

Urban Riparian Symposium

February 8 – 10, 2023

List of Presenters

(Alphabetical Order – Bold Names are Presenters)

Author: Elena Berg, Breanne Johnson, Crysta Guzman

Organization: North Central Texas Council of Governments

Contact Email: eberg@nctcog.org

Title: Protecting Texas Watersheds: Engaging Communities for a Trash Free Texas

Abstract: In 2020, the North Central Texas Council of Governments, in partnership with the Houston-Galveston Area Council and the Meadows Center for Water and the Environment at Texas State University, began work on a three-year grant funded through the U.S. Environmental Protection Agency's Trash Free Waters Program. The project aims to advance existing resources found on the Trash Free Texas website while also developing and adding new resources that can help engage residents and other communities in new ways. With over 50% of the state's population represented within the Dallas-Fort Worth and Houston-Galveston regions, which are connected through six river basins, any impact to trash removal and abatement has an impact upon the riparian areas within these basins and ultimately Galveston Bay and adjacent areas of the Gulf of Mexico.

The specific project goals are to: 1) Add Adopt-A-Spot litter cleanup locations to the Trash Free Texas (TFT) Adopt-a-Spot Map and promote the use of the Texas Litter Database for all litter cleanup data in Texas; 2) Provide outreach and engagement support for cleanup events held by communities and through partnerships with communities and recreational groups; 3) Foster partnerships between communities and restaurants that lead to the implementation of measures that reduce the use of single-use plastic waste; and, 4) Share the project and successes with other communities to replicate this work across the state.

This work builds upon previous efforts by a group of communities and non-profits working together to foster a litter-free environment in Texas' watersheds and track trash removal activities, which ultimately resulted in the creation of the Trash Free Texas website. The project team has built upon this foundation by adding resources to the website, growing awareness of the Trash Free Texas Adopt-a-Spot Map, and strengthening intra-regional and intra-agency collaboration on litter abatement.

Author: Olivia Bramlet, P.E., Marty Christman, P.E., Senior Engineer; and Brandon Klenzendorf, PhD, P.E., Principal, Geosyntec Consultants Inc.

Organization: Geosyntec Consultants, Inc.,

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Poster Title: Lower Buttermilk Creek Bank Stabilization and Restoration – City of Austin

Abstract: An approximately 450-foot reach of eroding stream bank along lower Buttermilk Creek in Austin, Texas was stabilized to protect a multi-family structure and to rehabilitate and restore riparian habitat along adjacent portions of the stream channel. Urbanization and increased impervious cover in the contributing watershed of the stream resulted in increased volume and frequency of storm runoff and stream flow, which in turn led to stream erosion. The eroding stream bank undermined an existing storm drain and fence and was threatening other infrastructure. The project objective was to design and implement solutions to stabilize the existing stream bank, protect threatened infrastructure, restore native vegetation along the riparian corridor, and preserve existing aquatic habitat. Geosyntec coordinated and completed a field survey of the existing channel conditions, a geotechnical investigation, hydraulic analyses of existing and proposed conditions, bank stabilization system analysis and design, riparian restoration design, construction drawing development, construction specification preparation, construction

permitting, bid phase assistance services, and construction phase assistance services. Geosyntec designed a drilled soldier pile and concrete lagging retaining wall for creek bank stabilization, which was combined with limestone block facing and reinforced vegetated soil slopes to retain a natural aesthetic and provide habitat benefits. Geosyntec led the hydraulic evaluation, demonstrated no impact to the floodplain, and developed the design to meet USACoE NWP 13 requirements. Geosyntec also coordinated the project with the THC, USFWS, and TPWD. Geosyntec's design provided an innovative and constructible bank stabilization measure that restored stream functionality and protected residential properties. The poster presentation will focus on the unique aspects of the bank stabilization construction process and the riparian restoration measures plus lessons learned in terms of vegetation outcomes and design/maintenance recommendations.

Author: Shannon Brown

Organization: Ecosystem Regeneration Artisans

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Title: Rainscape Contractor Lessons Learned from 5 Years of Building Residential Rainscapes

Abstract: Ecosystem Regeneration Artisans (ERA) takes a unique approach to landscaping, focusing on building rain gardens with native plants, primarily serving the ecosystems around Austin and San Antonio from our home base in San Marcos. Our homeowners benefit from our expertise in solving drainage problems, while creating an attractive oasis for wildlife. Word of mouth, foot traffic, and organic social media outreach built our client base. Our homeowners review their project at multiple stages. We analyze their watershed using GIS and explain the results to deepen their watershed understanding. Shortcutting watershed analysis and design leads to missed opportunities, primarily with lower stormwater capture than our standards. Clients review their completed design, and at installation confirm we achieved their goals. Simple systems work best, while overcomplicated systems tend to cause installation and maintenance headaches. Heavy equipment became critical to our installation process after a country project with ample space for machinery. Residential yards present access challenges. By utilizing a 1.5 ton mini-excavator on every installation, we can fit through small gates and transform full properties into Rainscapes cost effectively for homeowners, and profitably for our company. Rainscapes are a modular, repeatable solution to larger watershed problems. Drainage issues originating on neighboring lots are rerouted on our clients' properties by utilizing dry creeks leading to large basins for rainwater capture, which benefit surrounding riparian areas. Our projects for the Rain Catcher Pilot Program effectively managed large rain events and exceeded design parameters when tested in August 2022. We'd like to further understand how these systems exceeded their design capacity. Our current hypothesis considers that increasing the soil organic matter allows land to function as a sponge, while native bunch grasses increase soil porosity and infiltration. Rainscapes increase infiltration throughout residential watersheds, which reduces peak flows and flooding in urban riparian areas.

Author: Shannon Brown

Organization: Ecosystem Regeneration Artisans

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Title: Healthy Soil as the Largest Green Stormwater Infrastructure Tool

FRODO Abstract: Massive erosion and flooding problems can be prevented before stormwater enters riparian areas. Soil science revealed an incredible tool for managing stormwater. According to the Natural Resources Conservation Service (NRCS), "For each 1% increase in soil organic matter, soil can store an additional 20,000 gallons of water."

Author: Collen James Brownlow, PE, CFM, San Antonio River Authority, San Antonio, Texas; Tami Norton, PE, CFM, PMP, ENV SP, Ecosystem Planning & Restoration, San Antonio, Texas.

Organization: San Antonio River Authority

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Title: Mission Reach Lone Star Erosion Repair Project: Toewood for Bank Stabilization

Abstract: The San Antonio River Authority (SARA) is one of many such active river authorities in the State of Texas. Its jurisdiction covers 3,658 square miles in Bexar, Wilson, Karnes and Goliad Counties. In San Antonio, SARA owns and operates the Mission Reach Park. The Mission Reach ecosystem restoration and recreation project has increased the quality, quantity and diversity of flora and fauna along the eight miles of the Mission Reach area. The multi-year ecosystem restoration process will encompass several steps including construction on the river to reconfigure the channel and create improved aquatic habitat, reestablishing hundreds of acres of native grasses and wildflowers and finally the planting of over 20,000 native trees and shrubs. The culmination of these steps will result in the transformation of the river into a more natural state.

Following several major flashflood events from 2015-2018, sections of the Mission Reach bank along the San Antonio River were experiencing severe bank erosion. Approximately 220 feet of bank erosion was identified along the west bank of the San Antonio River adjacent to the former Lone Star Brewery. Using natural channel design principals, SARA intended to restore the stream channel and riparian areas to a more natural condition using native materials and minimal structures to reduce existing maintenance costs for removing downstream sediment and repairing infrastructure.

To address the bank erosion, SARA proposed the installation of toe wood. In 2019, a design was completed which included hydraulic modeling. The HEC-RAS hydraulic model was used to model the proposed toe wood structure effect on the regulated 100-year water surface elevations. The design specified use of 60 trees for footer logs and root wads. The repair project was completed in early 2020. This presentation will focus on lessons learned during the planning and construction of this exciting project!

Author: Andrew Clamann, Mateo Scoggins, and Leila Gosselink

Organization: City of Austin - Watershed Protection Department

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Title: Trash in Creeks: a field survey of volume and source types in Austin, TX

Abstract: The Watershed Protection Department conducted a field survey to understand distribution and sources of trash in creeks to inform solutions. Data points were collected every 30ft for a total of 19,467 observations in 110 miles along 20 creeks from November 2021 to April 2022. Results show that trash intensity does not correlate well with stream position (upstream-to-downstream) which implies that trash does not move evenly through the system which complicates efforts to quantify the relative impact of different sources. Presence of trash is more strongly influenced by stream roughness (primarily riparian vegetation) than by source inputs which presents an opportunity to use these natural "strainers".

Author: David Cowan, North Texas Municipal Water District; Mac Martin, Texas A&M Forest Service

Organization: North Texas Municipal Water District

Contact Email: dcowan@ntmwd.com

Title: Forests to Faucets-Partnerships, Trees & Water Quality (A Riparian Restoration Project)

Abstract: Healthy riparian ecosystems filter pollutants, stabilize stream banks and intercept rain and runoff to increase infiltration capacity of soils. These nature-based services play an important role in protecting source water. With the help of multiple partners and volunteers, the Texas A&M Forest Service and North Texas Municipal Water District collaborated to plant over 2,800 native trees along two tributaries of Lavon Lake, a key source of drinking water for over 2 million North Texans. Each site was undertaken as a separate project. The first project took place along Wilson Creek in McKinney, Texas in 2021. The second occurred on Tickey Creek in Princeton, Texas in 2022. Both projects align with implementation measures outlined in the Lavon Lake Watershed Protection Plan, which identified sediment and nutrient loading into the Lavon Lake as a primary threat to water quality. Estimated ecological benefits of the projects were modeled over 5, 10, and 20-year benchmarks. In addition to the quantifiable benefits to water quality and the environment, connecting the community with nature served to engage and educate the public

about their natural resources. The projects coalesced civic leaders, non-profits, sponsors and over 100 volunteers for unified cause. Careful planning and coordination among the various groups resulted in successful corporate-sponsored community planting events on Texas Arbor Day weekends in 2021 and 2022.

Author: Angela England, England, A., R. McGillicuddy, M. McGarrity, K. Eggers, and A. Hoffmann

Organization: Texas Parks & Wildlife Dept.

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Title: Seven Years in the Riparian Reeds: The Healthy Creeks Initiative to Control Arundo, 2016-2022

Abstract: Arundo donax (giant reed) is an Old-World grass that has invaded riparian habitats across northern Mexico and much of the southern United States. Arundo forms dense, 20- to 30-foot-tall monocultures that can crowd out native vegetation, reduce and alter patterns of stream flow, increase streambank erosion, degrade fish and wildlife habitat quality, and increase wildfire risk. Since 2016, the Healthy Creeks Initiative has provided management of invasive Arundo at no cost to hundreds of participating landowners across five watersheds within the Texas Hill Country in order to maintain quality habitat for Guadalupe Bass and other native fishes and mussels. This presentation will discuss the progress and challenges of this landscape-scale initiative.

Author: Heather Firn

Organization: Trinity River Authority of Texas

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Title: Don't Feed the Goat - A Public-Private Partnership to Combat Floatable Litter

Abstract: Trinity River Authority and UpSpire, in collaboration with the University of Texas at Arlington, Tarrant Regional Water District, and Dorris Family Foundation, were awarded the National Fish and Wildlife Foundation's Five Star Urban Waters Restoration Grant in 2021. The grant supports a recommended management practice identified in the Village Creek-Lake Arlington Watershed Protection Plan. The grant funded the purchase, installation, and maintenance of multiple trash barriers at 10 littered locations within Village Creek-Lake Arlington Watershed and City of Fort Worth Parks. This project aids in the expansion of the UpSpire Waterways litter prevention program as well as increases community engagement in addressing the root causes of litter. The project focuses on restoring 21,128 acres of Village Creek Lake Arlington watershed and 807 acres within the City of Fort Worth. The ten WATERGOATS funded by this grant were installed in May 2022. As of November 2022, 8,430 pounds of trash have been collected.

Project Website: https://www.trinityra.org/basin_planning/village_creek-lake_arlington_wpp/implementation_projects.php

City of Fort Worth StoryMaps: <https://storymaps.arcgis.com/stories/cdb8b55f174f49afad0bd8bf4e3e14e5>

Author: Heather Firn

Organization: Trinity River Authority of Texas

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Title: Trinity River Mid-Basin Watershed Study

Abstract: Funding for this project is provided by the Texas Water Development Board Flood Infrastructure Fund. The Trinity River Mid-Basin area encompasses all or portions of Anderson, Freestone, Grimes, Houston, Leon, Madison, Polk, San Jacinto, Trinity and Walker Counties.

The Trinity River Mid-Basin Watershed Study will develop baseline hydraulic modeling for approximately 100 stream miles of the Main Stem of the Trinity River from Freestone County to the headwaters of Lake Livingston in Polk and

San Jacinto counties. Up to three Trinity Tributaries spanning approximately 155 stream miles will be studied. The study will incorporate existing models and model development underway by local, state, and federal partners in the area to produce a regional flood plan for this area of the Trinity River.

Deliverables will include six total alternatives for potential flood risk reduction strategies. Public engagement with stakeholders in the study area will assist in confirming that the flood-prone areas are accounted for in the study. This project will be completed by June, 2023.

Web Map:

<https://gissolutions.half.com/portal/apps/webappviewer/index.html?id=def05bb87f26406ca5b99c4a9bc77b1c>

Project Website: https://www.trinityra.org/basin_planning/mid-basin_watershed_study.php

Author: Maddi Gunn

Organization: Tarrant Regional Water District

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Title: Jumping in With Both Feet: An Overview on TRWD's Watershed Technician Program

Abstract: The Tarrant Regional Water District (TRWD) is committed to supporting future innovators, leaders, and educators in the water sector. In commitment to this mission, TRWD's Watershed Program has created a technician position to give entry level experience to current college students or recent graduates. While in this role the technicians gain invaluable experience and insight into being a professional in the water field. Over the last five years, the position has evolved with each technician to support their education level and career goals. Consistent aspects of the position include field experiences utilizing the Stream Trailers and Watershed Experience Trailer, educational planning and creation of outreach materials, marketing and social media, and community outreach.

What started as a student internship has evolved into the Watershed Technician position, and we look forward to sharing more about how the program's growth is affecting the work we do and the people that are mentored.

Author: Aaron Hoff

Organization: Tarrant Regional Water District

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Title: Everyone's Turning Green - Building Public/Private Partnerships to Promote GSI in the Lone Star State

Abstract: The Tarrant Regional Water District (TRWD) has engaged with stakeholders in our watersheds to enact conservation on private property since the late 1960s. These landowners took advantage of both technical and financial assistance extended by governmental resource agencies to apply responsible land stewardship practices in TRWD watersheds. In the early 2000s, several corporate partners got involved, expanding both the reach and scope of these programs in other TRWD watersheds. In 2020, these partners took lessons learned and set the stage to expand their effort's reach into the rest of the Trinity River Basin, with more diversified programs, allowing for landowners to have more flexibility when choosing the program that best fits their needs in terms of project size, scope, timeframe, and the manner of assistance required. We will discuss these newer programs in context of how they complement existing governmental assistance opportunities. We will also discuss two newer regional land stewardship initiatives: one that seeks to grow a network connecting those seeking assistance to providers, and another that approaches land stewardship as a function of regional-level transportation planning in the developing areas throughout North Texas.

Author: Michael Homer Jr., Preston Bean, Timothy Birdsong, Ryan McGillicuddy, Travis Tidwell

Organization: Texas Parks and Wildlife Department - Inland Fisheries Division

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Title: Design and Implementations of Texas' Habitat and Angler Access Program

Abstract: Texas Parks and Wildlife Department (TPWD) is responsible for managing freshwater fisheries resources in over 1,100 reservoirs and small impoundments in addition to 191,000 miles of streams and rivers statewide. Many of these systems have suffered declines in habitat quantity and quality associated with land and water use patterns; and the state's rapid population growth has led to increased pressure on currently available public access fishing locations. To address current and emerging needs for fish habitat conservation and restoration and the increasing demand for angler access in these systems, TPWD allocated funds generated from freshwater fishing license revenues to develop and support the Habitat and Angler Access Program (HAAP). The HAAP was established to support freshwater fish habitat restoration and enhancement efforts as well as shoreline-based angler access projects. The HAAP was conceptualized with two funding allocation mechanisms: a competitive grant program that supports projects led by external partners and an internal funding stream supporting habitat and access projects proposed by TPWD fisheries biologists. Successful development of the HAAP required establishing a framework that would a) address established fish habitat and angler access priorities, b) be supported among TPWD staff, c) follow protocols congruent with other successful TPWD grant programs to effectively allocate resources, and d) efficiently deliver outcomes (high quality habitat and access) to meet program objectives. A workgroup of TPWD fisheries biologists was tasked to develop the external grant framework that included drafting a request for proposals (RFP), proposal scoring system, project selection process, and regulatory compliance documentation. The workgroup facilitated a statewide needs assessment to identify thematic funding needs and candidate shovel-ready projects for the internal funding stream. This discussion highlights the development of the HAAP framework, its implementation, strategic priorities, challenges encountered, projects selected for funding through the initial funding cycle, expected outcomes, and anticipated future steps of the program.

Author: Savannah Howell

Organization: Arkansas Natural Resources Division

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Abstract: Over the years, there has been a gradual increase in watersheds becoming polluted and degraded, as shown by a 25% increase of impaired waterbodies mileage from 2012 to 2018 on the Arkansas Department of Energy and Environment's 303(d) list. The 303(d) list is a list of waterbodies that are not attaining state standards for water quality or designated uses. Under Section 319 of the Clean Water Act, the EPA gives funding to the states to fund nonpoint source pollution grant projects within priority watersheds. The Arkansas 319(h) Nonpoint Source Pollution (NPS) Grant Program is a competitive grant process to implement education/outreach, best management practices, watershed management plan development, water quality monitoring, and other practices. These two-to-three-year projects must demonstrate water quality improvement and work primarily in NPS Priority Watersheds. Most funded projects are monitoring and restoration projects. Monitoring projects inform programmatic decisions on where to focus funds as well as implementing the physical work to improve water quality in the state. Over the last ten years, 20 watershed management plans have been created or in the process of creation through the NPS Program. Cost share projects with private landowners to implement best management practices have also helped decrease the amount of NPS entering the waterways. With the many best management practices implemented since 2012, we have seen an estimated load reduction of 101,302 lbs/year of nitrogen, 54,142 lbs/year of phosphorus, and 47,346 tons/year. Education and urban green infrastructure are also becoming more popular projects as we reach out to the public to help divert the human impact of degradation within the watersheds. The 319 Program has allocated \$30.5 million federal monies to help reduce nonpoint source pollution in Arkansas. Due to the efforts of the 319 program and hard work of project partners, there have been three different success stories published by the EPA over the last five years. These success stories are imperative to show that work is paying off as these watersheds reach attainment of pollution standards. The 319 Program will continue to fund projects that help reduce the amount of nonpoint source pollution and educate the public on the importance of water quality.

Author: Fouad Jaber and Aaron Hoff (and the Whole TSI team)

Organization: Texas A&M AgriLife Extension

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Title: A new approach to sustainable development: The Upper Trinity River Transportation and Stormwater Infrastructure Project

Abstract: With recent floods in urban areas in Texas, urbanizing areas have a need for comprehensive planning for reduced impact of impervious areas on downstream residential areas and transportation structures. The Upper Trinity watershed on the west side of DFW is experiencing growth and fast development that, if unmanaged, could lead to strong negative impact downstream. A collaboration between the NCTCOG, the USACE, UT Arlington, Texas A&M AgriLife Extension, Texas A&M University-Galveston, the Tarrant Regional water district, and the Trinity River Authority have initiated a project to integrate transportation and stormwater needs to address the health, safety, and welfare concerns of the region while helping local governments manage their growth and development in a cost effective manner. The project will inventory relevant data and stormwater structures, study the land and develop a list of site specific design considerations, develop plans, through modeling to offset the impact of urban development. This presentation will present details and methodologies of this project including expected outcomes.

Author: Kathy Jack Ph.D., Fouad Jaber, Bardia Heidari and Victoria Prideaux Nguyen

Organization: The Nature Conservancy

Contact Email: kathy.jack@tnc.org

Title: Green Stormwater Infrastructure for Urban Flood Resilience: Opportunity Analysis for Dallas, Texas

Abstract: Dallas-Fort Worth is the fastest growing metropolitan area in the United States (U S Census Bureau, 2020), experiencing rapid and widespread conversion of natural land cover to impervious surfaces. Meanwhile cities are outgrowing their stormwater drainage networks, and climate change is leading to more frequent and intense rain events. Together, these trends are causing tremendous challenges with stormwater management, water quality and flooding; these challenges are expected to grow worse. The Nature Conservancy (TNC) and Texas A&M AgriLife Extension, in collaboration with the City of Dallas and the Trust for Public Land completed an analysis to identify priority areas in Dallas where GSI can most effectively enhance urban flood management considering capacity, cost, and future impacts of climate change. The study identifies priority subwatersheds to target investment and estimated the costs and flood management benefits from comprehensive deployment of GSI in these areas, including as compared to investment in "gray"

Author: Kathy Jack Ph.D., Lynde Dodd, Eugene Yacobson, Ryan Smith, Jacob Rothberger,

Organization: The Nature Conservancy

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Title: Trinity Floodplain Planning & Prioritization Tool

Abstract: In Texas, multi-billion-dollar flood disasters are increasing in frequency, with communities in the Trinity River Basin feeling the impacts. Protection and restoration of floodplains, wetlands, and natural infrastructure provides important, often cost effective, flood mitigation, water quality, and ecosystem benefits for people and nature. However, communities and decision-makers do not always have the data or resources needed to prioritize investment in nature-based solutions. The Nature Conservancy (TNC) is collaborating with the U.S. Army Corps of Engineers Silver Jackets partner Fort Worth District (USACE-SWF) and additional partners and stakeholders to support the protection

and restoration of natural areas and greenspace in the floodplain for mitigating flood impacts, reducing risk to communities, improving water quality and ecosystem

function, and providing associated community and conservation benefits. As a part of this effort, TNC's Floodplain Prioritization Tool "originally developed to identify critical opportunities for floodplain conservation and restoration in the Mississippi River Basin" is being adapted to the Trinity Basin. This tool will allow for stakeholders to identify potential restoration and protection opportunities based on key conservation and community objectives such as habitat preservation, connectivity, water quality, and flood risk.

Author: Deborah January-Bevers, (Houston Wilderness) and Rachel Sanchez-Ruffra (Houston Wilderness)

Organization: Houston Wilderness

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Title: Enhancing Riparian Corridors through Targeted Use of Property Buyouts along Waterways (Greater Gulf-Houston region)

Abstract: When Texas counties expend funds to purchase frequently-flooded residential and commercial properties, often through the FEMA-qualified buyout assistance program, along riparian areas that flood in large rain events in rural/suburban communities, there are three main consequences that can result: 1) a "patchwork" of fragmented green spaces exist after the residential/commercial properties are removed along a myriad of riparian corridors, 2) the remaining non-buyout property owners continue to be at risk in future flood events, and 3) counties have a financial burden to maintain the green spaces after the properties are removed but are provided with no additional funds to plan for riparian area management or to prioritize contiguous buyout properties to enhance ecosystem services on the green spaces to benefit the surrounding community.

The pioneering Riverine Targeted Use of Buyouts (Riverine TUBs) Program assists in addressing these challenges through the utilization of green stormwater infrastructure (GSI) techniques on targeted contiguous buyout properties adjacent riparian corridors leading to Galveston Bay (Texas) and the Gulf of Mexico. With the assistance of local, regional and federal partners, including Harris County Flood Control District, Harris County and surrounding counties, mitigation companies and landscape architects firms and NRCS-Texas, the Riparian TUBs Program implements GSI techniques on these contiguous public lands to increase coastal and riverine resilience, address harmful impacts from frequent rainwater and storm events and establish new GSI best management practices (BMPs) that can be emulated by other stakeholders/decision-makers in the region and around the coastal U.S. The GSI techniques provide nature-based flood mitigation, air and water quality enhancements, increase carbon sequestration and riverine erosion control. Specific case examples are discussed.

Author: Tami Norton

Organization: Ecosystem Planning and Restoration

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Title: Mission Reach – Lone Star Site Erosion Project: Toewood for Bank Stabilization

Abstract: The San Antonio River, along the River Walk Mission Reach Trail System, was experiencing bank erosion near Roosevelt Park. The San Antonio River Authority (SARA) desired to address the erosion using natural channel design techniques, evaluating alternatives to avoid hard armoring methods, to preserve the natural look of the river and provide fish habitat, while protecting the riverbank. The Lone Star Bank Stabilization Project, completed in August 2020, will be presented, and include discussion of project goals and the selection of natural channel design techniques, specifically toewood, to address the erosion. Additionally, project constraints and challenges with the design, permitting, construction, and maintenance will be presented.

Author: Shonda Mace

Organization: Texas General Land Office

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Title: Texas' Combined River Basin Flood Studies

Abstract: The Texas General Land Office Community Development and Revitalization (GLO-CDR) Planning team empowers decision makers with the information they want. GLO-CDR recently implemented the Combined River Basin Flood Studies, detailing flood risk information and mitigation strategies for disaster-impacted counties impacted by 2015 Floods, 2016, Floods, and Hurricane Harvey. Additional funding is being directed toward interagency grants with the Texas Water Development Board (TWDB), US Army Corps of Engineers (USACE), and US Geological Survey (USGS) for the creation of a team of industry experts to assess and develop potential flood models that will build a comprehensive framework for evaluating flood risks. Finally, through an additional interagency grant, Texas University A&M Systems (TAMUS) is developing a system capable of housing, securing, and displaying the state's disaster data needs. Learn how these interrelated initiatives will help inform communities to mitigate against future disasters.

Author: Grant Moss, Bayou Preservation Association's Stream Corridor Restoration Committee

Organization: Bayou Preservation Association

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Poster Title: Stream Corridor Restoration Checklist: a Collaborative Effort to Advance Riparian Restoration Principles in Project Planning and Implementation in the Houston Region

Abstract: Bayou Preservation Association's Stream Corridor Restoration Checklist highlights four key areas important to thorough and successful project planning and implementation in the stream corridor.

Incorporating Outreach for Successful Stream Corridor Restoration.

Houston is the most diverse city in the U.S. In such a large city it is crucial for projects that will impact these various communities make every effort to reach out to, educate, and receive feedback from the communities served and affected by the region's many stream corridor projects.

Applying a Comprehensive Approach to Preserve, Improve, and Restore Stream Corridors

Houston has seen an evolution of the region's relationship with its many bayous throughout its history: from hard-structure engineering, to restoration and buybacks, to nature-based solutions and green infrastructure. All the tools available to environmental managers have roles to play, but we strongly encourage project planners and engineers to consider their projects from every angle, and to engineer with nature, rather than fight it, whenever possible.

Author: Katie Myers, Aaron Hoff

Organization: Tarrant Regional Water District

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Title: Sunny Side Up: How do we maximize benefits of the solar boom while minimizing water quality impacts?

FRODO Abstract: Take a drive around certain areas of rural Texas and you'll notice a new type of farm cropping up: solar farms. These large utility-scale sites are being developed at a fast clip, driven by national renewable energy incentives and market demands. However, while solar energy is a global climate win, some construction and management practices can lead to local environmental losses. As of right now, the rate of development is outpacing research about how different construction and vegetation management decisions affect runoff volume, water quality, soil health, and wildlife. In addition, we lack differentiation between what BMPs are most appropriate in different ecoregions. Questions for water quality professionals to consider include:

- Are you seeing this type of development in your landscape? If so, have you engaged with the energy companies, construction contractors, or landowners?
- What are the most urgent knowledge gaps? What do you want to know?
- What does an "ideal" solar farm look like to you?
- How do we encourage all parties (energy and construction companies and landowners) to work

Author: Mitch Nisbet, Robert Turner, Dr. Jeffrey Hutchinson, Randy Myers, Gordon Linam, Shaun Donovan

Organization: Texas Parks and Wildlife

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Title: Assessing the Fishery and Economic Value of a Restored Guadalupe Bass Population

Abstract: The Guadalupe Bass is important to Texans both culturally and economically and has been identified by the Texas Parks and Wildlife Department as a species of greatest conservation need. Stratified multistage creel surveys were conducted over a temporal sampling frame of twelve months on the Mission Reach area of the San Antonio River. This area has become a highly utilized urban fishery with fishing effort at 393 hours/hectare/quarter. Anglers were asked questions regarding their awareness of the Guadalupe Bass, the presence of the species in the river, species of fish sought, catch and harvest of any species, estimated monetary and time total of fishing trip, and their residency zip code. Angling effort totaled 59,683 hours, with the 45% of anglers targeting any species of fish, while angler effort targeting Guadalupe Bass singularly and simultaneously with Largemouth Bass comprised 1.5% (933 hours) and 27% (16,029 hours) respectively. Within the temporal sampling frame (July 1, 2021 - June 30, 2022) a total of 17,807 fish were caught and 1,615 of those were harvested. No Guadalupe Bass were recorded as being harvested during this study. Total annual angler expenditures were estimated at \$462,974, with 18.2% or \$84,565 attributed to anglers targeting Guadalupe Bass singularly and simultaneously with Largemouth Bass. The total economic value, which includes angler expenditures and consumer surplus, for the Mission Reach fishery was estimated at \$694,241, with anglers that targeted Guadalupe Bass singularly and simultaneously with largemouth bass comprising 30.7% (\$213,167) and 20.2% (\$140,177) respectively. Angler awareness of the presence of Guadalupe Bass in the system was 49%. Most anglers (57%) preferred the existing black bass harvest regulations over alternative harvest strategies.

Author: Virginia Parker, Dr. Kimberly Meitzen

Organization: San Marcos River Foundation

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Title: Lessons, Experiences and Management of SMRF's East Side Preserve

Abstract: The mission of the San Marcos River Foundation (SMRF) is to preserve and protect the quality and quantity of the San Marcos River. In 2017 SMRF was gifted a 31-acre piece of property inside the city-limits with the understanding that it would be protected and preserved. We call this land the East Side Preserve (ESP).

The ESP has approximately 1 mile of river frontage on the San Marcos River and is cut in half by Willow Springs Creek, which is a tributary of the river. In strong rainwater events, trash from the city and highway end up on our property via the creek and river, which we clean up regularly. Through different partnerships SMRF has removed invasive plant species along the riparian zone, and added native species that will more sufficiently stabilize the banks and prevent erosion, protecting water quality in the river.

The ESP sits on the east-side of San Marcos which has historically been underserved by the city. It is surrounded by land that the city and county would like to see turned into park land, but SMRF has debated for years if it is possible to open up the preserve to the public while maintaining the integrity of the vegetation. As a small non-profit, owning land adjacent to IH-35 in one of the fastest growing counties in the country comes with its fair share of issues, but the environmental rewards far outweigh the challenges.

Author: Mikaela Sako, Ryan McManamay

Organization: Baylor University

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Title: Sustainable university campus expansion to protect aquatic biodiversity

Abstract: Extensive urbanization impairs biological communities through landscape alteration and subsequent physiochemical changes in stream ecosystems. Analogous to urban development in cities, new building and facility expansion on university campuses can lead to dramatic changes in impervious cover and consequently, increased stormflow impacting downstream ecological communities. Natural land, critical species, and critical species' habitat are found in proximity to campuses across the contiguous United States, where campus expansion could have severe implications on species persistence. Here, we analyze the extent and relevance of this issue on a nationwide scale to determine the campuses with the highest risk for ecological impairment. We used one such high-risk campus as a case study where we explored how alternative sustainable development could lessen impacts of building and infrastructure expansion on a sensitive aquatic species. From the US-wide analysis of 5761 college/university campuses, about 45% of campuses were within critical aquatic species watersheds, and over 5% were identified as buffering critical habitat. These results indicated that campus expansion management and policies will be critical for preserving biodiversity in the future. Our case study, Concordia University Texas (CTX), had the highest risk for ecological impairment. This campus was selected to compare the impacts of planned, conventional development versus sustainable development on a sensitive aquatic species. Impervious cover, simulated increases in stormwater runoff and total suspended solids (TSS) from the conventional expansion is estimated to lower salamander density. Conversely, an alternative campus expansion plan, providing for stormwater mitigation, allowed for increased development but permitted provisions for reduced runoff and TSS, thereby maintaining current salamander densities. Our analyses show that sustainable campus development plans have the potential to mitigate ecological disruption within watersheds. Other high-risk campuses identified by our scoring system are likely to benefit from additional research on sustainable development plans.

Author: Gregory Schadt

Organization: Office of Gregory Schadt

Contact Email: 1landarcht@gmail.com

Title: Case Study: Observations of urban stormwater projects in northwest Arlington.

Abstract: Schadt, a landscape architect, has lived and worked adjacent to a tributary of Village Creek in west Arlington for over twenty-five years. This creek had been channelized in the residential areas. A natural channel was maintained within Randol Mill Park and empties into a pond at the north end of the park.

He has observed multiple projects implemented by the City of Arlington to deal with stormwater related problems in an area that has been built-out for several decades. Recently a small section was reworked due to a grass embankment failure as it transitions into the natural channel at the southwest corner of Randol Mill Park.

The case study area includes the Texas Masonic Retirement Home - built in the 1920s, multiple neighborhoods built as Arlington expanded to the northwest from the 1950s through the 1980s and Randol Mill Park (150 acres), opened in the early 1960s. This area includes a residential design project Schadt completed adjacent to the drainage channel in 2021. During the design phase his clients noted they had anticipated a City initiated widening of the drainage channel for ten years. This City work on the channel was performed in 2022. During post-project evaluation he followed up with his clients to learn about the neighborhood's experience working with City staff and the contractor. During this conversation he was told about a tragic event that occurred last March.

Author: Julia Schmidt, J.R.

Organization: Texas A&M Forest Service

Contact Email: julia.schmidt@tfs.tamu.edu

Title: The Integration of Forest Management in Watershed Protection Strategies

Abstract: This learning session will focus on the integration of community forest management in watershed protection strategies, discussing the benefits of trees in urban settings, various methods to manage stormwater runoff, and why this is important. The goal of the presentation is to give both corporate and individual's ways to contribute to our water systems health and share background to the importance of trees in society. By reviewing green infrastructure, low impact development practices, and how an individual's landscaping can enhance stormwater quality, we can give power to the public in a tangible and obtainable way. This presentation will demonstrate how anyone can take matters into their own hands and begin to make a difference even in their own backyard.

Author: Mary Sears, Matthew Troia, Randy Meyers, Mitch Nisbet

Organization: University of Texas at San Antonio

Contact Email: mary.finuane@my.utsa.edu

Title: Assessing the restored Guadalupe Bass population in the Mission Reach, San Antonio

Abstract: The Guadalupe Bass, *Micropterus treculii*, is a species of greatest conservation need found only in streams draining the Edwards Plateau in Central Texas. In 2015-16, Texas Parks and Wildlife Department introduced *M. treculii* to the Mission Reach, a 16.9 km segment of the upper San Antonio River that had been restored from homogenous artificial channel to pool-riffle habitat complexes in 2013 by the San Antonio River Authority. Our objectives were to (1) characterize population densities of *M. treculii* and Largemouth bass, *Micropterus salmoides*, and (2) quantify seasonal variation in microhabitat use in the restored reach. Eight uniformly distributed sites were selected for this study, five of which were wadeable pool-riffle units and three of which were non-wadeable pools. A capture-mark-recapture study was used to estimate population densities of both micropterids. Over three sampling events, 278 *M. treculii* and 365 *M. salmoides* were captured via boat and backpack electrofishing. Population densities based on the Schnabel Method were 39 fish/ha for *M. treculii* and 33 fish/ha for *M. salmoides*. Micropterids were also sampled in July and October of 2021 and in January and April of 2022, and microhabitat was quantified as depth, velocity, substrate, and habitat cover. Over the four sampling events, 527 *M. treculii* and 732 *M. salmoides* were captured. Smaller *M. treculii* were associated with shallow water of higher velocities and with larger substrate than *M. salmoides*. Larger *M. treculii* and *M. salmoides* occurred in deeper pools, representative of the ontogenetic habitat shift from riffle to pool habitats for *M. treculii*. Segregation of *M. treculii* and *M. salmoides* along lotic-lentic gradients in the restored reach matches patterns observed in non-urbanized watersheds. These findings demonstrate a successful introduction of a *M. treculii* population that is recruiting and utilizing the engineered riffle habitats in this restored urban riverscape.

Author: Lela Shepherd, Federal Projects Regulatory Compliance Coordinator, ENV SP (HCFCD); Jonathan Bolton-Sr. Environmental Scientist (BG&E)

Organization: Harris County Flood Control District (HCFCD)

Contact Email: lela.shepherd@hcfcd.hctx.net

Title: BMPs while waiting for 4(d) on AST

Abstract: How can we avoid and minimize impacts to the Alligator Snapping Turtle (AST) protected under the Texas Administrative Code while we await the much-anticipated listing of the species under the Endangered Species Act (ESA)? Until protective conservation measures are established under a 4 (d) rule, we turn to guidance from our state partners at the Texas Parks and Wildlife Department (TPWD). Through coordination with TPWD's Wildlife Habitat Assessment Program (WHAB), the Harris County Flood Control District, and its consultants, have been successful in finding common ground to implementable best management practices (BMPs). This presentation will offer potential AST BMPs from a regulatory compliance perspective and provide insight into the agency coordination process using lessons learned from the Mercer Stormwater Detention Basin project within the Cypress Creek Watershed in Harris County. An AST specialist will provide a brief overview of habitat identification, nest avoidance, construction timing and the State Park Scientific Study permit. The presentation will conclude with a discussion on the implementation of these BMPs, including biological monitoring, trapping, and relocation.

Author: David Smith

Organization: Texas A&M AgriLife Extension Service

Contact Email: david.smith@ag.tamu.edu

Title: Growing the Next-Generation Water Leaders Through the 4-H Water Ambassadors Program

Abstract: The Texas 4-H Water Ambassadors Program has provides high school youth an opportunity to gain knowledge and develop leadership skills related to the science, technology, engineering and management of water in Texas. Major components of the program include: 1) experiential learning, 2) continuing education, 3) leadership and service, and 4) career exploration and mentorship. Students are immersed in learning through hands-on experiences and education by water industry professionals which equip them to support county extension agents and local water educators through volunteer service and teaching. Since 2017, 158 students representing more than 60 counties have served as 4-H Water Ambassadors. They have delivered roughly 8,500 hours of education and service in their communities presenting at 4-H clubs, in schools, at county ag and water days, and have assisted local water districts with water education and outreach. The program is administered through Texas 4-H Youth Development and Texas A&M AgriLife Extension and is primarily funded through private sponsorships from individuals and organizations within the Texas water industry.

Author: David Smith

Organization: Texas A&M AgriLife Extension Service

Contact Email: david.smith@ag.tamu.edu

Title: The Texas 4-H Water Ambassadors Program

Poster Abstract: The Texas 4-H Water Ambassadors Program has provides high school youth an opportunity to gain knowledge and develop leadership skills related to the science, technology, engineering and management of water in Texas. Major components of the program include: 1) experiential learning, 2) continuing education, 3) leadership and service, and 4) career exploration and mentorship. Students are immersed in learning through hands-on experiences and education by water industry professionals which equip them to support county extension agents and local water educators through volunteer service and teaching. Since 2017, 158 students representing more than 60 counties have served as 4-H Water Ambassadors. They have delivered roughly 8,500 hours of education and service in their communities presenting at 4-H clubs, in schools, at county ag and water days, and have assisted local water districts with water education and outreach. The program is administered through Texas 4-H Youth Development and Texas A&M AgriLife Extension and is primarily funded through private sponsorships from individuals and organizations within the Texas water industry.

Author: Kelly Strickler

Organization: City of Austin Watershed Protection Department

Contact Email: kelly.strickler@gmail.com

Title: Rain to River: Learning About Community Values Surrounding Austin's Creeks

Abstract: The City of Austin Watershed Protection Department in the midst of a multi-year community engagement process to update its strategic plan: Rain to River. Rain to River will guide the work of the department, setting goals, prioritizing its work, and guiding decision making to tackle urgent and interrelated challenges such as climate change, population growth, and racial inequities. Our operations include construction projects, regulations, and ongoing programs to repair, protect, and restore riparian systems. Rain to River is leveraging new engagement strategies such as focus groups, community ambassadors, and grants to local organizations to learn from historically marginalized communities that have been denied a full opportunity to participate in past WPD planning and decision-making processes. This presentation will give an overview of some of Rain to River's strategies for priority stakeholders and present preliminary findings for how participants understand, use, and value Austin's creeks.

Author: Wilma Tichelaar

Organization: USDA NRCS

Contact Email: Wilma.Tichelaar@usda.gov

Title: USDA NRCS Urban Agriculture support in Texas

Abstract: Common urban agricultural best management practices will be discussed and related to resource concerns that can exist in urban settings. Practices discussed will include High Tunnel Systems, Irrigation methods/efficiency, City ordinances for Ag, and NRCS' new Interim conservation practices that include Low Tunnel Systems, Raised Beds, Soil Carbon Amendment, and Forage for Grazing systems. These practices will be discussed in terms of how they support urban agriculture and USDA's goal of building a more resilient food supply chain.

NRCS funding initiatives will be discussed, identifying the need to increase support for urban ag in high population areas or food deserts, where fresh food is not as readily available to the community. The funding initiatives include an "Urban Agriculture".

Author: Christi Upton

Organization: City of Denton

Contact Email: christi.upton@cityofdenton.com

Title: Can We Control the Invasive Chinese Privet?

Abstract: Natural areas and non-maintained properties across the City of Denton are quickly becoming dominated by the invasive Chinese privet (*ligustrum sinense*). Private property owners, developers, and the city's Parks and Recreation Department (PARD) have been clamoring for permission to remove this damaging plant in areas that are designated as protected habitat. The city's Environmental Services is researching and developing what we hope are best practices to remove the plant in a cost-effective manner while preventing further damage to environmentally sensitive areas (ESAs) during the process. A recently adopted Standard Operating Procedure was developed to direct PARD on identified best practices. Environmental Services' staff has also worked with a handful of developers to remove privet on private property for mitigation in exchange for other activities in ESAs. This presentation will offer best practices that have been identified, and descriptions and evaluation of current efforts.

Author: Staryn Wagner

Organization: City of Austin's Watershed Protection Department

Contact Email: staryn.wagner@austintexas.gov

Title: Humans Nesting In Restored Urban Natural Areas

FRODO Abstract: As cities and towns grow more and more people are finding themselves displaced or just struggling to exist. The reasons may be any combination of stressors such as mental problems, drug abuse, bad luck, or undefined circumstances. At the end of the day they have to fall asleep somewhere, they have to store their clothes somewhere, and they have to be able to let down their guard somewhere. Abandoned buildings are a common place for these people to stay, but as those become scarce and they are forced out of open public places like under bridges, in alleys and on sidewalks they are headed for anywhere they can hide their stuff and lay down their head.

A lovely shaded natural area fits the bill fairly well in many cases. So what do we do when people start building their nests in our forested or newly restored riparian zones? With their peace of mind also comes their trash, excrement, anger and rage, bad behaviors and constant presence. Not that any of us don't have many or all those same things but we have the opportunity to tuck it away inside of the walls that make up our residence.

Author: Jenna Walker

Organization: The Meadows Center for Water and the Environment

Contact Email: jjwalker@txstate.edu

Title: Texas Stream Team Riparian Evaluation Community Science Program

Abstract: Texas Stream Team riparian evaluation community scientists are trained to assess the health of lakes and streams based on the riparian habitat. Data is coupled with water quality data and used to track ecosystem and habitat health over time in the rivers and streams that flow to the Texas Coast.

Author: Casey Williams

Organization: BIO-WEST

Contact Email: cwilliams@bio_west.com

Title: Using Riparian Buffers to Protect Comal Springs Riffle Beetle Habitat

Abstract: The Comal springs are home to several endemic species including the federally listed Comal springs riffle beetle (*Heterelmis comalensis*). This species lives in and along the major spring runs of Comal springs which have been historically impacted by siltation/ erosion, foot traffic and storm water runoff. As part of ongoing habitat restoration funded by the Edwards Aquifer Habitat Conservation Plan our team implemented a riparian buffer system to stabilize the sensitive habitat where the beetle resides and divert foot traffic away from the area. Makeshift filter devices were also installed to capture and redirect storm water runoff away from known beetle locations. After four years the improved sites have shifted from an eroding stream edge impacted by heavy foot traffic to a lush riparian corridor.

Author: Michelle Wood-Ramirez

Organization: Tarrant Regional Water District

Contact Email: michelle.wood-ramirez@trwd.com

Title: TRWD Rainscapes: Lessons Learned for the Installation of Green Stormwater Infrastructure in North Texas

Abstract: The Tarrant Regional Water District (TRWD) has implemented low impact development strategies with its continued landscaping retrofits at its Fort Worth Campus. Applying green stormwater infrastructure (GSI) into its landscape components, it has developed campus-wide BMPs that help clean, slow, and reuse stormwater, leading to the branding of "TRWD Rainscapes." A re-designed stormwater wetland was created from a malfunctioning detention basin, and now is the first extended dry-detention basin with micro-pools in North Texas. The campus also has incorporated a meandering rock channel, which connects the roofs of nearby buildings to the wetland, helping to further decrease the velocity of runoff. Present too are rainwater cisterns that not only help slow down the rate of runoff from a nearby building, but help to re-use water for irrigation purposes, irrigating native and adapted plants that are on campus. Permeable surfaces, such as rock channels, gravel pavers, and permeable concrete are demonstrated on site. Five species of water efficient turf grasses are also part of the TRWD Rainscapes. The installation and maintenance of each of these features has many lessons learned. The TRWD Rainscapes components on the campus demonstrate benefits to biodiversity and water conservation, and also categories such as new, or innovative designs, retrofit and redevelopment as part of a master plan project. These benefits are applicable to residential, commercial, and industrial audiences, who tour

the campus every year. The TRWD Rainscapes help to improve the local watershed and clean our stormwater before it reaches the Trinity River. This project serves as a demonstration for stewards of the land, both urban and rural, showcasing how LID can be applied for stormwater management.

Author: Michelle Wood-Ramirez

Organization: Tarrant Regional Water District

Contact Email: michelle.wood-ramirez@trwd.com

Title: TRWD Rainscapes: Lessons Learned for the Maintenance of Green Stormwater Infrastructure in North Texas

Abstract: The Tarrant Regional Water District (TRWD) has implemented low impact development strategies with its continued landscaping retrofits at its Fort Worth Campus. Applying green stormwater infrastructure (GSI) into its landscape components, it has developed campus-wide BMPs that help clean, slow, and reuse stormwater, leading to the branding of "TRWD Rainscapes." A re-designed stormwater wetland was created from a malfunctioning detention basin, and now is the first extended dry-detention basin with micro-pools in North Texas. This feature has incorporated a variety of wetland plants, with 58 documented species present in the wetland last year. The campus also has incorporated a meandering rock channel, which connects the roofs of nearby buildings to the wetland, helping to further decrease the velocity of runoff. Present too are rainwater cisterns that not only help slow down the rate of runoff from a nearby building, but help to re-use water for irrigation purposes, irrigating native and adapted plants that are on campus. The campus has 170 documented vegetation species on its premises, most of which are native to the state. Permeable surfaces, such as rock channels, gravel pavers, and permeable concrete are demonstrated on site. Five species of water efficient turf grasses are also part of the TRWD Rainscapes. The installation and maintenance of each of these features has many lessons learned. The TRWD Rainscapes components on the campus demonstrate benefits to biodiversity and water conservation, and also categories such as new, or innovative designs, retrofit and redevelopment as part of a master plan project. These benefits are applicable to residential, commercial, and industrial audiences, who tour the campus every year. The TRWD Rainscapes help to improve the local watershed and clean our stormwater before it reaches the Trinity River. This campus serves as a demonstration for stewards of the land, both urban and rural, showcasing how LID can be applied for stormwater management. Rainscapes Story Map: <https://arcg.is/09ffqOo>

Author: Virginia Parker, Dr. Kimberly Meitzen

Organization: San Marcos River Foundation

Contact Email: virginia@sanmarcosriver.org

Title: Lessons, Experiences and Management of SMRF's East Side Preserve

Abstract: The mission of the San Marcos River Foundation (SMRF) is to preserve and protect the quality and quantity of the San Marcos River. In 2017 SMRF was gifted a 31-acre piece of property inside the city-limits with the understanding that it would be protected and preserved. We call this land the East Side Preserve (ESP).

The ESP has approximately 1 mile of river frontage on the San Marcos River and is cut in half by Willow Springs Creek, which is a tributary of the river. In strong rainwater events, trash from the city and highway end up on our property via the creek and river, which we clean up regularly. Through different partnerships SMRF has removed invasive plant species along the riparian zone, and added native species that will more sufficiently stabilize the banks and prevent erosion, protecting water quality in the river.

The ESP sits on the east-side of San Marcos which has historically been underserved by the city. It is surrounded by land that the city and county would like to see turned into park land, but SMRF has debated for years if it is possible to open up the preserve to the public while maintaining the integrity of the vegetation. As a small non-profit, owning land adjacent to IH-35 in one of the fastest growing counties in the country comes with its fair share of issues, but the environmental rewards far outweigh the challenges.

Author: Wilma Tichelaar,

Organization: USDA NRCS

Contact Email: Wilma.Tichelaar@usda.gov

Title: USDA NRCS Urban Agriculture support in Texas

Abstract: Common urban agricultural best management practices will be discussed and related to resource concerns that can exist in urban settings. Practices discussed will include High Tunnel Systems, Irrigation methods/efficiency, City ordinances for Ag, and NRCS' new Interim conservation practices that include Low Tunnel Systems, Raised Beds, Soil Carbon Amendment, and Forage for Grazing systems. These practices will be discussed in terms of how they support urban agriculture and USDA's goal of building a more resilient food supply chain.

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