[FINAL November 23, 2015]

Congestion Management Process: Methodology Report FY 2013-2016

South Jersey Transportation Planning Organization

www.sjtpo.org

Contents

1. Introduction 3
2. CMP Workflow 4
3. SJTPO's Congestion Management Process 7
   3.1. Step 1: Develop Regional Objectives for Congestion Management 7
   3.2. Step 2: Define the Congestion Management System Network 9
   3.3. Step 3: Develop Multimodal Performance Measures 10
   3.4. Step 4: Collect Data/Monitor System Performance 14
   3.5. Step 5: Analyze Congestion Problems and Needs 19
   3.6. Step 6: Identify and Assess Strategies 23
   3.7. Step 7: Program and Implement Strategies 28
   3.8. Step 8: Evaluating Strategy Effectiveness 30
   3.9. Next Steps 32

Figure 1.1. Timetable of SJTPO CMP-Related Documents 3
Figure 2.1. CMP Workflow 4
Figure 2.2. RTP Vision Keywords, the Subject Matter of the CMP 5
Figure 2.3. Following Safety through the Steps of the Congestion Management Process 5
Figure 3.1. SJTPO CMP Objectives 9
Figure 3.3. CMP Performance Measures 13
Figure 3.4. CMP Performance Measures and Associated Data Sources 18
Figure 3.5. Analysis within the CMP Work Flow 21
Figure 3.6. Linking Steps 5, 6, & Capital Programming 22
Figure 3.7. General Strategy Categories Related to Performance Measures 25
Figure 3.8. Specific Strategies and the Partners and Funding Relationship 26
Figure 3.9. FY 2016-2016 CMP Programming and Implementation Partners and CMP Topics 30

Appendices:

1. SJTPO CMP Workflow
2.1 Vehicle Probe Project Rankings
2.2 Vehicle Probe Project Congestion Scan
2.3 Vehicle Probe Project Cost-of-Delay Analysis

1. Introduction

The SJTPO is the Metropolitan Planning Organization (MPO) for the New Jersey four-county area of Atlantic, Cape May, Cumberland, and Salem Counties. Federal law requires that Transportation Management Areas (TMAs) such as the SJTPO construct and implement a CMP as part of their overall regional transportation planning process. The United States Department of Transportation (USDOT) provides detailed guidelines related to this requirement. The MPO must provide a process for effective management and operation of new and existing transportation facilities through the use of travel demand management (TDM) and operation management strategies. The CMP produces a prioritized list of locations, issues, or projects to be considered as input into the other parts of the SJTPO planning process.

The most recent SJTPO CMP Document is the 2012 Congestion Management Process Activity Report; it is incorporated into the SJTPO Regional Transportation Plan (RTP) 2040 (2012). The name of that document is The 2012 Congestion Management Process Activity Report. SJTPO is now updating its Congestion Management Process for the current RTP cycle (FY2013-FY16). This report, the SJTPO Congestion Management Process Methodology Report FY 2013-2016, documents that process. This CMP Methodology has be vetted and approved by the Congestion Management Process Advisory Committee (CMPAC), which was reestablished in 2012, and the Technical Advisory Committee.

SJTPO will follow this approved methodology when conducting the CMP activity through FY 2016. The activity will be summarized with findings in a report to follow this one, the Congestion Management Process Activity Report (2016), to be incorporated into the 2040 RTP Update (2016). This report will itemize the CMP-related activities for the current RTP cycle. Figure 1.1, below, summarizes the chronological order and the relationship for these CMP-related documents.

Figure 1.1. Timetable of SJTPO CMP-Related Documents

Congestion Management Process Activity Report (2012)

Regional Transportation Plan (RTP) 2040 (2012)

SJTPO CMP: Methodology Report FY 2013-2016

Congestion Management Process Activity Report (2016)

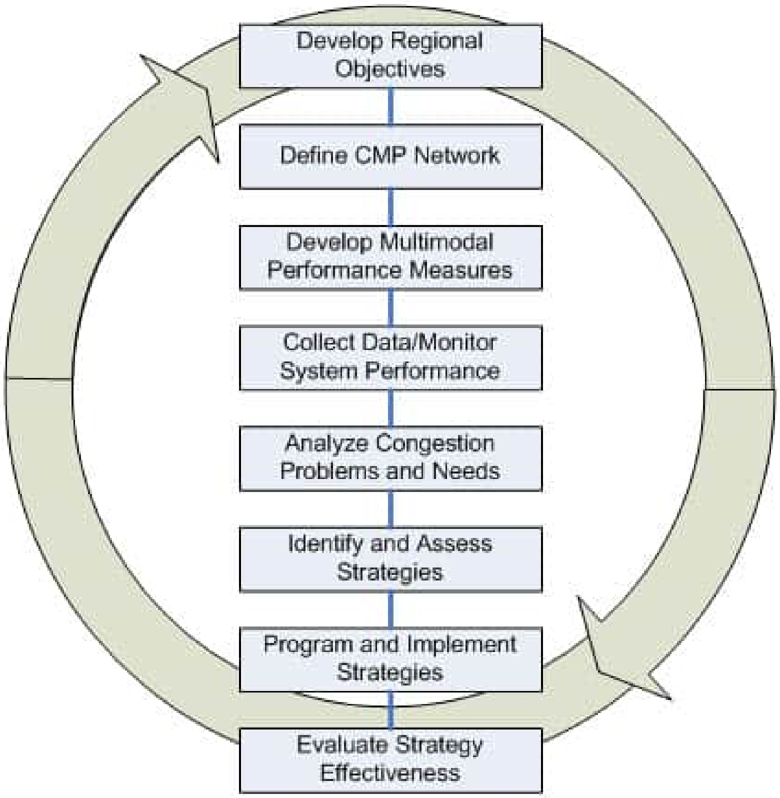
2040 RTP Update (2016)

This report, The SJTPO Congestion Management Methodology Report 2013-2016, is a documentation of the SJTPO process. The report is formatted to reflect the eight CMP steps prescribed by the FHWA.

2. CMP Workflow

The entire SJTPO planning process is driven by the FHWA Congestion Management Process and by SJTPO's Organizational Vision as detailed in RTP 2040 (2012). The FHWA CMP has eight distinct steps is seen in Figure 2.1, below.

Figure 2.1. CMP Workflow



Source: FHWA. Congestion Management Process Guidebook[1]

[1] http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/fig2.cfm

The SJTPO "Vision" is to provide a transportation system with these characteristics:

Figure 2.2. RTP Vision Keywords, the Subject Matter of the CMP

SJTPO RTP Vision	
Safe	Responsible
Efficient	Integrated
Accessible	Multimodal
Appropriate	

CMP Subject Matter

These characteristics provide the subject matter or topics that will permeate the eight steps of the SJTPO CMP. For example, Safety is part of SJTPO's Vision, as seen from Figure 2.2 above. It must therefore be incorporated into the Objectives. Safety will then also be a topic in the Performance Measures and the data collected for those performance measures. SJTPO's CMP Strategies will also include efforts that will impact safety. The topic of safety flows through the entire process, as will the other desired characteristics from our Vision (See Figure 2.3).

Detailed and Data Driven

The latest Federal transportation reauthorization legislation, *Moving Ahead for Progress in the 21st Century*, (MAP-21), calls for a performance measure- driven planning process. In response, SJTPO developed performance measures for all systems, including Congestion Management. This is the main reason for this CMP methodology update. The CMP and related documentation is very detail-oriented. Some of the detail is placed in the appendices at the end of this report.

The eight CMP steps and their subject matter are inter-connected. Detailed tables that describe the subject matter or topics for each CMP step are presented in the following sections. The tables' multi-column design displays the close relationship between the steps. For example, Figure 3.1 displays the Vision keywords and the Objectives. This allows the reader to see that the Vision subject matter is also addressed in the Objectives. Another example is Figure 3.4 which displays the relationship between the Objectives and Performance Measures. Appendix 1 is an overview of the CMP workflow. It displays how the SJTPO Vision drive the subject matter for each CMP step, and how the steps are interrelated.

Figure 2.3. Following Safety through the Steps of the Congestion Management Process

RTP
- Vision
- Safe System

RTP
- Goals
- Improve Safety

RTP
- Goals: CMP-related
- Improve Safety on Congested Corridors

CMP 1
- Objectives
- Reduce Crashes: Bike, Ped, & Same Direction

CMP 2
- Network
- Safety on the Congested Corridors of Network

CMP 3
- Performance Measures
- Number of Bike, Ped, Crashes on Congested Corridors

CMP 4
- Data Collection
- DOT Crash records using P4S software, on specific network locations.

CMP 5
- Analyze Problem & Needs
- Review corridor safety performance

CMP 6
- Identify & Assess Strategies
- Road Safety Audits, Counter Measures, Evaluate past safety efforts

CMP 7
- Implement and Program Strategies (TBD)
- Add bike lanes, bike signs, pedestrian infrastructure, education

CMP 8
- Monitoring Methods
- Monitor crash data for congested corridors

3. SJTPO's Congestion Management Process

3.1. Step 1: Develop Regional Objectives for Congestion Management

The CMP Objectives listed in this report are for the FY 2013-2016 RTP cycle. These objectives were developed in coordination with the Vision and Goals found in the Regional Transportation Plan 2040 (2012). MAP-21 emphasizes performance measures; and objectives should have a direct relationship with those measures.

SJTPO's objectives also reflect a multi-modal approach and emphasize demand and system management. This is called for in the FHWA CMP Guidebook. The following is a summary of the major keywords that comprise SJTPO's vision, and corresponding objectives. For every Vision keyword there is one or more Objective.

Vision 1-Safe: Targeting Non-Recurring Congestion

Safer roads have congestion-reduction benefits. Crashes contribute to non-recurring congestion. One SJTPO safety objective is to reduce crashes along congested corridors. SJTPO will focus on bike and pedestrian crashes along congested corridors. Making these alternative modes more attractive will also have congestion reduction benefits. SJTPO will also focus on vehicle rear-end crashes because they are associated with congested conditions. These topics relate to Objectives number 1 and 2 in Figure 3.1.

Vision 2-Efficient: Better Use of our Infrastructure

SJTPO's efficiency-related objectives are to reduce delay for congested corridors and intersections. Intelligent Transportation systems (ITS) can be one method to improve operational efficiency. However, improvements do not have to be state-of the-art. Any updates to the technology currently in use, can have a positive impact.

Transit will be more appealing given improved on-time performance. More use of this alternative mode will make the network more efficient. Another objective is to increase the occupancy rates for traditional vehicles. This takes vehicles off the road, thereby improving the network's efficiency.

Vision 3-Accessible: Focus on Non-Traditional Customers

SJTPO will strive to increase network use by our non-traditional customers by improving accessibility. The elderly, the poor, and the disabled are examples of our underserved and no-traditional citizens. Better access to transit and Human Service Transportation (HST) will make these systems more productive and will have an added benefit. Community members will not have to provide their time and vehicles for these trips.

Vision 4-Appropriate: Solutions that are Sensitive to Local Context

Our plan must be sensitive to the community context (land uses and demographics). Therefore, any improvements (congestion management strategies) are to consider and be compatible with land uses along the targeted corridors.

Not only are the current conditions relevant; future community needs should be anticipated. Therefore the plan will also consider projected growth when designing facilities

Vision 5-Responsible: Solutions that are Sensitive to the Environment

This plan reflects our desire to protect the environment from any adverse project impacts. Therefore, any CMP network transportation plans will identify and prioritize alternate routes, and or transportation methods, prior to widening any corridors.

Vision 6-Integrated into Related Regional Plans and Relevance

For the CMP to have any purpose; there must be integration of the CMP with other regional transportation plans. Relevant plans include the RTP, TIP, & other South Jersey (county) transportation plans. There should be evidence that the CMP is relevant. Therefore, one objective is for SJTPO's CMP to be cited or considered in the RTP as well as plans by other agencies. This is a measure of CMP effectiveness and related to CMP Step 8.

Vision 7-Multimodal: Prioritizing Multimodal Solutions

This plan prioritizes multimodal congestion management strategies. Therefore one objective is to focus our improvements on the corridors that already have or have potential for multi-modal usage.

SJTPO's Vision includes maximizing the efficient use of our transportation network. Therefore another objective is to increase the use of HOV trips, car share, transit, Human Service Transportation (HST), and bikes. Many of these alternative trip methods depend on the multi-modal corridors.

A detailed table of CMP Objectives and their relationship to SJTPO's Vision is in

Figure 3.1.

Figure 3.1. SJTPO CMP Objectives

	Vision		Objectives
1	**Safe**	1	Reduce bicycle and pedestrian crashes along congested corridors
		2	Reduce rear-end collision frequency along congested corridors
2	**Efficient**	3	Reduce average duration of delay within the SJTPO CMP network
		4	Increase transit on-time performance
		5	Increase vehicle occupancy rates
3	**Accessible**	6	Increase network use for non-traditional customers
4	**Appropriate**	7	Ensure congestion management strategies are context-sensitive
		8	Plan for future growth when designing facilities
5	**Responsible**	9	Prior to widening corridors on CMP network transportation plans: Identify and prioritize alternate routes and or methods.
6	**Integrated**	10	Ensure the CMP is considered in the RTP, TIP, & other South Jersey transportation plans
7	**Multimodal**	11	Prioritize multimodal congestion management strategies
		12	Increase alternative trip methods (HOV trips, car share, transit, HST, bike)

3.2. Step 2: Define the Congestion Management System Network

The CMP Network consists of area and system components. The area is the CMP's geographic dimensions; the system is the transportation infrastructure. Infrastructure includes transit, bicycle, pedestrian, and freight facilities[2]. The SJTPO CMP Network is displayed in Figure 3.2, below. The following defines the SJTPO CMP Network scope:

Area:

- SJTPO CMP area consists of the 4-county SJTPO region of Atlantic, Cape May, Cumberland, and Salem Counties

[2] FHWA CMP Guidebook

System-Roads and Road Assets:

- All routes within the SJTPO four county region, of any jurisdiction, that impact regional travel*
- All roadways within the NJCMS network (includes all state routes), and all National Highway System roadways within the SJTPO region (includes county routes that are classified Major Collector or higher).
- Roads that service transit centers
- Roads with transit service
- Evacuation routes Truck routes

System-Multi-Modal Infrastructure

- Bus Transit assets and facilities
- Light Rail
- Some Bike and Pedestrian Paths
- Park & Ride Lots

*Of special note, some corridors may be experiencing congestion as a function of weekend and seasonal patterns

3.3. Step 3: Develop Multimodal Performance Measures

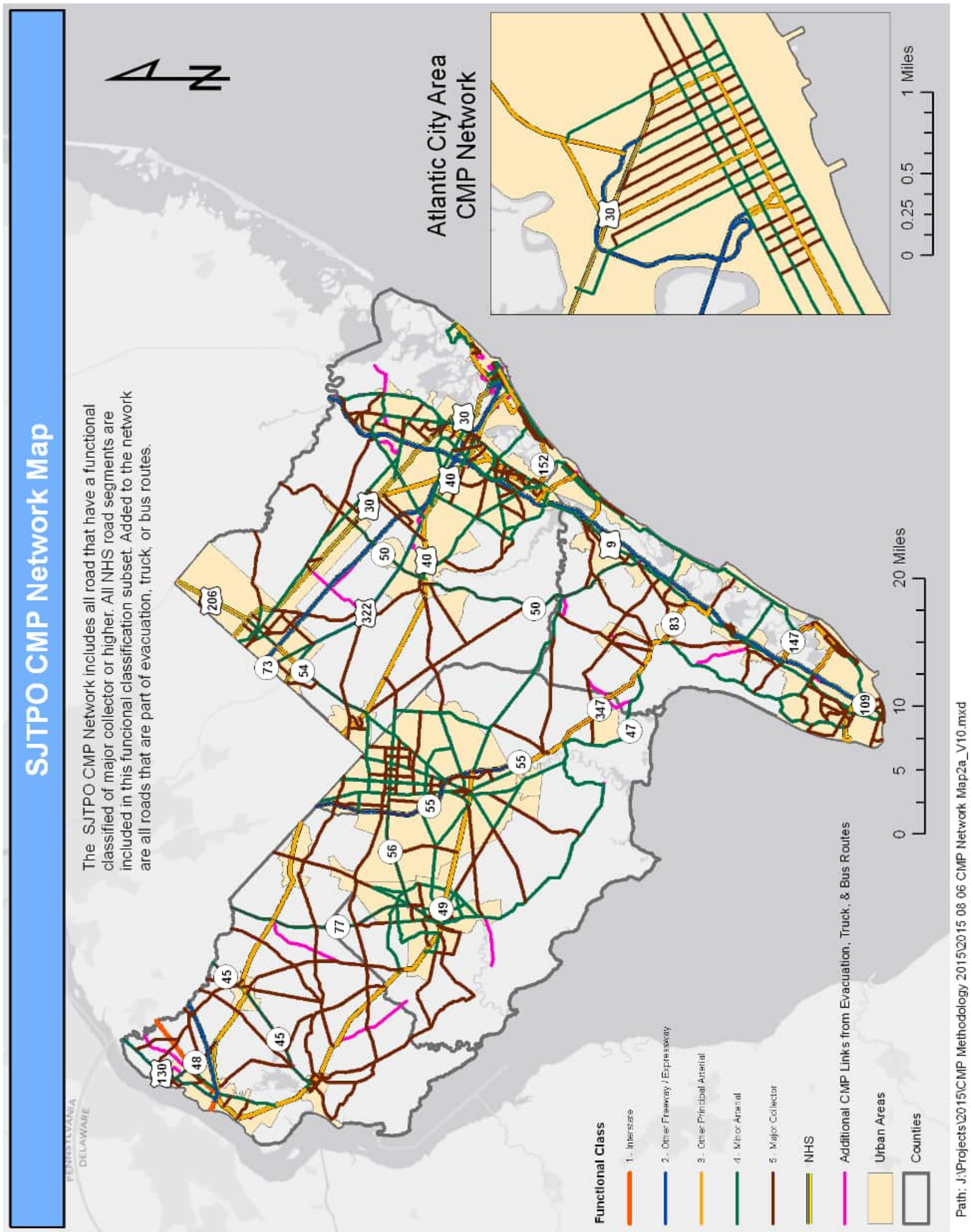
Performance Measures are used to define and measure congestion. The measures selected address the objectives, and a wide variety of congestion-related issues. Traditional and non-traditional Performance Measures (PM) should be considered including freight, economic development, multi-modal, etc.

The measures are to be focused on outcomes as opposed to CMP activity work that is performed. PMs should be "SMART:" Specific, Measurable, Agreed, Realistic, & Time-bound. Measures can be regional and local (corridor, segments, and intersections). Finally, PMs should consider the four Dimensions of Congestion: Intensity, Duration, Extent, & Variability.[3]

The SJTPO CMP is one of the SJTPO management systems. Each system (Safety, Congestion, Asset Management, etc.) is designed to meet organizational goals; and their performance measures reflect this. The CMP Performance Measures reflect a focus on multi-modal usage, and on corridors and intersections that regularly experience delay. SJTPO also monitors availability and usage of alternative modes including Human Service Transportation.

[3] FHWA CMP Guide

Figure 3.2. SJTPO CMP Network (Based on 2010 Functional Classifications, Dated September 30, 2013)



The Performance Measures are listed here, and are organized by Objective subject matter, as displayed in Figure 3.3, above:

Safe: Targeting Non-Recurring Congestion

- Number of bike and pedestrian crashes on congested corridors, within a 2-year timeframe
- Number of rear-end collisions on congested corridors, within a 2-year timeframe

Efficient: Corridors, Transit, Occupancy

- Average duration of delay within the SJTPO CMP network within a 2-year timeframe
- Percentage of fixed-route trips that are on-time in the SJTPO area within a 2-year timeframe
- Vehicle occupancy rates (using participation in the TDM program)

Accessible: Focus on Non-Traditional Customers

- NJ Transit customer trips originating from Environmental Justice Zones
- HST number of customer trips

Appropriate: Local Context and Future Needs

- Percentage of CMP corridor facility improvements that reflect context-sensitive strategies and designs.
- Percentage of the CMP facility improvements that incorporate consideration of the year 2040 projected volumes.

Responsible: Prioritize Strategies with Least Environmental Impact

- Percentage of the CMP facility improvements that avoid road widening.

Integrated & Relevant: CMP should be Relevant to Other Plans

- Percentage of SJTPO adopted plans in which the CMP is referenced over a two-year period

Multimodal: CMP Should Stress Alternative Travel Methods

- Percentage of strategies that involve alternative travel methods
- Alternative trip methods (HOV trips, car share, transit): number per year

*To the extent possible, peak season and off-season performance measures should be compiled and reviewed.

Figure 3.3. CMP Performance Measures

	Objectives (abbreviated) *		Performance Measures
1	Reduce bicycle and pedestrian crashes	1	Number of bike and pedestrian crashes on congested corridors, within a 2-year timeframe
2	Reduce rear-end collision frequency	2	Number of rear-end collisions on SJTPO congested corridors within a 2-year timeframe
3	Reduce average duration of delay within the SJTPO CMP network.	3	Average duration of delay within the SJTPO CMP network within a 2-year timeframe. This comprehensive objective would include: •**V/C (volume/capacity ratio)**—This is perhaps one of the most widely used measures of congestion. •**Travel Time Index**-Ratio of actual Travel Time over Free-Flow Travel Time (Recurring Congestion) •**Planning Time Index**—Ratio of 95th percentile travel time to free-flow travel time **
4	Increase transit on-time performance	4	Percentage of fixed-route trips that are on-time in the SJTPO area within a 2-year timeframe
5	Increase vehicle occupancy rates	5	Average vehicle-occupancy rates.
6	Increase network use for non-traditional customers	6	NJ Transit customer trips originating from Environmental Justice Zones, & Human Service Transportation: number of customer trips
7	Ensure congestion management strategies are context-sensitive	7	Percentage of CMP corridor facility improvements that reflect strategies appropriate for their CMP corridor, such as land use, major trip purposes.
8	Designing facilities for expected growth	8	Percentage of the CMP facility improvements that incorporate consideration of 2040 projected volumes.
9	Avoid road widening, prioritize alternatives	9	Percentage of the CMP facility improvements that avoid road widening.
10	Relevance to RTP, TIP, & partners' plans	10	Percentage of SJTPO & partner plans in which the CMP is referenced in over a two-year period
11	Prioritize multimodal Strategies	11	Percentage of strategies that involve alternative travel methods
12	Increase alternative method trips	12	Alternative trip methods (HOV trips, car share, transit): number per year

* The descriptions of the Objectives are abbreviated in column 1 to accommodate the space.

** (Non-recurring congestion and/or recurring congestion for specific ramp or turning movements)

3.4. Step 4: Collect Data/Monitor System Performance

Data is collected and monitored for all of the SJTPO Management Systems. Some of the data is used in CMP as well as other systems. The data sources tie directly into the CMP Performance Measures; this is illustrated in Figure 3.4, below. The following is a comprehensive list of CMP Data Sources. Not all the data sources listed here are needed for the performance measures found in this report; some are used in more detailed analysis.

Data Sources:

- PC Travel – Travel Time Software
- I-95 Vehicle Probe Project
- NJCMS V/C
- NJDOT Congested Places—This includes NJDOT field visits
- NJDOT Traffic Operations (signal system data)
- NJDOT Traffic Counts
- Local Member Agencies – Traffic Count Data Collection project
- NJDOT Crash Records, – Rutgers – P4Safety Software
- Cross County Connection TMA (TMA)
- NJ TRANSIT
- Human Service Transportation Providers
- NJDOT Road Survey
- New Jersey ITS Architecture Plan
- NJDOT – Facilities
- Local Member Agencies – Facilities
- New Jersey ITS Architecture Plan
- Census Transportation Planning Products (CTPP)
- Longitudinal Employer-Household Dynamics (LEHD)
- The National Household Travel Survey (NHTS)
- FY2014 South Jersey Household Travel Survey
- South Jersey Transportation Travel Demand Model (SJTDM)
- SJTPO – Management Systems

PC Travel - Travel Time Software

SJTPO acquired and employed travel-time software, known as PC Travel, to measure delay. Employees have also gathered empirical data first-hand by experiencing the delays along key corridors.

I-95 Vehicle Probe Project

SJTPO also subscribes to the I-95 Vehicle Probe Project (VPP). The VPP is a groundbreaking initiative providing comprehensive and continuous travel time information on freeways and arterials using probe technology. Analysis and data query are performed using the relevant performance measure tools. The basic tools include Bottleneck and Incident Dashboard and the

Massive Data Downloader. These allow the CMP Team to examine congestion conditions going back several years.

SJTPO has made use of the VPP for both performance measurement and congestion screening. Performance measures, including vehicle-hours of delay, Planning Time Index (PTI), Travel Time Index (TTI), and others have been developed for all major regional roadways. Roadways have been ranked by each of these performance measures. VPP coverage in the region is extensive, including all state roads and many major county and municipal roadways, allowing for a comprehensive congestion-screening tool. At a smaller scale, the VPP's Bottleneck Ranking tool has been used to locate bottleneck conditions, allowing sources of recurring congestion to be identified. Appendix 2 includes a detailed description and explanation of the Bottleneck Tool, including the top 10 congested state and authority roadways as well as county roadways. It also includes technical reports on some of the features of this powerful tool, including congestion scans and the cost of delay.

NJCMS Volume to Capacity

NJDOT also provides volume and capacity data (V/C), and allows the MPOs to participate in their Congestion Management System (CMS). SJTPO also uses the NJCMS V/C data along with data provided by our member agencies to produce analysis for local roads. Seasonal AADT data is also collected and utilized by SJTPO.

NJDOT & SJTPO Congested Places

Congested Places are identified for the state roads as part of the NJDOT CMP. SJTPO staff also collects and participates in NJDOT Field Visits related to Congested Places analysis.

NJDOT Traffic Operations

Data related to operations including performance is provided by NJDOT Operations.

Traffic Count Data Collection from Local Agencies and Outside Contractors

SJTPO frequently programs data collection activities as part of its UPWP. These are often conducted by outside contractors. SJTPO also receives traffic counts from its subregions, as part of its Subregional Transportation Work Program.

NJDOT Crash Records, including Rutgers - Plan4Safety Software

Specific crash types can be an indicator of congestion. Detailed crash record data is available through the Plan4Safety software (Rutgers), in which NJDOT and the MPOs had a hand in development.

Cross County Connection TMA (TMA)

The Cross County Connection TMA (TMA) provides extensive information on its Travel Demand Management Program (TDM), including ride share participation.

NJ TRANSIT

NJ TRANSIT provides ridership and on-time data. NJ TRANSIT has also produced bike facility information (e.g., bike racks on NJ TRANSIT vehicles).

Human Service Transportation Providers

The SJTPO Human Service Transportation (HST) Plan produces HST provider and customer data. This was an FY15 technical project. This product is produced on a five-year cycle and produces provider resources, territory covered, and ridership information.

NJDOT Road Survey

An NJDOT county road inventory (from circa 2007) included bike and pedestrian facilities. It is not known if this inventory is planned to be conducted regularly.

NJDOT & Local Member Agencies - Facilities

NJDOT and our member agencies produce CMP facilities and operational improvements. These can include the projects that add turning lanes, produce signal improvements, and other ITS efforts.

New Jersey ITS Architecture Plan

SJTPO also receives ITS-related data through its involvement in developing the New Jersey ITS Architecture Plan.

Census Transportation Planning Products (CTPP)

Certain regions of the country, including SJTPO, partnered with the American Association of State Highway and Transportation Officials (AASHTO) in 2006. This partnership committed to a new multi-year Census Transportation Planning Products (CTPP) consolidated purchase. This allowed for participating regions to incorporate American Community Survey (ACS) data into transportation planning practices.

The CTPP is a set of special tabulations designed by transportation planners. The CTPP taps the continuous survey called the American Community Survey (ACS), which is conducted by the Census Bureau.

CTPP data is allocated to small geographic units such as census tracts and Transportation Analysis Zones (TAZs). The CTPP tabulations are unique because they include three geographies:

- **Part 1:** Residence-based tabulations summarizing worker and household characteristics
- **Part 2:** Workplace-based tabulations summarizing worker characteristics
- **Part 3:** Worker flows between home and work, including travel mode

Longitudinal Employer-Household Dynamics (LEHD)

This is a program within the U.S. Census Bureau that uses modern statistical and computing techniques to combine federal and state administrative data on employers and employees with core Census Bureau censuses and surveys while protecting the confidentiality of people and firms that provide the data. LEHD is potentially an alternate/additional source of place of work and flow data.

The National Household Travel Survey (NHTS)

The NHTS is a Federal Highway Administration (FHWA) program that collects data on daily travel by the American public.

FY2014 South Jersey Household Travel Survey

In the spring of 2014, a household travel survey was conducted in the SJTPO region. This survey collected household demographic and travel behavior information from 1,850 households throughout the four-county region. The purpose of this survey was to provide up-to-date data for the South Jersey Travel Demand Model to recalibrate the model and ensure its accuracy.

South Jersey Transportation Travel Demand Model (SJTDM)

The South Jersey Transportation Travel Demand Model (SJTDM) provides performance data such as projected delay, travel time, average speed, etc. The travel model is calibrated to 2010 conditions, and projects travel in the region through the year 2040 for every major roadway. The SJTDM may also be used to model the effects of transportation projects including road widening, new roadways, and other congestion relief efforts.

SJTPO - Management Systems

SJTPO management system reports are produced on a four-year cycle in sync with the RTP. The various management system data are summarized every two years, mid-planning cycle and as part of the RTP in the System Performance Report. SJTPO released a draft of its 2040 Regional Transportation Plan Performance Report, which summarizes performance on all eight of the Regional Transportation Plan goals, including congestion, in November 2014.

Figure 3.4. CMP Performance Measures and Associated Data Sources

	Performance Measures	Data Sources
1	Number of bike and pedestrian crashes on congested corridors, within a 2-year timeframe	Rutgers - P4Safety – NJDOT Crash Data
2	Number of rear-end collisions on SJTPO congested corridors within a 2-year timeframe	Rutgers - P4Safety – NJDOT Crash Data
3	Average duration of delay within the SJTPO CMP network within a 2-year timeframe. This comprehensive objective would include: •**V/C (volume/capacity ratio)**—This is perhaps one of the most widely used measures of congestion. •**Travel Time Index**-Ratio of actual Travel Time over Free-Flow Travel Time (Recurring Congestion) •**Planning Time Index**—Ratio of 95th percentile travel time to free-flow travel time (Non-recurring congestion)	NJ CMS; SJTDM; Vehicle Probe Project
4	Percentage of fixed-route trips that are on-time in the SJTPO area within a 2-year timeframe	NJ Transit
5	Average vehicle-occupancy rates.	Cross County Connections (TMA); SJTPO 2014 Household Travel Survey
6	NJ Transit customer trips originating from Environmental Justice Zones, & Human Service Transportation: number of customer trips	NJ Transit & HST Provider Agencies
7	Percentage of CMP corridor facility improvements that reflect strategies appropriate for their CMP corridor, such as land use, major trip purposes.	TIP, Functional Classifications, & Local Land Use Plans.
8	Percentage of the CMP facility improvements that incorporate consideration of 2040 projected volumes.	TIP, 2016 SJTPO Demographic Projections, 2016 SJTDM Run
9	Percentage of the CMP facility improvements that avoid road widening.	TIP
10	Percentage of SJTPO & partner plans in which the CMP is referenced in over a two-year period	RTP, TIP, & Partner agencies' plans
11	Percentage of strategies that involve alternative travel methods	TIP, UPWP
12	Alternative trip methods (HOV trips, car share, transit): number per year	NJ Transit, Cross County Connections (TMA)

3.5. Step 5: Analyze Congestion Problems and Needs

As stated in this report, SJTPO created performance measures that are rooted in our RTP's Vision. Some of the performance measures are used to identify locations and congestion issues. Other performance measures provide insight into the network congestion management performance for various facets of the system (transit, non-traditional populations, etc.).

Identifying Congestion Locations and Issues

SJTPO utilizes several analysis tools to identify network congestion; these tools produce information about the congestion's location, times, and issues. The location or spatial aspects of congestion may be a specific spot or an entire corridor. The temporal aspects should note the time of day, the day of the week and the month or season of the year.

SJTPO is impacted by seasonal fluctuations in traffic volume, which causes some congestion. SJTPO will use VPP software and data to analyze travel speed and delay performance for the region and corridors. This tool taps into extensive database of information about travel speed on many network road segments. The road segment's actual travel speed is compared to its expected travel speed. This is one method used to identify congested locations. See Appendix 2 for a detailed report of VPP tools and analysis.

Volume to Capacity is another employed technique. This analysis produces theoretical congestion locations. The next step calls for empirical data to be collected. SJTPO & NJDOT staffs engage in on-site observations of intersections and corridors. Another empirical technique involves using PC Travel software; this allows for direct measure of the travel times through key corridors.

Commuting time for the region's residents will be monitored using Census ACS data. This data allows the commuting time along congested corridors to be spatially represented.

Multi-faceted Evaluation of Network Performance

CMP Step 5 analysis also includes performance measure-based evaluation of many facets of the SJTPO network specifically related to congestion management. Topics represented include safety, transit performance, demand reduction, nontraditional customer participation, consideration for local context, consideration for expected growth, avoidance of roadway expansion, the influence of the CMP, the prioritization of multi-modal solutions, and the use of alternative modes.

SJTPO regularly uses the Plan4Safety software from Rutgers and the NJDOT crash data that is linked to it. Plan4Safety allows SJTPO to analyze the congested-related crashes in congested corridors. Locations with many rear-end crashes are likely congested. Improvements that reduce these crash types are also improving congestion performance.

Increased bike and pedestrian activity can mitigate congestion. Bike and pedestrian counts are not usually collected; special studies would need to be arranged. However, spatial analysis of bike and pedestrian crashes can provide insight into congested corridors. Bike and pedestrian crash activity can be an indicator of congestion or it could indicate an opportunity to improve the corridor for alternative mode users.

On-time transit performance (provided by NJTransit) is an indicator of bus reliability. Reliability increases transit's attractiveness to network users. Trends in reliability will give insight into changes in transit use. With access to even more data, additional opportunities for transit analysis could focus on facilities such as bike racks at bus stops and on buses.

Rideshare is a travel demand reduction method. This can be monitored with information from another SJTPO Transportation Management Association (TMA) partner, Cross County Connection. Network efficiency can also benefit from increased use of specialized or conventional transit. SJTPO will monitor the number of Environmental Justice (EJ) area residents that use NJ TRANSIT, the number of Human Service Transportation (HST) riders, and the HST regional coverage. VPP will also be used to compare the congestion of EJ Areas vs. the Non-EJ Areas. Data from NJ TRANSIT, the HST providers, and the VPP service is needed for this analysis.

The selection process for the congestion mitigation techniques are to consider the local context, future expected growth, and SJTPO's desire to avoid adding road lane miles. Each congestion relief-related effort will be analyzed for its consideration of the roadway's function and the local planned land uses. SJTPO will also note for each improvement whether the 2040 travel projections were taken into consideration. Finally, each improvement will be evaluated for its impact to the road inventory. One of the performance measures relates to the CMP's effectiveness. This topic is addressed in CMP Step 8. As seen in the table below, various analysis tools and their sources are brought to bear on during CMP Step 5. Figure 3.5 displays the relationship between the objectives, and the performance measures and the analysis tools.

Figure 3.5. Analysis within the CMP Work Flow

Objectives *	Performance Measure	Analysis Tools
1 Reduce bicycle and pedestrian crashes	1 Pedestrian crashes on congested corridor	ID congested corridors with VPP, spatial crash analysis with Plan4Safety
2 Reduce rear-end collision frequency	2 Rear-end collisions on congested corridors	ID congested corridors with VPP, spatial crash analysis with Plan4Safety
3 Reduce average duration of delay	3 Travel time Index, Planning Time Index	Vehicle Probe Project, spatial analysis (SA)
4 Increase transit on-time performance	4 Transit trips on-time	NJ Transit statistics & SA
5 Increase vehicle occupancy rates	5 Vehicle occupancy average	Cross County Connections-TMA statistics &SA
6 Increase network use for non-traditional customers	6 Transit trips from EJ zones and Human Service Transportation	NJ Transit and HST provider statistics, EJ zones, Census, & SA
7 ensure congestion management strategies are context-sensitive	7 Improvements reflect local context	TIP, Straight-Line Diagrams (SLD), local land uses & SA
8 Designing facilities for expected growth	8 Designs that properly anticipate the expected growth through plan year	TIP, RTP 2040, 2040 demographics projection, 2040 TDM run, CTTP, & SA
9 Avoid road widening, prioritize alternatives	9 Improvements that improve efficiency not increase capacity	TIP & SA
10 Relevance to RTP, TIP, & partners' plans	10 Documents among RTP, TIP, & partner agencies' plans, that refer to the CMP	RTP, TIP, partner agencies' plans, & SA
11 Prioritize multimodal strategies	11 The number of project that are along or are creating multimodal corridors	TIP, SLD, multimodal GIS data, & SA
12 Increase alternative method trips	12 The number of trips made using alternative methods.	Cross County Connections TMA statistics & SA

* The Objectives column contains an abbreviated description of the Objectives.

The SJTPO CMP Team (Planners) performs the analysis described above; they then produce a prioritized list of locations and issues. This list is to be used by the SJTPO Engineering Team in CMP Step 6. The prioritized list of locations and issues is the subject of the next sections (3.5.1 & 3.5.2.)

CMP Step 5: Analyze Congestion Problems & Needs - SJTPO - CMP Team

3.5.1. Identifying the Locations of Interest (CMP Team)

The CMP team produces a short list of locations that they believe should be considered for congestion relief projects. Step 5 of the CMP process incorporates data-driven performance measures-based analysis. These are among the methods for identifying congested locations:

- Travel Time (PC Travel) and VPP
- Delay (VPP)
- V/C Calculations

This screening process produces the short list of possible locations called the CMP Locations of Interest.

3.5.2. Prioritizing the Locations of Interest (CMP Team)

Next, this list is prioritized by considering each location's possible contribution to other RTP Goals. For example, some sites may also host transit or pedestrian activity. Some of the factors that affect a location's priority are:

- Bus Routes
- Bike Routes
- Transit
- EJ Corridor
- HST Corridor
- Potential Alternative route
- Freight Truck Route
- Railroad Freight Service Road
- Railroad Transit Service Road
- Evacuation Route

Once this list is prioritized, the product (Locations of Interest) is presented to the Engineering team for consideration. Figure 3.6 displays the relationship between CMP Steps 5, 6, and Capital Programming.

Figure 3.6. Linking Steps 5, 6, & Capital Programming

CMP Step 5: Analyze Congestion Problems & Needs - SJTPO - CMP Team

3.5.1: Locations of Interest and their issues are identified.
3.5.2: Locations of Interest and their issues are prioritized.

CMP Step 6: SJTPO, Partners (CMPAC), or Consultants - Engineering

3.6.1: Specific strategy identification
3.6.2: Specific strategy assessment / evaluation / prioritization. Cost / benefit and other factors (Context, Overall Goals, and Coordination) are considered.

SJTPO – Capital Programming

Transportation Improvement Program (TIP): CMP strategies may develop into actual projects that are programmed in the TIP.

3.6. Step 6: Identify and Assess Strategies

A wide variety of strategies, including demand management, operational improvements, and multimodal facilities/services, should be identified and evaluated to address congestion.[4] This process, CMP Step 6, requires specialized engineering expertise. This is to be performed after the planning staff (CMP Team) performs Step 5, which produces a prioritized list of locations of interest. This list is then forwarded to qualified engineering staff at SJTPO, at our partner agencies, or from consulting firms. These engineers will then conduct the formal evaluation of congestion mitigation techniques. SJTPO will also solicit feedback from SJTPO's Congestion Management Process Advisory Committee (CMPAC). Any formally vetted congestion techniques will be further evaluated as a function of the SJTPO Capital Programming Division.

SJTPO, Partners (CMPAC), or Consultants - Engineering

The following sections relate to the strategy identification and evaluation process to be conducted by the engineering staff at SJTPO. The SJTPO Engineering Team may also work with the engineering teams of our planning partners, the Congestion Management Process Advisory Committee (CMPAC), or outside consultants. In either case, we expect that these broad guidelines reflect SJTPO's desired approach, and that this approach will be shared with our planning partners.

3.6.1. Strategy Identification

One of the most critical steps of the Congestion Management Process is the identification of strategies that can best manage regional and corridor congestion. This is a list of the general strategy categories.

- **Reduce Demand** – for motorized vehicular capacity on the congested corridors;
- **Shift Mode of Trip** – from single-occupant vehicles to more capacity-efficient modes;
- **Improve Operations** – specifically the operational aspects of congested corridors;
- **Increase Capacity** – of the congested corridors to accommodate additional traffic.

There will also be regional (as opposed to location-specific) strategies that should be evaluated, such as the benefit of reducing average regional delay and average regional commuting time. Note that increasing capacity will be done on an extremely limited basis. This is the method of last resort due to cost and to the impacts on the environment and quality of life. This is also pursuant to 23 CFR §450.322 The Congestion Management Process in Transportation Areas from the proposed Metropolitan Transportation Planning Rule.

[4] FHWA CMP Guidebook

The relationship between the general congestion management strategy categories (Demand, Mode, Operations, and Capacity (including Features)), and SJTPO's performance measures can be seen in Figure 3.7. The four main strategy categories are well represented in the SJTPO analysis process because of the performance measures that were selected. Next, specific congestion relief strategies are discussed.

Specific Strategies - Congestion Mitigation Techniques

The four congestion management strategy categories have corresponding Congestion Mitigation Techniques (CMT) recommended by experts. These experts include transportation engineers, traffic operations experts, and the FHWA. Figure 3.8 depicts the current, primary CMTs for each of the four types of strategies.

Note that many mitigation techniques are executed by other agencies, which include SJTPO's planning partners. SJTPO's mission calls for cooperation with these planning partners. In many cases, SJTPO can accomplish its objectives only by working with and through its partner agencies. Figure 3.8 also displays the relevant SJTPO partner agencies.

Congestion relief may also result from non-CMP projects that are funded from a variety of sources. For example, congestion mitigation benefits may result from new bicycle lanes. These improvements may result from the Transportation Alternatives (TA) funding stream, a program jointly administered by NJDOT in partnership with the MPOs. Other projects may come from Safety (S) funds, including the Highway Safety Improvement Program (HSIP). Figure 3.8 displays the funding program relevant to various CMTs. Having benefits that cross multiple systems (safety, operations, congestion, etc.) should positively impact a project's priority ranking.

Figure 3.7. General Strategy Categories Related to Performance Measures

Performance Measures	Strategies				
	Demand Mgt	Mode Shift	Operations	Features *	Capacity
1. Rear-end collisions on congested corridors	✓	✓	✓	✓	
2. Bicycle and pedestrian crashes on congested corridors		✓	✓	✓	
3. Average Duration of Delay	✓	✓	✓	✓	✓
•Planning Time Index	✓	✓	✓	✓	✓
•Travel Time Index	✓	✓	✓	✓	✓
4. Percentage of fixed-route trips that are on-time in the SJTPO area within a 2-year timeframe		✓	✓	✓	
5. Increase average vehicle occupancy rates	✓	✓		✓	
6. NJ Transit customer trips originating from Environmental Justice Zones, & Human Service Transportation: customer trips		✓			
7. Percentage of CMP corridor facility improvements that reflect strategies appropriate for their CMP corridor functional types		✓	✓	✓	✓
8. Percentage of the CMP facility improvements that incorporate consideration of 2040 projected volumes.		✓	✓	✓	✓
9. Percentage of the CMP facility improvements that avoid road widening.		✓	✓	✓	
10. Percentage of SJTPO & partner plans in which the CMP is referenced in over a two-year period	✓				✓
11. Percentage of strategies that involve alternative travel methods		✓		✓	
12. Alternative trip methods (HOV trips, car share, transit): number per year		✓		✓	

* Features: These strategies that do not fall into the traditional operations or capacity improvements. Examples are bike lanes or ITS improvements such as dynamic message signs.

Figure 3.8. Specific Strategies and the Partners and Funding Relationship

Congestion Mitigation Techniques	Partner Agency	Funding Program
1. Reduce Demand		
Transportation Demand Management, Alternative Work Schedules	TMA	Various
TDM- Carpools & Vanpools	TMA	Various
2. Shift Mode of Trip		
Complete Streets – Accommodate All Modes in New Development	NJDOT, L	S
Transit Express Routes	NJT	STATE
Transit – Increase Frequency	NJT	STATE
Expand Pedestrian Network	NJDOT	TA, S
Expand Bicycle Network	NJDOT	TA
Improve Multimodal Access at Intersections	NJDOT	TA
Improve Bicycle Storage	NJT	TA
Encourage Establishments of Park & Ride lots	NJT	TA
Car Sharing	TMA	TA
Bicycle Sharing Program	TMA	TA
3. Improve Operations		
Alternative Routes for Congestion Events	NJDOT, L	Various
Geometric Intersection Improvements	NJDOT, L	S
Signal Retiming/Synchronization	NJDOT, L	CMAQ
Signal Event/Holiday Timing Plans	NJDOT, L	S
Improve Signage	NJDOT, L	S
Dynamic Messaging	NJDOT	S
Mobile Apps – That provide real time routing.	TMA	
Reversible Lanes	NJDOT	STATE
Access Management	NJDOT	STATE
4. Increase Capacity		
Add Turning Lanes	NJDOT, L	STATE
Convert Intersection to Interchange	NJDOT	STATE

TMA: Transportation Management Association
NJT: New Jersey Transit
TA: Transportation Alternatives
NJDOT: NJ Department of Transportation
L: Local
S: Safety Program, such as Highway Safety Improvement Program (HSIP)
CMAQ: Congestion Mitigation Air Quality Program

3.6.2. Strategy Assessment

1-Evaluation-Evaluate Congestion Mitigation Potential

Assessment Tool Techniques will be applied in order to determine the congestion mitigation potential for the proposed projects. The tools may include models, sketch tools, past evaluation of strategies, HCM (Highway Capacity Manual), signal optimization, simulation models, and dynamic traffic assignment.

2-Evaluating Cost-Benefit

The cost benefit analysis can be performed for many of the proposed efforts or projects. The cost to implement and maintain the mitigation technique is compared to the estimated benefit. The benefit of some techniques will initially be expressed as the time saved for the network users. This time saved will be converted into dollars saved by assigning a value to the time of the network users.

3-Evaluating Context, Overall Goals, and Coordination

When evaluating, the local context should be considered. The project's contribution to other RTP goals (besides congestion) should be considered. In many cases, SJTPO will not have control over the desired mitigation efforts. There will be projects that are jurisdiction-sensitive. Therefore, the need for proper coordination with other agencies is an evaluation factor.

The overall assessment of any particular project or effort will take all of the above into consideration. A point system will be used to weight the various evaluation factors (cost/benefit, RTP goal contribution, Inter-agency coordination, etc.). A score for each factor will be given to the project, and each factor score will be weighted. The total of the combined weighted scores will be the score for the project.

4-Special Evaluation Considerations: Prioritizing Strategy Categories

As described in section 3.6.1 of this report, each congestion mitigation technique falls in one of four categories. Those categories are listed below and are in the order of priority.

1. Reduce Demand (Top Priority)
2. Shift Mode of Trip
3. Improve Operations
4. Increase Capacity

Therefore the priority given to a specific mitigation technique is dependent on its category.
In other words, reducing demand is always looked to first before Steps 2, 3, or 4 are considered. Step 2 is always considered before 3 & 4, and so on. Increasing capacity is always the strategy of last resort.

A Balanced Approach

As stated earlier, all the elements of the CMP (strategies, techniques, etc.) are driven by the regional goals. In some cases, the region's Goals may have conflicting desired results. For example, increasing speed may negatively impact safety. Therefore, strategies and the mitigation techniques selected should be considered collectively, as opposed to individually. A balanced approach ensures all the goals are addressed.

Regional and Financial Environment Considerations

Strategy and congestion mitigation techniques also consider the unique nature of the region and anticipated financial constraints. In many instances, the specific solutions recommended will depend on the types of trips using the corridor. For example, a corridor servicing primarily freight traffic will have different solutions than one servicing primarily tourism traffic. Financial considerations may limit the solutions that can be realistically employed.

3.7. Step 7: Program and Implement Strategies

CMP Strategies are implemented through the SJTPO TIP, the SJTPO UPWP, and through the work programs of our partner agencies. SJTPO participates in the planning process of NJDOT and other partners; it is in this capacity that SJTPO strives to implement strategies that are shared with other organizations.

Although other venues are used, the TIP programming is the most direct method of CMP strategy implementation. Therefore the TIP should be in sync with the CMP and the RTP. In the unusual event that a TIP project is not connected to the RTP or CMP, an update of the RTP and/ or CMP may be required.[5]

CMP Strategies can be at the Regional (R), Corridor (C), or Project levels. Examples of regional strategies are TMA activities and SJTPO's safety education outreach. Corridor strategy examples are bike lanes and operational improvements.[6]

The strategies generated by the Congestion Management Process are forwarded to the SJTPO Capital Programming Division for consideration during the TIP and UPWP programming.

[5] FHWA CMP Guidebook
[6] FHWA CMP Guidebook

Programming & Implementation

Programming is done by developing the RTP, TIP, and the UPWP. Some of the implementation is captured in the completion of the UPWP tasks. Other implementation is in the form of completed projects and programs. The Congestion Mitigation and Air Quality Program (CMAQ) is one method of implementing congestion management strategies. CMAQ is a federal program that funds projects and programs that improve air quality and reduce traffic congestion. As such, it is well-suited for implementing projects developed under the CMP.

Any transportation project that improves air quality is eligible for CMAQ funding, including traffic flow improvements, travel demand management (TDM), bicycle and pedestrian facility improvements, transit projects, transportation control measures (TCM), and many other project types. In recent years, SJTPO has been allocated $1.9 million for its CMAQ program. Regional agencies submit project applications to SJTPO, which are scored based on cost-effectiveness and support of other regional goals such as safety. SJTPO staff works actively with its subregions to develop CMAQ projects each year. For more on the SJTPO CMAQ program, visit http://sjtpo.org/cmaq.html

The numerous congestion management strategies are programmed or implemented by SJTPO and its partners. SJTPO's UPWP and the Work Programs of our partner agencies contained the projects and programs that are planned. Congestion management strategy implementation is performed by many agencies.

CMP Implementation-Partners

CMP Implementation Partners—SJTPO will work with the operations agencies listed below to implement many of its congestion mitigation strategies.

- NJ Department of Transportation
- NJ Turnpike Authority
- South Jersey Transportation Authority
- NJ TRANSIT
- Cross-County Connection TMA
- Atlantic, Cape May, Cumberland, and Salem Counties
- City of Atlantic City
- City of Vineland
- Rutgers University
- NJTPA
- DVRPC

Figure 3.9 below displays the relationship between some CMP topics and their partners and venues for programming and implementation.

Figure 3.9. FY 2016-2016 CMP Programming and Implementation Partners and CMP Topics

Organization	Topic	Venue
SJTPO	Projects, ITS, Bike Lanes, Pedestrian Assets	SJTPO TIP
SJTPO	Safety Education	SJTPO UPWP
SJTPO	HSTP	SJTPO UPWP
HST Providers	Special Population Transportation	HST Providers Work Plan
Counties	Projects, ITS, Bike Lanes, Pedestrian Assets, HST	County Work Plan
NJDOT	Projects, ITS, Bike Lanes, Pedestrian Assets	STIP
NJ Transit	Routes, Ridership, Bike Racks, EJ Transit Routes	NJ TRANSIT Work Program
NJ Turnpike Authority	Projects, ITS	NJTA Work Plan
South Jersey Transportation Authority	Projects, ITS, HST	SJTA Work Plan
TMA	Ride Share, Real-Time Traffic Info. Apps., Employer & Employee Alternate Modes Education	TMA UPWP

3.8. Step 8: Evaluating Strategy Effectiveness

The CMP evaluation/ monitoring step is part of the continual planning improvement cycle. It is a multi-level evaluation; the projects, programs, and the entire process is monitored.[7]

Monitoring Projects and Programs

The effectiveness of each project and program will allow for improvements to those projects and program types. It may also call for entirely different projects and programs when confronted with similar issues in the future. Before and after studies are to be conducted; this can gauge project and program effectiveness. See Step 6, Section 3.6.2., Strategy Assessment, of this report for more detail.

[7] FHWA CMP Guidebook

Before and after studies can tell us if traffic signal synchronization improves the traffic flow in a corridor; or if a pedestrian safety educational outreach effort improves safety at an intersection. These are examples of a corridor or site-specific strategy evaluation. Monitoring also occurs at a regional level. An effective region-wide program will create conditions for improved network performance. An example is a higher level of Rideshare participation. This would take vehicles off the road, thereby reducing the demands placed on the network.

Monitoring the SJTPO Congestion Management Performance

As described previously, it is also important to evaluate the entire network's congestion management performance. The methods that SJTPO uses to generate its CMP solutions should be constantly reviewed and changed to reflect the changing planning landscape. Personnel and financial resources available to SJTPO and its planning partners will also dictate CMP methods.

SJTPO will monitor its CMP network with the help of multiple partner agencies including the New Jersey Department of Transportation (NJDOT), NJ TRANSIT (NJT), the South Jersey Transportation Authority (SJTA), the NJ Turnpike Authority (NJTA), Regional HST providers, and local counties and municipalities. Since some of the strategies are controlled by these partners, it is necessary to work closely with these partners to acquire the data and other information that allows for constant monitoring. As part of the monitoring process, SJTPO will produce a CMP Activity Report.

The SJTPO CMP Activity report will describe all CMP activity for the given reporting period. It will also use data-driven performance measures to reflect multiple aspects of the network's congestion management performance. The effectiveness of the SJTPO Congestion Management Process itself is also the subject of one of the performance measures, and this is discussed in the next section. See Section 3.5. Step 5: Analyze Congestion Problems and Needs of this report. Section 3.5 gives a detailed description of the analysis and monitoring process and the related performance measures. The CMP Activity Report will reflect the analysis described in Section 3.5.

Monitoring the SJTPO Congestion Management Process Impact

CMP Step 8 includes a CMP impact analysis. In addition to evaluating the network performance, the CMP itself is to be evaluated. One method for this evaluation is to monitor the influence that the CMP has on other plans. These plans would include the SJTPO RTP, TIP, and plans of SJTPO's partner agencies. SJTPO will evaluate the plans that are created after the CMP Activity Report is released. Research by the SJTPO CMP Team will indicate if the CMP Activity Report is cited in the new plans, or if the CMP Activity Report was considered during plan development. This is part of the continuous feedback process.

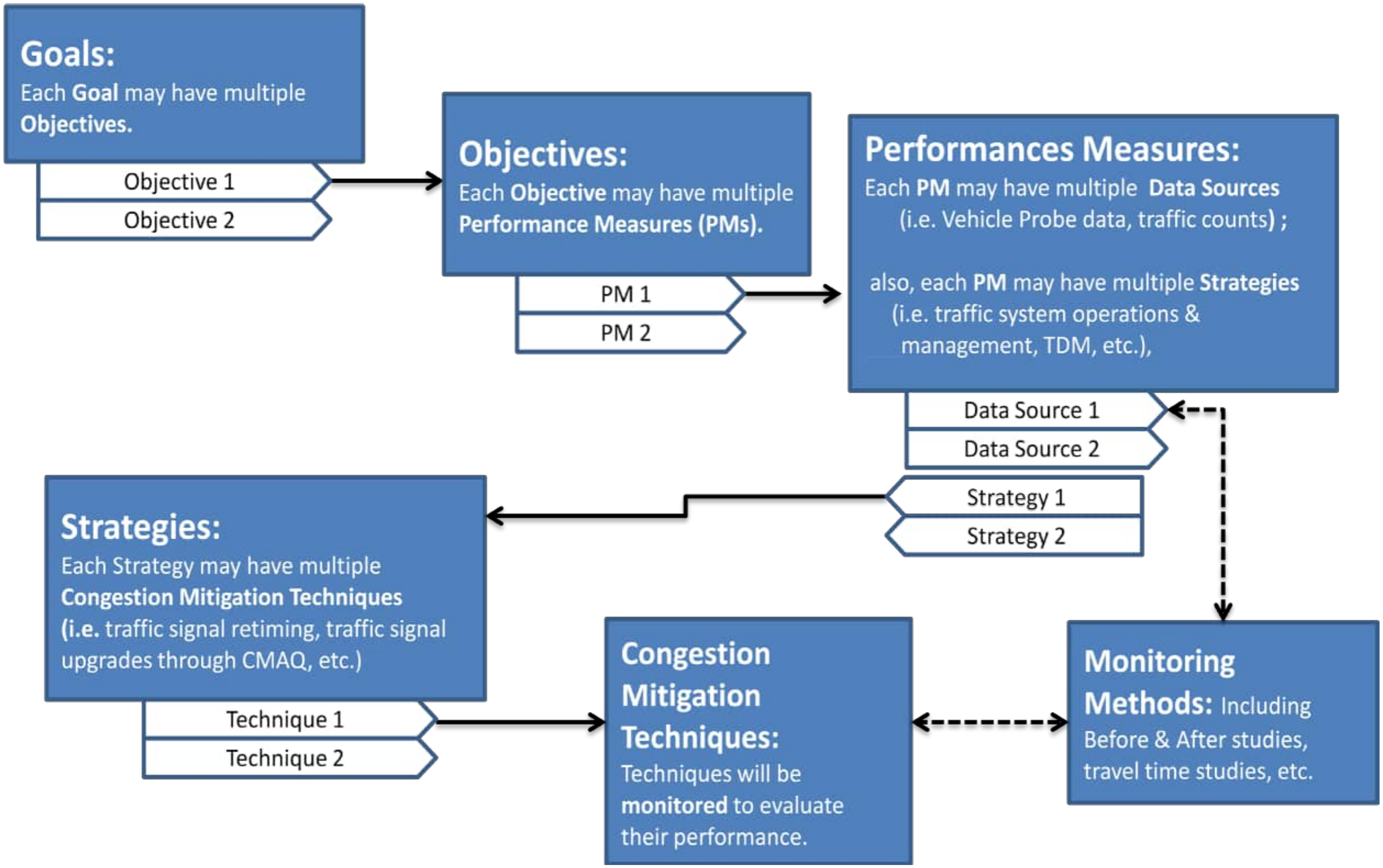
Therefore, SJTPO is continually monitoring the performance of our system, strategies, and congestion mitigation techniques. SJTPO will be able to make adjustments to its efforts on an ongoing basis. This process ensures that SJTPO is being effective as possible with its RTP implementation.

3.9. Next Steps

This Congestion Management Process FY2013-2016 report constitutes SJTPO's latest version of its CMP. It should be noted, however, that the CMP is continually evolving and will continue to evolve over time in conjunction with both internally generated documents and studies, such as the RTP Goals and Objectives, as well as external factors, such as changing planning guidelines, regional demographics and available fiscal resources.

As noted earlier, this report will be followed by a CMP Activity Report to be issued in 2016, as part of the 2040 Regional Transportation Plan Update (2016).

Appendix 1 SJTPO CMP Workflow



Appendix 2.1 Vehicle Probe Project Bottleneck Rankings

Background

Travel time data can provide an excellent basis for congestion screening. Travel time is a direct measure of roadway user experience, with high travel times indicating high delay and poor driver experience. By comparing an observed travel time to the expected free-flow travel time, the performance of the roadway can be measured.

The primary data source used in this analysis is travel time data collected from probe vehicles and compiled by the Vehicle Probe Project (VPP). The VPP is a project of the University of Maryland's CATT Lab (Center for Advanced Transportation Technology). The VPP Suite provides tools to retrieve archived travel time data and to analyze the data in a number of ways.

This travel time data is archived, and is retrievable for analysis. Presently, the VPP covers all authority roadways in the region (NJ Turnpike, Atlantic City Expressway, and Garden State Parkway), almost all state and US routes, and a small number of county and local roadways.

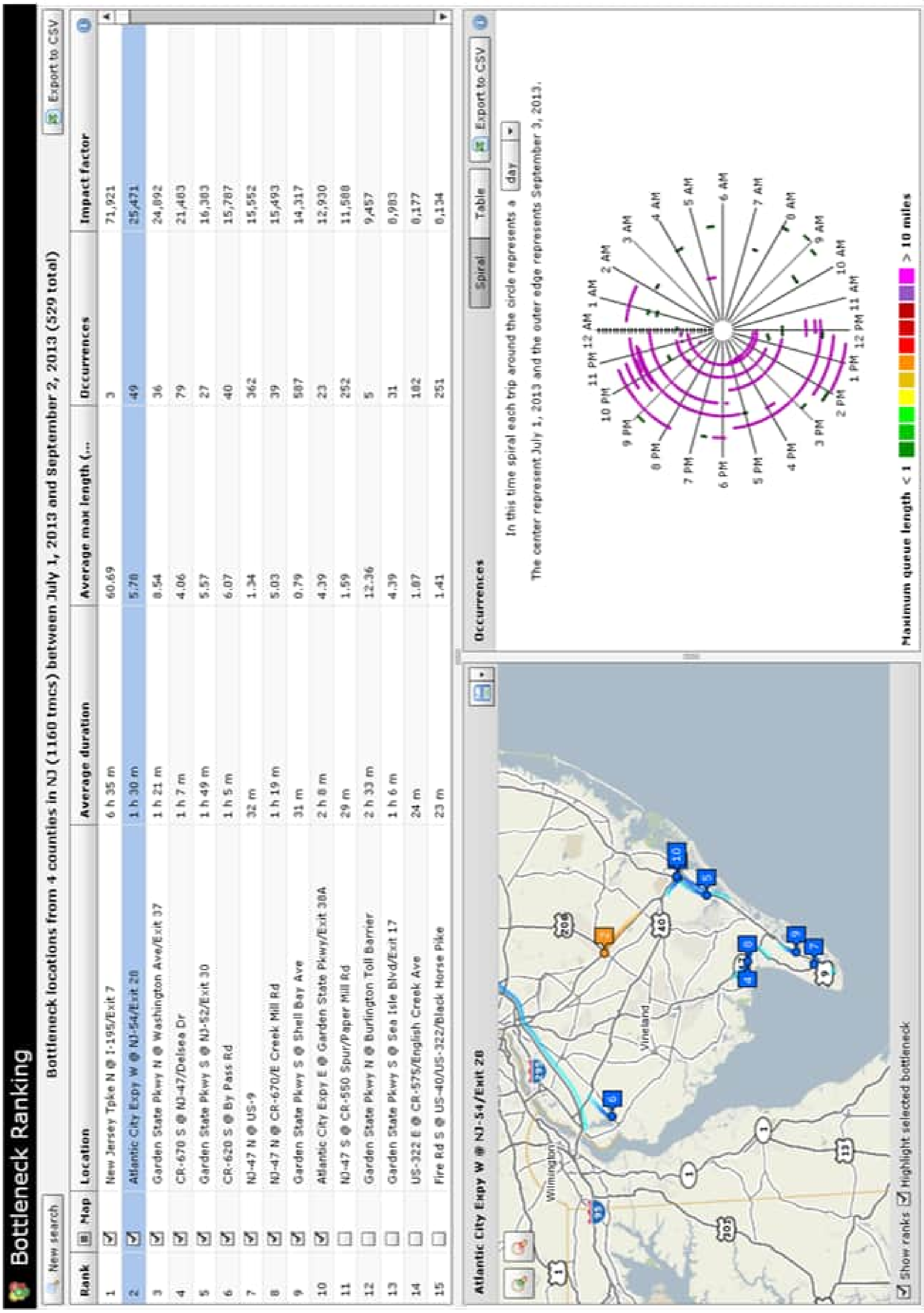
Data for the VPP is collected from GPS-enabled connected devices, including smart phones and GPS units, and is compiled by INRIX. Roadways are divided into segments referenced by TMC (Traffic Message Channel) code. Urban segments are typically one-tenth to one-quarter of a mile in length, and rural segments are longer. Segments typically begin and end at major intersections. Speed data reported by probe vehicles is aggregated by segment and into 1-minute time periods; this raw data may be downloaded directly as a database, or analyzed using the tools provided in the VPP Suite.

Bottleneck ranking tool

One of the tools available in the VPP Suite is the Bottleneck Ranking tool. This tool scans the archived travel time data for all roadways in a user-defined region for which there is VPP coverage. For each bottleneck, the location, average duration, average maximum bottleneck length, and number of occurrences are reported by the bottleneck tool. Bottleneck roadway segments are then ranked according to their Impact Factor, which is computed as a function of the duration, length, and frequency of the bottlenecks.

Pictured on the following page is a screenshot of the bottleneck ranking tool. This list on the top shows the top-ranked bottleneck locations for the given time period. In the bottom-left, the locations are mapped. In the bottom-right, the times at which bottlenecks occur are plotted on the circular graph.

Figure A2.1-1: Vehicle Probe Project bottleneck ranking tool



For each roadway segment, a reference speed is computed as the 85th percentile of the observed speeds for all time periods, with a maximum value of 65 mph. When the observed speed drops below 60% of the reference speed, a potential bottleneck is identified. If speeds remain below 60% of the reference speed for more than five minutes, the bottleneck is confirmed. The bottleneck is considered to be cleared when roadway speed is above 60% of the reference speed for at least 10 minutes. The duration of the bottleneck is then computed as the length of time the observed speed fell below 60% of the reference speed. The figure below illustrates the methodology used to identify bottlenecks and their durations.

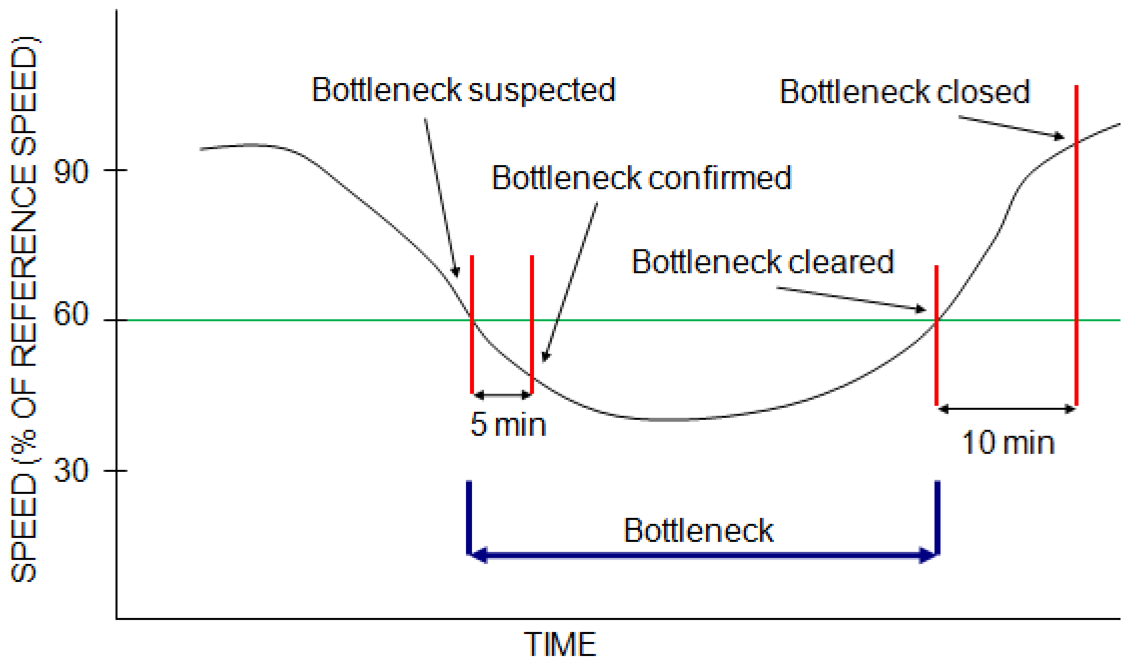


Figure A2.1-2- - VPP Bottleneck Criteria

Multiple adjacent roadway segments experiencing bottleneck conditions at the same time are joined together to determine the length of the bottleneck queue. In some cases, bottlenecks cause queues many miles in length; most notably, the bottleneck beginning at the Exit 7 construction on the NJ Turnpike created queues extending into the SJTPO region, a distance of 60 miles. Bottlenecks of less than 0.3 miles in length are ignored by the VPP Bottleneck Ranking tool. Because bottleneck queues can merge or break into multiple pieces, the tool may appear to display inconsistent numbers of bottleneck occurrences. According to VPP developers, the occurrence count in the top table includes only a single entry for each bottlenecked location, even if the queues merge or break apart before the queue completely clears. The table on the bottom shows all occurrences of the selected bottlenecked location before it clears the roadway completely. As a result, the counts in the two tables sometimes differ.

The VPP Bottleneck Ranking tool lists all bottleneck occurrences in the region in descending order of Impact Factor. The Impact Factor is calculated as the product of average bottleneck duration (in minutes), average maximum queue length (in miles), and the number of occurrences. In this way, more severe bottlenecks (either in terms of length or duration) contribute greater weight toward the impact factor. Note that the Impact Factor does not directly take traffic volumes or roadway capacity into account. Greater volumes cause longer queues, so volume is indirectly accounted for in this way, but low-capacity roadways may appear high on the list even if they have relatively low volume. The Impact Factor should be considered in conjunction with volume data to estimate the total magnitude and cost of the bottleneck.

Methodology

The VPP bottleneck ranking tool allows up to three months of data to be analyzed. As congestion in the region is largely seasonal, a period of three summer months was selected: July 1st though September 2nd, 2013. This period includes two major holiday weekends: Fourth of July and Labor Day. All roadways for which there is VPP coverage were selected. The bottleneck tool produced a list of roadways segments ranked by total impact factor. The list serves as a data source for preliminary congestion screening, and for identifying roadway segments that are commonly overcapacity.

Listed below are the top ten bottlenecked locations for summer 2013 as ranked by the VPP bottlenecking ranking tool. Two lists are presented. The first, Figure A2.1-3a, lists bottlenecks on state or authority roadways, defined as segments with VPP road classification of Interstate, State Route, US Route, Parkway, Turnpike, or Expressway. The second, Figure A2.1-3b, contains bottlenecks on county or local roadways, defined as VPP road classification ‘other’. The lists were manually screened; outliers caused by erroneous data were removed, and bottlenecks originating outside of the SJTPO region and extending onto SJTPO-region road segments were also removed. Note that VPP coverage on county and local roads is not comprehensive, and the list reflects the top bottlenecks only on the limited set of county and local roads with coverage.

Table A2.1-3a. Top 10 Bottlenecked Locations--State and Authority roadways

Rank	Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor
1	Atlantic City Expy W @ NJ-54/Exit 28	WESTBOUND	1 h 30 m	5.78	49	25,471
2	Garden State Pkwy N @ Washington Ave/Exit 37	NORTHBOUND	1 h 21 m	8.54	36	24,892
3	NJ-347 S @ NJ-47/Delsea Dr	SOUTHBOUND	1 h 7 m	4.06	79	21,483
4	Garden State Pkwy S @ NJ-52/Exit 30	SOUTHBOUND	1 h 49 m	5.57	27	16,383
5	NJ-47 N @ US-9	NORTHBOUND	32 m	1.34	362	15,552
6	NJ-47 N @ CR-670/E Creek Mill Rd	NORTHBOUND	1 h 19 m	5.03	39	15,493
7	Garden State Pkwy S @ Shell Bay Ave	SOUTHBOUND	31 m	0.79	587	14,317
8	Atlantic City Expy E @ Garden State Pkwy/Exit 38A	EASTBOUND	2 h 8 m	4.39	23	12,930
9	NJ-47 S @ CR-550 Spur/Paper Mill Rd	SOUTHBOUND	29 m	1.59	252	11,588
10	Garden State Pkwy N @ Burlington Toll Barrier	NORTHBOUND	2 h 33 m	12.36	5	9,457

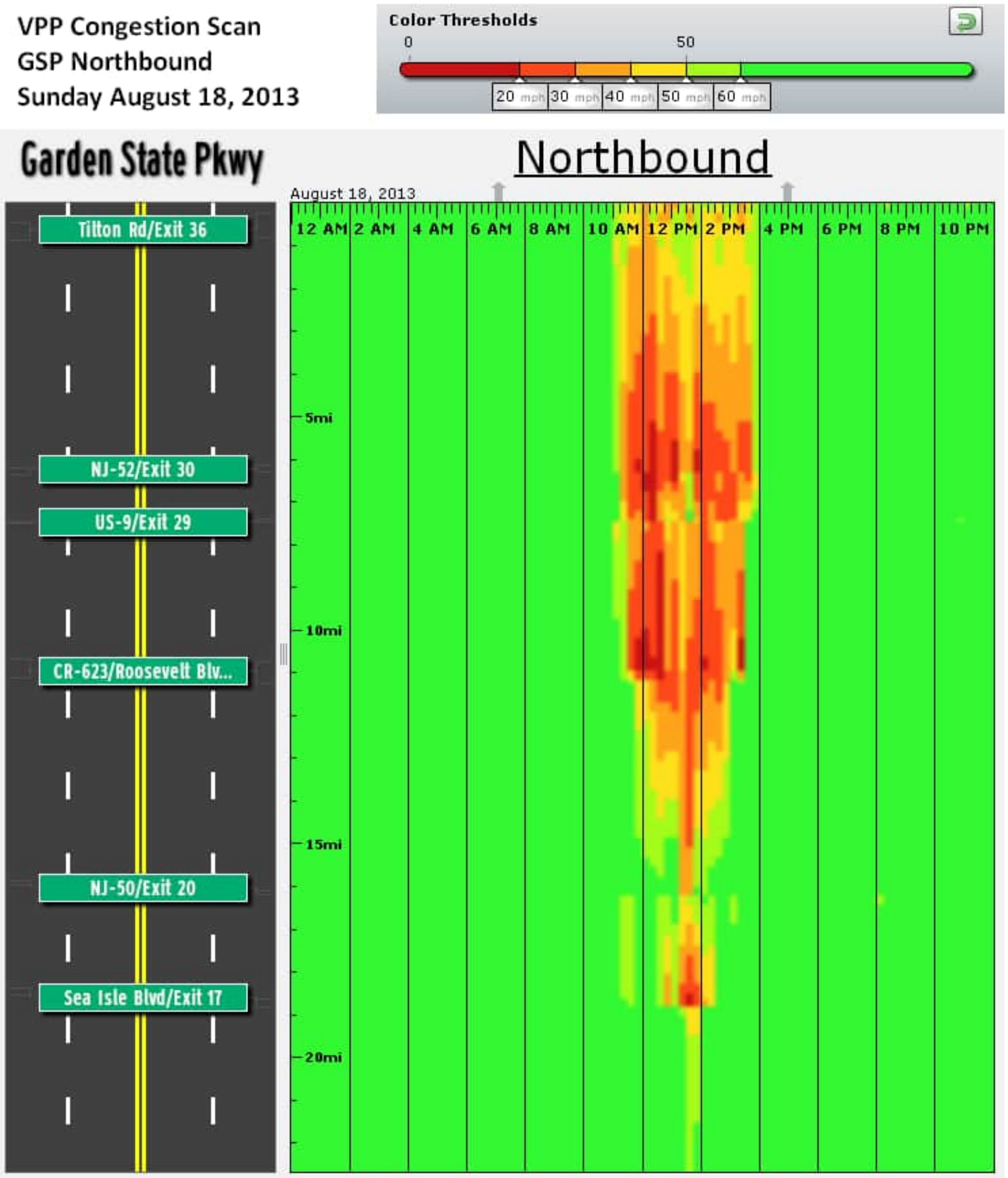
Table A2.1-3b. Top 10 Bottlenecked Locations--County and local roadways

Rank	Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor
1	Fire Rd S (Atlantic CR 651) @ US-40/US-322/Black Horse Pike	SOUTHBOUND	23 m	1.41	251	8,134
2	Wrangleboro Rd N (Atlantic CR 575) @ US-40/US-322	NORTHBOUND	23 m	1.41	215	6,955
3	Old Pennsville Auburn Rd W (Municipal, Pennsville) @ NJ-49/N Broadway	WESTBOUND	1 h 37 m	0.18	131	2,323
4	Tilton Rd S (Atlantic CR 563) @ Mill Rd	SOUTHBOUND	21 m	1.03	107	2,317
5	Pitney Rd N (Atlantic CR 575) @ US-9/New York Rd	NORTHBOUND	28 m	4.6	12	1545
6	Tilton Rd S (Atlantic CR 563) @ US-40/US-322/Black Horse Pike (Egg Harbor Township) (South)	SOUTHBOUND	17 m	0.56	150	1427
7	Tilton Rd S (Atlantic CR 563) @ US-9/New Rd	SOUTHBOUND	17 m	0.67	125	1427
8	W Sherman Ave E (Cumberland CR 552) @ NJ-47/S Delsea Dr	EASTBOUND	16 m	1	86	1372
9	Wrangleboro Rd S (Atlantic CR 575) @ US-40/US-322	SOUTHBOUND	19 m	0.3	219	1250
10	Mill Rd N (Atlantic CR 651) @ US-30/White Horse Pike	NORTHBOUND	28 m	0.71	60	1198

Appendix 2.2 Vehicle Probe Project Congestion Scan

Background

Another tool provided by the VPP Suite is the Congestion Scan. This tool produces a graph depicting congestion by time of day and by segment along a roadway. Users can select a roadway, or portion of a roadway, along with a time period, and congestion is graphed from red (heavy congestion) to green (no congestion) as a function of the percentage of the free-flow speed. The raw speed data may be plotted as well, as in the graph below.



This congestion scan shows congestion that occurred on the Garden State Parkway in the summer of 2013. The horizontal axis is time of day, the vertical axis is location on the roadway, and the color indicates the average speed at that location and time. In this scan, the congestion began around 11:00 AM and cleared up around 4:00 PM. On a nearly 20-mile stretch of the Parkway in Atlantic and Cape May counties, speeds fell from above 60 mph to less than 40 mph, with patches of dark red indicating speeds below 20 mph at some times. As this congestion was in the northbound direction on a Sunday afternoon, it was likely caused by visitors to the shore heading home at the end of the weekend. Congestion is worse north of CR-623, which carries traffic from Ocean City onto the Parkway, indicating that this additional northbound traffic caused the Parkway to become over-capacity.

Congestion scans allow us to gain a clear picture of the extent and severity of congestion, and can help locate the causes of bottlenecks. The congestion scan tool works well in conjunction with the bottleneck ranking tool. As congested segments are screened on a regional level by the bottleneck ranking tool, these segments may then be examined at a closer level using the congestion scan tool.

Appendix 2.3 Vehicle Probe Project Cost-of-Delay Analysis

Background

Another tool provided by the VPP Suite is the User Delay Cost Analysis. This tool allows users to estimate the total cost of congestion by assigning an average cost to each vehicle-hour of delay. The user may select any roadway, collection of roadways, or region to analyze. The user may also select a time period. A speed threshold may be defined as a function of the historic average speed, the free-flow speed, or an absolute speed (such as the speed limit). Delay is calculated as the difference between travel time at the free-flow speed and travel time at the delay threshold speed. For each vehicle-hour of delay, a dollar value is assigned. By default, these values are:

- **Passenger vehicles:** $16.79/veh-hr
- **Commercial vehicles:** $86.81/veh-hr

These values are based on research conducted by the Texas Transportation Institute, and are commonly used in cost-of-delay studies. When the delay cost report is run, a table is provided that lists the cost of delay for each hour of each day in the designated time period, along with the total delay cost.

The tables below show an example cost-of-delay analysis for the Garden State Parkway for a typical Friday-Saturday-Sunday period in August of 2013. In the first table, the columns show the total vehicle-hours of delay for each hour and day. The second table shows the cost of delay, in dollars, for this delay.

Table A2.3-1: VPP Vehicle-hours of delay on the Garden State Parkway

(Atlantic and Cape May counties)

	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM
8/16/13	0	0.07	0	0	0	0	0	0	0.42	2.72	0	0
8/17/13	0	0.63	0	0.06	0.08	0	4.26	0.22	0	0.33	26.42	74.3
8/18/13	44.11	53.07	0.82	0	0	0.06	0	0.65	1.57	0	0.91	175.81
Hourly totals	**44.11**	**53.77**	**0.82**	**0.06**	**0.08**	**0.06**	**4.26**	**0.87**	**1.99**	**3.05**	**27.33**	**250.11**

	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Daily Totals
8/16/13	0.5	0	0	0	0	0	0.55	0.64	0.38	0	0	0	5.28
8/17/13	235.3	245.1	100.0	14.4	0	0.89	0	1.43	2.03	1.12	2.78	1	710.6
8/18/13	389.7	498.1	467.5	401.6	306.9	82.08	0	0	0	4.18	1.58	0	2,428.98
Hourly totals	**625.6**	**743.3**	**567.6**	**416.0**	**306.9**	**82.97**	**0.55**	**2.07**	**2.41**	**5.3**	**4.36**	**1**	**3,144.86**

As seen in the table above, this Friday-Saturday-Sunday period experienced 3,145 vehicle-hours of delay on the Parkway in the SJTPO region. Using these delay estimates, the cost-of-delay values can be applied to obtain delay cost estimates, in dollars, as seen in the following table.

Table A2.3-2: VPP Cost of delay, in dollars, on the Garden State Parkway
(Atlantic and Cape May counties)

	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM
8/16/13	0	2	0	0	0	0	0	0	16	102	0	0
8/17/13	0	24	0	2	3	0	160	8	0	12	989	2782
8/18/13	1652	1987	31	0	0	2	0	24	59	0	34	6583
Hourly totals	**$1,652**	**$2,013**	**$31**	**$2**	**$3**	**$2**	**$160**	**$32**	**$74**	**$114**	**$1,024**	**$9,365**

	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Daily Totals
8/16/13	19	0	0	0	0	0	21	24	14	0	0	0	$198
8/17/13	8813	9179	3747	540	0	33	0	53	76	42	104	37	$26k
8/18/13	14595	18654	17507	15039	11493	3073	0	0	0	157	59	0	$90k
Hourly totals	**$23k**	**$27k**	**$21k**	**$15k**	**$11k**	**$3k**	**$21**	**$77**	**$90**	**$199**	**$163**	**$37**	**$117k**

As seen in the table above, the 3,145 vehicle-hours of delay are estimated by the VPP to cost approximately $117,000, according to the delay-cost figures provided by the Texas Transportation Institute. The cost of delay for the entire year of 2013 is estimated at $2.4 million by the VPP, and this figure may be used to help justify the cost of congestion-relief improvements.

Appendix 2.4 Example Congested Location Development Using Vehicle Probe Data

Tools provided by the VPP suite may be used in conjunction with one another to identify congested locations. These become locations of interest for the congestion management process, and may be prioritized for congestion-relief programming by SJTPO and partner agencies.

In this section, an example is given of how the VPP tools may be used together as a process to screen for locations of interest.

To begin, the bottleneck ranking tool is used to broadly screen all roadways in the region with vehicle probe coverage. A time period in summer of 2013 was selected, beginning July 1st and ending September 2nd. A bottleneck ranking report was requested for the four-county region for this time period. The table below shows the top 20 bottleneck rankings in the SJTPO region for this time period. The top-ranked bottleneck on the New Jersey Turnpike originates outside of the SJTPO region, and so in practice this bottleneck is excluded from our analysis. Using this list, we can examine each bottleneck location in sequence to consider them as locations of interest for the CMP. For this example, we will examine the fifth-ranked bottleneck: Garden State Parkway southbound, in the vicinity of Exit 30 to NJ-52 and the junction with the Atlantic City Expressway. This location is highlighted in the table below.

Bottleneck Ranking

New search

Bottleneck locations from 4 counties in NJ (1111 tmcs) between July 1, 2013 and September 2, 2013 (527 total)

Rank	Map	Location	Average duration	Average max length (...	Occurrences	Impact factor
1	☐	NEW JERSEY TPKE N @ I-195/EXIT 7	6 h 35 m	60.69	3	71,917
2	☐	ATLANTIC CITY EXPY W @ NJ-54/EXIT 28	1 h 30 m	5.77	49	25,447
3	☐	GARDEN STATE PKWY N @ WASHINGTON AVE/EXIT 37	1 h 21 m	8.53	36	24,887
4	☐	US-9 S @ NJ-47/DELSEA DR	1 h 7 m	4.06	79	21,482
5	☑	GARDEN STATE PKWY S @ NJ-52/EXIT 30	1 h 49 m	5.57	27	16,383
6	☐	CR-620 S @ BY PASS RD	1 h 5 m	6.07	40	15,786
7	☐	GARDEN STATE PKWY N @ US-9	32 m	1.35	362	15,591
8	☐	NJ-47 N @ CR-670/E CREEK MILL RD	1 h 19 m	5.03	39	15,493
9	☐	GARDEN STATE PKWY S @ SHELL BAY AVE	31 m	0.79	587	14,348
10	☐	ATLANTIC CITY EXPY E @ GARDEN STATE PKWY/EXIT 38A	2 h 8 m	4.39	23	12,931
11	☐	US-9 S @ NJ-83	29 m	1.59	252	11,588
12	☐	GARDEN STATE PKWY N @ BURLINGTON TOLL BARRIER	2 h 33 m	12.38	5	9,474
13	☐	GARDEN STATE PKWY S @ SEA ISLE BLVD/EXIT 17	1 h 6 m	4.39	31	8,982
14	☐	US-322 E @ CR-575/ENGLISH CREEK AVE	24 m	1.87	182	8,177
15	☐	GARDEN STATE PKWY S @ US-40/US-322/BLACK HORSE PIKE	23 m	1.41	251	8,134
16	☐	CR-670 N @ NJ-47/CR-670/MAURICETOWN CROSSWAY RD	1 h 2 m	2.63	47	7,678
17	☐	NEW JERSEY TPKE S @ I-295/US-40/NJ-49/1ST AVE/EXIT 1	58 m	3.40	37	7,293
18	☐	CR-575 N @ US-40/US-322	23 m	1.41	215	6,955
19	☐	RTE-109 S @ US-9	1 h 40 m	0.59	112	6,594
20	☐	GARDEN STATE PKWY N @ ATLANTIC CITY EXPY/EXIT 38	1 h 6 m	5.36	18	6,374

Figure A2.4-1: Bottleneck ranking

In the table, we see that this bottleneck occurred 27 times during the selected period, with an average queue length of 5.57 miles and an average duration of 1 hour, 49 minutes.

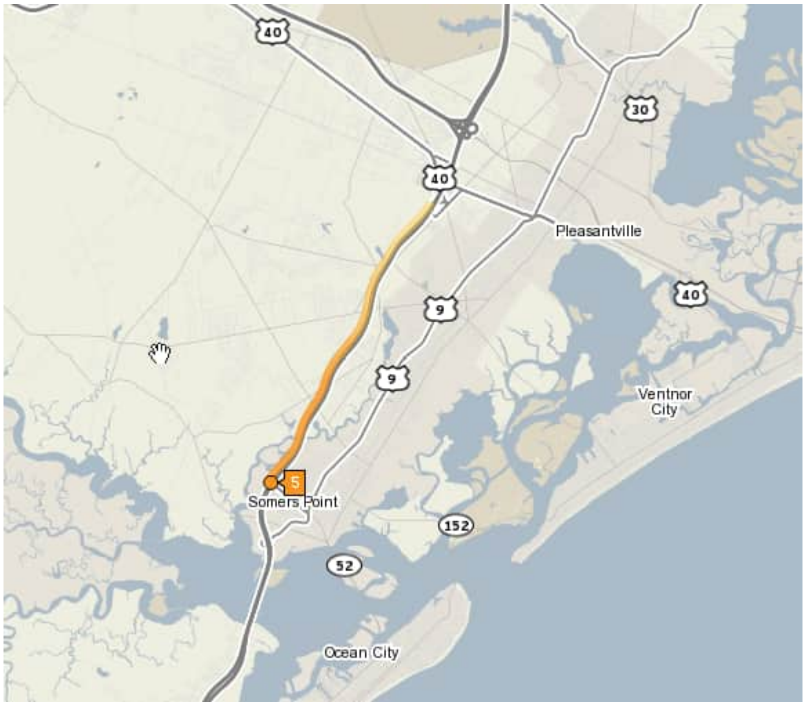


Figure A2.4-2: Map depicting Bottleneck Location

The bottleneck ranking tool can map the location and average extent of the bottleneck, pictured left. This segment of the Garden State Parkway brings traffic southbound from North Jersey and from the Atlantic City Expressway, and continues south to provide access to all of the shore communities in Cape May County.

There are several possible sources of congestion on this segment:

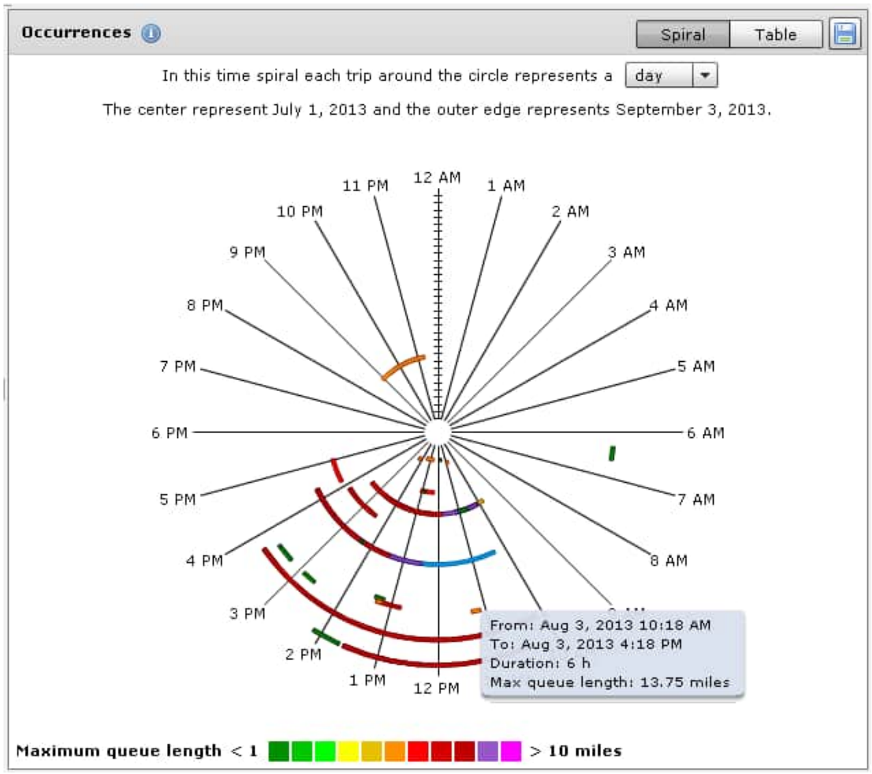
1. Junction with the Atlantic City Expressway – additional southbound traffic originating in the Philadelphia area and bound for Cape May will join the parkway just north of the highlighted segment.

Figure A2.4-2: Toll Plaza, GSP Exit 30

2. Toll plaza – pictured left, a toll plaza present only on the southbound lanes, just before the bridge over the Great Egg Harbor Bay. This toll plaza may reduce roadway capacity.

3. Merge with US-9 – also pictured left, there is a merge with US-9 just before the bridge over the Great Egg Harbor Bay, which carries both the Parkway traffic and traffic from US-9, as the US-9 Bridge (Beesley's Point Bridge) is no longer in use.

The bottleneck ranking tool displays the date and time of each bottleneck in the form of a circular plot, seen in the following figure. The plot displays bottleneck occurrences as rings, with the length of each ring indicating the length of the bottleneck in hours. The earliest day in the analysis period (July 1st) is the innermost ring, while the last day (September 2nd) is the outermost.



As seen in the figure, bottlenecks occur almost entirely between the hours of 10:00 AM and 5:00 PM. Outlier bottlenecks may be due to non-recurring events such as construction, accidents, or erroneous probe data. Bottlenecks do not occur every day, as the rings on the plot are spaced apart. By selecting the bottleneck rings, we can find that the larger rings represent weekends, primarily Saturdays.

Figure A2.4-3: Time Spiral Depicting Bottlenecks from July 1-September 2, 2013

Occurrences

Start time	Clear time	Duration	Max queue l...
Jul 20, 2013 10:36 AM	Jul 20, 2013 11:14 AM	38 m	0.53
Jul 20, 2013 11:03 AM	Jul 20, 2013 3:30 PM	4 h 27 m	9.82
Jul 20, 2013 11:48 AM	Jul 20, 2013 3:30 PM	3 h 42 m	7.30
Jul 20, 2013 12:04 PM	Jul 20, 2013 3:30 PM	3 h 25 m	7.30
Jul 20, 2013 12:37 PM	Jul 20, 2013 3:30 PM	2 h 53 m	7.30
Jul 20, 2013 1:24 PM	Jul 20, 2013 3:30 PM	2 h 6 m	7.30
Jul 26, 2013 2:24 PM	Jul 26, 2013 3:49 PM	1 h 25 m	7.30
Jul 26, 2013 2:38 PM	Jul 26, 2013 3:49 PM	1 h 11 m	7.30
Jul 26, 2013 2:39 PM	Jul 26, 2013 3:49 PM	1 h 10 m	7.30
Jul 27, 2013 4:11 PM	Jul 27, 2013 5:03 PM	52 m	6.01
Aug 3, 2013 10:18 AM	Aug 3, 2013 4:18 PM	6 h	13.75
Aug 3, 2013 12:28 PM	Aug 3, 2013 4:18 PM	3 h 50 m	9.84
Aug 3, 2013 1:25 PM	Aug 3, 2013 4:18 PM	2 h 53 m	7.30
Aug 3, 2013 2:16 PM	Aug 3, 2013 2:21 PM	5 m	0.89
Aug 3, 2013 3:04 PM	Aug 3, 2013 4:18 PM	1 h 14 m	7.30
Aug 3, 2013 3:25 PM	Aug 3, 2013 4:18 PM	52 m	7.30
Aug 15, 2013 6:19 AM	Aug 15, 2013 6:36 AM	17 m	0.17
Aug 15, 2013 1:10 PM	Aug 15, 2013 1:23 PM	13 m	0.17
Aug 16, 2013 12:47 PM	Aug 16, 2013 1:20 PM	33 m	7.48
Aug 16, 2013 1:12 PM	Aug 16, 2013 1:20 PM	8 m	5.48
Aug 17, 2013 11:06 AM	Aug 17, 2013 11:18 AM	12 m	5.48
Aug 20, 2013 2:36 PM	Aug 20, 2013 2:54 PM	17 m	0.17

The bottleneck ranking tool also lists the date and time each bottleneck occurs, as seen in the figure to the right. This table shows all bottlenecks on the selected road segment, including those that may have originated on adjacent segments, or queues that may have broken up or merged over the course of the day. This table is aggregated to produce the overall ranking.

Figure A2.4-4: Bottleneck Ranking Tool Listing of Time and Date of Each Bottleneck

By examining this table, we see that bottlenecks occur primarily on weekends: July 20th, 2013 was a Saturday; July 26th was a Friday, August 3rd was a Saturday, and so on. Weekend congestion is typical of recreational travel. Saturday congestion may be attributable to the many beach homes that are rented on a weekly basis, for which the changeover typically occurs on Saturday.

From here, we can use the Congestion Scan tool to take a closer look at travel speeds in the vicinity of the bottlenecks. The figure below shows a congestion scan for August 3rd, 2013, a Saturday. The horizontal axis shows the time of day, beginning at 6:00 AM and ending at 8:00 PM. The vertical axis shows the length of the Garden State Parkway, beginning at the Atlantic County boundary at the top, and ending in Cape May at the bottom. The colors on the plot indicate the average speed of probe vehicles. Green indicates that vehicles are travelling at greater than 80% of the historic average speed of 65 mph. Yellow, orange, and red indicate lower speeds, with the dark red indicating that vehicles are travelling at less than half of the historic average speed.

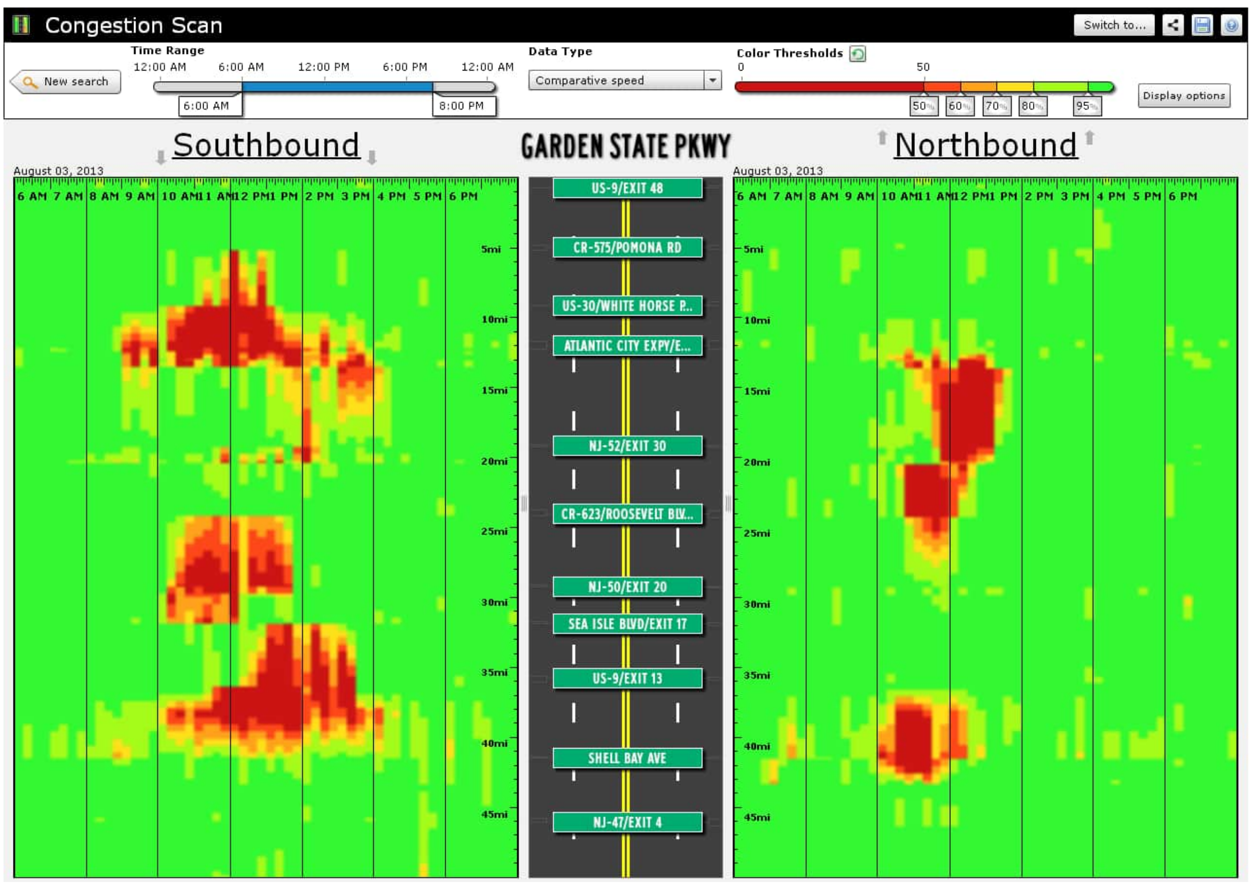


Figure A2.4-5: VPP Congestion Scan on GSP, Exit 30 and Vicinity

By examining the figure above, we can see distinctive areas of low travel speed in both the southbound and northbound directions. For each red area, the width corresponds with the duration of congestion, and the height corresponds with the length of the queues. The bottleneck selected for examination earlier is seen as the dark red area at the top of the southbound plot. This area shows that travel speeds as low as 20 mph are seen in the vicinity of the junction with the Atlantic City Expressway, indicating that this junction becomes congested during peak travel periods. Congestion at the toll plaza and junction with US-9 are seen as smaller red patches on the plot near the 20 mile marker.

The tools above also work in conjunction with the User Delay Cost Analysis tool. This tool gives users an estimate of the cost of delay, in dollars, on a particular roadway for a given time period. For the period in question, Saturday August 3rd, a User Delay Cost report was requested for the extent of the congestion scan in Atlantic and Cape May counties. The results are summarized in the tables below.

Figure A2.4-6: Cost of delay on the Garden State Parkway in Atlantic and Cape May counties: Saturday, August 3rd, 2014

Hour of Day	Delay (all vehicles, vehicle-hours)	Cost of delay (dollars)
6 AM	0.00	0.00
7 AM	0.00	0.00
8 AM	0.00	0.00
9 AM	24.72	925.52
10 AM	318.15	11,912.40
11 AM	353.77	13,246.07
12 PM	382.93	14,338.23
1 PM	201.28	7,536.59
2 PM	46.91	1,756.62
3 PM	0.00	0.00
4 PM	3.91	146.35
5 PM	0.00	0.00
6 PM	0.00	0.00
7 PM	3.93	147.10
8 PM	9.21	344.82
Daily Total	**1351.98**	**$50,622.26**

As seen above, the VPP estimates that delay on this typical Saturday costs travelers $50,622. For the entire year of 2013, VPP estimates a delay cost of $2,428,247. These figures may be used as an additional performance measure that is less abstract and more relatable. They may also be used to justify the cost of a transportation project.

To conclude, the tools provided by the VPP may be used in conjunction with one another to provide planners with a way to broadly screen for congested locations, identify potential bottlenecks, and quantify the extent, severity, and cost of congestion in these locations.