CITY OF SAN ANTONIO
EDWARDS AQUIFER
PROTECTION PROGRAM

Conservation Advisory Board
December 2, 2020

Proposition 1 (water quality projects) Update
Conservation Advisory Board
December 2, 2020

Ronald T. Green, Southwest Research Institute, SwRI
Douglas J. Schnoebelen, U.S. Geological Survey, USGS

Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer

December 2, 2020

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Proposition 1 Water Quality Demonstration Projects

Conservation Advisory Board

December 2, 2020

PARKS & RECREATION SAN ANTONIO

CITY OF SAN ANTONIO EDWARDS AQUIFER PROTECTION PROGRAM

SAN ANTONIO RIVER AUTHORITY Leaders in Watershed Solutions

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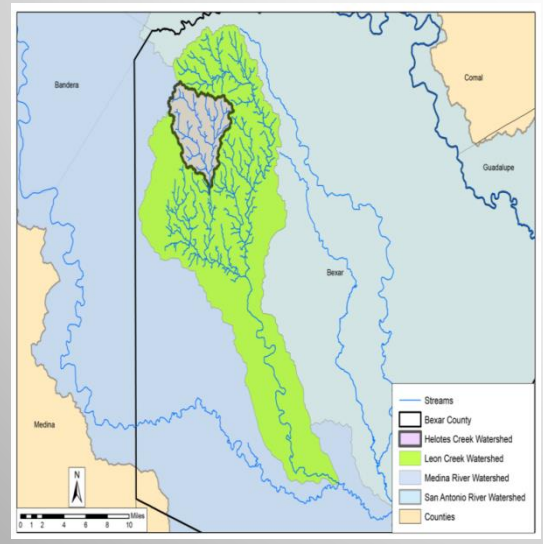
Project Overview/Scope

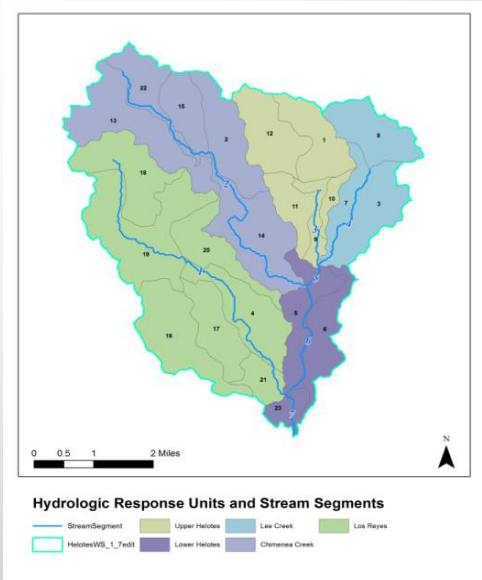
Objective:

Develop an **integrated surface-water/ groundwater model** to simulate transport from **OSSF, TLAP, TPDES** wastewater facilities in the Contributing and Recharge zones of the Edwards Aquifer to quantify the **impact of wastewater disposal on recharge to the Edwards Aquifer**.

Study area:

Helotes Creek Watershed of northwest Bexar County.





Collaborators

Edwards Aquifer Authority

City of Austin

University of Texas – San Antonio

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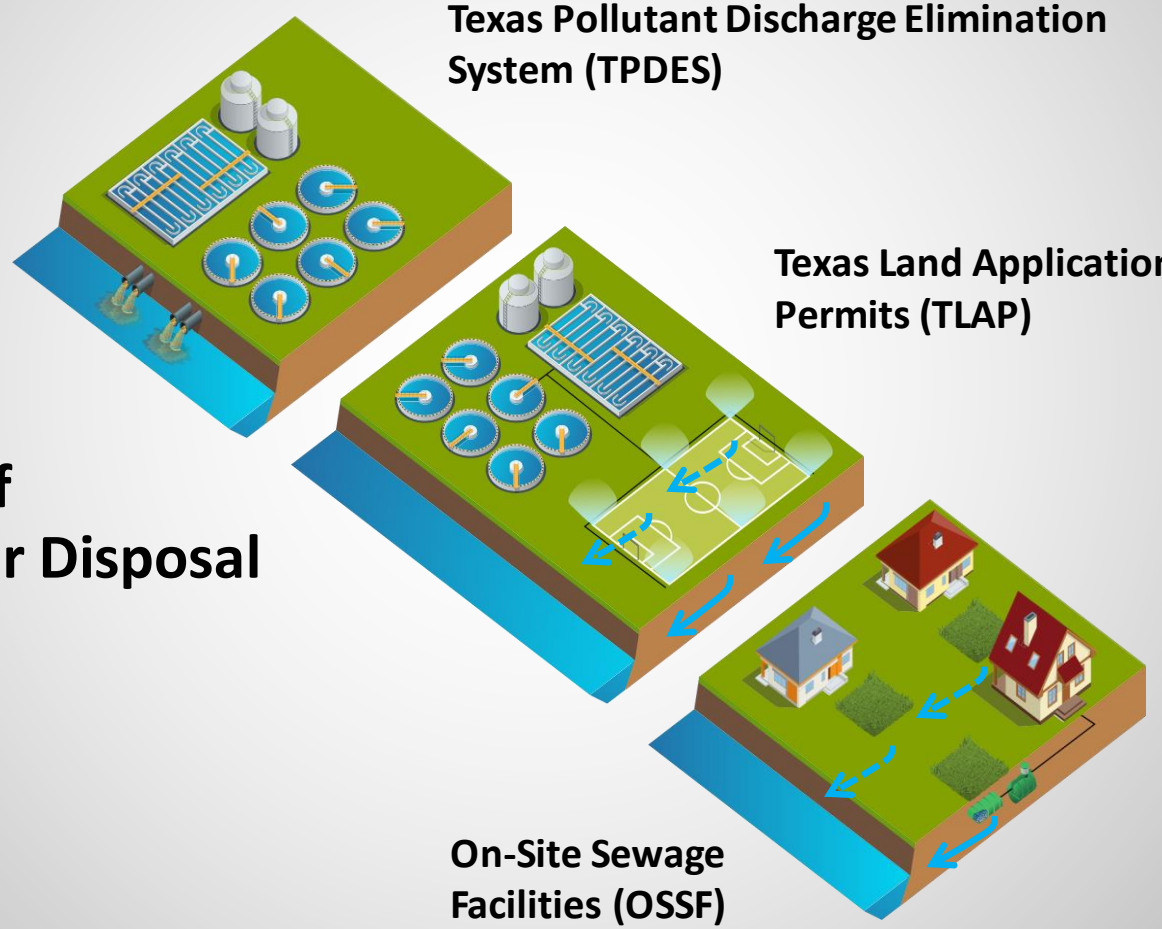
Project Overview/Scope

Methods of Wastewater Disposal



Texas Pollutant Discharge Elimination System (TPDES)

Texas Land Application Permits (TLAP)

On-Site Sewage Facilities (OSSF)

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Background: Objectives

This project will contribute to the
Edwards Aquifer Protection Project (EAPP) program

A critical, unanswered question:

What is the impact of wastewater disposal practices, such as on-site sewage facilities (OSSFs), Texas Land Application Permit (TLAP) facilities, and Texas Pollutant Discharge Elimination System (TPDES), on the quality of recharge to the Edwards Aquifer?

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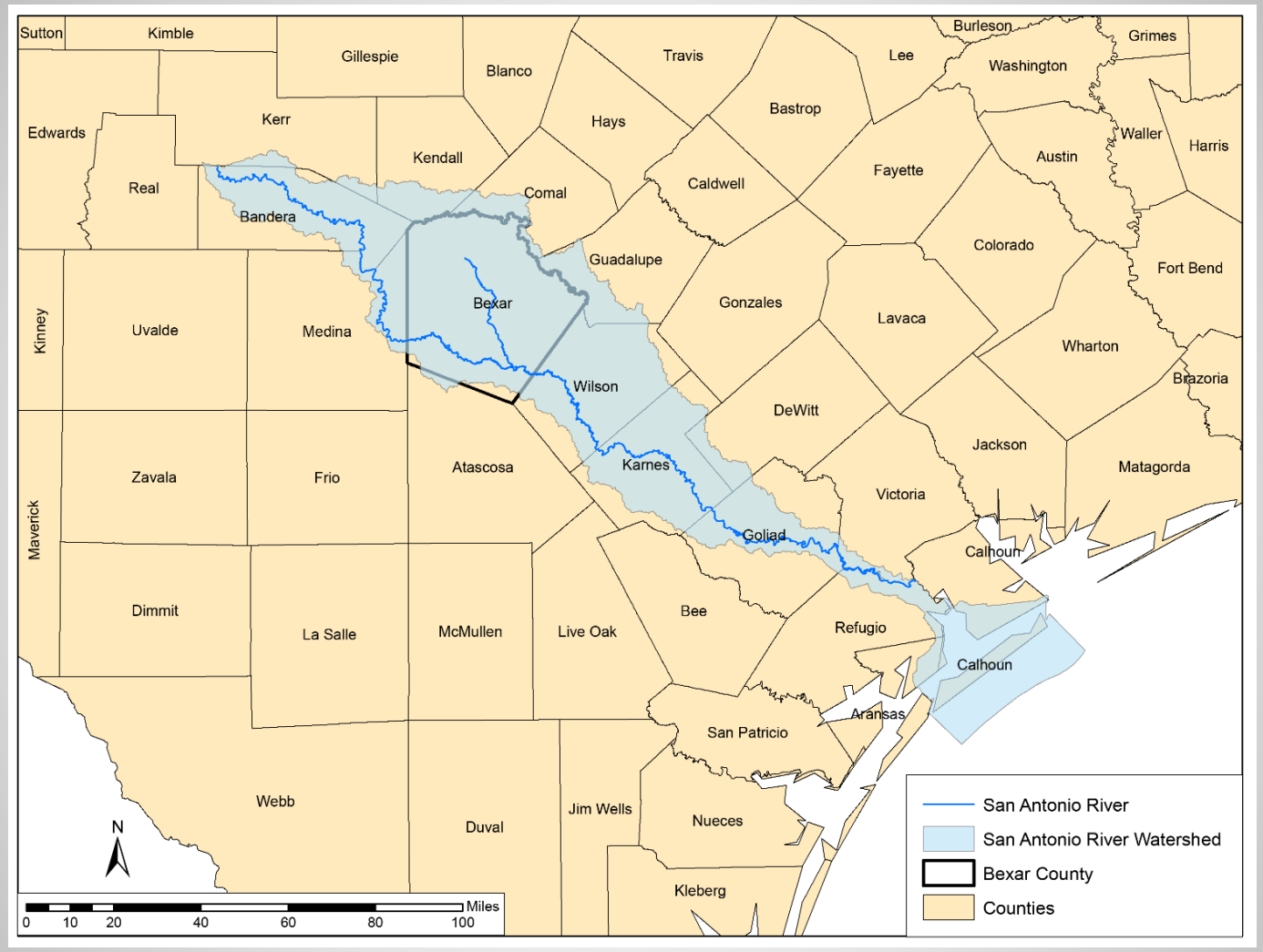
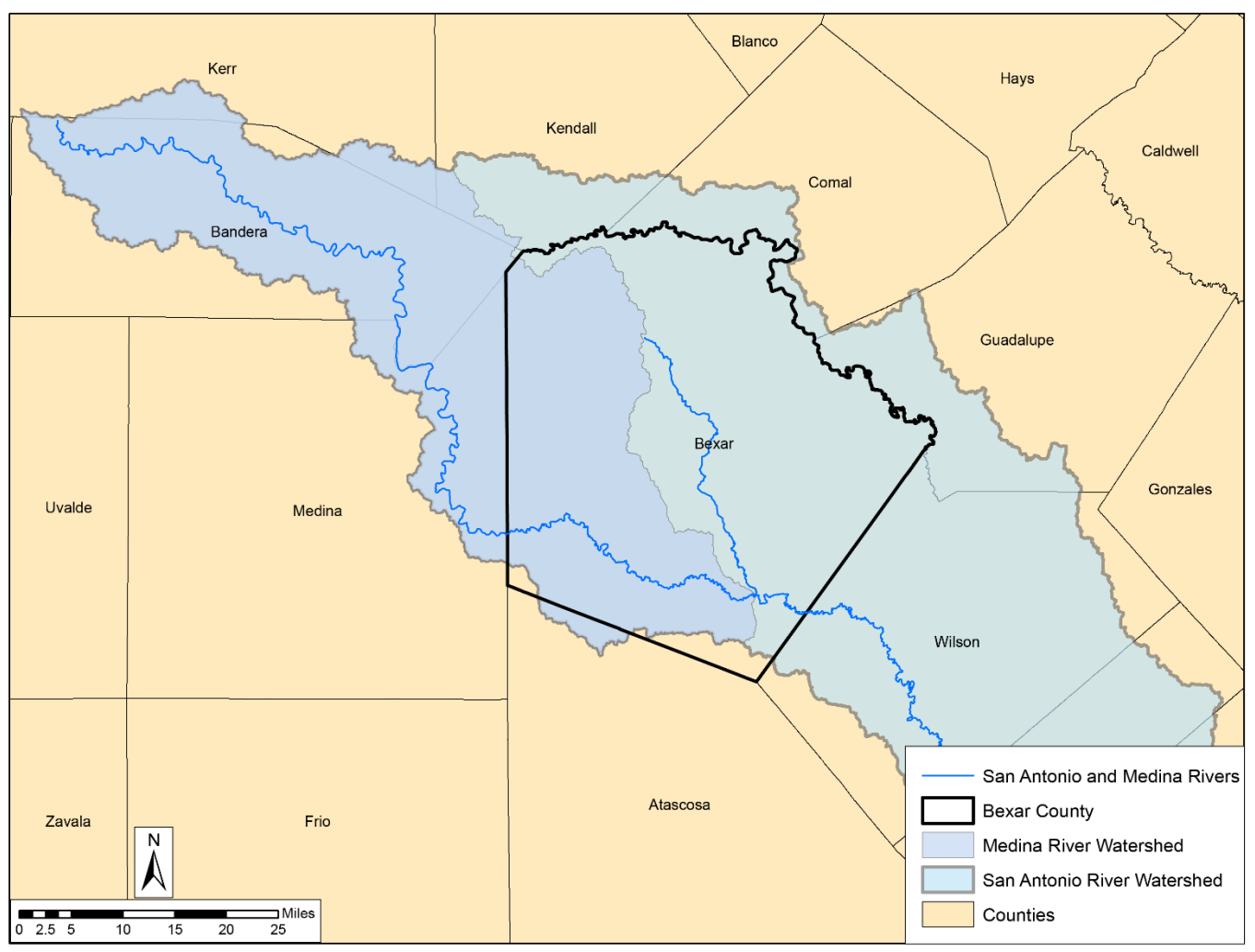
Background



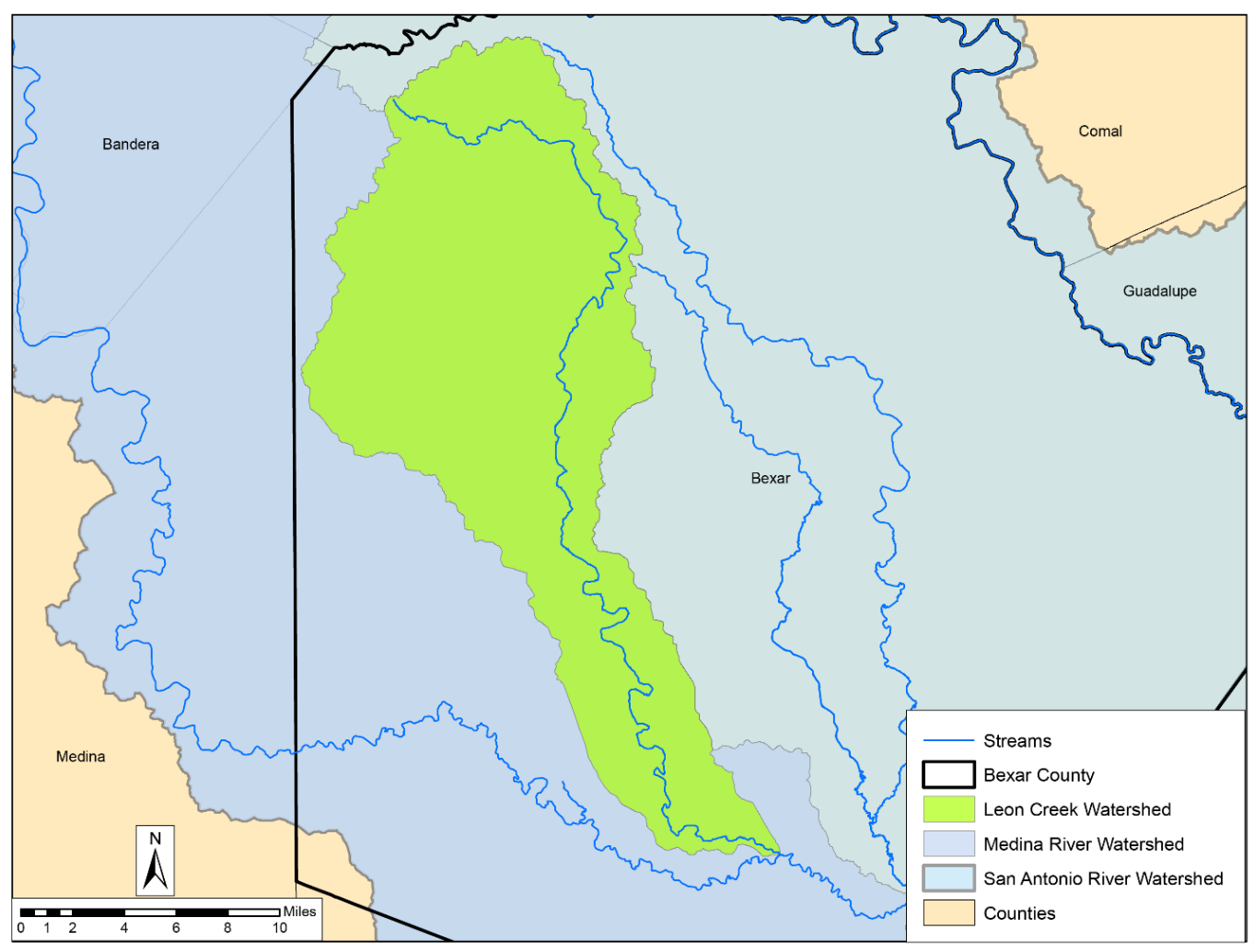
San Antonio River Watershed

Background



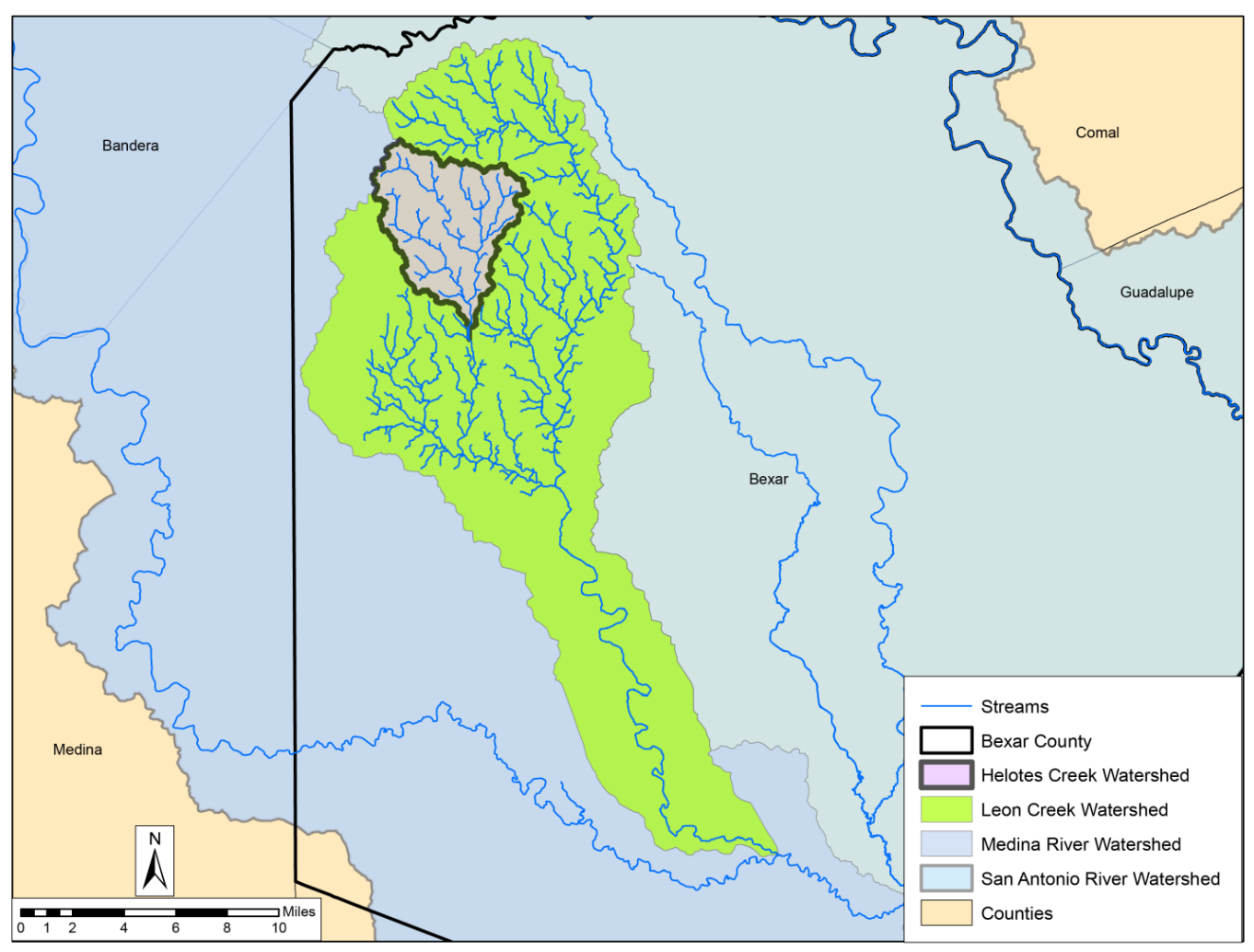
San Antonio River and Medina River Watersheds

Background



Leon Creek Watershed

Background



Helotes Creek Watershed

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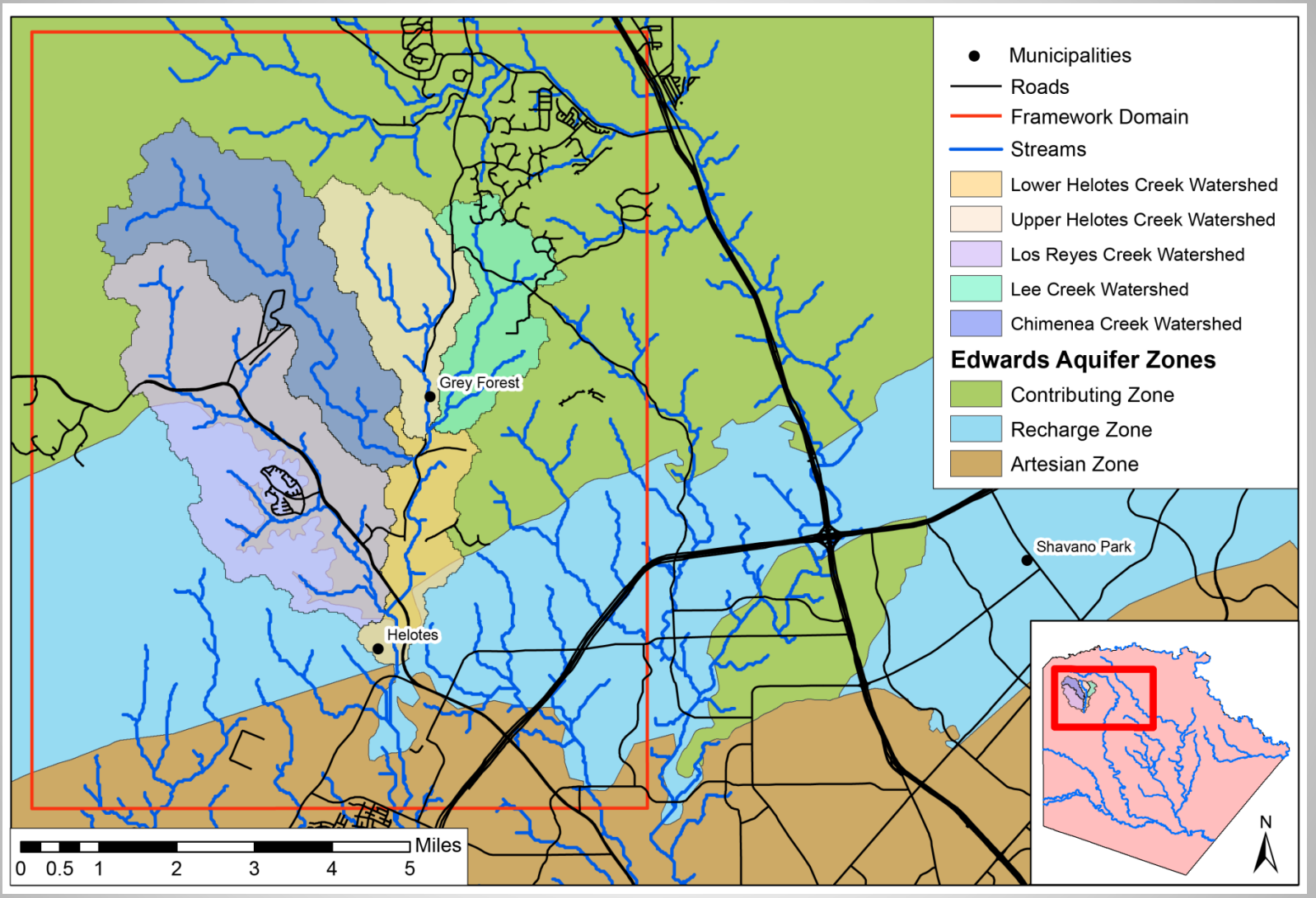
Background



Helotes Creek Watershed

Population Growth

Helotes

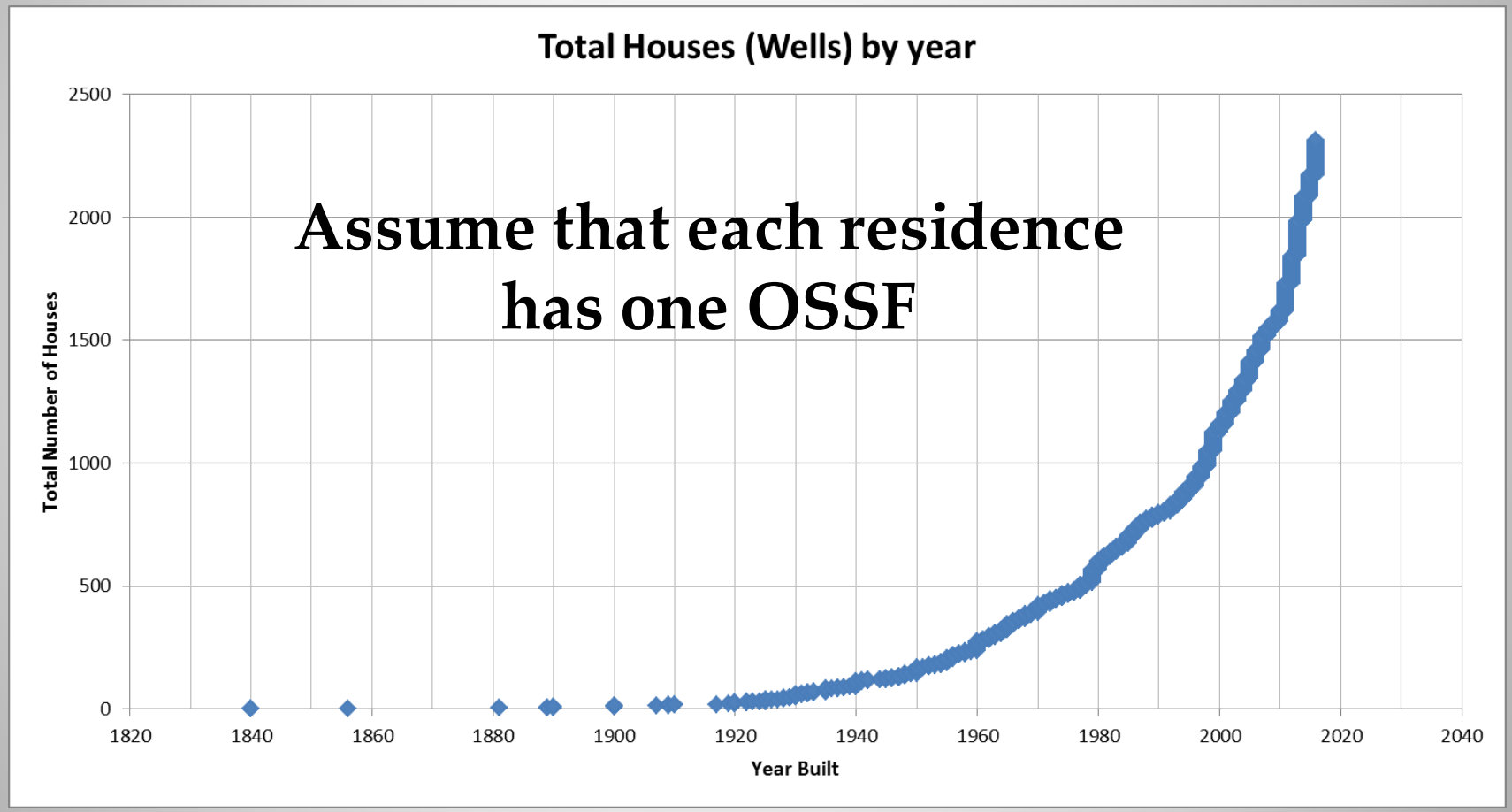
Census	Population	Percent Change
1990	1,535	---
2000	4,285	179.2
2010	7,341	71.3
2016 (Estimated)	8,758	19.3

Grey Forest

Census	Population	Percent Change
1970	385	---
1980	442	14.8
1990	425	-3.8
2000	418	-1.6
2010	483	15.6
2016 (Estimated)	532	10.1

Source: U.S. Census Bureau

“Exponential” Residential Growth In Helotes Creek Watershed



Bexar County Appraisal District

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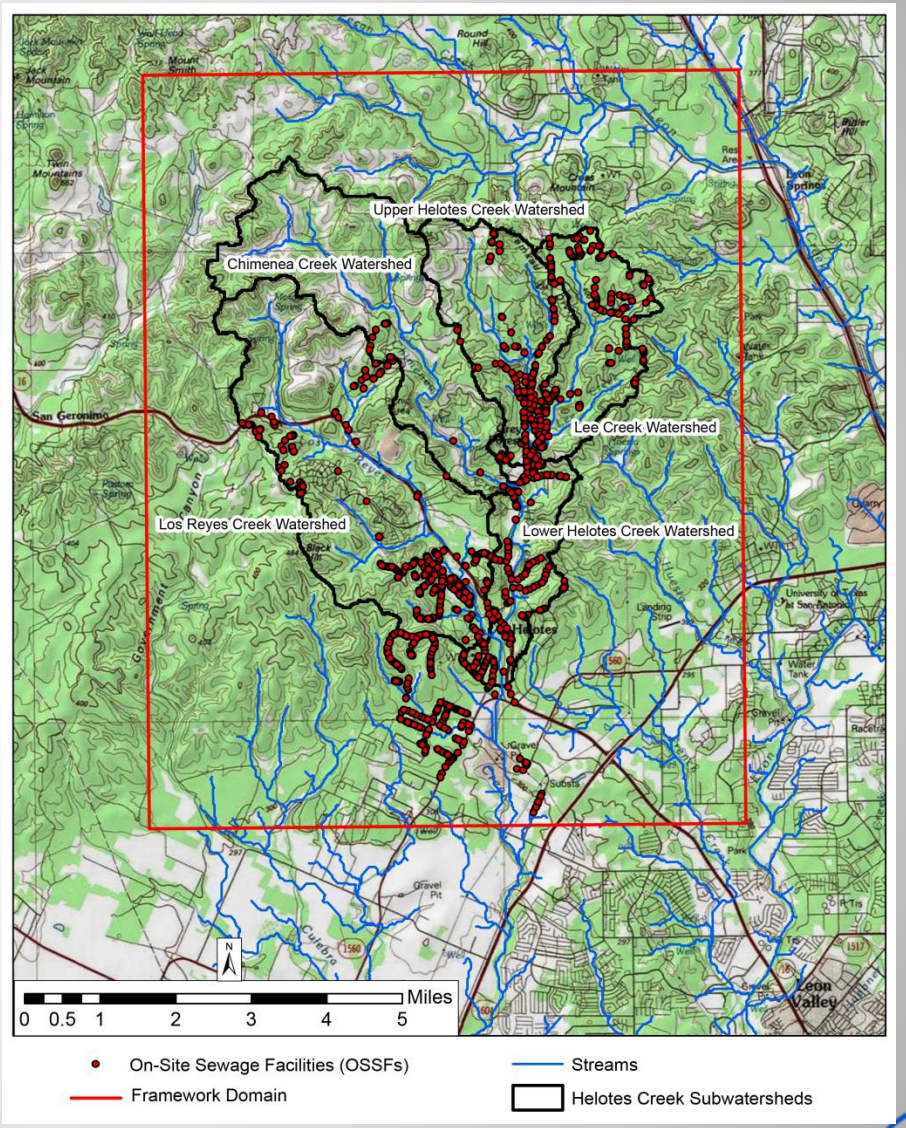
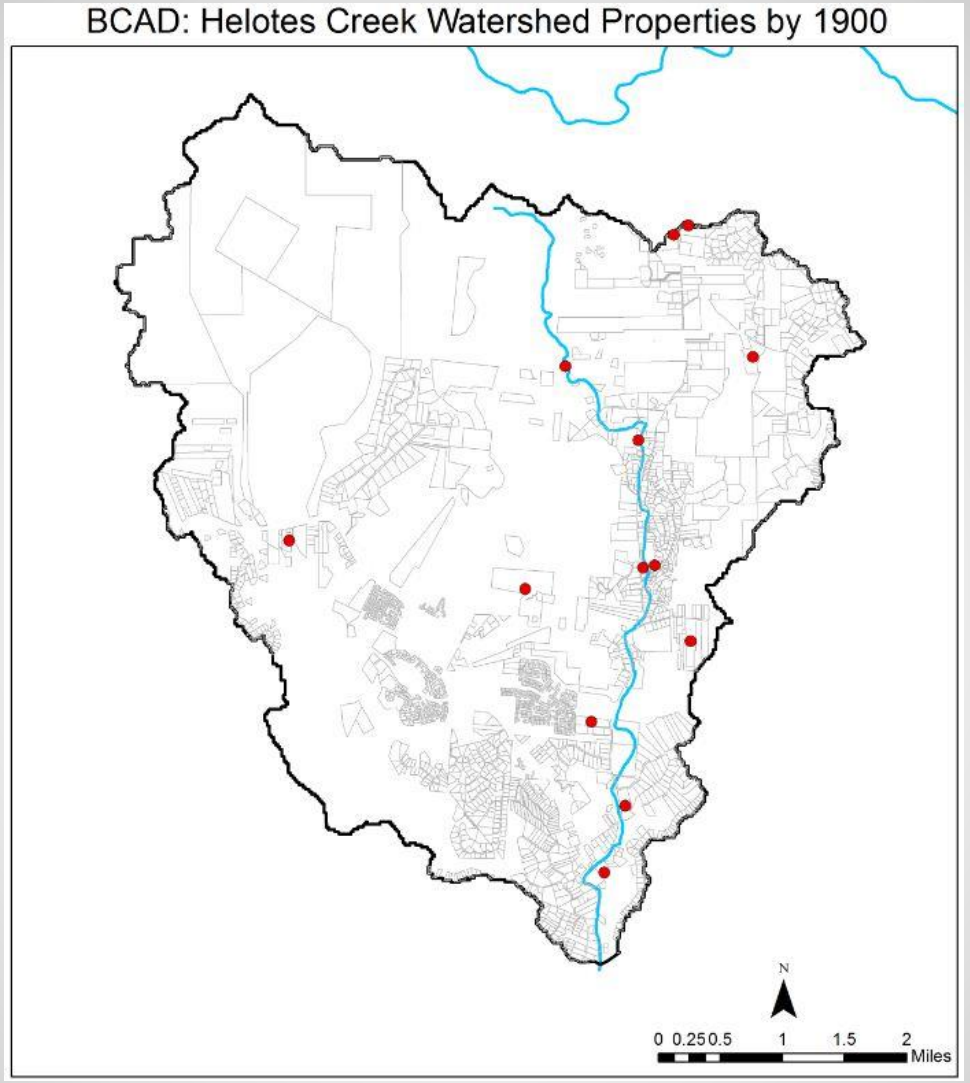
OSSF Permits

- There are 1,635 OSSFs within the framework domain
- Both standard systems and aerobic-surface spray systems,
- Distance to creek beds:
  - Lowest: < 1 ft
  - Greatest: ~ 2569 ft
  - Average: ~ 827.3 ft
  - Median: ~ 762.4 ft





1900

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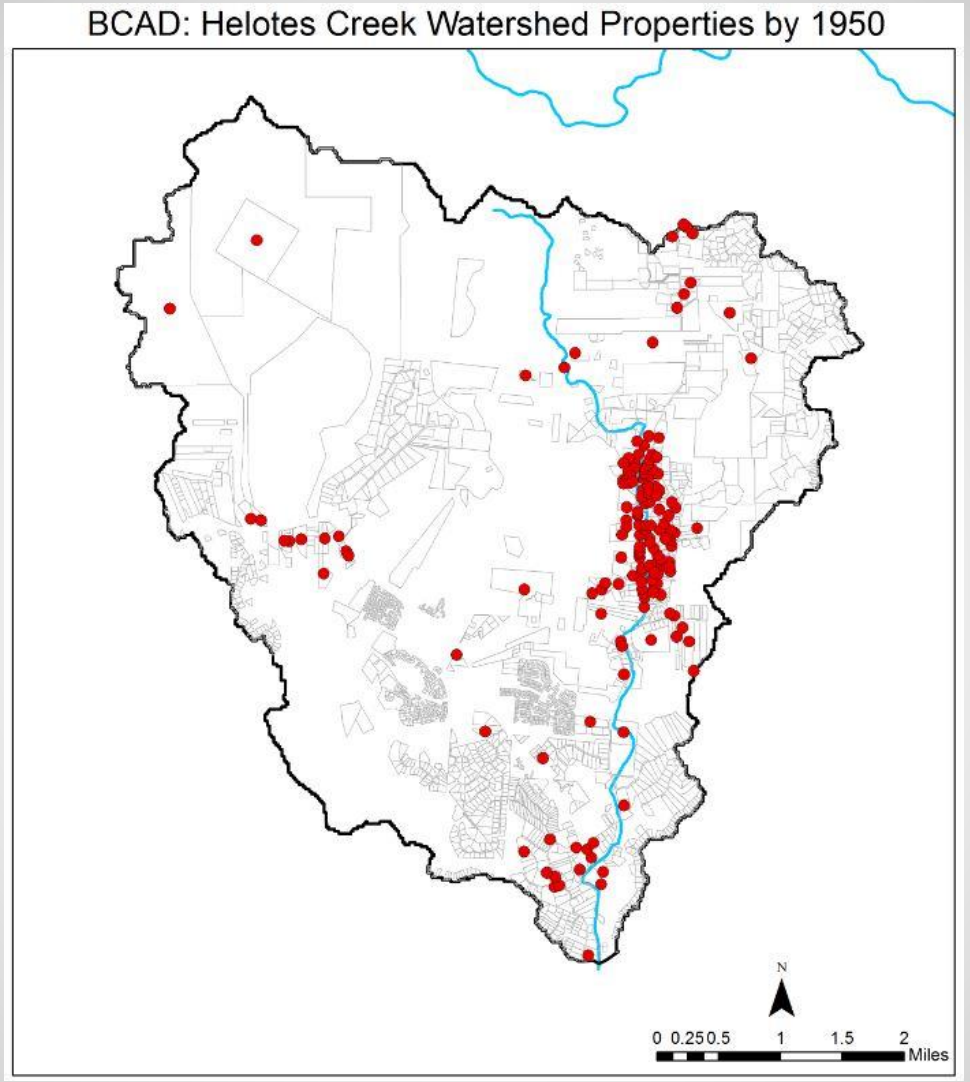

1950

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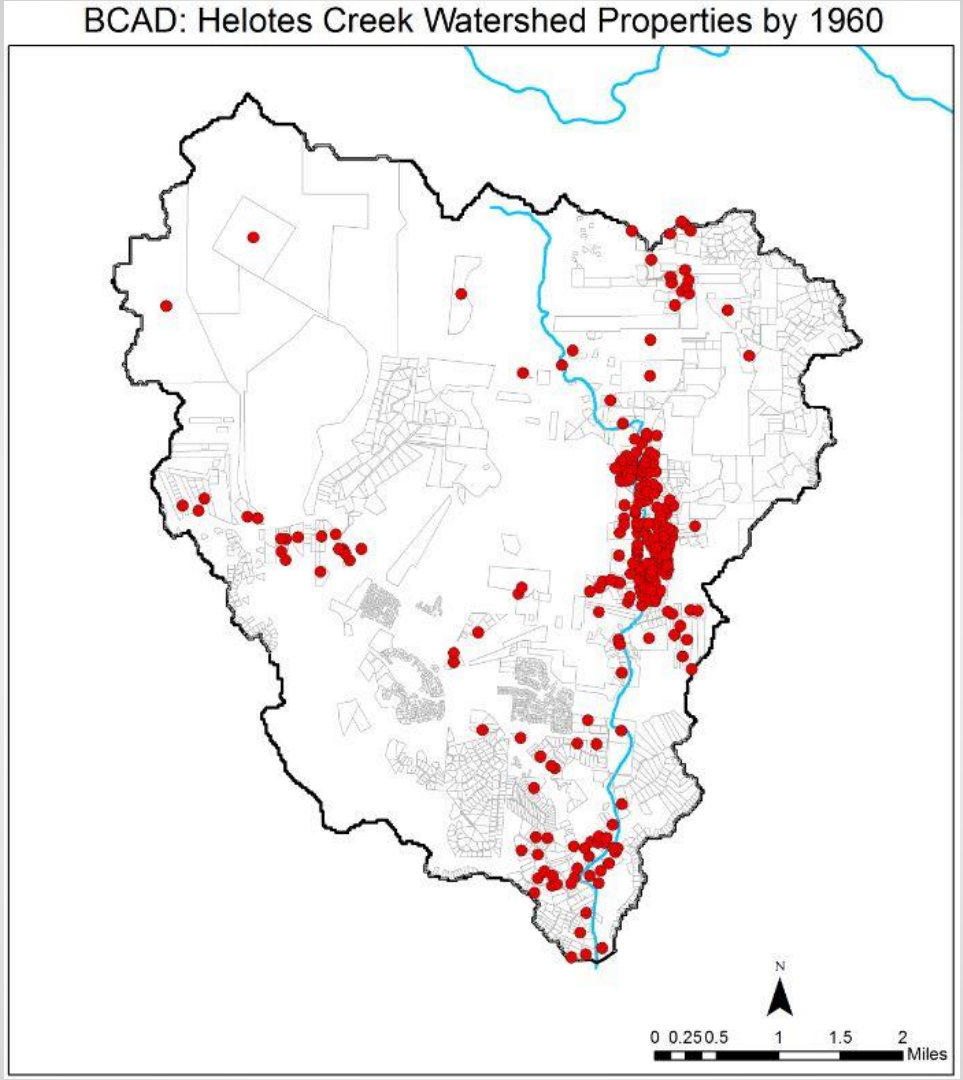

1960

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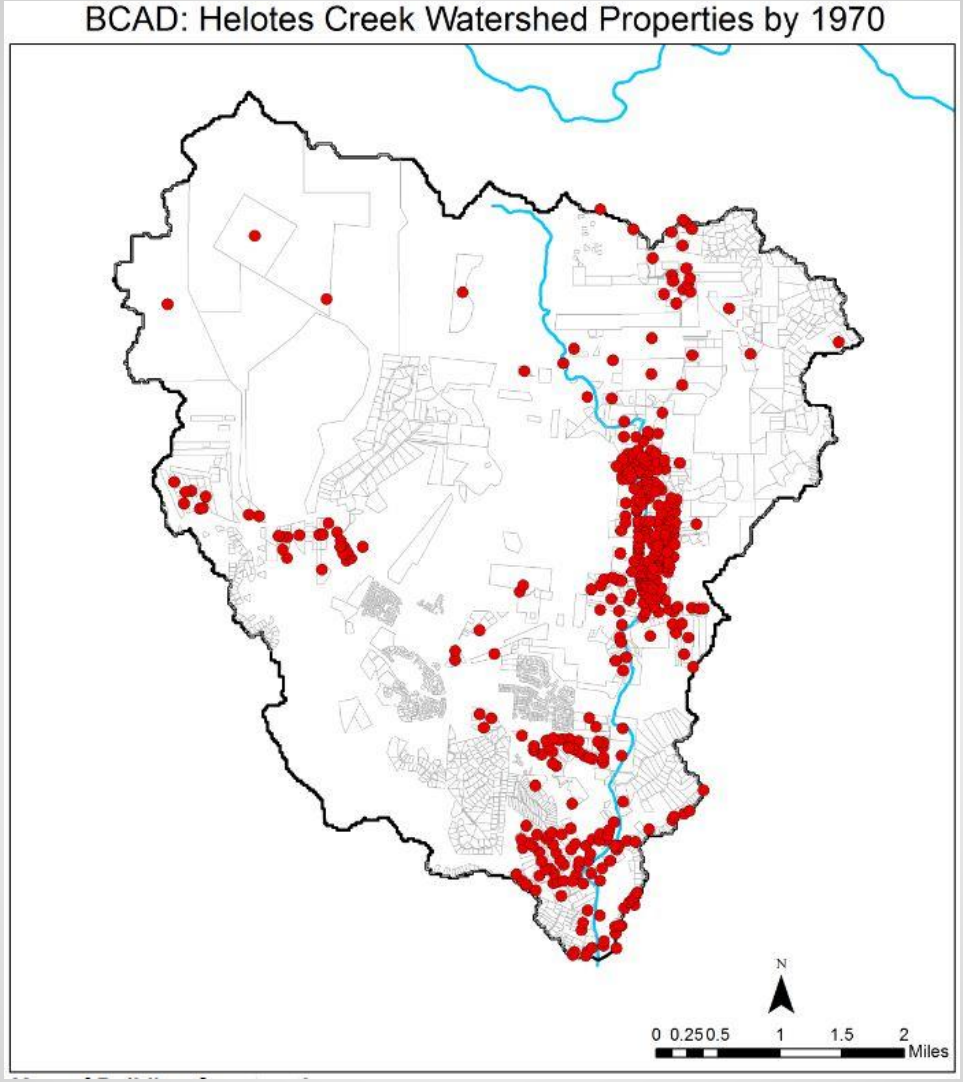

1970

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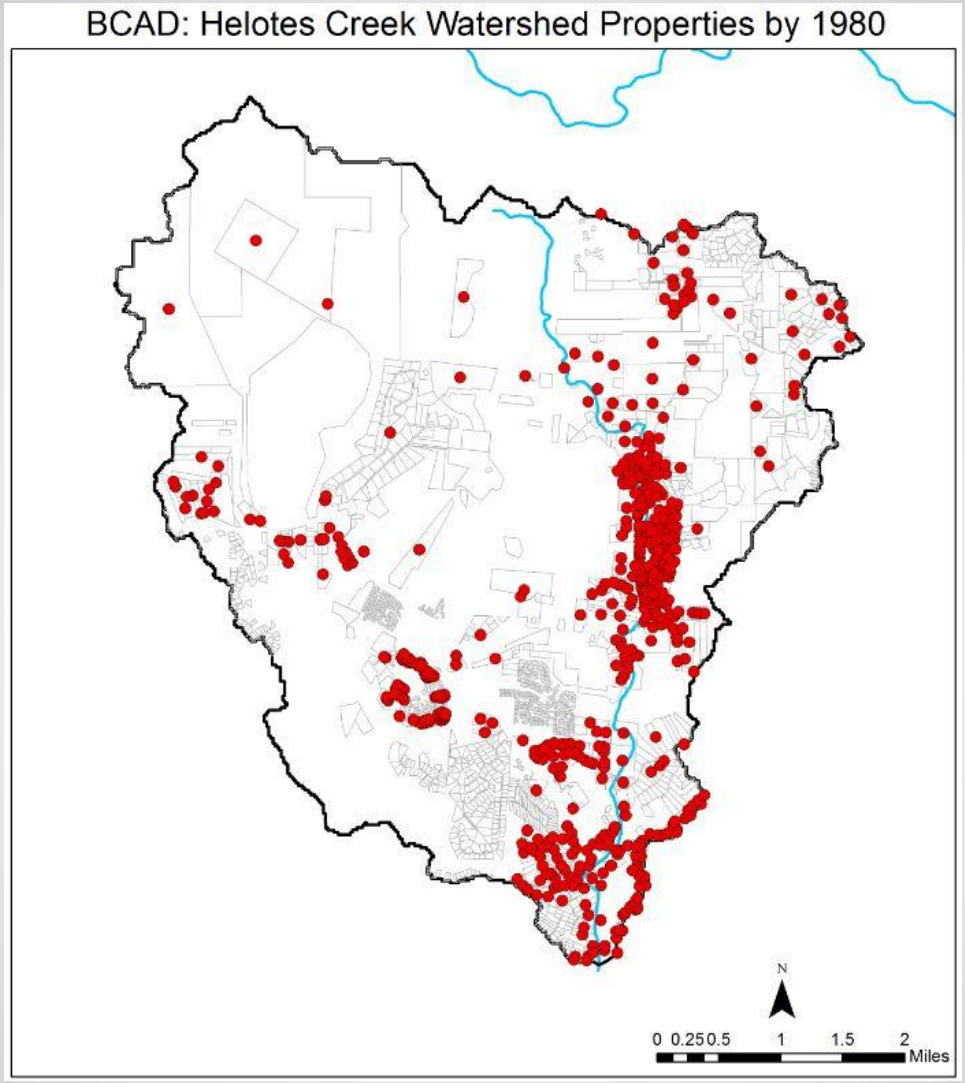
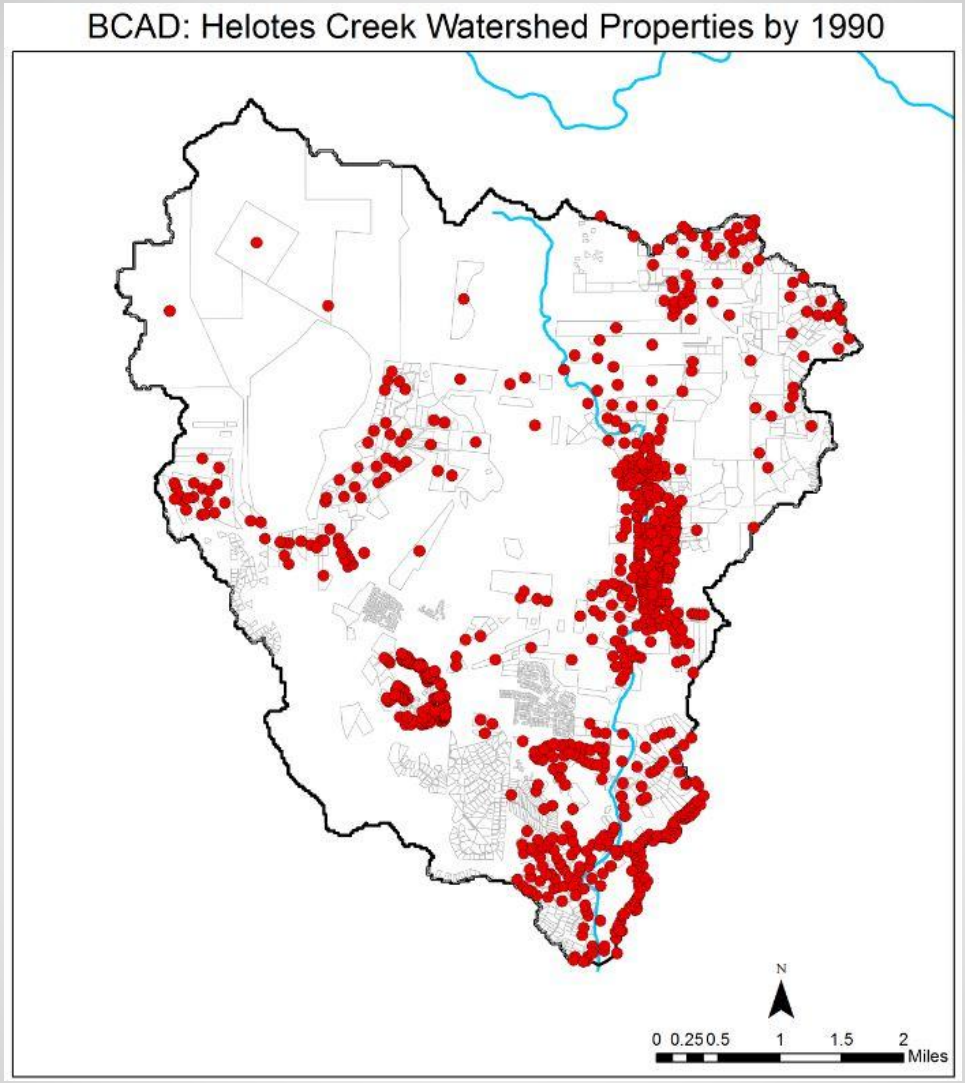

BCAD: Helotes Creek Watershed Properties by 1980
N
0 0.250.5 1 1.5 2
Miles

1980



1990

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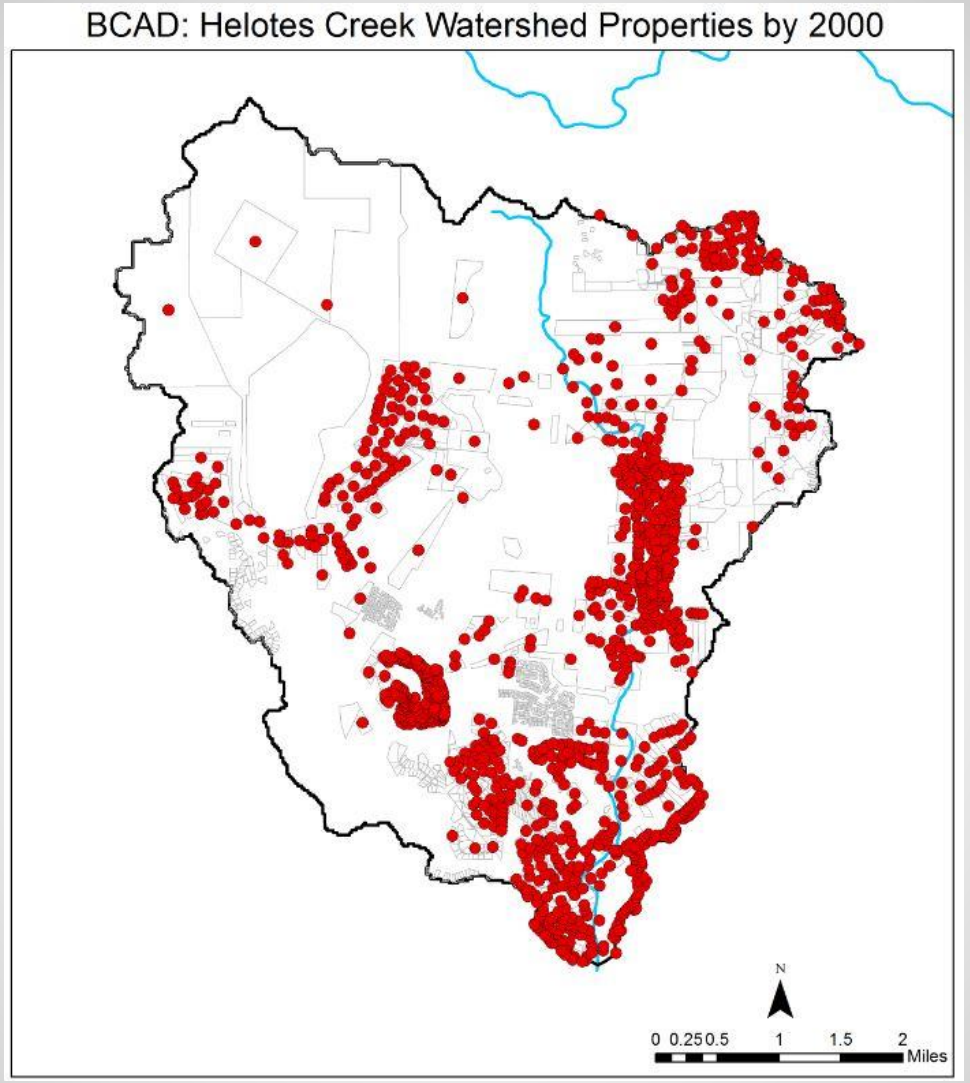

2000

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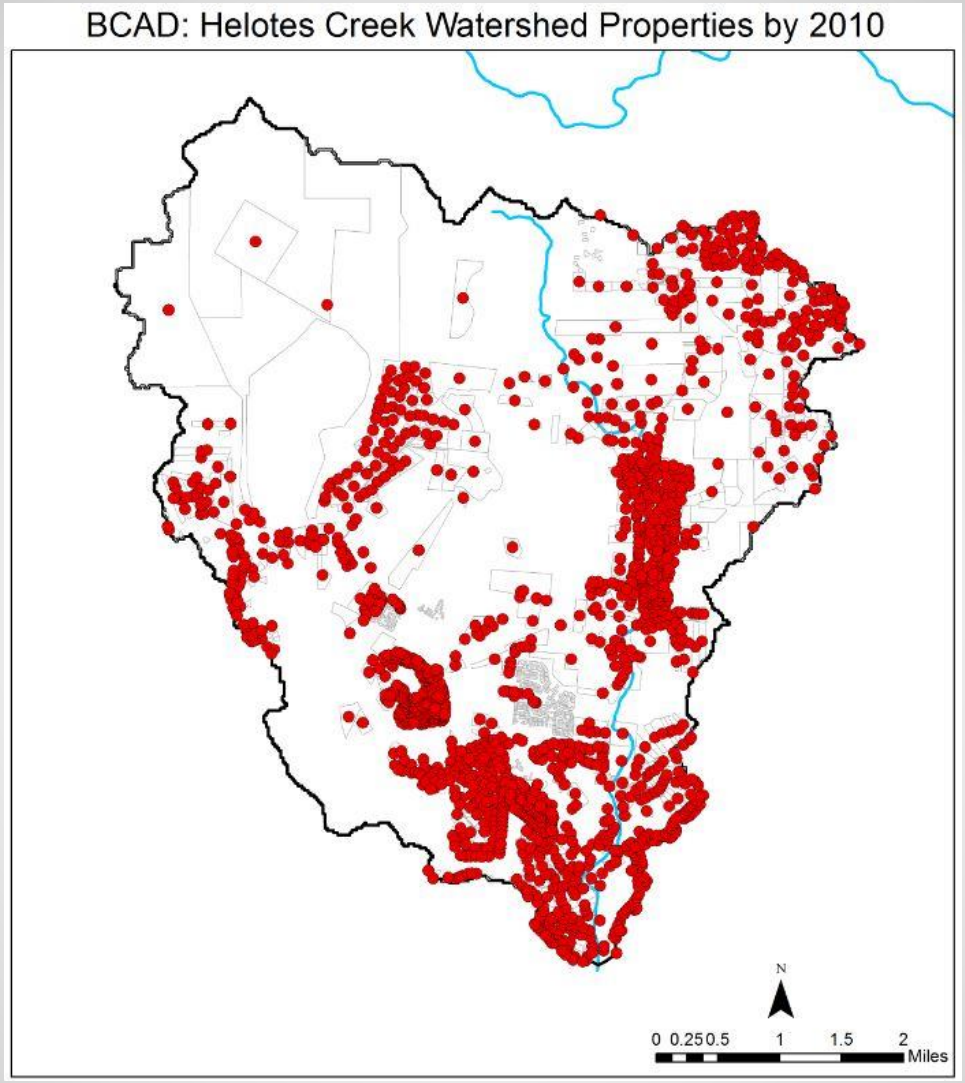

2010

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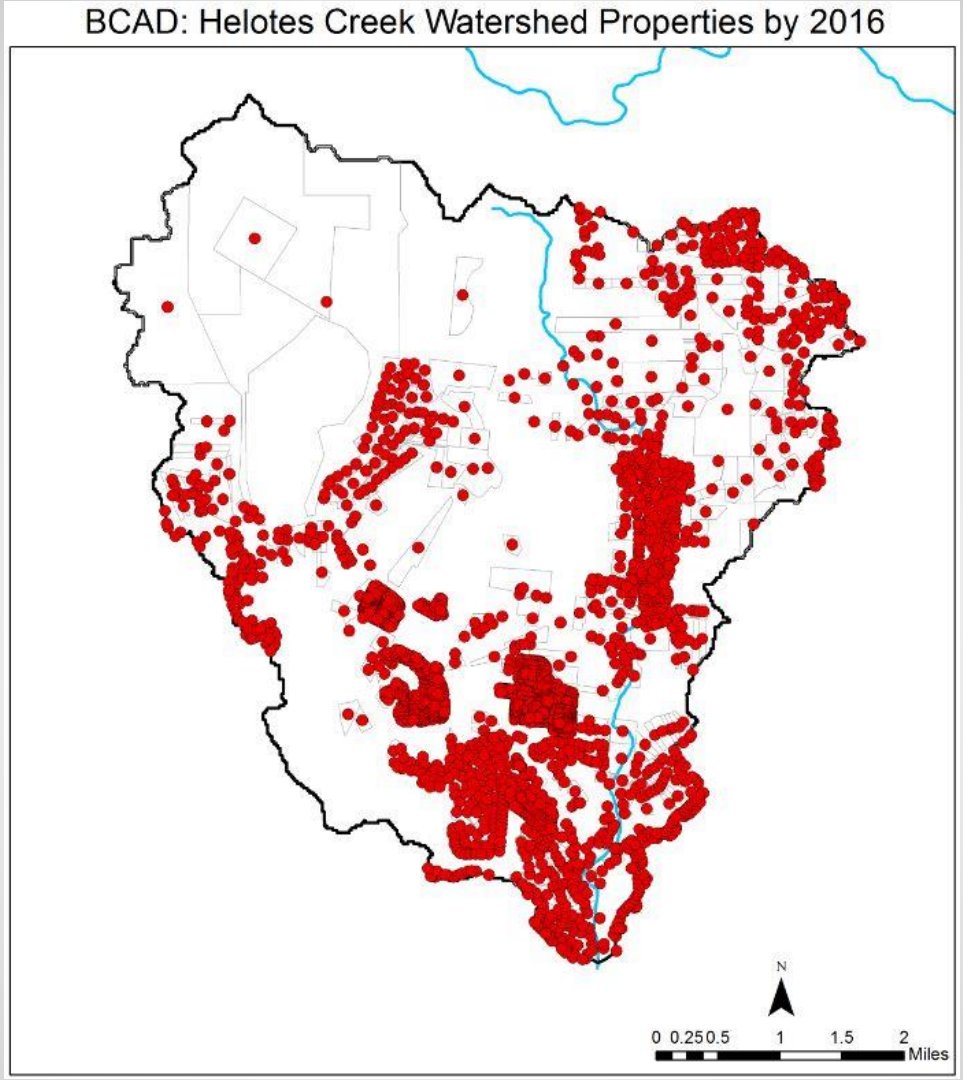

2016

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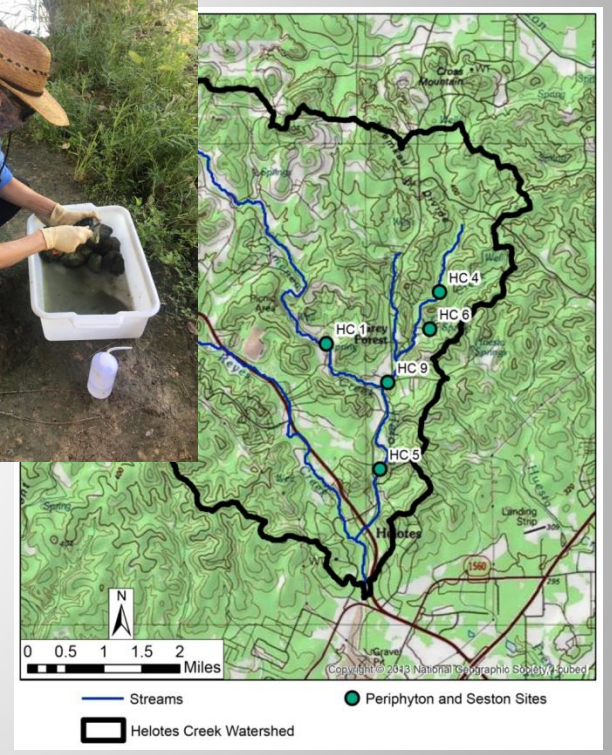
EAA/SwRI Sampled Water and Periphyton/Seston to Determine Trophic State of Helotes Creek Watershed (Not funded as part of Prop 1 EAPP project)



Use trophic state to determine degradation of the watershed

Oligotrphic	**Mesotrophic**	**Eutrophic**
Pristine	**So-So**	**Degraded**

Use trophic state to determine degradation of the watershed

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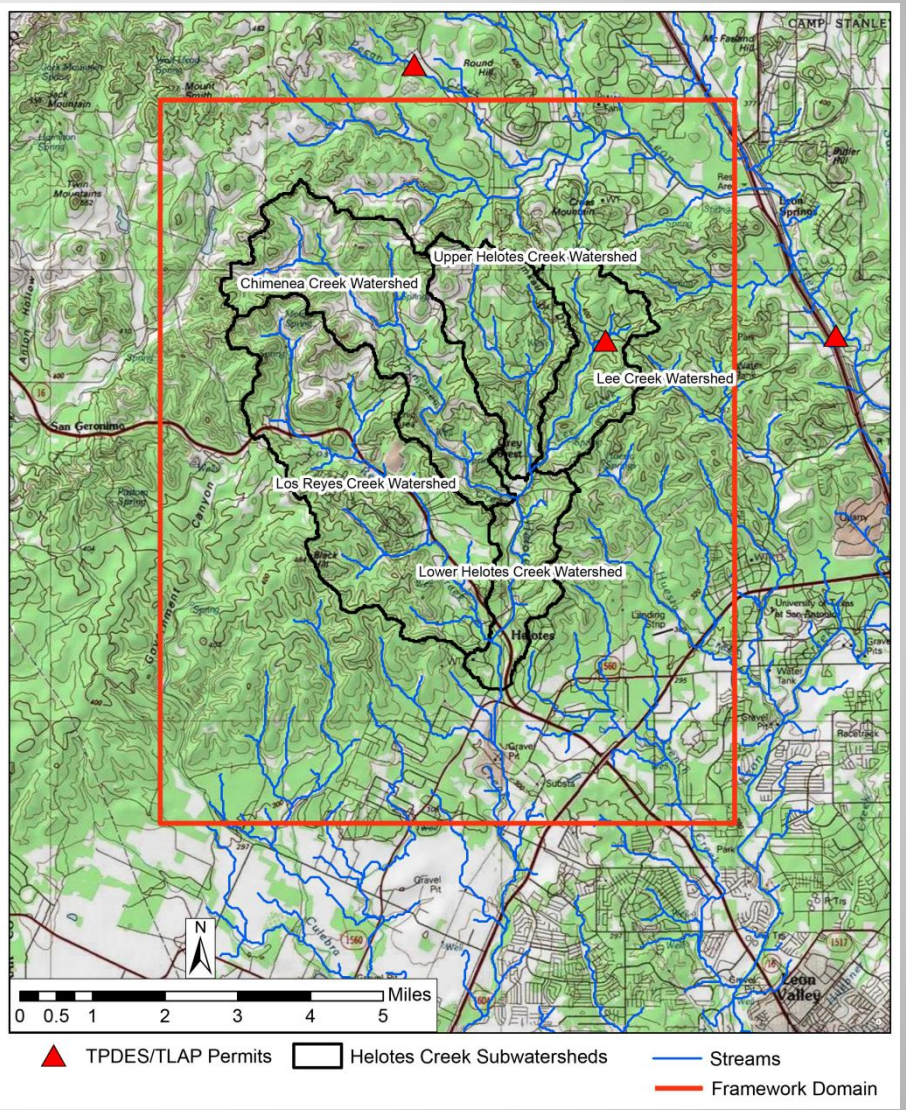
No TPDES and TLAP in Study Area*

- **TPDES** = Texas Pollutant Discharge Elimination System; federally-regulated permits
- **TLAP** = Texas Land Application Permit; state-regulated permits



* Some are “in the books” but not built

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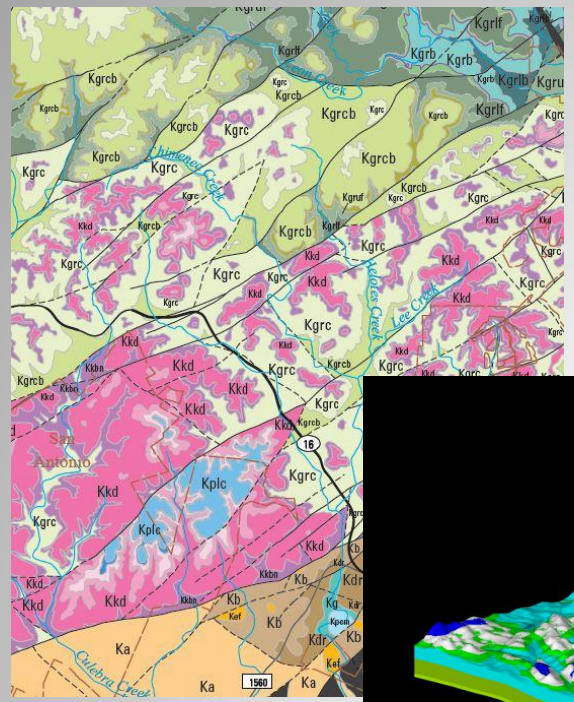
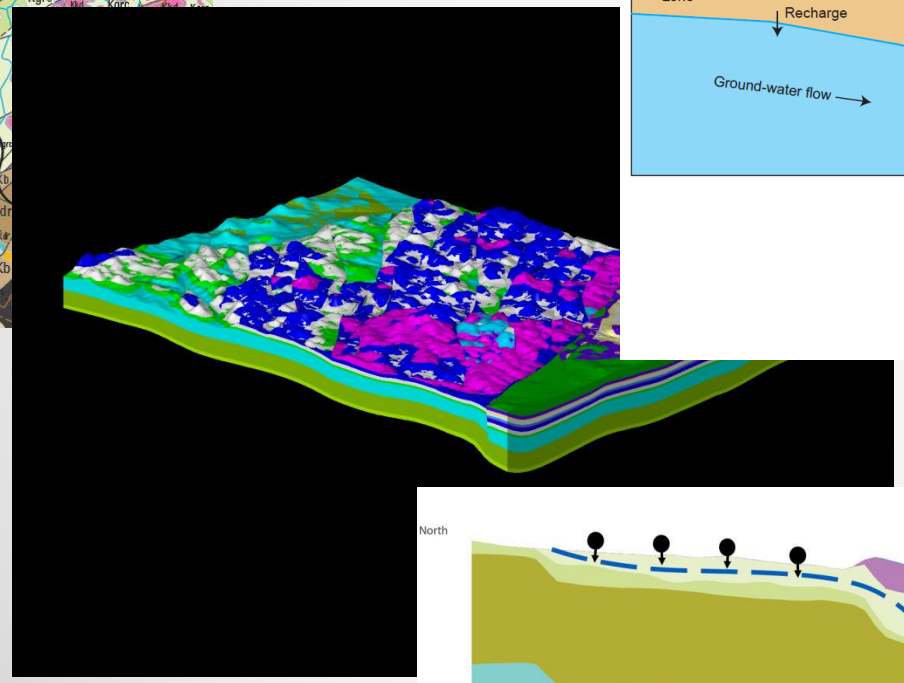
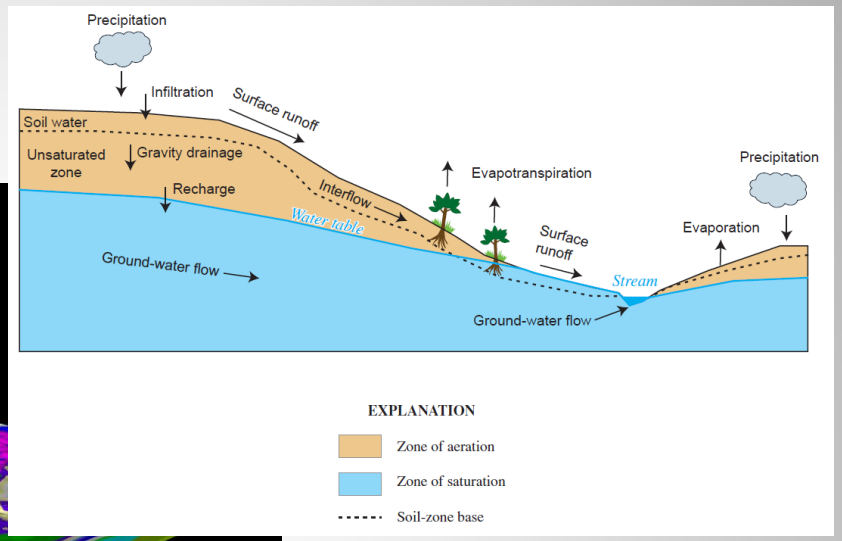
Developed Integrated Hydrologic Model to Predict Impact of Different Types of Waste Disposal Facilities

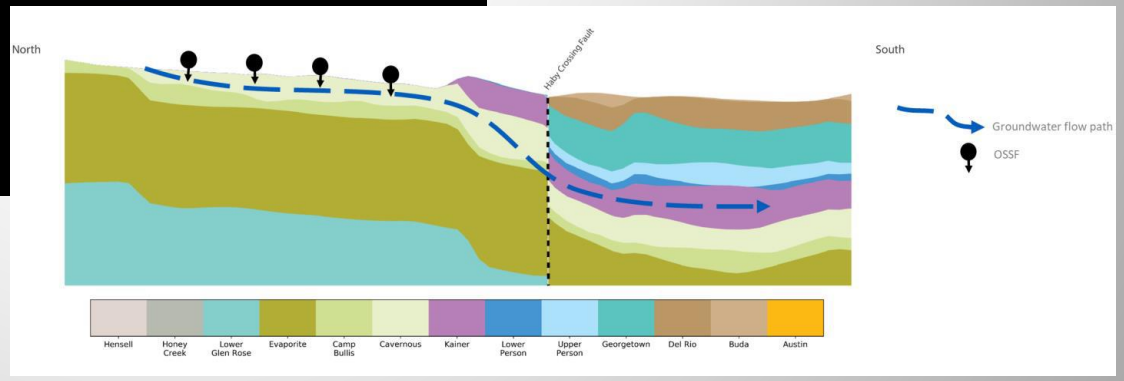
- Hydrologic modeling requires two integrated models.
  - Groundwater Model
  - Surface-Water Flow Model
- All modeling software is open source and available in the public domain.

Integrated Model









All Effluent Ends Up in Edwards Aquifer

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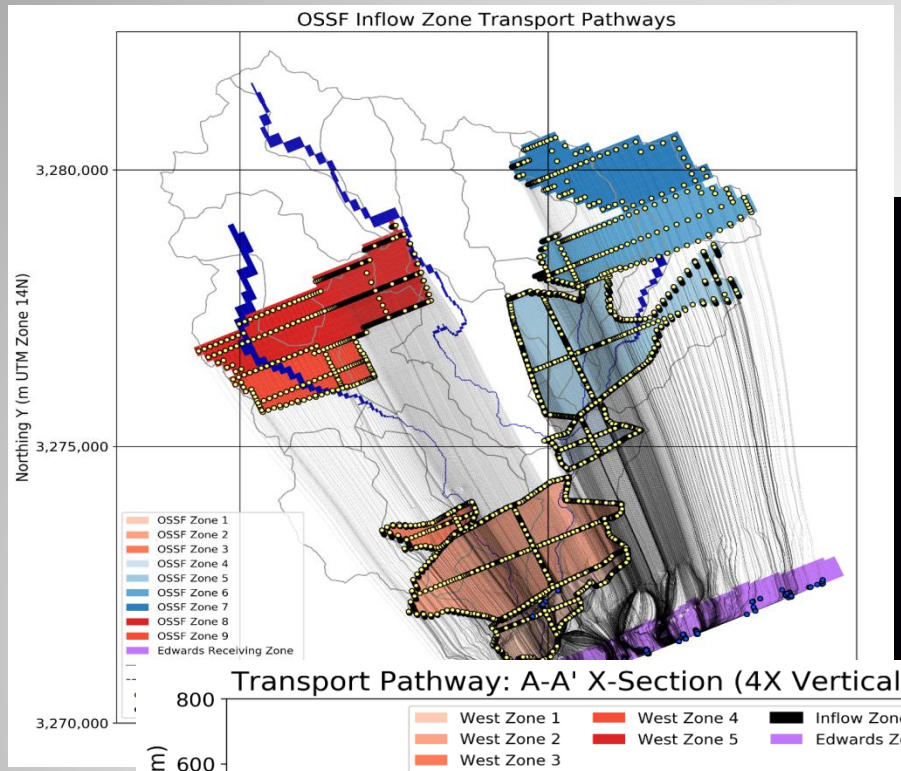
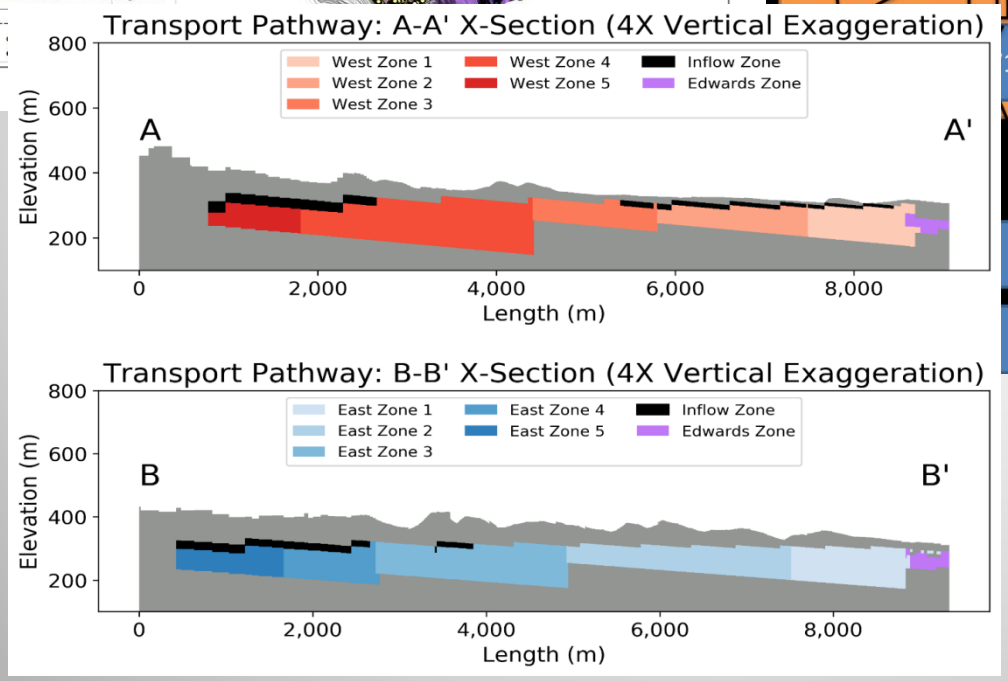
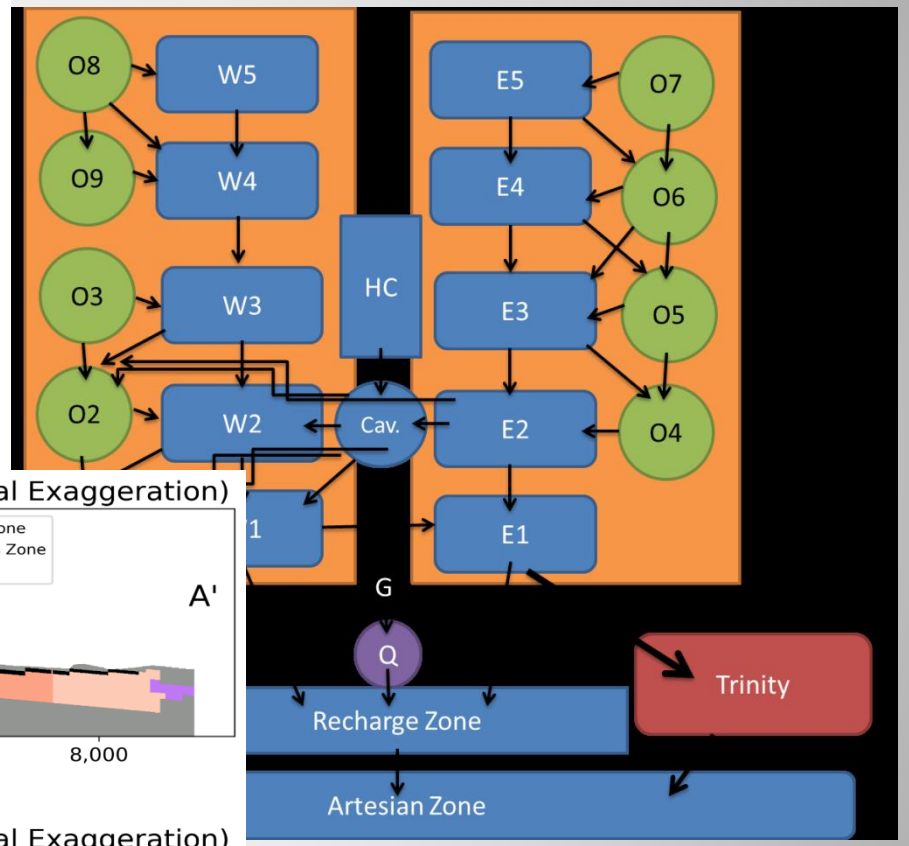
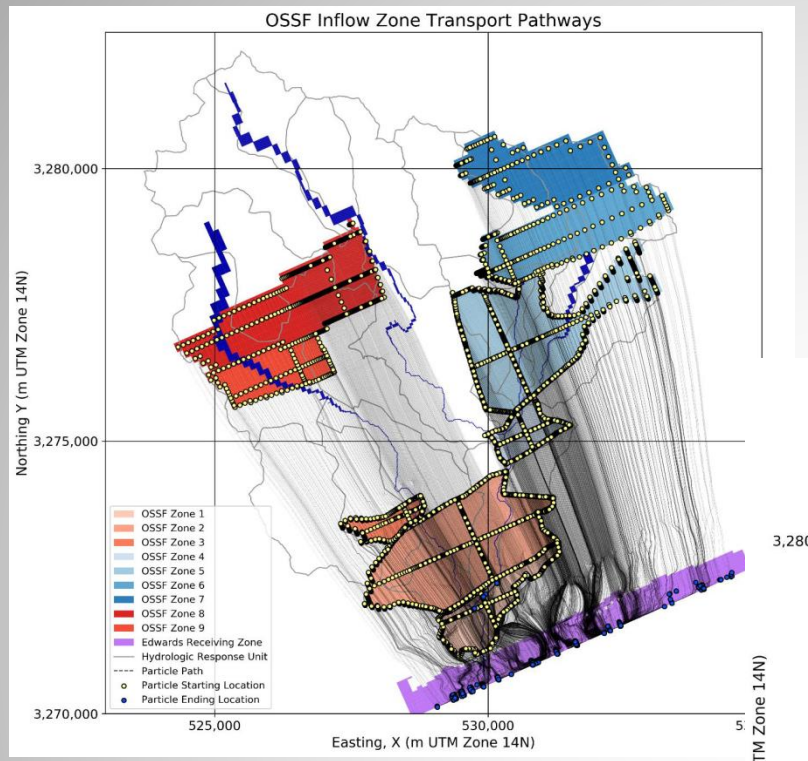
Transport Model GoldSim



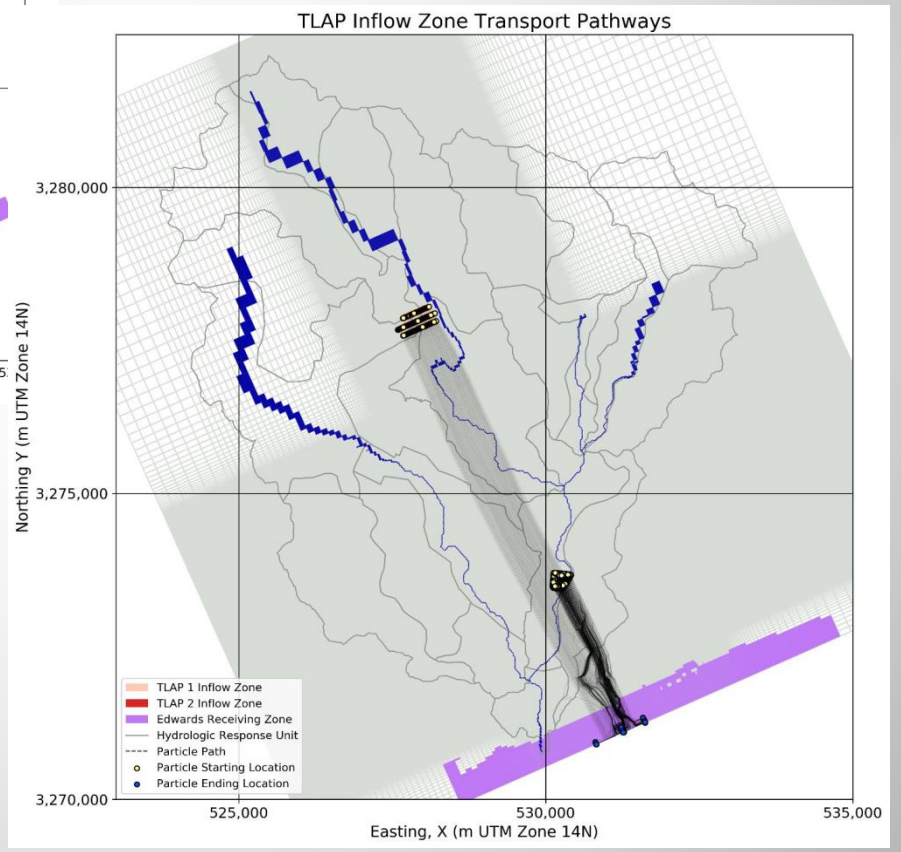




Transport Simulations



OSSFs



TLAPs & TPDES

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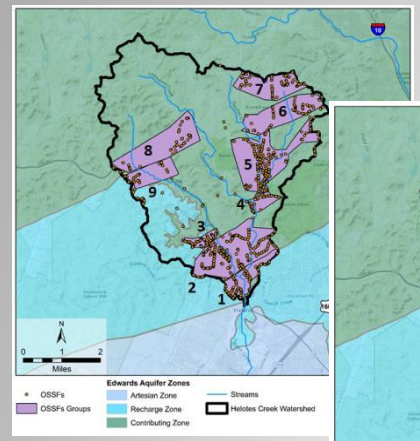
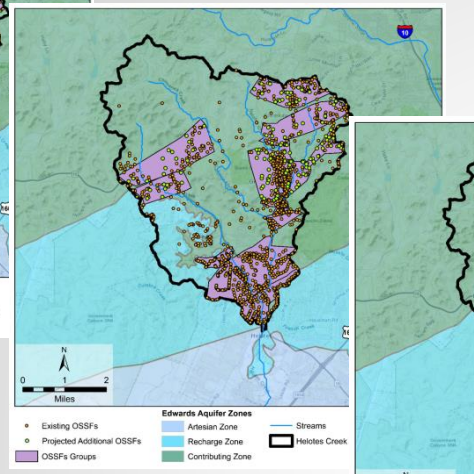
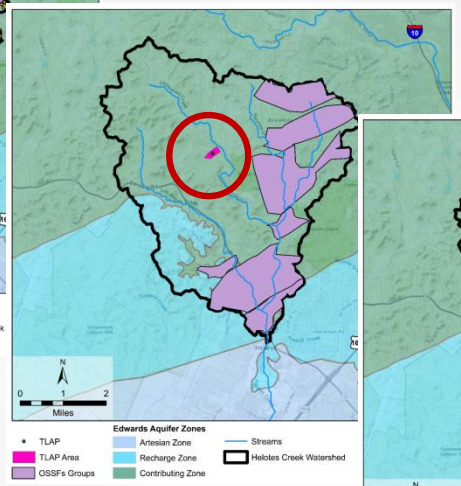
Considered Eight Scenarios



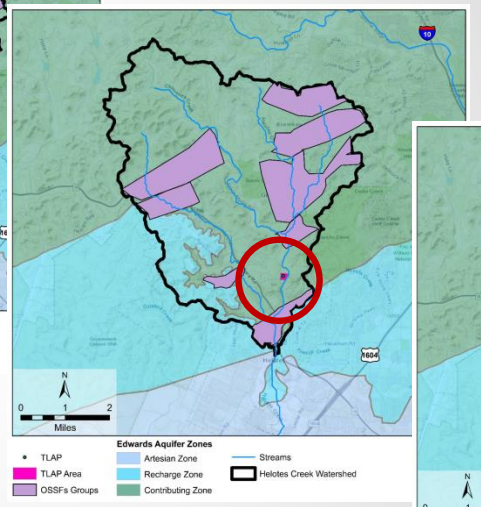
Basecase
Existing OSSFs



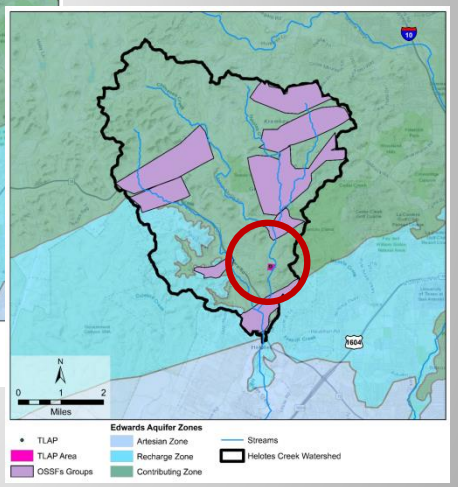
Scenarios 1-3
OSSFs



Scenarios 4 & 6
Upstream TLAP



Scenarios 5& 7
Downstream TLAP



Scenario 8
Downstream TPDES

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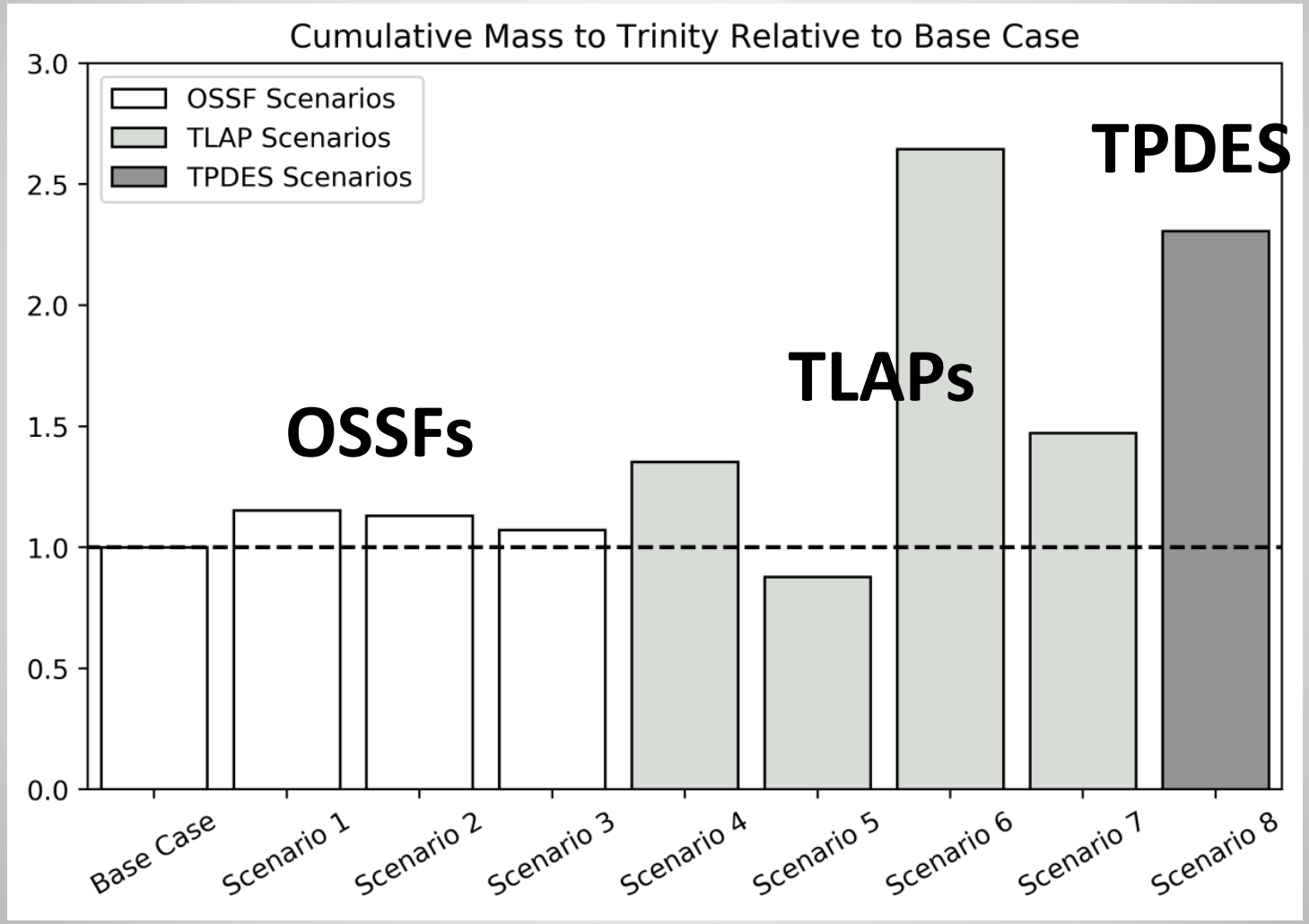
Scenarios

- OSSF scenarios include unaccounted and defective facilities.
- Capacity of the TPDES and TLAP facilities equates to 4,800 homes over 1,800 acres, a residential development conceivable in the 15,640 acre Helotes Creek watershed.

Results



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Conclusions

- **Integrated model developed** to simulate wastewater impact on recharge
- **Model has limitations** (i.e., porous media, not karst flow, limited data)
- Impact of OSSF, TLAP, and TPDES **simulated**
- Trophic state of Helotes Creek is **marginally impacted**
- Increased discharge of effluent, **regardless of facility type**, will render the creek **clearly degraded**
- **Eight scenarios evaluated**, many others possible (i.e., simulating particular facilities, varying distance to creek, field testing TLAP & TPDES, etc.)
- **Model applicable to other localities** (i.e., effluent discharge across Contributing Zone)

Source: The Helotes Herald

Source: edwardsaquifer.net

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Acknowledgements

SwRI:

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Marcus Gary (EAA)

Jessica Quintanilla (EAA)

Jim Boenig (EAA)

Taylor Bruecher (EAA)

Brent Doty (EAA)

Chris Herrington (City of Austin)

Abel Porras (City of Austin)

Ed Peacock (City of Austin)

Vikram Kapoor (UTSA)

Jessica Hinojosa (UTSA)

Jemima Green (UTSA)

Brian Laub (UTSA)

Jeff Back (Baylor University)

Thank you! Any questions?

Source: Palo Alto College

Source: San Antonio Express-News

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Proposition 1-Characterizing the Connection Between Storm-Water Runoff and Groundwater Quality in the Recharge Zone of the Edwards Aquifer, Bexar County, TX

U.S. Geological Survey
South Texas Branch Office
San Antonio, TX

City of San Antonio Conservation Advisory Board
December 2, 2020

Plain Language Summary

- Surface water and groundwater are connected
- Contaminants in runoff enter the aquifer during storms
- Urbanization is a source of contaminants to the aquifer
- Contaminant concentrations in the aquifer are currently (2020) low

USGS

The Frio River-A major source of San Antonio's water

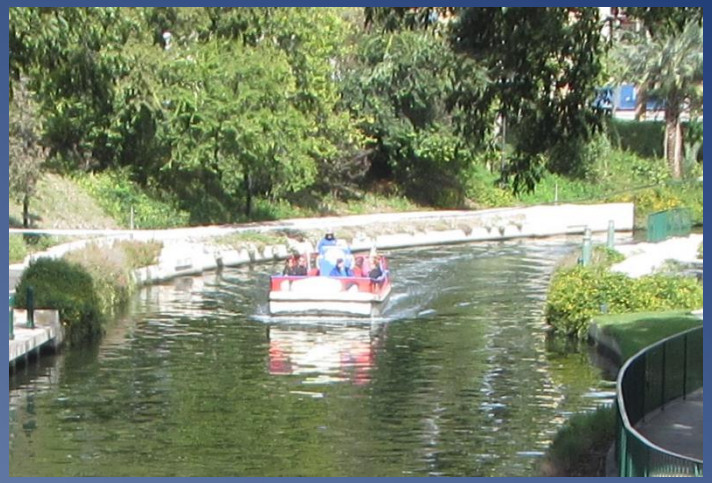
Headlines & Water Issues

Population growth poses challenges to San Antonio

By Rye Druzin Staff Writer, June 25, 2016, SA Express News

National Weather Service issues flash flood watch for Bexar county area through noon Friday

By Chris Eudally May 15, 2015 SA Express News



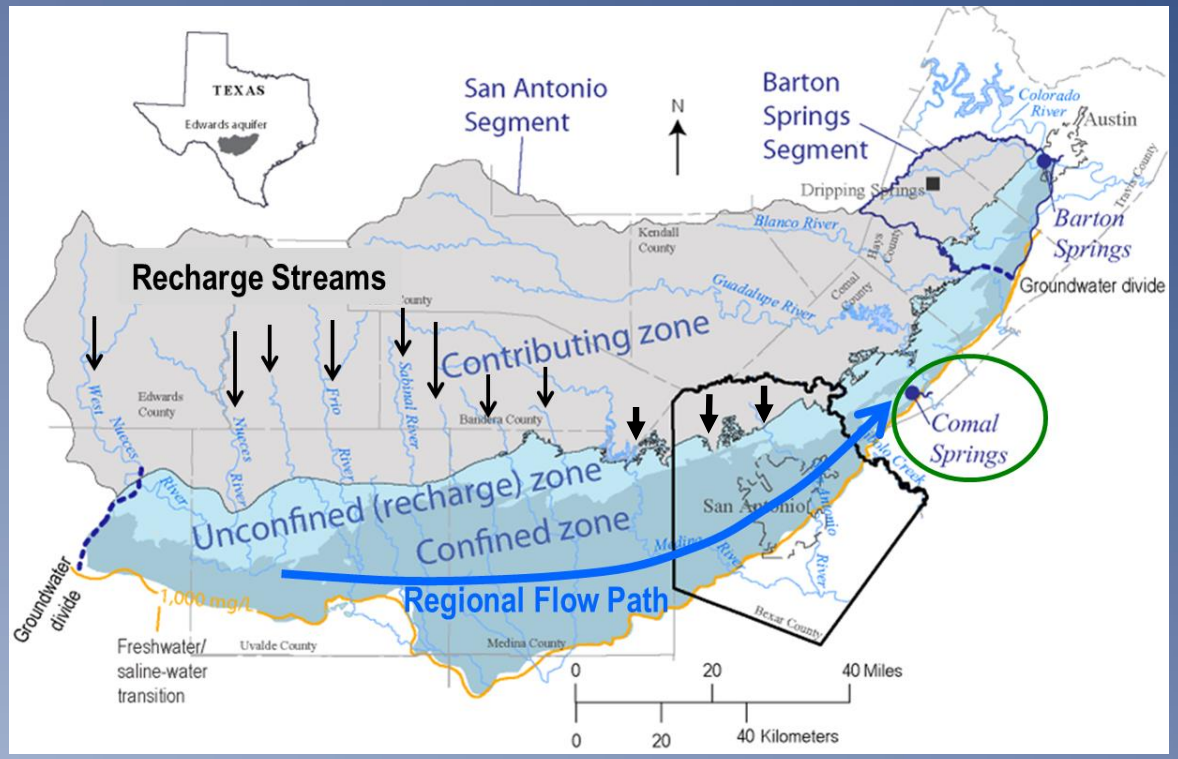
Guarding San Antonio's Eternal Water Future

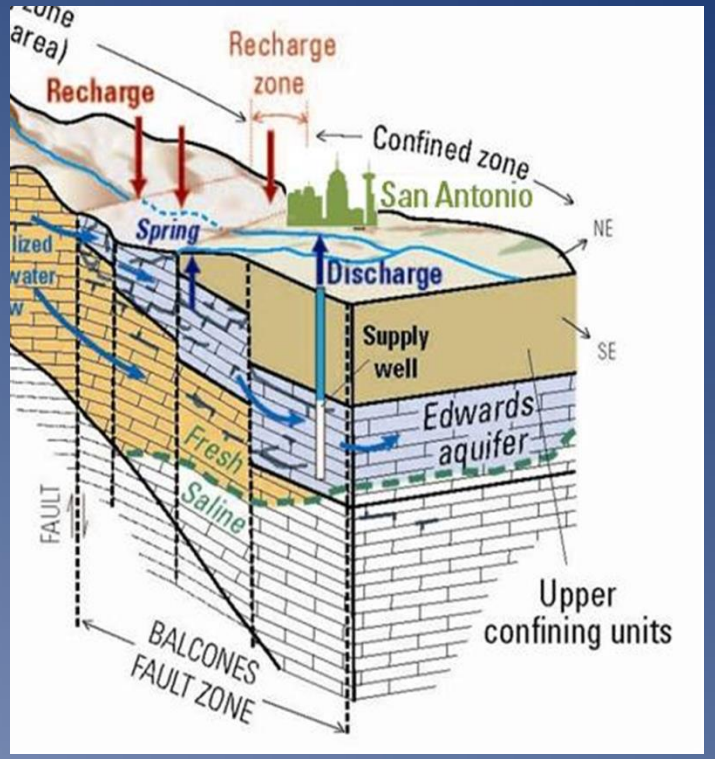
By Ron Nirenberg, District 8 Councilman, June 4, 2014

USGS

The Edwards Aquifer System

- How does the system work?
  - Rain falls on the **contributing zone**, streams flow across the **recharge zone**, and recharge water enters **confined zone**
  - Regional flow paths vs local contributions





USGS

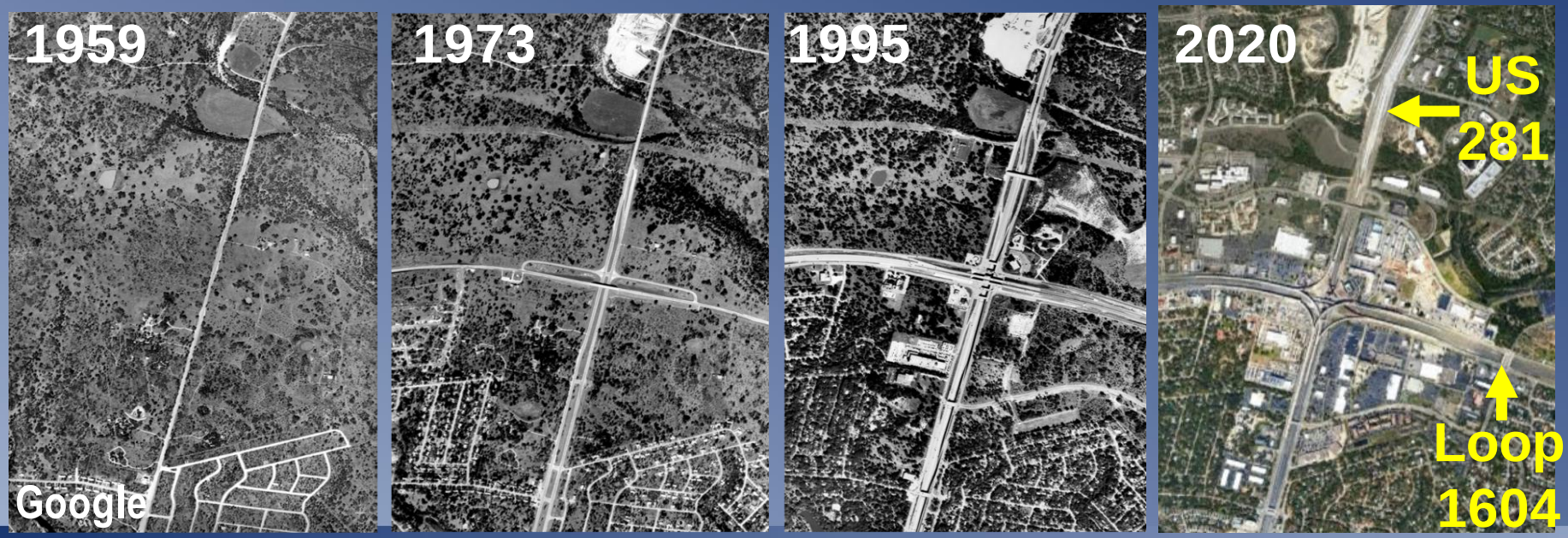
Opsahl, S.P., Musgrove, M., Mahler, B.J., and Lambert, R.B., 2018, Water-quality observations of the San Antonio segment of the Edwards aquifer, Texas, with an emphasis on processes influencing nutrient and pesticide geochemistry and factors affecting aquifer vulnerability, 2010–16: U.S. Geological Survey Scientific Investigations Report 2018–5060, 67 p., https://doi.org/10.3133/sir20185060.

Problem Statement

- There is a need to understand how the ***quality of surface water affects the quality of the groundwater***, especially in regions with BMPs.

Objective

- Assess aquifer response to storm runoff – specifically as it relates to water quality – for different urbanized areas, using a holistic SW/GW approach.

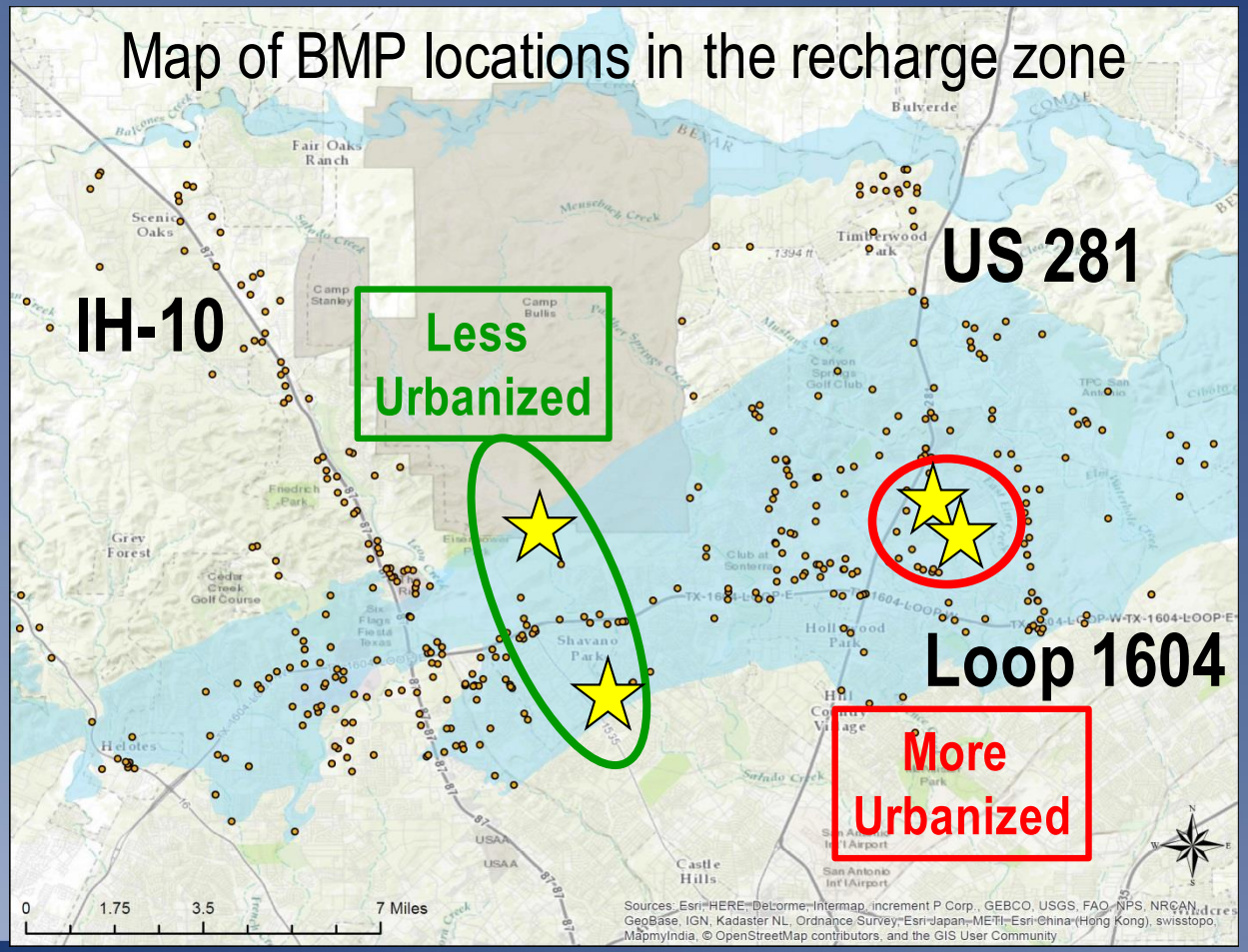


USGS

Area near US 281 and Loop 1604

Site Selection

- Establish two pairs of surface water/groundwater sites
  - One pair is in a more rapidly urbanizing area (US 281 and Loop 1604)
  - One pair is in a less urbanized area (Camp Bullis area)

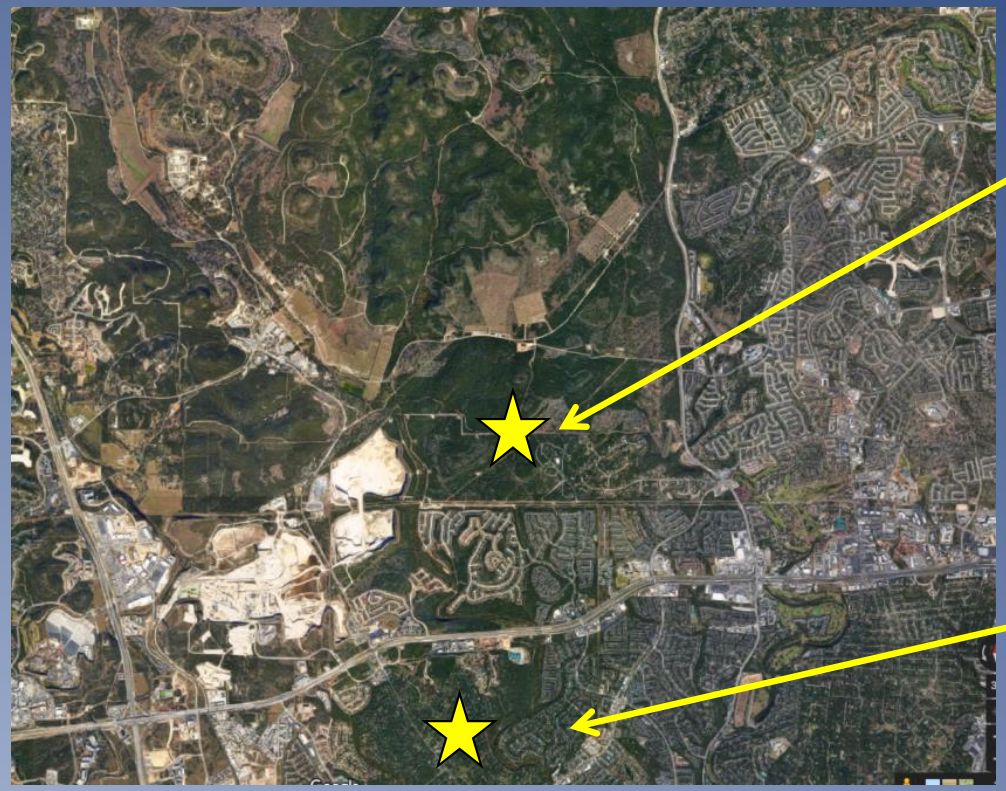


Edwards aquifer recharge zone shaded blue

USGS

Site 1 pair – Salado Creek and Shavano Park well

- Site pair represents less urban development
  - Surface water sampling is on military installation
  - Groundwater sampling is downstream

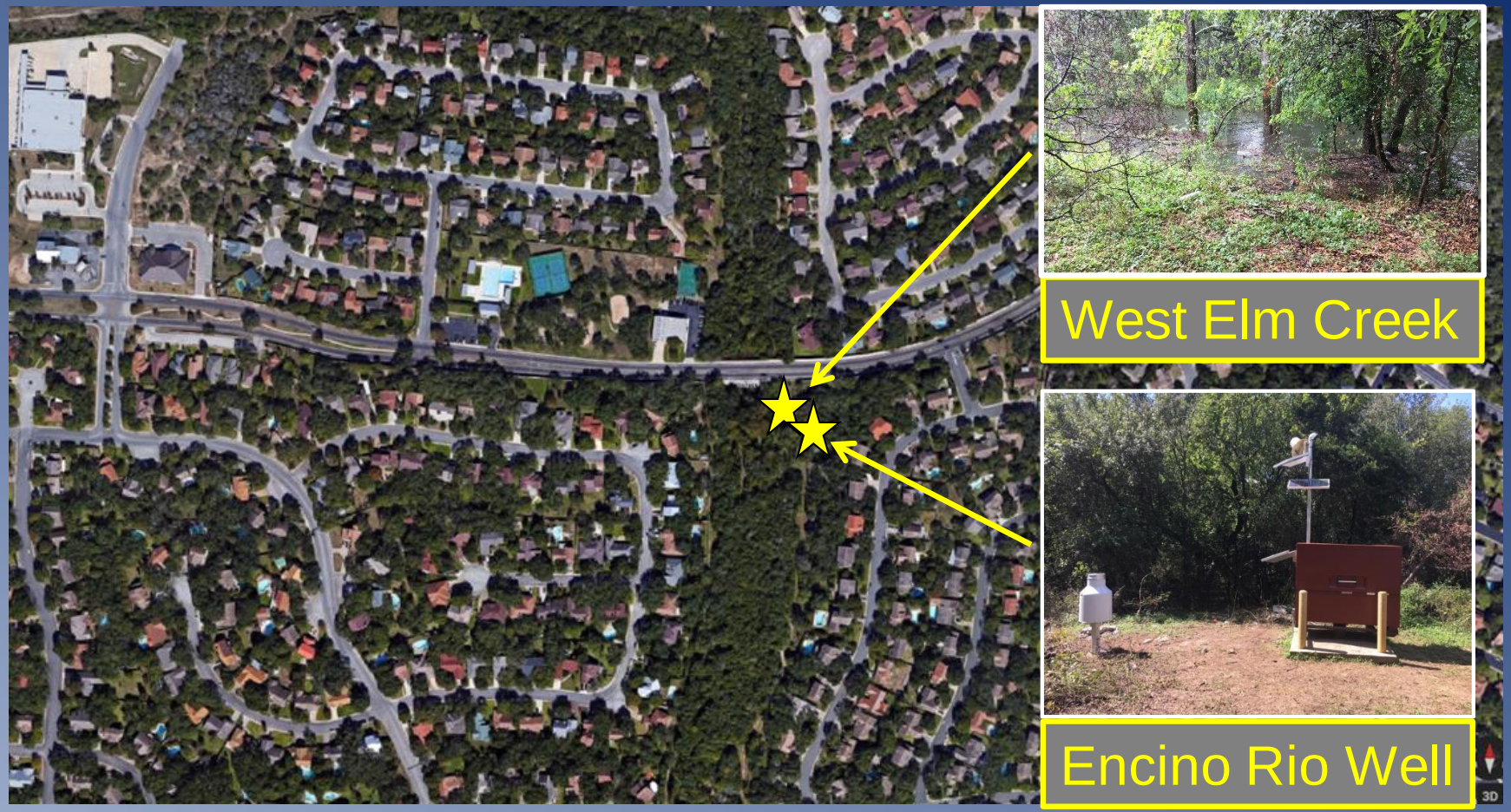


Salado Creek

Shavano Park well

Site 2 pair –West Elm Creek and Encino Rio Well

- Site pair represents more urban development



Collect Continuous Monitoring Data

- Real-time stream and groundwater data are needed to identify periods of drought, recharge, and changing water quality.

Gage equipment for monitoring surface water and groundwater

Collect Routine Groundwater-Quality Samples

Chemical analyses included: nutrients, pesticides, selected major and trace ions, nitrogen isotopes, and hydrogen and oxygen isotopes

USGS

Groundwater sampling at the Encino Rio well

Collect Storm Event Samples

- Sampled four stormwater-runoff events from each stream
- Additional groundwater samples collected during storms

Stormwater runoff at the West Elm Creek site

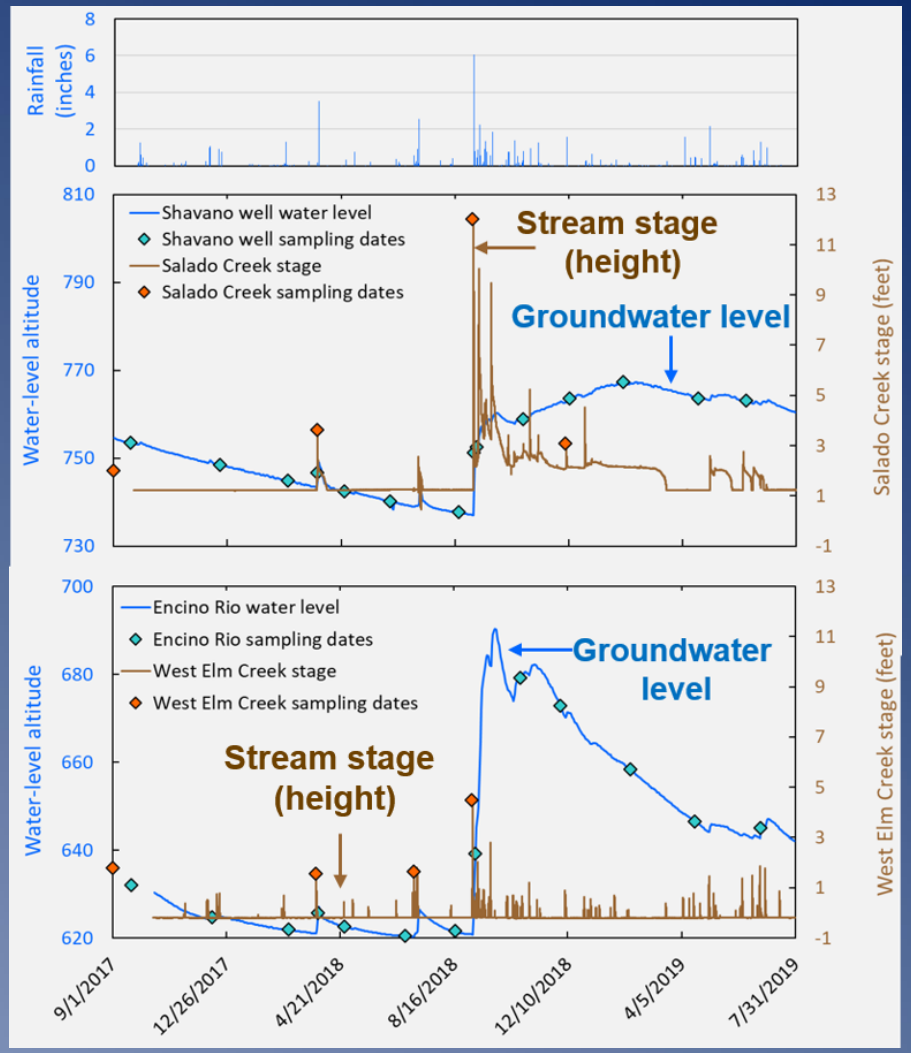
Groundwater sampling during a storm

Same measurements made on all samples

Surface Water and Groundwater are Connected

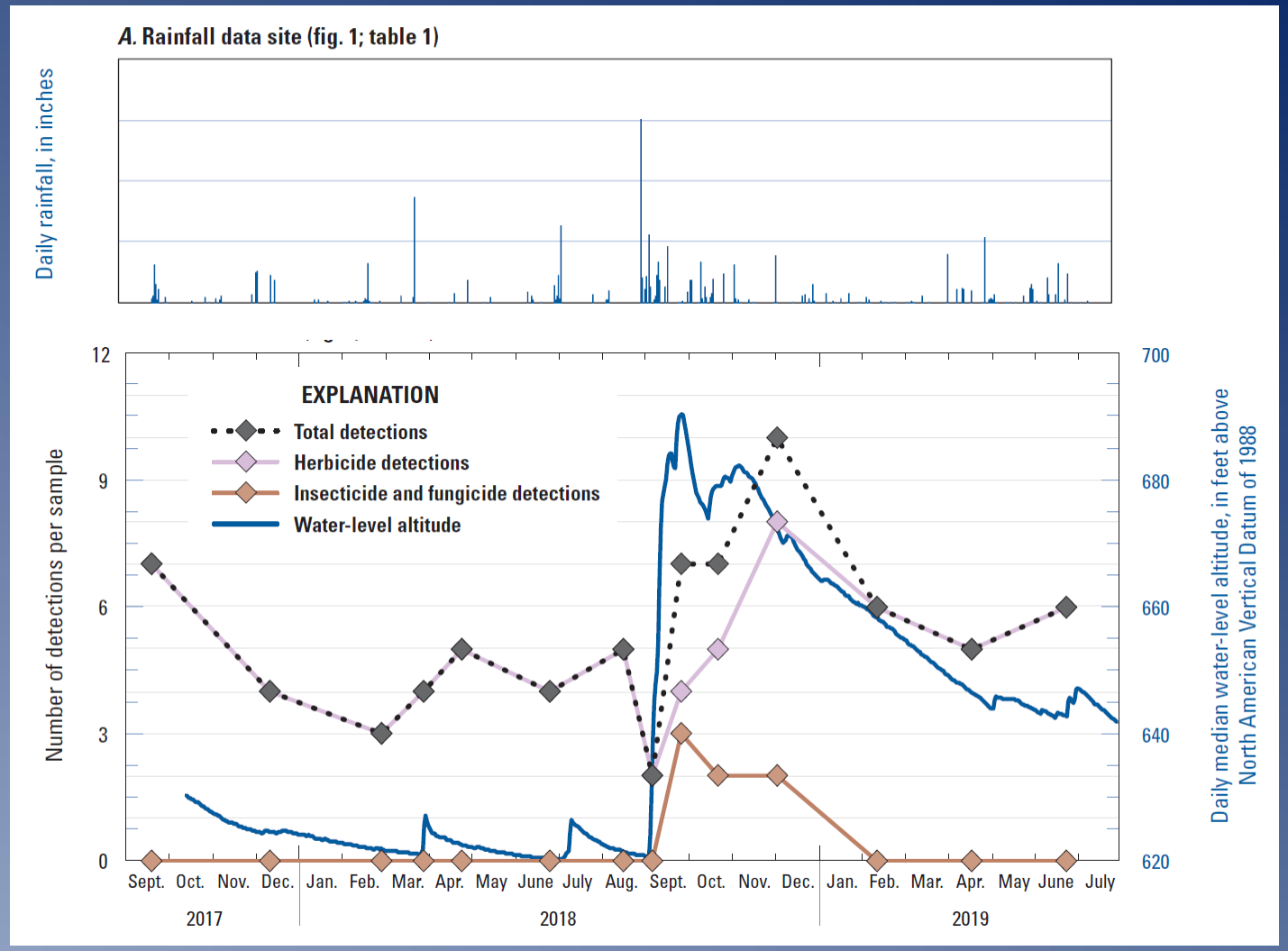
Subwatershed-
Less Urbanization

Subwatershed-
More Urbanization



- High stream stages and rapid increases in groundwater levels demonstrate aquifer recharge

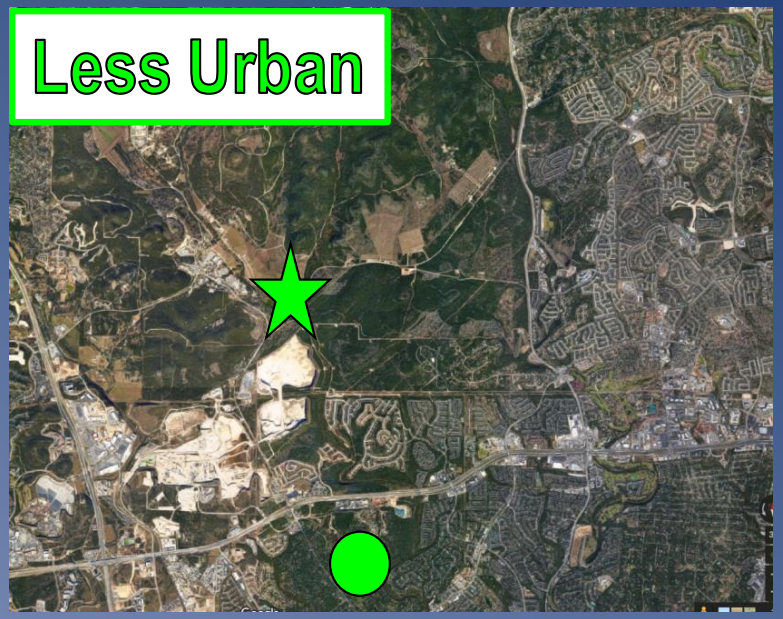
Contaminants in Runoff Enter the Aquifer During Storms

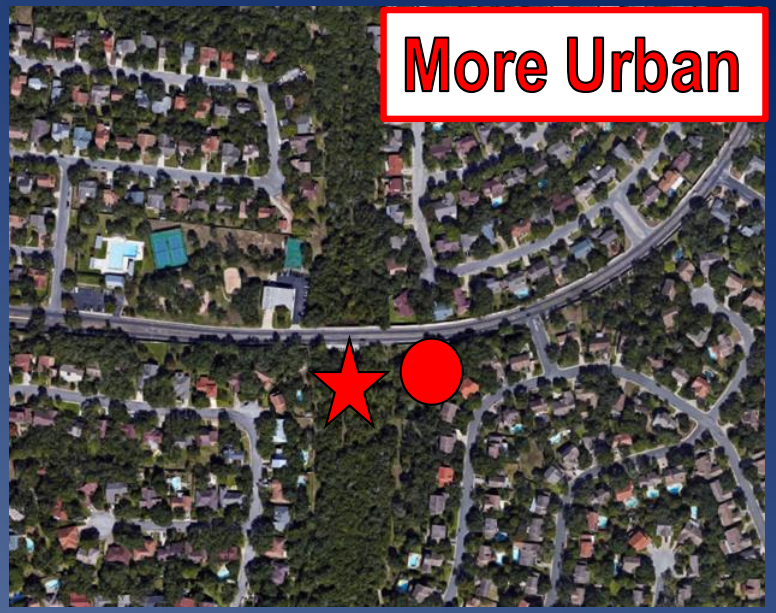


- Increases in pesticide detections during and after recharge

USGS

Urbanization is a Source of Contaminants to the Aquifer



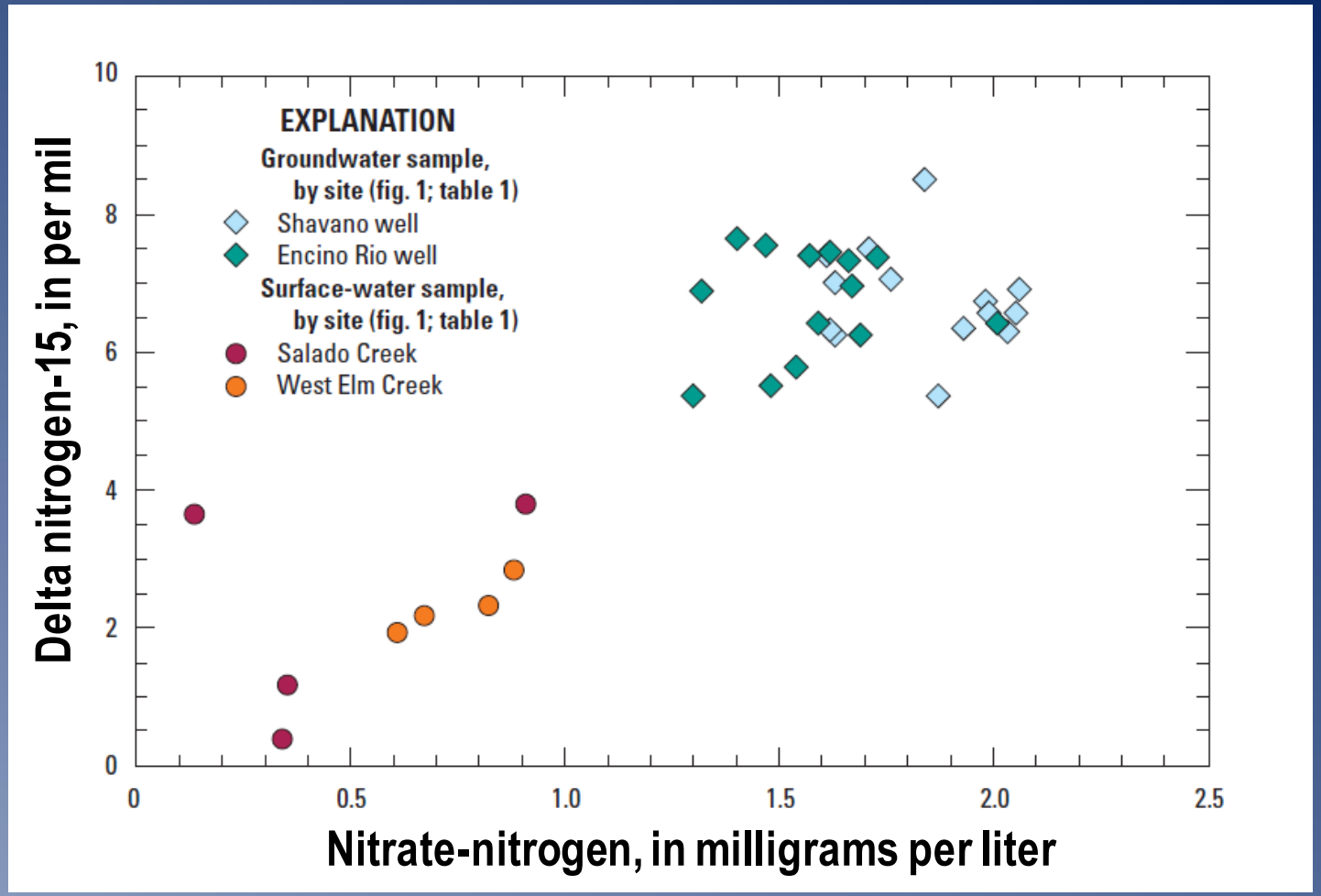


	Salado Creek	West Elm Creek	Shavano well	Encino Rio well
Number of samples	4	4	14	14
Number of different pesticides detected	7	25	13	13
Total number of detections per site	10	50	42	74
Average number of detections per sample	2.5	12.5	3.0	5.5

- Higher number of detections in the more urbanized stream
- Higher number of detections in the more urbanized well

USGS

Aquifer Contaminant Concentrations are Currently (2020) Low



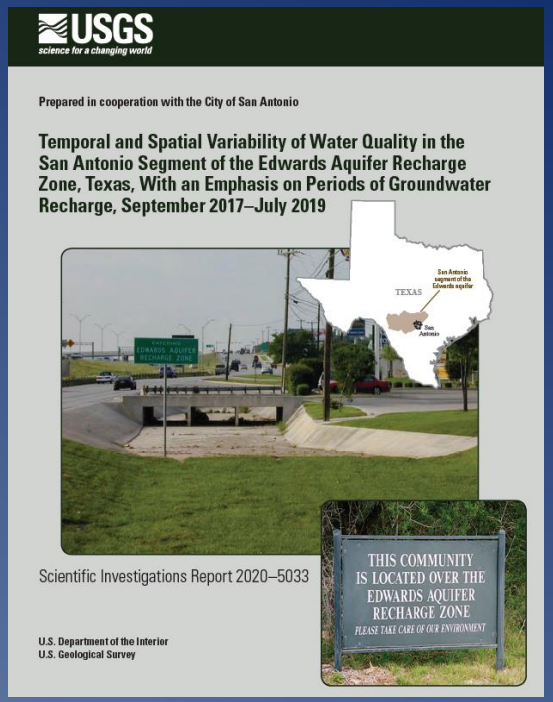
- Nitrate concentrations are low in both runoff and groundwater
- Little evidence of wastewater contamination

What Did You Get From This Study?

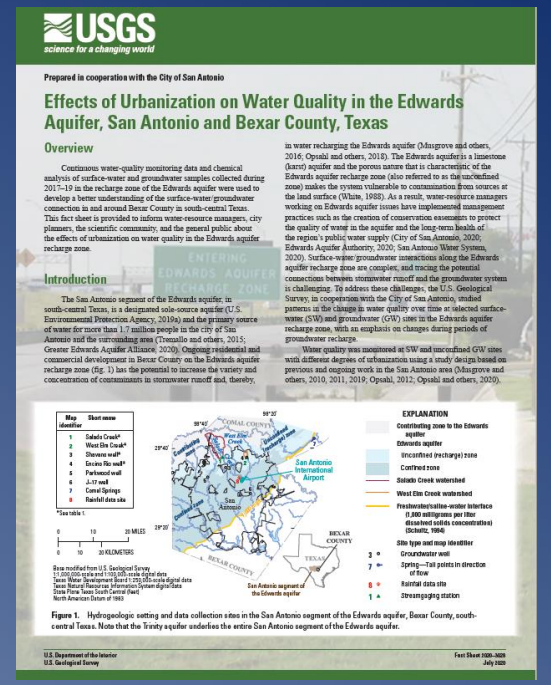
- Project completed on time and within budget
- Leveraging of funding and resources
  - Urban Waters Federal Partnership-$$ for site construction and analysis
  - USGS NAWQA program-Historical data
  - SAWS EARZ program-Comparative data from existing EARZ sites
  - EAA-site use
- Identification of urban contaminants of concern
- Demonstration of how urbanization affects groundwater quality
- Historical data for future comparisons (data archived for all)
- Better context for understanding BMP effectiveness

Deliverables

- USGS Scientific Investigation Report



- USGS Fact Sheet



- Public access to full datasets

Team Members

- USGS Key Personnel include:
  - Doug Schnoebelen, Ph.D., Branch Chief, South Texas Program
  - Steve Opsahl, Ph.D., Hydrologist
  - MaryLynn Musgrove, Ph.D., Research Physical Scientist
  - Mike Nyman, Data Chief, South Texas Program
  - Cassi Crow, Acting Studies Chief, South Texas Program
  - USGS Hydrologists and Technicians averaging 10 plus years of data and field experience

Questions?

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Additional questions or discussion?