REENGAGING THE LAND AT THE GEORGE W. BUSH PRESIDENTIAL CENTER

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INTRODUCTION

In planning the George W. Bush Presidential Center in Dallas, Texas, former First Lady Laura Bush presented a very clear vision of what the Center should epitomize: "Because George was the first president of the new millennium, I wanted it to be forward and modern."[1] For the president and Mrs. Bush this meant making the building and landscape environmentally responsible, beautiful, and welcoming. In particular, their love of native Texas landscapes was an important framework for transforming the project's urban site into a park that was sustainable and *experientially rich for visitors. Sustainability was addressed from the start with smart planning that privileged contiguous parkland over impermeable surfaces and structures. Simultaneous consideration of every landscape component—-stormwater, plants, soil, topography, and more—netted cohesive natural systems that are better able to succeed with short-term establishment and provide enduring long-term health, the ultimate goals for a sustainable landscape.*

KEYWORDS

presidential libraries, parks, sustainable landscapes, stormwater management, cistern, irrigation tank, forebay, bioswale, native ecologies, native plants, prairies, meadows, planting soil, Texas

NEW ASPIRATIONS FOR A PRESIDENTIAL LIBRARY

Presidential libraries are a relatively modern idea. Anyone nearing age 75 was alive when the first, Franklin Delano Roosevelt's library at Hyde Park, New York, was dedicated in 1941. This library was born out of necessity (FDR learned that the nation's archives were in disarray and worried about the fate of his presidential papers[2]), but with the building of the George W. Bush Presidential Center (GWBPC) in Dallas, Texas, presidential libraries have come to reflect something new—a response to the public's growing aspirations to see that buildings and landscapes are made sustainable. This is a significant departure from the landscapes of past presidential libraries with their traditional, less sustainable features like sweeping mown lawns, large paved plazas, irrigation fed by potable water, spray water features, high maintenance flower gardens, and super-sized parking lots. Michael Van Valkenburgh Associates, Inc. (MVVA), the landscape architects for the GWBPC, were afforded, by this shift in thinking, a

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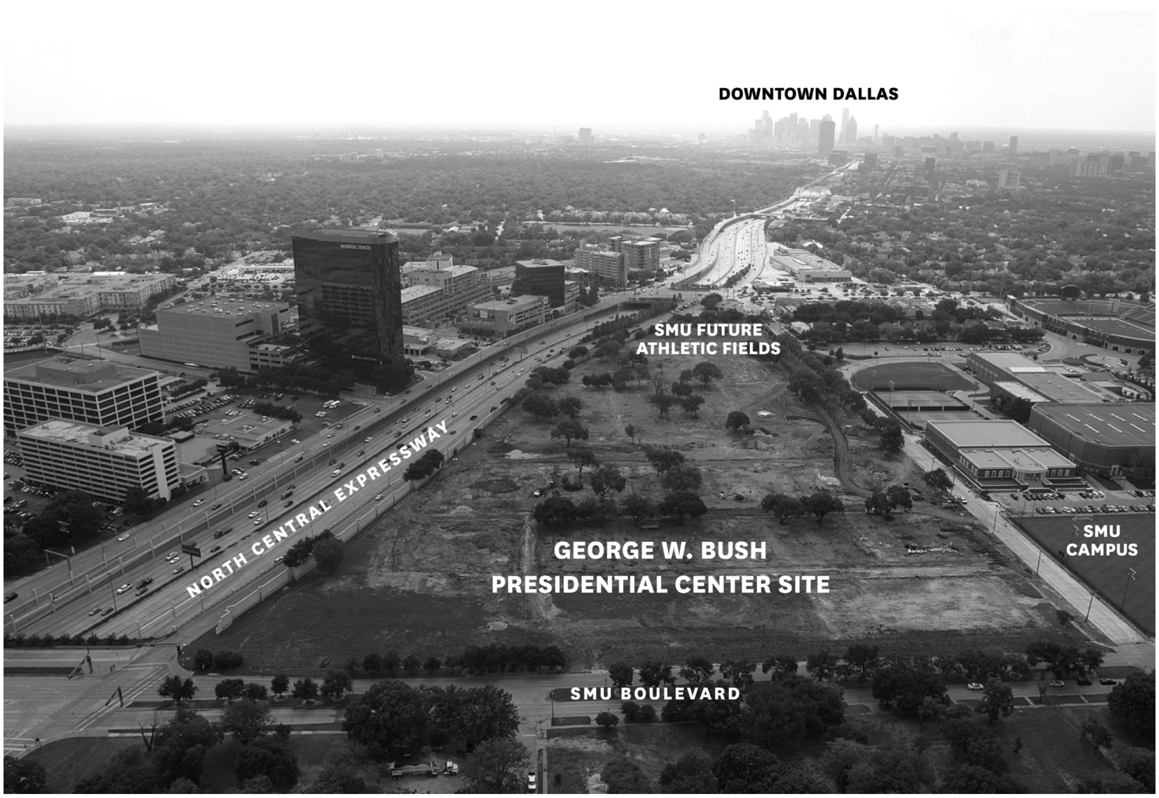
singular opportunity to work with President and Mrs. Bush to make a landscape embedded in environmental performance (with no lessening of experiential quality).

The privately funded George W. Bush Foundation (GWBF) paid for and oversaw the GWBPC's design and construction, but it also had to meet the standards of the National Archives and Records Administration, the federal agency responsible for the administrative establishment and aftercare of all presidential libraries. Before hiring MVVA in 2007, the Foundation selected Robert A.M. Stern Architects to design the GWBPC and to guide it toward Platinum Certification, LEED's highest sustainability rating. Set adjacent to Southern Methodist University (SMU), Mrs. Bush's alma mater, the building is made of brick and Texas Cordova Cream limestone to complement the historic American Georgian character of the SMU campus. It sits low to the ground and in Bob Stern's words, "does not overwhelm. It is dignified. But it does not hit you over the head with its monumentality."[3]

UNDERSTANDING THE SITE

For MVVA, the work of design always begins with the site itself, because every piece of land has particularities that must inform design and technological decisions. The 23-acre site is bordered by Southern Methodist University (SMU) to the west and by the North Central Expressway (US-75, depressed by 28 feet) to the east. The lot is cone shaped, with the wide end facing north to a residential zone and the narrow end on the southerly boundary, where it adjoins SMU recreational fields. Bisecting the northern end is SMU Boulevard, which serves as one of the campus's main entrances (Figure 1).

FIGURE 1. The existing site was flat and featureless, a remnant of many years of urban development.



Once a Blackland Prairie, the land was degraded by a succession of uses including athletic fields, post-WWII housing, and parking lots, leaving behind disturbed and dysfunctional natural systems. The parcel was open and windswept, battered by the roar of traffic, but also surrounded by stable academic and city neighborhoods. The Dallas skyline was clearly visible, a punctuation in the ever-present and fantastic Texan "big sky." The topography was a plain sloping 25 feet north to south, giving it great solar orientation. Natural features were absent, and while many trees were not thriving, some were healthy enough to transplant. Planting soil was sparse and mostly black clay. Overall there was little to preserve but also little to confine our thinking.

THE IDEAS UNFOLD

An initial design meeting with any client always stirs up some nervousness, but even more so when it takes place around a coffee table in the East Wing of the White House. At that first meeting Bob Stern, his partner Graham Wyatt, Michael Van Valkenburgh, MVVA project manager Herb Sweeney, Marvin Bush, and Mrs. Bush huddled around a study model and plan diagrams to discuss the appropriate location for the building. All agreed that the Bush Center's grounds had to provide a dignified setting for the building and space to create a publically accessible park. President and Mrs. Bush wanted the GWBPC to contribute to and be a part of the everyday life of nearby communities—the neighborly thing to do.

Establishing a program for the site was much more nuanced than analyzing its physical attributes. There were requisites like parking spaces for 400 cars, securing the building perimeter with crash-rated barriers set 100 feet away from the building, providing a separate entrance for dignitaries, and integrating bus parking and a service area. With the SMU athletic fields nearby, there was no need for an "active" area on the grounds. An amphitheater and event lawn were wanted, but those would be intermittently used and not the focus of the park. Above all, everyone agreed that the site should provide a unique experience in the city, one that would engage all the senses and be unlike any nearby open space.

Early discussions with Mrs. Bush revealed that she and the President had restored an 80-acre native prairie on their Prairie Chapel Ranch in Crawford, Texas.[4] Even before this Michael Van Valkenburgh was drawn to the native landscapes of Texas and research on them had already begun in our office. We learned that the Blackland Prairies stretched north-south in Texas from San Antonio to Oklahoma's Red River and were part of the much bigger True Prairie ecosystem.[5] Unfortunately, the magnificent Black Prairies were first diminished by 19th century agricultural development, the discovery that the rich black soil was especially suited for growing cotton, and then by the reach of the railroad that allowed export of bison, an important member of the prairie food chain. Today less than 1% of the original Blackland Prairies exist in the state.[6] Of the ten different eco-regions in Texas, Dallas is within overlapping zones for three: Post Oak Savannah, Cross Timbers Forest, and Blackland Prairie. The thinking about the landscape began to coalesce around these native ecologies.

FINDING A FITTING ORGANIZATION FOR THE SITE

Smart and sustainable site design begins with the proper placement of structures and paved areas. The wrong locations create a fragmented landscape with poor ecological resilience because isolated patches preclude a systems approach for overland drainage, shared rooting volumes, contiguous habitat creation, species diversity, disease resistance, pavement reduction, and maximization of human comfort and positive experiences. The size of the Bush Center's building proved to be challenging because displaying papers and artifacts is just one of its many functions. It also has an institute for post-presidency pursuits, archives, meeting rooms, food service, offices, reception and hospitality areas, an auditorium, a secure parking lot, service areas, and more. All this resulted in a 2.6-acre building footprint, which left 20.4-acres for roads, parking, and the park. Required parking spaces for 400 cars meant that nearly 4 more acres would be taken from the park. In a tour of four other presidential libraries, we noticed that parking lots were used far below capacity. Mrs. Bush supported reducing car spaces to 265, because nearby garages could accommodate more cars during special events. Over an acre of impermeable pavement was no longer needed because of this reduction.

So where to put the GWBPC building and parking? Working closely with RAMSA, MVVA developed a site plan that located the building and parking at the wide (north) end of the site, where both face SMU Boulevard. This arrangement left 14 acres of open land around the building for creating the landscape. Consolidating the largest impervious surfaces at the highest elevations (north) meant that water could be collected and transported by gravity to the lower contiguous parkland. Another benefit of this siting was that it allowed tucking one story of the building into the slope, minimizing its impact. The museum and library's entrance became a single story where it greets visitors (and neighbors), but the building has three floors (including an upper floor only on the southern portion) where it faces the park, so the lowest exit into the park is at grade. The building's largest façade is visually subdued and balanced by the park (Figure 2).

FIGURE 2. Aerial looking east, 15 months after the dedication. SMU Boulevard and the parking are located north, preserving a large tract for the park behind the GWBPC building.

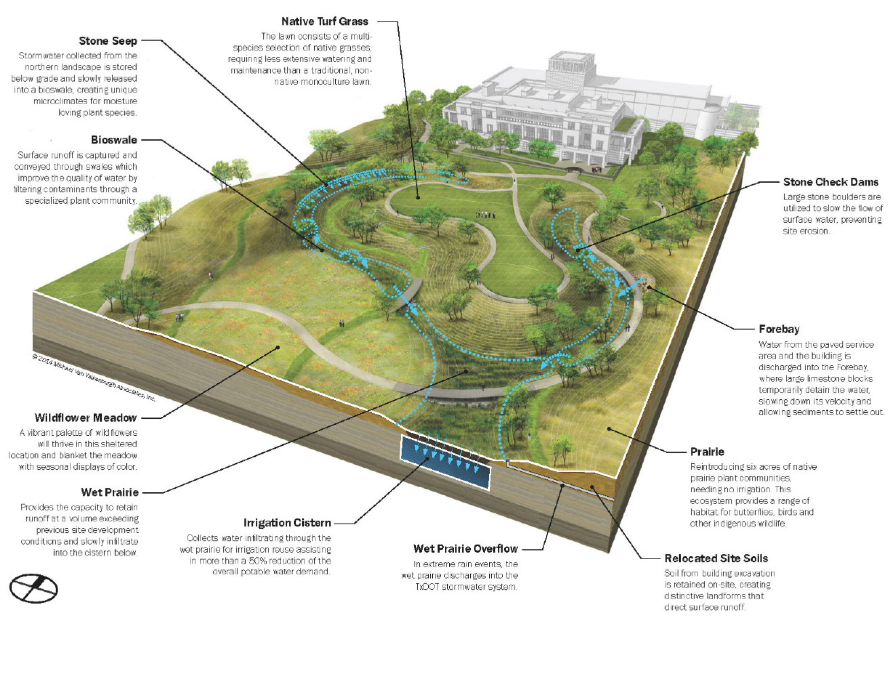
As the SMU grounds and the adjoining city expanded, SMU Boulevard was added as new campus entrance around 1970. Not nearly as grand as the original Bishop Boulevard entrance, it resulted in an unimpressive arrival experience for drivers. In meetings with GWBF and SMU, MVVA demonstrated that there was an opportunity to realign the road horizontally and vertically so that views of the campus would be slowly revealed to visitors while also giving a more dignified setback for the GWBPC. A median with street trees was added so that eventually the views would be framed and shady, like the most cherished spaces on the SMU campus.

THE MATRIX FOR A SUSTAINABLE LANDSCAPE

Native landscapes evolve over millennia in response to a region's dominant physical and biotic processes.[7] Soil, water, climate, and topography create the circumstances that allow particular plant species to thrive, which in turn creates forage for animals and supports the behaviors of predator and prey. Design success requires a deep understanding and management of hydrology, plants, and topographic form as separate but related systems. At the GWBPC, success resulted from water conservation strategies, native plant palettes, re-using 100,000 cubic yards of excess dirt, and importing 3,900 tons of manufactured planting soil. All these components were equally important and simultaneously in play for the formation of a landscape that is ecologically diverse, environmentally sustainable, and experientially engaging in every season. It was impossible to consider one component without the others (Figure 3).

Establishing native landscapes within a relatively small site presents ecological challenges. Although the Bush Center's site is ample by park standards, it is tiny compared to most indigenous landscapes. Wildlife corridors on a small site are constricted, and if animals can't move safely, their diversity becomes limited, and with reduced species, the all-important food chain is broken. Placing the park in the widest possible area of the park's land begins to address this problem. Plants too are vulnerable at the GWBPC site, which contains fewer species in

FIGURE 3. Plants, hydrology, and topography create a landscape that supports prairie, meadow, and upland ecologies while providing dynamic seasonal experiences.



smaller quantities than there are in the wild; a pathogen that does isolated damage on a big site could wipe out an entire plant population here. Invasive plants spread more rapidly on a small site because there are fewer natural "breaks" that can thwart undesirable plant growth. Additionally, the edges of native landscapes are variable transition zones that may not have the full complement of conditions needed by plants and animals. Edges are more vulnerable to disturbance in urban settings, due to foot and vehicular traffic, so wildlife tends to stay away from them, reducing the size of the fully-functioning site even more. Plants at site perimeters may get trampled, but the greater threat is soil compaction that compresses pore space and impedes root growth. At GWBPC, a lawn buffer zone lessens this, as does having park entrances away from important plantings. Tall earth berms shield interior spaces for wildlife habitat and steep banks prevent compaction by discouraging shortcuts through plant zones.

A STUDIED APPROACH TO NATIVE LANDSCAPES

Making successful landscapes means hedging one's bets, often by seeking out expert advice. Before MVVA committed to any ecology, we hired the Lady Bird Johnson Wildflower Center to be our native plants subconsultants, and all of us met with native plant experts at many natural sites within the North Central Texas region. Fortunately, we found a range of conditions that could be reinterpreted at the scale of our site, from closed savannah and woodland ecosystems to prairie grasses and forbs, as well as features like limestone escarpments eroded by dramatic drainage patterns. Park design focused not on replication but on using aspects transferrable to a relatively small urban site. Creating expansive prairies was not possible, but creating enclosed savannah and woodland conditions was—conditions equally if not more beautiful than a boundless sea of grasses (conditions that, in addition, provided a range of habitat for wildlife) (Figure 4).

Selling design and technological innovations is not always easy and, in an effort to confirm our approach and set expectations about the performance of native planting strategies, MVVA led the making of an 8,150-square-foot mock-up that included subgrade fill from the project site, specified planting soil, erosion control systems, plantings, shade structures, irrigation, and a weather station. Located off site, the mock up replicated the proposed slopes, was oriented with a similar solar aspect, and had a swale at the toe of the slope to test

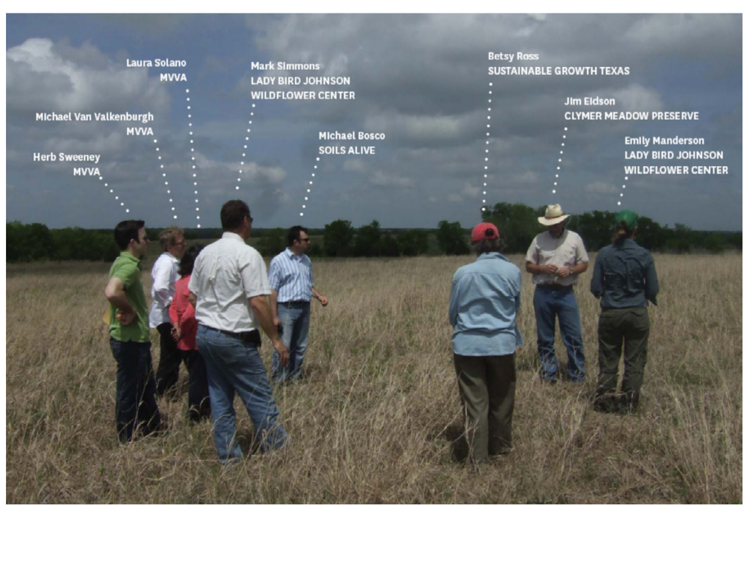


FIGURE 4. The design team worked with local experts to better understand native landscapes, including the 1,400-acre Clymer Meadow Preserve, one of Texas's largest and most diverse remnants of the Blackland Prairie.

FIGURE 5. A mounded mock-up was used to monitor seed mixes, slope stability, soil type, and water needs over 15 months. Test plots for native and commercial lawns were also observed.

wet-tolerant plants. Of particular interest was the look and performance of a native "lawn" mix, so separate plots were made to compare the proposed native lawn type against the traditional turf types typical of Dallas and SMU's campus. Shade netting used in nurseries was placed over half of the plot in anticipation of shade on the GWBPC native lawns (Figure 5).

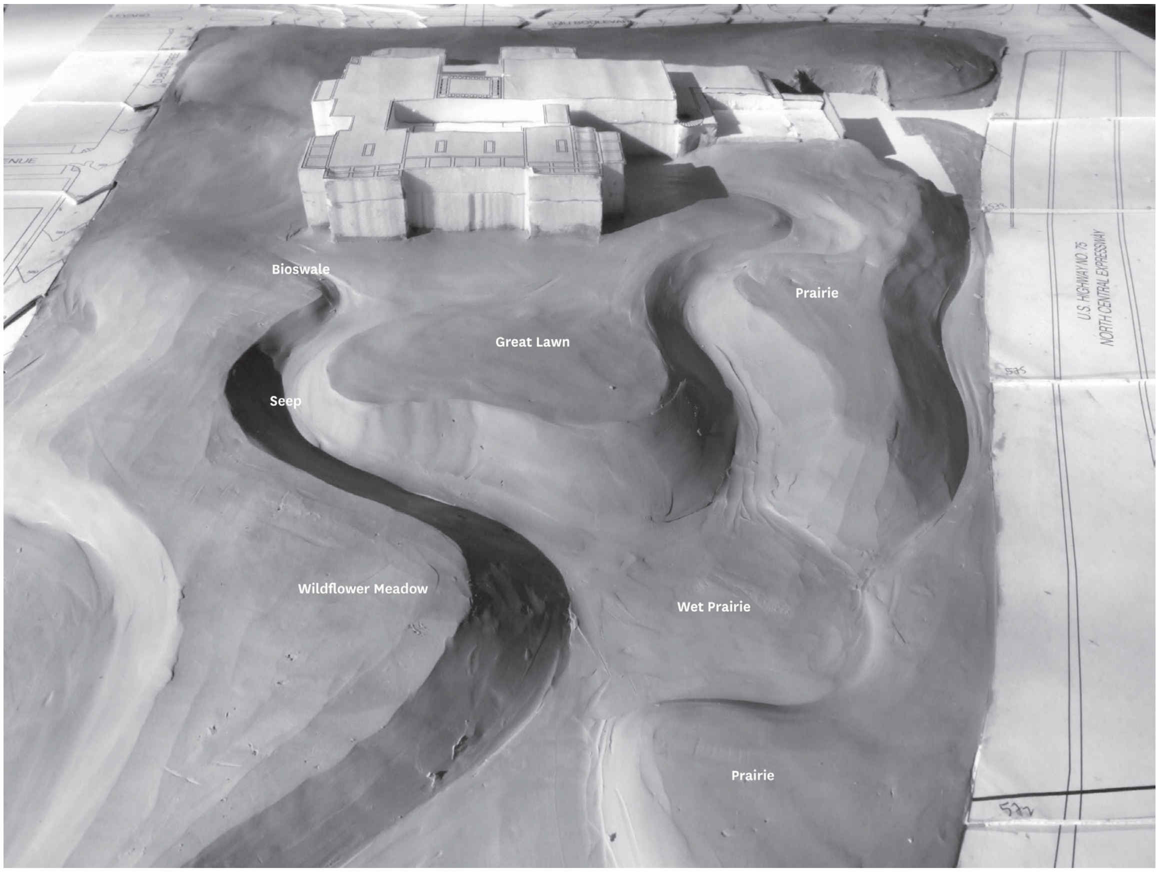
For fifteen months MVVA received reports and photos every two weeks that documented the progress of plant growth and viability, slope stability, and water use. Regular visits were scheduled with the client and design team, and MVVA calibrated the final design based on outcomes. For instance, partridge pea unexpectedly took over part of the mock-up, and, since it is a nitrogen-fixing species (it converts atmospheric nitrogen to a plant-useable form), this told us that it would spread whenever soil nitrogen levels fell. Our response was to reduce its percentage in the seed mix and to raise the available nitrogen in the soil.

SHAPING THE TOPOGRAPHY

Redistributing dirt excavated for the building foundation was an immediate design challenge since removing it was never considered. Not only would disposal have been cost-prohibitive, but damage to the environment and to our sustainability credentials also would have come at a high price. Our wasted dirt would have resulted in 5,000 trailer trucks congesting the roads, releasing greenhouse gases, and possibly destroying the ecology at the dumping site. Instead, the fill became an asset for transforming the flat and faceless site. Excavated earth was shaped into valleys, ridges, and plateaus, which added complexity to every biotic system in the park. Drainage channels narrow, widen, meander, and pool water depending on gradients and the intensity of storms. New hills and valleys create areas with distinct balances of sun, water, and wind, which, in conjunction with specially formulated horticultural soils, enable establishment of different ecological zones. Slope variations stratify wet to dry plant palettes, expanding the overall visual diversity and dynamism of the site.

The topography is also the physical framework for experience. Hill and gully make multi-scaled "rooms" of varied enclosure. Ambling paths connect the rooms as they cross or run parallel to the gradient, creating orchestrated views for a heightened experience of the park. On a stroll the building comes in and out of sight to orient the walker. A half-acre plateau,

FIGURE 6. The building excavation created 100,000 cubic yards of excess fill that needed to be used on site. Clay study models like this showed possibilities for configuring topography.



called the Great Lawn, is one of the few outdoor spaces that have a direct relationship with the building. Set a few steps down from the building's outdoor terrace, it can host large events or simply provide a point of prospect over the landscape (Figure 6).

PLANTING SOIL AS A FOUNDATION FOR SUSTAINABILITY

Making a landscape from scratch is extremely difficult. Michael Van Valkenburgh likes to say that the best moment in a *building*'s life is the day it opens, but that day is the worst moment in a constructed landscape's life. New buildings are certified to work. Not so landscapes, where natural systems may take years to fully function as intended.

Central to a landscape's full functioning is planting soil—its single-most important ingredient. Like plants, soil is a native material that is alive. A single teaspoon of healthy soil holds between 50 million and 1 billion microbes of bacteria, fungi, nematodes, and protozoa,[8] all working together but each having its own purpose and function.[9] Destroy these organisms and soil becomes "dead," unable to support plant life. Making things more complex, every plant community prefers a particular composition and balance of microbial populations. For instance, prairies need lots of fungi in soil, while trees prefer bacteria.

With little on-site soil usable, we imported 65,000 cubic yards of planting soil. Working with our soil scientist, Ted Hartsig of Olsson Associates, we mapped plant communities and their corresponding soil needs. We then translated this mosaic into soil profiles, differing by depth and composition. Low organic subsoil was designed for rapid root development, moisture balance, and stability. The "topsoil" was the nutrient layer, higher in organic matter but calibrated for specific ecosystems. Prairies prefer less organic soil while woody plants need higher organic content (Figure 7).

Finding such a large quantity of planting soil with the right composition and characteristics required months of trekking through soil suppliers' facilities. Samples were taken from each supplier and tested for compatibility with our specifications. In the end we found silty loam in Streetman, Texas, on a site that was already being stripped of its soil to extract gravel below it. From there it went to a blending facility for mixing with sand and/or compost. High-quality compost proved difficult to find because we needed it to be fully mature and teeming with biology, and this entails using specific processes for aging it properly. In the end we purchased un-aged yard and food waste compost then had it stored and managed to our specifications.

Finding and making soil is only half of soil management; controlling it during placement is essential to preserving its ability to function. In normal construction processes, soil is handled many times and is more susceptible to compaction, which threatens to ruin its structure, destroy its biology, and disturb its functioning. The solution is to set up strict soil handling and placement protocols in the specifications and then monitor the contractor's work throughout. Laboratory and on-site soil tests were required at specific construction intervals to verify that the soil continued to meet specifications.

FIGURE 7. Planting soil profiles, made up of varied soil layers, were calibrated to match plant needs. Base loam is amended with organic matter and sand.

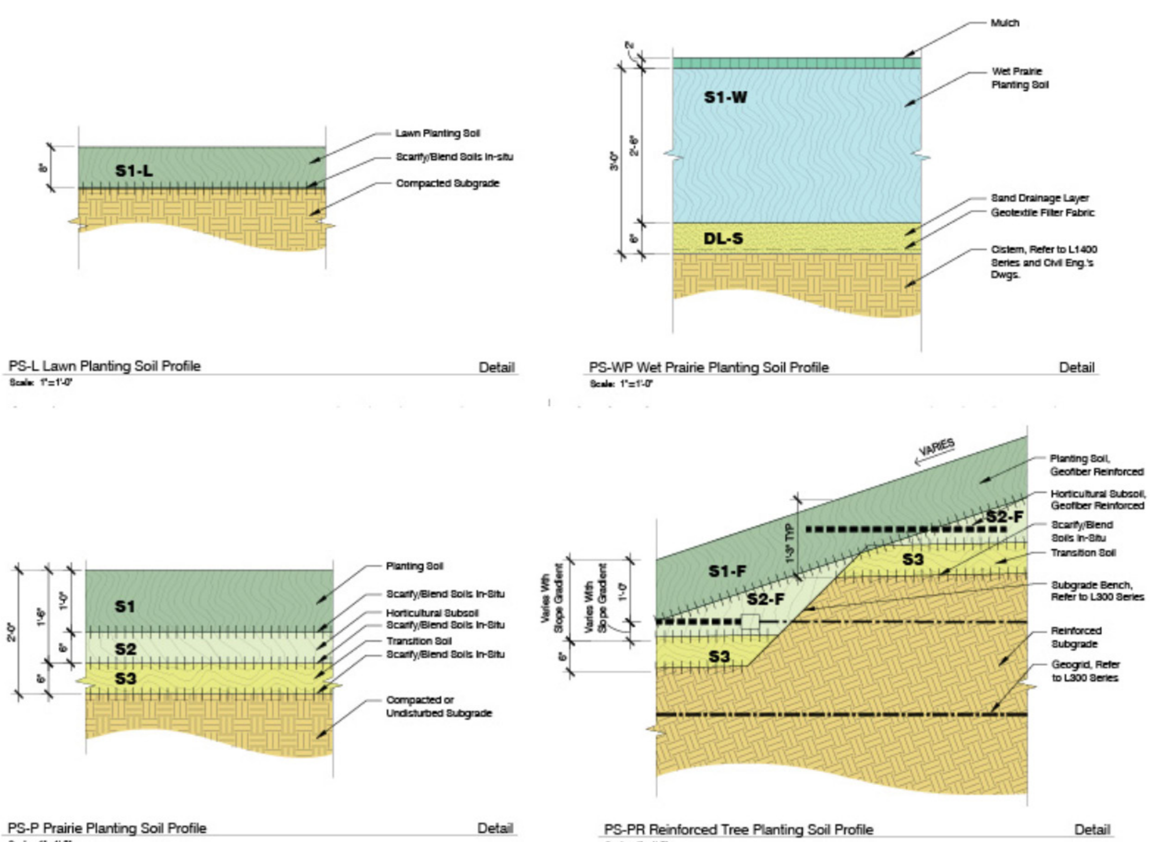
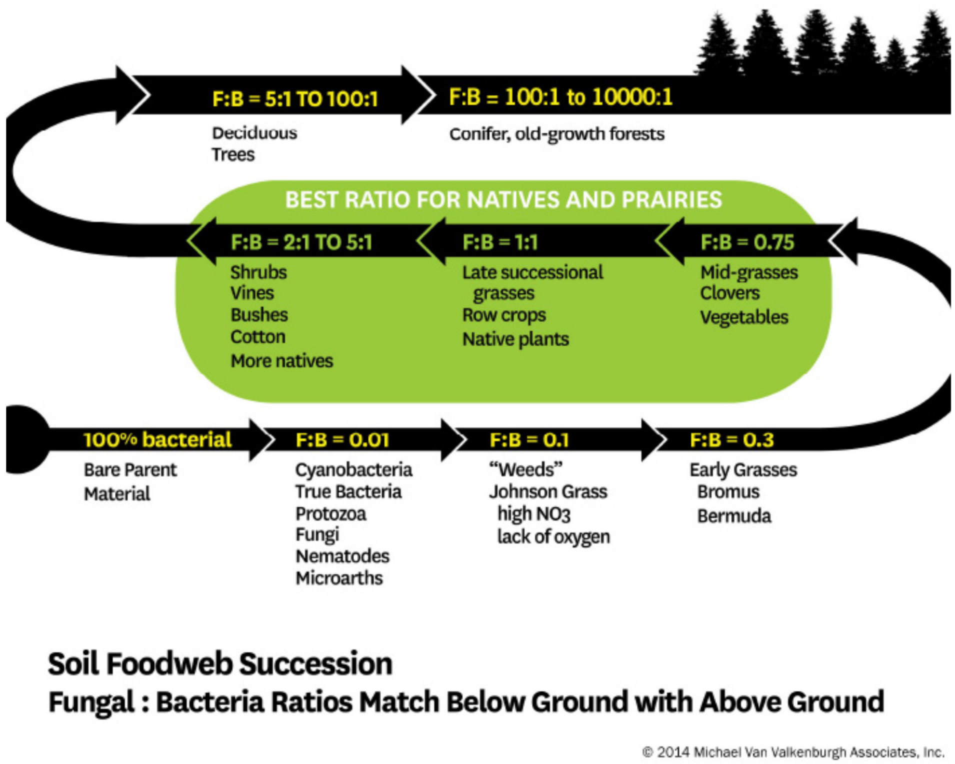


FIGURE 8. For the prairies, liquid biological amendments were applied to the planting soil to raise the fungal to bacteria ratio (F:B) to a range between 2:1 and 0.75.



Despite all the measures taken during soil making and placement, soil biology at the site was initially a problem. Stockpiling isolates soil organisms from roots needed to carry out the nutrient cycling system, and without this symbiotic relationship intact, the organisms begin to die off after a few weeks. To help counteract this condition, we applied liquid biological amendments (LBA) on the soil after planting and periodically throughout the establishment phase. These treatments restored microorganisms to the soil, matched fungi/bacteria ratios to the plant community types they needed to support, and raised the available nitrogen to operable levels (at least 150 lbs./acres). We hired Betsy Ross of Sustainable Growth Texas and her colleague Michael Bosco of Soils Alive to establish a program of LBA treatments and monitoring. They helped us write specifications, and during construction they analyzed "soil food web" tests so that applications could be calibrated. Following the installation of the landscape, the two continued to track the development of the plant communities and documented a shift within the soil microbiology toward populations that produce a healthy soil food web (Figure 8).

STORMWATER MANAGEMENT AND STEWARDSHIP

By locating the park at the natural low point of the site, we could capitalize on the 25-foot grade change from the north to south and address one of Texas's most critical environmental issues—water conservation. Dallas's average annual rainfall is around 40 inches,[10] and while that is close to our hometown Boston's annual precipitation rate of about 42, these rainfalls are completely different. Boston's rain events are long, soaking, and distributed throughout the year. The rain in Dallas arrives in torrents, mostly in warm months, often running off fast

FIGURE 9. Stormwater is conveyed north to south, collecting and cleansing surface runoff, roof water, and cooling tower blowdown before it reaches the irrigation cistern.

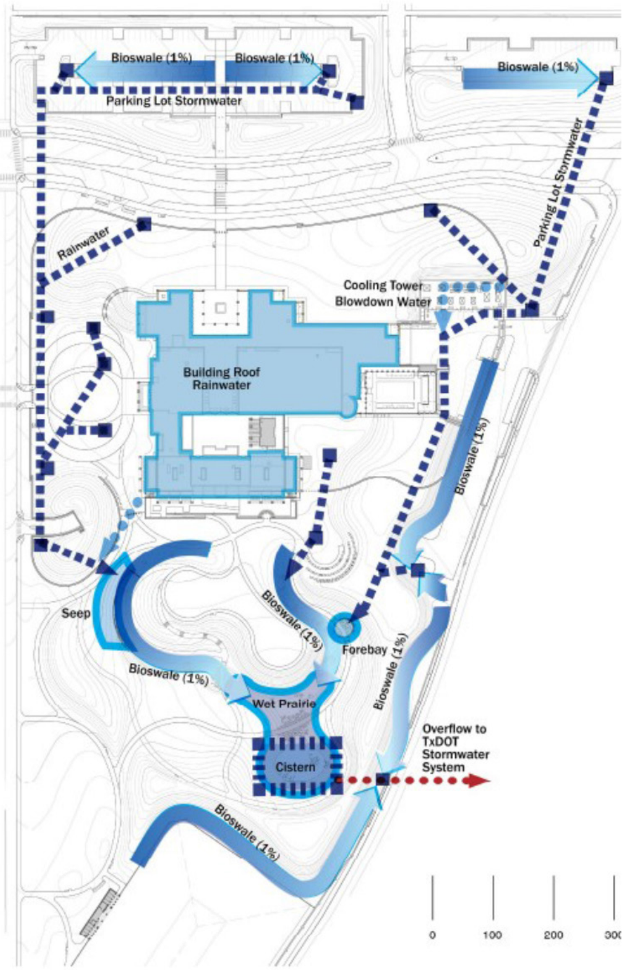


FIGURE 10. Pavement runoff at the north visitor parking lot flows to bioswales where grasses, sedges, and stone check dams cleanse the water before it is piped and released into the park's drainage features.

FIGURE 11. Water from upland parking is piped to the stone forebay where it can settle and be slowly released through 2″ wide joints in the stone block ford below the bridge.

and overwhelming traditional closed drainage systems. The city has a high evapotranspiration rate—water quickly vaporizes. Dallas also experiences drought. With water so volatile at the site locale, good stormwater management and stewardship were important goals. (Stormwater management is concerned with everyday events, whereas stormwater stewardship focuses on big issues and timeframes.) Stormwater will rarely leave the GWBPC site. It will be collected, contained, and reused, radically limiting the amount of municipal water used (Figure 9).

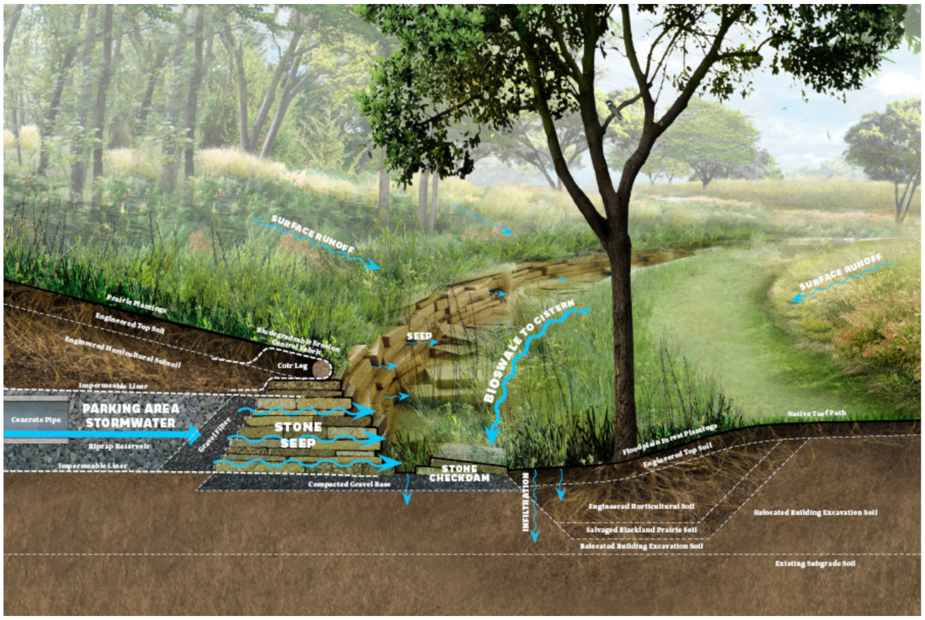
The stormwater system keeps every drop on site, including water collected in the parking lots and on the building's roof and cooling system, and whatever isn't absorbed by soil eventually makes its way to the 0.4-acre Wet Prairie that has the capacity to capture and retain large amounts of runoff generated by storms, both above and below grade. The first flush of a rain event is infiltrated in a 30-inch deep layer of base planting soil that sits above a 6-inch layer of drainage sand above a filter fabric-lined cistern. Once water reaches the filter fabric layer of the tank, it seeps down into a 252,000-gallon irrigation cistern. If the wet prairie captures more than 3-inch depth of runoff, the water level crests a riverstone-filled outcropping functioning as a dry well and conveying stormwater directly into the top of the tank. If the tank fills to capacity, water may sit for 24 to 48 hours before the irrigation pump draws down the water level, but this delay corresponds to the natural conditions of a wet prairie in which the plant community is adapted to both fully saturated and extremely dry conditions. Making seasonal precipitation patterns more visible to visitors, this ever-changing Wet Prairie plays a critical role in the site's hydrological system (Figure 12).

The highly efficient irrigation system is designed to operate only in times of need. Because of the expansive areas of prairie, the majority of the site required temporary irrigation for its establishment. Other areas with permanent irrigation have moisture sensors to water the right place at the right time. An on-site weather station provides data for constant calibration of the whole system. Water captured from the Bush Center building's roof and cooling system, which would normally be released into the overburdened city sewer, is discharged into the landscape for irrigation.

While the project uses several means to sustainably collect and reuse site water, the way that these mechanisms contribute to the immediate and future life of the landscape is what especially intrigued MVVA. We used topography to orchestrate the physical and visual journey of water through the site. Curved swales lengthen its route, varied gradients pace its flow, dams and forebays temporarily pool it, steep side slopes constrict and concentrate it, and

FIGURE 12. The east and west Bioswales spill into the Wet Prairie where water slowly percolates into the 252,000 gallon irrigation tank below it.

FIGURE 13. The Seep slows water traveling from uphill, holding it in a in a 20,000 CF rip-rap reservoir before discharging it through wall joints into the bioswale.



flat areas allow it to infiltrate. Seeing these features, a visitor can become aware of site runoff flowing from the landscape and parking lots to overland bioswales, flanking the east and west, which remove sediments before reaching the Wet Prairie. Tracing the west bioswale is the Seep, a long stacked stone wall that slows uphill drainage, holding it in a 20,000 CF rip-rap reservoir before discharging it through wall joints and into the bioswale. This delay of water means that the Seep expresses water long after a rain event has passed (Figure 13).

NATIVE PLANTING APPROACH

Working closely with the Lady Bird Johnson Wildflower Center, MVVA sought to create a landscape that was more than a collection of beautiful plants. We preferred a planting strategy that would restore ecological function to the site *and* be stunning. This meant using natural plant associations found in the wild, creating soil that would support these communities, calibrating moisture regimes, understanding wildlife habitat needs, and orchestrating all of these factors to make a landscape that always offers something appealing to see. The planting palette, with over thirty-seven species of grasses and fifty-three species of forbs, is designed to let species fill the various microclimatic niches created by different combinations of wind, moisture, sunlight, and topographic conditions. Recreating the foundation species of the Blackland Prairies was an important objective, with big bluestem, little bluestem, and indian grass dominant in the blend. But the design also incorporates a robust palette of wildflowers—including horsemint, coneflowers, daisies, standing cypress, and indian blanket—that will provide ecological benefits to insects, butterflies, and other wildlife, as well as added beauty to the park. The design team loosely mapped out broad microclimatic areas, such as savannah, forest, and wet prairie, but the intent was for natural processes and the diversity of the plant mixes to take over so the landscape will evolve dynamically (Figure 14).

One of the most prevalent of these ecologies is the savannah, which is composed of both tall- and short-grass prairie plant communities. Covering both the gentle and steep slopes that would be found in naturally occurring prairies, these grassy plantings are bordered by woodlands, recreating the natural relationship between open upland prairies and bottomland forests. After the establishment period, this native plant community will be mowed annually but require no irrigation.

FIGURE 14. A mosaic of plant communities from North Central Texas create a landscape of diverse ecological conditions and varied spatial experiences.

THE QUINTESSENTIAL TEXAS SCENE: THE WILDFLOWER MEADOW

One of Central Texas's most spectacular early springtime events is the blooming of the state flower, the bluebonnets (*Lupinus texensis*). Their flowering sparks an annual cultural pilgrimage of Texans to the countryside, cameras in hand, to see fields thick with the deep royal blue flowers. Witnessing this spectacular event for the first time, we were instant admirers and decided that the park should bring this display into a publicly accessible urban context. A rich spring palette of evening primrose, Texas paintbrush, and scrambled eggs [sic] accompanies the bluebonnets. To encourage the yearly display of wildflowers, the meadow is mown in late spring and irrigated only in late fall during drought conditions. Bluebonnets do best when the ground has been disturbed by, say, cattle grazing or wildfires. They are an annual and without that the blooms will diminish. With regular disturbance from mowing, the bluebonnet can continue to bloom for years. Because of the cultural value of bluebonnet season, the wildflower meadow, of all the native landscapes, is the one we would like carefully sustained and managed. Throughout the remainder of the year, the meadow features a short grass mix consisting of buffalo grass, blue grama, and curly mesquite, until the low rosettes of bluebonnet leaves unfurl in early winter (Figure 15).

LOCATING NATIVE PLANTS IN THE MARKETPLACE

One of the project's greatest challenges was to obtain over 900 thriving native trees. Though interest in providing native trees is increasing in the commercial nursery industry, planting only natives on a project of this scale was no simple feat, since there are fewer than a dozen widely available native Texan trees. The tree nursery that President Bush established at his Prairie Chapel Ranch supplied more than 400 of the project's trees. But many others required

FIGURE 15. Managed disturbance of the Wildflower Meadow through mowing in the early summer ensures that of Texas bluebonnet, Indian paintbrush, evening primrose and scrambled eggs return year after year.

MVVA to improvise: Some were sourced from derelict or closed tree nurseries, some were bought from ranchers who had plans to remove trees from their lands, and some (pecans—the state tree of Texas) had to be purchased from orchard growers. From San Antonio to Louisiana to Oklahoma City, MVVA trekked through hundreds of acres in search of trees that were important elements in native Texas ecoregions but were not available commercially. It has been gratifying to see that our project has made a difference in the industry: The following year, regional tree nurseries were planting new crops of natives.

Some seed quantities for the prairie and meadow plants were harvested specifically for our project, which meant working with seed suppliers well ahead of the planting schedule to find sources. Even that effort did not guarantee seed availability, because for a few species unfavorable weather conditions did not produce seed crops that season. When species were unavailable the LBJ Wildflower Center guided us toward substitutions. Additionally, our research revealed that some plants do not grow as quickly as others so they may be outcompeted when grown from seed—they need help with germination and establishment—so these plants were contract grown as plugs, which were more costly but almost assured establishment. Plugs, critical to managing heavy rain events, were also used as erosion control measures, installed at 8 inches on center in the bioswales and wet prairie. In all, 350,000 plugs were planted.

A BREAKTHROUGH FOR NATIVE LAWNS

Despite clear evidence that turf management contributes tremendously to the degradation of our environment, a lush green lawn has long been de rigeur in the United States and beyond.[11] To be fair, few alternatives for lawns exist, and it's not realistic to believe that people would voluntary trade consistently groomed blades to ever-changing tufted native grass. At GWBPC, our native plant consultants at the Ladybird Johnson Wildflower Center found a middle ground in a short prairie grass mix. The mix, which includes buffalo grass, blue grama, Texas grama, poverty dropseed, and curly-mesquite, was developed through several years of research and trials by the Ecosystem Design Group at the Wildflower Center with the goal of demonstrating a viable alternative to the typical cultivated turf. The nearly nine acres of lawn at the Bush Center are seeded with this mix, which has distinct grey-blue-green thin blades that are maintained at 6 to 8 inches high. This lawn is drought tolerant, needs little mowing, and is sustained by a thin layer of leaf compost applied yearly. Best of all, it forms a beautiful tousled carpet that ripples in the wind. The Bush Center represents the first large-scale use of this native short grass mix, and this helped accelerate its release to the public. The mix is now commercially available under the brand name Habiturf™[12] (Figure 16).

THE TEXAS ROSE GARDEN

There are two open-air gardens inside the library and museum. The Texas Rose Garden is integrated into the experience of the museum, offering a moment of rest and reflection at the halfway point in the exhibition space, just outside the replica of the Oval Office. Inspired by the proportions and architectural context of the White House Rose Garden, the Texas Rose Garden features different plants—plants adaptable to the humid subtropical climate of Dallas. The Garden's main role is to mirror the cultural experience of the President's surrounds while in Washington: One can imagine President Bush walking in the garden in contemplation or sharing a quiet moment with a visitor. This Rose Garden has something unique: a wide-open view to the park's native landscapes and to downtown Dallas. In this arrangement visitors can view the tall grass prairie, prairie and savannah, and wildflower meadow, even if they don't make their way down into the park.

An interpretation of the original rather than a copy, the Texas Rose Garden includes long limestone seatwalls. Bits of the native prairie park landscape are used in the Texas Rose Garden, including native evergreen hedges of dwarf yaupon holly as a substitute for the White

FIGURE 16. The Great Lawn, made of native short grasses, can host large events or simply serve as a prospect over the Wet Prairie, Wildflower Meadow, Bioswales, and trails.

House Rose Garden's boxwood hedges. These formal borders frame masses of annuals, perennials, and shrubs such as sage, hydrangea, roses, and yucca. Innovatively, native wildflowers are treated as annuals—species such as bluebonnets, horsemint, Texas bluebell, drummond phlox, foxglove, and aster are grown in a greenhouse, planted at their peak, and rotated out when they are done flowering. The eastern axis of the garden culminates in a large water garden planted with water lilies, irises, and lotuses. Natchez crape myrtle, chaste tree, and southern magnolia provide shade and help define the garden's scale.

REGIONAL MATERIALS THAT REFERENCE THE IDENTITY OF TEXAS

Careful consideration was given to selecting materials that were appropriate to North-Central Texas and had a timeless quality. Incorporating regional materials helps create culturally meaningful landscapes, contributes to local economies, and reduces the project's environmental footprint with less transportation for deliveries. Indigenous limestone is everywhere in Texas so it seemed fitting to use; it became a material unifying the building and the park. Oversized, roughly split Leuders Limestone boulders from Abilene, Texas, are used to intermittently line the bioswales, sometimes loosely stacked to form weirs to control water flows. Different forms and finishes of Leuders Limestone are also used as a veneer on the three-quarter mile long security wall and for the 17,000 square feet of stone pavement at the Library and Institute entrances. At the Texas Rose Garden, Hadrian's Limestone, in which fossilized crustaceans can be seen, from Midland, Texas, was selected for large seatwalls and stone curbs. Stabilized decomposed granite paving from Colliers, Texas, crisscross the prairie and resemble foot-worn ranch paths while providing an accessible route for visitors. The high albedo of these light color stone materials and the concrete pavement in the parking and service areas contribute to reducing the heat island effect across the site (Figure 17).

Challenges come along with "going local" for materials. For instance, one may draw long stone slab benches and later discover that the available stone can't be quarried to that size. We overcame these challengers by doing extensive research during the design phase on the availability and characteristics of local materials. Sometimes there were *welcome* surprises even during construction: In our quarry trips to tag stone for the rock seep wall, we noticed piles of varied ledge stone that had been put aside because the unique mineral colors made them

FIGURE 17. Limestone slabs line the forebay to reduce the erosive forces of downpours. Random stones at the mouth of the forebay disperse water velocity.

unsuitable for paver fabrication. But this "waste" was ideal for our seep wall, where the beautiful patina added depth and contrast, especially when wet.

Along the path, two robust but simple wood bridges near the wet prairie span stone weirs that control bioswale flow. Over-scaled timbers were used for decking to match the rugged qualities of the native landscape. Based on some previous firm-sponsored research, we decided to use black locust, an extremely hard and rot resistant wood. (Michael remembers his father saying, about the black locust fence posts that they used on the family farm, "They last one day longer than stone.") We believe that black locust trees have great potential for replacing harvested tropical forest trees because they grow quickly and can be thickly planted to increase yields. The wood at the Bush Center was harvested in Forest Stewardship Council-certified forests in the Northeast and sawn and dried prior to shipment to Texas.

ESTABLISHMENT AND BEYOND

Designed landscapes are wonderfully dynamic living systems. Because they are always changing, they need to be maintained in perpetuity, with more effort required during establishment and, if planned well, less as they age. The Bush Center's landscape will be cared for organically, a first for Presidential libraries. This approach shifts the maintenance program from one of getting rid of what is unwanted to one of setting up conditions that support what is desired. The benefits for plants include minimizing cyclical stresses that misallocate plant energy, reducing watering requirements, suppressing attacks by pests and diseases, sustaining soil pores for air and water, and degrading harmful pollutants.

At the Bush Center, the landscape will need less water over time and what water it needs will be drawn from the irrigation cistern. Integrated Pest Management and replenishment of organic matter on an as-needed basis will replace use of pesticides and inorganic fertilizers. Soil biology will be monitored and liquid biological amendments applied as needed to reintroduce the beneficial organisms that will create life in the soil by cycling nutrients to the plants. Initially the landscape will be allowed to settle in, with the Wildflower Center doing monthly reports and conferring with and aiding the specially trained landscape contractor that maintains the site. Plants may shift location, some will die, the seeds of new species will arrive in the winds, and invasive weeds will need to be controlled. This requires a nuanced maintenance in which caregivers must notice change and choose a course of action (or not). All of this aligns with our expectations as the designers but, most importantly, it is an approach that President and Mrs. Bush embraced from the outset (Figure 18).

THE LEGACY OF THE LANDSCAPE

The sustainable technologies in the GWBPC landscape interweave ecological performance and visitor aesthetic experience. The 250,000 people expected to come to the GWBPC each year will encounter this blend from the moment they step on the property, probably with little regard for all the efforts made to achieve sustainability. That's just fine. MVVA makes landscapes for people to use, enjoy, and return to in any season. The dynamism of these landscapes offers something different to see in every visit (Figure 19).

With the building of this landscape, President and Mrs. Bush offer the community a chance to see the robust beauty of native Texas up close and in the city. They wanted to share a landscape they love and appreciate and to make it accessible to all people, but especially to children. Mrs. Bush is a stalwart champion of outdoor play, which has steadily diminished.[13]

FIGURE 18. This native grass path is bordered by the Seep, to the left, and is shaded by a grouping of Chinkapin Oaks, Water Oaks, and American Sycamores.

FIGURE 19. The paths guide visitors through the different ecologies. In the foreground, wildflowers such as Indian blanket and horsemint mix with the grass-dominated prairie areas. Beyond, the bridge crosses over the Wet Prairie.

The Bush Center has a role in reversing this trend. In an article for the *San Antonio Express-News,* she wrote: “I want my grandchildren to enjoy the natural beauty of Texas. And that is my hope for every Texas child: that he or she comes to know the joys of the natural world and the simple pleasures of playing outside.”[14]

In establishing at the Center a landscape grounded in the native plants and ecologies of Texas, MVVA has created both sustainable conditions and opportunities for experiences of the heart of the Texas land—an act of cultural preservation.

AFTERWORD

In this article we have shared construction specifics, but we caution against using them outright in other projects. Every site, in its uniqueness, requires different strategies and components. The conditions under which different ecologies emerge and take hold are related to the given slope, soil, water, aspect, wind, and climate, as well as local wildlife and human use and disturbance. Our message is that to foster landscape sustainability in designed places, one should follow an extensive, detailed process of site investigation and analysis, creative responsiveness to unique conditions, and a willingness to change course if the evidence tells you to.

Becoming aware of more site realities, we faced many occasions in which spur-of-the moment changes in the design and building of the Center's park were called for. We were fortunate to have a client who understood all this. One size does not fit all, especially for sustainable landscapes.

ENDNOTES

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