"New Jersey's Lower Hudson River Waterfront—
25 Years of Construction: Challenges for the Next 25 Post-Sandy Era"

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IN-DEPTH CONFERENCE REPORT Paraphrased

Opening Remarks and Keynote Address paraphrased

Alan F Blumberg, PhD, George Meade Bond Professor of Ocean Engineering, Director of The Davidson Laboratory/Center for Maritime Systems, Stevens Institute of Technology, *Welcome & introduction of Michael Bruno*

Michael Bruno, PhD, Dean of School of Engineering and Science, Professor of Ocean Engineering, Stevens Institute of Technology, *History of Stevens Institute and Hoboken's founding family*

Col. John Stevens III was treasurer of the Revolutionary Army and a friend to George Washington. He purchased the "island" of Hoboken in 1784, where he then established his family's summer estate, so grand it was called "Stevens Castle," giving rise to the name Castle Point. From the late 1700s – 1800, Col. Stevens experimented with steam-powered transportation, setting the stage for a lot of what we do here at Stevens today: He operated the first commercial steam-powered ferry, and first ocean-going ferry service, then invented the twin-screw propeller and many other advances in maritime engineering.

The Colonel's son, John Cox Stevens, was a co-founder the New York Yacht Club, and with his brother Edwin, built a yacht in 1850 named America , took it to England for the international 100 Guinea Cup race and , brought the cup which was renamed the America Cup. Those of us who work here today owe our livelihood to the Stevens.

In 1870, Edwin Stevens founded Stevens Institute of Technology, the first university dedicated to mechanical engineering. The American Society of Mechanical Engineering was founded here, and the ocean engineering laboratory - Davidson Lab, with its 300-foot-long water tank - dates back to 1920s. Stevens' involvement in maritime advances stretches back over a very long time. On behalf of the faculty and students, we welcome you here.

Helen Manogue, President, Hudson River Waterfront Conservancy of New Jersey, *Welcome remarks and background on the Conservancy.*

[Showing a slide of the walkway map] New Jersey's Lower Hudson River Waterfront Walkway runs at river edge from the Bayonne Bridge to the George Washington Bridge. It encompasses 9 distinct municipalities, in two counties, 40 square miles of land (from river edge to the first inland road), and 18.5 linear miles. The waterfront Walkway was planned to be a 30-foot-wide, public-access, continuously connected walkway. Today, about 85% of the Walkway is complete.

In 1970, the docks that filled the riverfront were abandoned as containerization moved shipping to deeper ports. Railroads and factories left with them. Wild dogs roamed the waterfront. The oil industry tried to fill the void with first an oil refinery and later a huge oil tank farm on the Hoboken/Weehawken border. Citizens in these communities stood up and opposed industrial uses, and advocated for public access to the waterfront.

But with the country in recession, jobs were leaving the state, and Gov. Brendon Byrne appointed the Hudson River Waterfront Study, Planning and Development Commission that ultimately approved citizens' idea of a continuous waterfront public path along the river edge. In 1982, the first requirements for the installation of that path known as the Hudson River Waterfront Walkway were set in place. The legal justification for the Walkway is found in the Public Trust Doctrine.

The Public Trust Doctrine, which dates back to Roman Emperor Justinian, is a legal principle that says, "By the law of nature, these things are common to all mankind: the air, running water, the sea and consequently shores of the sea." This statement has been adopted as common law in most countries, including the U.S., and the State of New Jersey. It embodies the requirement that a governing body must allow the use of the waterways and their shores for the benefit of the general public. Even though the Hudson River waterfront was off-limits to the community for over 100 years, there still was a public benefit derived from shipping and warehousing (availability of food, goods, jobs, etc.). Once the shipping industry left, the public good was no longer being served. The Walkway, endorsed by the gubernatorial commission, is so very important as a public benefit that since 1982, it has been a requirement for any development proposed along the Hudson River assured via easements. The agreement to construct and maintain the Walkway is also the reason that residential and commercial developments are permitted (normally only marine-oriented development is permitted).

In 1988, the Hudson River Waterfront Conservancy was established as a stakeholder organization to assist the New Jersey Department of Environmental Protection in the construction, maintenance and repair of the Walkway. Even before superstorm Sandy, members of the Conservancy spent time touring the Walkway to document examples of deterioration and storm damage: from sinking foundations due to poor construction, to erosion, rotted pilings and deck collapse, sink holes, and faulty construction of the waterline retention barriers.

The deterioration has been going on for years, and the Conservancy has been calling attention to it for a long time. There's nothing like a hurricane, however, to emphasize the point the Conservancy has been trying to make for the need to reinforce the Walkway and river's edge

construction. For one example, one section, by Port Liberté, suffered severe damage. An estimated $2 – 4 million is needed for repairing the infrastructure and the Walkway that sits atop it.

In New Jersey, development and maintenance are the responsibility of the waterfront property owner. That's in the rules and regulations. But it has never been clearly defined as to what makes up the Walkway: is it just the paving itself or does the Walkway include the infrastructure, the foundations underneath? Sandy has thrown that question into stark relief.

There are now some places along the waterfront to which the public has no access because the condo associations that own the property just don't have the funds to repair the Walkway and the infrastructure underneath. While property owners should continue to be held responsible for their section of the Walkway, they should not be socked with the entire cost of maintaining the foundations.

The Conservancy believes that in order to address this matter, there needs to be a regional approach so we are asking for the creation of a Hudson River Waterfront Stability District with ability to create an in-depth study of the 18.5 linear miles; the selection of appropriate types of resilient installations; the assessment of costs and a formula for funding. It can no longer be left solely to the property owners and the nine municipalities to take their own approaches or ignore the problem.

John Weingart, Associate Director, Eagleton Institute, Rutgers University
Introduction of keynote speaker, Christopher Daggett

Christopher Daggett was a great commissioner for the DEP, who also served as deputy chief of staff to Governor Tom Kean, as regional administrator of the U.S. EPA, then the DEP commissioner. Just few years ago, he ran for governor as independent, earning some impressive endorsements. Now, he heads the Geraldine R. Dodge Foundation. He has a PhD in Education, which is a good skill to have in public administration.

I want to take a moment to acknowledge how much progress has been made on the Walkway, and how many cooperative efforts are needed for the future. Not too long ago, with some friends, I walked along the Walkway from the Sheraton Hotel in Weehawken to Lincoln Harbor in Jersey City —t they were very impressed with it and asked how long it would be until it was completed. It takes fresh eyes to see how much has been accomplished, and it bears remembering that it took a lot of cooperation to get this far:

- Army Corps of Engineer's efforts to clean up of river
- Activism of citizens to spur action
- The DEP's efforts to approve and review projects
- Municipal communities' government action
- Private developers' cooperation

The Walkway was never inevitable, and it never was a Democratic or Republican idea – it's always taken a broad coalition and a lot of cooperation to get the job done. It needs a continuing

champion to put it back in the radar of the public and policy makers to get what it needs to be finished.

Back in the late 1970s, I remember hearing Peter Goldmark, the Port Authority executive director, said about the New Jersey side of the Hudson: "It was an area of insurmountable potential." I couldn't agree more. (It still is.)

Keynote Address:
Christopher Daggett, President and CEO, Geraldine R. Dodge Foundation

One of the first things that landed on my desk as c0ommissioner of EPA was the NC Westway project which would have put a tunnel under the river at the edge of the city and built up landfill above it, threatening public access to the waterfront. Fortunately, the Westway project died, and now you have the wonderful Battery Park City and Hudson River Park on the New York side. So you can see there were battles over public access on both sides of the Hudson.

John Weingart is being modest – he was the division director for Division of Coastal Resources, and it was he who put together the original regulations that brought the vision to life for the Hudson River Waterfront Walkway. The future is what's important, that's what we're all talking about, but first, I'm going to recap some of the background of the Walkway, much of which I've drawn from John's excellent report on the Walkway.

The Walkway grew out of the report called "The Lower Hudson," published in 1966 by the Regional Plan Association (RPA), which envisioned a continuous bicycle and hiking path from the George Washington Bridge to the Morris Canal Basin in Jersey City, and a walkway along the rim of the Palisades. It captured some attention, including some favorable editorials in the New York Times, but did not lead to direct action.

In 1974-75, the Hoboken Environment Committee (discovered the publication) and brought over 1,000 people to a River City Fair on an abandoned Stevens dock to show the potential of a walkway, despite pretty derelict conditions. Then in 1977,(the Hoboken group invited other local nonprofit groups) to come together under the banner of the Waterfront Coalition of Hudson & Bergen which proposed moving RPA's proposed walkway down from the Palisades to the waterfront, and extending it all the way down to the tip of Bayonne. They created a Citizens' Plan for the Waterfront: their dream was to open the entire 18.5 mile stretch of Hudson River waterfront to the public, but their research showed that only 700 feet of it were currently accessible to the public.

In 1978, Governor Byrne established by executive order the Hudson River Waterfront Study, Planning (and) Development Commission in the hopes of stimulating support for legislation to spur redevelopment of the waterfront. It failed to establish a regional agency, but it did establish strong and unanimous support for the continuous public waterfront walkway plan.

It would have been forgotten, if it weren't for the fact that the DEP was finalizing its plan for the federal Coastal Zone Management Act, in 1980, when the DEP proposed and adopted regulations for the first land use for the coastal land and that established the requirement that

proposed developments include a walkway along any riverfront property. Though it was challenged in court, it ultimately received federal approval of a regional plan.

The planning firm of Wallace, Roberts and Todd was chosen to complete a detailed regional plan with maps, for the walkway.

The plan established the continuous walkway as official New Jersey public policy. It failed to spell out details like ongoing maintenance and 24-hour access, but it gained some support from a number of private and commercial developers – including Harborside and Hartz Mountain Industries.

On the other side of the Hudson, in New York, it took an enormous amount of public money to build the waterfront walkway from the Battery to the northern edge.

By contrast, in New Jersey, it required public-private collaboration. In New Jersey, it is necessary to build public support. There's tremendous potential, because people are attracted to the water, that's what makes communities here so attractive to developers. But what we need is more than just Public-Private partnership – also need philanthropic and nonprofit organizations to provide renewed leadership to protect the vision for future generations.

First, we need to develop strategies and deadlines for addressing gap sites and inland connector paths to get around those few sites where direct access may never be possible.

Second, along the entire walkway, there are significant issues of maintenance and access that need to be addressed. DEP and Corps of Engineers need to assist developers in addressing these and someone to enforce maintenance all along the walkway. We need a regional approach.

Unfortunately, these days, the word "regional" doesn't extend very far in N.J. It is common sense that what happens in one town affects its neighbors. (A regional plan) should not be enforced from top down. It should be a cooperative effort among all the parties involved locally. In the wake of Sandy, we have an opportunity to press government officials at the local and state level to action. These assets provide tourist attraction, recreation for local residents, stimulus for economic activity.

No level of government can provide the entire funding, but that's no excuse for inaction. It seems to me that restoring the waterfront is entirely consistent with Sandy relief and rebuilding funds, including hardening the shoreline, and completing and maintaining the walkway. We must prepare all of our riverfronts for future storms. This is a great place to do it, where there are so many people to benefit from it.

Related to that, we need transparency in how and where the funds are spent – how the priorities are set and gaining broad agreement on those. We are quick to simply replace what was there without regard to hardening the facilities for future storms.

I wish I had a blueprint. It's not easy; it's going to take a lot of discussion and cooperation to figure out how to do this. The DEP and EPA are still grappling with these questions. These

problems can be solved, it's just that all the parties need to come together and hash it out. We can't simply leave them to decay – we can't afford to lose this tremendous resource. For those of you under 40, it's your turn!

Session One: Understanding the Threat

Presentation 1: A Changing Climate

Radley Horton, PhD, Associate Research Scientist Center for Climate Systems, Columbia University, and Principal Investigator, Northeast Climate Science Center. *Also served on Mayor Bloomberg's panels on climate change and on NOAA panel.*

Starting with an update on the latest Intergovernmental Panel on Climate Change (IPCC) study. The study was updated from the 2007 version, the fifth assessment of summary for policy makers.

The most important take-home message from the updated report is the consistency of findings. This study represents the consensus view from thousands of scientists, and there's a high level of confidence that earlier findings have been confirmed.

- First major finding is that the percentage of global warming since 1950 that can be attributed to human activity was increased from greater than 90% (in the last study) to greater than 95% certainty (that human activity was primary cause of increasing carbon in the atmosphere and warming) Not to say that natural variability doesn't happen, but it's not driving increase)

- Increased emphasis on total greenhouse (cumulative) gas emissions and irreversibility. Limit of tolerable increase is 2 degrees celsius of warming. We may have already emitted over half of our allowable limits.

- Sea level rise projections are substantially higher – global average changes IPCC was criticized about those factors that climate models can calculate well. This time they added things like ice shelf melting. Last time it was about 2 feet. This time, the projection is rise of a meter by 2100. Door is open to higher projections.

- Strong statements on recent ice mass loss from Greenland and Antarctica. In 2007, the report said we can't say for sure, how much ice mass has been lost due to melting. Now, with longer observation and better satellite measurements, there has been a downward trend in the past 20 years of those ice sheets.

- Greenland Ice Sheet – and possibly Antarctic Ice Sheet – seen as less stable at long time scales. There previously was an estimate that sea level might have been 5 – 7 feet higher with 2 degrees additional climate average. But now we think it was 10 feet higher, which shows how sensitive these ice sheets really are to higher temperatures.

- Possible timing for an ice-free summer in the Arctic has been moved to mid-century from end-of-century. This cuts the estimate in half. Some people think it might be sooner, based on the variables.

- Range of estimates of climate sensitivity has been reduced – the lowest possible sensitivity has been lowered. Some evidence that we won't see as much global average warming as projected.

IPCC has taken a new approach – two possible futures. First: Assuming we stop emissions at current levels: still see additional warming by about 1 – 2 degrees Fahrenheit. We're locked in to some additional warming and sea level rise.

Second: assume we continue on current path for a long period – forecast is for warming at high latitudes of 9 – 10 degrees Fahrenheit- which environment and society would have a very difficult time adapting to.

Precipitation models – pretty large increases in rainfall in high latitudes and oceans, but less rainfall on land, particularly around arid areas.

Conclusion from the Second NYC Panel on Climate Change (Jan. 2013): Coastal flooding is very likely to increase in frequency, extent, and height as a result of increased sea levels, with a slightly higher sea level increase in the New York region than the global average.

Global atmospheric warming and sea level rise over the course of the 20th century have been documented at 4.4 degrees Fahrenheit, and 13 inches higher. Scientific consensus for the future is a continued acceleration of these trends, with a conservative forecast of an increase of 3 degrees Fahrenheit in global mean temperature and a 7-inch rise in sea level by the year 2050. The outer range of the forecast is for 6 degrees Fahrenheit and more than 2 feet in sea level. The net result is that coastal flooding is very likely to increase in frequency, extent, and height as a result of increased sea levels, meaning the chance of experiencing a100-year flood is expected to nearly double by 2050, and flood heights of such events would increase by a half a foot to two feet, covering a much larger area of land in the NYC area.

The Panel used several ranges of model-based climate projections and likelihoods, the majority of which project an increase of 4 – 6 degrees Fahrenheit by the year 2050, above the baseline level of 1970 – 2000. Mean annual temperature has already risen 4.4 degrees Fahrenheit between 1900 - 2011.

Precipitation has been a pretty gradual increase, but year to year precipitation variability was greater from 1956 to 2011 than the preceding 50 years.

Sea level has risen – over a foot at the Battery since 1900 (1.1 feet). Extreme events include – 75% increase in the heaviest rain events in Northeast in the past 50 years – e.g. they're happening almost twice as often. Increase in strength of hurricanes and number of hurricanes in North Atlantic since early 1980s. A warmer ocean should make it easier for hurricanes to form, but wind shear could make it less likely – this area is hard to predict.

Temperature projections:
By the 2020s – low range 1.5 degree, mid-range 2.0 – 2.8, high-range estimate 3.2+
By the 2050s – 3.1 – 6.6 degrees

Extreme event projections:
Baseline (1971 – 200) we experience 18 days per year 90 degrees or above. In 2050s, close to double that – 32 to 57 days per year. Heat waves last 2 days on average will rise to 5 – 7 days in a row.
Number of days below freezing, 72 will go down.

Sea level rise projections:
Using latest IPCC models, Revised meltwater and land-subsidence
2020s: mid-range forecast 4 – 8 inches, high range 11"
2050s: mid-range forecast 11 – 24 inches, high range: 31"

Coastal floods at the battery: simply increasing the sea level will make rare events more frequent.
100-year floods risk rises to 2.5, or 5% of the time
Flood heights go from 15 feet to 17.6 feet.

The Panel has posted its findings online – you can find a visual representation of the increase flood risk zones at the following websites:
www.Nyc.gov/planyc
www.Nyc.gov/resiliency
www.ccrun.org
www.cunysustainablecities.org

Presentation 2: How does a municipality plan for changing climate?

Stephen Marks, Assistant Business Administrator, City of Hoboken (filling in for Mayor Zimmer)

Since earlier this year, the city's Office of Emergency Management and Community Emergency Response Team have been reaching out to residents and business owners to prepare for next disaster. We all know it will happen. There's nothing the city can do to prevent it, but it's crucial that we are better prepared to respond. It's not just the city's services, but individual preparedness that counts. No matter how large the police and fire depts. are, we can't rescue everyone.

Challenge: Hoboken was once an island. Look at older maps – Castle Point was surrounded by natural wetlands (which were later filled). According to the FEMA national flood hazard maps, 80% of city is in 100-year flood hazard zone. 10% is in 500 year hazard area – only 20% is higher than the 100-year zone. This is complicated by rain or storm surges that coincide with high tide, when the outflow pipes cannot drain.

Hoboken has a combined storm-water runoff and sewer system, so in heavy rainfall events, sewer overflow goes out to river.

Hoboken's sewerage authority has a permit from EPA/DEP to operate the system this way – it goes back to 1880s. In some spots, the sewer lines are wooden structures predating the Civil War. We are working with North Hudson Sewerage Authority to fix it. Philadelphia is addressing the same issue by implementing green solutions. Rather than replacing their entire system, they're taking steps to reduce storm-water runoff into system.

The NHSA estimates that just in Hoboken, it would cost $1 billion to replace combined with a separated municipal system.

From Superstorm Sandy, Hoboken saw over $100 million in damage to private property and $10 million to city property – we lost a lot of vehicles stored in a municipal garage that had never flooded before, and some vehicles damaged during rescue operations. Making matters worse, the water was brackish, or salty – plus it was contaminated with oil and other pollutants from basement heating systems and storage – this ruined a lot of municipal vehicles. And, there was $100's of millions in damage to our regional transit system.

Unfortunately, the National Flood Insurance Program (NFIP) doesn't account for the realities of urban areas, only offering minimal compensation for basement and garden-level apartments and businesses, which are classified as unoccupied spaces in other parts of the country.

Flood insurance premiums are expected to raise dramatically, but as yet, no indication that the protection will cover urban areas the way they should. If we can't drive change to these insurance classifications, we need a comprehensive plan that would allow Hoboken to be designated a "Shaded X" area by NFIP, which would exempt properties from flood insurance requirements.

Showed a montage of photos of a flooded Hoboken, with the "island" fire station as an actual island, the Hoboken Terminal are flooded, and a boat stranded by the storm surge at Weehawken cove.

The city has put forward a comprehensive resiliency plan. The goal is three-fold: Physically protect Hoboken as much as possible from flooding; financially protect residents and businesses from unfair insurance program; and protect the urban character and streetscape of Hoboken.

Comprehensive plan includes:

- Flood pumps (3 additional flood pumps for heavy rain and storm surges)
- Storm surge protection and flood barriers
- Energy resiliency/operations of public safety and critical infrastructure
- Open space acquisition for stormwater management
- Emergency back-up generators

- "Hoboken Ready" – A program to help residents and businesses improve personal preparedness, with a Community Emergency Response Team, and improved public notification system

The city has submitted a request for $125 million dollars to the state, since the state is managing $50 billion from federal government. While the state is investing heavily in protecting shore communities – financing new dunes and beach replacement along the Jersey Shore – urban municipalities aren't getting a nickel. The City of Hoboken has $10 billion in ratable properties that are at risk from coastal storms.

So, the city is using alternative funding approaches where available. Just yesterday we submitted a low-interest loan application for $11 million for a new pumping station at 11th St.

Alternative funding for storm surge protection projects:

- Hoboken has applied for a $33 million FEMA Hazard Mitigation grant.
- Enter into public-private partnerships; require storm surge barrier to be incorporated as part of Hoboken Rail Yards Redevelopment Area and possibly in the North End Rehabilitation Area.
- Re-examining the Hoboken Cove park design, exploring concepts to incorporate berm, armored levee, etc., as part of the Hoboken Cove park design.
- HUD's "Rebuild by Design" competition (also funded by Rockefeller Foundation)

The comprehensive plan includes a combination of features from a proposed barrier system to green infrastructure, to water retention areas, and more. Revising plans for the waterfront park at 1600 Park to using existing topography to build in barriers and berms to prevent water. We want to use green infrastructure, with aesthetically pleasing public access facilities, such as tiered flood walls that could be used during non-flood periods for recreation (with ADA access), like those you see in Holland – where two-thirds of country is at or below sea level. There's a national saying in the Netherlands: "Pump or die." They build these facilities to protect communities but also to provide usable public recreation spaces. We are also looking at installing a system of temporary barriers to protect streets that would deploy only when needed.

Other preparedness projects: We are working with PSE&G's Energy Strong program to elevate our power substations above the new FEMA flood hazard levels, and are bonding to purchase backup generators for our emergency municipal services. We also have a grant to work with Sandia National Laboratories, NJ BPU, PSE&G, and the Department of Energy to develop a smart grid and micro-grid projects.

We are also working regionally with Sustainable Communities – Together North Jersey – which is providing strategic planning for green infrastructure across nine sewer shed areas to mitigate storm surge and rainwater. Through a grant, we are already working on a rain-garden curb extension project to demonstrate the effect of water retention during heavy rain events.

We have an opportunity to implement green design and storm-water management technology in three new park spaces – in southwest Hoboken, the city has a 1-acre parking lot just acquired through eminent domain, which could have storm-water detention facilities underneath. We have

received 14 proposals from a competitive bidding process to create a plan for the site, incorporating flood mitigation. Also hoping to use the former towing-yard site at 6th and Jackson and a factory site in northwest Hoboken (6.5 acres, owned by BASF) to help with flood reduction. If you incorporate enough storm-water retention on these sites, you can reduce runoff to zero.

The City of Hoboken has issued some RFPs for recovery plan development. Our goal is to revise our stormwater management plan and local ordinances, and requirements for developers. We are building in these components to our ordinances, with incentives to capture stormwater runoff. Also developing a plan for Frank Sinatra Drive from 4th to 11th Street to incorporate low-impact development elements into future improvements – rain gardens, water-retention tree pits, berms to project against storm surge impact, and more.

Luncheon Keynote Address:

Hendrick "Henk" W.J. Ovink, Senior Advisor to HUD Secretary Shaun Donovan, and a spatial and civic planner from the Netherlands
Tapped by President Obama as senior advisor to Shaun Donovan for Sandy Rebuilding Task Force. *(Due to the government shutdown at the time of the conference, he clarified that he was not officially representing the U.S., rather, he was speaking as a Dutch civic planner)*

My goal in running the Resilience by Design competition (#resiliencebydesign) is to demonstrate the power of design and role of design in dealing with issues of sea level rise, storm water issues, etc.

There are a lot of parallels between New York and my home country of the Netherlands, as demonstrated in a new book, *Island at the Center of the World* by Russell Shorto, a journalist who lived and worked in Amsterdam for four years, where he was head of the John Adams Institute, which was created when Adams was Ambassador to the Netherlands. The author traces a lot of the origins of the culture of New York City through reading letters in old Dutch.

The Netherlands is a delta region for four major rivers flowing from Northeastern Europe. It is essentially a giant pit:

- 26% is below sea level
- 29% above sea level
- 3% outside of dykes
- liable for flooding – 51%

When the Dutch started living there, it was mostly water. You might wonder what made them settle there. Well, they were traders, the network of rivers in a delta make for good soil, good trade, and prosperity. Over time, they created land by building more than 3,500 polders, or manmade tracts of land enclosed in dikes and embankments.

The country has a long tradition as a collective – the Netherlands was not created by engineers, or designers. It was the result of the collaboration of all the people. In 1222, people around Utrecht were tired of having wet feet. Twenty communities worked together on the local embankment to secure their communities for their businesses and their children's future. They realized they needed to appoint someone to be responsible for the water, so they created Water Boards, groups of people who make decisions about what to do with the water. These were the first democratic form of government after the Greeks. Water boards still exist. They're elected to protect, preserve and ensure clean water.

By creating these dykes and below-sea-level land, we felt safe, we forgot the risks. But this century, we have seen sea-level rise, river flooding, droughts, more extreme storms. Salt intrusion, erosion, subsidence, decreased and increased river discharge, continued human development.

Finally, in 1953, a big storm overwhelmed all our dunes, levees and dykes. The country had devastating flooding. So Netherlands responded with the world's best engineers – more dykes dunes, levees. In 1916, the country enclosed the Zuiderzee, made it a lake. Had to do it again in 1953. Lesson – Engineering is not enough

Politics: In the Netherlands, as in the U.S., we also have extreme political parties on the right and the left, but everyone agrees with planning and protection – there are hardly any debates on the need for it.

In U.S., by contrast, there is little talk about planning – all we talk about is response, by fire and police departments, communications systems. It's also about money. In the U.S. we spend billions of dollars on recovery and repair, but very little on prevention.

The U.S. could learn from the Dutch, who say: Act now and also prepare for the future. You need to develop a sound institutional framework, and adaptive strategy, three-level approach. So since 1953, the Dutch approach is now three levels:

1. Response – disaster management
2. Plan – land use planning, new developments, vital infrastructure
3. Protect – with dams, dikes, levees, dunes, etc.

In the long-term, it makes more sense to invest now, rather than waiting. Every dollar spent on repair is a lost dollar. It will be washed out again. And current dollars are cheaper than future dollars.

Plus, when you invest in a more robust and resilient way – in flood prevention – you not only save money later in response spending, but also by building a safer region, you attract more investment, from homeowners to global businesses.

To understand the risk of flooding, how many of you play poker? You've gotten a straight more than once, haven't you? A 100-year flood refers to a 1% chance – which is twice as likely as getting a straight in poker. By 2050, a hundred-year flood will be more likely than getting three of a kind.

Melanie Schulz Haegen, Shaun Donovan's counterpart for the Netherlands, says that water safety, scarcity and quality are worldwide urgent issues connected to urbanization, economic, ecological and social changes. We can't wait, we have to collaborate.

The impact of an event is different for different populations – economic factors. Understanding the specific impacts is important in planning. Sometimes it makes sense to build protection, other times it makes sense to move people. The Netherlands recently worked out a deal with some land owners that would continuously flood in Overdiepse Polder. The farmers who lived in that land, worked with designers to move their livestock to some high land (berms) that the country built for them. So they could stay in place, despite repeated flooding.

Prepare and prevent. Planning and design. The only way to plan is to think of yesterday, today, tomorrow and the day after. Learn from the past not to repeat mistakes, but to improve, and look to the future, drawing on scientific studies; make them tangible on a local and personal scale. Then bring them together to make decisions.

Amsterdam – one of the most privately developed cities – not socialism, but private collaboration. The people planned to protect the city from 1,000-year storms. The central station is the main dike. Canals were built to disperse water, etc.

Historical development of the Netherlands is network of cities with well-developed transportation systems. Still doing that. Still building new land into the sea – extension of Rotterdam harbor, but also giving land back to the water – turning farmland into waterways. "Ruimte voor de rivier" Room for the river.

Integration with urban development. Dikes, dams and levees are built into urban environment, with quality of life considerations, economic development and low-income housing department. In the Hague, these groups came together to collaborate on the design.

Also building with nature, the country is now experimenting with building artificial sand dunes that move with storms.

When it comes to disasters, there's no room for superheroes. It must be a collaborative approach, with politicians, scientists, engineers, policy makers, designers, and individuals all working together.

Alliance of these elements is a Trojan horse, it brings things you never thought of – surprise. Prizes and innovation – it's been show that using prizes can spur innovation. Rebuild by Design is a competition from the President's Hurricane Sandy Rebuilding Task Force.

Started with an RFQ – request for qualifications – to select a group of planners, designers, architects, engineers, etc. Their job is to pin down the research necessary for region-wide solutions. Small and replicable, or large and systemic. As of the June 20 deadline, 184 people had submitted applications. Task force selected 10 teams across disciplines. Deliverables: A

comprehensive regional analysis of the Sandy-impacted region, and projects that could earn funding for implementation. For more information, visit www.Rebuildbydesign.org.

Factoring social vulnerability into physical vulnerability. Power generation – 75% is in flood prone areas, 80% of liquid fuel storage is flood-prone. NY depends on NJ for a lot of fuel and power.

Session Two: Technology and Methods for Mitigating the Threat

Presentation 1: Architecture/planning – New approaches

Alexandros Washburn, Chief Urban Designer of City of New York, Department of City Planning and author of The Nature of Urban Design.

To bring the point home about urban design, I will also be speaking as a homeowner in Red Hook, on Van Brunt Street, who is concerned with how to make his home and neighborhood more resilient.

The storm was not unprecedented and will be repeated.

What is urban design? We are the hands that draw, while others (engineers) figure out the solutions. By day, I'm a regulator, by the evening, I'm regulated (as a homeowner). I dream of a system that would protect my neighborhood, which is former marshland. Creating polders, water basins, park land that functions as water management systems.

Developing these solutions can take time, but I needed to adapt my home now.
Anyone faced with rebuilding after Sandy is subject to rules and systems that control what we can do.

Anything I proposed has to pass review by
Zoning office,
Building regulations,
NFIP (National Flood Insurance Program).

Then, I have to consider if is it constructible (e.g., what does it cost), is it rentable (is it usable), and what about the streetscape? How does my project affect the vitality of all the other homeowners and businesses?

The new Federal flood elevation for my neighborhood is four feet above grade–which poses several questions of what to do with existing buildings along the streetscape.

People tend to take the path of least regulatory resistance. But that would mean knocking out the Victorian storefront, filling in the basement, pouring a slab, and possibly parking cars in the basement, which would destroy the street life.

So, instead, we decided to create a café on ground floor – pour a slab, fill the basement, and design a flood-resistant space. It's called a "wet flood-proof" basement – allowing flooding to come in. Building reverse French drains – a grid of holes that would be filled with concrete to stabilize the soil underneath.

Urban design solutions require a synthesis of my three heroes:

- Robert Moses – for quantity
- Jane Jacobs – quality of life
- Robert Law Olmstead – nature

Purpose of urban design is transformation. Making neighborhood resilient, while preserving the character of a community and the quality of common space.

Presentation 2: Green Technology – Infrastructure

Franco Montalto – Associate Professor and Director of Sustainable Water Resources Engineering Laboratory, Drexel University. *(Used to live in West New York and did a lot of his research in the Hudson County area.)*

Urban design is not just about mitigating threats, but also about delivering services. Projects can do multiple things: It's about garnering useful services from otherwise underutilized spaces and reducing vulnerability and risk.

Green infrastructure – the meaning has evolved from simple "land conservation" – preserving the natural features in the landscape like forests, wetlands and streams that occur in between urban spaces.

From land conservation, the concept of green infrastructure was first expanded to incorporate "storm-water management" – using trees, vegetation, wetlands and open space within urban areas to stop water pollution at its source.

Now green infrastructure has taken on a new meaning of "urban sustainability" – the EPA is now talking about green infrastructure as an approach to maintaining healthy water and providing multiple environmental benefits and supporting sustainable communities

Eventually, we may need to retreat from some coasts, but in the meantime, we still live here, so we need to engineer it to handle excessive water events, from heavy rains or tidal surges.

Temporary water storage (detention) causes pollutants to settle and slows down peak flow-rate, while improving water quality and reducing flood risks.

Permanent storage (retention) – Pollutant attenuation, reduced runoff volume, reuse opportunities, infiltration, evapotranspiration, enhanced infrastructure capacity and drought protection, enhanced ecology and heat island mitigation.

These projects can help us make better use of underutilized coastlines – coastline enhancement, habitat enhancement, aesthetic improvements, resulting in protection from sea-level rise, and enhanced livability.

Presentation 3: Review of Today's Technology for Coastal Engineering

Jon K. Miller, Research Assistant Professor of Coastal and Ocean Engineering, Stevens Institute of Technology

Traditional approaches: Bulkheads and floodwalls, which are not good for public access to the shoreline, not good for ecology or the environment

Three new approaches:

First, "engineered storm surge barriers" – major engineering projects designed to keep the water at bay. Sometimes these ambitious projects come with downsides too.

Examples include:

- Deltawerks, in the Netherlands
- Project Moses, in Venice, Italy
- Arcadis proposal for Verazzano Narrows flood barrier
- Halcrow – a barrier stretching from Sandy Hook in New Jersey to Rockaway Point in New York

Second approach is "working with nature" – examples include the "Sand Engine" project in the Netherlands – importing large scale sand nourishment to create manmade barrier islands. Then allow nature to move the sand up and down the coast as storms come along.

Another example from the Netherlands is the Overdiepse Polder, a river expansion project along the Maas River, creating water pathways – that divert the river where you want it to go. Or, create multiple levels of protection – where people can live at 100-year flood risk level, but have a safe evacuation level built up for extreme incidents.

There are also proposals for the New York area that would use natural defenses – for example, building natural marshland and oyster beds like were here in 17^{th} – 19^{th} century. The rule of thumb is that 3 miles of marsh = 1 foot of surge dissipation.

The third approach is creating "ecologically enhanced hybrid structures" at rivers' edges, to replace the industrial bulkheads that no longer serve their purpose.

Case study is a project called "Designing the Edge," at the Harlem River Park, in which Stevens collaborated with the New York City Parks and Rec Department.

The goal was to take an old bulkhead and improve ecological function of the urban shoreline while enhancing safe access to the shore for people. We removed a vertical bulkhead, created a

sloped, reveted shoreline with tidal pools, and used plantings to create natural landscape, with a walkway nearby.

Another example was a Green Bulkhead Project on the Cuyahoga River, in Ohio, where there was a failing bulkhead, on a heavily used industrial shipping channel (the one that gained notoriety in the 1960s for catching fire). The river had been cleaned up a great deal, and could support natural wildlife.

Looked at various options, including pocket habitats, floating plant baskets, tiered wall.

Another eco-concept is using an alternative concrete – that can make the surface attractive to marine life to attach and grow (improving pH and porousness). Concrete installations that are "eco" offer sinuosity, roughness, a milder slope and natural look.

Ultimately – combination of solutions – green roofs, water retention basins, floodwalls that are removable (to deploy as needed), use oyster beds around pier pilings.

Session Three: Financing the Future

(Due to the federal government shut-down, two of the scheduled speakers, Frank Scangarella and Cathleen Carlisle, were unable to attend; conference organizers were honored to present a prominent expert in major flood protection engineering and planning, Piet Dircke of Arcadis, to share his global perspective on flood prevention and planning.)

Presentation 1: A Global Perspective on Resilient Design

Piet Dircke – Global Program Director for water management at Arcadis,(a leading global expert in flood protection, who has played a major role in planning projects for the NYC region and the New Orleans delta region, among others.

By 2050, the majority of the world's population will live in delta or coastal cities. Last year, the world's population tilted to majority in urban instead of rural areas. Coastal cities drive the world economy. New York is a delta city, Rotterdam and the Hague, Bangkok, Jakarta, etc.

The impact of concentrating so much economic development in these delta cities means that even "normal" flooding has more serious impact on world economy – factories close, workers displaced, etc. The more serious storms can make a serious economic dent, as we have recently seen.

This is why flood mitigation is so important. It's not just sea level rise, it's also rate of urbanization and rate of subsidence (sinking) of land. Jakarta, Indonesia, is seeing 10 inches subsidence per year. Other delta cities are also built on soft land – such is the nature of a delta region. At least New York City is not such a challenge – its advantage is that it is mostly built on bedrock.

People may argue about the utility of flood barriers. Some floods are prevented by storm surge barriers, but some floods happen despite having barriers. The list of the former is much longer than the latter, and there are no examples of a barrier causing damage. New York is above sea level, so it has a lot more options than some cities. Netherlands has learned how to build around and live with water, building with nature, allowing room for the river to pursue its course.

The latest trend is to build multifunctional urban dikes – like in Rotterdam, where dikes are also urban parks, not an obstacle to the waterfront, but an amenity. We have built dikes hidden in dunes – In Scheveningen, they built a dike and hid it under a raised beach dune with a boulevard behind, which has actually created new commercial opportunities. Other innovations in Rotterdam include raised buildings, buildings on floating pavilions, raised buildings, etc.

The key is multiple lines of defense—redundancy. Like a car – to avoid accidents, they have both brakes and horns. Today there are dozens of protective measures.

In the Netherlands, we have a very strong green political movement, and a lot of regulations and environmental impact protection. It's good, but national flood protection is in the Netherlands is a law standing above environmental laws. In the U.S., flood protection is thought of in terms of insurance costs. If we want to be innovative, we need to look at future requirements, understand that old laws and regulations were based on conditions that are no longer relevant. Innovating with permitting and regulations is a big challenge

In planning, there's a three-tier approach:

1. Ensure no one gets hurt – short term solutions
2. The show must go on – mid-term solutions
3. Keep our feet dry – long term planning

For example, you could move and bury West Street, build up a natural wetlands leading up to a dike over the highway protecting the urban cityscape behind it.

In the New York area, you have about 520 miles of urban coastline – it's a lot of coast to protect! Green infrastructure is nice, but when sea level rise is 8 – 10 feet – it won't provide enough protection. You have to build multiple lines of defense and also be prepared to move during major storms.

Presentation 2: A New Path to Funding? Cancelled
As noted previously, the two speakers who were to discuss finance and insurance were unable to attend due to the government close down.

Session Four: Adapting to the Future along the Hudson River Waterfront

Presentation 1

Beth Ravit – PhD, Department of Environmental Sciences; Founder and Co-Director of Center for Urban Environmental Sustainability, Rutgers University

Pre-Sandy, the Center (CUES) was already working with Hoboken on a project called the "Hoboken City Hall Watershed Landscape" project. They chose the square block around city hall as the focus area for a demonstration project of a rain-water garden, because that's a scale that local block associations and other groups can relate to and adapt to their own blocks. Student teams are already doing research.

Post-Sandy, however, their mission becomes even more crucial. The storm was an extreme event.

The resiliency challenge becomes even more acute for the entire Northern New Jersey coastline, which includes five rivers: the Hudson, Raritan, Hackensack, Passaic, and Rahway Watersheds.

There has been a lot of focus at Rutgers on sustainability for the Jersey Shore, but not a lot of focus on Northern New Jersey, especially where the population is so dense in Hudson and Bergen Counties, plus Newark. So my team looked at population density in 17 towns/cities and discovered that there have already been over half a billion in insurance claims already paid. It's the most densely populated area in the state, with lower income than the state average.

Northern New Jersey's Coastal Impacts: In the state's most densely populated region:

- Northern NJ coastline development is contiguous
- NJ land use decisions made predominately at the municipal level
- Visionary resiliency design & planning must integrate existing conditions and land use regulations
- Regional infrastructure must be protected
- Cost of long-term resiliency cannot be born solely by individual communities
- Resilience initiatives must occur at municipal, county, regional, State, and Federal levels

Challenge is to envision resilient transformations at the municipal level in a complementary fashion.

There are precedents we can look at for how to do this. My co-director is from Germany, in the Ruhr region, where they have reimagined the Ruhr River valley. It's similar to northern New Jersey in that the river is bordered by a lot of old industrial sites, brownfields, and is densely populated. Developed an environmental plan, municipality by municipality, and then rolled the information from the bottom up into a regional plan.

It takes collaboration. Land use design occurs at municipal level. Resilience demands the regional level. But, you should start with the people who are going to be affected most – those who care the most.

Funding – where to begin –

- NJ Environmental Infrastructure Trust Fund,
- DCA County Block Grants
- New funding vehicles, regional, state, federal?

Other than Rebuilding By Design, there is no federal funding for planning. We're very worried about doing something, but until we have a sense of what existing conditions are and how to work within the time, we're stymied. We need to see how things work to understand how to start.

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Even if one municipality can fix its own problems, what about its neighbors?

Presentation 2: The Walkway: Its Role and Requirements

Hank White III, Principal, HM White Site Architects (landscape architecture and urban design), whose portfolio includes the New York Times Building lobby garden, St. George Maritime Park, Brooklyn Botanical Garden's new reception center
Former President of the Hudson River Waterfront Conservancy of NJ

Let's focus on the walkway itself. It's mostly a structured landscape, with varied shoreline conditions: Bulkheads, piers, stone revetments, with some tidal flats and palisades.

Land uses are also very varied along the walkway: There are industrial properties on the southern end, pier development, commercial uses, residential developments, municipal parks and regional parks.

From the original 1987 design guidelines recommended by Wallace Roberts Todd, the property owners have three options:

- 16-foot walkway and 10 foot bike path with 6 foot planting
- 16 ft walkway, 12 ft seating and planting area
- 16 ft walkway at bulkhead edge, with 6 ft seating and 6 ft planting

Design issues along the walkway continue to be:

- 24-hour access – essential for full public benefit, but for some of the property owners, it creates safety and cost issues
- Perpendicular access – the ability to see and access the walkway from upland locations – permeability of the landscape. If views are blocked, it can pose safety issues, as well.
- Marine ecology – (return of the teredo worm), fisheries, etc. Materials used can be more or less susceptible to destruction by worms or other hazards, and walkway design can have different impacts on the ecology – not just a municipal issue, it affects the ecology of the region
- Landscaping – for utility or beauty, and integration with adjacent upland
- Lighting – for beauty and safety and environmental impact
- Site furnishings (benches, etc.) – can reflect the individual municipality identity.
- Materials – we can use more sustainable design, recycled materials, permeable pavements, etc.
- Walkway architecture
- Coastal resilience – surviving the next surge

We are at the dawn of an era when we can view the walkway as a valuable regional asset.

Presentation3: Disaster Mitigation and Repair

Chris Obropta, PhD, Rutgers Cooperative Extension, Water Resources Program, associate professor, School of Environmental and Biological Studies, Rutgers University; www.water.rutgers.edu

The Rutgers Cooperative Extension was set up as a land grant college, founded to help farmers, now we work more with homeowners. We travel across the state and help people deal with water issues, spreading green infrastructure practices. We work with 560 municipalities, building partnerships to work on projects that protect cities from storm surges, shoreline protection, and storm-water runoff flooding.

Shoreline protection - strive for engineered natural systems – living shorelines -- these aren't practical in a lot of places along the Hudson, because of historical uses for industrial and shipping facilities. There are a lot of hard structures, nonliving shorelines. Bulkheads. But they weren't designed for storm surge protection. Elevated walls block the view of the water, and turn the city into a bathtub, where you need to drain it with pumps.

We need to figure out what we want to spend our money on, which depends on what our values are as a society. The dunes at the Jersey Shore – some people may not want dunes blocking their view of the ocean from their homes, where they can keep an eye on their kids playing on the beach. But they need dunes.

In more urban settings, you can use green infrastructure to manage water - capture, hold, retention. Some examples are green roofs, rainwater harvesting, porous pavement, rain gardens, etc.

Impervious surfaces are the problem –

- Eliminate – by de-paving
- Reduce – install pervious paving, turfstone
- Disconnect – prevent the rain water from flowing into the sewer system through water retention systems
- Harvest rain water – reuse water – put grass back in
- Conveyance systems – drainage systems, which don't have to be concrete, they can include landscaped bioswales

Examples of how to disconnect – storm water and sewers. Build curb extensions and create a storm-water rain garden, with side benefits of reducing urban heat island effect and increasing pedestrian safety.

Green roofs – can be very expensive, can be very heavy – need to ensure they don't exceed snow load.

Harvesting rain water – for example, car washes send soapy water into the streams. In Clark, NJ, a car wash has built a 5,000-gallon cistern, in which car wash water is channeled into a rain garden, where the water is cleaned by the garden before released to storm-water system.

- Focus on frequent localized flooding – storm water management
- Focus on incorporating long-term changes into building codes
- Focus on the people and their safety – reconsider basement apartments, maybe use it for parking, that way, you only lose your Toyota instead of your life

We need to communicate risks better – we now know what 15-foot storm surge means, but before Sandy, we couldn't picture it. Use technology to help people understand what storm surge impact might look like.

Presentation 3: The Future?

Claire Weisz, FAIA, Founding Partner WXY Architecture + Urban Design, based in NY, faculty member at NYU school of public service, frequent speaker on urban design

Using a slide showing the Stevens Institute's analysis of Hoboken's land elevation, she demonstrated where the water came on land. The walkway is at the point of entry for storm surge.

It's a regional asset. The walkway is part of a changing attitude – like the High Line elevated park in Manhattan. A well-designed walkway can increase real estate value and affords people a different view of the landscape.

Battery Park – was designed to resist water without interfering with public access. The grade is raised and there's a garden instead of impermeable surface.

The common complaint is that "there's no room" to build; but that's an issue we've been dealing with going back at least a century. In 1902, the Harlem River was a boat-racing waterway, with a horseracing track on the shore. Those have been replaced with industrial and transportation uses. The Harlem River is a manmade river – it had been an estuary.

But with thoughtful design, these facilities can be made to serve multiple purposes. Public right of way can be incorporated with cantilevered walkways on piers and natural shoreline. Elevate the piers above flood stage.

Presented several examples of multi-purpose, people-friendly urban design:

- Proposal to build a pedestrian flyover by the FDR Drive, which can also be used as flood protection.
- Proposal for the Coney Island Aquarium, under a dune, with walkways outside
- A building for the Battery, for a carousel, like a scuba diving experience – giving people an opportunity to understand what it feels like to live underwater.

Conclusion: Helen Manogue and Alan Blumberg
The Hudson River Waterfront Conservancy could never have planned this without Alan Blumberg and Stevens, who have been fabulous co-partners in the planning – which helped us bring together leading thinkers in the field. Thanks also to the technical staff, Stevens' facility coordinator, Conservancy board members and volunteers.