

An aerial photograph of a modern city skyline, likely Miami, featuring numerous skyscrapers and high-rise buildings. The buildings are reflected in the water in the foreground. The sky is blue with scattered white clouds. The text "THE RICHES" is overlaid in large white letters at the top, and "OF RESILIENCE" is overlaid in large white letters at the bottom.

THE RICHES

OF RESILIENCE

Cities Are Investing in Green Infrastructure.
Should Developers Help Foot the Bill?

By Anthony Flint

LIKE MANY COASTAL CITIES, Miami is facing a climate future that is already here. Even without a major storm, seawater has been washing over the streets and bubbling up from bathtub drains, a harbinger of what's to come when a projected two feet of sea-level rise invades the low-lying, porous land of South Florida by mid-century.

The threat is not going unanswered. Based in no small part on the experience of dealing with the region's notorious hurricanes, planners and political leaders in the metropolitan region have a good idea of what's necessary to build resilience: a combination of hard barriers and green infrastructure, including the restoration of natural systems to absorb and distribute the inundation.

Two years ago, voters approved a \$400 million Miami Forever Bond to help pay for a "stronger, more resilient future," distributing the money across five categories: flood prevention, parks, roadways, public safety, and affordable housing. Special emphasis has gone to protecting lower-income neighborhoods, as well as the city's legendary luxury beachfront properties. That juxtaposition—between Little Havana inland, for example, and the ritzy condominium towers of Brickell Bay Drive—has prompted consideration of how the funding could be augmented by those who can afford it most.

At Brickell Bay Drive, which is routinely flooded, a proposed park and seawall redesign incorporating green space and stormwater remediation—which is estimated to cost up to \$35 million—will help keep water away from some of the city's most iconic residential towers. The skyline will soon include two 1,000-foot luxury towers that will be the tallest on the East Coast south of New York City, made possible by changes in height restrictions. As such wildly successful private real estate development becomes the primary beneficiary of taxpayer-

funded resilience infrastructure, officials are weighing how the private sector might play a greater role in financing the green scheme.

Jane Gilbert, chief resilience officer at Miami's Office of Resilience and Sustainability, says when it comes to paying for resilience, all options are on the table—including land value capture, also known as land value return, a financing mechanism that recovers a portion of taxpayer-funded investments associated with increases in land values. A mounting body of evidence suggests a clear tie between green infrastructure and increased property values; and indeed, resilience infrastructure won't just enhance property values, like parks or transit stations have been shown to do. It will allow private developments to continue to exist in the first place.



The Miami waterfront, left, is a highly developed area vulnerable to flooding and sea-level rise. At right, the aftermath of Hurricane Irma along Brickell Bay Drive, 2017. Credits (left to right): Demetrius Theune/iStock, Mike Stocker/Associated Press.

“Could we do value capture for properties just outside the [proposed] park? Maybe,” Gilbert said. “We’re going to look at every financing vehicle we can.”

Just as climate change is inspiring new paradigms in insurance, home finance, agriculture, transportation, and so many other sectors, it is forcing cities to revisit the fundamental relationship between the infrastructure that government is providing and the real estate that is being protected. The magnitude of the task—communities around the world are spending an estimated \$25 billion per year on green infrastructure—necessitates a search for additional funding.

NO CHOICE BUT TO INVEST

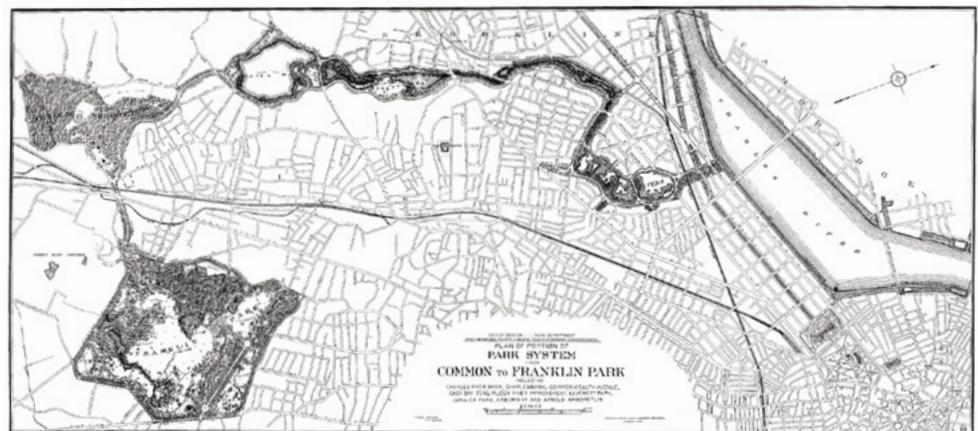
The relationship between government-provided infrastructure and the private sector has had a long history. Landowners, commerce, and industry have enjoyed most of the benefits of canals, railroads, bridges and tunnels, roadways, and many other facilities since the republic began investing in infrastructure in a meaningful way. Investments in infrastructure have also surged at key moments when cities have faced major problems like disease, overcrowding, and congestion.

By the end of the 19th century, cities were growing fast and trying to accommodate industry and a steady influx of immigrants. “It forced the need to invest,” said Alex Krieger, professor of urban design at Harvard University, principal at architecture and planning firm NBBJ, and author of *City on a Hill: Urban Idealism in America from the Puritans to the Present* (Belknap Press 2019).

“Boston had to build a subway system because it was facing utter congestion, horse manure in the streets, and a city doubling in size,” he said. The same was true for local projects most residents now consider part of the landscape, like the Charles River dam; the infilling of the city’s Back Bay, now a bustling residential and commercial district; and the creation of Frederick Law Olmsted’s Emerald Necklace, which was designed primarily as a sanitation and flood-control system, as well as a park. “The fear was that things would become completely dysfunctional and unmanageable,” Krieger said. “Things were closer to the boiling point and there was no choice but to invest.”

Cities are at a similar moment today, amid the growing recognition of the havoc that climate change is wreaking. Just as filling in mud flats made Back Bay possible, resilience infrastructure is the key to future urban development—and arguably plays an even

Frederick Law Olmsted’s Emerald Necklace, which has become a treasured corridor of parks and open space in Boston, was designed as a sanitation and stormwater management system in an era dominated by looming environmental and public health crises. Credit: Courtesy of City of Boston.



greater enabling role, as the climate stakes get ever higher.

The current crisis does not want for solutions. Many of the systems and approaches for dealing with sea-level rise and storm surge are close at hand, according to Billy Fleming, director of the McHarg Center at the University of Pennsylvania and one of the editors of the new Lincoln Institute of Land Policy book *Design with Nature Now* (Steiner 2019). Fleming helped curate the 25 green and blue infrastructure projects showcased in the book, which honors the ecological design tenets of pioneering landscape architect Ian McHarg (see page 47).

The interventions featured in the book include a New York City landfill transformed into a park, a wetland in China constructed to filter pollution from a planned city of 50,000 people, and a proposal for built landforms in coastal Norfolk, Virginia, that would absorb stormwater and tides. The fundamental concept behind this approach to resilience, cultivated by the Dutch in particular over the centuries, is to blend dikes, berms, barriers, and floodgates—the “hard” or “gray” infrastructure designed to keep water out—with “soft” systems that replicate nature and let water in, to be absorbed and distributed.

The projects in the book and others like them reflect design innovation, experimentation, and some trial and error, and can serve as prototypes for different urban conditions, Fleming said. But in addition to municipal commitments, they need a higher-level organizational framework so successful green infrastructure systems can be scaled up and implemented—on a par with preparing for war, building the interstate highway system, or sending a man to the moon.

“It’s a national problem that needs a national-scale mobilization,” he said. Federal agencies like the Army Corps of Engineers, he said, will have to be set up to administer and fund the best solutions for climate adaptation.

There is always more innovating to do, just as NASA constantly improved the design of its rockets. But the basic engineering solutions, Fleming suggests, are ready to be implemented.

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Weishan Wetland Park, a green infrastructure project in China built to filter urban pollution. The project is featured in the new Lincoln Institute of Land Policy book *Design with Nature Now*. Credit: Courtesy of AECOM.

To extend the metaphor, green infrastructure solutions are like the aircraft carriers and bombers needed for World War II: proven in terms of getting the job done, they simply needed to be built and deployed. The matter of funding was an assumption in the case of preparing for war; it just hasn’t been resolved in the case of battling climate change.

“If we decided tomorrow that this was as real a problem as cholera was in the 1870s, we would find the money,” said Harvard’s Krieger. “A consensus will only come out of a collectively understood crisis.”

AN APPROACH WITH MULTIPLE BENEFITS

The traditional means of financing infrastructure is centered around borrowing at the federal, state, and local levels. As federal funding generally has waned, some cities have explored new bonding mechanisms that clarify how investments in sustainability will pay dividends in the future. In Washington, DC, a green bonds program provides capital for riverways and stormwater and sewage management based on the measurable performance such efforts produce. The inaugural \$350 million issuance, in 2014, was the nation's first municipal century bond—a 100-year duration—and has become popular for its stability and greater yield.

The rationale for that approach is inherent in the Environmental Impact Bond, which, according to the financial firm Quantified Ventures, provides up-front capital from private investors for environmental projects, either to pilot a new approach whose performance is viewed as uncertain or to scale up a solution that has been tested in a pilot program.

While the most cautious investors view green infrastructure as new and unproven, in fact it is extraordinarily potent. “Green infrastructure delivers multiple benefits to society, including environmental, economic, and health outcomes,” said Eric Letsinger, founder of Quantified Ventures, which focuses on projects with positive social and environmental impact.

Green infrastructure practices can produce positive health outcomes, for example, that translate to reduced costs to local health systems and plans. Letsinger said involving other sectors in paying for resilience would address the “wrong pockets” problem—the economics scenario where one entity bears the cost of an investment that generates benefits for others—that has “historically limited green infrastructure economic beneficiaries, like health partners, from paying their share of the implementation costs.”

Similarly, some of the biggest economic beneficiaries are private land and property



Installation of a bioretention bumpout in Washington, DC, where a Green Bonds program provides capital for stormwater and sewage management projects. Credit: Chesapeake Stormwater Network.

owners. A 2017 report published by the Urban Land Institute quantified how water management mechanisms using green infrastructure can create value for real estate projects by improving operational efficiency as well as serving as an attractive amenity. One of the key takeaways was that natural resilience systems can enhance financial viability (Burgess 2017).

“We found many examples of thoughtful incorporation of green infrastructure that led to increased property values,” said Katharine Burgess, ULI’s Urban Resilience Program vice president. Green infrastructure, she said, can pay off in terms of operational cost savings. It can be integrated into placemaking and design, contributing amenity and market value, and can provide an ancillary benefit of freeing up developable land to increase yield.

A new matrix for risk assessment and due diligence in real estate, indeed, has climate change at its center. Another ULI survey of investors and developers concluded that factors like climate risk and vulnerability to flooding had become increasingly important for those considering developing, purchasing, or investing in property (Burgess and Rapoport 2019). “It’s definitely a changing atmosphere,” Burgess said.

The bottom line for the development community seems to be what is widely intuitively understood: higher, protected ground is more valuable ground.

“At the end of the day, this isn’t about building codes or insurance or technology—it’s about land use,” and the hazards, shocks, and stresses related to the serviceability of land, said Harvard University’s Jesse Keenan. He led research showing that lower-elevation properties in the Miami area gained value at a much slower rate than places that were high and dry (Keenan 2018).

Keenan coined the term “climate gentrification” to describe how inland neighborhoods in the city, like Little Haiti, have become suddenly sought-after. In the absence of resilience infrastructure to protect against rising seas, land that is higher than Miami’s average of six feet above sea level is seen as a place of refuge.

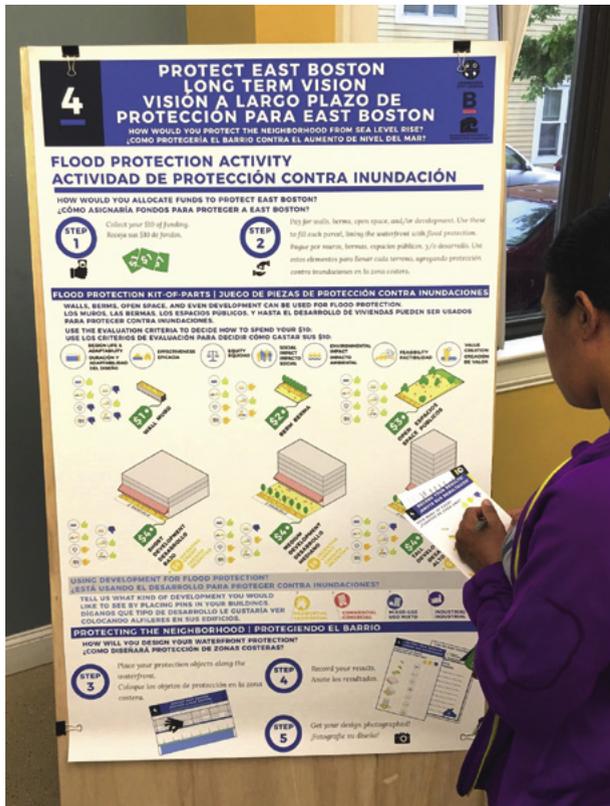
PUBLIC-PRIVATE COLLABORATION

Is there a way to quantify the benefits of green infrastructure to spread out the responsibility of paying for it? Miami is not the only city giving the concept serious consideration. In Boston, planners have commissioned a study on a section of East Boston waterfront that includes the “potential for value capture from new waterfront development to fund resiliency infrastructure based upon existing and potential future uses” (BPDA 2018).

The study area includes a long stretch of developable land that will be rezoned from industrial and maritime use, ushering in mixed-use development with greater height and density—but that is also directly in the path of anticipated future flooding. “It’s a discussion of equity . . . [potentially having] developers help pay for infrastructure that not only protects them, but also [offers protection] inland,” said Richard McGuinness, deputy director for climate change and environmental planning at the Boston Planning and Development Agency.

A more modest version of public-private collaboration is unfolding at the Gillette headquarters alongside Fort Point Channel in Boston, where the company is preparing to provide the right of way for a flood barrier to be funded by the Federal Emergency Management Agency. The project costs will be augmented by funds from the city’s capital budget that have been dedicated to resilience. Ultimately the company’s gesture is an act of self-preservation—the razor factory is right at the water’s edge—but city officials are encouraged by the recognition that building resilience requires businesses and government to work in sync.

Other metropolitan regions in the United States are also exploring how green infrastructure



At a Climate Ready workshop in Boston in 2017, the city invited participants to try their hand at balancing waterfront development with flood protection. Credit: City of Boston.

CAU Cañaveralejo Green Infrastructure Projects and Land Value Increment Per Neighborhood

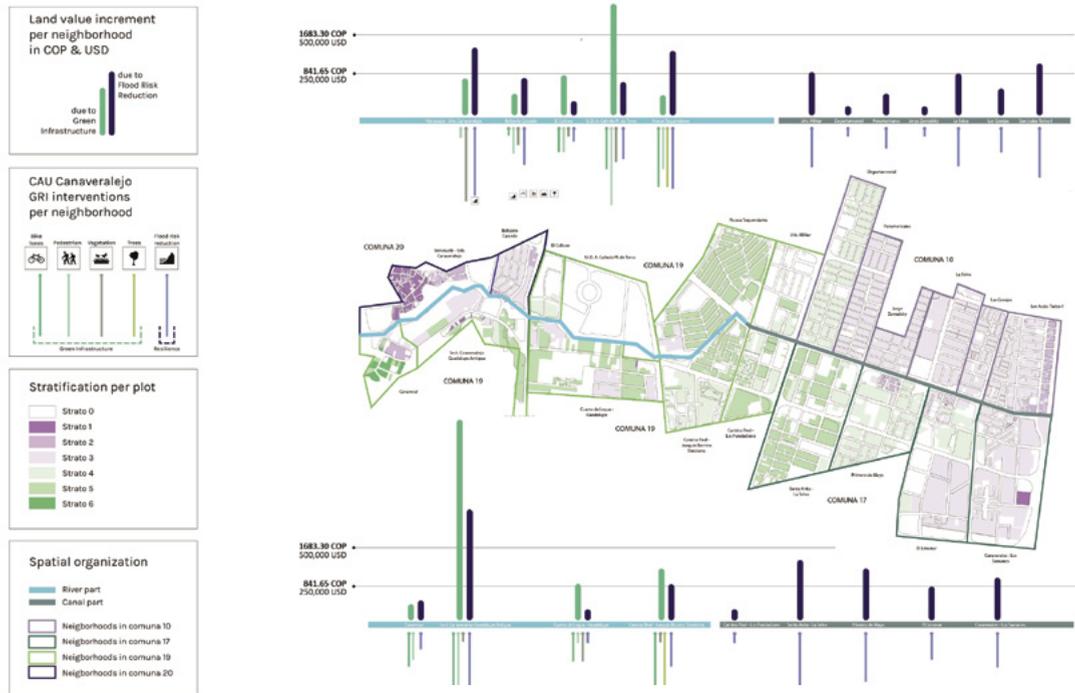


FIGURE 1 A team of researchers explored the connections between green infrastructure and land value in Cali, Colombia, concluding that “land value increases are attributable to investments in resilience measures.”

creates value, and they’re creatively harnessing that power. In Pittsburgh, a portion of some 10,000 vacant and tax-delinquent parcels are set for green makeovers—urban farms, community gardens, pocket parks and the like—that could be financed through transfer of development rights. The approach ensures that the parcels aren’t taken off the tax rolls because the development rights will get used in other areas planned for infill redevelopment. At the same time, the parks and community gardens will enhance property values in once-blighted areas, said Roy Kraynyk, a vice president at Allegheny Land Trust (Kraynyk 2017).

Meanwhile, research in South America suggests that well-established land value capture mechanisms in Colombia—which have long been used to support more traditional infrastructure projects related to housing and

transit—could feasibly be put into use for resilience. A team of researchers led by Stelios Grafakos, principal economist at the Global Green Growth Institute, assessed the impact of green infrastructure on land values along a river project in Santiago de Cali, Colombia, known as the CAU Cañaveralejo (Grafakos 2019).

The hedonic pricing model the team developed, aided by GIS analysis, “quantitatively demonstrates a useful increase in land values attributable to capital investments in resilience and risk reduction. . . . Land value increases are attributable to investments in resilience measures such as the implementation of sustainable urban drainage systems, green corridors for flood management, restoration of natural floodplains, and multifunctional public space for recreation and stormwater management” (Figure 1).

CALCULATING THE VALUE OF GREEN INFRASTRUCTURE

Fundamentally a stormwater management tool, green infrastructure also “creates amenities that can raise property values and provide health benefits,” said Robin Hacke, executive director of the Center for Community Investment (CCI) at the Lincoln Institute. CCI works with cities including Miami, Milwaukee, and Seattle to identify and secure funding for resilience projects including green infrastructure and affordable housing. Hacke said land value capture is a “promising approach” that has been part of those conversations. Such discussions will likely gain momentum, as a growing body of research indicates that green infrastructure increases value:

- “In Boston, the 1330 Boylston complex . . . saw rent increases of \$300 to \$500 per month for units overlooking a \$112,500 green roof, soon netting about \$120,000 a year” (Burgess 2017).
- “High quality green environments can contribute to . . . rental uplifts of up to 20 percent” (UKGBC 2015).
- “. . . the assessed property values of the Menomonee Valley industrial properties were 5.8 percent higher than they otherwise would have been without green infrastructure” (Madison 2013).
- “Hedonic studies show that a reduced risk of flooding can result in a 2 percent to 8 percent increase in property values” (Clements 2013).

With such data emerging, cities seeking buy-in from developers may find that they’re standing on firmer ground. But Hacke offered a word of caution: as values rise, so does the risk of displacement. Cities must prioritize affordability, she said, and invest in projects that “protect the community’s ability to remain in place.”

All told, the project has resulted in an overall increase in values of \$2.2 million across 48 blocks in nine neighborhoods, a boost of about 7 percent. The work, which is still underway, includes tree planting, green spaces, and bicycle and pedestrian pathways.

One of the paper’s coauthors takes the concept a step further, suggesting that green infrastructure’s most tangible benefit may be that it protects against loss. “Financing urban climate adaptation through land value capture, in some respects, requires an inversion of the fundamental premise of the concept: rather than creating value, investments in adaptation serve to preserve value that would otherwise be diminished or paid,” said James Kostaras, senior fellow at the Institute for International Urban Development.

“Land value increases are attributable to investments in resilience measures such as the implementation of sustainable urban drainage systems, green corridors for flood management, restoration of natural floodplains, and multifunctional public space for recreation and stormwater management.”

In that framework, Kostaras suggests, “some increment of the land value that is being preserved and protected by climate adaptation interventions is mobilized as a source of funding to mitigate the impact of flooding and other climate-driven events.”

Properties in Miami that flood or sit near roads that flood have already lost \$125 million in value since 2005, according to research compiled in the online Flood IQ education initiative. Future losses will easily double that amount in the next 15 years, and that projection doesn’t include any new properties that become at risk from now through 2033 (First Street).

Seen another way, new private development in any area that is vulnerable to the impacts of climate change creates a burden for the public, because of the people and property in need of protection. As such, private-sector contributions to green infrastructure are more akin to developer extractions or impact fees, which have been charged to builders of conventional suburban development for decades to help pay for the extension of utilities to previously undeveloped areas.

NEW WAYS TO PAY FOR INNOVATION

In the reconsideration of the relationship between public investments and private development, resilience infrastructure may well become the most critical of city services, alongside police or fire protection, or water, sewer, and power facilities. Keeping water at bay has acquired an outsized importance. “There’s a centrality to it,” said Enrique Silva, director of International and Institute-Wide Initiatives at the Lincoln Institute.

Measuring the benefits of that infrastructure will be complex, Silva said. In most land value capture mechanisms, the impact of public investments is measured in a more linear fashion; for example, the land value “uplift” within a half-mile radius of a new transit station. With green infrastructure, the land value impact is spread across a larger ecosystem, potentially producing significant variation in terms of assigning financial obligations. Do the properties closest to the intervention benefit most, or do those a mile down the rivershed enjoy the protections just as much? Or should all land and property within a special “resilience district” be treated the same?

“One could argue it’s less complex with a new metro line,” Silva said. Governments, he said, will “have to make that call—defining the catchment area.”

For others, it’s an open question that natural systems are such a singular driver of increased property values. Miami developer David Martin, principal at the Terra Group, said he would like to see a “fixed funding source for infrastructure that’s not relying on macroeconomic forces that go up and down.” In his view, resilience infrastructure is one of several factors determining land value—others being things like low interest rates or the quality of the local school system.

Such calibrations are an indication of the hard work ahead, but the impetus to find new ways of financing climate action will remain strong. “The infrastructure funding challenges that local governments face are just too great to solve through business-as-usual solutions,” said Letsinger, from Quantified Ventures. “They’ll need to innovate their way up this mountain, and if we’re going to expect them to innovate, then we’ve got to give them new ways to pay for innovation.”

Letsinger and others emphasize both the urgency of building climate resilience and the real-time availability of solutions. “We don’t need to wait,” he said. “Cities now have the tools, the means, and the access to capital today to advance the resilience projects that they need.” □

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