Integrated Stormwater Management (iSWM) Workshop: Multiple Perspectives on iSWM

March 3, 2025, 2:00 pm – 4:00 pm (Hybrid)

iSWM

North Central Texas Council of Governments
Environment & Development

1. Welcome and Introductions

Agenda: https://www.nctcog.org/getmedia/5ab2c3e0-0e23-4fc8-8a67-59e4988a156a/iSWM-Workshop-Spring-2025_Agenda.pdf?ext=.pdf.

Mic

Please mute your line

Chat

Please use the chat function to add your name and organization for attendance and ask questions

GREEN INFRASTRUCTURE (GI) RESEARCH AND COLLABORATIVE DESIGN STUDIO WORK

Workshop: Multiple Perspectives on Integrated Stormwater Management (iSWM), NCTCOG, 2025

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Associate Professor, Landscape Architecture
Associate Director of Research for the Center for Metropolitan Density
College of Architecture, Planning and Public Affairs – CAPPA, UT Arlington

UTA THE UNIVERSITY OF TEXAS AT ARLINGTON

CAPPA COLLEGE OF ARCHITECTURE, PLANNING AND PUBLIC AFFAIRS THE UNIVERSITY OF TEXAS AT ARLINGTON

OUTLINE

- **Introduction**
- **Green Infrastructure (GI) Collaboration Opportunities:**
- **GI & US EPA Campus Rainworks**
  - UTA Campus Rainworks Competitions since 2012
  - UTA GI Pilot, Exhibit, & Report 2022-24
- **GI & Landscape Performance by LAF**
  - Wayne Ferguson Plaza, Lewisville, TX
- **GI & Graduate Student Research**
- **Lessons Learned**

GI DEFINITION:

What is "Green Infrastructure (GI)"?

- **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, GI uses **soils, vegetation, landscape forms,** and other media to manage rainwater **where it falls through** capture, storage, and evapotranspiration.
- GI 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, 2024; Lamond & Everett, 2019; Abbott et al., 2013).

GOALS

*In collaborative work, **campuses** are used as **incubators** for future design professions and testing grounds for innovative GI and climate-responsive design practices.*

PURPOSE

- This presentation aims to **review the UTA collaborative projects explored, and the lessons learned while highlighting what is next for GI, performance research, climate-responsive**, education, practice, and service.

COLLABORATION

Community Service Design/Planning or Research Projects

USC Campus/TOD
TAMU

Educational

Alliance Town Center
Hillwood Assoc.

Private Development

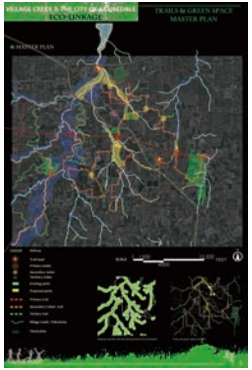
Uptown Canals,
TRVA

Partnership /Non-Profit

Junius Heights,
Neigh. Assoc.

Community

Village Creek & the City
The City of Kennedale



City/Public

Campus Vision
UTA

Educational/Competition

West End
The City of Dallas

Partnership /Non-Profit

UTA Competition Submissions since 2012

GI & US EPA Campus Rainworks

BACKGROUND

What is the Campus Rainworks Challenge?

- **The Campus RainWorks Challenge is a Green Infrastructure (GI) design competition** for American colleges and universities organized by the **U.S. EPA.**
- **It engages with the next generation of environmental professionals**, fosters a dialogue about the need for innovative stormwater management techniques, and showcases 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 initiative invites students to be part of the solution today and in the **future as liaisons**.

CAMPUS RAINWORKS CHALLENGE


Alamo Plaza
HOTEL COURTS
Sylvan Av.
Dallas


Arlington


UTA

UTA CAMPUS: Inventory & Analysis

Trinity, Dallas

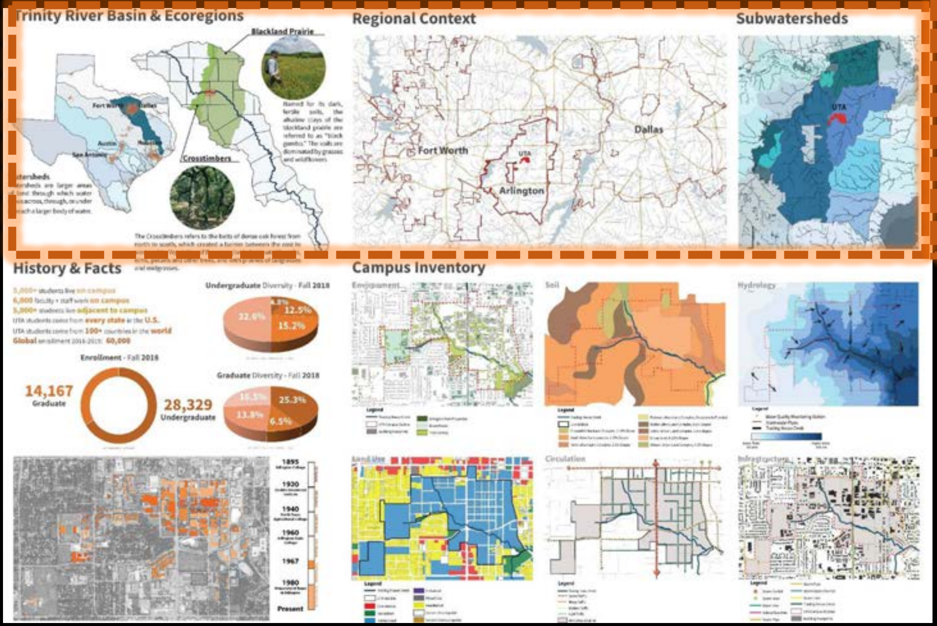
https://www.dallasnews.com/news/education/2022/08/22/classes-continue-for-most-north-texas-students-despite-flooding-bus-disruptions/

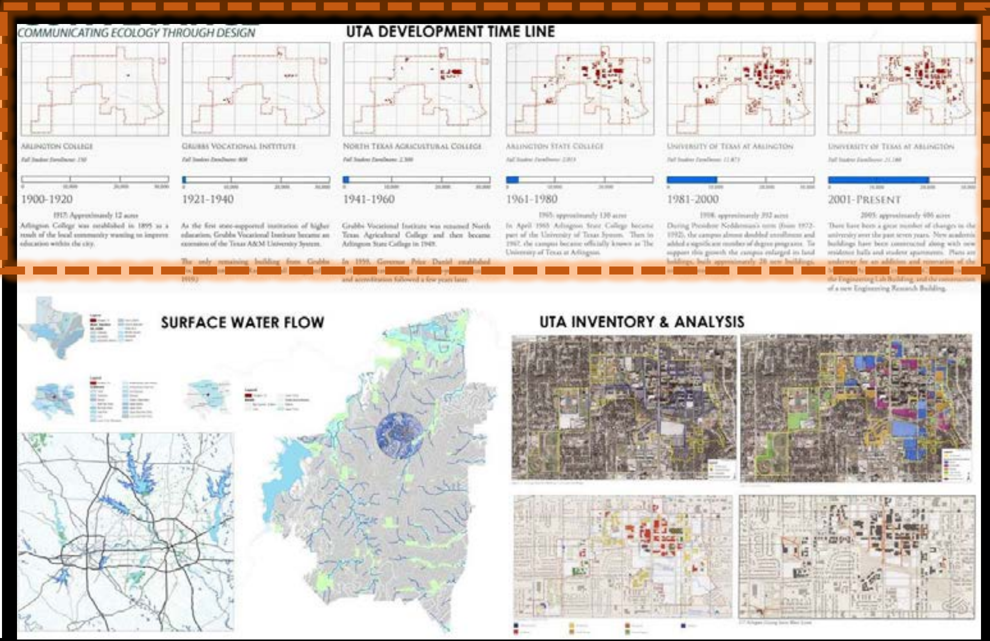
Johnson, Arlington

https://i.imgur.com/EtEroIK.jpg

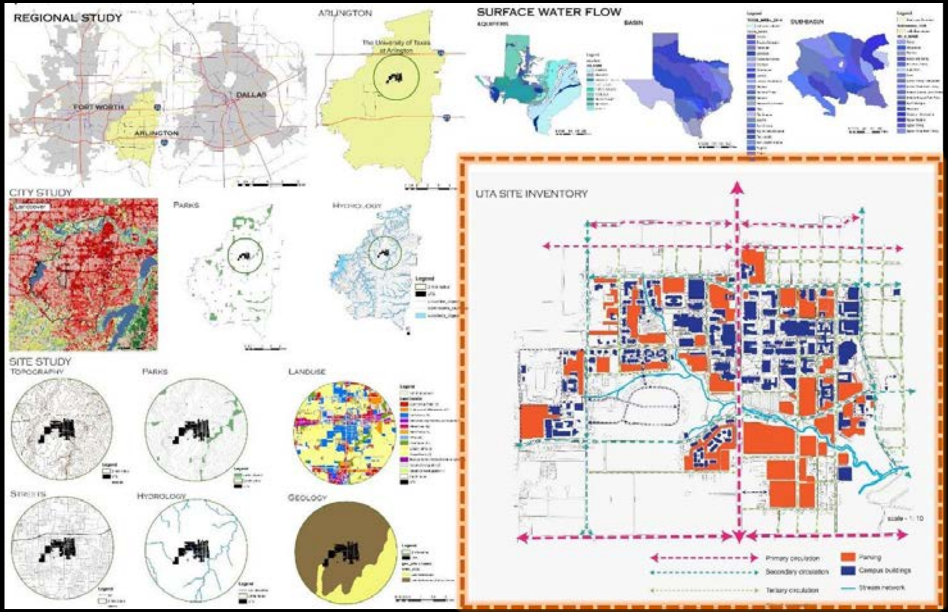
Trading House, UTA

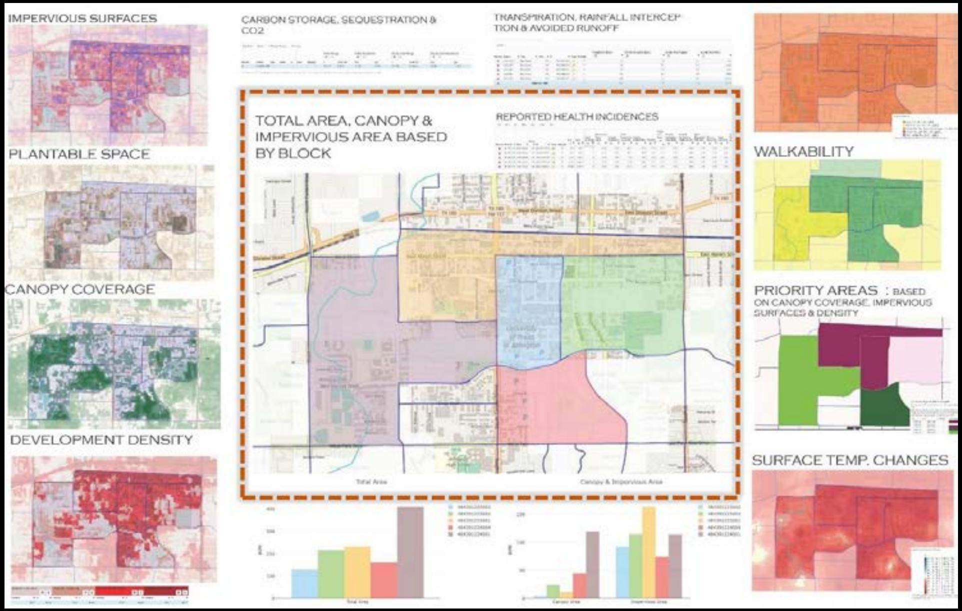
UTA CAMPUS Inventory & Analysis





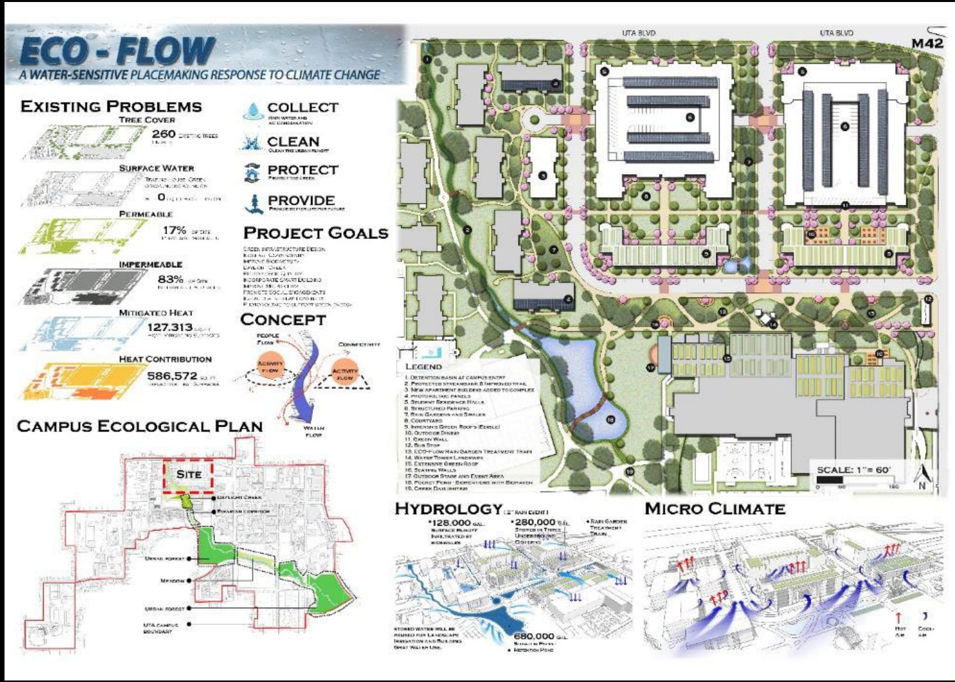
SAMPLE
STUDENT
INVENTORY

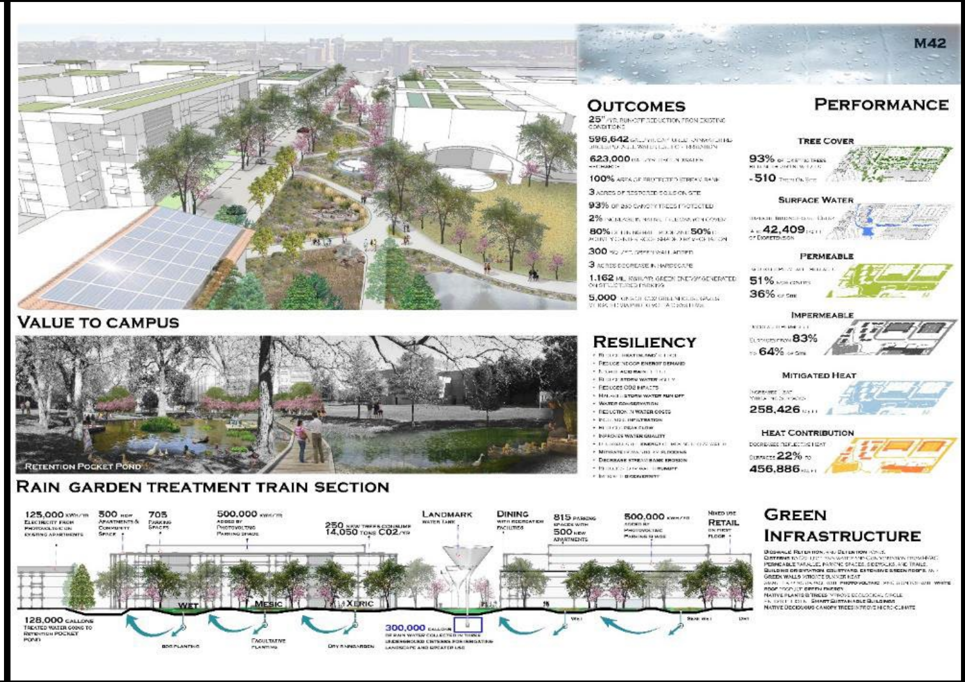




SAMPLE
STUDENT
INVENTORY

UTA CAMPUS Vision(s)



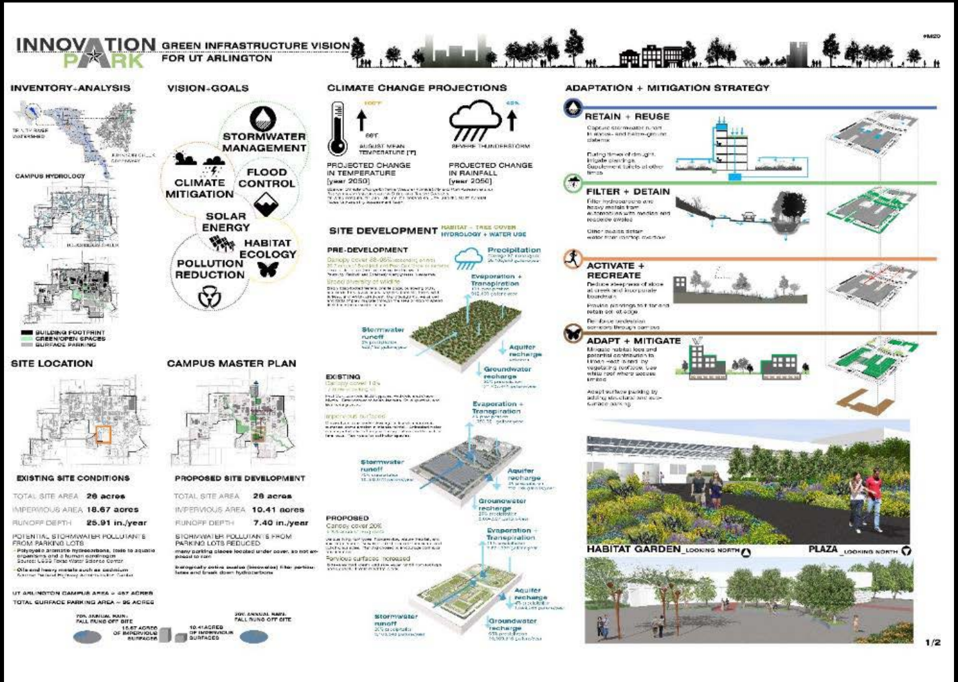


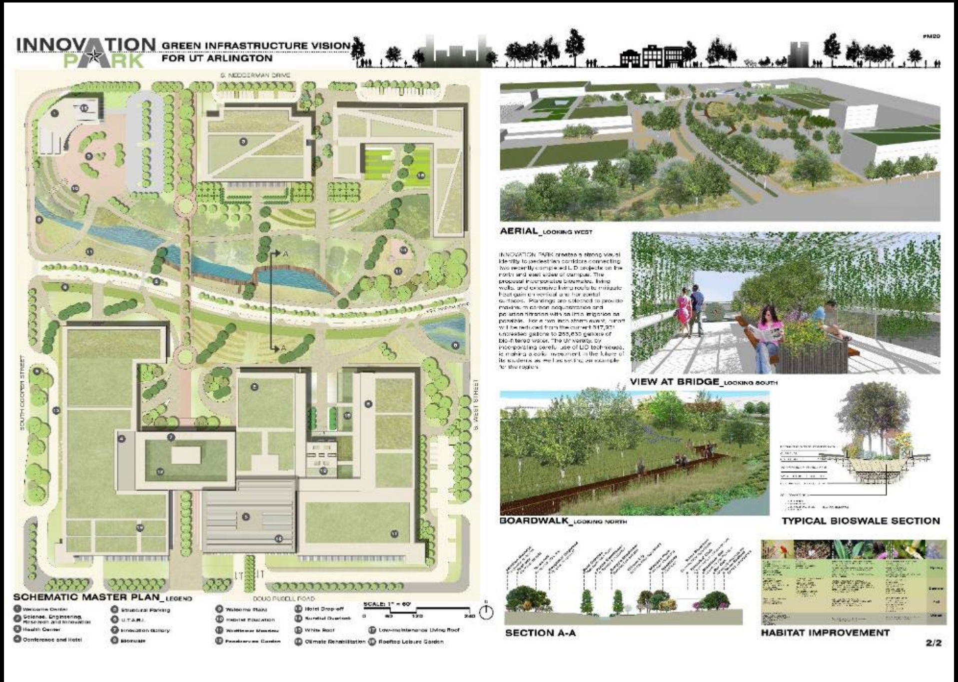
"*ECO-FLOW*"

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

First Place, Master Plan Category

2015-16 SUBMISSION BOARDS



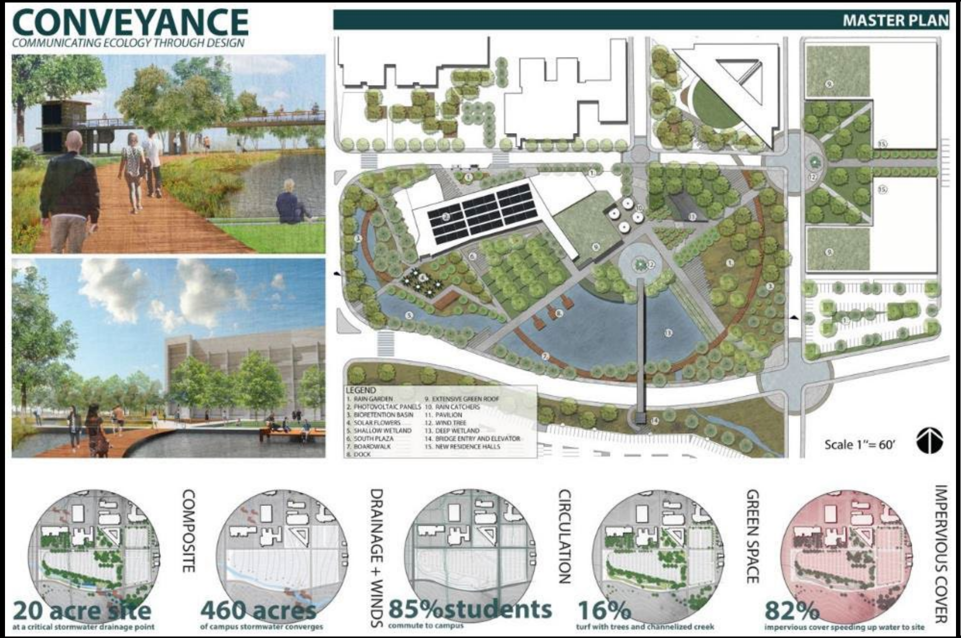


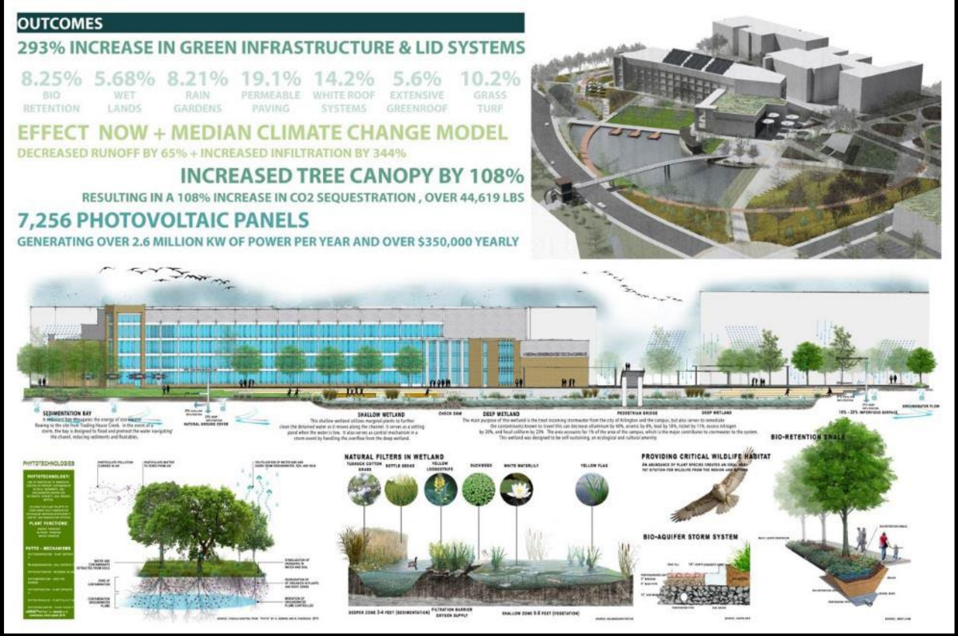
"*INNOVATION PARK AT UT ARLINGTON*"

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

"*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

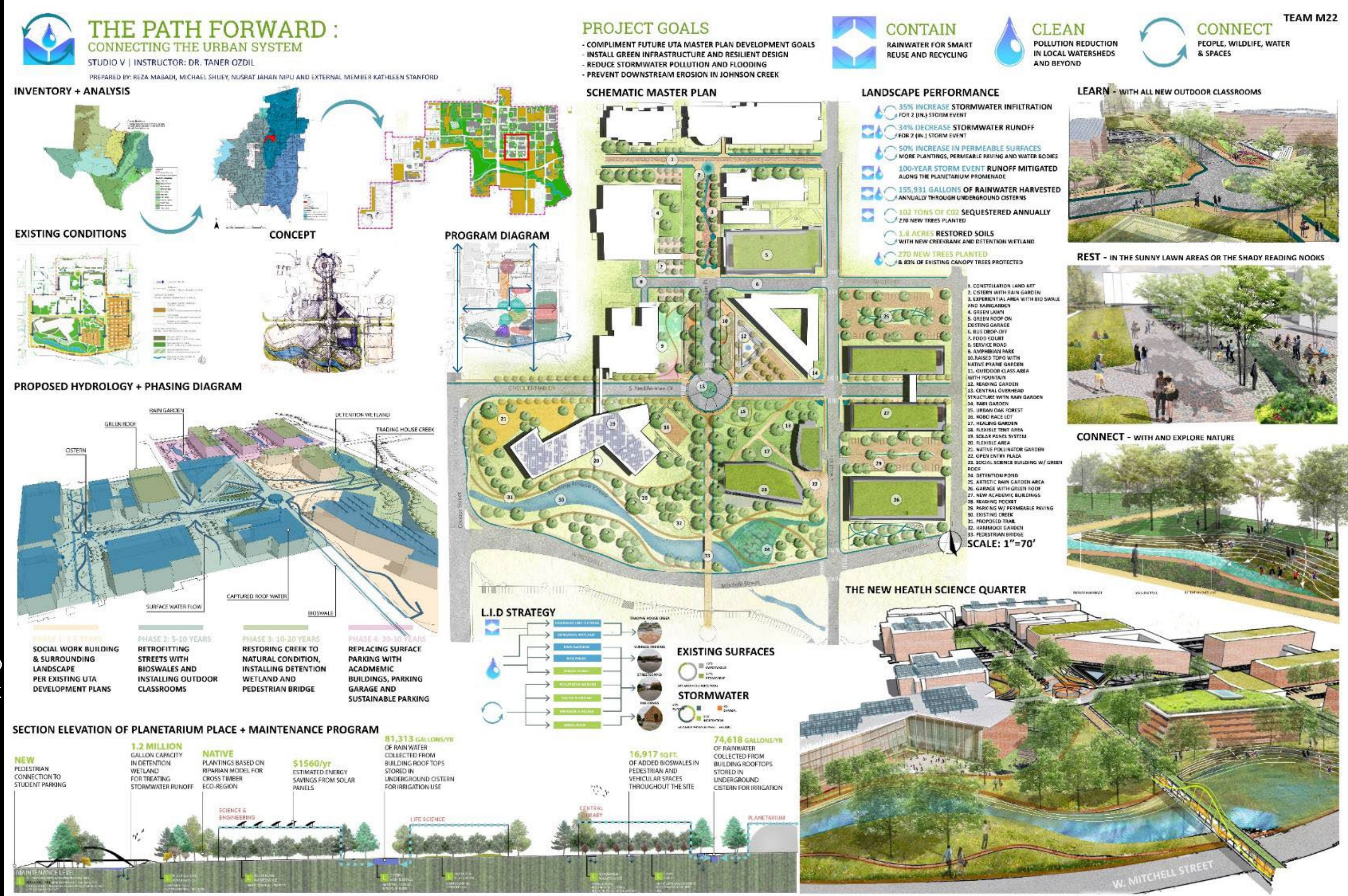
“ *THE PATH FORWARD*”

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



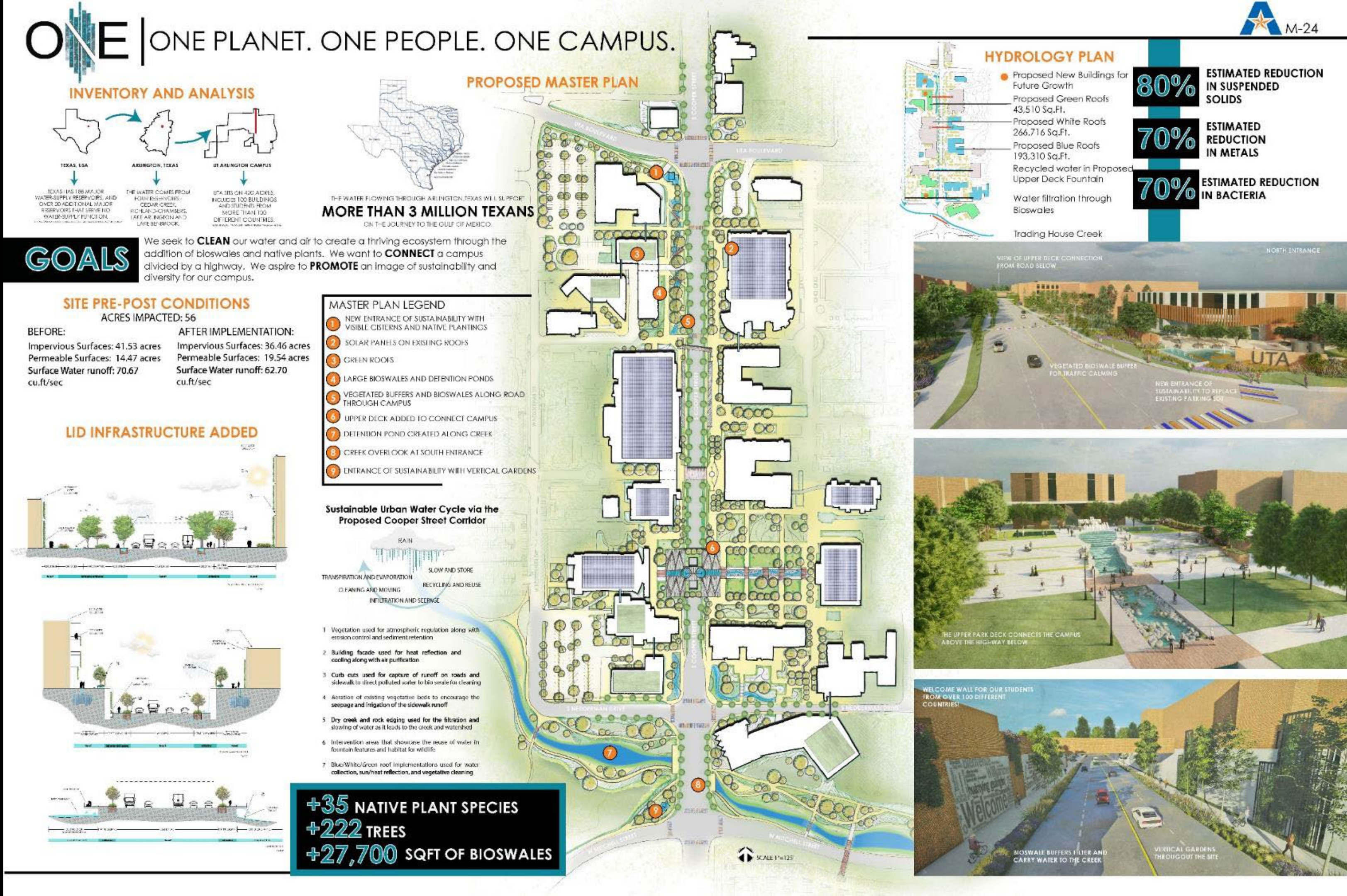
"ONE"

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

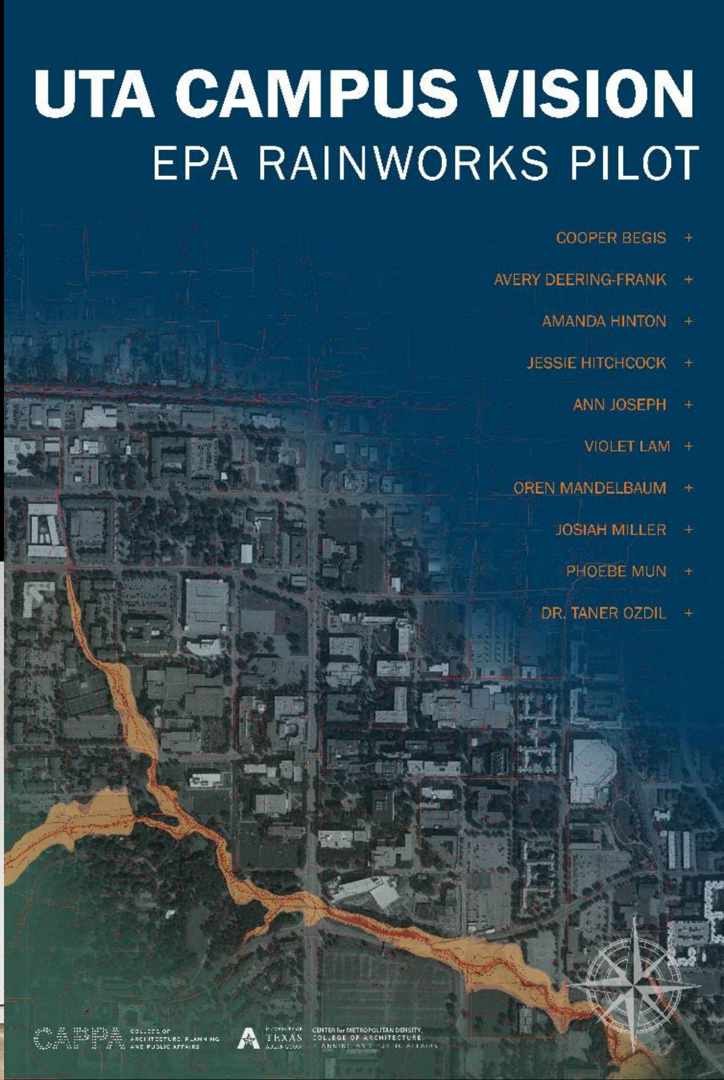


GI Pilot, Exhibit, & Report 2022-24

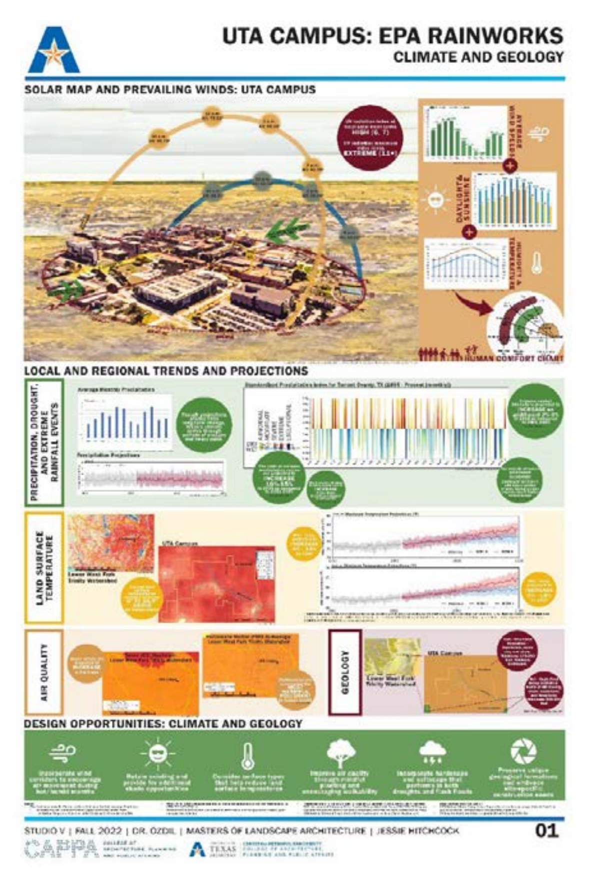
GI & US EPA Campus Rainworks

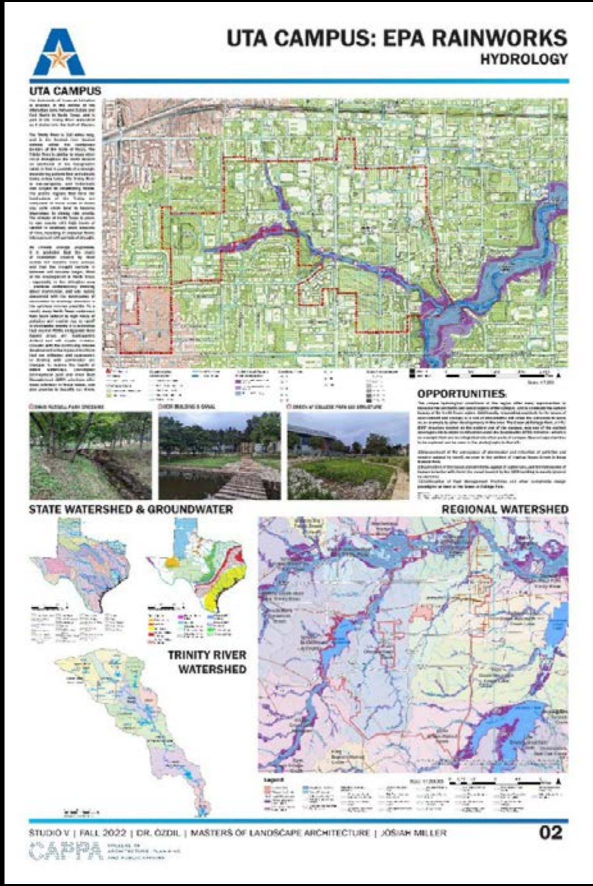
PROJECT & EXHIBIT,

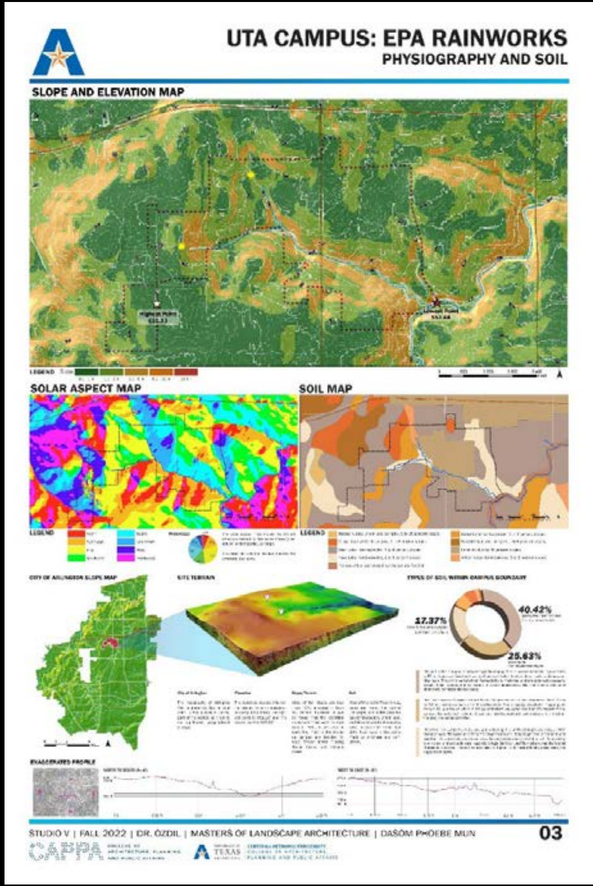
- The project & the exhibit showcased UTA campus visions for four separate sites instructed parallel with the Pilot. Selected sites respond to Trading House Creek.



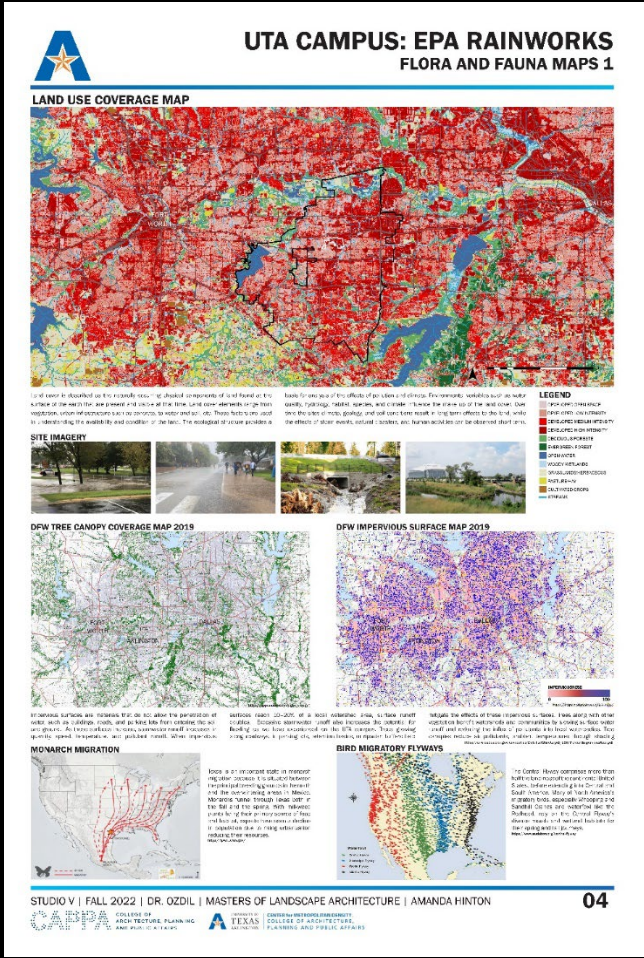
UTA CAMPUS Inventory & Analysis

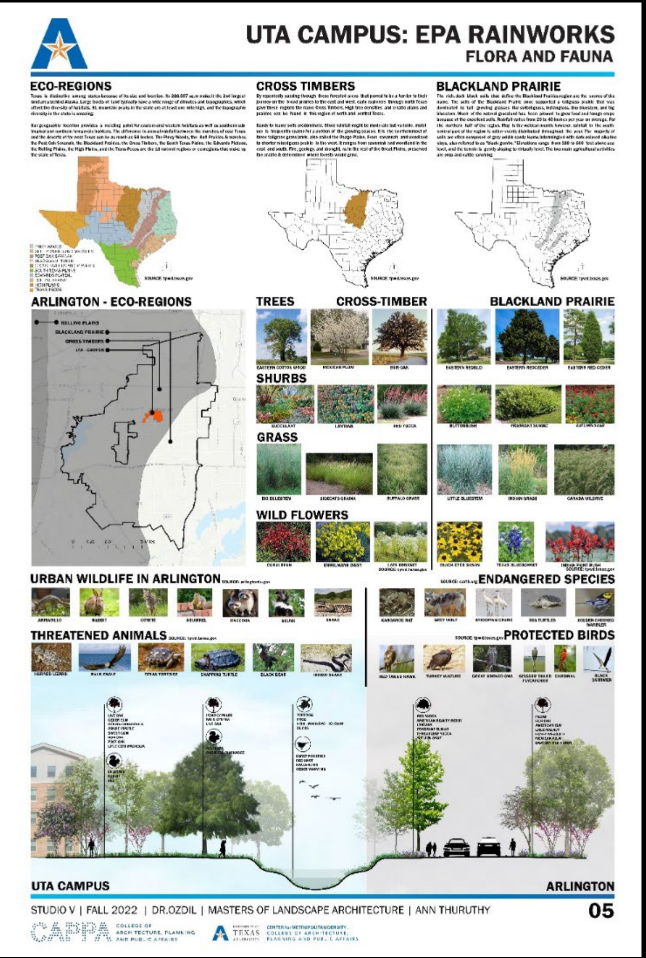




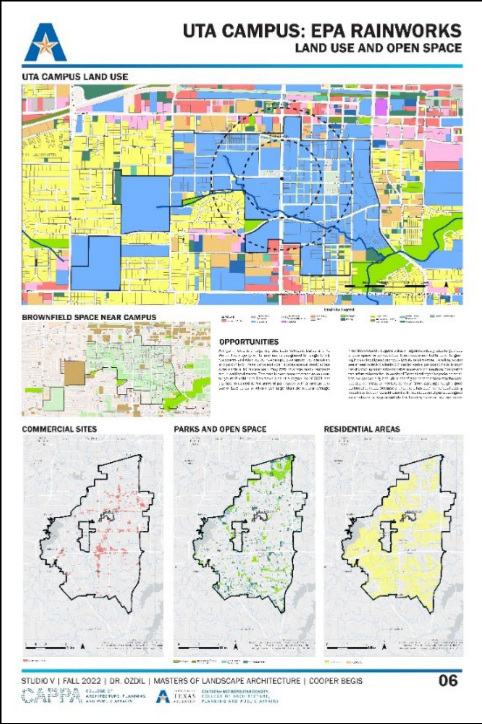


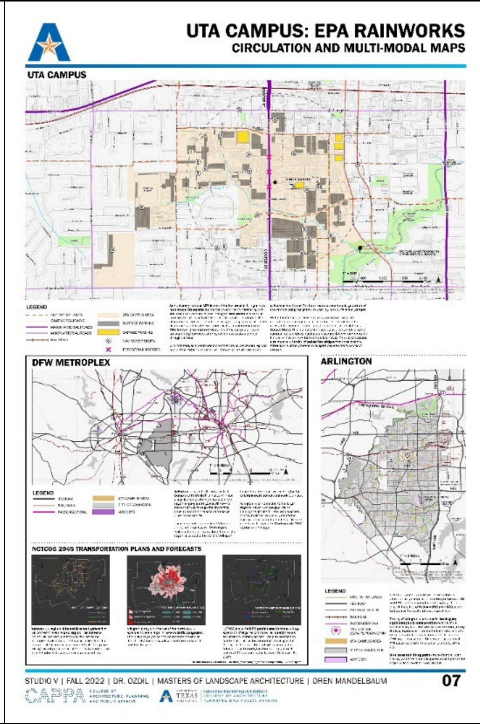
Student Team : Jessie Hitchcock, Josiah Miller, Dasom Phoebe Mun

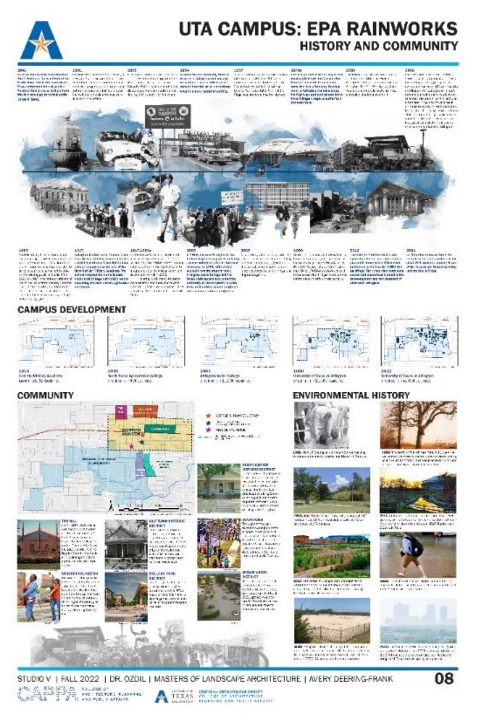


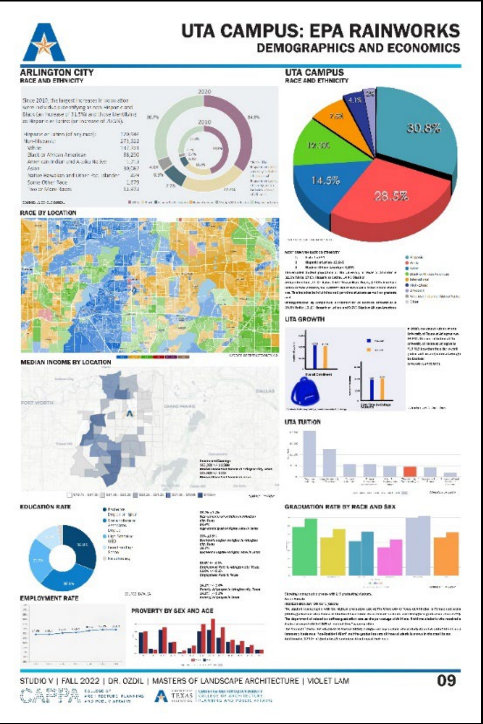


Student Team : Amanda Hinton, Ann Thuruthy



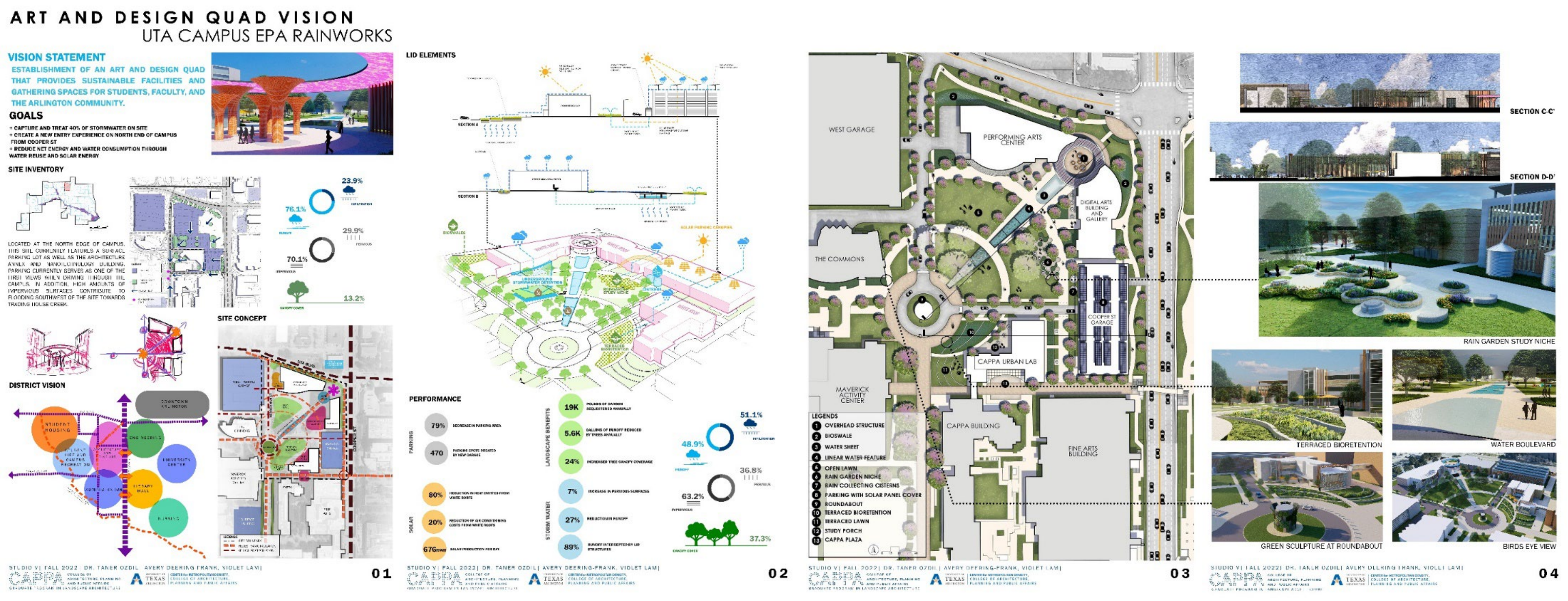




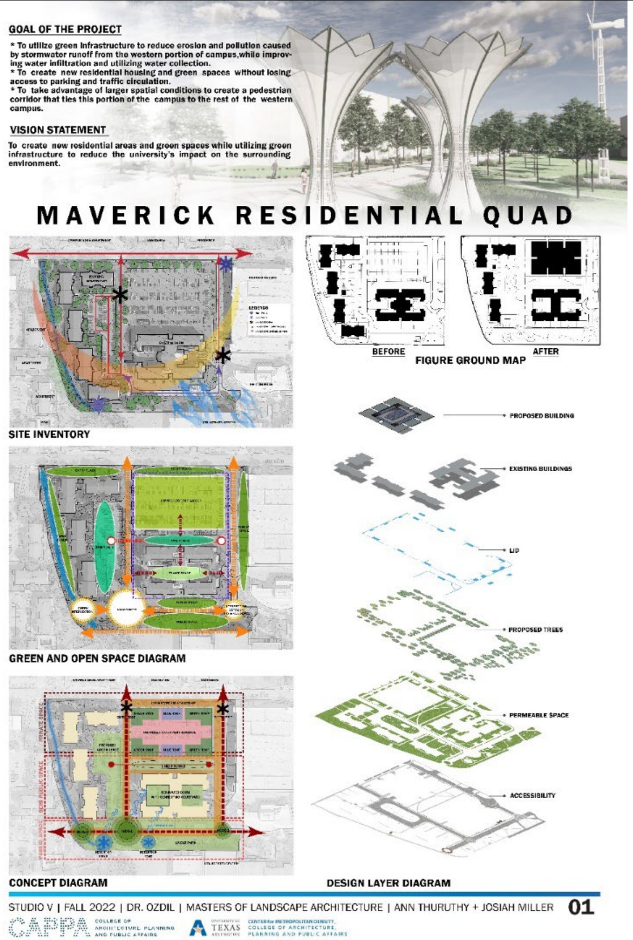


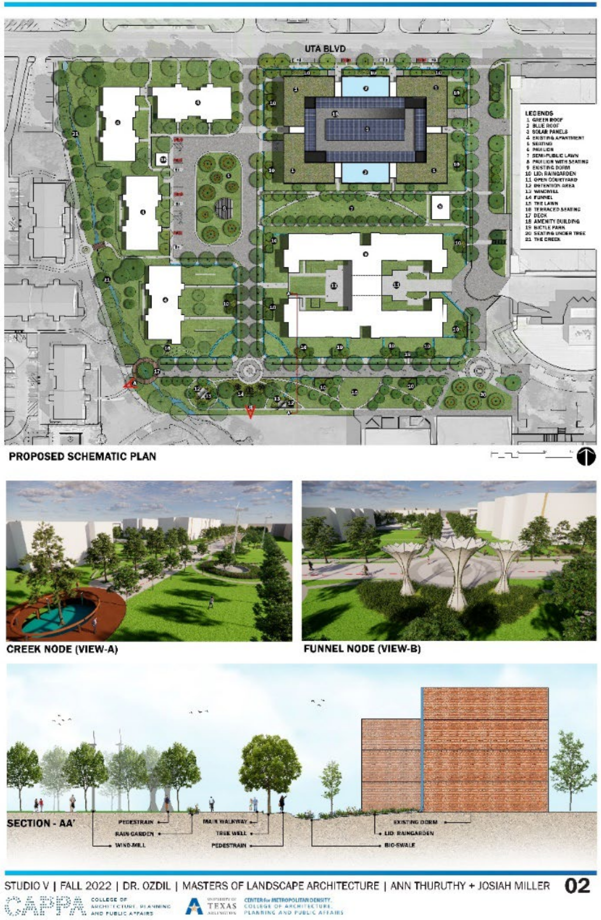
Student Team : Cooper Begis, Oren Mandelbaum, Avery Deering-Frank, Violet Lam

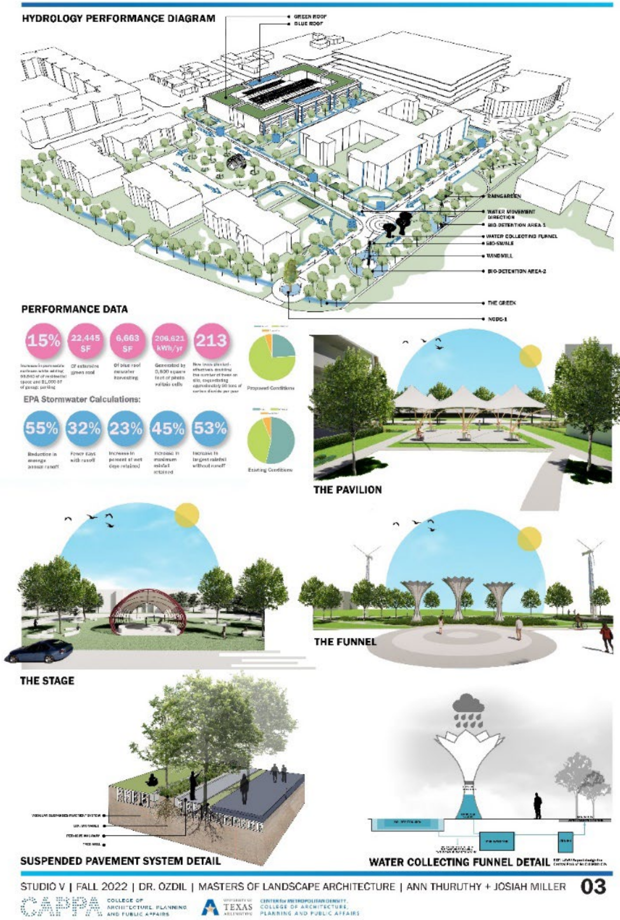
UTA CAMPUS Vision(s)



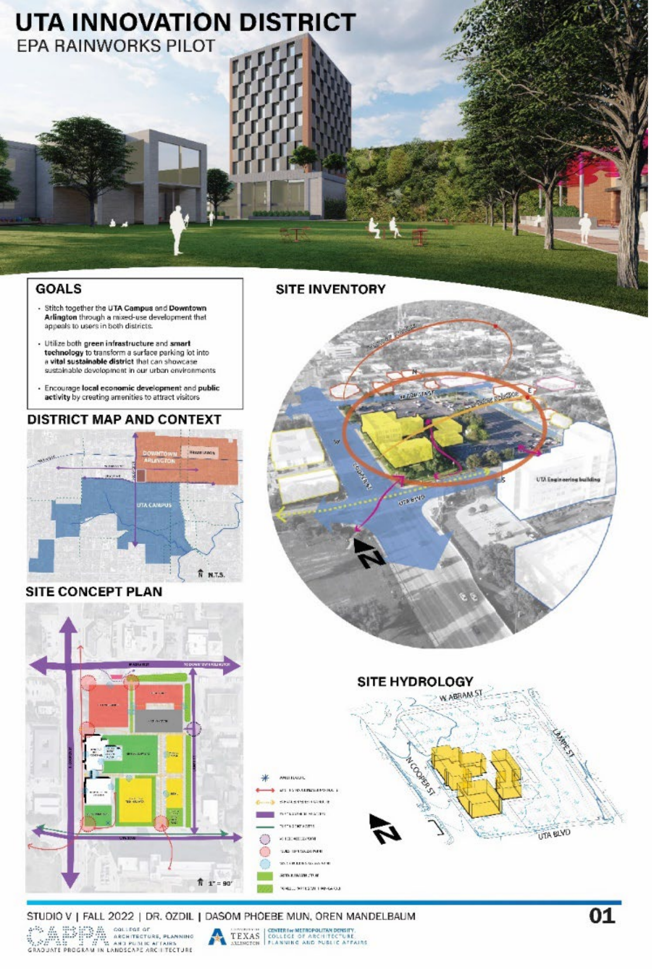
Student Team: Avery Deering Frank, Violet Lam

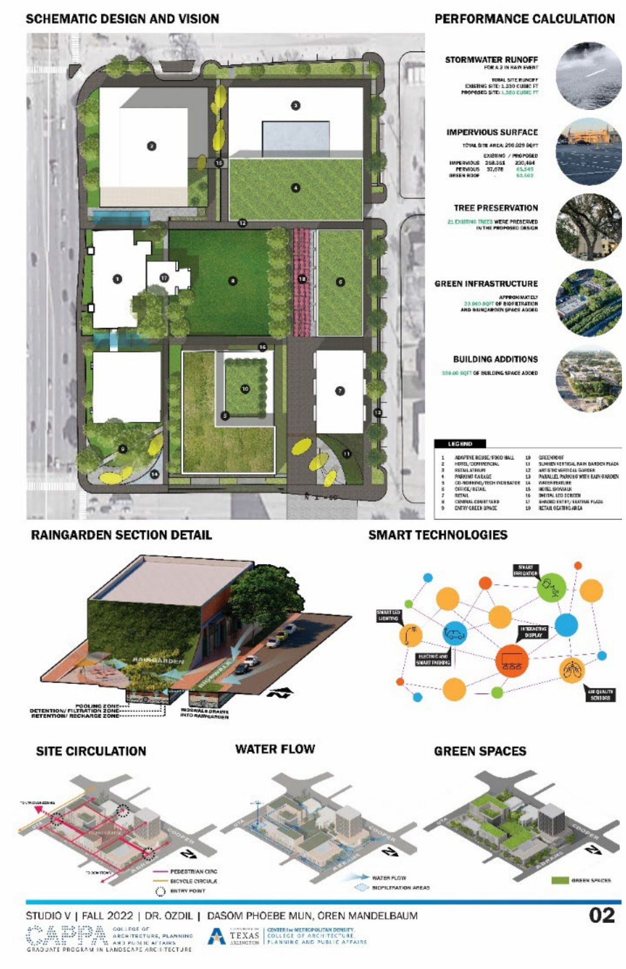


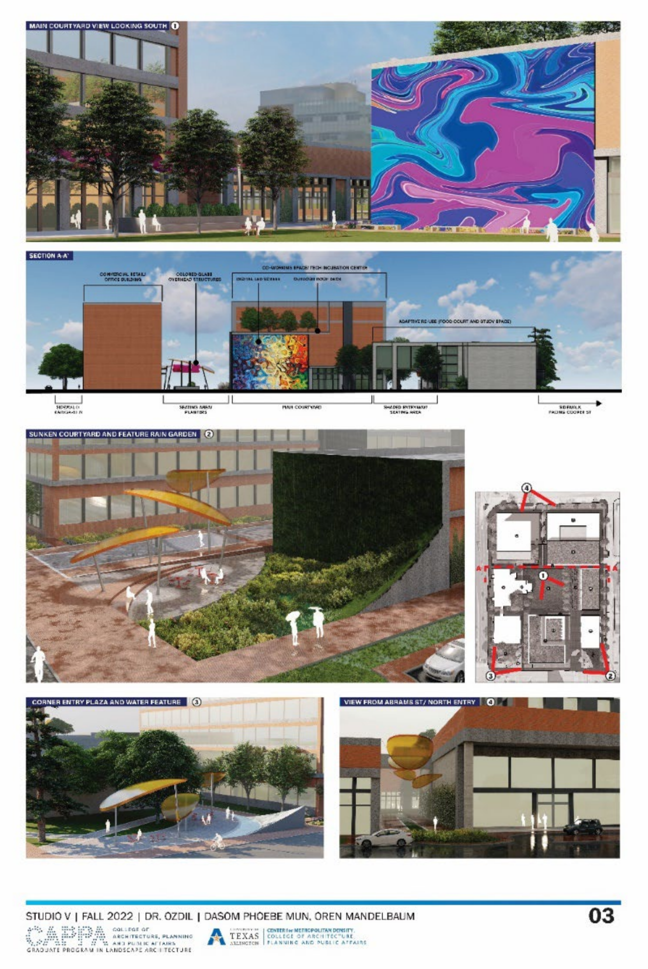




Student Team: Ann Thuruthy, Josiah Miller







Student Team: Dasom Phoebe, Oren Mandelbaum

PILOT: Technical Assistance,

- In its **10 years of this challenge,** the 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 challenge/competition designs** and **create new incentives to advance GI implementation** at higher education institutions**.**
- Direct assistance to two campuses: **University of Texas Arlington** (UTA T.R.Ozdil) and Morgan State University (MSU)
  - Brainstorming sessions with a core team
  - One-day design charrette
  - Final report
  - Create a resource to share with campuses nationwide
- Engage extensively with university and facilities staff to understand opportunities and barriers to 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)

OBJECTIVES

RainWorks Objectives:

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

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

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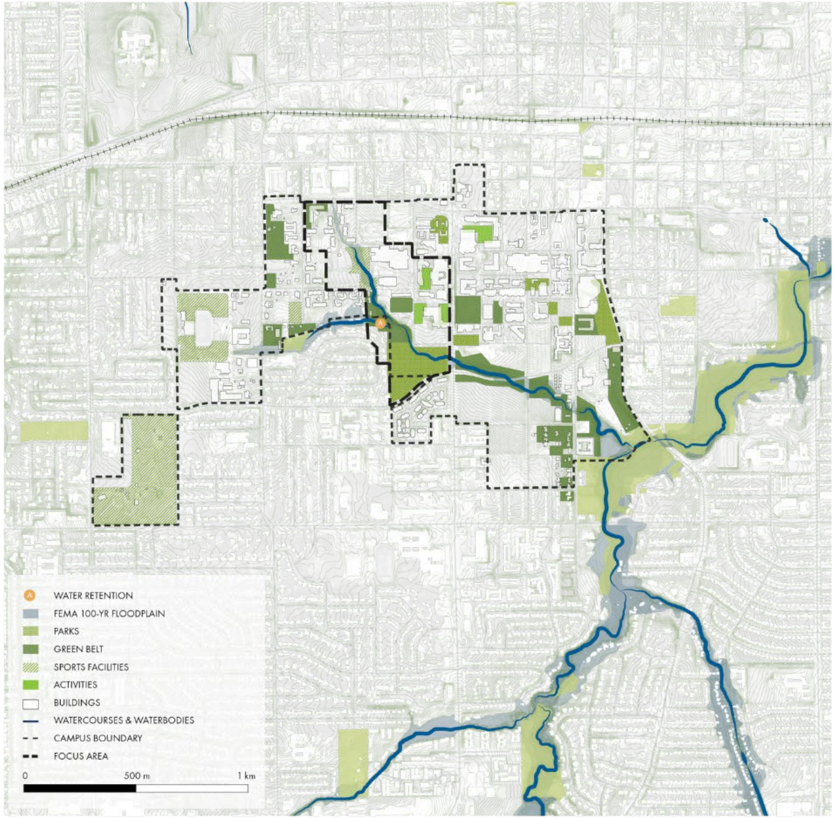

CHARETTE:

- 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

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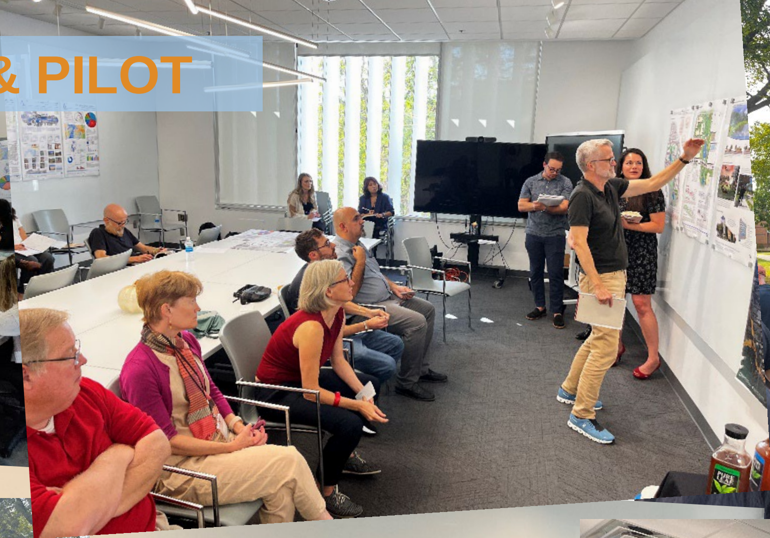
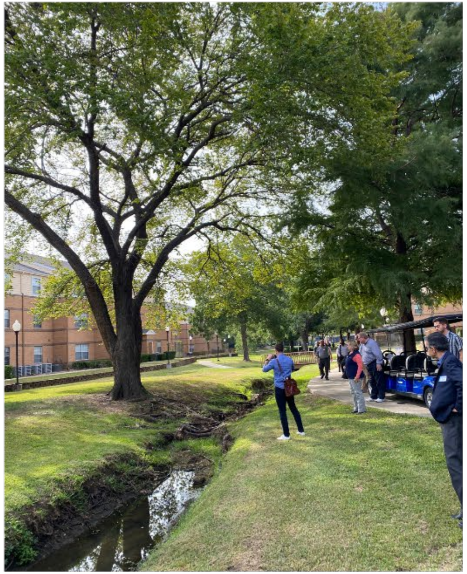
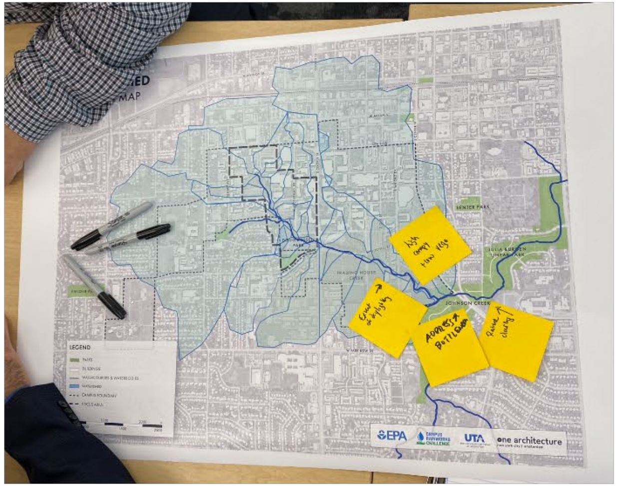
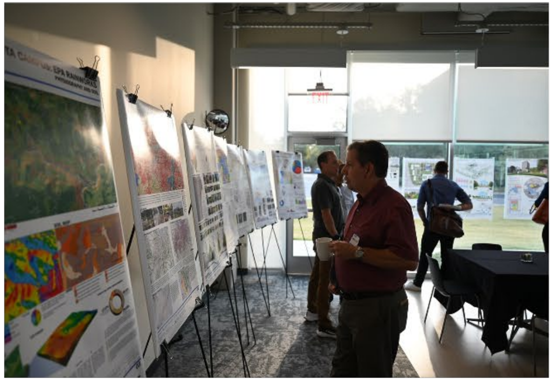
PROJECT, EXHIBIT, & PILOT





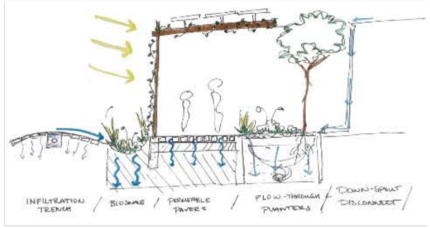

LEGEND
JOHNSON CREEK
EPA
UTA
one architecture

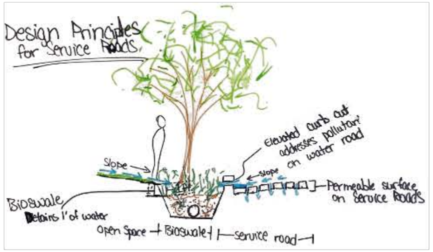



EXIT

CHARETTE & OUTCOMES

GREEK ROW CONCEPTS





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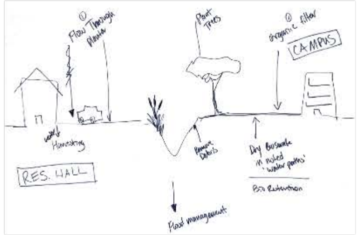
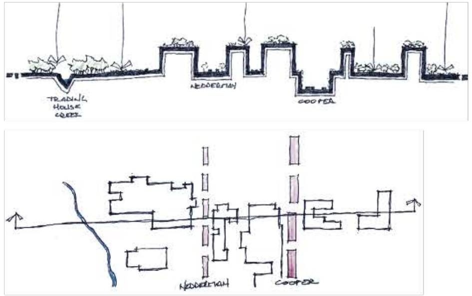
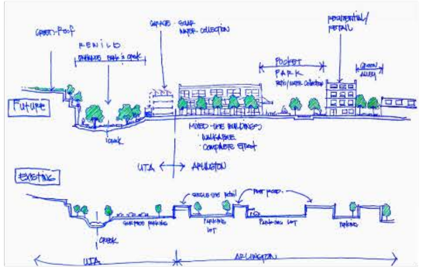


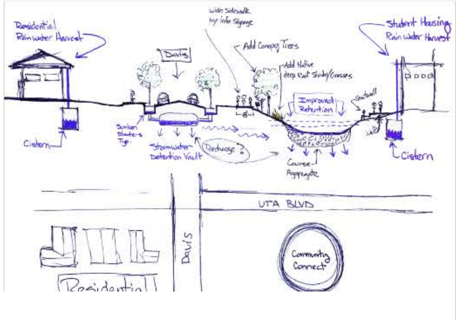
CAMPUS TRANSECT



COOPER ST TRANSECT



UTA BLVD TRANSECT



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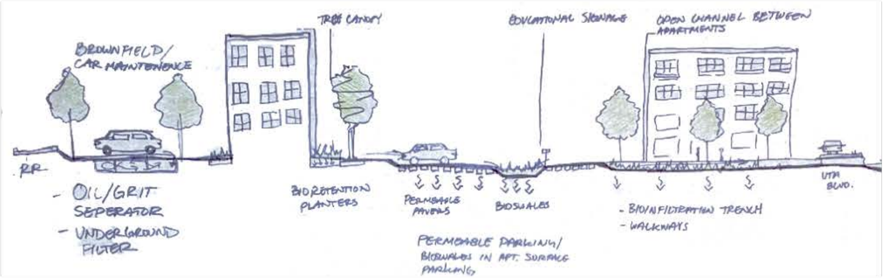

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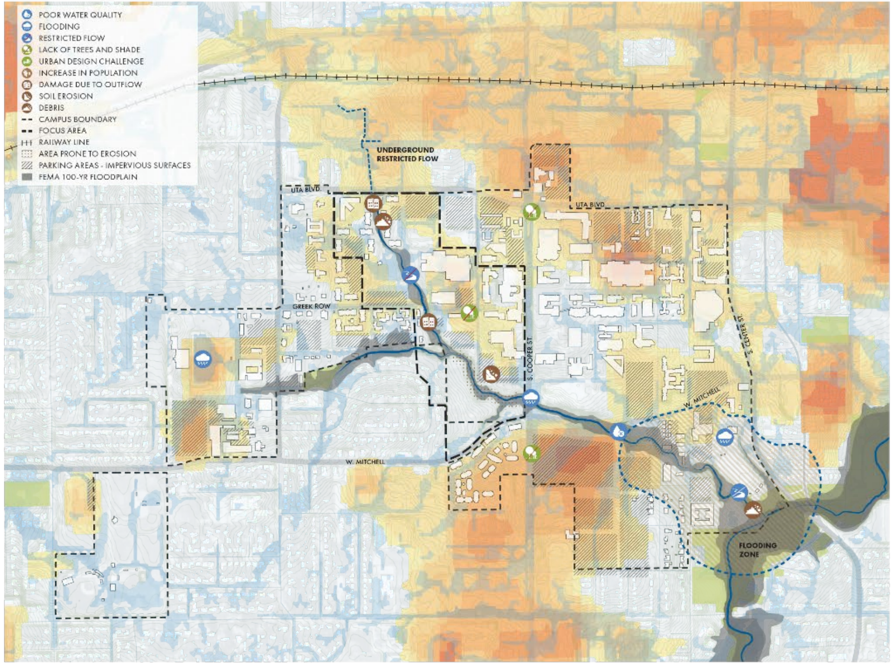
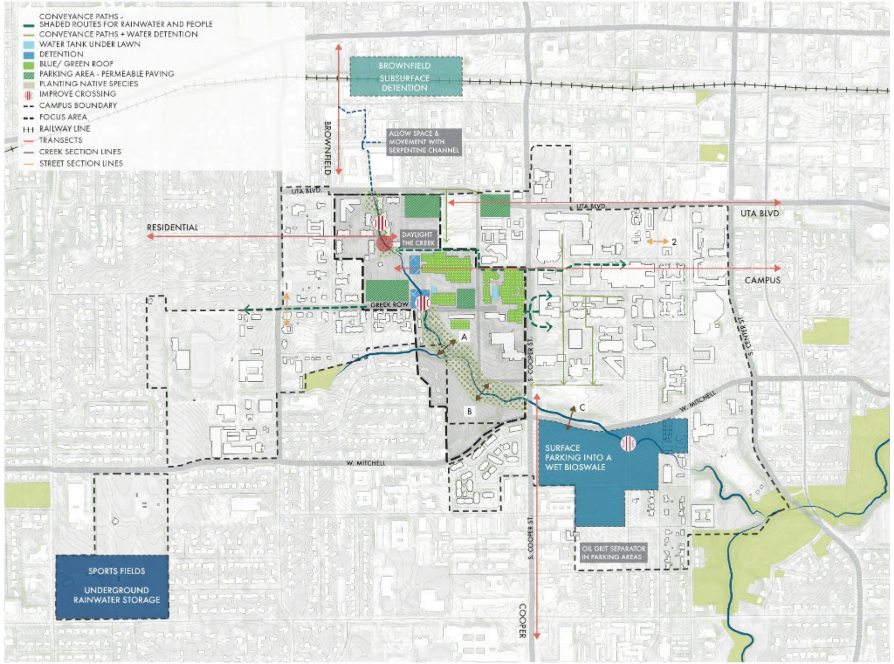
CHARETTE & OUTCOMES

SYNTHESIS OF CHALLENGES



SYNTHESIS OF OPPORTUNITIES



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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

- **UTA GI Report** can be accessed from https://rc.library.uta.edu/uta-ir/handle/10106/31708

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

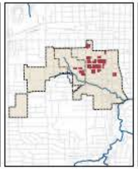
The City of Arlington is located between the cities of Fort Worth and Dallas. It forms a major part of the rapidly-growing metropolitan area, with nearly 400,000 residents living across its almost 100-square-mile area. It has expanded hand-in-hand with the university in the decades since World War II.

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.

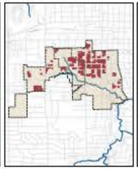
Below the campus sits the Barnett shale formation, a major natural gas production site. Trading House Creek, a tributary of the Trinity River, runs along the southern portion of the campus. The campus sits within the Trading House Creek watershed , the Johnson Creek watershed, Lower West Fork Trinity 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

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)

ENVIRONMENTAL CONTEXT

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

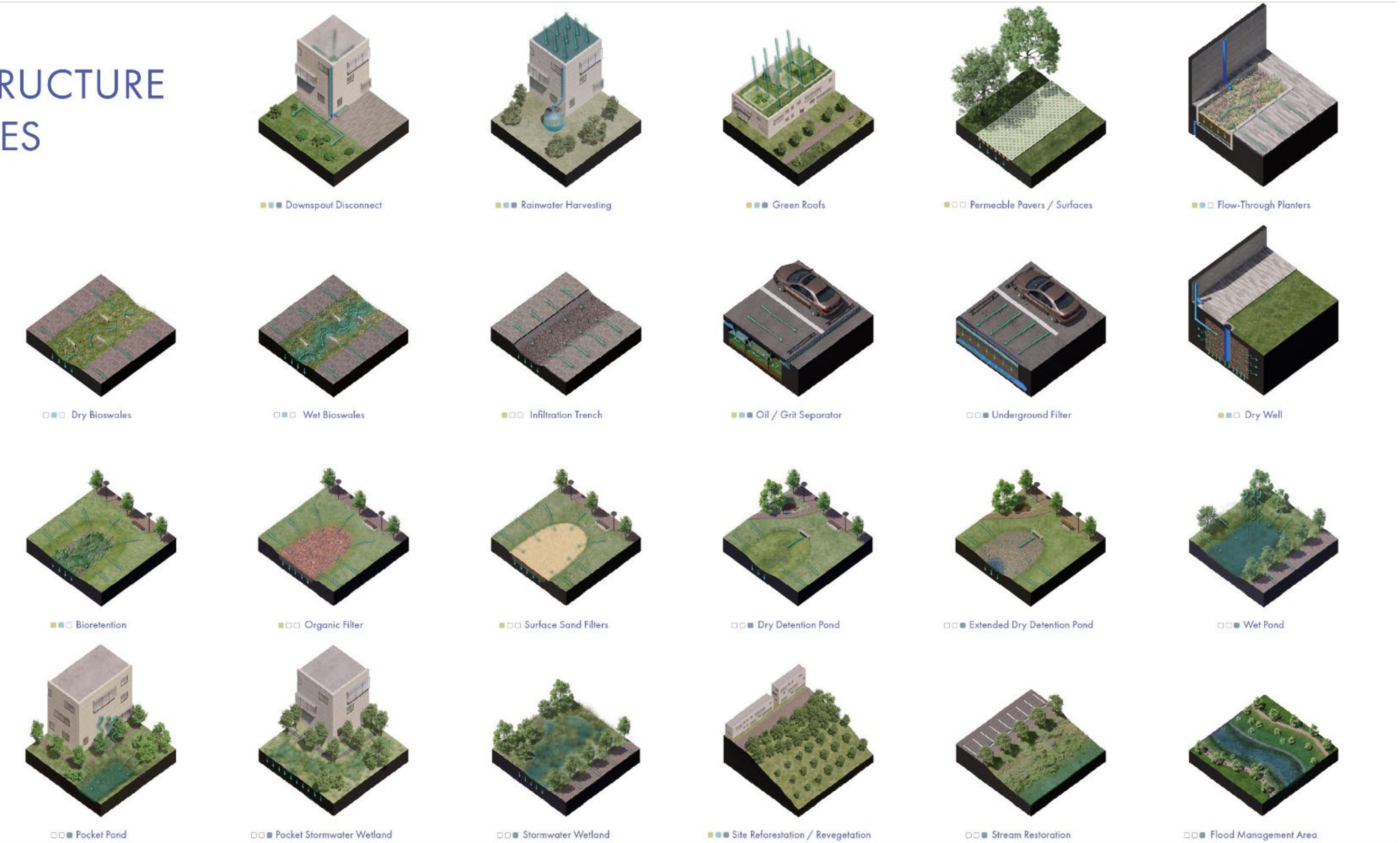
Watershed location:
Based on the priorities listed for each portion of watershed. Upper Watershed: Infiltrate, Convey Downstream; Middle Watershed: Slow Water Flows through storage, Divert Flows from Problem Areas, Convey Downstream; Lower Watershed: Absorb and Store.

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.

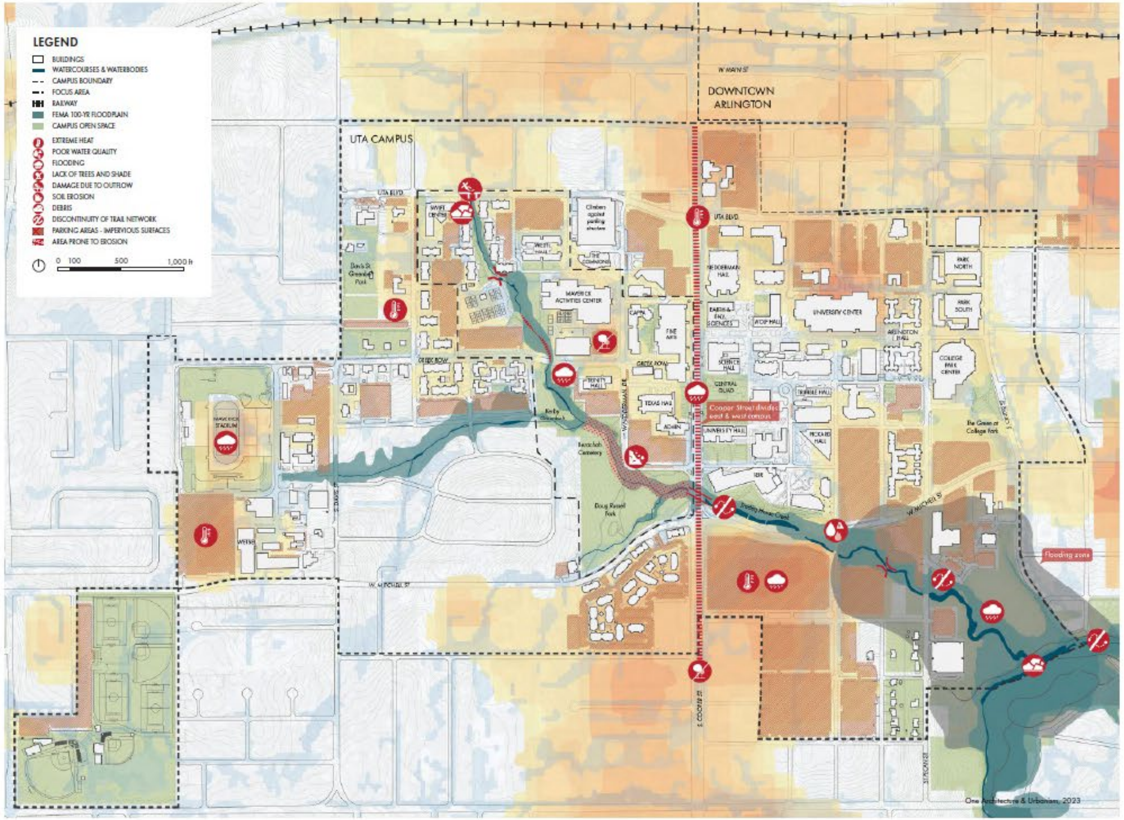
Permitting:
Evaluation based on the degree to which the GI either reduces the amount of impervious area or treats the stormwater that generates from impervious area on campus.

GREEN INFRASTRUCTURE MEASURES



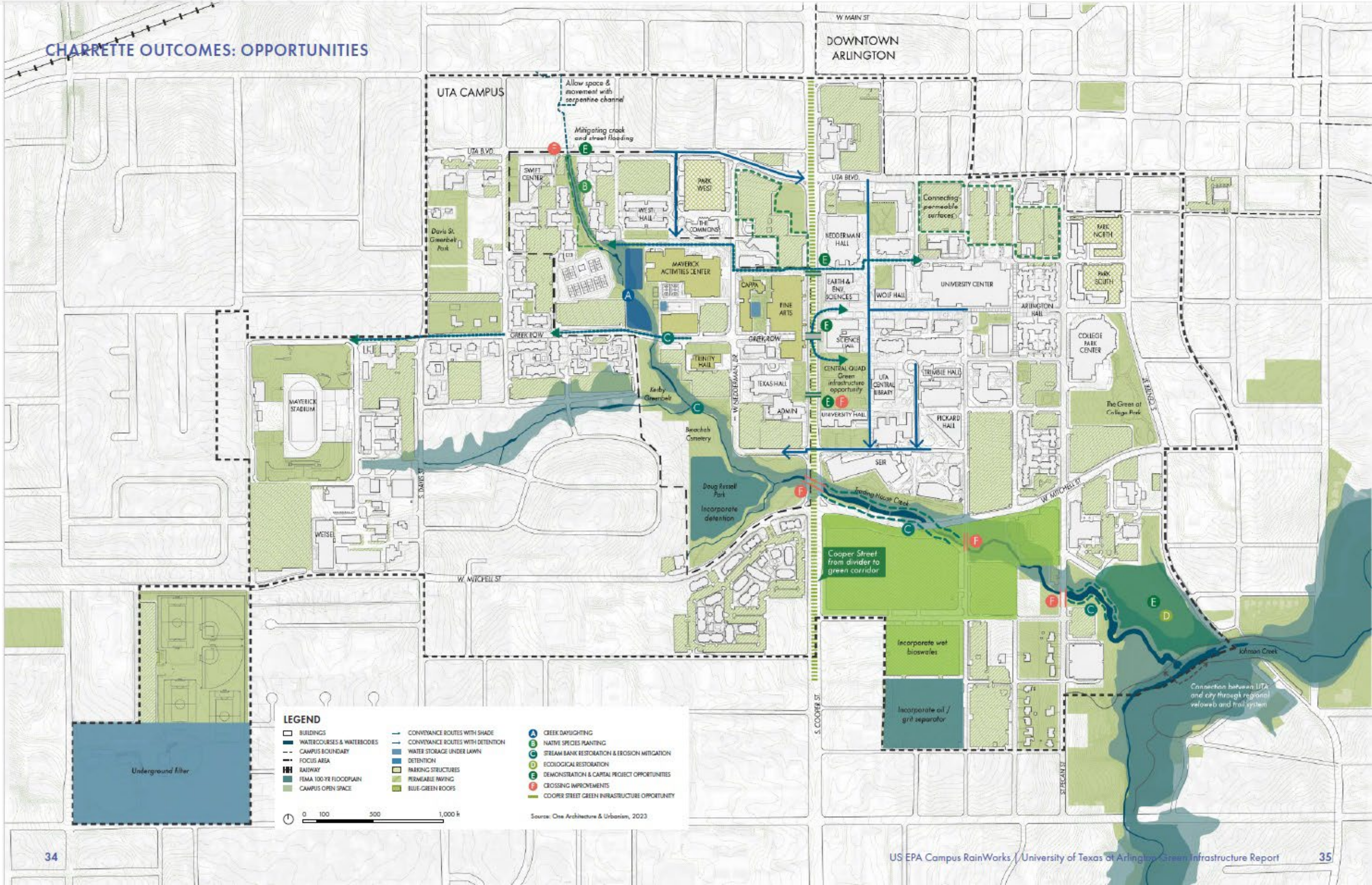
UTA GI REPORT: CHALLENGES

CHARRETTE OUTCOMES: CHALLENGES



Erosion along Trading House Creek (Source: ONE)

UTA GI REPORT: OPPORTUNITIES



UTA GI REPORT: VISION

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.

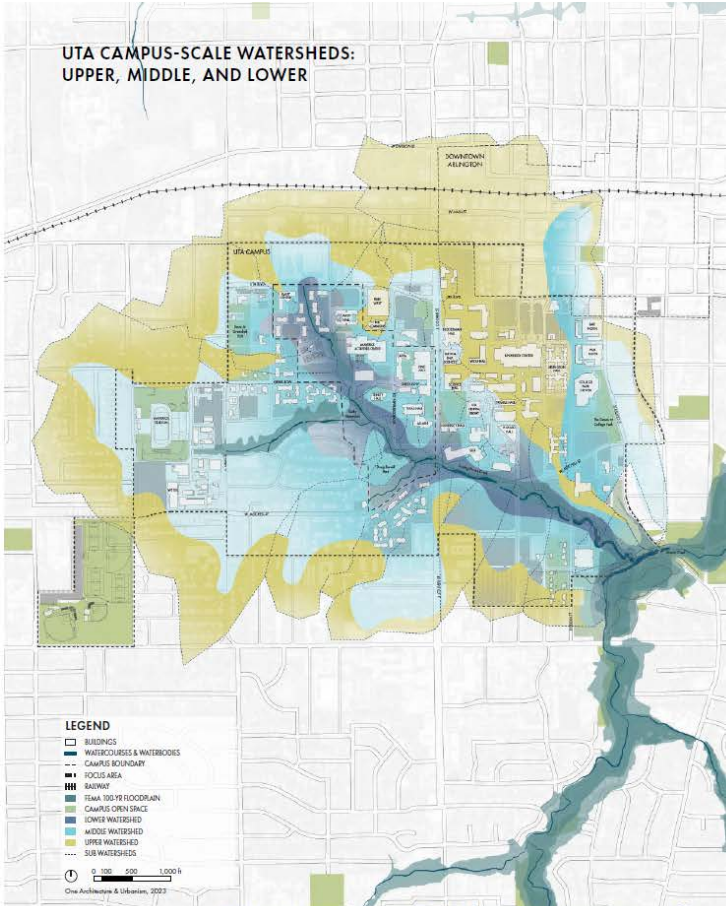
A watershed is typically organized into three portions, each with a distinct function and priorities:

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)



OUTCOMES:

- **Researched, taught, and exhibited work about GI and Climate Responsive Design**
- **Showcased campus leadership the research and student work on GI/BGI**
- **Explored current needs and opportunities among stakeholders**
- **Discussed environmental, economic, and social benefits** (landscape performance)
- **Built awareness for GI/, Climate Responsive Design, and Campus Planning**
- **Educated** campus community about the importance of **systems thinking** and sustainably
- **Established a framework** to guide upcoming campus planning efforts (**Master Plan & Climate Action Plan**),
- **Identified opportunities for collaboration and partnership (**looking for new ones)
- **Utilizing UTA as an Urban Lab and Resource Center for the Region** in GI Research and Demonstration (UN SDG)

Wayne Ferguson Plaza, Lewisville, TX

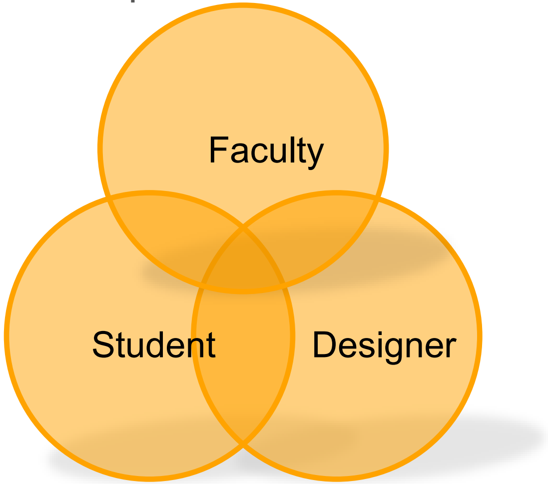
GI & LANDSCAPE PERFORMANCE

LANDSCAPE PERFORMANCE

- Landscape performance can be defined as **measuring the effectiveness with which landscape solutions fulfill their intended purpose and contribute to sustainability (LAF, 2025)**.
- Landscape performance involves assessment of progress toward **environmental, social, and economic goals** based on **measurable outcomes**.

- https://www.lafoundation.org/what-we-do/research/landscape-performance
- https://www.landscapeperformance.org/case-study-briefs/wayne-ferguson-plaza

Triple Bottom Line



WFP

WAYNE FERGUSON PLAZA

DESIGNER : DESIGN WORKSHOP

PROJECT TYPE : PUBLIC PLAZA

LOCATION : LEWISVILLE, TEXAS

SIZE : 1.5 ACRES

BUDGET : $5.2 MILLION (ESTIMATED)

COMPLETION DATE : 2015

OVERVIEW

- CENTRAL GATHERING AND GREEN OPEN SPACE FOR GROWING HISTORIC DOWNTOWN LEWISVILLE
- PLAN INSPIRED BY THE SCULPTURAL MANNER IN WHICH WATER CARVES THE LANDSCAPE OF THE NORTH TEXAS TALL GRASS PRAIRIE.

SUSTAINABLE FEATURES

- PROVIDES HABITAT FOR 17 TEXAS NATIVE PLANT SPECIES OUT 34 PLANTED AND 85% OF THE TREE SPECIES PLANTED IN WFP ARE TEXAS NATIVE .
- 75% OF THE MATERIALS ON THE SITE COME FROM 500 MILES AWAY OR LESS.

ENVIRONMENTAL BENEFITS

- SEQUESTERS 7326 LBS OF CARBON DIOXIDE ANNUALLY THROUGH **113 NEWLY PLANTED TREES**.
- REDUCES THE PEAK STORMWATER FLOW RATE FOR A 2-INCH RAIN EVENT BY 32.25% FROM 1.86 CFS TO 1.26 CFS BY **REDUCING IMPERVIOUS SURFACES BY 34.6%** OR 0.17 ACRES.
- THE TREE CANOPY OF WFP PROVIDES **38.14% SHADE** OVER THE SUMMER MONTHS, COMPARED TO **5.8% SHADE PRE-DEVELOPMENT**, PROVIDING THERMAL COMFORT.

WFP

SOCIAL BENEFITS

- **IMPROVES PERCEPTION OF THE DOWNTOWN LEWISVILLE FOR 95.8%** OF **PROMOTES HISTORY & HERITAGE OF LEWISVILLE FOR** 75%, CREATING A **SENSE OF IDENTITY FOR 91.5%**
- IMPROVES THE **QUALITY OF LIFE FOR 88.9%** OF THE 121 SURVEY RESPONDENTS BY ITS PRESENCE AS A PLACE FOR COMMUNITY AND PROMOTES **HEALTHY LIVING FOR 84.8%**, THROUGH PASSIVE ACTIVITY, RELAXING, AND FOUNTAIN PLAY.
- HOSTS 21 LARGE AND SMALL EVENTS ON AVERAGE BETWEEN MARCH AND JULY TOTALING OVER 2800 ONLINE RSVPS ONLINE. THUS PROMOTES SCHEDULED/ORGANIZED EVENTS FOR 98.3% OF THE 121 SURVEY RESPONDENTS.

WFP

ECONOMIC BENEFITS

- GENERATED **22 MAJOR TICKETED EVENTS//RENTALS** FOR ESTIMATED **129,000 VISITORS** SINCE ITS OPENNING.
- CONTRIBUTED TO **55.5 % INCREASE IN TOTAL PROPERTY VALUE** OF ADJACENT PARCELS IN ITS URBAN BLOCK BETWEEN 2012 AND 2017.
- **HELPS DECREASE HOUSING VACANCY BY 6.6%** BETWEEN 2010 AND 2017 IN THE US CENSUS BLOCK GROUP BY CREATING A DESIRABLE DESTINATION AND ATTRACTING ECONOMIC DEVELOPMENT.

WFP

Research

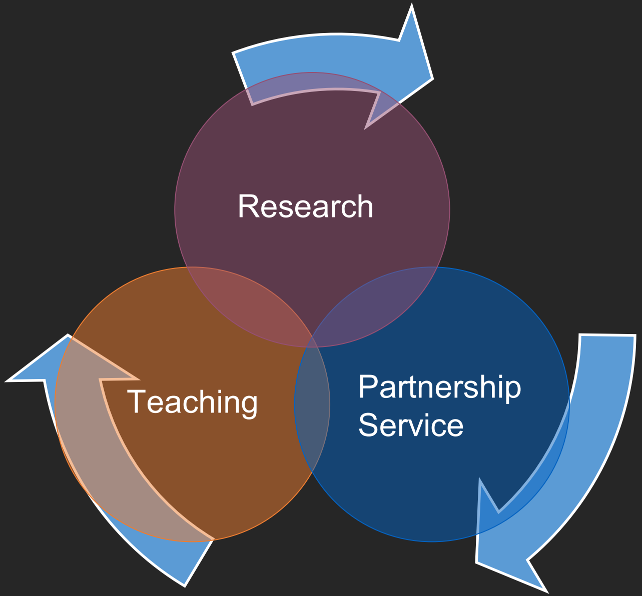
GI & GRADUATE STUDENT

THESES:

- Amanda Esperanza, MLA Student, Anticipated time of graduation 2025 "**The Impact of Biodiversity in User Experience: Learning from Urban Parks in Texas**"
- Elena Naccari, MLA,2021, "**Evaluating Dallas County Landfills for Public Amenity: Repurposing the City of Grand Prairie Landfill Through Landscape Architecture**."
- Layal Bitar Ghanem, MLA, 2016, "**Predictive Modeling with SWAT before Design Development in Landscape Architecture: Learning from Southwestern Medical District, Dallas, Texas**".
- Sameepa Modi, MLA, Spring 2014, "**Perspectives on Environmental Landscape Performance Indicators: Learning from LAF's Case Studies Investigation Program**".
- Dalit Bielaz, MLA, Fall 2013, "**The Impact of Green Walls and Roofs to Urban Microclimate in Downtown Dallas: Learning from Simulated Environments**."
- Kent Elliott, MLA, Fall 2013, "**Assessing Knowledge About Hydrology Among Landscape Architects in North Texas**."
- Nhasala Manandhar, MLA, Fall 2012, "**Developing Methods on Measuring Naturalness of Stream Restoration Projects: Learning from Johnson Creek**".
- Cameron Holmes, MLA, Spring 2012, "**Low Impact Development Practices: An Evaluation of the Practices Being Implemented in Dallas-Fort Worth Area**".
- Petrine Abrahams, MLA, Spring 2010, "**Stakeholders' Perceptions of Pedestrian Accessibility to Green Infrastructure: Fort Worth's Urban Villages**."
- Brian Parker, MLA, Spring 2010, "**Assessing Stormwater Runoff with 'SWAT' in Mixed-Use Developments: Learning from Southlake Town Square, Addison Circle in North Texas**."

LESSONS LEARNED:

Collaborative Projects, & Competitions:
Campus Rainworks Challenge,
Urban Landscape Projects



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

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

COLLEGE OF ARCHITECTURE, PLANNING AND PUBLIC AFFAIRS
THE UNIVERSITY OF TEXAS AT ARLINGTON

QUESTIONS?

- **Taner R. Ozdil**, Ph.D., ASLA, Landscape Architecture, CAPPA

  TOZDIL@UTA.EDU Office: 817 272 5089

- **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
- **Wayne Ferguson Plaza Performance** study https://www.landscapeperformance.org/case-study-briefs/wayne-ferguson-plaza

CAPPA COLLEGE OF ARCHITECTURE, PLANNING AND PUBLIC AFFAIRS
THE UNIVERSITY OF TEXAS AT ARLINGTON

REFERENCES

- Ahern, J. (2007). Green infrastructure for cities: the spatial dimension. In. In Cities of the future: towards integrated sustainable water and landscape management. IWA Publishing.
- Brown, R.D. & Corry, R.C. (2011). Evidence-based landscape architecture: The maturing of a profession. Landscape & Urban Planning, 100: 327-329.
- Derkzen, M. L., Van Teeffelen, A. J., & Verburg, P. H. (2017). Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences? *Landscape and urban planning*, *157*, 106-130.
- Klemm, W., Lenzholzer, S., & van den Brink, A. (2017). Developing green infrastructure design guidelines for urban climate adaptation. *Journal of Landscape Architecture*, *12*(3), 60-71.
- Loorbach, D. et al. (2017). Sustainability transitions research: Transforming science and practice for societal change. *Annual Review of Environment and Resources*, 42: 599-626.
- Newman, G., Li, D, Tao, Z., & Zhu, R. (2021). Recent Trends in LA-Based Research: A Topic Analysis of CELA Abstract Content. *Landscape Journal*, 39(2): 51-73.
- Ozdil, T. R. (2021). Who Will Teach the Next Generation of Landscape Architects? Ten-year Review of Academic Position Descriptions in Landscape Architecture in North America. *Landscape Journal*, 39(1): 55-69.
- U.S. EPA (2022). Green Infrastructure. The United States Environmental Protection Agency. Retried from Retrieved from **https://www.epa.gov/green-infrastructure**

END

Using iSWM as an Inspector

EROSION CONTROL AND POST CONSTRUCTION WATER QUALITY

Julian Holmes
Stormwater Coordinator
Environmental Services
City of Mansfield

Inspections (and plan review)

Key lessons:

- Construction details/schematics mater
- Know where the issues are
- Strength in consistency
- Usefulness of the Technical Manuals

Technical Manuals

iSWM™ Technical Manual — Construction Controls

Construction Controls:

1.0 Overview of Construction Controls
2.0 Erosion Controls
3.0 Sediment Controls
4.0 Material Waste Controls

Updated November 2020

iSWM™ Technical Manual — Site Development Controls

Site Development Controls:

1.0 Overview of Stormwater Controls for Site Development
2.0 Bioretention
3.0 Enhanced Swales
4.0 Grass Channel
5.0 Open Conveyance Channel
6.0 Alum Treatment System
7.0 Culverts
8.0 Inlets
9.0 Pipe Systems
10.0 Dry Detention / Extended Detention Dry Basins
11.0 Multi-Purpose Detention Areas
12.0 Underground Detention
13.0 Filter Strip
14.0 Organic Filter
15.0 Planter Boxes
16.0 Sand Filters
17.0 Underground Sand Filter
18.0 Gravity (Oil Grit) Separator
19.0 Downspout Drywell
20.0 Infiltration Trench
21.0 Soakage Trench
22.0 Stormwater Ponds
23.0 Green Roof
24.0 Modular Porous Pavement Systems
25.0 Porous Concrete
26.0 Proprietary Structural Controls
27.0 Rain Harvesting (Tanks/Barrels)
28.0 Stormwater Wetlands
29.0 Stormwater Control Design Examples
30.0 References

iSWM™ Technical Manual — Water Quality

Water Quality:

1.0 Water Quality Protection Volume and Peak Flow
2.0 Construction SWPPP Guidelines and Form

Erosion Control

SWPPP

Schematics

Temporary Sediment Basins

SWPPP

iSWM™ Technical Manual — Water Quality

Storm Water Pollution Prevention Plan Review Checklist

Project Name ____________________

Location/Address ____________________

Operator's Name ____________________ Operator's Phone No. ____________________

Preparer's Name ____________________ Preparer's Phone No. ____________________

Reviewer ____________________ Date ____________________

Storm Water Pollution Prevention Plan Narrative

Project Title	
Operator with Control Over Construction Plans and Specifications (Company Name and Address)	
Operator's Representative	Phone No.
Prepared by	Date
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	
Signatory Name and Title	Signature

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Stormwater Pollution Prevention Plan (SWP3) Template for the Construction General Permit

Site Name:

Address:

RN:

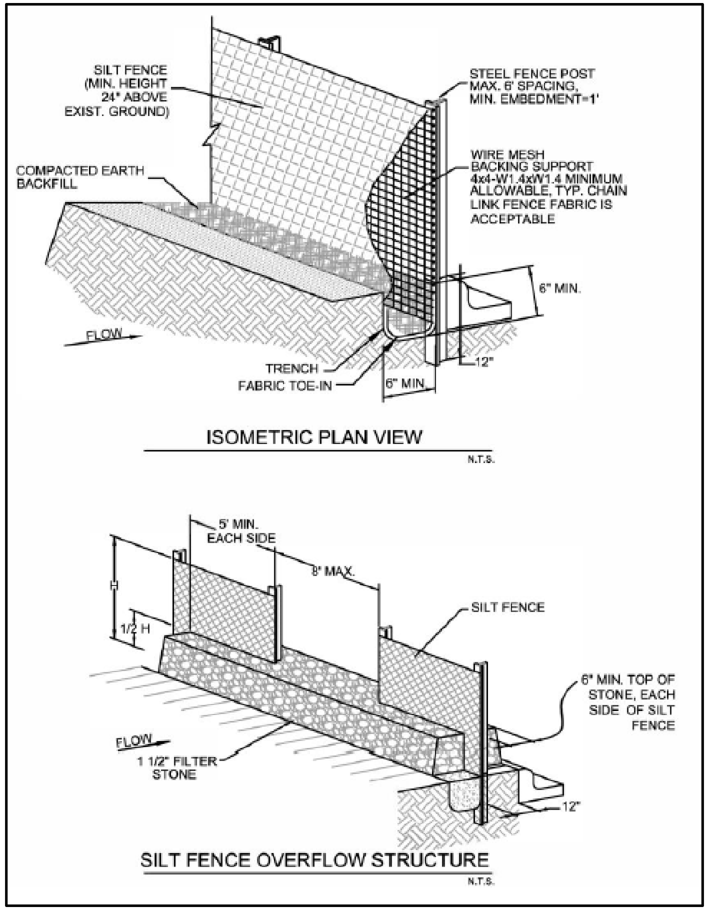
Contact Name:

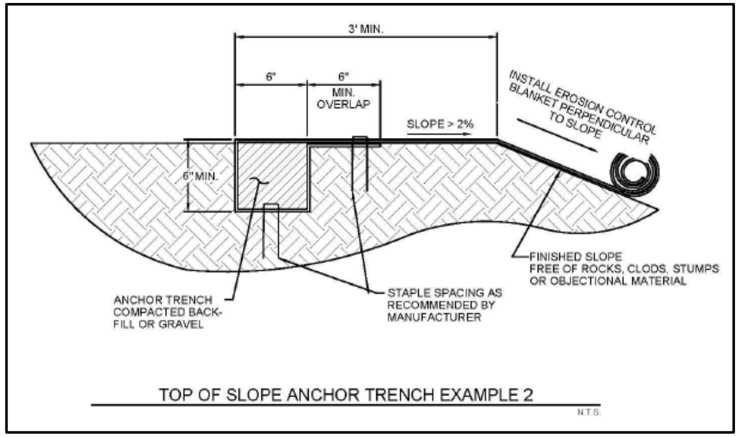
Contact Information:

Prepared by
Program Support and Environmental Assistance Division

RG-639
May 2023

Construction Schematics



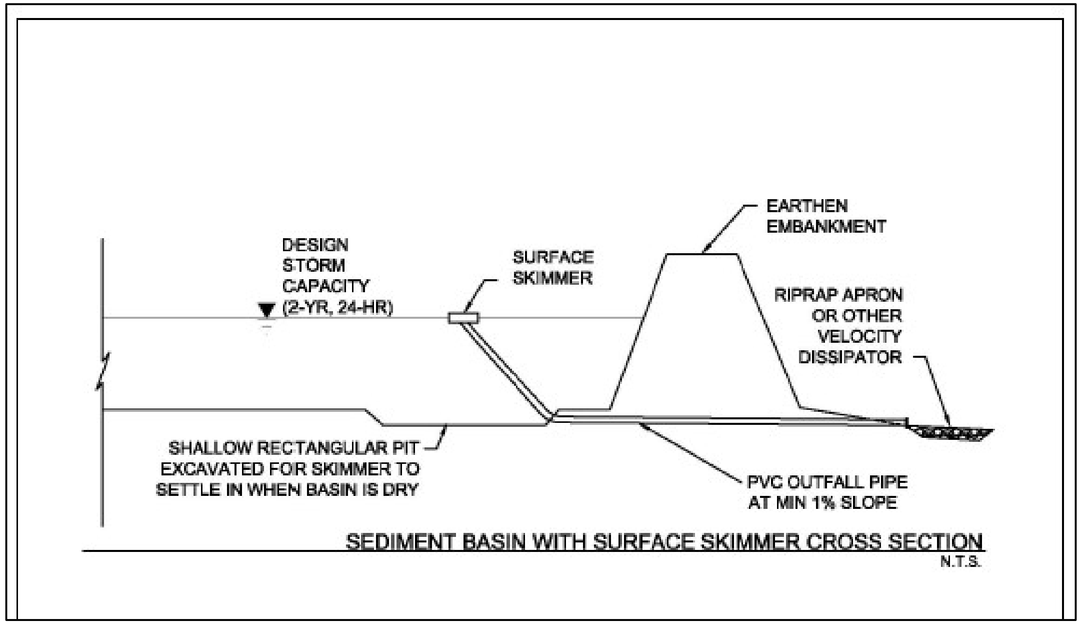


§ 52.40 DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY.

(A) All operators of construction sites shall use the methodology on best management practices from the most current North Central Texas Council of Government best management practices for construction activities manual…

TXR150000 Part III, Section F.2.(c).i.(A).(1):

"…A sedimentation basin or similar impoundment is required, where feasible, for a common drainage location that serves an area with ten (10) or more acres disturbed at one time."



TXR150000 Part III, Section F.2.(c).i.(A).(1):

"…A sedimentation basin or impoundment may be temporary or permanent, and must provide sufficient storage to contain a calculated volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained…"

Does not prescribe:

- Method
- Draw down time

iSWM[TM] Technical Manual Hydrology

1.0 Hydrological Analysis

1.1 Estimating Runoff

1.1.1 Introduction to Hydrologic Methods

Sizing and calculations

1.2 Rational Method

$$Q = CIA \qquad (1.2)$$

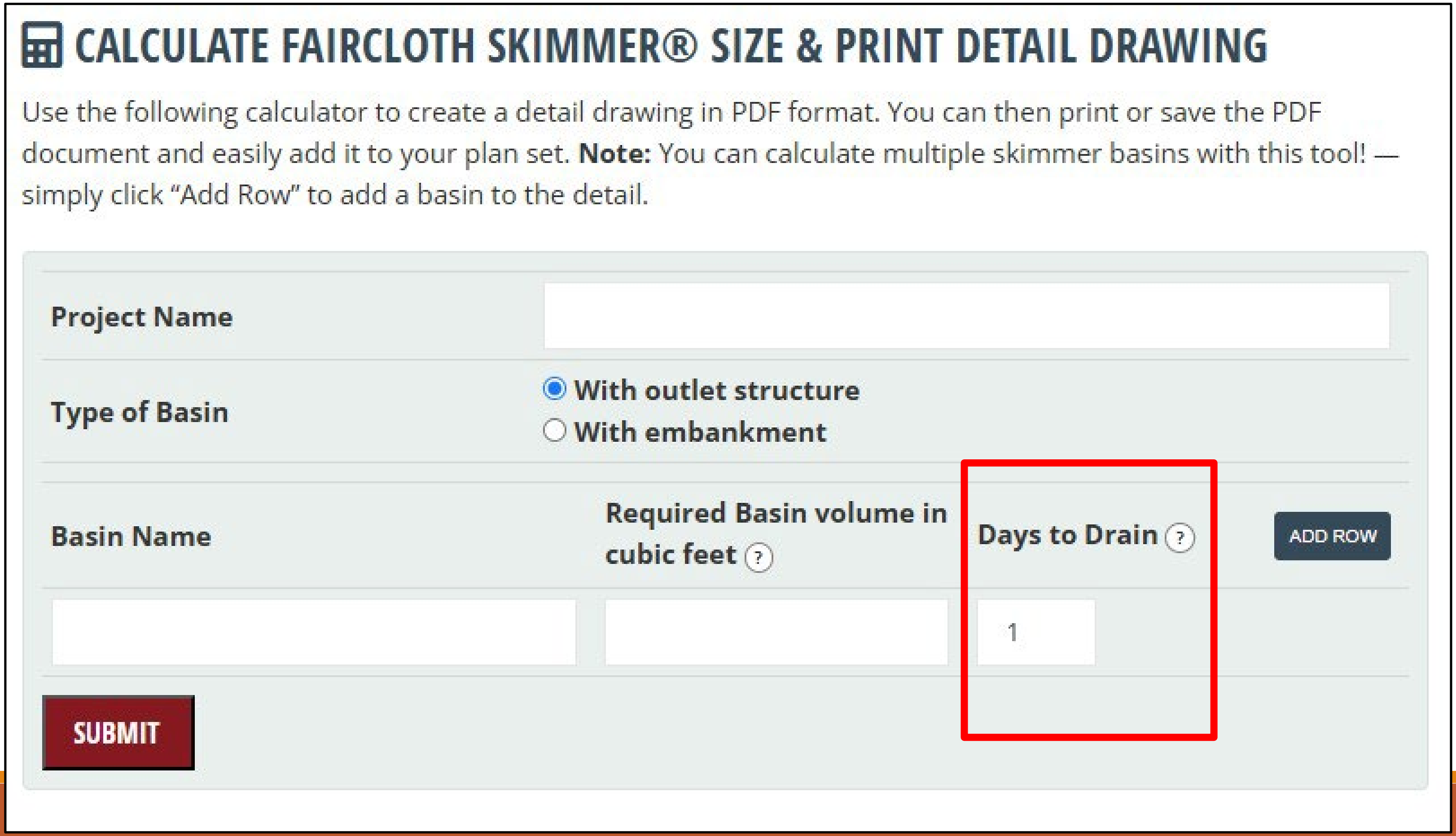
where:

Q	=	maximum rate of runoff (cfs)
C	=	runoff coefficient representing a ratio of runoff to rainfall
I	=	average rainfall intensity for a duration equal to the t_c (in/hr)
A	=	drainage area contributing to the design location (acres)

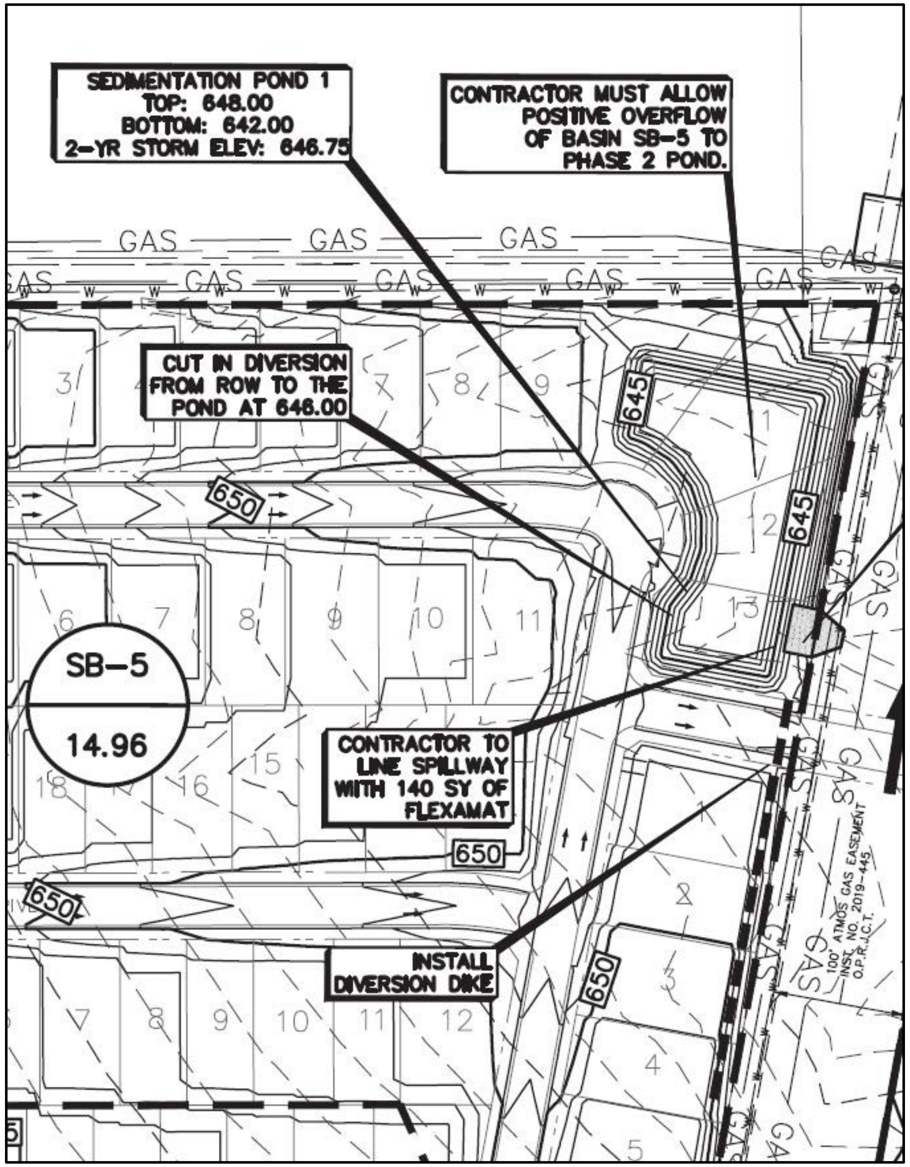
Table 1.6 Recommended Runoff Coefficient Values

Description of Area	Runoff Coefficients (C)
Lawns:	
Sandy soil, flat, 2%	0.10
Sandy soil, average, 2 - 7%	0.15
Sandy soil, steep, > 7%	0.20
Clay soil, flat, 2%	0.17
Clay soil, average, 2 - 7%	0.22
Clay soil, steep, > 7%	0.35
Agricultural	0.30
Forest	0.15
Streams, Lakes, Water Surfaces	1.00
Business:	
Downtown areas	0.95
Neighborhood areas	0.70
Residential:	
Single Family (1/8 acre lots)	0.65
Single Family (1/4 acre lots)	0.60
Single Family (1/2 acre lots)	0.55
Single Family (1+ acre lots)	0.45
Multi-Family Units, (Light)	0.65
Multi-Family, (Heavy)	0.85
Commercial/Industrial:	
Light areas	0.70
Heavy areas	0.80
Parks, cemeteries	0.25
Playgrounds	0.35
Railroad yard areas	0.40
Streets:	
Asphalt and Concrete	0.95
Brick	0.85
Drives, walks, and roofs	0.95
Gravel areas	0.50
Graded or no plant cover:	
Sandy soil, flat, 0 - 5%	0.30
Sandy soil, flat, 5 - 10%	0.40
Clayey soil, flat, 0 - 5%	0.50
Clayey soil, average, 5 - 10%	0.60

The primary outlet shall have a minimum design dewatering time of 36 hours for the temporary control design storm (2-year, 24-hour).



Phasing



Sediment Basin Location and Planning

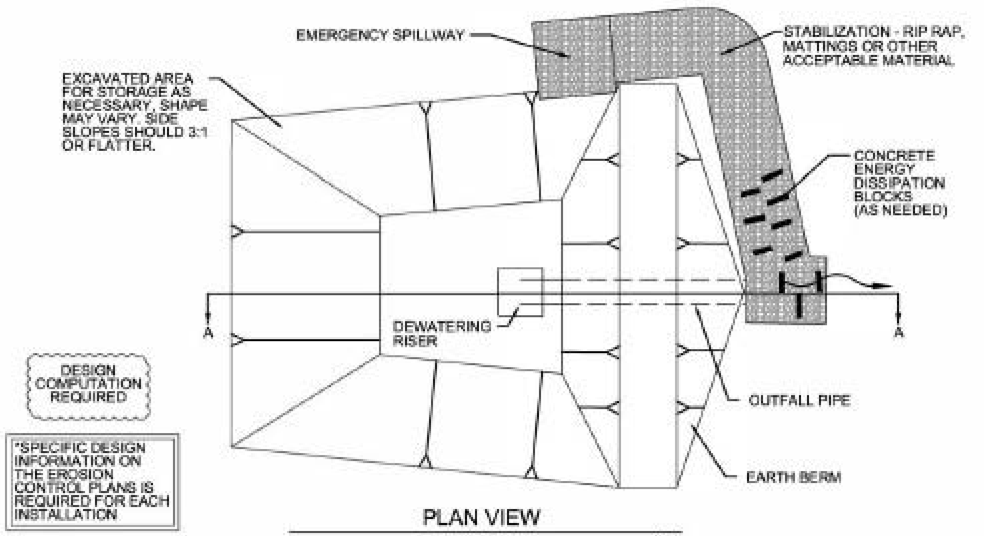
- Design of the sediment basin should be coordinated with design of the permanent drainage infrastructure for the development.
- The basin shall not be located within a mapped 100-year floodplain unless its effects on the floodplain are modeled, and the model results are approved by the reviewing municipality.
- Basins shall not be located on a live stream that conveys stormwater from upslope property through the construction site.
- Basins may be located at the discharge point of a drainage swale that collects runoff from construction activities, or the basin may be located off-channel with a swale or dike constructed to divert runoff from disturbed areas to the basin. Design criteria for these controls are in *Section 2.2 Diversion Dike* and *Section 2.4 Interceptor Swale*.
- Sediment basins must be designed, constructed, and maintained to minimize mosquito breeding habitats by minimizing the creation of standing water.
- Temporary stabilization measures should be specified for all areas disturbed to create the basin.

Phasing

Surface drawdown requirements

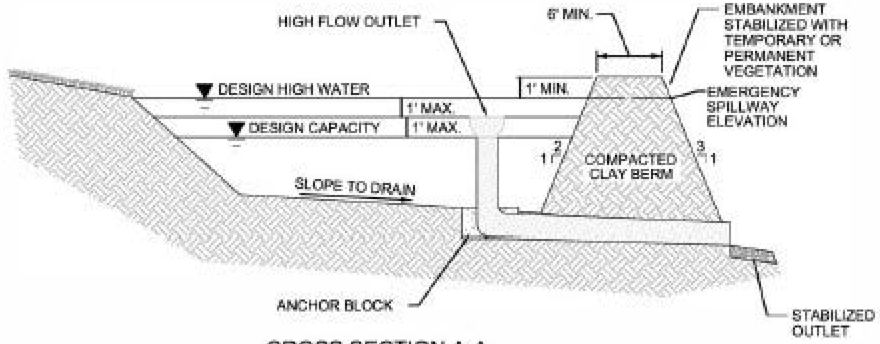
TXR150000 Part III, Section F.2.(c).i.(A).(4):

Unless infeasible, when discharging from sedimentation basins and impoundments, the permittee shall utilize outlet structures that withdraw water from the surface.



PLAN VIEW

N.T.S.



CROSS SECTION A-A

N.T.S.

REFERENCE: NCTCOG iSWM CRITERIA MANUAL FOR SITE DEVELOPMENT AND CONSTRUCTION, SECTION 3.9 SEDIMENT BASIN.

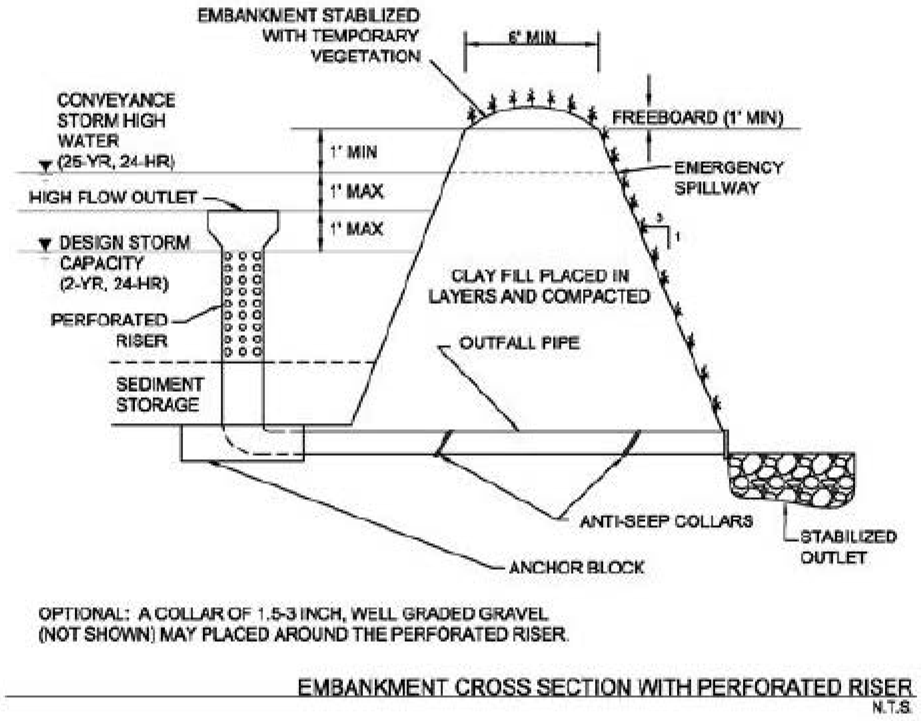


Figure 3.24 Schematic of Basin Embankment with Perforated Riser

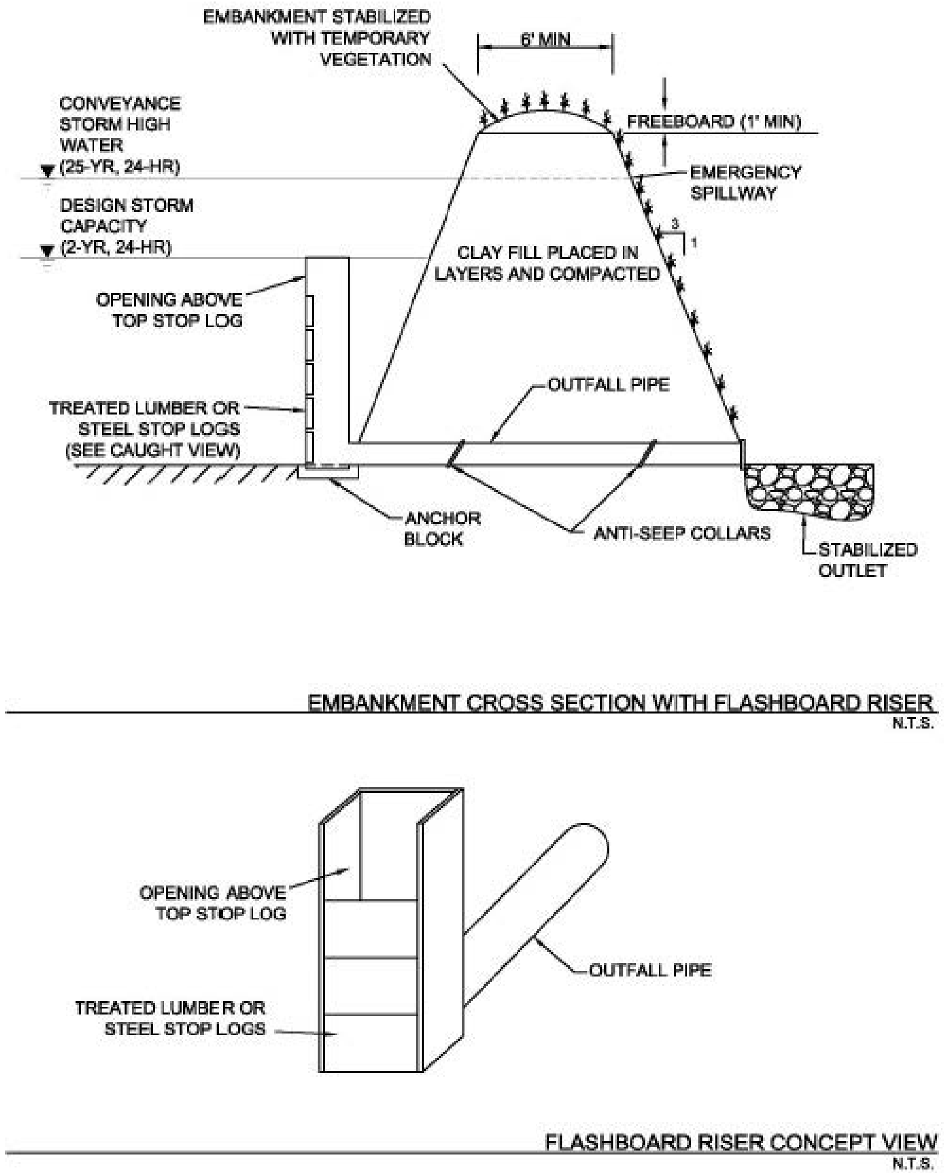
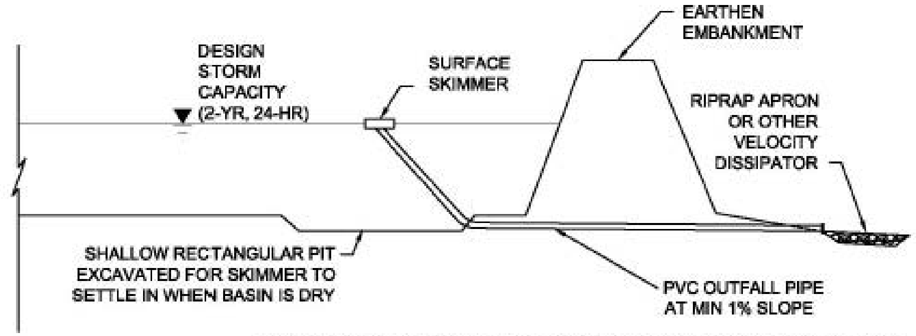
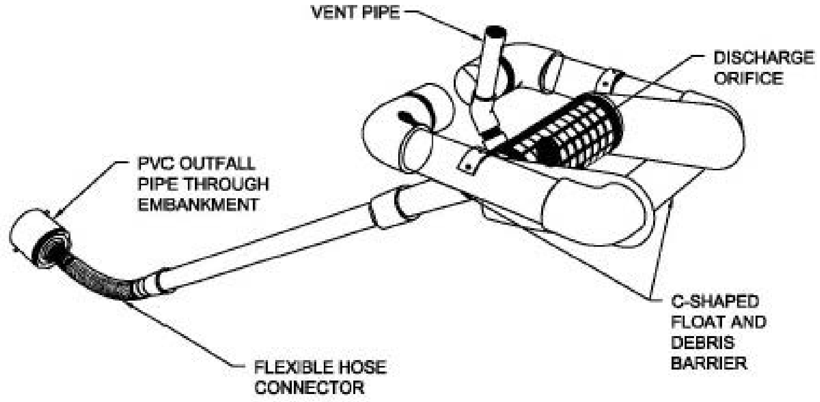


Figure 3.23 Schematics of Basin Embankment with Flashboard Riser



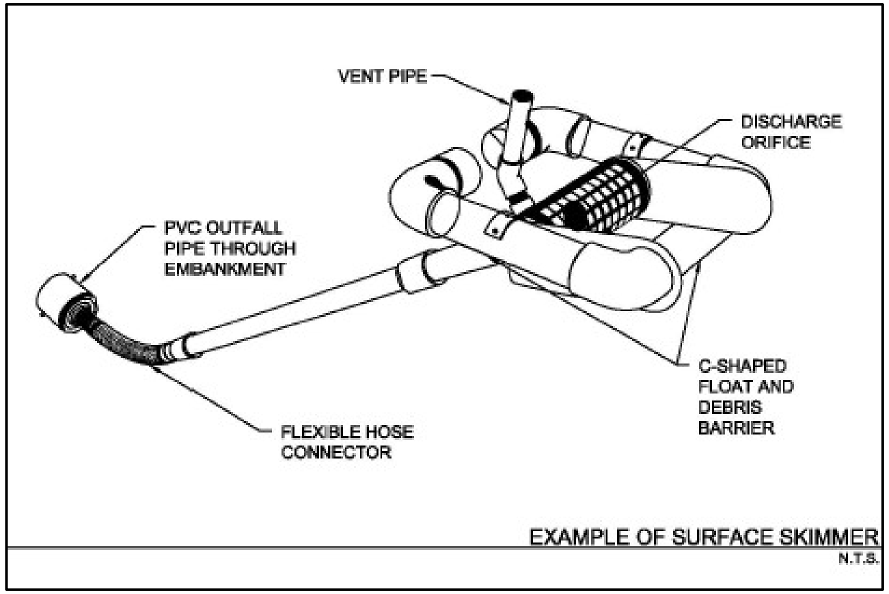
SEDIMENT BASIN WITH SURFACE SKIMMER CROSS SECTION
N.T.S.

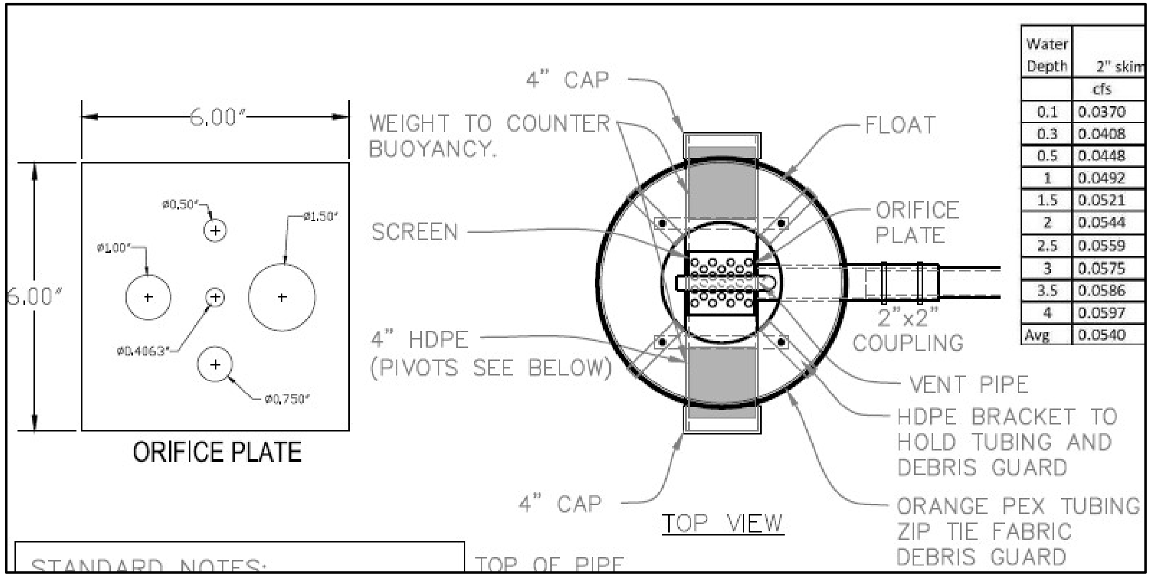


EXAMPLE OF SURFACE SKIMMER
N.T.S.

Figure 3.21 Schematics of Sediment Basin with Surface Skimmer
(Source: J.W. Faircloth & Son, Inc.)

Skimmers



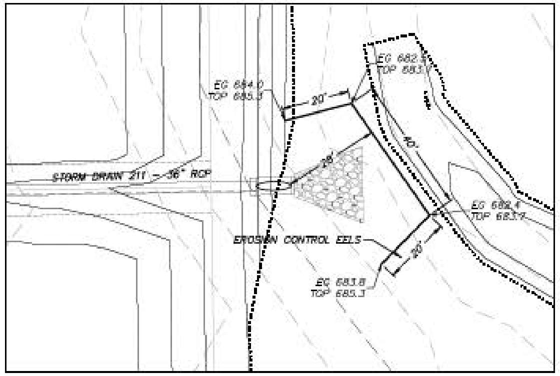


Water Depth	2" skim
	cfs
0.1	0.0370
0.3	0.0408
0.5	0.0448
1	0.0492
1.5	0.0521
2	0.0544
2.5	0.0559
3	0.0575
3.5	0.0586
4	0.0597
Avg	0.0540

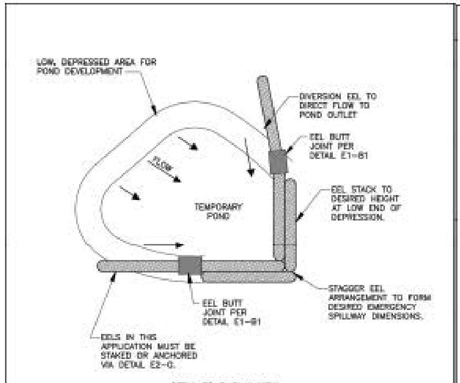
Infeasibility and Equivalent Alternative

TXR150000 Part III, Section F.2.(c).i.(A).(3):

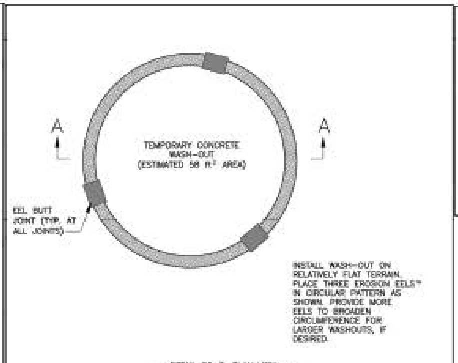
"If a sedimentation basin or impoundment is not feasible, then the permittee shall provide equivalent control measures until final stabilization of the site…"



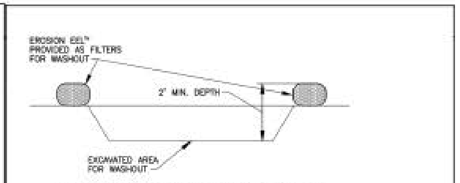
EROSION CONTROL EELS - STORM DRAIN 211



DETAIL E3–F: PLAN VIEW – TEMPORARY DETENTION POND
N.T.S.

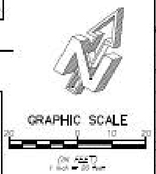


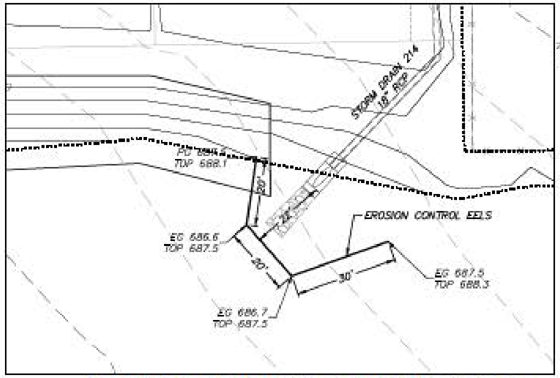
DETAIL E3–G: PLAN VIEW – TEMPORARY CONCRETE WASH–OUT
N.T.S.



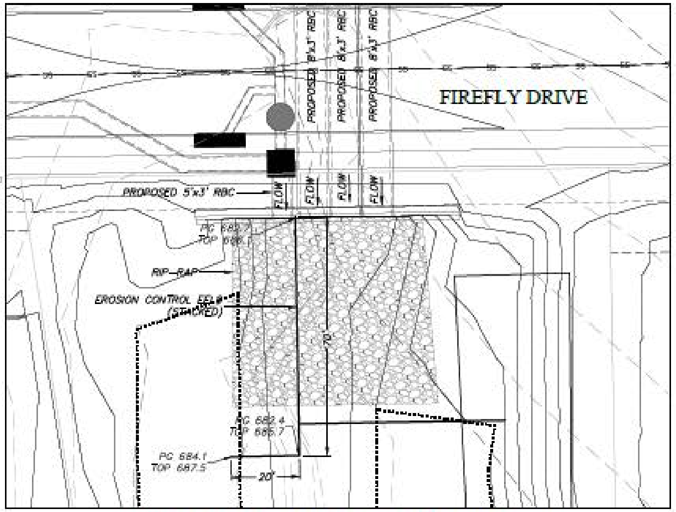
SECTION A FOR DETAIL E3–H: TEMPORARY CONCRETE WASHOUT
N.T.S.

21-010

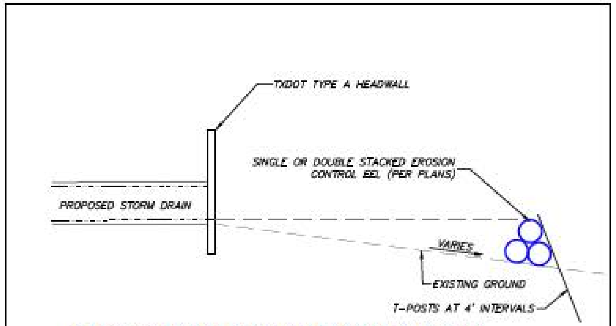




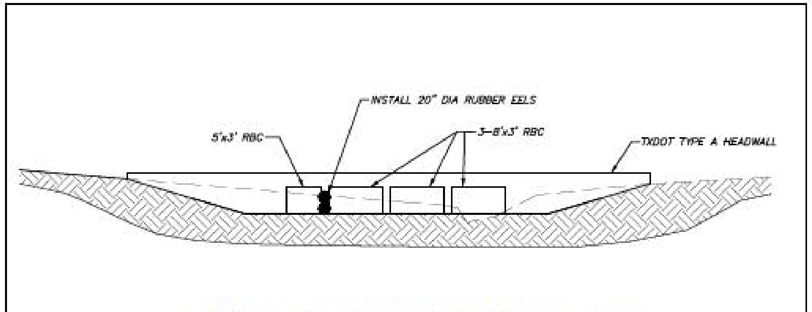
EROSION CONTROL EELS - STORM DRAIN 214



EROSION CONTROL EELS - STORM DRAIN 230



TYPICAL EEL PLACEMENT - PROFILE VIEW
N.T.S.



EEL PLACEMENT FRONT ELEVATION - SD 230
N.T.S.

Special Specification

Erosion Eels™

1. **Description.** Furnish, install, maintain, and remove Erosion Eels™ as shown on plans or as directed.

2. **Materials.**

   1. **Core Material.** Erosion Eels™ shall consist of core, internal filter materials comprised of one of two mixtures:

      I. **Mixture Specification 1.0.** A filter mixture comprised of 100% shredded rubber that has been washed and processed to remove most, if not all, metal components. The material shall be derived from recycled tires and shall be shredded to produce a maximum particle size of +/- ¾ inch.

      II. **Mixture Specification 2.0.** A filter mixture comprised of 100% shredded rubber that has been washed and processed to remove most, if not all, metal components. The material shall be derived from recycled tires and shall be shredded to produce a maximum particle size of +/-2-inches.

   2. **Containment Material.** The containment material for the filter core particles shall be a woven, polypropylene geotextile with UV-stabilizers and inert to biological decay and chemically resistant to naturally occurring chemicals, alkalis, and acids. Minimum fabric permeability shall be equal to or greater than 0.05 cm/sec per ASTM D 4491. Minimum strength retained relative to UV exposure shall be 70% when tested per ASTM D 4355 for 500 hours.

   3. **Size.** Erosion Eels™ shall be produced with a nominal diameter of +/-9.5 inches and +/-20 inches and standard nominal lengths of +/-4.5 feet and +/-10 feet.

3. **Construction.** Install Erosion Eels™ near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the Erosion Eels™ into the erosion control measures used to the control sediment on construction sites. Install, align, and locate the Erosion Eels™ as specified below, as shown on the plans, as direction.

   A. **Stabilizing/Securing.** Secure Erosion Eels™ in a method adequate to prevent displacement as a result of normal rain events and such that flow is not allowed under the bags.

   B. **Maintenance.** Inspect and maintain the Erosion Eels™ in good condition. Maintain the integrity of the control, including keeping the bags free of accumulated silt, debris, etc., until permanent erosion control features are in place, or the disturbed area has been adequately stabilized. Stabilize the areas damaged by the removal process using appropriate methods as approved. Repair or replace damaged Erosion Eels™ as required and as directed. Temporarily remove and replace Erosion Eels™ as required to facilitate work. Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed. Dispose of sediment and debris at an approved site in a manner that will not contribute to additional siltation.

   C. **Removal.** Remove and reuse Erosion Eels™ when directed.

4. **Measurement.** This item will be measured by the linear foot along the centerline of the top of the control bags.

5. **Payment.** The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for a the unit price bid for "Erosion Eels™" of the size specified. This price is full compensation for furnishing, placing, maintaining, temporarily removing and replacing as required to facilitate construction operations, and removing of the bags and for all other materials, labor, tools, equipment, and incidentals.

End-of Section

Note: Specifications are subject to revisions at the discretion of the Manufacturer.

Alternative Minimum?

TXR150000 Part III, Section F.2.(c).i.(A).(2):

“Where rainfall data is not available, or a calculation cannot be performed, the sedimentation basin must provide at least 3,600 cubic feet of storage per acre drained until final stabilization of the site.”

Table 5.15 AMS-based precipitation frequency estimates for Tarrant County (inches)

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.405	0.439	0.572	0.673	0.807	0.909	1.012	1.117	1.261	1.371
10-min	0.649	0.704	0.919	1.081	1.297	1.462	1.627	1.791	2.008	2.171
15-min	0.807	0.875	1.137	1.336	1.601	1.801	2.004	2.212	2.493	2.711
30-min	1.117	1.210	1.570	1.842	2.203	2.475	2.752	3.041	3.436	3.746
60-min	1.449	1.572	2.047	2.408	2.888	3.248	3.619	4.011	4.553	4.983
2-hr	1.773	1.935	2.555	3.031	3.671	4.159	4.669	5.215	5.977	6.588
3-hr	1.966	2.154	2.871	3.423	4.173	4.752	5.361	6.013	6.930	7.668
6-hr	2.323	2.558	3.446	4.135	5.077	5.810	6.586	7.419	8.591	9.536
12-hr	2.733	3.016	4.089	4.919	6.051	6.928	7.852	8.840	10.224	11.336
24-hr	3.191	3.522	4.776	5.747	7.069	8.096	9.175	10.321	11.921	13.201
48-hr	3.692	4.063	5.447	6.532	8.033	9.225	10.488	11.816	13.663	15.136
3-day	4.018	4.417	5.901	7.067	8.686	9.976	11.348	12.792	14.805	16.411
4-day	4.258	4.680	6.252	7.488	9.204	10.573	12.030	13.569	15.716	17.433
7-day	4.771	5.249	7.037	8.438	10.375	11.908	13.541	15.281	17.726	19.693
10-day	5.216	5.736	7.688	9.211	11.306	12.950	14.699	16.573	19.213	21.343
20-day	6.739	7.340	9.640	11.404	13.780	15.588	17.492	19.564	22.505	24.891
30-day	8.012	8.684	11.283	13.257	15.883	17.846	19.898	22.138	25.318	27.899
45-day	9.755	10.569	13.712	16.103	19.289	21.690	24.175	26.822	30.508	33.449
60-day	11.294	12.248	15.917	18.720	22.477	25.346	28.296	31.362	35.554	38.840

Post Construction

When to decommission?

Technical issues may arise…

Post-construction Water Quality

TSS removal and state guidance

Calculations

Inspections

Dry Ponds

Wet Ponds

Separators

TSS Removal

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

TXR040000, Part IV, Section D.5.(b).(1)

MCM 5

"All permittees shall develop, implement, and enforce a program… to control stormwater discharges from new development…"

But no specific guidance regarding

- Which pollutant
- What threshold

integrated Stormwater Management iSWM

TSS - Pollutant of Concern

Primary controls achieve 80% TSS removal

Table 1.2 Design Pollutant Removal Efficiencies for Stormwater Controls (Percentage)

Structural Control	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Fecal Coliform	Metals
Bioretention Areas	80	60	50	---	80
Grass Channel	50	25	20	---	30
Enhanced Dry Swale	80	50	50	---	40
Enhanced Wet Swale	80	25	40	---	20
Alum Treatment	80	80	60	90	75
Filter Strip	50	20	20	---	40
Dry Detention	65	50	30	70	---
Organic Filter	80	60	40	50	75
Planter Boxes	80	60	40	50	60
Sand Filters	80	50	25	40	50
Underground Sand Filter	80	50	25	40	50
Gravity (Oil-Grit) Separator	40	5	5	---	---
Downspout Drywell	80	60	60	90	90
Infiltration Trench	80	60	60	90	90
Soakage Trench	80	60	60	90	90
Stormwater Ponds	80	50	30	70*	50
Green Roof	85	---	25	---	95
Modular Porous Paver Systems with infiltration	**	80	80	---	90
Porous Concrete with infiltration	**	50	65	---	60
Proprietary Systems	***	***	***	***	***
Rain Harvesting	---	---	---	---	---
Stormwater Wetlands	80	40	30	70*	50
Submerged Gravel Wetland	80	50	20	70	50

Table 1.3 Structural Control Screening Matrix

Category	On-Site Storm Water Controls	STORM WATER TREATMENT SUITABILITY				WATER QUALITY PERFORMANCE				SITE APPLICABILITY					IMPLEMENTATION CONSIDERATIONS			
		Water Quality Protection	Streambank Protection	On-Site Flood Control	Downstream Flood Control	TSS/ Sediment Removal Rate	Nutrient Removal Rate (TP/TN)	Bacteria Removal Rate	Hotspot Application	Drainage Area (acres)	Space Req'd (% of tributary imp. Area)	Site Slope	Minimum Head Required	Depth to Water Table	Residential Subdivision Use	High Density/Ultra Urban	Capital Cost	Maintenance Burden
Bioretention Areas	Bioretention Areas	P	S	S	-	80%	60%/50%	-	✓	5 max***	5-7%	6% max	5 ft	2 feet	✓	✓	Moderate	Low
Channels	Enhanced Swales	P	S	S	S	80%	25%/40%	-	✓	5 max	10-20%	4% max	1 ft	below WT	✓		High	Low
	Channels, Grass	S	S	P	S	50%	25%/20%	-							✓		Low	Moderate
	Channels, Open	-	-	P	S	-	-	-							✓		Low	Low
Chemical Treatment	Alum Treatment System	P	-	-	-	90%	80%/60%	90%	✓	25 min	None				✓	✓	High	High
Conveyance	Culverts	-	-	P	P	-	-	-							✓	✓	Low	Low
	Energy Dissipation	-	P	S	S	-	-	-							✓	✓	Low	Low

Table 1.3 Structural Control Screening Matrix

✓ - Meets suitability criteria

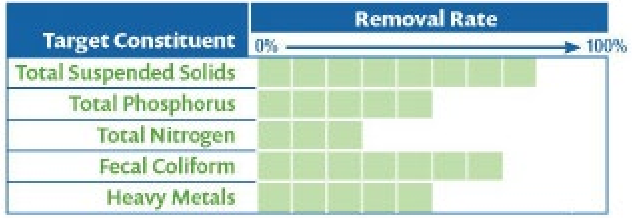
P - Primary Control, meets suitability criteria

S - Secondary Control, can be incorporated into the structural control in certain situations

Primary

Stormwater Ponds

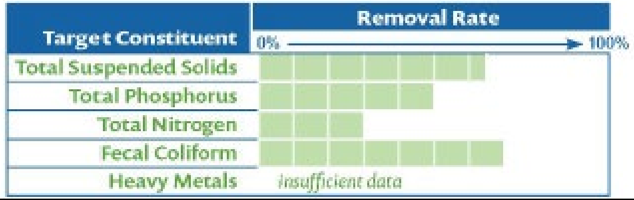
Stormwater Pond in San Antonio, TX. *(Source: Tetra Tech)*



Secondary?

Extended Detention Dry Basins

Dry Detention Facility in San Antonio, TX. *Source: Halff*



Calculations

iSWM™ Technical Manual — Water Quality

Water Quality:

1.0 Water Quality Protection Volume and Peak Flow
2.0 Construction SWPPP Guidelines and Form

$$WQ_v = \frac{1.5 R_v A}{12} \qquad (1.2)$$

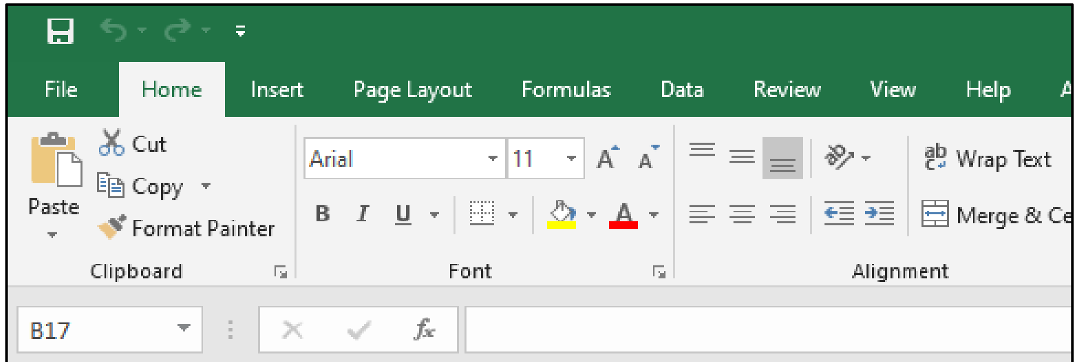
where:

- WQ_v = water quality protection volume (acre-feet)
- R_v = volumetric runoff coefficient
- A = total drainage area (acres)

$$Q_{wq} = q_u * A * Q_{wv}$$

where:

- Q_{wq} = the water quality peak discharge (cfs)
- q_u = the unit peak discharge (cfs/mi²/inch)
- A = drainage area (mi²)
- Q_{wv} = Water Quality Protection Volume, in inches ($1.5R_v$)



	A	B
1		
2	**Impervious area (I value)**	
3	Total drainage area (acres)	2.42
4	Impervious area	1.45
5	Percent Impervious	60%
6		
7	**WQv**	
8	Drainage area in acres "A"	2.42
9	Percent Impervious "I" expressed as a decimal	0.60
10	Volumetric Runoff Coefficeint "R_v" = 0.05+(0.009*I)	0.59
11	WQ_v = (1.5*R_v*A)/12 (acre-feet)	0.18
12	Water Quality Protection ~~Volume~~ *Depth* "Q_{wv}" (inches) = 1.5*R_v	0.89
13	WQv in Ft^3 = ((1.5*Rv*A)/12) * 43560	7774.37
14	q_u = unit peak discharge (cfs/mi²/in) (from Figure 1.10 Hydrology TM pg 32)	856
15	**Q_{wq} = Peak Discharge (cfs) = q_u * A * Q_{wv}**	2.86
16	Contech SCX-05	2.84

iSWM™ Technical Manual — Hydrology

Hydrology:

1.0 Hydrological Analysis
2.0 Downstream Assessment
3.0 Streambank Protection
4.0 Water Balance
5.0 Rainfall Tables
6.0 Hydrologic Soils Data

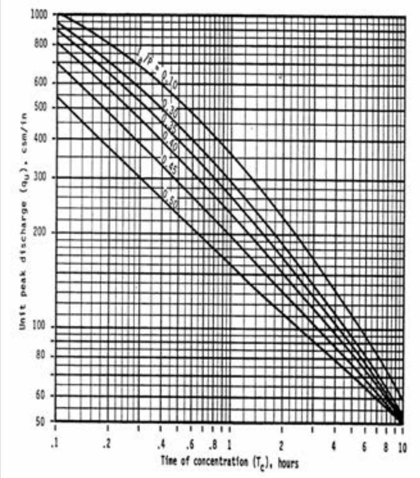


Figure 1.10 SCS Type II Unit Peak Discharge Graph
(Source: SCS, TR-55, Second Edition, June 1986)

Inspections

TXR040000, Part IV, Section D.5.(b).(2)

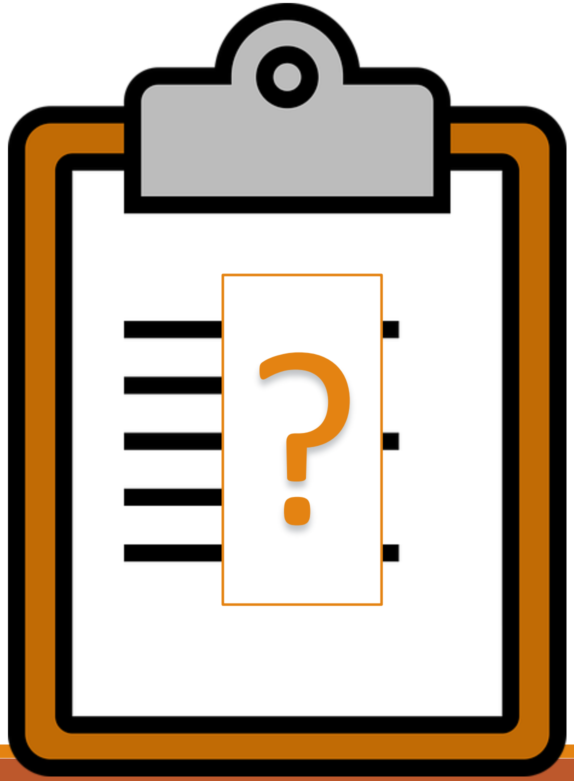
Each year, require 100% of the owners or operators of any new development or redeveloped sites to develop and implement a maintenance plan addressing maintenance requirement for any structural control measures installed on site.

Require the site owner or operators to maintain documentation, such as a tracking log, onsite of 100% of the maintenance performed and made available for review by the small MS4 operator or TCEQ within 24 hours of the request.

22.7 Inspection and Maintenance Requirements

Table 22.1 Typical Maintenance Activities for Ponds
(Source: WMI, 1997)

Activity	Schedule
• Clean and remove debris from inlet and outlet structures. • Mow side slopes. • Check visually for illegal dumping or other pollutants.	Monthly
• If wetland components are included, inspect for invasive vegetation.	Semiannual Inspection
• Inspect for damage, paying particular attention to the control structure. • Check for signs of eutrophic conditions. • Note signs of hydrocarbon build-up, and remove appropriately. • Monitor for sediment accumulation in the facility and forebay. • Examine to ensure that inlet and outlet devices are free of debris and operational. • Check all control gates, valves or other mechanical devices. • Check downstream face of dam for seepage (earth and concrete), settling (earth) and cracking (concrete).	Annual Inspection
• Repair undercut or eroded areas.	As Needed
• Perform wetland plant management and harvesting.	Annually (if needed)
• Remove sediment from the forebay.	5 to 7 years or after 50% of the total forebay capacity has been lost
• Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly, or the pond becomes eutrophic.	10 to 20 years or after 25% of the permanent pool volume has been lost



Dry Ponds

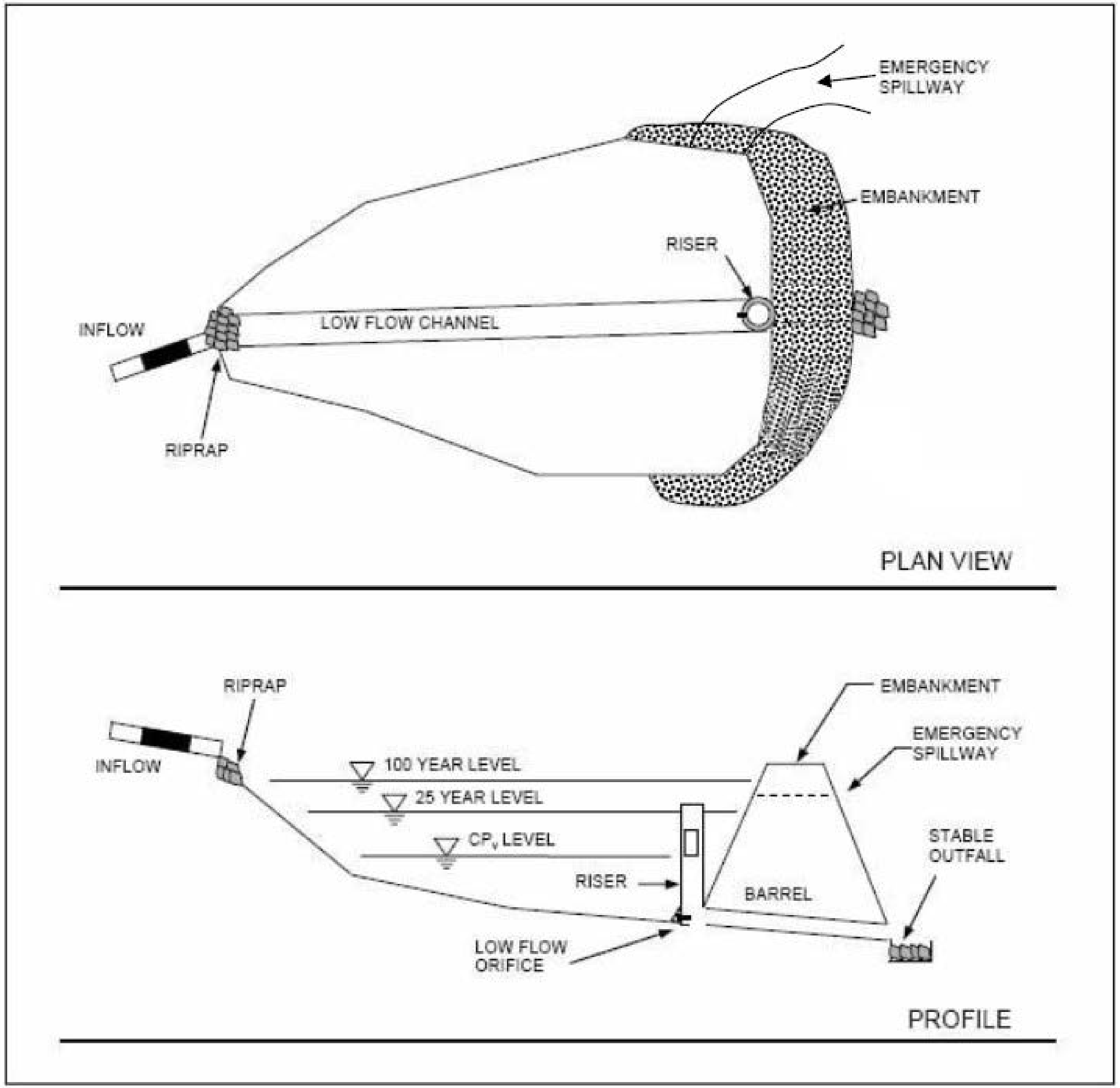


Figure 10.2 Schematic of Dry Extended Detention Basin

Dry Ponds – extended detention orifice

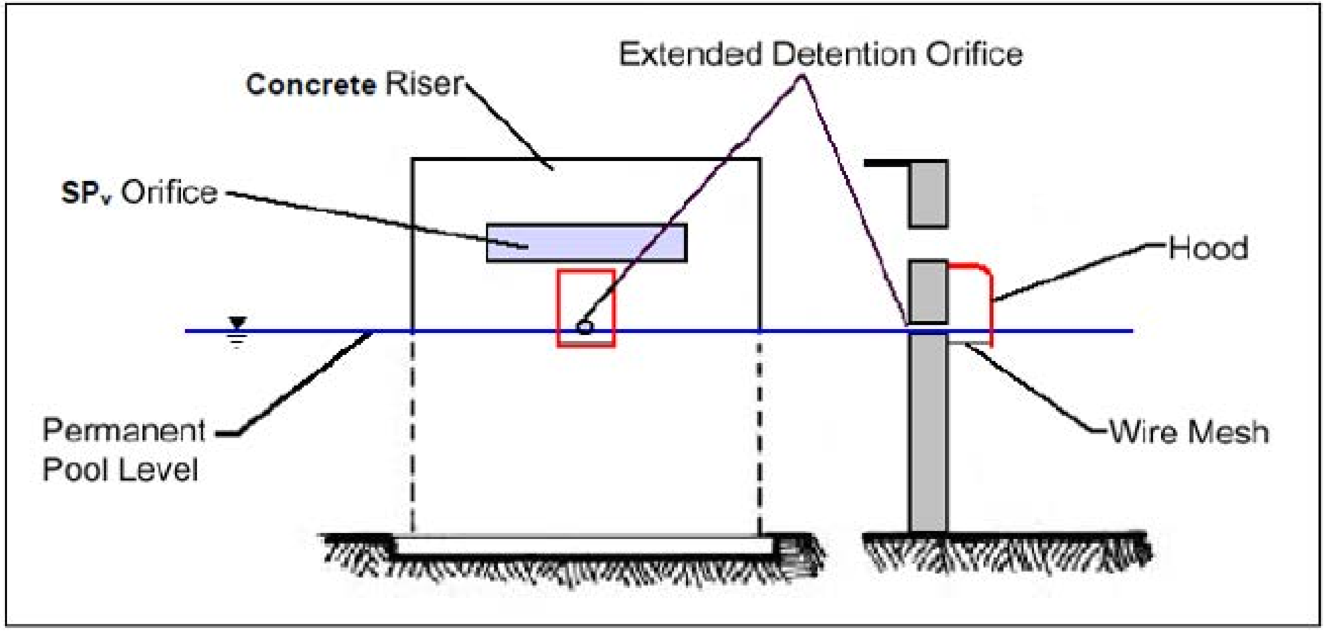


Figure 2.20 Hooded Outlet

Dry Ponds – internal orifice riser pipes

Internal orifice protection through the use of an over-perforated vertical stand pipe with ½-inch orifices or slots that are protected by wirecloth and a stone filtering jacket (see Figure 2.22).

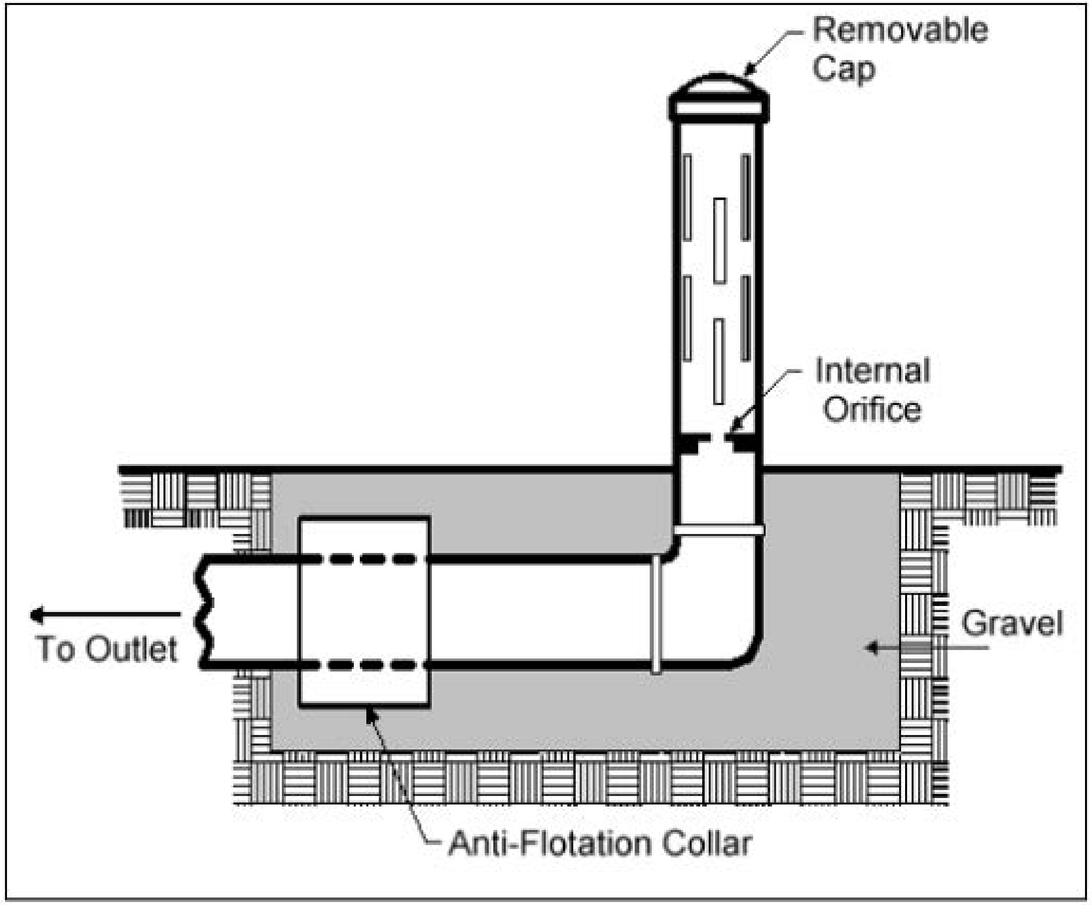


Figure 2.22 Internal Control for Orifice Protection



Dry Ponds – trash racks with hinges

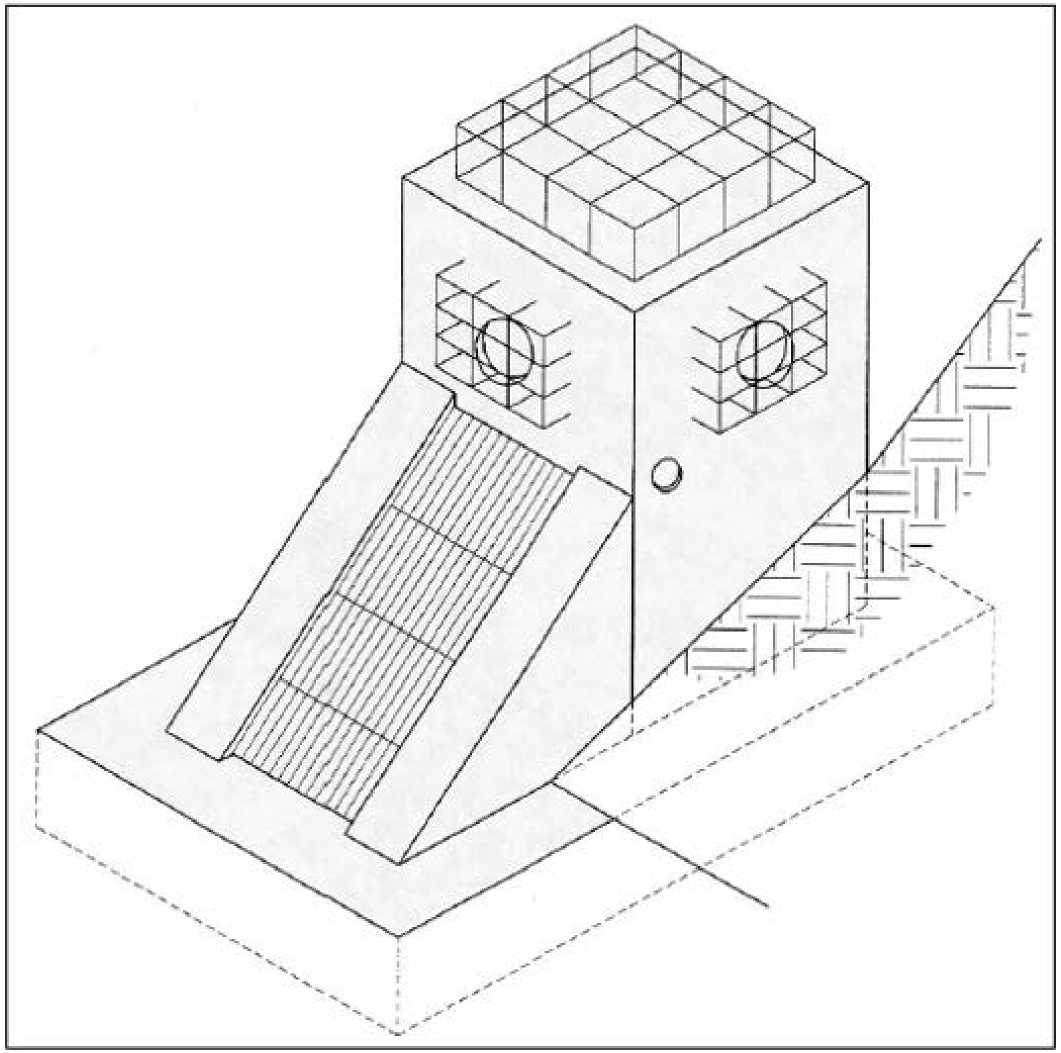
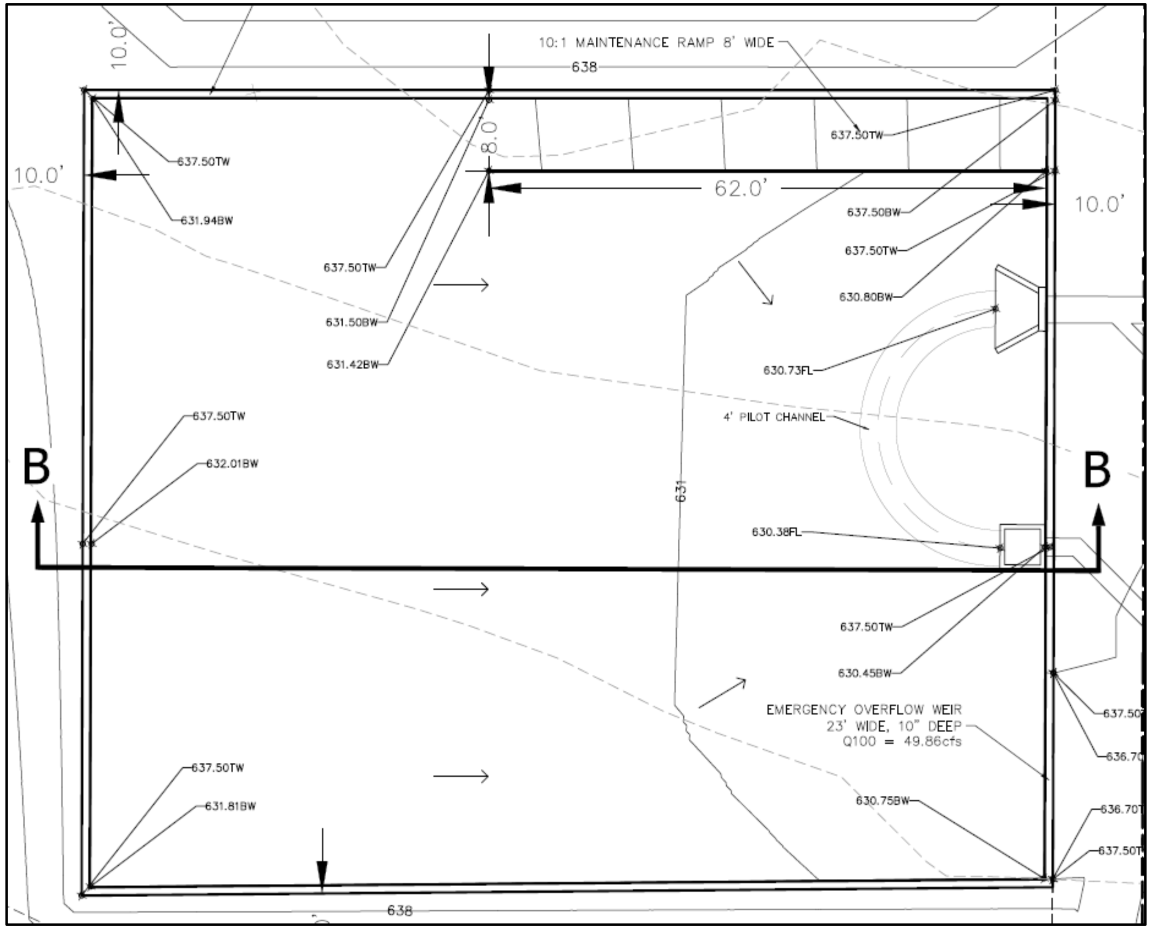


Figure 2.23 Example of Various Trash Racks Used on a Riser Outlet Structure
(Source: VDCR, 1999)


Dry Ponds – short circuiting



Wet Ponds

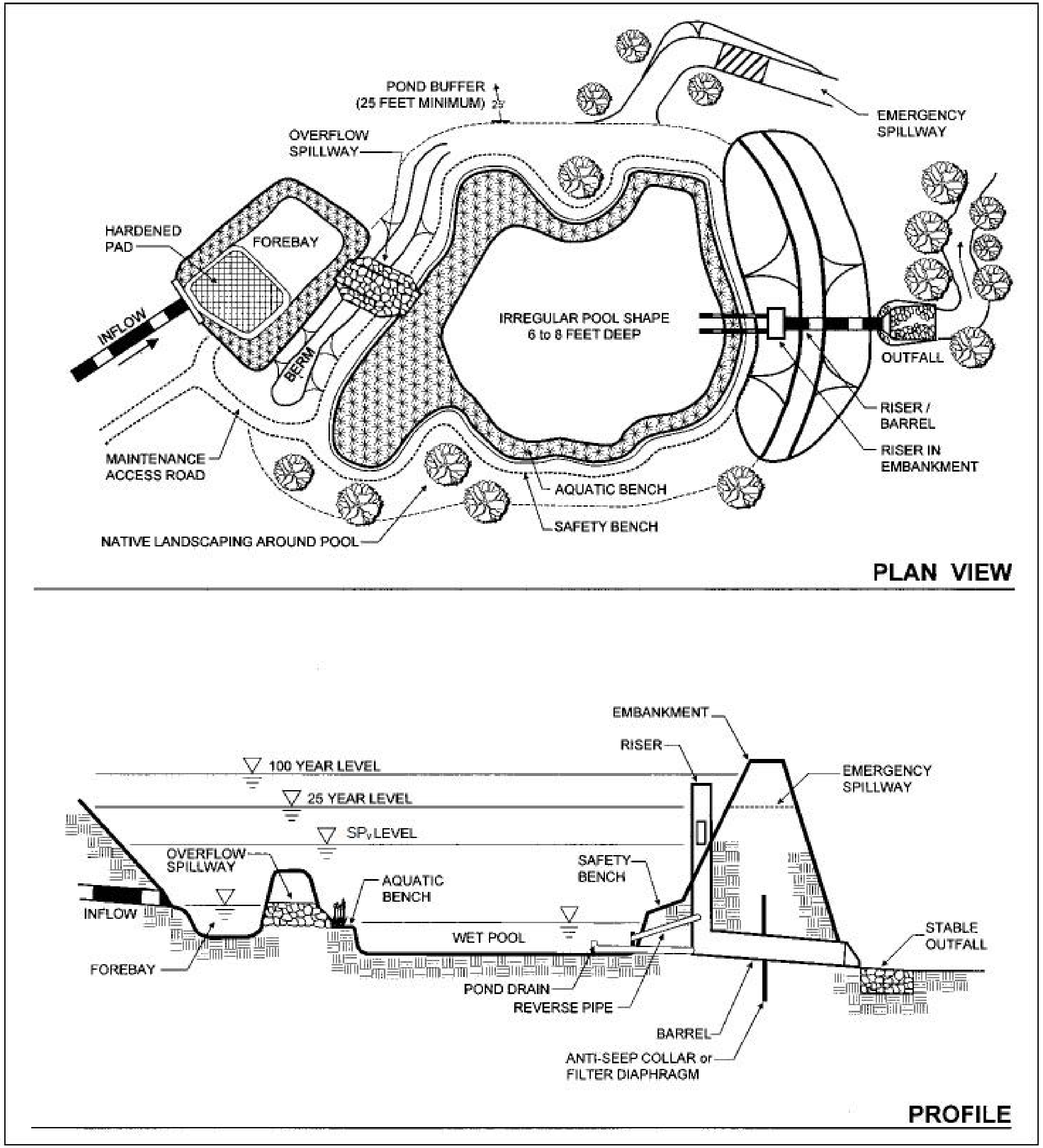


Figure 22.4 Schematic of Wet Pond
(Source: Center for Watershed Protection)

Wet Ponds – concrete forebays

Wet Ponds – *inspecting* concrete forebays

Wet Ponds – concrete forebays mistakes

Wet Ponds – cleaning concrete forebays

Wet Ponds – access to concrete forebays

Wet Ponds – vegetation

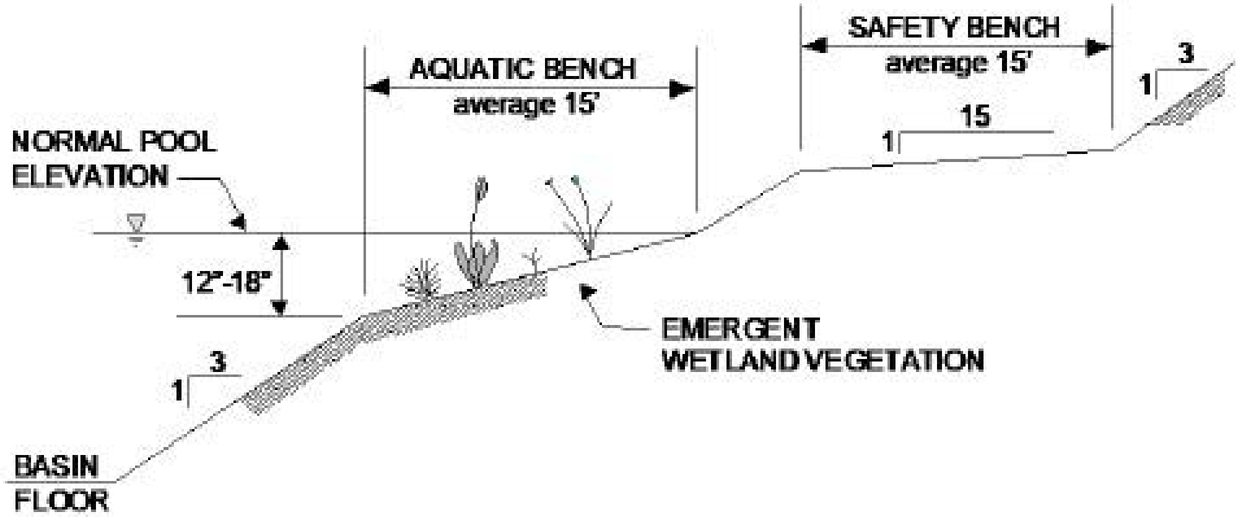


Figure 22.2 Typical Stormwater Pond Geometry Criteria

Wet Ponds – vegetation

1.5 Specific Landscaping Criteria for Structural Stormwater Controls

1.5.1 Stormwater Ponds and Wetlands

Figure 1.3 Legend of Hydrologic Zones Around Stormwater Facilities

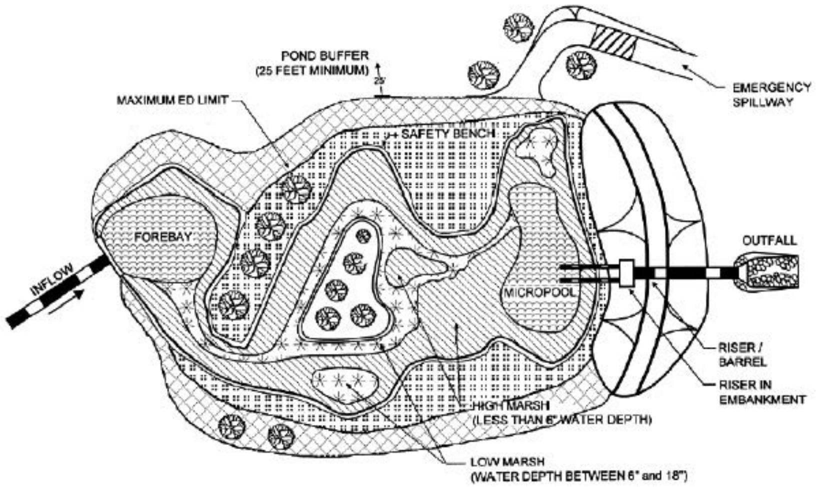


Table 1.2 Wetland Plants (Herbaceous Species) for Stormwater Facilities

Scientific Name	Common Name	Hydrologic Zone
Acorus calumus	Sweetflag	2
Andropogon gerardii	Big Bluestem	6
Andropogon glomeratus	Bushy Broom Grass	3

Separators

iSWM™ Technical Manual — Site Development Controls

26.0 Proprietary Structural Controls

Limited Application
Structural Stormwater Control

Description: Manufactured structural control systems available from commercial vendors designed to treat stormwater runoff and/or provide water quantity control

KEY CONSIDERATIONS

DESIGN CRITERIA:

- Independent performance data must be available to prove a demonstrated capability of meeting stormwater management goal(s)
- System or device must be appropriate for use in North Central Texas conditions, and specifically for the community in question
- Pre-treat runoff if sediment present

ADVANTAGES / BENEFITS:

- Provides reduction in runoff volume

DISADVANTAGES / LIMITATIONS:

- Depending on the proprietary system, there may be:
  - Limited performance data
  - Application constraints
  - High maintenance requirements
  - Higher costs than other structural control alternatives
- Installation and operations/maintenance requirements must be understood by all parties approving and using the system or device in question

STORMWATER MANAGEMENT SUITABILITY

- S Water Quality Protection
- S Streambank Protection
- S On-Site Flood Control
- S Downstream Flood Control

IMPLEMENTATION CONSIDERATIONS

- L Land Requirement
- H Capital Cost
- H Maintenance Burden

Residential Subdivision Use: Depends on the specific proprietary structural control

High Density/Ultra-Urban: Yes

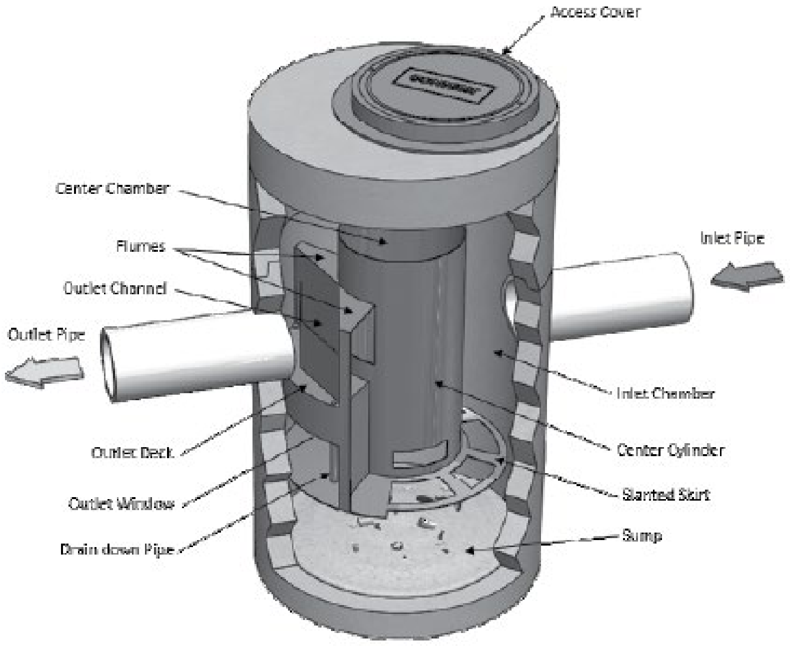
Drainage Area: Depends on the specific proprietary structural control.

Soils: No restrictions

L=Low M=Moderate H=High

Note: It is the policy of this Manual not to recommend any specific commercial vendors for proprietary systems. However, this section is being included in order to provide communities with a rationale for approving the use of a proprietary system or practice in their jurisdictions.

How big do they need to be?



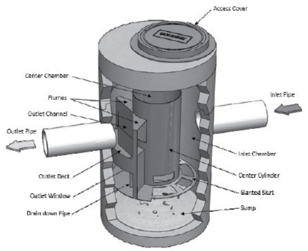


Image from the Contech Cascade Separator Inspection and Maintenance Guide
https://dep.nj.gov/wp-content/uploads/stormwater/mtd-pdfs/cascade_separator_maintenance_plan.pdf

Separators

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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S	**Downstream Flood Control**

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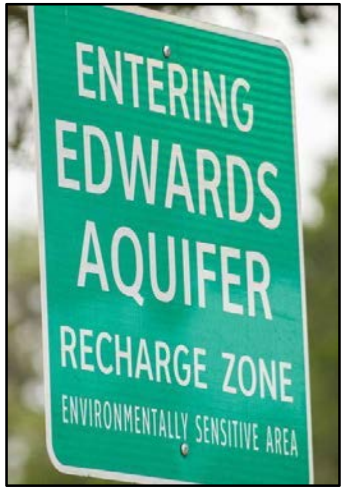
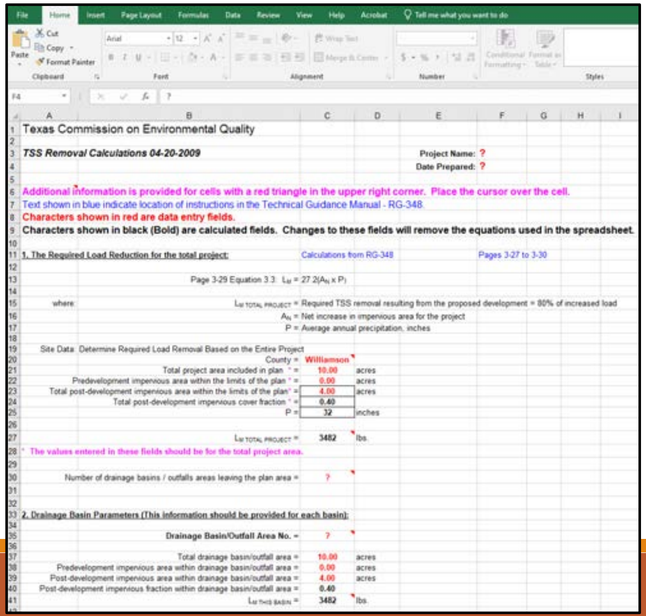


Rule for 80% removal

30TAC§213.5(b)(4)(D)(ii)(I):

BMPs and measures must be implemented to control the discharge of pollution from regulated activities after the completion of construction. These practices and measures must be designed, constructed, operated, and maintained to insure that 80% of the incremental increase in the annual mass loading of total suspended solids from the site caused by the regulated activity is removed. These quantities must be calculated in accordance with technical guidance prepared or accepted by the executive director.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY



Separators

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DFW - ?

Separators

iSWM™ Technical Manual — Site Development Controls

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NJCAT Corporation for Advanced Technology

- About Us
- Verification Process

Technology Verification Database

Stormwater Technologies: Laboratory Verified and

Hydrodynamic Separator (HDS) MTDs

HDS MTDs treat stormwater by enhancing particulate sedimentatio

Company	Product		
BioMicrobics Inc.	BioSTORM Stormwater Treatment System		
Hydro International	DryScreen Next Generation Baffle Box		
Hydro International	Hydro-Shield Advance Plus		
Hydro International	Hydro-Shield Advanced HDS Scaling Addendum		
Oldcastle Infrastructure	Nutrient Separating Baffle Box	January 2025	Download
S&M Precast, Inc.	Ocean Guardian Stormwater Treatment Device	May 2020	Download
StormTrap LLC	StormSettler HydroDynamic Separator	December 2022	Download
Upstream Technologies	SAFL Baffle	October 2023	Download
Xerxes	HydroChain Prime Separator	August 2023	Download

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Department of Environmental Protection

Post-Construction Stormwater Management (N.J.A.C. 7:8)

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Stormwater Manufactured Treatment Devices

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Regulations & Permits > Guidance & technical assistance > Stormwater permittee guidance & resources > Emerging stormwater treatment technologies (TAPE)

- Guidance & technical assistance
  - Stormwater permittee guidance & resources
  - Emerging stormwater treatment technologies (TAPE)

Emerging stormwater treatment technologies (TAPE)

Stormwater treatment technologies are reviewed and certified by the Washington state Technology Assessment Protocol - Ecology — better known as the TAPE program.

Separators

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			Download
			Download
			Download

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Stormwater Manufactured Treatment Devices

50% TSS removal

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Inspections (and plan review)

Key lessons:

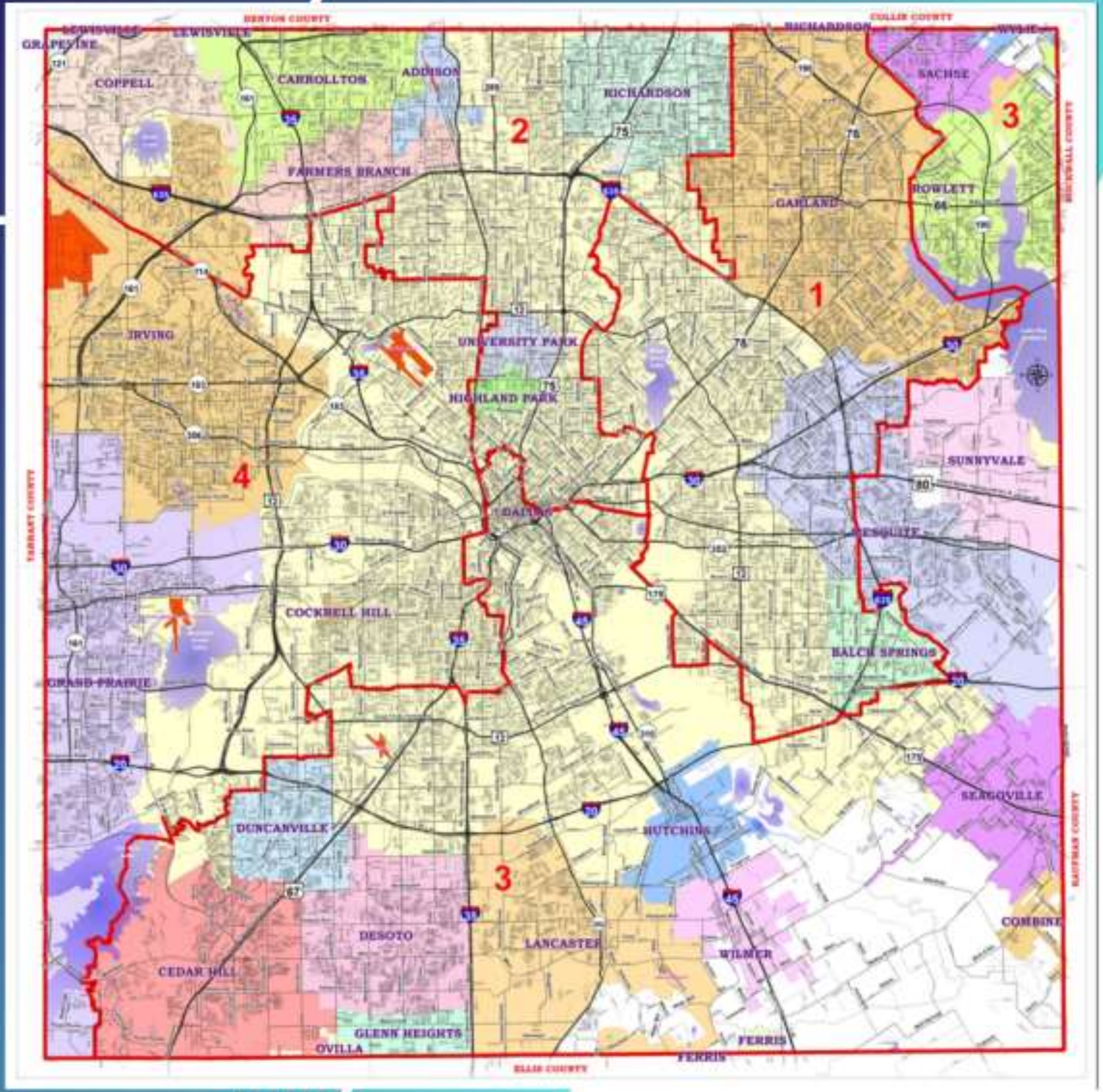
- Construction details/schematics mater
- Know where the issues are
- Strength in consistency
- Usefulness of the Technical Manuals

Questions?

Julian Holmes
Stormwater Coordinator
Environmental Services
City of Mansfield
817-276-4241
Julian.holmes@mansfieldtexas.gov

Monday March 3, 2025

iSWM at Dallas County



DALLAS COUNTY
COMMISSIONER COURT

County Judge
Judge Clay Jenkins

Commissioner District 1
Dr. Theresa Daniel

Commissioner District 2
Andy Sommerman

Commissioner District 3
John Wiley Price

Commissioner District 4
Dr. Elba Garcia

MISSION • VISION • VALUES

DALLAS COUNTY

Mission

Deliver exceptional services that promote a thriving community

Vision

Improving people's lives

Values

- Professionalism
- Customer Focus
- Diversity & Inclusion

DALLAS COUNTY PUBLIC WORKS

MISSION • VISION • VALUES

To improve the quality of life of our customers-- the citizens, taxpayers, transportation users, communities, and internal County partners -- by effectively planning, developing, implementing and administering approved regional transportation projects, supporting maintenance of countywide roads and bridges, and providing real property management services.

To be a recognized leader in regional transportation planning and coordination, an effective agent and valued partner for our cities, and a vital part of Dallas County government.

To be Respected, Responsive & Reliable in all our relationships.

County Governments

- Limited Authority
- Controlled by the Texas Legislature
- Have Regulations (vs. Ordinances)

Legislative Authority

- Texas Water Code
- Local Government Code
- SB 936 (2001)

NCTCOG Regional ly Recommended Standards

North Central Texas
Council of Governments

**Regionally Recommended Standards in Watershed Management
For New Development Within County Regulated Areas**

1. Design infrastructure to fully developed conditions with approved land-use maps if data is available
2. Begin protection at the most upstream end of the watershed above Federal Emergency Management Agency Limit of Detail Study
3. Maintain unfilled valley storage areas
4. Protect against and reduce erosive velocities
5. Match pre-developed site runoffs
6. Verify/require adequate downstream conveyance
7. Require freeboard from fully developed (if data is available) and changing watershed conditions
8. Define written operation and maintenance responsibilities
9. Size conveyance of street and storm systems adequately to safely convey traffic
10. Create stream buffers and preserve open space; limit clearing and grading
11. Consider regional (on or off stream) detention incentives
12. Implement Conservation and/or Cluster Development incentives
13. Encouraging low impact development techniques and/or green infrastructure

- Developed at a County Regional Watershed Roundtable meeting March 2017
- Around the time that Dallas County was making changes to Stormwater & Floodplain Regulations
- Dallas County adopted these Regional Standards through Court Order

Updated Regulations

- Subdivision - 2017
- Floodplain – 2019
- Separate Court Order Adopting the higher standards

Summarized Changes to the Dallas County Floodplain Management Regulations

- Requiring a development permit for floodplain and parcels over 5 acres or 500 lots (currently, a development permit is required if the property is located within the floodplain).

  (Ref. Scope page 16, Article 4, Section A; Permit Procedures Page 17, Section D)

  This requirement will allow county staff to continue to perform a comprehensive review of large developments and make sure the applicant is in compliance with the Texas Water Code and has all necessary permits.

- Stating that the Director of Public Works or his or her designee is the Dallas County Floodplain Administrator.

  (Ref. Designation of the Floodplain Administrator Page 16, Article 4, Section B)

  The Public Works Director has the knowledge, expertise and resources to manage the Dallas County floodplain and development permitting.

- Adjust freeboard to be 2' above BFE (currently the freeboard is 1' above BFE). This change will need to take place in every section – residential construction, non-residential construction, enclosures, manufactured homes, etc.

  (Ref. Specific Standards Page 25, Article 5, Section B)

  This change will be consistent with other counties and cities in North Texas and has been recommended by NCTCOG and TFMA.

- Using fully-developed flows rather than FEMA flows

  (Ref. Specific Standards Page 25, Article 5, Section B)

  Dallas County meets the minimum FEMA criteria currently. Changing to fully developed flows would assume open land is fully developed. This practice is one of the thirteen regionally recommended standards in watershed management for counties, which Dallas County participates (Oct. 2017).

- Addition of CDC to Dallas County Floodplain Regulations

  (Ref. Standards for the Trinity River Corridor and the East Fork of the Trinity and the Corridor Development Certificate Page 29, Article 5, Section F)

  Dallas County is a regional partner in the CDC. This has been verified by past Court Orders (89-283, 94-176, 2004-1698, 2013-0506). However, it is not specifically included in the Floodplain Management Regulations. The CDC employs higher floodplain management standards with regard to erosion, valley storage, and fully-developed future flows within the Trinity River Floodplain and the East Fork of the Trinity River Floodplain.

- Include statutory authority (through the Texas Water Code)

  (Ref. Statutory Authorization, Approval and Adoption of Flood Insurance Study Maps, and Manuals Page 4, Article 1, Section A)

  This requirement has been identified by FEMA.

Subdivision Regulations

SECTION J. DRAINAGE STANDARDS

1. The integrated Storm water Management (iSWM) program developed by the North Central Texas Council of Governments (NCTCOG) shall be used to develop properties within the unincorporated limits of Dallas County, Texas. However, the incentives, or credits referenced in the manual do not apply.

2. Drainage is to be designed by a Texas Professional Engineer. Drainage calculations shall be based on 100 year design for all roadways and bridges (bridges shall have 2' of freeboard) and the assumption that all property in the watershed is fully developed.

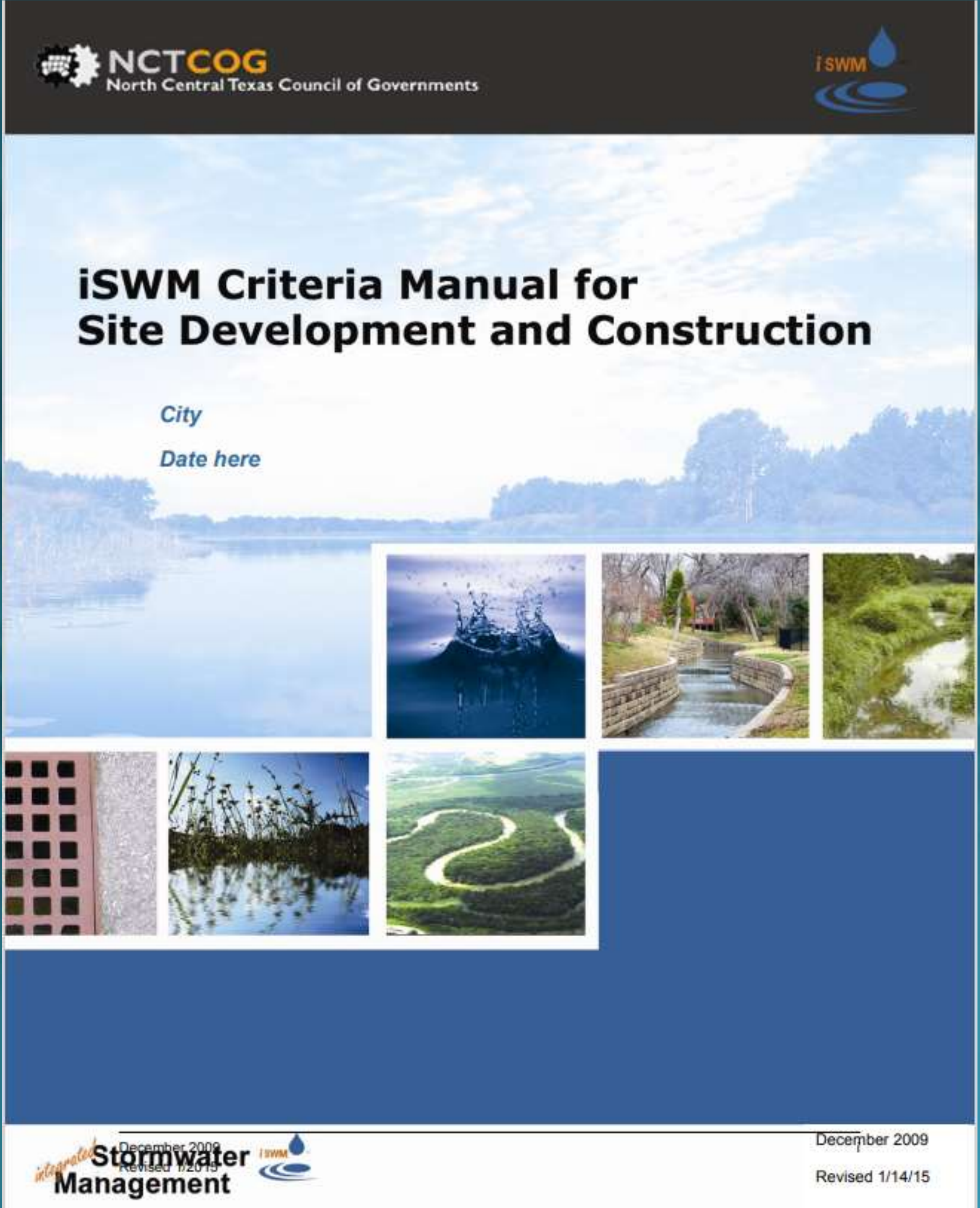
3. Chapters 1 through 5 of the iSWM Criteria Manual for Site Development and Construction should be used for the planning and design of storm water management facilities for residential subdivisions and internal residential streets within Dallas County. This manual can be found on the NCTCOG website.

4. Any reduction in floodplain storage or conveyance capacity must be offset with a hydraulically equivalent (one to one) volume of mitigation sufficient to offset the reduction. The reduction may result from development or the placement of fill within the floodplain.

5. Any placement of fill within FEMA-designated floodplain areas shall meet Dallas County Flood Regulations and state and federal regulations. The owner or developer of tract of land located in these areas shall supply sufficient hydrological/hydraulic data suitable to determine flood plain and flood way limits and to determine base flood elevations. Improvements that extend into the floodway must be adequately sized to insure that no encroachments will occur in the floodway.

6. The Developer shall provide copies of all permits required by TxDOT, TCEQ, EPA, USACE or any other governmental entity with jurisdiction of the real property or adjacent roads, streets or highways. Surface drainage from private property shall be taken to roads, streets, or drainage courses as directly as possible. Drainage water from roads and streets shall be taken to defined drainage courses as directly as possible. Roads and streets shall not be used as major drainage courses. All road and street drainage structures shall be complete within twenty-four months from the date of Plat approval, unless an extension of time is granted by the Director.

- Section I – Stormwater Pollution Prevention Plan
- Section J – Drainage Standards
  - #1 references iSWM

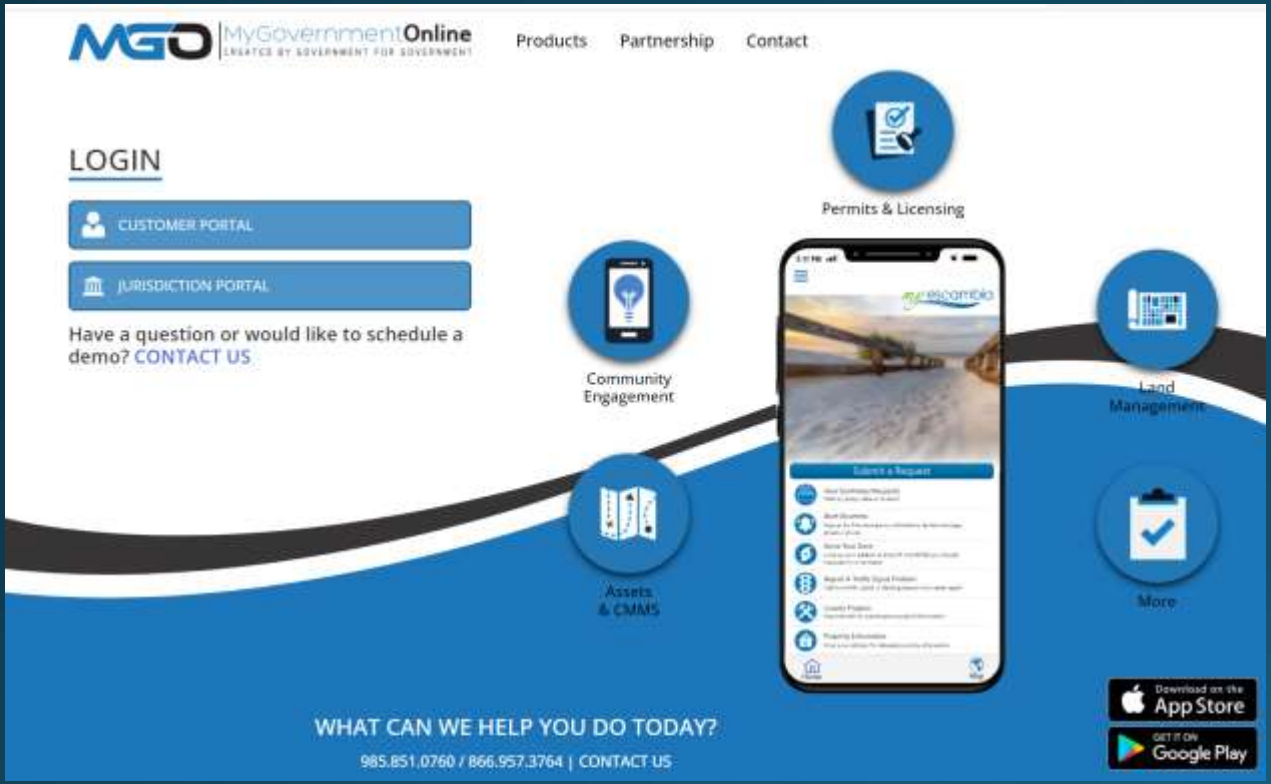


Drainage Standards

- Use iSWM
- Development Criteria
- Review Checklist

DCPW Permit Review Process Team

My Government Online Portal – permit software platform:



Development Permit Review Team :

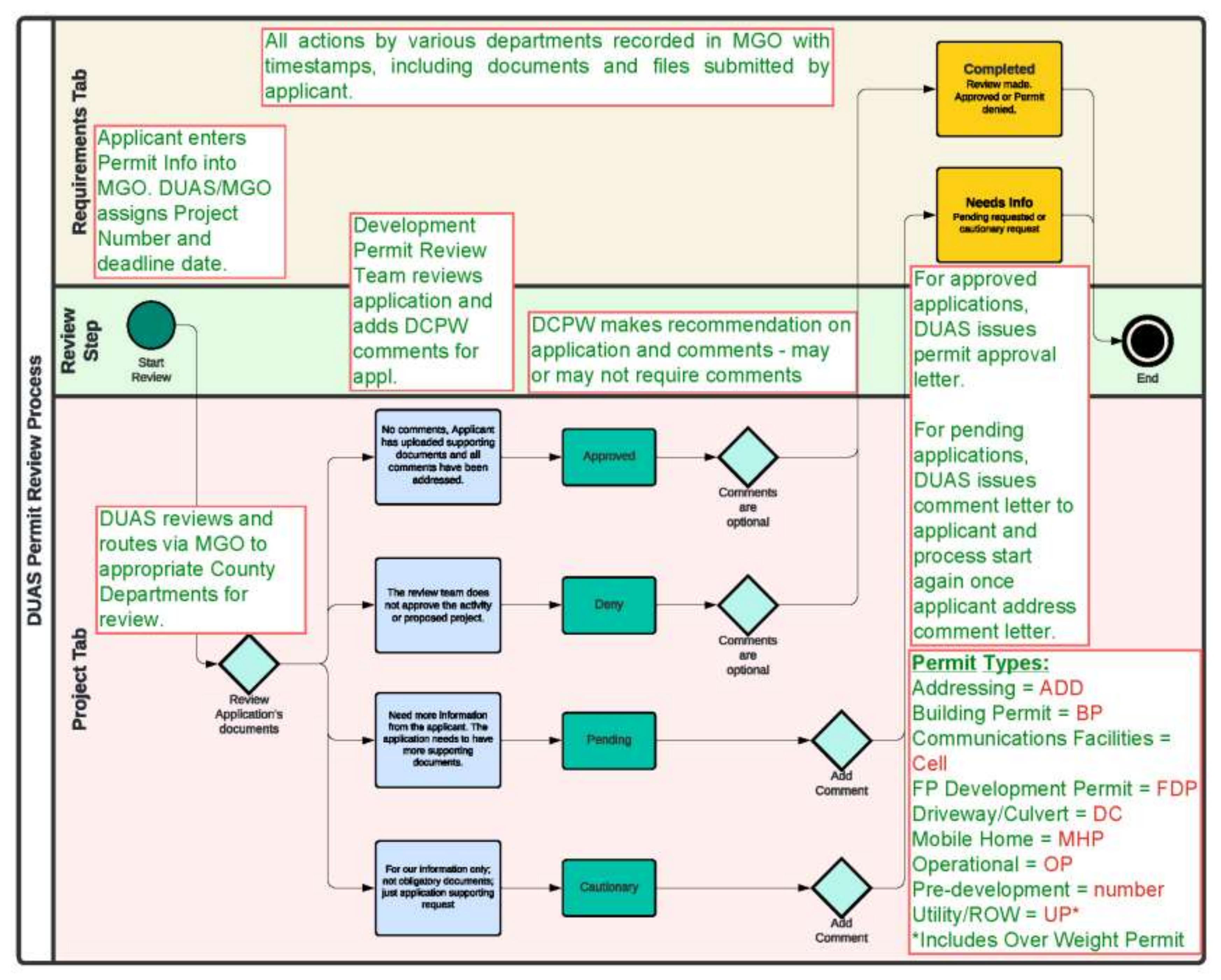
At Dallas County, permitting is channeled through the Department of Unincorporated Area Services (DUAS)

Permits are received through MGO and are sent to all county departments for review:

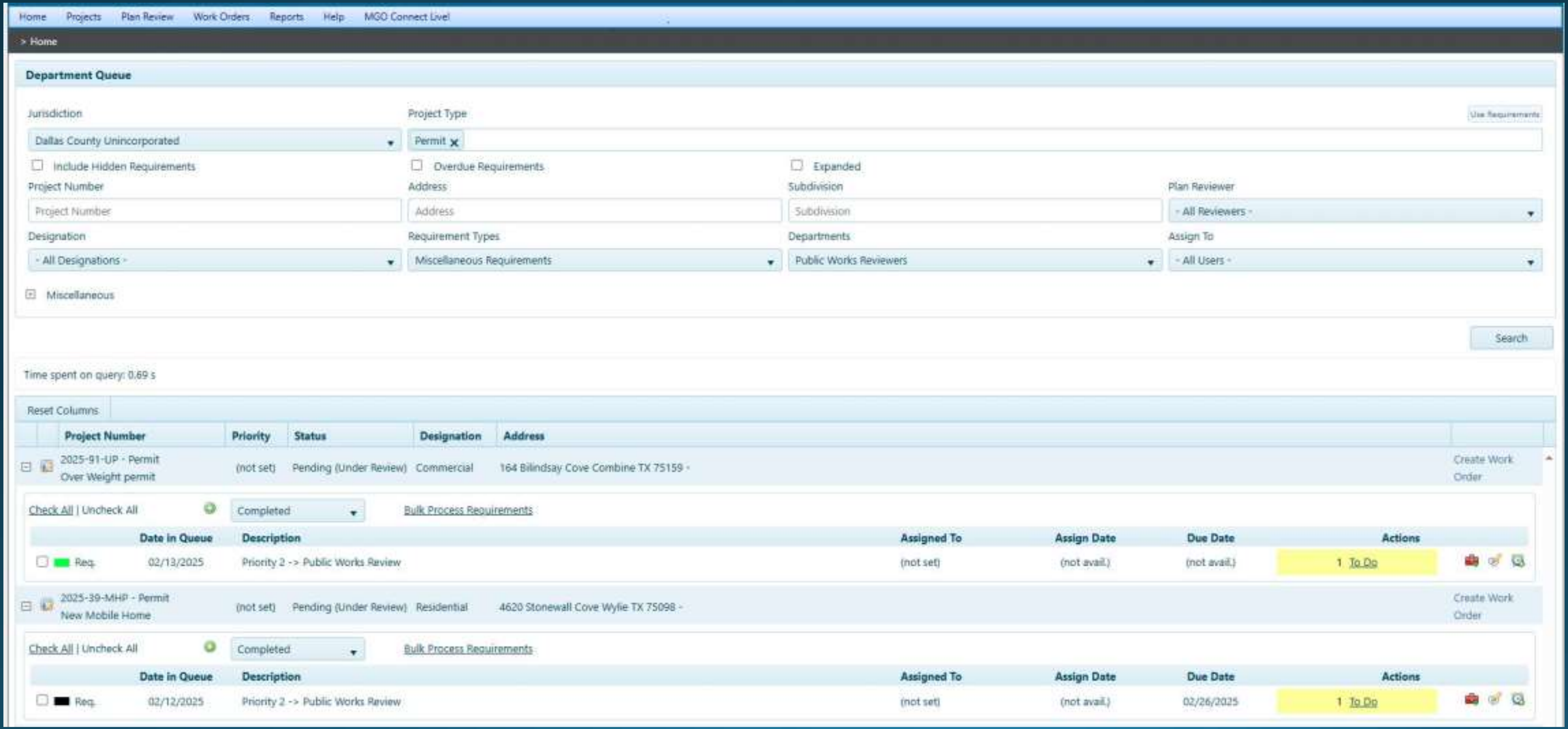
- Fire Marshal
- Road & Bridge
- Health & Human Services
- Public Works

Development Permit Review Team Conducts Weekly Team Meetings on Mondays at 3 PM

DUAS Permit Review Process Flow Chart



DCPW Review Portal in MGO



Permitting

- Checklist

Development Permit

Templates

Items needed for Permit Application Review by Public Works Dept.

Plan Sheets needed

- ☐ Cover Sheet
- ☐ Site Plan
- ☐ Erosion Control Plan
- ☐ Grading Plan
- ☐ Existing Drainage Area Map
- ☐ Proposed Drainage Area Plans and Map
- ☐ Water & Sewer Plan
- ☐ Paving Plan
- ☐ Traffic Control Plan
- ☐ Standard Construction Details

Site Plan (sealed by a PE licensed in Texas)

- ☐ Show Ingress/Egress
- ☐ Show adjacent Roadways
- ☐ Show lot dimensions
- ☐ Show existing drainage structures/facilities
- ☐ Show existing utilities
- ☐ Show proposed utilities
- ☐ Show ROW widths
- ☐ Drainage Flow Arrows on adjacent roadways
- ☐ Show dimensions of the driveway
- ☐ Drainage Amount of Stormwater coming from site
- ☐ Drainage – Amount of Stormwater prior to development
- ☐ Existing & Proposed Drainage Area Maps
- ☐ Excess stormwater generated by development shall be detained
- ☐ Detention Pond needs to be in an easement.
- ☐ Drainage Easements need to be identified on a plat or by separate instrument.
- ☐ Detention Pond needs to have a maintenance plan and agreement is filed at Dallas County and is maintained on the site and that describes the following:
    a. Identifies Responsible Parties
    b. Identifies required maintenance activities
    c. Identifies the frequency of inspections
- ☐ Calculate capacity of adjacent roadway drainage structures (ditches) & other drainage structures
- ☐ Provide calculations for the detention ponds
- ☐ North Arrow
- ☐ Scale labeled
- ☐ Provide Legend
- ☐ Provide Building Setback Lines

Detention Pond Maintenance Plan

Detention Pond Inspection & Maintenance Plan

SITE LOCATION:

____

____

DETENTION POND INFORMATION

Detention ponds are designed to settle out sediment and associated pollutants to improve water quality. Detention ponds also provide rate and flood control before discharging into a receiving waterway's storm drain system.

DETENTION POND INSPECTION/MAINTENANCE

The [CURRENT OWNER] or their designee is responsible for completing inspections and conducting maintenance. Such as:

1. **Vegetation:** The pond areas have a ground cover of grass, which if properly maintained will prevent erosion of the embankment and provide an easy surface for inspection.
2. **Re-Seeding:** Periodic re-seeding may be required to establish grass on areas where seed did not take or have been destroyed. Before seeding, fertilizer (12-12-12) should be applied at a minimum rate of 12 to 15 pounds per 1,000 SF. The seed should be evenly sown at a rate of three pounds per 1,000 SF. The seed should be covered with soil to a depth of approximately ¼". Immediately following the planting, the area should be mulched with straw.
3. **Trees and Shrubs:** Trees and shrubs are not permitted to be established in the detention pond or drainage channels leading to and from the pond. Grass shall be maintained and kept healthy and vibrant. This is for vegetation planted to buffer the dry pond.
4. **Mowing:** Grass mowing, brush cutting and removal of weed vegetation will be necessary to properly maintain the areas. All area slopes and vegetation should be mowed when the grass exceeds 8" in height. Acceptable methods include the use of weed whips or power brush cutters and mowers.
5. **Erosion:** Erosion occurs when the water concentrates causing failure of the vegetation or when vegetation dies and sets up the environment for rill erosion and eventually gullies from the stormwater runoff. The areas should be inspected. Proper care of vegetative areas that develop erosion is required to prevent more serious damage to the site. Rills and gullies should be filled with suitable soil compacted and then seeded. Methods described earlier on vegetation should be used to properly establish the grass surface. Where eroded areas are detected, the cause of the

THANKS FOR YOUR TIME!

Lissa Shepard, PE, CFM
Sr. Bridge Engineer & Floodplain Manager
Dallas County, Texas
Lissa.shepard@dallascounty.org

John Hopkins Research Grant

Nature, Our Best Water Treatment

Today's Speakers

Perry Harts, PE, CPMSM

- Graduated from Texas A&M in 1980 with a degree in civil engineering.
- City of Frisco Stormwater Division
- 39 years of municipal experience.
- He enjoys:
  - gardening
  - spending time with his dog
  - helping preserve the environment

Weston Bustetter, CESSWI

- Graduated from Texas A&M in 2017 with a degree in bioenvironmental sciences.
- City of Frisco Stormwater Division
- 8 years of municipal experience.
- He enjoys:
  - working outdoors,
  - spending time with his dogs
  - helping preserve the environment

Acknowledgements

Darell Bagley
Principal Landscape Architect
City of Frisco

Fouad Jaber, Ph.D., P.E.
Professor and Extension Specialist
Biological and Agricultural Engineering Dept.
Texas A&M AgriLife

Dr. Ciaran Harman
Associate Professor
John Hopkins University

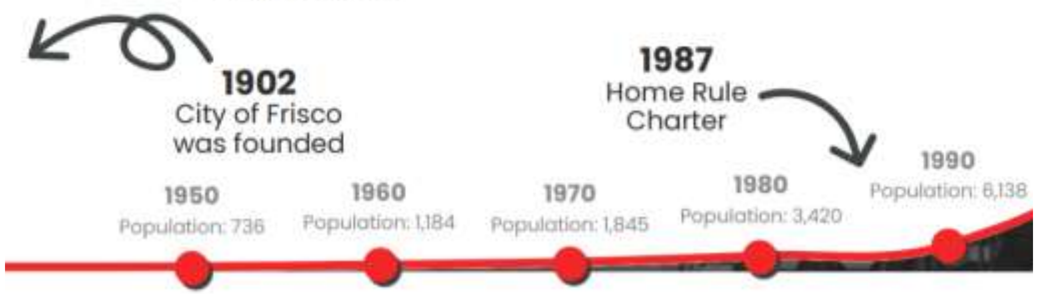
Background on Frisco

In 2004 Frisco suffered great drought.

The Planning Department developed the Water Resource Zone (WRZ)

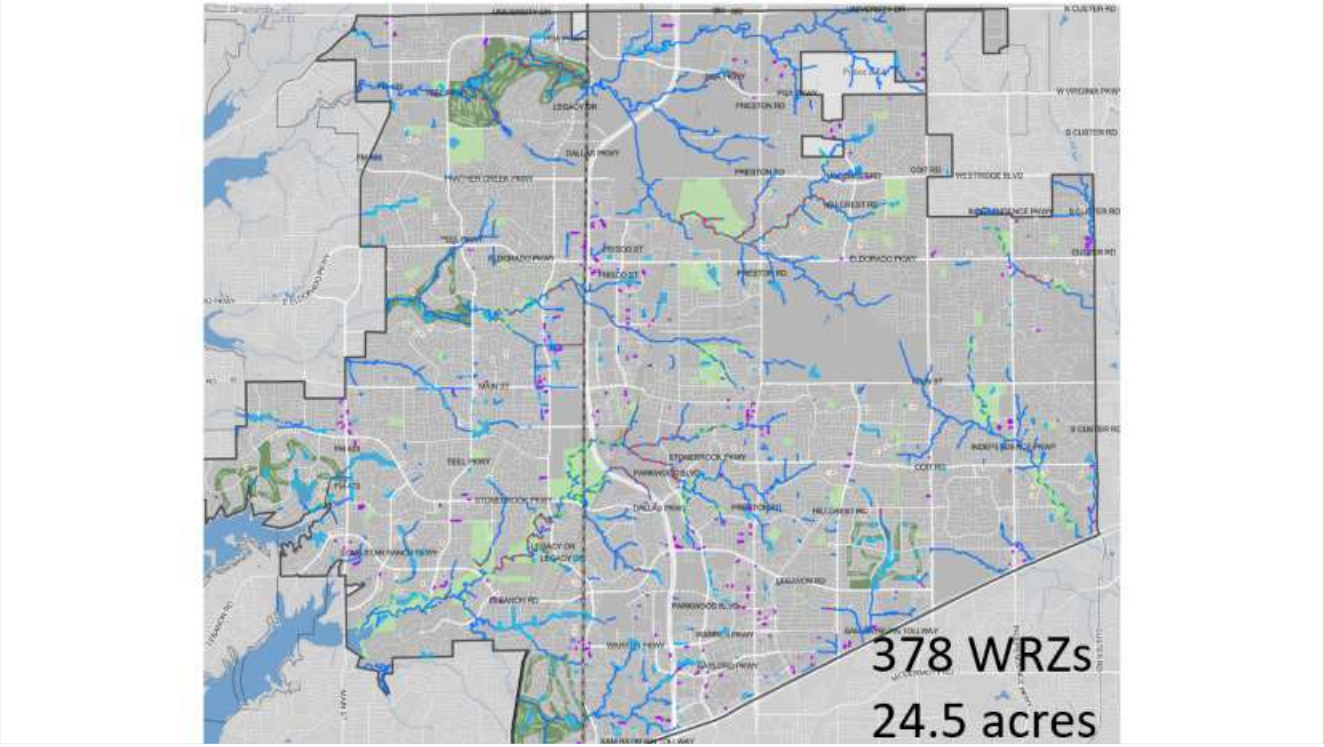
It is a depressed vegetative swale that needed no irrigation.

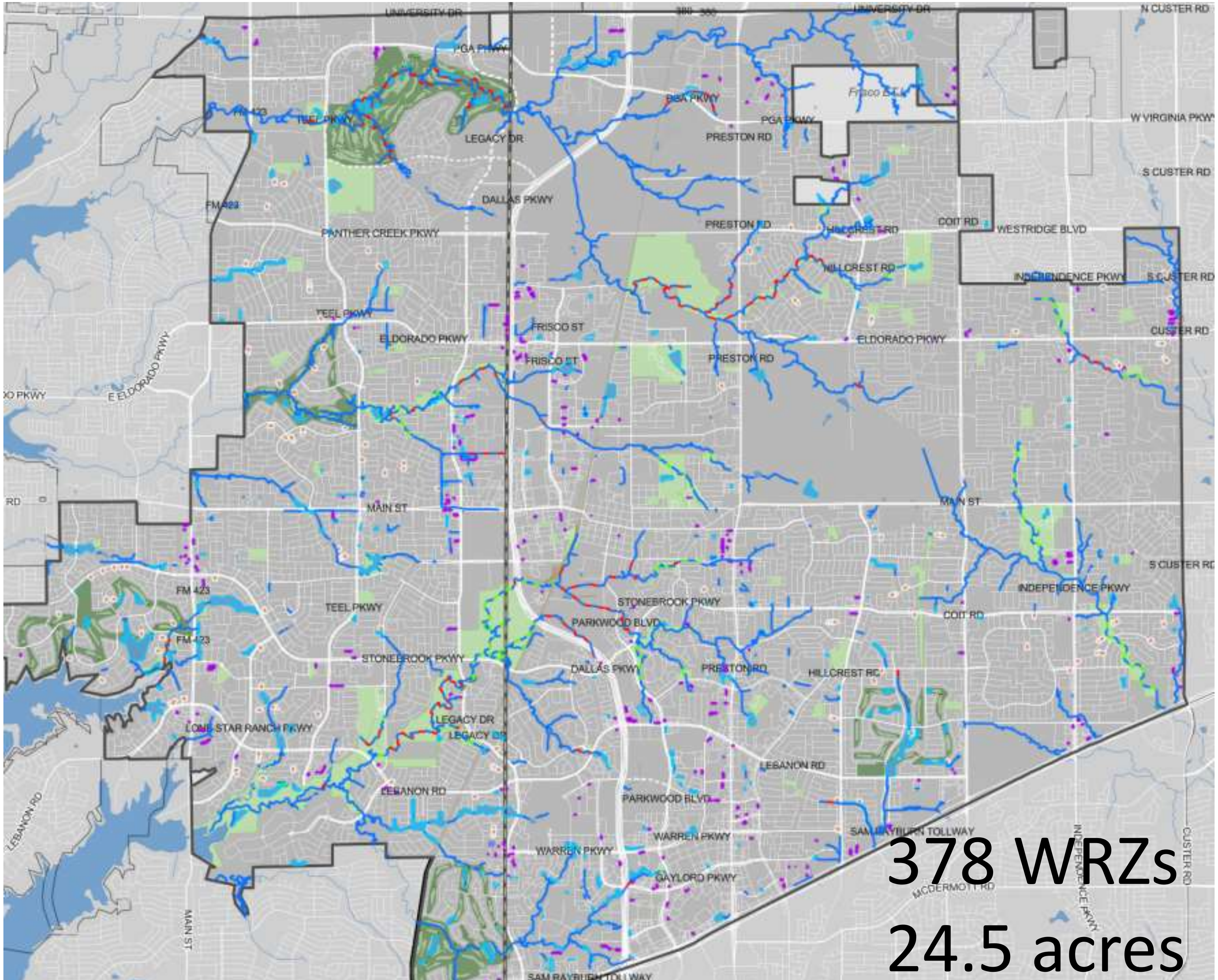
It was to be 5% of the parking area.



Result

378 WRZs
24.5 Acres





378 WRZs

24.5 acres

Multi-function

- It works for water conservation
- It also works for water quality.
- In 2011 considered stormwater program for post construction controls.

Fast forward to 2015 Public Works WRZ

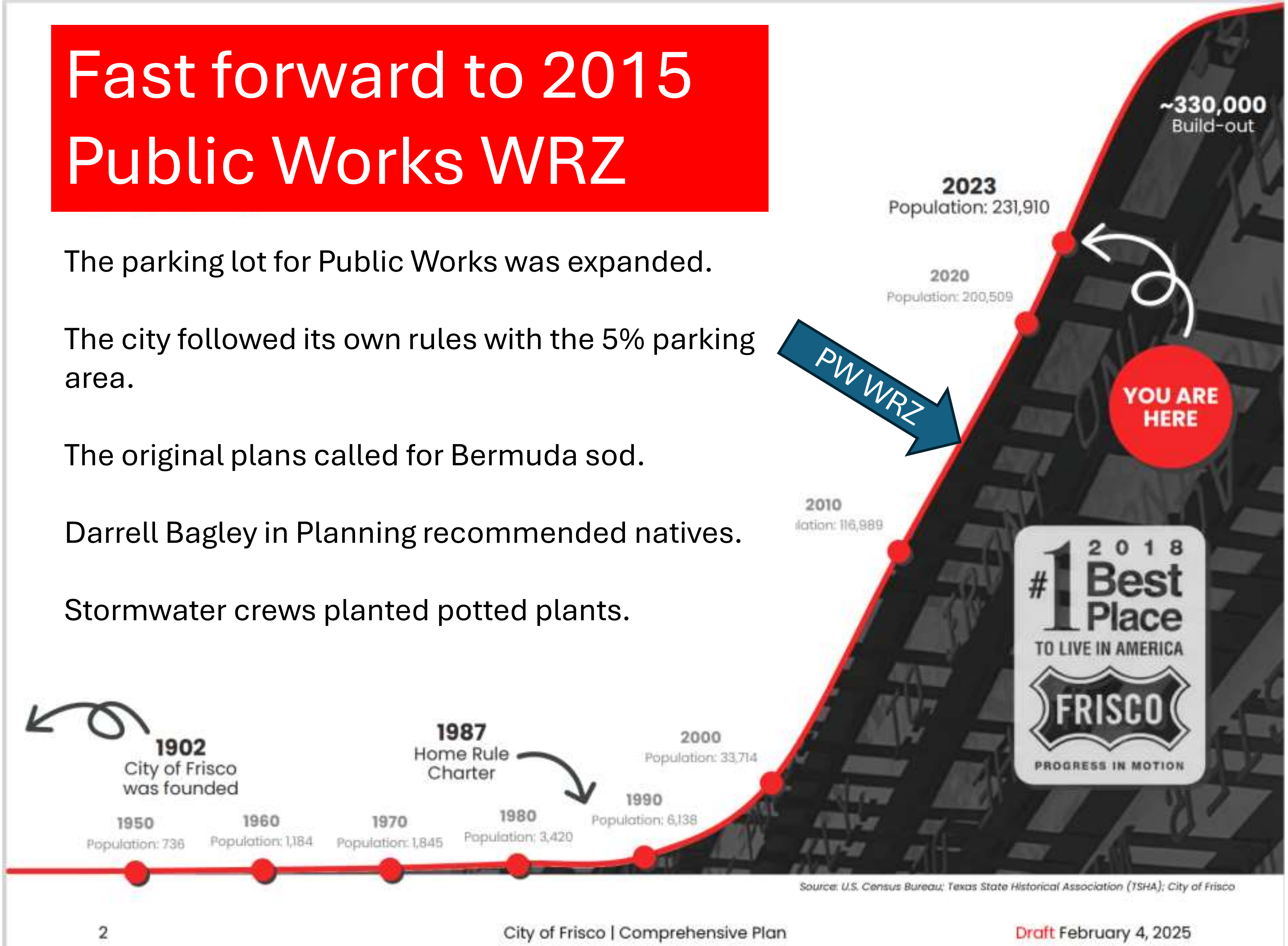
The parking lot for Public Works was expanded.

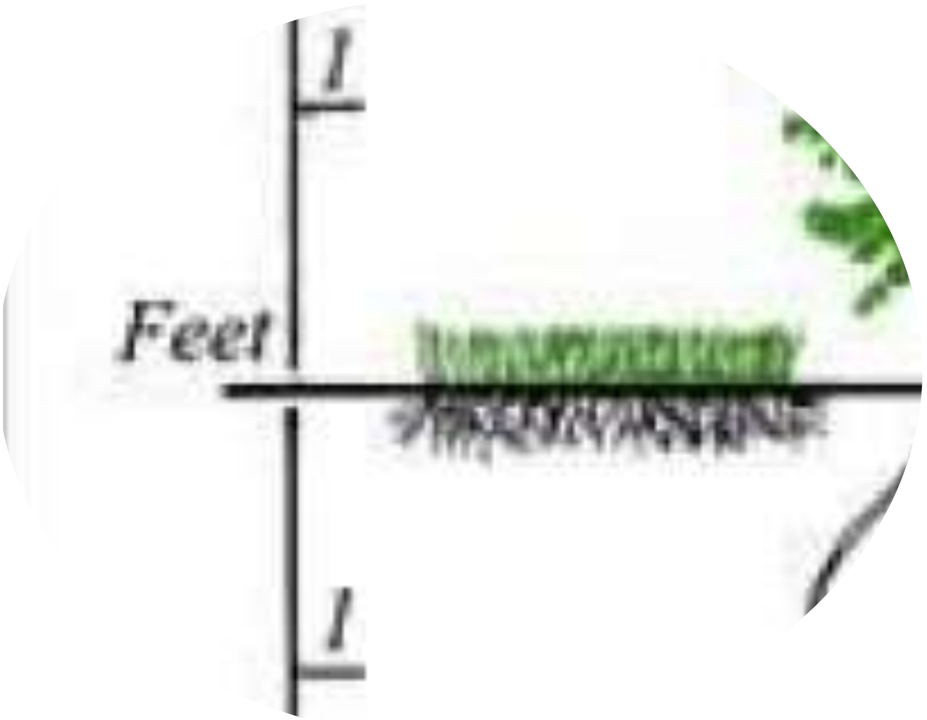
The city followed its own rules with the 5% parking area.

The original plans called for Bermuda sod.

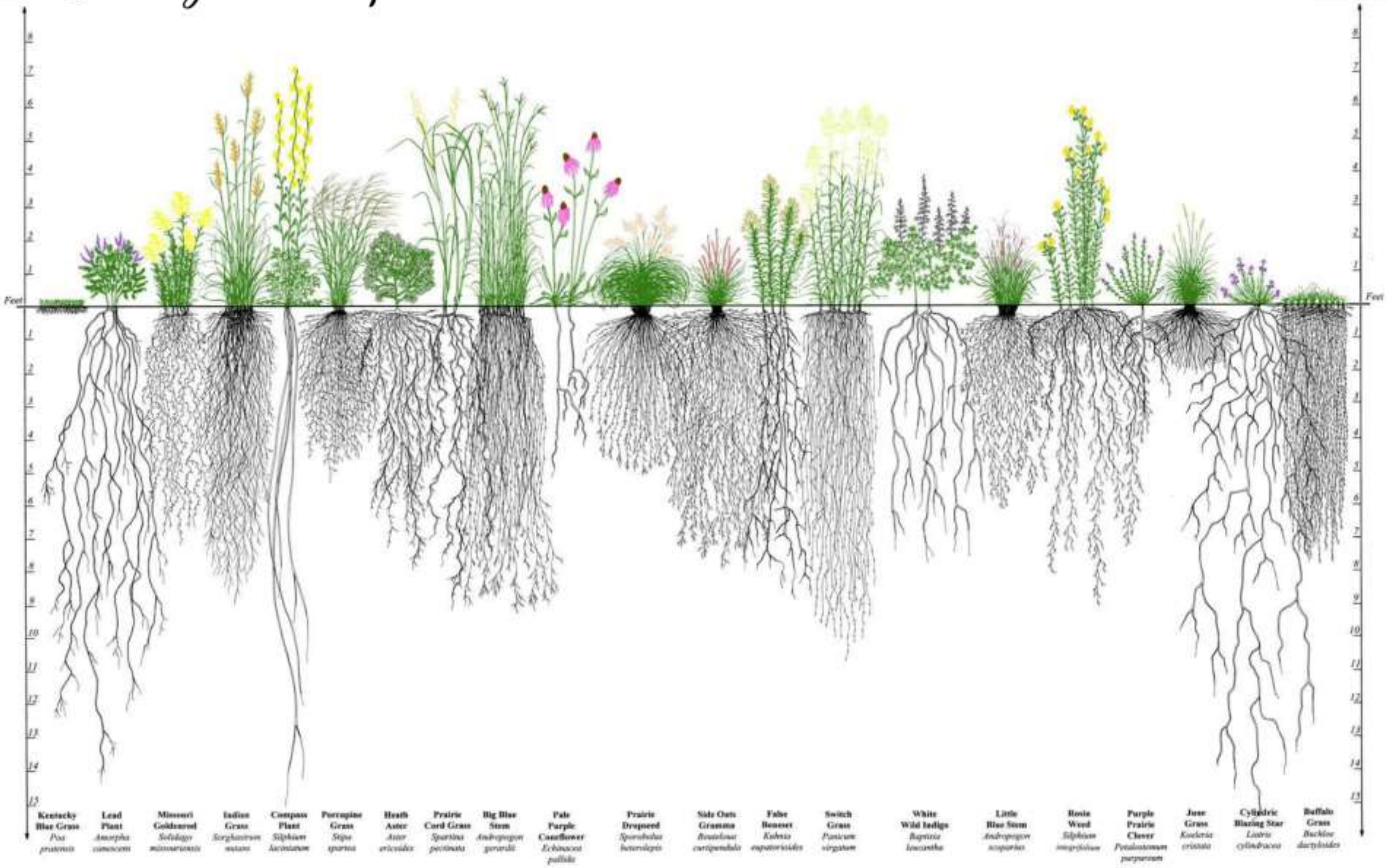
Darrell Bagley in Planning recommended natives.

Stormwater crews planted potted plants.



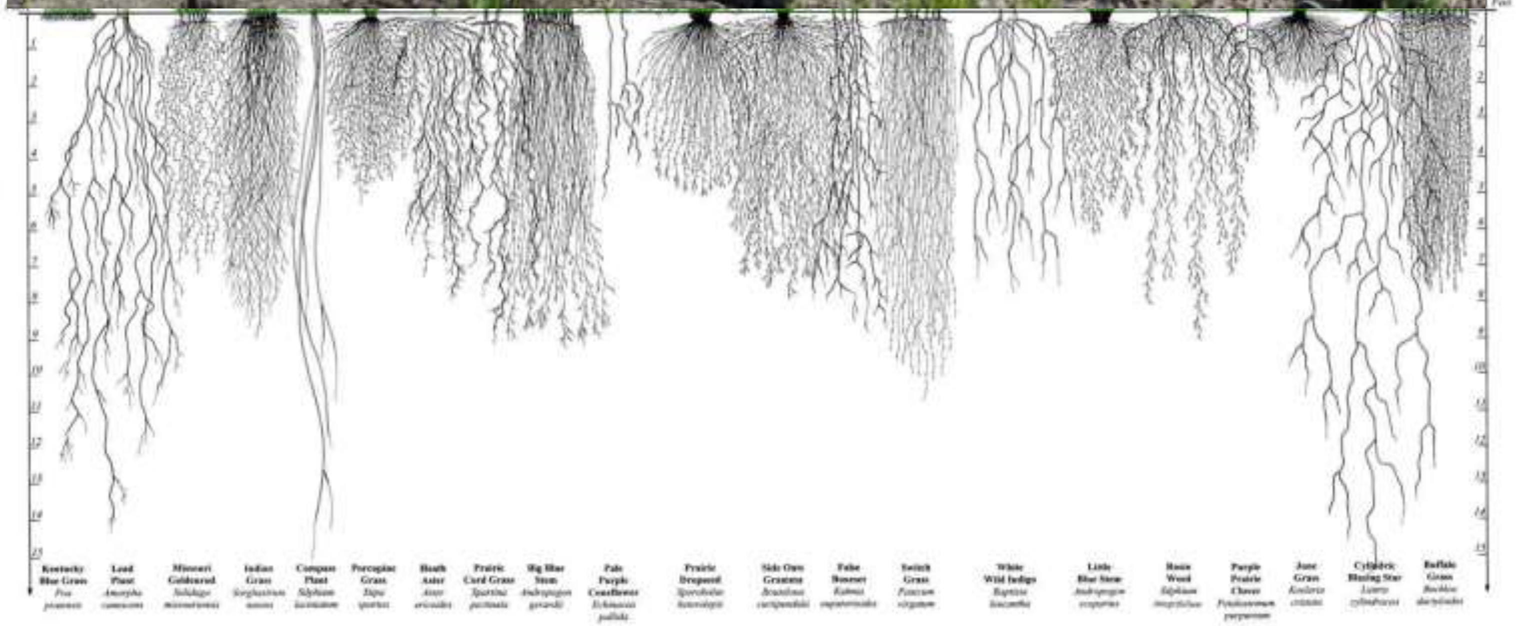

1
Feet
1

Root Systems of Prairie Plants



Heidi Natura, 1995 - Conservation Institute

Public Works Water Resource Zone



Heidi Natura, 1995 - Conservation Institute

Public Works Water Resource Zone

- A demonstration project in front of the Public Works facility
- Native grasses were planted in 2015.
- The idea was to develop a sustainable ecosystem by restoring the prairie.
- Terrible soils:
  - No under drain.
  - No select fill

Planting in hard black clay soil.
July 2015

Planting in hard black clay soil.
July 2015

March 2016

July 2016


STORM DRAIN

2018 Conditions

- We now have dozens of diverse plant species.
- Very sustainable.
  - No irrigation required.
  - Annual mowing.
  - No chemical
  - No weeding
  - High percolation


Water Resource Zone
Grow
Zone

Percolation Test

Percolation Test

- Engineered soils

  3.5 inches per hour.

- Public Works WRZ

  51.7 feet per hour.

JOHNS HOPKINS UNIVERSITY

FRISCO

Bioswale Research Study

Frisco Public Works

Public Works Bioswale

- (2) Nalgene bottles at curb cut (influent)
- (2) Nalgene bottles in front of outlet (effluent)
- (1) ISCO automated sampler with bucket in front of outlet (effluent)
- Moisture meter installed in flowline
- Deep-rooted native prairie plants

Frisco Badminton Bioretention

(2) Nalgene bottles installed at curb cuts (influent)

(2) Nalgene bottles installed in front of outlet (effluent)

Moisture meter installed within flowline

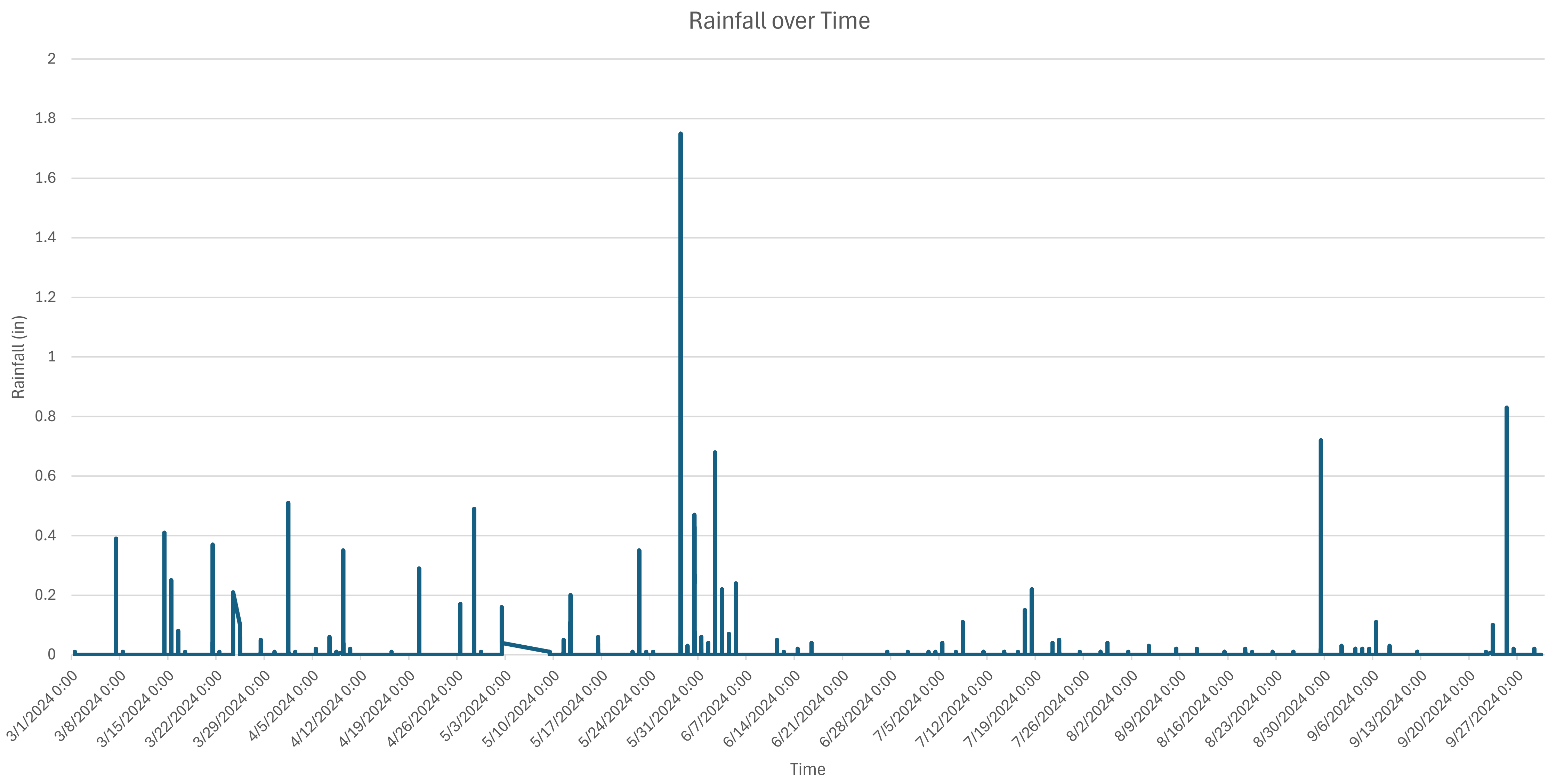
Collection methods - ISCO

- 4 glass jars used to collect samples from bucket over time
- Sampler set to collect upon activation by water in bucket
- Programmed to sample 1L every 20 minutes



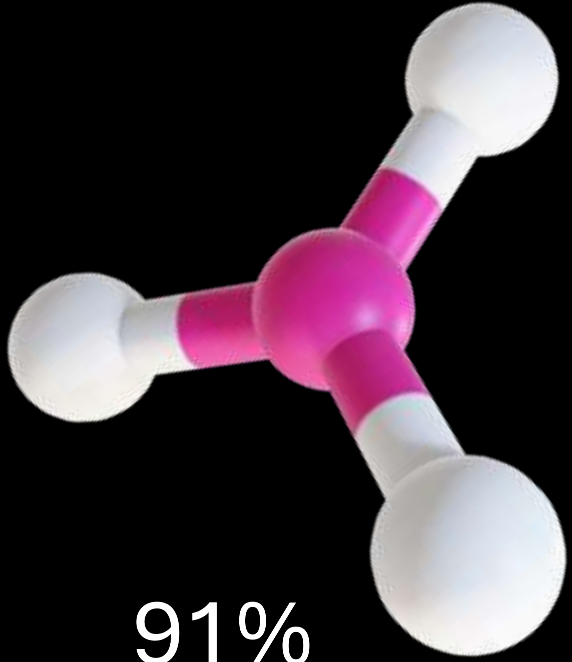
Collection Method – Nalgene

- Nalgene self closing bottle captures first flush
- Visual difference between influent and effluent can be seen



Rainfall over Time
Rainfall (in)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3/1/2024 0:00
3/8/2024 0:00
3/15/2024 0:00
3/22/2024 0:00
3/29/2024 0:00
4/5/2024 0:00
4/12/2024 0:00
4/19/2024 0:00
4/26/2024 0:00
5/3/2024 0:00
5/10/2024 0:00
5/17/2024 0:00
5/24/2024 0:00
5/31/2024 0:00
6/7/2024 0:00
6/14/2024 0:00
6/21/2024 0:00
6/28/2024 0:00
7/5/2024 0:00
7/12/2024 0:00
7/19/2024 0:00
7/26/2024 0:00
8/2/2024 0:00
8/9/2024 0:00
8/16/2024 0:00
8/23/2024 0:00
8/30/2024 0:00
9/6/2024 0:00
9/13/2024 0:00
9/20/2024 0:00
9/27/2024 0:00
Time

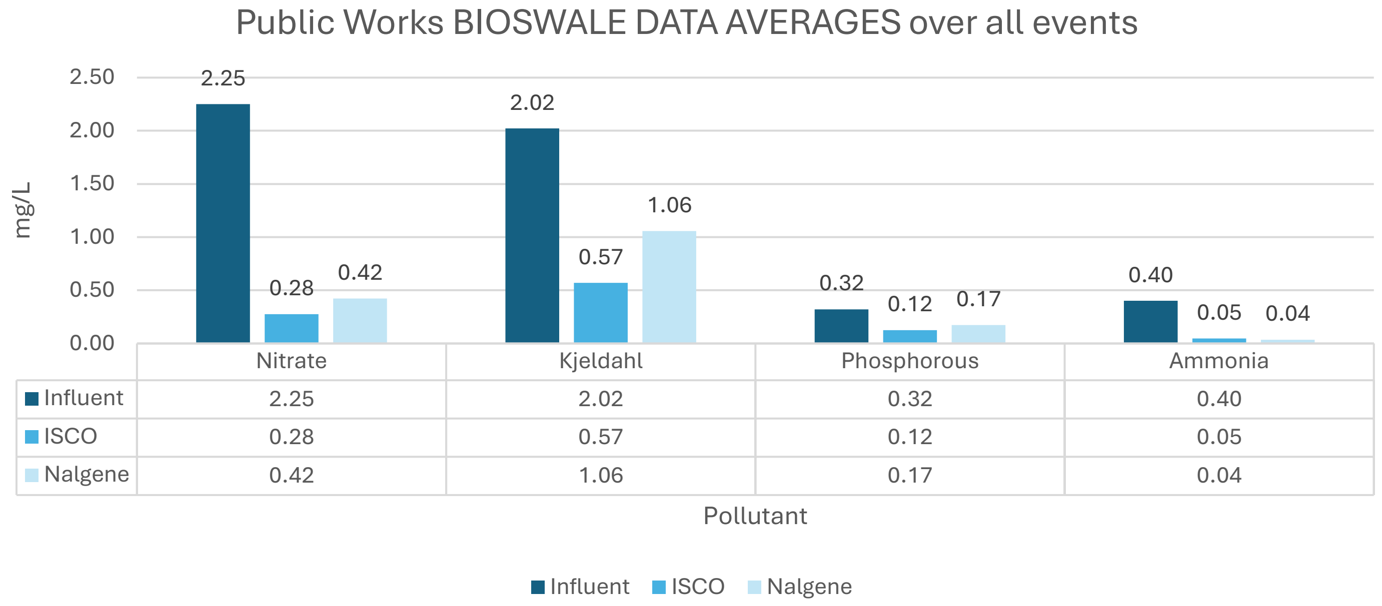
46%
PHOSPHOROUS
REMOVED



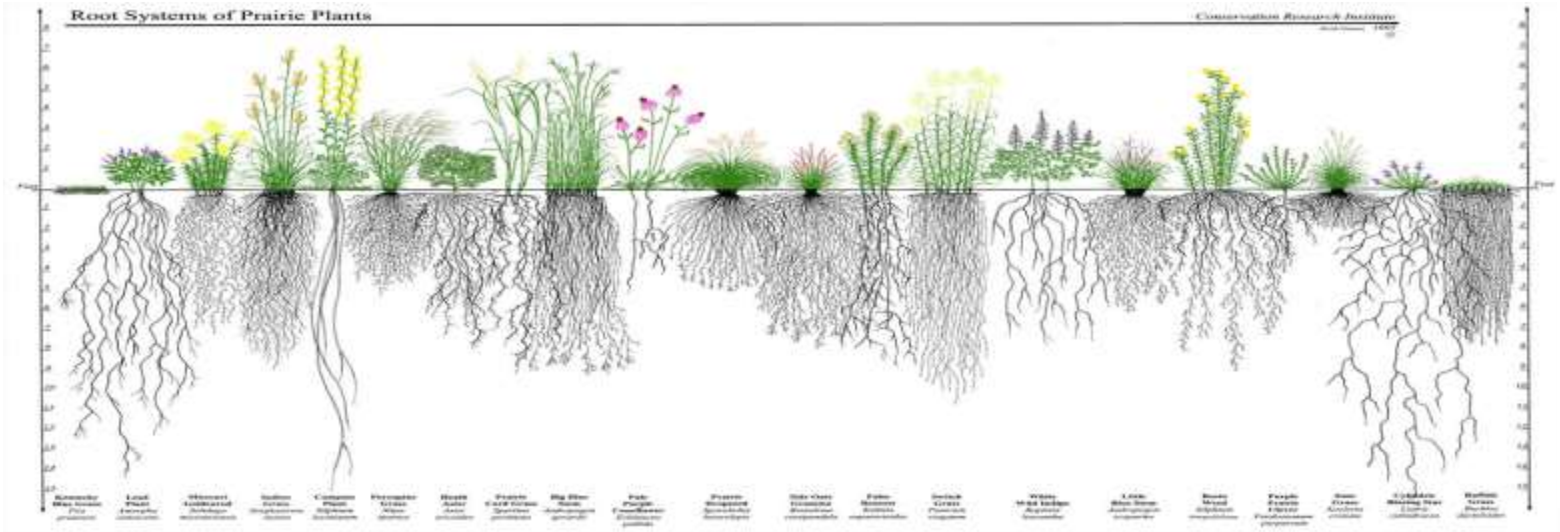
91%
AMMONIA
REMOVED

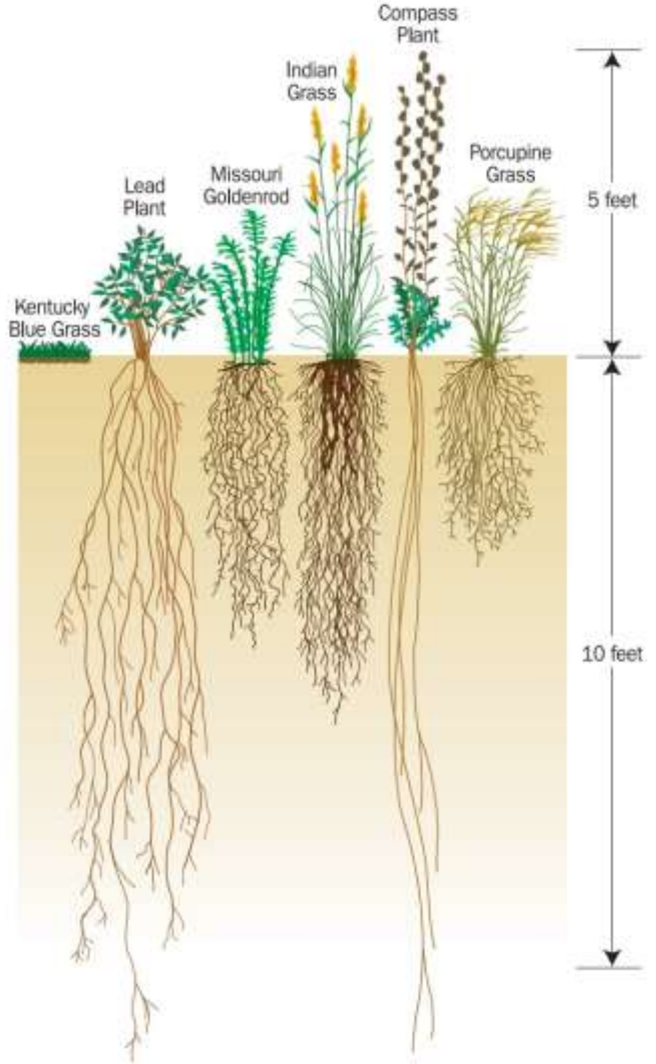
94% TSS
REMOVED

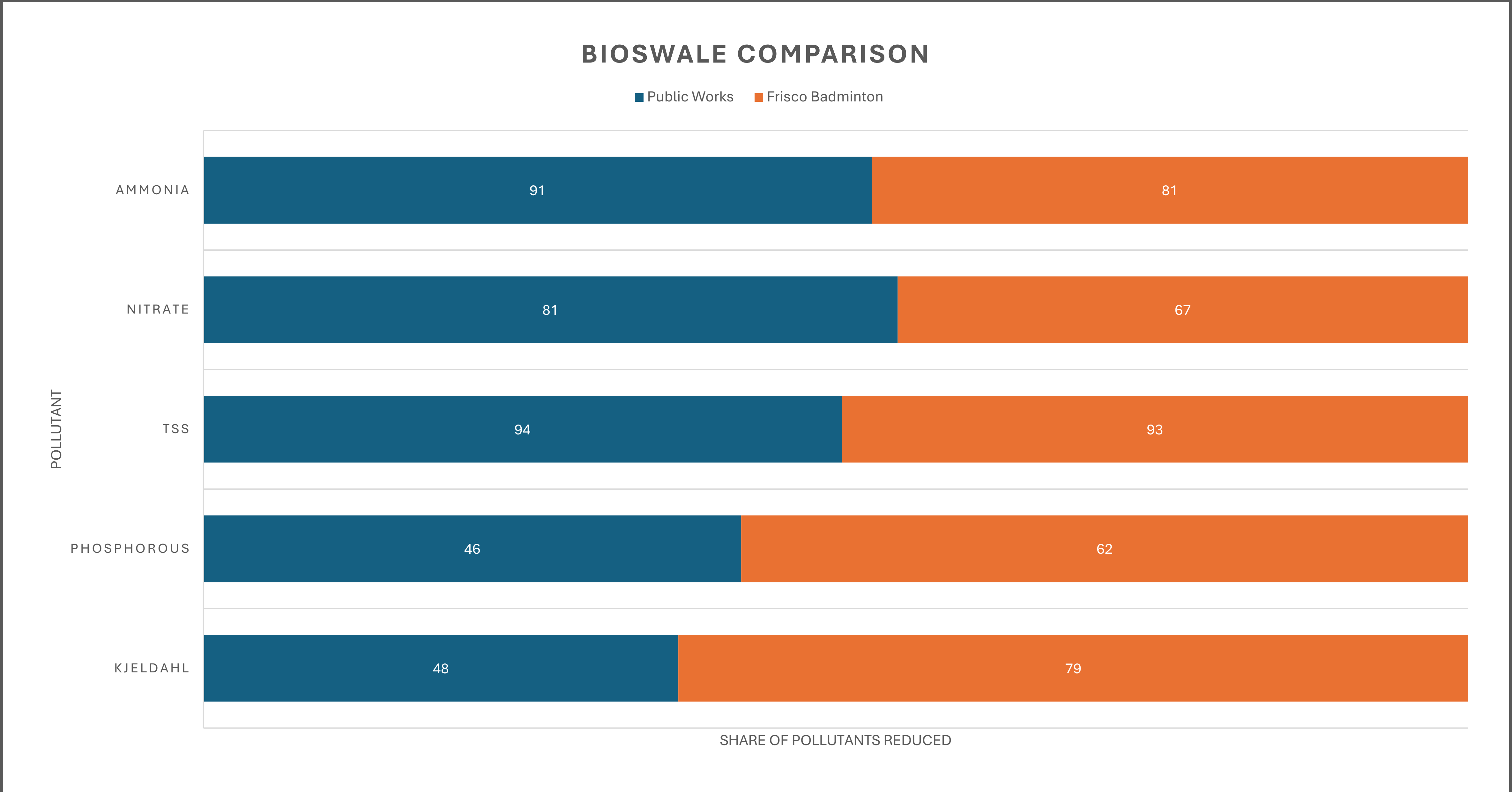
81%
NITRATE
REMOVED



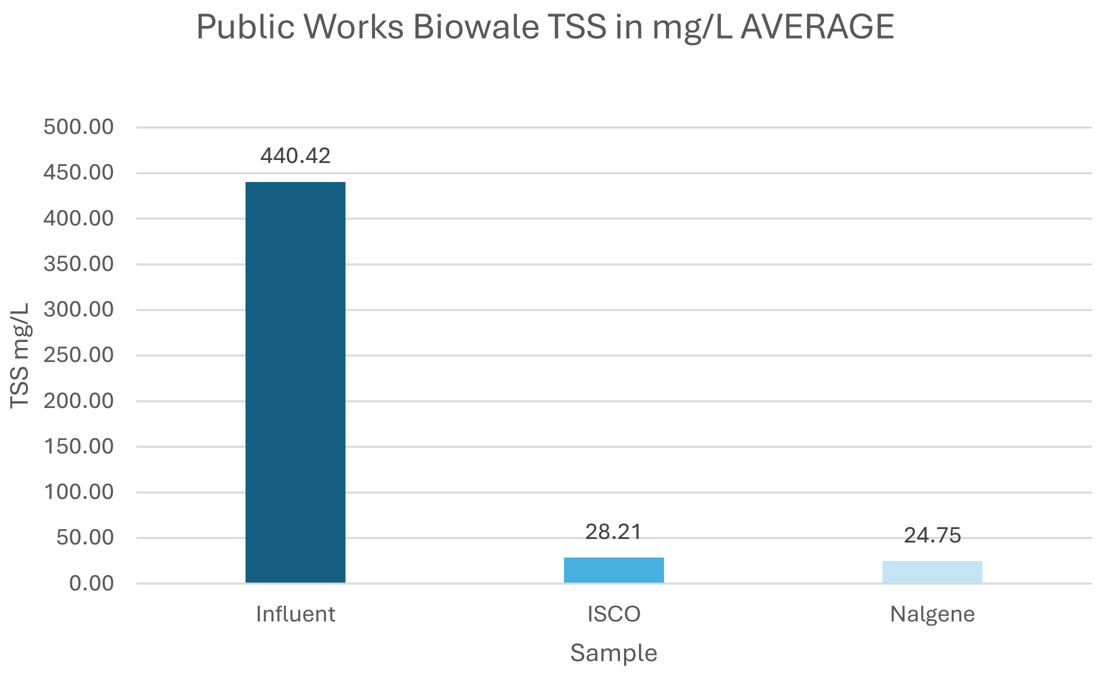
	Nitrate	Kjeldahl	Phosphorous	Ammonia
Influent	2.25	2.02	0.32	0.40
ISCO	0.28	0.57	0.12	0.05
Nalgene	0.42	1.06	0.17	0.04

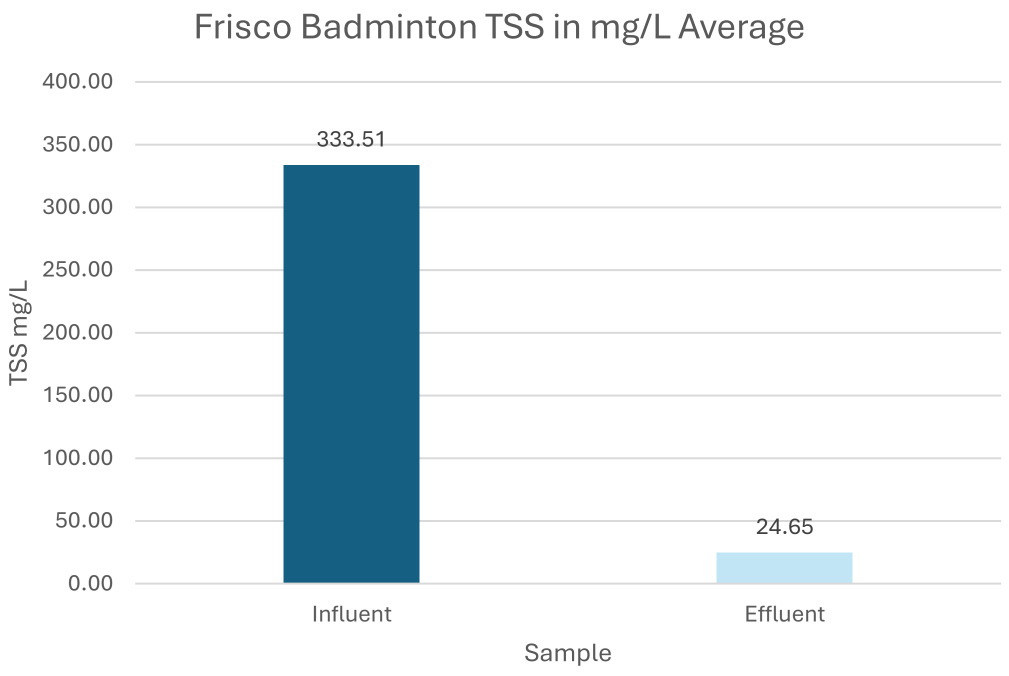




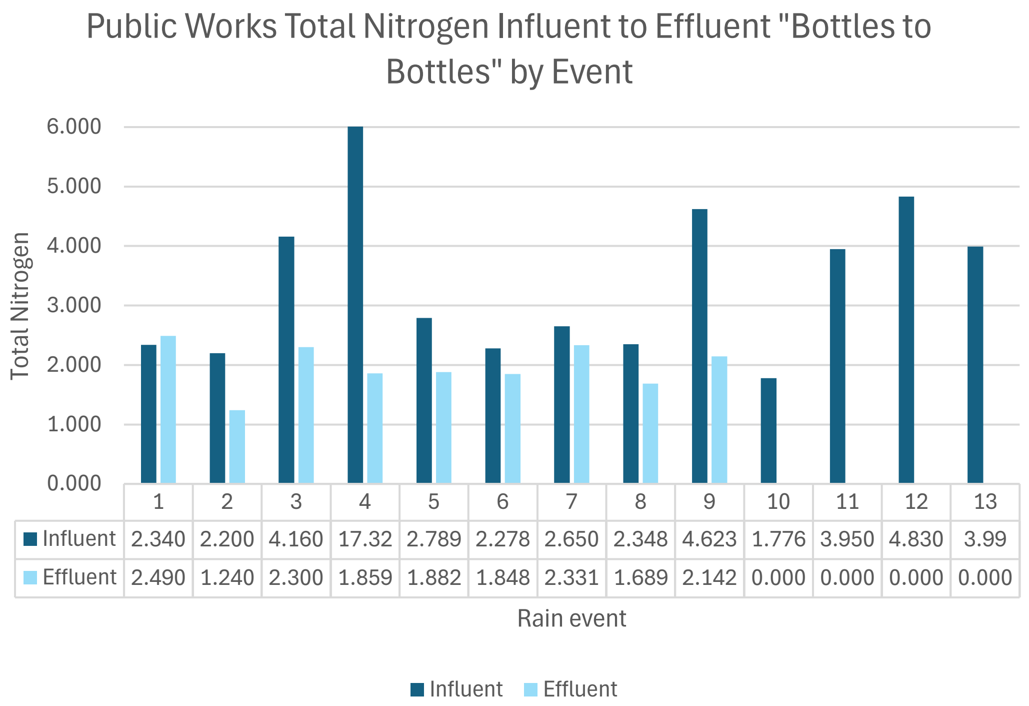

BIOSWALE COMPARISON
Public Works
Frisco Badminton
AMMONIA
NITRATE
TSS
PHOSPHOROUS
KJELDAHL
POLLUTANT
91
81
81
67
94
93
46
62
48
79
SHARE OF POLLUTANTS REDUCED

TSS Comparison

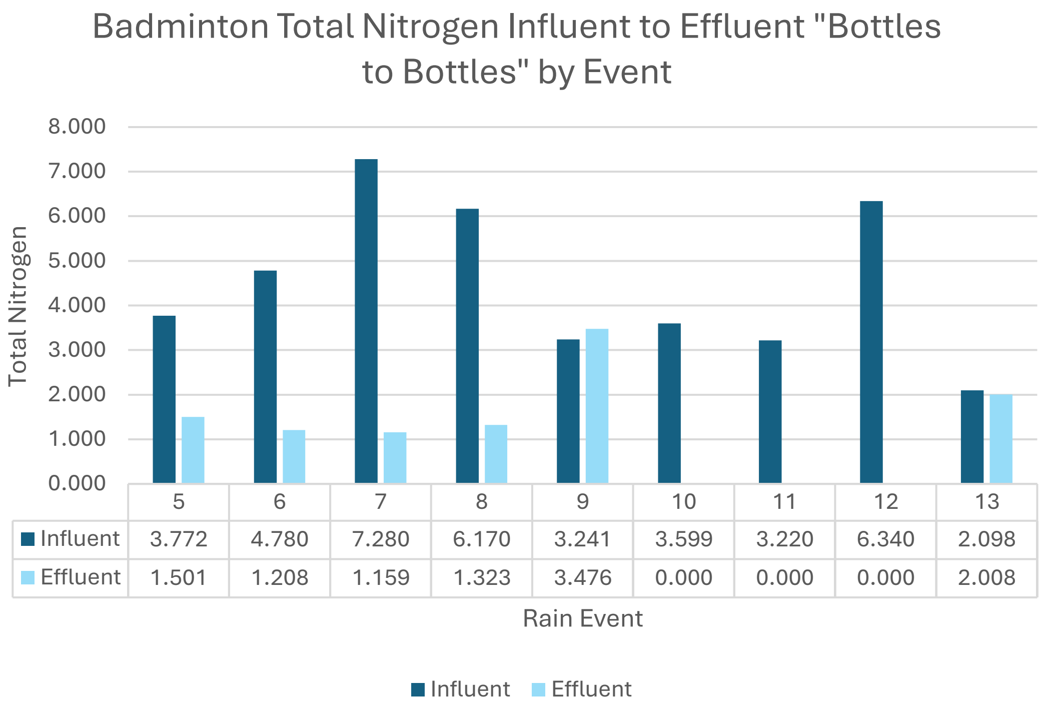




Nitrogen Comparison



	1	2	3	4	5	6	7	8	9	10	11	12	13
Influent	2.340	2.200	4.160	17.32	2.789	2.278	2.650	2.348	4.623	1.776	3.950	4.830	3.99
Effluent	2.490	1.240	2.300	1.859	1.882	1.848	2.331	1.689	2.142	0.000	0.000	0.000	0.000



	5	6	7	8	9	10	11	12	13
Influent	3.772	4.780	7.280	6.170	3.241	3.599	3.220	6.340	2.098
Effluent	1.501	1.208	1.159	1.323	3.476	0.000	0.000	0.000	2.008

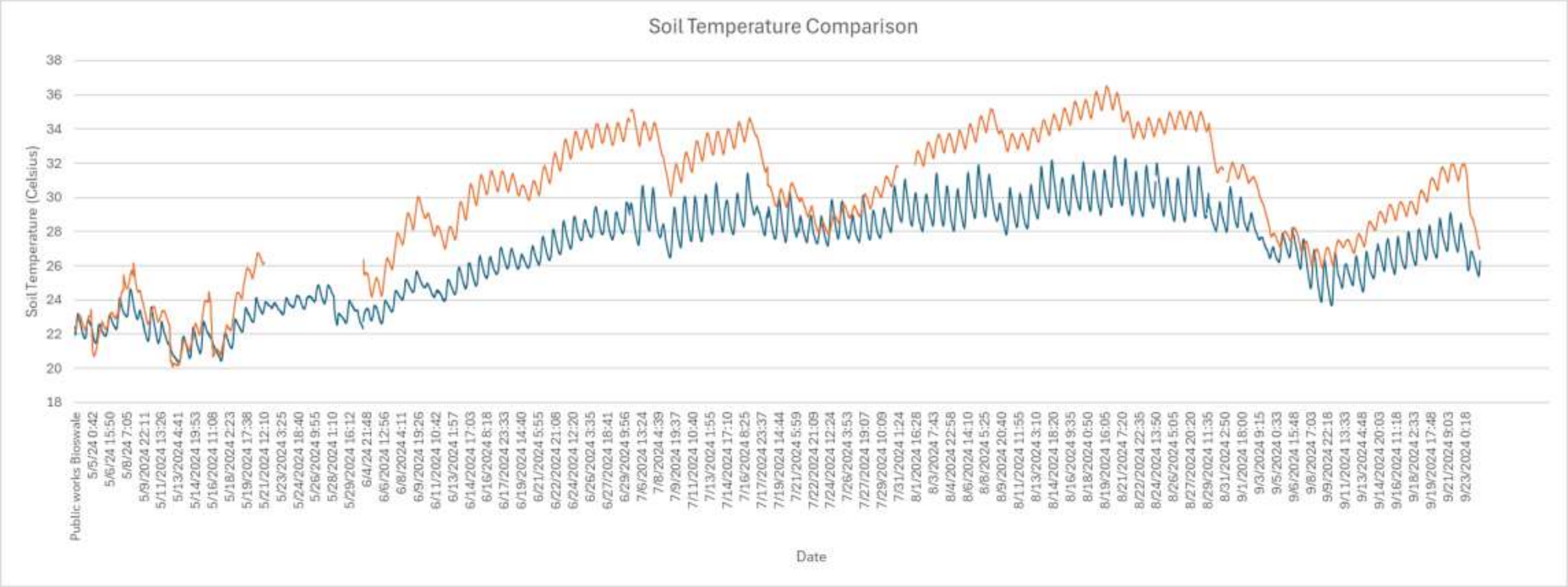
GroPoint Profile

The Only Soil Moisture and Temperature Profile Sensor To Give A True Soil Moisture Profile

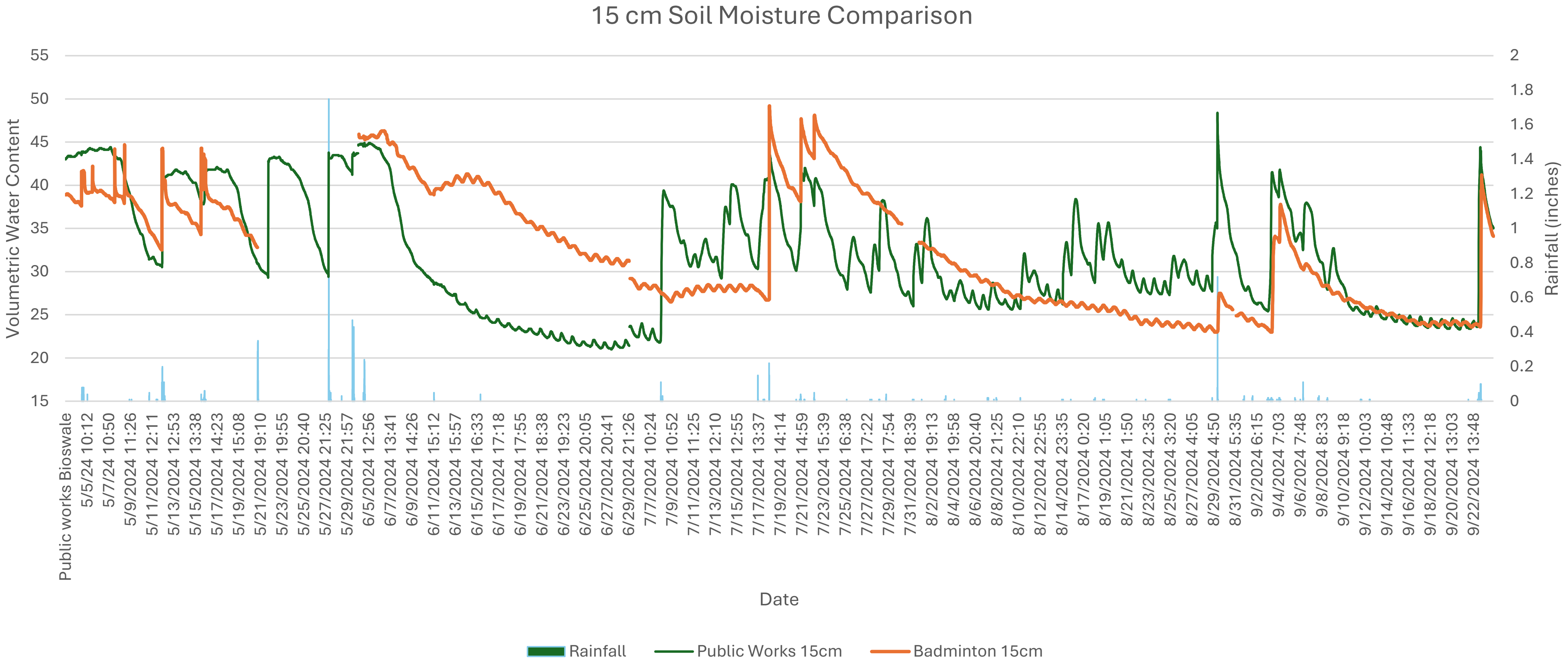
REQUEST QUOTE FOR PROFILE

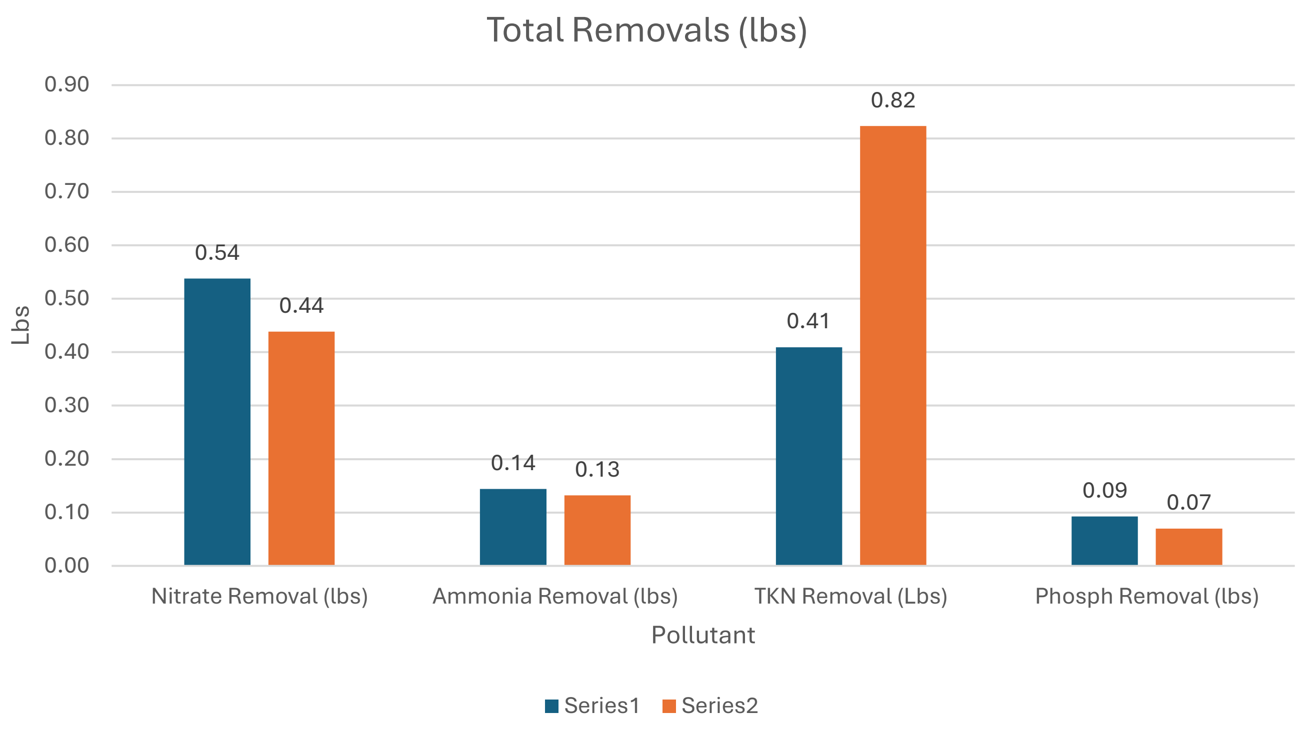
MULTI-DEPTH SOIL MOISTURE AND TEMPERATURE PROFILE SENSOR

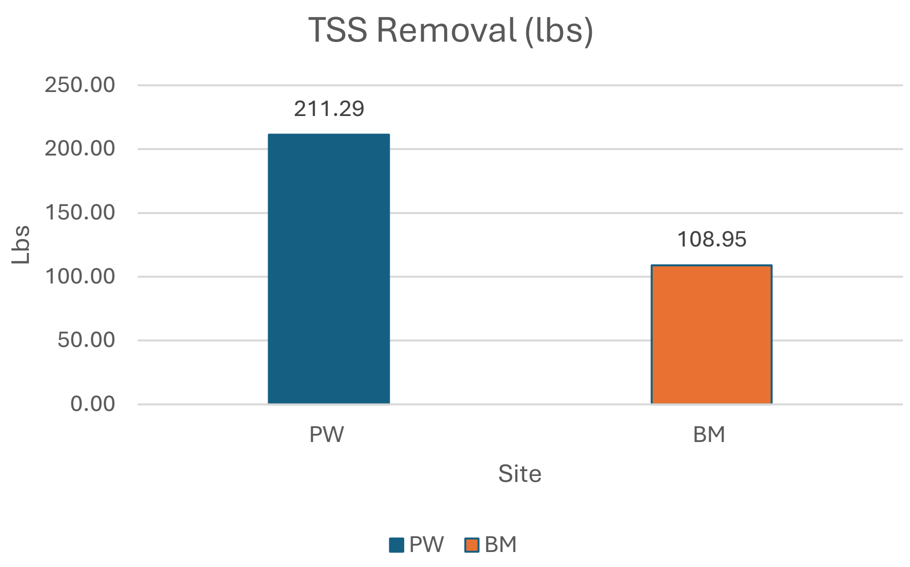
- Continuous soil moisture measurements over the entire length of the probe
- Configurable with or without soil temperature measurements at every 10 cm
- Available in 6 different probe lengths
- SDI-12 interface, optional Modbus over RS-485.
- Based on our unique patented TDT5 technology.
- Comes with 3 m (9.8') durable cable (Flying lead Standard, Optional 5-pin IP68-rated M-12 or 4-pin IP68-rated EN3 connector available).
- Factory-calibrated for most agricultural soils, but can be custom calibrated before shipping—request when ordering.
- Soil sensor can be custom calibrated by the customer—see the detailed procedure in the User Manual.



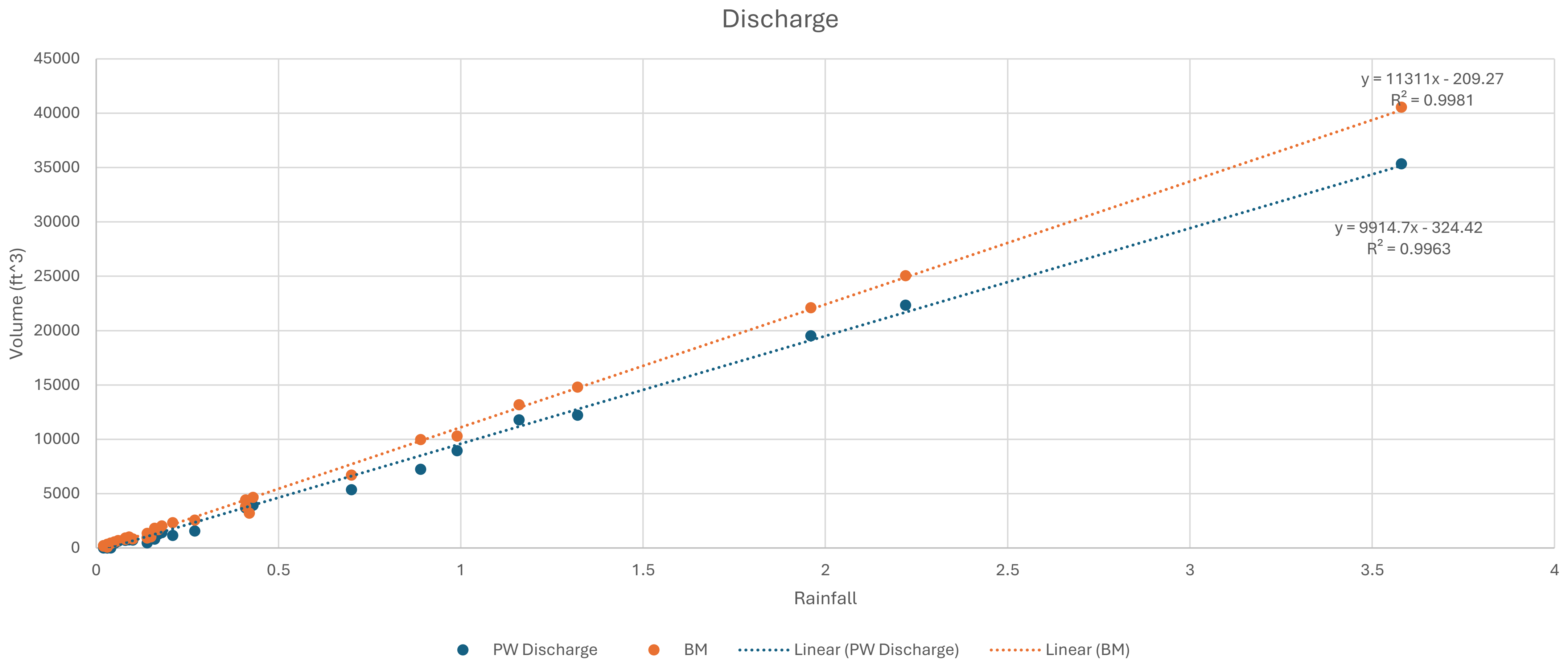
Soil Temperature Comparison
Soil Temperature (Celsius)
38
36
34
32
30
28
26
24
22
20
18
Public works Bioswale
5/5/24 0:42
5/6/24 15:50
5/8/24 7:05
5/9/2024 22:11
5/11/2024 13:26
5/13/2024 4:41
5/14/2024 19:53
5/16/2024 11:08
5/18/2024 2:23
5/19/2024 17:38
5/21/2024 12:10
5/23/2024 3:25
5/24/2024 18:40
5/26/2024 9:55
5/28/2024 1:10
5/29/2024 16:12
6/4/24 21:48
6/6/2024 12:56
6/8/2024 4:11
6/9/2024 19:26
6/11/2024 10:42
6/13/2024 1:57
6/14/2024 17:03
6/16/2024 8:18
6/17/2024 23:33
6/19/2024 14:40
6/21/2024 5:55
6/22/2024 21:08
6/24/2024 12:20
6/26/2024 3:35
6/27/2024 18:41
6/29/2024 9:56
7/6/2024 13:24
7/8/2024 4:39
7/9/2024 19:37
7/11/2024 10:40
7/13/2024 1:55
7/14/2024 17:10
7/16/2024 8:25
7/17/2024 23:37
7/19/2024 14:44
7/21/2024 5:59
7/22/2024 21:09
7/24/2024 12:24
7/26/2024 3:53
7/27/2024 19:07
7/29/2024 10:09
7/31/2024 1:24
8/1/2024 16:28
8/3/2024 7:43
8/4/2024 22:58
8/6/2024 14:10
8/8/2024 5:25
8/9/2024 20:40
8/11/2024 11:55
8/13/2024 3:10
8/14/2024 18:20
8/16/2024 9:35
8/18/2024 0:50
8/19/2024 16:05
8/21/2024 7:20
8/22/2024 22:35
8/24/2024 13:50
8/26/2024 5:05
8/27/2024 20:20
8/29/2024 11:35
8/31/2024 2:50
9/1/2024 18:00
9/3/2024 9:15
9/5/2024 0:33
9/6/2024 15:48
9/8/2024 7:03
9/9/2024 22:18
9/11/2024 13:33
9/13/2024 4:48
9/14/2024 20:03
9/16/2024 11:18
9/18/2024 2:33
9/19/2024 17:48
9/21/2024 9:03
9/23/2024 0:18
Date


15 cm Soil Moisture Comparison
Volumetric Water Content
Rainfall (inches)
Date
Rainfall
Public Works 15cm
Badminton 15cm
Public works Bioswale


Total Removals (lbs)
Lbs
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.54
0.44
0.14
0.13
0.41
0.82
0.09
0.07
Nitrate Removal (lbs)
Ammonia Removal (lbs)
TKN Removal (Lbs)
Phosph Removal (lbs)
Pollutant
Series1
Series2


TSS Removal (lbs)
Lbs
250.00
200.00
150.00
100.00
50.00
0.00
211.29
108.95
PW
BM
Site
PW
BM

Discharge



Discharge
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Volume (ft^3)
0
0.5
1
1.5
2
2.5
3
3.5
4
Rainfall
y = 11311x - 209.27
R² = 0.9981
y = 9914.7x - 324.42
R² = 0.9963
PW Discharge
BM
Linear (PW Discharge)
Linear (BM)

	TSS Removal (lbs)	Nitrate Removal (lbs)	Ammonia Removal (lbs)	TKN Removal (Lbs)	Phosph Removal (lbs)	Volume Removed ft^3	% volume removed
PW	211.29	0.54	0.14	0.41	0.09	18965.18	0.11
BM	108.95	0.44	0.13	0.82	0.07	10088.31	0.05
% Difference	48.44	18.47	8.33	-101.16	24.17	46.81	

Significant Results

Thank you

7. Adjournment

Thank you for attending!

Contact & Connect

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