

NEW YORK STATE HURRICANE EVACUATION RESTUDY TECHNICAL DATA REPORT

for New York City, Nassau, Suffolk, and Westchester Counties



NEW YORK CITY HURRICANE HISTORY SUMMARY

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Recent research shows that the New York Metropolitan Region has been hit *directly* by hurricanes two times in the historical past. While two of these events were only Category 2 storms, they both did major damage in this region. The third storm made a landfall in September 1938, 70 miles to the west of New York City and still did major damage in New York City. It is important to remember that all of these storms affected a far less developed and populated region. A review of their effects provides an insight into what we can expect when the *inevitable* future hurricane makes a landfall in New York City.

1821 HURRICANE

The 1821 Hurricane made a landfall in New York City on September 4. It entered the U.S. near Cape Hatteras and was shortly causing massive damage in Norfolk, VA. From there it moved northward at 30-35 miles per hour through the Middle Atlantic States across and into southern New England (**Figure 1**). *The American for the Country* (September 5, 1821) provides a description of the damage in New York City. "Conditions began to deteriorate around 2PM and the eye passed over the City around 7PM. Manhattan was cut into two islands along Canal Street for two hours as the waters of the Hudson and East Rivers met across Manhattan. Water levels rose 13.5 feet in one hour from low tide" (New York Daily Advertiser, Tuesday September 4, 1821). "The sea overflowed the wharves by a foot...had the tide been flood, it is probable we should have experienced the greatest inundation ever known" (Mercantile Advertiser, September 4, 1821)." 1821).



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The 1821 hurricane was significant in several respects. Although it was only a Category 2 event, it caused major wind and water damage in New York City. It also showed that a northern hurricane can maintain energy although one half of it is moving over land in the hundreds of miles it traveled from Cape Hatteras into Southern New England.



Figure 1: 1821 Hurricane Track



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1893 HURRICANE

A hurricane moved over water and hit New York City directly on September 24, 1893. This was the first time that a major developed American coastal urban center was hit by a hurricane. Although a Category 2 storm, it did the damage of a Category 3 hurricane. New York was now no longer the small city that it was when the 1821 Hurricane made a landfall. The storm wind field was immense and that resulted in damage along the length of Long Island (New York Times, September 25, 1893). The rainfall accompanying the storm set new records with 3.82 inches of rain falling in twelve hours in Southern New York (New York Times, September 25, 1893).

The first recorded interaction between hurricane winds and high-rise buildings was in this hurricane (**Figure 2**). The most dramatic damage was along the coast as the easterly winds drove shelf waters into the right angle of the New York Bight Apex. Although the R_{max} for the hurricane was far to the east at Fire Island, water levels were abnormally high along the coast in New York City. Dramatic damage was done to the beaches of present-day New York (**Figure 3**). The New York Times (September 5, 1893) reported that at Brighton Beach, waves swept 600 feet across the beach and rose up 30 feet, where they took away a 20-foot light at the end of the elevated railroad platform.

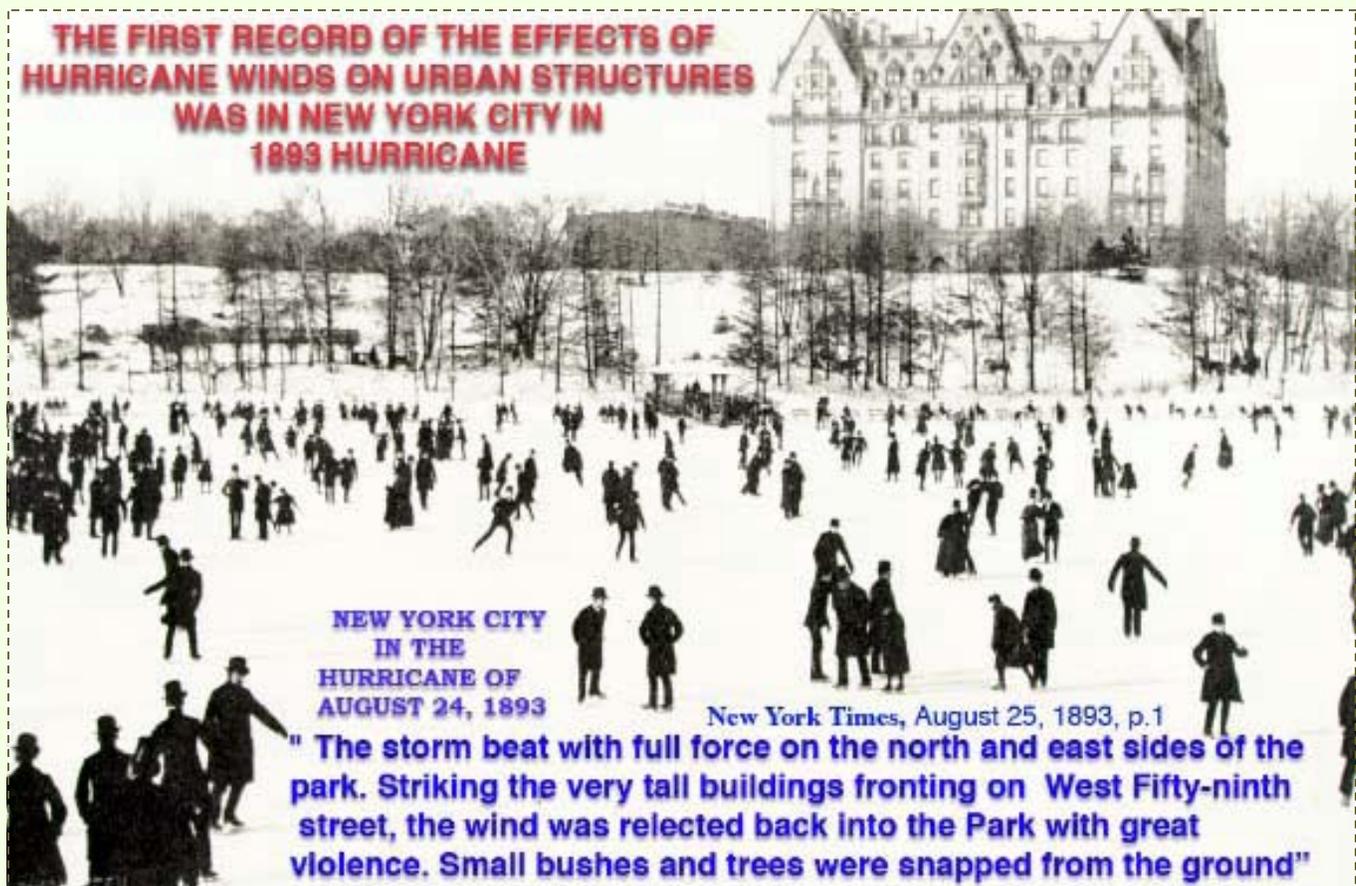


Figure 2: 1893 Hurricane Winds



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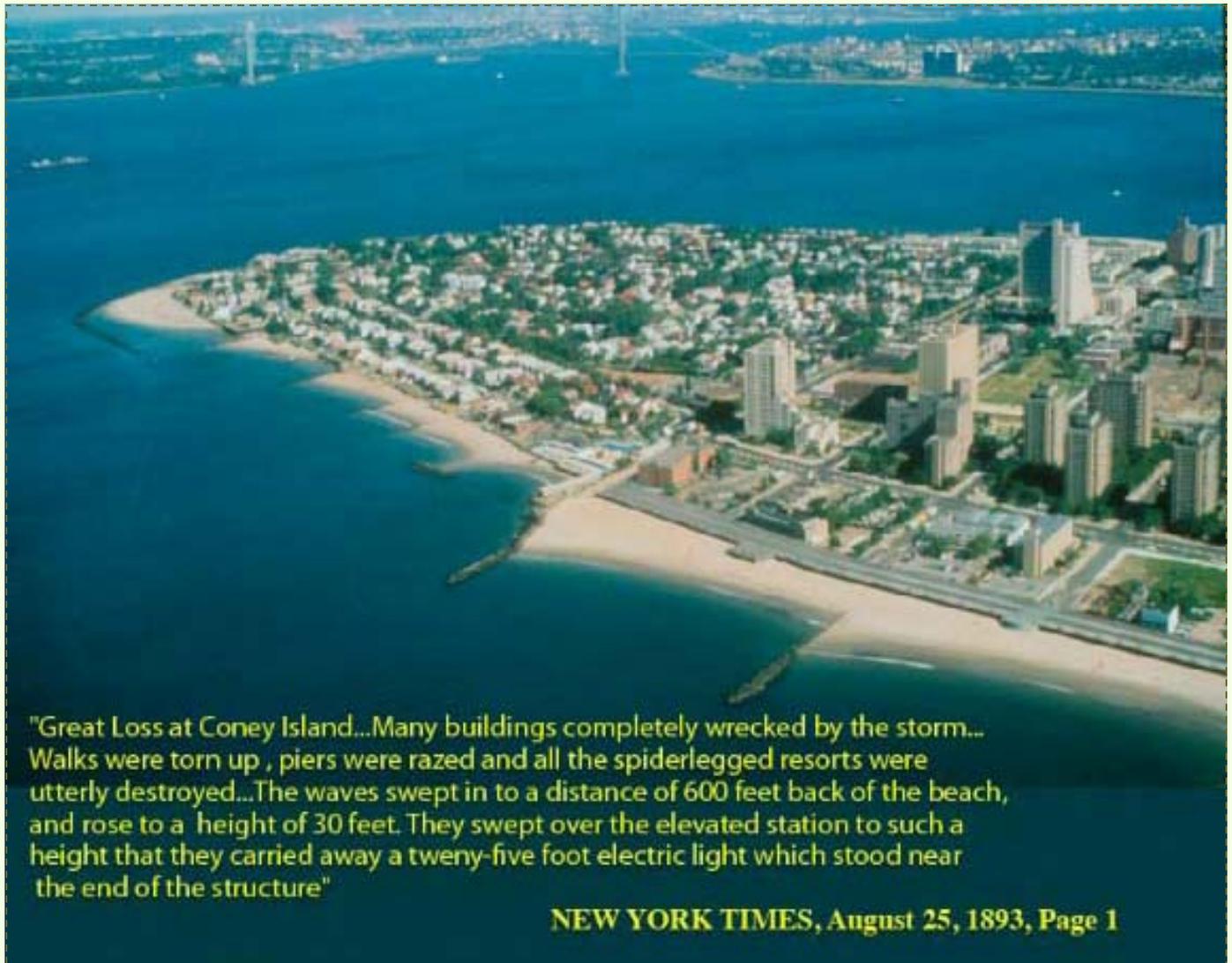


Figure 3: 1893 Hurricane Damage at Coney Island

About 1,000 feet south of the present day Rockaway shoreline was a resort complex called Hog Island (**Figure 4**). The island had formed around the end of the Civil War and it had been a major entertainment center for New York City. Causeways and a rope-driven ferry brought visitors to the island. Hog Island had restaurants, cabanas, saloons and amusement areas and was visited by many of the top entertainers of the day. The massive storm surge and waves of the 1893 Hurricane removed the structures and most of the island and deposited the debris on the ocean floor. The hurricane debris lay buried offshore for over 100 years until it was returned to the beaches of Rockaway when the debris was included in the sand that was dredged and pumped onto the beach by the Army Corps of Engineers during a beach renourishment project in 1995. The research that developed the Hog Island story is given in the New York Times of March 18, 1997.



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FEW PEOPLE KNOW THAT AN ISLAND (HOG ISLAND) ONCE EXISTED IN FRONT OF THE PRESENT DAY ROCKAWAY PENINSULA. EVEN FEWER PEOPLE KNOW THAT HOG ISLAND, AND ITS RECREATIONAL STRUCTURES, DISAPEARED IN A HURRICANE IN SEPTEMBER, 1893.

Modified from Bellot's "History of the Rockaways"

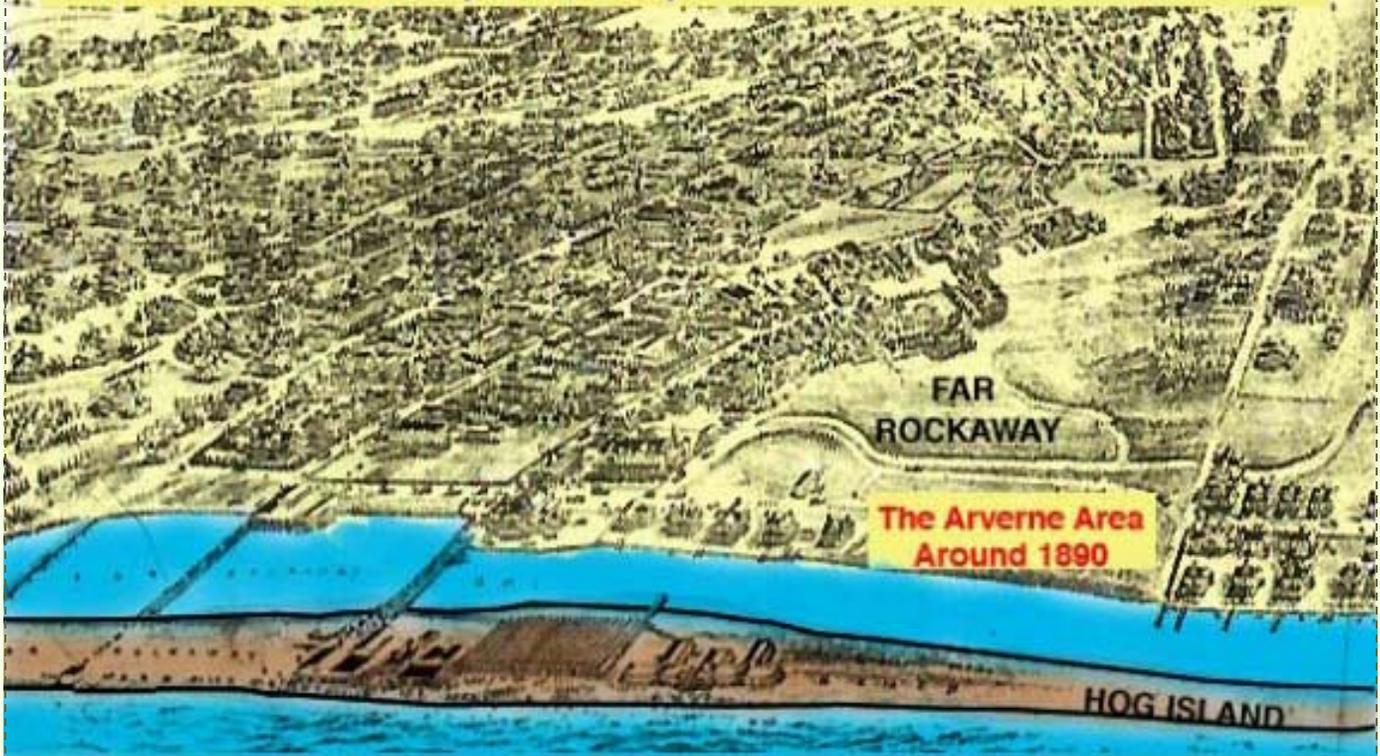


Figure 4: 1893 Hurricane Damage to Hog Island

The 1893 hurricane documents the severe damage that can result when even a *moderate* hurricane makes a landfall in the apex of the New York Bight. This hurricane affected a developing urban center with very sparsely populated coastal areas; the same areas today are highly developed with a population in the millions (Figure 3). A similar event in the future would cause massive destruction.

1938 HURRICANE

A great deal has been written on the effects of the 1938 Hurricane, namely in New England. The brief discussion here concerns only its affects in New York City. Although the storm eye made a landfall 70 miles east of New York City, and New York City was on the weaker left side of the storm, major damage occurred in western Long Island and New York City.

Once again, we saw the surge amplification that occurred when the easterly winds at the front of the hurricane drove the waters of the continental shelf into the right angle that makes up the apex of the New York Bight. Storm surge levels were high along the South Shore *both east and west* of the eye landfall at Westhampton Beach. Although the storm eye made a landfall 70 miles east of New York City, major damage occurred in both the City and western Long Island.



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For example, consider the flooding that occurred at Rockaway Beach, a barrier island in New York City. The official surge level was 9.7 feet, about the average land level. However, the actual water level was higher due to tidal effects and wind driven waves. The Peninsula was overwashed and boats from Sheepshead Bay floated down Rockaway streets into the Atlantic Ocean. In 1938, the Rockaway Peninsula was covered largely by private homes. The population and number of high rise structure has increased greatly since 1938 (**Figure 5**). Although the hurricane made a landfall 70 miles to the east, and New York City was on the weaker left side of the storm, damage was widespread across the New York Metropolitan Region (**Figure 6**).

The conclusion that can be made from studying all of the significant hurricanes that made a landfall in New York is that no matter where a hurricane makes a landfall on Long Island, abnormal surge levels will occur westward in the New York Bight. This will always cause major flooding in New York City.



Figure 5: Hog Island (1870—1893)



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THE 1938 HURRICANE SHOWED THAT A HURRICANE HITTING ANYWHERE ON LONG ISLAND WILL CAUSE GREAT WIND & WATER DAMAGE IN THE N.Y. CITY REGION

ROCKLAND IN DARK
Storm Leaves Scores of Homes Without Power.
 Electricity failed Rockland county last night and three-quarters of the homes were without lights or power after a day of winds and rain. Hundreds of homes in the eastern part of the county were damaged by falling trees. The principal roads were closed.
 The Erie Railroad canceled its schedule on the Nyack Sparkill branch at 2 P. M. and service was not expected to resume before today. Passengers at Sparkill, waiting to go to Nyack, were left standing on the platform to wait for friends or other motorists going their way.
 Washouts of roads were numerous. School buses loaded with children were marooned by water and fallen trees.

UPSTATE RIVERS RISE RAPIDLY
Communities Battling to Recover From Storm.
ONLY TWO DEATHS REPORTED
Hudson River Expected to Reach Flood Stage of 19 Feet.
 ALBANY, Sept. 23 (A. P.)—Streams and rivers rose rapidly to flood stage today as eastern New York counted two known deaths from the effects of yesterday's tem-

DEBRIS STREWS WESTCHESTER
May Be Buried by Wave Done to Tons.
NOTHING IS LEFT
The Spined and Felt Street in This is Ruined
 (A black and white photograph showing a street completely covered in debris and rubble.)

City Sizes Up Storm's Havoc
Only Three Known Dead—The Loss in Trees Cannot Be Measured in Money.
 Digging itself out of the debris which yesterday's storm of unprecedented violence left in all boroughs, the city took stock today and found that although millions of dollars of damage had been done, only three lives had been lost.
 One victim was John A. Martin, 62, who had it not been for a large 8 year old, who died of a skull fracture in front of the house, which perhaps he entered when the wind managed to withstand the fury, pushed him down in the yard of several of them would have crashed.

JERSEY FACES RIVER MENACE
Delaware Is Expected to Rise Eleven Feet.
PEAK AT MIDNIGHT TONIGHT
Prediction Is That Water Will Top Sea Wall at Trenton.
 As New Jersey surveyed the extent of its storm damage today a new danger arose in the continued rise of the Delaware River, which threatened to overflow at Trenton.

HURRICANE LANDFALL 70 MILES EAST OF N.Y. CITY

Fire Island Ruined by Storm
 (A black and white photograph showing a building destroyed by a storm.)
HURRICANE STORM ONLY 3 HOURS FROM COLLAPSE

Compiled by Nicholas K. Coch, 2008

Figure 6: 1938 Hurricane