"The Path Forward: Contain, Clean and Connect"

2020 Environmental Protection Agency Campus Rain Works Challenge
The University of Texas at Arlington December 11, 2020

Master Plan Category | Design Team

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ABSTRACT

"The Path Forward" is a design proposal that aims to Contain, Clean and Connect all parts of the urban system to their right destination. To address stormwater runoff on site, our team targeted four major areas for intervention. Streetscapes, surface parking, building footprints and Trading-House creek.

Major roads within the site are lined with bioswales. Each intersection will have adjacent rain gardens to capture, clean and release stormwater into the groundwater system before it reaches trading house creek. Parking areas are converted to academic buildings to align with the future UTA master plan for realistic development phasing. The remaining surface parking will be allocated to a more spatially efficient parking garage or retrofitted with central rain gardens.

To address pedestrian connections, the north/south circulation that was blocked by the new science and engineering building, now continues from planetarium place with a new pedestrian bridge across Johnson creek. This new promenade creates an experiential journey with science related educational programs along walk. Building tops within the site are targeted for solar panel placements, and all rainwater will be diverted to underground cisterns to be used locally throughout the year. This will reduce economic costs of irrigation and provide a useful resource during long periods of drought.

Lastly, a terraced detention wetland will provide additional storage for stormwater events, habitat for local wildlife, and a natural amenity for students during the dry seasons, complete with an amphitheater and boardwalk.

I. BACKGROUND:

The University of Texas at Arlington sits at the center of the Dallas Fort Worth Metroplex and is the largest university in north Texas. With Dallas to the East and Fort Worth to the west, the 420-acre campus is typical of the urban sprawl in the surrounding area. The watersheds in the city of Arlington, are frequently taxed due to the highly seasonal climate of north Texas. The short/intense rainfall events, paired with large areas of impervious surfaces, cause devastating flash flooding in local creeks and residences.

Site analysis revealed dense building environment with little wayfinding for students, large areas of impervious surface parking, and a damaged Trading House creek that runs through the southern portion of campus. Our team proposes to strengthen a primary north south connection for students, one that combines green infrastructure with the educational and social character of the science and engineering district of campus. The project goals are to work with the future UTA master plan, add resilient green infrastructure and improve the quality of outdoor social spaces.

II. CAMPUS & SITE CONDITIONS:

ABIOTIC FACTORS:

CLIMATE:

According to the Köppen climate classification system, the city of Arlington and UTA are considered as the Cfa that is humid subtropical region. Therefore, the climate of UTA is characterized by hot, humid summers and mild to cool winters. This humid climate (Zone 8b) has temperatures ranging from the 50s to low-100s and also has humidity in the hottest summer months. The majority of precipitation in the region is in the spring with large thunderstorms. In general, severe weather is in April and May months with tornadoes. Winters in this region are typically mild with seldom occurrence of snow (National Weather Service, DFW Climate Narrative).

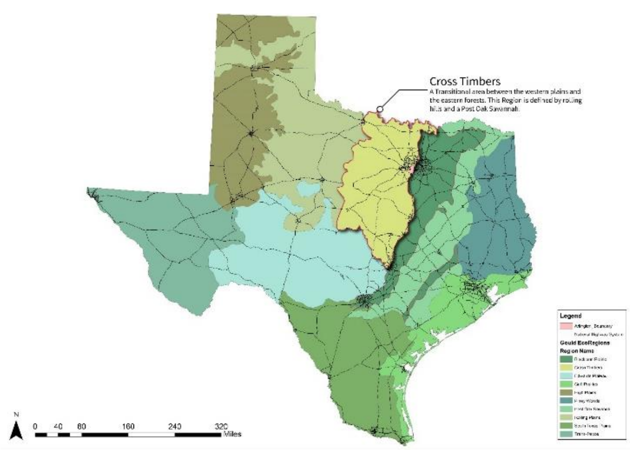


Figure 1. Texas Eco-Regions

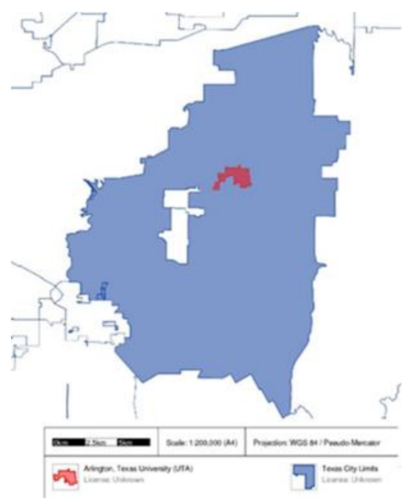


Figure 2. Location of UTA within the city of Arlington.

CONTEXT

Two major physiographic regions of Texas– Eastern Cross Timbers and Blackland Prairie embraced the city of Arlington and UTA campus (see Figure.1). The campus situated in the Northern part of central Arlington, which is located 20 miles from Dallas, and about 15 miles from Fort Worth (see Figure.2). The selected site is on the Eastern side of the central campus that consists of existing surface parking lots, UTA Planetarium, English Language Institute, UTA FabLab, Maverick Parking Garage, Life Science Building, open green space, UT Arlington College of Nursing and Health Innovation, and Trading Horse Creek. The study and analysis of the campus development from 1900 to 2005 shows that the concentration of building and collages have been on the central and north-west part of the campus. At the same time the chronological maps of the campus green belt illustrate the considerable lack of green space in central part and opportunities for growing more green areas in the both south east and south west parts of the campus (see Figure.3).

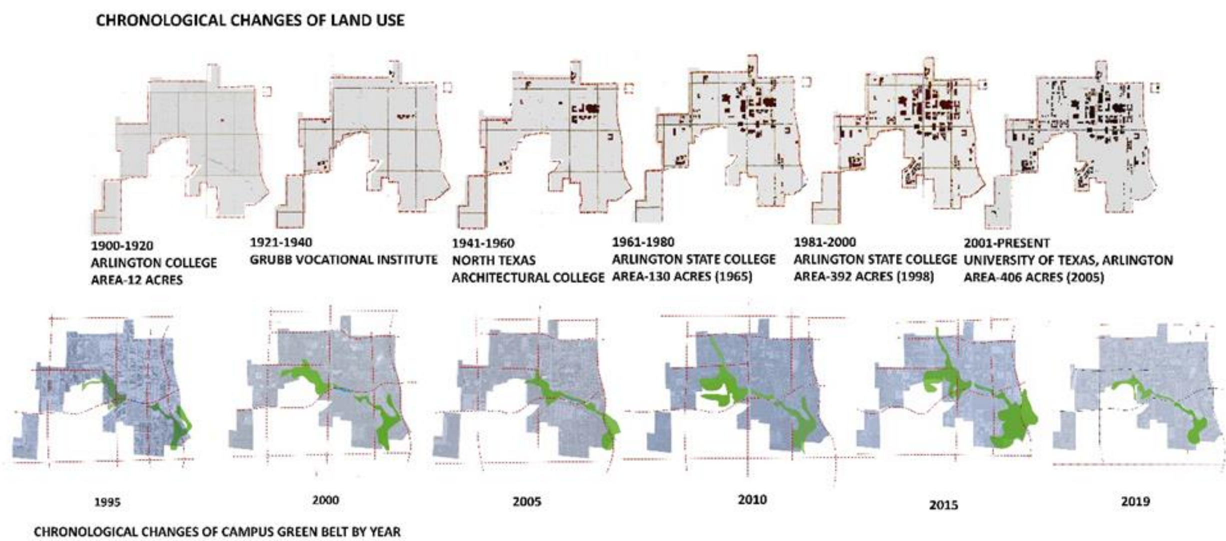


Figure 3.Historical development of the UTA campus and green belt project.

GEOLOGY:

The Dallas-Fort Worth Metroplex is standing on the western edge of slanting Cretaceous plains and on the eastern edge of Fort Worth Basin, with stable geology (see Figure.4). The for the west side of campus has physiographic bedrock and calcareous deposits while chalks and marls constructed the east side. The landform is gently level, and elevations range between 300 to 800 feet above sea level (A Natural History of North Texas Central Texas, Geologic History).

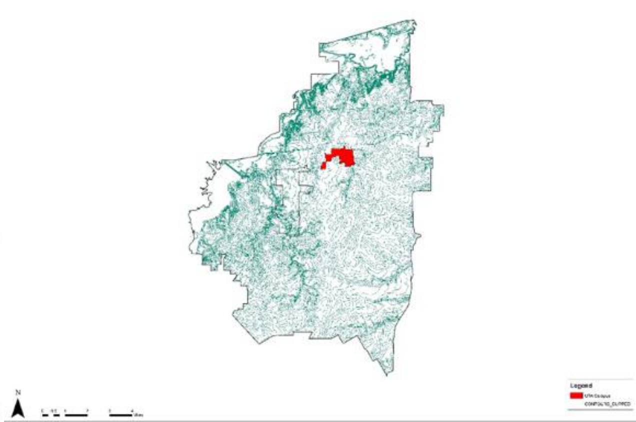
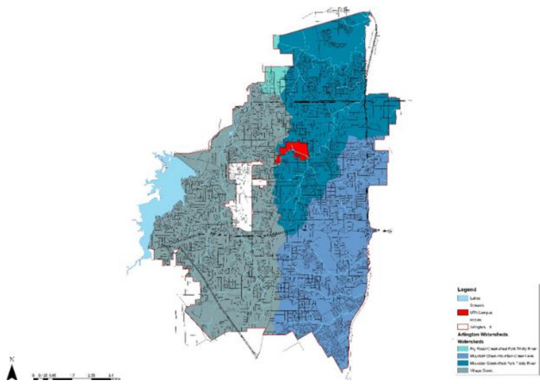


Figure 4. Basins of Texas

Figure 5.Topography of Arlington and the location of UTA

HYDROLOGY:

The city of Arlington is located within the Lower West Fork Trinity sub-watershed which is part of the larger Trinity River watershed which flows through Dallas, Houston and eventually empties into the Gulf of Mexico. The campus connects to two watersheds (see Figure.6), it also has two seasonal creek and one first order stream, Trading House Creek, running from northwest to the southeast side of campus. Trading House Creek exits campus to join with Johnson Creek to the southeast (see Figure.7). The underground aquifer serving the area is the Trinity (Subcrop) aquifer.



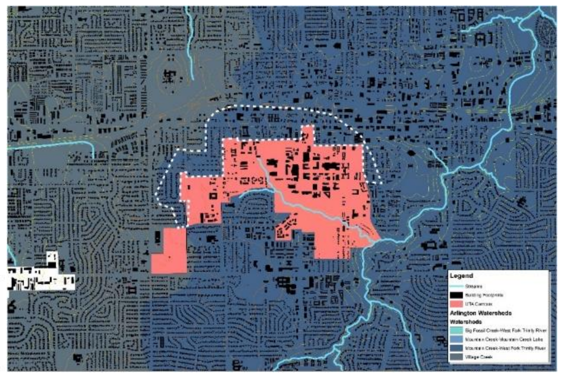


Figure 6. UTA campus, and watersheds of the city Arlington (Left).
Figure 7. UTA campus and creeks and related watersheds(right).

SOILS:

According to the Natural Resources Conservation Services Soil Survey, Urban Land covers 46.7% of the site, including surface parking lots, buildings, streets, sidewalks and lawns. The second soil types at the site are Gasil-Urban Land Complex at 19.8% and Rader-Urban Land Complex at 13.2%. The Navo-Urban Land Complex remains 20.3% of the site along Trading House Creek from Greek Row (see Figure.8). Therefore, it can be said that All these types of soil are poorly drained soils with clayey sediment that contributes to high runoff. The both sides of the creek consist of 1-8% slopes and show evidence of extensive erosion during heavy rain events (USDA Web Soil Survey).

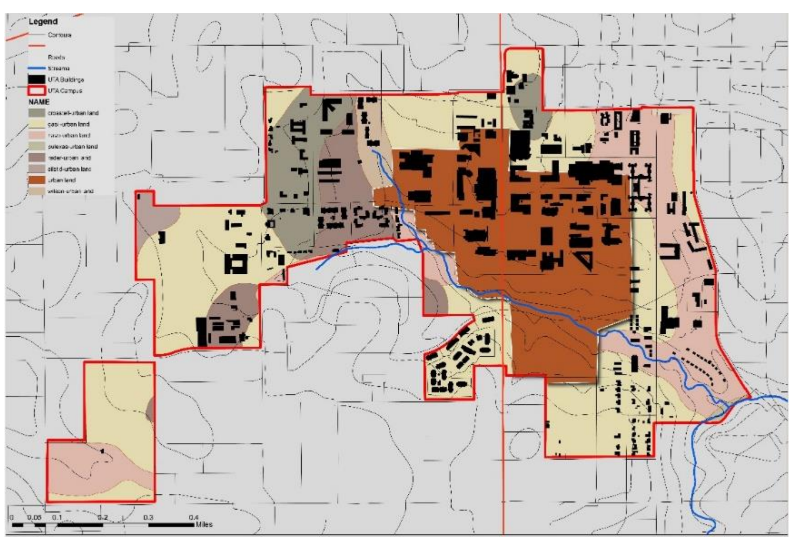


Figure 8. Soil and surface classification of UTA

BIOTIC FACTORS:

FLORA:

The UTA campus is located between two ecoregions of the northern Texas--the Cross timbers, the Blackland Prairies. The prairie was mainly covered by woodlands. The Blackland Prairies was characterized by fertile soil. Historically, the flora of the area includes Post Oak savannah and woodland, and also mixed grass prairie. Tall-growing grasses such as big bluestem, little bluestem, Indian grass, and switchgrass are prevailing in Blackland Prairie soils in eastern Arlington. Due to the fertile soils, the original prairie was converted to agricultural lands and the landscape fragmented to every day growing urbanized areas. Currently, the primary agricultural activities are crop production and cattle ranching. A previous study to analyzed “the benefit of mature trees on the site, an analysis was run (i-Tree Canopy v6.1). The results estimated the existing site canopy covers roughly 47.1% of the area where the majority of trees are typical Cross timbers Post Oaks mixed with other miscellaneous native deciduous hardwoods”. In the cities, a mix of shade and ornamental trees planted in landscaped areas provide shade, habitat for wildlife, and aesthetic value. The estimated benefits from the current tree canopy at UTA are as follows *(see Table.1).*

Abbreviation	Description	Removal Rate (lbs/ac/yr)	Monetary Value ($/T/yr)
CO	Carbon Monoxide removed annually	1.130	$1,333.50
NO2	Nitrogen Dioxide removed annually	6.241	$436.94
O3	Ozone removed annually	48.211	$2,597.84
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	13.683	$6,268.44
PM2.5	Particulate Matter less than 2.5 microns removed annually	2.463	$106,459.51
SO2	Sulfur Dioxide removed annually	3.068	$133.85
Carbon	Sequestered annually in trees	1.365	5.005
Carbon	Stored in trees (Note: this benefit is not an annual rate)	34.281	125.697

Table.1 Tree Benefit Estimates (I-Tree Canopy, 2020).

FAUNA:

Hundreds of species of native fauna was living in Arlington, due to urban sprawl the dominate species pushed out less-dominant species. Native animals in the area include armadillos, bats, beavers, foxes, opossums, raccoons, squirrels and skunks. Less common sightings include coyotes, alligator, bobcats and feral hogs. Additionally, ants, bees, beetles, birds, butterflies, flies, moths, wasps, and true bugs are common pollinators (Arlington Animal Sighting Report,2020).

ANTHROPOGENIC FACTORS:

GEOGRAPHY:

Locating within the Dallas- Fort Worth Metropolitan (DFW) area (*Figure 9*), UTA has increased a 28% enrollment growth rate over the past 5 years and is continuously expanding programs and facilities in order to serve the growing DFW region. UTA currently enrolls approximately 42,000 students with 10,000 of those living on or adjacent to campus.

LAND USE:

The current campus land use is primarily comprised of surface parking lots, streets, sidewalks, buildings, recreational fields and green space. Goals from the master plan include shifting from the predominance of surface parking lots to parking garages located on the edges of campus. Increasing the density of buildings to support the growing university. The integration of green spaces throughout the campus is planned to encourage recreational activities, foster campus identity and create connections to the natural environment not only for students but also for the community. The land use map shown in *Figure 10*. shows that UTA's campus (Institutional land use) sits within predominantly single-family residential and a few multi-family residences. Just to the north of campus is a mixture of Commercial and Retail land use.

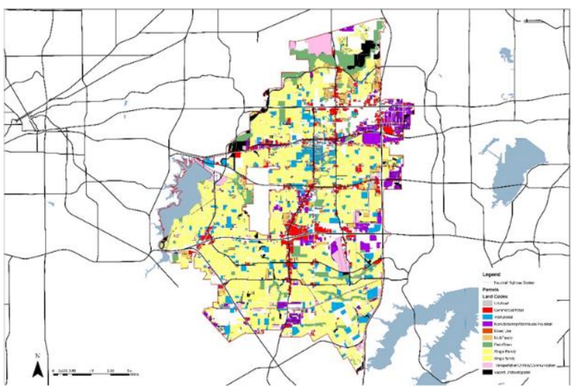


Figure 9. Arlington Land use and location.

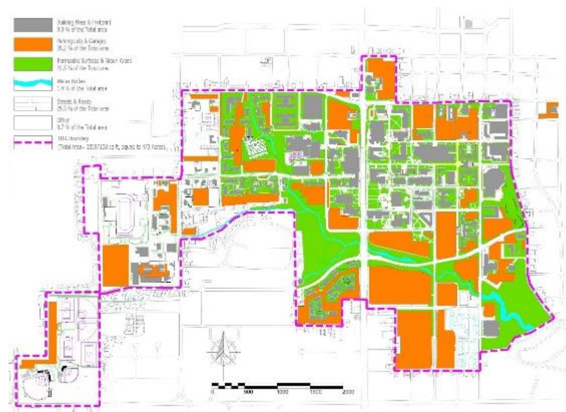


Figure 10.UTA land use.

CIRCULATION:

Cooper Street separated the campus from north and south into two parts. Two bridges have been built over the cooper St. that connects the east and west sides. In addition, smaller streets provide access and service to many interior buildings on campus. Future development will impact roadways, access, parking, transit and pedestrian mobility. The campus shuttle system are getting more importance as campus developed in future.

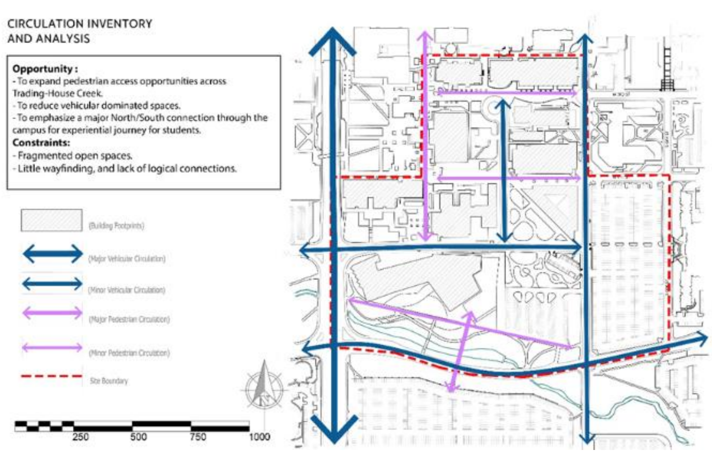


Figure 11.Current Circulation of selected site at UTA.

EXISTING STORMWATER RUNOFF:

The EPA's Stormwater Calculator was used to measure stormwater run-off from the study site. The calculator measured a 62% stormwater runoff rate as a baseline existing conditions (38.63" average annual rainfall/year) using the median/near-term climate change scenario over 20 years. The baseline infiltration rate measured 30% under the same scenario (Figure 12).

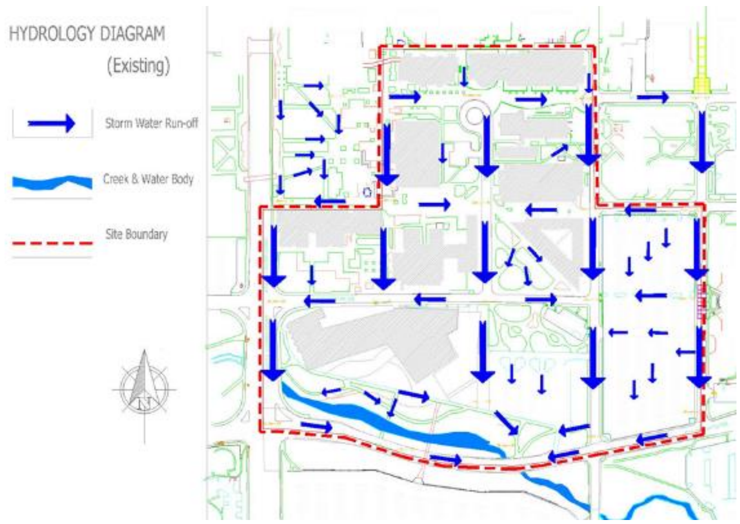


Figure 12. Current Water Circulation & Runoff path.

COMMUINITY ENGAGEMENT and UTA MASTE PLAN:

Our community engagement strategy ensured participation and feedback from students, faculty, staff and the greater Arlington community at every stage of the project, informing our decisions for the next stage. The graphic below describes the process in stages. The current master plan proposed following strategies in planning and design to encourage community engagement:

1- Create a sense of place: use of landmarks gateway buildings, pedestrian bridges.
2- Compliment the city of Arlington: transition between the campus and downtown.
3- Reputation and tradition: enhance teaching spaces, flexible various learning styles.
4- Rich Campus: use of civic art in open spaces, installing symbols.
5- Campus and Community: create culturally diverse community hubs. Integrate housing, open space and academic facilities. A welcoming accessible campus that open outwards.
6- Space and linkage: create outdoor spaces, shaded gardens, creating hubs, water features. Tree-linked pedestrian malls. Native plants, climate responsive spaces.

III. DESIGN ISSUES AND OPPORTUNITIES:

ENVIRONMENTAL:

- Reducing Water pollution – decrease runoff, recharge the water table.
- Reducing Air pollution – increased carbon sequestration and other filtering from tree canopy.
- Mitigate Habitat Fragmentation – provide opportunities to connect the campus to city trails and other green spaces for people and wildlife.

- Mitigate Urban Heat Island Effect – reducing hardscape surfaces and use of lower albedo materials.
- Conservation and protection of natural resources via design and education.
- Increasing water retention and ground water infiltration from deep rooted prairie vegetation.
- Creek Restoration – constructed wetland, slowing runoff rate, restoring banks, reducing erosion, improving accessibility, increasing safety.
- Reducing impervious surfaces- decrease asphalt surfaces of parking lots and replace it with porous materials.

SOCIAL:

- Planning for Trails – provide opportunities to connect UTA to greater Arlington.
- Increase the sense of place and Identity– Reveal the landscape with trails, programs and educational signage.
- Increase walkability of campus and pedestrian Mobility – Auto-centric culture and commuter mentality; reroute vehicular traffic to edges to.
- Providing Educational opportunities on history of site-specific features.
- Advocating for Health and Wellness – opportunities for walking, running, hiking, biking and group activities.
- Increase Aesthetic Enrichment – creating pockets of green and blue spaces for relaxation and enjoyment.

ECONOMIC:

- Increased enrollment via improving the physical environment of campus.
- Generate interest in blue-green infrastructure and low impact development strategies.
- Long-term Benefits – cost savings on energy use, and maintenance.
- Reducing the Environmental Impacts of campus development – Reduce downstream water treatment costs.
- Energy Conservation and Generation – White roofs, green roofs, photovoltaic systems, micro-climates, air conditioning water recovery.

PROJECT SITE SELECTION:

After campus inventory, analysis, meeting with campus leaders, interviewing students, and consulting with experts, we selected a 33.5-acre site on the southwest of campus that could benefit greatly from the implementation of blue-green infrastructure. This portion of campus is currently undergoing rapid redevelopment. The site includes the following unique features(see Table.2):

• Trading House Creek – a natural waterway collecting stormwater runoff from the entire west side of campus and beyond, currently considered a drainage ditch, in the southern side of the site.

• Two Parking Lots – two parking lots of 47 and F10 on the south and western sides with total area of 277,790 sq.ft. equals to 19% of the selected site,

• The southern campus Entrance at Cooper Street, South Nedderman Drive and W. Mitchell – includes 22- acres of UTA's total 420-acre campus, contains many surface parking lots, and Seir building.

Figure 13. Existing land use of the selected site.

Description	Total Area	Percent of Total
Impervious Surfaces & Streets	783,614 sq.ft,	**73%**
Roof surfaces	323,476 sq.ft.	22.12%
Parking Lots	277,790 sq.ft.	19%
Streets & Roads	255,726 sq.ft.	17.49%
Pedestrian & Other Pavements	210,452 sq.ft.	14.39%
Permeable Surfaces & Green Areas	364,831 sq.ft.	**27%**
Green Areas with Xeriscaping	24,949 sq.ft	1.71%
Green Areas with Lawn Surfaces	325,785 sq.ft	22.28%
Green Areas with Other Covers	14,097 sq.ft	0.96%
Water Bodies	29,928 sq.ft	2.05%
Site Boundary	1,462,203 sq.ft, (33.5 Acres)	**100%**

Table.2 Total and percentage of the impervious and permeable surfaces of the selected site.

IV. CONCEPT & MASTER PLAN:

The overall design concept of **"The Path Forward"** aims to integrate existing natural and urban systems currently separated by Nedderman Road, parking lots, and Trading House Creek through planning of Blue-Green infrastructure throughout the site. "**The Path Forward**" is a design proposal that aims to **Contain, Clean** and **Connect** all parts of the urban system to their right destination. To address stormwater runoff on site, our team targeted four major areas for intervention.

1. Streetscapes,
2. Surface parking
3. Building footprints
4. Trading-House creek.

Major roads within the site are lined with bioswales. Each intersection will have adjacent rain gardens to capture, clean and release stormwater into the groundwater system before it reaches trading house creek. Parking areas are converted to academic buildings to align with the future UTA master plan for realistic development phasing. The remaining surface parking will be allocated to a more spatially efficient parking garage or retrofitted with central rain gardens.

To address pedestrian connections, the north/south circulation that was blocked by the new science and engineering building, now continues from planetarium place with a new pedestrian bridge across Johnson creek. This new promenade creates an experiential journey with science related educational programs along walk. Building tops within the site are targeted for solar panel placements, and all rainwater will be diverted to underground cisterns to be used locally throughout the year. This will reduce economic costs of irrigation and provide a useful resource during long periods of drought.

Lastly, a terraced detention wetland will provide additional storage for stormwater events, habitat for local wildlife, and a natural amenity for students during the dry seasons, complete with an amphitheater and boardwalk.

• **Contain** – Using a variety of blue-green infrastructure to locally capture runoff by slowing it down and allowing infiltration on site and integrate all those strategies into one holistic approach.
• **Clean** – Using biofilters, vegetation, and soil to filter water before it enters the watershed and ground water aquifer.
• **Connect** – connect and merge the urban and natural systems of the sight with community by integrating blue-green infrastructure throughout.

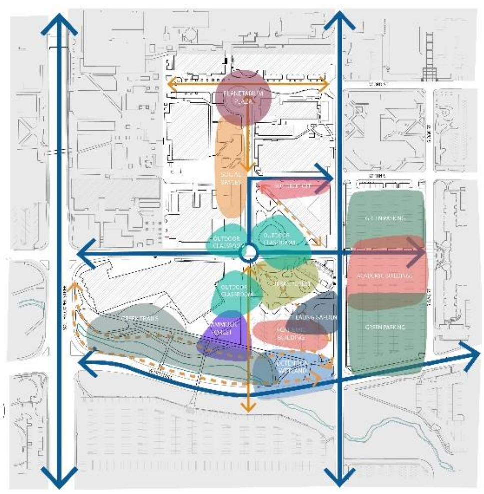


Figure 14. the Design Concept.

Figure 15. Final Design.

"LID" STRATEGIES INCLUDE IN DESIGN:

Low Impact Development (LID) is a stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives and fulfill environmental regulatory requirements. LID employs a variety of natural and built features that reduce the rate of runoff, filter out its pollutants, and facilitate the infiltration of water into the ground. By reducing water pollution and increasing groundwater recharge, LID helps to improve the quality of receiving surface waters and stabilize the flow rates of nearby streams (Low Impact Development Center).

- Permeable Paving strips around the planetarium plaza
- Underground Cisterns (x2) – for irrigation
- Bioswales along streetscapes
- Bioswales in parking lots
- Detention pond/wetland area adjacent to creek
- Green roofs on all new buildings and parking garages
- Solar Panels on all older buildings in the site
- Urban Forest in front of social work building

BLUE-GREEN INFRASTRUCTURE FEATURES:

- One constructed detention wetland intercept and retain 650,000 gallons of stormwater runoff while providing ecological, environmental and social benefits for recreational use.
- Tree proposed new outdoor classrooms in support of the campus master plan while introducing innovative, sustainable design features to increase connectivity and enhance climate resiliency.
- Two urban forest pocket native oak forest total area of 22162 sq.ft, and Hammock forest with total area of 29818 sq.ft. The forests provide an educational center while providing carbon sequestration, mitigation of the heat island effect, and soil stabilization.
- Curb cuts intermittently placed along Nedderman Drive and Planetarium Plaza will direct stormwater runoff into Creekside rain gardens and bio-swales, including an experimental area with bioswales and rain garden with total area of 13,520 sq.ft and one artistic rain garden with 11,350sq.ft..
- A new tree lined pedestrian mall featuring permeable paving, shaded seating and linear street rain gardens stretching approximately 1,200 linear feet. The mall offers a dynamic setting for student gatherings, organized activities, and Reading garden with total area of 7067 sq.ft.
- Two central nodes of the pedestrian mall contain two plazas with an overhead and cisterns to save rain water for irrigation.
- The creek banks will be stabilized in gathering areas with large areas of native plants, which provide an amenity for park visitors by creating a series of terraces and vantage points throughout the basin. The Amphibian park with 13,794 sq.ft., the Native prairie garden with 6,405 sq.ft, and native pollinator garden with 28,928 sq.ft..
- Total area of 45,623 sq.ft. with photovoltaic boards will be located on top of the existing building to generate clean energy.
- 5,800 sq.ft. of new permeable pathways throughout the site. The park is linked to the surrounding neighborhood and Arlington Trail system with 10 sidewalk and bike path connections.
- The planting design throughout uses a 75% native plant palette, reducing irrigation water consumption as well as maintenance and upkeep costs.
- Planning of 90,540 linear foot of trail across of the creek.
- Proposed green roofs for new and proposed buildings with total area of 107,856 sq.ft.

Proposed Stormwater System

Rain water will be captured from roofs and will be saved in two cisterns for irrigation. Other surface waters from streets and pavements will go into bioswales, and rain gardens and eventually will be slow down in constructed wetland and proposed detention pond (Overflow system) and will be released into the creek (see the Figure 16).

Figure 16. Storm Water Management Plan

IMPLEMENTATION PHASING PLAN:

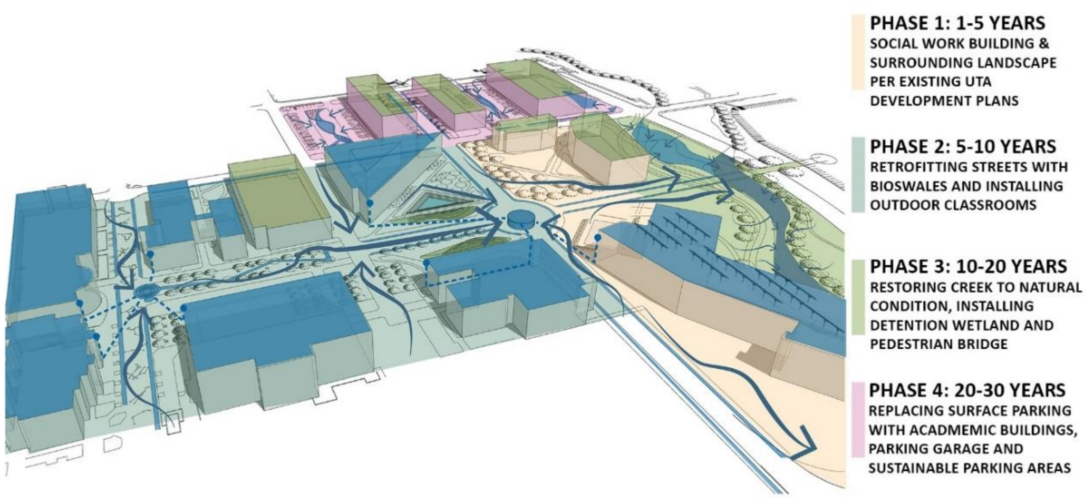


Figure 17. Phasing Schematic Plan for Storm Water Management

PHASE 1: 1-5 Years:

Social work building and surrounding landscape per existing UTA development plan. These works may include capturing rain water from roofs, streets and parking lots, filter and infiltrate them into rain gardens. The proposed retention ponds hold the water and lead it to the creek.

PHASE 2: 5- 10 Years:

Retrofitting streets with bioswales and installing outdoor classrooms. The pedestrian malls are implemented with permeable pavements. These malls will provide rain gardens and outdoor social spaces. New construction and proposed educational building provide opportunities for installing green roofs, the photovoltaic systems, saving energy and disconnecting built site hydrology.

PHASE.3: 10-20 Years:

Restoring creek to natural conditions, Installing new pedestrian bridge. New proposed constructed wetland works as detention pond captures, cleans and slows runoff then releases it into the creek. The Trading House Creek will be improved though creekbank restoration and detention ponds. This phase improving bio-habitat and encourage bio-diversity of the creek. Overall stream bank and habitat is targeted by restoring succession and meadow/prairie native plantings. Trails area are implemented incorporating educational signage and healing gardens focusing on native prairie and urban forests.

PHASE.4: 20-30 Years:

The last phase involves replacing surface parking with academic buildings, parking garages and sustainable designs. New parking garages with green roofs will be added.

V. MASTER PLAN PERFORMANCE:

STORMWATER ANALYSIS FINDINGS:

Results from "**The Path Forward: Contain, Clean and Connect"** design were calculated using the EPA Stormwater Calculator during a 2" rain event. Compared to existing 73% of impervious cover, the new site integration of blue-green infrastructure reduces impervious cover to 23.2%. Rain harvesting, rain gardens, green roofs, street planters, infiltration basins, and permeable paving were assumed to have a capture ratio of 73%. Table 3 reflects results based **on near term climate change (2020-2049)** under a **median climate change year**. Low Impact Development controls implemented estimate a decrease in average annual stormwater run-off from 23.88% baseline to 10.61% with infrastructure improvements (*Figure 18*).

EPA Calculator Statistics (2" Rain Event)	**Current Scenario** (near term thru 2049)	**Baseline Scenario** (Existing conditions 2020)
Study Site (33.5 acres)	(23.2% Impervious)	(73% Impervious)
Average Annual Rainfall (in.)	38.63	38.63
Average Annual Runoff (in.)	10.61	23.88
Days per Year with Rainfall	3	3
Days per Year with Runoff	0.2	1.3
Percent of Wet Days Retained	93.33	56.67
Smallest Rainfall w/Runoff (in.)	3.69	2.79
Largest Rainfall w/o Runoff (in.)	4.66	2.92
Max. Rainfall Retained (in.)	3.36	1.74

Table.3 EPA National Stormwater Calculator Statistics (adapted)

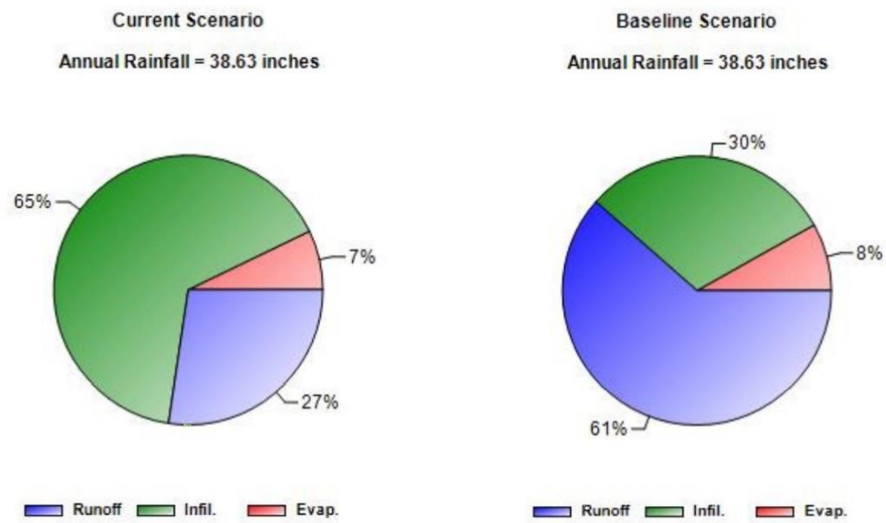


Figure 18.Storm Water and Impervious Surface Calculations

ENVIRONMENTAL ANALYSIS FINDINGS:

• Sequesters 102 tons of CO2 annually through 270 newly planted trees

• Reduces the peak stormwater flow rate for a 2-inch rain event by reducing impervious surfaces by almost 50% from 73% to 23.2%

• Manages all runoff along the 1200 ft. main promenade (from W. Mitchell St. to Planetarium Building) drive for up to a 100-year storm event using street planters and native landscaped, urban forest, and bioretention areas.

• Sidewalks 61,516 square feet/738 cubic yards of concrete removed. W.3rd St, and Planetarium Promenade, W. 4th St and Niederman Drive converted to permeable paving.

• Surface Parking 88732 square feet/1,064 cubic yards road base available for recycling.

• Increased stormwater infiltration, 34%

• Decrease in stormwater run-off, 35%

• Reduce potable water use for irrigation attributed to captured, rainwater harvesting and cisterns

• Increase in groundwater recharge by proposing bioswale and detention ponds, increasing porous surfaces and planting trees.

• Area of restored creekbank soils of 77,780 sq.ft. equals to 1.8 acres

• Canopy trees protected 83%

• Native/adapted trees added – Increase of 270 trees

• Green energy generated from photovoltaic system at several new and existing buildings, 1.42m. kWh

• Greenhouse gasses avoided via photovoltaic systems, 470 tons CO2/year

• Change to native and adapted planting beds, rain gardens and urban forest in concept design protects and improved ecosystem services and encourages bio-diversity and pollinator diversity.

• Stream bank restored with native plants and more trees for improved erosion control.

• Reduce directly connected (to traditional drainage) impervious area, 73%

SOCIAL ANALYSIS FINDINGS:

• Improves perception of the campus locally and beyond with improving the design features and providing spaces for social gathering.

• Improves the quality of life for campus users by reducing stress and providing better spaces to be outdoors and meet friends

• Connects the southwest edge of campus with the community by providing more opportunities for recreation and aesthetically inspiring gathering places, trails and outdoor classes.

ECONOMIC ANALYSIS FINDINGS:

• Attracts students, faculty and staff to apply/enroll at UT Arlington. The campus landscape improvements are expected to lead to an increase in enrollment

• Encourage university fundraising for the blue-green infrastructure throughout campus. Fundraising to include seeking sponsors to support design and construction and naming rights opportunities for trees, water features, landscape features and other design elements.

• Creation of jobs for environmental engineers, architects, construction workers, and future maintenance.

ESTIMATE OF PROBABLE COSTS:

Estimated capital costs and maintenance expenses are shown in Table 4. and 5. The total expense of infrastructure improvements appears to be comparable to other capital projects recently undertaken on campus, for example, the $9.8 million University Center Entrance reconstruction currently underway. Proposed phasing of construction would allow time for fundraising potentially for specific features and spread-out costs over time (Table 4 & 5).

Probable Costs

LID Control	Current Scenario	Baseline Scenario	Cost Difference
Disconnection	$ 652,900 - $ 838,800	$ 180,700 - $ 232,400	$ 472,200- $ 606,400
Rainwater Harvesting	$ 71,500 - $ 100,200	-	$ 71,500 - $ 100,200
Rain Gardens	$ 5,200 - $ 10,100	-	$ 5,200 - $ 10,100
Green Roofs	$ 251,500 - $ 510,000	-	$ 251,500 - $ 510,000
Street Planters	$ 8,900 - $ 23,500	-	$ 8,900 - $ 23,500
Infiltration Basins	$ 5,300 - $ 12,400	$ 4,100 - $ 9,300	$ 1,200 - $3,100
Permeable Pavement	$ 1,776,700 - $ 2,369,400	$ 65,100 - $ 87,100	$ 1,711,600- $ 2,282,300
Total	$ 2,772,000 - $ 3,864,400	$ 249,800 - $ 328,800	$ 2,522,200- $ 3,535,600

Table.4. Estimate of Probable Costs from EPA National Stormwater Calculator v.20.0.1

Maintenance Costs

LID Control	Current Scenario	Baseline Scenario	Cost Difference
Disconnection	$ 8,900 - $ 13,400	$ 2,500 - $ 3,700	$ 6,400- $ 12,900
Rainwater Harvesting	$ 8,900 - $ 21,300	-	$ 8,900 - $ 21,300
Rain Gardens	$ 100 - $ 1,900	-	$ 100 - $ 1,900
Green Roofs	$ 2,800 - $ 28,000	-	$ 2,800 - $ 28,000
Street Planters	$ 100 - $ 2,600	-	$ 100 - $ 2,600
Infiltration Basins	$ 100 - $ 3,600	$50 - $ 1,200	$ 50 - $ 2,400
Permeable Pavement	$ 21,200 - $ 115,600	$ 800 - $ 4,100	$ 20,400- $ 111,500
Total	$ 42,100 - $ 186,400	$ 3,200 - $ 9,000	$ 38,900- $ 177,400

Table 5. Maintenance Costs from EPA National Stormwater Calculator v.20.0.1

VI. CONCLUSION: ADDED VALUES AND BENEFITS

In conclusion, "The Path Forward" adds a variety of environmental, educational, and social benefits to the UTA campus. Addressing stormwater runoff remediation of the site enhances the street scopes, improves parking surfaces, encourages bio-diversity, and cleans rainwater from built surfaces. The design preserves the natural fragmented urban bio habitats across the campus, connects the green areas of the UTA to the city of Arlington via increasing the number of the planted trees and preserving the creek. The proposed water-sensitive strategies integrate the existing educational buildings and proposed outdoor learning spaces.

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