

Brooklyn-Queens Waterfront

The manager of a family-owned scrap-metal salvage company along the Queens side of Newtown Creek watches as backhoes lift mounds of shredded metal and deposit them into barges. Over in Williamsburg, a young couple hops off of the East River Ferry, walks past gleaming new high-rises along the waterfront and heads over to Bedford Avenue to meet friends at a coffee house. Meanwhile, in DUMBO, inside a loft space in a 19th-century factory building, a software developer creates a cutting-edge application that will be downloaded by users around the world. And outside of a 14-story brick building that is part of Red Hook Houses West, a resident who has lived in the complex since it first opened in the 1950s chats with neighbors she has known for decades.

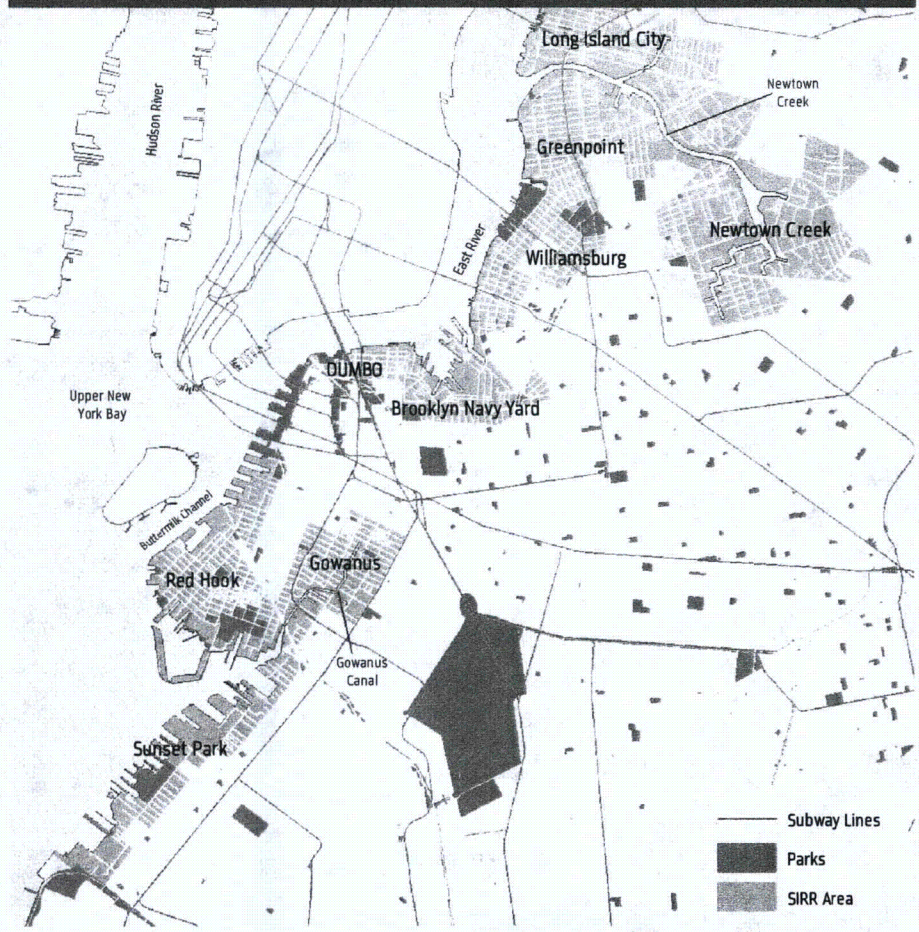
This is the Brooklyn-Queens waterfront, where old and new, past and present, historic industry and a burgeoning creative economy, all converge in a bracing, up-to-the-minute mix.

The "Waterfront," as it will be referred to in this chapter, stretches approximately 33 miles along the western edges of Brooklyn and Queens, bordering Upper New York Bay, Gowanus Bay, Buttermilk Channel, and the East River. The Waterfront includes major neighborhoods from Sunset Park, Gowanus, and Red Hook in the south, up through DUMBO and the Brooklyn Navy Yard, then north to Williamsburg, Greenpoint, and Long Island City. The area also encompasses scores of smaller neighborhoods as well as the areas along Newtown Creek. (See map: *Neighborhoods of Brooklyn-Queens Waterfront*)

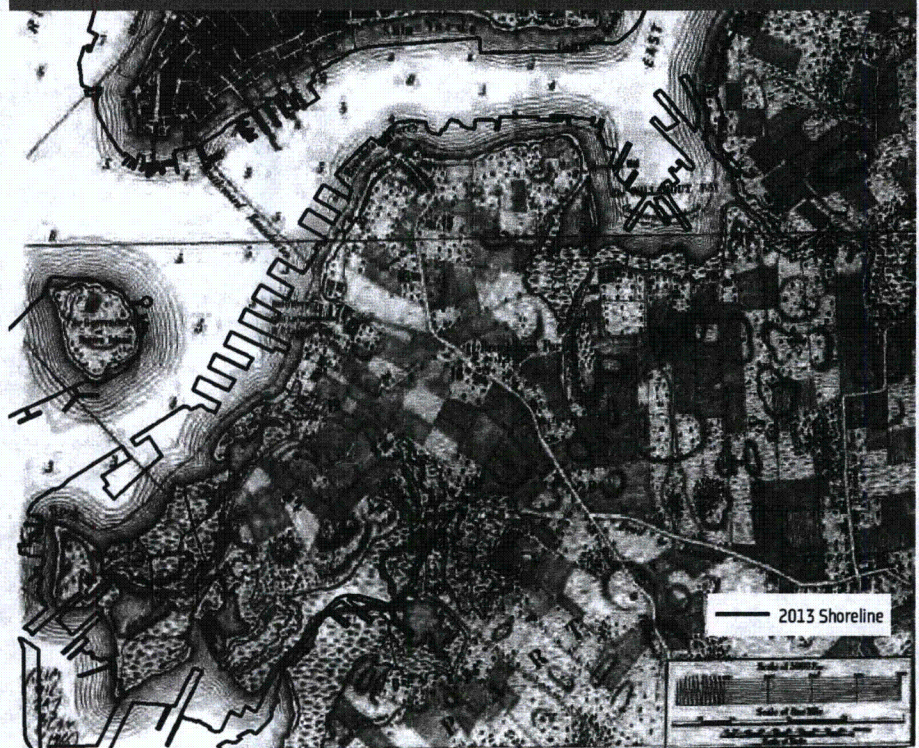
European settlers purchased much of this sprawling land from the Lenape people in the 1630s. At that time, the Waterfront largely consisted of marshlands, marked by navigable creeks and small islands. Eventually property owners and government filled in the marshes and extended and regularized the area's coastline, paving the way—literally—for development, which began in earnest in the 19th century, when the area became a center of shipbuilding, manufacturing, and waterborne commerce. Through this industrial boom, thousands of homes—mostly attached row houses—were built along or near the water to provide shelter to those whose labor was powering the businesses that dotted the area. (See map: *The Shoreline: Then and Now*)

Since the 19th century, use of this waterfront has changed greatly, with shifts in the types and amounts of waterborne activity, and the arrival of new businesses, nonprofits, and residents. In a number of areas, the City has played an active role in shaping the Waterfront, managing properties, pursuing programs to support

Neighborhoods of Brooklyn-Queens Waterfront



The Shoreline: Then and Now



industrial businesses and arts organizations, encouraging the redevelopment of underused lots for housing and open space, and increasing public access to the waterfront for recreational use and waterborne transportation.

As treasured as the neighborhoods of the Waterfront are to visitors and residents alike, the area always has been vulnerable to extreme weather—a vulnerability that is likely to increase as the climate changes in the coming years and decades. This vulnerability is due to the fact that significant sections of the Waterfront are low-lying and prone to flooding during coastal storms, placing buildings and infrastructure located there at risk. Many of these buildings are low-rise and attached, dating to the 19th century—and thus not easy candidates for flood-mitigation measures such as elevation.

The area's vulnerabilities were highlighted by Sandy. Although the Waterfront's sheltered location in New York Harbor largely protected the area from destructive waves, the storm's surge did cause extensive flooding throughout the area—in many places over 6 feet deep. Not surprisingly, flooding occurred along the Harbor and River-facing western edge of the Waterfront, inundating neighborhoods, industrial properties, and retail corridors. The surge also made its way up the Gowanus Canal and Newtown Creek, flooding areas much farther inland. The result of this deluge was damage to building systems and contents, loss of power, displacement of residents, and weeks to months of lost revenue for businesses and nonprofits.

Fortunately, as of the writing of this report, most residents of the Waterfront are back in their homes, most businesses have reopened, and key infrastructure is once again functioning. However, as extreme weather events become more severe and, in some cases, more frequent, challenges like those experienced during and after Sandy likely will increase along the Waterfront.

To help the Waterfront continue its post-Sandy recovery and face the challenges ahead, the City has developed a plan that reflects the overarching goals of this report—to seek to limit the impacts of climate change going forward, while enabling New York and its neighborhoods to bounce back quickly when those impacts cannot be averted. The plan for the Waterfront outlined in this chapter will address the area's most significant risk—its vulnerability to storm surge, particularly as sea levels rise—by adapting its coastline and addressing its exposures from inland water bodies, by facilitating retrofits of existing

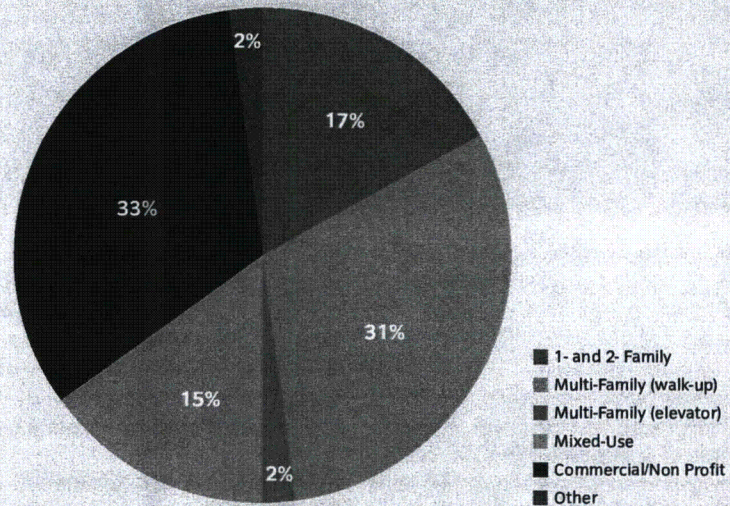
buildings and resiliency in new construction, and by protecting vital infrastructure. The plan also will address other risks the area faces, including heavy downpours, heat waves, and high winds, drawing upon citywide and locally tailored initiatives. Finally, the plan will build on the area's natural assets and local economic strengths to encourage reinvestment and growth in the many neighborhoods. Overall, the plan seeks to make the residents, businesses, nonprofits, buildings, and infrastructure of the Waterfront stronger and safer than they were before Sandy while simultaneously maintaining the area's unique character.

Area Characteristics

The Waterfront has been for centuries, and still is, home to a great diversity of people, a vital economic engine for New York City, and the site of critical infrastructure serving the entire city. Though the neighborhoods that line the Waterfront are distinct, many share important characteristics.

These common characteristics include large numbers of attached residential buildings; important industrial and water-dependent businesses; along with newer start-ups in the creative economy; communities with

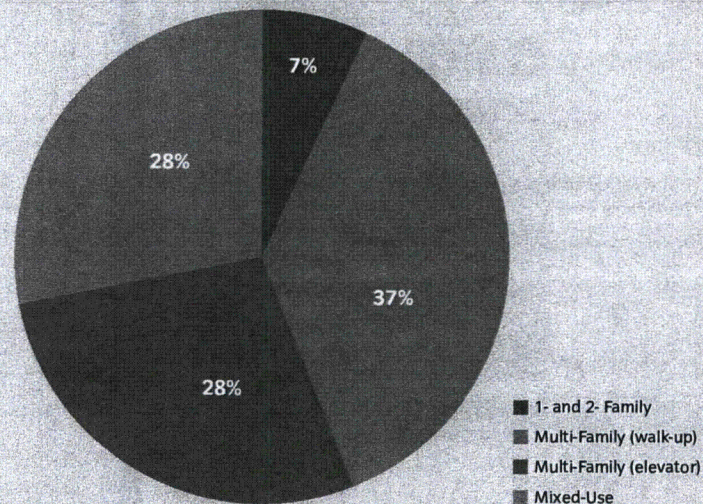
Area Buildings by Type



Total: 12,600 Buildings

Source: DCP PLUTO

Area Housing Units by Building Type



Total: 50,900 Housing Units

Source: DCP PLUTO



Typical walkups along the Waterfront

Credit: Joseph A/Flickr

large concentrations of immigrants; and, in recent years, increasing access to the water for recreational use by both residents and visitors alike.

Also, many neighborhoods along the Waterfront have a pronounced historic flavor. With the shared past of a booming industrial sector, various neighborhoods have abandoned sites that were used formerly for industrial purposes but now are designated as brownfields (see *Environmental Protection and Remediation*).

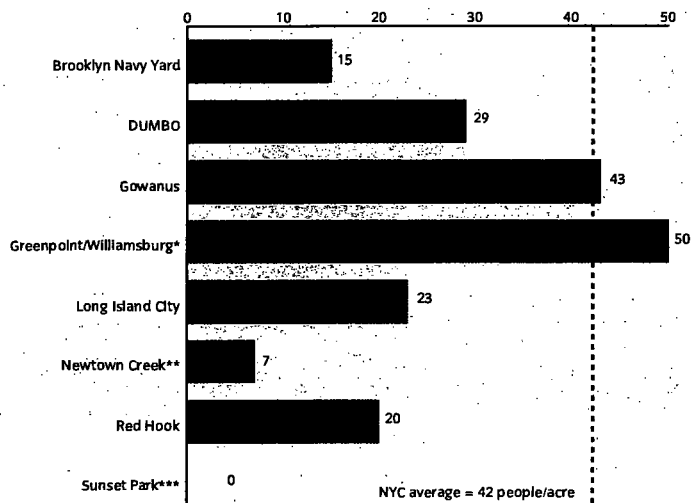
Also contributing to the historic feel is the area's building stock: only 9 percent of the area's buildings were constructed after 1983, when flood-protection standards were added to the New York City Building Code. In fact, along the Waterfront, 20 percent of all buildings and 27 percent of all residential buildings were built before 1900.

Neighborhoods and Residential Development

Residential buildings along the Waterfront, which house almost 100,000 area residents,

come in a variety of shapes and sizes. There are 1- and 2-family homes, multi-family walkups, multi-family elevator buildings, and larger mixed-use buildings. Generally, low- and mid-rise buildings from the 19th and 20th centuries predominate, with the notable exception of the new high-rise development that has taken place in Williamsburg, Long Island City, and DUMBO over the last decade or so. (See chart: *Area Buildings by Type*; See chart: *Area Housing Units by Building Type*)

Area Population Density



* Includes Greenpoint west of Manhattan Avenue
 ** Includes Greenpoint east of Manhattan Avenue
 *** Sandy Inundation Area for Sunset Park covers land that is almost exclusively commercial

Source: 2010 US Census

Because of the significant amount of area occupied by industry, the Waterfront area has a relatively low population density (20 people per acre) as compared to the citywide average (42 people per acre). The only exceptions are Greenpoint/Williamsburg (50 people per acre) and Gowanus (43 people per acre), which have more concentrated residential areas. (See chart: *Area Population Density*)

Even with their shared traits, as discussed above, each of the major neighborhoods along the Waterfront has its own character. For example, the waterfront in Sunset Park—roughly stretching from the Upper New York Bay to 3rd Avenue—remains very much a “working waterfront.” Much of the property in this area is owned by the City and managed by New York City Economic Development Corporation (NYCEDC), including the Brooklyn Army Terminal, Bush Terminal, and the South Brooklyn Marine Terminal. Together, these NYCEDC-managed properties house companies

Red Hook Past and Present

Red Hook remained largely rural and undeveloped from the mid-17th century through the mid-19th century, when the construction of sheltered ports at Atlantic Basin and Erie Basin on Red Hook's waterfront turned the area into one of the busiest shipping centers in the United States. From the beginning of the Civil War to the 1940s, ships from all over the world docked at Red Hook to load and unload cargo and for repairs and maintenance. This, in turn, attracted generations of immigrants and others to the area. To house the families of area dockworkers, in 1938, NYCHA's Red Hook Houses opened—among the first public housing complexes in the city and a model that would be replicated widely elsewhere.

In the second half of the 20th century, Red Hook's fortunes began to change. With the introduction of container shipping, many of Red Hook's dock facilities suddenly became obsolete. Rapidly, businesses—and the jobs they created—left. With the decline of the

maritime industry, the local economy weakened, a trend that was exacerbated by the construction of the Gowanus Expressway in 1946, which cut the neighborhood off from the rest of Brooklyn. At the same time, the area saw crime rates soar.

Over the past two decades, however, Red Hook has begun to turn around. Several factors, including community and government initiatives such as the Red Hook Community Justice Center, helped to contribute to the area's renaissance. As crime plummeted and community-based organizations increased their presence in the neighborhood, public and private investment followed. Businesses, including larger retailers, opened on and near Van Brunt Street, bringing new visitors and economic activity to the area.

However, transportation options to and through Red Hook remain limited. Red Hook lacks a subway stop, with the closest one

requiring crossing heavily trafficked Hamilton Avenue. This is a particular issue for area residents who face long commutes to work. In many cases, schools, healthcare, and other key services are also not easily accessible. The limited availability of public transit also has affected a number of the local businesses that have opened in recent years, making it difficult for them to attract a large customer base.

Transit access is not the only challenge Red Hook faces. The area is also vulnerable to weather-related events. This is because much of the neighborhood rests on low-lying former marshland, leaving it flood-prone. As demonstrated during Sandy, such flooding can damage the mechanical systems of buildings, the possessions of those living in ground-floor residential units, the inventory of ground-floor retailers, and the heavy equipment and products of industrial businesses.

that employ nearly 4,500 people, and, as of the writing of this report, occupancy at one of them, the Brooklyn Army Terminal, standing at 98 percent. Most of Sunset Park's nearly 2,100 residents, including a large immigrant population, live uphill of this waterfront area, and work on the waterfront.

Just north of Sunset Park lies the neighborhood of Gowanus, home to nearly 18,000 residents. Gowanus has a long industrial history centered on the 1.8-mile Gowanus Canal, which extends inland from Gowanus Bay. The Canal was once among the busiest industrial and commercial inland waterways in the United States. As a result, during its earlier history, the Canal suffered significant pollution. As of the writing of this report, it is in the early stages of the Environmental Protection Agency's (EPA) Superfund cleanup process. Though the Canal now is the site of much less maritime activity than in the past, the activity that does occur along the Canal is facilitated by the five New York City Department of Transportation (NYCDOT) movable bridges that cross the water body. Residents of Gowanus tend to live in attached walkup apartment buildings (many of which were built for industrial workers) or 1- and 2-family homes. Additionally, Gowanus Houses and Wyck-off Gardens, New York City Housing Authority (NYCHA) developments, together contain over 1,600 housing units. In recent years, Gowanus has seen the construction of some new low- and mid-rise residential buildings. More such buildings have been proposed for the future.

West of Gowanus is the peninsula of Red Hook, surrounded by Gowanus Bay, the Upper Bay, and Buttermilk Channel. A true mixed-use neighborhood, Red Hook contains residential and large- and small-scale commercial and industrial uses. The neighborhood was once one of the most active freight ports in the world. As of the writing of this report, significant maritime industrial uses remain. These include the Port Authority of New York and New Jersey's (the Port Authority) Red Hook Container Terminal, home to large businesses such as Phoenix Beverages, and Atlantic Basin and the Brooklyn Cruise Terminal, managed by NYCEDC. Elsewhere in the neighborhood, Red Hook contains a wide range of other industrial businesses, including a growing group of artisanal food and drink manufacturers. Van Brunt Street, the primary commercial corridor, is lined by restaurants and small businesses, as is Columbia Street, a burgeoning sub-neighborhood along the waterfront, just north of Red Hook. Larger retailers in the area, including IKEA and the Fairway supermarket, have also opened in Red Hook in recent years.

Meanwhile, Red Hook's 14,000 residents reside in a variety of buildings, though the majority live in NYCHA's Red Hook Houses, the largest public housing development in Brooklyn. An important piece of infrastructure, the Gowanus Expressway, under which runs Hamilton Avenue, forms the northern boundary of Red Hook, with the entrance to the Hugh L. Carey Tunnel (formerly Brooklyn-Battery) also on the

neighborhood's northern end. (See sidebar: *Red Hook Past and Present*)

Farther north along the Waterfront lies DUMBO, short for "Down Under the Manhattan Bridge Overpass." This area is characterized by a wide range of building types, including multi-story 19th- and 20th-century industrial lofts, glass-and-steel towers, and mixed-use walkups, many on cobblestone streets. In 2007, much of the area was designated an historic district by the Landmarks Preservation Commission (LPC), which described the neighborhood as "essential to Brooklyn's rise as a major American industrial center." In recent years, the area has grown, attracting new development and residents and supporting an active arts community as well as a growing technology sector. The area also has seen significant public and private investment, such as the opening of the first phases of Brooklyn Bridge Park beginning in 2010. As of the writing of this report, DUMBO, including the small Vinegar Hill neighborhood on its northern edge, has a population of 3,600.

Northeast of DUMBO is the Brooklyn Navy Yard, an industrial facility that first opened in 1801. The Navy Yard was one of the nation's preeminent Naval ship building facilities until its closure in 1966. Decommissioned and sold to the City in 1968, the 300-acre industrial park is operated by the Brooklyn Navy Yard Development Corporation (BNYDC) and is home to over 300 industrial businesses that employ

Socioeconomic Characteristics								
Area	Population	Poverty Rate	Median Household Income	Households	Owner-Occupied Housing Units	% Homeowners	% Owner-Occupied Housing Units with Mortgage	Median Owner-Occupied Unit Value
Brooklyn Navy Yard	5,100	36%	\$37,900	1,300	350	27%	60%	\$506,800
DUMBO	3,600	5%	\$167,700	1,300	600	46%	95%	\$1,000,000+
Gowanus	17,800	18%	\$68,500	8,000	2,000	25%	64%	\$854,100
Greenpoint/Williamsburg *	35,800	20%	\$60,400	15,300	2,700	18%	65%	\$705,800
Long Island City	9,700	7%	\$92,100	4,200	1,000	23%	81%	\$619,300
Newtown Creek**	12,400	19%	\$52,000	4,500	700	16%	59%	\$678,400
Red Hook	13,800	33%	\$47,700	5,900	870	15%	81%	\$615,600
Sunset Park ***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
Citywide Total/Average	8,175,000	19%	\$51,300	3,050,000	993,500	33%	64%	\$514,900

* Includes Greenpoint, west of Manhattan Avenue

** Includes Greenpoint, east of Manhattan Avenue

*** Sandy Inundation Area for Sunset Park covers land that is almost exclusively commercial

Source: 2010 US Census, 2011 American Community Survey, 5-Year estimate

6,400 workers. A residential community just east of the Navy Yard is compromised primarily of multi-family walk-ups.

Extending along the East River from the edge of the Brooklyn Navy Yard is Williamsburg. This neighborhood, too, has a storied industrial past. Today, it still retains significant industrial pockets. However, in recent years it has grown more residential, with a very diverse population. Some of the changes in Williamsburg have come about as a result of a rezoning that occurred in 2005. At that time, in an effort to reactivate vast stretches of Williamsburg's industrial waterfront, which had fallen into disuse, and to build on the momentum that the neighborhood was experiencing as young artists and others moved into older industrial loft buildings, the City rezoned much of the northern part of the neighborhood. This rezoning allowed the construction of much-needed new housing, including significant numbers of affordable housing units. It also created a blueprint for developing new public open space. After the rezoning, high-density waterfront development and mid-rise development farther inland took place. This development has resulted in some of the few buildings along the waterfront that were built to modern resiliency standards. As a result of this new development, the continuing appeal of the area to young people, and growth in

existing communities south of the Williamsburg Bridge, the area's population doubled in the first decade of the 21st century, now totaling 35,800, including the population in western Greenpoint.

The same 2005 rezoning that has been helping to revitalize Williamsburg also applied to Williamsburg's northern neighbor, Greenpoint, the northernmost part of Brooklyn. Though this area has seen less residential development following the rezoning than Williamsburg, substantial development is expected. Meanwhile, east of McGuinness Boulevard, Greenpoint retains an active industrial area. Its population is largely working-class and multi-generational, with concentrations of immigrant communities.

Bordering Greenpoint, and separating Brooklyn from Queens, is Newtown Creek, a 3.5-mile channel that extends deep into both boroughs. The area surrounding Newtown Creek includes portions of the Brooklyn neighborhoods of Greenpoint, East Williamsburg, and Bushwick, and the Queens neighborhoods of Long Island City and Maspeth. Newtown Creek remains an active industrial waterway, spanned by six movable bridges managed by NYCDOT and bordered by bulkheads suited to maritime use. As happened on the Gowanus Canal, past industrial uses along the Creek were responsible for significant contamination. In

2010, therefore, the EPA designated the Creek as a Superfund site. Cleanup efforts pursuant to the Superfund program are expected to start in a decade, following a study of the waterway's contamination, which will be completed in 2015. There are over 2,700 buildings along the Creek, housing 12,400 people and 1,800 businesses. Though over half of the surrounding buildings are occupied by maritime and other industrial uses, nearly 40 percent are residential walkups and 1- to 2-family homes.

The northernmost area of the Waterfront is Long Island City, located at the intersection of the East River and Newtown Creek. It is a transportation hub, with easy access to Manhattan. Long Island City is also a flourishing arts center and an important business center, with large commercial buildings, housing, and, among other things, back offices for Citigroup and the headquarters for JetBlue. A 2001 rezoning led to the development of new waterfront residential buildings that are complemented by other large projects such as Queens West and Hunter's Point South, the largest middle-income housing development in the city since Starrett City. Large new buildings are under construction at both sites.

Socioeconomic Characteristics

In aggregate, the socioeconomic profile of the Waterfront approximates the profile of the city

as a whole. However, there are wide variations from neighborhood to neighborhood. For example, the median household income in Red Hook is \$47,700, and the poverty rate in the area stands at approximately 33 percent. Meanwhile, in DUMBO the equivalent figures are \$167,700 and 5 percent, respectively. Great socioeconomic diversity can be found even within several of these neighborhoods. For example, according to a New York Times census analysis, in Williamsburg, in one census tract nearly 45 percent of households have a median income of \$100,000 or more, while in the census tract just to its south, 46 percent of the population makes under \$30,000. (See table: *Socioeconomic Characteristics*)

Businesses, Nonprofits, and the Local Economy

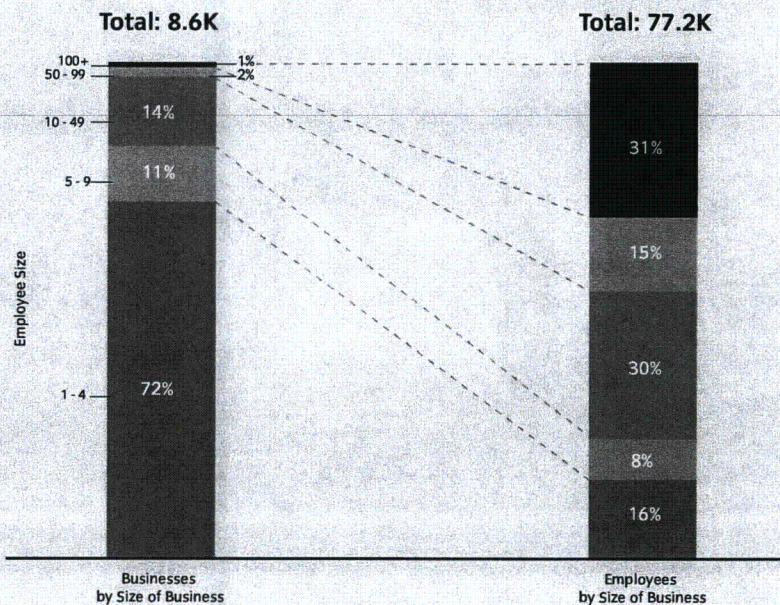
While the neighborhoods along the Waterfront contain a wide variety of businesses—totaling approximately 8,600 companies employing over 77,200 people—the most significant sector in the area remains the industrial sector, as was the case years ago. As of the writing of this report, industrial businesses make up nearly 40% of all businesses and nearly all of the area's large employers (those with 100 or more employees). These businesses range from food and equipment manufacturers to civil engineering firms. (See chart: *Profile of Area Businesses by Industry*)

Approximately 22 percent of buildings along the Waterfront have industrial uses in them. However, because they tend to be among the area's larger buildings, they account for about 40 percent of the total built square footage. Many of these industrial businesses perform important operations out in the open, including those involved in auto dismantling, recycling, and asphalt and cement manufacturing.

Retail businesses are also an important part of the economy along the Waterfront. They not only contribute to the active street life serving area residents but attract visitors from across the city and beyond. Some of the Waterfront's most vibrant commercial corridors include Van Brunt Street and the Columbia Street Waterfront District in Red Hook, as well as Manhattan and Bedford Avenues in Greenpoint/Williamsburg, and Vernon Boulevard and Jackson Avenue in Long Island City.

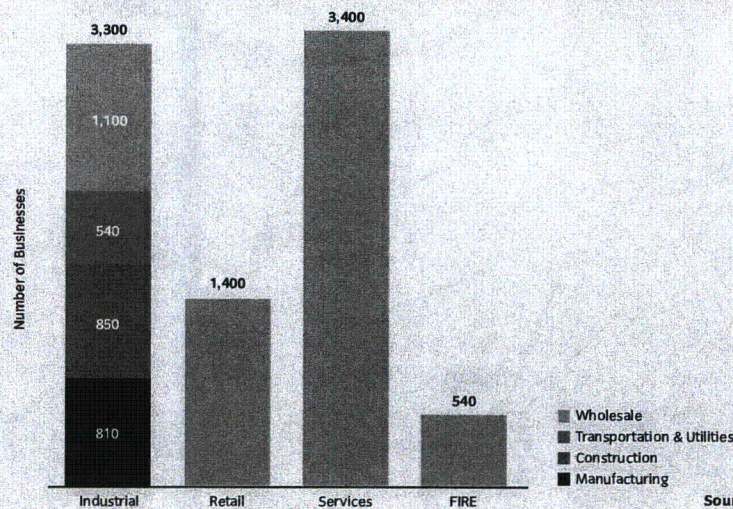
The arts community is another important economic engine along the Waterfront. There are galleries, event spaces, and theaters throughout the area. The area is also home to social service organizations that provide essential services to the area's low-income population, strengthen economic development, and offer employment opportunities.

Profile of Area Businesses



Source: Hoovers

Profile of Area Businesses by Industry



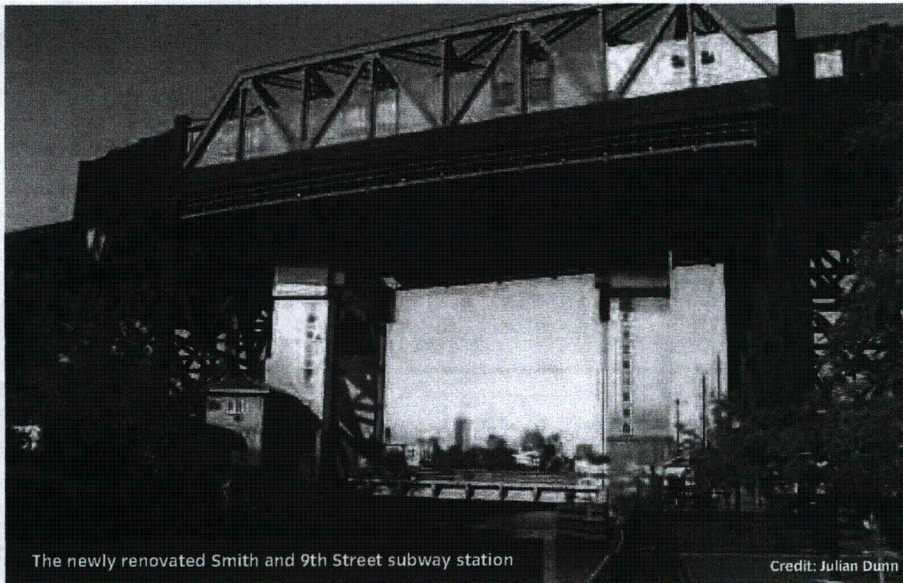
Source: Hoovers

Overall, the Waterfront is dominated by small businesses (those employing fewer than five people), which represent about 72 percent of area businesses. Large businesses also play an important role, though, with approximately 31 percent of all people employed along the Waterfront working for businesses with over 100 employees. (See chart: *Profile of Area Businesses*)

Critical Infrastructure

The Waterfront contains critical infrastructure that serves the entire region. For example, the Waterfront is host to a variety of important transportation assets. These include the eastern terminuses of two vehicular tunnels,

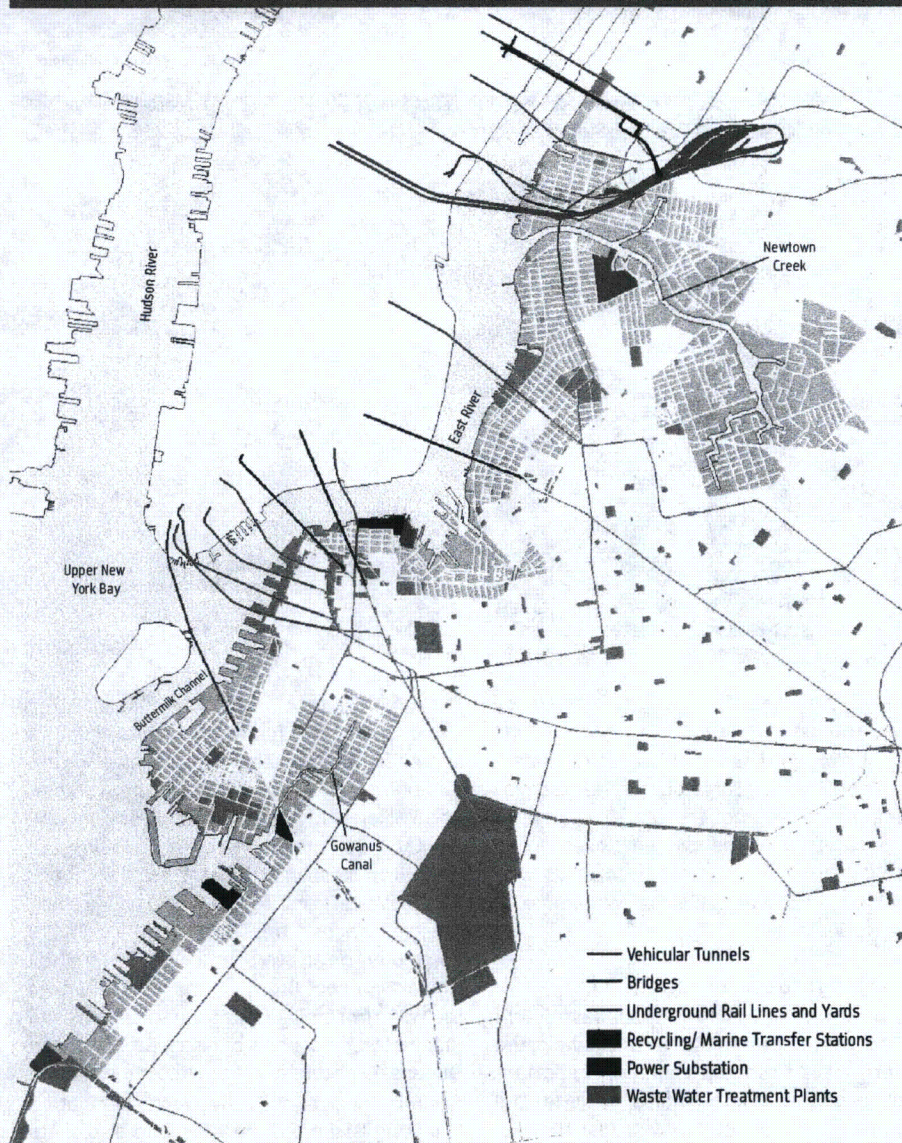
the Hugh L. Carey Tunnel in Red Hook and the Queens Midtown Tunnel in Long Island City. Together, these two tunnels transport nearly 140,000 commuters on an average workday. The Williamsburg, Manhattan, Brooklyn, and Ed Koch Queensboro Bridges spanning the East River, meanwhile, link the neighborhoods of the Waterfront to Manhattan. Together, these bridges transport over 600,000 commuters on an average workday. Six subway tunnels connect Brooklyn and Manhattan via the Waterfront, while four connect Queens and Manhattan, and one connects Brooklyn and Queens. Four tunnels carrying commuter and Amtrak train service between Manhattan and Long Island and New England also route



The newly renovated Smith and 9th Street subway station

Credit: Julian Dunn

Area Critical Infrastructure



through Long Island City. The Waterfront is also home to one of two NYCDOT asphalt plants (located on Hamilton Avenue), as well as Sunnyside Yards, one of the most active rail yards in the United States, in Long Island City.

Several Department of Environmental Protection (DEP) facilities are found along the Waterfront. These include the Owls Head Wastewater Treatment Plant (WWTP) in Sunset Park, the Red Hook WWTP near the Navy Yard, and the Newtown Creek WWTP in Greenpoint, which together serve over 2 million people and handle nearly 500 million gallons of wastewater per day. Ten pumping stations in the area help convey sewage and stormwater to these plants.

The Hamilton Avenue Marine Transfer Station, currently under construction, is one of four marine transfer stations citywide that will reduce truck traffic by shifting the transportation of solid waste to barges for transfer to landfills. Meanwhile, a major recycling facility is being developed by Sims at the South Brooklyn Marine Terminal in Sunset Park and is expected to be operational by 2015 (see Chapter 13, *Other Critical Networks*).

Important power assets along the Waterfront include Con Edison's Farragut Substation. Located between DUMBO and the Brooklyn Navy Yard, this substation is a vital piece of the electrical infrastructure that ensures the flow of power to Lower Manhattan and much of northern Brooklyn. (See map: *Area Critical Infrastructure*)

What Happened During Sandy

Given their locations in the Harbor, Waterfront neighborhoods generally were protected from Sandy's most destructive "wave action." However, storm surge coming directly off the Harbor and East River as well as the inland water bodies—the Gowanus Canal and Newtown Creek—did substantial damage in many areas. Flooding in some places exceeded 6 feet, overwhelming low-lying areas and inundating basements and ground floors. The flooding also overwhelmed the city's sewers in many places, resulting in sewage backing up into homes and businesses, as well as combined sewer overflows (CSOs). Not surprisingly, however, the extent and type of damage along the Waterfront varied greatly from neighborhood to neighborhood. (See map: *Area Inundation and Surge Height*)

For example, in Sunset Park, surge waters overtopped the banks of the East River from around 17th Street to 63rd Street. The

floodwaters pushed as far east as 3rd Avenue, between approximately 24th and 39th Streets. Generally, though, thanks to the steep elevation change between the largely industrial waterfront area and the residential areas to the east, Sandy resulted in very little impact on the area's residential population.

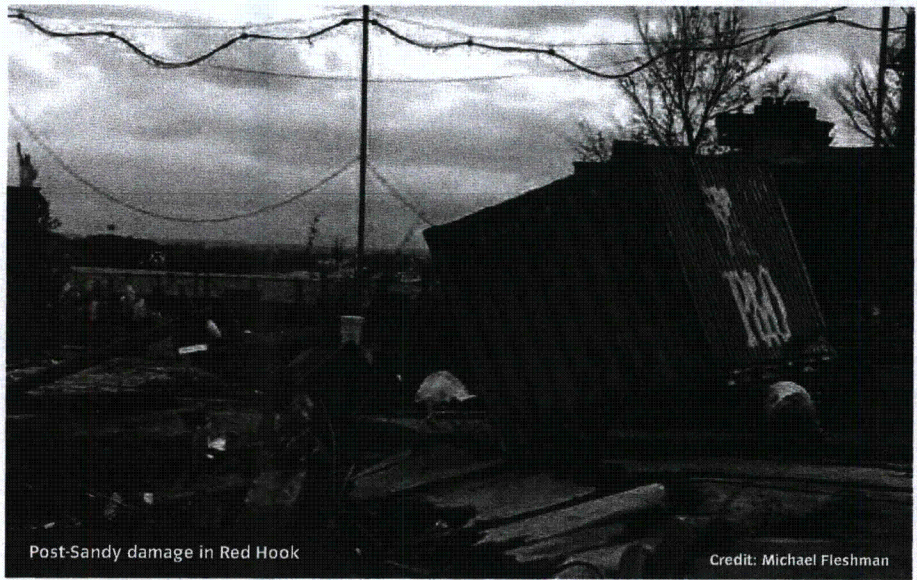
In Red Hook, water flooded the neighborhood from all three of its coasts—from the Upper Bay, Buttermilk Channel, and Gowanus Bay. This inundation impacted much of the neighborhood, including NYCHA's Red Hook Houses, save for a small elevated section around Coffey Street and a few streets in northern Red Hook close to Hamilton Avenue. Properties along the Columbia Street Waterfront District also experienced significant flooding.

In Gowanus, the impacts from Sandy came mainly from Gowanus Bay, which, as it filled with Sandy's surge, elevated water levels in the Gowanus Canal. Sandy's floodwaters eventually overtopped the Canal's bulkheads, inundating industrial and residential buildings surrounding the Canal. Although a significant community concern in the wake of the storm was whether the floodwaters from this Superfund site had contaminated the area, EPA testing showed that the toxic sediment at the bottom of the Canal remained largely undisturbed, and that bacteria levels in the floodwaters did not pose a significant health risk.

In DUMBO, meanwhile, waters from the East River flooded buildings along several streets, including Main Street and Water Street. And in the Brooklyn Navy Yard, approximately 20 of the Navy Yard's 45 buildings, mostly in the southwest section of the Yard, were flooded with between 4 and 6 feet of water.

In contrast, flooding and damage in Williamsburg was minimal, with waters rarely going far inland. The limited damage was due in part to the higher elevation of some of the new buildings in the area, as well as the buildings' esplanades, which served as an effective buffer for floodwaters.

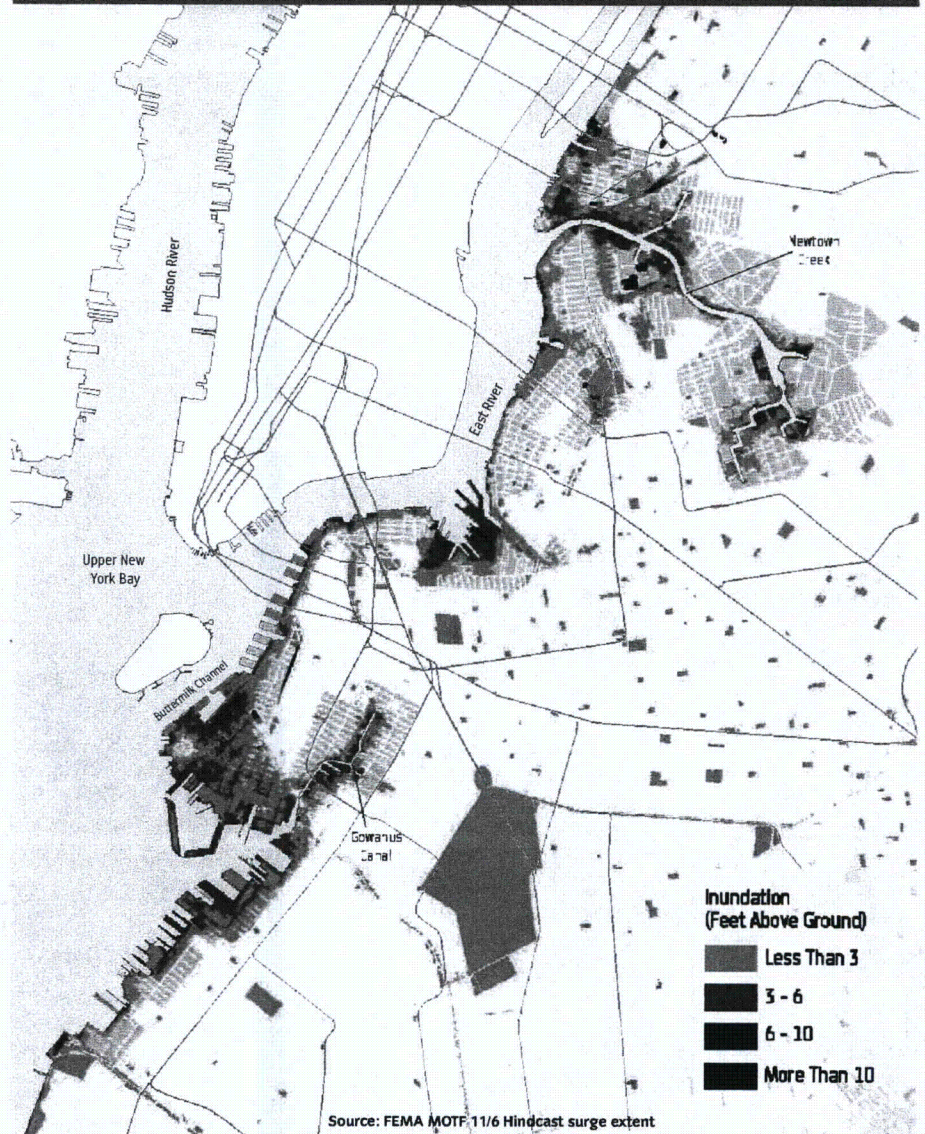
In Greenpoint, though, water from the East River and Newtown Creek caused flooding of streets and properties all along the neighborhood's perimeters. Floodwaters, for example, came significantly inland in the neighborhood's northeast, entering largely along Greenpoint Avenue and McGuinness Boulevard. The area also experienced flooding in its southwest section, close to the border it shares with Williamsburg.



Post-Sandy damage in Red Hook

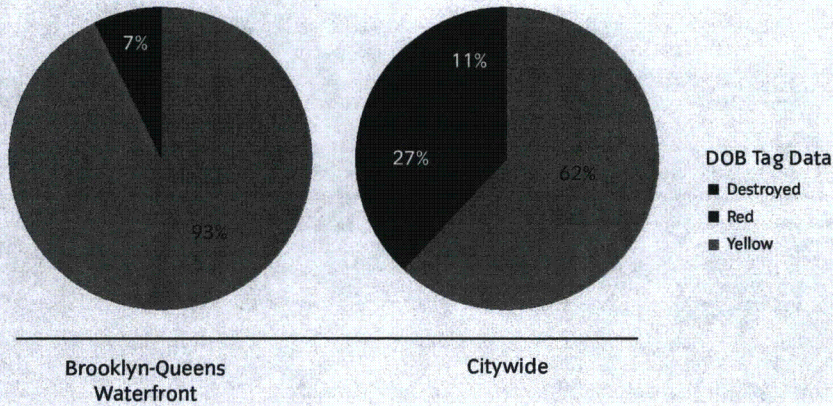
Credit: Michael Fleshman

Area Inundation and Surge Height



Source: FEMA MOTF 11/6 Hindcast surge extent

Level of Building Damage

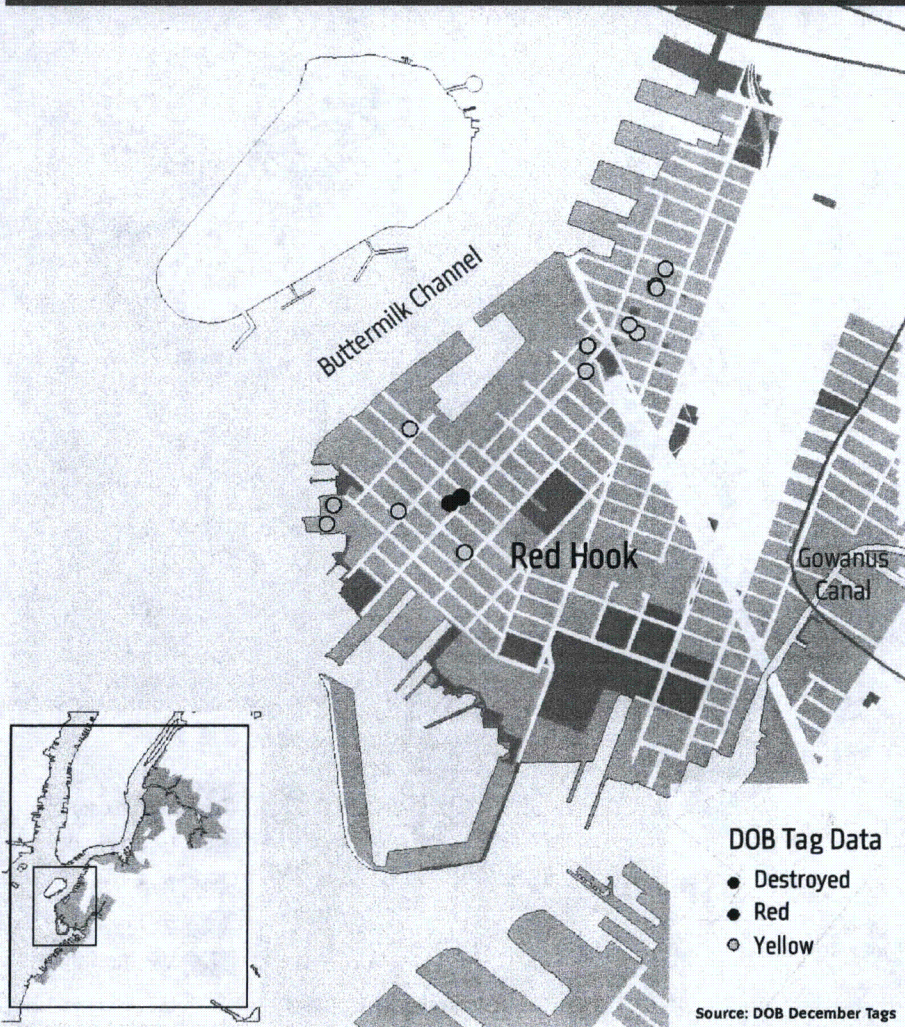


As Sandy's surge pushed into Newtown Creek from the East River, the Creek carried those waters inland, including to parts of Maspeth, Bushwick, and East Williamsburg. As with floodwaters off of the Gowanus Canal, floodwaters off of Newtown Creek also raised health concerns in surrounding communities. However, EPA testing here also showed that bacteria levels did not appear to pose a danger to area residents. The EPA also found that, post-Sandy, the various chemicals for which it tested were all below levels that should cause concern for area residents.

In Long Island City, inundation came from Newtown Creek as well as the East River, primarily via Anable Basin. While much of the neighborhood was unaffected, many buildings—such as those along 2nd Street, 5th Street, 51st Avenue, and Borden Avenue—experienced up to 6 feet of flooding, with important public infrastructure, such as Gantry Plaza State Park, also affected.

Source: DOB December Tags

Location and Level of Building Damage – Red Hook

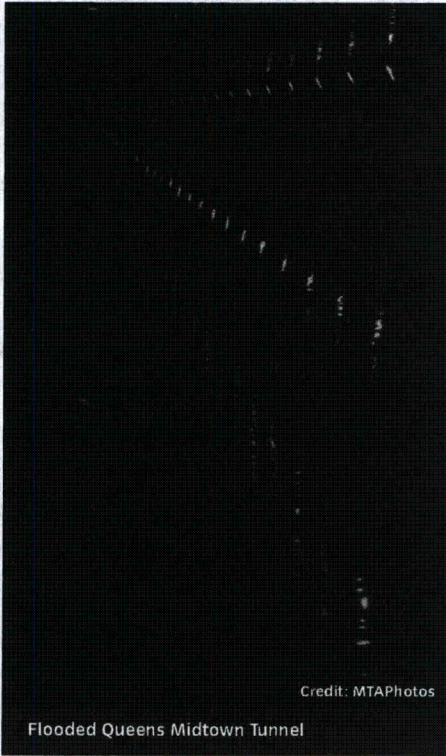


As a result of Sandy, a large number of buildings along the Waterfront suffered damage. After the storm, the New York City Department of Buildings (DOB) sent out inspectors to assess damages in buildings along the Waterfront and in other inundated areas of the City. These inspectors were asked to assign "tags" to buildings based on the observed condition of each structure. "Green" tags indicated less serious damage or no damage at all. "Yellow" tags indicated that portions of a building might be unsafe or might have significant non-structural damage. "Red" tags indicated structural damage. And a subcategory of "red" tags was further categorized as "destroyed."

The most methodologically rigorous building damage assessment undertaken by DOB was completed in December 2012. According to this assessment, of those buildings citywide that were tagged either yellow or red (including those further classified as destroyed), a relatively small percentage were located along the Brooklyn-Queens Waterfront. This is likely less a reflection of the relative damage in the area and more a reflection of the fact that, in doing these assessments, DOB was primarily focused on ocean-facing parts of the city, where a higher incidence of structural damage occurred. Regardless, to the extent that DOB did tag damaged buildings along the Waterfront, these buildings tended to be clustered in the Red Hook and Greenpoint neighborhoods.

Overall, along the Waterfront, the percentage of red and yellow tagged buildings that were tagged yellow (93 percent) was higher than the percentage citywide (62 percent). This largely was a result of the nature of the area's flooding

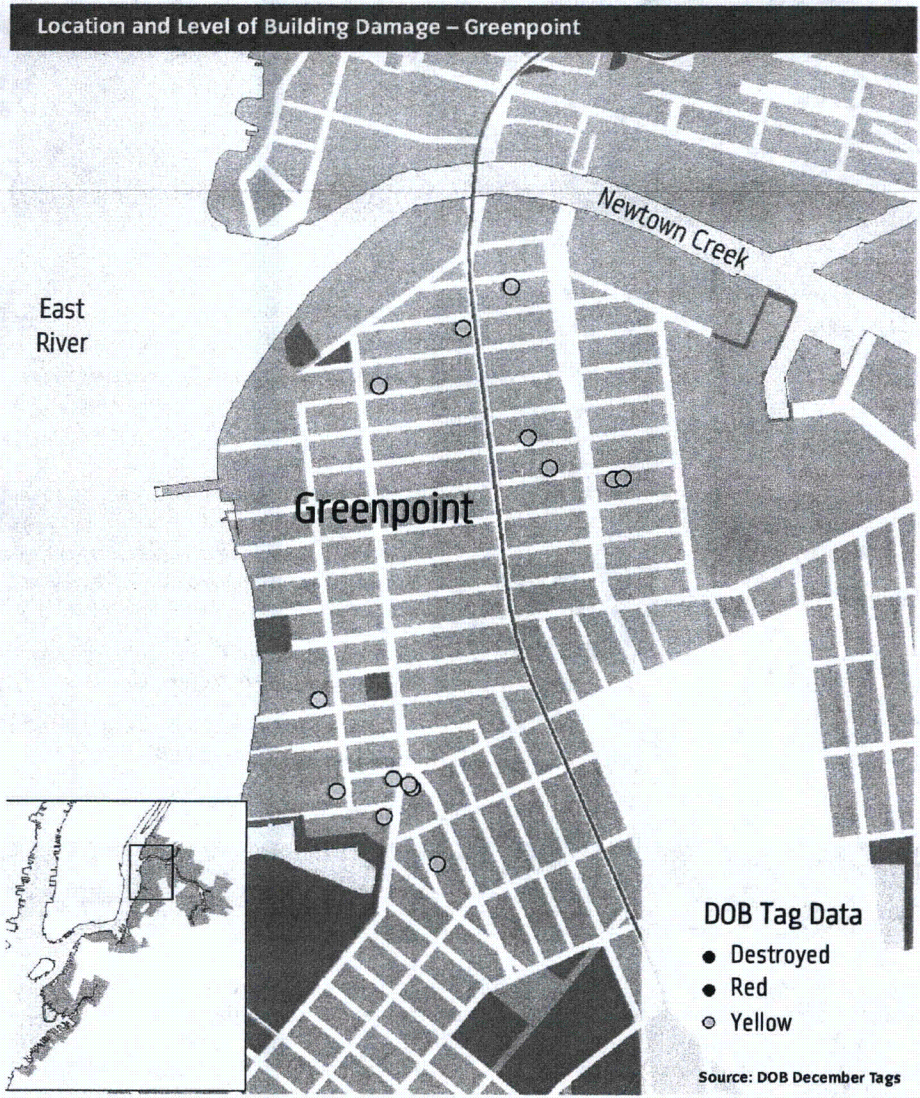
Source: DOB December Tags



(stillwater inundation, as opposed to destructive wave action), which tended to cause less structural damage and instead caused damage to building systems and contents. (See map: *Location and Level of Building Damage*)

Overall, along the Waterfront, over 1,300 residential buildings were within the inundation area, and these buildings contained nearly 16,200 residential units. In many cases, Sandy's inundation forced people out of their homes for days, weeks, and even months. In some cases, this was because they lived in flooded ground-floor or basement apartments that were destroyed by flooding. In others, such as along Pioneer Street in Red Hook, it was because vital building mechanical systems supporting their living spaces were knocked out of service.

Among the residential inventory impacted by Sandy were units in NYCHA developments along the Waterfront. The flooding of mechanical systems in the Gowanus Houses, for example, shut down the development's power, while residents of Red Hook Houses faced the challenges of weeks without power, heat, and, sometimes, running water. This was particularly difficult for residents who were elderly and/or had disabilities. In response, a massive volunteer effort in Red Hook coalesced to help these vulnerable residents, coordinated by existing community-based organizations (including Red Hook Initiative, Added Value, and the Red Hook Community Justice Center), as well as groups formed in response to Sandy (including Red Hook Coalition and Restore Red Hook). At the



same time, NYCHA staff, dealing with similar challenges in multiple locations, worked night and day to make necessary repairs and secure generators and temporary boilers to get these buildings back online.

Also impacted by Sandy were Waterfront businesses, which were impacted significantly by the storm, particularly as floodwaters filled ground floors and basements, damaging building systems and contents. In total, approximately 3,100 businesses employing some 34,600 people were impacted by Sandy. A number of retail businesses both large and small were also severely affected, including stores and restaurants along Van Brunt Street in Red Hook. Nearby, Fairway Market, an important area anchor, had to gut its Red Hook store, though it reopened after four months.

Some industrial structures, such as the Brooklyn Army Terminal, which was built at a relatively higher elevation and with a hardened exterior, were impacted only minimally. The Terminal

also benefitted from the foresight of NYCEDC property managers who brought in a backup generator from out-of-state as Sandy arrived.

Other industrial buildings, however, experienced greater challenges. At Bush Terminal, flooding of mechanical and electrical equipment resulted in the loss of Con Edison power for days, though NYCEDC property managers were able to restore power in eight buildings within 10 days and all buildings within 15 days, by sourcing generators from around the region. At the South Brooklyn Marine Terminal, a tenant storing new cars lost over 100 vehicles to a combination of inundation and fire. Meanwhile, at the Brooklyn Navy Yard, electric substations, boilers and dry docks, as well as bulkheads, were damaged significantly. Navy Yard tenants are estimated to have lost over \$75 million worth of equipment and inventory. Though the Navy Yard was able to help tenants reopen quickly, repairs continue as of the writing of this report. Generally speaking, maritime businesses along the Waterfront largely were able to protect

Risk Assessment: Impact of Climate Change

Major Risk Moderate Risk Minor Risk

Scale of Impact

Hazard	Today	2020s	2050s	Comments
Gradual				
Sea level rise				Some areas already experience occasional flooding from creeks; sea level rise likely would result in increases in localized flooding
Increased precipitation				Combined sewage and stormwater could exceed the capacity of wastewater treatment plants, leading to releases of untreated or partially treated sewage into waterways
Higher average temperature				Minimal impact
Extreme Events				
Storm surge				Significant risk of flooding from both coastal and inland water bodies (e.g., runoff, sewer backups), as evidenced by Sandy; risk primarily to building systems
Heavy downpour				Sewer system capacity may be exceeded more frequently, leading to street flooding, sewer backup and combined sewer overflow
Heat wave				Greater strain on power system with potential for more failures; most significant impact on high-rise buildings
High winds				Minimal impact

their vessels from Sandy, with professional mariners manning these ships during the storm to keep them safe. However, many of these businesses did experience significant damage to their landside operations.

Along the Waterfront, Sandy's floodwaters disturbed hazardous substances on a number of existing and former industrial sites. However, after Sandy's departure, DEP conducted extensive inspections of sites that had been known to contain hazardous materials in the floodplain, and generally found conditions to be safe (see *Environmental Protection and Remediation*).

Sandy also had a major impact on infrastructure along the Waterfront. For example, after Sandy, the Queens Midtown Tunnel was closed for a week and a half due to extensive flooding. Meanwhile, the Hugh L. Carey Tunnel, took nearly three weeks to be reopened fully to the public. Together, the two tunnels were flooded

with approximately 72 million of gallons of water. Subway service across the area was knocked out, as it was throughout the city. The Montague Subway Tunnel, which connects Brooklyn and Manhattan along the R line, experienced the worst flooding, shuttering R train service for nearly two months. Other lines, however, were generally back in service within a week. While the subways were out of service, the City's East River Ferry service ran modified routes that helped connect Brooklyn, Queens, and Manhattan, carrying double the number of passengers than would be carried on an ordinary weekday, during the first three days following the storm.

Sandy also impacted two major wastewater treatment plants. The Owls Head plant was partially impaired, due to the loss of its primary electrical systems. However, the plant was able to continue all treatment processes throughout the storm, though some loss of

capacity resulted in the release of only partially treated sewage. The Newtown Creek facility, meanwhile, lost approximately half of its flow after the Manhattan Pumping Station shut down due to significant flooding. This plant, too, however, continued to treat sewage throughout the storm.

Other infrastructure along the Waterfront also sustained damage. Brooklyn Bridge Park suffered damage to electrical systems, but in general proved to be flood-resilient, as designed, allowing the park to reopen within days. Additionally, three public schools in the neighborhoods along the Waterfront were impacted by Sandy, including P.S. 15, P.S. 78, and the PAVE Academy Charter School. These schools were closed for up to 21 days, during which time students were sent to other locations.

What Could Happen in the Future

Going forward, the neighborhoods along the Waterfront face a variety of challenges as the climate changes.

Major Risks

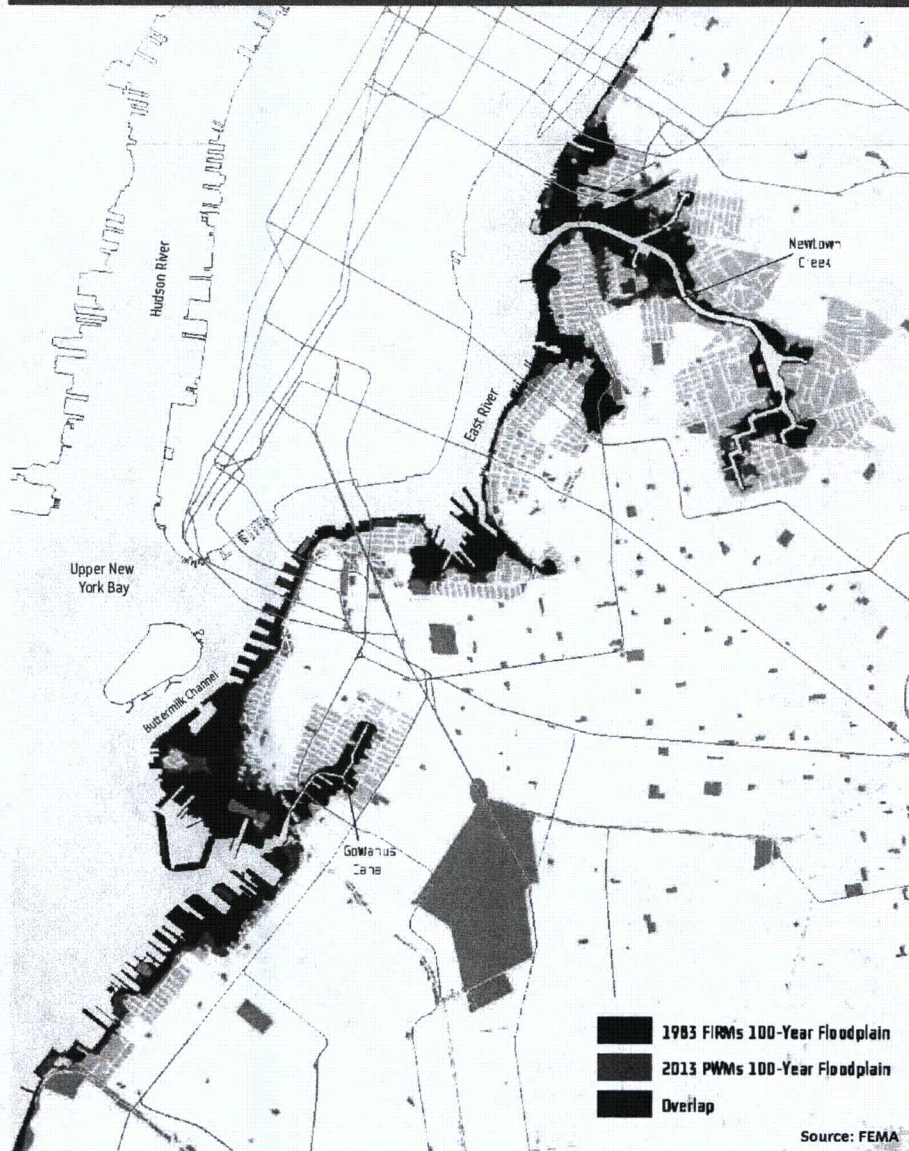
Given the Waterfront's coastal exposure, the most significant climate change-related risks for its neighborhoods are storm surge and flooding from coastal storms, which is likely to be exacerbated by projected sea level rise. This risk is significant even today along the Waterfront, as illustrated by flood maps released in June 2013 by the Federal Emergency Management Authority (FEMA). According to these Preliminary Work Maps (PWMs), the 100-year floodplain, the area with a 1 percent or greater chance of flooding in any given year, has expanded beyond that shown on the 1983 maps that were in effect when Sandy hit. In the new maps, the growth in the floodplain is most pronounced in Red Hook, Greenpoint, and Long Island City. The new maps show an expanded V Zone, the area where waves could exceed 3 feet in height, along the length of the Waterfront's coastline, including along piers containing buildings and equipment. (See map: *Comparison of 1983 FIRMs and Preliminary Work Maps*)

As the 100-year floodplain has expanded in size, there has been also an increase in the number of buildings in the floodplain—a 6 percent rise in residential buildings (from approximately 850 to 900 buildings) and a 15 percent increase in commercial buildings (from almost 1,350 to nearly 1,550 buildings). In addition, approximately 100 buildings—all commercial—are now located in a V Zone. Base Flood Elevations (BFE)—the height to which floodwaters could rise during a storm—have increased 1 to 3 feet throughout the area.

Critical infrastructure assets also are in the PWM 100-year floodplain, including the Owls Head, Red Hook, and Newtown Creek WWTPs, as well as Con Edison's Farragut Substation. Significant transportation infrastructure, such as the entrances to the Queens Midtown and the Hugh L. Carey Tunnels, also remain in the floodplain.

According to projections from the New York City Panel on Climate Change (NPCC), described in Chapter 2 (*Climate Analysis*), sea levels are forecast to rise through the 2020s and 2050s. During this period, the floodplain will expand, and throughout the area, BFEs could increase, resulting in a risk of even higher floodwaters during storms. (See table: *Buildings in the 100-Year Floodplain*)

Comparison of 1983 FIRMs and Preliminary Work Maps



Buildings in the 100-Year Floodplain				
Buildings & Units	100-Year Floodplain			
	1983 FIRMs	2013 PWMs	Projected 2020s	Projected 2050s
Residential Buildings	850	890	2,130	2,960
Residential Units	12,100	10,800	19,600	23,900
Commercial and Other Buildings	1,430	1,650	2,500	2,740

Note: From the 1983 FIRMs to the PWMs the floodplain retracts in parts of Long Island City and Greenpoint, leading to the decrease in residential units in the floodplain.

Source: DCP Pluto, FEMA, CUNY Institute for Sustainable Cities

The additional growth in the floodplain into Williamsburg and Greenpoint is expected primarily east of the Navy Yard, and farther north in Long Island City. The floodplain also extends farther from Newtown Creek on both the Brooklyn and Queens sides. Along with this expansion, according to NPCC's high end projections, the number of buildings in the 100-year floodplain could rise to over 4,500 by the 2020s (a 71 percent increase over PWMs) and to over 5,700 by the 2050s (an additional 44 percent increase over the PWMs). (See map: *Comparison of Preliminary Work Maps and Future Floodplains*)

Other Risks

Though coastal inundation poses the greatest threat to the neighborhoods along the Waterfront, these neighborhoods face other climate risks as well. For example, sea level rise—even without extreme weather events such as hurricanes—could lead to increased frequency and severity of street, basement, and sewer flooding in some communities by the 2050s.

Increased precipitation and more and heavier downpours also could overwhelm sewer systems, resulting in more flooding, as well as result in increased numbers of CSO events. While future projections for changes in wind speeds are not available from the NPCC, a greater frequency of intense coastal storms by the 2050s could present a greater risk of high winds in the New York area, which could result in downed overhead power lines and trees, and potentially damage older buildings not constructed to modern wind standards.

Finally, higher average temperatures outside of heat waves are not expected to cause meaningful impacts on the neighborhoods along the Waterfront. However, heat waves could lead to more frequent power outages and may strain industrial equipment and machinery. (See chart: *Risk Assessment: Impact of Climate Change*)

Comparison of Preliminary Work Maps and Future Floodplains





Brooklyn-Queens Waterfront community outreach workshop

Priorities from Public Engagement Along the Brooklyn-Queens Waterfront

Since the Special Initiative for Rebuilding and Resiliency (SIRR) was launched in December 2012, the input of local stakeholders has helped shape an understanding of what happened during Sandy, what risks the Brooklyn-Queens Waterfront faces in relation to climate change, and what approaches make sense to address these risks.

The area along the Waterfront is represented by a wide-array of elected officials at the Federal, State, and local levels. It also is represented by five community boards. The area is further served by a large number of community-based organizations, civic groups, faith-based organizations, and other neighborhood stakeholders. All played an important role in relief and recovery efforts after Sandy. Throughout the process of developing this plan, SIRR staff benefited from numerous conversations—both formal and informal—with these groups and individuals, including, along the Waterfront, two task forces that met regularly.

Task Force	Briefing Frequency	# of Stakeholders from the Brooklyn-Queens Waterfront
Elected Officials	Monthly	~20 City, State, Federal elected officials
Community-Based Organizations	4-6 weeks	5 community boards 40+ faith-based, business, and community organizations





SIRR also held three public workshops in March and April of 2013 along the Waterfront, part of a series of such workshops held citywide in which over 1,000 New Yorkers participated to discuss issues affecting their neighborhoods and communicate their priorities for the future of their homes and communities. Generally, the on-the-ground insights provided at these public workshops helped SIRR staff to develop a deeper understanding of the specific priorities of, and challenges facing, the communities of the Waterfront.

Overall, out of the various task force and other meetings and public workshops attended by SIRR staff since January, several priorities for the Waterfront and the SIRR effort clearly emerged:

- address the major expense of repairs and resiliency for low-rise buildings;
- understand the tremendous hurdles attached properties face in meeting FEMA guidelines;
- provide flood protection from inland water bodies;
- mitigate street and property flooding, combined sewer overflow events;
- address the particular risks of industrial properties; and
- increase transportation redundancy.

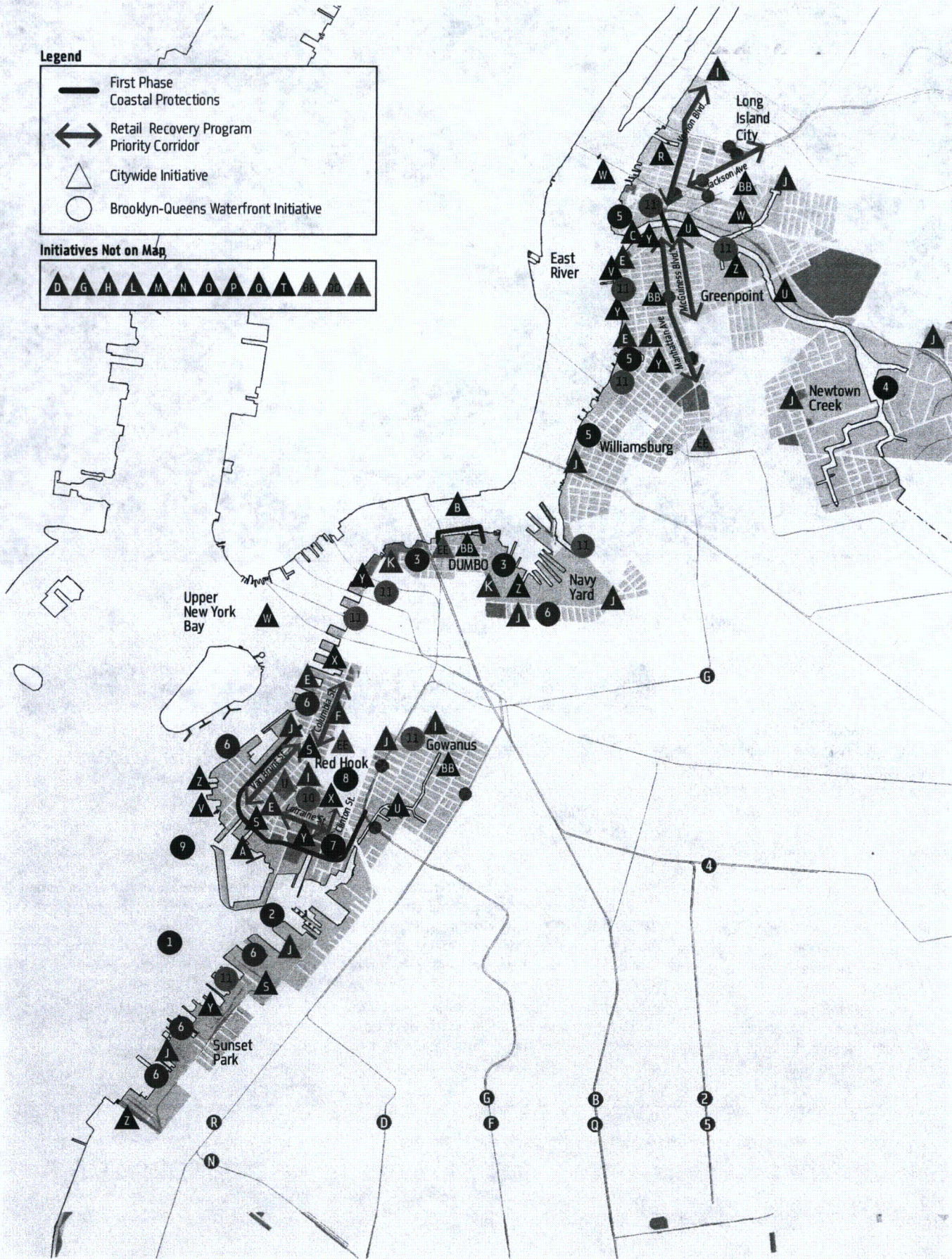
BROOKLYN-QUEENS WATERFRONT | Initiative Summary

Legend

-  First Phase Coastal Protections
-  Retail Recovery Program Priority Corridor
-  Citywide Initiative
-  Brooklyn-Queens Waterfront Initiative

Initiatives Not on Map

-  D
-  G
-  H
-  L
-  M
-  N
-  O
-  P
-  Q
-  T
-  U
-  V
-  W
-  X
-  Y
-  Z



Coastal Protection

Selected Citywide Measures

- A** Install integrated flood protection system in Red Hook
 - B** Call on and work with Con Edison to protect the Farragut substation
 - C** Call on and work with the (USACE) to study and install local storm surge barriers at Newtown Creek
- * For additional Coastal Protection initiatives, see Coastal Protection section of Community Plan

- 1** Work with Port Authority of New York and New Jersey to continue a study of innovative coastal protection measures using clean dredge material in Southwest Brooklyn
- 2** Call on and work with the USACE to develop an implementation plan and preliminary designs for a local storm surge barrier along the Gowanus Canal
- 3** Implement strategies to protect Brooklyn Bridge Park and DUMBO
- 4** Support private investments that reduce flood risk along Newtown Creek
- 5** Create an implementation plan for comprehensive flood-protection improvements on public and private property along the Williamsburg, Greenpoint and Long Island City coastlines

Buildings

Selected Citywide Measures

- D** Improve regulations for flood resiliency of new and substantially improved buildings in the 100-year floodplain
 - E** Rebuild and repair housing units destroyed and substantially damaged by Sandy
 - F** Study and implement zoning changes to encourage retrofits of existing buildings and construction of new resilient buildings in the 100-year floodplain
 - G** Amend the Building Code and complete studies to strengthen wind resiliency for new and substantially improved buildings
 - H** Encourage existing buildings in the 100-year floodplain to adopt flood resiliency measures through an incentive program and targeted mandate
 - I** Retrofit public housing units damaged by Sandy and increase future resiliency of public housing
 - J** Launch a sales tax abatement program for flood resiliency in industrial buildings
 - K** Clarify regulations relating to the retrofit of landmarked structures in the 100-year floodplain
 - L** Amend the Building Code and complete studies to improve wind resiliency for existing buildings
- * For additional Buildings initiatives, see Buildings section of Community Plan

- 6** Implement planned upgrades to vulnerable City-owned, industrial properties

Critical Infrastructure

Selected Citywide Measures

- M** Work with utilities and the Public Service Commission (PSC) to harden key electric transmission and distribution infrastructure against flooding
 - N** Work with utilities and the PSC to harden vulnerable overhead lines against winds
 - O** Work with utilities, regulators, and gas pipeline operators to harden the natural gas system against flooding
 - P** Require retrofitting of existing hospitals in 100-year floodplain
 - Q** Require retrofitting of nursing homes in 100-year floodplain
 - R** Require retrofitting of adult care facilities in 100-year floodplain
 - S** Reconstruct and resurface key streets damaged by Sandy
 - T** Elevate traffic signals and provide backup electrical power
 - U** Install watertight barriers to protect movable bridge machinery
 - V** Protect Staten Island Ferry and private ferry terminals from climate change-related threats
 - W** Call on non-City transportation agencies to implement strategies to address climate change threats
 - X** Expand the network of bus priority lanes on arterial highways
 - Y** Harden or otherwise modify shoreline parks to protect adjacent communities
 - Z** Harden pumping stations
 - AA** Harden wastewater treatment plants
 - BB** Reduce combined sewer overflow with high-level storm sewers
- * For additional Critical Infrastructure initiatives, see Critical Infrastructure sections of Community Plan

- 7** Improve connections between Red Hook and the rest of Brooklyn
- 8** Call for the MTA to explore Red Hook-Lower Manhattan bus connections
- Implement expanded free summer weekend ferry from Manhattan to Red Hook in 2013

Community & Economic Recovery

Selected Citywide Measures

- CC** Launch business recovery and resiliency programs
- BB** Launch the Neighborhood Game Changer Competition
-  Call for Neighborhood Retail Recovery Program
 - n** Columbia Street Waterfront District (Hamilton Ave. to Atlantic Ave.)
 - n** Jackson Ave. (52nd Ave. to 23rd St.)
 - n** Manhattan Ave. (Ash St. to Driggs Ave.)
 - n** McGuinness Blvd. (Ash St. to Calyer St.)
 - n** Van Brunt St. (Reed St. to Bowne St.)
 - n** Lorraine St. (Dwight St. to Hicks St.)
 - n** Clinton St. (Hamilton Ave. to Centre St.)
 - n** Vernon Blvd. (54th Ave. to Queensboro Bridge)
- EE** Support local merchants in improving and promoting local commercial corridors
- FF** Continue to support the FRESH program to increase the number of full-time grocers in underserved neighborhoods

- 10** Create and implement a revitalization strategy for targeted retail and community spaces within Red Hook Houses

- 11** Implement planned and ongoing investments by the City and private partners
 - n** Bush Terminal Piers Park
 - n** Brooklyn Bridge Park
 - n** Bushwick Inlet Park
 - n** Box Street Park
 - n** Newtown Barge Park Expansion
 - n** Hunter's Point South
 - n** Redevelopment of Brooklyn Navy Yard

This chapter contains a series of initiatives that are designed to mitigate the impacts of climate change on the Brooklyn-Queens Waterfront. In many cases, these initiatives are both ready to proceed and have identified funding sources assigned to cover their costs. With respect to these initiatives, the City intends to proceed with them as quickly as practicable, upon the receipt of identified funding.

Meanwhile, in the case of certain other initiatives described in this chapter, though these initiatives may be ready to proceed, they still do not have specific sources of funding assigned to them. In Chapter 19 (*Funding*), the City describes additional funding sources, which, if secured, would be sufficient to fund the full first phase of projects and programs described in this document over a 10-year period. The City will work aggressively on securing this funding and any necessary third-party approvals required in connection there with (i.e., from the Federal or State governments). However, until such time as these sources are secured, the City will only proceed with those initiatives for which it has adequate funding.

Brooklyn-Queens Waterfront Community Rebuilding and Resiliency Plan

The Brooklyn-Queens Waterfront is an area treasured for its diversity of people, cultures, and industries. The area benefits from a long waterfront that has been a source of jobs and economic activity for centuries, and increasingly is becoming a place for residences and public open space.

The following is a multilayered plan that not only applies citywide strategies to the neighborhoods along the Waterfront but also provides strategies designed to address the area's specific needs and particular vulnerabilities. In anticipation of future climate change-related risks, this plan proposes ways that Waterfront neighborhoods can adapt by: Addressing storm surge along the entire coastline; providing opportunities to retrofit the area's most vulnerable building stock; protecting and improving critical infrastructure; and focusing investments in strategic areas such as Red Hook to advance a long-term and sustainable recovery.

Coastal Protection

As Sandy illustrated, the greatest extreme weather-related risk faced by New York City is storm surge, the effects of which are likely to increase given current projections of sea level rise. Going forward, it is anticipated that climate change will render coastal regions of the city, including the neighborhoods of the Waterfront, even more vulnerable to these risks.

While it is impossible to *eliminate* the chance of flooding in coastal areas, the City will seek to *reduce* its frequency and effects—mitigating the impacts of sea level rise, storm waves including erosion, and inundation on the coastline of the city generally and the neighborhoods of the Waterfront in particular. Among the strategies that the City will use to achieve these goals will be the following: Increasing coastal edge elevations; minimizing upland wave zones; protecting against storm surge; and improving coastal design and governance. When evaluating coastal protection, other priorities including navigation and ongoing efforts to improve water quality and natural habitats also will be considered prior to implementation, where appropriate.

The initiatives described below provide important examples of how the City intends to advance its coastal protection agenda citywide. These initiatives will have a significant impact on the residents, businesses, and nonprofits

along the Waterfront. Taken together, when completed, the first four coastal protection initiatives described below would provide enhanced protection for over 1,600 buildings, representing over 8,700 housing units as well as many businesses and much of the critical infrastructure along the Waterfront.

For a full explanation of the following initiatives and a complete description of the City's comprehensive coastal protection plan, please refer to Chapter 3 (*Coastal Protection*).

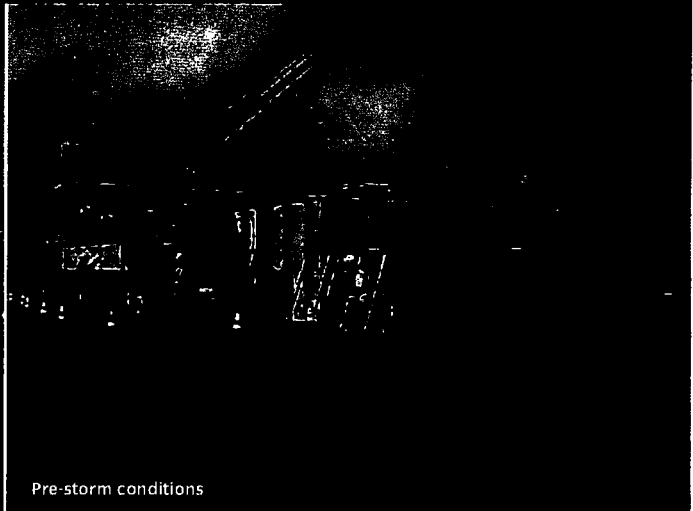
Coastal Protection Initiative 6 Raise bulkheads in low-lying neighborhoods to minimize inland tidal flooding

Bulkheads provide the first line of defense against flooding in many neighborhoods, including the Waterfront, but throughout the city many bulkheads are built to an elevation that may be insufficient given the latest projections of sea level rise by 2050. Subject to available funding, the City, therefore, will launch a program to raise bulkheads and other shoreline structures across the five boroughs in low-lying areas most at risk of daily or weekly tidal flooding, a phenomenon that could impact as much as 3 miles of the Waterfront's shoreline by the 2050s. The Mayor's Office of Long-Term Planning and Sustainability (OLTPS) will work with NYCEDC to manage this program, to begin implementation in 2013, in conjunction with the new citywide waterfront inspections program described in Chapter 3.

Coastal Protection Initiative 23 Install integrated flood protection system in Red Hook

Red Hook faces a number of challenges from climate change: A low-lying topography; older, often-attached buildings; a significant number of industrial businesses with valuable, ground-floor equipment and inventory that are difficult to elevate; vulnerable commercial corridors; and a significant population that lacks the means to make resiliency investments. These conditions make site-specific flood protection measures a challenge, likely leaving many residents, businesses, and infrastructure assets exposed. Subject to available funding, the City, therefore, will install an integrated flood protection system in Red Hook, composed of permanent features, temporary features, and landscaping and drainage improvements. This approach would protect much of the neighborhood but, at the same time, would not interfere with the neighborhood fabric during non-storm conditions. The design will be selected following an international competition and may include elevation of portions of the Brooklyn Waterfront

Conceptual Rendering of Red Hook Flood Protection System



Greenway. Other elements likely would run along the first mapped street inland of the waterfront throughout the neighborhood. The goal is to commence design in 2014 with completion expected by 2016. (See rendering: *Red Hook Flood Protection System*)

Coastal Protection Initiative 25 Call on and work with Con Edison to protect the Farragut substation

Con Edison's Farragut substation came close to flooding during Sandy. This vital element of the city's power distribution network, serving almost 500,000 customers (or approximately 1.25 million people), sits in an area of growing risk from storm surge. The City therefore, will, call on Con Edison to protect this vital electrical substation from the impacts of storm surge. To accomplish this, Con Edison could consider floodwalls along the perimeter of the facility or other measures to meet a higher design standard for flood protection. This project could be incorporated into Con Edison's upcoming rate case at the State's Public Service Commission (PSC). OLTPS will monitor and support with technical assistance the rapid implementation of this project.

Coastal Protection Initiative 26 Call on and work with the United States Army Corps of Engineers (USACE) to study and install local storm surge barriers at Newtown Creek

Newtown Creek was the source of extensive flooding during Sandy, carrying its surge miles inland. The risk of such flooding in the future is expected to grow as the climate changes. The City, through OLTPS, therefore, will call on the USACE to develop an implementation plan for, and construct, a storm surge barrier and

associated levees at the mouth of Newtown Creek. Such a barrier would be navigable during non-storm periods and would close in advance of storm activity to protect the areas inland of the barrier. As Newtown Creek is a Superfund site, proper coordination with the EPA and others will be required to implement the project successfully. Water quality impacts also will be considered in the study of this project. OLTPS will seek to have the USACE complete this project, subject to available funding, within six years following the completion of the development by USACE of its study. (See rendering: *Newtown Creek Surge Barrier*)

Beyond the priority coastal protection projects described in Chapter 3, including those summarized briefly above, the City is proposing

additional coastal protection initiatives specific to the Waterfront's vulnerabilities. These initiatives are described below.

Brooklyn-Queens Waterfront Initiative 1 Work with the Port Authority to continue a study of innovative coastal protection measures using clean dredge material in Southwest Brooklyn

Many pier-based businesses along the Waterfront, including some in Southwest Brooklyn, lie within a V Zone and, thus, may be subject to damaging waves during a storm. This risk is expected to grow in the future as the climate changes. The City, acting through NYCEDC, will work with the Port Authority to explore in-water protection measures, including a breakwater constructed from clean dredge material, and the creation of an oyster habitat

Conceptual Rendering of Newtown Creek Surge Barrier



and wetlands within Bay Ridge Flats, a shallow area offshore of Red Hook and Sunset Park and adjacent to Bay Ridge Channel. This combination of strategies could decrease the strength of surge impacting Southwest Brooklyn during extreme weather events. As part of the study, the City and the Port Authority will work with the New York State Department of Environmental Conservation and the United States Coast Guard to explore how construction activities could be staged so as to minimize impacts on shipping and anchoring. NYCEDC will pursue this effort in 2013.

Brooklyn-Queens Waterfront Initiative 2
Call on and work with the USACE to develop an implementation plan and preliminary designs for a local storm surge barrier along the Gowanus Canal

Much of the area surrounding the Gowanus Canal lies within FEMA's 100-year floodplain, even without accounting for climate change. The land surrounding the Canal supports a variety of land uses and densities, with all structures in the area at risk of flooding. Because flood protection along the length of the coastal edges of the Canal may be extremely expensive, disruptive, and in some cases nearly impossible, the City, through OLTPS, will call for the USACE to create an implementation plan and complete preliminary designs for a local storm surge barrier at the mouth of the Gowanus Canal. Such a barrier could provide comprehensive protection for the entire area. As the Gowanus Canal is a Superfund site, proper coordination with the EPA and others would be required to implement the project successfully. One potential location for the proposed barrier is across the Gowanus Bay from Erie Basin to 29th Street in Sunset Park. Such a barrier would be supported by a raised levee along both piers connected to natural high points, preventing flooding to properties near the barrier. The barrier would have the added benefit of creating a new stormwater basin that could be used to facilitate drainage. The barrier would be navigable to allow for continued shipping traffic along this working waterfront.

Brooklyn-Queens Waterfront Initiative 3
Implement strategies to protect Brooklyn Bridge Park and DUMBO

Parts of Brooklyn Bridge Park sit below FEMA's base flood elevations (BFEs) and, therefore, are exposed to storm surge, even without accounting for climate change. To mitigate this risk, the City, through the Brooklyn Bridge Park Corporation, will make investments to increase park elevation along its waterfront, will create additional "rip rap" edges to reduce the impact of wave action, will select soils and plant

material for future park phases that will increase resiliency and will work with the future developer of the John Street development site in DUMBO to elevate the new building and its coastal edges. These investments will begin in 2014.

Sandy also showed that the entire DUMBO waterfront is vulnerable to coastal flooding. This vulnerability is expected to increase as the climate changes. Subject to available funding, OLTPS will create a long-term implementation plan for an integrated flood protection system to protect the DUMBO neighborhood. The goal is to commence the plan in 2014.

Brooklyn-Queens Waterfront Initiative 4
Support private investments that reduce flood risk along Newtown Creek

Although the storm surge barrier at Newtown Creek described above would provide comprehensive protection for nearby properties, it could take time to build, leaving industrial and residential properties at risk in the near-term. A barrier also would not protect against the impacts of sea level rise outside of extreme weather events. The City, therefore, will offer technical assistance to businesses interested in obtaining relevant permits and investing private capital in restoring and upgrading bulkheads and making additional improvements that provide protection against flooding and sea level rise. NYCEDC will work with individual businesses, as well as local business improvement districts (BIDs) and local development corporations, to identify and advance these private investments, focusing, in particular, on the complicated permitting process that often accompanies them. The goal is that by the end of 2013, NYCEDC will advertise its support to businesses through local stakeholder groups.

Brooklyn-Queens Waterfront Initiative 5
Create an implementation plan for comprehensive flood-protection improvements on public and private property along the Williamsburg, Greenpoint, and Long Island City coastlines

Along the length of Williamsburg, Greenpoint, and Long Island City, significant new development is expected, presenting an opportunity to create a more resilient coastline. Subject to available funding, the City, through OLTPS in coordination with the Department of City Planning (DCP), the New York City Department of Parks and Recreation (DPR), and NYCDOT, will investigate resiliency strategies that rely on public and private solutions for these portions of the Waterfront, and can be implemented incrementally over time. Measures may include protections on private property that increase

flood resiliency for new development projects and the neighborhoods that they front, such as as well as edge elevations along esplanades and open spaces that provide flood protection and could be integrated into zoning regulations, and protections on public property, such as, increased street elevations and resiliency measures incorporated into park designs. These measures would ultimately be integrated into other proposed protection measures such as the proposed Newtown Creek surge barrier (see Coastal Protection Initiative 26), and the proposed program for raising bulkheads in low-lying areas (see Coastal Protection Initiative 6). The goal is to complete this study by 2015.

Buildings

The city's buildings give physical form to New York. As Sandy demonstrated, however, the building stock citywide, including along the Waterfront, is highly vulnerable to extreme weather events—a vulnerability that is expected to increase in the future. While the coastal protection measures outlined above are designed to reduce the effects of sea level rise, storm surge, and wave action on the city and the neighborhoods of the Waterfront, these measures will not completely eliminate those risks. They also will take time to design, fund, and build. It is equally important, therefore, to supplement these measures by pursuing resiliency at the *building* level.

To achieve building-level resiliency, the City will seek to protect structures along the Waterfront and throughout the five boroughs against a spectrum of climate risks, including not only flooding but also high winds and other extreme events. Among the strategies that the City will use to achieve these goals will be to construct new buildings to the highest resiliency standards and retrofit as many existing buildings as possible so that they will be significantly better prepared to handle the impacts of extreme weather events.

The initiatives described below provide important examples of how the City intends to advance building resiliency citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough building resiliency plan, please refer to Chapter 4 (*Buildings*).

Buildings Initiative 1 **Improve regulations for flood resiliency of new and substantially improved buildings in the 100-year floodplain**

Though buildings constructed to modern Construction Codes generally performed well during Sandy, given the increasing risk of flooding that is likely with climate change, modifications are warranted. The City, therefore, will seek to amend the Construction Codes and Zoning Resolution to provide for strengthened requirements that will, among other things, improve the design of new buildings through the application of appropriate resiliency measures that are calibrated to the best floodplain data available over time and that critical building systems are better-protected from flood risks. In 2013, the City, through OLTPS, will seek to implement these code changes and DCP will continue to take zoning changes through the public review process, with the goal of adoption before the end of the year. If adopted, they will improve resiliency for developments along the Waterfront, including thousands of units of new housing that are permitted to be constructed both in Greenpoint and Williamsburg, following the rezoning of that neighborhood approved by the City Council and City Planning Commission in 2005, and in Long Island City at Hunter's Point South and Queens West.

Buildings Initiative 2 **Rebuild and repair housing units destroyed and substantially damaged by Sandy**

Roughly 23,000 private residential buildings encompassing nearly 70,000 housing units were damaged or destroyed during Sandy. Subject to available funding, the City, therefore, through the Mayor's Office of Housing Recovery Operations (HRO), will provide financial and other assistance to owners of residential properties that were destroyed or substantially damaged during Sandy, including approximately 30 residential buildings encompassing approximately 80 housing units in the Waterfront neighborhoods. To address the damages sustained and to more effectively prepare these significantly damaged buildings for future storm events, the City either will assist owners or, in limited cases meeting City criteria, will facilitate the acquisition of properties by new owners whom it will assist, in rebuilding and substantially improving these properties based on the best floodplain data available over time. Additionally, the City is seeking to incorporate resiliency measures into approximately 500 to 600 multifamily properties that sustained minor damage including many publicly assisted properties such as those developed pursuant

to the Mitchell-Lama program and other affordable housing programs. The City, therefore, will support the retrofit of these publicly-assisted buildings, such as those developed pursuant to Mitchell-Lama and other affordable housing programs.

Buildings Initiative 3 **Study and implement zoning changes to encourage retrofits of existing buildings and construction of new resilient buildings in the 100-year floodplain**

The City, through DCP, will undertake a series of citywide and neighborhood-specific land use studies to address key planning issues in severely affected and vulnerable communities. As part of these studies, the City will identify ways to facilitate the voluntary construction of new, more resilient building stock, and to encourage voluntary retrofits of existing vulnerable buildings over time. To be undertaken in close consultation with local residents, elected officials, and other community stakeholders, these land use studies will focus on the challenges posed by the combination of flood exposure of the applicable neighborhoods and the vulnerability of the building types that are found in these neighborhoods (e.g., older, attached buildings that cannot easily or cost-effectively be elevated out of floodplains). Along the Waterfront, DCP will examine neighborhoods including the Columbia Street Waterfront District. Subject to available funding, the goal would be for DCP to commence this study in 2013. Thereafter, DCP would move to implement changes, if any, that it deems to be appropriate based on the results.

Buildings Initiative 5 **Work with New York State to identify eligible communities for the New York Smart Home Buyout Program**

The City will evaluate opportunities for collaboration with the State in connection with its home buyout program, using an objective set of criteria developed by the City, including extreme vulnerability, consensus among a critical mass of contiguous local residents, and other relevant factors. It is anticipated that these criteria will be met in a limited number of areas citywide. As of the writing of this report, no areas have been identified for this program along the Waterfront.

Buildings Initiative 6 **Amend the Building Code and complete studies to strengthen wind resiliency for new and substantially improved buildings**

As noted above, buildings constructed to modern Building Code standards generally performed well during Sandy. Sandy, however, brought relatively weak winds, compared to other hurricanes. Given the possibility of more frequent or intense wind events in the future, modifications to the Building Code are warranted. The City, therefore, through OLTPS, will seek to amend the Building Code to provide for strengthened requirements so that new buildings citywide can meet enhanced standards for wind resiliency. The City will further study whether additional wind resiliency standards should be required going forward. The amendments will be submitted to the City Council for adoption, and the study will commence, in 2013.

Buildings Initiative 7 **Encourage existing buildings in the 100-year floodplain to adopt flood resiliency measures through an incentive program and targeted mandate**

Even if every structure destroyed or damaged by Sandy were rebuilt to the highest resiliency standards, this would still leave tens of thousands of existing structures in the 100-year floodplain vulnerable—with more becoming vulnerable as the climate changes. Subject to available funding, the City, therefore, will launch a \$1.2 billion program to provide incentives to owners of existing buildings in the 100-year floodplain to encourage them to make resiliency investments in those buildings. Of the up to \$1.2 billion available through the program, the City will reserve up to \$100 million for 1- to 3-family homes, up to \$500 million for distribution across the five boroughs based on each borough's share of vulnerable buildings citywide, and \$100 million for affordable housing developments. The City also will mandate that large buildings (those with seven or more stories that are more than 300,000 square feet in size) undertake certain flood resiliency investments by 2030. If the City consistently achieves its stated goal of encouraging significant resiliency retrofit investments for the vast majority of the built floor area in the 100-year floodplain in the five boroughs, over 8,000 housing units encompassing approximately 45 million square feet of built space along the Waterfront would, over time, be made meaningfully less vulnerable. The goal is to launch these programs in 2013.

Buildings Initiative 8

Establish Community Design Centers to assist property owners in developing design solutions for reconstruction and retrofitting, and connect them to available City programs

The City, through HRO, will establish Community Design Centers in neighborhoods across the city, potentially including the Waterfront, to assist property owners in developing design solutions for reconstruction and retrofitting, and connect them to available City programs. The Centers would be managed by the City—through agencies such as HRO, the Department of Housing Preservation and Development (HPD), DOB, DCP, and NYCEDC—with support from local partners.

Buildings Initiative 9

Retrofit public housing units damaged by Sandy and increase future resiliency of public housing

During Sandy, public housing developments owned and operated by NYCHA suffered significant damage throughout the city. Still more were not impacted by Sandy but remain vulnerable to extreme weather, with even more likely to become vulnerable as the climate changes. The City, therefore, through NYCHA, will repair public housing developments across the City that were damaged by Sandy, incorporating new flood resiliency measures. Along the Waterfront, 28 buildings containing nearly 3,000 units will be repaired. NYCHA also will undertake a planning process to identify additional resiliency investments in developments that are vulnerable to weather-related events, even if they were unaffected by Sandy. Along the Waterfront, NYCHA, subject to available funding, is evaluating resiliency investments in 36 buildings containing nearly 3,000 additional units.

Buildings Initiative 10

Launch a sales tax abatement program for flood resiliency in industrial buildings

As Sandy demonstrated, many industrial buildings are vulnerable to extreme weather, with more likely to become vulnerable as the climate changes. However, many industrial buildings margins, making it challenging to invest in resiliency. The city, through the New York City Industrial Development Agency (NYCIDA), therefore, will launch a \$10 million program to provide incentives to owners of industrial buildings to encourage them to make resiliency investments in those buildings. The program will prioritize 1- to 2-story buildings with more than 4 feet between their actual

ground elevation and the applicable BFEs. Along the Waterfront, approximately 1,250 industrial buildings with over 29 million square feet of floor area will be eligible for this program. The program will be launched in 2013.

Buildings Initiative 11

Launch a competition to increase flood resiliency in building systems

Many existing strategies for improving resiliency in buildings are either imperfect, expensive, or a combination of both. The City, through NYCEDC, therefore, will launch an approximately \$40 million Resiliency Technologies Competition using allocated Community Development Block Grant (CDBG) funding to encourage the development, deployment, and testing of new resiliency technologies for building systems. Along the Waterfront, 2,540 buildings will be eligible to benefit from this competition. The program will be launched in 2013.

Buildings Initiative 12

Clarify regulations relating to the retrofit of landmarked structures in the 100-year floodplain

The City, through LPC, will clarify the Commission's regulations to assist owners of landmarked buildings and properties in landmarked districts in the 100-year floodplain who are contemplating retrofit projects. Along the Waterfront, there are 9 landmarked buildings in the floodplain, including buildings in the DUMBO Historic District and Fulton Ferry Historic District. The Commission will issue its clarifying regulations in 2013.

Buildings Initiative 13

Amend the Building Code to improve wind resiliency for existing buildings and complete studies of potential retrofits

As noted above, given the possibility for more frequent intense wind events in the future, modifications to the Building Code are warranted. The City, therefore, through OLTPS, will seek to amend the Building Code and expand the existing DOB Façade Inspection Safety Program for high-rise buildings to include rooftop structures and equipment. The City will further study whether additional wind resiliency standards are required going forward. These amendments will be submitted to the City Council for adoption and the study will commence in 2013.

Beyond the priority building resiliency projects described in Chapter 4, including those summarized briefly above, the City is proposing

an additional building resiliency initiative specific to the Waterfront's vulnerabilities.

Brooklyn-Queens Waterfront Initiative 6

Implement planned upgrades to vulnerable City-owned, industrial properties

As Sandy showed, numerous properties managed by City-affiliated entities, including the BNYDC and NYCEDC, lie within the 100-year floodplain and, therefore, are vulnerable to extreme weather events. To address the flood risks at these sites, the City will invest in upgrading these properties. Subject to available funding, upgrades, most of which will be completed by summer 2014, will include:

- Bush Terminal: Elevating electrical, mechanical, and safety systems; and installing watertight conduits.
- Brooklyn Navy Yard: Raising electrical substations; installing waterproof doors to the pump wells serving the dry docks; strengthening bulkheads; and evaluating building-specific protections.
- Brooklyn Army Terminal: Installing flood-proof doors; and moving backup generators out of the 500-year floodplain.
- Brooklyn Cruise Terminal: Raising electrical equipment to newly created mezzanines; and installing water-resistant floor materials.
- South Brooklyn Marine Terminal and Bush Terminal: Studying installation of in-water flood protections and developing operational plans to move valuable equipment out of vulnerable areas.

Insurance

Insurance can help provide residents and businesses with financial protection against losses from climate change and other types of risks. Sandy not only highlighted the importance of insurance, it also revealed that many New Yorkers are exposed to flood losses, which are not covered in standard homeowners or small business property insurance policies. Citywide, 95 percent of homeowners carry homeowners insurance, but when Sandy struck, less than 50 percent of residential buildings in the effective 100-year floodplain had coverage through the National Flood Insurance Program (NFIP), a Federal program, administered by FEMA that provides flood insurance to properties in participating communities like New York City. While larger properties, in particular large commercial properties, tend to purchase flood insurance through the private market, NFIP is the primary source of flood insurance for homeowners throughout the country. The City estimates that, in areas of the Waterfront inundated by Sandy, less than 16 percent of residential

properties are typically insured under the NFIP, including 1- to 2- family homes, amongst others, actually had policies in force during Sandy. Furthermore, Sandy drew attention to the significant cost increases in flood insurance that many New Yorkers will soon face, resulting from recent reforms to the NFIP as required by the Biggert-Waters Flood Insurance Reform Act.

The City will use several strategies to encourage more New Yorkers to seek coverage and to ensure the NFIP meets the needs of policyholders citywide. Specifically, the City will work to: Address affordability issues for the most financially vulnerable policyholders; define mitigation measures that are feasible in an urban environment such as the Waterfront communities and create commensurate premium credits to lower the cost of insurance for property owners who invest in these measures; encourage the NFIP to expand pricing options (including options for higher deductibles) to give potential policyholders more flexibility to make choices about coverage; and launch efforts to improve consumer awareness, to help policyholders make informed choices. The initiatives described below are important examples of how the City will advance these strategies. These initiatives will have a major impact on the residents, small businesses, and nonprofits in this community. For a full explanation of the following initiatives and a complete description of the City's five-borough insurance reform plan, please refer to Chapter 5 (*Insurance*).

Insurance Initiative 1

Support Federal efforts to address affordability issues related to reform of the NFIP

The City will call on FEMA to work with the National Academy of Sciences to complete the study of flood insurance affordability, as required under the Biggert-Waters Act. The City will urge its Federal government partners to comply with this provision of the Act and take swift action to enact the recommendations.

Insurance Initiative 4

Call on FEMA to develop mitigation credits for resiliency measures

The NFIP provides few incentives for property owners to protect their buildings from flood damage and reduce their premiums, other than by elevating their buildings—actually lifting structures above flood elevation levels. In an urban environment such as the neighborhoods of the Waterfront, for a variety of reasons, elevation can be impractical, undesirable, and/or economically infeasible. Fortunately, other mitigation options are available. The City,

therefore, will call upon FEMA to provide appropriate premium credits for mitigation measures other than elevation.

Insurance Initiative 6

Call on FEMA to allow residential policyholders to select higher deductibles

Flexible pricing options can encourage more people, especially those not required to carry insurance, to purchase insurance coverage that suits their needs. A higher-deductible option can substantially reduce premium costs to policyholders while remaining truly risk-based. Currently under the NFIP, deductibles up to \$50,000 are allowed for commercial policies, but residential policies are limited to a maximum deductible of \$5,000. The City, therefore, will call upon FEMA to allow homeowners who are not required to carry NFIP policies to purchase high-deductible policies, protecting them from catastrophic loss; initial estimates indicate that doing so could reduce insurance premiums by about half.

Critical Infrastructure

A resilient New York requires protection of its critical services and systems from extreme weather events and the impacts of climate change. This infrastructure includes the city's utilities and liquid fuel system, its hospitals and other healthcare facilities, telecommunications network, transportation system, parks, wastewater treatment and drainage systems, as well as other critical networks—all vital to keeping the city, including the neighborhoods along the Waterfront.

Utilities

The city's electric, natural gas, and steam systems are essential to everyday life in areas throughout the five boroughs, including the Waterfront. As Sandy proved, however, these systems are highly vulnerable to extreme weather events, with 800,000 customers losing electricity and 80,000 customers losing natural gas service during Sandy across the city, including approximately 160,000 lost electricity service in the borough of Brooklyn, and over 160,000 in Queens. This vulnerability likely will grow as the climate changes.

Among the strategies that the City will use to address these challenges for residents along the Waterfront and in other parts of the city will be to: Call for risk-based analysis of low-probability but high-impact weather events to be incorporated into utility regulation and investment decision-making; call for capital

investments that harden energy infrastructure and make systems more flexible in responding to disruptions and managing demand; and better diversify the city's sources of energy. The initiatives described below provide important examples of how the City intends to advance utilities resiliency citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough utilities resiliency plan, please refer to Chapter 6 (*Utilities*).

Utilities Initiative 5

Work with utilities and the Public Service Commission (PSC) to harden key electric transmission and distribution infrastructure against flooding

Various transmission substations, distribution substations, utility tunnels, and underground equipment in the city are at risk of flooding during extreme weather. For example, 40 percent of transmission substations are in the 100-year floodplain today, and 67 percent are likely to be in the 100-year floodplain by the 2050s. The City, through the OLTPS, will work with Con Edison and the Long Island Power Authority (LIPA) to prioritize these assets based on their roles in system reliability, and to harden them as appropriate. This effort will begin in 2013.

Utilities Initiative 6

Work with utilities and the PSC to harden vulnerable overhead lines against winds

During extreme weather events, high winds and downed trees threaten overhead electric poles, transformers, and cables. The City, through OLTPS, will work with Con Edison and LIPA to manage the risk of wind and downed-tree damage through tree maintenance, line strengthening, and a line-relocation program. In some limited cases, rerouting lines underground may also be warranted, depending on the outcome of a cost-benefit analysis to be performed in partnership with the utilities. This effort will begin in 2013.

Utilities Initiative 7

Work with utilities, regulators, and gas pipeline operators to harden the natural gas system against flooding

Although the city's high-pressure gas transmission system performed relatively well during Sandy, there were instances where remote operation of parts of the system failed. Additionally, the distribution system had localized outages due to water infiltration. Seeking to limit the compromising effects of future floods on both the system's backbone and the ability

of Con Edison and National Grid to control and monitor the system, the City, through OLTPS, will work with the PSC, Con Edison, and National Grid to harden control equipment against flooding. In addition, the City will call upon Con Edison and National Grid to take steps to prevent water from infiltrating its gas pipes. This effort will begin in 2013.

Utilities Initiative 21

Work with public and private partners to scale up distributed generation (DG), including microgrids

The city's DG systems, including microgrids, have the potential for significant expansion—but are constrained by regulations, financing challenges, and lack of information. The City, through OLTPS and the New York City Distributed Generation Collaborative—a stakeholder group convened by the City in 2012—will continue efforts to achieve a PlaNYC goal of installing 800 megawatts of DG citywide by 2030. These efforts will include reform of PSC tariffs and other regulatory changes, expansion of low-cost financing, and provision of technical assistance to property owners and developers. This ongoing effort will continue in 2013.

Liquid Fuels

The liquid fuels supply chain is essential for everyday life throughout the five boroughs, including along the Waterfront. Sandy demonstrated the vulnerability of this system to extreme weather events. In the aftermath of Sandy, citywide—and particularly along the Waterfront—there were long lines at gas stations and other challenges for drivers, including emergency responders. The vulnerability of this system will only grow as the climate changes.

Among the strategies that the City will use to address these challenges for residents of the Waterfront and other parts of the city will be to: develop a strategy for hardening of liquid fuels infrastructure along the supply chain; increase redundancy and fuel supply flexibility; and increase supply availability for vehicles critical to the City's infrastructure, safety, and recovery from significant weather events. The initiatives described below provide important examples of how the City intends to advance its liquid fuels resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the city's five-borough liquid fuels resiliency plan, please refer to Chapter 7 (*Liquid Fuels*).

Liquid Fuels Initiative 1

Call on the Federal government to convene a regional working group to develop a fuel infrastructure hardening strategy

The fuel supply shortage after Sandy was caused mainly by damage to infrastructure in New Jersey and other states, where the City and State of New York have no regulatory or legislative authority or oversight. The City, through OLTPS, will call on the Federal Hurricane Sandy Rebuilding Task Force and the United States Department of Energy to convene regional stakeholders to develop a strategy for hardening key infrastructure against future extreme weather. This effort will be launched in 2013.

Liquid Fuels Initiative 4

Work with New York State to provide incentives for the hardening of gas stations to withstand extreme weather events

New York State's 2013–2014 budget required that certain retail fuel stations will be required to invest in equipment that would allow them to connect generators quickly in the event of a power loss, and enter into supply contracts for emergency generators. The City, through OLTPS, will support the State in the design and implementation of this generator program, an effort that will include working with the New York State Energy Research and Development Authority (NYSERDA) to develop an incentive program to minimize the financial impact of the requirements on the businesses involved. In addition, OLTPS will work with the State to develop incentives to encourage retail fuel stations to implement resiliency measures other than backup power capability. This effort will be launched in 2013.

Liquid Fuels Initiative 5

Enable a subset of gas stations and terminals to have access to backup generators in case of widespread power outages

Gas stations are vulnerable to widespread power outages resulting from extreme weather events, which could prevent them from dispensing fuel. In New York State's 2013–2014 budget, NYSERDA was directed to develop a generator pool program for gas stations. The City, through its Office of Emergency Management (OEM), will work with NYSERDA, FEMA, and the USACE in 2013 and beyond to develop such a pool and to create a pre-event positioning plan to enable the ready deployment of generators to impacted areas in the wake of a disaster.

Liquid Fuels Initiative 8

Develop a package of City, State, and Federal regulatory actions to address liquid fuel shortages during emergencies

Various regulations relating to the transportation and consumption of fuels in New York City limit the flexibility of the market to respond to disruptions, including following extreme weather. The City, through OEM, will work with the State and Federal governments to prepare an "off-the-shelf" package of regulatory measures for use in the event of a liquid fuels shortage to allow supply-demand imbalances in the fuel supply to be mitigated more quickly. This effort will be launched in 2013.

Liquid Fuels Initiative 9

Harden municipal fueling stations and enhance mobile fueling capability to support both City government and critical fleets

The City must be able to respond quickly to a fuel supply disruption, providing continuous fueling to vehicles that are critical for emergency response, infrastructure rebuilding, and disaster relief. The City, through the Department of Citywide Administrative Services (DCAS), will procure fuel trucks, generators, light towers, forklifts, and water pumps to permit the City to put in place emergency fueling operations immediately following a disruption in the fuel supply chain. DCAS also will issue a Request for Expressions of Interest (RFEI) to potential suppliers of liquid fuels to evaluate options for sourcing such fuel during emergencies. The procurement effort will be launched in 2013, with the RFEI to follow in 2014.

Healthcare

The city's healthcare system is critical to the well-being of New Yorkers throughout the five boroughs, including throughout the neighborhoods along the Waterfront. This system is also a major economic engine for the city as a whole. Sandy exposed this system's vulnerabilities, which are expected to grow as the climate changes.

Among the strategies that the City will use to address these challenges for residents along the Waterfront and other parts of the city will be to: Build new hospitals, nursing homes, and adult care facilities to higher resiliency standards and harden existing facilities to protect critical systems; seek to keep lines of communication open between patients and providers, even during extreme weather events; and enable community-based providers to reopen quickly after a disaster. The initiatives described below provide important examples

of how the City intends to advance its healthcare resiliency agenda citywide. These initiatives will have a positive impact on the residents and healthcare providers along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough healthcare resiliency plan, please refer to Chapter 8 (*Healthcare*).

Healthcare Initiative 2

Require the retrofitting of existing hospitals in floodplains

Many existing hospital buildings in the floodplain remain vulnerable to the impact of storm surge, with more likely to become vulnerable the climate changes. The City, through OLTPS, therefore, will seek to amend the Construction Code to require existing hospital buildings in the 500-year floodplain to meet by 2030 a subset of the amended Construction Code standards for flood-resistant design. To minimize the risk of emergency evacuations and extended closures, these hospitals will be required to protect their electrical equipment, emergency power system, and domestic water pumps to the 500-year flood elevation. These hospitals also will be required to install backup air-conditioning service for inpatient care areas in case of utility outages, pre-connections for temporary boilers and chillers if primary equipment is not elevated, and pre-connections for external generators as a backup power source. OLTPS will propose these requirements to the City Council in 2013.

Healthcare Initiative 3

Support the Health and Hospitals Corporation's (HHC) efforts to protect public hospital emergency departments from flooding

Emergency departments (EDs) are critical access points for patients in need of hospital services, and at three public hospitals citywide—EDs are at risk of flooding due to storm surge. Subject to available funding, therefore, the City through HHC, will invest in measures to flood-protect vulnerable EDs so they can remain available to provide care during extreme weather events. HHC already has begun exploring strategies to protect their EDs and will continue to develop their mitigation plans through 2013.

Healthcare Initiative 4

Improve design and construction of new nursing homes and adult care facilities

New nursing homes and adult care facilities are at risk of power failures due to storm surge, which could result in patient evacuations. The City, through OLTPS, therefore, will seek to amend the Construction Codes to require that new facilities are constructed with additional

resiliency measures for their emergency power systems. New nursing homes also will be required to have emergency generators and electrical pre-connections for external stand-by generators. Adult care facilities will be required to install either emergency generators that are adequately protected or pre-connections to external stand-by generators. OLTPS will propose these requirements to the City Council in 2013.

Healthcare Initiative 5

Require retrofitting of nursing homes in floodplains.

Many existing nursing home facilities in the five boroughs are vulnerable to storm surge—a vulnerability that will only grow as the climate changes. The City, through OLTPS, therefore, will seek to amend the Construction Codes to require nursing homes in the 100-year floodplain retroactively to meet retroactive standards for the protection of electrical equipment, emergency power systems, and domestic water pumps (if applicable) by 2030. These systems will be protected to the 100-year flood elevation, in accordance with specifications already in the Construction Codes, and will help enable that patients can shelter in place safely or reoccupy quickly after a storm. OLTPS will propose these requirements to the City Council in 2013.

Healthcare Initiative 6

Require retrofitting of adult care facilities in floodplains

Nineteen adult care facilities in the city are vulnerable to storm surge, including one along the Waterfront. The City, through OLTPS, will seek to amend the Construction Code to require existing adult care facilities located in the floodplain to elevate or protect their electrical equipment to the 100-year flood elevation by 2030, in accordance with the specifications in the Construction Codes. In addition, the City will seek to require these providers to have either emergency generators that are adequately protected or electrical pre-connections to external generators. OLTPS will propose these requirements to the City Council in 2013.

Healthcare Initiative 7

Support nursing homes and adult care facilities with mitigation grants and loans

The primary challenge for most nursing homes and adult care facilities in implementing mitigation measures is obtaining financing. Subject to available funding, the City, through NYCEDC and the New York City Department of Health and Mental Hygiene (DOHMH); therefore, will administer competitive grants and subsidized loans to assist providers with mandated retrofit projects. The goal is for NYCEDC and DOHMH

to launch the program when the proposed Construction Codes amendments applicable to nursing homes and adult care facilities proposed in this report go into effect, likely in 2013.

Healthcare Initiative 8

Increase the air-conditioning capacity of nursing homes and adult care facilities

Nursing homes and adult care facilities typically do not have enough emergency power capacity to run their air conditioning systems following the loss of power. This could cause some providers to evacuate during power outages that occur during hot summer months. The City will offer sales tax waivers totaling \$3 million citywide to assist eligible nursing homes and adult care facilities that install emergency power solutions for air conditioning systems.

Healthcare Initiative 9

Harden primary care and mental health clinics

In communities such as those along the Waterfront that are at risk of extensive flooding during extreme weather events, primary care and mental health services may be compromised for weeks after a disaster due to extended facility closures. Subject to available funding, the City, through DOHMH and a fiscal intermediary, therefore, will administer a competitive financing program to harden large clinics providing primary care and mental health services in neighborhoods along the Waterfront and other high-need communities. The program will include grants and interest-free loans for capital investments that enable faster recovery of services—for example, installation of emergency power systems, protection of other critical building systems, and wet flood-proofing of facilities. The goal is for this effort to be launched in late 2013 or early 2014.

Healthcare Initiative 10

Improve pharmacies' power resiliency.

Pharmacies dispense life-saving medicines essential for those with chronic conditions. However, without power, pharmacists cannot access the necessary patient records or insurance information to dispense these medicines. The City, through DOHMH, will work with pharmacies to improve their ability to leverage generators for power resiliency and address their other emergency preparedness needs—including the launch of an emergency preparedness website for pharmacies. This effort already has begun and will continue throughout 2013.

Healthcare Initiative 11

Encourage telecommunications resiliency in the healthcare system

In the aftermath of a disaster, it is important that New Yorkers be able to speak to their doctors for guidance on needed medical care. The City, through DOHMH, therefore, will develop a best practice guide and outreach plan to help community-based providers understand the importance of telecommunications resiliency. Resiliency solutions could include using backup phone systems (such as a remote answering service that would not be affected by local weather hazards), Voice over Internet Protocol (VoIP) technology that allows office phone lines to be used off-site, and pre-disaster planning to inform patients of available emergency phone numbers. This effort will begin in 2013.

Healthcare Initiative 12

Encourage electronic health record-keeping

Doctors rely on patients' medical records to provide and track care, but paper records may be compromised or destroyed due to extreme weather events. The City, through existing DOHMH programs, therefore, will call upon community-based providers located in the 100-year floodplain and other disaster-prone areas to implement electronic health records (EHR) systems for resiliency. DOHMH's Primary Care Information Project will sponsor initiatives to provide primary care and mental health providers citywide with EHR technical assistance. This effort will begin in 2013.

Telecommunications

The city's telecommunications system is essential to individuals and businesses throughout the five boroughs, including throughout the neighborhoods along the Waterfront. While this is true at all times, it is especially true during emergencies. As Sandy demonstrated, however, this system is highly vulnerable to extreme weather events—precisely when telecommunications are most needed. Citywide and along the Waterfront, Sandy resulted in outages to landlines and mobile service, as well as to data service. The vulnerability of this system likely will grow as the climate changes.

Among the strategies that the City will use to address these challenges for residents, businesses, and nonprofits of the neighborhoods along the Waterfront and other parts of the city will be to: increase accountability among providers to promote resiliency; use strengthened City regulatory powers and stronger relationships with providers

to enable rapid recovery after extreme weather events; encourage hardening of facilities to reduce weather-related impacts; and increase redundancy to reduce the impact of outages. The initiatives described below provide important examples of how the City intends to advance its telecommunications resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits of the neighborhoods along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough telecommunications resiliency plan, please refer to Chapter 9 (*Telecommunications*).

Telecommunications Initiative 1

Establish an office within the Department of Information Technology and Telecommunications (DoITT) to focus on telecommunications regulation and resiliency planning

While the City has regulatory authority over some aspects of telecommunications service, it has no entity focused broadly on ensuring the resiliency of the public communications networks. The City, therefore, will form within DoITT, a new Planning and Resiliency Office (PRO) that will have the resources needed to develop, monitor, and enforce resiliency standards, in close cooperation with State and Federal regulators and providers. DoITT will launch the new office in 2013.

Telecommunications Initiative 2

Establish new resiliency requirements for providers using scheduled renewals of the City's franchise agreements

Flooding caused outages during Sandy in facilities that did not follow the Federal Communication Commission's recommended best practices for resiliency, including flood protection measures. The City, through DoITT, therefore, will encourage and enforce resiliency standards for telecommunications providers through the franchise renewal process, and through other agreements into which such providers enter with the City. The City also will seek to require standardized outage reporting and publishing. DoITT will launch this effort in 2014, in advance of 2020 franchise renewals.

Transportation

Without the city's expansive transportation system, New York would grind to a halt. This was illustrated starkly during Sandy when outages occurred across the system during and immediately following the storm. These outages severely impacted the neighborhoods along the Waterfront, which found itself isolated by the

shutdown of subway and other public transit systems, as well as flooding on arterial and secondary roads. The vulnerability of this system likely will grow as the climate changes.

Among the strategies that the City will use to address these challenges for residents of the neighborhoods along the Waterfront and other parts of the city will be to: Make the system more flexible and more resilient; protect critical elements of the system from damage; seek to maintain system operations during extreme weather events and, following extreme events, to enable quick recovery, while also putting in place plans for backup transportation options until regular service can be restored. The initiatives described below provide important examples of how the City intends to advance its transportation resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough transportation resiliency plan, please refer to Chapter 10 (*Transportation*).

Transportation Initiative 1

Reconstruct and resurface key streets damaged by Sandy

Sandy's waves and flooding caused significant damage to area roadways. The City, through NYCDOT, will reconstruct 60 lane-miles of streets that were damaged severely, and will repave approximately 500 lane-miles of streets with damaged surfaces. Along the Waterfront, this will include 1.4 linear miles of reconstructed streets. Wherever feasible, the reconstructed streets also will include resiliency features to prevent future damage. NYCDOT will launch this initiative in 2013 with funding from Federal and City sources.

Transportation Initiative 3

Elevate traffic signals and provide backup electrical power

New York's traffic signals—and particularly the controllers that operates these signals and communicate with the NYCDOT Traffic Management Center—are vulnerable to damage from flooding, as well as to power loss from various extreme weather events. Accordingly, the City, through NYCDOT, will raise controllers at approximately 500 intersections in flood-vulnerable locations across the city, including along the Waterfront. In tandem with this effort to place electrical hardware above the 100-year floodplain elevation, NYCDOT also will install power inverters in approximately 500 NYPD vehicles to allow these vehicles to provide backup electrical power to critical traffic signals. This effort will begin in 2013.

Transportation Initiative 5 **Install watertight barriers to protect** **movable bridge machinery**

The mechanical equipment that moves 25 of the city's bridges—including five over the Gowanus Canal and six over Newtown Creek and its tributaries—is vulnerable to flooding. Damage to this equipment could, if it were to lock bridges in either an open or closed position, disrupt marine and roadway traffic. Therefore, over the next three years and subject to available funding, NYCDOT will install watertight barriers to protect the bridges' mechanical equipment.

Transportation Initiative 6 **Protect Staten Island Ferry and** **private ferry service from climate** **change-related threats**

To allow for quicker restoration of service on the Staten Island Ferry, the East River Ferry, and other ferry services, the City will use Federal Transit Administration Emergency Relief funds to construct physical improvements to the floating infrastructure, loading bridges/gangways, pilings, and piers at both the Whitehall and Saint George Ferry Terminals and at additional ferry landings around the city, including along the Waterfront. NYCDOT will launch this investment immediately.

Transportation Initiative 8 **Call on non-City transportation agencies** **to implement strategies to address cli-** **mate change threats**

Many non-City agencies that own and operate critical portions of New York City's transportation system have already announced resiliency and protection initiatives appropriate to their systems. Without such action, the critical facilities managed by these agencies remain vulnerable to damage and disruption from future weather-related events. The City therefore, will call on these agencies to implement the initiatives that they have announced and take additional steps to protect their major transportation assets from climate change threats and prepare for quick restoration following an extreme weather event. Assets that may require hardening and/or preparation measures along the Waterfront include: the Hugh L. Carey Tunnel, the Queens Midtown Tunnel, underground subway tunnels, and Sunnyside Yard. The City will work with these agencies to advance these plans.

Transportation Initiative 9 **Plan for temporary transit services in the** **event of subway system suspensions**

When major portions of the subway system are out of service, there simply is not sufficient capacity in the rest of the transit network or the roadway system to carry the increased volume of commuters and other travelers. The City, through NYCDOT, therefore, will work with the MTA and other transportation partners to develop and regularly update formal plans to provide temporary transportation services in such an event, including following extreme weather. These services could take the form of temporary, high-capacity "bus bridges" of the type implemented during Sandy, linking, for example, Long Island City to Midtown Manhattan (see Initiative 16, below) or temporary point-to-point ferry services, for example connecting Sunset Park and Lower Manhattan. This planning effort will begin in 2013.

Transportation Initiative 10 **Identify critical transportation network** **elements and improve transportation** **responses to major events through** **regular resiliency planning exercises**

Many of the facilities critical to the City's ability to respond effectively to a disaster are vulnerable to disruption and damage during extreme weather events, potentially impairing delivery of emergency services and supplies, as well as impairing the restoration of critical non-transportation infrastructure and economic activity. This vulnerability is expected to increase as the climate changes. To respond better to a variety of different possible transportation outage and restoration scenarios, the City, through NYCDOT, will work with transportation agencies around the region to identify the critical elements of the surface transportation network that need to be available quickly following different types of events. The key tool to identify these networks will be an ongoing series of detailed and multidisciplinary resiliency planning exercises that will allow NYCDOT and its partners to understand where resources need to be focused before, during, and after an event. This effort will begin in 2013.

Transportation Initiative 16 **Expand the city's Select Bus Service** **(SBS) network**

Parts of the city lack subway access or have slow and unreliable public transportation. In these areas, the City and the MTA have been deploying SBS routes to improve general mobility. These routes can form the backbone of high-capacity bus service in the event of

major subway outages, including following extreme weather events. The City, through NYCDOT, will work with the MTA to expand the SBS network significantly, building on a plan developed jointly in 2010 and reinforced in the NYS 2100 Report issued in January 2013. Implementation of this plan already has begun.

Transportation Initiative 17 **Expand the network of bus priority lanes** **on arterial highways**

Bus priority lanes for express and local buses can significantly improve mobility during periods of highway congestion. Accordingly, the City, through NYCDOT, will work with the New York State Department of Transportation and the MTA to implement 15 miles of bus priority corridors on major limited-access arterial highways, including those serving the Waterfront, such as the Brooklyn-Queens Expressway (BQE) and the Gowanus Expressway, as these highways are improved or reconstructed over the next several years. Under the right conditions, these lanes also could be open to high-occupancy vehicles, further improving the efficiency of the roadway system in coordination with single-occupancy vehicle restrictions that may be in place following an emergency. This effort will move forward in 2013.

Beyond the priority transportation resiliency projects described in Chapter 10, including those summarized briefly above, the City is proposing additional transportation resiliency initiatives specific to the Waterfront's vulnerabilities. These initiatives are described below.

Brooklyn-Queens Waterfront Initiative 7 **Improve connections between Red Hook** **and the rest of Brooklyn**

As Sandy showed, the lack of transportation options in Red Hook made it more challenging for Red Hook residents to access services during and after the storm, as it does in non-storm conditions. Hamilton Avenue's current configuration further exacerbates the area's isolation by impeding direct, safe access to and from the neighborhood by pedestrians and public transit users. The City, therefore, will invest in improvements to provide residents and visitors alike with quicker, safer, and more reliable transportation options, available during both emergencies and under normal conditions. To this end, NYCDOT will create a new connection between Red Hook and the rest of Brooklyn at Mill Street and will install an Urban Art Design Project and enhanced lighting under the Brooklyn-Queens Expressway at Hamilton Avenue and West 9th Street during the summer of 2013.

These actions will shorten the bus trip between Red Hook Houses and the closest subway stop by 50 percent during the morning rush hour and 25 percent during afternoon rush hour. They also will provide safer and more direct pedestrian and bicycle access to Red Hook from the rest of Brooklyn. This effort will move forward in 2013.

Brooklyn-Queens Waterfront Initiative 8 Call for the MTA to explore Red Hook- Lower Manhattan bus connections

As noted above, the lack of transit options in Red Hook made it more challenging for Red Hook residents to access services during and after the storm, as it does in non-storm conditions. To address this, the City, through the NYCEDC, will call on the MTA to study bus routes from Red Hook to Lower Manhattan via the Hugh L. Carey Tunnel. Such service would support the more than 25 percent of Red Hook residents who work in Manhattan while also bringing new potential customers and workers to Red Hook's businesses. This will be advanced in 2013.

Brooklyn-Queens Waterfront Initiative 9 Implement expanded free summer weekend ferry service from Manhattan to Red Hook in 2013

As noted above, the lack of transit options in Red Hook made it more challenging for Red Hook residents to access services during and after the storm, as it does in non-storm conditions. To help with the recovery of area businesses and to assess the viability of such service on a long-term basis, the City, through NYCEDC has launched a weekend ferry service, in partnership with IKEA, Fairway Market, New York Water Taxi, and Billybey Ferry Company, that will run from Memorial Day weekend through Labor Day during 2013. The free service will make two stops in Red Hook (at IKEA and Van Brunt Street) and one stop in Manhattan. The service will be coordinated with the East River Ferry, allowing for a free transfer at Wall Street/Pier 11.

Building on this pilot ferry service, the City will explore expanded ferry service to areas city-wide, including Red Hook, on a permanent basis, through a Comprehensive Ferry Study. The study will be led by NYCEDC and will be launched during 2013.

Parks

During Sandy, it became clear that, in addition to serving as neighborhood front yards and recreation centers, in many places (including along the Waterfront), the city's parks serve as the city's front line of defense when extreme

weather events hit, buffering adjacent neighborhoods. As the climate changes, it will be even more critical that the city's parks be able to play all of these roles.

Among the strategies that the City will use to address these challenges for residents of the neighborhoods along the Waterfront and elsewhere in the City will be to: strengthen the city's parks so that they can survive weather-related events more effectively and can act as stronger buffers for adjacent communities; and pursue technologies and approaches that will enable the City to monitor, analyze, and prepare the park system for its many roles in an era of increasing change. The initiatives described below provide important examples of how the City intends to advance its parks resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits of the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough parks resiliency plan, please refer to Chapter 11 (*Parks*).

Parks Initiative 2 Harden or otherwise modify shoreline parks to protect adjacent communities

About 24 percent of DPR properties (by acreage) are today in the city's 100-year floodplain, and that percentage is expected to grow as sea levels rise—including in areas where the city's parks front residential and commercial districts. Subject to available funding, the City, through DPR, therefore, will study cost-effective ways to use its park system to protect particularly vulnerable adjacent neighborhoods, ideally identifying mitigation strategies that also protect the parks themselves. Target sites along the Waterfront include Bush Terminal Piers Park, Bushwick Inlet Park, Brooklyn Bridge Park, Box Street Park, and the Red Hook Recreational Area. The goal is for DPR to complete this study in 2014.

Parks Initiative 11 Improve the health and resiliency of the city's urban forest

The city's forests and trees provide an array of health and environmental benefits, but are vulnerable to a variety of climate change-related impacts, including storm surge, wind, and even changes in average temperatures. Subject to available funding, the City, through DPR, will undertake a variety of efforts to protect trees—whether located in natural areas and parks, or along streets. This would include adding forest management crews, identifying locations in which to expand tree beds, and modifying regular tree inspection and pruning efforts to prioritize trees in areas vulnerable to extreme

weather events. The goal is for DPR to launch this effort in 2013.

Water and Wastewater

The city's water and wastewater system is one of the most complex in the world, not only supplying millions of New Yorkers with safe drinking water in all conditions, but also treating wastewater to enable the area's waterways to remain clean, while draining rainwater to minimize flooding. Sandy demonstrated the system's vulnerability to a whole host of weather-related threats, ranging from surge and sea level rise, to heavy downpours—threats that are expected to worsen as the climate changes.

Among the strategies that the City will use to address these challenges for residents of the neighborhoods along the Waterfront and other parts of the city will be to: protect wastewater facilities from storm surge; improve and expand drainage infrastructure; and promote redundancy and flexibility to make available a constant supply of high-quality drinking water. The initiatives described below provide important examples of how the City intends to advance its water and wastewater resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough water and wastewater resiliency plan, please refer to Chapter 12 (*Water and Wastewater*).

Water and Wastewater Initiative 1 Adopt a wastewater facility design standard for storm surge and sea level rise

Sandy damaged wastewater treatment plants and pumping stations even though the design of City wastewater facilities typically has taken into account the highest historically recorded water height of nearby water bodies or the BFEs identified in FEMA maps. The City, therefore, will adopt an increased level of protection for design and construction of all wastewater facilities based on the latest FEMA maps, modified to reflect sea level rise projections for the 2050s. The design for upgrades to DEP's Gowanus Canal facility, for instance, will protect critical equipment that is located at or lower than 2.5 feet above the best-available BFE. DEP will adopt the new design guidelines in 2013.

Water and Wastewater Initiative 2 Harden pumping stations

Many of the city's pumping stations are located in low-lying areas and are necessary to convey

wastewater and stormwater out of communities; however, their location also increases their vulnerability to storm surge. Therefore, subject to available funding, the City, through DEP, will retrofit these pumping stations to improve their resiliency. These retrofits will include raising or flood-proofing critical equipment, constructing barriers, and installing backup power supplies. Preliminary estimates indicate that there are currently 58 at-risk pumping stations, of which several are already scheduled for capital improvements. Subject to available funding, DEP will pursue implementation of resiliency projects in conjunction with repairs and planned capital work, and as appropriate based on the level of risk, historical flooding, and potential community impacts, among other criteria. Among the pumping stations to be considered for hardening are 10 along the Waterfront. The goal is to begin implementation in 2014.

Water and Wastewater Initiative 3 Harden wastewater treatment plants

All 14 of the City's wastewater treatment facilities are located along the waterfront and are therefore at risk in the event of a coastal storm. Subject to available funding, the City, through DEP, will protect these critical treatment facilities by raising or flood-proofing assets that are critical to the treatment process, constructing barriers, improving waterfront infrastructure, or implementing redundancy measures to avoid failure of these critical treatment systems. DEP will initially target facilities that have been identified as either most at-risk, or most likely to create issues for adjacent communities and waterways, based on the findings of an in-depth study by DEP. The goal is for DEP to begin implementation of adaptation measures for these and other facilities in 2014 as part of repairs and other planned capital projects.

Water and Wastewater Initiative 8 Reduce combined sewer overflows (CSOs) with Green Infrastructure

As climate change brings increasing rainfall volume to the New York area, the city may also experience shifts in the frequency and volume of CSOs. The City will continue to implement its Green Infrastructure Plan and CSO Long-Term Control Plans (LTCPs) to reduce such CSOs. For this purpose, DEP, working with the DPR and NYCDOT, will continue to pursue its plan to capture the first inch of runoff in 10 percent of impervious surfaces citywide by 2030. At the same time, DEP also will continue to develop LTCPs to evaluate long-term solutions to reduce CSOs and improve water quality in New York City's waterways. DEP will issue an LTCP for Alley Creek in Queens in 2013, with nine additional water body-specific LTCPs and one

citywide LTCP to follow through 2017—including for Coney Island Creek, the Gowanus Canal, Newtown Creek, and Jamaica Bay. DEP will continue to implement this program in 2013, with the Gowanus Canal LTCP targeted for issuance in 2015 and Newtown Creek LTCP in 2017.

Water and Wastewater Initiative 9 Reduce combined sewer overflows with high-level storm sewers

While the construction of new, green infrastructure is an effective solution for managing rainfall and reducing CSOs in some locations, in other areas, it will be more cost-effective to enhance the city's existing sewer system. The City, through DEP, will augment existing combined sewers with so-called "high-level storm sewers" in certain areas, including along the Waterfront. These high-level storm sewers sit on top of a combined sewer and accept stormwater from the street before diverting it to a nearby waterway, capturing up to 50 percent of rainfall before it enters combined sewers. DEP, therefore, will continue to pursue high-level storm sewer projects along the Waterfront, including at 3rd Avenue in Gowanus; West Street in Greenpoint; and at multiple locations in DUMBO. These projects are to be completed by 2023. DEP will continue to seek additional opportunities for similar projects near the water's edge along the Waterfront, including a project in the Hunter's Point section of Long Island City that, as of the writing of this report, is in the design phase. Finally, the City also is making sewer investments in connection with new developments along the Waterfront, including at Hunter's Point South in Long Island City.

Other Critical Networks: Food Supply

Though the food supply chain generally emerged intact following Sandy, in certain local areas (including parts of the Waterfront), residents found themselves without access to basic sustenance after the storm. In addition, had Sandy played out just a little differently, it is possible that significant links in the food supply chain—including the food distribution center in Hunts Point in the Bronx—could have been seriously threatened. As the climate changes, it is likely that risks such as these will grow.

Although initiatives outlined in several other sections above are important contributors to the overall resiliency of the food supply network (including especially those addressing utilities, liquid fuels, and transportation), the City also will pursue food-specific strategies to meet this

goal for the benefit of residents of the neighborhoods along the Waterfront and other parts of the city. These strategies will involve calling for resiliency investments at the most significant food wholesaling and distribution centers in the city and addressing issues relating to retail access in the event of extreme weather. The initiatives in Chapter 13 describe how the City intends to advance its food supply resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a complete description of the City's five-borough food supply resiliency plan, please refer to Chapter 13 (*Other Critical Networks*).

Other Critical Networks: Solid Waste

On a daily basis, the solid waste collection system in New York disposes of more than 12,000 tons of waste and recycling in a safe and sanitary fashion. Unlike many other critical City systems, during Sandy this one proved remarkably resilient, resuming many of its normal functions almost immediately after the storm. In fact, thanks to the efforts of the City's Department of Sanitation, even as the agency was dealing with its own storm-related challenges, it was able to assist with the recovery of the neighborhoods along the Waterfront and the larger city by collecting the debris left by the storm in an organized and efficient manner.

However, the system does face real issues. For example, during Sandy, the city's solid waste disposal system experienced interruptions that interfered with its ability to convey refuse out of the city to its ultimate destination. Additionally, as the climate changes, it is likely that this system will become more vulnerable to extreme weather.

Among the strategies that the City will use to address these challenges for residents of the neighborhoods along the Waterfront and other parts of the city will be to: harden critical City-owned solid waste assets to protect them from extreme weather-related impacts; and seek to improve the resiliency of the broader solid waste network—both City- and third-party owned—enabling it to resume operation quickly should disruptions occur. The initiatives in Chapter 13 describe how the City intends to advance its solid waste resiliency agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a complete description of the City's five-borough solid waste resiliency plan, please refer to Chapter 13 (*Other Critical Networks*).

Environmental Protection and Remediation

Sandy showed that extreme weather events—which are likely to increase in severity with climate change—not only have the potential to impact the city's people, built environment, and critical systems; they can have a deleterious impact on the natural environment. To help minimize the impact of future extreme weather on the environment is minimized, the City will advance a range of initiatives to protect open and enclosed industrial sites containing hazardous substances in an economically feasible way, and to encourage the cost-effective remediation and redevelopment of brownfields in a resilient fashion. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront, which is home to approximately 3,330 industrial companies and approximately 13 sites designated under the New York City Brownfield Cleanup Program. For a complete description of the City's five-borough environmental protection and remediation plan, please refer to *Environmental Protection and Remediation*.

Community and Economic Recovery

New York is a city of neighborhoods, and these neighborhoods vary widely in size and nature. Notwithstanding this variety, successful neighborhoods across the city tend to share certain traits. Two of these are: A formal and informal network of community members who help and support one another in good times and bad; and vibrant commercial and nonprofit sectors that employ and provide goods and services to the people of the community.

As Sandy demonstrated, however, both the network of community-based organizations and the commercial and nonprofit sectors in New York's neighborhoods can be sorely tested when extreme weather hits. During these times (when contributions from these networks and sectors are desperately needed) these organizations and businesses *themselves* are frequently coping with the same set of challenges that the community at large is—a circumstance that can push even the most well-run organization or business to the breaking point. Even with these pressures, during and in the immediate aftermath of Sandy, New York's commercial and nonprofit sectors overcame many of their own difficulties, playing a critical role in the recovery of neighborhoods across the city, including those along the Waterfront. However, as the climate changes, difficulties such as these will likely arise more frequently, testing these institutions mightily.

Among the strategies that the City will use to achieve the goal of making its neighborhoods and their critical institutions more resilient will be to: help build grassroots capacity and foster community leadership; help businesses and nonprofits impacted by Sandy to recover; help businesses and nonprofits in vulnerable locations to make resiliency investments that will better prepare them for future extreme weather; and bring new economic activity to neighborhoods recovering from the impacts of Sandy to enable these neighborhoods to come back even stronger than before.

The initiatives described below provide important examples of how the City intends to advance its community and economic recovery agenda citywide. These initiatives will have a positive impact on the residents, businesses, and nonprofits along the Waterfront. For a full explanation of the following initiatives and a complete description of the City's five-borough community and economic recovery plan, please refer to *Community and Economic Recovery*.

Community Disaster Preparedness Initiative 1 Identify and address gaps in community capacity

The capacity of a community to organize to aid businesses and residents after an extreme weather event or other disaster is a strong predictor of the success of that community's recovery. To improve this capacity of vulnerable communities, OEM, working with the NYC Center for Economic Opportunity (CEO), will undertake a pilot assessment of the strengths and weaknesses of a Sandy-impacted community—which could be a neighborhood along the Waterfront—to inform the creation of a plan to address needs uncovered by the assessment. Subject to available funding, the City, through OEM and CEO, will choose a pilot community and begin their study in 2013.

Community Disaster Preparedness Initiative 2 Continue and expand OEM's Community Emergency Response Teams

OEM currently trains 54 teams of 1,500 volunteers across the city, which staff Community Emergency Response Teams (CERTs). Before, during, and after disasters, including extreme weather events, members of these teams help to organize community disaster preparedness and participate in emergency response and recovery. Going forward, OEM will work with communities to create additional teams, ensuring that the volunteers that staff them are as representative as possible of the communities that they serve. Towards the same end, OEM, working with CEO, will also identify low-income

young adults to be trained to lead their communities in disaster preparedness. OEM and CEO will launch this program by 2014.

Economic Recovery Initiative 1 Launch business recovery and resiliency programs

During Sandy, over 27,000 businesses citywide, including 3,130 along the Waterfront, were undated by the storm. For many, recovery has been challenging. To assist with this recovery, immediately after the storm, the City launched the series of programs previously described in *Community and Economic Recovery*, including a \$25 million loan and grant program and a \$25 million sales tax waiver program designed to help businesses get back on their feet. Building on the momentum of these programs, which have assisted over 2,500 businesses as of the writing of this report, the City, through NYCEDC, will launch the CDBG-funded Business Resiliency Investment Program of up to \$100 million to help vulnerable businesses throughout the city make resiliency investments in their buildings and equipment, and the Business Loan and Grant Program of up to \$80 million will assist businesses with recovery and rebuilding efforts. NYCEDC will launch these programs in 2013.

Economic Recovery Initiative 2 Launch the Neighborhood Game Changer Competition

The recovery of many of the communities impacted by Sandy, including those along the Waterfront, has been hampered by a lack of opportunities for economic advancement and employment among significant populations that were impacted by the storm. In many cases, these challenges existed even before Sandy, but have been exacerbated by the impacts of the storm. To address this, the City, through NYCEDC, will launch the CDBG-funded Neighborhood Game Changer Competition to invest up to \$20 million in public money in each of the five communities on which this report focuses, including those along the Waterfront. This funding will be available on a competitive basis to help finance transformational projects. To win the competition, a project will have to spur incremental economic activity, generate new employment opportunities, and match public funding with significant private capital. Projects that would be eligible to be funded along the Waterfront through this competition could include new attractions bringing new—visitors, significant new operations of a major business or nonprofit, the revitalization of important commercial corridors, the expansion of an existing neighborhood institution or a major new transportation option. NYCEDC will launch this program in 2013.

Economic Recovery Initiative 3 **Launch Neighborhood Retail Recovery Program**

At the core of many Sandy-impacted neighborhoods are the local commercial corridors that provide employment opportunities and services to those who live and work around them. They include local retailers, institutions, and service providers—such as food markets, pharmacies, social service organizations, laundromats, and others. In many cases, though, these corridors were devastated by the storm. To address this, the City will call on the PSC and Con Edison to amend the preferential Business Incentive Rate program, which offers a discount on Con Edison's electric delivery charges, to allow it to be extended to impacted small businesses in the five communities on which this report focuses, including the Waterfront. Businesses and nonprofits with 10 or fewer employees that have received support from City-sponsored loan and grant programs will be eligible for the discount for five years up to a maximum discount of \$50,000 per business or nonprofit. The maximum aggregate benefit available along the Waterfront will be \$1 million. The goal is for NYCEDC to launch this effort in 2013. Among the corridors where the benefit will be available along the Waterfront include:

- Columbia Street Waterfront District (Hamilton Ave. to Atlantic Ave.)
- Jackson Ave. (52nd Ave. to 23rd St.)
- Manhattan Ave. (Ash St. to Driggs Ave.)
- McGuinness Blvd. (Ash St. to Calyer St.)
- Van Brunt St. (Reed St. to Bowne St.)
- Lorraine St. (Dwight St. to Hicks St.)
- Clinton St. (Hamilton Ave. to Centre St.)
- Vernon Blvd. (54th Ave. to the Queensboro Bridge)

Economic Recovery Initiative 4 **Support local merchants in improving and promoting local commercial corridors**

As mentioned above, Sandy highlighted the important role played by local commercial corridors in many of the communities impacted by the storm. The City, through the Department of Small Business Services (SBS), will provide financial and/or technical assistance to area BIDs, merchant associations, and other groups that work to improve, market, maintain, and otherwise promote primary commercial corridors. Subject to review of applications received, SBS will prioritize Sandy impacted commercial corridors in allocating its resources, including its CDBG funding. Such funding could be used for a variety of purposes, including capacity building, façade improvement programs, streetscape improvements, and business recruitment and marketing efforts. Along the Waterfront, corri-

dors that could receive this additional assistance include corridors in Red Hook, East Williamsburg, and DUMBO. SBS will provide this assistance beginning in 2013.

Economic Recovery Initiative 5 **Continue to support the FRESH program to increase the number of full-line grocers in underserved neighborhoods**

Even before Sandy, the residents of many communities impacted by Sandy, including parts of the Waterfront, lacked adequate access to fresh fruits, vegetables, and other healthy foods. Noting this challenge, especially in underprivileged areas of the city, in 2009, the City launched the FRESH (Food Retail Expansion to Support Health) program, a series of zoning and financial incentives available to supermarkets to fill this gap in neighborhoods underserved by grocery retail. To promote the recovery of commercial corridors in these areas, the City will continue to support the FRESH program, with a particular focus on Sandy-impacted neighborhoods, including those along the Waterfront.

Economic Recovery Initiative 6 **Reassess commercial properties citywide to reflect post-Sandy market values**

After Sandy, many commercial properties were worth less than before the storm. To reflect this fact and to help with recovery from the storm, the City has reassessed more than 88,000 properties impacted by the storm citywide. Overall, these reassessments have lowered the tax burden on Sandy-impacted properties—including both commercial and residential properties—by over \$90 million, with commercial properties in neighborhoods impacted by Sandy receiving a reduction, on average, of approximately 10 percent off of their pre-storm assessed values.

In addition to the measures described above, the City will advance the following initiatives to address the Waterfront's community and economic recovery needs:

Brooklyn-Queens Waterfront Initiative 10 **Create and implement a revitalization strategy for targeted retail and community spaces within Red Hook Houses**

The residents of NYCHA's Red Hook Houses experienced significant disruption during Sandy. To help these residents recover and to provide new services and economic opportunities, subject to available funding, the City, through a partnership between NYCHA and NYCEDC, will

make capital improvements to NYCHA-controlled retail and community spaces. Among the facilities that could benefit from these investments are a currently vacant former retail structure located at the corner of West 9th and Columbia Streets. These improvements will seek to attract new retailers, offering better goods and services to area residents, creating job opportunities for residents, and generating additional revenue opportunities for NYCHA. These investments will also improve and/or expand facilities available to community organizations. The goal will be to launch this initiative in 2013.

Brooklyn-Queens Waterfront Initiative 11 **Implement planned and ongoing investments by the City and private partners**

Preservation and revitalization of neighborhoods most significantly impacted by Sandy will be hampered if the momentum of planned investments is lost. The City will continue to pursue and execute public and private investments that had been planned prior to Sandy along the Waterfront. Such projects include but are not limited to:

Parks and Open Space Projects

- *Bush Terminal Piers Park*, a new waterfront park between 43rd and 51st Streets in Sunset Park, with a first phase set to open in 2013.
- *Brooklyn Bridge Park*, an 85-acre sustainable waterfront park stretching 1.3 miles along Brooklyn's East River shoreline, with additional segments currently under construction.
- *Bushwick Inlet Park*, city parkland planned on the Williamsburg and Greenpoint waterfronts adjoining an existing State Park.
- *Box Street Park*, a planned new park at Box and Commercial Streets on the Greenpoint waterfront.
- *Newtown Barge Park Expansion*, an expansion of existing park onto adjacent City-owned property.

Residential and Economic Development

- *Hunter's Point South*, the largest City-sponsored, middle-income housing development in New York since the 1960s, situated on approximately 30 acres of prime waterfront property in Long Island City, with an adjoining public park and esplanade, with the first two towers under construction.
- *Redevelopment of the Brooklyn Navy Yard*, including adding over two million square feet of new industrial space, through the development of Admirals Row, Building 77, the Green Manufacturing Center, and the expansion of Steiner Studios.



East and South Shores of Staten Island

The massive glacier that covered all of New York City 22,000 years ago left behind certain indelible marks. As the ice sheet melted, it deposited rocks, gravel, and sand that it had amassed in its journey, forming the varied topography of what is now known as Staten Island. The area that would one day be known as the East Shore became a vast swath of marshes and swamps that sloped roughly from where Hylan Boulevard lies today down to the Atlantic Ocean. The South Shore, farther down the coast and surrounded on three sides by water, contained belts of hillier ground and was separated from the ocean in places by red clay bluffs.

When Staten Island officially became part of New York City in 1898, the low-lying East Shore consisted mostly of small towns and, near the coastline, clusters of seasonal bungalows and beachfront resorts. The South Shore was also lightly populated, with small towns along upland roads and an early railway terminus in the southernmost town of Tottenville. (See map: *The East and South Shores: 1900 vs. 2000*)

By the late 1960s, however, Staten Island's population started to grow rapidly, due largely to the opening of the Verrazano-Narrows Bridge. Residential development began to spread southward through the borough, including on the East and South Shores. On the East Shore, some development occurred on land in close proximity to, and sometimes within, wetland areas. On the South Shore, development also moved closer to the coastline.

Whether they live in the East Shore or South Shore, the residents of these areas, in many ways, live a unique lifestyle. They are part of the

nation's largest city, yet many own detached houses, and, within minutes of returning from work, can stroll along beaches or wooded paths. However, this independence, these homeownership opportunities, and the proximity to nature have always come with some significant downsides.

For example, the East Shore's low-lying topography makes some parts of the area prone to coastal flooding. In addition, a tall, invasive reed called *Phragmites* has flourished in former wetlands. Because its dry stalks are highly flammable, the reed has, from time to time, brought wildfires to the area.

On the South Shore, meanwhile, ocean waves have, over time, eroded the area's bluffs, threatening homes and businesses in some locations. Furthermore, low-lying areas around creeks and tributaries are subject to flooding during storms.

Perhaps of greatest concern, both the East and South Shores occupy a place in New York Harbor that leaves them particularly exposed to storm waves and surge during extreme weather events. This is because the coastlines of Long Island and New Jersey are angled such that, in certain circumstances, they can channel flood waters directly into these areas.

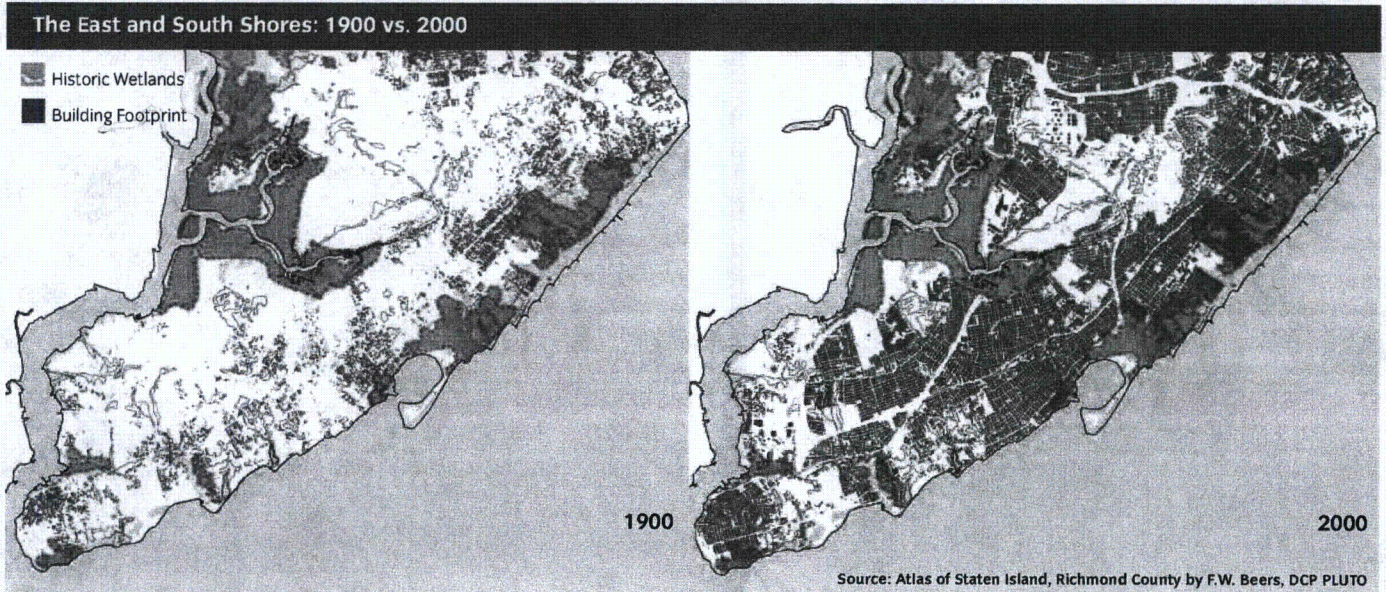
Sadly, many of these vulnerabilities came into play during Sandy. The storm's waves rose up over the East Shore's beaches, battering homes and sweeping some completely off their foundations. Waves also scoured the South Shore's bluffs and smashed ocean-facing houses, in some cases leaving behind only foundations and stairs. In both areas, water muscled its way inland, overwhelming

residential communities, business strips, marinas, and roads. Of the 23 storm-related deaths on Staten Island—more than in any other borough—all but one occurred on the East and South Shores.

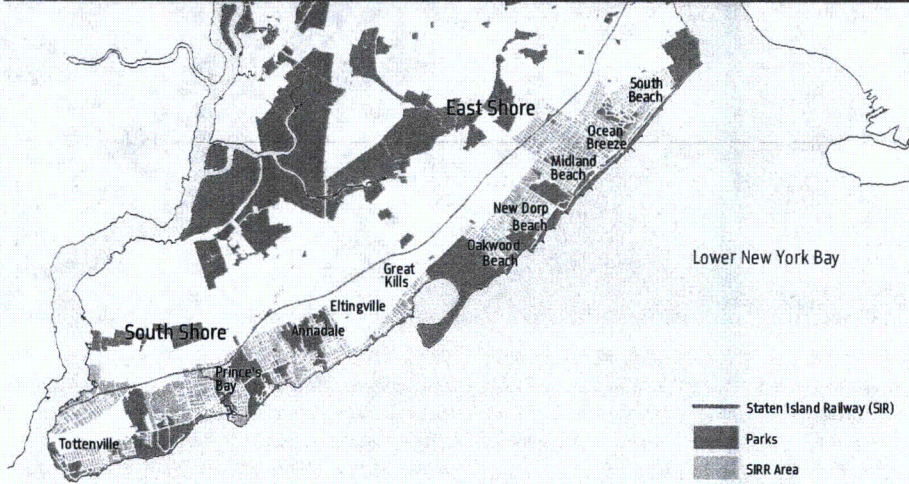
To help the East and South Shores recover from the tragedy of Sandy and prepare for a future of greater climate risks, the City has developed a plan that reflects the overarching goals of this report: To limit the impacts of climate change while enabling New York and its neighborhoods to bounce back quickly when those impacts cannot be avoided. The plan will address the area's most significant climate risk—its vulnerability to wave action and storm surge, particularly as sea levels rise—by protecting oceanfront and inland exposures, facilitating retrofits and resiliency in new and existing buildings, and safeguarding vital infrastructure. The plan also will address other significant risks—such as more heavy downpours, heat waves, and high winds—by drawing on both citywide and locally tailored initiatives. Finally, the plan will build on the natural assets of the East and South Shores and the powerful attachment residents have to their homes and neighborhoods to make the whole area even more vibrant and economically dynamic than it was before the storm.

Area Characteristics

The East and South Shores, as defined in the report, are predominantly low-density residential communities, with small business corridors primarily serving local residents. Each community encompasses many smaller neighborhoods. (See map: *Neighborhoods of the East and South Shores*)



Neighborhoods of the East and South Shores



Source: NYC Parks, NYCEDC GIS, DCP Pluto

The East Shore—which stretches approximately three miles, from Fort Wadsworth to Great Kills Park—includes the neighborhoods of South Beach, Midland Beach, New Dorp Beach, and Oakwood Beach. The South Shore extends from Great Kills Park to the southernmost point in New York State and includes neighborhoods such as Great Kills, Eltingville, Annadale, Prince's Bay, and Tottenville. While residents are attached to their individual neighborhoods, they also tend to identify with the broader geographies of the East Shore and South Shore.

Both areas have abundant parkland and open space. The East Shore's 2.5-mile beach, boardwalk and promenade—along South Beach, Midland Beach, and Cedar Grove Beach—are City parks managed by the Department of Parks & Recreation (DPR), as well as important economic drivers for the area. Within the South Shore neighborhood of

Prince's Bay sits Wolfe's Pond Park, one of several major waterfront open spaces that are managed by DPR. Other South Shore waterfront parks include Crescent Beach Park, Lemon Creek Park, and Conference House Park.

Between the East Shore and the South Shore is Great Kills Harbor, surrounded by Great Kills Park, one of three Federal parks (along with Fort Wadsworth and Miller Field) that form the Gateway National Recreation Area. Great Kills Park was built by the City, mostly on fill that dates to the 1930s. It was transferred to the National Parks Service in 1972. Ringed by private and public marinas, Great Kills Harbor is an economic hub and an important recreational amenity for the area.

Beyond the beaches, parks, and marinas—which draw residents from across the borough—the East and South Shores contain

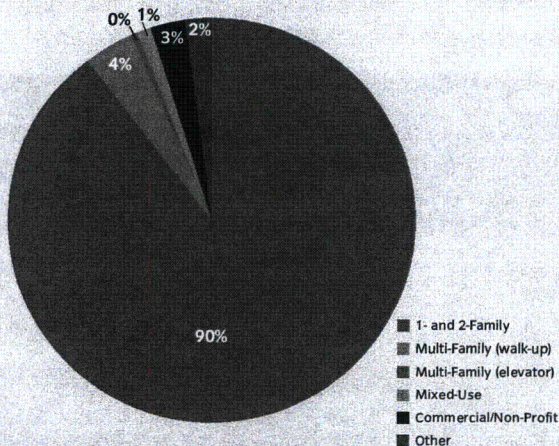
other important Staten Island assets. For example, the historic houses of Conference House Park, in Tottenville, serve as area attractions, while other historic properties, such as the Olmsted-Bell House and Seguire Mansion, have the potential to play a similar role in the future. Critical wastewater treatment and stormwater management infrastructure for the East and South Shores, and transportation assets for the entire borough, can also be found in the area. Finally, important institutions, such as Staten Island University Hospital (SIUH), are both major employers and providers of critical local and borough-wide services.

Residential Development

The population of the East and South Shores today totals approximately 70,000 residents. Between 2000 and 2010, the areas together saw population growth of 11 percent. Families of all incomes have been drawn to the areas by the chance to own homes in what many consider an idyllic setting.

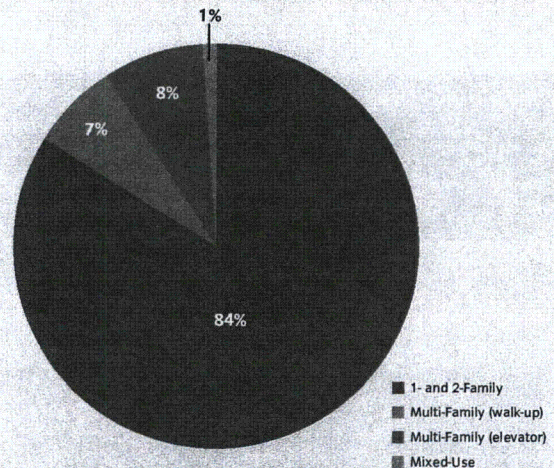
Generally, housing on the East and South Shores is freestanding, or detached, with pockets of semi-attached or attached houses. This stock consists predominantly of 1- and 2-family homes, which account for 90 percent of all area buildings, 93 percent of all residential buildings, and 84 percent of all housing units. Area homes also tend to be of a "combustible" construction type (e.g., wood-frame construction). Over one-half (59 percent) of 1- and 2-family homes were built before 1983, and thus constructed before current flood-protection standards were in place. (See chart: *Area Buildings Characterized by Type*; see chart: *Area Housing Units Characterized by Building Type*)

Area Buildings Characterized by Type



Source: DCP PLUTO

Area Housing Units Characterized by Building Type



Source: DCP PLUTO



Bungalow housing in Midland Beach

Credit: Sunghwan Yoon

Both the East and South Shores have population densities well below the citywide average of 42 people per acre, reflecting the area's single-family-home character as well its ample open space. The East Shore, however, is slightly more densely settled (16 people per acre) than the South Shore (7 people per acre) and Staten Island as a whole (11 people per acre). The East Shore's greater density reflects the fact that many homes in the neighborhoods of Midland Beach, South Beach, and New Dorp Beach are built on small lots and in close proximity to one another. (See chart: *Area Population Density*)

On the East Shore, many of the area's homes were built as seasonal cottages during the beachfront's heyday in the early 20th century, when it was lined with amusements and hotels.

Beginning in the 1950s, though, as those uses and some cottages were cleared by the State for the South Beach Psychiatric Center in Ocean Breeze and by Robert Moses for planned roadways and public beaches, families began turning their cottages into year-round residences, often passing these homes down from generation to generation. However, since the houses were not built to modern standards and many have not been upgraded since they were constructed, they remain vulnerable to extreme weather.

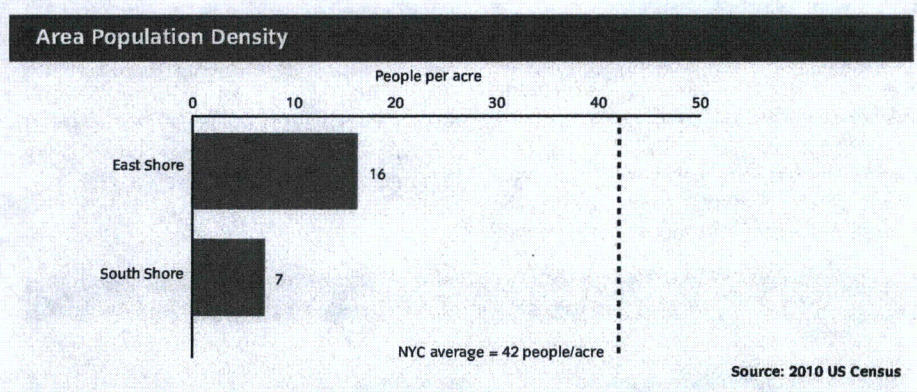
By contrast, in recent years the South Shore has witnessed the construction of more sizable homes on larger lots, with much of the recent building occurring between Hylan Boulevard and the coastline. Some of these residences have been built near the South Shore's

bluffs and beaches. Because of underwater topography, tides, and the natural movement of sediment, ocean waves can hit the South Shore nearly parallel to the coastline, carving away at the bluffs and making homes near the bluffs more vulnerable to flooding. Development also has occurred adjacent to many of the South Shore's creeks and inlets, including Lemon Creek. Though the South Shore community of Tottenville was not reached by the growth in construction after the opening of the Verrazano-Narrows Bridge, since the early 1990s, this area has seen more development, including along the shoreline below Hylan Boulevard, where rows of summer bungalows have been replaced by larger homes.

Socioeconomic Characteristics

Taken together, the East and South Shores are relatively prosperous with a higher combined median household income (\$76,800), higher combined homeownership rate (73 percent) and lower combined poverty rate (7 percent) than city averages. (See table: *Socioeconomic Characteristics*)

However, there are important socioeconomic differences between the East Shore and South Shore. As a whole, the East Shore has a lower median household income (\$68,600) than the South Shore (\$92,800). The median value of a housing unit in the East Shore before



Socioeconomic Characteristics								
Area	Population	Poverty Rate	Median Household Income	Households	Owner-Occupied Housing Units	% Homeowners	% Owner-Occupied Units with Mortgage	Median Owner-Occupied Unit Value
East Shore	45,300	8%	\$68,600	16,150	11,000	68%	72%	\$445,300
South Shore	24,400	4%	\$92,800	8,300	6,900	83%	74%	\$588,100
Total Staten Island SIRR Area	69,700	7%	\$76,800	24,450	17,900	73%	73%	\$500,000
Citywide Total/Average	8,175,000	19%	\$51,300	3,050,000	993,500	33%	64%	\$514,900

Source: 2010 US Census, 2011 American Community Survey, 5-Year estimate

Sandy (\$445,300) was slightly lower than the citywide median average (\$514,900). This was in contrast to the median price of a housing unit in the South Shore, which was higher (\$588,100). The East Shore also has a lower homeownership rate (68 percent) than that of the South Shore (83 percent).

Finally, there are 5,100 households that rent on the East Shore and 47 percent are classified as "cost burdened," defined by the Federal government as households that pay 30 percent or more of their annual income for housing. In the South Shore, there are only 1,400 households that rent, but the percentage of those that are cost burdened is similar to the East Shore (51 percent).

Business, Nonprofits, and the Local Economy

Before Sandy, there were approximately 2,800 businesses employing over 17,100 people in the East and South Shores. The majority of those businesses (82 percent) were small, employing fewer than five people. However, 40 percent of area employees worked for larger businesses (those with more than 100 employees). (See chart: *Profile of Area Businesses*)

On the East and South Shores, the retail and service sectors are major employers, with the healthcare industry offering the highest wages. In fact, SIUH, an approximately 700-bed teaching hospital, is the largest Staten Island-based employer, with 82 percent of its workforce consisting of Staten Island residents (5,104 residents employed as of 2012). SIUH has two campuses: a North Campus on the East Shore (in Ocean Breeze), that has Staten Island's only regional trauma and burn center, Staten Island's largest emergency room, and over one-third of the borough's inpatient beds; and a South Campus on the South Shore in the Prince's Bay neighborhood. Adjacent to the SIUH North Campus is a State hospital for the mentally ill, the South Beach Psychiatric Center, which has approximately 200 full- and part-time employees.

The area's marinas—many with repair facilities and restaurants—are also important to the local economy. Six (five private and one public) are located within Great Kills Harbor, with four more in the South Shore, such as Lemon Creek Marina, located along or in close proximity to inland waterways.

A primary commercial corridor for both the East and South Shores is Hylan Boulevard, a major north-south artery. In addition, the East Shore has small retail and commercial strips that serve local residents and summer visitors

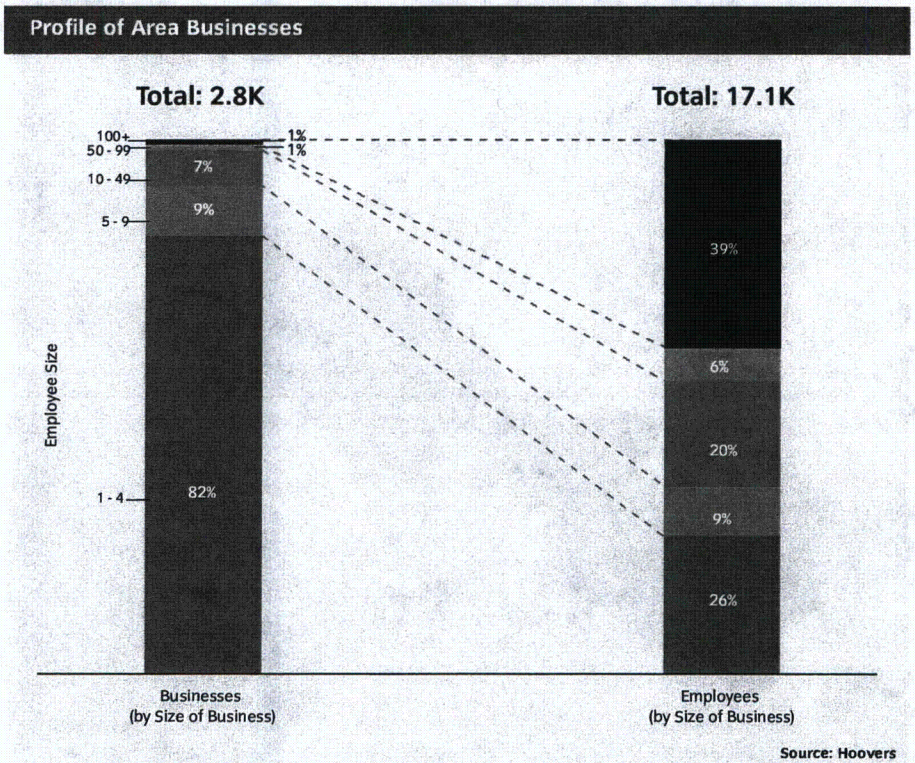
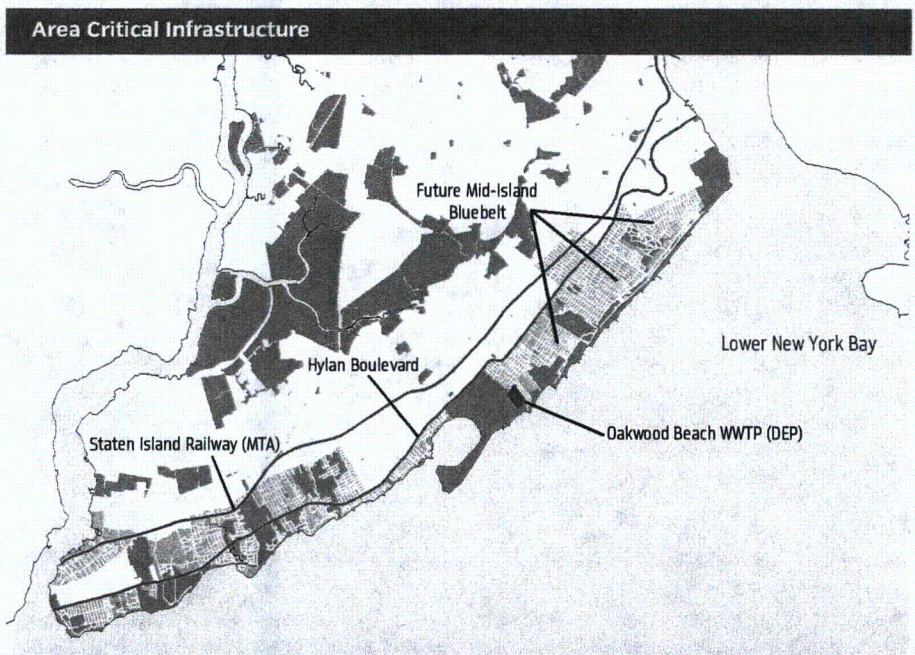
to beach areas. These include Midland Avenue, Sand Lane, Seaview Avenue (where a number of medical offices are clustered), and small strips along Father Capodanno Boulevard, which runs parallel to the beachfront.

In the South Shore, many neighborhoods have historic town centers, such as the commercial stretch of Main Street in Tottenville. Additional commercial thoroughfares include Page Avenue as well as small commercial districts

along Annadale Road in Annadale and around the Staten Island Railway (SIR) stations in Eltingville and Great Kills. The Bricktown Centre and South Shore Commons shopping centers, located in Charleston, just north of Tottenville, house stores that draw customers from other sections of Staten Island and from New Jersey.

Critical Infrastructure

The East and South Shores contain critical wastewater treatment, stormwater



management, and transportation systems. (See map: Area Critical Infrastructure)

In the East Shore, the Oakwood Beach Wastewater Treatment Plant has been in operation since 1956 and serves nearly a quarter of a million people (roughly half of the population of Staten Island) in an 11,000-acre drainage area. On an average day, the facility, operated by the New York City Department of Environmental Protection (DEP), treats 30 million gallons of wastewater.

DEP also manages the Staten Island Bluebelt, an innovative system that uses open space to control stormwater while preserving Staten Island's wetlands—the last great stand of freshwater wetlands in New York City. Currently, the Bluebelt system drains 15 watersheds on the

South Shore plus the Richmond Creek watershed, a combined area of approximately 10,000 acres. Property acquisition for the Bluebelt system on the South Shore is complete and DEP is now building out the drainage system for the area. (See sidebar: What is the Bluebelt?)

Building on the success of the South Shore system, DEP has proposed a comprehensive Mid-Island Bluebelt, which, would address street and property flooding in East Shore neighborhoods. When fully developed, the Mid-Island Bluebelt will drain a 5,000-acre area encompassing the South Beach, New Creek (Midland Beach), and Oakwood Beach watersheds. A little over half of the area needed for the Mid-Island Bluebelt has been acquired, though completion of the system is not expected until the 2040s.

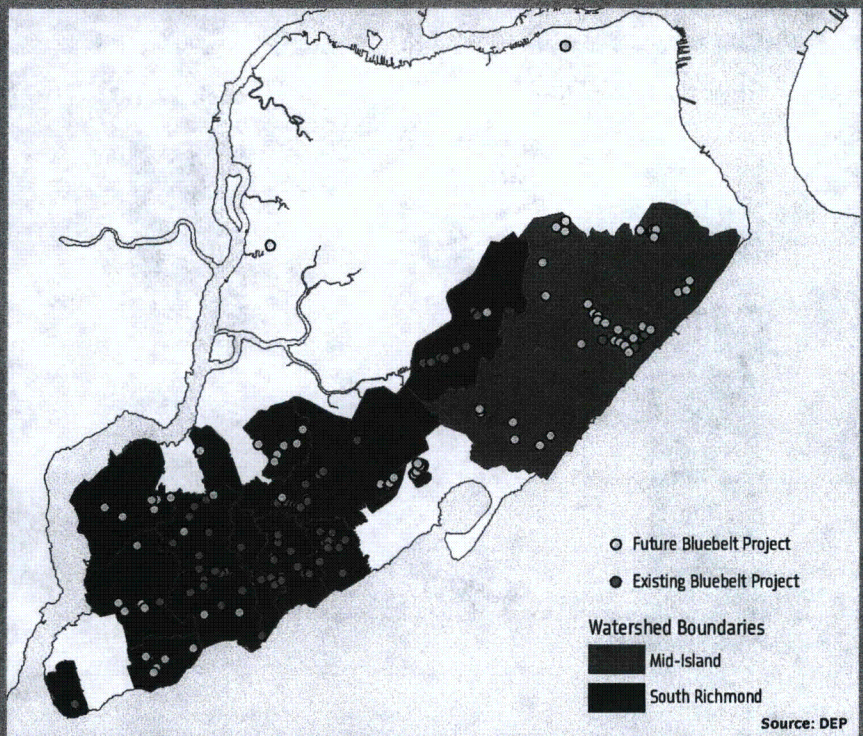
The area's transportation assets include Hylan Boulevard. Running the length of the shoreline—approximately 14 miles, from the North Shore neighborhood of Rosebank to the South Shore neighborhood of Tottenville—the roadway is highly trafficked, with 44,000 vehicles and 32,000 bus riders traveling it on a typical weekday. Select Bus Service (SBS), started in September 2012, connects Hylan Boulevard and Bay Ridge, Brooklyn. Many sections of Hylan Boulevard are low-lying and flood during even normal rainfall.

Another transportation asset on the East and South Shores is the SIR, a 14-mile commuter rail line operated by the Metropolitan Transportation Authority (MTA). The only rapid transit line on Staten Island, the SIR provides service along the east side of the borough between St. George and Tottenville. Many residents from the East and South Shores use the SIR to reach the St. George Ferry Terminal, from which they take the Staten Island Ferry to Manhattan, where more than one-quarter of working Staten Island residents are employed. Several South Shore SIR stations, including the Richmond Valley Station, are in low-lying areas that flood during heavy rains.

Yet another transportation corridor in the area is Father Capodanno Boulevard. The Boulevard, part of a Robert Moses-planned roadway that was never fully realized, was built at a higher elevation than the neighborhoods through which it runs. As a result, during extreme weather events and even smaller storms, the Boulevard has prevented floodwaters in neighborhoods farther inland from draining back into the Harbor.

What is the Bluebelt?

The Staten Island Bluebelt is an award-winning, ecologically sound, and cost-effective stormwater management system, which is also one of the most ambitious stormwater management efforts in the northeastern United States. Initiated in the late 1980s by DEP, the system makes use of natural drainage corridors—including streams, ponds, and other wetland areas—to convey, store, and filter stormwater, thus preserving these natural areas and minimizing the need to construct traditional underground stormwater systems. It works as follows: The Bluebelt natural drainage corridors, acquired by the City, convey stormwater from conventional storm sewers to the Raritan Bay or the Arthur Kill via concrete pipes that are located across beaches or open channels. At each point where storm sewers drain into the Bluebelt, a "best management practice" project, such as a detention basin or pond, is constructed to manage stormwater and enhance water quality. In sum, the Bluebelt program preserves open space, maintains natural floodplains, and provides flexible infrastructure—allowing for an adaptive and sustainable response to climate change.



What Happened During Sandy

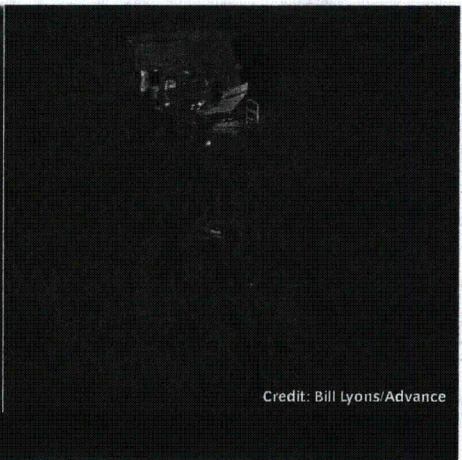
Sandy's arrival at high tide on the Atlantic, its massive surge, and its wind-whipped waves all spelled disaster for the East and South Shores. Peak storm tides reached 16 feet—almost five feet higher in Tottenville than at the Battery in Manhattan. Along the Staten Island coastline, monitors indicated storm tide fluctuations of 5 to 6 feet every 30 seconds, as large waves repeatedly slammed into the coast at the height of the storm.

On the East Shore, storm waves came across the beaches and battered homes. The surge was devastating for the neighborhoods of Oakwood Beach, South Beach, Midland Beach, and New Dorp Beach. In Oakwood Beach, for example, the surge swept some homes off of their foundations and deposited them in marshes. It flattened half of the houses on Kissam Avenue, inflicted extensive water



Devastation on Kissam Avenue/Oakwood Beach

Credit: Bill Lyons/Advance



Credit: Bill Lyons/Advance

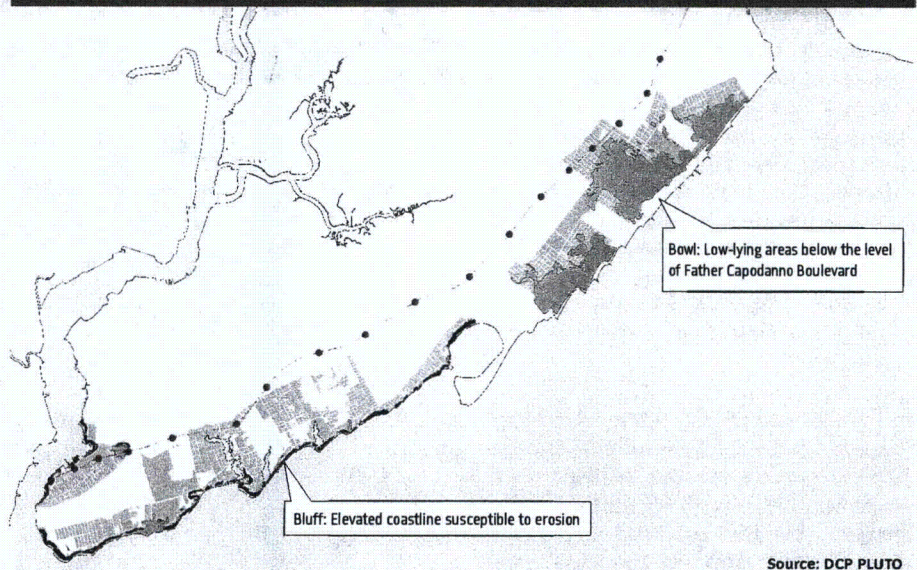
damage on the others, and forced all of the street's residents to seek temporary housing. On the beaches in front of South Beach and New Dorp Beach, much of the sand was washed away. (See photo: *Devastation on Kissam Avenue/Oakwood Beach*)

Many areas on the East Shore flooded due to their low elevation. The "bowl" topography of the East Shore, created by the higher elevation of Father Capodanno Boulevard, exacerbated damage to homes and businesses. When the storm surge topped this elevation, the "bowl" in which the communities inland of the Boulevard are built filled and floodwaters rose rapidly, following the natural contours of the land. With the ground saturated, this low topography trapped water in some neighborhoods at significant depths—in some places for several days. (See map: *Bowls and Bluffs*; see map: *Area Inundation and Surge Height*)

Sandy's surge also overwhelmed the area's drainage infrastructure, which is designed to drain rainwater and not to handle the massive volumes of water associated with a coastal surge. In some cases, floodwaters infiltrated roadway drainage and sewer systems through catch basins, manholes, and storm drains. Additionally, several tide and floodgates, devices that prevent water from flowing backwards through the drainage system—such as at Oakwood Beach—were damaged during the storm.

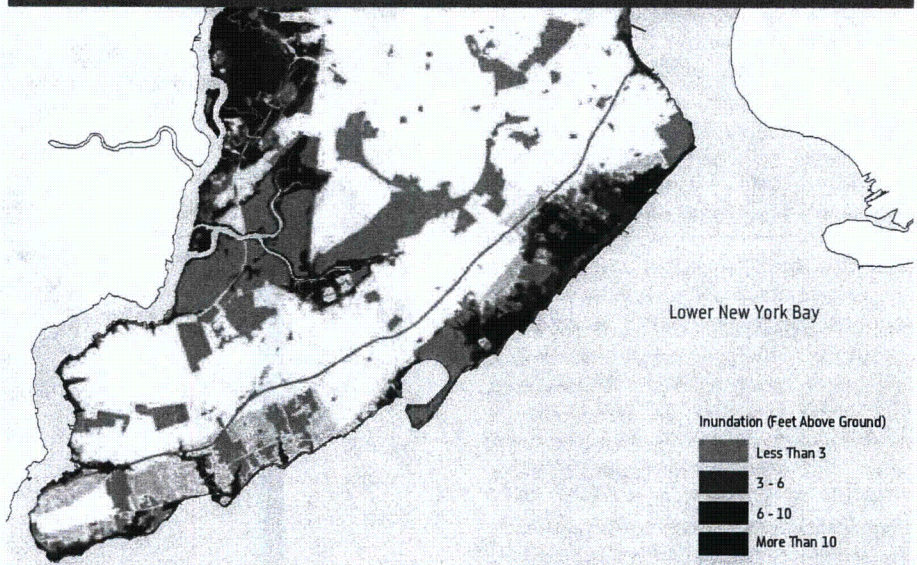
On the South Shore, early winds out of the northeast drove powerful waves almost parallel to the coastline. These waves carved away at the area's protective bluffs, causing significant erosion. Although the direction of the waves and the presence of the bluffs meant that generally only the first few rows of homes in most South Shore communities were exposed to the force of these waves, many homes that were hit, such as those around Tottenville Beach and Yetman Avenue, were smashed.

Bowls and Bluffs



Source: DCP PLUTO

Area Inundation and Surge Height

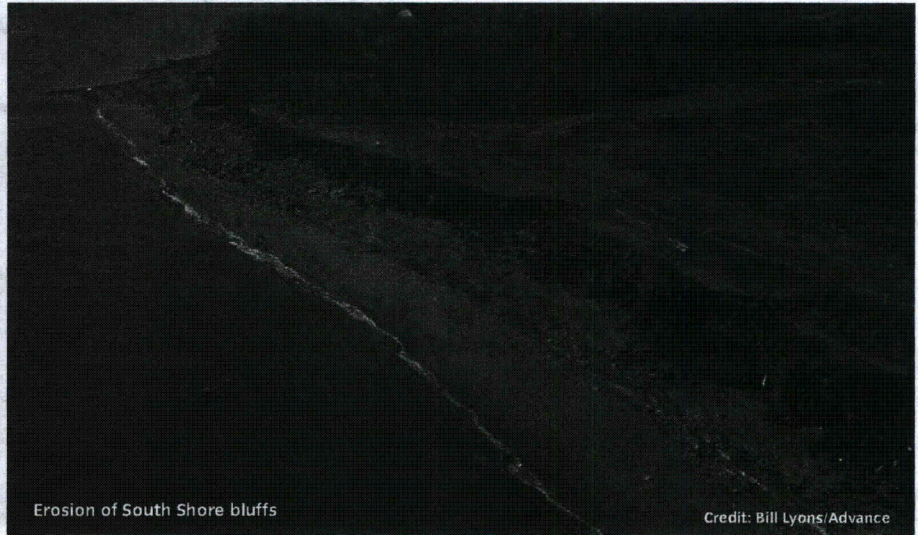


Source: FEMA (MOTF 11/6 Hindcast surge extent)



New Dorp Beach

Credit: John de Guzman



Erosion of South Shore bluffs

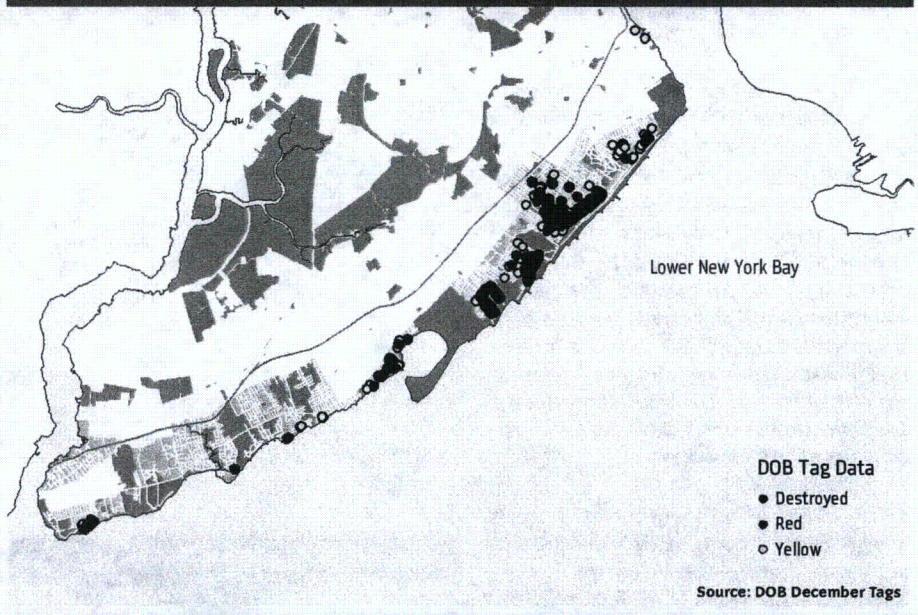
Credit: Bill Lyons/Advance

Meanwhile, in some neighborhoods along the South Shore, waterfront parks such as Wolfe's Pond Park took direct hits from the surge, likely buffering inland areas from further storm damage. However, many of these parks themselves sustained considerable damage that caused them to remain closed for months. Storm surge also traveled far inland on the South Shore into low-lying areas along creeks and tributaries, including Mill and Lemon Creeks. (See photo: *Erosion of South Shore Bluffs*)

As a result of Sandy, a large number of buildings in the East and South Shores suffered damage. After the storm, the New York City Department of Buildings (DOB) sent out inspectors to assess damages in the East and South Shores and other inundated areas of the City. These inspectors were asked to assign "tags" to buildings based on the observed condition of each structure. "Green" tags indicated less serious damage or no damage. "Yellow" tags indicated that portions of a building might be unsafe or might have significant non-structural damage. "Red" tags indicated structural damage. And a subcategory of "red" tags were further categorized as "destroyed". (See map: *Location and Level of Building Damage*; See chart: *Level of Building Damage*)

The most methodologically rigorous building damage assessment undertaken by DOB was completed in December 2012. According to this assessment, of those buildings citywide that were tagged, either yellow or red (including those further classified as destroyed), 23 percent were located in the East and South Shores. The yellow and red tagged buildings tended to be clustered in the East Shore neighborhoods of South Beach, Midland Beach, New Dorp Beach and Oakwood Beach and the South Shore neighborhoods of Great Kills,

Location and Level of Building Damage

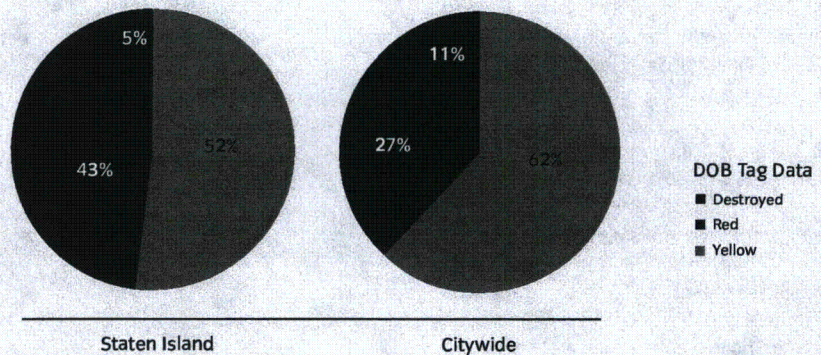


DOB Tag Data

- Destroyed
- Red
- Yellow

Source: DOB December Tags

Level of Building Damage



DOB Tag Data

- Destroyed
- Red
- Yellow

Source: DOB December Tags



Damage to bungalow in New Dorp Beach

Credit: John de Guzman

Annadale and Tottenville. In the East and South Shores, consistent with other ocean-facing areas of the city, the percentage of red and yellow tagged buildings that were tagged red (48 percent) was higher than the percentage citywide (38 percent). This overrepresentation was reflective of the destructive impact that powerful waves coming off of the ocean had on the area's building stock.

The structural characteristics of the area's building stock contributed to the scale of damage and destruction. As described in Chapter 4 (*Buildings*), throughout the city's inundation area, low-rise buildings of combustible construction predating 1983, when the City adopted FEMA's flood maps and incorporated flood-resistant construction standards, proved to be some of the most

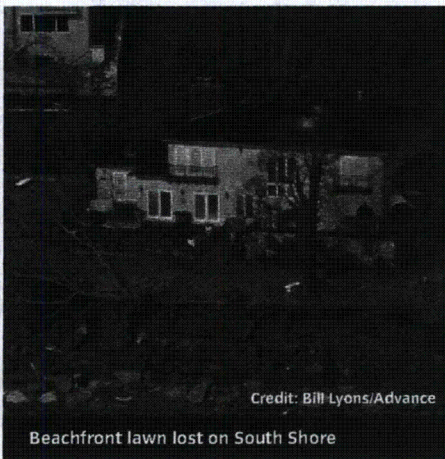
vulnerable building types during Sandy. This building type represented over half (61 percent) of the approximately 11,700 buildings in the inundated areas of the East and South Shores.

The damage from destructive waves during Sandy was especially severe for low-rise residential buildings in neighborhoods such as Midland Beach, South Beach, New Dorp Beach, and in East Shore communities along Father Capodanno Boulevard. In particular, a number of winterized bungalows in the area that were not properly anchored were washed off of their foundations during the storm. In these neighborhoods, post-storm demolitions have resulted in "missing tooth" residential blocks, where habitable homes stand next to empty lots previously occupied by neighboring houses.

SIUH also was impacted by the storm. Prior to Sandy's arrival, the hospital transferred especially vulnerable patients, such as those dependent on ventilators, to other facilities. Once Sandy hit, storm surge caused roads leading to the North and South campuses to be flooded, and some of the hospital's administrative and clinical support facilities to sustain damage. During and after the storm, the SIUH heliport was used as a landing site for relief helicopters, while the South campus lost power for days.

Meanwhile, marinas across the area were damaged severely. As of the writing of this report, all six marinas in Great Kills Harbor are still making repairs and have not reopened. At the publicly owned Nichols Marina in Great Kills Park, 350 floating wooden slips were swept away by Sandy. Repairs coupled with debris removal will effectively take this marina out of commission for the entire 2013 boating season.

A similar tale of damage and destruction played out for retail stores and commercial structures near the area's beaches. Businesses lost equipment, personal property, and building systems. In the East Shore, the small commercial corridor along Midland Avenue was devastated by flooding, winds, and power loss. Nearly four months after the storm, 51 of 72 Midland Avenue retailers remained closed. Businesses in Midland Beach along Father Capodanno Boulevard were similarly affected. In South Beach, professional offices along Seaview Avenue and retailers along Sand Lane suffered extensive damage. The Hylan Boulevard commercial corridor, roughly between Seaver Avenue and New Dorp Lane in the East Shore, was flooded with many businesses, including large-format retailers, forced to close for days. Businesses on and near Main Street in Tottenville sustained structural damage, with first floors often obliterated, leaving only wall studs.



Credit: Bill Lyons/Advance

Beachfront lawn lost on South Shore



Damage at Great Kills Marina

Credit: Bill Lyons/Advance

The storm also damaged critical infrastructure. The Oakwood Beach Wastewater Treatment Plant was completely surrounded by surge waters during Sandy, and the tremendous flow of seawater, sand, and other debris around the plant damaged some of the facility's pumps. DEP employees kept the plant running through the night of the storm, despite the fact that the facility lost some of its electrical power and had to run some functions on generators. Because of these efforts, the plant was able to treat over 80 million gallons of wastewater—more than 2.5 times the amount treated on a normal day—that otherwise would have backed up into homes and businesses.

As for the area's transportation assets, Hylan Boulevard was inundated in many areas during Sandy, causing severe delays in express and local bus service. Major damage also occurred at the SIR's operations and maintenance facilities, limiting service in the days after the storm (ultimately, full service was only restored in mid-December).

The Staten Island Ferry was also knocked out of service for five days after Sandy, mostly due to damage at the Whitehall Ferry Terminal in Lower

Manhattan. This left many residents without transportation options to and from Manhattan, while also affecting those who travel by ferry to Staten Island for work and school. In response, approximately one month after the storm, additional ferry service to Manhattan (to Pier 11, continuing on to Midtown) was launched on a temporary basis from a newly installed, temporary landing in Great Kills Harbor.

Meanwhile, four schools were impacted in the area, with two—I.S. R002 George L Ebert and P.S. 052 John C. Thompson—remaining closed for almost a month following the storm. P.S. 003, The Margaret Gioiosa School, lost power during the storm, and Tottenville High School was closed while operating as a temporary shelter for area residents. During these temporary closures, students at these schools were sent to alternative locations.

Following the storm, many homeowner and civic associations in Midland Beach, Ocean Breeze, New Dorp Beach, and other neighborhoods played an essential role in recovery efforts, even as their own members and leadership dealt with personal challenges and tragedies. Several organizations, including

many faith-based organizations, allowed their buildings to serve as distribution centers and temporary shelters, despite the fact that, in a number of cases, these facilities also suffered damage.

What Could Happen in the Future

Given the area's coastal exposure and low-lying topography, the most significant climate risk to the East and South Shores is the increased frequency of the most intense coastal storms. This risk likely will be exacerbated by sea level rise. (See chart: *Risk Assessment: Impact of Climate Change*)

Major Risks

Preliminary Work Maps (PWMs) were released in June 2013 by the Federal Emergency Management Agency (FEMA). These PWMs will be considered the best available information until FEMA releases Preliminary Flood Insurance Rate Maps (FIRMs), by the end of 2013. The PWMs show increased flood risk throughout the East and South Shores. On Staten Island, the 100-year floodplain, the area that has a 1 percent or greater chance of

Risk Assessment: Impact of Climate Change

Major Risk Moderate Risk Minor Risk

Scale of Impact

Hazard	Today	2020s	2050s	Comments
Gradual				
Sea level rise				Expected to make low-lying areas more vulnerable to coastal flooding; will also likely cause further erosion of beach and bluffs
Increased precipitation				Likely would cause additional flooding of low-lying areas, particularly in areas where the storm sewer system is not fully built out
Higher average temperature				Minimal impact
Extreme Events				
Storm surge				Significant risk of both wave action and coastal flooding, as evidenced by Sandy; risk likely would grow as V Zone and Coastal A Zone expand; increased storm frequency would leave less time to restore coastal protections
Heavy downpour				Will raise likelihood that the capacity of stormwater management systems may be exceeded more frequently, resulting in localized flooding
Heat wave				Will place greater strain on the area's power system, increasing the potential for failures
High winds				Would likely affect overhead power lines, the mode of power delivery to the majority of the area

flooding in any given year, has expanded 37 percent in land area since the FEMA flood maps that were in effect during Sandy were released in 1983.

In the East Shore, the floodplain has expanded to encompass most of Midland Beach and extends as much as a mile inland in locations, beyond Hylan Boulevard towards the SIR tracks. In addition, the area surrounding Ocean Breeze Park, and certain residential blocks in New Dorp Beach and Oakwood Beach, have been added to the floodplain. In the South Shore, the new floodplain reaches additional residential blocks along the coastline in Annadale, Prince's Bay, and Tottenville, and extends inland along waterways, such as Mill Creek and Lemon Creek. (See map: *Comparison of 1983 FIRMs and Preliminary Work Maps*)

All beaches along the East and South Shore coastlines, and the northern edge of Great Kills Harbor, are now within a V Zone, which is a coastal area at risk of storm waves of three feet or more. In some limited instances, V Zones even encompasses residential properties, including the first inland rows of homes in certain South Shore neighborhoods such as Great Kills, Prince's Bay, and Annadale.

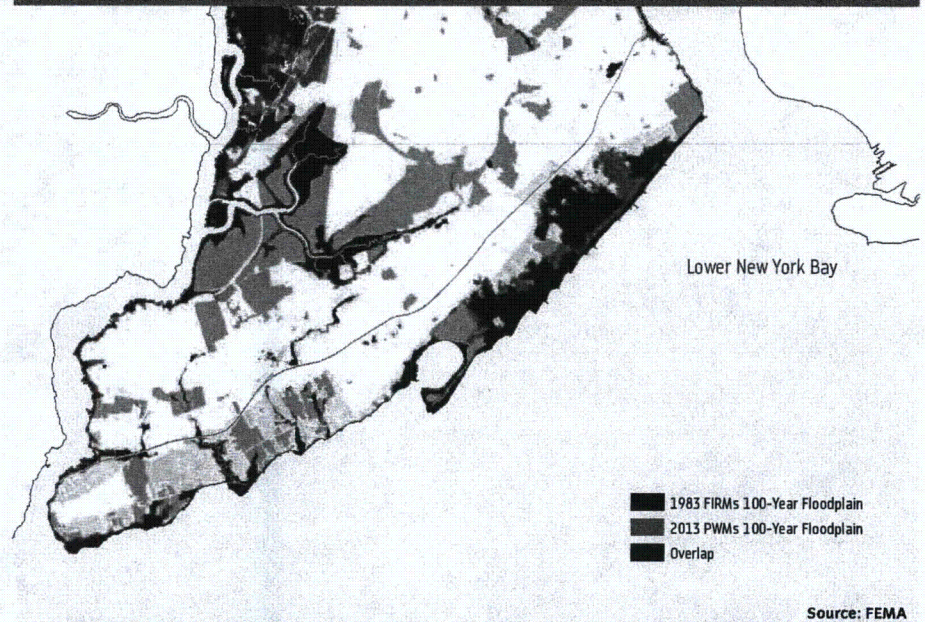
Overall, Base Flood Elevations (BFEs), or the height to which floodwaters could rise during a storm, have increased by two to four feet, in large swaths of the area.

In addition to expanding in area, according to the PWMs, the 100-year floodplain along the East and South Shores also now encompasses significantly more buildings (approximately 9,700 buildings total, a 46 percent increase). This includes an approximate 50 percent increase in residential units in the floodplain, a 32 percent increase in commercial buildings in the floodplain and, perhaps most significantly, a 49 percent increase in the area's 1- and 2-family homes—a housing type that is, as noted earlier, particularly vulnerable to storm surge. (See chart: *Buildings in the Floodplain*)

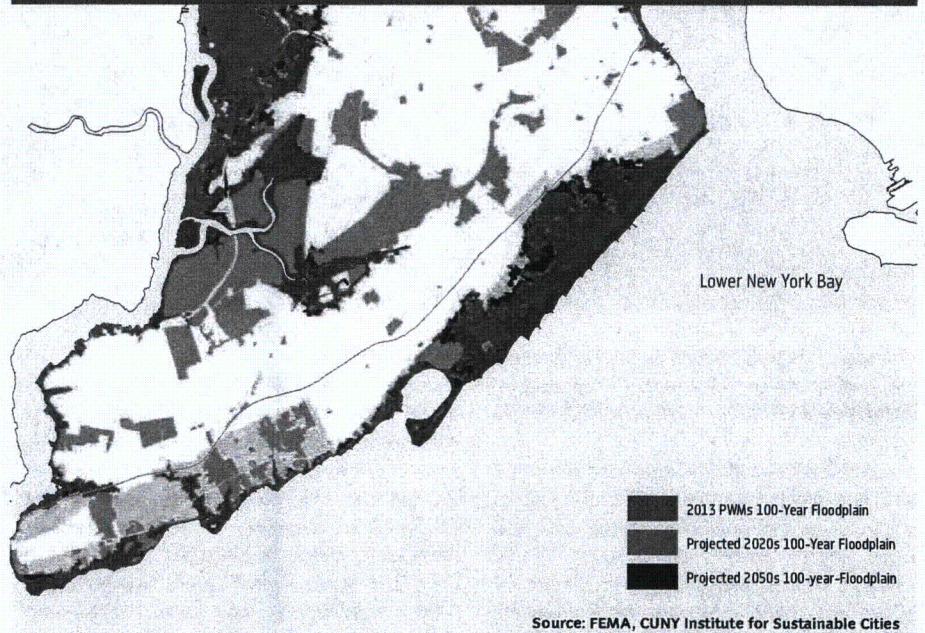
The PWMs also show critical facilities and infrastructure within the 100-year floodplain. Examples range from stretches of Hylan Boulevard in both the East and South Shores, to the areas surrounding the Oakwood Beach Wastewater Treatment Facility and the North Campus of the Staten Island University Hospital.

Looking forward, according to projections from the New York City Panel on Climate Change (NPCC), sea levels are likely to rise through the 2020s and 2050s (see Chapter 2). As sea levels rise, the floodplain will likely expand,

Comparison of 1983 FIRMs and Preliminary Work Maps



Comparison of Preliminary Work Maps and Future Floodplains



Buildings in the Floodplain

	100-Year Floodplain			
	1983 FIRMs	2013 PWMs	Projected 2020s	Projected 2050s
Residential Buildings	6,300	9,240	10,730	12,100
Residential Units	7,000	10,500	12,300	14,700
Commercial and Other Buildings	380	490	550	600

Source: DCP PLUTO, FEMA

Staten Island's Historic North Shore

The neighborhoods on Staten Island's historic North Shore experienced Sandy in some ways that were similar to the neighborhoods on which this report focuses and in some ways that were different. However, each was impacted in ways that continue to affect the residents and businesses of these neighborhoods.

During Sandy, floodwaters reached beyond Bay Street in Clifton, Stapleton, and Tompkinsville, causing property damage and business disruption. The John B. Caddell tanker ran ashore in Stapleton during the storm, closing down Front Street. Piers driven ashore by Sandy blocked the Bay Street Landing in St. George. Along the Kill Van Kull, many docking and landside facilities were damaged. Inundation went beyond Richmond Terrace in parts of West Brighton, Port Richmond, and Mariners Harbor. At the Snug Harbor Cultural Center, volunteers and maintenance workers spent days clearing debris.

Looking to the future, the risks faced by the North Shore from extreme weather events are likely to increase due to climate change. The initiatives described in this report are designed to help address these risks through a range of strategies. Among these are: a program to raise bulkheads and other shoreline structures in low-lying areas most at risk of flooding, including, potentially, areas of the North Shore (see Coastal Protection Initiative 6); investments to harden the St. George Ferry Terminal (see Transportation Initiative 6); loans and grants to help thousands of New Yorkers repair and rebuild housing and reopen businesses (see Buildings Initiatives 2 and Economic Recovery Initiative 1); loans and grants to help thousands of New Yorkers make resiliency investments in their businesses, including a sales tax abatement program for owners of industrial buildings in the 100-year floodplain (see Buildings Initiative 7 and Buildings Initiative 10); and investments to promote community and economic recovery, including planned and on-going investments along the St. George Waterfront and at Stapleton.



Bay Street Landing

Credit: Bill Lyons/Advance

potentially resulting in even higher floodwaters due to storm surge. (See map: *Comparison of Preliminary Work Maps and Future Floodplains*)

Using the high end projections from the NPCC the City projects that the number of buildings in the future floodplain along the East and South Shores could rise to over 11,200 buildings by the 2020s (an approximate 16 percent increase of over what is shown by the PWMs) and to approximately 12,700 buildings by the 2050s (a further 15 percent increase over what is shown in the PWMs). Most of these will be 1- and 2-family homes. During this period, Coastal A Zones—area landward of a V Zone, at risk of storm waves of between 1.5 feet and 3 feet—are also likely to expand westward into East Shore communities and farther inland along the coastline and creeks in the South Shore. It is also possible that sea level rise, even without extreme weather events, could place further strain on low-lying areas and contribute to greater erosion of beaches and bluffs.

Other Risks

Though coastal inundation poses the greatest threat to the neighborhoods along the waterfront, these areas face other climate risks, as well. For example, going forward, increased precipitation and heavy downpours could lead to localized flooding of low-lying areas, particularly areas in the East Shore where the storm sewer system is not fully built out. Heavy downpours may also exceed the capacity of stormwater management systems more frequently, leading to localized street flooding in other low-lying areas of the East and South Shores.

While future projections for changes in wind speeds are not available from the NPCC, a greater frequency of intense coastal storms by the 2050s could present a greater risk of high winds in the New York area, which could result in downed overhead power lines and trees, and potentially damage older buildings not constructed to modern wind standards.

Heat waves may strain electric systems, resulting in power failures that can impact homes and businesses and the functioning of infrastructure. Finally, drought may increase the threat of wildfires in the area, especially in the East Shore, where the pervasiveness of *Phragmites* has resulted in more than 100 serious brush fires in the last 15 years. Many homes in the East Shore are within a designated Wildland-Urban Interface (WUI) zone, which is a zone where homes are built near or among lands prone to wildfire—a rarity in major cities such as New York.