



Bagby Street detail

DESIGNED

... those rippling syllables have symbolized for me the bilateral extensions of the phrase “control of nature.” Atchafalaya. The word will now come to mind more or less in echo of any struggle against natural forces—heroic or venal, rash or well advised—when human beings conscript themselves to fight against the earth, to take what is not given, to rout the destroying enemy, to surround the base of Mt. Olympus demanding and expecting the surrender of the gods.

—John McPhee, from the essay “Atchafalaya”

Urban Design in an Age of Unrelenting Floods

BY ERIC LESHINSKY

Tax Day IT'S BEEN A VERY WET YEAR IN HOUSTON. THIS IS TRUE EVEN BY THE STANDARDS OF A CITY THAT HAS FLOODED WITH REGULARITY FOR AS LONG AS ANYONE CAN REMEMBER.

No day made this more apparent than April 18. Eight people lost their lives and nearly 7,000 buildings were damaged in what have become known as the Tax Day Floods. To see the events unfold through media coverage was to witness many of the same heart-wrenching scenes we've seen before—only this time a greater swath of the city, including areas that had never before flooded, was affected. And there was no hurricane to blame. This was merely a rain event, albeit one that brought some 240 billion gallons of water down in just 24 hours.

Houston deals with three types of flooding—tropical, riverine, and “everyday” flooding—and it's this last category that is happening with increasing regularity. This is a city that lives with flooding: shortly after its founding in 1836, nearly every structure of the settlement was flooded. But Houston has grown faster than any other American city in the last 50 years. With each passing year, the frequency of these “everyday” floods are making us question the standards used to designate 100-year and 500-year floodplains, which determine where we build, how much we develop this once expansive coastal plain, and just how much work still needs to be done to make the city safe from flooding.

TO FLOOD

Each new flood yields a flurry of finger pointing. “It's the developers' fault” is the most popular refrain in this city of relentless outward growth and minimal development regulations. We also hear that it's our politicians' fault for not creating the policies to keep development in check and preserve those landscapes that help absorb stormwater. Or it's the municipal agencies that have not been proactive enough in advising those politicians on best practices and the urgency to act. In general, the prevailing narrative is that not enough is being done to mitigate flooding. It's hard to argue with any of these perspectives, given the rising impacts from flooding, the city's long-standing culture of privileging growth at all costs, and our historical unwillingness to steer that growth in any way that would reduce the risk of flooding.

But there's another narrative that tends to get lost in the conversation that follows every devastating storm. What if the problem isn't that we have done too little to manage floods, but that we have not been smart about it? When was the last time you heard someone talk about Houston's \$4 billion network of drainage infrastructure? Its 2,500 miles of stormwater channels? Its 22 watersheds? There has been nothing if not a constant effort to redesign the landscape to better manage stormwater. But this effort has rarely yielded a more livable city. The struggle to safeguard the city from flooding has worked

at best independently of, and at worst against, other urban goals such as walkability, recreation, neighborhood preservation, access to parks, biodiversity, and public health.

Houston's governmental entities have been vigorous in applying flood control measures across the region, but they have not implemented them in the kind of coordinated way that could yield a truly resilient region. With no unified consensus across agencies, city departments, and elected officials to integrate flood control within policymaking, multiple goals collide: prime natural areas are paved for new development or bisected by roadways and utilities; oddly shaped detention basins are shoehorned into shopping mall parking lots; new master-planned communities feature massive entry fountains; and many Houston neighborhoods have drainage ditches but not sidewalks. Indeed, for many Houston residents, flood control is still heavily signified by the now abandoned Army Corps' policy of reducing bayous to concrete drainage channels—a policy designed to move stormwater out of the city at the expense of its most identifiable natural features.

The challenge of balancing flood control goals with other urban design goals is not insurmountable. The 1912 master plan prepared for Houston by landscape architect Arthur Coleman Comey did exactly that with its clear emphasis on leveraging the bayous for drainage and parkland, but it was never fully implemented. People critical of Houston's historically *laissez-faire* approach to development often remark that this is exactly what happens in the absence of sufficient planning. But Houston does plan for flooding. What would a more coordinated approach to flood control look like? What should it look like?

In the last two decades, we have finally started to envision an approach and can now point to numerous examples of flood control efforts across many scales that aim to achieve multiple goals. Though Bayou Greenways, led by the Houston Parks Board, has received the most attention, its goals of combining flood control with greater community amenities and mobility can be found in projects ranging from the Barker and Addicks Reservoirs in west Houston, to the parklike network of stormwater detention basins at Willow Waterhole, to the rain gardens that line Bagby Street in Midtown. These projects suggest how drainage infrastructure can become interwoven within the landscape of the city, producing to great effect the kind of urbanism that the majority of Houstonians want—what many landscape practitioners have recently begun to refer to as landscape infrastructure.

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PHOTOS BY PETER MOLICK

FROM TOP: Barker Dam, Willow Waterhole, Brays Bayou, and Bagby Street

FLOODPLAINS

Houston's original drainage infrastructure is its native landscape. The region's relatively flat, marshy coastal prairie, despite being endangered, still defines much of the Gulf Coast. Indeed, nearly every early visitor to the region described a landscape seemingly intended to flood by design. "This large district ... has, throughout, the same general characteristics, the principal of which are lowness, flatness, and wetness," Frederick Law Olmsted quipped in his travel diary on an epic trip across Texas in 1853. Houston is still low, flat, and wet, but less than 2 percent of its native coastal prairie remains.

After being drained for agriculture, cleared for timber, and ultimately filled in for development, what remains of our original drainage system is more often than not found in the region's lowest-lying areas. These places that during every rain event inevitably get inundated first are more commonly known as floodplains. Yet few of these floodplains are pristine. Our most visible floodplains, the vascular networks of bayous, have been channelized, reshaped, paved, compacted, and denuded of their native vegetation to support urbanization. Despite recent efforts to reclaim these bayous as natural features through Bayou Greenways, visitors are still more likely to see Houston as having developed in spite of its floodplains, not in accord with them. The historical transect of the region—vast pine and mixed hardwood forests leading to freshwater streams and rivers that course through expansive prairies and drain to bayous, terminating at a tidal marsh with the bay just beyond—can still be seen if you look close enough. But whereas these natural stormwater-absorbing features were once the prevailing vocabulary, they are now but the punctuation to a largely constructed landscape.

"We didn't know how wide our floodplains actually were until we had the technology to see them for what they are," explains recently retired Harris County Flood Control District (HCFCD) director Mike Talbott when asked why the city allowed development to happen in areas at risk of being flooded. Talbott points to the early 1980s as a key period of discovery. "Over two million people already lived in Houston,

but this was the first time the floodplains of Harris County were comprehensively mapped to understand their capacity for flooding."

Tellingly, many Houstonians' awareness of the floodplains is based on Flood Insurance Rate Maps (FIRMs), first released in the early 1980s, the signature product of the Federal Emergency Management Agency. Considered the standard for mapping flood hazards in communities across America, FIRMs have successfully educated property owners. Yet they have failed to provide a deeper understanding of how floodplains work or their importance as a remnant of our natural drainage system. For most informed homeowners, reading a FIRM is a lesson in what to avoid, not what to embrace. Any positive sense of how floodplains function ecologically is not their goal. In many respects, it's too late to undo much of what we've done to alter the floodplains. But as we work today to retrofit Houston to accommodate the next flood, everything we do, every tool, policy, or program we deploy, simulates ecological functions—how the native landscape of the region once worked.



Fishing the release of Buffalo Bayou from Barker Dam



Barker Dam detail



THE VIEW FROM BARKER AND ADDICKS

Standing atop the monumental levee structure at the Barker Reservoir, you can't see anything remotely resembling ecological functions. What you do see is see a quintessential Houston landscape: to the east are the six lanes of Highway 6 flanked by low density and undifferentiated strip malls, walled-off residential subdivisions, massive parking lots fronting the highway, anonymous midrise office buildings, and billboards. To the west is the reservoir, which might surprise those expecting a pristine lake. Just beyond the reservoir's control structure, you see a remnant of Houston's native landscape—degraded coastal prairie mixed with riparian forest, albeit one now wrapped in an earthen levee—and a body of water whose level fluctuates dramatically as regulated by the Army Corps. Standing at this spot in the weeks following the Tax Day Floods, you would have seen record levels of water released from the reservoir, rushing through the gate structure into Buffalo Bayou at more than 2,000 cubic feet per second (cfs). With base flow on the bayou typically in the 100-200 cfs range, it took more than two months to bring the reservoir back to normal water levels.

The dam at Barker Reservoir and its nearby twin at Addicks Reservoir are monuments to Houston's decades-long battle to control flooding by redesigning the landscape. Rising up incongruously from the flatness, these were the first of many engineered landscapes initiated following the devastating floods of 1929 and 1935, which led to the creation of the HCFCO by the 45th Texas Legislature. Conceived as a signature part of the Buffalo Bayou and Tributaries Project (BBTP) and designed to protect Downtown from future floods rushing along Buffalo Bayou, the dams have been quite successful over the last 65 years. By providing approximately 410,000 acre feet of stormwater detention, the reservoirs have also effectively replaced the ecological functions of Buffalo Bayou, which once provided an equal amount of storage in its floodplain. The Army Corps estimates that the reservoirs prevented nearly \$5 billion in damage and protected more than 24,000 residential and commercial structures during the Tax Day Floods. Of course, the collateral impact of the dams has been the explosive growth of development in west Houston, in close proximity to Buffalo Bayou and fully surrounding the reservoirs.



“I had a real estate agent tell me that home lots backing up to the reservoir were selling better than those backing up to a golf course,” Richard Long says. As the Army Corps’ natural resources manager for the reservoirs, Long has become a natural spokesperson, with his 35 years of experience and down-to-earth manner. Those greater sales have less to do with the safety afforded by the reservoirs than with their enormous value as community amenities. Though recreation, access to nature, and habitat preservation were never considered goals for the reservoirs when Congress authorized them in the 1940s, these aspects are highly valued today. “We’ve seen times when moving water was more important than preserving land,” says Long. “Right now, we’re seeing an interest in preserving land.”

The only problem is that the Army Corps doesn’t have a mandate to manage parkland. They rely instead on signed lease agreements between the Army Corps and Harris County, Fort Bend County, and the City of Houston to allow for reservoir acreage to be used as parkland, though Long acknowledges that every acre is designed to flood. Still, visitors to these parks—Bear Creek Pioneer Park and George Bush Park within the Harris County parks system, Cinco Ranch Park within the Fort Bend County parks system, and Cullen Park within the City of Houston parks system—will never know they are prone to flooding except during a downpour.

Back at your spot atop the Barker Reservoir levee, you can see only a fraction of this parkland, but the area is buzzing with visitors, on foot and on bikes, either running up the levee steps or jogging and riding along the maintenance road. What brings many of them is not just the pleasure of climbing a hill in a city as flat as Houston, or watching the rush of water flowing from the reservoir, but a popular trailhead built by the Army Corps. The trailhead—a large parking area with wayfinding—links the reservoirs to a regional trail system along Buffalo Bayou and through Terry Hershey Park, the namesake park of Houston’s most well-known environmental activist who, ironically, fought to save the riparian character of the bayou whose flow is forever controlled by the dams just upstream.

In recent years there has been considerable discussion of the use of so-called “non-structural measures” to minimize the impact of urban development on flood flows, and to reduce the structural measures that would otherwise be required to accommodate increased flood flows. These measures are generally considered to include, but not necessarily be limited to, the following: Retention Ponds, Detention Ponds, Rooftop Storage, Parking Lot Storage, Porous Pavement, Grassed Swales, Etc.

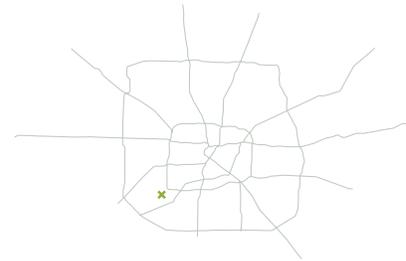
In most cases, of course, these measures involve some “structural” construction techniques, and are only “nonstructural” insofar as they avoid modifications to the stream itself. The term “structural” should be generally considered as meaning a concrete-lined or covered facility.

—Excerpt from letter by former HCFCD Director James B. Green to the Harris County Commissioners Court explaining changes to the agency’s drainage policy, November 1980

MEET ME AT WILLOW WATERHOLE

South Willow Drive seems a world away from the Barker and Addicks Reservoirs. Indeed, we crossed watersheds as we went from Buffalo Bayou to Brays Bayou, and after heading south from The Galleria, we are now in Westbury. Navigating this small side street that connects South Post Oak to Chimney Rock, you’d never expect to see the massive ponds that constitute the Willow Waterhole Stormwater Detention Complex. Developed by HCFCD, but managed jointly with the Houston Parks and Recreation Department and the Willow Waterhole Greenspace Conservancy, the network of parks, trails, and habitat areas is less dramatic than Barker and Addicks Reservoirs but still one of the best examples of drainage infrastructure as a community commons.

In the 1980s, a variety of circumstances set in motion a policy shift that would have a catalytic impact not only on how landscape changes in the interest of flood control could be deployed across Houston, but also on their relationship to surrounding communities. In the late 1970s, Hershey, the nascent Buffalo Bayou Preservation Association (now Bayou Preservation Association), and then U.S. Representative George H.W. Bush worked together to save Buffalo Bayou from being reshaped in concrete. But the 1989 creation of Terry Hershey Park along Buffalo Bayou had more to do with the intensifying demand



for more parks, trails, and general recreation opportunities in Houston’s expanding west side. State legislative action provided new allowance for trails along flood control easements and Congress passed the 1986 Water Resources Act that enabled the Army Corps to work with local partners on flood control projects. By bringing community input to major infrastructure projects, the 1990 Sims Bayou Federal Flood Damage Reduction Project became the first effort to treat flood channel improvements along a bayou as more than infrastructure by also creating a greenway amenity for surrounding communities. Many of the bayou enhancements we now consider commonplace—planted banks and paved trails, interpretive signage and seating areas, preserved or restored habitat areas, and destination parks sited strategically at stormwater detention basins along the trails—were first tested on Sims Bayou.

But it was the drainage policy and design proposals of former HCFCD director James B. Green that had the most transformative impact

WITH ITS WETLAND SHELVES, NATIVE PLANT PALETTE, “NO-MOW” AREAS, SINOUS TRAILS, AND REFORESTATION THAT CLIMBS THE BANKS, WILLOW WATERHOLE BUILDS ON THE ART STOREY PARK PROTOTYPE.



The Westbury Cross Country Classic race and fun run at Willow Waterhole



THE HOUSTON OF TOMORROW

Successful as many of HCFCD's basins have been at combining drainage needs with other urban goals, many working on the frontlines of flood control readily acknowledged that this tactic might have run its course. "We're running out of land," recently retired HCFCD director Mike Talbott says. "Or the land that's available is far too expensive."

Meanwhile, an ever growing and densifying Houston continues to attract new residents, many of whom have little knowledge of just how badly the city floods. When I asked Talbott and others what the Houston of tomorrow will look like, all agreed that the city will be retrofitting itself to better manage flooding. For Stephen Costello, Mayor Sylvester Turner's newly appointed Flood Czar, retrofitting is not scale-dependent. Costello is planning to launch a study of all possible open space sites across Houston—schools, parks and recreation facilities, and utility easements are the principal opportunities—that could be modified to detain more stormwater. He's also quick to mention a potential "gray to green" program that would give businesses incentives to adopt the well-proven Low Impact Development (LID) strategies—what many now call green infrastructure. The aim is to replace impervious ground cover with treatments that allow stormwater to percolate naturally into the ground, either detained for a brief period or retained for re-use. "But what kind of incentive would you give to a car dealership?" Costello asks, implying that voluntary measures, no matter how generous the incentive, might not get the job done.

The question remains: Will this improvement of the city be limited to reducing flood risks, or will it leverage the inevitable landscape enhancements to improve Houston's urban experience? The answer to this question will rest on the willingness of our elected officials to integrate the principles of LID into new guidelines. John Blount, as Harris County's director of Public Infrastructure, has become the region's most visible proponent of LID. With Storey, Talbott, the Harris County Commissioners, and the advocacy group the Houston Land/Water Sustainability Forum, Blount was instrumental in drafting the *Harris County Low Impact Development and Green Infrastructure Design Criteria for Stormwater Management*, now considered a keystone policy document.

Yet for many regional civil engineers of Blount's generation, LID is still something of a new religion. He recounts his own conversion years ago when a developer connected him to Larry Coffman, the foremost pioneer of LID. Blount's first reaction to the idea of designing surfaces that would allow stormwater to percolate naturally was disbelief. "Do you have any idea how bad the clay soils are in Houston for natural drainage?" he said. But when he realized that LID is more about slowing down the flow of stormwater, the logic became clear. Since then he has helped many others—especially developers—see the value in the approach. If there is one thing holding back LID from wider application, he says, it's the Texas Commission on Environmental Quality (TCEQ) and their longstanding unwillingness to offer developers the same reimbursements for LID improvements that they would get for conventional solutions.

during those years. His letter to the Harris County Commissioners Court holds the seed for much of the landscape infrastructure that defines Houston today. Detention basins were once seen as an untested idea that could have unintended consequences, offering at best a temporary fix. Finally, though, the straightforwardness of the concept—undeveloped tracts of land are purchased, excavated into deep craters with inflow and outflow channels, and intentionally flooded with overflow from bayous and other tributaries during peak storm events—proved to be not only highly effective for flood control but also highly adaptable. As Houston grew, and more and more impervious surfaces pushed larger volumes of stormwater toward the bayous and their tributaries, it became clear that they could not carry it all. Harris County policies filled the gap by requiring on-site stormwater detention for all new roadways and any new construction larger than five acres. Houston's landscape is now replete with basins of all sizes and in places you might never expect.

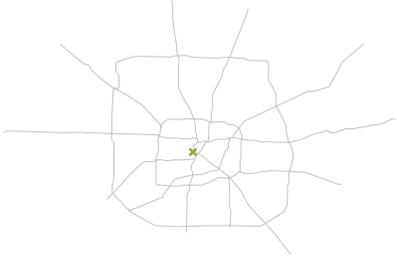
In 1997, when Arthur Storey Park opened in the Brays Bayou watershed near the intersection of Beltway 8 and Bellaire, it was the first wet-bottom detention basin developed by HCFCD. Named for Jim Green's successor, the park reflected Art Storey's interest in marrying the functional requirements for drainage infrastructure with human (and ecological) needs. In essence, creating a dedicated lake within the detention basin presented the opportunity to address the area's broader ecology. The park was the culmination of years of advocacy to create the kind of "nonstructural" infrastructure that Green first promoted. Designed by Kevin Shanley of SWA Group, who spent years fostering interest in this type of high-performance landscape and is now retired, the basin became as much a park as a piece of drainage infrastructure. Today, Art Storey Park is a prototype for ambitious, multi-use detention basins developed by HCFCD across Houston. They, too, have become hubs for habitat restoration and open spaces for the community.

With its wetland shelves, native plant palette, "no-mow" areas, sinuous trails, and reforestation that climbs the banks into new upland plateaus, Willow Waterhole builds on the Art Storey Park prototype. The creation of islands as bird habitat supports an astonishing range of species. It also revolutionized the concept of detention basin as park by infusing it with stewardship from a diverse network of local residents and neighborhood and environmental organizations, notably the Willow Waterhole Greenspace Conservancy, Brays Bayou Association, and Houston Audubon. An impassioned community base now sustains and programs Willow Waterhole all year, organizing cleanups, plantings, workshops, and even regular wildlife inventories.

The result is a landscape that has quickly become an urban place, a hub of activity, and a model for other detention projects. You'll find few parking spaces here, which is odd for a park in Houston, especially one that is 300 acres, but this is a testament to how integrated it is with surrounding communities, just a walk or bike ride away.

PHOTOS COURTESY WILLOW WATERHOLE GREENSPACE CONSERVANCY AND PETER MOLICK





BAGBY STREET

One place that has been retrofitted for greater stormwater capacity in a way that enhances urban livability is Bagby Street in Midtown, which remains one of the best applications of LID in the region. Constructed in 2013, the LID rain garden and biofiltration areas are so integrated with the other components of the street that the typical pedestrian might not notice them. They might not see that 33 percent of the stormwater enters the rain gardens, which keep 75 percent of the bacteria, 73 percent of the phosphorus, 93 percent of the oil and grease, 43 percent of the nitrogen, and 85 percent of the total suspended solids from leaving the site. What they will notice are beautiful, thriving plantings, selected for their ability to absorb water, and custom street furnishings designed to help pedestrians along—including short footbridges across the rain gardens and educational environmental graphics.

Former Mayor Annise Parker signed her Complete Streets Executive Order in 2013 for street designs that both support all modes of transportation and integrate green infrastructure. Many saw Bagby Street as the inevitable model—and not only because she made the announcement at the Bagby Street ribbon-cutting. After all, it's also one of Houston's most walkable streets. It boasts active ground-floor retail, an unusually diverse mixed-use character, and a generous pedestrian right of way. It's almost un-Houston-like in its outwardly urban design. However, in many ways Bagby was designed as a high-visibility demonstration project rather than as a model for every street. Its success has had a lot to do with its primary patron, the Midtown Redevelopment Authority, which covered the cost of the design, construction, and ongoing maintenance. And the four firms collaborating on the street's design had already worked hard to promote LID throughout Houston: Walter P Moore, Design Workshop, Asakura Robinson, and Construction Eco-Services. (Disclosure: I became an employee of Asakura Robinson after the completion of the project.)

Not every project can expect to have the same success. Many current streetscapes lack the minimum five-foot width for pedestrians, let alone the six feet needed for Bagby's substantial

rain gardens. And even with sufficient space in the right of way, rain gardens might not be the best use of space in a tight urban context. Where Bagby Street does create a precedent, though, is in its placement of drainage infrastructure and pedestrian infrastructure on equal footing. Neither undermines the other. It could be said they even complement each other. Think about that in the context of a typical residential street in Houston, where a drainage ditch claims the street edge with no additional provision for walking or parking.

As we continue to retrofit the city, this basic ethic of recalibrating how we situate drainage improvements in the context of urban space is a good place to start. Streetscapes are not the only opportunity. Think about the number of surface parking lots that dominate the landscape. Houston's reliance on the automobile for much of its history has produced an urban landscape with far more impervious coverage than its low-density development patterns would seem to require. And because the city is veined with waterways, the places where sheet flow of stormwater could be mitigated are numerous. Just look around.

Despite a two-year downturn in the oil and gas economy, Houston continues to expand outward, claim more land for development, absorb additional population, and even add density in some places. History has shown that this growth will produce more flood damage when the next rain event hits. But a growing inventory of flood mitigation projects, collaborations between multiple partners with diverse goals, has proved that greater coordination can lead to a multifunctional urban landscape. As the ambition of Bayou Greenways suggests, what's at stake is not so much flood resiliency as it is true urban resiliency. Faced with a very similar challenge in recent years, New Orleans took the bold step of creating a visionary Urban Water Plan that marries the need for flood protection with enhanced urban amenities. Its proposed implementation cuts across multiple communities, agencies, and jurisdictions, but provides a common goal for all to work toward. What could Houston do with such a plan? Based on the resources committed to flood control since 1937, it seems just about anything. 



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PHOTO COURTESY SEATTLE.GOV

Seattle Street Edge Alternatives pilot on Broadview that integrates drainage, traffic calming, landscape, and pedestrian infrastructure, 2001