13TH TEXAS WATER RESEARCH NETWORK

November 9-10 | UT-Austin Campus

TEXAS
The University of Texas at Austin
Environmental Science Institute
Jackson School of Geosciences

Abstract List for Presentations and Posters

Oral Presentations

Title: The Water-AI Nexus: Dual Water Footprints of Data Centers and Pathways to a Water-Secure Digital Future

Author List: Zainab Mishaal Ashkanani[1] and Rabi Mohtar[1]

[1]Texas A&M University, College Station, TX

Abstract: The artificial intelligence (AI) buildout is among the largest concentrated industrial investments in a generation; the United States hosts roughly 5,400 data centers, more than half the global total. Oversight has not kept pace: fewer than one-third of operators measure their own water use, no federal disclosure standard exists, and permits capture only the on-site share. This presentation quantifies the full footprint, traces its energy and health couplings, and evaluates proven remedies.

The assessment synthesizes federal datasets, peer-reviewed literature, and documented community cases, operationalized in NEXUS FORGE, an open-source decision-support platform coupling 10 impact dimensions, 18 data sources, and 47 compliance thresholds in one pre-permit workflow.

U.S. data centers consumed an estimated 228 billion gallons in 2023. Only about 17 billion were drawn on site for cooling; roughly 211 billion, twelve times as much, flowed through the electricity that powers them. Demand is projected to double by 2028. Since 2022, nearly two-thirds of new facilities have risen in high water-stress areas; five states, including Texas, host 72% of them. Across six representative sites, coupled screening surfaced impacts 40% to 300% larger than single-sector review identified. Each site spiked on a different dimension: health in Memphis, water in Tucson, grid in Northern Virginia, food and land in central Ohio. Water-smart siting alone can cut the industry's water-scarcity footprint by up to 90%, and coordinated cooling and electricity sourcing could

reduce projected 2050 use by approximately 95%. AI-driven management has already cut municipal water losses by 20% to 40%.

These results establish that twelve of every thirteen gallons attributable to U.S. data centers never appear on the facility's water permit. Coupled screening closes that blind spot before a permit is signed, not after. Water availability is projected to surpass power access as the binding siting constraint within five years; the stakes concentrate in Texas. The state pairs one of the nation's fastest buildouts in stressed basins with El Paso's 10 million gallons per day of direct potable reuse: the remedies are operational. Water-secure digital growth is achievable; this presentation shows where the water goes, what it costs, and how to keep it.

Title: Understanding Drought and Hydrologic Variability in the Central Texas Hill Country Using High-Resolution Data and Machine Learning

Author List: Aylar Samadi[1], Justin Thompson[1], Maria Ulatowski[1], and Mary Eminue[1]

[1]Bureau of Economic Geology, The University of Texas at Austin, Austin, TX

Abstract: Drought is one of the most persistent and damaging natural hazards in Central Texas, affecting water availability, ecosystems, agriculture, and rapidly growing communities. The Texas Hill Country is particularly vulnerable because of its highly variable climate, increasing water demand, and karstic geology, which creates strong interactions between surface water and groundwater. Understanding the interconnected responses of climatic and hydrologic systems to drought is essential for effective water-resource management and long-term drought preparedness. This study examines the relationships among climatic variables, soil moisture, groundwater, surface water, and evapotranspiration across the Texas Hill Country from 2010 to 2024. Fine-resolution gridded datasets, downscaled to approximately 1 mi^2, are used to capture localized hydrologic patterns that may not be adequately represented by conventional regional drought assessments. Machine-learning methods are applied to quantify the spatial and temporal relationships among these variables and characterize their responses during drought onset, intensification, persistence, and recovery. By integrating multiple climatic and hydrologic variables within a unified framework, this study provides a more comprehensive representation of drought than approaches based on a single indicator. The findings will advance understanding of how drought signals propagate through the hydrologic system and support drought monitoring, water-resource planning, and climate-resilience strategies in the Texas Hill Country.

Title: Predicting Groundwater Contamination Risk for a Karstic Quarry in the Edwards Aquifer Recharge zone: A Geospatial Analysis of Post-mining Reclamation Scenarios

Author List: Kaitlyn Tran[1,2]

[1]Texas Institute of Applied Environmental Research, Tarleton State University, Stephenville, TX

[2]Austin Community College, Austin, TX

Abstract: Limestone quarrying greatly worsens karst aquifer vulnerability by removing protective layers and exposing groundwater to rapid contamination. Despite growing trends in post-mining redevelopment worldwide, regulations on groundwater quality under post-mining conditions remain scarce, and understanding how different reclamation strategies affect contamination risk in quarried karst is limited. The Lime Creek Quarry in Cedar Park, Texas, situated on the Edwards Aquifer Contributing Zone, exemplifies this challenge. Although mining ended in 2023, 173 years of excavation removed protective karst layers, exposing the groundwater table directly to surface contamination. The city's proposed redevelopment of the 216-acre site raises critical questions about groundwater quality under different land-use scenarios.

This study developed the first systematic geospatial modeling framework for delineating groundwater contamination risk zones in reclaimed, quarried karst. The GIS workflow established baseline aquifer vulnerability by optimizing the EPIK method, reweighing Epikarst, Protective Cover, Infiltration, and Karst conditions derived from aerial imagery and elevation data. Digitized development scenarios and pollutant loads were overlaid to generate contamination risk maps for three reclamation scenarios: minimal development, enhanced green infrastructure, and conservation park.

Results demonstrated that revegetation and green infrastructure reduced high-risk infiltration areas by 39.4% compared to minimal reclamation, while park development achieved 58.1% total reduction in high-risk zones, with highest reductions concentrated at open-pit mining regions where the vadose zone was completely removed. Risk models were rigorously validated through sensitivity analysis and hydrochemical field testing, with measured nitrate-nitrogen concentrations correlating strongly with predicted infiltration vulnerability (r ‰ˆ 0.824). This framework provides a cost-effective, transferable geospatial approach for communities managing groundwater protection in karst regions worldwide.

Title: Can Better Hydroclimatic Information Improve Treaty Compliance? Data Politics and Diplomacy in the Rio Grande Basin

Author List: Vianey Rueda[1], Lara Tobias-Tarsh[2], Mohammed Ombadi[1], Andrew Gronewold[1]

[1]University of Michigan, Ann Arbor, MI

[2]Princeton University, Princeton, NJ

Abstract: Transboundary water systems are increasingly strained by climate change, population growth, and governance frameworks designed under assumptions of hydrologic stationarity. The Rio Grande Basin (RGB), governed by the 1944 WaterTreaty between the United States and Mexico, exemplifies these challenges, as prolonged drought, declining reservoir storage, and recurring delivery shortfalls have heightened tensions over Treaty compliance. While these conflicts are often framed as consequences of water scarcity, they also reflect contested questions over what constitutes authoritative hydroclimatic knowledge, who produces it, and how it is used in transboundary decision-making. As historical hydrologic baselines become less reliable under climate non-stationarity, the governance challenge shifts from allocating fixed water volumes to managing under conditions of deep uncertainty. This study evaluates Mexico's capacity to meet its Treaty delivery obligations by integrating observational, satellite, and reanalysis datasets to examine long-term trends in basin-wide precipitation and aridity, while assessing the contribution of tropical cyclones (TCs) to reservoir storage and Treaty deliveries. Results reveal significant drying in the Rio Conchos, the basin's primary Treaty tributary, and show that although episodic TC-driven inflows have occasionally enabled Treaty compliance, their contributions are highly variable and insufficient to offset long-term drying trends. These findings are interpreted within the broader politics of data and information in the RGB to examine whether improved hydroclimatic understanding can meaningfully inform transboundary water governance. The study argues that while climate information can better characterize the physical limits of Treaty compliance, its influence on decision-making ultimately depends on the political authority accorded to that knowledge, highlighting the need to address both hydrologic uncertainty and the politics of environmental data in adapting transboundary water governance to a changing climate.

Title: Tracking Earth's Changing Water from Space: The GRACE and GRACE-FO missions

Author List: Himanshu Save[1]

Center for Space Research, Cockrell School of Engineering, The University of Texas at Austin, Austin, TX

Abstract: n/a

Title: Data Centers and Water Concerns in Texas

Author List: Lucy Atkinson[1], Deidra Miniard[2]

[1]Stan Richards School of Advertising & Public Relations, The University of Texas at Austin, Austin, TX

[2]LBJ School of Public Affairs, The University of Texas at Austin, Austin, TX

Abstract: AI data center construction is booming in Texas. With 405 data centers currently online and another 442 planned or under construction, Texas is second only to Virginia in the number of data centers. Data centers and the massive server farms they house are integral to the functioning of AI by providing the required computing power, storage, and infrastructure. As demand for AI-related services intensifies, so will the need for more data centers.

Yet the costs of this data center construction boom are high and carry significant, far-reaching environmental impacts. The energy and water required to run and cool data centers is staggering. Data centers use times more energy than a typical household and consume 17 billion gallons of water a year: a number that is projected to quadruple by 2028.

In Texas, concerns about the water use impacts of data center are growing. Our proposed research presentation reports on data collected in August assessing Texansâ€™ concerns about data centers. Our data show that more than 75% are concerned about data center water consumption. When asked to rank their concerns about data centers, water use is the number one issue for almost 40%, outweighing potential positive impacts like jobs and tax revenue.

Texans also show strong support for policies that would regulate data centers, for example, requiring data centers to publicly report water and electricity consumption and restricting new data centers in water-shortage areas. These policies have bipartisan support, suggesting the issue is not a political one but concerns Republicans and Democrats alike.

Our proposed presentation will report more detailed insights from our survey, shedding light on individual predispositions like trust in institutions and technology as they influence attitudes toward data centers and their water use.

Title: Identifying Paleochannel Networks Through Subsurface Lithologic Connectivity for Land Subsidence and Groundwater-Flow Assessment

Author List: Juan Marcel Campos[1], Brent Elloitt[1], Hassan Dashtian[1]

[1]Bureau of Economic Geology, The University of Texas at Austin, Austin, TX

Abstract: The Texas Coastal Plain consists of a complex sequence of interbedded sand, silt, and clay deposits formed within fluvial, deltaic, estuarine, and coastal environments. Collectively, these units form an important shallow groundwater system composed of water-bearing intervals and confining units. Using a spatially interpolated model that targets material proportions, it becomes possible to identify regions that may exhibit land-subsidence susceptibility and groundwater-bearing potential based on lithologic composition. More importantly, the approach provides a means of tracing subsurface connections and modeling paleochannel pathways between two compositionally distinct end members: sand-rich and clay-rich zones.

A new Python-based geoprocessing toolkit allows users to utilize well-log lithology reports to generate material proportions within selected depth intervals, which are then laterally interpolated using kriging. Because driller logs contain inconsistent terminology, historical phrasing, and variable interpretations, the workflow can also evaluate the use of large language models to classify and standardize lithologic descriptions. While the natural-language processing component remains under continued development, semantic filtering of documented lithologic descriptions combined with material-dominance logic has produced sufficiently consistent results to support continued development of algorithms designed to evaluate subsurface geomaterial connectivity.

The resulting thematic maps show spatial variations in subsurface lithologic composition within specified depth intervals and are used to evaluate the potential connectivity of paleochannel systems. Sand-rich zones are interpreted as possible remnants of former channels, bars, and other higher-energy fluvial deposits, while clay-rich zones may represent intervening floodplain, overbank, or lower-permeability deposits that disrupt or constrain connectivity. By comparing the spatial continuity of these sand- and clay-rich zones across successive depth intervals, the workflow provides a basis for modeling paleochannel networks and identifying potentially interconnected subsurface pathways.

These products can be used independently or integrated into existing groundwater and land-subsidence models to improve regional planning, forecasting, and mitigation of groundwater-related and subsidence-related issues affecting the Texas Coastal Plain, particularly in major metropolitan areas such as Houston and Corpus Christi.

Title: Opportunities for the built environment to contribute to water supply in Texas

Author List: Chandler Crouch[1]

[1]Texas Water Trade, Austin, TX

Abstract: Alternative water supplies at the building scale have been historically underutilized as a means to reduce potable demands in the built environment. Being located behind the private water meter makes this demand management strategy challenging for water providers to plan for and incentivize. Texas Water Trade's (TWT) Net Zero Water program works to lower those barriers to entry and prioritizes scaling the strategy into the development playbooks across the State. By working across private and public sectors to convene development professionals, highlight research and case studies, and providing direct technical expertise, TWT is moving the needle in Texas towards a more water sustainable future. This session will highlight lessons from built and operational projects in Texas and discusses common barriers to adoption, including perceived operations risk and the added cost and effort of integrating reuse strategies during design. Our program draws on experience of a licensed civil engineer and former contractor who has designed and installed onsite reuse systems to lead the program and bring to the table a wide consortium of public and private stakeholders. The session will conclude with actionable recommendations for public agencies on how to lead by example with onsite reuse, enable onsite reuse within private development, and collaborate across utilities, regulators, and the development community to scale the practice.

Title: Advancing Water Conservation Communication Through Real-Time Audience Measurement: A Review of Technological Advancements in Messaging Research

Author List: Coy Callison[1] and Ali Van Fleet[1]

[1]Texas Tech University, Lubbock, TX

Abstract: Texas faces increasing challenges in maintaining reliable water supplies as population growth, development, and recurring drought place greater demands on water resources. Strategic communication research can play an important role in addressing

these challenges by identifying more effective ways to encourage water conservation and helping Texas communities remain resilient during future droughts. For stakeholders, a central challenge is determining whether conservation information is actually being noticed, whether audiences can find the information they need, and how they respond to specific elements of persuasive messages. Advances in communication research technologies provide new opportunities to move beyond traditional, retrospective measures of message effectiveness and examine how audiences actually respond to specific elements of persuasive messages as they encounter them in real-time.

This presentation recaps three studies that demonstrate the value of real-time audience measurement for water conservation communication. The first two studies used eye-tracking technology to examine visual attention to water-conservation information. One study found that conservation messaging included with a utility water bill received little visual attention, suggesting that simply providing information does not ensure that audiences will notice it. A second eye-tracking study demonstrated that participants had difficulty locating basic, commonly sought water-saving information on a municipal website, highlighting opportunities to improve the design and placement of online conservation resources. The third study used continuous-response dial testing with high plains farmers to examine reactions to a series of water-conservation videos. Rather than asking participants to evaluate each video after viewing it, the technology captured moment-by-moment changes in audience response, identifying the specific portions of individual videos that generated the strongest positive or negative reactions.

Together, these studies illustrate how eye tracking and continuous-response measurement can provide communication researchers and water-resource professionals with more granular insights into message effectiveness. By identifying which visual elements attract attention and which words, images, or moments generate audience response, these technologies allow water-resource communicators to refine messages inch by inch and second by second. This kind of research can reveal communication barriers and provide actionable insights to strengthen conservation messaging. Such evidence-based approaches can help develop more persuasive conservation messaging and ultimately support Texas communities in maintaining reliable water supplies now and in the future.

Title: Constraining Modern and Deglacial Climate Mechanisms in the Southwestern US Using Water Isotopes from Cave Dripwaters and Speleothems

Author List: Alexander Janelle[1], Giuseppe Lucia[1], Jiayue Yin[1], Sylvia Dee[1], Daniel Breecker[1], Nathaniel Miller[1], Jose Abella-Gutiérrez[1], Staci Loewy[1], R. Lawrence Edwards[1]

[1]The University of Texas at Austin, Austin, TX

Abstract: Central Texas encompasses an aridity transition, currently marked by the 100th Meridian, between the desert Southwestern US and the humid Southeastern Gulf Coastal Plain. In recent decades, this transition has migrated eastward, drying the region, potentially linked to movement in the western ridge of the North Atlantic Subtropical High (NASH). Yet, greenhouse gas-only climate models fail to reproduce this drying, implying other dynamical mechanisms as the cause for this change. We aim to better understand these mechanisms through water isotopes as preserved in deglacial speleothem records in the Southwestern US.

We first establish a modern water isotope transect by compiling cave drip water data in a E-W transect spanning ~600 km from the eastern margin of the Edwards Plateau in central Texas (96ºW) to the Guadalupe Mountains in New Mexico (106ºW). Drip waters show a systematic $\delta^{18}O$ decrease from the SE to the NW, reflecting Rayleigh distillation of Gulf of Mexico (GOM)-sourced moisture and/or an increasing contribution from low $\delta^{18}O$ Pacific-sourced winter precipitation. This dual-source moisture budget may be modulated by the intensity and frequency of mesoscale convective systems (MCSs), in turn controlled by the NASH and its effect on the Southern Great Plains Low-Level Jet.

Building on this framework, we present a speleothem oxygen isotope $\delta^{18}O$ transect with existing and new records spanning the last deglaciation from the eastern and western Edwards Plateau, and compare these with previous records from the Guadalupe Mountains, Fort Stanton Cave (NM), Cave of the Bells (AZ), and Leviathan Cave (NV). On average, the deglacial isotopic gradient is similar to its modern configuration with variability in magnitude of the slope through major warm and cool intervals. We posit that the proximity to the GOM moisture source rather than longitudinal distance exerts primary isotopic control: eastern sites reflect vapor source effects and influence of MCSs, while western sites are increasingly influenced by the North American Monsoon and the Pacific storm track intensity. By coupling our new speleothem $\delta^{18}O$ transect with iTRACE isotope-enabled transient simulations we aim to deconvolve how the isotopic gradient exists in various forcing states, clarifying mechanisms governing Southwestern US climate dynamics."

Title: Changing hydrology and impacts on water planning in the Highland Lakes Watershed, Central Texas

Author List: Jordan Furnans[1]

[1]Windward Water Resources Engineering & Geoscience, Round Rock, TX

Abstract: The Highland Lakes watershed, defined here as the land area between the outlet from OH Ivie Lake and Lake Travis on the Colorado River, provides the primary water supply for millions of residents in Central Texas. The agencies responsible for managing that supply, namely the Lower Colorado River Authority (LCRA) and the Texas Commission on Environmental Quality (TCEQ), utilize sophisticated models to assess how current water policies would dictate water availability under historically observed hydrologic conditions. These water availability models (WAMs) use naturalized streamflow data as input, which are computed approximations of the historical streamflow that would have occurred within the watershed without human interference (through reservoir construction, diversions, return flows, etc.). The WAMs use the naturalized flows to distribute available water to end users (communities, agricultural production, etc.), computing how much water each entity would have historically received given the simulated water allocation policies.

Recent observations have shown that the lowest inflows to the Highland Lakes (specifically Lakes Buchanan and Travis) have occurred within the 2006-2025 time period, yet the lowest historical rainfall totals occurred during the 1946-1957 drought period. To determine current water availability from the Highland Lakes watershed under the 1946-1957 low rainfall pattern, adjustments to the naturalized flows were made, based on comparisons between current and historical â€œCapture Rates.â€ The capture rate, defined as the ratio of watershed outflow to rainfall over a specific time interval, is a measure of the watershed productivity and demonstrates the efficiency with which the watershed creates streamflow from rainfall. Four different methods were evaluated for adjusting naturalized flows based on relative capture rates, and WAMs using the adjusted flows were compared to original WAMs developed by LCRA during its 2032 Water Management Plan (WMP) revision process. Model results from all WAMs run with modified naturalized flows datasets indicate lower water availability for LCRA's firm customers and suggest lower reservoir storage levels under proposed LCRA water management policies. Model results also indicate that using modified naturalized flows results in the 1946-1957 drought period to become the "drought of record" for the Highland Lakes watershed, rather than the 2008-2016 period currently endorsed by LCRA and TCEQ.

While the causes of declining capture rates and inflows to the Highland Lakes were not explicitly addressed, the theoretical influence of small ponds was detailed. Recommended

future studies include the development of rainfall-runoff models for the Highland Lakes watershed, and potentially shifting the flow naturalization process to involve both rainfall and streamflow calculations.

Title: Twelve Years Later: Updating Texas Outdoor Residential Water Use for 2012-2023

Author List: Mary Eminue[1] and Justin Thompson[1]

[1]Bureau of Economic Geology, The University of Texas at Austin, Austin, TX

Abstract: Residential outdoor water use is a poorly quantified component of water demand in Texas and a key input to long-term water supply planning. In 2012, the Texas Water Development Board's Technical Note 12-01 provided the first statewide characterization of seasonal single-family water use, applying the minimum-month method to directly reported monthly volumes, and establishing a baseline still embedded in the state's regional water planning process. Over a decade later, that baseline has not been updated, despite substantial population growth, recurring drought, and expanding conservation efforts across Texas in the interim, raising the question of whether it still reflects current outdoor water use conditions.

Updating this baseline is complicated by a change in data availability and quality: the Technical Note 12-01 study relied on monthly single-family water use volumes directly reported through the Water Use Survey, a dataset the survey has since discontinued. To address this data gap, we develop and validate two proxy methods to reconstruct monthly single-family water use from other data that water utilities still report today, benchmarking the reconstructing volumes against the original study's directly reported values and finding strong agreement in seasonal timing and shape across the majority of the utilities.

Across 253 Texas Public Water Systems, we estimate single-family outdoor water use from 2012 through 2023 and evaluate the extent to which monthly outdoor demand is driven by temperature and precipitation. We find that the weighted statewide average outdoor water use share has declined to approximately 27%, down from the 31% reported in the Technical Note 12-01 study, with pronounced year-to-year variations, and a consistent relationship with temperature that outweighs precipitation as a seasonal driver. These findings, together with the underlying dataset and methodology, present the Texas Water Development Board and the broader Texas water community with an updated foundation for outdoor demand forecasting and conservation planning.

Title: Toward Sustainable Water Planning: A Regional Water Budget Framework for Texas

Author List: Priyanjali Bose[1]

[1]The Meadows Center for Water & Environment, Texas State University, San Marcos, TX

Abstract: Texas water planning depends on understanding how water may move across its diverse landscapes. This study develops a statewide water-budget framework for 1995 - 2024 that can also be summarized across Texas's 16 Regional Water Planning Areas (RWPAs). The framework integrates climate data, watershed-based runoff estimates, groundwater information, reservoir evaporation, river-boundary inflows, and historical water-use records. The outcome of this investigation indicates that precipitation is the dominant water input, followed evapotranspiration which accounts for the largest loss, with other water-budget components varying spatially and temporally across Texas. Therefore, this reproducible framework provides a consistent basis for regional water-supply assessment, drought analysis, and long-term water planning across Texas.

Title: Exploring the Concentrations of Rare Earth Elements in Basinal Brines

Author List: Cindy Escamilla[1], Daniel Alessi[1]

[1]Jackson School of Geosciences, University of Texas at Austin, Austin, TX

Abstract: Rare earth elements (REEs) are crucial to modern technologies, as their unique chemical properties allow for the development of a wide range of electronics, defense systems, and the growing field of clean energy. However, global REE supply chains are challenged by centralized production and the environmental impacts of traditional mining. These challenges have driven interest in exploring unconventional resources to address rapidly increasing REE demand globally. Among these resources, brines in sedimentary basins have been studied extensively for critical minerals such as lithium, yet little is known about their REE composition and the overall resource potential. This study aims to develop a methodology to quantify REEs in basinal brines using triple-quadrupole inductively coupled plasma–mass spectrometry (ICP-MS/MS), using brine samples collected from the Duvernay and Montney Formations in the Western Canadian Sedimentary Basin (WCSB). Such analyses are challenging because the brines studied have salinities many times that of seawater, while REE concentrations are hypothesized to be present at parts-per-billion or parts-per-trillion concentrations. Our research evaluates detectable concentrations of the entire suite of light rare earth elements (LREEs) and heavy rare earth elements (HREEs). Ultimately, this research will establish foundational detection

baselines, identifying methodological needs in REE quantification in sedimentary brines, and contributing to future investigations of basinal brine REE potential.

Posters

Title: Data Centers, Water Stress, and Social Vulnerability: Mapping Emerging Water Resource Challenges in the United States

Author List: Sarah Traore[1]

[1]The University of Texas at Austin, Austin, TX

Abstract: The rapid expansion of artificial intelligence (AI) and cloud computing is driving demand for data centers across the US. While recent research has highlighted the substantial energy and water requirements associated with data center operations, less is known about how data center development intersects spatially with existing water constraints and the social characteristics of communities hosting this infrastructure. This study examines the spatial relationship between data center locations, water risks, and social vulnerability across the contiguous US. We integrate data center locations with the World Resources Institute's baseline and future water stress data and the Centers for Disease Control and Prevention's Social Vulnerability Index (SVI) at the census-tract level. The analysis identifies areas where data center development may intersect with existing water constraints and differential capacity to respond to changing water demands. The findings can help water managers and policymakers anticipate emerging demands associated with AI infrastructure, identify locations where additional information or monitoring may be needed, and consider social and distributional dimensions alongside conventional measures of water availability.

Title: Tracing urbanization impacts through emerging contaminant and microbial indicators to assess sources and pathways for surface water quality degradation in Austin, Texas

Author List: Trinity Chou[1]

[1]The University of Texas at Austin, Austin, TX

Abstract: Rapidly urbanizing areas, such as Austin, Texas, face a multitude of compounding factors that impact water quality, such as aging infrastructure, continued development driven by increasing population density, and climate variability. Aging infrastructure leads to municipal water (supply water [or drinking water] and wastewater)

leakage, resulting in the release of contaminants into surface waters. Wastewater poses a threat to human health and the environment, as it can introduce emerging contaminants (ECs) and pathogenic microorganisms into watersheds. Whereas traditional geochemical parameters (e.g., major ions) and isotopic tracers (e.g., Sr isotopes) are effective tracers of municipal water contributions to Austin-area streams, distinguishing between municipal supply water vs. municipal wastewater contributions remains a challenge. Prior studies have identified some ECs as effective signals of both raw and treated wastewater. We apply here traditional geochemical parameters as well as Escherichia coli (E. coli), per- and polyfluoroalkyl substances (PFAS), pharmaceuticals, artificial sweeteners, and virus markers to assess the extent and potential sources of contamination in eight Austin watersheds that exhibit a range of urbanization extents and drain into the Colorado River as it flows through the city. We find that the extent of water quality degradation relates to the extent of watershed development, whereby highly urbanized watersheds (Waller and Boggy Creeks) exhibit higher concentrations of E. coli and some ECs (PFOA, PFOS, PFNA, PFHxS) compared to rural and developing watersheds. We also find that concentrations of some PFAS (PFOA, PFOS, PFNA, PFHxS), pharmaceuticals (carbamazepine, sulfamethoxazole), artificial sweetener (sucralose), and wastewater-associated ions (NO3, SO4) increase downstream in the Colorado River as it passes through Austin's urban core and adjacent to several industrial facilities. We also find an increase in PFAS (PFOA, PFOS, PFNA, PFDA, PFHxS, PFHxA, PFHpA, PFHpS, PFBA, PFBS, PFPeA, 6.2FtS) concentrations in a semi-urbanized watershed (Onion Creek) as it passes by the international airport. These preliminary findings highlight the negative impact of expansive urbanization on surface water quality and demonstrate the value of a multi-tracer approach in identifying major contaminant transport pathways, improving the delineation between treated and raw wastewater inputs, and providing key insights to improve infrastructure and watershed management for the city of Austin and policymakers.

Title: Detecting and tracking heavy metals in Austin's Waller Creek

Author List: Amrit Ghosh[1], Brett Mills[1], Jiaying Luo[1], Sudip Madala[1], Chumeng Cai[1,2], Joey Vo[1], Ruth Shear[1]

[1]Urban Ecosystems Research Group, Freshman Research Initiative, College of Natural Sciences, The University of Texas at Austin, Austin, TX
[2]John Sealy School of Medicine, The University of Texas Medical Branch, Galveston, TX

Abstract: Heavy metals, elements with high atomic mass and density, can pose environmental and human health hazards when their concentrations surpass safe

thresholds. Although these elements exist naturally in the environment, anthropogenic activities such as farming, drug production, mining, and manufacturing have intensified their accumulation, leading to potential detriments for both biotic and abiotic components of the ecosystem. This research focuses on detecting and quantifying some of the most common environmental heavy metal contaminants (arsenic, cadmium, chromium, copper, lead, and silver) in Austin's Waller Creek, a fully urbanized waterway running through the UT Austin campus. Water samples collected over the past 80 months were analyzed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Due to the high sensitivity of the ICP-MS, care must be taken to perform thorough acid washing and precise dilutions to ensure datapoint accuracy.

Over multiple instances, concentrations for each metal superseded Criterion Continuous Concentration (CCC) freshwater limits set by the Environmental Protection Agency (EPA) by up to 5 orders of magnitude. Pb-208, Cd-111, and Ag-107 have less than a 50% rate of exceeding the CCC whereas the majority of As-75, Zn-66, Cu-63, and chromium measurements exceed it. Ongoing work focuses on addressing experimental limitations of measurements exceeding limits of detection. These findings demonstrate the ability of continuous water monitoring to assess the aqueous heavy metal composition of Waller Creek, and its broader toxicological impact on aquatic and surrounding terrestrial ecosystems.

Title: From Pixels to Policy: Assessing Drought Hazard and Systemic Resilience in the Texas Colorado River Basin

Author List: Priyanjali Bose[1], and Dr. Denise Blanchard[1]

[1]Department of Geography and Environmental Studies at Texas State University, San Marcos, TX

Abstract: Texas water planning depends on understanding how water may move across its diverse landscapes. This study develops a statewide water-budget framework for 1995 - 2024 that can also be summarized across Texas's 16 Regional Water Planning Areas (RWPAs). The framework integrates climate data, watershed-based runoff estimates, groundwater information, reservoir evaporation, river-boundary inflows, and historical water-use records. The outcome of this investigation indicates that precipitation is the dominant water input, followed evapotranspiration which accounts for the largest loss, with other water-budget components varying spatially and temporally across Texas. Therefore, this reproducible framework provides a consistent basis for regional water-supply assessment, drought analysis, and long-term water planning across Texas.

Title: Photons to Pecans: Solar Desalination for Afforestation in Texas

Author List: Johnathan Brett Sicard[1], Dr. Yael Glazer[2,3], and Dr. Michael Webber[2,3].

[1]Maseeh Department of Civil, Architectural and Environmental Engineering, The University of Texas at Austin, Austin, TX

[2]Walker Department of Mechanical Engineering, The University of Texas at Austin, Austin, TX

[3]LBJ School of Public Affairs, The University of Texas at Austin, Austin, TX

Abstract: Natural climate solutions (NCS) are pathways to remove CO2 from the atmosphere through nature-based approaches, including afforestation, reforestation, grassland restoration, and improved grazing methods, among other methodologies. NCS have been proposed to serve a significant purpose in mitigating climate change (Yin, 2023) and have seen significant interest from corporate offtakers and NGOs in recent years (ERM, 2024). However, NCS often struggles overcoming barriers such as a lack of water, suitable land, or access to funding (Brumberg, 2025). In Texas, persistent drought and increasing water demand driven by population increase, datacenter development, and growing industrial use is stressing water supplies and reducing the volume of water that can be used for NCS without compromising existing or future municipal, commercial, or industrial needs (Nielsen-Gammon, 2020). However, Texas possesses a significant groundwater resource that is not extensively exploited at present: brackish groundwater, which is too saline to use in most applications without treatment first. Studies have found that there are some 2.7 billion acre-feet of brackish groundwater across the state, with nearly every region of Texas having access to brackish groundwater at some salinity and depth (Kalaswad, 2004). This work evaluates the feasibility of using solar power to extract and desalinate brackish groundwater to salinity levels suitable for native tree species, which are then used for carbon sequestration through afforestation across the state of Texas.

Solar desalination for afforestation has already been researched at a global level, but these analyses are generally very broad in scope and can fail to capture localized differences in cost (Caldera, 2023). To estimate the economic feasibility of solar-based desalination for afforestation on a county-by-county resolution across Texas, water demand, solar production, system cost, and carbon sequestration all needed to be combined into an analytical framework to provide a cost per metric ton of CO2e sequestered. To estimate water demand by county for each month, evapotranspiration data from 19 weather stations managed by Texas A&M's ET Network (TexasET Network, 2016) were interpolated, then the American Society of Agricultural and Biological Engineers Simplified Landscape Irrigation Demand Estimate methodology was used to estimate monthly water demand (University of

California, 2025). To determine the energy requirements of desalination for necessary quantities of water in each county, multiple desalination technologies were compared, including brackish water reverse osmosis (BWRO), electrodialysis removal (EDR), and multi-stage flash (MSF). Ultimately, BWRO was chosen due to favorable energy consumption, ranging from 0.3-1.5 kWh/m3 of produced water (Patel, 2021), favorable economics (Pearson, 2021), and a proven track record for desalination globally and in Texas. Once the required quantity of energy by month was determined, Renewables Ninja was used to estimate monthly capacity factors for solar energy production in each county, enabling the size of each solar installation to be calculated (Renewables Ninja, 2026). System cost was found using data from the National Lab of the Rockies (NLR) for solar (NLR, 2025) and battery storage (NLR, 2024), rural land costs by county (Texas Real Estate Research Center, 2025), and CAPEX/OPEX figures from existing Texas BWRO plants (Pearson, 2021). Carbon sequestration was estimated by level 3 ecoregion (US EPA, 2016) by dividing land area proportionally between all native trees for a given ecoregion (Native Plant Society of Texas, 2024) and estimating the carbon sequestration potential of individual trees with the Forest Service's Urban Tree Database and Allometric Equations (McPhearson, 2016). Additionally, income from growing extra trees that are later harvested for timber is included, as the model optimizes tree spacing for 50 years. This approach allows additional trees to be planted and harvested around the 30-year mark, which helps offset some of the initial system cost. Additional value delivered by the project through increased home value and thus property tax income at the county level was also included (Kovacs, 2022). The price of delivered carbon credits was calculated over a 50-year period, with results depending on which additional value streams were included shown below in Figure 1.

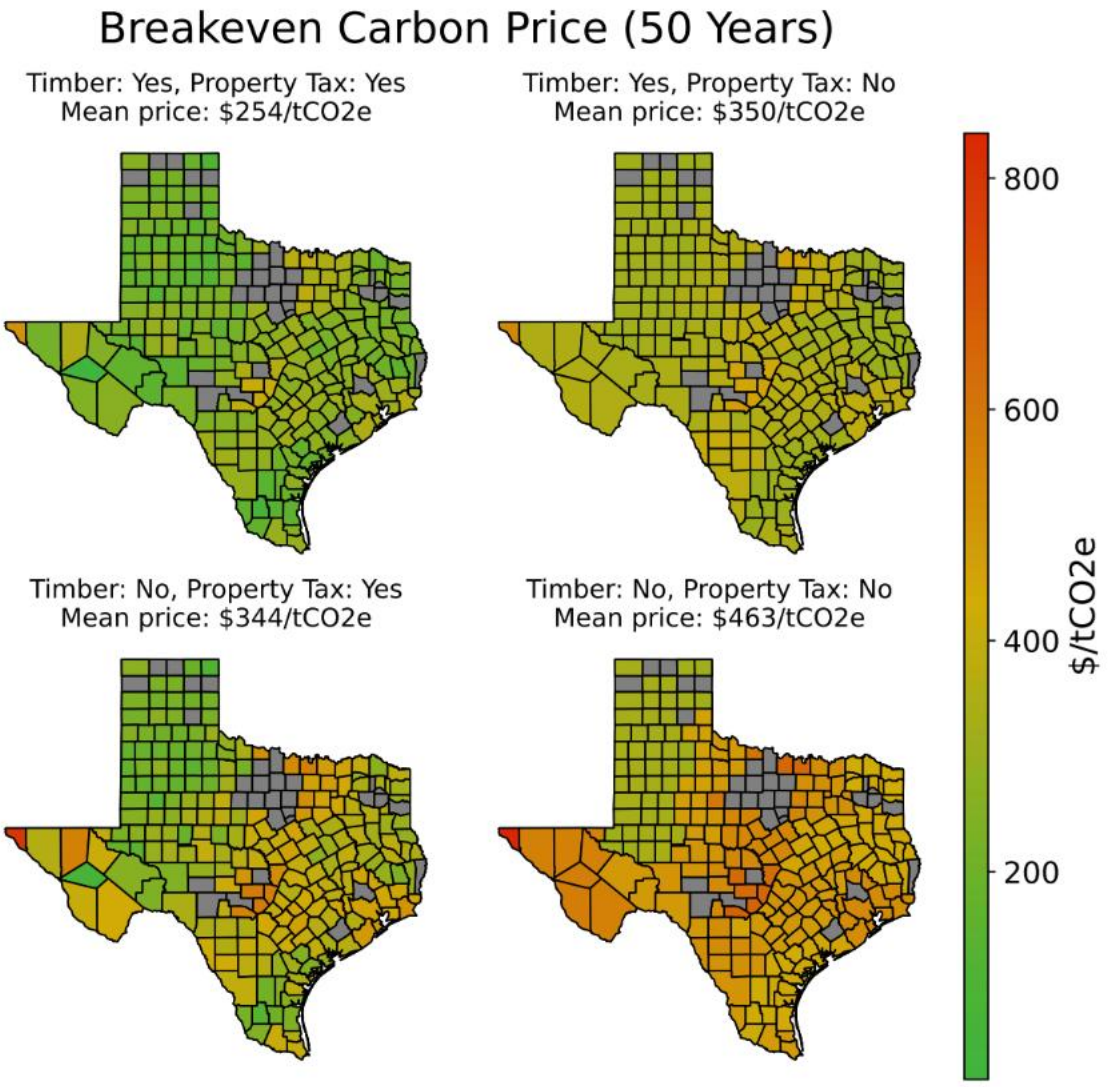


Figure 1. Delivered Carbon Price by County

The delivered cost of carbon over 50 years with no additional co-benefit value approaches $300/tCO2e in some regions of Texas, particularly the panhandle and gulf coast. Additional co-benefits and revenue streams including land valuation increases and timber production lower the cost of delivered carbon dramatically. This suggests that solar desalination for afforestation is already cost competitive with leading methods of carbon dioxide removal (CDR) today, such as direct air capture (DAC) and biomass geological sequestration (BGS), which have average costs of $500/tCO2e and $400/tCO2e, respectively (cdr.fyi, 2026). Additionally, with costs for utility-scale battery storage decreasing rapidly in recent years (Orangi, 2024), this system has the potential to become more economically competitive with CDR methods including bioenergy for carbon capture and storage (BECCS), which costs $220/tCO2e (cdr.fyi, 2026)."

Title: The Memories of the Water: How Oral Histories from Boggy Creek Residents Inform Our Water Quality Research

Author List: Sena Oguzman[1]

[1]Department of Rhetoric and Writing, The University of Texas at Austin, Austin, TX

Abstract: If we cut through the trees of Govalle Neighborhood Park, walking further away from the intersection of Shady Lane and Bolm Road, we eventually find ourselves staring into a hollowed-out concrete channel, a tiny sliver of polluted water trudging along its surface. But the longtime residents who lived on the banks of Boggy Creek do not see the same. Instead, they encounter children playing in the water on a hot summer day, and fishers catching red crawfish for a late-night dinner. But they also see the floods swelling rushing to inundate their homes, as well as the chemicals swimming around and polluting their water. Today, the water's quality continues to deteriorate, no longer affording its residents the "pristine paradise" that they grew up in. The best way to fully understand this environmental injustice is to hear from the experts: the residents themselves.

Our project, "Ground Truth Initiative: Memory on the Banks of Boggy Creek," chronicles the evolution of Boggy Creek, in all of its complexity. Our research tracks the quality of the creek's water through the oral histories of current and displaced residents of East Austin. These histories inform us of the events that significantly affected Boggy's water quality, including the floods that ravaged neighborhoods, the channelization that the residents advocated and fought for, and the influx of contamination from the Tank Farm. However, we also learn that Boggy Creek's history is not one that's only tainted by pollution. The creek once had a flourishing ecosystem, with water so immaculate that you could walk through it. Most importantly, our project demonstrates how the present state of Boggy Creek does not match its past. Listening to these rich histories allows us to examine the creek's water quality from a perspective that differs from a scientific lens.

Title: The Health Tax of Water Insecurity in Hornsby Bend, Texas

Author List: Victoria Kebano[1]

[1]The University of Texas at Austin, Austin, TX

Abstract: Unincorporated cities near major cities often face structural infrastructure neglect, leaving them more vulnerable to private utility monopolies. In Hornsby Bend,

Texas, residents often face high and unpredictable water costs from their private water utility provider. In addition to affordability concerns, residents experience water quality concerns such as mineral hardness and rust-colored discoloration, which can create additional health concerns and home maintenance costs. This research study looks at water cost over a 10-year period from 2021 to 2031 in order to compare the cost of the current private water systems with the possible costs and savings of Hornsby Bend being annexed by the City of Austin. It compares current water expenses and possible changes in property taxes and water costs under the City of Austin water services. Using Public Utility Commission filings, community billing records, and tax documentation, this research tracks and estimates water cost for the residents of Hornsby Bend over a 10-year period. It also looks at costs beyond the water bill, including possible health-related costs based on water quality research. It will be looking at skin-care costs, water filters and treatment, and costs of repairs or replacement of household appliances caused by mineral accumulation. Early findings suggest that although annexation may increase property taxes, those costs could possibly be reduced by lower rates, fewer private utility fees and lower out-of-pocket costs. In conclusion, limited oversight of private water utilities can increase water costs and create health concerns for residents. Municipal annexation could help lower household water costs, reduce water health concerns and improve the overall well-being of the community.

Title: (Mis)Information on Kerrville's Drinking Water Quality After the July 4th Floods

Author List: Delaney Engstrom[1] and Talia Zagarella[1]

[1]Bridging Disciplines Program, Environmental and Sustainability Studies, University of Texas at Austin, Austin, TX

Abstract: Flooding is a major natural disaster that can cause widespread devastation to affected areas and alter river chemistry by carrying contaminants, nutrients, and bacteria downstream. These changes affect not only the river's ecosystem but also its surrounding communities. The July 2025 flooding in Kerrville, Texas, raised widespread concern amongst Kerr County residents about the safety of the Guadalupe River and local drinking water. This study considered: how did the July 2025 flooding affect drinking water quality and Kerrville residents' perceptions of that water quality? Four community interviews were conducted to understand residents' perceptions of water quality concerns following the flood event. These interviews described widespread public uncertainty and concern despite limited evidence of long-term water quality deterioration. A spatial and temporal analysis was then conducted to track and interpret Escherichia coli (E. Coli), nitrate, and

sulfate data using Upper Guadalupe River Authority (UGRA) records. From our findings, E. coli experienced temporary (lasting approximately two weeks) spikes at several sites following the flood, with concentrations ranging from 4 - 570 MPN/100 mL and the highest concentration occurring at Site 12615. On the other hand, nitrate and sulfate concentrations remained relatively stable, ranging from 0.08 - 2.6 mg/L and 11 - 18 mg/L, respectively, suggesting that the event did not substantially alter concentrations of these parameters. Ultimately, our research proves that public perception may not always align with environmental data or conditions. Together, these findings exemplify the importance of analyzing scientific data and community perceptions together when evaluating the effects of flooding on water quality and safety.

Title: Contaminant Transport and Groundwater Surface Water Interactions in a Dam-Regulated, Urban-Fringe River System

Author List: Elle Scott[1], Alexander Janelle[1], Jay Banner[1,2] Timothy Shanahan[1] Daniel Alessi[1,3]

[1]Department of Earth and Planetary Sciences, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX

[2]Environmental Science Institute, The University of Texas at Austin, Austin, TX

[3]Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin, Austin, TX

Abstract: Urban watersheds face higher contamination risks than rural counterparts due to concentrated human activities, dense infrastructure, and extensive impervious cover. Industrial and emerging contaminants, including trace metals and PFAS, occur disproportionately in areas with high social-vulnerability indices. This spatial pattern reflects the legacy effects of historical redlining, discriminatory industrial zoning, and persistent inequities in environmental protections and enforcement. Together, these policies have concentrated polluting land uses near lower-income and minority communities for decades. Because these contaminants bioaccumulate in natural systems and living tissues, they pose risks to human and ecological health at low concentrations. Despite a growing literature base, the importance of specific hydrologic pathways and mechanisms that connect contamination sources to vulnerable communities, particularly to the role of groundwater-surface water exchange, remain poorly constrained in urban systems.

To address this gap, we present an analysis of PFAS, trace elements, and dissolved inorganic ions in surface water and groundwater within an industrialized segment of the Lower Colorado River immediately downstream of Austin, Texas. This reach is bordered by industrial land use and several socially vulnerable communities. Additionally, the Lower Colorado River experiences diurnal dam releases, typically ranging between 80 to 1200 cfs, which creates a natural laboratory for studying groundwater-surface water interactions.

Monthly sampling initiated in May 2026 includes surface water and surrounding spring systems to characterize spatial and temporal variability in water chemistry. Preliminary transect data indicate that contaminant concentrations in surface waters increase only modestly downstream. However, adjacent spring systems exhibit greater spatial variability, with nearby springs exhibiting among the highest PFAS concentrations recorded from natural waters in the Austin metropolitan region. This contrast suggests that while daily flow regulation from upstream dam releases promotes significant dilution within surface waters, groundwater inputs represent localized areas of higher contaminant concentrations that serve as important pathways for contaminant transport.

These findings suggest that sampling surface waters alone may substantially underestimate contamination risk in urban river corridors, and that groundwater-surface water interactions must be considered in environmental monitoring frameworks. Better constraining contaminant sources and transport pathways is essential not only for understanding contaminant fate in this reach, but for informing equitable development decisions in a part of the metropolitan region where socially vulnerable communities are increasingly affected.

Title: Hydrographic Delineation and Hydrologic Characterization of the Rio Grande Delta's Abandoned Channels (Resacas)

Author List: Bridgett Collis[1]

[1]The University of Texas Rio Grande Valley, Edinburg, TX

Abstract: This project maps, categorizes, characterizes, and analyzes resacas, abandoned river channels of the binational Rio Grande delta. Although resacas became naturally disconnected from the Rio Grande through avulsions, they continued to function as distributaries. Human alterations of the river reduced periodic flooding from the river. Today, they function as novel ecosystems with cultural, ecological and infrastructural value, yet their extent and condition remain poorly documented. To address this gap, system-level outlines will first be developed for main and secondary resaca systems, followed by detailed polygon delineations of Tier 1 mainline pools and Tier 2 oxbows within

eight selected main systems. Using 1-5 m LiDAR-derived DEMs, Dynamic Time Warping will identify resaca edges by tracking downstream changes in channel form as features narrow, expand, and vary in elevation. Polygons will be refined and validated through comparison with visually interpreted bank positions on a 15 m local-relief detrended DEM and with available manually mapped polygons using boundary-distance and spatial-overlap measurements. For each detailed polygon, morphometric and hydrologic attributes will be calculated, including length, area, width, bank slope, sinuosity, alphanumeric feature codes, normalized linear-referencing position, and mean surface-water occurrence from surface-water occurrence datasets. JRC's 30 m Landsat-based product will assess long-term inundation, while Dynamic World's 10 m Sentinel-2 product will characterize recent finer-resolution conditions. These metrics will test whether Dynamic Time Warping can effectively delineate resacas and whether morphometric and hydrologic patterns are more consistent within individual main systems than between systems. The resulting standardized database will support future research, conservation, restoration, and binational planning.

Title: Hydrologic Response to the July 4 Extreme Precipitation Event in the South Fork Guadalupe River Watershed, Texas

Author List: Almoutaz El Hassan[1], Awal Ripendra[1], Ali Fares[1], Richard Griffin[1] and Chad Furl[2]

[1]Prairie View A&M University, Prairie View, TX

[2]Edwards Aquifer Authority, San Antonio, TX

Abstract: On July 4, 2025, an unprecedented precipitation event triggered catastrophic flooding within the Upper Guadalupe River watershed, with the most severe impacts occurring in southeast Kerr County, Texas. The region's distinctive hydrogeological features, shallow soils, numerous semiarid and arid shrubs such as juniper, mesquite, huisache, and acacia, that produce hydrophobic oils that coat the soil surface and clog soil pores, and exposed bedrock, facilitated rapid surface runoff. Rainfall accumulations ranged from 254 to 305 mm over four hours, with peak intensities between 50 and 100 mm per hour, generated by a slow-moving mesoscale convective vortex. The resulting runoff caused the Guadalupe River gauge at Hunt, Texas, to rise by 7.9 meters within 45 minutes before failing at 8.8 meters. This event led to widespread destruction and significant loss of life, particularly among campers along the river. This study employs the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model to simulate the watershed's hydrologic response to the July 4 event in the South Fork Guadalupe River. The modeling framework

incorporates high-resolution datasets, including a 30-meter Digital Elevation Model (DEM), the 30-meter National Land Cover Database (NLCD), and STATSGO2 soil data. Precipitation inputs were derived from multi-sensor Stage IV and Multi-Radar/Multi-Sensor System (MRMS) products to ensure robust spatial and temporal representation. Model calibration was conducted using data from the watershed outlet at Hunt and validated against observed discharge and gauge-height records from the USGS station at Hunt, Texas. The hydrologic processes in the ungauged South Fork Guadalupe River watershed were evaluated following validation. The resulting flood hydrograph and inundation simulations provide valuable insights into runoff's spatial and temporal dynamics, supporting improved flood forecasting, enhanced early warning systems, and more effective regional mitigation strategies.