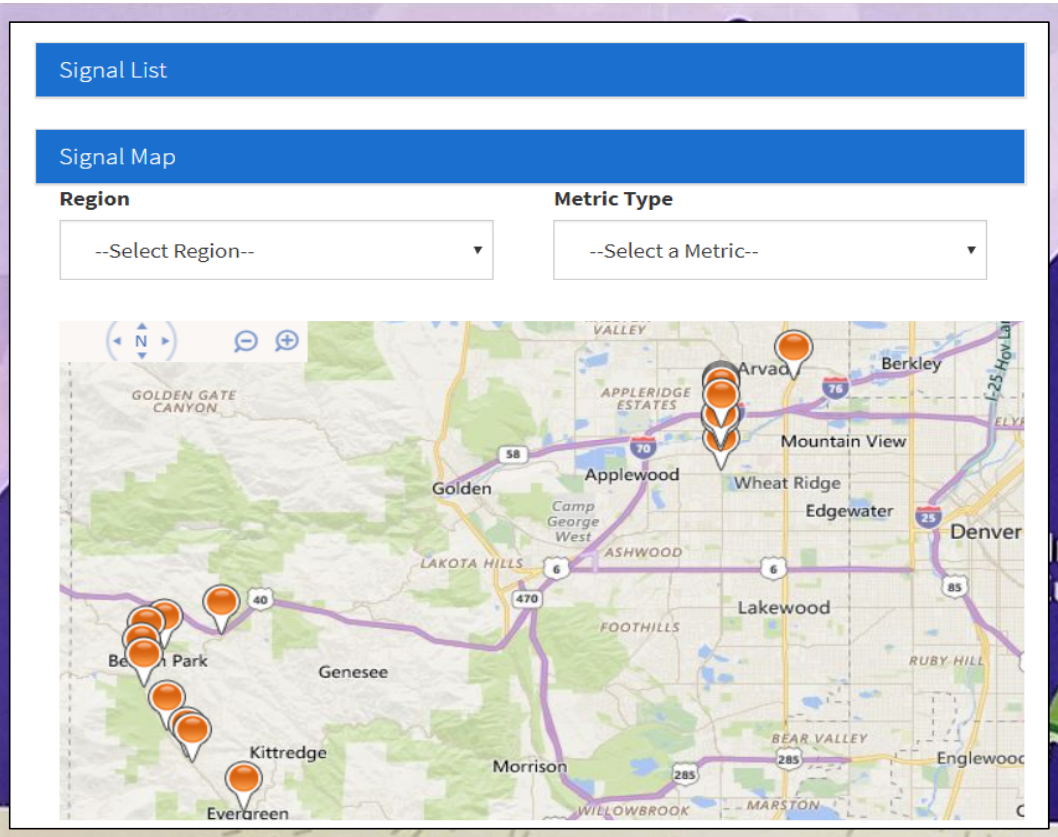
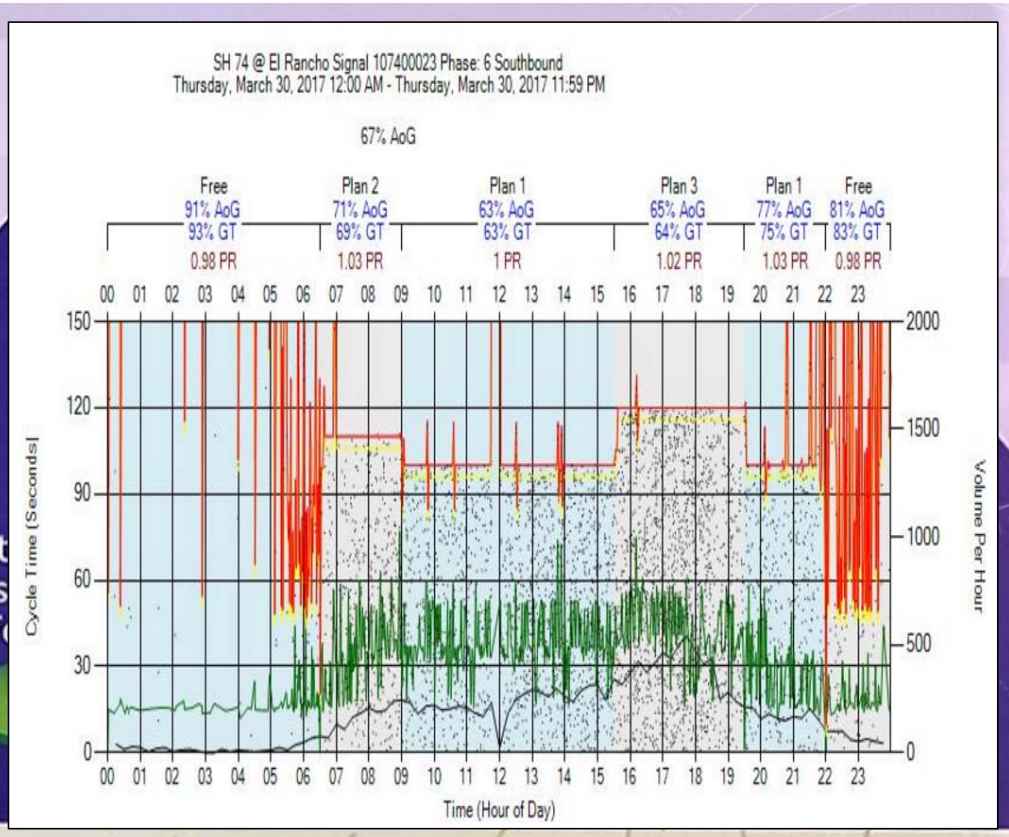




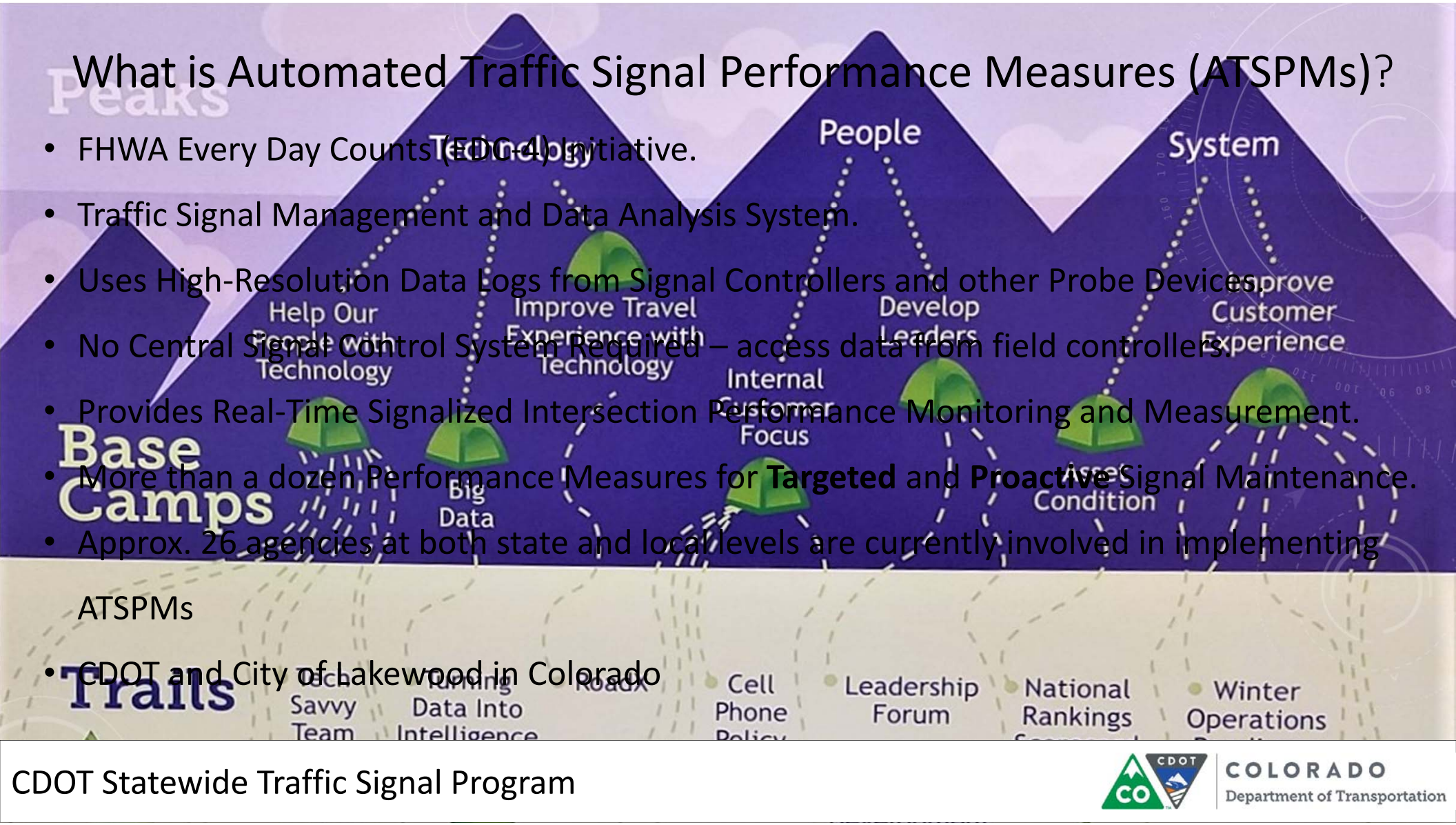
CDOT Automated Traffic Signal Performance Measures (ATSPMs)

2017 CO/WY ITE and ITS Rocky Mountain Joint Meeting

COLORADO
Department of Transportation

What is Automated Traffic Signal Performance Measures (ATSPMs)?

- FHWA Every Day Counts (EDC-4) Initiative.
- Traffic Signal Management and Data Analysis System.
- Uses High-Resolution Data Logs from Signal Controllers and other Probe Devices.
- No Central Signal Control System Required – access data from field controllers.
- Provides Real-Time Signalized Intersection Performance Monitoring and Measurement.
- More than a dozen Performance Measures for **Targeted** and **Proactive** Signal Maintenance.
- Approx. 26 agencies at both state and local levels are currently involved in implementing ATSPMs
- CDOT and City of Lakewood in Colorado



COLORADO
Department of Transportation

ATSPM Basic Concept

Reliable Communications

Automated Data Collection

- Signal Controller
- Field Detectors
- Other Probe Devices

ATSPM Server

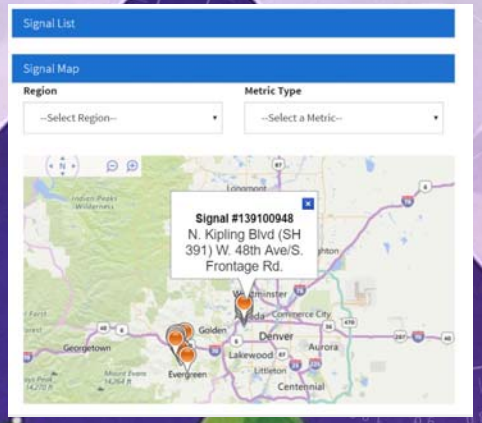
- Data Archive
- Data Analysis

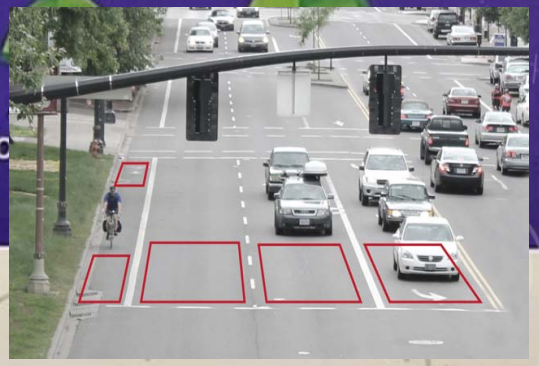
Useful Information on Signal Performance

- Signal
- Corridor
- System

System Requirements for Implementing ATSPM

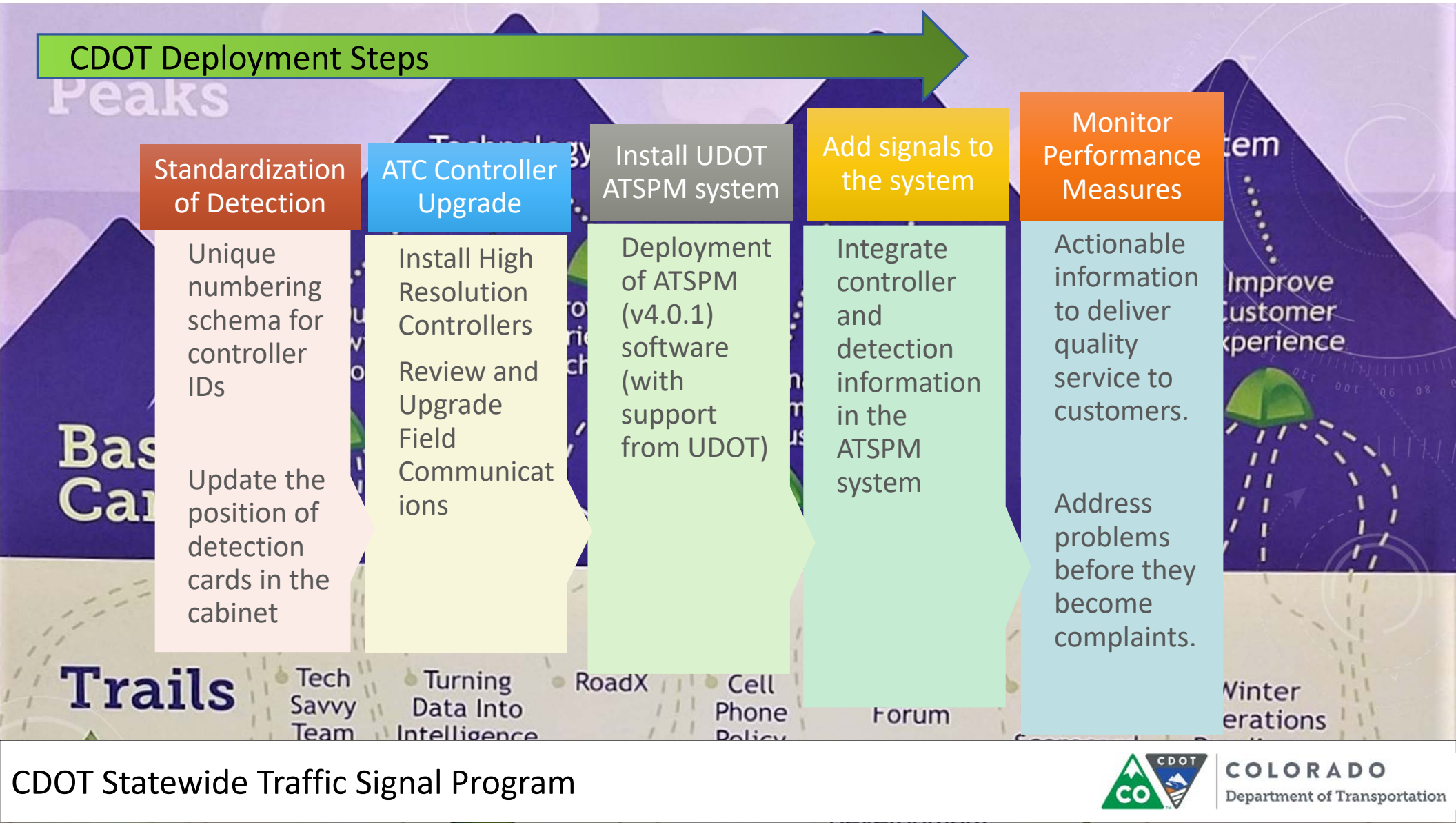
- ❑ High Resolution Controller (CDOT uses Intelight)
  - Ability to Log 1/10th of a second data
- ❑ Reliable communications
  - Fiber
  - Cell Modems
- ❑ Database Server*
- ❑ ATSPM Software*
- ❑ Detection Equipment





*For server requirements, software and installation manuals visit:
https://www.itsforge.net/index.php/community/explore-applications#/30/133

COLORADO
Department of Transportation



COLORADO
Department of Transportation

Types of Performance Metrics

Performance Metric	Type of Detection
Purdue Coordination Diagram	Advance Count Detection (350ft-400ft behind stop bar)
Purdue Link Pivot Offset Optimization	
Approach Volume	
Approach Speed	
Approach Delay	
Preemption Details	Preemption Devices (Opticom)
Pedestrian Delay	Pedestrian Push Buttons
Purdue Split Failure	Lane by Lane Presence Detection
Turning Movement Counts	Lane by Lane Stop Bar Count Detection
Yellow and Red Actuations	
Purdue Phase Termination	Stop Bar or Advance Detection
Split Monitor	Stop Bar or Advance Detection

ATSPM Watch Dog

Watch Dog Application Settings

Minimum Record Threshold (Low Detector Count Alarm)	500
Consecutive Event Count (Max Out and Force Off Alarms)	3
Min Phase Termination Threshold (Max Out and Force Off Alarms)	50
Percent Threshold (Max Out and Force Off Alarms)	0.9
Ped Actuations Threshold (Ped Alarm)	200
Minimum Count Threshold (Low Detector Count Alarm)	50
Current Day Evaluation Start Hour (Max Out, Force Off, & Ped Alarms)	1
Current Day Evaluation End Hour (Max Out, Force Off, & Ped Alarms)	5
Previous Day Evaluation Start Hour (Low Detector Count Alarm)	17
Previous Day Evaluation End Hour (Low Detector Count Alarm)	18
Weekday Only	☐

Sample Email from Watch Dog

ATSPM Alerts for 6/4/2017

CDOTATSPM@dot.state.co.us

Sent: Sun 6/4/2017 7:00 AM

To: mbrian.tennent@state.co.us; Vijay Sabawat; warren@kritek.org; warren@kritek.org

--No new missing record errors were found on 6/3/2017:

--No new force off errors were found between 1:00 and 5:00:

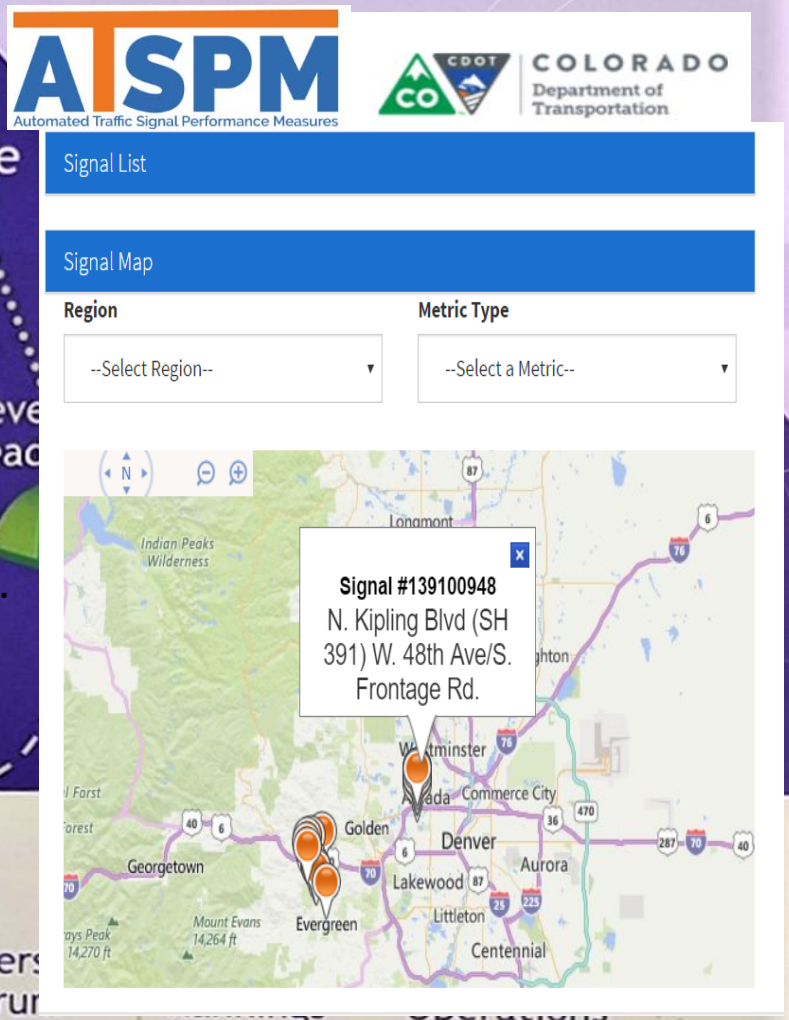
--The following signals had too many max out occurrences between 1:00 and 5:00:
107400534 - SH 74 & Stagecoach Rd. - Phase 1 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 2 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 5 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 6 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 8 (Max Outs 100%)

--The following signals had unusually low advanced detection counts on 6/3/2017 between 17:00 and 18:00:
107400296 - SH 74 & Squaw Pass - Phase 4 (Count: 28)
107400296 - SH 74 & Squaw Pass - Phase 8 (Count: 38)
107400444 - SH 74 & Lewis Ridge Rd. - Phase 4 (Count: 49)
107400444 - SH 74 & Lewis Ridge Rd. - Phase 8 (Count: 43)

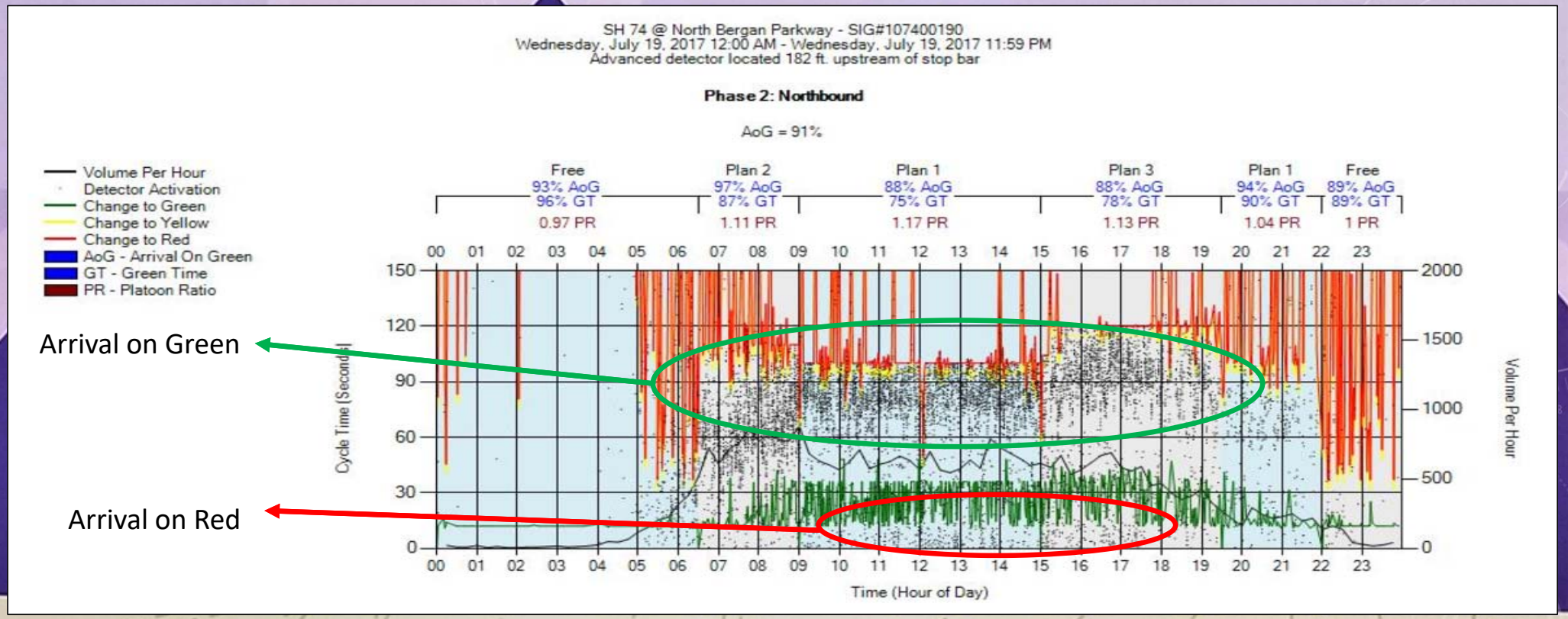
--No new high pedestrian activation errors between 1:00 and 5:00:

Benefits of ATSPM Implementation

- ❑ Proactive operations and maintenance activities.
- ❑ Continuous monitoring of device and system health.
- ❑ Automated Notifications (watchdog emails).
- ❑ Before and After studies (why model what we can measure!).
- ❑ Efficient Allocating of Scarce Resources.
- ❑ Increased Safety (by a shift to proactive operations and maintenance practices).



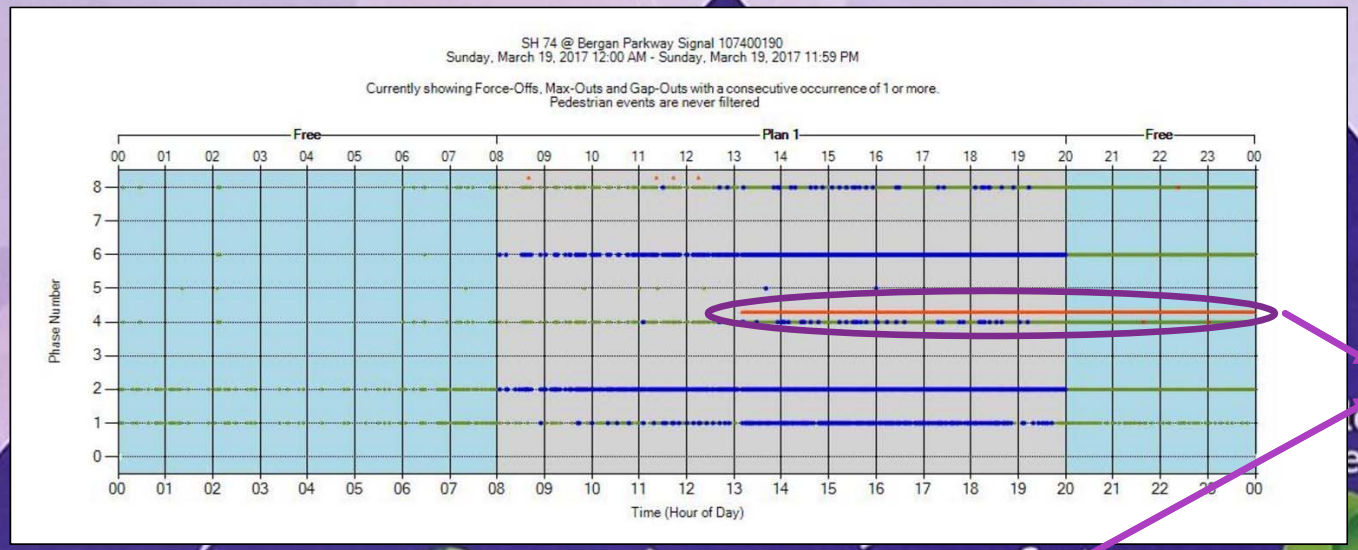
COLORADO
Department of Transportation



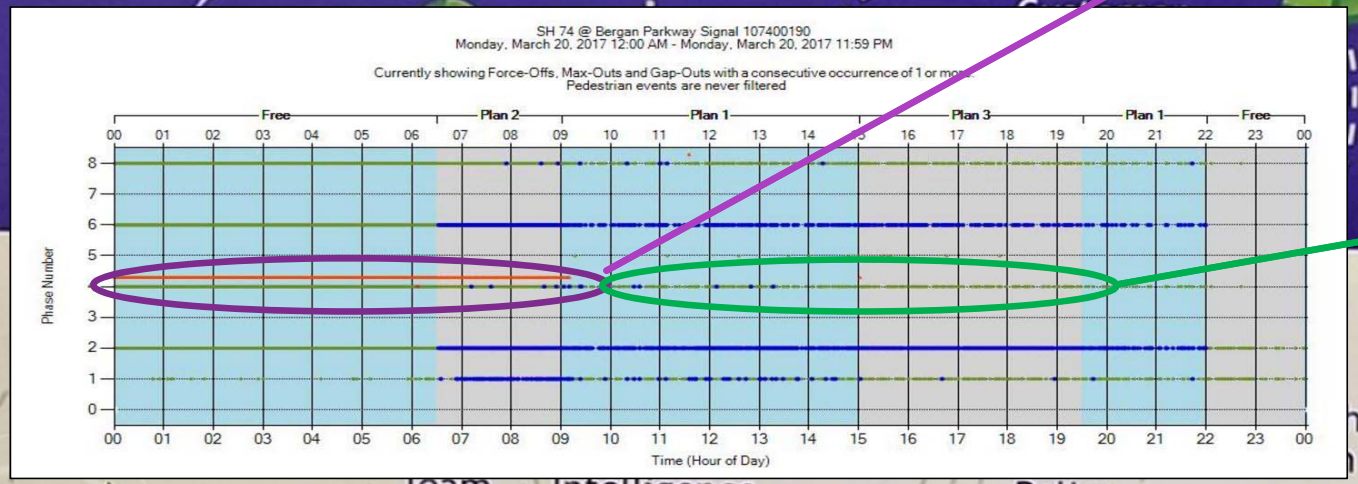
Plots vehicle arrivals during each phase and movement of each cycle

Use Case: Troubleshoot Coordination Related Issues

Use Case: Detection Failures (Constant Ped. Call)



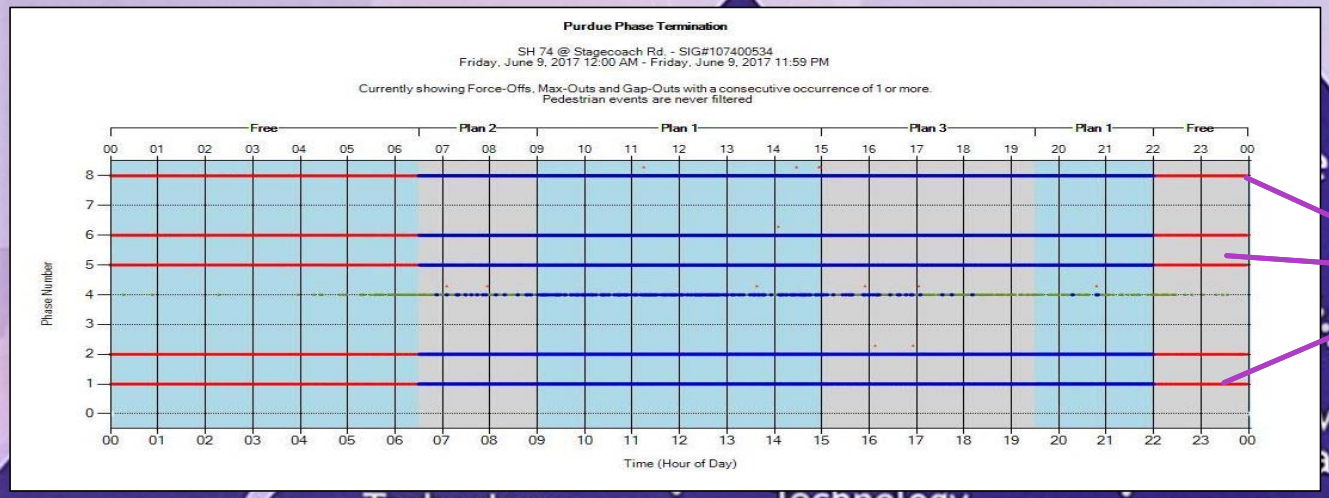
Before: Continuous Ped Calls

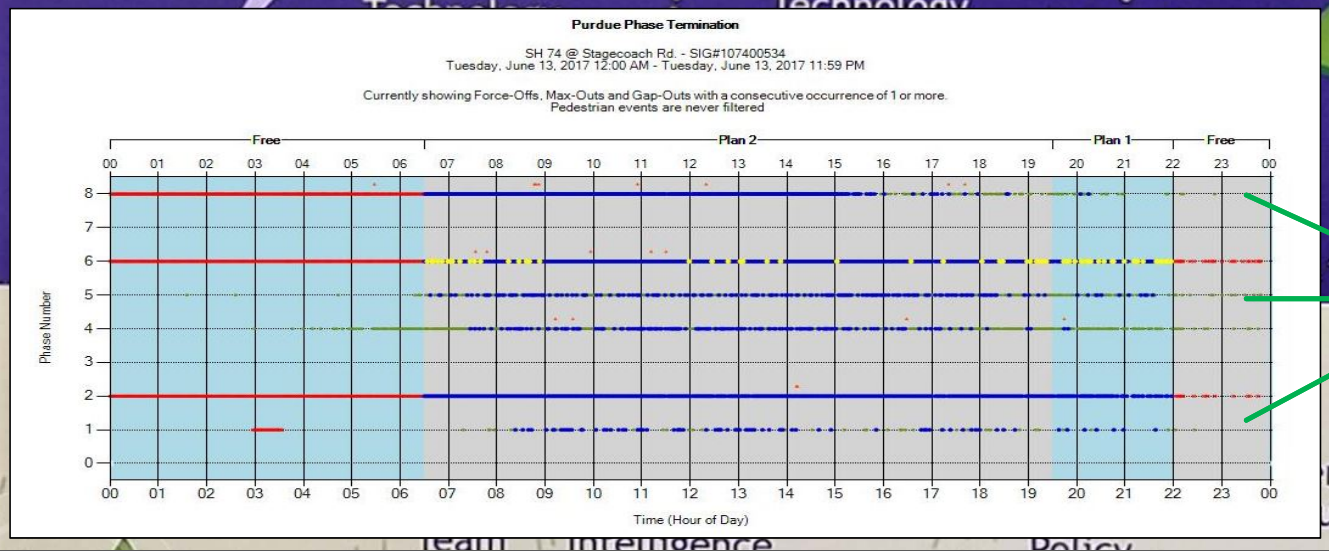


- Gap out
- Skip
- Max out
- Pedestrian activation (shown above phase line)
- Force off

After: Ped Button Repaired

SH 74 & Bergen Pkwy intersection





Use Case: Detection Failures (Constant Vehicle Call)

Before: Constant Veh. Call

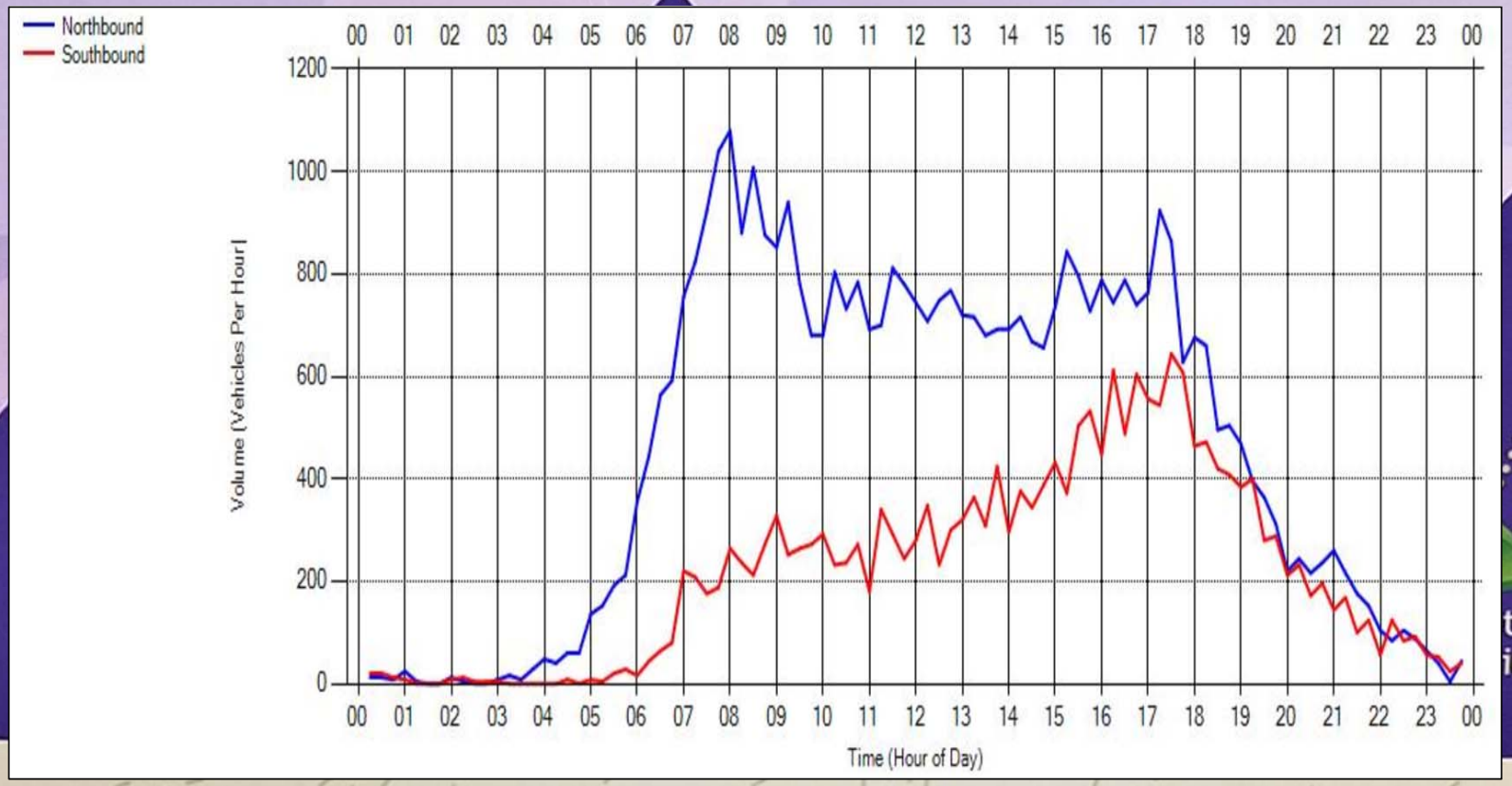
- Gap out
- Max out
- Force off
- Skip
- Pedestrian activation (shown above phase line)

After: Detection Repaired

SH 74 & Stage Coach Rd. intersection

CDOT ATSPM: Purdue Phase Termination

COLORADO Department of Transportation



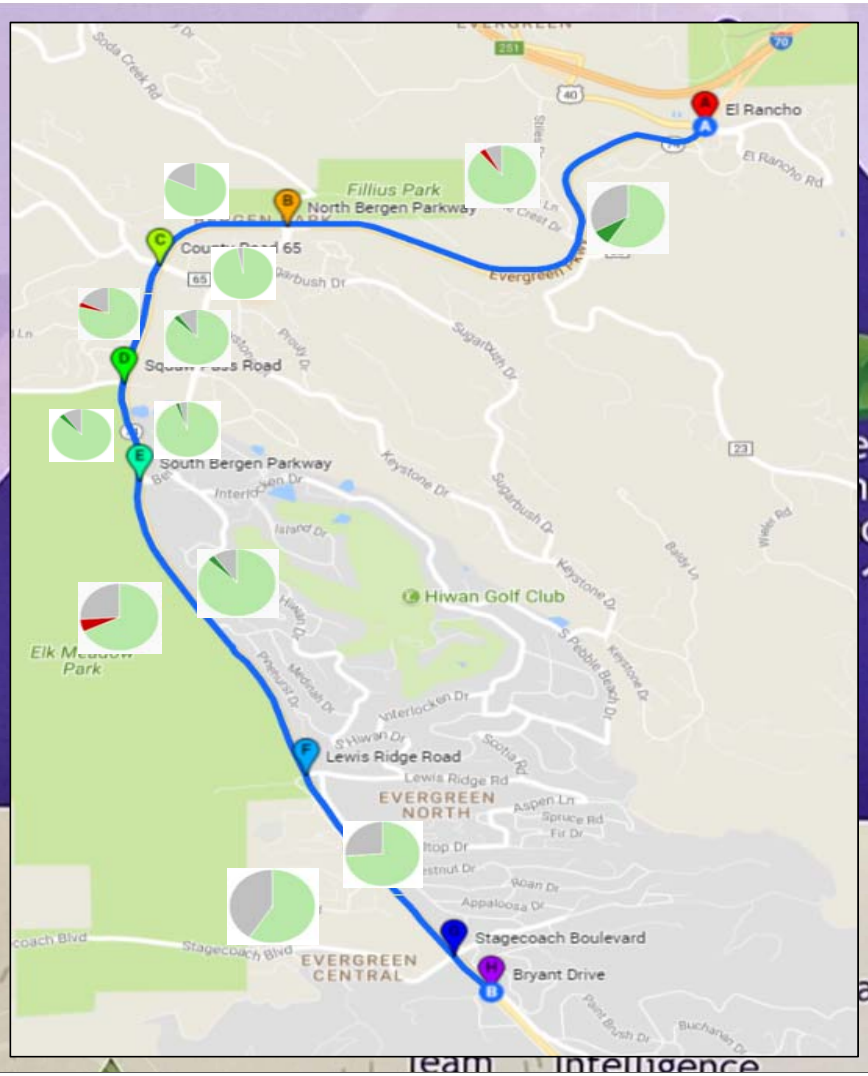
Metric	Value
Peak Hour	9/21/2017 4:45:00 PM
Peak Hour Factor	0.351
Peak Hour Volume	5640
Peak Hour Factor	0.935
Total Volume	16064
-	-
Northbound Peak Hour	7:45 AM - 8:45 AM
Northbound Peak Hour D Value	0.225
Northbound Peak Hour K Value	0.368
Northbound Peak Hour Volume	4008
Northbound Peak Hour Factor	0.928
Northbound Total Volume	10899
-	-
Southbound Peak Hour	5:00 PM - 6:00 PM
Southbound Peak Hour D Value	1.35
Southbound Peak Hour K Value	0.455
Southbound Peak Hour Volume	2352
Southbound Peak Hour Factor	0.913
Southbound Total Volume	5165

Use Case: Analyze Traffic Demand, Retime or Optimize the Signal Plans

Trails · Tech Savvy Team · Turning Data Into Intelligence · RoadX · Cell Phone Policy · Leadership Forum · National Rankings · Winter Operations

CDOT ATSPM: Approach Volumes

COLORADO Department of Transportation



	Corridor Summary (Arrivals on Green)			
	Northbound		Southbound	
	Before	After	Before	After
AM Peak (6:00 – 9:00)	83% (11,517)	85% (12,012)	77% (5,612)	75% (5,495)
Off Peak (9:00 – 15:30)	80% (18,922)	84% (19,688)	76% (15,485)	75% (15,371)
PM Peak (15:30 – 19:00)	77% (9,881)	79% (10,159)	84% (16,230)	86% (16,584)

Use Case: Troubleshoot Corridor Coordination issues or Offset Optimization

Customer Focus

Asset

Cell Phone

Leadership Forum

National Rankings

Winter Operations

CDOT ATSPM Example: Link Pivot Analysis on SH74 Corridor

COLORADO Department of Transportation