Campus Master Plan
and Design Guidelines

January 2008
Our Vision:

The new Texas A&M Health Science Center will be a campus in a forest: a pleasant, peaceful, comfortable place that inspires a healing environment. The Campus will portray an image of technology, yet preserve the natural environment, promoting a friendly, safe setting that encourages thoughtfulness and investigation. As a medical and academic destination, the Campus will be a flexible collaborative translational environment. It will reflect the Health Science Center commitment to ‘BRINGING LEARNING TO LIFE’ with synergy, energy and momentum.
Bryan, Texas

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Introduction

The Texas A&M Health Science Center (HSC) is devoted to educating health professionals and researchers of extraordinary competence and integrity. Its faculty, staff and students are united by a belief that all people – regardless of geography, economics or culture – deserve the benefits of compassionate care, superior science and exceptional education.

Planning the new Campus for the Health Science Center was a collaborative process, occurring between April 2007 and January 2008. After a comprehensive site analysis, which explored the opportunities and constraints of the Site, ‘charrette’ workshop design sessions and the exploration of several framework possibilities helped to shape the final master plan for the Health Science Center.

This section covers the following topics:

- Texas A&M Health Science Center
- A campus in a forest
- Scope of master plan
- Project team
Texas A&M Health Science Center*

The creation of the Health Science Center began in September 1996, when the Texas A&M University System Board of Regents authorized a comprehensive analysis regarding the feasibility of consolidating the major health-related elements within the A&M System into a System-wide health science center. The resulting study recommended the Texas A&M University College of Medicine, the then-proposed School of Rural Public Health, Baylor College of Dentistry and the Institute of Biosciences and Technology be integrated as the Texas A&M Health Science Center. The study also recommended creating a Graduate School of Biomedical Sciences to offer graduate degree programs in medicine, dentistry and public health. A sixth component, The Irma Lerma Rangel College of Pharmacy, was created in 2006, and approval for a seventh component, the College of Nursing, is anticipated during 2008.

A new campus was proposed for the Health Science Center in order to integrate education, research and clinical facilities located in the Bryan-College Station community and to enhance the opportunity for clinical affiliations in an environment conducive to public private partnerships. Planned and designed as a state-of-the-art facility, the proposed new Health Science Center campus will foster collaborative education for health professions and break-through scientific discovery. In particular, the project Site, located in the City of Bryan, is less than three miles away from the Campus for Texas A&M University, in College Station, allowing maximum collaboration between the two universities.

A Campus in a Forest

The concept for the Texas A&M Health Science Center campus master plan is ‘a campus in a forest’. The 203-acre Site is bisected by a deeply incised ravine, as well as several tributary channels heavily vegetated with large oak trees and dense under-story plantings. The Health Science Center master plan seeks to integrate natural areas into the Campus, and to establish a pleasing aesthetic.

Preserved natural areas, reduced parking footprints, sensitively allocated building locations and uses, and adaptive campus landscape maintenance practices can all enhance the academic and healing environment encompassing the new Health Science Center campus. An extensive analysis has been instrumental in maintaining ‘a campus in a forest’ feel, and has included assessments of: buildable area, appropriate building densities, campus program, phasing, utility infrastructure layout, and building locations, footprints and heights. Maintaining and treating the ravines and wooded areas as amenities of the Site have been imperative to the planned image and character of the Campus.

* Compiled by Dr. Alicia Dorsey, Vice President for Communication & Program Development for Texas A&M HSC
Scope of Master Plan

Per the project’s (2007) Request for Qualifications, the relocation of research, education, outreach and administrative activities currently distributed throughout the Bryan-College Station community to a single location was the first step in creating the Health Science Center campus. A sustainable campus setting that preserved much of the natural environment and existing terrain was highly desired, as well as one that would emphasize a collaborative and translational teaching and research environment.

Future outpatient and sub-specialty clinics will provide space for local clinical partners to deliver health care to patients from the surrounding community. These clinics will also provide educational and outreach opportunities, serving to train a range of health professional students.

The master plan project scope was revised to include the following components:

Initial HSC Facilities (2009-2013)
- Health Professions Education Center
- Administrative headquarters for HSC
- Medical Education and Research Building
- Central physical plant and infrastructure

Initial Affiliate Sites (2009-2013)
- Two potential affiliate organizations (for which negotiations are underway)

- Relocation of the School of Rural Public Health
- Student and visiting scholar housing
- Ambulatory clinical facility for group practice
- Additional research facilities
- Additional educational facilities

Affiliate / Partner Facilities (2020+)
- Federally Qualified Health Clinic
- Advanced diagnostic services
- Community partner health facility
- Various health-related small businesses
- Initial 250-bed hospital and 250-bed expansion

Project Team

FKP Architects and EDAW, Inc. collaborated on the master plan, in association with civil engineers Mitchell and Morgan, traffic engineers from Walter P. Moore, and thermal and utilities engineers Shah-Smith and Associates.

Along with the Health Science Center and the Texas A&M System Facilities and Planning office, FKP and EDAW hosted a series of workshops and discussions between May and October of 2007. Also participating were representatives from: the City of Bryan, the Texas Department of Transportation (TX DOT), HSC’s project managers from Broaddus Associates, Manhattan Construction, anticipated health partners, as well as neighboring property owners from the Traditions Club and Melrose Company.
Site Analysis

The Site’s opportunities and constraints are shaped by its regional, ecological and urban context, as well as by specific areas of consideration including vegetation, elevation, drainage and soils. Examining these factors was key to creating a site-sensitive design and ‘a campus in a forest.’

Identifying a series of natural constraints (floodplain, highest value vegetation, steep slopes) helped shape the diagram of buildable area, which was pivotal in determining the Site’s master plan.

This section covers the following topics:

- Regional context
- Ecological context
- Urban context
- Airport impact
- Existing conditions
- Vegetation
- Highest value vegetation
- Elevation
- Soils
- Environmental assessment
- Buildable area
- Site character
Regional Context

The project Site falls in the City of Bryan near the municipal boundary with the City of College Station, within Brazos County in southeast-central Texas. The nearest major airport is Houston’s George Bush Intercontinental Airport, about two hour’s drive from the Site. San Antonio and Dallas are both a little more than three hours away, at 165 and 181 miles, respectively.

Soils in Brazos County were formed under prairie vegetation and oak savannah (Chervenka 2002). At a finer scale, the major land resource areas shaping Brazos County are the Post Oak Savannah and Southern Blackland Prairie.

The USDA Natural Resources Conservation Service (2006) has determined that Texas contains seven large land resource regions; of these, the Site falls within the Texas Claypan of the Southwestern Prairie (see figure at right). This area is characterized by oak savannah and mixed pine-hardwood forest.

Post Oak Savannah regions are underlain with a dense clay soil within a depth of a few feet, whereas Blackland Prairie is more typical of river and stream bottomlands. The formation of both landscapes was influenced by two factors: the grazing of bison and periodic fire. In the absence of fire, yaupon (Ilex vomitoria) tends to replace the grassland understory of the Post Oak Savannah (TX Parks & Wildlife 2007).
Regional Context

The USDA Natural Resources Conservation Service divides Texas into seven land resource regions. The Site is located in the City of Bryan and within the Texas Claypan portion of the Southwestern Prairie region. The closest major airport is located within a two-hour drive, in Houston.
Ecological Context

At the margin between agriculture and urban land use, the Site has potential to serve as a catalyst for urban development in Bryan along the Texas State Highway 47 corridor.

Local Wildlife Species

According to the Texas Parks and Wildlife Department (2007), common species in the Post Oak Savannah and Blackland Prairie include: white-tailed deer (*Odocoileus virginianus*), mourning dove (*Zenaida macroura*), wild turkey (*Meleagris gallipavo*) and bobwhite quail (*Colinus virginianus*).

Brazos River Valley

A potential wildlife corridor flanks the nearby Brazos River (see dashed lines in diagram at right).

While patches of potential wildlife habitat (green) appear to connect the Site to the Brazos River corridor, in truth the potential habitat connection is impaired by the presence of Texas State Highway 47 (TX-47). The same is true of potential wildlife connections across the major east-west arterial road north of the Site, West Villa Maria Drive. While preserving wildlife connections along the northwest border of the Site is desirable, the importance of maintaining connections to the Brazos River corridor can be considered marginal due to the existing wildlife deterrent presented by TX-47.

Geology

The county’s geology is distinguished by the abundant presence of petrified wood, a product of fluvial and deltaic deposits dating to the Eocene period (38-21 million years ago). The Yegua formation underlying the majority of the Site (see page 25) dates to this geologic period, and is 750-1000 feet thick (CSC 2006). The depth to bedrock is considerable, posing no limitations for development (per civil engineer J. Mitchell). The presence of volcanic ash in the area contributed silicates necessary to the formation of petrified wood (Senkaji et al: 1985).

Petrified wood forms when trees are submerged in highly mineralized waters, with variation in coloring forming from the presence of different minerals. Petrified wood from the Yegua formation contains, among other minerals, microcrystalline quartz and opaline silica (Senkaji et al: 1985). The common exposure of petrified wood in the area of the Site is most likely a consequence of soil erosion caused by both disturbance and the action of stormwater runoff on highly erodible soils.

Local Climate

The average annual precipitation in Brazos County is around 39 inches, with the majority (54%) falling between April and September (see graphs at upper right). Usually, the first freeze date falls after November 11 and the last freeze occurs before March 5, leading to a growing season of 268 days. Brazos County falls within plant hardiness zone 8, with prevailing winds from the north and south (Chervenka 2002).
Ecological Context

Located near the municipal boundary between College Station and the City of Bryan, the site is cut off from the larger Brazos River wildlife corridor (dashed line) by Texas State Highway 47. Urban land use is expected to continue to grow near the intersection of highways TX-47 and FM-60.

Petriﬁed wood on the Site dates to 38-21 million years ago.

In the face of continued habitat loss and isolation, many landscape ecologists stress the need for providing landscape connectivity, particularly in the forms of wildlife movement corridors and stepping stones. Roadways, railroads, powerlines, canals, and trails, may be thought of as 'troughs' or barriers.

- Wenche Dramstad et al. (1996: 35)
Urban Context

The Union Pacific Railroad in the City of Bryan dates to 1867, when it connected Houston and Dallas as the Houston and Central Texas Railroad. Texas A&M University was established along the rail line nine years later, giving the town of College Station its name. Since the merger between Union Pacific Railroad and the Southern Pacific Transportation Company, the rail has been used almost exclusively as a freight line.

Project North

The local vernacular defines north and south as aligning with the railroad tracks in College Station, which are oriented approximately 48 degrees west of true north. This local tradition led to the use of Project North in the remainder of this document. Directions, unless otherwise noted, are given in relation to Project north.

Transportation Connections

Maintaining the vision of ‘a campus in a forest’ that capitalizes on the unique and natural resources, the HSC will encourage maximal use of pedestrian bicycle, and other non-motor traffic.

As the occupancy of the Campus grows, consideration will be given to mass transit processes like shuttle services. As exchange of faculty, students, and vistors increase, between Texas A&M University and the Texas A&M HSC, provision of bus service between the universities may be instituted.

Texas State Highway 47

The Site is bound on its west edge by Texas State Highway 47 (TX-47). TX-47 currently consists of four lanes at 70 mph divided by a median. According to the Texas Department of Transportation (personal communication with TX DOT, 2007), TX-47 is likely at some point in the future to be converted to an interstate, in which case the existing lanes would become one-way frontage roads. Additional lanes would be constructed in what is now TX-47’s median. In this event, access to the Site would be dictated in part by regulations governing the frequency of grade-separated intersections. Per TX DOT guidelines, there is a minimum one-mile spacing (on center) for grade-separated crossings, with no driveways permitted within 250’ of the intersection of an interstate ramp and crossing road.

Improvements Proposed for F&B Road

According to representatives of the City of Bryan, there is also a 10-year capital improvement plan under design to enhance F&B Road. In fact, F&B is expected to connect to TX-47 by 2009-2010, with a traffic light proposed for the intersection of Discovery Drive and F&B Road (see diagram at right). Improvements to South Traditions Drive are also expected by late 2009.
The Site is located approximately 2.5 miles from Texas A&M University’s West Campus.
Airport Impact

Texas A&M University owns Easterwood Field Airport, which provides service for more than 100,000 passengers per year through American Airlines and Continental Express, as well as for freight carriers and charter services. Military aviation operations form almost one third of Easterwood Field’s operations (see sidebar at left).

The end of one minor runway associated with Easterwood Field Airport comes within 3,000 feet of the south end of the Site property.

Potential Groundwater Contamination

Both aviation fuel associated with fixed base operators (FBOs) and automotive fuel associated with rental car operators are likely contaminants within the area of the airport. However, the groundwater in the City of Bryan is slow-moving and found at considerable depth, with potable water approximately 150-800 feet from the surface (CSC: 2006). Furthermore, the underlying soils in the area are not of especially high permeability, as they contain high proportions of clay. Finally, the general direction of groundwater movement in the area follows the overall elevation, tending to move towards Easterwood Airport from the Site, from north to south-southeast. Thus, groundwater contamination from Easterwood Field Airport in the area of the Site is of minimal concern.

Airport Approach Constraints

Per Federal Aviation Administration (FAA) requirements, the presence of a runway within 10,000 feet of a property can limit building heights. However, the approach slope elevations associated with the airport exceed 470 feet above sea level, even at the highest point of the Site (340 feet elevation). This implies that a building as high as eight stories (or 130 feet) would be permissible even at the highest point of the Site. As the master plan program calls for buildings no higher than six stories, the flight cone associated with Easterwood Field does not have a significant impact on planned building masses on site. However, at the level of planning individual buildings, it will remain important to consider possible noise associated with airport runway activity, particularly for potential in-patient facilities, even if the airstrip in question (Runway 10, see diagram at lower left) is estimated to be used only 10-15% of the time.

Diagram of Easterwood Field Airport shows runway lengths and relationships. The approach for Runway #10 (red dot above) intersects the Site.

Easterwood Field Airport’s operations:

Average aircraft operations per day: 165
Transient general aviation: 40%
Military aviation: 28%
Local general aviation: 21%
Air taxi: 11%
Commercial aviation: <1%

Diagram of Easterwood Field Airport shows runway lengths and relationships. The approach for Runway #10 (red dot above) intersects the Site.
Airport Impact

While one of the flight paths associated with Easterwood Field Airport intersects the Site, this approach is used only a minority of the time. The approach slope of this flight path comes no closer than 130’, or 8 stories, to the highest point of the Site, posing no significant impediment to site master planning.
Existing Conditions

An aerial photo downloaded in 2007 indicates additional areas have been disturbed since the 2004 aerial photograph and 2006 environmental assessment. These include several patches of light color (visible at far right) in the northwest corner of the Site. Also visible in the aerial photograph are adjacent land uses, including the Traditions housing development (to the northeast) and associated golf course (to the southeast).

Historic Site Disturbance

A series of historic aerial photos (at right), dating back to 1954, demonstrate the succession of land use. Of particular interest are photos from 1973 to 1994, which show disturbances associated with oil drilling in two central areas of the Site. By 2004, the area disturbed in 1983 showed new vegetative cover, demonstrating the ability of pioneer species to colonize disturbed sites.

At right:
A series of aerial photos, taken at approximately 10-year intervals, reveal the Site's history of disturbance and revegetation. The core of the Site consists of a relatively undisturbed natural woodland area, where plant dominants include post oak and blackjack oak (see photos of Quercus stellata and Q. marilandica, page 20).
Existing Site Conditions

The Site lies adjacent to the Traditions Club housing development and golf course, and to Texas State Highway 47, which could in the future become an interstate.

Evidence of prior disturbance from oil drilling and associated clearing of vegetation is visible.
Vegetation

Mesquite was observed in Brazos County as early as 1808, having probably been introduced through Spanish cattle (Chervenka 2002). The common name mesquite encompasses three species (Prosopsis glandulosa, P. pubescens and P. velutina), all with deep taproots particularly adapted to drought. Mesquite is a thorny shrub (see photo at left), which in conditions of adequate water may take the form of a small, multi-stemmed tree, rarely taller than 15 to 20 feet.

Many of the Site’s formerly disturbed areas have filled in with mesquite shrubs, which in aerial photographs are difficult to discern from higher value mixed hardwood forest and oak savannah. Consequently, ‘mixed hardwood scrub’ forms one of three categories classifying existing vegetation on the Site; the other categories are grassland meadow and disturbed areas (see diagram at right).

Grassland meadow areas include a range of grasses and wildflowers, such as black-eyed susan, Rudbeckia spp., and meadow pink, Sabatia campestris (see photos at top left).

According to the USDA-NRCS (2006), plant dominants that can be expected within the Texas Claypan include: little bluestem (Schizachyrium scoparium), beaked panicum (Panicum anceps), indiangrass (Sorghastrum nutans), brownseed papsalum (Papsalum plicatum), switchgrass (Panicum virgatum), and big bluestem (Andropogon gerardii). Additional common species include: dayflower (Commelina erecta), spiderwort (Tradescantia spp.), bundleflower (Desmanthus illinoensis), and Lespedaza species.

The expected dominant woody plants in the region are post oak (Quercus stellata) and blackjack oak (Quercus marilandica). Other common shrubs and trees include: sensitive briar (Mimosa nuttalli), hackberry (Celtis spp.), hawthorn (Crataegus spp.), yaupon (Ilex vomitoria), elbowbush (Forestiera spp.), and honeysuckle (Lonicera spp.). Many of these species were observed in the mixed hardwood scrub areas of the Site.

In contrast, disturbed areas tended to show patchy vegetative cover with a high proportion of exposed soil, highly vulnerable to soil erosion.
An analysis of an aerial photo of the Site determined three primary existing landscape types: mixed hardwood scrub, grassland meadow, and disturbed areas.
Highest Value Vegetation

Parts of the Site, particularly those surrounding the central ravine, consist of oak savannah and mixed hardwood forest relatively undisturbed since at least 1954 (see photos at left). Preserving these areas as much as possible during the master planning process was key to creating ‘a campus in a forest.’

An overlay of historic aerial photographs (see figure at right) was useful in distinguishing areas dominated by mature oak trees from those more recently colonized by mixed mesquite scrub. By tinting the historic photographs with a range of color hues, it was possible to overlay them and determine the approximate age of wooded stands. In the composite image, the darkest areas are the least disturbed. Combining this analysis with the diagram of existing vegetation (green areas at far right) identified the least disturbed wooded areas on the Site.

The area diagrammed as ‘least disturbed wooded vegetation’ (outlined in light green at far right) formed a natural constraint during the master planning process, defining an area of high value woods to be preserved as much as possible.
An overlay of historic aerial photos (at left) helped identify wooded areas that had not been disturbed after 1954 (above). This analysis helped identify which areas of ‘mixed hardwood scrub’ were populated with oaks (outlined in lime green above), and which were disturbed areas newly covered with mesquite scrub.
Generally speaking, areas of highest value vegetation coincide with the central ravine of the Site. This channel (darker area at right) overlaps, in part, with Turkey Creek’s 100-year floodplain. Depressed by as much as 50 feet and in some areas quite steeply incised (see diagrams at left), this channel proved to be a major determinant in shaping the master plan.

**High and Low Points**

The highest point of the Site (white asterisk at right) is slightly more than 340 feet above sea level, while the Site’s low point (purple asterisk) is below 239 feet in elevation. Thus, the fall in elevation across the Site from its southeast corner to north edge is approximately 100 feet.

**Ridgelines**

Two major ridgelines (dotted lines at right) intersect the Site, buffering views to Texas State Highway 47 along the Site’s western edge and separating the western portion of the Site from the Traditions housing development and golf course.

**Drainage**

With the exception of water falling on areas outside of these two ridgelines, stormwater tends to move through the central ravine toward Turkey Creek, exiting the Site at the low point. The slopes of the ravine tend to be vulnerable to soil erosion.
Elevation

The fall in elevation across the Site is approximately 100 feet, with a high point over 340' above sea level and a low point below 239'. In addition, two ridgelines divide the site.
Soils

The Texas Claypan region is characterized by geology underlain with fluviodeltaic and marine sediments and soils that are mostly alfisols, vertisols, mollisols and entisols (USDA-NRCS 2006). Alfisols develop under humid forests in middle latitudes. Vertisols contain high percentages of the expansive clay known as montmorillonite. Mollisols form a rich upper organic layer under grassland vegetation; entisols are disturbed developed soils with little horizon development. The project Site contains soils in three groups: Gredge, Zack, and Boonville fine sandy loams (CSC Engineering 2006).

The high shrink-swell potential of Zack and Gredge soils can affect roads and building foundations. Their low permeability also commonly causes septic system failures. The following description of soil classes is drawn from the 2002 Brazos County Soil Survey (Chervenka 2002).

Zack Soils

Both Zack and Boonville sandy loams are characteristic of prairies in erosional uplands or footslopes, and may be moderately to very deep. The underlying material is frequently alkaline or shale. Zack soils have a thin and strongly acid surface layer underlain with slightly acid or alkaline clays and then moderately alkaline loam. Zack soils, which are vulnerable to erosion, typically occur on summits and upper backslopes, and have shale within a depth of 40 inches. Their low fertility and available water capacity can affect plant productivity.

Boonville Soils

Boonville soils have a slightly acid, fine sandy loam surface layer of varying thickness above a layer of neutral clay. Below these layers is an alkaline clay mixed with shale. Very highly erodible, Boonville soils are typical of more gently sloping footslopes, and are native to open savannah with grasses of middle and taller height (Chervenka 2002).

Gredge Soils

Gredge soils form along stream terraces under post oak savannah. They have a thin surface layer above clay and are very strongly acid. Low fertility and high susceptibility to both drought and erosion can affect productivity of plants growing on Gredge soils.
The Site's soils are fine sandy loams, presenting no significant constraints on buildable area. However, their high erodibility requires that stormwater quality ponds be built off-line from drainage channels. Also, the high shrink-swell potential of underlying clay on the Site may affect the design of roads and foundations.

*At right:* Most of the Site's soils are part of the Yegua formation, which dates to 38-21 million years ago.
Environmental Assessment

The Phase I Environmental Assessment (CSC Engineering and Environmental Consultants: 2006) identifies the following items of potential environmental concern pertaining to the project Site.

Prior Industrial Use

Historic oil drilling activity at two sites on the property (and current activity at two sites adjacent to the Site) could, potentially, have resulted in soil contamination. Oil wells can seep oil or gas, or may be associated with surface contamination. The area adjacent to the gas gathering line (see photo at left) could have also been impacted by prior use. Further sampling and fieldwork are required in the next phase of the environmental assessment to determine what measures might be required for mitigation of potential soil contamination in these areas.

Existing Water Wells

Although there are no restrictions on development near capped oil wells, there are four water wells on the property. Of unknown depth and functionality, these wells are marked with blue circles at right. The potential abandonment or conversion of these wells for irrigation water supply requires further investigation. It is likely that the wells were associated with prior ranching on the Site, as water for livestock is available in the area at a shallower depth than potable water. Two stock ponds testify to former ranching on the Site.

Floodplain and Stormwater ROW

An interior stormwater right of way (ROW) connecting the Traditions housing development to Turkey Creek flows along the northern boundary of the Site (dashed blue line at right). This stormwater ROW takes the form of a vegetated swale.

Also intersecting the Site is the 100-year floodplain associated with drainage ways contributing to Turkey Creek. The drainage ways themselves (blue lines, right) could be classified as Waters of the United States, subject to the U.S. Army Corps of Engineers’ requirements of Section 404 of the Clean Water Act. The Health Science Center must check the applicability of regulatory requirements before each phase of development, and avoid development in Waters of the U.S.

Potential Soil Contamination

A patch of dead vegetation near the existing pond at the south end of the Site indicates an area of possible soil contamination (see photo at upper left, lavender asterisk at right). Further environmental assessment of this area is needed, as similar vegetation kill has been seen in cases of illicit dumping of substances as varied as assorted fuels to radioactive wastes. The contamination could also be a byproduct of prior industrial (oil-drilling) use of the Site. Hopefully, the contaminant present in this area could be adequately contained from exposure through the application of an impermeable surface layer, taking the form of either a paved surface or an impermeable clay cap covered with a layer of topsoil and shallow-rooted vegetation.
Environmental Assessment

The Site has a history of past use for ranching and oil drilling, and is adjacent to one producing oil well. Furthermore, Turkey Creek’s 100-year floodplain intersects the Site. Its drainage ways could be considered Waters of the U.S., and, as such, potentially subject to the requirements of Section 404 of the Clean Water Act.
Buildable Area

The site analysis considerations described above contributed to the diagram of overall buildable area (at right). Of the Site’s 203 acres, 128 (63.1%) can be considered buildable.

Natural Constraints

Among the natural constraints limiting buildable area were: (1) areas of steep slopes (20% and higher), (2) areas of highest value wooded vegetation, (3) drainage ways and (4) Turkey Creek’s 100-year floodplain.

Steep slopes should be avoided for development because of the instability of highly erodible soils. Federal requirements limit development within floodplains and along drainage ways considered Waters of the U.S. It was desirable to preserve wooded areas dominated by mature oak trees in order to create ‘a campus in a forest.’ Together, these natural constraints covered approximately 75 acres (36.9%) of the Site, forming a core, natural area preserved from development. This central natural area formed a major organizing element in the master planning process.

Above:
Several areas of environmental consideration combine to shape the area diagrammed as ‘buildable area’ at right. These include: (1) steep slopes, (2) areas with high quality vegetation, and (3) open water and drainage ways.
Buildable Area

Approximately 75 acres (36.9%) of the Site are covered with high value oak woodlands, drainage ways, and/or steep slopes. The remaining 63.1% can be considered buildable area.
Site Character

In summary, the 203-acre Site, similar to the surrounding Brazos County, has experienced a varied history, having housed in the past both agricultural and industrial land uses. Evidence of prior ranching and oil drilling is present (see photos at left), with consequences for vegetation patterns - and, in the case of oil drilling, some concern about possible soil contamination.

The abundant presence of petrified wood on the Site (see photos, facing page) suggests a rich geologic history that should be acknowledged in the final design of the Campus. At the master planning level, however, of more immediate concern was the development of a plan for "a campus in a forest" that would impact high-quality natural areas as little as possible. The analysis of community connections (pages 12-13) helped shape the alternatives for framework, access and circulation that follow; the overlay of historic photos and diagram of high value wooded areas influenced the master plan's early concept sketches. In order to create a distinct Health Science Center campus, it was important to identify these distinctive elements of site character.

Above, at right:
The Site’s geology features a broad palette of stone colors (above) as well as an abundance of petrified wood (facing page).

Site photos show (from top to bottom): evidence of ranching, an existing entrance from TX-47 and grassland meadow.
The Site’s natural amenities led to the master planning concept of ‘a campus in a forest.’ The master plan seeks to preserve areas of highest natural value (at right) and focus development in disturbed areas (above).
Conceptual Master Plan

The conceptual master plan diagram, which formed part of the consultant selection process in April 2007, captured the spirit of the future Health Science Center campus. This diagram guided the project team as master planning progressed.

This section covers the following topics:

- Conceptual campus master plan
- Preliminary site utilization
Conceptual Master Plan

The conceptual master plan (at right) featured a horseshoe shaped loop road paired with formal pedestrian axes.

A quantity takeoff of the conceptual master plan revealed the accommodation of 2.48 million gross square feet (GSF) of development and 7,006 parking spaces. These estimates approached 60% and 76% of the totals of the final program, respectively (see pages 45-46).

Preliminary Site Utilization

Site utilization in the conceptual plan incorporated the three major categories of the master plan program (Health Science Center academic Campus, affiliated research partner facilities, and a healthcare complex), as well as an area of commercial development. (In the final campus plan, some small service and convenience retail remained integrated with the healthcare complex.) The conceptual plan accommodated 1.5 million GSF for the Health Science Center campus, 0.4 million GSF for affiliated research, and 1.1 million GSF for the hospital complex. In comparison, the final master plan program totals were: 2.3 million GSF for the Health Science Center campus, 0.3 million GSF for affiliated research, and 1.5 million GSF for healthcare facilities.

The general relationships of the Campus, hospital, and research park in the conceptual master plan held up under the scrutiny and analysis of the master planning process, influencing the final master plan (see page 60).
Preliminary Site Utilization

A quantity takeoff of the conceptual master plan found a total of 2,483,900 GSF and 7,006 parking spaces.
Campus Definition

The exploration of framework, circulation and access alternatives (see pages 42-53) began with a study of other campuses. These alternatives and comparisons helped define the campus master plan and program (pages 45-47). The master plan (page 60) formed a counterpoint to the conceptual master plan, with higher density and a loop road system. A charette, or intense but short design ‘brainstorm,’ in July of 2007 helped distill two design concepts, of which the second formed the basis of the campus master plan.

This section covers the following topics:

- Campus precedents
- Charette concepts
- Program summary
- Concept sketches
- Framework alternatives
- Access and circulation alternatives
Campus Precedents

A comparison of other campuses, in terms of form, density, and composition, helped explore the plan and program possibilities for the Health Science Center. A series of campus posters with figure-ground studies and summary statistics, published by Ayers Saint Gross (1998-2002), were used for the following exercises.

Figure-Ground Comparisons

First, imposing figure-ground studies of a number of campuses within the boundary of the Site helped demonstrate a range of approaches to campus planning. The campuses selected for this exercise were either located within Texas or similar in function to the proposed Health Science Center campus (e.g., the Medical University of South Carolina.)

Statistical and Parking Ratio Comparisons

Secondly, an analysis of summary statistics available from Ayers Saint Gross Architects for 108 campuses in the U.S. and Canada revealed the following patterns. Overall, the average parking ratio (number of spaces per 1,000 gross square feet of building) was 1.17, slightly more than one space per two students (see pages 40-41). As the featured campuses ranged in size from 230,750 to more than 23 million GSF and were accordingly varied in their ratios of parking and students, an examination of campuses closer in size to the proposed Health Science Center was valuable.
The master plan program calls for Campus facilities totaling 2.32 million GSF (see pages 45-47). Sorting campuses by building GSF revealed that campuses within 25% of the size of the Health Science Center (i.e., from 1.72 to 2.86 million GSF) had a mean parking ratio of 0.99 spaces per 1,000 GSF, and 0.50 spaces per student (see Average Statistics, page 41). This is close to the master plan program’s overall academic parking ratio of 0.94 space per 1,000 GSF, as well as the City of Bryan’s recommendations for one space per two students (City of Bryan 2004: 43). Following the City of Bryan’s metric of 1.00 space per faculty/staff and 0.50 space per student on campus would result in 2,037 spaces for the 2,316,753 GSF of buildings proposed for the Health Science Center campus.

However, the average parking ratios for universities in Texas proved to be higher than the average for all campuses. The five Texas campuses for which summary statistics were available are parked at an average of 1.68 spaces per 1,000 GSF, or 0.64 spaces per student (see Average Statistics, page 41). The two medical campuses for which statistics were available allocated more building space per student than the liberal arts campuses; on average, 1,317 GSF.
Dividing the HSC’s proposed 2.32 million GSF by 1,317 GSF per student suggests a student population of 1,759 at full buildout. This appears to be in accord with the Health Science Center’s projections (see graph below). Applying the Texas parking ratio of 0.64 spaces per student would result in a total of 1,126 parking spaces: one space per faculty/staff and one for each two students, and implying a ratio of 3.5 students per faculty/staff. If the ratio of students to staff were to remain at the Phase 1 level (1.52 students per staff), then between 2,037 and 2,187 parking spaces would be needed at full buildout, using City of Bryan and Texas A&M metrics, respectively (see page 44). The A&M metric is based on providing parking for 75% of a building’s occupants.

For more information about campus parking, see the Campus Guidelines (page 90).

A graph of HSC’s projected student population (y axis) against time (x axis) suggests the Health Science Center student population will reach the full buildout level of 1,759 around 2044.

### Campus Summary Statistics

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### Campus Summary Statistics

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</tr>
<tr>
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<td>482</td>
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<tr>
<td>University of Rochester; Rochester, NY</td>
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</tr>
<tr>
<td>University of South Florida; Tampa, FL</td>
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<tr>
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<tr>
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<td>353</td>
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</tr>
<tr>
<td>University of Victoria; Victoria, British Columbia</td>
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<td>9,359</td>
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<td>Yale University; New Haven, CT</td>
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<td>3,580</td>
<td>1,120</td>
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</table>

Mean: 530

4: Campus Definition
Charette Concepts (13 June 2007)

In June 2007, a charette refined the concepts set forth by the preliminary plan and incorporated client and stakeholder feedback. Charette participants included representatives of the Health Science Center, Texas Department of Transportation, City of Bryan, two proposed clinical affiliates, and neighboring property owners. Having these ‘major players’ at one table (see page 44) helped streamline the decision making process and allowed planning transportation and circulation access outside the boundaries of the Site.

The outcome of the design charette was the development of two opposing site utilization schemes, with varying approaches to circulation and phasing, as well as varying proportions of ‘town and gown,’ (i.e., community and Health Science Center) relationships.

Charette Concept A

Concept A begins with a focus on ‘gown’ (i.e., the Health Science Center campus), with development starting at ‘front and center,’ progressing initially toward the south. Limited convenience retail could be included in the early development phases.

Once reaching a critical mass, development would spur north to form a ‘town’ center, featuring retail integrated with the hospital complex. The loop road then circles back to the Phase 1 area to provide emergency access to the east side of the hospital.
Charette Concept B

Concept B flips the relationship of hospital and campus, and moves the center of gravity northward. This concept would allow for a greater mingling of program and use, with research, healthcare facilities and the academic campus interfacing within a 5-minute walk of one another. This scheme would also initially focus on ‘gown’, with hospital, retail and the associated south half of the loop road developing in a more piecemeal fashion over time.
Early sketches investigated a range of organizational possibilities for the Site.

Collaboration was an important aspect of the master planning process.

Members of the Project Team stand with Dr. Dickey at the Convocation Ceremony.
Program Summary

The master plan accommodates, at maximum buildout, 4.19 million gross square feet (GSF) of development and 8,914 parking spaces. Most buildings are 3-4 stories. The program (at right) is divided into three categories: (1) the Health Science Center campus, (2) affiliated partner research facilities, and (3) healthcare complex. Detailed phasing information is presented in pages 65-73 of this document.

The Health Science Center Campus

Through a series of workshops with representatives of the Health Science Center, it became apparent that a priority for the master plan was creating an interdisciplinary environment. The client stressed the importance of breaking down discipline-specific “silos,” resulting in increased opportunities for interdisciplinary and interprofessional collaboration. This philosophy strongly influenced the proposed Health Science Center campus program.

The facilities of the Health Science Center campus fall into three main categories: education, academic, and research. Classroom facilities form a series of inter-departmental education buildings (delimited as the ‘ED-’ series). Faculty offices and administrative support combine within academic (‘AC-’) buildings, and interdisciplinary research (‘R-’) buildings facilitate infrastructural efficiency as well as additional collaborative opportunities among faculty. A student center comprises a fourth organizational category (‘S-‘), encompassing student affair facilities. Housing associated with the Health Science Center campus, for students and visiting scholars, falls in a fifth category (‘HS-‘). Finally, campus infrastructure (‘CI-‘) accommodates the infrastructural and utilities demand associated with campus development.

Altogether, the campus component of the Health Science Center is projected to consist of 2.32 million GSF and require, at full build out, 2,187 parking spaces.

Affiliated Partner Research Facilities

Four buildings for affiliated partner research facilities (‘R&D-‘) are planned for Phase 3, contributing another 325,000 GSF and 1,073 parking spaces to the planned Site totals.

Healthcare Complex

Two health partners are expected to participate in the first phase of the development of the healthcare complex. A medical office building (MOB-2), the Ambulatory Care Clinic, and the Family Medicine Center (CL-1), will comprise the Phase 2 portion of the health complex’s development, from 2010-2017. Two additional MOB’s, and an expansion of the Clinical Affiliate facility (CL-A2), and the first phase of a hospital with associated integrated retail are projected for Phase 3, between 2020-2030. Finally, sufficient land was reserved for a potential hospital expansion in Phase 4’s full buildout.

The healthcare complex component of the master plan consists of 1.54 million GSF and 5,654 parking spaces.
### Master Plan Program

<table>
<thead>
<tr>
<th>Phase</th>
<th>Move in date</th>
<th>Building</th>
<th>GSF</th>
<th># Stories</th>
<th>Footprint (SF)</th>
<th>Parking ratio</th>
<th>Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HEALTH SCIENCE CENTER: Education &amp; Research Facilities</td>
<td>2,316,753</td>
<td>4 to 4</td>
<td>669,980</td>
<td>0.94</td>
<td>2,187</td>
</tr>
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<td>1</td>
<td>2010 ED-1</td>
<td>Health Professions Education Center (HPEC)</td>
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<td>4</td>
<td>30,890</td>
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<tr>
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<td>Medical Education &amp; Research Building (MERB)</td>
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</tr>
<tr>
<td>1</td>
<td>2010 CI-1</td>
<td>Campus central plant</td>
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<td>2</td>
<td>15,000</td>
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</tr>
<tr>
<td>1</td>
<td></td>
<td>Health Science Center Phase 1 totals</td>
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<td></td>
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<td>710</td>
</tr>
<tr>
<td>2</td>
<td>2019 ED-2</td>
<td>Temporary Administration / Residency Program</td>
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<td>25,000</td>
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<td>2</td>
<td>2010-15 AC-1</td>
<td>Central Administration Building</td>
<td>100,000</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>2014-15 ED-3</td>
<td>Education building with auditorium</td>
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<td>3 to 4</td>
<td>55,938</td>
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<tr>
<td>2</td>
<td>~ 2015 R-2</td>
<td>Research expansion</td>
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<td>5</td>
<td>31,213</td>
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<tr>
<td>2</td>
<td>~ 2015 HS-1</td>
<td>Student and visiting scholar housing</td>
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<td>2020 AC-2</td>
<td>Faculty offices</td>
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<td>50,000</td>
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<td>2020 ED-4</td>
<td>Education facility</td>
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<td>2025 S-1</td>
<td>Student Center</td>
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<td>Campus central plant expansion</td>
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<td>Faculty offices</td>
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<td>3</td>
<td>25,000</td>
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<td>Possible additional research building</td>
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<td><strong>4. full buildout</strong></td>
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<tr>
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<td></td>
<td>AFFILIATED PARTNER RESEARCH FACILITIES</td>
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<td>20,313</td>
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<td>20,313</td>
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<tr>
<td>3</td>
<td>2020+ R&amp;D-3</td>
<td>Research partner building</td>
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<td>20,313</td>
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<td>2010 CL-A1</td>
<td>Clinical Affiliate, in-patient (24 beds)</td>
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<td>2</td>
<td>25,000</td>
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<td>Family Medicine Center</td>
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<td>3 to 4</td>
<td>20,831</td>
<td>1.00</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>~ 2017 MOB-2</td>
<td>Ambulatory Clinical Care</td>
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<td>2020 CL-A2</td>
<td>Extension of Clinical Affiliate's in-patient facilities</td>
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<tr>
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<td>Hospital central plant (integrated w/ parking)</td>
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<td>30,000</td>
<td>1.00</td>
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<tr>
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<td>2020+ H-1</td>
<td>HOSPITAL-1 (250 beds)</td>
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<td>4 to 6</td>
<td>129,195</td>
<td>3.70</td>
<td>1,912</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3 Bedtowers (part of Hospital-1), each 6 stories, 119,520 GSF</td>
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</tr>
<tr>
<td>3</td>
<td>2020+ MOB-4</td>
<td>Integrated retail</td>
<td>67,500</td>
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<td>67,500</td>
<td>5.00</td>
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<td>3</td>
<td>~ 2030 MOB-3</td>
<td>Health clinic / advanced diagnostic clinic</td>
<td>62,500</td>
<td>3</td>
<td>20,833</td>
<td>5.00</td>
<td>313</td>
</tr>
<tr>
<td>3</td>
<td>~ 2030 MOB-4</td>
<td>Health clinic / advanced diagnostic clinic</td>
<td>62,500</td>
<td>3</td>
<td>20,833</td>
<td>5.00</td>
<td>313</td>
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<tr>
<td>4</td>
<td>2030+ H-2</td>
<td>HOSPITAL-2 (250 beds)</td>
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<td>4 to 6</td>
<td>129,195</td>
<td>3.70</td>
<td>1,912</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3 Bedtowers (part of Hospital-2), each 6 stories, 119,520 GSF</td>
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<tr>
<td></td>
<td></td>
<td>FULL BUILDOUT SITE TOTALS</td>
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### Master Plan Parking Metrics

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<tr>
<th>Phase</th>
<th>Building GSF</th>
<th>Move in date</th>
<th>Projected students</th>
<th>Projected faculty / staff</th>
<th>Student to faculty ratio*</th>
<th>Total population</th>
<th>Parking ratio for students</th>
<th>Student parking</th>
<th>Parking ratio for faculty / staff</th>
<th>Faculty / staff parking</th>
<th>Total Cars</th>
<th>New spaces</th>
<th>New parking ratio (per 1000 GSF, by each phase)</th>
<th>Overall parking ratio (per 1000 GSF, by full buildout)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>257,602</td>
<td>2010</td>
<td>570</td>
<td>376</td>
<td>1.52</td>
<td>946</td>
<td>0.75</td>
<td>428</td>
<td>0.75</td>
<td>282</td>
<td>710</td>
<td>710</td>
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<td>2.75</td>
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<tr>
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<td>1,088</td>
<td>716</td>
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<td>1,804</td>
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<td>816</td>
<td>0.75</td>
<td>537</td>
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<td>1.29</td>
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<td>2,089</td>
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<td>945</td>
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<td>622</td>
<td>1,567</td>
<td>214</td>
<td>0.52</td>
<td>1.07</td>
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<tr>
<td>4</td>
<td>1,754,253</td>
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<td>0.75</td>
<td>713</td>
<td>1,797</td>
<td>230</td>
<td>0.78</td>
<td>1.02</td>
</tr>
<tr>
<td>**</td>
<td>2,316,753</td>
<td>2040+</td>
<td>1,759</td>
<td>1,157</td>
<td>1.52</td>
<td>2,916</td>
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<td>0.94</td>
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</tbody>
</table>

* Student to faculty ratio assumed to remain consistent with Phase 1 ratio; **Full buildout

### Parking for Health Science Center Research and Education Facilities: City of Bryan Metric

<table>
<thead>
<tr>
<th>Phase</th>
<th>Building GSF</th>
<th>Move in date</th>
<th>Projected students</th>
<th>Projected faculty / staff</th>
<th>Student to faculty ratio*</th>
<th>Total population</th>
<th>Parking ratio for students</th>
<th>Student parking</th>
<th>Parking ratio for faculty / staff</th>
<th>Faculty / staff parking</th>
<th>Total Cars</th>
<th>New spaces</th>
<th>New parking ratio (per 1000 GSF, by each phase)</th>
<th>Overall parking ratio (per 1000 GSF, by full buildout)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>257,602</td>
<td>2010</td>
<td>570</td>
<td>376</td>
<td>1.52</td>
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<td>285</td>
<td>1.00</td>
<td>376</td>
<td>661</td>
<td>661</td>
<td>2.57</td>
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<td>2</td>
<td>1,045,515</td>
<td>2019</td>
<td>1,088</td>
<td>716</td>
<td>1.52</td>
<td>1,804</td>
<td>0.50</td>
<td>544</td>
<td>1.00</td>
<td>716</td>
<td>1,260</td>
<td>599</td>
<td>0.76</td>
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<td>3</td>
<td>1,458,265</td>
<td>2020</td>
<td>1,260</td>
<td>829</td>
<td>1.52</td>
<td>2,089</td>
<td>0.50</td>
<td>630</td>
<td>1.00</td>
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<td>1,459</td>
<td>199</td>
<td>0.48</td>
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<tr>
<td>4</td>
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<td>1,445</td>
<td>951</td>
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<td>2,396</td>
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<tr>
<td>**</td>
<td>2,316,753</td>
<td>2040+</td>
<td>1,759</td>
<td>1,157</td>
<td>1.52</td>
<td>2,916</td>
<td>0.50</td>
<td>880</td>
<td>1.00</td>
<td>1157</td>
<td>2,037</td>
<td>364</td>
<td>0.65</td>
<td>0.88</td>
</tr>
</tbody>
</table>

* Student to faculty ratio assumed to remain consistent with Phase 1 ratio; **Full buildout

Above:
The higher of two parking metrics shaped the final program.

At left:
The master plan program calls for 4.19 million gross square feet of development at full buildout (2030+).
Concept Sketches

Concurrent with the development of the master plan program, a variety of master plan concepts explored possible arrangements of elements on the Site. The concepts generated fall into two categories: informal and formal schemes.

Of these concepts, three were explored in additional detail as framework alternatives.

Informal Concepts

The informal Concepts 1-3 (below) derive their organization from the central green way, either with the main campus road closely flanking the ravine (green), as in Concepts 1 and 2, or perpendicular to it as in Concept 3.

Informal Concept Sketches

Concept Sketches

Concept sketches for informal (1-3) and formal (4-6) schemes explore possible arrangements of Site elements. Concept 7, which adopts a hybrid approach, formed the basis of the master plan.
Formal Concepts

The more formal Concepts 4-6 (below) introduce organizing elements perpendicular to Texas State Highway 47 as well as strong axes to facilitate pedestrian movement (orange). In contrast, Concept 7 (lower right) adopts a hybrid approach, with formalized pedestrian elements bordered by a more informal, somewhat curvilinear, loop road (black) for campus vehicular circulation.

Formal Concept Sketches

Hybrid Concept Sketch
Framework Alternatives

Exploring a range of framework alternatives was important to maximizing the asset of the core greenspace delimited by the Site Analysis. These alternatives establish three different possible arrangements of road and pedestrian access, with varying implications for the core greenspace and number of drainage crossings.

Framework alternatives 1 and 2 (at right) are formal schemes that both focus major points of entry from TX-47. Framework 3 (at far right) is a less formal scheme which pushes vehicular access out to the periphery of the Site.

Framework Alternative 1

Alternative 1 (at left) abandons connections to the south of the Site in favor of two links to the north. The central loop road in this scheme crosses the core greenspace twice, with a secondary loop accessing the south end of the Site through additional channel crossings. The focus of pedestrian activity is central, with one main pedestrian access surrounded by a pedestrian connection (dashed gray line) within the loop road.

A major disadvantage in this scheme is the considerable number of channel crossings required. Paths of vehicular access cross the core greenspace six times, constricting the opportunities for pedestrians to experience campus greenspace.

Framework Alternative 2

In contrast, the loop road in Alternative 2 (at left) crosses the central greenspace four times, ending in two cul-de-sacs to the north. The loop road in this alternative connects to South Traditions Drive at the southeast corner of the Site. Three pedestrian access spines transect the Site. Additional pedestrian circulation occurs, similar to Framework 1, along a pedestrian spine within the loop road.

While this framework was adapted for the preliminary master plan and explored further in design charettes, it was discarded in favor of the increased pedestrian opportunities and closed loop road of Alternative 3.
Framework Alternative 3

In Alternative 3 (above), the loop road assumes a more organic and curvilinear form, just within the property line of the Site. This arrangement minimizes the need for major channel crossings, while maximizing the area of pedestrian activity bound by the loop road. Two pedestrian axes and a more formal pedestrian loop define circulation patterns around the core greenspace of the Site. This alternative, with further modifications, formed the basis of the master plan.
Access and Circulation Alternatives

Using Framework Alternative 3, two access and circulation alternatives explored potential relationships of the loop road to the southern property line of the Site. Both schemes allow access to TX-47 from the Site, as well as a connection toward Texas A&M University’s campus along an extension of F&B Road (anticipated in 2009-2010, according to representatives of the City of Bryan).

Alternative A

In Alternative A (at right), the internal campus loop road would connect to an external collector road just outside the southern boundary of the Site. This scheme, proposed to increase the distance between the loop road and existing pond, was seen as disadvantageous for two reasons. First, traffic counts along the shared loop/collector road could prove heavier than desired, potentially impacting site and campus character. As areas west of TX-47 develop, an extension of F&B Road might host levels of traffic comparable to those on West Villa Maria Drive, the existing arterial connecting the City of Bryan to TX-47. Secondly, the client expressed concerned about the Health Science Center “losing control” over its loop road through this scheme, both in aesthetic terms and in matters of campus security.
Alternative B

In Alternative B (at right), the F&B Road extension and campus loop road remain separate, although sharing a common outlet onto TX-47. This scheme provides commercial development opportunities between TX-47 and the F&B extension, and also could catalyze a higher density development along TX-47. Representatives of the City of Bryan considered these factors desirable, and the client also preferred this internal loop road scheme.
Campus Master Plan

Exploring a series of framework, circulation, access alternatives contributed to a more robust design for the Health Science Center. The previous considerations led to the development of a master plan that integrates the program requirements with the Site’s natural areas to form ‘a campus in a forest.’ The master plan avoids development in the most valuable natural areas of the Site and along its central ravine. Access to the Health Science Center’s academic campus is structured around a pedestrian spine. Vehicular access is restricted to a loop road at the periphery of the Site, with the exception of a series of formal entrances serving the healthcare facilities and campus.

This section covers the following topics:

- Image and character
- Planned facilities
- Site utilization
- Phasing
- Sun and shadow
- Vehicular circulation
- Pedestrian circulation
- Utilities
- Massing study
- Campus sections
Aerial views of the Health Science Center at full buildout show the interface of development with natural areas on the Site, ‘a campus in a forest.’
Image and Character

The Site’s central ravine and green space presents opportunities for multiple pedestrian crossings. The interface of natural areas and buildings provides open spaces of differing scales. Both intimate and extensive outdoor spaces, as well as external gathering places are important to a campus, where open space is as important as cyber space. The campus bell tower proposed for Phase 2 is an important iconic element, potentially visible from TX-47 as well as from Texas A&M University’s campus.

The master plan delineates three landscape types: (1) campus landscape, (2) native landscape and (3) wooded areas. Each of these landscape types has a distinct character (see following pages).

Campus Landscape

Precedent images demonstrate what the campus landscape might look like. Campus ponds will serve both aesthetic and water quality functions. Campus landscapes also include plazas and flexible-use lawns.
Native Landscape

Precedent images demonstrate what the campus native landscape might look like. Native plants are vital for reducing water demand (from irrigation) and for providing wildlife habitat. Manicured edges delimit native areas from higher use zones.
Wooded Area

Precedent images demonstrate what the campus wooded areas might look like. Preserving as much of the existing tree canopy as possible is integral to creating ‘a campus in a forest.’
Native landscape
Campus landscape
Wooded area
Highest quality vegetation
Water
Pedestrian plaza
Pedestrian path
Pedestrian trail
Surface parking
Parking structure
Underground parking, 2 stories
Building
2-foot contour
10-foot contour
Property line
Drainage channel
Planned Facilities

The campus master plan provides for the following facilities.

### Hospital and Health Complex

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOB-1</td>
<td>Medical office building</td>
<td>~2010</td>
</tr>
<tr>
<td>CL-A1</td>
<td>Clinical Affiliate, in-patient (24 beds)</td>
<td>2010</td>
</tr>
<tr>
<td>CL-1</td>
<td>Family Medicine Center</td>
<td>2010-2015</td>
</tr>
<tr>
<td>MOB-2</td>
<td>Ambulatory Care Clinic</td>
<td>~2017</td>
</tr>
<tr>
<td>CL-A2</td>
<td>Extension of Clinical Affiliate’s in-patient facilities</td>
<td>2020</td>
</tr>
<tr>
<td>MOB-3 &amp; 4</td>
<td>Medical office buildings</td>
<td>2020+</td>
</tr>
<tr>
<td>H-CP</td>
<td>Hospital central plant</td>
<td>2020+</td>
</tr>
<tr>
<td>H-1</td>
<td>250-bed hospital</td>
<td>2020+</td>
</tr>
<tr>
<td>H-2</td>
<td>250-bed expansion of hospital</td>
<td>2030+</td>
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### Affiliated Research Partner Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D-1 - 4</td>
<td>Research partner buildings</td>
<td>2020+</td>
</tr>
</tbody>
</table>

### Education Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED-1</td>
<td>Health Professions Education Center (HPEC)</td>
<td>2010</td>
</tr>
<tr>
<td>ED-2</td>
<td>Temporary administration / Residency program</td>
<td>2019</td>
</tr>
<tr>
<td>ED-3</td>
<td>Education building with auditorium</td>
<td>2014-2015</td>
</tr>
<tr>
<td>ED-4</td>
<td>Program expansion education facility</td>
<td>2020</td>
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### Academic Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-1</td>
<td>Central Administration building</td>
<td>2010-2015</td>
</tr>
<tr>
<td>AC-2</td>
<td>Faculty offices</td>
<td>2012</td>
</tr>
<tr>
<td>AC-3</td>
<td>Faculty offices</td>
<td>2020</td>
</tr>
<tr>
<td>AC-4 - 9</td>
<td>Prospective additional academic buildings</td>
<td>2030+</td>
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</table>

### Research Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-1</td>
<td>Medical Education and Research Building (MERB)</td>
<td>2010</td>
</tr>
<tr>
<td>R-2</td>
<td>Research expansion</td>
<td>~2015</td>
</tr>
<tr>
<td>R-3 &amp; 4</td>
<td>Possible additional research buildings</td>
<td>2030+</td>
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### Campus Infrastructure Facilities

<table>
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<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
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<tr>
<td>CI-1</td>
<td>Campus central plant</td>
<td>2009</td>
</tr>
<tr>
<td>CI-2</td>
<td>Campus central plant expansion</td>
<td>2020+</td>
</tr>
<tr>
<td>CI-3</td>
<td>Maintenance shop facility</td>
<td>2020+</td>
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### Student Affairs Facilities

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<th>Facility</th>
<th>Description</th>
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<tr>
<td>S-1</td>
<td>Student Center</td>
<td>2025</td>
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</table>

### Housing Associated with the Health Science Center

<table>
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<tr>
<th>Facility</th>
<th>Description</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-1</td>
<td>Student and visiting scholar housing</td>
<td>~2015</td>
</tr>
</tbody>
</table>
Site Utilization

As previously discussed (see master plan program, pages 45-47) the master plan calls for 4.19 million GSF of development at full buildout.

Health Science Center Campus

The largest portion of development (2.32 million GSF) falls within the Health Science Center’s academic campus, which occupies the center of the Site and surrounds the majority of the pedestrian spine’s arc (see dark blue area at right). Within the academic campus, there are two additional types of development: (1) campus infrastructure facilities, including the campus central plant and maintenance shop area (brown) and (2) the student and visiting scholar housing area (light yellow). These facilities will be composed of no more than two stories and constitute 130,000 and 58,100 GSF, respectively.

Healthcare Complex

The second largest proposed land use is the healthcare complex (light blue), located on the largest pad of buildable area, in the northwest quadrant of the Site. The healthcare complex comprises 1.55 million GSF. The 74,000 GSF and 186 parking spaces associated with the medical partner located at the south end of the Site (CL-A1 and CL-A2) are included in the healthcare complex total. The existing pond, mature oak trees and easy access to trails at this location provide a peaceful and private backdrop befitting the in-patient services this anticipated partner will provide (see photo at upper left).

Research Park

The research park, which provides facilities for research partners affiliated with the Health Science Center, also spans two locations (tan). The considerable amount of surface parking associated with the research park requires relatively flat development areas. Accordingly, three R&D buildings occupy the southeast corner of the Site, with the fourth taking advantage of the large level area across the campus loop road from the campus central plant.
Site Utilization

The Site's development is organized into distinct zones by use type (see categories at upper left). The diagram of site utilization summarizes these proposed land uses and their associated totals of building gross square feet (GSF).
Phasing

Phasing was an important consideration during the master planning process.

With some buildings in Phase 1 scheduled for occupancy in the summer of 2010, but Phase 4 expected no sooner than 2030, phasing was a crucial aspect of the master planning process. Detailed phasing information is presented on the following pages.
Phase 1 includes 387,602 GSF of building space and requires 1,124 parking spaces.

Phase 2 adds 725,413 GSF and 1,031 parking spaces to the Site's totals, now 1,113,015 GSF and 2,154 spaces.

Phase 3 adds 1,626,030 GSF and 4,227 parking spaces to the Site's totals, now 2,739,045 GSF and 6,381 spaces.

Phase 4 adds 1,450,268 GSF and 2,533 parking spaces to the Site's totals, at full buildout 4,189,313 GSF and 8,914 spaces. Four lanes may eventually be required to serve traffic around the loop road.
Phase 1 (2009-2010)

Five buildings comprise Phase 1. Two healthcare partners hope to be ready for move-in by 2010. The first phase of the Health Science Center Campus consists of two buildings, the Health Professions Education Center (HPEC) and the Medical Education and Research Building (MERB). A central plant adequate to supply utilities for these four buildings completes the list of facilities scheduled for 2010-2011. Together, the buildings of Phase 1 constitute 387,602 GSF and require 1,124 parking spaces.

Phase 1 Site Amenities

Besides providing a formal entry to the Campus, Phase 1 initiates the network of pedestrian trails crucial to experiencing natural areas of the Site. Water quality ponds intercept stormwater and filter sediments before they reach the central ravine, serving an aesthetic function as well.

Phase 1 Parking

While parking in the Phase 1 area can be initially accommodated through surface lots, a two-level parking structure (below) is ultimately required in the area. An all-surface approach to parking in Phase 1 reduces initial infrastructure cost, but once budget allows, constructing a parking structure will reduce the amount of surface parking present at the ‘front door’ of the Campus, helping to preserve a more aesthetic campus entrance.

<table>
<thead>
<tr>
<th>Move in date</th>
<th>Building GSF</th>
<th>Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEALTH SCIENCE CENTER: Education &amp; Research Facilities</strong></td>
<td>227,602</td>
<td>699</td>
</tr>
<tr>
<td>2010 ED-1</td>
<td>Health Professions Education Center (HPEC)</td>
<td>123,560</td>
</tr>
<tr>
<td>2011 R-1</td>
<td>Medical Education &amp; Research Building (MERB)</td>
<td>104,042</td>
</tr>
<tr>
<td><strong>HOSPITAL COMPLEX / HEALTH PARTNERS</strong></td>
<td>130,000</td>
<td>414</td>
</tr>
<tr>
<td>2010 MOB-1</td>
<td>Medical Office Building</td>
<td>80,000</td>
</tr>
<tr>
<td>2010 CL-A1</td>
<td>Clinical Affiliate, in-patient (24 beds)</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>CAMPUS INFRASTRUCTURE</strong></td>
<td>30,000</td>
<td>11</td>
</tr>
<tr>
<td>2009 CI-1</td>
<td>Campus central plant</td>
<td>30,000</td>
</tr>
</tbody>
</table>

Phase 1 totals: 387,602 1,124
Phase 1 Development

Phase 1 introduces five buildings (0.39 million GSF) and 1,124 parking spaces to the Site.
Phase 2 (2012-2019)

In Phase 2 (at right), the main entry plaza fills out with a bell tower, a parking structure, and a third campus building, which might initially provide space for central administration. The first of two pedestrian axes spans the central greenspace, linking to the Phase 2 plaza and Central Administration building planned for 2010-2015. Two education buildings and an extension of the pedestrian loop begin to define the campus core. Housing, for students and visiting scholars, links to the Campus through an expanded trail system.

The healthcare complex, anticipated to be the fastest growing facility on the Site, starts construction with the first half of its underlying parking garage and two medical buildings (MOB-2 & CL-1), the Ambulatory Care Clinic and Family Medicine Center. By the end of Phase 2, the loop road is two thirds complete.

Phase 2 adds 725,413 GSF and 1,031 parking spaces to the Site’s totals, now 1,113,015 GSF and 2,154 spaces.
Phase 2 Development

Phase 2 introduces seven buildings (725,413 GSF) and 1,124 parking spaces to the Site.
Phase 3 (2020+)

In Phase 3, the development of the hospital and health complex accelerates, with construction of additional parking structures, two MOBs, an independent hospital central plant, and the first phase hospital.

The second pedestrian axis spans the central greenspace to link the hospital to the Student Center. A building for additional health professions faculty offices (AC-2) joins Central Administration, and an additional education facility anchors the southeast corner of the Phase 2 plaza.

The campus central plant expands, adding a maintenance shop facility to keep pace with development. Four affiliated research partner facilities take up residency at the south end of the Site. The loop road closes its circuit, and the network of pedestrian trails is complete.

Phase 3 adds 1,626,030 GSF and 4,227 parking spaces to the Site’s totals, now 2,739,045 GSF and 6,381 spaces.

### Phase 3 Development

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<tr>
<th>Move in date</th>
<th>Building GSF</th>
<th>Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEALTH SCIENCE CENTER: Education &amp; Research Facilities</td>
<td>437,750</td>
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<tr>
<td>2020</td>
<td>ED-4 Education facility</td>
<td>117,750</td>
</tr>
<tr>
<td>2020</td>
<td>AC-2 Faculty offices</td>
<td>200,000</td>
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<tr>
<td>2025</td>
<td>S-1 Student Center</td>
<td>120,000</td>
</tr>
<tr>
<td>AFFILIATED PARTNER RESEARCH FACILITIES</td>
<td>325,000</td>
<td>1,073</td>
</tr>
<tr>
<td>2020+</td>
<td>R&amp;D-1 Research partner building</td>
<td>81,250</td>
</tr>
<tr>
<td>2020+</td>
<td>R&amp;D-2 Research partner building</td>
<td>81,250</td>
</tr>
<tr>
<td>2020+</td>
<td>R&amp;D-3 Research partner building</td>
<td>81,250</td>
</tr>
<tr>
<td>2020+</td>
<td>R&amp;D-4 Research partner building</td>
<td>81,250</td>
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<tr>
<td>HOSPITAL COMPLEX / HEALTH PARTNERS</td>
<td>763,280</td>
<td>2,941</td>
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<tr>
<td>2020</td>
<td>CL-A2 Extension of CL-A1’s in-patient facilities</td>
<td>24,000</td>
</tr>
<tr>
<td>2020+</td>
<td>H-CP Hospital central plant (integrated w/ parking)</td>
<td>30,000</td>
</tr>
<tr>
<td>2020+</td>
<td>H-1 HOSPITAL-1 (250 beds, 3 bed towers)</td>
<td>516,780</td>
</tr>
<tr>
<td>2020+</td>
<td>- Integrated retail</td>
<td>67,500</td>
</tr>
<tr>
<td>2030+</td>
<td>MOB-3 Health clinic / advanced diagnostic clinic</td>
<td>62,500</td>
</tr>
<tr>
<td>2030+</td>
<td>MOB-4 Health clinic / advanced diagnostic clinic</td>
<td>62,500</td>
</tr>
<tr>
<td>CAMPUS INFRASTRUCTURE</td>
<td>100,000</td>
<td>25</td>
</tr>
<tr>
<td>2020+</td>
<td>CI-2 Campus central plant expansion</td>
<td>75,000</td>
</tr>
<tr>
<td>2020+</td>
<td>CI-3 Maintenance shop facility</td>
<td>25,000</td>
</tr>
</tbody>
</table>

**Phase 3 totals:** 1,626,030 4,227  
**Phases 1-3 totals:** 2,739,045 6,381
Phase 3 Development

Phase 3 adds 14 buildings (1,626,030 GSF) and 4,227 parking spaces to Site totals, which by 2030 reach 2,739,045 GSF and 6,381 spaces.
Phase 4 (2030+)

Phase 4 represents the maximum buildout potential of the Site.

The ten additional campus buildings scheduled for Phase 4 are not programmed at this time, although the master plan anticipates that at least two would house research. Up to three parking structures would be required to accommodate this level of campus density.

Should a hospital expansion prove necessary, space is available at the northwest corner of the Site for a second hospital wing (H-2), expanded central plant and additional parking. Once the hospital and health complex is complete, the Site’s population will likely be sufficient to warrant the expansion of the two-lane loop road into a four-lane, divided boulevard along the west edge of the Site (see page 76). Sufficient right of way exists for four lanes along the east edge of the Site as well, should it be required (dashed line, facing page).

Phase 4 adds 1,450,268 GSF and 2,533 parking spaces to the Site’s totals, at full buildout 4,189,313 GSF and 8,914 spaces.

### Phase 4 Development

<table>
<thead>
<tr>
<th>Move in date</th>
<th>Building GSF</th>
<th>Cars</th>
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<tbody>
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<td>HEALTH SCIENCE CENTER: Education &amp; Research Facilities</td>
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<td>620</td>
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<tr>
<td>- 2027 R-3 Possible additional research building</td>
<td>148,212</td>
<td>92</td>
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<tr>
<td>- 2027 R-4 Possible additional research building</td>
<td>147,776</td>
<td>92</td>
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<tr>
<td>- 2027 AC-3 Faculty offices</td>
<td>75,000</td>
<td>47</td>
</tr>
<tr>
<td>2030+ AC-4 Possible additional academic building</td>
<td>93,750</td>
<td>65</td>
</tr>
<tr>
<td>2030+ AC-5 Possible additional academic building</td>
<td>93,750</td>
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</tr>
<tr>
<td>2030+ AC-6 Possible additional academic building</td>
<td>93,750</td>
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<td>2030+ AC-7 Possible additional academic building</td>
<td>93,750</td>
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<td>2030+ AC-8 Possible additional academic building</td>
<td>93,750</td>
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</tr>
<tr>
<td>2030+ AC-9 Possible additional academic building</td>
<td>93,750</td>
<td>65</td>
</tr>
<tr>
<td>HOSPITAL COMPLEX / HEALTH PARTNERS</td>
<td>516,780</td>
<td>1,912</td>
</tr>
<tr>
<td>2030+ H-2 HOSPITAL-2 (250 beds) and 3 bedtowers</td>
<td>516,780</td>
<td>1,912</td>
</tr>
</tbody>
</table>

**Phase 4 totals:** 1,450,268 2,533

**Phases 1-4 totals:** 4,189,313 8,914
Phase 4 Development

Phase 4 adds ten buildings (1,450,268 GSF) and 2,533 parking spaces to Site totals, which at full buildout reach 4,189,313 GSF and 8,914 spaces.
Sun and Shadow

Patterns of light and shade are quite different on the summer and winter solstices, June 22 and December 22, respectively. An analysis of sun and shadow at 9 am and 3 pm on these dates (at right) helped identify environmental opportunities and constraints within the campus landscape and among its proposed buildings.

Areas of Southern Exposure

The main campus entry plaza and Student Center terrace share a (true) southern exposure, and will require either architectural elements or canopy trees to provide shade in warmer weather. In addition, maintaining tree cover along the pedestrian loop and two pedestrian bridges spanning the ravine will be important to ensuring shade (and comfort) in these areas.

Architecturally, the south-facing aspects of some of the healthcare facilities are likely to require extra design attention to maximize energy efficiency (and occupant comfort).

Areas of Northern Exposure

The ‘front doors’ for several campus buildings along the pedestrian spine have a northern exposure, potentially creating a challenge for planting design in these areas. While north-facing pockets in these entry areas are likely to be among the most habitable for people in the summer months, a limited number of plants tolerate the deep shade of a northern exposure.

Half of the plaza surrounding the Central Administration building will also be north-facing, likely another asset to outdoor comfort in the summer. Buildings in the research park also feature north-facing entry areas.
Development of the campus main entry area requires manipulating grade adjacent to TX-47.

Section 2a: Pre-development

Section 2b: Post-development

9 am, June 22.

9 am, December 22.

3 pm, June 22.

3 pm, December 22.
Vehicular Circulation

In keeping with ‘a campus in a forest’ aesthetic, patterns of vehicular access emphasize the core area of the Site as a pedestrian and natural zone. Vehicle travel lanes (in blue, at right) serve the periphery of the Site, with a sequence of drop off points (red asterisks) allowing users with limited mobility to access the campus and its partner facilities. At full buildout, surface parking is largely restricted to the south end of the Site.

Service and emergency access (orange) is provided through a series of service drives and reinforced pedestrian walks. For instance, the fire lane associated with the hospital will take the form of a ten-foot pedestrian sidewalk, edged with two five-foot shoulders of reinforced turf. Installing a grid of plastic cells (above left) before planting turf in these shoulders allows for fire truck access without impacting the day-to-day pedestrian experience.

**At left:**
Reinforcement before planting installation along a pedestrian sidewalk allows a turf shoulder to serve as a fire lane.

**Below:**
Sections through the campus loop road demonstrate the difference between two and four lanes of vehicle travel, and the relationship of travel lanes to the outer loop pedestrian trail.

**Two-lane campus loop road (Phases 1-2)**

**Four-lane campus loop road (Phases 3-4)**
Campus Guidelines

To support the campus master plan and its concept of "a campus in a forest," design guidelines provide specific recommendations for the Campus, its architecture and landscape.

The following Campus Guidelines are intended to foster a visually unified campus and reflect the goals and objectives of the Texas A&M Health Science Center. These guidelines also provide direction for design professionals working for the Health Science Center campus, ensuring unity as the campus develops over time.

This section covers the following topics:

- Campus planning principles
- Campus identity
- Public transportation access
- Vehicular access
- Service and emergency access
- Parking
- Pedestrian access and circulation
- Bicycle parking
- Campus gathering spaces
- Site lighting
- Light pollution reduction
- Site furnishings
- Paving materials
Pedestrian Circulation

An important consideration during the master planning process was maximizing the pedestrian experience. Accordingly, two pedestrian axes cross the central ravine, connecting the hospital to the Student Center and the Phase 1 campus area to the Central Administration building and plaza. A pedestrian spine links other campus buildings, and a network of pedestrian trails allows users to experience the Site’s core greenspace. Finally, the pedestrian loop trail at the periphery of the Site provides a 2.25-mile circuit, ideal for joggers and walkers.
Campus Identity

The Texas A&M Health Science Center is a distinct academic entity, separate from the Texas A&M University. Creating a sense of campus identity is important to the Health Science Center, the surrounding community, and future students and staff. Three levels of identity shape campus spaces:

1. Defining points of primary access
2. Secondary access and way-finding
3. Internal campus way-finding

Level 1: Defining points of primary access

The first level of campus identity addresses visitors to the Health Science Center campus. This level defines entrance or gateway signage and serves as the first point of campus recognition.

Level 2: Secondary access and way-finding

The second level of campus identity communicates to two groups: the surrounding community and campus users. This level defines the various points of access, both for pedestrians and vehicles, and serves as a way-finding tool on campus.

Level 3: Internal campus way-finding

The third level of identification is meant for campus users specifically. Elements at this level identify the various buildings and functions throughout the Campus for faculty, staff and students of the Health Science Center.
Utilities

Because of the existing Traditions Club housing development, public utilities and recycled water (‘purple pipe’) are available at the periphery of the Site. Gas and water utilities will extend from South Traditions Drive, crossing the central ravine under a pedestrian bridge scheduled for Phase 2. In contrast, communications and electricity will extend from TX-47 and be distributed from the central plant. Generally speaking, utilities access development of the Site along the campus loop road and pedestrian spine. For stormwater management practices, see pages 124-129.

Sanitary Sewer

An easement along the north boundary of the Site allows the City of Bryan to provide sanitary sewer service through a public sewer main. Connecting to this sewer main at the low point of the Site, two sanitary lines flank the Site’s main ravine within the central greenspace (see red lines at right). As the course of the sewer lines must be clear of trees, a network of pedestrian trails (tan lines at right) overlays the sanitary sewer location. Behind the proposed hospital, sanitary sewer lines run below the pedestrian path / fire lane. Aligning pedestrian trails and sanitary sewers minimizes disruptions of the experience of ‘a campus in a forest.’

Water

Water also enters from the Traditions Club development, from South Traditions Drive along the eastern edge of the Site (see blue line at right). Both potable water and water for fire service will connect through this large waterline operated by the City of Bryan. The existing water line has sufficient capacity to provide water needed for the Site’s development. Running parallel to the campus loop road, the Site’s water line will initially access Phase 1 across the central ravine. Non-potable water (‘purple pipe’ for irrigation) is available from the Traditions golf course.

Natural Gas

Natural gas will follow the same routes as the water line, extending from South Traditions Drive at the Site’s eastern boundary (see purple line at right). Atmos Energy, which currently serves the Traditions Club, has determined the existing gas supply network has adequate capacity to satisfy the demand that will be presented by research and hospital development of the Site.

Electricity

Electrical power is currently available at all sides of the Site through Bryan Texas Utilities (BTU). BTU will connect power to the campus central plant from the TX-47 corridor. From the central plant, electricity (brown dashed line at right) will be metered and distributed throughout the Site. Electricity distribution follows both the campus loop road and pedestrian spine.

Communications

Verizon will provide telephone service to the Site. In Phase 1, telephone service will extend from the FM-60 corridor. In later phases, Verizon will connect additional service from the Nagle Street center. Like electric power, telephone service will be distributed throughout the Site from the central plant, following both the campus loop road and pedestrian spine. The telecommunications hub, however, may be located in a building separate from the central plant.

A local cable provider will provide cable television service to the Site as requested.
Service and Emergency Access

While emergency vehicles can access the Campus through reinforced pedestrian walks, service access will generally be separate from major pedestrian routes. Service vehicle crossings of pedestrian paths will also be avoided.

Landscaping, topography and visual barriers can minimize the impact of service operations (e.g., loading and delivery zones, trash removal, and mechanical equipment access). Service areas should not be within view of the main entrances to buildings, to minimize negative effects on the pedestrian experience. Designating specific drives and parking spaces for service vehicles can also reduce conflicts with passenger vehicles and pedestrians.

Finally, building design will allow adequate service access. Typically, service access should be limited to one location per building, although larger buildings may require additional points of service access. In some cases, a central service court can serve several buildings.
Massing Study

With the exception of six-story bed towers associated with the proposed hospital, most buildings on the Site are planned at three to four stories (see figure below). Only one campus building (R-2) is expected to be five stories, the lower level of which would be partially exposed, revealed by the significant change in elevation across that building’s footprint.

Parking structures are expected to be no higher than four levels, equivalent in height to three-story buildings (as cars park on the ‘roof’). The only buildings expected to be of two stories are the Student Center, the Clinical Affiliate located at the south end of the Site (CL-A1 & CL-A2), and the campus central plant. The campus maintenance shop facility will also consist of a single story.

Campus Sections

Cross sections of the Campus along the two main pedestrian axes (see key map below) establish the relationship between the Site’s architecture and topography. The considerable fall and rise in elevation across the Site, associated with the central ravine, is readily visible (see sections at far right).

Preserving as much of the natural grades as possible contributes to the sense of ‘a campus in a forest.’
Pedestrian Access and Circulation

To preserve the sense of ‘a campus in a forest’, the Health Science Center will encourage pedestrian travel rather than transportation methods. The Campus must provide effective way-finding cues, accommodate a variety of users and establish clear primary and secondary pedestrian route networks. Users with limited mobility will have equal access not only to buildings, but also to all primary pedestrian paths.

At major intersections, entrances, and parking structures, informational maps and directional signs will clarify pedestrian routes. Paths must take into account the shortest route for pedestrians to eliminate unwanted shortcuts across vegetated areas.

The width of primary paths must be adequate to accommodate user volumes, as well as multiple transportation types. Generally, primary paths should be 8- to 12-feet wide. Primary paths may require considerable extra width to accommodate multi-modal transportation, for instance access by bicycles, rollerblades, or emergency vehicles.
-campus-guidelines

To support the campus master plan and its concept of 'a campus in a forest,' design guidelines provide specific recommendations for the Campus, its architecture and landscape.

The following Campus Guidelines are intended to foster a visually unified campus and reflect the goals and objectives of the Texas A&M Health Science Center. These guidelines also provide direction for design professionals working for the Health Science Center campus, ensuring unity as the campus develops over time.

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- Bicycle parking
- Campus gathering spaces
- Site lighting
- Light pollution reduction
- Site furnishings
- Paving materials
Campus Planning Principles

Three basic principles guide the development of the Health Science Center campus. The Campus will:

1. Create a world-class medical and academic destination for Texas A&M Health Science Center, Texas A&M University, the City of Bryan, the City of College Station and the region.

2. Use sustainable design to form ‘a campus in a forest,’ in accord with the Health Science Center’s mission statement. This includes prioritizing pedestrian, bicycle and public transportation access to preserve the campus center as a pedestrian and natural zone.

3. Achieve the sustainability standard, if not the commissioning, of LEED-Silver™ certification.

Campus Identity

The Texas A&M Health Science Center is a distinct academic entity, separate from the Texas A&M University. Creating a sense of campus identity is important to the Health Science Center, the surrounding community, and future students and staff. Specific identifying elements can both establish and define relationships to the Campus. Three levels of identity shape campus spaces:

1. Defining points of primary access
2. Secondary access and way-finding
3. Internal campus way-finding

The selection of the Health Science Center materials palette required outdoor discussion.
Level 1: Defining points of primary access

The first level of campus identity addresses visitors to the Health Science Center campus. This level defines entrance or gateway signage and serves as the first point of campus recognition. For instance, the primary campus entrance, from Texas State Highway 47 will require identifying elements to define the campus entrance for visitors. Identifying signage at campus entrances requires large-scale landscape design and gateway elements to delineate points of primary access and to establish a first impression for motorists passing the site at 70 mph. The tower proposed for the main entry plaza (see sketch below) will provide a large, identifiable iconic element, serving as a way-finding landmark for the entire campus.

Level 2: Secondary access and way-finding

The second level of campus identity communicates to two groups: the surrounding community and campus users. This level defines the various points of access, both for pedestrians and vehicles and serves as a way-finding tool on campus. This level also shapes student and faculty gathering spaces, providing distinct elements to contribute to the identity of important pedestrian spaces.

Level 3: Internal campus way-finding

The third level of identification is meant for campus users specifically. Elements at this level identify the various buildings and functions throughout the Campus for faculty, staff and students of the Health Science Center.
Vehicular Access

To preserve the campus center as a pedestrian and natural zone, the Health Science Center will distinguish between primary and secondary vehicular streets. Vehicular travel will be restricted to the campus periphery, with a few points of automobile access near major campus destinations to provide ‘drop off’ zones. Primary streets will also include provisions for bicycle access, most commonly in combination with pedestrian walks.

Primary streets will include measures to reduce traffic speed and ensure pedestrian safety, particularly at major traffic intersections. Such ‘traffic calming measures’ might include: neck downs at major crossings, changes in paving material, or elevated crosswalk tables (see photos at right). Both primary and secondary streets will be designed with minimum safe lane widths to discourage speeding. Secondary streets will be designed for speeds no greater than 15-20 mph to allow pedestrians and bicyclists to access internal campus areas safely.

A neck down slows traffic, allowing pedestrians to cross an intersection more safely.

Changes in paving materials help draw attention to a pedestrian crossing.

Campus streets must minimize conflicts among vehicles, bicycles and pedestrians.

A raised crosswalk table encourages drivers to slow down.

A designated bike lane separates bicyclists from both parked cars and travel lanes.
Service and Emergency Access

While emergency vehicles can access the Campus through reinforced pedestrian walks, service access will generally be separate from major pedestrian routes. Service vehicle crossings of pedestrian paths will also be avoided.

Landscaping, topography and visual barriers can minimize the impact of service operations (e.g., loading and delivery zones, trash removal, and mechanical equipment access). Service areas should not be within view of the main entrances to buildings, to minimize negative effects on the pedestrian experience. Designating specific drives and parking spaces for service vehicles can also reduce conflicts with passenger vehicles and pedestrians.

Finally, building design will allow adequate service access. Typically, service access should be limited to one location per building, although larger buildings may require additional points of service access. In some cases, a central service court can serve several buildings.
Parking

As ‘a campus in a forest,’ the Health Science Center must carefully control its associated automobile parking, minimizing the total number of automobile parking spaces to encourage pedestrian, bicycle, and public transportation access.

In accordance with LEED™ guidelines (USGBC 2005), parking capacity will meet, but not exceed, minimum local zoning requirements (see Master Plan, page 60). Adjacent facilities will share parking, when possible. Campus buildings will provide an appropriate number of parking spaces for people with disabilities and for service vehicles.

Infrastructure and support programs can facilitate carpooling, through drop-off areas, designated preferred parking for carpools, and shuttle services to mass transit.

Double-loaded parking provides the most efficient layout. The slope of parking areas must not exceed 6%, with a preferred cross slope of less than 3%.

Within parking lots, generous planting areas improve stormwater function and contribute to ‘a campus in a forest’ aesthetic, even at the campus periphery. Planting areas should be included for every 10-15 parking spaces and be at least 10-15 feet wide. Temporary parking lots may either reduce planting islands or use them as small scale ‘nursery’ areas from which plant materials can be moved to other areas on campus. Excess maintenance expenses, in terms of increased irrigation costs and pavement damage, can be avoided by designing planting areas of appropriate size and plantings.

Permeable (or pervious) paving allows water to reach tree roots. Planting areas in parking lots can take the form of rain gardens, serving a stormwater management function.
Pedestrian Access and Circulation

To preserve the sense of ‘a campus in a forest’, the Health Science Center will encourage pedestrian travel rather than transportation methods. To do this, the Campus must provide effective way-finding cues, accommodate a variety of users and establish clear primary and secondary pedestrian route networks.

At major intersections, entrances, and parking structures, informational maps and directional signs will clarify pedestrian routes. By streamlining paths, that is, controlling the number of ways to reach a destination, the Campus can also assist way-finding.

However, paths must take into account the shortest routes for pedestrians to eliminate unwanted shortcuts across vegetated areas. Landscaping can help direct pedestrian movement, but must provide routes that approximate desire lines in order to be effective. To ensure user comfort, paths will include sizeable corners at major intersections and nodes. Similarly, path connections must minimize the need for 90-degree turns. Closer to campus destinations, narrow masonry surfaces can accommodate a range of connections.

The campus pedestrian network will include both primary and secondary paths. The width of primary paths must be adequate to accommodate user volumes, as well as multiple transportation types. Generally, primary paths should be 8- to 12-feet wide. Primary paths may require considerable extra width to accommodate multi-modal transportation, such as access by bicycles, rollerblades, or emergency vehicles (see photo at lower left).

Users with limited mobility will have equal access not only to buildings, but also to all primary pedestrian paths. Accordingly, primary paths must eliminate barriers to accessibility, presenting slopes no greater than 5% (with 2% cross slope) to accommodate wheelchairs (ADA: 2007).

The lower user volume of the secondary pedestrian network allows for a narrower path width (typically 5 to 8 feet). In a very few cases, even narrower paths may be appropriate (see photos below).

Landscape elements, like these paths, shape movement best when they approximate pedestrian desire lines.

Very narrowly paved secondary paths (above left) can minimize informal shortcuts (above right).

Designated bike lanes separate pedestrians from faster traffic.
Bicycle Parking

The Health Science Center must also provide adequate bicycle storage, security, and associated amenities. Bicycle parking areas will be located near campus activity centers and along multi-modal streets. Bicycle storage facilities must not be located further than 50 feet from frequently used building entrances. Shower and changing facilities within some campus buildings encourage long-distance bicycle commuting.

The bicycle storage capacity for campus buildings should be based on possible loading at one time, rather than on the cumulative load of total transients per day.

Finally, bicycle storage layout must incorporate appropriate aisle width. Adequate space allows a bike length of 72 inches and at least 48 inches of aisle space. Wider aisles are necessary in high-traffic bicycle parking areas.
Campus Gathering Spaces

Campus gathering spaces form the transition between buildings and outdoor spaces; accordingly, gathering spaces will be incorporated into key pedestrian intersections and at building entrances. Buildings can extend gathering spaces indoors, with building entrances contributing to the pedestrian experience.

Gathering spaces serve a variety of functions. Uses include quiet study areas, larger spaces for outdoor recreation, places to rest, and cafés or meeting places. The ability to move through the space is important and must be considered in the design.

The intended use of a gathering space will shape its design. Landscape elements, including planting design, topographic change and seating define the intended activities of a space. Elements such as views, fountains, shade structures, sculptures, seating, and group gathering spaces enrich the design. Finally, solar orientation, prevailing winds and seasonal conditions shape the design of these spaces.

This proposed plaza will provide a campus gathering space in Phase 1 of the Health Science Center’s development.

Uses for campus gathering spaces can range from quiet study areas, outdoor recreation, resting, or socializing.
Site Lighting

Campus projects will provide lighting that maximizes the safety and security of pedestrians, bicyclists, and motorists, as the Health Science Center is anticipated to attract a range of round-the-clock users. Site lighting will contribute to ‘a campus in a forest’ aesthetic and enhance the greenspace experience.

Lighting will provide good visibility and visual guidance. Exterior building lighting will emphasize entries and building names to assist way-finding. Campus signs will be properly illuminated, and corridor lighting will allow night access to at least primary paths.

Lighting will create points of emphasis on the nighttime Campus, providing focal point lighting for building fronts, walls, trees, public art, and special landscaped areas. Landscaping will not interfere with the effectiveness of lighting.

Lighting fixtures will be standardized in pedestrian areas, streets and parking lots. The use of LED fixtures is encouraged to minimize energy consumption and life-cycle cost. Other fixtures, particularly street lights, will use metal halide fixtures.
Light Pollution Reduction

Campus lighting will minimize energy consumption and light pollution (excessive or obtrusive light). Specified lighting fixtures will reduce light pollution by adhering to International Engineering Society of North America (IESNA) ‘Dark Sky’ requirements; which recommend, for instance, the use of full cut-off and low reflectance fixtures.

Areas will be illuminated only as needed (see inset at left), with minimal interior lighting transmitted through building windows. Directional lighting (see diagram at lower left) minimizes glare and light pollution, along with low angle spotlights, full cutoff luminaires, and low-reflectance surfaces. Landscaped berms and planting areas help control light spill from automobile headlights.

Lighting designs for campus projects will be tested prior to finalization through computer modeling to minimize light pollution.

**Lighting Levels:**

Plazas: 1 - 10 foot candles

Primary pedestrian paths: 1 - 10 foot candles

Building entrances: 2 - 10 foot candles

Secondary paths and trails: 0.5 – 2 foot candles

Parking areas: 0.5 – 5 foot candles

Full cutoff luminaires limit light pollution and are available in a range of styles. The two styles selected here, the ‘Stockholm’ and ‘Copenhagen’ series, are intended for pedestrian and vehicular path lighting, respectively.
Site Furnishings

A consistent style of site furnishings helps unify the campus environment (see photo at right). Site furnishings include: waste and recycling bins, bollards, benches, and bike racks. These items should be placed where they will be most needed, such as building entrances and intersections, and where they will not impact pedestrian safety.

Seating should be provided near building entrances and campus gathering spaces, as well as in places where students are likely to study or relax between classes. Benches, tables, and umbrellas will be provided in some areas to facilitate studying, eating, and group activities. Waste and recycling bins will be placed in high traffic areas, but in a way that does not obstruct paths.

Site furnishings should be durable and require minimal maintenance. Site furnishings should be selected, where possible, for: recycled content, recyclable materials, Forest Stewardship Council (FSC) certified wood and regional materials (see photos at left).

In some cases, distinct furnishings can accent special places within the campus. For instance, wood from removed trees could be milled on site for use in benches in natural areas, or in bridges or erosion control elements for pedestrian trails. Generally, however, powdercoat finishes will coordinate with the anodized aluminum of campus buildings, similar to the Landscape Forms products pictured at left.
Paving Materials

Paving materials for pedestrian paths and plazas should complement brick and limestone selected for campus buildings. Paving materials will blend with the Health Science Center’s natural surroundings.

Where possible, permeable paving should be used (e.g., porous asphalt, unit pavers, and reinforced turf). Durability of paving materials is an important consideration.

Paving materials should include a high percentage of recycled content, such as fly ash in concrete. The use of local materials should also be encouraged, where feasible (USGBC 2005).

Paving materials will include unit pavers equivalent to the Pacific Clay ‘Royal Saltillo’, ‘Rose Tan’, and ‘Light Iron Spot’ series (see photos at right). In other areas, granite pavers or stamped and colored concrete may be appropriate. Colored concrete will feature an etched surface treatment (CHI-027), or be lightly sand blasted.

The use of asphalt will be limited to temporarily paved areas. In parking lots, the use of permeable or pervious paving is encouraged, especially in parking stall areas. Concrete is preferred over asphalt in parking lot areas, in areas where permeable paving is not feasible.

Porous paving allows water to percolate through.

Paving materials should complement the natural colors of the Site, such as ‘Agate’ and ‘Carmelian’ granites.

Colored concrete with a sand-blasted or etched finish can mimic granite.

Engraved bricks provide donor funding opportunities.

Brick pavers like the ‘Royal Saltillo’, ‘Rose Tan’, and ‘Light Iron Spot’ series coordinate well with the materials palette selected for campus buildings.

The use of regional materials, for instance stone, can help bring nature into pedestrian spaces.

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The use of regional materials, for instance stone, can help bring nature into pedestrian spaces.
Architectural Guidelines

- Architectural guiding principles
- Architectural character
- Architectural vocabulary and materials
- Exterior materials
- Roof forms and materials
- Fenestration: solid to transparency ratios
- Building entrances
- Colonnades, loggias and arcades
- Plazas and courtyards
- Orientation and solar angles
- Sustainable design
- Daylight and energy performance
Architectural Guiding Principles

The creation of Architectural Guidelines at the Master Plan level will identify the design parameters for all initial and future buildings. Establishing guiding principles for design provides a benchmark for which all building development should adhere. The guiding principles reflect the client’s values. The following guiding principles were established through work sessions with executive leadership of the Health Science Center.

- Image that supports strategic vision
- Responsive design for multiple consumers
- Consistent campus image
- Flexible buildings
- Create a campus to be icon for HSC System
- Drawing form from the environment
Architectural Character

The architectural heritage of higher education at colleges and universities has been developed on distinct building character and vocabulary. These traits are a result of the establishment of the guiding principles, identification of the drivers that influence the architecture and the incorporation of the various design elements that shape the buildings and the surrounding environment.

Drivers of Architectural Character

The social views of the client become the drivers that influence and provide direction for the architecture.
Elements of Architectural Character

The designer shapes the building and the environment through the use of architectural elements.

Sense of Place

The collective of these identified influences support the creation of a sense of place that bridges a building’s use and its physical image.
Architectural Vocabulary & Materials

Historically, academic campus buildings have incorporated the use of masonry and stone as the primary building materials. These materials, when used in building construction, have invoked an image of strength, knowledge and stability. A contemporary interpretation of ‘traditional’ architecture is desired.

Work sessions with executive leadership of the Health Science Center identified material guidelines that will be followed for all buildings during the development of the campus.

The major exterior walls of buildings should be constructed with brick masonry and stone, with some use of stucco.

Brick colors will be the medium to dark range of reds with complementary use of light tones to correspond to the stone materials. This color range is related to the natural materials that were found existing upon the site.

Texas limestone with a warmer hue, should be considered over the cooler color Indiana limestone. Complementary simulated or cast stone may be acceptable. Stone material can be of smooth or rock / chiseled cut finishes, and used as base, wainscot, lintels, column covers and entry portal accents.
The fenestration should primarily utilize ‘punch’ windows within the masonry. Vertical proportions are desired over horizontal expressions. Larger areas of glazing may be utilized for specific emphasis at entrances, lobbies, public spaces, vertical circulation and major spaces which focus views to site amenities. Glazing will utilize state-of-the-art materials, such as Low-E type glass, in a blue-green tint to correspond to the surrounding site.
Exterior Materials

Consistent material usage on all buildings will reinforce the strength and unity of an academic campus.

The color and texture of materials selected was largely based on petrified wood artifacts and indigenous stones found on the site. Colors ranging from dark gray to red to white, and textures consisting of smooth to very rough, provided the base palette from which to select the building materials.

The following material selections are to be used in exterior applications.

**Exterior veneer**
- Red base or field brick
- Accent red brick
- Accent ivory brick
- Smooth and chiseled cut white stone
- Smooth and rock cut simulated white stone

**Exterior Glazing**
- Low-E (VE and VRE) Insulated units in blue-green tint

**Roofing**
- Standing seam metal roofs in gray or gray-green, in combination with built-up roofing.
  Alternatives: slate tile or flat clay tile.

See Appendix for further definition.
Roof Forms and Materials

To support the concept of a campus-in-a-forest, the roofscape of the buildings will be a vital design element. Low scale buildings, three to five levels in height, will create in general a horizontal, but undulating effect across the campus as they are sited on the varying site topography. Pitched or sloped roofs will be utilized to provide an articulate cap to each building.

Standing seam metal panels will be the preferred system of sloped roofing, in combination with a modified bitumen built-up material used in the limited flat roofed areas. Metal roof colors should be chosen from a range of gray to a gray green patina color. Alternate synthetic materials may include slate tile or flat clay tile in similar color ranges.
Another of the defining characteristics in fenestration of university and academic buildings is the solid to transparency ratio. This distinguishes the academic architecture from commercial and corporate vernaculars. Academic architecture is more often characterized with clearly defined established orders with a base, middle and top to the buildings.

The illustrations show a range of openings in an appropriate building façade. The overall ratio of glass to solid wall should be in the 30% to 40% range. This range is generally preferred by environmental agencies.

Variances in depth between the masonry plane detail and the glass planes should be developed, to create shade, shadow and texture to reinforce the strength and character of the academic environment.
Building Entrances

As the campus develops and becomes a self contained learning environment, each individual building will need to respond to the site and existing buildings. Each, or even a collection of buildings, will have a primary entrance, which will be a major component in the overall architecture of the building. The entrances should support the connectivity between site and the internal use of the building and serve as a primary means of way finding. Entrances should incorporate the established materials, and can be integral with the overall design or exhibit a unique architectural presence.
Colonnades, Loggias and Arcades

Creating a physical connection between structures and the campus landscape is an important attribute of university buildings. The use of colonnades, loggias, and arcades will provide pedestrian protection from sun, rain and wind. They can be freestanding links between structures or be major component within the building architecture.

It is encouraged that they be integrated into building architecture, to provide articulating facades that create shade, shadow and depth.

As a freestanding element, they are an extension of the building architecture that needs to coexist with the surrounding landscape.
Plazas and Courtyards

Outdoor spaces and their interrelationship among the buildings are vital to the success of an academic campus. Plazas and courtyards are the common spaces for social interaction and serve as a transitional environment between exterior and interior space. The size and scale will depend on use, location and overall importance within the campus.

Plazas are large outdoor spaces formed by the clustering of major use buildings. Courtyards are usually considered as intimate outdoor environments around secondary academic buildings and support buildings. These areas can be standalone areas or part of a circulation pathway creating interaction nodes around the campus. Plaza and courtyard materials should relate to both the building architecture and the natural and developed landscape features.
Orientation and Solar Angles

Building orientation along with fenestration design and the seasonal changes of solar angles must support an overall sustainable design. With the site’s latitude location of approximately 30 degrees N, orientation concepts suggest that the longer faces of the buildings be set on an east–west axis for optimum energy efficiency and sun control. With any large campus development, desired orientation cannot be obtained with all buildings. On this new campus, other factors may also influence the building’s orientation.

The site topography, the concept of creating ‘a campus in a forest’ and the dominant or longest orientation of the site being on a northeast by southwest axis, require that each building design be a specific study to achieve optimum energy efficiencies.
Sustainable Design

Sustainable design is a synergistic approach to design wherein aspects of environmental conservation, material selection, human interface and economic prosperity merge to form the most positive holistic system.

Benefits that ‘green’ or sustainable design produces are:

- **Environmental**: reduces the harmful impacts to land, air, and water.
- **Economical**: reduces operating costs and enhances building marketability.
- **Health**: increases worker productivity and comfort and reduce potential liability.

The Texas A&M Health Science Center supports guidelines of the USGBC as ‘best practices,’ but currently is not seeking a LEED certified rating.
Daylighting and Energy Performance

Certain architectural initiatives supporting sustainable design should be considered and include:

*Daylighting*: Lighting concepts include perimeter daylight glazing, skylight glazing and artificial lighting systems with sensors and dimming capabilities.

*Energy Performance*: Conservation of generated energy needs to be a priority. Architectural building systems, including high performance glass, wall and roof systems along with efficient heating, ventilation and air conditioning systems and controls are required to correspond to current energy codes.
Landscape Guidelines

The landscape environment contributes significantly to the campus experience, both for students and faculty. Well-designed and maintained campus environments increase prospective student applications, alumni donations and student retention rates.

This section covers the following topics:

- Landscape character
- Landscape principles
- Landscape typologies
- Native landscapes
- Natural landscapes
- Cultivated landscapes
- Programmed landscapes
- Campus ponds
- Wetlands
- Water quality
- The ‘water smart’ campus
Landscape Character

A consistent landscape character unifies the Campus and is instrumental in creating a sense of place. Landscape design brings the natural environment into the Campus, contributing to the Health Science Center’s vision as ‘a campus in a forest.’

Campus landscape character has a profound impact on the appearance of the Campus and on its relationship with the surrounding community. Landscape character shapes the nature of social interactions and perceptions of the overall campus experience. The campus landscape must be designed and maintained to ensure equitable access and physical safety.

The landscape environment can affect the health and comfort of campus users. ‘Green’ views from windows increase users’ sense of wellbeing, and a well-designed campus landscape provides opportunities for “restorative experiences” to counter the daily stress of academic life.*

Other aspects of ‘a campus in a forest’ landscape benefit both users and the ecological context. For example, lessening glare from reflective surfaces reduces both visual discomfort and the urban ‘heat island’ effect (see sidebar at right). Canopy trees moderate summer air temperatures, provide shade, and improve air quality.

Following these Landscape Guidelines will help create a campus that benefits the Health Science Center, the surrounding community and the region in a way that is sustainable over time.

* Rachel Kaplan, Professor of Environment and Behavior, University of Michigan.

The Urban Heat Island Effect:

The temperature in cities is often several degrees warmer than in surrounding areas as a result of solar heat absorbed by paving and rooftops. Dark surfaces and paving exacerbate the heat island effect.

Increasing the number of shade trees can mitigate the heat island effect, as can encouraging the use of green roofs in densely developed areas.
Landscape Principles

Landscape character helps define the relationships between the Health Science Center campus and the surrounding natural and built environments. The following eleven general principles help define the overall landscape character of the Health Science Center. These principles provide the means to maximize aesthetic appeal, user well-being and environmental function within the Health Science Center campus landscape.

The campus landscape will:

1. Preserve the Site’s core natural area to create ‘a campus in a forest’ and maintain areas of high quality habitat.
2. Use native plants as much as possible, to maximize the drought tolerance of campus landscapes.
3. Adopt best practices for stormwater management to control runoff and floods.
4. Use landscaping to control soil erosion, limiting slopes to a maximum of 4:1 (or 3:1 with turf, in special situations).
5. Grade sites to slope away at least 1-2% from higher use areas and buildings, reducing the need for engineered stormwater infrastructure.
6. Use site walls to reduce the scale of buildings, define outdoor gathering spaces and provide seating. To the greatest extent possible, grade sites to eliminate retaining walls that cannot serve these functions.
7. Design outdoor areas with appropriate attention to: seating, lighting, solar orientation, natural ventilation, focal points and view corridors.
8. Create gathering spaces for a range of densities and activity levels.
9. Focus high-maintenance, irrigated landscapes in high traffic and high profile areas such as in small gathering spaces, building entries and campus entrances. In lower-profile areas, use plants that require less water and maintenance.
10. During plant installation, use larger sized trees and plantings to enhance key focal points and entrances.
11. Limit lawn to areas with the highest demand for flexible recreational space.

Native plant species are often the most drought tolerant.
Landscape Typologies

Within the Health Science Center, different landscape typologies can create distinct environments and senses of place. These landscape types, discussed in the following pages, vary in their approaches to: topography and drainage, planting palettes and existing vegetation, solar orientation, alignment to prevailing winds, program and activity levels and Site and building relationships.

The four landscape typologies are:

1. Native landscapes,
2. Natural landscapes,
3. Cultivated landscapes, and
4. Programmed landscapes.
Native Landscapes

Native landscape includes the core wooded area of the Health Science Center as well as areas outside of the campus loop road (see yellow areas in diagram, facing page.) This landscape type enhances and preserves existing native habitat, while focusing the pedestrian experience on distinct views, specimen trees and other natural elements.

Intimate gathering areas and quiet spaces for reflection in this landscape form a counterpoint to larger scaled, more active spaces elsewhere on campus. Major bicycle and pedestrian paths and secondary trails provide safe and accessible access.

The planting palette in native landscapes consists of plants native to the region’s Blackland Prairie and Post Oak Savannah; for plant species, see Appendix C (pages 138-140).

Protected / Restored Habitat

Native landscapes also include areas of protected and restored wildlife habitat. Providing habitat areas contributes to water quality, biodiversity and ecological function, as well as to the long-term sustainability of the Campus and its relationship with the surrounding community. Protecting and restoring habitat requires a long-term strategy of ‘conservation by design,’ which includes: setting goals and priorities, developing implementation strategies, and monitoring results. For specific maintenance recommendations, see Appendix B.

Native wildflowers adapted to the Site’s soils include blanket flower, and winecup (Gaillardia pulchella and Callirhoe digitata).
Natural Landscapes

Natural landscapes provide a transition between native landscapes and cultivated or programmed campus areas. Natural landscapes link the core of the Site to the rest of the Campus, supporting the vision of ‘a campus in a forest.’ They maintain a consistent character for the boundaries of programmed space on campus, softening edges with native and naturalized plants that require minimal maintenance and irrigation. Natural landscapes border primary paths through native areas and provide a groomed edge in areas where attracting local wildlife, like rattlesnakes, could be a concern (see green areas, page 118 diagram).

Natural landscapes are subject to closer inspection than native areas. At installation, plant materials must be of moderate size and density to speed planting establishment. More detailed planting design in these areas combines shrubs, trees, and perennials to achieve year-round interest, with planting and paving details accenting important campus edges. A range of perennials, both native and adapted, are suited to natural landscapes (see Appendix C, pages 142-143).

This landscape forms the interface among buildings, pedestrian areas, and streetscapes within the Campus. Planting beds, changes in grade and appropriate architectural elements (e.g., walls, arcades, and gateways) screen and frame outdoor spaces from adjacent uses as needed. Natural landscapes soften the visual impact of parking and service areas, with trees and shrubs of various heights adding interest to these areas. Horizontal layering of plant materials helps create a sense of depth and a richness of texture within natural landscapes.

Soft edges form a gentle transition between natural and native landscapes.

Both native and adapted plants, such as honey mesquite (Prosopis glandulosa) and prickly poppy (Argemone spp.) shape natural landscapes.
Cultivated Landscapes

Campus landscapes can be divided into two types, cultivated and programmed landscapes. Cultivated landscapes provide intimate outdoor rooms for studying and reflection and create large, iconic but un-programmed spaces contributing to the Health Science Center’s sense of identity. Cultivated landscapes create dynamic spaces in the forecourts of distinct buildings and help generate a sense of unity and identity for the campus community.

Cultivated landscapes provide a setting for focal points, such as public art and monuments. Cultivated landscapes include a range of seating options and locations, as well as small contemplative spaces. Cultivated landscapes frame, screen and define outdoor rooms through: plantings, seating walls, elevation changes, and distinct paving materials. They require less irrigation and maintenance than programmed landscapes on campus; for plant species, see Appendix C (pages 146-147).

Cultivated landscapes include places for sitting, eating and studying.
Programmed Landscapes

The most intensely used campus landscapes will be programmed, or active, space. Programmed landscapes include spaces designed for larger organized outdoor events (e.g., recreational and ceremonial spaces). This typology provides pockets of high-maintenance landscape, such as open lawns that allow for a range of recreational and social uses. Turf sod will be hardy and able to stand up to heavy traffic and use; for plant list, see Appendix C (pages 146-147).

Programmed landscapes are the most irrigation-intensive of all landscape types, and provide an appropriately ornamental and groomed context for heavily-frequented landscapes surrounding large public spaces and plazas. This landscape surrounds outdoor gathering spaces, cafés and other venues near high activity areas, and as such must provide adequate seating, lighting, power sources, and shade structures.

Site walls accommodate elevation changes, define active spaces, provide seating and define entries. Programmed landscapes require some shaded areas for rest and outdoor studying. Prominent icons and markers shape and define focal points, and distinctive views help define key spaces.

Programmed campus space can be used for a range of active and large group activities, including: sports, performances and ceremonies.
Campus Ponds

The proposed campus ponds contribute to the visual character of the landscape and are an important, attractive means of restoring and protecting habitat. The ponds also function to promote water quality and provide wildlife habitat on campus.

Many of the proposed building sites and parking areas on campus will require water quality ponds; existing ponds can be modified to enhance water quality. Retention ponds, which permanently store water, can provide water for irrigation. Detention ponds help prevent flooding and soil erosion by temporarily slowing stormwater flow.

Due to the Site’s mixed clay and sandy soils, various liner schemes may be required in some areas to create ponds. Because of the high potential for siltation associated with the Site’s soils, the main drainage channel will not be dammed. Some of the small tributaries, however, can be manipulated to form ponds within a small portion of the main drainage channel.

The campus ponds will work within the overall water strategy for the Health Science Center. Accordingly, the ponds will overflow to existing drainage ways and include vegetated buffers to reduce open water safety hazards and improve water quality. Buffer areas can provide wetland habitat and improve the scenic quality of the ponds by eliminating a ‘bath tub ring,’ a zone subject to drastic flooding where not many plant species are able to survive. Generally, a shallow flooding depth (no more than 6-12 inches) is desirable to ensure a more attractive edge for wetlands bordering campus ponds.

Campus ponds can improve habitat and ecosystem function.

Roman Street Parkland; Brisbane, QLD; EDAW (D. Carrillo)
Wetlands

Wetlands provide wildlife habitat, promote biodiversity, and integrate wildlife into the broader vision of campus landscape character.

Natural wetlands are critical water filters, replenishing groundwater and filtering sediment. Constructed wetlands can serve as detention basins, absorbing stormwater from swales and surface runoff. It is important to remove pollutants from stormwater before it reaches natural or created wetlands, as these areas are typically very attractive to wildlife.

Wetlands are protected by a variety of federal, state and local regulations. Any disturbance that occurs within wetlands must comply with all necessary regulations. Some of the areas within the Site’s 100-year floodplain could be classified as wetlands or as Waters of the U.S. (see Master Plan, page 27). The design of constructed wetlands may be subject to approval of the appropriate legislative entities.
Water Quality

Maintaining and enhancing water quality on campus is central to sustainability. Water quality greatly affects landscape character and is critical for biodiversity, as well as for habitat restoration and preservation. Improving water quality reduces erosion, flooding, and siltation that can pose significant costs associated with conventional stormwater and wastewater mitigation.

Water quality areas can provide viable natural habitat for wildlife, especially birds and waterfowl, and can also treat and reuse ‘graywater’ (see sidebar at right). Reusing graywater decreased the amount of wastewater generated and can efficiently and economically provide a significant portion of the water required for irrigation on campus.

Improving water quality provides a number of benefits to the campus landscape, and:

- Helps reduce soil erosion by slowing stormwater and stabilizing slopes.
- Reduces siltation by filtering stormwater and minimizing soil erosion.
- Removes pollutants from rainfall, such as sediments and fertilizers, that would otherwise concentrate at outfall areas.
- Increases opportunities to reuse stormwater for irrigation with minimal additional treatment.
- Reduces the use of potable (drinkable) water for landscape irrigation.
- Directs stormwater runoff to landscape areas, reducing the demand for irrigation of these areas.
- Reduces the amount of land needed for stormwater storage, thus increasing the land available for development and recreation.
- Reduces the size and expense of engineered infrastructure, by controlling the volume, speed, and sediment content of stormwater.
- Cools surrounding air by encouraging evapotranspiration, the controlled release of water through plants’ leaves.
- Improves the wildlife habitat quality and the biodiversity of Campus landscapes.

Blackwater vs. Graywater

‘Blackwater’ is wastewater that contains a high percentage of organic matter. Blackwater from kitchen sinks, dishwashers and toilets, requires extensive treatment before it can be recycled.

‘Graywater’ is wastewater that has minimal organic content; for instance, water from bathroom sinks, showers and laundry facilities. Many plants are naturally able to recycle and cleanse graywater.
Water Quality Management Tools

A holistic approach to improving water quality includes measures for: mitigating the impact of wastewater discharge, preserving and enhancing areas for water remediation, and minimizing impervious surfaces. (Impervious surfaces are those through which rainwater cannot percolate through to recharge groundwater.) Techniques for improving water quality include:

- **Below-grade detention**: The underground storage of stormwater for later use, for instance in cisterns collecting rainwater from Campus roofs.
- **Buffer strips**: Vegetated areas planted with species that help filter contaminants from stormwater, stopping sediment and pollutants before they impact wildlife habitat areas.
- **Check dams**: Mechanisms for reducing the speed and sediment content of water in streams and channels.
- **Conveyance**: The routing of water from impervious to pervious areas, enabling groundwater recharge.
- **Detention**: The temporary storage of stormwater.
- **Dry wells**: Underground structures that dissipate stormwater into the ground.
- **Green curbs**: Curbs that are flush with adjacent streets or that include gaps to facilitate conveyance.
- **Green roofs**: Planted roofs that reduce energy use and stormwater runoff.
- **Infiltration**: Groundwater recharge through permeable, often vegetated, areas.
- **Permeable (pervious) paving**: Paving that allows stormwater percolation, usually filtering contaminants and sediment through a gravel sub-base.
- **Purple pipe**: Conveys treated but non-potable graywater, provided by the local wastewater treatment plant at minimal cost. Purple pipe is already used to irrigate the Traditions golf course, making it easy for the Campus to tap into non-potable water for irrigation.
- **Rainwater gardens**: Low points in the landscape planted with species known for their ability to uptake water and whose roots assist percolation through to groundwater.
- **Retention**: The permanent storage of stormwater, often in vegetated areas where plants speed water uptake and evaporation.
- **Swales**: Gently depressed channels that move stormwater through the landscape; also known as bio-swales (see page 128).
- **Water quality ponds**: Areas for stormwater detention, retention, or infiltration, that often contribute aesthetically to the landscape.
Stormwater Management

To mitigate the intensity of storm events, and associated erosion and siltation, measures to slow the flow of stormwater will be designed into the campus landscape, especially adjacent to paved areas of the Campus. Stormwater management promotes conveyance, through swales and buffer strips, and infiltration, through permeable paving and infiltration areas. Both infiltration areas and permeable paving feature highly permeable subsurfaces (coarse sand or gravel) to remove sediment and facilitate groundwater recharge.

Infiltration areas will include a slightly depressed central channel, in order to handle low-flow drainage and promote recreation in infiltration areas when stormwater flow is low.

Wetland grasses can take up excess nutrients associated with fertilizers in stormwater runoff. Infiltration areas can include seasonally inundated wet prairies. Infiltration areas can include seasonally inundated wet prairies. An overflow trench prevents excess flooding of detention areas. Green curbs facilitate groundwater recharge by either being flush with adjacent paving or providing gaps for stormwater flow (above). Green roofs (above, above right) reduce the energy used for cooling by more than 75% by improving building insulation (Green Roofs for Healthy Cities 2006: 28).
Swale Design and Maintenance

Swales will convey water at a 1%-4% slope or include check dams to reduce flow velocities in steeper areas. The side slopes of swales must not exceed 25%, to allow planting establishment and maintenance. Vegetation within swales is critical for promoting infiltration.

Suitable plant species can include a variety of turf grasses, sedges, and tussock grasses (see Lowland Landscapes planting list, page 141), but must cover the whole width of the swale at a height above the treatment flow water level. Swales can be planted with grasses and grass-like sedges and mown periodically. Foot traffic is discouraged in swale areas as it compacts soil and disrupts vegetative cover.

Swale vegetation will be mown each year before producing seeds or fruits that attract wildlife. Because swales form the first trap for stormwater sediment, they can over time become highly concentrated with lead and other urban pollutants.
Campus Irrigation

Campus irrigation will fall under central plant control to maximize efficiency, promote moisture sensor monitoring and reduce the use of potable water for irrigation. The campus will encourage passive irrigation, through cistern and pump systems for rainwater collection and reuse in areas with significant amounts of impervious surface. Passive sub-surface irrigation systems, such as the ‘EPIC’ system produced by Rehbein, can further facilitate the reuse of captured rainwater for irrigation.

Where passive systems are not efficient, irrigation requires highly efficient, low-volume drip systems. Watering turf and seed areas at the root zone, for instance through the Netafim system, is encouraged to reduce evaporative water loss. Pop-up spray heads are acceptable only where necessary, for instance in recreational areas where drip-systems are not practical.

Seeded areas will require temporary irrigation for establishment. These areas can use pop-up or rotor style irrigation heads for the first two years of establishment, provided that the irrigation systems are reused in other areas at the end of the establishment period. Prior to plant installation, water volume budgets must be calculated for all planting zones, including temporary planting areas. The Campus will evaluate water budgets efficiency, and adjusted them as necessary to minimize overall water consumption.

The ‘Water-Smart’ Campus

In summary, water quality management is crucial to establishing a water-smart campus. Adherence to these basic water-smart principles will reduce the cost of landscape maintenance and infrastructure and help create a suitable and sustainable campus landscape that:

- Maximizes the use of native plants to reduce maintenance and irrigation demand;
- Creates attractive water-quality enhancing landscapes that can withstand challenging environmental conditions;
- Limits the use of high water use plants, such as turf;
- Reduces the use of potable water for landscape irrigation and use ‘purple pipe’ where possible; and
- Uses highly efficient irrigation systems.
Conclusion

The Texas A&M Health Science Center (HSC) will be a "campus in a forest." The campus master plan is shaped by the natural constraints of the Site and preserves a core natural area which features an existing stand of mature oak trees. The abundant presence of petrified wood on the Site suggests a rich geologic history.
Summary of Sustainable Principles

By respecting the most valuable natural features of the Site, the Health Science Center limits natural disturbance. To encourage sustainability, the Campus also will:

- encourage pedestrian access,
- access public transportation,
- include ‘traffic calming’ measures,
- meet, but not exceed, local zoning requirements for parking,
- provide bicycle parking, and associated amenities,
- minimize light pollution,
- select site furnishings for recycled content and renewable / recyclable materials,
- use best practices for stormwater management,
- design outdoor areas with appropriate attention to climate, solar orientation and natural ventilation,
- focus high-maintenance, irrigated landscapes in high traffic and high profile areas,
- use native plants as much as possible to maximize drought tolerance,
- incorporate green roofs where possible,
- design buildings that maximize daylight and energy performance.

Conclusion

Former industrial use of the Site necessitates further environmental assessment, to determine what mitigation measures might be necessary to address any soil contamination in prior oil-drilling areas. As the Site intersects Turkey Creek’s 100-year floodplain, the applicability of Section 404 of the Clean Water Act also requires further investigation before each phase of development.

Phase 1 of the Health Science Center is scheduled for completion in 2010, and establishes the formal entrance of the Campus and initiates the network of pedestrian trails to allow users to experience the natural areas of the Site. A detailed development program, with campus landscape, and architectural guidelines, will shape later phases of development. This will ensure that the Health Science Center will achieve the high standard for sustainable development set during the master-planning process.
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Texas A&M University Campus Master Plan. Campus Master Plan Steering Committee: College Station, TX. Available online at: www.tamu.edu/campusplan/final_report.html. (July 2004.)


Texas Wildscapes: Native Plant List, Post-Oak Savannah and Blackland Prairie. Available online at: http://apc.tamu.edu/wfsc406/mgmtplan/AppendixX.pdf. (Downloaded October 2007.)


Architectural Materials Palette

The following material selections are to be used in exterior applications as standards.

**Exterior Veneer**

- Lighter Red Brick from ACME Brick Company, ‘251-Valley Rose’ color,
  Denton Plant or approved similar.
- Dark Red Brick from ACME Brick Company, ‘137-Burgundy’ color,
  Denton Plant or approved similar.
- Accent ivory brick from ACME Brick Company, ‘Dove gray’ color,
  Perla Plant or approved similar.
- Smooth and/or chiseled cut limestone from Alamo Stone company,
  ‘Champagne’ color or approved similar.
- Smooth and/or rock cut manufactured stone, from Arriscraft International,
  ‘Renaissance’ and/or ‘Tan’ or approved similar.

**Exterior Glazing**

- Low-E (VE and VRE) Insulated units,
  from Viracon, green-blue color or approved similar.

**Roofing**

- Standing seam metal roofs, in combination with built-up roofing,
  in gray or gray-green, Berridge or approved similar.
- Slate tile or flat clay tile, gray or green color range.
## Landscape Maintenance

<table>
<thead>
<tr>
<th>Planting Type</th>
<th>Weed Control</th>
<th>Fertilization</th>
<th>Mowing / Trimming</th>
<th>Mulching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For all planting types</strong></td>
<td>Use integrated weed management**</td>
<td>Use organic products</td>
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<td>Use double-shredded hardwood mulch from on site as available.</td>
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<td><strong>Native seed</strong></td>
<td>Apply 'fish-friendly' broadleaf herbicide two-three times per season OR</td>
<td>Proper soil amendment</td>
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<td>consider physical controls (such as burning) and grazing instead of</td>
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<td>herbicides.</td>
<td>ongoing fertilization.</td>
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<td>Mow once per year in</td>
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<td>height</td>
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<td><strong>Wildflower native seed mix</strong></td>
<td>Hand pull weeds as needed</td>
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<td>Proper soil amendment should reduce need for</td>
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<td><strong>Turf grass</strong></td>
<td>Apply 'fish-friendly' broadleaf herbicide two-three times per season OR</td>
<td>Minimize fertilizer</td>
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<td>(three times per season for first two seasons; twice per season thereafter)</td>
<td>applications.</td>
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<td>Mow once per week</td>
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<td><strong>Bio-swale plantings</strong></td>
<td>Hand pull weeds as needed</td>
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<td>Proper soil amendment should reduce need for</td>
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<td>ongoing fertilization.</td>
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<td>Trim only dead material</td>
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<td>as needed</td>
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<td><strong>Trees, shrubs and groundcovers</strong></td>
<td>Hand pull weeds as needed</td>
<td>Minimize fertilizer</td>
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<td>Mulch once per year or as needed</td>
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<td>Mow once per year in</td>
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<td>early spring or as needed</td>
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<td>branches</td>
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<td><strong>Perennials</strong></td>
<td>Hand pull weeds as needed</td>
<td>Minimize fertilizer</td>
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<td>Mulch once per year or as needed</td>
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<td>Dead-head spent flowers</td>
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<td>blooming</td>
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<td><strong>Ornamental grasses</strong></td>
<td>Hand pull weeds as needed</td>
<td>Minimize fertilizer</td>
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<td>Mulch once per year or as needed</td>
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<td>applications.</td>
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<td>Mow / trim once per year</td>
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<td>before spring growth</td>
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* Reuse / recycle all plant containers from planting installation.

** Once a healthy stand is achieved, minimal weed control will be needed. Integrated weed management includes a combination of the following:
- cultural controls, which suppress undesired species, for instance by minimizing soil disturbance, reseeding disturbed areas and using nurse crops;
- physical controls, which disrupt invasive plant growth, for instance by mowing, burning, mulching, or hand weeding;
- grazing, for instance by goat herds (which can be rented);
- biological controls, such as insects;
- chemical controls, which are most useful for managing large weed invasions.
Plant Palettes

Native Landscape Plant Palette

The planting palette in native landscapes consists of plants native to the region's Blackland Prairie and Post Oak Savannah. The following species are also adapted to the Site's acid soils and require less maintenance and soil amendment than other plants. Many of these species are also adapted to riparian soils, clays, or variable soil pH. This list of native shrubs, vines and trees can be supplemented by the list of herbaceous species featured on page 140.

- Post oak, Quercus stellata
- Live oak, Quercus virginiana
- Texas buckeye, Aesculus glabra v. arguta
- Red mulberry, Morus rubra
- Texas madrone, Arbutus xalapensis
- Texas ash, Fraxinus texensis
- Thornless cockspur hawthorn, Crataegus crus-galli 'Inermis'
- Witch hazel, Hamamelis virginiana
- Flowering dogwood, Cornus florida
- Flowering dogwood, Cornus florida
- Rechorn hawthorn, Crataegus reverchonii
- Texas madrone, Arbutus xalapensis
- Texas madrone, Arbutus xalapensis
- Texas madrone, Arbutus xalapensis
Canopy Trees for Native Landscapes

Liquidambar styraciflua* Sweetgum
Populus deltoides** Eastern cottonwood
Quercus marilandica* Blackjack oak
Quercus stellata* Post oak
Quercus virginiana*** Live oak

Understory Trees for Native Landscapes

Acer leucoderme* Chalk Maple
Aesculus glabra v. arguta Texas buckeye
Aesculus xalapensis*** Texas madrone
Carpinus caroliniana*** Musclewood
Cornus florida* Flowering dogwood
Crataegus crus-galli ‘Inermis’*** Thornless cockspur hawthorn
Crataegus marshallii*** Parsley hawthorn
Crataegus reverchonii Texas persimmon
Diospyros texana*** Texas persimmon
Hamamelis virginiana* Witch hazel
Ilex opaca* American holly
Juglans microcarpa* Little walnut
Morus rubra*** Red mulberry
Zanthoxylum clava-herculis* Hercules’ club

Shrubs for Native Landscapes

Baccharis halimifolia* Coyote bush

* Species adapted to poor drainage or to riparian zones.
** Species adapted to calcareous soils.
*** Species adapted to acid soils.
**** Species adapted to clay soils.
Native Herbaceous Species

Native plantings include large swaths of perennials and annuals installed from seed, which use temporary irrigation as needed for establishment. Maintenance will likely require yearly mowing or prescribed burning in prairie understory areas, to control invasive species.

The following herbaceous species are native to the region and therefore adapted to periodic fire and/or mowing. This list is intended as a starting point for selecting perennials, annuals, succulents and grasses for native landscapes as well as for other landscape typologies. The category ‘native grasses’ encompasses both true grasses and a number of grass-like plants.

Post Oak Savannah Native Grasses

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon gerardii</td>
<td>Big bluestem</td>
</tr>
<tr>
<td>Andropogon glomeratus</td>
<td>Bushy bluestem</td>
</tr>
<tr>
<td>Andropogon ternarius</td>
<td>Split-beard bluestem</td>
</tr>
<tr>
<td>Andropogon virginicus</td>
<td>Broomsedge / Yellow Bluestem</td>
</tr>
<tr>
<td>Bothriochloa barbinodis</td>
<td>Cane bluestem</td>
</tr>
<tr>
<td>Bouteloua curtipendula</td>
<td>Sideos grama</td>
</tr>
<tr>
<td>Buchloe dactyloides</td>
<td>Buffalo grass</td>
</tr>
<tr>
<td>Chasmanthium latifolium</td>
<td>Inland sea-oats</td>
</tr>
<tr>
<td>Chloris cucullata</td>
<td>Hooded windmillgrass</td>
</tr>
<tr>
<td>Elymus canadensis</td>
<td>Canada wild rye</td>
</tr>
<tr>
<td>Eriochloa sericea</td>
<td>Texas cupgrass</td>
</tr>
<tr>
<td>Muhlenbergia lindheimeri</td>
<td>Big muhly</td>
</tr>
<tr>
<td>Muhlenbergia reverchonii</td>
<td>Seep muhly</td>
</tr>
<tr>
<td>Paspalum plicatulum</td>
<td>Indian nut grass / Indian grass</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Tall dropseed</td>
</tr>
<tr>
<td>Sporobolus asper</td>
<td>Purple-top grass</td>
</tr>
<tr>
<td>Triandis flavus</td>
<td>Purple triplexis</td>
</tr>
<tr>
<td>Triplasis purpurea</td>
<td>Eastern gamagrass</td>
</tr>
</tbody>
</table>

Post Oak Savannah Perennials

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asclepias tuberosa</td>
<td>Butterfly weed</td>
</tr>
<tr>
<td>Camassia scilloides</td>
<td>Wild hyacinth</td>
</tr>
<tr>
<td>Castilleja indivisa</td>
<td>Entire-leaf Indian paintbrush</td>
</tr>
<tr>
<td>Delphinium carolinum</td>
<td>Prairie larkspur</td>
</tr>
<tr>
<td>Erythrina herbacea</td>
<td>Coralbead</td>
</tr>
<tr>
<td>Eupatorium serotinum</td>
<td>Late boneset</td>
</tr>
<tr>
<td>Lobelia cardinalis</td>
<td>Cardinal flower</td>
</tr>
<tr>
<td>Melampyris drumondii</td>
<td>Turk’s cap</td>
</tr>
<tr>
<td>Nemastylis geminiflora</td>
<td>Prairie celestial</td>
</tr>
<tr>
<td>Rudbeckia hirta</td>
<td>Black-eyed susan</td>
</tr>
<tr>
<td>Salvia coccinea</td>
<td>Scarlet sage</td>
</tr>
<tr>
<td>Solidago canadensis</td>
<td>Giant goldenrod</td>
</tr>
</tbody>
</table>

Post Oak Savannah Succulents

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hesperaloe parviflora</td>
<td>Red yucca</td>
</tr>
<tr>
<td>Opuntia lindeimerei</td>
<td>Prickly-pear cactus</td>
</tr>
<tr>
<td>Yucca angustifolia</td>
<td>Narrow-leaf yucca</td>
</tr>
<tr>
<td>Yucca arakensa</td>
<td>Thread-leaf yucca</td>
</tr>
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</table>

Post Oak Savannah Annuals

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Callithoe digitata</td>
<td>Winecup</td>
</tr>
<tr>
<td>Coreopsis tinctoria</td>
<td>Tickseed / Golden wave</td>
</tr>
<tr>
<td>Eustoma grandiflora</td>
<td>Texas bluebell</td>
</tr>
<tr>
<td>Gaillardia pulchella</td>
<td>Blanket flower</td>
</tr>
<tr>
<td>Ipomopsis rubra</td>
<td>Standing cypress</td>
</tr>
<tr>
<td>Lupinus texensis</td>
<td>Texas bluebonnet</td>
</tr>
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</table>

Blackland Prairie Native Grasses

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon gerardii</td>
<td>Big bluestem</td>
</tr>
<tr>
<td>Bouteloua curtipendula</td>
<td>Sideos grama</td>
</tr>
<tr>
<td>Elymus canadensis</td>
<td>Canada wild rye</td>
</tr>
<tr>
<td>Muhlenbergia lindheimeri</td>
<td>Big muhly</td>
</tr>
<tr>
<td>Panicum virgatum</td>
<td>Upland switchgrass</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Little bluestem</td>
</tr>
<tr>
<td>Sorghastrum nutans</td>
<td>Indian nut grass / Indian grass</td>
</tr>
<tr>
<td>Tripsacum dactyloides</td>
<td>Eastern gamagrass</td>
</tr>
</tbody>
</table>

Blackland Prairie Perennials

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphanostephus skirrhobasis</td>
<td>Lazy daisy</td>
</tr>
<tr>
<td>Aquilegia canadensis</td>
<td>Native columbine</td>
</tr>
<tr>
<td>Aster ericoides</td>
<td>Heath aster</td>
</tr>
<tr>
<td>Engelmannia pinnatifida</td>
<td>Cutleaf daisy</td>
</tr>
<tr>
<td>Geum canadense</td>
<td>White avens</td>
</tr>
<tr>
<td>Helianthus maximilianii</td>
<td>Maximilian sunflower</td>
</tr>
<tr>
<td>Monarda fistulosa</td>
<td>Wild bergamot</td>
</tr>
<tr>
<td>Penstemon cobra</td>
<td>Giant foxglove</td>
</tr>
<tr>
<td>Rudbeckia hirta</td>
<td>Black-eyed susan</td>
</tr>
<tr>
<td>Ruellia nudiflora</td>
<td>Violet ruella</td>
</tr>
<tr>
<td>Salvia azurea v. grandiflora</td>
<td>Pitcher sage</td>
</tr>
<tr>
<td>Salvia lyrata</td>
<td>Lyreleaf Sage</td>
</tr>
<tr>
<td>Senecio obovatus</td>
<td>Golden groundsel</td>
</tr>
<tr>
<td>Silphium gracie</td>
<td>Rosinweed</td>
</tr>
<tr>
<td>Solidago spp.</td>
<td>Goldenrod</td>
</tr>
<tr>
<td>Tephrosia lindheimeri</td>
<td>Tephrrosia</td>
</tr>
<tr>
<td>Thlesperma filifolium</td>
<td>Greenthread</td>
</tr>
<tr>
<td>Veronica baldwinii</td>
<td>Ironweed</td>
</tr>
<tr>
<td>Vioia missouriensis</td>
<td>Wood violet</td>
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</tbody>
</table>

Blackland Prairie Succulents

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yucca arkansana</td>
<td>Thread-leaf yucca</td>
</tr>
<tr>
<td>Opuntia spp.</td>
<td>Prickly pear</td>
</tr>
</tbody>
</table>

Blackland Prairie Annuals

<table>
<thead>
<tr>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamaecrista fasciculata</td>
<td>Partridge pea</td>
</tr>
<tr>
<td>Coreopsis tinctoria</td>
<td>Tickseed / Golden wave</td>
</tr>
<tr>
<td>Eustoma grandiflora</td>
<td>Texas bluebells</td>
</tr>
<tr>
<td>Lupinus texensis</td>
<td>Texas bluebonnet</td>
</tr>
</tbody>
</table>
Lowland Plant Palette

Emphasizing native species in lowland areas helps restore natural habitats and ensure the historic continuity of the region’s Post Oak Savannah and Blackland Prairie ecosystems. The following native and adapted species are adapted to drainage and riparian areas. These plants can stand periodic flooding or can stand poorly draining soil.

More plants tolerate partial submersion than total immersion. Which plant species are appropriate for lowland areas depends on water depth and frequency of flooding. An additional resource is the US Department of Agriculture’s Natural Resources Conservation Service (USDA-NRCS) publication, Guidelines for Establishing Aquatic Plants in Wetlands, which offers recommendations for selecting, planting, and maintaining wetland species.

Canopy Trees for Lowland Landscapes*

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer rubrum v. drummondii</td>
<td>Drummond red maple</td>
</tr>
<tr>
<td>Betula nigra</td>
<td>River birch</td>
</tr>
<tr>
<td>Celtis reticulata</td>
<td>Canyon hackberry</td>
</tr>
<tr>
<td>Fraxinus americana</td>
<td>White ash</td>
</tr>
<tr>
<td>Fraxinus pensylvanica</td>
<td>Green ash</td>
</tr>
<tr>
<td>Liquidambar styraciflua</td>
<td>Sweetgum</td>
</tr>
<tr>
<td>Populus deltoids</td>
<td>Eastern cottonwood</td>
</tr>
<tr>
<td>Quercus falcata</td>
<td>Southern red oak</td>
</tr>
<tr>
<td>Quercus virginiana</td>
<td>Live oak</td>
</tr>
<tr>
<td>Ulmus americana</td>
<td>American elm</td>
</tr>
<tr>
<td>Ulmus crassifolia</td>
<td>Cedar elm</td>
</tr>
</tbody>
</table>

Understory Trees for Lowland Landscapes*

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia farnesiana</td>
<td>Huisache / Sweet acacia</td>
</tr>
<tr>
<td>Aesculus pavia</td>
<td>Red buckeye</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>Redbud</td>
</tr>
<tr>
<td>Cornus drummondii</td>
<td>Rough-leaf dogwood</td>
</tr>
<tr>
<td>Crataegus viridis</td>
<td>Green hawthorn</td>
</tr>
<tr>
<td>Diospyros virginiana</td>
<td>Common persimmon</td>
</tr>
<tr>
<td>Ilex decidua</td>
<td>Deciduous holly</td>
</tr>
<tr>
<td>Ilex opaca</td>
<td>American holly</td>
</tr>
<tr>
<td>Myrica cerifera</td>
<td>Wax myrtle</td>
</tr>
<tr>
<td>Sassafras albidum</td>
<td>Sassafras</td>
</tr>
<tr>
<td>Taxodium distichum</td>
<td>Bald cypress</td>
</tr>
</tbody>
</table>

Shrubs for Lowland Landscapes*

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amorpha fruticosa</td>
<td>False indigo</td>
</tr>
<tr>
<td>Callicarpa americana</td>
<td>American beauty-berry</td>
</tr>
<tr>
<td>Cephalanthus occidentalis</td>
<td>Button bush</td>
</tr>
<tr>
<td>Sambucus canadensis</td>
<td>Golden elder</td>
</tr>
<tr>
<td>Viburnum rufidulum</td>
<td>Rusty black-haw viburnum</td>
</tr>
</tbody>
</table>

Vines for Lowland Landscapes*

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampelopsis arborea</td>
<td>Peppervine</td>
</tr>
<tr>
<td>Aristolochia tomentosa</td>
<td>Wooly pipevine</td>
</tr>
<tr>
<td>Bignonia capreolata</td>
<td>Cross-vine</td>
</tr>
<tr>
<td>Campsis radicans</td>
<td>Trumpet vine</td>
</tr>
<tr>
<td>Clematis pitcheri</td>
<td>Purple leatherflower</td>
</tr>
<tr>
<td>Lonicera sempervirens</td>
<td>Trumpet honeysuckle</td>
</tr>
</tbody>
</table>

* Species adapted to poor drainage or to riparian zones.
* Species adapted to calcareous soils.
* Species adapted to acid soils.
* Species adapted to clay soils.
‘Natural’ Plant Palette

The plant palette for natural landscapes expands on the species list used in native areas, adding plants that require amendment of soil pH but not of soil texture. Accordingly, the following species are adapted to clays, disturbed soils, or a range of soil types, and are low to moderate in their use of water.

Canopy Trees for Natural Landscapes

- **Bumelia lanuginosa**
- **Carya illinoinensis**
- **Celtis laevigata**
- **Fraxinus pennsylvanica**
- **Gleditsia triacanthos inermis**
- **Platanus occidentalis**
- **Quercus falcata**
- **Quercus macrocarpa**
- **Quercus muehlenbergii**
- **Quercus shumardii**
- **Quercus virginiana**
- **Ulmus americana**
- **Ulmus crassifolia**

Understory Trees for Natural Landscapes

- **Acacia farnesiana**
- **Aesculus pavia**
- **Arbutus xalapensis**
- **Carpinus caroliniana**
- **Cercis canadensis**
- **Crataegus crus-galli**
- **Crataegus marshallii**
- **Diospyros texana**
- **Diospyros virginiana**
- **Frangula caroliniana**
- **Frangula californica urarina**
- **Fraxinus texensis**
- **Ilex decidua**
- **Juniperus ashei**
- **Juniperus virginiana**
- **Maclura pomifera**
- **Pinus taeda**
- **Prosopis glandulosa**
- **Prunus mexicana**
- **Sophora affinis**
- **Ugniadia speciosa**

Shrubs for Natural Landscapes

- **Amorpha fruticosa**
- **Callicarpa americana**
- **Dalea frutescens**
- **Forestiera pubescens**
- **Ilex vomitoria**
- **Lantana horrida**
- **Rhus aromatica**
- **Rhus copallina**
- **Rhus glabra**
- **Rhus tanceolata**
- **Salvia greggi**
- **Sambucus canadensis**
- **Symphoricarpos orbiculatus**
- **Viburnum rufidulum**

- **False indigo / Bastard indigo**
- **American beauty-berry**
- **Black date**
- **Elbow bush**
- **Yapon holly**
- **Lantana**
- **Fragrant sumac**
- **Flameleaf sumac**
- **Scarllet sumac / Smooth sumac**
- **Prairie flameleaf sumac**
- **Cherry sage / Autumn sage**
- **Golden elder**
- **Rusty black-haw viburnum**

- *** Species adapted to poor drainage or to riparian zones.**
- **Species adapted to clay soils.**
Appendix C: Plant Palettes

- **Yaupon holly**, *Ilex vomitoria*
- **Smooth sumac**, *Rhus glabra*
- **Southern red oak**, *Quercus falcata*
- **Chinquapin oak**, *Quercus muehlenbergii*
- **Flameleaf sumac**, *Rhus copallina*
- **Yaupon holly**, *Ilex vomitoria*
- **Bois d’arc / Osage orange**, *Maclura pomifera*
- **Prairie flameleaf sumac**, *Rhus lanceolata*
- **Lantana**, *Lantana floridana*
- **Texas persimmon**, *Diospyros virginiana*
- **Red buckeye**, *Aesculus pavia*
- **Huisache / Sweet acacia**, *Acacia farmesiana*
- **Ashe juniper**, *Juniperus ashei*
- **Mexican buckeye**, *Ugnadia speciosa*
- **Eastern red cedar**, *Juniperus virginiana*
- **False Indigo**, *Amorpha fruticosa*
- **Coralberry**, *Symphoricarpos orbiculatus*
- **Mexican plum**, *Prunus mexicana*
- **Golden elder**, *Sambucus canadensis*
- **Black dales**, *Dalea frutescens*
The following adapted, introduced and native species use low to moderate amounts of water, and are either adapted to a wide range of soil textures or prefer lighter textured soils (sands and loams). These plants are appropriate in areas of significant cut and fill, where amendment of the Site’s clay soils can be considerable, or as borders to programmed landscapes.

**Canopy Trees for Cultivated Landscapes**

- *Lagerstroemia fauriei* - Japanese crepe myrtle
- *Quercus stellata* - Post oak
- *Ulmus alata* - Winged elm

**Understory Trees for Cultivated Landscapes**

- *Arbutus xalapensis* - Texas madrone
- *Cercis canadensis texensis* - Texas redbud
- *Crataegus crus-galli* - Cockspur hawthorn
- *Diospyros texana* - Texas persimmon
- *Juniperus ashei* - Ashe juniper
- *Juniperus virginiana* - Eastern red cedar
- *Prosopis pubescens* - Velvet mesquite
- *Quercus incana* - Bluejack oak
- *Quercus sinuata v. breviloba* - Scaly-bark oak / White shin oak
- *Sapindus drummondii* - Western soapberry

**Shrubs for Cultivated Landscapes**

- *Dalea frutescens* - Black dalea
- *Forestiera neomexicana* - New Mexico olive
- *Forestiera pubescens* - Elbowbush
- *Lantana horrida* - Lantana
- *Lagerstroemia indica* - Crepe myrtle
- *Rhus copallina* - Flameleaf sumac

**Vines for Cultivated Landscapes**

- *Clematis drummondii* - Old man’s beard
- *Ibervillea lintheimeri* - Globe-berry
- *Maurandya antirrhiniflora* - Snap dragon vine

* *Species adapted to poor drainage or to riparian zones.
  • *Species adapted to calcareous soils.
  ◇ *Species adapted to acid soils.
  ◇ ◇ *Species adapted to clay soils.*
Appendix C: Plant Palettes

Japanese crepe myrtle, Lagerstroemia fauriei

Winged elm, Ulmus alata

Scaly-bark oak, Quercus sinuata v. breviloba

Bluejack oak, Quercus incana

Old man’s beard, Clematis drummondii

Globe-berry, Ibervillea lindheimeri

Velvet mesquite, Prosopis velutina

Elbowbush, Forestiera pubescens

Snap dragon vine, Maurandya antirrhiniflora

Japanese crepe myrtle, Lagerstroemia fauriei

Winged elm, Ulmus alata

Scaly-bark oak, Quercus sinuata v. breviloba

Bluejack oak, Quercus incana

Old man’s beard, Clematis drummondii

Globe-berry, Ibervillea lindheimeri

Velvet mesquite, Prosopis velutina

Elbowbush, Forestiera pubescens

Snap dragon vine, Maurandya antirrhiniflora
‘Programmed’ Plant Palette

Plantings in programmed landscapes include both native and appropriately adapted species, but rely more heavily on natives due to their greater resistance to local climate, drought, and disease. The following list of native and adapted species includes plants that use moderate amounts of water and are adapted to moderately textured soils (sands and loams). Other adapted species may be appropriate, provided that they are not considered invasive or aggressive in the region.

Canopy Trees for Programmed Landscapes

- **Bumelia lanuginosa** = Wooly-bucket bumelia
- **Carya illinoiensis** = Pecan
- **Carya texana** = Black hickory
- **Fraxinus pensylvanica** = Green ash
- **Gleditsia triacanthos inermis** = Honeylocust
- **Juglans nigra** = Black walnut
- **Liquidambar styraciflua** = Sweetgum
- **Platanus occidentalis** = Sycamore
- **Quercus macrocarpa** = Bur oak
- **Quercus muehlenbergii** = Chinquapin oak
- **Quercus shumardii** = Shumard red oak
- **Quercus virginiana** = Live oak
- **Tilia americana** = Carolina basswood
- **Ulmus americana** = American elm
- **Ulmus crassifolia** = Cedar elm

Understory Trees for Programmed Landscapes

- **Acacia farnesiana** = Huisache / Sweet acacia
- **Acer leucoderme** = Chalk Maple
- **Aesculus pavia** = Red buckeye
- **Colinus obovatus** = American smoke tree
- **Crataegus crus-galli ‘Inermis’** = Thornless cockspur hawthorn
- **Diospyros virginiana** = Common persimmon
- **Frangula caroliniana** = Carolina buckthorn
- **Frangula californica ursina** = California buckthorn
- **Ilex decidua** = Deciduous holly
- **Juglans microcarpa** = Little walnut / River walnut
- **Maclura pomifera** = Bois d’arc / Osage orange
- **Myrica cerifera** = Wax myrtle
- **Prunus munsoniana** = Munson plum
- **Prunus serotina v. serotina** = Black cherry
- **Ptelea trifoliata** = Water ash
- **Sophora affinis** = Eve’s necklace
- **Ugnadia speciosa** = Mexican buckeye
- **Zanthoxylum clava-herculis** = Hercules’ club

Additional images include:
- **American smoke tree**, *Cotinus obovatus*
- **Wax myrtle**, *Myrica cerifera*
- **Carolina basswood**, *Tilia caroliniana*
- **Gray-leaf grape**, *Vitis cinerea*
- **Mustang grape**, *Vitis mustangensis*
**Shrubs for Programmed Landscapes**

- **Rhus aromatica** \(^a\) - Fragrant sumac
- **Symphoricarpos orbiculatus** \(^a\) - Coralberry
- **Vaccinium arboresum** - Farkleberry
- **Viburnum rufidulum** \(^a\) - Rusty black-haw viburnum

**Vines for Programmed Landscapes**

- **Aristolochia tomentosa** \(^a\) - Wooly pipevine
- **Bignonia capreolata** \(^a\) - Cross-vine
- **Campsis radicans** \(^a\) - Trumpet vine
- **Cocculus carolinus** - Carolina moonseed
- **Lonicera sempervirens** \(^a\) - Trumpet honeysuckle
- **Parthenocissus quinquefolia** - Virginia creeper
- **Passiflora incarnata** - Maypop
- **Passiflora lutea** - Yellow passionvine
- **Vitis cinerea**\(^a\) - Gray-leaf grape
- **Vitis mustangensis**\(^a\) - Mustang grape

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* Species adapted to poor drainage or to riparian zones.
* Species adapted to calcareous soils.
\(^a\) Species adapted to acid soils.
\(^a\) Species adapted to clay soils.
Plant Species Information Tables

Big bluestem
Andropogon gerardii

Little bluestem
Schizachyrium scoparium

Cutleaf daisy
Engelmannia pinnatifida

Diamond petal primrose
Oenothera rhombipetala

Prairie celestial
Nemastylis geminiflora

Tephrosia
Tephrosia lindheimeri

Wild hyacinth
Camassia scilloides

Golden groundsel
Senecio obovatus

Cedar sedge
Carex planostachys

Canada wild rye
Elymus canadensis

Turk’s cap
Malvaviscus drummondii

Partridge pea
Chamaecrista fasciculata

Heath aster
Aster ericoides

Coralbean
Erythrina herbacea

Cardinal flower
Lobelia cardinalis

Giant foxglove
Penstemon cobaea

Prickly pear cactus
Opuntia lindheimerii

Canada wild rye is also known as Elymus canadensis.
| Species Name | Common Name | Shade | Part Sun / Light shade? | Full Sun | Water requirements: Very Low / Low / Moderate / High | Tolerates calcareous soils (X) | Tolerates clay soils (X) | Tolerates salt (X) | Tolerates disturbed soils (X) | Tolerates acid soils (X) | Tolerates calcareous soils (=) | Tolerates clay soils (=) | Tolerates salt (=) | Tolerates disturbed soils (=) | Drought tolerance (if known) | Mature Height (x Width) | Minimum installation size | Minimum distance on center (OC) | Native landscape | Natural garden design | Cultivated landscape | Programmed landscape | Lowland landscape (* | Understory tree (X) | Native tree (X) | Shrub (X) | Vine (X) | Annual / Biennial (X) | Perennial (X) | Canopy tree (X) | Shrub (X) | Canopy tree (X) | Understory tree (X) | Understory tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Understory tree (X) | Understory tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canopy tree (X) | Canop...
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<th>Tolerates acid soils (≠)</th>
<th>Tolerates clay soils (Δ)</th>
<th>Tolerates salt (Ө)</th>
<th>Tolerates disturbed soils (●)</th>
<th>Lowland' landscape (※)</th>
<th>Drought tolerance (if known)</th>
<th>Mature Height (x Width)</th>
<th>Minimum installation size</th>
<th>Minimum distance on center (OC)</th>
<th>Landscape type</th>
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<th>Programmed landscape</th>
<th>Other notes</th>
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<td>Tolerates acid soils (–)</td>
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<td>Tolerates disturbed soils (●)</td>
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<td>TX Blackland Prairie native</td>
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<td>Honeylocust</td>
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<td>Canopy tree</td>
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<td>Hameamela virginiana</td>
<td>Witch hazel</td>
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<td>Maximilian sunflower</td>
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<td>Succulent</td>
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<td>Hesperaloe parviflora</td>
<td>Red yucca / Hesperaloe</td>
<td>X X X L = X L 2-3' + 5' stalk 1 gallon 3-4 OC</td>
<td>Succulent</td>
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<td>Lagerstroemia indica</td>
<td>Crepe myrtle</td>
<td>X M = X 6-12' 2&quot; caliper 10-15 OC</td>
<td>Understory tree</td>
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<td>Lagerstroemia fauriei</td>
<td>Japanese crepe myrtle</td>
<td>X M = X 2-3' x 5' stalk 1 gallon 3-4 OC</td>
<td>Canopy tree</td>
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<td>Ashe juniper</td>
<td>X X X L = X 10-30' 3&quot; caliper 15-20 OC</td>
<td>Understory tree</td>
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<td>Juniperus virginiana</td>
<td>Eastern red cedar / Juniper</td>
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<td>Lagerstroemia floribunda</td>
<td>Crepe myrtle</td>
<td>X M = X 6-12' 2&quot; caliper 10-15 OC</td>
<td>Understory tree</td>
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<td>Lantana horrida</td>
<td>Lantana</td>
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<td>Liquidambar styraciflua</td>
<td>Sweetgum</td>
<td>X X X H = X 60-100' 4&quot; caliper 40 OC</td>
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<td>Lobelia cardinalis</td>
<td>Cardinal flower</td>
<td>X X X VL/M/H = X L 6-6' seed n/a</td>
<td>Perennial</td>
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<td>Lonicera sempervirens</td>
<td>Trumpet honeysuckle</td>
<td>X X X M = X L 40' 5 gallon 3-5&quot; X X Vine</td>
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<td>Texas bluebonnet</td>
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<td>Big muhly</td>
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<td>Species Name</td>
<td>Common Name</td>
<td>Shade?</td>
<td>Part Shade?</td>
<td>Partial Sun?</td>
<td>Light Shade?</td>
<td>Sun?</td>
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<td>Tolerates clay soils ( )</td>
<td>Tolerates acid soils ( )</td>
<td>Tolerates calcareous soils (=)</td>
<td>Drought tolerance (if known)</td>
<td>Minimum distance on center (OC)</td>
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<td>TX Blackland Prairie native</td>
<td>TX Lowland landscape ( )</td>
<td>TX Natural grass</td>
<td>TX Native prairie</td>
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<td>Opuntia lindheimeri</td>
<td>Prickly-pear cactus</td>
<td>1-5'</td>
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<td>Panicum anceps</td>
<td>Beaked panicum</td>
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<td>Panicum virgatum</td>
<td>Upland switchgrass</td>
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<td>Virginia creeper</td>
<td>30'</td>
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<td>Brownseed paspalie</td>
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<td>Yellow passionvine</td>
<td>3'</td>
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<td>Penstemon cobaea</td>
<td>Giant foxglove / Wild foxglove</td>
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<td>Pinus taeda</td>
<td>Loblolly pine</td>
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<td>Platanus occidentalis</td>
<td>Sycamore</td>
<td>100-150'</td>
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<tr>
<td>Populus deltoides</td>
<td>Eastern cottonwood</td>
<td>40-100'</td>
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<tr>
<td>Prosopis glandulosa</td>
<td>Honey mesquite</td>
<td>25-35' x 30-50'</td>
<td>3'</td>
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<tr>
<td>Prosopis pubescens</td>
<td>Screwbean mesquite / Torrillo</td>
<td>X</td>
<td>L/M</td>
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<td>Prosopis velutina</td>
<td>Velvet mesquite</td>
<td>20-30'</td>
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<tr>
<td>Prosopis mexicana</td>
<td>Mexican plum</td>
<td>15-35'</td>
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<tr>
<td>Prosopis munsoniana</td>
<td>Munson plum</td>
<td>15-25'</td>
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<tr>
<td>Prosopis serentina v. serotina</td>
<td>Black cherry</td>
<td>40-60'</td>
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<td>Ptelea trifoliata</td>
<td>Water ash</td>
<td>5-20'</td>
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<tr>
<td>Quercus falcata</td>
<td>Spanish oak / Southern red oak</td>
<td>X</td>
<td>M/H</td>
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<td>X</td>
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<tr>
<td>Quercus incana</td>
<td>Bluejack oak</td>
<td>30-40'</td>
<td>3.5'</td>
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<td>X</td>
<td>Very Low / Low</td>
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<tr>
<td>Quercus macrocarpa</td>
<td>Bur oak</td>
<td>60-80' x 30'</td>
<td>4'</td>
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<td>Very Low / Low</td>
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<tr>
<td>Quercus marilandica</td>
<td>Blackjack oak</td>
<td>40-60'</td>
<td>4'</td>
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<tr>
<td>Quercus muenchbergi (Q. prinoides)</td>
<td>Chinquapin oak</td>
<td>Good 40-60' x 40'</td>
<td>4'</td>
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<tr>
<td>Quercus shumardii</td>
<td>Shumard red oak</td>
<td>50-100'</td>
<td>4'</td>
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<td>Quercus sinuata v. breviflora</td>
<td>Scaly-bark oak</td>
<td>30-40'</td>
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<tr>
<td>Quercus stellata</td>
<td>Post oak</td>
<td>40-50'</td>
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<tr>
<td>Quercus virginiana</td>
<td>Live oak</td>
<td>Good 50' x 150'</td>
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<tr>
<td>Rhus aromatica</td>
<td>Fragrant sumac</td>
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<tr>
<td>Rhus copalina</td>
<td>Flameleaf sumac</td>
<td>15-25'</td>
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<tr>
<td>Rhus glabra</td>
<td>Scarlet sumac</td>
<td>3-10 x 10'</td>
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<td>Rhus lanceolata</td>
<td>Prairie flameleaf sumac</td>
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<tr>
<td>Rosa setigera</td>
<td>Prairie rose</td>
<td>9-15'</td>
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<td>Species Name</td>
<td>Common Name</td>
<td>Shade?</td>
<td>Part Shade?</td>
<td>Part sun / Light shade?</td>
<td>Sun?</td>
<td>Water requirements:</td>
<td>Tolerates calcareous soils (≠)</td>
<td>Tolerates acid soils (≠)</td>
<td>Tolerates clay soils (≠)</td>
<td>Tolerates salt (≠)</td>
<td>Tolerates disturbed soils (≠)</td>
<td>Lowland' landscape (*)</td>
<td>Drought tolerance (if known)</td>
<td>Mature Height (x Width)</td>
<td>Minimum installation size</td>
<td>Minimum distance on center (OC)</td>
<td>Nature landscape</td>
<td>Native landscape</td>
<td>Cultivated landscape</td>
<td>Programmed landscape</td>
<td>Lowland landscape (*)</td>
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<tr>
<td>Rudbeckia hirta</td>
<td>Black-eyed susan</td>
<td>X</td>
<td>X</td>
<td>M</td>
<td></td>
<td>Poor</td>
<td>1-2’ seed n/a X X Perennial</td>
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<tr>
<td>Salvia coccinea</td>
<td>Scarlet sage</td>
<td>X</td>
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<td>M</td>
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<td>*</td>
<td>2-4’ seed n/a X X Perennial</td>
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<tr>
<td>Salvia greggi</td>
<td>Cherry sage / Autumn sage</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
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<td>2-4’ x 2’ seed 12-15’ OC X X Shrub</td>
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<tr>
<td>Sambucus canadensis</td>
<td>Golden elder / Elderberry</td>
<td>X</td>
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<td>MH =</td>
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<td>Fair 15-30’ 5 gallon 8-10’ OC X X Shrub</td>
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<tr>
<td>Saucedia drummondii</td>
<td>Soapbush / Western soapbush</td>
<td>X</td>
<td>X</td>
<td>L</td>
<td></td>
<td>*</td>
<td>15-30’ x 20’ 3’ caliper 15-20’ OC X Understory tree X</td>
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<td>Sassafras albidum</td>
<td>Sassafras</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Poor</td>
<td>15-20’ 3’ caliper 40’ OC X * Understory tree *</td>
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<tr>
<td>Schizachyrium scoparium</td>
<td>Little bluestem</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
<td></td>
<td>*</td>
<td>Poor 2-5’ seed n/a X X Native grass</td>
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<tr>
<td>Seneio obovatus</td>
<td>Golden groundsel</td>
<td>2’</td>
<td>seed n/a</td>
<td>X X Biennial</td>
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<tr>
<td>Staphyum gracle</td>
<td>Rosinweed</td>
<td>4’6’ x 2-4’</td>
<td>seed n/a</td>
<td>X Perennial</td>
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<tr>
<td>Soliloegus canadensis</td>
<td>Giant goldenrod</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
<td></td>
<td>*</td>
<td>3-6’ seed n/a X Perennial</td>
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<tr>
<td>Sophora afflora</td>
<td>Eve’s necklace</td>
<td>X</td>
<td>X</td>
<td>M</td>
<td></td>
<td>Good</td>
<td>15-30’ 3’ caliper 6-12’ OC X Understory tree X X</td>
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<tr>
<td>Sorghastrum nutans</td>
<td>Indian nut grass / Indian grass</td>
<td>X</td>
<td>X</td>
<td>MH =</td>
<td></td>
<td>*</td>
<td>3-8’ 1 gallon 2-3’ OC X Native grass</td>
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<tr>
<td>Sporobolus asper</td>
<td>Tall dropseed</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
<td></td>
<td>*</td>
<td>3-5’ plug 18’2” OC X Native grass</td>
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<tr>
<td>Symphoricarpus orbiculatus</td>
<td>Coralberry</td>
<td>X</td>
<td>M</td>
<td>=</td>
<td></td>
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<td>18’-6’ 5 gallon 6-8’ OC X Shrub X X</td>
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<tr>
<td>Taxodium distichum</td>
<td>Bald cypress</td>
<td>X</td>
<td>X</td>
<td>MH =</td>
<td></td>
<td>*</td>
<td>45-100’ 3’ caliper 30-40’ OC X Understory tree *</td>
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<tr>
<td>Tephrosia linhaemeri</td>
<td>Tephrosia</td>
<td>1-3’</td>
<td>seed</td>
<td>15-18’ OC Perennial</td>
<td></td>
<td>*</td>
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<tr>
<td>Thelesperma flavidulum</td>
<td>Threadleaf thelesperma</td>
<td>1-3’</td>
<td>seed</td>
<td>15-18’ OC Perennial</td>
<td></td>
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<tr>
<td>Tilia caroliniana</td>
<td>Carolina basswood</td>
<td>X</td>
<td>M</td>
<td>40-80’ 3’ caliper 40’ OC X Canopy tree X</td>
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<tr>
<td>Tridentes flavus</td>
<td>Purple top grass</td>
<td>X</td>
<td>M</td>
<td>=</td>
<td></td>
<td>*</td>
<td>2-4’ seed (9-12’ OC) X Native grass</td>
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<tr>
<td>Triplasis purpurea</td>
<td>Purple stipple</td>
<td>X</td>
<td>L</td>
<td>plug</td>
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<tr>
<td>Tripsacum dactyloides</td>
<td>Eastern gamagrass</td>
<td>X</td>
<td>X</td>
<td>MH =</td>
<td></td>
<td>*</td>
<td>3-8’ seed (9-12’ OC) X Native grass</td>
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<tr>
<td>Ulmus alata</td>
<td>Winged elm</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
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<td>*</td>
<td>30-60’ 3’ caliper 20-30’ OC X Canopy tree X</td>
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<tr>
<td>Ulmus americana</td>
<td>American elm</td>
<td>X</td>
<td>X</td>
<td>MH =</td>
<td></td>
<td>*</td>
<td>40-80’ 2.5’ caliper 40’ OC X Canopy tree X X</td>
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<tr>
<td>Ulmus crassifolia</td>
<td>Cedar elm</td>
<td>X</td>
<td>X</td>
<td>M</td>
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<td>*</td>
<td>30-60’ 3’ caliper 35’ OC X Canopy tree X X</td>
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<tr>
<td>Ungnadia speciosa</td>
<td>Mexican buckeye</td>
<td>X</td>
<td>X</td>
<td>M</td>
<td></td>
<td>*</td>
<td>15-30’ 3’ caliper 10-15’ OC X Understory tree X X</td>
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<tr>
<td>Vaccinium arboresum</td>
<td>Farkleberry</td>
<td>X</td>
<td>X</td>
<td>M</td>
<td></td>
<td>*</td>
<td>15-30’ 7 gallon 15-20’ OC X Shrub X</td>
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<tr>
<td>Vernicia baldwinii</td>
<td>Ironwood</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Viburnum rufidulum</td>
<td>Rusty black-haw viburnum</td>
<td>X</td>
<td>X</td>
<td>MH =</td>
<td></td>
<td>*</td>
<td>6-30’ 5 gallon 25’ OC X Shrub X X</td>
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<tr>
<td>Viguiera dentata</td>
<td>Goldeneye</td>
<td>X</td>
<td>X</td>
<td>L/M =</td>
<td></td>
<td>*</td>
<td>3-6’ seed n/a X Perennial</td>
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<tr>
<td>Viola missouriensis</td>
<td>Missouri violet / Wood violet</td>
<td>6’</td>
<td>seed</td>
<td>n/a Perennial</td>
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<tr>
<td>Vitis cinerea</td>
<td>Gray-leaf grape</td>
<td>X</td>
<td>X</td>
<td>M =</td>
<td></td>
<td>*</td>
<td>13’ X Vine X</td>
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<tr>
<td>Vitis mustangensis</td>
<td>Mustang grape</td>
<td>X</td>
<td>X</td>
<td>M =</td>
<td></td>
<td>*</td>
<td>30-40’ X Vine X</td>
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<tr>
<td>Yucca angustifolia</td>
<td>Narrow-leaf yucca</td>
<td>X</td>
<td>X</td>
<td>L</td>
<td></td>
<td>*</td>
<td>1’ x 2’ x 3’ stalk 5 gallon 2-3’ OC X X Succulent</td>
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<tr>
<td>Yucca arakensana</td>
<td>Thread-leaf yucca</td>
<td>X</td>
<td>X</td>
<td>L =</td>
<td></td>
<td>*</td>
<td>2’ x 3’ x 6’ stalk 5 gallon 2-3’ OC X Suculent</td>
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<tr>
<td>Zanthoxylum clavaescens</td>
<td>Hercules’ club</td>
<td>X</td>
<td>M</td>
<td>=</td>
<td></td>
<td>*</td>
<td>20-40’ X Understory tree X X</td>
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</table>
## Manufacturer Contact Information

### Brick Pavers

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
14741 Lake Street, Lake Elsinore, CA 92530-1609  
Tel: 909.674.2131 / 951.674.2131  
| 'Paciﬁc Clay Products, Inc.'                      | P.O. Box 28; Gaffney, SC 29342-0028  
Tel: 864.487.3535 / Fax: 864.487.3175  
www.hessamerica.com |

### Accent Lighting

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 'LEDIA LL OD' LED strip light                      | HessAmerica  
P.O. Box 28; Gaffney, SC 29342-0028  
Tel: 864.487.3535 / Fax: 864.487.3175  
www.hessamerica.com |
| 'V-Line Gen 4' LED cove light                      | Winona LED  
3760 W. Fourth Street, Winona, MN 55987  
Tel: 800.328.5291  
www.winonaloighting.com |

### Roadway Lighting

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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</thead>
</table>
| "Copenhagen" series, EC13RT 2DS                    | Acuity Brands Lighting, Inc.  
2011-B W. Rundberg Lane; Austin, TX 78758  
Tel: 800.410.8899 / Fax: 512.977.9622  
www.antiquestreetlamps.com |

### Stone

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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</thead>
</table>
| 'Texas limestone'                                  | Alamo Stone Company  
13020 S Kirkwood Rd; Stafford, TX 77477  
Tel: 281.240.4600  
alamostonecompany.com |
| 'Agate' granite, quarried in Ortonville, MN        | Cold Spring Granite Company  
202 South Third Avenue, Cold Spring, MN 56320  
Tel: 320.685.3621  
w.w.coldspringgranite.com |
| 'Carnelian' granite, quarried in Milbank, SD      | Cold Spring Granite Company  
202 South Third Avenue, Cold Spring, MN 56320  
Tel: 320.685.3621  
w.w.coldspringgranite.com |

### Lighted Bollards

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| "Annapolis" bollard                                | Landscape Forms, Inc.  
431 Lawndale Avenue; Kalamazoo, MI 49048  
Tel: 800.521.2546 / Fax: 269.381.3455  
www.landscapeforms.com |
| 'Annapolis' bollard                                | Landscape Forms, Inc.  
431 Lawndale Avenue; Kalamazoo, MI 49048  
Tel: 800.521.2546 / Fax: 269.381.3455  
www.landscapeforms.com |

### Granite: Thermal or Diamond 10 Finish*

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| 'Agate' granite, quarried in Ortonville, MN        | Cold Spring Granite Company  
202 South Third Avenue, Cold Spring, MN 56320  
Tel: 320.685.3621  
w.w.coldspringgranite.com |
| 'Carnelian' granite, quarried in Milbank, SD      | Cold Spring Granite Company  
202 South Third Avenue, Cold Spring, MN 56320  
Tel: 320.685.3621  
w.w.coldspringgranite.com |

### Accent Lighting

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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</thead>
</table>
| 'LEDIA LL OD' LED strip light                      | HessAmerica  
P.O. Box 28; Gaffney, SC 29342-0028  
Tel: 864.487.3535 / Fax: 864.487.3175  
www.hessamerica.com |
| 'V-Line Gen 4' LED cove light                      | Winona LED  
3760 W. Fourth Street, Winona, MN 55987  
Tel: 800.328.5291  
www.winonaloighting.com |

### Site Furnishings

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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</thead>
</table>
| 'Chase Park' litter receptacles                    | Landscape Forms, Inc.  
431 Lawndale Avenue; Kalamazoo, MI 49048  
Tel: 800.521.2546 / Fax: 269.381.3455  
www.landscapeforms.com |
| 'Lakeside Group' litter receptacles                | Landscape Forms, Inc.  
431 Lawndale Avenue; Kalamazoo, MI 49048  
Tel: 800.521.2546 / Fax: 269.381.3455  
www.landscapeforms.com |

### Pedestrian Lighting

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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| 'Stockholm' series, ES22ST GCF                     | Acuity Brands Lighting, Inc.  
2011-B W. Rundberg Lane; Austin, TX 78758  
Tel: 800.410.8899 / Fax: 512.977.9622  
www.antiquestreetlamps.com |

### Shade Umbrellas

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
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| 'MegaShade' (25-40-ft diameter) umbrella           | American Holtzkraft  
9242 Route 35; Mt. Pleasant Mills, PA 17853  
Tel: 570.539.8945 / Fax: 570.539.2592  
www.holtzkraft.com |

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* for paved and vertical surfaces, respectively