U.S. EPA'S RAINWORKS CHALLENGE:
THE UNIVERSITY OF TEXAS AT ARLINGTON'S EXPERIENCE, & ROLE FOR NORTH TEXAS

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College of Architecture, Planning and Public Affairs – CAPPA, UT Arlington

Annual Public Works Roundup, NCTCOG, 2023, Grapevine, TX

OUTLINE

- Introduction
- Green Infrastructure (GI) & US EPA Campus Rainworks
- UTA Rainworks Challenge 2012-2021
- The Technical Challenge & Exhibit, 2022-2023
- The UTA's GI Report, 2023
- Lessons Learned

GI / BGI DEFINITION:

What is “Green Infrastructure (GI) or (BGI)”?

- **A more nature friendly means of managing urban flood-risk,**
- Practices that **restore or mimic natural** hydrological processes. While “gray” stormwater infrastructure is largely designed to convey stormwater away from the built environment,
- BGI uses **soils, vegetation, landscape forms,** and other media to manage rainwater where it falls through capture, storage, and evapotranspiration.
- BGI has **community benefits**, including reducing stormwater flooding impacts, improving water and air quality, reducing urban heat island effects, creating habitat for wildlife, and providing aesthetic and recreational value (EPA, 2023; Lamond & Everett, 2019; Abbott et al., 2013).

BACKGROUND

What is Campus Rainworks Challange?

- **The Campus RainWorks Challenge is a Green Infrastructure (GI) design challenge** for American colleges and universities organized by **U.S. EPA.**
- **It engages with the next generation of environmental professionals**, foster a dialogue about the need for innovative stormwater management techniques, and showcase the environmental, economic, and social benefits.
- Since **2012**, this challenge has invited multidisciplinary faculty, students, staff, and professionals to **produce evidence-based ideas to promote solutions**.
- The Campus RainWorks Challenge initiatives invites students to be part of the solution today and in the **future as a liaison**.

GOALS

Campuses are used as incubators of future design professions, and the testing ground for innovative GI and climate change responsive design practices.

PURPOSE

- This presentation aims to **review the projects explored, and the lessons learned** from EPA's RainWorks **initiatives** (challenges and the pilot) within the past ten years while highlighting what is next for GI and climate action research, education, practice, and service.

QUESTIONS

- What is EPA’s **mission** with GI Initiatives?
- What UTA has participated and is **achieved** within the **past ten years**?
- What is **faculty advisor’s experience** to teach, research and serve its community through this challenge, and pilot in this period?
- **What is next**? How can GI and EPA’s Rainwork initiatives be **implemented and scaled up** on and off campuses?
- Can UTA be used as **Urban Lab** for GI/BGI research and demonstration in North Texas Region?

QUESTIONS

Rainworks Challenge, the Pilot, Exhibit & Report, UTA Experience

- Since **2012**, UTA CAPPA's **Landscape Architecture Studio-5 is competing** in EPA's Campus RainWorks Challenge. In its **10 year** of this challenge U.S. EPA decided to run a pilot and sponsored it.
- *EPA's Campus RainWorks Challenge Pilot* is intended to **highlight the merits of past Campus RainWorks challenge/competition designs** (2012 through 2021) and **create new incentives to advance green infrastructure implementation** at institutions of higher education**.**
- Intended to **bridge the communication** between academic departments (researchers, teachers), operational staff (facilities), administrators, and community.
- EPA invited the UTA faculty advisor and UTA to participate as **one of two national institutions invited to participate due to its previous participation and successes** in this challenge.
- UTA and EPA Design Team started the pilot in the Spring with had a major **design charette and series of visioning sessions** (October 7th Design Charette). Dr. Taner R. Ozdil serves as the lead and initial point of contact.
- Pilot produced compendium of past work and a GI report for UTA Campus.

UT ARLINGTON

|CHALLENGE : 20122| COMPETITION SUBMISSIO


A
Alamo Plaza
HOTEL COURTS
Sylvan Av.
Dallas


Arlington


UTA


Trinity, Dallas
https://www.dallasnews.com/news/education/2022/08/22/classes-
continue-for-most-north-texas-students-despite-flooding-bus-disruptions/


Johnson, Arlington
https://i.imgur.com/EtEroIK.jpg


Trading House, UTA
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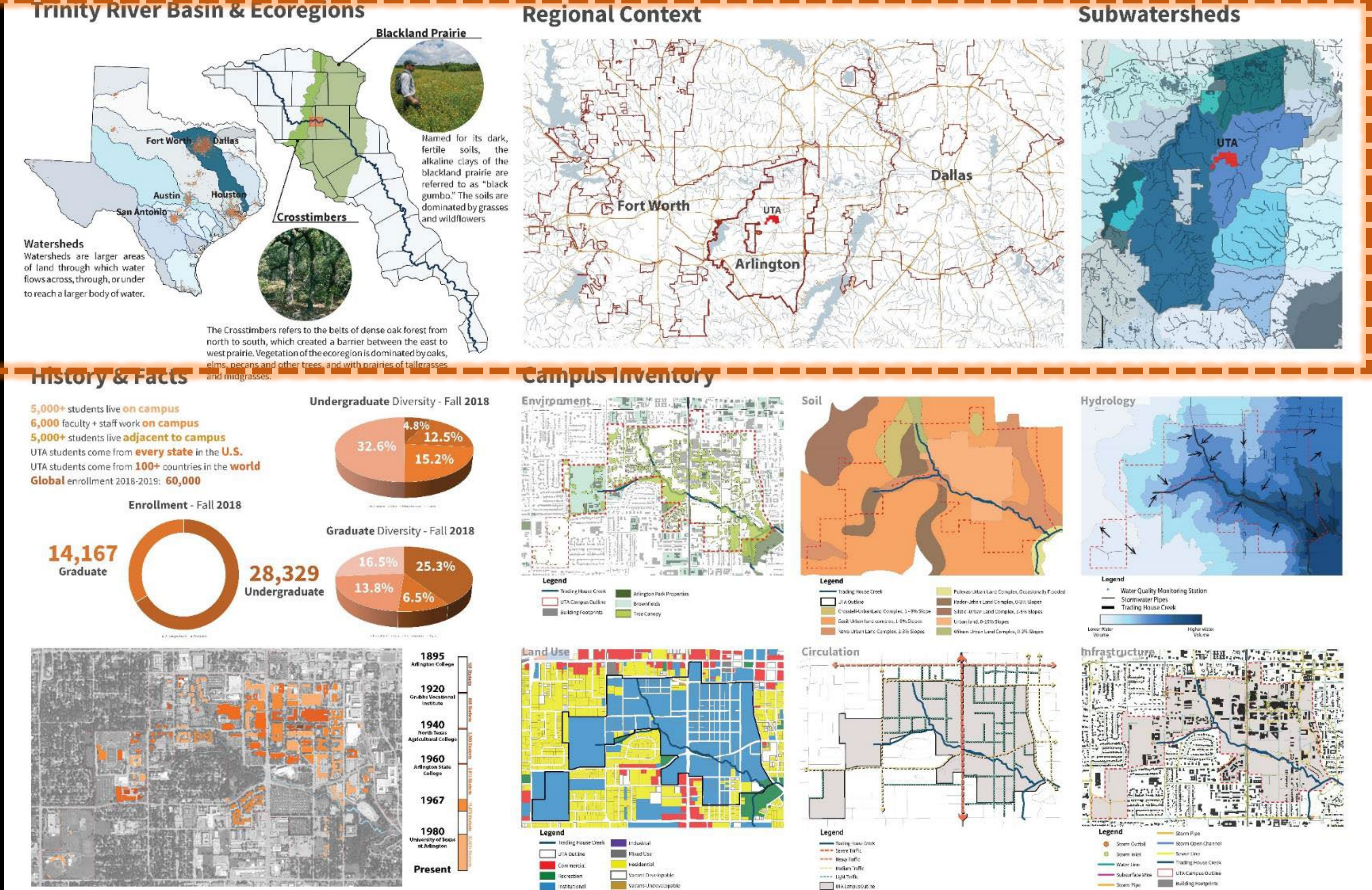
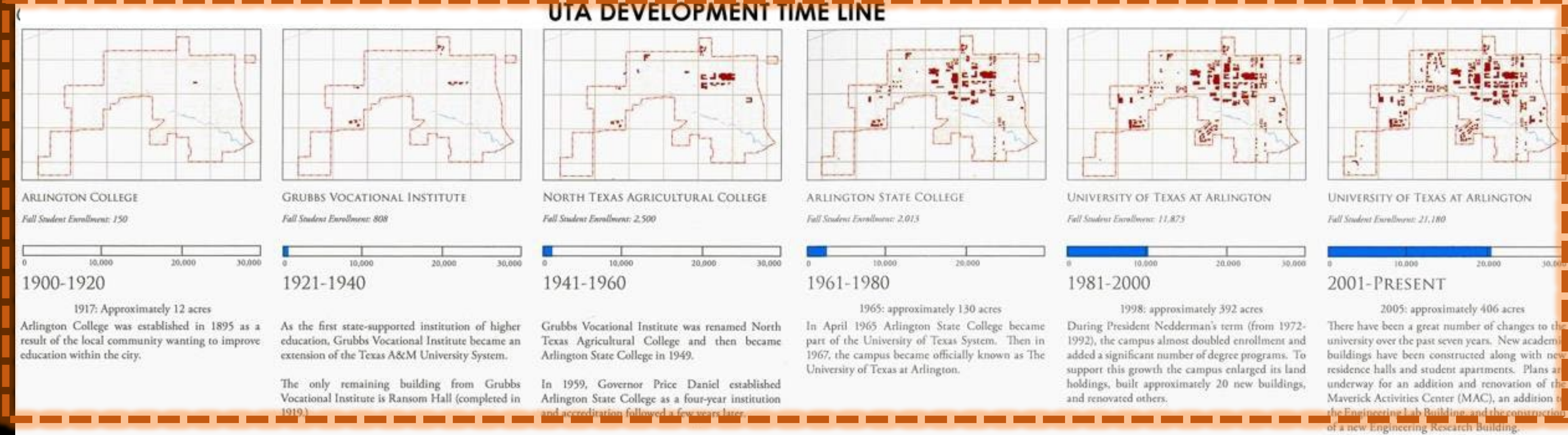
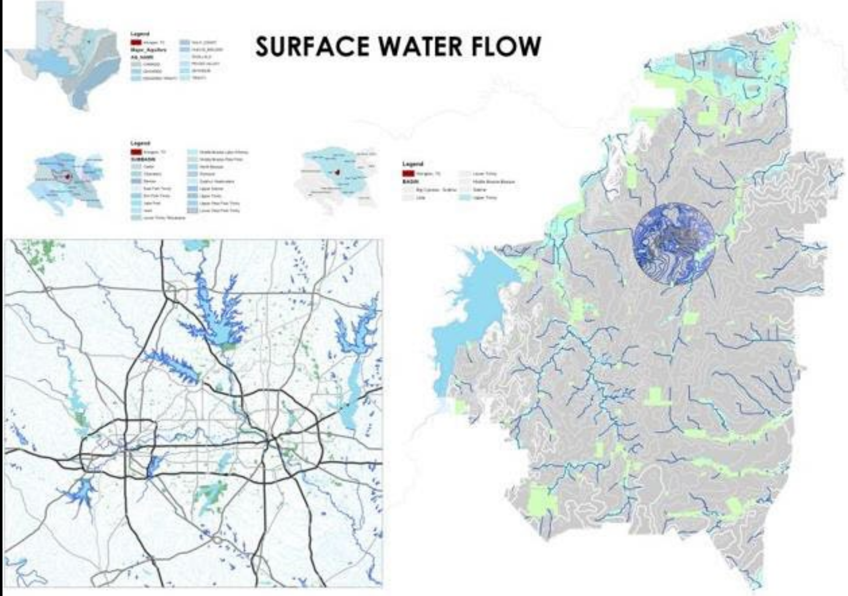
http://creativecommons.org/licenses/by-nc/4.0/

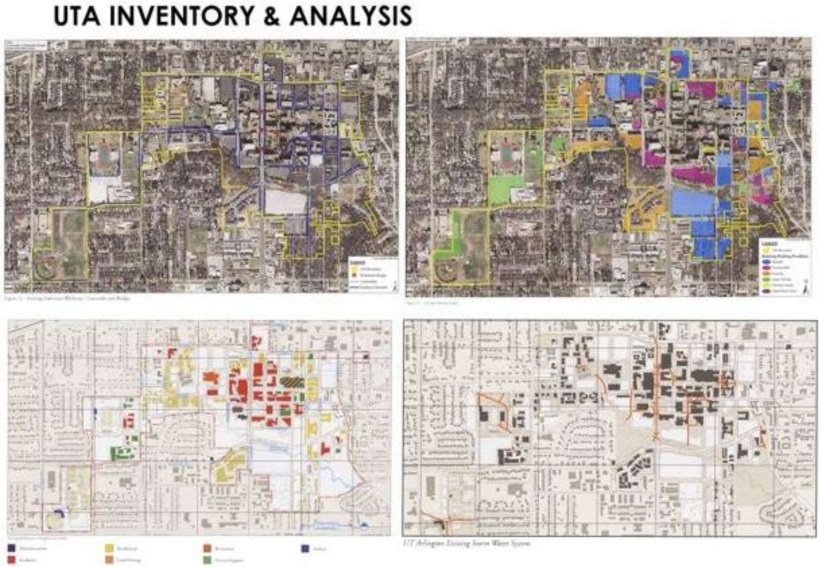
UTA CAMPUS, 2012-22
Inventory & Analys



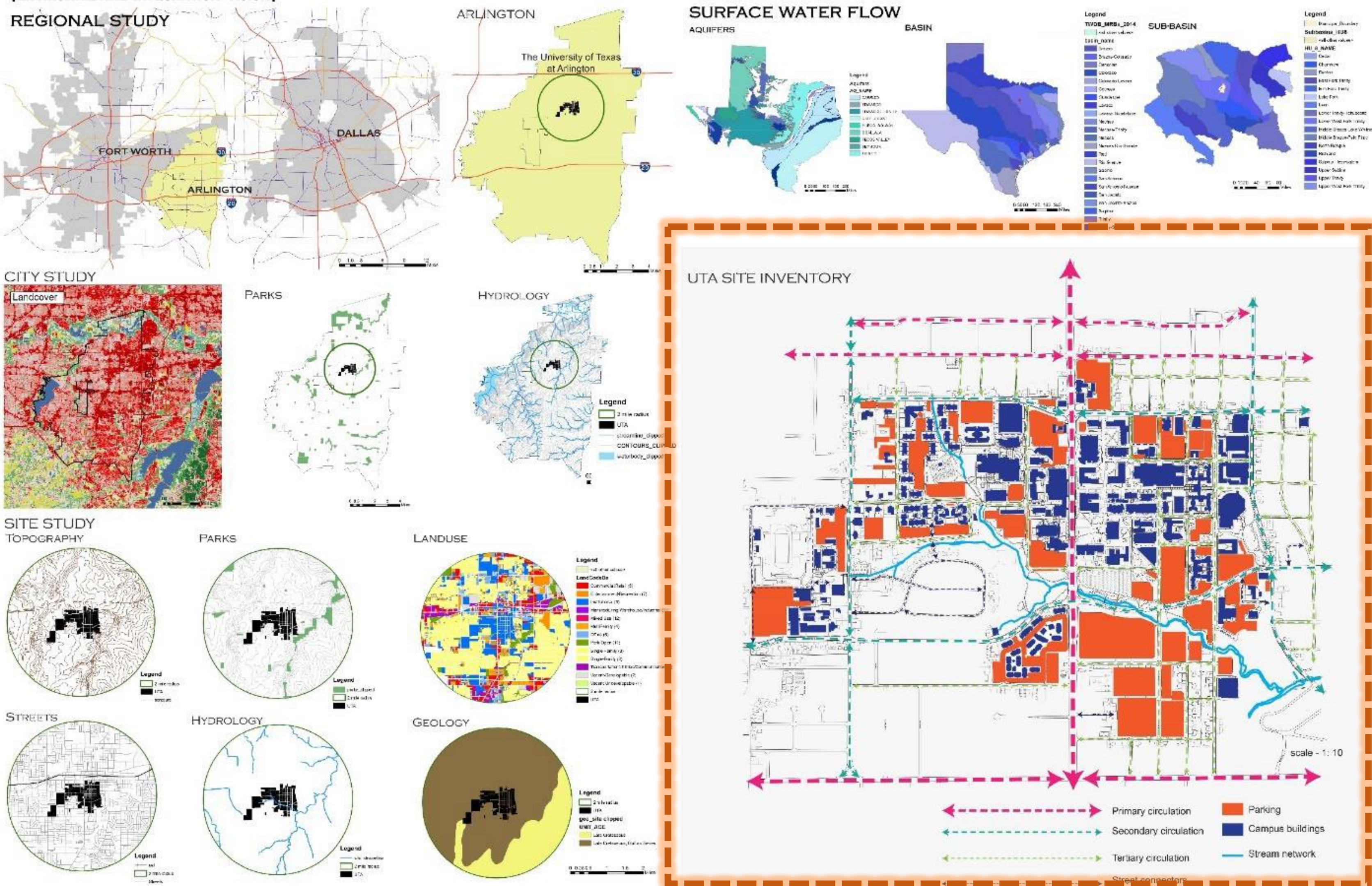
SAMPLE STUDENT INVENTORY





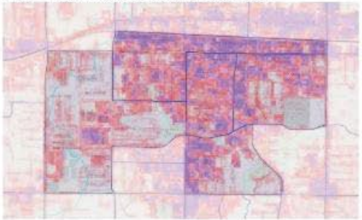


SAMPLE
STUDENT
INVENTORY

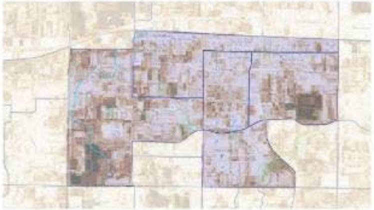


SAMPLE STUDENT INVENTORY

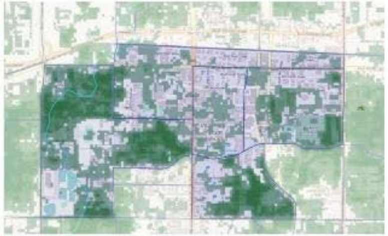
IMPERVIOUS SURFACES



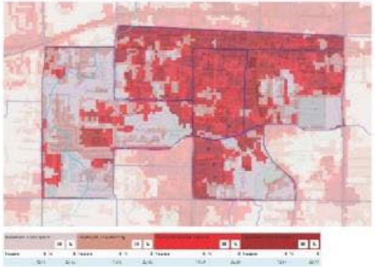
PLANTABLE SPACE



CANOPY COVERAGE

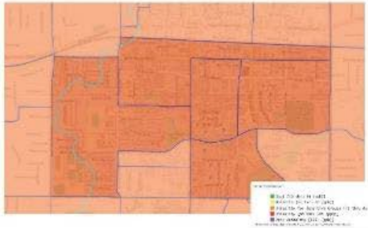


DEVELOPMENT DENSITY



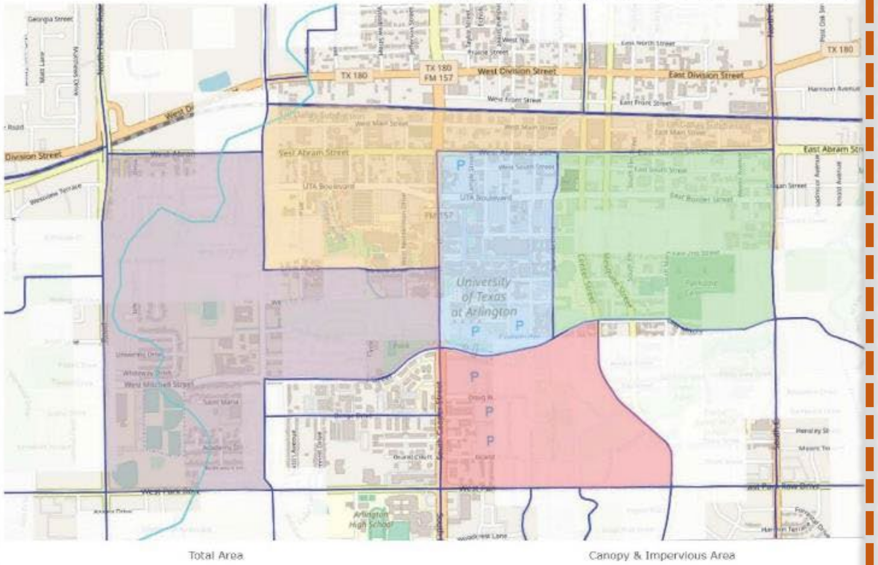
CARBON STORAGE, SEQUESTRATION & CO_2

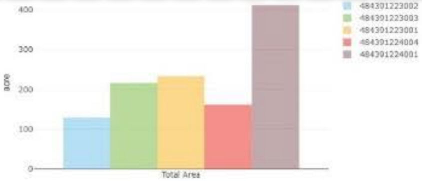
TRANSPIRATION, RAINFALL INTERCEPTION & AVOIDED RUNOFF

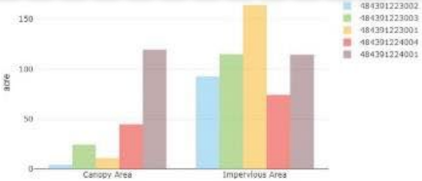


TOTAL AREA, CANOPY & IMPERVIOUS AREA BASED BY BLOCK

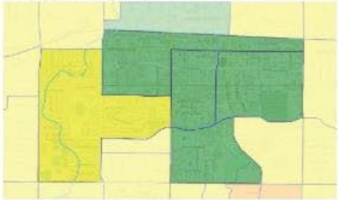
REPORTED HEALTH INCIDENCES



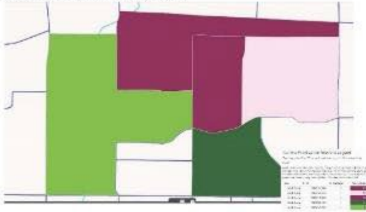




WALKABILITY



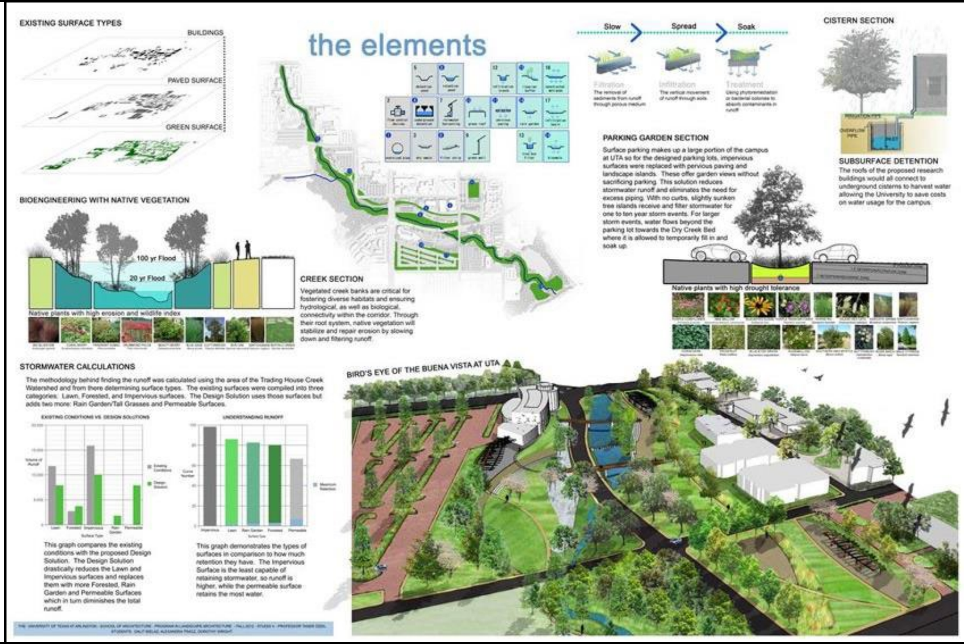
PRIORITY AREAS : BASED ON CANOPY COVERAGE, IMPERVIOUS SURFACES & DENSITY



SURFACE TEMP. CHANGES

SAMPLE STUDENT INVENTORY

UTA CAMPUS, 2012-22
Vision(s)



“*LIQUID LOGIC*”

Student Team:
Xie Tracz
Dorothy Wright
Dalit Bielaz

2012-13 SUBMISSION BOARDS

"*HYDROSCAPE*"

Student Team:
Kent Elliott
Blake Sampler

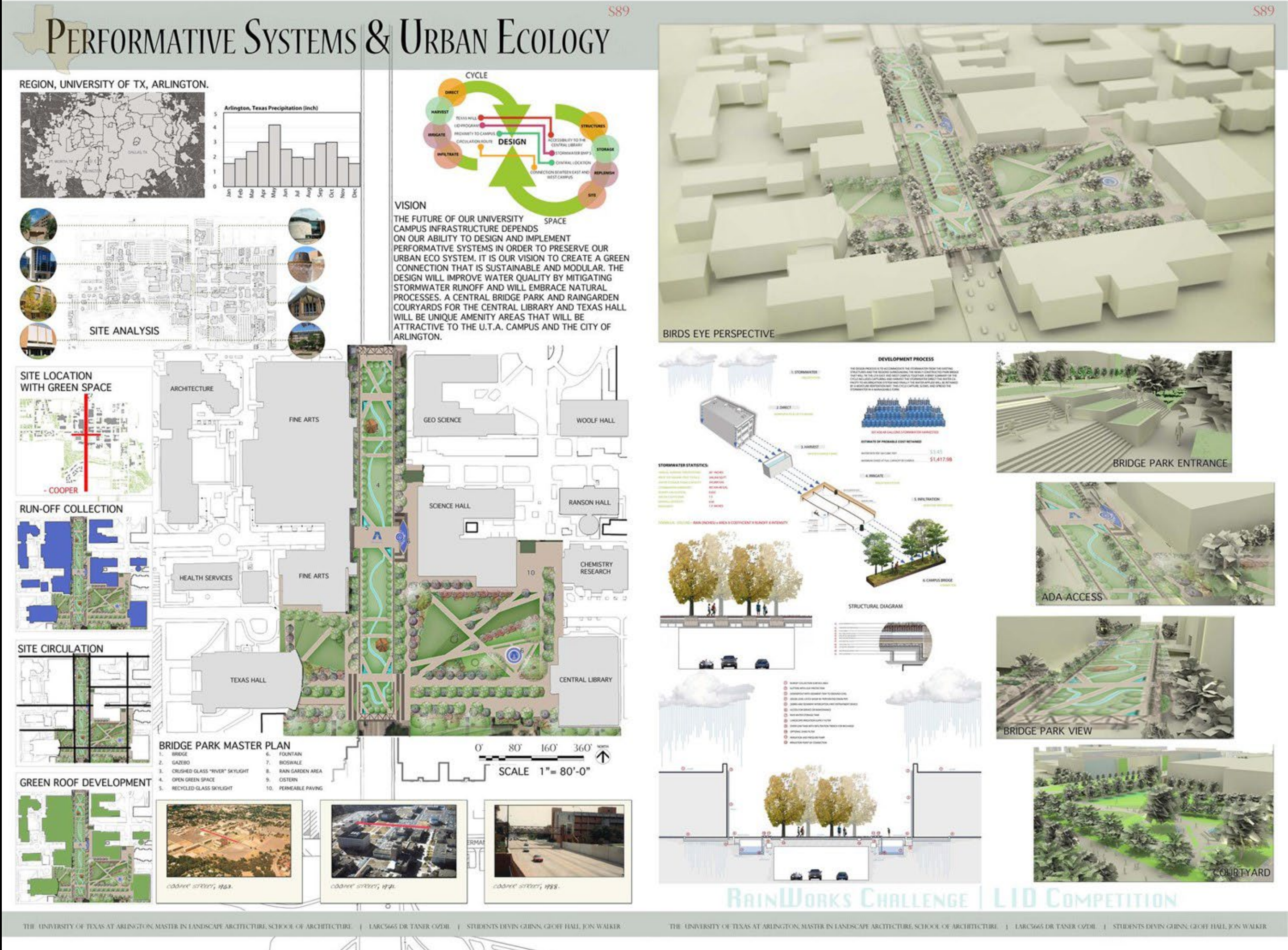
SUBMISSION BOARDS
Honorable Mention - Video
Ranked in the top 8 out of 218
Master Plan Category

2012-13 SUBMISSION BOARDS

“*PERFORMATIVE SYSTEMS*”

Student Team:
Devin Guinn
Geoffrey Hall
Jonathan Walker

Master Plan Ctg.

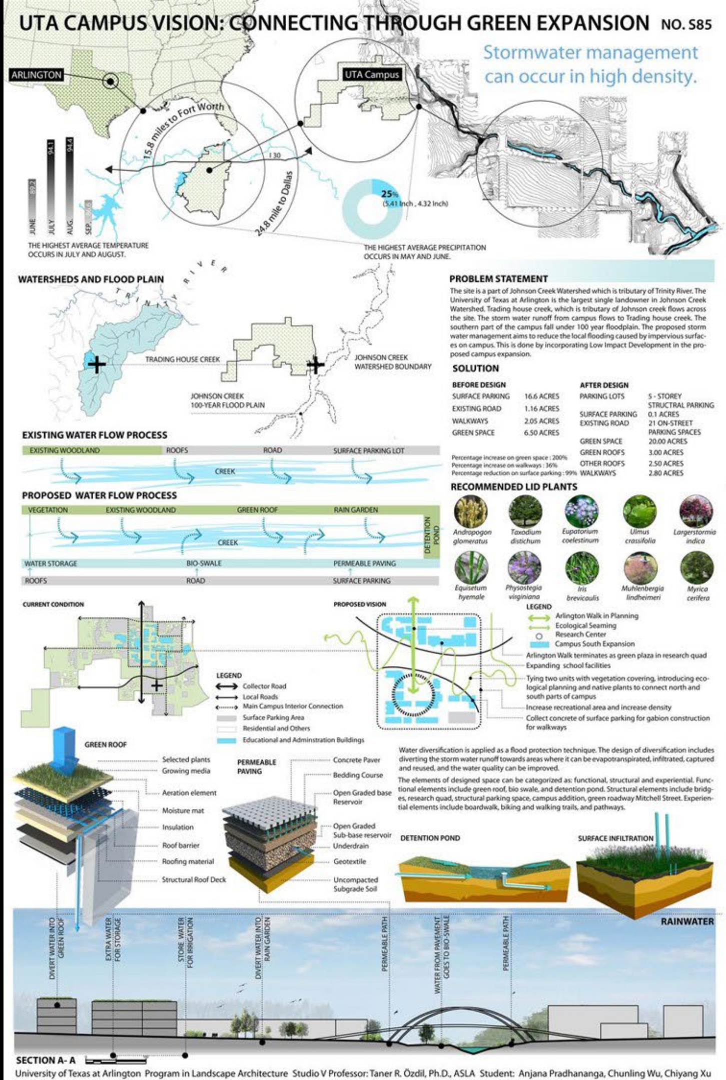


2012-13 SUBMISSION BOARDS

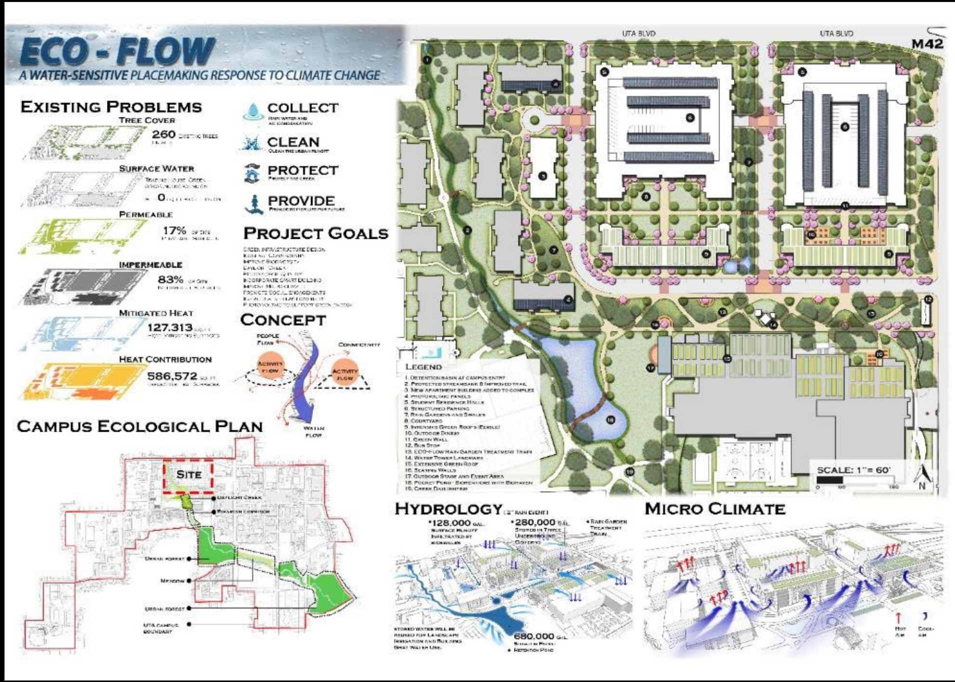
"*UTA CAMPUS VISION*"

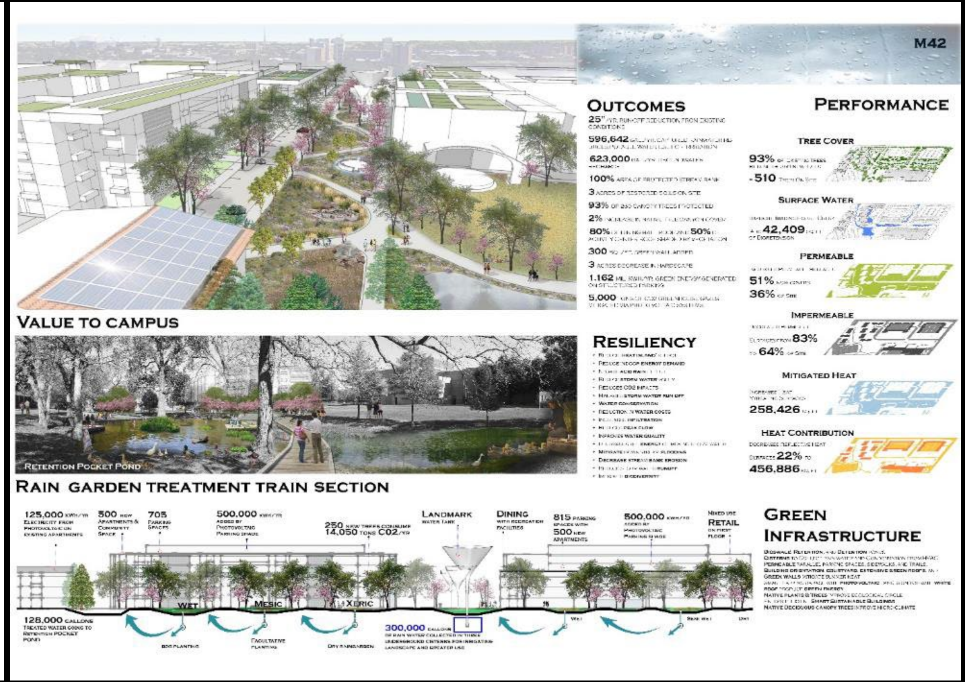
Student Team:
Chiyang Xu
Chunling Wu
Anjana Pradhananga

Master Plan Ctg.



2012-13 SUBMISSION BOARDS



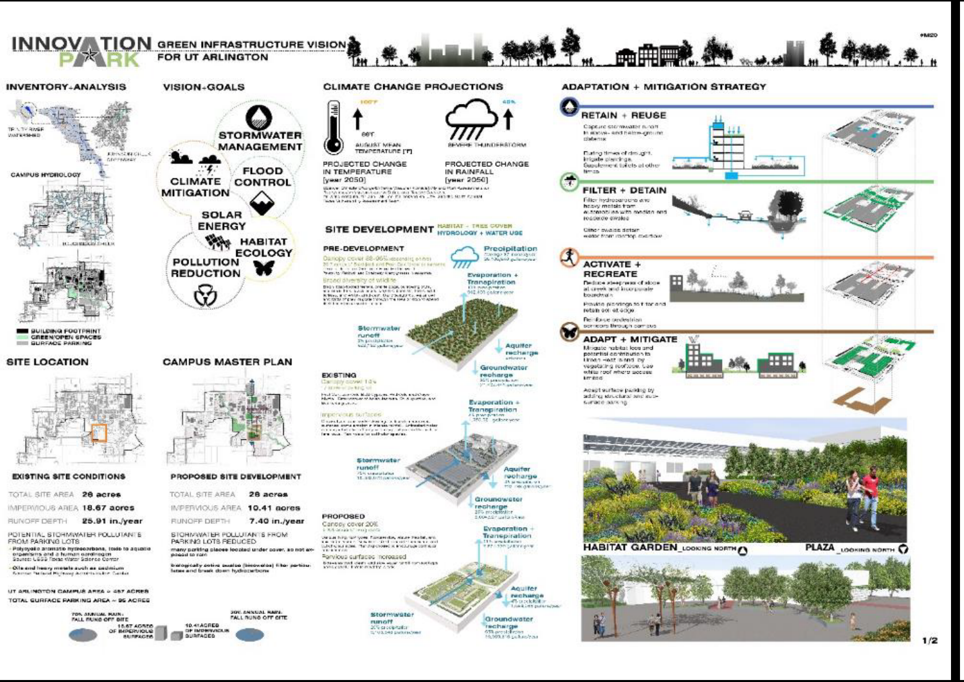


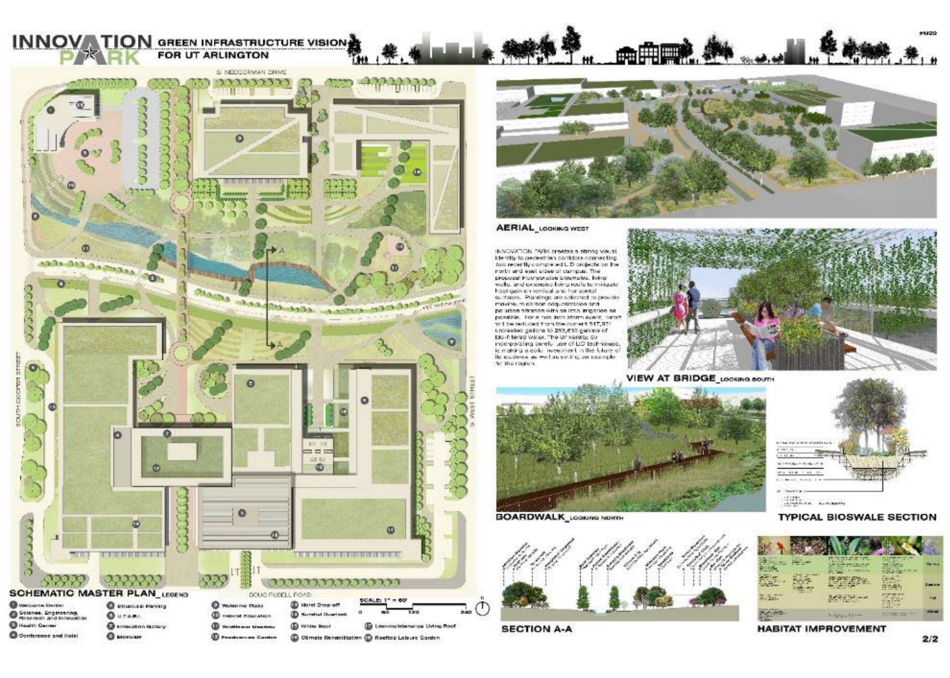
"*ECO-FLOW*"

Student Team; Jake Schwarz, Baishakhi Biswas & Sherry Fabricant, Ahoura Zandiatashbar

First Place, Master Plan Category

2015-16 SUBMISSION BOARDS



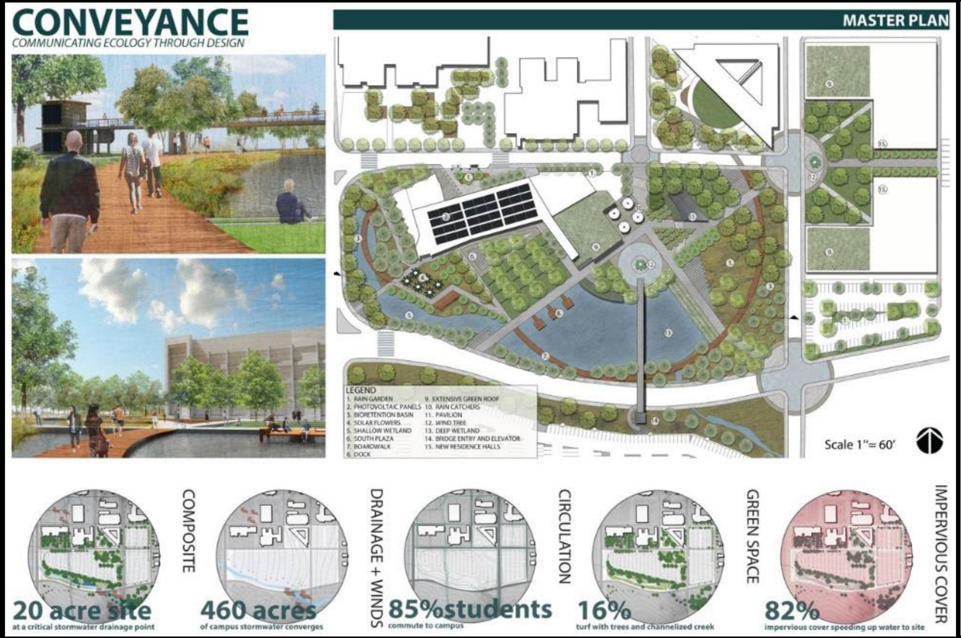


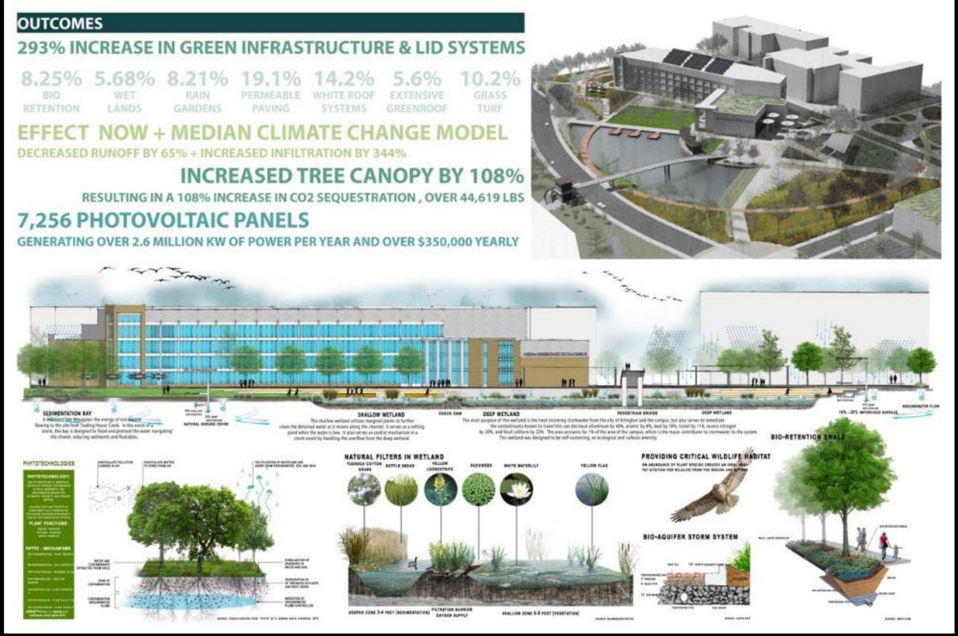
"*INNOVATION PARK AT UT ARLINGTON*"

Student Team; Layal Bitar-Ghanem, Kerry G.Harrison, Riza Pradhan, Somayeh Moazzeni

Honorable Mention, Master Plan Category

2015-16 SUBMISSION BOARDS





"*CONVEYANCE*"

Student Team; Molly Plummer, Reza Paziresh, Ann Podeszwa, & John Watkins,

This project is part of UNESCO's SDG Local Project Archive - http://localprojectchallenge.org/

Master Plan Category

2016-17 SUBMISSION BOARDS

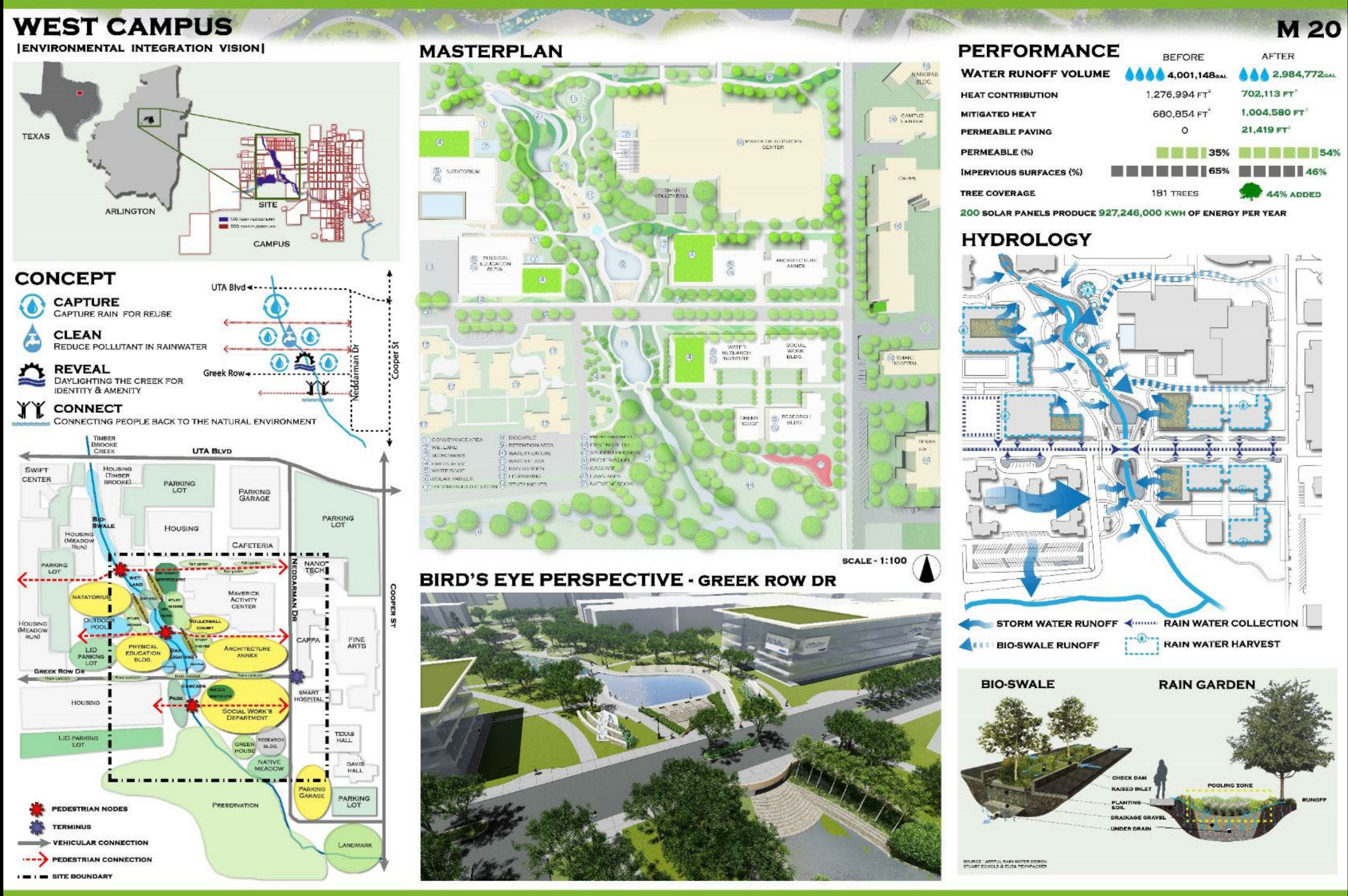
"*COELESCENCE*"
Student Team;
Mohamed Amer
Ali Khoshkar
Steven Nunez
Master Plan Ctg.

SUBMISSION
BOARD 2017-18

“*WEST CAMPUS*”
Student Team;
Crystal Kazakos
Annabeth Webb
Juan Fuentes
Niveditha Gangadhar

Master Plan Ctg.

SUBMISSION
BOARD 2018-19



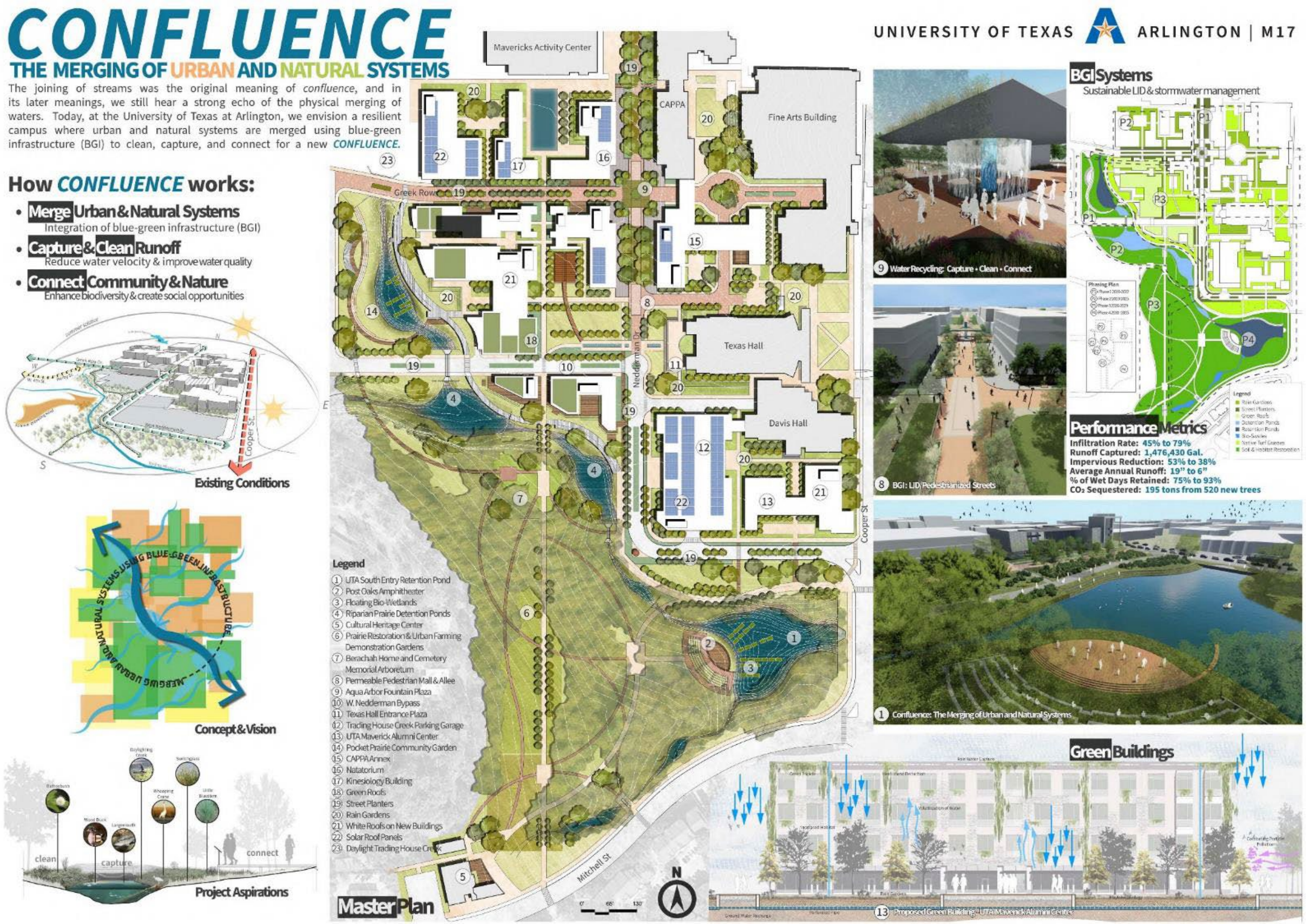
"*CONFLUENCE*"

Student Team;
Melissa Lemuz
Angeles Margarida
Monte McMahen
Luiz Rojo
Michael Webb

This project is part of UNESCO's SDG Local Project Archive - http://localprojectchallenge.org/

Master Plan Ctg.

SUBMISSION BOARD 2019-20



Prj.III

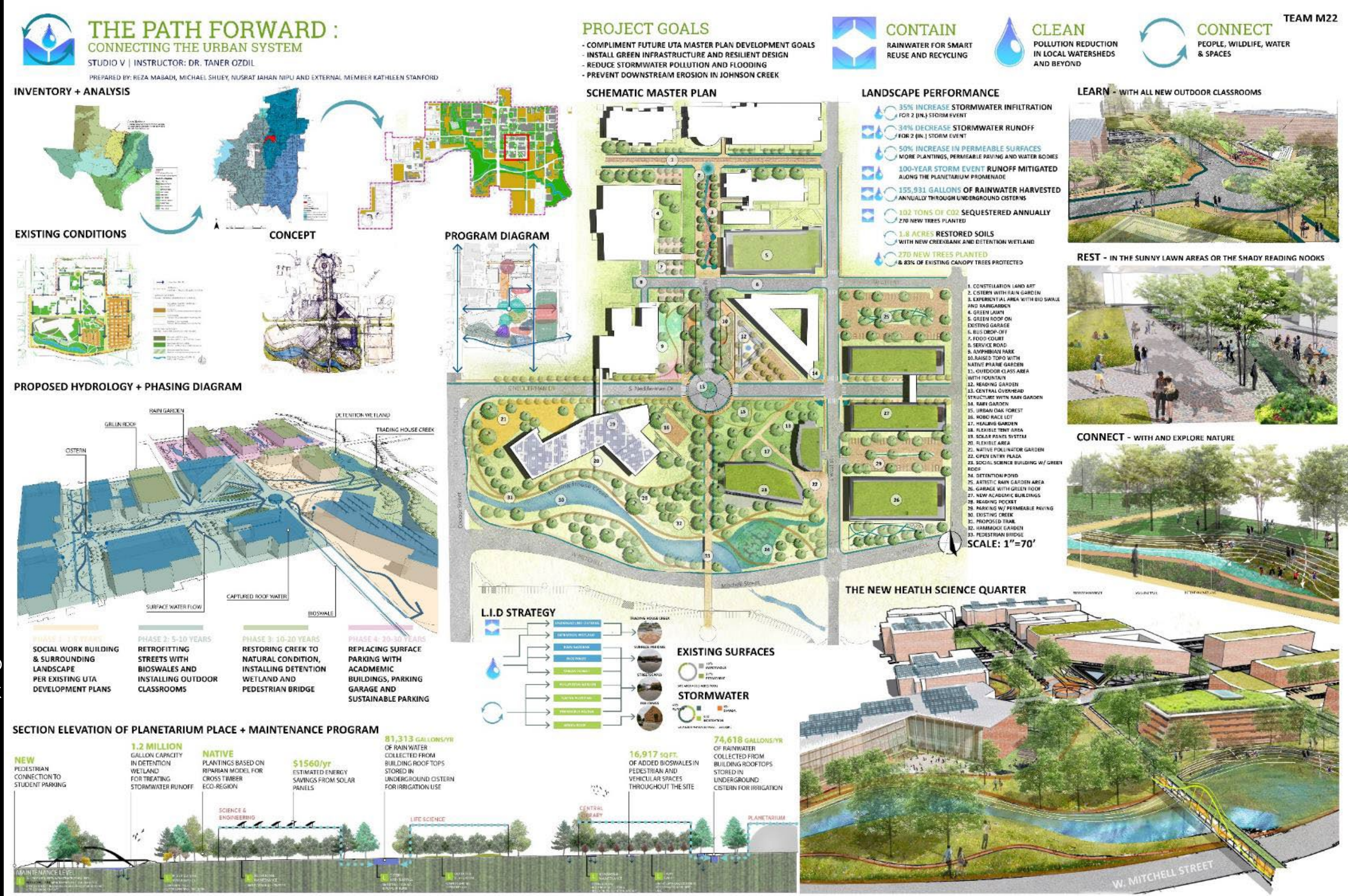
“ THE PATH FORWARD”

Student Team;
Michael Shuey,
Nusrat Jahan Nipu,
Reza Mabadi,
Kathleen Stanford

First Place
Master Plan Ctg.

Video-1 Path
https://www.youtube.com/watch?v=iUgd1lE-m-k

SUBMISSION
BOARD 2020-21

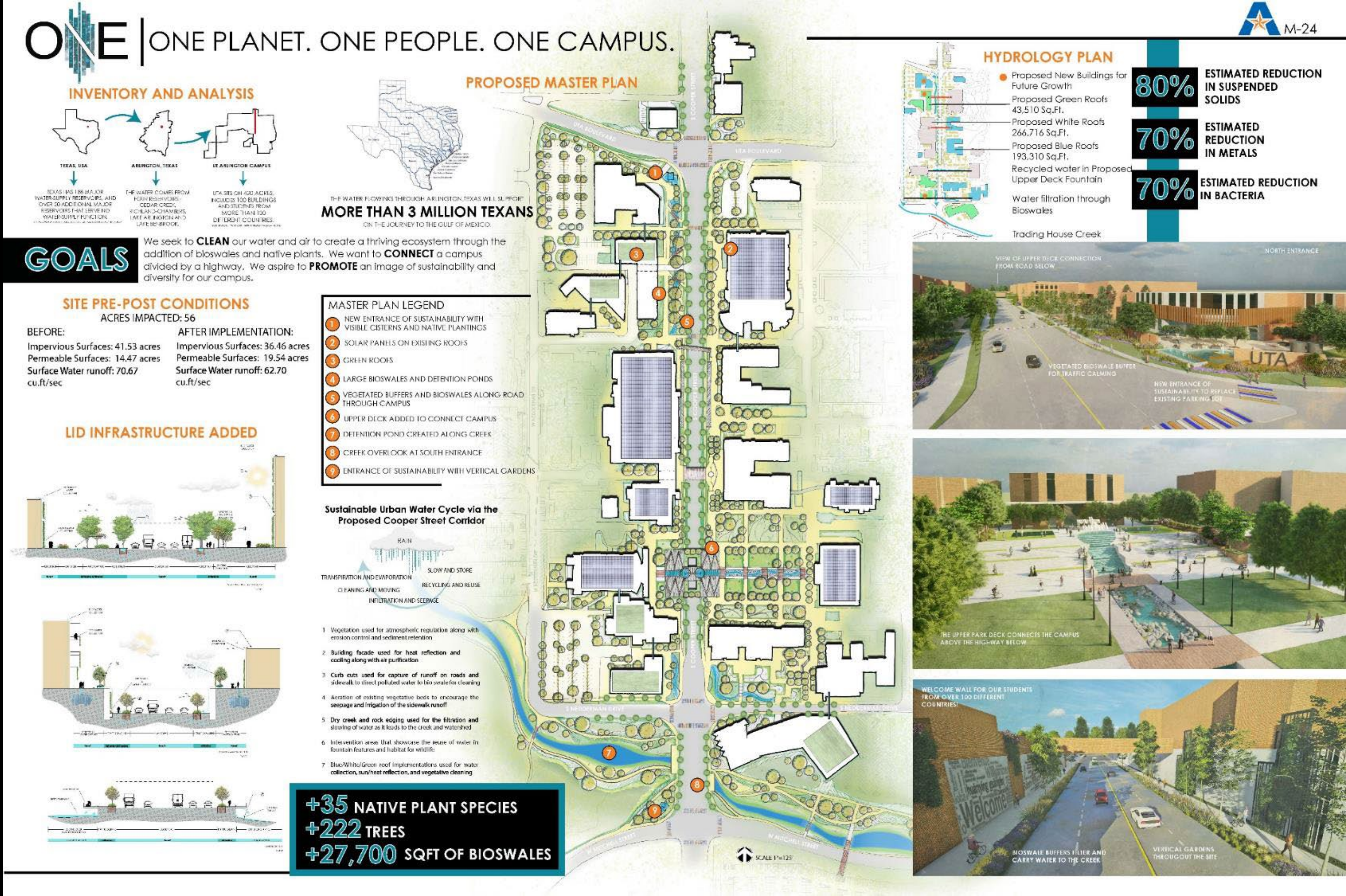


"*ONE*"

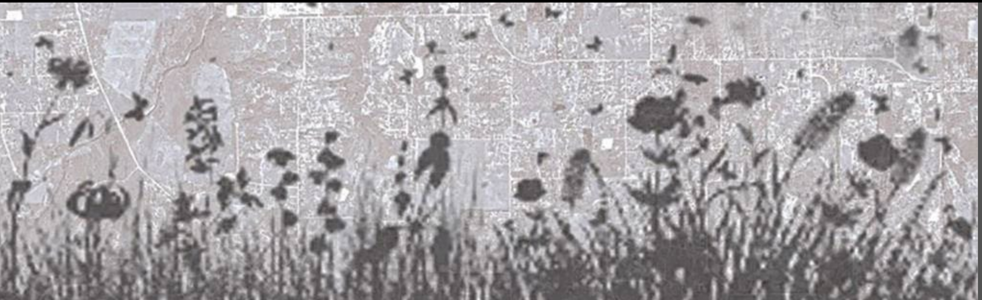
Student Team; Anjelyque Easley, Bonnie Blocker, Nikki Simonini

Honorable Mention Master Plan Ctg.

Video-2 One https://www.youtube.com/watch?v=OzdL6lU2KVg



SUBMISSION BOARD 2020-21



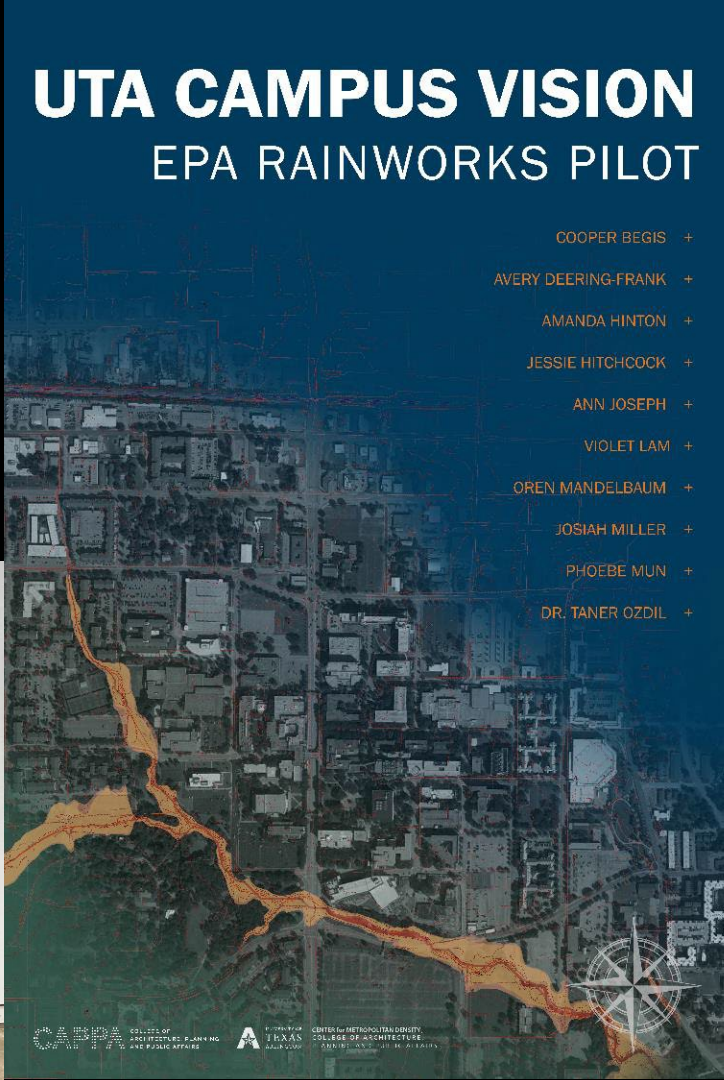
UTA CAMPUS, 2022-23

Project Exhibit, & Pil

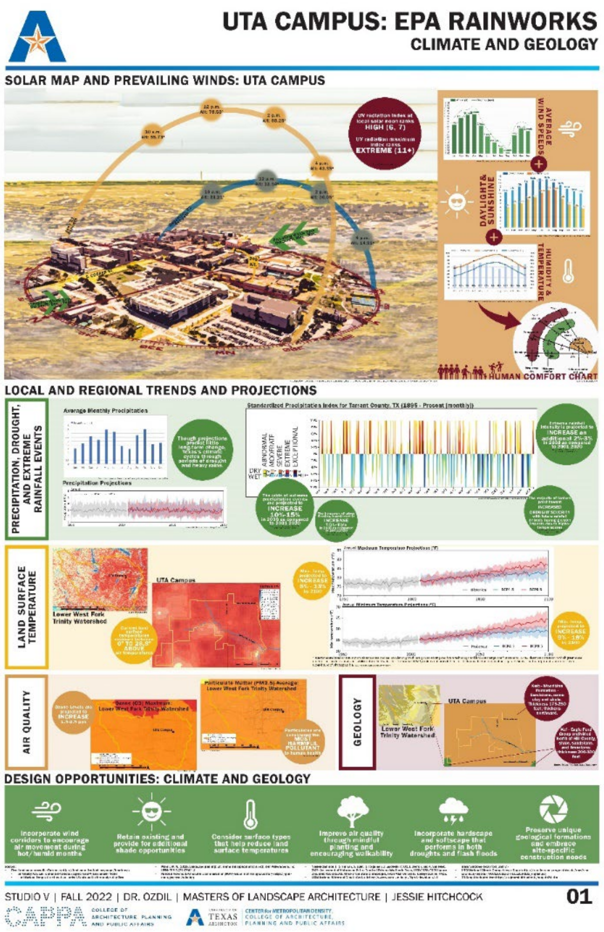
PROJECT, EXHIBIT, & PILOT

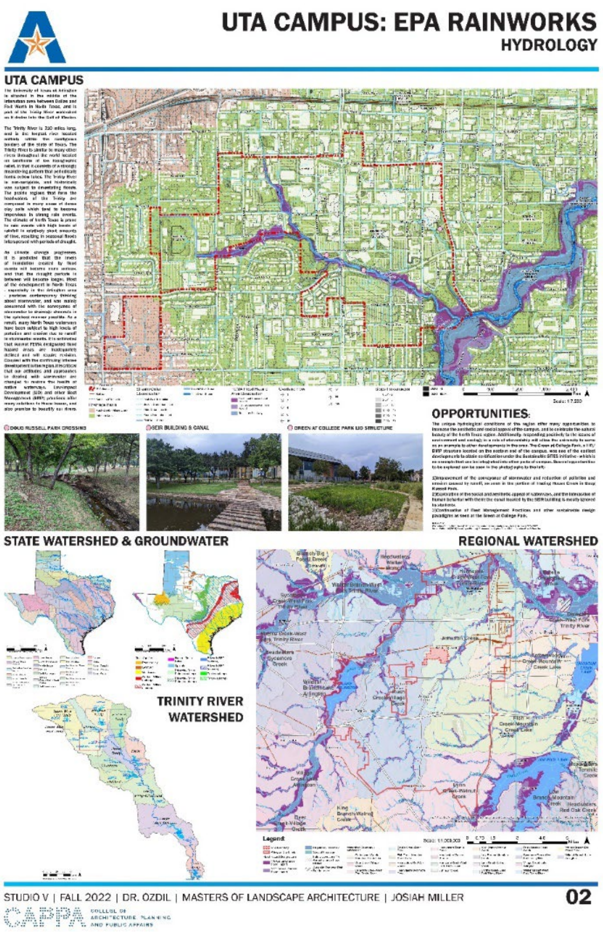
- *There was no competition to go after in 2022 but our desire to change the world one project at a time as a Landscape Architecture Studio has not changed!*

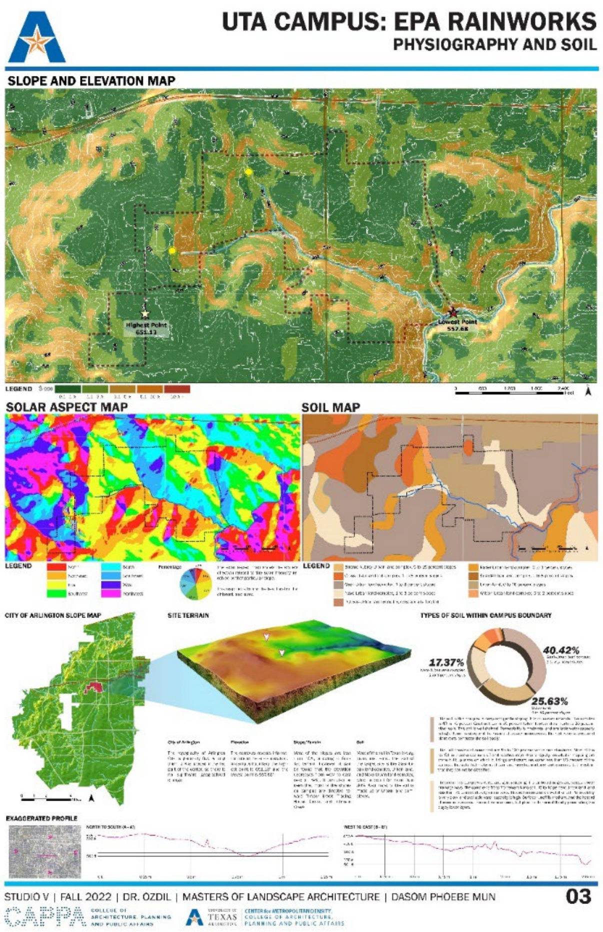
- The project & the exhibit showcased UTA campus visions for four separate sites instructed parallel with the Pilot. Selected sites respond to Trading House Creek.



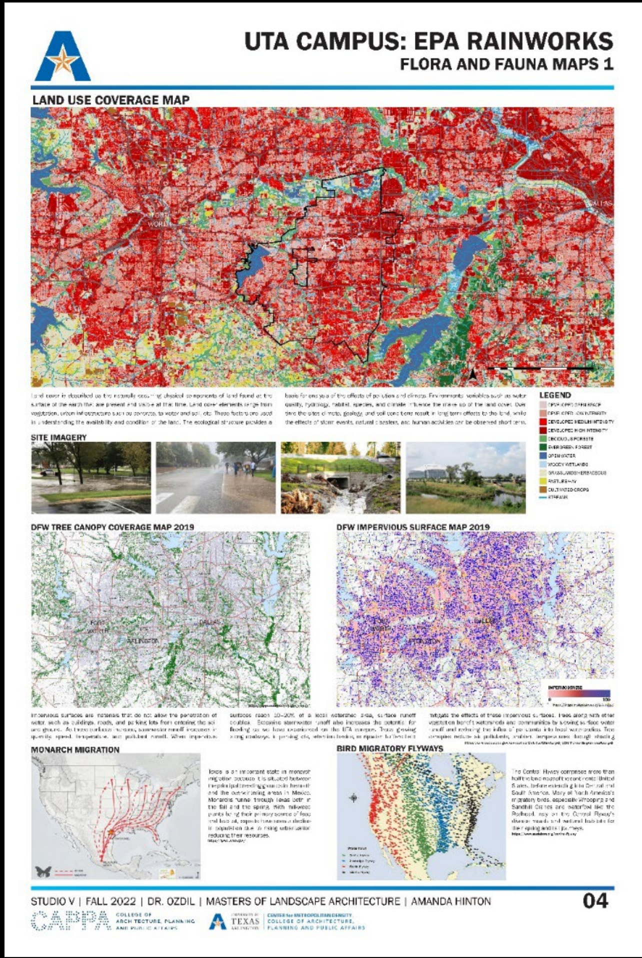
UTA CAMPUS, 2022
Inventory & Analys

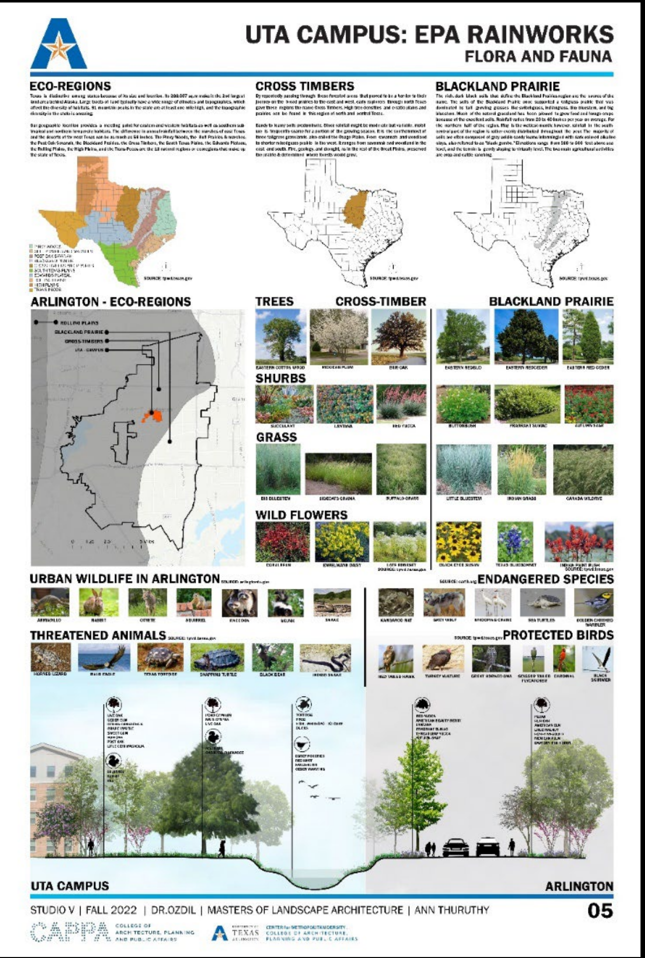




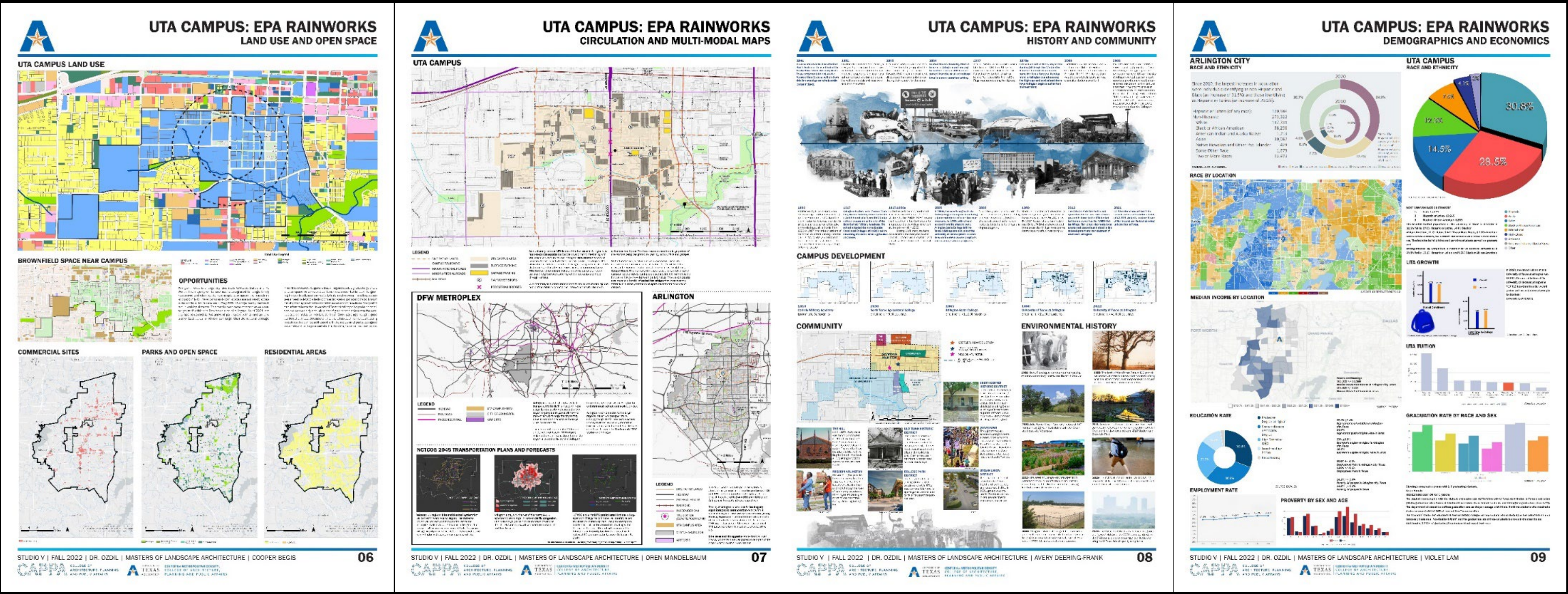


Student Team : Jessie Hitchcock, Josiah Miller, Dasom Phoebe Mun





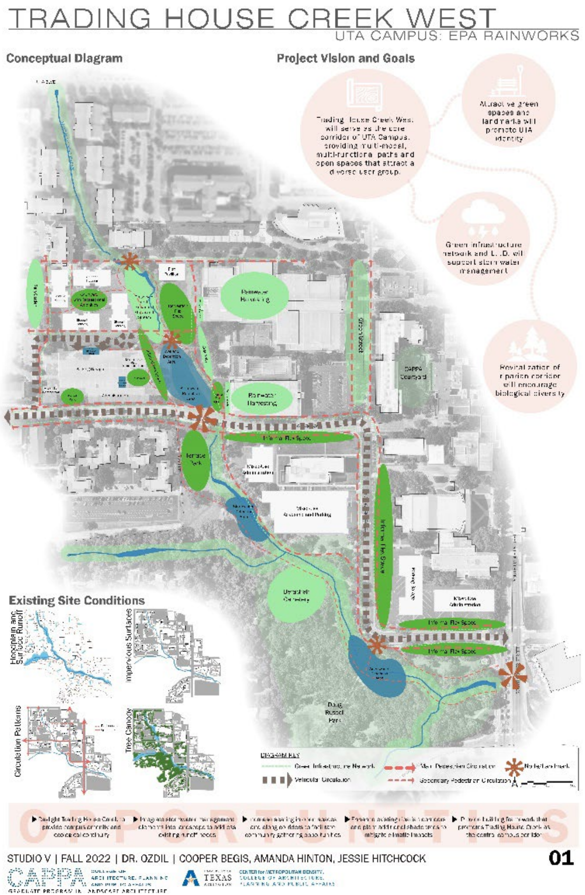
Student Team : Amanda Hinton, Ann Thuruthy

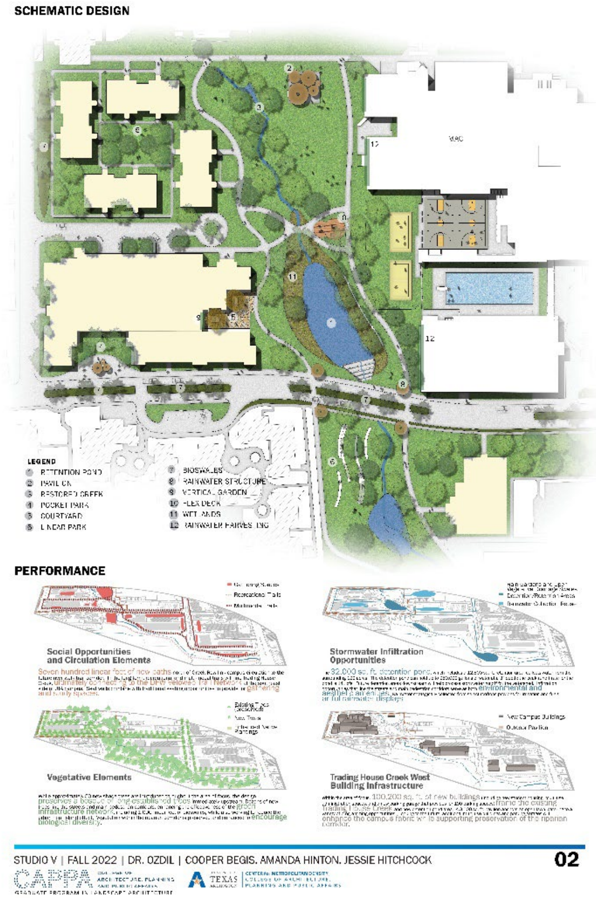


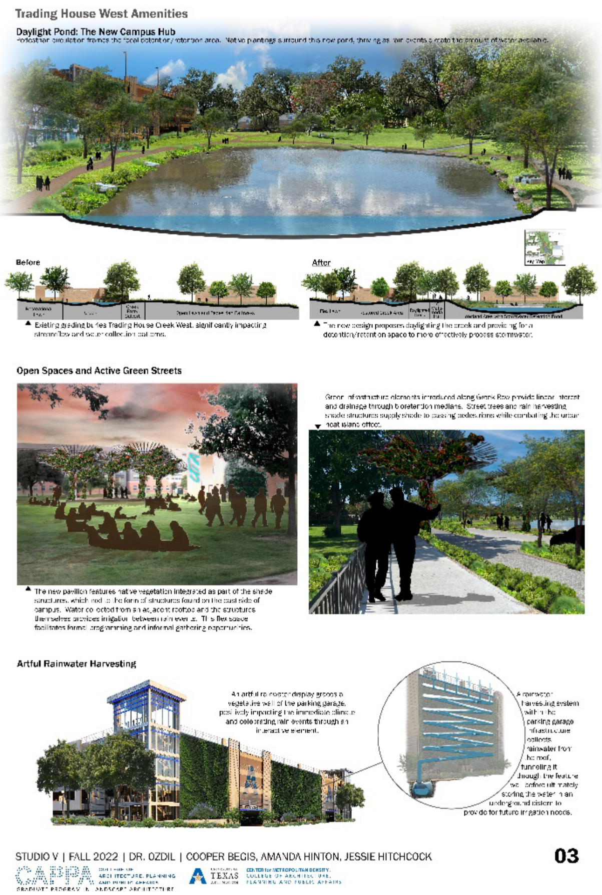
Student Team : Cooper Begis, Oren Mandelbaum, Avery Deering-Frank, Violet Lam

UTA CAMPUS VISIO

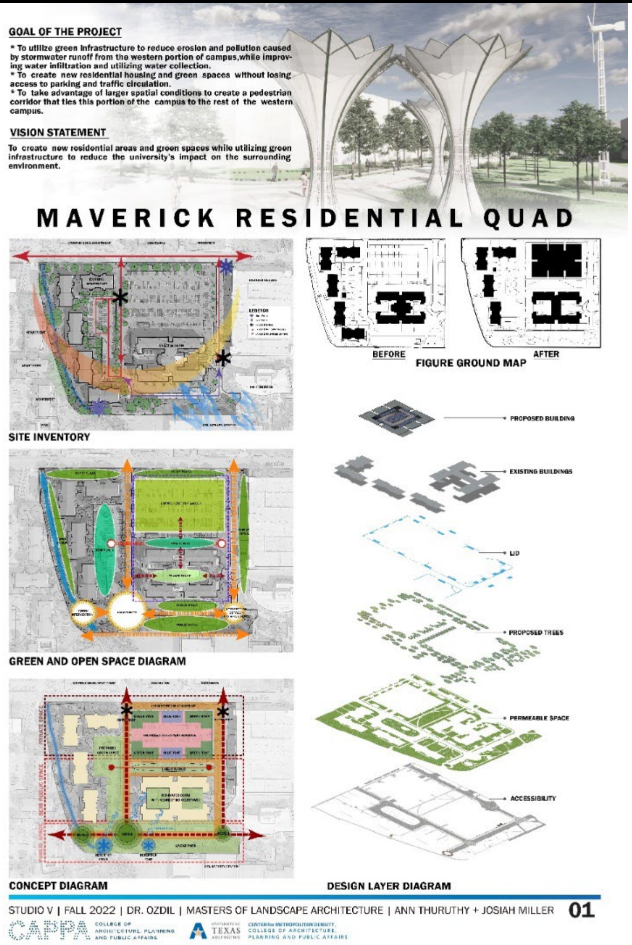
2022-23

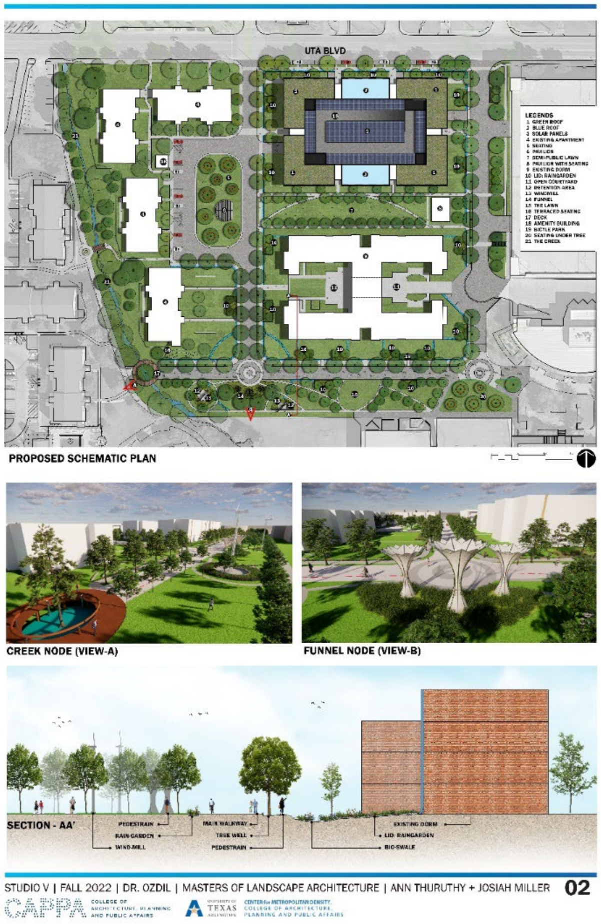


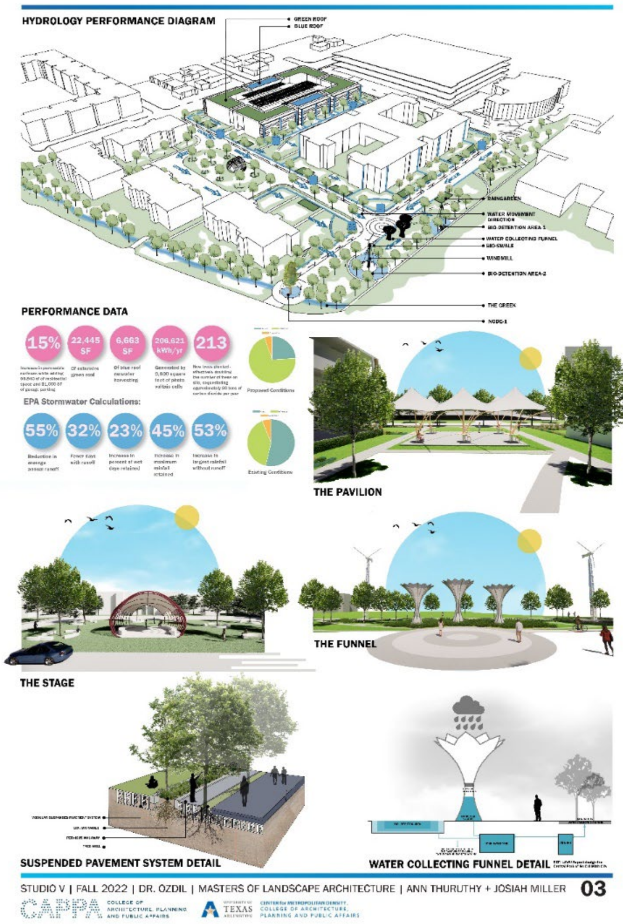




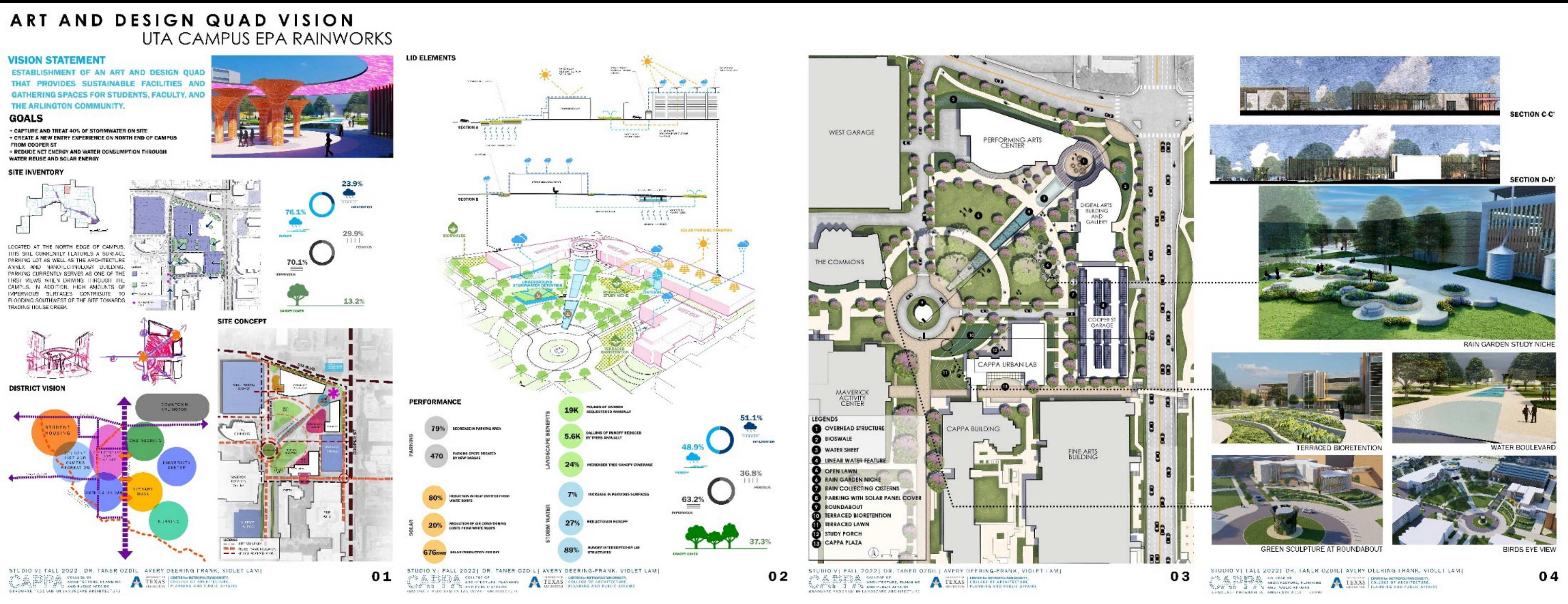
Student Team: Cooper Begis, Amanda Hinton, Jessie Hitchcock



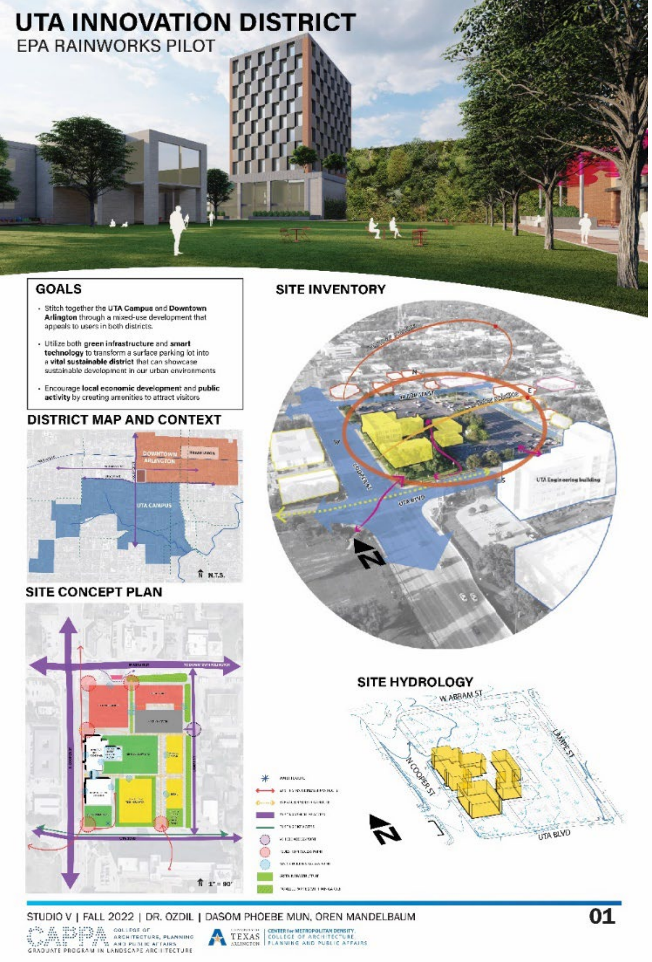


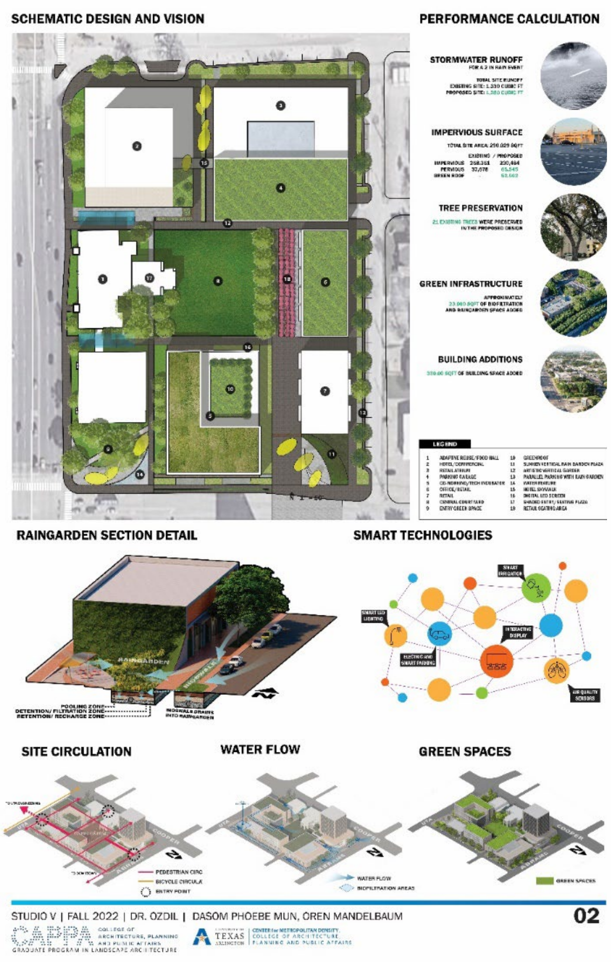


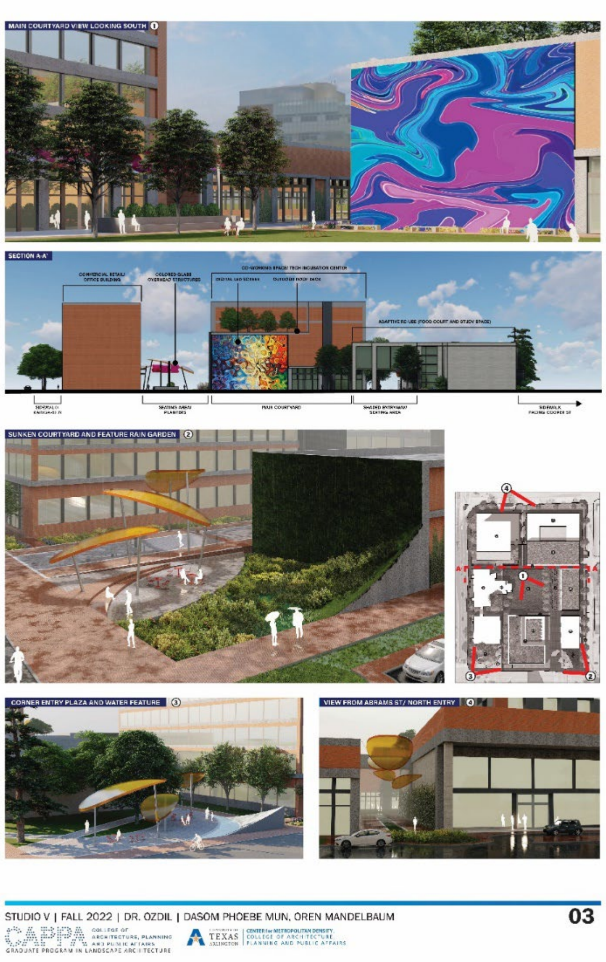
Student Team: Ann Thuruthy, Josiah Miller



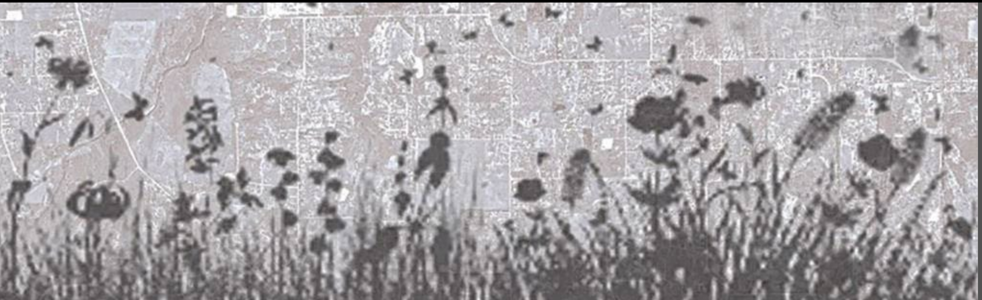
Student Team: Avery Deering Frank, Violet Lam







Student Team: Dasom Phoebe, Oren Mandelbaum



UTA CAMPUS, 2022-23
Pilot & The Charet

PILOT: CRW Technical Assistance

- Direct assistance to two campuses: University of Texas Arlington (UTA) and Morgan State University (MSU)
  - Brainstorming sessions with core team
  - One day design charrette
  - Final report
  - Create a resource to share with campuses nationwide
- Engage extensively with facilities staff to understand opportunities and barriers for green infrastructure implementation.

EPA CAMPUS RAINWORKS CHALLENGE UTA THE UNIVERSITY OF TEXAS AT ARLINGTON

PILOT TEAM

Funded By

- **U.S. EPA -** Clark Wilson, Office of Wasterwater Management

UTA Core Team & Presenters

- **Taner R. Ozdil**, Center for Metropolitan Density (CfMD), & Landscape Architecture, CAPPA
- **Jeff Johnson, Don Lange, John Hall,** & (Bill Poole) UTA Facilities
- **Meghna Tare**, UTA Office of Sustainability
- **Lyndsay Mitchell, Gincy Thoppil, Patricia Sinel,** The City of Arlington

UTA Student Representatives:

- **Hanan Boukhaima**, Ph.D. Student in Public Affairs and Planning, CAPPA
- **Oren Daniel Mandelbaum**, Master Student in Landscape Architecture, SASLA,

Consulting Team

- **Lot Locher**, One Architecture & Urbanism
- **Justine Shapiro-Kline**, One Architecture & Urbanism
- **Joyce Coffee**, Climate Resilience Consulting
- **Christopher Riale**, Sherwood Design Engineers
- **Rachel Still**, Sherwood Design Engineers

Thank you: Matt King (EPA), Susanna Perea (EPA Region 6), Doug Breuer
Mark Meyer & Jim Manskey (TBG Partners) Catherine Soto (UTA), Joowon Im (UTA),
Ann Thuruthy & Angelica Villalobos (UTA GRAs)

GI & CAMPUS PLANNING

One Architecture & Urbanism

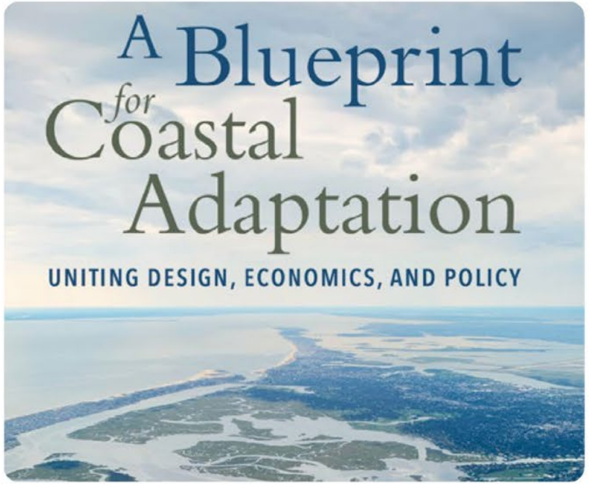
New York & Amsterdam

Sherwood Design Engineers

San Francisco, New York & Atlanta

Climate Resilience Consulting

Chicago



OBJECTIVES

RainWorks Objectives:

- **Explore current needs and opportunities** to advance blue-green infrastructure, climate resilient design and implementation,
- **Explore environmental, economic, and social benefits** of green-blue infrastructure for the campus, community, and watershed,
- **Foster communication** between key campus, city, and metropolitan area community and stakeholders,

UTA Objectives:

- **Establish a framework**, goals, and objectives to guide upcoming campus planning and design efforts,
- **Build consensus** among campus, city, and community stakeholders
- **Establish priorities and direction for future BGI** research and campus projects
- Identify opportunities
- **Showcase campus leadership and student work on BGI**, **Equip UT Arlington as Urban Lab**.
  - 10-year worth of our campus designs &
  - 2023 Studio Project and Exhibit (run parallel with the pilot)

GI & CAMPUS PLANNING

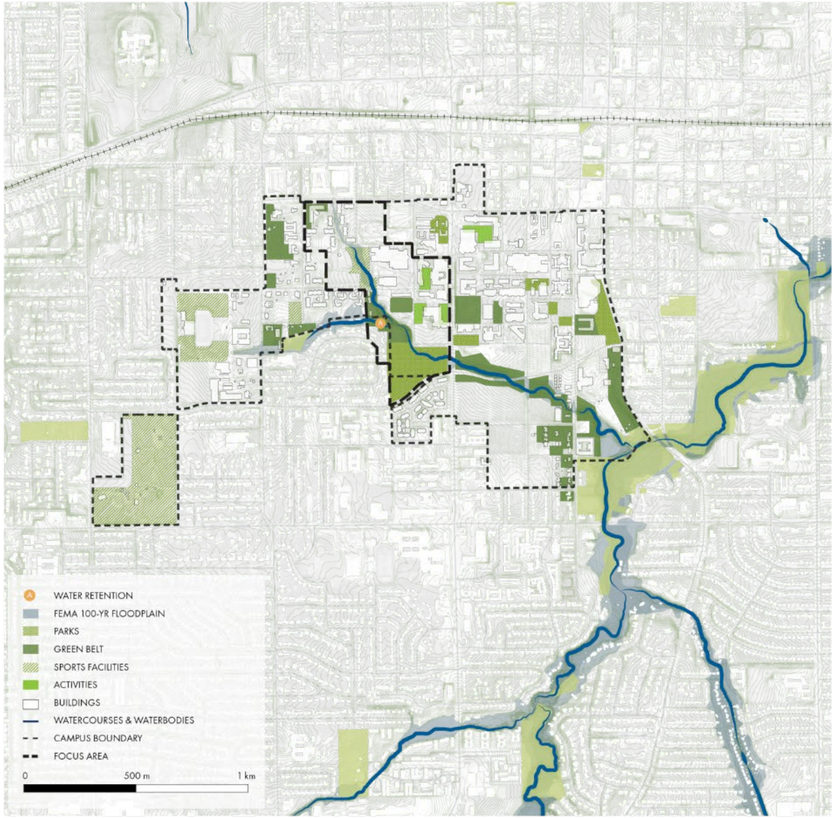
Unique Considerations for Campus GI Planning?

Scale — integrate buildings, landscape, and infrastructure strategies; engage systems thinking and watershed planning

Users — plan for and with staff, faculty, students + local residents

Context — align with campus master plans and capital planning cycles

Impact — advance research through pilots and project implementation; lead by example



CHARETTE:

- Creating focus: carving out time and space to focus on green infrastructure
- Making concrete: design tools and practices help synthesize diverse inputs and visualizations make ideas spatial and tangible
- Advancing collaboration: bringing together a range of campus, community, and governmental participants who don't interact regularly
- Building momentum: taking Campus RainWorks competition proposals one step farther

DESIGN & FACILITATION

AGENDA:

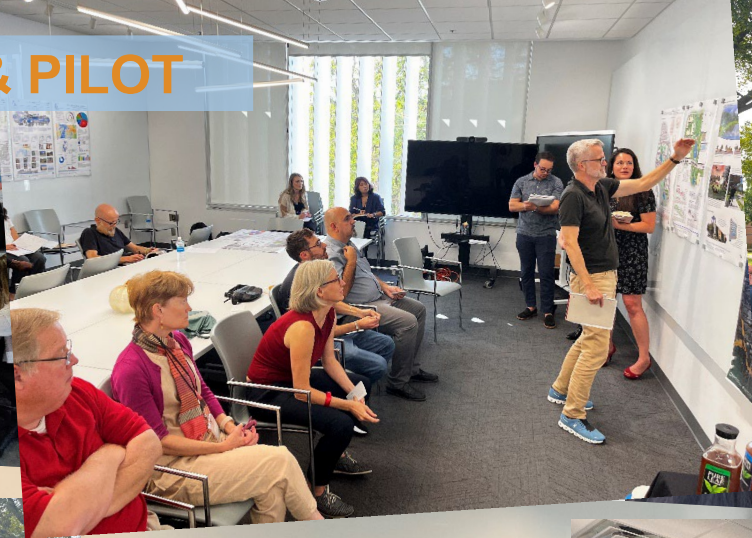
Friday, October 7, 2022 | on campus

- 08:30 Welcome
- 09:00 Introduce charrette agenda & goals
- 09:10 Campus context & initiatives
- 10:10 Campus tour
- 11:10 Breakout: challenges, opportunities & principles →
- 11:50 Report back ←
- 12:15 *Lunch break*
- 12:45 Breakout: objectives & design strategies →
- 02:15 Presentations ←
- 03:00 Takeaways & implications
- 03:20 Closing remarks & adjourn

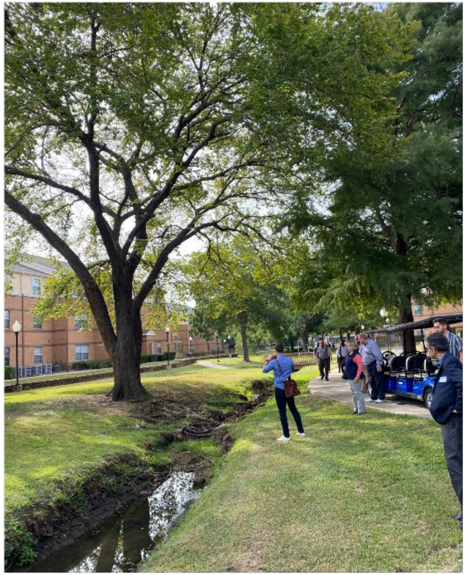
Breakout topics:

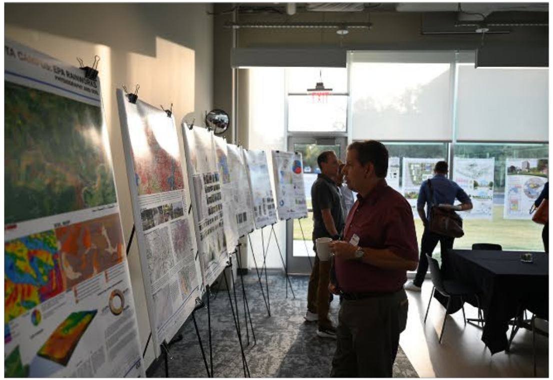
1. Healthy water, healthy creek
2. Climate resiliency on campus
3. Connecting communities
4. Trails for people and nature

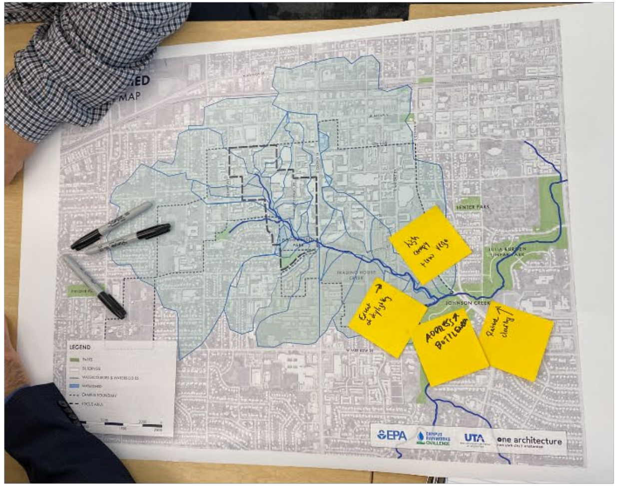
PROJECT, EXHIBIT, & PILOT





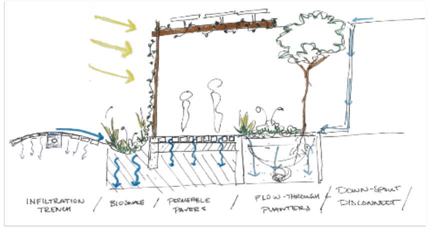


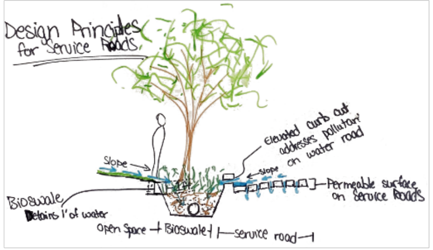

LEGEND
EPA
UTA
one architecture


EXIT

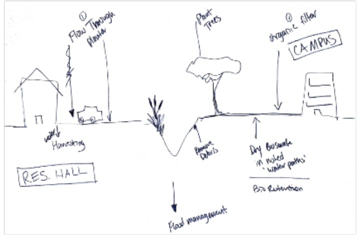
CHARRETTE OUTCOMES

GREEK ROW CONCEPTS

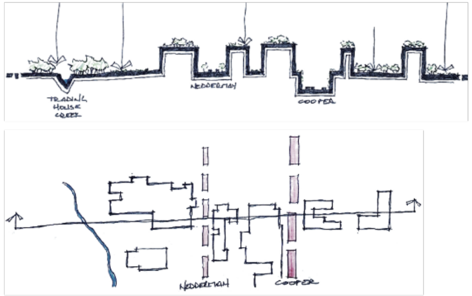




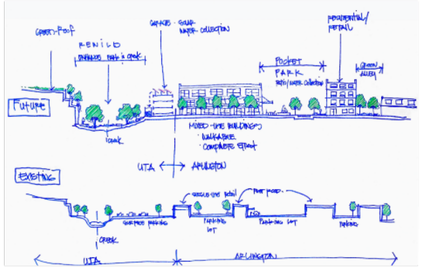
RESIDENTIAL TRANSECT



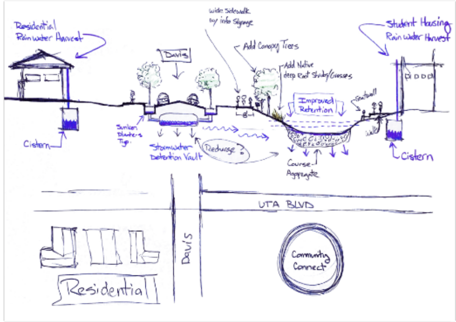
CAMPUS TRANSECT



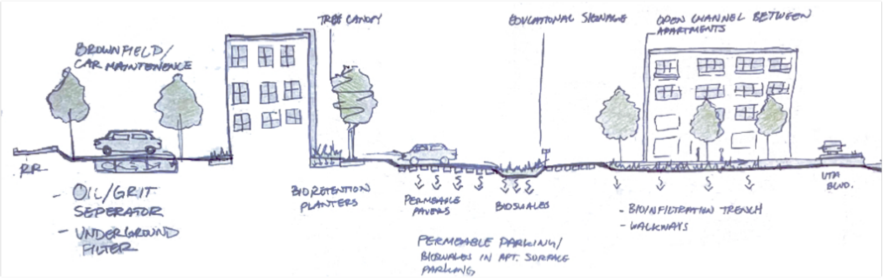
COOPER ST TRANSECT



UTA BLVD TRANSECT

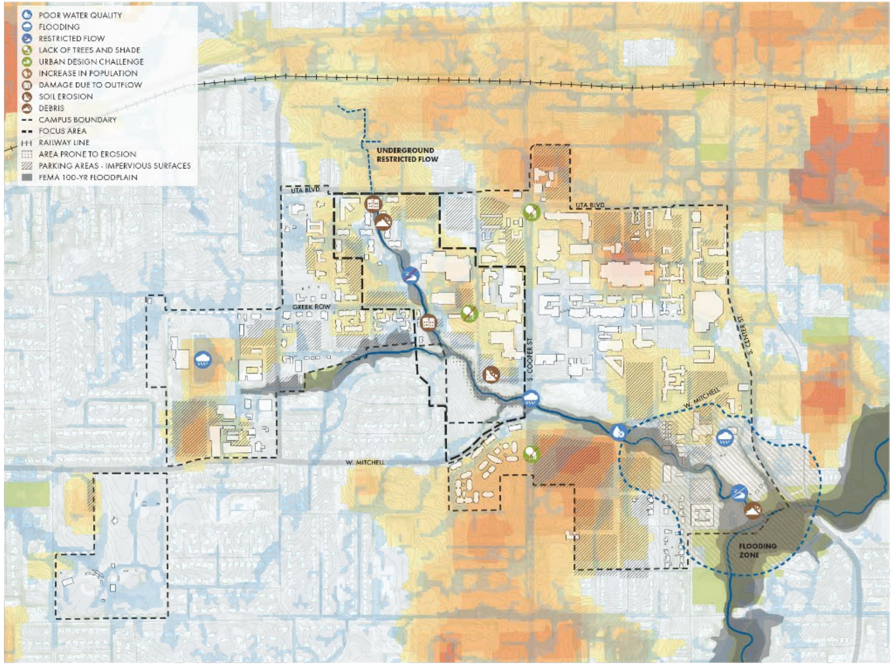


BROWNFIELD TRANSECT

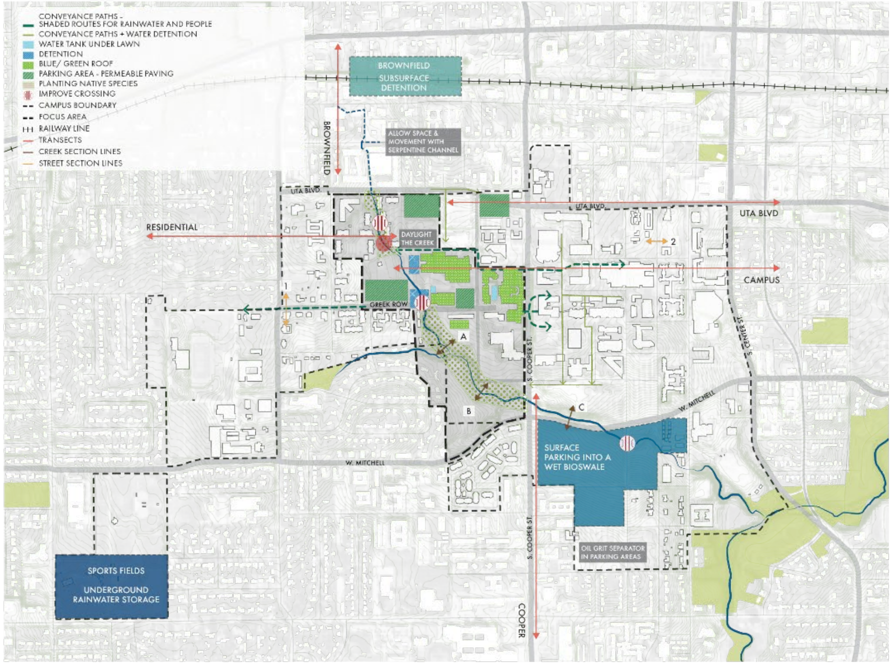


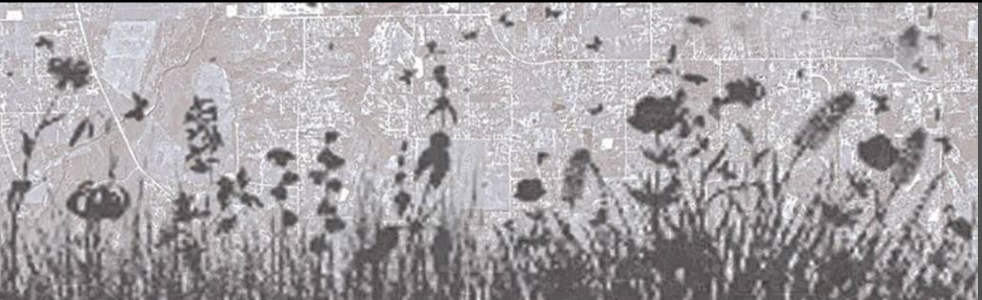
CHARRETTE OUTCOMES

SYNTHESIS OF CHALLENGES



SYNTHESIS OF OPPORTUNITIES





UTA CAMPUS, 2022-23

THE REPOR

UTA GI REPORT

1. Introduction
2. Existing campus & community conditions
3. RainWorks charrette
4. Strategic green infrastructure framework
5. Green infrastructure measures & considerations
6. Campus design & planning opportunities for green infrastructure
7. Next steps: pilots, funding, implementation & maintenance
8. Appendix

EXISTING CAMPUS CONDITIONS

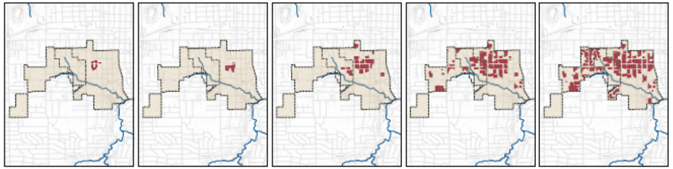
This chapter provides an overview of UTA campus ecological and geological systems, which inform the behavior of water, current stormwater management practices, potential for green infrastructure, and anticipated impacts of climate change. It briefly looks at the community conditions, campus surroundings, and the City of Arlington's characteristics to understand the relationship between the university and the wider context. It also summarizes UTA's past submissions to the Campus RainWorks programs.

COMMUNITY & CAMPUS OVERVIEW

The City of Arlington is located between the cities of Fort Worth and Dallas. It forms a major part of the rapidly-growing metropolitan area, with nearly 400,000 residents living across its almost 100-square-mile area. It has expanded hand-in-hand with the university in the decades since World War II.

The University of Texas at Arlington is a public research university founded in 1895 which has occupied its current campus in the southern edge of downtown Arlington since its founding. The university traces its roots back to Arlington College, which was established in September 1895 and became a public junior vocational college called Arlington State College (ASC) in 1949. Previously part of the Texas A&M University system, it joined the University of Texas system in 1965 to accommodate the expansion and development of the existing campus. As of Fall 2021, Arlington campus enrollment consisted of 45,949 students. Its 420-acre main campus is within walking distance of Downtown Arlington, including Arlington City Hall, Arlington Public Library (Main), Theatre Arlington, and numerous businesses, around which the City of Arlington has expanded over time.

Below the campus sits the Barnett shale formation, a major natural gas production site. Trading House Creek, a tributary of the Trinity River, runs along the southern portion of the campus. The campus sits within the Trading House Creek watershed , the Johnson Creek watershed, Lower West Fork Trinity River Watershed, and the Trinity River watershed. The green areas of the campus significantly increased in the last twenty years with the creation of Greene Research Quad, the five-acre Green at College Park, a sunken courtyard at Davis Hall, Brazos Park, and the Davis Street west campus edge.



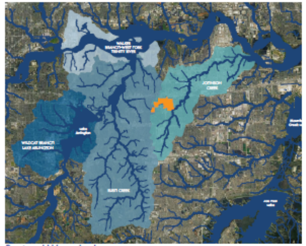
1910
Carlisle Military Academy
Enrollment: 32 Students
1910 Sanborn Fire Insurance Map of Arlington, TX

1930
North Texas Agricultural College
Enrollment: 900 Students
University of North Texas Libraries, Portal to Texas History

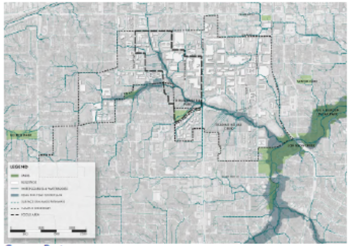
1965
Arlington State College
Enrollment: ≈ 11,000 Students
UT Arlington Digital Libraries

1990
University of Texas at Arlington
Enrollment: ≈20,000 Students
University of North Texas Libraries, Portal to Texas History

2021
University of Texas at Arlington
Enrollment: ≈41,000 Students
University of Texas at Arlington



Regional Watersheds



Campus Drainage

ENVIRONMENTAL CONTEXT

A **watershed** (also called drainage basin, drainage area, catchment area) is: an area of land within which all surficial stormwater drains to a common point.

GIS uses the raster of the **Digital Elevation Model (DEM)** to detect the differences in relative elevation between each cell of the raster, and formulates vectors that show how surface water conveys on the land based on elevations in the topography, known as surface drainage flow paths.

Delineated watersheds and stormwater pipe networks are typically highly correlated, since subsurface networks generally leverage gravity to convey water (instead of pumps).

opposite:
UT Arlington campus growth, 1910 - 2001 (Source: UTA student work)

above:
UT Arlington watershed context and drainage pathways (Source: Sherwood)

Any discussion of green infrastructure planning must utilize an understanding of environmental conditions and natural systems. Green infrastructure harnesses plant and soil systems and conditions. Understanding environmental conditions is critical to optimize the efficacy of green infrastructure in terms of placement and size, for example, giving consideration to climatic conditions, soil characteristics, and location in the watershed, among other criteria.

Watersheds
Contextual knowledge of watersheds and drainage flow paths is critical to understand how water conveys through an area, how much water is reaching a given point on campus, and where pollutants might be expected to accumulate. A watershed (also known as a drainage basin, drainage area, or catchment) is an area of land where all surface runoff generated within that area drains to one common point. Watersheds can exist on a variety of scales and depend on which common point is selected for analysis. For example, a location in the northwest corner of the campus can be located in a campus-scale watershed and simultaneously the Trading House Creek watershed, the Johnson Creek watershed, the Lower West Fork Trinity River Watershed, and the Trinity River watershed. For the purposes of this analysis, watershed analysis was restricted to campus-scale watersheds.

To understand campus-scale watersheds at UTA and their associated drainage patterns, drainage paths of surface runoff and watersheds were generated with GIS based on a Digital Elevation Model (DEM) obtained from the United States Geological Service's online database, originally generated via LIDAR Satellite data. Delineated watersheds are derived from the topographical patterns of the ground that are represented in the DEM, and not the subsurface stormwater pipe network. Watersheds for pipe networks often align as stormwater pipe networks usually rely on gravity to convey water.

UTA is composed of 36 campus-scale watersheds that all drain to Trading House Creek. Generally, most stormwater that falls within these watersheds is intercepted by storm pipes and drains to the Creek at point-source outfalls. These pipe interceptions ultimately still convey water to the Creek, but concentrate the points at which stormwater drains so that the amount of water reaching the Creek at any one time is significantly increased, exacerbating water velocity issues and bank erosion. Stormwater within these watersheds is additionally not treated of pollutants before reaching the Trading House Creek system, disrupting water quality for downstream communities and wildlife.

Built Environment & Impervious Area
An impervious surface is any material that prevents or significantly hinders the infiltration of water into soil below. Impervious surfaces include asphalt and concrete and are commonly found as roads,

GREEN INFRASTRUCTURE MATRIX

	ECOLOGICAL CONSIDERATIONS		ECONOMIC CONSIDERATIONS		COMMUNITY CONSIDERATIONS				
MEASURE NAME	Location in Watershed	Ecological Co-Benefits	Relative Initial Cost	Relative Maintenance Cost	Integration with Neighborhoods	Environmental Stewardship	Aesthetic Value & Placemaking Potential	Permitting / Coordination Complexity	Benefit to MS4 Compliance
	Upper, Middle, Lower	Low, Medium, High	$ / $$ / $$$	$ / $$ / $$$	Low, Medium, High	Low, Medium, High	Low, Medium, High	Low, Medium, High	Low, Medium, High
Green Roofs	All	Medium	$$$	$$$	Medium	Medium	High	Medium	Medium
Rainwater Harvesting	All	Low	$$	$	Medium	High	Medium	Medium	Medium
Oil Grit Separator	All	Low	$	$$	Medium	Medium	Low	Medium	Low
Downspout Disconnect	All	Low	$	$$	Medium	High	Low	Low	Low
Site Reforestation / Revegetation	All	High	$$$	$	High	High	High	Low	High
Infiltration Trench	Upper	Medium	$	$$	Low	Medium	Medium	Low	Low
Permeable Pavers / Surfaces	Upper	Medium	$$$	$$	Low	Low	High	Medium	Medium
Bioretention	Upper/Middle	High	$$$	$$	Medium	High	High	Medium	High
Flow-Through Planters / Landscape Infiltration	Upper/Middle	Medium	$$	$	Medium	Medium	High	Low	Medium
Dry Bioswales	Middle	Medium	$$$	$$	Medium	Medium	High	Medium	Medium
Wet Bioswales	Middle	Medium	$$$	$$	Medium	Medium	High	Medium	Medium
Dry Well	Upper/Middle	Medium	$$	$$	Low	Low	Low	Medium	Low
Organic Filter	Upper	Medium	$$	$$	Low	Medium	Low	Low	Low
Surface Sand Filters	Upper	Low	$$	$$	Low	Low	Low	Low	Medium
Dry Detention Pond	Lower	Medium	$	$$	Low	Medium	Medium	Medium	High
Extended Dry Detention Pond	Lower	Medium	$	$$	Low	High	Medium	Medium	High
Wet Pond	Lower	High	$	$$	Medium	High	Medium	High	High
Pocket Pond	Lower	Medium	$	$$	Low	Medium	Medium	Medium	Low
Underground Filter	Lower	Low	$$	$	Low	Low	Low	Medium	Medium
Flood Management Area	Lower	Low	$	$	Low	Medium	Medium	Medium	Low
Stormwater Wetland	Lower	High	$$	$	High	High	High	High	Medium
Pocket Stormwater Wetland	Lower	Medium	$$	$	Medium	High	Medium	Medium	Low
Stream Restoration	Lower	High	$$$	$	High	High	High	High	Low

Notes

Watershed location:
Based on the priorities listed for each portion of watershed. Upper Watershed: Infiltrate, Convey Downstream; Middle Watershed: Slow Water Flows through storage, Divert Flows from Problem Areas, Convey Downstream; Lower Watershed: Absorb and Store.

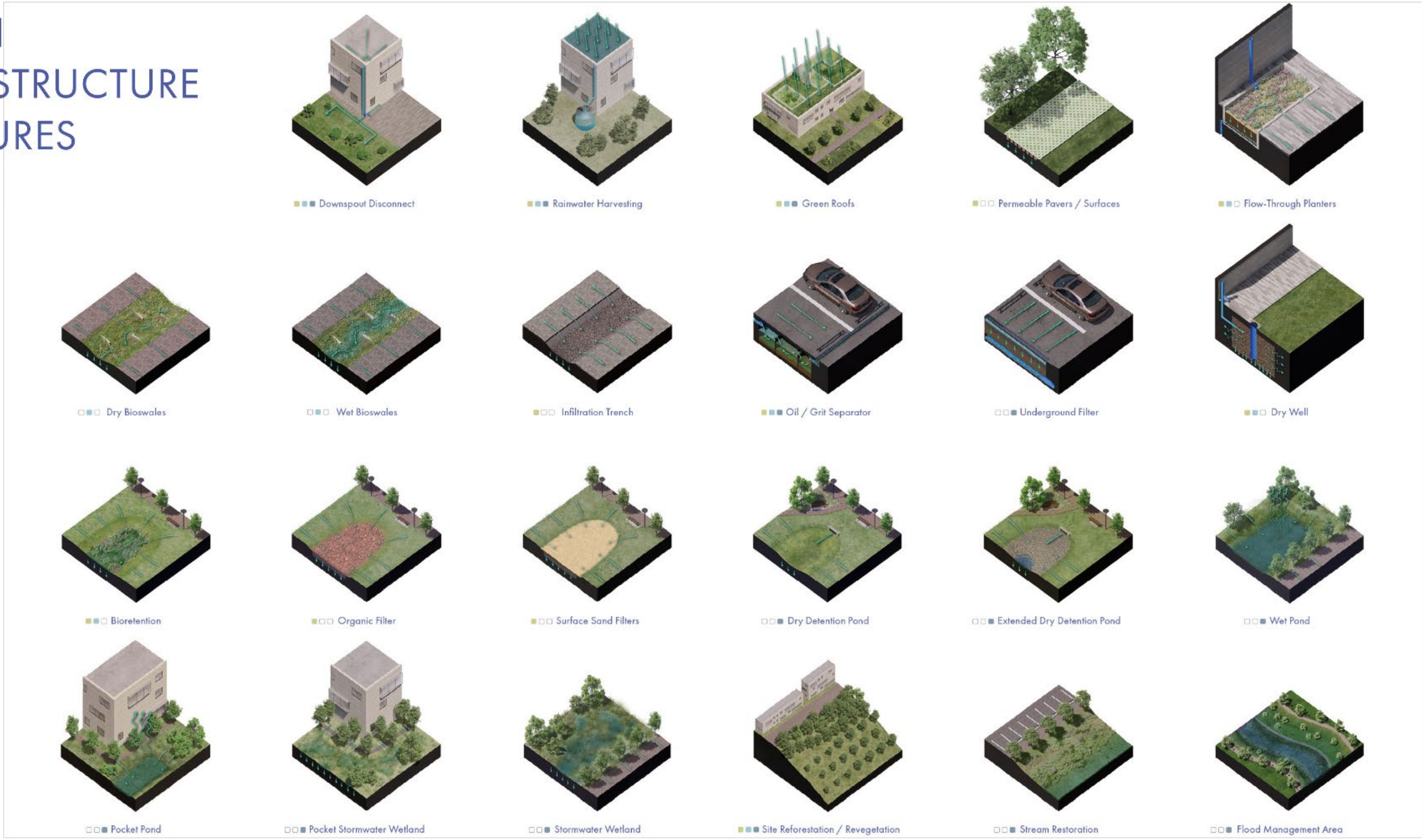
Ecological co-benefits:
Evaluation considers the ancillary benefits associated with the incorporation of Green Infrastructure on campus, including the provision of habitat within the Green Infrastructure and the mitigation of Urban Heat Island Effect through the decrease of impervious area or the increase of tree canopy.

Costs:
Due to the unavailability of data from the Integrated Stormwater Manual, costs were taken from Volume 2 of the Georgia Stormwater Management Manual (2016) and NOAA Guidance for Cost Estimations of Nature Based Solutions (2020). Costs are considered in terms of price per square foot (SF) that is treated by the measure.

Permitting:
Evaluation based on the degree to which the GI either reduces the amount of impervious area or treats the stormwater that generates from impervious area on campus.

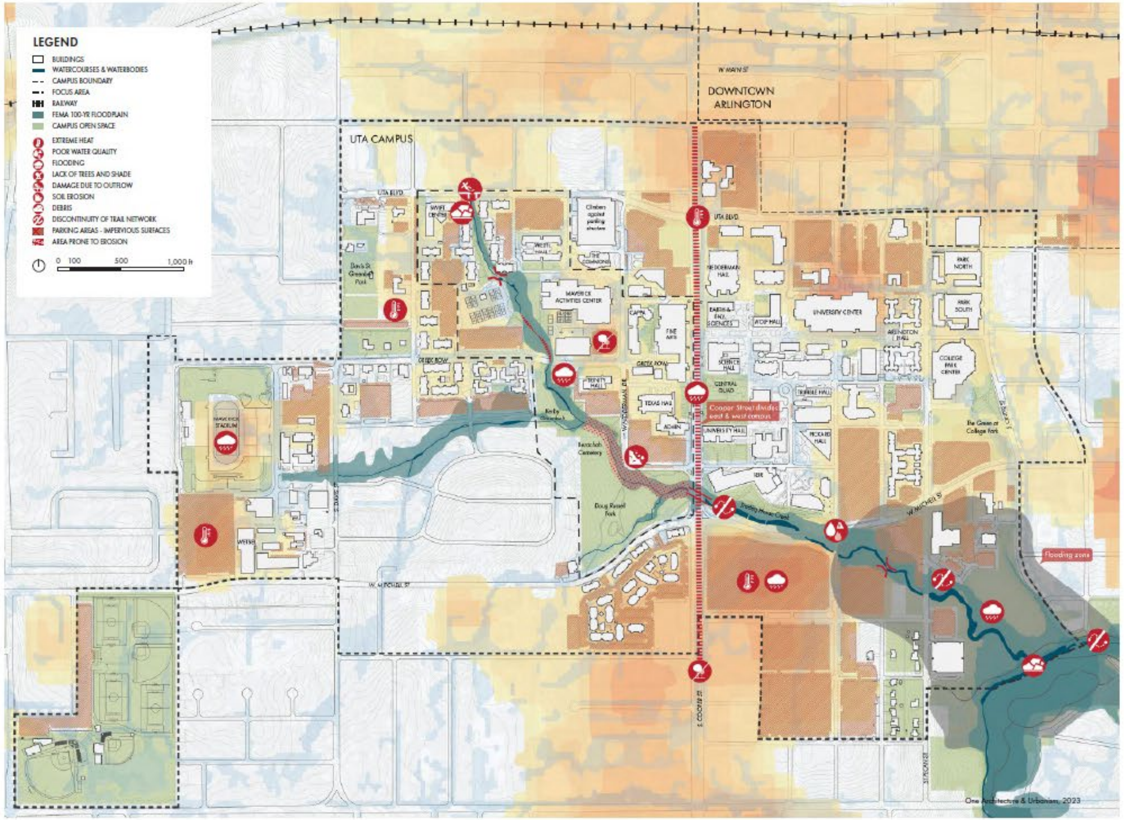
UTA GI REPORT: MESASURES

GREEN INFRASTRUCTURE MEASURES



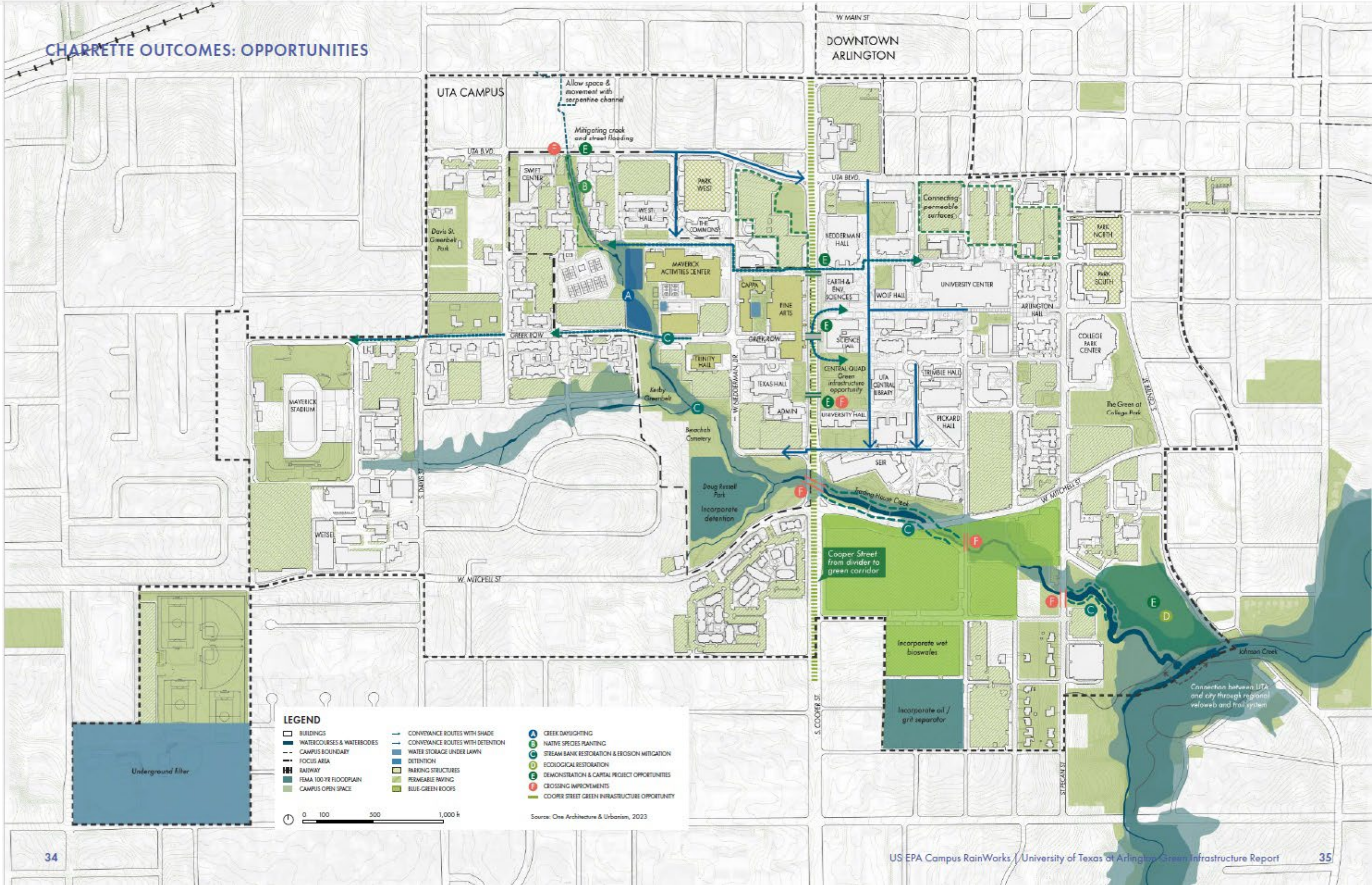
UTA GI REPORT: CHALLENGES

CHARRETTE OUTCOMES: CHALLENGES



Erosion along Trading House Creek (Source: ONE)

UTA GI REPORT: OPPORTUNITIES



VISION FRAMEWORK

A campus framework for designing, implementing, and maintaining green infrastructure for the greatest benefit requires an integrated understanding of the technical optimization of green infrastructure to capture and detain stormwater as well as the multiple benefits that the infrastructure provides to campus beyond stormwater management and heat mitigation. The framework must draw on and reference the existing environmental constraints and incorporate the opinions and needs of key campus stakeholders: UTA's staff, faculty, students, and visitors.

Watershed analyses are critical to properly locate and size green infrastructure measures and ensure their technical optimization. Individual measures have different intended designs that work in tandem to mimic the water cycle and range between infiltration of water into ground, conveyance of water throughout the watershed, and absorption/storage. These intended designs should be sited across the watershed based on what is naturally happening in the water cycle.

Location in the watershed generally dictates the sizing of green infrastructure interventions. As drainage pathways follow gravity and water seeks the lowest point, what begins as many small streams at the top of a watershed will continually combine and converge, picking up more water along the way until they reach one common study point. This phenomenon explains why watersheds are characteristically larger at the top and smaller at the bottom and results in areas of lower watersheds with larger volumes of water and correspondingly larger green infrastructure measures.

Understanding existing built context (buildings and roads) is also important to account for built impacts on drainage patterns. These in turn determine the prioritized design function, the size of the green infrastructure intervention, and help evaluate how much water is expected to reach the feature. In addition to technical optimization, green infrastructure should also be evaluated for its capacity to deliver co-benefits to the campus community.

Intended green infrastructure benefits should be agreed upon and prioritized by key stakeholders during a visioning process to ensure that future green infrastructure designs work in alignment with the desired outcomes. Discussing both the technical and non-technical implications of green infrastructure measures during visioning ensures that the greatest benefit is attained.

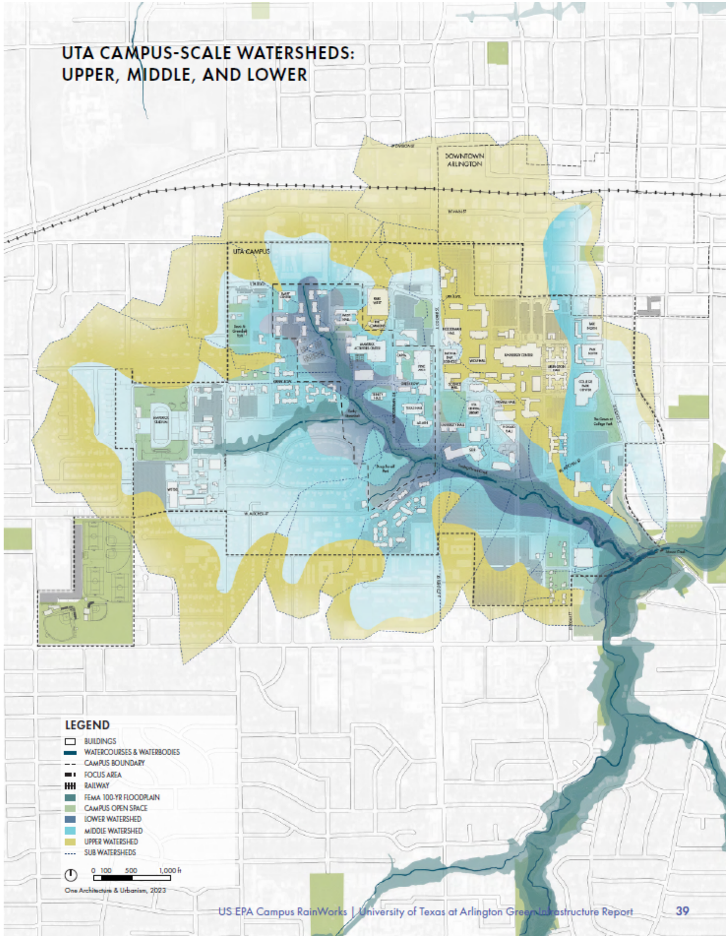
A watershed is typically organized into three portions, each with a distinct function and priorities:

Upper Watershed: Infiltrate
Infiltration of stormwater into the ground via green infrastructure can mitigate runoff in upper portions of the watershed and reduce the volume of runoff that reaches lower portions of the watershed. Conveying water to the lower portions of the watershed is an additional priority to mimic surface runoff.

Middle Watershed: Slow & Store
Middle watershed green infrastructure focuses on moving and slowing stormwater as it conveys toward inlets for existing gray stormwater infrastructure. These strategies include vegetated waterways, stormwater inlet optimization, and pockets of temporary storage (e.g. cisterns, bioretention areas with outlets). By slowing the rate at which stormwater reaches this gray infrastructure, stormwater can be more safely conveyed from the upper toward the lower watershed, while reducing the rate and frequency of overcapacity infrastructure.

Lower Watershed: Restore
Lower portions of watershed leverage restoration strategies to recreate natural drainage patterns as well as ecological patterns of the area to re-establish the storage capacity and flood-tolerant vegetation that once mitigated further flooding downstream. This is especially important at the confluence of waterways where there may be additional backups of water due to hydraulic interactions.

opposite:
UTA campus hydrology and conceptual map of upper, middle, and lower watersheds (Source: ONE / Sherwood)

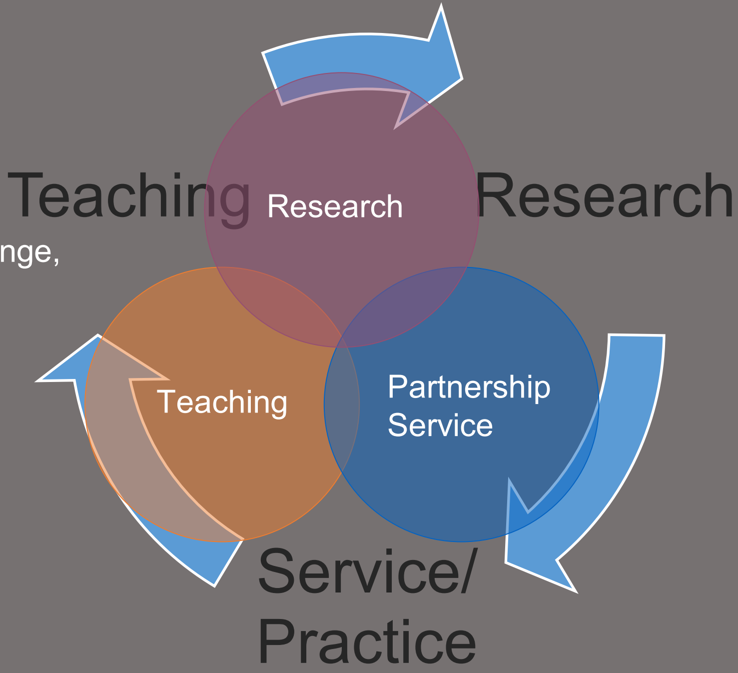


REFLECTIONS & OUTCOMES:

- **Researched, taught and exhibited work about GI/BGI and Climate Responsive Design**
- **Showcased campus leadership the research and student work on GI/BGI**
- **Explored current needs and opportunities**
- **Discussed environmental, economic, and social benefits** (landscape performance)
- **Fostered communication among stakeholders**
- **Built awareness for GI/BGI, Climate Responsive Design, and Campus Planning**
- **Educated** campus and community about the importance of **systems thinking** and acting sustainably so that we can use resources responsibly while improving the livelihood of present and future generations (Office of Sustainability).
- **Established a framework**, to guide upcoming campus planning efforts (**Master Plan & Climate Action Plan**),
- **Established priorities and direction for future GI/BGI**
- **Identified opportunities for collaboration and partnership (**looking for new ones)
- **Utilizing UTA as Urban Lab and Resource Center for the Region** in GI Research and Demonstration (UN SDG)

KNOWLEDGE CYCLE

Projects & Competitions:
Campus Rainworks Challenge,
Urban Landscape Projects



Knowledge:
Ongoing Research Projects:
LID, GI, Performance,
Landscape Performance

Partners:
Government, & Non-profit
Private Owner/Developer
Educational Institutions

QUESTIONS?

CONTACT

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- **UTA GI Report** can be accessed from https://rc.library.uta.edu/uta-ir/handle/10106/31708
- News Release: https://www.uta.edu/academics/schools-colleges/cappa/news-events/news/2023/09/13/uta-epa-greene-infrastructure

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THE UNIVERSITY OF TEXAS AT ARLINGTON

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