UT Austin Landscape Master Plan: Evaluating Opportunities for Progressive Storm Water Management

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GIS In Water Resources, Fall 2014
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Introduction

On May 9th 2013, the University of Texas at Austin adopted a new Campus Master Plan that establishes a physical framework for future growth and sustainability. Capitalizing on existing assets, the Master Plan outlines eight strategic opportunities that will enable the University to further cement its status as a leading research institution. These opportunities mark the first phase of UT's development and include: 1. Accommodating Potential Growth 2. Revitalizing the Core Campus; 3. Enhancing the Central Campus; 4. Forging Strategic Partnerships; 5. Facilitating Safe and More Efficient Mobility; 6. Transforming the Waller Creek / San Jacinto Corridor; 7. Improving the Learning and Research Environments; and 8. Integrating Academic and Residential Life.

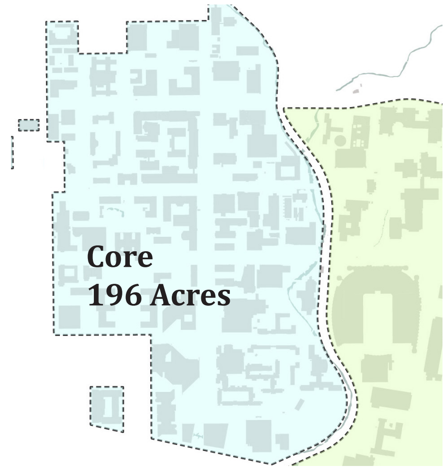
To support their objectives, UT Austin developed seven additional plans, including a Landscape Master Plan, which align the design and construction of newly built environments with established campus aesthetics. Campus aesthetics aim to honor the long-standing identity of UT Austin, speaking directly to the nexus between past, present, and future. To ensure future sustainability, UT must emphasize design in support of natural systems that have become increasingly vulnerable within the last decade.

Water is a particularly susceptible campus resource due to Texas's prolonged drought conditions and the methods by which storm water is channeled through current infrastructure. The following paper will address UT's water vulnerability through the lens of geodesign. Geodesign is an emergent practice that utilizes geographic information systems (GIS) to inform design. It results in integrated design decisions informed by environmental and social vulnerabilities.

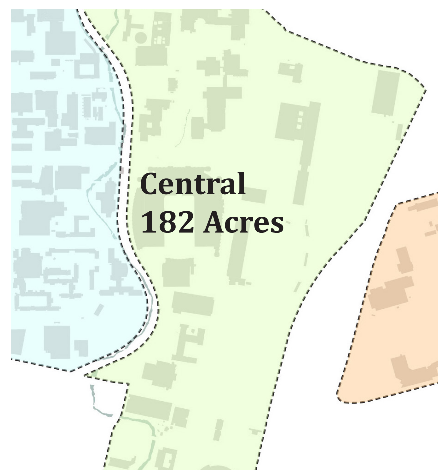
I first investigate and determine formal campus aesthetics, providing a visually literate set of descriptions and images that detail site specific identify across campus. This section determines the degree to which aesthetic constrains limit progressive storm water management. I then analyze existing environmental conditions and water systems within campus boundaries in an effort to highlight points of vulnerability. Maps are used to illustrate areas where strategic, yet place-based design, can provide the greatest positive impact. The analysis will be used to answer two research questions. To what degree do aesthetic considerations limit progressive storm water management? Where are opportunities for implementation?

Identity and Defined Space

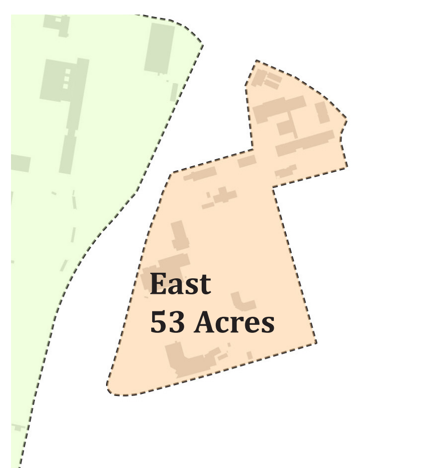
The University of Texas Landscape Master plan specifies four priorities for future development. They include 1. The expansion of campus facilities in new districts that will require an integration of buildings and landscape; 2. The revitalization of core campus and call to protect the history of buildings and landscapes; 3. The redevelopment of central campus to accommodate growth and enhance the pedestrian environment; 4. The transformation Waller Creek and the San Jacinto Corridor, making it less of a barrier within campus.



Development priorities are underpinned by principles of use that define how individuals experience a given space. These principles refer to circulation and access, connection to place, experience of user, ecosystem benefits, appropriateness, aesthetic value, and efficient management. While each principle is generally applied to the core priorities discussed above, they are increasingly context dependent in relation to defined landscape types. Seven unique landscape types exist within campus: Civic Space; Streets; Quads, Courtyards, and Plazas; Connective Space, Parklands; Service and Parking; and Waller Creek. Each landscape type requires a tailored application of use principles to maintain campus's hierarchical identity. Principle are formalized in tandem with specific aesthetic values to create the built environment.



The UT Campus is divided into three geographic areas of future development, each of which contains a mix of landscape types. Core campus contains 196 acres, central campus contains 182 acres, and east campus contains 53 acres. The following section will discuss each primary landscape type in relation to defining characteristics, issues, and design considerations. Each landscape type exhibits a varying ability to implement storm water management technologies.



Civic Space

Civic space provides the foundation of campus identity, integrating a classical composition of landscape, architecture, and sculpture to create iconic, institutional, and ceremonial references. Typically, a central plaza sits at the topographical highpoint in these areas with "formal symmetrical spaces [placed] along axle views."[1] Vegetation type is limited, with Live Oaks acting as the primary planting in an effort to juxtapose the Beaux-Arts building geometry. Material is elegant yet constrained, consisting of limestone or masonry of a similar nature.

Issues: Infrastructural decay due to high use and foot traffic; Poor environmental conditions due to compacted soil; Ornamental and non-institutional secondary plantings; Water intensive and non-native landscaping; limited habitat value; Storm water runoff due to excess impervious cover.

Design Considerations: In developing future civic space, the University seeks to balance historic identity with ecological services. Symmetrical designs with geometric order are encouraged to promote identity. Spaces are to be read as a single, non-segmented unit. Maintaining view sheds structured by high quality masonry materials and a limited variety of vegetation allows for a proportional, understated, and dignified form. High quality or symbolic art is encouraged.

Application of Progressive Storm Water Management: Relating to storm water, the University recognizes that "…Opportunities to reduce water use and improve storm water management in existing Civic landscapes should be explored; however, human use should be prioritized in these important public spaces."[2] The University recognizes the water and maintenance intensive characteristics of current lawn types yet state that "their importance to the quality of student life argues for continued investment in them."[3]

1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 33.
2 Ibid, 37.
3 Ibid, 37.

Quads, Courtyards, and Plazas

These spaces are self-contained and noncontiguous. Typically outdoors and structured by formal buildings and walls, the aesthetics of this landscape type is defined by the surrounding architecture. Transitions and connections between the interior and exterior of these spaces are often prominent. Scale is used to determine the degree of detail. As self-contained spaces, unique and individual design is supported. This allows for a diversity of form, color, and texture across campus.

Issues: Older quads, courts, and plazas were not designed for social activity; Programming, planting, and seating is mismatched to the surrounding architecture; Storm water is conveyed off-site which limits filtration and groundwater recharge.

Design Characteristics: The master plan identifies quads, courts, and plazas as social and inviting spaces that support ecological functions. Taking a "landscape as laboratory" approach, specific materials, planting types, and building forms are undefined and flexible, allowing for integrated storm water management.

Application of Progressive Storm Water Management: Storm water "collection, detention and infiltration can be integrated as a design feature. Consideration should be given to storing the SITES Prerequisite Water Quality Storm Volume for each space's immediate catchment area in a small wet-dry infiltration feature. If employed across the campus, this strategy would significantly reduce storm water runoff volume entering Waller Creek during storm events."[1]

1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 76-77.

Storm Water Implementation: Constrained
Current Acres: 126.7
Proposed Acres: 114.3

Streets and Connective Spaces

Streets provide the primary means of circulation that define campus structure. Similar to Civic Space, streetscapes maintain visual simplicity, spatial continuity, and consistency. Multi-modal use is encouraged. Connective spaces are semi-liminal areas between and behind buildings where people move through rather than gather.

Issues: Streetscape paving types (concrete, asphalt, etc.) are inconsistent; Street tree plantings lack uniformity and fragment visual continuity; Plantings fail to provide shade, thus contributing to the heat island effect; Storm water runoff results in poor water quality, erosion, and flooding. Within connective spaces, a wide variety of design and materials exist, resulting in a lack of coherent identity and sense of place; Functional issues have been typically solved with little aesthetic consideration.

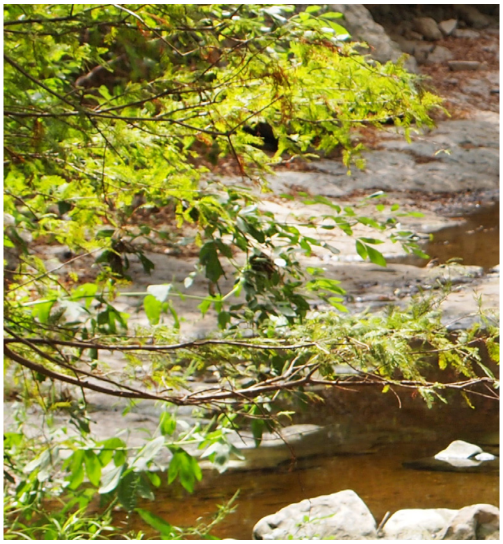
Design Characteristics: Streetscapes should provide continuous shade to support safe and comfortable multi-modal travel. Plantings should be simple, understated, and linear to provide order and scale in relation to surrounding buildings. Connective spaces should be functional and accommodate a variety of uses. A consistency in material is suggested to generate a fluid identity across campus. Appropriately scaled vegetation and a limited selection of materials and plantings should be employed to avoid "garden effects."

Application of Progressive Storm Water Management: Streets, as with Civic Space, should incorporate best management practices where possible. Connective spaces should be "designed to retain and infiltrate storm water. In high use areas, pervious pavements should be considered."[1]

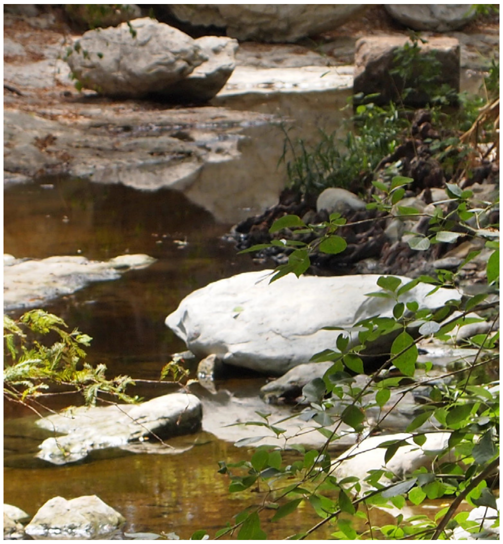
1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 85.

Waller Creek

Waller Creek is a narrow, degraded urban stream flowing through campus. The creek is bounded by urban development, varying in width from 250 ft. to under 100 ft. Roads, buildings, and sidewalks restrict access and, in some cases, redirect the creek's flow path. Steep banks, invasive understory, and pollution are often associated with the space.



Issues: UT's storm system transfers runoff, pollution, and sediment directly into the Waller Creek system; Pollutants levels are high; Overland flow increases levels of sediment and pollutant deposits; Limited biodiversity and stream bank erosion exists.



Design Considerations: An environmental framework is used to address Waller Creek's vulnerabilities. This framework extends to campus's surrounding watersheds as well as the creek. Considerations support the creation of an ecologically sound and physically resilient environment. Restoration efforts attempt to promote biodiversity and engage the connection between Waller Creek and Lady Bird Lake.

Application of Progressive Storm Water Management: The Landscape Plan supports the implementation of "storm water management techniques that improve water quality including rain gardens, bioretention ponds, vegetative filter strips, vegetative swales, rainwater harvesting, porous pavement, tree planters, and hybrid engineering/ecological solutions."[1] To reduce the quantity and increase the quality of storm water entering the creek, the plan promotes "capturing, holding, and infiltrating rain water in dispersed rain gardens, roadside verge and median native plantings and infiltration galleries before it enters the storm water system."[2]

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1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 120.

2 Ibid, 118.

Storm Water Implementation: Unconstrained
Current Acres: 44.7
Proposed Acres: 38.2

Parkland

Parkland area is characterized by extensive lawns, vegetation, and trees that mimic native Central Texas landscapes. Open views are maintained to facilitate a connection with the surrounding environment. Repetitive materials are common in these areas. Simple and unified structures are often incorporated. Parkland occupies less dense areas of campus.

Issues: Extensive maintenance and irrigation needs stress operation and facility resources; Limited natural habitat is provided; Areas appear fragmented; Erosion and bare compacted soil is present as a result of erosion and non-native vegetation.

Design Considerations: Ecological services are the primary design consideration in parkland. Unity between park space and visual quality is a secondary design objective.

Application of Progressive Storm Water Management: Storm water management is not explicitly discussed, however, parkland can provide ample opportunity for soft retention and detention engineering.

Storm Water Implementation: Unconstrained
Current Acres: 80.7
Proposed Acres: 38.6

Services and Parking

Services and parking areas are primarily located at the edges of UT campus. These are paved spaces with connected pedestrian and automobile activity. Limited space for planting exists.

Issues: Excess impervious cover; Storm water runoff enters UT's storm system and runs untreated into Waller Creek; Unshaded areas increase the heat island effect; Existing plantings are often out of scale; Fragmented pedestrian systems create an unwelcoming and unsafe experience.

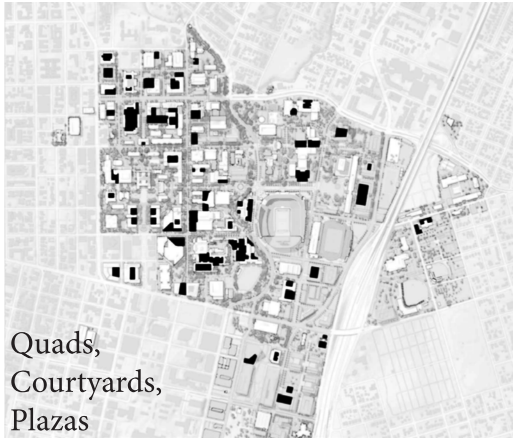
Design Considerations: Design considerations place emphasis on functionality. These spaces should be perceived as part of a pedestrian oriented landscape with simple and orderly accents. Shading should be increased through a network of small trees, with vegetation placed linearly around a lot's perimeter.

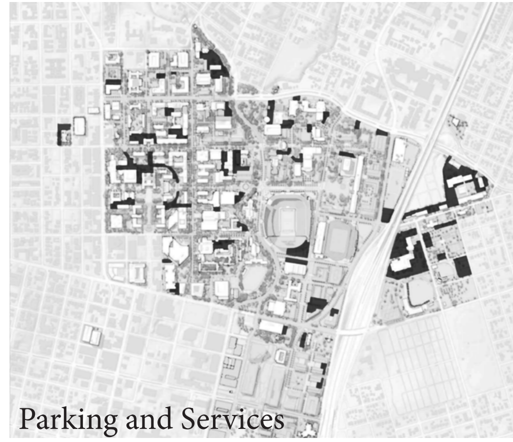
Application of Progressive Storm Water Management: UT encourages "Best Management Practices to improve water quality and reduce the rate and volume of runoff."[1] Technologies considered include "planted filter strips within parking lots, pervious pavements, storm water storage systems below pavements, and separator catch basins at connections to the storm sewer network."[2]

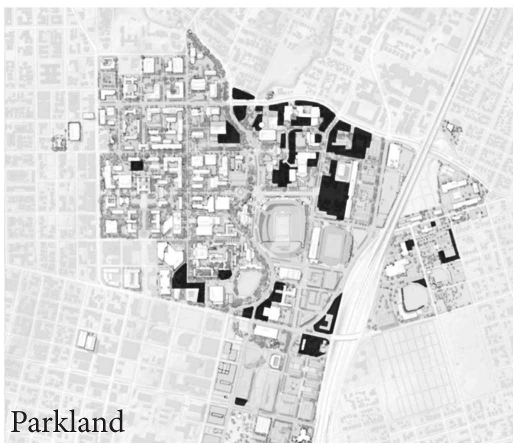
1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 109.
2 Ibid, 109.

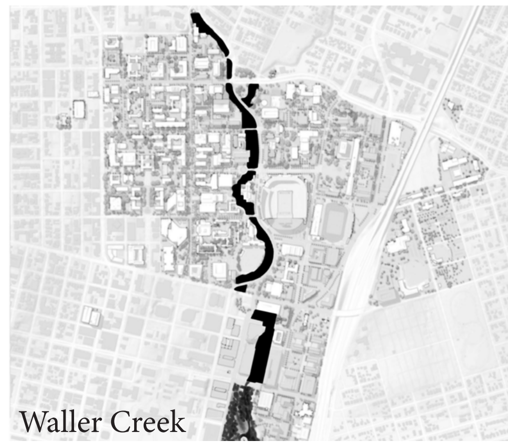
Landscape Types: Unconstrained and Constrained

Unconstrained Implementation

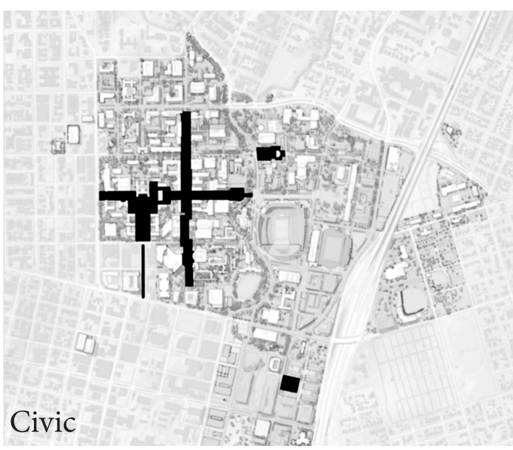

Quads, Courtyards, Plazas

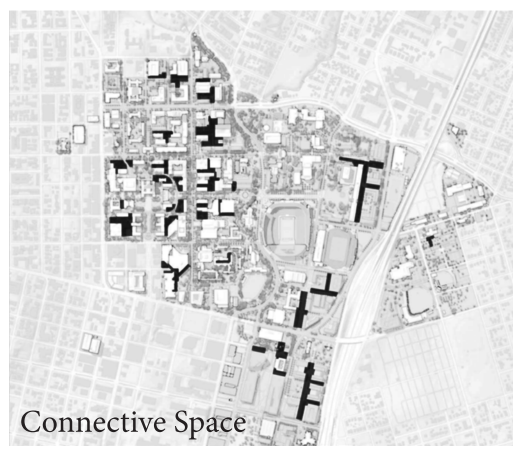

Parking and Services

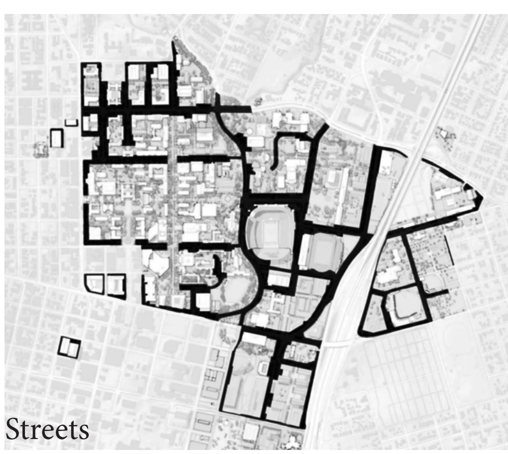

Parkland


Waller Creek

Constrained Implementation


Civic


Connective Space


Streets

Campus Environmental Conditions

UT's storm water drainage system is designed to protect roads and buildings during heavy precipitation by rapidly channeling runoff towards Waller Creek. Water is directed below-grade through a system of impervious streets, curbs, drain inlets, pipes, and culverts. As a result, the "benefits of rainwater infiltration to restore ground supplies and the ability of the landscape to slow, cleanse, and use runoff..."[1] are lost. Degraded conditions associated with this pipe and pump process include erosion; degraded habitat value; impaired groundwater recharge; excess storm water runoff due to impervious cover; and minimal storm water filtration opportunities.

Runoff occurs when precipitation flows over impervious surfaces, such as driveways, sidewalks, and streets, preventing water from absorbing naturally into the ground. Pollutants exist on top of impervious surfaces, mixing with precipitation as it travels through the built environment. As water follows the steepest topographical slope, polluted runoff is often discharged directly into lakes, streams, rivers, and wetlands, or into untreated sewer systems that release into natural bodies of water. As a result, drinking water sources are compromised, decreasing water quality and increasing treatment costs.

Progressive storm water management uses ecologically-based technologies and practices to control and direct polluted rainfall. Employing soft-engineering techniques to sustain a site's naturally occurring hydrological systems, these technologies utilize and mimic ecological systems to infiltrate, filter, store, and evaporate runoff close to the contamination source.[2] As a result, water resources are better managed, cleaned, and regulated; soil maintains healthy characteristics, suffering less erosion and compaction; and a diversity of habitat conditions for both plants and animals can establish.[3] Progressive storm water management maintains five core water control methods: flow control, detention, retention, filtration, and treatment. A combination of all five methods result in best practices.

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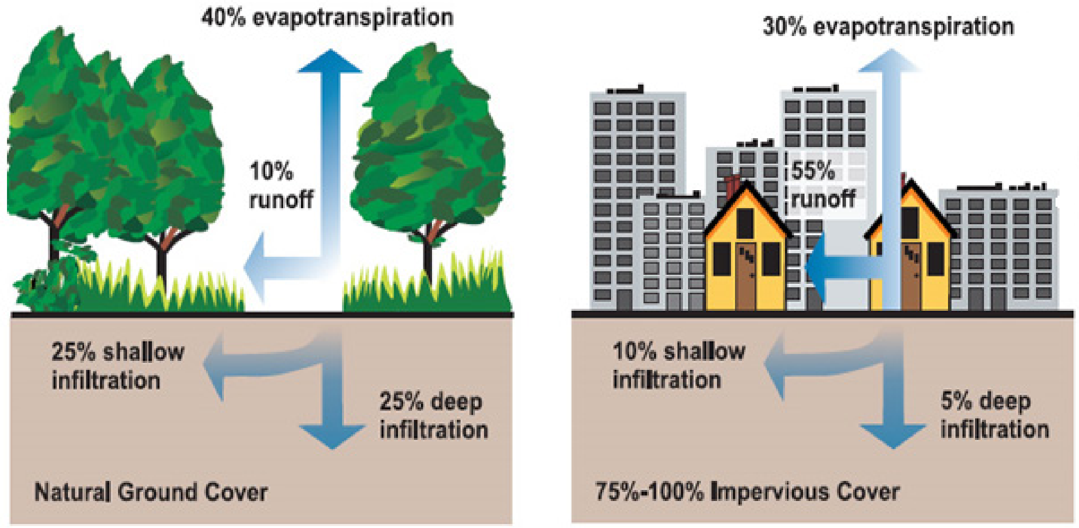
1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 26.

2 Fay Jones School of Architecture. (2010). Low Impact Development: A Design Manual for Urban Areas. Fayetteville, AK: University of Arkansas Press.

3 Ibid.

Figure 1. Runoff Rates Resulting from Impervious Cover
Travis County, Texas.



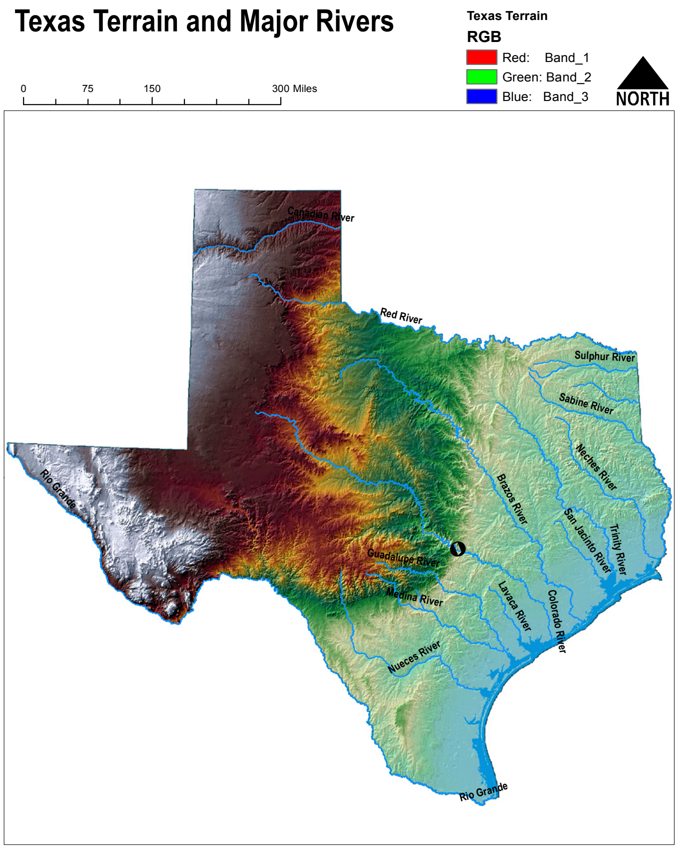
While storm water management is an important consideration in both urban and rural environments, highly urbanized areas, such as UT, require a greater amount of storm water management due to increased development and impervious surface. According to the Travis County Storm Water Management Program, "when impervious area in a watershed reaches 10 percent, stream ecosystems begin to show evidence of degradation, and coverage over 30 percent is associated with severe, practically irreversible degradation."[1] As demonstrated in Figure 1, urban areas maintain a 55% runoff rate when 75% to 100% of the built environment is impervious. This stands in stark contrast to a 10% runoff rate on natural ground cover. Deep and shallow infiltration is also decreased as a result of urban development. At a rate of 5% and 10% in urban settings, restricted drainage increases the on-grade volume and velocity of runoff.[2] As developed areas contain larger populations and a diversity of development type, the percent of pollution per acre is increased as well.

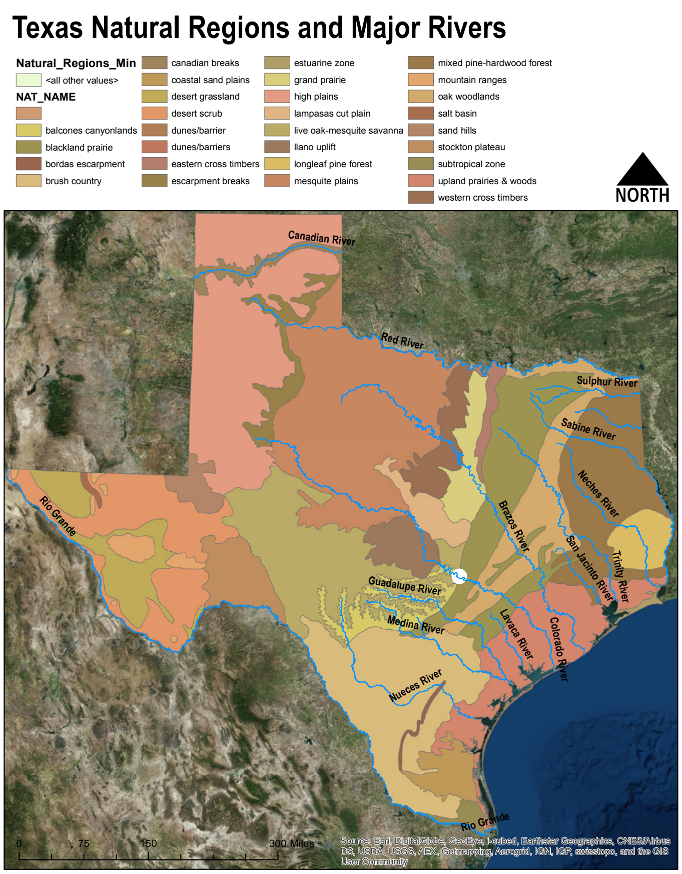
The following section includes a discussion of environmental conditions on campus. Using a variety geographic of scales, each map provides a visual understanding of site conditions. Maps are also used as a tool to investigate water-related vulnerabilities on campus, and conversely, to demonstrate where the greatest opportunities of storm water management can occur.

1 Travis County, Texas. (2013). Impervious Cover. Industrial Storm Water Program. Retrieved from: http://www.co.travis.tx.us/tnr/stormwater_management_program/industrial_storm_water_guidance/travis_count y_compliance_program.asp.

2 Environmental Protection Agency. (February, 2014). Water: Managing Urban Runoff. Retrieved from: http://water.epa.gov/polwaste/nps/urban.cfm.

Ecological Regions





UT Austin lies at the intersection of two primary Texas ecoregions, the Blackland Prairie Ecoregion and the Edwards Plateau. The Balcones Fault bisects these regions on the North-South axis. The Blackland Prairie consists of bedrock chalk or soft limestone, with dark and clay rich mollisol soil. The Edwards Plateau Prairie is composed primarily of limestone overlayed with thin soils.[1]

Converging ecologies allow for a diversity of native habitat, plant species, and wildlife to establish on campus. And due to the proximity to the Colorado River, Savannah conditions consisting of woody plants, fertile tall grasses, and wildflowers are easily established.

On campus, however, native conditions have been suppressed by ornamental plantings whose origins lay outside of Texas. As a result, environmental up-keep is water-intensive, soils have degraded, and habitat value has decreased-- all of which contribute to runoff and erosion based vulnerabilities on campus.

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1 UT Austin. (n.d). School of Biological Sciences. Ecoregions of Central Texas. Retrieved from: http://www.sbs.utexas.edu/fowler/generalinfo/ecoregionscentx.html.

FloodPlain and Water Quality Buffer

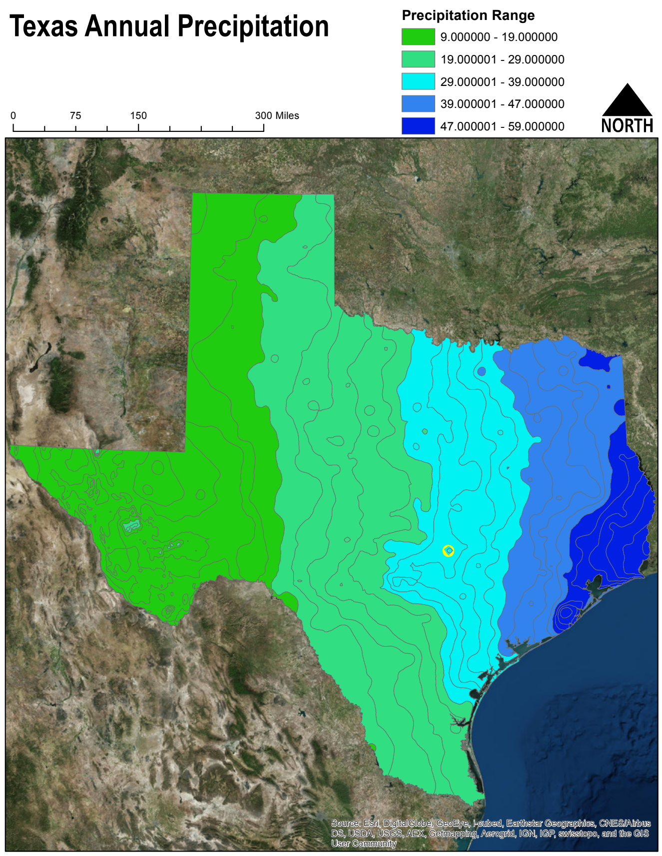
UT Austin is bisected by Waller Creek, an urban stream which drains into the Colorado River and Shoal Creek. The creek and its tributaries are the principle natural drainage system that moves rainwater and runoff through campus. The Waller Creek catchment area reaches north of campus, receiving water flow from watersheds roughly 2700 acres beyond the 400 acres within campus boundaries.[1]

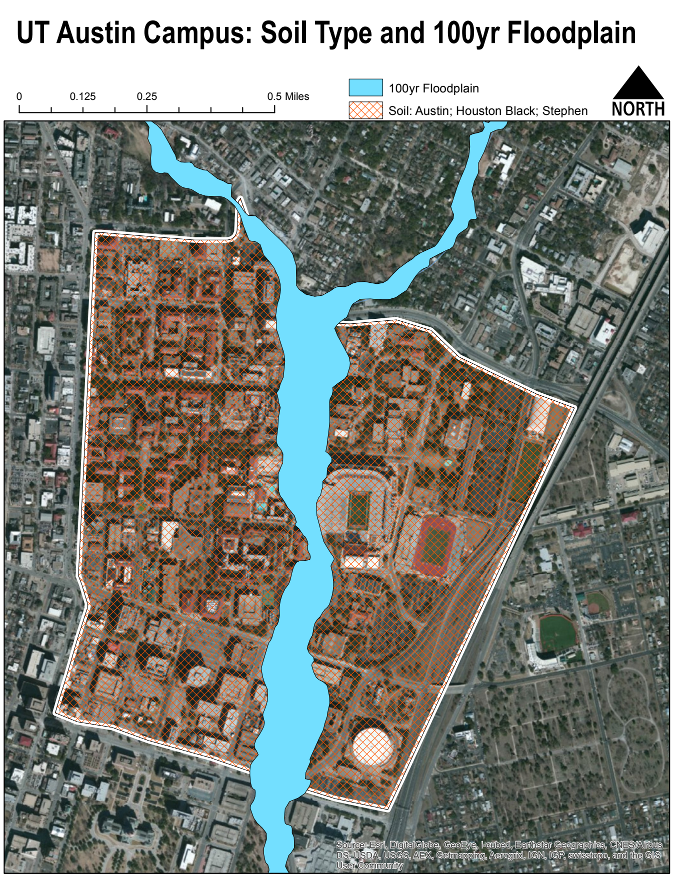
Although a water quality buffer is established on campus, the creek system is hydrologically and ecologically degraded due to excess impervious cover. Biological systems that once slowed, cleansed, and recharged groundwater have been compromised due to rapid development within the buffer zone and 100yr floodplain.

723,045.5 Ft of impervious surface on exist on campus. Of this, 128,979.9 Ft lie within the 100yr floodplain and water quality buffer. Areas within the water quality buffer zone and the 100yr floodplain are, therefore, particularly vulnerable high priority for progressive storm water management.

1 University of Texas at Austin. (Spring 2014). Landscape Master Plan, 26.

Precipitation and Soil





Campus biodiversity is dependent upon temperature and precipitation. Of these two, water is the primary vulnerable and limiting factor on campus. Austin receives between 29in and 30in of rain annually. As the majority of the campus landscape is non-native, many plantings lack drought resistant characteristics.

Problems associated with low annual precipitation are increased due to soil type. Depending on particle size, soils have the ability to process and retain considerable water quantities. Sand based soils, for example, retain a smaller quality of water than clay based soils due to a coarse and limited particle size. Soil water that is not retained or used by plants is stored in the water table. When a soil reaches infiltration capacity, on grade flow or runoff occurs.

The ability for soil to retain moisture has profound effects on the hydrological cycle and species viability. Campus soils are classified as urban, with STATSGO components identified as Austin, Houston-Black, and Stephen.[1] When over-saturated, compacted, or under-saturated these soils become unstable, resulting in erosion, excess runoff, and limited groundwater recharge.

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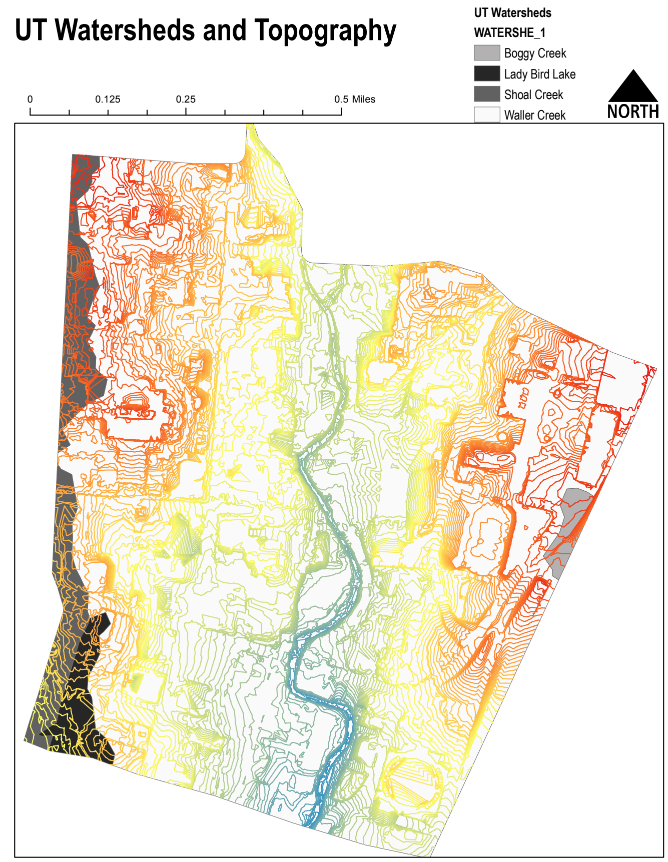
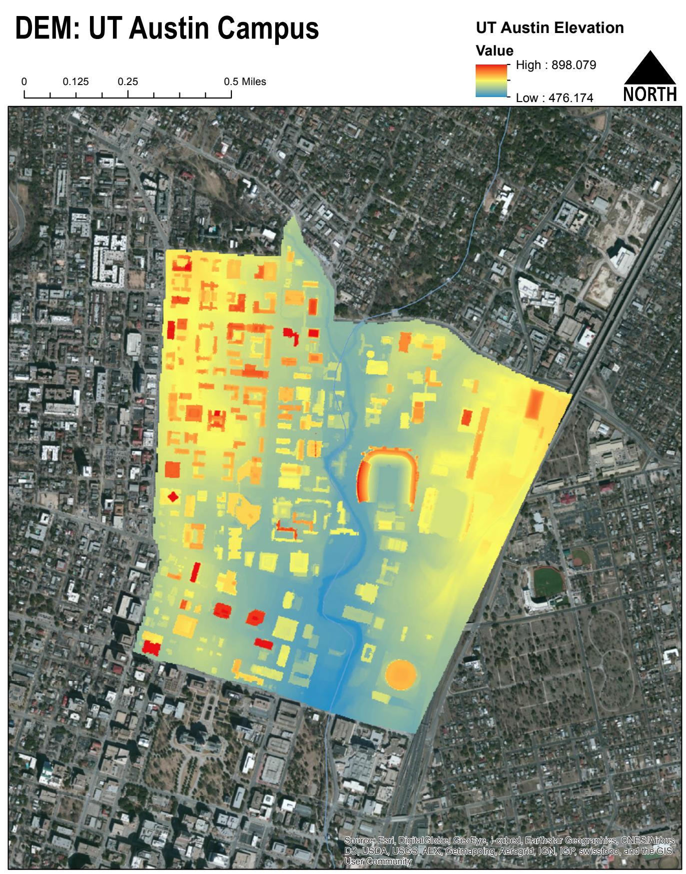
1 Oregon State University. (N.D) Texas Soil Data. Retrieved from: http://ippc2.orst.edu/soil_data/TX/tx035.soil.txt

Topography and DEM





Topography determines the direction of ground water flow, recharge, and discharge within a given area. Four sub-watersheds are present within campus boundaries. These include the Boggy Creek watershed, the Lady Bird Lake watershed, the Shoal Creek watershed, and the Waller Creek watershed. The Waller Creek watershed constitutes the largest percentage of campus area.

The digital elevation model (DEM) depicts this topographical information in raster form. High points are present on the edges of campus, with Waller Creek representing the lowest elevation. Buildings are included in the DEM model, with red denoting an elevation scale among buildings.

Topographical high points are featured at the edge of campus and gradually reduce elevation in proximity to Waller Creek. In relation to water flow, this means that the majority of precipitation and its associated runoff is channeled into the creek system. Creek water then flows south towards Lady Bird Lake.

Constrained Areas of Progressive Storm Water Management

Vulnerable areas highlight opportunities for progressive storm water management. Two types of water vulnerabilities exists on campus. The first are tangible, environmental constraints which include existing infrastructure. The second are aesthetic constraints, areas where design guidelines limit the ability to implement progressive management technologies.

In relation to environmental and infrastructural constraints, areas most vulnerable lie within the Waller Creek water quality buffer and the 100yr floodplain. Paved or impervious surfaces are also considered highly vulnerable excess run-off during storm events.

Landscape types determined least compatible with progressive storm water management include Civic Space, Streetscapes, and Connective Space. These typologies are constrained because aesthetic considerations do not prioritize designs that integrate progressive management techniques. Civic Space constitutes 12.9 Ac. of campus. Streets and Connective Spaces constitute 126.7 Ac.

Proposed development in the Landscape Plan will increase Civic Space to 24.7 Ac., while decreasing Streets and Connective Space to 114.3 Ac.

Unconstrained Areas for Progressive Storm Water Management

Opportunities for progressive storm water management are dependent upon the aesthetic guidelines associated with each landscape type. While environmental constraints, including existing infrastructure, highlight areas where soft-management techniques would alleviate water related vulnerabilities, design guidelines dictate where and how development can occur.

Landscape types determined most compatible with progressive storm water management include Quads, Courtyards, and Plazas, Parkland, Waller Creek, and Services and Parking. These typologies are considered compatible because aesthetic considerations are malleable, providing an opportunity for integrative design in service of the environment. Quads, Courtyards, and Plazas constitute 18.4 Ac. of campus. Services and Parking constitute 80.7 Ac. and Parkland constitutes 44.7 Ac. Waller Creek amounts to 19.7 Ac.

Proposed development in the Landscape plan will increase Quads, Courtyards, and Plaza to 24.6 Ac. and Waller Creek to 20.8 Ac. Services and Parking will decrease to 38.6 Ac. and Parkland will decrease to 38.2 Ac.

Conclusion

UT campus identity is formalized through landscape type and corresponding aesthetics dictate how we experience and perceive a space. Materials, plantings, and built form serve campus identity by creating a site and context specific sense of place. The degree to which progressive storm water management can be implemented is then dependent upon how one should perceive campus identity within a specific location.

Where landscape aesthetics call for formalized and traditional space, implementing progressive technologies are materially and formally constrained. “Soft” methods do not align with the sought after “institutional” identity. In areas of flexible aesthetics, where identity is less-constrained by formal considerations, progressive management is increasingly possible.

Understanding the relationship between aesthetics and implementation allows for strategic storm water planning and management. If , for example, a courtyard lies within the flow path of civic space runoff, progressive management can be integrated into the courtyard’s design to slow, retain, and cleanse water collected within the space and flowing from the external location.

Identifying opportunity and constrained areas for progressive storm water management allows the design and construction of newly built environments to better serve the campus ecosystem. Emphasizing design in support of increasingly vulnerable natural systems can help remedy degraded landscaped conditions which stem from our current practices.

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Parkland:
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Services and Parking:
University of Texas at Austin. (Spring 2014). Landscape Master Plan, 108.

Campus Landscape Type Maps (Base Image Extracted as Template):
University of Texas at Austin. (Spring 2014). Landscape Master Plan.

Figure 1:
Travis County, Texas. (2013). Impervious Cover. Industrial Storm Water Program. Retrieved from:http://www.co.travis.tx.us/tnr/stormwater_management_program/industrial_storm_water_guidance/travis_count y_compliance_program.asp.

Cover Photo:
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