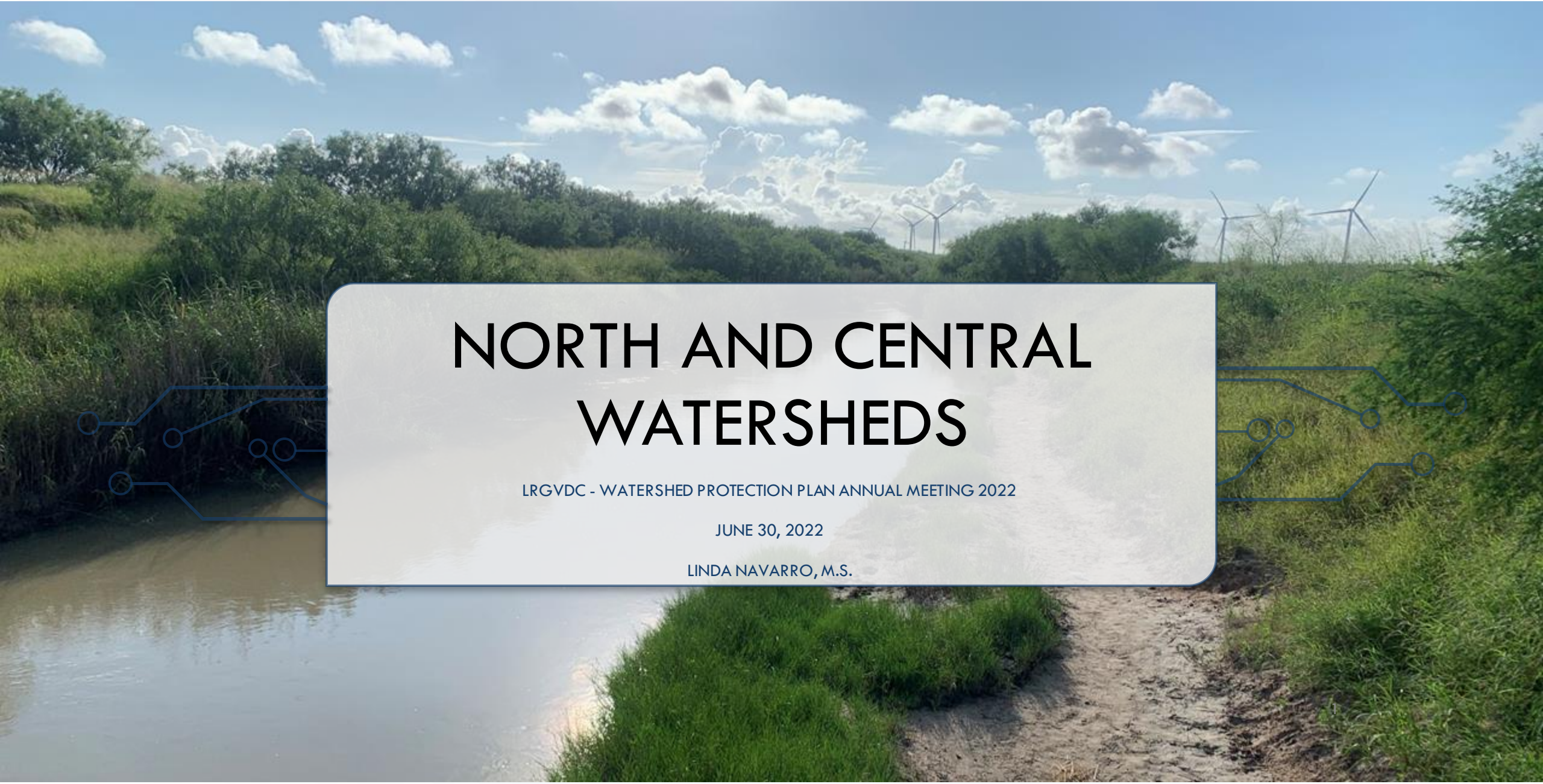


NORTH AND CENTRAL WATERSHEDS

LRGVDC - WATERSHED PROTECTION PLAN ANNUAL MEETING 2022

JUNE 30, 2022

LINDA NAVARRO, M.S.

RESEARCH, APPLIED TECHNOLOGY EDUCATION AND SERVICE
Rio Grande Valley

TCEQ Clean Water Act 319 Project Funding

- Watershed Characterization for the North and Central Watersheds

UTRGV Thesis Project

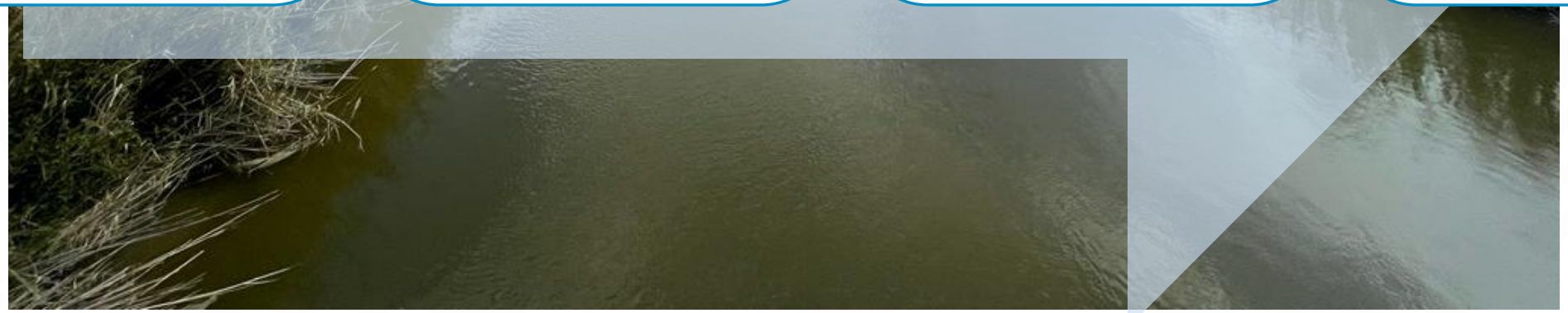
- Watershed Characterization Publication

TWDB Projects

- Texas Water Development Board Fresh Water Flows (TWDB FWF)
- Texas Water Development Board Flood Infrastructure Fund TWDB FIF

Future Work

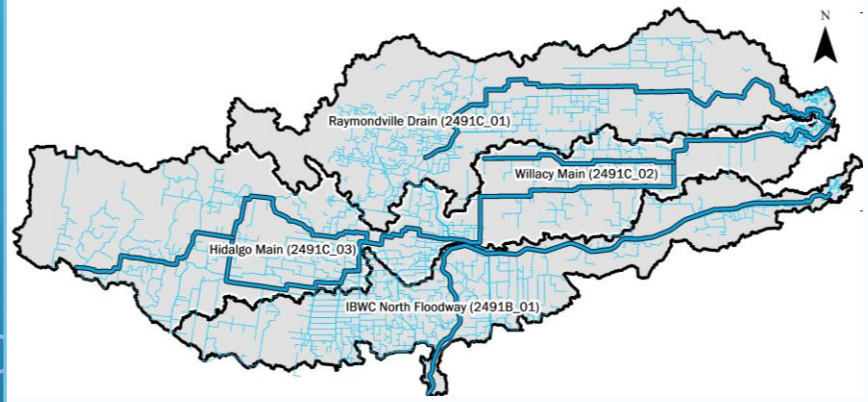
- TCEQ Clean Water Act 319 Phase II
  - September 2022
- Final Watershed Characterization Report to be submitted

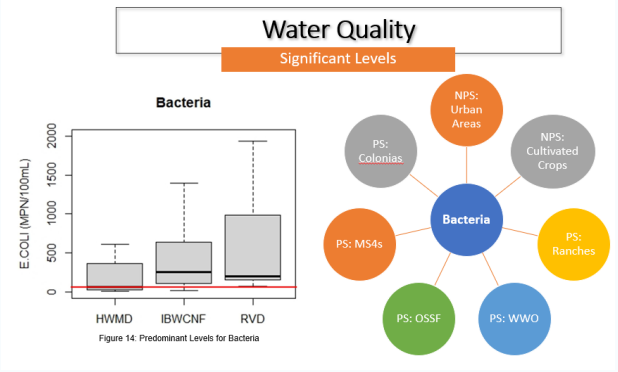


NORTH AND CENTRAL WATERSHEDS CHARACTERIZATION

UTRGV Thesis Project

Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics





- **Delineation of Watersheds/Subwatersheds**
- **Map Development**
- **Cyberinfrastructure and Database**
- **Flow and Water Quality Graphs**
- **USGS NHD Markup Application**

PUBLICATION

sustainability

MDPI

Article

Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics

Linda Navarro [1], Ahmed Mahmoud [2,*], Andrew Ernest [1], Abdoul Oubeidillah [1], Jessica Johnstone [3], Ivan Rene Santos Chavez [1] and Christopher Fuller [4]

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2 Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, AR 72704, USA
3 Nonpoint Source Program, Texas Commission on Environmental Quality, Austin, TX 78753, USA; jessica.johnstone@tceq.texas.gov
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* Correspondence: ahmedm@uark.edu

Abstract: Lower Laguna Madre (LLM) is designated as an impaired waterway for high concentrations of bacteria and low dissolved oxygen. The main freshwater sources to the LLM flow from the North and Central waterways which are composed of three main waterways: Hidalgo/Willacy Main Drain (HWMD), Raymondville Drain (RVD), and International Boundary & Water Commission North Floodway (IBWCNF) that are not fully characterized. The objective of this study is to perform a watershed characterization to determine the potential pollution sources of each watershed. The watershed characterization was achieved by developing a cyberinfrastructure, and it collects a wide inventory of data to identify which one of the three waterways has a major contribution to the LLM. Cyberinfrastructure development using the Geographic Information System (GIS) database helped to comprehend the major characteristics of each area contributing to the watershed supported by the analysis of the data collected. The watershed characterization process started with delineating the boundaries of each watershed. Then, geospatial and non-geospatial data were added to the cyberinfrastructure from numerous sources including point and nonpoint sources of pollution. Results showed that HWMD and IBWCNF watersheds were found to have a higher contribution to the water impairments to the LLM. HWMD and IBWCNF comprise the potential major sources of water quality impairments such as cultivated crops, urbanized areas, on-site sewage facilities, colonias, and wastewater effluents.

Keywords: watershed management; nonpoint source pollution; point source pollution; water quality; pollutant loadings; South Texas

Citation: Navarro, L.; Mahmoud, A.; Ernest, A.; Oubeidillah, A.; Johnstone, J.; Chavez, I.R.S.; Fuller, C. Development of a Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics. *Sustainability* **2021**, *13*, 11186. https://doi.org/10.3390/su132011186

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into the DEM is an attempt to force alignment between topographically derived flowlines and independently mapped hydrography [35].

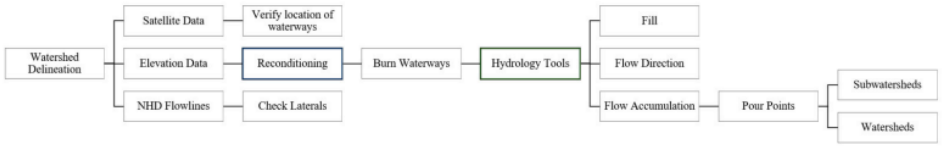


Figure 2. Watershed delineation methodology.

Once processing the LIDAR elevation data, the hydrology tools were used to develop elevation raster files such as fill, flow direction, and flow accumulation. Only three pour points were added manually to each corresponding waterway and then automated sub-watersheds were developed. With the subwatersheds delineated, the overall watershed boundaries for the three watersheds were determined based on the flow accumulation lines. The flow accumulation lines correspond to the flow path for each watershed based on elevation data. The flow accumulation lines embody the actual waterways in mostly all the watersheds. The watershed boundaries correspond to the flowlines and follow an enhanced methodology for the type of terrain in the region.

3.3. Data Collection

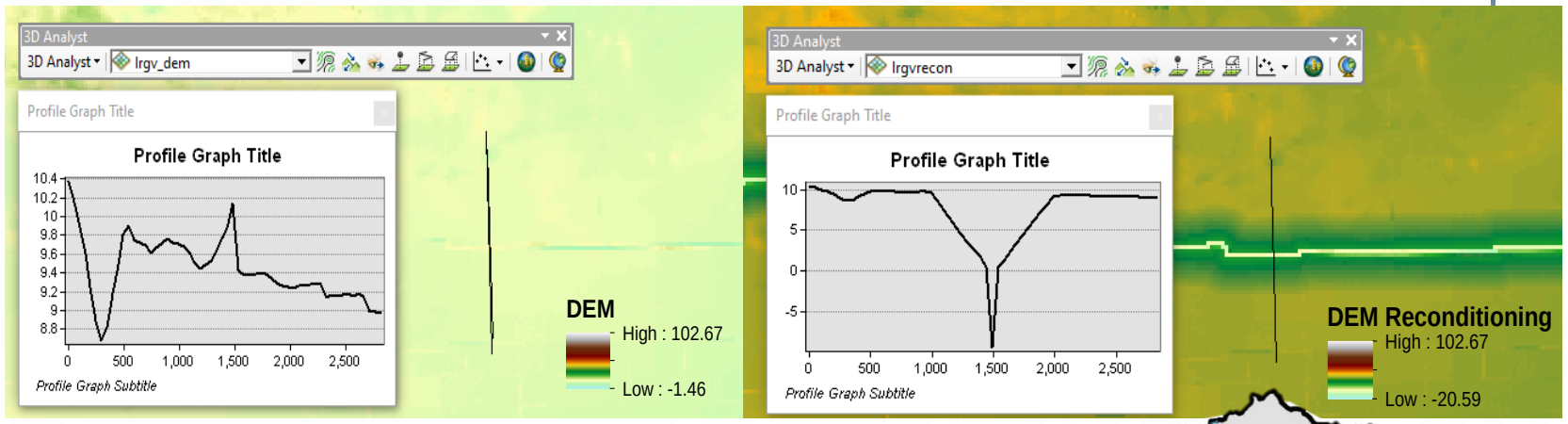
The study was developed based on the guidelines of the United States Environmental Protection Agency (USEPA) Handbook for Developing Watershed Plans to Restore Our Waters [36]. A summary of the data used in the study can be found in Table 1. NPS pollutant loads through sediment and runoff courses are highly related not only to land use/cover characteristics but also to topography [37–39]. This study integrates land cover data from the 2016 National Land Cover Database (NLCD) [40] with a spatial resolution of 30 m to determine relative contributions of NPS pollution in the north and central watersheds. The land cover type data identified as NPS pollution encompass urban and agricultural areas only. Each watershed was treated individually to characterize the type of land cover in the area. The NPS pollutants identified within the watersheds were cultivated crops areas and urbanized areas and South Texas large ranches (STLR), species, wildlife management areas (WMA), Onsite Sewage Facility (OSSF), and colonias.

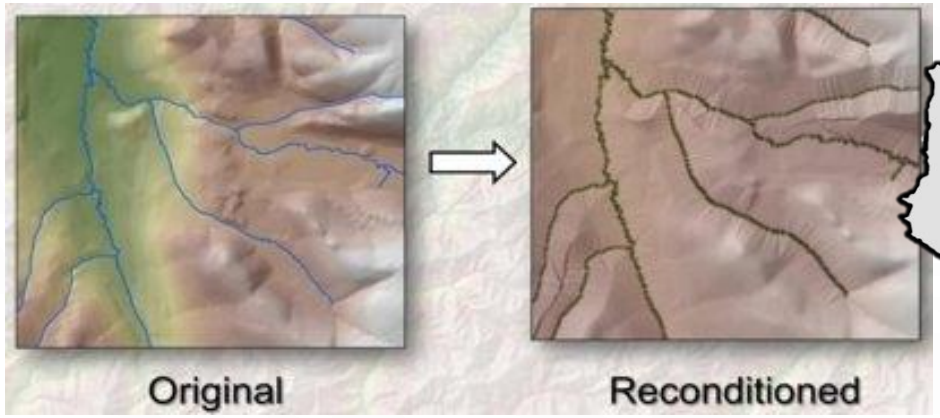
Table 1. Data sources used for characterization the IBWCNF, HWMD and RVD.

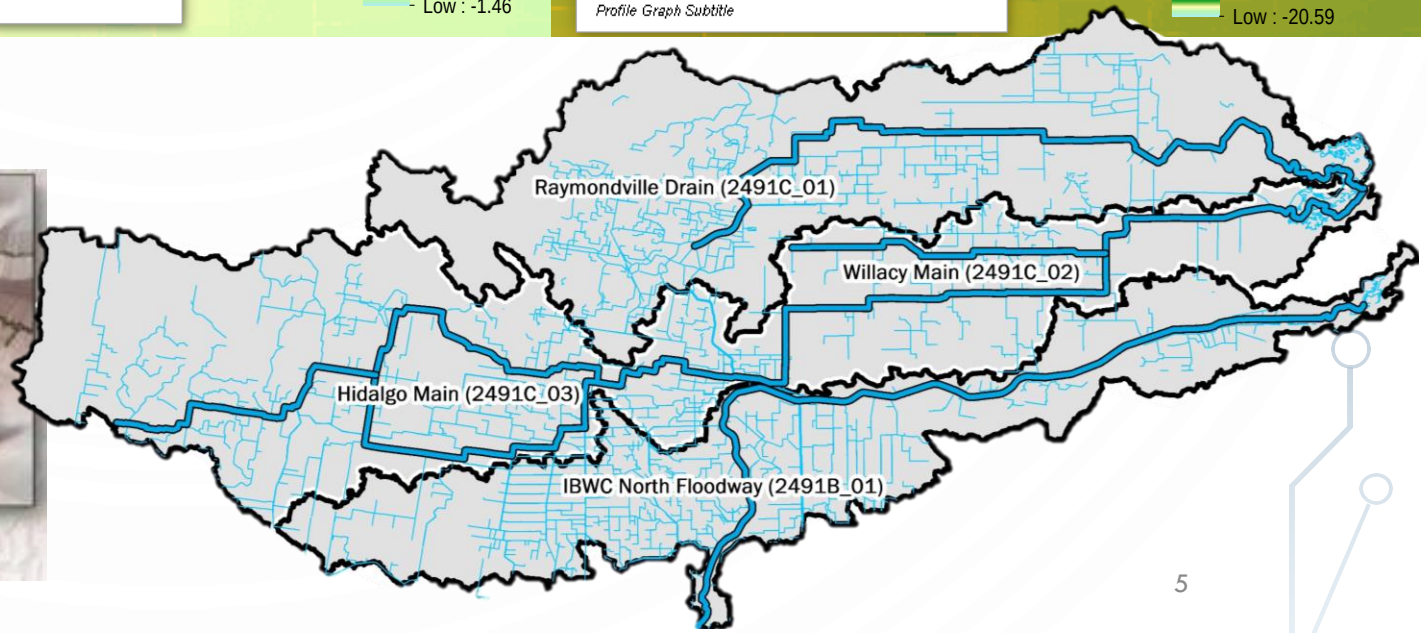
Data	Source	Year	Usage
LIDAR Data	USGS, TNRIS	2018	Watershed Delineation
Hydrograph (NHD)	USGS	2012–2019	Watershed Delineation
Land Cover	NLCD	2016	NPS
STLR	TCEQ	2018	NPS
TLAP	TCEQ	N/A	PS
WWO	TCEQ	N/A	PS
MSW	TCEQ	N/A	PS
OSSF	Colonias	2021	NPS
MS4s	TCEQ	N/A	PS
Colonias	TCEQ	2015	NPS; OSSF points
Desalination Plants	TWDB	2021	PS
Address Points	TNRIS	2018	OSSF points
IBWC Gage Stations	IBWC	2012–2020	Flow data (IBWCNF)
SWQM Station	TCEQ	2011–2019	Flow and water quality (IBWCNF)
SWQM Stations	TCEQ	2017–2019	Flow and Water quality (HWMD and RVD)

DELINEATION OF WATERSHEDS

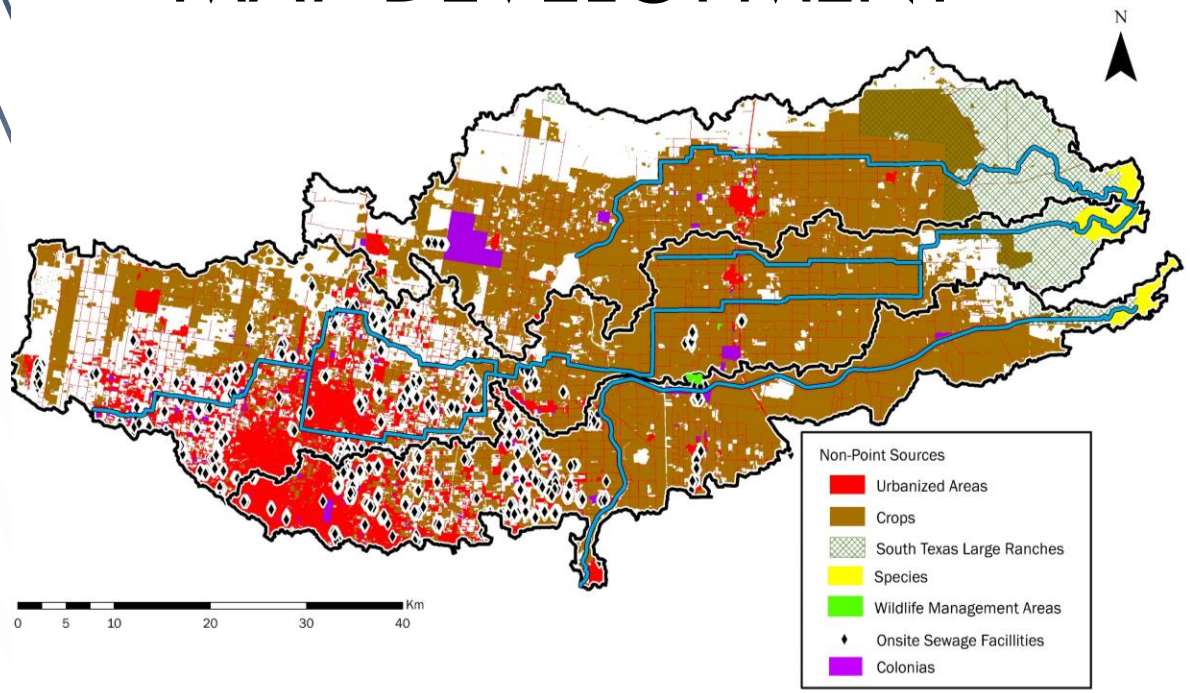
- Reconditioning
  - LIDAR Elevation 2018
  - 60 m resolution
- ArcGIS Hydrology Tools

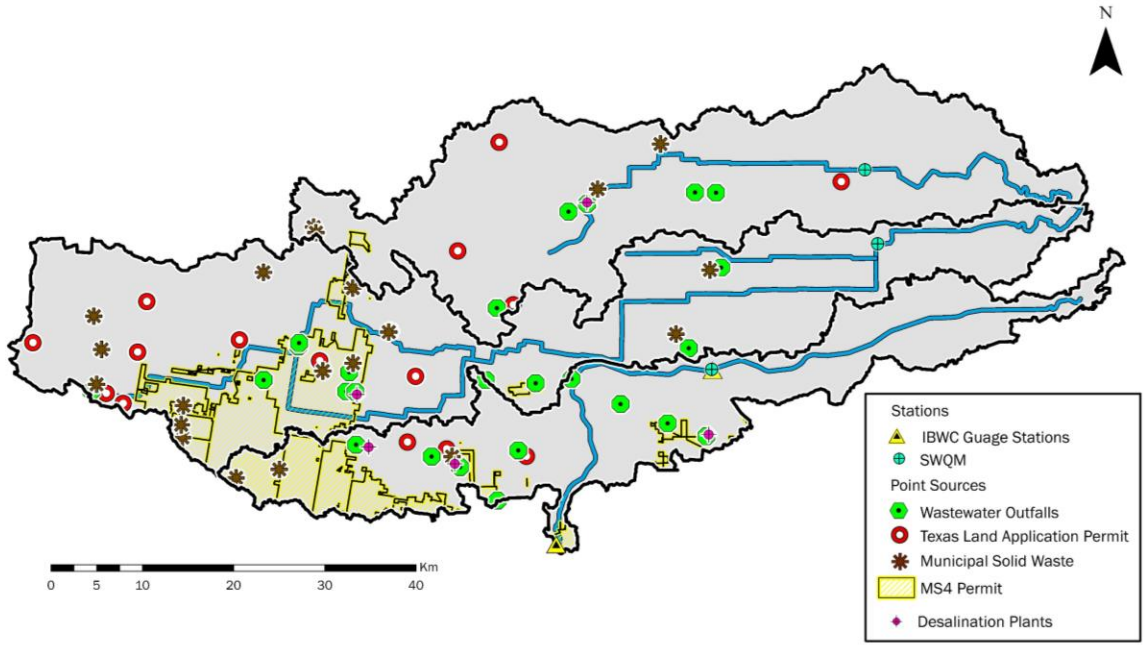


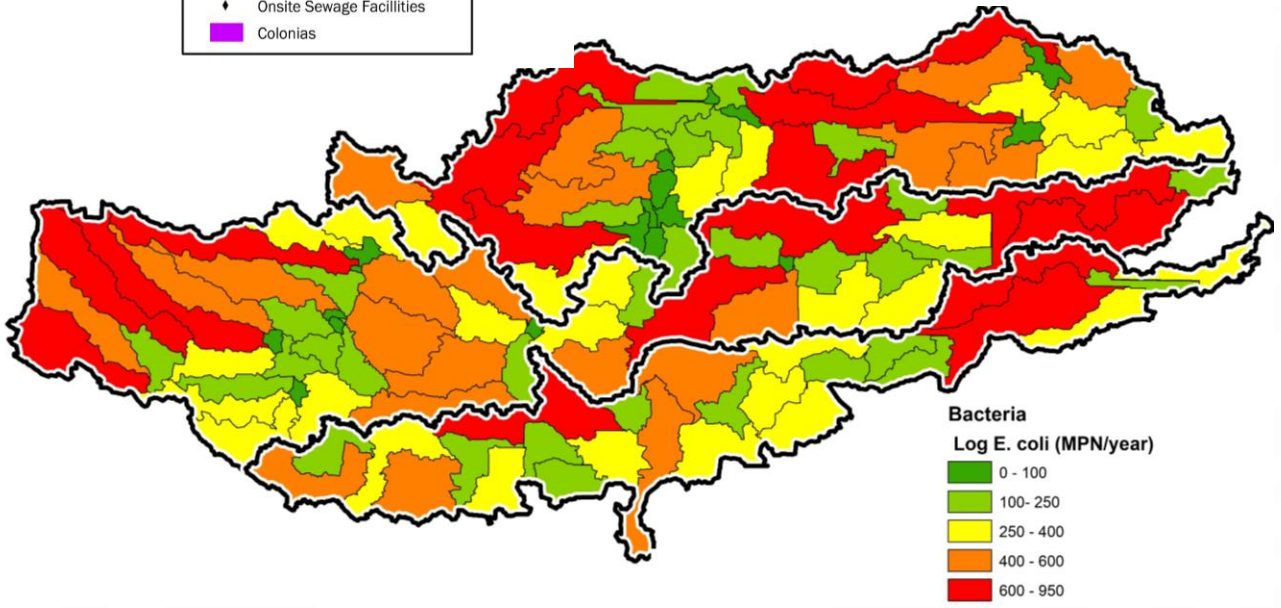




MAP DEVELOPMENT



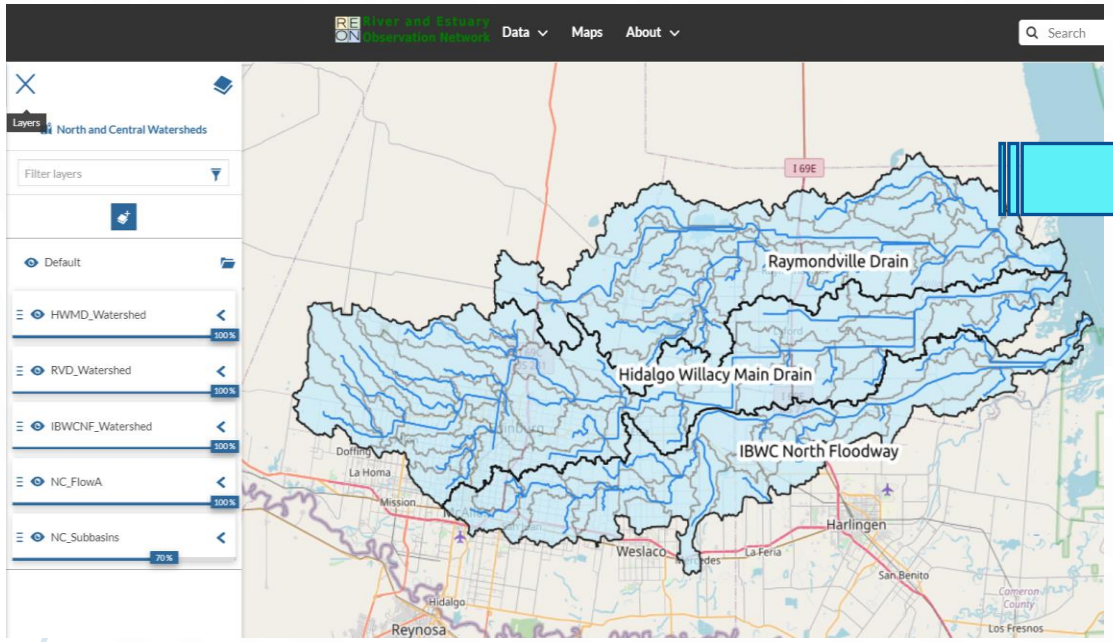




TCEQ Clean Water Act 319 Project Funding

Publication

CYBERINFRASTRUCTURE



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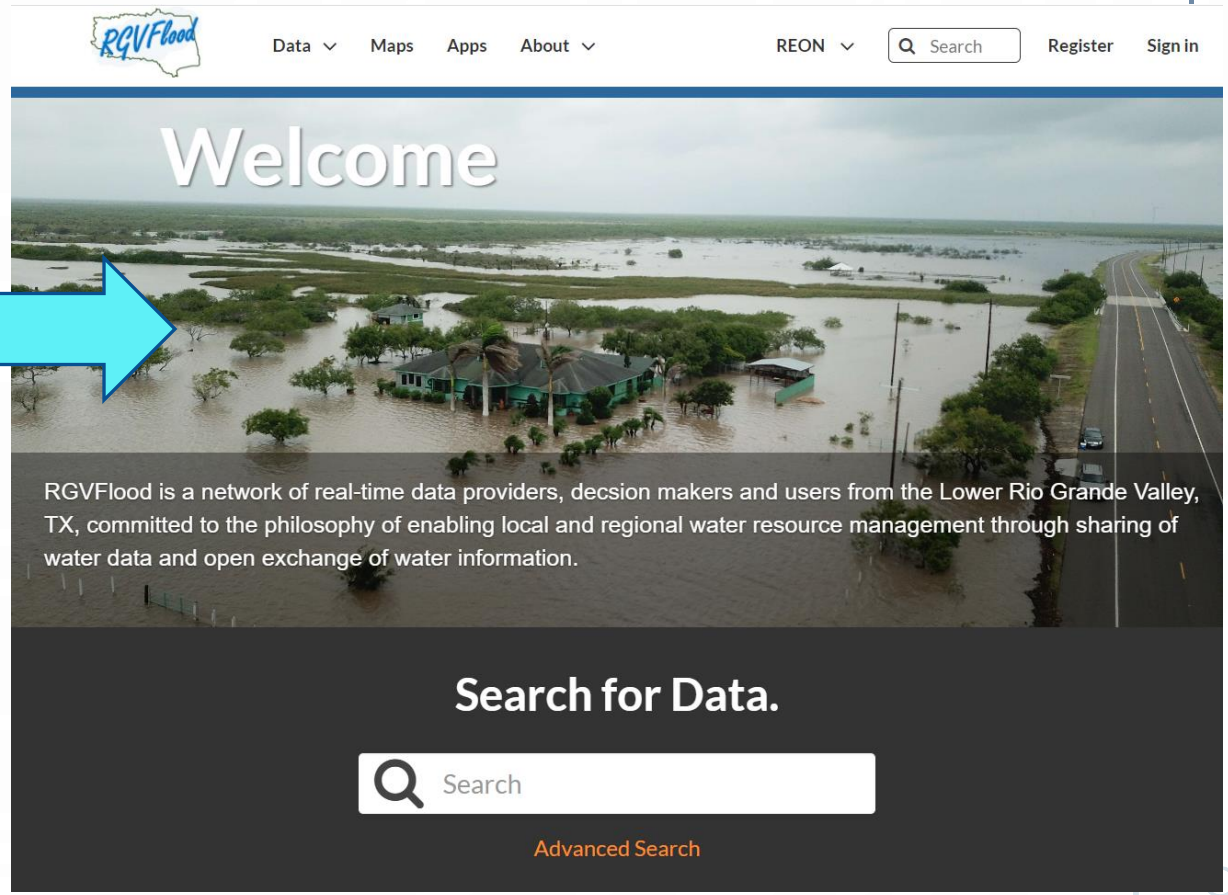


RGVFlood Website

WATER QUALITY AND FLOW DATA

Hidalgo Willacy Main Drain

- Clean Rivers Program
- 8 Samples
- 2017-2019

Raymondville Drain

- Clean Rivers Program
- 8 Samples
- 2017-2019

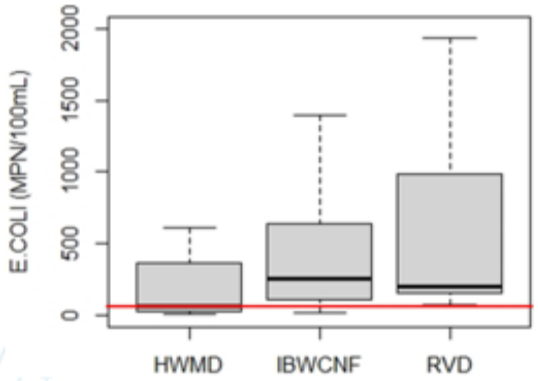
IBWC North Floodway

- SWQMs
- 29 Samples
- 2011-2019

Water Quality

Significant Levels

Bacteria



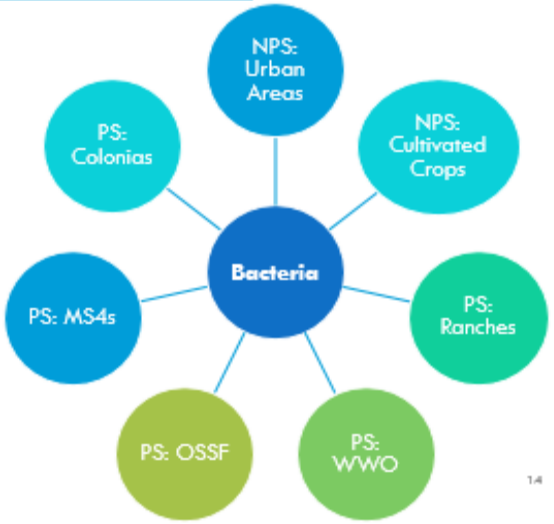


Figure 14: Predominant Levels for Bacteria

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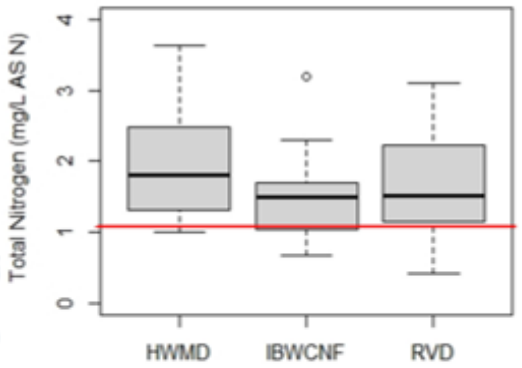
Water Quality

Significant Levels

Total Nitrogen



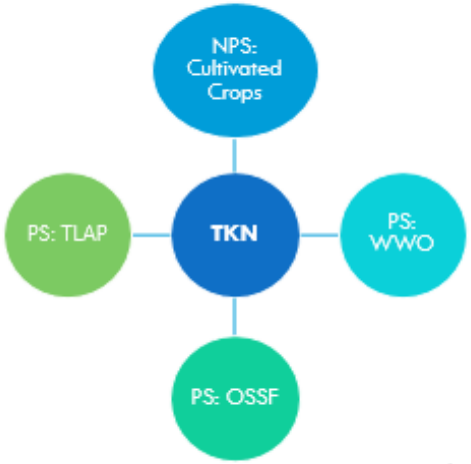


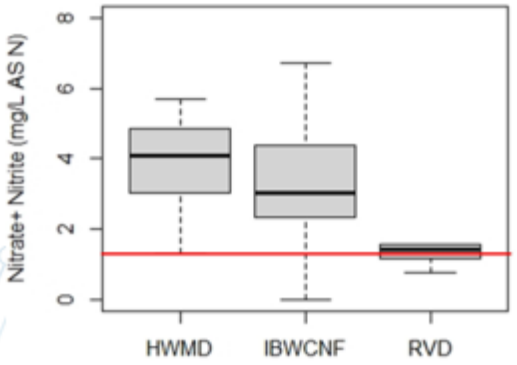
Figure 16: Predominant Levels for Total Nitrogen

13

Water Quality

Significant Levels

Nitrate + Nitrite



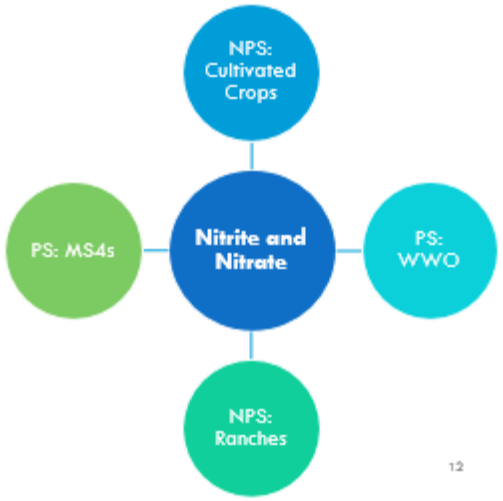


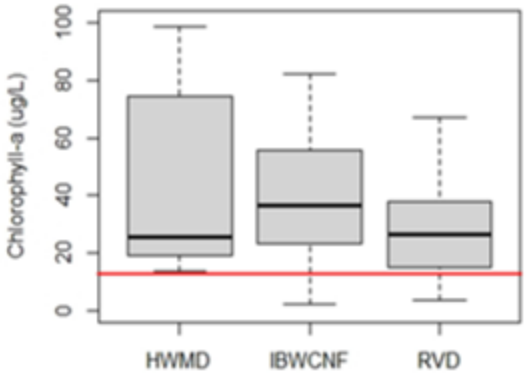
Figure 18: Predominant Levels for Nitrate and Nitrite

12

Water Quality

Significant Levels

Chlorophyll-a



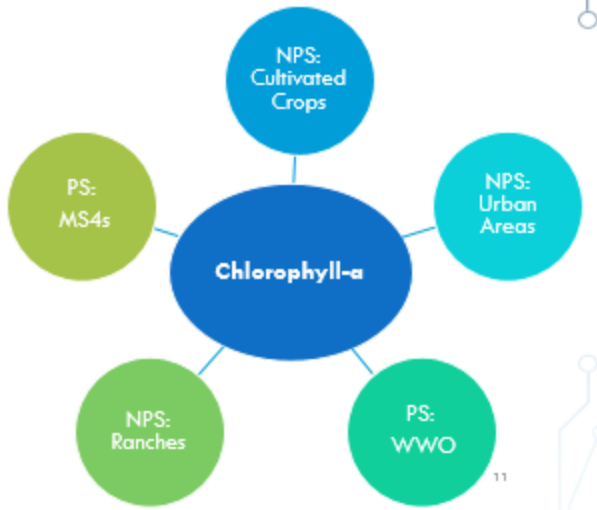


Figure 19: Predominant Levels for Chlorophyll-a

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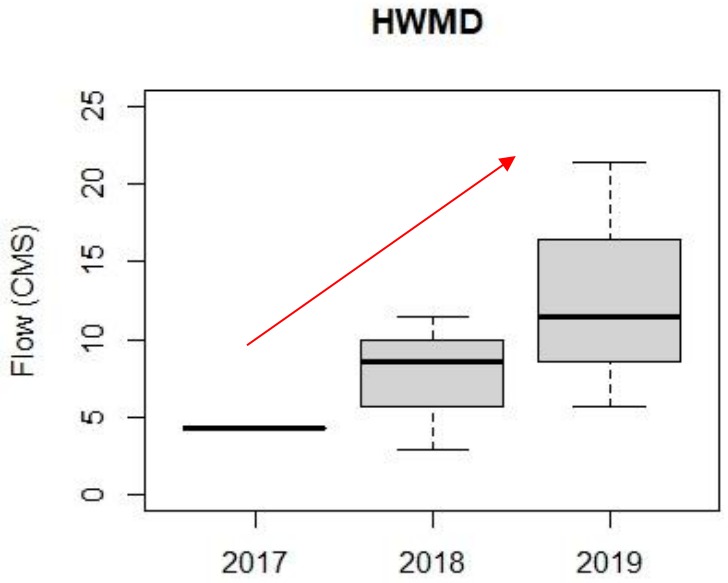
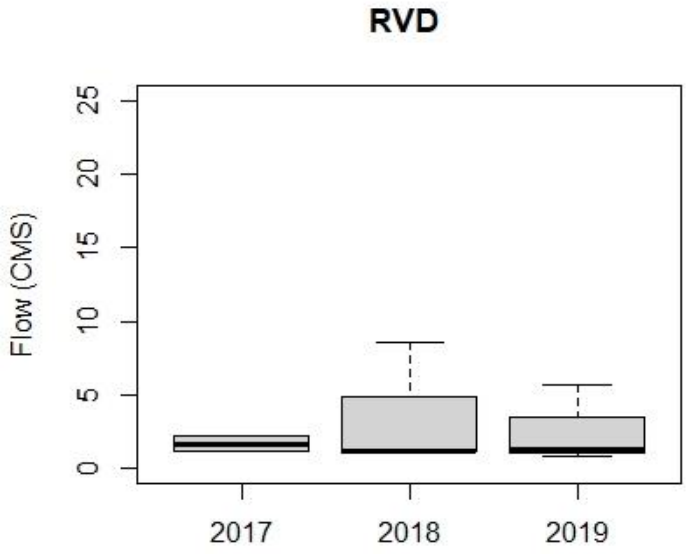
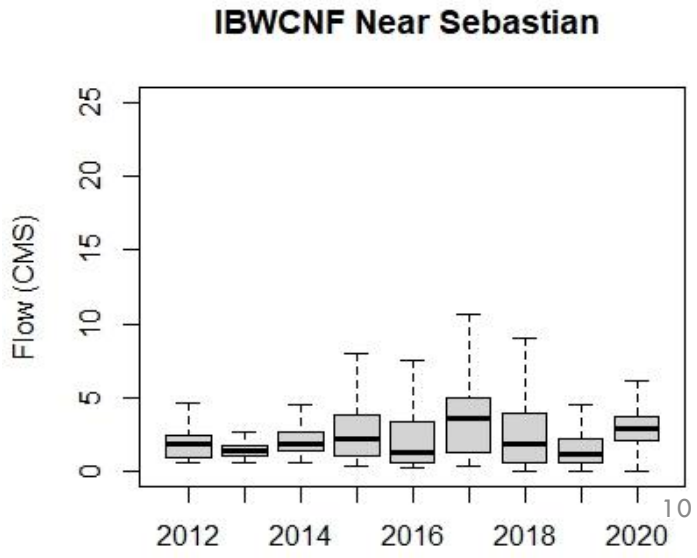
FLOW DATA

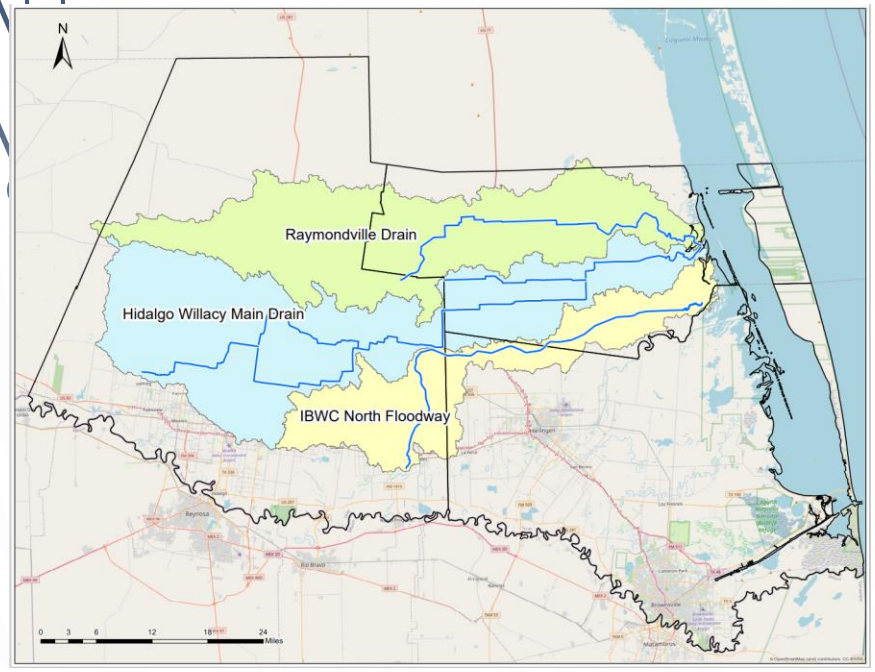
	HWMD	RVD	IBWCNF
Median	7.1	1.2	1.8
Mean	8.8	2.7	6.3
Min	2.9	0.9	0
Max	21.4	8.6	8,412.6

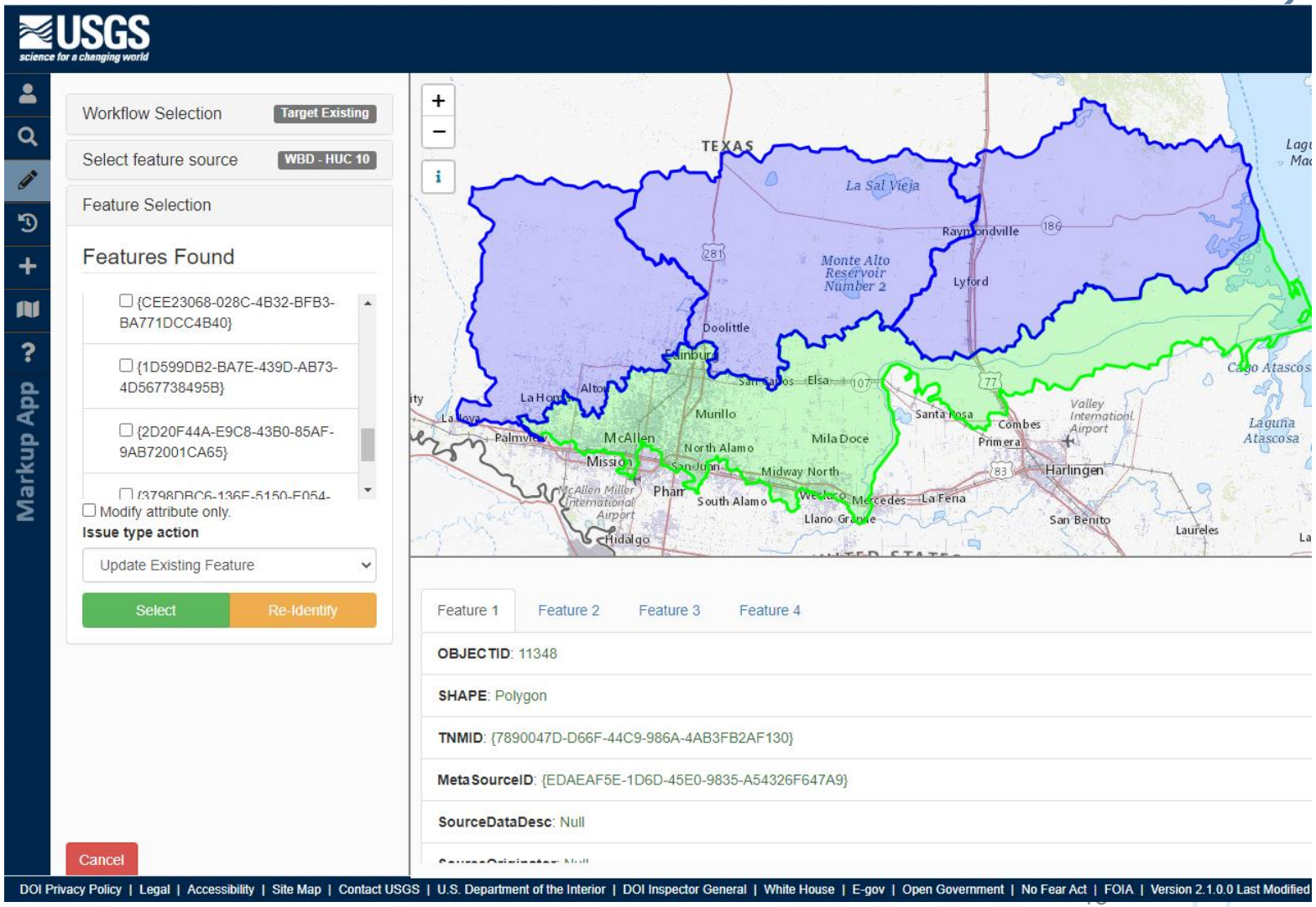






USGS NHD MARKUP





- Completed by UTRGV Graduate Student
- Markup App
- Recommend delineated watersheds for Watershed Boundary Datasets HUC 10

FWF PROJECT
MONITORING EFFORTS

- RTHS-Stage Heights: REON websites
- Two Quarterly Monitoring Campaigns
  - 2021-2022
  - Water quality samples
  - Flow measurements
- Future: Developing Rating Curves for Design

TWDB 1

- Raymondville Drain

TWDB 2

- Hidalgo Willacy Main Drain

TWDB 3

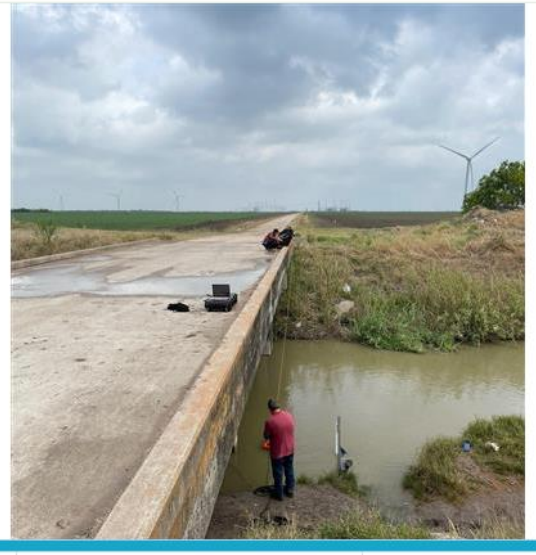
- IBWC North Floodway

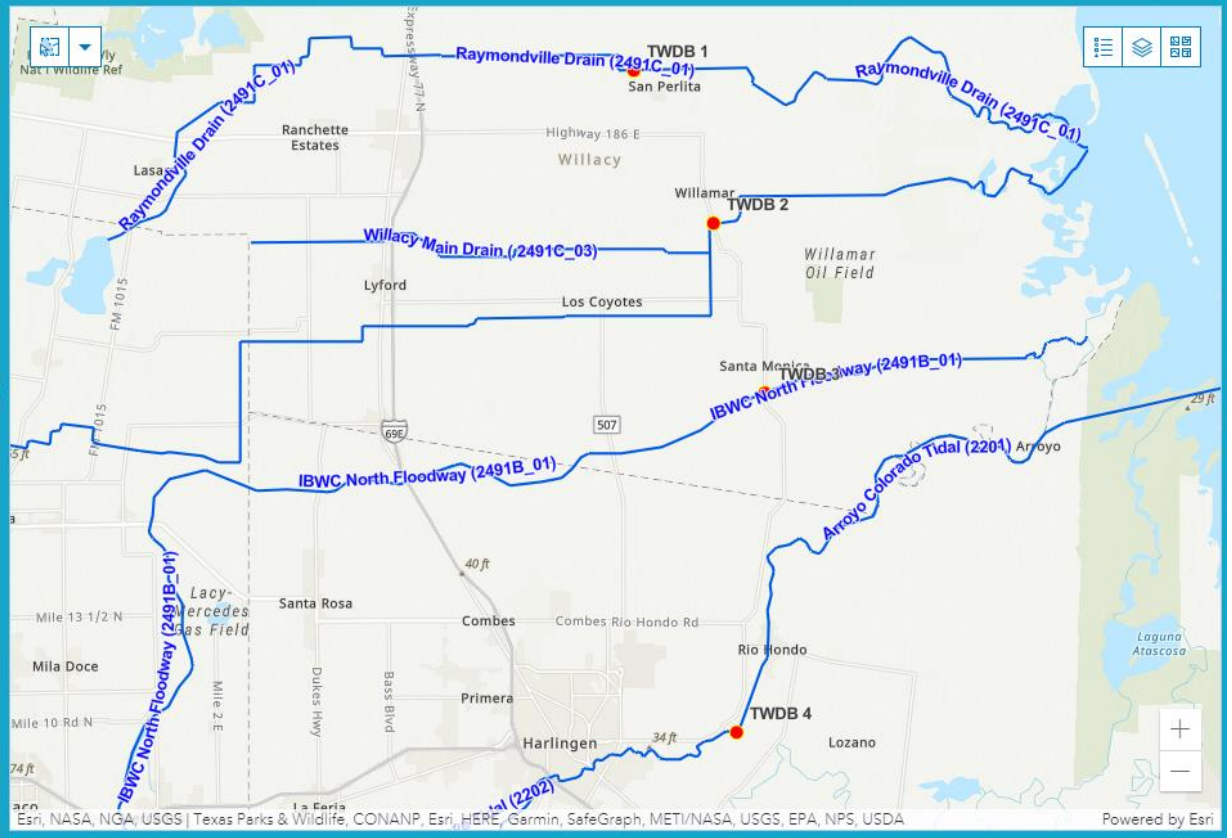
TWDB Freshwater Flows 2nd Quarter Monitoring Campaign

Select RTHS Station
TWDB 1

Field Data

Attendees for Field Work Activities	Christopher_Fuller,Mitch_Scoggins,Linda_Navarro,Ivan_Santos
Additional Attendees for Field Work Activities	
Date Field Work	
Purpose of Field Work	FWF Monitoring Campaign
Stations ID	TWDB 1
Station ID	
Time of the Records	11:22 am





RESEARCH, APPLIED TECHNOLOGY
EDUCATION AND SERVICE

Stations ID	RTHS Stage Height	Staff Gage Reading	Temperature	pH	SC (uS/cm)	DO (mg/L)
TWDB 1	0.925'	0.925' +- 0.005'	25.408	8.00	5463.7	7.09

WATER QUALITY AND FLOW DATA

Station ID	Waterway	Date	Total Coliform	E. coli	TKN [mg/L]	Total, NO2+NO3 [mg/L]	Total P [mg/L]	Flow [CMS]
TWDB 1	Raymondville Drain	12/01/2021 04/12/2022	>2419.16 >2419.6	3.1 727	1.51 <0.05	2.89 1.78	0.212 0.468	2.462 1.532
TWDB 2	Hidalgo Willacy Main Drain	12/01/2021 04/12/2022	>2419.16 >2419.60	579.4 727	1.66 1.5	6.23 3.87	0.393 0.512	4.229 3.483
TWDB 3	IBWC North Floodway	12/08/21 4/12/2022	>2419.16 >2419.60	159.7 150	0.657 1.28	8.39 4.61	0.234 0.464	5.02 1.859

NORTH AND CENTRAL WATERSHED CHARACTERIZATION PHASE II

- Extend Phase I Lower Rio Grande Valley-North and Central Watershed Characterization (UTRGV)
- Provide combination of continuous and event-based monitoring (modeled after LLM-BSC WPP)
- RTHS- stream monitoring
- 3 monitoring stations commissioned by TWDB-FWF
  - Raymondville Drain
  - Hidalgo-Willacy Main Drain
  - USIBWC North Floodway
- Monitoring Campaigns
  - Quarterly- water quality and hydrodynamic measurements
- DO, Water Temp, Conductivity, pH, Nitrate/Nitrite, Total Phosphorus, TKN, and *E. coli*
- ADCP discharge transects, flow measurements to develop discharge rating curves as a function of stage height

Project Lead

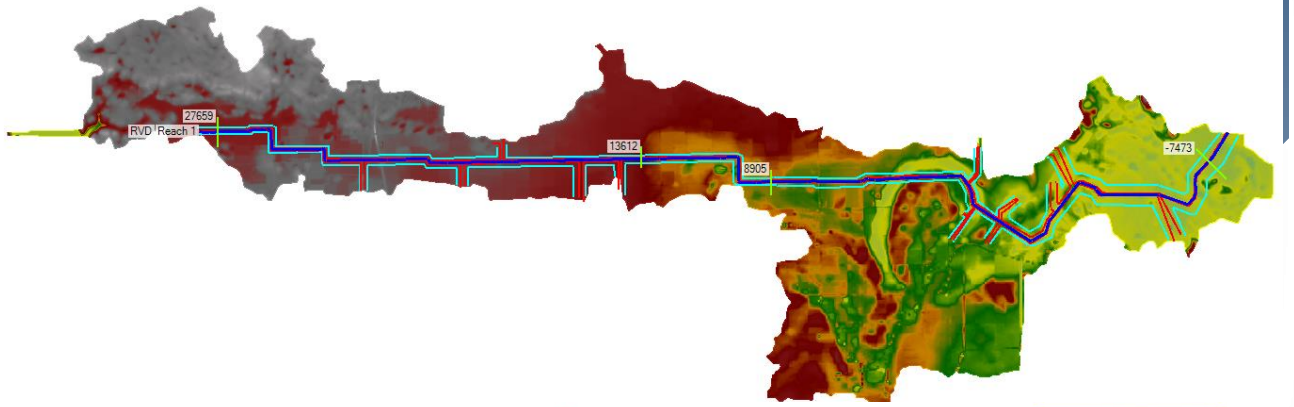
- RATES

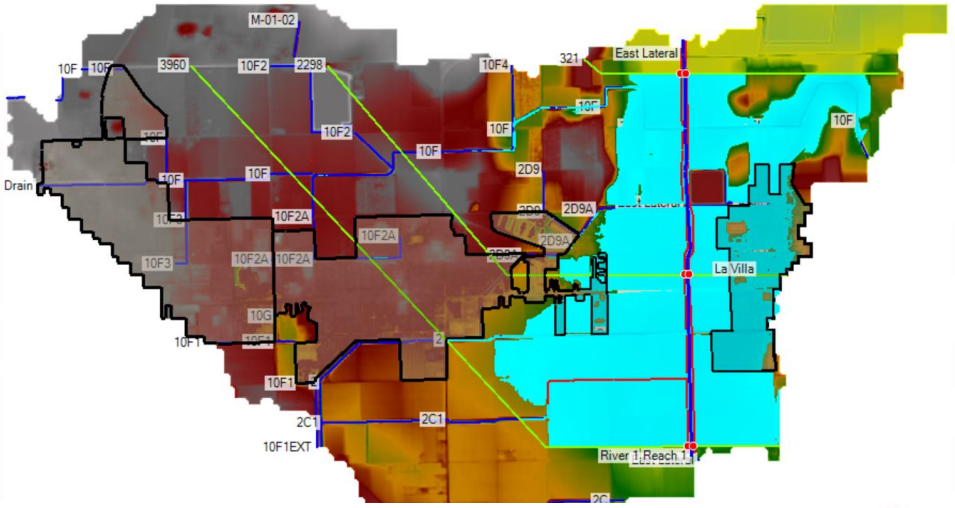
Budget:

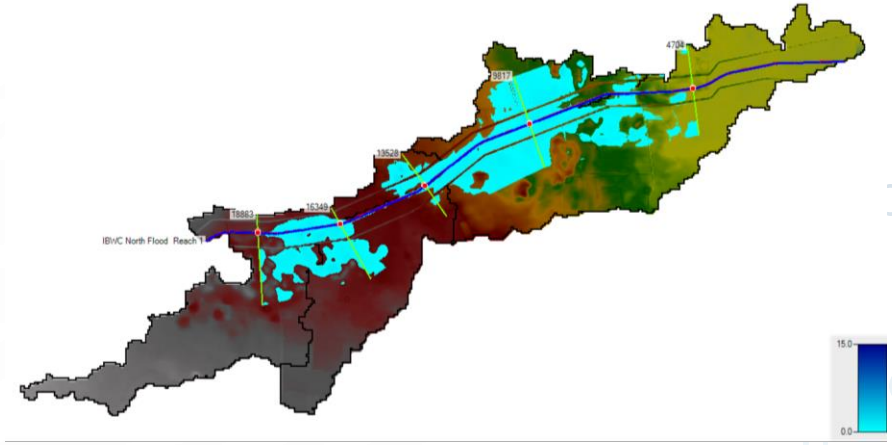
- Total: $225,000
- Federal: $135,000
- Match: $90,000
  - Lower Rio Grande Valley-TPDES Stormwater Tasks Force
  - Cameron County Texas

FIF PROJECT
MODELLING EFFORTS

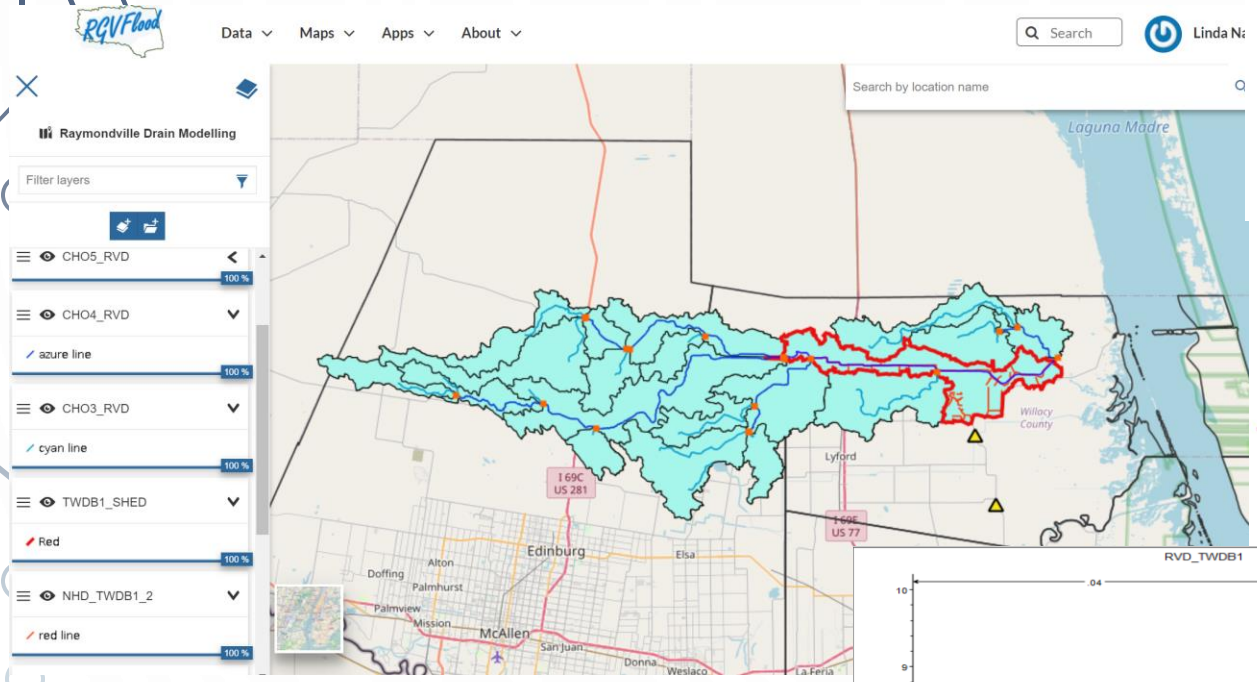
- Hydrologic and Hydraulic
  - Ultimate Operational Hydrologic Model
    - WRF-Hydro Model
  - Preliminary Model for HEC-RAS Development
    - HEC-HMS
  - Hydraulic Model HEC-RAS
- Hydrologic Model
  - Precipitation Data: NOAA Frequency Storm Events
    - 10- year
    - 50- year
  - Land Cover Data from Texas Natural Resources Information System (TN
- Hydraulic Model HEC-RAS
  - LiDAR elevation data from 2018- (TNRIS)
  - Roughness Coefficient



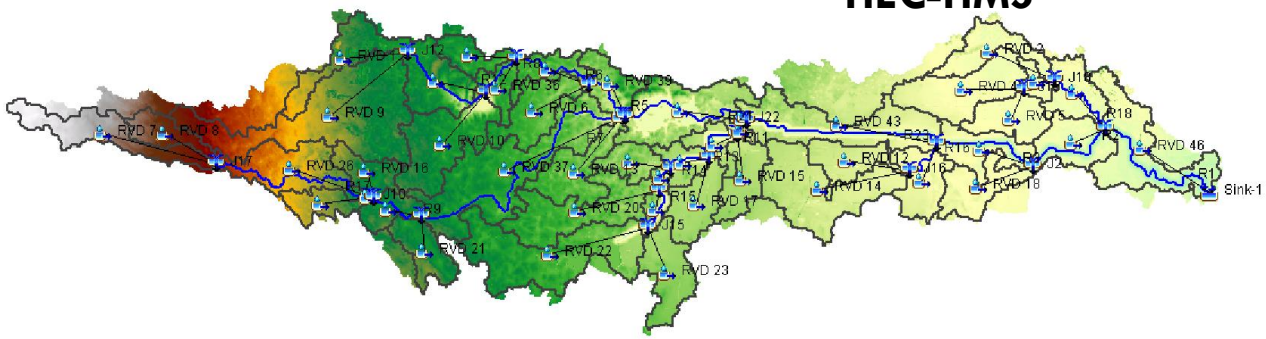




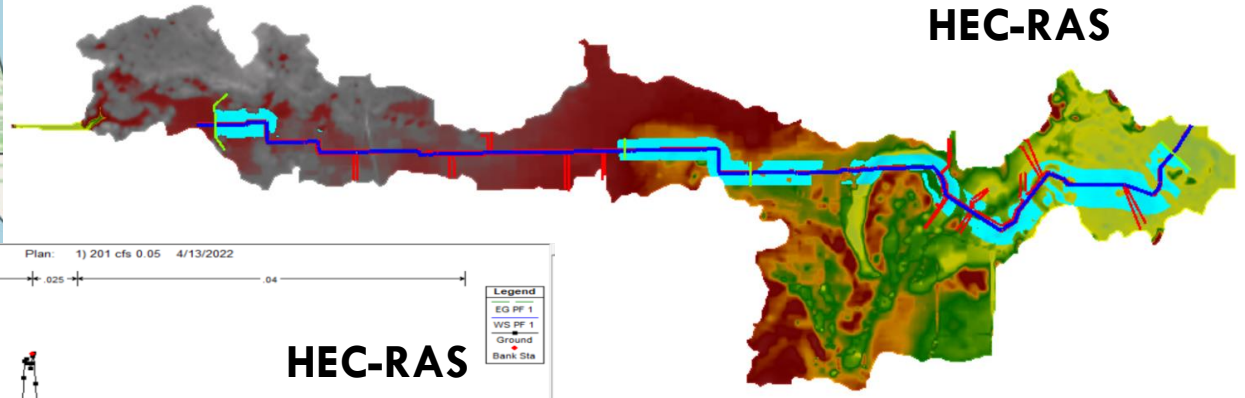
RAYMONDVILLE DRAIN



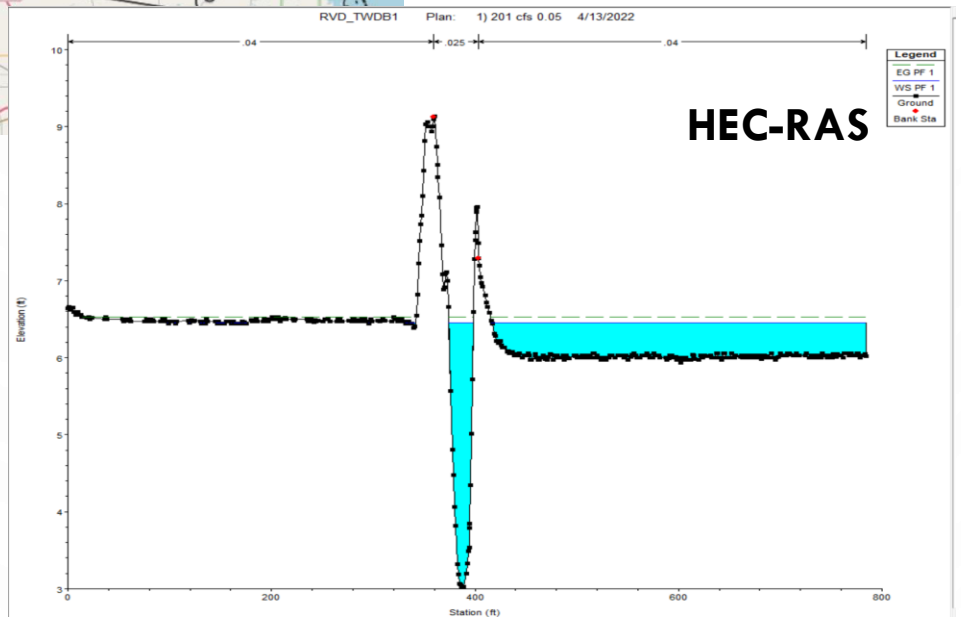
HEC-HMS



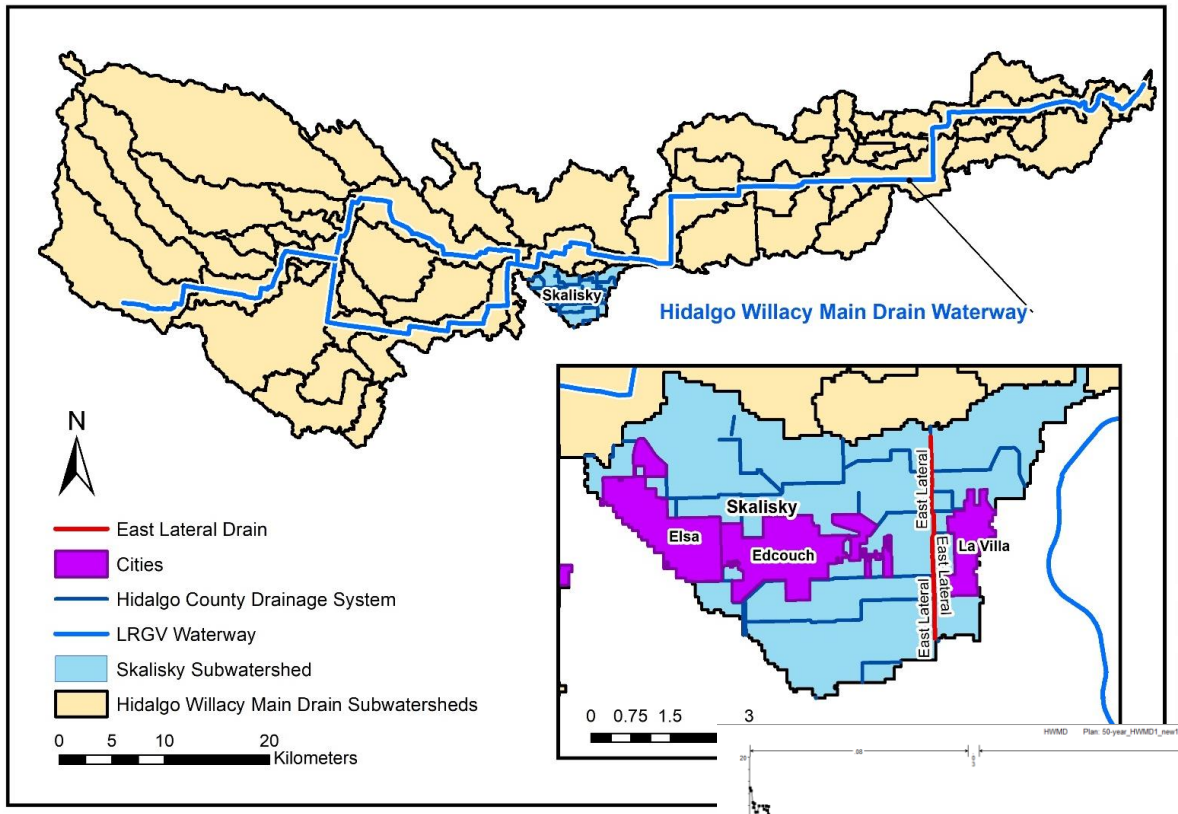
HEC-RAS



HEC-RAS



HIDALGO WILLACY MAIN DRAIN



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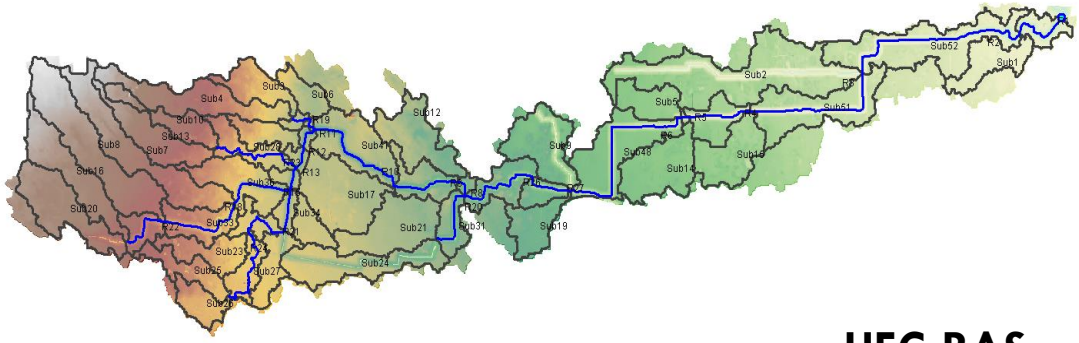

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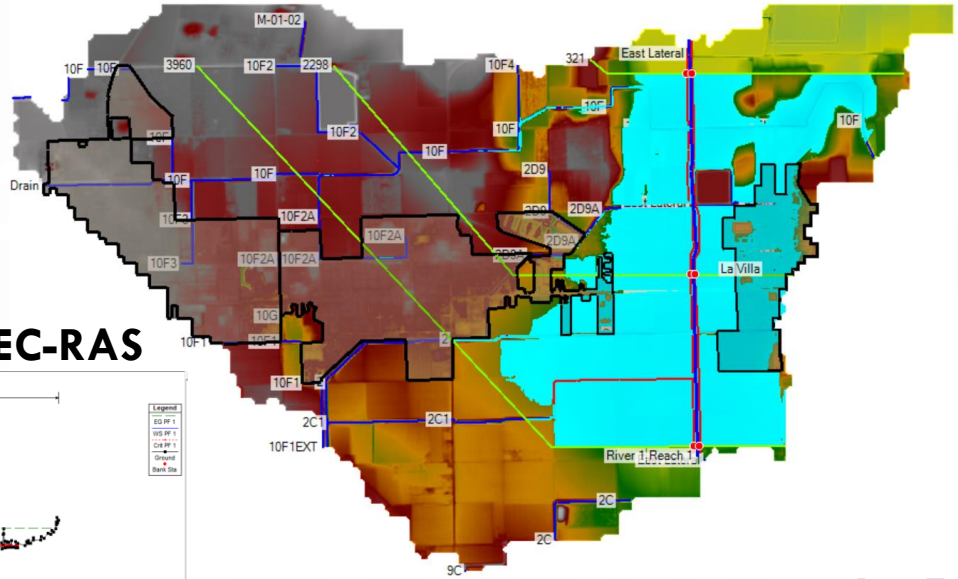
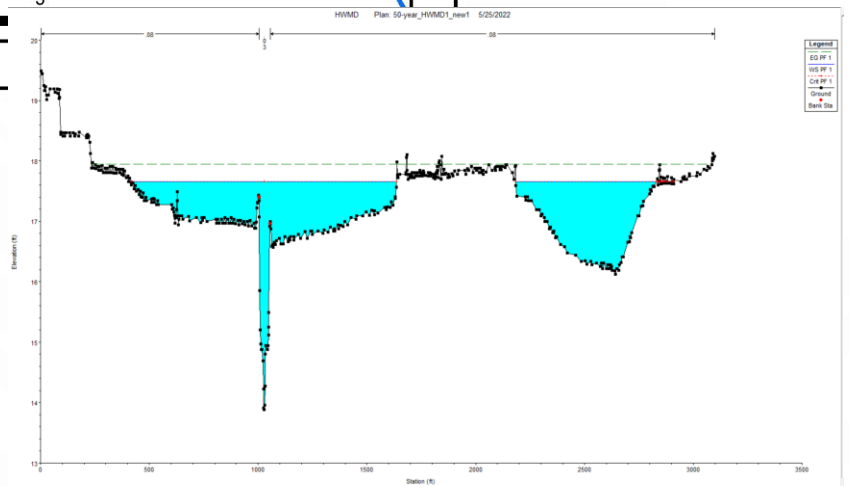
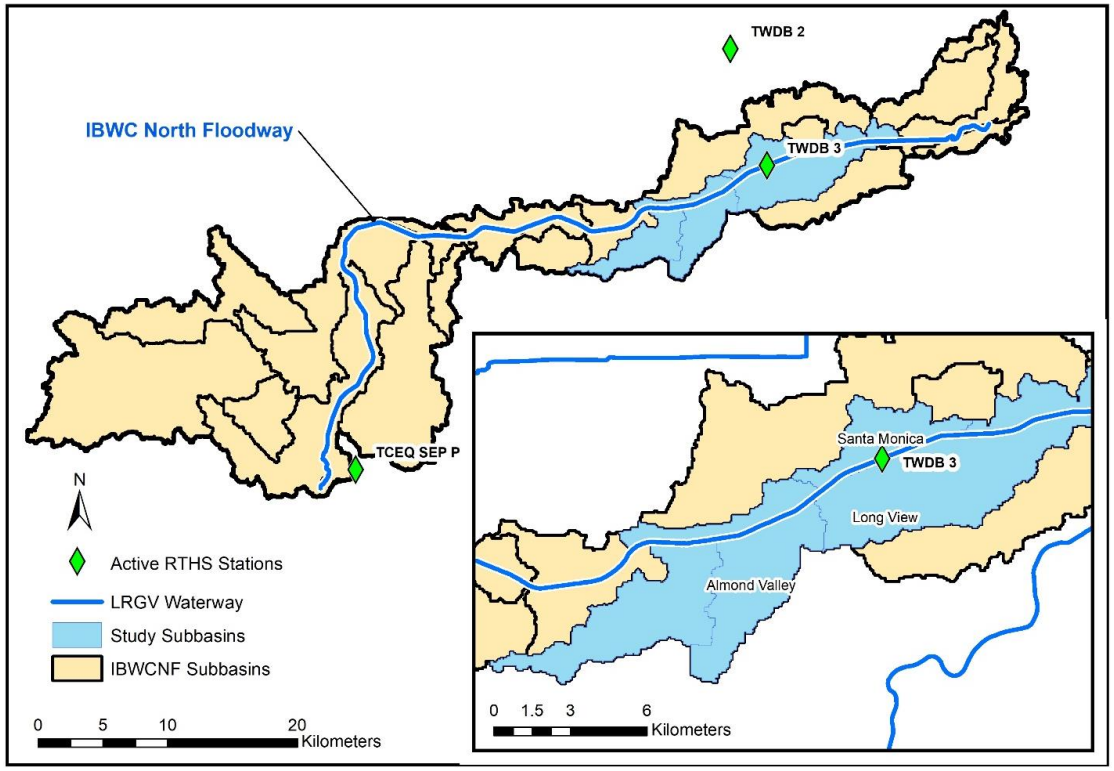


HEC-RAS



IBWC NORTH FLOODWAY



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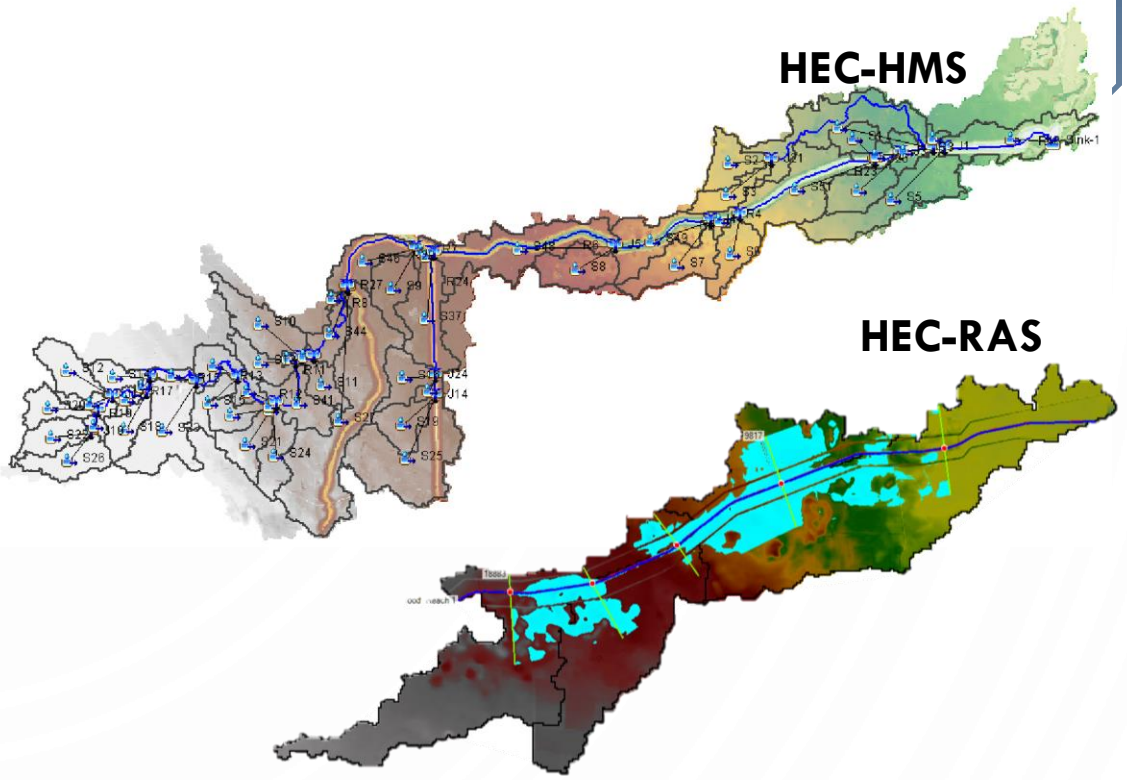

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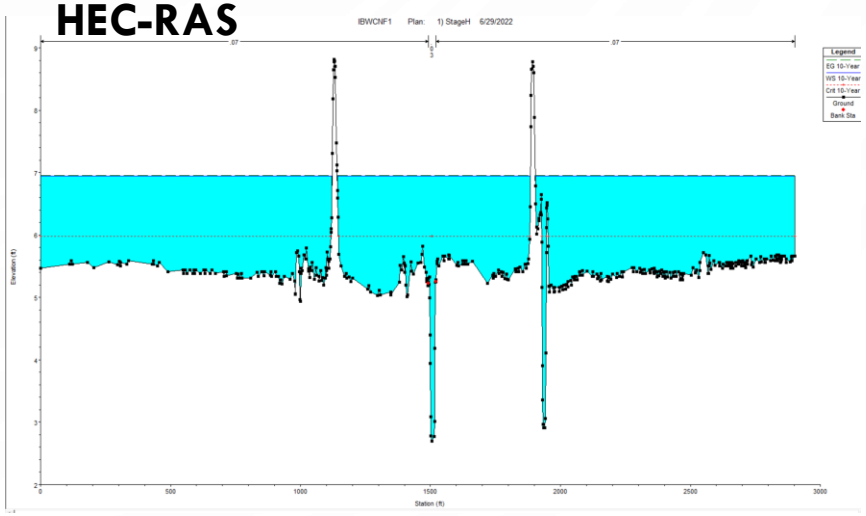
HEC-RAS



CURRENT AND FUTURE EFFORTS

- 319 Project
  - Watershed Characterization Report Draft by July 2022
- FWF
  - 3rd Sampling Event July 19-20 2022
- FIF
  - Modelling Effort for IBWC North Floodway Prototype
  - Deploying RTHS Stations

QUESTIONS

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