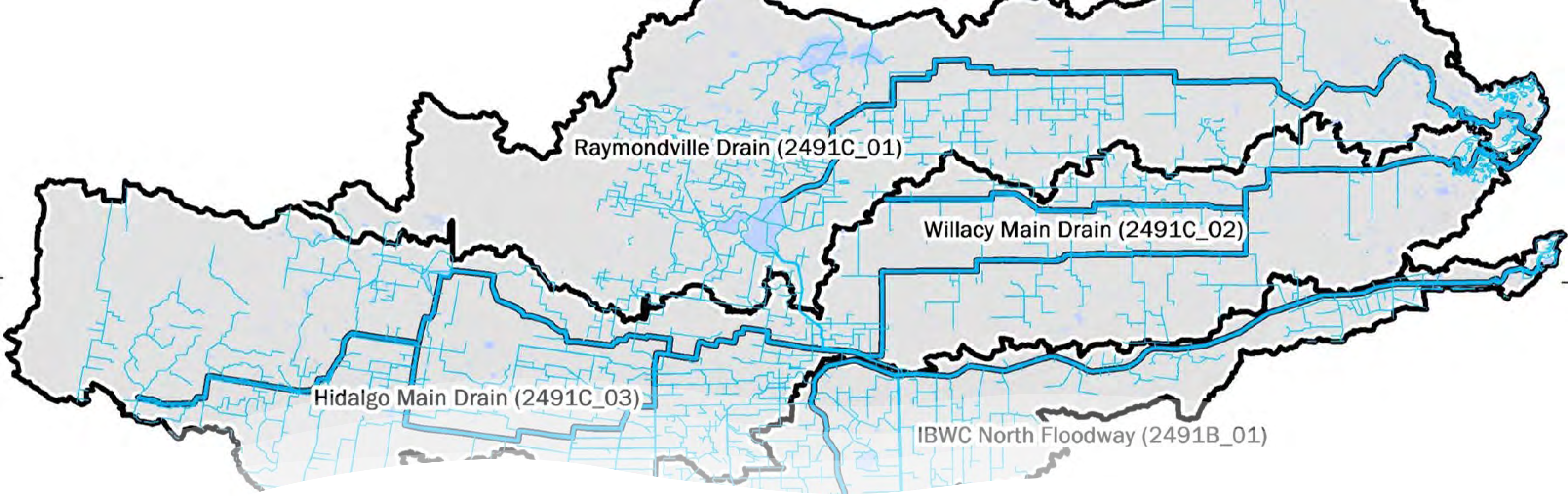
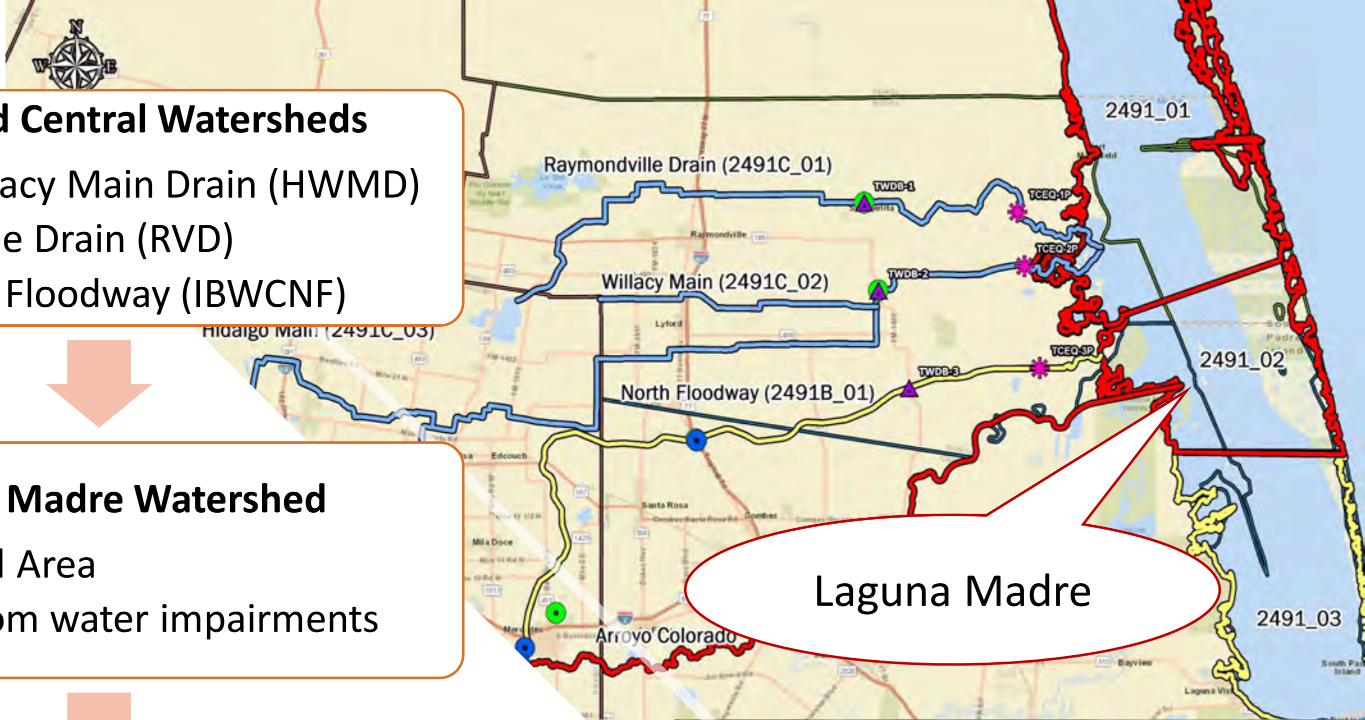


Development of Cyberinfrastructure for Assessment of the Lower Rio Grande Valley North and Central Watersheds Characteristics

Linda Navarro
April 20, 2020

Introduction



North and Central Watersheds

- Hidalgo Willacy Main Drain (HWMD)
- Raymondville Drain (RVD)
- IBWC North Floodway (IBWCNF)

Laguna Madre Watershed

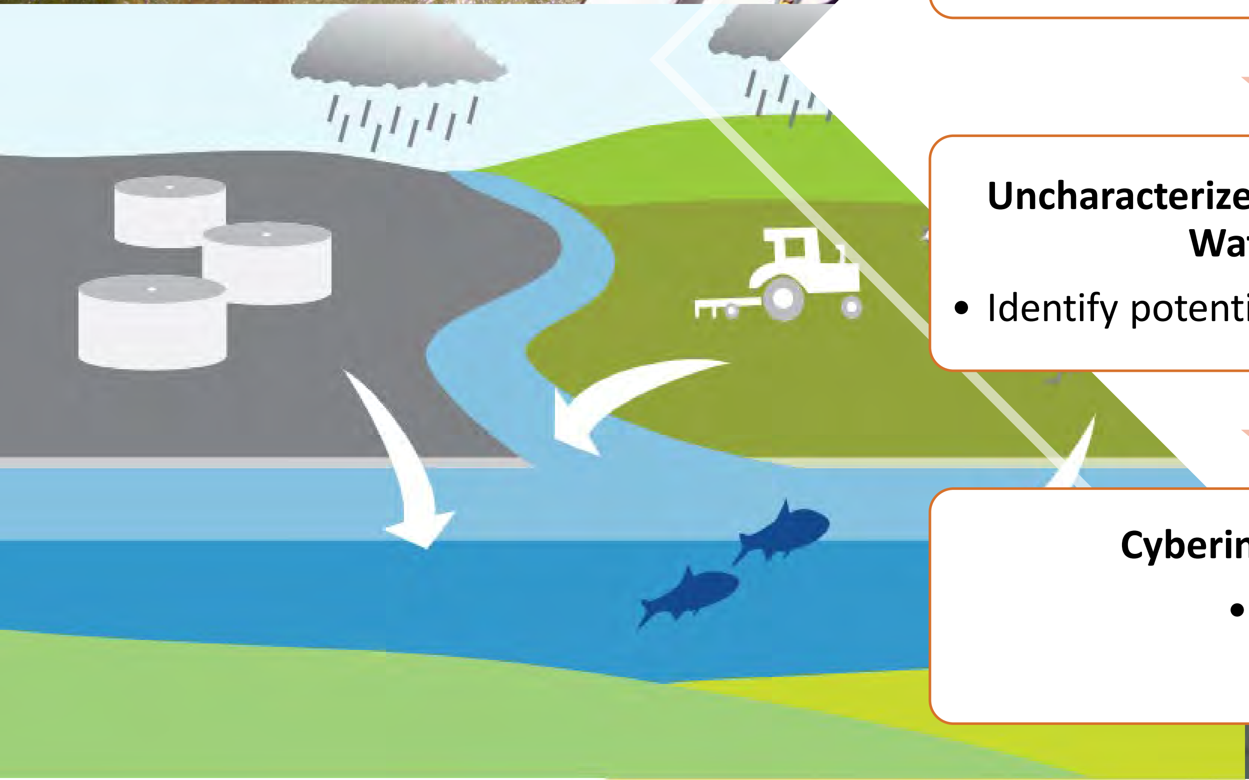
- Recreational Area
- Threaten from water impairments

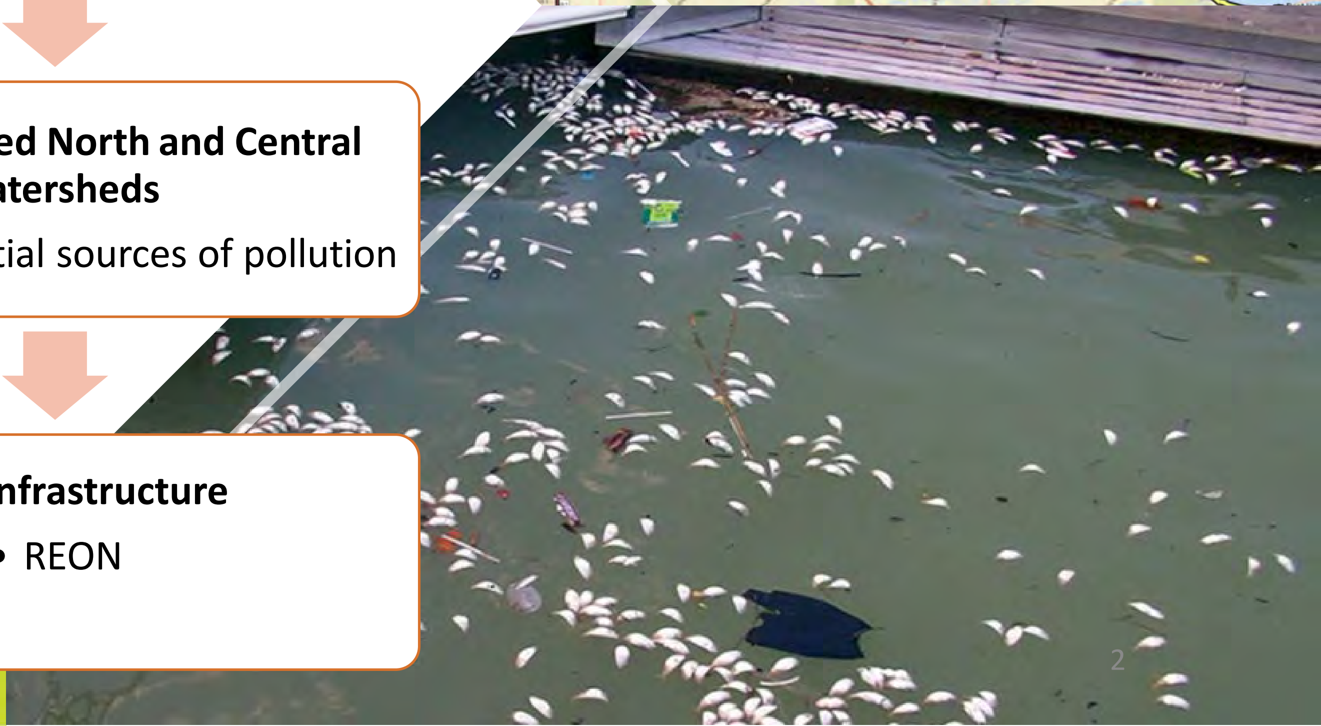
Uncharacterized North and Central Watersheds

- Identify potential sources of pollution

Cyberinfrastructure

- REON





Background

Cyberinfrastructure

- A study observed that not only did the use of technical infrastructure increase the widespread access to data; the available computing power also made it possible for the researchers to analyze large amounts of data, over longer time spans and a greater range of locations (Yu et al., 2021)
- An author stated that the cyberinfrastructure secures data and delivers interpreted information via a sequence of web services distinct stakeholders (Gutenson et al.,2020).
  - REON.cc now serves as a cyber-collaboratory platform for engaging stakeholders with an interest in data and information for a certain location

Watershed Delineation

- A study conducted a hydrological analysis with watershed GIS-based applications to assist both technical and non-technical users for decision-making (Gutenson et al.,2020).
- A study highlighted the importance of high resolution in data resources to obtained accurate results in watershed drainage areas (Amatya et al., 2013).

Background

Sources of Pollution

- A report indicated that more than 40 percent of all impaired waters were affected solely by nonpoint sources, while only 10 percent of impairments were caused by point source discharges(EPA, n.d.-b) .
- Urbanization has led to increased water transfers from agriculture to urban uses(Hernandez & Uddameri, 2013;Black&Veatch,2016)

Water Quality

- In the US, 70% of rivers and streams are not assessed (EPA 2017). 53% that are assessed are considered impaired.
- A study stated that fecal bacteria usually comes from stormwater discharges (Abrams 2012).
- Improper wastewater management practices have caused severe water quality problems regarding dissolved oxygen, bacteria, and algae (TCEQ, 2006a).

Objectives

Laguna Madre Watershed
- Impairments

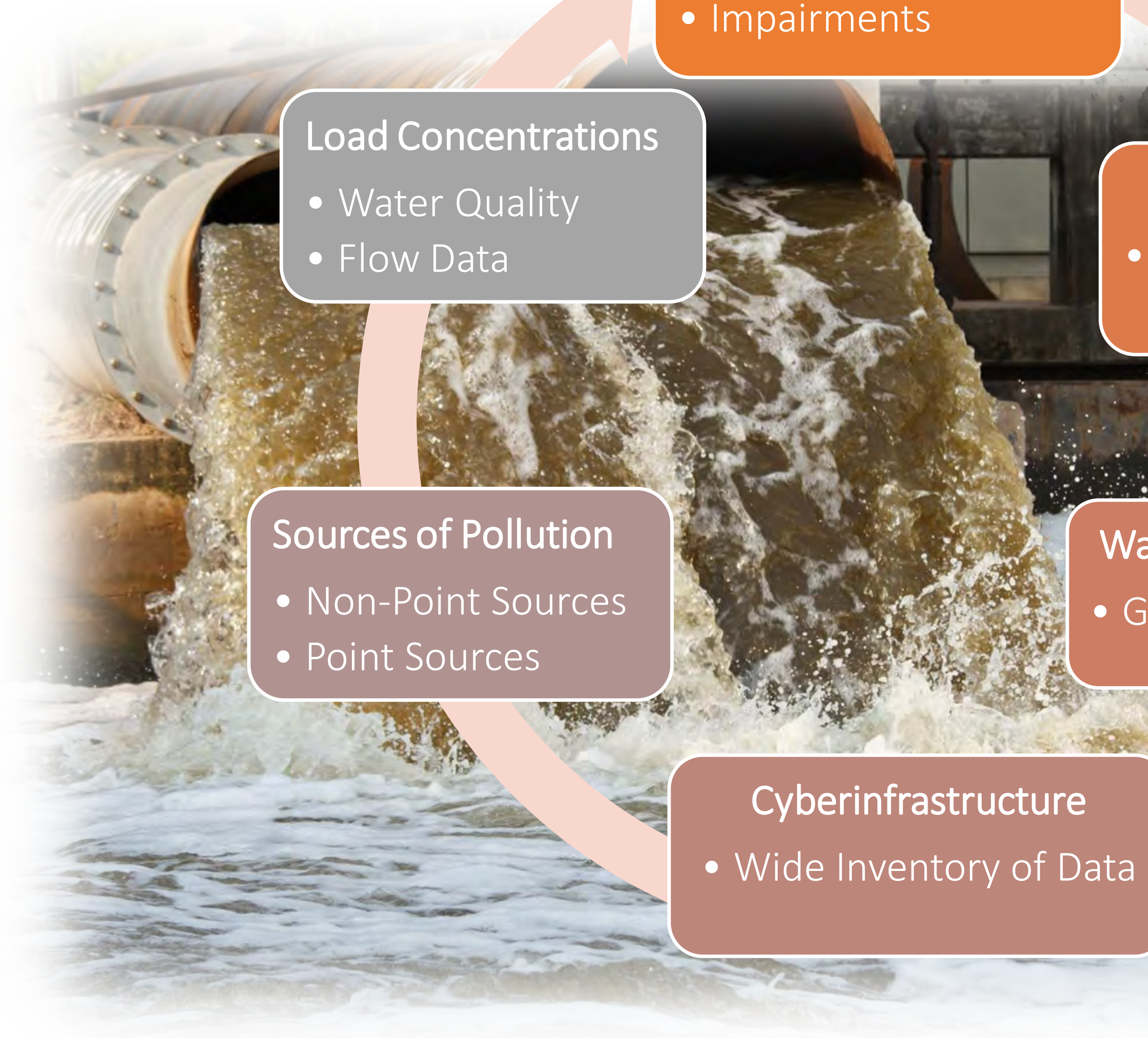
Insufficient Data
- Watershed Characterization

Watershed Delineation
- GIS Platform

Cyberinfrastructure
- Wide Inventory of Data

Sources of Pollution
- Non-Point Sources
- Point Sources

Load Concentrations
- Water Quality
- Flow Data



Study Area

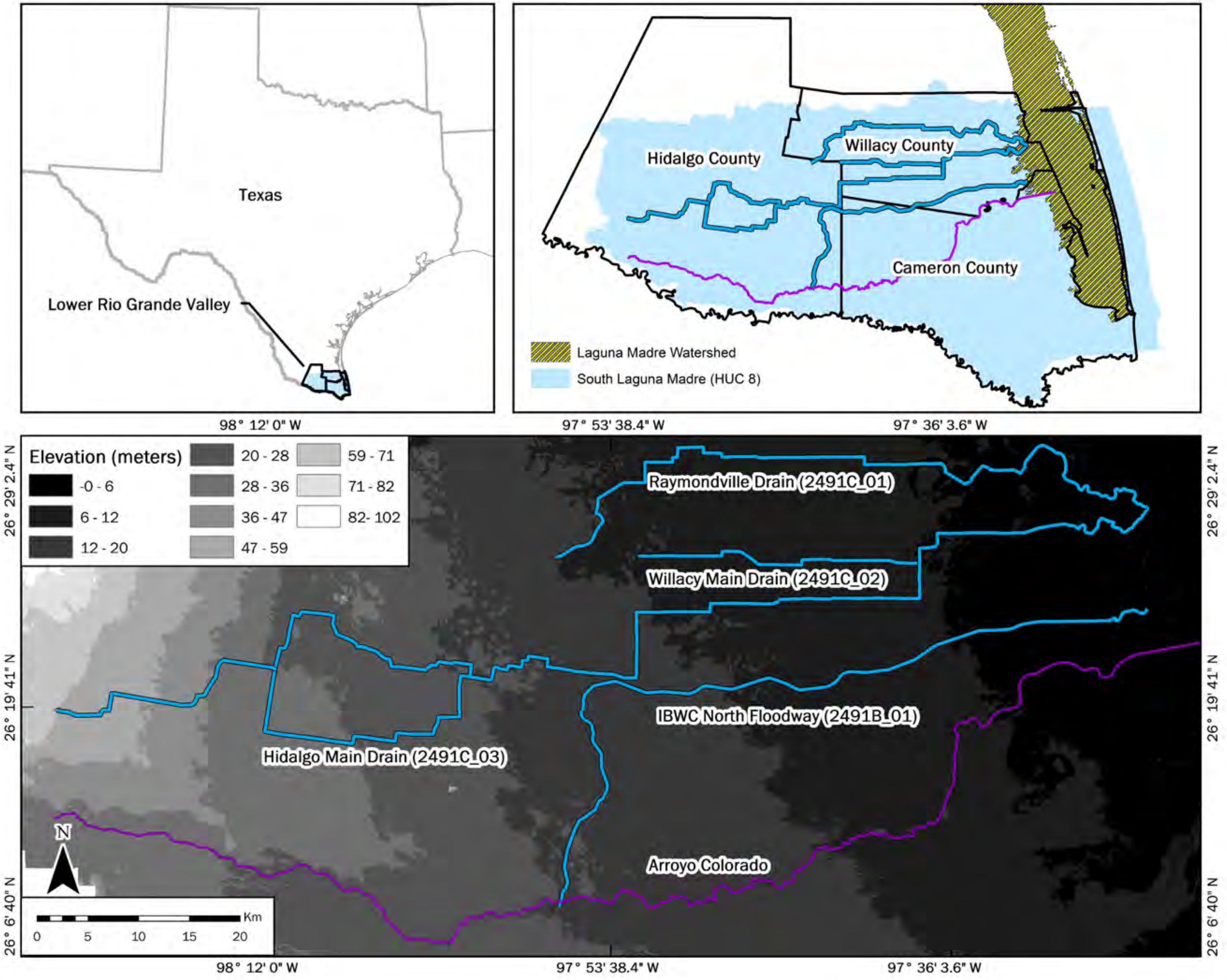


Figure 1: Location of the North and Central Watersheds

- **LRGV Region**: Hidalgo, Willacy, and Cameron Counties
- The waterways area generally slopes southeast
- Flat elevation from 102 to 0 meters
- Clay soils: Low permeability
- Proximity to the Arroyo Colorado

Study Area

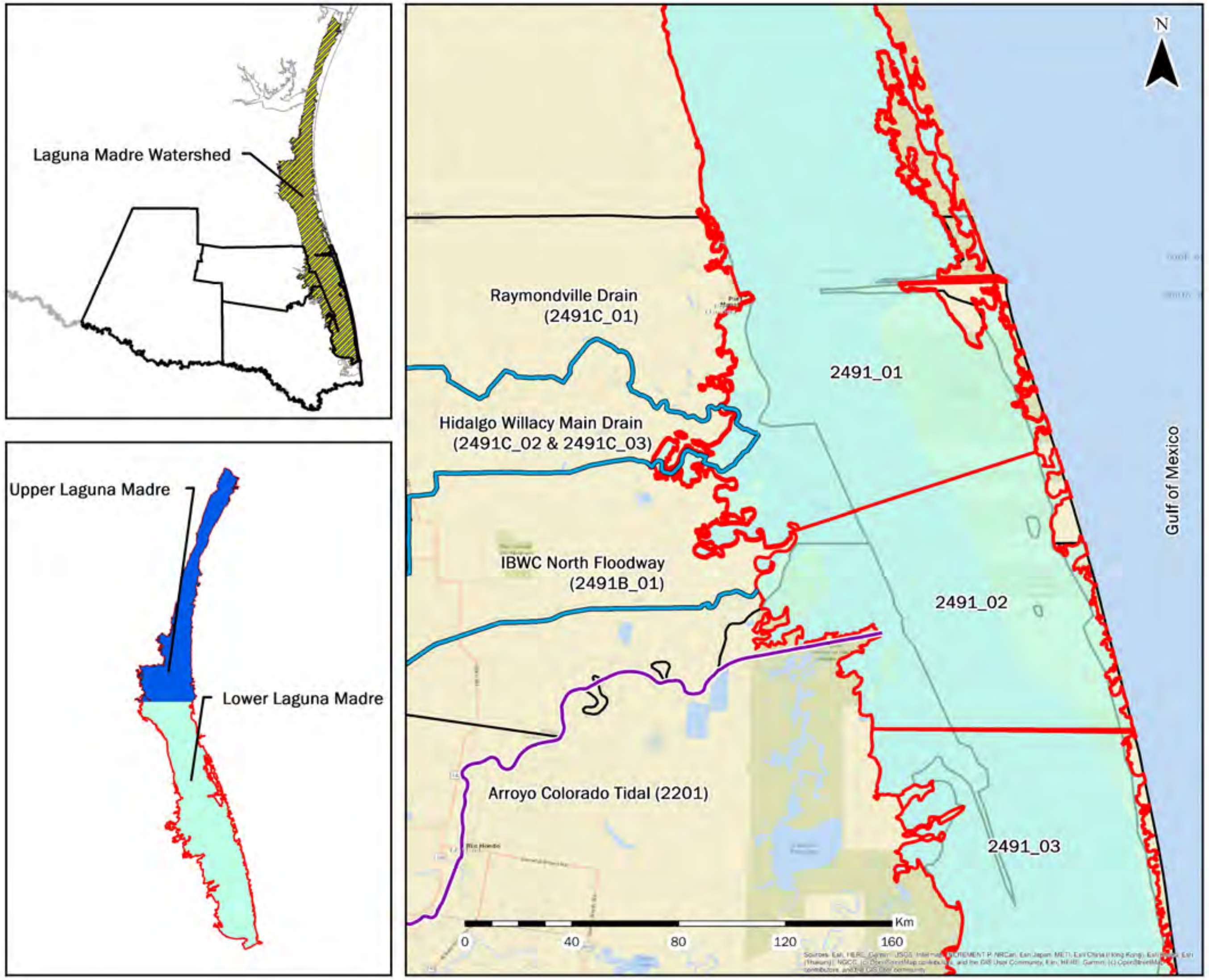


Figure 2: Location of the Laguna Madre

Methodology

Cyberinfrastructure

- **REON:** Development of Maps
- Data collection
- Watershed Characterization

Watershed Delineation

- DEM Reconditioning
- Hydrology Tools

Sources of Pollution

- Non-Point Source
- Point Sources
- State and Local data

Water Quality and Flow data

- State and Local Agencies
- Loading Concentrations

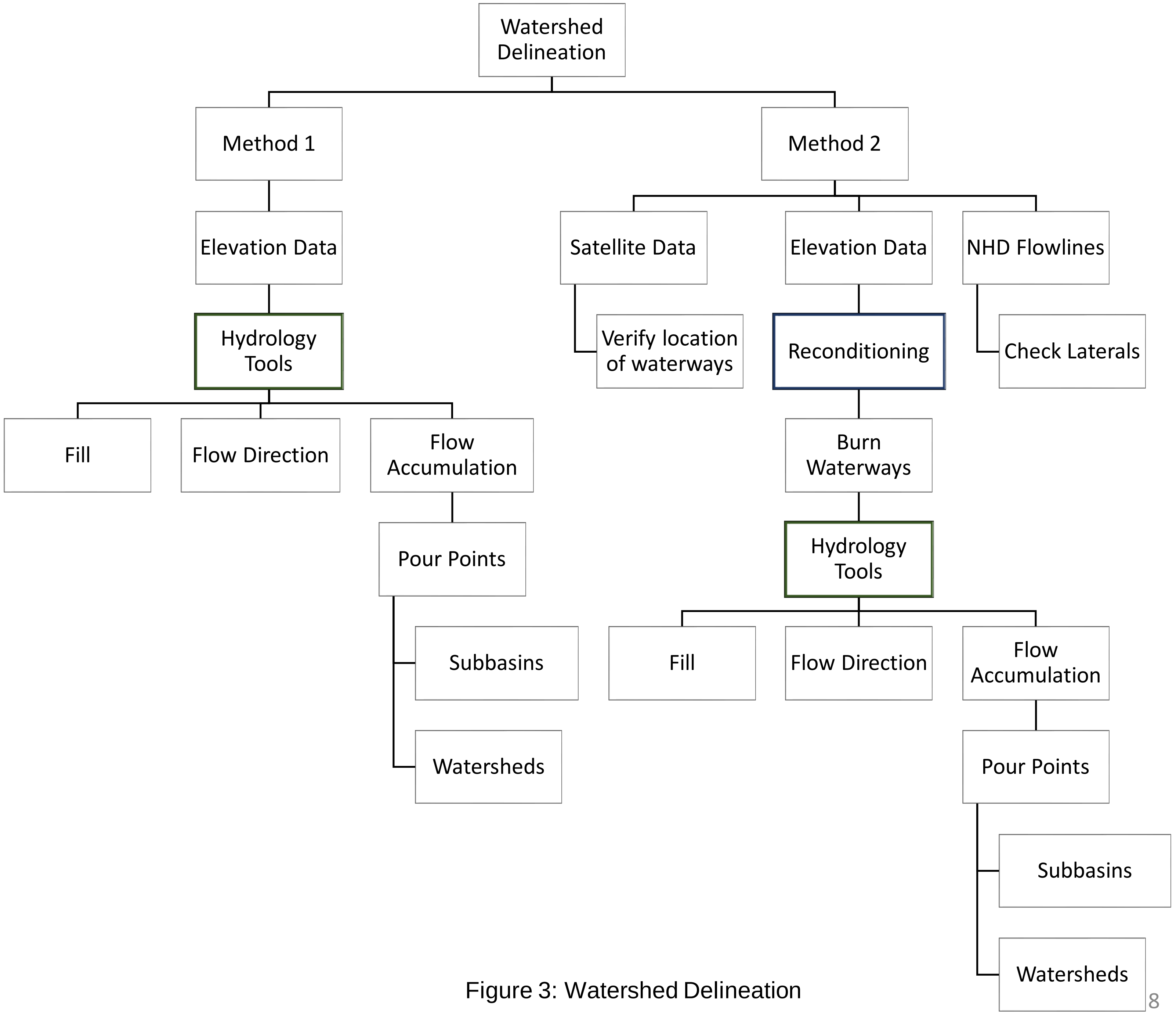


Figure 3: Watershed Delineation

Watershed Delineation

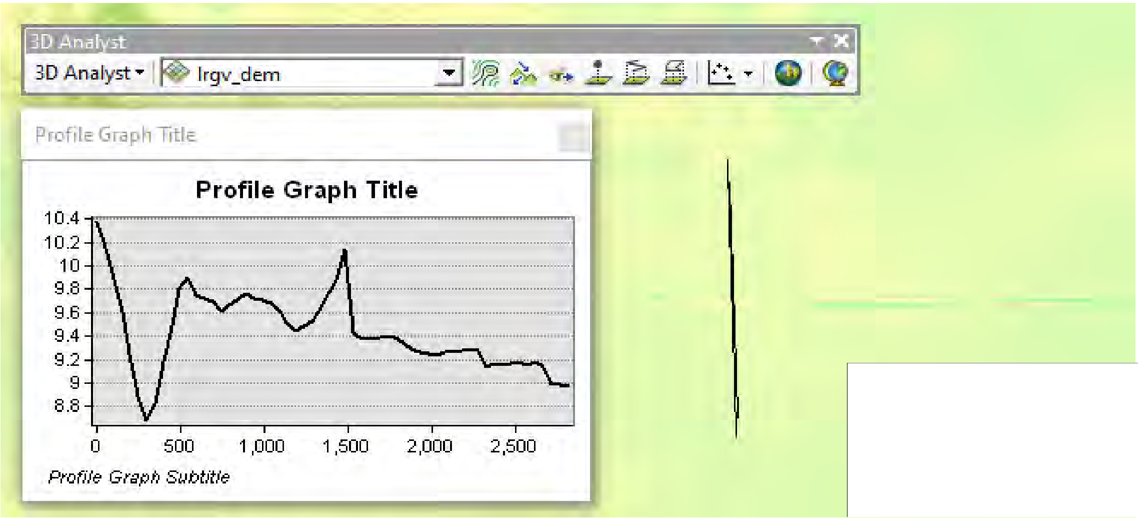


Figure 4: LIDAR elevation data

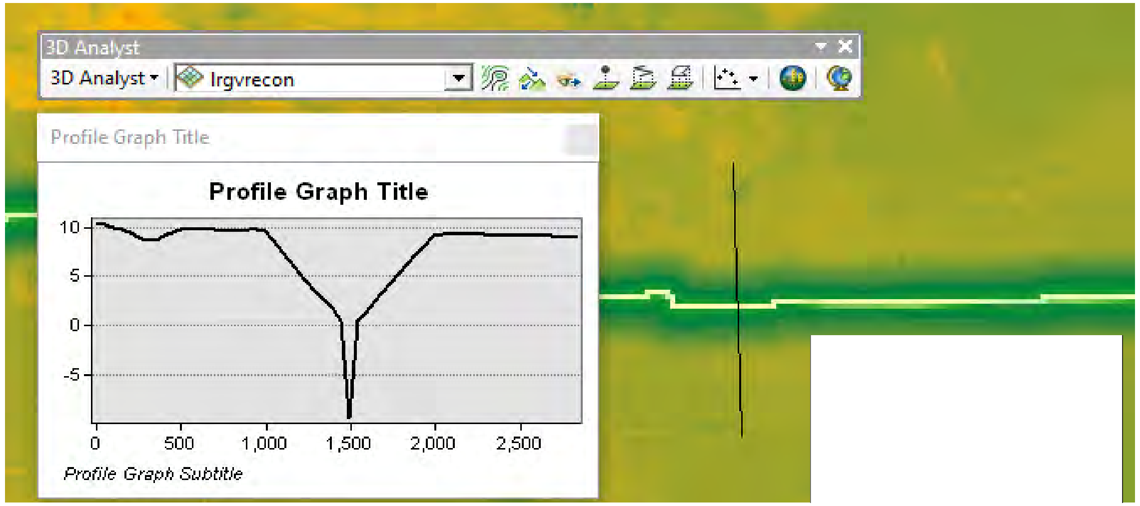


Figure 5: LIDAR elevation data recondition

Results

Cyberinfrastructure

REON Website

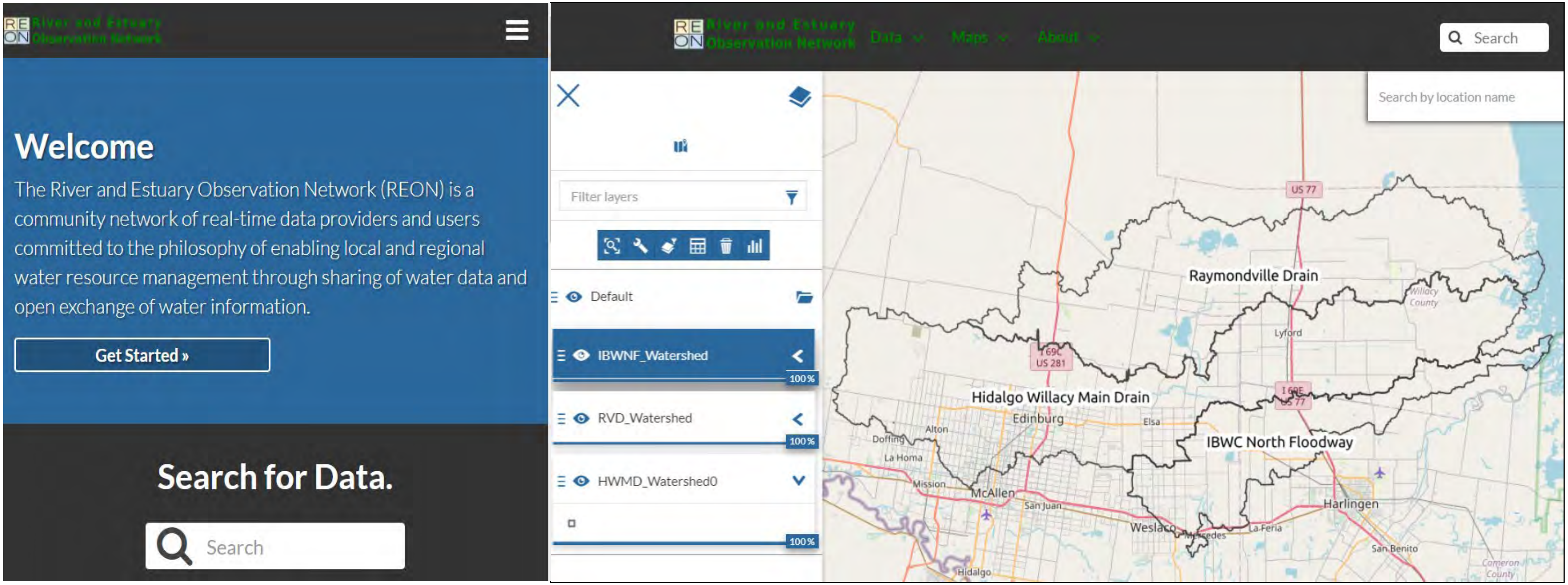


Figure 6: Cyberinfrastructure site

Watershed Delineation
Method 1

Addition of pour points

- Proximity between waterways

Flow Accumulation lines

- No correlation with the waterways

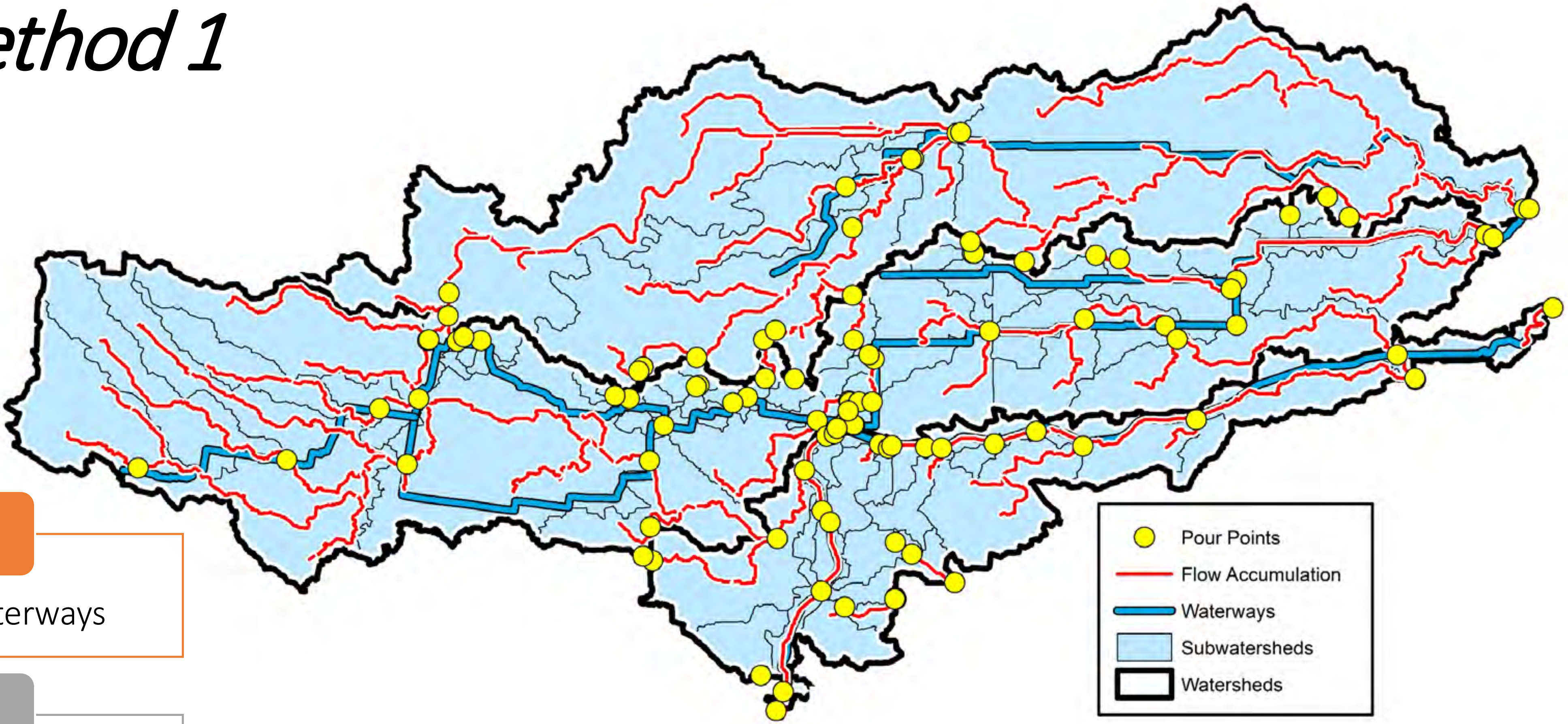


Figure 7: Subbasins of the North and Central watersheds

Watershed Delineation

Method 2

Addition of pour points

- Only 3 pour points

Flow Accumulation lines

- Correlated with the waterways

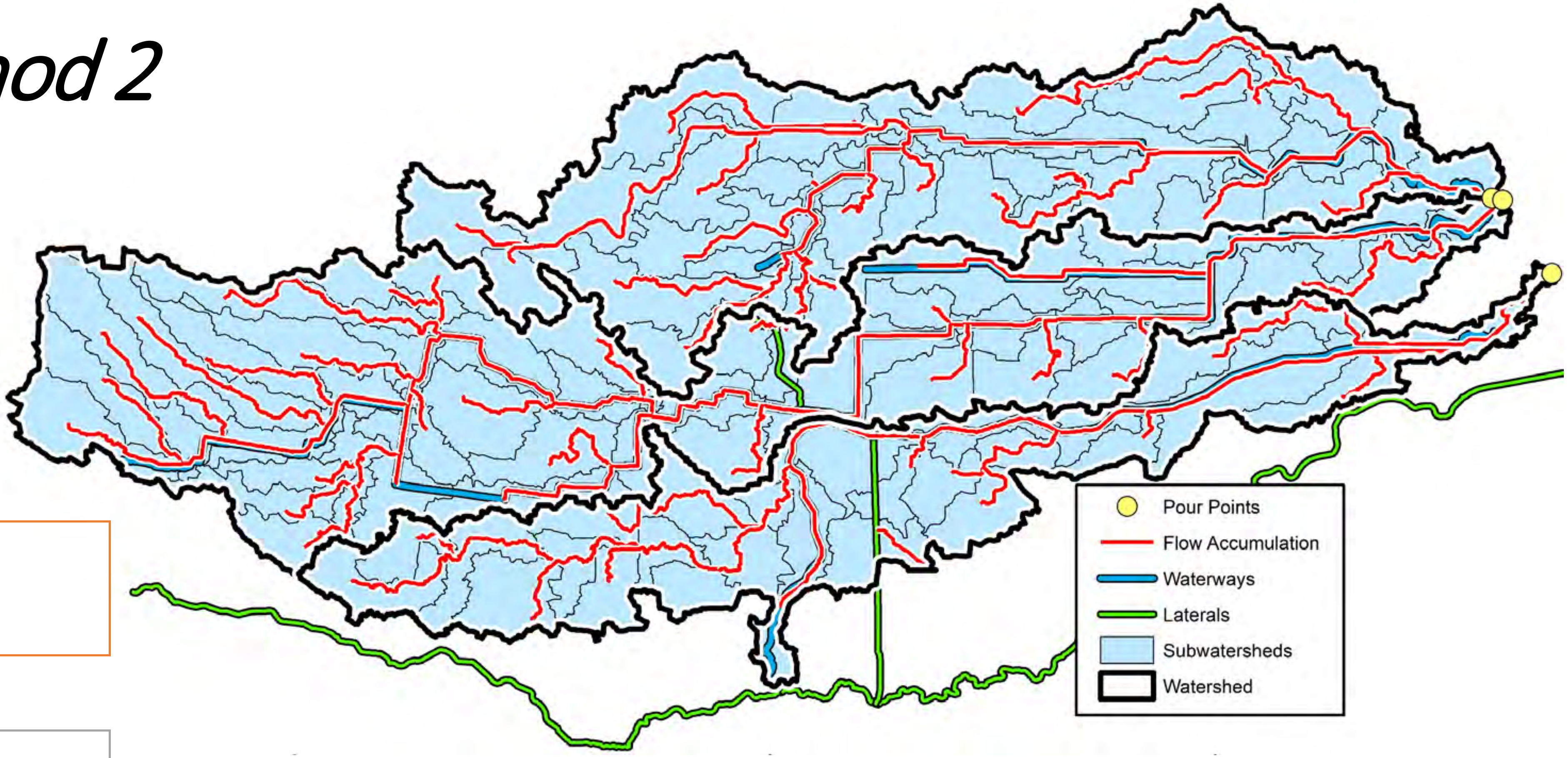


Figure 8: Subbasins of the North and Central watersheds with new DEM

Watershed Delineation

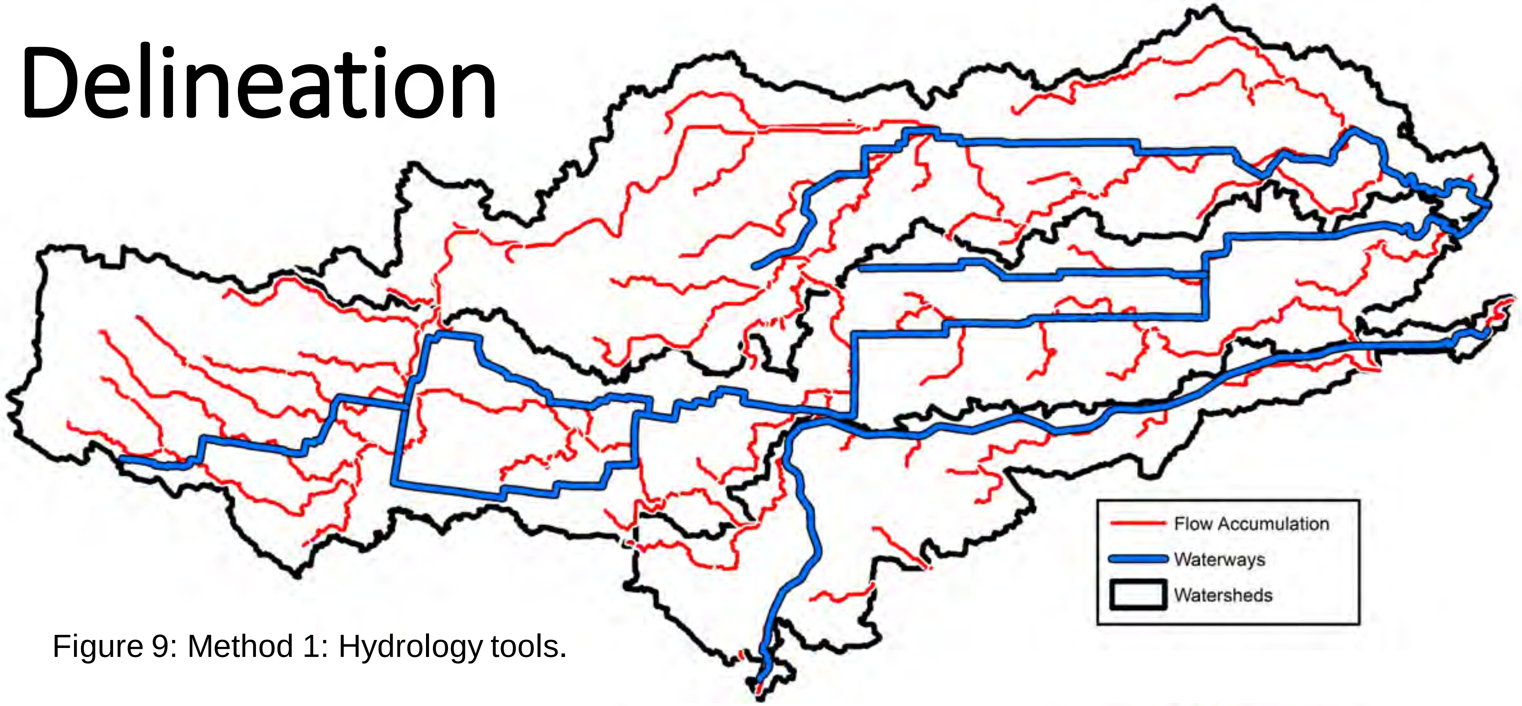


Figure 9: Method 1: Hydrology tools.

Method 1

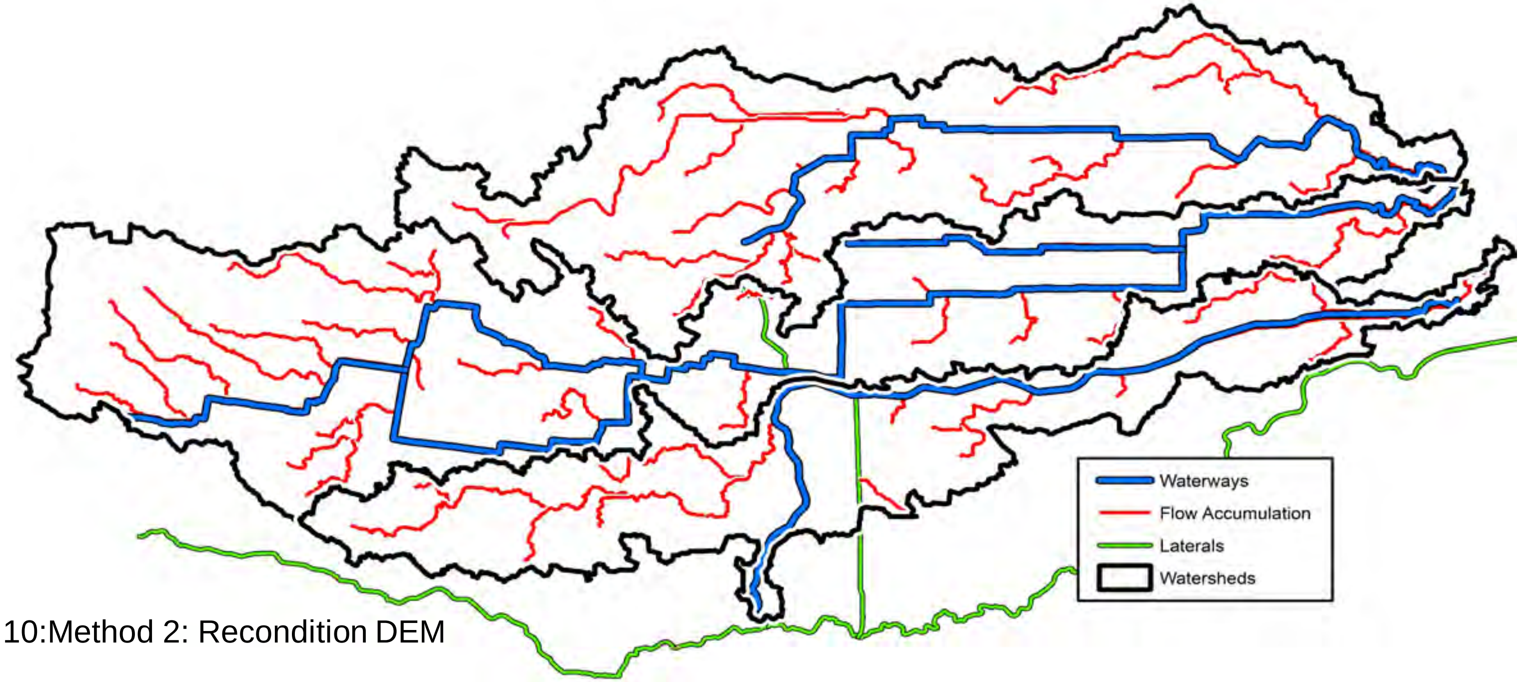


Figure 10:Method 2: Recondition DEM

Method 2

Watershed Delineation

Areas Results

Counties Contribution

Cities:

- HWMD: MSA –McAllen-Edinburg-Mission
- RVD: San Perlita and Raymondville
- IBWCNF: McAllen, Pharr, San Juan

Subwatersheds

- HWMD: 91
- RVD: 72
- IBWCNF:73

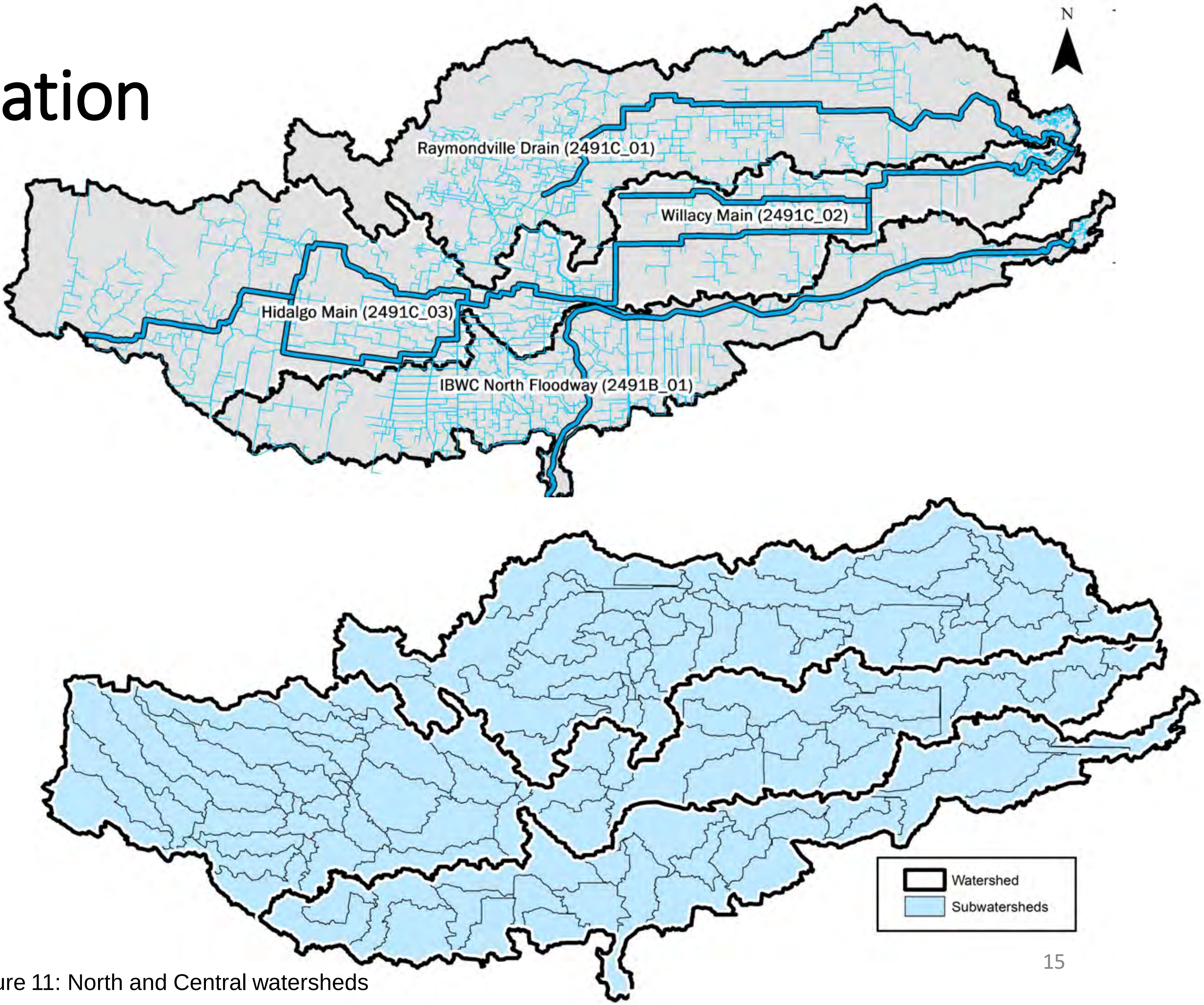


Figure 11: North and Central watersheds

Table 1: Non-Point Sources of pollution

	HWMD	RVD	IBWCNF
Urbanized Areas	0.20	0.05	0.24
Cultivated Crops	0.47	0.52	0.59
STLR	0.06	0.20	0.04
Species	0.03	0.10	0.20
WMA	0.00	0.00	0.00
OSSFs	3.38	0.05	6.13
Colonias	0.25	0.01	0.29

Non-Point Sources

HWMD

- Urban Areas

RVD

- (STLR)Ranches

IBWCNF

- Agricultural lands
- Species
- OSSFs
- Colonias

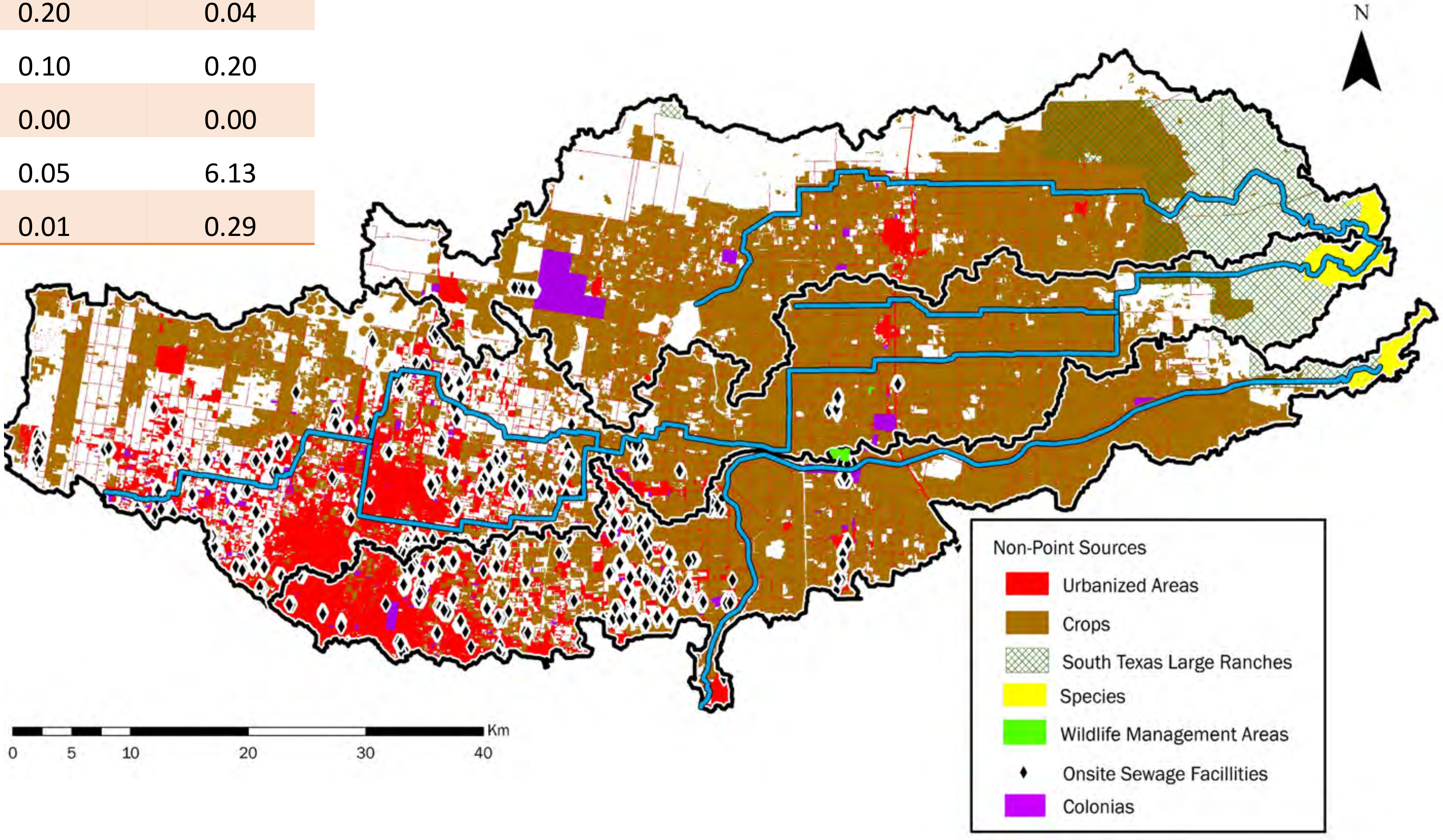


Figure 12: North and Central Watersheds Non-Point Sources

Point Sources

Table 2: Point Sources of pollution

	HWMD	RVD	IBWCNF	Total
TLAP	0.006	0.004	0.004	0.014
WWO	0.008	0.005	0.012	0.025
MSW	0.013	0.004	0.004	0.021
MS4s	3.383	0.055	6.133	9.571
DP	0.006	0.001	0.016	0.023

HWMD

- TLPA
- MSW

IBWCNF

- WWO
- MS4s
- DP

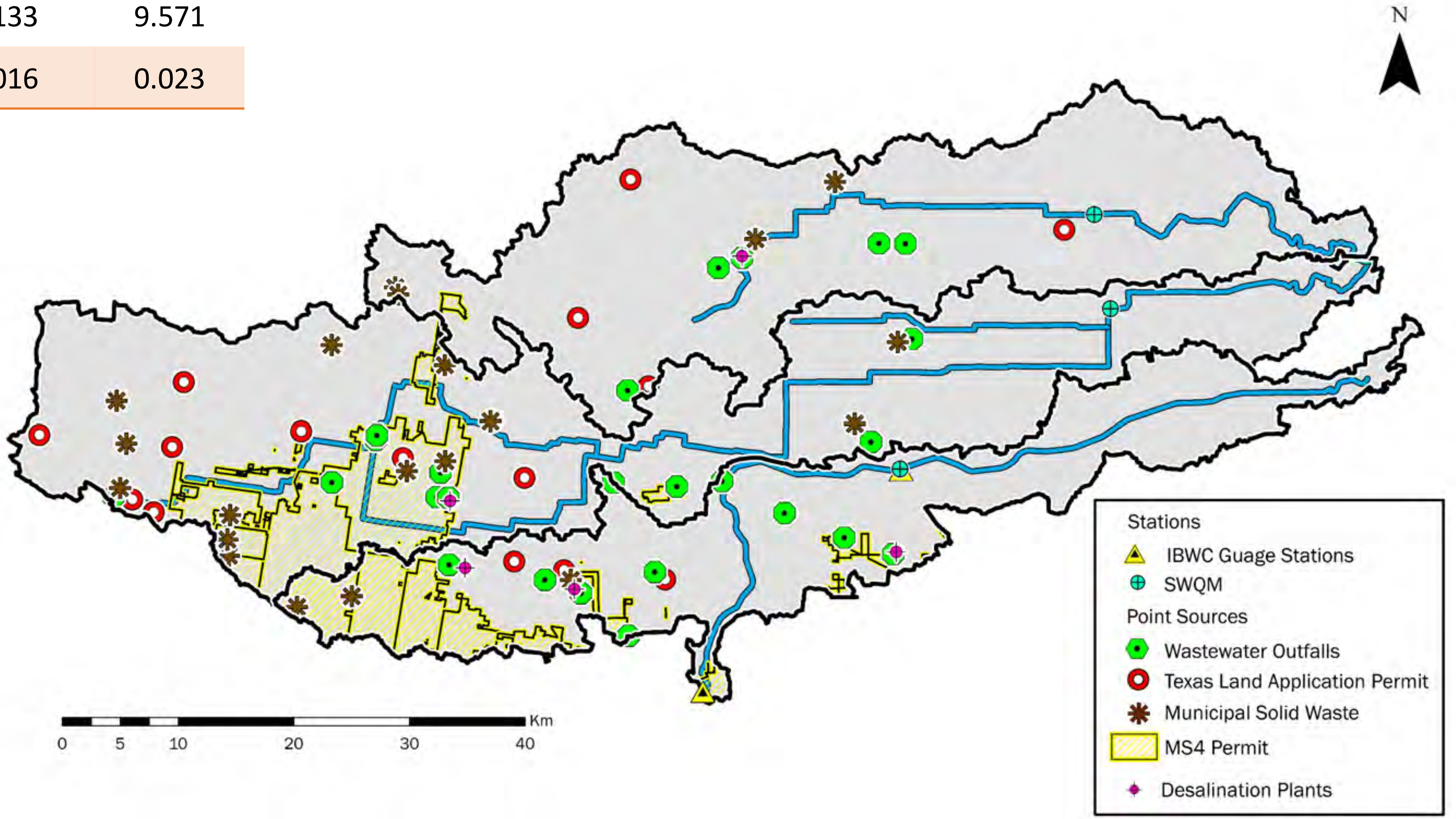


Figure 13: North and Central Watersheds Point Sources

Water Quality Samples

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

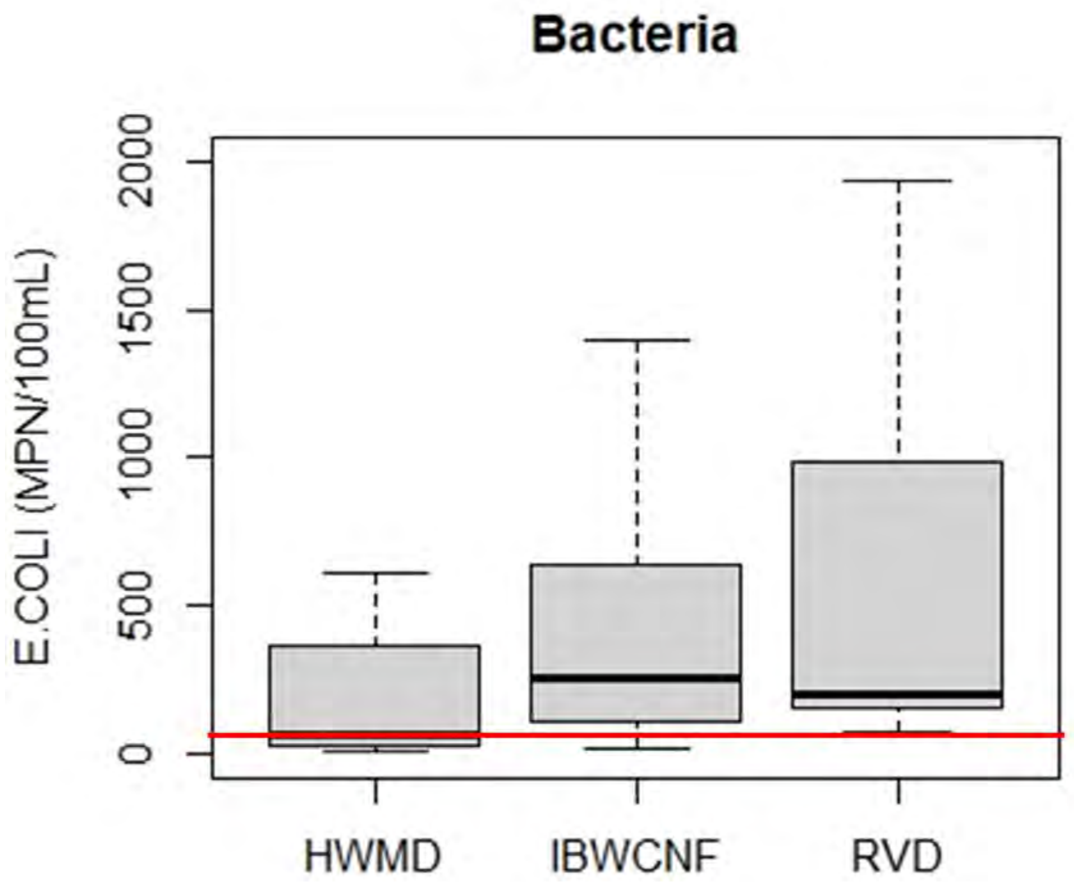
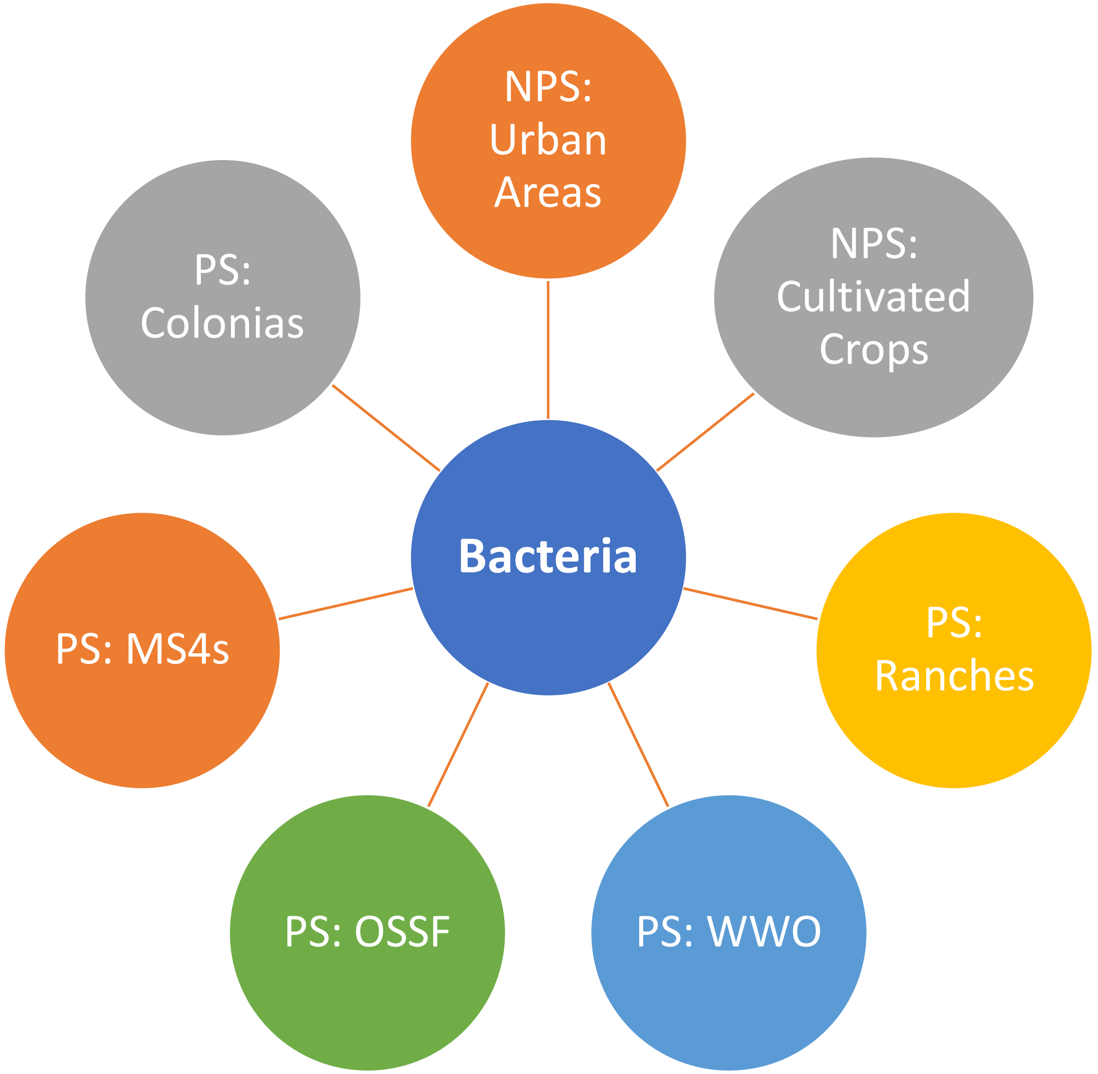


Figure 14: Predominant Levels for Bacteria



Water Quality

Concerning Levels

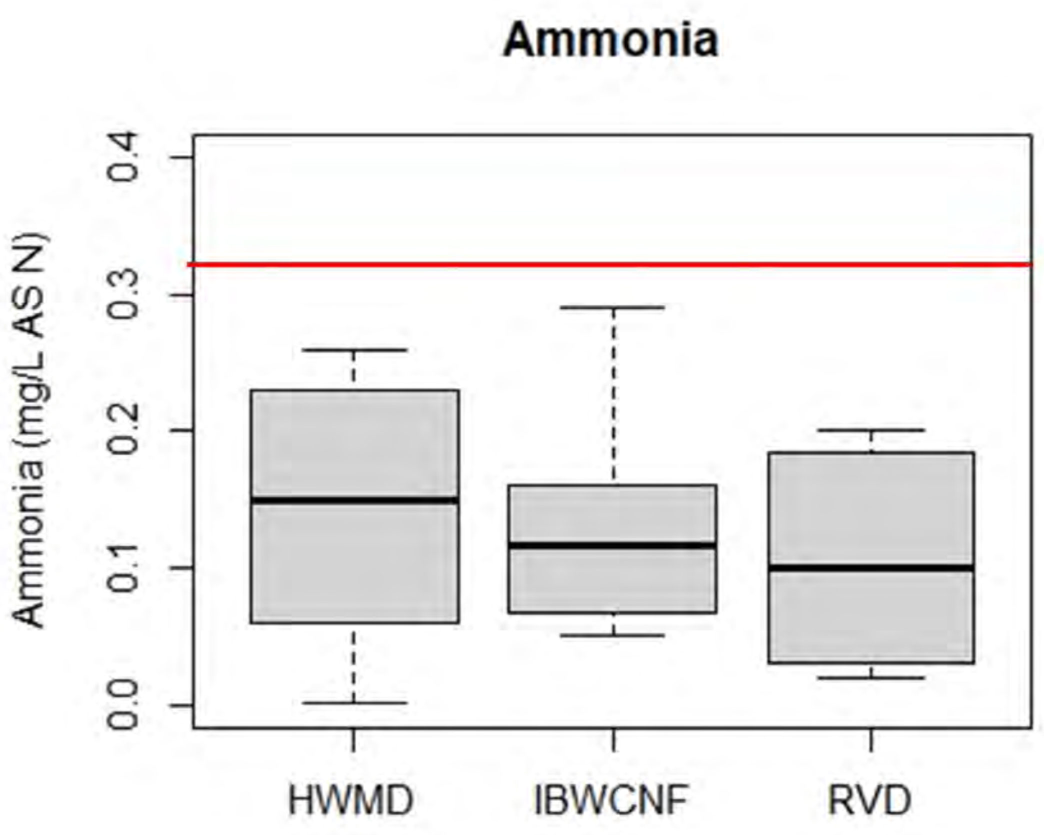
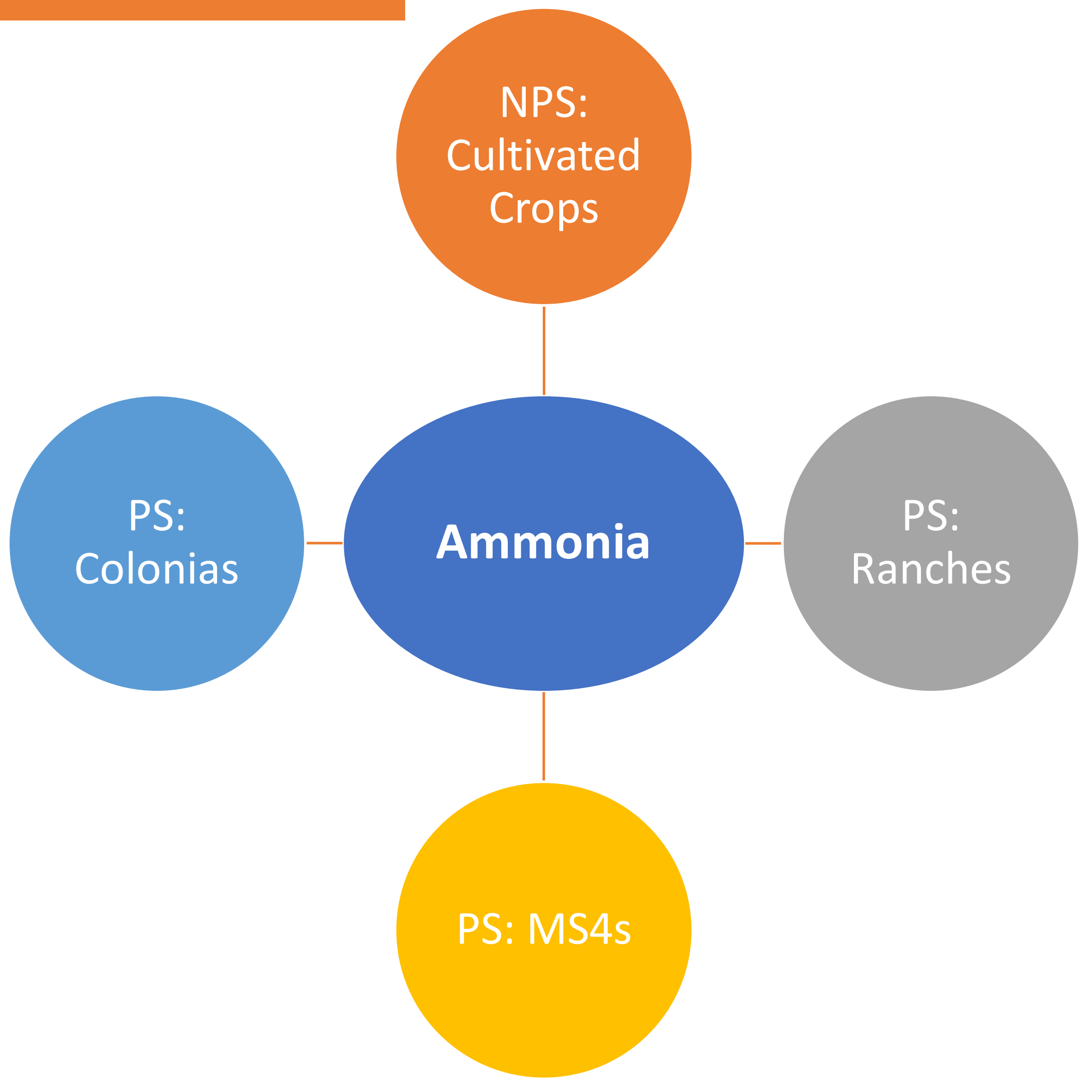


Figure 15: Predominant Levels for Ammonia



Water Quality

Significant Levels

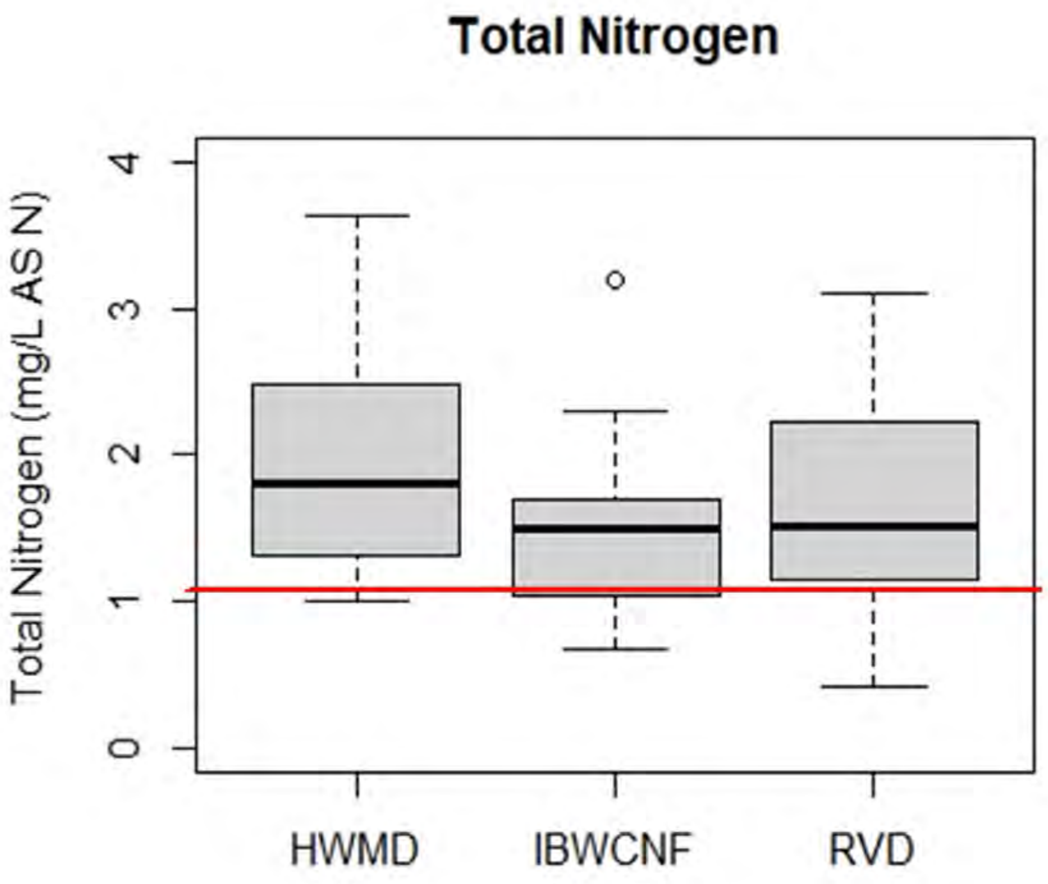
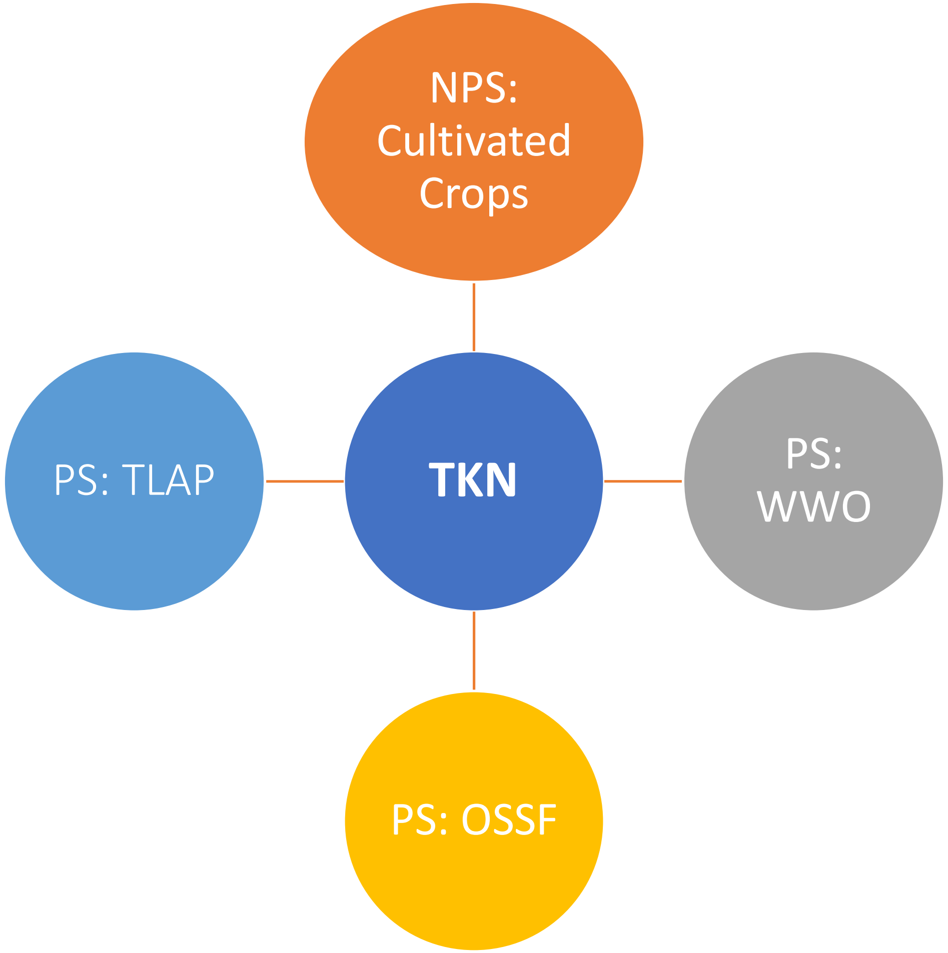


Figure 16: Predominant Levels for Total Nitrogen



Water Quality

Concerning Levels

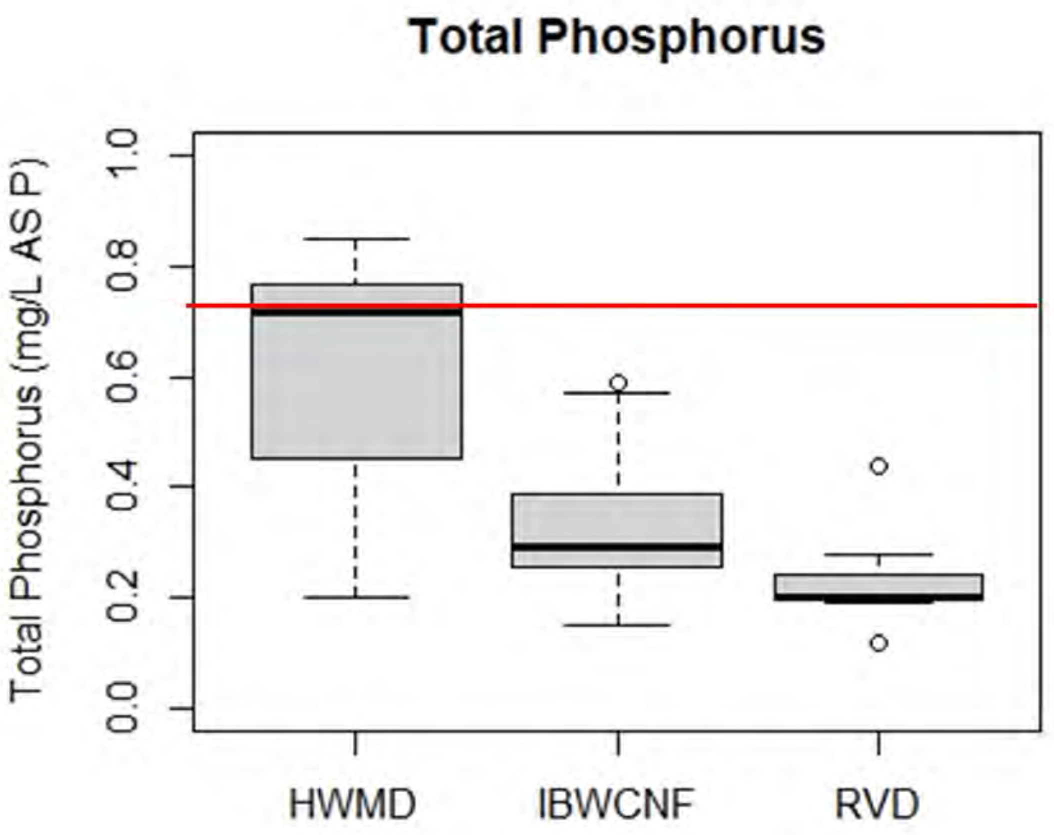
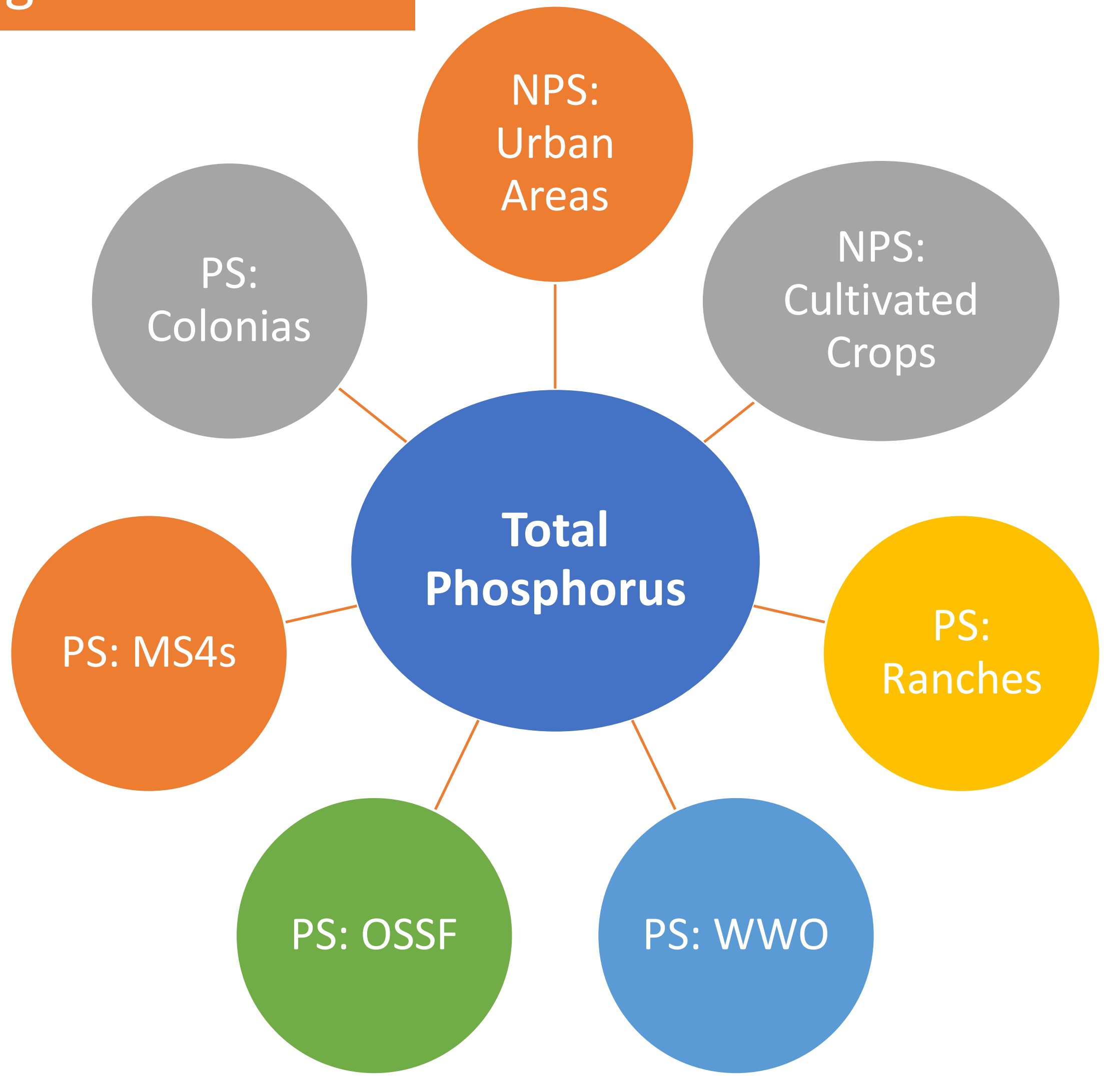


Figure 17: Predominant Levels for Total Phosphorus



Water Quality

Significant Levels

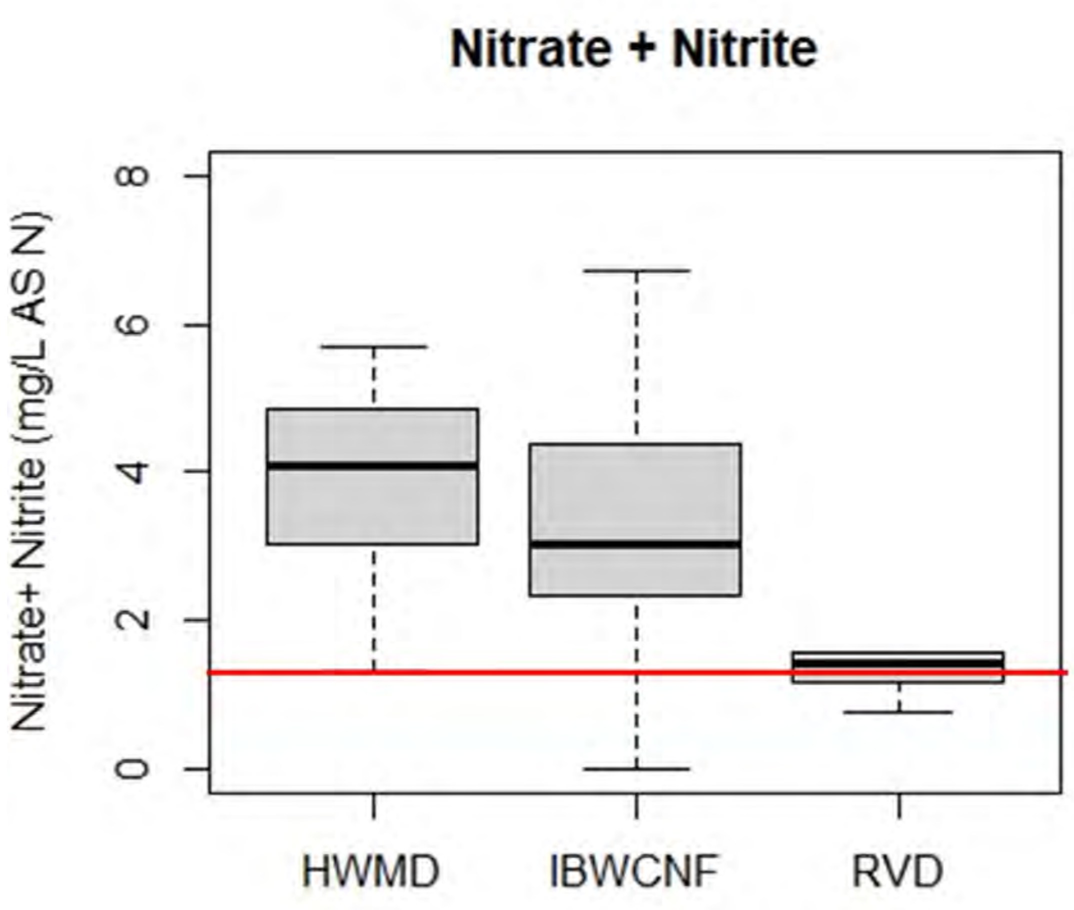
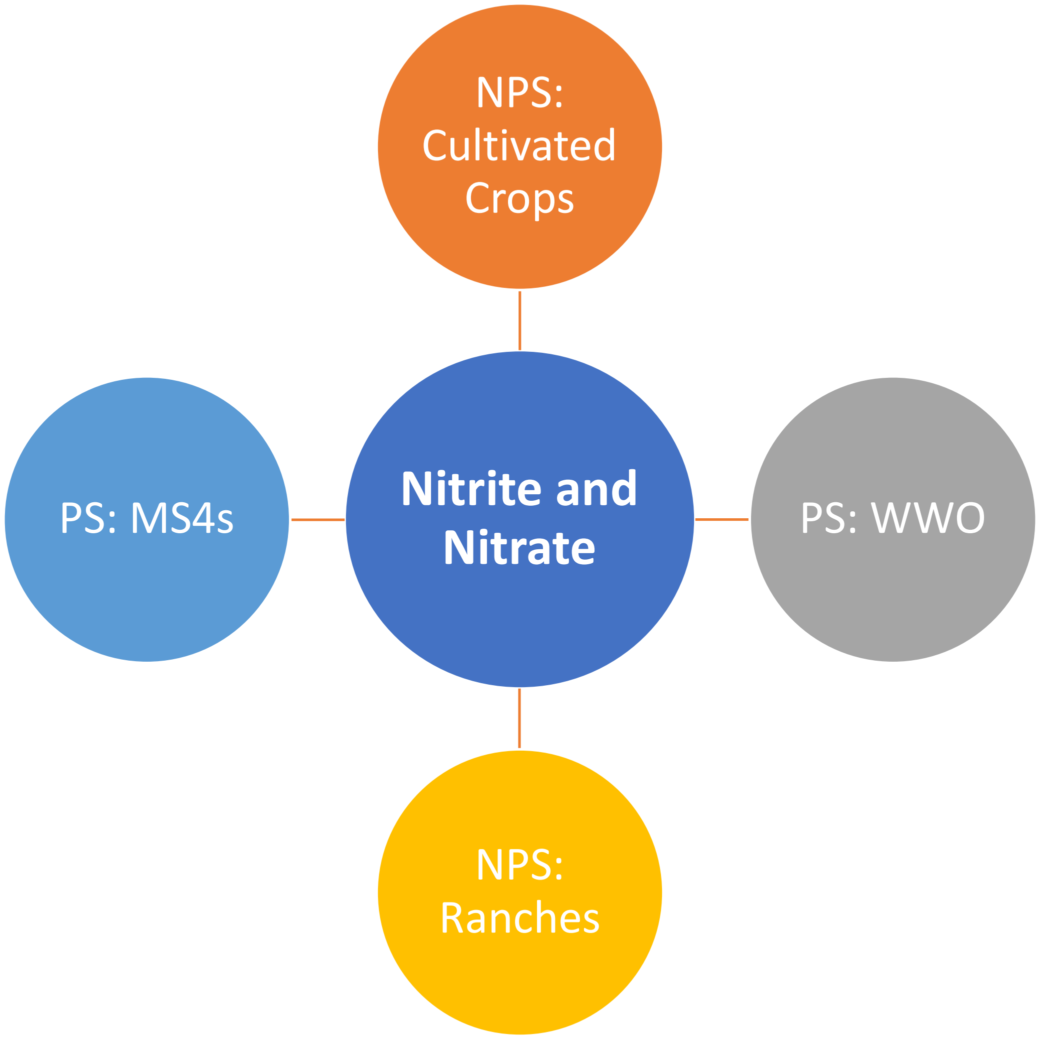


Figure 18: Predominant Levels for Nitrate and Nitrite



Water Quality

Significant Levels

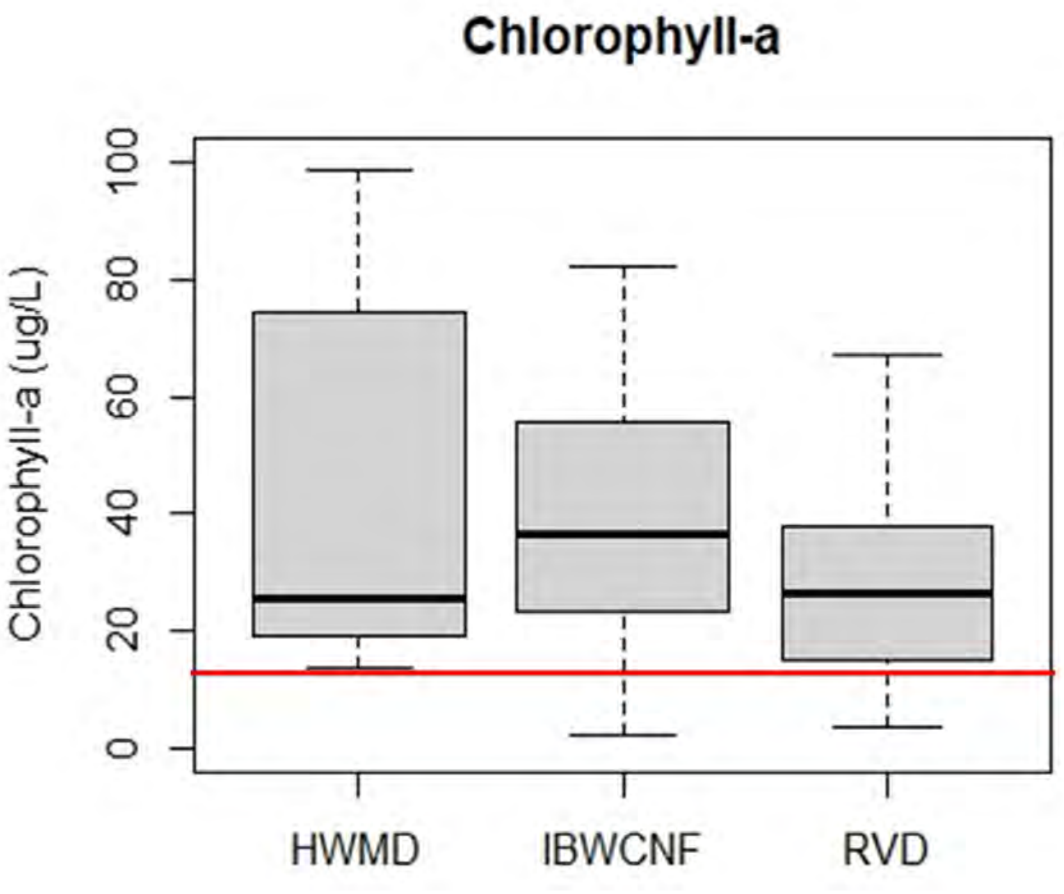
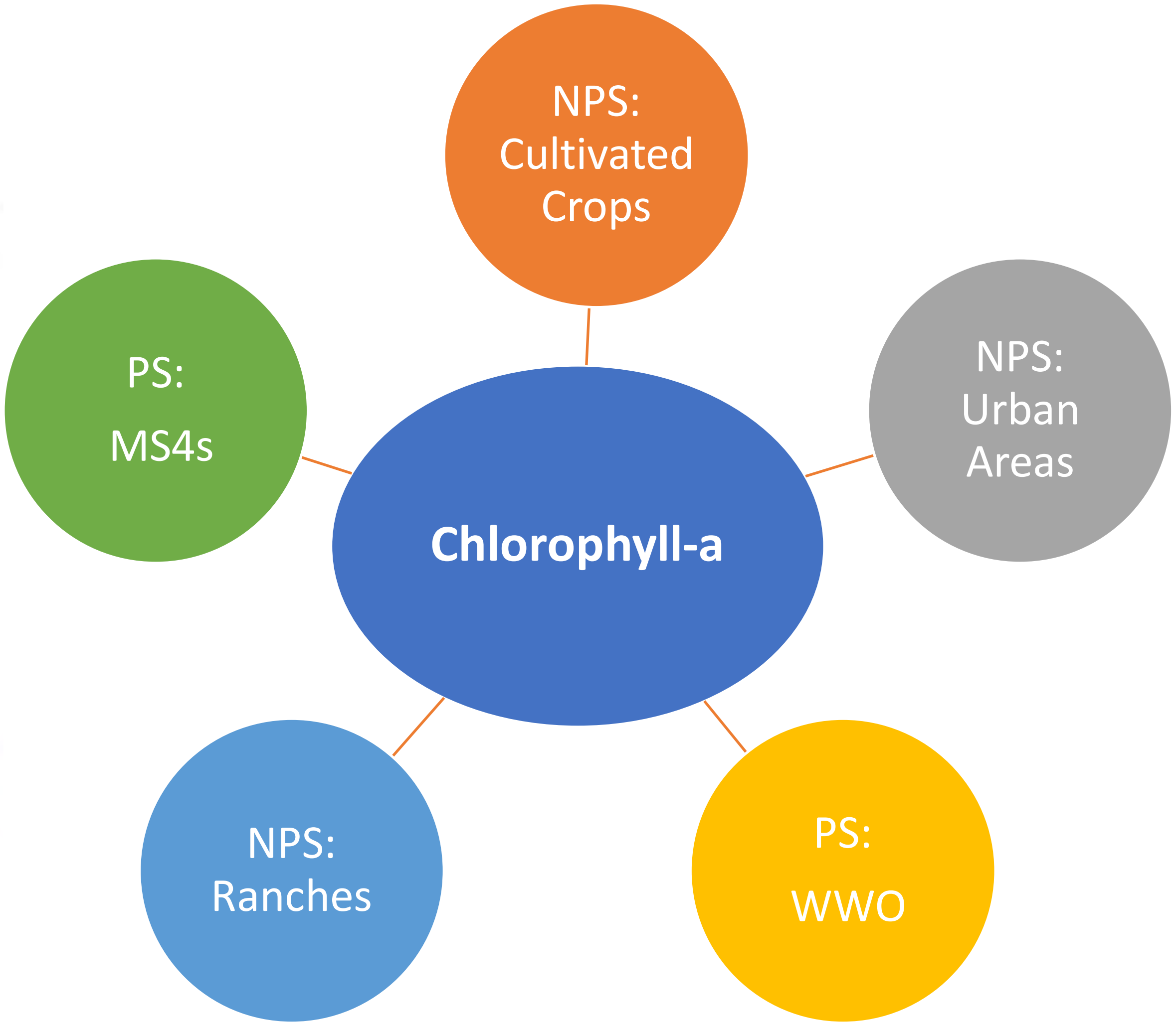


Figure 19: Predominant Levels for Chlorophyll-a



Water Quality

Significant Levels

Organic Nitrogen

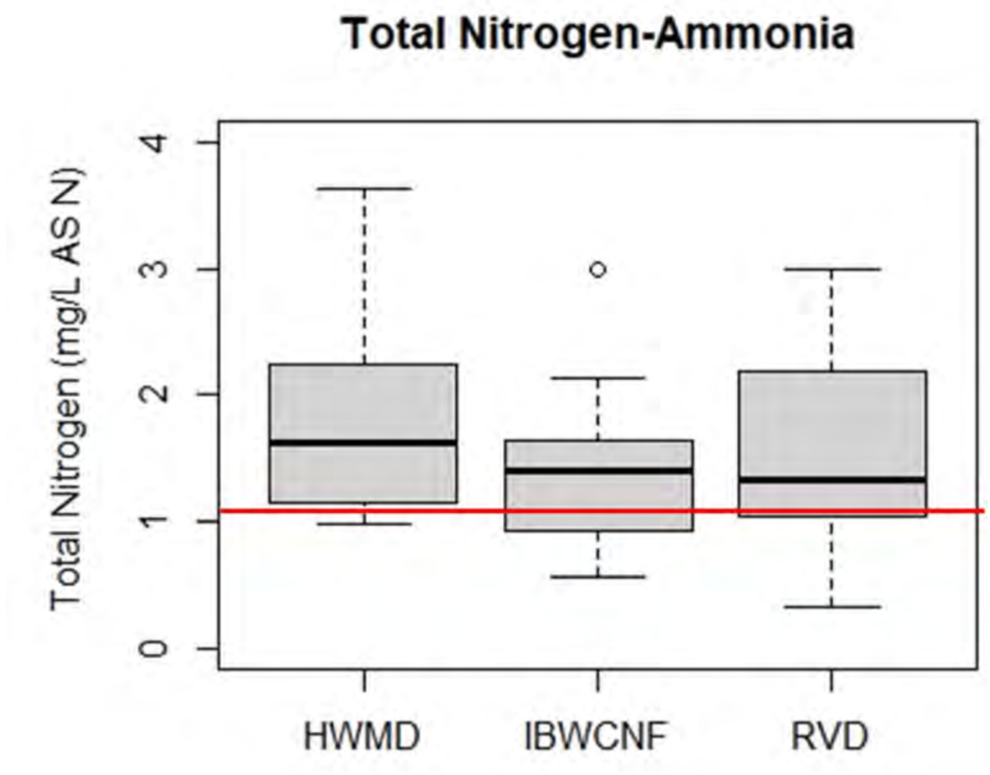
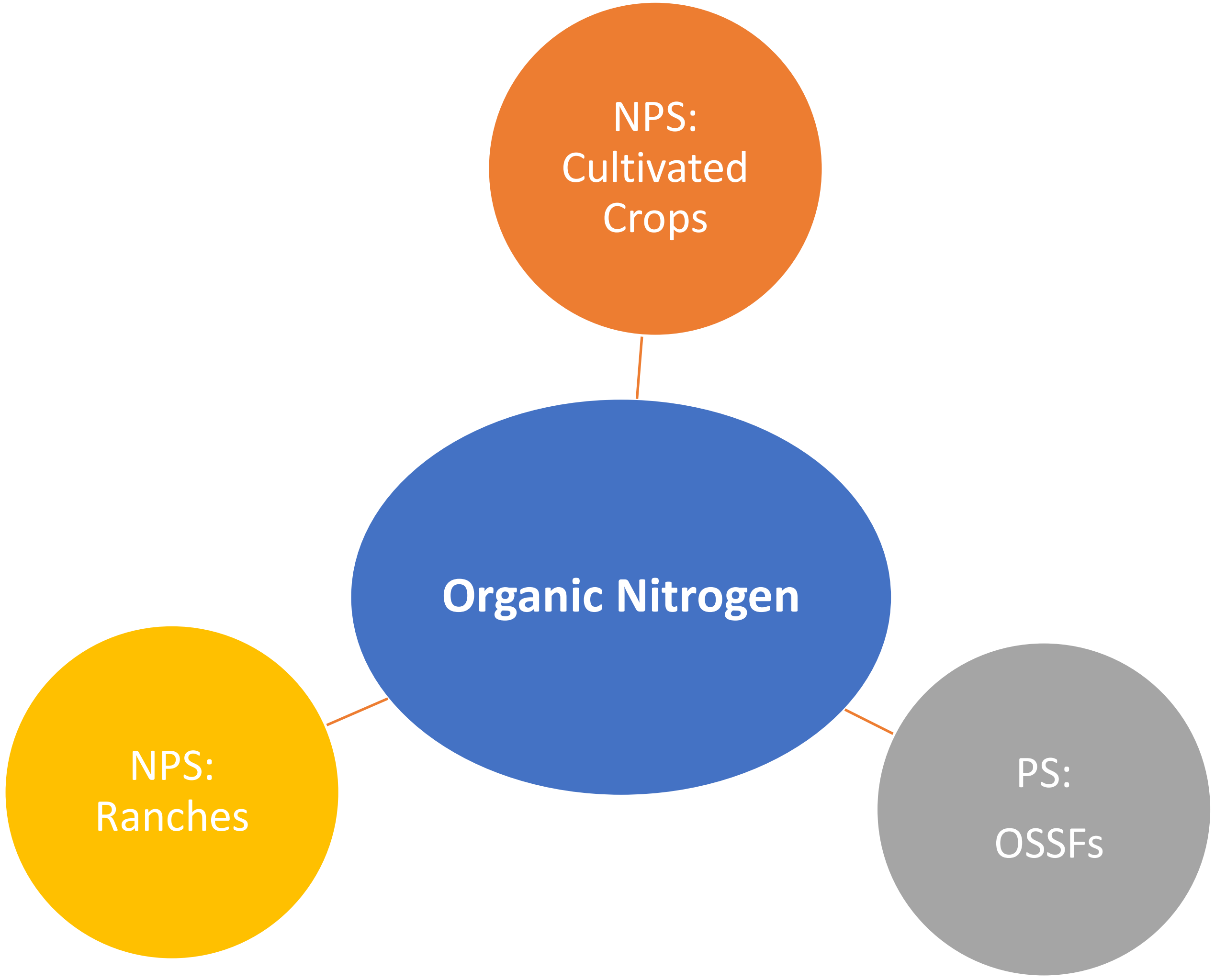


Figure 20: Predominant Levels for Organic Nitrogen



Loading Concentrations

Water Quality + 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

Flow Data

Table 3: North and Central Watersheds 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

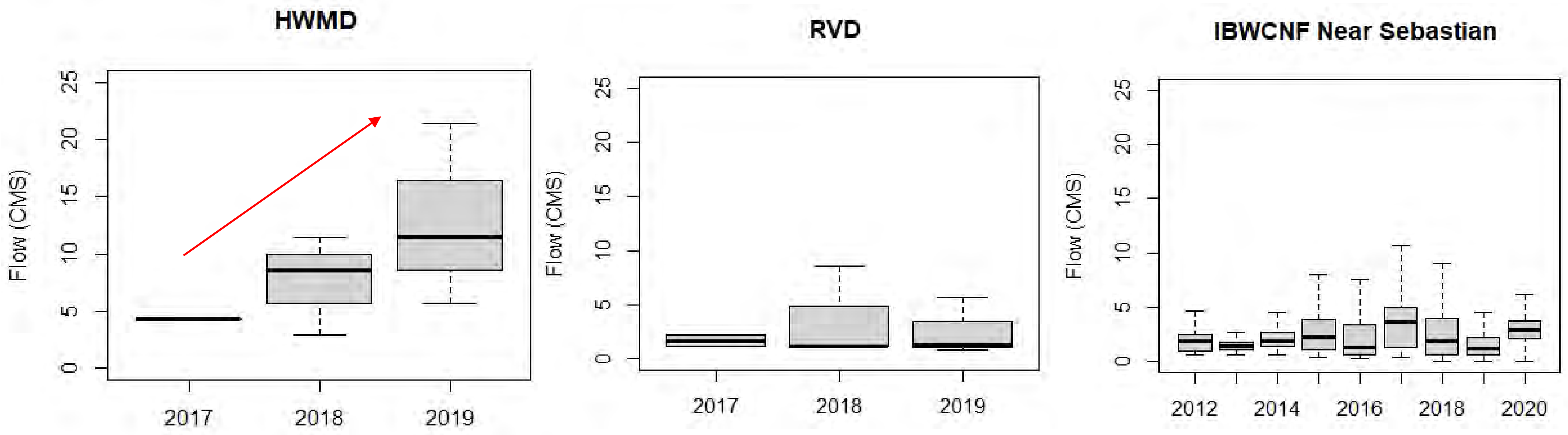


Figure 21: North and Central Watershed Boxplots for Flow Data

Flow Data + Water Quality + Watershed Area

Unit Area Loading Rates

Table 4: North and Central Watersheds Loading Rates

Water Quality Parameters		HWMD	RVD	IBWCNF
Bacteria (E.Coli)	MPN/km²/year	17.24*	1.86*	6.91*
Ammonia	kg/km²/year	120.68	30.77	47.72
TKN		1,586.32	669.73	477.14
TKN-Ammonia		1,465.64	638.96	429.42
TP		518.85	63.29	122.67
Nitrite +Nitrate		2,950.04	581.46	1,512.10
Chlorophyll-a		31,593.23	9,870.43	13.24

* *E. Coli* In trillions

Higher Loadings

Concentration vs Loadings

Bacteria

Total Nitrogen

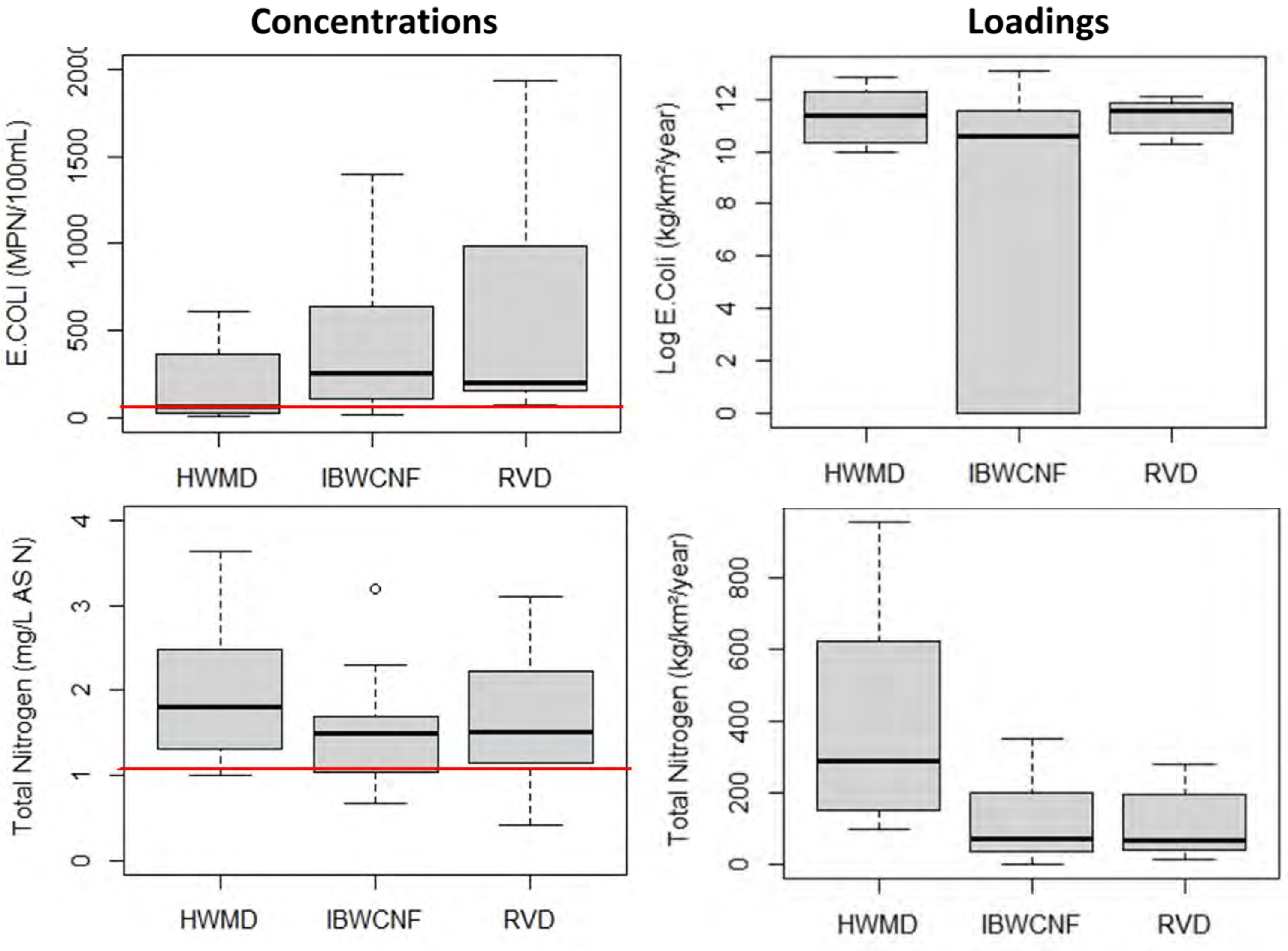


Figure 22: Concentration vs. Loadings

Concentration vs Loadings

Nitrate +Nirtite

Chlorophyll-a

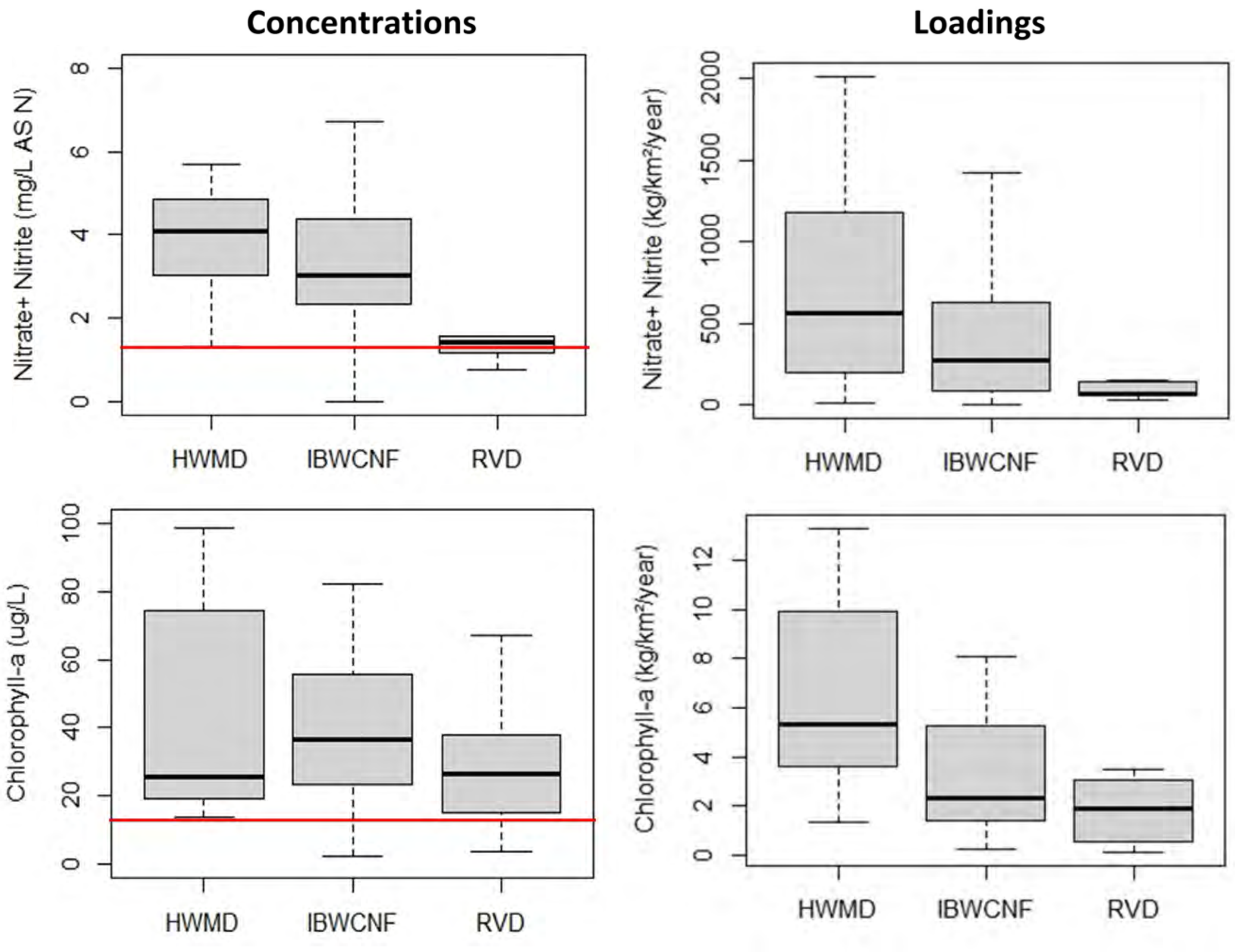


Figure 23: Concentration vs. Loadings

Concentration vs Loadings

Concentrations | **Loadings**

Ammonia

Total Phosphorus

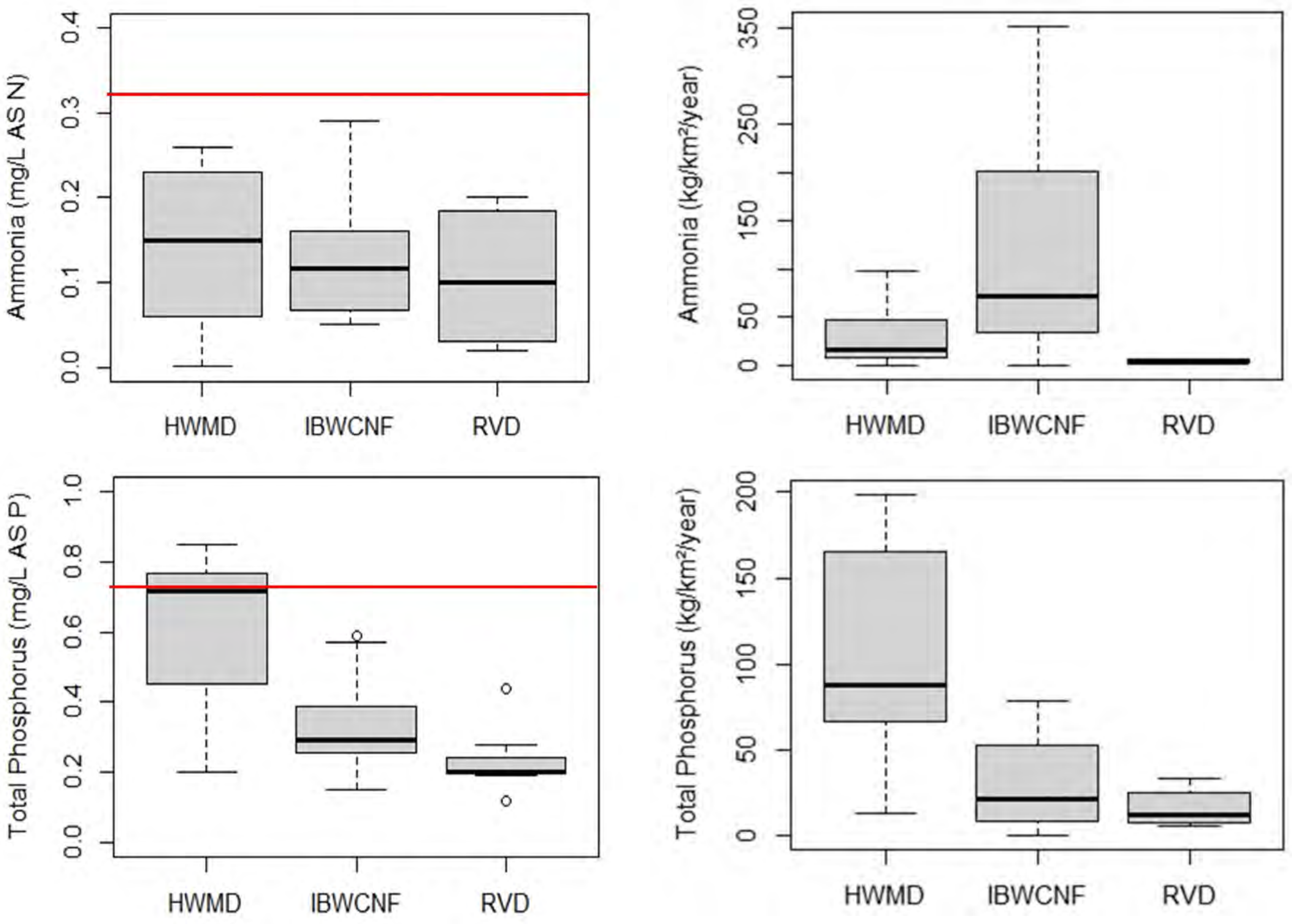


Figure 24: Concentration vs. Loadings

Concentration vs Loadings

Organic Nitrogen

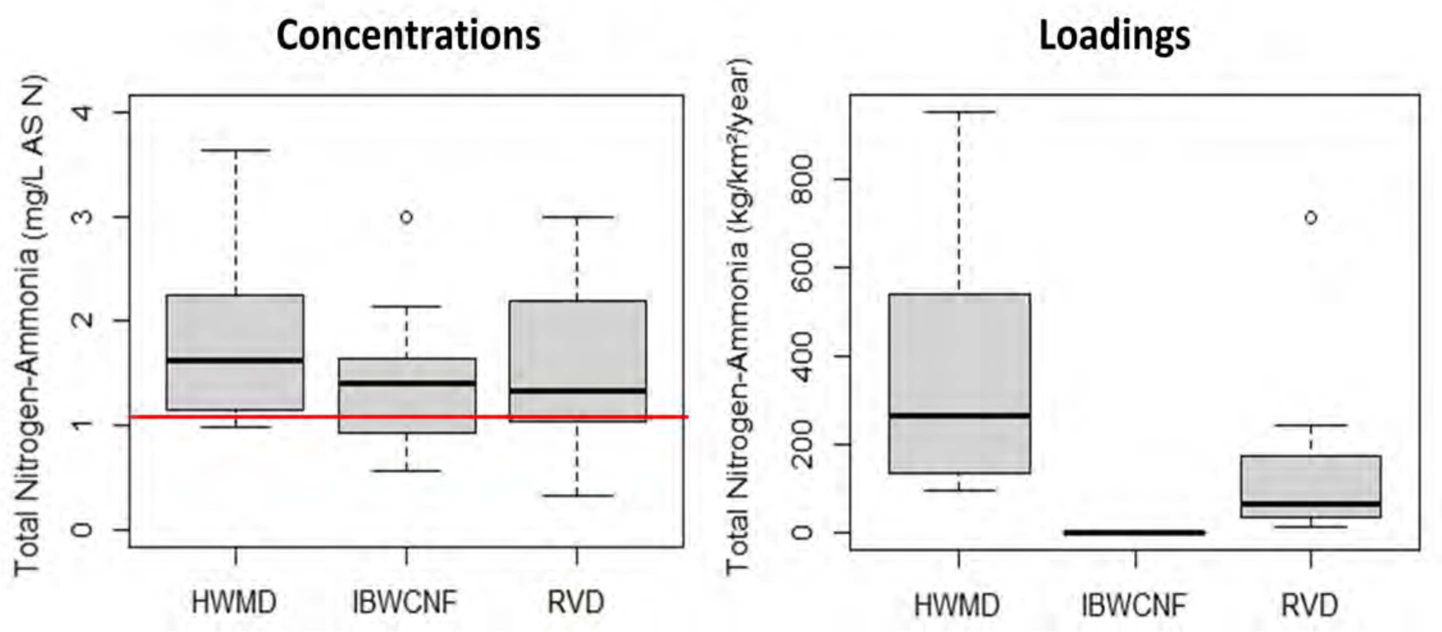
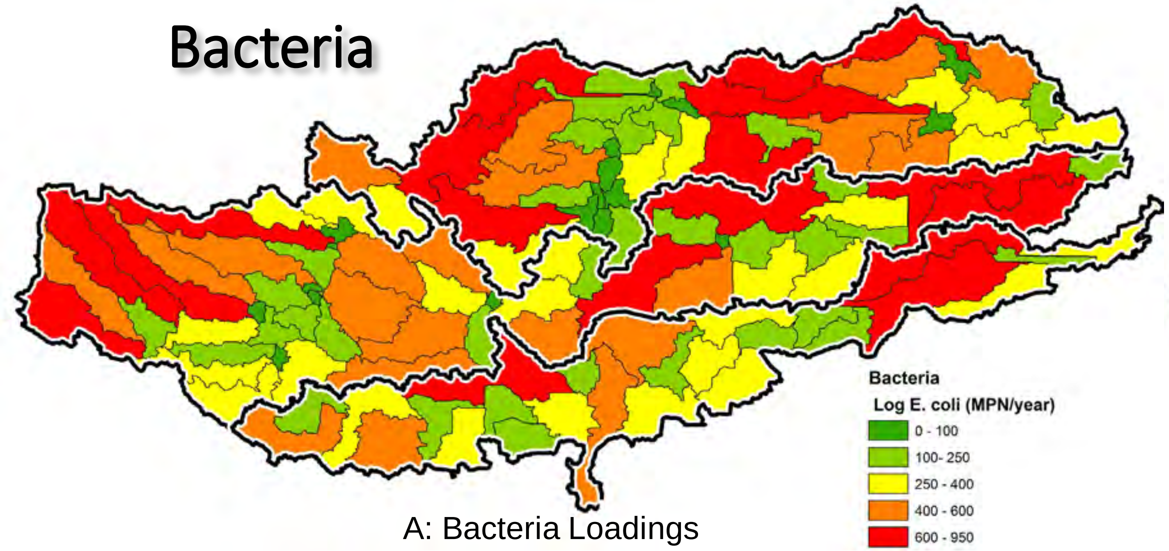


Figure 25: Concentration vs. Loadings

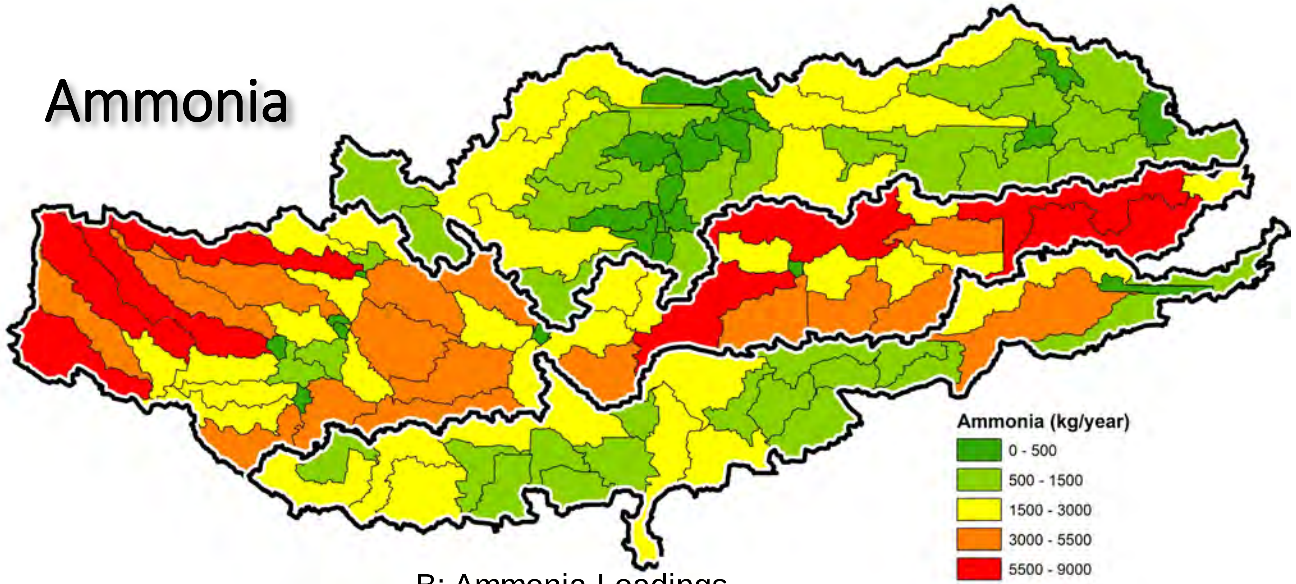
Subwatershed Loadings

Bacteria



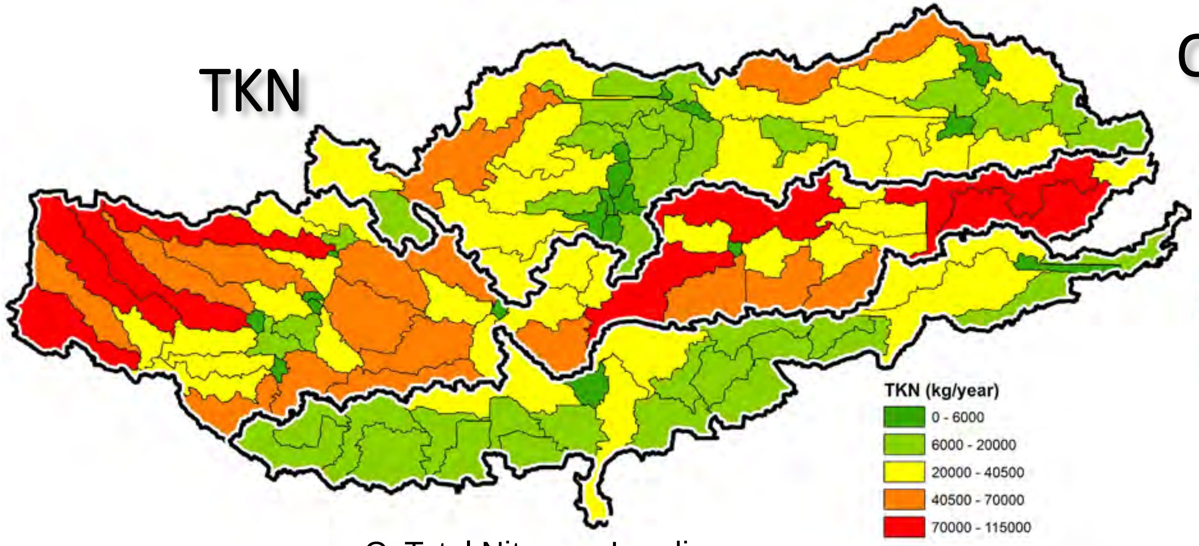
A: Bacteria Loadings

Ammonia



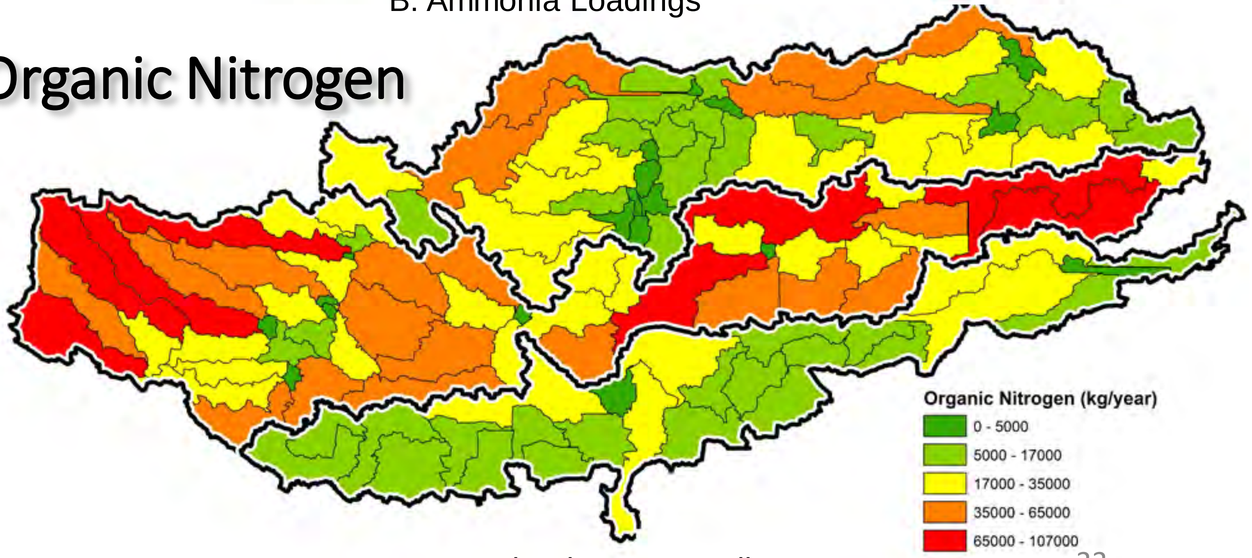
B: Ammonia Loadings

TKN



C: Total Nitrogen Loadings

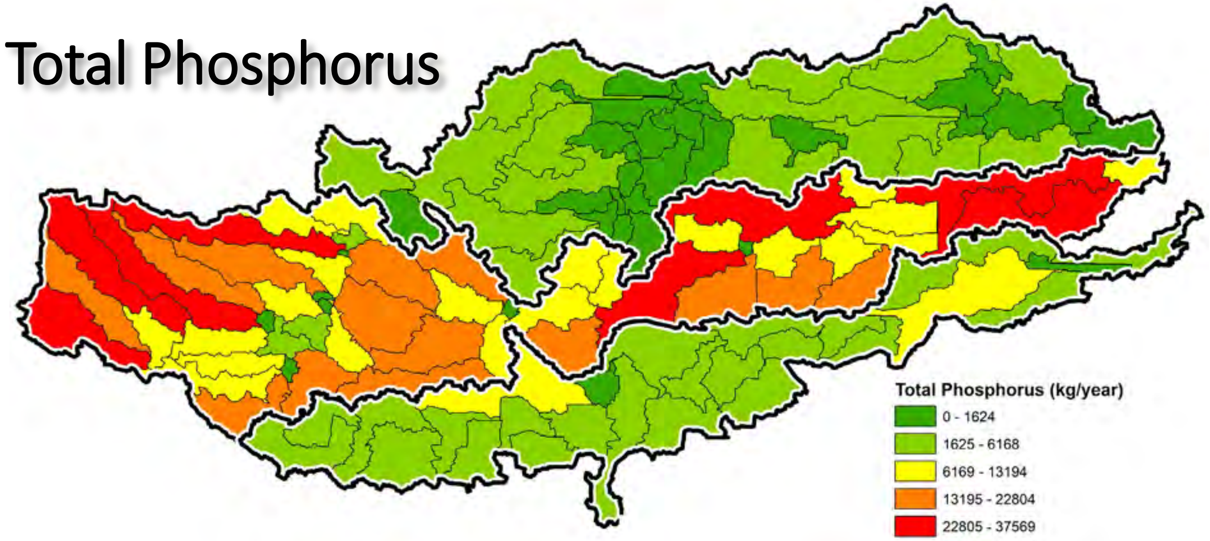
Organic Nitrogen



D: Organic Nitrogen Loadings

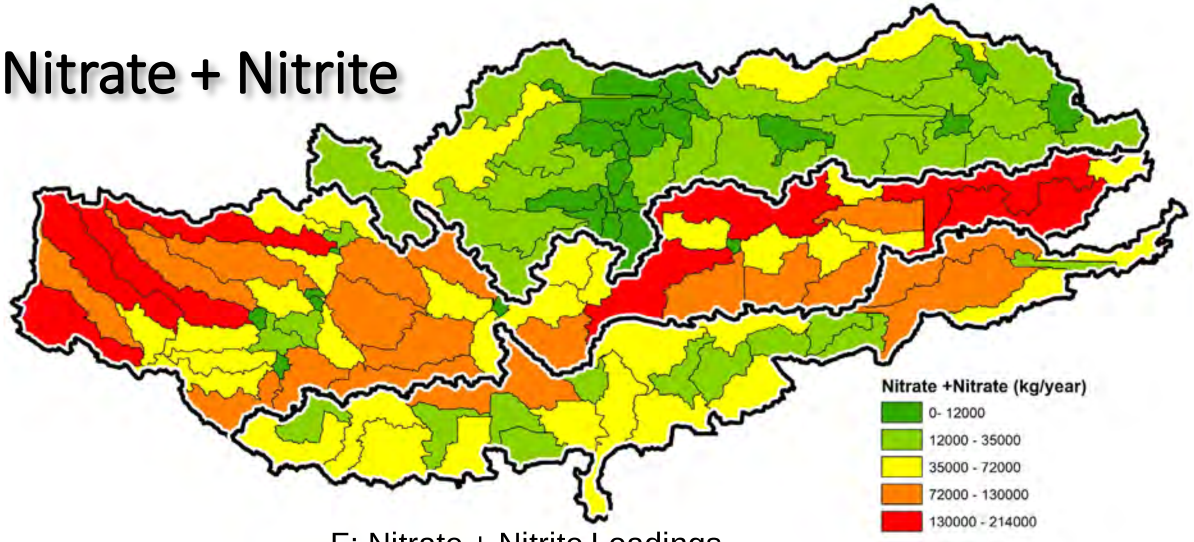
Subwatershed Loadings

Total Phosphorus



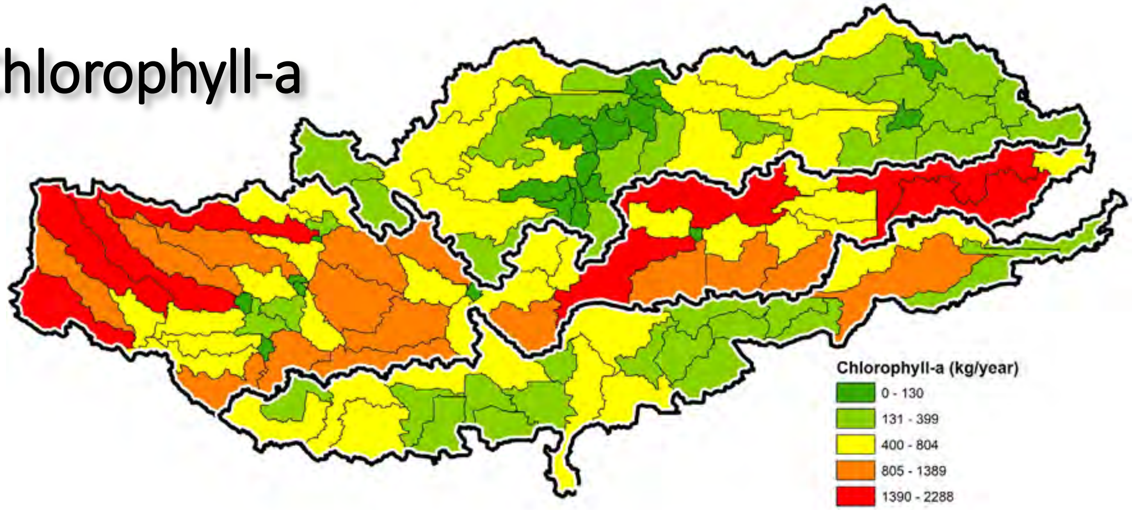
E: Total Phosphorus Loadings

Nitrate + Nitrite



F: Nitrate + Nitrite Loadings

Chlorophyll-a



G: Chlorophyll-a Loadings

Conclusions

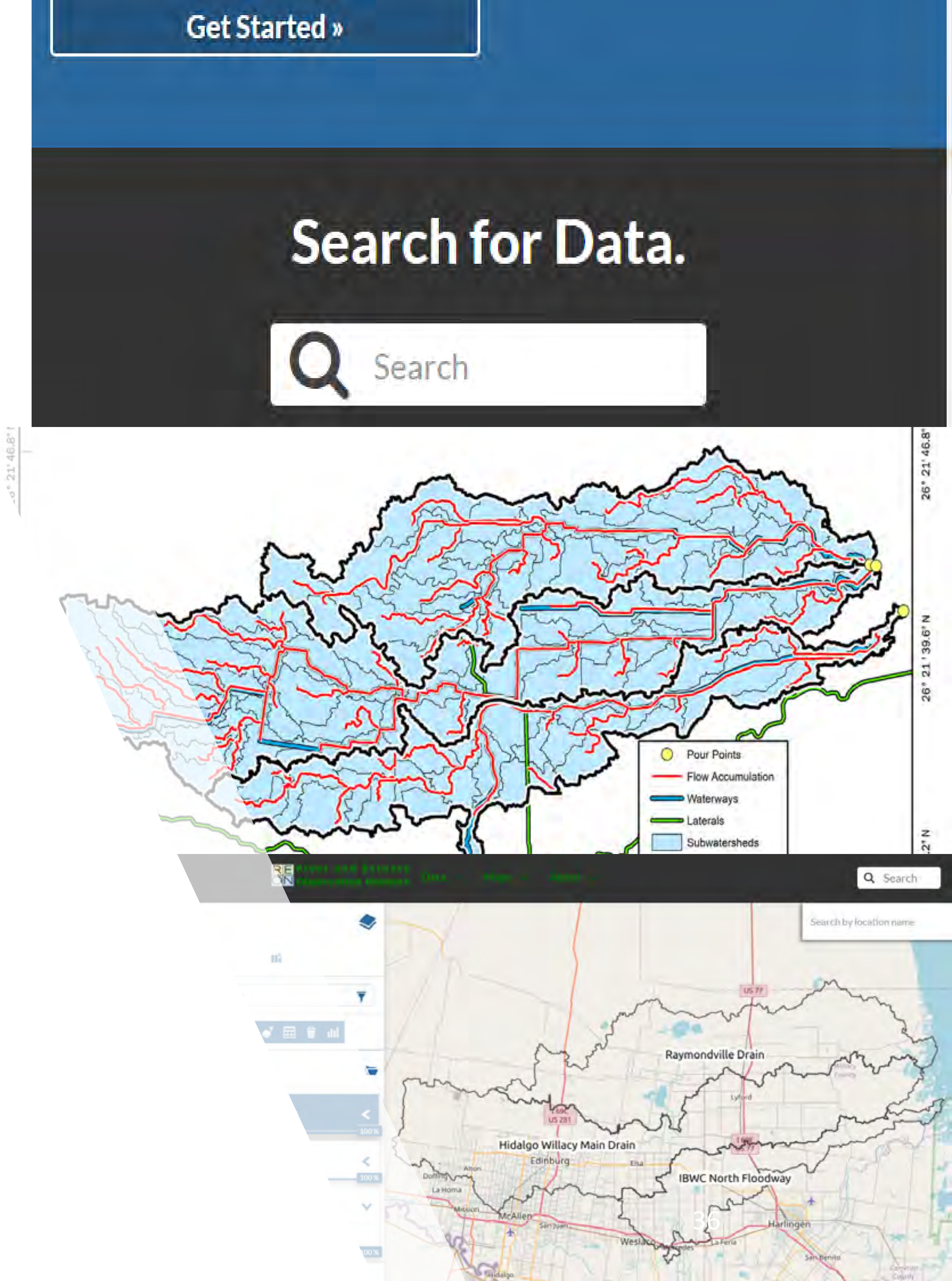
Conclusion

Cyberinfrastructure

- The site satisfies EPA guidelines manual for watershed characterization.
- Facilitated an effective data collection to extract distinct information into one single source.
- Enables Stakeholder's input to have a better overview of the watershed characteristics.

Watershed Delineation

- Elevation reconditioning showed satisfactory results for unique features for flat topography and man-made waterways.
- Areas contribution for HWMD watershed was 1,357 Km2.
- Covers 68 % of its area in Hidalgo County, 13 % in Willacy County, and a small portion of 1 % in Cameron County



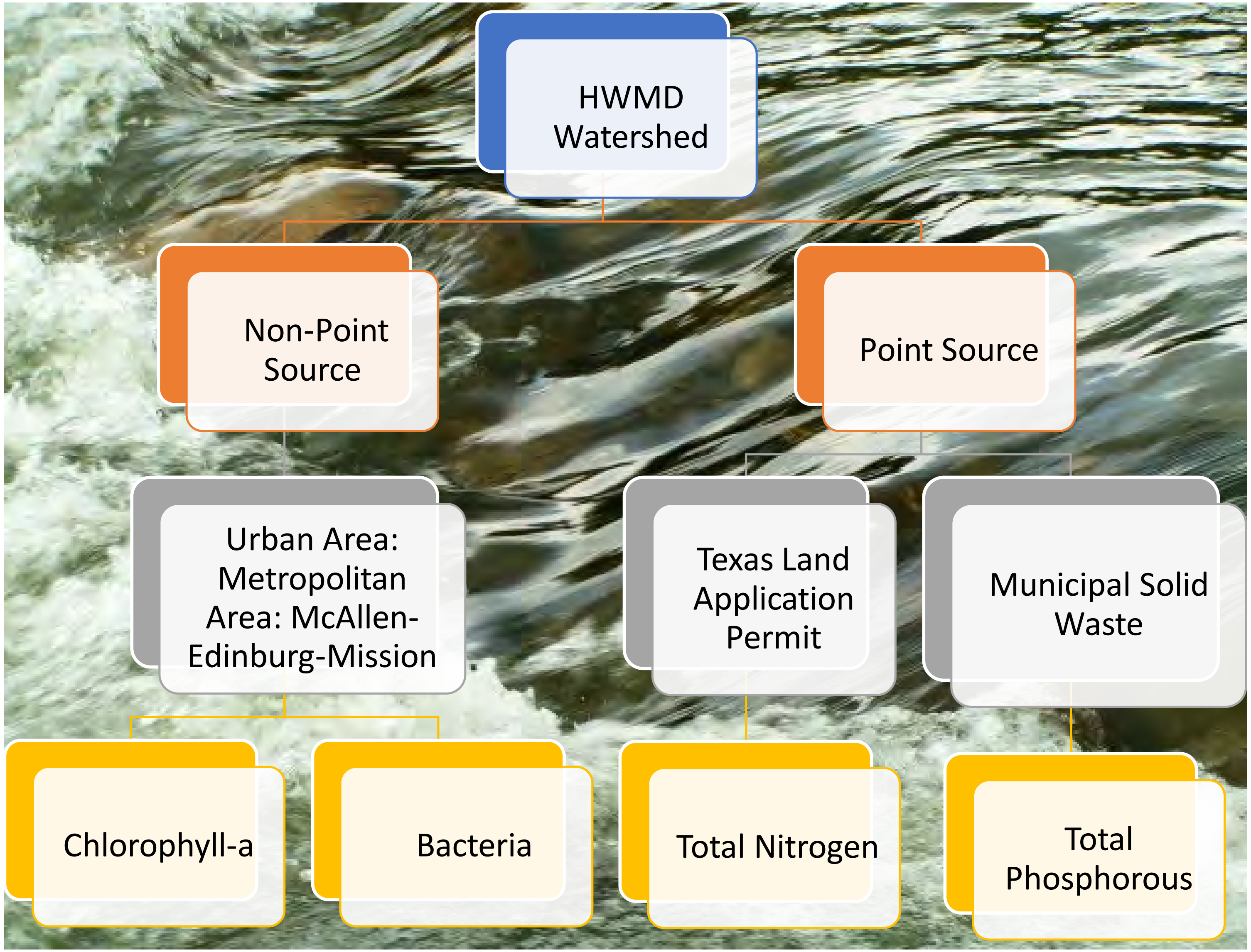
Conclusion

Sources of Pollution

- Point Sources seem to have more impact on the watershed

Water Quality

- Several water quality parameters were identified.
- Surpasses screening levels



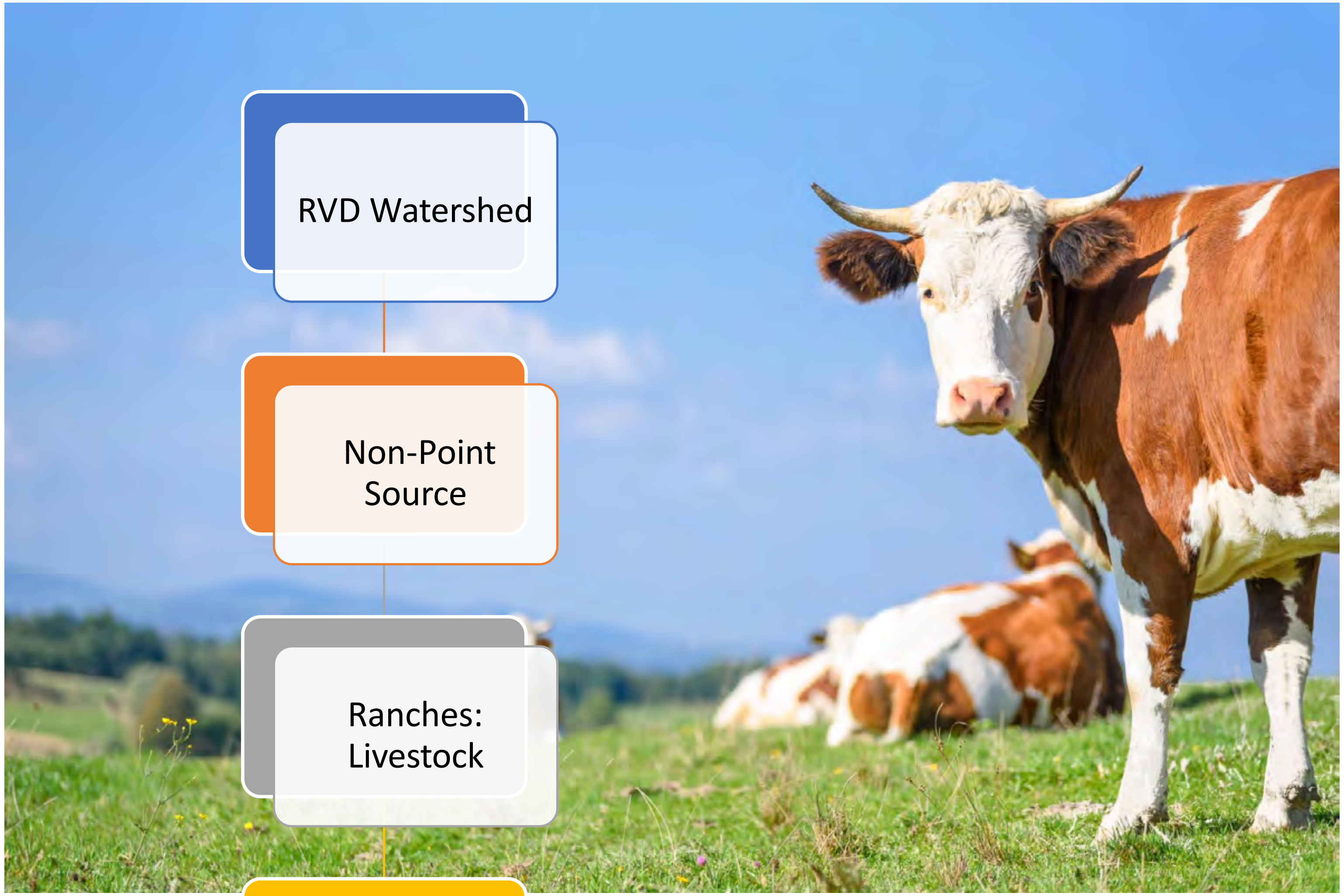
Conclusion

Sources of Pollution

- Non-point sources seem to have more impact on the watershed

Water Quality

- Only one water quality parameter seem to impact the most.



RVD Watershed

Non-Point Source

Ranches: Livestock

Bacteria

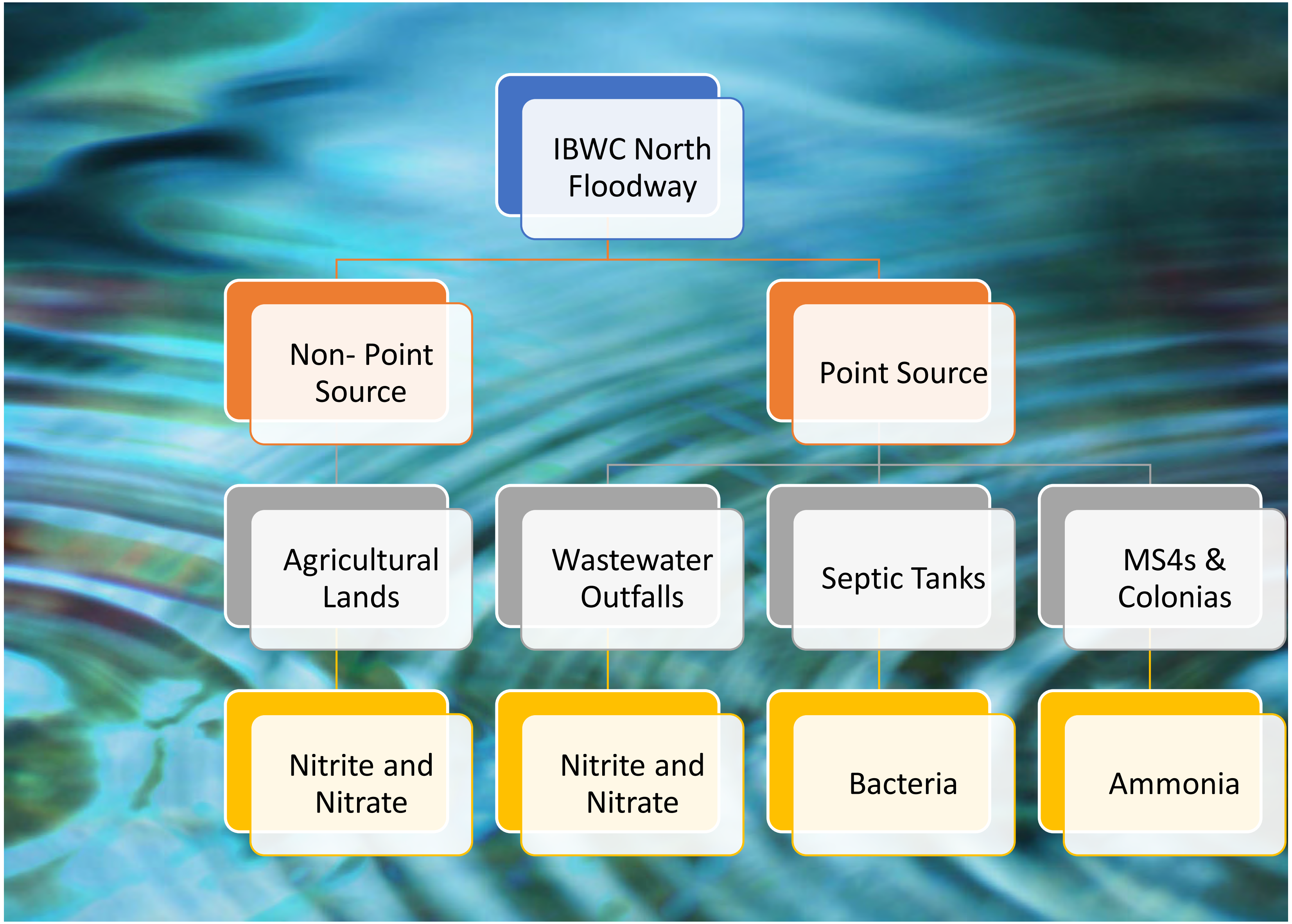
Conclusion

Sources of Pollution

- Point Sources seem to have more impact on the watershed

Water Quality

- Several water quality parameters were identified



Conclusion

Loading Concentrations

- HWMD watershed was the watershed to contribute the most to loadings.
- High presence of NPS and PS as well as high flow records contributes to this loads
- Relation between water quality concentrations, NPS and PS

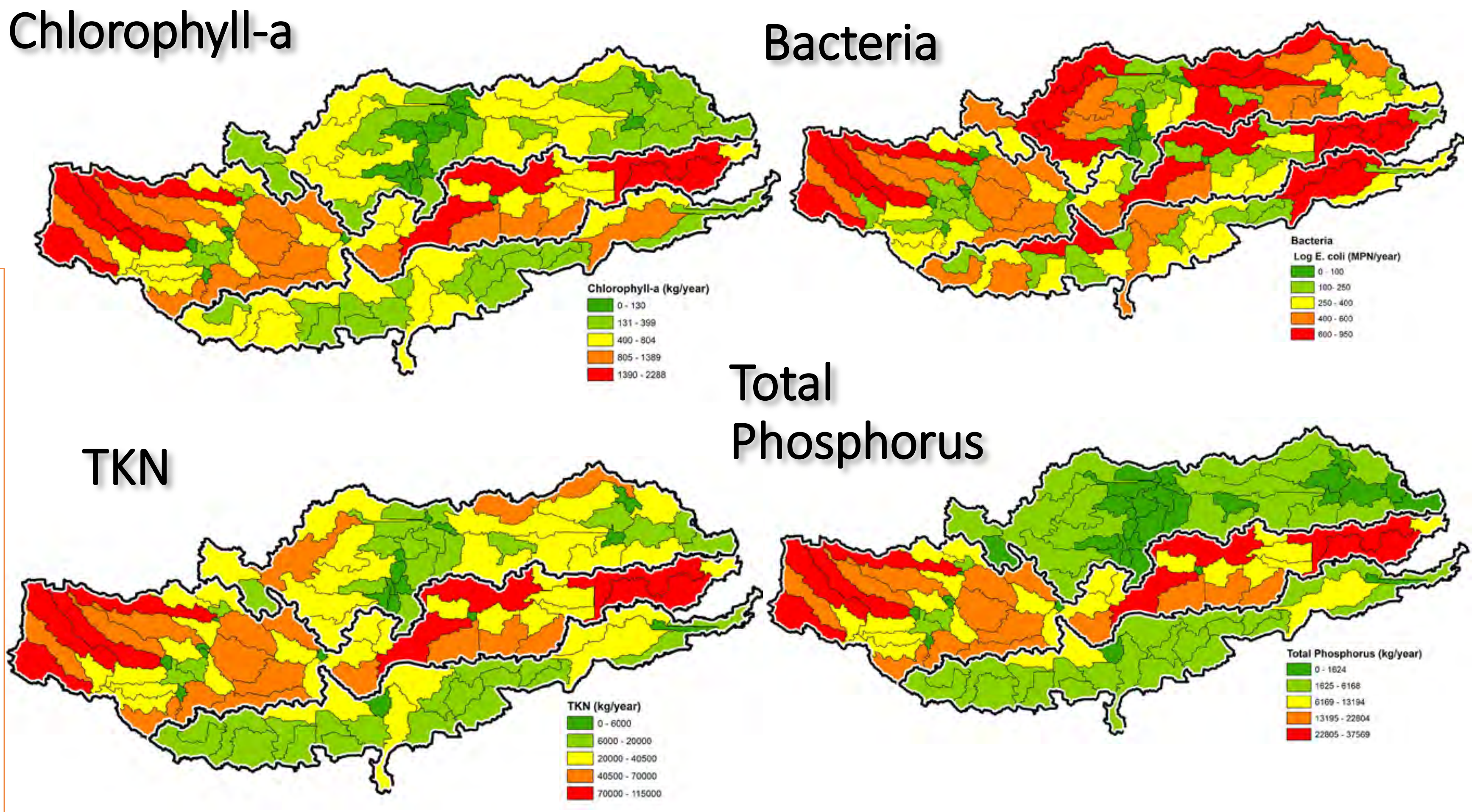


Figure 32: High Loadings

Acknowledgements

Committee Members

- Dr. Ahmed Mahmoud
- Dr. Andrew Ernest
- Dr. Gangadomage Chandana
- Dr. Abdoul Oubeidillah

TCEQ 319 Grant

- Funding for the North and Central Watersheds Non-Point Source Program

RATES Teams

- Development of cyberinfrastructure and
- Dr. Christopher Fuller

Thank You