

REON/RGV

Innovative

Sustainable

Replicable

Extensible

Comprehensive

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

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Research Engineer

Rebeca Santos Chavez
Communications and Outreach Associate



**RESEARCH, APPLIED
TECHNOLOGY**
EDUCATION AND SERVICE

CONTENTS

- About Research, Applied Technology, Education, and Service (RATES, Inc)
- About River & Estuary Observation Network (REON)
- LRGV Flood Management
- REON/RGV Innovation in Practice:
 - Current
 - Pending
 - Planned
- Water Wizard



RESEARCH, APPLIED
TECHNOLOGY
EDUCATION AND SERVICE



SMART WATERSHED PHASES: THE FUTURE OF THE LRGV



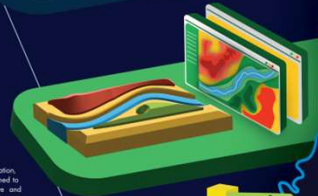
Install stations within hydrologic hotspots

RATES designed low-cost Real-Time Hydrologic System (RTHS) stations that have been deployed at multiple locations across New York, Texas, and Arkansas, as part of state or federal funded projects, that collect real-time observation directly from the waterways. The RTHS stations are characterized for being minimally invasive, solar powered, use of cellular modems, and custom-made sensors. As of March 2025, RATES has installed over 50 RATES-designed RTHS stations throughout the Lower Rio Grande Valley (LRGV).



Real-Time data collection

Stations feature an operating system which collects data from connected sensors, performs functions such as timely alerts if data exceeds certain levels, and pass the data on to RATES central servers in near-real-time. Stations continuously monitor at minimum, water level and water temperature, where applicable, using sensors are being developed for computing water level into discharge. Some stations (TWIS, TWIS2, and TWIS3) are primarily recording continuous water quality data for various parameters using in-situ bonded sondes as part of USGS funded watershed characterization activities.

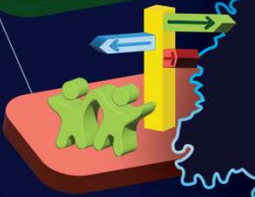


Develop hydrologic models using real-time observed data

Hydrologic and Hydrologic (HSM) models are built using different computational software to simulate, such as US Army Corps of Engineers' SWAN2, HEC-RAS, and HEC-HMS. Environmental Protection Agency's SWAN, and others that may be applicable. An HSM model is driven by 1) basin data, 2) stormwater system infrastructure, 3) precipitation data (rain) and time observations on historical reported events, 4) land cover, 5) flow control specifications, and others that might be applicable (temperature, water temperature, river bankline condition). Knowing this information allows us to understand flow patterns, forecast water supply and discharge within watersheds, identify vulnerable areas, assess flood risk (inundation extent and water depths), address the impact of flood mitigation projects (e.g., infrastructure projects or regulatory policies, watershed resilience).

About RATES

RATES, Research Applied Technology Education and Service is a 501(c)(3) Non-Profit funded to promote and coordinate the collaborative and cooperative use of technology by and among colleges, high schools, public schools, community school districts, public and school libraries, 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, equipment and related services, including distance learning, teleconferencing between professional, professional development, technical training, collaborative research, engineering analysis, and access to shared databases.



Informed decision-making

Our mission is to make knowledge-based policy and decision making possible with regard to water resource management. In order to achieve this, we have to address monitoring needs of under-served areas to ensure technology and monitoring solutions are available to all. The water and environmental data must be translated to actionable intelligence that can inform decision makers and elected officials to promote knowledge-based decision making. This mission requires implementation through facilitation of collaborative efforts between stakeholders such as municipalities, academic institutions, not-for-profit, conservancy and environmental groups as well as state and federal regulatory agencies.

As of March 2025,
RATES has installed **over 60 RTHS**
Real Time Hydrologic Systems
throughout the Lower Rio Grande Valley, and New York.



Scan the QR code to find more information about RATES

Poster made by Rebeca Santos

A hydro-Informatics Centered Capacity Development Non-Profit Corporation

DATA

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

INFORMATION

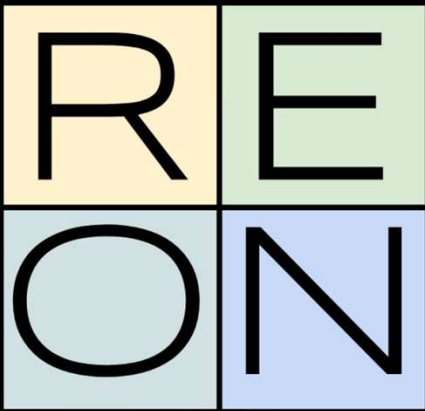
Translate water & environmental data into actionable intelligence.

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.



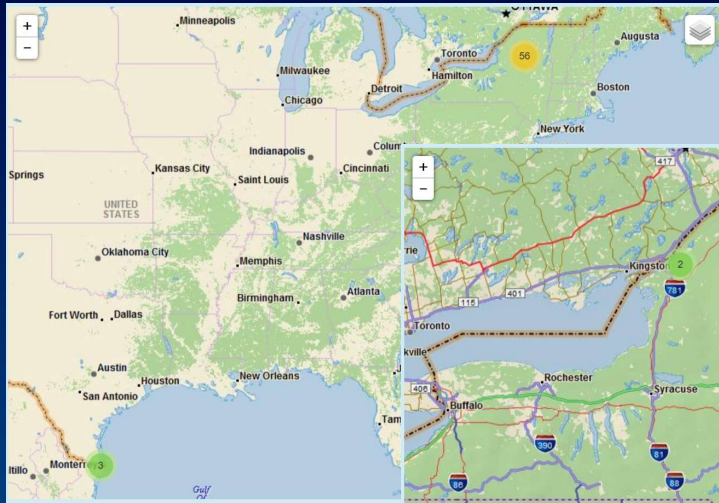
RIVER & ESTUARY OBSERVATION NETWORK

DEMOCRATIZING WATER INTELLIGENCE

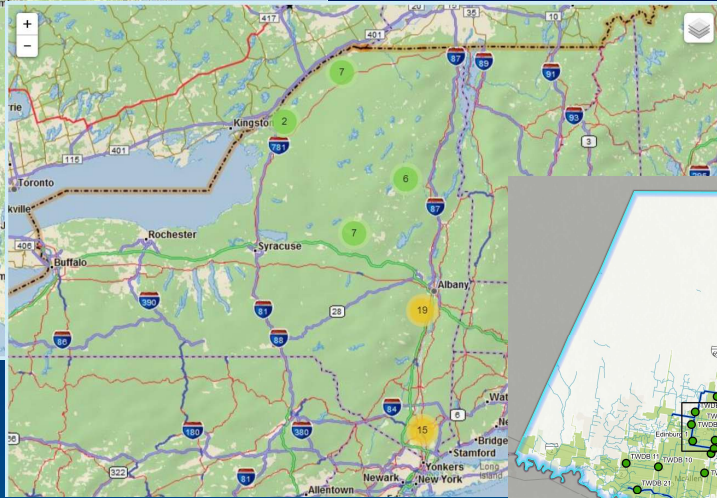
***THE RIVER AND ESTUARY OBSERVATION NETWORK IS A
A COMMUNITY NETWORK OF REAL-TIME DATA
PROVIDERS AND USERS COMMITTED TO THE
PHILOSOPHY OF ENABLING LOCAL AND REGIONAL
WATER RESOURCE MANAGEMENT THROUGH SHARING
OF WATER DATA AND OPEN EXCHANGE OF WATER
INFORMATION.***



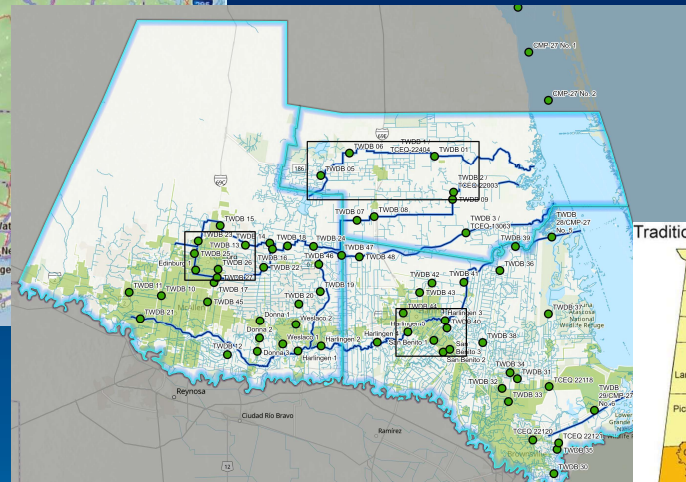
National: 138 (and counting)



New York (66)



South Texas (67)



Alabama (5)

Traditional Counties of the Alabama Black Belt



The Growing REON

REAL TIME HYDROLOGIC SYSTEM (RTHS) STATIONS

LOW COST, HIGH FIDELITY

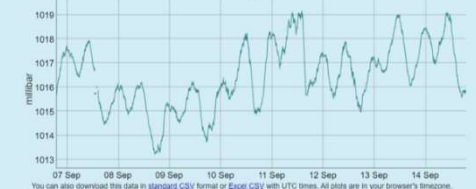


Real-Time Hydrologic System

Site: Brownsville Public Works County: Cameron

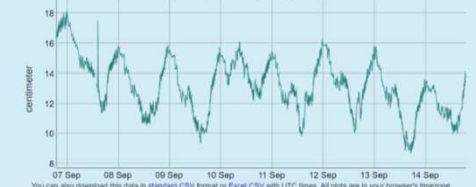


Barometric pressure



You can also download this data in [Standard CSV](#) format or [Excel CSV](#) with UTC times. All plots are in your browser's timezone.

Stage height using Large range



You can also download this data in [Standard CSV](#) format or [Excel CSV](#) with UTC times. All plots are in your browser's timezone.

LRGV: REGIONAL FLOOD MANAGEMENT CONCEPTION & INSTANTIATION



Conceived by
RATES &
Stormwater
Taskforce



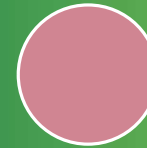
Established Regional
Watershed Coordinator



Established the
Regional Water
Resource Advisory
Committee (RWRAC)



Counties
Committed
\$1M Cost Share



LRGVDC Selected
Fiscal
Vehicle

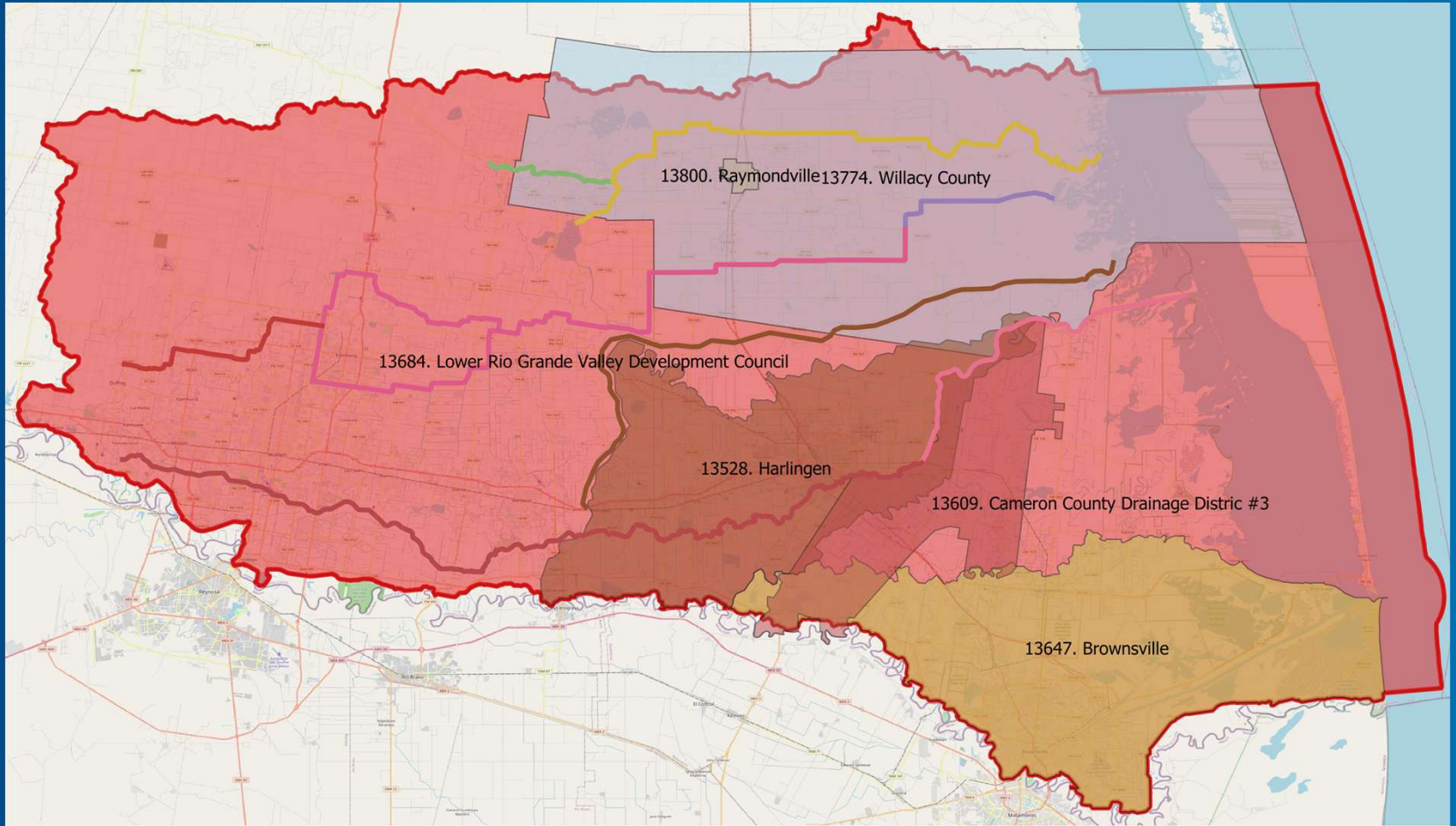


RESEARCH, APPLIED
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Photo courtesy of Cameron County Constable PCT 5

TWDB FIF Cat 1 Projects

Brownsville \$1.2M
 CCDD#3 \$1.5M
 Harlingen \$5.6M
 LRGVDC \$7.9M
 Raymondville \$400K
 Willacy County \$1.6M



Lower Rio Grande Valley TWDB-FIF Category 1 Applications

Main Drains	IBWC Floodway	HCDD1 NMD	Category 1 Applications	Raymondville	LRGVDC
Raymondville Drain	Hidalgo-Willacy W Spur	Arroyo Colorado West-Central	CCDD3	Harlingen	
Raymondville Drain II	Hidalgo-Willacy	Arroyo Colorado East (Tidal)	Brownsville	Willacy	

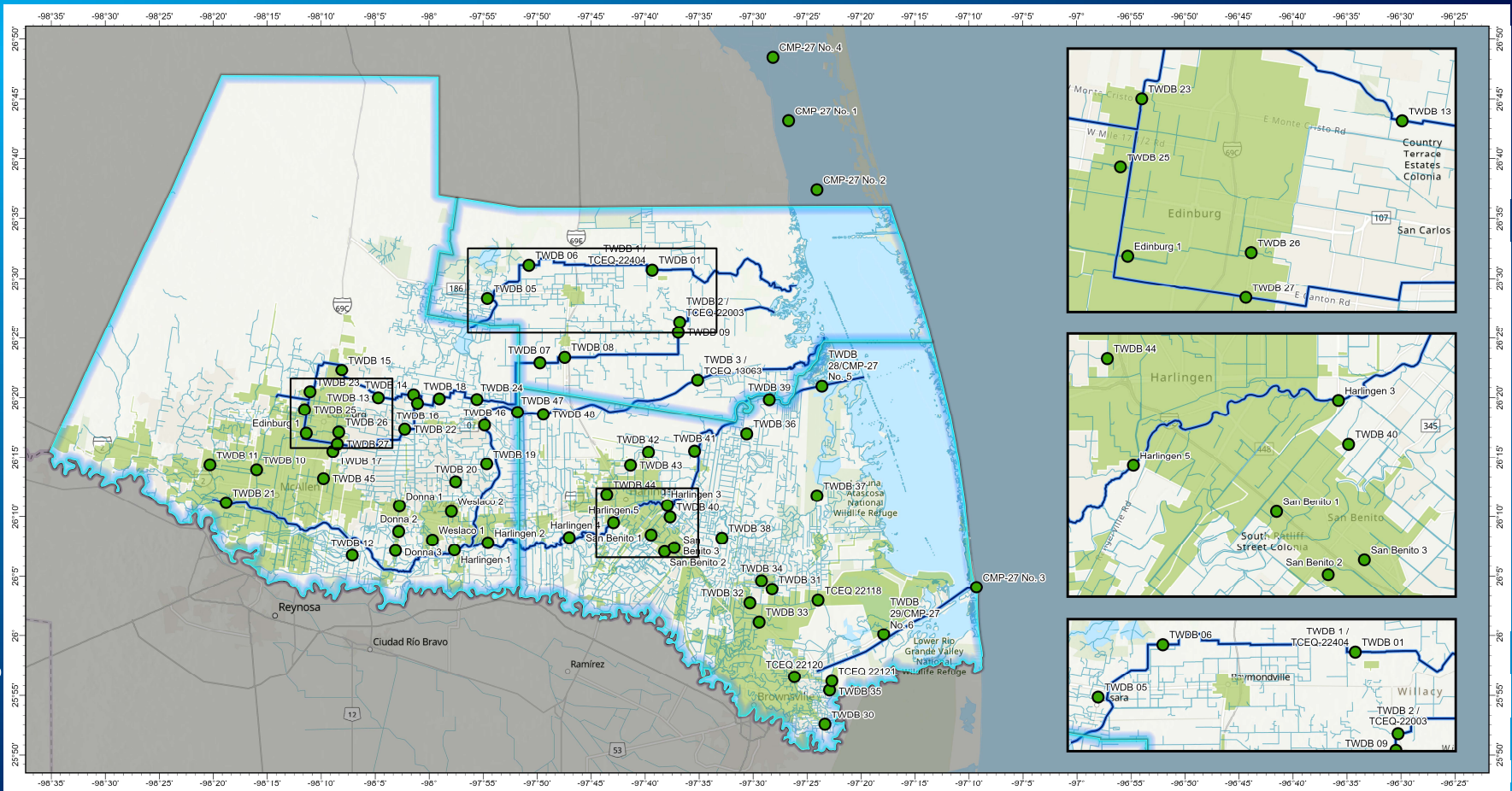
Regional Water Resource Advisory Committee
 HARLINGEN TEXAS
 RESEARCH APPLIED TECHNOLOGY EDUCATION AND SERVICE

LRGVDC FLOOD STUDY

- **RTHS:** 44 Real Time Hydrologic Stations
- **REON.cc:** River & Estuary Observation Network Cyber Collaboratory
- **REON/WM:** River & Estuary Observation Network Water Model
 - LRGV Regional Real Time Hydrologic Model
 - On-Demand Sub-Regional Hydraulic Models
 - Selected Urban Stormwater Models
- Coordination of Regional Projects
- Selected Feasibility Assessments
 - Cameron County
 - Hidalgo County

Total	\$8.9M
Grant	\$7.9M
Cost-Share (Counties)	\$1.0M
LRGVDC	\$0.4M
RATES	\$5.5M
Cameron County	\$1.0M
Hidalgo County	\$1.0M





TITLE:
River and Estuary Observation Network
(REON) Rio Grande Valley (RGV)

PRODUCED BY:

RESEARCH APPLIED TECHNOLOGY
 EDUCATION AND SERVICE
 Rio Grande Valley

SYMBOLY

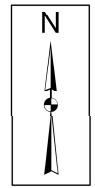
- RTHS Stations
- Major Waterways
- Canals
- LRGV Counties
- LRGV Cities

Real-Time Hydrologic System (RTHS) stations per project in the RGV

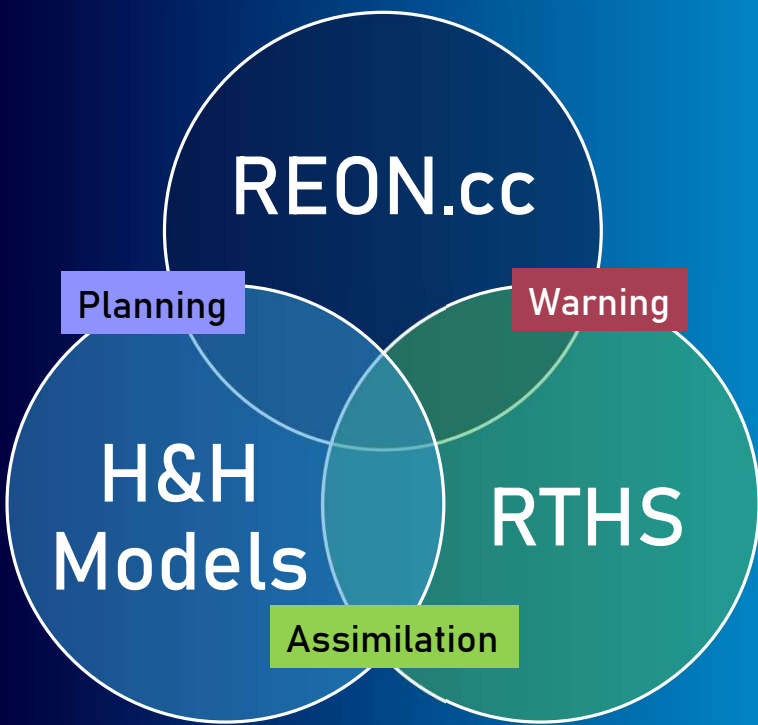
TWDB FIF: 44 stations	-City of Donna: 3 stations
TxGLO CMP-27: 6 stations	-City of San Benito: 3 stations
Harlingen/CSE: 5 stations	-City of Weslaco: 2 stations
-TCEQ LLM/BSC : 3 stations	-City of Edinburg: 1 station
-TCEQ N&C II: 3 stations	

GRAPHIC SCALE:
 0 3 6 12
 Miles

SCALE:
 1 : 600,000



Multi-Tiered Model Calibration & Validation



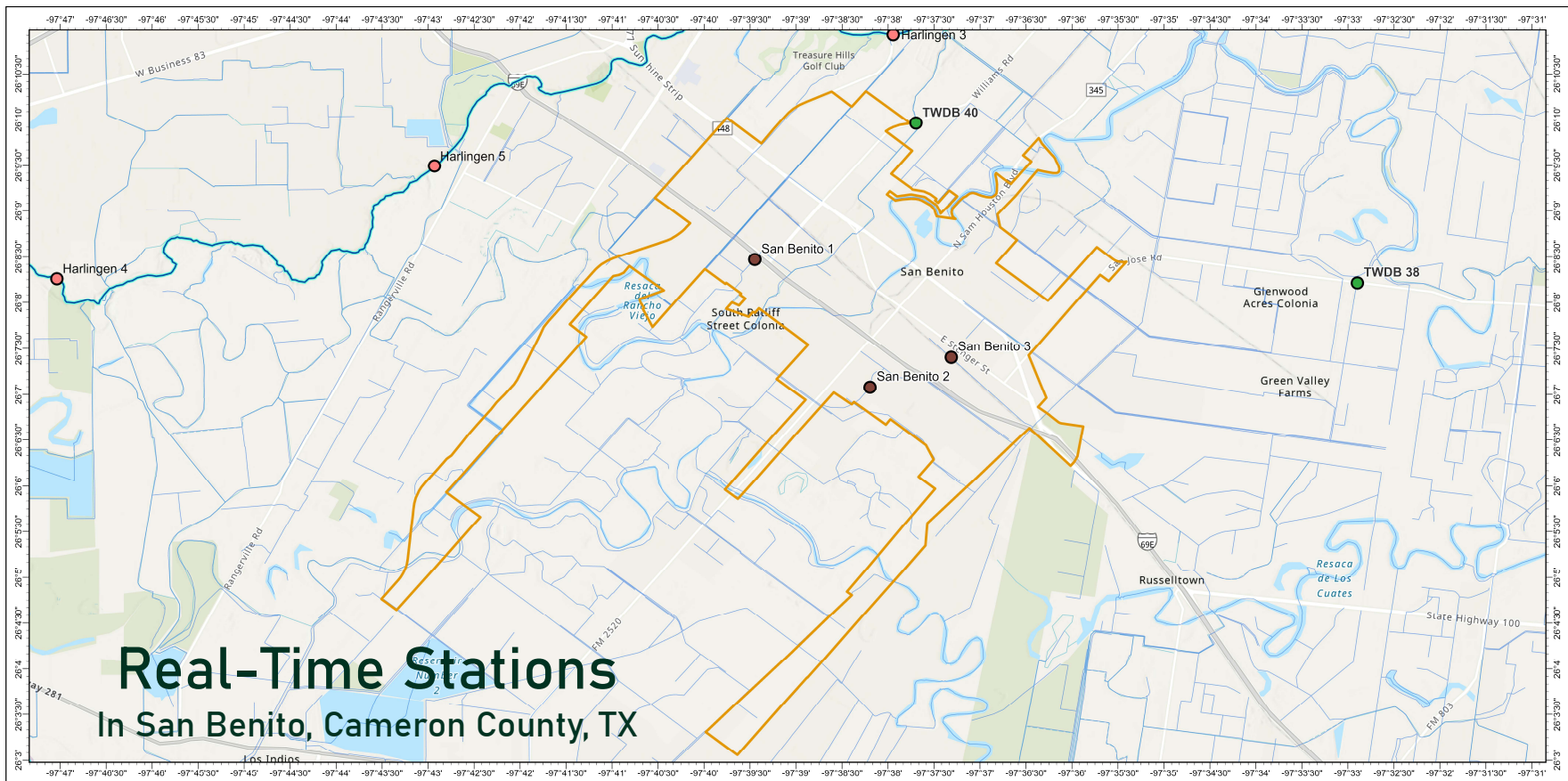
Slide 11

AE1 [@Rebeca Santos] need a FEWS slide before this, modeling on. The FEWS slide should demonstrate the unique value of our approach vs weather-based sirens

Andrew Ernest, 2026-04-12T16:42:02.370

MRSC1 0 Sure! Can I get a few points of what is our unique proposition value?

Maria Rebeca Santos Chavez, 2026-04-12T23:41:10.413







Real-Time Stations In San Benito, Cameron County, TX

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

PRODUCED BY:

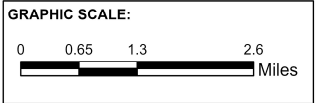
**RESEARCH, APPLIED
TECHNOLOGY**
 CONSULTING AND SERVICES
Rio Grande Valley

SYMBOLOLOGY

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

DETAILS

RTHS stations in San Benito:
 -SB 1: US BUSS 83
 -SB 2: near E Yost Rd and Audrey Ln
 -SB 3: Rebecca St



SCALE:
1 : 73,000



Real-Time Stations March 28th, 2025, Storm



Station "San Benito 2".

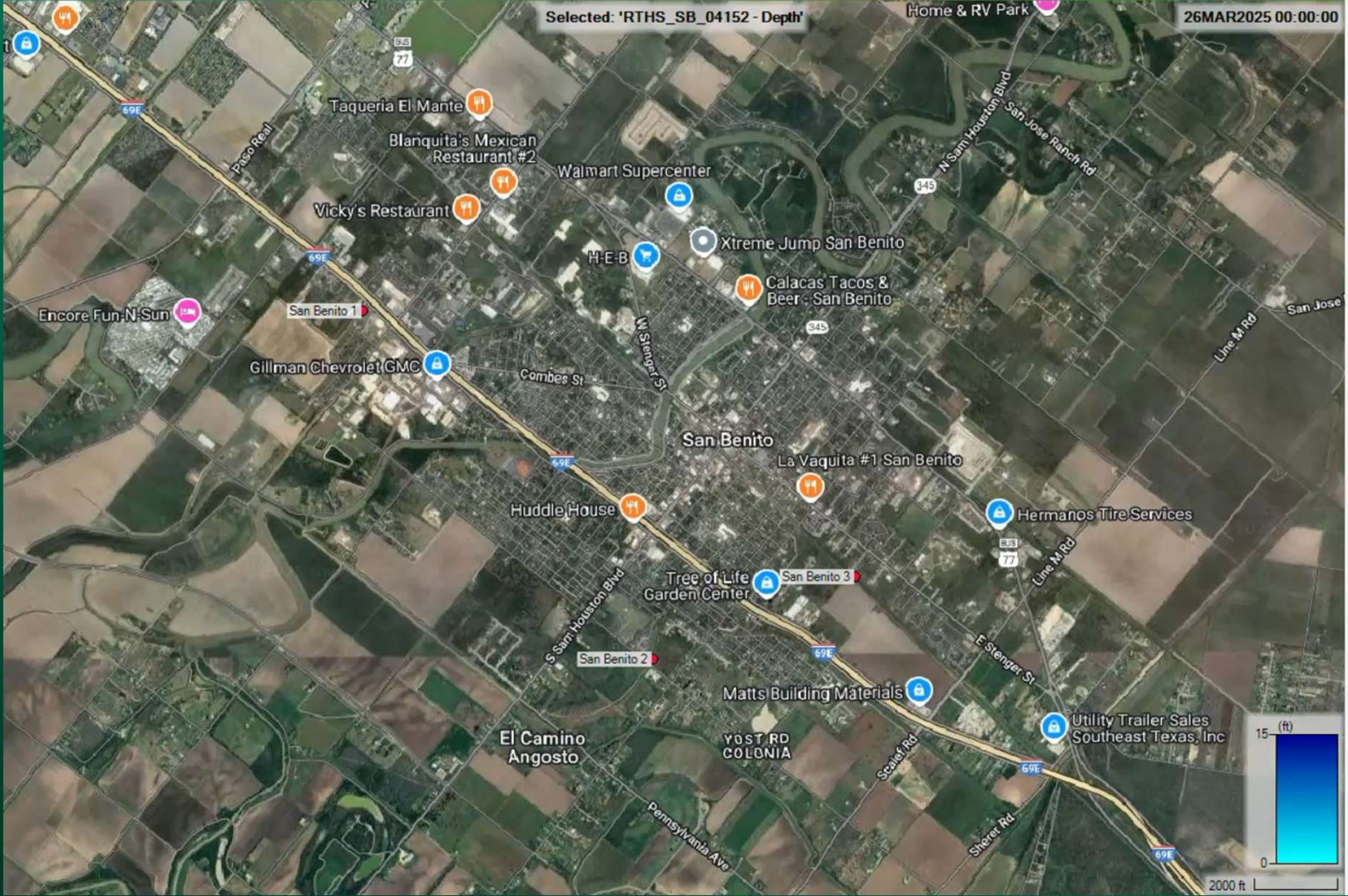
Maximum stage height was 10.52' at 06:15 AM on March 28, 2025.



Station "San Benito 3"

Maximum stage height was 8.55' at 05:30 AM on March 28, 2025.

FLOOD MITIGATION PROJECT DEVELOPMENT



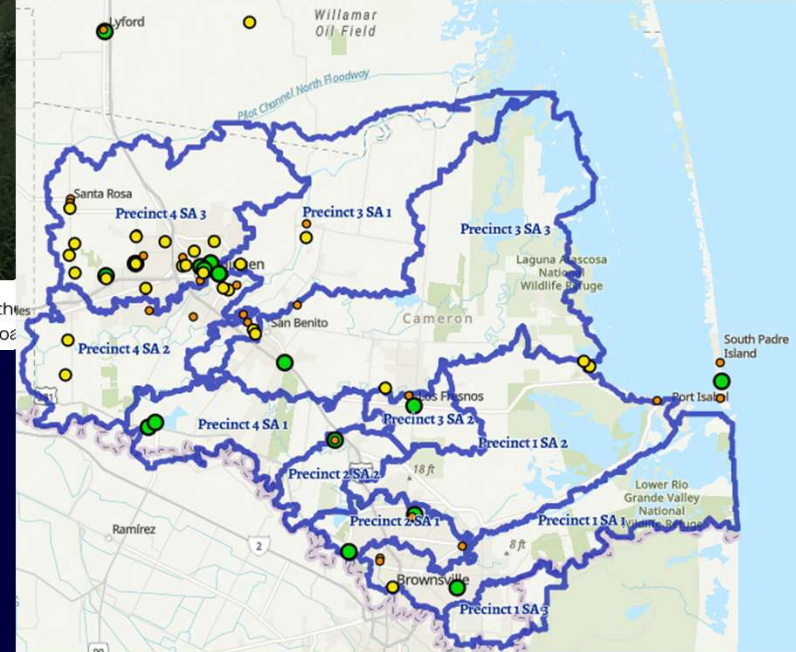
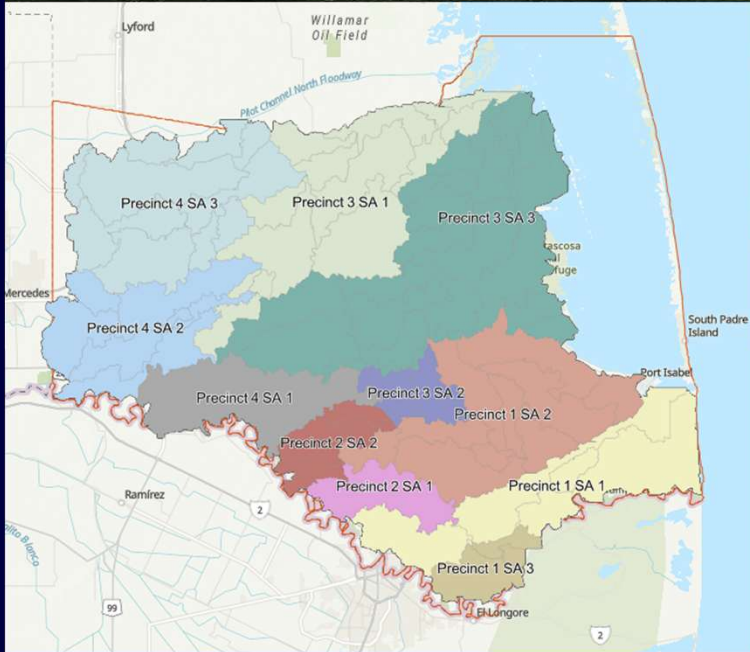


Cameron and Willacy County

Task 2 Data Portal

loading GIS data, discovering and building apps, and engaging others
s develop new web and mobile applications. Let's achieve our goals

Task 2: Flood Mitigation Projects



FLOOD MANAGEMENT STRATEGY

LRGV

FEWS

Planning

Deployment

Cameron County

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



**RESEARCH, APPLIED
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LRGV: REGIONAL FLOOD MANAGEMENT INNOVATION & SUSTAINABILITY AT ITS CORE

Round1

LRGV Cat 1

- LRGVDC Fiscal Agent
 - Coalesces Counties
 - Limited Technical Capacity
- Task 1: Building the 'Engine'
 - Intelligent Watershed
 - Cyberinfrastructure
 - Tiered Models
 - Engaging Communities
- Task 2: Proof-of-Concept
 - 25 FMP Submittal

Round2

FMS: Early Warning

- Tiered Algorithms
- Training

FME: Community Clusters

- Shared Project Development
- Cluster-Wide Drainage Ordinance Optimization

Institutionalization

- County Fiscal
- Institute/PPP

Round3

FMS: Coastal Compound Flooding

- Infrastructure Inventory
- Vulnerability Assessment

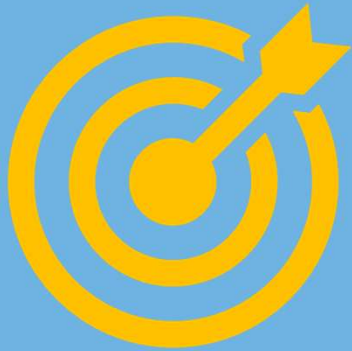
FME: Regional Retention Network

- Inventory & Condition Assessment
- Network Layout
- Rehab BCA

PENDING FIF SFY 2023-2024 FMS PROJECT:



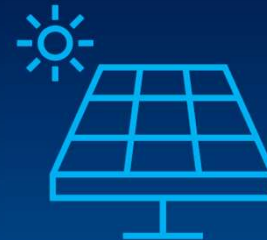
LRGV REGIONAL FLOOD EARLY WARNING SYSTEM: PLANNING, DEPLOYMENT, OPERATION & MAINTENANCE



Goal:
Integrate Flood Warning
Capabilities into the Existing
REON-RGV Monitoring
Network



REON-RGV is a fully
operational network,
which can
simultaneously be used
for technology R&D



The monitoring network is
already in place;
integrating FEWS
capability into this network
will be much less costly
than creating a standalone
network



The design of the
FEWS system will be
done in coordination
with regional
stakeholders

REON-RGV -> FEWS: PROJECT TASKS



Administration and Regional Coordination

- Cameron County will administer the project

Stakeholder Engagement

- Solicit participation from local entities in project activities
- Outreach to stakeholders for ideas/feedback on FEWS design and implementation
- Key stakeholders: First Responders, Public Works Personnel

RTHS Commissioning

- Collecting on-site data for characterizing flows, and for system quality control



Additional RTHS Stations

Install 18 additional RTHS stations, selected based on:

- Support from local entities / stakeholders (for both installation and long-term sustainability)
- Significance of location for FEWS

Cyberinfrastructure

- Involves integration, testing, and refinement of FEWS capability into the existing REON cyberinfrastructure
- Includes development of an O&M manual for the FEWS system designed for use by regional and local stakeholder participants



The following slides provide some examples of recent REON-RGV R&D

REON-RGV Cost-Effective Design Example

RATES-Designed “Shell” Water Level Sensor vs. Commercial Alternative: Costs



SHELL Assembly Costs:

Sensor: \$60 parts + 2hrs Labor

Cable: \$60 parts + 1hr Labor



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

Journal of
Environmental
Informatics Letters
www.iseis.org/jeil

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

W. D. Kirkey¹*, C. B. Fuller¹, P. O'Brien¹, P. J. Kirkey¹, A. Mahmoud², A. N. Ernest^{1, 2}, and J. Guerrero¹

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



LevelTROLL 400

Retail Prices:

Sensor: \$800

Cable: \$475

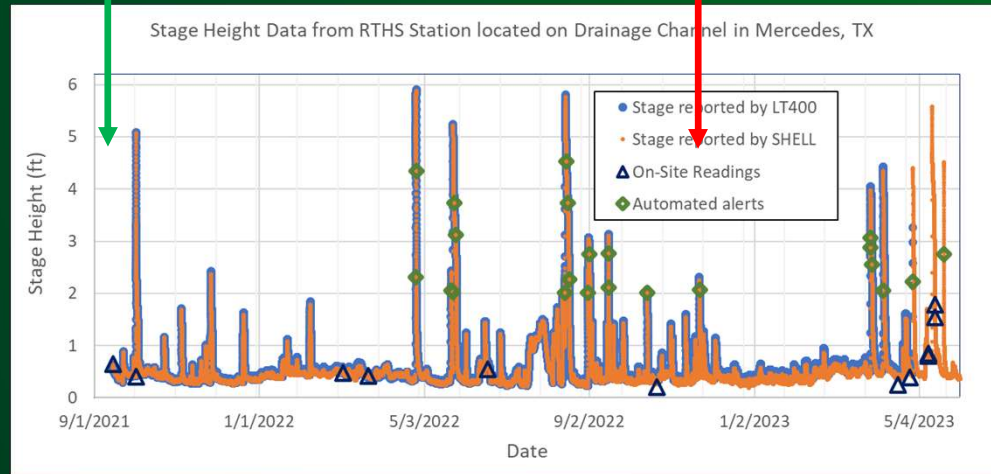
September 2021:

- Mercedes, TX commissioned RATES to install RTHS in local drainage channel, to provide water-level alerts for city staff.
- RATES co-deployed both sensors to compare performance

RATES-Designed “Shell” Water Level Sensor vs. Commercial Alternative: Performance Assessment

September 2021:

- Mercedes, TX commissioned RATES to install RTHS in local drainage channel, to provide water-level alerts for city staff.
- RATES co-deployed both sensors in order to compare performance



May 2023:

- LevelTROLL 400 Stopped Functioning
- SHELL sensor continued to operate

Both sensors gradually developed error over time, but SHELL drift was smaller than LevelTROLL 400 drift

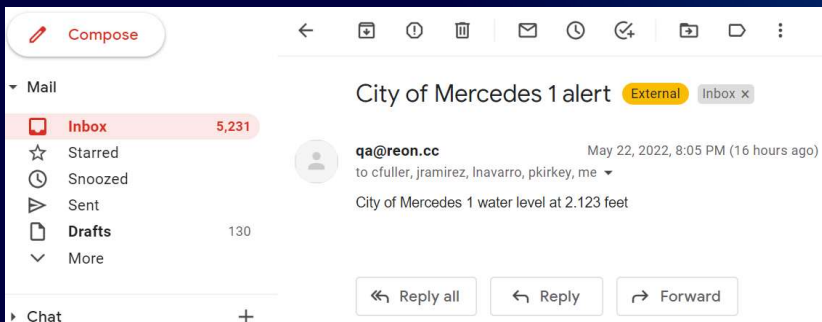
Date	9/14/2021	10/1/2021	3/3/2022	3/22/2022	6/18/2022	10/21/2022	4/17/2023	4/26/2023	5/10/2023	5/15/2023
On-site readings (ft)	0.64	0.40	0.48	0.42	0.55	0.21	0.25	0.39	0.80	1.79
SHELL-reported (ft)	0.64	0.42	0.51	0.43	0.60	0.27	0.37	0.52	0.91	1.91
LT400-reported (ft)	0.64	0.43	0.54	0.42	0.63	0.33	0.46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

REON BACK-END CYBERINFRASTRUCTURE

rths.us database

- ODM database
- Stores 5-minute averages for time-series data
- Stores timestamped spot readings
- Data visualization/download pages (<http://rths.us/reonrgv.cgi>)

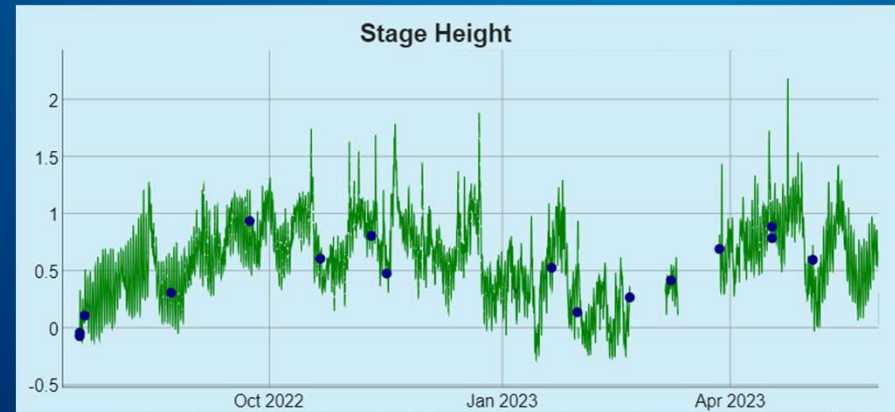
Real-Time Alerts



Secure Remote Access to Linux OS

```
pi@108:~$ ssh pi@108
Warning: Permanently added '108' (rsa) to the list of known hosts.
pi@108:~$ tail -f /service/logger/log/main/current
4400000062a124817625fc ttyACM0 windair,63,1,6,71,221,43,30,35,0,56
4400000062a124816b339c ttyACM0 windair,63,1,6,41,218,55,30,35,0,52
4400000062a12481206a1b4 ttyACM1 vlt700,706996,L,1,485,34,294,41,94,0
4400000062a1248128106cc ttyACM1 pbar5,19,1,42,10,1009,50
4400000062a1248176f43bc ttyACM0 windair,63,1,6,36,217,49,30,37,0,52
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4400000062a124e3788a24 ttyACM0 windair,63,1,6,66,234,20,30,39,0,51
4400000062a124e716cb887c ttyACM0 windair,63,1,5,22,248,81,30,47,0,49
4400000062a124e7199b4f0c ttyACM1 pbar5,19,1,42,10,1009,61
```

Visualization of Continuous and QC data



TWDB4

UTC Date and Time
09/20/2023 15:13

RTHS Reported Stage at:

Stage Height(ft) +

Select Month Date Year

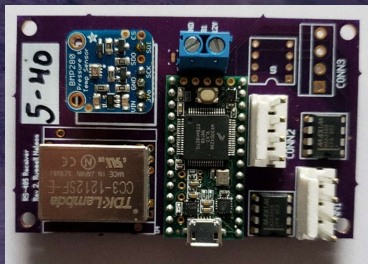
UTC Hour Minute

RTHS Expansion Example: Water Quality

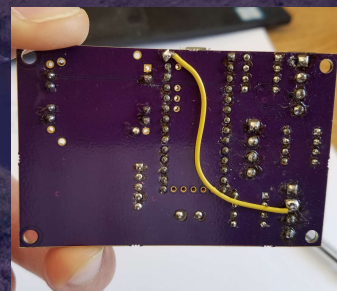
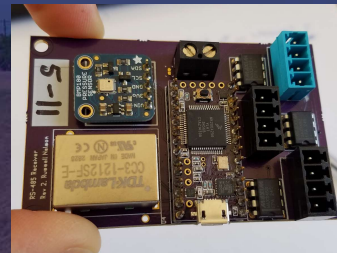
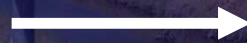
Instrumentation: In-Situ AquaTROLL 500



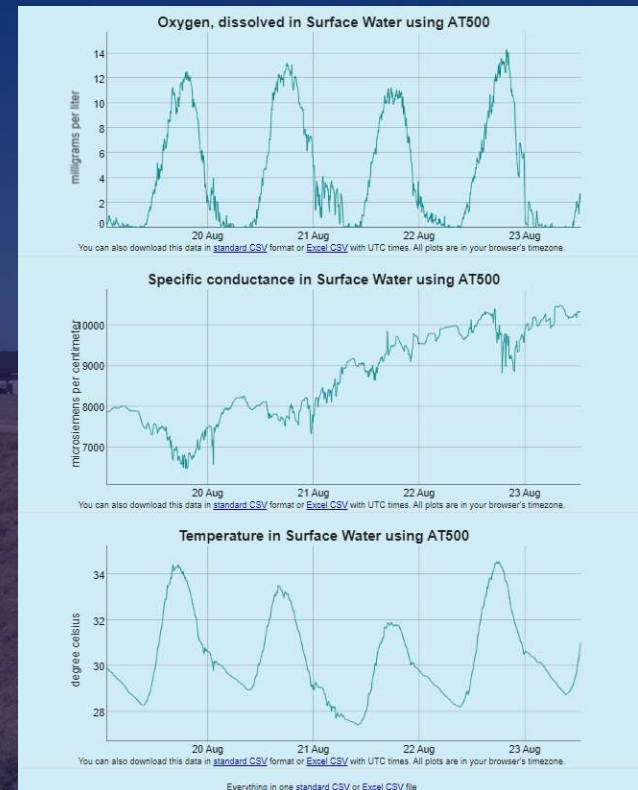
Interface – Modified RS-422 Interface Board:



- Wiring adjustments
- Expanded program

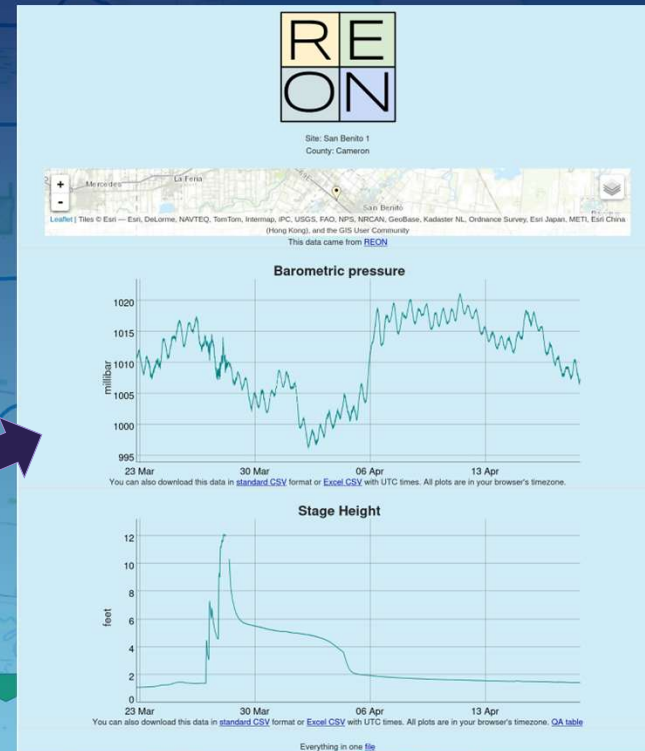


Example Data (CCD1D2, August 2021)



Current State: Manual Observations

Passive
Early
Warning



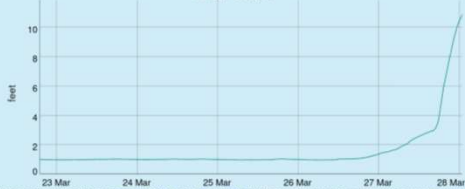
Current State: Neighbor Knowledge and Trajectory Tracking



Site: Harlingen 1
County: Hidalgo



Stage Height



Precipitation



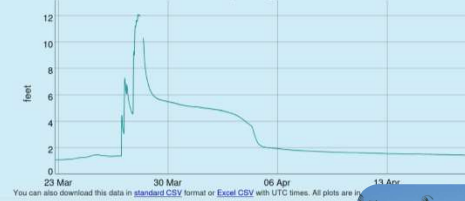
Site: San Benito 1
County: Cameron



Barometric pressure



Stage Height



Information Exchange

Flood front

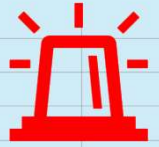
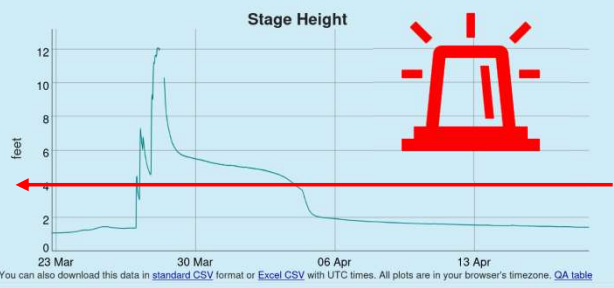
INFORMED
Early Warning



Upcoming Applications: Rate-of-Rise and Water Surface Elevation thresholds



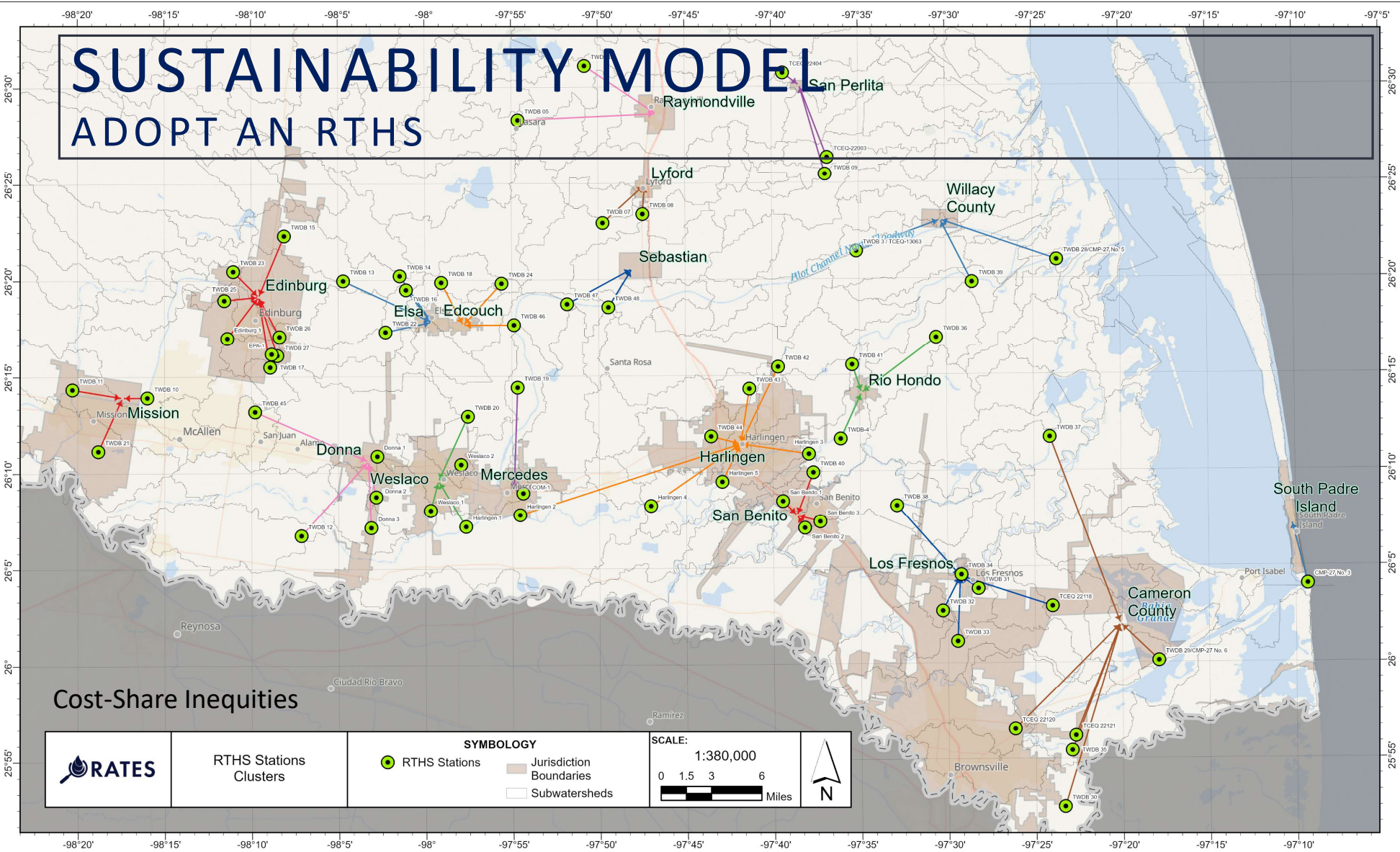
Site: San Benito 1
County: Cameron



[Everything in one file](#)

SUSTAINABILITY MODEL

ADOPT AN RTHS



Cost-Share Inequities

	<p>RTHS Stations Clusters</p>	<p>SYMBOLY</p> <ul style="list-style-type: none"> ● RTHS Stations Jurisdiction Boundaries Subwatersheds 	<p>SCALE: 1:380,000</p> <p>0 1.5 3 6 Miles</p>	
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A dynamic splash of clear blue water against a solid blue background. The water is captured in mid-air, creating a sense of movement and energy. The splash is centered horizontally and extends across most of the width of the image. The water droplets are sharp and detailed, showing individual bubbles and the texture of the liquid. The overall color palette is monochromatic, using various shades of blue.

WATER WIZARD





More Regions = More Public \$\$\$\$

- FMS Early Warning
- FME Regional Network of Cascading Clusters
- FMS: Coastal Compound Flooding

More Technology = More Research \$\$



RATES/REON
Public Service
Public \$\$\$
Public Project Must Have Public Good Outcome

Water Wizard
LEAS

Tele-Engineering
Open Eng

Implementation
Open Env.

- AI
- Continuous Forecasting

- Remote Engineering Experts

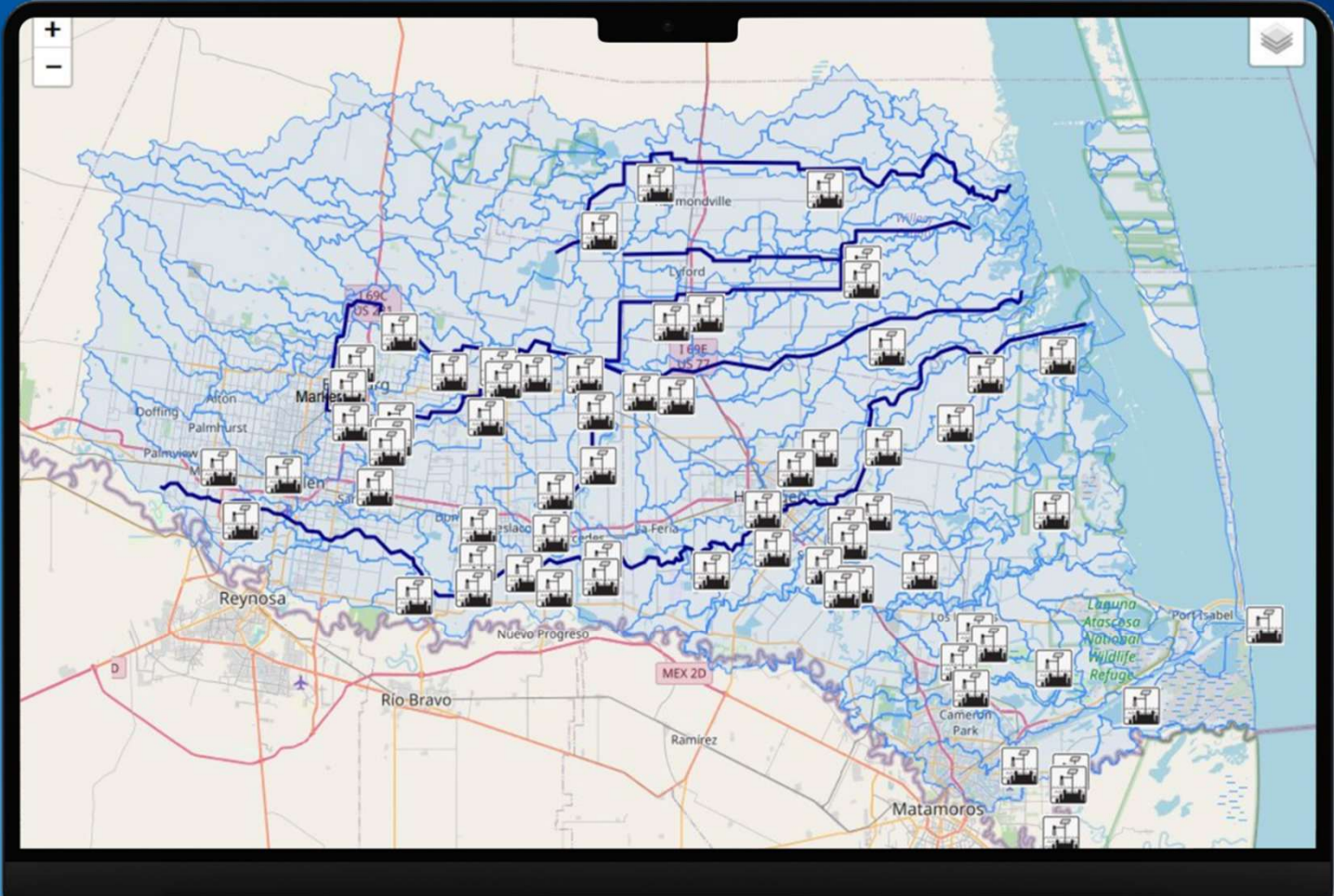
- Network Installations
- Product Retail

Ease of Use = Expanding Market

Competitiveness = Product Quality

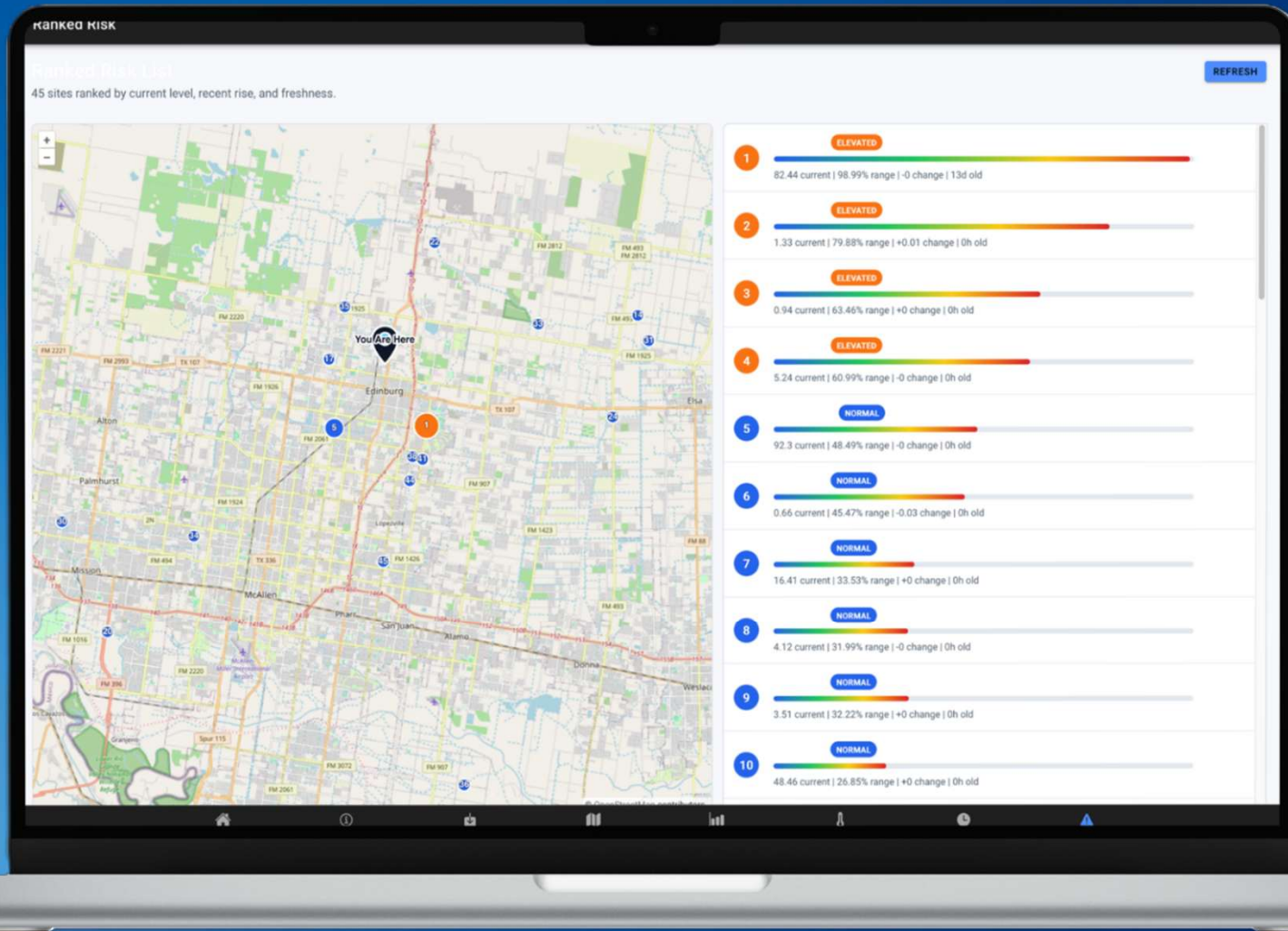
Water Wizard
Commercial Revenue

INTERACTIVE MAP OF THE STATIONS

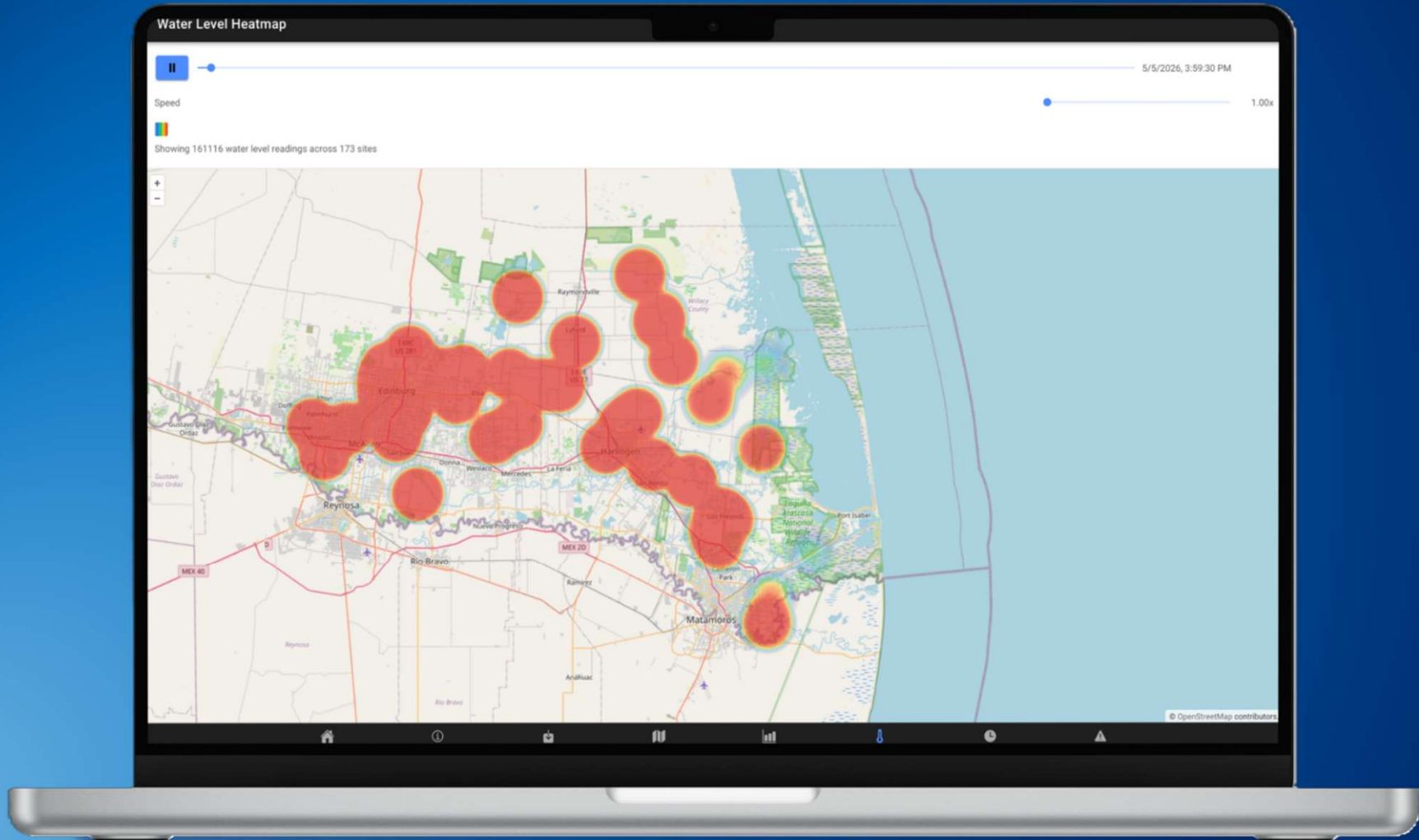


RANKED RISK BASED ON LOCATION

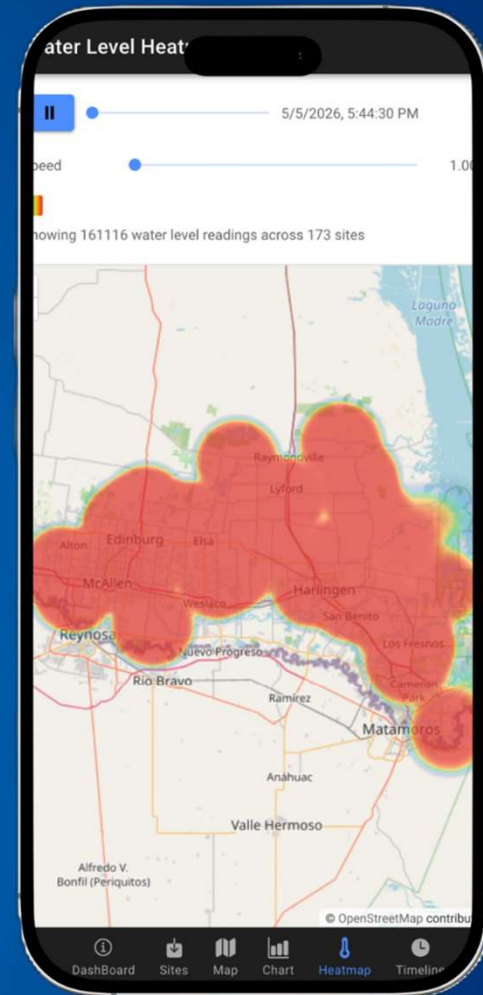
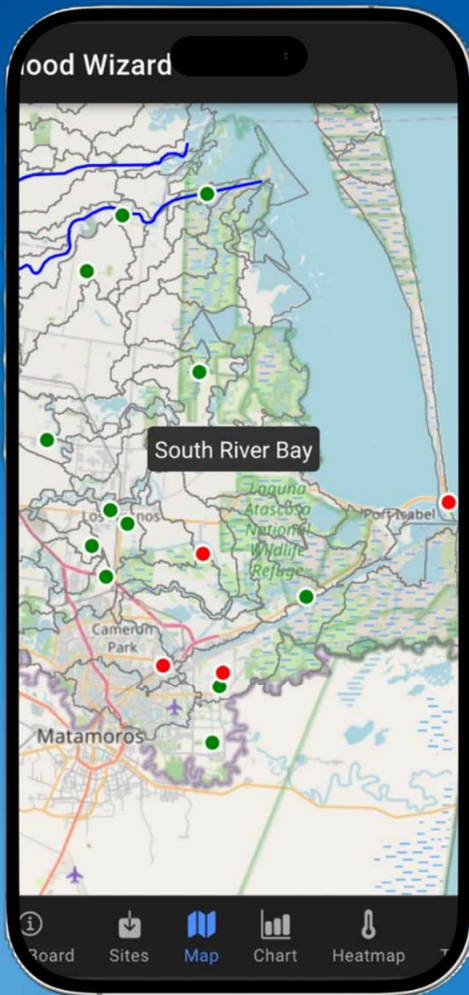
*Stations ranked
by water level
near user's
location*



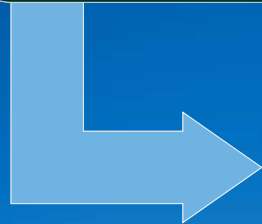
WATER LEVEL HEATMAP



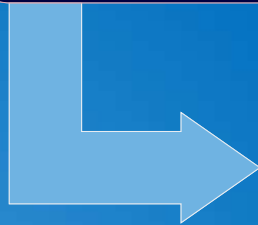
PHONE APP VIEW



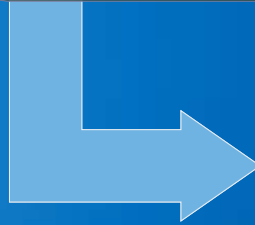
Model Trained on
weather and water
data



Water level forecasts
using meteorological
forecasts



Users can set their
own trigger
conditions in-app



App provides
monitoring and other
value-added tools to
subscribers and
REON RGV members



Station- Level AI

Network AI

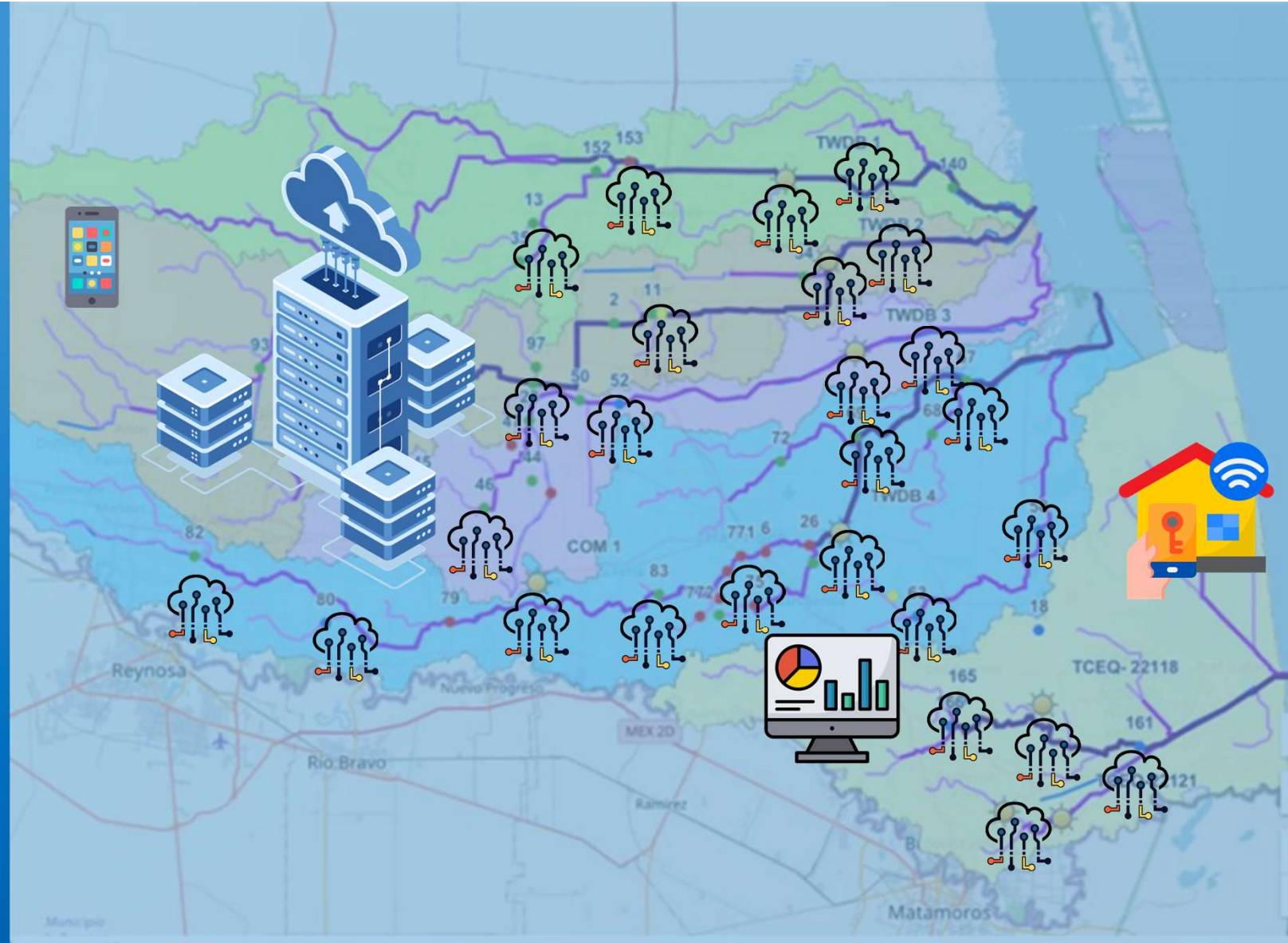
*A True Intelligent
Watershed*



Data Center HPC
Regional Intelligence



Intelligent RTHS
Local Intelligence



ACWIRRED

AN INSTITUTE FOR

APPLIED COASTAL WATER INTELLIGENCE
FOR REGIONAL RESILIENCE AND ECONOMIC
DEVELOPMENT

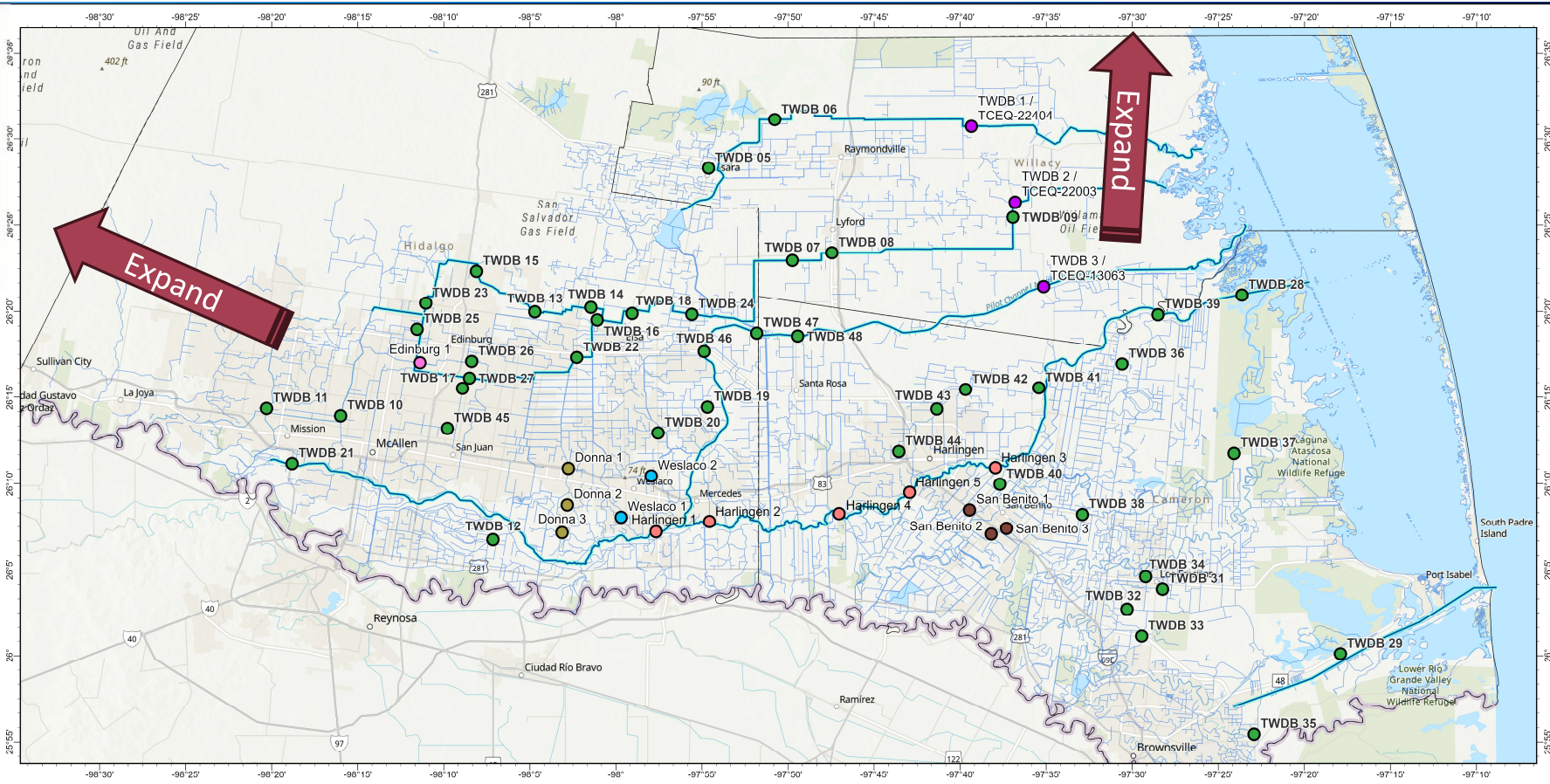




RGV

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

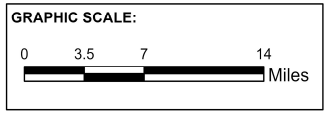
SYMBOLOLOGY

- 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



SCALE:
1 : 390,000

INDUSTRIAL EVOLUTION



1784

Mechanization, steam power, weaving loom



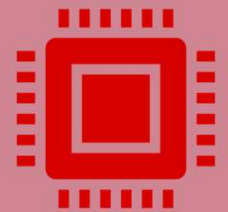
1870

Mass production, assembly line, electrical energy



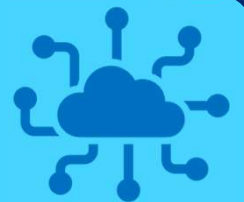
1969

Automation, computers, and electronics




Today

Cyber Physical Systems, Internet of Things, Networks



CUTTING EDGE RESEARCH



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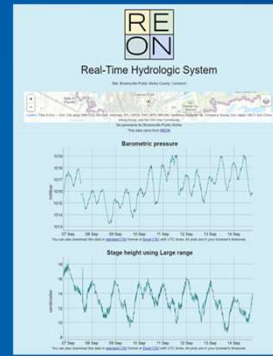
Cyber-Physical Systems (CPS)

[View guidelines](#)

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CYBER-PHYSICAL SYSTEMS



Big Data



Data Center HPC
Regional Intelligence

Internet of Things

Cloud Computing



Robotics

Artificial Intelligence





100AKER HIGH PERFORMANCE COMPUTE CLUSTER

750+ TERAFLOPS

COMPUTE NODES

- 4x Dual-Socket Ampere Altra Q80-30 (320C)
- 1x Dual-Socket Ampere Altra Max M128-30 (128C)
- 2x Single Socket AMD EPYC (128C)
- 1x Dual Socket Xeon E5 2696 (36C)
- 1x Single Socket Xeon E5 2696 (18C)



630 Compute Cores



DEEP LEARNING (AI)

- 2x Single Socket AMD EPYC (64C)
- 6x AMD Instinct Mi25 GPU Accelerators (24,576 ROCm C)
- 1x Nvidia RTX 4090 GPU (16,384 CUDA C)
- 1x Nvidia Tesla K80 GPU Accelerator (4992 CUDA C)
- 4x Xilinx Alveo U200 FPGA Accelerators (3.6M LUTS)
- RTHS/Edge Inference Options (~5W)
 - Rockchip RK3588 NPU (6 TOPS)
 - Google/Coral Edge TPU (4 TOPS)
 - Nvidia Jetson Nano GPU (472 GFLOPS)





**RESEARCH, APPLIED
TECHNOLOGY**
EDUCATION AND SERVICE

*Turning Research and
Technology into Community
Resilience*

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