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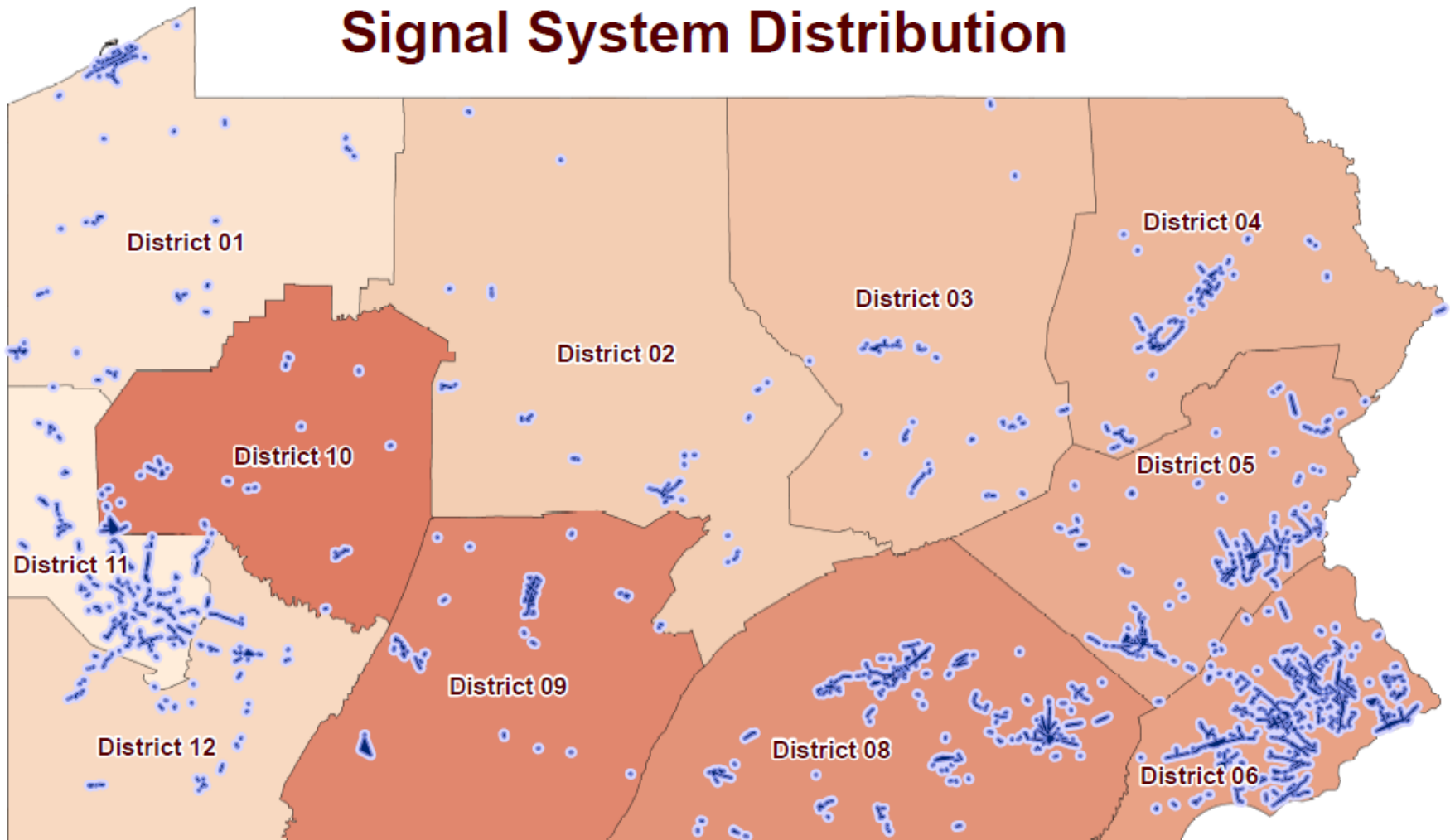
PENNDOT' S Traffic Signal Roadmap

Transportation Engineering and Safety Conference

**Session 6E: “Preparing Engineers for Future
Innovation”**

December 7, 2017

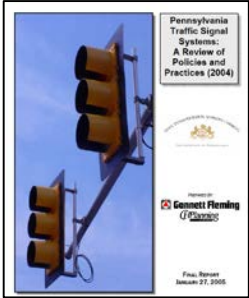
Signal System Distribution



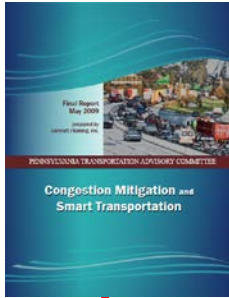
District	Number of Signals	Number of Signal Systems	Number of Signal Owners
01	468	71	61
02	322	44	62
03	274	42	71
04	599	74	93
05	1186	178	148
06	2956	245	252
08	1653	139	167
09	391	39	67
10	282	28	57
11	1691	131	126
12	495	56	79

PA Traffic Signal Timeline

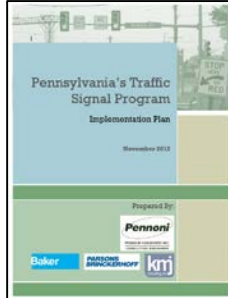
2005 TAC Study



2009 TAC Study



2012 PennDOT Study



2013 Act 89



2015 FHWA Scan Tour



2016 Remote Communications



2005

2010



2015



2020



2007 National Report Card



2012 National Report Card



2014 GLG Begins



2016 Act 101



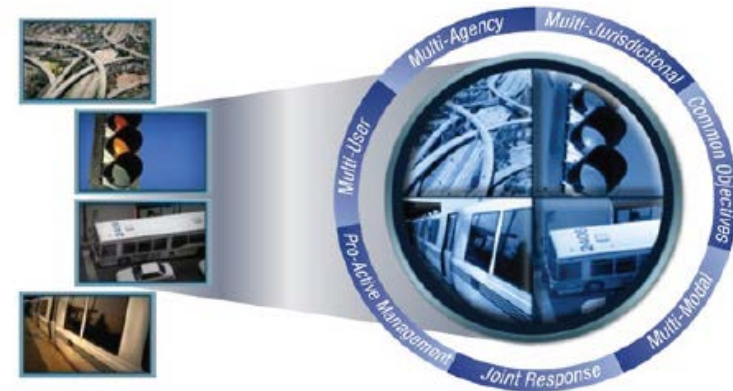
2017 Connected and Automated Vehicles

Traffic Signal Operations Approach

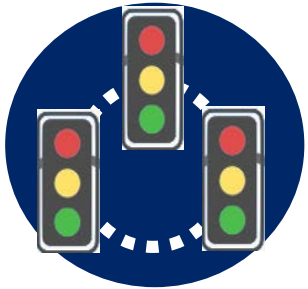
Goals:

- Reducing delay, emissions, and fuel consumption
- Reducing crashes and fatalities
- Focus impacts on the economy and job creation
- Standardizing traffic signal equipment
- Establishing regional and multi-jurisdictional collaboration

<u>Currently</u>		<u>Moving Towards</u>
Isolated	➡	Coordinated
Jurisdictional	➡	System
Project Focus	➡	Customer Focus
Local	➡	Regional
Reactive	➡	Proactive
Piecemeal	➡	Comprehensive
Historical information	➡	Real-Time Information
8/5 operations	➡	24/7 operations
Output oriented	➡	Performance-based



Traffic Signal Roadmap



Standardization

- Pub. 191 (1 Signal Publication)
- Product Approvals
- E-Permitting System
- Signal Permit Plans



Asset Management

- Asset Inventory
- Maintenance Records
- Municipal Budgeting



Performance Management

- EDC-4 High Resolution Data
- Arterial Probe Performance Metrics
- Pooled Fund Study (TPF-1453)



Maintenance and Operations

- Communications
- Command & Control
- Signal Mgmt. Plan
- Maintenance Strategies



Technology and Innovation

- Adaptive Signals
- Communication & DSRC Deployments
- CAV Applications



Sustainability and Funding

- Grants
- Ownership
- Systematic Statewide Improvements



Research and Training

- HSTOD Training Committee
- Identify Needs/Gaps

Transportation Improvement Program (TIP)

Project Planning

- Life Cycle Evaluation
- Project Planning



Standardization

- **Publication 191 (1 – Electronic Signal Publication)**
 - Rolls up all publication except 408
 - Searchable document with additional training materials (figures, design lists, tutorials, and connect with relevant national publications)

- **Intersection Control Evaluation (ICE)**
 - Standard scalable approach to properly evaluating and documenting the appropriate control at intersections.

- **Electronic Traffic Signal Submissions through E-Permitting**
 - Get all traffic signal submissions electronically through one system regardless as to whether it's a Department project, HOP, or Local project.
 - Ensure coordination and seamless interaction between other Department established systems.



Standardization

➤ **Traffic Signal Management Plan**

- FHWA initiative to clarify and improve on Maintenance and Operations by identifying the Goals, Objectives, Strategies, and Tactics needed on key facilities.
- Clarify by roadway the main objectives so they are clear from project to project (i.e. smooth flow & progression versus optimal local operations)

➤ **Traffic Signal Products**

- Refreshing Traffic Signal Standards and Specifications with a focus on new technology and the most reliable and effective operation
- Traffic Signal Procurement

➤ **Standardization of Documentation and Standards**

- Traffic Signal Permit Plans
- Traffic Signal Processes



Standardization

Traffic Signal Software Solutions



Asset Management

Probe Vehicle Arterial Performance Metrics

Management, Operations, and Performance Metrics



Traffic Analysis Tools



Other DTE Approved HCM Software

Approval Process



Project Delivery



Green Light-Go Funding Program



Unified Traffic Signal Command and Control



Location Map

Measurement

Feet

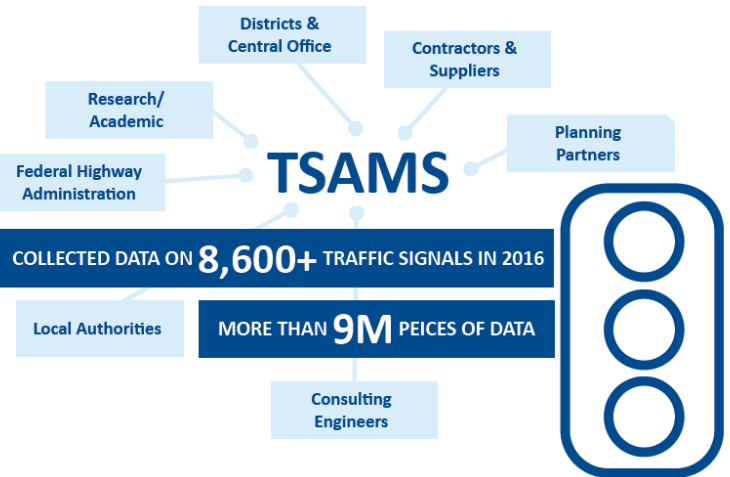
Measurement Result
486.3 Feet

- Hold the [Ctrl] key to enable snapping
- Double click at the last drawing position

Legend

- Search Results
- All Signals
 - Cabinet
 - Structure
 - Signal
 - Isolated Signal
 - Removed Signal
 - Signal System
 - Signal Connections
- All Non-Signals

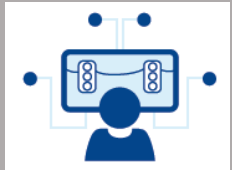
Session will expire in 30 minutes.
 Pennsylvania Department of Transportation. All Rights Reserved.
 Pennsylvania DOT Privacy Policy
 Tue, Dec 5, 2017 11:36:58 PM EST



COLLECTED DATA ON **8,600+** TRAFFIC SIGNALS IN 2016

MORE THAN **9M** PEICES OF DATA

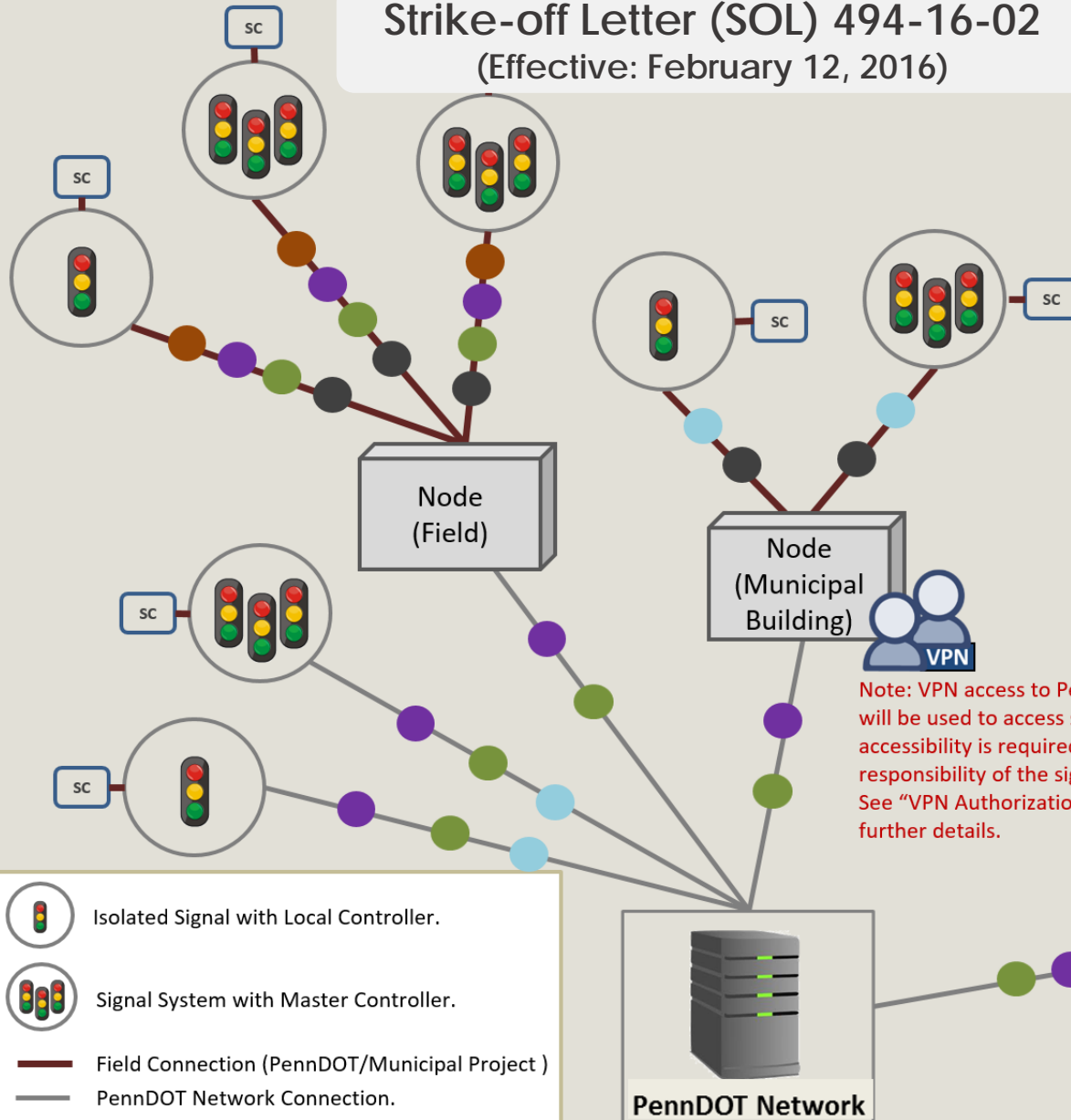
- Inventory
- Maintenance
- Electronic Files
- GIS Enhancements
- Work Flow
- ITS Assets
- Reporting
- Project Management
- Modelling & Analytics
- Mobile



Maintenance and Operations

Remote Traffic Signal Communications Policy

Strike-off Letter (SOL) 494-16-02
(Effective: February 12, 2016)

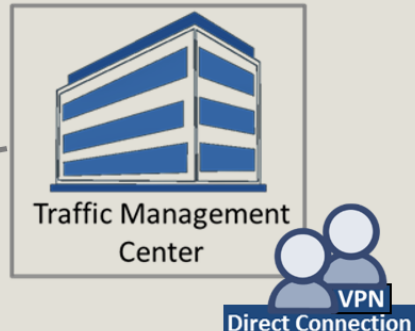


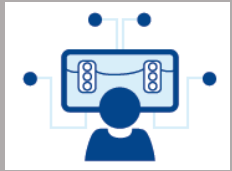
- sc** Signal Components
- Local/Master Controller
 - Adaptive System
 - Preemption System
 - Detection System
 - MMU/Conflict Monitor
 - Transit Priority
 - Modem & Router
- Note: PennDOT IP address assignment is required. Coordinate with IT prior to project PS&E.

Connection Type	
	Twisted-Pair
	Ethernet
	Fiber Optic
	Cellular
	Radio

Note: VPN access to PennDOT Network will be used to access signal(s). Internet accessibility is required and will be the responsibility of the signal owner. See "VPN Authorization Process" for further details.

- Isolated Signal with Local Controller.
- Signal System with Master Controller.
- Field Connection (PennDOT/Municipal Project)
- PennDOT Network Connection.





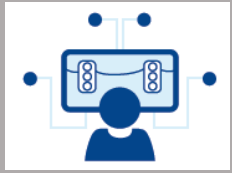
Maintenance and Operations

Statewide Unified Traffic Signal Command and Control

ID	Section	Subsection	Requirements
1	5		5. Traffic Signal Controller Interface
2	5		The following requirements apply to the traffic signal controller interface:
3	5	1.	The Software must interface to the existing controllers using the protocols identified within this specification.
4	5	a.	Any devices which will require hardware upgrades or cannot be interfaced with must be clearly identified.
5	5	2.	The Software must support other controllers using the NTCIP Center-to-Field (C2F) communications protocol.
6	5	a.	The NTCIP C2F protocol must be NTCIP 1202 and 1202 based using custom-MIBS when available from the controller manufacturer.
7	5	b.	The Vendor must describe their C2F capabilities and controller brands supported with their Software.
8	5	c.	The system must be capable of using custom MIBS when available from the controller manufacturer.
9	5	d.	For each device type identified, Vendors shall indicate if the controller can be integrated out of the box, integrated after some custom code is written, or if integration with the device is not possible.

Why is this needed?

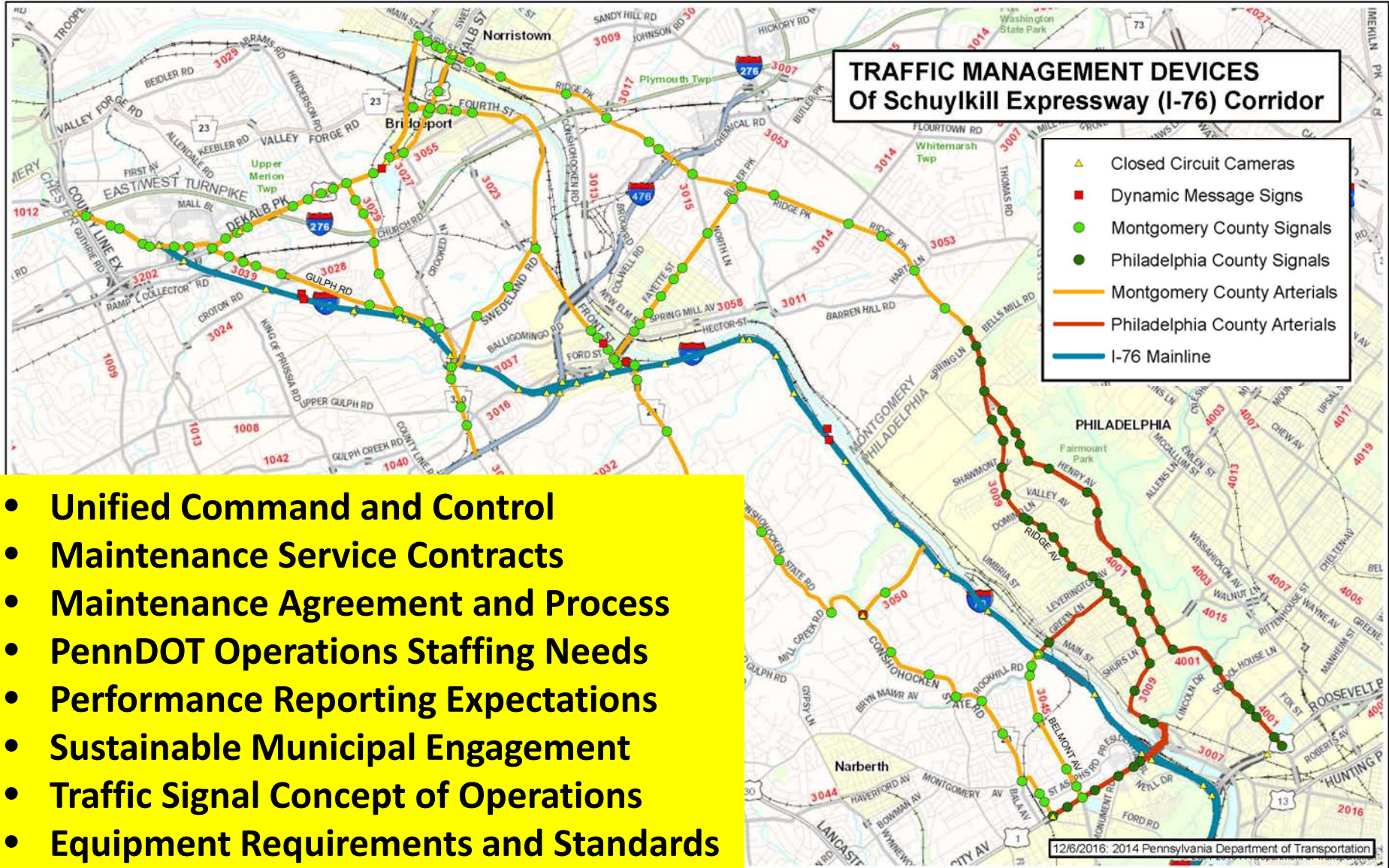
- Successfully deployed in other state and regional deployments
- Inter-operability is critical to maximizing the existing capacity
- PennDOT and Municipal situational awareness and seamless operations
- Connected and Automated Vehicle applications
- Integrated Corridor Management (ICM)



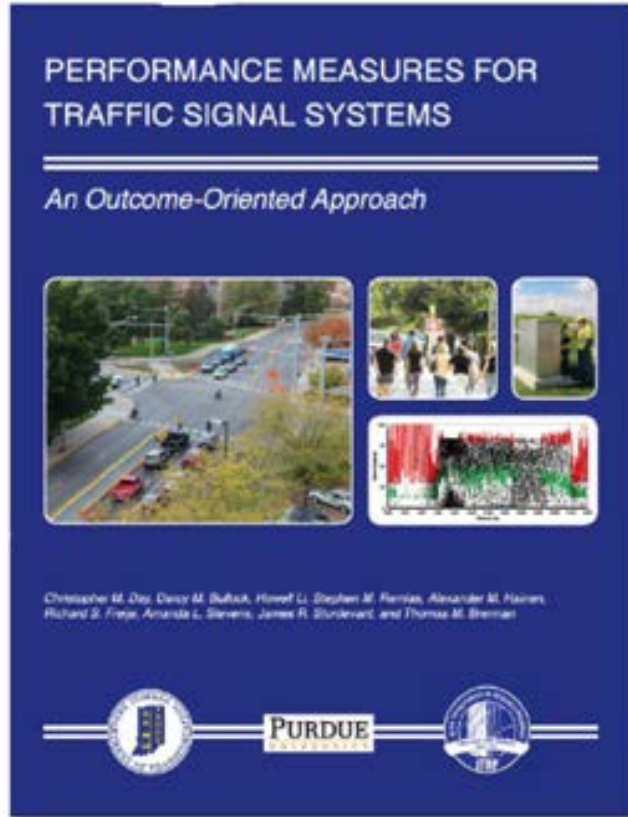
Maintenance and Operations

Traffic Signal Ownership

I-76 Parallel Corridor Ownership Pilot (160 Signals in 9 municipalities)



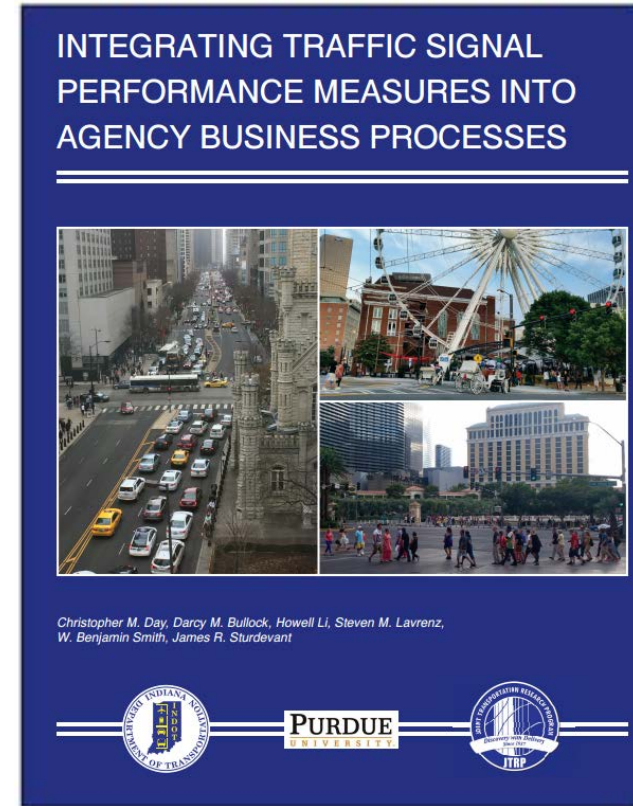
- Unified Command and Control
- Maintenance Service Contracts
- Maintenance Agreement and Process
- PennDOT Operations Staffing Needs
- Performance Reporting Expectations
- Sustainable Municipal Engagement
- Traffic Signal Concept of Operations
- Equipment Requirements and Standards



“Volume 1”

Defining Performance Measures...

<http://docs.lib.purdue.edu/jtrpaffdocs/3/>



“Volume 2”

Business Practices, Use Cases, and
Implementation...

<http://docs.lib.purdue.edu/jtrpaffdocs/24/>

Signal

Signal Selection

Signal ID

3177

Dickerson Road - PECO Driveway @ Sumneytown Pike

Signal List

Signal Map

Region

District 6

Metric Type

Purdue Coordination Diagram

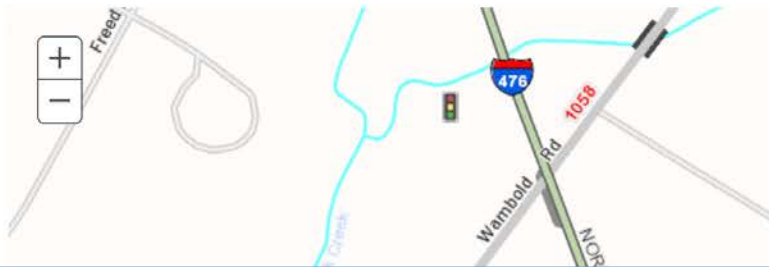


Chart Selection

Metrics List

- Purdue Phase Termination
- Split Monitor
- Pedestrian Delay
- Preemption Details
- Turning Movement Counts
- Purdue Coordination Diagram**
- Approach Volume
- Approach Delay
- Arrivals On Red
- Approach Speed

Purdue Coordination Diagram Options

Y-axis Max

150

Secondary Y-axis Max

2000

Volume Bin Size

15

Dot Size

Small

Show Plans

Show Volumes

Date Selection

Start Date

06/13/2017

12:00

AM

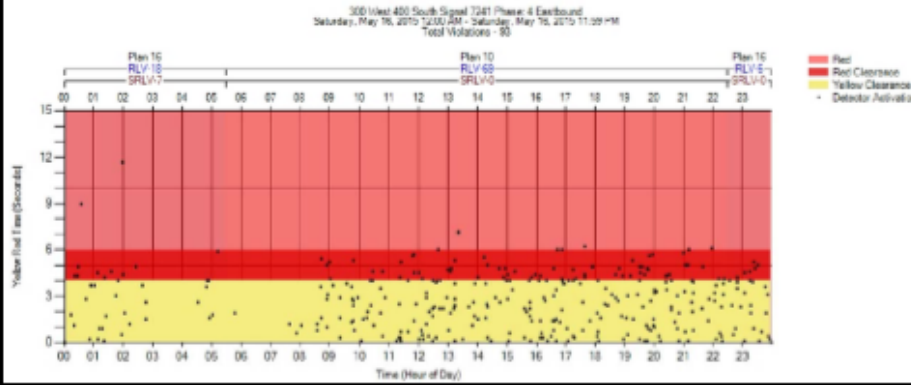
< May 2017 >

Performance Management

High Resolution Data/ Automated SPMs

Red Light Monitoring

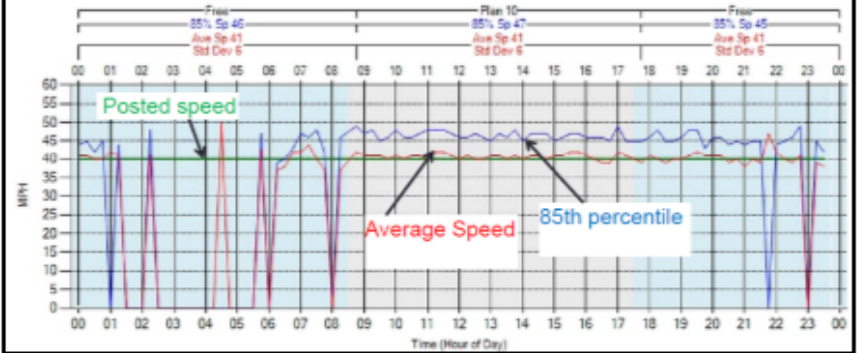
Use for identifying safety trends and engineering countermeasures



Approach Speeds

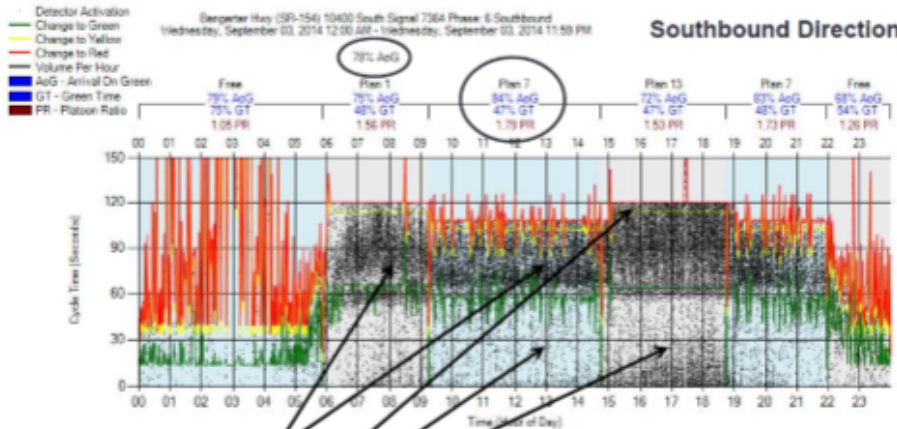
Use for Traffic Studies, Severe Weather Timing Plans, and Calculating Yellow and Red Clearance Intervals

Bluff St. & 100 S., St. George, Utah – North Bound



Purdue Coordination Diagram

Evaluating progression quality – Are vehicles arriving on green or red?

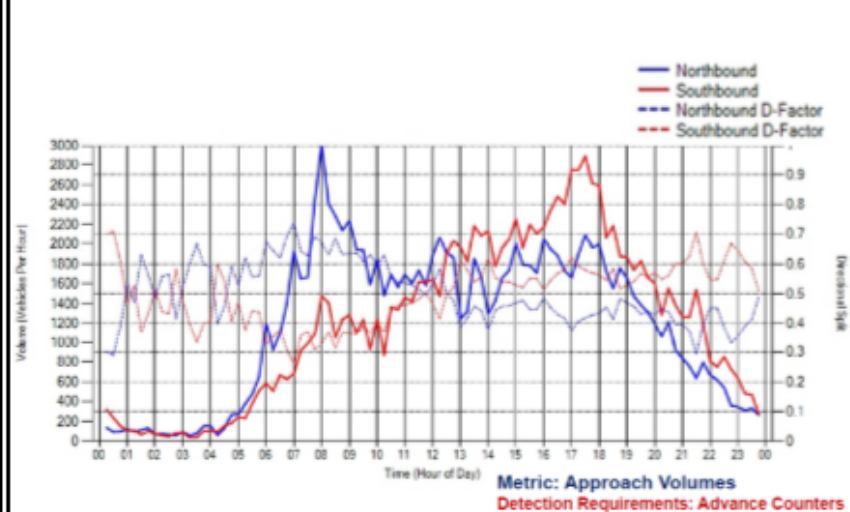


- Vehicles arrive on green
- Vehicles arrive on yellow
- Vehicles arrive on red

Metric: Purdue Coordination Diagram
Detection Requirements: Advance Counters

Approach Volumes

When to Take a Lane for Maintenance Activities, Directional Splits, Traffic Models

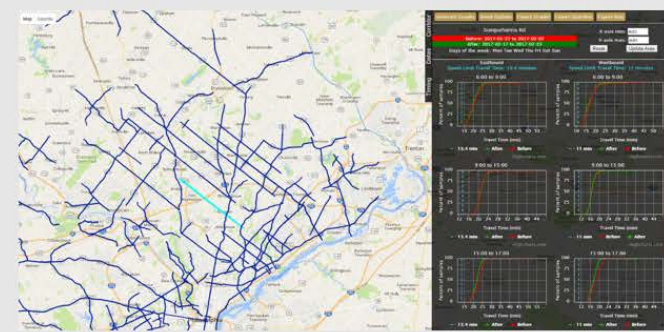


3 Interactive Web Dashboards

- **Travel Time Comparison Tool**
 - Travel times for user specified date ranges
 - CFD's for before/after comparison

- **Arterial Ranking Tool**
 - Ranks the corridors based on performance measures
 - Normalized median and IQR

- **Travel Delay Monitor**
 - Cumulative miles of a corridor operating under a particular speed



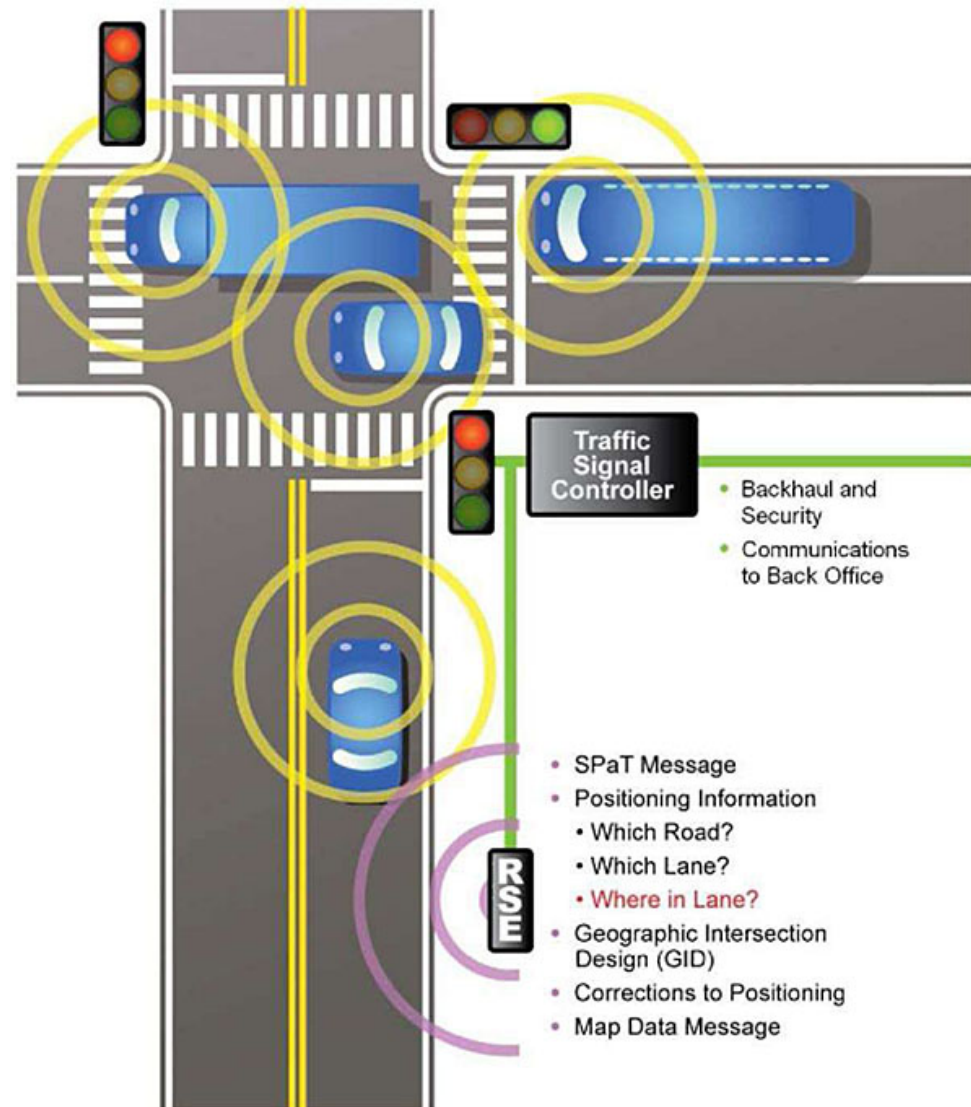
Type of Event	(1) Travel Time Comparison	(2) Arterial Ranking	(3) Congestion Ticker
Signal Timing Plan Degradation			
Signal Maintenance and Retiming			
Adaptive Installation			
Construction Activities			
Special Events			
Crashes			
Weather Events (Winter Storms)			
Land Use Changes			



Technology and Innovation

Connected and Automated Vehicle Efforts at Traffic Signals

- Identify and Deploy appropriate Pilots
- Understand the Connected and Automated Vehicle Terminology
- Understanding how DSRC Works
- Understand Inter-operability between the Road Side Units (RSUs) and On-Board Units (OBUs)
- Monitor the FHWA Connected Vehicle and Smart City Deployments
- Understand the needed Map Message and updates
- Understand the Applications and Pilot
- Preparing for a Security Certificate System
- Monitor the DSRC and 5G debate
- Collaborate and Innovate with Other Agencies and Practitioners





Sustainability and Funding

Up to \$40 Million Annually

Local Grant Element

- Annual Program
- Counties, Municipalities, and Planning Partners Eligible
- All Existing Traffic Signals
- 20% Match and Municipal Managed unless otherwise identified

Statewide Systematic Improvements

- Statewide TSAMS data collection
- Unified Command and Control
- ATSPM mapping and communications
- Improve Communications and Data Structure

PennDOT Management Element

- PennDOT ownership [Pilot Evaluation is 160 signals in 9 municipalities that parallel I-76 (Schuylkill Expressway)]
- Focus on Key Super Critical (AADT > 25,000) and Emergency Detour Routes
- Prepare for Connected Traffic Signals



Research and Training

- **Highway Safety and Traffic Operations (HSTO) Training Committee**
 - Signals/ITS Subcommittee
 - Identify, program, and develop necessary training to improve and establish a sustainable workforce
 - Improve the current state of the Practice of Signals in PA

- **International Municipal Signal Association (IMSA)**
 - Get the boundary to be the entire state and not split into 2 regions
 - Rebuild relationships to get appropriate and sustainable technical training

- **Leverage Other State Best Practices**
 - Continue to work closely with lead states as well and participate in the leading pool fund studies.
 - Utilize FHWA to assist with training needs

TRANSPORTATION IMPROVEMENT PROGRAM

HOME CONSTRUCTION ACT 89 PROGRESS **FOUR & TWELVE YEAR PLANS** CONTACT ABOUT

TIP Project - Atherton Street Phase III

Project No:	101960
Title:	Atherton Street Phase III
Type of Work:	Restoration
District:	02
Planning Partner:	Centre
State Representative:	H. Scott Conklin, (D)
State Senator:	Jacob D., III Corman, (R)
US Representative:	Glenn W. Thompson, (R)
County:	CENTRE
Route:	3014
TYP_APPR_IND	Y
Is TYP:	Yes
Is Decade of Investment Project:	No
Project Manager:	
Name:	Craig A. Sattesa, P.E.
Email:	csattesa@pa.gov
Phone:	814-765-0678
Video Log:	Click to view in Video Log
Report:	Click to view report

TIP Project - Atherton Street Phase III

- Utilizing and Leveraging TSAMS
- Using GIS-IQ to evaluate needs
- Develop evaluation methodology
- Identify projects or potential projects for TIP and other Grant Programs
- If we don't do it then who is going to-do it?

Identifying systematic needs so that Projects can be planned. Bridge has SD, Pavement has IRI, what do we have for Signals to compete for funding?

Questions

www.dot.state.pa.us/signals

Tuesday, September 5, 2017

2017 - Green Light-Go Program (Year 4) Program Updates and Application Period

PennDOT will be accepting applications for the 2017 Green Light-Go Funding Program (Year 3) from September 2 through November 9, 2017. The 2017 Green Light-Go Program has up to \$40 million for the competitive application and reimbursement grant program for existing traffic signal improvements such as: light-emitting diode technology and intelligent transportation applications, such as autonomous and connected vehicle-related technology, performing regional operations such as retiming, developing special event plans and monitoring traffic signals and for maintaining and operating traffic signals.

Municipalities are strongly encouraged to work with their PennDOT District Traffic Signal Unit representatives to define project scopes in a manner consistent with the program goals and requirements, which will allow PennDOT to assist applicants with refining the scope to ensure a successful project (e.g. equipment compatibility, appropriateness of project for location, etc.). A new project scoping form has been developed (see Appendix III of the [Program Guidelines](#)) to assist in this process, and the PennDOT contacts are identified in Appendix IV.

Please visit the PennDOT Traffic Signal Portal's Green Light-Go page for more information:
<http://www.dot.state.pa.us/Portal%20Information/Traffic%20Signal%20Portal/FUNDGLG.html>.

The 2017 program continues the following updates enacted in Act 101 of 2016 (Enhancing Pennsylvania's Green Light-Go Program):

- Reduction of the Municipal Match from 50% to 20%

Publications

Strike-off Letters

Traffic Engineering Forms

Analysis & Design (Excel Workbooks)

Green Light-Go Program

ARLE Program

Approved Products Listing (eCAMMS)

Manufacturer Structure Drawings

Laws & Regulations

Flashing Yellow Arrow (FYA)

Traffic Signal Training Courses

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Traffic Signal Asset Management System (TSAMS)