Disclaimer

The preparation of this report has been financed through the U.S. Department of Transportation’s Federal Transit Administration and Federal Highway Administration. This document is disseminated under the sponsorship of the New York Metropolitan Transportation Council in the interest of information exchange. The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Transit Administration, Federal Highway Administration or the State of New York. This report does not constitute a standard, specification or regulation.

Title VI Statement

The New York Metropolitan Transportation Council is committed to compliance with Title VI of the Civil Rights Act of 1964, the Civil Rights Restoration Act of 1987, and all related rules and statutes. NYMTC assures that no person or group(s) of persons shall, on the grounds of race, color, age, disability, national origin, gender, or income status, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any and all programs, services, or activities administered by NYMTC, whether those programs and activities are federally funded or not. It is also the policy of NYMTC to ensure that all of its programs, polices, and other activities do not have disproportionate adverse effects on minority and low income populations. Additionally, NYMTC will provide meaningful access to services for persons with Limited English Proficiency.
# Table of Contents

**INTRODUCTION** .................................................................................................................. I

1 **OVERVIEW** ......................................................................................................................... 1-1

2 **TRANSPORTATION SYSTEM CHARACTERISTICS** .......................................................... 2-1
   2.1 SOURCES OF CONGESTION .............................................................................................. 2-2

3 **THE CONGESTION MANAGEMENT PROCESS** .................................................................. 3-1
   3.1 PLAN 2045 STRATEGIC FRAMEWORK ........................................................................... 3-2
   3.2 THE CMP IN CONTEXT ..................................................................................................... 3-3

4 **ANALYSIS METHODOLOGY** .............................................................................................. 4-1
   4.1 ANALYSIS TOOLS ........................................................................................................... 4-1
   4.2 PERFORMANCE MEASURES ......................................................................................... 4-2
   4.3 DATA COLLECTION ........................................................................................................ 4-3
   4.4 CONGESTION ANALYSIS .............................................................................................. 4-4

5 **REGIONAL ANALYSIS** ....................................................................................................... 5-1
   5.1 COMPARISONS OF CONGESTION .................................................................................. 5-1
   5.2 PERFORMANCE MEASURES ......................................................................................... 5-5
   5.3 CRITICALLY CONGESTED ROADWAY CORRIDORS IN 2045 .............................................. 5-18

6 **COUNTY/BOROUGH CONGESTION ANALYSIS** ............................................................... 6-1

7 **CONGESTION MANAGEMENT STRATEGIES** ................................................................. 7-2

# List of Figures

Figure 1.1 - Map of NYMTC Region ............................................................................................ 1-1
Figure 2.1 - National Distribution of Sources of Congestion ..................................................... 2-3
Figure 3.1 - Actions Commonly Part of a Congestion Management Process ............................... 3-2
Figure 3.2 - CMP and the Metropolitan Planning Process ........................................................ 3-5
Figure 5.1 - Travel Volumes in New York and Comparable Metro Areas ................................. 5-2
Figure 5.2 - Measures of Systemwide Congestion ................................................................ 5-3
Figure 5.3 - Per Capita Annual Hours of Delay ........................................................................ 5-4
Figure 5.4 - Comparison of Travel Time Indices across U.S. Cities ........................................ 5-4
Figure 5.5 - NYMTC Planning Area Daily Vehicle Hours of Delay by County ......................... 5-9
Figure 5.6 - NYMTC Planning Area Daily Person Hours of Delay by County ......................... 5-9
Figure 5.7 - NYMTC Planning Area Daily Vehicle Miles Traveled by County ......................... 5-10
Figure 5.8 - Reliability on Select Highway Corridors in the NYMTC Region ............................ 5-12
Figure 5.9 - 2017 Jobs Accessible Within a 45 Minute Drive during a Morning Peak Commute.................. 5-14
Figure 5.10 - 2045 Jobs Accessible Within a 45 Minute Drive during a Morning Peak Commute.................. 5-15
Figure 5.11 - Top Congested Corridors New York City............................................................................. 5-18
Figure 5.12 - Top Congested Corridors Long Island .................................................................................. 5-19
Figure 5.13 - Top Congested Corridors Lower Hudson Valley ................................................................. 5-19
List of Tables

Table 5.1 - Comparison of Daily VMT per Capita and Travel Time Index ................................................................. 5-1
Table 5.2 - 2017 Regional Performance Measures ........................................................................................................... 5-6
Table 5.3 - 2045 Regional Performance Measures ........................................................................................................... 5-7
Table 5.4 - Percentage Difference between 2017 and 2045 ............................................................................................ 5-8
Table 5.5 - Commodity Flow by Direction for NYMTC Planning Area All Modes, 2012 and 2045 ............................... 5-17
Table 5.6 - Commodity Flow by Mode for NYMTC Planning Area All Modes, 2012 and 2045 ........................................ 5-18
INTRODUCTION

Under current federal planning regulations, metropolitan areas with populations greater than 200,000 are designated as Transportation Management Areas (TMAs) and are required to engage in a Congestion Management Process (CMP) to provide for “safe and effective integrated management and operation of the transportation system” (Sections 23 CFR 450.320 and 23 CFR 500.105). The CMP is required to include 1) methods to monitor and evaluate performance, 2) definition of congestion management objectives, 3) establishment of data collection and system performance monitoring programs, 4) identification and evaluation of performance and benefits of management strategies, 5) identification of an implementation schedule and responsibilities, and 6) a process for periodic assessment of the effectiveness of implemented strategies.

The planning area of the New York Metropolitan Transportation Council’s (NYMTC) meets the federal definition of a TMA. Therefore, NYMTC must systematically forecast traffic congestion in its planning area, produce specific performance measurements to identify levels of congestion, and prepare a program to reduce that congestion. NYMTC’s CMP fulfills these requirements and identifies strategies for congestion reduction as defined through its Regional Transportation Plan (Plan) and Transportation Improvement Program (TIP).

NYMTC’s CMP Operating Procedures stipulate that a status report should be issued every four years with each new Plan. The first CMP Status Report was issued in 2005. This 2017 CMP Status Report, organized into the following seven sections, has been developed in conjunction with NYMTC’s Plan 2045:

- An introduction, which summarizes the purpose of the CMP and the work conducted to produce the status report.
- Section 2 describes the transportation characteristics within the NYMTC planning area.
- Section 3 describes the federal regulations related to NYMTC’s CMP.
- Section 4 describes the methodology used for the CMP analysis, including tools used for analyzing congestion, selected performance measures, types of analysis performed, and reporting periods and scenarios are described.
- Sections 5 and 1 present the results of the CMP analysis at two levels – regional in Section 5 and county/borough-level in Section 1. In response to the CMP analysis results, a description of the strategies committed to and further discussed in the Plan, as well as a toolbox of strategies for mitigating congestion is provided.
1 OVERVIEW

NYMTC is a regional council designated by the Governor of the State of New York and certified by the federal government as the metropolitan planning organization (MPO) for New York City, suburban Long Island, and the lower Hudson Valley. The NYMTC planning area includes ten counties (five suburban counties and the five boroughs of New York City) with an area of approximately 2,440 square miles and a population of close to 12.4 million people (64 percent of the population of New York State). Figure 1.1 presents the counties of the NYMTC region.

Figure 1.1 - Map of NYMTC Region

Designated in 1982, NYMTC provides a collaborative forum for regional transportation planning for sixteen members. Those members include five suburban counties (Nassau, Suffolk, Westchester, Rockland, and Putnam) and the City of New York as represented by the New York City Department of Transportation and the New York City Department of City Planning, the New York State Department of Transportation, the Metropolitan Transportation Authority and seven advisory members, including the Port Authority of New York and New Jersey.

NYMTC’s Plan, entitled Plan 2045, acknowledges that roadway congestion will continue to be a major issue in the NYMTC planning area, given the increased demand on the transportation system from forecasted population, employment and economic growth. The CMP is intended to help NYMTC’s members to: (a) monitor and advise the regional planning processes by establishing an objective set of performance measures to define and quantify transportation system congestion; (b) provide a toolbox of strategies to address congestion; (c) provide a
methodology to evaluate and prioritize congestion-reducing projects and strategies, and (d) provided a mechanism to periodically assess the effectiveness of implemented strategies relative to previously established performance measures.¹

The 2017 CMP Status Report is organized into seven sections. Following this Overview, Section 2 describes the characteristics of the transportation system in the NYMTC planning area. Section 3 describes the relationship between federal regulations and elements of NYMTC’s planning and programming process, including the CMP. Section 4 describes the methodology used for the CMP analysis, including tools used for analyzing congestion, selected performance measures, types of analysis performed, and reporting periods and scenarios are described. The results of the CMP analysis are provided at two levels — regional and county/borough-level — in Sections 5 and 1, respectively. In response to the CMP analysis results, Section 7 describes the strategies committed to and further discussed in the Plan. Appendix A contains a toolbox of strategies for mitigating congestion, while Appendix B contains a worksheet summarizing the characteristics of the most congested corridors in each county or borough in the region.

2 Transportation System Characteristics

New York City’s metropolitan region has one of the oldest, largest, most complex and highly utilized transportation networks in the world. On a typical weekday, the region’s multimodal transportation network handles millions of passenger trips and thousands of tons of freight shipments. The share of travelers using public transportation is much higher than in other regions of the United States.

The NYMTC planning area is served by intercity rail, road, air, and waterborne networks. Amtrak’s busiest intercity station in the nation is Penn Station in Manhattan, which served roughly 10.2 million passengers in 2015. The Port Authority Bus Terminal in Manhattan has long been a primary location for long-distance bus service. In addition, since the late 1990s, curbside-pickup intercity carriers have played an increasing role in transporting bus passengers beyond the region.

The multi-state metropolitan region includes several major commercial service airports, including the John F. Kennedy (JFK) and LaGuardia (LGA) airports in New York City, Newark Liberty in northern New Jersey and several other reliever and general aviation airports and heliport facilities of varying sizes that together serve millions of passengers and ship tons of freight both within and immediately beyond NYMTC’s planning area. Finally, New York
and New Jersey host port facilities that are essential to international trade and domestic distribution with one of the largest concentrations of public and private marine terminal facilities in the United States.

Adjacent to NYMTC’s planning area, the northern New Jersey and southwestern Connecticut sub-regions contain transportation infrastructure that is inextricably linked with the New York sub-region. New Jersey Transit operates an extensive network of commuter rail, light rail and bus services, including services which enter the NYMTC planning area. New Jersey’s highways interface with New York at six bridges and tunnels, along with roads that cross the state line into Rockland County. Connecticut contracts with the MTA Metro-North Railroad to operate service on the New Haven Line and Connecticut Transit operates regional bus routes such as the I-Bus linking Stamford, CT with White Plains, NY. Numerous roads, bridges and tunnels or all functional classifications also cross state lines, and ferries regularly cross from New Jersey and Connecticut to New York destinations. A summary description of the multi-state transportation network can be found in Chapter 1 of Plan 2045.

### 2.1 Sources of Congestion

Congestion occurs when a transportation facility or service experiences demand that exceeds the capacities of the facilities or services. This results in overcrowded facilities and services, reduced throughput, reduced travel speeds, increased travel time, and increased crashes and incidents.

The Federal Highway Administration (FHWA) defines seven categories of the causes of traffic congestion:

- **Physical Bottlenecks** – where demand exceeds capacity: along roadways at intersections, interchanges, transit facilities (not represented in Table 1 statistics)
- **Traffic Incidents** – non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand (i.e., crashes, disabled vehicles)
- **Weather** – weather events such as snow storms or flooding due to rainfall
- **Work Zones** – construction activities on the roadway that temporarily reduce capacity like lane reductions, lane shifts, and detours
- **Special Events** – events that create a surge in traffic beyond normal traffic patterns such as sporting events, concerts, street festivals, visiting dignitaries
- **Traffic Demand and Flow Fluctuations** – day-to-day variability in traffic and peaking of demand which can be as much as 15 to 20% on an individual roadway depending on day of week
- **Traffic Operations** – disruption of traffic flow due to non-optimized or non-integrated signals and/or insufficient intersection capacity

The national averages in Figure 2.1 provide insights with regard to the sources of traffic congestion. It is no mystery that bottlenecks (40 percent) are the greatest source of congestion. It is probably not surprising that traffic cause 25 percent of congestion, but improvements in incident detection and systems management tools can bring this number down. In the NYMTC planning area, signal timing may contribute more than 5 percent as the signal density is greater than in most cities in the United States. The NYMTC planning area is a huge attraction for tourists and special events. In 2015, 58.5 million visited New York City generating over $42 billion in spending. It is probably

---

2 Traffic Incident Management Handbook, Parsons Brinckerhoff, 2000
3 NYC Travel & Tourism Visitation Statistics, 2015
safe to assume that congestion from special events in the NYMTC planning area probably contributes more than 5 percent to total congestion in the region.

**Figure 2.1 - National Distribution of Sources of Congestion**

There are several specific factors/issues that contribute to traffic congestion in the NYMTC planning area, including:

- The region’s topography. NYMTC’s planning area includes three large islands (Staten Island, Manhattan Island and Long Island) which, along with the Hudson River and Long Island Sound, create the need for numerous water crossings for roadways, rail lines and waterborne services. Limitations to the capacity of these crossings create congestion.

- Major transportation hubs, such as the regional and international airports in and around the NYMTC planning area, as well as major rail and bus stations and port facilities. Traffic to and from these transportation hubs creates major congestion issues along roadways and on rail lines.

- Large event venues, such as stadiums and arenas that generate considerable vehicle, transit and foot traffic.

- Tourist and recreational attractions, generating considerable visitor traffic on the public transit system and the pedestrian network, as well as on roadways.

- Significant goods movement, whether by truck, rail or barge, moving into, out of, within and through the NYMTC planning area.

---

"Figure ES.2 The Sources of Congestion National Summary, FHWA"
3 THE CONGESTION MANAGEMENT PROCESS

The CMP is required to include 1) methods to monitor and evaluate performance, 2) definition of congestion management objectives, 3) establishment of data collection and system performance monitoring programs, 4) identification and evaluation of performance and benefits of management strategies, 5) identification of an implementation schedule and responsibilities, and 6) a process for periodic assessment of the effectiveness of implemented strategies.

The CMP also includes requirements for the addition of roadway capacity in specific corridors or locations, including:

- All reasonable, multi-modal Transportation Systems Management and Operations (TSM&O) strategies must be analyzed in corridors where roadway capacity increase is proposed;
- If the analysis demonstrates that the TSM&O strategies cannot offset the need for additional capacity, the CMP shall identify all reasonable strategies for managing the increased roadway capacity effectively;
- All TSM&O strategies identified in the CMP shall be incorporated into roadway capacity projects or committed to by the State and the MPO; and
- Federal funds may not be programmed in a non-attainment TMA for any roadway capacity project unless based on an approved CMP.

Consistent with federal requirements, NYMTC’s CMP is a systematic process for planning to address system-level and corridor-level congestion by exploring the basic questions of where, when, and to what extent congestion occurs. The CMP also identifies strategies that can be considered by NYMTC’s members for reducing and managing congestion. NYMTC’s CMP is one component of the metropolitan transportation planning process and congestion, although very important, is not the sole factor under consideration when planning the priority of transportation improvements. The proper role of the CMP is as a specific element that adds value to the planning process by providing agencies, the public and decision-makers with a tool by which congestion can be examined in greater detail and more effectively addressed.

In 2011, the Federal Highway Administration (FHWA) issued an advisory document entitled Congestion Management Process: A Guidebook. The Guidebook is intended to provide guidance on “how to create an objectives driven, performance-based” Congestion Management Process. The Guidebook sets out an eight step Process Model comprised of elements or “actions” common to successful CMPs. The actions, shown in Figure 3.1, are considered essential to CMP formulation, but can be performed in varying sequences and, potentially, iteratively.

The Guidebook provides in-depth reviews of the recommended considerations, processes, and partners that should be involved in formulating each action. Of particular applicability to NYMTC are the actions that underpin and promote performance-based CMP development: Action 1 (develop regional objectives), Action 3 (develop multimodal performance measures), Action 6 (identify and assess strategies), and Action 8 (evaluate strategy effectiveness). The Guidebook includes a companion document that focuses on the visualization of results.

3.1 Plan 2045 Strategic Framework

NYMTC’s Plan 2045 includes a set of regional strategic goals along with specific desired outcomes and near-term actions. The eight shared goals are:

- Enhance the regional environment;
- Improve the regional economy;
- Improve the regional quality of life;
- Provide a convenient and flexible transportation system within the region;
- Enhance the safety and security of the transportation system for both motorized and non-motorized users;
- Improve the resiliency of the regional transportation system;
- Build the case for obtaining resources to implement regional investments; and
- Preserve the existing transportation system.
Several desired outcomes under these goals are directly related to the CMP. They include the following:

- Desired outcomes under the regional strategic goal “Enhance the Regional Economy”:
  - Reduced traffic congestion and improved air quality; and
  - Reduced greenhouse gas emissions.
- Desired outcomes under the regional strategic goal “Provide a Convenient and Flexible Transportation System within the Region”:
  - A sufficient array of transportation choices;
  - Expanded connections, particularly across modes and between communities; and
  - Increased reliability for passenger and freight trips.

In order to pursue these relevant goals and desired outcomes, NYMTC’s CMP has been designed to provide and make available:

- Performance measures for regional levels of traffic delay and congestion;
- Data and procedures for measuring changes in regional traffic conditions;
- Forecasts of future congestion levels derived from the Plan’s regional population and employment forecasts;
- A catalogue of strategies for reducing and managing congestion; and
- County/Borough-level and corridor-level forecasts of congestion.

### 3.2 The CMP in Context

Roadway traffic congestion occurs when vehicle volumes exceed the available capacity of the roadway. Generally, traffic congestion can be categorized as either recurring or nonrecurring. Recurring traffic congestion is caused by the predictable daily use of roadways for work, school, services, and leisure activities. Recurring congestion is exacerbated as demand for road space continues to grow through population and job growth, decreasing land use densities, higher rates of automobile ownership, and rapid growth in truck freight. In contrast, nonrecurring traffic congestion is caused by atypical events, such as highway crashes, other incidents that close lanes or roads, weather conditions, or an increase in traffic demand caused by special events.

According to the Texas A&M Transportation Institute, the New York area has five of the top 20 ranked corridors for least reliable travel based on weekday peak period travel time reliability. New York also had the second highest number of corridors (nine) ranked for truck delay. Traffic congestion is a significant impediment to mobility in the NYMTC planning area and has many negative effects, including increased fuel consumption, air quality impacts, increased vehicular travel costs, and increased costs for shipping goods.

As explained in the Section 4 Analysis Methodology, the CMP has been designed to make use of the New York Best Practice Model (NYBPM), which is NYMTC’s regional transportation demand simulation model, to develop forecasts of congestion-related performance measures, and to integrate the findings of the CMP into NYMTC’s metropolitan transportation planning process.
The CMP procedures closely integrate the CMP with the metropolitan transportation planning process, as illustrated in Figure 3.2. The CMP is integrated into the planning process as part of the development of the following regional planning and programming documents:

- The Plan, which defines the region’s transportation needs and lays out a long range planning framework for improving the transportation system over a minimum of a twenty-year period;
- The TIP, which is a five-year program of all proposed federally funded transportation projects in the NYMTC region; and
- The Unified Planning Work Program, which defines NYMTC’s annual planning activities.

The CMP involves the direct participation of NYMTC’s member agencies. At the regional level, the New York Best Practice Model (NYBPM) is the demand modelling tool used for estimating the extent of existing traffic congestion and forecasting the level of future congestion. At the subarea or corridor-level, other appropriate technical tools are also utilized to meet CMP requirements, as described in detail in Section 4.

For selected congestion locations, NYMTC’s CMP provides a toolbox of strategies to address congestion for consideration by the member agencies (see Section 7 and Appendix A). The member agencies propose mitigation projects utilizing the feasible strategies identified through the CMP. This process is repeated every planning cycle, or as needed by the members. Thus, it is both an interactive and iterative process.

System monitoring and data collection are also critical elements of the integration of CMP into NYMTC’s overall planning process. Monitoring and data collection efforts provide feedback on the effectiveness of strategies at various levels, which ultimately influences regional policy, planning, and programming of projects for addressing congestion.

The CMP can also be an important input into the development of major project analyses and subarea or corridor studies. First, it provides county/borough-level and corridor-level performance information, which may be used to target corridors or locations for detailed analysis. Second, the CMP toolbox identifies alternative congestion management strategies for consideration in studies of this type, which ultimately define transportation improvements. This does not preclude the study from considering other strategies that may not be in the CMP, nor does it require that the study select a strategy from the CMP as the preferred alternative.
Figure 3.2 - CMP and the Metropolitan Planning Process

- **Regional Transportation Plan**: Defines long-range needs.
- **Unified Planning Work Program and Members' Planning**: Defines the improvements.
- **Transportation Improvement Program**: Defines schedule and funding.
- **Congestion Management Process and Regional Emissions Analysis**: Analyzes impacts.
- **Project Planning and Implementation**: Implements improvements.
4 Analysis Methodology

This section outlines the methodology used to identify and quantify congestion in the NYMTC planning area. It includes an overview of the transportation area and network, tools used to analyze congestion, the NYBPM, selected performance measures, types of congestion analysis, and reporting periods and scenarios. NYMTC’s CMP is applicable to the entire 10-county planning area. Within that area, the CMP is focused on the roadway system—specifically, all roadway functional classes from freeways to minor arterial roadways.

4.1 Analysis Tools

The NYBPM, used with a travel demand model post processor, is the analysis tool used to forecast and analyze traffic congestion within the NYMTC planning area. The NYBPM is a suite of activity-based travel demand forecasting sub-models that contains a coded representation of the transportation system—both roadways and transit services—in 28 contiguous counties in New York, New Jersey, and Connecticut, including the 10-county NYMTC planning area. The roadway network in the NYBPM is represented by over 60,000 highway links, and the transit network is represented through over 4,000 transit routes that include route variations for all forms of public transportation, such as commuter rail, subway, express bus, local bus, and ferry. The NYBPM can be used to forecast travel patterns by time periods, trip purposes, and modes of travel.\(^6\)

The NYBPM employs the following input data:

- Socioeconomic and Demographic (SED) forecasts – household, population, and employment county forecasts disaggregated to 16 variables at the NYBPM zonal level, with future year forecasts extending to 2045;
- Census data;
- Travel characteristics collected through the Regional Household Travel Survey;
- Twenty-four-hour traffic counts at screen-line locations; and
- Transit ridership counts.

For the 2017 CMP Status Report, the NYBPM was used to estimate the 2017 base year traffic congestion levels, as well as to forecast traffic congestion in the 2045 horizon year. The congestion analysis, described in more detail below, was based on the most recent NYBPM forecasts, which include the programs and projects contained in the fiscally-constrained element of Plan 2045 and the Federal Fiscal Years (FFYs) 2017–2021 TIP.

A post-processor was used to develop CMP performance measures from NYBPM outputs. To calculate traffic volumes, the post-processor uses the AM and PM peak period and two off-peak period assignments along with a 24-hour traffic volume distribution file (by county and function class) to develop hourly volumes for each roadway link in the NYBPM. The post-processor computes speeds on all of the links for each hour of the day based on the 24-hour distribution of volumes.

4.2 Performance Measures

As required, NYMTC’s CMP employs performance measures to assess the effectiveness and efficiency of the roadway system. These measures are separate and apart from those newly defined under federal Transportation Performance Management requirements. The CMP-related performance measures are described below:

- **Demand-to-Capacity (D/C)** ratio is a measure that reflects the level of mobility and the quality of travel of a roadway or a section of a roadway. The D/C ratio compares the roadway capacity with the estimated trip demand generated directly from the travel demand models. The capacity of a roadway is defined as the theoretical maximum volume that can be processed by that roadway during a specified time period. The main advantage of using D/C ratio (instead of the conventional vehicle to capacity or V/C ratio) is to allow estimation of congestion explicitly based on travel demand. (Note: Under saturated flow conditions, field counts cannot reflect the actual travel demand and hence do not provide reliable information about the intensity of congestion, whereas the travel model provides a more comprehensive demand estimate.)

- **Vehicle Hours of Delay (VHD)** is the sum total of delay experienced by all vehicles on the network. Delay is defined as the difference between estimated actual travel speed and free flow travel speed, and is therefore a measure that is readily understood by the traveling public.

- **Person Hours of Delay (PHD)** is calculated by multiplying VHD by the average vehicle occupancy rate. As vehicle occupancy differs from place to place, the following rates were used: 1.48 for New York City counties, 1.75 for Nassau and Suffolk counties, and 1.44 for Westchester, Rockland, and Putnam counties.

- **Average Travel Speed (ATS)** is the calculation for a weighted average of speed. The average speed for each element of the road system is multiplied by the amount of travel on the set of roads. Using the amount of travel as a weighting factor provides an average “system experience” of travelers for each portion of the road system.

- **Lane Miles of Congestion** measures the road space that functions at less than free-flow speeds during the peak, and compares actual roadway volume with maximum acceptable volume for the roadway. It reflects the mobility of roadway or section of roadway, indicating the proportion that is congested. Lane Miles of Congestion can easily be aggregated from facility to corridors to sub-regional to region. For purposes of this performance measure, a roadway is defined as congested if the volume is greater than or equal to 85 percent of the Maximum Acceptable Volume (MAV) for that roadway (essentially the Level of Service E volume).

- **Travel Time Index (TTI)** is the ratio of peak-period travel time to free-flow travel time. The TTI expresses the average amount of extra time it takes to travel in the peak relative to free flow travel. For example, a TTI of 1.5 for a specific route indicates that if the free-flow time is 30 minutes, the travel time during peak congestion is 45 minutes (30 x 1.5 = 45).

For this update there are two TTI performance measures calculated. The first is a TTI for all vehicles along all roadways in the network. The second is a TTI specific for freight (truck) vehicles along roadways where trucks are allowed to travel. The truck based TTI is a measure that allows for identification of corridors and bottlenecks specific to freight.

- **Vehicle Miles Traveled (VMT)** is another performance measure that is developed by the post processor. VMT is the sum of distances traveled by all motor vehicles in a specified region. Travel demand forecasting is used to generate the average trip lengths for a region. The average trip length measure is then used to estimate vehicle miles of travel, which in turn is used in estimating gasoline usage or mobile source emissions of air pollutants. It should be noted that VMT estimated by the travel model was adjusted for consistency with the observed travel in the base year that is reported for the federally mandated Highway Performance Monitoring System (HPMS). For the 2017 CMP analysis base year VMT adjustments were made based on the 2010 version of the NYBPM.
• **Accessibility** indicates the collective performance of land use and transportation systems and determines how well that complex system serves its residents. There may be many ways of improving transportation, including improved mobility, improved land use accessibility (which reduce the distance between destinations), or improved mobility substitutes such as telecommunications or delivery services. This performance measure was evaluated outside the post processor environment.

• **Reliability** is the consistency or dependability in travel times for each link, by time period, for one day. Reliability is calculated as the average standard deviation of travel time, on links of each road group (freeways, arterials, and local streets), within a county.

### 4.3 Data Collection

NYMTC’s CMP is built on a large database that includes information describing regional travel patterns, the regional transportation network, and regional socioeconomic/demographic patterns. These data provide the basic information to assess the state of existing and forecast traffic congestion on the regional transportation system. NYMTC and its members collect these data to update, calibrate, and validate the NYBPM, among other purposes. The NYBPM highway and transit networks represent the region’s transportation system and simulate travel conditions. The data required to adequately model the highway and transit networks include the following items:

• Roadway classifications
• Number of lanes
• Posted speed limits
• Parking restrictions
• Truck usage
• Subway and commuter rail routes and schedules
• Bus routes and schedules
• Ferry routes and schedules

NYMTC collects and maintains a large socioeconomic and demographic database at transportation analysis zone (TAZ) level covering the 28 counties in the NYBPM study area. The data variables summarized by TAZs include:

• Total population
• Household population
• Group quarters population (total, in institutions, homeless/streets, other)
• Households; average household size and income
• Employed labor force
• Employment (total, office, retail)
• Average earnings per worker
• K-12 school enrollment
• University enrollment
4.4 Congestion Analysis

Types of Analyses

Three types of analyses were performed to forecast traffic congestion within the NYMTC planning area for the 2017 CMP Status Report: a regional-level analysis, a county-/borough-level analysis, and identification of bottlenecks (congested locations).

The regional-level analysis was performed to assess traffic congestion and the performance of the transportation system on a regional scale. The CMP regional analysis allows a means for assessing the effectiveness of planned transportation improvements in addressing future traffic congestion.

The county/borough-level analysis is a subset of the regional analysis, focusing on congestion and system performance in each county and facility group in NYMTC’s planning area.

The hot spot analysis identifies bottleneck locations and congested areas within each of the ten counties/boroughs in the NYMTC planning area. A bottleneck is defined as a specific location that causes localized, point-source congestion on the regional transportation system. A bottleneck typically occurs due to physical capacity constraints or other characteristics that affect traffic flow, such as traffic control devices and weaving movements. The congested area is defined as an area consisting of a set of congested links in proximity or in sequence. Two criteria were used to identify the congested areas within each county, including:

- Demand-to-Capacity (D/C) ratios (greater than 0.8) as an initial screening process; and
- Visual inspection of corridors or areas that experience congestion defined by high D/C ratios.

The CMP Post-Processor identifies congested roadway links for each time period described below. It identifies and creates a map of up to ten top congested links for each county. It also reports all congested links with Demand-to-Capacity ratios between 0.8 and 1.0 and above 1.0 as this is the Demand-to-Capacity threshold used to select bottleneck locations in each county.

Time Periods

For the 2017 CMP Status Report, three time periods (weekday AM peak period, weekday PM peak period, and 24-hour weekday period) and two scenarios (2017 Base Year and 2045 Build) were used for the regional-level and county-level congestion analyses.

The weekday AM and PM peak periods were chosen under the assumption that a significant percentage of the recurring delay can be captured by analyzing these two time periods. The AM peak period is the four-hour morning period lasting from 6:00 AM to 10:00 AM Congestion in this period is typically of greater intensity and shorter duration than the PM peak period and consists primarily of trips between work and home.

The PM peak period is the four-hour evening period lasting from 4:00 to 8:00 PM Congestion in this period is typically of longer duration and lesser intensity than the AM peak period. Trip-making characteristics also are different; while some trips are the reverse of the AM peak period trips (such as work-to-home trips); a significant number of trips are from work to other locations, or from home to other destinations such as retail or recreational. These characteristics are captured by the activity-based structure of the NYBPM.

The peak periods have been selected for analysis instead of the peak hour to account for both the intensity and duration of traffic congestion in the NYMTC planning area. Therefore, only those segments that experience an average demand-to-capacity ratio of 0.8 or greater during the entire AM or PM peak period were identified as a
congested link for CMP purposes. The weekday period is the entire 24-hour period. This time period is included as it captures the entire trip-making activity of the population on a typical weekday for all purposes. Although congestion is generally not perceived as occurring on a daily level, a 24-hour study period provides an estimate for the range of congestion throughout the entire day.

**Analysis Years**

In this CMP Status report congestion analysis has been done for the 2017 Base year and the 2045 Forecast Year (RTP forecast year). The 2017 Base Year scenario reflects current congestion in the NYMTC planning area. The RTP’s 2045 Forecast Year is considered the Build Scenario as it includes all transportation improvements NYMTC has made a commitment to by programming them in the 2017-2021 TIP or including them in the fiscally constrained element of the Plan 2045. These are employed for forecasts of future traffic congestion.

**Identification of Congested Corridors – Methodology**

The hot spot analysis identifies problem areas with high congestion levels for the entire NYMTC planning area based on high demand-to-capacity ratios. When evaluated at the county level, the process helps to isolate local congestion problems. This effort directly supports the selection and prioritization of potential congestion mitigation projects.

Specific areas of congestion – bottlenecks – are currently reported by the CMP Post Processor and based on demand-to-capacity ratio for each transportation network segment for all four time periods, as well as a daily statistic. The 10 top locations within the highest demand-to-capacity ratio are selected in each county.

To identify congested corridors, congested links identified by the post processor in each county were further evaluated with Congestion Ranks that include the following scoring components and weights:

- **Importance** – Functional class of the roadway (15 percent);
- **Magnitude** – Daily one-way traffic on the link (45 percent);
- **Intensity** – Level of congestion that is based on demand-to-capacity ratio (25 percent); and
- **Consistency** – length of the corridor of consecutive congested links on the transportation network (15 percent).

By design, **Magnitude** or Volume is considered to be a high priority in assessing congested corridors. High daily volume is usually an indicator of a corridor where congestion is present.

Second highest is the **Intensity** or demand-to-capacity ratio. The highest hourly D/C ratio represents how “intense” congestion is in the peak-of-the-peak. Intensity is important as it represents the highest deviation from “normal” traffic conditions.

Higher functional class roads (i.e., freeways) are more important in the regional travel system than arterials and local roads. Importance gives the higher weights to more regional roads.

The length of a congested corridor or **Consistency** has a bearing on the how much of the network is impacted by the congestion of a particular road.

Examples of other possible link scoring components could include severity, based on link average speed estimated by the post processor.
5 Regional Analysis

This section discusses the level of congestion forecast for the entire NYMTC planning area in 2017 and 2045. Congestion levels in the New York metropolitan region are first benchmarked against congestion in other peer regions. Section 5.2 discusses performance measures derived from the forecasts. Section 5.3 presents the top congested corridors in New York City, suburban Long Island and the lower Hudson Valley.

5.1 Comparisons of Congestion

The NYMTC planning area is second only to the greater Los Angeles region (Los Angeles, Long Beach, Santa Ana) in terms of total population, but far exceeds the population density of any other metropolitan region in the country. Among the large peer regions shown in Table 5.1 - Comparison of Daily VMT per Capita and Travel Time Index, the NYMTC planning area has the fourth lowest daily VMT per capita due mainly to high population density and high proportion of transit use.

Table 5.1 - Comparison of Daily VMT per Capita and Travel Time Index

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Population (million)</th>
<th>Daily VMT/Capita (Freeway + Arterial)</th>
<th>Travel Time Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta</td>
<td>4.50</td>
<td>21.56</td>
<td>1.24</td>
</tr>
<tr>
<td>Dallas Fort Worth</td>
<td>5.49</td>
<td>19.35</td>
<td>1.27</td>
</tr>
<tr>
<td>Los Angeles, Long Beach, Anaheim</td>
<td>12.64</td>
<td>19.05</td>
<td>1.43</td>
</tr>
<tr>
<td>Houston</td>
<td>5.00</td>
<td>18.18</td>
<td>1.33</td>
</tr>
<tr>
<td>Boston</td>
<td>4.44</td>
<td>17.39</td>
<td>1.29</td>
</tr>
<tr>
<td>Washington D.C.</td>
<td>4.92</td>
<td>17.18</td>
<td>1.34</td>
</tr>
<tr>
<td>Seattle</td>
<td>3.33</td>
<td>16.76</td>
<td>1.38</td>
</tr>
<tr>
<td>Chicago</td>
<td>8.70</td>
<td>15.39</td>
<td>1.31</td>
</tr>
<tr>
<td>San Francisco, Oakland</td>
<td>3.48</td>
<td>15.01</td>
<td>1.41</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>5.56</td>
<td>14.77</td>
<td>1.24</td>
</tr>
<tr>
<td>NYMTC planning area (from 2017 CMP estimates)</td>
<td>12.44</td>
<td>13.03</td>
<td>1.21</td>
</tr>
</tbody>
</table>

Source: Texas A&M Transportation Institute, 2015 Urban Mobility Scorecard (all regions except NYMTC).

NYMTC’s peer regions evaluate mobility and congestion performance measures as part of their federally-required CMPs; however, comparative performance measurement across regions is difficult given the many different measures and methodologies used to evaluate congestion. Data from the Texas A&M Transportation Institute’s 2015 Urban Mobility Scorecard Report—the latest available as of this writing—which assesses congestion in 101 Metropolitan Statistical Areas (MSAs) across the country was reviewed to provide a comparison of congestion estimated in the NYMTC planning area through the CMP. The Report provides estimates of travel, several metrics of overall congestion, plus specific analyses of the impacts of system operations and public transportation on congestion.

For the purposes of this analysis, we compared the NYMTC planning area to other metropolitan areas in the ‘very large’ category, which includes MSAs with over 3 million residents. In 2014, there were 11 MSAs with over 3 million residents.
Travel Estimates

In terms of total travel, only Los Angeles metro area exceeds the volume of travel experienced in New York and no other metro area comes close. Figure 5.1 presents the travel on freeways, and arterials for the average of the very large areas and the top 5 travel markets.

**Figure 5.1 - Travel Volumes in New York and Comparable Metro Areas**

System Congestion

Figure 5.2 shows three indicators of total congestion for the 15 very large metropolitan areas:

- The percentage of travel that is in congested conditions (x-axis)
- The percentage of the system that is congested (y-axis)
- Total delay (bubbles are sized based on total delay)

The New York MSA is shown in red and the average of all 15 areas is shown in orange. By percentage of travel or system, New York is not the most congested MSA. However, because of the amount of travel, New York travelers experience the most aggregate delay (over 600 million hours per year), with only travelers in Los Angeles experiencing anything close to the level of delay.
On a per-capita basis, travelers in the New York metropolitan region experience the fourth highest level of travel time delay per year according to the 2015 Urban Mobility Scorecard Report data, with Washington, D.C., Los Angeles, and San Francisco metropolitan areas exceeding New York levels (Figure 5.3).

The extensive public transportation system in the New York metropolitan region is illustrated by the comparison of travel time index (TTI) and planning time index (PTI) (Figure 5.4), where TTI is the ratio of travel time in the peak period to travel time at free-flow conditions. A TTI of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period. The PTI is the ratio of travel time on the worst day of the month to travel time at free-flow conditions. A PTI of 1.80 indicates a traveler should plan for 36 minutes for a trip that takes 20 minutes in free-flow conditions (20 minutes x 1.80 = 36 minutes). The PTI is computed for freeways only; it does not include arterial roadways. When a PTI is followed by a number, the number indicates a percentage of on-time arrival.
**Figure 5.3 - Per Capita Annual Hours of Delay**

<table>
<thead>
<tr>
<th>City</th>
<th>Annual Hours of Delay per Commuter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington D.C.</td>
<td></td>
</tr>
<tr>
<td>Los Angeles, Long Beach, Anaheim</td>
<td></td>
</tr>
<tr>
<td>San Francisco Bay Area</td>
<td></td>
</tr>
<tr>
<td>New York-Newark (NY/NJ/CT)</td>
<td></td>
</tr>
<tr>
<td>Boston</td>
<td></td>
</tr>
<tr>
<td>Seattle</td>
<td></td>
</tr>
<tr>
<td>Houston</td>
<td></td>
</tr>
<tr>
<td>Chicago Bay Area</td>
<td></td>
</tr>
<tr>
<td>Very Large Area Average</td>
<td></td>
</tr>
<tr>
<td>Dallas Fort Worth</td>
<td></td>
</tr>
<tr>
<td>Miami</td>
<td></td>
</tr>
<tr>
<td>Detroit</td>
<td></td>
</tr>
<tr>
<td>Atlanta</td>
<td></td>
</tr>
<tr>
<td>Phoenix Bay Area</td>
<td></td>
</tr>
<tr>
<td>Philadelphia</td>
<td></td>
</tr>
<tr>
<td>San Diego</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5.4 - Comparison of Travel Time Indices across U.S. Cities**

<table>
<thead>
<tr>
<th>City</th>
<th>Ratio of Travel Time in Peak Period to Travel Time at Free-Flow Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philadelphia</td>
<td></td>
</tr>
<tr>
<td>Atlanta</td>
<td></td>
</tr>
<tr>
<td>San Diego</td>
<td></td>
</tr>
<tr>
<td>Dallas Fort Worth</td>
<td></td>
</tr>
<tr>
<td>Phoenix</td>
<td></td>
</tr>
<tr>
<td>Detroit</td>
<td></td>
</tr>
<tr>
<td>Boston</td>
<td></td>
</tr>
<tr>
<td>Miami</td>
<td></td>
</tr>
<tr>
<td>Very Large Area Average</td>
<td></td>
</tr>
<tr>
<td>Houston</td>
<td></td>
</tr>
<tr>
<td>Chicago</td>
<td></td>
</tr>
<tr>
<td>New York-Newark</td>
<td></td>
</tr>
<tr>
<td>San Francisco, Oakland</td>
<td></td>
</tr>
<tr>
<td>Seattle</td>
<td></td>
</tr>
<tr>
<td>Washington D.C.</td>
<td></td>
</tr>
<tr>
<td>Los Angeles, Long Beach</td>
<td></td>
</tr>
</tbody>
</table>

Note: TTI is the ratio of travel time in the peak period to travel time at free-flow conditions. PTI is the ratio of travel time on the worst day of the month to travel time at free-flow conditions; PTI95 translates to the additional time required to ensure an on-time arrival 95 percent.
5.2 Performance Measures

Table 5.2 and Table 5.3 provide regional performance measures in the NYMTC planning area, by county, for the years 2017 and 2045. Table 5.4 provides a percentage difference between the two. The first two tables provide estimates by county and time period for the following measures:

- Lane miles of congestion (LMC)
- The travel time index (TTI) for all vehicles and trucks
- Daily vehicle miles traveled (VMT)
- Vehicle hours of delay (VHD)
- Person hours of delay (PHD)
- Vehicle hours of delay per one thousand miles traveled
- Daily person hours of delay per capita

Lane miles of congestion appear to be consistently higher in the AM peak compared to the PM peak, across counties. TTI estimates reflect the same pattern. According to the Texas A&M Transportation Institute 2011 Congested Corridors Report, in the case of Very Large urban areas (greater than three million residents), the minimum TTI value for a portion of an hour to be considered congested is 1.12. Queens has amongst the highest vehicle and highway person hours of delay, followed by Manhattan and Brooklyn. Queens' high estimate for LMC is likely due to several very congested roadways that pass through the borough, including the Long Island Expressway, the Brooklyn-Queens Expressway, the Van Wyck Expressway, and the Grand Central Parkway. However, the suburban Long Island counties exhibit the highest levels of VMT.

Across all counties, total VHD per one thousand miles traveled increases significantly by 30% between 2017 and 2045. Rockland County, however, is forecast to grow by 172% between 2017 and 2045, a result of the large growth compared to the relatively small base of VHD. Figure 5.5, Figure 5.6, and Figure 5.7 represent modeled VHD, PHD, and VMT, at a county level, for years 2017 and 2045.
### Table 5.2 - 2017 Regional Performance Measures

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>LMC AM</th>
<th>TTI (Weighted by VMT) AM</th>
<th>VHD AM Daily</th>
<th>VMT AM Daily</th>
<th>PHD AM Daily</th>
<th>VHD per Lane Miles Daily</th>
<th>PHD per Capita Daily</th>
<th>VMT per Capita Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New York City Boroughs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronx</td>
<td>371</td>
<td>24</td>
<td>1.67</td>
<td>1.05</td>
<td>179,721</td>
<td>8,859,310</td>
<td>265,986</td>
<td>0.19</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>725</td>
<td>280</td>
<td>1.85</td>
<td>1.23</td>
<td>386,044</td>
<td>12,397,123</td>
<td>571,345</td>
<td>0.22</td>
</tr>
<tr>
<td>Manhattan</td>
<td>368</td>
<td>341</td>
<td>1.71</td>
<td>1.31</td>
<td>389,309</td>
<td>8,804,885</td>
<td>576,176</td>
<td>0.37</td>
</tr>
<tr>
<td>Queens</td>
<td>1,256</td>
<td>254</td>
<td>2.14</td>
<td>1.20</td>
<td>799,586</td>
<td>19,658,724</td>
<td>1,183,387</td>
<td>0.52</td>
</tr>
<tr>
<td>Staten Island</td>
<td>95</td>
<td>20</td>
<td>1.22</td>
<td>1.03</td>
<td>66,842</td>
<td>5,694,789</td>
<td>98,927</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Suburban Counties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nassau</td>
<td>371</td>
<td>24</td>
<td>1.67</td>
<td>1.05</td>
<td>179,721</td>
<td>8,859,310</td>
<td>265,986</td>
<td>0.20</td>
</tr>
<tr>
<td>Suffolk</td>
<td>227</td>
<td>262</td>
<td>1.07</td>
<td>1.05</td>
<td>293,417</td>
<td>40,983,205</td>
<td>513,480</td>
<td>0.35</td>
</tr>
<tr>
<td>Putnam</td>
<td>7</td>
<td>0</td>
<td>1.03</td>
<td>1.00</td>
<td>3,288</td>
<td>3,484,730</td>
<td>4,734</td>
<td>0.05</td>
</tr>
<tr>
<td>Rockland</td>
<td>73</td>
<td>12</td>
<td>1.08</td>
<td>1.01</td>
<td>23,964</td>
<td>8,275,831</td>
<td>34,507</td>
<td>0.11</td>
</tr>
<tr>
<td>Westchester</td>
<td>164</td>
<td>76</td>
<td>1.05</td>
<td>1.00</td>
<td>114,323</td>
<td>24,679,612</td>
<td>164,625</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYMTC Planning Area</td>
<td>3,658</td>
<td>1,433</td>
<td>1.33</td>
<td>1.08</td>
<td>2,612,397</td>
<td>162,070,083</td>
<td>4,036,002</td>
<td>0.32</td>
</tr>
</tbody>
</table>

D/C = Demand to Capacity; LMC = Lane Miles of Congestion; TTI = Travel Time Index; ATS = Average Travel Speed; VHD = Vehicle Hours of Delay; PHD = Person Hours of Delay; VMT = Vehicle Miles Traveled

Note: D/C = average Demand to Capacity for the particular facility type and period. The “0.8<=D/C<=1” and “D/C>1” are the percent of travel that occurs in various conditions (somewhat congested and very congested).
### Table 5.3 - 2045 Regional Performance Measures

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>AM LMC</th>
<th>PM LMC</th>
<th>AM TTI</th>
<th>PM TTI</th>
<th>Daily VHD</th>
<th>Daily VMT</th>
<th>Daily PHD</th>
<th>VHD per Lane Miles</th>
<th>PHD per Capita</th>
<th>VMT per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New York City Boroughs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronx</td>
<td>439</td>
<td>36</td>
<td>1.78</td>
<td>1.09</td>
<td>233,698</td>
<td>9,664,710</td>
<td>345,873</td>
<td>13.73</td>
<td>0.22</td>
<td>6.22</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>823</td>
<td>329</td>
<td>1.95</td>
<td>1.27</td>
<td>472,345</td>
<td>13,244,902</td>
<td>699,072</td>
<td>16.28</td>
<td>0.25</td>
<td>4.67</td>
</tr>
<tr>
<td>Manhattan</td>
<td>407</td>
<td>415</td>
<td>1.77</td>
<td>1.40</td>
<td>457,656</td>
<td>9,368,120</td>
<td>677,331</td>
<td>30.04</td>
<td>0.42</td>
<td>5.75</td>
</tr>
<tr>
<td>Queens</td>
<td>1,400</td>
<td>311</td>
<td>2.30</td>
<td>1.28</td>
<td>965,629</td>
<td>21,083,998</td>
<td>1,429,132</td>
<td>27.74</td>
<td>0.60</td>
<td>8.79</td>
</tr>
<tr>
<td>Staten Island</td>
<td>143</td>
<td>31</td>
<td>1.28</td>
<td>1.08</td>
<td>97,342</td>
<td>6,170,281</td>
<td>144,066</td>
<td>10.05</td>
<td>0.29</td>
<td>12.47</td>
</tr>
<tr>
<td><strong>Suburban Counties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nassau</td>
<td>439</td>
<td>36</td>
<td>1.78</td>
<td>1.09</td>
<td>233,698</td>
<td>9,664,710</td>
<td>345,873</td>
<td>6.00</td>
<td>0.22</td>
<td>6.23</td>
</tr>
<tr>
<td>Suffolk</td>
<td>286</td>
<td>372</td>
<td>1.11</td>
<td>1.08</td>
<td>482,490</td>
<td>46,643,765</td>
<td>844,358</td>
<td>7.22</td>
<td>0.51</td>
<td>28.18</td>
</tr>
<tr>
<td>Putnam</td>
<td>15</td>
<td>1</td>
<td>1.04</td>
<td>1.00</td>
<td>4,808</td>
<td>3,935,760</td>
<td>6,925</td>
<td>0.51</td>
<td>0.06</td>
<td>36.91</td>
</tr>
<tr>
<td>Rockland</td>
<td>136</td>
<td>29</td>
<td>1.15</td>
<td>1.02</td>
<td>46,716</td>
<td>10,180,661</td>
<td>67,271</td>
<td>3.61</td>
<td>0.18</td>
<td>26.54</td>
</tr>
<tr>
<td>Westchester</td>
<td>278</td>
<td>117</td>
<td>1.08</td>
<td>1.00</td>
<td>183,043</td>
<td>28,207,146</td>
<td>263,582</td>
<td>4.71</td>
<td>0.24</td>
<td>25.39</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYMTC Planning Area</td>
<td>4,436</td>
<td>1,862</td>
<td>1.39</td>
<td>1.11</td>
<td>3,482,588</td>
<td>181,277,599</td>
<td>5,420,613</td>
<td>12.76</td>
<td>0.40</td>
<td>13.22</td>
</tr>
</tbody>
</table>

D/C = Demand to Capacity; LMC = Lane Miles of Congestion; TTI = Travel Time Index; ATS = Average Travel Speed; VHD = Vehicle Hours of Delay; PHD = Person Hours of Delay; VMT = Vehicle Miles Traveled

Note: D/C = average Demand to Capacity for the particular facility type and period. The “0.8<=DC<=1” and “D/C>1” are the percent of travel that occurs in various conditions (somewhat congested and very congested).
## Table 5.4 - Percentage Difference between 2017 and 2045

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>LMC (Weighted by VMT)</th>
<th>TTI</th>
<th>VHD</th>
<th>VMT</th>
<th>PHD</th>
<th>VHD per Lane Miles</th>
<th>PHD per Capita</th>
<th>VMT per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
<td>PM</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td><strong>New York City Boroughs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronx</td>
<td>18.1%</td>
<td>49.2%</td>
<td>7.1%</td>
<td>3.5%</td>
<td>30.0%</td>
<td>9.1%</td>
<td>30.0%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>13.5%</td>
<td>17.6%</td>
<td>5.5%</td>
<td>3.2%</td>
<td>22.4%</td>
<td>6.8%</td>
<td>22.4%</td>
<td>21.5%</td>
</tr>
<tr>
<td>Manhattan</td>
<td>10.4%</td>
<td>21.6%</td>
<td>3.5%</td>
<td>6.5%</td>
<td>17.6%</td>
<td>6.4%</td>
<td>17.6%</td>
<td>17.2%</td>
</tr>
<tr>
<td>Queens</td>
<td>11.5%</td>
<td>22.5%</td>
<td>7.6%</td>
<td>6.1%</td>
<td>20.8%</td>
<td>7.3%</td>
<td>20.8%</td>
<td>19.9%</td>
</tr>
<tr>
<td>Staten Island</td>
<td>49.7%</td>
<td>59.4%</td>
<td>4.8%</td>
<td>4.6%</td>
<td>45.6%</td>
<td>8.3%</td>
<td>45.6%</td>
<td>45.3%</td>
</tr>
<tr>
<td><strong>Suburban Counties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nassau</td>
<td>18.1%</td>
<td>49.2%</td>
<td>7.1%</td>
<td>3.5%</td>
<td>30.0%</td>
<td>9.1%</td>
<td>30.0%</td>
<td>30.1%</td>
</tr>
<tr>
<td>Suffolk</td>
<td>26.2%</td>
<td>41.7%</td>
<td>3.8%</td>
<td>3.0%</td>
<td>64.4%</td>
<td>13.8%</td>
<td>64.4%</td>
<td>63.2%</td>
</tr>
<tr>
<td>Putnam</td>
<td>119.7%</td>
<td>100.0%</td>
<td>0.8%</td>
<td>0.4%</td>
<td>46.2%</td>
<td>12.9%</td>
<td>46.3%</td>
<td>46.2%</td>
</tr>
<tr>
<td>Rockland</td>
<td>86.9%</td>
<td>147.4%</td>
<td>6.2%</td>
<td>1.5%</td>
<td>94.9%</td>
<td>23.0%</td>
<td>94.9%</td>
<td>94.2%</td>
</tr>
<tr>
<td>Westchester</td>
<td>69.1%</td>
<td>52.9%</td>
<td>3.1%</td>
<td>0.6%</td>
<td>60.1%</td>
<td>14.3%</td>
<td>60.1%</td>
<td>60.1%</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYMTC Planning Area</td>
<td>21.3%</td>
<td>30.0%</td>
<td>5.1%</td>
<td>3.0%</td>
<td>33.3%</td>
<td>11.9%</td>
<td>34.3%</td>
<td>32.8%</td>
</tr>
</tbody>
</table>

D/C = Demand to Capacity; LMC = Lane Miles of Congestion; TTI = Travel Time Index; ATS = Average Travel Speed; VHD = Vehicle Hours of Delay; PHD = Person Hours of Delay; VMT = Vehicle Miles Traveled

Note: D/C = average Demand to Capacity for the particular facility type and period. The “0.8<=DC<=1” and “D/C>1” are the percent of travel that occurs in various conditions (somewhat congested and very congested).
Figure 5.5 - NYMTC Planning Area Daily Vehicle Hours of Delay by County

Figure 5.6 - NYMTC Planning Area Daily Person Hours of Delay by County
Reliability

Increasingly, transportation agencies are looking to travel time reliability as a measure to capture system performance. Travel time reliability typically refers to the variability of travel times that travelers experience from one day, season, or year to the next. The focus on reliability comes from the recognition that congestion is a function of several root causes, including crashes and other incidents, special events, weather, and normal fluctuations in demand in addition to limited capacity.

A variety of performance measures have been developed to measure reliability, but all of them draw from the distribution of travel times on a given segment, corridor, or system. Common reliability measures in use today include:\footnote{The SHRP 2 Reliability program has developed several measures of reliability through a range of projects. SHRP 2 L03, \textit{Analytical Procedures for Determining the Impacts of Reliability Mitigation Strategies}, has the most current published version and can be found at: http://www.trb.org/Main/Blurbs/166935.aspx.}

\begin{itemize}
  \item The PTI and other variants of the TTI. These measures capture the multiple of free flow time (travel time under uncongested conditions) required to complete a given percentage of trips “on time.” The PTI typically considers the 95\textsuperscript{th} percentile of travel time (i.e., a PTI of 3 means that a traveler must allow for a trip that is three times as long as free flow time to be on time 95 percent of the time). The PTI is a special instance of the TTI measure, which typically considers the relationship between average travel time and free flow time. The 95\textsuperscript{th} percentile can be thought of as one day a month. Several agencies also consider the 80\textsuperscript{th} percentile, which might be thought of as the travel time that a system user may expect once a week.
\end{itemize}
The semi variance is a one-sided variance that looks at the relative variation of the entire travel time distribution (i.e., the sum of the difference of each observed travel time from free flow, calculated only in one direction). The buffer index is similar to the planning time index, except that it compares the 95th percentile of travel time to average travel time. Failure measures capture the percent of trips that occur on a segment or corridors above some threshold (e.g., 2.5 times free flow speed).

For the purposes of this particular report the reliability measure reported is TTI; however, this can be changed in the future based on the requirements of the final rules on Systems and Performances that address performance measures for traffic congestion.

As one of the largest metropolitan areas in the U.S., the NYMTC region experiences significant unreliability on its road network. The Texas A&M Transportation Institute Congested Corridors Report 2011 identified 28 congested highway corridors in the NYMTC region. The data are drawn from continuous travel time data that, to date, has been most effectively collected on limited access facilities. This analysis does not address the reliability of the arterial network, which is of equal concern.

Figure 5.8 presents reliability performance measures drawn from the Texas Transportation Institute's Congested Corridors Report, 2011 (latest available) for the corridors in the NYMTC region. Three measures are shown:

- **TTI** – the ratio of average travel time to free flow travel time
- **TTI₈₀** – the ratio of the 80th percentile of travel time (the 80th worst travel time) to free flow time – this measure captures how unreliable travel is on a corridor roughly once a week
- **TTI₉₅** – the ratio of the 95th percentile of travel time to free flow time – this measure captures how unreliable travel is on a corridor roughly once per month.

Nearly all of the corridors identified in this analysis face unreliable conditions. Even average travel times on these corridors takes twice as long as free flow. Put another way, travel on these corridors occurs at best at half the posted speed. At least one day a week (TTI₈₀), travel times on many of these facilities are 3.5 to 4 times longer than free flow or twice as bad as average conditions. Notable exceptions include the Belt Parkway (which has substantially more reliable conditions than the other corridors while still generally unreliable), I-95 and Harlem River Drive (both of which have a TTI₈₀ value of close to 6.0), and the Van Wyck, which experiences severe congestion (TTI₈₀ of over 8 in the Northbound direction, meaning that it takes 8 times as long as free flow time to traverse this corridor roughly once a week).

---

8 The semi-variance measure was developed by SHRP 2 L02, Establishing Monitoring Programs for Travel Time Reliability, http://www.trb.org/Main/Blurbs/168765.aspx.
Figure 5.8 - Reliability on Select Highway Corridors in the NYMTC Region

Note: The indices shown are not additive, but layered one on top of the other for each corridor, illustrating the relative difference amongst the three travel time indices- TTI, TTI80 and TTI95.
TTI – the ratio of average travel time to free flow travel time
TTI80 – the ratio of the 80th percentile of travel time (the 80th worst travel time) to free flow time
TTI95 – the ratio of the 95th percentile of travel time to free flow time
Accessibility

Accessibility (or “access”) refers to the ease of reaching goods, services, activities and destinations, which together are called opportunities. It can be defined as the potential for interaction and exchange (Hansen 1959; Engwicht 1993). Accessibility can be thought of as having two components: attractiveness and impedance. The attractiveness component is usually measured as the number of opportunities at destinations. For example, when measuring accessibility to jobs, the attraction value can be the number of jobs at the various potential destinations, while for shopping centers this can be the number of shops in the center. The impedance function decreases the probability of being attracted to such destinations based on distance or travel time.9

There is no single method to evaluate accessibility. For example, accessibility can be measured by the travel times between two points, the availability of jobs within a certain travel time, the availability of transit options, and so on.

Figure 5.9 and Figure 5.10 illustrate one common measure of accessibility—the availability of jobs within 45 minutes of travel time (at congested speeds) in 2017 and 2045, respectively. The region represented by dark red represents TAZs with access to over 4 million jobs within 45 minutes. The blues and greens represent the other end of the spectrum with access to considerably fewer jobs. In 2045, more of the TAZs turn from green to blue and red to yellows, indicating fewer jobs within 45 minutes. This is a sign of an increasingly congested transportation system; however, the difference does not appear to be dramatic. One reason for this could be that the 2045 alternative contains committed projects planned to alleviate current traffic congestion. One region that will likely see an accessibility improvement in the future (as measured by access to jobs) is part of suburban Long Island and Queens, partially attributable to the presence of the MTA Long Island Rail Road East Side Access project, linking Long Island and Queens to Grand Central Terminal.

---

Figure 5.9 - 2017 Jobs Accessible Within a 45 Minute Drive during a Morning Peak Commute
Figure 5.10 - 2045 Jobs Accessible Within a 45 Minute Drive during a Morning Peak Commute
Freight Performance Measures

In 2012, 365 million tons of freight moved into, out of, within, or through the ten-county NYMTC region. Table 5.5 below presents the freight flows by weight and direction in 2012 and 2045, in addition to the proportion of regional freight by direction. Approximately 174 million tons (48 percent) traveled inbound, 65 million tons (18 percent) traveled outbound, and 50 million tons (14 percent) was intraregional, having traveled from one point within the NYMTC region to another point within the NYMTC region. Through freight accounted for 76 million tons or 21 percent of the total.

Table 5.5 - Commodity Flow by Direction for NYMTC Planning Area All Modes, 2012 and 2045

<table>
<thead>
<tr>
<th>Direction of Movement</th>
<th>2012</th>
<th>2045</th>
<th>Total Growth (2012-2045)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons (in millions)</td>
<td>% of Total</td>
<td>Tons (in millions)</td>
</tr>
<tr>
<td>Inbound</td>
<td>174.4</td>
<td>47.7%</td>
<td>274.1</td>
</tr>
<tr>
<td>Outbound</td>
<td>74.2</td>
<td>20.3%</td>
<td>126.0</td>
</tr>
<tr>
<td>Through NYMTC</td>
<td>76.1</td>
<td>20.8%</td>
<td>126.3</td>
</tr>
<tr>
<td>Intra-NYMTC</td>
<td>40.7</td>
<td>11.1%</td>
<td>83.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>365.3</td>
<td>100.0%</td>
<td>609.7</td>
</tr>
</tbody>
</table>

Source: 2012 IHS Global Insight Transearch Data, 2012 Surface Transportation Board (STB) Waybill Sample

By 2045 these flows are expected to grow by 67 percent, amounting to 610 million tons. Inbound flows are expected to grow 57 percent to 274 million tons, at an annual growth rate of 1.4 percent. Outbound shipments are expected to increase by 70 percent to 126 million tons, at an annual growth rate of 1.6 percent. Intra-NYMTC freight is estimated to increase nearly 105 percent to 83 million tons, at an annual growth rate of 2.2 percent, and through freight is expected to increase to 126.3 million tons by 2040, a 66 percent increase, and 1.6 percent compound annual growth rate.

As shown in Table 5.6, trucks were the dominant mode of freight transportation throughout the region. The NYMTC planning area is highly dependent on trucks for the movement of the vast majority of its freight. Approximately 89 percent of all freight tonnage in 2012 was moved by truck in all directions. Rail was the second most common mode, transporting nearly 7 percent of freight tonnage in the same year, the vast majority of which was passing through the region. Freight transport by water comprised approximately 5 percent of freight tonnage. Air and other modes of transportation each accounted for less than 1 percent of flow. These modes are not expected to change substantially between 2012 and 2045.
Table 5.6 - Commodity Flow by Mode for NYMTC Planning Area All Modes, 2012 and 2045

<table>
<thead>
<tr>
<th>Direction of Movement</th>
<th>2012</th>
<th>2045</th>
<th>Total Growth (2012-2045)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons (in millions)</td>
<td>% of Total</td>
<td>Tons (in millions)</td>
</tr>
<tr>
<td>Rail</td>
<td>24.3</td>
<td>6.6%</td>
<td>41.7</td>
</tr>
<tr>
<td>Truck</td>
<td>321.8</td>
<td>88.1%</td>
<td>536.9</td>
</tr>
<tr>
<td>Air</td>
<td>0.2</td>
<td>0.1%</td>
<td>0.3</td>
</tr>
<tr>
<td>Water</td>
<td>19.1</td>
<td>5.2%</td>
<td>30.8</td>
</tr>
<tr>
<td>Other</td>
<td>&lt;0.1</td>
<td>&lt;0.1%</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>365.3</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>609.7</strong></td>
</tr>
</tbody>
</table>

Source: 2012 IHS Global Insight Transearch Data, 2012 Surface Transportation Board (STB) Waybill Sample

5.3 Critically Congested Roadway Corridors in 2045

Figure 5.11, Figure 5.12, and Figure 5.13 present the top congested corridors in the three subareas of NYMTC’s planning area based on the most significantly congested corridors. The methodology adopted to identify these corridors is described in Section 4 based on four factors: importance, magnitude, intensity, and consistency. Appendix C, Congested Corridor Screening Worksheet, illustrates how the most congested regional corridors were identified.

Figure 5.11 - Top Congested Corridors New York City
Figure 5.12 - Top Congested Corridors Long Island

Figure 5.13 - Top Congested Corridors Lower Hudson Valley
6 COUNTY/BOROUGH CONGESTION ANALYSIS

This section provides a county-level summary of congestion estimates for the 2017 Base Year and the 2045 Build Scenario. As discussed in the Methodology section, the 2045 Build Scenario includes all transportation improvements NYMTC has programmed in the TIP and the fiscally constrained element of Plan 2045.

For each of the ten counties (five boroughs of New York City and five suburban counties) in the NYMTC planning area, an overview is provided, including background information and travel characteristics for the 2017 Base Year and 2045 Build Scenario. Background information includes population (2017 Base Year, 2045 Build Scenario, and percent change), major portals and roadways. The travel characteristics are derived from the NYBPM and include:

- **Vehicular Travel** – vehicle miles of travel for the 2017 Base Year and 2045 Build Scenario and the percent change.
- **Traffic Congestion** – vehicle hours of delay for the 2017 Base Year and 2045 Build Scenario, and the percent change.
- **Origins and Destinations** – forecasted intercounty (two-directional) vehicular daily trips for the year 2045 based on the NYBPM.
- **Performance Measures** – the tables summarize the performance measures, as described in the Analysis Methodology section, disaggregated by functional class. The first table in each section presents performance measure data for the 2017 Base Year in the AM peak, PM peak, and daily periods. The next table presents performance measure data for the 2045 Build Scenario for the same time periods and the third table presents the percentage difference between the two.
- **Congestion Patterns and Bottlenecks** – these maps identify congested corridors and bottlenecks for the 2045 Build Scenario. As further described in the Analysis Methodology section, using output data from the NYBPM, demand-to-capacity ratio congestion levels are represented for individual links in the roadway system. To account for the levels of area-wide congestion, other factors such as length of the congested segment, traffic volume and importance of the roadway were used to identify congested corridors. Congested corridors are shown for the 2045 Build Scenario AM and PM peak periods. Also shown are potential bottleneck locations. Roadway links that experience a D/C ratio greater than 1.0 for a four-hour peak period are shown in red, while those with a ratio between 1.0 and 0.8 are shown in blue. Only roadway links that experience a D/C ratio of 0.8 or greater are identified as congested. Using the NYBPM-derived measures of congestion, together with our familiarity with the NYMTC regional highway network, and data from the 2011 Texas A&M Transportation Institute Congested Corridors Report, a list of approximately 50 roadway sections were used to develop the top regional congestion bottlenecks. These roadway sections are listed and discussed below (and in Appendix B) by county/borough. (Please note that the order is arbitrary and does not imply a ranking.)
7 CONGESTION MANAGEMENT STRATEGIES

This section provides an overview of potential strategies for facilitating the movement of people and goods by alleviating congestion in the NYMTC planning area, consistent with the goals outlined in NYMTC’s Plan 2045. As part of the CMP, Federal regulations require MPO in transportation management areas to identify potential strategies to reduce congestion and evaluate the expected effectiveness of those strategies in improving the efficiency and safety of existing and future transportation systems. Moreover, because NYMTC’s planning area is part of air quality nonattainment areas designated by the Clean Air Act Amendments of 1990, the use of Federal funds for the expansion of the transportation system’s capacity to move single-occupancy vehicles (SOV) is precluded unless it is documented that travel demand reduction and operational management strategies cannot fully satisfy the need for the additional capacity.

Recognizing a wide range of strategies are available to address mobility challenges, NYMTC has developed a CMP Toolbox of strategies for use in planning congestion-reduction measures around the region. The CMP Toolbox is divided into nine categories of congestion management strategies:

1. **Transportation Demand Management** strategies (part of TSM&O) – The objective of demand management strategies is to influence travel behavior for both commute and non-commute trips. Subcategories of Transportation Demand Management strategies include:
   - Alternative Commute Programs – Promotes alternatives to single-occupancy commuter travel through employer-based programs or other regional initiatives.
   - Pricing/Managed Facilities – Imposes restrictions or fees for the use of specific lanes/roadways with the common goal of reducing the amount of single-occupancy vehicles.

2. **Transportation System Management and Operations** strategies (TSM&O) – TSM strategies including Integrated Corridor Management (ICM) contribute to a more effective and efficient use of existing systems. Many of these operations-based strategies are supported by the use of enhanced technologies or Intelligent Transportation Systems (ITS). TSM strategies are divided into seven categories, which are individually detailed as part of the CMP Toolbox Strategies (Appendix A). The strategies include, Intelligent Transportation Systems, Traveler Information, Incident Management, Work Zone Management, Access Management, Congestion Pricing, and Active Transit and Traffic management. The toolbox further subcategorizes TSM strategies as follows:
   - Highway/Freeway Operations – Strategies to increase throughput and alleviate the causes of recurring and nonrecurring congestion.
   - Arterial and Local Roads Operations – Strategies to improve traffic flow through the existing network of local roads and intersections.
   - Other Operations Strategies – General operations strategies that can be applied on a regional scale.

3. **Transit Strategies** – Strategies aimed at making transit more attractive or accessible can help to reduce the number of vehicles on the road. Transit strategies commonly supplement the demand management and TSM&O strategies described above. The CMP Toolbox includes the following subcategories of transit strategies:
   - Fare Strategies – Encourages additional transit use through fare policies, employer-based incentive programs, or universal fare cards/payment systems.
– Operations Strategies – Includes service adjustments to better align transit service with ridership markets. Similar to traffic operations, ITS features often enhance transit operations as well. Also includes Bus Rapid Transit (BRT) and Select Bus Service (SBS) with signal pre-emptions and/or bus-only lanes to provide superior service.

– Capacity Strategies – Expands transit coverage and/or frequencies to make transit more accessible and attractive to use.

4. Accessibility Strategies – Improves access to transit facilities by both auto and non-auto travel modes.

5. Bicycle and Pedestrian Strategies – Strategies that promote non-motorized travel through the provision of safer bicycle and pedestrian-oriented facilities and amenities.

6. Access Management Strategies – Includes policies, facilities, and design criteria that minimize the number of driveways and intersecting roads accessing a main thoroughfare.

7. Land Use Strategies – Policies to support/encourage mixed-use development, transit-oriented design, and incentives for high-density development.

8. Parking Strategies – Strategies to manage the availability and cost of parking and promote access to transit.

9. Regulatory Strategies – Closely tied to the strategies described above, regulatory strategies restrict vehicle movements or enforce congestion-management policies.

10. Road Capacity Strategies – Addresses improvements to specific bottlenecks (such as interchanges and intersections), as well as the need for more base capacity to the existing road network when all of the other congestion-reduction strategies described above cannot fully satisfy demand.

Descriptions of specific strategies within each of these nine categories are included in Appendix A, including a qualitative assessment of congestion and mobility benefits, costs and impacts, and implementation timeframe. Also included in Appendix A are existing TSM and TDM strategies in the NY Region, as reported in Plan 2045. Additionally, NYMTC’s Plan 2045 includes a number of system enhancement projects that will help to alleviate congestion in the NYMTC planning area. A list of these projects is also found in Appendix A.