Quick Response 243

IMPACTS OF SUPERSTORM SANDY ON NEW YORK CITY'S NEW WATERFRONT PARKS

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Background

Metropolitan New York is not the world's largest megacity but it is the most experienced in dealing with the impacts of rapid growth and unexpected disasters. In 1900, the newly-consolidated Greater New York of 4.2 million inhabitants ranked second only to Greater London among the top ten cities; except for Tokyo the rest of the list were all situated in Europe or North America. Today, the New York Urban Region is the only survivor of the old industrial "West" among the present ten largest urban regions.[1] New York is thus the matriarch of the world's megacities, which has much experience to share with younger city-regions around the world.

As New York evolved from a post-colonial port of 60,000 in 1800 to a world-city in 1900, it confronted many threats: street congestion, poverty, filthy air and water, over-crowded housing, epidemics, fires, crime, natural disasters, and civil unrest. In the face of such challenges, and despite a long history of political corruption, New York has been eminently resourceful in developing and applying new forms of technology, law, finance, and public administration. These have been reflected in such landmark achievements as the Commissioners Plan of 1811 for Manhattan's future streets, the Croton River reservoir and aqueduct in the 1840s, Central Park, the Brooklyn Bridge, and the consolidation of the five boroughs in 1898. In the twentieth century, New York City has led the nation with such planning milestones as the nation's first zoning ordinance in 1916, the several plans of the Regional Plan Association, and in this century, Mayor Michael Bloomberg's PlaNYC of 2007.[2] The infamous destruction of the World Trade

Center towers on September 9, 2001 necessitated a still-unfolding new learning experience in how to rebuild after such a horrific attack and memorialize its victims.

The New York City Waterfront

New York City's five boroughs are bounded by 520 miles of diverse shorelines and waterfronts. These include: 1) sandy beaches on barrier spits in Queens and Brooklyn and along Staten Island's south shore; 2) coastal saltmarsh and freshwater wetlands in Queens (north and south shores) and Staten Island; 3) maritime piers, warehouses, and industrial facilities in Manhattan and Brooklyn; 4) High-density residential development ranging from public housing projects of the Robert Moses era (1950s and 60s) to high-end condominiums and apartments along the Hudson and East Rivers and other waterfronts; and 5) public and quasi-public waterfront parks.

This complex, multi-use waterfront is a major focus of New York's quest for economic and environmental sustainability. According to the Metropolitan Waterfront Alliance, a network of some 500 public and private waterfront stakeholders in Greater New York: "More than half of the Bloomberg Administration's action items for moving New York City towards sustainability will create the dual benefit of an economically productive and environmentally healthy waterfront and waterways."[3]

The current waterfront agenda, as expressed in PlaNYC and the 2011 Comprehensive Waterfront Plan[4] certainly does not begin with a *tabula rasa*. The city's waterfront today is an amalgam of past public and private policies, actions, investments, aspirations, and fantasies reflectsd in a long history of plans, projects, and goals.[5] Between the 1920s and the 1960s, Robert Moses, the city's legendary public works czar, lined the city's waterfronts with highways, bridges and tunnels, public housing and many still-valued parks.[6]

During the 1950s and 1960s, several mega-trends clashed on New York's waterfront as in cities across the nation. On the one hand, federal and state urban renewal and highway programs encouraged public-private redevelopment of older city districts—emphatically including urban waterfronts as sites for high-end residential districts paradoxically interwoven with waterfront highways. This process in turn stimulated a new generation of New York-based urbanists like William H. Whyte, Jane Jacobs, and Lewis Mumford to appeal for more attention to people-oriented street design, building scale, and public open spaces. In the 1970s, with the advent of the National Environmental Policy and Clean Water acts, environmental quality and public

health emerged as a third mega-trend. The evolution of the city's waterfront since the 1960s has thus been a continuing struggle among advocates of economic development, public access and recreation, and environmental quality. (This struggle was most vividly reflected in the 1970s battle over the ill-fated "Westway" project proposal described below). And as demonstrated by Hurricanes Irene in 2011 and Sandy in October, 2012, natural disaster mitigation and adaptation to rising sea levels have now joined the debate shaping the future of the city's diverse waterfronts.

"Superstorm Sandy"

Just before Halloween, 2012, the epic "Superstorm Sandy" struck the mid-Atlantic region of the United States, causing coastal and riverine flooding from North Carolina to Maine and as far inland as Ohio. Millions lost power for periods lasting up to three weeks. By the time it made landfall, Sandy was barely a Category 1 hurricane, being described by meteorologists as a "post-tropical cyclone." But the convergence of several factors generated widespread and intense flooding, especially along the ocean shorelines of New Jersey, New York, and Connecticut exposed to very high storm surge levels:

1) A tropical-force windfield of approximately 1,100 miles in diameter;
2) A jet stream deviation ("blocking high") that forced Sandy to make a sharp turn toward land;
3) Landfall at local high tide along the nation's most heavily populated shorelines; and
4) A barometric pressure of 945 mb marked the lowest such measurement at landfall for any storm north of North Carolina.[7]

In the New York area, storm surges up to thirteen feet on top of high tides engulfed coastal communities of New Jersey and Long Island. Mayor Bloomberg issued a timely evacuation order for low-lying areas of the city. A storm surge of up to 13 feet lasting over two high tide cycles inundated much of the Financial District and low-lying areas adjoining the Hudson and East Rivers. Subway tunnels, commuter railways, electrical systems, and other below-grade or low-lying infrastructure were widely disabled by flooding. The New York Stock Exchange was closed for two days, the first time since 1888.[8] Flooding of a Con Edison generating station on the East River at 14th

Street blacked out the financial district and most of Manhattan below 23rd Street for several days.[9] Bellevue Hospital lost its back-up power and patients had to be transferred to other facilities by columns of ambulances.

Elsewhere in the city, beachfront communities and parks in Brooklyn, Queens, and Staten Island experienced catastrophic flooding which reached several blocks inland, causing heavy damage to public boardwalks, recreational facilities, and adjoining residential and commercial structures.[10] The disabling of several of the city's sewage treatment plants released raw sewage into floodwaters, adding to public health hazards throughout the region.[11] Residents of public housing projects near waterfronts at Coney Island and Rockaway Beach were deprived of power, heat, elevators, and daily necessities well into November, as poignantly reported in several articles in *The New York Times*. Some 120 private homes in a gated community on the Rockaway peninsula in Queens burned as firefighters were unable to reach them.

In addition to such bitter human impacts, the storm also inflicted unknown levels of damage on the ecological resources of the New York/New Jersey Estuary, including New York Harbor, the Hudson River, and Jamaica Bay Wildlife Refuge. Facilities for marine biology restoration, research, and education such as the New York Aquarium at Coney Island[12] and The River Project[13] at Pier 40 on the Hudson River were crippled.

The vulnerability of New York City to the effects of climate change and sea level rise has been recognized for at least the past decade.[14] In 2011, as part of a massive report on climate change in New York,[15] a research team led by Klaus Jacob of Columbia University drafted a case study that estimated the effects of a 100-year storm on the city's transportation infrastructure. Based on their models, Jacob and colleagues estimated that a 100-year storm could leave roughly one billion gallons of water to be pumped from the city's network of subway tunnels.[16] This forecast was nearly fulfilled by Hurricane Irene in 2011 whose storm surge came within one foot of paralyzing transportation to and from Manhattan.[17] Only two weeks before Sandy, a prescient front-page article in *The New York Times* cited experts who faulted the city for "moving too slowly to address the potential for flooding that could paralyze transportation, cripple the low-lying financial district and temporarily drive hundreds of thousands of people from their homes."[18]

Post-Sandy Hazard Mitigation Assessments and Proposals

As would be expected for a disaster of this magnitude in the nation's largest metropolitan region, Sandy generated a plethora of post-disaster studies, reports, colloquia, and proposals from all levels of government and various nongovernmental, scientific, and public interest organizations. A complete inventory and discussion of these many activities is beyond the scope of this Quick Response study. A few of the more prominent initiatives include the following:

- New York City Special Initiative for Rebuilding and Resiliency (SIRR);[19]
- New York City Panel on Climate Change "Climate Risk Information 2013";[20]
- Proposal by New York Governor Andrew Cuomo to purchase chronically at-risk coastal properties;[21]
- Proposals by Mayor Bloomberg and others to build sea barriers against future storm surge events;[22]
- Award of $1.7 billion in HUD Community Development Block Grants to rebuild homes and businesses in eight low-income neighborhoods devastated by Hurricane Sandy;[23]
- American Institute of Architects New York Chapter "Post-Sandy Initiative;[24]
- Regional Plan Association (various reports);[25]
- Metropolitan Waterfront Alliance 2013 Post-Sandy Waterfront Conference and "Heroes of Sandy" Awards;[26]

Waterfront Parks Impacts and Recovery

About 130 miles of New York City's 520-mile waterfront is devoted to parks, conservation areas, and other public spaces. These include large city beaches in Queens, Brooklyn, and Staten Island, riverfront parks along the Hudson and East Rivers, and miscellaneous pocket parks along the waterways between Manhattan and the Bronx and elsewhere. The city's famous and heavily used ocean beaches, at Coney Island in Brooklyn and Rockaway Beach in Queens were devastated, as were the Staten Island beaches and other such facilities along the south shore of Long Island and New Jersey.

Although not the primary focus of this study, I discussed the ocean beach parks with Joshua Laird, then the Associate Commissioner of the New York City Parks and Recreation Department and made a brief site visit to Coney Island in March, 2013. I also discussed the beachfront parks with William Woods, the city's former Director of

Waterfront Planning. New York's bountiful inventory of oceanfront and bayfront parks is a major legacy of Robert Moses (who dominated public works in New York from the 1920s into the 1960s) as well as a relic of a bygone era of plentiful federal, state, and city resources for public recreation. Sandy's worst damage to the city's oceanfront beaches was experienced along the south shore of Staten Island which lost about one million cubic feet of sand and all its wood boardwalks. Residential neighborhoods bordering the shoreline were evacuated and either destroyed or badly damaged. (Their owners are now in discussion about selling their homes under the pending state buy-out program.)

Rockaway Beach also lost much sand and its entire boardwalk and related business structures. Residential neighborhoods on the Rockaway Peninsula lost electrical power and many low-income residents were trapped in high-rise apartment towers without heat, lights, water, or elevator service. Rockaway's rapid transit link to the rest of the city was closed for several months due to damage to its trestle across Jamaica Bay (now reopened).

The beach at Coney Island was less heavily damaged due to partial sheltering by the Rockaway Peninsula but much of its broad and lengthy boardwalk was under repair or replacement at the time of my visit in March. Most of the recreational and educational facilities located along the Coney Island boardwalk were closed due to storm surge flooding from Sandy. The Carousel and other ground level amusement facilities at the world-famous Steeplechase Park experienced structural and electrical damage. Overwash sand and debris buried local streets up to three blocks from the beach, indundating many Coney Island attractions like Coney Island, USA, the Mermaid Parade, and the Coney Island Museum. The Wildlife Conservation Society's New York Aquarium, with its fourteen acres of indoor and outdoor exhibits of maritime fauna was devastated by Sandy but reopened on May 25, 2013.[27]

According to Commissioner Laird, a broad spectrum of public and private stakeholders are debating the objectives and means of the city's waterfront restoration efforts. The primary competing goals are 1) public recreation; 2) ecology and sustainability; and 3) protection of residential uses and economic development. Among strategies under consideration are 1) seawall repair and expansion' 2) groin fields and riprap; 3) beach replenishment; 4) wetlands restoration (in sheltered areas); and offshore reef creation to attenuate wave energy. According to Laird, a 1990s agreement between

the city and the Army Corps of Engineers regarding beach nourishment has expired, and a new Congressional authorization and mandate is needed to fully restore the beaches.

Most of my Quick Response study was directed to a subset of new or rehabilitated waterfront parks bordering the Hudson and East Rivers in Manhattan and Brooklyn. This study builds on my earlier research on the city's evolving new waterfront published in *Environment*[28] which was the basis for a four-part series of public panel sessions that I organized at Hunter College in 2010 titled: *Turning the Tide: New York's Waterfront in Transition*.

In contrast to Chicago whose thirty-two mile lakefront is owned and administered primarily by a single public agency, the Chicago Park District, the waterfronts of New York City are a mosaic of discrete fiefdoms, each owned, administered, and funded by a different set of public and private institutions. Each segment of the city's shoreline represents a different historic, economic, and legal provenance. The age of Robert Moses and his "top-down" style of technocracy has been replaced in the 21st Century by a new age of improvisation, public-private partnerships, grassroots initiative, multiple (and often conflicting) goals, and creative use of available resources.[29] Not surprisingly, the waterfront facilities examined for this study varied widely in the impacts inflicted by Sandy and their respective recovery experiences.

Battery Park

Located at the tip of lower Manhattan, The Battery is the city's oldest public space, dating back to Dutch settlement in the early 17th Century. Its early military function as the site of fortifications and artillery to defend the city from invaders is recalled today in the surviving War of 1812-era Castle Clinton.[30] The twenty-five acre Battery Park has long been a favorite destination for tourists and nearby office workers, offering a tang of salt breeze and views of passing vessels, the Statue of Liberty, Governors Island, Brooklyn, and the New Jersey shoreline in the distance. The park is a terminus for ferries to the Statue of Liberty and Staten Island, as well as a variety of sightseeing and water taxi services.

The Battery is a city-owned park administered by The Battery Conservancy, a private nonprofit organization founded in 1994.[31] As with its counterpart conservancies for Central Park and Prospect Park in Brooklyn, the Battery Conservancy plays a dual role: 1) as a source of non-tax financial support and 2) as the actual manager of the Park under contract with the city's Department of Parks and Recreation. This provides

much greater flexibility in design, development, and administration than would be available under conventional city park administration subject to city-hall domination, civil service regulations, and tax allocations. This flexibility is reflected at Battery Park in the quality of its landscaping, the sustainable design of walkways, park furniture, and lighting, its small urban farm, and a spectacular new fountain and carousel now under construction.

Unfortunately, Battery Park was Ground Zero for Hurricane Sandy in New York Harbor. On the eve of the storm, the Weather Channel sent its anchor to report live from there and *The New York Times* featured a front-page photograph of storm surge overtopping the park's seawall. A last-minute sandbag dike (erected with Parks Department resources) reduced the force of the frontal assault from the storm surge, but low-lying portions of the park were inundated from sewer back-up and from "backdoor flooding" that outflanked the sandbags. The Battery Conservancy staff returned the day after Sandy to find their park awash in sewage, debris, diesel oil from ruptured storage tanks, and broken equipment. Their own office in the basement of an adjacent building was flooded and they lost "18 years of archives" as well as their office computers and furniture. (Their office is now located in donated space on the 17th floor of another nearby building).

The damage to the park was complex and costly. Below-grade electrical equipment powering the new fountain, park infrastructure, Castle Clinton, and other facilities, was largely destroyed. Subways serving the area were flooded including a brand-new South Ferry subway station at the Staten Island Ferry terminal. The Statue of Liberty visitor security facility in the park was destroyed and visitation to the statue itself suspended for several months due to Sandy-related damage. The structure housing the Battery's future post-modern carousel designed by Seaglass Architects survived serious flooding due to sandbagging and an extra six inches of elevation provided when a high ground water table was identified during its design. Below-grade electrical and mechanical equipment to drive the carousel however was flooded and will need to be replaced. Likewise, new pumps and motors are required to power the new outdoor fountain near Castle Clinton.

As with other waterfront parks I visited, an immediate concern to the horticultural staff was the build-up of salt in the soils of gardens, lawns, and tree plots. The lack of rain during Sandy and the loss of electrical power for irrigation allowed the topsoil saline level to rise to lethal levels for most plants, as measured in soil samples sent to the

University of Massachusetts Soil and Plant Testing Lab a few days after the storm. With the reactivation of fresh water irrigation, both the landscape and office staff of the Conservancy, assisted by "hundreds of volunteers" flushed most of the salt out of the topsoil, as verified by further testing.

At this writing, Battery Conservancy staff and their colleagues in other waterfront parks are evaluating the relative survival rate of various horticultural plants shrubs, and trees. Representatives of several parks met informally on March 13, 2013 (I was present) and planned a follow-up meeting for August 7. Some preliminary shared findings of this ad hoc "Consortium of Coastal Parks" are summarized in the Appendix.

The considerable financial costs of repairing and restoring Battery Park are borne in part by private contributions from the Conservancy's member organizations and individuals. As a city park, however, it is expected that most of such costs will eventually be reimbursed out of the city's share of the Post-Sandy federal disaster assistance funds administered by the Federal Emergency Management Agency.

Battery Park City

Directly adjoining Battery Park on the Hudson (west side) waterfront of Manhattan is Battery Park City (BPC), a high-density residential and commercial development that launched the revitalization of Manhattan's crumbling Hudson River waterfront for high-end, mixed-use new development. The BPC site originated as a 92-acre tract of landfill partly created with material excavated from the World Trade Center construction site in the early 1960s. In 1966, Governor Nelson Rockefeller, a leading promoter of the World Trade Center itself, outlined his vision for a planned mixed-use development to be constructed on the new land. The Battery Park City Authority (BPCA) was created by the state in 1968 to oversee the project as a public-private joint venture. But for a decade, " , , , the project remained nothing but a sandy white beach . . .stalled by complexities of planning, bureaucratic rivalries, and New York's fiscal crisis in the 1970s."[32] In 1979, after a prolonged and contentious design process, the state approved a master plan incorporating BPCA planning and design guidelines to govern the construction of diverse components of overall project. Battery Park City finally emerged as a multi-billion dollar planned development that includes the World Financial Center, an upscale retail mall, various commercial and residential buildings, and a series of new waterfront greenspaces. Under its original mandate, the Battery Park City Authority transfers a portion of its revenues to the city, averaging $200 million as of 2007.[33]

Pursuant to lengthy negotiation with civic interests, the BPC Master Plan required that at least 30 percent of the site would be retained as public open space, including an esplanade along the water's edge. The nonprofit Battery Park City Parks Conservancy today operates a mini-park system totaling 36 acres, including the riverside pedestrian esplanade, the Robert F. Wagner, Jr. Park, several other parks, gardens, walkways, and 1.9-acre Teardrop Park, a meticulously-designed green oasis amid the BPC towers completed in 2004.

Battery Park City fared better than Battery Park and other Lower Manhattan sites during and after Hurricane Sandy.[34] The public esplanade provided a modest setback for all BPC buildings, and grade level for the complex was established about 4-6 feet above normal high tide (according to my observation). Storm surge reaching 13 feet overtopped the seawall over two high tide cycles, flooding the esplanade and gardens and some below-grade spaces within BPC buildings. However, rebuilding of the BPC electrical grid after 9/11 helped to avoid power outages and most of the complex never lost power, unlike the rest of Lower Manhattan. Many evacuated residents were able to return within days to their apartments. Buildings in the northern part of BPC were largely unscathed.[35] However, "backdoor flooding" along West Street caused some major electrical problems in certain buildings in southern BPC. According to the *New York Post* (Jan. 24, 2013):

> "Tenants of the Ocean Luxury Residences in Battery Park City still endure hellish conditions of diesel-generator fumes, free-falling elevators and dirty water months after Hurricane Sandy flooded the building, according to a new class-action lawsuit. Owners of 1 West St., where one-bedrooms go for $3,500 a month, allegedly ignored the impending hurricane by failing "to place sandbags or restrictive barriers in front of the doors and windows" the suit states."[36]

As in Battery Park, the topsoil layer in BPC parks was found to have elevated levels of salt when tested at the University of Massachusetts Amherst plant and soils laboratory. Intense flushing with fresh water over 2-3 weeks after the storm and salt reduced levels returned to normal. Several Linden trees along the esplanade suffered root damage and later toppled over during a sudden "microburst" storm later in the fall. By and large, however, BPC's floral gardens and shrubs have recovered from the infusion of saltwater last year. The BPC parks are a demonstration project in the use of organic landscaping techniques according to horticulture director, Eric T. Fleisher, who is

a co-convenor of the post-Sandy consortium of waterfront parks. In contrast to Battery Park, most of the costs of landscape replacement at BPC will be covered in part by insurance carried by the Battery Park City Authority and its BPC Parks Conservancy. A final tally of Sandy-related losses at BPC has not been completed as of this writing (August, 2013).

Hudson River Park

The precedent of BPC helped to spawn the idea of "Westway"—a much larger proposal in the 1970s to develop 700 acres of proposed new landfill along the west side of Manhattan for an interstate highway with space for high-end real estate development and new park space on a deck above the highway, all to be funded by federal highway trust funds.[37] Westway was supported by all levels of government and many civic organizations including the prestigious Municipal Art Society. But it was passionately opposed by a coalition of neighborhood and environmental interests. After years of litigation, Westway ultimately was killed by a 1982 Federal District Court decree which held that a permit for new landfill in the Hudson River "violated the National Environmental Policy Act, the Clean Water Act, and the Rivers and Harbors Appropriations Act."[38] Famously, the Court based its decision on the Westway sponsors' failure to assess impacts of the project on striped bass habitat in the Hudson River Estuary, deeming the area proposed to be filled a "biological wasteland.[39]

However, the idea of a linear waterfront park along the Hudson River shoreline – –without any new landfill—prompted the New York legislature in 1989 to establish the Hudson River Park Trust, a unique state-city partnership authorized to plan and finance the park with input from an advisory committee and community groups. The Hudson River Park (HRP) now under development by the Trust extends five miles from Battery Park City north to 59th Street with an area of 550 acres.[40]

The park occupies a narrow strip of land between a multi-lane avenue (Route 9A) and the existing structures along the water's edge. A double-lane paved bikeway is now in place providing a high-speed cycling and running route for stressed-out New Yorkers. (This is a major segment of the city's growing network of bikeways and greenways). In a unique adaptation of aging port infrastructure, the HRP incorporates several immense and deteriorating piers which are being reutilized for sports, fishing, and harbor viewing. Chelsea Piers is a commercial recreational complex occupying three former ocean liner piers which it leases from the Hudson River Park Trust.[41] Other existing piers will be

repaired and adapted to new uses while two new recreation piers (on the footprints of earlier piers) are under development. Reflecting the growing awareness of the Hudson River as an important estuary (as reflected in the Westway decision), the 1989 Hudson River Park Trust Act also established a marine sanctuary covering 400 acres of water between the shoreline and the park boundary (a line connecting the seaward ends of piers). Once major capital projects funded by the city and state are completed, the park is intended to be self-funding from parking, leases, concessions, and other income sources.

Hudson River Park was grievously damaged by Hurricane Sandy and its recovery continues at this writing.[42] Electrical power within the park was disrupted for several months after the storm due to flooding of aging transformer equipment needed to step down the high voltage power supplied by Consolidated Edison and the park's electrical cable network needs to be upgraded. On a late afternoon site visit in March, 2013, long after Con Edison had restored power to the rest of Manhattan, I found the park still lacking internal power for its street lights, crossing signals, and other outdoor electrical needs. Pier 40 at Houston Street, an immense multi-block-long structure devoted to parking and recreation facilities, was still reduced to emergency lighting and water supply. The HRP office on the second level of Pier 40 was not flooded but its staff endured months of limited power, water, and heat.

Sandy added huge additional costs to an ongoing financial crisis faced by the Hudson River Park Trust. According to its CEO, Madelyn Wils, the park is restricted under its unusual legislative mandate from engaging in real estate development to enhance its own revenues. This holdover from the Westway furor deprives HRP of the "cash cow" (my term) enjoyed by another new state/city park venture: Brooklyn Bridge Park, as discussed below. Ms. Wils stated emphatically that as a state/city joint venture, the HRP Trust "has no champion" to advocate for it politically.

Meanwhile state and city fiscal woes are reducing or eliminating their contributions to HRP which under its establishing legislation is supposed to be revenue-neutral. Available revenue from parking in Pier 40 and recreation leases like Chelsea Piers have been diminished by Hurricane Sandy. Furthermore, pilings supporting most of its older piers are deteriorating due to lack of maintenance and may require costly replacement. (HRP recently prevailed in a lawsuit by its lessee Chelsea Piers complaining that the Trust was liable to replace wood pilings that are being damaged by marine borers, due ironically to improving water quality in the Hudson River.

HRP is incorporating flood resilience where possible into its infrastructure reconstruction. Replacement electrical and mechanical equipment will be elevated where feasible above the new standard of 13.5 feet (the limit of Sandy's surge). A new pier now under construction will have a restaurant equipped with flood closure elements.

The HRP lacks the private fund-raising reach of the Battery Conservancy (and the nearby wildly popular High Line greenway). It also lacks access to insurance proceeds available to the Battery Park City Parks Conservancy. The Trust is financing much of its post-Sandy costs out of loans from a city fund established after Sandy in anticipation of eventual FEMA disaster payments. The process of applying for city, state, and federal disaster funds requires the services of a full-time employee in HRP headquarters.

The River Project

Another Hurricane Sandy victim was The River Project, a nonprofit marine research and education facility with office space and a "wet-lab" that occupy space in Pier 40 donated by the HRP Trust.[43] The wet-lab near the outer end of the pier's lowest level was entirely destroyed by flooding. Fish tanks, pumps, computers, furniture, files, wallboard–– all had to be replaced. Meanwhile its small administrative office on the second level of Pier 40 escaped flooding but its staff suffered through the winter with limited heat, lighting, and water along with the HRP Trust office down the hallway. As a nonprofit organization, the River Project has to apply for federal disaster funds through indirect city or state agencies. As with HRP, it has received some city loans in anticipation of eventual federal disaster payments. Meanwhile, the project's director, Cathy Drew, lost elevator access to her nearby apartment and endured several weeks in a hotel. And to keep her small staff on board, she paid their salaries out of her personal resources.[44]

The River Project is back in business as of July, 2013 with many school visitors and science projects scheduled for the coming year. But the fiscal and emotional hangover from Sandy for its director, staff, and board members will continue indefinitely.

Solar One and Stuyvesant Cove Park

"Solar One" is one of New York's most remarkable environmental education and outreach programs. It was founded in 2004 and directed since then by Chris Collins with a present staff of 35 and an annual budget of about $4 million.[45] While its administrative

office is in a midtown office building, Solar One operates an environmental education and performing arts program at a small prefab building situated on a tiny patch of East River waterfront leased from the New York City Economic Development Corporation. Sandwiched between the elevated FDR East Side Drive and the rubble of an old seawall. Solar operates from a humble prefab building that serves as the temporary hub of an growing program of environmental education and outreach. Directly adjoining the building is Stuyvesant Cove Park (SCP), a narrow 1.9 acre "jewel of a sustainably-managed native plant park."[46] The tiny park features indigenous species of grasses, shrubs, and trees. Maintenance by volunteers under Solar One supervision utilizes manually operated tools and integrated pest management, while shunning chemical fertilizers and pesticides. Solar One is planned to be replaced by a much larger $25-million structure ("Solar Two").[47] Solar Two will provide 13,000 square feet of outdoor and enclosed space for teaching and performances and support for the organization's outreach programs on K-12 environmental education, workforce training, and solar energy.[48]

Once again, Hurricane Sandy altered the trajectory of a significant new facility on the waterfront of New York City. The existing Solar One prefab building was thoroughly damaged by the storm surge pushing north along the East River. According to Solar One's 2012 Report: "The [Stuyvesant Cove] Park beds were filled with filthy, brackish water and debris, and the force of the storm surge uprooted trees, destroyed the Solar One [outdoor] stage and storage sheds, dumped large amounts of trash everywhere and flood our solar-powered building." As in other parks, hundreds of volunteers helped to collect trash, shore up trees, and clear out debris that washed onto the site. New topsoil and mulch was in place within two weeks after the storm.

In another respect, Solar One literally provided a bright spot amid its blacked-out surrounding neighborhoods. Staff members were able to reactivate its solar array within days after Sandy, generating power both for their own facility clean-up and for minimum needs of the surrounding neighborhood as a charging station for cell phones and laptops, and an emergency medical device for one neighbor, providing sources of emergency power over several weeks. According to Chris Collins, this was an unexpected demonstration of the resilience of solar energy.

Sandy necessitated drastic revisions to the design of the yet-unstarted Solar Two facility. Since its site has now been remapped as "V Zone" by the National Flood Insurance Program, it will be elevated 15 feet above grade with concomitant changes in

accessibility features. The display floor and classroom floor will be reverse to place the former at an even higher elevation. Its massive photo-voltaic array will be recessed into the roof of the structure to reduce wind damage. It will also be designed to serve as a post-disaster refuge for some displaced neighborhood residents in the event of another disaster. According to Chris Collins, Solar Two will be the first "LEED Platinum, energy-positive structure of its kind in the United States."

Brooklyn Bridge Park

One of the city's most acclaimed new waterfront parks, Brooklyn Bridge Park (BBP), is situated on the East River opposite Lower Manhattan and straddling the eastern end of the Brooklyn Bridge. In the post-Sandy litany of tales of woe, BBP stands out as a relative success story due to its sophisticated design that incorporated features that anticipated of the threat of rising sea level and storm surge.[49]

Like Hudson River Park, BBP occupies and repurposes a former commercial maritime waterfront including several dilapidated wooden piers and warehouse structures. When completed, BBP will extend along 1.3 miles of waterfront with a total park area of 85 acres. As with other recent waterfront parks, the modest size of the park (one-tenth the area of Central Park in Manhattan) is offset by a creative landscape design incorporating: 1) elements of the historic waterfront; 2) reconstructed piers and harbor edges; 3) restoration of biodiversity through tree and salt tolerant plant selection; 4) bike and pedestrian paths; 5) recreation facilities for various age levels and activities; 6) a series of artificial hills created from recycled fill material and; 7) spectacular views of downtown Manhattan, the harbor, and nearby Brooklyn Bridge.

The park is physically isolated from the adjoining neighborhood of Brooklyn Heights and the rest of Brooklyn by a steep bluff and the double-decked Brooklyn-Queens Expressway (BQE) that winds along the bluff just behind and above the park's site. A pedestrian bridge over the expressway is planned to connect Brooklyn Heights with the park.

The concept for Brooklyn Bridge Park originated with the decision in 1984 by the Port Authority of New York and New Jersey to divest some of its obsolete piers and warehouses on the Brooklyn waterfront. The idea of a park at this location was promoted by a community group, "Friends of Fulton Ferry Landing," which in 1989 renamed itself the Brooklyn Bridge Park Coalition. This led to the signing of a memorandum of understanding (MOU) in 2002 between the state and city to develop what would become

BBP. The actual work of designing, building, and operating the park was delegated to the Brooklyn Bridge Park Development Corporation, a nonprofit entity created by the MOU. The state, city, and the Port Authority together contributed $360 million towards the capital costs of developing the park which would thereafter be expected to be "revenue-neutral." In contrast to Hudson River Park where real estate development is legally prohibited, BBP is already receiving revenue from a former warehouse converted to luxury condominiums under the park's control. Additional high-end real estate development is in progress which will further contribute to the park's operating costs.[50] The park's capital funds and operating budget are further augmented by contributions to the Brooklyn Bridge Park Conservancy, founded in 1995 as the fund-raising arm of the park venture.

The prescient *New York Times* article two weeks before Sandy cited earlier singled out Brooklyn Bridge Park as an exception to the prevailing apathy regarding sea level rise in New York City.[51] Indeed, much of the park experienced comparatively light damage compared with other waterfront parks described above due to incorporation of sea level forecast data in the 2005 Master Plan for BBP created by Michael Van Valkenburgh Associates, a Cambridge-based landscape design firm. In a post-Sandy assessment, BBP credited the design team with making: "…a conscious effort to design a park capable of withstanding the impact of storms and major floods. With this thinking in mind, the park's elevation, soil types, vegetation and edge design were all carefully selected and constructed."[52] Foremost among the park's resilient elements are the new mounds or hills created from fill derived from a nearby transportation tunnel project. These served multiple purposes, according to the designer (writing before Sandy) including scenic diversity along the waterfront trail, tiered seating areas, multiple exposures and microclimates for different types of plants, and attenuation of noise from the BQE.[53] Storm surge resilience was added to the list of benefits of the mounds after Sandy. The Van Valkenburgh design incorporated NOAA water level predictions for 2045: "With a predicted mean high water level increase of 1.32 feet and a 100 year storm surge of +7.8 feet. An +8 foot elevation was selected. …All of the park's tree root balls have been planted at or above +8 feet to protect from the vast major of storm surges."[54] The park design also incorporates various treatments for the water's edge to diminish wave force and resist erosion. Salvaged granite blocks and durable park furniture also helped to reduce damage from Sandy.

Sandy's 13-foot storm surge in fact did flood low areas of BBP to depths of up to six feet, lasting as long as four hours. Thousand-pound concrete planters became floating objects, ending up in various locations. Electrical and mechanical equipment at low elevation was disabled; replacement equipment will be elevated above the reach of future floods. Playgrounds at the southern end of the park (Pier 6) were damaged and landscaping required some replacement. Some pavement buckled due to prolonged submersion. But tree damage was slight due to elevation and choice of species. A park focal point, a newly opened 1920s-era carousel ("Jane's Carousel") narrowly escaped destruction as floodwaters reached a depth of three feet outside its sandbagged post-modern enclosure structure.

Two months after Sandy, BBP staff horticulturalist Rebecca McMackin reported in a journal article how park plants incurred relatively light damage due to the park's design and plant selection:

> "Topographical changes blocked incoming flood waters, soft edge treatments of rip-rap and salt marshes held up against violent water forces, and the park itself soaked up waters that mignt have damaged the surrounding neighborhoods further. The sandy soil profiles used in the park (between 70-90%) helped the initially salty soils drain quickly. Plants were selected for salt tolerance and placed with rising water levels in mind, using many salt tolerant natives like Pitch Pine, Beach Plum, and Baccharis in flood zones. It is this kind of design sophistication that can help create the adaptible and climate-change appropriate landscapes of the future."[55]

In March, Ms. McMackin convened a meeting at BBP of some of her colleagues from other waterfront parks to discuss comparative experience with landscaping issues relating to Sandy. The minutes of that meeting are attached herewith as an Appendix. The group convened again on August 7, 2013 at the office of Battery Park City Parks Conservancy. They intend to develop a set of guidelines for landscape design and storm recovery for managers of waterfront parks in the path of rising sea levels.

Some Concluding Observations

This Quick Response study has addressed the impacts of Hurricane Sandy on selected waterfront parks in New York City, and their comparative experiences in recovering from that disaster. I would offer the following generalized observations:

1) Although each park sustained a certain amount of damage, the impacts and recovery costs were certainly less onerous than would have occurred if these waterfront areas were fully built-out with residential structures and offices, rather than parks. The latter are categorically less vulnerable to, and more resilient from, catastrophic flooding events like Sandy than conventional urban development.

2) However, parks themselves incurred varying levels of damage and recovery costs. These related in part to the elevation and design of each park, the vulnerability of its electrical and mechanical infrastructure, and the resources available to its management entity. Among those discussed in this report, the lightest or most readily repairable damage was experienced by the highly solvent *Battery Park City Conservancy* and the sustainably-designed *Brooklyn Bridge Park*. The longest-lasting and financially crippling damage was incurred by *Hudson River Park*, due in part to obsolete infrastructure and inadequate financial resources. *Battery Park* suffered costly damage to its equipment, landscaping, and new structures in progress, but as a city-owned park with a strong fund-raising Conservancy it has made good progress in its recovery.

3) *Solar One/Stuyvesant Cove Park* demonstrated a more proactive role for waterfront parks and educational facilities, namely as centers of expertise on green building, sustainble energy, and landscaping practices. Furthermore they may directly help their neighbors in various ways in the event of a natural disaster. After Sandy, Solar One provided emergency power to its immediate neighborhood and to other communities where it located its mobile PV arrays. The future Solar Two facility will also be designed as a shelter for refugees from other buildings in the neighborhood.

4) The legal-institutional context of a facility is a powerful variable affecting its flexibility in adapting and responding to traumatic events like Hurricane Sandy. Each park or program discussed in this report operates under a different legal-institutional framework. While detailed comparison is beyond the scope of this study, it may be generalized that the parks that fared best (*Battery Park City*, *Brooklyn Bridge Park*) have a strong funding base with the expectation of future revenue increases, (e.g. from lease or concession revenue). The *Hudson River Park Trust*—an unusual and somewhat unworkable state and city partnership—lacks a political “champion” and has less access to private sector contributions than those facilities with strong conservancy arms. Naturally, legal status also is an important variable affecting access to federal disaster assistance funds.

5) The most encouraging finding of this study was the readiness of professionals—in this case the waterfront park landscape managers—to voluntarily pool their experience and share lessons with each other and the wider community regarding what they learned about making parks (or neighborhoods) more disaster-resistant and resilient.

APPENDIX:

Consortium of Coastal Parks
(Minutes of March 13, 2013 meeting written by Rebecca McMackin – Park Horticulturalist, Brooklyn Bridge Park, NYC)

Objective
To share horticultural experiences from Hurricane Sandy with the goal of knowledge dissemination, data collection, and preparing for future storm events.

Attendees
Rebecca McMackin – Park Horticulturalist, Brooklyn Bridge Park, NYC (rmcmackin@bbpnyc.org)
T Fleisher – Dir. Horticulture, Battery Parks City, NYC (tfleisher@bpcparks.org)
Tessa Huxley – Executive Director, Battery Park City, NYC (thuxley@bpcparks.org)
Marechal Brown – Dir. Horticulture, NYC Dept of Parks and Rec., NYC (Marechal.Brown@parks.nyc.gov)
Kean Eng – Horticulture Manager, Brooklyn Dept. of Parks and Rec., NYC (kean.eng@parks.nyc.gov)
Matt Post – Dir. Horticulture, Hudson River Park Trust, NYC (mpost@hrpt.ny.gov)
Anthony Davis – Asst. Dir. of Facilities, The Trust for Governors Island, NYC (adavis@govisland.nyc.gov)
Pat Kirshner – Dir. of Ops. & Planning, The Battery Conservancy, NYC (pkirshner@thebattery.org)
Sean Kiely – Horticulturalist, The Battery Conservancy, NYC (skiely@thebattery.org)
Eric Peterson - Deputy Administrator, Randall's Island Park, NYC (Eric.Peterson@parks.nyc.gov)
Phyllis Odessey – Dir. of Horticulture, Randall's Island Park, NYC (Phyllis.Odessey@parks.nyc.gov)
Eunyoung Sebazco – Hort. Manager, Randall's Island Park, NYC (Eunyoung.Sebazco@parks.nyc.gov)
Dr. Rutherford Platt - Professor of Geography Emeritus, UMass, Amherst, MA (platt@geo.umass.edu)

Calling In
Stuart Shillaber – Superintendent of Hort, Rose Kennedy Greenway (sshillaber@rosekennedygreenway.org)
Anthony Ruggiero – Hort Foreman, Rose Kennedy Greenway

(aruggiero@rosekennedygreenway.org)
Stephanie Kruel – Exec. Secretary, Boston Conservation Committee
(Stephanie.Kruel@cityofboston.gov)

Meeting Notes
Regina Meyer (Brooklyn Bridge Park President) and Jeffrey Sandgrund (VP of Operations) welcomed attendees to the meeting, emphasizing the value of information sharing to the stewardship of the city's coastal parks and future design and construction.

Consortium attendees introduced themselves and described key impacts and experiences in storm preparation and recovery.

Rebecca, Pat, Sean, Kean, and T Fleisher presented slides to support discussion of salinity, remediation strategies, data collection, plant health and storm preparation and recovery.

Salinity and Remediation Strategies

Among consortium members, there was a wide range of salinity testing performed, proximity of sampling to the storm and available baseline data. In most cases, given the lead time in getting results back, parks implemented remediation strategies based on research and prior experience.

- T Fleisher uses the UMass/Amherst soil lab's acceptable salinity range of 0.08 - 0.5 dS/m. Battery Park City saw a range of 0.76 – 3.71 dS/m immediately after the storm; within two weeks of flushing with water (areas were irrigated at least 3 times during this period) all levels were below 0.63 dS/m.

- Hudson River had levels as high as 1.45 dS/m 2 weeks after the storm; most readings were under 0.5 dS/m. Hudson River Park did not have power for irrigation to flush soils, but Matt attributed relatively low salinity levels to the sandy composition of the park's soils.

- The Battery Conservancy took samples soon after the storm but did not have data immediately available. Their remediation strategy was informed by Sean's outreach to New Orleans parks and LSU reports that recommended flushing.

- BBP used water trucks to flush soils and wash evergreens and applied humic acid. BBP did not have data available until 3 weeks after the storm; but found that salinity levels dropped quickly except in compacted areas and shallow soils.

- The Brooklyn Parks Department's remediation strategy includes compost tea applications, irrigation/watering, and compost and gypsum applications on a case by case basis. Kean noted that the scale of the Parks Dept's operations does not allow for tailoring compost composition to specific site needs. T Fleisher offered assistance in testing the soil biology in compost samples to select the best source for Parks conditions.

Data Collection

Rebecca described her frustration with tools available for measuring salt levels: field meters and home kits did not work, and time-consuming in-house testing equipment was not sensitive enough. With hundreds of samples to test at varying depths and dates, paying for testing was not feasible. The majority of the group uses soil labs for salinity readings. Although all consortium members cannot use the same testing lab, they can request methodology adjustments to ensure comparable data.

Rebecca asked for data or resources that support the use of humic acid in reducing salinity. Although the sources she consulted mentioned this function and supported its broad use; she found she felt it was too expensive to recommend for salinity remediation without more solid info. T Fleisher noted that BPC's experience from 9/11 remediation would support the case for salinity reduction; and that the dry form used in compost tea applications can be cheaper.

Plant Health

Kean's survey from Brooklyn parks described the main plant groups impacted by the storm surge, including pines, holly, cherry laurel, and new sod (<2 years). The Brooklyn Parks Dept. continues to assess plants every 3 weeks. Group members agreed on the need for a longer time frame for assessment before firmly identifying resilient plants. T Fleisher said that BPC would continue to assess plantings until June 1 before making recommendations.

The group discussed the gap between 'salt tolerance' as generally applied in plant descriptions v. the ability to withstand being submerged in saltwater. T Fleisher also noted that the engineered soils of newer parks will result in a different set of resilient plants than clay soils with established strata.

Storm Preparation and Recovery

Consortium members described unexpected storm effects, such as the direction of flooding, movement of large planters, damage from large debris (including large timber in Hudson and East Rivers, and containers from Brooklyn that washed onto Governor's island). Some storm effects, such as lighting damage, are still emerging.

All parks experienced strong volunteer response immediately after the storm and struggled with how to accommodate and effectively deploy volunteers, given park closures and limited tools/supplies. BBP, volunteers cleaned exterior of parks using tools brought from home. Because of closures, parks primarily used staff for large scale cleanup and volunteers for later efforts (such as restoring soil). The NYC Parks website, which directed volunteers to specific sites, was very helpful. Marechal described the Parks Dept's need to prioritize street tree damage - with over 30,000 311 calls immediately after the storm – above park horticulture.

In general, members did not test storm debris. At the Battery Conservancy, Pat assumed contamination from known sewage and fuel discharge points, informed volunteers and took precautions. Eric noted that in many areas, debris represented larger volume of regular park/rip rap refuse.

Tessa emphasized the difficulty in rebuilding the right way given opening deadlines.

Marechal described the pressure to reopen and replant and the corresponding need for public education on the process of storm recovery, rebuilding soils, and replanting with resilient species. T Fleisher expressed concern about overreaction in infrastructure decisions.

Anthony stressed the importance of organizational capacity to execute storm preparation and response plans. Tessa agreed, noting that recovery efforts hinged on well-trained staff who are able to react to conditions as they arise.

Preparedness list suggestions:
- List of supplies for dealing w/ potential contamination in public and storage areas
- Things volunteers can do immediately following storm, even if parks are closed

Resource suggestions:
- APGA disaster issue

FEMA

Matt described Hudson River Park's application for infrastructure and recovery labor costs. Pat noted that the Battery Conservancy determined it would not receive FEMA assistance as a nonprofit and is applying through parks department. Randall's Island is applying through both nonprofit and parks channels. BBP was denied assistance as a nonprofit and is seeking assistance through Parks.

Future Steps

- Preparedness list/emergency plan that includes both horticulture and relevant operations items
- Set up group communication mechanisms for storm events (twitter feed; email list)
- Plant list – meet in July
- Design recommendations ?

[1] Neal Peirce and Curtis W. Johnson, Century of the City: No Time to Lose. New York: The Rockefeller Foundation, 2008, pp. 26-27 (based on data from www.citymayors.org).
[2] City of New York, *PlaNYC: A Greener, Greater New York.* 2007.
[3] Metropolitan Waterfront Alliance, press release, 4/23/07
[4] *Vision 2020: New York City Comprehensive Waterfront Plan* (NYC Dept. of City Planning, 2011).
[5] Two recent histories of the Manhattan waterfront are: Phillip Lopate, *Waterfront: A Walk Around Manhattan* (Anchor Books, 2004) and Ann L. Buttenwieser, *Manhattan Water-Bound: Manhattan's Waterfront from the Seventeenth Century to the Present* (Syracuse University Press, 2nd ed. 1999).

[6] Hilary Ballon and Kenneth T. Jackson, eds., *Robert Moses and the Modern City: The Transformation of New York* (New York: W. W. Norton, 2007).

[7] Malcolm J. Baldwin, "Superstorm Sandy: How did it happen and are we prepared for the future" http://somas.stonybrook.edu/storm/sandy/archive/2013-Feb-UUPINSIGHTFeb13.pdf and http://www.cunysustainablecities.org/climate-projections-future-flood-risk-maps-inform-a-stronger-resilient-york/

[8] William Nechamen, Director of New York State Floodplain Management Program, in remarks presented at annual conference of the Association of State Floodplain Managers, Hartford, CT, 11, 2013.

[9] As described by Nick Paumgarten in *The New Yorker*: "Last week, amid the solidarity of regional devastation, New York, itself…was two cities in one. One comprised the neighborhoods that were inundated, blacked-out, half-abandoned, and verging on humanitarian crisis and ominous disorder, and one consisted of those which were functioning as usual, albeit at a dazed half-speed." ("Another City," *The New Yorker*, Nov. 2, 2012, 31.)

[10] The geographic extent of flooding for the New York area is displayed at http://www.nytimes.com/newsgraphics/2012/1120-sandy/survey-of-the-flooding-in-new-york-after-the-hurricane.html. The U. S. Geological Survey "Hurricane Sandy Storm Tracker" is posted at http://54.243.149.253/home/webmap/viewer.html?webmap=c07fae08c20c4117bdb8e92e3239837e.

[11] Michael Schwirtz, "Sewage flows after storm exposes flaws in system," *New York Times* (Nov. 20, 2012). Posted at www.nytimes.copm/2012/11/30/nyregion.sewage-flows-after…

[12] http://www.nyaquarium.com/

[13] http://www.riverprojectnyc.org/

[14] Cynthia Rosenzweig and William D. Solecki, Climate Change and a Global City: Learning from New York" *Environment* (April, 2001) 43.2: 8-18. This article summarized an EPA-funded study of the effects of climate change in the "Metro East Coast Region" by the Columbia University Earth Institute.

[15] http://www.nyserda.ny.gov/Publications/Research-and-Development-Technical-Reports/Environmental-Reports/EMEP-Publications/Response-to-Climate-Change-in-New-York.aspx

[16] http://www.theatlanticcities.com/commute/2012/10/2011-report-predicted-new-yorks-subway-flooding-disaster/3748/

[17] Malcolm J. Baldwin, "Superstorm Sandy: How did it happen and are we prepared for the future" http://somas.stonybrook.edu/storm/sandy/archive/2013-Feb-UUPINSIGHTFeb13.pdf

[18] Mireya Navarro, "New York is Lagging as Seas and Risks Rise, Critics Warn," *New York Times* (Sept. 10, 2012, 1, posted at: http://www.nytimes.com/2012/09/11nyregion/new-york-faces-risks

[19] http://www.nyc.gov/html/sirr/html/home/home.shtml.

[20] http://www.cunysustainablecities.org/climate-projections-future-flood-risk-maps-inform-a-stronger-resilient-york/

[21] Thomas Kaplan, "Cuomo seeking home buyouts in flood zones," *New York Times*, Feb. 3, 2013.

[22] Michael Kimmelman, "Vetoing Business as usual after the storm," *New York Times,* Arts Section (Nov. 20, 2012); Eric Klinenberg, "Adaptation," *The New Yorker* (Jan. 7, 2013), 32-37.
[23] www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57b
[24] http://postsandyinitiative.org/wp-content/uploads/2013/05/Post-Sandy-Report_ExecutiveSummary.pdf
[25] www.rpa.org/taxonomy/term/208
[26] http://www.waterfrontalliance.org/conference2013 I attended this conference and reception preceding it.
[27] http://www.nyaquarium.com/
[28] Rutherford H. Platt, "The Humane Megacity: Transforming New York's Waterfront," *Environment* (July/August, 2009) 51(4): 46-59.
[29] Rutherford H. Platt, *Reclaiming American Cities: The Struggle for People, Place and Nature* (Amherst: University of Massachusetts Press, in press).
[30] http://www.nps.gov/cacl/index.htm
[31] This information was derived from an interview and walking tour of Battery Park with Pat Kirshner, Director of Operations and Planning for the Battery Conservancy and some of her staff on July 31, 2013.
[32] Lopate, 30.
[33] http://en.wikipedia.org/wiki/Battery_Park_City
[34] The following information was derived from an interview and walking tour of BPC on July 31, 2013 with Eric T. Fleisher, Director of Landscape Management for the Battery City Parks Conservancy. Also see: http://www.bpcparks.org/bpcp/home/index.php
[35] http://www.batterypark.tv/first-precinct/hurricane-sandy-battery-park-unscathed-compared-to-rest-of-new-york.html
[36] http://www.nypost.com/p/news/local/sandy_tenants_raise_tink_gdcWyJyG27MmidTwIq1RwM
[37] Wagner, 93.
[38] Sierra Club v. U.S. Army Corps of Engineers 546 F. Supp. 1225 (1982), at 1229
[39] Ibid.
[40] http://www.hudsonriverpark.org/
[41] http://www.chelseapiers.com/
[42] This case study is based on an interview with Madelyn Wils, CEO of the Hudson River Park Trust on July 31, 2013.
[43] http://www.riverproject.org/,
[44] Interview with Chris Anderson, The River Project, July 31, 2013.
[45] This case study is based on an interview with Chris Collins, CEO of Solar One on Aug. 1, 2013.
[46] *Solar One 2012 Program Report,* p. 18. Formerly a harbor-related industrial site, SCP has been planted and maintained by Solar One as a public greenspace under a lease with the city Economic Development Corporation.
[47] Colin Cathcart, "Building the Right Shade of Green" in Rutherford H. Platt, *The Humane Metropolis: People and Nature in the 21st Century City* (Amherst: University of Massacusetts Press, 2006), 210-220.
[48] It is one of fourteen city-designated PlaNYC green design pilot projects. It will be "net zero" energy efficient (i.e. carbon neutral) with heating and cooling provided by 20 geothermal wells extending 300 feet into bedrock.. Its roof will consist of angled 85 kw solar panels. It will also involve a "green screen" and other green design features. It is expected to open in 2009. Funding is provided by a consortium of public and private

sources, including $1 million/year from the New York State Energy Research and Development Authority.

[49] This case study is based in part on interviews with Brooklyn Bridge Park CEO Regina Myer and other staff and a walking tour of part of the park on March 13, 2013. Additional information was posted at: http://www.brooklynbridgepark.org/

[50] Regina Myer and http://en.wikipedia.org/wiki/Brooklyn_Bridge_Park.

[51] http://www.nytimes.com/2012/09/11nyregion/new-york-faces-risks

[52] "Brooklyn Bridge Park: Storm Resilience through Design," Report of the Brooklyn Bridge Park Corporation, (March 2013?)

[53] Michael van Valkenburgh, "From Mill Race to Brooklyn Bridge: Two Decades of Waterfront Parks," *View* (Library of American Landscape History, Amherst, MA) (Summer, 2012): 9-13.

[54] "Brooklyn Bridge Park: Storm Resilience through Design," Note 54 supra.

[55] http://www.ecolandscaping.org/wp-content/uploads/2013/03/January-2013.pdf