

Planning for Resiliency

Adapting the Transportation System to Emerging Vulnerabilities



About NYMTC

The New York Metropolitan Transportation Council (NYMTC) is a regional council of governments that is the metropolitan planning organization for New York City, Long Island and the lower Hudson Valley. NYMTC provides a collaborative planning forum to address transportation-related issues, develop regional plans and make decisions on the use of federal transportation funds.

The NYMTC planning area covers 2,440 square miles, with a population of approximately 12.4 million people in 4.5 million households, or about 64 percent of the New York State population in 2010.



NYMTC Mission Statement

- To serve as the collaborative forum to address transportation-related issues from a regional perspective;
- To facilitate informed decision-making within the Council by providing sound technical analyses;
- To ensure the region is positioned to capture the maximum Federal funds available to achieve the goals of the Unified Planning Work Program, Regional Transportation Plan and Transportation Improvement Program; and
- To focus the collective planning activities of all Council members to achieve a shared regional vision.

Preface

Over recent years, the New York metropolitan region has experienced the direct and destructive effects of dozens of hurricanes, nor'easters, winter storms and other extreme weather conditions, with seeming increasing severity. On October 29, 2012, Hurricane Sandy's record-breaking surge and intense winds ravaged the transportation links so critical to the region's mobility, economy and way of life.

In the aftermath of Sandy, members of the New York Metropolitan Transportation Council (NYMTC) have focused their efforts on adapting the transportation system to increase resiliency to the impacts of extreme weather and climate risks, and to the vulnerabilities exposed as never before by the storm.

To provide perspective, the following is an account of the events and effects of the storm, and lessons learned.

On the morning of October 30th, the New York metropolitan region awoke to an unprecedented transportation crisis...travel within New York City and between the city and its suburbs was constrained for days – and in some cases weeks and months – as roads were made impassable by downed trees and power lines, and transit service was disrupted by power outages, flooding and wind damage.

Planning for Resiliency: Adapting the Transportation System to Emerging Vulnerabilities



Overview: October 29, 2012

During the early morning hours of October 29, 2012, Hurricane Sandy, a powerful late season storm, made its way northeast along the eastern seaboard of the United States. Sandy was an extremely large storm; at its peak, the storm's hurricane-force winds extended 175 miles from its center, with tropical storm-force winds felt 520 miles away.

Forecasters also saw the potential for the hurricane to develop into a "superstorm" after colliding with a cold front from the north and a winter storm in the west. The hurricane followed very closely to the forecasted track. As the storm made landfall near Atlantic City, New Jersey, seawater was propelled directly into the New York Bight, the shallow waters where Long Island and New Jersey make a nearly right angle bend at the mouth of the Hudson River. Amplified by tons of water and rain that traveled with the storm from the south,

combined with wind and wave action and an astronomical high tide, the surging seas generally peaked at heights of 10 feet or more above normal tide levels. According to the U.S. Geological Survey, Sandy's peak storm surge occurred at Long Beach, NY, reaching a record 17.48 feet. Elsewhere in the region, the surge pushed water to a record 13.88 feet at Battery Park in lower Manhattan, beating a previous record set there by Hurricane Donna in 1960. Thousands were evacuated from low lying areas along the coast and rivers, and much of the region's transit network was preemptively shut down to minimize risk to customers and staff and damage to vehicle stock and equipment.

Overall, these precautions proved worthwhile as the hurricane's force led to widespread flooding, wind damage, power outages, and over 100 fatalities along much of the East Coast. The region's coastline was inundated and devastated by the storm surge. Forced up

the Hudson and East rivers, it deposited a boat on the MTA Metro-North Railroad tracks in Ossining, New York, and breached the sea walls to flood the FDR Drive on Manhattan's East Side. The Coney Island and Rockaway peninsulas were swamped, as was Long Island's south shore. Wind battered Long Island and set into motion an equally powerful surge across the Sound, which flooded communities along Long Island's north shore and Peconic Bay, and Connecticut's coast. Blackouts caused by seawater-damaged electrical equipment and downed power lines all but halted travel in and around the region.

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Impacts in the NYMTC Planning Area

Following the storm, travel within New York City and between the city and its suburbs was constrained for days – and in some cases weeks and months – as roads were made impassable by downed trees and power lines, and transit service was disrupted by power outages, flooding and wind damage.

Hurricane Sandy brought the Metropolitan Transportation Authority's network to a standstill and caused unprecedented damage. To protect people and

infrastructure from the storm, all commuter rail service on Metro-North Railroad and the Long Island Rail Road was halted in advance of the hurricane, and the subway was completely shut down for only the second time in its 108-year history. Despite this planning, electrical, lighting, communications, surveillance, ventilation, signals, switches and relay systems were exposed to corrosive salt water and damaged; railroad overhead power lines were destroyed by high winds; and rail yards, bus garages and maintenance shops were underwater. In addition, stations were damaged and even destroyed and parking lots flooded; a third rail on segments of an MTA Metro-North Railroad line was crushed; an entire transit bridge and rail line serving the Rockaways was lost; public address systems were ruined; and power outages left stations dark. In all, twelve transit tunnels – eight serving the subway system between Manhattan, Brooklyn and Queens, and four serving the Port Authority Trans-Hudson (PATH) system between Manhattan and northern New Jersey, were flooded and inoperable, making mobility impossible. Tunnel and system flooding also shut down Amtrak and New Jersey Transit for several days, further limiting travel within and out of the region.



Among the region's vehicular crossings, the Hugh L. Carey Tunnel, Queens Midtown Tunnel and Holland Tunnel flooded with seawater. The city's coastal and circumferential arterial roadways were washed over. Roadways and bridges sustained damage after being over-topped by floodwaters or being struck by breakaway barges and other transported debris. Numerous overhead sign structures were damaged. Bridges and tunnels around the city were closed because of the danger from high winds and flooding.

Hurricane Sandy also affected many of the Port Authority's transportation facilities in both New York and New Jersey, especially along the region's shorelines. Extensive flooding forced the PATH system and Holland Tunnel out of operation; the Hoboken PATH station reopened for regular business on January 30th. Airports and port facilities were also closed for several days in the aftermath of the storm.

The coastal storm surge and high winds took a hard toll on Long Island, leaving significant infrastructure damage in their wake.





Nassau County's highway operations and traffic control infrastructure sustained major damage ranging from traffic signal span wires and hanger hardware to traffic signal control cabinets, signal controllers and communications equipment, affecting approximately 300 traffic signalized intersections. These losses led to temporary traffic control measures at many of these intersections for roughly 60 days after the event. With over 75 percent of the county's roads blocked by downed trees and wires, some areas of the county were rendered inaccessible; however due to a

quick response, all but a few roads were fully or partially passable within 36 hours. The south shore's transportation infrastructure was severely damaged by floodwaters, with one road closed for 34 days after the storm. On the north shore, one road was so badly damaged that it will not reopen until July 2013. All normal Nassau Inter-County Express (NICE) bus service was disrupted due to the weather; however, NICE vehicles were used to provide shuttle service to all of the temporary shelters opened due to the storm and its aftermath. The bus system sustained approximately \$50,000 of material loss.

Similar conditions existed in Suffolk County. With numerous harbors and more than 345 miles of inland waterways, floodwaters swirled through downtowns like Port Jefferson and Riverhead. Although Suffolk County Transit escaped with no infrastructure damage, power outages and blocked roadways shut down its fixed bus route system for two days and service was limited to its sister SCAT (paratransit) program for the duration of the storm, mainly to assist dialysis patients.

The counties of Rockland, Putnam, and Westchester also experienced

flooding and high winds, which toppled trees and cracked branches, pulling down overhead electric wires and causing widespread power outages and blocked roadways. Utility companies had to shut down electricity before work crews could clear many areas. Traffic signal outages caused delays on roadways where buses could otherwise operate, causing detours on many routes for several days.

In Westchester County, at least 500 streets were blocked. Westchester Bee-Line System bus service, including paratransit service, did not operate for two days. Initially suspended due to concerns over high winds, heavy rain and potential flooding during the storm, impassable roads due to downed power lines, trees and debris extended the suspension. Primary roadways, including the Cross County, Saw Mill and Hutchinson River parkways were mostly cleared by the day after the storm, but secondary roads took longer to open.

In Rockland County, emergency response during the storm was also hampered by storm surge flooding and downed trees and power lines. At the height of the storm, nearly 500 roads were obstructed, resulting in either partial or complete closures. For three-to-five days in the storm's aftermath, 200-300 road obstructions remained. In addition to blockages, the long-term loss of power throughout Rockland caused signalized intersections to go dark without back-up generators, battery or solar power to keep the signals working. The Transport of Rockland (TOR), TAPPAN ZEEExpress (TZx) and TRIPS paratransit bus services were suspended during the storm and immediately after. In Putnam County, downed wires and trees due to the strong winds caused more than 200 roads to be closed, and shut down Putnam Area Rapid Trans-



portation (PART) transit and paratransit service for days.

All told, damage to the region's transportation system has been estimated in the billions of dollars.

A Transportation Calamity

The cumulative effect of this unprecedented damage was the virtual isolation of whole sections of the region and a drastic reduction in the transportation system's capacity for many days. In particular, Manhattan was in many ways cut off from the rest of the region. Flooding and power outages completely disrupted subway and train service between Manhattan, Brooklyn and Queens, Manhattan and northern New Jersey, and south of 34th Street. Vehicular crossings which reopened quickly after the storm – the East and Harlem River bridges, the Henry Hudson Parkway and Broadway bridges, the Alexander Hamilton and Washington bridges, the George Washington Bridge and the Lincoln Tunnel – were quickly overwhelmed by traffic due to the severe

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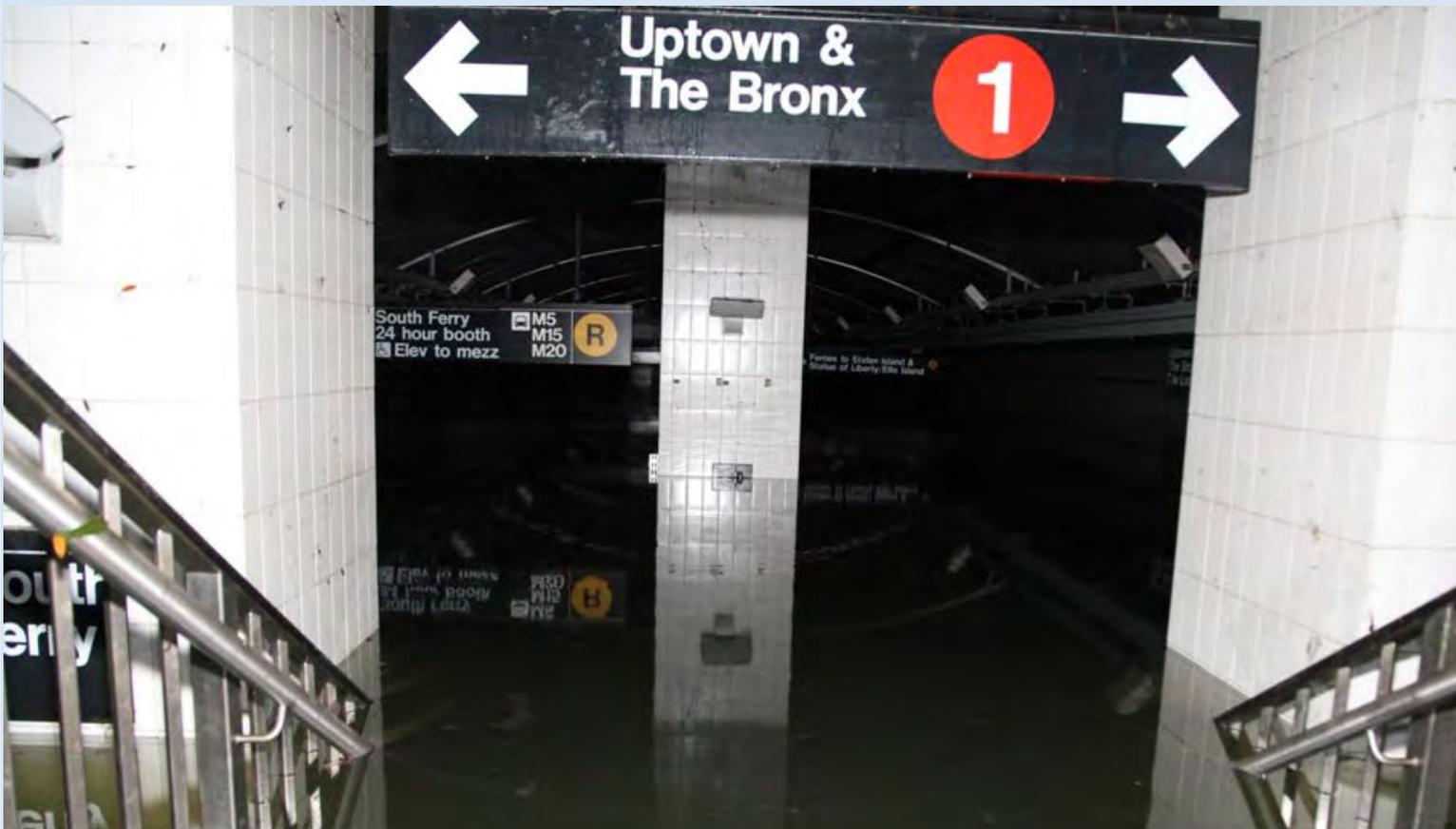
reductions in rail and subway service and flooding of the Holland and Hugh L. Carey tunnels.

The storm and its aftermath had devastating impacts to people, property and the economy. A lack of transit service combined with closed roads throughout the region diminished people's ability to get to work. Gasoline shortages further limited travel, and resulted in odd/even gas rationing in New York City, on Long Island and in northern New Jersey. Many stores and offices were closed throughout the region, deliveries of goods – including gasoline – were delayed, retail sales plummeted and visits to tourist sites were curtailed.

Restoring the Region's Transportation System

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Despite the enormity of the damage to the MTA system, the Governor's Office, along with MTA management and labor, moved immediately to restore service as quickly as possible in an effort that exhausted nearly all of the MTA's supplies of replacement inventory and





equipment. MTA Metro-North Railroad resumed East of Hudson service within 48 hours after the storm, and the MTA Long Island Rail Road operated under modified schedules as Amtrak worked to repair their flooded East River tunnels, use of which is shared by both rail lines. During the time it was not able to resume full service, the LIRR arranged bus service for customers from major stations. In addition, the waiting room of the Long Beach station, in one of the hardest hit areas of the region, was turned into a “comfort station” offering heat, water, restrooms and a charging station for cell phones and other electronic devices.

In order to provide subway customers with information as service got back under way beginning November 1st, the MTA utilized 102 double-sided digital screens above station entrances to update service status of trains, and staff regularly updated the MTA website despite being dislocated. A free “Bus Bridge” was set up to connect functioning subways on both sides of the East River: 330 buses on three routes carried approximately 200,000 daily riders for three days, from Thursday through Saturday. Most subway service was restored within

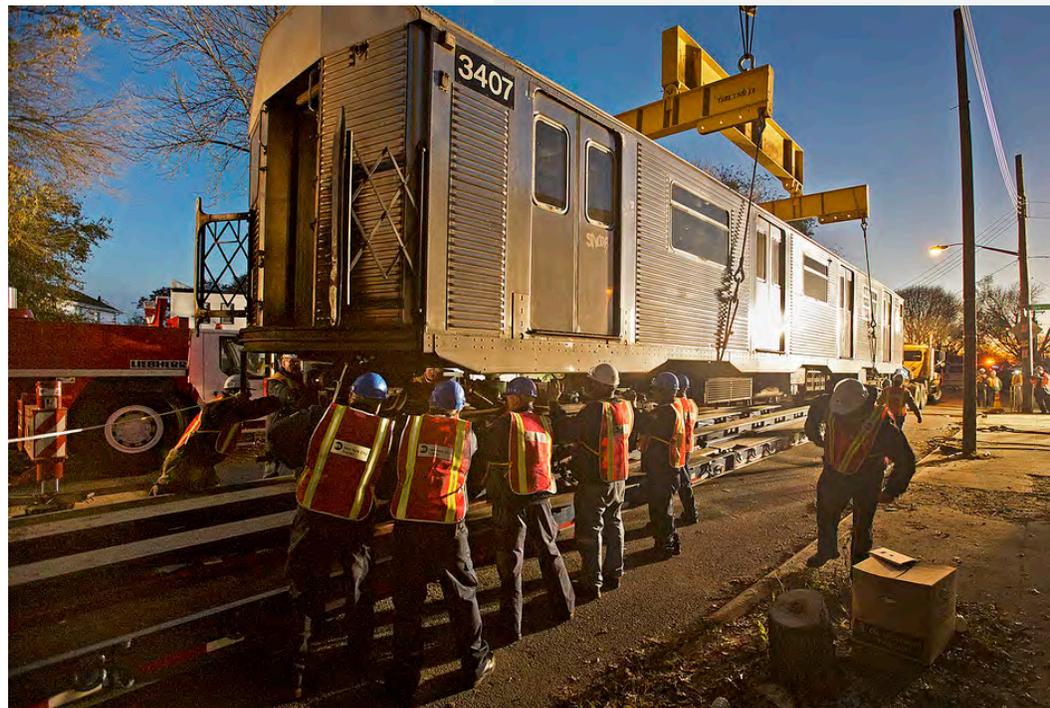
a week of the storm. Tunnels were pumped of water and critical infrastructure was repaired and replaced quickly. On the Rockaway subway line, MTA New York City Transit removed damaged cars by flatbed trucks and set up temporary free shuttle bus service. For vehicles, traffic patterns at the Hugh L. Carey and Queens Midtown tunnels were restored incrementally as repairs finished.

Recovery efforts for Port Authority of New York & New Jersey focused on bringing key trans-Hudson connections safely back on line as quickly as possible. Port Authority staff worked with New Jersey Transit and other agencies to provide an evolving combination of alternative services including bus, ferry, rail, and phased return of PATH service to restore travel between Manhattan and west of the Hudson River. The agency also moved to repair surge damage to the cross-harbor rail car float facilities that

move freight across New York Harbor. Airports reopened within days of the storm.

New York City Department of Transportation employees helped recovery in the city in many ways, surveying road conditions from the Traffic Management Center in Queens, helping to clear fallen trees and debris from streets and parks, delivering goods and generators to hard hit areas of the city, and quickly restoring service to nearly 3,000 damaged traffic signals.

In addition, more than 100 Staten Island Ferry crew members protected the boats during Sandy which allowed the Ferry, which carries approximately 65,000 passengers on a typical week-day, to resume service just four days after the storm. To provide additional access for residents of Staten Island, the city DOT coordinated with New York Water Taxi to operate a temporary Great Kills Ferry serving Great Kills, Midland Beach, Tottenville, and other Staten



Island communities that saw some of the worst surge damage. Funded by the Federal Emergency Management Agency, this temporary ferry service had stops in Manhattan at Pier 11 in the Financial District and East 35th Street in Midtown.

On Long Island, severe power outages covered over 90 percent of Suffolk County, resulting in virtually no functioning traffic controls and shutting down Suffolk County Transit buses for two days; the system operated during daylight hours only through Friday, November 2nd. By Saturday, Suffolk County Transit was fully operational with only one modification: route 1B did not travel into Tanner Park in Copiague, as the road was closed for two weeks.

Similarly, in Nassau County, partial NICE bus service was restored to several routes and limited paratransit service went into effect two days after the storm. Within three days, service was restored to all but three bus routes,



which were temporarily inaccessible due to downed trees and wires. By November 1st, 98 percent of the fleet was operational. A “no passenger fare” policy remained in effect until November 2nd.

In the lower Hudson Valley, Rockland County used funding it received from the Department of Homeland Security following Hurricane Irene to launch its beta version of an interactive GIS

mapping tool to manage, share, analyze and respond to information on road blockages and closures in real time. When Hurricane Sandy hit, the GIS tool provided a map-based common operating picture, which enabled county, local and state highway, fire, police, utility, the Red Cross and other emergency personnel to record and share information on road obstructions and closures as events unfolded. The county used



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this information during the storm to organize, prioritize and direct crews in clearing major highways and roads and to route emergency vehicles and evacuations. After the storm, updated information on changing road conditions was critical to restoring power, managing cleanup and detours, re-opening schools and businesses and restoring both transit and traffic circulation.

Due to severe track damage, the MTA Metro-North Pascack Valley Rail Line could not resume service at full capacity until after the new year. As a result, within days of the storm, Rockland

County teamed with the MTA to offer free rides on the County's TAPPAN ZE-Express bus to Tarrytown's Hudson Line station for Pascack Valley line monthly and weekly ticket holders. Rockland's TOR and TZx bus services were up and running just one day after the storm, with some detours, providing "fare free" service in the week following Sandy. The County's TRIPS paratransit service operated on an emergency and ADA basis the day after the storm, and was back in regular service the following day.

Westchester County also provided timely information and updates on ser-

vice advisories concerning road closures, transit service suspensions and modifications to increase awareness of travel hazards and the need for modifying travel patterns. It was able to restore Bee-Line System bus service days after the storm by working with utility companies and state, local and county road crews to remove debris from blocked streets.

In Putnam County, officials worked quickly to clear debris, and within a week of the storm, only two closed roads remained and PART transit and paratransit service had resumed normal operations.

Regionally, the New York State Department of Transportation (NYSDOT) also provided a significant and robust response to Hurricane Sandy: more than 2,200 maintenance staff (of the nearly 3,400 statewide) were deployed for "boots on the ground" repair work. Incident Command Systems protocols ensured that, to the maximum extent possible, staff and equipment were staged at strategic locations based on weather forecasts and were ready to be deployed when and where needed. Having redundancy in communications and services helped in evacuation and recovery efforts: while Long Island's INFORM sustained damage, TRANSCOM & 511NY still functioned, informing travelers of alternatives and detours.

Staff was deployed until November 21st and NYSDOT also made extensive use of its contractors during and after that period to assist in repair and debris removal. Over the three week response, NYSDOT maintenance forces worked more than 83,000 hours to clean up and repair storm damage. More than 35,000 of these hours were worked in the hardest hit counties of Nassau, Suffolk, Orange, Rockland and Westchester.





Planning in the Aftermath of Hurricane Sandy

Hurricane Sandy took a toll on the New York metropolitan region that is still being felt. The transportation system proved to be both vulnerable and resilient. It became clear that it is imperative the region plan to protect and adapt its critical transportation networks and linkages for the future, particularly in the face of extreme weather and potential climate risks.

At the state level, Governor Cuomo established the *NYS 2100 Commission*, tasked with finding ways to improve the resilience and strength of the state's infrastructure in the face of natural disasters and other emergencies. The Commission's report notes: *Overall, the State's transportation infrastructure is vital to the health of our economy, environment, and well-being. Recent severe events, such as Superstorm Sandy, Tropical Storm Lee, Hurricane Irene and the 2010 snowstorm, have revealed vulnerabilities in our transportation infrastructure. Much of it is aging and susceptible to damage from extreme weather events or seismic threats, and many facilities, such as tunnels and airports, have been built in locations that are increasingly at risk of flooding. Steps must be taken to make the State's transportation infrastructure more resilient to future severe events.*

The report includes recommendations for developing a risk assessment of the state's transportation infrastructure, strengthening and strategically expanding existing transportation networks, and building for a resilient future with enhanced guidelines, standards, policies, and procedures. Recommendations include measures that will harden the transportation system such as flood-proofing subways and bus depots with vertical roll-down doors, vent closures, inflatable bladders, and upsized fixed pumps (with back-up power sources) to remove water.

Even before Hurricane Sandy, NYMTC's members had undertaken various planning initiatives to begin to address the possibility and risks of climate change and weather extremes.

A premier example of this type of planning is contained within New York City's *PlaNYC*, a long-range sustainability plan partially funded through the NYMTC planning process. The *PlaNYC* chapter on climate change notes the following:

New York City has always faced climate risks, including heat waves, snow storms, high winds, tropical storms, storm surges, lightning, and torrential downpours. These events affect every New Yorker, and as our climate changes, they will become more frequent and severe. We need to reduce our contributions to climate change, and simultaneously be ready for its effects.





In the wake of Hurricane Sandy, regional planning efforts aimed at addressing these risks have been amplified and accelerated, both to assist where possible in the recovery effort and to anticipate future events and emergencies. In the immediate aftermath of the storm, NYMTC's members were on the front lines in the recovery effort. Looking forward, their planning processes will be expanded in the following ways:

- The MTA will re-examine its infrastructure to try to prevent the kind of damage that Hurricane Sandy inflicted. For example, MTA New York City Transit is well underway with plans to enhance operations planning response;

coordinate with federal, state and city agencies and the real estate community to protect vulnerable zones; investigate concepts to harden assets; and capture lessons learned across the organization for better information sharing.

- For the Port Authority, post-Sandy responses encompass 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.

- Building on previous efforts already underway, the New York State Department of Transportation is 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 infrastruc-

ture 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 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 would facilitate potential evacuation.

- New York City is applying lessons learned from the storm recovery to better prepare and respond to any similar disasters in the future. In terms





of immediate recovery of travel options within the city, pedestrian and bicycle access across major bridges was critical. Over 18,000 people crossed the four East River bridges on foot or bicycle after the storm, an increase of more than 13,000 above everyday numbers. The new ferry service to southern Staten Island gave planners a sense of latent demand for such a service in the future. The East River Ferry and the “bus bridge” from Atlantic Station to Manhattan also formed critical parts of the connection between Manhattan, Brooklyn, and Queens in the immediate days after the storm.

- 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 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 the county’s new GIS tool 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.

- In Suffolk County, initial lessons of Sandy underscore the urgency of some of the plans already being pursued, including an initiative to CONNECT LONG ISLAND through innovative mass transit – 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 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.

- In Nassau County, 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 infrastruc-





ture that addresses roles and responsibilities of personnel and includes emergency procedures for a variety of scenarios. The county will also implement mitigation measures to 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 and signals to its evacuation routes and tie those routes to the Center.

Regionally, NYMTC's metropolitan planning process also considers the potential impacts of climate change on the transportation sector. Its current Regional Transportation Plan, entitled *A Shared Vision for a Shared Future*, notes: "The transportation sector in the New York greater metropolitan area, which is vital to the regional economy and quality of life, is particularly exposed

to climate variability, floods, sea level surges and land subsidence. Increased incidence of high winds and flooding could disrupt major thoroughfares, tunnels, and transit services."

More than simply recognizing these potential impacts, the Plan contains a strategic regional policy guideline to incorporate climate change and carbon reduction considerations into regional "green" transportation policies. Moving forward, NYMTC's next Regional Transportation Plan – *Plan 2040* – which is scheduled to be adopted in August 2013, will contain a new emphasis on climate change and extreme weather adaptation for the transportation system that will be in part informed by the *2100 Commission* report.

In addition, NYMTC is partnering with its sister metropolitan planning organizations in New Jersey and Connecticut to apply for funding through the Federal Highway Administration's newly announced *Climate Change and Extreme Weather Vulnerability Assessment and Adaptation Options Analyses Pilot Program*. The grant will allow for an assessment of the transportation impacts of Hurricane Sandy, identify critically vulnerable areas and transporta-

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tion infrastructure in the New York-New Jersey-Connecticut region and explore adaptation options. The results of this work will ultimately be integrated into *Plan 2040* and the rest of NYMTC's planning process.

A broader planning effort is also underway. In 2010, NYMTC helped to organize New York-Connecticut Sustainable Communities, a bi-state collaboration of cities, counties and regional planning organizations which won a \$3.5 million grant from the U.S. Department of Housing and Urban Development's (HUD) Sustainable Communities Regional Planning Grant Program. One of the elements of the work program is a climate resiliency project undertaken by the New York City Department of City Planning to build on *PlaNYC* by identifying strategies that can be used throughout the region to minimize damage and disruption from coastal flooding and storm surges.

The Consortium is also increasing its emphasis on climate resiliency by forming a Joint Climate Resilience Committee with a similar consortium in northern New Jersey to establish a regional planning framework for resiliency, based in part on the work of the city Department of City Planning, advocating for better response coordination among federal agencies to assist in recovery from Hurricane Sandy, organizing information related to climate resiliency and informing the Regional Plans for Sustainable Development which the consortia are charged with producing under the HUD grant program.

Lessons Learned

Lessons learned to-date and to be learned from Hurricane Sandy are many, but they recognize the transportation network's vulnerabilities to extreme weather events and risks associated with climate change. The New York metropolitan region's topography and land use patterns present huge challenges, which cannot be fully addressed in a fragmented fashion. An integrated approach to managing these risks, including coordinated regional planning, will help prepare the region to ensure that people and goods can continue to move throughout the area with minimal possible interruption during urgent situations, and that the transportation system can recover quickly from any disruptions.

In the aftermath of Hurricane Sandy, work is proceeding on these fronts – and NYMTC and its members are at the forefront of those efforts.

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