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The $5.9 Billion Question

Alex Marshall

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Standing on a narrow strip of land in Breezy Point, Queens, with the gaping mouth of New York Harbor in front of me to the south and a line of ruined houses behind me to the north, I can see five miles across the water to another long spit of land with rolling hills: Sandy Hook, New Jersey. It looks from here like another continent, as seen from one of Columbus's ships.

In the wake of Hurricane Sandy, which flooded subway tunnels for the first time and devastated the region, politicians and planners are talking about building a series of walls and gates across this five-mile gap, as well as at other important watery interchanges. It's an idea that once had been only been discussed at "visionary" planning conferences and in engineering papers. If built as envisioned, this storm surge barrier, called the New York–New Jersey Outer Harbor Gateway, could also include a highway, tunnels, and a rail line.

Other cities, from Seattle to Shanghai, from Norfolk to Nairobi, will almost certainly follow New York City's lead in considering such once-unthinkable mega-projects. New Orleans recently completed fortifications to its levees and storm barriers. The one-two-three punches of Hurricanes Katrina, Irene, and Sandy in the last decade have brought home the reality of climate change and rising sea levels in ways that are shifting agendas from drawing-room debates to action.

But it's not as simple as just gathering the money and digital blueprints. As barriers and gates are getting serious attention, many in the environmental and planning communities are beginning to advocate a softer, tai-chi-like approach to floodwaters, working with, rather than against, them. They say, first, store some of the water by restoring wetlands and dunes, strategies that have a range of benefits besides flood mitigation. Then, faced with the inevitability of more flooding from rising sea levels, let water flow in controlled, or at least anticipated, ways. Raise buildings so water can pass underneath, put mechanical equipment on second floors, prepare subway and other tunnels for regular soaking and drying. If you must protect a particular structure, then do so on site. Learn to live with water.

The anti-barrier group includes prominent environmentalists, public officials, and one particularly well-known politician, an engineer by education: New York City mayor Michael Bloomberg. "Over the past month, there has been a lot of discussion about seawalls," said the billionaire mayor in front of a

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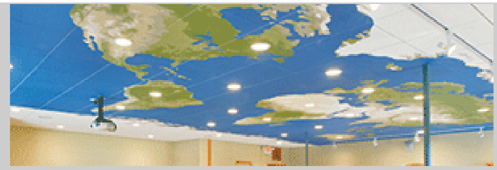

packed audience in December in lower Manhattan (an area where landline phone service still had not been restored six weeks after the flooding). “It would be nice if we could stop the tides from coming in, but King Canute couldn’t do it—and neither can we, especially if, as many scientists project, sea levels continue rising.”

Others, while not rejecting the softer approaches, insist that harder remedies still need to be put on the table. “There is a big philosophical void right now, a divide,” says Malcolm Bowman, who, along with his colleagues at the Storm Surge Research Group at Stony Brook University, has done much of the initial work on barriers for the New York City region. “You have the engineers on one side, and the environmentalists on the other.” As for Bloomberg, Bowman thinks the mayor’s engineering background would eventually bring him over.

Having been at this task for many years before Sandy hit, Bowman and his group have serious bragging rights for prescience. He wrote an important op-ed piece in the New York Times in 2005 in the wake of Hurricane Katrina that both advocated a system of storm barriers for New York City and predicted the future. “The question is not if a catastrophic hurricane or northeaster will hit New York, but when,” Bowman wrote.

While there are a number of ways to do it, storm barriers are relatively simple in concept. A gate or panel is stretched across a harbor, inlet, or bay. Most of the time the gates are left open, so that tides, shipping, and marine life can function. During a storm, or whenever high water threatens, the panels are lowered or the gates swing shut. In New York City, Sandy’s storm surge hit a record 14 feet, the highest ever recorded.

For a conference Bowman organized in 2009 that was sponsored by the American Society of Engineers, the British firm Halcrow, part of CH2M HILL, proposed the Outer Harbor Gateway. In design and function, it is similar to the firm’s recently completed 15-mile, $6.4-billion storm surge barrier across the Neva Bay in St. Petersburg, Russia. As conceived, the Outer Harbor project would have a series of five to ten sluice gates. There would be a large opening in the middle, across the Ambrose shipping channel, where tankers, container ships, and other large vessels would pass. Across this main route would swing two gigantic gates, football-field-length in size and similar to ones already working in Rotterdam, Netherlands, and St. Petersburg. Bowman calls them “saloon doors.” Aside from this channel, there would be two smaller ones for pleasure boats and smaller commercial traffic operating closer to shore.

The estimated cost of this project at the conference, without a highway and train line, was $5.9 billion, according to Graeme Forsyth of Halcrow in London. By comparison, the Dutch firm Arcadis at the same conference estimated it would cost $6.5 billion to build storm gates across the Narrows, about a mile in length. Because the outer harbor gate would stretch across the entire harbor, it would make the Narrows gate unneces-sary as well as protect a larger part of the region. Jonathan Goldstick, a senior vice president for Halcrow in New York City, says the Outer Harbor gate is relatively affordable since most of it would consist of massive rocks piled in an upside-down V. Placing huge pieces of “engineered rock” is cheaper and simpler than making a watertight man-made structure at the bottom of the seafloor, he says, adding that this low-tech solution is easily adaptable, since more rocks could be added if the barrier settled or sea levels rose.

A number of firms are lining up for the work, including Halcrow and Arcadis, which has already done work in New Orleans. Should the storm barrier project go forward, there would be no problem finding someone to build it. “You’d have Dutch firms swarming all over New York, vying for contracts,” says Bowman, who notes that the barrier “doesn’t have to be some monster in the sky.” In Rotterdam and London, the gates are considered beautiful civic structures.

But are massive public works the right approach? In recent years, local authorities have been leaning toward lighter, smarter, cheaper infrastructure. It’s better, the thinking goes, to install low-flush toilets and buy up development rights in the farms and forests upstate (which New York City successfully did in the 1990s) than build new water treatment plants. Better to squeeze more capacity from existing streets through traffic management systems using smart sensors, as London, Stockholm, and Singapore do, than to build more roads. Better to install porous sidewalks to filter storm water than to dig up pavement and install huge pipes underground. It’s better, in other words, to work with nature than attempt to override it.

One of the leading advocates of this approach is Klaus Jacob, a specialist in climate change adaptation at Columbia University’s Lamont-Doherty Earth Observatory. Jacob, a native of Germany, says storm barriers will not be effective in a 100-year time frame. Rising sea levels, he says, would eventually necessitate the barriers being closed most of the time, which will cause a range of problems. In addition, the barriers will likely take so long to plan and build, Jacob says, that many of the mitigation efforts would have to be done anyway. Better to spend the billions on these measures that would require far less state and federal approval and funding. “I never ruled out the mid-term utility of barriers in the next half-century or so,” Jacob says. “But I rule them out categorically if not combined with an ‘exit strategy,’” by which he means, “a managed and planned retreat to higher ground when sea level renders the barrier useless.”

An exit strategy. This is not something New Yorkers, or indeed citizens of any city, like to hear. It might mean not only abandoning oceanfront homes in New Jersey, but also evacuating large swaths of lower Manhattan, which Sandy flooded extensively. This area is not only the city’s historic core, but is also home to Wall Street, the World Trade Center memorial, a growing residential population, and more than 100 million square feet of office space.

While the idea of keeping floodwaters out through giant walls and gates may seem Herculean in scale, it’s not a new idea. Other cities, both here and abroad, have done it. Nearby Providence, Rhode Island, and Stamford, Connecticut, have storm barriers, completed in 1966 and 1969, respectively, which functioned perfectly during Sandy. London has cathedral-shaped, silver-clad gates across the Thames, which from a distance look like multiples of the Sydney Opera House. They were completed in 1982 and have swiveled into place and shut out rising water more than 100 times since then, according to Bowman. In Venice, after years of debate, work is underway on its $7.9 billion MOSE system, a mammoth project that includes a series of 78 inflatable gates that would be filled with compressed air when needed and rise up off the seafloor, stopping high water. Repeatedly delayed but now substantially built and scheduled for completion next year, the system would have prevented the most recent “aqua alta” that inundated the historic city in October and November 2012, the worst in decades. In 2011, Halcrow finished its St. Petersburg gates project, which includes a highway and tunnel system. Begun in the late 1970s, it was stopped when the Soviet Union broke up and then restarted in 2003 under President Vladimir Putin. The barrier across the Neva River stops the Baltic’s Gulf of Finland from pouring in, something that has happened almost annually over the centuries.

In terms of projects and overall experience living with water, there's no question that the Netherlands, the small country of 16 million people on the North Sea, roughly a quarter of which is below sea level, provides the best examples. Although the country has been famous for centuries for its system of dikes, in the last half-century it has constructed its Delta Works, a series of 15 projects built in response to the notorious 1947 and 1953 floods, which killed thousands. It took these two big disasters in quick succession to mobilize the country to build these projects, many of which had been discussed but not acted upon. "Human fatality galvanizes people," Bowman notes.

The Delta Works consists largely of gates and dams across bays and inlets, which in effect shorten the coastline and keep the sea out. The projects include the Oosterscheldekering dam and gates, which stretch nine kilometers over the North Sea. The last, completed in 1997, were the enormous and beautiful Maeslant gates across the Rotterdam Harbor. These spoked "saloon door"-style gates, each the size of a football field, swing shut and then are filled with seawater and allowed to sink to the ocean floor, forming a barrier. Since completion, they have been used once, in 2007. It is anticipated that they will be used more frequently as the earth warms, the polar ice caps melt, and the sea level rises.

In Holland, the system was originally designed to prevent storms and flooding up to a 1-in-10,000-year event, but climate change has altered the odds: A 1,000-year storm may now strike every century, a 100-year storm every decade. Adding evidence to this changing formula is Sandy. Its storm surge exceeded predictions of a 500-year storm prepared in 1983 by the Federal Emergency Management Agency.

Despite their successes with large engineering projects, the Dutch have begun to reconsider their approach. "They have discovered that all this engineering of the water has had serious ecological consequences," says Tracy Metz, an American journalist who has lived in Holland for many years and is the author of a recent book, Sweet & Salt: Water and the Dutch (nai010 Publishers, 2012). "The Oosterscheldedam was designed to allow tides through, but the openings are too small and the shellfish are disappearing as well as the sandbars where the seals hang out. Some other water bodies were sealed off altogether and were changed from salt to fresh, but now the water quality is dismal."

The country is now exploring modifying some barriers to let water in, create more wetlands, and intentionally allow some fields to flood with salt water. There is also discussion of more radical ideas, such as floating cities. But the debate is just starting, Metz says, with many continuing to advocate simple barriers as most effective. "This new softer approach to water will always be complementary to the existing system," she says. "The hope is that this approach will also help soften the impact of the water so that there will be less hard infrastructure needed."

If more storm surge barriers were built in this country, the organization taking the lead would almost certainly be the U.S. Army Corps of Engineers, which has tackled flood control projects for centuries. (The Port Authority of New York and New Jersey, which has built bridges, tunnels, and airports, might also be involved regionally.) Just a week before Sandy hit, coincidentally, the Bloomberg administration asked the Corps to examine hurricane and flood protection.

Joseph Seebode, Deputy District Engineer for the U.S. Army Corps of Engineers, says Sandy has jump-started studies that were already underway. “Now we’re in a totally different place,” Seebode says. “We know how high the water went, where the water went. We have a lot of information that will be critical in developing a path ahead. We have elevations, we have data on inundations.”

Estimating how long it would take to build such a project is difficult, because so much depends on the often-Byzantine planning process. As is typical with big projects, the political, legal, and bureaucratic work takes more time and perhaps even more creativity than the engineering work. The Outer Harbor Gateway would involve building along or through Sandy Hook and Breezy Point, and the Gateway National Recreation Area, a national park. Estimates of two decades or more are plausible.

But swifter action may be possible. Public and professional sentiment is turning against environmental review processes that drag on for extended periods. Design and construction of a new Tappan Zee Bridge in New York is now anticipated under an accelerated review schedule. Seebode notes that just seven years after Katrina inundated much of New Orleans in 2005, the Army Corps has largely completed additions, repairs, and alterations to that city’s previously inadequate system of levees, spending a whopping $14 billion. Given their importance, the federal government could fast-track storm surge barriers.

Whatever happens, it’s clear that Sandy was a wake-up call for not only New York City and the region, but for the entire nation as to what climate change and rising sea levels mean. Though costly, storm gates can be intelligently designed to serve multiple purposes: flood mitigation, transportation, even energy generation. The possible negative environmental effects of gates and dikes need to be recognized and remedied, but rising sea levels may make barriers inevitable.

Other cities, dating back to ancient Rome, have tackled the problem of low-lying land and rising water. Seattle and Chicago raised their entire street systems one level in the nineteenth century to combat poor drainage. It’s hard to imagine lower Manhattan becoming a Waterworld version of Venice, with bankers commuting between skyscrapers in boats. But the evidence does suggest that we are heading into a newer, wetter world. Every strategy, whether it involves concrete or burnished alloy, sand dunes, or oyster beds, needs to be on the table.

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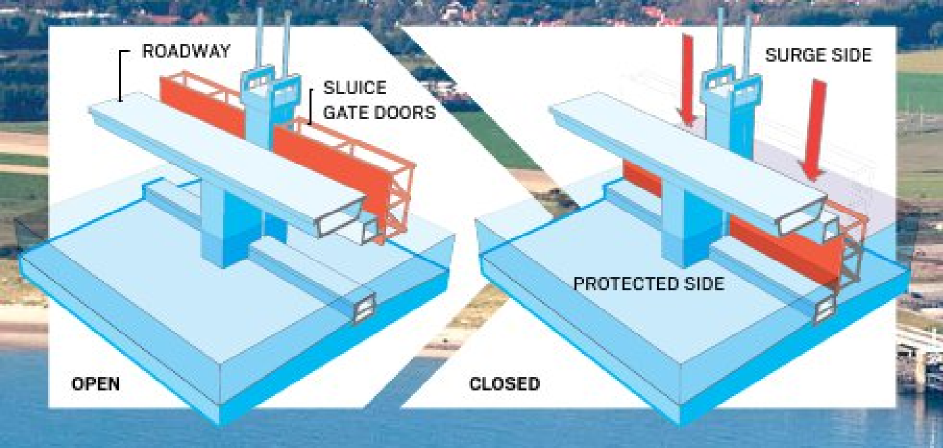
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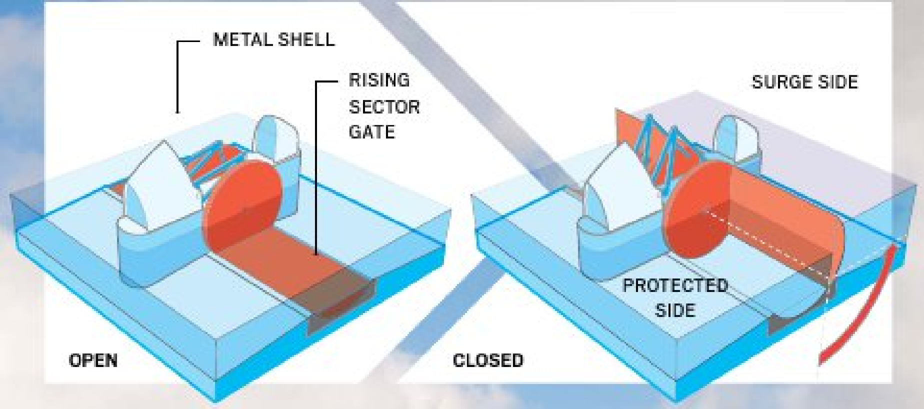
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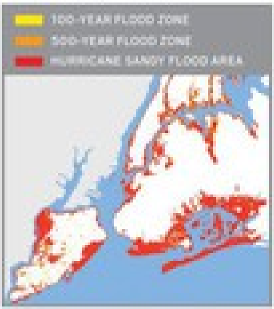
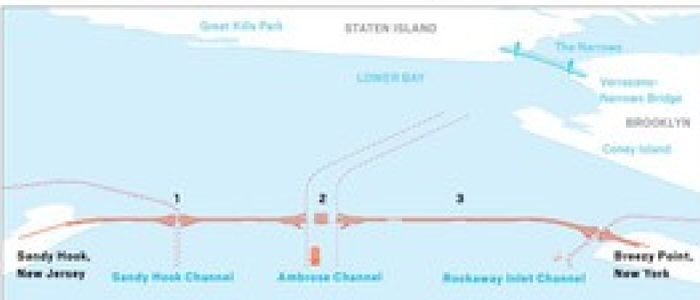
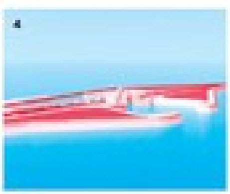
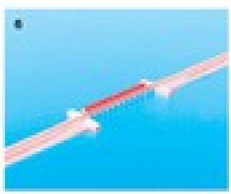


THE OUTER HARBOR GATEWAY
New York Harbor

Top: The map, prepared by the City of New York, shows how flooding from Hurricane Sandy exceeded levels in both a 100-year and a 500-year flood, as estimated in 1983 by the Federal Emergency Management Agency. Right: The proposed storm surge barrier—which was developed by the British engineering firm Halcrow for a 2009 conference—would stretch across the mouth of the harbor and close when high waters threatened. The five-mile-long barrier would include a series of sluice gates, for boats of varying sizes.







1. VERTICAL LIFT GATE
The gate rises from below and is 300 feet wide. It is similar to the Lake Borgne Surge Barrier in New Orleans, LA.

2. TWIN SECTOR GATES
These two pie-shaped gates are more than 50 feet tall, and suitable for the passage of ocean-going ships. The gates are stored in a dry condition.

3. SLUICE GATES
The gates allow operators to control the flow and velocity of water. The frequency of openings also allows for the passage of marine life.

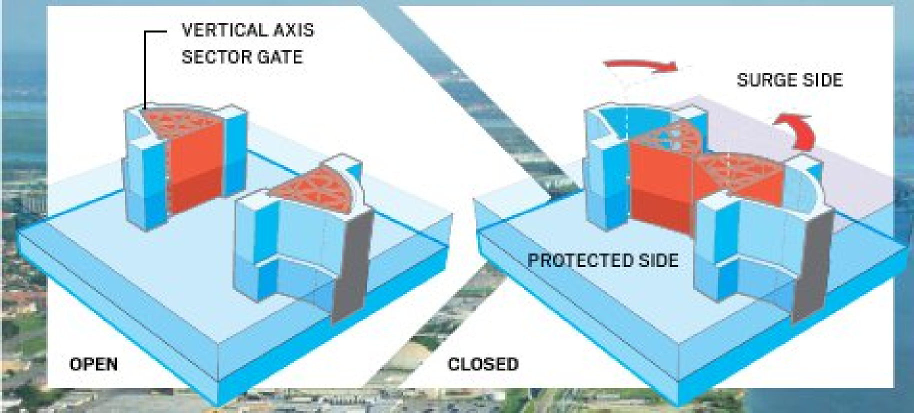
4. VERTICAL LIFT GATE DETAIL

5. TWIN SECTOR GATE DETAIL

6. SLUICE GATE DETAIL

FEMA map, courtesy the N.Y.C. Mayor's Office

Illustrations by Christopher Lee


VERTICAL AXIS
SECTOR GATE
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OPEN
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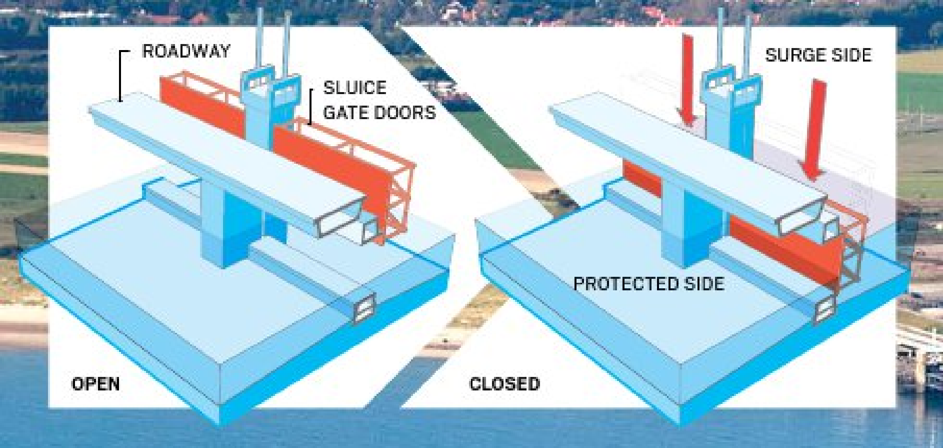
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