NYMTC
NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

NEW YORK METROPOLITAN TRANSPORTATION COUNCIL
ADOPTED ON **JUNE 29, 2017**

REGIONAL TRANSPORTATION PLAN

PLAN 2045

MAINTAINING THE VISION FOR A SUSTAINABLE REGION

Disclaimer

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Title VI Statement

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José M. Rivera, P.E.
Executive Director

PROGRAM, FINANCE AND ADMINISTRATION COMMITTEE

RESOLUTION #449
RECOMMENDATION OF THE DRAFT FEDERAL FISCAL YEARS (FFYs) 2018-2045 REGIONAL TRANSPORTATION PLAN AND DRAFT 2017 CONGESTION MANAGEMENT PROCESS STATUS REPORT FOR COUNCIL ADOPTION

WHEREAS, the New York Metropolitan Transportation Council (NYMTC) is a regional council of governments which is the metropolitan planning organization for New York City, Long Island and the lower Hudson Valley; and

WHEREAS, pursuant to 23 CFR 450.324, NYMTC is responsible for the development of a Regional Transportation Plan (Plan) for the downstate New York region; and

WHEREAS, NYMTC's current FFYs 2014-2040 Plan was adopted by the Council on September 4, 2013, having addressed all federal planning requirements set forth in 23 CFR 450.324, and, per federal regulations, expires on September 30, 2017; and

WHEREAS, NYMTC has prepared a draft FFYs 2018-2045 Plan *(Plan 2045)* to address the federal planning requirements set forth in 23 CFR 450.324, beginning on October 1,2017; and

WHEREAS, in conjunction with the *Plan 2045* draft, NYMTC has also prepared a draft 2017 Status Report for the Congestion Management Process (CMP) to address regulations set forth in 23 CFR 450.322 and 23 CFR 500.109; and

WHEREAS, these draft products meet all applicable federal requirements and have undergone public involvement and public review per federal regulations and NYMTC's Operating Procedures; and

WHEREAS, per the Memorandum of Understanding between NYMTC's members, the Program, Finance, and Administration Committee (PFAC) must act to recommend drafts of the three federally-required planning products to the full Council prior to Council action.

NOW, THEREFORE BE IT RESOLVED, THAT PFAC recommends that the draft FFYs 2018-2045 Regional Transportation Plan and draft 2017 CMP Status Report be adopted by the Council.

This resolution shall take effect on the twenty-seventh day of June, two thousand and seventeen.

ADOPTED: June 27, 2017

"I hereby certify that the above is a true copy of Resolution #449, Recommendation of the Draft Federal Fiscal Years 2018-2045 Regional Transportation Plan and Related Congestion Management Process Status Report for Council Adoption, and was motioned by Mr. Jack Schmidt, representing the New York City Transportation Coordinating Committee and seconded by Mr. Patrick Gerdin, representing the Mid-Hudson South Transportation Coordinating Committee. This Resolution was adopted and passed unanimously."

Ron Epstein, PFAC Chair

José M. Rivera, P.E.
Executive Director

RESOLUTION #2017-5

ADOPTION OF THE FEDERAL FISCAL YEARS (FFYs) 2018-2045 REGIONAL TRANSPORTATION PLAN AND RELATED 2017 CONGESTION MANAGEMENT PROCESS STATUS REPORT

WHEREAS, the New York Metropolitan Transportation Council (NYMTC) is a regional council of governments which is the metropolitan planning organization for New York City, Long Island and the lower Hudson Valley; and

WHEREAS, pursuant to 23 CFR 450.324, NYMTC is responsible for the development of a Regional Transportation Plan (Plan) for the downstate New York region; and

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WHEREAS, these draft products meet all applicable federal requirements and have undergone public involvement and public review per federal regulations and NYMTC's Operating Procedures; and

WHEREAS, at its June 27, 2017 meeting, NYMTC'S Program, Finance and Administrative Committee recommended that the draft *Plan 2045* and draft 2017 CMP Status Report be adopted by the Council.

NOW, THEREFORE, BE IT RESOLVED THAT NYMTC adopts the FFYs 2018-2045 Regional Transportation Plan and the 2017 CMP Status Report; and

BE IT FURTHER RESOLVED, THAT NYMTC instructs the Council Secretary to submit the adopted products to the appropriate federal agencies.

This resolution shall take effect on the twenty-ninth day of June, two thousand and seventeen.

ADOPTED: June 29, 2017

"I hereby certify that the above is a true copy of Council Resolution #2017-5, Adoption of the Federal Fiscal Years 2018-2045 Regional Transportation Plan and Related Congestion Management Process Status Report, was motioned by Mr. Jack Schmidt, representing New York City Department of City Planning Director Marisa Lago, and seconded by Mr. Douglas Schuetz, representing Rockland County Executive Edwin Day. This Resolution was adopted and passed unanimously."

Ron Epstein, Council Secretary

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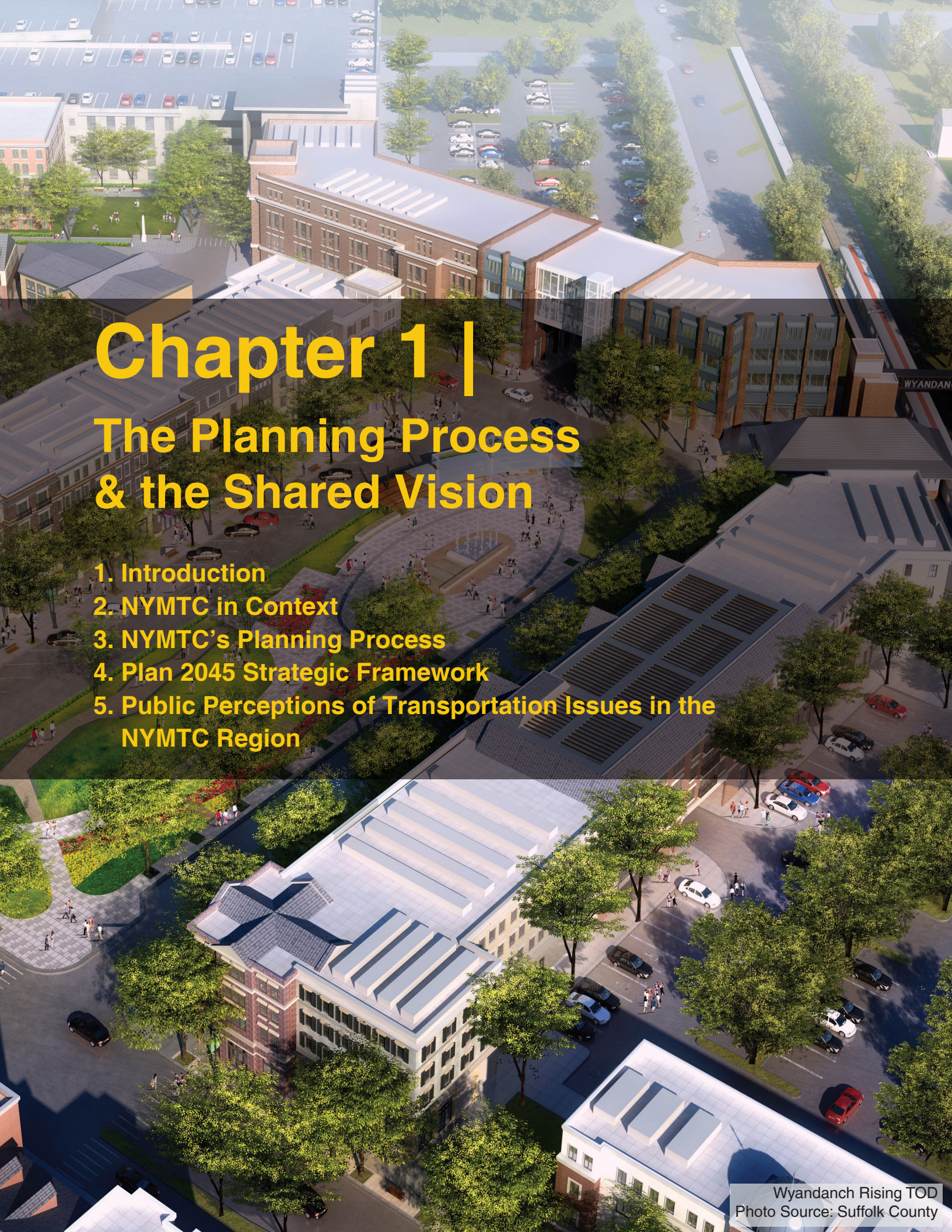


Wyandanch Rising TOD
Photo Source: Suffolk County

1. INTRODUCTION

All indicators suggest that the planning area of the New York Metropolitan Transportation Council (NYMTC) will continue to grow in population to 14.3 million by 2045, remaining the largest population and job center in the United States. The transportation system in NYMTC's planning area currently supports on a daily basis approximately 3.3 million trips by bus, 5.7 million trips on rail rapid transit, 1.2 million trips on commuter rail, 103,000 trips on ferries, and over 162 million vehicle miles traveled on its roads. Long-range forecasts (found in Chapter 2 of Plan 2045) suggest that daily trips will increase by more than 2.5 million (nearly 10 percent growth), of which 1.5 million will be auto trips and another million in transit trips.

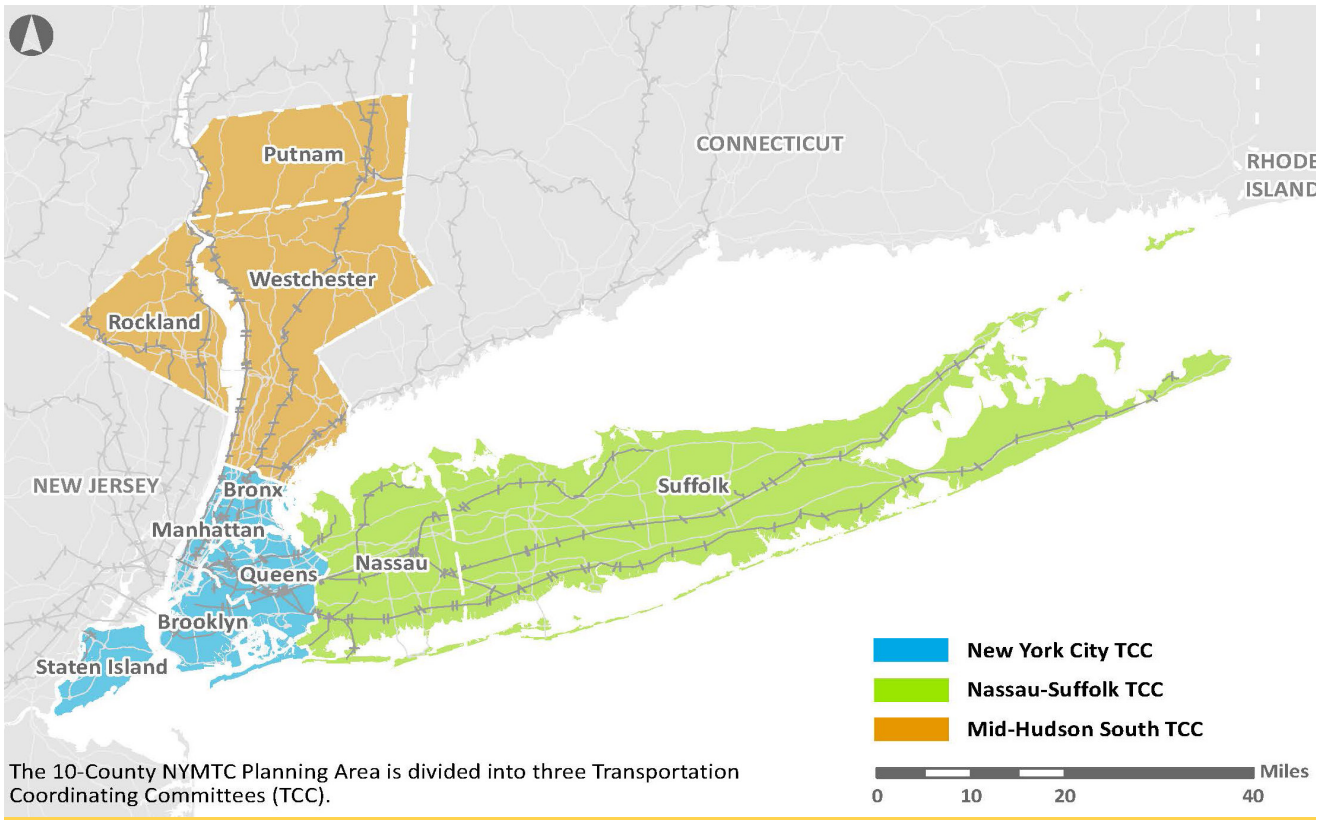
With the anticipated growth, the existing transportation network must be maintained, as well as further integrated and improved. It is critical to the economic health of the region that future resources be brought to bear for this purpose.

WHY A REGIONAL TRANSPORTATION PLAN?

Plan 2045 is a comprehensive, multimodal, and coordinated Regional Transportation Plan for the New York Metropolitan Transportation Council (NYMTC) planning area, covering the period of Federal Fiscal Years (FFYs) 2018-2045. The theme of Plan 2045 is "Maintaining the Vision for a Sustainable Region" building on the foundation of its predecessor, Plan 2040. A Plan covers all major modes of transportation from a regional perspective, including roadways, public transportation, bicycles and pedestrian facilities, goods movement and special needs transportation. In addition, key transportation topics are addressed, such as transportation system management and operations, safety and security, resiliency, freight transportation, specialized transportation and congestion management.

Like its predecessor, Plan 2045 has been developed through a cooperative effort among the NYMTC members and has included a vigorous community outreach and public involvement program. It is built around current and estimated future demand for transportation services and the current and future needs of the transportation system that are key to maintaining a sustainable region in the long-term.

FIGURE 1.1: NYMTC PLANNING AREA



The 10-County NYMTC Planning Area is divided into three Transportation Coordinating Committees (TCC).

2. NYMTC IN CONTEXT

Federal legislation requires that any urbanized area (UZA) with a population greater than 50,000 must have a metropolitan planning organization (MPO) to plan for and make decisions on the use of federal transportation funding. MPOs ensure that existing and future expenditures for transportation projects and programs are based on a continuing, cooperative and comprehensive planning process. Among other functions/requirements, MPOs cooperate with state agencies and public transportation operators to program federal funds for eligible transportation projects.

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graphically-based Transportation Coordinating Committees (TCCs) in order to also address subregional transportation needs and issues.

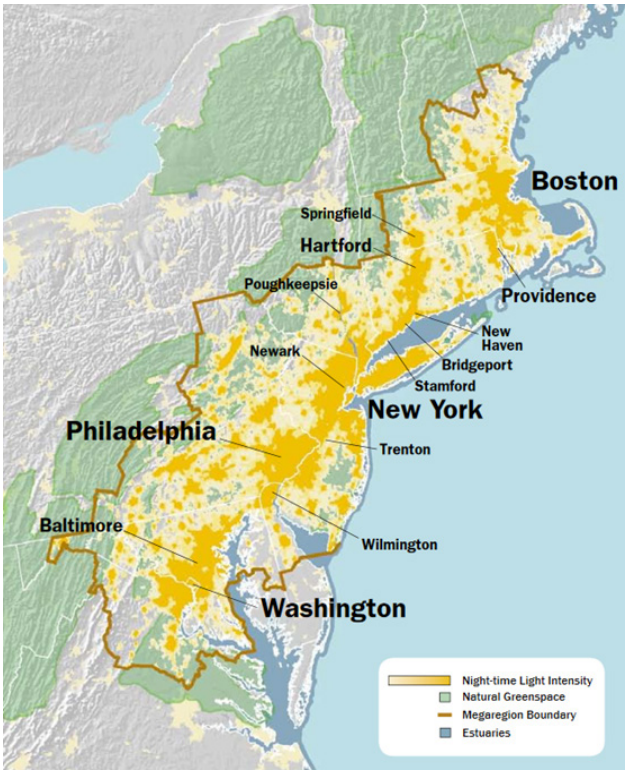
NYMTC's planning area lies at the core of a multi-state metropolitan region surrounding New York City, which in turn is a portion of the Northeast Megaregion, the most densely populated, urbanized land in the country. The Megaregion, as defined by the Regional Plan Association, includes the metropolitan areas of Washington, D.C., Baltimore, Philadelphia, New York City and Boston (see Figure 1.2), is home to 49.5 million people (translating to nearly 18 percent of the nation's total population), and is also a major contributor to the United States' economy, producing one-fifth of the national GDP in 2010.[1]

The multi-state New York City metropolitan region is demarcated by the U. S. Census Bureau's New York Metropolitan Statistical Area (MSA), the largest such area in the nation in terms of population and one of the largest in the world. The New York MSA is home to over 20 million people (2015 estimate) and covers 25 counties (see Figure 1.3).[2]

While the multi-state region is centered on New York City, it also contains some of the largest cities in New Jersey (i.e., Newark, Jersey City, and Paterson) and Connecticut (i.e., Stamford, Bridgeport and New Haven) as well as large suburban municipalities on Long Island (i.e., Hempstead, Brookhaven and Babylon) and in the lower Hudson Valley (i.e., Yonkers, Mount Vernon, Newburgh, New Rochelle, Poughkeepsie, and White Plains).

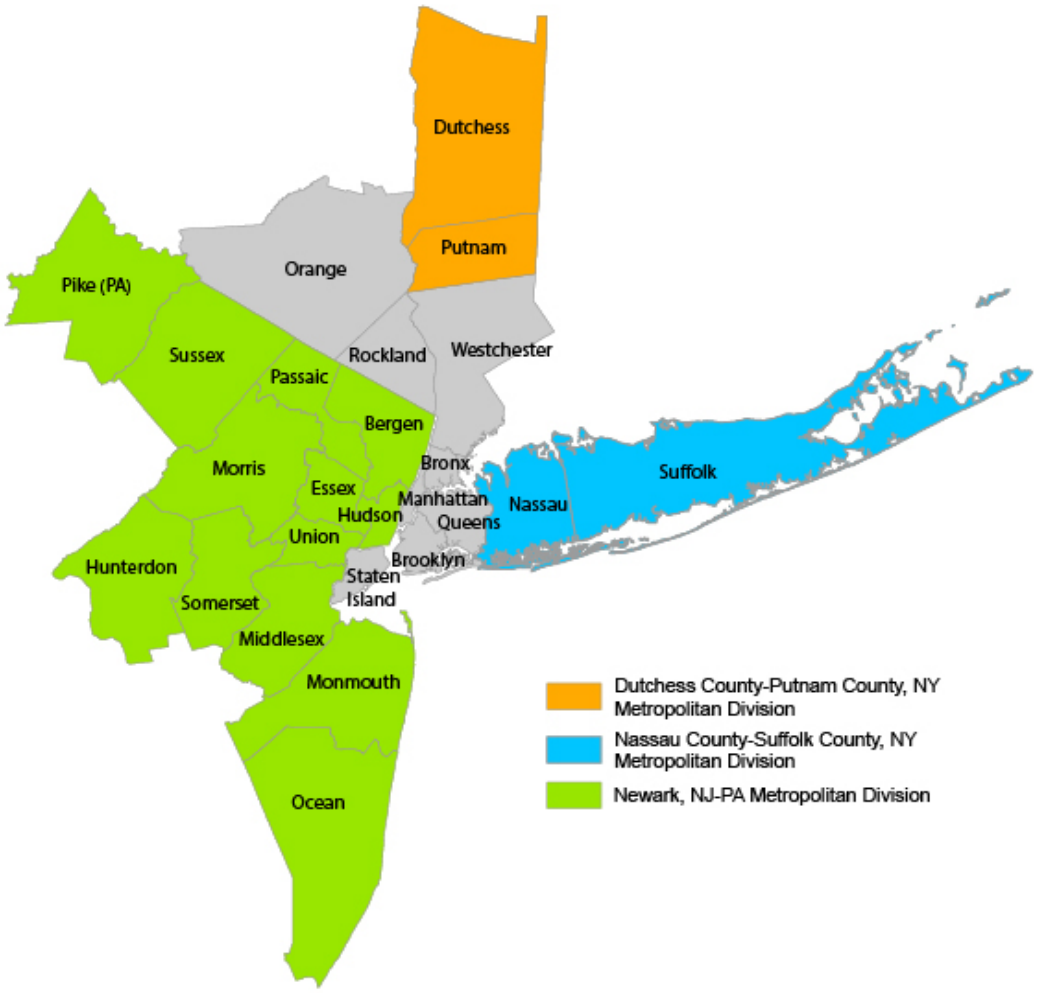
The multi-state region also includes the planning areas of various MPOs and Councils of Government, or COGs, including NYMTC, the Orange County Transportation Council, the Poughkeepsie-Dutchess County Transportation Council, the Ulster County Transportation Council, the North Jersey Transportation Planning Authority, the Lehigh Valley Planning Commission, the Western Connecticut Council of Governments, the Naugatuck Valley Council of Governments, the Connecticut Metropolitan Council of Governments, the South Central Regional Council of Governments, and the Lower Connecticut River Valley Council of Governments.

FIGURE 1.2: THE NORTHEAST MEGAREGION



Source: The Regional Plan Association of New York

FIGURE 1.3: THE NEW YORK MSA



GEORGRAPHY AND THE ENVIRONMENT

The multi-state metropolitan region is geographically centered on New York City, which is made up of Manhattan Island and Staten Island, the western end of Long Island (the boroughs of Queens and Brooklyn), and part of the North American mainland (the Bronx). The City possesses a well-used natural harbor and sits at the southern end of the Hudson River. East of Queens lie Nassau and Suffolk counties in suburban Long Island, known for its beach-lined coastline and barrier islands.

Across the Hudson River to the west of the City, lies northern New Jersey, an area which contains thirteen individual counties and several major cities. North of the Bronx on the east side of the Hudson River, and north of the New Jersey-New York state border on the west side of the river, lies the Lower Hudson Valley, a hilly region comprised of several counties (Westchester, Rockland, Putnam, Orange, and Dutchess counties) and dotted with suburban communities of varying size. Rockland County in particular is occupied by large swaths of natural habitat, such as Harriman and Bear Mountain state parks.

To the east of these Hudson Valley counties lies the southwestern portion of the State of Connecticut, across the Long Island Sound from Queens and suburban Long Island. This area of Connecticut is comprised of two counties (Fairfield and New Haven) and seven of the largest communities in the state are located in the area. It is characterized by a fairly dense, urban landscape, interspersed by a number of wealthy suburban towns.

The Pennsylvania portion of the multi-state region lies at the foothills of the Poconos Mountains, and is characterized by the valleys formed by the Lehigh River and Delaware River, the latter of which creates the border between Pennsylvania and New Jersey, and the Susquehanna River. The southernmost portion of the multi-state region is made up of southern New Jersey in an area to the southeast of Philadelphia. Southern New Jersey's coastline and barrier islands also are included in this metropolitan region.

ECONOMY

The multi-state metropolitan region's economy is large, diverse, and international. In 2015, the region produced a gross metropolitan product of $1.6 trillion, the largest in the country among metropolitan regions. The multi-state region's economic output is nearly twice that of the Los Angeles metropolitan area and second only to Tokyo globally, by a margin of about nine percent.[3] It is home to numerous Fortune 500 companies and foreign corporations, with one in ten private sector jobs being at a foreign company.[4]

Although significant numbers of workers who reside in the multi-state region commute to New York City - Manhattan in particular - suburban Long Island, the Lower Hudson Valley, northern New Jersey and southwestern Connecticut are all home to their own industries which contribute to the multi-state region's economy. Agriculture and tourism are important to the suburban Long Island and Lower Hudson Valley economies. The New York City region is home to some of the busiest ports in the country, including the Newark-Elizabeth Marine Terminal in Northern New Jersey. In 2016, the Port Authority of New York & New Jersey's (PANY&NJ) terminals handled approximately 6.25 million twenty-foot equivalent units (TEUs), or nearly 3.7 million cargo containers.[5] The suburban areas close to New York City also have their own economic ecosystems, often including major corporations. Westchester County in New York State and Fairfield County in Connecticut, for example, have become major business centers which draw commuters who live in New York City as well as elsewhere in the region.[6]

Areas further from the New York City core have varied demographic and economic profiles. Eastern Pennsylvania, for example, has historically been manufacturing-based, and is currently the site of a variety of industrial-related firms, such as the global headquarters of Air Products and Chemicals.[7] In New Jersey's capital city of Trenton, officials are attempting to incentivize more industrial and business development along the Route 1 corridor, using Boston's Back Streets program and Chicago's Local Industrial Retention Initiative as models. The city is also looking to encourage more retail development within city limits, as many residents currently travel outside the city for their shopping needs.[8]

DEMOGRAPHICS

The multi-state metropolitan region is large and diverse. The U. S. Census Bureau estimates its 2015 population at 23,723,696.[9] While New York City is famous for its diversity, the region as a whole is also quite ethnically and racially diverse, with large communities hailing from all over the world. Nearly 27 percent of the region's population in 2015 was born outside the United States. The total size of the region's work force is 9,046,910, with the largest shares of jobs in the office and administrative support, sales, food, education, and financial sectors.[10]

TRANSPORTATION

The transportation system of the multi-state metropolitan region is large, complex, and aging, tied together by a network of highways, rail lines, bridges, tunnels, and other infrastructure. As the largest metropolitan area in the nation, the multi-state region is traversed by numerous major limited access highways and rail lines. These include:

- Interstate highways I-78, I-80 and I-280 which extend from New York City west into Pennsylvania; I-87, which becomes the New York State (NYS) Thruway between New York City and Albany; I-95, a north-south highway of which a portion is the New Jersey Turnpike; and I-495, known as the Long Island Expressway.
- Rail lines include the New Jersey Transit, MTA Metro-North Railroad (MNR), and MTA Long Island Rail Road commuter rail networks; the Shore Line East commuter rail service; MTA New York City Transit's subway network; the Port Authority of New York & New Jersey's PATH rail rapid transit service; and New Jersey Transit's Hudson-Bergen Light Rail and Newark Light Rail systems.
- Intercity rail services provided by Amtrak along the Northeast Corridor.
- Maritime freight facilities at the Port of New York & New Jersey and reliever ports in Bridgeport, New Haven and New London.
- Three major commercial airports; John F. Kennedy International Airport in southern Queens, Newark Liberty International Airport in Newark, and LaGuardia Airport in northern Queens; and a variety of smaller commercial and general aviation airports, including Lehigh Valley International Airport in Lehigh County, Pennsylvania; Long Island MacArthur Airport in Suffolk County, New York; Stewart International Airport in Orange County, New York; Trenton-Mercer Airport in Mercer County, New Jersey; and Tweed New Haven Regional Airport in New Haven, Connecticut.
- Due to the large numbers of islands, rivers, and other geographic features, bridges and tunnels are common throughout the multi-state region, carrying both roadways and rail lines across or under various topographical features.

Photo Source: NYMTC

TRAVELSHED

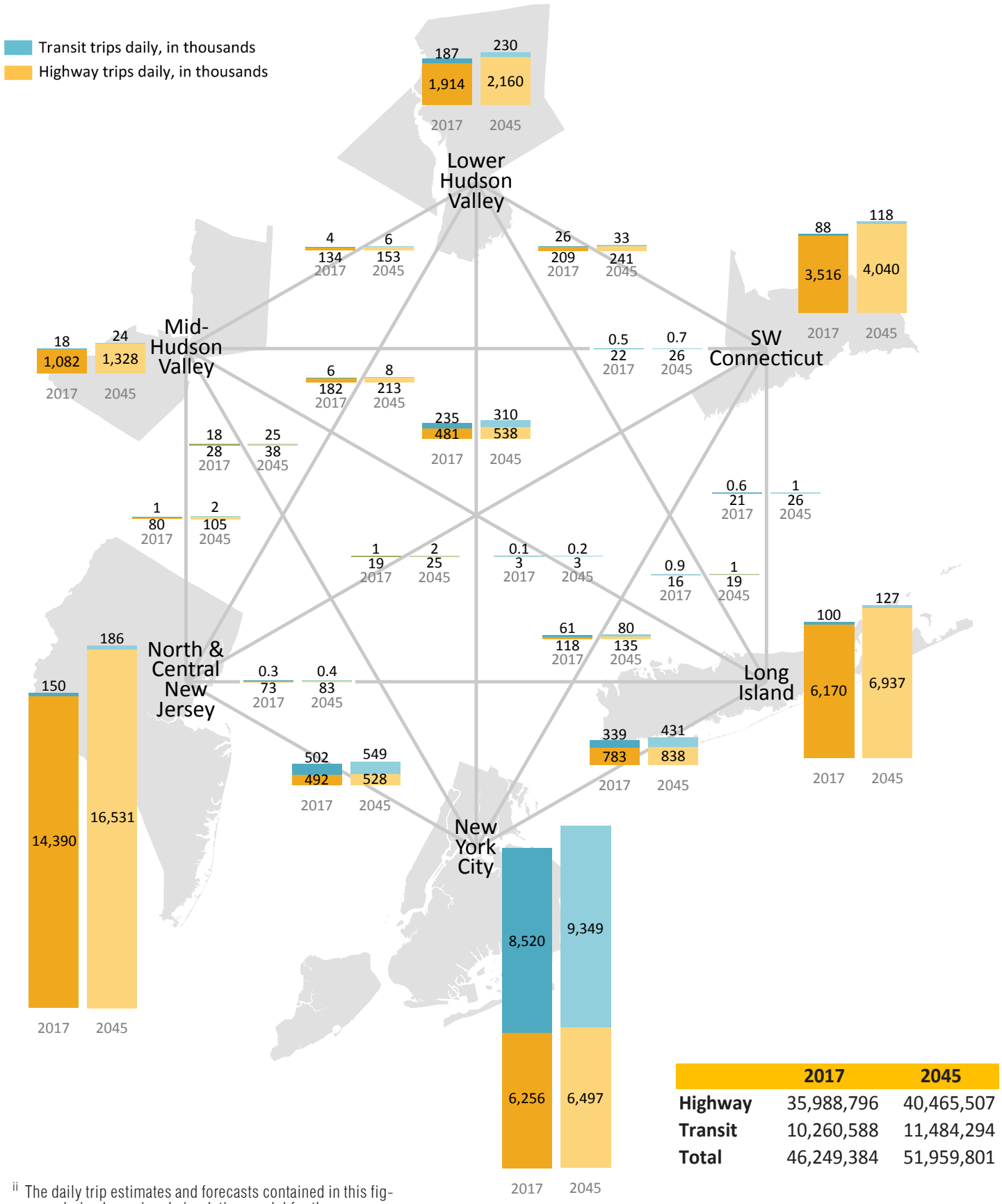
Figure 1.4 is a representation of the daily metropolitan travelshed in the multi-state region. Daily transit and highway trips estimates are shown for 2017 and forecasted to the 2045 horizon year within and between six subregional areas: northern and central New Jersey, New York City, suburban Long Island, southwestern Connecticut, the lower Hudson valley and the mid-Hudson Valley.[i]

Figure 1.4 demonstrates that the majority of current and future trips are and will be within these six subareas, with the greatest volume of daily intra-area trips being made in northern and central New Jersey, in New York City and within suburban Long Island. By far, the greatest number of daily transit trips made within a subarea is and will be in New York City. In terms of daily trips made between the subareas, the majority of these inter-area trips are made between New York City and northern and central New Jersey, between New York City and suburban Long Island, and between New York City and the lower Hudson Valley. These three sets of inter-area trips also feature significant proportions of transit trips.

The core of the multi-state region is notable for its enormous mass transit system. It is estimated that in the United States, about one in every three users of mass transit, and two out of three rail riders, use this system.[11] New York City is served by an intensively used subway and bus system, and its more immediate suburban neighbors are served by commuter rail and local bus systems. Inter-city travel is provided by Amtrak, as well as long-haul buses and air travel facilities. The region is the busiest airspace in the United States, serving over 130 million passengers annually.[12]

[i] These estimates are derived from the 28-county New York Best Practice Model, a four-step tranpsortation demand model maintained by NTMC.

FIGURE 1.4: MULTI-STATE METROPOLITAN TRAVEL SHED (DAILY TRIPS)



	2017	2045
Highway	35,988,796	40,465,507
Transit	10,260,588	11,484,294
Total	46,249,384	51,959,801

[ii] The daily trip estimates and forecasts contained in this figure are derived a regional simulation model for the purposes of providing an overview of travel in the multi-county metropolitan region. Therefore, the estimates and forecasts are calibrated regionally with a focus on inter- and intra-county travel, not for individual travel corridors and sectors.

TRANSPORTATION INVESTMENTS

Due to the continued growth of the region and the aging state of many key pieces of infrastructure that require renewal, a number of regionally-significant improvements to the transportation infrastructure are either planned or moving forward in the multi-state metropolitan region. Major New York City-focused projects include the Second Avenue Subway in Manhattan, various trans-Hudson River rail and vehicular crossing improvements, and commuter rail improvements.

There are a range of projects in the multi-state region designated as "boundary projects" whose impacts cut across planning areas and state lines. Examples include:

- The Penn Station (New York) Access project that would provide direct access for the MTA MNR New Haven Line to Manhattan's Penn Station[13] while creating four new neighborhood stations in eastern Bronx.
- Interstate 95 (I-95) improvement projects from Stamford to Bridgeport and Old Lyme to New London, along with New Haven Line commuter rail service improvements.
- Various improvement projects along I-84 in both Connecticut and the Hudson Valley, including a complete replacement of the I-84/Route 8 interchange in Waterbury.
- A Cross Long Island Sound Connection between suburban Long Island and either the Bronx, Westchester or Connecticut.
- The New New York (NY) Bridge project to replace the Tappan Zee Bridge across the Hudson River between Westchester and Rockland counties,[14] in tandem with the development of new BRT services in the I-287/Tappan Zee Bridge corridor.
- West-of-Hudson transit improvements, including improvements to the Port Jervis Line in Orange County, New York.
- The replacement of the aging Goethals Bridge between Elizabeth, New Jersey and Staten Island.[15]
- The replacement of the Lincoln Tunnel Helix in Weehawken, New Jersey.
- The Hudson Tunnel Project to create an additional rail tunnel that would preserve the current functionality and strengthen the resiliency of the Northeast Corridor's Hudson River rail crossing between New Jersey and New York.
- The Amtrak Gateway Program's strategic rail infrastructure improvements designed to improve current services and create new capacity that will allow the doubling of passenger trains running under the Hudson River.
- The replacement of the Port Authority Bus Terminal, the redevelopment of Penn Station and the completion of Moynihan Station on Manhattan's west side.
- The Cross Harbor Freight Program for rail freight across New York Harbor.
- Airport access improvements, including the extension of the Port Authority Trans-Hudson rail service to Newark Liberty International Airport, a new AirTrain connection to LaGuardia Airport and transit and roadway access improvements for John F. Kennedy International Airport.

While passenger transport is critical, these important projects are not limited to the movement of people. In such a densely populated and economically active region, freight transportation is critical as well, and there are several major projects dedicated to freight in the region. For example, the Port Authority's Cross Harbor Freight Program is seeking to address the difficulty of moving freight from one side of New York Harbor to the other by examining a wide range of alternatives, including railcar and truck floats, container barges, and a cross-harbor rail tunnel. After review, the enhanced railcar float and double-track rail tunnel emerged as the preferred alternatives.[16]

The Lincoln Tunnel Helix in
Weehawken, NJ
Photo Source: PANY&NJ

East Side Access
construction progress
Photo Source: MTA

2. NYMTC'S PLANNING PROCESS

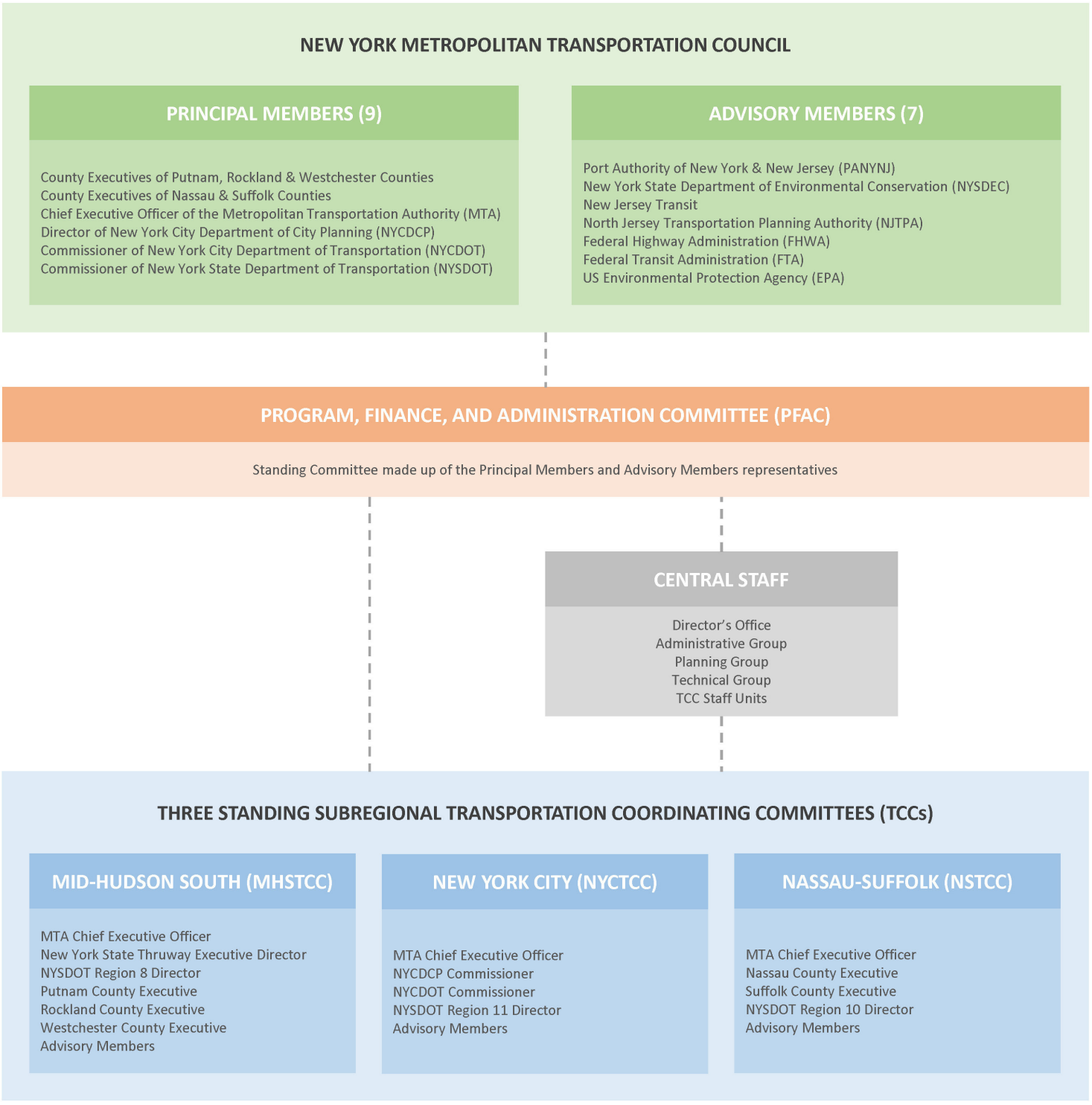
NYMTC acts as a forum for collaborative planning from a regional perspective. It facilitates informed decision-making among its members by providing sound technical analysis and forecasts. NYMTC's collective efforts help ensure that the region is prepared to obtain the maximum federal funds available to achieve the shared regional goals. All of this is in an attempt to focus the collective planning activities of NYMTC's members to achieve a shared regional vision.

Federal legislation and related planning regulations require MPOs to produce a long-range Plan, a five-year Transportation Improvement Program (TIP), and an annual Unified Planning Work Program (UPWP). Plan 2045 is the FFYs 2018-2045 Plan for NYMTC's planning area. The Plan includes forecasts of future conditions and needs and potential transportation improvements, as well as a shared strategic vision for transportation and development within the NYMTC planning area. Thus Plan 2045 fulfills federal planning requirements and maintains NYMTC's eligibility for federal funding for transportation planning and improvement projects.

NYMTC is comprised of the chief elected or appointed officials of its member agencies, which include nine voting members and another group of seven non-voting advisory members (see Figure 1.5). It operates through four standing committees: the Program, Finance and Administration Committee (PFAC), which oversees the day-to-day operations of the organization, and the three geographically-based TCCs, which provide subregional planning forums. NYMTC is supported by a professional staff, which is responsible for conducting the daily business of the organization.

U.S. Department of Transportation Secretary Foxx addressing the September 2016 NYMTC Council Meeting
Photo source: NYMTC

FIGURE 1.5: NYMTC STRUCTURE



THE METROPOLITAN TRANSPORTATION PLANNING PROCESS

The Metropolitan Transportation Planning Process ensures a cooperative, continuous, and comprehensive regional framework for multi-modal transportation planning, as required by federal regulation. As part of this process, NYMTC is required to produce the following products and analyses:

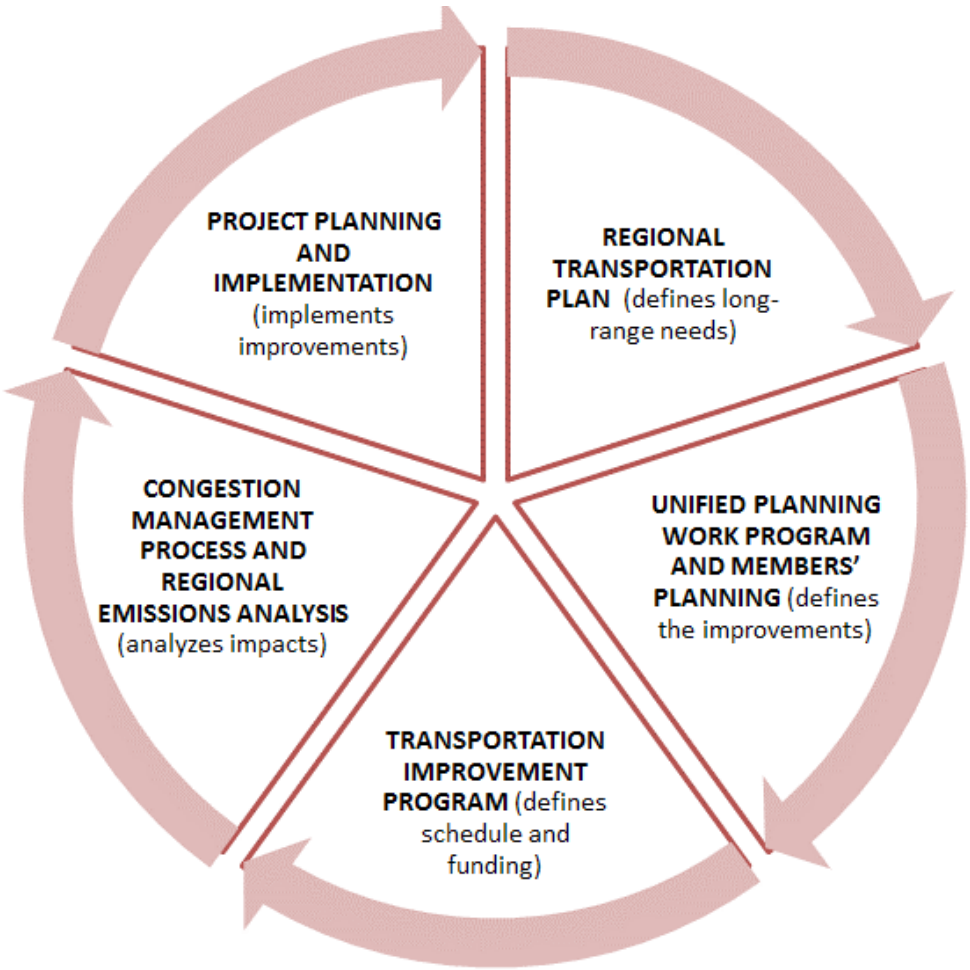
THREE PLANNING PRODUCTS

1. The Plan, which describes long-range goals, objectives, and needs, typically over a 25-year horizon for the NYMTC planning area;
2. The TIP, which defines federal funding for specific transportation projects and actions, typically over a five-year period; and
3. The UPWP, which determines how federal funding for planning activities will be spent over the course of a program year.

TWO PLANNING ANALYSES

4. The Congestion Management Process (CMP): since NYMTC's planning area is part of a federally-designated Transportation Management Area, NYMTC must maintain a CMP to forecast traffic congestion and consider congestion reduction strategies.
5. Transportation Conformity: NYMTC's Transportation Conformity Determinations quantitatively demonstrate how Plan and TIP projects impact future mobile source emissions milestones set in response to federally-mandated air quality standards.

FIGURE 1.6: PLANNING PRODUCTS AND ANALYSES



LEGISLATION AND REGULATIONS

The current federal legislation that guides the development of the Plan is the Fixing America's Surface Transportation (FAST) Act, which was signed into law by President Obama on December 4, 2015. This Act builds on its predecessor – Moving Ahead for Progress in the 21st Century (MAP-21). Planning regulations under the FAST Act require the following of long-range Plans:

> *(a) The metropolitan transportation planning process shall include the development of a transportation plan addressing no less than a 20-year planning horizon as of the effective date. In formulating the transportation plan, the MPO(s) shall consider factors described in § 450.306 as the factors relate to a minimum 20-year forecast period. In nonattainment and maintenance areas, the effective date of the transportation plan shall be the date of a conformity determination issued by the FHWA and the FTA. In attainment areas, the effective date of the transportation plan shall be its date of adoption by the MPO(s).*
>
> *(b) The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.*
>
> *(g) The metropolitan transportation plan shall, at a minimum, include:*
>
> *(1) The current and projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan;*
>
> *(2) Existing and proposed transportation facilities (including major roadways, public transportation facilities, intercity bus facilities, multimodal and intermodal facilities, nonmotorized transportation facilities (e.g., pedestrian walkways and bicycle facilities), and intermodal connectors) that should function as an integrated metropolitan transportation system, giving emphasis to those facilities that serve important national and regional transportation functions over the period of the transportation plan.*
>
> *(3) A description of the performance measures and performance targets used in assessing the performance of the transportation system in accordance with § 450.306(d).*
>
> *(4) A system performance report and subsequent updates evaluating the condition and performance of the transportation system with respect to the performance targets described in § 450.306(d), including -*
>
> *(i) Progress achieved by the metropolitan planning organization in meeting the performance targets in comparison with system performance recorded in previous reports, including baseline data; and*
>
> *(ii) For metropolitan planning organizations that voluntarily elect to develop multiple scenarios, an analysis of how the preferred scenario has improved the conditions and performance of the transportation system and how changes in local policies and investments have impacted the costs necessary to achieve the identified performance targets.*
>
> *(5) Operational and management strategies to improve the performance of existing transportation facilities to relieve vehicular congestion and maximize the safety and mobility of people and goods;*

(6) Consideration of the results of the congestion management process in TMAs that meet the requirements of this subpart, including the identification of SOV projects that result from a congestion management process in TMAs that are nonattainment for ozone or carbon monoxide.

(7) Assessment of capital investment and other strategies to preserve the existing and projected future metropolitan transportation infrastructure, provide for multimodal capacity increases based on regional priorities and needs, and reduce the vulnerability of the existing transportation infrastructure to natural disasters. The metropolitan transportation plan may consider projects and strategies that address areas or corridors where current or projected congestion threatens the efficient functioning of key elements of the metropolitan area's transportation system.

(8) Transportation and transit enhancement activities, including consideration of the role that intercity buses may play in reducing congestion, pollution, and energy consumption in a cost-effective manner and strategies and investments that preserve and enhance intercity bus systems, including systems that are privately owned and operated, and including transportation alternatives, as defined in 23 U.S.C. 101(a), and associated transit improvements, as described in 49 U.S.C. 5302(a), as appropriate;

(9) Design concept and design scope descriptions of all existing and proposed transportation facilities in sufficient detail, regardless of funding source, in nonattainment and maintenance areas for conformity determinations under the EPA's transportation conformity regulations (40 CFR part 93, subpart A). In all areas (regardless of air quality designation), all proposed improvements shall be described in sufficient detail to develop cost estimates;

(10) A discussion of types of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the metropolitan transportation plan. The discussion may focus on policies, programs, or strategies, rather than at the project level. The MPO(s) shall develop the discussion in consultation with applicable Federal, State, and Tribal land management, wildlife, and regulatory agencies. The MPO(s) may establish reasonable timeframes for performing this consultation;

(11) A financial plan that demonstrates how the adopted transportation plan can be implemented. (i) For purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain the Federal-aid highways (as defined by23 U.S.C. 101(a)(5)) and public transportation (as defined by title 49 U.S.C. Chapter 53).

(ii) For the purpose of developing the metropolitan transportation plan, the MPO(s), public transportation operator(s), and State shall cooperatively develop estimates of funds that will be available to support metropolitan transportation plan implementation, as required under § 450.314(a). All necessary financial resources from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified.

(iii) The financial plan shall include recommendations on any additional financing strategies to fund projects and programs included in the metropolitan. In the case of new funding sources, strategies for ensuring their availability shall be identified. The financial may include an assessment of the appropriateness of innovative finance techniques (for example, tolling, pricing, bonding, public private partnerships, or other strategies) as revenue sources for projects in the plan.

(iv) In developing the financial plan, the MPO(s) shall take into account all projects and strategies proposed for funding under title 23 U.S.C., title 49 U.S.C. Chapter 53 or with other Federal funds; State assistance; local sources; and private participation. Revenue and cost estimates that support the metropolitan transportation plan must use an inflation rate(s) to reflect "year of expenditure dollars," based on reasonable financial principles and information, developed cooperatively by the MPO(s), State(s), and public transportation operator(s).

(v) For the outer years of the metropolitan transportation plan (i.e., beyond the first 10 years), the financial plan may reflect aggregate cost ranges/cost bands, as long as the future funding source(s) is reasonably expected to be available to support the projected cost ranges/cost bands.

(vi) For nonattainment and maintenance areas, the financial plan shall address the specific financial strategies required to ensure the implementation of TCMs in the applicable SIP.

(vii) For illustrative purposes, the financial plan may include additional projects that would be included in the adopted transportation plan if additional resources beyond those identified in the financial plan were to become available.

(viii) In cases that the FHWA and the FTA find a metropolitan transportation plan to be fiscally constrained and a revenue source is subsequently removed or substantially reduced (i.e., by legislative or administrative actions), the FHWA and the FTA will not withdraw the original determination of fiscal constraint; however, in such cases, the FHWA and the FTA will not act on an updated or amended metropolitan that does not reflect the changed revenue situation.

(12) Pedestrian walkway and bicycle transportation facilities in accordance with 23 U.S.C. 217(g).

(h) The MPO(s) shall consult, as appropriate, with State and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation concerning the development of the transportation plan. The consultation shall involve, as appropriate:

(1) Comparison of transportation plans with State conservation plans or maps, if available; or
(2) Comparison of transportation plans to inventories of natural or historic resources, if available.

(i) The metropolitan transportation plan should integrate the priorities, goals, countermeasures, strategies, or projects for the metropolitan planning area contained in the HSIP, including the SHSP required under 23 U.S.C. 148, the Plan required under 49 U.S.C. 5329(d), or an Interim Agency Safety Plan in accordance with 49 CFR part 659, as in effect until completion of the Public, and may incorporate or reference applicable emergency relief and disaster preparedness plans and strategies and policies that support homeland security, as appropriate, to safeguard the personal security of all motorized and non-motorized users.

A key new feature of both MAP-21 and the FAST Act is the establishment and use of a performance-based approach to transportation planning and decision-making. On May 27, 2016, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) jointly issued a Final Rule to update the federal planning regulations governing the development of metropolitan transportation plans and programs and provide revisions related to the use of a performance-based approach to the metropolitan transportation planning process.

NATIONAL GOALS AND PERFORMANCE MEASURES

MAP-21 established National Goals in the areas of safety, pavement and bridge infrastructure, congestion reduction, system reliability, freight movement, environmental sustainability, and project delivery. These National Goals, which appear in Table 1.1, were carried forward into the FAST Act, along with requirements for performance management. Plan 2045's approach to the Transportation Performance Management (TPM) requirements, which accompany the National Goals, is described at length in Chapter 4. Since the TPM requirements will become effective after Plan 2045 is adopted, a future amendment of the Plan will be needed at that time to fulfill the TPM mandates.

TABLE 1.1: NATIONAL GOALS

GOAL AREA	NATIONAL GOAL
Safety	To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
Infrastructure Condition	To maintain the highway infrastructure asset system in a state of good repair.
Congestion Reduction	To achieve a significant reduction in congestion on the National Highway System.
System Reliability	To improve the efficiency of the surface transportation system.
Freight Movement & Economic Vitality	To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
Environmental Sustainability	To enhance the performance of the transportation system while protecting and enhancing the natural environment.
Reduced Project Delivery Delays	To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

FEDERAL PLANNING FACTORS

The FAST Act requires that the following planning factors be considered in the long-range Plan and throughout the planning process:

- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;
- Increase the safety of the transportation system for motorized and non-motorized users;
- Increase security of the transportation system for motorized and non-motorized users;
- Increase accessibility and mobility of people and for freight;
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;
- Promote efficient system management and operation;
- Emphasize the preservation of the existing transportation system;
- Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation; and
- Enhance travel and tourism.

These federal planning factors are incorporated into the shared goals and desired outcomes of Plan 2045 and by extension the strategies and action to be implemented by the NYMTC members as described throughout the Plan document. As will be seen later in this chapter these federal planning factors are all built into the various aspects of the strategic framework set forth by NYMTC's members.

URBAN AREA BOUNDARIES AND METROPOLITAN PLANNING AREA BOUNDARIES (UABS AND MPAS)

MPOs are required to examine their urbanized area growth patterns following each decennial census. The U.S. Census determines which areas are considered urbanized based on an area's concentration of residential density. The urbanized area designations established in the 2010 Census are used to establish Metropolitan Planning Area (MPA) boundaries for MPOs. Adjusting the Census Urban Area Boundaries (UAB) to include the areas expected to become urbanized within a 20-year horizon is a necessary first step to establishing the eligibility of various components of the transportation system for federal transportation funding under specific funding programs.

Adjusted UABs are subject to approval by the U. S. Department of Transportation and review by NYSDOT. The 2010 UAB map (see Figure 1.7) contains minor adjustments to NYMTC's UAB.

THE MULTI-STATE METROPOLITAN REGION

Inter-organizational communication between government agencies and planning organizations across jurisdictions is essential for sustaining the integrity of overlapping transportation networks, ecosystems, economies, and environments. To address these geographically expansive issues, NYMTC must participate in planning at the level of the entire multi-state metropolitan region.

Toward this end, NYMTC is part of a Memorandum of Understanding (MOU) among the Orange County Transportation Council in the State of New York; the North Jersey Transportation Planning Authority in the State of New Jersey; the Western Connecticut Council of Governments, Connecticut Metro Council of Governments, Naugatuck Valley Council of Governments, South Central Regional Council of Governments, and Lower Connecticut River Valley Council of Governments in the State of Connecticut, and the Lehigh Valley Planning Commission in the State of Pennsylvania. The MOU recognizes that these planning councils are interdependent of each other and share ecosystems, environments, transportation systems, and a metropolitan travelshed. Through this MOU, NYMTC and the other MPOs/Councils of Government (COGs) collaborate as the Metropolitan Area Planning (MAP) Forum, which is working on issues such as data exchange, information sharing on regional projects, and other transportation planning issues related to the metropolitan transportation planning process.

FIGURE 1.7: NYMTC URBAN AREA BOUNDARIES

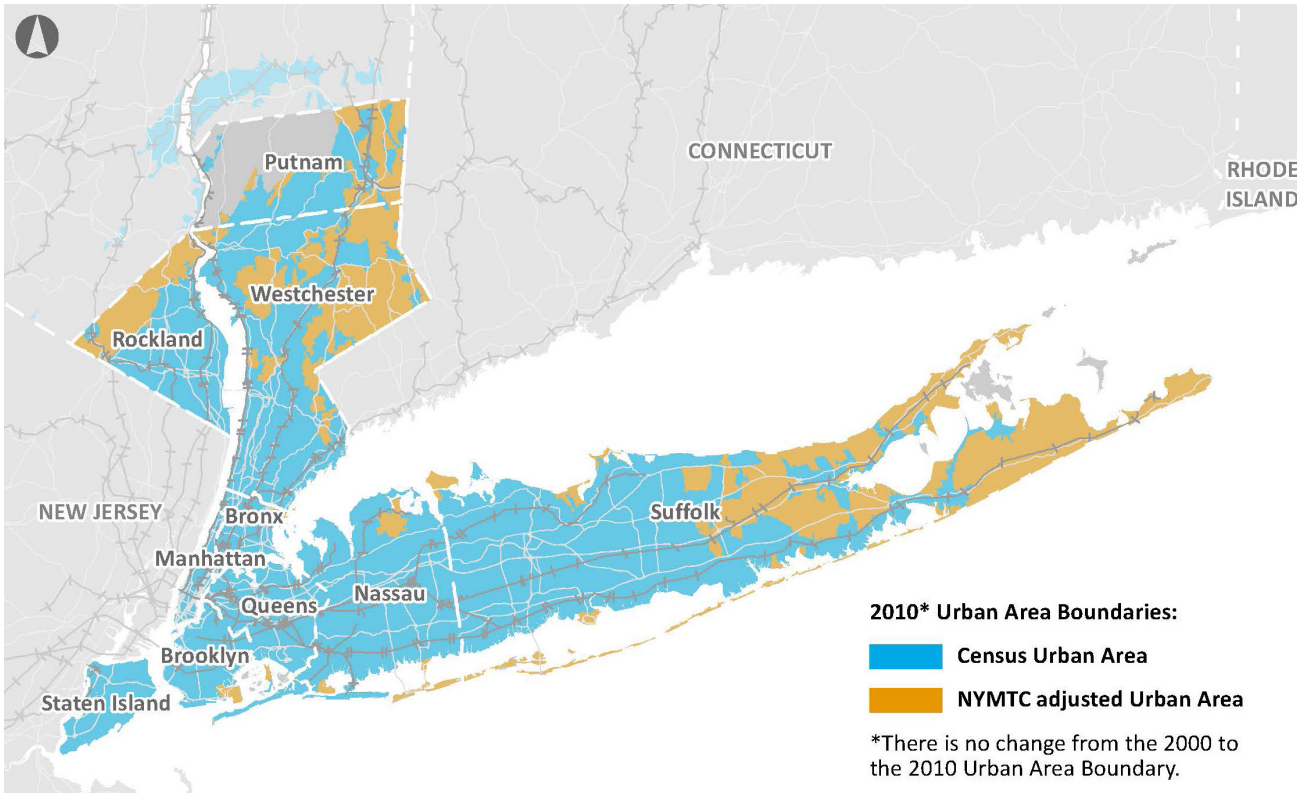
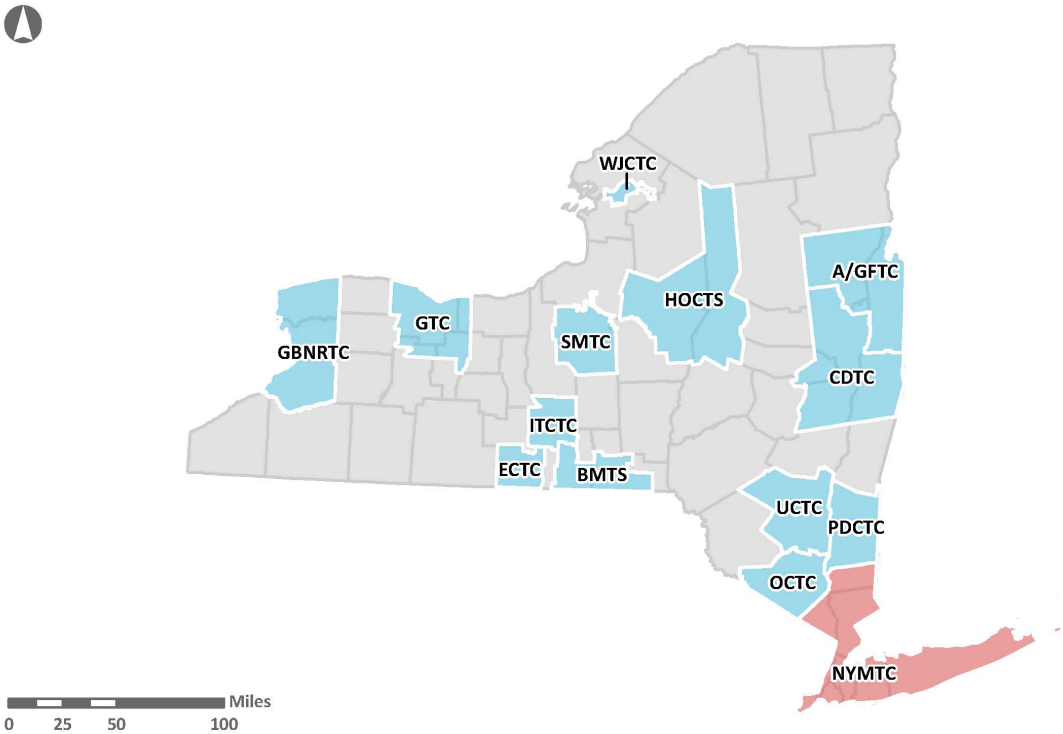


FIGURE 1.8: NEW YORK STATE MPA BOUNDARIES



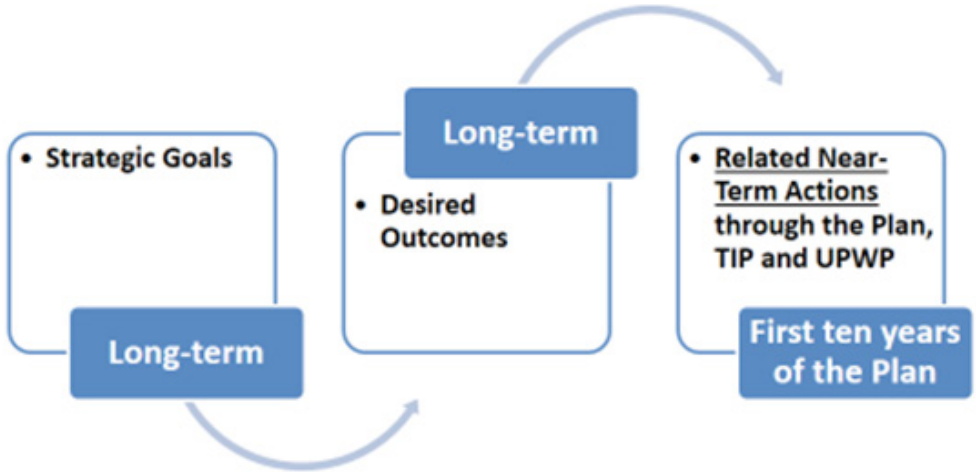
NYMTC: New York Metropolitan Transportation Council
A/GFTC: Adirondack/Glens Falls Transportation Council
BMTS: Binghamton Metropolitan Transportation Study
CDTC: Capital District Transportation Committee
ECTC: Elmira-Chemung Transportation Council
GTC: Genesee Transportation Council
GBNRTC: Greater Buffalo-Niagara Regional Transportation Council
HOCTS: Herkimer-Oneida Counties Transportation Study
ITCTC: Ithaca-Tompkins County Transportation Council
OCTC: Orange County Transportation Council
PDCTC: Poughkeepsie-Dutchess County Transportation Council
SMTC: Syracuse Metropolitan Transportation Council
UCTC: Ulster County Transportation Council
WJCTC: Watertown-Jefferson County Transportation Council

3. PLAN 2045 STRATEGIC FRAMEWORK

Plan 2045 is built from a framework of the members' strategic goals, their desired outcomes associated with the goals, and near-term actions related to the goals and outcomes which are intended to be advanced during the Plan's first ten years. NYMTC members collaboratively developed eight strategic goals and related desired outcomes that are consistent with both the National Goals and the federal planning factors described above. In addition to other elements described throughout the Plan, Coordinated Development Emphasis Areas (CDEAs) and other sustainability initiatives described below are also part of this strategic framework; all of them working towards the achievement of the strategic goals. CDEAs are described in greater detail in Appendix 11.

The following section presents the eight goals developed by NYMTC members, with desired outcomes and near-term actions detailed for each goal. The goals are not structured hierarchically and as such the achievement of one goal and its outcomes and actions are just as important as any of the others. Some of the near-term actions listed here contribute to achieving more than one goal or set of desired outcomes.

FIGURE 1.9: PLAN 2045 STRATEGIC FRAMEWORK



GOAL: ENHANCE THE REGIONAL ENVIRONMENT

NYMTC's members are committed to selecting transportation projects and programs and encouraging land use policies that, in the aggregate, continue efforts to reduce the negative impacts of transportation on the natural environment and human health.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

- Reduced traffic congestion and improved air quality;
- Reduced greenhouse gas emissions;
- Improved water quality; and
- Preservation of open space, especially wetlands.

NEAR-TERM ACTIONS

- Evaluate and enhance demand management programs;
- Evaluate and enhance mobile source emissions reduction programs;
- Inventory greenhouse gas emissions;
- Plan for additional financing strategies;
- Implement transit improvements, enhancements in the FFYs 2017-2021 TIP;
- Implement mobility, traffic improvement projects in the FFYs 2017-2021 TIP;
- Implement programmed strategic improvements and initiatives (see Chapter 6):
    - MTA NYCT Second Avenue Subway, Phase II (current planned completion: 2027)
    - MTA LIRR East Side Access (current planned completion: 2022)
    - Additional NYC Select Bus Service routes (current planned completion: 2022)
    - MTA LIRR Ronkonkoma Branch Second Track (current planned completion: 2021)
    - MTA LIRR Expansion Project (current planned completion: 2021)
    - Lower Hudson Transit Link (current planned completion: 2018)
    - Nassau Hub Transit Initiative – Initial Operating Segment (current planned completion: 2021)
    - Nicolls Road Multimodal Corridor (current planned completion: 2021)

New bus shelters in Nanuet, as part of the Lower Hudson Transit Link Project
Photo Source: NYSDOT

GOAL: IMPROVE THE REGIONAL ECONOMY

NYMTC's members must continue to maintain and develop the regional transportation infrastructure to support the vitality, competitiveness, and sustainable growth of the entire regional economy that will create employment opportunities and support the local tax base.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

> A strengthened position of the region as a global and national gateway;
> Strategic distribution of growth throughout the region (see Coordinated Development Emphasis Areas (CDEAs) below); and
> Improved regional mobility for people and goods.

NEAR-TERM ACTIONS

> Advance Bus Rapid Transit (BRT) and managed-use lane projects as part of a regional system;
> Continue planning for multi-modal access to ports and airports;
> Continue planning for multi-modal goods movement and distribution improvements;
> Implement programmed strategic improvements and initiatives (see Chapter 6):
  - Bayonne Bridge Navigational Clearance Project (navigational clearance improvements: 2017; full bridge modernization: 2019)
  - Moynihan Station Phase II (current planned completion: 2020)
  - MTA LIRR Expansion Project (current planned completion: 2021)
  - Lower Hudson Transit Link (current planned completion: 2018)
  - Nassau Hub Transit Initiative – Initial Operating Segment (current planned completion: 2021)
  - Nicolls Road Multimodal Corridor (current planned completion: 2021); and
> Complete planning and/or environmental assessments for the following vision projects:
  - Cross Harbor Goods Movement improvements (Tier II EIS)
  - Hudson Tunnel Project
  - Amtrak Gateway Program
  - Northeast Corridor (Tier II EIS) and Empire Corridor inter-city passenger rail improvements
  - Port Authority Bus Terminal Replacement Program
  - Van Wyck Expressway Access & Capacity Improvements

The Port Authority Bus Terminal
Photo Source: PANY&NJ

GOAL: IMPROVE THE REGIONAL QUALITY OF LIFE

NYMTC's members must work together to coordinate regional transportation, land use and zoning to provide a high quality of life for all residents of the region, thereby attracting and retaining people and businesses in the region.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

- Increased intra-regional mobility and accessibility for commuting, recreation and tourism;
- Mitigation of negative externalities of transportation in the design, construction, and operation of the system (i.e., noise, emissions, viewsheds, safety, etc.);
- Increased ability to safely enjoy walking, bicycling, and the use of public space; and
- Help create/sustain vibrant communities through placemaking; and
- Improve transportation access and mode choice options for the elderly, persons with disabilities, and other population groups that may have special transportation needs

NEAR-TERM ACTIONS

- Implement programmed strategic improvements and initiatives:
  - NYBridge project (Tappan Zee Bridge replacement project) (current planned completion: 2018)
  - Nassau Transit Hub Initiative – Initial Operating Segment (current planned completion: 2021)
  - Nicolls Road Multimodal Corridor (current planned completion: 2021) and Suffolk County Innovation Zone
  - NY 347 corridor reconstruction (current planned completion: 2022-2033)
- Complete planning and/or environmental assessments for the following transit-oriented development (TOD) and transportation improvement vision projects linked to land use plans:
  - Wyandanch Rising and Ronkonkoma Hub TOD development
  - Route 110 BRT
  - Staten Island North Shore transit improvements
  - I-684 capacity improvements
  - Southeast MTA Metro-North Railroad (MNR) Station parking and pedestrian improvements
  - Southern Westchester East-West Corridor (Yonkers-New Rochelle) transit improvements
  - Nanuet TOD study
- Advance the recommendations of the New York-Connecticut Sustainable Communities Initiative;
- Advance the Plan 2045 Pedestrian and Bicycle Element (see Appendix 2) and implement pedestrian and bicycle projects in the 2017-2021 TIP;
- Complete planning and/or environmental assessments for the following pedestrian and bicycle projects:
  - Brooklyn and Manhattan waterfront greenways
  - Hudson River Valley Greenway link;
- Continue implementation of Complete Streets policies;
- Continue implementation of Vision Zero policies;
- Continue Safe Routes to School policies;
- Advance planning in the CDEAs
  - Continue local capacity-building through community planning workshops;
- Continue planning for transportation sector clean fuels expansion; and
- Implement initiatives and actions from the Coordinated Public-Transit Human Services Transportation Plan

GOAL: PROVIDE CONVENIENT, FLEXIBLE TRANSPORTATION ACCESS WITHIN THE REGION

NYMTC's members provide mobility and transportation options, to maximize individuals' opportunities to participate in society, regardless of income level, residence, access to transit, age, or ability. NYMTC's members also must provide for the efficient movement of freight to, from and through the region.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

- A sufficient array of transportation choices;
- Expanded connections, particularly across modes and between communities;
- Increased reliability for passenger and freight trips; and
- Increased transit ridership.

NEAR-TERM ACTIONS

- Implement programmed strategic improvements and initiatives, including:
  - MTA NYCT Second Avenue Subway, Phase II (current planned completion: 2027)
  - MTA LIRR East Side Access (current planned completion: 2022)
  - Additional NYC Select Bus Service routes (current planned completion: 2022)
  - MTA LIRR Ronkonkoma Branch Second Track (current planned completion: 2021)
  - MTA LIRR Expansion Project (current planned completion: 2021)
  - MTA MNR Penn Station Access (current planned completion: 2023)
  - Lower Hudson Transit Link (current planned completion: 2018)
  - New Staten Island Ferry vessels (current planned completion: 2021)
  - Kew Gardens Interchange (current planned completion: 2020)
  - 11th Avenue Viaduct replacement (current planned completion: 2022)
  - Harlem River Viaduct replacement (current planned completion: 2018)
  - Cross Bronx Expressway improvements (current planned completion: 2022)
- Complete planning and/or environmental assessments for the following vision projects:
  - East River crossing and Hudson River crossing bus/High Occupancy Vehicle (HOV) capacity
  - Bruckner Expressway Bridge replacement
  - I-495 Integrated Corridor Management, New Jersey to Queens
  - Route 110 BRT
  - Central Avenue Bus Rapid Transit BRT
  - Bronx-to-Getty Square transit improvements
- Continue planning for ferry service enhancements and station access improvements;
- Implement congestion-related improvements and enhancements in the FFYs 2017-2021 TIP;
- Implement Transportation Demand Management (TDM) and Transportation Systems Management (TSM) projects; and
- Complete planning and/or environmental assessments for the following projects:
  - Cross County Parkway-Saw Mill River Parkway interchange
  - MTA NYCT Queens Communications-Based Train Control
  - MTA NYCT vehicle fleet, depot and station expansion, and sustainability investments
  - MTA MNR Port Jervis Line improvements
  - PATH Extension to Newark Liberty International Airport Rail Link Station
- Study the impacts of future changes likely to impact transportation

GOAL: ENHANCE THE SAFETY & SECURITY OF THE TRANSPORTATION SYSTEM

NYMTC's members will work to reduce the rate and severity of transportation-related crashes in the region and make the transportation system safer for all users. Members will also strive to increase the security of the transportation system, and support emergency management response and recovery efforts.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

> Reduced rate of annual injuries and fatalities on the region's transportation systems;
> Promulgation of advanced safety and security measures throughout the region;
> Enhanced coordination, data, and information sharing among members and other stakeholders; and
> Promotion of safety and security improvements in all aspects of transportation planning and implementation.

NEAR-TERM ACTIONS

> Implement safety recommendations/strategies in Plan 2045;
> Enhance access to safety-related data;
> In conjunction with TPM requirements to be completed in 2018:
  - Develop a regional approach to safety-related data analysis;
  - Develop operating procedures for safety and security considerations;
> Implement safety improvements and enhancements in the FFYs 2017-2021 TIP;
> Implement programmed strategic improvements and initiatives, including:
  - Manhattan Bridge seismic retrofit (current planned completion: 2025)
  - Ed Koch Queensboro Bridge seismic retrofit (current planned completion: 2025)
  - Brooklyn Bridge seismic retrofit (current planned completion: 2028)
  - Brooklyn Bridge approach arches and towers rehabilitation (current planned completion: 2021)
> Complete planning and/or environmental assessments for the following projects:
  - Sagtikos Parkway operational improvements.

Brooklyn Bridge Promenade
Photo Source: NYC DOT

GOAL: BUILD THE CASE FOR OBTAINING RESOURCES TO IMPLEMENT REGIONAL INVESTMENTS

NYMTC's members and the region's other elected officials must think regionally about transportation needs, solutions, strategies, and investment priorities. In developing a shared regional vision, NYMTC's members support the position that these investments are a shared priority, and are of strategic importance to this region and to the nation.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

- Coordinated long-term planning;
- Developing a list of prioritized projects supporting the region's shared vision;
- An increase in the use of alternative methods of financing transportation investments to supplement existing Federal and State funding sources;
- Obtain a fair share of Federal funds available for transportation, proportional to its transportation needs and economic share relative to the nation; and
- Elimination of unfunded mandates as feasible.

NEAR-TERM ACTIONS

- Advance near-term actions, immediate strategic regional investments and improvement projects through the TIP;
- Pursue agreed upon alternative funding sources; and
- Reach consensus on other alternative funding sources to be used individually or cooperatively.

Ellison Avenue Bridge Ribbon Cutting over LIRR tracks in Westbury, NY
Photo Source: MTA

Station hardening demonstration at Whitehall Station
Photo Source: MTA

GOAL: IMPROVE THE RESILIENCY OF THE REGIONAL TRANSPORTATION SYSTEM

NYMTC's members will continue to plan for improving the resiliency of the transportation system so that the system can better resist disruptions to services and facilities and recover from them when they occur. Greater resiliency will help mitigate the adverse impacts of disruptions on the movement of people and goods due to weather, climate, or other acts of nature.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

> Member-defined adaptation measures for critical components of the transportation system to accommodate variable and unexpected conditions without catastrophic failure;
> Greater resiliency of the regional supply chain by identifying options for goods movement during and after events; and
> Cooperative partnerships with federal, state, local agencies, and other stakeholders to adapt the transportation system and improve recovery from disruptions.

NEAR-TERM ACTIONS

> Planning and implementation to improve the resiliency of the existing system, including:
  - Superstorm Sandy recovery projects
  - New York-New Jersey-Connecticut Transportation Vulnerability Assessment and Adaptation Analysis
  - MTA's system-wide resiliency projects
> Create new cooperative partnerships with multiple government agencies when responding to disasters; and
> Pursue new partnerships through the Federal Recovery Framework for recovery from disasters.

GOAL: PRESERVE THE EXISTING TRANSPORTATION SYSTEM

NYMTC members will continue to maximize the service life of the existing transportation system with the resources available by systematically and strategically maintaining and replacing transportation assets based on need. Using asset management principles and data-driven decision-making will result in a sustainable approach to programming that considers the relative and cumulative value of transportation assets as they benefit the public, economy and environment.

NYMTC WILL CONTINUE TO WORK IN A COLLABORATIVE FASHION TO ACHIEVE THESE OUTCOMES:

> Making the investments necessary to maximize the useful life of existing assets and to manage these assets in the most cost-effective manner through preventive maintenance and other measures;
> Keeping existing federal-aid eligible and local roadway systems – pavement, bridges and tunnels safe and functioning as intended;
> Keeping the existing transit infrastructure and equipment safe and functioning as intended;
> Keeping the existing pedestrian and bicycle facilities safe and functioning as intended.
> Protecting the existing freight network; and
> Promoting and sustaining asset management and operations activities for the regional transportation system.

NEAR-TERM ACTIONS

> Implement programmed strategic investments and initiatives related to system preservation, including:
  - Kosciuszko Bridge replacement (current planned completion: 2020)
  - Goethals Bridge replacement (current planned completion: 2018)
  - George Washington Bridge “Restoring the George” Program (current planned completion: 2024)
  - Cross Bronx Bridge rehabilitation (current planned completion: 2022)
  - Major Deegan Expressway rehabilitation (current planned completion: 2022)
  - I-678 Van Wyck Expressway Bridges replacement and rehabilitation (current planned completion: 2022)
  - Belt Parkway bridges replacement, Gerritsen Inlet and Mill Basin (current planned completion: 2021)
  - Brooklyn-Queens Expressway/Grand Central Parkway interchange reconstruction (current planned completion: 2024)
  - Kew Gardens Interchange (current planned completion: 2020)
  - Brooklyn-Queens Expressway rehabilitation (from Sands St to Atlantic Ave) (current planned completion: 2025)
  - West 79th Street Bridge rehabilitation (current planned completion: 2021)
  - Broadway Bridge (over the Harlem River) rehabilitation (current planned completion: 2020)
  - Ed Koch Queensboro Bridge upper roadways replacement (current planned completion: 2021)
  - NY 347 safety, mobility & environmental improvements (current planned completion in multiple phases: 2022-2033)
  - Ashford Avenue Bridge replacement (current planned completion: 2018)
> Implement other system preservation-related projects in the 2017-2021 TIP including:
  - Support members’ Asset Management Plans
  - Implement recommendations from the NYMTC Regional Freight Plan (see Appendix 8)

PLANNING FOR SUSTAINABILITY

Plan 2045's strategic framework contains an emphasis on sustainability, which is built around the on-going connection between transportation planning and the use of land in NYMTC's planning area. Key components of this connection include:

A. COORDINATED DEVELOPMENT EMPHASIS AREAS (CDEAS)

CDEAs are an essential component of the Plan 2045 Strategic Framework, as described above. They are locations where changes to land use and transportation that will help shape future growth and the manner in which that growth is accommodated by the transportation system. Recognizing the intrinsic connection between land use and transportation planning, CDEAs provide a framework for sustainable growth and development, where land use changes and investment in transportation can help foster more efficient, sustainable growth, as well as mitigating environmental pollution, conserving land and strengthening economic vitality by investing in development and transportation in a coordinated fashion, particularly linked to the existing and future transit network.

Building on the sustainability features of recent Plans and the work done through the federal Sustainable Communities Initiative, the CDEAs identified in Plan 2045 represent an evolutionary step in coordinated land use and transportation planning. They also represent a key linkage between the master plans and sustainability plans of NYMTC's members and Plan 2045, helping to inform transportation investments and ensure that the development plans of individual jurisdictions in the NYMTC planning area are vital components of the transportation planning future.

Finally, the definition of CDEAs is an important step towards achieving several of Plan 2045's strategic goals and desired outcomes goals by better linkages between land use decisions made at the local level with transportation investment decisions made at the regional level. The CDEAs identified by NYMTC members are mapped in Appendix 11.

B. SUSTAINABLE COMMUNITIES INITIATIVE (SCI)

Related to the CDEAs are sustainability planning initiatives such as the SCI, a key initiative of the federal partnership of the U.S. Department of Housing and Urban Development, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency. Funded through a Sustainable Communities Regional Planning Grant, an SCI for the New York-Connecticut portion of the multi-state metropolitan region was developed through the New York-Connecticut Sustainable Communities Consortium, a partnership established in 2011 of nine cities, two counties and six regional planning organizations, including NYMTC. This resulted in the 2014 release of an implementation plan to create more sustainable and equitable growth in the region under study.

Through the SCI, the Consortium worked to foster livable and sustainable communities and growth centers around existing and planned transit services in order to enhance affordable housing and continue to reduce traffic congestion, improve the environment and expand economic opportunities. One of the major underlying factors was the understanding that transit-oriented development (TOD) is a foundation for sustainable and equitable development.

A major outcome of the SCI was the development of a set of project plans for specific locations that can provide a new dimension of growth for the region's economy and models for other locations. Some of these projects developed community plans, while others either assessed the feasibility and potential impacts of major infrastructure improvements or addressed key sustainability and development issues that affected several communities in a jurisdiction.

C. TRANSIT-ORIENTED DEVELOPMENT (TOD) PROJECTS

TOD is compact, mixed-use development near transit facilities and high-quality walking environments. It is about creating sustainable communities where people of all ages and incomes have transportation and housing choices, increasing location efficiency where people can walk, bike and take transit. NYMTC has facilitated a number of Walkable Community and

Parking Management workshops in areas identified for TOD, while its members have partnered with local municipalities on development projects around transit stations and hubs. Chapter 2 details TOD projects in the NYMTC planning area.

D. COMPLETE STREETS REQUIREMENTS

New York State's Complete Streets Act requires state, county and local agencies to consider the convenience and mobility of all users when developing transportation projects that receive state and federal funding. Complete Streets are roadways planned and designed to consider the safe, convenient access and mobility of all roadway users of all ages and abilities. This includes pedestrians, bicyclists, public transportation riders, and motorists; it includes children, the elderly, and persons with disabilities. They are a key building block to sustainable and equitable TODs.

In the NYMTC planning area, complete streets resolutions or policies are in place in Nassau, Suffolk, Rockland and Westchester counties, as well as at the municipal level in a number of constituent villages, towns, and cities. NYMTC has facilitated a number of workshops in the areas of Complete Streets and Safe-Routes-to-Schools to provide the tools required to develop complete streets and identify potential projects for funding through the transportation planning process.

4. PUBLIC PERCEPTIONS OF TRANSPORTATION ISSUES IN THE NYMTC PLANNING AREA

Throughout the development of Plan 2045, NYMTC has engaged the public for input through different methods. This section will briefly describe each effort, and provide valuable insight into what the public perceives to be the most important transportation issues in the NYMTC region.

Online tools were administered for two different campaigns: the first was a survey that sought to understand what factors the public perceived to be the most influential drivers of future changes that would impact transportation in NYMTC's planning area. Survey respondents cited technological advancements and climate change as important drivers of change. These drivers will be discussed at length in Chapter 2.

The second online tool used in the development of Plan 2045 was an interactive website called MySidewalk, which allowed for the public to submit and discuss their feedback with other participants on major plan components (e.g. the strategic goals, impact of future growth on the transportation system, ideas for transportation solutions, financing options, and thoughts about planned projects).

In addition to these online forms of public engagement, NYMTC also conducted face-to-face public outreach. During the Spring of 2016, public workshops were held in each county and borough in the NYMTC planning area. At each workshop, the Plan development process was described, and participants could express local concerns and provide ideas and feedback on major plan components, special element plans, and planned projects. Later that spring, NYMTC held professionally-convened focus groups for each of its subareas (the Lower Hudson Valley, suburban Long Island, and New York City), as well as with residents of Communities of Concern . The focus groups were held to gain an understanding of what the public perceived to be the most significant issues in their local areas and in the region as a whole.

Appendix 7 includes the information gathered through these methods. Some of the major, overarching issues shared across geographies included the need to invest in transit infrastructure to achieve more reliable, higher-capacity service; the need to upgrade freight infrastructure for higher efficiency; and im-

provements to transportation safety. In addition, TOD and sustainable growth initiatives and projects were generally well-supported by participants.

Concerns among participants about vehicular congestion were more prevalent in the suburban subareas. Of particular concern was congestion at important interchanges, on thoroughfares bound for New York City, and on east-west highways on Long Island. The need for improved east-west movement across the Hudson River was also identified.

At the same time, in recognition of the potential for public transit investments to alleviate roadway congestion, there was significant support among the participants for investments in transit service. Participants identified a need for better connectivity between transit services; for example, for trans-Hudson and north-south Long Island trips. Lower Hudson Valley and Long Island participants also expressed the need for increased service capacity and frequency at peak hours.

Participants in the suburban subareas also supported pedestrian and bicycle projects, citing the need for better pedestrian infrastructure around stations, as well as expanding recreational pedestrian and bicycle pathways.

For the New York City participants, most concerns were centered on public transit; specifically, the desire for subway service expansion to new, currently unserved destinations, concerns over aging infrastructure, overcrowding on trains and platforms, and frequent service delays. The expansion of bicycle infrastructure, especially on bridges, was supported in all boroughs, although the need to improve safe interactions with other modes was cited as a major concern. Vehicle-related comments mostly focused on the need to manage the volume of trucks through New York City communities.

As mentioned, Appendix 7 provides a detailed discussion of the public engagement process employed specifically for Plan 2045, including public comments collected during the public review period.

Spring 2016 Plan 2045 workshop in Rockland County
Photo Source: NYMTC

ENDNOTES

[1] The Regional Plan Association. November 2007. **Northeast Megaregion 2050: A Common Future**. http://www.rpa.org/pdf/Northeast_Report_sm.pdf

[2] U.S. Census. 2015. **Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2015 – United States – Metropolitan Statistical Areas**.

[3] Cabinet Office, Government of Japan. 2014. **GDP of Tokyo Metropolitan Area** (Prefecture of Tokyo, Kanagawa, Saitama, and Chiba). http://www.esri.cao.go.jp/jp/sna/sonota/kenmin/kenmin_top.html

[4] Wylde, Kathryn. January 23, 2006. **Keeping the Economy Growing**. *Gotham Gazette*. http://www.gothamgazette.com/index.php/economy/3127-keeping-the-economy-growing

[5] Port Authority of New York and New Jersey (PANYNJ). 2016. **Monthly loaded container TEUs and Express-Rail Lifts: 2016**.

[6] Prevost, Lisa. August 12, 2007. **Now Arriving: Reverse Commuters**. *The New York Times*. http://www.nytimes.com/2007/08/12/realestate/12wczo.html

[7] Air Products and Chemicals. No date. **Worldwide Locations and Contacts**. http://www.airproducts.com/Company/about-us/worldwide-locations.aspx

[8] Rojas, Cristina. July 3, 2015. **5 Things Trenton Is Focusing On to Foster Economic Development**. *NJ.com*. http://www.nj.com/mercer/index.ssf/2015/07/5_things_trenton_is_focusing_on_to_foster_economic.html

[9] U.S. Census Bureau, 2015, Id.

[10] U.S. Census Bureau of Labor Statistics. 2015. **May 2015 Employment Estimates**. http://www.bls.gov/oes/current/oes_35620.htm#00-0000

[11] Transportation Research Board. October 16, 2006. **Facts from Alan Pisarksi's Commuting in America III Study**. http://onlinepubs.trb.org/onlinepubs/nchrp/CIAIIIfacts.pdf

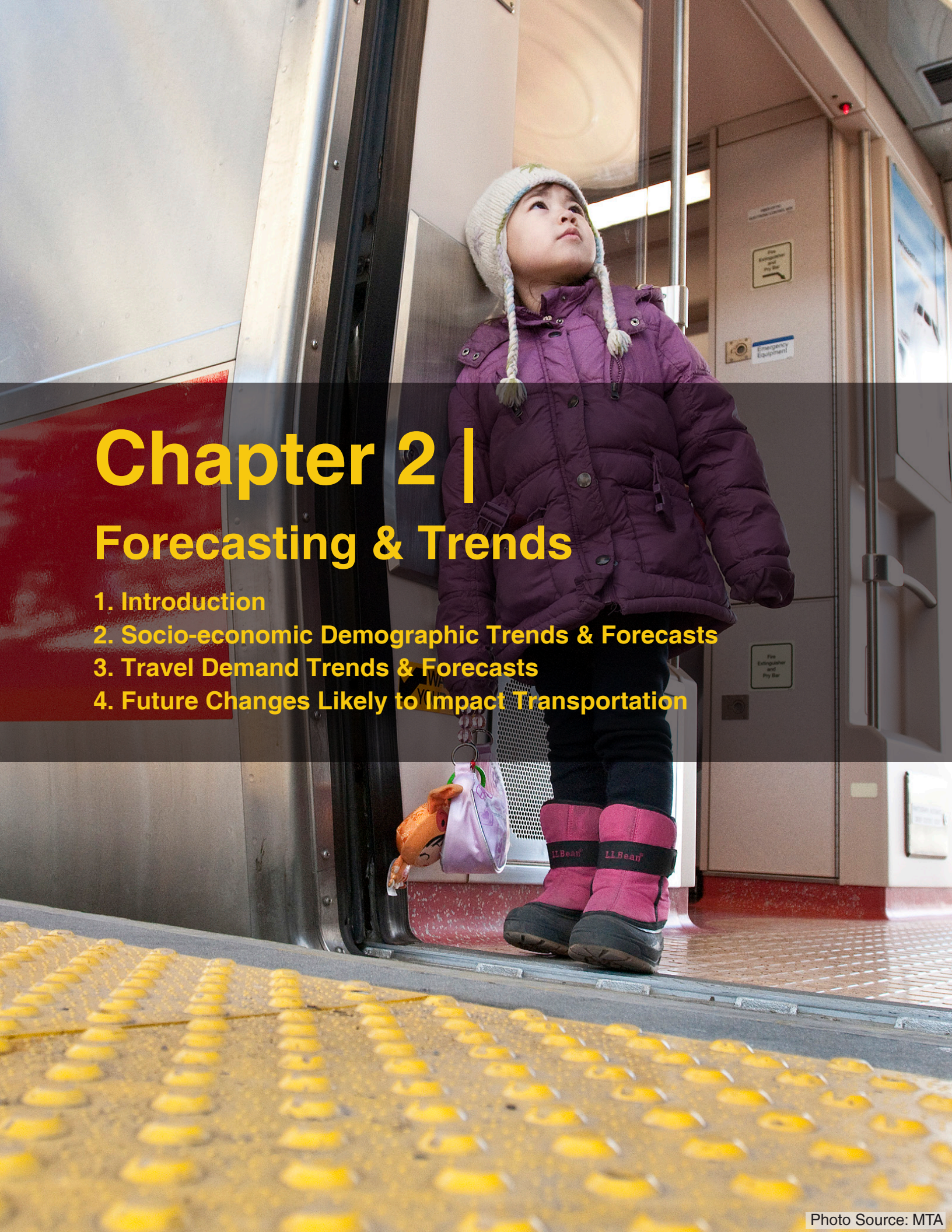
[12] Port Authority of New York and New Jersey. January 25, 2017. **Passenger Activity at Port Authority Airports Sets New Record for Fourth Consecutive Year.** http://panynj.info/press-room/press-item.cfm?headLine_id=2627

[13] MTA. No date. **Metro-North Penn Station Access.** http://web.mta.info/mta/planning/psas/pdf/PennAccess_MTAweb.pdf

[14] New York State. 2017. **The New NY Bridge: About the Project**. http://www.newnybridge.com/about/

[15] PANYNJ. 2017. **Goethals Bridge Replacement Construction**. http://www.panynj.gov/bridges-tunnels/goethals-bridge-replacement-about.html

[16] PANYNJ. 2017. **Cross Harbor Freight Program**. http://www.panynj.gov/port/cross-harbor.html



Chapter 2 |
Forecasting & Trends

1. Introduction
2. Socio-economic Demographic Trends & Forecasts
3. Travel Demand Trends & Forecasts
4. Future Changes Likely to Impact Transportation

Photo Source: MTA

Herald Square Pedestrian Plaza
Photo source: NYC DOT

1. INTRODUCTION

NYMTC's socioeconomic and demographic (SED) forecasts establish the likelihood that NYMTC's planning area will experience significant growth in population, jobs, economic activity, and travel over the period of Plan 2045. This likelihood presents a challenge to the transportation system on a number of levels. Accommodating future growth while safeguarding the quality of life and health of residents and visitors is a critical concern for NYMTC's member agencies. The emphasis on sustainability in Plan 2045's strategic framework is one response to this looming challenge.

This chapter presents data and information on a wide range of recent socioeconomic and demographic trends and forecasts that form the basis of anticipated travel demand over the course of Plan 2045. Additional technical detail is available in Appendix 3. U.S. Census data is employed to describe trends since the turn of the millennium as a basis for forecasting methods that project these trends to the 2045 horizon year. The chapter ends with a discussion of the underlying factors that are expected to continue to impact the region's transportation network.

FORECASTING METHODS

The SED and travel demand forecasts which are the foundations for Plan 2045, were made with the use of simulation models to predict how the NYMTC ten county planning area is expected to change over the planning period. It is important to note that the forecasts are based on available data and information, and do not take into account the impact of factors that cannot be reasonably quantified, such as that of new technologies on future travel demand.

There are two stages in NYMTC's forecasting process. For Plan 2045, the first step was to produce regional SED forecasts for the planning period by county/borough. In the second step, the SED forecasts are used as inputs to the NYMTC's travel demand simulation modelling tool, which is called the New York Best Practice Model (NYBPM). The NYBPM, along with relevant post-processing software, was employed to produce travel demand, modal split and mobile source emissions forecasts for the planning period. The technical details of the forecasting process, including methodologies and assumptions, can be found in Appendix 3.

The first stage of the process forecast the following four key SED metrics:

Population which refers to the number of people living in the region and each of its subregions. This variable is a key indicator of growth and where this growth is occurring.

Employment which refers to the number of jobs in the region and each of its subregions. Employment trends influence both the end points of commute trips and the demand for the movement of various types of goods in the region. The employment figures help decision-makers understand whether the region is generating or shedding jobs. Employment trends influence the number of people utilizing transportation networks in the region, and is geographically associated with places of work.

Labor force which refers to the number of eligible workers living in the region and each of its subregions. This figure allows planners and decision makers to infer where commute trips originate, and is geographically associated with places of residence.

Households which refers to two data points: the total number of households and the average household size of people living in the region and each of its subregions. This figure can be used to predict travel patterns (e.g., how many cars a household owns and which modes of transportation household members are likely to take).

These SED metrics were used as inputs to the NYBPM to forecast travel patterns for the broader twenty-eight county multi-state metropolitan region. The outputs of the NYBPM included the following:

Daily Vehicle Trips which refers to the origins and destinations of all vehicular trips in the broader region. These trips were broken down by specific vehicle type.

Daily Transit Trips which refers to the origins and destinations of all transit trips in the broader region, broken down by specific transit mode.

Daily Vehicle Miles Traveled (VMT) which refers to the total miles traveled by all vehicles, in total and disaggregated by county/borough.

Daily Vehicle Hours Traveled (VHT) which refers to the total hours spent traveling by all vehicles, in total and broken down by county.

Like its predecessor, Plan 2045 has been developed through a cooperative effort among the NYMTC members and has included a vigorous community outreach and public involvement program. It is built around current and estimated future demand for transportation services and the current and future needs of the transportation system that are key to maintaining a sustainable region in the long-term.

WHAT IS THE BEST PRACTICE MODEL?

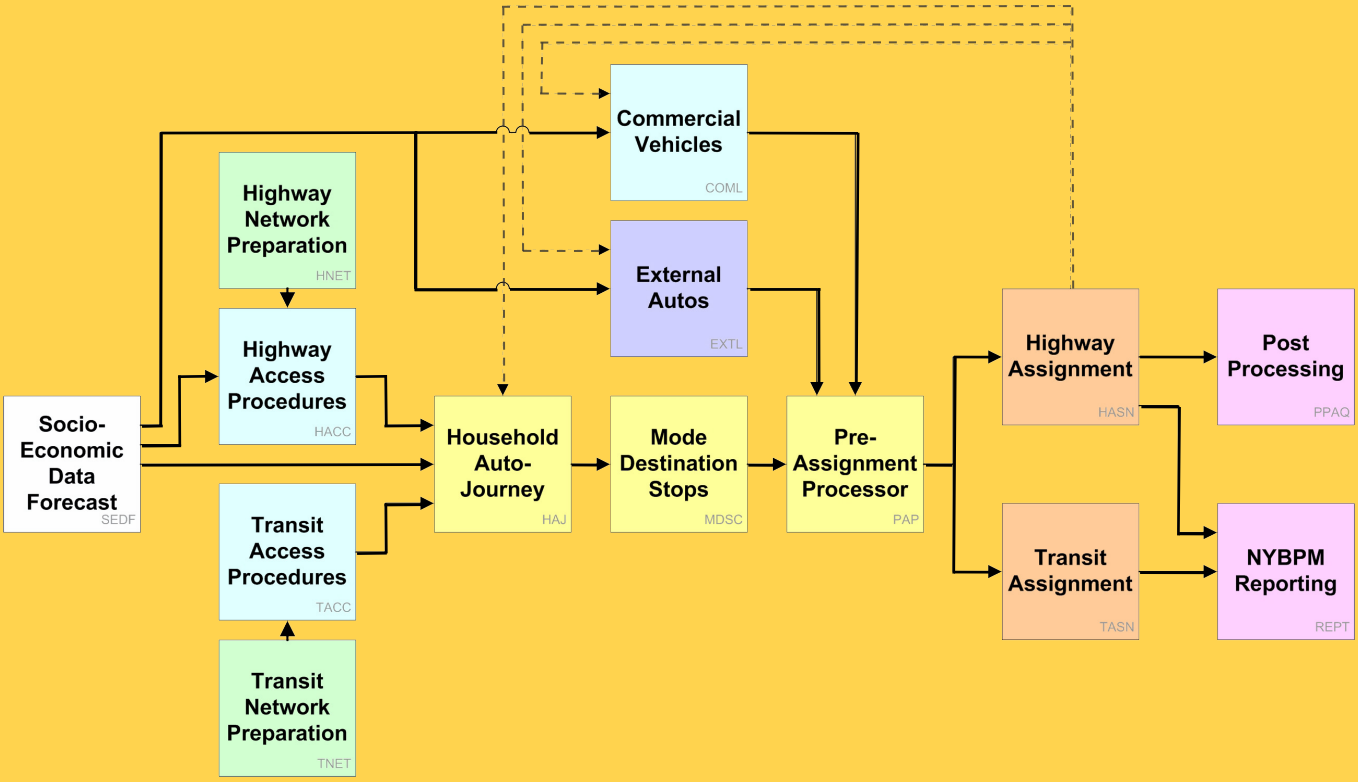
The New York Best Practice Model (NYBPM) is NYMTC's in-house methodology for forecasting travel patterns. It responds to projected changes in socioeconomic and demographic conditions and to planned changes in the region's transportation system. It helps simulate and visualize future travel patterns including where people travel, how people travel (car, subway, bus, or commuter rail), their preferred routes (highway or local roads), and their trip times. It provides decision-makers and planners in the NYMTC planning area with a valuable tool for the long-term planning of regional transportation improvements. The NYBPM process requires significant human and technological resources and the model is reconfigured and updated every three to four years to incorporate the latest information and trends.

Some of the salient features of the NYBPM are as follows:

- The model uses the concept of "journeys" (multiple trip segments) rather than conventional "trips" to identify travel patterns in the region.
- The model is an activity-based travel demand model. Unlike the traditional models that operate at the zone level, the NYBPM uses the micro-simulation method to simulate the travel patterns of each household, each person and each journey in the region.
- The model's highway and transit networks are very complex, using data from various transportation agencies and operators such as New York State Department of Transportation (NYSDOT), New York City Department of Transportation (NYCDOT), Metropolitan Transportation Authority (MTA), Port Authority of NY & NJ (PANYNJ) and New Jersey Transit (NJT).
- The model is comprised of a set of sub-models applied in sequence: Household Synthesizing Model; Auto-ownership Model; Journey Production (Frequency) Model; Mode, Destination and Stop Choice Model; Time of Day Model, and other models.
- The model is available for local planners to use on a variety of transportation software. The transit and highway components are based on a geographic information system (GIS) which provides a realistic and accurate representation of the highway and transit network.
- The present NYBPM is updated based on 2010 Census data and the most recently available traffic counts. Highway volume assignments were calibrated based on the 2010 Screenline Count Database.

Additional details about the Best Practice Model can be found in Appendix 3.

FIGURE 2.1: NYBPM FLOWCHART



Grand Central Station
Photo source: MTA

2. SOCIOECONOMIC TRENDS & FORECASTS

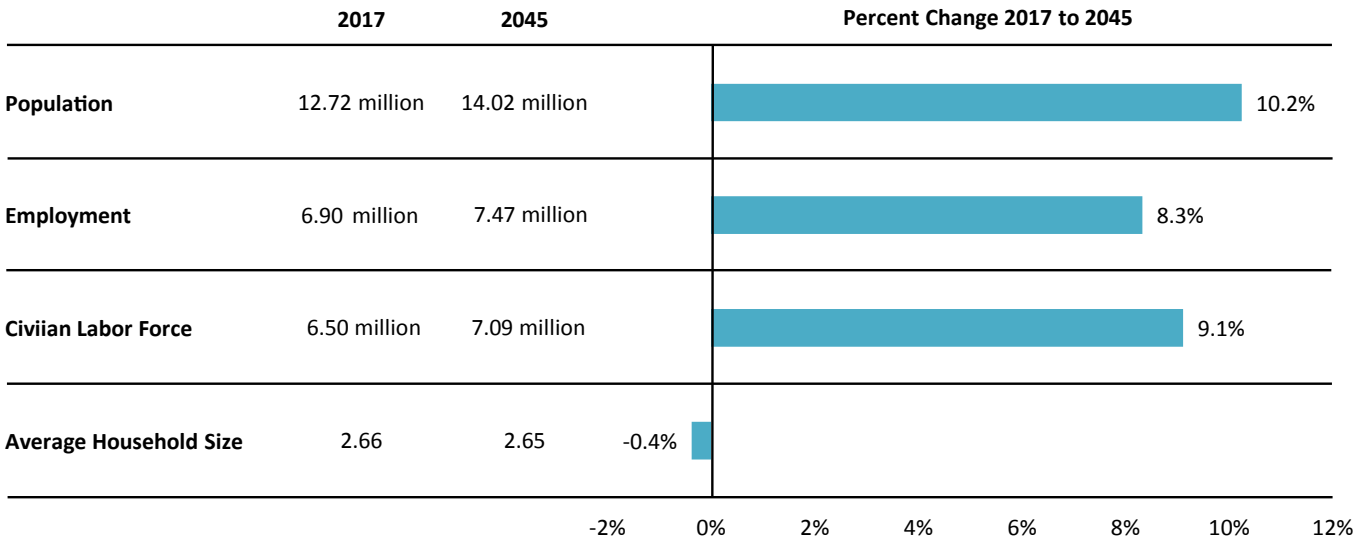
Understanding the SED trends is an essential step to forecasting future travel demand in the region. Typically, NYMTC uses U.S. Census Bureau data from the multi-state metropolitan region as a base for the forecasts. Understanding the trends provides insights on the potential for economic and population growth in the future. However, the focus of Plan 2045 is the ten-county NYMTC planning area, which is disaggregated into the following subregions:

- The Lower Hudson Valley, consisting of Putnam, Rockland, & Westchester counties;
- New York City, consisting of Bronx, Queens, Manhattan, Brooklyn, & Staten Island; and
- Suburban Long Island, consisting of Nassau and Suffolk counties.

Figures 2.2(a) and (b) break down the four demographic metrics and display NYMTC's forecasts for 2017 (interpolated from the 5-year increment forecasts – see Table 2.1-2.4 below) and 2045. Growth is expected to occur in the NYMTC planning area over the course of Plan 2045 in all metrics except average household size (generally a less volatile statistic). Population is expected to grow by 10.2 percent through 2045, an annualized growth rate of approximately 0.36 percent. Meanwhile, growth rates for employment and civilian labor force are expected to be 8.3 percent and 9.1 percent, respectively.

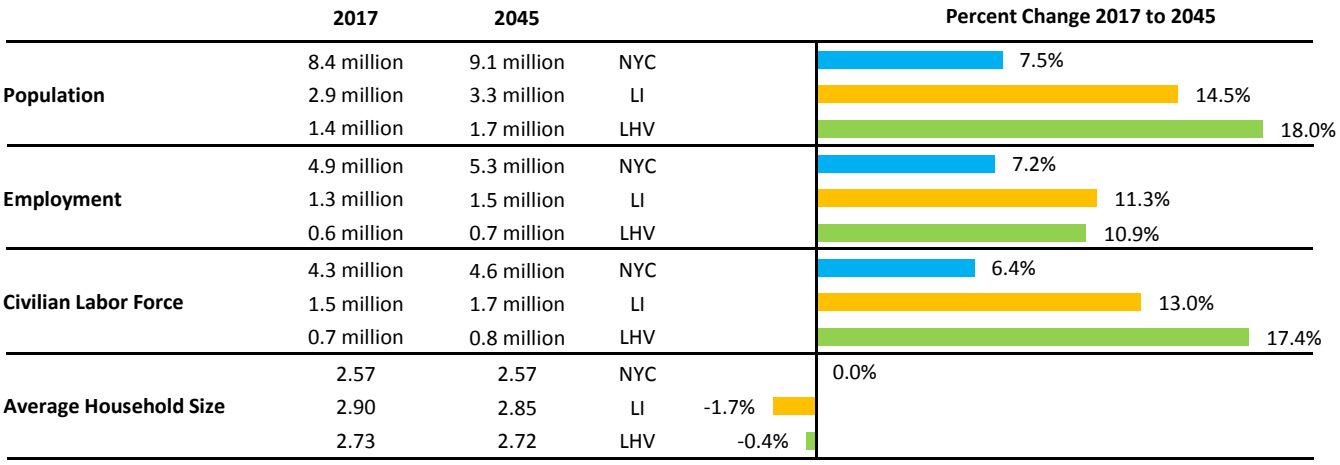
As shown in Figure 2.2(b), when these metrics are broken down by TCC, Lower Hudson Valley stands out for the highest rate of growth over the next 25 years with an increase in population of 18.0 percent and an increase in civilian labor force of 17.4 percent. While New York City experiences slower rates of growth, it will add the highest total numbers for all indicators except household size, adding over half a million to its population, 400,000 jobs and 300,000 more people to the civilian labor force. Average household size is expected to decrease by 1.7 percent and 0.4 percent for Long Island and Lower Hudson Valley, respectively, while it remains the same for NYC during the projection period.

FIGURE 2.2A: SED FORECASTS FOR THE NYMTC PLANNING AREA



Source: NYMTC
Note: Total numbers and percent change may not translate exactly due to rounding.

FIGURE 2.2B: SED FORECAST FOR THE NYMTC PLANNING AREA BY SUBREGION



Source: NYMTC

POPULATION

The decade of the 1990s saw rapid population growth across the NYMTC planning area, as well as across the country. By 2000, the total population of the NYMTC planning area was roughly 12.1 million, an increase of 8.2 percent over 1990 levels. This represents an annualized growth rate of 0.8 percent. Nationally, the population grew by 13.2 percent during this period.

National population growth slowed during the decade of the 2000s, growing by approximately 9.7 percent between 2000 and 2010.[1] The NYMTC planning area followed a more dramatic pattern - population growth slowed to 2.5 percent overall between 2000 and 2010.

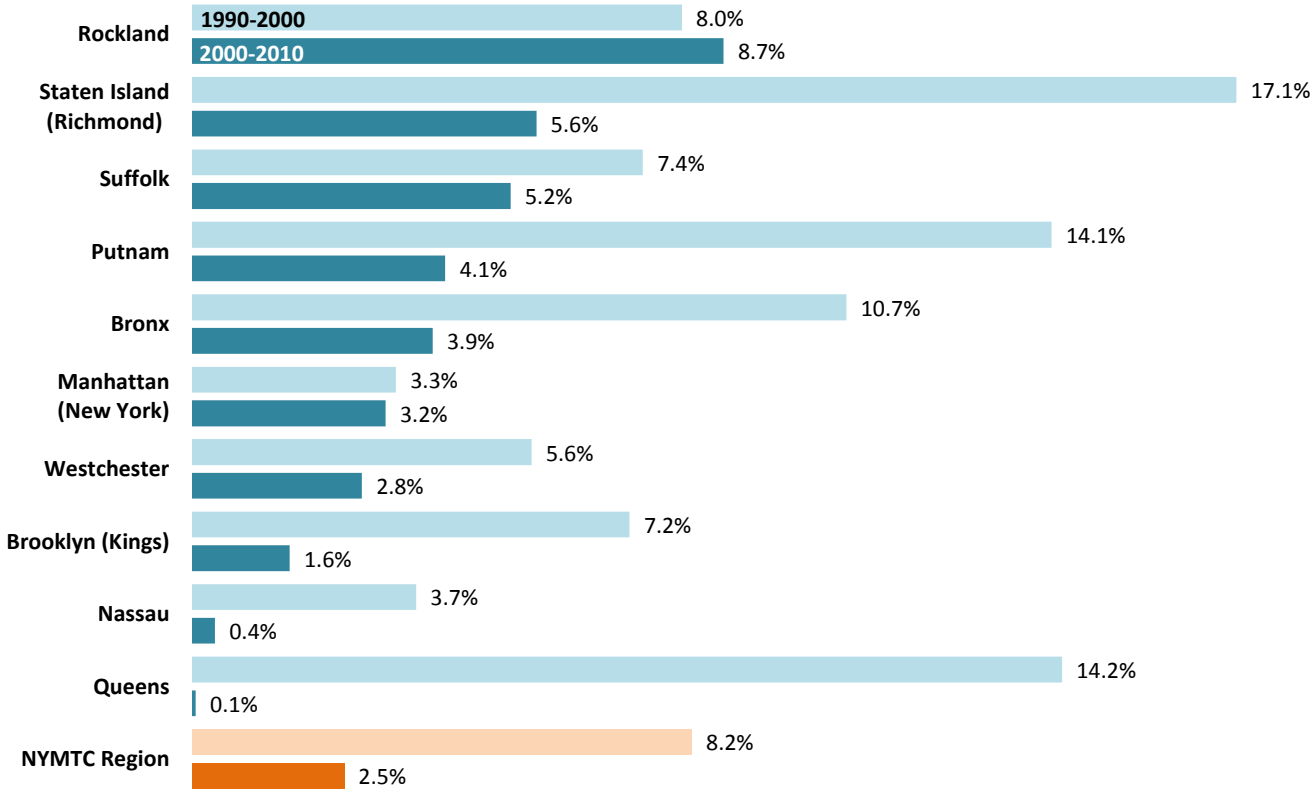
Population growth at the national level continued to slow after 2010: between 2010 and 2016, the annualized population growth rate for the country was 0.61 percent, compared to 0.93 percent between 2000 and 2010 and 1.2 percent between 1990 and 2000. In fact, the year from July 2015 to July 2016 saw the slowest rate in national population growth since 1937.[2] The NYMTC planning area, however, saw a slight uptick in its annualized growth rate from 0.25 percent during the 2000s to 0.45 percent from 2010 to 2015. This period has also been characterized by lower birth rates, fewer marriages, lower economic growth and less immigration.[3]

Figure 2.3 shows population growth in the NYMTC planning area disaggregated by county/borough. All NYMTC counties/boroughs experienced greater population growth between 1990 and 2000 than between 2000 and 2010 except Rockland County, which was the fastest growing county between 2000 and 2010. Staten Island, Putnam and Queens Counties led population growth in the region from 1990 to 2000, with growth rates at 17, 14, and 14 percent, respectively.

The New York City subregion is forecast to grow by approximately 7.5 percent, from 8.5 million to 9.1 million between 2017 and 2045. The population of Nassau and Suffolk counties on Long Island is expected to grow by 14.5 percent through 2045, while the Lower Hudson Valley subregion is expected to grow by 18.0 percent.

New York City Subway
Photo Source: MTA

FIGURE 2.3: POPULATION GROWTH BY COUNTY/BOROUGH



Source: U.S. Census Bureau, 1990, 2000 and 2010

TABLE 2.1: POPULATION TRENDS & FORECASTS BY COUNTY/BOROUGH & SUBREGION (IN 000S)

AREANAME	1980	1990	2000	2010	2015	2017 *	2020	2025	2030	2035	2040	2045
NYC	**7,072**	**7,323**	**8,008**	**8,175**	**8,397**	**8,459**	**8,551**	**8,700**	**8,821**	**8,931**	**9,025**	**9,094**
Bronx	1,169	1,204	1,333	1,385	1,416	1,428	1,447	1,485	1,519	1,551	1,579	1,600
Brooklyn	2,231	2,301	2,465	2,505	2,603	2,621	2,649	2,706	2,754	2,799	2,841	2,870
Manhattan	1,428	1,488	1,537	1,586	1,611	1,622	1,638	1,662	1,677	1,686	1,692	1,696
Queens	1,891	1,952	2,229	2,231	2,290	2,306	2,330	2,353	2,374	2,394	2,413	2,426
Staten Island	352	379	444	469	478	482	487	493	498	501	501	503
LI	**2,606**	**2,609**	**2,754**	**2,833**	**2,856**	**2,861**	**2,869**	**2,922**	**3,011**	**3,106**	**3,196**	**3,277**
Nassau	1,322	1,287	1,335	1,340	1,354	1,355	1,356	1,379	1,423	1,475	1,530	1,579
Suffolk	1,284	1,322	1,419	1,493	1,502	1,507	1,513	1,542	1,588	1,630	1,666	1,698
LHV	**1,203**	**1,224**	**1,306**	**1,361**	**1,397**	**1,401**	**1,407**	**1,437**	**1,486**	**1,543**	**1,598**	**1,652**
Putnam	77	84	96	100	100	100	101	102	104	106	108	110
Rockland	260	266	287	312	324	325	328	338	351	365	380	394
Westchester	867	875	923	949	973	975	978	998	1,031	1,072	1,110	1,148
REGION	**10,881**	**11,156**	**12,068**	**12,369**	**12,650**	**12,720**	**12,826**	**13,059**	**13,318**	**13,580**	**13,819**	**14,023**

Source: NYMTC
** Interpolated data*

EMPLOYMENT

In 2015, there were 6.84 million jobs in the NYMTC planning area, a decline of approximately 60,000 jobs, or 0.9 percent, from 2010. Approximately 72 percent of all the jobs in the area were located in New York City. Roughly 2.6 million jobs were located in Manhattan, more than the rest of New York City combined.

Over the period 2000 to 2015, there was significant change in the distribution of jobs in the NYMTC planning area. While jobs in all three subregions grew during the decade of the 2000s, from 2010 to 2015, Long Island and the Lower Hudson Valley saw declines in employment of 15 percent each. New York City, by contrast saw a 6.3 percent increase in jobs during that period.

Within New York City, job growth was dispersed across the outer boroughs. Manhattan, which had the largest share of jobs in the NYMTC planning area in 2015, employment declined by 67,000 (2.5 percent) from 2010 to 2015, while the other boroughs gained 363,000 jobs, 61 percent of which were in Brooklyn. The employment forecast anticipates some rebalancing of growth throughout the NYMTC planning area.

Several larger employment trends are expected to influence the NYMTC planning area during the period of the Plan:

- Manufacturing continues to decline both in the nation and the metropolitan region. Although some of these industries may have relocated within the region, many have moved to other parts of the United States or abroad. Indeed, while manufacturing jobs in the nation declined by 29 percent between 2000 and 2015, the NYMTC planning area lost close to 45 percent of its manufacturing jobs, with a decline from more than 300,000 to approximately 170,000 jobs (see Figures 2.4 and 2.5).[4]
- Advancements in information and communications technology combined with globalization has resulted in the "off-shoring" of technology-enabled back-office jobs (e.g., telephone or online-based customer service) to other countries.[5] Despite some of these jobs returning to the U.S., most evidence points to a continuation of this trend in the near-term future. Census data shows that jobs in the information industry declined by 25 percent between 2000 and 2015 in the nation,[6] and by 15 percent in the NYMTC planning area.[7]
- High-skill and knowledge-based jobs have also been decreasing in the NYMTC planning area. Despite a three percent increase in finance and insurance jobs for the nation, the NYMTC planning area lost roughly 11 percent of its jobs in the Finance and Insurance sector between 2000 and 2015 (Figures 2.4 and 2.5). The decrease was steepest in Manhattan where 13 percent of the Finance and Insurance jobs were lost during this period.[8]

Employment in the NYMTC planning area increased between 2000 and 2015, despite a recession that lasted from late 2007 to mid-2009,[9] and a slight dip in employment levels after 2010. The greatest growth was in accommodation and food services; educational services; arts, entertainment, and recreation; and health care and social assistance. Employment is forecast to increase by 6.7 percent (or 469,000) from 2020 to 2045. Higher percentage increases are projected for Rockland, Suffolk and Westchester counties, and the Bronx. Overall, the Long Island subregion is forecast to have the greatest proportional employment growth at 9.3 percent between 2020 and 2045, but New York City is forecast to make up over half of the total number of jobs added during this period. Table 2.2 summarizes employment growth forecasts for each subregion.

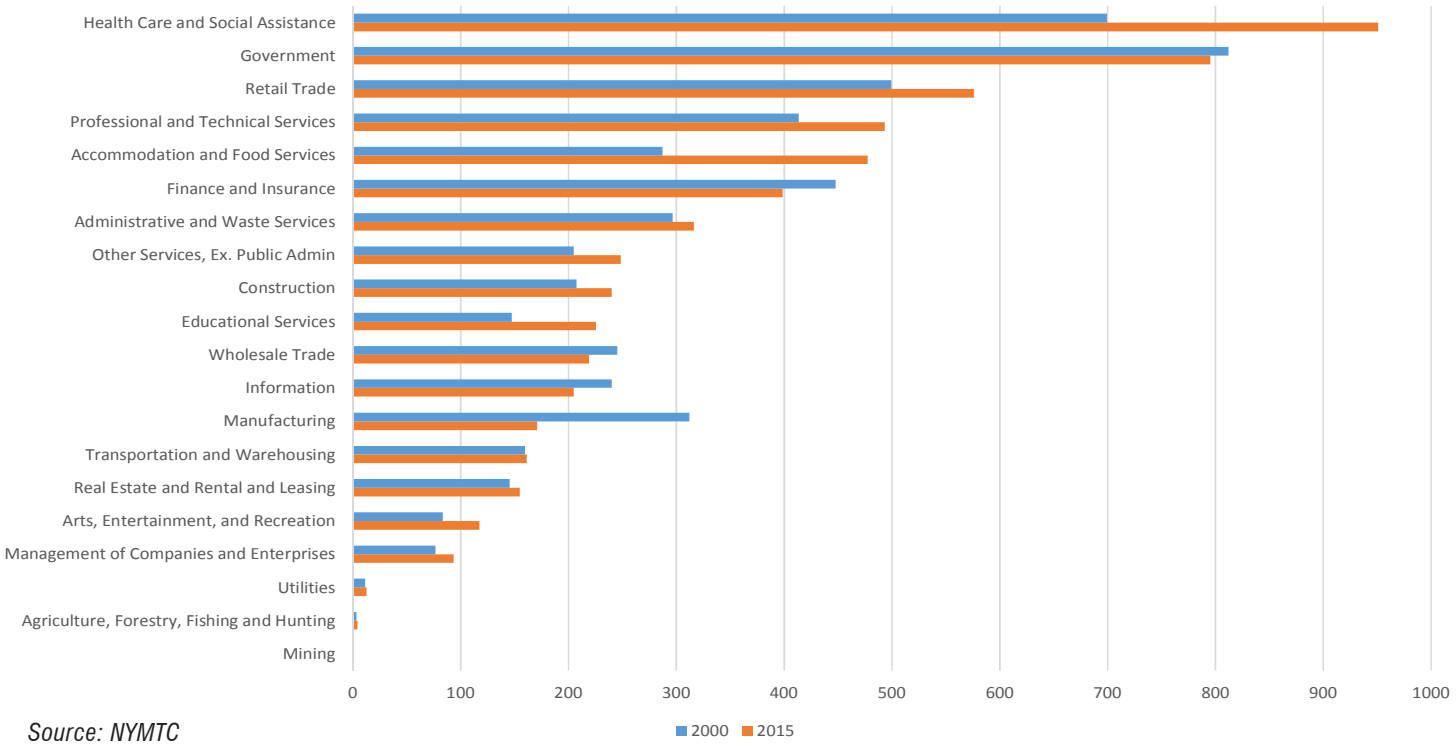
While employment is growing, the rate of growth as described above will be lower than the previous 30-year period. For example, between 1990 and 2015, more than 910,000 jobs were added in the NYMTC planning area.

TABLE 2.2: EMPLOYMENT TRENDS & FORECASTS BY COUNTY/BOROUGH & SUBREGION (IN 000S)

AREA NAME	1980	1990	2000	2010	2015	2017 *	2020	2025	2030	2035	2040	2045
NYC	**3,614**	**3,966**	**4,277**	**4,611**	**4,905**	**4,947**	**5,017**	**5,075**	**5,124**	**5,183**	**5,245**	**5,303**
Bronx	217	238	269	339	415	419	425	432	439	445	452	459
Brooklyn	516	504	585	702	925	933	946	959	970	984	998	1,012
Manhattan	2,278	2,565	2,682	2,714	2,647	2,671	2,712	2,742	2,770	2,802	2,833	2,867
Queens	537	567	624	709	772	777	785	789	793	798	805	808
Staten Island	66	92	117	146	147	148	149	152	153	155	156	158
LI	**1,093**	**1,330**	**1,458**	**1,544**	**1,305**	**1,319**	**1,344**	**1,366**	**1,387**	**1,413**	**1,440**	**1,468**
Nassau	661	717	743	751	628	634	644	650	657	668	679	691
Suffolk	432	613	714	793	677	686	700	716	729	745	761	777
LHV	**535**	**633**	**686**	**747**	**632**	**639**	**651**	**662**	**672**	**684**	**696**	**708**
Putnam	17	26	31	39	30	30	31	31	31	31	31	31
Rockland	98	123	134	152	126	128	131	135	139	143	147	152
Westchester	420	484	520	556	476	481	489	496	502	510	517	526
REGION	**5,242**	**5,929**	**6,421**	**6,903**	**6,841**	**6,905**	**7,011**	**7,102**	**7,183**	**7,280**	**7,381**	**7,480**

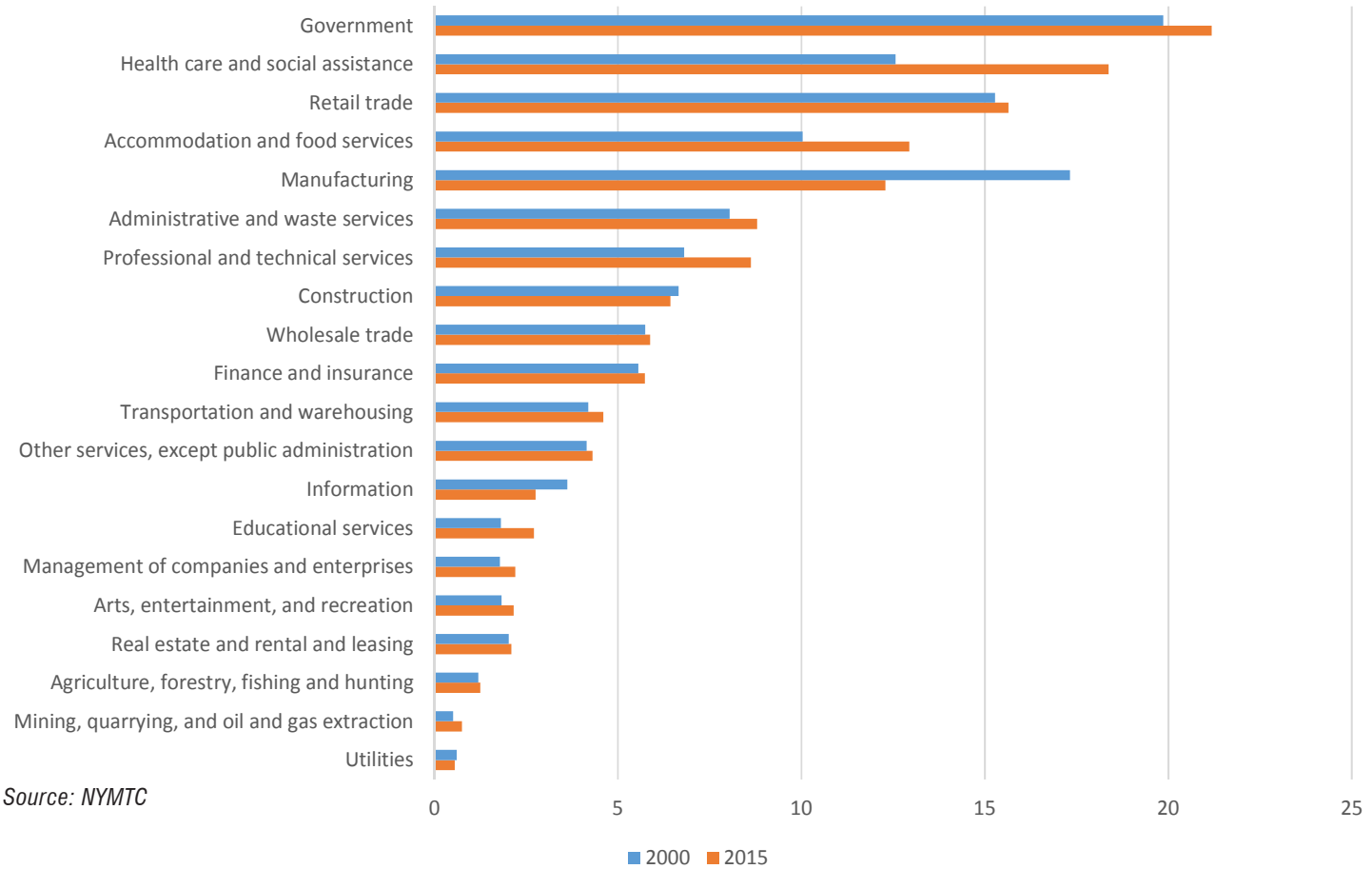
Source: NYMTC
** Interpolated data*

FIGURE 2.4: JOB GROWTH BY MAJOR INDUSTRY IN THE NYMTC PLANNING AREA, 2000-2015 (IN 000S)



Source: NYMTC

FIGURE 2.5: JOB GROWTH BY MAJOR INDUSTRY IN THE U.S., 2000-2015 (IN 000S)



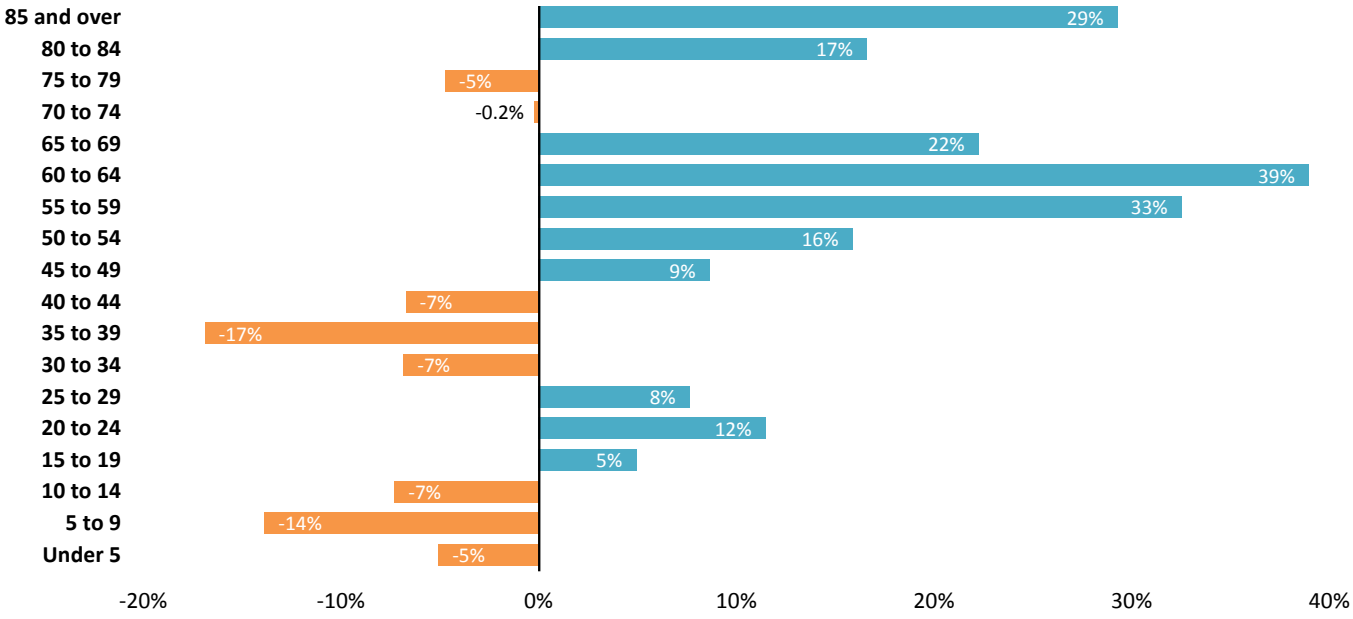
Source: NYMTC

LABOR FORCE

Two significant trends have influenced the labor force in the NYMTC planning area in recent decades: an aging working population and an influx of immigrants. As Figure 2.6 shows, from 2000 to 2015, the most significant population growth occurred within the 45-to-74 and 80-and-over age cohorts, with significant decreases observed in the population of young children and young adults between 30 and 44 years of age. Demographic data for the U.S. also reveals that older populations are representing increasingly larger shares of the labor force. This trend of an aging population and labor force is likely to continue in the coming decades, with Baby Boomers increasingly moving into older age cohorts.[10]

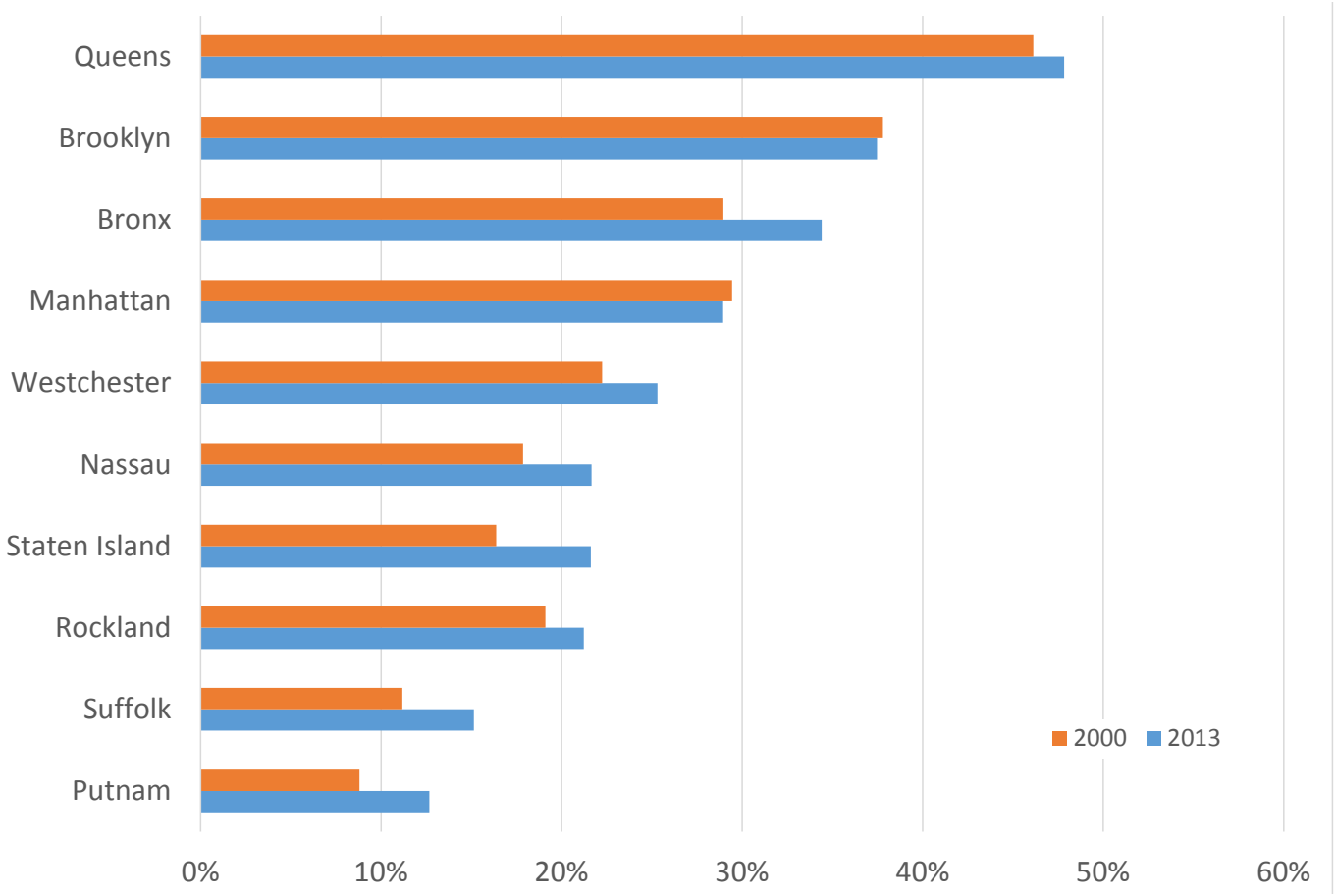
These trends present new challenges to the transportation system, since aging populations have different travel patterns and needs from other demographic groups. For example, older adults often find themselves unable to drive and in need of alternative transportation modes, be it traditional public transit or demand-responsive services. An aging population also requires more specialized facilities such as elevators, escalators, curb extensions and pedestrian islands to compensate for slower walking speeds when crossing streets. In 2014, people 65 and older made up 17 percent of total traffic fatalities and 20 percent of pedestrian fatalities in the United States. In New York, approximately 23 percent of total traffic fatalities involved people in this age group in 2014.[11]

FIGURE 2.6: CHANGE IN POPULATION BY AGE COHORT IN THE NYMTC PLANNING AREA, 2010-2015



Source: U.S. Census Bureau, 2000 Census, 2011-2015 American Community Survey

FIGURE 2.7: PERCENTAGE OF POPULATION THAT IS FOREIGN BORN BY COUNTY/BOROUGH, 2000-2015



Source: U.S. Census Bureau, 2000 Census, 2011-2015 American Community Survey

Foreign-born workers are likely to play an important role in the NYMTC planning area's labor force. In 2010, 43 percent of New York City's workforce consisted of foreign-born residents, notably from the Dominican Republic, China, and Jamaica.[12] In 2000, the overall foreign-born population represented about 29 percent of the NYMTC planning area's total population. By 2015, this figure had increased to 31 percent. The proportion of foreign-born residents increased in all NYMTC counties except Manhattan and Brooklyn, where it decreased slightly during this period (Figure 2.7). Furthermore, while the foreign-born population in 2015 was 31 percent of the total population, foreign-born workers made up 40 percent of the region's prime working age population (25-to-44 years old). The continuation of this trend to the horizon year lessens the impacts of an aging native-born workforce.

TABLE 2.3: LABOR FORCE TRENDS & FORECASTS BY COUNTY/BOROUGH AND SUBREGION, (IN 000S)

AREA NAME	1980	1990	2000	2010	2015	2017 *	2020	2025	2030	2035	2040	2045
NYC	**3,161**	**3,580**	**3,666**	**4,003**	**4,264**	**4,308**	**4,374**	**4,399**	**4,426**	**4,482**	**4,545**	**4,583**
Bronx	444	502	487	543	640	647	659	668	675	688	704	716
Brooklyn	902	1,036	1,043	1,133	1,269	1,281	1,299	1,313	1,331	1,358	1,383	1,395
Manhattan	754	837	855	935	939	949	964	967	969	976	985	991
Queens	907	1,016	1,064	1,142	1,192	1,205	1,223	1,222	1,224	1,232	1,243	1,250
Staten Island	154	189	217	250	224	226	229	228	227	228	229	232
LI	**1,229**	**1,389**	**1,414**	**1,474**	**1,473**	**1,474**	**1,476**	**1,488**	**1,512**	**1,553**	**1,609**	**1,666**
Nassau	655	690	678	688	695	695	695	703	719	745	779	812
Suffolk	574	699	736	787	777	779	781	785	793	808	830	854
LHV	**595**	**656**	**663**	**687**	**716**	**718**	**721**	**735**	**752**	**779**	**810**	**843**
Putnam	36	47	52	54	54	54	54	54	53	54	55	56
Rockland	125	141	145	152	160	160	161	165	171	178	187	195
Westchester	434	468	465	481	502	504	507	516	528	547	568	591
REGION	**4,985**	**5,624**	**5,743**	**6,165**	**6,452**	**6,499**	**6,571**	**6,621**	**6,690**	**6,814**	**6,964**	**7,092**

Source: NYMTC
** Interpolated data*

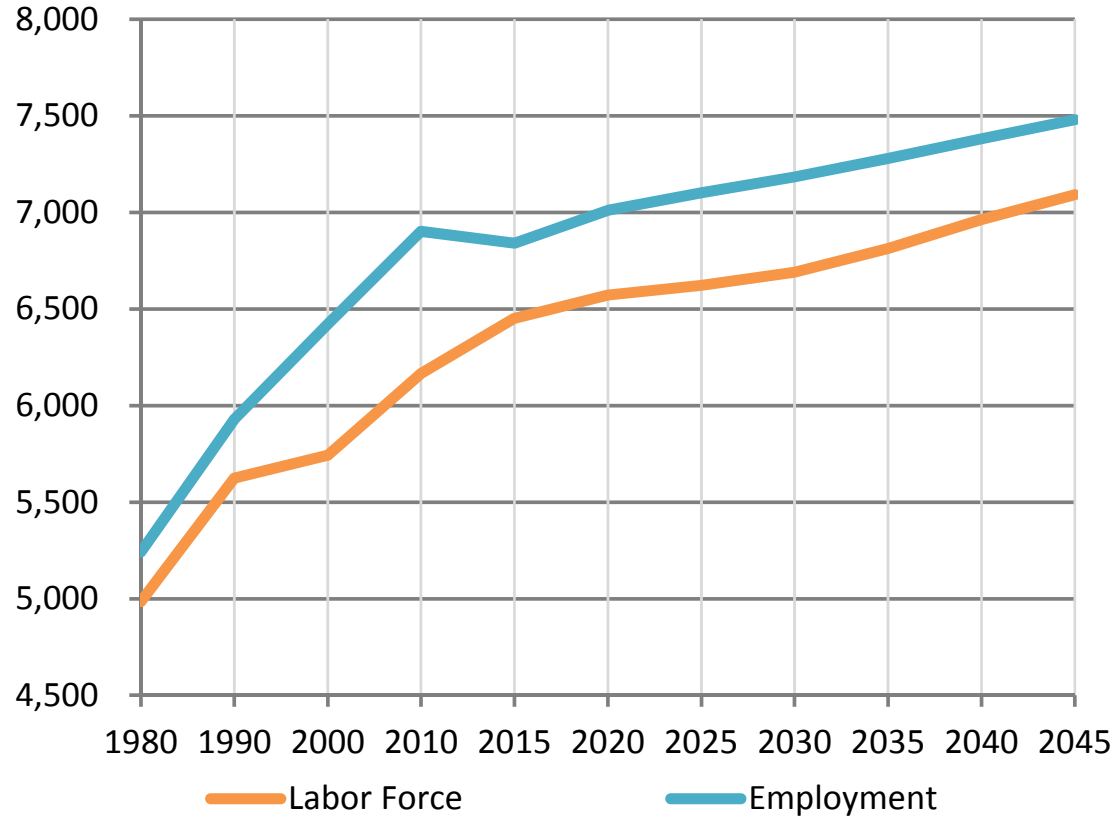
Overall, the number of eligible workers in the NYMTC planning area is predicted to grow to 7.1 million in 2045. The predicted growth rate of the labor force is 9.1 percent from 2017 to 2045, slightly faster than the growth rate of the number of jobs for the region (Figure 2.8). The largest growth in labor during this period is expected to occur in Lower Hudson Valley, at approximately 17.4 percent. While the lowest rate is expected to occur in New York City, at 6.4 percent (Figure 2.9), New York City is expected to account for 46 percent of the total NYMTC growth, translating to approximately 275,000 eligible workers.

In 2017, approximately 51 percent of the region's total population was in the labor force, and the percentage is expected to remain stable through 2045. During this same period, however, this ratio is expected to decline by nearly three percentage points for Putnam County. This could be as a result of changing demographics: as baby boomers leave the labor force and fewer children are born, there will be fewer people of prime working age.

Employed residents refers to residents of a place who are employed regardless of employment location, whereas employment refers to the number of jobs in the region. NYMTC's forecast also predicts that the number of employed residents in the region will increase to approximately 6.7 million in 2045 (see Appendix 3 for more details). The growth of employed residents is expected to outpace the growth of the labor force, which could indicate an economic recovery for the planning area throughout the projection horizon.

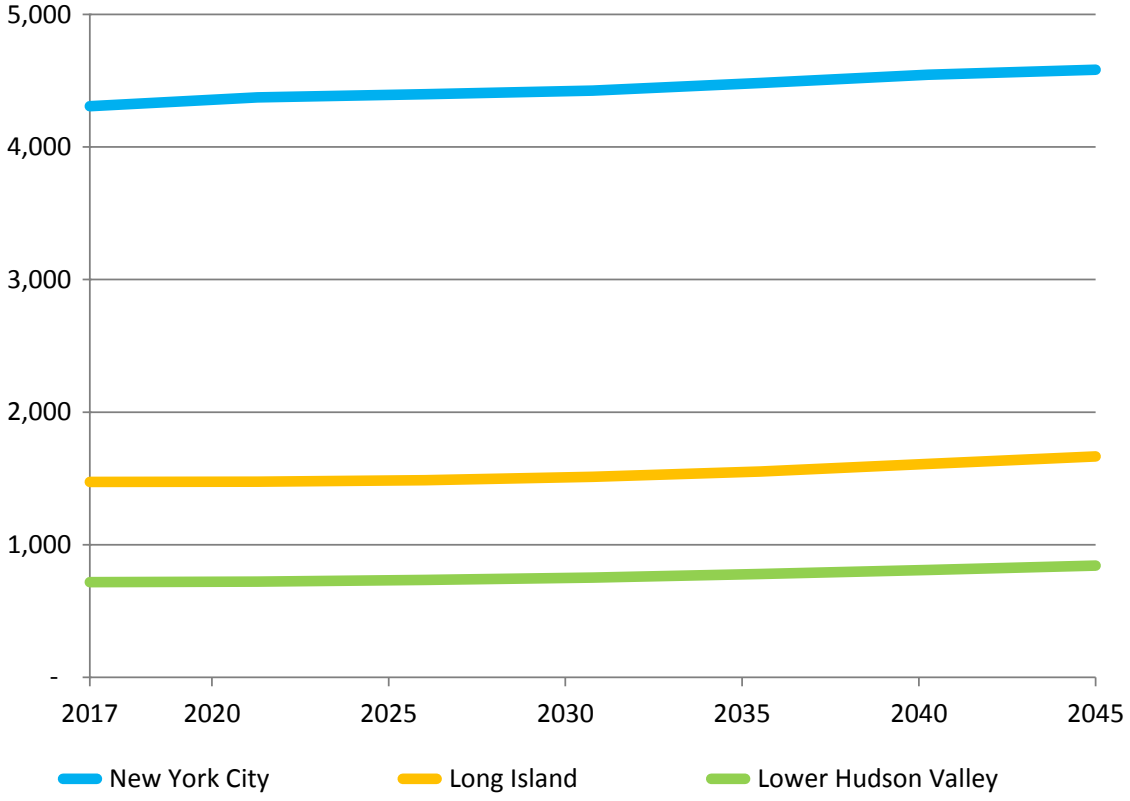
A comparison of employed residents and employment can help us understand the commuting pattern in the region. New York City is expected to have more jobs than the number of employed residents while Long Island and Lower Hudson Valley see the opposite (Appendix 3) through 2045.

FIGURE 2.8: LABOR FORCE VS. EMPLOYMENT IN THE NYMTC PLANNING AREA (IN 000S)



Source: NYMTC

FIGURE 2.9: LABOR FORCE GROWTH IN THE NYMTC PLANNING AREA (IN 000S)



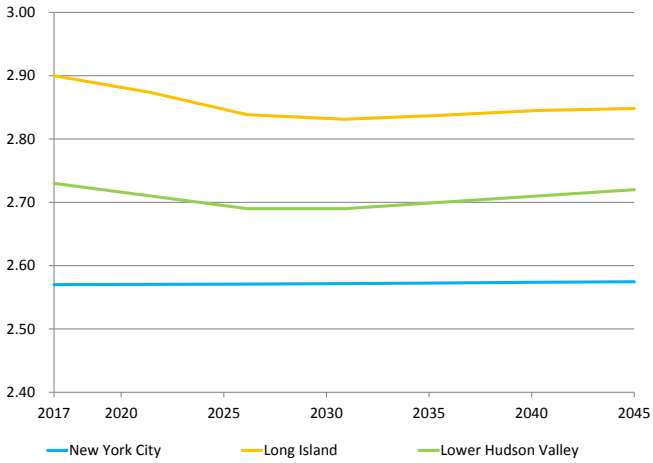
Source: NYMTC

HOUSEHOLDS

The number of households in the NYMTC planning area is projected to increase by 10.5 percent between 2017 and 2045, translating to approximately 490,000 new households. The number of households on Long Island and in Lower Hudson Valley is predicted to grow by 16.4 percent and 18.0 percent, respectively - much faster than the average growth rate in households for the region. The number of households in New York City is projected to grow at the slower pace of 7.5 percent, but in absolute terms, New York City is expected to add 242,000 households - the most of all three TCCs.

Average household size for the NYMTC planning area is expected to decline marginally between 2017 and 2045 from 2.66 to 2.65. At the subregional level, average household sizes are expected to shrink from 2.90 to 2.85 for Long Island, and decrease slightly from 2.73 to 2.72 for Lower Hudson Valley (Figure 2.10). Household sizes in New York City are projected to remain constant throughout the Plan's horizon.

FIGURE 2.10: AVERAGE HOUSEHOLD SIZE BY SUBREGION



Source: NYMTC

TABLE 2.4: HOUSEHOLD TRENDS & FORECASTS BY COUNTY/BOROUGH & SUBREGION (IN 000S)

AREA NAME	1980	1990	2000	2010	2015	2017	2020	2025	2030	2035	2040	2045
NYC	**2,789**	**2,819**	**3,022**	**3,110**	**3,195**	**3,218**	**3,254**	**3,312**	**3,358**	**3,399**	**3,435**	**3,460**
Bronx	429	424	463	483	495	499	506	520	532	543	554	561
Brooklyn	828	828	881	917	954	960	970	992	1,010	1,027	1,042	1,053
Manhattan	705	716	739	764	776	782	790	802	810	814	817	819
Queens	712	720	783	780	801	807	816	824	831	839	845	850
Staten Island	115	131	156	166	169	170	172	174	176	177	177	178
LI	**809**	**856**	**917**	**948**	**959**	**967**	**980**	**1,010**	**1,043**	**1,073**	**1,100**	**1,126**
Nassau	423	432	447	449	451	453	456	468	482	497	512	526
Suffolk	386	425	469	500	509	514	523	542	561	576	588	600
LHV	**410**	**433**	**463**	**482**	**497**	**500**	**506**	**520**	**539**	**557**	**574**	**591**
Putnam	24	28	33	35	36	37	37	38	39	40	40	41
Rockland	78	85	93	99	104	105	106	109	113	118	122	126
Westchester	308	320	337	347	357	359	363	373	386	399	411	424
REGION	**4,007**	**4,109**	**4,401**	**4,540**	**4,651**	**4,686**	**4,739**	**4,842**	**4,940**	**5,029**	**5,108**	**5,176**

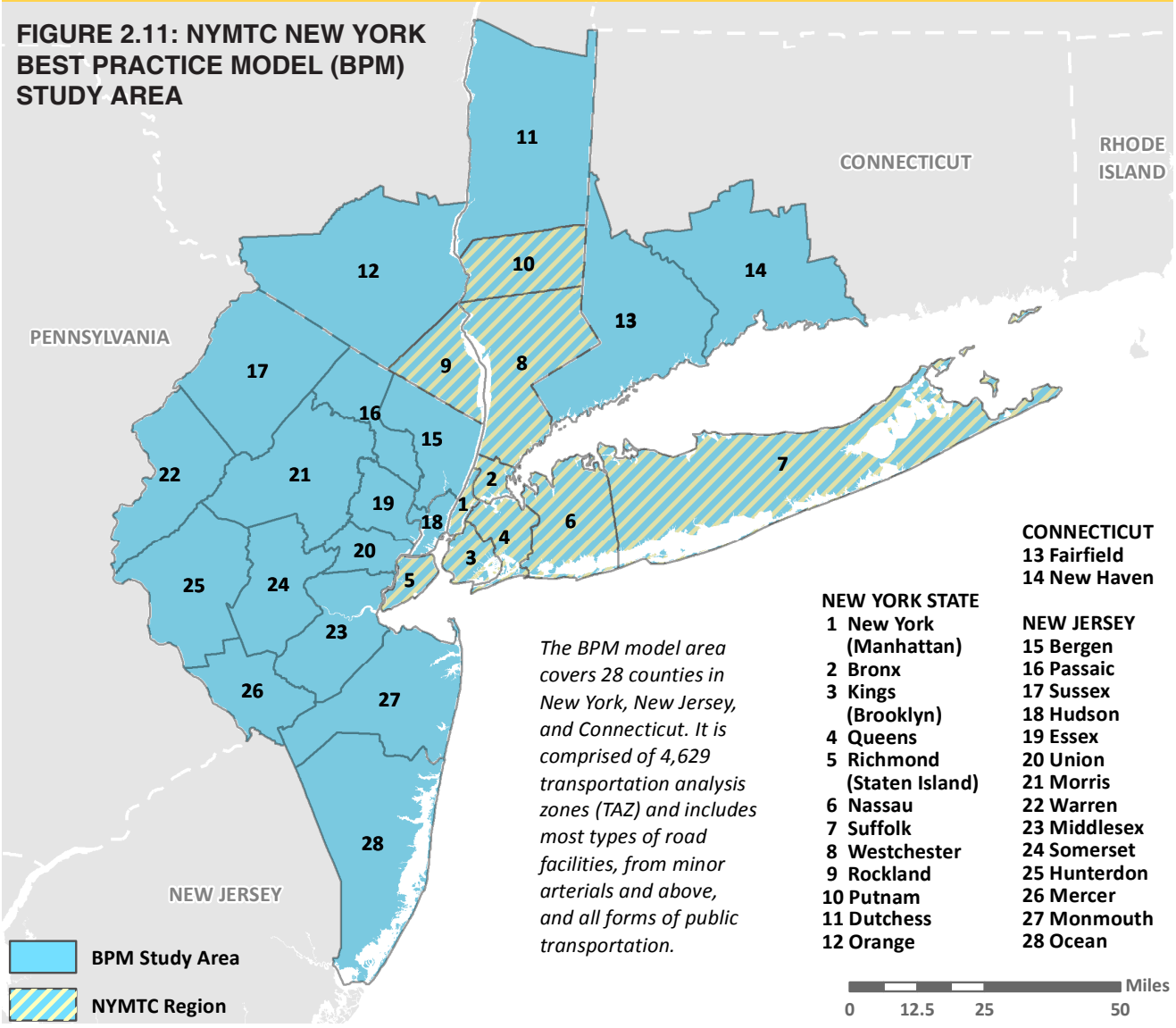
Source: NYMTC

3. TRAVEL DEMAND TRENDS & FORECASTS

SED trends and forecasts are the basis for forecasts of travel demand in the NYMTC planning area. The SED forecasts described above (and in more detail in Appendix 3) are key inputs into the NYBPM, the travel demand simulation model used to generate forecasts of passenger and freight travel demand.

NYMTC forecasts travel for people and goods in the multi-state metropolitan using complex algorithms that predict the travel and modal choices made by each household and consequently each person who resides in the NYBPM coverage area. Auto trips coming from outside the coverage area or passing through it are also forecast, as well as all truck and commercial vehicle trips. Forecasts of travel, average travel time, travel origins and destinations, and modal choice are aggregated for the NYMTC planning area as a whole and then by subregion and county/borough.

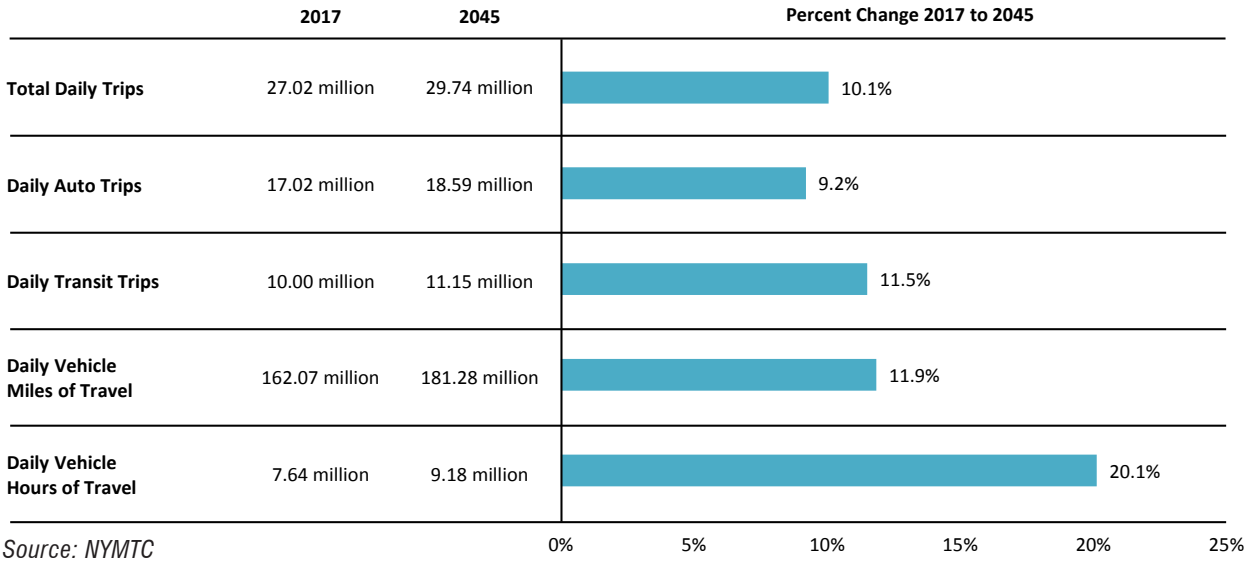
FIGURE 2.11: NYMTC NEW YORK BEST PRACTICE MODEL (BPM) STUDY AREA



TRAVEL DEMAND

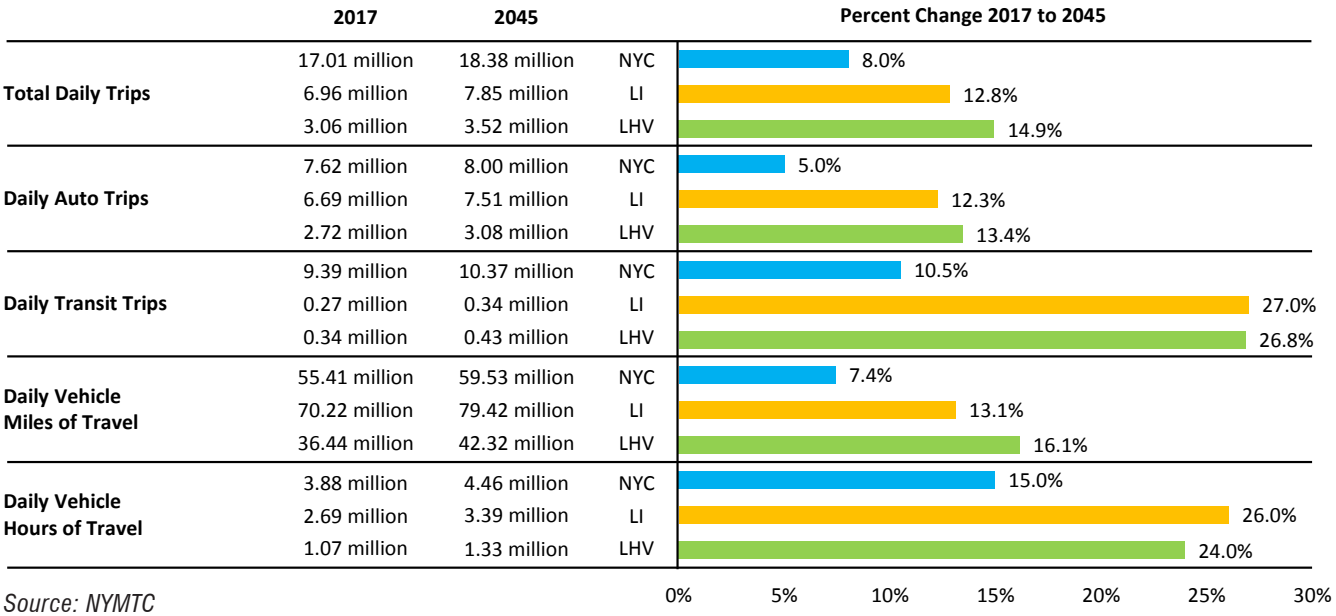
Figures 2.12a and 2.12b display NYBPM travel forecasts for the planning period. Growth in travel is expected to occur in the NYMTC planning area and its subregions for all of the travel metrics. Total daily trips are forecast to reach 29.7 million by 2045, an increase of 10.1 percent. Daily auto trips are expected to grow by 9.2 percent, while daily transit trips are forecast to grow by 11.5 percent. Percentage growth in daily Vehicle Miles of Travel (VMT) and Vehicle Hours of Travel (VHT) is expected to be significantly greater (except for VMT in New York City) than for the trip metrics, as more trips taken on the transportation system add to vehicle use and congestion. When these metrics are broken down by subregion, the percentage growth in both daily auto and transit trips predicted for the Lower Hudson Valley and Long Island can be seen as significantly greater than the percentage growth forecast for New York City. Daily transit trips are projected to grow by 27 percent and 26.8 percent respectively on Long Island and in the Lower Hudson Valley, compared to 10.5 percent growth for New York City. However, New York City is projected to add the greatest number of daily transit trips, nearly one million trips over the planning period. Auto trip metrics indicate that the suburban subregions will likely see a greater increase than New York City both in percentage terms and in absolute numbers.

FIGURE 2.12A: TRAVEL FORECASTS FOR THE NYMTC PLANNING AREA



Source: NYMTC

FIGURE 2.12B: TRAVEL FORECASTS BY SUBREGION



Source: NYMTC

Note: Subregional trips include those that begin in a subregion and end anywhere (including within the same subregion), plus those that originate outside of a subregion and end in that subregion.

In 2015, over three million people travelled daily by bus, nearly seven million by rail and rapid transit, and more than 100,000 by ferry. MTA subways, buses, railroads and ferries alone accounted for nearly 40 percent of total transit passenger trips in the United States and 67 percent of the nation's rail and rapid transit trips.[13] MTA New York City Subway serves over 5.6 million passenger trips on a typical weekday.[14] While the MTA Metro-North Railroad and the MTA Long Island Rail Road are the most used commuter rail systems in the nation, averaging nearly 600,000 riders combined every weekday.[15]

In the NYMTC planning area, the number of single-occupant vehicle (SOV) work trips – those trips made by a single person driving a car – increased by 6 percent from 2000 to 2015. On Long Island, SOV trips increased by 7.4 percent while Lower Hudson Valley saw a two percent increase.[16]

Although driving alone remains a prominent transportation mode, many other transportation alternatives have historically been well used by residents and workers in the NYMTC planning area. In 2015, public transportation trips accounted for 42 percent of all commutation trips, compared to 37 percent in 2000. The total number of public transportation commute trips increased by 26 percent during that period. In 2015, there were almost 450,000 walking commuters, translating into an approximately eight percent share of NYMTC commuters, and the number of bicycle commute trips also increased by over 130 percent between 2000 and 2015. Ridesharing declined by 22 percent in the overall mode split over the same period.[17]

From 2000 to 2015, the average travel time to work in the NYMTC planning area remained relatively unchanged Figure 2.13 shows the mean travel times for all NYMTC counties/boroughs.

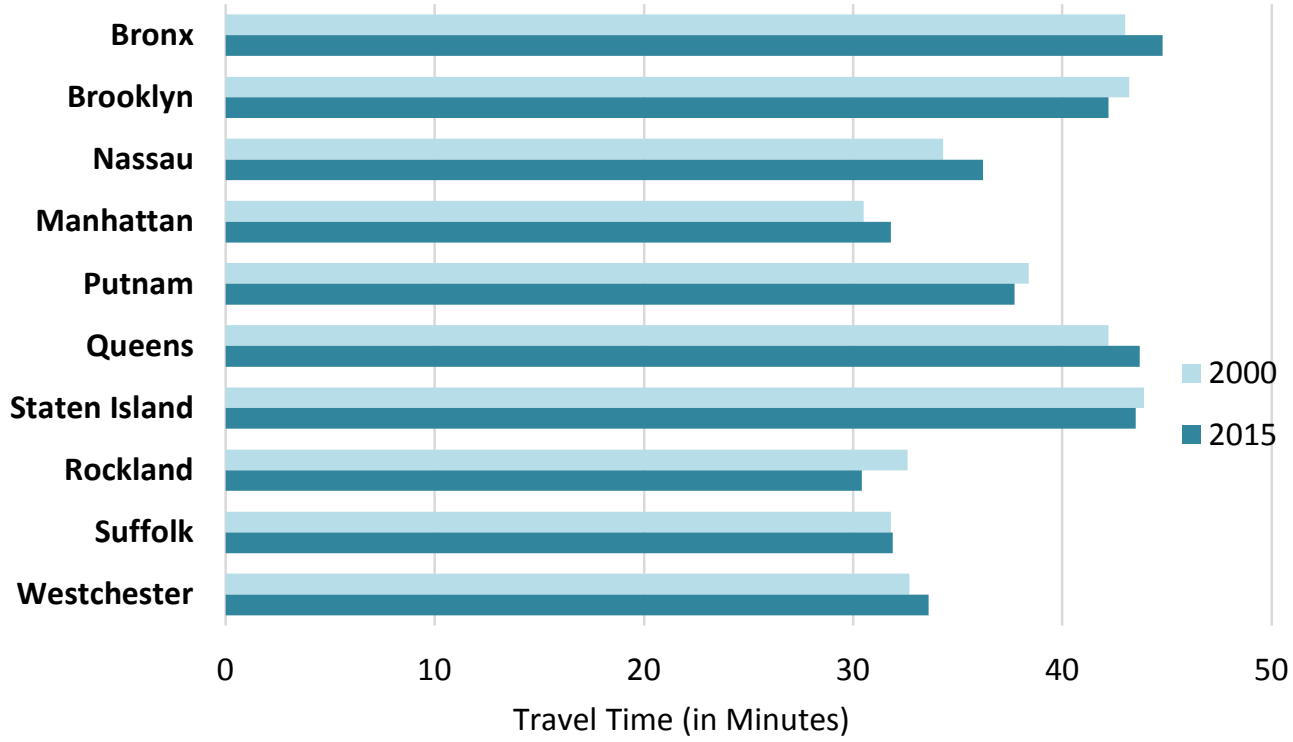
The majority of travel in the NYMTC planning area consists of trips within counties/boroughs (see Table 2.7a and 2.7b) and within subregions (see Figure 2.14). Automobiles were the mode of choice for the majority of intra-county/borough trips in 2017, with the exception of Manhattan and the Bronx. Automobiles are also the predominant mode choice for trips within and between subregions. However, local, intra-county transit trips are forecast to have a greater percentage growth than local, intra-county auto trips through 2045 (see Table 2.6). In the 2045 forecast year, Brooklyn is expected to join Manhattan and the Bronx, becoming the third "transit-dominant county" across the region. In 2045, it is projected that there will be 300,000 more transit trips than automobile trips.

TABLE 2.5: TOTAL DAILY TRANSIT PASSENGER TRIPS IN THE NYMTC PLANNING AREA

Transit Mode	Average Weekday Ridership in NYMTC Region
Rapid Transit (Subway)	5,710,393
Bus	3,254,648
Commuter Rail	1,230,467
Ferry	102,280

Source: NYMTC

FIGURE 2.13: MEAN TRAVEL TIME TO WORK FOR COUNTIES/BOROUGHS, 2000 & 2015



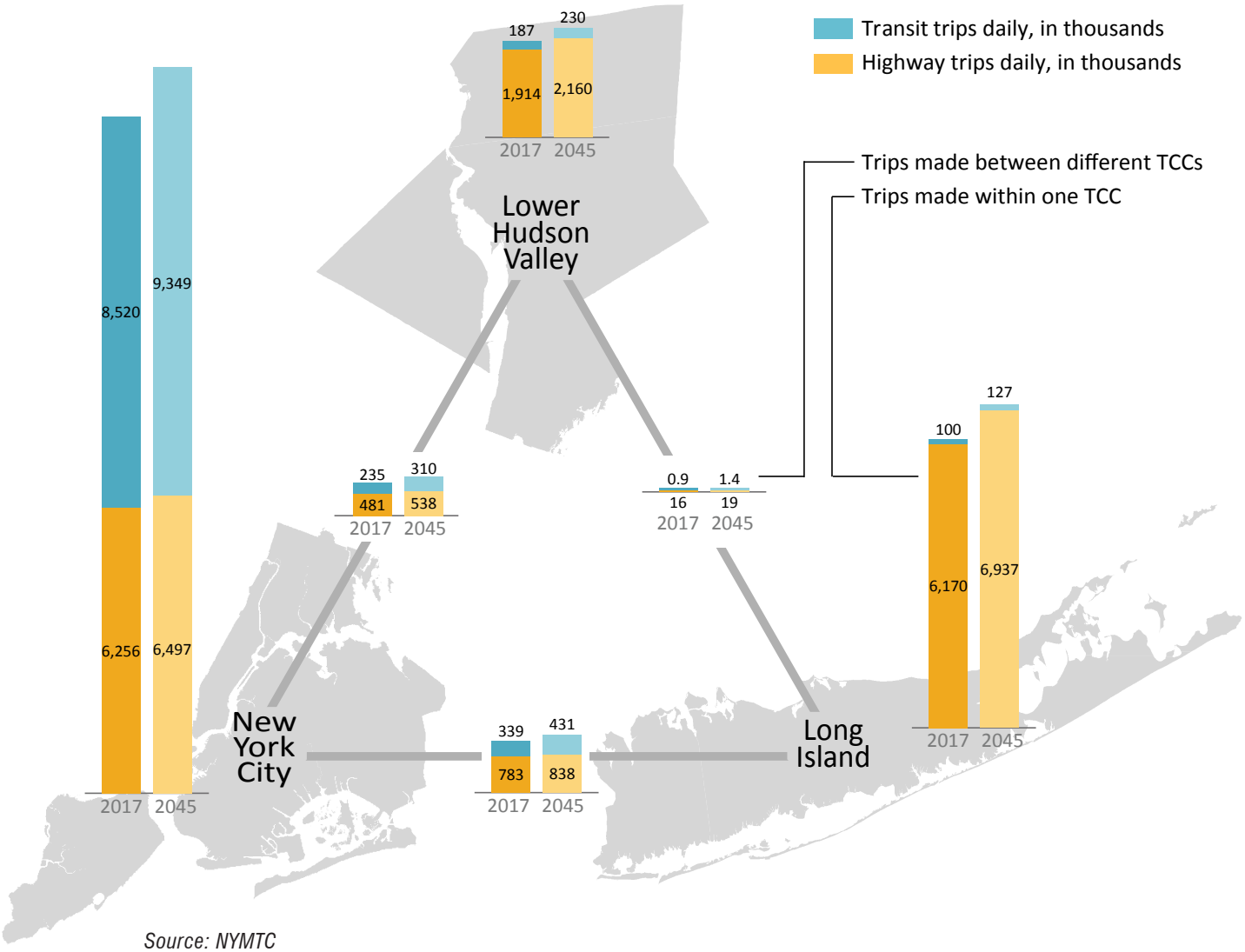
Source: U.S. Census Bureau, 2000 Census, 2011-2015 American Community Survey

TABLE 2.6: FORECAST CHANGE IN INTRA-COUNTY/BOROUGH TRIPS BY MODE, 2017 TO 2045

	Auto Change	Auto Change %	Transit Change	Transit Change %
Bronx	31,131	6%	105,493	20%
Brooklyn	92,838	6%	218,490	14%
Manhattan	18,590	2%	95,973	4%
Queens	19,745	1%	85,640	9%
Staten Island	18,937	3%	4,388	7%
Nassau	261,289	13%	10,659	24%
Suffolk	441,864	13%	10,788	23%
Putnam	9,041	6%	-84	-9%
Rockland	78,812	16%	7,740	23%
Westchester	139,470	12%	34,130	23%

Source: NYMTC

FIGURE 2.14: INTER- & INTRA-SUBREGIONAL TRAVEL, 2017 AND 2045



Source: NYMTC

From 2017 to 2045, total daily transit trips are projected to increase by 11 percent region-wide, and the share of all trips by transit is expected to grow both within counties and between most county pairs. In particular, substantial increases in transit ridership are expected within Nassau, Westchester, Suffolk and Rockland counties.

Through 2045, intra-county automobile trips are forecast to increase approximately 16 percent for Rockland County, the largest rate of increase in the region, followed by Suffolk, Nassau and Westchester Counties, each forecasted to grow at a rate of 12 percent but with much higher actual numbers of increases in auto trips (more than 430,000 and 250,000 in Suffolk and Nassau Counties, respectively compared with less than 80,000 in Rockland) (See Table 2.6). At the same time, the rate of increase of intra-county transit trips is also expected to exceed that of intra-county auto trips substantially for most counties except for Putnam County. Figure 2.14 illustrates auto and transit trips being made both within and between TCCs.

TABLE 2.7A: DAILY AUTO TRIP ORIGINS & DESTINATIONS

2017

	Manhattan	Queens	Bronx	Brooklyn	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	980,710	150,809	98,563	75,810	10,815	36,160	8,141	32,963	10,289	1,530
Queens	151,859	1,419,161	52,184	138,256	6,479	201,131	27,322	14,677	4,733	4,602
Bronx	104,399	50,998	501,460	38,813	1,067	11,182	3,824	152,716	13,566	366
Brooklyn	70,494	136,070	42,183	1,551,612	35,207	76,110	17,790	3,679	1,385	311
Staten Island	10,520	7,752	968	34,800	585,379	7,741	245	158	43	18
Nassau	37,122	206,761	11,142	77,853	6,249	2,088,132	295,270	3,956	2,688	178
Suffolk	7,331	25,612	3,708	16,956	221	300,126	3,486,823	724	223	32
Westchester	31,117	14,180	154,858	3,826	171	4,082	665	1,138,938	17,113	54,714
Rockland	10,078	4,760	13,146	1,379	42	2,905	218	18,120	489,726	652
Putnam	1,316	5,048	319	201	12	156	23	54,961	696	139,228

2045

	Manhattan	Queens	Bronx	Brooklyn	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	999,300	167,942	96,018	75,658	10,015	36,939	7,298	35,394	13,388	1,539
Queens	169,173	1,438,906	55,380	150,459	6,839	215,582	31,262	19,724	6,287	5,501
Bronx	101,947	54,602	532,591	40,646	997	12,181	3,974	164,830	15,544	418
Brooklyn	69,855	147,618	43,985	1,644,450	34,227	82,160	18,957	3,996	1,851	336
Staten Island	9,749	8,219	932	33,406	604,316	7,743	259	187	65	22
Nassau	38,029	221,903	12,293	84,185	6,214	2,349,421	326,482	4,644	3,166	180
Suffolk	6,895	29,600	3,865	18,105	308	332,008	3,928,687	963	322	39
Westchester	33,486	19,175	167,130	4,129	164	4,867	745	1,278,408	19,582	61,573
Rockland	13,163	6,323	15,153	1,812	59	3,461	302	20,684	568,537	760
Putnam	1,337	6,055	370	188	24	181	22	61,751	783	148,268

Source: NYMTC

TABLE 2.7B: DAILY TRANSIT TRIP ORIGINS & DESTINATIONS

2017

	Manhattan	Queens	Bronx	Brooklyn	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	2,480,754	494,073	400,444	309,801	28,619	107,962	17,954	60,719	13,283	1,217
Queens	495,768	952,614	47,219	109,174	1,112	21,673	2,079	4,683	484	1,008
Bronx	406,418	46,526	519,621	71,343	604	4,005	360	33,943	214	41
Brooklyn	302,086	112,933	74,955	1,538,700	15,478	12,972	2,082	1,894	97	50
Staten Island	27,945	1,270	563	15,791	65,949	479	26	18	1	4
Nassau	110,687	20,933	3,543	12,027	309	43,958	5,021	368	7	16
Suffolk	17,717	2,074	347	2,039	28	5,239	46,164	19	-	2
Westchester	61,087	3,928	34,347	1,948	30	388	19	147,758	473	1,643
Rockland	13,352	498	192	93	1	9	-	476	33,842	2
Putnam	1,210	961	37	44	2	28	1	1,670	6	967

2045

	Manhattan	Queens	Bronx	Brooklyn	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	2,576,727	539,937	445,174	333,981	30,769	132,980	24,701	77,337	19,322	1,293
Queens	540,863	1,038,254	56,693	126,387	1,392	27,202	3,337	7,651	758	1,445
Bronx	452,639	56,058	625,114	84,811	902	5,692	817	43,267	471	38
Kings	323,410	131,243	89,444	1,757,190	17,492	16,561	3,367	2,680	187	69
Staten Island	30,119	1,477	892	17,829	70,337	535	37	32	2	3
Nassau	137,920	25,655	4,780	15,051	371	54,617	7,454	542	16	37
Suffolk	24,280	3,302	815	3,232	38	7,937	56,952	71	3	8
Westchester	78,837	6,053	43,933	2,754	40	521	83	181,888	998	1,773
Rockland	19,539	781	465	169	2	18	2	996	41,582	6
Putnam	1,327	1,362	41	59	6	44	9	1,806	17	883

Source: NYMTC

VMT is a measure commonly used to define the extent of automobile use on a daily or annual basis. It is the sum of distances travelled by all vehicles in a specified region, and is used as an indicator of vehicular travel demand across the region. In the NYMTC planning area, daily VMT is expected to rise by approximately 11.9 percent during the planning period (See Table 2.8). At the subregional level, the Lower Hudson Valley is projected to have the highest percentage growth in VMT at 16.1 percent based on an additional 5.9 million daily VMT by 2045. Within the Lower Hudson Valley, Rockland and Westchester counties are forecast to increase by 23 percent and 14.3 percent, respectively, in daily VMT. Long Island is projected to experience a 13.1 percent increase in daily VMT through 2045, with over 9.2 million additional daily VMT. New York City's forecasted daily VMT increase of 4.1 million is an increase of 7.4%.

VHT reflects the efficiency and reliability of vehicular travel, primarily in terms of travel speed. In the NYMTC planning area, VHT is projected to rise by 20.1 percent by 2045. Among the subregions, the Lower Hudson Valley will experience the greatest percentage growth in VHT, increasing by nearly 26 percent by 2045, compared to 24 percent for Long Island and 15 percent for New York City.

TABLE 2.8: DAILY VMT BY COUNTY/BOROUGH & SUBREGION

	2017	2045	Change
Bronx	8,859,309	9,664,710	9.1%
Brooklyn	12,397,124	13,244,903	6.8%
Manhattan	8,804,886	9,368,120	6.4%
Queens	19,658,725	21,084,000	7.3%
Staten Island	5,694,788	6,170,281	8.3%
New York City Total	**55,414,832**	**59,532,014**	**7.4%**
Nassau	29,231,877	32,778,258	12.1%
Suffolk	40,983,209	46,643,771	13.8%
Long Island Total	**70,215,086**	**79,422,029**	**13.1%**
Putnam	3,484,730	3,935,760	12.9%
Rockland	8,275,831	10,180,662	23.0%
Westchester	24,679,613	28,207,148	14.3%
Lower Hudson Valley Total	**36,440,174**	**42,323,570**	**16.1%**
NYMTC Planning Area	**162,070,092**	**181,277,613**	**11.9%**

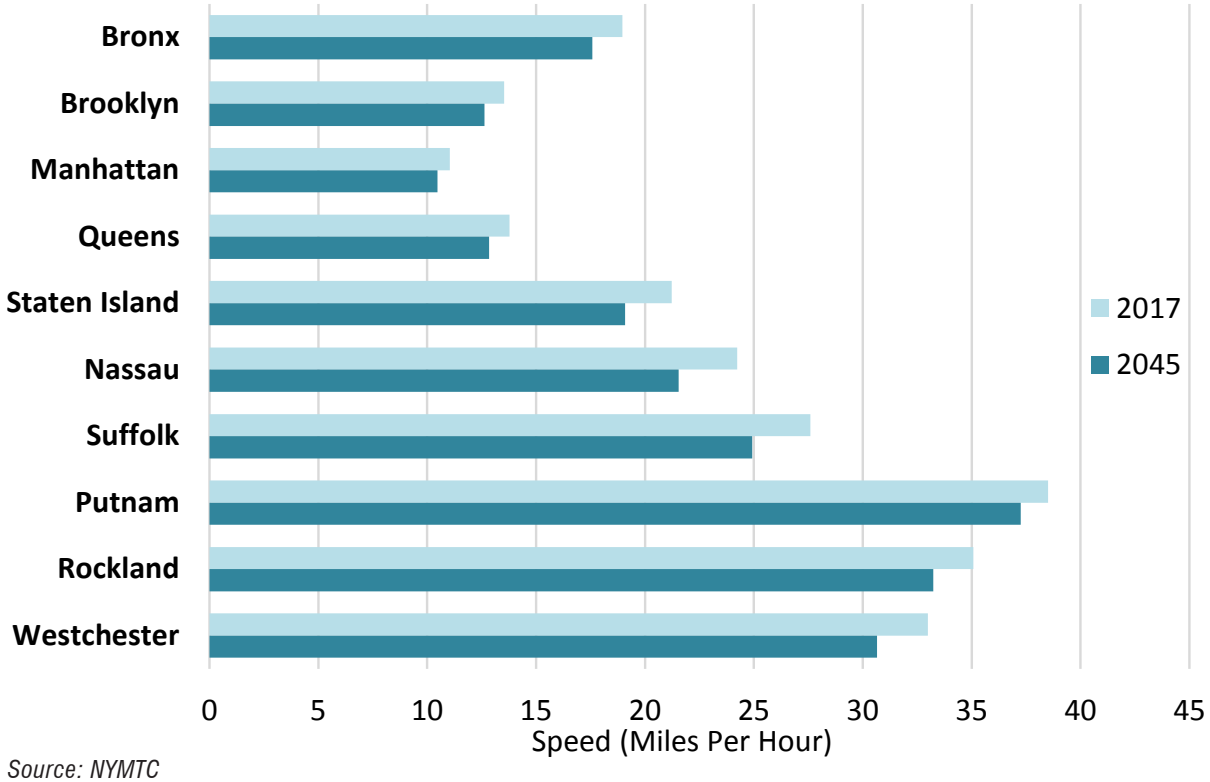
Source: NYMTC

TABLE 2.9: DAILY VHT BY COUNTY/BOROUGH & SUBREGION

	2017	2045	Change
Bronx	467,247	549,740	17.7%
Brooklyn	916,540	1,048,260	14.4%
Manhattan	797,731	895,380	12.2%
Queens	1,427,153	1,640,941	15.0%
Staten Island	268,326	323,192	20.4%
New York City Total	**3,876,997**	**4,457,513**	**15.0%**
Nassau	1,206,034	1,520,815	26.1%
Suffolk	1,485,558	1,871,546	26.0%
Long Island Total	**2,691,592**	**3,392,361**	**26.0%**
Putnam	90,471	105,653	16.8%
Rockland	235,881	306,242	29.8%
Westchester	748,122	920,007	23.0%
Lower Hudson Valley Total	**1,074,474**	**1,331,902**	**24.0%**
NYMTC Planning Area	**7,643,063**	**9,181,776**	**20.1%**

Source: NYMTC

FIGURE 2.15: AVERAGE VEHICLE SPEED BY COUNTY/BOROUGH, 2017 AND 2045



Source: NYMTC

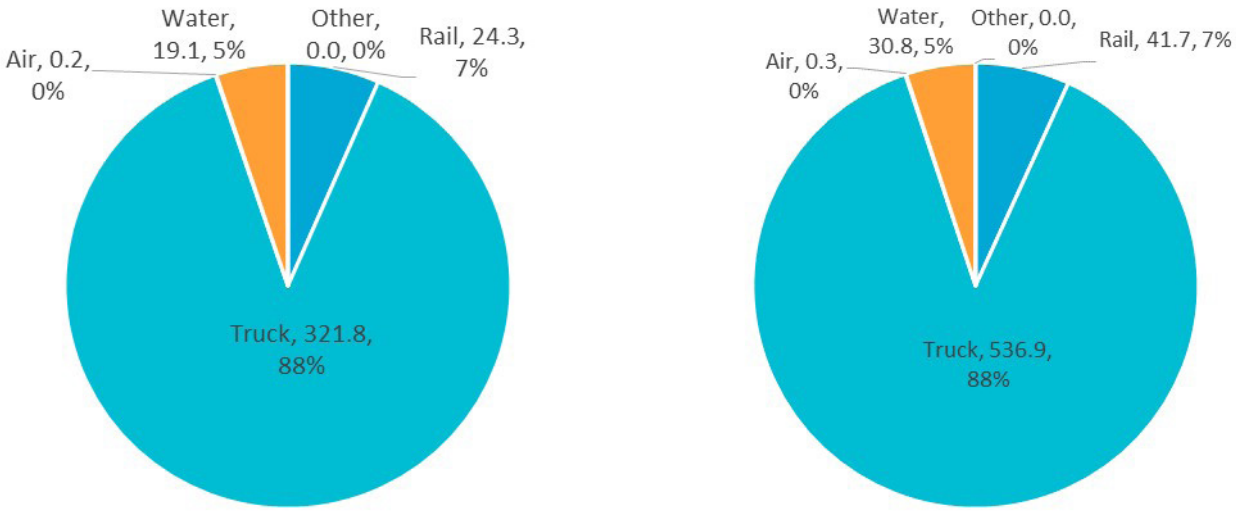
Average vehicle speed is another indicator of the impact of travel demand on transportation system performance. It is noted that the countywide average speed is calculated based on total VMT divided by VHT for each county. As Figure 2.15 shows, average daily vehicle speeds are expected to decline in all NYMTC counties over the course of Plan 2045. Nassau County is expected to have the greatest percentage decrease in average speed with an 11.1 percent drop, followed by Richmond and Suffolk counties with 10.0 percent and 9.7 percent decreases, respectively.

COMMODITY FLOWS

Plan 2045's Regional Freight Element is contained in Appendix 8. The Appendix contains a detailed forecast for commodity flows during the planning period. In summary, as of the most recent Economic Census in 2012, 365 million tons of freight moved into, out of, within, or through the NYMTC planning area. 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 planning area to another point within the NYMTC planning area. Through freight accounted for 76 million tons or 21 percent of the total.

By 2045 these flows are expected to grow by 67 percent, to 610 million tons. This growth in commodity flows reflects anticipated population and economic growth, increasing wealth and consumer spending, and increasingly complex logistics and distribution networks. 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. Freight moving completely within the NYMTC planning area 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 2045, a 66 percent increase, and 1.6 percent compound annual growth rate.

FIGURE 2.16: FREIGHT TONNAGE BY MODE, 2012 AND 2045



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

Long Island Rail Road (LIRR)
Photo Source: Nassau County

Route 35A in Rockland County
Photo Source: Rockland County

COMMUTING PATTERNS

U. S. Census Bureau data provides a snapshot of recent commuting patterns (See Table 2.10). In 2014, in the five boroughs of New York City, the majority of workers commuted within their home county, or to Manhattan. Approximately 71 percent of Manhattan resident-workers commuted within Manhattan. Staten Island, the Bronx, Queens and Putnam County had the highest percentages of workers who commuted outside of their home county. In addition to workers from within the region, travellers from beyond the NYMTC planning area commute to New York City each day. For example, in 2014, approximately 10 percent of New Jersey workers and eight percent of workers in Fairfield County, Connecticut, were employed in New York City.[18]

Indeed, a significant portion of NYMTC planning area workers have long commutes. In 2015, a third of workers employed in New York City, and 39 percent of Manhattan workers made commutes of over 60 minutes in each direction.[19]

These commuting patterns, as mentioned earlier, are evidence of the growing imbalance between the locations of the NYMTC planning area's labor force and its employment opportunities. Greater numbers of people are therefore commuting longer distances for work. This has significant implications for the transportation network.

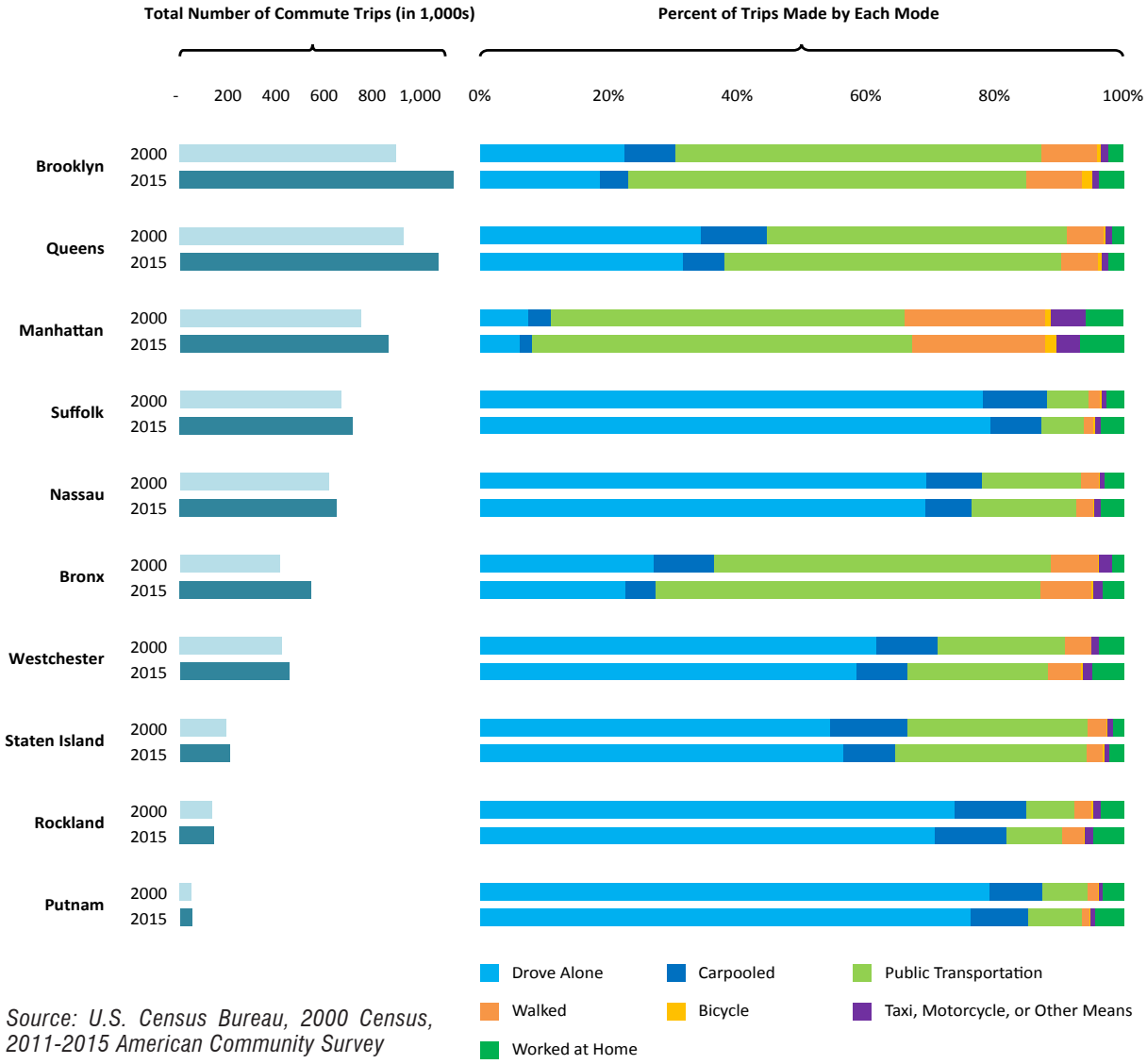
Other notable commutation trends include the increase in the number of people working from home. Between 2000 and 2015, the NYMTC planning area saw a significant increase in workers who worked from home from approximately 150,000 to 230,000, a 54 percent increase.[20] Another potentially mitigating trend is toward transit-oriented development (TOD) and the development of subregional centers. This can lead to efficiencies in the travel network by creating shorter commutation trips and encouraging the use of public transit and non-motorized modes such as walking and bicycling.

TABLE 2.10: TOP WORK LOCATIONS BY RESIDENCE, 2010

Residence	Work Location	Share of Total Workers
Bronx	Bronx	44%
	Manhattan	37%
Brooklyn	Brooklyn	50%
	Manhattan	37%
Manhattan	Manhattan	84%
	Bronx	3%
Queens	Queens	42%
	Manhattan	36%
Staten Island	Staten Island	47%
	Manhattan	26%
Nassau	Nassau	58%
	Manhattan	15%
Suffolk	Suffolk	75%
	Nassau	12%
Putnam	Putnam	32%
	Westchester	41%
Rockland	Rockland	59%
	Manhattan	11%
Westchester	Westchester	63%
	Manhattan	19%

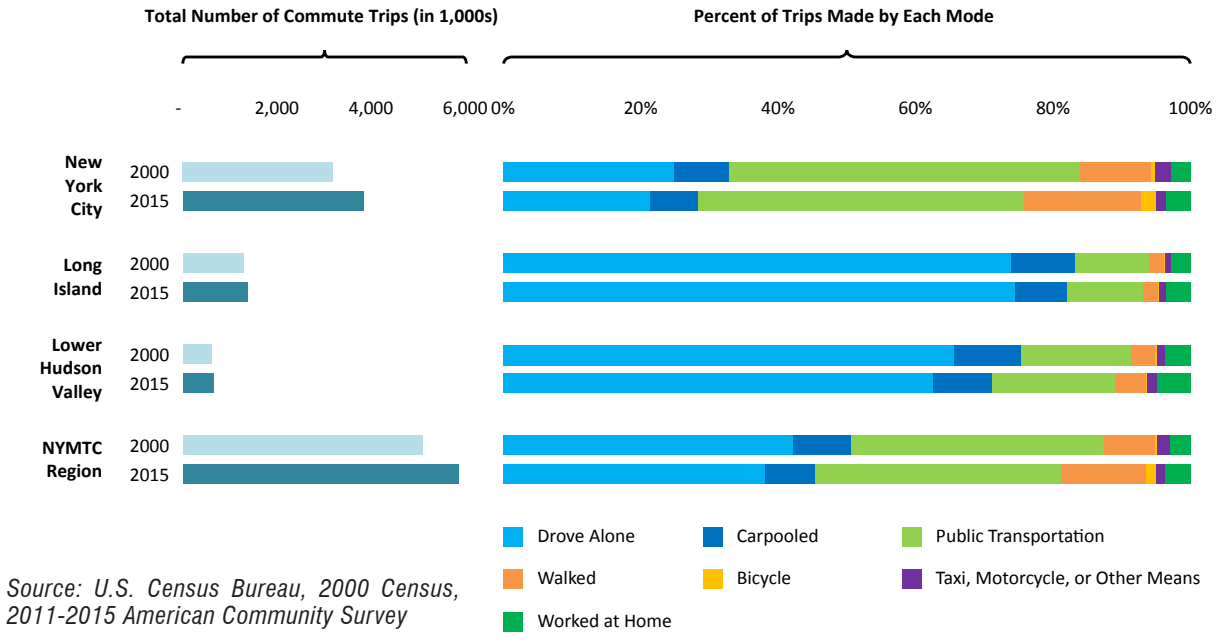
Source: U.S. Census Bureau, Census Transportation Planning Package, 2006-2010

FIGURE 2.17A: MODAL CHOICE FOR DAILY COMMUTATION TRIPS BY COUNTY, 2000 & 2015



Source: U.S. Census Bureau, 2000 Census, 2011-2015 American Community Survey

FIGURE 2.17B: MODAL CHOICE FOR DAILY COMMUTATION TRIPS BY SUBREGION, 2000 & 2015



Source: U.S. Census Bureau, 2000 Census, 2011-2015 American Community Survey

TOURISM

Not only is tourism a significant travel generator in the NYMTC planning area, it also plays an important role in the economy of the region by contributing tax revenues, driving purchases at businesses, and helping to create or sustain jobs. Tourism also contributes to travel demand, sometimes significantly. The Economic Impact of Tourism in New York: 2015 Calendar Year describes the impact that tourism has on New York State's overall economy. In 2015, the State's tourism economy grew by one percent over the year, and statewide traveler spending reached a high of $63.1 billion, representing a 19 percent increase above the pre-recession peak in 2008.[21] Each household in New York State is estimated to save an average of $1,100 in taxes each year thanks to tourism revenue, and 8.3 percent of jobs in the state are sustained directly or indirectly by tourism.[22]

One of the main impacts of increased tourism on Long Island is an increase in vehicular traffic, since many of Long Island's attractions are dispersed and private vehicles are the preferred mode of travel to these locations. In the warmer months, the LIRR and ferry services experience increased ridership for access to popular beaches and barrier islands. The MTA partners with local transportation providers to offer discounted summer travel packages including LIRR, taxi, and ferry service to popular locations like Fire Island.[23]

In the Lower Hudson Valley, Westchester County has seen marked growth in its tourism sector, and now ranks third in visitor spending in New York State (behind New York City and Long Island).[24] In particular, Westchester County has seen significant growth in its agritourism sector. The 17-mile "Westchester-Grown" Farm Trail is a New York State designated route, and provides visitors with a chance to explore over a dozen farms in Westchester County.[25]

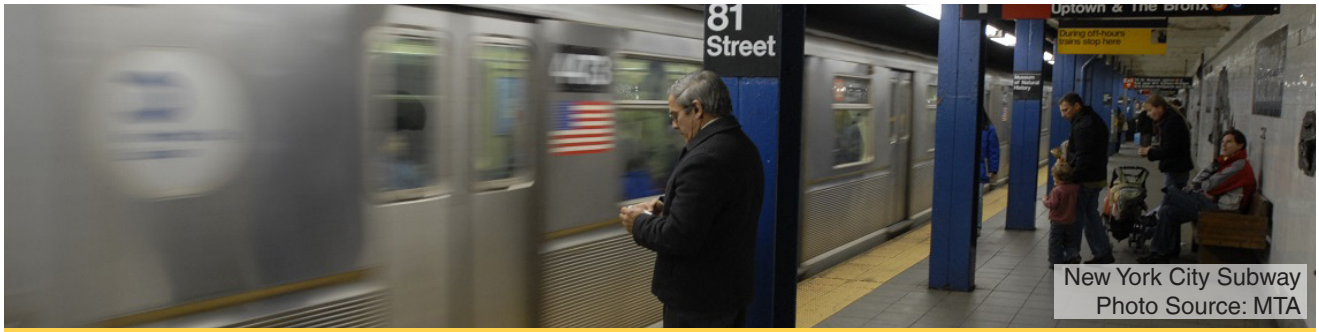
New York City is a major tourist destination, consistently ranking as one of the most visited cities in the world. In March 2016, NYC & Company announced a forecast of 59.7 million visitors to the City in 2016, exceeding the previous year's 58.3 million by 2.4 percent and putting the City well on track to reach its goal of drawing 67 million annual visitors by 2021.[26] Visitors come for a variety of reasons: the City's historical sites, renowned museums, lively theater and art scene, and dining. Overall, visitors to the City spend more than $41 billion each year, generating more than $22.5 billion in wages for more than 362,000 workers throughout the City and more than $10 billion in tax revenue.[27]

Travel in New York City is heavily impacted by tourism. In fact, the City's key pieces of transportation infrastructure are tourist destinations, including the Staten Island Ferry (22 million total annual riders, 1.5 million of whom are tourists) and Grand Central Terminal (which sees 21.6 million tourists annually).[28] Tourists also join commuters on the already well-used New York City subway, in addition to taxis and app-based ride services such as Uber. Some international travelers to the City take regional rail or bus service to attractions in other parts of the metro area, such as the Woodbury Commons shopping center in Central Valley.[29] New York City is also home to a variety of tour buses which offer "hop-on, hop-off" tours for visitors and make curbside stops throughout the core of Manhattan.

Technical Upgrades

An important component of integrating tourism travel into the transportation planning and project delivery is the availability of data. NYMTC is currently conducting a Regional Establishment Survey (RES) collecting travel information from key establishments in New York, New Jersey and Connecticut. These establishments include major hotels and the data collected will include travel information on tourists. The data collected from the RES will be used to improve the NYBPM so that it has the ability to more accurately and realistically consider the impacts of trips made by customers in the region's establishments, visitors to the area, taxis, and trucks.

Additionally, NYMTC is working on the development of a "Visitors' Model" which will be a component of the NYBPM. This model will use the data collected from the RES and help to forecast the travel behavior of visitors to the NYMTC planning area. This will assist in better integration of the travel demands of tourists into the transportation planning process and as such possible strategic investments which will support the economic vitality of the region.



New York City Subway
Photo Source: MTA

4. FUTURE CHANGES LIKELY TO IMPACT TRANSPORTATION

Major changes are occurring across the nation and in the NYMTC planning area which are likely to significantly transform the provision, management and use of transportation services and facilities. The drivers of these changes could, and in fact in some cases already are, redefining when, how and why people are traveling and goods are being moved during the planning period. Examples include the following:

- Personal mobility is likely to evolve from vehicle ownership toward increased use of shared, on demand, possibly autonomous vehicles.
- Goods movement is likely to be impacted by technological changes including additive manufacturing (also known as 3D printing), vehicle automation and automated delivery, and the further automation of goods production.
- The availability of new types of data will likely results in new approaches to providing and using transportation services, managing the transportation system, new organizational arrangements for service provision and facility management, and even new approaches to financing services and infrastructure. Personal and organizational access to data is already driving change.
- Metropolitan regions worldwide are and will continue to face unprecedented challenges. According to the National Cooperative Highway Research Program, these arise from the impacts of major global trends including climate change, the future availability and cost of fuels, and the development of new technologies and energy sources. They also include domestic trends, such as changing demographics and lifestyle expectations, changes in land use patterns, and limitations in current transportation finance methods. Additionally, USDOT's report "Beyond Traffic 2045: Trends and Choices" identifies many of the very trends that will have impacts on the national transportation system through 2045.

Given the need to anticipate transformational technologies and other drivers of change in Plan 2045, a month-long online survey was employed to solicit public opinion on change and its drivers and potential impacts. The survey revealed that the most influential drivers of change are seen to be real-time transit and traffic information; connected vehicle technologies; improvements to rail technologies; changes to employment and productivity; population age structure; and the emergence of app-based, demand-responsive transportation services. Moderately influential drivers were identified as cashless and mobile electronic payment; self-driving vehicles; hybrid & plug-in electric vehicles and supporting infrastructure; energy prices and fuel efficient vehicles; active transportation; local changes in land use and development density; real estate and transportation costs; and technological developments related to extreme events.

CRITICAL DRIVERS OF CHANGE

Over the planning period of Plan 2045, the following drivers of change will likely have the most critical impact, based on both research and public input. They are seen as likely to impact the nature and scale of transportation demand and services during the planning period:

A. INFORMATION AND COMMUNICATION TECHNOLOGIES

Advances in communication, mobile technologies and data collection have the potential to change the way we travel and deliver goods and services. Research indicates that real-time, on-line traffic and transit information will have the most significant impact on travel in the NYMTC planning area during the period of Plan 2045. Real-time, on-line traffic and transit information technologies are already in wide use across the region. For example, real time traffic data is also collected through TRANSCOM, a coalition of 16 transportation and public safety agencies in the New York – New Jersey – Connecticut metropolitan region. The public can access this real-time traffic and transit information from a number of online applications, including 511NY, New York State's official traffic and travel information source.

In addition to real-time, on-line information, cashless and mobile electronic payment can lead to changes in travel demand and transportation financing. One such technology is highway-speed electronic toll collection, which debits the accounts of registered car owners without requiring them to stop or slow from posted speed limits, eliminating the need for formal toll plazas. Additionally, the MTA is replacing the MetroCard payment system with contactless payment. The new system will utilize smartphone apps, allowing for no-swipe entry and automatic refilling of accounts, among other benefits.[30]

The main impacts of advancements in information and communication technologies is that travelers (motorists and transit passengers) will be further enabled to make informed trip and modal choices, avoid congested routes, and hail rides from a variety of service providers. These technologies can also increase roadway or transit operational efficiency by enabling transportation operators to respond quickly to incidents and congestion, while efficiencies in road toll and transit fare payment systems also decrease travel times by reducing wait times at tolls and boarding transit.

B. OPERATIONAL & SAFETY TECHNOLOGIES

Technological advances could lead to the improvement of the operations and safety of the transportation system. For example, new technologies and operational innovations have made rail transport a safer, more secure and efficient way to travel. The implementation of positive train control (PTC) technology on railroads greatly reduces the risk of accidents, and improves operational efficiency and capacity. According to the Federal Railroad Administration,[31] when fully implemented, PTC technology is expected to have a positive, transformative, and life-saving impact on rail safety and operating efficiency in the decades to come. PTC is being implemented in the NYMTC planning area - the MTA is expected to complete the installation of PTC on the Metro-North Railroad and the Long Island Rail Road in the short-term, which will result in significant safety gains for the region. NJ Transit is on a similar completion schedule for PTC on their rails on the West side of the Hudson River in New York State. Connected vehicle technologies, such as vehi-

cle-to-vehicle or vehicle-to-infrastructure communication, are also potentially major drivers of change. Connected vehicles feature safety warnings that alert drivers of potentially dangerous conditions – impending collisions, icy roads and dangerous curves – before the driver is aware of them.[32] In 2015 USDOT awarded a grant to NYC DOT for a connected vehicle pilot program. This pilot will install vehicle-to-vehicle (V2V) technology in up to 10,000 City-owned vehicles, including cars, buses, and limousines, that frequently travel in Midtown Manhattan, as well as vehicle-to-infrastructure (V2I) technology throughout Midtown.

Another technology that will potentially change the way that we travel is the autonomous, or self-driving vehicle. A self-driving vehicle is capable of sensing its environment and navigating without human input, and could reduce the occurrence of automobile accidents caused by dangerous driving, enhance human productivity by freeing them from driving, and improve mobility for children, the elderly and the disabled.[33] No longer a futuristic idea, self-driving vehicles are in development at Tesla, Google, Mercedes, BMW, and other companies.[34] In September of 2016 Uber launched its pilot program of autonomous vehicles in Pittsburgh, Pennsylvania using self-driving Ford Fusion vehicles. Boston has also partnered with the World Economic Forum to launch a yearlong program to test autonomous vehicles which began in January 2017.[35]

Innovative concepts are also being developed to protect pedestrians, bicyclists, and motorcyclists. In New York City, for example, there is a pilot program to install side guards on trucks to help protect pedestrians and cyclists from the rear wheels of a vehicle in the event of a collision. A pilot program in the United Kingdom was successful in reducing pedestrian and cyclist fatalities involving side-impact collisions with trucks.[36]

A recent report by the USDOT's Volpe Center - 2015 OST-R Transportation Technology Scan: A Look Ahead - identified emerging technologies and innovative applications that may have significant impacts on our transportation systems within the next three to five years. The report recognizes that while these technologies are still in their research stages, and there is still a lot of uncertainty around implementation and impacts, they have the potential to have significant impacts in the future by reducing crashes, relieving traffic congestion, and reducing vehicle emissions.[37]

Connected Vehicle Pilot
Photo Source: NYC DOT

C. ALTERNATIVE FUELS & VEHICLE TECHNOLOGIES

Most vehicles on the road today are powered by fossil fuels (gasoline and diesel). However there has been an interest in the development of alternative technologies to address the adverse effects of fossil fuels, including greenhouse gas and other mobile source emissions, as well as the uncertainty surrounding future oil supply and prices. Many automobile companies are working to develop vehicles which would use alternative fuel sources such as electricity, biofuels, and hydrogen.

Energy prices and improved fuel-efficiency are influential factors in this development. After spiking above $4 per gallon in 2014, gasoline prices have dropped. As of February 2016, the average price of gas in New York State had dropped below $2 per gallon, and the national average was approximately $1.80.[38] At the same time, renewable energy sources, especially solar, have decreased in cost and are forecast to continue to do so. New York State also offers tax credits to encourage the use of solar and other green energy sources where feasible.

In addition, the fuel economy of vehicles is increasing, which further decreases the cost of driving. According to the Environmental Protection Agency, the production-weighted fuel economy of cars has increased from 23.1 miles per gallon (mpg) for model-year 2005 to almost 28 mpg for model-year 2014, an increase of approximately 21 percent. Similarly, the fuel economy for trucks has increased 19 percent, from 16.9 mpg to 20.1 mpg in the same time frame.[39]

In the medium-term, hybrid and plug-in electric vehicles and supporting infrastructure can potentially having a great impact on personal and commercial transportation. These vehicles are propelled fully or partially by electric motors powered by rechargeable battery packs. Electric Vehicles (EVs) can be charged from standard electricity sources. Hybrid electric vehicles (HEVs) combine an internal combustion engine with an electric motor. Both EVs and HEVs also convert energy from coasting and braking into electricity, which is stored in batteries. Compared to regular vehicles, EVs have greater energy efficiency, produce lower emissions and cost less to operate. However, there are still issues with the range of EVs that limit their practicality. EVs and HEVs have gained presence in the NYMTC planning area: the first hybrid electric buses and taxis entered service in New York City in 2004 and 2005 respectively.[40] Hybrid buses are also used by transit operators in Westchester and Rockland counties. A New York State initiative, ChargeNY, has supported the installation of nearly 500 charging stations for EVs and HEVs since 2013. The State has also revised regulations to clarify charging station ownership rules, and supported research and demonstration projects on new EV technologies and policies.[41]

The economics behind the cost of different fuel types will continue to be a driver of change by determining the attractiveness of certain modes or of adopting certain fuel types. For example, lower gasoline and diesel prices combined with improvements in vehicle fuel mileage will likely encourage continued use of fossil fuels, while decreases in the cost of alternative and green energy would potentially incentivize their adoption. This relationship in turn has implications on public health and emissions reductions efforts. The potential impacts of fuel costs similarly apply to public transit. Transit agencies' decisions to transition from diesel or compressed natural gas (CNG) to EVs and HEVs could provide significant operating cost savings to transit agencies in the long-term, while also mitigating air quality and emissions concerns from continuing to use traditional fossil fuels.

Hunts Point Clean Truck Program
Photo source: NYC DOT

D. EMPLOYMENT & ECONOMIC TRANSFORMATION

"Technology has changed the workplace in an extraordinary way. It has allowed some jobs to be mobile that were previously desk-bound, and enabled many workers to do their jobs from almost any location at any time. Whenever there is any kind of a "work" revolution, there is a related and required shift in skill sets. As technology evolves and replaces traditional ways of doing work, it not only changes the very nature of the work, including tools, practices and processes, it also impacts the skills required to adapt to this paradigm shift."[42]

Employment and productivity have a significant impact on the transportation network, since transportation demand is determined by the number of people who need to travel and the volume of goods that need to be transported. In general, when the economy is strong, employment and consumption are high, stimulating more trips for passengers and goods. Indeed, a California State University study found that increased unemployment translates into decreased vehicle usage since those who are unemployed discontinue commuting and forego other trips they may have taken.[43]

Changes in modes of production can impact travel demands. In particular, additive manufacturing (3D printing) could supersede supply chains and distribution networks for certain types of goods and allow more decentralized production. Similarly, changes in the form of employment that may be brought about by evolving technologies could impact where, when and how people are employed and perform their work, thus impacting their mobility needs. Other economic factors impacting travel behavior are tax rates and bank regulations, which impact business location decisions and thus where general economic activity and population growth occur.

These dynamics are especially important drivers of change for the NYMTC planning area, given the concentration of business and residences, and the resulting travel behavior. Changes in tax rates, bank regulations, interest rates and employment can have a profound influence on the region's investment environment and economy vitality, which in turn would impact travel demands.

In addition, the large concentration of economic activity and population makes New York City and its surrounding region a major center of goods movement. Thus, changes in production origins will impact the volume and mode of goods movement, which could be a step toward mitigating freight congestion.[44]

Metro-North passengers
Photo source: MTA

E. GENERATIONAL CHANGE

Demographic changes over the past decade have altered the way people use transportation, resulting in the emergence of new travel patterns and demands. One of the most prominent demographic trends during the period of Plan 2045 will be the aging of the population in NYMTC's planning area. In 2013, the population 65 years and older living in the NYMTC planning area numbered over 1.6 million, 13 percent of the total residential population.[45] This figure is expected to increase rapidly with the aging of the Baby Boom generation. According to the NYMTC population forecasts, by 2045 one in six persons in the NYMTC planning area is projected to be 65 and over. Changes to the population age structure will likely influence travel patterns in the region. In general, older adults have a higher incidence of disabilities and a lower rate of workforce participation, which results in an overall reduction in travel and also in a higher demand for assisted and accessible transportation. Indeed, the American Association of Retired Persons (AARP) reported in 2013 that more than 20 percent of adults over the age of 65 do not drive and do not have good access to public transit facilities,[46] although earlier reports found that they are using public transit more and more.[47] Measures that can accommodate the mobility needs of an aging population include more specialized public transportation, complete streets, older driver safety measures, and accessible design at public transportation stations.

Generational changes will also likely impact the acceptance and use of new technologies, which in turn can impact travel patterns. The future development of app-based, demand-responsive transportation services will likely be influenced by their acceptance by younger generational cohorts, such as the Millennials and the generation which follows. Young Americans have readily adopted new technology-enabled transportation services, such as smartphone application (app)-based peer-to-peer ride-hailing, car sharing and bike sharing networks, real-time transportation information, on-demand ride services, and other transportation network services.[48] For example, app-based, for-hire ride-hailing services such as Uber and Lyft, allow consumers with smartphones to submit a trip request to find the nearest available drivers and pay their fare digitally. These demand-responsive transportation services can eliminate barriers that limit personal mobility, and reduce the need for households to own private vehicles. At the same time, the convenience offered by these technologies could replace transit or non-motorized trips, resulting in higher VMT and traffic congestion.[49] Nevertheless, as a whole, these technologies are gradually changing Americans' travel behavior as an increasing number of people adopt them, although as the aforementioned Volpe report notes, the overall impacts of these services are yet to be determined and for this reason have not been included in the forecast assumptions for this Plan.

Another trend distinguishing younger Americans is their preference for transit and active transportation, such as walking and biking. In our survey, approximately 41 percent of respondents viewed active transportation as a major factor influencing future travel patterns in the NYMTC planning area. Research shows that Millennials (those born between 1980 and 2000) tend to drive less, take transit, bike and walk more, and seek out places to live in cities and walkable communities that encourage walking and biking.[50] According to the Urban Land Institute, 19 percent of Millennials bike at least once a week, compared with 16 percent of Generation X and 12 percent of Baby Boomers.[51] Given the surge in active transportation, especially among the young generation, there will likely be greater demand and need for pedestrian and bicycle transportation infrastructure and policy.

Generational changes are significant drivers of change because of the different travel preferences associated with certain generations. These preferences significantly determine how people will travel, and how much demand will be placed on different modes. Trends show that the aging of the population combined with non-vehicular mode preferences by young Americans could result in an overall shift away from vehicular modes of travel, in favor of public transit and non-motorized forms of travel, for example walking and biking. At the same time, technological advances in on-demand rides (e.g. Uber and Lyft) could improve the convenience of, and thus demand on travelling by motor vehicle.

F. LAND DEVELOPMENT PATTERNS

Various factors will likely influence land development patterns, which in turn influence the type and amount of travel demand. These factors include continued regional growth, local land use preferences and real estate market conditions.

Over the past two decades, population and job growth in urban areas has outpaced growth in suburbs nationally, completely reversing earlier trends. As one of the most populous metropolitan areas in the world, the four-state region centered on New York City attracts people from around the nation and globe. In particular, young people are moving to cities seeking employment opportunities, housing affordability, and compact lifestyles in environments that are diverse in land use, walkable, and do not require vehicle ownership.[52] In recent years, NYMTC's planning area has seen a steady increase in walking, biking and public transit ridership, and those trends are expected to continue.

In addition, TOD has gained the attention of states, municipalities, public authorities, developers and consumers as a way to achieve more sustainable development patterns. TOD projects have increased in presence throughout the NYTMC planning area. Examples on Long Island include Wyandanch Rising, which is transforming one of Long Island's most economically distressed communities into a transit-oriented downtown with excellent access to the MTA Long Island Rail Road, affordable housing units, and commercial uses offering daily amenities. Similar concepts are in progress or under study in the lower Hudson Valley, for example, around MTA Metro-North Railroad stations in the suburban cities of Yonkers, Mount Vernon and New Rochelle.

Real estate and transportation costs often determine where people live and how people travel, thus also impacting the types of travel services in demand. With the resurgence of city centers described above, housing costs are generally lower in low-density suburban or rural areas, but the cost of transportation is higher since living in these areas requires further travel to the central business district, workplaces and other amenities. This factor is especially important to households in the NYMTC planning area where real estate costs are much higher than the national average. According to a New York State Comptroller report, housing affordability has been declining statewide, due to factors such as household income, overall housing costs, real estate taxes, and relative scarcity of housing.[53] If real estate costs continue to increase, many people are likely to settle further away from city centers, potentially leading to longer commute times and higher transportation costs. If these locations are not adequately served by public transportation options, demand for automobile infrastructure can be anticipated.

Patchogue Village
Photo Source: Suffolk County

While land use patterns are determined by many factors, including generational preferences, local land use policies, regional transportation infrastructure and real estate cost trends, it is clear that land use patterns are important drivers of change by determining where people live, where they travel and how they travel.[54] Low-density development generally favors private vehicle ownership and mode preference, whereas denser, mixed land-use patterns encourage non-vehicular mobility options by offering convenient lifestyles and easier access between residences, workplaces, amenities and mobility options. A better understanding of the relationship between land use and lifestyle preference can help anticipate and prioritize future investments in and planning for transportation services and infrastructure.

G. EXTREME WEATHER EVENTS & RESILIENCY

An increase in extreme, climate-related weather events will likely be an important driver of change for the NYMTC planning area, given its location along coastlines, islands and river valleys. Recent extreme weather events have increased consideration of resiliency and climate adaptation at all levels of planning, changing the way systemwide transportation planning is being conducted as transportation agencies continually look for ways to better prepare for extreme events.

Technological development can help enhance the resiliency of the transportation system in the NYMTC planning area to extreme weather events and improve emergency response, infrastructure robustness and redundancy in extreme weather situations. Techniques to harden or equip transportation infrastructure against weather effects such as flooding and extreme heat are being developed to protect the region's transportation assets. For example, the MTA is investing in projects that will improve drainage in rail yards to protect its rolling stock, and seal off tunnels from damaging floodwaters.[55] Additionally, simulation modelling technology will continue to enable planners to identify vulnerabilities in the transportation system and target infrastructure and equipment for hardening, as well as developing emergency plans in response to extreme events.

Flooding and clean-up in Breezy Point, Queens
Photo source: NYC DOT

IMPLICATIONS FOR TRANSPORTATION

The transportation systems around which the modern world has been built are on the verge of a significant transformation...Soft infrastructure - the realm of concepts, policies and legislation - is rapidly evolving to accommodate the demand for global investment in hard transportation infrastructure. Technology is bridging the two as vehicles and the infrastructure on which they operate become increasingly connected.

Traffic and population growth create demand for more transportation infrastructure, but many jurisdictions don't have sufficient money or space to build more roads and rail...New transportation technologies are emerging to meet these challenges, including connected and autonomous vehicles, alternative fuels, keyless fleet management and traffic analytics, as well as local zoning and planning policies that support transit-oriented development. New technology for on-road communications will dramatically change how vehicles operate and provide information and capabilities for better, real-time traffic management - if the necessary network infrastructure is in place.[56]

At this writing, it is impractical to quantitatively predict the impact that the drivers of change identified above may have on the trends and forecasts in this section of the Plan, as well as the operation of the transportation system in the NYMTC planning area. However, there is little doubt that some combination of these drivers will have an impact on either or both demand for transportation and/or the manner in which transportation services are provided. Impacts will likely also be felt in the way in which transportation planning is accomplished.

As described in the previous section, changes are already occurring due to emerging information and communication technologies, fuels and vehicle technologies, employment and economic transformation and generational changes. The MTA, for example, has been able to show that specific increases in transit ridership and travel patterns have been essentially due to the travel behavior of millennials using emerging communication and information technologies and responding to changes in the nature and location of employment.

The drivers which will likely define change over the planning period are important and emerging realities that will continue to shape the future of transportation nationally, globally, regionally and within the NYMTC planning area. In general terms, NYMTC's members will continue to monitor these changes and respond as needed to make the regional transportation system safer, more sustainable, and more efficient as we move towards 2045.

Additionally, transportation planning as practiced through the NYMTC process and individually by NYMTC's members will itself be transformed, as data and technical tools are modified or overhauled in response to changing technological and operational capabilities.

We live in an increasingly interconnected world of techno-social systems, in which infrastructures composed of different technological layers are interoperating within the social component that drives their use and development.

Modern techno-social systems consist of large-scale physical infrastructures (such as transportation systems and power distribution grids) embedded in a dense web of communication and computing infrastructures whose dynamics and evolution are defined and driven by human behavior.

Although many basic conceptual questions remain unresolved, the major roadblock in defining the fundamental predictability limits for technosocial systems is their sensitivity and dependence on social adaptive behavior.[57]

Although quantitative predictions of the impacts of the drivers of change on transportation demand and supply is impractical as of this writing, due mainly to uncertainty about the pace of technological development and its interplay with social adaptive behavior, some qualitative assessments can be made. For the purposes of Plan 2045, these qualitative assessments will need to be noted until better information on trends and behaviors is quantified.

THE PLAN'S FIRST TEN YEARS

It is likely that the impacts of the drivers of change on the Plan's SED and travel demand forecasts will be somewhat muted during the first ten years of the Plan, due mainly to the pace of development of the various technologies for communications/information and for vehicles themselves (both public and private) and the behavioral change that will mature along with the technologies. This will likely also be true of the employment and economic transformation, and operational and safety changes, since their overall development and acceptance will follow a similar dynamic.

Generational changes are already manifesting themselves in altered travel behavior, but their continued evolution will largely be wedded to the pace of technological development and acceptance, with some important caveats:

- The vanguard of the Baby Boomers will be approaching and passing into their early 80s during this period and will begin to present a new set of mobility needs, which may translate into a higher demand for specialized transportation services.
- The vanguard of the Millennials will be moving through middle age toward their 50s during this period and it is unclear how their travel behavior might be modified as they age.
- The vanguard of the following generation will be introduced to the work force during this period and it is unclear how they will be adapting to the developing technology.

Changes in land development patterns should be more fully realized during this period, as regulatory and zoning changes made at present will result in private investment and development that is realized during this period. This should maintain the growing demand for transit service that is seen in the forecasts.

THE BALANCE OF THE PLANNING PERIOD

Beyond this initial ten year period and through the 2045 horizon year, the impacts of these drivers on transportation demand and supply will likely be more evident due to the maturation of technologies and related behavioral adaptation. Some of these impacts may be far reaching, but it is not possible to reasonably forecast when and how the drivers will mature and what they will ultimately become. It seems certain however, that the needs of the transportation system will change along with the structure of the population.

A case in point is additive manufacturing (3D printing).This technology has the potential for far reaching, even transformative commercial impacts that could revolutionize the movement of goods. Similarly, the combination of enhanced communication/information technologies and vehicle autonomy also has the potential to radically change personal mobility in the longer term, moving away from a vehicle-based system into a more trip-based system in which private ownership of vehicles is unnecessary and private and public transport have been melded together entirely. And finally, the continued evolution of the "Internet of Things" may radically transform both the mobility needs of people and the efficiency with which transportation resources are used.

This summary of potential impacts points to both the unpredictability of future impacts and the great potential of the drivers of change, as well as any future drivers emerging down the road to transform the transportation system in unpredictable ways. This argues for a degree of sensitivity testing for the period beyond the first ten years of Plan 2045, since it is generally unknowable whether the most transformative of these changes will be realized with the planning period.

ADDITIONAL NOTES

Census Data

The demographic data used to analyze trends between 1980 and 2015 in various timeframes in Plan 2045 is derived from U.S. Census Data products, including the Decennial Census and American Community Survey (ACS). ACS data is derived from a sample of a geography's population, whereas the Decennial Census provides 100% data. One consideration arising from this is that time-based comparisons made in Plan 2045 compares two different types of data (estimate vs. count). Furthermore, while 2015 1-year ACS data would have provided greater accuracy for the year 2015 itself, data is not available for Putnam County, and thus 2015 5-year data was used.

A second consideration is that because ACS data is based on samples, many indicators examined in Plan 2045 carry notable margins of error (margins of error, or MOE, represent the level of uncertainty about a given estimate). High margins of error are particularly characteristic of data collected for small geographies (for example the census tract level); whereas data for larger geographies (such as county-level data) have smaller margins of error because they use larger sample sizes. While this is an important consideration to make when examining these data, high margins of error are the nature of tract-level data and many of the analyses done in Plan 2045 would not be possible without using these datasets.

Much of the commute and employment data was derived from Quarterly Census of Employment and Wages (QCEW) and Longitudinal Employer-Household Dynamics (LEHD) and its derivative LEHD Origin-Destination Employment Statistics (LODES). The QCEW is a U.S. Census program that partners with the Bureau of Labor Statistics (BLS) to provide employment data (number of jobs) and wage information using establishment (workplace) data as well as State and Federal unemployment insurance data. The data also provides the number of establishments, monthly employment and quarterly wages, breakdown by NAICS industry and at different geographic levels.

The LEHD program creates statistics on employment, earnings and job flows at various geographic levels (zip codes, census tracts, county, and so on), while also synthetically producing worker residence patterns. This data is built by combining unemployment insurance earnings data (provided by States), QCEW data, along with other administrative data and data from censuses and surveys.

Comparing Plan 2040 and Plan 2045

Plan 2045 used a different forecasting methodology from its predecessor, Plan 2040. Thus, comparisons of the forecasts should not be made. For more information on methodology, please visit: https://www.nymtc.org/DATA-AND-MODELING/SED-Forecasts/2050-Forecasts

ENDNOTES

[1] U.S. Census Bureau. 2000. **Total Population: Census 2000 Summary File 1**; and U.S. Census Bureau. 2010. **Total Population 2010 Census Summary File 1**.

[2] Chokshi, Niraj. December 22, 2016. **Growth of U.S. Population Is at Slowest Pace Since 1937**. *The New York Times*. https://www.nytimes.com/2016/12/22/us/usa-population-growth.html?_r=0

[3] Berman, Jillian. December 30, 2013. **U.S. Population Grows At Slowest Rate since the Great Depression**. *The Huffington Post*. http://www.huffingtonpost.com/2013/12/30/population-growth-rate_n_4520485.html

[4] New York State Department of Labor. **2000 Quarterly Census of Employment and Wages; 2015 Quarterly Census of Employment and Wages**. https://labor.ny.gov/stats/ins.asp; Bureau of Labor Statistics. **2000 Quarterly Census of Employment and Wages; 2015 Quarterly Census of Employment and Wages**. https://www.bls.gov/cew/

[5] Anne Fisher. September 12, 2013. **Got a back-office job? It may be headed overseas**. *Fortune*. http://fortune.com/2013/09/12/got-a-back-office-job-it-may-be-headed-overseas/

[6] Bureau of Labor Statistics. **2000 Quarterly Census of Employment and Wages; 2015 Quarterly Census of Employment and Wages**. https://www.bls.gov/cew/

[7] New York State Department of Labor. 2**000 Quarterly Census of Employment and Wages; 2015 Quarterly Census of Employment and Wages**. https://labor.ny.gov/stats/ins.asp

[8] Ibid.

[9] Rampell, Catherine. September 20, 2010. **The Recession has (Officially) Ended**. *The New York Times.* https://economix.blogs.nytimes.com/2010/09/20/the-recession-has-officially-ended/?_r=0

[10] Appelbaum, Binyamin. January 10, 2014. **Debating Why the Work Force Is Shrinking**. *The New York Times.* http://economix.blogs.nytimes.com/2014/01/10/debating-why-the-work-force-is-shrinking/

[11] United States Department of Transportation (USDOT) National Highway Traffic Safety Administration (NHTSA). 2014. T**raffic Safety Facts - 2014 Data**. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812273

[12] Thomas P. DiNapoli and Kenneth B. Bleiwas. 2010. **The Role of Immigrants in the New York City Economy.** *New York City Public Information Office, Office of the State Comptroller*. Vol. 17 http://www.osc.state.ny.us/osdc/rpt17-2010.pdf

[13] American Public Transportation Association. 2016. **APTA Q4 2015 Ridership Report**. https://www.apta.com/resources/statistics/Documents/Ridership/2015-q4-ridership-APTA.pdf

[14] New York Metropolitan Transportation Council (NYMTC). 2015. **2015 Travel Patterns** https://www.nymtc.org/DATA-AND-MODELING/Transportation-Data-and-Statistics/Publications/Travel-Patterns

[15] Ibid.

[16] U.S. Census. 2000. **P030: Means of Transportation to Work for Workers 16 Years and Over, 2000 Census Summary File 3**; and U.S. Census. 2015. **B08301: Means of Transportation to Work**, 2011-2015 American Community Survery 5-Year Estimates.

[17] Ibid.

[18] U.S. Census Bureau, Center for Economic Studies: On the Map. 2014. **Work Destination Analysis**. https://onthemap.ces.census.gov

[19] U.S. Census Bureau. 2015. **B08603: Travel Time to Work for Workplace Geography**, 2015 American Community Survey 1-Year Estimates.

[20] U.S. Census Bureau. 2000. **P030: Means of Transportation to Work for Workers 16 Years and Over**, 2000 Census Summary File 3; and U.S. Census Bureau. 2015. **B08301: Means of Transportation to Work**, 2011-2015 American Communtiy Survey 5-year Estimates

[21] Empire State Development: Tourism Economics. 2015. **The Economic Impact of Tourism in New York: 2015 Calendar Year.** http://esd.ny.gov/Reports/NYS_Tourism_Impact_2015.pdf

[22] Ibid.
[23] MTA. 2016. **LIRR Beach Getaways 2016**. http://web.mta.info/lirr/getaways/beach/
[24] Westchester County Government. 2015. 2**015 Westchester Visitor Statistics**.
[25] Id.
[26] McGeehan, Patrick. March 9, 2016. **Record Number of Tourists Visited New York City in 2015, and More Are Expected This Year.** *The New York Times.* http://www.nytimes.com/2016/03/09/nyregion/record-number-of-tourists-visited-new-york-city-in-2015-and-more-are-expected-this-year.html?_r=0
[27] NYC and Company. 2016. **NYC Travel and Tourism Visitation Statistics**. http://www.nycandcompany.org/research/nyc-statistics-page
[28] Cross, Heather. April 2016. 1**1 Most Popular New York City Tourist Attractions and Landmarks**. *GoNYC*. http://gonyc.about.com/od/attractions/ss/10-Most-Popular-New-York-City-Tourist-Attractions-and-Landmarks.htm
[29] Santana, Danni and Davies, Erica. August 23, 2015. **Exchange rate? Bah!** *Crain's New York*. http://www.crainsnewyork.com/article/20150823/HOSPITALITY_TOURISM/150829979/stats-and-the-city-2015-tourism
[30] Colt, Sam. January 2015. **New York Is Considering Letting You Pay for the Subway with Your Smartphone. Business Insider**. http://www.businessinsider.com/the-mta-has-a-450-million-plan-to-replace-the-metrocard-with-contactless-payments-2015-1
[31] Federal Railway Administration. August 2015. **Status of Positive Train Control Implementation.** https://www.fra.dot.gov/eLib/details/L16962
[32] USDOT. September 2015. **U.S. Department of Transportation Announces Up to $42 Million in Next Generation Connected Vehicle Technologies**. http://www.its.dot.gov/press/2015/ngv_tech_announcement.htm
[33] Bell, Lyndon. No date. **10 Benefits of Self-Driving Cars**. *AutoBytel*. Web. http://www.autobytel.com/car-ownership/advice/10-benefits-of-self-driving-cars-121032/
[34] Greenough, John. July 2015. 1**0 Million Self-Driving Cars Will Be on the Road by 2020**. *Business Insider*. http://www.businessinsider.com/report-10-million-self-driving-cars-will-be-on-the-road-by-2020-2015-5-6
[35] WBUR News. January 2, 2017. **Buckle Up, Boston: Testing of Self-Driving Cars Begins Tuesday**. http://www.wbur.org/bostonomix/2017/01/02/self-driving-car-testing-begins
[36] John A. Volpe National Transportation Systems Center. December 2015. **2015 OST-R Transportation Technology Scan: A Look Ahead**, 18-19. https://www.rita.dot.gov/sites/default/files/technology_scan.pdf
[37] Ibid, 9.
[38] U.S. Energy Information Administration. February 29, 2016. **Weekly Retail Gasoline and Diesel Prices**. http://www.eia.gov/dnav/pet/PET_PRI_GND_DCUS_SNY_W.htm
[39] U.S. Energy Information Administration. December 2014. **U.S. household gasoline expenditures in 2015 on track to be the lowest in 11 years**. http://www.eia.gov/todayinenergy/detail.cfm?id=19211
[40] Wikipedia. **MTA Regional Bus Operations Bus Fleet**. https://en.wikipedia.org/wiki/MTA_Regional_Bus_Operations_bus_fleet; Austin Considine. May 21, 2006. **Is That a Tinge of Green on New York's Yellow Cabs?** *The New York Times*. http://www.nytimes.com/2006/05/21/automobiles/21TAXI.html?scp=8&sq=hybrid%20taxis%20new%20york%20city%20-harlem&st=cse
[41] New York State Energy Research and Development Authority. October 2, 2015. **ChargeNY**. https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY
[42] Heiman, Giorgio. May 26, 2015. **The Next Workplace Revolution– how technology is changing jobs**. *Orange Business Services*. Blogs/Connecting technology.

[43] Hymel, Kent M. June 2014. **Factors Influencing Vehicle Miles Traveled in California: Measurement and Analysis**. *California State University, Northridge*.
http://www.csus.edu/calst/FRFP/VMT%20Trends%20-%20Hymel%20-%20Final%20Report.pdf
[44] Volpe, Id., 23.
[45] U.S. Census Bureau. 2014. **Population 65 Years and Over in the United States**. 2009-2013 American Community Survey 5-Year Estimates.
[46] AARP. 2013. **The Benefits of Public Transportation Options in an Aging Society**. http://www.aarp.org/content/dam/aarp/livable-communities/old-learn/transportation/benefits-of-public-transportation-aarp.pdf
[47] Jana Lynott, Carlos Figueiredo. 2011. **How the Travel Patterns of Older Adults Are Changing: Highlights from the 2009 National Household Travel Survey**. *AARP*. http://www.aarp.org/home-garden/transportation/info-04-2011/fs218-transportation.html
[48] Dutzik, Tony, Madsen, Travis, Baxandall, Phineas. Fall 2013. **A New Way to Go: The Transportation Apps and Vehicle-Sharing Tools that Are Giving More Americans the Freedom to Drive Less**. *U.S. PIRG Education Fund, Frontier Group*. http://www.uspirg.org/sites/pirg/files/reports/A%20New%20Way%20to%20Go%20vUS1.pdf
[49] Volpe, Id, 17.
[50] Dutzik, Tony, Madsen, Travis, Baxandall, Phineas. October 2014. **Millennials in Motion: Changing Travel Habits of Young Americans and the Implications for Public Policy**. *U.S. PIRG Education Fund, Frontier Group*. http://uspirg.org/sites/pirg/files/reports/Millennials%20in%20Motion%20USPIRG.pdf
[51] Urban Land Institute. 2013. **America in 2013: A ULI Survey on Housing, Transportation and Community: Appendix A**. http://uli.org/wp-content/uploads/ULI-Documents/America_in_2013_web.pdf
[52] Chakrabarti, Vishaan. April 16, 2014. **America's Urban Future**. *The New York Times*. http://www.nytimes.com/2014/04/17/opinion/americas-urban-future.html?_r=0
[53] New York State Comptroller. March 2014. **Housing Affordability in New York State**. http://www.osc.state.ny.us/reports/housing/affordable_housing_ny_2014.pdf
[54] Litman, Todd and Steele, Rowan. August 2015. **Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior.** Victoria Transportation Policy Institute. http://www.vtpi.org/landtravel.pdf
[55] U.S. Department of Transportation. September 22, 2014. **Resilience Projects in Response to Hurricane Sandy**. http://www.fta.dot.gov/15138_16147.html
[56] King, Janice. November 4, 2014. **How Transportation Technologies Will Change Everything**. *Government Technology*.
[57] Vespignani, Alessandro. 2009. P**redicting the Behavior of Techno-Social Systems**. *Science* 325, 425

Chapter 3 |
The Transportation System

1. Introduction
2. Passenger Rail
3. Bus Transit
4. Waterborne & Aerial Services
5. Air Travel
6. Pedestrian & Bicycle Facilities
7. Roadways & Crossings
8. Taxicabs & Livery Cabs
9. Goods Movement

96 Street station, Second Avenue Subway
Photo Source: MTA

1. INTRODUCTION

The multi-state New York City metropolitan region features one of the oldest, 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 in this region than in other metropolitan regions of the United States. In addition, the region is an important hub of air and freight travel, with three major international airports in the New York City area, and several other regional airports and aviation facilities. With one of the nation's largest concentration of private and public marine terminal facilities, the Port of New York and New Jersey is a vital component of the national and international freight distribution network.

Within the NYMTC planning area, the transportation system includes:

- 1,381 track miles of commuter rail, 662 track miles of subway service, plus hundreds of miles of local, express, commuter, and intercity bus routes and an aerial tramway;
- An extensive network of passenger hubs, such as bus terminals and subway transfer facilities, ferry landings, and train stations where people transfer between modes of transport, including one of the most successful rail-to-airport links in the country;
- More than 1,100 miles of bicycle facilities, ranging from shared-use bike trails to on-road bike lanes, in addition to pedestrian sidewalks, trails, and paths;
- More than 50,000 lane miles of roads and highways, including more than 30 major bridges crossing navigable waterways (there are over 3,200 bridges of all types in the region), four major underwater vehicular tunnels, and special lanes for high occupancy vehicles (HOVs) and buses;
- Four commercial service airports, major passenger and air cargo operations and supporting infrastructure, plus general aviation and heliport facilities;
- Major deep-water seaport facilities owned and operated by a mix of public and private sector entities, plus an extensive network of marine cargo support infrastructure and services;
- An extensive network of inland waterways supporting barge and ferry services;
- More than 400 route miles of freight rail, some of which is shared with commuter rail services;
- A widespread network of freight hubs, including rail transfer facilities, rail yards, and truck-oriented warehouse and distribution centers; and
- Supporting infrastructure like rail yards and highway maintenance facilities, highway rest areas, parking lots and garages, bus depots and transit storage yards, bicycle parking areas, toll plazas, signage, signals, electronics, and other equipment.

Southwestern Connecticut and northern New Jersey also have extensive transportation networks that feed into the NYMTC planning area, with roads, rails, and ferries crossing state boundaries at numerous points. A significant portion of the MTA Metro-North Railroad's New Haven Line is funded by the State of Connecticut, and tunnels and bridges crossing the Hudson River bring New Jersey Transit trains and buses, Port Authority Trans-Hudson (PATH) trains, and trucks and personal vehicles from New Jersey into Manhattan.

Interior of World Trade Center Oculus
Photo Source: MTA

2. PASSENGER RAIL

The sheer volume and proportion of passengers carried by rail services in the multi-state metropolitan region is unique among similar metropolitan regions. Over 10 million daily passenger trips are made using the multi-state region's rapid transit and commuter rail networks[1]. Other metropolitan regions in the United States – even those with substantial passenger rail networks, such as Washington D.C., Boston, Chicago and San Francisco - do not come close to this level of usage.

7 train approaching Queensboro Plaza
Photo Source: MTA

RAPID TRANSIT

Rapid transit is designed to carry large numbers of people with great frequency, usually on dedicated rights-of-way. These services follow a fixed route and operate underground, at surface level, or on elevated structures. MTA New York City Transit's subway is one of the largest and most complex raid transit systems in the world, serving the boroughs of Manhattan, Brooklyn, Queens, and the Bronx. On Staten Island, the MTA Staten Island Railway links 22 communities with surface-level rapid transit.

In additions to these services, PATH trains are a critical rapid transit link between Manhattan and northern New Jersey. PATH is a service of the Port Authority of New York and New Jersey (Port Authority).

A. MTA NEW YORK CITY SUBWAY

The MTA New York City Transit (NYCT) subway system operates 24 routes, spanning 666 miles of track and 472 stations[2]. In 2015, annual subway ridership was 1.763 billion[3] – the highest annual ridership in more than 65 years. The subway system carried more than six million customers on 49 weekdays in 2015, higher than in 2014 and a level not seen since the post-World War II boom. This growth was seen across the city in all boroughs and all lines, with the highest percentage increase in neighborhoods seeing rapid residential development and population increases, such as Bushwick in Brooklyn and Long Island City in Queens. While ridership grew in every part of the day and every day of the week, weekday growth was strongest outside of the traditional morning and evening rush hours. See Table 3.1.

This high level of usage is a reflection of growth in population and visitors, as well as over three decades of capital investment to make the system far more reliable and attractive. Nevertheless, portions of the system are nearly 110 years old, and a significant percentage of the asset base remains overdue for attention.

In addition to vital maintenance work, major rehabilitation and expansion projects are also ongoing throughout the system. Examples include the Fulton Street Transit Center, a fully digital and accessible transit and retail hub, opened to the public in November 2014. The extension of the #7 subway to a new terminal at 11th Avenue and 34th Street opened in September 2015, with work continuing on the station to open a second entrance in 2017.

The Second Avenue Subway opened on the first day of 2017. A new station entrance was created at 63rd St and 3rd Avenue, and new stations were built at 72nd Street, 86th Street and 96th Street. The Second Avenue Subway currently serves about 160,000 passengers per weekday and is expected to serve 200,000 per day once riders become fully aware of the new service.

These investments have occurred despite the devastating blow the system suffered from Superstorm Sandy in 2012. Flooding from the storm caused substantial damage to subway infrastructure, which the MTA has worked to repair and fortify in order to make more resilient to future weather events. Steady progress is being made, but many years of work still lie ahead.

B. PATH

Operated by the Port Authority, PATH is a rapid transit system comprised of four routes and 13 stations located in Manhattan, Hoboken, Jersey City, Harrison and Newark. The PATH system also serves Newark Penn Station, a major transportation hub in downtown Newark (See Table 3.2 for annual ridership).

New fare media and new railcars have figured prominently in PATH's development since 2008. PATH's rolling stock have been entirely replaced. Ongoing enhancements to the PATH system include a signal replacement program as well as additional new rail cars, which would allow PATH to optimize the capacity enhancements enabled by the new signal system.

Construction of the World Trade Center Transportation Hub has been largely completed and the Hub opened on March 3, 2016. Currently, the Hub includes a connection to the nearby Fulton Transit Center.[4]

FIGURE 3.1: RAPID TRANSIT SYSTEMS IN THE NYMTC PLANNING AREA

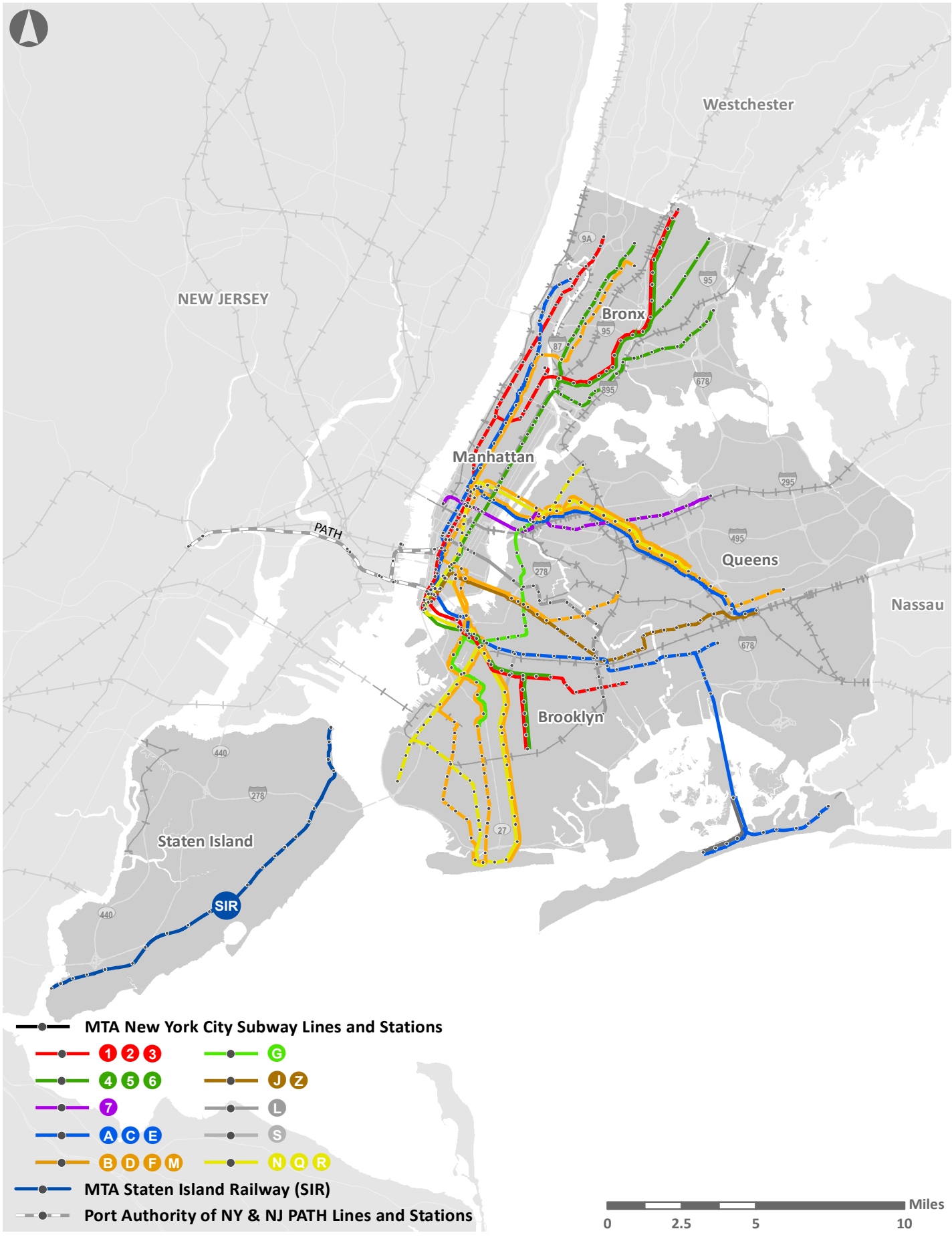


TABLE 3.1: PROPORTIONAL INCREASES IN WEEKEND NYC SUBWAY RIDERSHIP (1998-2015)

Year	Weekday	Saturday	Sunday	Saturday % of Weekday	Sunday % of Weekday
1998	3,962,222	2,015,003	1,490,327	50.9	37.6
1999	4,226,709	2,206,869	1,625,211	52.2	38.5
2000	4,522,410	2,393,186	1,794,874	52.9	39.7
2001	4,579,222	2,512,490	1,883,489	54.9	41.1
2002	4,590,570	2,573,817	1,937,375	56.1	42.2
2003	4,511,857	2,469,237	1,884,342	54.7	41.8
2004	4,612,703	2,594,065	1,973,605	56.2	42.8
2005	4,737,093	2,660,594	2,058,666	56.2	43.5
2006	4,865,769	2,735,177	2,090,005	56.2	43.0
2007	5,042,150	2,917,234	2,211,490	57.9	43.9
2008	5,229,435	2,981,699	2,312,745	57.0	44.2
2009	5,086,822	2,928,247	2,283,621	57.6	44.9
2010	5,156,913	3,031,289	2,335,077	58.8	45.3
2011	5,284,295	3,033,660	2,367,261	57.4	44.8
2012	5,380,184	3,172,627	2,490,736	59.0	46.9
2013	5,465,034	3,243,495	2,563,022	59.3	46.9
2014	5,597,551	3,233,114	2,662,791	57.8	47.6
2015	5,650,610	3,309,731	2,662,795	58.6	47.1

Source: http://web.mta.info/nyct/facts/ridership

TABLE 3.2: RAPID TRANSIT AND RAILROAD ANNUAL RIDERSIP AND USAGE, 2008-2015

Year	NYCT Subway	PATH	SI Railway	LIRR	Metro-North	NJ Transit
2008	1,623,881,370	74,955,660	4,379,855	87,358,476	83,555,228	84,508,279
2009	1,579,866,601	72,281,310	4,127,137	82,950,847	79,899,148	83,586,312
2010	1,604,070,666	73,911,746	4,370,233	81,507,851	81,095,849	82,223,534
2011	1,640,434,672	76,600,000	4,583,389	80,983,003	82,037,786	79,632,021
2012	1,654,582,265	72,563,052	4,445,112	81,745,989	82,953,628	81,353,894
2013	1,707,555,714	72,802,576	4,220,600	83,384,250	83,378,506	78,600,000
2014	1,751,287,621	73,676,770	4,367,646	85,868,246	84,659,126	84,017,359
2015	1,762,565,419	76,565,452	4,501,937	87,648,046	86,018,159	89,348,383

NYCT Source: http://web.mta.info/nyct/facts/ridership/
PATH Source: http://www.panynj.gov/path/statistics.html
SIRR 2013 data: http://www.apta.com/resources/statistics/Documents/Ridership/2013-q4-ridership-APTA.pdf
SIRR 2014 data: http://web.mta.info/mta/network.htm
LIRR/MNR 2013 Data: http://web.mta.info/mta/compliance/pdf/2013_annual/2013Annual-Report.pdf
LIRR/MNR 2014 Data: http://web.mta.info/mta/network.htm
NJT 2013 data: http://www.njtransit.com/pdf/NJTRANSIT_2013_Annual_Report.pdf
NJT 2014 data: https://www.njtransit.com/pdf/FactsAtaGlance.pdf
NJT 2015 dat: https://www.njtransit.com/pdf/FactsAtaGlance.pdf

COMMUTER RAIL

The region has three commuter rail service providers – the MTA Long Island Rail Road, the MTA Metro-North Railroad, and New Jersey Transit. Compared to subway service, commuter rail offers inter- and intra-regional transportation services, generally with greater distances between stations, wider coverage areas, zoned fares, and a greater emphasis on rider comfort. Commuter rail operations are separated from rapid transit.

A. MTA LONG ISLAND RAIL ROAD (LIRR)

The LIRR is the busiest commuter railroad in North America. In 2016, the LIRR experienced record-breaking ridership with 89.4 million customers. This marks the highest ridership since the previous post-war high number of 91.8 million customers in 1949. Also in 2016, the LIRR saw a rise in both commutation and non-commutation trips.

The LIRR system is comprised of approximately 700 miles of track situated on 11 different branches, stretching 120 miles from Montauk on the eastern tip of Long Island to Penn Station in midtown Manhattan, Atlantic Terminal in Brooklyn and Hunters' Point in Queens.

Currently, LIRR is expanding service through the East Side Access project. This project is constructing an eight track terminal beneath Grand Central Terminal, which will serve approximately 162,000 customers per day by bringing LIRR service to the east side of Manhattan. In conjunction with the East Side Access project, the LIRR is also progressing capital projects aimed at supporting this future train service to Grand Central Terminal. LIRR is also constructing a second track on the Main Line's Ronkonkoma Branch and is planning a project to add a third track to the Main Line itself.

B. MTA METRO-NORTH RAILROAD (MNR)

The MNR services 122 stations distributed across six lines in seven counties in New York State – Dutchess, Orange, Putnam, Rockland and Westchester counties in the Hudson Valley and the Bronx and Manhattan in New York City -- as well as two counties in the State of Connecticut: New Haven and Fairfield.

In 2014, the MNR carried approximately 86.5 million passengers in 2016. Although rising in absolute numbers, traditional Manhattan-bound commutes have been declining as a proportion of total MNR ridership, accounting for 49 percent of trips taken in 2016 as compared to 67 percent in 1984. Bronx residents commuting to Westchester County, and Westchester residents commuting to Connecticut, as well as Connecticut residents commuting from the east end of the New Haven Line to major employment centers in Connecticut, are some of the fastest growing types of travel on Metro-North.

The MTA and the Connecticut Department of Transportation have introduced 405 new railcars for MNR's New Haven Line. Additionally, catenary wire is being upgraded on the Line, and five bridges along the route are being replaced.

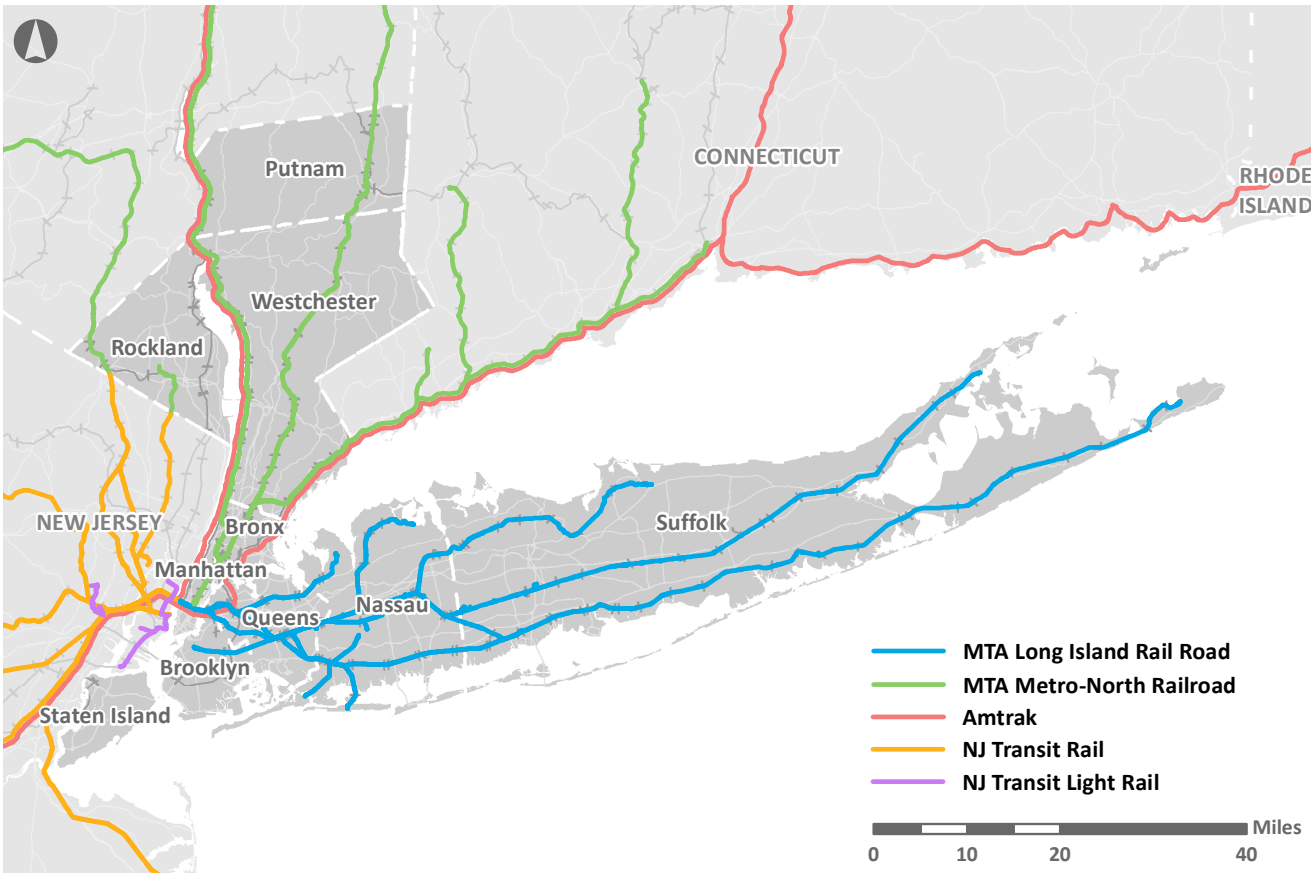
C. NEW JERSEY TRANSIT (NJT)

NJT is New Jersey's public transportation corporation covering a service area of 5,325 square miles, and operating commuter rail, light rail and bus networks. Although NJT's rail operations are primarily outside the NYMTC planning area, it provides substantial service to New York's Penn Station. In the fiscal year ending June 30, 2015, NJT's commuter rail operations carried 89 million riders, a 6.3 percent increase over the previous fiscal year.[5]

NJT is currently planning the Hudson Tunnel Project, which will add two new tracks beneath the Hudson River, allowing NJT to maintain current service levels while sequentially removing the two existing North River tunnels from service for comprehensive rehabilitation.

Table 3.3 summarizes vital statistics for rapid tranasitand commuter rail service providers in the NYMTC planning area, along with services to and within New Jersey.

FIGURE 3.2: COMMUTER RAIL AND AMTRAK NETWORKS IN THE NYMTC PLANNING AREA



INTER-CITY RAIL

A. NATIONAL RAILROAD PASSENGER CORPORATION (AMTRAK)

Since 1971, Amtrak has been the provider of inter-city, long-distance passenger rail service in the NYMTC planning area. Amtrak operates three services in the region:

- Acela/Northeast Regional Service: Frequent service along the Northeast Corridor (NEC) between Boston and Washington D.C. (Recently through service to Virginia has been added.) Acela service uses a dedicated fleet of trains to provide higher-speed express service along the corridor, while Northeast Regional trains use standard Amtrak equipment and generally make more stops. In recent years, the Acela line has been exceedingly popular, with over 3.5 million passengers in 2014 and a 10.4 percent increase in ticket revenue from 2013.[6]
- Empire Corridor Service: Frequent service between New York City and Albany with more limited but daily service to Buffalo and Niagara Falls. An additional train, the Ethan Allen Express, serves the New York-Albany corridor and continues north to Rutland, VT.
- Long distance routes: Other services originating or passing through New York Penn Station include trains to northern Vermont, Montreal, Toronto, Chicago, Pittsburgh, New Orleans, North Carolina, and Florida.

Amtrak serves four stations in the NYMTC planning area: Penn Station New York, New Rochelle, Yonkers, and Croton-Harmon. Penn Station New York served over 10 million Amtrak passengers beginning or ending their trips in 2016.[7] Additional stations immediately surrounding the NYMTC planning area are in Stamford, CT; Bridgeport, CT; New Haven, CT; Poughkeepsie, NY; Newark, NJ; Newark Liberty International Airport, NJ, and MetroPark, NJ. Limited service is also provided to New Brunswick, NJ. Table 3.4 displays ridership data for these stations since 2008.

TABLE 3.3: VITAL STATISTICS FOR RAPID TRANSIT AND COMMUTER RAIL PROVIDERS IN THE NYMTIC PLANNING AREA AND IN THE METROPOLITAN AREA

Provider	Route Miles	Routes	Stations	Fixed Route Fleet Size	Average Weekday Unlinked Trips	Service Geography
Rapid Transit						
MTA NYCT Subway	666	24	472	6,407	5,650,610	Bronx, Brooklyn, Queens, Manhattan
MTA Staten Island Railway	29	1	22	63	16,025	Staten Island
PATH	13.8	4	13	355	288,988	Manhattan, Jersey City, Hoboken, Newark
New Jersey						
NJ Transit Hudson-Bergen Light Rail	34.1	3	24	52	47,010	Bayonne, Jersey City, Hoboken, Union City, West New York
NJ Transit Newark City Subway	12.4	1	17	21	19,289	Newark, Bloomfield
Commuter Rail						
MTA LIRR	594	11	124	1,185	334,650	Manhattan, Brooklyn, Queens, Nassau, Suffolk
MTA Metro-North Railroad	774	5	110	1,244	291,342	Manhattan, Bronx, Westchester, Putnam, Dutchess, Rockland, SW Connecticut
NJ Transit Railroad	536	9	164	1,400	308,523	Manhattan, NJ

Sources: All data compiled from member agencies and agency webites, American Public Transportation Association, National Transit Institute 2015 National Transit Database
**Many of the system's 472 stations are linked by free transfers.*

TABLE 3.4: AMTRAK RIDERSHIP, 2008-2016 (OCTOBER - SEPTEMBER

Station	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Stations Serving the NYMTC Region									
New York, NY	8,739,345	7,832,874	8,377,944	8,995,551	9,493,414	9,556,424	10,024,474	10,189,521	10,436,909
New Rochelle, NY	87,463	79,674	78,876	79,264	8,477	81,757	83,707	85,876	87,510
Yonkers, NY	18,720	18,850	20,433	20,987	22,187	24,227	24,760	26,127	25,322
Croton-Harmon, NY	39,893	42,003	41,570	42,562	45,578	48,694	50,321	48,773	45,685
Stations Serving the Surrounding Metropolitan Area									
Newark, NJ	679,279	630,939	658,089	683,626	680,803	656,822	677,175	641,346	661,344
Newark Airport, NJ	116,979	109,517	116,526	120,428	126,705	129,565	111,919	138,724	138,785
Metropark, NJ	406,287	369,477	388,371	396,902	393,713	383,353	381,178	364,805	366,994
New Brunswick, NJ*	7,538	7,204	6,609	6,678	8,470	9,052	8,898	8,365	7,857
Stamford, CT	368,918	337,674	355,232	385,069	393,703	388,733	401,414	394,824	401,545
Bridgeport, CT	75,487	70,765	72,809	76,653	84,446	80,309	80,571	80,199	83,211
New Haven, CT	705,458	661,656	723,287	740,902	755,669	745,530	714,146	698,656	642,471
Poughkeepsie, NY	65,860	67,492	75,775	84,236	88,354	95,083	98,516	100,791	101,536

Source: Amtrak State Fact Sheets
**Limited service*

Acela train
Photo Source: Amtrak

Amtrak ridership has increased in recent years. In 2016, Amtrak carried over 31 million passengers. That same year, the Northeast Corridor (NEC) also had its highest ridership ever, with combined ridership on the Acela Express and Northeast Regional services totaling 11.9 million.[8] Projected growth in population and transportation demand in the Northeast has placed increasing pressure on the Northeast Corridor (NEC), the country's busiest rail artery. This has posed challenges in terms of accommodating more trains, reducing trip time, and increasing train speed and ensuring service reliability. To address this outlook, Amtrak is undertaking the following planning initiatives:

- NEC Future is the Northeast Corridor's long-term capital planning program which is developing funding options and priorities for improving service. Initiated in 2012, this initiative has included extensive intergovernmental and public outreach culminating in the release of a Tier 1 Environmental Impact Statement (EIS) in December 2016. Funding and implementation priority will be given to elements of the program that would have the largest impact on improving reliability, increasing capacity, and reducing trip times, in order to generate the revenue and capital needed for additional elements of the program.[9]
- The Gateway Program is a related Amtrak planning initiative in partnership with USDOT, the Port Authority, NJT and the states of New Jersey and New York. Gateway is a comprehensive program of strategic rail infrastructure improvements designed to improve current services and create new capacity that will allow the doubling of passenger trains running under the Hudson River. The program will increase track, tunnel, bridge, and station capacity, eventually creating four mainline tracks between Newark, NJ, and Penn Station, New York, including a new, two-track Hudson River tunnel.[10]

B. EMPIRE CORRIDOR

NYSDOT and the Federal Railroad Administration are evaluating potential improvements to intercity passenger rail service on the Empire Corridor from New York City to Buffalo via Albany, a distance of 463 miles. Work has been ongoing on a Tier I EIS analyzing a range of alternatives for introducing higher speed passenger rail service.

A Draft EIS for public review was released in January 2013 and a Final EIS is anticipated by the end of 2017. Following completion of the Final EIS, its recommendations will include specific improvement projects that may be analyzed further in Tier II.

M86 Select Bus Service
Photo Source: MTA

3. BUS TRANSIT

This section describes local bus transit operators in the NYMTC planning area, as well as providing information on commuter and long-distance bus service.

LOCAL TRANSIT

A. MTA REGIONAL BUS OPERATIONS

MTA New York City Transit (NYCT) provides round-the-clock bus service in New York City via 192 local, 12 Select Bus Service, and 31 express routes[11], while, MTA Bus provides service via 46 local, 1 Select Bus Service, and 43 express routes. In 2016, these two bus divisions served over 2.4 million customers on an average weekday and 2.5 million over an average weekend, leading to a total of nearly 764 million rides over the course of the year.[12]

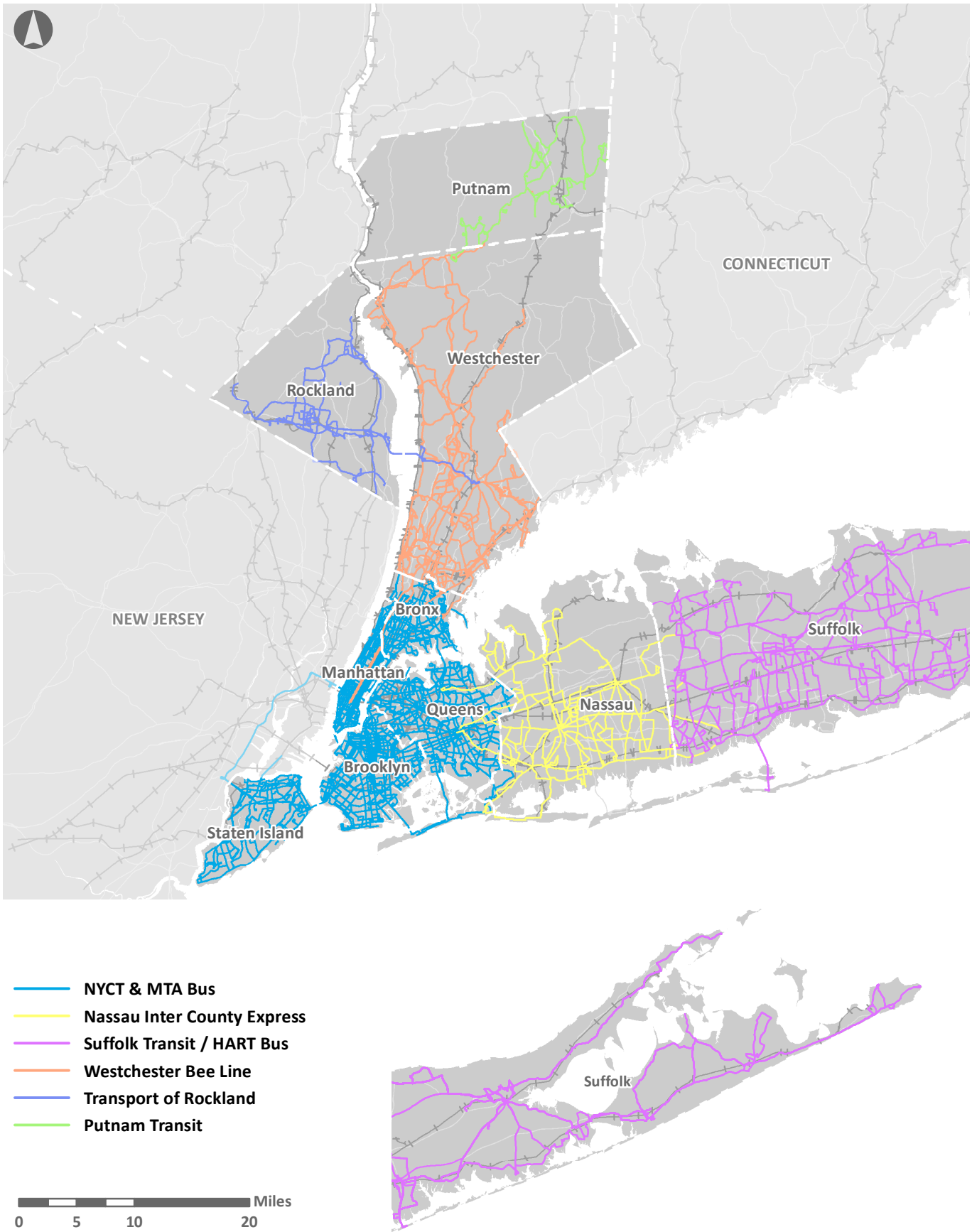
NYCT is continuing to partner with the New York City Department of Transportation (NYCDOT) to implement Select Bus Service (SBS) routes which incorporates several elements of bus rapid transit service. Most SBS routes prepaid fares using ticket machines at bus stops. Signal prioritization and camera enforced bus lanes help to expedite SBS buses through traffic. A list of planned and implemented SBS routes can be found in Chapter 6.

NYCT began providing its customers with real-time bus tracking starting in February 2011 through a smartphone app called Bus Time.[13] Table 3.6 shows essential service features of the NYCT bus system.

NYCT also administers a paratransit service known as Access-A-Ride, which is a "demand-response" service available to individuals with disabilities who are unable to use the public transportation system. which allows eligible customers to reserve trips in advance within the covered geography.

MTA Bus was created in September 2004 to merge into one organization the services formally provided by seven private bus companies under franchise agreements with the City of New York. Those companies included: Command Bus, Green Bus Lines, Jamaica Bus, Liberty Lines, New York Bus Company, Triboro Coach, and Queens Surface. Transition of

FIGURE 3.3: MAJOR LOCAL BUS TRANSIT SYSTEMS IN THE NYMTC PLANNING AREA



service began in January 2005 and was completed in February 2006. Since the merger into MTA Bus, the agency has instituted new maintenance practices, adjusted schedules and travel paths, and regularized service.

With investments through 2014, all of the buses from before the creation of MTA Bus have been retired. These retirements, along with purchase of new buses, have reduced the average age of the fleet to approximately seven years. MTA Bus has also made numerous improvements and repairs to its facilities.

MTA Bus launched its first SBS route in September 2016, the Q70, which links LaGuardia Airport with regional subway and Long Island Rail Road hubs in Jackson Heights and Woodside, Queens.

B. OTHER NEW YORK CITY SERVICE PROVIDERS

A handful of smaller service providers operate bus service within New York City. Academy Bus, which provides inter-city bus service in the region, also operates two peak-period express bus routes from southern Staten Island to Midtown Manhattan. Other bus services have developed mainly to connect ethnic groups which are located in multiple communities. Private Transportation Corp. runs a single bus route, the B110, which connects the Orthodox Jewish communities living in Borough Park and South Williamsburg.[14] Several private van companies provide service connecting some of the City's major populations of Chinese immigrants: Chinatown in Manhattan, Sunset Park in Brooklyn, and both Flushing and Elmhurst in Queens.[15] The Roosevelt Island Operating Corporation runs that island's ubiquitous free red buses; service operates 21 to 23 hours a day and is coordinated with tram arrivals and departures.[16] New York University's (NYU) Department of Public Safety operates three bus routes during the fall and spring semesters, and one during the summer semester for NYU faculty, staff, students, administrators and alumni. NYU also operates an on-demand "safe ride" overnight service and a mobile device application that allows riders to access real-time bus locations and request an overnight "safe ride."

TABLE 3.5: MAJOR BUS TRANSIT PROVIDERS, ANNUAL RIDERSHIP, 2011-2015

Year	MTA NYCT Bus	Nassau Inter-County Express (NICE Bus)	Suffolk County Transit (SCT)	Westchester Bee-Line	Putnam Area Rapid Transit (PART)	Transport of Rockland (TOR)
2008	868,005,155	32,649,109	6,707,900	32,271,574	250,300	3,884,100
2009	846,464,099	30,787,662	6,464,400	31,953,355	177,600	3,682,900
2010	817,137,824	30,816,889	6,095,000	32,273,641	167,800	3,534,231
2011	790,079,732	30,327,226	6,708,021	31,584,657	172,781	3,405,632
2012	781,978,816	29,545,079	6,538,326	32,069,161	168,331	3,390,268
2013	802,520,617	28,849,938	6,368,219	32,739,591	160,464	3,178,084
2014	792,632,407	28,744,207	6,224,262	31,682,977	144,151	3,014,395
2015	776,080,692	27,535,454	5,801,342	30,177,431	134,381	2,765,276

Source: MTA from http://web.mta.info/nyct/facts/ridership/; Others from http://www.ntdprogram.gov/ntdprogram/cs?action=showRegionAgencies&region=2
** Prior to January 1, 2012, Bus service in Nassau County was provided by MTA Long Island Bus*

TABLE 3.6: MTA NYCT AND MTA BUS COMPANY SERVICE, COMBINED VITAL STATISTICS (DECEMBER 2015)

Route miles	Routes Operated	Number of Stops	Number of Passenger Fleet	Number of Paratransit Fleet	Average Weekday Ridership
2,869	315	16,350	5,706	2,045	2,476,364

Source: http://web.mta.info/nyct/facts/ridership/; http://web.mta.info/nyct/facts/ffbus.htm
Source for Paratransit data: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/Transit%20Profiles%202015%20-%20Complete%20Set%20and%20Report%20Year%20Summary%20%28Part%201%20of%203%29.pdf
Data is for MTA NYCT bus service and MTA Bus Company service combined

The following sections discuss Long Island's bus operations. Table 3.7 provides a statistical overview of each system.

C. NASSAU INTER-COUNTY EXPRESS (NICE)

On January 1, 2012, Nassau County transferred operation of its fixed-route bus transit and paratransit services from the MTA to Transdev Transportation Services (formerly known as Veolia), relaunching the service as NICE. NICE operates 48 fixed route bus lines throughout Nassau County, western Suffolk County, and eastern Queens.

NICE operates a fleet of 308 fully- accessible, Compressed Natural Gas powered buses. In 2016, NICE Bus introduced new service models to Nassau County with the addition of both a flexi and community shuttle service. The flexi service was launched in the fall of 2016 in the community of Elmont and is offered by request, with predetermined off-route pick up/ stops along with a series of fixed stops using a smaller vehicle dispatched in real time. Additionally, routes that were previously underutilized were re-engineered as community shuttles offering better, more frequent service during peak hours and double as paratransit transit vehicles during off peak hours. NICE also operates a fleet of 96 paratransit vehicles for the Able-Ride service. Able-Ride paratransit service under the Americans with Disabilities Act (ADA) offers shared, door-to-door bus service to those who cannot use the standard bus transit service. Able-Ride, on average provides 1,200 rides a day throughout most of Nassau County.

Suffolk County Transit Route 110 BRT
Photo Source: Suffolk County

D. SUFFOLK COUNTY TRANSIT (SCT)

SCT provides bus service throughout Suffolk County, with service into southeastern Nassau County at the Sunrise Mall, under contract with private bus companies. SCT operates a fleet of 158 buses consisting of 30-, 35-, and 40-foot diesel and hybrid diesel buses. SCT also provides Suffolk County Accessible Transportation (SCAT), a curb-to-curb paratransit service. The paratransit fleet consists of 180 gasoline and diesel powered wheelchair lift equipped buses.

E. OTHER LONG ISLAND SERVICE PROVIDERS

Within Nassau County, the City of Long Beach operates a separate bus system. The five-route system (with a seasonal weekend Trolley Route) serves the City, with one route operating east to the hamlet of Point Lookout. The N15 (departing from Roosevelt Field) and N33 (departing from Far Rockaway, Queens) NICE routes also serve Long Beach.

The Town of Huntington in northwestern Suffolk County also operates its own four-route bus system, called Huntington Area Rapid Transit (HART).

TABLE 3.7: BUS OPERATORS ON LONG ISLAND: VITAL STATISTICS (2016)

Provider	Route Miles	Number of Routes	Number of Stops	Number of Passenger Fleet	Number of Paratransit Vehicles	Average Weekday Ridership
NICE Bus	39,012*	41	4,000	314	134	90,396
City of Long Beach Bus	353	5	75	9	4	1,270
SCT	15,252,687	42	3,178	157	181	19,317
Huntington Area Rapid Transit (HART)	102	4	Hail stops	8	13	718

**All route lengths summed*
***In service and out of service stops*

F. WESTCHESTER COUNTY BEE-LINE SYSTEM

Westchester County operates the Bee-Line System under contract with Liberty Lines Transit and a smaller private operator, PTLA Enterprise. With 60 bus routes, the Bee-Line System service area extends from the northern and central Bronx through Westchester and into Putnam County. All of the Bee-Line System routes serving the Bronx connect with New York City subway stations. Several routes within the county operate as feeders to MNR stations and others provide access from the White Plains TransCenter to office parks in the Cross-Westchester Expressway corridor. An express route to Manhattan from White Plains is also provided.

Bee-Line ParaTransit service operates on two different types of schedules. Core service is available Monday through Friday from 6:00am to 7:00pm and Saturday from 8:00am to 7:00pm. However, ParaTransit users whose trips begin and end within three-quarters of a mile of a Bee-Line System bus route have expanded service hours corresponding to the parallel routes. In May of 2012, Bee-Line ParaTransit launched a ParaTaxi program to help reduce costs and make service more convenient for users. ParaTransit riders can opt to use a taxi service for trips within White Plains, New Rochelle and Peekskill. Westchester County is pursuing opportunities to expand the ParaTaxi program to other parts of the county and expand service to more closely "mirror" regular Bee-Line System service.

To enhance service in one of its most heavily-used corridors, transit signal priority in the Central Avenue Corridor became operational in early 2016. There is signal priority at 48 intersections including three queue jumps.

G. PUTNAM AREA RAPID TRANASIT (PART)

PART consists of four fixed routes that operate in the eastern part of the county, one of which crosses the border into northern Westchester County. A seasonal trolley operates between Cold Spring and the City of Beacon.[17] Commuter shuttle services are also provided to MNR stations. The system is administered by Putnam County under contract with MV Contract Transportation, Inc., a private company.

Except for the system's central transfer point at the Donald B. Smith Campus, there are no fixed stops in the PART system – passengers can flag down a bus anywhere along its routes. Some stops are also "on-call", which means that passengers need to call in advance to schedule a pickup.

PART Paratransit offers transportation service for people who are unable to use PART due to a disability. It operates only when the rest of the system is running, and only in locations within three-quarters of a mile of a PART route.

H. TRANSPORT OF ROCKLAND (TOR)

The TOR system, which includes the TAPPAN ZEExpress commuter bus service is provided by Rockland County through contracts with private service providers.[18] TOR operates 10 local routes with a fleet of 43 vehicles, and the TAPPAN ZEExpress operates with a fleet of 19 vehicles across the Tappan Zee Bridge to Tarrytown and White Plains. It is anticipated that this service will be replaced in 2018 by New York State's new Lower Hudson Transit Link service.

Rockland County's paratransit service, called TRIPS (Transportation Resources Intra-County for Physically Handicapped and Senior Citizens), is a curbside-to-curbside, shared-ride paratransit service for eligible Rockland residents. TRIPS offers two levels of service. Regular TRIPS service is reserved for residents with physical, mental, developmental or intellectual disabilities or senior citizens who are aged 60 or over who find it difficult or impossible to use municipal, fixed-route bus service. ADA TRIPS service is designed to meet the service criteria established by the Federal government and serves as Rockland's complementary paratransit bus service to the municipal, fixed-routes.

TABLE 3.8: BUS OPERATORS IN THE LOWER HUDSON VALLEY, VITAL STATISTICS (2016)

Provider	Route Miles	Number of Routes	Number of Stops	Number of Passenger Fleet	Number of Paratransit Vehicles	Average Weekday Ridership
Westchester Bee-Line	877*	59	3,000**	329	88	103,057
PART	144	4	Hail stops	14	8	411
TOR and Tappan Zee Express	213*	11	182 stops, 2 terminals and hail stops	62	28	8,970
Clarkstown Mini-Trans	115	5	Hail stops (2)	11	0***	355^

** All route lengths summed*
*** In service and out of service stops*
**** All fleet are accessible*
^ Daily average (Weekdays and Saturdays)

I. LOWER HUDSON TRANSIT LINK

In conjunction with the New New York Bridge project, NYSDOT is developing the Lower Hudson Transit Link. When initiated, this service will be a high-quality/frequency transit service between Rockland and Westchester counties that will replace the TAPPAN ZEExpress. The service will conveniently connect major concentrations of residential, employment, commercial, entertainment, medical and educational land uses, and provide key connections to existing local bus and rail services. The Link service will work in tandem with Integrated Corridor Management strategies being established in the Route 59 and Route 119 corridors.

In conjunction with the Link project, the NYS DOT is now managing and funding the Nanuet Exit 14 Park & Ride Expansion project, which was initiated by Rockland County. This project, which broke ground in 2016, will provide additional parking capacity and improve traffic circulation and travel times for the Link and other commuter bus services.

J. OTHER LOWER HUDSON VALLEY SERVICE PROVIDERS

The Clarkstown Mini-Trans, which is operated by the Town of Clarkstown, has five routes which operate Mondays through Saturdays. The Spring Valley Jitney, operated by the Village of Spring Valley, runs two fixed bus routes.[19]

Commuter Buses

New York City is a central destination for commuter bus services carrying passengers from as close as Hudson County, New Jersey, and as far as Montauk and western Pennsylvania. Most commuter buses to Manhattan from west of the Hudson River operate to/from the Port Authority Bus Terminal (PABT) in midtown Manhattan, with a smaller number using the George Washington Bridge (GWB) Bus Station in northern Manhattan.

NJT provides commuter bus service to the PABT and the GWB Bus Station from destinations throughout New Jersey, while private bus carriers provide services from areas in New Jersey and New York west of the Hudson River, and eastern Pennsylvania. A major bus holding company, Coach USA, operates numerous commuter bus services into New York City. Coach USA also operates the Orange-Westchester Link (OWL) which provides bus service between Monroe, NY and White Plains, NY. Rockland Coaches, which is owned by Coach USA, operates 16 bus routes in Rockland County, NY, and Bergen County, NJ, with service to both the GWB Bus Station and the PABT.[20] Other commuter bus services from Rockland County include Monsey Trails, which provides service to the PABT, Lower Manhattan and Brooklyn; Saddle River Tours/Ameribus, which provides service to the GWB Bus Station; and Coach USA's Shortline, which provides service to midtown Manhattan, Wall Street and the PABT. Leprechaun Lines provides commuter bus service between Newburgh, Stewart Airport and Beacon in Orange and Dutchess counties, as well as between Poughkeepsie and White Plains.

In February 2017, the Port Authority Board of Commissioners authorized funds to support formal planning for a project to replace the PABT, in conjunction with approval of a ten-year capital plan that includes an initial allocation of $ 3.5 billion to support the project. The plan also includes funding for intermediate improvements to enhance customer service and improve efficiency of bus operations at the busy facility. Planning for this major regional transportation project will involve federal, state, and local reviews and approvals. The proposed investment would address the functional obsolescence of the existing terminal; the need for additional peak-period capacity in conjunction with other trans-Hudson commuter network improvements; and incorporation of strategies to address potential community impacts in siting, construction, and operation of the new facility.

Transport of Rockland Bus
Photo Source: Rockland County

Several commuter bus routes bypass the major bus terminals and operate along city streets, especially in Lower Manhattan. The largest such presence is Academy Bus, which offers commuter bus services between Lower Manhattan and Port Authority Bus Terminal in Midtown Manhattan, and multiple locations in New Jersey such as Burlington, Mercer, Middlesex, Monmouth, and Ocean counties.[21] Other, smaller bus companies provide connections from several counties in New Jersey to New York City. For example, Lakeland Bus Lines connects commuters from Dover, New Jersey, to Lower and Midtown Manhattan. Other services in New Jersey connect commuters to New York City via New Jersey Transit.

Commuters from exurban communities in the multi-state metropolitan region also have access to commuter services into New York City. Trans-Bridge Lines operates peak-directional service between Lower Manhattan and the Bethlehem/Allentown/Easton region of Pennsylvania.[22] Similarly, Martz Trailways provides service between Northeastern Pennsylvania communities such as the Poconos, Scranton and Wilkes-Barre, PA, to the Port Authority Bus Terminal, Lower Manhattan, East Midtown, and points in between.[23]

To provide additional options to commuters in Danbury, CT, the MTA began a shuttle bus between New Fairfield, CT and the MNR station in Southeast, NY. The service provides five morning trips and eleven evening trips and is operated by Connecticut's Housatonic Area Regional Transit (HART). HART provides shuttle service from Danbury, Ridgefield and New Fairfield to MNR rail stations during peak hours. Connecticut Transit also operates the I-Bus Express service between Stamford, CT and White Plains, NY.[24]

Long-Distance and Inter-City Buses

New York City is also a major hub for long-distance and inter-city bus services to/from destinations such as Boston and Washington, DC, as well as more distant cities such as Toronto and Atlanta. Many intercity buses operate into the PABT and the GWB Bus Station.

Intercity bus travel has been regaining popularity due to discount operators based in Chinatown, and services offered by companies like Megabus, a Coach USA brand started in 2006, and BoltBus, a joint venture of Greyhound Lines and Peter Pan Bus launched in 2008. Megabus and BoltBus offer discount express city travel between New York and various cities throughout the eastern United States and Canada including Washington, D.C., Boston, Philadelphia, Albany and Toronto. Other bus companies such as Vamoose Bus and Go Buses offer less variety in destinations (mostly to the Washington, D.C. and Boston areas) and similar amenities. All of these discounted services arrive and depart from on-street locations in Midtown Manhattan instead of the Port

Westchester County Bee-Line
Photo Source: Westchester County

Authority or George Washington Bridge Bus Station. "Chinatown" buses, which began providing intercity service in the late 1990s, also provide frequent, inexpensive bus services from Manhattan Chinatown, mostly to the Washington, D.C. and Boston areas. Lucky Star, Dragon Deluxe and Easter Travel all offer services to Boston and Washington D.C. for one-way fares around $25, which is slightly cheaper than Megabus and Bolt Bus.[25]

Tour Buses

Tour buses in New York City are distinct in that their passengers are not commuters, but rather tourists who are either riding in a closed loop or using a system of "hop on-hop off" routes to visit specific attractions or neighborhoods. Therefore, these buses often occupy road space without their motor coaches or passengers being counted in standard baseline traffic counts, but nonetheless contribute to the overall transportation ecosystem in the city.

Although bus tourism has historically been confined to the Manhattan Central Business District with the occasional foray into Brooklyn, tour buses are now a more common sight in upper Manhattan, Brooklyn and the Bronx. Both Gray Line and City Sights tours' uptown loops now include the Bronx, Harlem, and Brooklyn.[26] The bus tour industry has also expanded to include topic-specific tours, often centered on popular TV shows, local foods, or specific cultural sites.[27]

Feeder Buses

New York Waterway operates a network of free bus routes in Manhattan providing feeder/distributor service to its West 39th Street terminal. Five peak-period routes provide Midtown crosstown service from the West Side ferry terminal to 3rd Avenue, and five off-peak period routes provide similar routes to 5th Avenue and the World Financial Center ferry terminal at Battery Park City.[28] A separate, more condensed network of routes serves western Manhattan during off-peak periods.[29] New York Waterway also operates similar free bus services in New Jersey that serve Edgewater, Port Imperial, Weehawken and Fort Lee.[30]

FIGURE 3.4: INTERCITY FACILIITIES IN THE NYMTC PLANNING AREA

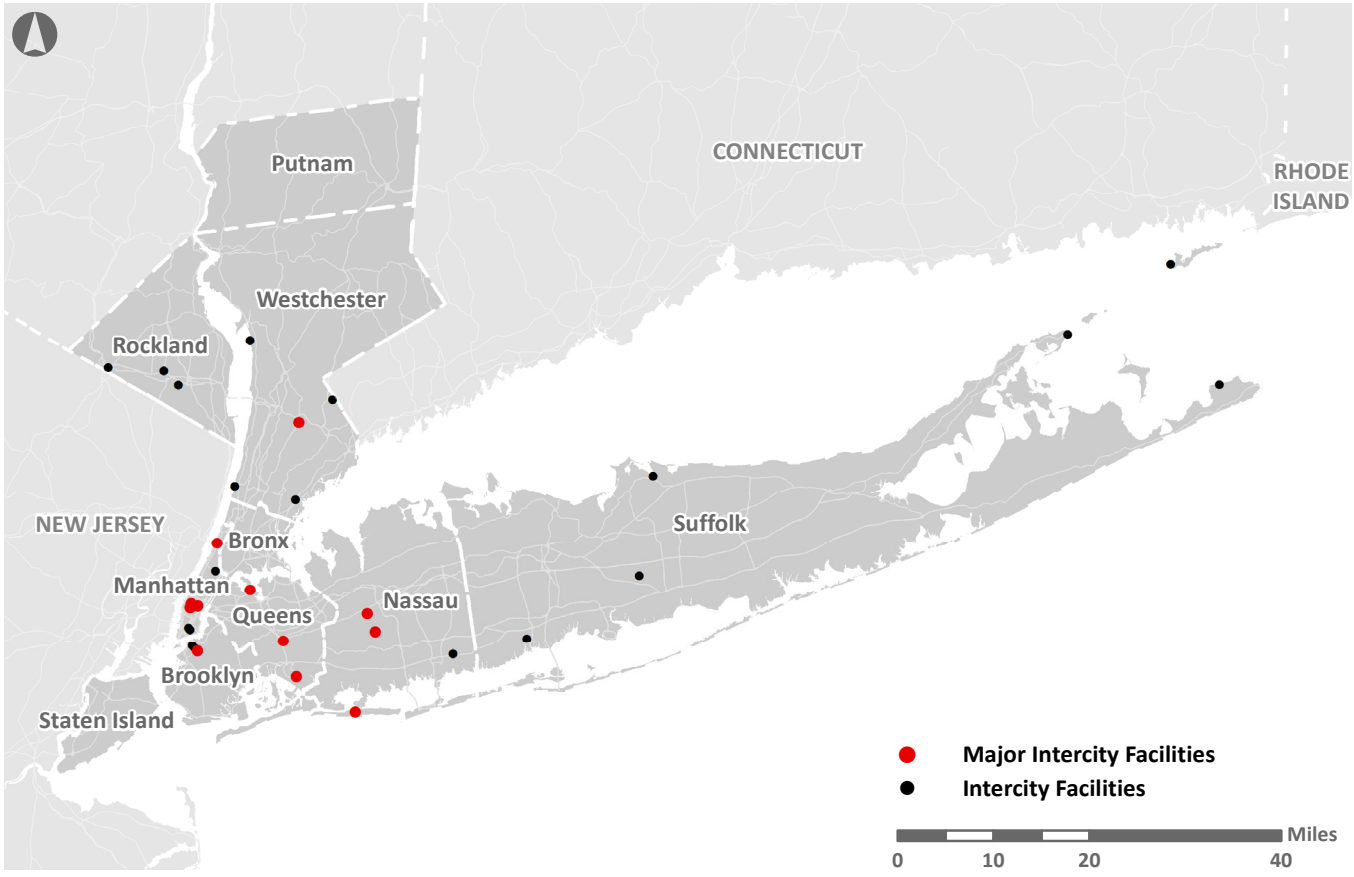


TABLE 3.9: INTERCITY FACILIITIES IN THE NYMTC PLANNING AREA

Manhattan		
Facility Name	**Location**	**Intercity Mode**
Port Authority Bus Terminal	**42nd St & 8th Ave**	**Bus**
Penn Station	**32st St & 8th Ave**	**Rail, Bus**
Grand Central Terminal	**42nd St & Park Ave**	**Rail, Bus**
George Washington Bridge Bus Station	**178th St & Fort Washington Ave**	**Bus**
Allen St/Pike St Bus Stops	Along Allen St/Pike St	Bus
Bowery Bus Stops	Along Bowery	Bus
Harlem-125th St Station	125th St & Park Ave	Rail, Bus
Brooklyn		
Facility Name	**Location**	**Intercity Mode**
Atlantic Terminal	**Atlantic Ave & Flatbush Ave**	**Rail, Bus**
Fulton St Bus Stop	Fulton St & Pearl St	Bus
Greyhound Bus Station	Livingston St & Bond St	Bus
Queens		
Facility Name	**Location**	**Intercity Mode**
John F. Kennedy International Airport	**JFK Int'l Airport**	**Air, Bus**
La Guardia Airport	**Ditmars Blvd & 94th St**	**Air, Bus**
Jamaica Center	**153rd St &Archer Ave**	**Rail**
Nassau		
Facility Name	**Location**	**Intercity Mode**
Hempstead Transit Center	**Hempstead**	**Rail, Bus**
Mineola Transit Center	**Mineola**	**Rail, Bus**
Long Beach Intermodal Center	**Long Beach**	**Rail**
LIRR Massapequa Station	Massapequa	Rail, Bus
Suffolk		
Facility Name	**Location**	**Intercity Mode**
LIRR Babylon Station	Babylon	Rail, Bus
Long Island MacArthur Airport	Ronkonkoma	Air, Bus
Port Jefferson Ferry Terminal	Port Jefferson	Ferry
Orient Point Ferry Terminal	Orient Point	Ferry
Montauk Dock	Montauk	Ferry
Fishers Island Ferry Terminal	Fishers Island	Ferry
Westchester		
Facility Name	**Location**	**Intercity Mode**
White Plains Transit Center	**White Plains**	**Rail, Bus**
Yonkers Amtrak/Metro North Station	Yonkers	Rail, Bus
New Rochelle Metro North Station	New Rochelle	Rail, Bus
Westchester County Airport	White Plains	Air, Bus
Ossining Ferry Terminal	Ossining	Ferry, Rail, Bus
Rockland		
Facility Name	**Location**	**Intercity Mode**
Spring Valley Transit Center	Spring Valley	Rail, Bus
Nanuet Park & Ride	Nanuet	Bus
Suffern Bus Terminal	Suffern	Bus

Ferry berth at Pier 11 in Manhattan
Photo Source: NYCDOT

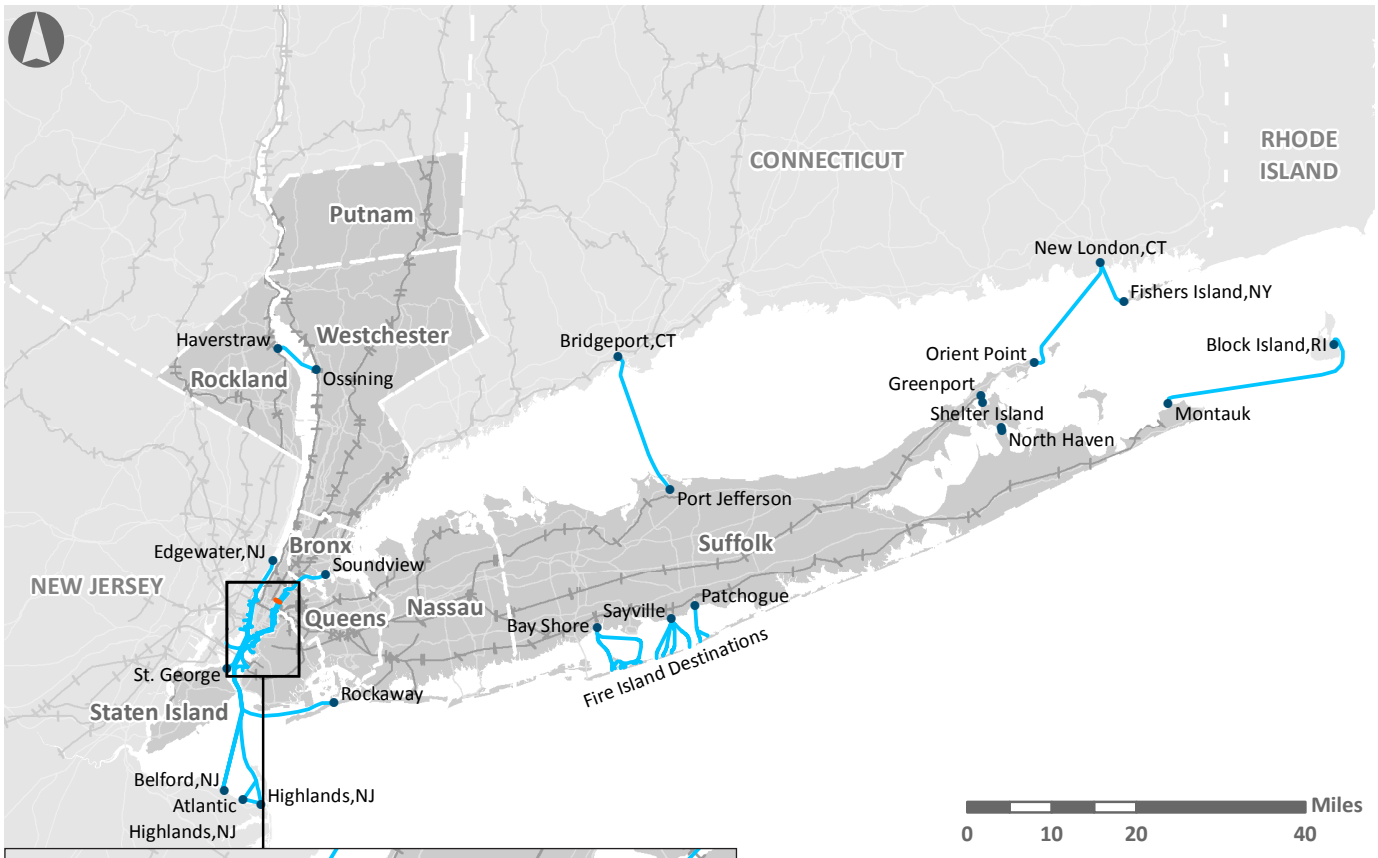
4. WATERBORNE & AERIAL SERVICES

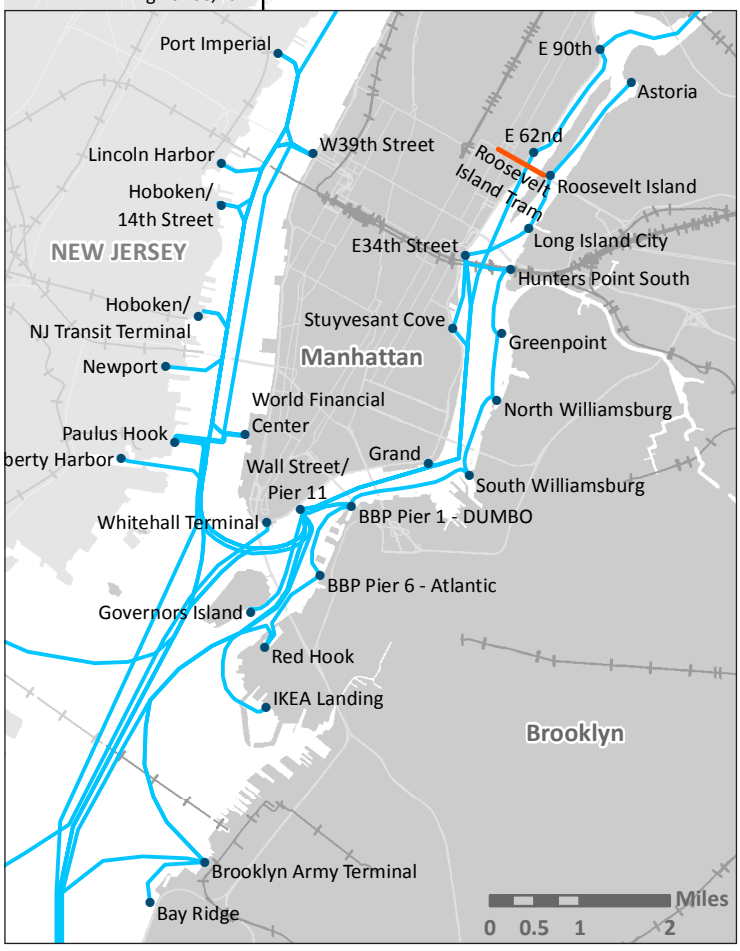
The island of Manhattan is well-served by ferries that provide connections to various point throughout the city as well as regional service to locations in New Jersey, Connecticut, and Long Island. Major operators of ferries include NYCDOT (operator of the Staten Island Ferry), New York Waterway, BillyBey, New York Water Taxi and Seastreak. Ferries access St. George Terminal on Staten Island, Whitehall Terminal, Battery Park City and the World Financial Center in Lower Manhattan, and various terminals on the east and west sides of Manhattan.

A. CITYWIDE FERRY SERVICE

In 2010, New York City introduced the East River Ferry (now called Citywide Ferry Service), a three-year pilot ferry service serving Manhattan, Brooklyn, and Queens. Developed in concert with the New York City Economic Development Corporation's 2011 Comprehensive Citywide Ferry Study, the East River Ferry travelled between Pier 11 and East 34th Street in Manhattan, with four stops along the Brooklyn waterfront, and a stop at Hunters Point South in Queens. Initial ridership far outperformed expectations, and in 2014 the ferry was made permanent through 2019.[31] Service to the Rockaways in Queens was also added in 2012, with a stop added at the Brooklyn Army Terminal in South Brooklyn in 2013. The Rockaway ferry service was discontinued in 2014. After significant and consistent growth in ridership over the first several years of operation, the East River Ferry settled into a more stable growth pattern of approximately five percent per year. In 2016, total ridership reached nearly 1.6 million trips.[32]

FIGURE 3.5: FERRY SERVICES IN THE NYMTC PLANNING AREA





In February 2015, Mayor Bill de Blasio announced a plan for expanded Citywide Ferry Service. Hornblower Cruises was chosen as the operator, and the first routes began operation in 2017: the Astoria route, serving Western Queens and Roosevelt Island; the Rockaway route, serving the Rockaway peninsula and Sunset Park, Brooklyn; and the South Brooklyn route, linking the Brooklyn waterfront from Bay Ridge to Brooklyn Heights. The routes scheduled to open in 2018 are the Soundview route, which will serve Bronx's Soundview neighborhood and Manhattan's Upper East Side; and the Lower East Side route. The existing East River Ferry route will also be integrated into the network, and all routes will continue to start at Pier 11/Wall Street.

B. THE STATEN ISLAND FERRY

The Staten Island Ferry is the busiest and most frequent water transportation service in the New York City area, with an extensive peak and off-peak schedule connecting St. George Terminal on Staten Island to Whitehall Terminal at the southern tip of Manhattan. The Ferry carries over 23 million passengers annually on its 5.2-mile run. Five boats make 118 weekday trips between the two terminals, and 96 trips each day on Saturdays and Sundays. In recent years, the Staten Island Ferry has transitioned to burning ultra-low sulfur fuel and embarked upon a fleet-wide emissions reductions program with the installation of various technologies.[33]

C. OTHER NEW YORK CITY FERRY SERVICES

New York Harbor is also home to a number of smaller-scale water taxi operations, such as the IKEA ferry between Wall Street and Red Hook, Brooklyn, and a wide array of excursion vessels, charter cruises, sight-seeing lines, and recreational ferry operations to destinations including Yankee Stadium and Martha's Vineyard, Massachusetts. Between all of these routes and services, the harbor supports a robust network of private ferry operators, including NY Waterway, Seastreak, NY Water Taxi, Liberty Park Water Taxi, Hornblower Cruises and Events, World Yacht, and others. The city projects that the increased infrastructure, expanded workforce, and higher visibility associated with the Citywide Ferry System will serve to further stimulate this extensive ferry transportation industry.

There are a number of tourist ferries in the New York City area. The Circle Line is one of the oldest and largest tour companies, offering 1 to 3-hour cruises around the city. The New York Water Taxi has been a New York fixture since 2002, beginning with a fleet of five distinctive black and yellow checkered vessels. The company offers hop-on, hop-off tours in addition to service to the Statue of Liberty, Ellis Island, and IKEA in Red Hook, Brooklyn. Statue Cruises is the concessioner authorized by the National Park Service, Department of the Interior, to serve the public at the Statue of Liberty National Monument and Ellis Island. Other similar tourist ferries are operated by Hornblower Cruises and Events, World Yacht and others. While the Staten Island Ferry is a passenger service ferry operated by NYC DOT, the 5-mile, 25-minute ride serves as a free sightseeing vehicle. However, it is not possible to know what percent of its users are tourists.

Seastreak operates several routes, including summertime service from Lower Manhattan and Midtown to various summer vacation destinations such as Martha's Vineyard, MA and Sandy Hook, NJ.[34] In March 2009, the PANYNJ opened a new, permanent ferry terminal that replaced a temporary facility at the World Financial Center, which New York Waterway utilizes for service to New Jersey destinations such as Paulus Hook, Hoboken, Liberty Harbor, Weehawken and Belford.[35]

South Amboy, in Middlesex County, NJ, is also working to bring a ferry service to Lower Manhattan. In 2014, the city of South Amboy approved plans for an extensive waterfront development that would include ferry service to Manhattan.[36] Several other points in Monmouth County, NY, such as Belford and Atlantic Highlights, also have ferry service to New York City via Hoboken and Jersey City.[37]

D. LONG ISLAND FERRY SERVICES

New ferry infrastructure is also being completed in the City of Glen Cove in Nassau County, which could accommodate ferry service to New York City and potentially other Long Island Sound destinations.[38] Construction completion and ferry service is expected to start in 2017.[39] Ferry service also operates across the Long Island Sound between Orient Point

on Long Island's North Fork, and New London, CT, as well as from Port Jefferson to Bridgeport, CT. Other Long Island ferries connect Shelter Island with Greenport and North Island, and Montauk with Block Island, RI, New London, CT, and Martha's Vineyard, MA (seasonally). An additional ferry serves Fishers Island, NY to New London, CT.[40] In Patchogue, a new terminal welcomed its first passengers in April 2010, providing ferries to Fire Island.[41] Improvements will be made at the Bay Shore Terminal, while the Ocean Beach Terminal on Fire Island will be completely replaced.[42]

E. LOWER HUDSON VALLEY FERRY SERVICES

In Rockland County, the ferry connecting Haverstraw to Ossining's MNR station has seen increased ridership since its introduction in 2001. This service is operated by New York Waterway and allows for travel from Haverstraw to Grand Central Terminal to be covered in approximately 70 minutes. On weekdays, there are fourteen trips leaving Haverstraw and fifteen leaving Ossining.

AERIAL SERVICE

A. ROOSEVELT ISLAND TRAM

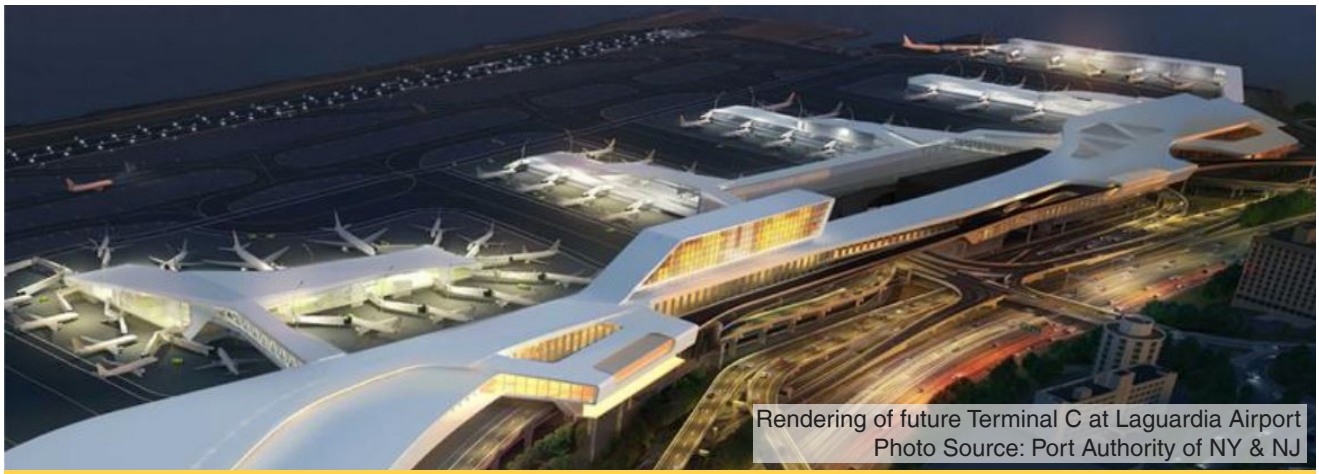
The Roosevelt Island Tram operates between the island and Manhattan, and supplements the Island's subway service. Originally opened in 1976 as a compromise for islanders waiting for the subway station to be built, the Tram, operated by the state-run Roosevelt Island Operating Corporation, now carries over 6,400 people per day between the two stations.[43] The tram operates at 7.5-minute headways during peak hours, 7:00am to 9:30am and 3:30pm to 8:00pm, and at 15-minute headways otherwise, while the overall trip takes four-to-five minutes.

Table 3.10 summarizes vital statistics for ferry and tram service providers in the NYMTC planning area.

TABLE 3.10: FERRY AND TRAM OPERATORS IN THE NYMTC PLANNING AREA, VITAL STATISTICS (2016)

Service	Routes	Stations	Average Weekday Unlinked Trips	Service Geography
Ferry				
Staten Island Ferry	1	2	70,960	Staten Island, Manhattan
East River Ferry	1	7	4,767	Manhattan, Brooklyn, Queens
Hudson River ferries*	14	14	24,680	Manhattan, New Jersey
NY Water Taxi**	2	6	1,364	Manhattan, Brooklyn
Atlantic Highlands***	4	5	5,782	Manhattan, New Jersey
Hudson Valley ferries^	2	4	748	Rockland, Westchester
Port Jefferson-Bridgeport Ferry	1	2	N/A	Suffolk, Bridgeport, CT
Orient Point-New London Ferry	1	2	N/A	Suffolk, New London, CT
Fishers Island Ferry	1	2	N/A	Suffolk, New London, CT
Shelter Island North Ferry	1	2	N/A	Suffolk
Shelter Island South Ferry	1	2	N/A	Suffolk
Tram				
Roosevelt Island Tram	1	2	7,709†	Manhattan

** Includes NY Waterway, Liberty Landing Ferry and Billybey Ferry Co. Trans-Hudson services*
*** Includes Manhattan to Red Hook/Ikea service and hop-on/hop-off service*
**** Includes Seastreak and NY Waterway service from Manhattan and New Jersey to Monmouth County*
^ Haverstraw-Ossining and Newburgh-Beacon service
† Daily average (weekday and weekend)



Rendering of future Terminal C at Laguardia Airport
Photo Source: Port Authority of NY & NJ

5. AIR TRAVEL

Four major airports operated by the Port Authority accommodate commercial air service in or around the NYMTC planning area: John F. Kennedy (JFK) International Airport and LaGuardia Airport in Queens; Newark Liberty International Airport in New Jersey; and Stewart International Airport in Orange County, NY, 60 miles north of New York City and immediately west of Newburgh, NY. Smaller commercial airports include Westchester County Airport near White Plains, NY, operated by Westchester County; and on Long Island MacArthur Airport, operated by the Town of Islip.

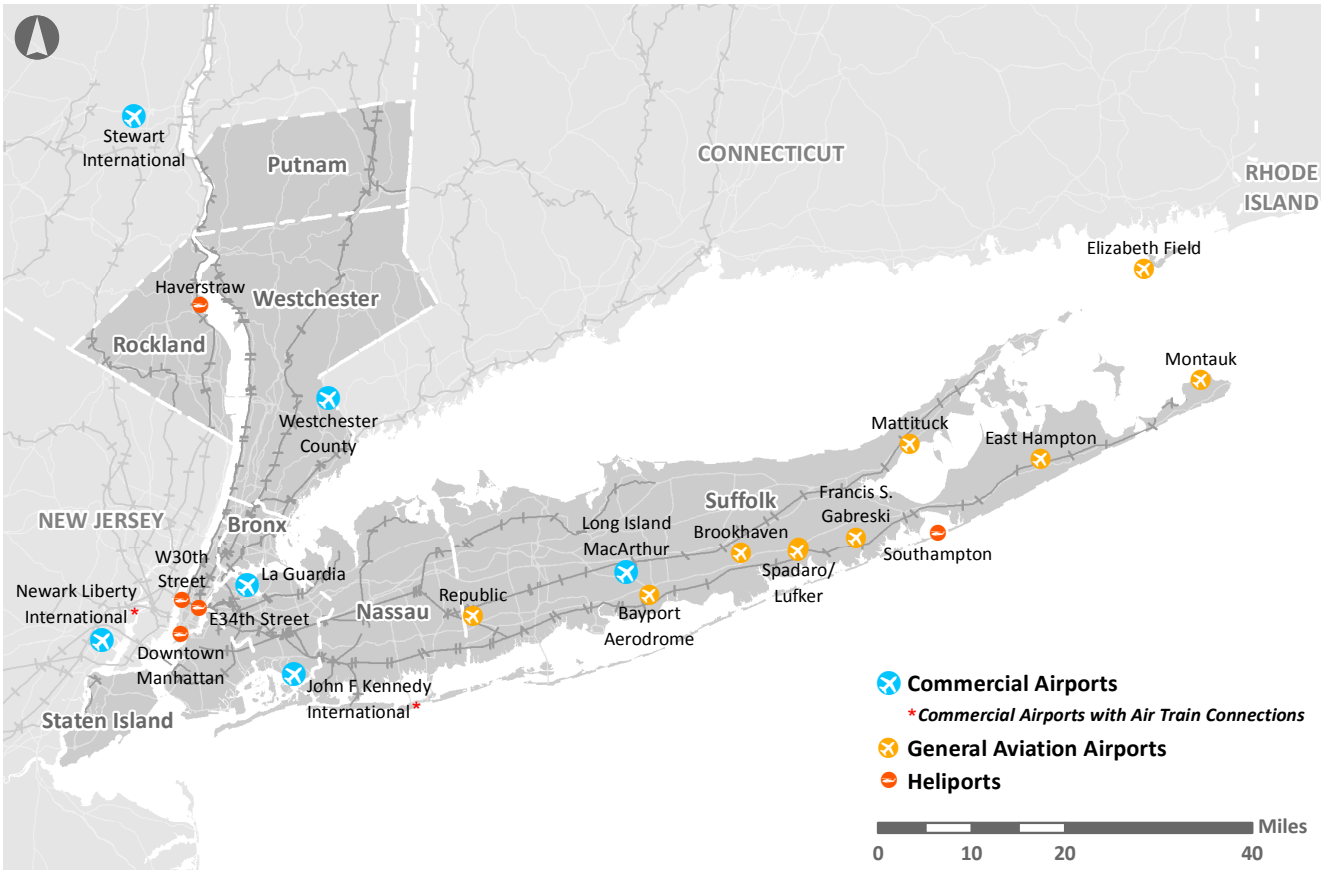
In 2016, over 130 million air passengers passed through the Port Authority's airports. JFK was used by nearly 59 million passengers, while LaGuardia was used by 28 million passengers.[44] Newark saw 40 million passengers in the same period.[45] In 2016, JFK, LaGuardia, and Newark airports served a total of 1.3 million annual flights.

Teterboro Airport in New Jersey is perhaps the region's best-known general and corporate aviation airport. General aviation reliever airports service smaller and slower aircraft and thus relieve congestion at the major commercial airports. In addition, Republic Airport, Brookhaven Airport, Gabreski Airport and Spadaro Airport in Suffolk County also serve general aviation traffic. Taken together, these airports are among the busiest in the nation.

In 2015, over two million tons of air cargo moved through the Port Authority's airports, mostly through JFK with 1.3 million tons and Newark with 700,000 tons. As a major air cargo gateway, JFK and Newark rely on surface transportation and local and regional roadways to move arriving and departing air cargo shipments to and from local, regional, and national destinations. JFK and Newark are home to numerous international and domestic cargo airlines including integrators such as FedEx, UPS, and DHL. While Newark is dominated by major FedEx and UPS hubs, JFK maintains its prominence as one of the nation's largest air cargo facilities by volume. Located in one of the busiest regions in the world for goods transport by air, these airports provide intermodal freight facilities to handle and transfer goods to and from other cities, and local distribution centers, warehouses, and customers.

The AirTrain is two automated rapid transit systems that serve JFK and Newark with connections to regional rail systems.

FIGURE 3.6: AIR TRAVEL FACILITIES IN THE NYMTC PLANNING AREA



HELIPORTS

New York City has three main public heliports – Downtown Manhattan/Wall Street and East 34th Street owned by the New York City Economic Development Corporation, and West 30th Street, owned by the Hudson River Park Trust -- generating over 103,000 flights per year.[46] The majority of these flights were for air-taxi service, followed by commercial, itinerant and military operations. There are also a number of heliports serving medical and police purposes.

Several publicly- and privately-owned heliports are located throughout the NYMTC planning area. Some are connected with corporations such as IBM in Westchester and Cablevision in Suffolk, and others are for private and public use. The Haverstraw Heliport in Rockland County and the Southampton Heliport in Suffolk County are the only two public heliports outside of New York City, reporting nearly 2200 and 400 flights respectively during the 2012-2013 year.[47] Within the Nassau, Suffolk, Westchester, Rockland and Putnam counties there are over 50 heliports for private and public use.[48]

Photo Source: NYC Dept. of City Planning

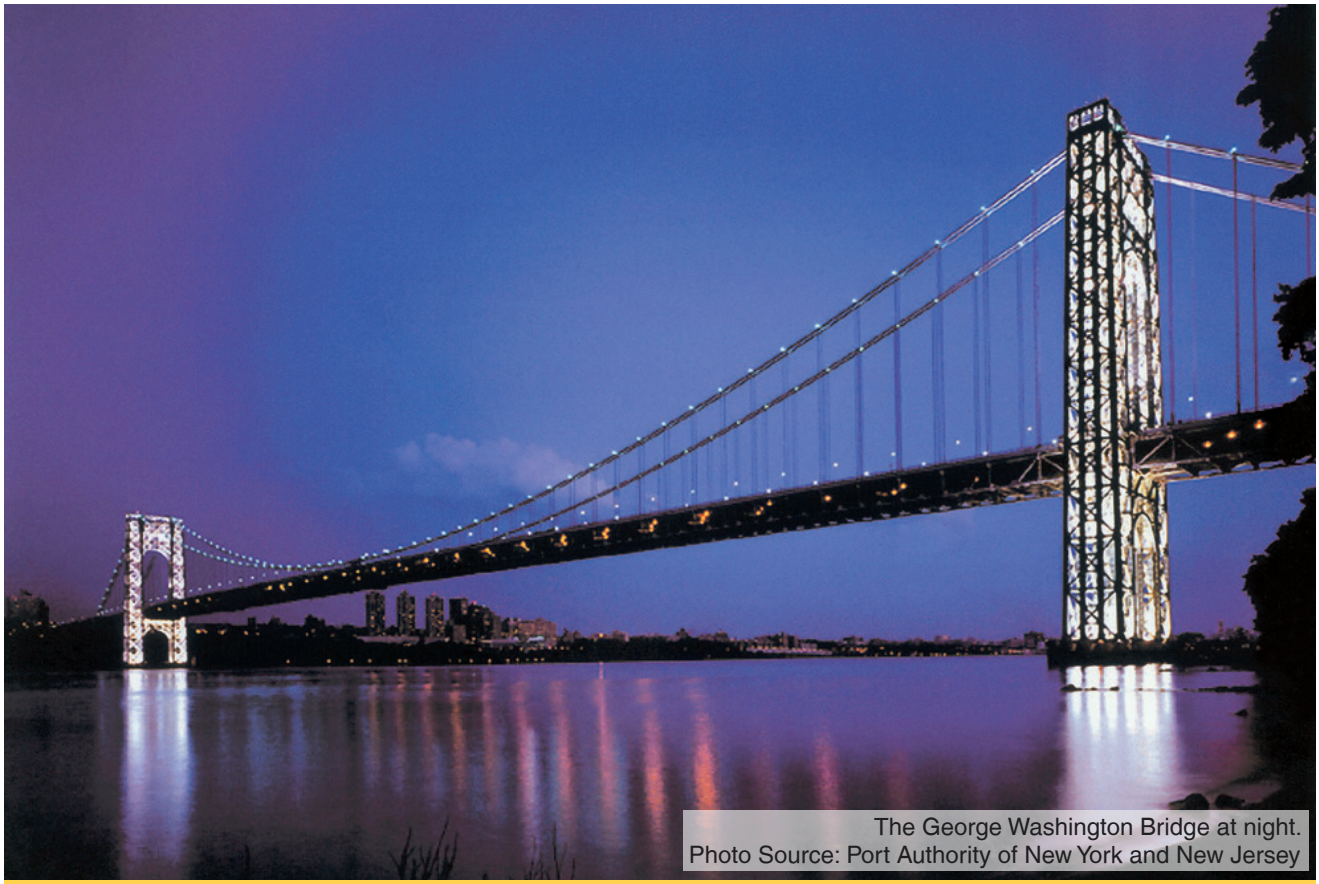
6. PEDESTRIAN & BICYCLE FACILITIES

Walking and bicycling are sustainable forms of transportation that provide residents with active modes of commuting and recreation. Nearly half of all commuters in the NYMTC planning area rely on walking or bicycling for at least a portion of their commute. According to the most recent 2015 American Community Survey (ACS) five-year estimates, the number of commuters who primarily walked to work increased by 17.5 percent between 2000 and 2015, and bicycle commuters more than doubled in the same timeframe. However, in the larger context, both modes represent marginal shares of all commuters - 7.7 percent of all commuters walk to work, and 0.8 percent bicycle to work. Appendix 2 contains *Plan 2045*'s required Bicycle-Pedestrian Element, which provides a description of existing and planned ped-bike facilities throughout the NYMTC planning area.

Hudson River Greenway
Photo Source: NYC Dept. of City Planning

TABLE 3.11: MEANS OF TRANSPORTATION TO WORK BY COUNTY OF RESIDENCE, 2000 AND 2010 DECENNIAL U.S. CENSUS AND 2011-2015 5-YEAR AMERICAN COMMUNITY SURVEY (ACS)

County	Walked			Bicycled			Total Workers			Percentage of Workers who Walk to Work			Percentage of Workers who Bike to Work		
	2000	2010	2015	2000	2010	2015	2000	2010	2015	2000	2010	2015	2000	2010	2015
Nassau	16,760	17,610	17,509	1,345	1,573	1,395	619,586	626,842	653,345	2.7%	2.8%	2.7%	0.2%	0.3%	0.2%
Suffolk	11,081	9,582	11,359	1,457	1,793	1,647	670,406	704,250	721,417	1.7%	1.4%	1.6%	0.2%	0.3%	0.2%
Long Island Total	**27,841**	**27,192**	**28,868**	**2,802**	**3,366**	**3,042**	**1,289,992**	**1,331,092**	**1,374,762**	**2.2%**	**2.0%**	**2.1%**	**0.2%**	**0.3%**	**0.2%**
Westchester	17,180	19,383	23,822	472	739	751	425,052	444,428	454,471	4.0%	4.4%	5.2%	0.1%	0.2%	0.2%
Putnam	770	n/a	608	80	n/a	97	48,167	n/a	50,308	1.6%	n/a	1.2%	0.2%	n/a	0.2%
Rockland	3,659	4,152	5,008	197	96	150	132,302	137,430	142,565	2.8%	3.0%	3.5%	0.1%	0.1%	0.1%
Lower Hudson Valley Total	**21,609**	**23,535**	**29,438**	**749**	**835**	**998**	**605,521**	**581,858**	**647,344**	**3.6%**	**4.0%**	**4.5%**	**0.1%**	**0.1%**	**0.2%**
Bronx	30,076	38,166	43,569	987	1,997	1,726	415,075	507,594	547,961	7.2%	7.5%	8.0%	0.2%	0.4%	0.3%
Kings	78,933	91,334	100,234	4,846	12,130	17,525	901,027	1,067,431	1,142,200	8.8%	8.6%	8.8%	0.5%	1.1%	1.5%
Queens	52,776	55,220	62,079	2,417	5,083	5,715	931,709	1,019,618	1,076,754	5.7%	5.4%	5.8%	0.3%	0.5%	0.5%
New York	164,934	173,499	179,198	6,410	8,707	14,547	753,114	823,612	867,298	21.9%	21.1%	20.7%	0.9%	1.1%	1.7%
Richmond	5,545	6,054	5,213	364	n/a	342	191,145	197,333	205,922	2.9%	3.1%	2.5%	0.2%	n/a	0.2%
New York City Total	**332,264**	**364,273**	**390,293**	**15,024**	**27,917**	**39,855**	**3,192,070**	**3,615,588**	**3,840,135**	**10.4%**	**10.1%**	**10.2%**	**0.5%**	**0.8%**	**1.0%**
TOTAL	**381,714**	**415,000**	**448,599**	**18,575**	**32,118**	**43,895**	**5,087,583**	**5,528,538**	**5,862,241**	**8%**	**8%**	**7.7%**	**0.4%**	**0.6%**	**0.7%**



The George Washington Bridge at night.
Photo Source: Port Authority of New York and New Jersey

7. ROADWAYS & CROSSINGS

Roadways are grouped into functional classes according to the type and character of service they provide. New York State currently uses seven functional classifications, which are further distinguished as urban and rural facilities. With the exception of three classes—Urban Local, Rural Minor Collector, and Rural Local—all are Federal Aid eligible. The various functional classes are shown in Table 3.12 (note: FHWA codes do not contain the urban/ rural distinction).

There are 32,173 lane-miles of interstates, arterials, collectors, and local roadways serving its residents and visitors. Many of these roadways are heavily used despite their age, contributing to the need for repair and upgrade work throughout the region.

Local roadways make up 80 percent of the NYMTC region's public space, and are used by all modes—not just personal vehicles, but also by buses, cyclists, and pedestrians. Adjacent uses include parking, bus stops, bicycle racks, and other features to support commerce. NYMTC agencies work to improve multiple facets of the region's local roads, with projects focusing on reducing congestion, improving air quality, increasing safety, and other goals. NYCDOT, for example, will repave more than 1,200 lane-miles of road between July 2015 and June 2016, in addition to its maintenance and inspection work.

In addition to local, arterial, and collector roads, fourteen Interstate highways serve the NYMTC planning area. Interstate 95 links the region to the eastern seaboard, I-80 and I-78 to the Midwest, I-84 and the future I-86 to New York's Southern Tier and

FIGURE 3.7: INTER-STATE & LIMITED ACCESS HIGHWAYS IN THE NYMTC PLANNING AREA

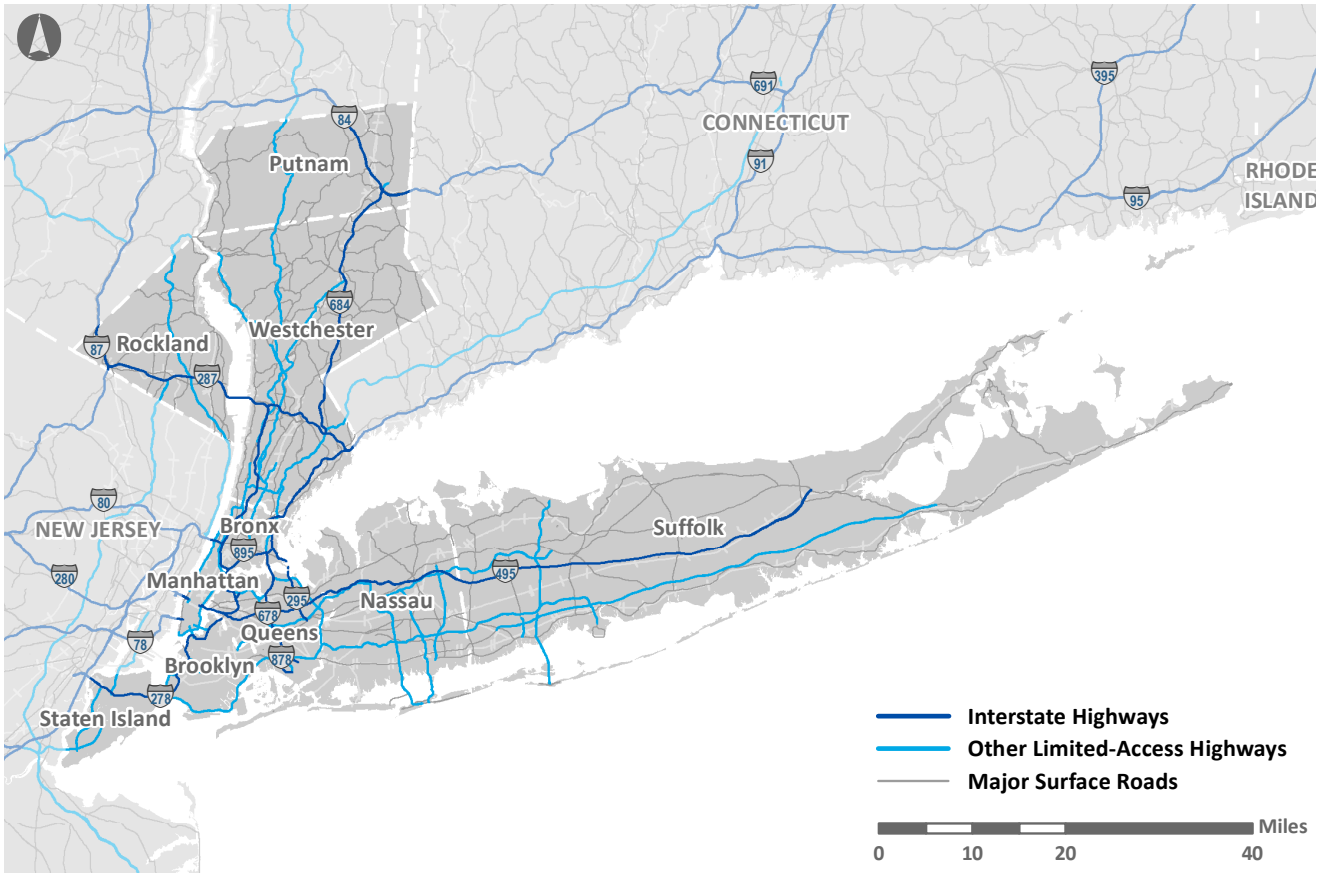


TABLE 3.12: FUNCTIONAL CLASSIFICATION CODES

Functional Classification Codes	NYS Codes Urban	NYS Codes Rural	FHWA Codes
Principal Arterial - Interstate	11	1	1
Principal Arterial - Other Freeway/Expressway	12	2	2
Principal Arterial - Other	14	4	3
Minor Arterial	16	6	4
Major Collector	17	7	5
Minor Collector	18	8	6
Local	19	9	7

northern Pennsylvania, and I-87 (the New York State Thruway) connects to Upstate New York and Canada. These highways provide vital economic links to other regions of the country and international trading partners. Along with 14 expressways and 36 parkways, the highway system also supports regional automobile and truck travel. In an effort to decrease congestion and improve regional air quality, several of these roadways feature designated High Occupancy Vehicle (HOV) lanes to incentivize a reduction in single-occupancy vehicle travel.

Multiple roadway projects around the NYMTC planning area will improve safety and traffic flow. NY 347 is undergoing reconstruction along a fifteen-mile corridor between Hauppauge and Port Jefferson Station. The NY 347 reconstruction project is improving safety by reducing the speed limit, making crosswalks shorter and more visible and providing a shared use path for pedestrians and cyclists. The project is also providing modern solar powered bus shelters. Since construction began in 2010, two and a half miles of roadway have been reconstructed between Town Line Road in Hauppauge and Terry

Road in Smithtown and nearly another mile between Terryville Road and Davis Avenue in Port Jefferson Station. Another mile is currently in construction between Terry Road and Gibbs Pond Road. Anticipated completion date of this project is 2032.

Also in 2015, a $114 million bus and HOV lane extension was constructed on Staten Island, achieving a continuous bus/HOV lane from Victory Boulevard to the Verrazano-Narrows Bridge in both directions. This extension will encourage people to use the bus or to carpool to work, reducing congestion, enhancing mobility, and reducing the carbon footprint of Staten Island's transportation system. Auxiliary lanes were also installed in both directions between Bradley Avenue and Clove Road. In Rockland County, a $32 million road reconstruction on a two-mile stretch of New Hempstead Road, which leads to the county seat in the hamlet of New City was completed in 2013. The construction included aesthetic treatments in the hamlet center to coordinate with the treatments used in the Town of Clarkstown's hamlet revitalization and included sidewalks along much of the project's two-mile length. Rockland County is currently completing another roadway reconstruction on 1.5 miles of Forshay Road.

Oak Tree Road reconstruction, Orangetown, NY
Photo Source: Rockland County government center

New Hempstead Road reconstruction, New City NY.
Photo Source: Rockland County government center

BRIDGES AND TUNNELS

There are over 3,200 bridges of all types in the NYMTC planning area, including more than 30 major bridges crossing navigable waterways. Among the major bridges connecting various parts of the planning area and other parts of the region are: the George Washington Bridge; the Verrazano-Narrows Bridge; the Tappan Zee Bridge (the New NY Bridge); the Robert. F. Kennedy Bridge; four East River bridges – Brooklyn Bridge, Manhattan Bridge, Williamsburg Bridge, and Ed Koch Queensboro Bridge; the Goethals Bridge; and the Bayonne Bridge.

Additionally, there are four major underwater vehicular tunnels that provide intra- and inter-regional transportation connections. The four tunnels are: the Lincoln and Holland tunnels connecting New York City with New Jersey; the Queens-Midtown Tunnel connecting Queens to Manhattan; and the Hugh L. Carey Tunnel connecting Manhattan and Brooklyn.

Several critical bridge projects are currently underway in the NYMTC planning area. In 2014, construction began to replace the Tappan Zee Bridge which carries I-87/I-287 over the Hudson River between Westchester and Rockland counties. This replacement project is expected to be completed in 2018 at a cost of $3.9 billion.[49] The new bridge has been designed to improve safety and will feature seismic protections, emergency lanes and shoulders, electronic cashless tolling and a shared use path for pedestrians and bicyclists. At bridge opening, a new Bus Rapid Transit-style transit service will be able to use the structure's emergency lanes for peak travel, and the bridge has been designed to accommodate commuter rail in the future.

Also in the Hudson Valley, the Ashford Avenue Bridge in Westchester County connects the villages of Ardsley and Dobbs Ferry over the Saw Mill River, Saw Mill River Parkway, South County Trailway and the New York State Thruway. The $17.9 million construction project commenced in January, 2016 and will be completed by September, 2018. Another major bridge reconstruction project in Westchester County included the replacement of the Crane Road Bridge on the Bronx River Parkway, which was completed in September 2015. This was the largest bridge construction project ever undertaken by Westchester County, at a total cost of $53 million. In Rockland County, the Orangeburg Road Bridge, an obsolete and structurally deficient bridge, is currently being reconstructed at a cost of $13 million.

There are several bridges undergoing major work in New York City, including improvements on the Robert F. Kennedy Bridge (formerly known as the Triborough Bridge) continues through 2019, with work including reconstructing ramps and repaving bridge surfaces.

The Verrazano Narrows Bridge is undergoing two major improvements. The first is the $237.5 million replacement of the bridge's original 1960s concrete grid roadway deck with a lighter-weight, longer-lasting orthotropic deck. Work began in early 2015 and was completed in spring 2017. The second improvement is a 42-month, $84.3 million project that includes the construction of a new Bus/HOV ramp that will connect a new Bus/HOV lane from the bridge to the Gowanus Expressway HOV lane in Brooklyn. This work was completed in December 2016. In addition, two original Belt Parkway entrance ramps that connect to the main span of the Verrazano-Narrows were rehabilitated and reconfigured. This work is also expected to be complete by summer 2017, several months ahead of schedule.

The Port Authority also has major projects underway at three of its bridges connecting New Jersey and New York. Construction is continuing on the Goethals Bridge Replacement Project, linking I-278 over the Arthur Kill between Staten Island and Elizabeth New Jersey. The new crossing is expected to open in stages beginning in 2017. Construction also is advancing on the "Raise the Roadway" project at the Bayonne Bridge, where a new roadway deck is being built within the iconic arch of the structure to relieve the navigational clearance constraint of the existing roadway above the harbor's major shipping channel. The work also includes investment to extend the life of the bridge. The agency also has initiated the first steps in an anticipated $ 1.9 B "Restoring the George" project at the George Washington Bridge, which will include replacing the suspender ropes supporting the double-deck roadway.

New York City yellow cabs.
Photo Source: NYC Taxi & Limousine Commission

8. TAXICABS & LIVERY CABS

Taxis and livery vehicles are an important component of the region's transportation network. In Manhattan, they are a primary mode of transportation for many people, and in more outlying areas, they provide links to the rail network and greater mobility for residents who cannot or do not wish to drive. Aside from New York City's iconic yellow taxicabs, taxi services are found throughout the NYMTC planning area. Several taxi services exist in the counties outside of New York City, for example there are nine taxi companies available in Putnam County, and 33 in Suffolk County.

The yellow taxicab is present in great numbers throughout New York City, especially Manhattan, and is a vital mode of intra-city transportation. In 2015, there were 13,587 taxi medallions in New York City [50], 87,867 vehicles (yellow, "medallion" taxis, green street hail liveries, and for-hire vehicles) and approximately 140,000 licensed drivers.[51]

In 2011, as part of former mayor Bloomberg's push to create a "greener" city, the New York City Taxi and Limousine Commission (TLC) awarded Nissan a contract to replace the city's aging taxi fleet with the Taxi of Tomorrow - a fuel-efficient vehicle with improved passenger safety features. The new taxi was to be rolled out beginning in 2013, but was delayed until September 2015 due to a court appeal brought by an interest group. While the Taxi of Tomorrow plan was upheld, a revised agreement allows drivers with certain medallions to buy other fuel hybrid or wheelchair accessible vehicles in lieu of a Taxi of Tomorrow from Nissan. Even still, the Taxi of Tomorrow could account for a significant portion of the city's taxi fleet.[52]

In summer of 2013, the TLC introduced the Boro Taxi. To improve taxi service in areas of New York that are not commonly served by medallion (yellow) cabs, the TLC licensed thousands of livery cabs to pick up passengers hailing a cab, which was not previously permitted. These new cabs are uniformly green, are inspected by the TLC as with all other cabs, and are equipped with standard fare meters, credit card

readers, and cameras or partitions. Within months of the program's launch, it became clear that there was more ridership demand for Boro Taxis than the initially-issued permits could accommodate.[53] The TLC plans to monitor this new market but acknowledges the need to meet both rider and driver demand for permits.[54]

RIDE HAILING SERVICES

In recent years, a new segment of the for-hire-vehicle segment has emerged in the form of app-based ride-hailing services such as Uber and Lyft. These companies offer the convenience of quickly hailing a car directly from the user's smart phone, as well as other features like ridesharing, driver ratings, and included tip. Uber in particular has been extremely successful, making more than 100,000 trips on an average day in July 2015, a fourfold increase from the previous year.[55] The popularity and success of these services has sparked debate about the current regulatory structure of the taxi industry in New York City, as well as concern for the impacts Uber's growth may have on traffic congestion in the region. While some of these services operate legally in New York City and surrounding counties, there is no legal authorization for them to do so outside of New York City. Legislation is currently pending with the New York State Legislature to authorize these services outside of the city.

SPECIALIZED TRANSPORTATION

Plan 2045's Coordinated Public Transit-Human Services Transportation Plan is contained in Appendix 6 and contains a description of specialized transportation services throughout the NYMTC planning area.

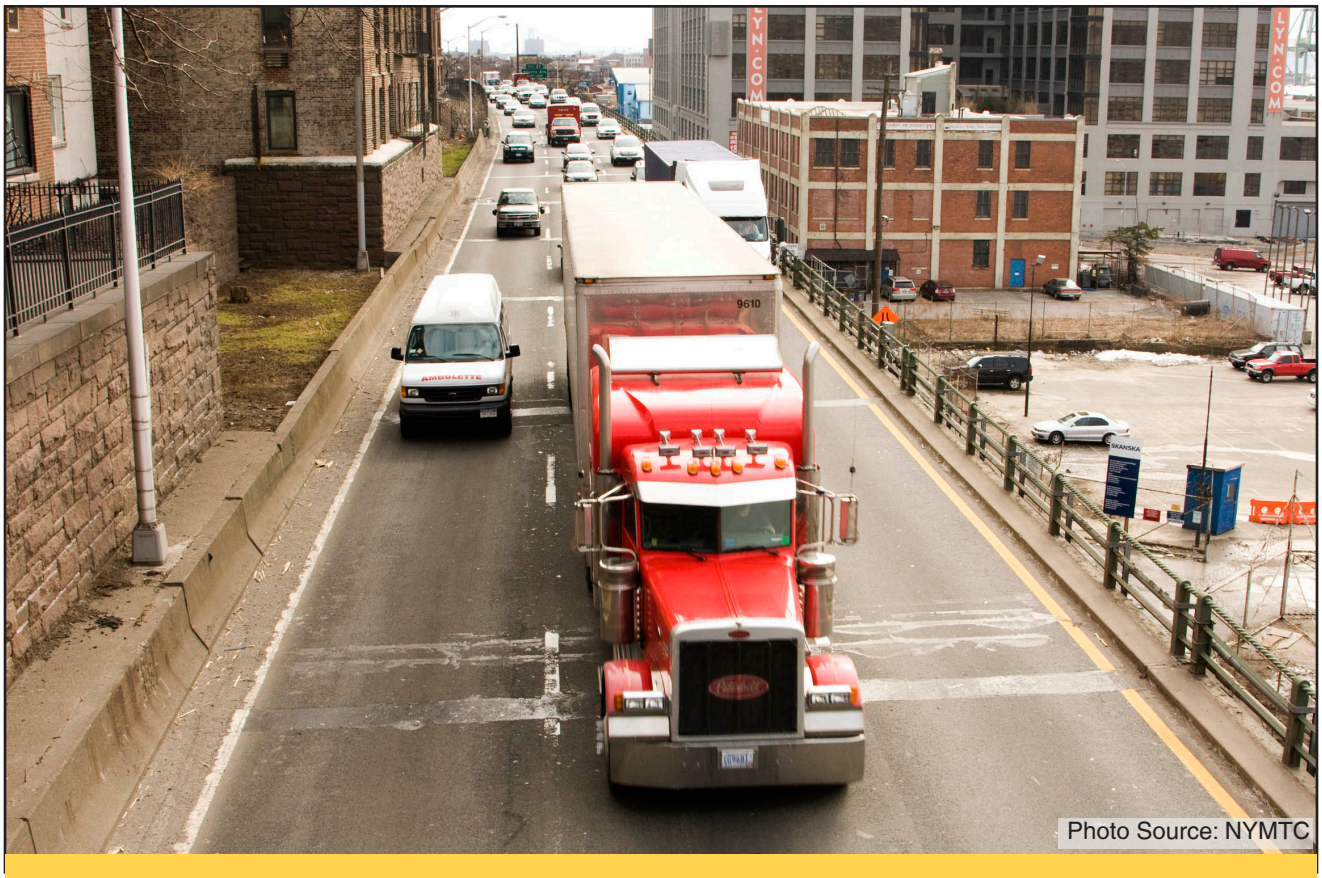


Photo Source: NYMTC

9. GOODS MOVEMENT

Plan 2045's Regional Freight Element is contained in Appendix 8, which provides a description of existing and planned rail freight facilities throughout the NYMTC planning area.

Three Class I freight railroads operate in the multi-state metropolitan region, including:

- CSX, which operates along the River Line in Rockland County, Hudson Line in Putnam, Westchester, and Bronx counties, the Hell Gate Line and Fremont Secondary from Bronx County into Queens County. CSX also provides local industry service to customers along the New Haven Line and to the Hunts Point Distribution Center in Bronx County;
- Norfolk Southern (NS), which only serves the metropolitan region from the south and west, and its lines do not directly enter the NYMTC counties; New Jersey freight rail access to the NYMTC region depends on the cross-harbor float; and
- Canadian Pacific Railway (CP), which until 2010, operated carload train service east of the Hudson to Oak Point Yard and Fresh Pond Yard, CP has established a haulage agreement with CSX, with CSX handling CP traffic in their trains south of Albany. CP retains the right to resume trackage rights operations in lieu of the haulage agreement. CP's intermodal operations continue at a modest level over the NS Lehigh Line in New Jersey to Oak Island Yard in Newark.

In addition, Conrail Shared Assets, a switching carrier jointly owned by NS and CSX, operates in much of Northern New Jersey and over the Arthur Kill Lift Bridge to Arlington Yard and the Travis Industrial Track in Richmond County (Staten Island).

Rail customers in the NYMTC Region are also served by five short line railroads, including:

- The Housatonic Railroad (HRRC), which holds pres9ently unused freight rights over Metro-North's Beacon Line, from Beacon east through Hopewell Junction to the New York-Connecticut state line.
- The New York and Atlantic Railway (NYA) has held an exclusive franchise to provide freight service over trackage owned by the Long Island Rail Road (LIRR) since 1997. The NYA operates from a hub at Fresh Pond Junction in Queens. NYA serves Brooklyn via the freight-only Bay Ridge Branch, and points west, east, and south on Long Island via the Lower Montauk Branch, Main Line of the Long Island Rail Road (LIRR), Montauk Branch, and Port Jefferson Branch. In early 2016, CSX recognized NYA for cooperative efforts that resulted in the highest carload growth in the northeast.[56]
- New York New Jersey Rail, LLC (NYNJR), which is owned by the PANYNJ, operates a carfloat bridge route between Greenville Yard in Jersey City, NJ and the 65th Street Yard in Brooklyn.
- The P&W accesses New York through trackage rights over the freight operating rights held by CSX (as successor to Conrail and PC) on Metro-North's New Haven route. The only regular move by P&W on this route is the handling of crushed rock in unit train service to Fresh Pond Junction on Long Island, which is the only commodity permitted under P&W's limited trackage rights.
- The South Brooklyn Railway (SBK) is a freight carrier owned by the MTA/New York City Transit that presently consists of isolated segments of track at 39th Street and 3rd Avenue and at NYCT's Coney Island Yards.

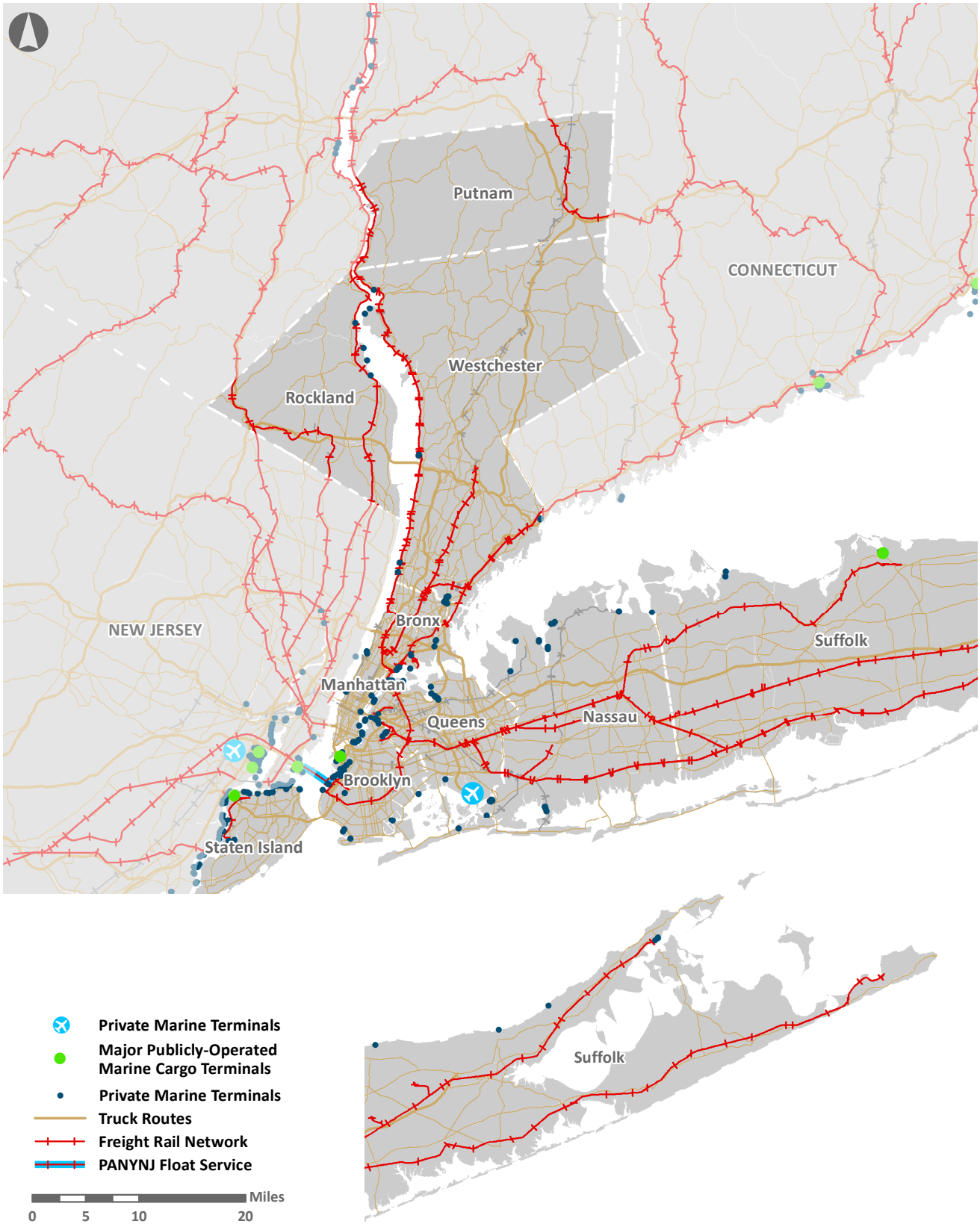
TRUCKING

The Regional Freight Element in Appendix 8 also provides a comprehensive description of existing and planned truck routes and facilities throughout the NYMTC planning area. Freight in the NYMTC planning area is carried predominantly by truck. According to USDOT's Freight Analysis Framework, about 30 percent of freight tonnage in the United States was carried by modes other than truck (including waterborne, rail, and air), less than 15 percent of freight tonnage in the NYMTC planning area is carried by modes other than truck.[57] Consequently, the highway system in the region is crucial to the efficient movement of freight into, out of, through, and within the region. Further, the efficient operation in the face of chronic congestion in many parts of the network and maintenance of a state of good repair on this network is vital to the region's economy. The fact that there are many limited-access highways in the region barred to trucks or with size and weight limits more restrictive than federal standards, makes freight access to, and travel within, the region even more difficult.

WATERBORNE FREIGHT

The Regional Freight Element in Appendix 8 also provides a comprehensive description of existing and planned waterborne freight routes and facilities throughout the NYMTC planning area. New York Harbor is home to one of the largest concentrations of public and private terminal facilities in the United States, serving shipments of important commodities as well as passenger traffic. Within the larger Port of New York and New Jersey district, the Port Authority and the City of New York are the main public facility operators, supplemented by private passenger and cargo facilities. Over the years the Port Authority has undertaken several initiatives to expand waterborne port commerce and capacity, and it continues to do so through its Good Movement Action Plan (G-MAP) which is currently underway.

FIGURE 3.8: FREIGHT TRANSPORTATION NETWORKS IN THE NYMTC PLANNING AREA



ENDNOTES

[1] American Public Transportation Association. 2016. **Fourth Quarter 2016 Ridership**. http://www.apta.com resources/statistics/Documents/Ridership/2016-q4-ridership-APTA.pdf

[2] While the subway system serves 469 individual stations, many of these are connected by free transfers. As of December 2015, there were 420 stations or multistation complexes joined by such transfers.

[3] MTA. **Introduction to Subway Ridership**. http://web.mta.info/nyct/facts/ridership/

[4] Port Authority of New York and New Jersey (PANYNJ). February 25, 2016. P**ress Release #31: First Phase of Iconic WTC Transportation Hub to Open on March 3.** http://www.panynj.gov/wtcprogress/press_release-sItem.cfm?headLine_id=2378

[5] NJT. 2015. **NJ Transit Facts at a Glance**. https://www.njtransit.com/pdf/FactsAtaGlance.pdf

[6] Amtrak. October 27, 2014. **Amtrak ridership and revenues continue strong growth in FY 2014**. http://www.amtrak.com/ccurl/238/481/Amtrak-FY2014-Ridership-and-Revenue-ATK-14-096%20.pdf

[7] Amtrak. 2016. **National Facts**. https://www.amtrak.com/national-facts.

[8] Amtrak, *Id.*

[9] U.S. DOT Federal Railroad Administration. April 2013. **NEC FUTURE: Preliminary Alternatives Report**. Pg. 3

[10] Amtrak. 2016. **NEC Projects: The Gateway Program**. https://nec.amtrak.com/content/gateway-program

[11] MTA. I**ntroduction to Subway Ridership**, Id.

[12] Ibid.

[13] Kabak, Benjamin. February 2011. **B63 BusTime Pilot Officially Live**. http://secondavenuesagas.com/2011/02/01/b63-bustime-pilot-officially-live/

[14] Private Transportations Corp. No date. **B110**. http://www.wbbpbus.com/

[15] As of 2011, most Chinese-American intra-city van services do not have an Internet presence. For further background on these services, see: Chao, Loretta. March 9, 2005. **What Drives the Chinatown Van Drivers?** *The Villager*. http://www.thevillager.com/villager_97/whatsdriversthechinatown.html; Tsai, Michelle. June 1, 2010. **The Chinatown Shuttle: Better than New York's Subway**. *Chinatown Stories*. http://www.chinatown-stories.com/chinatown-shuttle/; Riordan Seville, Lisa. October 16, 2009. **Commuter "Van Wars" Heat Up in Sunset Park**. *Sunset Park Chronicled*. http:// sunsetpark.wordpress.com/2009/10/15/commuter-vans-face-off-in-sunset-park/

[16] RIOC. **Bus Transportation**. http://rioc.ny.gov/bustransportation.htm

[17] Putnam Area Rapid Transit (PART). **Route Information**. http://www.putnamcountyny.com/planningdept/putnam-transit-schedules/route-information/

[18] Rockland County. October 31, 2013. **Brega Takes Over County Bus Services Nov. 3**. *Rockland County Times*. http://www.rocklandtimes.com/2013/10/31/brega-takes-over-county-bus-services-nov-3/

[19] Village of Spring Valley. **Spring Valley Jitney Bus**. http://www.villagespringvalley.org/Jitney Bus/Jitney Bus Website.pdf

[20] Coach USA. **Welcome to Coach USA**. http://www.coachusa.com/

[21] Academy Bus. 2012. **Academy Bus Commuter Map**. http://www.academybus.com/Commuters/Map. aspx

[22] Trans-Bridge Lines. **About.** http://www.transbridgelines.com/daily.htm

[23] Martz Trailways. **Martz Trailways Bus Service Locations in New York**. http://www.martztrailways.com/locations.asp?state=NY

[24] Stacom, Don. September 30, 2011. D**OT's Next Stop: Higher Fares**. *Hartford Courant*. http://articles.courant.com/2011-09-30/news/hc-transit-fares-0930-20110930_1_commissioner-james-redeker-fare-increases-first-fare

[25] Lucky Star. **Bus Schedules**. https://www.luckystarbus.com/Schedule.aspx; Eastern Travel. **New York to Washington, D.C.** https://www.nydcexpress.com/chinatown-bus.html?from=New%20York,NY&to=Washington,DC&p=77,36

[26] Gray Line New York. **NYC Tours**. http://www.newyorksightseeing.com/; City Sights NY. **Bus Tours**. http://www.citysightsny.com/

[27] On Location Tours. **NYC TV and Movie Tour**. http://onlocationtours.com/tour/new-york-tv-movie/

[28] NY Waterway. **Peak Buses Master Map**. http://www.nywaterway.com/UserFiles/Files/Peak%20Bus%20Map.pdf

[29] NY Waterway. **Off Peak Buses Master Map**. http://www.nywaterway.com/UserFiles/Files/OffPeakBusMapFINAL.pdf

[30] NY Waterway. **New Jersey Buses**. http://www.nywaterway.com/NewJerseyBus.aspx

[31] Short, Aaron. 2011. **Ferry Good News — Ridership Soaring on East River Boats**. *Brooklyn Paper*. http://www.brooklynpaper.com/stories/34/42/dtg_ferrynumbers_2011_10_21_bk.html

[32] EDC. December 29, 2016. **East River Ferry Ridership Hits All Time High in 2016**. https://www.nycedc.com/press-release/east-river-ferry-ridership-hits-all-time-high-2016

[33] Michael Sedon. Dec 31, 2012. **LNG to power a Staten Island Ferry, saving a boatload on fuel costs**. *Staten Island Advance*. Apr 30, 2013.

[34] Seastreak. July 30, 2015. **Ferry Routes and Schedules**. http://seastreak.com/ferry-routes-and-schedules/

[35] Dunlap, David W. June 6, 2008. **This Ferry Terminal Will Come to You**. *New York Times*. http://cityroom.blogs.nytimes.com/2008/06/06/this-ferry-terminal-will-come-to-you/?scp=1&sq=this%20ferry%20terminal%20will%20come%20to%20 you&st=cse; New York Waterway. July 30, 2015. Ferry Routes and Schedules. July 30, 2015. http://www.nywaterway.com/FerryRoutesSchedules.aspx

[36] Loyer, Susan. November 20, 2014. **New waterfront development slated for South Amboy**. *My Central Jersey.* http://www.mycentraljersey.com/story/news/local/middlesex-county/2014/11/19/new-waterfront-development-slated-south-amboy/19287431/

[37] PANYNJ. **Ferry Transportation**. http://www.panynj.gov/commuting-traveling/ferry-transportation.html

[38] Glen Cove CDA. August 24, 2012. **Project Overview: Glen Cove Ferry**. http://www.glencoveferry.org/projectoverview.html

[39] City of Glen Cove. September 21, 2016. **City of Glen Cove Shifts Commuter Ferry Service Timeline**. http://www.glencove-li.us/city-glen-cove-shifts-commuter-ferry-service-timeline/

[40] Port Jefferson-Bridgeport service is run by The Bridgeport & Port Jefferson Steamboat Company, while the Cross Sound Ferry operates the Orient Point to New London service. For ferries to Shelter Island, see www.northferry.com and www.southferry.com. Seasonal Montauk service is run by Viking Fleet, and the Fishers Island Ferry District runs service to New London.

[41] National Parks Service. July 12, 2012. **Planning Patchogue Ferry Terminal**. http:// www.nps.gov/fiis/parkmgmt/planning-patchogue-ferry-terminal.htm

[42] Associated Press. August 24, 2009. **New Funding for FI Ferry Terminals**. *Long Island Press*. http://www.longisland-press.com/2009/08/24/new-funding-for-li-ferry-terminals/?doing_wp_ cron

[43] RIOC. February 11, 2013. **Report from Acting RIOC President Don Lewis – Roosevelt Island Tram Ridership Statistics at Record High Numbers, Outdoor Movie Selections and More**. *Roosevelt Islander Online*. http://rooseveltislander.blogspot.com/2013/02/report-from-acting-rioc-president-don.html

[44] PANYNJ. 2016. **Passenger Activity at Port Authority Airports Sets New Record for Fourth Consecutive Year**. http://panynj.info/press-room/press-item.cfm?headLine_id=2627

[45] PANYNJ. 2015. **December 2015 Traffic Report: EWR**. http://www.panynj.gov/airports/pdf/EWR_Dec_2015.pdf

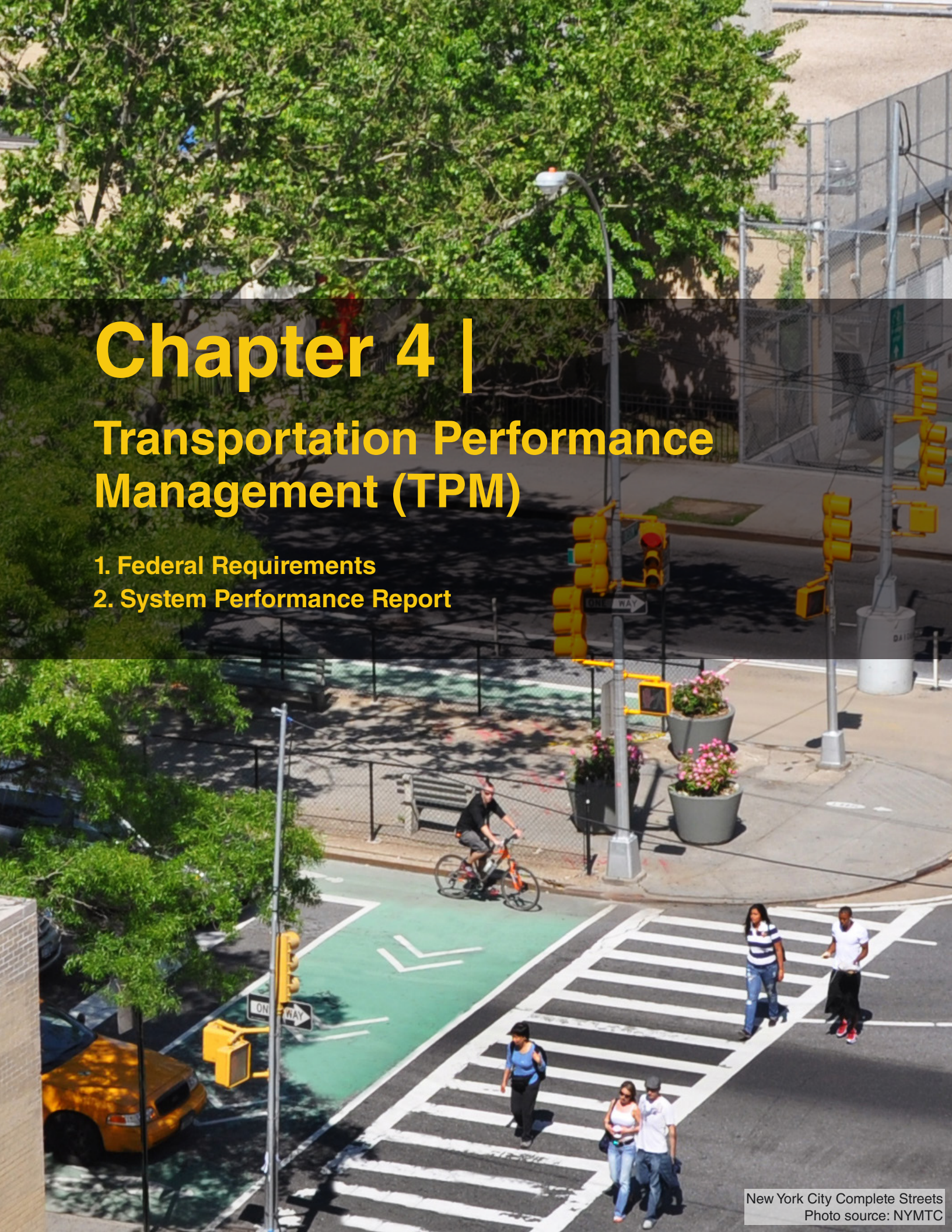
[46] AirNav.com data for Downtown, West 30th Street and East 34th Street heliports. Web. February 16, 2017. An average of 283combined flights a day were multiplied by 365 to get a total of 103.295 flights. Data for Downtown Manhattan Heliport covers Sep 16, 2014 through Sep 15, 2015, while data for West 30th Street and East 34th Street is for Sep 18, 2013 through Sep 17, 2014.

[47] AirNav.com data for Haverstraw and Southampton heliports. 2014. An average of 42 flights a week from Haverstraw (for 12-month period between September 25, 2012 and September 24, 2013) and 33 flights a month from Southampton (for 12-month period between September 28, 2012 and September 27, 2013) were multiplied by 52 and 12 respectively to get these totals.
[48] Ibid.
[49] New York State. **About the Project**. http://www.newnybridge.com/about/index.html
[50] New York City Taxi and Limousine Commission. 2016. 2**016 Annual Report**. http://www.nyc.gov/html/tlc/downloads/pdf/annual_report_2016.pdf
[51] New York City TLC. 2016. **2016 TLC Factbook**. http://www.nyc.gov/html/tlc/downloads/pdf/2016_tlc_factbook.pdf
[52] Fitzsimmons, Emma G. July 17, 2015. '**Taxi of Tomorrow' will be New York City's Standard Cab starting Sept. 1.** *The New York Times*. http://www.nytimes.com/2015/07/18/nyregion/taxi-of-tomorrow-will-be-new-york-citys-standard-cab-starting-sept-1.html?search-input=taxi+of+tomorrow
[53] New York City Taxi and Limousine Commission. December 2013. **HAIL Market Analysis**. Pgs. 18-19.
[54] Id., 53.
[55] Tangel, Andrew and Austen Hufford. October 25, 2015. **Uber Logs Major Gains in New York City, Figures Show**. *The Wall Street Journal*. http://www.wsj.com/articles/uber-logs-major-gains-in-new-york-city-figures-show-1445821132
[56] Anacostia. March 9, 2016. **CSX recognizes NYA for Carload Growth**. http://www.anacostia.com/news/csx-recognizes-nya-carload-growth
[57] **NYMTC Regional Freight Plan Update 2015-2040**, Task 4, Summary Report, February 2015. https://www.nymtc.org/Regional-Planning-Activities/Freight-Planning/Interim-Freight-Report

Chapter 4 |

Transportation Performance Management (TPM)

1. Federal Requirements
2. System Performance Report



New York City Complete Streets
Photo source: NYMTC

1. FEDERAL REQUIREMENT

The current federal transportation law, the Fixing America's Surface Transportation (FAST) Act continues MAP-21 provisions on using performance-based approaches in transportation planning (including the systems performance reporting). States and MPOs must establish transportation performance measures and targets for certain goal areas, including safety, infrastructure condition, system performance and environmental sustainability.

FHWA defines Transportation Performance Management (TPM) as a strategic approach that uses transportation system information as a guide to making investment and policy decisions that are consistent with national goals (described in Chapter 1). The federal transportation legislation enacted in 2012, which was entitled the *Moving Ahead for Progress in the 21st Century* Act (MAP-21) strengthened the growing focus on using performance-based approaches in transportation planning. That law required states and MPOs to establish transportation performance targets for all of the national performance measures in areas such as safety, infrastructure condition, system performance and environmental sustainability (see Figure 4.1 below). MAP-21 further required MPOs to include in their Plans "a system performance report and subsequent updates evaluating the condition and performance of the transportation system with respect to the performance targets."

The FAST Act, which is the current federal transportation law, was enacted in December 2015. This legislation continues the MAP-21 requirements for using performance-based approaches in transportation planning. This requirement was further stipulated in the Metropolitan Transportation Planning Final Rule issued May 27, 2016, in section 23 CFR 450.306(d). The legislation transformed the Federal-aid program by placing greater emphasis on transportation decision-making on performance-based planning, where performance measures and targets provide an objective means of informing decisions about strategies and investments.

Vision Zero
Photo source: NYMTC

FEDERAL TPM REQUIREMENTS FOR MPOs

"[MPOs]…, in cooperation with the State and public transportation operators, shall develop long-range transportation plans and transportation improvement programs through a performance-driven, outcome-based approach to planning." 23 USC § 134(c)(1); 49 USC § 5303(c)(1).

"The metropolitan transportation planning process shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals…." 23 USC §134(h)(2); 49 USC § 5303(h)(2).

Goethals Bridge Replacement
Photo source: NYMTC

FIGURE 4.1: NATIONAL PERFORMANCE MEASURES

The following national performance measures were established by MAP-21 and carried forward under the FAST Act:

- **For the National Highway Performance Program (NHPP):**
  - Pavement conditions on the Interstate system and remainder of the National Highway System (NHS)
  - Bridge conditions on the NHS
  - Performance of the Interstate system and remainder of the NHS
- **For the Highway Safety Improvement Program (HSIP):**
  - Number and rate per vehicle mile traveled of fatalities
  - Number and rate per vehicle mile traveled of serious injuries
- **For the Congestion Mitigation and Air Quality (CMAQ):**
  - Traffic congestion
  - On-road mobile source emissions
- **Freight movement on the Interstate system**
- **Public transportation:**
  - State of good repair
  - Safety

Source: 23 USC § 150(c) and 49 USC § 5326(c) and § 5329(d)

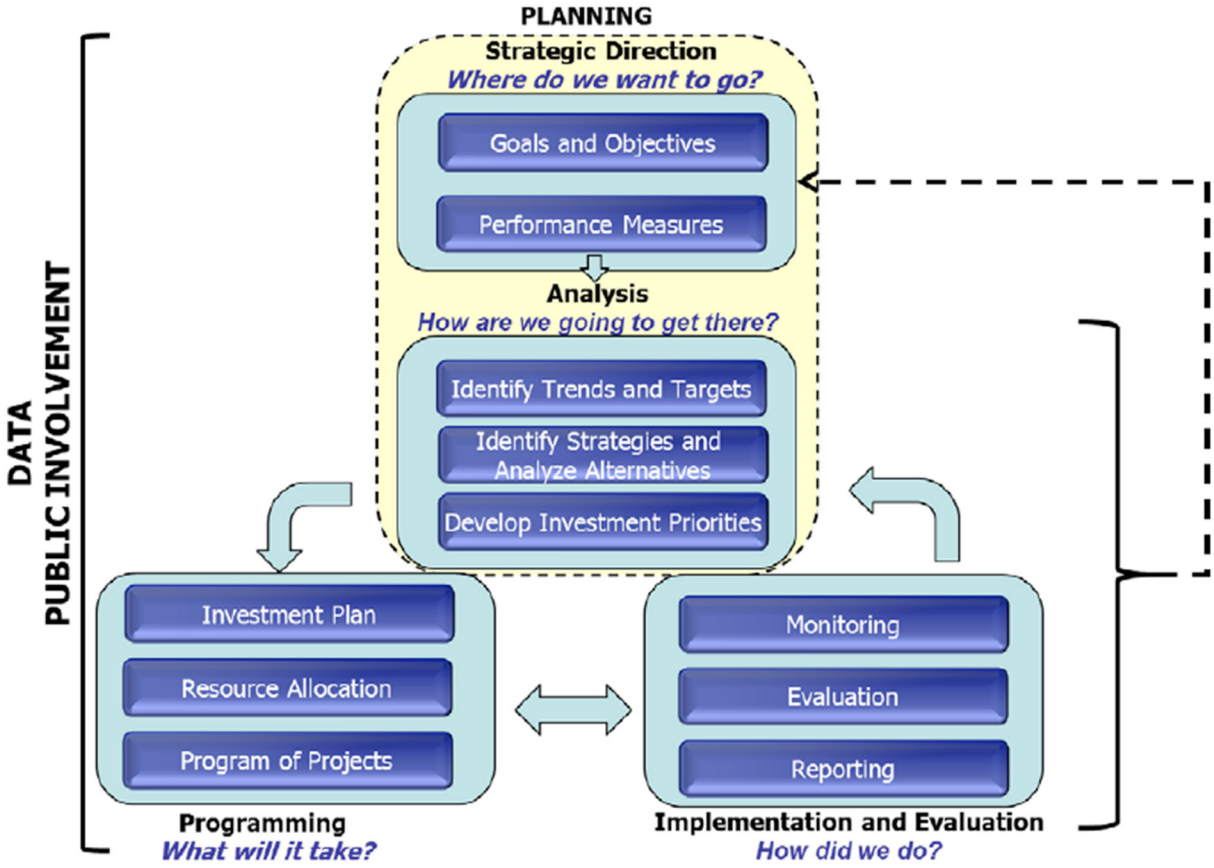
THE TPM FRAMEWORK

USDOT has recommended a particular framework for TPM which should result in a performance-based transportation plan, as shown in Figure 4.2 below. The framework in built on three phases: 1) Planning; 2) Programming; and 3) Implementation and Evaluation.

- The Planning phase consists of setting a strategic direction ("where do we want to go?"), which encompasses goals and objectives and performance measures, followed by conducting an analysis of how a region will move forward in achieving identified goals and objectives through investments and policies ("how are we going to get there?").
- The Programming phase tries to answer the question "what will it take?"
- The last phase of Implementation and Evaluation seeks to answer the question "how did we do?"

NYMTC is currently undertaking many of the phases and actions identified in the TPM framework and, as such, is moving toward a more performance-based approach to its metropolitan transportation planning requirements. This approach will help NYMTC undertake a more systematic approach to using transportation system performance information – past, present, and anticipated future – to develop investment strategies and priorities.

FIGURE 4.2: THE TPM FRAMEWORK



Source: FHWA Performance-based Planning and Programming Guidebook. Page iv.

REQUIRED PERFORMANCE MEASURES & TARGETS

The federal TPM regulations require MPOs to either establish targets for their planning area or support the targets set by New York State for the defined performance measures no later than 180 days after the states do so. As of this writing. Final federal rules have been promulgated for the following:

- Highway Safety Improvement Program (HSIP) and Safety Performance Management Measures;
- Transit Asset Management (TAM) and Public Transportation Safety Program;
- National Highway System (NHS) Asset Management Plan (part of the National Highway Performance Program (NHPP);
- Assessing Pavement and Bridge Conditions for the NHPP and Assessing Performance of the NHS;
- Freight Movement on the Interstate System, and
- Congestion Mitigation and Air Quality Improvement Program (CMAQ).

These rules outline the roles and responsibilities of the states and MPOs, and the details of the relevant performance measures, and of target-setting and reporting. They are briefly summarized here.

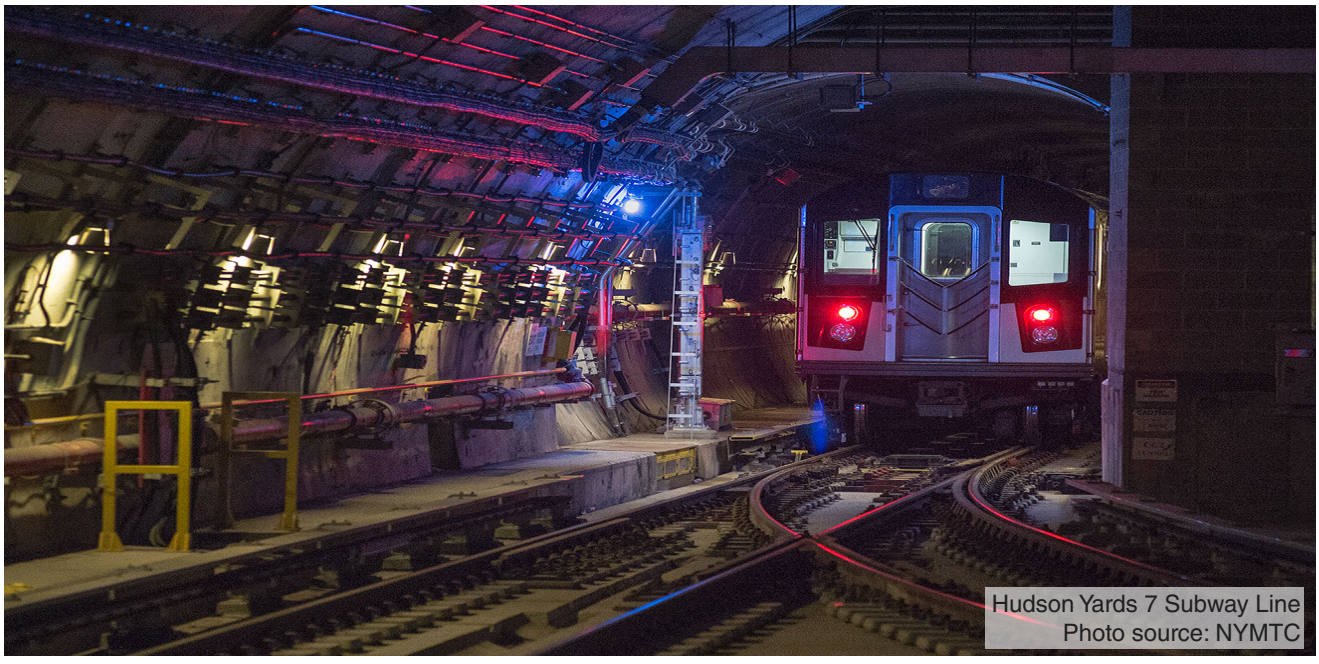
HSIP & SAFETY PERFORMANCE MANAGEMENT MEASURES[1]

The final safety rule published on March 15, 2016 identified five performance measures:

- Number of fatalities
- Rate of fatalities
- Number of serious injuries
- Rate of serious injuries
- Number of non-motorized fatalities and non-motorized serious injuries

TRANSIT ASSET MANAGEMENT (TAM)[2]

The FTA published this final rule on July 26, 2016 which (a) defined the term “state of good repair” (b) required public transportation providers develop and implement transit asset management (TAM) plans and (c) established state of good repair standards and four state of good repair performance measures for: (i) equipment – non-revenue, support-service and maintenance vehicles equipment; (ii) rolling stock; (iii) infrastructure – rail fixed-guideway, track, signals, and systems; and (iv) facilities. Providers’ initial TAM must be completed no later than October 1, 2018.



Hudson Yards 7 Subway Line
Photo source: NYMTC

PUBLIC TRANSPORTATION SAFETY PROGRAM[3]

This final rule published on August 11, 2016 established substantive and procedural rules for FTA's administration of a comprehensive safety program to improve the safety of the nation's public transportation systems. It provides the framework for FTA to monitor, oversee and enforce transit safety, based on the methods and principles of Safety Management Systems.

ASSESSING PAVEMENT & BRIDGE CONDITIONS FOR THE NHPP[4]

This final rule was issued on January 18, 2017 with an effective date of February 17, 2017, which was subsequently extended to March 21, 2017. The performance measures identified in this rule are:

- The condition of pavements on the Interstate System;
- The condition of pavements on the NHS – excluding the Interstate; and
- The condition of bridges on the NHS.

ASSESSING PERFORMANCE OF THE NHS, FREIGHT MOVEMENT ON THE INTERSTATE SYSTEM, & CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM[5]

Like the Pavement and Bridge Conditions rule, this rule was issued on January 18, 2017 and subject to the same extended effective date of March 21, 2017. The performance measures identified in this rule are for:

- NHS Travel Time Reliability;
- Greenhouse gas (GHG) emissions for the NHS;
- Freight movement on the Interstate System; and
- Traffic congestion.

New York State is required to set targets for the various performance measures within timeframes established in the rules. Similarly, in keeping with the requirements of these rules and the Metropolitan Transportation Planning Regulations, NYMTC will then have to set its performance targets no later than 180 days after the date on which the State establishes its targets. For example, in the case of the HSIP and Safety Performance Management Measures, NYSDOT is scheduled have targets in place by August 2017 and NYMTC by February of 2018. Figure 4.3 below provides a basic flowchart of performance measures and performance targets. After the performance targets are selected, the Plan and TIP will be amended by NYMTC, as needed, to reflect them.

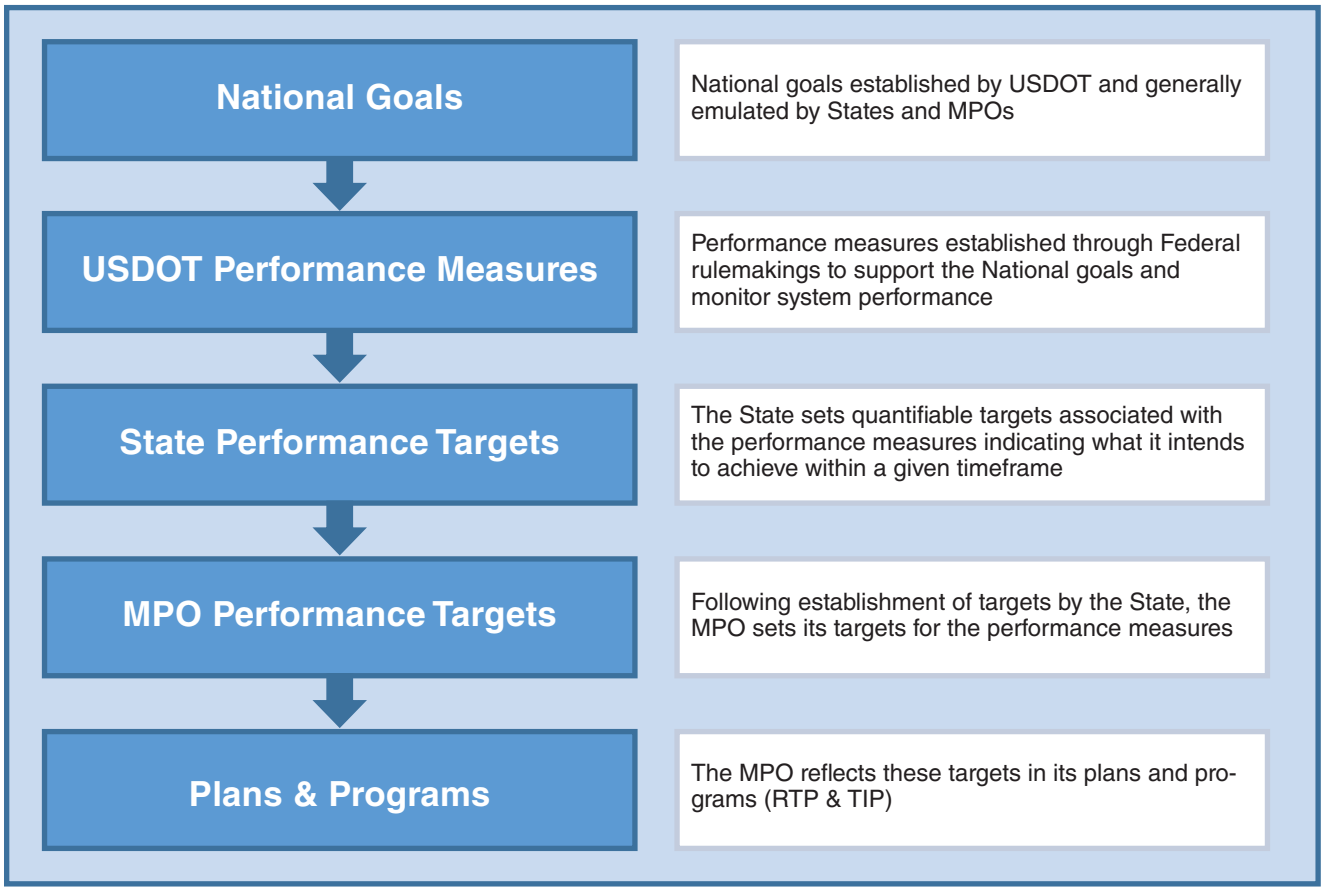
2. SYSTEM PERFORMANCE REPORT

As previously mentioned, MPOs are required to produce a metropolitan transportation system performance report on all the required performance measures and this report needs to be included in the long-range transportation plan. Figure 4.3 below shows how and when this occurs. The report describes the baseline condition/performance and progress toward achievement of the targets for the associated performance measures described in Section 1 of this chapter.

Federal regulations also require that metropolitan transportation plans adopted or amended after the following dates must include performance targets for the measures associated with the following performance management rulemakings:

- May 27, 2018 – Highway Safety Improvement Program (HSIP) and Highway Safety
- October 1, 2018 – Transit Asset Management
- October 1, 2018 – Public Transportation Safety Program
- May 20, 2019 – Pavement and Bridge Condition
- May 20, 2019 – System Performance/Freight/Congestion Mitigation & Air Quality Improvement Program

FIGURE 4.3: FLOWCHART OF PERFORMANCE MEASURES PERFORMANCE AND TARGETS



HSIP and Highway Safety

As mentioned in Section 1 of this chapter, on March 15, 2016 the FHWA published the final rule for HSIP and Safety Performance Management (Safety PM) Measures in the Federal Register with an effective date of April 14, 2016. The requirement was for targets to be set for the following performance measures:

- Number of Fatalities
- Fatality Rate (per 100 million vehicle miles traveled - VMT)
- Number of Serious Injuries
- Serious Injury Rate (per 100 million vehicle miles traveled - VMT)
- Number of Non-Motorized Fatalities and Serious Injuries

BASELINE/CURRENT CONDITION IN THE NYMTC PLANNING AREA AND NEW YORK STATE

NYMTC staff and members collaborated the development of baseline conditions for the NYMTC planning area using data from: The Fatality Analysis Reporting System (FARS); the Department of Motor Vehicles Accident Inventory Reporting system (AIS); and FHWA approved data from New York State DOT (NYSDOT), including Vehicle Miles Traveled (VMT) data from the Highway Data Services Bureau. Using these same data sources, New York State DOT (NYSDOT) worked collaboratively with the State's MPOs to establish baseline conditions (and performance targets as described below) for the State. The results of the baseline calculations, based on 2012-2016 five-year rolling averages are shown in Table 4.1 below.

PERFORMANCE TARGETS

On January 18, 2018 through Resolution 458, NYMTC agreed to support the NYSDOT statewide 2018 targets for the above-mentioned Safety Performance Measures based on five-year rolling averages per Title 23 Part 490.207 of the Code of Federal Regulations. These targets are shown in Table 4.1 below.

Table 4.1: 2018 Safety Measures Baseline and Targets

	Number of Fatalities	Rate of Fatalities per 100M Vehicle Miles Traveled (VMT)	Number of Serious Injuries	Rate of Serious Injuries per 100M VMT	Number of Nonmotorized Fatalities and Serious Injuries
NYSDOT Baseline	1,143	0.89	11,547	8.99	2,872
NYMTC Baseline	548	0.97	4,880	8.68	2,032
NYSDOT Targets	1,086	0.87	10,854	8.54	2,843

ACHIEVING TARGETS

The 2017 New York Strategic Highway Safety Plan (SHSP) is intended to reduce "the number of fatalities and serious injuries resulting from motor vehicle crashes on public roads in New York State." The SHSP guides NYSDOT, the MPOs, and other safety partners in addressing safety and defines a framework for implementation activities to be carried out across New York State. The NYSDOT Highway Safety Improvement Program (HSIP) annual report documents the statewide performance targets.

In supporting the State's targets, NYMTC will address areas of concern for fatalities and serious injuries within its planning area through continued coordination with NYSDOT and programming of projects in the Transportation Improvement Program (TIP). The current 2017-2021 TIP includes a description of the anticipated effects of projects in achieving the above-mentioned targets, effectively linking investment priorities to the safety targets. Additionally, this Plan includes a safety goal thereby allowing outcomes, performance measures and targets to be integrated into the transportation planning process.

EXISTING NYMTC PERFORMANCE MEASURES

Currently, NYMTC has a number of performance measures in place as part of its Congestion Management Process (CMP). These performance measures are used to assess the effectiveness and efficiency of the roadway system, and are reported in the CMP Status Report published with each new Regional Transportation Plan.

No single metric adequately defines traffic congestion on a regional basis. That being the case, NYMTC's CMP analyzes the performance of the roadway system using a number of different measures which are described in detail in the Congestion Management Status Report (see https://www.nymtc.org/Required-Planning-Products/Congestion-Management-Process):

- **Demand-to-Capacity Ratio** (D/C): this measure reflects the level of mobility and the quality of travel of a roadway or section of a roadway. It compares the roadway capacity with the estimated trip demand generated directly from the travel demand models.
- **Vehicle Hours of Delay** (VHD): the sum total of delay experienced by all vehicles on the network. Delay is defined as the difference between estimated (actual) travel and free flow travel speed.
- **Person Hours of Delay** (PHD): vehicle hours of delay multiplied by the average person occupancy rate per vehicle.
- **Average Travel Speed** (ATS): is the calculation for a weighted average of travel speed and helps to provide an average "system experience" of travelers for each portion of the road system.
- **Lane-Miles of Congestion** (LMC): measures the road space that functions at less than free-flow speeds during the peak period, and compares actual roadway volume with maximum acceptable volume for the roadway. For the 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 of that roadway (essentially Level of Service E volume).
- **Travel Time Index** (TTI): is the ratio of peak period travel time to free-flow travel time. It expresses the average amount of extra time it takes in the peak relative to free flow travel and is used as a reliability measure for the roadway system.
- **Vehicle Miles of Travel** (VMT): is the sum of distances traveled by all motor vehicles in a specified region and is an aggregate performance measure. This measure helps estimate mobile source emissions of air pollutants.

The NYBPM is used with related post-processing software to estimate and forecast the above metrics. Two types of forecasts of traffic congestion are performed: regional forecasts and county/borough-level forecasts. The regional forecasts assess traffic congestion and the performance of the entire transportation system as a whole. They provide a means for assessing the effectiveness of system-level transportation investment strategies in addressing regional traffic congestion. County/borough-level forecasts are subsets of the regional forecasts which focus on subarea congestion and system performance. These forecasts can identify local areas of congestion in greater detail, as well as the influence of more localized transportation improvement approaches on congestion.

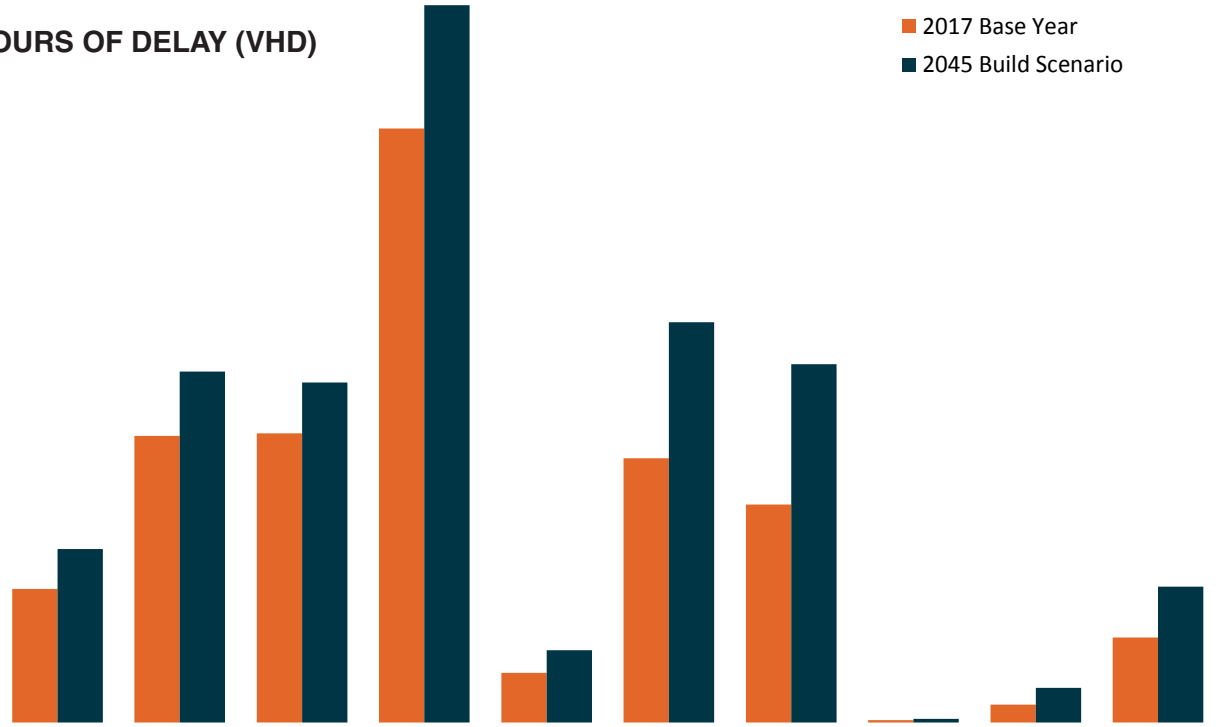
Figure 4.4, 4.5 and 4.6 are examples of selected CMP performance metrics at the county/borough level from NYMTC's 2017 CMP Status Report.

IINTEGRATION OF PERFORMANCE MEASURES FROM OTHER PLANS & PROCESSES

The Metropolitan Transportation Planning Regulations[6] require that the Plan should integrate performance measures from various relevant plans and planning processes, including:

- The State Transportation Asset Management Plan (TAMP): a risk-based asset management plan for the National Highway System (NHS).
- The State's Strategic Highway Safety Plan (SHSP): a statewide coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads.

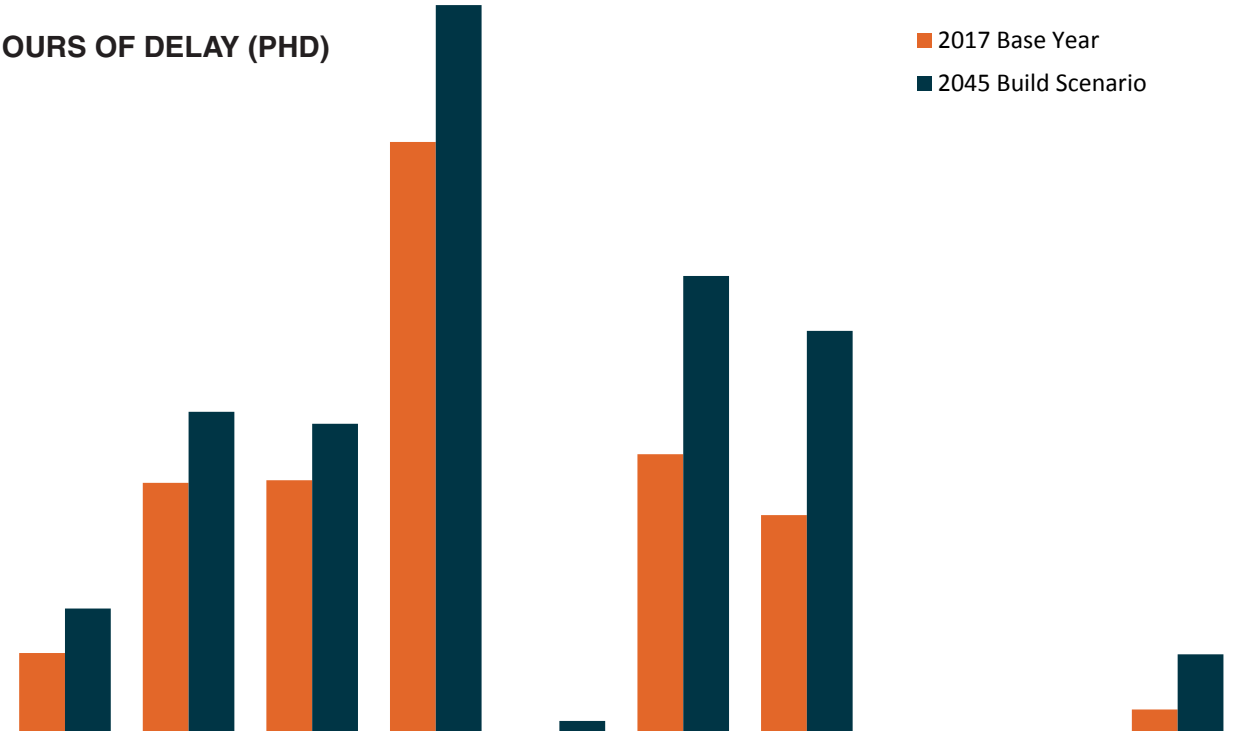
FIGURE 4.4
VEHICLE HOURS OF DELAY (VHD)



	BRONX	BROOKLYN	MANHATTAN	QUEENS	STATEN ISLAND	NASSAU	SUFFOLK	PUTNAM	ROCKLAND	WESTCHESTER
2017 Base Year	179,721	386,044	389,309	799,586	66,842	355,904	293,417	3,288	23,964	114,323
2045 Build Scenario	233,698	472,346	457,656	965,630	97,341	538,860	482,490	4,808	46,716	183,043

Source: NYMTC

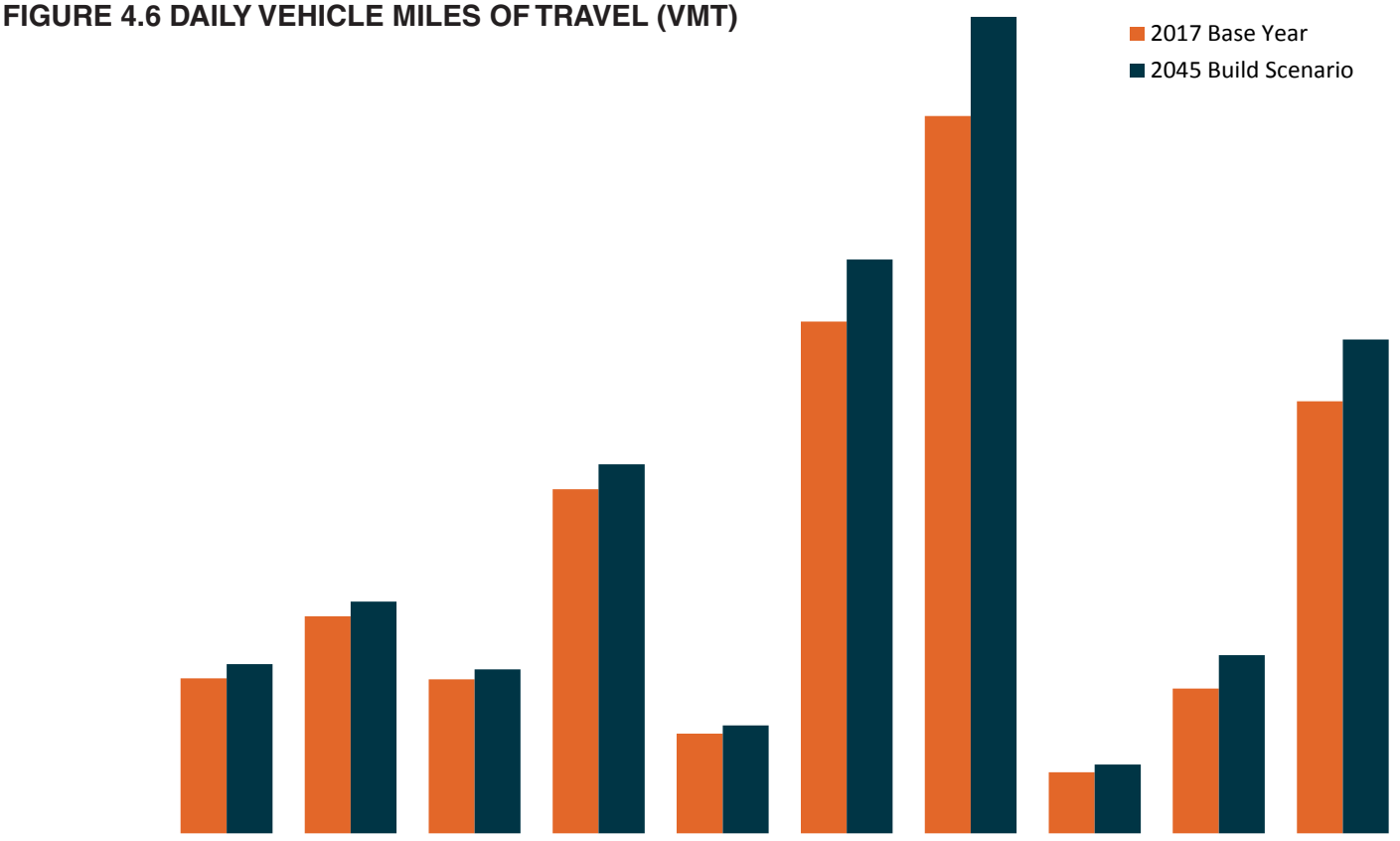
FIGURE 4.5
PERSONS HOURS OF DELAY (PHD)



	BRONX	BROOKLYN	MANHATTAN	QUEENS	STATEN ISLAND	NASSAU	SUFFOLK	PUTNAM	ROCKLAND	WESTCHESTER
2017 Base Year	265,986	571,345	576,176	1,183,387	98,927	622,832	513,480	4,734	34,507	164,625
2045 Build Scenario	345,873	699,072	677,331	1,429,132	144,065	943,005	844,358	6,924	67,271	263,582

Source: NYMTC

FIGURE 4.6 DAILY VEHICLE MILES OF TRAVEL (VMT)



	BRONX	BROOKLYN	MANHATTAN	QUEENS	STATEN ISLAND	NASSAU	SUFFOLK	PUTNAM	ROCKLAND	WESTCHESTER
2017 Base Year	8,859,310	12,397,123	8,804,885	19,658,724	5,694,789	29,231,875	40,983,205	3,484,730	8,275,831	24,679,612
2045 Build Scenario	9,664,710	13,244,902	9,368,120	21,083,999	6,170,281	32,778,256	46,643,765	3,935,760	10,180,661	28,207,147

Source: NYMTC

- The Public Transportation Agency Safety Plan: a safety plan that includes (a) methods for identifying and evaluating safety risks and (b) strategies to minimize the exposure of the public, personnel, and property to hazards and unsafe conditions.
- The Congestion Mitigation and Air Quality Improvement Program Performance Plan, which includes (a) a baseline level for traffic congestion and on-road mobile source emissions; (b) progress made in achieving performance targets; and (c) a description of projects for funding and how projects will contribute to achieving emission and traffic congestion reduction targets.
- The Congestion Management Process (described in previous sections of this Plan).
- The State Freight Plan (appropriate metropolitan portions): a statewide multi-modal and intermodal plan to improve freight movement and connections to markets and supporting the economic importance of freight movement.
- The Transit Asset Management Plan: developed by FTA designated recipients, this plan should include at a minimum capital asset inventories, assessments of condition, and investment prioritization.
- Other relevant State or regional plans and processes (e.g. pedestrian and bicycle plans).

The integration of performance measurement in this fashion will be demonstrated in the System Performance Report which is amended into *Plan 2045* in the timeframes specified by the relevant regulations.

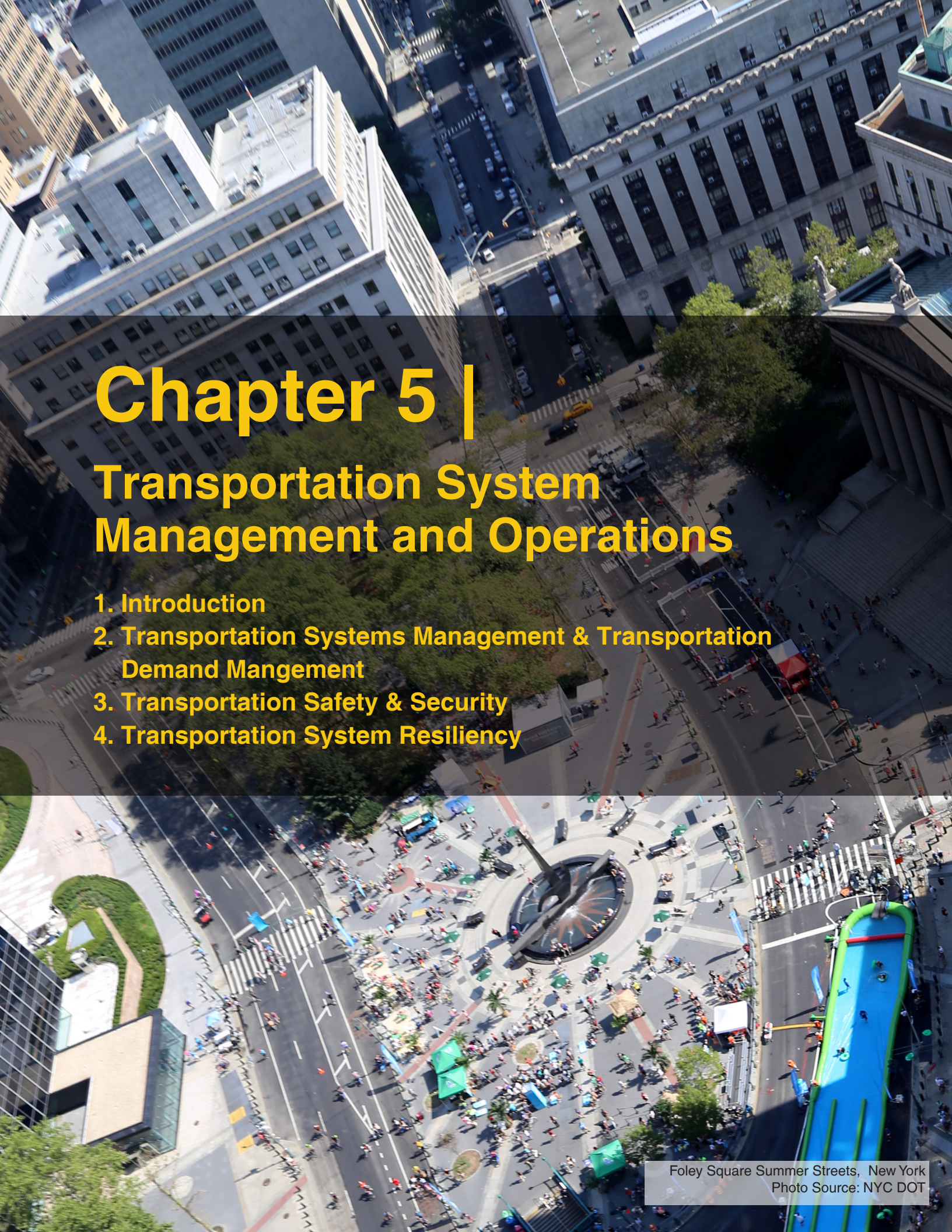
ENDNOTES

[1] https://www.federalregister.gov/documents/2016/03/15/2016-05202/national-performance-management-measures-highway-safety-improvement-prog
[2] https://www.federalregister.gov/documents/2016/07/26/2016-16883/transit-asset-management-national-transit-database
[3] https://www.federalregister.gov/documents/2016/08/11/2016-18920/public-transportation-safety-program
[4] https://www.federalregister.gov/documents/2017/01/18/2017-00550/national-performance-management-measures-assessing-pavement-condition-for-the-national-highway
[5] https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system
[6] 23 CFR Part 450.306(d)(4)

Chapter 5 |

Transportation System Management and Operations

1. Introduction
2. Transportation Systems Management & Transportation Demand Mangement
3. Transportation Safety & Security
4. Transportation System Resiliency



Foley Square Summer Streets, New York
Photo Source: NYC DOT

West 6th Street, Brooklyn
Photo Source: NYC DOT

1. INTRODUCTION

The forecasted increased in demand on the transportation system from continued growth described in Chapter 2 will be one of the greatest mobility challenges in the NYMTC planning area during the planning period. Implementing the system enhancement projects recommended in Plan 2045, as well as the projects programmed in the FFYs 2017-2021 TIP, will not be sufficient to offset the increased demand and alleviate congestion on the system. Additionally, there are financial, environmental, regulatory and political constraints on the level of capacity expansion that can reasonably be achieved for the transportation system through the Plan's horizon year. For these reasons in particular, the management and operations of the system to optimize its efficiency and effectiveness are of paramount importance.

The forecasted increased in demand on the transportation system from continued growth described in Chapter 2 will be one of the greatest mobility challenges in the NYMTC planning area during the planning period. Implementing the system enhancement projects recommended in Plan 2045, as well as the projects programmed in the FFYs 2017-2021 TIP, will not be sufficient to offset the increased demand and alleviate congestion on the system. Additionally, there are financial, environmental, regulatory and political constraints on the level of capacity expansion that can reasonably be achieved for the transportation system through the Plan's horizon year. For these reasons in particular, the management and operations of the system to optimize its efficiency and effectiveness are of paramount importance.

The term *Transportation Systems Management and Operations* (TSM&O) refers to the integrated strategies which optimize the performance of transportation infrastructure through projects and programs designed to operationally maximize capacity and improve the safety and reliability of the transportation system.
TSM&O enhancements can help provide travelers with real time information about transportation choices in and around the region. TSM&O solutions can offer high returns on lower-cost operational projects and programs which can delay or eliminate the need for capital-intensive infrastructure projects. Additionally, these solutions can help reduce emissions of transportation-related greenhouse gases and other mobile source pollutants by maximizing system efficiency. TSM&O also seeks to improve the safety and security of the transportation system, as well as its resiliency.

The management of demand and congestion and maximizing of capacity and reliability within a safe transportation environment using TSM&O strategies can enhance air quality and the regional environment while improving mobility, system safety and security, system resilience and optimizing travel times and costs for all travelers. The core components of TSM&O are described in the following sections.

2. TRANSPORTATION SYSTEMS MANAGEMENT (TSM) & TRANSPORTATION DEMAND MANAGEMENT (TDM)

TSM and TDM strategies and techniques are key components of TSM&O. Current and planned TSM and TDM projects and programs are recommended in order to:

- Increase the carrying capacity of the transportation system, reduce congestion, and improve safety on existing roads and transit networks;
- Manage and reduce peak-hour automobile travel; and
- Improve and promote alternatives to driving.

TSM focuses on projects and programs that use technology and minor infrastructure changes to increase the capacity and efficiency of existing road and transit systems. TDM is a separate set of techniques that focus on modifying travel behavior and encouraging travel on higher-occupancy modes of transportation. The availability of travel and transportation system data has become increasingly important in the effective implementation both TSM and TDM strategies.

TSM STRATEGIES

TSM strategies are intended to increase the safety, efficiency, and capacity of existing transportation networks by means of physical, operational, and regulatory improvements. TSM strategies are significant in the NYMTC planning area because they are low-cost, localized modifications of existing infrastructure, and generally take little time to implement compared to building new roads or new transit lines.[1] These strategies range from technology and information that help commuters respond efficiently to conditions on the transportation system, to low-scale construction projects that optimize infrastructure capacity.

TSM strategies can be grouped into seven categories:

1. Intelligent Transportation Systems;
2. Traveler Information;
3. Roadway Management and Operations;
4. Transit/Rail Management and Operations;
5. Value/Congestion Pricing;
6. Active Transportation Demand Management; and
7. Integrated Corridor Management

The transportation system in the NYMTC planning area includes many examples of deployment of TSM strategies:

A. INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Intelligent Transportation Systems involve the application of technology (such as wired and wireless communication technologies, advanced sensors, surveillance cameras, computers and electronics) in an integrated manner, in conjunction with effective management strategies. As indicated in Table 5.1, NYMTC's members continue to enhance the transportation system through various ITS investments.

ITS is implemented through an ITS architecture, which is a plan that outlines how specific ITS technologies should be deployed and integrated. In the NYMTC planning there are ITS architectures for each of the three subregions: New York City, Long Island and the Lower Hudson Valley. These architectures are drawn from the National ITS Architecture first promulgated by the USDOT in 1994. Each of the subregional ITS architectures apply a particular method of operation to a specific area where ITS has been and will continue to be deployed.

- The New York City subregional ITS architecture is large and complex and is operated largely by four major owners: NYC DOT, NYSDOT, MTA, and the Port Authority. An update of this architecture is currently near completion. The architecture features a Joint Transportation Management Center (JTMC) located in Long Island City, Queens, where advanced ITS controls and monitoring are undertaken.

  TMCs foster a holistic approach by using ITS to create system integration. Through electronic communication with field devices, TMCs can remotely monitor, control and disseminate information related to transportation conditions. The JTMC in New York City is operated by NYC DOT, NYSDOT, the New York Police Department and the New York State Police. It is one of the largest and most complex transportation management centers in the nation. In addition, the MTA and the Port Authority have various other operational centers to manage their bridges and tunnels and their transit operations.

- The Long Island subregional ITS architecture encompasses Nassau and Suffolk counties and is focused on the INFORM (INformation FOR Motorists) system. A TMC coordinates and manages incidents, communicates with other agencies and monitors traffic conditions on major roadways. The major ITS participants include NYSDOT, Nassau County, Suffolk County, MTA, and the municipal police, fire and public works departments.
- The Lower Hudson Valley subregional ITS architecture integrates ITS information in the Hudson Valley, including Rockland, Westchester, and Putnam counties in the NYMTC planning area. Traffic operations are managed by its TMC located in Westchester County. The major participants are NYSDOT, the New York State Police, and Westchester County, as well as several other agencies.

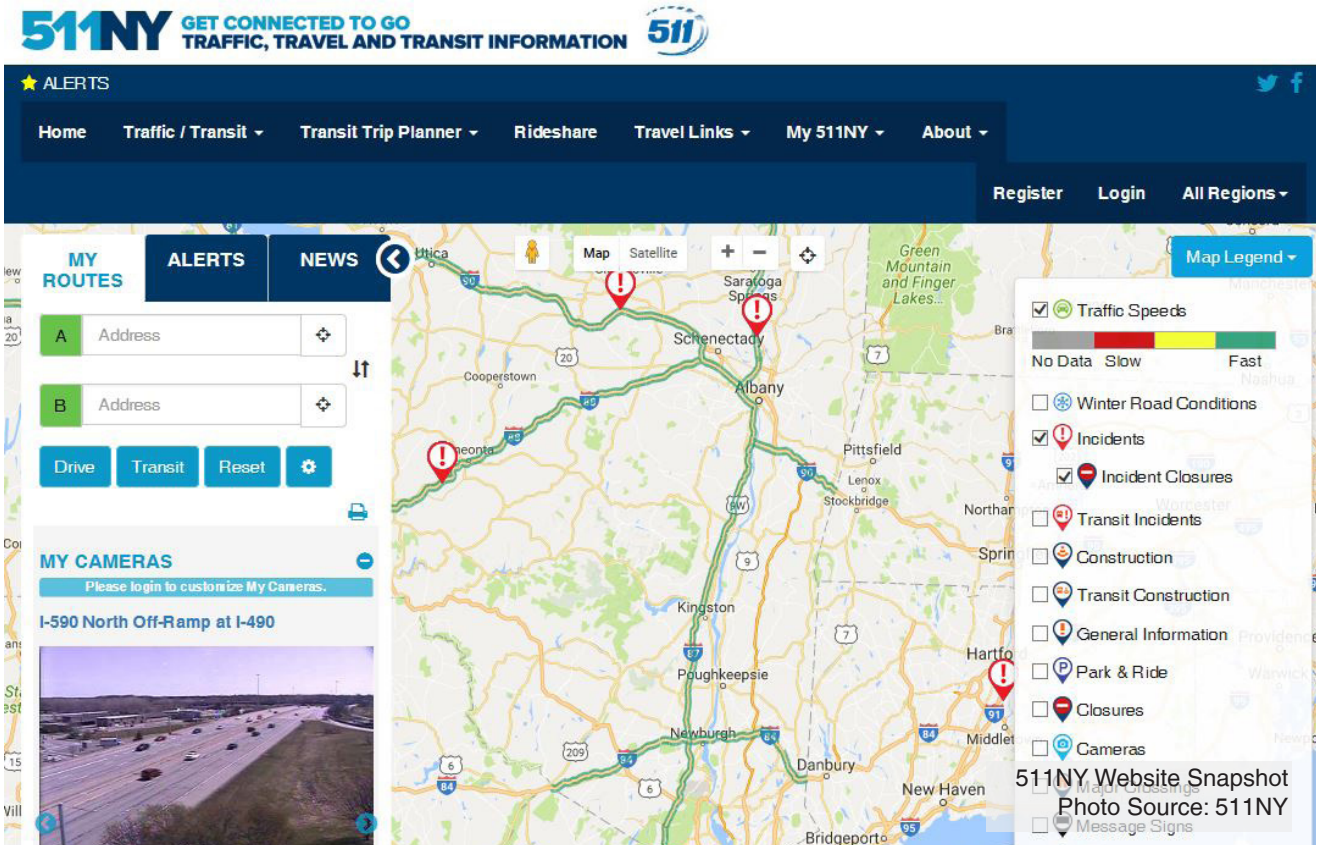
Another ITS-related resource in the NYMTC planning area is TRANSCOM, which is a coalition of 16 transportation and public safety agencies in the multi-state metropolitan region. TRANSCOM was created in 1986 to provide a cooperative, coordinated approach to regional transportation management. Additionally, the I-95 Corridor Coalition has a major role in the development and maintenance of a megaregional ITS architecture. The Coalition provides regional ITS coordination among its members through ITS infrastructure, which facilitates the sharing of live and archived data and video images for managing traffic operations, incidents, and traveler information.

ITS Integration

NYMTC developed an ITS Integration Strategy Report in 2009 that recommended how each of the three subregional ITS architectures described above should work together. The Report proposed three major goals: identification of opportunities where ITS investments can work together toward regional interoperability and provide the desired regional ITS services; enhancement of interagency cooperation in the management and development of ITS; and, targeting of ITS projects and initiatives early in the planning process to facilitate greater integration.

There are more than 260 categories of ITS operations In the NYMTC planning area, included in the inventory of New York Sub-regional ITS Architecture: http://www.consystec.com/nycsraupdate/web/inventory.htm

Real-time Traffic Sign in Nassau County
Photo Source: Nassau County



511NY Website Snapshot
Photo Source: 511NY

B. TRAVELER INFORMATION

Traveler information can broadly be defined as the provision of road or transit information to travelers so that they will be aware of weather conditions, congestion and delays, alternative routes, and service schedules. The availability of this information allows users of the transportation system to make more knowledgeable decisions about routes and travel modes, thereby increasing the efficiency of the transportation system. The two primary components of traveler information are real-time information for traffic and transit, and trip planning.

The quality and effectiveness of traveler information strategies are highly dependent on the availability comprehensive, real-time data relating to system conditions and service status. Different methods of reaching travelers range from low-tech radio broadcasts to the continuously expanding field of personal mobile communications.

The most common technologies used to communicate traffic conditions to motorists include public broadcasting on television or radio, variable message signs (VMS) posted on roadways alerting drivers to current and future conditions, smartphone applications, portable navigation devices that combine global positioning system (GPS) with remote traffic updates to reroute drivers, and trip planning and navigation services that are based on current or average travel conditions and user specified inputs.

In the NYMTC planning area, *511 New York* (511NY) is the most comprehensive Traveler Information system available. This system is available via phone by dialing 511 or on the web at www.511ny.org. It provides information via text and maps regarding current traffic and transit conditions, as well as transit route trip planning and rideshare services. 511NY also provides via additional links travel information related to specific modes of transportation, such as automobile, public transportation, bicycling and air travel. There are various smartphone applications available to travelers that source information from 511NY and other national providers of traffic and transit information.

C. ROADWAY MANAGEMENT & OPERATIONS

Incident Management

Nonrecurring traffic incidents such as vehicle breakdowns, crashes, or delays due to severe weather are typically responsible for more than half of peak-hour traffic congestion in major US cities.[2] They also increase the risk of secondary collisions between uninvolved motorists. In mass transit systems, incidents such as stalled trains, signal malfunctions, sick passengers or police activity cause delays for riders.

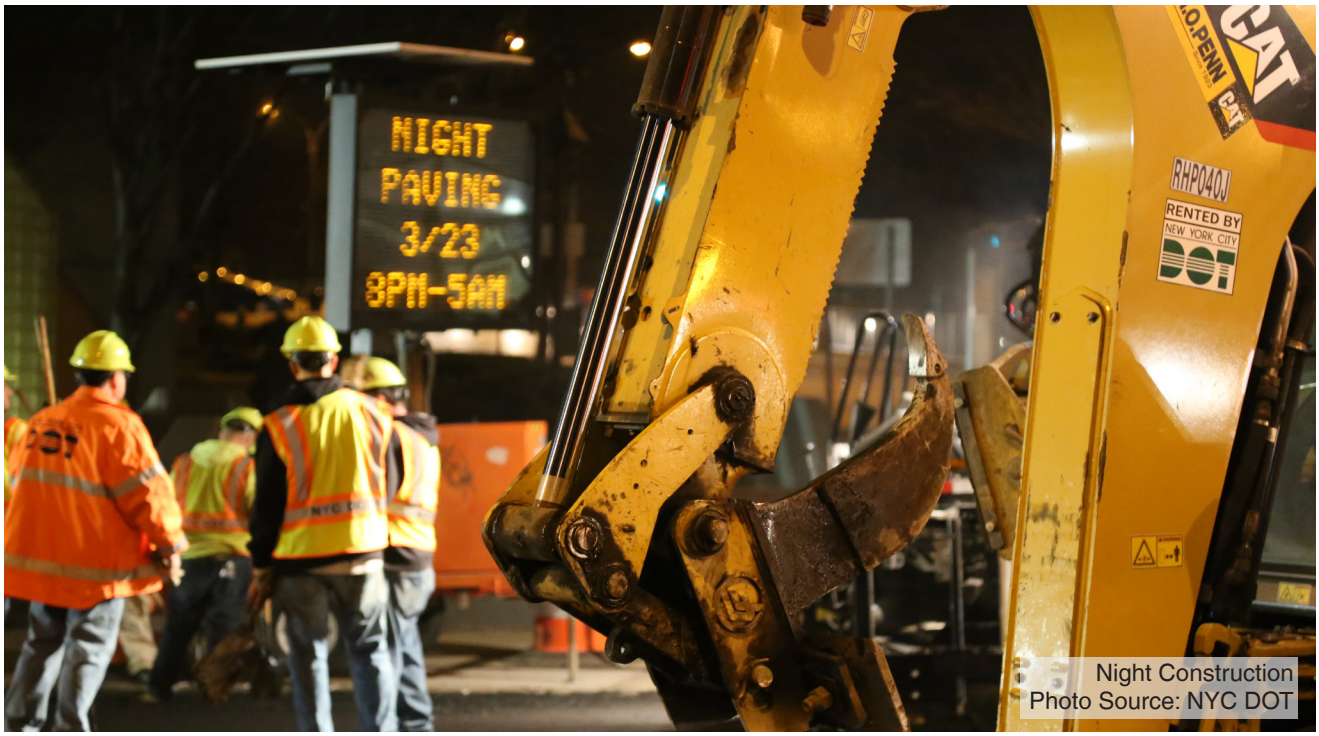
Incident management is the response to such events, and it is defined by the Federal Highway Administration as any "planned and coordinated program to detect and remove incidents and restore traffic [and transit] capacity as safely and quickly as possible."[3] Though some incident management strategies involve using traveler information to warn travelers of delays and to suggest alternatives, there are numerous other measures that must be taken to clear incidents as efficiently as possible so that regular operation can be restored.

In the NYMTC planning area, various incident management systems and protocols are already in place, involving transportation, public safety, and emergency agencies. These systems can effectively address transportation as well as security-related incidents. Governmental and nongovernmental bodies work closely to coordinate operations and share information across jurisdictions.

In response to traffic incidents that occur on New York State highways, NYSDOT and the New York State Police have implemented the Highway Emergency Local Patrol (HELP) program. Using a designated fleet of vehicles patrolling major roadways, HELP can locate and assist in the clearance of traffic incidents. Expansion of the HELP system to cover a larger area would successfully reduce system delays in the NYMTC planning area.

Work Zone Management

Work zone management encompasses a range of techniques aimed at reducing delays, maintaining worker and traveler safety, ensuring that construction is accomplished on schedule, and maintaining access for businesses and residents over the course of a project. Work zone management on roadways and transit can impact congestion at various levels in regard to both space (local to regional effects) and time (projects that range from one day to several years).



Night Construction
Photo Source: NYC DOT

From the perspective of a traveler, work zones and incidents have similar effects on travel time and the possible need for travel alternatives, which makes traveler information technologies important to work zone management. However, mitigating congestion caused by construction is very different from managing incidents since the work is planned in advance, allowing traffic and transit planners and engineers to collaborate with construction personnel so that steps can be taken to mitigate the anticipated impacts of the work.

Aside from notifying the public through traveler information mechanisms, the following additional methods may be employed as part of a comprehensive work zone management plan: improving alternative routes of travel and advertising them; providing temporary facilities to absorb demand for travel during facility closures; staging work to occur in off-peak hours; providing police officer control in case of unanticipated conditions; and providing proper signage, safety devices, and lighting to ensure the safety of all travelers and construction workers.

Access Management

FHWA describes access management as "a set of techniques that State and local governments can use to control access to highways, major arterials, and other roadways. The benefits of access management include improved movement of traffic, reduced crashes, and fewer vehicle conflicts."[4] Access management is a key technique for optimizing roadway capacity and improving the efficiency of roadway operations in the NYMTC planning area, particularly in light of forecasted growth and anticipated land use changes.

Access management includes several techniques that are designed to increase the capacity of these roads, manage congestion, and reduce crashes. These include: Increasing spacing between signals and interchanges; driveway location, spacing, and design; use of exclusive turning lanes; median treatments, including two-way left turn lanes that allow turn movements in multiple directions from a center lane and raised medians that prevent movements across a roadway; use of service and frontage roads; and land use policies that limit right-of-way access to highways.

Raised Median and Exclusive Left Turn Bay, Brooklyn
Photo source: NYC DOT

NYMTC's members can use access management policies to preserve the functionality of their roadway systems. This is often done by designating an appropriate level of access control for each of a variety of facilities. Local residential roads are allowed full access, while major highways and freeways allow very little. In between are a series of road types that require standards to help ensure the free flow of traffic and minimize crashes, while still allowing access to major businesses and other land uses along a road.

Managed Use Lanes

Managed use lanes (MULs) are operational strategies for managing the use of roadway segments or lanes in response to changing conditions.[5] In 2014, NYSDOT completed a MUL study that investigated the feasibility of implementing and operating a MUL network within New York City to improve overall mobility on selected corridors on the state highway and local arterial system. The strategies explored included:

> On limited access highways
  - Transit: high-occupancy vehicle (HOV) lanes; exclusive transitways; queue jumps and bus-only use of roadway shoulder lanes;
  - Pricing: high-occupancy toll (HOT) lanes; and

- Efficiency: Exclusive/dedicated truck lanes; contra-flow lanes; temporary shoulder use; speed harmonization; queue warning; dynamic rerouting; and junction control.

> On arterial roadways:

- Transit: HOV lanes; exclusive transitways; bus rapid transit (BRT) measures; transit signal priority; bus-on-shoulders/parking lanes; and queue jumps.
- Efficiency: Shoulder/parking lane use and dynamic rerouting

Localized Bottleneck Reduction (LBR)

The LBR program was initiated by NYSDOT to investigate opportunities and develop measures for the application of operational and low-cost infrastructure improvements to address (a) localized recurring chokepoints on the roadway system, and (b) to implement cost-effective congestion improvements in the short-term or as alternative solutions are being developed. NYSDOT has implemented a number of LBR projects on the Clearview Expressway, and others are being planned.

C. TRANSIT/RAIL MANAGEMENT & OPERATIONS

While many of the roadway TSM&O measures described above also impact transit operations, there are a number of techniques available to transit operators in the NYMTC planning area to further improve the efficiency, reliability and safety of the transit systems. It should be noted that while the common objective would be improving the efficiency and safety of the regional transportation system, many of these strategies are dependent on the operational objectives of individual transit operators. Among the techniques available to transit operators are:

> Service directness – limiting the number and time of transfers;
> Loading standards – strategic improvements to match with the busiest point along routes;
> Traveler information – described in Section (ii) above;
> Customer service/safety improvements – such as increased use of closed-circuit television on vehicles and facilities (also described in the transit enhancements/marketing section below);

Selected Bus Service
Photo Source: NYC DOT

- Transit signal priority – identification and prioritization of transit routes for transit signal priority systems. Also collaboration with traffic management agencies to leverage transit signal priority implementation with traffic signal upgrades;
- Improvements in automated fare collection (also described in the transit enhancements/ marketing section below); and
- Support for park-and-ride facilities to facilitate better access to transit service

D. VALUE/CONGESTION PRICING

Congestion pricing, or value pricing, is a market-based strategy to help manage travel demand whereby travelers are charged a fee for access to and/or travel within a specified region, road, or road segment (lane, bridge, or tunnel). By pricing facilities that experience severe congestion, especially during peak hours, congestion pricing seeks to reduce traffic by diverting peak travel to off-peak periods or less congested routes. The fees charged can be either flat, or set to vary according to the time of the day and the level of traffic.

By dissuading a proportion of travelers from using highly traveled routes, congestion pricing helps reduce traffic flow disruptions that otherwise would have occurred without pricing and as a result maintains a high level of vehicle throughput during peak travel periods.[6] Electronic toll collection technologies such as electronic "passes" and GPS (Global Positioning Systems) can enable congestion pricing by making toll collection possible without the need for toll booths or traffic interruption. The system may be complemented by automated enforcement, whereby video cameras are used to detect violators.[7]

Congestion pricing exists under various forms: variably priced lanes, such as HOT lanes; variable tolls on entire roadways; cordon charges, which are fixed or variable charges to drive within or into an area; and area-wide charges, such as per-mile charges within an area or network that may vary by level of congestion.[8]

By reducing congestion and ensuring higher vehicle throughputs, congestion pricing can help increase vehicle speed and travel time predictability as well as reduce travel delays without the cost of road widening. Congestion pricing also has demand management effects in that it can help shift a portion of travelers to higher capacity modes such as carpooling or transit, or non-motorized modes such as bicycling. In addition, congestion pricing generates revenue that can be used to operate the system and to fund transit or road improvements.[9]

E-ZPass Toll Collection at Queens Midtown Tunnel
Photo Source: MTA Bridges and Tunnels

E. ACTIVE TRANSPORTATION DEMAND MANAGEMENT (ATDM) & INTEGRATED CORRIDOR MANAGEMENT (ICM)

ATDM is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow on transportation facilities. Through the use of available tools and assets, traffic flow is managed and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency.

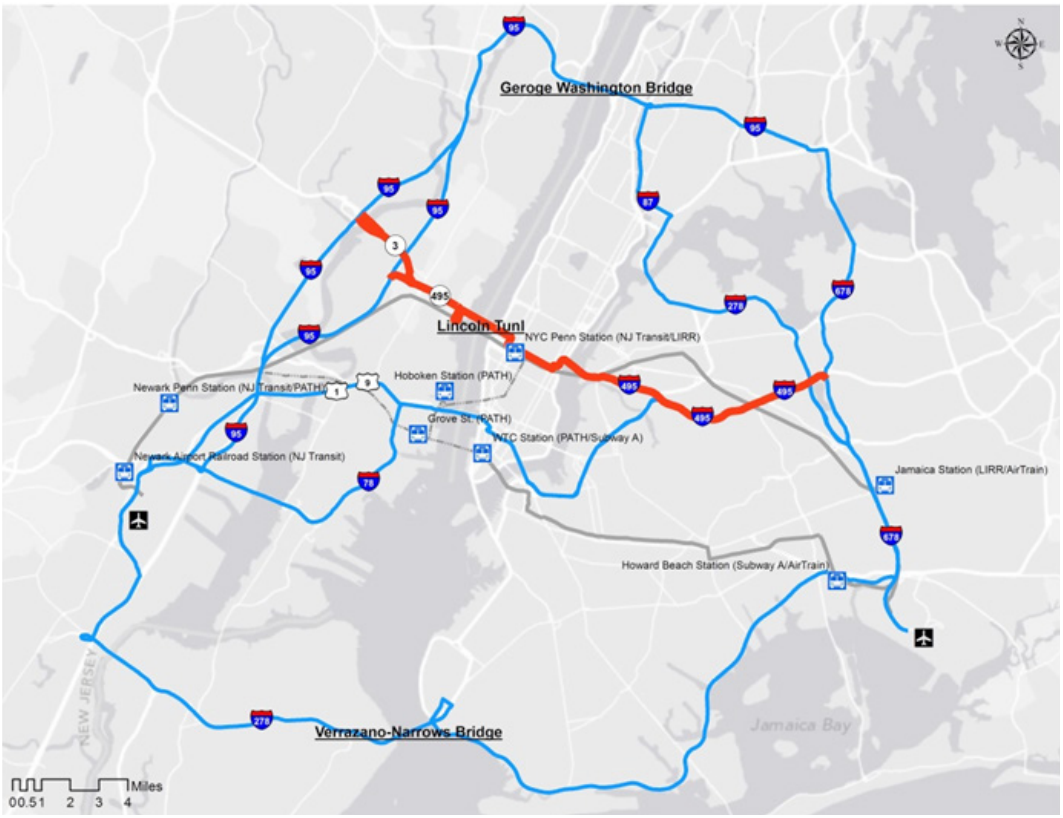
Under an ATDM approach, the transportation system is continuously monitored and actions are performed in real-time to achieve or maintain system performance. The ATDM approach combines the use of both TSM and TDM strategies in a corridor in real time in response to changing conditions. It is dependent on coordinated ITS technologies to monitor and respond to congestion and delays using technologies embedded in the transportation system itself to detect traffic and transit flow conditions and respond adaptively to ease congestion.

ICM is a particular example of an ATDM approach. ICM analyzes transportation information from a multimodal perspective, allowing, where feasible, technologies for traffic, transit, and other modes to work together in easing overall congestion. The following ICM projects are being planned and/or tested in the NYMTC planning area:

I-495 Corridor

In February 2015, USDOT approved a grant for the development of an ICM Concept of Operations for the I-495 Corridor. The proposed corridor includes sections of I-495 and Route 3 in New Jersey and Interstate 495 (the Long Island Expressway or Queens-Midtown Expressway) in New York. The Corridor connects the New Jersey Turnpike (a section of I-95) to Van Wyck Expressway (I-678) and traverses midtown Manhattan and two key regional facilities – the Lincoln Tunnel, which connects New Jersey and Manhattan under the Hudson River, and the Queens Midtown Tunnel, which connects Manhattan and Queens under the East River.

FIGURE 5.1 - PRIMARY CORRIDOR FOR THE I-495 CONCEPT OF OPERATIONS

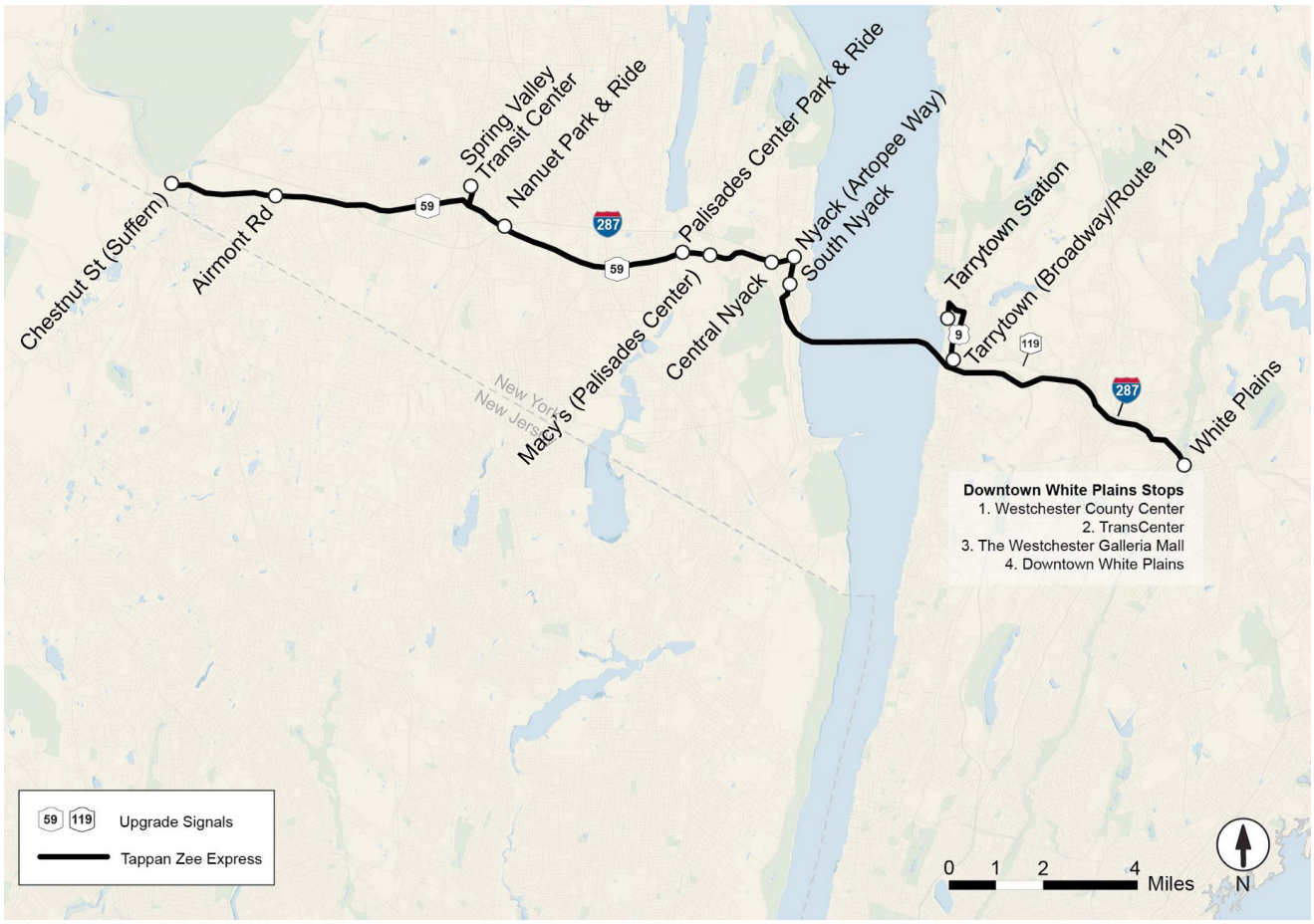


The Concept of Operations will be for a full deployment of traditional and innovative Active Transportation Demand Management and Intelligent Transportation System solutions for this multi-modal corridor which already has robust ATDM and ITS solutions in place. It will establish the technical and institutional framework within which the partnering agencies can pursue ATDM initiatives that advance their strategic goals. These initiatives are expected to include: Reducing non-recurring delay and improving situational awareness and incident management by broadening the sources of real-time data about roadway performance; formalizing incident reporting and ICM event definitions; encouraging mode shift by giving travelers better information about their alternatives to driving, and technology to speed up transit; creating data partnerships with private sector freight shippers and receivers; and reducing recurring congestion by using more granular data to target and mitigate congestion hot spots.

I-87/I-287 Corridor

The I-87/I-287 Corridor is a critical east-west corridor in the Lower Hudson Valley, including the parallel and connecting arterial roadways within Rockland and Westchester counties. The New New York (NY) Bridge Project is currently constructing a replacement for the Tappan Zee Bridge, which carries I-87/I-287 over the Hudson River between the counties. The Lower Hudson Transit Link (LHTL) is a program of integrated transit-supportive infrastructure projects along the I-287/I-87 corridor being undertaken in conjunction with the New NY Bridge Project. The LHTL program will initiate implementation of a corridor transit plan put forth by the 31-member Mass Transit Task Force (MTTF). The various program elements include new distinctive buses, shelters and modern passenger amenities at a combination of existing and proposed new bus stop locations; pedestrian safety and operational improvements at the bus stop/shelter locations and adjacent intersections

FIGURE 5.2 - LOWER HUDSON TRANSIT LINK



along Routes 59/119/9; and an Integrated Corridor Management (ICM) system to maximize efficiencies of the existing traffic and transit networks, integrated into the Hudson Valley Transportation Management Center (HVTMC) see additional details in Chapter 6.

Long Island Expressway HOV Contra-Flow Lane Extension/ATDM

The project will extend the existing morning peak period westbound Contra-flow HOV Lane on the Long Island Expressway (LIE), a distance of 3.3 miles from its current terminus to the Grand Central Parkway Interchange. ATDM strategies including variable speeds, buses on shoulder, peak period shoulder use, travel time advisories, queue warning signs, will be deployed to help manage traffic flow and improve safety along this corridor.

The ATDM strategies that would be applied through this project will allow HOVs, taxis, and buses from points east of 97th Street to bypass congestion in the existing westbound LIE between Woodhaven Boulevard and Grand Central Parkway. As part of the project, the eastbound roadway right shoulder will be hardened between Queens Boulevard and 108th Street to replace the lane taken away for the extended contraflow lane. The objective is to maintain the same or better level of service along the eastbound roadway during the AM/PM peak period as it would be under existing conditions.

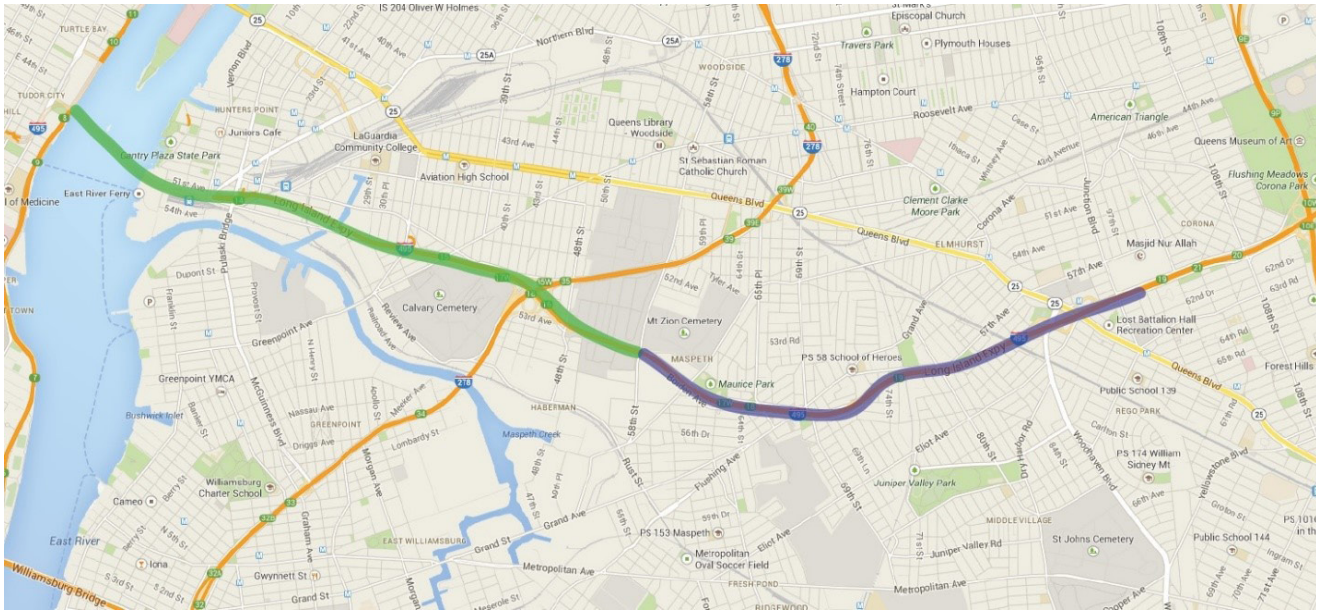
The project would reduce travel time and improve trip reliability for both buses and carpools with three or more occupants within the project corridor, generating trip diversion from single occupant vehicles (SOVs) to both buses and High Occupancy Vehicle (HOV) modes. The project will result in faster and more reliable bus trips and reduce the severe congestion experienced by westbound Manhattan traffic along the LIE Corridor between the LIRR overpass and GCP.

Connected Corridors Pilot Project in the Bronx

This pilot project will provide cooperative traffic management strategies for the mainline, service roads, and major signalized intersections/arterials on the Bruckner Expressway and adjacent highways like the Cross Bronx and Major Deegan expressways. The Connected Corridor system will help transportation agencies to work together to more effectively move vehicles, people and goods on east-west corridors in the Bronx.

The project will employ the use of ATDM strategies to flexibly manage and control traffic based on prevailing conditions, both during typical daily congestion and during congestion that occurs due to accidents, severe weather, construction, stalled vehicles, etc. These strategies may include quick incident response/clearing, speed harmonization (gradually reduced speed advisories as vehicles ap-

FIGURE 5.3 - LIE HOV CONTRA-FLOW LANE EXTENSION



proach a traffic backup), queue warning (messages in advance of queues which allow vehicles time to smoothly and safely reduce speed), junction control (providing a better balance of traffic flow at entrance and exit ramps) part-time shoulder use (using the shoulder as a travel lane during congested periods), dynamic re-routing (to help bypass congestion as necessary), and traveler information (to help travelers make informed decisions).

ATDM for Incident Response for Gowanus Expressway
The focus of this pilot project is the Gowanus Expressway Corridor from the Brooklyn approach to the Verrazano Narrows Bridge at the south to the Hugh L. Carey Tunnel on the north. The purpose of this project is to provide an integrated, responsive, efficient, and flexible incident response system on the Gowanus Expressway Corridor that will reduce incident clearance times, incident related delays, and secondary incidents. The project will employ the use of ATDM strategies to flexibly manage and control traffic during congestion that occurs due to accidents, severe weather, construction, stalled vehicles, etc. These strategies will ultimately improve mobility and enhance safety by using real-time data, technology, and decision support structures for operating agencies to make informed, performance-driven decisions on how to manage traffic flow.

Future ICM Projects
The 2017 Congestion Management Process Status Report identifies a number of critically congested corridors in the NYMTC planning area which are potential targets for ICM projects during the period of *Plan 2045*. These corridors include:

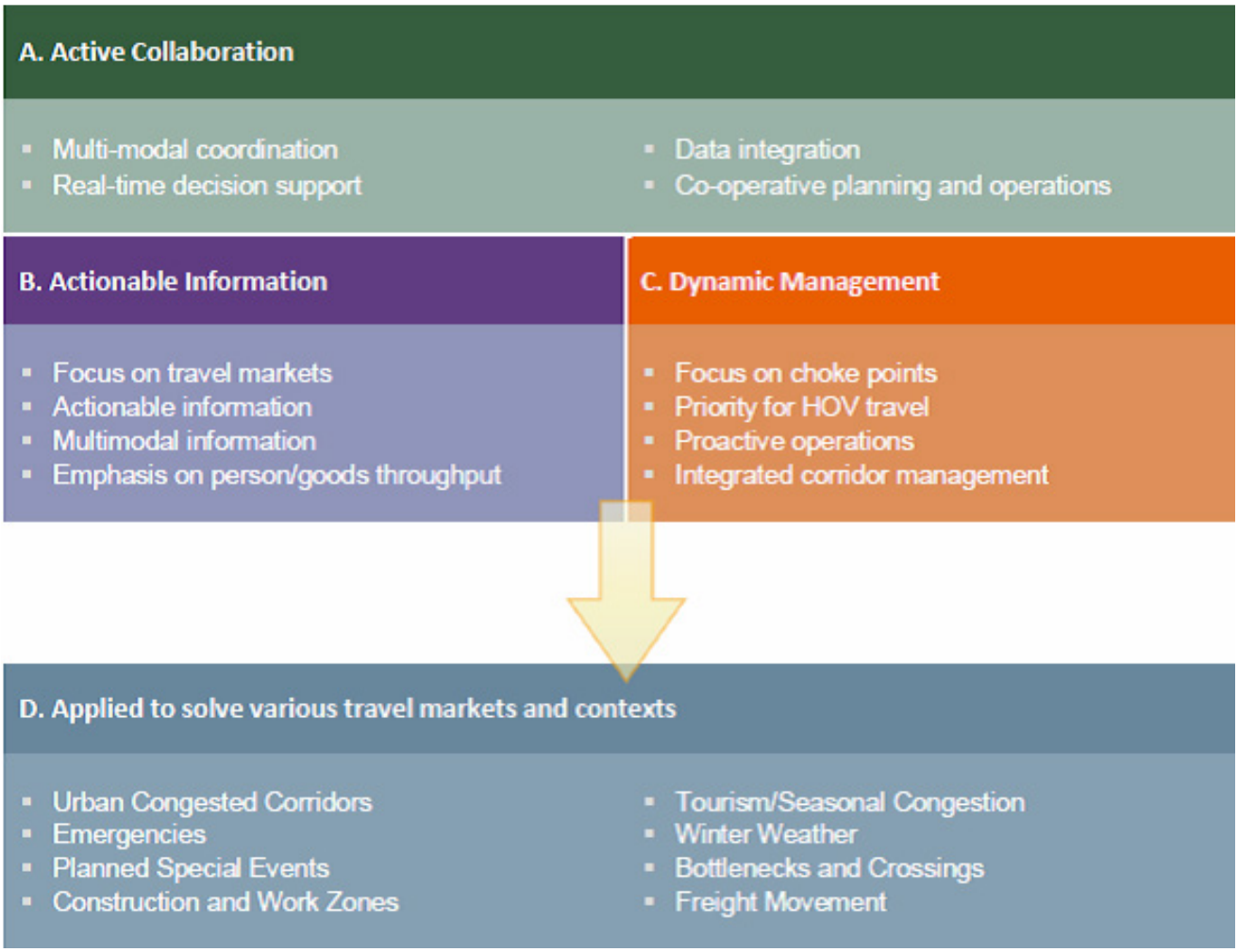
- New York City: the I-95/Cross Bronx Expressway; FDR/Harlem River Drive; Henry Hudson Parkway/Miller Highway; Grand Central Parkway; Belt Parkway; and I-678/Van Wyck Expressway;
- Long Island: I-495/Long Island Expressway; Northern State Parkway; Sunrise Highway; and Southern State Parkway; and
- Lower Hudson Valley: I-87/NYS Thruway; I-95/New England Thruway; and Hutchinson River Parkway.

NYSDOT ATDM Framework
In December 2015, NYSDOT developed and published a framework for ATDM (shown in Figure 5.4 below) which describes a vision for managing a safe, multimodal, and reliable transportation system. Under this vision, transportation is seen as a shared responsibility between state, local, and regional transportation agencies. Accompanying the framework was the ATDM Implementation Plan, providing a list of strategies and recommendations for NYSDOT and its agency partners to consider in the near-term to advance components of the ATDM framework. The framework and implementation plan are not meant to be prescriptive, but could provide strategic framework for this system-level active collaboration that supports safe, reliable and sustainable mobility in New York State in the near future.

Implications of Emerging Technologies
There are emerging technologies that will impact the way in which TSM/TDM & ATDM/ICM strategies will be implemented in the NYMTC planning area now and in the future. These new technologies might influence investments NYMTC members make in order to realize the full potential of the TSM/TDM & ATDM/ICM strategies previously described. Some of these emerging technologies such as connected vehicles, on-demand ride services, and smartphone applications were previously discussed in Chapter 2. It is understood that there would be technical, operational challenges and policy issues to overcome before many of these technologies can be fully implemented. Among these emerging technologies are the following:

Internet of Things (IoT)
IoT is the network of interconnected, uniquely identifiable computing devices embedded in physical objects or things.[10] The devices can be sensors, actuators, and communications technologies that enable communication and control functions between devices and external operators, external systems, and among devices themselves. Connected vehicle systems (including Vehicle-to-Vehicle [V2V], and Vehicle-to-Infrastructure [V2I]) currently under development represent a potentially transformative application of IoT to transportation. Other application examples include vehicles that coordinate with us-

FIGURE 5.4 - STATEWIDE ATDM FRAMEWORK



ers' calendars and reserve parking at destinations. The ability to monitor and collect data from many new sources through IoT should allow for better asset management and maintenance of the transportation system.

Cashless Tolling

Cashless tolling is helping to reduce congestion, improve safety, and reduce vehicular pollution. Under this state-of-the-art technology, more specifically referred to as All Electronic Tolling (AET) and Open Road Tolling (ORT), sensors and cameras are suspended over the roadway on structures called "gantries" and tolls are collected as vehicles pass through at highway/facility speeds. Vehicles with E-ZPass are automatically charged. Non-E-ZPass vehicles have their license plate recorded and a bill is mailed to the registered owner of the vehicle; a system known as Tolls by Mail. New York State Governor Andrew M. Cuomo has announced a plan to bring AET/ORT to all MTA Bridges and Tunnels facilities. In February 2017, the Port Authority also implemented cashless tolling at the Bayonne Bridge, in conjunction with its ongoing "Raise the Roadway" project to improve navigational clearance for ocean-going vessels and to modernize and extend the life of the bridge.

Advanced Robotics and Automation

Given the aging transportation infrastructure in the NYMTC planning area, advances in robotics and automation have the potential to provide vast improvements in the assessment of structural integrity and deterioration of various assets, especially the roadway and bridge networks. Improvements in robotic inspection technologies which use tools such as surface robots, sensors, and 3D imaging could result in a more reliable, safer transportation system and additional longevity of existing infrastructure.

TABLE 5.1: MAJOR TSM PROJECTS/OPERATIONS IN THE NYMTC PLANNING AREA

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Transit				
MTA New York City Transit Bus Transit Signal Priority (TSP)	To create a wireless and centrally-controlled TSP system which could be deployed anywhere in NYC. Within several years 100% of traffic signals will have state-of-the-art controllers connected through a wireless network to the central NYC traffic computer. The MTA will initially equip 200 buses to communicate with the central NYC traffic computer.	Initially 7 bus routes and corresponding traffic signals; ultimately the entire bus fleet and applicable traffic signals	ITS/ADTM	Advanced Traffic Management and Advanced Public Transportation Systems
Westchester Bee-Line TSP	Westchester County has installed TSP on the Central Avenue Corridor, extending from the Bronx border to White Plains.	Initially 78 buses, with entire fleet and additional corridors under consideration	ITS	Advanced Traffic Management and Advanced Public Transportation Systems
Nassau County Hub Transit Initiative	Nassau County will be installing TSP as part of the Initial Operating Segment (IOS) of the Hub Transit Initiative. The IOS service will run from Hempstead Village to Roosevelt Field via the Nassau Hub, and TSP will be an integral component of this new BRT service in Central Nassau.	All new BRT buses will be ordered with TSP, and signalized intersections along the IOS will be retrofit with TSP.	ITS	Advanced Traffic Management and Advanced Public Transportation Systems
Bus lane enforcement cameras	This automated enforcement project will record the license plate number of vehicles that violate bus lane regulations, and send a summons which is not a moving violation to the owner. The cameras do not capture an image of the people in the vehicle, only the license plate number.	Selected bus route corridors in New York City	ITS	Advanced Public Transportation
Bus Security Cameras	Bus security camera systems are currently being installed in MTA buses. The purpose of these cameras is to serve as a deterrent to criminal activity, thereby improving the efficiency and safety of the bus system. In the event of an incident, the video recorded on the cameras can help to explain what transpired and serve as evidence.		ITS	Advanced Public Transportation

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Rail Control Center (RCC) & Automatic Train Supervision (ATS)	Automatic Train Supervision to monitor service and route subway trains to the right tracks. The RCC also centralizes the management of subway maintenance disciplines and customer information systems in stations. Future infrastructure is intended through the installation of advanced signal systems like Communications-Based Train Control or through adoption of new service monitoring technologies.	In the coming years, NYCT is looking to expand ATS-like capabilities to additional subway lines (lettered lines and the 7)	ITS	Advanced Public Transportation
Communications-Based Train Control (CBTC)	The computer-based Communications-Based Train Control allows subway trains to safely operate closer together and at higher speeds, resulting in an increase in maximum track capacity by approximately ten percent.	CBTC is now under construction on the 7 and planned for additional lines as they come due for signal modernization	ITS	Advanced Public Transportation
MTA LIRR and Metro North Positive Train Control Implementation	PTC system is designed to prevent train- to-train collisions, over-speed derailments, incursions into established work zones limits, and the movement of a train through a switch left in the wrong position. The Rail Safety Improvement Act of 2008 requires implementation of PTC on all commuter railroad main-line tracks.	The system could be expanded as necessary	ITS	Advanced Public Transportation System
PATH Signal System Replacement/ Positive Train Control Implementation	Replacement of the PATH signal system to provide Communications Based Train Control (CBTC) and Positive Train Control is ongoing, with PTC compliance on schedule for 2018 completion and full CBTC project completion by 2022.	The system can be expanded as necessary	ITS	Advanced Public Transportation System
Bus Time	Bus Time is a real-time bus information system for customers. The system can provide next bus information by bus stop or bus route, using computer, handheld or text message. It has the capability to be expanded to offer fixed displays at bus stops. Today the system informs customers how many minutes until the next bus arrives and the distance away.	NYC DOT is in the process of installing a fixed display with this information at many SBS stops	ITS/Automatic Vehicle location (AVL) and Traveler Information	Advanced Public Transportation System

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Real time bus information	Westchester County plans to launch real time bus information in 2017 via Google Transit. Static schedule information is currently available.	Information would initially be available on mobile devices.	ITS/Automatic Vehicle Location (AVL) and Traveler Information	Advanced Public Transportation System
Public Address/ Customer Information Screens (PACIS)	Building upon its ATS and CBTC systems, these are variable message signs which provide real-time train-arrival information to passengers waiting on station platforms and mezzanines.	PA/CIS will be installed on other segments of the system as they are outfitted with ATS, CBTC, or other technologies enabling real-time information.	Traveler Information	Advanced Traveler Information Systems
Vehicular Traffic Management				
Advanced Solid State Traffic Controllers	The new controllers support complex intersections with phase skipping and real-time traffic responsive operation. The new controllers are able to adapt to the variety of communication media and protocols (fiber, coaxial, twist pairs and wireless) in order to support federal NTCIP standards. The ASTC is capable of being computerized, controlled by the TMC and implementing all of the central system timing patterns, scheduled by time of day and as holiday's event. The new ASTC's are also capable of implementing various traffic patterns for different traffic situations.	Expansion to include all NYC 12,800 traffic signals	ITS/Incident Management	Advanced Traffic Management Systems
Midtown in Motion	This system optimizes traffic mobility in midtown Manhattan via a set of field sensors and software equipment, which communicate wirelessly (via NYCWiN) with the joint traffic managements center (JTMC) and adjust signal timing appropriately in real time. The system utilizes ASTC controllers and includes 100 microwave sensors, 32 traffic video cameras and E-ZPass readers at 23 intersections to measure traffic volumes, congestion, and travel times.	The system is being expanded to downtown Flushing in Queens and Flatbush Avenue in Brooklyn. If necessary, future expansion of this system could include other areas in NYC.	ITS	Advanced Traffic Management Systems

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Regional Signal Timing and Coordination	This corridor based traffic signal retiming project improves traffic mobility and safety. It optimizes arterial traffic flow capacity, discourages speeding, and increases pedestrian walk times at crosswalks.	Future expansion includes additional intersections.	ITS	Advanced Traffic Management Systems
Smart Lights (Adaptive Control System)	This pilot project has been implemented at the entrance to the Staten Island College at Victory Blvd. This is a good signal timing option for improving traffic flow on limited size local areas, where traffic patterns are inconsistent and unpredictable. Smart lights are connected with field sensors to monitor changes in traffic flow and via wireless communication receive signal timing changes from the JTMC almost immediately.	Future expansion could include other NYC areas.	ITS	Advanced Traffic Management Systems
Highway Intelligent Transportation System (ITS)	This system uses traffic cameras and electronic message boards to monitor and improve traffic flows, as well as to inform drivers. The deployment includes fiber and wireless communication to support video traffic cameras, variable message signs (VMS), radio (RFID) readers and travel time signs. All NYC major construction projects require Mobil ITS deployment to support maintenance and protection of traffic management. Current implementation includes the Korean Veteran Parkway, Belt Parkway, and Jackie Robinson Parkway. In Nassau County, the Traffic Management Center (TMC) located in Westbury, NY, uses ITS to communicate with most of the County's traffic signals, surveillance cameras, travel time signing and eventually, variable message signs along arterial roadways.	Future expansion could include other NYC areas.	ITS	Advanced Traffic Management Systems Maintenance and Construction Operations

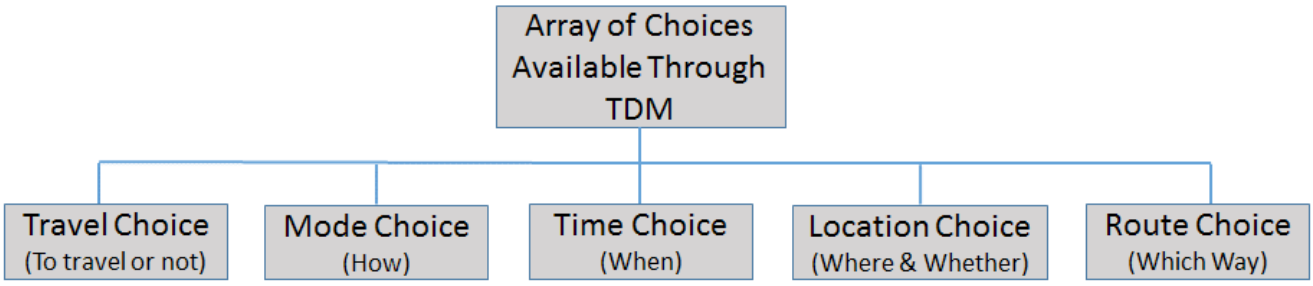
Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Connected Vehicles (CV) Pilot	The goal of the CV Pilot Program is to improve intersection efficiency. Using Dedicated Short Range Communications (DSRC), the Pilot will collect Basic Safety Message data that may negate the need for existing NYC DOT traffic signal system detection. Approximately 250 intersections will be instrumented with roadside equipment (RSE) to communicate with up to 10,000 vehicles equipped with aftermarket safety devices (ASD). These devices will monitor communications with other connected vehicles and the infrastructure and provide alerts to drivers/operators.		ATDM/ITS	Advanced Traffic Management; Advanced Traveler Information Systems
INFORM (INformation FOR Motorists)	The system is one of the nation's largest and most advanced transportation management systems, and consists of electronic monitoring, communications, signing and control components, providing motorist information for warning and route diversion, ramp control, and signal control. All operations are monitored and controlled by the TMC in Hauppauge. It includes more than 4000 vehicle detectors, 206 overhead and 48 portable variable message signs, 1080 traffic signals (500 under central control), 91 ramp meters, 228 closed circuit television cameras, managed lanes, and other ITS features.	The Region intends on eventually having approximately 360 centerline miles of instrumented roadway (see related map following this table).	ITS	Advanced Traffic Management Systems
Freight				
Freight Weight-In-Motion (WIM)	The goal of this research project is to quantify the damage and the corresponding cost to NYC's infrastructure caused by heavy vehicles, utilizing WIM sensors placed at strategic locations. The project also obtains data on vehicle speeds, existing axle weights of heavy vehicles and quantifies the annual damage caused by overweight vehicles using PaveDAT, a FHWA software. The project also examines using WIM and License Place Reader (LPR) technologies along with overview cameras for monitoring compliance with regulations.	Permanent WIM sites have been installed on the Alexander Hamilton Bridge, and Van Dam Street and Rockaway Boulevard in Queens. Other WIM sites may be installed at locations on NYC truck routes.	Active Traffic Management	Advanced Traffic Management Systems Commercial Vehicle Operations Systems

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Vehicular Information and Support				
TRANSCOM OpenReach Servers	The TRANSCOM regional architecture is a program that coordinates the collection and redistribution of traffic flow, origin-destination, incident, construction, equipment status and special event information data between transportation management centers running the TRANSCOM regional architecture.	The system could be expanded as necessary	ITS/Incident Management/ Traveler Information	Advanced Traffic Management, Public Transportation, Emergency Management and Traveler information Systems Maintenance and Construction Operations
511NY	This system is available via phone by dialing 511 or via the web. It provides information via text and maps for current traffic and transit conditions, transit route trip planning, rideshare and other services. www.511ny.org	The system would include additional travel information elements	Traveler Information	Advanced Traveler Information Systems
Highway Emergency Local Patrol (HELP)	Patrol Vehicles/Trucks on major roadways provide motorist assistance as necessary. They also communicate with local TMC to coordinate the response for roadway incidents.	The system would be expanded as necessary to include additional roadways	ITS/Incident Management	Emergency Management Systems
NYSDOT R-11, Regional ITS Deployment	The ITS deployment covers all interstate highways in NYC, including partial coverage along many of the City's Parkways. It includes an extensive electronic monitoring and communications network that provides motorist information about traffic incidents, road construction, travel time, and other traffic conditions. It includes 76 variables message signs, 260 closed circuit television cameras, more than 600 vehicular detectors, 8 highway advisory radio frequencies, managed lanes, and other components.	The system would be expanded in Eastern Queens, Manhattan and southern Brooklyn. Improvements would also include integration via new technologies (i.e., cross-agency via TMCs and vehicle-infrastructure communications)	ITS	Advanced Traffic Management Systems
E-ZPass Customer Service Center	This system includes several Customer Service Centers (CSC) linked with various Toll Collection subsystems. The centers manage toll transactions and interface with a Financial Institution.	The system could be expanded as necessary	ITS	Advanced Traffic Management Systems

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
Transit Operations and Emergency Management				
Long Island Municipal/ County Local Traffic Operation Center (TOC)	The center monitors, analyzes and stores traffic data and controls traffic conditions. The center exchanges highway-rail intersection information with rail operations centers. Its operations include regional traffic management, wide area alerts, and work zone management and coordination.	The system could be expanded as necessary	ITS	Advanced Traffic Management and Emergency Management Systems Maintenance and Construction Operations
Mid-Hudson South Municipal/ County Local TMC	The TMC operations include incident dispatch, coordination and communication, and multimodal coordination, including signal coordination along a particular transit route.	The system could be expanded as necessary	ITS	Advanced Traffic Management and Emergency Management Systems Maintenance and Construction Operations
MTA Bridges & Tunnels Operations Central Command and Control (OCCC)	The OCCC's responsibilities include traffic surveillance, commercial vehicle operations, emergency management, regional traffic management, environmental information management, work zone operations, etc.	The system could be expanded as necessary	ITS/Incident Management	Advanced Traffic Management, Advanced Public Transportation and Emergency Management Systems Maintenance and Construction Operations
MTA LIRR Operations Center Systems	The center operations include rail dispatch operations, vehicle tracking and scheduling systems and emergency management.	The system could be expanded as necessary	ITS	Advanced Public Transportation and Emergency Management Systems Maintenance and Construction Operations
MTA Metro-North Operations Center Systems	The center operations include rail dispatch operations, vehicle tracking and scheduling systems and emergency management.	The system could be expanded as necessary	ITS	Advanced Public Transportation and Emergency Management Systems Maintenance and Construction Operations

Name of Project/ Operation	Description of Project/Operation	Planned Future Expansion	TSM Category	Related NYMTC/ Regional ITS Architecture Strategy
MTA Bus Command Center (BCC)	An expanded, replacement Bus Command Center (BCC) building is being constructed across from the East New York Bus Depot in Brooklyn, NY. It will include a Console Operating Theater, capable of supporting both voice and data traffic between the BCC and individual buses and non-revenue vehicles. The BCC will also house the infrastructure to operate the new digital Bus Radio System.		Security and ITS	Advanced Public Transportation Security & Communication System
New York City Joint Transportation Management center (JTMC)	The center operations include traffic and transit network control and monitoring, emergency management, emissions management, and maintenance and construction management.	The system could be expanded as necessary	ITS/Incident Management	Advanced Traffic Management, Advanced Public Transportation and Emergency Management Systems Maintenance and Construction Operations
NYC Emergency Management Watch Command Center	This is the emergency operations center for the City of New York. The command center is responsible for coordinating responses between the various agencies operating within New York City during major incidents and events.	The system could be expanded as necessary	Incident Management	Emergency Management Systems
PANYNJ Airports Communication desk/operations center	This includes central operations for coordination and communication systems as well as facility-based ITS servers. The functional areas include traffic surveillance, incident management, traffic and transit information services, multi-modal coordination, transit center security, work zone management, etc.	The system could be expanded as necessary	ITS/ Incident Management	Advanced Traffic Management, Advanced Public Transportation and Emergency Management Systems Maintenance and Construction Operations
TRANSCOM OpenReach Servers	The TRANSCOM regional architecture is a program that coordinates the collection and redistribution of traffic flow, origin-destination, incident, construction, equipment status and special event information data between transportation management centers running the TRANSCOM regional architecture.	The system could be expanded as necessary	ITS/Incident Management/ Traveler Information	Advanced Traffic Management, Public Transportation, Emergency Management and Traveler information Systems Maintenance and Construction Operations

FIGURE 5.5 - COMPONENTS OF TDM



TDM STRATEGIES

TDM is the demand-side of TSM&O and complements the previously-discussed supply-side or TSM. TDM refers to a host of strategies that expand travel choices while reducing vehicular SOV travel. TDM also enhances the flexibility of the transportation system by encouraging the types of choices shown below,[11] in order to maximize the efficiency and sustainable use of transportation facilities. TDM strategies/measures allow increased access to transportation systems, improve mobility, and minimize negative impacts of vehicular travel such as traffic congestion, vehicular emissions, and an auto-dominated physical environment.

It should be noted, however, that many TDM approaches require travelers' behavior change. Given this, the opportunities for implementation vary across the NYMTC planning area, as they do in most metropolitan areas. Basically, one size does not fit all and the effectiveness of TDM strategies is highly dependent on local conditions.

A. PROGRAMS PROMOTING ALTERNATIVES TO SOV TRAVEL

Rideshare/Carshare Programs

Ridesharing occurs when two or more people share a single vehicle when making trips. In the NYMTC planning area, ridesharing and carsharing services are promoted by the primary ridematching service in the region - 511NY Rideshare. These services include:

- Carpools – Online ridematching service that allows users to search for and be matched with carpool partners for work trips and other trip purposes.
- Vanpools - The van is owned or leased by a vanpool participant or an employer, or contracted on a month-to-month basis from a third-party vendor. One member of the vanpool volunteers to drive, while riders share the cost of operating the vanpool. In most cases, the driver rides free and has personal use of the van during the evenings and on weekends. The other participants pay a low monthly fare.
- Car-Sharing – These are member-based programs offering 24-hour access to a fleet of vehicles within a city or neighborhood. Car-sharing services substitute for private vehicle ownership, enabling households that only occasionally need a vehicle to save on ownership costs and also reducing the overall demand for parking spaces and the vehicle ownership rate. New York City adopted a car share zoning text amendment that allows car share vehicles to park in off-street parking facilities in appropriate locations.[12] One of the more popular programs in the NYMTC planning area is Zipcar.
- Supporting Programs
  - Park-and-Ride – These facilities allow motorists commuting from peripheral areas to leave their vehicle in park-and-ride lots where they can transfer to public transportation, carpools, or vanpools to complete their journey. The NYMTC planning area and surrounding counties feature a number of park-and-ride locations, some of which require a parking permit.[13]
  - HOV facilities/MULs – These facilities support TDM by giving priority to ridesharing and transit. They provide a travel time incentive to travelers involved in vanpooling, carpooling and using transit.

Active Transportation Programs and Infrastructure
Active transportation includes bicycle and pedestrian programs that improve the attractiveness, convenience, comfort, and safety of both bicycling and walking. These are often implemented in tandem with transit enhancements, streetscape improvements, traffic-calming measures, and initiatives which promote public health.

Among the more successful programs implemented in the NYMTC planning area is the CitiBike Program in New York City with over 22.2 million rides in 2015, many of which were commuting trips. NY511 Rideshare provides maps and other information for bicycling and walking, and also has a "buddy matching" function to help find partners for biking to work. See Appendix 2 for more information on specific pedestrian and bicycling programs and infrastructure improvements.

Second Avenue Subway
Photo Source: MTA

Transit Enhancements and Marketing
Transit Enhancement and Marketing helps reduce traffic congestion and increase transit ridership by improving the appeal of mass transit and by offering financial incentives to lower the cost of taking transit.

- Traveler Information: Transit riders are concerned with waiting time or frequency of service, and the reliability of public transportation.[14] Increasing and improving Rider Information Strategies on buses, subways, and commuter railroads at station entrances and on platforms could help to reduce travel stress and enable riders to make better informed decisions about their travel options,[15] that is, whether to walk, take the bus, ride a different train, or run additional errands before the next arrival. Aside from providing arrival time information, the following strategies help to foster a more comfortable experience for riders;
- Improved payment methods: Prepaid tickets for improved bus boarding speed and fare cards that work for all modes of transit;
- Enhanced smartphone applications: including ticket sales via smartphone and improved customer information;
- Circulator services[16]: Reduced fare transit that has localized service to popular destinations, e.g. downtown, universities, shopping centers;
- Transit station improvements: Comfortable, covered bus stations, temperature controlled stations, cell service and WiFi access in stations, ramps and elevators for people with disabilities and bicyclists, easy pedestrian access to stations, readable maps and clearly marked entrances;[17] and
- Security systems: Installing covert microphones, silent alarms, surveillance cameras, and automatic vehicle location (AVL) to bolster the riders' sense of security on transit.[18]
- Branding is another strategy used to help increase ridership and rider experience. Improving the image of bus services and bus rapid transit has been shown in a study by the American Public Transit Association that it has the potential to increase ridership from 10 to 20 percent, as the public becomes more accepting of riding buses.[19] NYC's Select Bus Service (SBS) provides a good example of the effectiveness of this strategy.

Parking Management Programs

Parking management includes a range of strategies that aim to achieve a more economical use of parking resources and encourage more efficient travel patterns by regulating the demand for, and supply of, both on- and off-street parking. NYMTC has conducted numerous parking management workshops in municipalities across the region. Some of the strategies considered for implementation are listed below and will see further application as the CDEAs recommended by *Plan 2045* are developed.

> Parking pricing and other cost-based measures:
  - Charging vehicle users directly for the use of parking facilities. Optimizing parking availability and cost can reduce vehicle traffic by decreasing "circling" (vehicles searching for an available parking space), recovering parking facility costs, and generating revenues that can potentially be used to fund transit and commercial district improvement projects.
  - Parking spaces near transit stations strategically priced to encourage mass transit usage.
  - Variable rate pricing that can be used to regulate parking demand based on time (weekday, peak hours, or evening), location (residential neighborhood or commercial street), and type of vehicles and/or users (commercial vehicles or owners of residential parking permits).

> Parking supply strategies regulate the availability of on- and off-street parking spaces:
  - On-street parking management addressed by a number of regulations, such as imposing time restrictions for on-street parking spaces, banning overnight parking, requiring permits for certain neighborhoods, or restricting daytime parking on alternate sides of the street and days.
  - Additional parking supply management strategies as well as sustainable development and TOD are discussed in Appendix 4: Pedestrian-Bicycle Plans.

Multi-functional Parking Meter
Photo Source: NYC DOT

> Land use and building regulations, particularly local zoning ordinances, to optimize the supply of off-street parking.[20] Parking standards can be adjusted or made more flexible to reflect contextual factors such as levels of car ownership and use, geographic location, availability of other transportation options, land use mix, building type and function, residential and built density levels, and demographic and socioeconomic characteristics (income, age, and household structure).[21] New York City has made the commitment to evaluate appropriate off-street parking requirements based on these and other variables.[22]

> Unbundling the costs of parking and housing which can help to eliminate unnecessary parking space and save on construction and housing costs.[23]

> Shared parking, where a parking facility is shared among several neighboring sites or uses, reducing the number of parking spaces needed in places where users have different peak parking demand periods.[24]

Programs to Promote Changes in Work Travel Patterns

Employers can influence the travel choices of their employees by offering flexible work arrangements such as telework, compressed work weeks, and flexible work hours. These programs could contribute to the reduction of SOV travel and congestion.

- Telework - Teleworking allows employees to work at home one or more days per week or as permitted by an employer based on need. Employers who offer telework could benefit from increased employee productivity. Employees' benefits could include less parking and commuting expenses in addition to other personal benefits.
- Compressed and Flexible Work Schedules - Compressed work schedules allow employees to complete their weekly work schedule in 4 days instead of 5 or on a bi-weekly basis in 9 days instead of 10 (e.g. some employees in New York State could work their 75 or 80 hours in 9 days instead of 10). In this way commuters could avoid peak congestion weekday travel times based on their compressed schedules. Alternative or flexible work schedules allow employees to start and end their work days at non-traditional times, thereby avoiding peak travel times.

Other Programs to Support the Use of Alternative Travel Modes

There are several other strategies that can further encourage the use of alternative travel modes or conversely discourage the use of SOVs. Some of these are being implemented in some parts of the NYMTC region.

- Guaranteed Ride Home programs –providing occasional employer-subsidized rides (usually by carpooling, shuttles, or taxi) for non-driving employees from their workplace in case of emergencies or unexpected circumstances.[25]
- Pay-As-You-Drive Insurance – these programs link insurance premiums to vehicle miles of travel and basically reward low-mileage drivers with lower premiums than traditional flat-rate insurance. This type of insurance is offered by a number of companies in New York State.
- Parking Cash-Out programs, where employees are given the choice to accept a cash payment instead of a free or subsidized parking space at work if they use alternative travel modes instead of driving alone.[26]
- Commuter Tax Benefits to encourage employees to use transit or vanpool, whereby the company either covers the full cost of the benefit offering a "pre-tax" benefit, or shares transportation costs with the employee.[27]

NYC's Commuter Benefits Law
Photo Source: NYC DOT

Integrated Land Use Planning
TOD is often defined as higher-density, mixed use development within walking distance of transit stations. By locating trip origins and destinations near each other, this compact land-use pattern reduces the demand for motor vehicle travel and facilitates increased transit usage.

Emerging Strategies
Chapter 2 describes anticipated changes over the period of *Plan 2045* that will have implications for transportation. A number of these anticipated changes also have TDM implications and in many instances may alter and amplify TDM strategies such as carsharing, bikesharing, ridesharing and parking. These changes include:

- Real-time Information: Technology that delivers real-time information to travelers now has significant impact on managing demand for commute and non-commute trips alike. Travelers can now make better decisions about how they travel (mode), when they travel (time), where and whether they travel (location), and which route they travel (path or which way). Real-time capabilities through smartphones etc. are changing the dynamics of carsharing, carpooling, parking and other TDM strategies.
- Transportation Network Companies (TNCs, also known as ride-hailing services): these companies use smartphone technology to connect passengers with drivers who use their personal vehicles to provide rides for a fee. Two of these companies that operate in the NYMTC planning area are Uber and Lyft.
- Electric Vehicles: The rapid advance in battery technology is leading to a transformation of the world's vehicle supply. While growth in the region has been slow, battery electric and plug-in hybrid vehicle ownership has been steadily increasing. At this point significant challenges exist surrounding the provision of vehicle charging. The density of New York City makes off street as well as on-street charging a more difficult solution as compared to the lower densities of California and other West Coast and Sun-Belt states. Charger development has potential impacts on the region including electricity supply, land use and curb space policy and parking garage design. Those effects expand to buildings design as the electrification of freight delivery is included in the mix.

Electric Vehicle Charging Station
Photo Source: NYC DOT

Freight Transportation
Photo Source: Port Authority of NY&NJ

Goods Movement

The impact of goods movement is a major issue in the NYMTC planning area, with truck traffic being a major contributor to congestion. TDM can play a vital role in mitigating the interaction between trucks and cars by both managing the demand for goods movement during peak congested periods and by reducing overall personal vehicle demand when and where goods movement is a priority.[28] The linkage between TDM and goods movement and freight is relatively new and continues to be investigated. That said, TDM strategies that remove bottlenecks also benefit freight transportation, but specific approaches that incorporate technology to manage freight transportation and supply chain management continue to emerge.

Following are some related strategies for freight transportation management, many of which are addressed in *Plan 2045*'s Regional Freight element in Appendix 8:

- Improve rail and marine transportation infrastructure and services to make these modes more competitive with trucking.
- Organize regional delivery systems so fewer vehicle trips are needed to distribute goods (e.g., using common carriers that consolidate loads, rather than company fleets).
- Use smaller vehicles and human powered transport, particularly for distribution in urban areas.
- Implement fleet management programs that reduce vehicle mileage, use optimal sized vehicles for each trip, and ensure that fleet vehicles are maintained and operated in ways that reduce external costs (congestion, pollution, crash risk, etc.).
- Change freight delivery times to reduce congestion.
- Create pricing and tax policies that encourage efficient freight transport.

TABLE 5.2: MAJOR TRANSPORTATION DEMAND MANAGEMENT PROJECTS IN THE NYMTC PLANNING AREA

Name of Project	Description/Aim of Project	TDM Category
Policy		
Transit Oriented Development	Various jurisdictions throughout the NYMTC region are promoting TOD initiatives to coordinate land use development and transportation, in order to foster growth around transit hubs such as rail and bus stations/stops. TOD programs at railroad stations aim to promote and coordinate TOD initiatives among its operating agencies, to work closely with local land use jurisdictions and to support initiatives at the regional scale to coordinate land use and transportation planning. These efforts are undertaken in conjunction with such efforts to facilitate approaches that address the "last mile" transportation gap.	Bike/ped enhancement
Complete Streets legislation	To "accommodate and facilitate safe travel by pedestrians, bicyclists, and motorists of all ages and abilities and allow pedestrian and motor traffic to easily coexist." Nassau County has already adopted Complete Streets legislation and will be moving into the implementation phase during the first five years of *Plan 2045*.	Bike/ped enhancement
Paratransit		
• Access-A-Ride (NYC) • Able Ride (Nassau County) • Suffolk County Accessible Transportation (SCAT) • Putnam Area Rapid Transit (PART) Paratransit • Bee-Line Paratransit (Westchester County) • TRIPS (Rockland County) • HART (Huntington Area Rapid Transit) Paratransit • Dial-a-Lift (Long Beach Transit)	Special mobility services: adapted multi-passenger vehicles provide demand-response transportation for passengers with special needs such as the disabled and the elderly. Services are offered within a designated radius from existing transit routes and can be used as a feeder service to accessible transit service.	Paratransit/Rideshare

Name of Project	Description/Aim of Project	TDM Category
Rideshare and Ride Services		
Guaranteed Ride Home	Customers using certain connecting services are provided with a limited number of transportation back-up options in case they need to leave work outside of the operating hours of these connecting services	Employer program/ Vehicle Sharing
511 NY Rideshare	Outreach program to demonstrate the benefits of rideshares and promote alternative travel choices	Rideshare/Marketing
Vanpool and shuttle services	Region 11 TDM team coordinates with targeted employers to facilitate and establish rideshare services for employees Westchester County's SMART Commute program performs outreach to employers to facilitate ridesharing and the use of transit among employees.	Employer Program/Rideshare
Commuting Options		
Regional Commuter Choice Program (RCCP)	A program that delivers benefits to travelers who use TDM services in the NYMTC planning area.	Employer Program/ Rideshare
Go Smart NYC Personalized Travel Choice Marketing	Neighborhood-based travel choice marketing program that educates residents about sustainable options and encourages their use through incentive structures	Transit Enhancements and Marketing
Employer Education	Outreach to promote and educate employers about pre-tax commuter benefit options	Employer program

Name of Project	Description/Aim of Project	TDM Category
Bicycle Programs		
Bicycle Locker Program	Provision of secure bicycle lockers at transit stations. Currently at select LIRR stations in Nassau and Suffolk Counties, administered locally and by NYSDOT. In addition, Stony Brook University, Suffolk State Office Building in Hauppauge, Town of Brookhaven, Riverhead Town Hall, and Rockville Centre have locally administered bicycle locker programs. MTA Metro North also currently has 8 stations with bike lockers. 2 of these stations are administered by the local municipality (Scarsdale & Pawling) and the remaining 6 are administered by MNR's Private Parking Operator at locations owned by the railroad. NYC DOT is also exploring secure bike parking facilities.	Bike/ped enhancement
Bicycle Share	The CitiBike bike share program will have 12,000 bikes at 700 stations by the end of 2017. The program was designed for convenient, quick trips that serve as alternatives to taxis or public transit. Planned expansions will increase the number of bikes and stations in all five boroughs. A bike share program in the City of New Rochelle is scheduled to begin in 2017. SoBi bike share in Long Beach City, Nassau County	Bike/ped enhancement

CONGESTION MANAGEMENT PROCESS

As a federally-designated Transportation Management Area (TMA), NYMTC is required to maintain a Congestion Management Process (CMP), which is a systematic approach for measuring and managing traffic congestion. The CMP is a major component of TSM&O, and provides information on transportation system performance and various strategies for alleviating congestion and enhancing the mobility of people and goods. The 2017 CMP Status Report (which has been developed and prepared in conjunction with *Plan 2045*) identifies the sources of congestion in the NYMTC planning area; identifies congested corridors and hot spots at the county/borough level; reports on the status of the roadway transportation network using seven performance measures; and identifies congestion management strategies based on a toolbox of strategies. The toolbox of strategies, which is the programmatic source for the TSM and TDM measures and strategies described above, includes:

- Highway Strategies: Increasing the number of lanes without highway widening (use of break-down lanes or medians), creation of more HOV lanes;
- Transit Strategies: Encouraging transit use by making transit service more attractive, such as reducing or providing discounted fares, increasing bus route coverage and/or frequencies, establishing intelligent bus stops that provide riders with real-time information regarding the location of buses and their arrival times and other enhancements;
- Pedestrian and Bicycle Strategies: Roadway and sidewalk enhancements aimed at increasing pedestrian and bicycle safety and accessibility;
- TDM Strategies:. Alternative work hours, telecommuting, ridesharing and other programs reduce driving;
- ITS and TSM Strategies: A series of technology based strategies/projects that assist in vehicular and pedestrian mobility;
- Access Management Strategies: Vehicular movement restrictions, interchange modifications, and other roadway design changes;
- Land Use Strategies: Mixed-use and TOD;
- Parking Strategies: Various parking policy plans that aim to decrease VMT and increase the use of non-vehicular transportation modes; and
- Regulatory Strategies: Trip reduction ordinances, congestion pricing, and truck restrictions.

The CMP performance measures used to assess the effectiveness and efficiency of the roadways system are: demand-to-capacity ratio; vehicle hours of delay; person hours of delay; average travel speed; travel time index; and vehicle miles traveled.

TSM/TDM RECOMMENDATIONS

Plan 2045 recommends the following with regard to TSM and TDM over the course of the planning period:

- A continuation of the TSM and TDM programs and activities described above, as well as their adaptation in light of the anticipated technological changes noted in Chapter 2;
- A continuing build out of the ITS architecture, and
- Application of ATDM/ICM approaches to the critically congested corridors identified in the 2017 CMP Status Report, including those corridors identified earlier.

Toward these ends, an on-going project is defined among the recommended System Enhancement projects which appear in Chapter 7.

Vision Zero Education to Drivers
Photo Source: NYC DOT

3. TRANSPORTATION SAFETY & SECURITY

Safety is a key measure of the quality of the region's transportation system. In 2005, federal transportation authorization legislation elevated transportation safety to a national priority by re-quiring safety to be a separate planning factor in the transportation planning process and establishing the Highway Safety Improvement Program (HSIP) and other safety-related programs. The emphasis on safety in federal transportation regulations continues, with safety transitioning to a performance and outcome-based program.

In keeping with these requirements, NYMTC continues to promote a safe and secure transportation system as an integral part of its transportation planning process. NYMTC and its member agencies seek to go beyond the fulfillment of federal safety requirements to work constantly to ensure the overall safety of highway infrastructure and transit systems. NYMTC's safety planning work is guided by its Safety Advisory Working Group and is also influenced by other federal, state and local plans, policies and guidelines, which are discussed later in this section.

DESIRED OUTCOMES

Plan 2045's strategic goals include the goal to enhance the safety and security of the transportation system for both motorized and non-motorized users. The following desired outcomes have been identified in pursuit this goal:

- Reduced rate of annual serious injuries and traffic fatalities on the region's transportation systems;
- Promulgation of advanced safety and security measures throughout the region;
- Enhanced coordination, data, and information sharing among members and other stakeholders; and
- Promotion of safety and security improvements in all aspects of transportation planning and implementation.

These desired outcomes provide the framework for the Plan's safety & security element. They are designed to help NYMTC and its member agencies target safety projects, programs and funding priorities.

TRANSPORTATION SAFETY DATA

Transportation safety data is at the center of the evaluation of safety issues and the planning and implementation of safety programs. Federal transportation legislation emphasizes a data-driven approach to safety planning. This approach involves gathering and analyzing data, identifying needs, and investing safety funds accordingly. The Highway Safety Improvement Program (HSIP) directs funds as the data suggests.

To further incorporate a data-driven approach into its transportation safety planning, NYMTC continues to support New York State's ongoing efforts to collect timely and accurate electronic data. In addition to accuracy, the state's data collection goal includes real-time data transmission. The cooperation of enforcement agencies is important to gathering timely and accurate crash information. A goal of NYMTC's incorporation of a data-driven approach is to transition enforcement agencies to the electronic transmission of crash data from paper copies. The benefit to police agencies of electronic data collection may become clearer as data analysis becomes streamlined and resources such as the Accident Location Information System (ALIS) are made available to participating agencies. Data dissemination is part of NYMTC's strategy to improve data collection.

Crash data and reports of roadway crashes are maintained by appropriate state agencies such as the Department of Motor Vehicles. The primary source of safety data is the crash report, which includes contributing factors, crash location, and driver vehicle and vulnerable road user characteristics. This information is very useful in identifying the characteristics of crashes. All fatal crashes are reported to the National Highway Traffic Safety Administration (NHTSA), another key data source. In the NYMTC planning area, the major sources of data on transit accidents are the transit operators.

Further planning and research is needed to support local governments in prioritizing safety work. Additionally, local governments need information on their roads' traffic volumes in order to compute crash rates so that locations with statistically significant safety issues can be readily identified. There is a need to prioritize region-wide access to information including crash history and traffic volumes. Empirical data should support transportation projects and programs and safety improvement investments.

A. NATIONAL CRASH DATA

The NHTSA reports that the motor vehicle traffic fatality rate per 100 million VMT increased 3.7 percent, from 1.08 in 2014 to 1.12 in 2015. In terms of actual number of fatalities the increase was from 32,744 in 2014 to 35,092 in 2015 (7.5 percent).[29] This increase represents the largest increase in nearly 50 years, and coincides with the largest increase in VMT since 1992. These trends reverse a general decrease in fatalities and injuries over the past decade. Increases occurred in almost all segments of the population – passenger vehicle occupants, passengers of large trucks, pedestrians, cyclists, motorcyclists, and alcohol-impaired driving fatalities.

The number one cause of deaths and injuries in rail transportation are due to incidents at crossings and trespassing on rail rights-of-way. More than 200 people are killed every year in crossing accidents in the United States according to the Federal Railroad Administration.[30]

B. NYMTC REGION CRASH DATA

The crash records (Table 5.3 below) show that the number of traffic crashes did not vary significantly between the years 2013 and 2015. However, overall the total number of fatal crashes decreased by 6 percent from 2013 to 2015. Motorcycle fatalities were observed to have the largest decrease during this period with a decrease of 23 percent for motorcyclists, while fatalities among cyclists increased significantly in the NYMTC region by 50 percent from 2013 to 2015.

TABLE 5.3: CRASHES IN NYMTC PLANNING AREA

NYMTC Region Totals (10 counties)	2013	2014	2015
Total Crashes	157,078	153,573	150,376
Total Fatal Crashes	679	575	637
Motor Vehicle Fatalities and Injuries			
Motor Vehicle Crashes (excluding pedestrians, bikes and motorcycles)	135,810	134,293	133,186
Motor Vehicle Fatalities - Driver	244	212	231
Motor Vehicle Fatalities - Passengers	59	68	73
Motor Vehicle Injuries - Driver	63,152	59,953	59,857
Motor Vehicle Injuries - Passengers	30,580	29,539	30,164
Pedestrian Fatalities and Injuries			
Pedestrian/Motor Vehicle Crashes	13,888	12,426	10,791
Pedestrian Fatalities	274	188	242
Pedestrian Injuries	13,754	12,427	10,981
Bicycle Fatalities and Injuries			
Bicycle/Motor Vehicle Crashes	4,836	4,498	4,070
Bicycle Fatalities	18	31	27
Bicycle Injuries	4,703	4,365	4,027
Motorcycle Fatalities and Injuries			
Motorcycle Crashes	2,544	2,356	2,329
Motorcycle Fatalities	83	76	64
Motorcycle Injuries	2,478	2,335	2,352

C. NYMTC MEMBER ACCIDENT DATA

Given the size and importance of the transit system in the NYMTC planning area, transit safety is also of great importance to NYMTC members. Table 5.4 through 5.9 provide accident data for each member agency's transit system for the period 2013-2016.

TABLE 5.4: ANNUAL MTA ACCIDENT RATES

Performance Indicator	12 Month Average		
FRA Reportable Customer Accident Rate per Million Customers	August 2013 - July 2014	August 2014 - July 2015	August 2015 - July 2016
MNR	2.15	1.76	1.23
LIRR		4.45	3.34
[1] Subway	2.60	2.64	2.50
[2] Bus	1.05	1.10	1.21
[3] MTA B&T		0.91	1.04

Source: http://web.mta.info/mta/news/books/pdf/160926_0830_Safety.pdf
[1] 12 month average from July – June; includes SIRTOA
[2] Includes MTA and NYCT Bus
[3] Customer injury collisions rate for bridge customers per million vehicles

TABLE 5.5: TOTAL ANNUAL TRANSIT ACCIDENTS: NASSAU COUNTY

	12 Month Total		
	January 1 – December 31 2014	January 1 – December 31 2015	January 1 – December 31 2016
Number of Accidents*	46	44	41

* Reflects all reported accidents (injuries, fatalities, non-injuries, moving and non-moving vehicles)

TABLE 5.6: AVERAGE ANNUAL ACCIDENTS: SUFFOLK COUNTY

	12 Month Average		
	August 2013 - July 2014	August 2014 - July 2015	August 2015 - July 2016
Number of Accidents*	3.3	3.2	3.3

*Accidents defined as number of moving vehicle accidents where at least 1 injury was sustained and removed from scene.

TABLE 5.7: AVERAGE ANNUAL TRANSIT ACCIDENTS: WESTCHESTER COUNTY BEE-LINE

	12 Month Average		
	August 2013 - July 2014	August 2014 - July 2015	August 2015 - July 2016
Number of Accidents*	1.75	1.50	1.75

*Average number of reported accidents per month involving injuries

TABLE 5.8: AVERAGE ANNUAL TRANSIT ACCIDENTS: ROCKLAND COUNTY

	12 Month Average		
	August 2013 - July 2014	August 2014 - July 2015	August 2015 - July 2016
Number of Accidents*	0.68	1.48	1.58

*Accidents defined as number of moving vehicle accidents where at least 1 injury was sustained and removed from scene.

TABLE 5.9: AVERAGE ANNUAL TRANSIT ACCIDENTS: PUTNAM COUNTY

	12 Month Average		
	January 2013 - December 2014	January 2014 - December 2015	January 2015 - December 2016
Number of Accidents*	1.33	1.33	0.83

* Incidents include preventable and non-preventable accidents, based upon a determination of bus driver responsibility.

SAFETY EMPHASIS AREAS & STRATEGIES

A. PRIORITY EMPHASIS AREAS

Plan 2045 identifies several transportation safety issues to monitor and address across the region. One of the major guiding forces in identifying these issue areas is the available data. Thus, an overarching priority of the Plan is to cooperatively implement an electronic crash data system among enforcement and transportation agencies to seamlessly provide access to recent crash data.

Pedestrians

Pedestrian safety is *Plan 2045*'s first priority emphasis area. A disproportionate number of the crashes involving pedestrians occur in the NYMTC planning area. Based on data from 2011-2015 American Community Survey (ACS) and from the New York State Department of Motor Vehicles, 64 percent of the state residents live in the NYMTC planning area but 83 percent of pedestrian injuries and 75 percent of pedestrian fatalities occur in this area. Although New York City accounts for a large share of the NYMTC planning area's pedestrian activity, many communities within the region have a downtown area with commercial and community uses, where walking is the primary mode of transportation.

In the NYMTC planning area, according to the U.S. Census and the ACS, the population aged 65 and older is estimated to have increased by 13.6 percent from 2000 to 2014 to 1.7 million people. While the older adult population continues to be a vibrant and productive part of the society, seniors face more pedestrian challenges compared to other adults. Therefore, providing safe mobility for older adults is a priority for pedestrian safety. In addition to seniors, younger pedestrians are another priority area for pedestrian safety. Nationally, 207 (or 4 percent) of pedestrian fatalities in the U.S. involved children.[31]

Motor Vehicles

Intersections are a planned point of vehicular conflict in the roadway system. A typical two-way road intersection has 56 potential conflicts: 32 vehicle-to-vehicle conflicts and 24 vehicle-to-pedestrian conflicts. With different crossing and entering movements by drivers, pedestrians and bicycles, an intersection is one of the most complex traffic situations encountered by motorists. Dangers are compounded by speeding and distracted motorists who disregard traffic controls.[32]

FHWA has identified roadway departures as one of the three major safety areas (along with intersections and pedestrians) that require a special focus. Nationally, most highway fatalities occur in roadway departure crashes (53 percent), intersection-related crashes (24 percent), and pedestrian crashes (12 percent).[33]

New York State's Strategic Highway Safety Plan (SHSP) states that lane departures and intersections represent the highest fatality areas in the state. The 2014 FARS data show that 49 percent of the state's motor vehicle fatalities involved a lane departure, while 36 percent of the state's motor vehicle fatalities involved intersections.

Distracted driving continues to be a national problem. In 2014, 3,179 people nationwide were killed in crashes involving a distracted driver.[34] While 46 states have recently banned text messaging for all drivers,[35] there is a continuing need to better educate and train drivers, bicyclists, and pedestrians to develop better safety awareness and skills. As personal devices continue to increase distraction in pedestrians and drivers alike, inattention and/or distraction are also significant human factors contributing to crashes.

The 2014 crash data show that 78 percent of crashes in New York State are related to human factors.[36] Safety issues related to driver behavior include impaired driving or driving under the influence, speeding and aggressive driving, and inadequate occupant protection (e.g. seatbelts). Most issues in this area are addressed through education and/or enforcement and are currently well-managed by the Traffic Safety Boards within the NYMTC planning area.

While there are many active and alert senior drivers, in 2014, senior drivers comprised 11 percent of all drivers in New York State but were involved in 24 percent of all fatality crashes. As the senior age group grows, senior drivers emerge as an important issue requiring safety planning attention. Just as senior pedestrians can be the victims of many pedestrian crashes, senior drivers can potentially be a hazard to other pedestrians and motorists. Aging can impact a person's visual, cognitive and physical health. Due to medical and technological advances, recent population forecasts predict an increase in the national elderly population, which could lead to higher percentages of senior drivers on the roads. Currently, federal agencies are promulgating guidelines to address this growing segment of the population. These new guidelines will help states develop plans to address the particular needs of older drivers and to address the emerging challenges posed by an increasing population of older drivers.

Delancey Street Safety Improvement, New York
Photo Source: NYC DOT

Motorcycles

Over the past decade, motorcycling has become increasingly popular in the NYMTC planning area. Along with the dramatic increase in the number of motorcycle licenses and registrations in the region, the number of motorcycle crashes involving fatalities or injuries remained fairly constant over the past decade, however, there have been steady decreases since 2012. To ensure crashes do not increase along with the increase in motorcyclists, this mode of transportation requires a special focus in relation to roadway safety.

NYC DOT recently completed the New York City Motorcycle Safety Study, a comprehensive study which examined the state of motorcycle safety within the five boroughs. Although only accounting for two percent of motor vehicle registrations in New York City, motorcycles account for 14 percent of all traffic fatalities. Drawing on 5 years of comprehensive motorcycle crash data, this study determined the "who, when, where and why" of motorcycle crashes in the City. In addition, a number of recommendations addressing education, enforcement and policy/legislation will be put forward based on the study findings.

Bicycles

A livable community provides safe and convenient transportation choices to all, including walking, bicycling, transit, or driving. Bicycle safety is a major concern in the NYMTC planning area. Bicycle safety improvements depend on an integrated approach that involves education, planning, design, and maintenance. NYMTC member agencies use street design, such as traffic calming and Complete Streets principles, to improve safety for bicyclists and all roadway users. Educational programs for drivers, bicyclists, and pedestrians, like Coexist New York State, "Share the Road," and Bike Smart Campaigns, also improve safety. Additional information about bicycle safety is in Appendix 2.

Intermodal Connectivity

Safe pedestrian connections at intermodal transfer points, such as bus to rail transfers, are a crucial component of regional intermodal planning. Improved roadway design and wayfinding can greatly improve both safety and connectivity. Intermodal connectivity areas include interface areas between subway and sidewalks, parking lots connecting to commuter rail stations, ferry terminals or airports, and pedestrian paths connecting bus stops with major trip generators, like residential or office complexes, malls, and hospitals.

Transit

Various transit providers in the NYMTC planning area have established safety programs to achieve the highest practical level of safety for all modes of transit. In order to protect passengers, employees, revenues, and property, all transit systems are required to develop and implement a proactive system safety program plan. The FTA supports these efforts by developing guidelines and best practices, providing training and by performing system safety analyses and reviews. One program developed and implemented by the FTA is the Safety Management Systems (SMS) and Safety Performance Measurement Systems (SPMS). SMS offer the most promising means of preventing public transportation crashes by integrating safety into all aspects of a transit system's activities, including planning, design, construction, operations, and maintenance.

Bike Smart Campaigns
Photo Source: NYC DOT

B. STRATEGIES

Various strategies are recommended by *Plan 2045* to address the transportation safety issues described in this section. These include the continuation of those strategies that are currently in place and those described below. The outcomes related to *Plan 2045*'s safety goal, as described in this section's introduction, will likely be improved through implementation of these strategies. One of the focuses of the safety goal is to develop comprehensive access to safety-related data, including an electronic crash data system that will provide vital crash data between enforcement and transportation agencies.

Build Partnerships between Agencies and Stakeholders

All transportation agencies in the NYMTC planning area have formed partnerships with other public agencies, including police departments, municipal governments, and Community Boards, to address all aspects of transportation safety, including safety engineering, enforcement, education, and emergency and medical services. Traffic Safety Boards focus on safety education and enforcement in local areas, while other statewide partnerships focus on statewide road safety issues. Agency coordination is especially necessary in multi-jurisdictional areas of the roadway network, such as roadway segments operated by different transportation agencies that connect highway ramps, bridges, and tunnels with the local street network, in order to ensure continuity for roadway safety. NYMTC and its members will continue to foster relationships with other public organizations in order to broaden its approach to improving the safety and efficiency of the entire transportation system.

Integrate Safety at All Levels of Planning

Safety should be integrated into all aspects of the transportation planning processes. This entails both dedicating funding to safety-specific research on key safety issues and facilitating multi-agency communication by sharing information and collaboratively generating strategies. Each NYMTC member agency participates in the Safety Advisory Working Group (SAWG) which identifies issues, barriers, and opportunities related to safety integration. In addition to participation in SAWG, each agency should appoint Pedestrian-Bicycle Coordinators or identify specific staff as needed to assist with pedestrian and bicycle safety issues. Additionally, many regional issues mirror statewide issues. NYMTC will continue to participate in the New York State Association of Metropolitan Planning Organizations' Safety Working Group, where statewide issues are addressed and potentially future issues are identified.

Traffic Safety Education and Outreach
Photo Source: NYC DOT

Continue Education and Training

Promoting an awareness of safety strategies for all road users, along with improving roadway geometry and operations, are vital components of safety planning. Education and outreach is needed for the public as well as for those who implement improvements to the transportation network. NYMTC agencies will work with their Traffic Safety Boards, who have educational programs in place, to address many issues, such as distracted or impaired driving. Drivers, bicyclists, and pedestrians must understand the traffic regulations and yield to each other appropriately.

Plan 2045 recognizes that community-based workshops have been particularly effective at bringing together stakeholders around common issues. With continued federal and state programming support, the Plan recommends that training workshops be financed on topics such as Complete Streets, Walkable Communities, Safe-Routes-to-School, Designing Streets for Pedestrian Safety, and Road Safety Audits.

Continue a Focused Approach to Safety (FHWA Focus State Program)
FHWA's Focus State program recognizes that three focus areas account for almost 90 percent of traffic fatalities: intersections, roadway departure, and pedestrian safety. The purpose of the Focus State program is to further decrease the number of fatalities and serious injuries on the nation's highways through the targeted delivery of technical assistance and resources. New York State was identified as a pedestrian focus state and New York City as a pedestrian focus city. When ranked by the number of crashes, 48 percent of the pedestrian crashes between 2009 and 2013 (outside of New York City) occurred in the 20 focus communities located among several New York State counties including Nassau, Suffolk, Westchester, and Rockland counties.[37]

The program also calls for the transportation community to think beyond traditional approaches and to consider low-cost, comprehensive, and/or systematic safety solutions. This approach allows Focus States to demonstrate results and to take advantage of lessons learned across the country by states and localities that have implemented safety improvements on their highways.

Support Traffic Safety Boards
Article 43 of the New York State Vehicle and Traffic Law provides for the formation of county traffic safety boards. In the NYMTC region, the counties of Nassau, Suffolk, Westchester, Putnam, and Rockland have these boards. Pursuant to the state law, the boards have the duties and functions listed below:

- Promotion and encouragement of street and highway traffic safety;
- Formulation of county-wide highway safety programs and coordination of efforts of interested parties and agencies engaged in traffic safety education;
- Cooperation with local officials within the county in the formulation and execution of traffic safety programs and activities;
- Study of traffic conditions on streets and highways within the county, study of and analysis of reports of accidents and causes thereof, and making of recommendations to the appropriate legislative bodies, departments or commissions, such changes in rules, orders, regulations and existing law as the board may deem advisable;
- Obtaining and assembling motor vehicle accident data, and analysis, study of and consolidation of such data for educational and informational purposes; and
- Coordination of and direction of local activities related to the implementation of the state highway program, as approved by the Governor or his or her designee.

NYMTC member agencies should continue to utilize and to support these boards in their work to improve traffic safety.

Road Safety Audits
A Road Safety Audit, or Safety Assessment, is a proactive, low-cost safety tool to assist agencies in addressing problematic locations. Similar processes are used by many agencies under different names. In a safety assessment, an independent multi-disciplinary audit team examines a site and offers solutions. The assessment process emphasizes the connection between the transportation planning process, multimodal considerations, enforcement activities, safety education, and engineering solutions. NYMTC member agencies should consider this tool in its efforts to systematically address safety issues. Both pedestrian and bicycle specific road safety audit guidance are available from FHWA.

Crash Reduction / Crash Modification Factor
A crash reduction factor or crash modification factor (CRF or CMF) is the percentage reduction in traffic crashes that might be expected after implementing a given countermeasure at a specific site. CRFs are available for roadway improvements as well as pedestrian measures. Not only can CRFs be used in cost-benefit analysis, they can also serve as a tool in the investment decision-making process.

Establish Asset Preservation Programs

Safety appurtenances such as guiderails, signs, and pavement markings are critical elements in highway safety design. In order to keep these elements functioning as designed, an asset management program must be in place to provide ongoing routine maintenance. Asset preservation may be accomplished through both capital and maintenance efforts.

Expand Emerging Strategies

New York City launched Vision Zero in 2014 as a targeted effort to eliminate traffic fatalities involving the coordinated efforts of NYC DOT, New York Police Department, New York City Taxi and Limousine Commission, New York City Department of Health and Mental Hygiene, and other city stakeholders. Vision Zero initiatives focus on education, enforcement, street design, and legislation. More information on Vision Zero initiatives can be found in Appendix 2.

Another example is automated monitoring for enforcement. Studies indicate that the fatality rate drops to 45 percent when a person is struck by a car going 30 miles per hour, and to 5 percent at 20 miles per hour or less.[38] While red light cameras have been in use for some years, the installation of additional cameras or of speed cameras, would require changes in legislation. Nevertheless, as described in greater detail in Appendix 2, red light cameras are currently used in several counties throughout the NYMTC region.

New York City Vision Zero Initiatives
Photo Source: NYC DOT

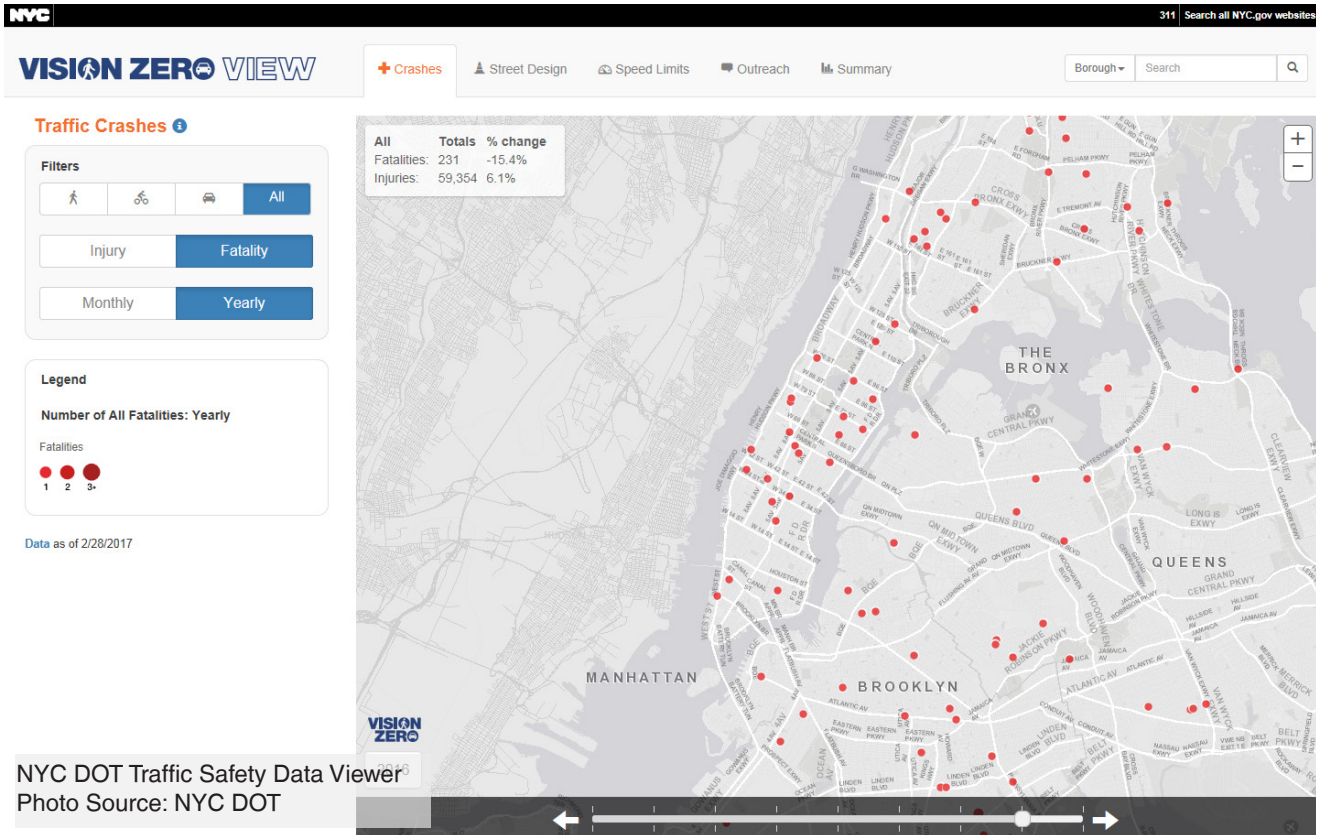
TOOLS & TECHNIQUES

A. ENGINEERING AND PLANNING

Modern traffic engineering, design, operations and planning techniques are available to counties, regions, and municipalities to inform their road management and planning decisions. These techniques, which include location prioritization, road safety audits, the use of crash reduction and modification factors, and systemic safety approaches, can help inform design decisions and improve evaluations of past projects based on post-completion safety and operational data.

Accident Location Information System (ALIS)
NYSDOT has developed ALIS and is working through the Safety Working Group of the New York State Association of Metropolitan Planning Organizations to expand use of this web-based system. ALIS visually displays queried crash data in a GIS format. Feedback from the users of ALIS indicates it is a powerful tool for safety analysis. *Plan 2045* recommends continued support of ALIS and ensuring member agency access and training.

Traffic Safety Data Viewer
NYC DOT has developed the Traffic Safety Data Viewer to allow easy access to detailed data by planners, analysts, and project managers, in a user-friendly interactive map format. Users are able to display all injury and fatality data on a map of New York City, or can generate their own analysis of the crash history for a given location. Provided with a user's selected geography, the data viewer outputs an automatic analysis of the location, comparing it to the borough as a whole using the KSI (Killed or Severely Injured) rate per mile (based on the latest 5 years of data). The interface allows access to safety data quickly to determine a potential project's priority level. The geographical extents of the project may also be saved and accessed, or modified, at a later date. Additionally, the Safety Viewer application provides functionality for post implementation effectiveness analysis. This allows for a quick safety impact analysis of projects to inform future work. This feature outputs a tailored report which includes comparisons of age, mode, time of day and other crash characteristics.



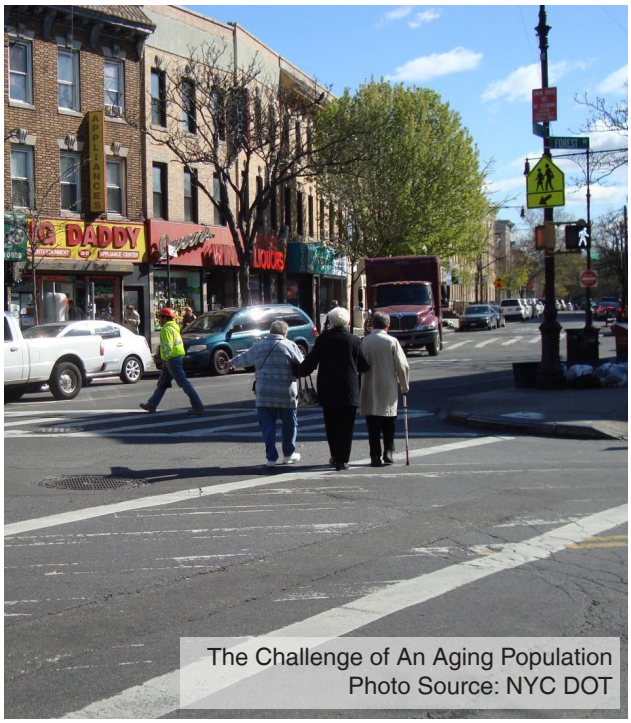
NYC DOT Traffic Safety Data Viewer
Photo Source: NYC DOT

Complete Streets Design Principles

Complete Streets design principles are roadway design features that accommodate and facilitate safe travel by pedestrians, bicyclists, and motorists of all ages and abilities. Several municipalities within the NYMTC planning area adopted complete streets policies prior to the passage into law of New York's Complete Streets Act in August 2011.[39] NYMTC member agencies must consider Complete Streets design principles on all future projects which receive both federal and state funding. More details about the Complete Streets programs of different counties and municipalities of NYMTC are provided in Appendix 2.

Safe-Streets-for-Seniors

Safe-Streets-for-Seniors is a pedestrian safety initiative for older New York City residents. This program studies crash data, and then develops and implements mitigation measures to improve the safety of seniors and other pedestrians, as well as all road users. Since launching the program in 2008, NYC DOT has addressed senior pedestrian safety issues in 37 Senior Pedestrian Focus Areas (SPFAs) citywide, has implemented within the Senior Areas 165 Street Improvement Projects (SIPs) since 2009. A detailed description of this New York City program is provided in Appendix 2.



The Challenge of An Aging Population
Photo Source: NYC DOT

Additionally the Safe Seniors program, a NYSDOT pilot project, expanded targeted senior pedestrian initiatives in Smithtown (Suffolk County) and on Hempstead Turnpike (Nassau County), with other municipalities under consideration. As part of its Livable Communities Program, Westchester County is actively involved in the AARP pedestrian needs program. AARP launched a New York State survey in the spring of 2011 that evaluated 530 intersections across more than 30 counties to bring attention to the safety issues that pedestrians face and what needs to be improved in the pedestrian infrastructure. The results of the survey highlighted several poor pedestrian conditions and driving behaviors which are listed in Appendix 2.

Safe-Routes-to-School

Safe-Routes-to-School (SRTS) originated in New York City and was adopted nationally as a federally-funded program. Through SRTS, NYC DOT has identified 270 Priority Schools and recommended and implemented several safety improvements citywide. This ongoing project is described in detail in Appendix 2 of the Plan. The program recently received additional funding for capital improvements at locations in priority geographies. Safety improvements at other school locations will be folded into the Street Improvement Projects (SIP) Program for in-house implementation.

In the Lower Hudson Valley and on Long Island, SRTS workshops have been held in many communities and schools. Several Westchester County municipalities and school districts have implemented SRTS programs which involve capital improvements as well as education campaigns and encouragement efforts. Within Rockland County, municipalities and school districts have received SRTS grants for safety education, including surveys of students and parents and programs on safe walking and bicycling to and from school.

Transit Safety

Westchester County is examining pedestrian access to bus stops in order to identify improvements which will encourage transit use and minimize safety hazards. Safe-Routes-to-Transit is a New York City initiative to improve pedestrian and motor vehicle

movement around subway entrances and bus stops in order to increase the accessibility, safety and convenience of mass transit. The Safe-Routes-to-Transit program identifies high priority locations through crash data analysis and transit rider counts. At high priority locations NYC DOT implements safety and accessibility improvements such as curb extensions, bus boarding islands, and sidewalk construction. The three programs comprising the Safe-Routes-to-Transit initiative include bus stops under elevated subways structures, subway-sidewalk interface, and sidewalks-to-buses.

Safety Studies

NYMTC member agencies are currently investigating intersections and roadway segments within their respective jurisdictions with statistically significant, above-average crash rates. The identified locations are further studied by in-house safety investigators and/or consultant engineers to determine the cause of the safety problems so that appropriate improvements can be implemented. The highway safety investigations will first evaluate implementation of low-cost improvements, such as improved signage, minor paving, sight distance improvements, guiderails, improved pavement markings, adding countdown pedestrian heads, changed signal timing, and others. However, in certain cases, capital investments may be necessary and could be included in large-scale capital projects.

NYC DOT is conducting a crash analysis study that will develop a systematic approach to prioritize locations for safety improvements. Roadway treatments such as chevrons, wet reflective pavement marking, rumble strips, and wider shoulders, can decrease unsafe lane departures. Other similar low-cost systemic treatments should be evaluated for intersection and pedestrian safety. In addition to locations identified by crash statistics, safety investigations may also be completed at locations with perceived safety concerns identified by the public and elected officials.

In 2015, as part of the implementation of USDOT's action plan to increase walking and biking and reduce pedestrian and bicycle fatalities, the NHTSA completed a Roadway Pedestrian Safety Audit in Rockland County. The Audit look at areas along State Route 59 and State Route 45 in the Town of Ramapo and the Village of Spring Valley. As a consequence, NYSDOT initiated a pedestrian safety study in these areas, which identified recommendations that could be implemented, emphasizing engineering, education and enforcement. The resulting Pedestrian Safety Study, published in March 2016, contains an implementation plan with solutions categorized by short, medium and long term goals, with cost estimates.

Rail Crossing Safety

Rail crossing safety is receiving increased attention in the NYMTC planning area, in New York State, and nationally. In November 2016, Governor Andrew Cuomo signed two bills aimed at reducing train-motor vehicle incidents at crossings. One will require frequent inspections of traffic control devices at highway-rail crossings; the other will require the state to study rail crossings and make improvement recommendations.

As an outcome of Rockland's Pedestrian Safety Study, Ramapo Town Police conduct pedestrian crosswalk decoy operations, where a decoy officer attempts to cross in a crosswalk. If motorists do not yield, warnings are issued and educational materials are provided.

The following are some of the actions being taken by NYMTC members to address this issue.

- Rockland County has developed a plan to install supplemental safety measures – primarily four-quadrant gate systems – at 14 roadway-rail grade crossings along the West Shore (River) freight line, where over 40 accidents occurred between 1998 and 2014. Planning and design have been completed for these improvements, which will result in improved safety and the creation of a Train Horn Quiet Zone. The project is utilizing Federal grant funds along with State and County funds and construction is expected to begin in 2017.
- MTA's LIRR and MNR are undertaking grade crossing safety enhancements. LIRR will equip ten public highway grade crossings across LIRR territory with loop activated CCTV cameras and digital video recorders.[i] MNR will be similarly equipping all of their public crossings and one private crossing in the State of New York with cameras and recorders. The equipment will provide valuable information on crossing function and driver behavior for both forensic investigations into specific incidents as well as analysis of crossing/traffic operations for targeted modifications to improve safety.

  In addition, the railroads are partnering with local municipalities and NYSDOT to undertake customized safety enhancements at two additional public highway grade crossings within the LIRR territory (Atlantic Avenue in Oceanside, and Executive Drive in Deer Park) and eight public highway grade crossings within the MNR territory to incorporate traffic signal preemption and undertake roadway/traffic improvements which are targeted to address local traffic conditions. It is LIRR's intention to roll out additional installations of CCTV cameras and other grade crossing safety enhancements at crossing locations with high volumes of train and/or vehicular traffic.
- In updating the State Highway Safety Plan (SHSP) NYSDOT has identified a number of strategies to address safety across the State. One of these strategies involves upgrading rail grade crossings with a principle strategy of reducing the frequency and severity of accidents involving vehicles and pedestrians at grade crossings through the improvement or elimination of highway-railroad grade crossings. The supporting activities proposed for this strategy are (a) Identification of existing conditions of grade crossing locations to identify needs such as interconnection with traffic signals or geometric issues, and (b) upgrade of warning devices priorities such as standard signs and pavement markings; installation or replacement of active warning devices (flashers and gates); upgrading active warning devices, including track circuitry improvements and interconnections with highway traffic signals; crossing illumination; crossing surface improvements; and general site improvements.
- NYC DOT has implemented markings refurbishments and signage enhancements at several intersections and at-grade crossings along the LIRR Lower Montauk Branch from Long Island City to Glendale, Queens. NYC DOT is studying the feasibility of a signal design at the intersection of Maspeth Avenue and Rust Street in coordination with the LIRR crossing gates. The feasibility study, which is locally funded, is expected to be completed by summer 2017. If feasible, implementation and construction of the signal would require capital construction and funding would need to be identified.

[i] The ten crossings being improved are distributed among the following branches: the Main Line (four), Far Rockaway (one), Montauk (2), Oyster Bay (one) and Port Jefferson (two).

High Crash Corridor Programs

NYSDOT's "corridor approach" identifies systemic improvements to be implemented throughout a study corridor. Current corridor approach projects in the Long Island area include the Hempstead Turnpike Pedestrian Safety Study, the Sunrise Highway Pedestrian Safety Study, and the Southern Parkway Nassau County Lane Departure Crash Analysis.

A current corridor project in Rockland County resulted from the Route 303 Sustainable Development Study, initiated in 1999 by NYMTC, in concert with the Town of Orangetown, Rockland County and NYSDOT. The objective of the study was to chart a path for future improvements that balanced safety, accessibility, mobility, sustainable land use and community needs. Implementation is ongoing and includes safety and other improvements throughout the corridor.

Putnam County is undertaking a Commercial Corridors Feasibility Study for nine commercial corridors. The County is preparing a transportation analysis of each of the corridors, including but not limited to vehicular and pedestrian traffic efficiencies, safety, accessibility and mobility issues, circulation within the corridors, parking management strategies in order to assess and determine transportation infrastructure improvements and efficiencies, zoning changes and future development, growth and transportation needs in the County, both in the short- and long-terms, for all nine commercial corridors.

The I-81 Corridor Study

Prepared by New York State Department of Transportation
In partnership with the Syracuse Metropolitan Transportation Council and Federal Highway Administration
July 2013

NYSDOT I-81 Corridor Study
Photo Source: NYS DOT

Vision Zero Education Initiatives
Photo Source: NYC DOT

EDUCATION

FHWA's Pedestrian Safety Campaign is a comprehensive set of materials for local communities to use in implementing their own campaigns. It includes materials designed for use in television, radio, cinema, and print advertising. Forums and other targeted educational programs are used to reach specific groups such as children and seniors. Public Information and Education (PI&E) initiatives in the region include the Vision Zero education programs in New York City, Safe-Routes-to-schools; Safety City and Transit initiatives, as well as ongoing safety education forums focused primarily on children and seniors.

Safety City

Programs like Safety City teach children about bicycle and pedestrian safety.

The TRACKS Program (Together Railroads and Communities Keeping Safe) TRACKS is an MNR in partnership with MTA Police designed to educate the community about safe behavior at or around railroad grade crossings and tracks. MNR offers free educational programs tailored to schools (K-12), camps, libraries, community centers, busing and trucking companies, driving schools and more.

Vision Zero Education Initiatives

Vision Zero Education Initiatives provides comprehensive traffic safety education to New York City children in grades K–12, older adults, parents of young children, and other at risk populations in target communities with the highest numbers of pedestrian injuries and fatalities. Funded multi-session education programs, which engage students in active participation with hands-on lessons, include: Safer Streets, Stop Think Act, and CSI: City Street Investigators. Pedestrian safety workshops for older adults provide opportunities for identifying and addressing safety issues specific to routes around their senior centers. Vision Zero initiatives also include a data-driven, hard-hitting paid media advertising campaign, public traffic safety community forums hosted by NYC DOT and other agencies, and Street Team outreach on high crash corridors by NYC DOT and the New York Police Department.

Safe-Routes-to-School (Non-Infrastructure)
Safe-Routes-to-School (non-infrastructure) funding is used in New York City to provide walking and biking encouragement and education programs including Bike-to-School programs for high school students, school-based *We're Walking Here* activities, and after-school Mileage Clubs.

In Rockland County, this funding is typically used for promoting safe and healthy walking and bicycling to and from elementary and middle schools. Parent surveys, educational events such as student assemblies, special games, display and distribution of printed materials and planning for signage and bike racks are featured.

The City of Long Beach in Nassau County also conducts a Safe-Routes-to-School Program for all children in grades K-5, in addition to after school pedestrian and bicycle safety programs conducted by the Long Beach Police and Fire departments. Nassau County works closely with parents and parents' associations to help promote the Safe Routes to School Program. Parents also assist with community events and bicycle rides such as ones held during Bike-to-School Week.

In Westchester County, many municipalities and school districts have non-infrastructure activities which include encouragement and education campaigns such as letters home to parents, *Golden Sneaker* contests, and student video and poster contests.

Other Programs

- **Westchester County** - The Plan4Safety Community Traffic Safety Awareness Grant program, funded by the Governor's Traffic Safety Committee through the NHTSA, is a community outreach program to bring the message of traffic safety and injury prevention to the community. The program is administered by the Westchester County Department of Public Works and Transportation, Traffic Safety office and provides programs to all age groups in the community in an effort to reduce the rate of preventable traffic crashes, injuries and fatalities in Westchester County. Another goal of the program is to promote traffic safety through community partnerships and heighten the public's awareness toward injury prevention. Traffic safety programs are presented to schools, corporations, hospitals, civic groups, senior citizen groups, libraries, etc. Programs are presented in the areas of: mitigating distracted driving and use of electronics while driving, deterring speeding, mitigating aggressive driving, drowsy driving and educational programs on seat belts and child safety seats, school bus, bicycle and pedestrian safety. The program also works in cooperation with local police departments in their traffic safety enforcement efforts.

City of Long Beach Safe-Routes-to-School Program
Photo Source: Bike Long Beach

> **Nassau County** - A program is currently being planned for Nassau County middle school children that, in addition to general pedestrian and bicycle safety best practices, will also include actual footage of the children riding to and from the middle school. This video was shot from a GoPro camera by one of the students who recorded it on his way to and from school. Clips will be used to demonstrate risky behaviors engaged in by the children when no adults are present. There will also be an on-line survey conducted to better understand why children do not regularly wear their bicycle helmets.

In addition, the New York Coalition for Transportation Safety continues to conduct pedestrian and bicycle safety education programs/ bicycle rodeos throughout Nassau County at schools, churches, senior centers and at locations requested by local legislators. County staff work with injury prevention specialists at Nassau University Medical Center and Winthrop University Hospital to teach seniors how to prevent falls that they may incur when they are pedestrians.

> **Westchester and Rockland Counties** - The Police Traffic Services Block Grant program, funded by the Governor's Traffic Safety Committee, also funds communities in Rockland County in order to bring the message of traffic safety to residents. In Rockland, individual police departments apply for grants, which are approved by the county's Traffic Safety Board. In 2016, each of the county's five towns, five villages, the County Sherriff's Office and a Community Outreach Center received grants for police traffic services and child passenger safety programs.

In May of each year, the Rockland County Sheriff's Office runs a special program called *Buckle Up New York* and conducts annually two major events for the Child Passenger Safety Program to ensure proper fitting and use of child car seats.

In addition, during 2010-2015 a Local IMPACT grant and a Creating Healthy Schools and Communities grant from the NYS Department of Health supported the initiation of a pedestrian safety education campaign in a number of locations in Summer 2016 in Rockland County. The campaign includes implementation of the State's *See! Be Seen!* pedestrian safety program, and of the education recommendations of the NYSDOT 2016 Routes 45 and 59 Pedestrian Safety Study in the Town of Ramapo and the Village of Spring Valley.

In Westchester, the program provides funds to local Westchester police agencies and Westchester County Police to conduct traffic law enforcement for motorist violations based on agency jurisdictions' traffic and crash data. This program targets increasing traffic safety enforcement to reduce traffic crashes, associated with speeding, distracted driving, pedestrian and school bus/motor vehicle violations. The program promotes safe driving and works in cooperation with community partnerships. This grant is administered by the Westchester County Department of Public Works and Transportation, Traffic Safety office. A mandatory component of this grant is the highly visible *Click it or Ticket* seat belt campaign. During this campaign, police focus enforcement efforts on seat belt and child safety seat violations.

Rockland County is using NY State's pedestrian safety program materials to enhance local efforts, such as these posters that appear on Transport of Rockland buses in English, Spanish, Yiddish and French Creole.

ENFORCEMENT

STOP DWI is an important program in the NYMTC planning area that addresses impaired driving. The comprehensive program consists of five areas: education/public information; enforcement; court-related; rehabilitation; and probation. In addition, several other programs address aggressive driving behavior and occupant protection, including Selective Traffic Enforcement Program (STEP), *Buckle Up New York*, and Child Passenger Safety. STEP encourages jurisdictions to use local data to identify problem areas and to develop enforcement countermeasures that reduce crashes, injuries and fatalities. *Buckle Up New York* grants are for seat belt enforcement and compliance. Child Passenger Safety grants support child passenger fitting stations, training, and child restraint education.

STOP-DWI

STOP-DWI education programs for high school students, including improvisational theater and workshops, provide a forum for discussion of real life situations teens encounter and encourage them to make safer decisions as they become old enough to drive.

- **New York City** - Funded by a New York State Special Traffic Options Program for Driving While Intoxicated (STOP-DWI) grant, New York City's *Choices* campaign presents the viewer with two options: a safe trip home or a consequence of drinking and driving. In qualitative testing of this concept, *Choices* displayed effectiveness due to the personal accountability it places on the driver and the power it gives the viewer in allowing him to make his own choice. The creative elements of the campaign make it attention grabbing, relevant and believable, with the inclusion of New York City specific imagery. Since launch, the campaign had grown to include a mobile app and microsite, as well as media placements on billboards, radio, in bars, cinema previews, and sponsorships at professional sporting events.
- **Rockland County** - Relying on the 1981 State legislation that authorized counties to coordinate local efforts to reduce alcohol and other drug related traffic crashes, Rockland County implements a STOP DWI program, funded through fines collected from persons convicted of driving while intoxicated.

Program implementation is undertaken through a county STOP DWI and Traffic Safety Coordinator, police officers, probation officers and enforcement actions taken by law enforcement agencies. For students and the general public, a presentation is provided that gives an overview of laws related to driving while intoxicated and describes the arrest process. A second type of presentation is an interactive mock DWI trial that uses audience members for all roles.

The program's presence is maintained in the high schools. The message is further delivered to the public through print and broadcasting methods and at events, Online Drug/Alcohol Education Courses are made available for legal, professional, and employment purposes (https://www.alcoholdrugcourses.com/rockland-county-ny-alcoholdrug). A Facebook page is also maintained for the program: https://www.facebook.com/rcstopdwi. The Traffic Safety Board has recently formed an associated charitable foundation to receive donations for safety education initiatives, which include the purchase of a portable driving simulator for high school students to demonstrate to themselves that texting while driving cannot be done safely.

The Rockland County Traffic Safety Board will use a new Driving Simulator to demonstrate to high school students that texting while driving is unsafe.

RELATED PLANNING PROCESSES

A. STRATEGIC HIGHWAY SAFETY PLAN

New York State's Strategic Highway Safety Plan establishes statewide highway safety goals. The purpose of the Plan is to promote best practices and strategies that if implemented could have a substantial impact on reducing fatal and injury crashes.[40] This important statewide safety planning process directly guides and influences the safety element of *Plan 2045*.

B. THE GOVERNOR'S TRAFFIC SAFETY COMMITTEE'S HIGHWAY SAFETY STRATEGIC PLAN

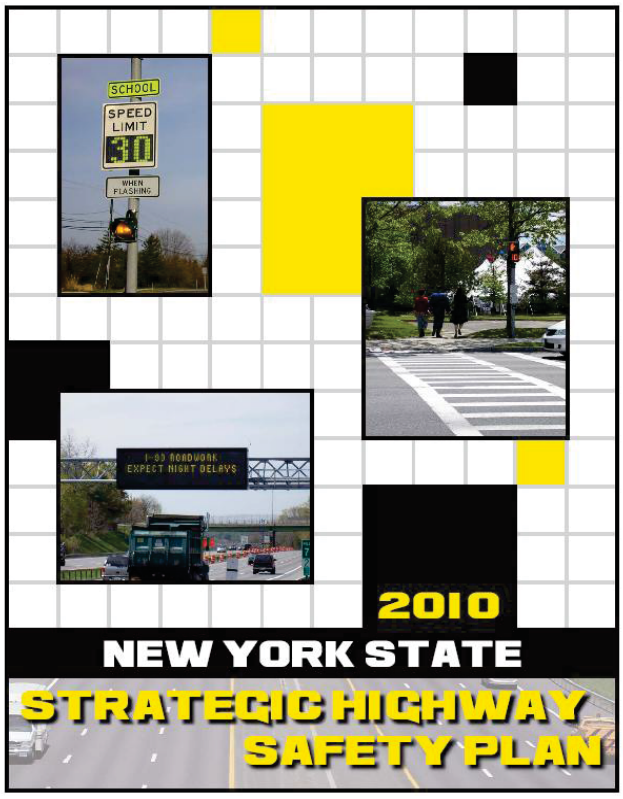
The Governor's Traffic Safety Committee administers National Highway Traffic Safety Grants, which are referred to as Section 402 funding, from the NHTSA. These federal funds are used to support State and Community Highway Safety programs to reduce deaths and injuries. The GTSC's Highway Safety Strategic Plan (HSSP) is the principal document for setting priorities, directing program efforts, and assigning resources in New York State.

C. NEW YORK STATE PEDESTRIAN SAFETY ACTION PLAN

The purpose of the Pedestrian Safety Action Plan is to identify the current safety conditions and to recommend a distinct set of engineering, education and enforcement countermeasures that can be accomplished over the next five years to improve safety for pedestrians on both state and local streets. Funding will include Highway Safety Improvement Program (HSIP) funds as well as other state and federal funding sources.

D. VISION ZERO BOROUGH PEDESTRIAN SAFETY ACTION PLANS

The Vision Zero Borough Pedestrian Safety Action Plans were released in early 2015 and are NYC DOT's comprehensive plan to address pedestrian fatalities and serious injuries. See Appendix 2 for more details.



NYS Strategic Highway Safety Plan
Photo Source: NYS DOT

E. COMPLETE STREETS PROGRAMS

As described in greater detail in Appendix 2, NYSDOT, NYMTC's other members and several local municipalities in NYMTC's planning area are applying Complete Street provisions in each stage of project planning and development to ensure that safety, mobility and accessibility are duly considered. Because NYSDOT and local agencies share the responsibility of implementing Complete Streets, the ability of municipalities to identify opportunities for Complete Streets features, and ultimately to install them, will be critical to achieving safer and more sustainable communities.

F. HIGHWAY SAFETY IMPROVEMENT PROGRAM

NYSDOT manages the Highway Safety Improvement Program and solicits proposals for safety projects to be funded through the program. Funding is awarded based on an evaluation in order to maximize investment in the most cost-effective safety projects statewide. Selected projects must be consistent with the strategies and emphasis areas identified in the statewide Strategic Highway Safety Plan. Both targeted and systematic projects are eligible for funding.

G. NATIONAL EFFORTS

The NHTSA, FHWA, and Federal Motor Carrier Safety Administration, in conjunction with the National Safety Council, launched a Road to Zero coalition with a goal of ending fatalities on the nation's roads within the next 30 years. USDOT provides grants to organizations working on lifesaving programs such as improving seat belt use, installing more rumble strips, truck safety, behavior change campaigns, and data-driven enforcement. Additionally, USDOT developed two tools - a national definition for serious injuries and State Injury Conversion Tables - to help states get the best information on how and where serious injuries occur by improving the quality of data reported and collected. Using the Conversion Tables, state and local agencies not currently using the new national definition can convert and report their serious injury data in their HSIP reports and their Highway Safety Plans.

SAFETY RECOMMENDATIONS

Plan 2045 recommends the continuation and expansion of the projects, programs and activities described above. Of paramount importance is the on-going coordination and vertical integration of activities and planning processes at the various levels identified; a role which NYMTC is well positioned to play, working with and through the MAP Forum and the New York State Association of Metropolitan Planning Organizations.

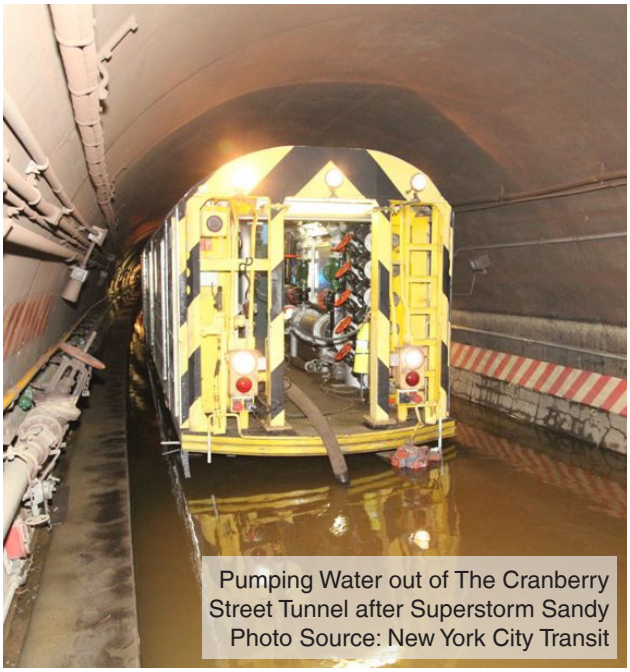
NYC Safe-Routes-to-School Program
Photo Source: NYC DOT

TRANSPORTATION SECURITY & EMERGENCY PLANNING

Security planning for the NYMTC planning area and for the multi-state metropolitan region is the responsibility of many agencies and institutions. Since security depends on extensive communication and coordination, the planning and execution of security measures are interrelated and responsibilities overlap in some instances. NYMTC members are involved in ongoing and coordinated efforts to protect the overall transportation system and to respond as required to unforeseen natural events and disasters. These efforts include yearly participation in simulation exercises of emergency situations to train personnel for such events. At the regional and local levels, disaster preparedness and emergency response planning is led by county, municipal and local governments that are responsible for developing their own Emergency Management plans for their respective areas, as well as through the New York State Office of Emergency Management.

Emergency events, whether natural or human-made, can impact the entire environment of an area thereby affecting land-based and in-water infrastructure (i.e., buildings, roads, etc.). Securing transportation systems in the New York City metropolitan area continues to be a primary concern for state and federal transportation agencies as well as for each of NYMTC's member agencies. Following recent events, specifically Superstorm Sandy, NYMTC members have been working diligently on understanding and implementing measures to address vulnerabilities in the regional transportation system. The recent unpredictable weather events have only strengthened NYMTC's commitment to the planning and implementation of security procedures and infrastructure improvements appropriate for each county.

Climate change increases the likelihood of extreme weather events, damage to facilities and service disruptions. Superstorm Sandy illustrated the centrality of transportation and resilience within the NYMTC planning areas; assessing the aftermath will be key to composing plans for the future.



Pumping Water out of The Cranberry Street Tunnel after Superstorm Sandy
Photo Source: New York City Transit

According to the Transportation Research Board's 2011 report *Adapting Transportation Impacts of Climate Change State of Practice*,[41] there are a number of operational impacts associate with extreme weather events, including:

- Increase in traffic incident management activities
- Road lane closures
- Reduced (and variable) speed limit
- Disruption of transit service
- Road and transit diversions
- Truck restrictions
- Work zone management (to accommodate additional lane closures)
- Flood control infrastructure system management

These impacts became quite evident during Superstorm Sandy and other recent weather-related events that have impacted the NYMTC planning area. Various TSM&O strategies were used by agencies in the region to help mitigate the impacts of these events. In particular, in the NYMTC planning area regional traveler information (511NY) became important during these events. NYMTC members have made

adjustments to the planning, designing, operation and maintenance of the regional transportation system to accommodate the impacts of climate changes, and they will continue to make investments in these areas. Incorporating climate change considerations into how agencies plan and execute TSM&O and maintenance programs will help to make the transportation system more resilient to unanticipated shocks.

During an emergency, multi-level coordination is necessary. Depending on the severity and scale of the event, the federal, state and local agencies coordinate their response efforts. Emergency coordination is usually conducted via the emergency operation centers that exist in each region. For major emergencies, coordination with media (i.e., television, radio, and the internet) is used to inform and give instructions to the public.

An excellent recent example of an effective large-scale emergency coordination effort was during Superstorm Sandy in October 2012. The coordination for this event and its aftermath involved federal agencies working closely with multiple state and local agencies along with media and many volunteers to effectively address the response efforts. However, Superstorm Sandy also highlighted the need for NYMTC members to focus efforts on adapting the transportation system to increase resiliency to the impacts of climate change, sea level rise and extreme weather.

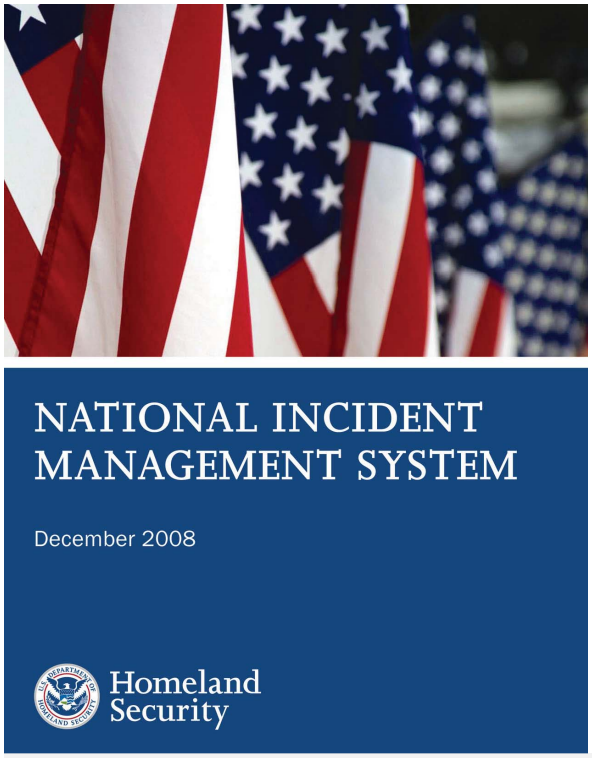
Looking forward, their planning processes will be expanded in the following ways:

A. FEDERAL

At the Federal level, the U.S. Department of Homeland Security (DHS) is an overarching agency whose responsibilities include critical infrastructure protection, and emergency preparedness and response, as well as providing a set of requirements of safety measures to state and regional agencies. The National Incident Management System (NIMS) is an emergency management doctrine used as a guide to facilitate emergency preparation, management and mitigation for public and private sectors nationwide. The provision of transportation security rests with the Transportation Security Administration (TSA) whose mission is to protect the nation's transportation systems to ensure the freedom of movement for people and commerce. The FTA and TSA have developed a list of Security and Emergency Management Action Items to elevate security readiness throughout the public transportation industry. Among the other agencies operating under DHS is the Federal Emergency Management Agency (FEMA), which is responsible for coordinating efforts with state and local governments in order to manage all hazards including natural and man-made disasters. It should also be noted that in addition, each administration within the U.S. Department of Transportation is involved with different aspects of transportation security.

B. STATE & REGIONAL

New York State Executive Law, Article 2B, enacted in 1978, created the Disaster Preparedness Commission (DPC) and required the development of a statewide Emergency Management Plan. The DPC comprised of the commissioners, directors or chairpersons of 23 state agencies and one volunteer organization – the American Red Cross. The responsi-



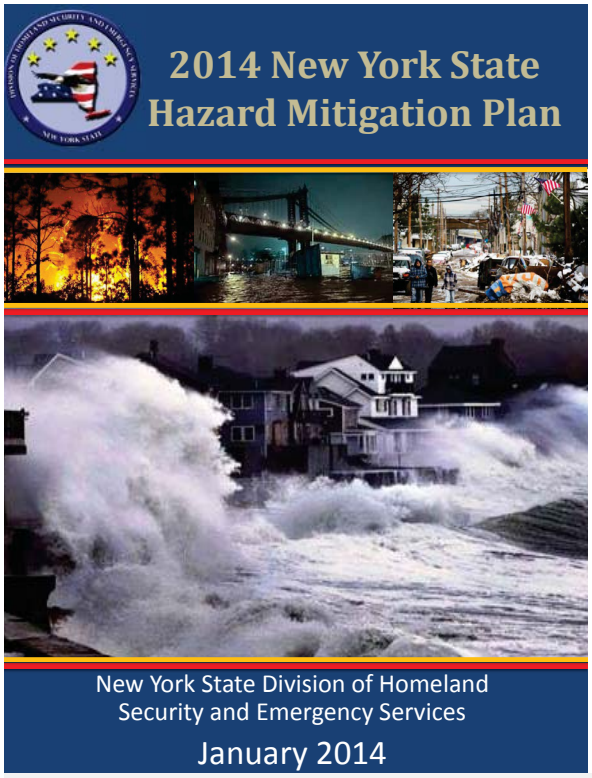
National Incident Mangement System
Photo Source: U.S.Department of Homeland Security

bilities of the Commission include: the preparation of state disaster plans; the direction of state disaster operations and coordination with local government operations; and the coordination of federal, state, and local recovery efforts. The New York State Office of Emergency Management provides administrative and program support to the DPC and plans and coordinates the responses of the state in times of emergency or disaster. The New York State Office of Homeland Security was created after the September 11, 2001 terrorist attacks and by law coordinates the policies, protocols, and counterterrorism strategies for New York State government agencies. NYMTC members refer to the *State Homeland Security Strategy* and *New York's State Preparedness Report* to establish goals and initiatives appropriate to their respective counties.

NYSDOT created the Emergency Transportation Operations (ETO) Program, which is the foundation for preparation, response and recovery for major emergency incidents that occur in New York State. New York State is broken into different regions, each of which has an Emergency Manager who has oversight in the ETO Program, allowing for statewide coordination during emergency events. In the event of a major emergency, NYSDOT responds by implementing the Incident Command System, the command and control system used by state and federal responders.

NYSDOT works with the state Office of Emergency Management (OEM) to create emergency plans that prepare for possible and probable natural or man-made disasters that directly affect the transportation system. One example is the Transportation Infrastructure Branch Annex of the *State Comprehensive Emergency Management Plan*. This annex describes how NYSDOT will respond to emergency events that disable the use of the transportation system, particularly how to restore the system for local customers. Coordination with federal agencies and standards is also outlined in this annex, but the actual coordinating is handled by the state OEM.

At the local level, NYSDOT coordinates with county Emergency Management plans through training and exercises that foster relationships and coordination prior to the occurrence of a disaster. On the state level, NYSDOT works with the New York State Disaster



2014 New York State Hazard Mitigation Plan
Photo Source: NYS Division of Homeland Security and Emergency Services

Preparedness Commission, which is a commission of agencies that helps during state wide disaster and disaster recovery.

NYSDOT provided assistance to local governments in response to multiple events in 2014. After severe flooding in western New York from May 13th-May 22nd, 2014, NYSDOT, using a combination of State assets and contract support, provided more than $7 million in emergency infrastructure assistance to affected areas. When a 10-county area in western New York experienced a major lake effect snow event in late November 2014, NYSDOT responded by deploying more than 2,200 personnel and 675 pieces of equipment to assist in recovery.

NYSDOT is also undertaking additional efforts to identify critical transportation infrastructure within the region vulnerable to extreme weather events, storm surge, sea level rise and seismic events, and to develop a risk assessment of transportation infrastructure that will assist in future capital and emergency mobility planning. This more detailed assessment will help define critical facilities, corridors, systems, or routes that must remain functional during a crisis

Signal Maintainers Clearing Switches in Coney Island Yard after Snow Storm
Photo Source: MTA

or be restored most rapidly. A recent synthesis study undertaken by the agency entitled "*Mainstreaming Climate Change Adaptation Strategies into New York State Department of Transportation's Operations*," suggests that the agency integrate adaptation to climate change considerations into all aspects of its decision-making. As a result, climate resiliency will be considered a factor for long-term planning and investigated as a criterion for future project selection. In addition, NYSDOT will continue to improve communication among agencies, and is developing plans for system upgrades to improve outreach to the public. Further, the department is developing an asset management planning and replacement schedule for ITS equipment, infrastructure and devices to ensure resiliency and redundancy; plans for integrated corridor management and enhanced signal systems that would facilitate potential evacuation.

The MTA is developing and implementing strategies and projects to protect its infrastructure from the kind of damage that Sandy inflicted. All MTA agencies are coordinating with applicable federal, state, county and city agencies, as well as the real estate community to protect vulnerable zones; harden assets; and capture lessons learned across the organization for better information sharing. Specific infrastructure projects include rebuilding tunnels, developing strategies to harden subway station entrances, vents, manholes, and other means of water intrusion to stations and tunnels. Tracks, signals, line and power equipment are being repaired and hardened against future damage. Yards, shops and depots in vulnerable locations, as well as the headquarters building in lower Manhattan are being hardened as well. New technologies are being developed, tested, and implemented to facilitate creating a stronger more resilient system. In addition to hardware improvements, agencies have strengthened storm-related processes and response plans using upgraded tracking tools to facilitate improved communication and coordination of deployment activities.

The Port Authority is undertaking a wide range of initiatives: intensive review of facility systems to control flooding and anticipate other incidents with potentially dramatic impact, and lessons learned reviews for improving communication with the traveling public and other transportation operators. The agency is redoubling its efforts to apply investment strategies that will reduce the vulnerability of critical infrastructure connections – notably the multi-modal Hoboken transit hub – and improve the resilience of the overall regional transportation network through availability of ferry resources, working closely with both states, federal and regional partners, and host communities.

C. COUNTY & LOCAL

Nassau County

In preparing for disaster and emergency relief, Nassau County relies on its Office of Emergency Management (OEM), mandated by the Nassau County Charter. The Nassau County OEM is responsible for preparing plans for possible emergency situations. In addition, since emergency response overlaps the jurisdiction of multiple agencies, the Nassau County OEM plans the coordination for multi-department response situations.

The county-specific plans are developed based on the probability of occurrence (moderate to high probability is a priority). These plans are periodically reviewed and updated when necessary.

The following is a non-exhaustive list of emergency plans that have been prepared by the Nassau County OEM:

- A general, comprehensive county emergency plan.
- Hurricane Relief: Strategies and an implementation timeline, along with actions that must be taken and resources that will be needed.
- Coastal Evacuation: Routes and contraflow plans for coastal flooding, especially where evacuation is needed, such as barrier beaches and low lying areas in flood zones.
- Sheltering: Shelter locations, implementation strategies, and needed resources emergencies.
- Hazard Mitigation: Strategies and guidelines to deal with specifically identified hazards and risks that are probable within the county infrastructure.
- Debris Management: Debris mitigation and staging and removal plans for large scale incidents.
- Mass Fatalities: Strategies to deal with incidents that usually involve numerous deaths.
- Interoperable Communications: Communication plans to coordinate disparate radio systems.

To ensure rapid response and coordination during emergency events, the Nassau County OEM has formed many Memoranda of Understanding (MOUs) with other local non-county agencies in Nassau County. The NYC Urban Area Work Group and the Regional Catastrophic Planning Team are just two examples of MOUs formed within Nassau County. On the State level, Nassau County ensures coordination with state strategies by following the goals and objectives included in the ***S**tate Homeland Security Strategy* and in the *New York's State Preparedness Report*. Additionally, Nassau County follows federal security strategies for disaster preparedness by managing a local Citizen Emergency Response Team (CERT). CERT is a community-based organization based on the federal "whole community" approach, where volunteer members are trained in emergency preparations and response. These volunteers are vital resources during and after emergency incidents. Nassau County's coordination strategies were effectively applied during the recent weather events: Hurricane Irene and Superstorm Sandy. In another effort to streamline the communications process during emergencies, when the National Guard is activated to assist with incidents, each vehicle is paired with a member of the Nassau County Police Department so as there are no communication gaps. MOUs between county and non-county agencies, along with 71 volunteer fire departments and other emergency crews make Nassau County's OEM a successful example of a county, non-county, state, and federal agency coordinated response to a regional disaster.

Lessons learned from Sandy include the need for its Department of Public Works to bid new contracts that fully comply with federal requirements to ensure recovery work is eligible for federal reimbursement, and to establish an Emergency Operations Plan related to traffic control infrastructure that addresses roles and responsibilities of personnel and includes emergency procedures for a variety of scenarios. The county will also implement mitigation measures for backup generation and the motor control centers at its two drawbridges, the Long Beach and the Bayville bridges. Backup generation is also being analyzed for traffic control equipment. Additionally, the county

will look at hardening measures related to all transportation infrastructure, including tide flex valves on drainage systems in low lying areas, shoreline and bridge scour protection and the types and locations for curbside trees. Finally, the county will look at ways to expand use of its Traffic Management Center cameras, VMS and signals to its evacuation routes and tie those routes to the Center.

Suffolk County

In preparing for emergencies, Suffolk County relies on the Office of Emergency Management (OEM) to coordinate the county's response to natural and man-made disasters. OEM personnel are responsible for development of the Comprehensive All-Hazards Emergency Management Plan, the operation of the county's Emergency Operation Center (EOC) and work with local, state, and federal officials in all aspects of shelter management, planning, resource management, and emergency response and recovery activities.

Long Island's southern coastline faces the open waters of the Atlantic Ocean and is vulnerable to numerous coastal hazards, especially the unobstructed path of southern storms traveling up the coast. Eastern Long Island is listed in the top ten areas in the U.S. most vulnerable to hurricanes. Because of this unique geographic location, exposure, and vulnerability, the 1.5 million residents of Suffolk County are susceptible to a variety of coastal events and natural disasters. The following is a non-exhaustive list of emergency plans and directions that were prepared by the Suffolk County OEM:

- A general, comprehensive county emergency plan.
- Hurricane Preparedness: Includes information on hurricanes in general, hazards connected with them, how to stay informed and a Family Emergency Plan.
- Mitigation for Natural Disasters: Included among the natural disasters are extreme heat, fires, floods, hurricanes, lightning storm safety, tornado preparedness, winter storms and extreme cold, wild fires and rip current safety.
- Special Needs Registry and Joint Emergency Evacuation Program (JEEP): JEEP is a database of individuals who require emergency evacuation and special assistance during evacuations. The data base is maintained by the Suffolk County Office of Emergency Management and is activated prior to an impending disaster. Services provided will be based on need and availability.

Photo Source: Nassau County

Included on the Suffolk County Government website is a shelter and storm surge zone mapping tool. The tool was developed by Suffolk County through the efforts of the Department of Information Technology and Fire, Rescue and Emergency Services, to assist with preparations when emergency situations and storm flooding conditions or potential evacuations may occur.

Suffolk County transit will also participate in evacuations from flood prone areas. A separate telephone hotline will be provided which will allow for address specific locations to transport residents to Red Cross designated shelters.

In Suffolk County, initial lessons of Sandy underscore the urgency of some of the plans already being pursued, including Connect Long Island, a Bus Rapid Transit initiative – that will help reduce dependence on automobiles. A less auto-dependent Suffolk County will be less vulnerable to disruptions in the availability of fuel; and innovative transit will enhance Suffolk's resiliency and economy. Suffolk County also seeks to reinvigorate hazard mitigation plans and go beyond previous paradigms to create comprehensive, state-of-the-art flood protection systems that balance "bricks and mortar" such as buildings, roads, waste-water infrastructure and power grids with Suffolk's natural water systems of ocean, bay, sound, rivers and creeks.

Westchester County

Westchester County is undertaking various initiatives to adapt services and infrastructure to address the increasing severity and frequency of storms such as Sandy, including identifying detours for bus routes and developing flood mitigation plans to minimize roadway closures and minimize disruptions in bus service. The county will continue to make full use of its Office of Emergency Management (OEM) to facilitate up-to-date communication among transportation agencies, first responders and utility companies, and work with them to direct resources to the areas of greatest need.

Preparing for emergency incidents and recovery within Westchester County is the responsibility of the County OEM, which works regularly with the Westchester County Department of Public Works and Transportation. The Department of Public Works and Transportation frequently meets with other county agencies to discuss training, drills and exercises for relevant emergency situations. The most prominent agencies that the Department of Public Works and Transportation coordinates with are the Westchester County Office of Emergency Management and the Westchester County Emergency Preparedness Group, which is chaired by the county OEM.

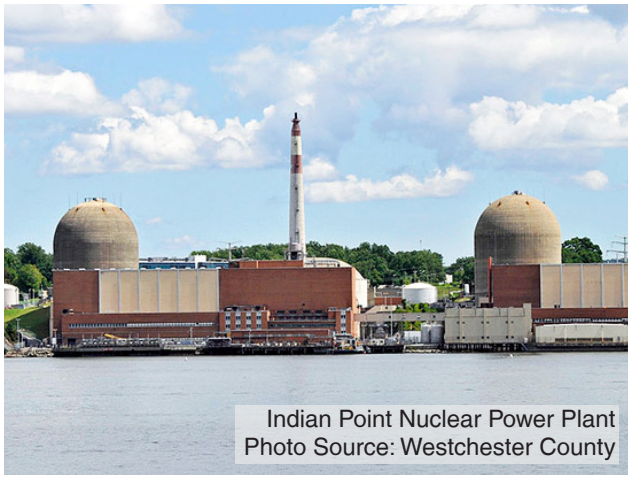
Evacuation Guidance Sign
Photo Source: Suffolk County

The coordination effort between the Westchester County Department of Public Works and Transportation and other agencies has led to many ongoing emergency related planning projects. The following is a partial list of current emergency preparedness plans in Westchester County:

- Westchester County Comprehensive Emergency Management Plan: Managed by the Westchester County OEM, the plan details the county's overall preparedness strategies for all hazards and the associated recovery efforts.
- Indian Point Radiological Emergency Preparedness Plan and Procedures: Also maintained by the county OEM, this plan involves nearly all departments of county government and thousands of emergency responders. These resources can be applied to any other emergency response situation. The Indian Point REP is practiced annually.
- Security Assessment of Westchester County's Bee-Line Bus System: This project includes a security risk assessment for all components of the Bee-Line Bus System, along with recommended security policies and procedures to be undertaken.
- Security Emergency Preparedness Plan for the Bee-Line System: Details standard procedures for the Bee-Line System and its operators to protect against a terrorist attack.
- Transit Strike Plan: This plan outlines the Bee-Line Bus System's procedures in the event of a union strike against the MTA or a strike of Bee-Line employees.
- Emergency Operating System: This project provides snow emergency extended service in case of interruptions to Metro-North Railroad's operations.

The Westchester County OEM is the conduit for regional, state and federal coordination. On the regional and state levels, the county OEM manages Westchester's preparedness and relief plans, working daily with local, county, state, federal and private partners in planning for large-scale, multi-departmental, multi-jurisdictional disasters. On the federal level, the county's Department of Public Works and Transportation is involved with the National Incident Management System (NIMS). NIMS standardizes processes, procedures and systems when addressing a major incident that requires help from neighboring counties, states or the federal government. NIM'S standards allow for the efficient integration of resources and strategies during an emergency. FEMA, the FBI, TSA and NRC (National Response Center) are partners in the planning, training and exercises for a large-scale disaster in Westchester County.

"Bee-Aware" Security Campaign
Photo Source: Westchester County



Indian Point Nuclear Power Plant
Photo Source: Westchester County

Rockland County

A Comprehensive Emergency Management Plan (CEMP) is a framework, developed by Rockland County, for coordinating agency responses to all types of emergencies that occur within Rockland County. The CEMP combines all operation efforts, regional, state wide, and federal, to ensure efficient and effective responses to emergencies.

The CEMP currently has comprehensive strategies and guidelines for the occurrence of the following disasters: hurricane and coastal storms; winter storms; radiological emergency response; bio-terrorism; and hazardous material response.

In an effort to coordinate regionally, Rockland County has established partnerships with the surrounding five townships, 19 villages, and private sectors. With these relationships Rockland County serves as a key player in emergency preparedness, mitigation, response, and recovery. On the state level, Rockland County's Office of Fire and Emergency Services works closely with the New York State Office of Emergency Management to review and improve county preparedness plans on a monthly basis. The current County Plan for Emergency Preparedness is in accord with federal standards and policies, such as the National Response Framework, the New York State Emergency Operations Plan, the National Incident Management System, the Robert T. Stafford Disaster Relief and Emergency Assistance Act, and the Title III Superfund Amendment and Re-authorization Act of 1986. The Rockland County Department of Public Transportation is an active participant in the County's emergency preparedness plans, training and response activities, including representation from its Transport of Rockland fixed-route and TRIPS paratransit bus operations.

Rockland County plans to step-up efforts to work more closely with utility companies and other agencies to continue establishing a more organized approach to restoring the transportation infrastructure in a timely manner. This will include pursuing more direct communication links between transportation agencies, responders and utilities, as well as more basic efforts like further encouraging that main power lines be secured underground and implementing more vigorous tree monitoring programs to limit future exposure to outages. Plans to define more specific staging areas, improve resources, establish more widespread power redundancies, increase supply levels before a storm and continuing to call for all service stations and food stores to have generators will improve response and recovery time. Continued use and refinement of GIS mapping tools will also ensure Rockland County's ability during future weather events to monitor fast changing conditions and to direct emergency crews more efficiently and effectively.

Putnam County Emergency Services
Photo Source: Putnam County

Putnam County

The Bureau of Emergency Services, along with County, Town, and Village representatives are working to create a Putnam County Hazard Mitigation Plan. The plan's main objective is to address and correct current problem areas and mitigate future problems throughout the County. This federally run program plan through FEMA provides federal support and resources for the County and its municipalities. In the event of a disaster this plan aims to provide additional resources and support the affected communities and the County, resulting in long-term community well-being. Without mitigation actions, safety, financial security, and self-reliance are jeopardized.

Putnam County Bureau of Emergency Services (BES) formulates plans for all large-scale emergencies within the county. The BES of Putnam County is in charge of the following emergency preparations:

- Emergency Equipment Stockpile: The BES can gain access to state emergency equipment, when needed.
- Weather Alerts: Sends weather alerts for use by schools and public officials.
- Emergency Management Personnel Training: Trains those involved with Radiological Emergency Response, relating to the Indian Point nuclear plant.

With regards to regional emergency coordination, Putnam County works with the Putnam County Bureau of Emergency Services, which also coordinates with state disaster strategies, and the Sheriff's Office. Putnam County also works with the Putnam Emergency and Amateur Repeater League (PEARL), the non-county public emergency and information radio station that cooperates with Putnam County during emergencies and drills. While the plans for disaster preparedness in Putnam County are mandated and instituted by the county, the transportation response service is carried out by MV Transportation, the operator of Putnam Area Rapid Transit. Putnam County follows the Federal Transit Administration's Triennial Review, which details the measures to be taken to ensure a safely operated and prepared transit network, and updates to the FTA Safety and Security Plan.

New York City

To plan for disaster preparedness and emergency relief, New York City Emergency Management along with NYC DOT meets monthly with various city, state regional and federal agencies, non-profit organizations, and public utility companies to discuss the mitigation, planning, response and recovery for New York City before, during and after an emergency. A large number of agencies and other public associations meet on a regular basis to accomplish these tasks including: American Red Cross, Community Affairs Unit, Con Edison, NYC Department of Citywide Administrative Services, US Department of Environmental Protection, NYC Department for the Aging, US Department of Energy, US Coast Guard, Verizon, NYC Department of Information Technology and Telecommunications, NYC Department of Sanitation, Fire Department of NY, Greater New York Hospital Association, NYC Health and Hospitals Corporation, NYC Department of Correction, NYC Department of Homeless Services, NYC Department of Buildings, New York Police Department, NYC Office of the Chief Medical Examiner, NYC Department of Parks and Recreation, New York State Emergency Management Office, NYC Department of Housing Preservation and Development, NYC Human Resources Administration and Long Island Power Authority.

In preparation for any disaster, City agencies work together to create the following preparedness plans:

- Citywide Health and Safety Plan: A coordinated multi-agency plan that ensures the health and safety of NYC response and recovery teams.
- Coastal Storm Plan: Strategies focused on sheltering NYC evacuees in case of a major hurricane. This plan targets at risk coastal communities.
- Commodity Distribution Plan: Guidance to distribute life sustaining commodities to up to 1.2 million New Yorkers in 59 different Community Districts.
- Continuity of Operations Plans: An overall, all-hazard plan that manages a framework of preparation in the event of a disruption.
- Evacuation Plan: Regionally situational plan that facilitates rapid, safe, and efficient evacuation of threatened areas.

- Flash Flood Plan: Entails a coordinated response to flash floods in NYC and pre/post flood mitigation strategies.
- Maritime Emergency Plan: Coordinates mass maritime transit in the event of an unforeseen surge in demand for over water travel. This could be caused by manmade or natural disasters or a disruption in the transit system.
- Snow Storm Plan: Planned response to snow advisories issued by the National Weather Service.
- Transit Strike Plan: Staffing plan of essential personnel, authorized travel advisories, city contingency plans and emergency proclamations from the Mayor and DOT Commissioner.

To further prepare for an emergency event, tabletop exercises and full scale exercises are held yearly. Tabletop exercises are city and state wide emergency exercises that take place in an informal meeting setting. Full scale exercises are operational exercises that are as close to a real event as possible, involving personnel, equipment and a specified location.

NYC DOT meets semi-annually and monthly with different city and regional agencies and authorities to update, discuss and coordinate current plans. Four times a year, NYC DOT meets with New York City Emergency Management and state OEMs to coordinate on a larger scale, in case of a state wide emergency. By following the National Incident Management System (NIMS), the standardized federal emergency management plan, NYC DOT is prepared to coordinate on the federal level.

New York City is also applying lessons learned from Superstorm Sandy recovery to better prepare and respond to any similar disasters in the future. Pedestrian and bicycle access across major bridges was critical to immediate recovery of travel options within the city. Over 16,300 people crossed the four East River bridges on foot or bicycle after the storm, an increase of more than 11,700 above everyday numbers. The temporary ferry service to southern Staten Island provided travel options for residents in areas highly impacted by Superstorm Sandy. The East River Ferry and the "bus bridge[ii]" from Atlantic Station to Manhattan also formed critical parts of the connection between Manhattan, Brooklyn, and Queens in the immediate days after the storm.

[ii] Because the subway tunnels between the New York City boroughs were closed in the immediate aftermath of Superstorm Sandy, New York City Transit deployed buses to connect passengers between boroughs.

Return of Shuttle Train Service to The Rockaways after Superstorm Sandy
Photo Source: MTA

4. TRANSPORTATION SYSTEM RESILIENCY

There is a strong consensus within the scientific community that human activities (primarily fossil fuel combustion and deforestation) have contributed significantly to climate change. According to the United States Climate Action Report 2014, transportation activities accounted for 33 percent of CO2 emissions from fossil fuel combustion. Transportation emissions dropped by eight percent from 2005 to 2011, in part due to increased vehicle fuel efficiency and a 2.6 percent decrease in annual passenger miles driven. Even so, the United States' prevailing low-density development patterns mean that US commuters still use more energy and generate higher emissions per person than those in other industrialized countries.

These concerns have been underscored by recent extreme weather events that impacted the NYMTC planning area. Since 2011, three significant weather events have affected the NYMTC planning area: Hurricane Irene and Tropical Storm Lee in 2011, and Superstorm Sandy in 2012. Superstorm Sandy caused damaging, high wind speeds and storm surges of up to 17 feet (at Long Beach, the highest recorded storm surge in the region) and resulted in more than 100 deaths. Tens of billions of dollars in damage were also incurred upon infrastructure, businesses, and residences in several states, particularly New York and New Jersey. Superstorm Sandy exposed inherent vulnerabilities of the New York Metropolitan Area's transportation system. Coastal roadways were submerged, and subway and auto tunnels were flooded. In total, the MTA suffered nearly $5 billion in damages - most subway lines in New York City were closed for several days and some stations did not re-open for months after the storm.

There continues to be an urgency around adapting and protecting transportation infrastructure from the effects of future, extreme weather events. This urgency is compounded by leading climate models that indicate that these types of weather events are likely to occur more frequently in the coming decades, and that the NYMTC planning area faces increased flood risks due to climate change and rising sea levels. This is problematic given that New York has the second-highest coastal population of any state in the country, much of which is concentrated in the NYMTC planning area.

There have been multiple efforts to increase the resiliency and redundancy of the transportation system and better prepare for future incidents.

NY-NJ-CT POST-HURRICANE SANDY TRANSPORTATION VULNERABILITY ASSESSMENT AND ADAPTATION ANALYSIS

To better plan and invest in the long-term climate resilience of the nation's transportation infrastructure, FHWA established a vulnerability and risk assessment pilot program in 2010 in partnership with State Departments of Transportation, MPOs and Federal Land Management Agencies (FLMAs). One of these pilot program took place in 2011 in Northern New Jersey. Each pilot program assessed system vulnerabilities to extreme weather events, and identified strategies to protect and improve the resiliency of transportation assets. The program also aimed to improve the FHWA's model for responding to extreme weather events that impact the nation's transportation systems, in the current context of the uncertainties of a changing climate.

In 2014, FHWA launched an initiative to enhance the tri-state region's resiliency to climate change and extreme weather in the longer term, while informing the ongoing Hurricane Sandy recovery process. Building from the aforementioned FHWA-sponsored New Jersey vulnerability assessment pilot performed in 2011, the agency is collaborating with NYMTC and other partners in New York, New Jersey, and Connecticut to survey the damage and disruption wrought by Hurricane Sandy on the region's transportation systems, along with that of Hurricane Irene, Tropical Storm Lee, and Winter Storm Alfred (the Halloween Nor'easter of 2011). The results of this work are anticipated before the end of calendar year 2017 and will be amended into *Plan 2045* when available.

NEW YORK RISING COMMUNITIES RECONSTRUCTION PROGRAM

New York State continues to invest in strengthening coastlines, repairing infrastructure and other resiliency efforts since Superstorm Sandy's impacts in 2012. In 2013, Governor Cuomo established the Governor's Office of Storm Recovery (GOSR) to oversee the New York Rising Community Reconstruction (NYRCR) program, a $700 million initiative providing rebuilding and resiliency assistance to communities severely damaged by Superstorm Sandy and other major storms. The program employs community-driven planning in combination with state-level technical expertise to make decisions on what projects should receive funding. The first round of New York Rising communities completed the program in March 2014, and Round 2 communities were announced in early 2015. Numerous locations in the NYMTC planning area have benefited from the program, including Suffern, Yonkers, Babylon, West Islip, Baldwin, and several New York City neighborhoods.

Another State initiative was the 2014 passage of the Community Risk and Resiliency Act (CRRA). The purpose of this act was to ensure that State funds and permits include consideration of the risks of future extreme weather events and the consequences of climate change. From 2014 through 2017, the State will develop sea level rise projections, mitigation measures for storm surges and flooding, and create comprehensive guidance on the use of natural resiliency measures to reduce the risk of damage from storms. The Act has implications for a wide range of programs, including Department of Environmental Conservation (DEC) permits for wells and sewers, Department of State (DOS) programs for waterfront revitalization, and agriculture and farmland protection initiatives.

The New York State Climate Smart Community grant program began in 2009, and provides communities funding support in the range of $25,000 to $100,000 to climate change impact mitigation and adaptation projects in the range of $100,000 to $2 million. In 2016, Governor Cuomo appropriated $11 million to Climate Smart. NYMTC planning area grantees include the Village of Haverstraw in Rockland County to support its Comprehensive Plan Update to include adaptation strategies, and Alley Creek protection and restoration work in Little Neck, Queens.

MTA'S CLIMATE ADAPTATION TASK FORCE

In 2014, MTA's then-Chief Executive Officer Thomas Prendergast formally instituted the MTA's Climate Adaptation Task Force and tasked key personnel throughout the organization to coordinate all adaptation and resiliency focused activities to fortify its assets against future adverse climate events. The

Task Force organizes forums with relevant local and regional public sector agencies, commercial entities, and with academic and research institutions for continuous information exchange and knowledge sharing.

The MTA currently has a $6.9 billion post-Sandy recovery and resiliency program, of which $2.4 billion have been committed to 187 projects to date. In an effort to promote transparency and accountability to stakeholders, the status and description of each project is tracked and reported through an online dashboard portal on the MTA's Capital Program website. Projects include immediate responses such as restoring subway service to the Rockaways soon after Superstorm Sandy. Other projects, like refurbishing the Montague tube with resilient systems and flood-protected electrical rooms, were recently completed, and still others - such as protecting the portals to the Hugh L. Carey and Queens Midtown Tunnels, hardening the power and signal system along Metro-North's Hudson Line, and building walls and improving drainage to protect subway and rail yards - are in advanced stages of planning, design, and procurement. In the near future, the MTA will need to make extensive repairs to the Canarsie Tube carrying the L train between Brooklyn and Manhattan, which could impact up to 300,000 daily riders on the heavily-used route.

LOCAL INITIATIVES

In 2015, Mayor de Blasio released OneNYC: "The Plan for a Strong and Just City", a plan to address future challenges in housing, transportation, resiliency, and other areas. The OneNYC vision pledges that "the City will use the best available climate science, as well as robust research, legislative action, advocacy, and regional coordination to adapt the city's infrastructure to be resilient against disruption." The plan lays out municipal investments such as upgrading buildings to be more energy efficient, and continuing to invest in storm-resilient infrastructure.

The Mayor's Office of Recovery and Resiliency (ORR) is spearheading several coastline resiliency projects throughout the City. One project focuses on strengthening Hunts Point, Bronx – an important food distribution center located on a flood plain and in an impoverished area - against future storm and flooding events.

The New York City Department of Transportation (NYC DOT) is implementing hazard mitigation measures to better protect assets by elevating electrical/mechanical equipment and flood proofing facilities, hardening street ends in certain vulnerable neighborhoods, and elevating streetlight/traffic signal infrastructure in the Rockaways. NYC DOT is also protecting movable bridge structures and the Battery Park/West Street Underpasses to ensure coastal storm surge doesn't negatively impact those facilities. Also, NYC DOT received funding from the Federal Transit Administration Resiliency grant program to partially fund three new ferry vessels that will be better capable of navigating in increased wind and precipitation events.

Westchester County is undertaking various initiatives to adapt services and infrastructure to address the increasing severity and frequency of storms such as Sandy, including identifying detours for bus routes and developing flood mitigation plans to minimize roadway closures. The county will continue to make full use of its Emergency Operations Center to facilitate up-to-date communication among transportation agencies, first responders and utility companies, and work with them to direct resources to the areas of greatest need.

Rockland County plans to step up efforts to work more closely with utility companies and other agencies to continue establishing a more organized approach to restoring the transportation infrastructure in a timely manner. This will include pursuing more direct communication links between transportation agencies, responders and utilities, as well as more basic efforts like further encouraging that main power lines be secured underground and implementing more vigorous tree monitoring programs to limit future exposure to outages. Plans to define more specific staging areas, improve resources, establish more widespread energy redundancies, increase supply levels before a storm and continuing to call for all service stations and food stores to have generators, will improve response and recovery time.

Post-Superstorm Sandy, Putnam County implemented mitigation strategies as part of its ongoing efforts to address water, wind and other damages resulting from severe weather/storm events. There were significant damages in Putnam County resulting from severe weather/storms, notably at the Mill Road Bridge in the town of Philipstown and at Snake Hill Road in the Village of Cold Spring. Keenly aware that mitigation efforts pertaining to future potential damages caused by such natural disasters are necessary, Putnam County employed specific methodologies county-wide (e.g., hardening) in order to protect infrastructure, equipment and buildings from such natural disasters in the future. Additionally, Putnam County has/continues to engage in emergency planning and preparation in order to improve the County's Incident Command System (ICS) under these types of circumstances.

Since Superstorm Sandy, Nassau County is not only rebuilding, but they are rebuilding bigger and stronger than ever. Nassau County's sanitary sewer system and sewer treatment facilities, particularly along the South Shore, were overwhelmed and severely damaged by the storm surge and key projects, such as the $28.6 million project to mitigate sanitary sewer overflow, and the $830 million in ongoing and planned projects to fully rehabilitate the Bay Park Sewage Treatment Plant, are two examples where Nassau has made significant improvements to its sewer facilities infrastructure. In addition, Nassau County has a $28.2 million construction project to replace and mitigate traffic signals and controls throughout Long Beach and the South Shore that were damaged by Sandy. On the highway side, Nassau County has several post-Sandy rehabilitation projects in the Long Beach Road corridor, including the roughly $10 million project to replace the Barnum Island Bridge, a key connector in this designated Evacuation Route. On its North Shore, Nassau County has been working on a multi-phase project to restore West Shore Road in Mill Neck, with the first phase focused on emergency repairs and the second to fully rehabilitate this important road that connects Bayville to Oyster Bay and Mill Neck. Regarding transit, the Nassau Inter-County Express (NICE) bus system currently has two post-Sandy resiliency projects in progress. Specifically, NICE has begun the process to replace the current overhead garage doors at all its operating facilities with high-capacity roll up doors to withstand high wind damage as much as possible. In addition, NICE's replacement CNG station has been designed to allow for the ability to fuel its fixed route fleet from its major operating facility in the event of system failure.

In Suffolk County, initial lessons from Sandy underscore the urgency of some of the plans already being pursued, including an initiative to Connect Long Island through Bus Rapid Transit that will help reduce dependence on automobiles. A less auto-dependent Suffolk County will be less vulnerable to disruptions in the availability of fuel; and innovative transit will enhance Suffolk's resiliency and economy. Suffolk County also seeks to reinvigorate hazard mitigation plans, going beyond previous paradigms to create comprehensive, state-of-the-art flood protection systems that balance "bricks and mortar" (such as buildings, roads, waste-water infrastructure and power grids) with Suffolk's natural water systems of ocean, bay, sound, rivers and creeks. In 2013, the County submitted 62 applications for funding through the US Department of Agriculture, Natural Resources Conservation Service, Superstorm Sandy Emergency Watershed Protection Program – Floodplain Easements (EWPP-FPE), to acquire flood prone properties that were inundated or damaged by Superstorm Sandy on the Mastic/Shirley peninsula, to provide coastal resiliency for future storm events. To date, the County has acquired about 60 acres totaling 322 parcels in the Mastic/Shirley Conservation Area. Additionally, New York State owns 90 acres and the Town of Brookhaven owns almost 20 acres. Altogether, over 170 of the 625 acres within the Mastic/Shirley Conservation areas have been protected. Outside of climate adaptation strategies, there are efforts being made to address some of the root causes behind the increasing frequency of extreme weather events. NYMTC members, partners, and beyond have explored strategies to reduce reliance on fossil fuels and reduce carbon emissions.

ENDNOTES

[1] Nash, Andrew B. and Ronald, Sylvia. 2001. **Implementation of Zürich's Transit Priority Program.** *Mineta Transportation Institute.* http://www.andynash.com/nash-publications/Nash2001-Zurich-PT-MTI-01-13.pdf

[2] Downs, Anthony. 2004. **Still Stuck in Traffic: Coping with Peak-hour Traffic Congestion.** Washington, D.C.: Brookings Institution.

[3] United States Department of Transportation (USDOT) Federal Highway Administration (FHWA). July 2012. **Emergency Transportation Operations.** http://www.ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm>.

[4] USDOT: Federal Highway Administration (FHWA). 2017. **Access Management.** http://ops.fhwa.dot.gov/access_mgmt/

[5] FHWA. 2017. **Managed Lanes.** http://ops.fhwa.dot.gov/freewaymgmt/managed_lanes.htm

[6] FHWA Office of Transportation Management. April 2009. **Transit and Congestion Pricing: A Primer.** http://ops.fhwa.dot.gov/publications/fhwahop09015/fhwahop09015.pdf

[7] Ibid.

[8] Ibid.

[9] Sorensen, Paul, et al. 2008. **Moving Los Angeles: Short-Term Policy Options for Improving Transportation.** http://www.rand.org/content/dam/rand/pubs/monographs/2008/RAND_MG748.pdf

[10] Volpe. December 2015. **2015 OST-R Transportation Technology Scan: A Look Ahead**

[11] NYSDOT. April 12, 2011. **Presentation: Opportunities for Advancing Travel Demand Management in New York State.**

[12] New York City Department of City Planning. September 2010. **Car Share Zoning Text Amendment.** http://www.nyc.gov/html/dcp/html/car_share/index.shtml

[13] New York State Department of Transportation (NYSDOT): NY Rides. 2012. **Park-n-Ride Lots.** http://www.nyrides.com/parknride/index.html

[14] Litman, Todd. 2008. **Valuing Transit Service Quality Improvements.** *Journal of Public Transportation*, 11(2) 43-63. http://www.nctr.usf.edu/jpt/pdf/JPT11-2Litman.pdf

[15] Ibid.

[16] USDOT. 2012. **Fundamentals: How to Manage and Operate Transportation Systems to Support Livability and Sustainability.** http://www.ops.fhwa.dot.gov/publications/fhwahop12004/c3.htm

[17] Victoria Transport Policy Institute. 2010. T**ransit Station Improvements: Improving Public Transit Waiting Conditions.** http://www.vtpi.org/tdm/tdm127.htm

[18] USDOT: Federal Transit Administration (FTA). 2007. **Security Cameras / Security Systems Fact Sheet: Transit Overview.** http://www.pcb.its.dot.gov/factsheets/security/secOve.pdf

[19] American Public Transportation Association (APTA). 2010. **APTA Standards Development Program: Recommended Practice BRT Branding, Imaging and Marketing.** http://www.aptastandards.com/Portals/0/Bus_Published/001_RP_BRT_Branding.pdf

[20] Arora, Amit. 2007. **Inventory of Policies Affecting Parking within the NYMTC Region.** *Rep. Bloustein School of Planning and Public Policy.* http://www.utrc2.org/education/assets/Arora-Report.pdf

[21] Litman, Todd. 2012. **Parking Management: Strategies, Evaluation and Planning.** *Victoria Transport Policy Institute (VTPI).* http://www.vtpi.org/park_man.pdf

[22] New York City Department of City Planning. 2011. **Parking Best Practices: A Review of Zoning Regulations and Policies in Select US and International Cities.** http://www.nyc.gov/html/dcp/pdf/transportation/parking_best_practices.pdf

[23] VTPI. 2011. **Parking Management: Strategies for More Efficient Use of Parking Resources.** http://www.vtpi.org/tdm/tdm28.htm

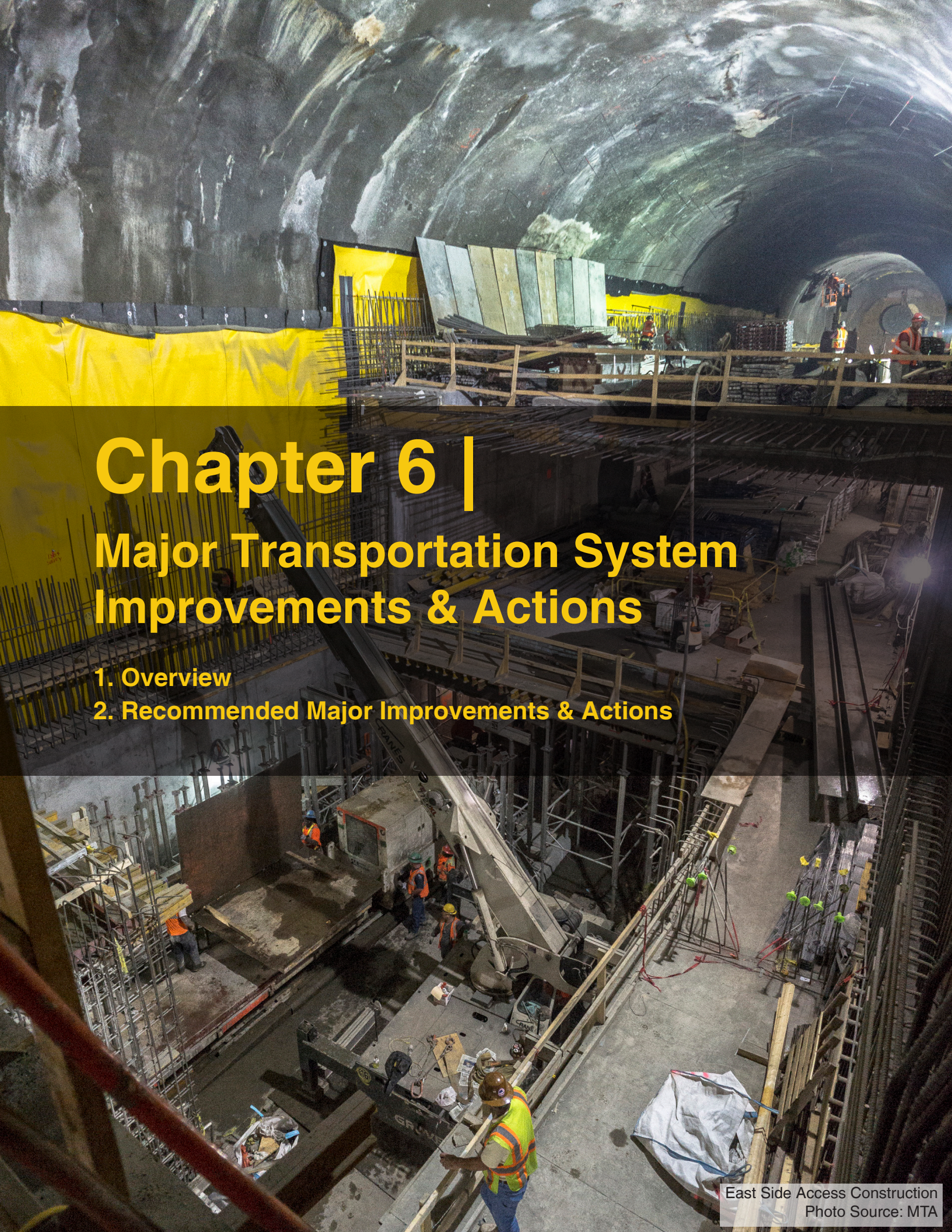
[24] New York City Department of City Planning. 2011. **Parking Best Practices: A Review of Zoning Regula-**

tions and Policies in Select US and International Cities. http://www.nyc.gov/html/dcp/pdf/transportation/parking_best_practices.pdf
[25] FHWA. 2004. **Mitigating Traffic Congestion: The Role of Demand-Side Strategies.** http://www.ops.fhwa.dot.gov/publications/mitig_traf_cong/mitig_traf_cong.pdf
[26] United States Environmental Protection Agency (EPA). 2012. **Issue Brief: Parking Cash Out.** http://www.bestworkplaces.org/pdf/ParkingCashout_07.pdf.
[27] U.S. EPA. 2005. **Commuter Tax Benefits. Issue brief: Best Workplaces for Commuters.** http://www.bestworkplaces.org/pdf/taxbenes_07.pdf
[28] FHWA. 2017. **Application of TDM to Policy Issues.** http://www.ops.fhwa.dot.gov/publications/fhwahop12035/chap3.htm
[29] USDOT National Highway Traffic Safety Administration (NHTSA). August 2016. **Traffic Safety Facts: Research Note – 2015 Motor Vehicle Crashes: Overview.** https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812318
[30] Rail News. January 2017. **Safety.** http://www.progressiverailroading.com/safety/article/FRAs-Feinberg-Theres-been-gradecrossing-safety-progress-but-states-railroads-and-tech-companies-can-do-more--50550?source=pr_digital01/25/2017&email=emailAddress
[31] NHTSA. May 2016. **Traffic Safety Facts: Children.** https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812271
[32] USDOT FHWA. December 2015. **Intersection Safety.** https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/case_studies/fhwasa09018/
[33] USDOT FHWA. February 2017. **Roadway Departure Safety.** https://safety.fhwa.dot.gov/roadway_dept/
[34] NHTSA. April 2016. **Traffic Safety Facts: Research Note - Distracted Driving 2014.** https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812260
[35] Distraction.Gov - Official U.S. Government Website for Distracted Driving. 2016. **State Laws.** https://www.distraction.gov/stats-research-laws/state-laws.html
[36] NYS Department of Motor Vehicles (DMV). 2015. **Summary of Motor Vehicle Crashes: 2014 Statewide Statistical Summary.** https://dmv.ny.gov/statistic/2014-nyscrashsummary.pdf
[37] New York State. June 2016. **Pedestrian Safety Action Plan.** https://www.ny.gov/pedestrian-safety-action-plan/pedestrian-safety-action-plan
[38] Bellafante, Ginia. March 9, 2013. **Is it Safe to Cross?** *The New York Times.* http://www.nytimes.com/2013/03/10/nyregion/after-a-spate-of-vehicular-deaths-is-it-safe-to-cross-the-road.html?_r=1&
[39] The New York State Senate: Fuschillo, Charles J. February 8, 2012. **Senator Fuschillo: New York State's Complete Streets Law Takes Effect This Saturday.** https://www.nysenate.gov/newsroom/press-releases/charles-j-fuschillo-jr/senator-fuschillo-new-york-state%E2%80%99s-complete-streets
[40] NYSDOT. 2010. **New York State Strategic Highway Safety Plan.** https://www.dot.ny.gov/divisions/operating/osss/highway-repository/SHSP%202010%20Final.pdf
[41] TRB Special Task Force on Climate Change and Energy, Transportation Research. June 2011. **Circular E-C152: Adapting Transportation to the Impacts of Climate Change State of the Practice 2011.** http://onlinepubs trb.org/onlinepubs/circulars/ec152.pdf

Chapter 6 |

Major Transportation System Improvements & Actions

1. Overview
2. Recommended Major Improvements & Actions



East Side Access Construction
Photo Source: MTA

Ashford Avenue Bridge over the Saw Mill River Parkway
Photo Source: NYMTC

1. OVERVIEW

Plan 2045 makes a variety of recommendations to be undertaken during the planning period. Chapter 5 included recommendations related to TSM&O. This chapter will detail major transportation system improvements and actions recommended for the planning period. A listing of recommended projects, proposals and studies appears in Appendix 1 for transit, roadways and bridges; Appendix 2 for non-motorized modes, Appendix 6 for specialized transportation services, and Appendix 8 for goods movement.

The recommended projects described in this chapter are in various stages of development: some are purely conceptual vision projects, while others have been more fully defined through planning work, design, or engineering, or specification and are programmed within the fiscally-constrained element of Plan 2045. All of the recommended projects require development before the costs can be finalized for their implementation. These short-, medium-, and long-term transportation improvement projects all support Plan 2045's strategic goals and desired outcomes.

The Plan's strategic framework guides the investments that are recommended for various aspects of the transportation system. The connection between these recommended investments and the Plan's goals and desired outcomes is summarized below:

- The goal of enhancing the regional environment will be supported by actions and strategies that should reduce congestion, decrease greenhouse gas emissions, improve air and water quality, and preserve open space. Among the transportation investments and initiatives that will support this goal are those that provide safe and convenient pedestrian and bicycle travel; manage rail and vehicular congestion; encourage mass transit use by increasing capacity, integration, and accessibility; modernize infrastructure through replacements and rehabilitations that maximize efficiency and useful life; and consider a range of environmental issues and impacts in planning and evaluation studies.
- Improving the regional economy will bring sustainable growth and accommodate the mobility of people and goods in the NYMTC planning area. Planned and programmed projects that support this goal will increase transportation connectivity and efficiency, modernize or replace bridges and other linking facilities; encourage Transit-Oriented Development (TOD) and complementary land-use policies; and optimize the movement of freight to, from, within and through the multi-state metropolitan region through rail and roadway improvements.
- Initiatives and projects that will pursue the goal of improving the regional quality of life in order to realize improved mobility, safety, and accessibility, and a resulting vibrancy in communities. These include rehabilitating or replacing facilities, and managing traffic flows and congestion to mitigate security and safety risks; coordinating planning to address the special needs of pedestrians, bicyclists, persons with disabilities, and older adults; conducting impact studies in dialogue with the public and community stakeholders; improving transportation experiences, including travel times, ease of connectivity, and accessibility, through modernization and expansion projects; and considering negative externalities, community needs, and environmental impacts throughout the planning process.
- The goal of providing convenient and flexible transportation will be supported by actions and strategies that will help increase the regional transportation system's connectivity, reliability, and ridership. These include modernizing infrastructure through replacements and rehabilitations that maximize efficiency, safety, and ease of access; increasing multi-modal, inter-regional, and intra-regional transit choices, expanding the capacity and reach of passenger and freight transportation infrastructure; and considering special needs individuals and underserved communities throughout the planning process.
- The goal of building the case for obtaining resources to implement regional investments will be aided by recommended actions and strategies that enhance the ability to finance coordinated, prioritized projects with a variety of funding methods.
- Actions and strategies that will promote coordinated, ongoing safety and security measures to reduce the rate of annual injuries and fatalities will assist in pursuing the goal of enhancing transportation safety and security. The initiatives and projects relating to this goal include consideration of pedestrian and bicyclist safety in roadway planning; rehabilitating or replacing outdated facilities through modernizations and improvements to mitigate safety and security risks; managing traffic flows and congestion; and enhanced data collection.
- The goal to improve the resiliency of the transportation system will be support by projects and actions that focus on "hardening" the transportation system and by evolving partnerships among agencies to help reduce impacts of disasters on the movement of goods and people.
- Finally, preserving the existing transportation system will be supported by system preservation projects that will keep transit infrastructure in a state of good repair; preserve existing roadways, bridges and tunnels; protect the existing freight network; and preserve exiting pedestrian and bicycle facilities.

MTA Chairman Prendergast Announcing
LIRR Double Track Project
Photo Source: MTA

2. RECOMMENDED MAJOR IMPROVEMENTS & ACTIONS

Plan 2045's recommended improvements and actions fall into two distinct categories: programmed projects that are in the Plan's fiscally-constrained element and aspirational projects, proposals and studies that are in the Plan's vision element. Programmed projects in the fiscally-constrained element are sufficiently developed that likely costs and potential funding are defined. The aspirational vision projects are those projects, proposals, and studies that are relatively undefined and in almost all cases do not have an identified source of funding. Vision projects are often moved into the constrained Plan when they are sufficiently defined.

Fiscal constraint is an important federal requirement and threshold in the metropolitan transportation planning process. Fiscal constraint requires that revenues in transportation planning and programming (Federal, State, local, and private) are identified and "are reasonably expected to be available" to implement the metropolitan long-range Regional Transportation Plan and the Transportation Improvement Program, while providing for the operation and maintenance of the existing highway and transit systems. Plan 2045's fiscal constraint is described and established in Chapter 7. Generally, when a project is placed in the fiscally-constrained element of the Plan, it becomes eligible to receive federal transportation funding for its implementation.

Generally, over time, projects in the fiscally-constrained element of the Plan move into the Transportation Improvement Plan (TIP), which is a program of prioritized transportation improvements identified by NYMTC members for implementation using federal funding in whole or in part. Projects on the TIP are well defined, with the anticipated schedule and cost of each improvement. As the TIP represents the first five years of the Plan 2045 planning period, it is consistent with its goals, objectives and policies. The TIP is enabling document which makes federal reimbursement of project expenses possible. The TIP is linked to the financial analysis in Chapter 7, but the projects are not included in the lists of projects in Appendix 1 of this Plan.

CATEGORIES OF MAJOR IMPROVEMENTS & ACTIONS

One category of recommended investments and initiatives recommended by Plan 2045 is focused on preserving the transportation system, while others enhance the capacity and accessibility of the system, and expand its reach and integration. The following list of significant investments and initiatives are categorized as preserving or enhancing the system, and each is important to the region as a whole and to the strategic vision of sustainable regional growth.

PRESERVING THE TRANSPORTATION SYSTEM

Many capital investments in the NYMTC planning area are directed to the preservation of the region's extensive and relatively old transportation infrastructure. System preservation is a critical part of Plan 2045's strategic framework that protects past investments in the system and support a platform for future investment.

System preservation is to be accomplished through day-to-day Operations and Maintenance (O&M) as well as lifecycle replacement, rehabilitation or reconstruction of all system components, including public transit facilities and equipment; roadways, bridges, and tunnels; and non-motorized transportation infrastructure such as walkways, trails, paths, and greenways.

ENHANCING THE TRANSPORTATION SYSTEM

Capital investments and projects also address the need to enhance capacity and accessibility of transportation in the NYMTC planning area. These type of investments will help create a framework to support growth in a more sustainable fashion by bringing together local land use decisions and regional transportation investment decisions and focusing transportation and development projects to produce complementary and more sustainable outcomes.

New NY Bridge construction alongside the Tappan Zee Bridge
Photo Source: MTA

MAJOR METROPOLITAN TRANSPORTATION INVESTMENTS

NYMTC's adopted procedures for major projects are as follows:

a) Major projects will be identified by sponsoring agencies working in the context of the regulations and NYMTC.

i) For the purposes of the NYMTC transportation planning process, major projects are considered to be those with an estimated total cost of $100 million or more to be funded through federal financial assistance and/or any other projects identified by FHWA as major projects.

ii) For transit projects that do not include FHWA funding, the major project requirements do not apply. Transit projects that have no FHWA funding would only be subject to FTA's New Starts process and NEPA requirements.

iii) Projects meeting the thresholds for major projects that are multi-modal in nature are subject to the major project requirements for all of the alternatives being considered. Both the major projects and the New Starts/NEPA processes will apply to multi-modal projects.

b) Once identified, the major project must be specified in NYMTC's Regional Transportation Plan.

i) The major project must be specified in the constrained element of the Plan, except in cases where it is defined as a pure planning study. Then it may be specified in the Plan's vision element.

(1) If the NEPA process has commenced for the project, it must be specified in the constrained element as a prerequisite for federal review of a Draft Environmental Impact Statement and for federal funding to be used to begin preliminary design.

ii) The major project specification in the Plan must include a purpose and need statement, a description of a reasonable range of alternatives for the major project, particularly for projects in the constrained element – a range of potential project costs and contingencies related to the alternatives if appropriate, and descriptions of potential environmental justice/Title VI implications of the project, critical environmental areas that might be affected by the project and historic preservation implications of the project.

(1) The costs specified in the major project specification must be accounted for in the Plan's long-range fiscal assessment.

iii) All applicable public review requirements related to the amendment of the Plan must be followed to specify a major project.

c) Once specified in the Plan, the major project will be subject to the applicable federal requirements and FHWA guidance.

Plan 2045's Appendix 9 contains information on major that fulfills these requirements under the NYMTC operating procedures for programmed projects in the fiscally-constrained element. Those projects are itemized here, with detailed information available in the appendix:

BRONX

Bronx River Parkway Bridge Replacements *Total Projected Cost ($ million):* $ 270.0
Projected Completion Year: 2026;
Category: Preservation

Bruckner Expressway Bridge Replacement *Total Projected Cost ($ million):* $292.0;
Projected Completion Year: 2021;
Category: Preservation

Bruckner Expressway Viaduct Rehabilitation (Phases 1 & 2)
Total Projected Cost ($ million): $330.0
Projected Completion Year: 2021
Category: Preservation

Major Deegan Expressway Bridge Rehabilitations
Total Projected Cost ($ million): $ 182.0, $100.0
Projected Completion Year: 2022, 2025
Category: Preservation

Cross-Bronx Expressway Bridge Rehabilitations
Total Projected Cost ($ million): $ 269.0
Projected Completion Year: 2022
Category: Preservation

BROOKLYN

Brooklyn-Queens Expressway Rehabilitation from Sands Street to Atlantic Avenue
Total Projected Cost ($M): $1,710.8
Projected Completion Year: 2025
Category: Preservation

Belt Parkway Bridge Replacements
Total Projected Cost ($ million): $108.2, $263.7
Projected Completion Years: 2018, 2021
Category: Preservation

QUEENS

Kew Gardens Interchange Phases 2B & 3
Total Projected Cost ($ million): $155.0, $ 330.0
Projected Completion Years: 2020, 2021
Category: Enhancement

Brooklyn-Queens Expressway Bridge Rehabilitation
Total Projected Cost ($ million): $ 195.0
Projected Completion Year: 2026
Category: Preservation

Great Streets Vision Zero – Queens Boulevard
Total Projected Cost ($ million): $103.0
Projected Completion Year: 2024
Category: Enhancement

MANHATTAN

Harlem River Drive Viaduct Replacement
Total Projected Cost ($ million): $195.3
Projected Completion Year: 2018
Category: Preservation

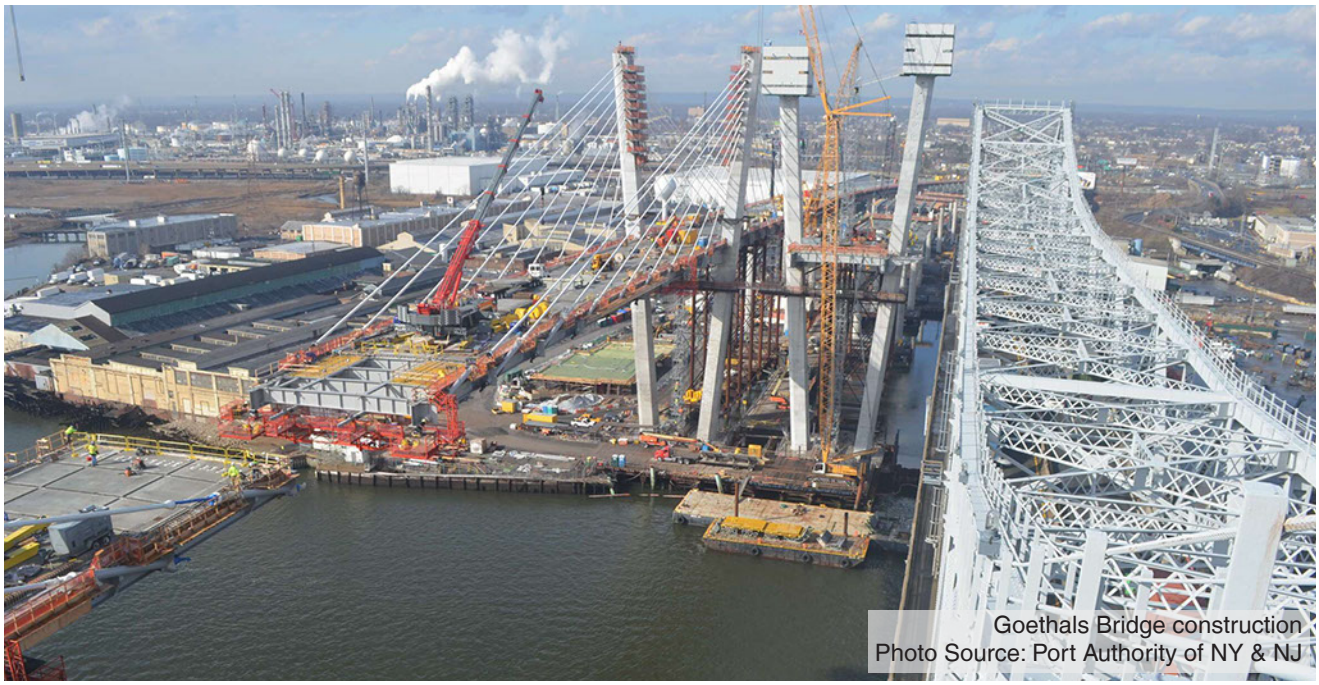
West 79th Street Bridge Rehabilitation
Total Projected Cost ($ million): $127.6
Projected Completion Year: 2021
Category: Preservation

11th Avenue Viaduct Reconstruction
Total Projected Cost ($ million): $118.5
Projected Completion Year: 2022
Category: Preservation

STATEN ISLAND

Bayonne Bridge Navigational Clearance Project
Total Projected Cost ($ million): $1,600.0
Projected Completion Year: 2019
Category: Enhancement

Goethals Bridge Replacement
Total Projected Cost ($M): 1,500.0
Projected Completion Year: 2019
Category: Enhancement



Goethals Bridge construction
Photo Source: Port Authority of NY & NJ

MULTI-BOROUGH

Brooklyn Bridge, Manhattan Bridge & Ed Koch Queensboro Bridge Seismic Retrofits
Total Projected Cost ($ million):
$175.0, $175.0, $175.0
Projected Completion Years: 2028, 2025, 2025
Category: Preservation

Ed Koch Queensboro Bridge Upper Roadways Replacement
Total Projected Cost ($ million): $250.0
Projected Completion Year: 2021
Category: Preservation

Rehabilitation of Brooklyn Bridge Approaches
Total Projected Cost ($million): $287.5
Projected Completion Year: 2021
Category: Preservation

Broadway Bridge Rehabilitation
Total Projected Cost ($ million): $158.5
Projected Completion Year: 2020
Category: Preservation

Kosciuszko Bridge Replacement
Total Projected Cost ($ million):
$ 685.0 (Phase 1) and $330.495 (Phase 2)
Projected Completion Year:
2017 (Phase 1) and 2020 (Phase 2)
Category: Enhancement

NASSAU COUNTY

Nassau Hub Transit Initiative
Total Projected Capital Cost ($ million):
$400.0 (full build out, in 2012 $), $95 million (initial operating segment (IOS), in 2012 $)
Projected Completion Years:
2021 (IOS), 2035 (full build out)
Category: Enhancement

SUFFOLK COUNTY

NY 347 Corridor Reconstruction & Green Route Implementation (remaining phases)
Total Projected Cost ($ million): $565.0
Projected Completion Year: 2032
Category: Enhancement

MAJOR TRANSIT INVESTMENTS

As noted in NYMTC procedures for major projects:

> *ii) For transit projects that do not include FHWA funding, the major project requirements do not apply. Transit projects that have no FHWA funding would only be subject to FTA's New Starts process and NEPA requirements.*

Given the differing requirements for major transit projects, Plan 2045's recommended major transit investments which are programmed in the fiscally-constrained element do not appear in Appendix 9 but are outlined here:

NEW YORK CITY

Second Avenue Subway Phases 2-4
The Second Avenue Subway project will ultimately include an 8.5-mile two-track line along Second Avenue from 125th Street to the Financial District in Lower Manhattan. In addition to the three new stations that opened on January 1, 2017 as part of Phase 1, thirteen new accessible stations compliant with the Americans with Disabilities Act will be constructed. Design and environmental review activities for Phase 2 (E.96th St to E.125th St.) are now underway by the MTA. Plan 2045 includes Phases 3 and 4 in the fiscally-constrained element. Category: Enhancement

Select Bus Service (SBS) Projects
SBS projects that are being planned and implemented in New York City will improve the speed, reliability, and appeal of bus transit by bringing elements of bus rapid transit (BRT) into the operation of specific transit routes. The projects are jointly developed by MTA New York City Transit (NYCT) and New York City Department of Transportation (NYCDOT). The routes currently recommended for implementation are listed below. Category: Enhancement

- **14th Street, Manhattan**
  Projected Implementation: 2018 or 2019
- **Bushwick–Downtown Brooklyn**
  Projected Implementation: 2020
- **Flatbush Avenue, Brooklyn**
  Projected Implementation: 2020

- **Hillside Avenue, Queens**
  Projected Implementation: 2018
- **South Bronx East-West Crosstown, Bronx**
  Projected Implementation: 2017
- **South Brooklyn East-West Crosstown, Brooklyn**
  Projected Implementation: 2018
- **Southeast Queens (Merrick or Guy Brewer), Queens**
  Projected Implementation: 2020
- **Woodhaven Boulevard, Queens**
  Projected Implementation: 2017

MTA Communications-Based Train Control (CBTC) Subway Enhancements
Currently in operation on the L and 7 subway lines, CBTC enables the MTA to address heavy passenger demand and record subway ridership by reducing subway headways, safely spacing trains more closely together, and adding passenger capacity to the subway system as a whole. Near-term plans are for installing CBTC on the Queens Blvd., Culver, and 8th Avenue Subway Lines as well as supportive ancillary equipment.

Category: Enhancement

James A. Farley Building Redevelopment, Moynihan Station Phase 2
This project redevelops the historic James A. Farley building as a 1.1 million SF mixed-use transportation hub, featuring a new sky-lit train hall constructed within the original Farley courtyard, with direct access to the train platforms below, which at one time serviced USPS operations in the building. The project, sponsored by the Moynihan Station Development Corporation, will expand the existing Penn Station rail complex to the west and dramatically increase both the amount of concourse space and the number of vertical circulation points for passengers between the platforms and street-level, thereby easing congestion across the facility and speeding the loading and unloading of trains. Additional elements of the project include: restoration of the building's historic architectural features; a 32nd Street pedestrian corridor linking the train hall with the development west of 9th Avenue; continuing service as a postal facility, including the original retail postal lobby on 8th Avenue; 675,000 SF of private commercial development of the remainder of the building, primarily for office and retail use; and, structural and resiliency reinforcements to the building and train shed below it.

The project will be completed through a public-private partnership arrangement with a projected cost is $1.6 billion and completion year of 2020.

Category: Enhancement

Canarsie Power Project
This project includes the addition of three electric power substations and related improvements to the Canarsie Line and tube and the addition of vertical circulation elements at Bedford Avenue (Brooklyn) and 1st Avenue (Manhattan) stations. These improvements will allow additional peak-hour trains to be operated thereby relieving existing train crowding, and reducing dwells and uneven loading conditions on trains. These improvements will also relieve existing platform and stair congestion, easing travel conditions and improving operating reliability.

Construction is projected to be completed in 2021 at a cost of approximately $300 million.

Category: Enhancement

Jamaica Capacity Improvements
The project includes the creation of a new platform and tracks at the Jamaica station, the LIRR's central hub and main transfer point. The new platform and tracks at Jamaica station will allow the LIRR to more easily re-route trains, take tracks out of service and support supplemental train service to and from Atlantic Terminal. The project will also modernize the Jamaica Station infrastructure, which was built in 1913, streamline the existing track configuration and speed service.

Construction is projected to be completed in 2021 at a cost of approximately $140 million.

Category: Enhancement

LONG ISLAND

LIRR East Side Access

The project will connect the LIRR's Main and Port Washington lines in Queens to a new terminal beneath Grand Central Terminal in Manhattan. The new connection will increase the LIRR's capacity into Manhattan and dramatically shorten commuting time from Long Island and eastern Queens to Manhattan's East Side when opened for service in 2025 at a cost of approximately $4.7 billion ($2.4 billion of which is programmed in the FFYs 2017-21 TIP).

Category: Enhancement

LIRR Ronkonkoma Branch Second Track Project

The project entails the construction of an uninterrupted second track between Farmingdale and Ronkonkoma on the LIRR Ronkonkoma Branch. The Second Track Project will improve service and reliability on the Ronkonkoma Branch, spur economic activity and improve LIRR service to Long Island MacArthur Airport.

Construction is projected to be completed in 2019 at a cost of approximately $250 million.

Category: Enhancement

Nicolls Road Multimodal Corridor

The Locally Preferred Alternative for this corridor is comprised of two BRT routes operating from Stony Brook in the north to Patchogue in the south and connecting key destinations including Stony Brook University, Stony Brook University Hospital, Suffolk County Community College Ammerman Campus, St. Joseph's College, Ronkonkoma Hub, Long Island MacArthur Airport, and Patchogue Village. In addition, the route will create a transit link between the three lines of the LIRR, providing a connection between LIRR stations at Stony Brook, Ronkonkoma, and Patchogue. The corridor will also feature a hiking/biking trail adjacent to the route, offering residents and commuters with an additional mode of access to the corridor.

This project is slated for completion in 2020 at a cost of approximately $80 million.

Category: Enhancement

LIRR Expansion Project

The Metropolitan Transportation Authority's (MTA) Long Island Rail Road (LIRR) is proposing the LIRR Expansion Project from Floral Park to Hicksville (the "Proposed Project" or "LIRR Expansion Project"). The Proposed Project extends 9.8 miles between the

Rendering of Nicolls Rd. BRT
Photo Source: Suffolk County

LIRR Floral Park and Hicksville stations, where five branches converge carrying approximately 41 percent of LIRR's daily ridership. The addition of a third track would increase track capacity through the corridor making it easier to run trains along this busy, congested rail corridor. This would improve service reliability and make transit more attractive, with the further goal of getting travelers out of cars, reducing traffic congestion, and reducing adverse environmental impacts. This 9.8-mile stretch also includes seven street-level train crossings ("grade crossings") where road traffic must stop each time a train passes. Eliminating these grade crossings through grade separation (e.g., underpasses) or potentially, in one or two cases, closure (with consideration of public input), is anticipated to substantially reduce noise, traffic congestion, delays, and air pollution, and greatly improve safety for residents, motorists, and pedestrians. The Draft Environmental Impact Statement (DEIS) for this project was prepared pursuant to the New York State Environmental Quality Review Act (SEQRA) and released on November 28, 2016. The public comment period for the DEIS ended on February 15, 2017. The Final Environmental Impact Statement (FEIS) for this project was released on April 12, 2017. For the purpose of analyzing construction impacts, this EIS conservatively assumes that the Proposed Project construction would take approximately four years, commencing in 2017 and completed in 2021. The construction cost estimate for the LIRR Expansion Project is approximately $2 billion, with funding to come from the MTA and other State sources.

Category: Enhancement

Route 110 Bus Rapid Transit
The project will introduce a BRT system to the Route 110 corridor and will require roadway and traffic signal modifications, including dedicated bus lanes, traffic signal priority, queue jumps, stations, and other capacity improvement measures. The route will provide a necessary connection between the regional assets along the route including the Walt Whitman Mall, Huntington, Melville, SUNY-Farmingdale, and the Amityville LIRR.

This project is slated for completion in 2021 at a cost of $28 million.

Category: Enhancement

LOWER HUDSON VALLEY

MNR Penn Station Access
The project will open a new MNR link directly into Penn Station via the New Haven Line and Amtrak's Hell Gate Line. Only three miles of new track alongside existing tracks on an existing right-of-way and no new tunnels would need to be built for this project. As part of this project, MNR will build four new stations in the Bronx, Co-op City, Morris Park, Parkchester, and Hunts Point.

This project is slated for completion in 2023 at a cost of $695 million.

Category: Enhancement

Lower Hudson Transit Link
A program of integrated transit-supportive infrastructure projects along the I-287/I-87 corridor, including the parallel and connecting arterial highways, within Rockland and Westchester counties. The project will initiate implementation of the consensus regional transit plan put forth by the Mass Transit Task Force convened by NYSDOT, the New York State Thruway Authority and partnering agencies. The various project elements include new distinctive buses, shelters and modern passenger amenities at a combination of existing and proposed new bus stop locations; pedestrian safety and operational improvements at the bus stop/shelter locations and adjacent intersections along Routes 59/119/9; and an Integrated Corridor Management system to maximize efficiencies of the existing traffic and transit networks. Collectively, the project elements will seek to enhance the quality and reliability of the existing east-west transit service in the corridor by laying the foundation for introducing BRT service, as well as improve the overall safety and traffic operations for all users of the transportation network.

This project is slated for completion in 2018 at a cost of approximately $90 million.

Category: Enhancement

VISION PROJECTS & STUDIES

As indicated earlier, aspirational vision projects are those projects, proposals, and studies that are relatively undefined and in almost all cases do not have an identified source of funding. Vision projects are often moved into the constrained Plan when they are sufficiently defined. The following vision projects and studies are notable for their potential to define major and/or regionally-significant investments in the medium- and long-term future.

NEW YORK CITY

Hunts Point Interstate Access Improvement Project

The purpose of the project is to provide improved interstate access between the Bruckner (I-278) and Sheridan (I-895) expressways and the Hunts Point Peninsula, reducing the use of local streets by automobiles and trucks traveling to and from the commercial businesses located on the peninsula. In addition, the project will address structural and operational deficiencies related to the existing infrastructure within the established project limits.

Arthur E. Sheridan Expressway Enhancement Project

This project will enhance the Arthur V. Sheridan Expressway (I-895) to provide the community with a safe & accessible route to the waterfront and park in Bronx.

Brooklyn and Manhattan Waterfront Greenways

These projects focus on the continued development and design of greenways along the waterfront in Brooklyn and Manhattan. See Appendix 2 for additional details.

Hudson River Valley Greenway Link

The Hudson River Valley Greenway is actually a multicounty network of trails which generally bracket the Hudson River extending from Lower Manhattan to Troy, New York. This project will address a missing link in the Greenway between northern Manhattan and the Old Croton Aqueduct in Yonkers.

New York City Smart Truck Management Plan

The New York City Department of Transportation is leading an effort that aims to enhance the economic vitality and quality of life for all New Yorkers by providing for the safe, efficient, and environmentally responsible movement of goods. The Smart Truck Management Plan's goals are to: improve safety for all road users; reduce truck-related congestion; improve trucking industry environmental performance; create a culture of compliance with truck-related regulations; support New York City's economy through more efficient goods movement and deliveries; expand partnerships with the freight and trucking industry; and Identify, evaluate, and invest in essential freight corridors. The Smart Truck Management Plan will identify and implement a series of regulatory, procurement, and partnership strategies, and produce a city-wide and series of borough truck freight plans.

Hudson Tunnel Project

The purpose of the Hudson Tunnel Project is to preserve the current functionality of Amtrak's Northeast Corridor (NEC) service and New Jersey Transit's commuter rail service between New Jersey and Penn Station by repairing the deteriorating North River Tunnel; and to strengthen the NEC's resiliency to support reliable service by providing redundant capability under the Hudson River for Amtrak and NJ TRANSIT. Construction of the new Hudson Tunnel is expected to take approximately seven years after obtaining the environmental approvals, permits and real estate, and subject to availability of a steady stream of funding. After the new tunnel is complete, rehabilitation of the existing NEC rail tunnel beneath the Hudson River (the North River Tunnel) will take another three years. A preliminary schedule aims to complete the new tunnel in 2026 to enable the planned rehabilitation of the existing tunnel to be complete in 2030.

Hudson Yards Right-of-Way Preservation Project

In Manhattan, it is anticipated that the Hudson Tunnel Project will utilize concrete casings previously incorporated into plans for the ongoing Hudson Yards development to preserve a right-of-way for additional rail tunnel connections to the Penn Station complex. Concrete casing sections No. 1and No. 2 have been

constructed beneath 11th Avenue, and the Eastern Rail Yard. Concrete Casing Section No. 3 beneath the Western Rail Yard would complete the protective ROW construction beneath the Hudson Yards development.

Amtrak Gateway Program

This program is a critical part of Amtrak's NEC planning that will address the need for trans-Hudson tunnel redundancy and added capacity for commuter, regional and long-distance intercity services. It will address critical capacity issues, safety, and operational needs in the congested segment of the NEC stretching from Newark, NJ to the west side of Manhattan.

Port Authority Bus Terminal Replacement

Following several years of preliminary planning, the Port Authority of New York and New Jersey has taken formal steps toward planning for the redevelopment of the outmoded Port Authority Bus Terminal, which opened in 1950. The agency's Board of Commissioners approved a ten-year capital program in early 2017 allocating an initial $ 3.5 billion toward the cost of a replacement facility, and funding to improve conditions at the existing facility. The Board also authorized funds to initiate formal planning for the PABT Redevelopment Program as well as for intermediate actions to maintain sufficient bus staging and storage on both sides of the Hudson River. Initial planning and external engagements suggest a consensus on the need to replace this critical transit facility in West Midtown. Planning challenges include safeguarding the neighborhood quality of life, achieving more efficient bus network and terminal operations, and evaluating multi-modal strategies to serve forecast growth in the commuter and intercity markets that rely on the PABT and other capacity-constrained trans-Hudson transit connections.

Cross Harbor Goods Movement Program

In January 2016, the FHWA issued a Record of Decision (ROD) for the Tier 1 Final Environmental Impact Statement (FEIS) for the Cross Harbor Freight Program. The primary purpose of the Cross Harbor Freight Program (CHFP) is to improve the movement of the freight across New York Harbor between the east-of-Hudson and west-of-Hudson regions. By improving the movement of goods across the harbor, the project would provide near-term and long-term improvements to the regional freight network, reduce truck traffic congestion, improve air quality, and provide economic benefits. After analyzing a number of alternatives, the Enhanced Railcar Float Alternative and the Rail Tunnel Alternative (a double track tunnel with vertical clearances to accommodate double stack intermodal service) were selected as the two preferred alternatives. These two alternatives will be further developed in the upcoming Tier 2 analysis.

Hudson River Greenway
Photo Source: NYC DOT

Brooklyn-Queens Connector (BQX)
The BQX is a new, state-of-the-art streetcar system being planned by the City of New York. The BQX will be efficient and emissions-free and it will run on tracks flush with the existing roadway. Possibly constructed without overhead catenary wires or underground power sources, it will also be resilient against major weather and flood events. BQX trains will be ADA (Americans with Disabilities Act) accessible and will accommodate bicycle parking. The BQX will link neighborhoods along a 16-mile route from Astoria to Sunset Park. Stops are expected to be approximately ½ mile apart and the line will connect to up to 10 ferry landings, 30 different bus routes, 15 different subway lines, 116 Citi Bike stations, and 6 LIRR lines. It will travel primarily in dedicated lanes, separated from traffic and bicycles along the route. This project is anticipated to cost approximately $2.5 billion to construct and approximately $30 million per year to operate and maintain. Construction of this project could begin in 2019.

Van Wyck Expressway Capacity & Access Improvements to John F. Kennedy (JFK) Airport
The purpose of the project is to provide increased capacity on the Van Wyck Expressway between the Kew Gardens Interchange and JFK Airport to improve vehicular access to and from the airport. In addition, the project will address the operational, geometric, and structural deficiencies on the Van Wyck Expressway between the Kew Gardens Interchange and JFK Airport. A reasonable range of alternatives is currently being developed and will be refined during the NEPA scoping process in consideration of agency and public comments received. Notice of the Environmental Impact Statement (EIS) was published in the Federal Register on June 1, 2017.

LaGuardia AirTrain
As part of the LaGuardia Airport redevelopment program, the Port Authority is initiating planning for a project to create an AirTrain between the redeveloped airport terminals and Willets Point, Queens, providing a convenient and reliable link between airport and the LIRR and No. 7 subway at the Willets Point stations, thereby improving access to the Manhattan Central Business district, the Borough of Queens, and Nassau and Suffolk counties.

LONG ISLAND

Long Island Motor Parkway Trail
The Long Island Motor Parkway, also known as the historic Vanderbilt Parkway, was the first roadway designed for automobiles only. Parts of the parkway survive today in sections of other roadways and as a bicycle trail in Queens. Nassau County now seeks to develop an 18 mile continuous, multi-use trailway that will utilize the route of the historic parkway. When implemented, the new Motor Parkway Trail will once again provide an important recreational connection through Nassau County, but this time for hikers and bicyclists. Furthermore, the Trail will provide an important alternative transportation link between communities, open space resources and employment centers for those wishing to walk or bike through Nassau County to these destinations. The full project is expected to be completed in segments by 2030 at a cost of about $25 million.

Shoreham Deep Water Port Feasibility Study
The proposed Deep Water Port would be located at the long-since abandoned nuclear power plant in Shoreham, Suffolk County. The majority of goods delivered to Long Island currently arrive by truck. This facility would provide a place where cargo can arrive by ship and reduce the truck traffic currently utilizing our roads, bridges and tunnels. The study will determine potential market(s), assess the viability of direct marine transfers of imports from New York City metropolitan area ports, and evaluate whether the potential advantages of the Shoreham site are sufficient to overcome any existing constraints.

Sagtikos State Parkway/Sunken Meadow State Parkway Operational Study
In addition to the transit options for the Sagtikos Parkway being investigated by Suffolk County as part of Connect Long Island, NYSDOT is conducting an operational study from Southern State Parkway to NY25A, including the parallel roadways in the towns of Islip and Smithtown to determine future repairs required.

LOWER HUDSON VALLEY

I-84 Capacity Improvements between the Connecticut State Line and I-684

This project will improve capacity on I-84 in conjunction with similar improvements on I-84 in Connecticut.

Central Avenue Bus Rapid Transit

The 14.4-mile long Central Avenue corridor serves Westchester County between White Plains and the Bronx, linking Westchester to New York City. Major destinations along the corridor include downtown White Plains, Westchester County Center, the shopping areas along Central Avenue, Cross County Shopping Center, Yonkers Raceway, the New York City Subway, and Bee-Line System routes. In 2016, a Transit Signal Priority (TSP) system consisting of 48 intersections and three queue jumps became operational at key intersections in White Plains, Greenburgh and Yonkers. The next phase will be an overall BRT service in the corridor which would reduce travel times, attract new riders, improve mobility, create an integrated and customer friendly transit service, and improve operating efficiency. Additional elements that could be implemented include limited stop operations, preferential lane treatments, and attractive stations with customer amenities, faster fare collection, brand identity, and alignment with TOD in the corridor.

Transit Improvements in East-West Corridors

A planning analysis of two major east-west Bee-Line System bus routes has been completed. The analysis looked at the Route 13, serving Ossining, Tarrytown, White Plains and Port Chester, and the Route 7, extending from Yonkers to Mount Vernon to New Rochelle, and recommended bus stop consolidations, alternative routing and roadway/traffic treatments to improve the efficiency of bus operations. Implementation of the recommendations will begin in 2017.

Brewster Village Walkable Community Initiative

The Village of Brewster in Putnam County is undertaking a TOD revitalization initiative along their Main Street corridor that includes a multi-modal subsurface parking structure that will mitigate congestion, attract new riders to the adjacent MNR train station while connecting to the PART and HART bus services, all of which furthers regional economic development opportunities.

Rendering of Brewster Village TOD
Photo Source: Putnam County

CSX River Line, Second Track
Trains dispatched from Selkirk Yard near Albany, New York travel south along the west shore of the Hudson River through Rockland County to yards in Northern New Jersey. Passenger trains are absent from this heavily used route south of Selkirk, which has seen some lengthening and addition of passing sidings to accommodate rail traffic growth and improve reliability. CSX is planning capacity expansions along this route.

Nanuet TOD Plan
The Town of Clarkstown in Rockland County has been awarded a grant from the New York State Energy Research and development Authority under the Cleaner, Greener Communities Program. The grant will be used toward developing a plan to redevelop Nanuet into a mixed-use, transit-oriented neighborhood centered on a new Multi-Modal transit station.

REGIONAL

NEC Future
In December 2016 the Federal Railroad Administration released the Tier 1 Final Environmental Impact Statement (FEIS) for NEC Future, the comprehensive planning effort for the NEC rail line from Washington, D.C. to Boston. The Selected Alternative maintains and improves service on the existing NEC between Washington, D.C., and Boston; provides a mix of services (Intercity, Intercity-Express and Intercity-Corridor and Regional rail); provides for upgrades to the communication and signaling systems where needed to permit higher-density operations; modernizes the NEC catenary system to support higher speeds and includes electrification of new segments; includes new stations and physical improvements to stations; incorporates an upgraded and electrified Hartford/Springfield Line, connecting to the NEC at New Haven; and includes chokepoint relief projects, new track, curve modifications and new segments at key locations throughout the corridor to support additional service, increase performance, and eliminate capacity and operational constraints. The Tier 1 FEIS does not allow construction to begin on the Selected Alternative, but rather provides a framework to inform a series of project-level planning efforts to determine and evaluate site-specific details.

Empire Corridor
NYSDOT and the FRA are evaluating potential improvements and projects to intercity passenger rail service within the Empire Corridor, which proceeds north from NYC to Albany, turns west to Schenectady, passes through Utica, Syracuse, Rochester, and Buffalo, then terminates at Niagara Falls. Work has been ongoing on a Tier I EIS analyzing a range of alternatives for introducing high-speed passenger rail service on the Empire Corridor. A Final EIS should be released by the end of 2017 and then specific improvement projects can be evaluated and planned.

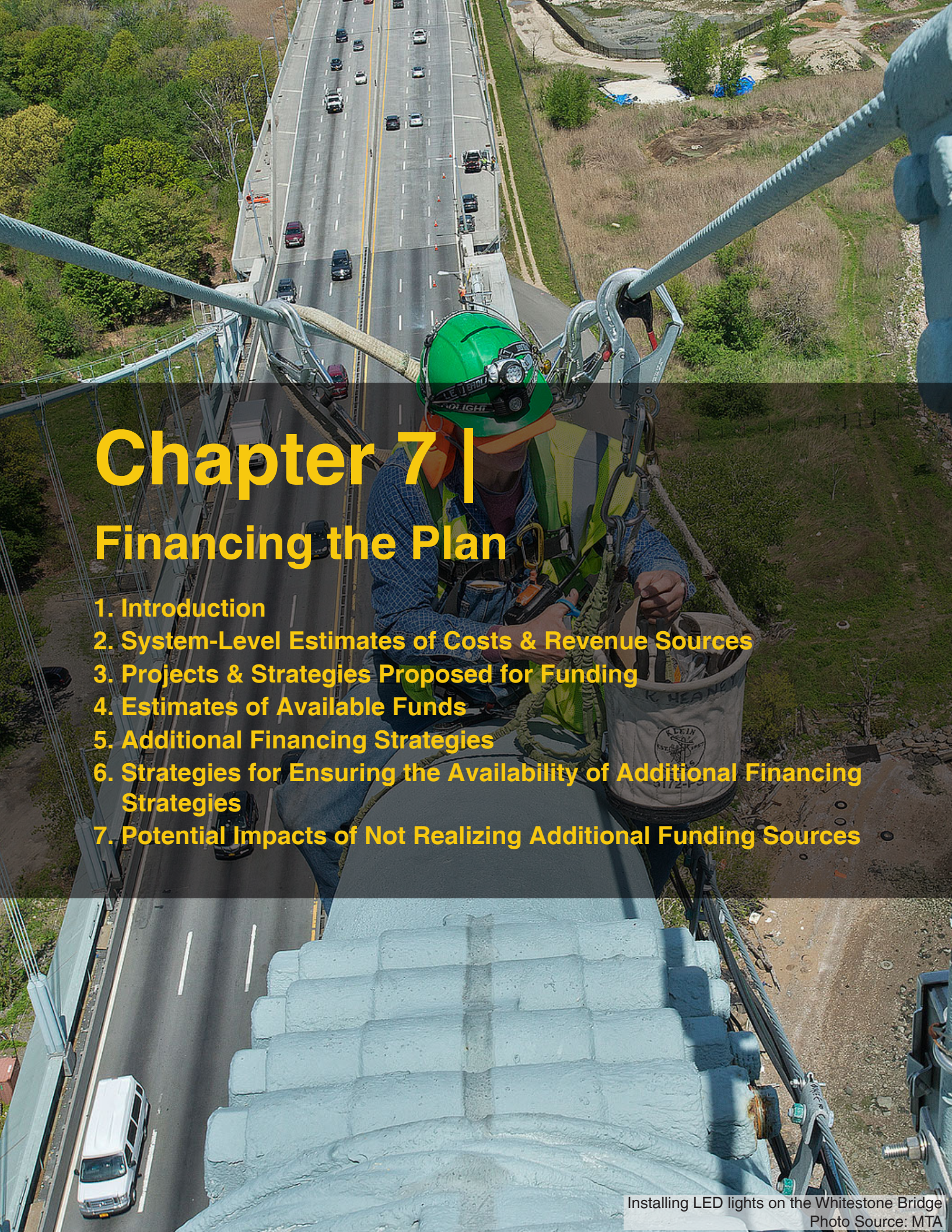
Cross Sound Connection Study
This high-level feasibility study is evaluating potential Long Island Sound crossing locations along the north shore of Nassau and Suffolk counties on Long Island (generally north of the Long Island Expressway) and along the north shore of Long Island Sound in Westchester County and southwestern Connecticut.

New Hudson Yards station entrance
Photo Source: MTA

North White Plains Station Parking Garage
Photo Source: Westchester County

Chapter 7 |
Financing the Plan

1. Introduction
2. System-Level Estimates of Costs & Revenue Sources
3. Projects & Strategies Proposed for Funding
4. Estimates of Available Funds
5. Additional Financing Strategies
6. Strategies for Ensuring the Availability of Additional Financing Strategies
7. Potential Impacts of Not Realizing Additional Funding Sources



Installing LED lights on the Whitestone Bridge
Photo Source: MTA

Rendering of New Hyde Park LIRR Station - Double Track Project
Photo source: MTA LIRR

1. INTRODUCTION

The purpose of this chapter is to demonstrate how the federal requirements for fiscal constraint are met and how Plan 2045, NYMTC's long-range metropolitan transportation plan, when adopted can be implemented. Federal regulations require that the financial plan includes the following (see Appendix 10 for the full regulatory language):

- System-level estimates of the costs and revenues reasonably expected to be available to adequately operate and maintain Federal-aid highways and public transportation;
- Estimates of funds that will be available for the implementation of the Plan; and
- Additional financing strategies for the implementation of the Plan.

THE FISCALLY-CONSTRAINED ELEMENT OF PLAN 2045

The current federal legislation which authorizes federal aid to highway and transit programs through September 2020 largely maintains pre-existing transportation planning requirements (including fiscal constraint) for MPOs. The fiscal constraint requirements apply to the metropolitan long-range transportation plan (Plan 2045), the metropolitan Transportation Improvement Program (TIP), and the Statewide Transportation Improvement Program (STIP).

23 CFR 450.104 provides the following definition of fiscal constraint:

> *Financially constrained or Fiscal constraint means that the metropolitan transportation plan, TIP, and STIP includes sufficient financial information for demonstrating that projects in the metropolitan transportation plan, TIP, and STIP can be implemented using committed, available, or reasonably available revenue sources, with*

reasonable assurance that the federally supported transportation system is being adequately operated and maintained.

Further, 23 CFR 450.324 states the following:

(i) For purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain the Federal-aid highways (as defined by 23 U.S.C. 101(a)(5)) and public transportation (as defined by title 49 U.S.C. Chapter 53).
(ii) For the purpose of developing the metropolitan transportation plan, the MPO(s), public transportation operator(s), and State shall cooperatively develop estimates of funds that will be available to support metropolitan transportation plan implementation, as required under §450.314(a). All necessary financial resources from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified.

Additionally, revenue and cost estimates that support the metropolitan transportation plan must use an inflation rate(s) to reflect "year of expenditure (YOE) dollars." To fulfill this federal requirement, Plan 2045's forecasts of costs and revenues are provided in YOE dollars and define the following fiscally-constrained elements of the Plan and the associated 2017-2021 TIP:

- Current and anticipated Operations & Maintenance costs of the existing and planned transportation system;
- Costs of System Preservation projects and strategies for the existing and planned transportation system proposed for funding through Plan 2045;
- Costs of the System Enhancements included within the fiscally-constrained element of the Plan; and
- Anticipated revenues – reasonably expected for meeting these various costs.

Emergency relief projects, eligible pursuant to the Disaster Relief Appropriations Act of 2013 or successor legislation, are not required to be included in the TIP or the Plan. Projects that provide for resiliency or address adaptation needs above the repair and replacement of damaged facilities will be amended into the Plan as these projects are approved for funding by the appropriate federal agency.

Plan 2045's forecasts of costs and revenues indicate that some additional federal and non-federal resources may be necessary to address needs that exceed reasonably expected revenues. Discussion of potential sources for additional resources are included in Sections 5 and 6.

Plan 2045 also contains an aspirational vision element as allowed by federal regulations. Aspirational projects and strategies contained in the vision element are conceptual and are not included in this chapter's forecasts of costs and revenues.

COST AND REVENUE CATEGORIES

Plan 2045's financial chapter is built around the following activity categories:

1. **Operations and Maintenance (O&M)** - O&M, as defined by the Federal Highway Administration, is "an overarching term for activities related to the performance of routine, preventive, predictive, scheduled, and unscheduled actions aimed at preventing transportation system failure or decline."

   This chapter contains current systems-level estimates of costs and revenues for O&M that are reasonably expected to be available to operate and maintain the Federal-aid highways and public transportation system as defined by Federal regulations [23U.S.C 101 (a)(5) and 49 U.S.C. Chapter 53].

2. **System Preservation** - System Preservation is broadly defined as costs related to the life-cycle replacement, refurbishment, rehabilitation, reconditioning or reconstruction of transportation system components (i.e., equipment and facilities).

3. **System Enhancement** - System Enhancements are extensions to the existing transportation system or new segments or services added to the transportation system to improve capacity and/or through-put.

KEY STEPS IN THE DEVELOPMENT OF THE FINANCIAL FORECASTS

The costs and revenue forecasts associated with transportation-related projects in Plan 2045 have been developed through the multi-step process outlined below:

1. **Defining the Federal-Aid Eligible Portions of the Transportation System** - The transportation network that moves people and goods in the NYMTC planning area is a complex network of facilities under a variety of jurisdictions. Some of these facilities are operated and maintained by fiscally self-supporting public authorities that generally do not access federal transportation funding. Others are owned by local municipalities and not federal-aid eligible.

   Given these distinctions, Plan 2045 first defines the federal-aid eligible portions of the transportation system as a basis for forecasting the long-range costs and resources. This federally-supported component of the transportation system is a subset of the overall transportation network in NYMTC's planning area. Plan 2045 assumes that the fiscal needs of those system components[3] owned, operated and maintained by self-financed public authorities (described below) and local municipalities are met by those authorities and municipalities as demonstrated in their board/council-approved capital and operating budgets, plans and programs.

2. **Inventorying System Components** - Plan 2045 inventories the condition of the facilities and equipment that are determined to be part of the federally-supported transportation system to define the long-term System Preservation needs. Note that this forecast includes both existing system components and any planned future components that appear in the fiscally-constrained elements of the Plan.

3. **Forecasting Costs** - Based on the inventory of the federally-supported transportation system components, forecasts of O&M, System Preservation and System Enhancements costs were developed through the Plan 2045's horizon year. The forecasts are aggregated modally for roadways (including pavements, bridges and non-motorized facilities) and transit (including facilities and equipment).

4. **Forecasting Revenues** - Plan 2045 estimates resources that are reasonably expected to be available from all sources to support the Plan's implementation. Plan 2045 identifies additional revenue alternatives that may be considered should the need arise.

CAUTIONS IN FORECASTING LONG-RANGE RESOURCES

Federal planning regulations require MPOs to adopt a long-range plan with a fiscally-constrained element based on reasonably anticipated revenues. Plan 2045 covers a period of 28 federal fiscal years beginning on October 1, 2017.

Forecasting costs and revenues over such long period presents risks and significant challenges for states and MPOs. For example, forecasting federal resources is complicated by the perennial threat to the financial solvency of the Highway Trust Fund, which partially supports federal highway and transit programs. Similar complications exist at the State, public authority and local levels. Taken together, all of these factors introduce a level of risk and uncertainty into long-range resource and cost forecasts.

2. SYSTEM-LEVEL ESTIMATES OF COSTS & REVENUE SOURCES

Federal regulatory language: *For purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain Federal-aid highways (as defined by 23 U.S.C. 101(a)(6)) and public transportation (as defined by title 49 U.S.C. Chapter 53).*

THE FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM

In Chapter 3, Plan 2045 inventories the components that comprise the federally-supported transportation system that is the focus of the Plan. This inventory includes existing system components, as well as new components planned in the future, which are defined in either the FFYs 2017-2021 TIP or Plan 2045's fiscally-constrained element.

As noted in Chapter 3, the New York City (NYC) metropolitan area has one of the oldest, most complex and highly utilized transportation networks in the world. On a typical weekday, the region's multimodal transportation network handles over five million passenger trips and thousands of tons of freight shipments. Notably, public transit mode share on this network is the highest in the U. S., accounting for more than one-third of all transit trips taken in the country, which is a testament to the scale of the public transit components of the network. By way of comparison, all U. S. airports enplaned 2.2 million passengers on an average day in 2015.[4]

The federally-supported transportation system is a subset of this overall transportation network. To assist in the estimation of resources and costs, federal-aid eligibility of a transportation system component defines it as federally-supported.

Transportation system components that fall within this threshold are eligible for and make use of federal funding to help meet O&M, System Preservation, and/or System Enhancements costs. Table 7.1 provides details of the general parameters of the federally-supported transportation system. Planning includes improvement projects planned for system components that are not federally-supported but that require a federal action to proceed.

Local roadways that are not part of the Federal-aid highway system and whose costs are borne by the locality, regardless of ownership, are not included in the federally-supported system. Similarly, any transportation system components that are financed exclusively with non-federal funds through state, local or private means are not included in the federally-supported system, regardless of eligibility.

In the NYMTC planning area, five self-financed public authorities have jurisdiction over significant components of the overall regional transportation network that are not considered part of the federally-supported system for the purposes of Plan 2045. Brief descriptions of these five authorities and the system components that are under their jurisdictions follows. Information also appears in Appendix 10.

- **The Port Authority of New York and New Jersey (PANYNJ)** provides a diverse, multimodal portfolio of infrastructure assets that support regional transportation, trade, and commerce, including some major facilities and services that are integrated into the bi-state surface transportation network: the George Washington Bridge and Bus Station; the Lincoln and Holland tunnels; the Bayonne Bridge, Goethals Bridge and Outerbridge Crossing; the Port Authority Bus Terminal

in midtown Manhattan; the Port Authority Trans-Hudson (PATH) rapid-transit system and World Trade Center transportation hub; rail freight and car float operations, and the World Financial Center Ferry Terminal. In addition, the PANYNJ has taken the lead in financing infrastructure at its airports (Kennedy, LaGuardia, Newark-Liberty, and Stewart) and marine terminals to connect with that network, including on-dock rail freight service at the container terminals and the AirTrain-JFK and AirTrain-Newark transit links.

> **MTA Bridges and Tunnels**, whose legal name is the Triborough Bridge and Tunnel Authority, is one of the component operating authorities of the Metropolitan Transportation Authority (MTA). MTA Bridges and Tunnels operates seven bridges and two tunnels, connecting the five boroughs of NYC over and under various water bodies. The bridges are the Robert F. Kennedy, Throgs Neck, Verrazano-Narrows, Bronx-Whitestone, Henry Hudson, Marine Parkway-Gil Hodges Memorial, and Cross Bay Veterans Memorial and the tunnels are the Hugh L. Carey Tunnel (formerly Brooklyn-Battery Tunnel) and the Queens Midtown Tunnel. See Figure 7.1 for a map of these bridges and tunnels and the following section for their descriptions.

BRIDGES

1. **The Robert F. Kennedy Bridge**, formerly the **Triborough Bridge**, is actually three bridges, a viaduct, and 14 miles of approach roads connecting Manhattan, Queens, and the Bronx. The bridge's three branches meet on Randall's Island, where an interchange and two toll plazas sort out traffic flowing in 12 directions and also provide access to the island itself.
2. **The Throgs Neck Bridge** serves as a vital link in the NYC interstate highway system, connecting the Bronx and Queens. On the Bronx side it feeds into the Cross Bronx and Bruckner expressways, the Hutchinson River Parkway, and the New England Thruway, providing access to New Jersey, upstate New York, Westchester County and New England. On the Queens side it feeds the Cross Island Parkway, the Clearview and Long Island expressways, and the Grand Central Parkway, that lead, respectively, to Long Island, Manhattan, Brooklyn, and points west.
3. **The Bronx-Whitestone Bridge** also spans the East River, providing another link between the Bronx and Queens. The bridge provides connections to the Hutchinson River Parkway, the Bruckner Expressway, the Cross Bronx Expressway, the Cross Island Parkway, and the Whitestone Expressway.

TABLE 7.1: MAJOR COMPONENTS OF THE FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM IN NYMTC'S PLANNING AREA

Over 19,000 lane-miles of interstates, freeways, parkways, expressways, arterial and collector roadways
Over 2,400 roadway bridges of all types under the ownership of the State, counties and local municipalities
Nearly 480 route miles of commuter rail and 225 route miles of subway tracks in passenger service, plus hundreds of miles of local, express, commuter and intercity bus routes and an aerial tramway
An extensive network of passenger hubs, transit stations and stops, bus terminals and subway transfer facilities, ferry landings and bus stops.
More than 1, 100 miles of bicycle facilities, ranging from shared-use bike trails to on-road bike lanes, in addition to pedestrian sidewalks, trails and paths.
Supporting infrastructure such as rail yards and highway maintenance facilities, highway rest areas, parking lots and garages, bus depots and transit storage yards, bicycle parking areas, toll plazas, signage, signals, electronics and other equipment.

4. **The Verrazano-Narrows Bridge**, which spans the mouth of upper New York Bay, not only connects Brooklyn with Staten Island, but is also a major link in the interstate highway system, providing the shortest route between the middle Atlantic states and Long Island. In Brooklyn, the bridge connects to the Belt Parkway and the Brooklyn-Queens Expressway as well as to the largely residential community of Bay Ridge. On Staten Island, which saw rapid development after the bridge opened in 1964, it joins to the Staten Island Expressway.
5. **The Henry Hudson Bridge** connects northern Manhattan to the Bronx, and was built as part of the Henry Hudson Parkway.
6. **The Marine Parkway-Gil Hodges Memorial Bridge** was originally opened in 1937 to provide access to the Rockaway Peninsula. Today, the land at both ends of the bridge is part of the Gateway National Recreation Area. On the Brooklyn side is Floyd Bennett Field and a direct connection to the Shore Parkway and Flatbush Avenue. On the Queens side in the Rockaways, there is access to beaches and Jacob Riis Park. Thousands visit the area's beaches and parklands each year, producing a 50 percent traffic increase on the bridge in the summer months.
7. **The Cross Bay Bridge**, located four miles east of the Marine Parkway-Gil Hodges Memorial Bridge, connects the Rockaway Peninsula to the rest of Queens, the Belt Parkway, and the Southern State Parkway.

TUNNELS

8. **The Hugh L. Carey Tunnel (formerly Brooklyn-Battery Tunnel)** is the longest continuous underwater vehicular tunnel in North America, connecting Southern Brooklyn and Lower Manhattan.
9. **The Queens Midtown Tunnel** serves as a major connection between midtown Manhattan and Queens. On the Manhattan side is Murray Hill and on the Queens side is the Hunters Point district of Long Island City, a historic entryway to the borough.

MTA Bridges and Tunnels serves more than 800,000 vehicles each weekday - close to 300 million vehicles each year - and carries more traffic than any other bridge and tunnel authority in the nation. All MTA Bridges and Tunnels facilities accept payment by E-ZPass, an electronic toll collection system that moves traffic through toll plazas faster and more efficiently. Eighty-one percent of the vehicles that use MTA Bridges and Tunnels crossings on weekdays now use E-ZPass. MTA Bridges and Tunnel intends to implement Open Road Tolling on all of its toll facilities in an expedited manner. Cashless, All-Electronic Tolling has been the permanent method of toll collection at the Henry Hudson Bridge since January 2015 and a pilot program since November 2012 has been a huge success.

Note that all of the other MTA component operating authorities (i.e., MTA NYC Transit, MTA Metro-North Railroad, MTA Long Island Rail Road, MTA Staten Island Railway and MTA Bus) operate facilities and services that are defined as part of the federally-supported transportation system. In addition to funding the MTA Bridges and Tunnels operating and capital budgets, MTA Bridge and Tunnel toll revenue goes to help support other MTA-operated transit services.

Other authorities in the New York Metropolitan area include:

- **The New York State Thruway Authority** operates the New York State Thruway (I-87), the New England Thruway (I-95) and the Cross Westchester Expressway (I-287) within the NYMTC planning area, as well as the Tappan Zee Bridge, which carries the New York State Thruway over the Hudson River between Westchester and Rockland counties.
- **The New York State Bridge Authority** operates the Bear Mountain Bridge, which carries U.S. 202 and U.S. 6 over the Hudson River between the northern portions of Westchester and Rockland counties.
- **The Nassau County Bridge Authority** operates the Atlantic Beach Bridge, which connects the Nassau Expressway with Atlantic Beach across the Reynolds Channel.

Other transportation facility owners and service that are not included in the financial forecasts for the federally-supported transportation system are described below. See Appendix 10 for a listing of the system components that are under their jurisdictions.

- **The National Railroad Passenger Corporation**, otherwise known as Amtrak™, which provides intercity rail services in the NYMTC planning area but does not program its federally-funded projects through NYMTC's metropolitan transportation planning process.
- **New Jersey Transit and Connecticut Transit**, public benefit corporations operating transit services in the states of New Jersey and Connecticut, provide services that terminate in Man-hattan and in the City of White Plains in Westchester County. Although these carriers are eligible for and make use of federal transportation funding through other MPOs, they do not program federally-funded projects through NYMTC's metropolitan transportation planning process.
- Privately owned and operated ferry systems, rail freight systems and intercity and interstate bus systems that provide services in the NYMTC planning area.
- Suburban municipalities that have jurisdiction over Federal-aid eligible roadways and/or bridges within their jurisdictions.

COSTS TO OPERATE AND MAINTAIN THE FEDERALLY-SUPPORTED SYSTEM

Plan 2045's system-level **forecasts of costs to operate and maintain system components and services** are based on the current operating budgets of NYMTC's member agencies, as well as any longer-range operational plans they maintain. Entities generally have annual budgets approved by their respective legislatures or boards, while a capital program may have a longer term. New York State (NYS) and local municipal sponsors have shown a historically demonstrated commitment and track record to not only match federal capital funding but also to provide enough funds to balance operating budgets. The O&M costs of System Enhancements are included in these estimates in cases where planned enhancements add new components to the system. System Enhancements that are included within the fiscally-constrained element of the Plan 2045 are described in detail in sub-sequent sections of this chapter.

Plan 2045 forecasts that nearly $627 billion in YOE dollars will likely be needed through the 2045 horizon year to adequately operate and maintain system components and services. These O&M cost forecasts are detailed in Section 7 of Appendix 10. Figures 7.2 and 7.3 provide a modal and agency breakdown of these projected O&M costs for the federally-supported transportation system. More than 90 percent of the NYMTC planning area's O&M costs are related to the operation of transit services.

Forecasts of revenue sources that will be available to adequately operate and maintain the federally-supported transportation system are based on revenues reasonably expected to be available from all sources. These funding sources were projected into the future using the assumptions of local tax receipts, user fees and/or budget allocations that underlie the agency operating budgets themselves. A conservative two percent escalation rate was employed, compounded annually, based on an analysis of monthly inflation rates for five years calculated using the Current Consumer Price Index published monthly by the Bureau of Labor Statistics.

FIGURE 7.1: MTA BRIDGES & TUNNELS FACILITIES

Source: MTA

FIGURE 7.2: O&M COSTS BY MODE - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM
(IN MILLIONS OF YOE DOLLARS)

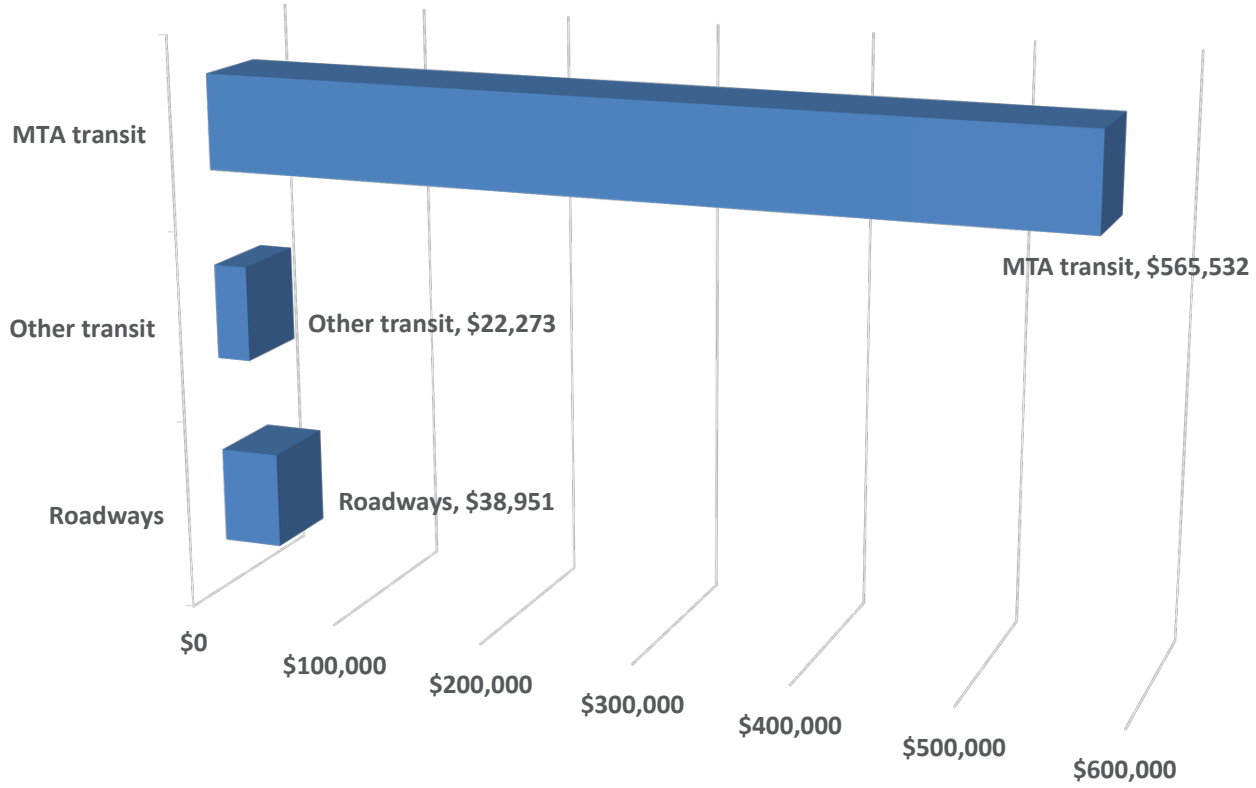
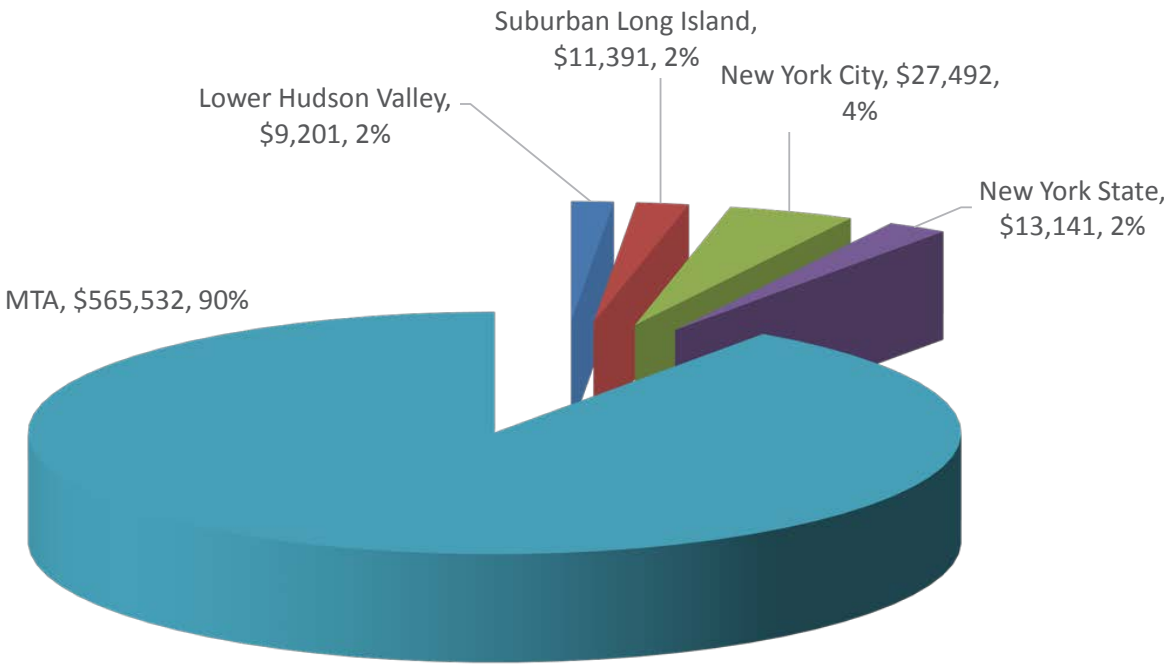


FIGURE 7.3: O&M COST BY AGENCY - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM
(IN MILLIONS OF YOE DOLLARS)



TOTAL COST: $626,756

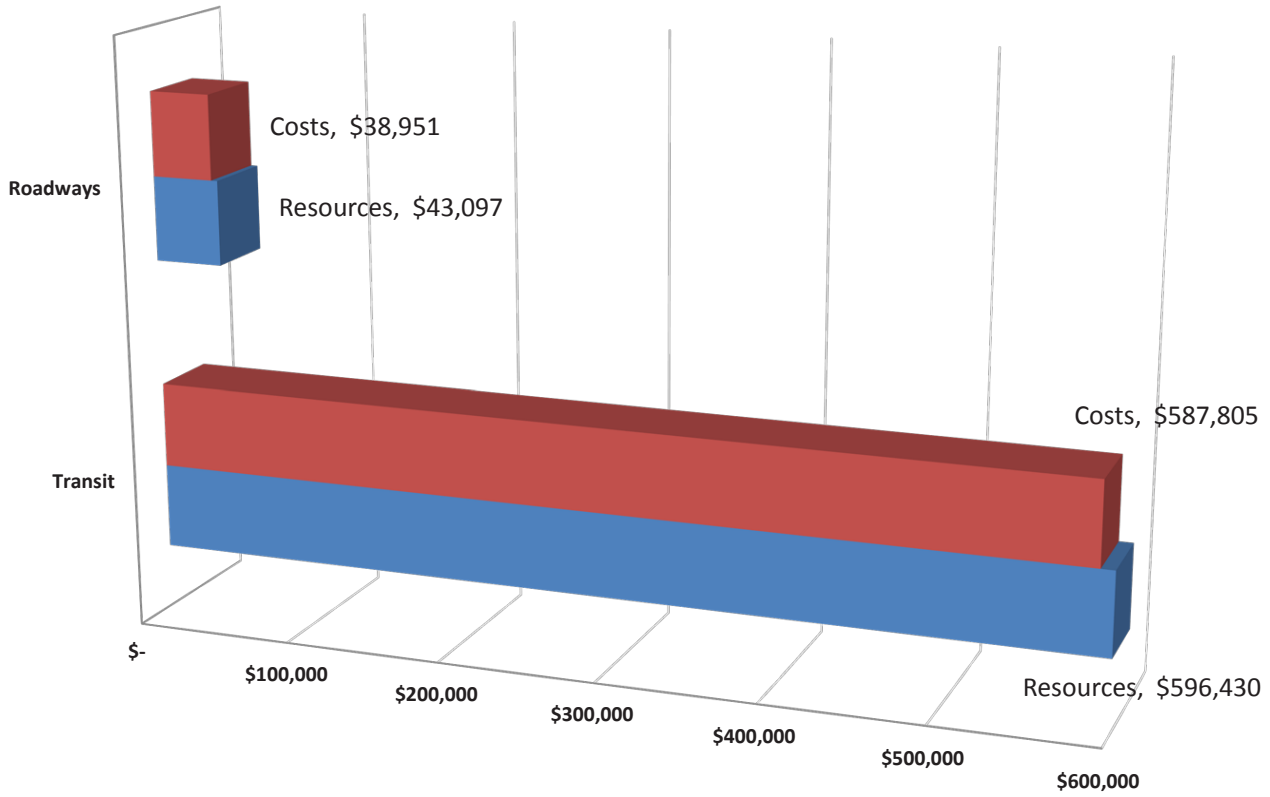
Plan 2045 assumes that NYS and local revenue sources are used to address the majority of the O&M costs. The MTA - the region's largest transportation-related public authority - forecasts its revenues based on current and anticipated capital and operating plans. Figure 7.4 presents the forecasted O&M revenue. Within the NYMTC planning area, New York's Statewide Transit Operating Assistance (STOA) program provided more than $5.1 billion in SFY 2016-2017 in transit operating assistance to transportation providers.[5]

Based on the forecasts of the revenue sources likely to be employed by the NYMTC member agencies to operate and maintain system components and services, which is detailed in Section 8 of Appendix 10, Plan 2045 forecasts that roughly **$640 billion in YOE dollars** will be available to NYMTC's member agencies through the 2045 horizon year for this purpose. Figure 7.4 provides a modal breakdown of these projected O&M revenue sources for the federally-supported transportation system. As with O&M costs, more than 90 percent of the revenues are related to the operation and maintenance of transit services.

The projected revenue sources that can be reasonably expected to be available to NYMTC's members from all sources to address the forecasted O&M costs slightly exceed the forecasted costs by roughly two percent. This slight difference is due mainly to the budgeting practices and forecasting assumptions of the larger members, such as the MTA and NYCDOT, which reflect issues such as debt service and operational efficiencies. It does not reflect a surplus in operational resources among NYMTC's members.

Through these forecasts, Plan 2045 meets the federal regulatory requirement for a financial plan that shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to operate and maintain Federal-aid highways (as defined by 23 U.S.C. 101(a)(6)) and public transportation (as defined by title 49 U.S.C. Chapter 53).

FIGURE 7.4: O&M REVENUE SOURCES - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM
(IN MILLIONS OF YOE DOLLARS)



3. PROJECTS & STRATEGIES PROPOSED FOR FUNDING

Federal Regulatory Language: *In developing the financial plan, the MPO shall take into account all projects and strategies proposed for funding under title 23 U.S.C., title 49 U.S.C. Chapter 53 or with other Federal funds; State assistance; local sources; and private participation.*

The projects and strategies proposed for funding through Plan 2045 fall into two broad categories:

- **System Preservation** includes project and program costs related to the lifecycle replacement, refurbishment, rehabilitation, reconditioning or reconstruction of the components (i.e., equipment and facilities) of the federally-supported transportation system under the jurisdiction of NYMTC's member agencies.
- **System Enhancements** include project and program costs related to the expansion of the federally-supported system's capacity through the addition of new components or the significant expansion of the capacity of existing components to move, people, vehicles and/or goods.

SYSTEM PRESERVATION

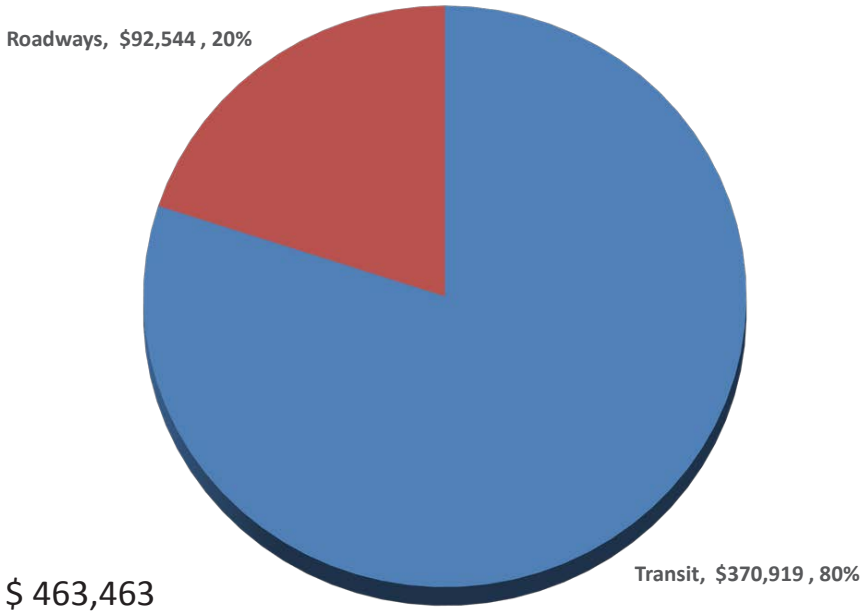
System Preservation projects and strategies proposed for funding in Plan 2045 for the different transportation system components in NYMTC's planning area were developed using NYSDOT's infrastructure models; the MTA's 2015-2019 Capital Plan and 2015-2034 Twenty Year Capital Needs Assessment; and the capital plans and programs of the other NYMTC member agencies. In building these forecasts, NYMTC's members relied on system preservation goals and methods for prioritizing capital investments that were based on their internal capital budgeting assumptions and policies. Figures 7.5 and 7.6 present summaries of these forecasted costs.

The forecasts incorporate a number of regional and local assumptions and policies, such as pavement treatment costs and strategies as well as transit fleet life-cycle replacement cycles. The unit costs for the preservation of individual system components, such as lane miles of roadway or track miles of rail, were assumed to include costs of peripheral infrastructure, such as signage, lighting, and fencing.

Inflation rates were applied to unit cost estimates to represent YOE dollars, using either local inflation data for planning and programming estimates, or, in the absence of such data, applying an inflation rates of 2.3 percent, compounded annually, to their cost estimates. These inflation rates were arrived at through a five year analysis of the Consumer Price Index.

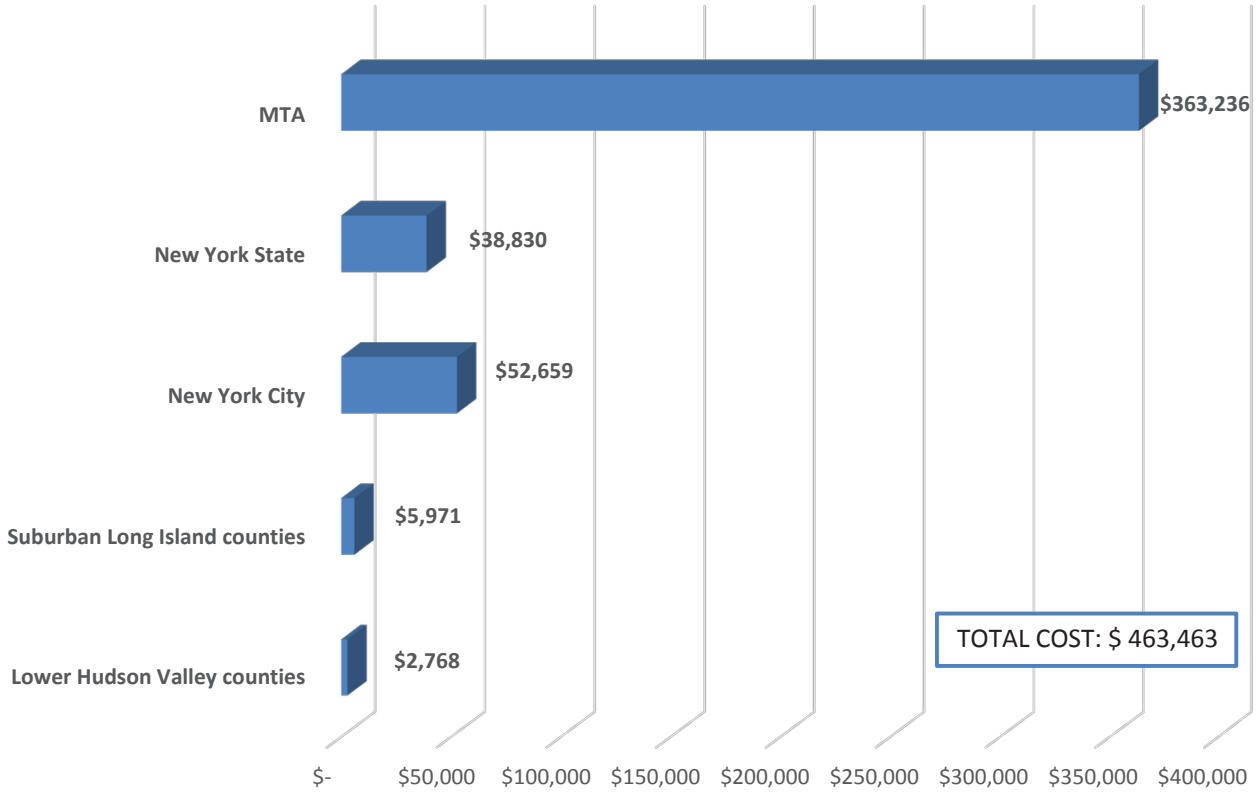
Based on the forecasts of the member agencies' costs to preserve the various components of the federally-supported transportation system under their jurisdiction, (see Appendix 10 for details), Plan 2045 forecasts that approximately **$463 billion in YOE dollars** in System Preservation projects and strategies may need to be funded through the 2045 horizon year for this purpose. Figures 7.5 and 7.6 provide a modal and agency breakdown of these projected System Preservation costs for the federally-supported transportation system. The majority of the costs (80 percent) are related to the preservation of federally-supported transit facilities and equipment.

FIGURE 7.5: SYSTEM PRESERVATION COSTS BY MODE - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM (IN MILLIONS OF YOE DOLLARS)



TOTAL COST: $ 463,463

FIGURE 7.6: SYSTEM PRESERVATION COSTS BY AGENCY - FEDERALLY SUPPORTED TRANSPORTATION SYSTEM (IN MILLIONS OF YOE DOLLARS)



SYSTEM ENHANCEMENTS

System Enhancements include forecasted costs related to projects and strategies proposed to be funded through Plan 2045 and/or FFYs 2018 through 2021 from the FFYs 2017-2021 TIP to expand the federally-supported transportation system's capacity through the addition of new components or by significantly expanding the capacity of existing components. These include both major System Enhancements, generally defined as transportation projects or programs that meet this definition with an estimated cost of $100 million or greater and/or those of regional scope or impact, and minor System Enhancements with lower estimated costs and/or lesser scope or impact. Generally, major System Enhancement projects included in the fiscally-constrained Plan and/or FFYs 2017-2021 TIP are derived from the Plan 2045 strategic vision described in Chapters 1 and 6.

Given the System Enhancement projects and strategies proposed for funding through Plan 2045, as summarized in Figure 7.7 and Table 7.2 below, **$33 billion in YOE dollars** may be needed through the 2045 horizon year to fund these projects and programs. Figure 7.7 provides a breakdown of these projected costs from the FFYs 2017-2021 TIP and from the fiscally-constrained element of Plan 2045. The majority of the costs (70 percent) are related to longer-term enhancement projects contained within Plan 2045's fiscally-constrained element. Table 7.2 lists these system enhancement projects and programs.

In total, Plan 2045 projects may cost up to **$496 billion in YOE dollars** for System Preservation and System Enhancements activities through the planning period. Estimates of the revenues that will likely be available to fund the implementation of these projects and strategies are based on revenues reasonably expected to be available all sources. Private financing of infrastructure projects are addressed on a project-by-project basis.

FIGURE 7.7: SYSTEM ENHANCEMENT COSTS - FEDERALLY SUPPORTED TRANSPORTATION SYSTEM (IN MILLIONS OF YOE DOLLARS)

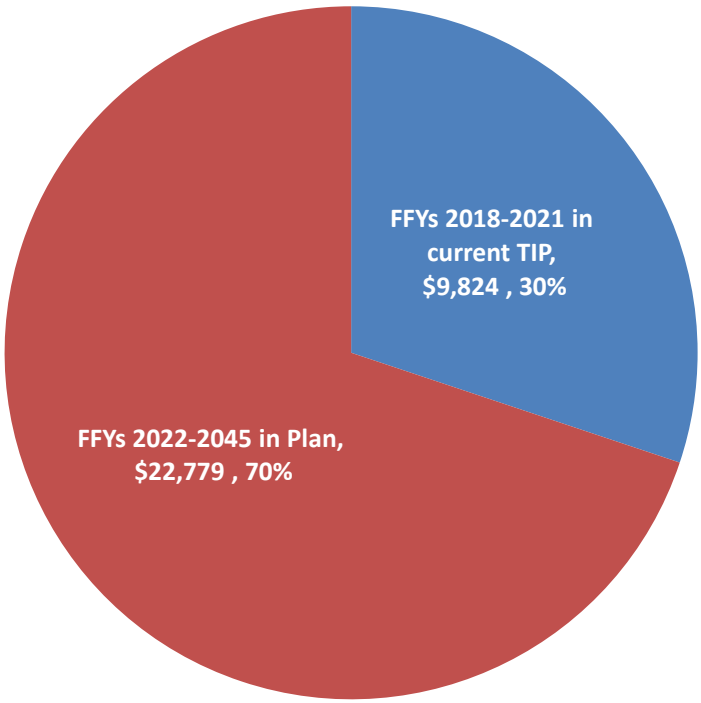


TABLE 7.2: SYSTEM ENHANCEMENT PROJECTS & PROGRAMS

No.	Plan ID#/PIN #	Category/Item	Funding category	TIP	PLAN						Total $$ programmed
				2018-2021	2022	2023-2027	2028-2032	2033-2037	2038-2042	2043-2045	
Minor Projects (from TIP & Plan)											
FFYs 2017-21 TIP			Formula federal	$ 0.634							$ 0.634
			Project-specific: federal	$ 0.023							$ 0.023
			Project-specific: state/local	$ 0.084							$ 0.084
FFYs 2018-2045 Plan			Formula federal	$ 0.080	$ -	$ 0.216	$ 0.088	$ -	$ -	$ -	$ 0.384
			Project-specific: federal								$ -
			Project-specific: state/local	$ 0.034	$ 0.014	$ 0.130	$ 0.022	$ -	$ -	$ -	$ 0.200
Major Projects (Itemized)											
1	PIN: G609/01/AA 09; PLAN ID: NYCMB2411C	MTA LIRR East Side Access Project	Formula federal								$ -
			Project-specific: federal	$ 0.262							$ 0.262
			Project-specific: state/local	$ 2.158							$ 2.158
2	PLAN ID: NYCM2014C	James A. Farley Building Redevelopment, Moynihan Station Phase 2	Formula federal	$ 0.022							$ 0.022
			Project-specific: federal	$ 0.040							$ 0.040
			Project-specific: state/local	$ 1.533							$ 1.533
3	PIN: L703/04/WX PLAN ID: NSMC795C	MTA LIRR Ronkonkoma Branch 2nd Track	Formula federal	$ 0.049							$ 0.049
			Project-specific: federal								$ -
			Project-specific: state/local	$ 0.123							$ 0.123
4	PIN: X09629, PLAN ID: NYCMC1785C	Bayonne Bridge Clearance Project	Formula federal								$ -
			Project-specific: federal								
			Project-specific: state/local	$ 0.380							$ 0.380
5	PLAN ID: NSSC650C	NY Route 347 Safety, Mobility and Environmental Improvements	Formula federal	$ 0.004	$ 0.106	$ 0.165	$ 0.154				$ 0.429
			Project-specific: federal								$ -
			Project-specific: state/local	$ 0.030	$ 0.026	$ 0.041	$ 0.039				$ 0.136
6	PLAN ID: NYCM2663C	MTA NYCT Second Avenue Subway Phase 2	Formula federal								$ -
			Project-specific: federal	$ 0.500			$ 0.935				$ 1.435
			Project-specific: state/local	$ 0.340			$ 2.183				$ 2.523
7	PLAN ID: NYCM2664C	MTA NYCT Second Avenue Subway Phase 3-4	Formula federal								$ -
			Project-specific: federal				$ 1.336	$ 1.252	$ 2.405	$ 1.583	$ 6.576
			Project-specific: state/local				$ 1.336	$ 1.252	$ 2.405	$ 1.583	$ 6.576
8	PIN: X05160; PLAN ID: NYCQ98C	Kew Gardens Interchange Phase 3 – Contract 4 : Reconstruction of Parkways	Formula federal	$ 0.264							$ 0.264
			Project-specific: federal								$ -
			Project-specific: state/local	$ 0.066							$ 0.066
9	PLAN IDs: MHSDM708C, NYCDM2304C, NSDM2305C	Transportation Systems Operations & Management Programs	Formula federal	$ 0.429	$ 0.113	$ 0.598	$ 0.660	$ 0.729	$ 0.805	$ 0.522	$ 3.855
			Project-specific: federal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Project-specific: state/local	$ 0.107	$ 0.028	$ 0.149	$ 0.165	$ 0.182	$ 0.201	$ 0.131	$ 0.964
10	PLAN ID: NYCBK2350C	Canarsie Power Improvement Project	Formula federal								$ -
			Project-specific: federal								
			Project-specific: state/local	$ 0.300							$ 0.300
11	PIN: X77338 PLAN ID: NYCQ2361C	Great Streets Vision Zero – Queens Boulevard	Formula federal								$ -
			Project-specific: federal								
			Project-specific: state/local	$ 0.037		$ 0.064					$ 0.101
12	PIN: 082498; PLAN ID: NSNC1787C	Nassau Hub Transportation Improvement	Formula federal	$ 0.016							$ 0.016
			Project-specific: federal							$ 0.180	$ 0.180
			Project-specific: state/local	$ 0.040						$ 0.180	$ 0.220
13	PLAN ID: NYCMB767C	Penn Station Access on the New Haven Line via Amtrak's Hell Gate Line	Formula federal								$ -
			Project-specific: federal								$ -
			Project-specific: state/local			$ 0.695					$ 0.695
14	PLAN ID: NSMC800C	LIRR Expansion Project (Floral Park-Hicksville)	Formula federal								$ -
			Project-specific: federal								$ -
			Project-specific: state/local	$ 2.000							$ 2.000
15	PLAN ID: NSSC2689C	Nicolls Road Multimodal Corridor	Formula federal	$ 0.052							$ 0.052
			Project-specific: federal	$ 0.001	$ 0.053						$ 0.054
			Project-specific: state/local	$ 0.015	$ 0.053						$ 0.068
16	PIN: L703/04/WU; PLAN ID: NYCQ1778C	Jamaica Capacity Improvements	Formula federal	$ 0.094							$ 0.094
			Project-specific: federal								$ -
			Project-specific: state/local	$ 0.106							$ 0.106
Subtotals			**Formula federal**	$ 1.644	$ 0.219	$ 0.979	$ 0.902	$ 0.729	$ 0.805	$ 0.522	**$ 5.799**
			Project-specific: federal	$ 0.826	$ 0.053	$ -	$ 2.271	$ 1.252	$ 2.405	$ 1.763	**$ 8.570**
			Project-specific: state/local	$ 7.354	$ 0.121	$ 1.080	$ 3.745	$ 1.434	$ 2.606	$ 1.894	**$ 18.234**
			TOTALS	**$ 9.824**	**$ 0.393**	**$ 2.058**	**$ 6.918**	**$ 3.415**	**$ 5.816**	**$ 4.179**	**$ 32.603**

4. ESTIMATES OF AVAILABLE FUNDS

Federal regulatory language: *For the purpose of developing the metropolitan transportation plan, the MPO, public transportation operator(s), and State shall cooperatively develop estimates of funds that will be available to support metropolitan transportation plan implementation, as required under 23 U.S.C. 450.314(a). All necessary financial revenues from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified.*

FEDERAL FUNDING FORECASTS

Plan 2045 continues to assume a strong federal partnership in the preservation and enhancement of the region's transportation infrastructure. The most recent federal surface transportation act, the Fixing America's Surface Transportation (FAST) Act, represents the first long-term surface transportation authorization enacted in more than a decade. While the five-year authorization act is fully-funded, the longer-term sustainability of the Highway Trust Fund (HTF) was not addressed. The FAST Act relies on $70 billion in offsets during the life of the program to sustain authorized funding levels for highway and transit programs. These planned offsets/transfers to the HTF, however, are only an interim measure to sustain funding through FFY 2020. The HTF has been insolvent since 2008 and has relied on annual support from the general treasury. The Congressional Budget Office estimates that, absent the identification/dedication of additional revenues, the annual gap in revenues will increase to more than $20 billion annually by 2021.

Notwithstanding the impending insolvency of the federal HTF, Plan 2045 assumes, as a lower limit, that the formula federal-aid transportation programs will continue to grow at no less than two percent annually from the FAST Act's 2015 funding levels. (Figure 7.8).

At the higher-end of the planning spectrum, Plan 2045 assumes that federal aid transportation programs will continue at the historical rate of federal surface transportation acts that preceded the FAST Act. Based on the historical increases, average annual formula funding is assumed to grow at 24.8 percent more than the funding authorized in the immediately preceding act.

Table 7.3 illustrates the historical funding trends. Table 7.4 projects this average trend for the federal authorization acts anticipated during the planning period. For the purpose of this forecast, each successor act to the FAST Act is assumed to be five fiscal years in duration and is assumed to be followed immediately by its successor. The table presents the upper limit of the range of formula federal funding.

FIGURE 7.8: FEDERAL LOWER LIMIT FUNDING FORECAST - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM (IN MILLIONS OF YOE DOLLARS)

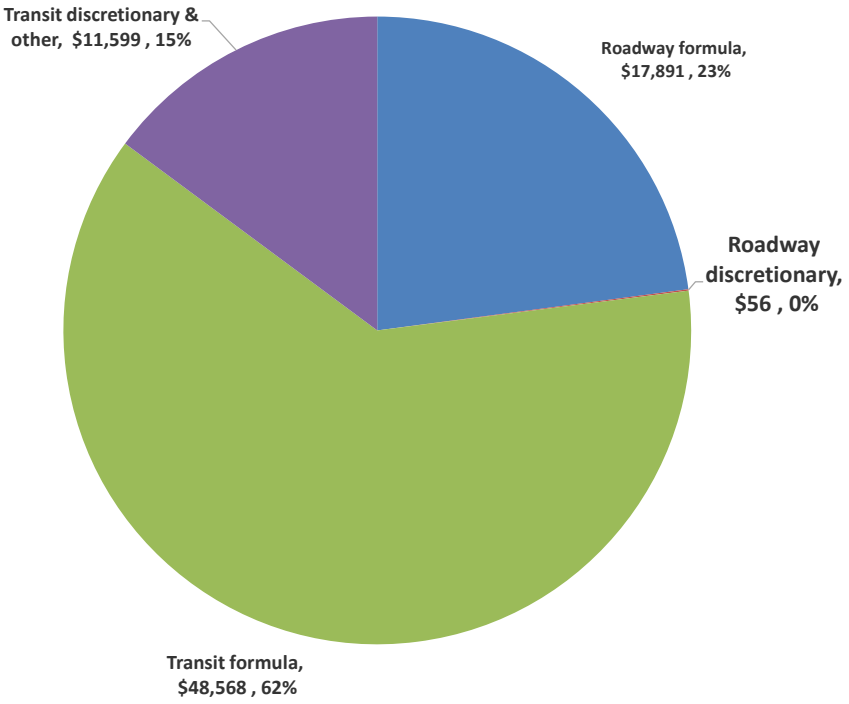


TABLE 7.3: FEDERAL AUTHORIZATION ACTS & HISTORICAL FUNDING TRENDS

FEDERAL ACT	FEDERAL FISCAL YEARS	TOTAL FEDERAL AUTHORIZATION	AVERAGE ANNUAL FEDERAL AUTHORIZATION	% CHANGE	NO. OF EXTENSIONS (TOTAL LENGTH OF EXTENSIONS)
ISTEA	1992-97	$ 155,299.96	$ 25,883.33	n/a	1 (OCT '97-MAR '98)
TEA 21	1998-03	$ 198,195.00	$ 33,032.50	27.6%	12 (SEP '03 - AUG '05)
SAFTEA-LU	2005-09	$ 244,148.00	$ 48,829.60	47.8%	9 (SEP '09 - JULY '12)
MAP-21	2013-14	$ 105,000.00	$ 46,200.00	-5.4%	5 (SEP '14 - DEC '15)
FAST	2017-21	$ 304,679.00	$ 59,613.17	29.0%	
			AVERAGE	**24.8%**	

TABLE 7.4: ASSUMED FUTURE FEDERAL AUTHORIZATION ACTS & FEDERAL UPPER LIMIT

Historical Escalation Rate:		1.248			
FEDERAL ACT	**FEDERAL FISCAL YEARS**	**AVERAGE ANNUAL FEDERAL AUTHORIZATION (National)**	**TOTAL AUTHORIZED (National)**	**AVERAGE ANNUAL NYMTC FORMULA FEDERAL PLANNING TARGET**	**TOTAL NYMTC FORMULA FEDERAL PLANNING TARGET**
FAST (actual)	2017-21	$ 101,559.67	$ 304,679.00	$ 1,949.95	$ 7,799.79
SUCCESSOR 1	2022-25	$ 126,746.46	$ 633,732.32	$ 2,433.54	$ 9,734.14
SUCCESSOR 2	2026-30	$ 158,179.59	$ 790,897.94	$ 3,037.05	$ 15,185.26
SUCCESSOR 3	2031-35	$ 197,408.12	$ 987,040.62	$ 3,790.24	$ 18,951.21
SUCCESSOR 4	2036-40	$ 246,365.34	$ 1,231,826.70	$ 4,730.22	$ 23,651.11
SUCCESSOR 5	2041-45	$ 307,463.94	$ 1,537,319.72	$ 5,903.32	$ 29,516.58
TOTALS			**$ 5,485,496.30**		**$ 104,838.09**

STATE AND LOCAL FUNDING FORECASTS

New York State-authorized revenues for transportation purposes were projected from base year funding levels and generally follow a two percent annual growth rate. Additional State and local revenues are assumed to be available, as necessary, to address the non-federal share forecasted in the upper limit of federal aid.

NYMTC members have a long standing and demonstrated history of providing the non-federal share necessary to leverage any additional funds that are apportioned/allocated to the region.

ESTIMATED FUNDS FOR PLAN IMPLEMENTATION

Plan 2045 forecasts that between **$445 billion and $493 billion in YOE dollars** is expected to be reasonably available from all sources.

Figure 7.9 and Appendix 10 detail reasonably expected revenues during the planning period. More than 75 percent of reasonably expected revenues are derived from non-federal sources.

FIGURE 7.9: ESTIMATED FUNDS FOR PLAN IMPLEMENTATION - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM (IN MILLIONS OF YOE DOLLARS)

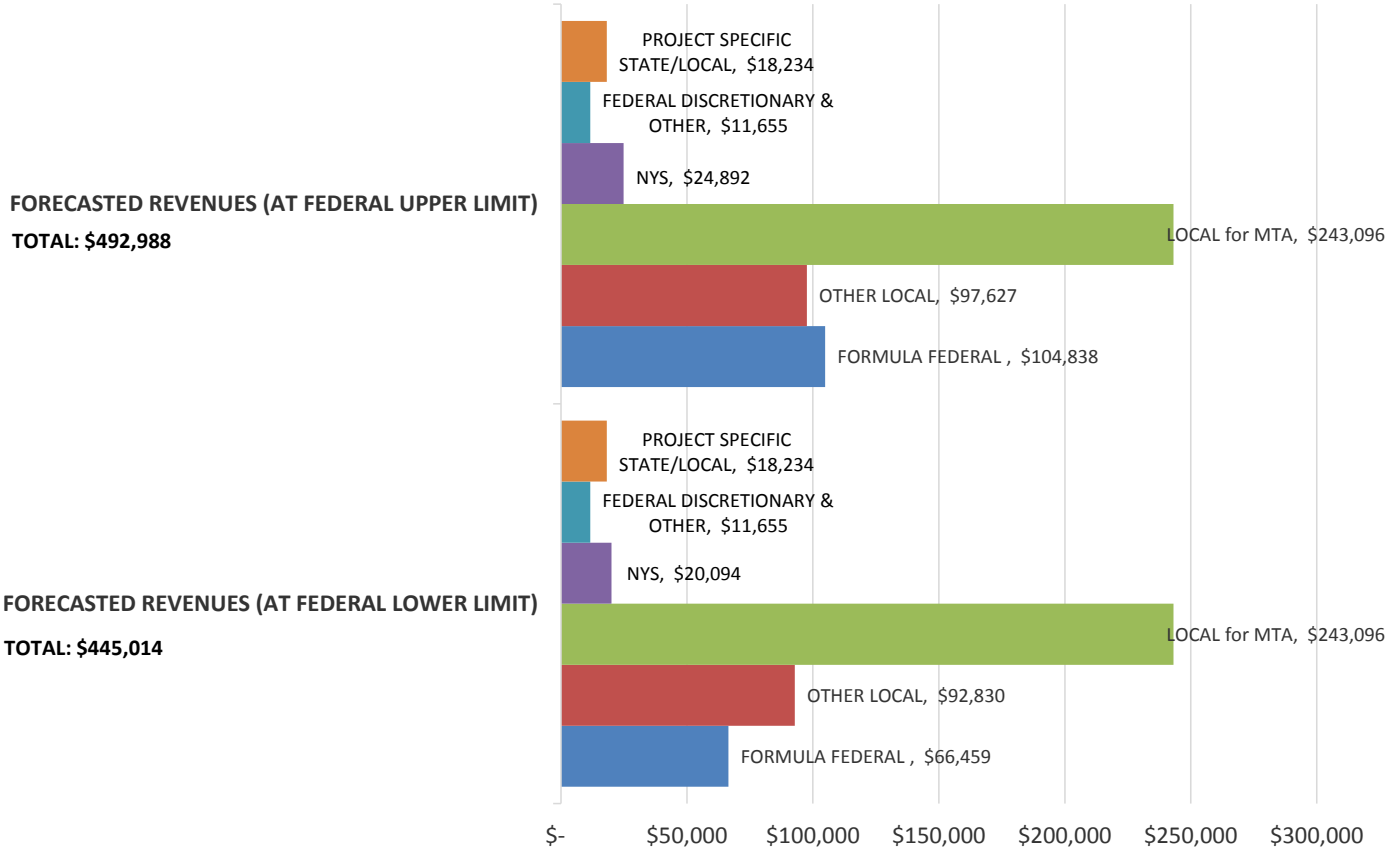
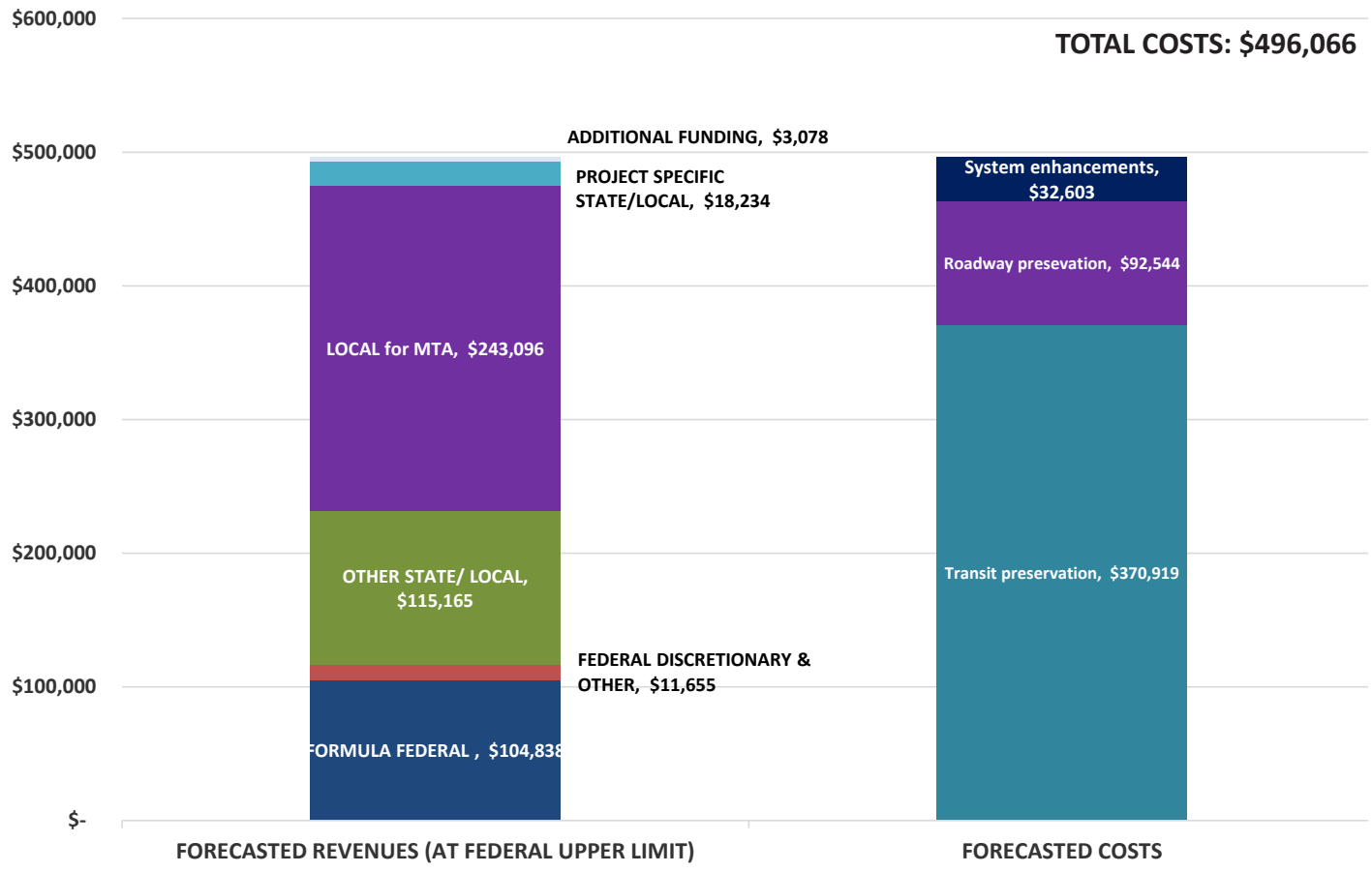


Figure 7.10 compares the forecasts of reasonably expected revenues to the forecasts of the estimated costs to implement the projects and strategies proposed for funding in Plan 2045. Broadly speaking, the reasonably expected revenues at the higher end of the spectrum will address most of the projected costs of Plan 2045 implementation. The potential difference between estimated resources at the upper level of the range and forecasted costs is approximately **$3 billion in YOE dollars, or 0.6% of the total cost of Plan 2045 implementation.**

FIGURE 7.10: REVENUES VS. COSTS - FEDERALLY-SUPPORTED TRANSPORTATION SYSTEM
(IN MILLIONS OF YOE DOLLARS)



5. ADDITIONAL FINANCING STRATEGIES

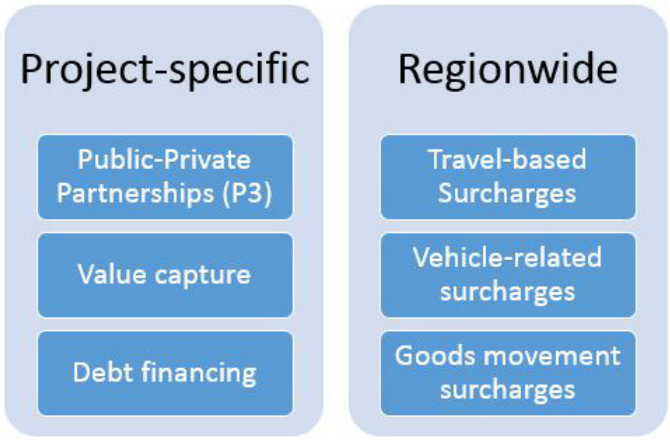
Federal regulatory language: *The financial plan shall include recommendations on any additional financing strategies to fund projects and programs included in the metropolitan transportation plan. In the case of new funding sources, strategies for ensuring their availability shall be identified.*

In keeping with the federal regulation cited above, Plan 2045 recommends consideration of additional funding opportunities (cited below) that might be developed to fund projects and strategies should the need arise during the planning period.

These additional opportunities, presented for discussion purposes only, provide a non-inclusive menu of strategies that might be considered to address any long-term resource shortfalls. The potential additional funding opportunities generally address project-specific sources and regionwide sources.

The adoption and implementation of additional funding opportunities are subject to individual member agency budgeting and policy decisions, as well as legislative actions at municipal, county, and/or state levels. NYMTC does not have the statutory authority to adopt and/or implement these additional funding opportunities as they fall outside the purview of the metropolitan planning process. For purposes of inclusion, these opportunities are identified and presented for future consideration.

FIGURE 7.11: PROJECT-SPECIFIC & REGIONWIDE FINANCING STRATEGIES



PROJECT-SPECIFIC FUNDING OPPORTUNITIES

Opportunities for additional project-specific resources may only be employed through individual transportation improvement projects. Table 7.2 details several programmed System Enhancement projects that are part of Plan 2045's fiscally-constrained element. The table indicates where project-specific funding sources are being or will be applied for individual projects. Approximately $29 billion have been programmed from federal, state and local project-specific sources for these System Enhancement projects (Figure 7.9).

The project-specific funding sources that could be pursued for current or future development are described below.

PUBLIC-PRIVATE PARTNERSHIPS (P3 AGREEMENTS)

P3 agreements are contracts between a public entity or jurisdiction and a private entity. Through these contractual arrangements, the private entity (or entities) is involved to various extents in the financing and delivery of public services and facilities. Transportation improvement projects capable of generating returns from user fees could be financed in whole or in part through P3 agreements.

P3 agreements are generally employed for new or enhanced facilities or services, rather than existing ones. Although P3 agreements can take various forms, two possible arrangements are known as Design-Build-Operate-Maintain (DBOM) and Design-Build-Finance-Maintain (DBFM). Under DBOM and DBFM, a project's implementing agency contracts with a private entity to construct the project and then operate or finance and maintain it for a set period of time. In this type of arrangement, the user fees act as a return on the private entity's investment in the project. Examples of P3 agreements in the form of DBOMs/DBFMs in the New York City metropolitan region include the Hudson-Bergen Light Rail in northern New Jersey, and the PANYNJ's Goethals Bridge replacement project between Staten Island and New Jersey.

Another type of P3 agreement involves the privatization or monetization of a transportation asset or improvement. Under this arrangement an asset (for example, a bridge) can be leased to a private operator for funds upfront, while the operator collects tolls and other operational revenues from the asset.

According to the Federal Highway Administration, 33 states and one U.S. territory have enacted legislation authorizing P3 agreements for the development of transportation infrastructure. New York is not currently one of those states, but several entities within the state have that ability, including the MTA and the PANYNJ.

VALUE CAPTURE

In broad terms, value capture is a funding mechanism that captures projected increases in property value that result from new infrastructure or infrastructure improvements. One form of value capture is Tax Increment Financing (TIF), which uses projected increases in future tax revenue (resulting from increases in property values conferred by infrastructural improvements) to finance the improvements in the present day. Although TIF can take various forms, a development entity is usually created to manage TIF-financed projects. Such an entity can often issue bonds to fund the infrastructure improvements in the present day, with the bonds being repaid through the TIF revenues. Often, the base tax rate in the redevelopment zone is frozen so that future tax revenues in excess of the base rate flow into a fund used to make payments on the principal and interest for the issued bonds.

Since TIF generates surplus revenues from the incremental increases in the base tax rate only, it is most appropriate for undeveloped or underdeveloped land where the base tax rate is very low. As of this writing, NYS makes no legal provisions for TIFs. TIFs are prevalent elsewhere in the country and have been used to fund transportation projects.

In 1984, NYS authorized the use of PILOTs (Payments in Lieu of Taxes; a variation of TIFs). One of the most notable uses of PILOTs for a transportation improvement is the extension of MTA NYC Transit's #7 subway line to the Hudson Yards development on midtown Manhattan's Far West Side. This subway extension was financed primarily through municipal appropriations to be repaid over time by PILOTs, and to a lesser extent, another form of value capture: density bonuses (the right to build additional building height) in the redevelopment zone. [1] Density bonuses were offered by NYC to developers who met specified conditions, such as making financial contributions to a District Improvement Fund that would help pay for infrastructure improvements. Density bonuses are feasible in Manhattan because of the high value of land.

Municipalities in NYS have also used other forms of value capture to finance transportation improvements. Special tax assessment districts apply a tax or surcharge in a development area to help pay for transportation improvements that make the development area possible or optimal. In the 1980s, a special taxing district was established for commercial developments in the Town of Greenburgh and Village of Tarrytown in Westchester County to fund improvements on a section of Route 119 in anticipation of the increased traffic to be generated by nearby large development projects.

DEBT FINANCING

Transportation improvements can also be financed through debt, using mechanisms such as bonding, various federal credit programs and a state infrastructure bank, as well as any national infrastructure bank that may be developed through future legislation. In all cases, capital is effectively loaned for the transportation improvement and must be paid back over time, along with some level of interest. As with P3 agreements, debt financing is usually applied to transportation improvements capable of generating revenues. Examples of debt financing include the *New* NY Bridge project, which is replacing the Tappan Zee Bridge across the Hudson River between Rock-land County and Westchester County, as well as the MTA LIRR East Side Access project, which is also under construction.

DISCRETIONARY FEDERAL FUNDING

Additional project-specific funding through discretionary federal programs may also be available to individual projects on a competitive basis. Selection of projects for these discretionary funding pro-grams is usually undertaken nationally. Two current discretionary programs, described below, illustrate the potential availability of supplemental federal funding at the level of individual projects:

Under current federal authorization legislation, Section 5309 (Capital Investment Grants) is a discretionary grant program administered by the Federal Transit Administration (FTA) to provide financing for major transit capital projects. There are four categories of eligible projects under Section 5309: New Starts (major, fixed guideway capital projects), Small Starts (smaller-scale, fixed guideway or corridor-based capital projects), Core Capacity (capacity-increasing corridor projects) and Programs of Interrelated Projects (a combination of categories). Each category has unique criteria and requirements set forth in legislation, and must satisfactorily complete a multi-step and multi-year selection process. Section 5309 financing has been employed in Phase I of the Second Avenue Subway project on the East Side of Manhattan and will also be sought for Phase II of this project, as well as in the MTA LIRR's East Side Access project. It has also been used for Select Bus Service projects in NYC.

The Transportation Investment Generating Economic Recovery, or TIGER, discretionary grant program provides an opportunity for federal investment in a wide range of projects (e.g. transit, highways, freight, ports, bicycle and pedestrian) that meet specific criteria. Similarly, the FASTLANE program provides dedicated, discretionary funding for projects that address critical freight issues facing our nation's highways and bridges. These programs use competitive processes to select projects with significant benefits. TIGER funding has been used in Phase I of the Moynihan Station project adjacent to Pennsylvania Station in midtown Manhattan, as well as Vision Zero safety improvements in NYC, Fordham Plaza in the Bronx, Hunts Point freight improvements in the Bronx, greenway improvements, and planning studies in the Rockaways and for the Sheridan Expressway. FASTLANE has helped fund the PANYNJ's Cross Harbor Freight Program.

CREDIT AND LOANS

Credit and loan programs also provide a potential financing source for infrastructure projects. Transportation Infrastructure Finance and Innovation Act (TIFIA) financing is available from the federal government on a competitive basis. TIFIA provides low-cost, flexible loans, loan guarantees and lines of credit for transit, highways, intercity rail and multimodal facilities projects. Under TIFIA, loans can be used to cover up to 33 percent of a project's cost (or up to 49 percent under compelling circumstances). The program requires an identified repayment source, for example tolls or special taxes. The main benefit of TIFIA over bonding is lower interest rates that can translate to major project cost savings over time. TIFIA financing has been used for the New New York Bridge project (Tappan Zee Bridge replacement), the Goethals Bridge project and the reconstruction of the State Island Ferry terminals and acquisition of three new boats.

Revolving loan funds may also be offered through state infrastructure banks or funds, or a federal infrastructure bank, should one be created, to leverage reliable government revenue streams (for example grants and dedicated taxes) and provide loans, bonds or grants for infrastructure projects. A survey of national revolving fund deals since 1996 reveals that a significant amount of projects were offered interest-free or below market rate interest loans.

PRECEDENCE, FEASIBILITY, IMPLEMENTATION CONSIDERATIONS & ANTICIPATED YIELD

Plan 2045 considers the project-specific funding opportunities described above as reasonably expected to be implemented should they need to be employed as individual projects are planned and executed. This determination is based on an assessment of precedence, feasibility, and implementation considerations as shown in Table 7.5 below.

The two main hurdles to implementing these project-specific sources are state authorizations and the uncertainty surrounding federal funding programs going forward. P3 agreements and their variations are burdened by the absence of legal provisions in NYS and establishing such legal frameworks would take significant time, although there has been activity in the NYS Legislature in this regard. However, once such legal authorizations are in place, implementation time for P3 agreements would likely be approximately five years, in which time contract negotiations and necessary state actions could be finalized and revenue generation could begin, depending on the timeliness of project construction and contract specifics such as revenue streams and revenue sharing between government and contractor.

Value capture programs have a wide range of implementation timeframes. Some mechanisms, such as assessment districts, are less complex than TIF- or PILOT-based projects for which land acquisition, rezonings and project fund procurement are all required. The Hudson Yards project took eleven years from the time project oversight entities were established to the opening day of the #7 line extension. Additionally, projects (especially those that are large scale) may not generate surplus revenue (revenue in excess of debt service and interest payments) for potentially decades, due to project cost and because tax rates will begin relatively low and will increase over time.

Implementation timeframes for federal credit and loan programs such as TIFIA depend heavily upon the political climate and the level of demand for financing nationwide. TIFIA is an existing program and project proposals are judged nationally on a competitive basis. A state infrastructure bank was established for NYS and federally capitalized in 1997. Further capitalization was authorized in 2012 as the NY Works Infrastructure Fund.

In contrast, debt financing or bonding is already widely used and has much shorter implementation timeframes compared to previously described financing strategies. Bonds require approval by issuing agency or state or local government, as well as bond ratings by a rating agency before issuance, but once bonds are issued, project funds are available. Bond repayment timeline relies upon factors such as project cost, bond rating (which determines interest rate and thus total amount to be repaid), and the ability to secure revenues for repayment (for example, taxpayer revenues).

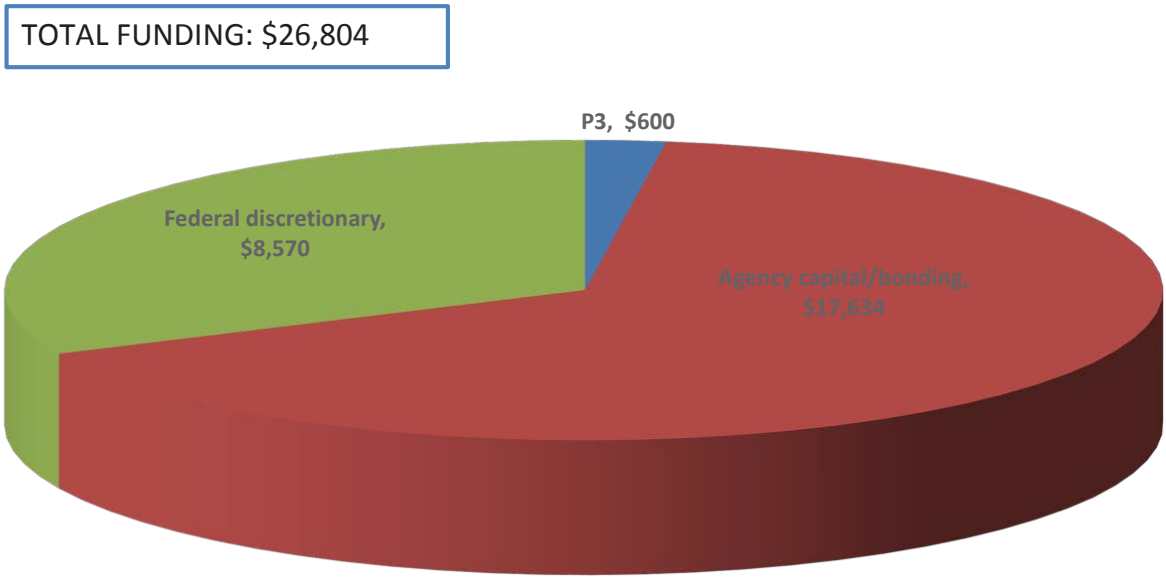
TABLE 7.5: PRECEDENCE FOR PROJECT-SPECIFIC FUNDING OPPORTUNITIES

Project-Specific Alternative	Successful deployment elsewhere	Precedence within the region	Extension of prior programs/ initiatives
Public-Private Partnerships (P3s)	I-495 HOT Lanes Dulles Greenway Chicago Skyway	Goethals Bridge Replacement	New programs are project dependent
Design-Build-Operate-Maintain (DBOM)	Port of Miami Tunnel I-595 Fort Lauderdale	Hudson-Bergen Light Rail	Project specific
Privatization	Chicago Skyway, Indiana Turnpike (financial failure)	Proposed for New Jersey toll roads	Not currently used in NYS
Value capture	Hong Kong rail system	#7 Extension Brooklyn Bridge Park; Brooklyn-Queens Streetcar (proposed)	Project-specific
Bonding	Widely used in toll agencies and State DOTs, e.g., Golden Gate Bridge and Chesapeake Bay Bridge & Tunnel; Erie Canal	Tappan Zee Bridge, Bayonne Bridge, Second Avenue Subway	Widely deployed, well understood, most agencies have existing administrative process; subject to bond rating and risk
Credit	TIFIA Loan Program; State Economic Development Corporations	Tappan Zee Bridge, Goethals Bridge	Existing federal and state programs may be available; dependent on the grantsmanship of local agencies

ANTICIPATED YIELD

By definition, the financial yield of project-specific funding sources is determined as the scope of an individual project to which it will be applied is defined. Figure 7.12 shows the type and amount of project-specific financing already programmed in either the FFYs 2017-2021 TIP or in Plan 2045 for System Enhancement projects.

FIGURE 7.12: CURRENT PROJECT SPECIFIC FINANCING (IN MILLIONS OF YOE DOLLARS)



REGIONWIDE FUNDING OPPORTUNITIES

Additional resource opportunities that may be employed include the following regionwide strategies

TRAVEL-BASED SURCHARGES

Travel-based surcharges include a variety of fees charged to travelers based on the level of their use of various transportation services and/or facilities. Unlike general taxes that are levied regardless of the level of transportation system use of those taxed, travel-based surcharges are levied either in proportion to actual use of the system or geographically in relation to specific services or facilities.

For the purposes of Plan 2045, the following surcharges are among a menu of options from which additional revenue could be generated.

A vehicle-miles traveled (VMT) surcharge applies a fee based on total vehicular travel. There are different ways to apply such a surcharge. An Oregon Department of Transportation pilot program employed onboard distance trackers that add VMT surcharges to the cost of fuel. An alternative method used by the Oregon pilot program was to use the vehicle's existing odometer to track and charge for miles travelled. The latter option would clearly be less costly and time-intensive to implement. VMT surcharges have the potential to internalize the cost of driving but may have a disproportionate impact on people who travel long distances and may be limited to driving as a primary mode of transportation.

Another travel-based surcharge that could generate revenues regionwide is *premium lane conversion*, or the sale of unused capacity on existing High Occupancy Vehicle (HOV) or bus lanes and High Occupancy Toll (HOT) lanes to single-occupant vehicles. Pricing can be responsive to traffic flow conditions for both HOV/HOT/bus and regular lanes.

Tolling and road pricing is a basic user fee for vehicles travelling on certain roadways. Tolls can be a flat-rate entry fee, based on distance travelled, or on time-of-day. Cordons represent a more complex pricing system, whereby vehicles entering a cordoned area pay a toll. The City of London instituted a Congestion Charge Zone in 2003, while a similar proposal for Lower Manhattan failed in 2008.

The *garage parking turnover surcharge* is an additional fee per movement into a parking garage.

VEHICLE-BASED SURCHARGES

One vehicle-based surcharge is a stepped fee for vehicle registrations, which would impose increasing registration fees as the number of vehicles owned by a household increases. For example, a household's first vehicle would be charged a base registration fee, and each car owned after that would be charged progressively higher fees.

Another vehicle-related surcharge is curb space leasing to private entities such as commercial delivery and trucking firms, or even travelers who want desirable parking locations (known as a vanity lease). This surcharge allows delivery and trucking firms to save money on illegal parking charges they incur, while also promoting roadway safety.

GOODS MOVEMENT SURCHARGES

A weight-based fee would capture the impact of a vehicle's weight on the maintenance of roadways. While NYS already has a weight and distance fee via the Highway Use Tax, charges could also be placed on shipments being made within the NYMTC planning area. In Germany, all trucks over a certain weight must pay a toll based on emission class of the vehicle, the axle number, and length of toll road travelled. This toll generated nearly 40 billion euros in revenue for the country in 2009.

Shipment-based fees could be applied to each package or box delivered within the NYMTC planning area as a way of capturing revenue from the increase in volume of shipping as a result of the expanded role of home delivery and online shopping. Fees could be applied to the sender, although it is unclear how much of the fee burden would ultimately be passed on to the receiver from the sender in product cost and shipping charges.

ADDITIONAL FEDERAL AND STATE FUNDING

Additional federal and state funding sources represent potential regionwide funding sources for both System Preservation and new System Enhancement projects. As discussed above, Plan 2045 assumes a range of assumptions about the availability of federal funding through the period of the Plan. Recent congressionally-mandated national transportation commissions recommended increased federal investment in the nation's transportation infrastructure above and beyond the financing trends defined by the last three federal authorization acts. Similarly, state financing could be increased in the future above the levels forecast by Plan 2045.

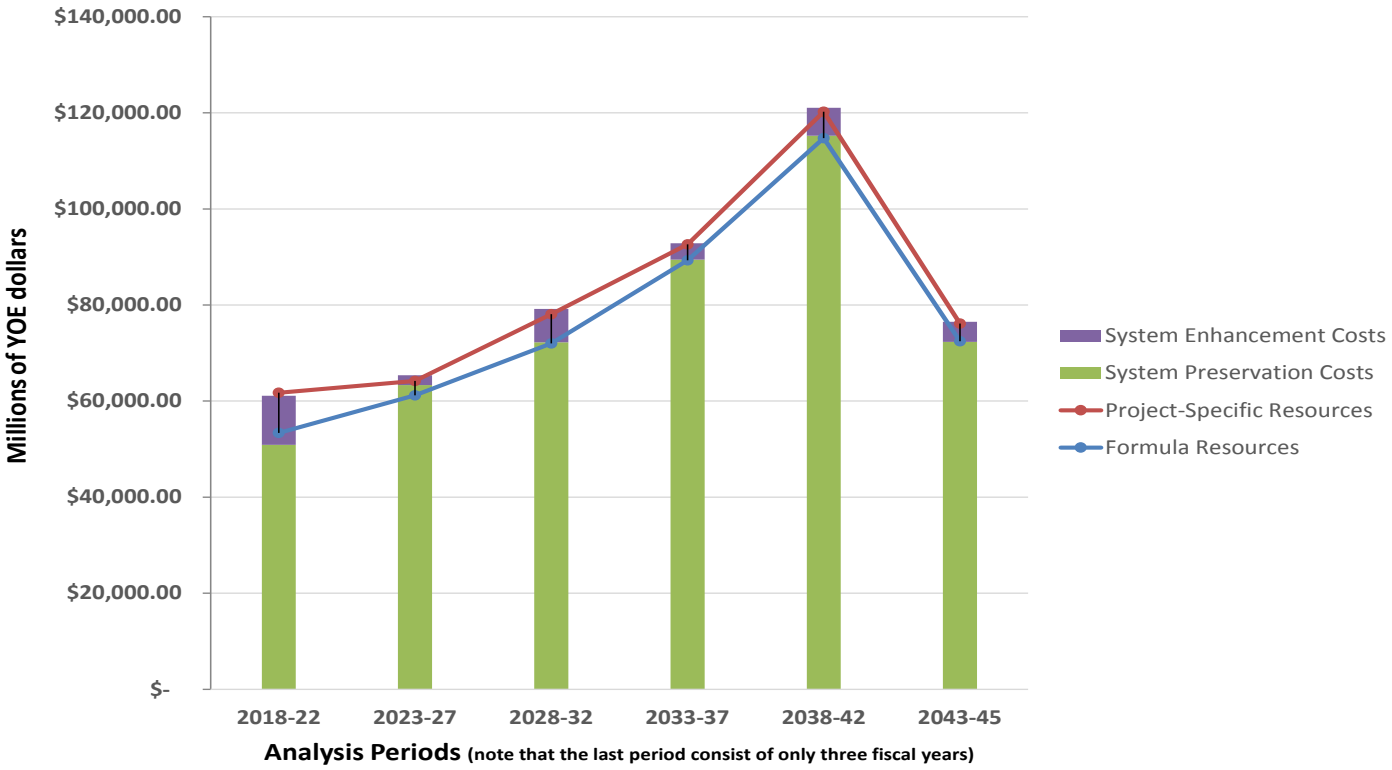
TABLE 7.6: PRECEDENCE FOR REGIONWIDE FINANCING STRATEGIES

Regionwide Alternative	Successful deployment elsewhere	Precedence within the region	Extension of prior programs/ initiatives
VMT Charge	Proposed in Oregon and California; deployed on trucks in Germany	None	None
Premium Facilities/ High Occupancy or Toll Lanes	HOT Lanes are widely deployed: I-45, Houston; SR 91, Orange County, CA; US 59, Texas	HOV/3 used in region; conversion possible	Not currently deployed; potential to use existing electronic toll collection tags to speed implementation
Additional Tolling/Road Pricing	Widely used in USA: Golden Gate Bridge, Sunshine Skyway, New Jersey Turnpike, Delaware Turnpike	Extensively deployed in region.; 25% of nations tolls collected in Downstate 10	Widely in place; potential to add tolls to existing facilities using existing toll tags and technology. 17 bridges and tunnels and 568 miles of road are currently tolled in NYS
Parking Garage Turnover Surcharge	Los Angeles -10%; San Francisco – 25%; Philadelphia: 22.5% gross receipt tax.	Currently utilized – with exemption for Manhattan residents	Existing tax in place and collection system is deployed
Stepped Vehicle Registration Fee (based on number of vehicles)	Wide variation in registration fees by state; some fees based on weight and value of vehicle	NYS has a fixed fee schedule based on weight	Existing fee structure is established but tracking metrics of multiple vehicle households would be required
Curb Space Leasing	Existing leasing program for vending carts and park concessions may be parallel; Chicago privatization of street parking spaces.	Not currently utilized; NYC CitiBike system granted exclusive curb space use under contract	Auction type market for curb space would need to be established
Weight-Based Fee (truck/freight movement)	NYS has existing weight distance fee via Highway Use Tax; also used in Kentucky, New Mexico and Oregon	Places additional charges based on location of shipment in Downstate 10	Rate for existing system; evasion needs to be monitored and managed
Shipment-Based Fee (box fee on package delivery boxes)	Existing taxes on shipments – such as import and excise taxes; no known direct local delivery box taxes in place	None	Need to determine taxable items and method of collection; allowing holdback of some revenue to shippers would reduce administrative costs and speed implementation

FORECASTS OF REVENUES AND COSTS BY FIVE YEAR PERIOD

Figure 7.13 illustrates that projected resources and costs are balanced through at least 2028. This provides sufficient time for NYMTC members to deliberate strategies to address any potential funding gaps that may materialize during the 2028-2032 plan period.

FIGURE 7.13: PLAN 2045 COSTS & RESOURCES BY FIVE-YEAR ANALYSIS PERIOD
(IN MILLIONS OF YOE DOLLARS)



6. STRATEGIES FOR ENSURING THE AVAILABILITY OF ADDITIONAL FINANCING STRATEGIES

The strategic basis for the additional funding sources is found in Plan 2045's Shared Vision and strategic framework. Specifically, Plan 2045's shared goals include the following:

> *Build the case for obtaining resources to implement regional investments. NYMTC's members and the region's other elected officials must think regionally about transportation needs, solutions, strategies, and investment priorities. In developing a shared regional vision, NYMTC's members support the position that these invest-ments are a shared priority, and are of strategic importance to this region and to the nation.*

One of the desired outcomes stated for this strategic goal is that NYMTC will continue to work in a collaborative fashion with member organizations to increase the use of alternative methods of financing transportation investments – as necessary - to supplement existing sources of revenues. Thus, Plan 2045's exploration of additional funding opportunities is drawn from within its strategic planning framework. Evidence of the current implementation of several of these additional funding sources can be found in the fiscally-constrained components of the planning process - the TIP and the constrained element of Plan 2045 - which demonstrate that NYMTC and its members are already using some of these sources to advance System Enhancement projects (See Figure 7.12 above).

ENDNOTES

[1] FHWA and FTA. February 14, 2007. **Statewide Transportation Planning: Metropolitan Transportation Planning: Final Rule**. https://www.gpo.gov/fdsys/pkg/FR-2007-02-14/pdf/07-493.pdf

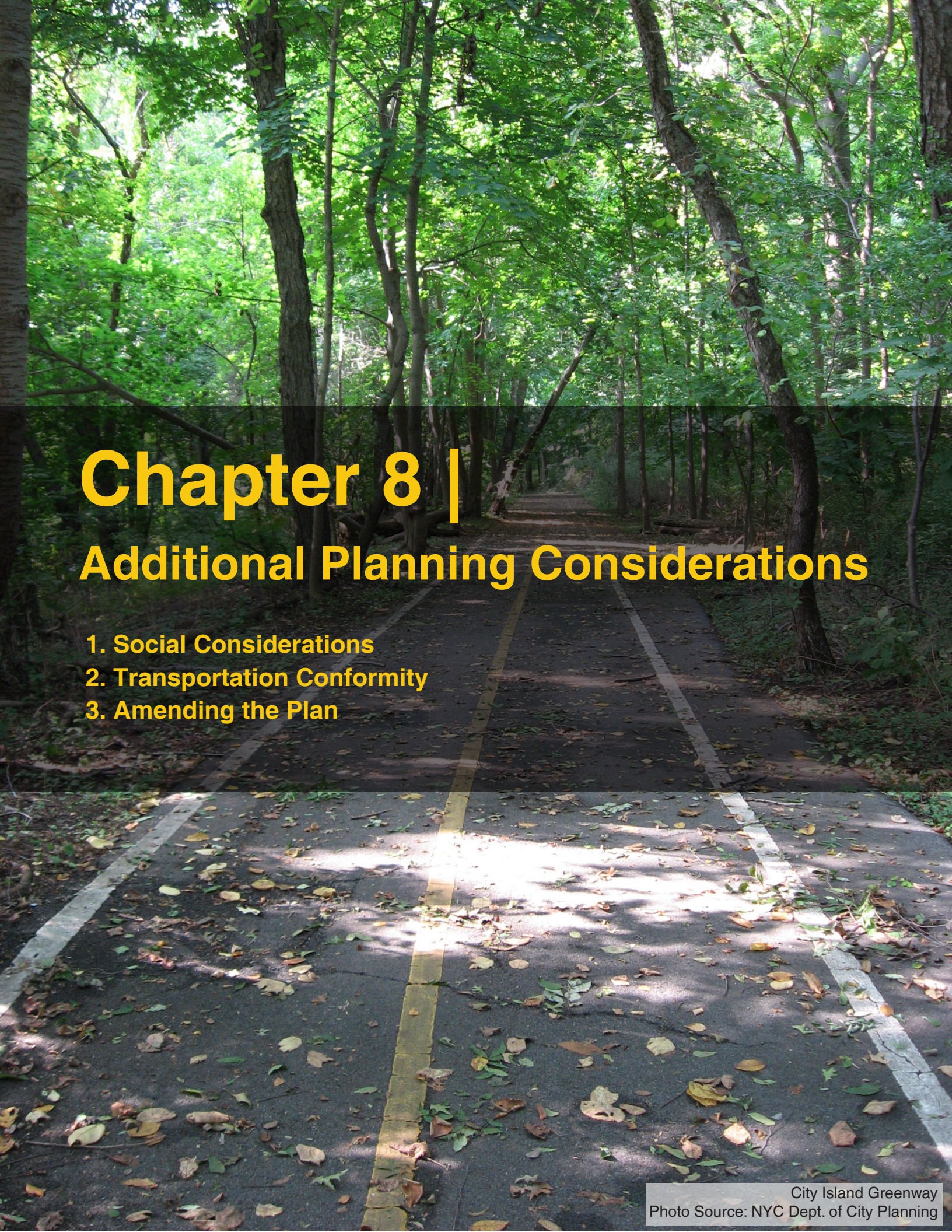
[2] Federal Highway Administration. 2016. **Fiscal Constraint Definitions**. http://www.fhwa.dot.gov/planning/fcdef62805.htm.

[3] These components are identified in Plan 2045 Appendix 10: Financial Plan.

[4] USDOT, Bureau of Transportation Statistics. **National Transportation Statistics**. https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html#chapter_1

[5] New York State Department of Transportation. 2016. **Public Transportation Funding Sources**. https://www.dot.ny.gov/divisions/policy-and-strategy/public-transportation/funding-sources

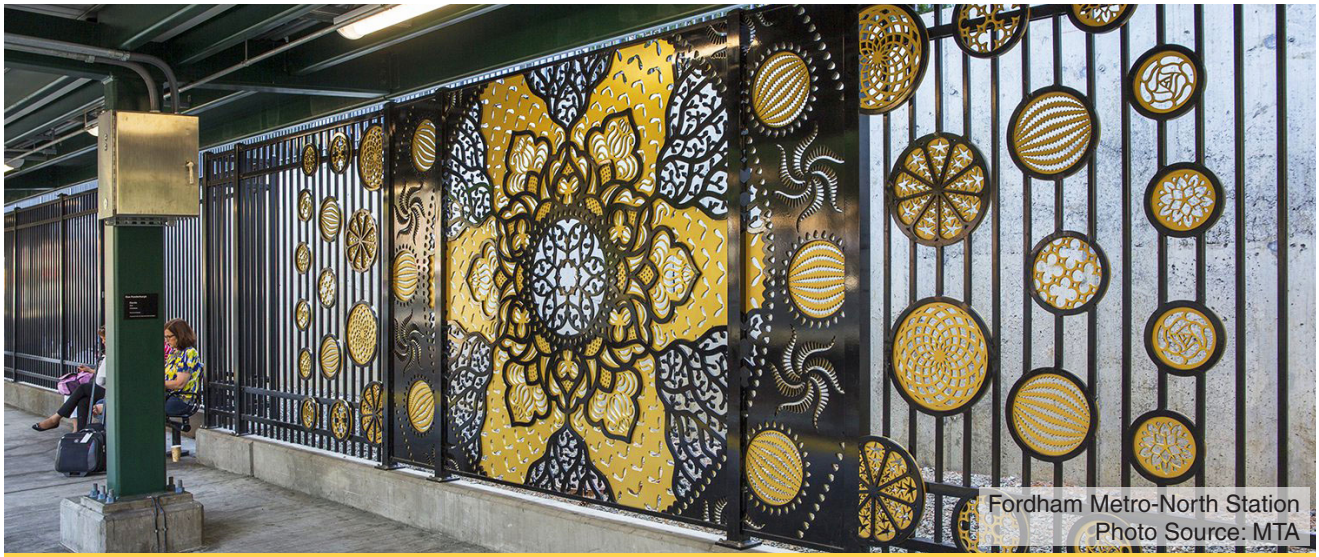
[6] FHWA. 2016. **State P3 Legislation**. http://www.fhwa.dot.gov/ipd/p3/state_legislation/



Chapter 8 |
Additional Planning Considerations

1. Social Considerations
2. Transportation Conformity
3. Amending the Plan

City Island Greenway
Photo Source: NYC Dept. of City Planning



Fordham Metro-North Station
Photo Source: MTA

1. SOCIAL CONSIDERATIONS

Plan 2045 is a product of extensive coordination and collaboration between NYMTC, its member agencies, its partners in the public and private sectors, and the general public, during which these groups worked together to reconcile long-term transportation plans with regional, social and environmental concerns. The environmental justice and environmental mitigation assessments were specifically developed by NYMTC to ensure that the planning process continues to be attentive to the transportation needs of low-income minority communities, and to the potential impacts of transportation projects on natural and historical resources.

TITLE VI & ENVIRONMENTAL JUSTICE

Many federal mandates emphasize environmental justice principles in all aspects of the transportation planning process, including the nondiscrimination policies set forth in Title VI of the Civil Rights Act of 1964 and other directives. Additionally, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires all federal agencies to incorporate environmental justice principles into their policies, activities, and procedures.[1] The order also requires federal agencies to identify and address disproportionately high and adverse health and environmental impacts on minority and low-income populations to the maximum extent practical and as permitted by law. Each federal agency is also directed to develop a strategy for implementing environmental justice principles.

In response to Executive Order 12898, federal agencies set out their own orders to ensure compliance. In April 1997, USDOT issued Order 5610.2, "Environmental Justice in Minority Populations and Low-Income Populations," which established environmental justice guidelines and procedures to be incorporated into USDOT planning, programs, and policies. This order was updated in 2012 as Order 5610.2(a) to clarify certain aspects of the original Order.[2] In 1998, FHWA issued Order 6640.23, which established policies and procedures for agency compliance with Executive Order 12898. This Order was also updated in 2012 as Order 6640.23(a) to provide further guidance on compliance.[3] On August 12, 2012, FTA issued Circular C4703.1 to provide recipients of FTA financial assistance with guidance on incorporating environmental justice principles into plans, projects, and activities that receive funding.

Based on these federal actions and guidance, environmental justice issues that should be considered in the metropolitan transportation planning process, including proper identification of communities; assessment of program benefits; assessment of participation in the development of products and activities (public involvement); and any disproportionate impacts. Nondiscrimination is also an integral part of NYMTC's transportation planning and project development processes. NYMTC and its members work assiduously to ensure that the needs of protected populations are addressed and impacts of activities are assessed from project planning to implementation. NYMTC and its members understand that the transportation needs of specific populations should be considered and that these needs will vary from group to group.

In September 2014, NYMTC adopted its Title VI Program to help meet its obligations in serving protected populations within the planning area and ensuring that the relevant requirements of the metropolitan transportation planning process are being met. Additionally in the same year, the Language Access Operating Procedures were also adopted to fulfill Federal requirements (including Executive Order 13166) concerning persons with Limited English Proficiency (LEP).

PLANNING PROCESS ASSESSMENT

Notwithstanding the above-mentioned programs/procedures, an Environmental Justice & Title VI Assessment was completed as part of Plan 2045 to inform and guide the efforts of NYMTC to ensure that the benefits and burdens of the transportation planning process and the projects, programs and initiatives that result, do not disproportionately affect minority and low-income populations. More detailed analysis and assessment of impacts are conducted by NYMTC's members at the project planning level.
For the purpose of this analysis, the term minority refers to a person's racial or ethnic identity. The USDOT defines minority as a person who is:

1. African American: a person having origins in any of the black racial groups of Africa;
2. Hispanic or Latino: a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race;
3. Asian American: a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent;
4. American Indian and Alaskan Native: a person having origins in any of the original people of North America, South America (including Central America), and who maintains cultural identification through tribal affiliation or community recognition; or
5. Native Hawaiian and Other Pacific Islander: people having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

Similarly, USDOT defines as low-income a person whose median household income is at or below the U. S. Department of Health and Human Services' poverty guidelines. For example, the 2016 Federal Poverty Level for a household of four is an annual income $24,300.

Plan 2045's Environmental Justice and Title VI assessment evaluates trends and identifies geographic locations as Communities of Concern in the NYMTC planning area. The following section briefly outlines its findings. All demographic data were obtained from the 2011-2015 5-year American Community Survey. A complete presentation of data and analysis, and a list of the agencies contributing to the assessment, is available in the Plan 2045 Appendix 4: Environmental Justice and Title VI.

Communities of Concern

In keeping with federal mandates, Communities of Concern were located and identified at the census tract level using two criteria: percentage of minority population,[i] and percent of persons below the poverty level.[ii] Census tracts were designated as a Community of Concern when (1) the percent minority population equaled or exceeded the regional average of 56 percent, and (2) the percent of persons below the poverty level equaled or exceeded the regional average of 16 percent.

Of the 3,081 census tracts within the NYMTC planning area, 31 percent were identified as Communities of Concern. As shown in Table 8.1, New York City has the largest share of Communities of Concern, followed by the Lower Hudson Valley and Long Island, respectively.

Travel Characteristics

Public transportation tends to be more vital to Communities of Concern in the aggregate than to the remainder population of the planning area: within the region's Communities of Concern, 60 percent of workers use public transportation to commute to work, compared to 33 percent of the remainder population. However, the use of public transportation in Communities of Concern varies by sub-region. In New York City, 64 percent, or over 950,000 workers in Communities of Concern use public transportation to commute, whereas only 16 percent or just over 9,300 workers in Long Island Communities of Concern do so, and are more likely to commute by car, truck, or van. Nevertheless, public transportation is an important mode of transportation for Communities of Concern. The percentage of workers that use bicycles, taxicabs, walking, or working from home in Communities of Concern is similar to the percentage of workers in the remainder population.

Travel Time to Work

Among the three subregions of the NYMTC planning area, only New York City exhibited longer commutes for Communities of Concern, on average, than the remainder population. Approximately 72 percent of workers in Communities of Concern commute longer than the national average of 25 minutes, as compared to approximately 64 percent of the remainder population. It is important also to note that since New York City contributes a significant share of the region's total population as well as number of Communities of Concern, New York City workers' longer travel times skew the regional average.

Workers commuting from the Lower Hudson Valley and Long Island, regardless of whether they reside in a Community of Concern, have commute times closer to the national average. In fact, workers in Communities of Concern on Long Island and in the Lower Hudson Valley have slightly shorter commute times than the remainder population: 43 percent and 44 percent of those in Communities of Concern on Long Island and in the Lower Hudson Valley, respectively, commute longer than 30 minutes, compared to 46 percent of Long Island's remainder population and 49 percent of the remainder population in the Lower Hudson Valley.

Linguistic Isolation

The U.S. Census Bureau defines a linguistically isolated household as one in which "no person 14 years old and over speaks only English and no person 14 years old and over who speaks a language other than English speaks English 'very well.'"[4]

Among all of the households within the Communities of Concern, 283,030 (or 20 percent) of households are considered linguistically isolated. Over 260,000 of these households are located in New York City's Communities of Concern. In both the Lower Hudson Valley and Long Island, 19 percent of total households are linguistically isolated.

The data reveals that households in Communities of Concern are between two to five times more likely to be linguistically isolated than other households. Thus, language needs should be taken into account in linguistically isolated Communities of Concern when communicating public engagement efforts and project and service notifications to ensure that these populations have ample access and opportunity to provide public input, and are informed about projects.

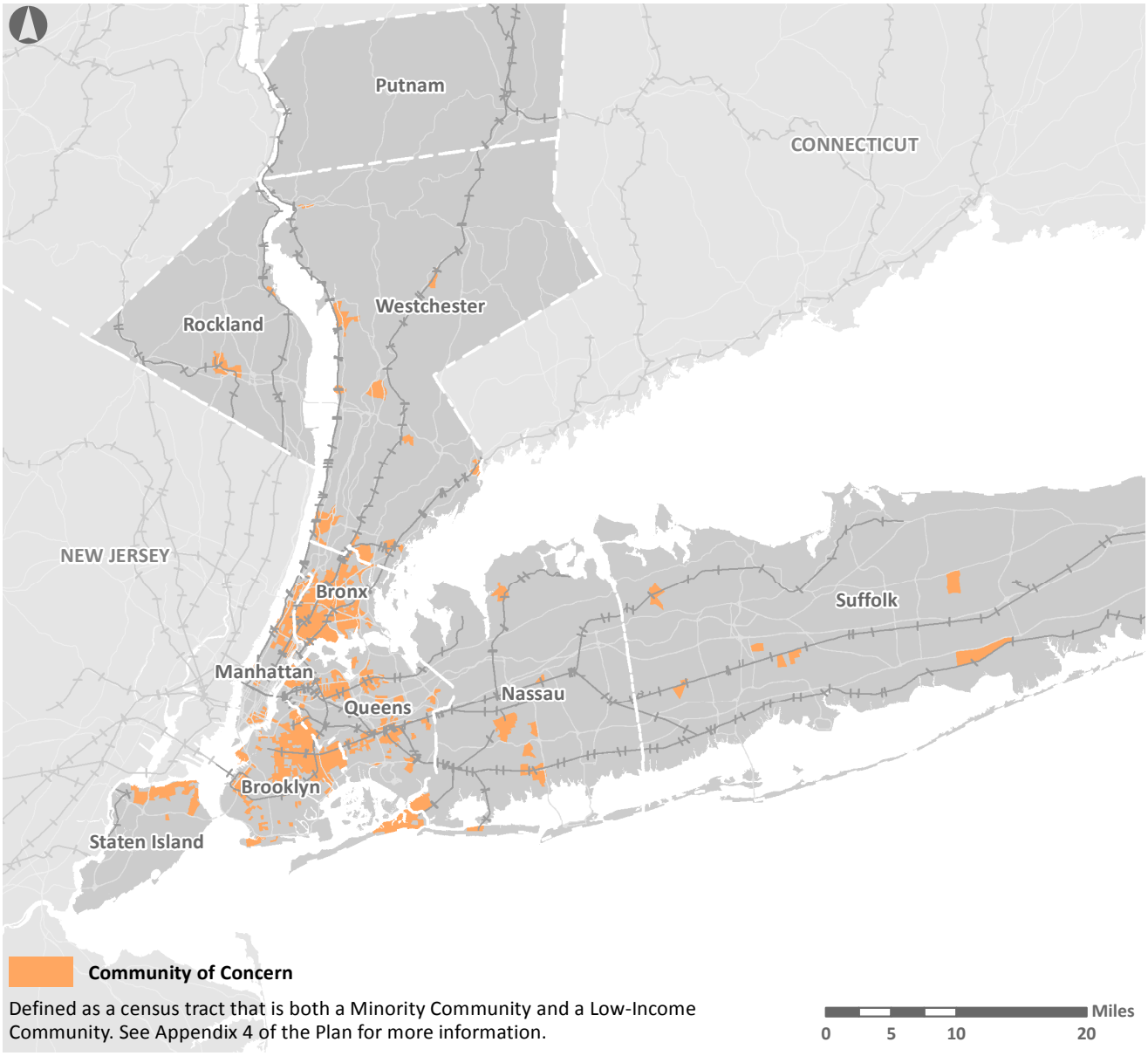
[i] Minority and minority population are defined in Plan 2045's Environmental Justice Assessment, Appendix E.
[ii] Low-income person and low-income population are defined in Plan 2045's Environmental Justice Assessment, Appendix E, along with information on the determination of poverty status.

TABLE 8.1: COMMUNITIES OF CONCERN IN NYMTC REGION

Communities of Concern by Subregion					
Subregion	**Minority Population**	**Percent Minority***	**Population Below Poverty Level**	**Percent Below Poverty Level****	**Communities of Concern**
New York City	5,686,988	67%	1,710,872	21%	900
Lower Hudson Valley	566,377	41%	142,082	10%	45
Long Island	958,986	34%	185,415	7%	28
NYMTC Planning Area	**7,212,351**	**57%**	**2,806,582**	**16%**	**973**

Source: 2011-2015 5-year American Community Survey
** Percent minority is calculated by dividing minority population by total population*
*** Percent below poverty level is determined by dividing population below poverty level and total population for who poverty status is determined (population over age 15, and do not live in group quarters, for example dormitories)*

FIGURE 8.1: COMMUNITIES OF CONCERN IN THE NYMTC REGION



ENVIRONMENTAL CONSERVATION

NYMTC and its members are committed to protecting and enhancing natural resources, promoting energy conservation, improving the quality of life, and promoting compatibility of transportation improvements with state and local planned growth. Therefore, resource conservation and environmental impact mitigation are key elements of NYMTC's transportation planning process. NYMTC worked with its partners and the public to reconcile Plan 2045 with environmental concerns. In keeping with federal requirement, NYMTC was in consultation with federal, state, tribal, wildlife, land management, and regulatory agencies, in addition to state and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation, during the development of Plan 2045.

Compliance with the National Environmental Policy Act (NEPA), the State Environmental Quality Review Act (SEQRA) regulations ensure that NYMTC members are engaged in environmental impact mitigation activities during project planning and implementation processes. These mitigation activities aim to implement projects that are in harmony with the community and preserve the environmental, scenic, aesthetic, historic, and natural resource values of the area in which they are located. In the NYMTC planning area, there are a number of ongoing environmental mitigation activities targeting watersheds, wildlife areas, and eco-systems. Appendix 5 of Plan 2045 presents the data, maps, and research produced through comprehensive regional coordination of environmental regulation and initiatives in the development of the Plan.

Partner Agencies & Process

NYMTC's members have formal and informal relationships with federal, state, and local partner agencies that provide feedback on environmental and other issues related to transportation projects and studies in the planning area. NYMTC formalized Plan 2045's consultation process through various outreach strategies, including one-on-one meetings, letters, teleconferences, and webinars. These consultations produced resource and conservation concerns that may impact future transportation planning efforts in the planning area. A full list of partner agencies can be found in Appendix 5.

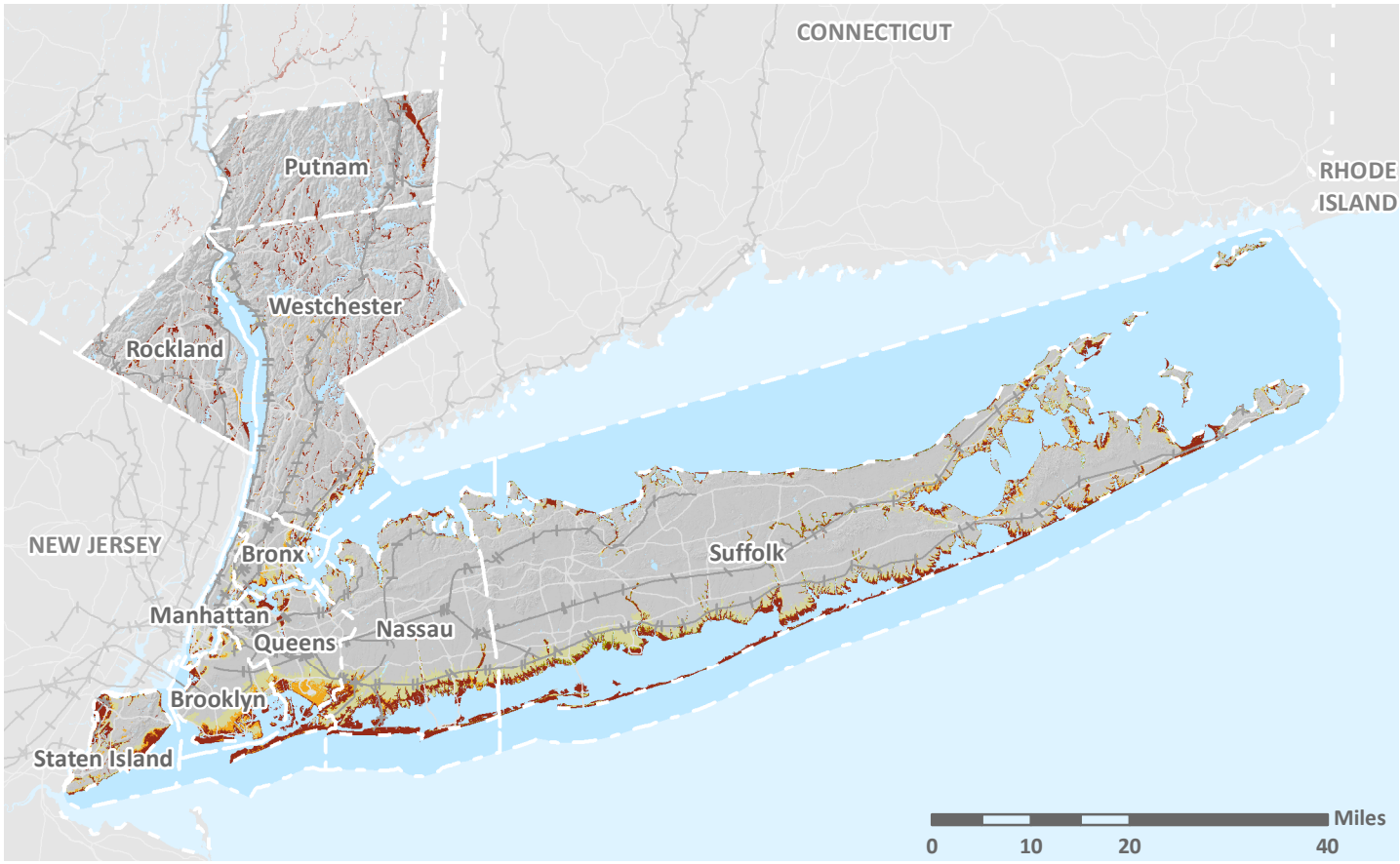
In developing the appendix the process included:

- Identifying partner agencies to consult regarding natural and cultural resources.
- NYMTC compiled a list of agencies in the planning area responsible for land use management, natural resources, environmental protection and conservation, and historic preservation in order to identify the federal, state and local agencies relevant to the long-range transportation plan.
- Identifying agencies' goals, objectives and geographic focus areas.
- Initially, research was conducted through partner agency websites and other online resources that house documents and data related to the agencies' work, such as the New York State GIS Clearinghouse. The agencies were then contacted individually to confirm the accuracy of the data sources. Efforts were made to contact each agency at various points in the production of Plan 2045.
- Reviewing planning documents.
- Partner agencies provided planning documents with agency-wide and program-specific goals and objectives. The goals and objectives from these plans were reviewed and com-pared with the goals of the member agencies. Where this review identified issues not addressed specifically by NYMTC in its shared vision, goals, and individual projects, the issue was researched in coordination with the partner agency and the appropriate NYMTC member agency. The agencies' respective goals and objectives were then taken into consideration in the development of the vision, goals, and objectives in Plan 2045.
- Mapping identified natural and cultural resources.

Maps were created to compare the environmental and historic preservation areas and redevelopment areas to projects included in the Plan. When projects are in proximity to these resources, the NYMTC member agency responsible for the project will review available information and, if needed, undertake further analysis.

Three types of maps were created for each of the three subregions: land-based issue maps, water-based issue maps (for example flood hazard and coastal risk areas, as shown in Figure 8.2 for Long Island), and redevelopment area maps. Land-based issue maps display parks and wildlife areas, historic sites, and government-run facilities. Water-based issue maps show protected water bodies, coastal wildlife habitats, and wetlands. Redevelopment area maps illustrate areas which present opportunities for development and need for future access. These maps can be found in Appendix 5.

FIGURE 8.2: ENVIRONMENTAL CONCERNS IN THE NYMTC PLANNING AREA - FLOOD ZONES



Special Flood Hazard Areas
Areas that will be inundated by the 1 percent annual chance (or 100-year) flood. In these areas, the National Flood Insurance Program's floodplain management regulations must be enforced and purchase of flood insurance is mandatory for federally backed mortgages.

Moderate Flood Hazard Areas
Areas that are between the limits of the 1 percent annual chance (or 100-year) flood and the 0.2 percent annual chance (or 500-year) flood. While these areas may be at a moderate risk of flooding, flood insurance is not mandatory for federally backed mortgages.

Coastal Risk Areas
Extreme Risk Areas: These are areas currently at risk of frequent inundation, vulnerable to erosion in the next 40 years, or likely to be inundated in the future due to sea level rise.

High Risk Areas: These are areas that fall outside of the Extreme Risk Areas and are currently at infrequent risk of inundation or are at risk in the future from sea level rise.

Moderate Risk Areas: These are areas that fall outside of the Extreme and High Risk Areas, but are currently at moderate risk of inundation from infrequent events or are at risk in the future from sea level rise.

Source: FEMA Map Service Center, accessed June 2015, using the most up-to-date flood zone data available for each county.
National Flood Hazard Layer (NFHL), effective 06/02/2015; Rockland County FEMA Advisory Base Flood Elevations, effective 06/21/2013;
Westchester County Preliminary Flood Insurance Rate Map (PFIRM), generated 12/08/2014;
New York City Preliminary Flood Insurance Rate Map (PFIRM), generated 01/30/2015;
Coastal Risk Ares (NYS Dept. of State), published 08/04/2014

2. TRANSPORTATION CONFORMITY

The U.S. Environmental Protection Agency (USEPA), through the Clean Air Act Amendments of 1990, established National Ambient Air Quality Standards (NAAQS) for various pollutants. Areas where air quality monitoring show a violation of the NAAQS are designated as non-attainment areas and are subject to a provision in the Clean Air Act's §176(c) known as transportation conformity. The New York State Department of Environmental Conservation (NYSDEC) produces a State Implementation Plan that details how the NAAQS will be achieved for each of the State's non-attainment areas.

The intent of transportation conformity is to fully coordinate transportation and air quality planning to ensure that the Plan and TIP, and their constituent transportation projects will not:

1. Cause or contribute to any new violation of the NAAQS,
2. Increase the frequency or severity of any existing NAAQS violations, or
3. Delay timely attainment of the NAAQS or any required interim emissions reductions or other milestones in any area.

For transportation conformity, the overall set of investments contained in the Plan and TIP must not result in forecasted mobile source emissions that exceed emissions milestones defined in the State Implementation Plan. Therefore, NYMTC must consider the air quality impacts of its transportation investments. A Transportation Conformity Determination addresses all non-attainment or maintenance areas that fall in whole or in part within the NYMTC planning area, including such areas defined for Nitrogen Oxide (NOx), Volatile Organic Compounds (VOC), carbon monoxide (CO) and fine particulate matter (PM2.5) at the 2.5 micron level or smaller.

This transportation conformity determination (conformity determination) addresses all non-attainment and maintenance areas that fall in whole or in part within the NYMTC Planning Area Boundary. These include the following:

- The New York Metropolitan Eight-Hour Ozone Moderate Non-Attainment Area consisting of all NYMTC counties except Putnam County.[iii]
- The New York-New Jersey-Connecticut Annual and 24-Hour Fine Particulate Matter Maintenance (PM 2.5) Area includes all NYMTC counties except Putnam. It also includes within New York State Orange County and all or portions of eight other MPO boundaries across the tri-state area. Coordination with the Orange County Transportation Council (OCTC) is done as part of each conformity determination. Details are shown in the analysis by pollutant section and Appendix 3.

[iii] Putnam County, although in the NYMTC Planning Area Boundary, was a part of the Poughkeepsie Moderate 8-Hour Ozone Non-Attainment Area (PONA). Under the 1997 NAAQS as of July 20, 2013 this area is in attainment for the 2008 ozone standard and is no longer required to demonstrate transportation conformity under the 1997 NAAQS. This non-attainment area includes Putnam, Orange and Dutchess counties.

To determine the impact of its Plan and TIP, NYMTC uses the third generation of travel demand models, which are commonly referred to as activity-based models. Known as the NYBPM, this model uses journeys (travel between two primary locations, including stops) as a unit of travel rather than using only home-to-work trips. NYBPM looks at the daily activity agenda of each household member, intra-household interactions, and other spatial and temporal constraints that af-fect travel choices. To do this, NYBPM encodes the characteristics of the transportation system and planned improvements using spatially-accurate digital mapping. NYBPM then uses sixteen categories of forecasted SED data to simulate travel demand.

Air quality impacts will continue to be considered in the regional transportation planning process and in achieving the goals and outcomes of Plan 2045. Many of the projects, policies, and pro-grams that are included in Plan 2045 and the TIP result in air quality benefits through improved efficiency of the regional transportation system.

3. AMENDING THE PLAN

As a living document, Plan 2045 needs to be adjusted as implementation occurs. Among the actions that are likely to be taken during life of this Plan are: addition of projects, policies and investment options; revision of existing actions and investments; changes in the status of actions and investments within the Plan; changes in the financial analysis underlying the Plan; and changes due to new or updated federal legislation or regulation. In amending Plan 2045, fiscal constraint and transportation conformity impact will be fully considered.

ENDNOTES

[1] Full text of Federal Executive Order 12898 can be found in Plan 2045's Environmental Justice Assessment, Appendix B.
[2] Full text of USDOT Order 5610.2(a) can be found in Plan 2045's Environmental Justice Assessment, Appendix C.
[3] Full text of FHWA Order 6640.23(a) can be found in Plan 2045's Environmental Justice Assessment, Appendix D. See also http://www.fhwa.dot.gov/legsregs/directives/orders/6640_23.htm
[4] U.S. Census Bureau. **Census 2000, Definition of Subject Characteristics**. http://www.census.gov/population/cen2000/ phc-2-a-B.pdf