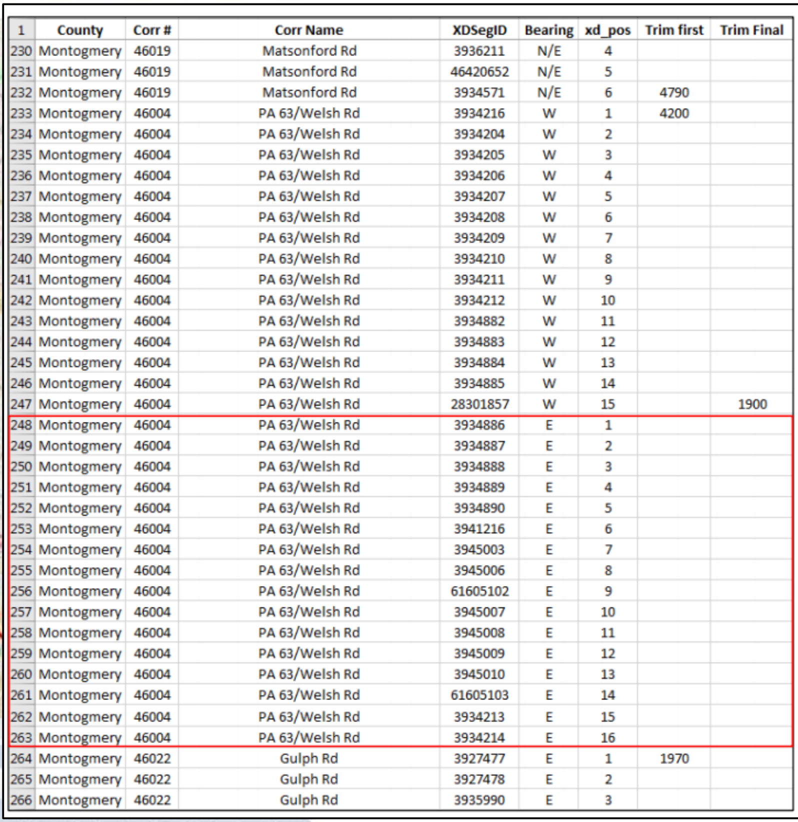
Import the INRIX Shapefile into ArcMap, Map INRIX XD Segments for the Corridor



Selected XD segments in blue

FID	Shape *	OID_	XDSegID	FRC	ToExport	IsPublishe	RoadNumber	RoadName	LinearID	Country	State	County	PostalCode	Miles	SlipRoad	SpecialRc
4119	Polyline	0	3934886	3	0	1	63	Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19446	1.005978	0	
4119	Polyline	0	3934887	3	0	1	63	W Main St	44991795	United States	Pennsylvania	Montgomery	19446	1.057439	0	
4120	Polyline	0	3934888	3	0	1	63	E Main St	44991795	United States	Pennsylvania	Montgomery	19446	1.025777	0	
4120	Polyline	0	3934889	3	0	1	63	E Main St	44991795	United States	Pennsylvania	Montgomery	19454	1.073396	0	
4120	Polyline	0	3934890	3	0	1	63	Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19454	1.108308	0	
4189	Polyline	0	3941216	3	0	1	63	W Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19454	1.024258	0	
4314	Polyline	0	3945003	3	0	1	63	W Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19454	0.101318	0	
4314	Polyline	0	3945006	3	0	1	63	W Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19454	1.240591	0	
5719	Polyline	0	61605102	3	0	1	63	E Welsh Rd	44991795	United States	Pennsylvania	Montgomery	19002	0.032951	0	

0 (3 out of 16 Selected)



1	County	Corr #	Corr Name	XDSegID	Bearing	xd_pos	Trim first	Trim Final
230	Montogmery	46019	Matsonford Rd	3936211	N/E	4		
231	Montogmery	46019	Matsonford Rd	46420652	N/E	5		
232	Montogmery	46019	Matsonford Rd	3934571	N/E	6	4790	
233	Montogmery	46004	PA 63/Welsh Rd	3934216	W	1	4200	
234	Montogmery	46004	PA 63/Welsh Rd	3934204	W	2		
235	Montogmery	46004	PA 63/Welsh Rd	3934205	W	3		
236	Montogmery	46004	PA 63/Welsh Rd	3934206	W	4		
237	Montogmery	46004	PA 63/Welsh Rd	3934207	W	5		
238	Montogmery	46004	PA 63/Welsh Rd	3934208	W	6		
239	Montogmery	46004	PA 63/Welsh Rd	3934209	W	7		
240	Montogmery	46004	PA 63/Welsh Rd	3934210	W	8		
241	Montogmery	46004	PA 63/Welsh Rd	3934211	W	9		
242	Montogmery	46004	PA 63/Welsh Rd	3934212	W	10		
243	Montogmery	46004	PA 63/Welsh Rd	3934882	W	11		
244	Montogmery	46004	PA 63/Welsh Rd	3934883	W	12		
245	Montogmery	46004	PA 63/Welsh Rd	3934884	W	13		
246	Montogmery	46004	PA 63/Welsh Rd	3934885	W	14		
247	Montogmery	46004	PA 63/Welsh Rd	28301857	W	15		1900
248	Montogmery	46004	PA 63/Welsh Rd	3934886	E	1		
249	Montogmery	46004	PA 63/Welsh Rd	3934887	E	2		
250	Montogmery	46004	PA 63/Welsh Rd	3934888	E	3		
251	Montogmery	46004	PA 63/Welsh Rd	3934889	E	4		
252	Montogmery	46004	PA 63/Welsh Rd	3934890	E	5		
253	Montogmery	46004	PA 63/Welsh Rd	3941216	E	6		
254	Montogmery	46004	PA 63/Welsh Rd	3945003	E	7		
255	Montogmery	46004	PA 63/Welsh Rd	3945006	E	8		
256	Montogmery	46004	PA 63/Welsh Rd	61605102	E	9		
257	Montogmery	46004	PA 63/Welsh Rd	3945007	E	10		
258	Montogmery	46004	PA 63/Welsh Rd	3945008	E	11		
259	Montogmery	46004	PA 63/Welsh Rd	3945009	E	12		
260	Montogmery	46004	PA 63/Welsh Rd	3945010	E	13		
261	Montogmery	46004	PA 63/Welsh Rd	61605103	E	14		
262	Montogmery	46004	PA 63/Welsh Rd	3934213	E	15		
263	Montogmery	46004	PA 63/Welsh Rd	3934214	E	16		
264	Montogmery	46022	Gulph Rd	3927477	E	1	1970	
265	Montogmery	46022	Gulph Rd	3927478	E	2		
266	Montogmery	46022	Gulph Rd	3935990	E	3		

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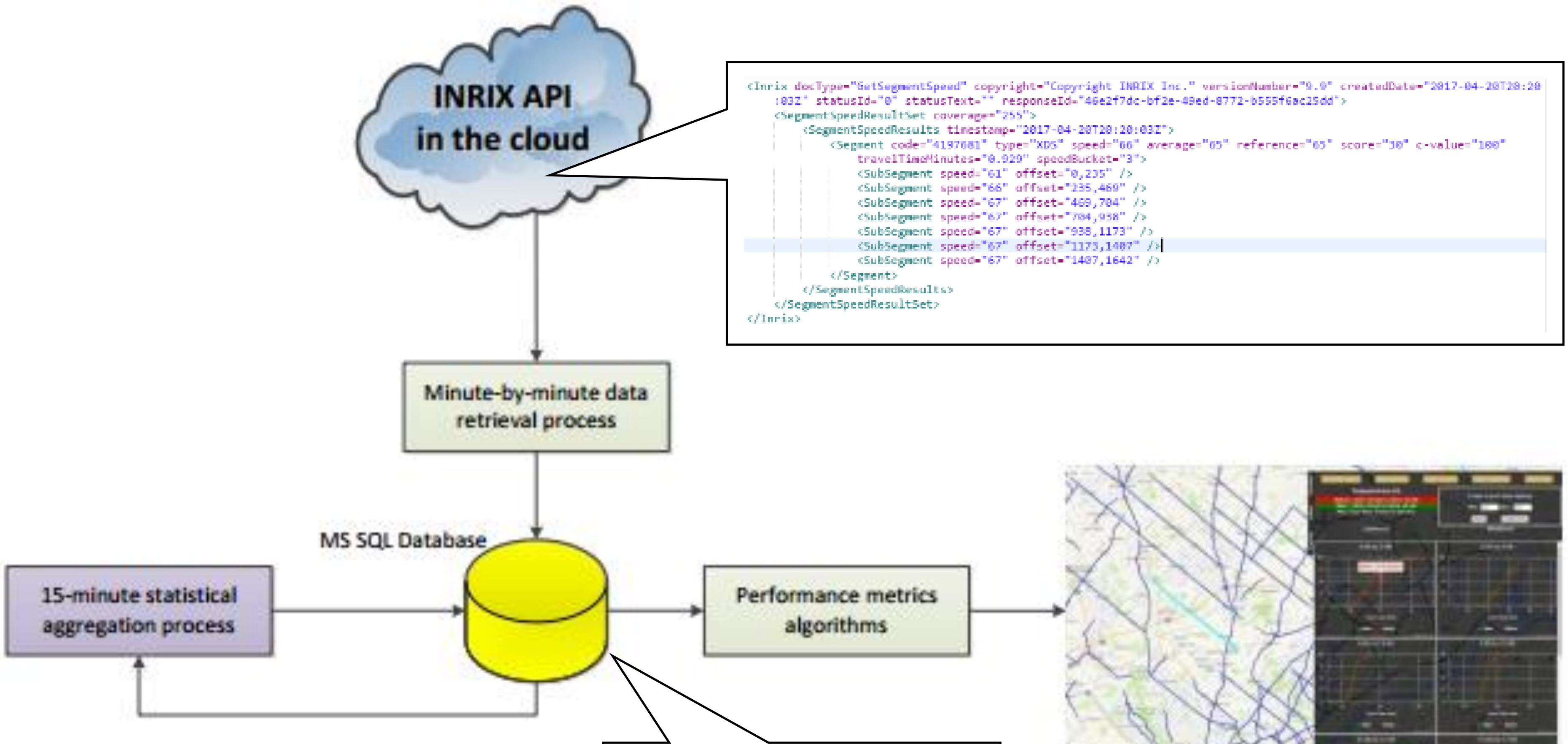
How it Works?

Overview of the Real-Time Ingestion Process



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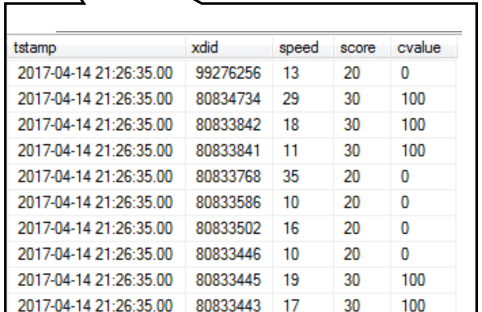
Performance measure dashboards (web)



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2017-04-14 21:26:35.00	80833842	18	30	100
2017-04-14 21:26:35.00	80833841	11	30	100
2017-04-14 21:26:35.00	80833768	35	20	0
2017-04-14 21:26:35.00	80833586	10	20	0
2017-04-14 21:26:35.00	80833502	16	20	0
2017-04-14 21:26:35.00	80833446	10	20	0
2017-04-14 21:26:35.00	80833445	19	30	100
2017-04-14 21:26:35.00	80833443	17	30	100

pennsylvania
DEPARTMENT OF TRANSPORTATION

PURDUE
UNIVERSITY

Next Steps

Phase 2 Research Efforts

- Statewide Deployment (11 additional regions)
- Further refining of filters and corridor identifiers (i.e. by counties, municipality, identification #, etc…)
- Subdividing Corridors and possible user-defined corridor selection
- Integration with Real-Time Event Data (PennDOT's RCRS)
- Executive dashboard and Automated Reports (performance at-a-glance)
- Export data directly into Benefits worksheet

  Linear diagram showing relation of travel time to length and signal locations
- Integration with high-resolution signal controller event data
- Further refine Real-Time metrics and Operator flags
- Additional Metrics as identified

Daniel P. Farley
Section Chief
Traffic Operations Deployment and Maintenance

……

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717-783-0333

……

TRB Annual Meeting 2017 Paper Number 17-00314
http://docs.trb.org/prp/17-00314.pdf

Questions?

Special Thanks

PURDUE UNIVERSITY

Darcy Bullock
Howell Li
Jijo Mathew
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Chris Day

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Lou Belmonte
Doug Tomlinson
Glenn Rowe
PennDOT IT Team

Alan Davis, PE, PTOE
Georgia Department of Transportation

Focused Operations: Measuring Arterial Performance Using Automated Traffic Signal Performance Measures

Focused Operations

ATSPM
Automated Traffic Signal Performance Measures

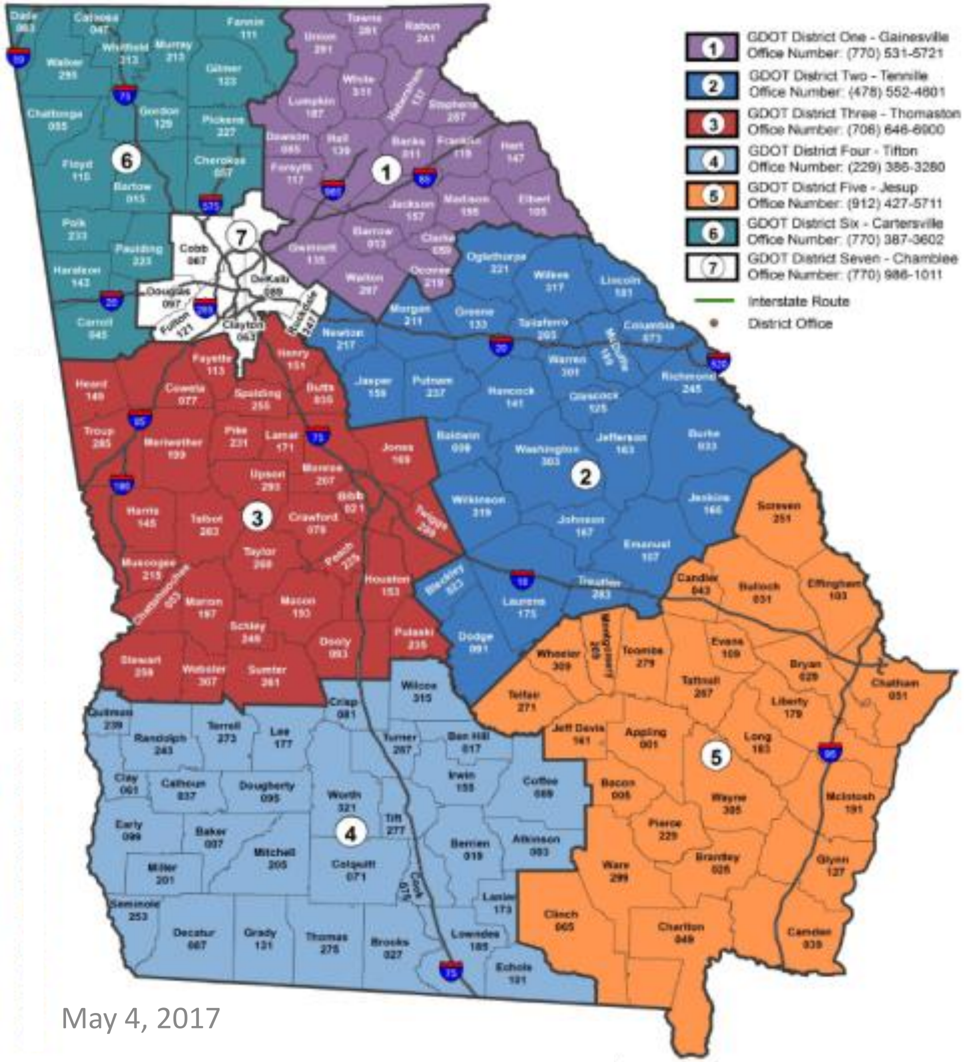
Measuring Arterial Performance Using Automated Traffic Signal Performance Measures

Alan Davis, PE, PTOE
Assistant State Traffic Engineer

Overview

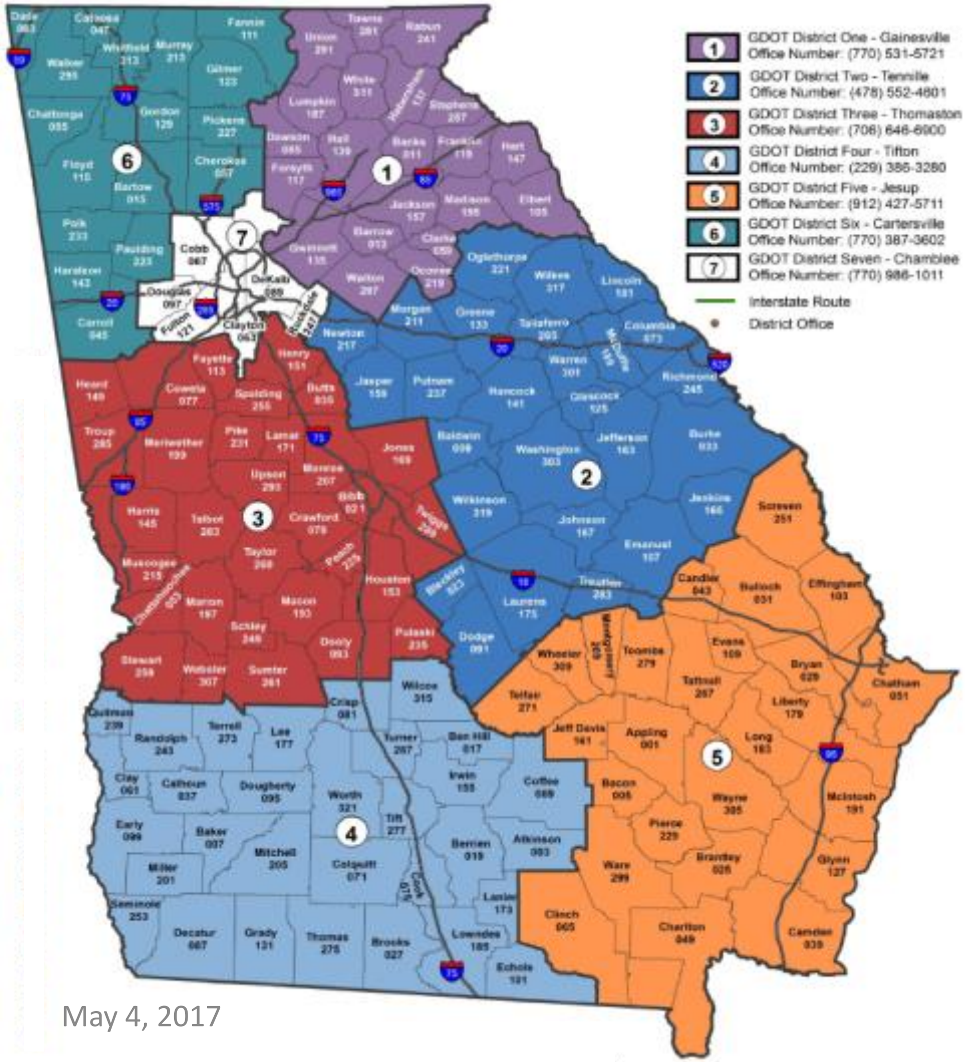
- State of Georgia
- Regional Traffic Operations
- Early Performance Measures
- Automated Traffic Signal Performance Measures
- Real World Applications
- Recommendations

State of Georgia



- Seven Districts
- One Central Office
- Two Transportation Management Centers (TMC)

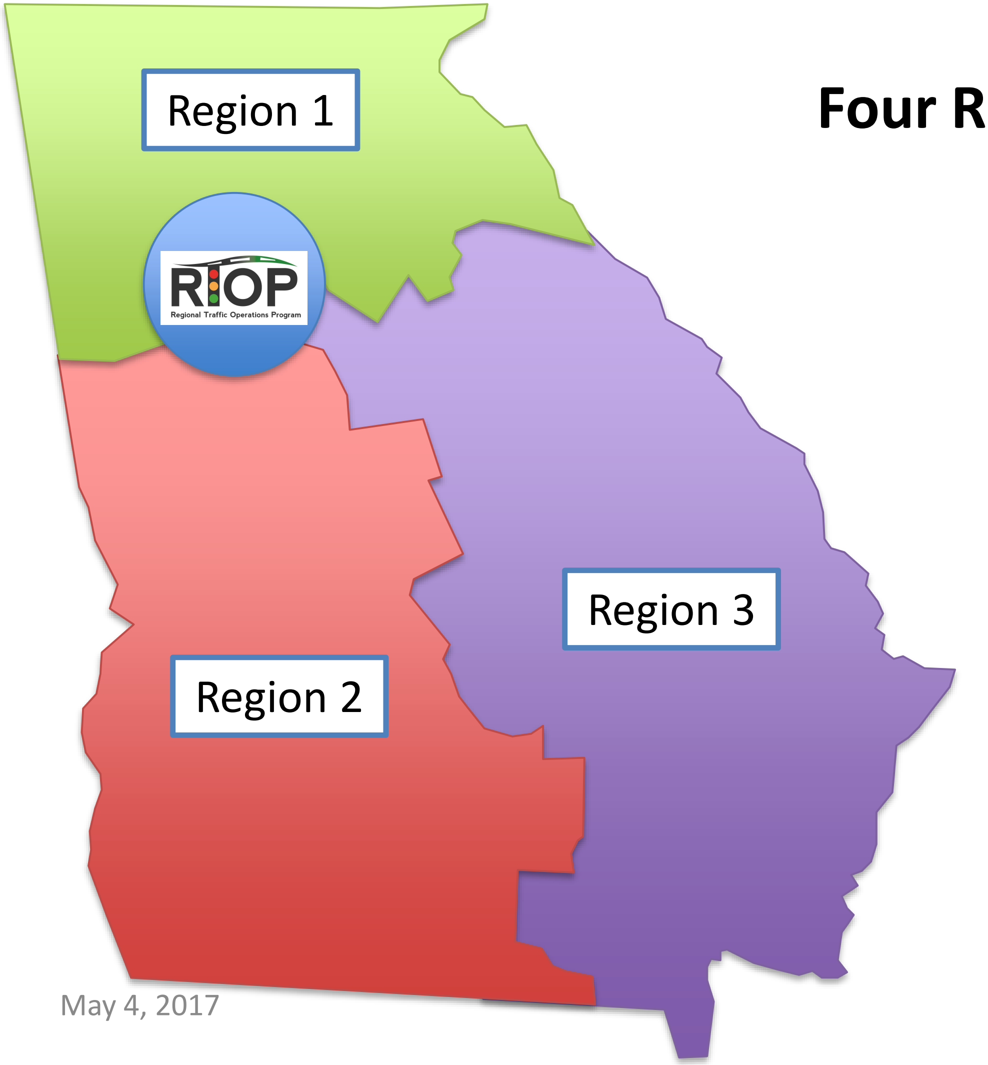
State of Georgia



- 9,500 signals statewide
- 6,500 on-system
- 3,500 GDOT maintained

GDOT Traffic Operations

Regional Traffic Operations



Four Regions for Traffic Operations:

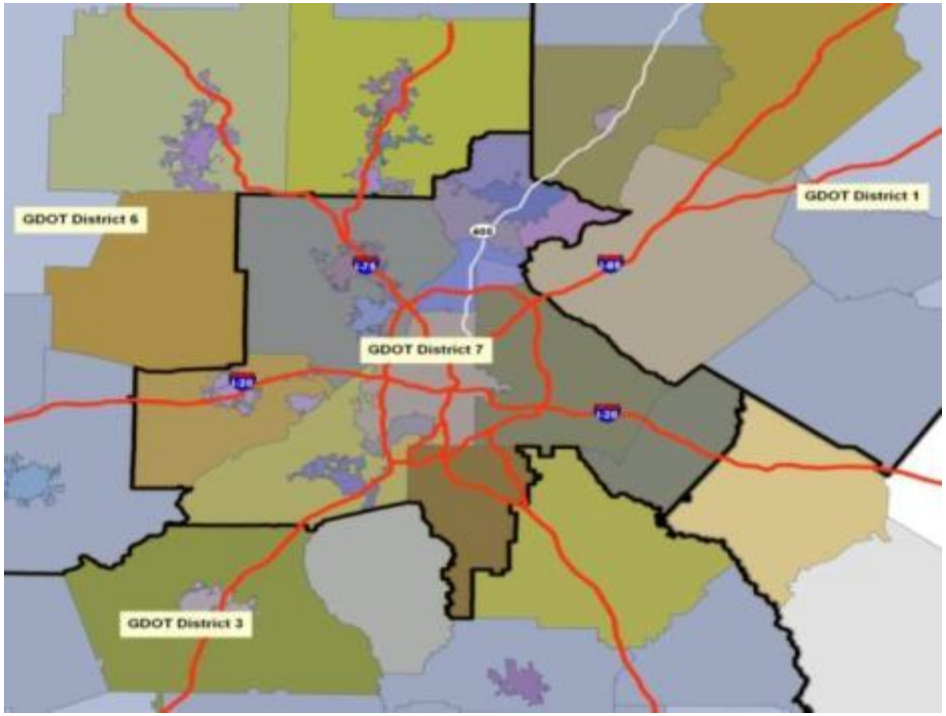
- Region 1: GDOT Districts 1 & 6
- Region 2: GDOT Districts 3 & 4
- Region 3: GDOT Districts 2 & 5
- Metro Atlanta Region: RTOP

RTOP

What is RTOP?

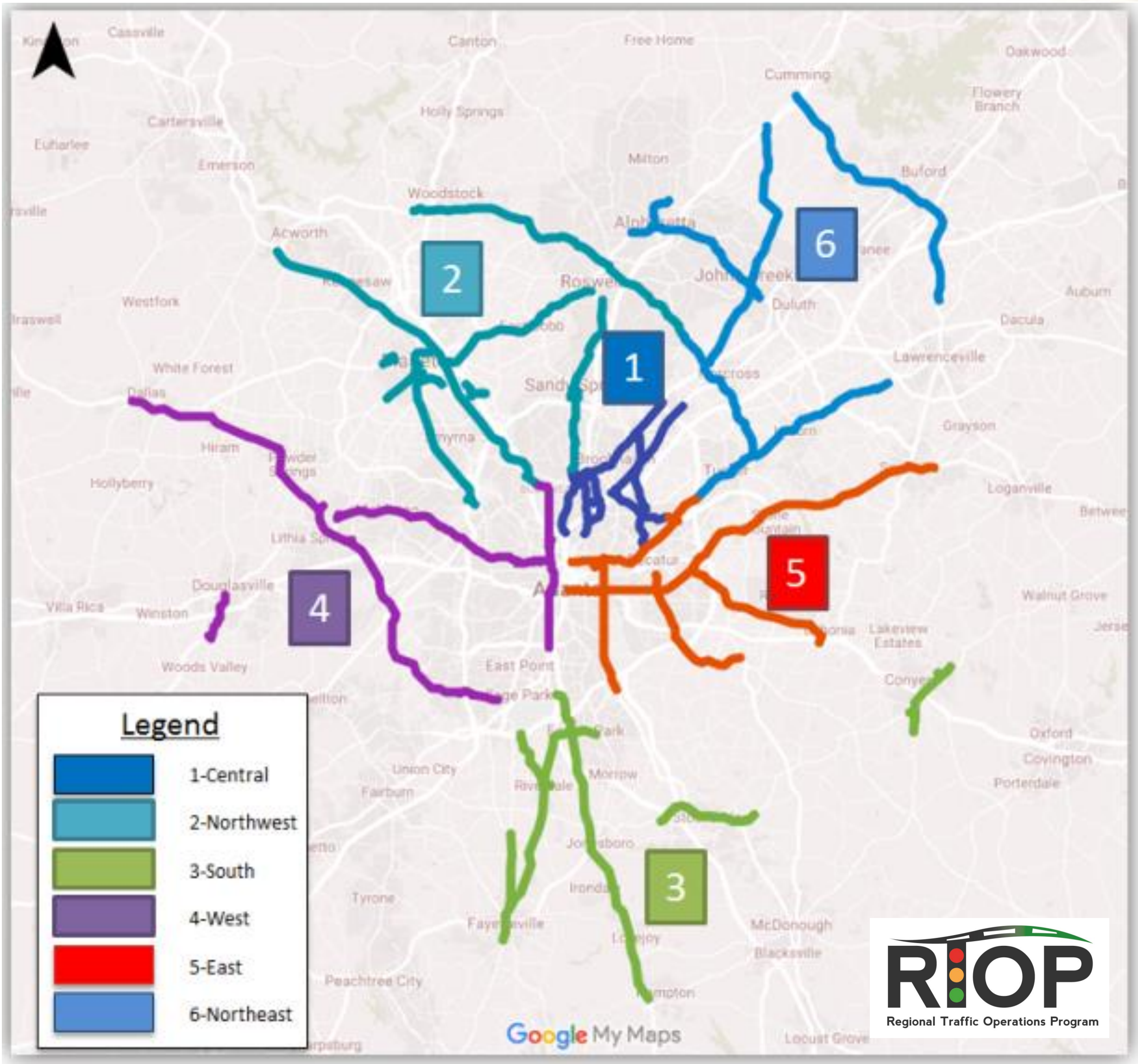
Regional **T**raffic **O**perations **P**rogram

- Active management of regionally significant corridors in metro Atlanta
- Travel time reliability
- Data driven operational decisions
- Consistent maintenance and operations across region



- 12 Counties, 28 Cities, 4 GDOT Districts
- Consultant program
  - Arcadis, Kimley Horn

RTOP
Regional Traffic Operations Program



25 Corridors, 1100+ signals, Span 12 Counties, and 13 Cities in the Metro Region

Based on corridors of Regional Significance

3 CID’s, 350+ signals

RTOP: Early Performance Measures

Maintenance:
- Operational detection – vehicular and pedestrian
    - 95% operational is program goal

Measure:
- Manual field detection checks

Operations:
- Maximize throughput on the mainline
- Reduce number of stops

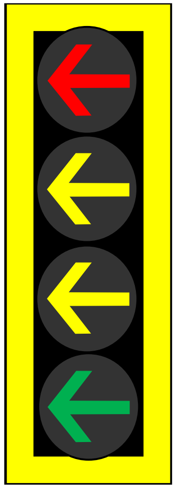
Measure:
- Monthly volume counts
- Corridor ride-throughs

Troubleshooting:
- Proactive identification of events

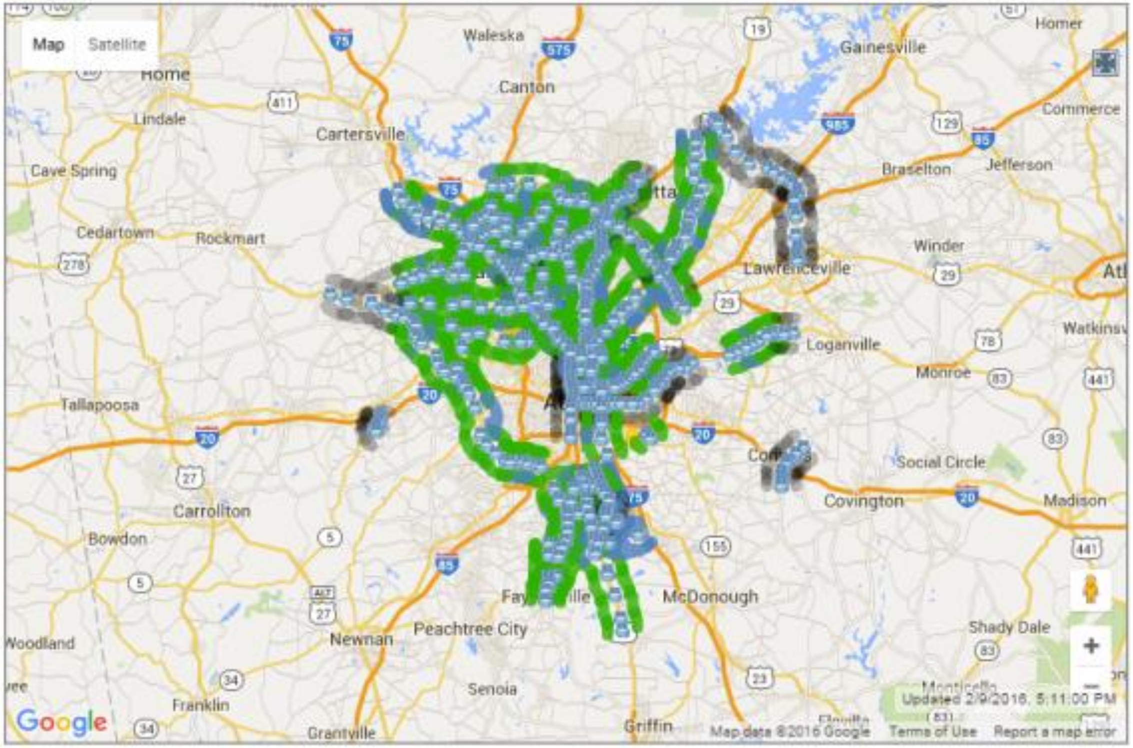
Measure:
- Counts, field identification

Limitations Identified

- **System Limitations:** Central signal software and local signal firmware limited in capabilities
- **Labor intensive:** manual reporting was time consuming
- **Inaccuracies:** Ride-throughs did not capture full system performance
- **Program Evolution:** Mainline volume no longer the primary goal



RTOP Evolution



- 230 BlueTOAD Units installed through RTOP
- Addition of Travel Time Index into reporting
- Ability to do Origin-Destination Studies
- Sharing information with local BlueTOAD Servers
- Information being broadcast to ATMS system

Improved Reporting

GEORGIA DEPARTMENT OF TRANSPORTATION
REGIONAL TRAFFIC OPERATIONS PROGRAM (RTOP 2)

PERFORMANCE REPORT

4TH QUARTER OF 2016

2016 Q4 Operational Cost: **$1.5 m**
2016 Q4 Operational Benefit [1]: **$3.2 m**
Benefit/Cost Ratio: **2.2**

Current conditions

Average Delay Per Mile [2]: **33 Sec** (peak periods: 47 sec)
Average Daily VMT [2]: **5.2 m** (peak periods: 1.3 m)
Travel Time Index (TTI) [2]: **1.43** (peak periods: 1.55)
(Good< 1.500, Fair < 2.500, and Poor >= 2.5) [3]

Reliability

Planning Time Index (PTI) [2]: **1.75** (peak periods: 1.98)
(Good < 1.300, Fair < 2.000, Poor >= 2.000) [3]

System performance goals

40% of travelers experience a TTI below **1.500** (peak periods: 45%)
84% of travelers experience a TTI below **2.000** (peak periods: 86%)

Equipment inventory

Miles of arterial: **129**
Number of signalized intersections: **506**
Surveillance cameras: **210**
Travel Time detectors: **205**

---

[1] Benefits are estimated from savings in reduced delay, fuel consumption, emission, as well as reductions in non-recurrent congestion due to active arterial traffic management actions.

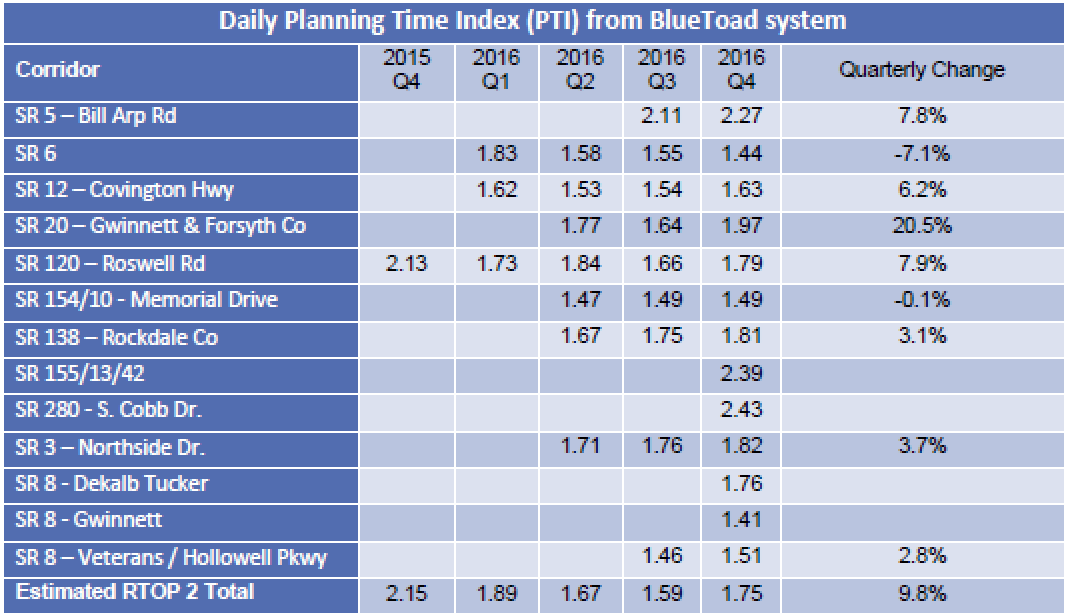
[2] Travel time and delay statistics generated from 24-hour BlueToad data in weekdays. Peak period is 7-9 am and 5-7pm.

[3] TTI thresholds originated from the FHWA's Traffic Analysis Toolbox Volume VI. The PTI thresholds come from the SHRP2 report Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes.

2016 Q
ACTIVI

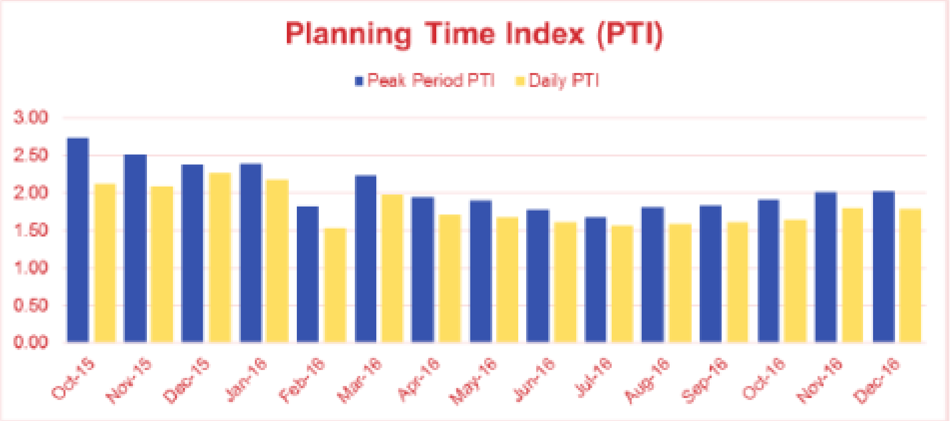
437 Malfuncti
109 Incidents
255 Operatio
1661 Prevent
Maintenance

RTOP
Regional Traffic Operations Program



Daily Planning Time Index (PTI) from BlueToad system

Corridor	2015 Q4	2016 Q1	2016 Q2	2016 Q3	2016 Q4	Quarterly Change
SR 5 – Bill Arp Rd				2.11	2.27	7.8%
SR 6		1.83	1.58	1.55	1.44	-7.1%
SR 12 – Covington Hwy		1.62	1.53	1.54	1.63	6.2%
SR 20 – Gwinnett & Forsyth Co			1.77	1.64	1.97	20.5%
SR 120 – Roswell Rd	2.13	1.73	1.84	1.66	1.79	7.9%
SR 154/10 - Memorial Drive			1.47	1.49	1.49	-0.1%
SR 138 – Rockdale Co			1.67	1.75	1.81	3.1%
SR 155/13/42					2.39	
SR 280 - S. Cobb Dr.					2.43	
SR 3 – Northside Dr.			1.71	1.76	1.82	3.7%
SR 8 - Dekalb Tucker					1.76	
SR 8 - Gwinnett					1.41	
SR 8 – Veterans / Hollowell Pkwy				1.46	1.51	2.8%
Estimated RTOP 2 Total	2.15	1.89	1.67	1.59	1.75	9.8%



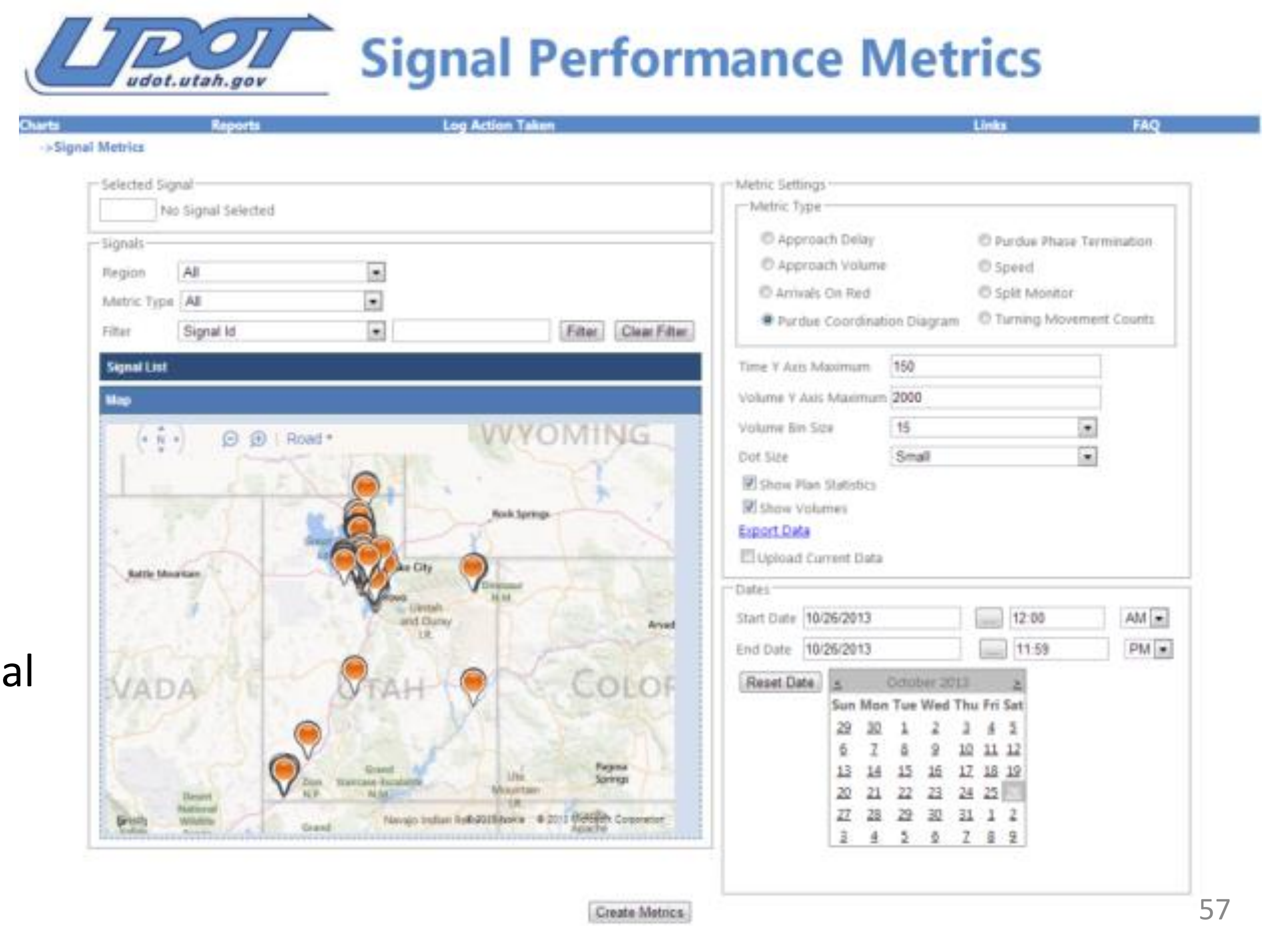
Planning Time Index (PTI)

RTOP Evolution

FHWA Scan Tour – Signal Software Procurement

udot.utah.gov

- Included high-resolution data in software specification
- Core of operational future
- GDOT procured Intelight MaxTime/MaxView for local and central software



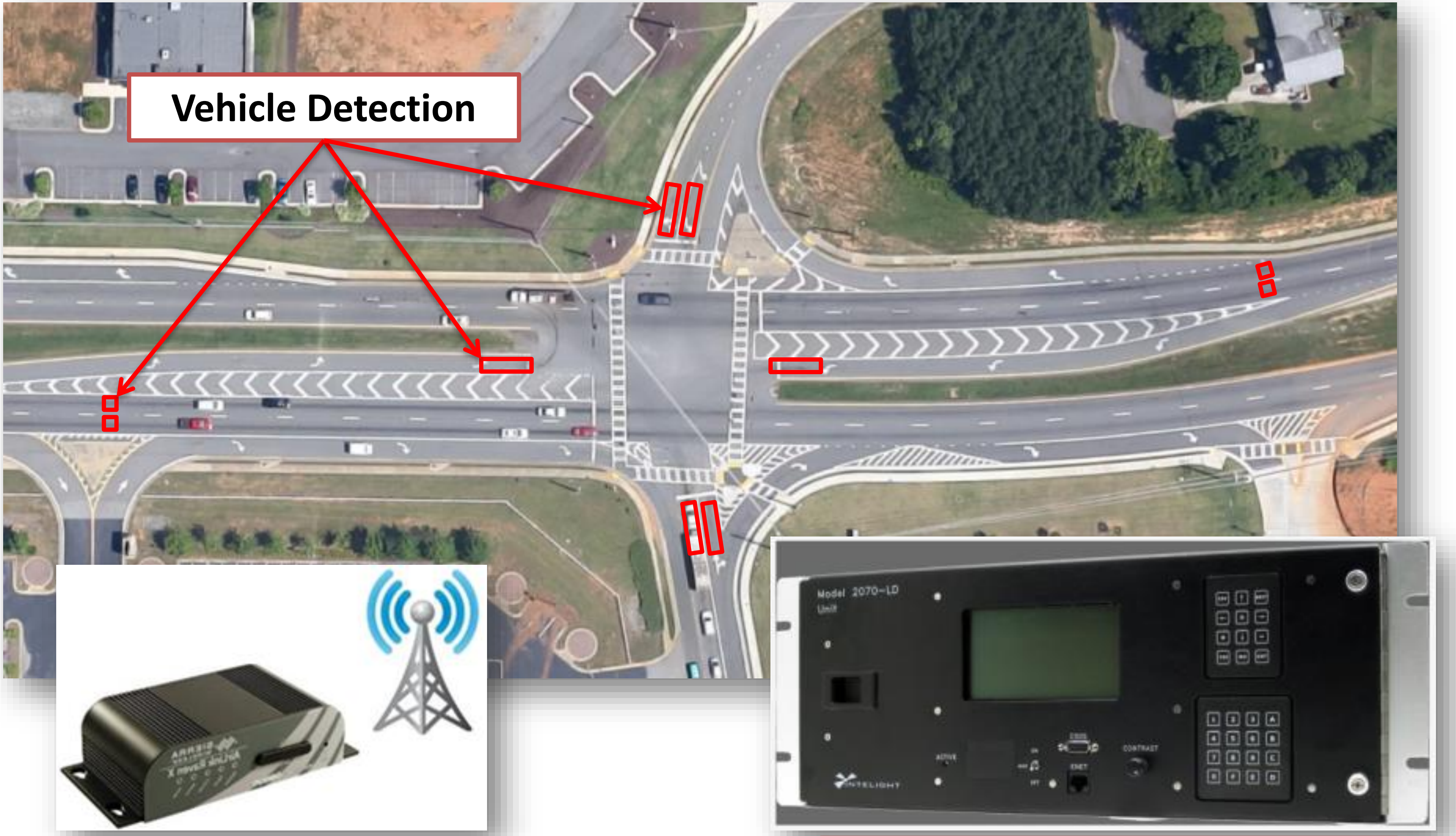
Selected Signal: No Signal Selected

Signals
Region: All
Metric Type: All
Filter: Signal Id

Metric Settings
Metric Type
○ Approach Delay
○ Approach Volume
○ Arrivals On Red
● Purdue Coordination Diagram
○ Purdue Phase Termination
○ Speed
○ Split Monitor
○ Turning Movement Counts

Time Y Axis Maximum: 150
Volume Y Axis Maximum: 2000
Volume Bin Size: 15
Dot Size: Small
☑ Show Plan Statistics
☑ Show Volumes
Export Data
☐ Upload Current Data

Dates
Start Date: 10/26/2013 12:00 AM
End Date: 10/26/2013 11:59 PM



Vehicle Detection

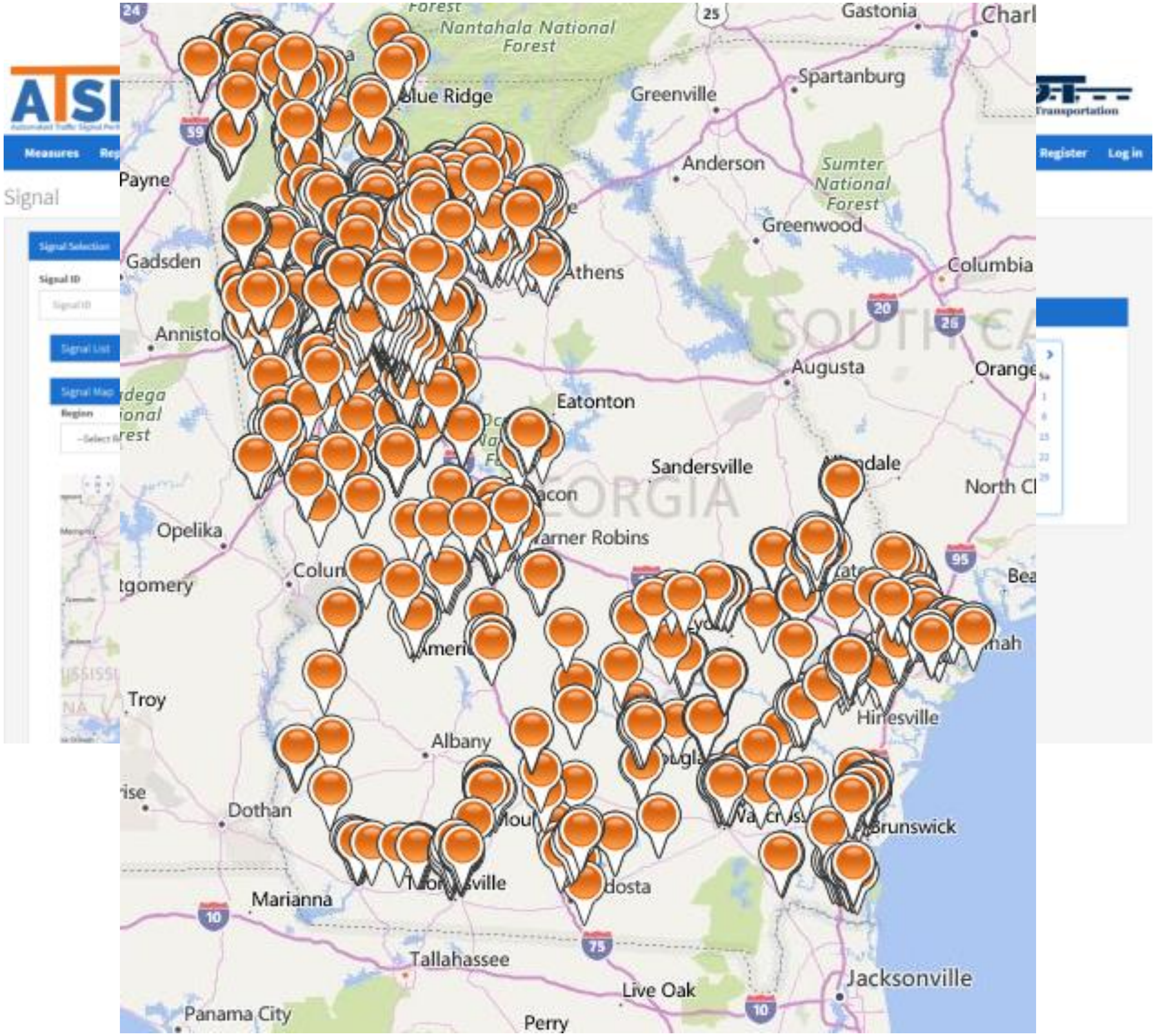
Communications

High resolution controller

Software Upgrade

- Maintain existing 2070 architecture
- Turn-key deployment
- Statewide conversion: state routes and local routes
- Statewide implementation of Automated Traffic Signal Performance Measures (ATSPM)


ATSPM



- 3,109 signals logging high resolution data
- UDOT-produced source code
- Primary tool for operations and maintenance of traffic signals

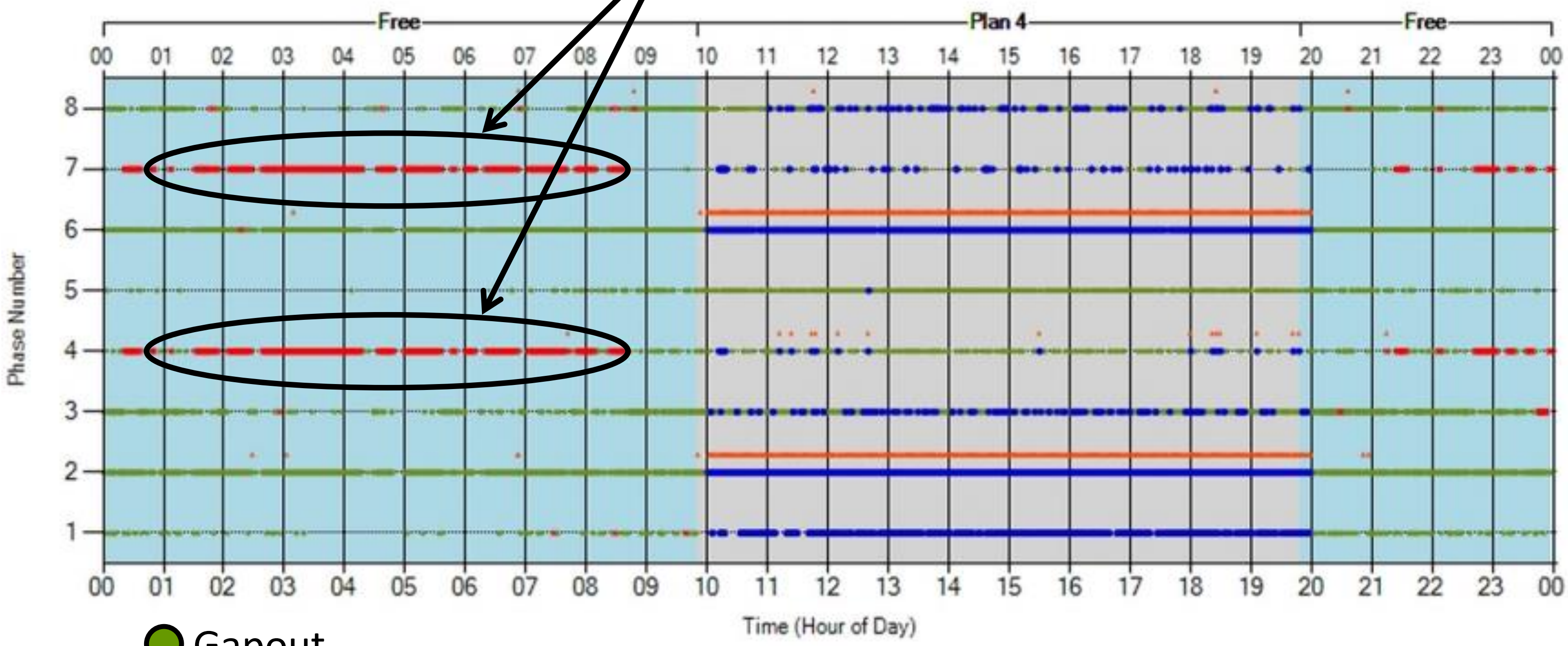
ATSPM

Available Metrics

- Approach delay
- Approach volume
- Arrivals on red
- Purdue Coordination Diagram
- Purdue Split failure
- Pedestrian delay
- Preemption details
- Purdue Phase Termination
- Speed*
- Split monitor
- Turning movement counts
- Yellow and Red Actuations

ATSPM

Purdue Phase Termination



Minor street through & left max out at night only

● Gapout

● Max out

● Force off

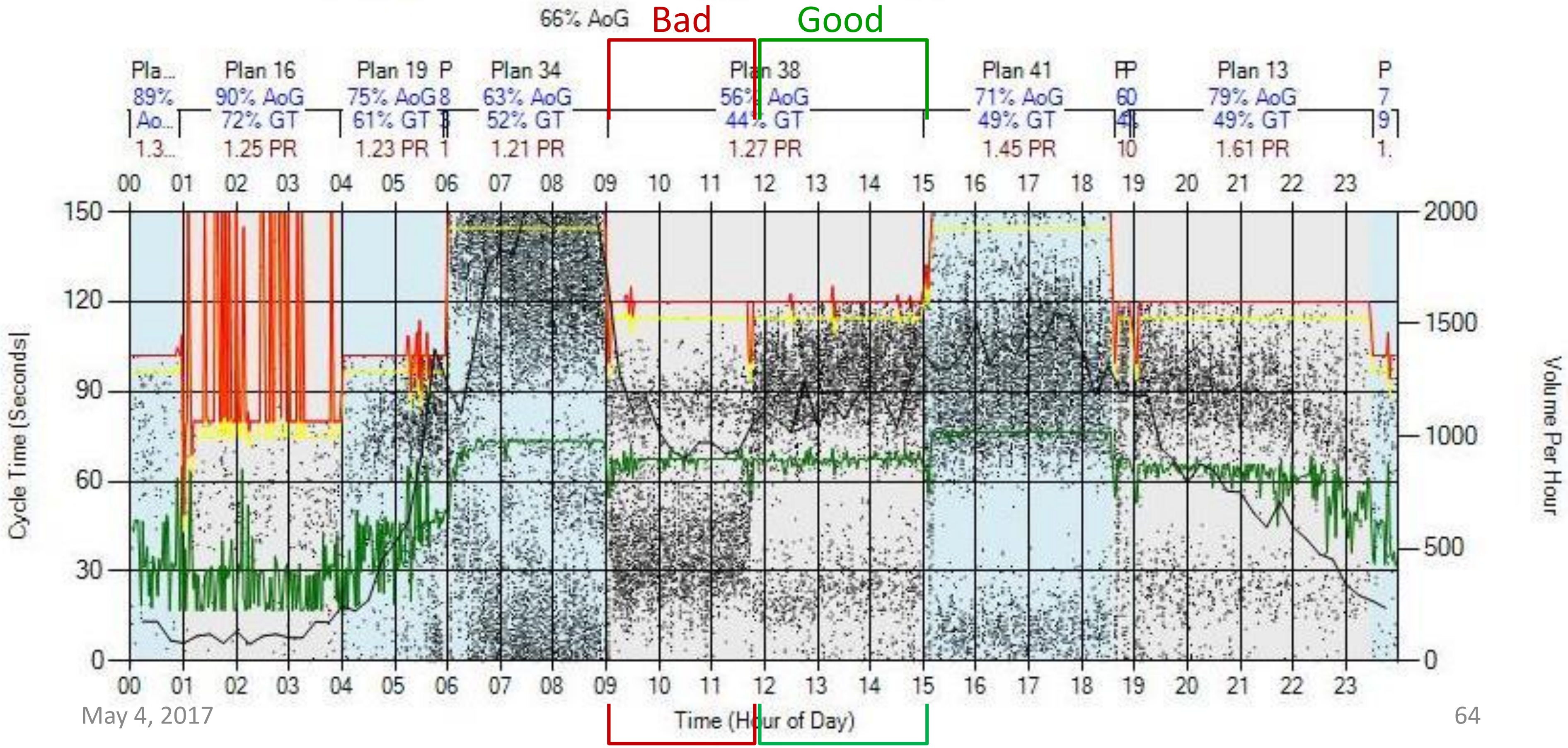
● Pedestrian activation (shown above phase line)

○ Skip

- Faulty video detection
- Resulted in product evaluation
- Replaced equipment with alternate technology

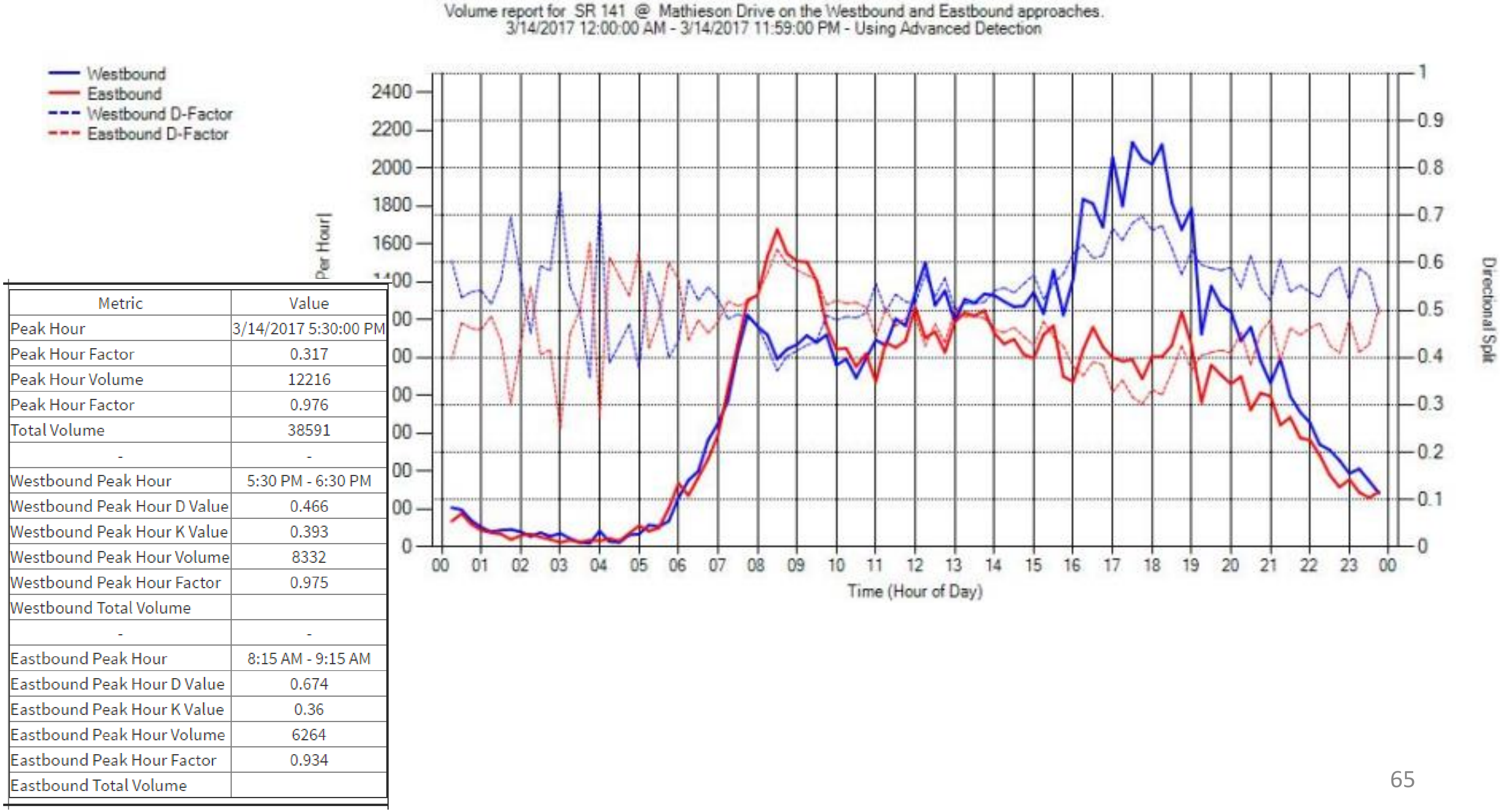
ATSPM

Purdue Coordination Diagram



ATSPM

Approach Volume

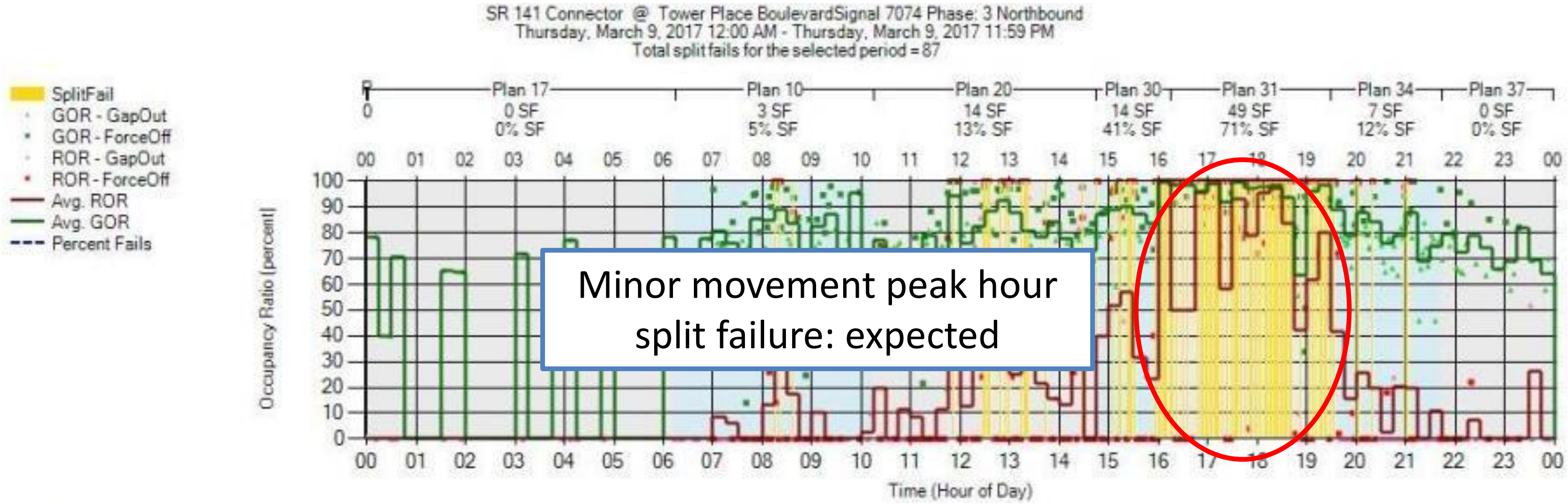


Volume report for SR 141 @ Mathieson Drive on the Westbound and Eastbound approaches.
3/14/2017 12:00:00 AM - 3/14/2017 11:59:00 PM - Using Advanced Detection

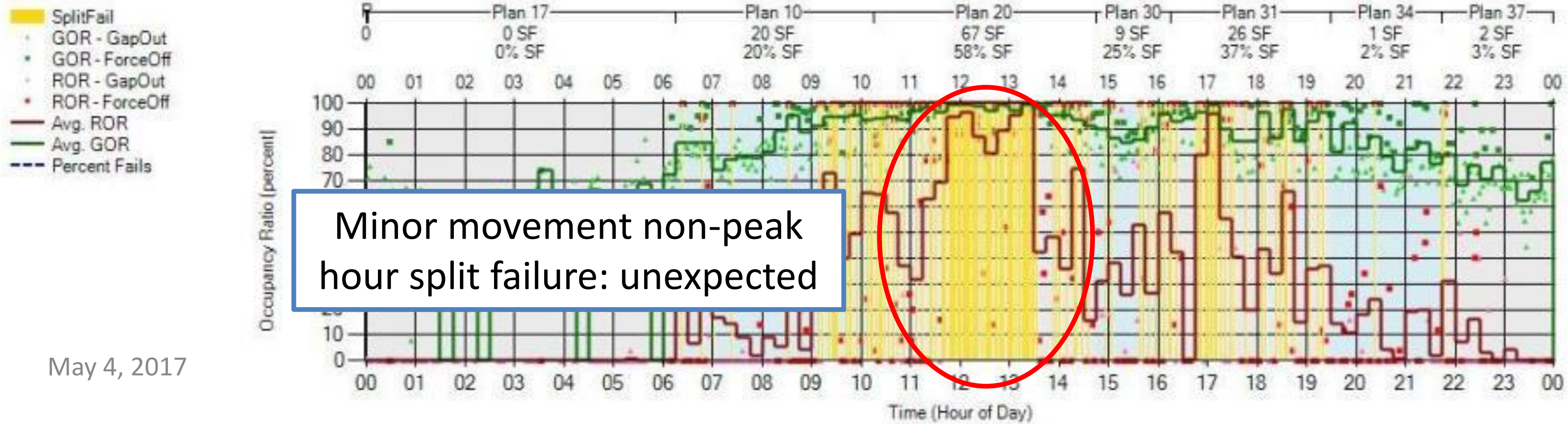
Metric	Value
Peak Hour	3/14/2017 5:30:00 PM
Peak Hour Factor	0.317
Peak Hour Volume	12216
Peak Hour Factor	0.976
Total Volume	38591
-	-
Westbound Peak Hour	5:30 PM - 6:30 PM
Westbound Peak Hour D Value	0.466
Westbound Peak Hour K Value	0.393
Westbound Peak Hour Volume	8332
Westbound Peak Hour Factor	0.975
Westbound Total Volume	
-	-
Eastbound Peak Hour	8:15 AM - 9:15 AM
Eastbound Peak Hour D Value	0.674
Eastbound Peak Hour K Value	0.36
Eastbound Peak Hour Volume	6264
Eastbound Peak Hour Factor	0.934
Eastbound Total Volume	

ATSPM

Purdue Split Failure


SR 141 Connector @ Tower Place BoulevardSignal 7074 Phase: 3 Northbound
Thursday, March 9, 2017 12:00 AM - Thursday, March 9, 2017 11:59 PM
Total split fails for the selected period = 87

Minor movement peak hour split failure: expected



Minor movement non-peak hour split failure: unexpected

ATSPM

Not Just Operations

Analysis: 7:00 AM to 8:15 AM - May 18, 2015

- Is green time too short? – Would increasing the split fix the problem?
- Is coordination poor? – More vehicles arriving on green could fix this?
- Is sight distance poor? – Are their trucks or other obstructions blocking signal?
- Is law enforcement needed? – Time can be pinned down for law enforcement.

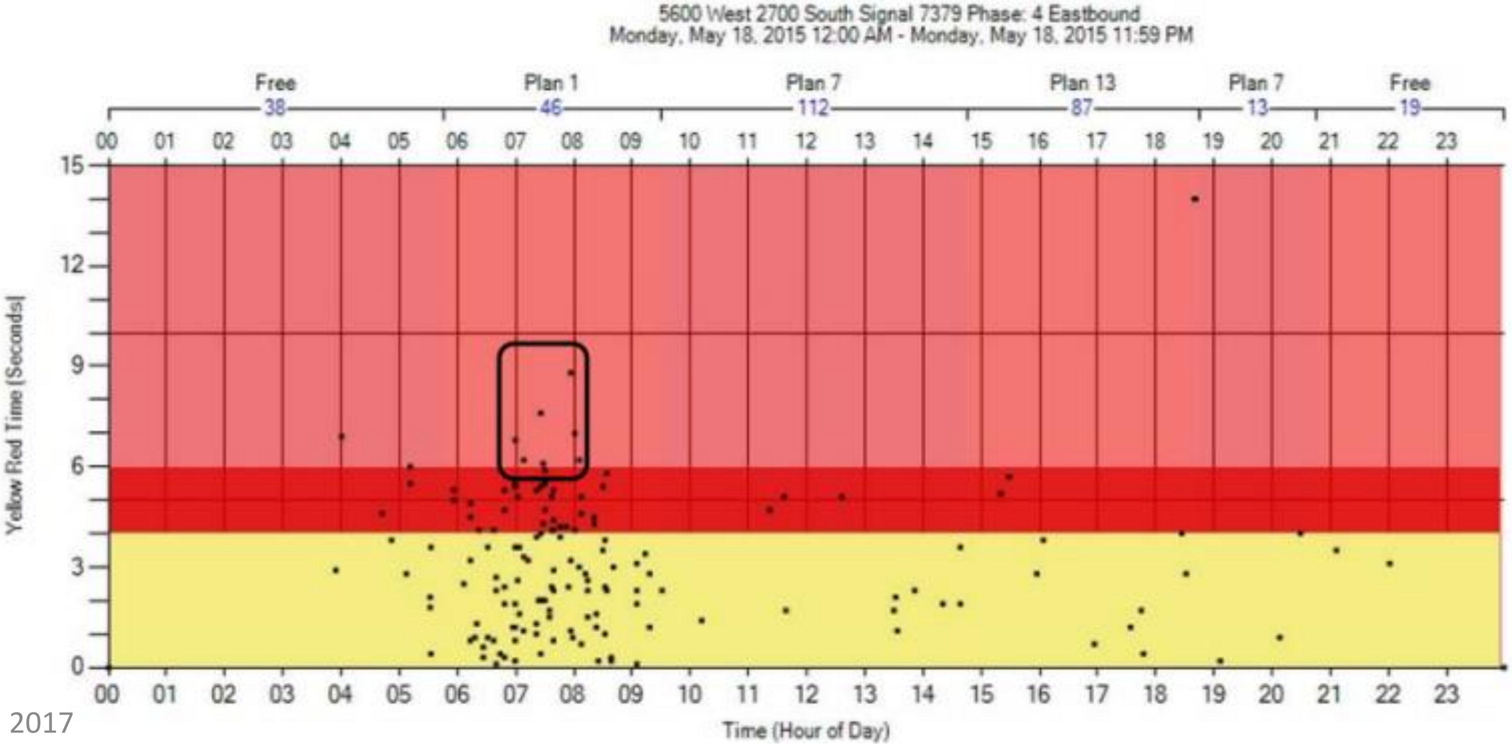
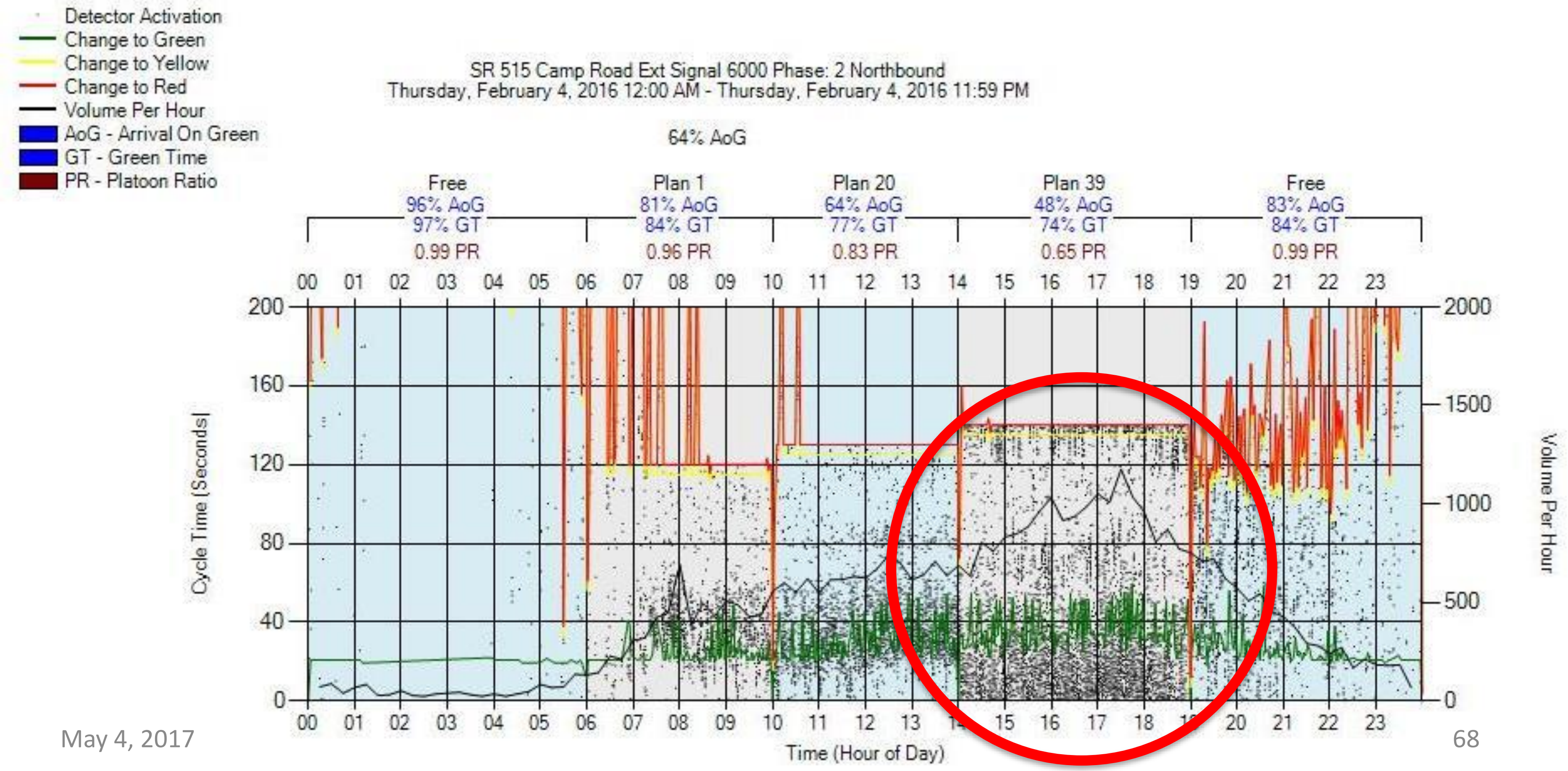


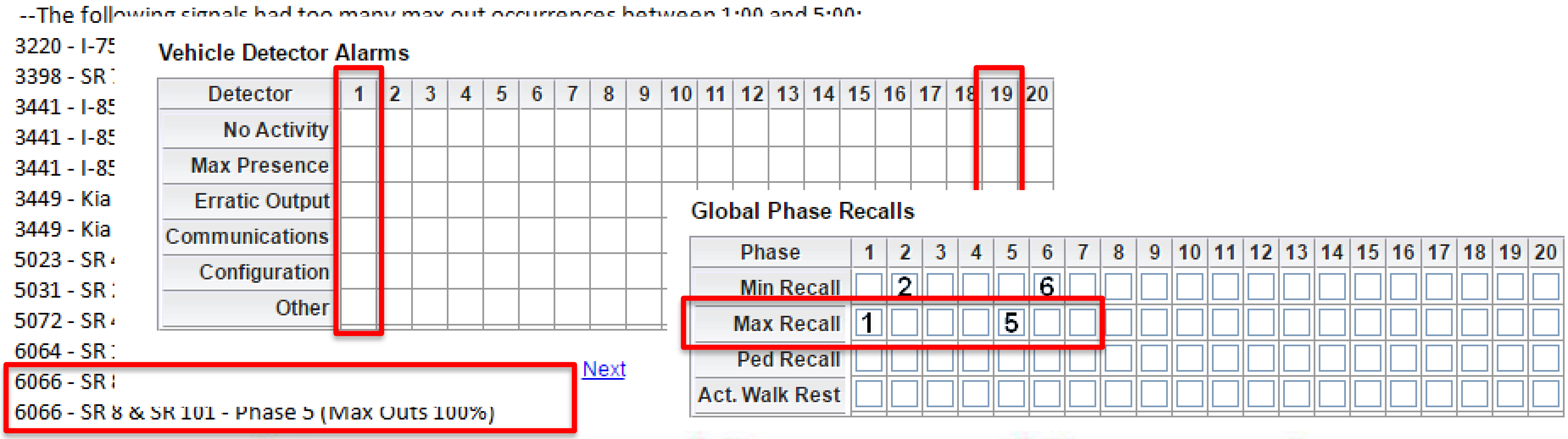
Chart Credit: UDOT

ATSPM In Practice

Consultant Retiming Project



ATSPM In Practice



--The following signals had too many max out occurrences between 1:00 and 5:00:

3220 - I-7
3398 - SR
3441 - I-8
3441 - I-8
3441 - I-8
3449 - Kia
3449 - Kia
5023 - SR
5031 - SR
5072 - SR
6064 - SR
6066 - SR
6066 - SR 8 & SR 101 - Phase 5 (Max Outs 100%)

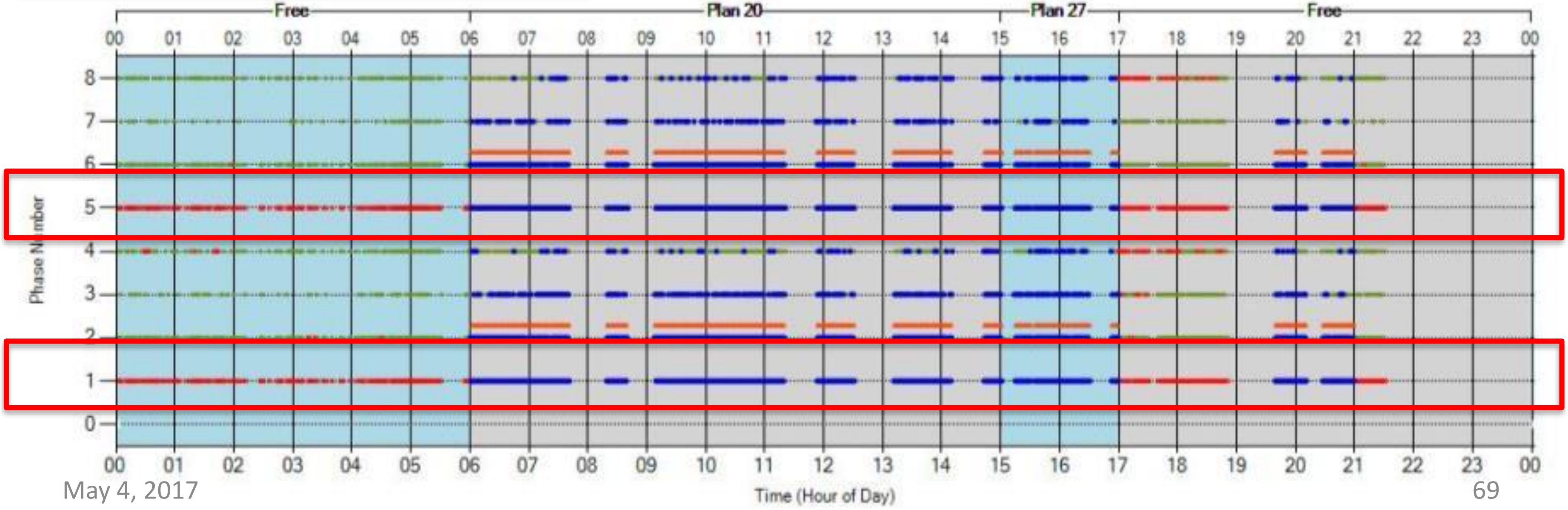
Next

Vehicle Detector Alarms

Detector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No Activity																				
Max Presence																				
Erratic Output																				
Communications																				
Configuration																				
Other																				

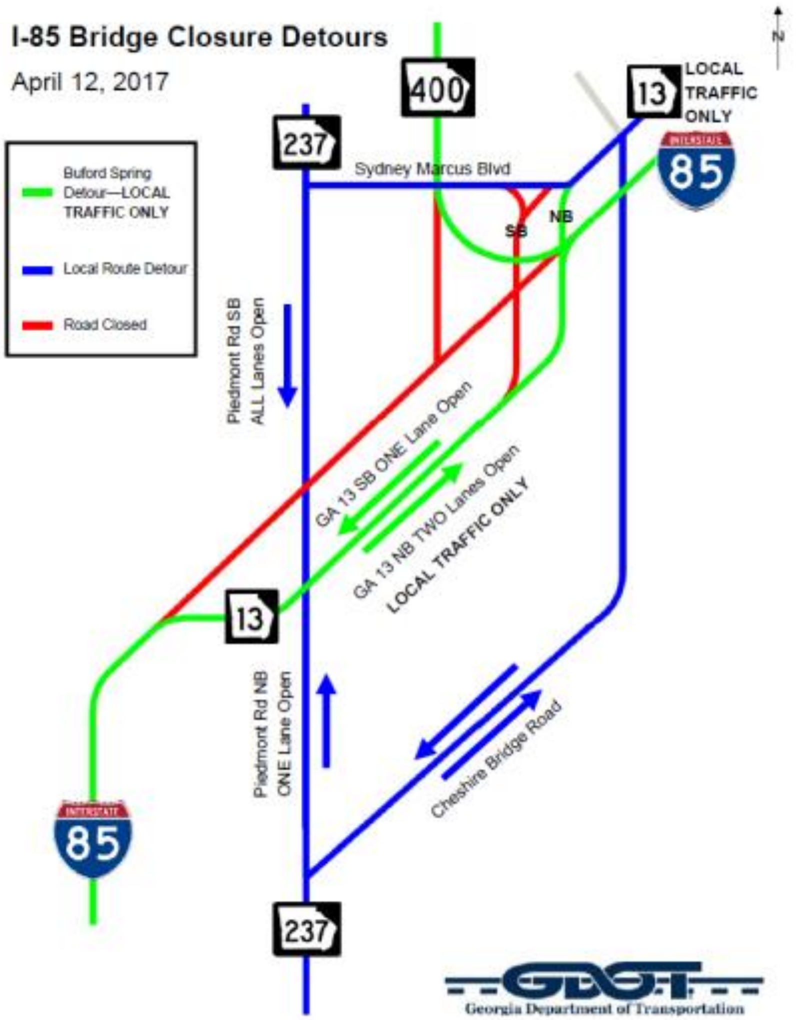
Global Phase Recalls

Phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Min Recall	☐	2	☐	☐	☐	6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Max Recall	1	☐	☐	☐	5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ped Recall	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Act. Walk Rest	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐



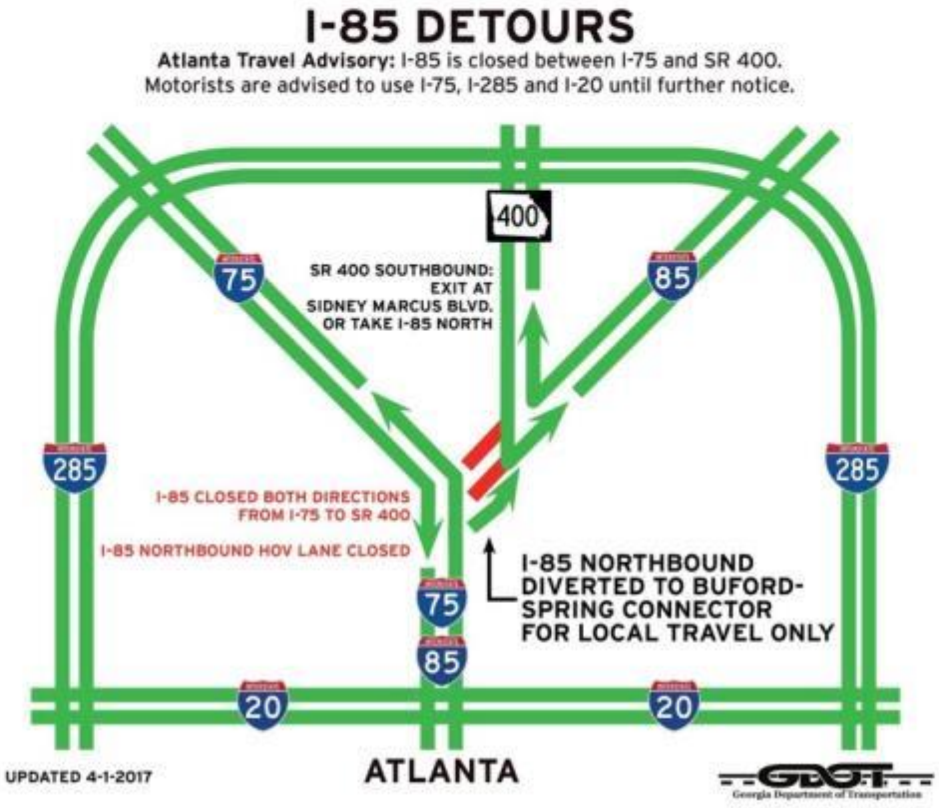
ATSPM In Practice

ATSPM In Practice



I-85 Bridge Closure Detours

April 12, 2017



I-85 DETOURS

Atlanta Travel Advisory: I-85 is closed between I-75 and SR 400. Motorists are advised to use I-75, I-285 and I-20 until further notice.

SR 400 SOUTHBOUND: EXIT AT SIDNEY MARCUS BLVD. OR TAKE I-85 NORTH

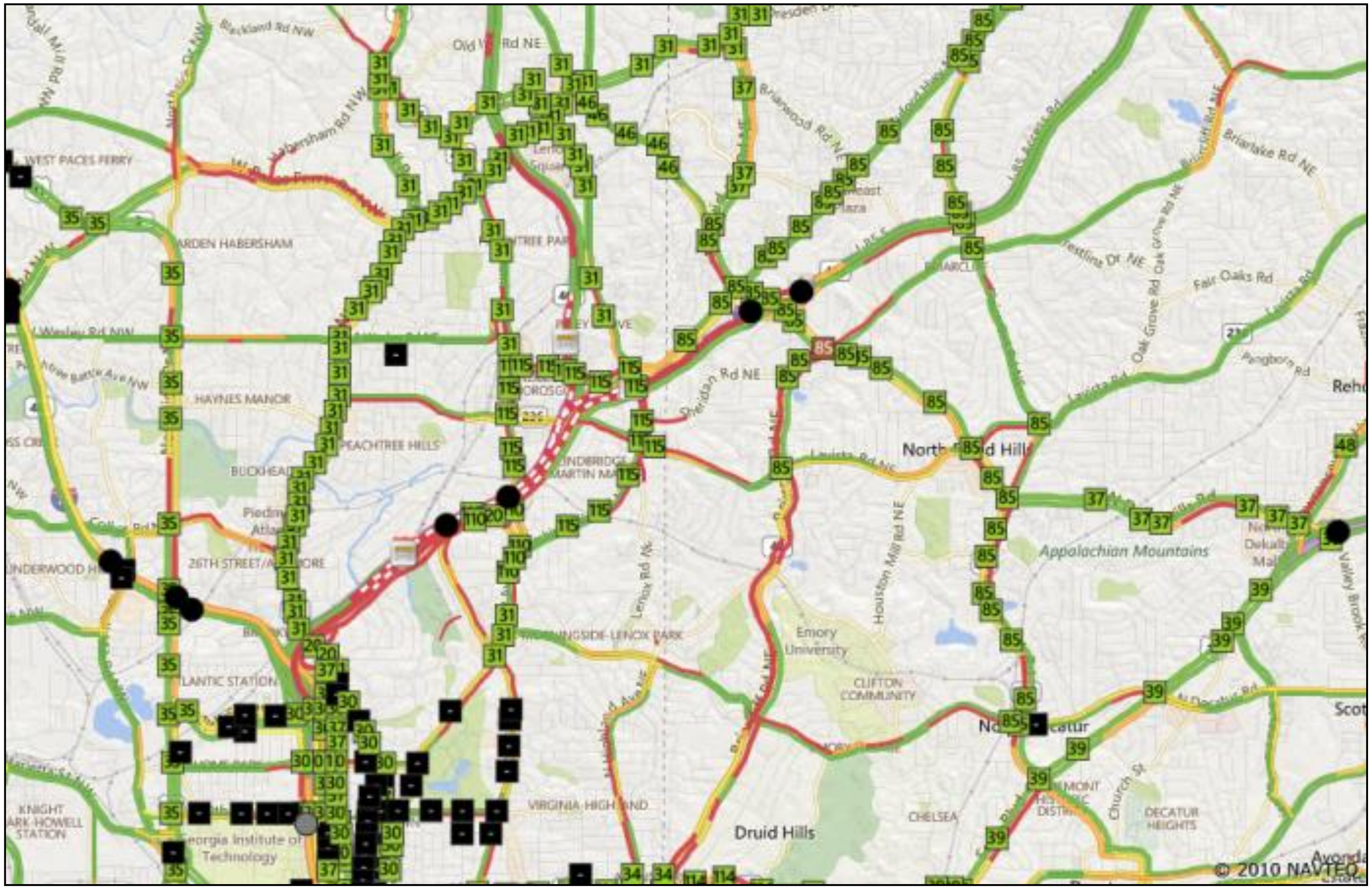
I-85 CLOSED BOTH DIRECTIONS FROM I-75 TO SR 400

I-85 NORTHBOUND HOV LANE CLOSED

I-85 NORTHBOUND DIVERTED TO BUFORD-SPRING CONNECTOR FOR LOCAL TRAVEL ONLY

UPDATED 4-1-2017

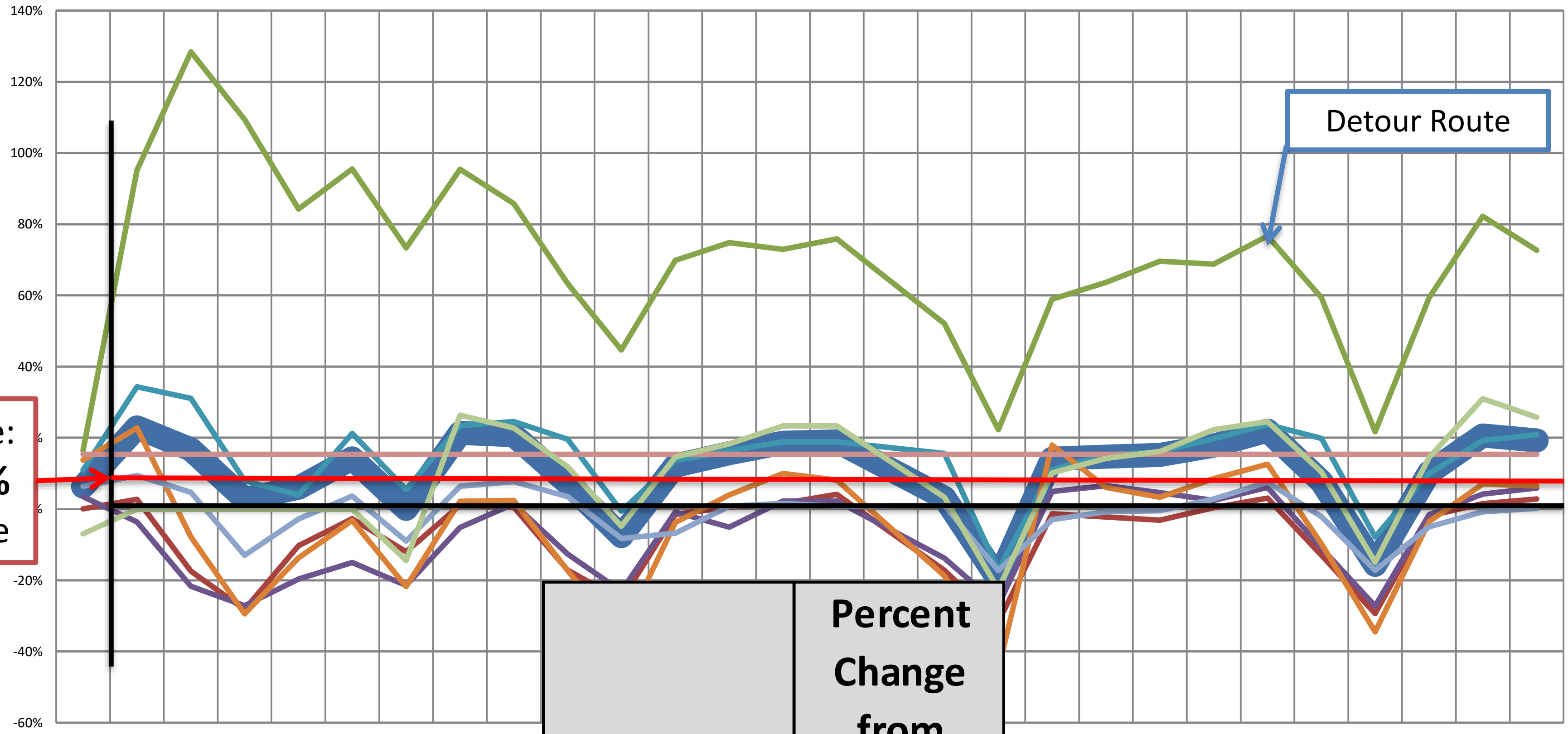
ATSPM In Practice



- Where will 250k detoured vehicles relocate?
- Special plans implemented
- Were they effective?

Arterial Volumes

Key Arterial Volume Changes - Post Collapse



Detour Route

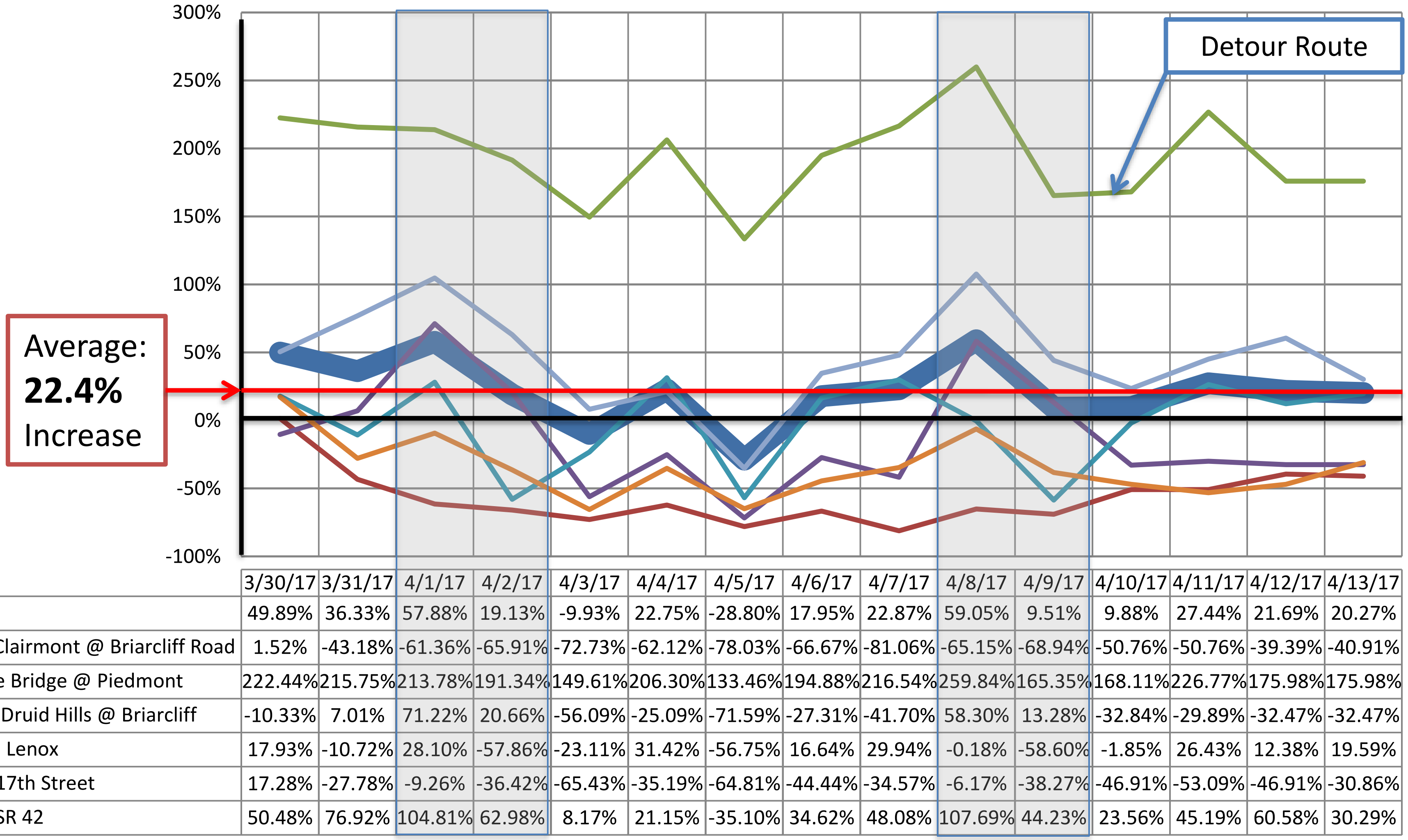
Average:
10.58%
Increase

	3/30/17	3/31/17	4/1/17	4/2/17	4/3/17	4/4/17	4/5/17	4/6/17	4/7/1	4/17/17	4/18/17	4/19/17	4/20/17	4/21/17	4/22/17	4/23/17	4/24/17	4/25/17	4/26/17
Average	6.28%	22.97%	16.73%	2.80%	5.97%	14.19%	0.01%	21.38%	20.73	14.11%	14.66%	15.17%	17.82%	22.04%	7.68%	-15.63%	10.25%	20.64%	19.27%
SR 155	0.03%	2.72%	-17.46%	-28.20%	-10.31%	-2.70%	-12.03%	1.14%	0.52	-1.30%	-2.20%	-3.10%	0.37%	3.02%	-12.95%	-29.39%	-1.91%	1.55%	2.85%
Cheshire Bridge	16.40%	95.18%	128.37%	109.38%	84.25%	95.46%	73.31%	95.38%	85.80	58.95%	63.61%	69.57%	68.77%	76.71%	59.33%	21.72%	59.32%	82.23%	72.67%
North Druid	3.43%	-3.58%	-21.67%	-27.16%	-19.65%	-15.02%	-21.46%	-5.18%	1.42	4.90%	6.55%	4.59%	2.37%	6.06%	-10.92%	-27.20%	-1.61%	4.22%	5.92%
SR 141 Peachtree	10.92%	34.32%	31.06%	7.98%	3.97%	21.18%	5.54%	23.39%	24.52	11.06%	15.16%	16.11%	19.73%	23.73%	19.86%	-7.86%	10.00%	19.27%	20.90%
SR 3 Northside	13.70%	22.74%	-7.85%	-29.42%	-13.68%	-3.22%	-21.81%	2.18%	2.41	17.93%	6.06%	3.28%	8.48%	12.62%	-9.77%	-34.51%	-3.54%	7.01%	6.51%
SR 42 Moreland	6.40%	9.39%	4.70%	-12.96%	-2.77%	3.61%	-9.03%	6.41%	7.72	-2.95%	-0.81%	-0.42%	2.79%	7.55%	-2.16%	-17.22%	-4.99%	-0.79%	0.24%
Weekday Only	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%	15.32%
SR 9 Peachtree	-6.96%	0.00%	0.00%	0.00%	0.00%	0.00%	-14.44%	26.31%	22.74	10.14%	14.26%	16.17%	22.24%	24.59%	10.40%	-14.98%	14.47%	30.98%	25.81%

	Percent Change from Average
Average	10.58%
Weekday Only	15.32%

Arterial Minor Movements

Split Failure Changes - Post Collapse

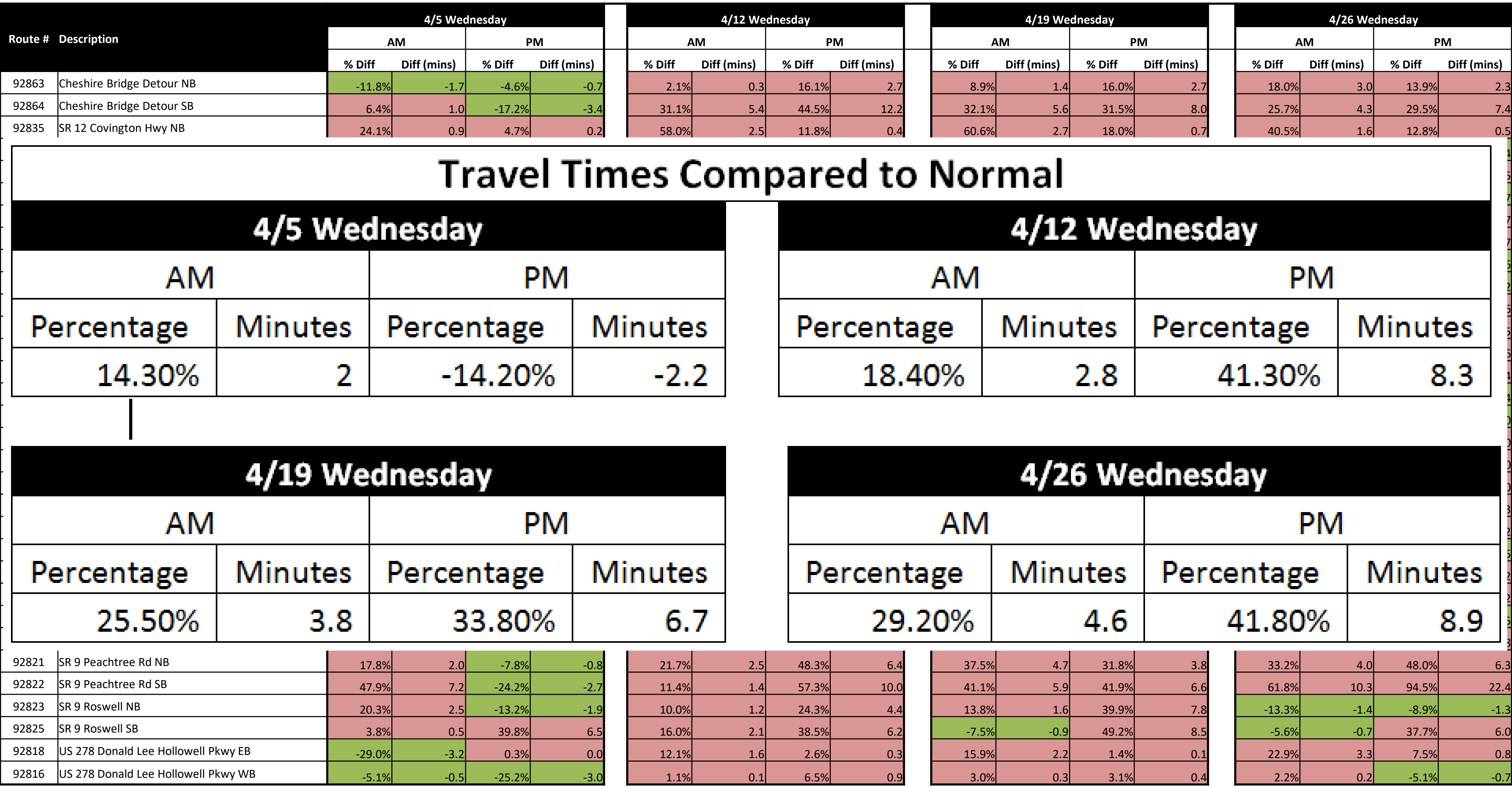


Detour Route

Average:
22.4%
Increase

	3/30/17	3/31/17	4/1/17	4/2/17	4/3/17	4/4/17	4/5/17	4/6/17	4/7/17	4/8/17	4/9/17	4/10/17	4/11/17	4/12/17	4/13/17
Average	49.89%	36.33%	57.88%	19.13%	-9.93%	22.75%	-28.80%	17.95%	22.87%	59.05%	9.51%	9.88%	27.44%	21.69%	20.27%
SR 155 Clairmont @ Briarcliff Road	1.52%	-43.18%	-61.36%	-65.91%	-72.73%	-62.12%	-78.03%	-66.67%	-81.06%	-65.15%	-68.94%	-50.76%	-50.76%	-39.39%	-40.91%
Cheshire Bridge @ Piedmont	222.44%	215.75%	213.78%	191.34%	149.61%	206.30%	133.46%	194.88%	216.54%	259.84%	165.35%	168.11%	226.77%	175.98%	175.98%
SR 42 N Druid Hills @ Briarcliff	-10.33%	7.01%	71.22%	20.66%	-56.09%	-25.09%	-71.59%	-27.31%	-41.70%	58.30%	13.28%	-32.84%	-29.89%	-32.47%	-32.47%
SR 13 @ Lenox	17.93%	-10.72%	28.10%	-57.86%	-23.11%	31.42%	-56.75%	16.64%	29.94%	-0.18%	-58.60%	-1.85%	26.43%	12.38%	19.59%
SR 3 @ 17th Street	17.28%	-27.78%	-9.26%	-36.42%	-65.43%	-35.19%	-64.81%	-44.44%	-34.57%	-6.17%	-38.27%	-46.91%	-53.09%	-46.91%	-30.86%
SR 8 @ SR 42	50.48%	76.92%	104.81%	62.98%	8.17%	21.15%	-35.10%	34.62%	48.08%	107.69%	44.23%	23.56%	45.19%	60.58%	30.29%

Arterial Volumes



Route #	Description	4/5 Wednesday				4/12 Wednesday				4/19 Wednesday				4/26 Wednesday			
		AM		PM		AM		PM		AM		PM		AM		PM	
		% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)	% Diff	Diff (mins)
92863	Cheshire Bridge Detour NB	-11.8%	-1.7	-4.6%	-0.7	2.1%	0.3	16.1%	2.7	8.9%	1.4	16.0%	2.7	18.0%	3.0	13.9%	2.3
92864	Cheshire Bridge Detour SB	6.4%	1.0	-17.2%	-3.4	31.1%	5.4	44.5%	12.2	32.1%	5.6	31.5%	8.0	25.7%	4.3	29.5%	7.4
92835	SR 12 Covington Hwy NB	24.1%	0.9	4.7%	0.2	58.0%	2.5	11.8%	0.4	60.6%	2.7	18.0%	0.7	40.5%	1.6	12.8%	0.5
92821	SR 9 Peachtree Rd NB	17.8%	2.0	-7.8%	-0.8	21.7%	2.5	48.3%	6.4	37.5%	4.7	31.8%	3.8	33.2%	4.0	48.0%	6.3
92822	SR 9 Peachtree Rd SB	47.9%	7.2	-24.2%	-2.7	11.4%	1.4	57.3%	10.0	41.1%	5.9	41.9%	6.6	61.8%	10.3	94.5%	22.4
92823	SR 9 Roswell NB	20.3%	2.5	-13.2%	-1.9	10.0%	1.2	24.3%	4.4	13.8%	1.6	39.9%	7.8	-13.3%	-1.4	-8.9%	-1.3
92825	SR 9 Roswell SB	3.8%	0.5	39.8%	6.5	16.0%	2.1	38.5%	6.2	-7.5%	-0.9	49.2%	8.5	-5.6%	-0.7	37.7%	6.0
92818	US 278 Donald Lee Hollowell Pkwy EB	-29.0%	-3.2	0.3%	0.0	12.1%	1.6	2.6%	0.3	15.9%	2.2	1.4%	0.1	22.9%	3.3	7.5%	0.8
92816	US 278 Donald Lee Hollowell Pkwy WB	-5.1%	-0.5	-25.2%	-3.0	1.1%	0.1	6.5%	0.9	3.0%	0.3	3.1%	0.4	2.2%	0.2	-5.1%	-0.7

Travel Times Compared to Normal

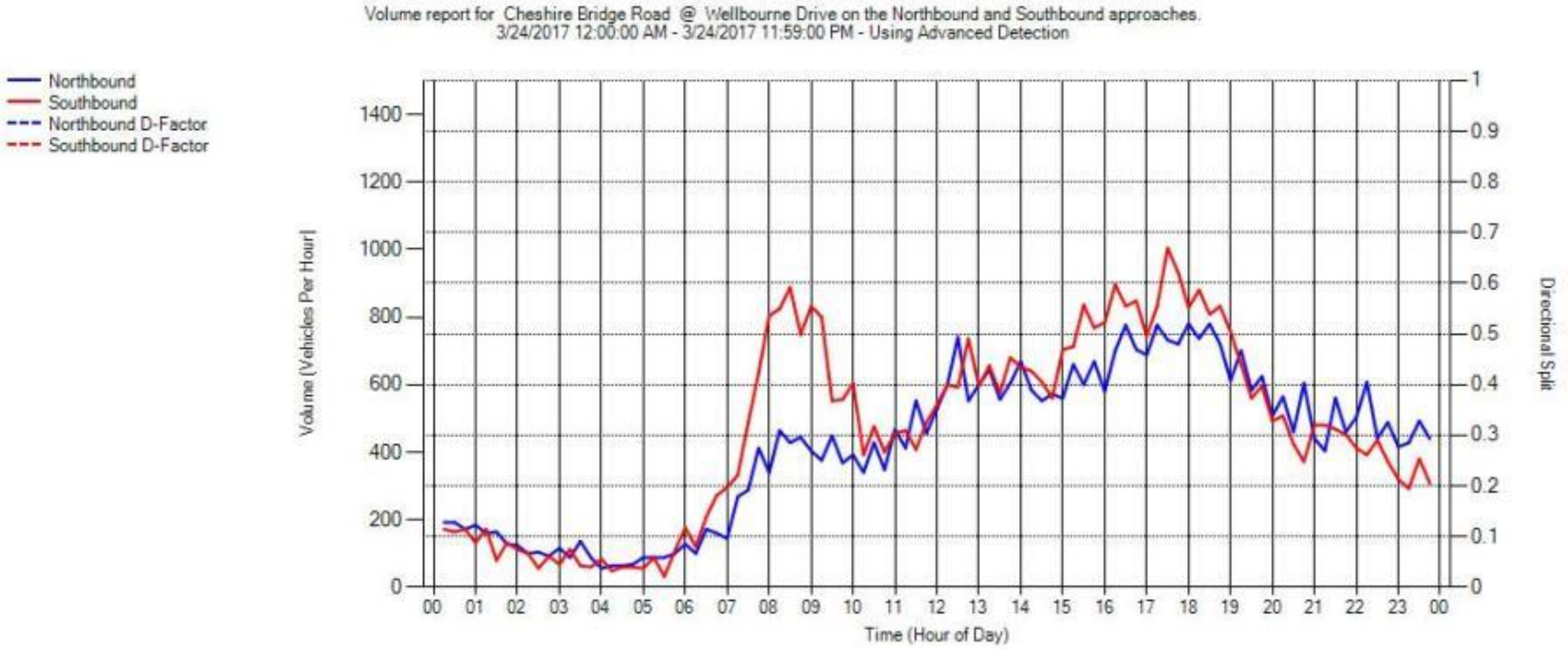
4/5 Wednesday			
AM		PM	
Percentage	Minutes	Percentage	Minutes
14.30%	2	-14.20%	-2.2

4/12 Wednesday			
AM		PM	
Percentage	Minutes	Percentage	Minutes
18.40%	2.8	41.30%	8.3

4/19 Wednesday			
AM		PM	
Percentage	Minutes	Percentage	Minutes
25.50%	3.8	33.80%	6.7

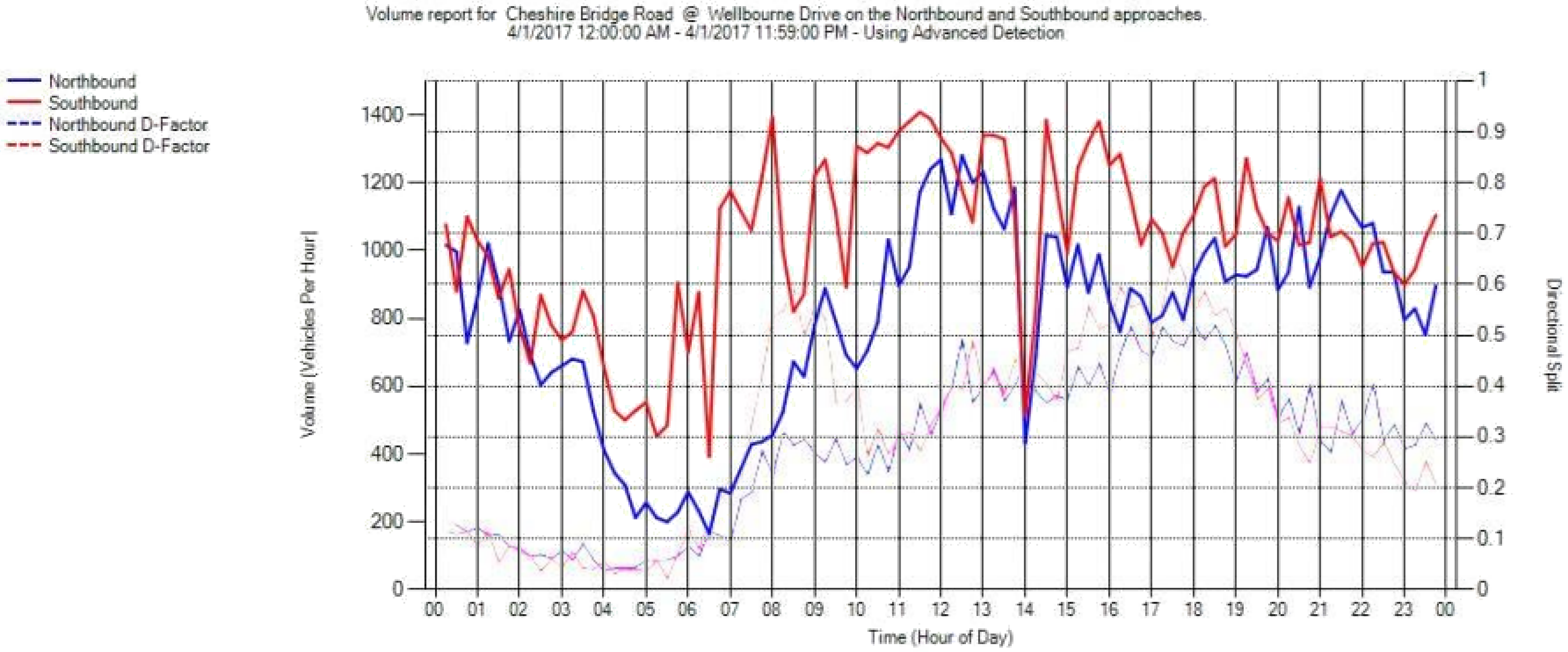
4/26 Wednesday			
AM		PM	
Percentage	Minutes	Percentage	Minutes
29.20%	4.6	41.80%	8.9

Cheshire Bridge (Detour)



Normal ADT: 20,998

Cheshire Bridge (Detour)

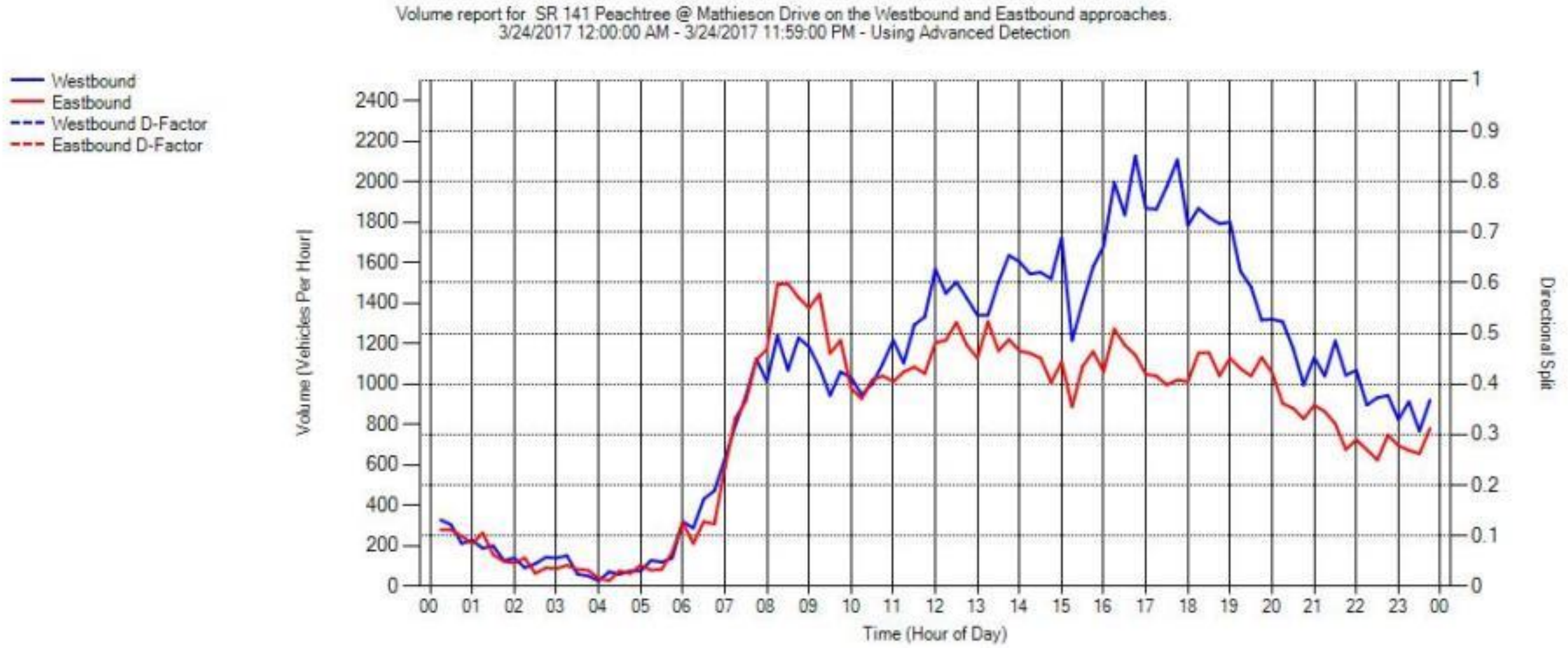


Normal ADT: 20,998

Closure ADT: 43,324

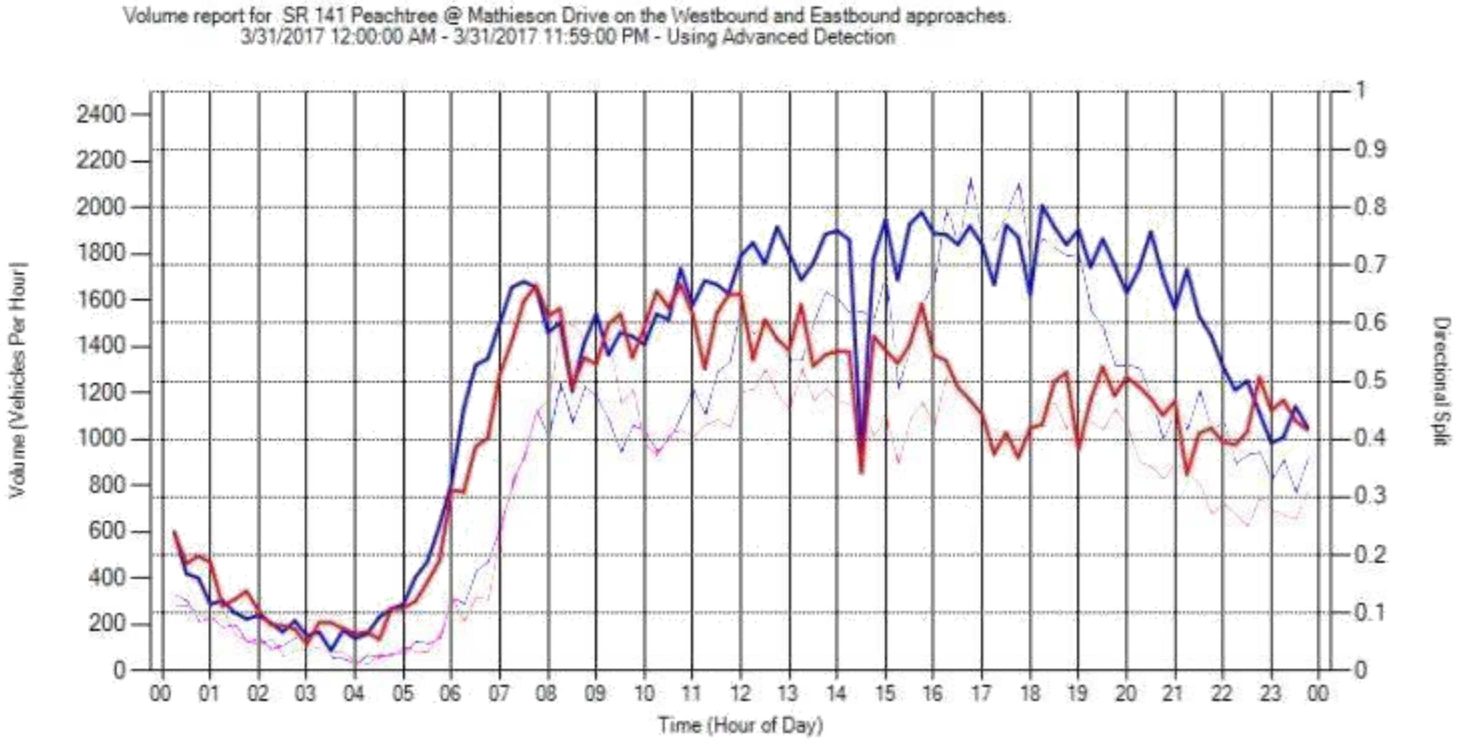
106.3% Volume Increase

SR 141 Peachtree (Buckhead)


Volume report for SR 141 Peachtree @ Mathieson Drive on the Westbound and Eastbound approaches.
3/24/2017 12:00:00 AM - 3/24/2017 11:59:00 PM - Using Advanced Detection

Normal ADT: 42,564

SR 141 Peachtree (Buckhead)

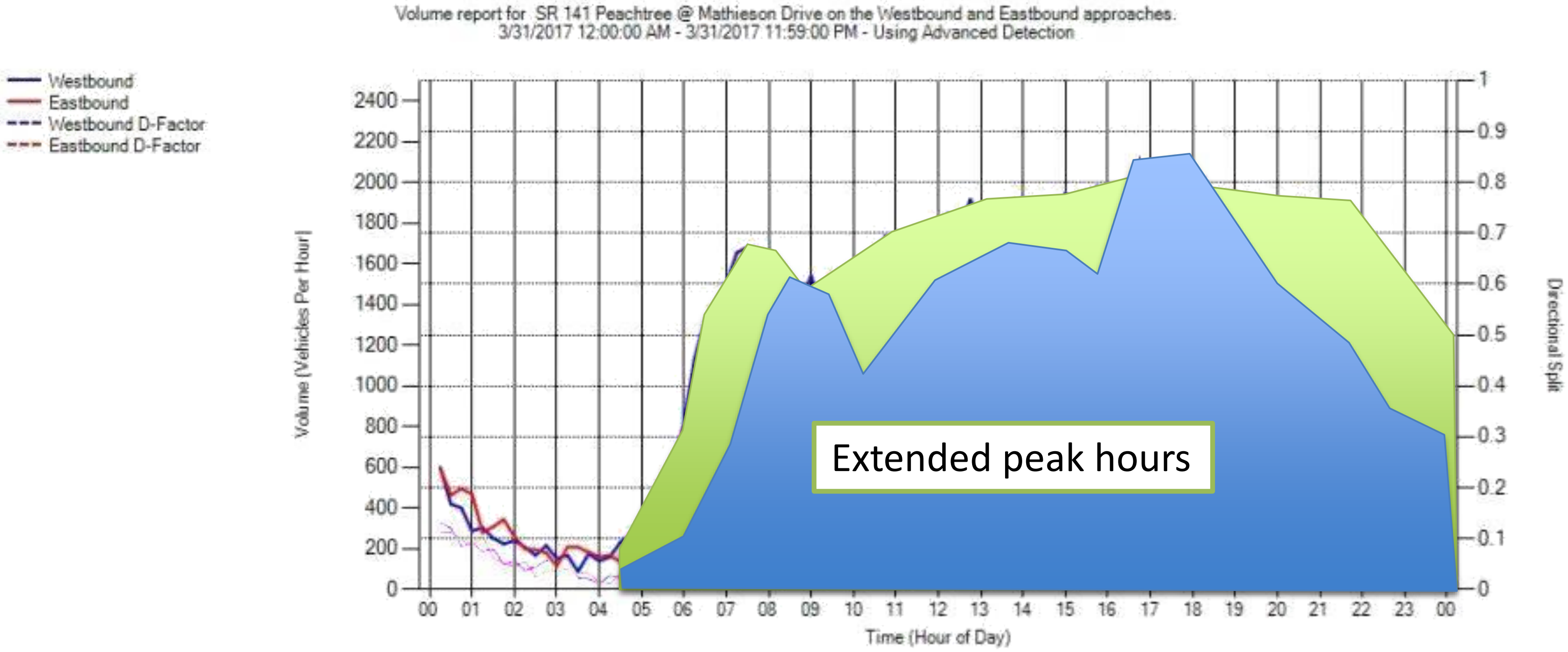

Volume report for SR 141 Peachtree @ Mathieson Drive on the Westbound and Eastbound approaches.
3/31/2017 12:00:00 AM - 3/31/2017 11:59:00 PM - Using Advanced Detection

Normal ADT: 42,564

Closure ADT: 55,041

29.3% Volume Increase

SR 141 Peachtree (Buckhead)



Extended peak hours

Normal ADT: 42,564

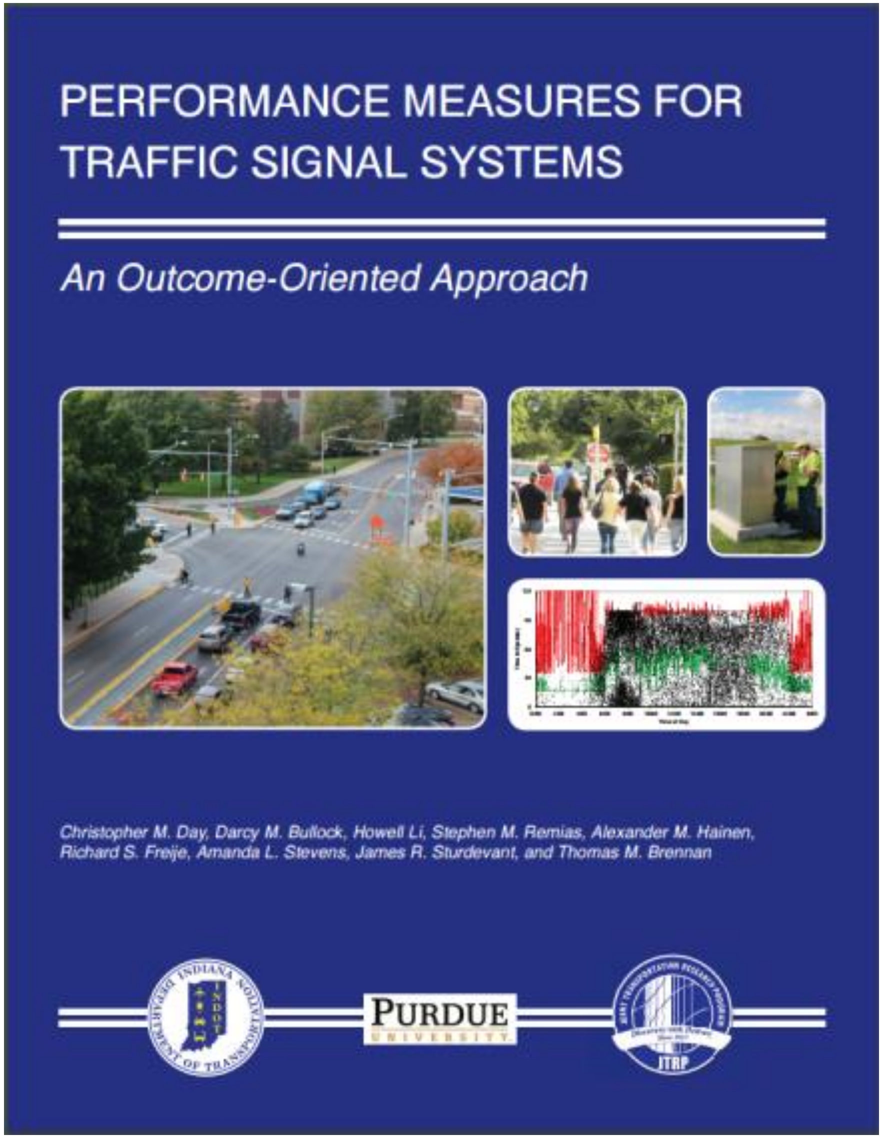
Closure ADT: 55,041

29.3% Volume Increase

Recommendations

- ATSPMs: Extremely valuable
- Have a data management plan
- Lean on early adopters
  - INDOT, UDOT, MNDOT, GDOT, Many Others
- Use the data
- Know what you have

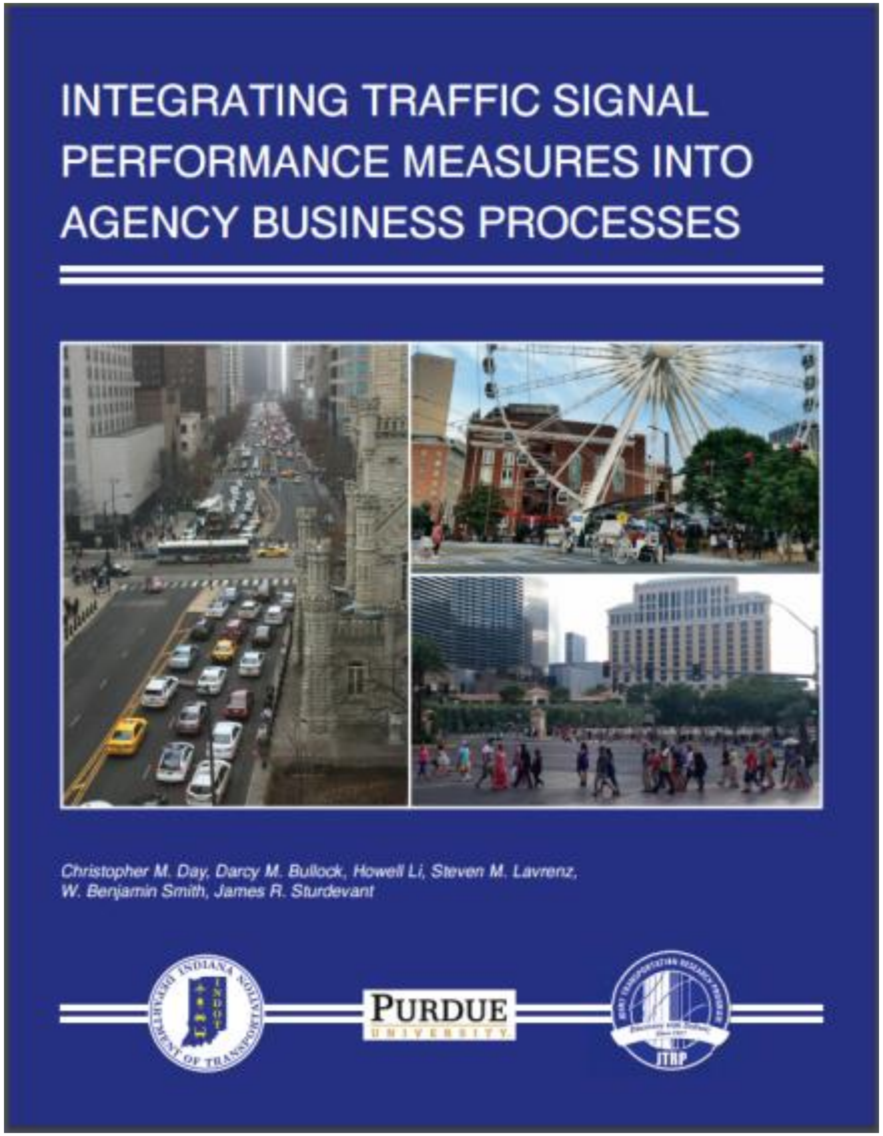
Pooled Fund Study



PERFORMANCE MEASURES FOR TRAFFIC SIGNAL SYSTEMS

An Outcome-Oriented Approach

Christopher M. Day, Darcy M. Bullock, Howell Li, Stephen M. Remias, Alexander M. Hainen, Richard S. Freije, Amanda L. Stevens, James R. Sturdevant, and Thomas M. Brennan



INTEGRATING TRAFFIC SIGNAL PERFORMANCE MEASURES INTO AGENCY BUSINESS PROCESSES

Christopher M. Day, Darcy M. Bullock, Howell Li, Steven M. Lavrenz, W. Benjamin Smith, James R. Sturdevant

Alan Davis, PE, PTOE
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404-635-2832

Georgia Department of Transportation

Now that you have heard the presentations-

Hearing from you – Poll Questions

I-95 CORRIDOR COALITION

- *POLL 1: Have these presentations been helpful in understanding the varying technologies involved in arterial monitoring?*
- *POLL 2: There are a number of approaches available to implement Automated Traffic Signal Performance Measures (Select all that you are familiar with)?*
- *POLL 3: What is the most prominent barrier within your organization to implementation of Automated Traffic Signal Performance Measures?*

Now that you have heard the presentations-

Questions?

- Remaining Questions from the CHAT Box

Wrap Up

Contact Information

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Thank You!