Research Applied Technology Education Service

Andrew N.S. Ernest, Ph.D., P.E., BCEE, D.WRE
President & CEO

Javier Guerrero, E.I.T., M.S.
Stormwater Task Force, CEO

William Kirkey, Ph.D.
Chief Research Officer

Christopher Fuller, Ph.D.
Chief Operations Officer

Benjamin Vondrak
Project Comptroller

December 12, 2025

About RATES

Turning research and technology into community resilience

History/ Background

1974 → Winter Water Sampling

1991 → Andy Ernest's Ph.D. Completion
-Water Quality Modeling and Parameter Estimation

1994 → Opportunities in Texas

1996-1998 Stormwater TaskForce

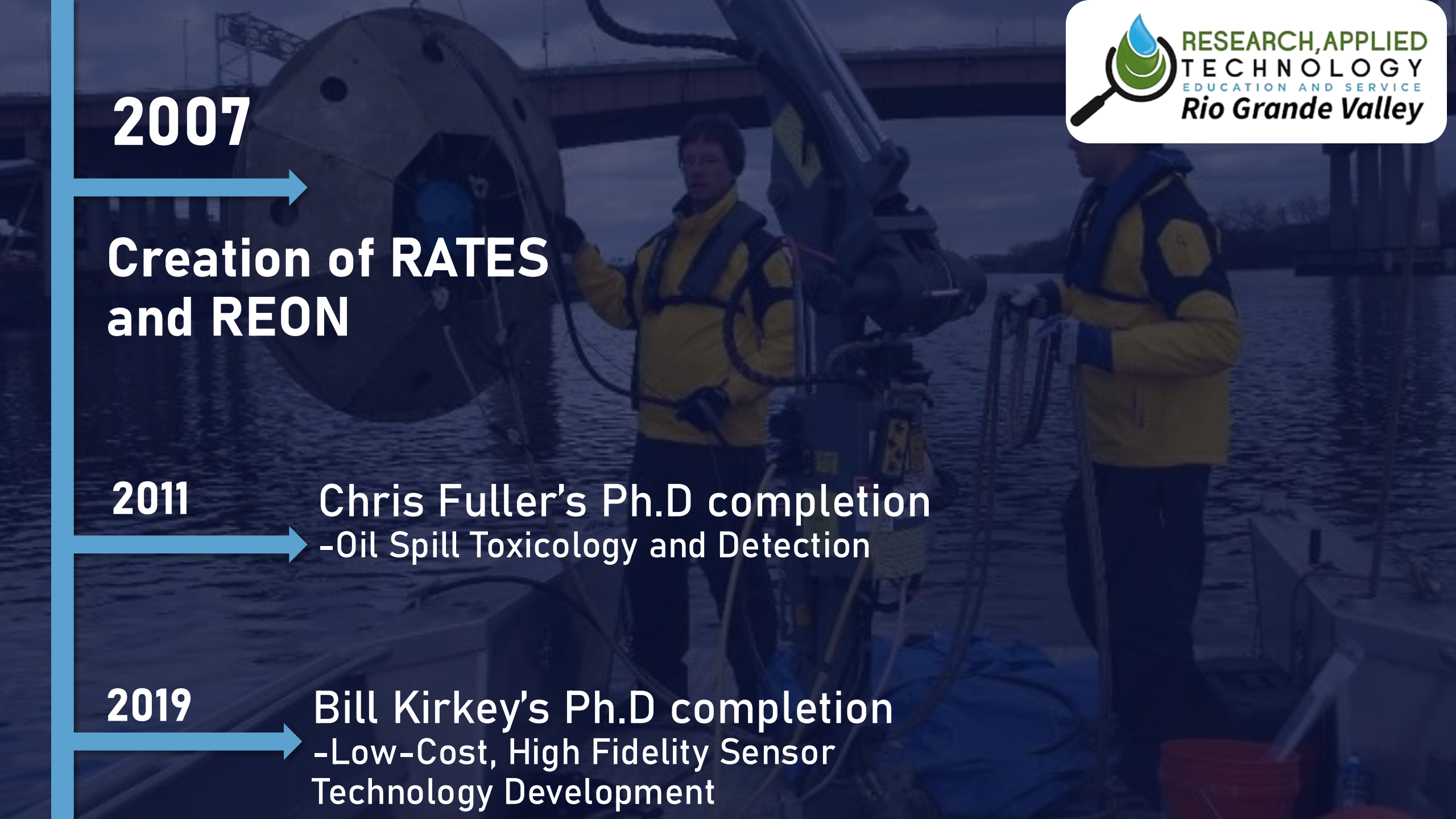
- The Task Force was established in 1998.
- As of June 2023, the Task Force has been established as a 501(c)3.
- We currently have 33 members within our coalition.

Community Outreach & Visibility –

Participate in coordinated school presentations, public outreach campaigns, and regional events that fulfill MS4 requirements while elevating your organization's presence in the community.

Regional Collaboration & Support –

Gain access to technical experts, shared training, permit compliance resources, and partnership opportunities that strengthen stormwater management and funding capacity.



RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICE
Rio Grande Valley

2007

Creation of RATES and REON

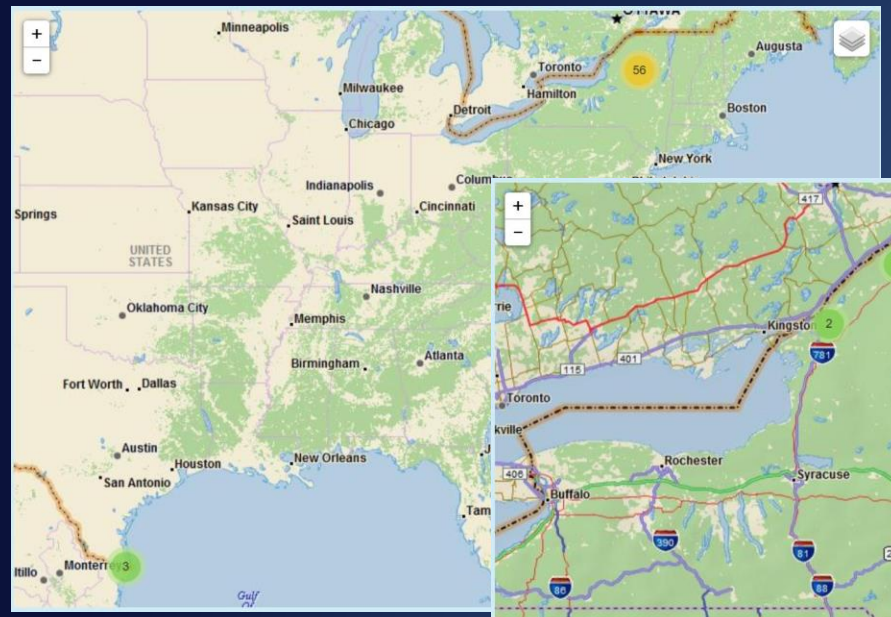
2011

Chris Fuller's Ph.D completion
-Oil Spill Toxicology and Detection

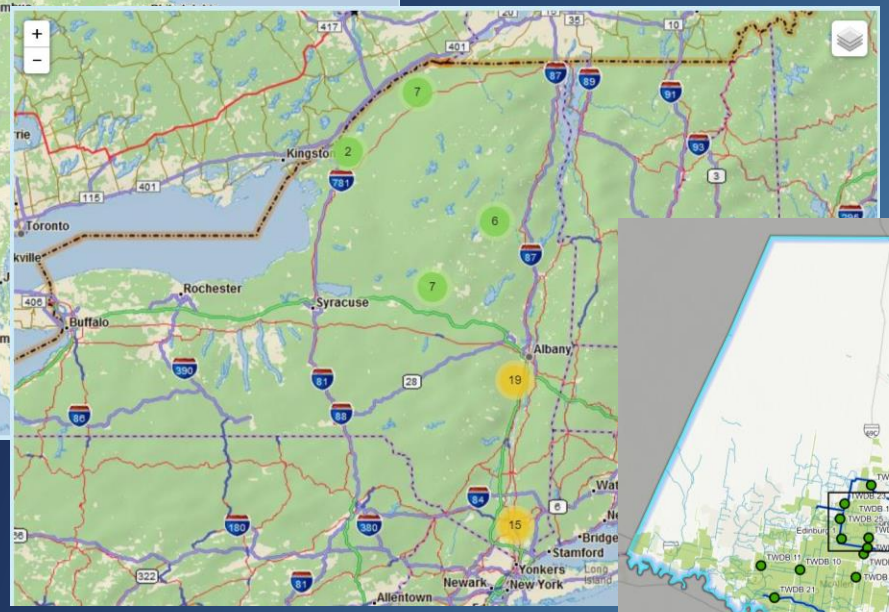
2019

Bill Kirkey's Ph.D completion
-Low-Cost, High Fidelity Sensor Technology Development

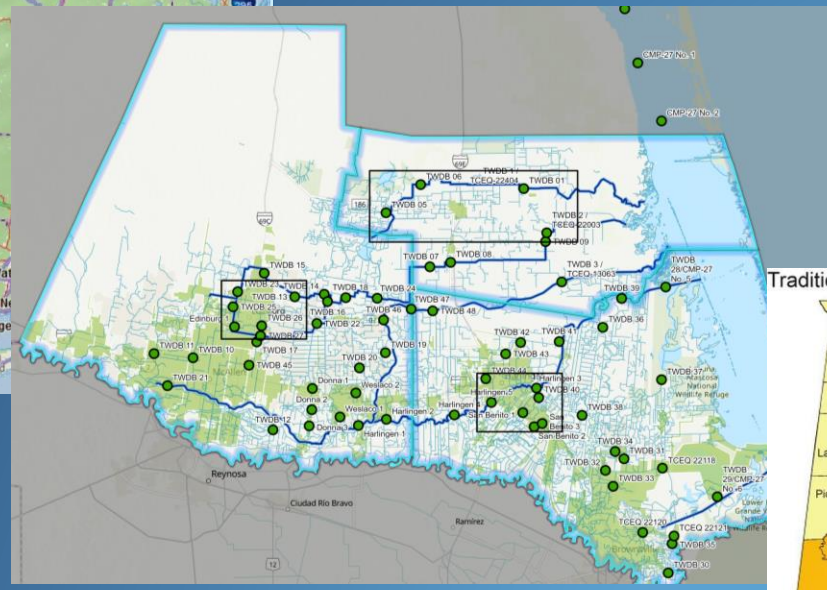
National: 138 (and counting)



New York (66)



South Texas (67)

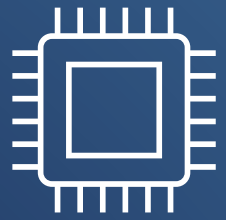


Alabama (5)

The Growing REON Network

Monitoring System Components

- Sensors
- Hardware
- Power
- Telemetry
- Data Management / Dissemination / Application
- Processes (Deployment, Maintenance, Quality Assurance, etc.)



Balancing Commercial Offerings with User Designs

- Historically: User-Integrated
- Today: Commercial Subsystems Available

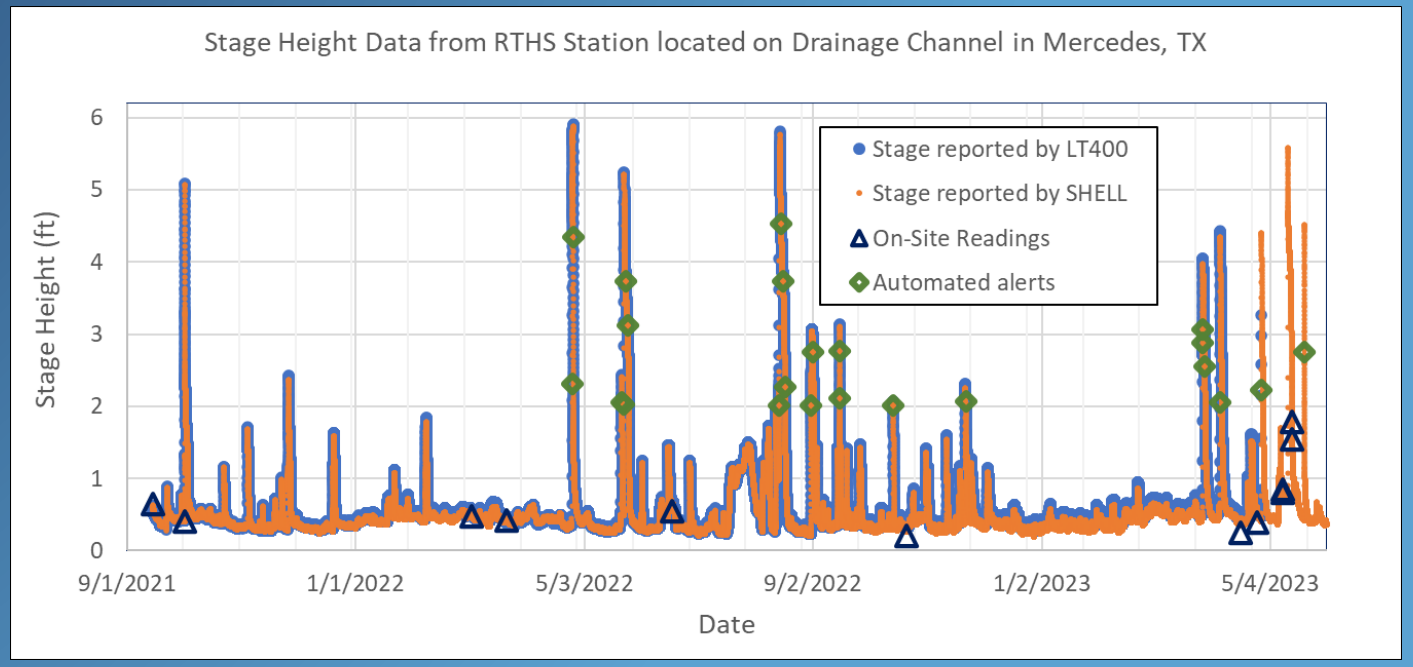
RATES Approach: Use both

Need to balance: Meeting pressing needs v. Long-term cost-effectiveness

- Example Development: Water Level Sensing
  - Needed (2019): Robust water level sensor for LRGV deployments
  - Parallel tracks:
    - 1) Integrate commercial sensor into RTHS for immediate deployment
    - 2) Design and develop custom sensor

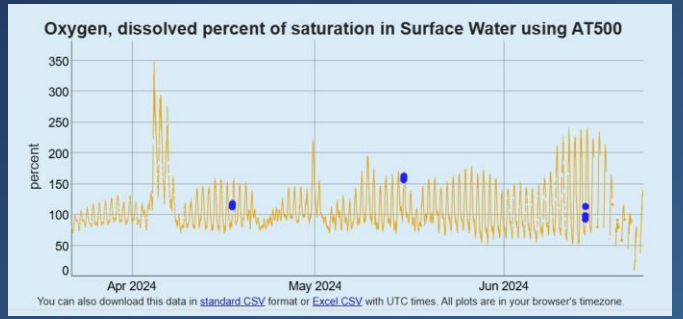
Date	9/14/2021	10/1/2021	3/3/2022	3/22/2022	6/18/2022	10/21/2022	4/17/2023	4/26/2023	5/10/2023	5/15/2023
On-site readings (ft)	0.64	0.40	0.48	0.42	0.55	0.21	0.25	0.39	0.80	1.79
SHELL-reported (ft)	0.64	0.42	0.51	0.43	0.60	0.27	0.37	0.52	0.91	1.91
LT400-reported (ft)	0.64	0.43	0.54	0.42	0.63	0.33	0.46	0.60	None	None

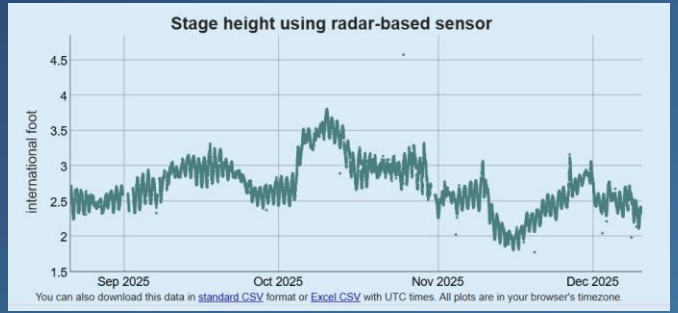
- 2021 – 2023: Side-by-side testing:

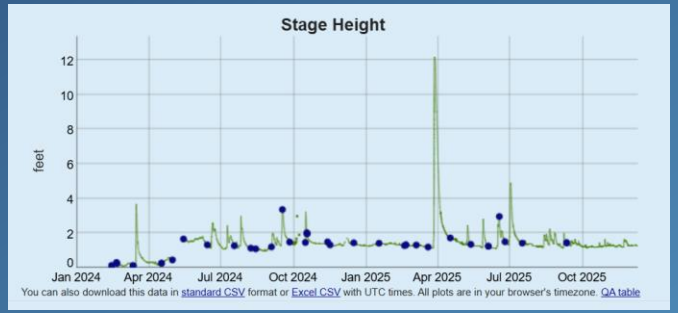


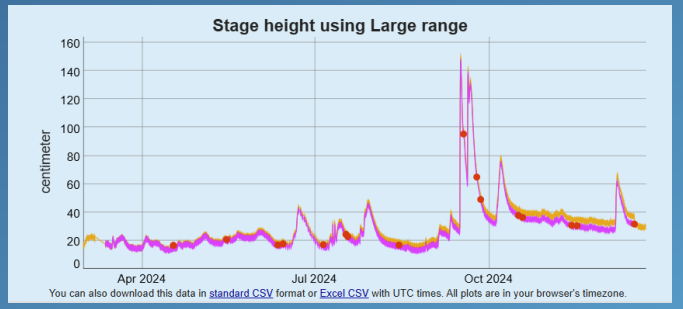
Ongoing Developments

- Integration of additional sensors:
  - Water quality sondes
  - Precipitation gauges
  - Doppler flowmeters
- Integration of data from independent CI platforms
- Water surface elevation above sea level
- QA spot check data integration w/ continuous data
- Drift adjustments
- 60-minute -> 5-minute data blocks
- Partnerships for station operations:
  - Local partner handles on-site activities
  - RATES provides materials, support, cyberinfrastructure

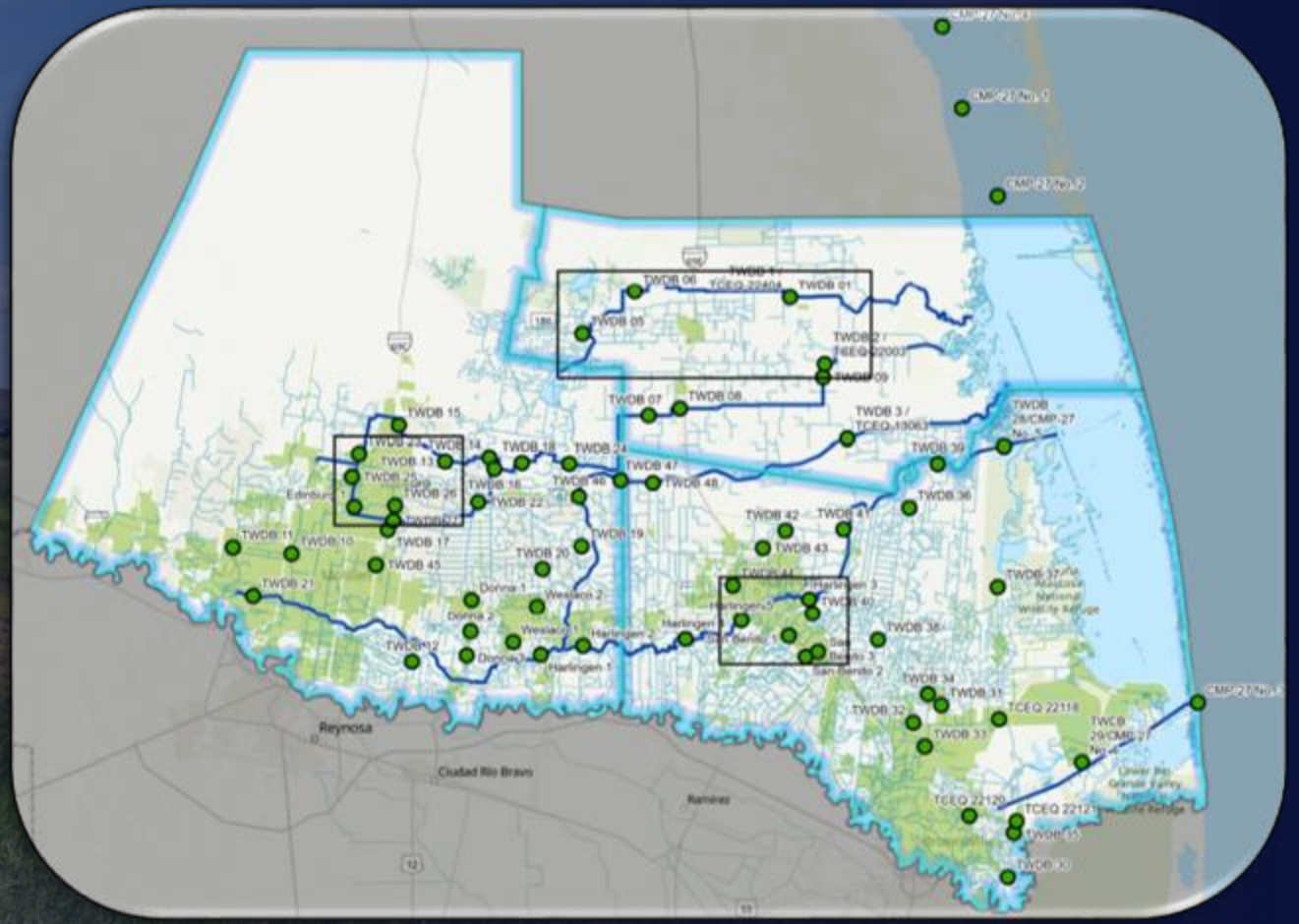








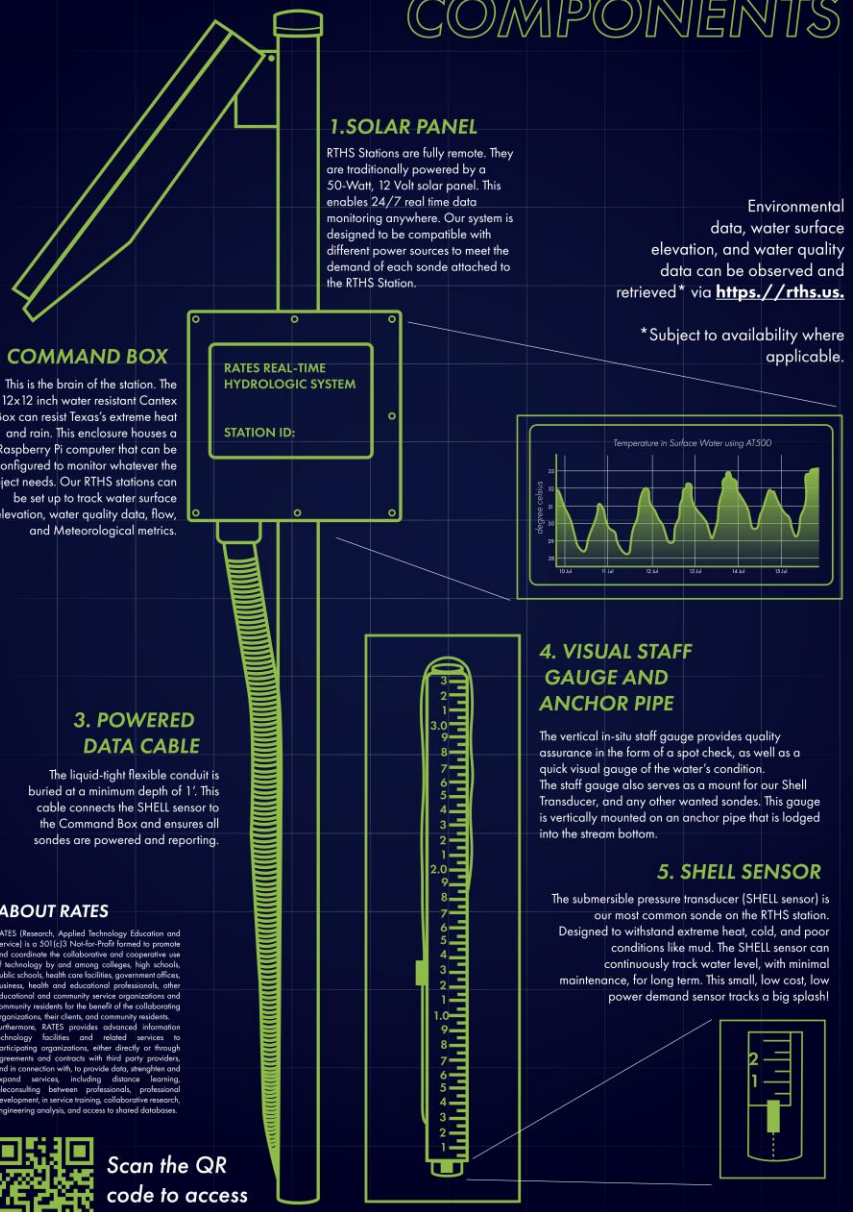
REON RGV



SCAN TO
ACCESS DATA

RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICE

RTHS STATIONS COMPONENTS



1.SOLAR PANEL

RTHS Stations are fully remote. They are traditionally powered by a 50-Watt, 12 Volt solar panel. This enables 24/7 real time data monitoring anywhere. Our system is designed to be compatible with different power sources to meet the demand of each sonde attached to the RTHS Station.

Environmental data, water surface elevation, and water quality data can be observed and retrieved* via **https.//rths.us.**

*Subject to availability where applicable.

2. COMMAND BOX

This is the brain of the station. The 12x12 inch water resistant Cantex Box can resist Texas's extreme heat and rain. This enclosure houses a Raspberry Pi computer that can be configured to monitor whatever the project needs. Our RTHS stations can be set up to track water surface elevation, water quality data, flow, and Meteorological metrics.

3. POWERED DATA CABLE

The liquid-tight flexible conduit is buried at a minimum depth of 1'. This cable connects the SHELL sensor to the Command Box and ensures all sondes are powered and reporting.

4. VISUAL STAFF GAUGE AND ANCHOR PIPE

The vertical in-situ staff gauge provides quality assurance in the form of a spot check, as well as a quick visual gauge of the water's condition.
The staff gauge also serves as a mount for our Shell Transducer, and any other wanted sondes. This gauge is vertically mounted on an anchor pipe that is lodged into the stream bottom.

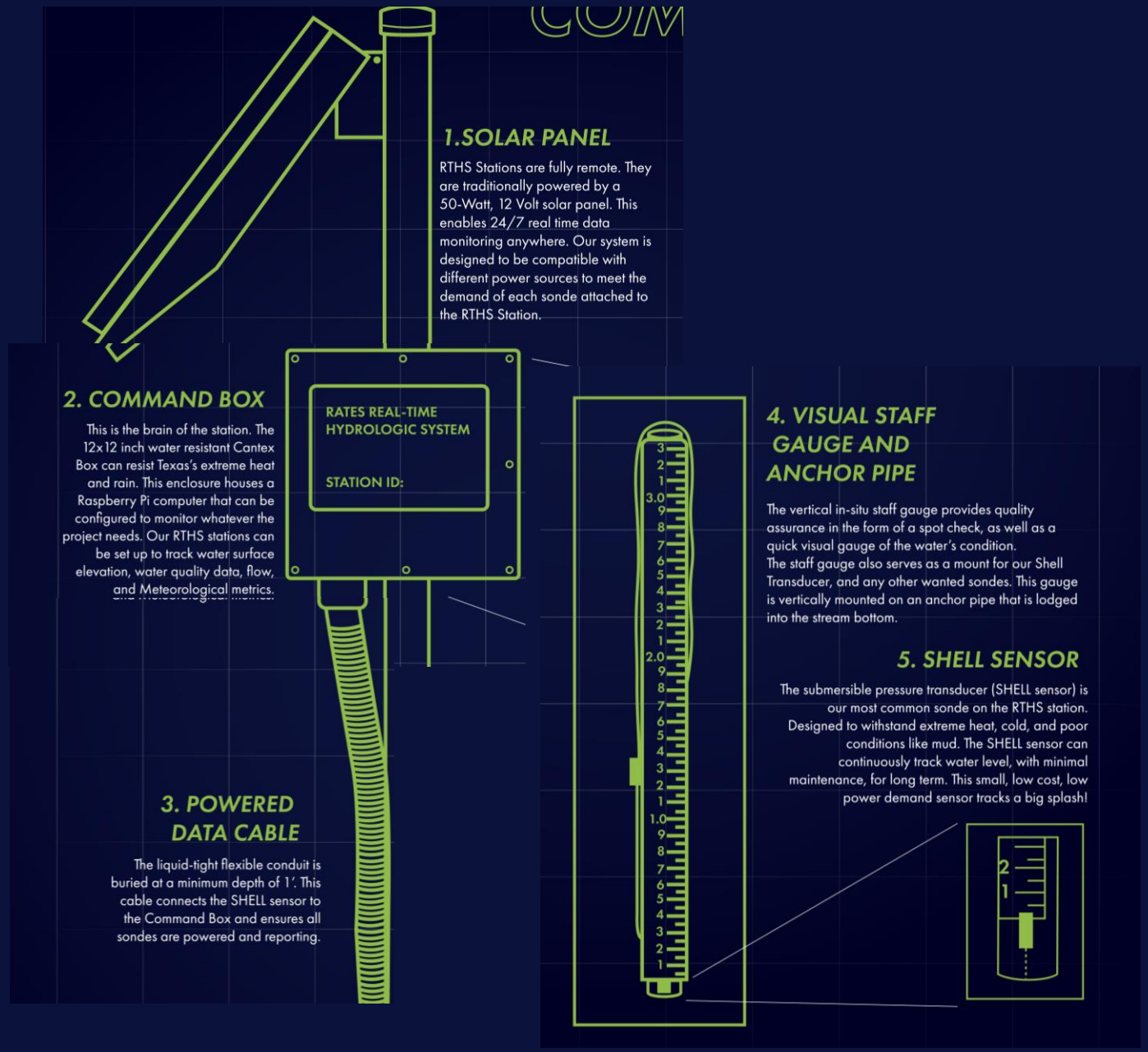
5. SHELL SENSOR

The submersible pressure transducer (SHELL sensor) is our most common sonde on the RTHS station. Designed to withstand extreme heat, cold, and poor conditions like mud. The SHELL sensor can continuously track water level, with minimal maintenance, for long term. This small, low cost, low power demand sensor tracks a big splash!

ABOUT RATES

RATES (Research, Applied Technology Education and Service) is a 501(c)3 Not-for-Profit formed to promote and coordinate the collaborative and cooperative use of technology by and among colleges, high schools, public schools, health care facilities, government offices, business, health and educational professionals, other educational and community service organizations and community residents for the benefit of the collaborating organizations, their clients, and community residents. Furthermore, RATES provides advanced information technology facilities and related services to participating organizations, either directly or through agreements and contracts with third party providers, and in connection with, to provide data, strengthen and expand services, including distance learning, teleconsulting between professionals, professional development, in service training, collaborative research, engineering analysis, and access to shared databases.

Scan the QR code to access RTHS



Where are we now?

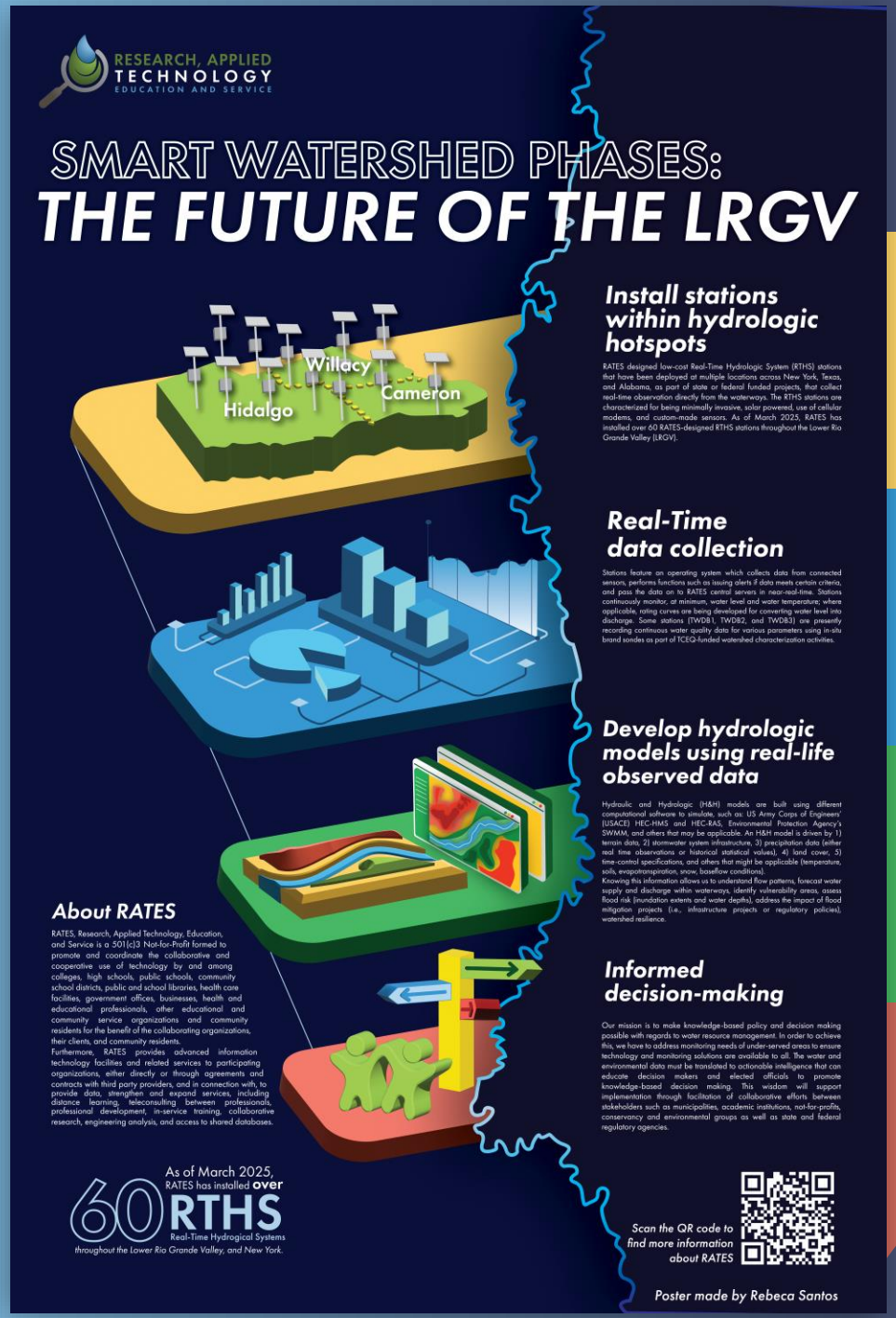
- FIF Project of 44 RTHS stations
- Over 15 other privately funded RTHS Sites
- North and Central Phase I and II
- NOAA GCOOS: HF Radar
- CMP-27
- REON

Road Map

- Department Specialization
- Dumble Drain
- Open Environment
- Open Engineering
- LEAS Solution
- Stormwater Taskforce
- RATES

Collaboration

- Flood Resiliency
- Alert-based app
- FEWS
- TX Expansion
- AI Forecasting
- Real-Time Modeling
- Strategic Partnerships



Democratizing Water Knowledge-Enabled Policy and Decision Making

DATA

Address monitoring needs of under-served areas to ensure technology and monitoring solutions are available to all

INFORMATION

Translate water & environmental data into actionable intelligence

KNOWLEDGE

Educate decision makers and elected officials to promote knowledge-based decision making

WISDOM

Support implementation through facilitation of collaborative efforts between stakeholders such as municipalities, academic institutions, not-for-profits, conservancy & environmental groups as well as state and federal regulatory agencies

The RGV. It's flat!

Flat, engineered watershed

Extremely low slopes, poor soil permeability, and highly modified drains/canals means water doesn’t follow neat, natural basins. Instead, it ponds, backs up, and crosses jurisdictional lines.

Cross-county dependence, unequal capacity

Much of the region’s runoff must move through resource limited Willacy County, while Hidalgo and Cameron have in-house engineering, creating built in equity and coordination challenges.

Patchwork to partnership

With no historic regional water forum, RWAC and RATES were created to provide a neutral watershed coordinator and turn fragmented projects and studies into a unified, regional approach to flood and water management.

Projects in Texas

TWDB LRGV

- Flood Infrastructure Fund (FIF)
- FWF

TCEQ

- TCEQ 319
- North and Central WPP
- Lower Laguna Madre-Brownsville Ship Channel

TXGLO

CMP-27 Lower Laguna Madre

NOAA GCOOS

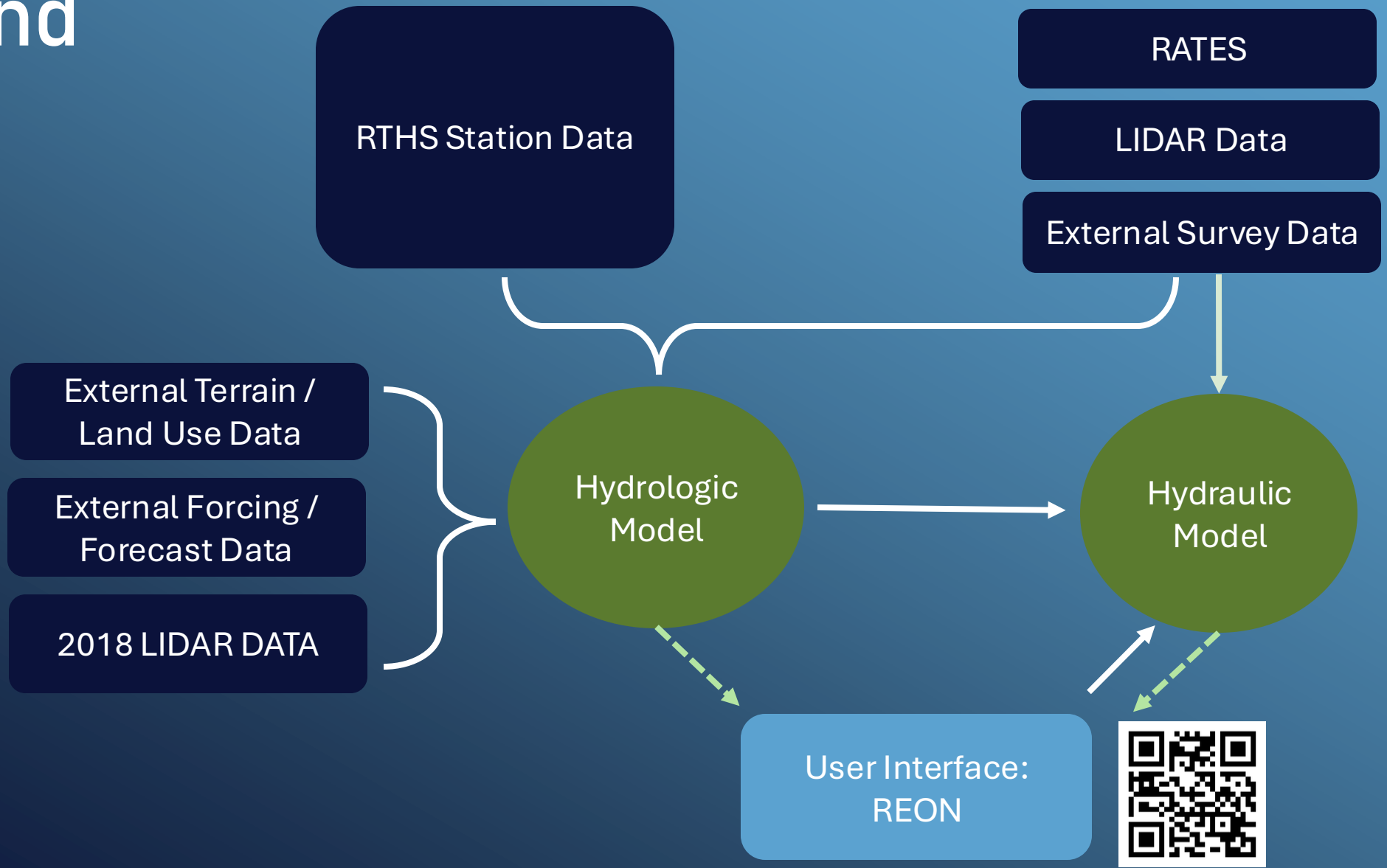
HF Radar

City of Harlingen Hydrologic Unit Code 10 Flood Protection Plan Study

Enhancing Hydrologic Forecasting in the Rio Grande Basin

City-funded projects

TWDB LRGV Flood Infrastructure Fund

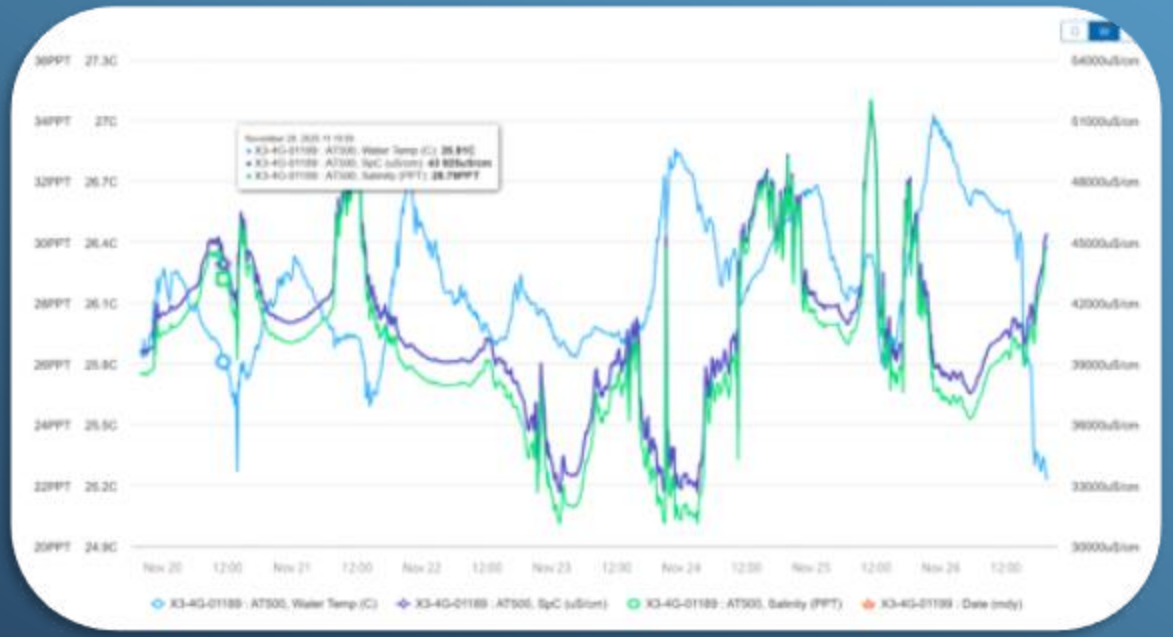


OUTCOME: Flood Resiliency

TGLO CMP-27 Lower Laguna Madre Hydrodynamic Characterization

- **PROJECT LEAD:** Cameron County
- Proposal developed in collaboration with TWDB and USACE
- **TOTAL BUDGET:** $852, 254
- PROJECT DURATION: 24 months

ADTH AT500

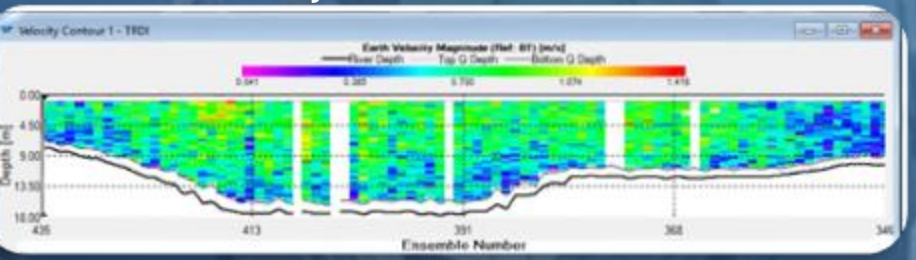


Deploy an integrated hydrodynamic and water-quality monitoring program at six Lower Laguna Madre sites, using existing NOAA CO-OPS infrastructure and two new RTHS stations equipped with continuous CTD and ADCP sensors. The resulting datasets will improve multi-agency models of freshwater inflow, storm surge, oil-spill movement, and non-point-source pollutant transport.

CMP-27 Overview

Data Collection

- Continuous-5 stations
- Quarterly-23 station

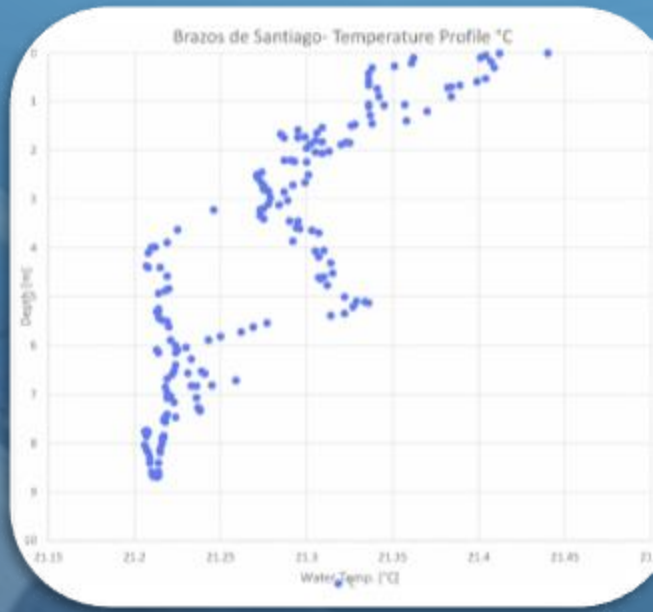


Applications

- Coastal flood, estuarine water quality, coastal infrastructure design

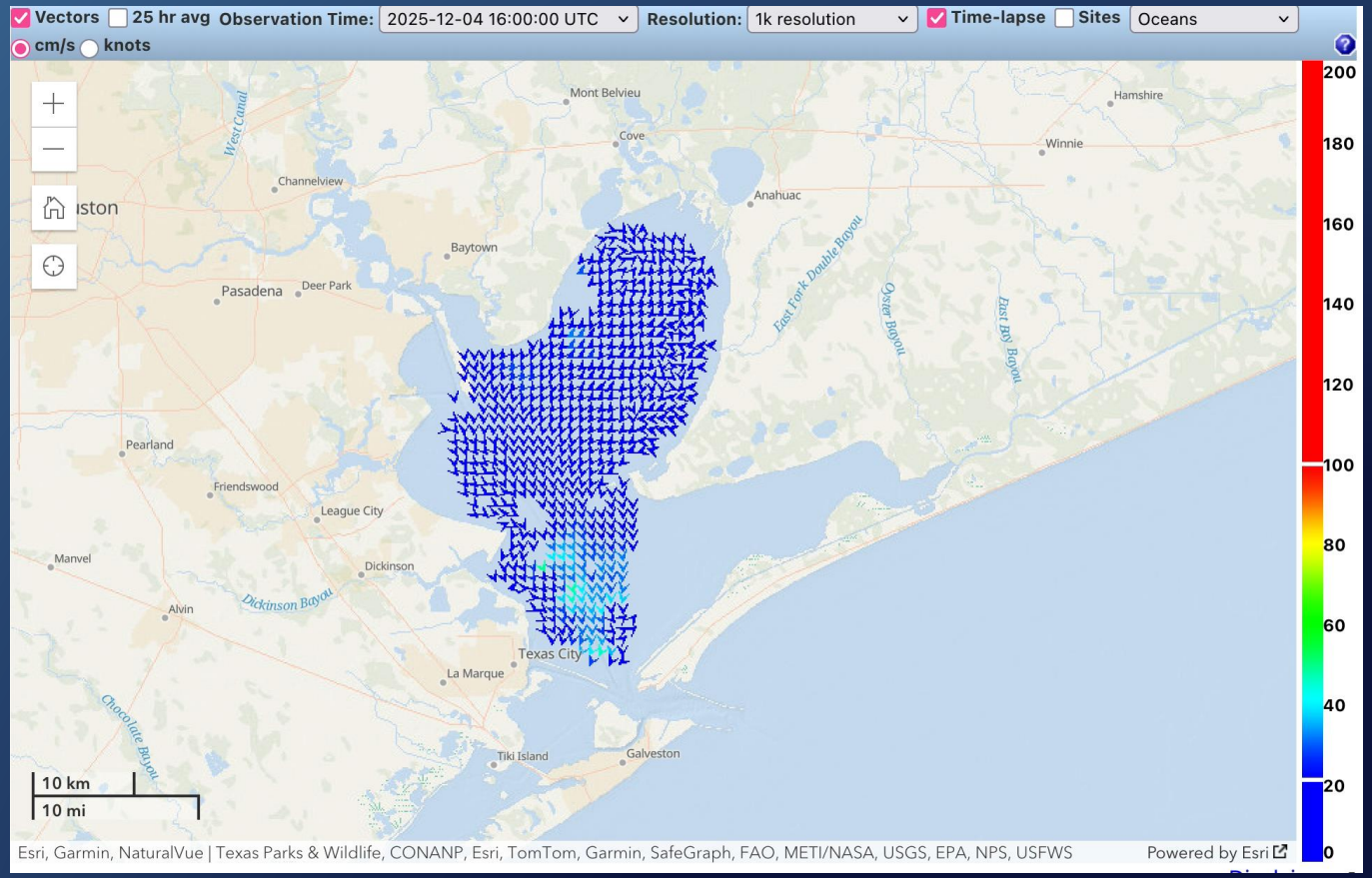
Stakeholders

- TWDB, USACE, USACE, Research



NOAA GCOOS: HF Radar

- Pass through entity: TAMU
- Total: $650,000
- Sept 2024-Aug 2029
- O&M Funding of assets originally commissioned under TGLO CMP-26 PSM
  - Galveston Bay
  - Sabine Lake
  - Asset value: $1,5-million
- Near real-time surface currents and waves (*H, t, direction*)
- Applications:
  - Coastal and combined flood modeling
  - Oil spill and contaminant transport modeling
  - Coastal hydrodynamic characterization and modeling
  - Damage assessment
  - Maritime safety
  - Search and Rescue Operation



SCAN TO OPEN NOAA

RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICES

CODAR CABINET OVERVIEW MCPK,SMPT,PLPI,AND PLA8

Front View, Door Closed

MODEL
5G LTE 02134
C A B I N E T
81"H x 30"W x 34"D
DDB UNLIMITED

SERIAL NUMBERS:

MCPK: 561220458807

SMPT: 561220458809

PLPI: 56122045806

PLA8: 56122045801

Front View, Door Open

DDB unlimited
MT-DD Mtg Shelf
EIA 19", 29" Deep (X3)

SSTX TRANSMITTER

SSTX RECEIVER

SIDE-MOUNTED
ELECTRONICS
BOARD

MONITOR

KEYBOARD

MOUSE

UPS

Top Compartment
NEMA 4 IP66

AMBIENT STORAGE
NEMA 3R IP24

CLIMATE
CONTROL
BARRIER

AMBIENT STORAGE
NEMA 3R IP24

Garmin GA 38
Codar GPS Ant.

West Marine
Dual Axis
Ratchet
Ant. Mount

Right Hand Side View

DBB CAB.
ENCLOSURE
BRKR BOX

KEY LOCKED
KEYS KEPT
IN CABINET

BNC-to-BNC
8' Cable

LTE MODEM ANT.

BNC CABLE
SIDE ENTRY
COWLING

LTE LIGHTNING
SUPPRESSION
PANEL LOCATED
INSIDE BOX

Ground Wire
connects to
Buss Bar in
side box

Insulated 6AWG
Stranded Cu
Ground Wire

NvENT PENTAIR N28
AC/HEATER UNIT
110VAC 4000 BTU
SERIAL No.s

MCPK: 22006360-11-A

SMPT: 22003895-10-A

PLPI: 22006540-11-A

PLA8: 22006543-11-A

28.5"
Ø0.875
30"
Cabinet
Pad Eye
Hole
Pattern

CONTROLS HEATER
GENERALLY SET
TO 55d F

CONTROLS
CONDENSOR,
BLOWER &
COMPRESSOR

GENERALLY
SET
TO 70d F

NvENT THERMOSTAT

DDB PART NO.
ZP-20D-MTFT-W
PAD MTG. FT. (X4)

Sigma ProConnex
5/8 Bronze Clamp
P/N 49163 (Lowes)

Galvan P/N 70850
.625" x 8' Cu Gnd Rod
(Lowes)

For internal distribution and client perusal only. This document is not cleared for general release

CMP-26
RATES.org
HF Radar
Texas Bays

C O D A R
Five Station
Drawing Set

East
Galveston
Bay and
Sabine
Lake

Illustrations
reflect status
as of one year
operational
January 2024

RATES RGV
P.O. Box 697
Edinburg, TX
78540

www2.ratesresearch.org
Rev B Drawing Set
Illustrator: Mitch S.

City of Harlingen HUC 10 Flood Protection Plan Study

- **PROJECT LEAD:** City of Harlingen
- **SCOPE**: 5 RTHS Stations upgraded to monitor precipitation and other meteorological parameters along the Arroyo Colorado. Transects and discharge measurements to follow.
- Precipitation Density data gap

TIFF and RATES

Observations & Monitoring Fill Priority Gaps

Waves and nearshoring conditions

LONG TERM
Texas Flood Hazard Quilt
FEMA Estimated Base Flood Elevation
FEMA National Flood Hazard Layer
Flood Factor

SHORT TERM
TxGio Flood Viewer
TWDB TexMesonet
Flood Decision Support Toolbox
USGS Texas Water Dashboard

FIF GIS Data Hub
RGV Flood Water Wizard
WQ2 Data Live Integration
Scada integration
Del Rio
REON

NOAA GCOOS
HF Radar
FIF Task I
ADVs
CMP-27

USGS TIFF
Coastal Data Surfer (CDS)

Keep data sets findable and consistent

Bathymetry / Topobathy refresh

CMP-27 Transects from Costal RTH Stations

NOAA GCOOS
HF Radar
CMP-27WQ
Data Live

Catalog & API's

Texas Integrated Flooding Framework

Data Management, Standards and Discoverability

Waves and nearshoring conditions

Keep data sets findable and consistent

Bathymetry / Topobathy refresh

NOAA GCOOS HF Radar
FIF Task I ADV
CMP-27

Catalog & API's

FIF GIS Data Hub
RGV Flood
Water Wizard
WQ2 Data Live
Integration
TDIS
REON

SHORT TERM
TxGio Flood Viewer
TWDB Tex Mesonet
Flood Decision Support Toolbox
USGS Texas Water Dashboard

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Coastal Data Surfer (CDS)

LONG TERM
Texas Flood Hazard Quilt
FEMA Estimated Base Flood Elevation
FEMA National Flood Hazard Layer
Flood Factor

CMP-27 work/ Transect

NOAA GCOOS
HF Radar
CMP-27WQ
Data Live

Texas Integrated Flooding Framework

Science and Tools Library

Waves and nearshoring conditions

Keep data sets findable and consisten t

Bathymetry / Topobathy refresh

FIF GIS Data Hub
RGV Flood Water Wizard
WQ2 Data Live Integration
Scada integration Del Rio
REON

NOAA GCOOS HF Radar
FIF Task I ADV
CMP-27

SHORT TERM

- TxGIO Flood Viewer
- TWDB TexMesonet
- Flood Decision Support Toolbox
- USGS Texas Water Dashboard

LONG TERM

- Texas Flood Hazard Quilt
- FEMA Estimated Base Flood Elevation
- FEMA National Flood Hazard Layer
- Flood Factor

- NOAA GCOOS HF Radar
- CMP-27 WQ Data Live
- Water Wizard
- REON

CMP-27 work/ Transect

Catalog & API's

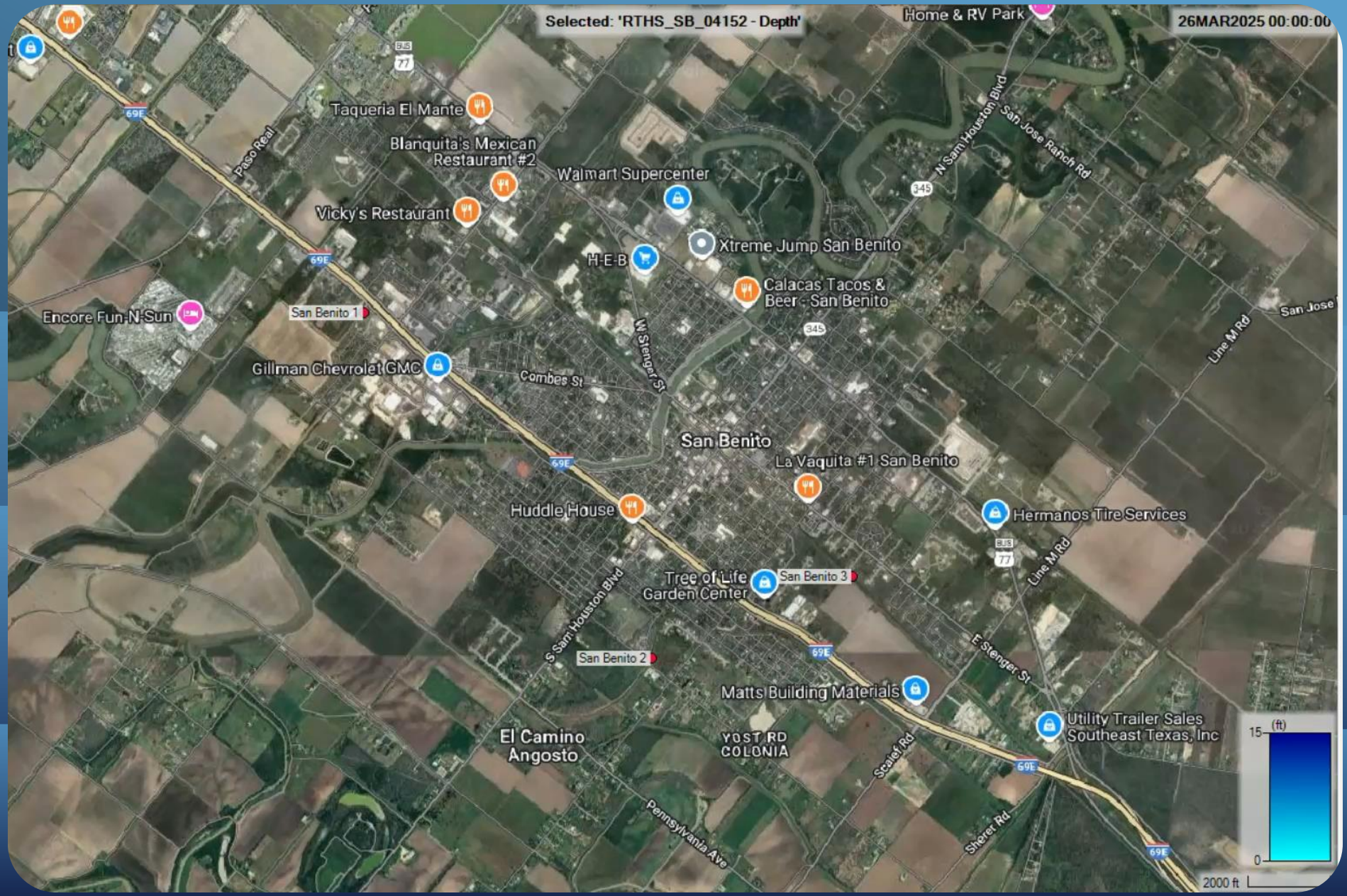
UzSGS TIFF Coastal Data Surfer (CDS)

Texas Integrated Flooding Framework

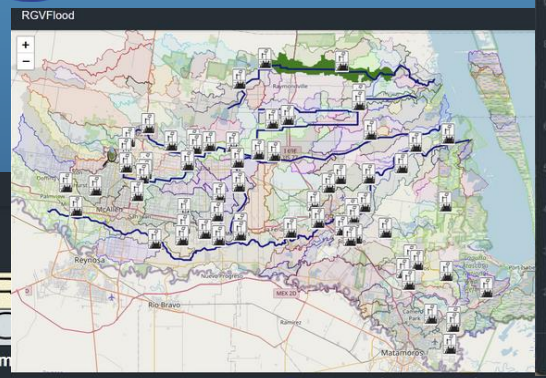
- AI
- Open-Source Community
- Commercialization
- TDIS
- Research Partnerships
- ...

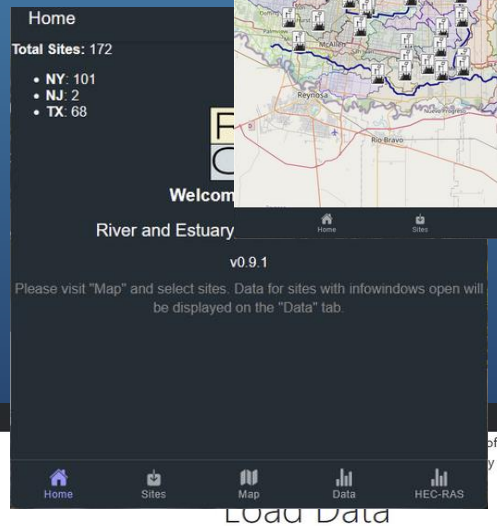
Where do we want to go?

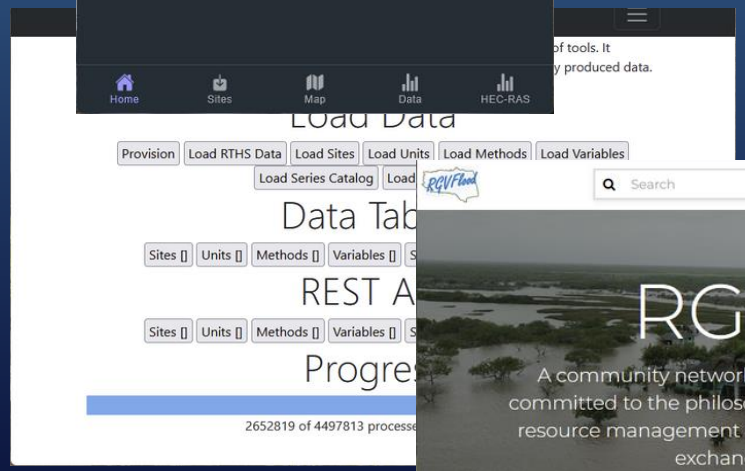
FLOOD MITIGATION PROJECT DEVELOPMENT



WATER WIZARD







STC3
South Texas Coastal County Consortium
est. 2023

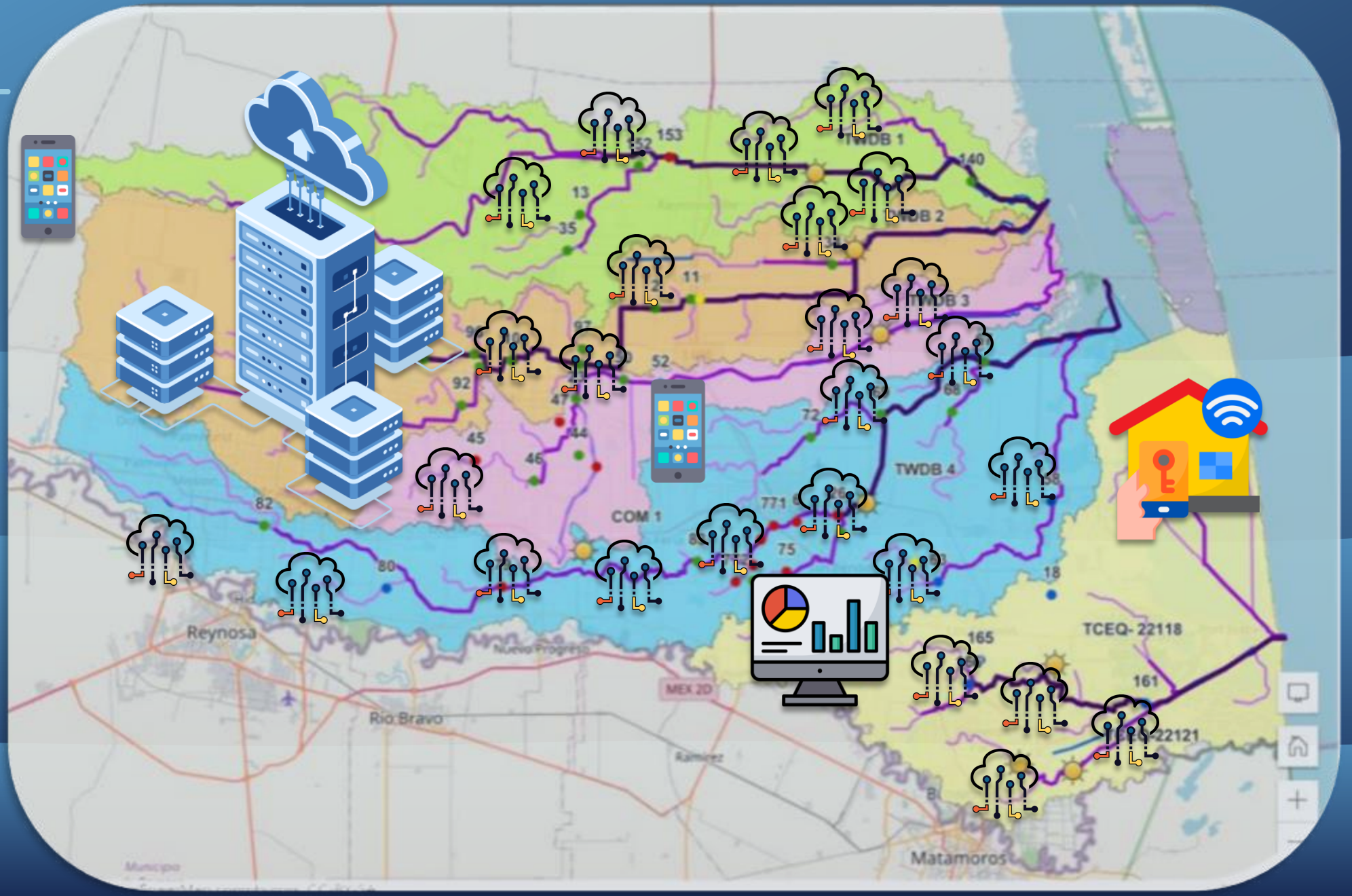
Rio Grande Valley Stormwater
Management

Network AI

A True Intelligent Watershed

Data Center HPC
Regional Intelligence

Intelligent RTHS
Local Intelligence



Pending FMS Application: LRGV Regional Flood Early Warning System (FEWS)

Application Development

Based on $5M Cameron County FEWS included in 2024 State Flood Plan

RATES:

- Proposed to Cameron County: Leverage existing RTHS network for FEWS Purposes
  - Expand scope to include Hidalgo and Willacy Counties
  - Reduce budget to $3M
- Worked with Task Force to promote regional coordination
- Worked with Cameron County to develop applications
  - Abridged Application: April 2024; Full Application: November 2024

Project Scope

- Stakeholder Engagement on FEWS Implementation Design
  - Focus: First Responders, Public Works Personnel
- RTHS Siting/Installation/Commissioning
  - Not-yet-monitored sites for which data would be impactful
  - Transition station "ownership" to local stakeholders
- Cyberinfrastructure Development
  - Back-End: Implementation and testing of FEWS capabilities on FEWS-focused implementation of existing CI
    - Automated validation of alert conditions using data from multiple stations
  - Front-End: Delivery of FEWS alerts/information to Target Users
  - Long-Term Sustainability: Develop platforms and documentation facilitating O&M of stations by local stakeholders

Pending FME Application: Developing a Regional Master Drainage Plan for Cameron and Hidalgo County

Abridged FME Application submitted April 2024 (FIF SFY 2024-2025 funding cycle)

- Basis: Cameron County Holistic HUC Flood Protection Study from 2024 State Flood Plan
- RATES:
  - Recommended inclusion of Hidalgo Co.
  - Worked with Cameron County on application development
  - Worked with Task Force to engage communities
- Budget: $13M
- TWDB prioritization (Feb. 2025): #6/203 statewide FMEs

Project Goals

- Holistic Data-Driven Analysis for Every Community
- Systematic Flood Risk Mapping and Capital Improvement Planning
- Implementing a Coordinated, System-Based Approach for Maximum Regional Benefit

What do we need?

- Investment
- Transferability
- Sustainability
  - Partnerships
  - Commercialization
- …

Cameron County proposes:

ACWIRRED

An Institute for

Applied **C**oastal **W**ater **I**ntelligence for **R**egional **R**esilience and **E**conomic **D**evelopment

RE ON

RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICE

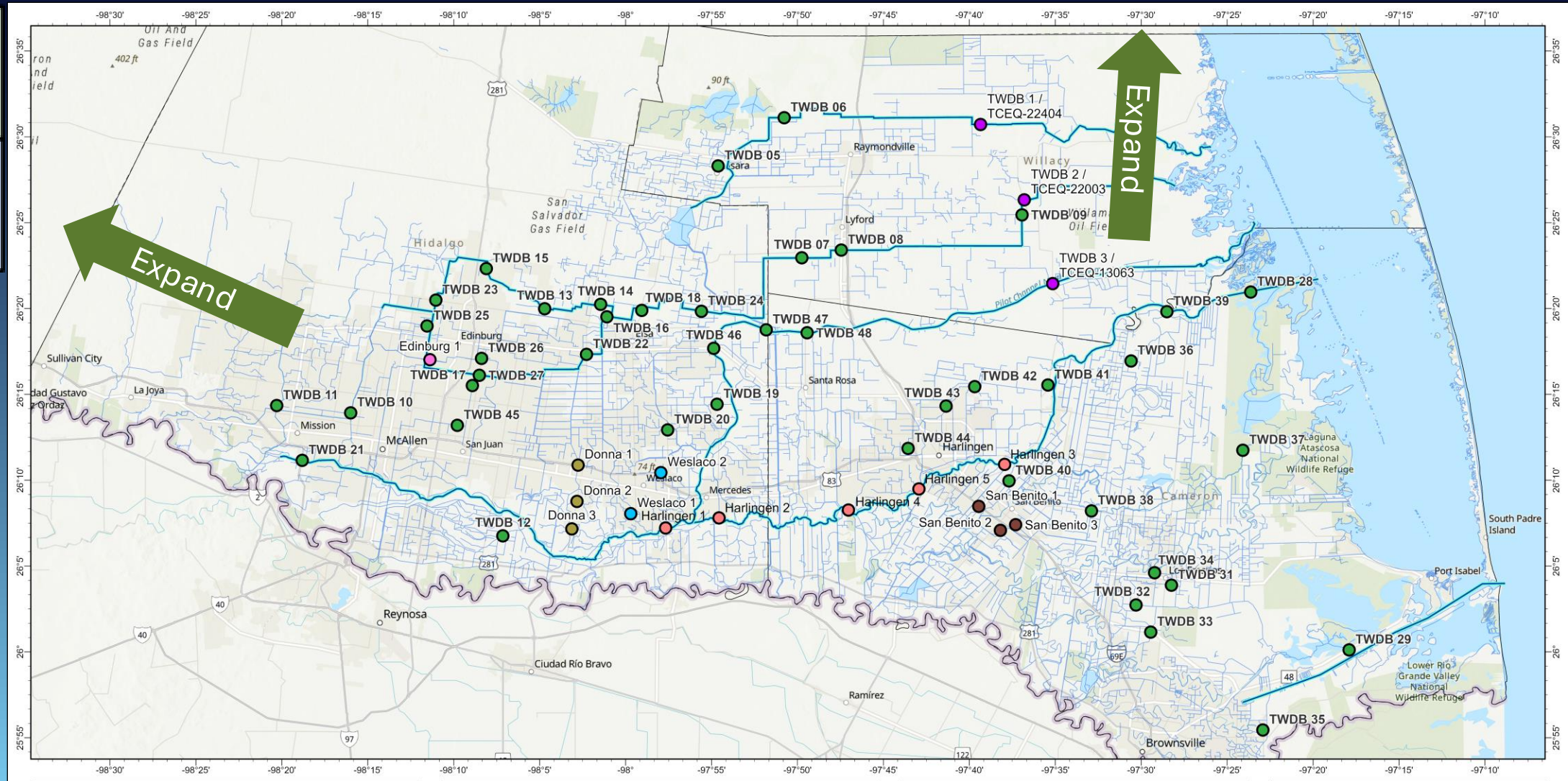
Rio Grande Valley Stormwater Management Founded 1998

THE COUNTY OF CAMERON STATE OF TEXAS

RGV

Coastal

Rio Grande Basin



TITLE:

Real-Time Hydrologic System (RTHS) Stations in the Rio Grande Valley

PRODUCED BY:

RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICE Rio Grande Valley

SYMBOLOGY

- CSE
- FIF
- City of Donna
- City of San Benito
- City of Weslaco
- City of Edinburg
- North & Central Phase 2
- Major Waterways
- LRGV Counties
- Streams

DETAILS

RTHS stations distributed in the Rio Grande Valley:
-CSE: 5 stations
-FIF: 44 stations
-Donna: 3 stations
-San Benito: 3 stations
-Weslaco: 2 stations
-Edinburg: 1 station
-N&C Phase II: 3 stations

GRAPHIC SCALE:

0 3.5 7 14 Miles

SCALE:

1 : 390,000

N

Value Proposition

Applied Research

- The Need:

  Workforce Development ⟲ Industry Recruitment

- The Niche:

  Embrace the 4th Industrial Revolution

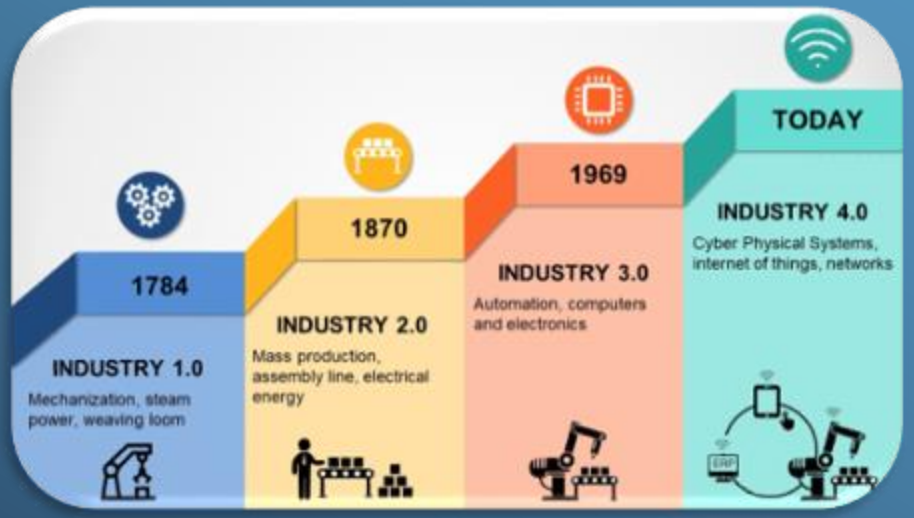
- The Engine:

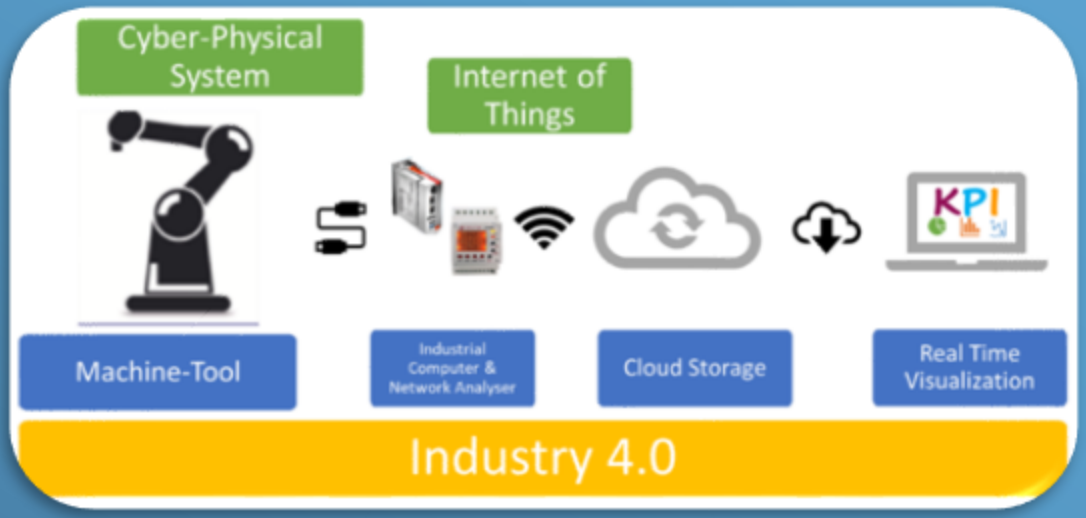
  Institute for Regional Resilience & Economic Development

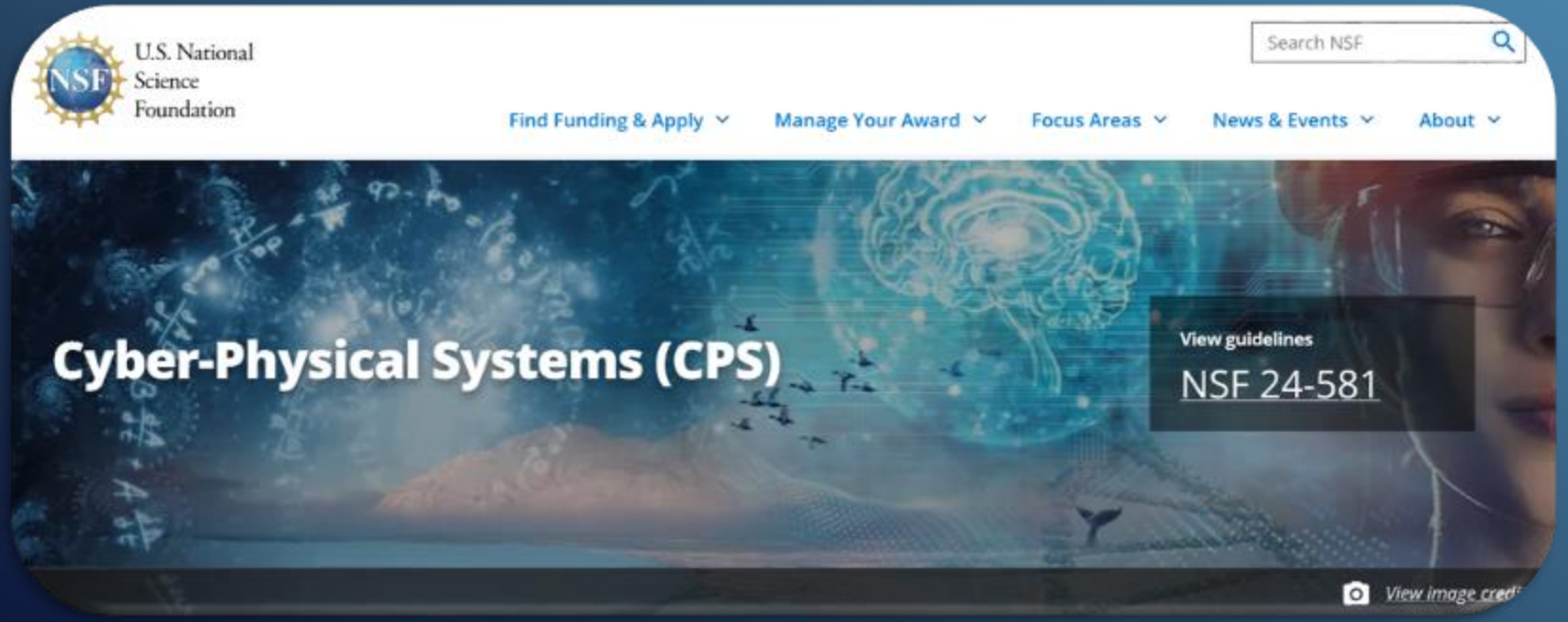
Academy

Accelerator

Extension


1784
INDUSTRY 1.0
Mechanization, steam power, weaving loom
1870
INDUSTRY 2.0
Mass production, assembly line, electrical energy
1969
INDUSTRY 3.0
Automation, computers and electronics
TODAY
INDUSTRY 4.0
Cyber Physical Systems, internet of things, networks


Cyber-Physical System
Internet of Things
KPI
Machine-Tool
Industrial Computer & Network Analyser
Cloud Storage
Real Time Visualization
Industry 4.0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Cyber-Physical Systems (CPS)
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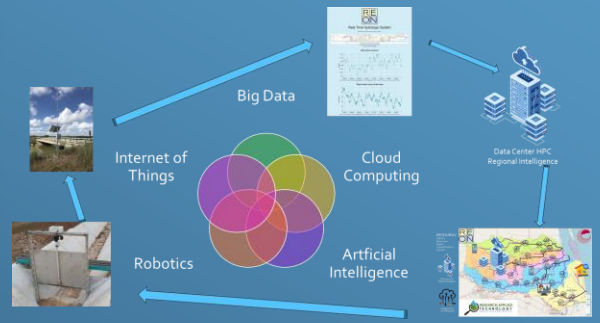
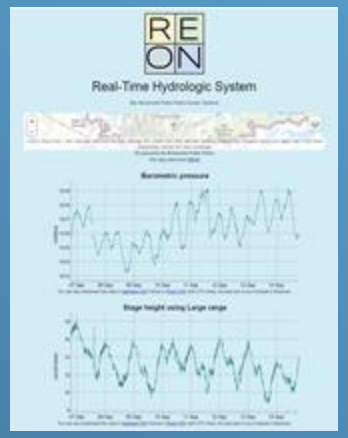

Big Data
Internet of Things
Cloud Computing
Robotics
Artficial Intelligence

ACWIRRED

Cyber-Physical Systems



Big Data

Data Center HPC
Regional Intelligence

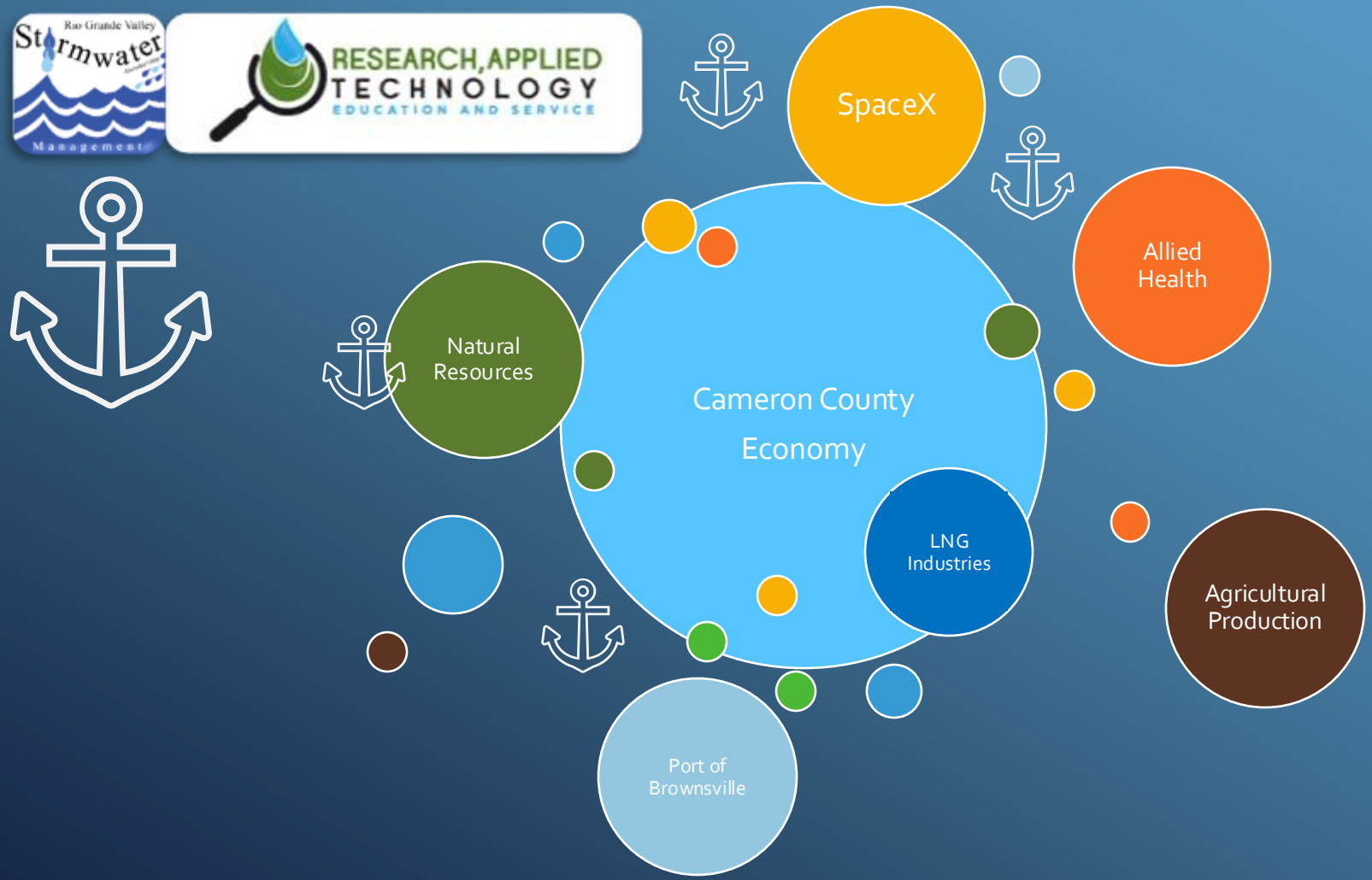
Cloud Computing

Artficial Intelligence

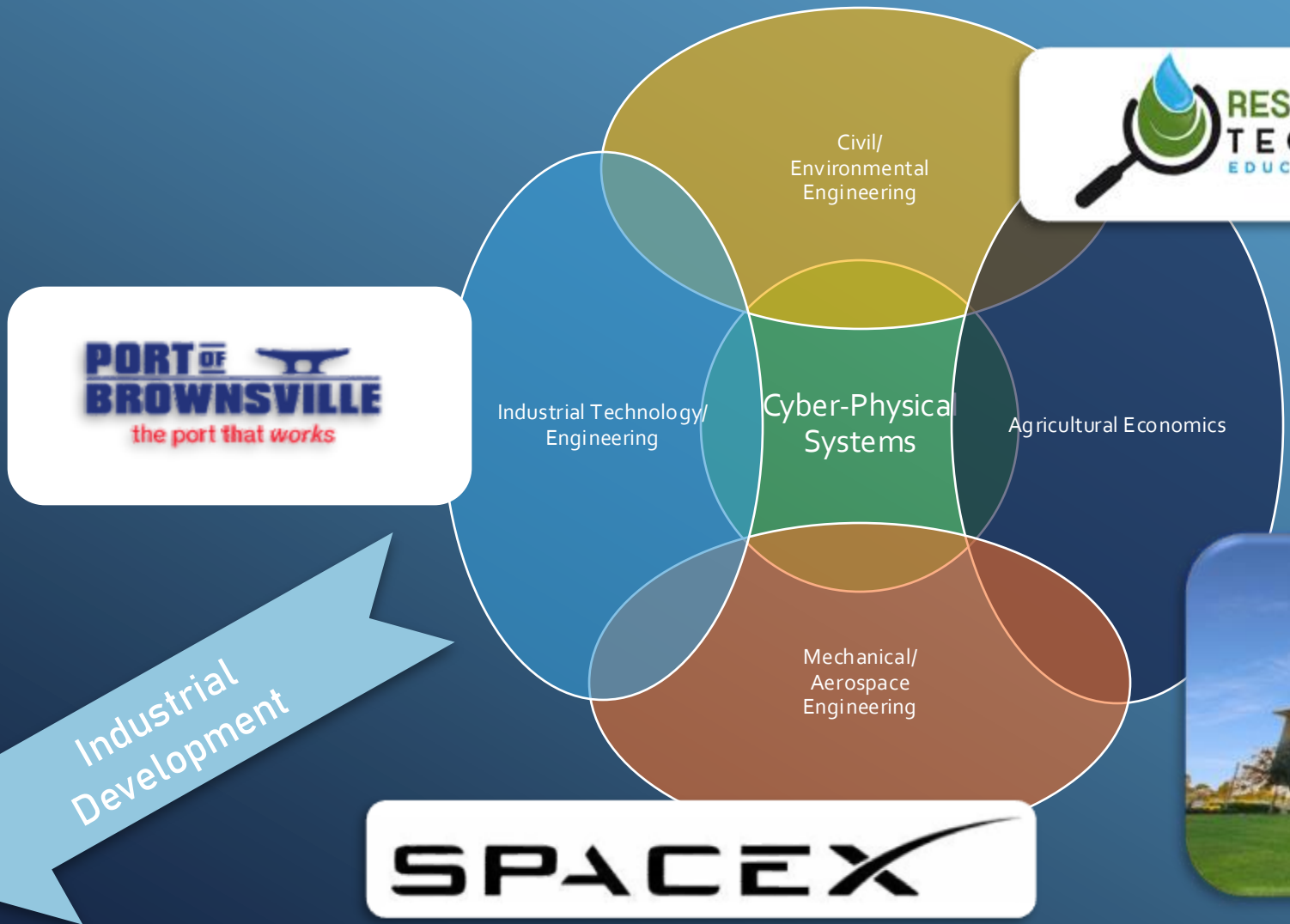
Robotics

Internet of Things

Key County Economic Drivers



Workforce Needs



RESEARCH, APPLIED TECHNOLOGY
EDUCATION AND SERVICE

PORT OF BROWNSVILLE
the port that works

SPACEX

Resource Resiliency

Industrial Development

Academic Model . . .

Circa 1990's
TGLO-TAMUS Ph.D. Pipeline
Oil Spill

Ph.D. {Cyber-Physical}
TAMU / UT

M.S.
Cyber-Physical
[2+3]

TSTC

TSC

SCI

M.S.
Cyber-Physical
[4+1]

TAMU/HEC

UTRGV

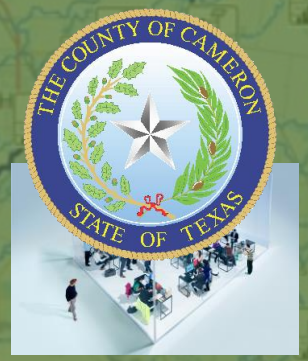
TAMUK

New Program

Leveraging REON/RGV

TAMU
Higher Education Center

New
Programs



ACWIRRED

Core

Fundamentals of Big Data
Fundamentals of Cloud Computing
Fundamentals of Artificial Intelligence
Fundamentals of Robotics
The Internet Of Things

Concentration

Civil/Environmental Engneering	Mechanical/ Aerospace Engineering	Agricultural Economics	Industrial Technology/ Engineering

Research
Technology Extension/Start-Ups
Workforce Development

Economic Consequences of Coastal Storm Surge

Agriculture

Industry

New Students

Technology Need

Industry Professors of Practice

Innovation

Theses Dissertations

Engaged Workforce

Institute Acceleration Model

THE COUNTY OF CAMERON
STATE OF TEXAS

Rio Grande Valley Stormwater Management
Founded 1998

RESEARCH, APPLIED TECHNOLOGY
EDUCATION AND SERVICE

Open Environment, LLC

RGVFlood

CYBER-PHYSICAL SYSTEM FOR REGIONAL FLOOD MANAGEMENT

O E

Open Engineering, PLLC

LEAS Solutions, LLC

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Chief Research Officer
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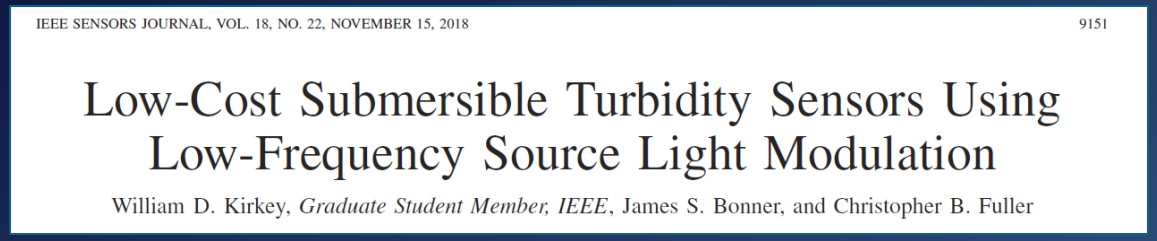
Presentation created by Emily Ernest and Rebeca Santos

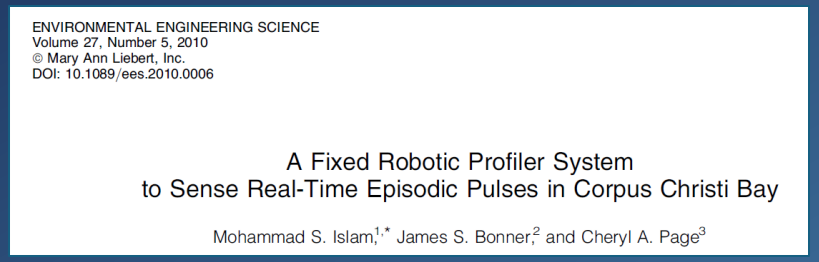
Assorted Publications



IEEE SENSORS JOURNAL, VOL. 18, NO. 22, NOVEMBER 15, 2018 9151

Low-Cost Submersible Turbidity Sensors Using Low-Frequency Source Light Modulation

William D. Kirkey, *Graduate Student Member, IEEE*, James S. Bonner, and Christopher B. Fuller



ENVIRONMENTAL ENGINEERING SCIENCE
Volume 27, Number 5, 2010
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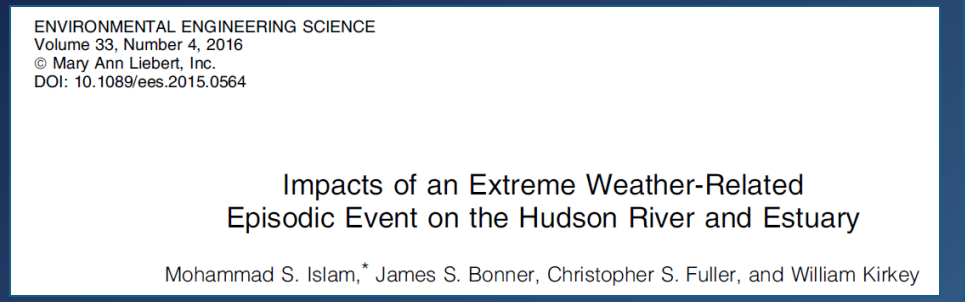
DOI: 10.1089/ees.2010.0006

A Fixed Robotic Profiler System to Sense Real-Time Episodic Pulses in Corpus Christi Bay

Mohammad S. Islam,[1,*] James S. Bonner,[2] and Cheryl A. Page[3]



ENVIRONMENTAL ENGINEERING SCIENCE
Volume 33, Number 4, 2016
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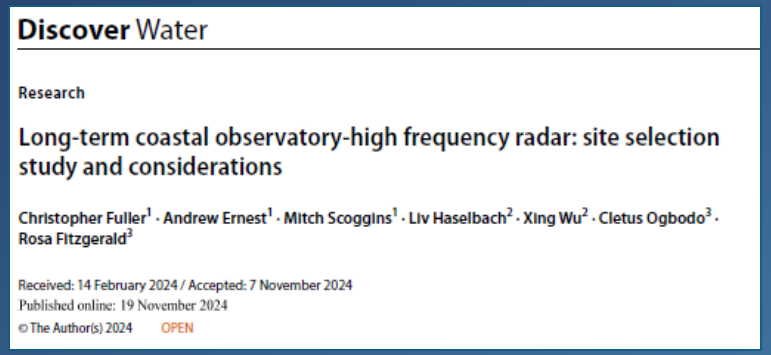
DOI: 10.1089/ees.2015.0564

Impacts of an Extreme Weather-Related Episodic Event on the Hudson River and Estuary

Mohammad S. Islam,* James S. Bonner, Christopher S. Fuller, and William Kirkey



Discover Water

Research

Long-term coastal observatory-high frequency radar: site selection study and considerations

Christopher Fuller[1] · Andrew Ernest[1] · Mitch Scoggins[1] · Liv Haselbach[2] · Xing Wu[2] · Cletus Ogbodo[3] · Rosa Fitzgerald[3]

Received: 14 February 2024 / Accepted: 7 November 2024
Published online: 19 November 2024
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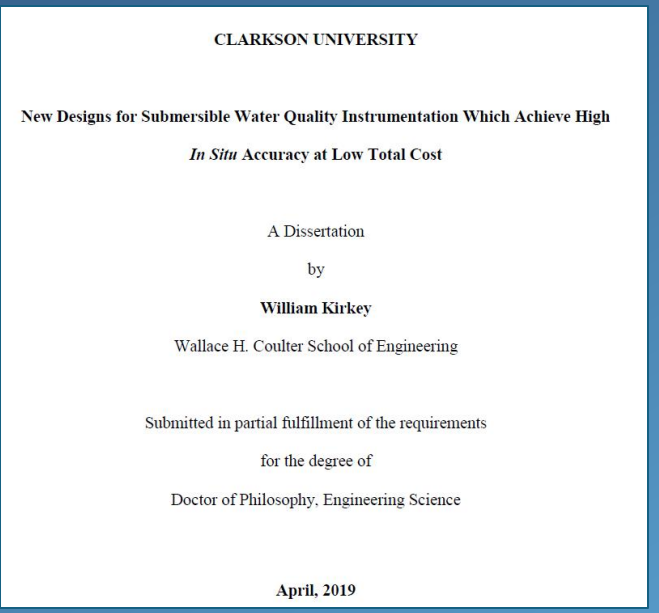


CLARKSON UNIVERSITY

New Designs for Submersible Water Quality Instrumentation Which Achieve High *In Situ* Accuracy at Low Total Cost

A Dissertation

by

William Kirkey

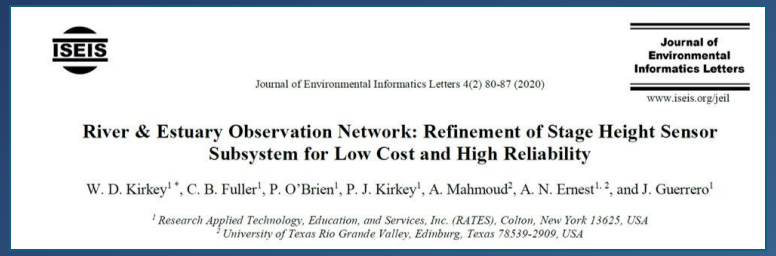
Wallace H. Coulter School of Engineering

Submitted in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy, Engineering Science

April, 2019



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Journal of Environmental Informatics Letters

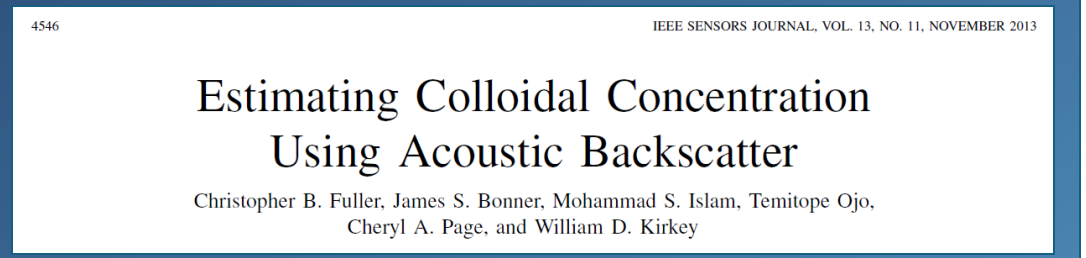
Journal of Environmental Informatics Letters 4(2) 80-87 (2020)

www.iseis.org/jeil

River & Estuary Observation Network: Refinement of Stage Height Sensor Subsystem for Low Cost and High Reliability

W. D. Kirkey[1 *], C. B. Fuller[1], P. O'Brien[1], P. J. Kirkey[1], A. Mahmoud[2], A. N. Ernest[1, 2], and J. Guerrero[1]

[1] *Research Applied Technology, Education, and Services, Inc. (RATES), Colton, New York 13625, USA*
[2] *University of Texas Rio Grande Valley, Edinburg, Texas 78539-2909, USA*



4546 IEEE SENSORS JOURNAL, VOL. 13, NO. 11, NOVEMBER 2013

Estimating Colloidal Concentration Using Acoustic Backscatter

Christopher B. Fuller, James S. Bonner, Mohammad S. Islam, Temitope Ojo, Cheryl A. Page, and William D. Kirkey