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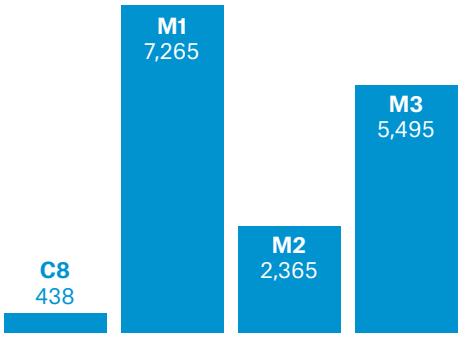
New York City's Industrial Floodplain

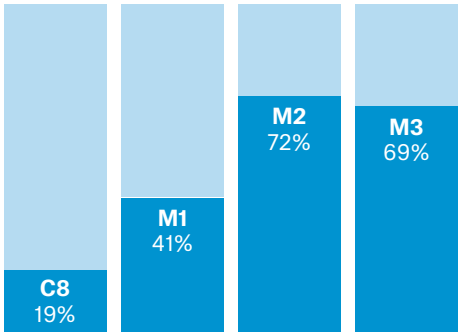
The city relies on its manufacturing districts to locate high-impact, truck-dependent, and potentially hazardous operations that are best sited away from residences. These uses are often permitted only in manufacturing districts, which are typically mapped in low-lying areas in locations where industry has historically chosen to operate due to access to waterways and relative isolation from residences. Roughly half of the city's industrially zoned land falls within the 0.2 percent annual chance floodplain, areas subject to moderate risk of flooding. This amounts to more than 15,000 acres of industrially zoned land. Of this, 10,000 acres are within the high risk, 1 percent annual chance floodplain. In M2 and M3 districts, which tend to contain heavier industrial uses such as waste management and petrochemical distribution, the percentage of land that falls in the floodplain is approximately 70 percent. More detailed information about zoning in NYC can be found on page 43.

Properties located in the V Zone and A Zone are in the 1 percent annual chance floodplain and are considered at high risk of flooding.

Acres in Floodplain by Zoning District (X, A, V Zones)



Percent of Citywide Manufacturing Districts Located within the Floodplain by Zoning District

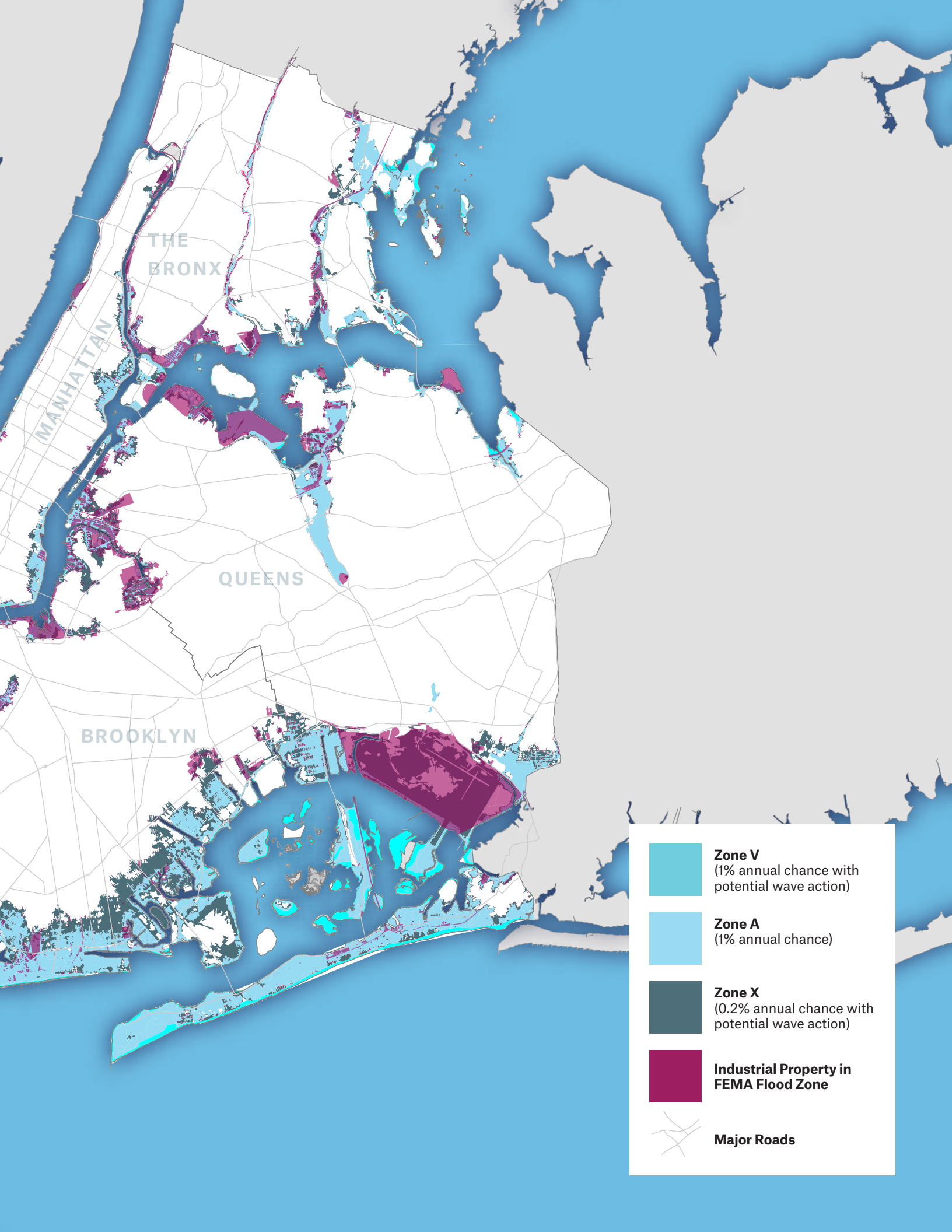


Flood Depths in Sandy Inundation Area

13.2′: Highest flood depth

13% of flooded industrial buildings had depths greater than 5′

2.57′: Average flood depth


THE BRONX
MANHATTAN
QUEENS
BROOKLYN
Zone V
(1% annual chance with potential wave action)
Zone A
(1% annual chance)
Zone X
(0.2% annual chance with potential wave action)
Industrial Property in FEMA Flood Zone
Major Roads

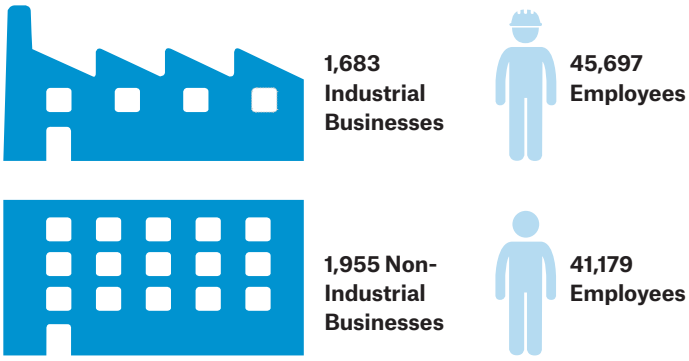
The city's industrial floodplain includes numerous facilities and operations that serve critical functions or provide for necessary, but difficult to site, services that support the growing population and economy, such as construction yards, utilities, distribution, and recycling.

Though a wide range of businesses operate within the city's floodplain, the industrial sectors that are most heavily represented include wholesale trade, transportation and warehousing, construction, and manufacturing. These four industrial sectors also provide the greatest employment within the floodplain, with transportation and warehousing businesses providing nearly half of industrial jobs, and a quarter of total jobs, within areas at high risk of flooding.

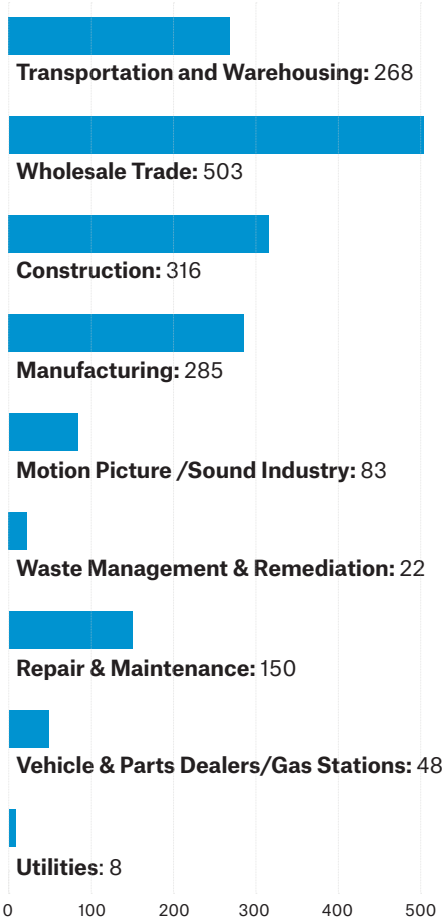
In recent years, there has been considerable growth of specialty trade contractors, such as businesses that provide plumbing, heating, air conditioning, and electrical services. These companies support the construction industry and are essential for the maintenance of the city's large building stock. The grocery wholesale sector, a critical component of the city's food distribution supply chain, has also expanded in manufacturing areas of the city in recent years. While the manufacturing sector has experienced less overall growth, a burgeoning market for locally produced food and beverages has driven growth within food manufacturing, breweries, and distilleries. The film and television industry has also thrived over the last decade, leading to substantial use of the city's industrial floodplain for studios and production sites in industrial buildings with large floorplates and high ceilings.

In addition to the economic importance of the city's industrial sector, many industrial facilities are important to the emergency response and recovery effort following disruptions. For example, fuel distribution facilities, many of which are located along the water in low-lying areas, are essential to maintaining power, heat, and mobility of people and goods. Similarly, debris removal by the New York City Department of Sanitation and private waste management companies is vital early in the recovery process from many natural disasters. Local construction contractors and material distributors are essential to any rebuilding effort. Ensuring that these and other critical industrial facilities are resilient to future flooding and coastal storms is important for the city to maintain operations and support its citizens while responding to and recovering from future events.

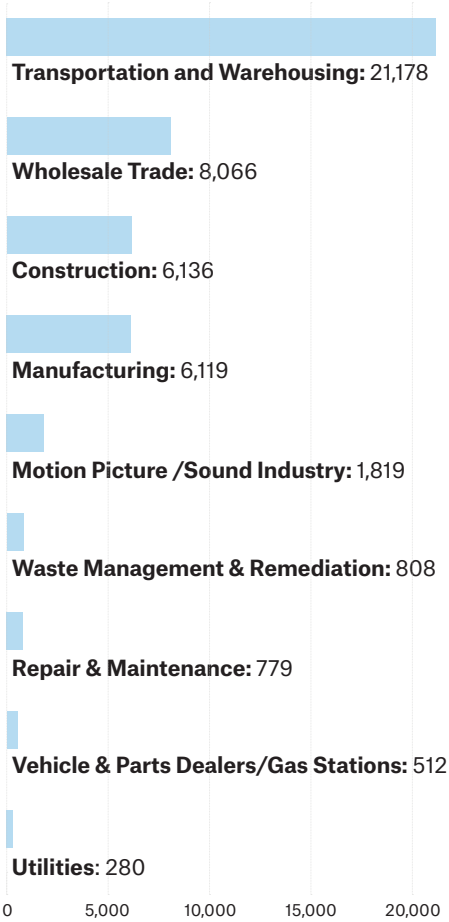
Number of Business & Employees within the Industrial Floodplain



Business in the Industrial Floodplain by Sector



Employees in the Industrial Floodplain by Sector



Source: Bureau of Labor Statistics,
Quarterly Census of Employment and Wages. 2015

87 percent of industrial buildings in the flood zone predate floodplain regulations

Single-story industrial building constructed in 1950 in Gowanus, Brooklyn.

Industrial Building Stock

The city's industrial building stock is vulnerable to extreme weather events. The vast majority of these buildings predate requirements to elevate, floodproof, or otherwise mitigate risk. More than half of the warehouses and factory buildings that house the city's industry were built before 1946, and over 87 percent of industrial buildings in the floodplain were built prior to 1983 when New York City adopted its first flood maps and enacted floodplain regulations.

Furthermore, almost two-thirds of industrial properties in the floodplain are single-story warehouses, causing most industrial businesses to locate their entire operation on the ground floor. This offers little flexibility to relocate equipment, inventory, or production space to higher floors where there is less risk of flood damage.

Despite these vulnerabilities, industrial buildings do present many unique opportunities related to flood protection. Most notably, the high floor-to-ceiling heights and greater spacing between columns typical of many warehouses and manufacturing spaces allow for more flexibility to raise critical equipment, machinery, and inventory within existing building envelopes. Compared with commercial and residential buildings, the interiors of industrial buildings tend to have fewer investments in finished spaces and typically incorporate more flood-resistant construction materials, such as concrete, cement, and steel floor trusses and beams.[2] Strategies to enhance the resiliency of industrial businesses should be tailored to these unique challenges and opportunities faced by New York City's industrial businesses and the existing building stock they occupy.

Concrete trucks parked along Newtown Creek in East Williamsburg, Brooklyn.

Commercial Vehicles

Many businesses that operate in the city's industrial floodplain rely on large fleets of commercial trucks, including food wholesale, freight trucking, construction, and film and television production. These vehicles represent a significant asset for many companies and are critical to their daily operation. During Hurricane Sandy, many businesses failed to relocate commercial trucks from parking lots in the floodplain, resulting in major losses. In fact, three of the seven businesses used as case studies within this report had more than half of their vehicles significantly damaged or destroyed by Hurricane Sandy. In addition to the financial losses and lengthened timeline to resume operations, vehicle flooding can cause fuel and other hazardous materials to leak, potentially exposing employees, neighbors, and the surrounding environment to greater concentrations of harmful chemicals.

Following Hurricane Sandy, there were 274 claims to the NFIP for damages to businesses within industrial areas, with an average claim of approximately $288,000 for damages to buildings and $447,000 for damages to building contents.

Hurricane Sandy Impacts

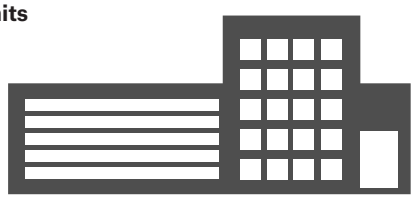
Hurricane Sandy caused significant damage and financial loss for many industrial businesses throughout the city. Most of these losses resulted from damage to building electrical and mechanical systems, flooded commercial truck fleets, submerged machinery and inventory within buildings, and lost revenue while normal operations were ceased or reduced.

In the aftermath of Hurricane Sandy, the NYC Department of Buildings performed an initial assessment of homes and businesses to determine which buildings sustained irreparable damage, requiring a partial or full demolition. Of the 1,130 industrial buildings evaluated during this assessment, only eight were considered irreparably damaged. Sixty-six were tagged as having received non-structural damage, and the remaining 1,056 were designated as having been affected by the storm, but receiving little evident damage. Although these post-storm assessments likely did not capture every industrial facility, they do suggest that relatively few industrial buildings were structurally damaged during Hurricane Sandy.
A review of building permit data following Hurricane Sandy indicates that few permits were filed to repair industrial buildings. Of the 848 buildings permits classified as a substantial improvement in the floodplain, only five were industrial buildings located in M districts. A substantial improvement occurs when the cost of any repair, reconstruction, addition or improvement to a structure equals or exceeds 50 percent of the structure's market value.

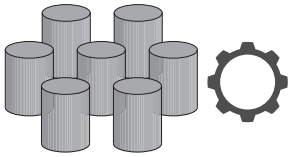
Despite the low number of industrial buildings tagged by DOB as having received significant damage and the limited number of substantially improved industrial buildings, there were significant losses. Following Hurricane Sandy, there were 274 claims to the **National Flood Insurance Program (NFIP)** for damages to nonresidential buildings within industrial areas, with an average claim of approximately $288,000 for damages to buildings and $447,000 for damages to building contents. Notably, because NFIP caps coverage for commercial properties at $500,000 for both buildings and contents, the actual average losses from businesses likely exceeded these values. Additionally, a large portion of industrial businesses that were damaged by Hurricane Sandy were uninsured or held flood coverage through a private insurance or reinsurance carrier and are not captured by these claims.

In the aftermath of Hurricane Sandy, the NYC Department of Environmental Protection (DEP) conducted inspections of facilities that store hazardous substances to identify and remediate chemical spills caused by the storm. Of the 367 firms initially identified in the flood zone, 48 facilities reported being severely affected, but reported no spills. Eleven facilities reported spills but were cleaned prior to DEP inspection, and seven facilities were completely washed out. A subsequent analysis identified an additional 650 facilities located within the floodplain, though the majority of these claimed that Hurricane Sandy had no impact on stored chemicals.[3] In addition, the New York State Department of Environmental Conservation maintains a Spill Database to document hazardous substance spills and leaks. Citywide, approximately 1,620 spills were attributed to Hurricane Sandy, primarily linked to motor fuel and oil tanks for heating supply, many of which occurred in residential buildings.[4]

NFIP nonresidential insurance policies have low coverage limits



ONLY $500,000 FOR BUILDINGS



ONLY $500,000 FOR CONTENTS

NFIP (National Flood Insurance Program) is a federal program that makes flood insurance available to property owners in municipalities that enforce floodplain management regulations.

Repairing damage at a flooded dry cleaning facility following Hurricane Sandy.

New York City's Response to Hurricane Sandy

Hurricane Sandy drew a rapid response from fire, medical, police, and other emergency service crews who were dispatched across storm-impacted areas throughout the city. In addition to the emergency response, a variety of financial assistance programs were established to aid businesses in the recovery process. City agencies distributed $28 million in up to $25,000 low-interest loans and up to $10,000 matching grants to nearly 650 businesses. More than $1 million in micro-grants were also issued to more than 200 businesses. These emergency funds from private and public sources assisted businesses with working capital, damage repairs, and equipment and inventory replacement, among other things. To assist businesses with purchases of materials, equipment and personal property needed to rebuild after the storm, the NYC Industrial Development Agency provided more than $2.8 million in sales tax exemptions. Additionally, the City launched programs addressing storefront improvements, general business recovery services, and agency fee relief for impacted businesses.

In August 2013, the NYC Department of Small Business Services (SBS) launched the Hurricane Sandy Business Loan and Grant Program to assist small businesses with remaining unmet recovery need. The program has awarded approximately $55.7 million to 352 business across New York City along three distinct award categories: working capital, inventory, and movable equipment. The most significant concentrations of grant and loan recipients were in Rockaway Beach, Sheepshead Bay, Coney Island, Lower Manhattan, Red Hook, and the East Shore of Staten Island. In November 2015, SBS introduced the Business Preparedness and Resiliency Program (Business PREP) to help small businesses better prepare for emergencies. Assistance includes business continuity workshops, on-site risk assessments with micro-grants to implement specific recommendations, and online resiliency resources.

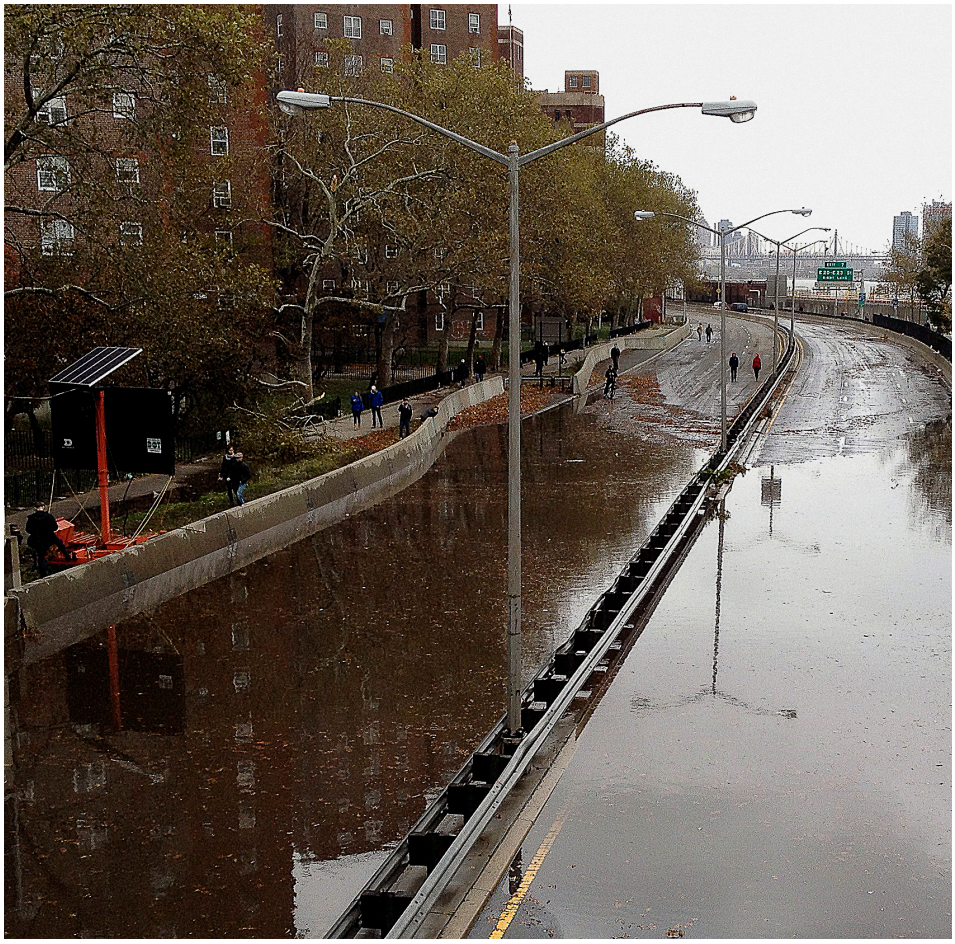
Climate change is expected to increase flood risk substantially in the coming decades.

Climate Change and Extreme Weather

Hurricane Sandy reminded many New Yorkers of the risks that our diverse waterfront communities face from coastal storms and flooding. While these hazards are by no means new, climate change is altering the intensity and frequency of flooding events, and is expected to increase flood risk substantially in the coming decades.

The New York City Panel on Climate Change projects that by 2080 the average annual precipitation will increase between 5 and 13 percent. In addition to changes in rainfall averages, there will likely be more variability in heavy rainfall, leading to approximately one and a half times more extreme precipitation days per year by the 2080s compared to the current climate.[5] During this same time period, sea level is projected to increase 18 to 39 inches, and could reach as high as six feet by 2100. Even without any changes in storms themselves, projected sea level rise would at least double the frequency of current 100-year coastal floods by the 2080s and, according to the higher-end estimates of sea level rise, could lead to a 10- to 15- fold increase in floods of this magnitude.

Hurricane Sandy is fresh on the minds of many New Yorkers, yet floods are not the only hazard that residents and businesses should plan and prepare for. For example, the frequency of heat waves is projected to triple by the 2080s, resulting in tremendous public health risks and potential power outages and equipment failures. Although this report focuses on flooding and coastal storms, industrial businesses should employ a similar process to evaluate their vulnerability to other likely hazards and implement strategies to prepare their facilities, protect their workers, and maintain operations. New York City Emergency Management prepared **NYC's Risk Landscape: A Guide to Hazard Mitigation** to outline key vulnerabilities and present strategies for managing these risks citywide.



Flooding caused by Hurricane Sandy on FDR Drive in Manhattan.

Newtown Creek,
Greenpoint, Brooklyn