TECHNICAL MEMO

NYMTC Regional Freight Plan Update 2015-2040 Interim Plan

Task 2.1.1, Part 2
Truck Trips Analysis Summary

NYMTC
NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

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technical memorandum

Task 2.1.1 Technical Memorandum, Part 2

Truck Trips Analysis Summary

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

The Commodity Flow Analysis, prepared as Task 2.2 of the NYMTC Regional Freight Plan Update 2015-2040 Interim Plan, presents a regional-level summary of the moves of goods into, out of, through, and within the NYMTC Region, and an overview of which routes the population of commodity trucks use in the region. A logical extension of that analysis calls for the examination of the unique travel patterns and transportation system challenges facing several key factions of truck trips, including: through trips; terminal and warehouse access trips; distribution and interplant trips; urban freight and local delivery trips; local trips; and access to construction trips. Within each faction, the number of trucks, share of all truck moves represented, routes used specifically by trucks performing these duties, and highway network challenges, based upon the findings of the Highway Network Analysis (Task 2.1.1 of the NYMTC Regional Freight Plan Update 2015-2040 Interim Plan) are explored. The result of this effort is the identification of key highway network assets that support each truck trip type and an assessment of the physical and operational condition of the network components that serve each truck trip type.

1.1 ORGANIZATION

The organization of this technical memorandum is as follows:

- Section 2.0 describes the six key truck trip types, the trucks that compose each type, the volume of trucks and routes used, and observations regarding key challenges and opportunities. The six trip types are:
    - Through trips (Section 2.1);
    - Terminal and warehouse access trips (Section 2.2);
    - Distribution and interplant trips (Section 2.3);
    - Urban freight and local delivery trips (Section 2.4);
    - Local trips (Section 2.5); and
    - Access to construction trips (Section 2.6).
- Section 3.0, Next Steps and Further Research, describes how the findings of this analysis will support subsequent tasks in the Regional Freight Plan Update and potential data collection efforts to improve the region's understanding of non-commodity truck trips.

1.2 DATA AND INFORMATION SOURCES

Truck trip tables for the truck trip types presented in Sections 2.1 through 2.5 were developed by querying the enhanced TRANSEARCH database, which was developed, analyzed, and adjusted as part of the Task 2.2 Commodity Flow Analysis. The query criteria for each trip table are described in Sections 2.1 through 2.5, respectively. The truck trip tables were assigned to the NYMTC Best Practices Model (BPM) to develop routing maps. The access to construction truck trips were estimated using construction permit data available from the U.S. Census Bureau, truck trip generation rates from published environmental review documents, and input from private-sector construction industry professionals. The methodology used for estimating construction trips is presented in Section 2.6.

2.0 Truck Trip Purposes and Behaviors

The volume, composition, and travel behaviors of six truck trip types are examined in this section. Five of the truck trip types—through trips, terminal and warehouse access trips, distribution and interplant trips, urban freight and local delivery trips, and local trips—consist primarily of commodity trucks. Estimation of the volume, commodities, origins and destinations are based upon data available in the enhanced TRANSEARCH database. The sixth truck trip type, access to construction trips, includes some commodity trucks, but consists largely of non-commodity trucks.

Table 2.1 summarizes the number of annual truck trips in each category, and all commodity truck trips. It is important to note that some truck trips can be considered part of more than one truck trip type. For example, a truck traveling from Union County, New Jersey to New York Container Terminal in Richmond County, New York is a terminal and warehouse access trip, because it is an inbound trip to a terminal in the NYMTC region, and it is a local trip because it is traveling between two neighboring counties. For this reason, each truck trip type is compared individually to the total commodity truck trips observed in the region. Adding truck trip type subtotals together would result in a double-counting of many truck trips.

Table 2.1: Annual Truck Trips by Type, 2007

Truck Trip Type	Annual Truck Trips
Through	5,210,383
Terminal and Warehouse Access	5,322,301
Distribution and Interplant	5,770,202
Urban Freight and Local Delivery	8,270,666
Local	1,319,832
All Commodity Truck Trips	30,214,674[1]

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

[1] "All Commodity Truck Trips" is not the sum of the other specified truck trip types. Because the truck trip types overlap, some truck trips would double-counted if the annual trips for each trip type were summed.

2.1 THROUGH TRIPS

Through trips consist of trucks traveling between origins and destinations outside the NYMTC region, which use highways in the region during their journey. More than 5 million through trips moved on highways in the region in 2007, accounting for about 17 percent of all commodity truck trips in the region. Top commodities moving through the region by truck include chemicals (20 percent), secondary traffic moving from warehouses and distribution centers (15 percent), nonmetallic minerals (11 percent), food (9 percent), and clay/concrete/glass/stone (7 percent). About 14 percent of all through truck trips are traveling from the South Atlantic states (Delaware, Florida, and coastal states between the two) to Massachusetts or vice-versa, as shown in Table 2.2. All of the top ten origin-destination pairs for through truck trips require a crossing of the Hudson River.

Table 2.2: Top Origin-Destination Pairs for Through Trips, 2007

Origin	Destination	Annual Truck Trips
South Atlantic	Massachusetts	550,322
Northern New England	Northern New Jersey	353,727
Northern New Jersey	Connecticut	327,563
South Atlantic	Northern New England	266,551
Northern New Jersey	Northern New England	260,434
Northern New Jersey	Massachusetts	250,734
Upstate New York	Connecticut	215,429
Massachusetts	South Atlantic	162,322
Pennsylvania	Massachusetts	161,716
Northern New Jersey	Rhode Island	136,959
All Other Origin-Destination Pairs		2,524,626

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

As Figure 2.1 shows, through trips are found almost exclusively on interstate highways, and, in particular, those that provide access to the George Washington Bridge and Tappan Zee Bridge. Those two crossings of the Hudson River carry the highest volume of through truck trips in the region. Interstate 95 (including the Trans Manhattan Expressway, Cross Bronx Expressway, and New England Thruway) in New York, Bronx, and Westchester counties; interstates 87 and 287 in Rockland and Westchester counties; and interstates 684 and 84 in Putnam and Westchester counties are the chief routes for through trucks in the region. Each of these routes carry more than 3,000 through truck trips per day.

Key challenges to the successful accommodation of through truck traffic include congestion, pavement and bridge condition, and safety considerations. According to data presented in the Task 2.1.1 Technical Memorandum titled, "Highway Network and Infrastructure," the routes through trucks use to traverse the NYMTC region are among the most congested highways in the

region. The Interstate 95 corridor between the Alexander Hamilton Bridge and the New England Thruway, in particular, is the most congested highway corridor in the United States.[2] This corridor also has a pavement condition rating of "fair" and contains three structurally-deficient bridges.[3] Four fatal truck-involved crashes occurred on this highway segment between 2007 and 2011.[4] Though traffic congestion is not a significant problem on the Interstate 684 corridor, it contains several segments of fair and poor pavement in Westchester and Putnam counties and two structurally-deficient bridges in Westchester County.[5] The Interstate 87/287 corridor between Suffern in Rockland County and Rye in Westchester County experiences congestion in the vicinity of the Tappan Zee Bridge. Pavement is "fair" only on the Tappan Zee Bridge itself, and "good" or "very good" elsewhere.[6] Five structurally-deficient bridges exist in this corridor (four in Rockland County and one in Westchester County)[7], and three fatal truck-involved crashes occurred along the corridor between 2007 and 2011.[8]

[2] "2013 Traffic Scorecard," INRIX, Inc., 2014, available from: http://scorecard.inrix.com/scorecard/worstcorridors.asp.

[3] NYSDOT Pavement Database, 2012; Federal Highway Administration (FHWA), "National Bridge Inventory," 2012.

[4] National Highway Traffic Safety Administration (NHTSA), 2012.

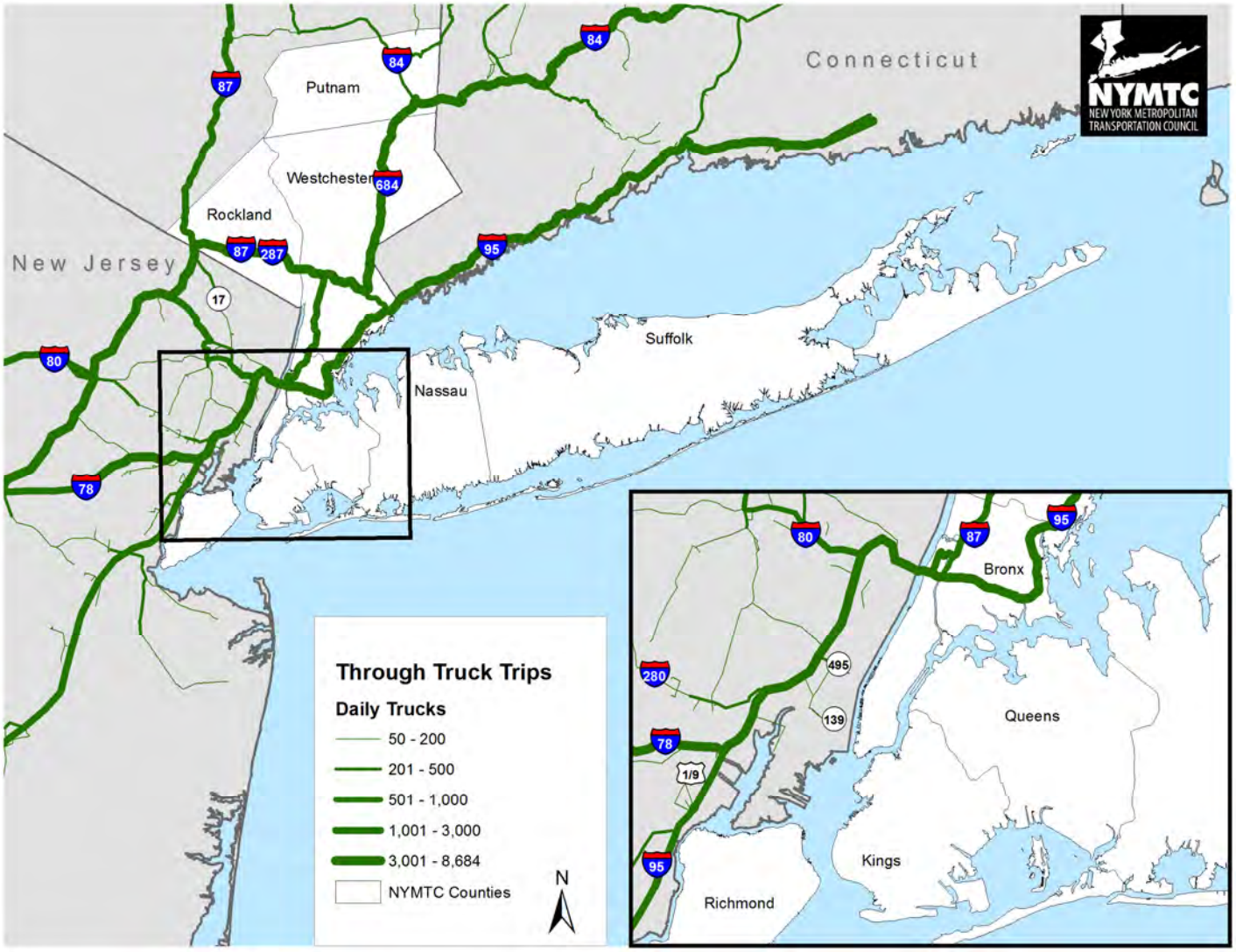
[5] NYSDOT; FHWA.

[6] NYSDOT.

[7] FHWA.

[8] NHTSA

Figure 2.1 Through Trips on Highways in the NYMTC Region



Source: IHS Global Insight TRANSEARCH Database; NYMTC Best Practices Model; Cambridge Systematics analysis.

2.2 TERMINAL AND WAREHOUSE ACCESS TRIPS

Terminal and warehouse access trips consist of trucks moving from origins outside the ten-county NYMTC region, which are destined for marine, rail, or air cargo terminals or warehousing or distribution center facilities in the region. TRANSEARCH contains a commodity code which represents movement of freight from marine, rail, and air terminals and from warehouses and distribution centers, but estimating the volume of traffic moving into those facilities from outside the region requires extra data and analysis. According to the truck origin-destination survey that was completed in 2009 on Hudson River crossings owned and operated by the Port Authority of New York and New Jersey, about 63 percent of trucks crossing the George Washington Bridge in the eastbound (inbound) direction were destined for a port, railyard, truck terminal, yard (general), warehouse, or airport. For the purpose of this analysis, 63 percent of all inbound truck trips identified in TRANSEARCH were assumed to be traveling to these types of facilities in the region.

Approximately 4.3 million truck trips traveled into the NYMTC region, destined for terminals or warehousing and distribution facilities. This represents about 17 percent of all commodity truck trips in the region. About 25 percent of the inbound trucks are carrying secondary traffic, which is freight moving from a warehouse, distribution center, or terminal. Secondary traffic could consist of some commodity-specified freight, such as food, apparel, and other consumer goods. About 18 percent are hauling nonmetallic minerals, 11 percent are carrying food, 7 percent are moving clay/concrete/glass/stone, and 6 percent are moving chemicals.

As shown in Table 2.3, 57 percent of the inbound terminal and warehouse access trips originate in Northern New Jersey, Pennsylvania, or Upstate New York. Other key origins include the South Atlantic states, Pacific states (California, Alaska, Oregon, and Washington), Connecticut, and the East North Central states (Ohio, Indiana, Michigan, Illinois, and Wisconsin).

Table 2.3: Top Origins of Inbound Terminal and Warehouse Access Trips, 2007

Origin	Annual Truck Trips
Northern New Jersey	951,371
Pennsylvania	835,353
Upstate New York	654,352
South Atlantic	360,526
Pacific	246,901
Connecticut	242,594
East North Central	200,287
West South Central	133,444
Massachusetts	114,357
Northern New England	107,645
All Other Regions	502,245

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

The most heavily-used route for inbound terminal truck trips is the corridor defined by interstates 80 and 95 in New Jersey, the George Washington Bridge, Cross Bronx Expressway, and Interstate 295 (Throgs Neck Bridge and Clearview Expressway). More than 7,700 trucks per day access the region using this route, as Figure 2.2 illustrates. In Bronx County, about 1,800 of trucks divert off of this access route to connect to Interstate 87 southbound to Interstate 278 in order to reach New York County and western Queens and northern Kings counties. More than 1,400 trucks per day use Interstate 678 in northern and central Queens. About 400 continue to the vicinity of JFK International Airport. About 3,000 trucks connect to Interstate 495 in Queens County to reach locations in Nassau and Suffolk counties.

Other access routes for inbound terminal truck trips include the Interstate 84/Interstate 684 corridor, by which 2,600 trucks enter the region; Interstate 278 (Goethals Bridge and Staten Island Expressway), which 2,300 trucks use to enter the region daily; Interstate 95, where 2,000 trucks enter the region from Connecticut and points north and east; and Interstate 87 (New York State Thruway), which carries 1,300 inbound trucks destined for terminals in the region.

Key challenges to the successful service of inbound terminal and warehouse access truck trips along the major corridors that carry these types of trucks include congestion, pavement and bridge condition, and safety issues. Interstate 95 in New York, Bronx, and Westchester counties; Interstate 278 in Richmond, Kings, and Queens counties; Interstate 678 in Queens County; and Interstate 495 in Queens and Nassau counties are the most congested of the major highway corridors serving inbound terminal and warehouse access trucks. Pavement conditions are "fair" or "poor" on sections of Interstate 95, Interstate 278, Interstate 295, Interstate 495, Interstate 678, and Interstate 684.[9] Of the 46

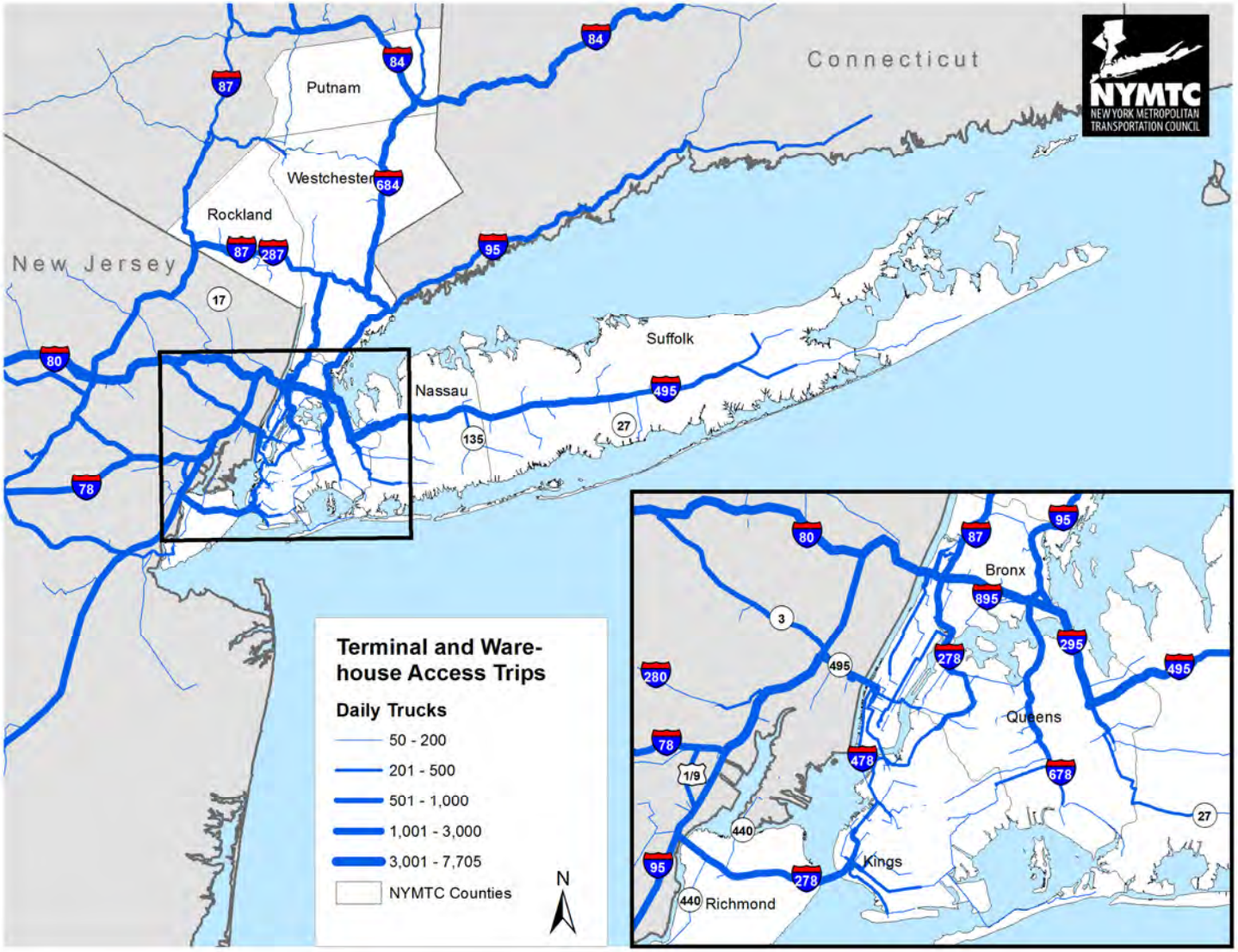
[9] NYSDOT.

structurally-deficient bridges listed in Table 2.4 of the "Highway Network and Infrastructure" technical memorandum, 36 are located on the major terminal and warehouse access trip corridors.[10] Twenty-six fatal truck-involved crashes occurred on the same group of highway corridors between 2007 and 2011.[11]

[10] FHWA.

[11] NHTSA.

Figure 2.2 Terminal and Warehouse Access Trips on Highways in the NYMTC Region



Source: IHS Global Insight TRANSEARCH Database; NYMTC Best Practices Model; Cambridge Systematics analysis.

2.3 DISTRIBUTION AND INTERPLANT TRIPS

Distribution and interplant trips consist of truck trips between points in the NYMTC region and points elsewhere in the three-state metropolitan region, including Orange and Dutchess counties in New York; Fairfield, Litchfield, and New Haven counties in Connecticut, and 13 counties in northern New Jersey. Distribution and interplant trips accounted for nearly 5.8 million truck trips, or 19 percent of all commodity truck trips in the region, in 2007. About 34 percent of distribution and interplant trips carried secondary freight from warehouses, distribution centers, or intermodal freight terminals. Other top commodities being moved within the metropolitan region include nonmetallic minerals (31 percent of truck trips in this category), clay/concrete/glass/stone (11 percent), and food (5 percent).

As Figure 2.3 shows, about 60 percent of distribution and interplant trips moved within the ten NYMTC counties, 28 percent were inbound trips originating in parts of the metropolitan region outside the ten-county NYMTC region, seven percent were outbound trips originating in the NYMTC region and destined for other parts of the metropolitan region, and six percent traveled through the NYMTC counties between origins and destinations in other parts of the metropolitan region.

As shown in Table 2.4, the top ten origin-destination pairs account for 23 percent of all distribution and interplant truck trips in the region. Trips within Suffolk County alone account for about 5 percent of moves of this truck trip type.

Figure 2.3 Direction of Movement, Relative to the NYMTC Region, for Distribution and Interplant Trips in the Three-State Metropolitan Region

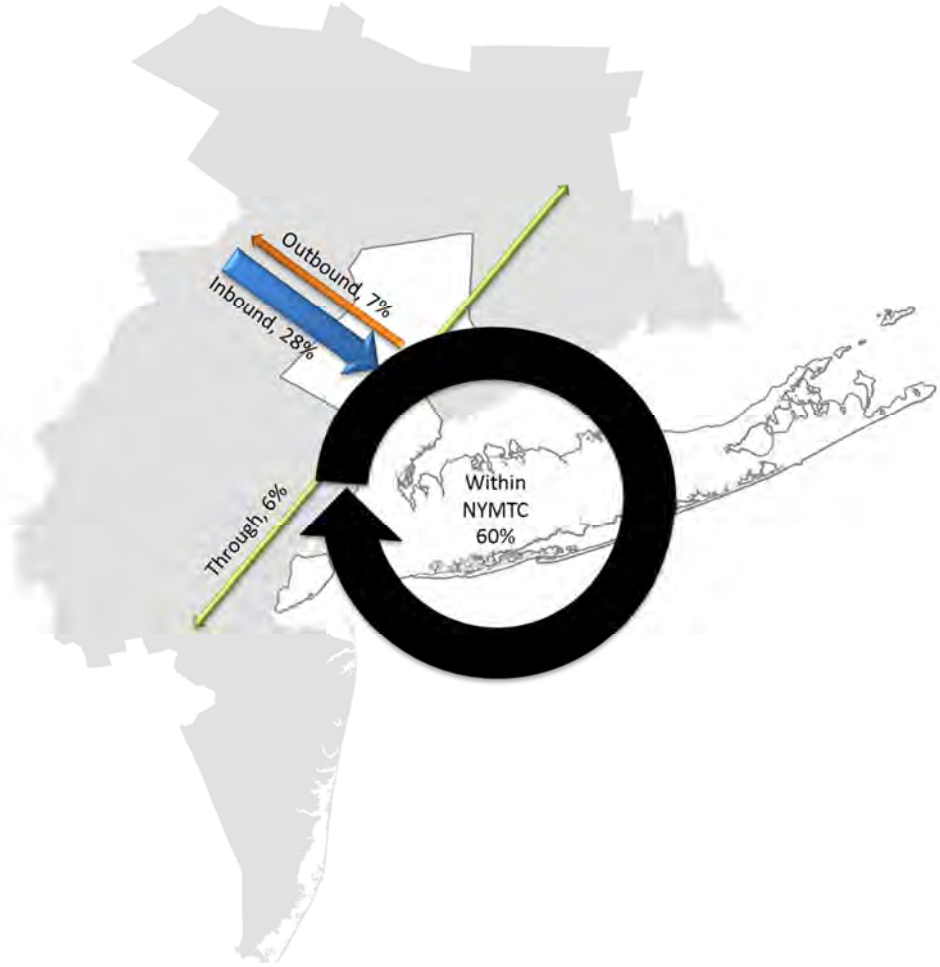


Table 2.4: Top Origin-Destination Pairs for Distribution and Interplant Trips, 2007

Origin	Destination	Annual Truck Trips
Suffolk County	Suffolk County	270,837
Nassau County	Queens County	147,484
Suffolk County	Queens County	132,890
Morris County, NJ	Queens County	128,288
Kings County	Queens County	118,272
Kings County	Kings County	116,643
Rockland County	Westchester County	114,865
Dutchess County	New Haven County, CT	113,917
Essex County, NJ	Kings County	103,235
New York County	New York County	93,041
All Other Origin-Destination Pairs		4,430,730

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

The George Washington Bridge, Goethals Bridge, and the Interstate 84/Interstate 684 corridor are the primary gateways into and out of the NYMTC counties for freight traveling to or from other parts of the larger metropolitan region, as Figure 2.4 illustrates. About 3,700 distribution and interplant trips cross the George Washington Bridge daily. About 1,200 trucks cross the Goethals Bridge, and 1,000 trucks enter or exit the NYMTC region via Interstate 84 in Putnam County. Other major highway corridors used for regional distribution and interplant trips include: Interstate 495, where 4,200 distribution and interplant trucks cross the border between Queens and Nassau counties; Interstate 295, where 3,500 distribution and interplant trucks cross the Throgs Neck Bridge daily; Interstate 95 (Cross Bronx Expressway) in Bronx County, where 2,600 trucks travel daily; Interstate 678, where nearly 2,000 trucks cross the Bronx-Whitestone Bridge each day; the Interstate 87/Interstate 287 corridor, where 1,800 trucks cross the Tappan Zee Bridge daily; and Interstate 95 (New England Thruway) in Bronx and Westchester counties, where 1,800 trucks travel each day.

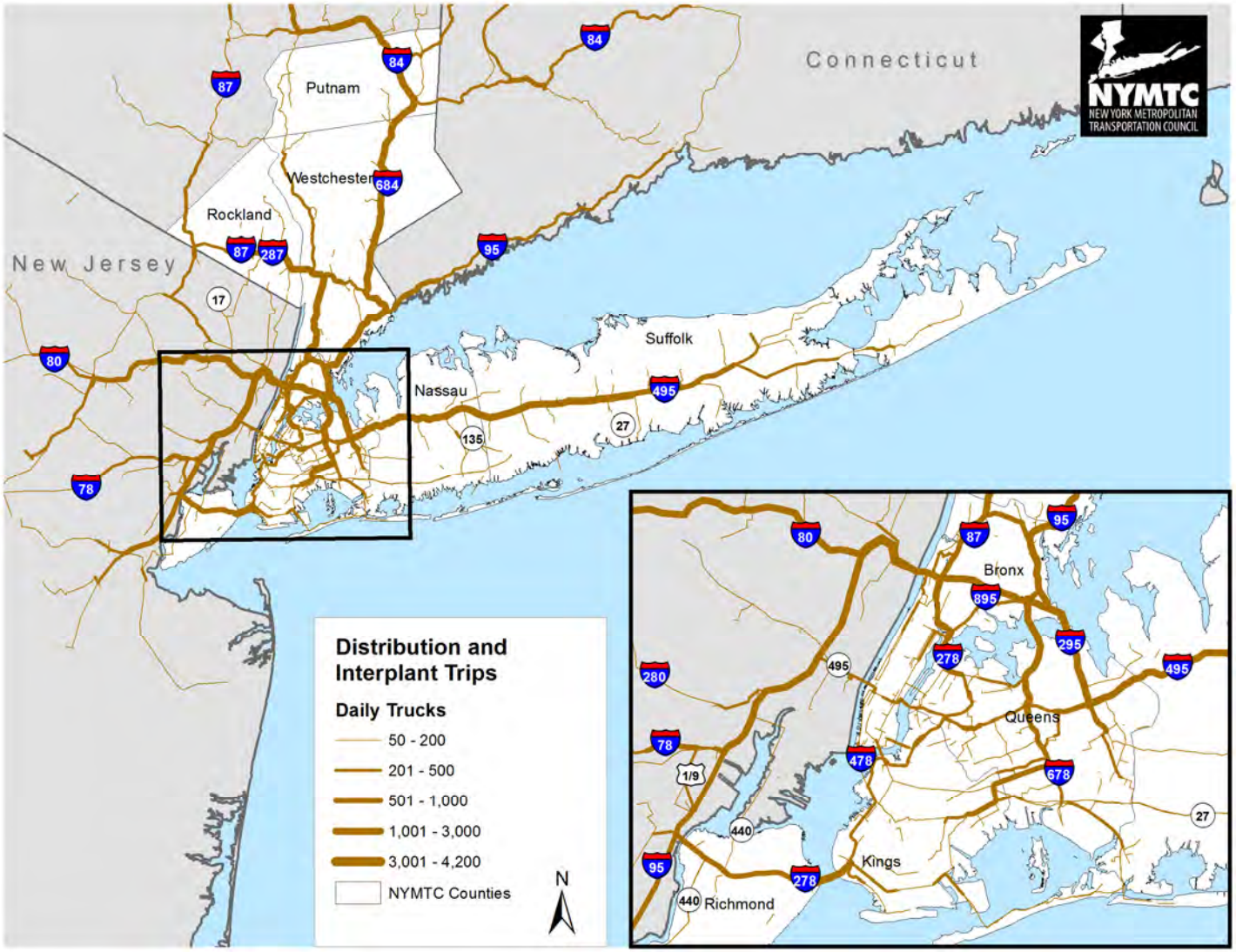
Among these corridors, traffic congestion is especially problematic along Interstates: 95 in New York, Bronx and Westchester counties; 87/287 in Rockland and Westchester counties; 278 in Richmond, Kings, and Queens counties; 495 in Queens and Nassau counties; and 678 in Queens County. Pavement conditions are "fair" or "poor" on sections of Interstate 95, Interstate 278, Interstate 295, Interstate 495, Interstate 678, and Interstate 684.[12] There are 19 bridges along these corridors that are structurally-deficient.[13] Twenty-three fatal truck-involved crashes occurred on the same group of highway corridors between 2007 and 2011.[14]

[12] NYSDOT.

[13] FHWA.

[14] NHTSA.

Figure 2.4 Distribution and Interplant Trips on Highways in the NYMTC Region



Source: IHS Global Insight TRANSEARCH Database; NYMTC Best Practices Model; Cambridge Systematics analysis.

2.4 URBAN FREIGHT AND LOCAL DELIVERY TRIPS

Urban freight and local delivery trips consist of truck trips transporting freight from warehouses, distribution centers, and intermodal terminals in the NYMTC region to receivers in the NYMTC region. The commodities included in this group include secondary traffic and containers. Urban freight and local delivery trips generated 8.3 million truck trips in 2007, or 27 percent of all commodity truck trips in the NYMTC region. About 82 percent of the urban freight moves consisted of containers, and 18 percent carried secondary freight.

The top ten origin-destination pairs account for about 43 percent of all urban freight and local delivery trips in the region, as shown in Table 2.5. About 36 percent of trucks performing urban delivery trips originate in Kings County. Kings and New York counties alone are the origin for more than half (52 percent) of these moves. Kings County is the top destination for urban delivery trips (19 percent). Kings, Bronx, and Suffolk counties together receive 50 percent of urban freight and local delivery trucks.

Table 2.5: Top Origin-Destination Pairs for Urban Freight and Local Delivery Trips, 2007

Origin	Destination	Annual Truck Trips
Kings County	Bronx County	726,206
Kings County	Kings County	696,595
Kings County	New York County	336,584
Kings County	Queens County	305,411
Kings County	Suffolk County	302,568
Suffolk County	Suffolk County	274,530
New York County	Kings County	247,328
New York County	Bronx County	245,889
Kings County	Nassau County	240,231
Queens County	Kings County	221,502
All Other Origin-Destination Pairs		4,673.823

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

The greatest volumes of urban freight and local delivery trips are found on the region's interstate highways, as shown in Figure 2.5. Interstate 495 carries the greatest number of trucks performing this trip type, and approximately 3,000 trucks in travel on this highway in eastern Queens County and western Nassau County daily. Other major routes for urban freight and local delivery trips include: Interstate 678 (Whitestone Expressway and Van Wyck Expressway), which carries 2,400 to 2,800 daily urban freight trucks; Interstate 278 (Brooklyn-Queens Expressway) in northern Kings County, which carries 2,100 urban freight and local delivery trucks per day; Interstate 87 in Bronx and Westchester Counties, Interstate 295 in Bronx and Queens counties, and Interstate 95 in Bronx County, all carry more than 1,000 urban freight and local delivery trucks daily.

Off of the interstate highway network, portions of Atlantic Avenue in Kings and Queens counties carries 2,500 daily urban freight and local delivery trucks, Linden Boulevard in Kings and Queens counties and the Conduit Avenue and Nassau Expressway corridor in Queens County carry 2,200 and 1,100 daily trucks, respectively.

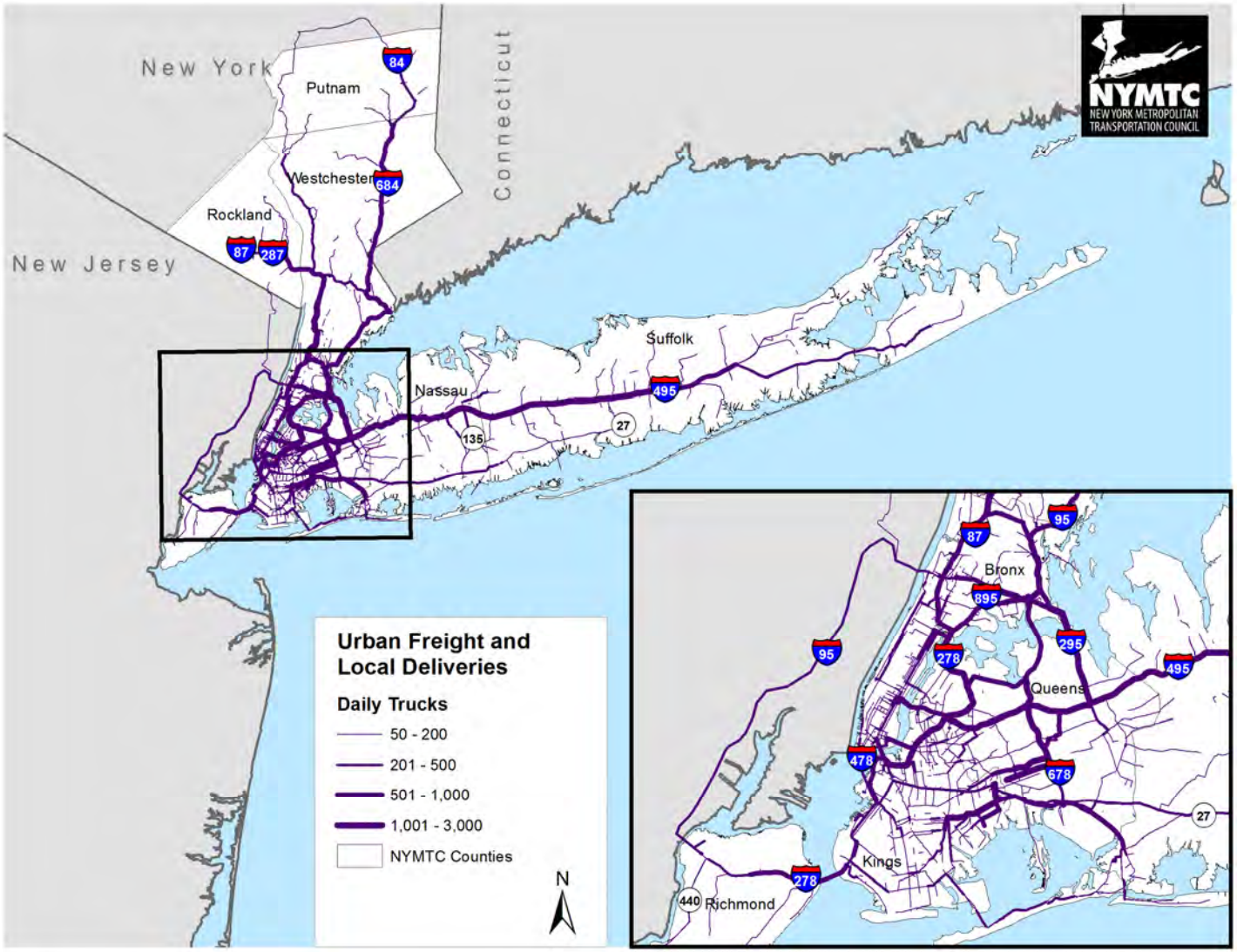
Among the highways that are the primary carriers of urban freight and local delivery trips, traffic congestion is an issue on Interstates: 278 in Richmond, Kings, and Queens counties; 495 in Queens and Nassau counties; and 678 in Queens County. Pavements are in fair or poor condition on sections of Interstates 87 in Bronx County; 278 in Richmond, Kings, and Queens counties; 295 in Bronx and Queens counties; 495 in eastern Nassau County; and 678 in Queens County; and on Conduit Avenue and Nassau Expressway in Queens County.[15] Pavement condition data were unavailable on Atlantic Avenue and Linden Boulevard. Twenty-two bridges along these corridors are structurally-deficient.[16] Thirty fatal truck-involved crashes occurred on the same group of highway corridors between 2007 and 2011.[17]

[15] NYSDOT.

[16] FHWA.

[17] NHTSA.

Figure 2.5 Urban Freight and Local Delivery Trips on Highways in the NYMTC Region



Source: IHS Global Insight TRANSEARCH Database; NYMTC Best Practices Model; Cambridge Systematics analysis.

2.5 LOCAL TRIPS

Local truck trips are defined as trips whose destinations are in the same county as the origin, or a in a county neighboring the county of origin. For example, truck trips destined for New York County, which originate in Bronx, Kings, New York, Queens, or Hudson (NJ) counties are considered local trips. Approximately 1.3 million annual truck trips, about 4 percent of all commodity truck trips, are operating locally, according to the TRANSEARCH database. Top commodities carried in local trips include secondary traffic (40 percent), nonmetallic minerals (32 percent), clay/concrete/glass/stone (11 percent), printed matter (7 percent), and food (4 percent). The top origin-destination pairs for local trips account for 64 percent of local trips, as Table 2.6 shows.

Table 2.6: Top Origin-Destination Pairs for Local Trips, 2007

Origin	Destination	Annual Truck Trips
Nassau County	Queens County	147,484
Kings County	Queens County	118,272
Rockland County	Westchester County	114,865
New York County	Queens County	72,506
New York County	Kings County	72,316
Kings County	New York County	71,124
Suffolk County	Nassau County	68,436
Rockland County	Bergen County	63,431
Queens County	Kings County	63,347
Bronx County	New York County	57,417
All Other Origin-Destination Pairs		470,634

Sources: IHS Global Insight TRANSEARCH Database; Cambridge Systematics analysis.

Not surprisingly, due to the short distances traveled, local trips are more dispersed on the region's highway network, appearing on secondary and tertiary roads in greater volumes than most of the other trip types. Due to the lower volume of local commodity truck trips relative to the other truck trip types, the volume classifications in Figure 2.6 are set to a different scale of values than the scale presented in figures 2.1, 2.2, 2.4, and 2.5. Many of the region's bridges and tunnels are among the highest-volume connectors between neighboring counties. The Tappan Zee Bridge, which connects Rockland and Westchester counties, carries nearly 400 local trips per day. The RFK/Triborough Bridge, Queens-Midtown Tunnel, 59th Street/Queensboro Bridge, Bronx-Whitestone Bridge, and the Long Island Expressway at the Queens-Nassau County border all carry approximately 200 local trips daily. The George Washington Bridge carries about 135 truck trips traveling between New York County and Bergen County, NJ every day. Linden Boulevard, a link between Kings and Queens counties, carries about 125 local trucks per day. About 80 truck trips use the Lincoln Tunnel or the Verrazano-Narrows Bridge to cross a county boundary each day.

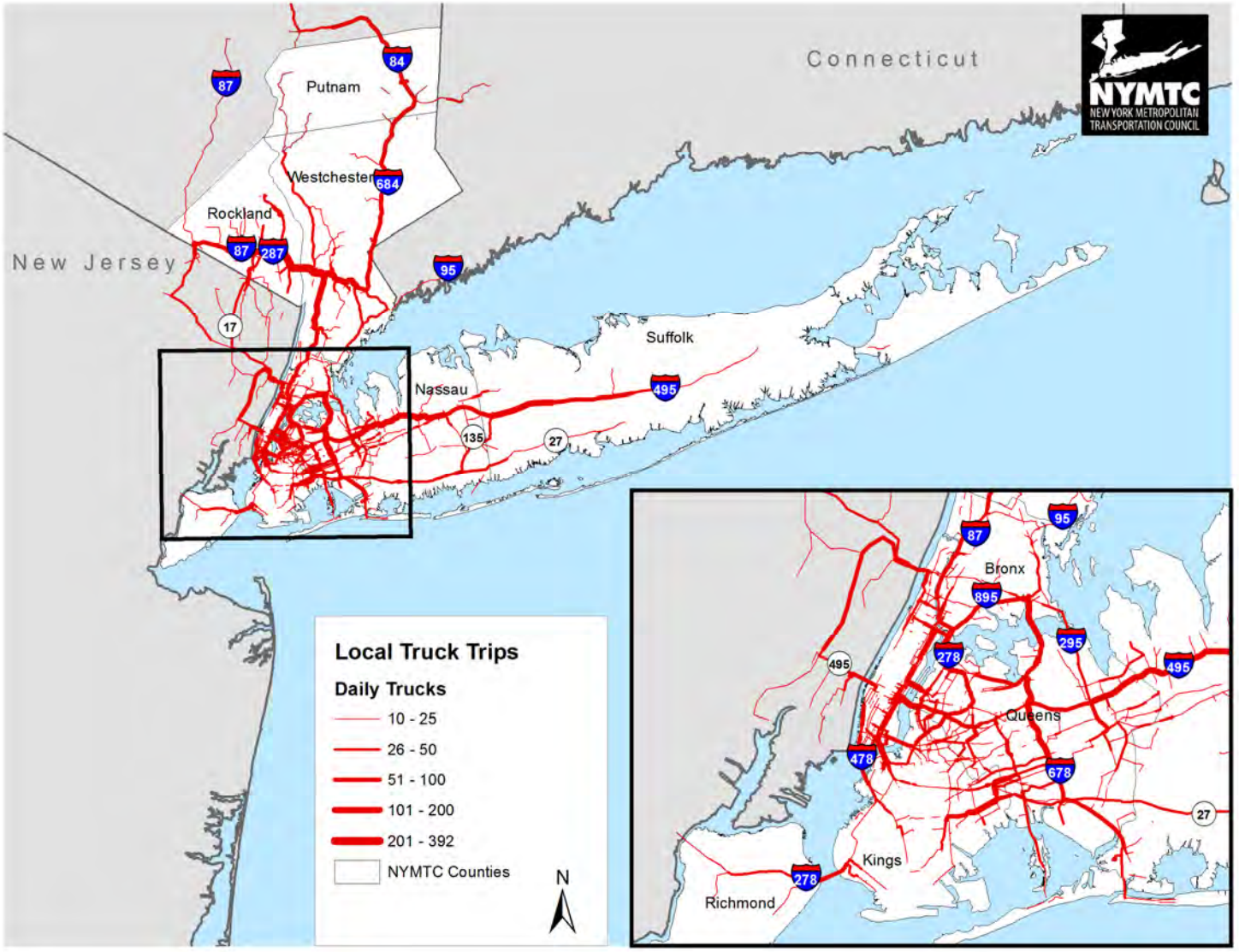
Among the highways that are the primary carriers of local trips, traffic congestion is an issue on Interstates: 87/287 in Rockland and Westchester counties; 495 in Queens and Nassau counties; and 678 in Queens County. Portions of Interstates 87/287 in Rockland and Westchester counties; 495 eastern Nassau County; and 678 in Queens County have fair or poor pavement.[18] Pavement condition data were unavailable on Atlantic Avenue and Linden Boulevard. Ten structurally deficient bridges are located along the major highways serving local trips.[19] Between 2007 and 2011, sixteen fatal truck-involved crashes occurred along these corridors.[20]

[18] NYSDOT

[19] FHWA.

[20] NHTSA.

Figure 2.6 Local Trips on Highways in the NYMTC Region



Source: IHS Global Insight TRANSEARCH Database; NYMTC Best Practices Model; Cambridge Systematics analysis.

2.6 ACCESS TO CONSTRUCTION TRIPS

Several classes of non-commodity truck trips, such as service vehicle trips and construction vehicles, are challenging to estimate using available data. Unlike commodity trips, which typically move goods and equipment between brick-and-mortar terminals and business locations, usually on regular delivery schedules year after year, the origins and destinations for construction vehicles and service vehicles change month-to-month or day-to-day in many cases.

For the purpose of assessing residential construction truck trips in the NYMTC Region, a proxy estimation was developed using available U.S. Census Bureau residential construction permit data, truck trip generation rates from several residential construction projects in the region, and input from home builders and residential construction contractors in the region. Residential construction is the subject of this analysis due to the availability of uniform residential construction permit data throughout the region. Further research, beyond the scope of the NYMTC Regional Freight Plan Update Interim Plan, must be conducted in order to generate estimations for office, industrial, institutional, transportation, and other types of construction projects.

Construction truck trips for multiple-unit (five or more units) residential buildings were estimated by establishing a per-unit truck trip generation rate, based upon average daily truck trip estimates for several multiple-unit residential construction projects completed in the region in recent years, and adjusted based on input from private sector builders.[21] The per-unit truck trip generation rate of 0.5 trucks per unit per day was then multiplied by the number of units found in the residential construction permit data in each county in the NYMTC Region. The average construction schedule for multiple-unit buildings was assumed to be 12 months.

For single-family, two-family, and three- and four-family buildings, estimated daily truck volumes were developed based upon input provided by private-sector home builders and residential construction contractors. The volume of trucks generated day-to-day varies over the life of a project, due to the types of

[21] Truck trip estimates published in several City Environmental Quality Review (CEQR) documents for major residential and mixed-use buildings in New York City were the primary source for generating these estimates. In addition, catalogued Construction Update newsletters Empire State Development regarding the residential component of the Atlantic Yards redevelopment project provided data on truck trips generated during different construction phases. Because these documents address projects consisting of 200 residential units or more in New York City, this estimation skews toward representing the truck trips generated by large residential buildings in urban settings.

activities that are occurring on-site during different phases of the project, subcontractors' schedules, and a variety of project-specific considerations.

Using a hypothetical project to construct a 2,400 square foot single family home with a six-month construction schedule, one to eight trucks may need to be on-site on any given day, but an average daily count of three commodity and/or service trucks per day over the six month construction period was determined to be an acceptable assumption. The average size of a new-construction single-family home in United States metropolitan areas in 2010 is approximately 2,400 square feet.[22] For two-, three-, and four-family buildings, three-to-four trucks per day were considered an acceptable average truck generation rate with an eight month project schedule.

This approach yields a rough estimate that can inform a regional planning process, however it is important to note that a number of factors can significantly impact the number of truck trips required to construct each residential building project. For example, a 300-unit apartment building which is 25 stories tall requires concrete and/or steel frame construction, while a 300-unit apartment complex in 3-story buildings can be constructed using wood frame. Differences in the average unit size, lot size and configuration, rock and soil composition, demolition of existing structures, construction schedule, whether a home is custom-built or part of a subdivision with several homes being constructed at once, etc., can also influence the types, number, and schedule for truck trips to and from the construction site project-by-project.

As Tables 2.7 through 2.10 show, in 2012, new privately-owned residential building permits were issued for nearly 5,200 buildings containing more than 25,000 housing units. The number of housing units is 7 percent higher than the number of units issued in 2011, and 59 percent greater than the 2009 post-recession low.

[22] "Median and Average Square Feet of Floor Area in New Single-Family Houses Completed by Location," United States Census Bureau, available from: http://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf

Table 2.7: Residential Building Permits for Single-Family Buildings by County, 2007-2012

County	2007	2008	2009	2010	2011	2012
Bronx	44	162	61	6	1	8
Kings	0	0	1	5	0	1
Nassau	737	822	365	400	311	375
New York	6	3	0	0	1	4
Putnam	83	75	37	74	38	37
Queens	267	140	124	63	83	76
Richmond	310	185	130	251	179	191
Rockland	324	246	76	99	92	76
Suffolk	2,030	972	791	910	759	815
Westchester	464	321	177	175	192	189
Total	**4,265**	**2,926**	**1,762**	**1,983**	**1,656**	**1,772**

Source: U.S. Census Bureau, available from: http://censtats.census.gov/bldg/bldgprmt.shtml.

Table 2.8: Residential Building Permits for Two-Family Buildings by County, 2007-2012

County	2007	2008	2009	2010	2011	2012
Bronx	281	66	23	25	24	53
Kings	197	197	37	44	77	51
Nassau	9	3	4	14	1	1
New York	2	0	0	2	0	2
Putnam	1	0	0	1	1	1
Queens	829	319	181	342	220	119
Richmond	197	147	135	95	161	103
Rockland	2	9	3	9	8	10
Suffolk	3	0	0	0	3	3
Westchester	82	37	3	9	8	5
Total	**1,603**	**778**	**386**	**541**	**503**	**348**

Source: U.S. Census Bureau, available from: http://censtats.census.gov/bldg/bldgprmt.shtml.

Table 2.9: Residential Building Permits for Three- and Four-Family Buildings by County, 2007-2012

County	2007	2008	2009	2010	2011	2012
Bronx	268	86	33	15	13	23
Kings	558	147	51	39	53	92
Nassau	1	0	0	21	0	0
New York	7	0	4	1	1	0
Putnam	2	2	2	0	8	0
Queens	332	112	67	57	46	48
Richmond	1	2	0	2	0	0
Rockland	28	1	0	4	15	8
Suffolk	9	0	0	0	0	3
Westchester	0	0	0	3	2	5
Total	**1,206**	**350**	**157**	**142**	**138**	**179**

Source: U.S. Census Bureau, available from: http://censtats.census.gov/bldg/bldgprmt.shtml.

Table 2.10: Residential Building Permits for Five-or-More-Unit Developments by Units by County, 2007-2012

County	2007	2008	2009	2010	2011	2012
Bronx	9,369	1,669	1,924	1,435	1,024	2,356
Kings	27,479	8,825	11,858	765	1,195	2,959
Nassau	1,434	63	1,040	5	20	274
New York	26,077	9,485	9,697	1,347	2,531	2,320
Putnam	129	18	8	12	86	0
Queens	16,919	4,682	6,599	771	2,502	950
Richmond	1,386	31	769	170	80	276
Rockland	675	158	22	75	130	126
Suffolk	1,060	57	424	199	91	228
Westchester	2,877	1,300	106	276	735	308
Total	**87,405**	**26,288**	**32,447**	**5,055**	**8,394**	**9,797**

Source: U.S. Census Bureau, available from: http://censtats.census.gov/bldg/bldgprmt.shtml.

Table 2.11 shows the estimated number of trucks generated by each class of residential construction in 2012 by county, expressed in annual trucks and daily trucks, assuming 290 working days per year. The precise location of the construction sites within each county is unknown, and therefore truck trip tables were not developed and mapped to the BPM highway network. As the table shows, single-family and two-family homes generate more trucks on a per-unit basis than larger multi-unit buildings, and therefore Suffolk County, which issued the greatest number of single family home construction permits in 2012, is estimated to have the greatest number of truck trips generated by residential construction sites. Kings and Bronx counties rank second and third in residential construction truck trip generation, and traffic in both counties is fueled primarily by multi-unit buildings.

The estimated trend in truck trip generation by county shown in Table 2.12 suggests that data from one year alone may not be an indicator the geographic distribution of residential construction trips in years to come. Even in the post-recession recovery years of 2010 through 2012, the estimated number of trips change significantly year-to-year, county-by-county. Estimated truck trips in Bronx County, for example, declined by 43 percent between 2010 and 2011, and more-than-doubled between 2011 and 2012. In Westchester County, estimated truck trips increased by more than 36 percent between 2010 and 2011, but declined by 23 percent the following year, a mirrored pattern compared to the Bronx County trend. These year-to-year swings in construction activity and truck trips generated do not match demographic trends, rather are likely due to market conditions, and phasing-in of larger projects or subdivisions which skew the results in a given county in a given year.

Table 2.11: Estimated Annual and Daily Truck Trips Accessing Residential Construction Sites by County, 2012

County	Annual Trucks					Daily Trucks				
	Single-Family	2-Family	3-4 Family	5+ Family	**Total**	Single-Family	2-Family	3-4 Family	5+ Family	**Total**
Bronx	3,456	22,896	13,248	170,810	**210,410**	12	79	46	589	**726**
Kings	432	22,032	52,992	214,528	**289,984**	1	76	183	740	**1,000**
Nassau	162,000	432	0	19,865	**182,297**	559	1	0	69	**629**
New York	1,728	864	0	168,200	**170,792**	6	3	0	580	**589**
Putnam	15,984	432	0	0	**16,416**	55	1	0	0	**57**
Queens	32,832	51,408	27,648	68,875	**180,763**	113	177	95	238	**623**
Richmond	82,512	44,496	0	20,010	**147,018**	285	153	0	69	**507**
Rockland	32,832	4,320	4,608	9,135	**50,895**	113	15	16	32	**176**
Suffolk	352,080	1,296	1,728	16,530	**371,634**	1,214	4	6	57	**1,281**
Westchester	81,648	2,160	2,880	22,330	**109,018**	282	7	10	77	**376**
Total	**765,504**	**150,336**	**103,104**	**710,283**	**1,729,227**	**2,640**	**518**	**356**	**2,449**	**5,963**

Source: Cambridge Systematics analysis of environmental review documents and interviews with private-sector home builders and construction contractors.

Table 2.12: Estimated Annual Truck Trips Accessing Residential Construction Sites by County, 2007-2012

County	Annual Trucks						
	2007	2008	2009	2010	2011	2012	Average, 2007-2012
Bronx	415,771	287,522	159,334	161,377	92,528	210,410	209,545
Kings	1,046,325	1,029,481	101,255	315,797	150,430	289,984	466,198
Nassau	327,416	431,800	159,771	195,584	136,234	182,297	238,464
New York	695,151	704,329	99,962	102,505	184,506	170,792	317,785
Putnam	38,745	34,132	18,006	33,125	27,691	16,416	27,959
Queens	1,004,149	741,228	226,250	412,967	338,787	180,763	466,926
Richmond	221,848	200,329	126,805	159,324	152,680	147,018	167,276
Rockland	168,415	112,331	39,566	72,740	61,265	50,895	82,220
Suffolk	887,573	450,644	356,140	401,965	335,782	371,634	466,552
Westchester	330,122	162,341	97,770	103,256	140,840	109,018	155,388
Total	**5,135,512**	**4,154,136**	**1,384,856**	**1,958,640**	**1,620,741**	**1,729,227**	**2,598,312**

Source: Cambridge Systematics analysis of environmental review documents and interviews with private-sector home builders and construction contractors.

Unlike the permanent locations of multimodal terminals, warehouses and distribution centers, and shippers and receivers of goods carried in commodity trucks, construction sites are active for relatively brief periods of time. The distribution of construction sites within the region therefore changes year-over-year. Whether any specific link on the region's highway network is critical to supporting residential construction today or in 2040 is unknown. The primary issues facing construction vehicles in the NYMTC Region, especially in New York City, include designating and keeping available parking and loading areas for construction vehicles on site, identifying appropriate access routes connecting through and local routes or major highways and construction sites, and mitigating potential community impacts due to truck traffic, noise and vibration. These issues must be considered on a project-by-project basis. For the purpose of regional planning, developing methods to collect and manage better data on truck trips which travel to various types of construction sites can lead to improved understanding of the extent of the impacts of these issues, and to the development of a program of strategies to support the needs of construction truck movements.

3.0 Next Steps and Further Research

The findings of this analysis show that there are areas in which the region's highway network presents challenges to the safe and efficient movement of various types of truck trips. The interstate highways that through trucks use to traverse the region are also the key points of entry for inbound terminal and warehouse access trips. Interstate highways in New York City, Long Island, and the Hudson Valley are also major routes for intraregional distribution and interplant trips, urban freight and local delivery, and local trips. These corridors are also popular routes for commuter and other non-truck traffic, and are among the region's most congested corridors. Poor pavement condition, structurally-deficient bridges, and fatal truck-involved crashes also appear in greater numbers along these corridors than other strategic freight highways.

Task 4 of the NYMTC Regional Freight Plan Update will more thoroughly explore these challenges as part of a process to identify what the region needs to accomplish in order to ensure the productive, safe, and cost-effective movement of freight across all modes through 2040. Potential programs, projects, and strategies will be presented, evaluated, and recommended in subsequent tasks of the project, based upon the assessment of needs.

In addition, the construction truck trips estimation exercise revealed how little data are available to describe the movements of non-commodity truck trips. Should NYMTC's member agencies wish to achieve a better understanding of these truck movements, several methods for collecting primary (observation-based) data could be pursued. A representative sample of construction sites of various types, including high-rise residential, low-or-mid-rise multiple-unit residential, single-family homes, and various classes of commercial, industrial, institutional, and utility or infrastructure projects in urban and suburban settings could be identified and observed. Using automatic traffic recording devices, sensor-triggered cameras, and/or surveillance cameras similar to those NYCDOT has used to monitor "delivery windows" pilot programs, trucks traveling to and from the representative construction sites can be observed. Over the life of the project(s) patterns in the number, type, and frequency of truck trips can be documented and used to develop average truck trip generation rates for specific types of construction projects. The patterns could be used to tailor the generation rates to specific project phases. Such effort would require considerable time and labor effort to deploy, monitor, synthesize, and maintain. This type of a data collection effort could also be applied to other non-commodity truck trip types as well.