

Civic Innovation Hub Supplemental Materials

A. Stormwater 101

1. EPA Definition of Green Infrastructure
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Environmental Protection Agency (EPA) Definition of Green Infrastructure

<https://www.epa.gov/green-infrastructure/what-green-infrastructure>

What is Green Infrastructure?

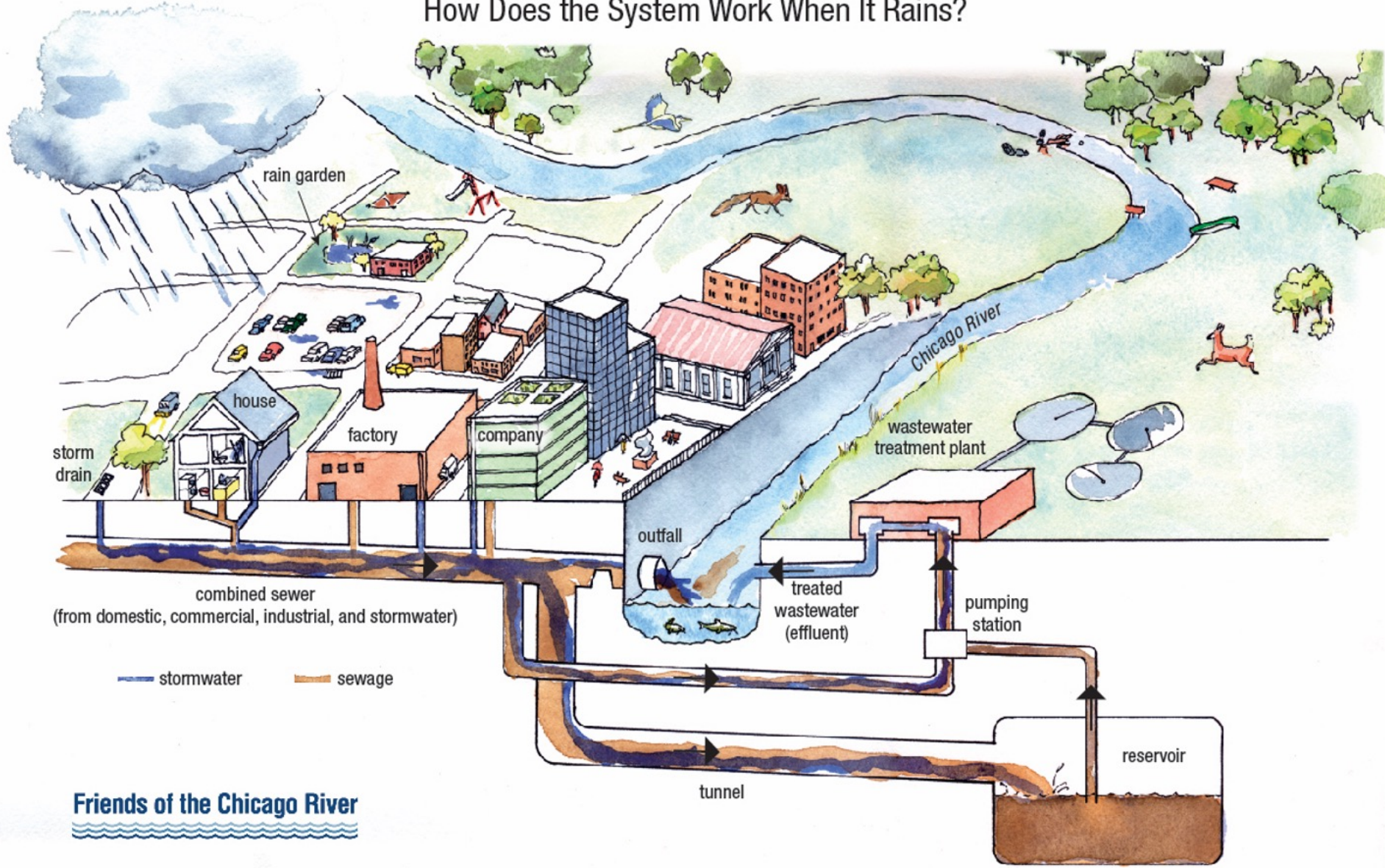
Runoff from stormwater continues to be a major cause of water pollution in urban areas. It carries trash, bacteria, heavy metals, and other pollutants through storm sewers into local waterways. Heavy rainstorms can cause flooding that damages property and infrastructure.

Historically, communities have used gray infrastructure—systems of gutters, pipes, and tunnels—to move stormwater away from where we live to treatment plants or straight to local water bodies. The gray infrastructure in many areas is aging, and its existing capacity to manage large volumes of stormwater is decreasing in areas across the country. To meet this challenge, many communities are installing green infrastructure systems to bolster their capacity to manage stormwater. By doing so, communities are becoming more resilient and achieving environmental, social and economic benefits.

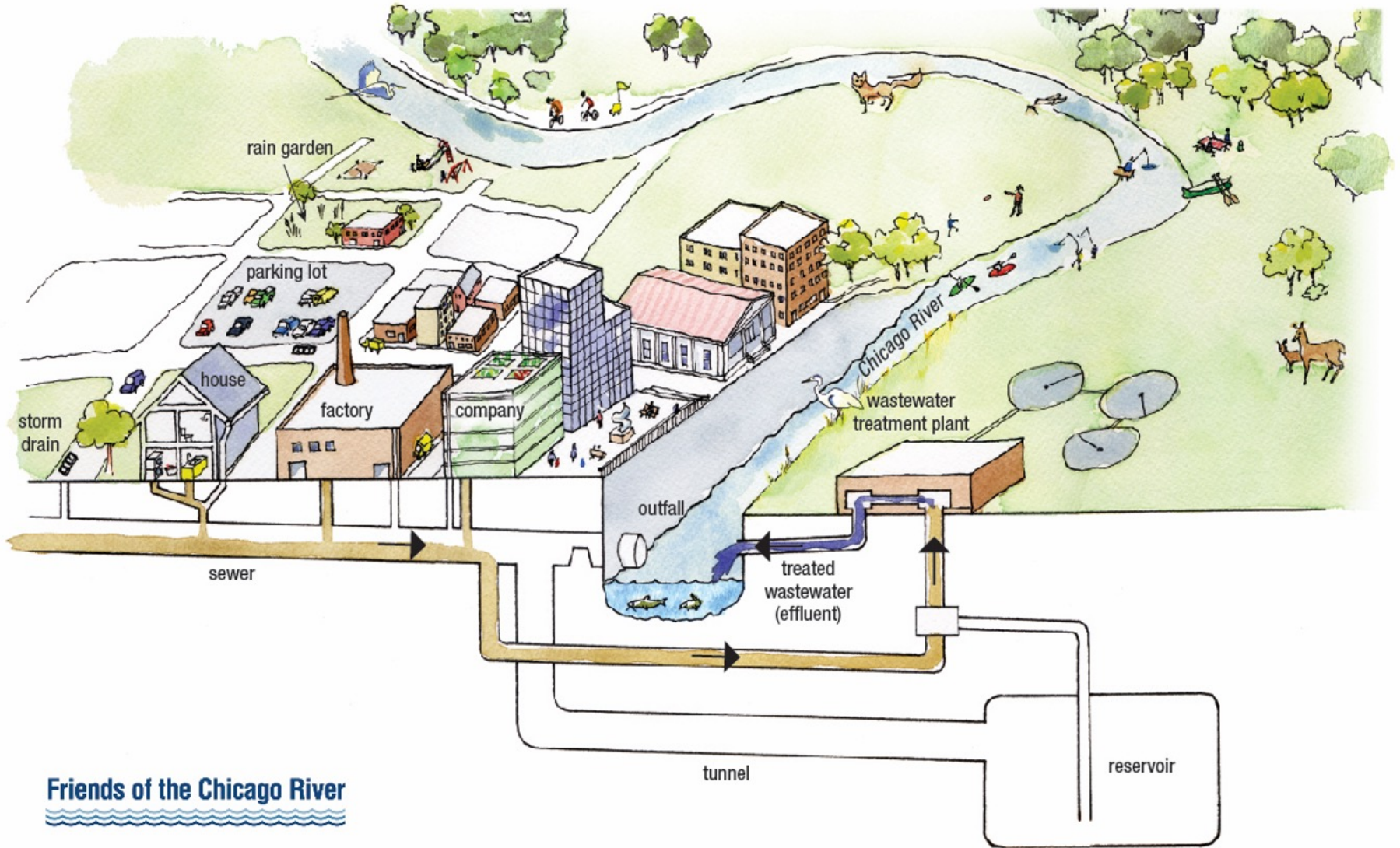
Basically, green infrastructure filters and absorbs stormwater where it falls. In 2019, Congress enacted the [Water Infrastructure Improvement Act](#), which defines green infrastructure as "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire stormwater and reduce flows to sewer systems or to surface waters."

Green infrastructure elements can be woven into a community at several scales. Examples at the urban scale could include a rain barrel up against a house, a row of trees along a major city street, or greening an alleyway. Neighborhood scale green infrastructure could include acres of open park space outside a city center, planting rain gardens or constructing a wetland near a residential housing complex. At the landscape or watershed scale, examples could include protecting large open natural spaces, riparian areas, wetlands or greening steep hillsides. When green infrastructure systems are installed throughout a community, city or across a regional watershed, they can provide cleaner air and water as well as significant value for the community with flood protection, diverse habitat, and beautiful green spaces.

How Does the System Work When It Rains?



How Does the System Work When It Is Dry?



https://www.bayjournal.com/news/pollution/green-stormwater-projects-less-likely-in-black-neighborhoods/article_d70ea1ec-da58-11ed-93e0-c3f5cf10c64b.html

Green stormwater projects less likely in Black neighborhoods

Jeremy Cox

Apr 14, 2023

In Butchers Hill, one of Baltimore's more affluent neighborhoods, a small patch of nature stands out in a landscape dominated by brick rowhouses, asphalt roads and other hard surfaces. The colorful sign planted in the soft earth identifies this corner of the intersection of East Lombard and South Chester streets as a "rain garden."

The city government, nonprofit groups and private developers have invested millions of dollars for the construction of hundreds of these and similar types of nature-mimicking projects over the past two decades. The primary purpose of this "green" infrastructure is to capture and soak up polluted stormwater runoff before it flows into the Inner Harbor and Chesapeake Bay.

It can also spruce up a neighborhood, said Amanda Phillips de Lucas, a Baltimore-based social scientist, as she knelt over the winter-brown plants in the Butchers Hill nook. "There's not a lot of trash," she observed, "so they're taking care of it."



The late Rocky Brown, a community association president in Baltimore, and Shannon Sneed, then a city councilwoman, were among the volunteers helping to replant a rain garden in the Fayette Street Pocket Park in October 2018. (Molly McCullagh)

Green stormwater infrastructure has long been cast as a win-win in big cities. But a recent line of research suggests that underprivileged communities are far less likely to see it. And a new study that exclusively examines Baltimore's efforts finds that the Charm City isn't immune.

More than half of the 712 green projects documented inside the city were installed by developers, who were required to do so to offset the environmental impacts of new building projects. In those cases, the study found that green infrastructure was nearly twice as likely to land in white neighborhoods.

Development-related green infrastructure projects were rare even in Black neighborhoods with higher incomes, the authors said.

Green infrastructure projects that were not related to development were typically constructed voluntarily by city workers or nonprofit groups. Those efforts were largely centered in neighborhoods whose populations were either wealthy and white or poor and Black, the analysis revealed.

“That just reflects two prongs of the way nonprofits operate,” said Joanna Solins, the study’s lead author and a University of California-Davis environmental horticulture adviser. “Some are really focused on trying to provide benefits for low-income and underprivileged communities. And some are focused on helping community groups and schools do these [green projects] themselves, and those projects tend to be in the whiter, wealthier areas.”

But the voluntary projects in under-privileged neighborhoods were relatively few and small in scope, the study found.

The paper was part of the long-running **Baltimore Ecosystem Study** and published in January in the journal *Landscape and Urban Planning*. The other partners in the research were the University of California-Davis and the U.S. Forest Service.

Their efforts produced the most comprehensive database of green stormwater projects in the city, enabling the researchers to categorize them by location.

Struggling to adapt

Interviews conducted by the *Bay Journal* with the study’s authors, local environmental leaders and the former head of Baltimore’s stormwater division portray a greening effort with well-meaning intentions but spotty execution. (A media relations representative with the city’s Department of Public Works said she was looking into possible interviews with current stormwater personnel but didn’t respond to follow-up messages.)

More than **45% of Baltimore’s landscape is covered** by pavement, rooftops or other impervious surfaces where rainfall cannot penetrate the ground. Decades of **stormwater research** suggest that water quality is considered severely degraded when impervious coverage is greater than 25%.

The city is crisscrossed by more than 100 miles of streams, but historically there were many more waterways. Development in the 1800s and early 1900s filled in and paved over many of them. They were replaced by a jumbled network of storm drains and pipes designed to capture rainfall and quickly shunt it to remaining waterways to prevent flooding. Much of that infrastructure is outdated and **rapidly deteriorating**.

When they began to be adopted in earnest across the country in the 1990s, green stormwater projects presented a promising solution. In addition to treating stormwater by allowing it to filter into the ground, greening the landscape could, among other benefits, provide recreation spaces and lower temperatures in asphalt-ridden “heat islands.”

But the rollout in Baltimore has been uneven, the sources said. The biggest obstacles included haphazard planning that has deepened pre-existing neighborhood inequities, poor coordination with community members and a dearth of funding for maintaining projects beyond the first couple of years.

These flaws often have implications for environmental justice.



Johns Hopkins University students, participants in the university's annual President's Day of Service, helped with the 2018 replanting of the Fayette Street Pocket Park rain garden in Baltimore. (Molly McCullagh)

For example, development-related green projects, which tend to occur more often in white neighborhoods, must be inspected to ensure proper maintenance every three years. There is no such requirement for voluntary projects.

Many of the voluntary projects are built with grant money. Some get funding to cover maintenance for the first year or so. But anything longer than that is rare. It usually falls to overextended nonprofits or individuals in the community to manage their upkeep.

As a result, voluntary projects are much more prone to failure, said de Lucas, a co-author of the study and researcher with the New York-based Cary Institute of Ecosystem Studies.

“A lot of places we had a location for, we’d get out and it was a dirt field,” de Lucas said.

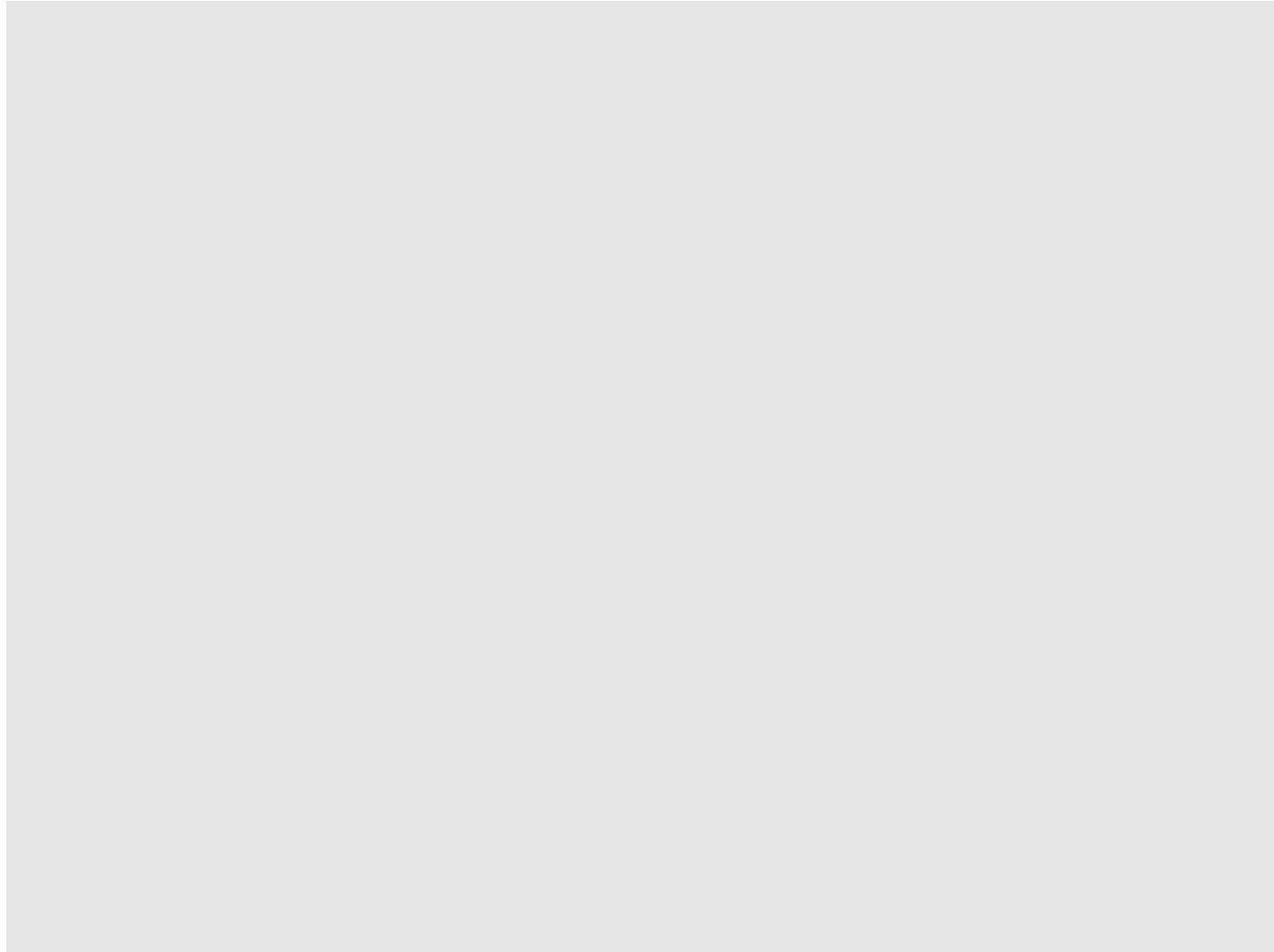
The study authors, citing a growing body of environmental scholarship, say that Baltimore’s inequities aren’t unique. For instance, **a separate study published in 2017** found similar disparities in Philadelphia, with Black and low-income neighborhoods receiving the short end of the green infrastructure stick.

Another analysis, which examined planning documents in 19 cities, showed that environmental justice was rarely factored into green infrastructure projects, accounting for barely 2% of the siting criteria language. Baltimore was among a handful of cities that explicitly incorporated the philosophy, though. One of the factors to consider in prioritizing a project, according to the city’s 2015 stormwater plan, is its “potential to address environmental justice.”

Still, the results of the latest Baltimore Ecosystem Study suggest that there remains a disconnect between the city’s plans and its actions, said Fushcia-Ann Hoover, the lead author of the planning-document study and a professor at the University of North Carolina-Charlotte.

“There is not as much alignment between the particular equity criteria when it comes to the actual planning at the site scale, where things are actually being placed,” she said. Hoover, who was not involved in the Baltimore Ecosystem Study, added that she was particularly struck by the finding that disparities persisted even in Black neighborhoods with higher incomes.

De Lucas cautioned that many community members and a sizeable number of experts don’t necessarily view such projects as “inherently a good thing.”



Amanda Phillips de Lucas, a social scientist with the Cary Institute of Ecosystem Studies, studied green stormwater infrastructure in Baltimore.

Dave Harp

If the projects thrive, they can contribute to a neighborhood's gentrification, putting economic stress on lower-income families, critics say. And if the projects are poorly maintained and fail — a result in about 25% of cases, according to a separate **citywide assessment** — they can become eyesores.

“It can empower one set of people while disempowering another set of people,” de Lucas said.

Fairness put into action

The racial disparity in green stormwater amenities would be far more glaring in the new study, the authors say, if not for a particularly large project constructed in the 2000s across nearly a dozen neighborhoods in west and southwest Baltimore.

Called the Watershed 263 project, it sought to inject nature into one of the city's most urbanized sectors, said Bill Stack, who oversaw Baltimore's stormwater management program at the time. No streams existed within the drainage area — just a hodgepodge of storm drains all leading to a single outlet, spewing untreated runoff into the Middle Branch of the Patapsco River.

As Stack saw it, here was an area where he could make an ecological and socio-logical difference.

“I wanted to focus on more of the inner city and the more disadvantaged neighborhoods that were more disconnected from the streams,” said Stack, now a senior adviser to the nonprofit Center for Watershed Protection. “It just seemed to be unfair to focus our restoration efforts on the parts of the city that had flowing streams where those people could take advantage of them.”

Stack enlisted the help of community members and a local group, the Parks and People Foundation of Baltimore, and began rolling out projects across the 930-acre project area. Participants planted trees, transformed vacant lots into verdant sanctuaries, removed asphalt from schoolyards and installed green infrastructure to absorb wayward rainwater.

From an environmental standpoint, **the consensus** is that water quality improved. But experts say it's unclear how much of that improvement was attributable to Watershed 263 or instead to separate efforts underway at that time, such as the repair of a long-running sewage leak.

“One of the lessons of that is it's very difficult to measure the influence of green stormwater infrastructure on nutrients,” Solins said.

Today, Watershed 263 is sometimes viewed as a cautionary tale. Steven Preston, a parks design manager with Parks and People, said organizers at the time should have worked harder to put community members at the center of the effort to help ensure stronger support for the project in the long term.

“When we put those practices in, we were only thinking about stormwater stuff, and they kind of sit in isolation,” he said. “That was a good teachable moment to us on a better way to do it, which is incorporating them into a larger green space plan.”



Trash collects in a rain garden in a tiny park in Baltimore.

Dave Harp

Watershed 263 was the city's first foray into green stormwater, Stack said. Missteps were almost inevitable. But future generations of planners and designers can learn from them, he added.

“When we would go to the community meetings, even though we had a lot of support, there was a lot of talk about [how] we're trying to improve the environment, [when] the real issues are jobs, crime and education,” Stack recalled. “There are other benefits that go beyond water quality, and in all good conscience I feel strongly that the investment to improve water quality has to be holistic and be associated with other benefits.”

The work ahead

The Baltimore Ecosystem Study researchers point out that their database isn't as complete as they would like it to be. To simplify the analysis, they excluded tree-planting efforts and stream restoration projects because they often cross neighborhood boundaries. Because of the lag time between the data collection and publication, the projects are updated only to 2019.

By its own account, the city has a large workload.

According to Baltimore's 2015 watershed implementation plan for the Chesapeake Bay, officials face a goal of treating stormwater runoff from 20% of the city's eligible impervious cover. That equates to nearly 4,300 acres of land. At the time of the plan's adoption, only slightly more than 350 acres of the city's jurisdiction qualified as properly treated.

To meet that new pollution reduction goal, the plan largely relies on a stepped-up street cleaning program. But it has identified dozens of potential targets for green stormwater retrofits, mainly consisting of stream restoration projects, tree plantings and the creation of small, park-like additions to streetscapes, like those in Butchers Hill.

Progress has been sluggish. According to the latest **project tracking report**, which was published by the city in 2021, 10 of the 85 projects have been completed.

Jeremy Cox

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