

Defending Boston from the sea

A massive ocean barrier. Hidden Holding tanks. With Sea Levels Rising, Urban Planners Start Envisioning a More Waterproof City

By Drake Bennett | June 6, 2010

For 400 years the sea has been kind to Boston. Maritime trade fed the city's early economic rise, and countless cod laid down their lives to feed its inhabitants. With the exception of boatloads of occupying redcoats, the Atlantic hasn't given the city much to complain about. When the area has flooded — as it did this spring — it hasn't been because of the mighty Atlantic, but the placid Charles.

But when Boston's planning visionaries think about the future, increasingly, it's the sea they're worried about. Huge swaths of the city are on landfill, just a few feet above sea level, and as ocean levels rise in the coming decades — as most earth scientists project they will — Boston faces the prospect of an ocean that is higher and more dangerous than the one it has long known. So-called 500-year floods — freak meteorological events of extreme destructive power, now expected only twice a millennium — will become 100-year floods, and 100-year floods will become 20-year floods.

The specter of rising seas has long been invoked by environmentalists as a kind of warning, to spur action on climate change. But in recent years, a growing chorus of planners and scientists have begun talking about higher sea levels not as some cautionary scenario, but as a fact of life — one that everyone who lives near the ocean, whatever his views on the climate, needs to prepare for.

What does Boston need to do? Architects, city officials, insurers, and engineers have begun to lay the groundwork

for a new version of the city, one prepared to keep pace with rising tides. In the past few years, the conversation has gained momentum, with meetings in City Hall, academic conferences on the topic, and a widely discussed article in the current issue of the journal *ArchitectureBoston*.

The ideas run the gamut from basic infrastructure fixes — raising the entrances to the city's subway and highway tunnels, or moving electrical equipment out of downtown basements and onto the roofs — to zoning changes that discourage construction in high-risk areas. And a pair of architects is proposing a megalithic building project that would completely reshape Boston Harbor, using massive sea gates that could swing shut to seal the city off from the most devastating storm surges.

"This isn't just an environmental issue," says James W. Hunt III, the city's chief of environmental and energy services. He ticks off the agencies currently involved in the effort: the Boston Redevelopment Authority, the Mayor's Office of Homeland Security, the office of Environmental and Energy Services, the transportation department, the public health commission.

Boston isn't the only city trying to figure out how to head off a flooded future. In New York City, one team of architects has proposed lining lower Manhattan with wetlands to absorb the rising waters of New York Harbor. One of the winners of a competition in San Francisco last year was a design for a giant ventilated levee that would maintain different sea levels in different parts of the bay. Planners are looking to places like the Netherlands, Venice, and London, all of which have built mammoth gates — Venice's is slated for completion next year — to hold back unruly seas. They're seeing whether some of the lessons that cities have learned by living with regularly flooding rivers can apply. The imperative is to start to think, in a detailed, nuts-and-bolts way, about how to deal with rising seas.

But even as it gathers steam, the effort is running up against the practical obstacles that face any grand building plan. It takes decades to design and construct projects at the massive scale of some of the harbor proposals. At the same time, the threat from the ocean is hugely uncertain, politically controversial, and unlikely to hit us with acute force for

decades: a recipe, in other words, for political inertia. In Boston and elsewhere, those pushing for transformative measures to fight rising oceans must contend with human psychology, a force as powerful as the sea.

Like most port cities, Boston doesn't sit right out on the ocean. A wave rolling ashore from the Atlantic first encounters Hull Peninsula, then Deer Island, then passes among the islands strewn around the broad outer harbor. Only then does it enter the chute between South Boston and East Boston, reaching the inner harbor and finally lapping against the piers of downtown.

Until the 19th century, the wave would have had to travel slightly farther. Boston, famously, is built on soil shaved off of the hilly peninsulas around the harbor and spread between them as the city's population grew.

That means much of the city is barely above sea level as it is, and relatively small sea level rises could put most of the Back Bay and the South End, along with much of downtown, South Boston, East Boston, Charlestown, and Cambridge underwater. A paper put out last year by the World Wildlife Fund and the insurer Allianz calculated that a one-and-a-half-foot rise in sea level by 2050 would put over \$400 billion in local assets at risk.

"The history of Boston is such that we kind of made the situation worse, because we cut down our hills to make land, and that land is pretty low to the water," says Alex Krieger, an architect and professor at Harvard University's Graduate School of Design.

There is, of course, a significant range in estimates for how much sea rise the city will actually see, from several inches to several feet. And the rise itself will be gradual, since it will depend on the expansion of warming ocean water and, in the worst-case scenarios, the melting of glacial sheets in Greenland and Antarctica.

The fear is that higher sea levels will mean higher storm surges: the waves whipped up by offshore storms and hurricanes that can wreak havoc when they crash ashore. While New England sees far fewer storm surges than, say, New Orleans or Fort Lauderdale, it has seen some — the mid-March storm this year created a 2-foot surge, and a 1938 hurricane known as the Long Island Express created a 30-foot surge that killed 700 people and left Providence under 15 feet of water. In addition to higher seas, many atmospheric scientists argue that climbing global temperatures will also make for more frequent and intense storms.

The effects of higher storm surges would be felt below ground as well as above. Water high enough to top the Charles River dam, which protects the city from tidal surges, would also gush into the city's tunnels, quickly flooding them. Nearly 30 miles of the city's highway and subway system would be turned into an impassable network of subterranean saltwater rivers.

One response to this prospect is to make the city itself more flood-proof. Back in the 1990s, the designers of the new sewage plant on Deer Island raised the whole structure a couple of feet to better withstand higher surges. The Boston Water and Sewer Commission is launching a multiyear study of how to drain the city during a massive inundation — one in which, for example, torrential rains combine with a high surge. According to chief engineer John Sullivan, the study will look at everything from bigger sewer pipes to turning playgrounds into temporary reservoirs. Another possibility is giant holding tanks under roads, perhaps in combination with underground pumping stations along the coast.

Some of this citywide flood-proofing can be accomplished through zoning, in particular working with FEMA to update flood plain maps. Doing so would force builders in the newly flood-prone areas of town to build higher off the ground and vent ground-level areas so that they can flood and drain with minimal damage. Though these changes haven't yet been made, a few private institutions are already taking things into their own hands. Plans for the new Spaulding Rehabilitation Hospital facility in the Charlestown Navy Yard include features that upend traditional building design: The ground floor will be nearly two and a half feet above today's 500-year-flood line, and the building's electrical transformers and switch gear, rather than being in the basement, will be on the roof, where even the most Biblical flood can't get them.

"Even with a monster surge, there will be no dire catastrophe in the building. There's a principle of resiliency that we're trying to build into it," says Hubert Murray, an architect and the manager of sustainable initiatives at Partners HealthCare, the hospital's parent company.

Murray, who was formerly chief architect for the Central Artery Project and president of the Boston Society of

Architects, has been a leading voice in trying to get the city's leaders to prepare for higher seas. With the architect Antonio Di Mambro, he wrote an article in the current issue of ArchitectureBoston urging the city to consider a design Di Mambro first proposed in 1988 for what he calls the Sea Belt, a colossal, dock-lined barrier that would link Deer Island, Long Island, and Squantum into a bulwark across the harbor, with 15-foot gates that would rotate closed to protect the city from storm surges. The outer harbor would effectively become an encircled pond, shielding the city and all around it from the fury of the swollen ocean.

The scope of that project, reminiscent of the vast barrier being built outside Venice, or those that already protect London and the northern Netherlands, raises issue that hangs over all of this: cost.

Di Mambro doesn't have a price tag for the project, but he says estimates for similar projects elsewhere have run from \$2 billion to \$5 billion. And while his plan is the most ambitious on the horizon, any significant change in how the city relates to the harbor will impose its own costs, in money, time, or simply convenience. That means the problem won't be addressed without the sort of long-term perspective that can be hard for public and private sector leaders to muster. Who would pay? What authority would even tackle the problem?

"I think it's a big challenge both for government and business," says Bud Ris, president and CEO of the New England Aquarium. "How do you deal with things that basically won't happen on your watch, particularly where you don't get the benefit from doing the right thing, nor do you get the pain for doing the wrong thing." Ris is a member of Mayor Thomas M. Menino's Climate Action Leadership Committee, which this spring delivered a report to the mayor with recommendations for "reducing Boston's contribution to climate change [and] addressing changes we cannot avoid."

City Hall has yet to make any concrete moves — the discussion, at this point, is mostly just that, though Boston's leadership appears to be paying attention to the issue in a way few other American cities are. "Is it early in the process? I would say yes," Hunt says. "The key thing is we're integrating adaptation into our planning in the city."

Last year the New England Aquarium hosted a conference that dealt in some detail with the question of how Boston could adapt to higher seas. A similar conference is planned for this fall, co-hosted by the aquarium, along with the University of Massachusetts Boston, Tufts University, Massport, The Boston Harbor Association, and others.

And while the gradual pace of predicted sea level rise means the city has time to adapt, it's also true that the unwieldy process by which massive infrastructure projects are designed, approved, and built follows a near-geological timetable of its own. As Di Mambro sees it, that means if we're going to building something to head off a problem that is still decades in the future — whether it's his sea gate or something else — we need to start thinking very seriously about it now.

"It takes about 20 years to do environmental studies and design and it takes another 15 years to build it," he says.

If that seems excessive, think back to the last major infrastructure project the city embarked on. As Matthew Kiefer, a lawyer who worked with the mayor's climate change committee on adaptation issues, points out: "The Big Dig, from conception to completion, that was 30 years."

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