Galveston Bay Estuary Program
FY 2025 WSQ Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

SECTION ONE: GENERAL INFORMATION

Subcommittee:

WSQ

Project Name:

Supporting permeable alternatives to conventional pavement in the Lower Galveston Bay watershed.

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

Texas A&M AgriLife Extension Service, Texas Community Watershed Partners

☐ Federal, State, or Local Government ☐ Council of Government ☒ Public ISDs or Universities
☐ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Celina Gauthier Lowry
Project Representative Phone	(281) 560-3970
Project Representative Email	celina.lowry@ag.tamu.edu

Amount Requested:

$63,847

Is the project scalable? ☐

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$0.00
FY 2026 (09/01/2025-08/31/2026)	$0.00
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$0.00

Total Project Cost:

63,847

Is this an estimate? ☐

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

12 months

Project Urgency:

This cycle of funding is concurrent with separate WBP implementation through an engaged stakeholder group comprised of local leaders (Galveston Bay Coalition of Watersheds). Funding for the Coalition remains intermittent with partial support through TCEQ319 to reconvene the group Fall2023. Project outcomes described below are not funded outside of this GBEP proposal.

Leveraging (in-kind and/or cash):

The Galveston Bay Coalition of Watersheds will reconvene for 36 months; anticipated start is 9/1/23. This GBEP project will utilize Coalition synergy and deliver implementation actions separate from those funded under TCEQ319. Additional funding has been sought under TX GLO-CMP; pre-proposal submitted June 2023. The CMP project is focused on separate NPS outreach to homeowners and businesses adjacent to Coalition bayous.

Partners and Their Roles:

Galveston Bay Coalition of Watersheds - participation in project planning and implementation. Active members of the Coalition have included: Hitchcock, Lake Jackson, League City, Galveston County Health District, and Keep Dickinson Beautiful.

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

NPS - Improving water quality through nonpoint source pollution abatement.

The project supports watershed-based plan implementation through nonpoint source best management practices with stakeholders from three of the five Galveston Bay area WPPs participating in the Galveston Bay Coalition of Watersheds.

Permeable alternatives to conventional asphalt or concrete allow for infiltration and improved water holding capacity onsite-reducing erosion; all key factors in reducing microbial, sediment, and nutrient export to streams. Increased adoption of permeable pavements by local governments would have a profound impact on local water quality by reducing both stormwater runoff volumes and NPS pollution.

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 1: Ensure Safe Human and Aquatic Life Use

NPS-1 ☒ NPS-2 ☐ NPS-3 ☐ NPS-4 ☒
PS-1 ☐ PS-2 ☐ PS-3 ☐
PHA-1 ☐ PHA-2 ☐ PHA-3 ☐ PHA-4 ☐ PHA-5 ☐

Plan Priority Area Actions Detail:

NPS-1 Support existing WBP implementation
NPS-4 Enhance technical understanding and expand the use of BMPs

With GBEP funding, TCWP staff will coordinate with local practitioners (engineers, contractors, landscape architects) and local decision makers in the Galveston Bay Coalition of Watersheds area to develop a white paper with a financial comparison of permeable alternatives to conventional pavement. This project supports the implementation of multiple watershed-based plans (WBPs) in the region. (NPS-1). Engagement with local decision makers and practitioners will help bridge the gap between awareness of these best management practices and wider implementation, providing intermediate steps to incorporate these practices into infrastructure projects. Resources developed will be broadly applicable to surrounding watersheds and distributed through partner organizations throughout the region. (NPS-4).

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?

☒ NRU (Protect and Sustain Living Resources)
☒ PPE (Engage Communities)
☐ M&R (Inform Science-Based Decision Making)

Other Subcommittee Detail:

NRU HC-3 Enhance existing habitats to increase overall function and productivity - This project will not deliver an on-the-ground outcome like the majority of NRU projects, but furthering stormwater best practices is a first step toward action and behavioral change in land use practices producing runoff closer to pre-development conditions; widespread adoption of GI contributes to increased habitat function in surrounding landscapes.

PPE SPO-3 Support Regional Initiatives – Supporting permeable alternatives to conventional pavement in the Lower Galveston Bay watershed aligns with H-GAC's Low Impact Development and GLO's Clean Coast Texas initiatives by building capacity to support local decision makers in furthering GI adoption.

PPE SPO-4 Local Government Outreach – Local government leaders will provide information on the barriers and needs they face in incorporating permeable alternatives in local infrastructure projects. Resources developed for local government outreach will include a financial comparison that will be broadly distributed in the region. The white paper will be accompanied by outreach messaging to aid in distributing the resource.

Other Plans Implemented:

Practitioner interviews and input from local governments will occur in multiple watersheds. EPA-accepted Watershed Protection Plans (WPPs) include, the Highland Bayou Coastal Basin WPP and Bastrop Bayou WPP; Additional WBPs in the region: Dickinson Bayou I-Plan and Bacteria Implementation Group I-Plan. Materials and outcomes will be shared with Clean Coast Texas collaborative partners. Clean Coast Texas is included in the Coastal Resiliency Master Plan.

SECTION THREE: SUBCOMMITTEE PRIORITIES

WSQ Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☒ Supporting management measures and watershed-based plans
☐ Monitoring and research that evaluates GI effectiveness in water quality and soil health
☐ Targeted/Direct Monitoring

Subcommittee Priority Detail:

Management measures addressing GI often include mention of practices with some description. These holistic plans seldom dive into the level of detail necessary to facilitate implementation of individual practices. The financial comparison between several permeable pavement options and conventional pavement (with multiple estimates for each material) will inform implementation actions and contribute information for future WBPs in the region. The project includes coordination local decision makers and practitioners to bridge the gap between awareness of these best management practices and wider implementation.

Does the Project work with new, smaller communities/partnerships?
☒ Yes
☐ No

The Galveston Bay Coalition of Watersheds includes several smaller communities in Brazoria and Galveston Counties. The project will engage local leaders in the Coalition for barriers and needs they face in incorporating permeable alternatives in local infrastructure projects. Coordination with these local governments and multiple local practitioners (engineers, contractors, landscape architects) is essential to build the financial comparison and develop the white paper.

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

The project will deliver resources to local government leaders on permeable alternatives to conventional pavement to support wider implementation of permeable materials in infrastructure projects. A white paper will be developed following engagement with local decision makers and practitioners, providing a financial comparison of permeable and conventional options to arm local governments in furthering permeable pavement adoption in the Lower Galveston Bay watershed.

Full Project Description (1,000 words or less):

Increasing pressure from development converts native landscapes to other uses, adding impervious cover and degrading the water quality of coastal bayous and Galveston Bay. The use of nature-based green infrastructure (GI) solutions is increasing along the Texas Coast and as more entities are exploring these ideas, it is important that available resources continue to expand and fill knowledge gaps.

Through our work with local municipalities, the Green Infrastructure for Texas (GIFT) team has seen many hurdles to implementing GI, especially for smaller communities. Integrating permeable pavement as communities develop allows a property to mimic pre-development runoff conditions while achieving the desired functionality. This project incorporates two aspects in adopting permeable alternatives to conventional pavement at the local level; (1) practitioner experience with designing and installing permeable alternatives and (2) local jurisdictions' understanding of how to integrate permeable surfaces into their infrastructure projects.

The Galveston Bay Coalition of Watersheds brings together stakeholders and technical advisors from four watersheds with existing WBPs to share ideas and resources and to implement local solutions identified in these plans for Brazoria and Galveston counties. Partial funding for Coalition activities will occur alongside the proposed project. GBEP funds will allow TCWP staff (Coalition coordinator) to:

- Poll Coalition communities about needs and barriers for incorporating permeable pavement alternatives in local infrastructure projects;
- Hold one-on-one interviews with local practitioners (engineers, contractors, landscape architects) to compile information on their experience level, willingness to install, and the nature of customer requests for permeable pavement alternatives;
- Obtain estimates for a specified installation selected by the Coalition (e.g. ½ acre parking lot) using conventional pavement versus permeable alternatives – three to six estimates for each option;
- Develop a white paper to capture local needs, barriers, and provide a financial comparison between various permeable surfaces and conventional pavement options; the comparison will include material cost to construct, average life span, and maintenance cost (e.g. 10 year period).

The whitepaper will be accompanied by outreach messaging and broadly distributed through established communication channels: Galveston Bay Coalition of Watersheds, the GIFT partner events and listserv, and GBEP partners.

Opportunities to bring GI approaches like permeable pavement into the mix of local development practices and standards are often overlooked, assuming they are recognized. Permeable pavements have a variety of applications: parking lots, sidewalks, and low volume roads like neighborhood streets. These surfaces cover a considerable portion of our Lower Galveston Bay Watershed and local governments are positioned to promote these best practices on a larger scale. Delivering this information to municipalities will help with some of the challenges they face when considering alternatives: limited resources, fragmented responsibilities, and low risk tolerance.

Management measures addressing GI in WBPs typically include practices and descriptions with little detail. The financial comparison between several permeable materials and a conventional pavement (with multiple estimates for each) will inform future implementation and may inform future WBPs in the region.

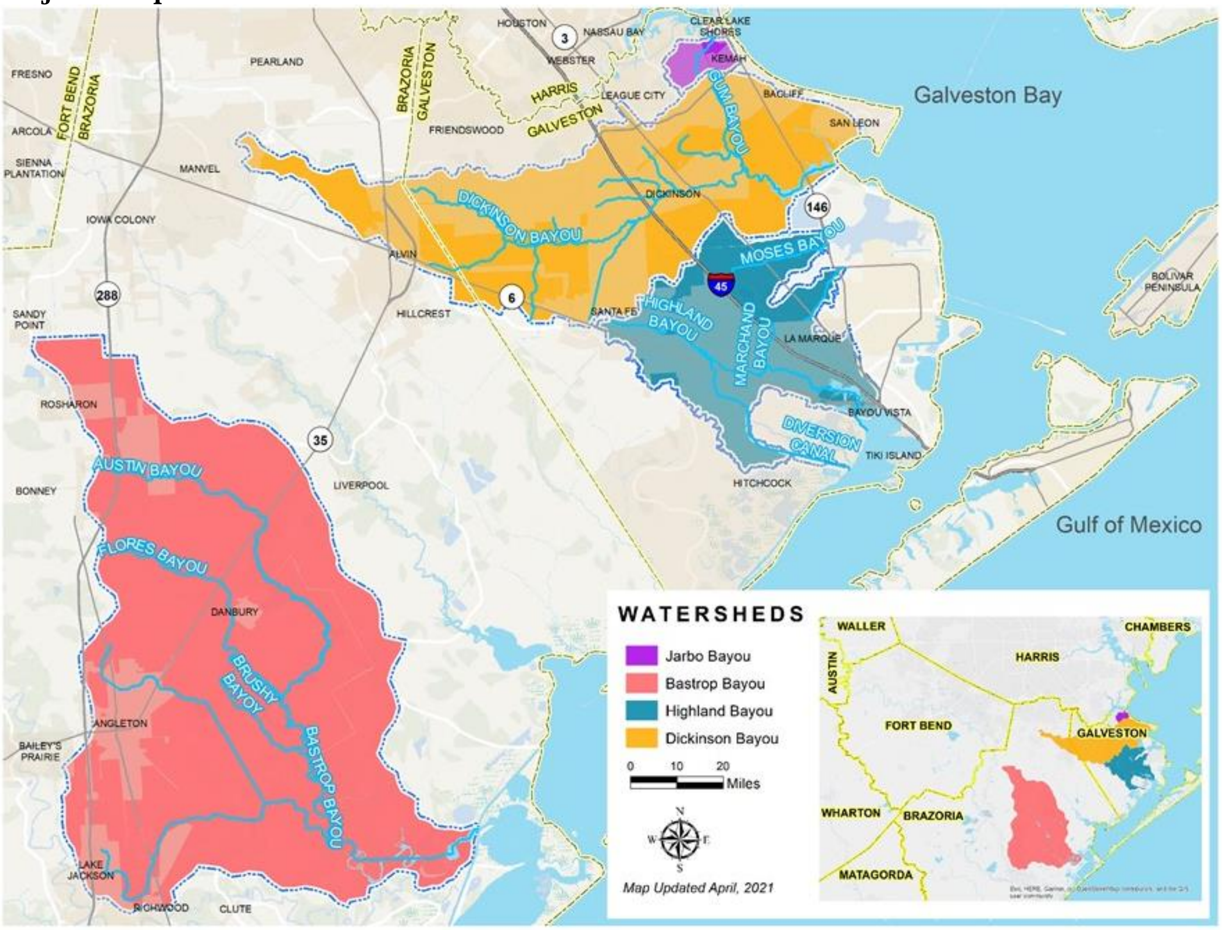
Latitude/Longitude (Optional):

NA

Location:

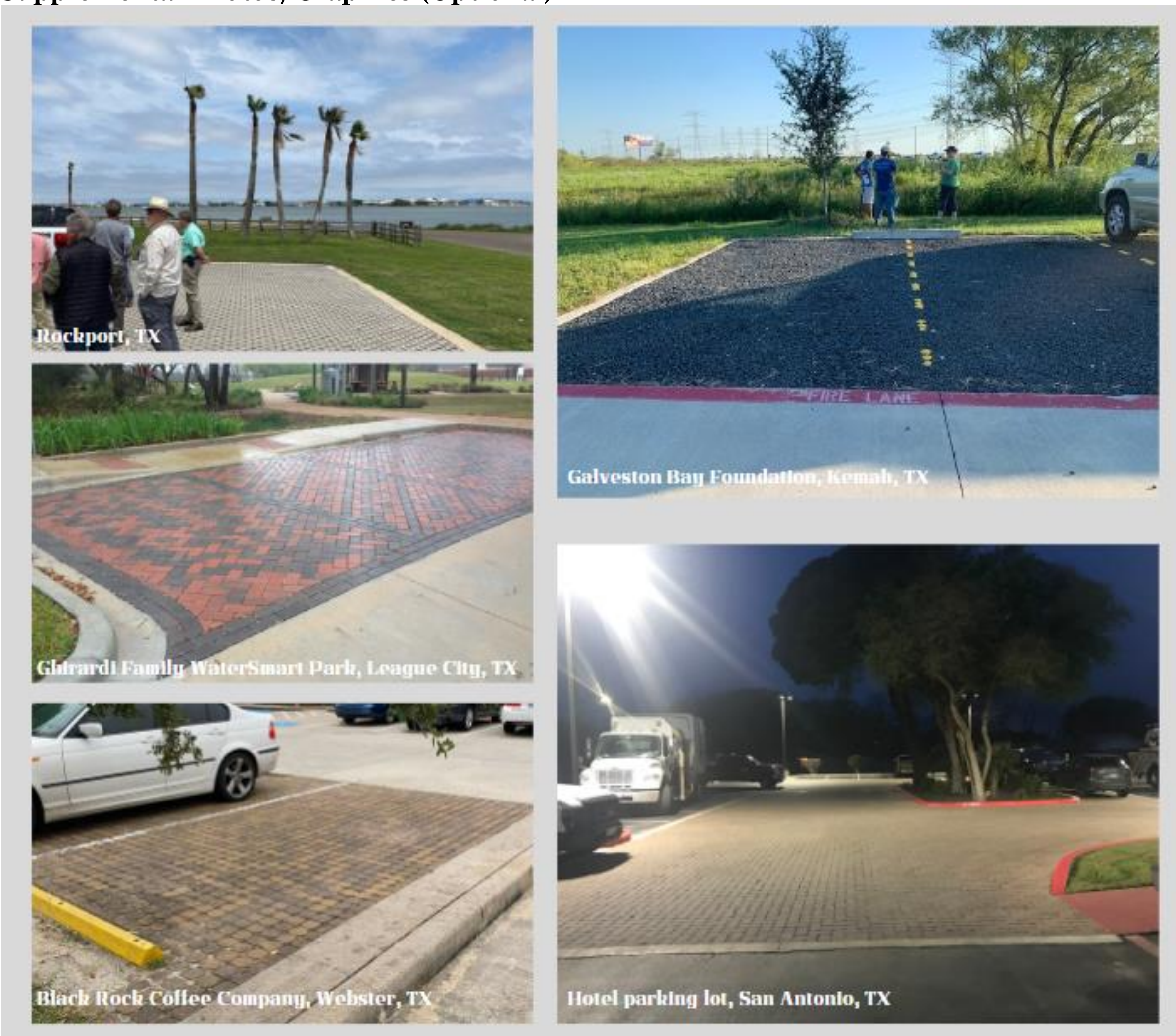
Galveston Bay Coalition of Watersheds and surrounding area. Primarily mainland Galveston County and Brazoria County. Outreach to practitioners may extend into Harris County. Materials developed broadly applicable for coastal Texas and widely distributed during the project period.

Projects Map



Galveston Bay Coalition of Watersheds area.

Supplemental Photos/Graphics (Optional):



Pervious pavement in Texas.

SECTION FIVE: BUDGET DETAILS

BUDGET CATEGORIES:		Budget
a.	Personnel/Salary	$36,798
b.	Fringe Benefits	$12,502
c.	Travel	$472
d.	Supplies	$800
e.	Equipment	$0
f.	Contractual	$0
g.	Construction	$0
h.	Other*	$100
i.	Total Direct Costs (Sum a - h)	$50,672
j.	Indirect Costs	$13,175
k.	Total (Sum of i & j)	$63,847

*Other: If Budget Category "Other" is greater than $25,000 or more than 10% of budget total, identify the main constituents:

Indirect Cost Agreement

Indirect Cost Reimbursable Rate: The reimbursable rate for this Contract is 26% of (check one):

☐ salary and fringe benefits
☒ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☒ Predetermined Rate—an audited rate that is not subject to adjustment.
☐ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☐ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

IDC Agreement submitted as attachment.

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

WSQ Subcommittee
Christian.Rines@tceq.texas.gov

NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov

PPE Subcommittee
Kari.Howard@tceq.texas.gov

M&R Subcommittee
Cassandra.Taylor@tceq.texas.gov

Galveston Bay Estuary Program
FY 2025 WSQ Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

A PROGRAM OF TCEQ

SECTION ONE: GENERAL INFORMATION

Subcommittee:

WSQ

Project Name:

Enhancing Clear Creek Watershed Protection and Galveston Bay Plan through Community Engagement and Monitoring

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

Bayou Preservation Association

☐ Federal, State, or Local Government ☐ Council of Government ☐ Public ISDs or Universities
☒ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Grant Moss, Program Manager
Project Representative Phone	713-529-6443
Project Representative Email	gmoss@bayoupreservation.org

Amount Requested:

$30,000

Is the project scalable? ☐

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$20,000.00
FY 2026 (09/01/2025-08/31/2026)	$10,000.00
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$30,000.00

Total Project Cost:

$30,000

Is this an estimate? ☒

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

18 months

Project Urgency:

While this project will be engaged in activities that will be ongoing efforts, supporting these measures in conjunction with the creation of the Clear Creek Watershed Protection Plan presents an excellent opportunity to promote the completed plan to the public and create momentum in implementation.

Leveraging (in-kind and/or cash):

Private funds acquired for community engagement in watershed stewardship:

Sisters of Charity of the Incarnate World: $5,000
Wortham Foundation: $10,000 (anticipated)

Partners and Their Roles:

H-GAC: As the lead coordinator for guiding the creation of the Clear Creek Watershed Partnership, and a long-time coordinator of the Texas Stream Team for our region, advice and coordination with H-GAC will be sought in the implementation of this project.

Local HOAs (such as Shadow Creek Ranch, Green Tee, Audubon Place, and others near waterways): we will seek to partner with three local HOAs to install pet waste stations, determine long-term management, as well as organize outreach materials to communicate the harms of pet waste on our local waterways to their residents.

Local Jurisdictions: BPA will work with local jurisdictions to work to install educational signage pertaining to pet waste, targeting parks that are adjacent to waterways or contain dog parks or hiking trails where dogs are likely to be present.

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

The proposed project seeks to aid in the implementation of Clear Creek Watershed Protection Plan by implementing measures to address bacteria from pet waste and to produce watershed stewards through volunteer opportunities such as the Texas Stream Team. This campaign will address sections NPS-1,2 by addressing some of the educational components geared toward reducing nonpoint source pollution outlined in local watershed-based plans. The project will also seek to implement other action items geared toward reducing bacteria from pet waste such as installing pet waste stations and distributing pet waste bags at local events. The goal of reducing bacteria in our waterways also supports section PHA-3 by highlighting the dangers that bacteria pose to contact recreation and human health and highlighting the importance of local efforts and individual actions to address this issue. The project also works to implement SPO-1,3 by coordinating with regional efforts to provide education and volunteer opportunities for communities to become better stewards of the Galveston Bay Watershed.

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 1: Ensure Safe Human and Aquatic Life Use

NPS-1 ☒ NPS-2 ☒ NPS-3 ☐ NPS-4 ☐
PS-1 ☐ PS-2 ☐ PS-3 ☐
PHA-1 ☐ PHA-2 ☐ PHA-3 ☒ PHA-4 ☐ PHA-5 ☐

Plan Priority Area Actions Detail:

NPS-1: Bayou Preservation Association participated on the steering committee for the Clear Creek Watershed Partnership during the creation of the WPP. Bayou Preservation is excited about the creation of the plan and seeks to aid in the implementation of proposed measures to help improve watershed health. NPS-2: Bayou Preservation seeks to continue ongoing efforts in the region to educate the public on issues of water quality. BPA hopes that with the establishment of a new plan, targeted efforts in the Clear Creek Watershed will highlight the issues targeted in the plan and make progress toward implementing the plan's goals. PHA-3: This project will help to improve contact recreation safety through its implementation of actions in the Clear Creek Watershed Plan that address issues of water quality that pose a threat to recreators, namely bacteria.

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?

☐ NRU (Protect and Sustain Living Resources)
☒ PPE (Engage Communities)
☐ M&R (Inform Science-Based Decision Making)

Other Subcommittee Detail:

SPO-1: BPA seeks to provide volunteer and stewardship opportunities through participation in the Texas Stream Team

SPO-3: The efforts outlined in the project support efforts currently ongoing throughout our region to address issues of bacteria and watershed stewardship. BPA hopes to focus these efforts within the Clear Creek Watershed to coincide with the creation of the new WPP and make progress toward implementation.

PEA-1: BPA seeks to educate and engage communities on the dangers posed by bacteria, particularly due to pet waste. BPA will work to provide solutions, such as the installation of pet waste stations, as well as engaging educational material to better highlight the importance of being responsible pet owners and watershed stewards. To that end, BPA will also seek to engage the community by training citizen scientists to become active Texas Stream Team monitors in the watershed.

PEA-2: BPA will not limit our education to adult audiences, but as decision-makers that can have an immediate impact on watershed health we target adults as the primary project audience.

Other Plans Implemented:

DRAFT Clear Creek Watershed Protection Plan

- Urban Stormwater E1: Expand Texas Stream Team Participation
- Pet Waste 1: Install Pet Waster Stations
- Pet Waste E1: Handheld Pet Waste Bag Dispensers at Local Events
- Pet Waste E3: Promote Model Educational Materials

Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region

- Implementation Activity 8.1: Expand Homeowner Education Efforts throughout the BIG Project Area

SECTION THREE: SUBCOMMITTEE PRIORITIES

WSQ Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☒ Supporting management measures and watershed-based plans
☐ Monitoring and research that evaluates GI effectiveness in water quality and soil health
☐ Targeted/Direct Monitoring

Subcommittee Priority Detail:

This project supports the Clear Creek Watershed Protection Plan, as well as several watershed based plans, that have been published to address watershed issues. This project will work to implement several actions outlined in the Clear Creek Watershed Protection Plan. This project will primarily focus on creating watershed stewards by educating and engaging community members in activities supported by the plan, such as reducing pet waste and training Texas Stream Team water quality and riparian monitors.

Does the Project work with new, smaller communities/partnerships?
☒ Yes
☐ No

To be determined

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

The proposed project aims to implement and elevate the Clear Creek Watershed Protection Plan (CCWPP) through community engagement and monitoring. By focusing on pet waste education and Texas Stream Team monitoring, the project seeks to improve water quality, reduce pollution, and enhance the ecological health of the Clear Creek watershed and Galveston Bay. Key activities include distributing educational materials, installing pet waste stations and training volunteers for water quality monitoring and riparian evaluation. Through these efforts, the project aims to foster environmental stewardship and strengthen collaborations among stakeholders to better protect the Clear Creek Watershed. Bayou Preservation Association is already actively engaged in the watershed through our Clear Creek Riparian Restoration project at Challenger Seven Memorial Park: https://www.bayoupreservation.org/_files/ugd/98befb_cf19ecdc8adf4ce89e16587b0178b51f.pdf. This project included educational workshops, field tours, and installation of educational signage in high traffic areas of the park.

Full Project Description (1,000 words or less):

1. Introduction

The proposed project aims to implement and elevate the Clear Creek Watershed Protection Plan (CCWPP). By focusing on community engagement, education, and monitoring, this project seeks to improve water quality, reduce pollution, and enhance the ecological health of the Clear Creek watershed and Galveston Bay. The primary activities include pet waste education and Texas Stream Team monitoring to foster a sense of stewardship among residents and stakeholders.

2. Background

The Clear Creek watershed is a vital natural resource in the Galveston Bay region, supporting flora, fauna, and providing recreational opportunities. However, the watershed faces various challenges, including water pollution from stormwater runoff and the negative impacts of bacteria on water quality. These issues have a direct bearing on the overall health of Galveston Bay. The CCWPP, Galveston Bay Plan, and BIG-I Plan already outline key strategies to address these challenges. This project aims to complement these existing plans by implementing targeted activities that engage the community and empower them to actively participate in conservation efforts.

3. Objectives

a) Pet Waste Education

- Develop and distribute educational materials to raise awareness about the impact of pet waste on water quality.
- Install pet waste stations in high-traffic areas, such as parks, walking trails, or neighborhoods adjacent to Clear Creek, to encourage responsible pet waste disposal.
- Place educational signage near pet waste stations and in public spaces to reinforce the importance of proper pet waste management.

b) Texas Stream Team Monitoring

- Identify key locations within the watershed for water quality monitoring, in alignment with the Texas Stream Team program guidelines, we will focus on reactivating inactive sites during this project period.
- Train and equip volunteers to collect water quality data regularly, providing valuable data on water quality parameters and pollution trends. We will also work to include riparian evaluation training in the watershed to provide additional field observations and photo-points to monitoring sites.

4. Implementation

a) Community Engagement

- Establish a community outreach plan to engage residents, businesses, and community groups through presentations and public events.
- Utilize social media, local newspapers, and community platforms to disseminate information and updates about project activities.
- Foster partnerships with local pet-related businesses and veterinary clinics to promote responsible pet waste disposal.

b) Texas Stream Team Monitoring

- Recruit and train volunteers to become certified Texas Stream Team monitors, ensuring adherence to scientific protocols for both Standard Core and Riparian Evaluation monitoring.
- Work to activate inactive monitoring sites (as indicated in H-GAC's Water Resources Information Map: H-GAC's Water Resources Information Map (WRIM) (arcgis.com)) or create new sites if deemed appropriate.

5. Benefits and Outcomes

The proposed project is expected to yield several benefits and outcomes:

- Improved water quality in Clear Creek and Galveston Bay through reduced pollution
- Awareness and participation in protecting the Clear Creek watershed and Galveston Bay.
- Strengthened collaboration among local stakeholders, businesses, NGOs, and government agencies for a coordinated approach to environmental conservation.

6. Conclusion

The proposed project presents an integrated approach to elevate the Clear Creek Watershed Protection Plan, support the Galveston Bay Plan and BIG-I Plan, and engage the community in meaningful efforts to better steward their watershed. By focusing on pet waste education and Texas Stream Team monitoring, this project aims to foster environmental stewardship of the Clear Creek Watershed and Galveston Bay region.

Latitude/Longitude (Optional):

N/A

Location:

The project will target the Clear Creek Watershed which is covered by the Clear Creek Watershed Protection Plan (currently in draft form). This project also falls within the area of the Bacteria Implementation Group and works make progress on the group's goal of reducing bacteria levels in area waterways.

Projects Map

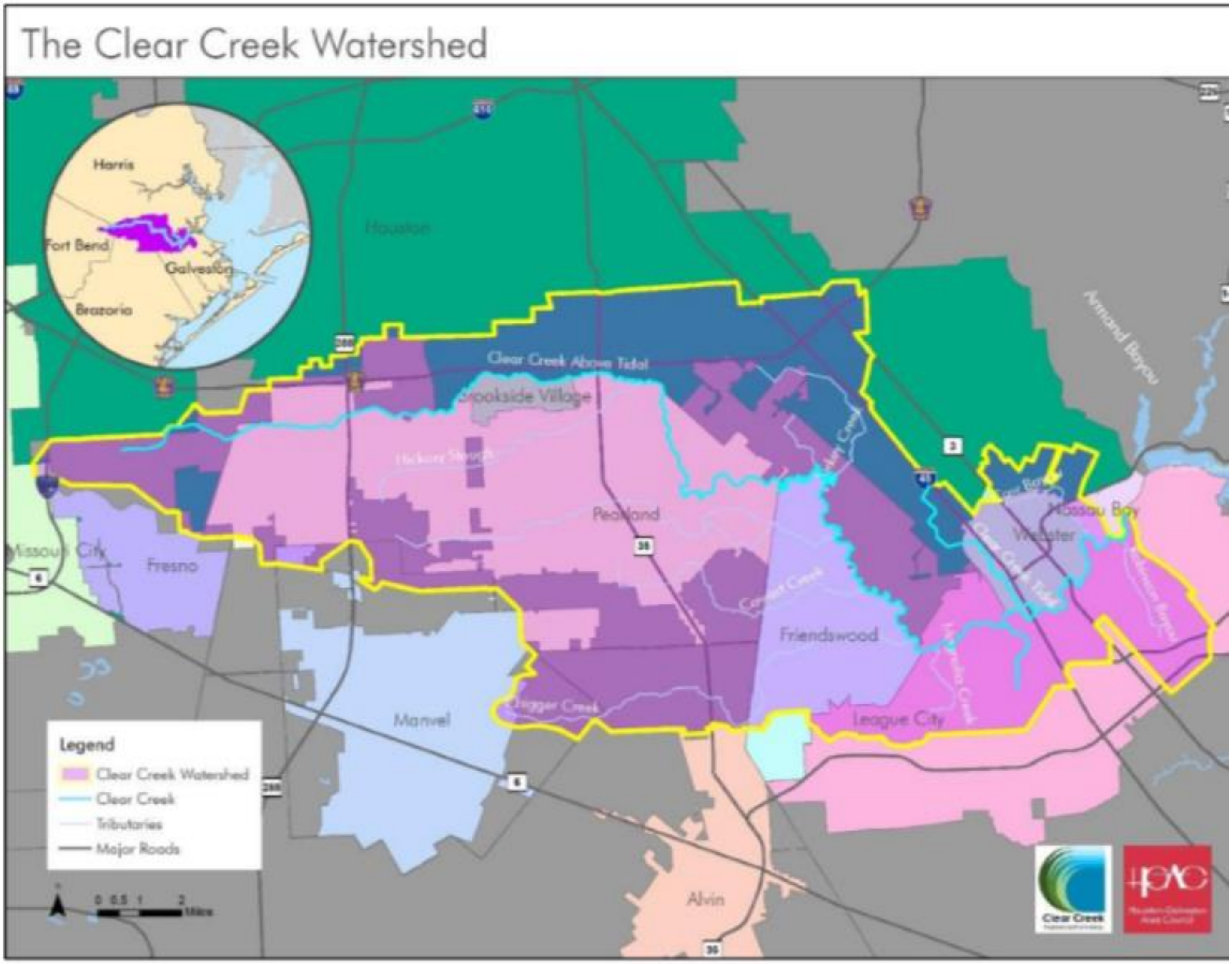


Figure 1 - The Clear Creek Watershed

Supplemental Photos/Graphics (Optional):

[Insert Here or Attach as an Appendix]

SECTION FIVE: BUDGET DETAILS

BUDGET CATEGORIES:		Budget
a.	Personnel/Salary	$10,000.00
b.	Fringe Benefits	$1,000.00
c.	Travel	$0.00
d.	Supplies	$14,000.00
e.	Equipment	$0.00
f.	Contractual	$5,000
g.	Construction	$0.00
h.	Other*	$0.00
i.	Total Direct Costs (Sum a - h)	$30,000
j.	Indirect Costs	$0.00
k.	Total (Sum of i & j)	$30,000

*Other: If Budget Category "Other" is greater than $25,000 or more than 10% of budget total, identify the main constituents: N/A

Indirect Cost Agreement

Indirect Cost Reimbursable Rate: The reimbursable rate for this Contract is 0% of (check one):

☒ salary and fringe benefits
☐ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☐ Predetermined Rate—an audited rate that is not subject to adjustment.
☐ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☒ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

[Insert Indirect Cost Agreement or Attach as an Appendix if Applicable]

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

WSQ Subcommittee
Christian.Rines@tceq.texas.gov

NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov

PPE Subcommittee
Kari.Howard@tceq.texas.gov

M&R Subcommittee
Cassandra.Taylor@tceq.texas.gov

Galveston Bay Estuary Program
FY 2025 WSQ Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

A PROGRAM OF TCEQ

SECTION ONE: GENERAL INFORMATION

Subcommittee:

WSQ

Project Name:

Watershed Protection Plan Development for Greens Bayou

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

Houston-Galveston Area Council

☐ Federal, State, or Local Government ☒ Council of Government ☐ Public ISDs or Universities
☐ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Rachel Windham
Project Representative Phone	713.993.2497
Project Representative Email	rachel.windham@h-gac.com

Amount Requested:

$30,000.00

Is the project scalable? ☒

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$30,000.00
FY 2026 (09/01/2025-08/31/2026)	$0.00
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$30,000.00

Total Project Cost:

$427,831.50 ($238,698.90 federal 319 dollars, $159,132.60 in local match, $30,000.00 in proposed match)

Is this an estimate? ☐

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

Scalable between one and three years

Project Urgency:

This funding will help ensure the ability to leverage existing federal dollars for a FY 2024 319 project at a ratio of roughly 8:1, and total project costs at a ratio of over 14:1. Early match supplement is crucial to leverage federal dollars before additional longer-term match sources accumulate.

Leveraging (in-kind and/or cash):

\$397,831.50 from \$238,698.90 in federal 319 dollars (TCEQ NPS contracts), and \$159,132.60 in additional local match (Clean Rivers Program monitoring value, local partner time, volunteer value, etc., not inclusive of the requested amount)

Partners and Their Roles:

The Texas Commission on Environmental Quality will act as the 319 project sponsor for the WPP project. Texas State Soil and Water Conservation Board will act as a technical advisor and provide formal 319 review. Bayou Preservation Association, City of Houston Public Works, Harris County Flood Control District, Port of Houston Authority, Greens Bayou Coalition, and the Houston Parks and Recreation Department have all agreed to support the project via formal letters of support and will serve as stakeholder committee members.

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

The project directly contributes to developing a new watershed-based plan, by supporting the development of a WPP for Greens Bayou in the Galveston Bay Watershed. The project will support general outreach campaigns to the watershed stakeholders/residents at local events, and specifically in hosting workshops like H-GAC's homeowner OSSF training, etc.

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 1: Ensure Safe Human and Aquatic Life Use

NPS-1 ☒ NPS-2 ☒ NPS-3 ☐ NPS-4 ☒
PS-1 ☐ PS-2 ☐ PS-3 ☐
PHA-1 ☐ PHA-2 ☐ PHA-3 ☐ PHA-4 ☐ PHA-5 ☐

Plan Priority Area Actions Detail:

This project supports the development of a watershed-based plan as part of EPA 9-Element watershed protection plan project with TCEQ (NPS-1). The scopes of work for the project include direct outreach components aimed at nonpoint source education (NPS-2). As part of those requirements, H-GAC will be holding outreach events like nonpoint source workshops or related seminar events for watershed stakeholders (NPS-4).

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?

☐ NRU (Protect and Sustain Living Resources)
☒ PPE (Engage Communities)
☐ M&R (Inform Science-Based Decision Making)

Other Subcommittee Detail:

In addition to supporting the priorities of Ensuring Safe Human and Aquatic Life Use, this project would implement Galveston Bay Plan Priority Actions related to Engaging Communities as well as subcommittee priorities selected by PPE. Specifically, this project will support existing stewardship programs and volunteer opportunities for stakeholders (SPO-1), support and promote workshops and events that facilitate stakeholder involvement (SPO-2), expand and support the Back the Bay campaign and other regional initiatives (SPO-3), and ensure local governments have the latest knowledge of estuary issues especially as they relate to the Greens Bayou watershed (SPO-4). Additionally, this project will support programs engaging the public in key issues (PEA-1) with a specific focus on adult education (PEA-2). These actions align with PPE designated priorities of continuing the expansion of established outreach and education programs and adult engagement in science literacy pertaining to the Galveston Bay watershed.

Other Plans Implemented:

The WPP will further broaden efforts conducted as part of the Bacteria Implementation Group TMDL I-Plan, and elements of the Texas Coastal Nonpoint Source Control Program/Texas Coastal Management Program.

SECTION THREE: SUBCOMMITTEE PRIORITIES

WSQ Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☒ Supporting management measures and watershed-based plans
☐ Monitoring and research that evaluates GI effectiveness in water quality and soil health
☐ Targeted/Direct Monitoring

Subcommittee Priority Detail:

This project directly supports an awarded 319 WPP development project for Greens Bayou which will initiate in FY 2024. The funds will supplement existing federal and local funds to directly pay for the facilitation of the project.

Does the Project work with new, smaller communities/partnerships?
☒ Yes
☐ No

H-GAC will work closely with the Greens Bayou Coalition throughout the development of the WPP.

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

The project will engage stakeholders to develop a WPP to address listed impairments, concerns, and stakeholder-identified water quality priorities in the waterways of the Greens Bayou watershed. The WPP will be developed to conform to the EPA's 9-element watershed-based plan standard and will utilize existing data for technical analysis.

Full Project Description (1,000 words or less):

The Greens Bayou watershed covers 208 square miles of densely developed area in Harris County. Much of the watershed area represents disadvantaged and underserved communities. Over 60% of the watershed population is considered low to moderate income. Greens Bayou and its tributaries face water quality challenges similar to many waterways in the greater Galveston Bay Watershed including elevated fecal bacteria levels, depressed dissolved oxygen, and elevated nutrient concentrations which impact recreation, local economies, public health, and the environment.

H-GAC is currently working with TCEQ on a Clean Water Act Section 319 watershed protection plan (WPP) development project for Greens Bayou which will initiate in September 2023 and continue through August 2027. The effort will produce an EPA 9-Element watershed-based plan and conduct NPS education and outreach elements during the course of the project.

Strong local support for WPP development specific to this watershed was expressed by various partners including Bayou Preservation Association, City of Houston Public Works, Harris County Flood Control District, Port of Houston Authority, Greens Bayou Coalition, and the Houston Parks and Recreation Department.

Funding under this project would be used to support the existing federal funding and local match for the project, as supplemental local match. The intended use of the funds will be to cover staff time and related allocation expenses (fringe, indirect, and other) for:

- Stakeholder facilitation and WPP development (other than modeling and data assessment tasks requiring a QAPP).
- Outreach and education in the watershed, including NPS-oriented H-GAC workshops, outreach presence at local events, and support and coordination with partner agencies on joint outreach events.
- Supplemental outreach efforts in coordination with GBEP or GBEP partners to forward Galveston Bay Plan goals in this watershed.

The requested funding is under 8% of the total combined project costs for this effort. H-GAC can and will leverage the requested funding at a high ratio with existing federal dollars and other local match sources. Our request is scalable in amount and time frame.

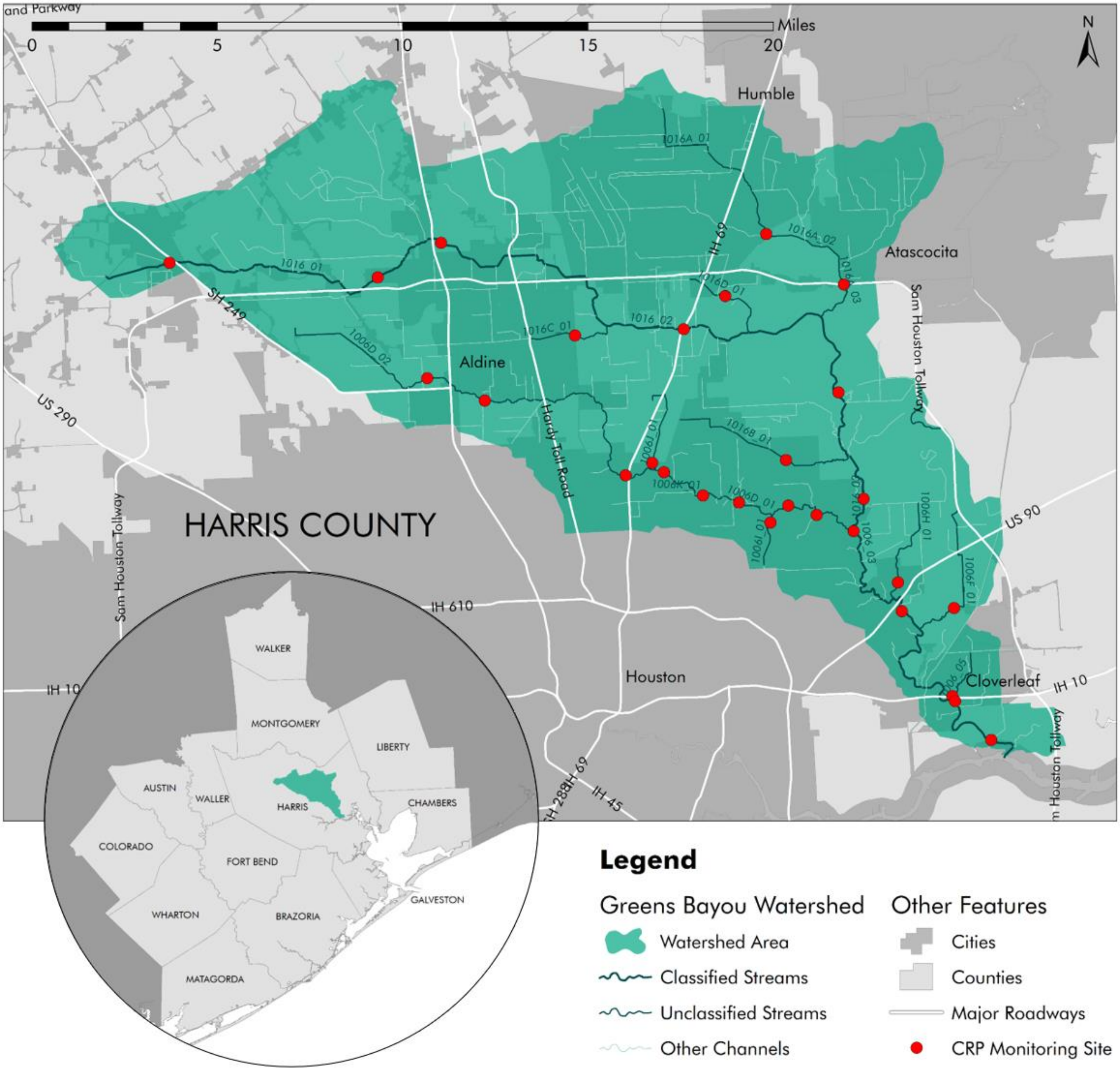
Latitude/Longitude (Optional):

(see map)

Location:

The areas within the watershed boundaries of Greens Bayou Above Tidal, Greens Bayou, and Halls Bayou as well as their respective tributaries (see map).

Projects Map



Supplemental Photos/Graphics (Optional):

N/A

SECTION FIVE: BUDGET DETAILS

BUDGET CATEGORIES:		Budget
a.	Personnel/Salary	$14,754.42
b.	Fringe Benefits (46.51%)	$6,862.28
c.	Travel	$0.00
d.	Supplies	$0.00
e.	Equipment	$0.00
f.	Contractual	$0.00
g.	Construction	$0.00
h.	Other*	$5,906.03
i.	Total Direct Costs (Sum a - h)	$27,522.73
j.	Indirect Costs (11.46%)	$2,477.27
k.	Total (Sum of i & j)	$30,000.00

*Other: Staff-hour based allocations for facility rental, GIS/data network services, internal services, and software licenses.

Indirect Cost Agreement

Indirect Cost Reimbursable Rate: The reimbursable rate (see Appendix A) for this Contract is 11.46% of (check one):

☒ salary and fringe benefits
☐ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☐ Predetermined Rate—an audited rate that is not subject to adjustment.
☒ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☐ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

WSQ Subcommittee
Christian.Rines@tceq.texas.gov

NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov

PPE Subcommittee
Kari.Howard@tceq.texas.gov

M&R Subcommittee
Cassandra.Taylor@tceq.texas.gov

Appendix A. 2023 Indirect Rate Agreement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

COGNIZANT AGENCY
NEGOTIATION AGREEMENT

Houston-Galveston Area Council
Houston, Texas

Date: March 8, 2023
Filing Ref: February 23, 2022

The indirect cost rates contained herein are for use on grants and contracts with the Federal Government to which Office of Management and Budget 2 CFR 200 applies, subject to the limitations contained in the Circular and in Section II, A below.

SECTION I: RATES

Type	Effective Period Start	End	Rate	Base	Location	Applicable To
FIXED						
Indirect	1/1/2023	12/31/2024	11.46%	(a)	All	All Programs
Fringe Benefit Rate	1/1/2023	12/31/2024	46.51%	(b)	All	All Programs

Basis for Application

(a) Direct salaries and wages, including applicable fringe benefit costs.
(b) Direct chargeable salaries and wages. The fringe benefit rate should not be applied to any release time (vacation, sick, holiday, and other paid absences).

Treatment of Fringe Benefits: Fringe benefits and release time (vacation, sick, holiday, and other paid absences) applicable to direct salaries and wages are included in the fringe benefit rate cited above.

SECTION II: GENERAL

A. LIMITATIONS: The rates in this Agreement are subject to any statutory and administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the department/agency or allocated to the department/agency by an approved cost allocation plan were included in the indirect cost pool as finally accepted; such costs are legal obligations of the department/agency and are allowable under governing cost principles; (2) The same costs that have been treated as indirect costs have not been claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the department/agency which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. CHANGES. The fixed rate contained in this agreement is based on the organizational structure and the accounting system in effect at the time the proposal was submitted. Changes in the organizational structure or changes in the method of accounting for costs which affect the amount of reimbursement resulting from use of the rate in this agreement, require the prior approval of the authorized representative of the responsible negotiation agency. Failure to obtain such approval may result in subsequent audit disallowances.

C. THE FIXED RATE contained in this agreement is based on an estimate of the cost which will be incurred during the period for which the rate applies. When the actual costs for such a period have been determined, an adjustment will be made in the negotiation following such determination to compensate for the difference between the cost used to establish the fixed rate and that which would have been used were the actual costs known at the time.

D. NOTIFICATION TO FEDERAL AGENCIES: Copies of this document may be provided to other Federal agencies as a means of notifying them of the agreement contained herein.

E. SPECIAL REMARKS: Please confirm your acceptance of the terms of the indirect cost rate agreement by signing and returning this letter to me. Please retain a copy for your records.

SECTION III: ACCEPTANCE

The undersigned official warrants that he/she has the proper authority to execute this agreement on the behalf of the State Agency:

Nancy Haussler
(Signature)

Nancy Haussler
(Name)

CFO
(Title)

H-GAC
(Agency)

3/14/2023
(Date)

By the Cognizant Federal Agency:

JACQUELINE SMITH Digitally signed by JACQUELINE SMITH Date: 2023.03.08 14:14:48 -05'00'
(Signature)

National Policy, Training and Compliance Division
U.S. Environmental Protection Agency

Negotiated by: Jacqueline Smith
Telephone: (202) 564-5055

Galveston Bay Estuary Program
FY 2025 WSQ Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

A PROGRAM OF TCEQ

SECTION ONE: GENERAL INFORMATION

Subcommittee:

Water and Sediment Quality

Project Name:

Groundwater as a potential nonpoint source pollution to Galveston Bay

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

Texas A&M University at Galveston

☐ Federal, State, or Local Government ☐ Council of Government ☒ Public ISDs or Universities
☐ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Dini Adyasari
Project Representative Phone	(409) 714 7115
Project Representative Email	dini.adyasari@tamug.edu

Amount Requested:

[$] $119.468

Is the project scalable? ☒

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$67.934
FY 2026 (09/01/2025-08/31/2026)	$51.534
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$119.468

Total Project Cost:

[$]119.468

Is this an estimate? ☐

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

2 years (September 1, 2024 – August 31, 2026)

Project Urgency:

Groundwater discharge to estuaries and coastal water has been overlooked as a land-ocean pathway for freshwater and nutrients. Previous studies have shown that groundwater can contribute between 10-100% of diffuse freshwater flow to the estuarine water budget. Considering the regional aquifer age of 20-70 years, groundwater can also still transport terrestrial pollutant from the 1950s to Galveston Bay and its tributaries. Despite this, **no studies have assessed groundwater's contribution to freshwater and nutrient inflow in this region.** Investigating coastal groundwater quality, groundwater seepage spatial variability, subsurface nutrient fluxes, and hydrologic response to extreme climate events (e.g., intense precipitation) is urgently needed considering Galveston Bay's history of groundwater pollution, susceptibility to storm and hurricane events, and thriving commercial fishing and oyster harvesting. This project will raise awareness of the importance of coastal groundwater, contribute to understanding how it affects water quality, and have direct implications for the best management practice, rehabilitation, and protection of water quality and ecosystem in Galveston Bay.

Leveraging (in-kind and/or cash):

None declared at this time.

Partners and Their Roles:

N/A

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

Groundwater has been identified as a nonpoint source of pollution in estuarine and coastal areas around the world. Approximately 20% of coastal water in the USA have been considered vulnerable to groundwater-borne contaminants (Sawyer et al., 2016). However, data and studies related to the groundwater's contribution to Galveston Bay's water quality remain scarce. It has not been incorporated into the Comprehensive Conservation and Management Plan for the Galveston Bay Ecosystem for "nonpoint source pollution" or "freshwater inflows" topics. This project aims to fulfill this gap by providing scientific information to protect, sustain, and ensure safe human and aquatic land use through three main objectives: (1) determining coastal groundwater quality, (2) establishing spatial and temporal variability of groundwater seepage, and (3) quantifying nutrients delivered to Galveston Bay and its tributaries through groundwater seepage.

By addressing nutrient seepage via groundwater, this project also aims to improve water quality in Galveston Bay by refining its nutrient budget. The study's results can form the basis for further research relating groundwater to ecosystem management or best management practices (BMP) in the region. In addition, the results of this project will improve database related to groundwater and surface water quality in Texas, including those managed by Texas Groundwater Protection Committee.

Furthermore, this project addresses RES-2, RES-3, RES-5, RES-8, and FWI-2 by monitoring physical and geochemical stressor on water quality, investigating potential linkages between groundwater seepage and bottom biota populations, enhancing knowledge of coastal resiliency through the management of coastal water resources and identification of groundwater hydrologic response to extreme climate events, and implementing studies on freshwater inflow (i.e., groundwater seepage) in Galveston Bay (for further description, please refer to the next page).

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 1: Ensure Safe Human and Aquatic Life Use

NPS-1 ☒	NPS-2 ☐	NPS-3 ☐	NPS-4 ☐	
PS-1 ☐	PS-2 ☐	PS-3 ☐		
PHA-1 ☐	PHA-2 ☐	PHA-3 ☐	PHA-4 ☐	PHA-5 ☐

Plan Priority Area Actions Detail:

This project aims to support watershed-based plan development and implementation (NPS-1) by examining the relationship between water body (i.e., groundwater) to water quality. By identifying areas affected by groundwater as a nonpoint source pollution, the project will contribute to the improvement of coastal hydrogeological models in Texas Gulf Coast and water quality in Galveston Bay and its tributaries. The initiative involves targeted, high-resolution monitoring of groundwater and surface water quality parameters, such as radionuclides (radon and radium), trace metals, and nutrients; thereby expanding database and increasing access to water quality monitoring data.

Even though Galveston Bay's current water quality meets environmental standards, groundwater seepage may still transport pollutants from decades ago due to groundwater apparent age of the regional Chicot aquifer being between 20-70 years (Oden and Truini, 2013). This means that pollutants leaching into the aquifers from as far back as the 1950s, two decades before the approval of the Clean Water Act, are now seeping out along Galveston Bay shorelines. Therefore, understanding constituents and pathways of coastal groundwater is critical to preserving long-term water quality and efficiently allocating management resources in Galveston Bay.

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?

☒ NRU (Protect and Sustain Living Resources)

☐ PPE (Engage Communities)

☒ M&R (Inform Science-Based Decision Making)

Other Subcommittee Detail:

- **M&R RES-2 and RES-3.** This project implements data collection related to physical and geochemical measurements potentially act as stressors to water quality and ecosystems. The contrasting physicochemical parameters between surface water and groundwater, such as nutrient concentration, pH, temperature, salinity, and dissolved oxygen, may affect local water quality and alter primary productivity (low/high N:P ratio) in receiving coastal water. By conducting temporal and spatial surveys and measurements, this project improves knowledge of potential sources and drivers of water quality in Galveston Bay and its tributaries.
- **M&R RES-5.** Groundwater often diffuses from the seafloor, which may influence bottom biota populations. Studies have observed that groundwater can have both negative or positive associations with oyster reef, crab, and fish ecosystem (e.g., Spalt et al. (2020), Laurier et al. (2007)). Thus, groundwater may have significant implications in Galveston Bay, where high activities of commercial fishing and shellfish and oyster harvesting are found. By identifying groundwater seepage spatial variability and its quality, this project adds understanding of the role of hydrogeology in sustaining ecosystem health and support economic growth in Galveston Bay.
- **M&R RES-8.** This project will improve understanding of Galveston Bay ecosystem components and its resiliency to climate events by (1) determining coastal aquifer quality, which act as water resources for coastal population and activities, and (2) conducting high-resolution groundwater discharge monitoring to estimate groundwater hydrological response to extreme climate events. Intense precipitation or storm events can temporarily alter shallow groundwater residence time and nutrient attenuation capacity, leading to higher nutrient concentration seeping into the estuary (Adyasari et al., 2021). The results can be used as a basis for coastal hydrogeological models in Galveston Bay, including the prediction of future scenarios where sea level rise and high frequency of extreme climate events can alter coastal aquifer quantity and quality.
- **FWI-2.** This project will improve knowledge on daily and seasonal freshwater inflow to Galveston Bay. While data related to temporal variability surface water fluxes into Galveston Bay are abundant, data on groundwater discharge is still limited. This project will refine water budget calculation in Galveston Bay by identifying the currently unknown quantity, quality, and timing of groundwater fluxes into the bay and its tributaries.

Other Plans Implemented:

Texas Groundwater Protection Strategy. Parameters measured in this project (e.g., radionuclides, nutrients, metals) are included in the list of constituents regularly monitored by Texas Groundwater Quality Monitoring Survey. Data generated by this project will be submitted and incorporated into Texas Groundwater Protection Committee database.

Texas Coastal Management Plan. This project will improve understanding of groundwater seepage as a potential coastal nonpoint sources pollution, which can be used to develop local policy and water quality planning elements. For instance, groundwater seepage studies have resulted in implementation of best management practices (BMP) such as the modification of farming methods to reduce nitrogen leaching to groundwater (McCoy and Corbett, 2009), installation of permeable reactive barrier in coastal aquifer (Hiller et al., 2015), or suggestion to construct artificial wetland in groundwater discharge hotpots (Adyasari, 2019).

Texas Coastal Resiliency Master Plan. This project aims to address the management of coastal habitats, specifically focusing on the degradation of coastal water resources (quality and quantity) resulted from potential nonpoint source pollution. The unique nature of coastal aquifers differentiates them from inland aquifers, as they are more susceptible to salinization and water quality alterations due to the interaction between freshwater and seawater, leading to complex flux and biogeochemical dynamics. Another significant concern is the coastal aquifer's vulnerability to extreme climate events. In polluted coastal aquifers, intense precipitation can trigger rapid hydrological responses, causing the discharge of groundwater with high concentrations of contaminants. This, in turn, temporarily worsens the local water quality. Considering changing climate patterns, land use, and water usage scenarios, it becomes crucial to understand the quality, quantity, and dynamics of the coastal aquifer. By gaining a deeper understanding of these factors, researchers and stakeholders can effectively conserve its role as a vital water resource for coastal populations and their activities.

SECTION THREE: SUBCOMMITTEE PRIORITIES

WSQ Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☒ Supporting management measures and watershed-based plans
☐ Monitoring and research that evaluates GI effectiveness in water quality and soil health
☒ Targeted/Direct Monitoring

Subcommittee Priority Detail:

This project addresses groundwater quantity and quality as potential nonpoint source pollution affecting Galveston Bay and its tributaries. Groundwater often contains higher nutrient concentrations than surface water due to longer residence time, lower water/rock ratio, and the absence of photosynthesis, as observed in surface waters (Slomp and Van Cappellen, 2004). Considering that groundwater flows on time scales of decades, it may also contain pollutants that were leached into the aquifer decades ago. For instance, the Chicot aquifer, the regional shallow aquifer in Harris-Galveston County, has an apparent age between 20-70 years (Oden and Truini, 2013). *Despite this fact, studies related to groundwater quality in counties surrounding Galveston Bay are still limited.* The few regional groundwater studies show a history of contamination from anthropogenic or geogenic sources (Schmitt et al., 2022; Uddameri et al., 2014); however, these studies covered more inland than coastal aquifers. I hypothesize that **coastal groundwater quality in Galveston Bay reflects the complexity of terrestrial anthropogenic activities and hydrogeological cycling in the area**. This leads to the first objective of this project: **to characterize coastal groundwater origins and quality in Galveston Bay**. In terms of quality, this project targets radionuclides, metals, and nutrients—three contaminants most often found at elevated concentrations in wells across the United States (USGS, 2019).

Terrestrial groundwater seepage occurs wherever a coastal aquifer is connected to the river or ocean via permeable sediments. In estuaries and coastal areas dominated by sandy alluvial deposits, groundwater appears as diffuse, low-flux seepage with spatial scales ranging from meters to kilometers. Groundwater seepage can be classified as fresh groundwater (i.e., its flow is driven by terrestrial hydraulic gradients) and brackish/saline groundwater (i.e., its flow is influenced by marine forces such as tidal or wave setup) (Santos et al., 2012). Groundwater's contribution to river or estuarine water budget have been assessed in several estuaries incorporated into the National Estuary Program, e.g., Coastal Bend Bays and Estuaries (Murgulet et al., 2016), Mobile Bay (Montiel et al., 2019), or Indian River Lagoon (Burnett et al., 2010),. These studies found that groundwater seepage contributes between 10-100% of river baseflow (e.g., Burnett et al. (2010)). Considering the size and productivity of the shallow and regional aquifer, I hypothesize that **terrestrial groundwater contributes to a significant fraction of river baseflow, while tidal forces enhance fresh or saline groundwater input to Galveston Bay**. Using naturally occurring geochemical tracers, this project aims to test this hypothesis by **establishing temporal and spatial variability of groundwater seepage (i.e., hotspots) and determining groundwater's contribution to surface waters (river and estuary).** Estimating groundwater seepage temporal variability and hydrological response to extreme events is important considering (1) the susceptibility of Galveston Bay to storms and hurricanes, and (2) storm events can temporarily shorten shallow groundwater residence time, implying that biological communities may not have sufficient time to degrade nutrients in coastal aquifer, resulting in a sudden increase of groundwater-derived nutrient seepage at the coastline (Adyasari et al., 2021; Hu et al., 2006).

Nitrogen and phosphorus transported by groundwater to estuaries and coastal areas can influence nearshore nutrient biogeochemistry (Santos et al., 2021). Groundwater also often diffuses from the seafloor, thus it may also have implications for bottom water biota, such as oysters, mussels, or crabs (Spalt et al., 2020). While nutrient concentrations in Galveston Bay water column are currently in good quality (Galveston Bay Foundation, 2022), cautions should still be exercised since groundwater flows on time scales of decades; hence, it can bring "legacy" pollutant to nearshore waters. In addition to terrestrial groundwater, tidal-induced groundwater recirculation also generates "recycled" nutrients. Such nutrients are produced when recirculated seawater infiltrates coastal sediments and returns into estuarine water column with different chemical compositions. Considering active mineralization in Galveston Bay's coastal sediments (Zimmerman and Benner, 1994), I hypothesize that **nutrient budget in Galveston Bay involves contributions from terrestrial and recycled nutrients**. Hence, to test this hypothesis, the third objective of this project is to **estimate total groundwater-derived nutrient input into Galveston Bay.**

By implementing research to achieve the objectives, this project contributes to **(1) environmental management measures by identifying potential nonpoint source pollution, and (2) implementation of targeted/direct monitoring of groundwater seepage and contamination.** A better understanding of groundwater pathway, solutes, and fluxes is significant for enabling the local authority to determine the carrying capacity of Galveston Bay and its future response to increased anthropogenic activities and frequency of extreme climate events. Finally, an understanding of different contaminant sources, water component, and hydrologic response are needed to accurately develop and calibrate water quality models and create efficient allocations for watershed-based plan and solutions.

Does the Project work with new, smaller communities/partnerships?
☐ Yes
☒ No

[TBD.]

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

The primary goal of this study is to assess the role groundwater seepage as a nonpoint source pollution to Galveston Bay and its tributaries. Through estimating groundwater seepage quality and quantity and analyzing its temporal and spatial variability, this project aims to identify potential nonpoint source pollution hotspots and to assist in developing best management practice and protection strategies to safeguard water quality and the ecosystem in Galveston Bay.

Full Project Description (1,000 words or less):

Proposed works and methods

Work Package 1 (WP-1)

Hypothesis: coastal groundwater quality in Galveston Bay reflects the complexity of terrestrial anthropogenic activities and hydrogeological cycling in the area.
Objective: characterization of coastal groundwater origins and quality in Galveston Bay.
Deliverables: public database of coastal groundwater quality in regions surrounding Galveston Bay and the submission of these data to Texas Groundwater Monitoring Survey.

In WP-1, groundwater samples will be collected from existing United States Geological Survey (USGS) wells, private wells, and piezometers deployed at the intertidal zones. Nutrients and trace metals (iron, manganese, copper, cadmium, zinc, calcium/magnesium) are measured to assess anthropogenic stressor to coastal groundwater. Water stable isotope analysis will also be conducted to trace the origin of groundwater and surface water and analyze the mixing process between different groundwater sources in coastal aquifer. Nitrate (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+), phosphate (PO_4^{3-}), and silica will be analyzed in the Geochemical and Environmental Research Group (GERG) at Texas A&M University. Dissolved organic nitrogen (DON), DOC, and trace metals will be measured at Texas A&M University at Galveston. $\delta^{18}O$ and δD isotopic composition of groundwater and surface water will be analyzed in Stable Isotope Geosciences Facility at Texas A&M University.

Work Package (WP-2)

Hypothesis: terrestrial groundwater contributes to a significant fraction of river baseflow, while tidal forces enhance fresh or saline groundwater input to Galveston Bay.
Objective: determination of temporal and spatial variability of groundwater seepage (i.e., hotspots) and groundwater's contribution to surface waters (river and estuary)
Deliverables: groundwater discharge hotspot map and a refined water budget of Galveston Bay.

To account for both types of groundwater (fresh and saline), this project will utilize radon-222 (^{222}Rn) and radium (Ra) isotopes (^{223}Ra, ^{224}Ra, ^{226}Ra, and ^{228}Ra). ^{222}Rn is a widely used groundwater discharge tracer to surface water due to its relatively short half-life ($t_{1/2}$ = 3.8 days), chemically inert nature, and significant enrichment in groundwater compared to surface waters (Adyasari et al., 2023). Meanwhile, Ra isotopes are powerful tracers of brackish or saline groundwaters, as high ionic strength water promotes the desorption of surface-bound Ra due to cationic exchange (Garcia-Orellana et al., 2021). The combination ^{222}Rn and Ra isotopes has been utilized in over 400 studies worldwide to elucidate coastal groundwater discharge quantity and quality (reviewed in Adyasari et al. (2023) and Garcia-Orellana et al. (2021)).

Groundwater seepage rate can be calculated using ^{222}Rn mass balance after considering various ^{222}Rn sources and sinks in coastal areas (see Supplemental Photos [b]). An open script R codes will used to convert the ^{222}Rn mass balance to water seepage rates (Adyasari et al., 2023). For groundwater seepage estimation in rivers, the hyporheic exchange will be considered and the discharge will be estimated using FINIFLUX model

(Frei and Gilfedder, 2015). Quantification of ^{226}Ra, a parent isotope of ^{222}Rn, will be done using Radium Delayed Coincidence Counter (RaDeCC) based on Diego-Feliu et al. (2020). To validate groundwater seepage calculation, an independent modeling assessment using Darcy's law will be conducted. Darcy's law can be calculated using water level in coastal wells and/or piezometers. The hydraulic conductivity and permeability of regional Chicot aquifer are known (Young, 2016), while local, shallow groundwater can be measured using slug tests.

Considering Galveston Bay water residence time between 15-45 days (Rayson et al., 2016), three types of Ra isotopes will be used to delineate the contribution of saline groundwater: ^{223}Ra ($t_{1/2}$ = 11.4 days), ^{224}Ra ($t_{1/2}$ = 3.6 days), and ^{228}Ra ($t_{1/2}$= 5.75 years). The Ra source terms and sinks for a given area will be evaluated to assess brackish groundwater seepage (see Supplemental Figure [c]). Short-lived Ra isotopes will be sampled using Mn-impregnated fibers and quantified using RaDeCC based on Diego-Feliu et al. (2020) (see Supplemental Photos [d]), while ^{228}Ra will be quantified using gamma spectrometry (Van Beek et al., 2010). Ra diffusion experiment will be conducted as explained in Garcia-Orellana et al. (2014).

To determine spatial variability of groundwater seepage, a continuous, automatic radon detector (RAD7, Durridge Inc.) will be set up on a research vessel to capture the distribution of ^{222}Rn in surface water [see Projects Map for the scope of the spatial survey and Supplemental Photos [e]). Particular attention will be given to oyster bed reefs and other areas with prevalent mariculture or aquaculture activities to assess any potential linkage between groundwater and farming practices.

Temporal variability of groundwater seepage will be determined by continuously deploying the autonomous ^{222}Rn detector in estuaries and sites with high ^{222}Rn activities based on the spatial survey (see Supplemental Photos [f]). This deployment will be conducted continuously to cover different diurnal (ebb and flood tide) and spring tidal cycles; thus, allowing determination of the driver of groundwater seepage. ^{222}Rn detector will also be stationed incidentally on Pelican Island during hurricane seasons (September-November 2024 and 2025) to assess groundwater hydrological response to extreme climate events. This assessment allows characterization of groundwater interaction with surface water (river, offshore seawater) and compare hydrologic response between groundwater and rivers in this area.

Work Package (WP-3)

Hypothesis: nutrient budget in Galveston Bay involves contributions from terrestrial and recycled nutrients.
Objective: estimation of total groundwater-derived nutrient input (fresh and saline) into Galveston Bay.
Deliverables: a refined water-derived nutrient budget of Galveston Bay, conference presentation, and manuscript submission to scientific journals.

To calculate groundwater-derived nutrient inputs, nutrient concentration from groundwater endmember will be multiplied by Ra- and ^{222}Rn-derived groundwater seepage rates from WP-2. Groundwater endmember samples will be collected from piezometers installed in the intertidal zone close to groundwater discharge hotspots (based on WP-2). This deployment allows for monthly water level assessment (WP-2) and sample collection.

To ensure the research findings reach diverse audiences, the scientific outcomes will be published in an open-access publication and stored in an open archive. Furthermore, to promote accessibility to varying levels of education, the findings will be translated into both English plain language and disseminated through a not-for-profit media outlet like The Conversation.

Preliminary data

This project will be the first study assessing groundwater seepage quality and quantity in Galveston Bay.

Latitude/Longitude (Optional):

Multiple coordinates, see Project Map.

Location:

Lower Galveston Bay.

Projects Map

[Insert Map Here or Attach as an Appendix if Applicable]

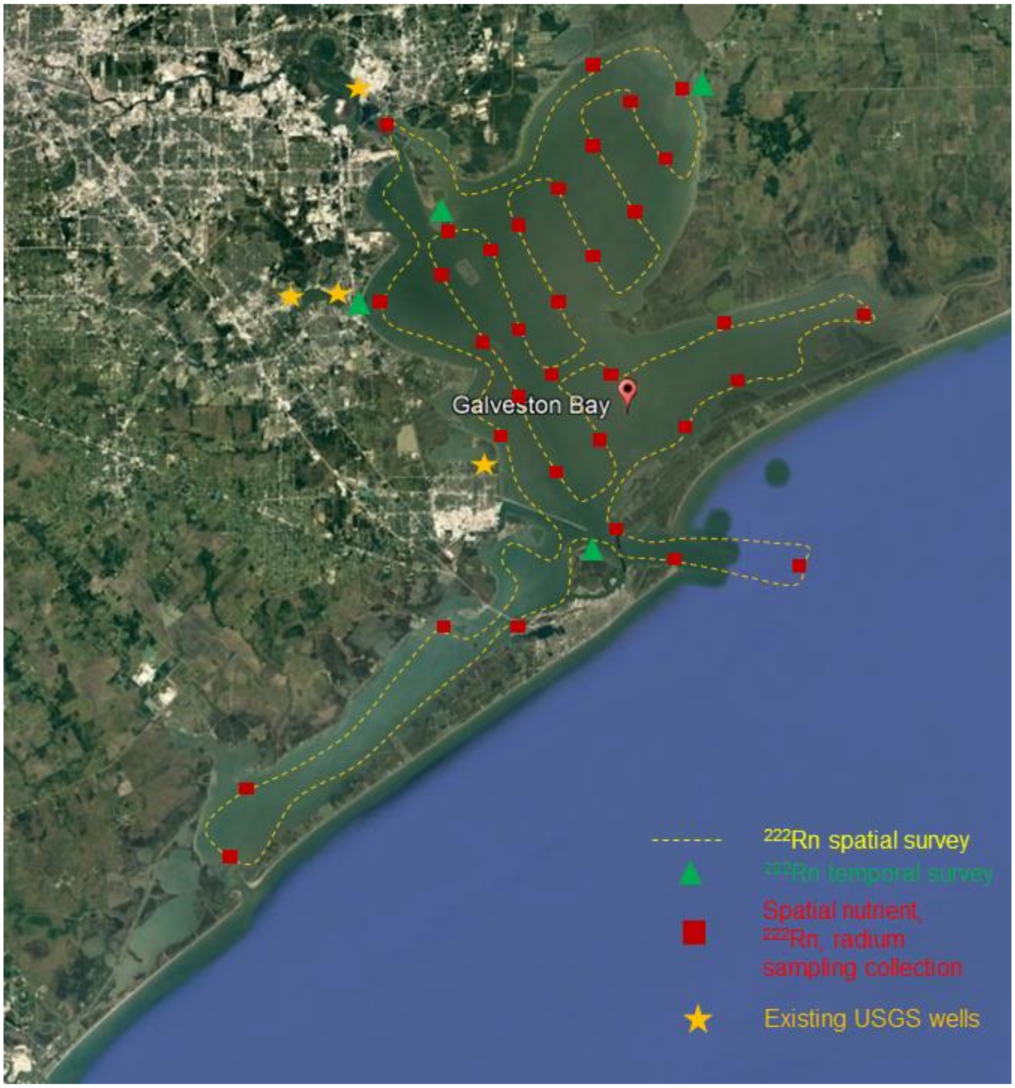


Figure 1. Spatial and temporal sampling collection sites

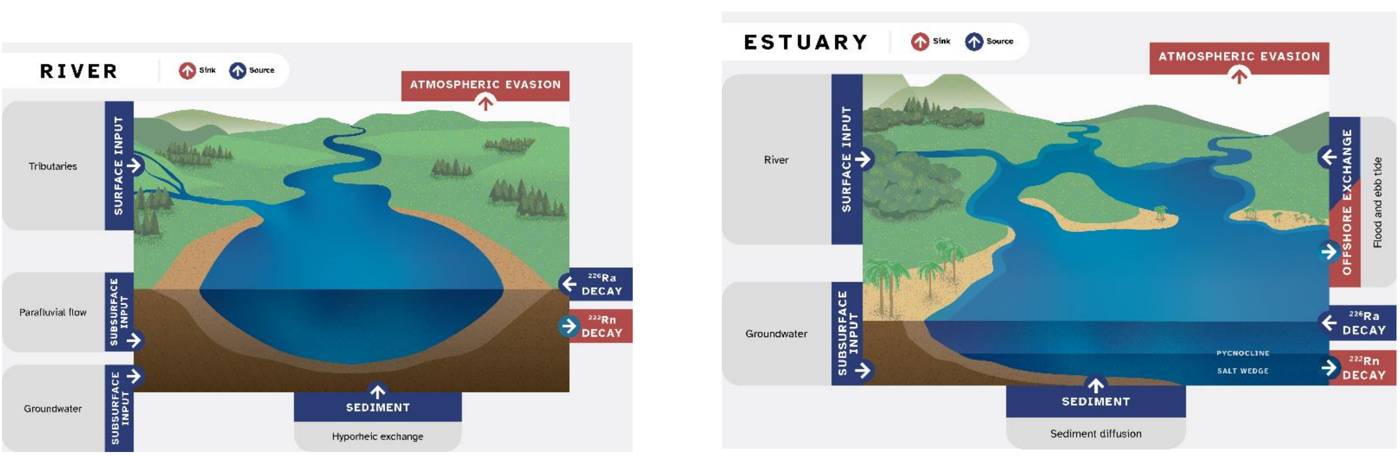
Supplemental Photos/Graphics (Optional):

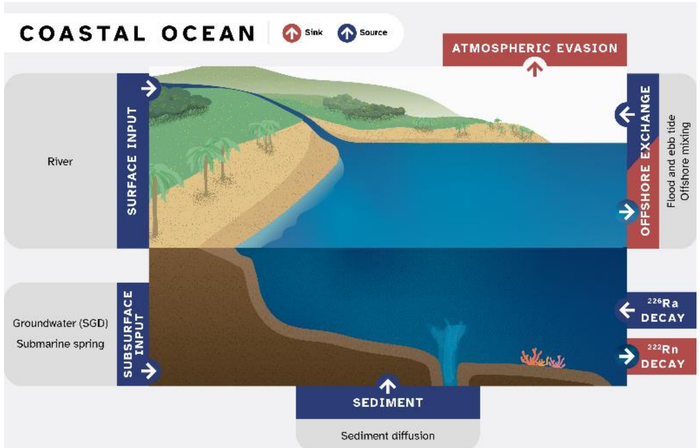
[Insert Here or Attach as an Appendix]

a. <u>Project timeline</u>

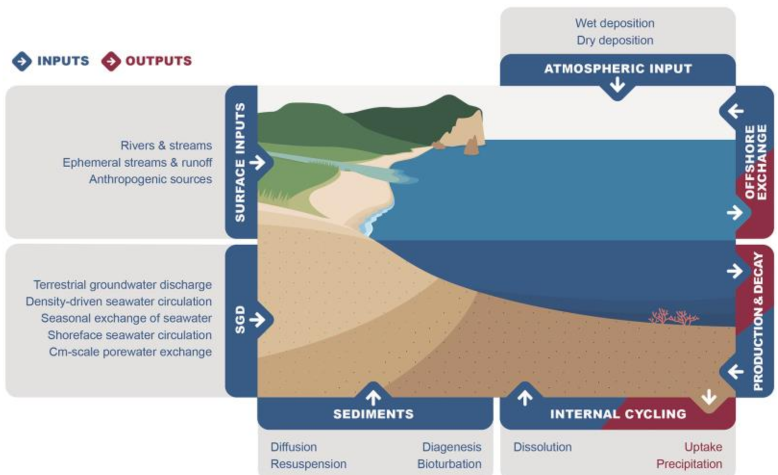
Activities	Sub-activities	2024				2025												2026							
		9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Field work	Organize field logistics and supplies	■	■								■				■										
	Spatial survey and water sample collection			■								■				■									
	Temporal ^{222}Rn survey				■								■				■								
	Incidental ^{222}Rn survey during hurricane season	■	■	■							■	■	■	■	■	■									
	Piezometer installation and monthly water collection					■	■	■	■	■	■	■	■	■	■	■	■	■							
Laboratory analyses and experiments	Rn and Ra sediment diffusion						■	■							■	■			■	■					
	^{223,224}Ra measurement				■							■				■									
	^{226,228}Ra measurement					■							■				■								
	Stable isotope analysis (TAMU)					■							■						■						
	Nutrient analysis (TAMU)					■							■						■						
	DOC, DON, and trace metal analyses (TAMUG)					■	■							■	■				■	■					
Intermediate, long-term research products	Conference attendance (also Deliverable WP-3)				■												■								
	Scientific manuscript writing and submissions (also Deliverable WP-3)													■	■	■	■	■	■	■	■	■	■	■	■
	database of coastal groundwater quality																				■	■	■	■	■
	Deliverable WP-2: groundwater discharge hotspot map and refined water budget																				■	■	■	■	■
	Deliverable WP-3: a refined nutrient budget																				■	■	■	■	■
	Final report writing and submission																	■	■	■	■	■	■	■	■

b. Schematic figure of ^{222}Rn mass balance in river, estuary, and coastal water (source: Adyasari et al. (2023))



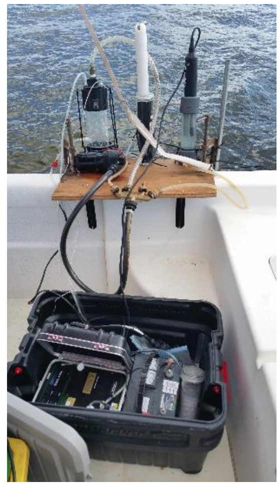


c. Schematic figure of Ra mass balance in coastal ocean (source: Garcia-Orellana et al. (2021))



d. Radium Delayed Coincidence Counter (picture: Dini Adyasari)

e. ^{222}Rn spatial survey (picture: Dini Adyasari)



f. ^{222}Rn temporal survey (picture: Dini Adyasari)

SECTION FIVE: BUDGET DETAILS

	BUDGET CATEGORIES:	Budget
a.	Personnel/Salary	$35,773
b.	Fringe Benefits	$10,088
c.	Travel	$1,200
d.	Supplies	$8,900
e.	Equipment	$0
f.	Contractual	$0
g.	Construction	$0
h.	Other*	$24,140
i.	Total Direct Costs (Sum a - h)	$80,101
j.	Indirect Costs	$39,367
k.	Total (Sum of i & j)	$119,468

*Other: If Budget Category "Other" is greater than $25,000 or more than 10% of budget total, identify the main constituents:
1. Open access publication fees (Frontiers in Marine Science: $3,225
2. Boat rental: $1,800
3. Nutrient analysis fees (380 samples): $9,500
4. Water stable isotope analysis fees (200 samples): $1,600
5. Instrument service fees: $2,000
6. Graduate student tuition & fees: $6,015

Indirect Cost Agreement

Indirect Cost Reimbursable Rate: The reimbursable rate for this Contract is 52.5% in Year 1 and 54.0% in Year 2 of (check one):

☐ salary and fringe benefits
☒ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☒ Predetermined Rate—an audited rate that is not subject to adjustment.
☐ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☐ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

Indirect Cost Rate Agreement dated 9/2/2022 is attached as Appendix A
Cognizant Federal Agency: Department of Health & Human Services, Denise Shirlee, (214) 767-3261

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

WSQ Subcommittee
Christian.Rines@tceq.texas.gov

NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov

PPE Subcommittee
Kari.Howard@tceq.texas.gov

M&R Subcommittee
Cassandra.Taylor@tceq.texas.gov

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Galveston Bay Estuary Program
FY 2025 WSQ Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

A PROGRAM OF TCEQ

SECTION ONE: GENERAL INFORMATION

Subcommittee:

Water and Sediment Quality (WSQ)

Project Name:

Application of Rapid Methods of Microbial Source Tracking to Assess the Source of Fecal Contamination to Western Galveston Bay

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

University of Houston – Clear Lake

☐ Federal, State, or Local Government ☐ Council of Government ☒ Public ISDs or Universities
☐ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Michael G. LaMontagne (UHCL)
Project Representative Phone	281-283-3754
Project Representative Email	lamontagne@uhcl.edu

Amount Requested:

$104,859

Is the project scalable? ☒

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$104,859
FY 2026 (09/01/2025-08/31/2026)	$0.00
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$0.00

Total Project Cost:

$104,859

Is this an estimate? ☐

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

1.0 year

Project Urgency:

It is critical that this project commence in the fall of 2024, so that this project can leverage ongoing work supported by the EPA. The EPA-funded project will end on February 28th, 2025.

Leveraging (in-kind and/or cash):

This project will leverage research conducted by undergraduate students in Microbiology laboratory courses taught by PI-LaMontagne at UHCL. We anticipate one section of 15 students in the fall of 2024 to work on this project. These students pay lab fees ($100/semester) to support purchasing of materials and supplies.

This project will also receive indirect support from two federal grants to PI-LaMontagne. These grants are not to be considered in-kind or cash but this support makes this work feasible.

An EPA grant to PI-LaMontagne ($465,016) currently supports a project to track the source of fecal contamination of two watersheds that feed into Clear Creek and Dickinson Bayou. In the work proposed herein, we propose to expand the scope of sampling to include tributaries that feed into Chocolate Bay. By collecting samples in these two projects in parallel, we can leverage resources for molecular analysis. In particular, realizing the throughput of dPCR and next-generation sequencing (NGS) requires pooling of multiple samples and running them together. In other words, the major cost is per run not per sample. It costs about the same to run one sample as it does to run a hundred.

We also anticipate that this project will leverage support from the NSF. We have received an unofficial notice from the program officer in the Major Research Instrumentation program at the NSF that our proposal to obtain a MALDI-TOF/FTIR system will be funded. Bringing MALDI-TOF analysis in-house will greatly increase the throughput, and lower the cost per isolate, of identification of the source of FIB.

Partners and Their Roles:

Co-PI Johnston will be responsible for coordinating communication with stakeholders and water quality managers regarding the planning and results of this project. Communication of research plan is important, as stakeholders should have an input in the generation of the data they receive. We have an outline of methods and primary stations, but we understand that preliminary results, and input of stakeholders, may lead to modifications of the sampling plan.

Co-PI Johnston will also help organize a workshop to give stakeholders and water quality managers hands-on experience in the microbial source tracking techniques proposed herein. At this workshop participants will learn how to collect and process samples for dPCR and metagenomic analysis.

Michael Allen, Ph.D. (University of North Texas Health Science Center) will provide dPCR and NGS services using methods developed and optimized in the EPA project. Professor Allen is a Co-PI on that project.

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

Ensuring safe human and aquatic life use of Galveston Bay requires identification of the source of pollution. Mustang Bayou connects to Western Galveston Bay, which is an important habit for oysters and recreational fishing. The TCEQ currently characterizes Mustang Bayou as an impaired basin because of consistently high levels of fecal indicator bacteria. Mustang Bayou watershed stakeholders are currently working with co-PI Johnston to develop an implementation plan (I-Plan), The Chocolate Bay I-Plan, to voluntarily reduce fecal bacteria as part of a Total Maximum Daily Load (TMDL) Project.

This project will inform that plan by providing actionable data. That is, we seek to identify the source of FIB in this Bayou both in terms of the host and the location. We suspect, based on preliminary analysis of the abundance of crAsspahges, that humans are an import source (see below). We will test this hypothesis with culture-dependent and -independent methods. In subsequent work, we will conduct higher spatiotemporal resolution sampling to map nonpoint sources and hotspots, which will inform remediation strategies.

Effective implementation of this project will require communication with the community. Importantly, until we identify the cause of the contamination, the public will be suspicious of, and resent any costs and restrictions associated with proposed remediation strategies. We will engage the community and stakeholders in the research planning and inform managers through a workshop. This workshop will give water quality managers hands-on experience with the molecular methods we use for microbial source tracking.

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 1: Ensure Safe Human and Aquatic Life Use

NPS-1 ☒	NPS-2 ☒	NPS-3 ☐	NPS-4 ☒	
PS-1 ☒	PS-2 ☒	PS-3 ☒		
PHA-1 ☐	PHA-2 ☐	PHA-3 ☒	PHA-4 ☐	PHA-5 ☐

Plan Priority Area Actions Detail:

This proposed work directly addresses priority area actions NPS-1 (Support Watershed-Based Plan Development and Implementation) and NPS-4 (Host Nonpoint Source Workshops); PS-1 (Stormwater Education Programs, PS-2 (Achieve Sanitary Sewer System Capacity and Integrity), and PS-3 (Increase Wastewater Treatment Facility Compliance); and PHA-3 (Improve Contact Recreation Safety Through Watershed-Based Plans).

NPS-1. The Chocolate Bay I-Plan is in development. Project results will assist implementation goals and help assist identification of human sources of fecal bacteria. The overall objective of this project is to develop, implement and support three emerging methods of indicating the presence of pathogens in recreational waters. Matrix-assisted laser desorption ionization – time of flight mass spectrometry (MALDI-TOF MS) will be used for library-dependent microbial source tracking (MST). Metagenomics and dPCR will be used for library-independent MST. These two approaches complement each other and will help managers identify the sources of fecal contamination. This will inform science-based decision-making.

NPS-4. We will host a workshop to teach managers and stakeholders the science behind MST methods and provide attendees hands-on experience with MST methods and interpretation of the corresponding data.

PS-1. Project results are expected to define sources of fecal bacteria and assist local stormwater managers improve stormwater management.

PS-2. Project will be shared with local jurisdictions highlighting sanitary sewer system sources of fecal bacteria.

PS-3. Project results will be shared with local wastewater operators. The TMDL reports identified assessment units that might be influenced by wastewater. This project will assist in identifying contributions from human sources that was not available during prior studies. Results should support discussions and inform future actions.

PH-4. Project will focus on a watershed impaired for contact recreation. An existing TMDL project is ongoing and stakeholders are developing an implementation plan to address the impairment. Project results are expected to assist implementation.

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?

☐ NRU (Protect and Sustain Living Resources)
☒ PPE (Engage Communities)
☒ M&R (Inform Science-Based Decision Making)

Other Subcommittee Detail:

The proposed project directly addresses plan priorities PPE (Engage Communities) and M&R (Inform Science-Based Decision Making).

PPE. This project specifically implements SPO-2 in hosting a workshop that will share project results and encourage implementation of fecal bacteria reduction strategies. The project also implements SPO-4 by targeting local governments within the Chocolate Bay watershed. Outreach initiatives in addition to the workshop, including meetings and one-on-one consultations, which will convey project results and if the hypothesis is correct, quantify human sources of fecal bacteria.

This project will leverage an existing program PL-LaMontagne developed that engages hundreds of students at the University of Houston – Clear Lake (UHCL) - a Hispanic Serving Institution – in authentic research on environmental microbiology topics related to this MST project. As a regional university, UHCL serves communities where we propose to work. The vast majority of students who enroll in UHCL live in this area and have strong connections, through their families, to the community. Educating these students will engage their families [5].

M&R. This project implements RES-4 by conducting monitoring and research to address limits to contact recreation. This project will conduct applied research to improve methods of monitoring water quality. Most water quality managers rely on cultivation of FIB to assess microbial contamination of waters. These protocols take at least 24 hours and do not assess the source of the contamination or the risk posed to the public. Molecular techniques can be integrated to provide rapid results, which can be deployed to the point-of-sampling protocols and provide definitive microbial source tracking. Additionally, the project implements ACS-2 in that all data and research will be made public and will more importantly be shared directly with watershed stakeholders who live and/or work in the impaired watersheds.

Other Plans Implemented:

The Texas General Land Office has developed the Coastal Resiliency Master Plan to promote the recovery of coastal communities following extreme weather events. These storms can generate floodwaters laden with fecal-associated bacteria, which presents a severe public health risk. Human waste in floodwaters present a particular health threat because high levels of host-specific pathogens and antibiotic resistant bacteria (ARB) in wastewater [13-15]. Low-income communities are particular at risk to infectious diseases associated with exposure to floodwater [3].

Managers need to know the risk of exposure to floodwaters to reassure the public and make scientifically informed decisions that accelerate recovery. Our proposed work will validate rapid microbial source tracking methods that can provide direct detection of pathogens in near real-time at the point-of-sampling. This will provide managers water quality data when they need it most.

SECTION THREE: SUBCOMMITTEE PRIORITIES

WSQ Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☒ Supporting management measures and watershed-based plans
☐ Monitoring and research that evaluates GI effectiveness in water quality and soil health
☒ Targeted/Direct Monitoring

Subcommittee Priority Detail:

Supporting management measures and watershed-based plans
Co-PI Johnston is working with local governments, businesses, non-profits, residents, and other Chocolate Bay watershed stakeholders to develop the Chocolate Bay I-Plan to address chronic bacterial contamination. The I-Plan is expected to be finished and submitted to the TCEQ Total Maximum Daily Load Program in August 2024. Stakeholders have identified wastewater, onsite sewage facilities and stormwater as important sources of fecal bacteria. Management measures are expected to include strategies to pinpoint sources and work with local jurisdictions to reduce or remove sources. Results of this project will directly assist efforts to identify fecal sources, particularly in Mustang Bayou.

Targeted/Direct Monitoring
This project will conduct ambient monitoring at five routinely monitored sites (Fig. 1) in the Mustang Bayou watershed. Direct monitoring will seek to identify fecal sources of bacteria in concert with traditional methods of FIB analysis. FIB counts are widely used to assess fecal contamination; however, this approach does not directly assess the risk of waterborne diseases associated with human waste. We propose to directly assess the presence of human waste by targeting crAssphages. Phages can be described as viruses that infect bacteria. CrAssphages are abundant in human waste, but rare or non-existent in other animals, and provide a direct measure of human waste. Results will be shared directly with local governments and other watershed stakeholders. These results, and feedback from stakeholders, will inform development of a plan for targeted monitoring, at a higher spatiotemporal resolution, along transects upstream of hotspots.

Does the Project work with new, smaller communities/partnerships?
☒ Yes
☐ No

Project investigators intend to work directly with the Chocolate Bay watershed stakeholders. Co-PI Johnston will reach out to those stakeholders before, during and after the project to encourage actions to reduce fecal bacteria. The communities of Manvel, Alvin, Hillcrest and others will be asked to participate.

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

The objective of this project is to bring water quality monitoring into the 21st century by making microbial source tracking, with rapid, validated, molecular techniques, routine. To achieve this end, we will evaluate a rapid method of concentrating microbes for water samples and validate this approach in a system, Mustang Bayou, which is chronically contaminated with fecal indicator bacteria. Methods and results will be shared with local and regional watershed stakeholders and resource agencies.

Full Project Description (1,000 words or less):

Communities along the coast of Galveston Bay depend on the health of this system for their livelihood [21]. Several locations in this estuary have chronically high levels of fecal indicator bacteria (FIB) [8, 11] and this metric of fecal contamination is increasing with sea-level rise and population growth [12]. Human waste in receiving waters presents a particular health threat because it is laden with host-specific pathogens and high levels of antibiotic-resistant bacteria (ARB) [13-15]. In urban, northern regions of Galveston Bay, high levels of FIB appear linked to runoff of stormwater [4]. In suburban, southwestern regions of the bay, high levels of FIB may reflect failing on-site wastewater treatment systems (OWTS) [22].

Interestingly, one segment within the Chocolate Bay watershed (segment 2432), Mustang Bayou presents an opportunity to evaluate and improve on new methods for identifying sources of fecal bacteria. Specifically, the concentration of bacteria in Mustang Bayou's assessment unit (AU) 2432A_02 exhibits significantly elevated levels when compared to upstream and downstream AUs. This AU falls within the heart of the cities of Alvin and Hillcrest, suggesting a hypothetical strong influence of human sources. TMDL studies have highlighted potential sources in the Mustang Bayou watershed include: wastewater, OSSF, SSO, pet, livestock, feral hogs, and wildlife. Determining a high incident of human source, above what standard methods cannot, potentially can assist local decision makers and watershed stakeholders to seek specific solutions to address this target source.

Managers typically assess fecal contamination of coastal (tidal) waters by culturing FIB. This 19th-century technology reliably indicates gross contamination; however, counts of FIB do not indicate the source of contamination and culturing requires at least a day to generate results. In the last few decades, microbial source tracking (MST) methods have been developed that quickly and reliably indicate the source of fecal contamination with either library-dependent or -independent techniques.

Library-dependent MST offers the advantage of directly identifying the source responsible of FIB. This provides managers with actionable data. The approach involves generating libraries of isolates from microbial sources and field samples [17]. This is expensive and time-consuming. For example, Ahmed and Katouli [2] typed 1,853 *Enterococcus* sp. and 905 *E. coli* isolates to identify failing OWTS. MALDI-TOF MS shows potential as a high-throughput method for MST [18]. MALDI-TOF MS systems provide strain-level identification of microbes for pennies per isolate [1, 16, 19] at a throughput of hundreds per day [9]. These systems can accurately identify the source of FIB [7]. For example, MALDI-TOF can differentiate *Enterococci faecalis* strains isolated from sewage from strains isolated from animal sources (Fig. 2). With funding from the EPA, undergraduates in microbiology courses PL-LaMontagne teaches at UHCL are building a library of reference isolates for this MST approach.

Library-independent MST with primers specific for crAssphage is a reliable indicator of human waste contamination [6, 20] and NGS [10] can accurately quantify contamination of waterways with human waste. PI-LaMontagne and Dr. Allen validated that dPCR targetting crAssphages is specific for human waste (Fig. 3) and used dPCR to show that Mustang Bayou is likely contaminated from human sources (Fig.4).

These MST methods are typically applied sporadically to investigate a particular hotspot or event. They are not used routinely. This reflects logistical challenges and lack of resources. Filtration to concentrate water samples for metagenomic analysis can easily take an hour per sample. Subsequent steps of processing the filters and extraction of nucleic acids can require extensive training and specialized equipment. This project will address this by achieving these specific aims:

1. Validate rapid MST protocols by applying them to an impaired system.
2. Host a workshop on the application of MST for quantifying non-point sources of human waste.
3. Testing the ability to produce bacteria source identification and success in implementing the Chocolate Bay I-Plan.

Research to achieve aim 1 will leverage ongoing research, supported by an EPA grant to PL-LaMontagne, to develop culture-dependent and -independent MST approaches (Fig 5). Herein, we propose to expand the scope of that ongoing project to include stations in Mustang Bayou (Fig. 1), which will be sampled 4 – 5 times in this project. This will validate the rapid filtration protocols and demonstrate that it is reasonable and feasible to incorporate MST into water quality monitoring programs.

To address challenges in sample collection, we propose to implement a protocol that uses a concentrating pipette (CP). Concentration of viruses and phages from turbid water samples, like Galveston Bay, is challenging. Most investigators use filtration of acidified samples but this can take hours. Recently, InnovaPrep introduced a CP device that can automatically concentrate crAssphages, and other virus-like particles, from estuarine samples in a minute. Nucleic acids can then be recovered from concentrated samples with simple commercial kits. We propose to collect samples with an InnovaPrep CP system. Recovery of crAssphages will be assessed with spiked samples.

Workshop to achieve aim 2 will provide training and resources to encourage adoption of these MST protocols. We will target organizations, including members of Bacterial Implementation Group and the Clean Rivers Program, that routinely monitor water quality in the Houston-Galveston area with support from the TCEQ. Attendees at this workshop will receive hands-on experience with water sample concentration with a CP and nucleic acid extraction for dPCR and metagenomic analysis.

Research aim 3 in the target Mustang Bayou watershed will work directly with stakeholders to use the project results to inform and begin dialogue on potential solutions. Specifically, Mustang Bayou assessment unit (AU) 2432A_02 geometric mean concentration of *E. coli* is elevated well above the other four AUs in the watershed. Capitalizing on prior work with these new methods, along with project results, the PIs will work with wastewater and stormwater practitioners in 2432A_02 to address what is believed to be higher than referenced human sources. The PIs will also use this work to seek additional funding to carry out more intensive targeted monitoring on this particular reach to pin down specific sources.

Latitude/Longitude (Optional):

29.261833, -95.182158 (station 18554, Fig. 1)

Location:

Project is being carried out in Basin 24, specifically 2432, Chocolate Bay and its subwatershed, 2432A, Mustang Bayou (Fig. 1).

Projects Map

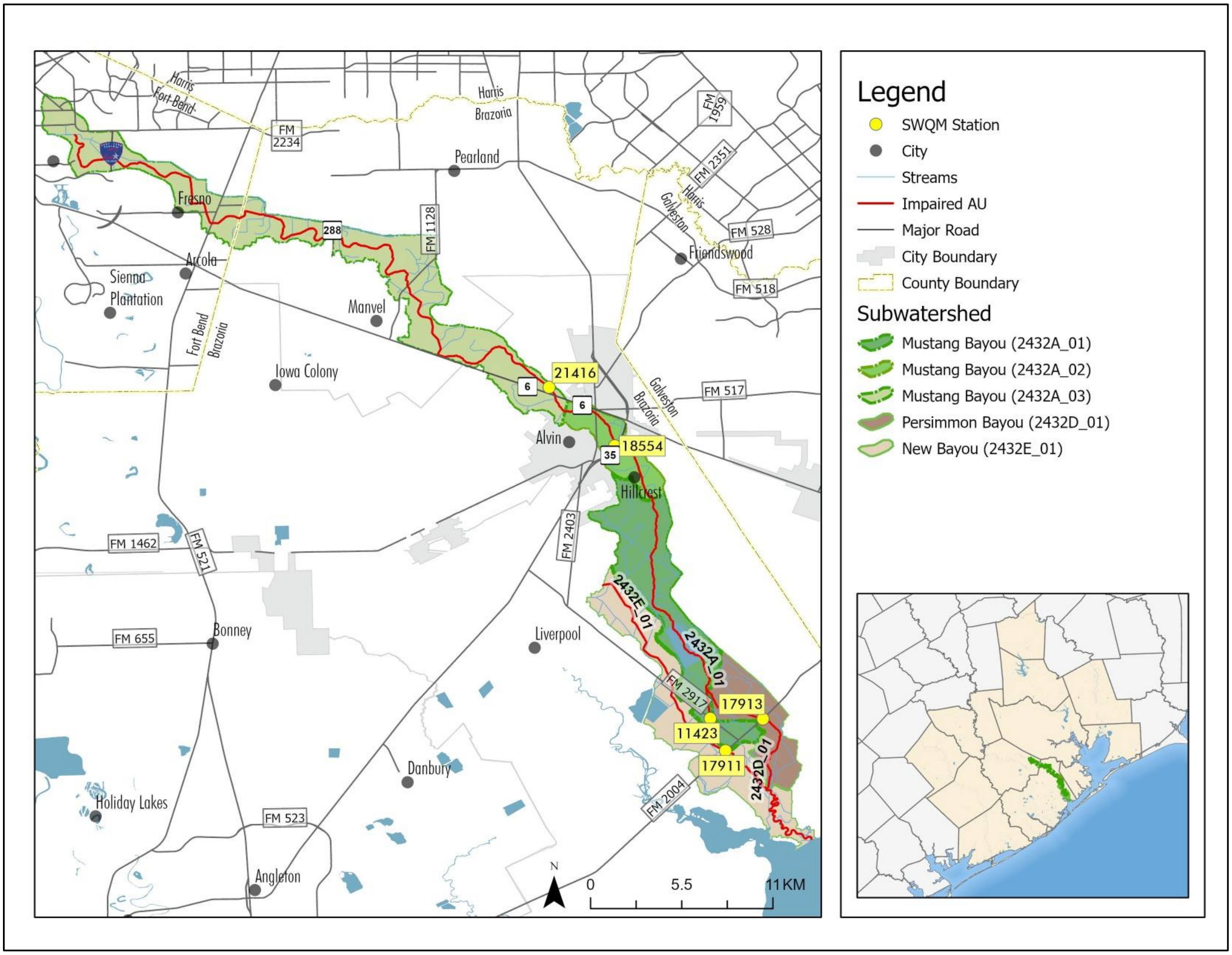

Figure 1. Map of study area. Proposed sampling stations (21416 – 17911) are indicated in yellow. Mustang Bayou station in 2432A_02 is identified as 18554.

Supplemental Photos/Graphics (Optional):

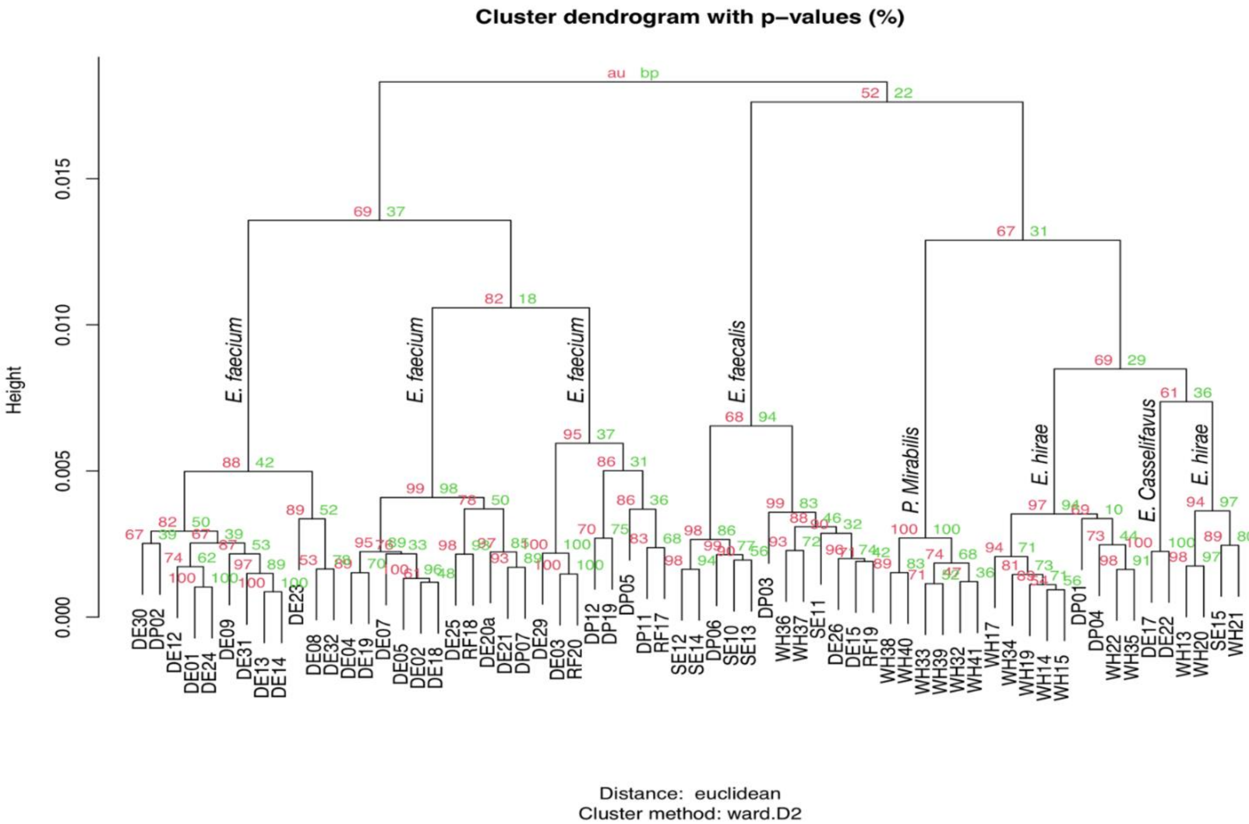

Figure 2. Cluster analysis of mass spectra generated from *Enterococci* species isolated from wild hogs (WH##), sewage and septic samples (SE##, RF## and DP##) and domestic dogs (DE##). Figure is reproduced from poster presented by PI-LaMontagne at ASM Microbe (June 2023).

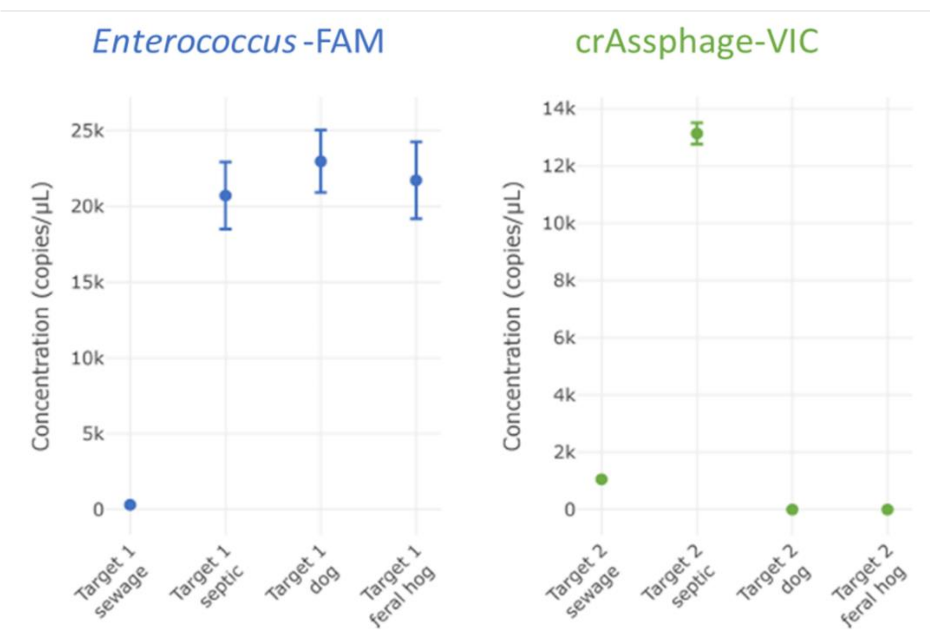

Figure 3. Quantification of *Enterococcus* spp. (FAM) and crAssphage (VIC) DNA copies in sewage (serially diluted), septic tank waste, dog feces, and wild hog scat by digital PCR. A) Absolute quantification of *Enterococcus* spp. (FAM) and crAssphage (VIC). DNA copies reveals presence of *Enterococcus* spp. in all samples tested. CrAssphage were present in human associated (sewage, septic) but undetected (i.e., below detection limits) for dog feces and hog scat. Figure is reproduced from a poster presented by PI-LaMontagne at ASM Microbe (June 2023).

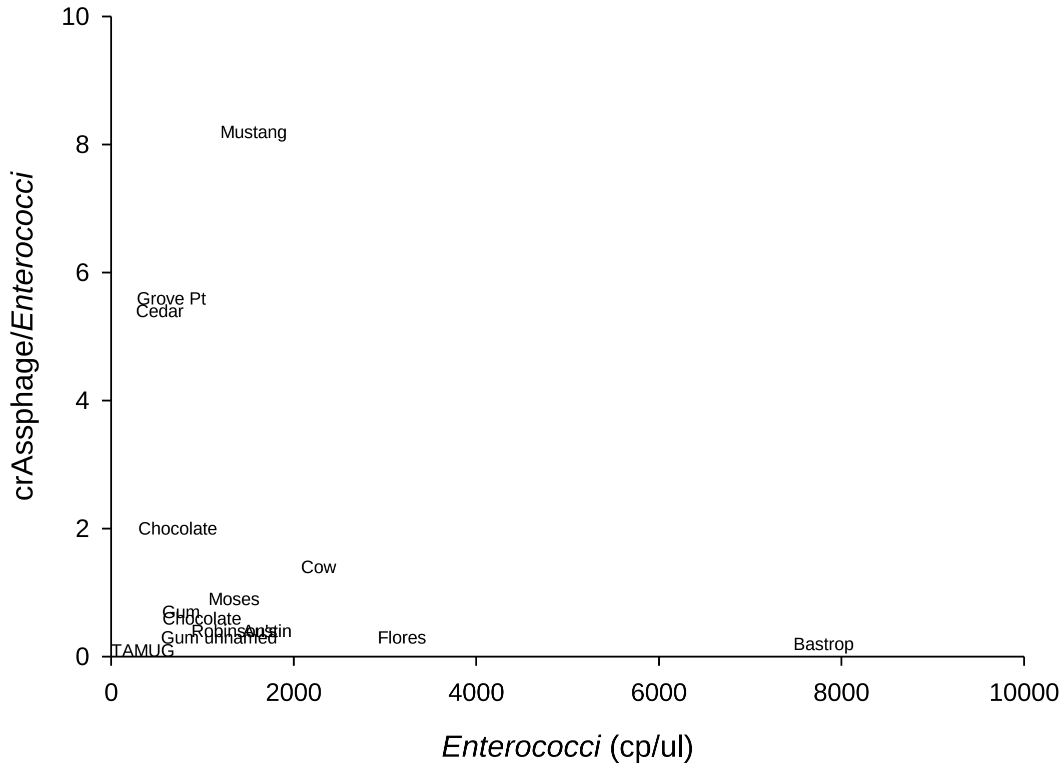

Figure 4. Ratio of crAssphage to *Enterococcus* spp in water samples collected in tributaries to Galveston Bay. Water body (bay or bayou) is indicated. Methods are as in Figure 3. High ratios of crAssphage to Enterococcus may indicate contamination with human waste.

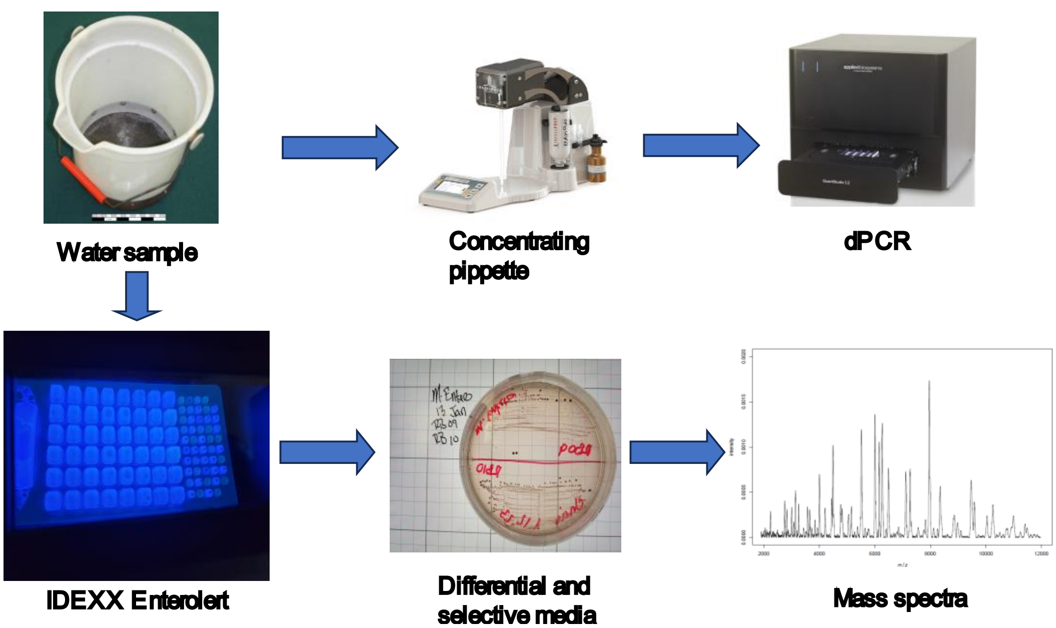

Figure 5. Conceptual map of combined culture-independent (top) and -dependent (bottom) microbial source tracking protocols.

SECTION FIVE: BUDGET DETAILS

BUDGET CATEGORIES:		Budget
a.	Personnel/Salary	$23,326
b.	Fringe Benefits	$2,231
c.	Travel	$1,157
d.	Supplies	$10,000
e.	Equipment[1]	$21,027
f.	Contractual	$0
g.	Construction	$0
h.	Other[2]	$32,000
i.	Total Direct Costs (Sum a - h)	$89,584
j.	Indirect Costs	$15,081
k.	Total (Sum of i & j)	$104,859

InnovaPrep Estimate12238_Univ

InnovaPrep Estimate12238_Univ

1. InnovaPrep Concentrating Pippette. Quote inserted (right)
2. University of North Texas Health Science Center sample testing ($10,000) and Houston-Galveston Area Council ($20,000). Publication charges ($2,000).

Indirect Cost Agreement

Indirect Cost Reimbursable Rate: The reimbursable rate for this Contract is 22% of (check one):

☐ salary and fringe benefits
☒ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☒ Predetermined Rate—an audited rate that is not subject to adjustment.
☐ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☐ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

Indirect Cost Agreement is Inserted (right):

UHCL IDC Agreement 2020 FIN

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

WSQ Subcommittee
Christian.Rines@tceq.texas.gov
NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov
PPE Subcommittee
Kari.Howard@tceq.texas.gov
M&R Subcommittee

Cassandra.Taylor@tceq.texas.gov

References

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Galveston Bay Estuary Program
FY 2025 M&R Project Proposal

Please complete the proposal form and submit to the appropriate Subcommittee Coordinator (end of form) by August 4, 2023. No late submittals will be considered for funding.

A PROGRAM OF TCEQ

SECTION ONE: GENERAL INFORMATION

Subcommittee:

M&R

Project Name:

Distribution of key emergent pollutants in the aquatic biota (oysters and fish), sediments and surface waters of Galveston Bay.

Project Previously Funded by GBEP? Yes ☐ No ☒

Lead Implementer:

Texas A&M University at Galveston

☐ Federal, State, or Local Government ☐ Council of Government ☒ Public ISDs or Universities
☐ Nonprofit ☐ Other*

* If lead implementer not listed above, the proposing party will need to partner with an interlocal/interagency entity to be selected for funding. Please reach out to GBEP staff with any questions.

Contact Information:

Project Representative Name	Dr. Antonietta Quigg
Project Representative Phone	409-740-4990
Project Representative Email	quigga@tamug.edu

Amount Requested:

$203,660

Is the project scalable? ☐

Amount Requested per year (if applicable):

FY 2025 (09/01/2024-08/31/2025)	$47,244
FY 2026 (09/01/2025-08/31/2026)	$156,416
FY 2027 (09/01/2026-05/31/2027)	$0.00
Total	$203,660

Total Project Cost:

$203,660

Is this an estimate? ☒

Project Duration (beginning no earlier than September 1, 2024 – 2.5 year maximum project length):

2 years: 9/1/2024 – 8/31/2026

Project Urgency:

Contaminants of emerging concern (CEC) is a term used by water quality professionals to describe pollutants that have been detected in environmental monitoring samples, that may cause ecological or human health impacts, and typically are not regulated under current environmental laws. According to the US EPA (https://www.epa.gov/wqc/), the CECs of greatest concern are per- and polyfluoroalkyl substances (PFAS) chemicals, pharmaceuticals, and micro-plastics.

PFAS are often called "forever chemicals" due to their very slow breakdown in the environment which also allows them to accumulate in people and animals. Some estimates suggest 98% of humans have some level of PFAS in their blood. In March 2023, the US EPA made its first attempt to nationally regulate PFAS in drinking water. It is thought that ~500,000 Texans live in communities with contaminated groundwater. Yet, Texas does not have any established metrics because of the paucity of available data. This project will measure the proposed US EPA PFAS of greatest concern in the Galveston Bay: PFOA, PFOS, PFNA, PFHxS, PFBS, and GenX.

Annually, billions of prescriptions are filled across the U.S. The potential for hormones and **pharmaceuticals** to be present in drinking water is of great concern because unintentional exposure to some of these bioactive compounds could result in adverse effects on human health. At low doses, they can exert a wide range of effects including endocrine disruption and antibiotic resistance. Pharmaceuticals are known to be entering the environment, particularly after storms and/or flood events, but again there is a paucity of information available for levels in Texas, and in particular in the water and aquatic life in Galveston Bay.

With the help of the Galveston Bay Estuary Program funding, the community is beginning to understand the extent of **plastic** pollution in Galveston Bay. For example, the team at UHCL is measuring the microplastics found in oysters, while others at TAMU(G) are looking at levels in fish, and a diverse group of stakeholders meets annually at the Texas Plastic Pollution Symposium.

These CEC's are present in aquatic biota (oysters and fish), sediments, drinking and surface waters, but we do not know the spatial extent, nor do we know what are "typical" concentrations occurring in Galveston Bay. A meta-analysis is proposed to bring together available data on these and other CEC's as well as measuring their concentrations in collected materials.

Leveraging (in-kind and/or cash):

None declared at this time.

Partners and Their Roles:

Given the cost of field work, we will work with GBEP researchers and stakeholders interested in collaborating to use a "split" sample approach. By this we mean that we will share samples, collection protocols and locations. In this way, the overall number of samples and data available will be significantly higher than working in a traditional mode. Thus far the following partners have agreed to participate:

Texas Parks & Wildlife Department (TPWD), Dickinson, TX - shellfish and fish samples from their regular monitoring program

Dr George Guillen (UHCL) – oyster samples; new proposals pending

Dr Anna Armitage (TAMUG) – marsh sediment and plant samples; new proposals pending

Dr Heidi Whitehead (TMMSN) – dolphin blubber and liver samples

Dr David Hala (TAMUG) – fish samples; new proposals pending

All interested partners are welcome to split/share sample materials for analysis.

SECTION TWO: *GALVESTON BAY PLAN, 2ND EDITION* IMPLEMENTATION

Galveston Bay Plan, 2nd Edition References
https://gbep.texas.gov/ensure-safe-human-and-aquatic-life-use/
https://gbep.texas.gov/protect-and-sustain-living-resources/
https://gbep.texas.gov/engage-communities/
https://gbep.texas.gov/inform-science-based-decision-making/

Plan Priority One: Ensure Safe Human and Aquatic Life Use
The proposed project will measure nonpoint sources and potential point sources of CECs in Galveston Bay in order to raise publica health and awareness.
Action Plan: NPS-2 Support Nonpoint Source Education and Outreach Campaigns
Action Plan: PS-3 Increase Wastewater Treatment Facility Compliance
Action Plan: PHA-1 Improve Seafood Advisory Awareness

Plan Priority Three: Engage Communities
The proposed project will support public education and awareness initiatives.
Action Plan PEA-1 Key Issue Engagement

Plan Priority Four: Inform Science-Based Decision Making
The proposed project will collaborate with research institutions to support research and monitoring and to increase access to Galveston Bay ecosystem information.
Action Plan: Collaborate with Research Institutions to Support Focus Area Applied Research and Monitoring (RES), specifically
RES-1 Conduct Biological Stressor Monitoring and Research
RES-5 Conduct Monitoring and Research to Address Limits to Seafood Consumption.

Galveston Bay Plan Priority Area Actions Addressed:

Plan Priority 4: Inform Science-based Decision Making

RES-1 ☒	RES-2 ☐	RES-3 ☐	RES-4 ☐
RES-5 ☒	RES-6 ☐	RES-7 ☐	RES-8 ☐
ACS-1 ☐	ACS-2 ☐	ACS-3 ☐	

Plan Priority Area Actions Detail:

This project aims to increase the current understanding of the distribution of CECs in Galveston Bay. The project will use sophisticated instruments (e.g., GC-MS, LC-MS) to quantify the levels of priority chemicals in the waters and biota (oysters, fish) from Galveston Bay. The specific priority area actions addressed are as follows:

Plan Priority One: Ensure Safe Human and Aquatic Life Use
In accordance with the Galveston Bay Plan, there are several crucial factors that determine safe human and aquatic life use of Galveston Bay. The foremost of these is the quality of the surface water in the lower watershed. Water quality is a key indicator of the health of the bay. The 2017 Galveston Bay Report Card, deemed it as generally good, especially in the open bay. Seafood consumption safety however received a grade of C in the same Report Card, and a grade of D for rivers and bayous. Contamination from polychlorinated biphenyls (PCBs) and dioxins (toxic pollutants that are driving factors in seafood consumption advisories). People who eat fish or shellfish contaminated by PCBs and dioxins can develop long-term, serious illnesses. *Little is known however about emergent pollutants including CEC's*.

Plan Priority Three: Engage Communities
Protecting and promoting the health of Galveston Bay are important, but communicating to residents and visitors is a challenge. Long-term success in environmental awareness and stewardship takes time and is not

simple. To adequately engage communities, two Action Plans were identified by the PPE subcommittee. By working with available tools (e.g., the Galveston Bay Action Network), GBEP and its stakeholders, we will raise awareness in the community of CECs in Galveston Bay. Given that pharmaceuticals are materials that all residents are aware off, while there is a growing body of interest in microplastics in the environment, especially biota that people consume (oysters, fish), we will leverage interest in these materials primarily to raise overall understanding of CECs in Galveston Bay. In doing so, we want to preserve Galveston Bay through stakeholder and partner outreach activities.

Plan Priority Four: Inform Science-Based Decision Making
RES-1: Conduct Biological Stressor Monitoring and Research
The surface waters of Galveston Bay have been shown to be polluted with CECs. However, there is a general lack of knowledge on concentrations in associated with the known major contaminant sources (see project map) and biota. Most data to date has been collected in response to major events (hurricanes, fires) and so there is a strong need to develop baseline data/levels. We will determine CECs (**PFASs, pharmaceuticals and microplastics**) levels in water, sediments and biota (oysters, fish, dolphins) sampled from Galveston Bay. The results of this project will contribute to the US EPA database of CEC concentrations which is needed to develop policies to protect communities. The bay must be managed to ensure its productivity and ecological diversity on a long term, sustainable basis while also supporting a diverse group of stakeholders. This research will help stakeholders better understand the health of the bay which will hopefully translate to better stewardship decisions and actions by both residents and visitors. GBEP and its partners support science-based decision making; this project will provide necessary data to help preserve Galveston Bay for future generations.

Does the project implement any other Galveston Bay Plan Priority Area Actions, or the other Subcommittee priorities?
☒ WSQ (Ensure Safe Human and Aquatic Life Use)
☒ NRU (Protect and Sustain Living Resources)
☒ PPE (Engage Communities)

Other Subcommittee Detail:

The results of this project will be of relevance to the WSQ, NRU and PPE Subcommittees as it will quantify the extent to which CECs are present in Galveston Bay, potential point and non-point sources, as well as body burdens in a variety of biota. This knowledge will contribute to goals to understand pollution sources, fate and distributions. With a broad watershed understanding, we will work with PPE to engage communities to help them understand potential sources of risk.

Other Plans Implemented:

This project contributes to the Texas Coastal Management Plan, particularly as it concerns (i) supporting protection of natural habitats and wildlife and (ii) provides baseline data on the health of gulf waters (https://www.glo.texas.gov/coast/grant-projects/cmp/grants).

SECTION THREE: SUBCOMMITTEE PRIORITIES

M&R Subcommittee Identified Priorities
Proposals must address one or more of the following actions:

☐ Meaningful and effective monitoring of existing and new projects (NRU/WSQ/PPE support)
☒ Exposure and response to emerging contaminants across trophic levels
☐ Reestablishing dermo monitoring programs (Ex. Oyster Sentinel)
☒ Project Component: Results translated to plain language/practical knowledge

Subcommittee Priority Detail:

The proposed project addresses the M&R Subcommittee's identified priorities as follows:

1) **Exposure response across trophic levels:**

The project will use highly sophisticated instruments (e.g., LC– GCMS) to quantify the concentrations of a variety of CECs including the 6 US EPA priority PFASs. pharmaceuticals and microplastics

- in surface water at the mouths of the major rivers and bayous entering Galveston Bay (during a low and high flow period),
- in biota (phytoplankton, zooplankton, oysters, fish, dolphins) from Galveston Bay,
- in drinking water from major industrial facilities (5), wastewater treatment plants (5), formerly used defense sites (5) and major airports (2) (see project map) known to be important sources of PFASs and potentially other CECs,
- The proposed project complements existing GBEP funded studies as it focuses attention on quantifying important emergent chemicals or CEC's.
- By collaborating with other funded GBEP scientists, we will "split" samples whenever possible to increase the overall knowledge of emergent chemicals in Galveston Bay. For example, we will work with teams from the Hala, Guillen and other labs to split oyster and fish samples and measure PFAS concurrently with microplastics and other chemicals being measured. This will reduce the overall cost of the project and increase the overall spatial and temporal distribution of samples collected (and concurrent data such as lat, long, salinity, temp, etc…)
- The knowledge of PFAS body-burdens in biota will enable a dietary risk assessment to be performed to estimate likely human exposure from the consumption of PFAS-tainted seafood (oysters, fish muscle).

2) Project Component: Results translated to plain language/practical knowledge:

- The results of this project will contribute to the US EPA database of CEC concentrations which is needed to develop policies to protect communities.
- We will work with GBEP and their stakeholders to translate the findings to enable stewardship decisions and actions. GBEP and its partners support science-based decision making; this project will provide necessary data to help preserve Galveston Bay for future generations.
- A flyer (one pager) will be developed to explain the significance of the research and distributed to TCEQ personnel, extension agents and others.
- We will visit with the various working groups to increase stakeholder engagement and the distribution of the project findings.

Does the Project work with new, smaller communities/partnerships?

☒ Yes
☐ No

If funded, the PI's will work with other funded GBEP researchers to develop new partnerships and enhance existing partnerships.
In addition, the findings will be shared with the US EPA database of CEC concentrations and for example, the "PFAS project lab" which is developing a nationwide database of PFAS measurements (see Salvatore et al. 2022). If other similar such databases exist for the CECs being measured, we will share our findings with them too.

SECTION FOUR: PROPOSAL DETAILS

Project Summary:

Contaminants of emerging concern (CEC) is a term used by water quality professionals to describe pollutants that have been detected in environmental monitoring samples, that may cause ecological or human health impacts, and typically are not regulated under current environmental laws. CECs of greatest concern are per- and polyfluoroalkyl substances (PFAS) chemicals, pharmaceuticals, and micro-plastics. US EPA attempts to nationally regulate CECs is struggling because of the paucity of available data yet we know these chemicals maybe present in the drinking water and biota that we consume. This project will measure the *exposure response across trophic levels* to a selection of CECs and then translate the results to both *plain language/ practical knowledge*. At low doses, these CECs may exert a wide range of adverse effects on the biota and perhaps, the humans that consume the biota. *These CEC's are present in aquatic biota (oysters and fish), sediments and surface waters, but we do not know the spatial extent, nor do we know what are "typical" concentrations occurring in Galveston Bay.* A meta-analysis is proposed to bring together available data on these and other CEC's as well as measuring their concentrations in newly collected materials.

Full Project Description (1,000 words or less):

Contaminants of emerging concern (CEC) is a term used by water quality professionals to describe pollutants that have been detected in environmental monitoring samples, that may cause ecological or human health impacts, and typically are not regulated under current environmental laws. According to the US EPA (https://www.epa.gov/wqc/), the CECs of greatest concern are per- and polyfluoroalkyl substances (PFAS) chemicals, pharmaceuticals, and micro-plastics[1-3]. At this time, nearly 500,000 Texans live in communities with CEC contaminated groundwater, but there is little to no information available on the kinds present. Without this critical information, citizens cannot advocate for policy or mitigation strategies or protect themselves. Following the contamination of ecosystems (**Fig. 1**), CECs may disrupt biological processes and elicit a wide range of toxic effects on aquatic species (e.g., fish), including inhibiting growth, disrupting reproduction and increasing oxidative stress. These chemicals are also known to negatively impact humans either directly (e.g., through aerosols) or indirectly (e.g., through diets). *The persistent nature of these chemicals, combined with their toxicity, illustrates a necessity for contemporary research to investigate their distributions*.

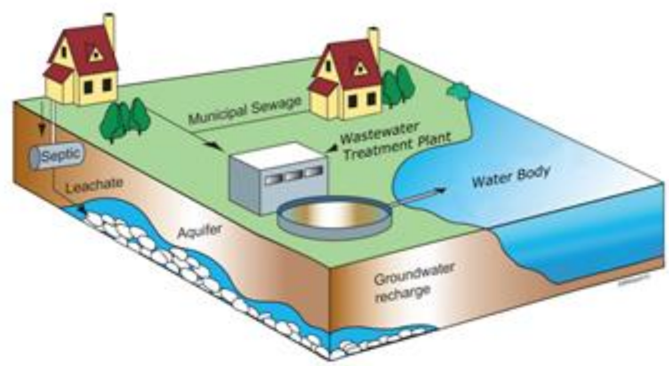

Fig. 1: Movement of CECs in the environment (USEPA).

Galveston Bay is the nexus of water/food/energy and other sectors in the region. It is home to a billon dollar commercial and recreational fishery. It is located south of Houston (4th largest city in US) and the Dallas/Fort Worth metroplex. Concurrently, Houston is the leading domestic and international center for virtually every segment of the energy industry (e.g., 14.3% of the nation's oil production is done in the refineries clustered in the Houston area), making the watershed/bay at risk from this vast commerce[4]. For example, in response to a major fire which blazed for more than a week (storage tanks at the International Terminals Company in Deer Park (Houston, TX, March 2019), US EPA priority PFASs were measured in Galveston Bay (**Fig. 2**)[2]. In surface waters in the months after the fire, there were 4× to ~300× higher PFASs than what would be found a year later. PFOS was the most abundant homolog, was found in eastern oysters (*Crassostrea virginica*), red drum (*Sciaenops ocellatus*), gafftopsail catfish (*Bagre marinus*), and spotted seatrout (*Cynoscion nebulosus*) [2]. As a result, we calculated the hazard ratio for seafood safety and suggested an advisory of 1–2 meals of fish per week to be protective for human exposure; levels in oysters indicated no immediate concerns for the dietary exposure of humans[2]. These results highlight the need for continual monitoring to assess the fate and seafood advisories for PFASs. Further, Galveston Bay is often impacted by major floods or hurricanes. After Hurricane Harvey, pharmaceuticals, PAH, PCBs and other CECs and legacy chemicals were measured in the bay[3].

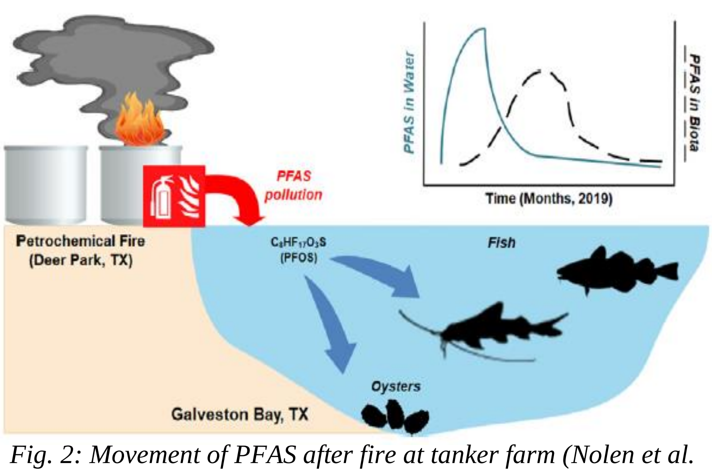

Fig. 2: Movement of PFAS after fire at tanker farm (Nolen et al. 2022).

Objectives:

Overall objective: *To determine CEC levels surface and drinking waters, sediments and biota of Galveston Bay in order to assess potential adverse health effects to biota and humans.*

Specific Objective 1: Measure CECs (PFASs, pharmaceuticals and microplastics) levels in water, sediments and biota (oysters, fish, dolphins) sampled from Galveston Bay.

Specific Objective 2: Contribute to the US EPA national database of contaminant concentrations.

Specific Objective 3: Support GBEP and its partners in science-based decision making and stewardship decisions and actions.

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Experimental Design and Methods: Surface water and drinking water samples will be sampled from various dock-side locations, focusing on areas that are thought to be sources of CECs including the 'forever chemicals' known as PFASs around Houston Galveston Bay (see project map below for target areas). We will sample major industrial facilities (5), wastewater treatment plants (5), formerly used defense sites (5) and major airports (2) based on these maps.

By working with project partners (see above), we will examine previously archived tissue samples of dolphins and collect fresh samples of oysters and fish (i.e., red drum, spotted seatrout) which will be analyzed for CEC body-burdens using standard protocols for each CEC. We have experience measuring PFASs, pharmaceuticals and microplastics, hence our focus will be these emergent pollutants[2,3].

This will allow us to examine the source(s), fate and transport of CECs to determine the overall spatial distributions in water, biota (oysters, fish), and in sediments associated with marshes around Galveston Bay. Given the large scope of the project, we will coordinate with other funded GBEP projects to leverage sampling opportunities. For example, GBEP is already funding projects examining microplastics, so we will partner with those entities to split samples (e.g., Guillen, Hala). This will allow us to develop a “big picture” view of CECs in Galveston Bay food webs, without bearing the entire expense in one project.

Potential Impact and Project Outcomes: The data generated will be submitted to national databases as well as developing a database associated with the project in which all the CECs and ancillary data (e.g., lat, long, water quality) will be deposited to provide an overall portfolio of emergent pollutants in Galveston Bay. The work contributes to the Galveston Bay Plan by addressing 3 key areas: Plan Priority One: Ensure Safe Human and Aquatic Life Use (NPS-2, PS-3, PHA-1), Plan Priority Three: Engage Communities (PEA-1) and Plan Priority Four: Inform Science-Based Decision Making (RES-1, RES-5).

References cited:

1. Prevedouros, K., et al. 2006 *Environmental Science and Technology* 40, 32–44.
2. Nolen, R. M. et al. et al. 2022 *Science of The Total Environment* 805, 150361.
3. Steichen, J. L. et al. 2020 *Frontiers in Marine Science.* 7, 186.
4. Barrientos, M. et al. 2022 Houston Facts. *Greater Houston Partnership*. 62 pages.

Latitude/Longitude (Optional):

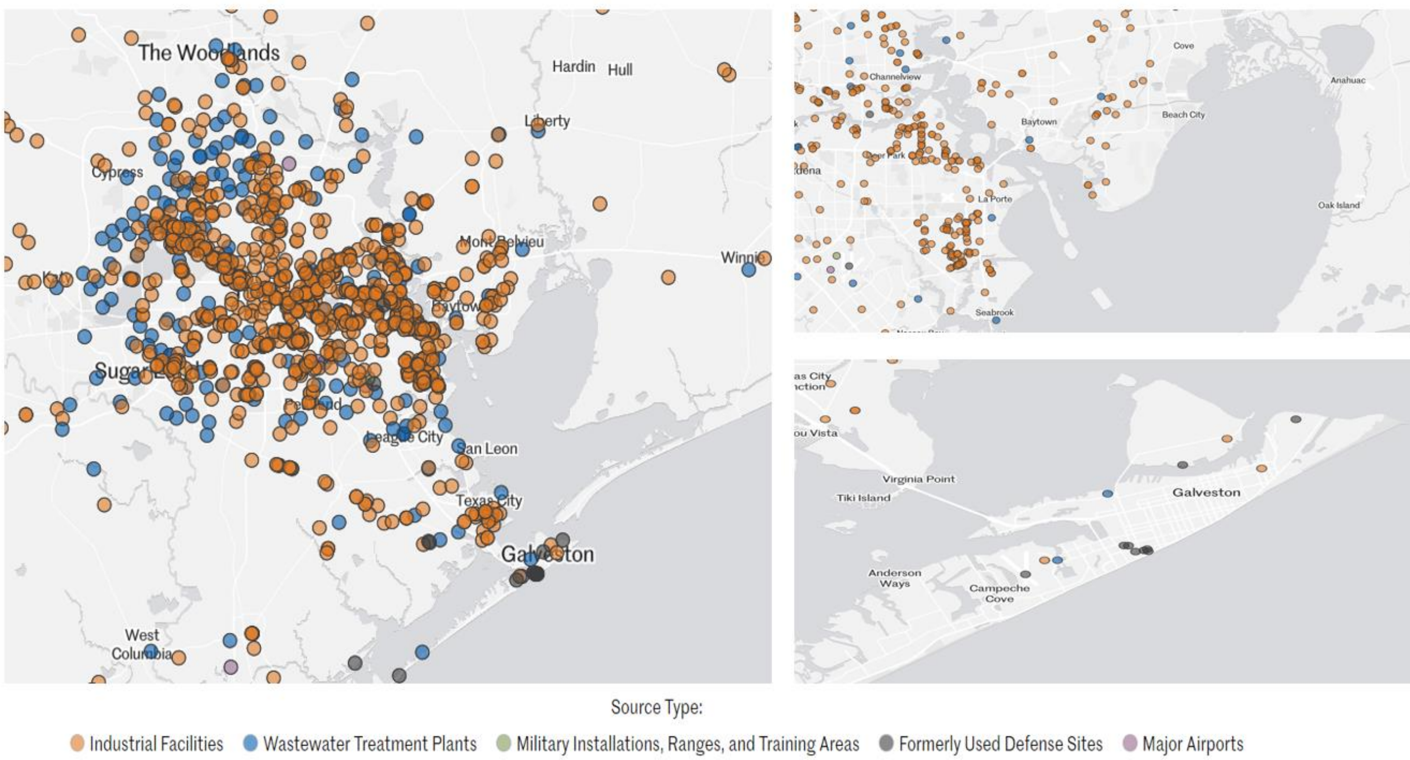
N/A

Location:

Sampling for biota will be opportunistic (e.g., that performed by TPWD, TMMSN and colleagues such as those included in the partner list above), and dockside sampling for surface water samples at sites including (but not limited to) major industrial facilities (5), wastewater treatment plants (5), formerly used defense sites (5) and major airports (2) (see project map). Laboratory analysis will be performed at the research facilities of Texas A&M University at Galveston (TAMUG).

Projects Map

Map shows likely sources of 'forever chemicals' aka PFASs around Houston Galveston Bay. EPA is attempting to nationally regulate this type of chemical in drinking water. Though there is no comprehensive national tracking of the origins of PFAS pollution, researchers from the PFAS Project Lab have compiled a nationwide database of *likely* sources of contamination (Salvatore et al. 2022). We will sample major industrial facilities (5), wastewater treatment plants (5), formerly used defense sites (5) and major airports (2) based on these maps. We will measure concentrations of other CECs collected from the same sample locations.



Supplemental Photos/Graphics (Optional):

N/A

SECTION FIVE: BUDGET DETAILS

BUDGET CATEGORIES:		Budget
a.	Personnel/Salary	$78,583
b.	Fringe Benefits	$28,792
c.	Travel	$3,000
d.	Supplies	$10,500
e.	Equipment	0
f.	Contractual	0
g.	Construction	0
h.	Other*	$12,684
i.	Total Direct Costs (Sum a - h)	$133,559
j.	Indirect Costs	$70,101
k.	Total (Sum of i & j)	$203,660

*Other: If Budget Category "Other" is greater than $25,000 or more than 10% of budget total, identify the main constituents: $12,684 (6.2% of total budget and includes tuition for student, fees and publication costs)

Indirect Cost Agreement
Indirect Cost Reimbursable Rate: The reimbursable rate for this Contract is 52.5% in Year 1 and 54% in Year 2 of (check one):
☐ salary and fringe benefits
☒ modified total direct costs
☐ other direct costs base
If other direct cost base, identify:

This rate is less than or equal to (check one):
☒ Predetermined Rate—an audited rate that is not subject to adjustment.
☐ Negotiated Predetermined Rate—an experienced-based predetermined rate agreed to by Performing Party and TCEQ. This rate is not subject to adjustment.
☐ Default rate—a standard rate of ten percent of salary/wages may be used in lieu of determining the actual indirect costs of the service.

Indirect Cost Rate Agreement dated 9/2/2022 is attached as Appendix A.
Cognizant Federal Agency: Department of Health & Human Services, Denise Shirlee, (214) 767-3261

Please Submit Project Proposals (Microsoft Word Only – No PDFs) by August 4, 2023 to:

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Christian.Rines@tceq.texas.gov

NRU Subcommittee
Lindsey.Lippert@tceq.texas.gov

PPE Subcommittee
Kari.Howard@tceq.texas.gov

M&R Subcommittee
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