Assessing Surface and Groundwater Interactions Between the Middle Brazos River Alluvium Aquifer and the Brazos River

MARK G.F. NICKELS

ADVISOR DR. JOE YELDERMAN

Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Brazos Valley
GROUNDWATER CONSERVATION DISTRICT

Overview

1. Purpose
2. Study Site
3. Methods
4. Results
5. Conclusions

Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Purpose and Motivation

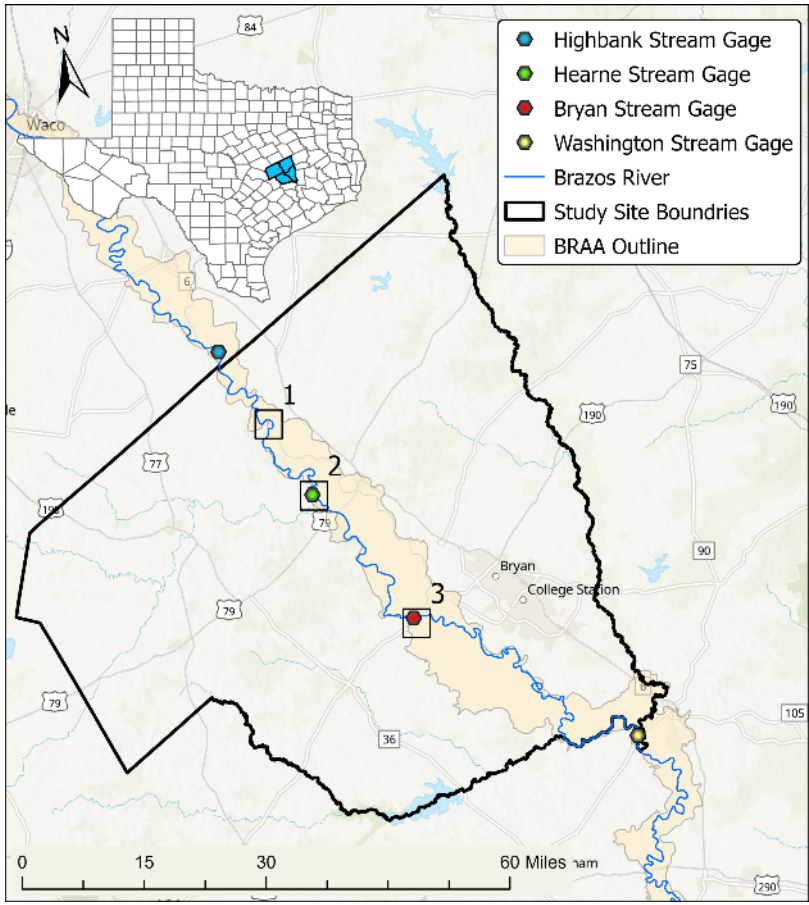
- The Brazos River and the Brazos River Alluvium Aquifer (BRAA) are vital water resources in east-central Texas.
- Current modeling of the BRAA has been based on limited data which are insufficient for understanding such a heterogeneous aquifer and its complex interactions.

Better define the interactions between Brazos River and the BRAA

- What is the influence of seasonality?
- What is the influence of pumping (irrigation)?
- What are the impacts of high/low river stage?
- What are the chemical differences?

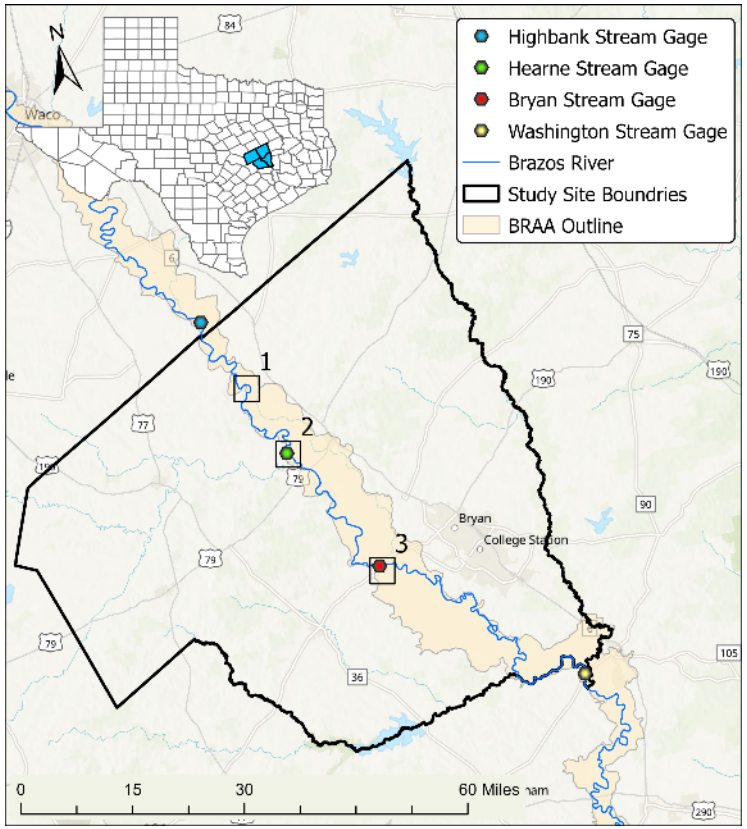
Study Site

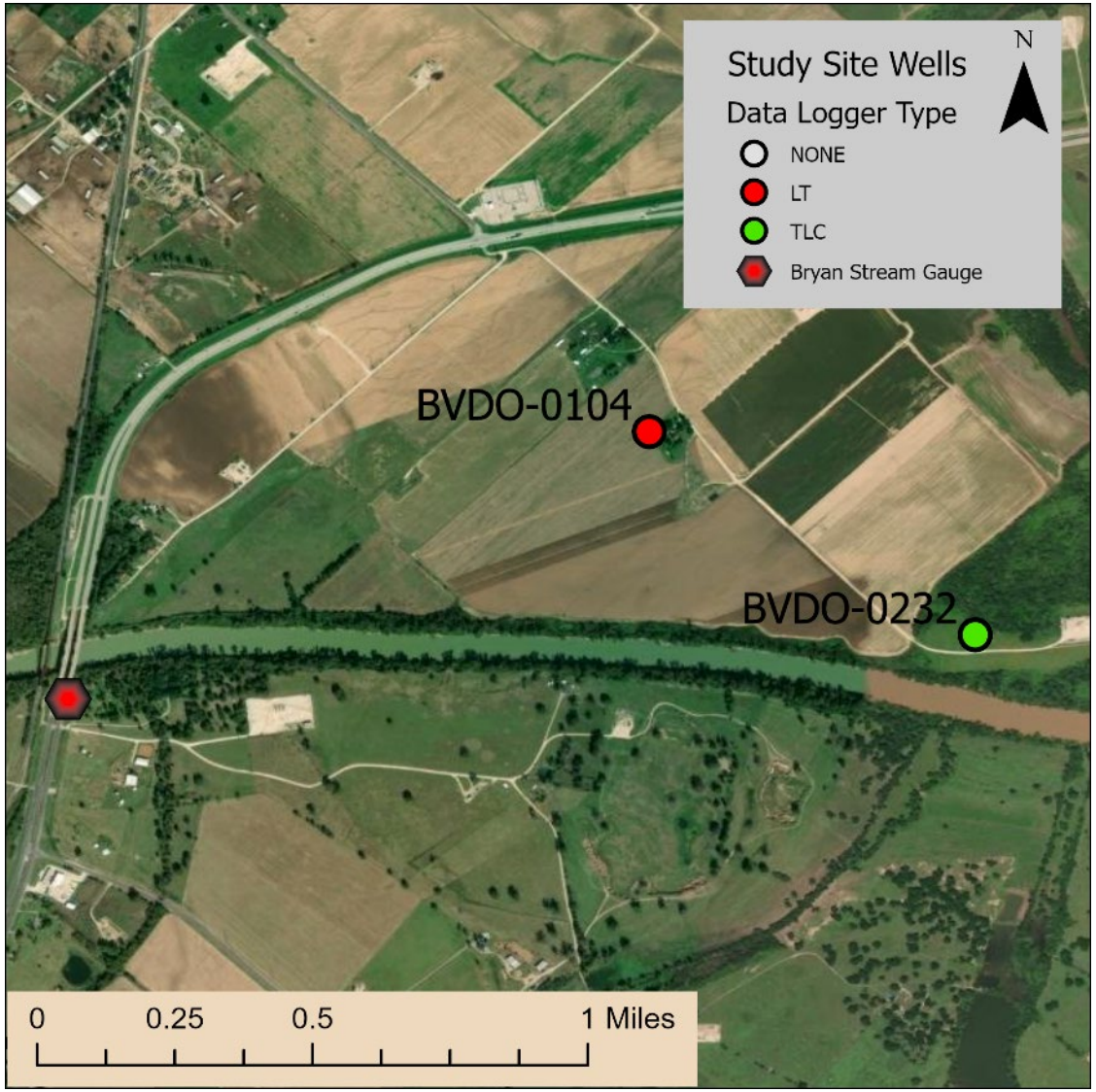
- Middle segment
  - Brazos, Burleson, Milam, and Robertson counties
- BRAA
  - Quaternary age
  - Unconsolidated sediment aquifer
  - Discontinuous clay lenses
  - Clay to gravel sized clasts
  - Heterogenous and compartmentalized



Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

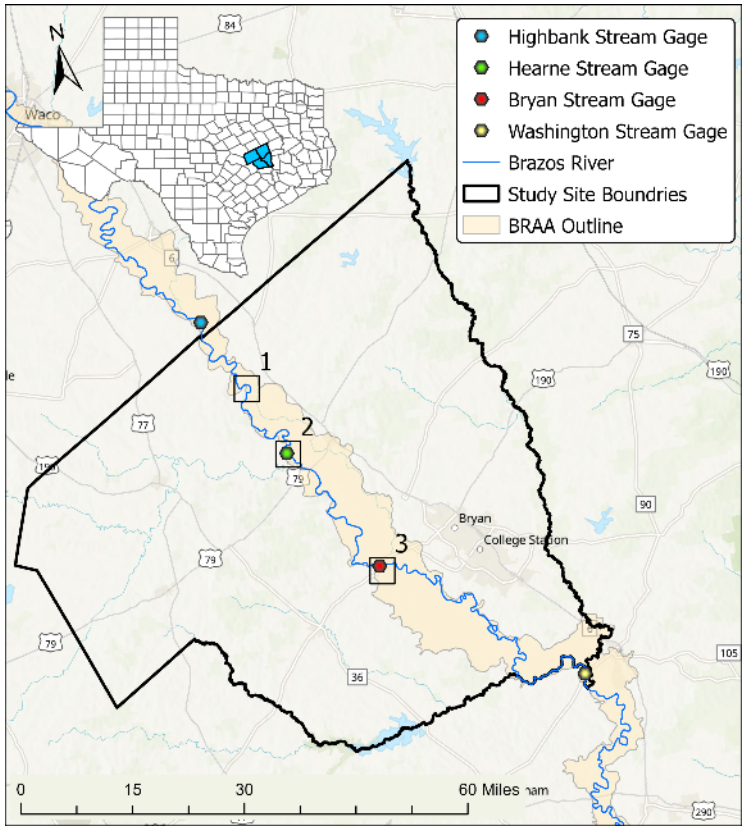
Local Study Site: Bryan

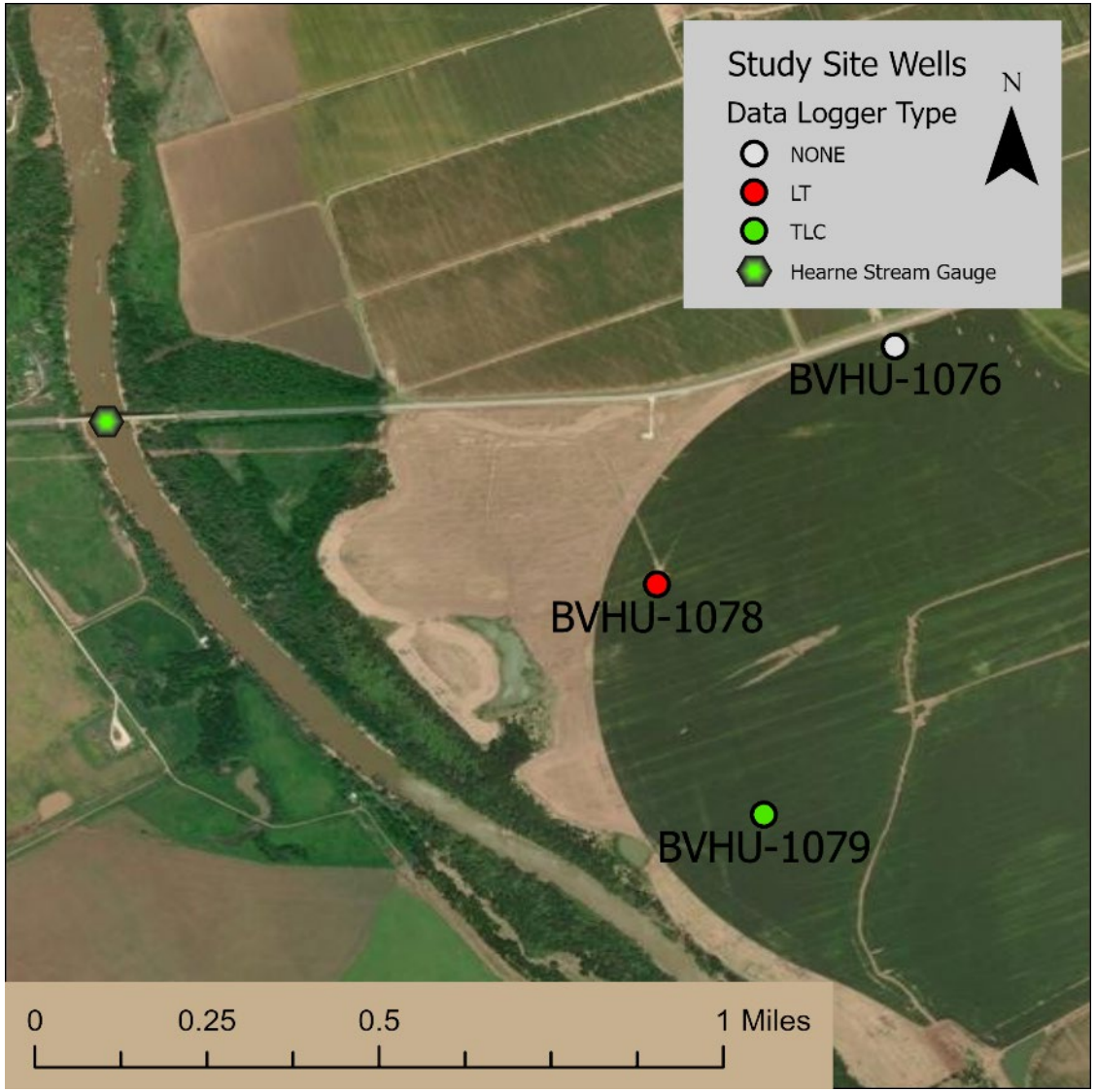




Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Local Study Site: Hearne





Methods: Historical Data

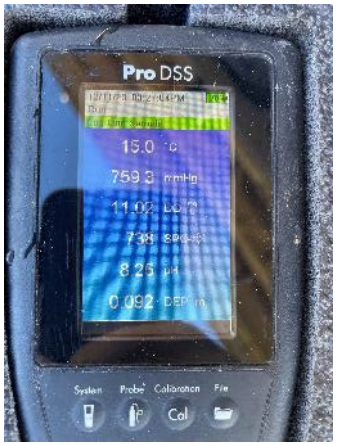
Using data from:

- The Texas Water Development Board's (TWDB) Groundwater Database (GWDB)
  - Groundwater level (hydraulic head)
  - Groundwater quality
  - Lithology
- Brazos Valley and Post Oak Savana Groundwater Conservation Districts
  - Groundwater level (hydraulic head)
- United States Geological Survey (USGS) National Water Information Service (NWIS)
  - River elevation
  - River discharge

Methods: River Sampling

At each location:

- Water chemistry samples
  - Ionic chemistry
  - Isotopic chemistry
- Field measurements
  - Temperature
  - Dissolved Oxygen (DO)
  - Specific Conductance (SpC)
  - pH
- Field alkalinity titrations

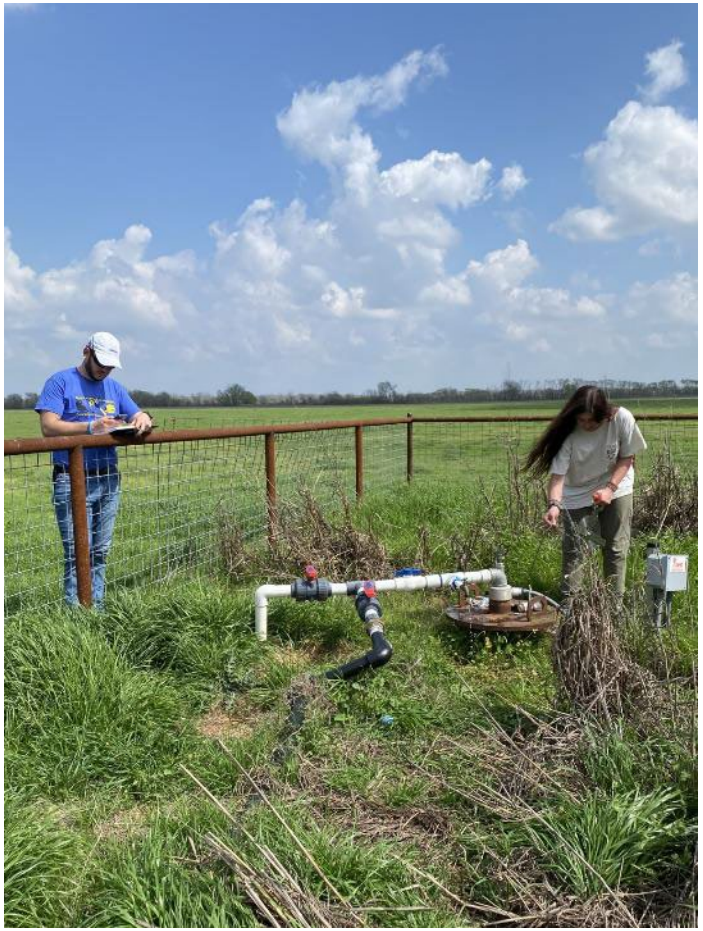


Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Methods: Groundwater Sampling

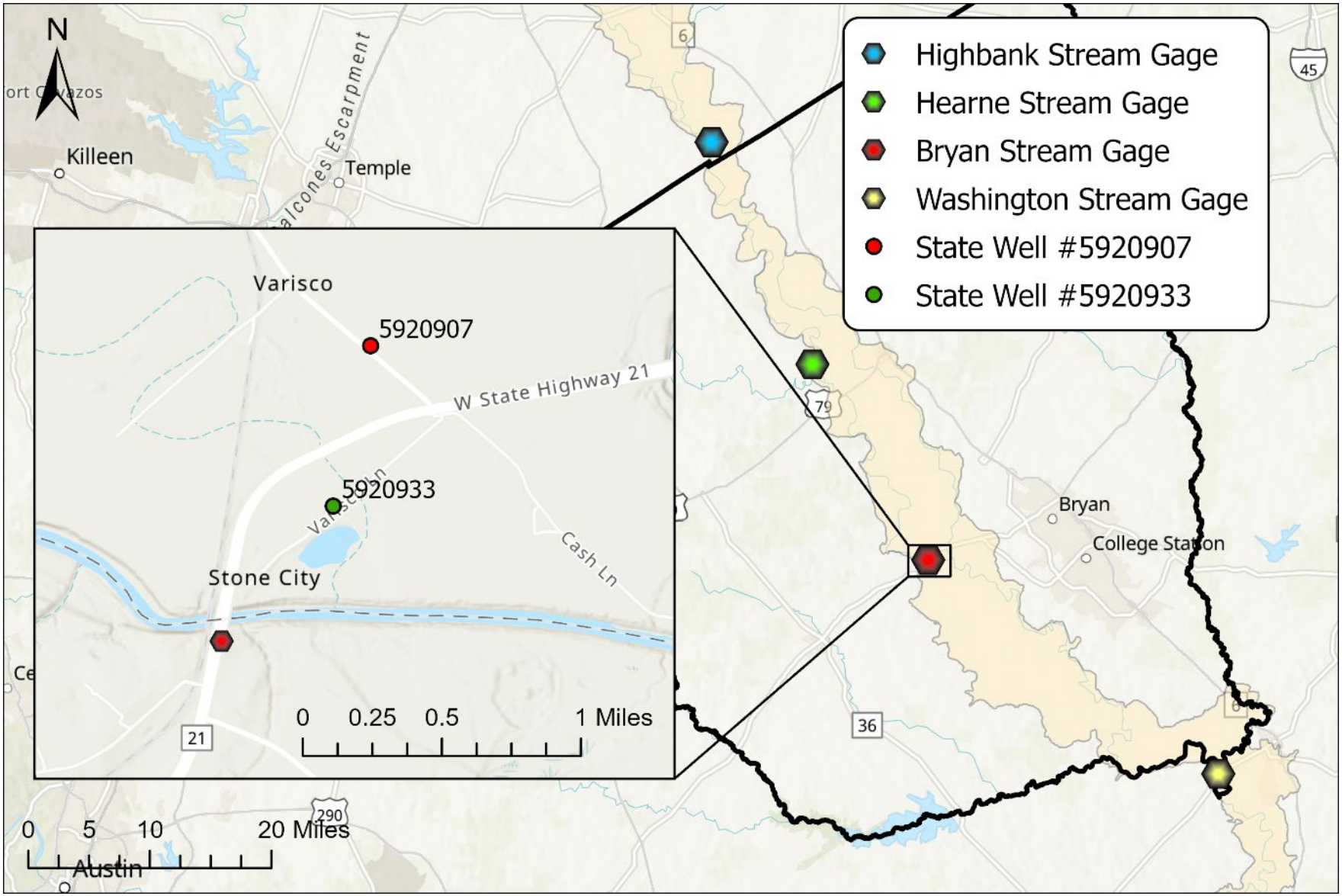
At each location:

- Water level
  - Sonic and steel tape/E-Line
- Water chemistry samples
  - Ionic chemistry
  - Isotopic chemistry



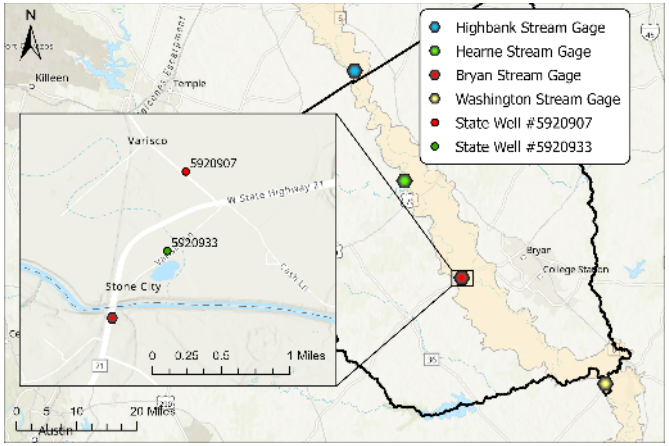
Results

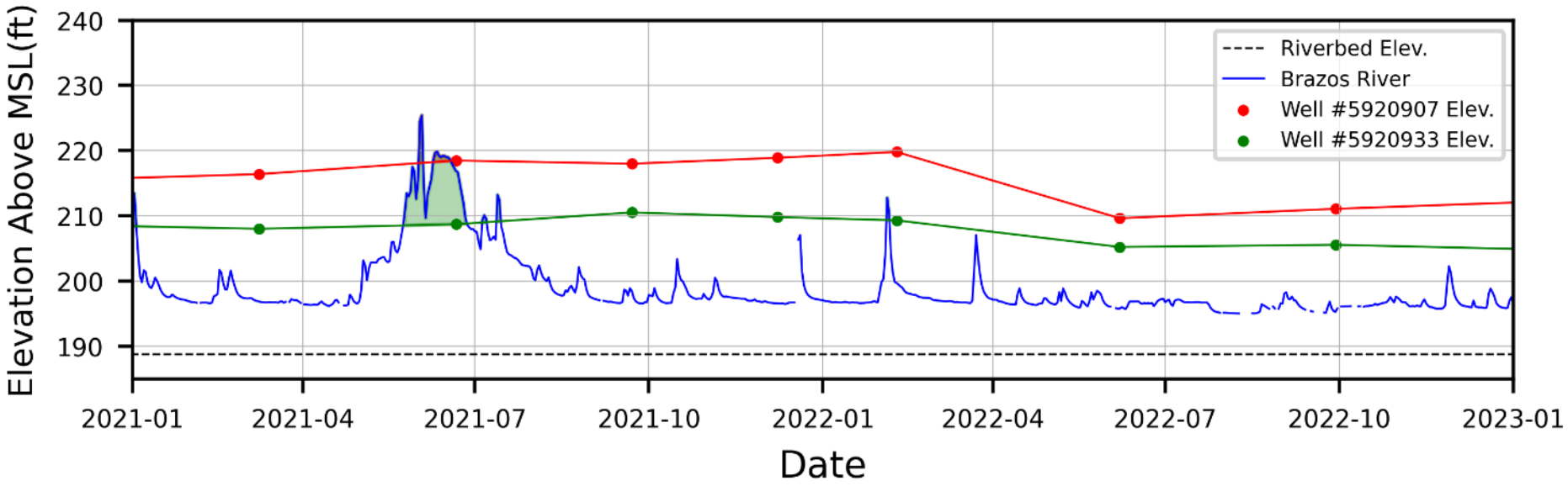
Results: Historical Data



Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

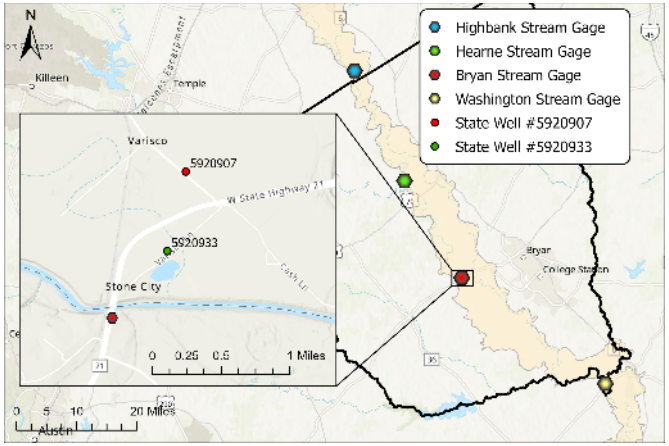
Results: Historical Data

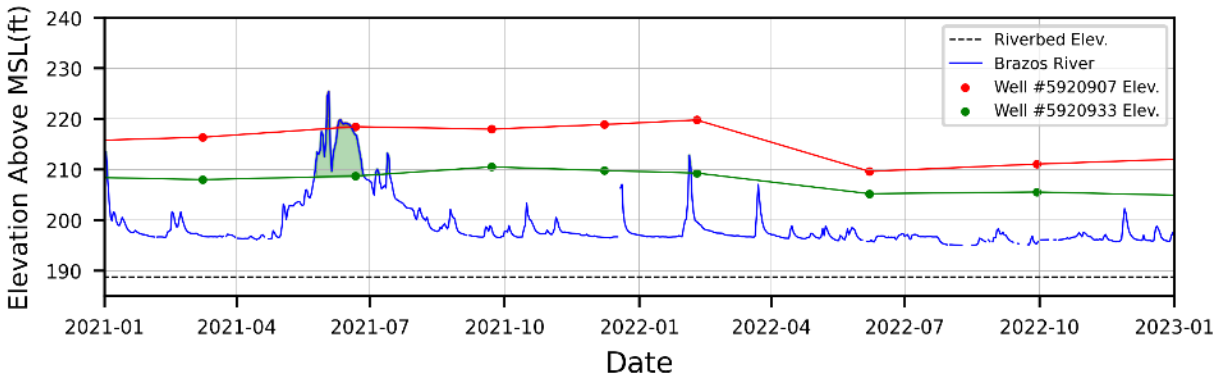


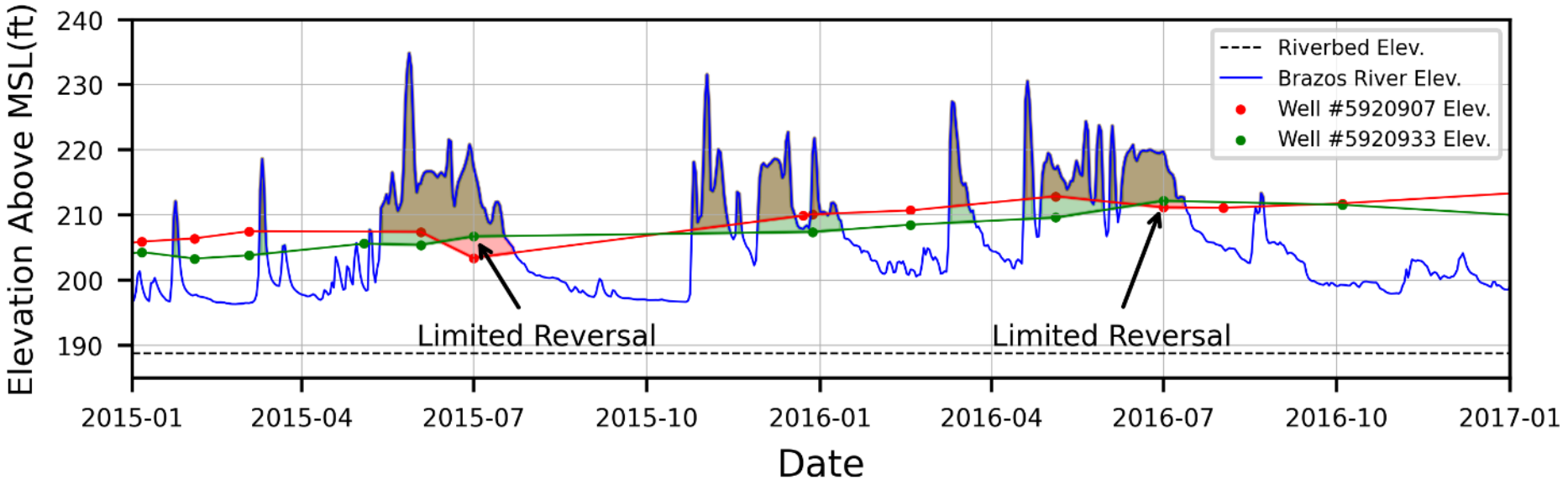


Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Results: Historical Data

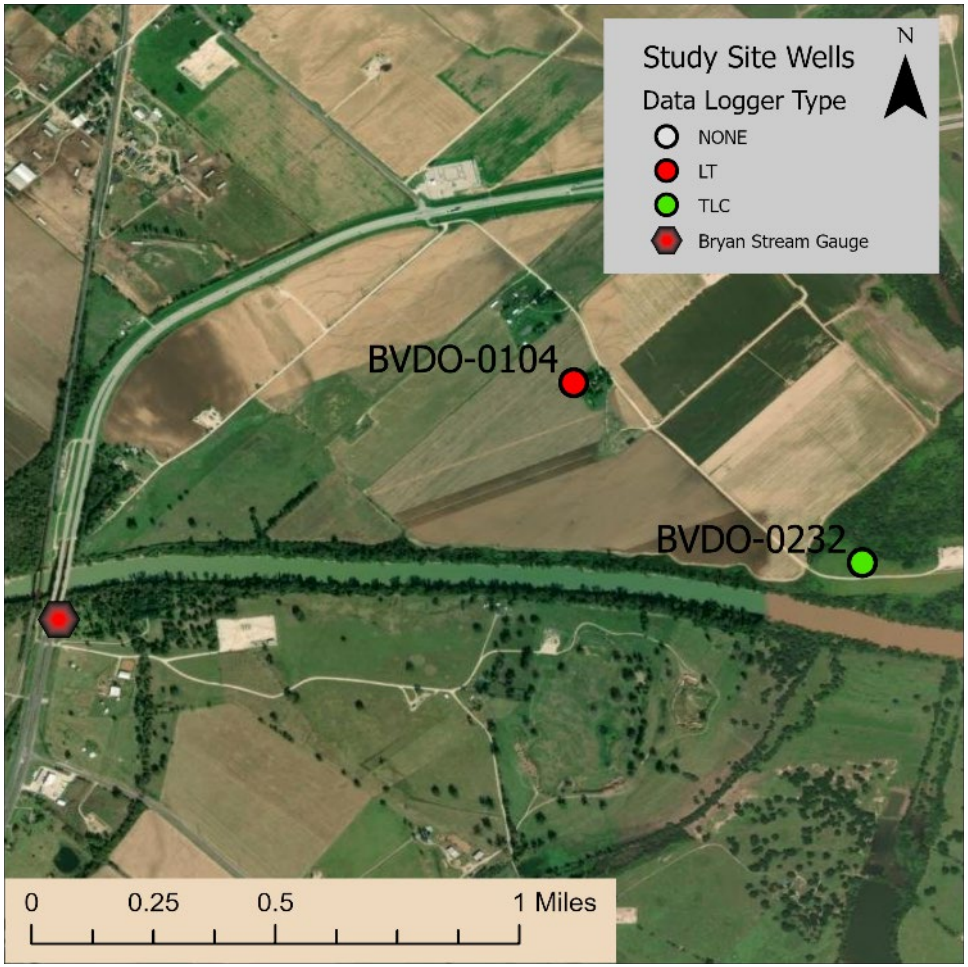




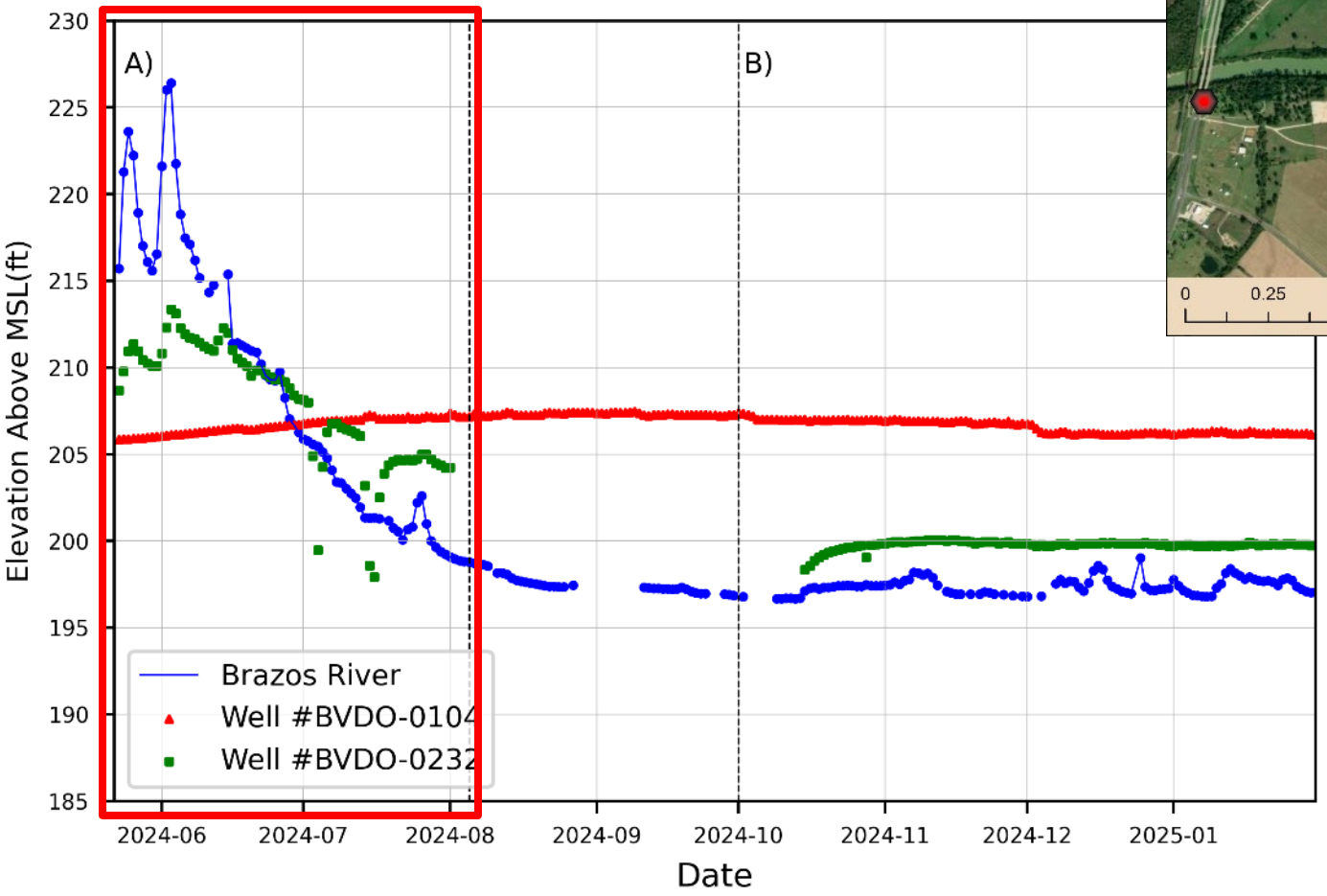


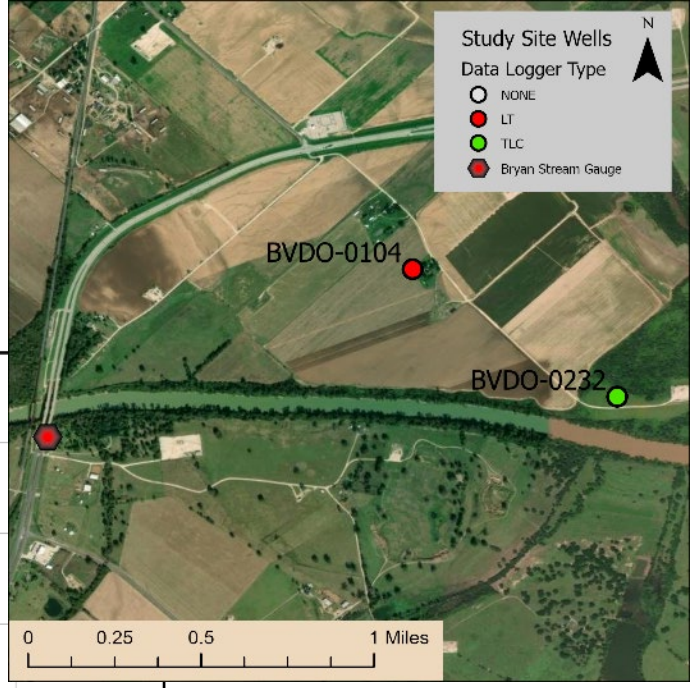
Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

New Data: Hydraulic Head



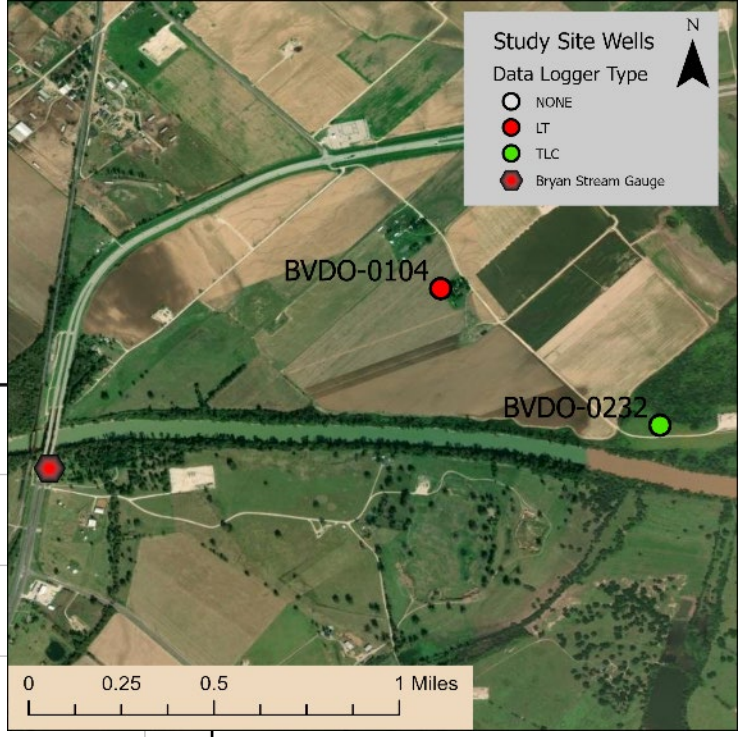
Bryan Data Logger Data

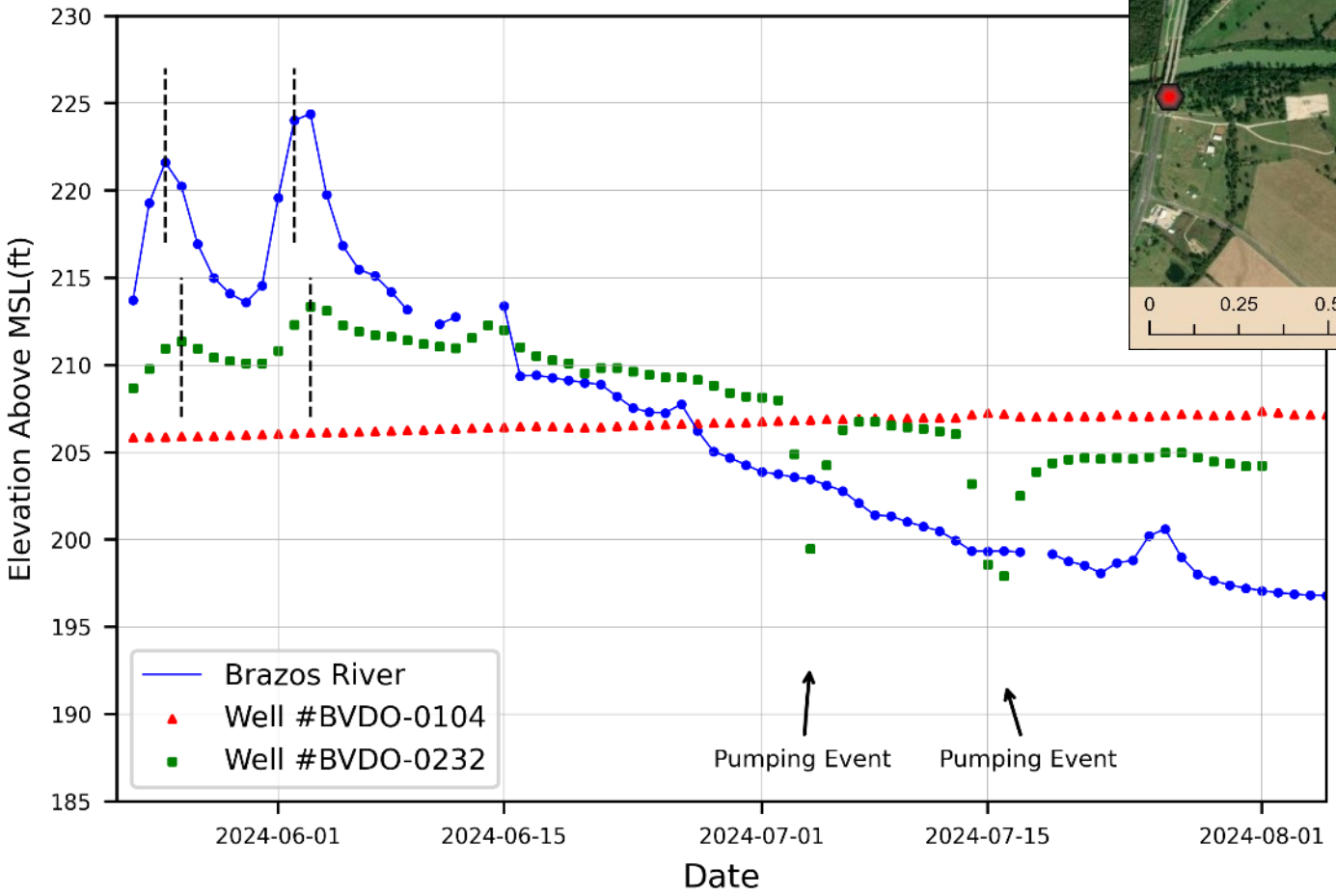




Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

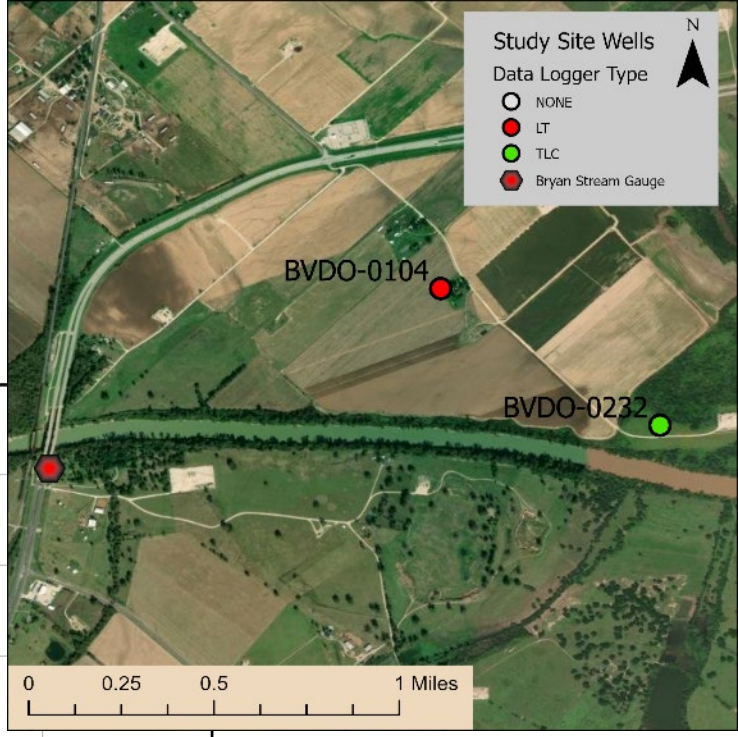
Bryan Data Logger Data Section A

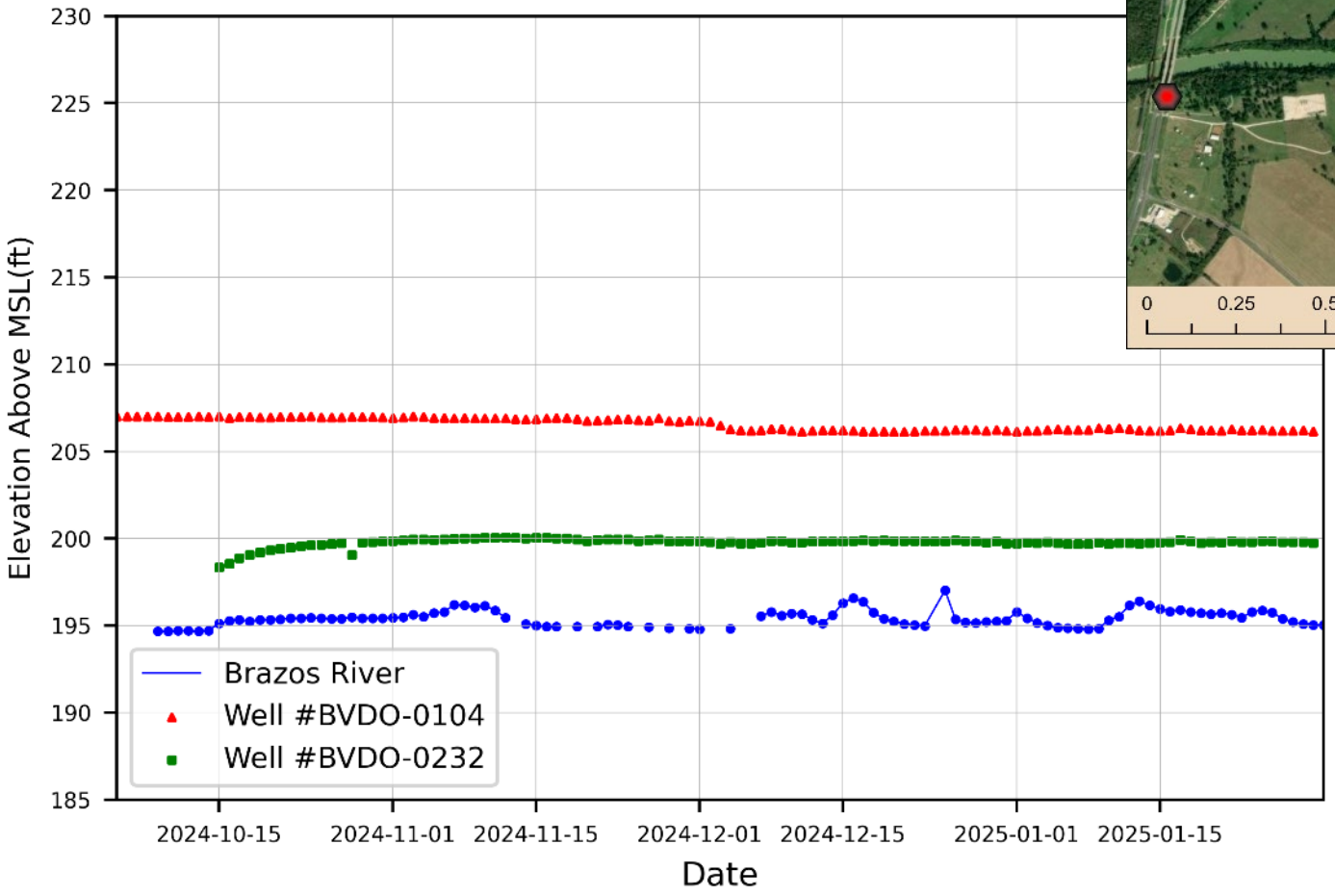




Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

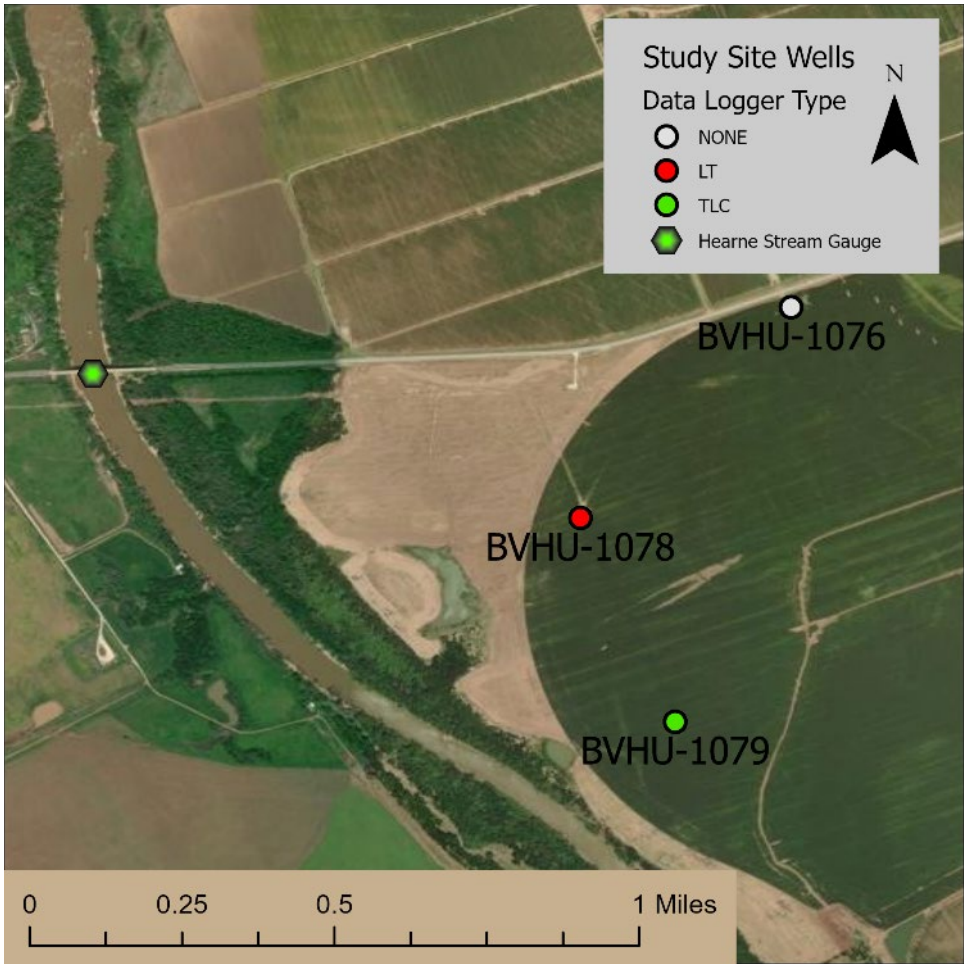
Bryan Data Logger Data Section B



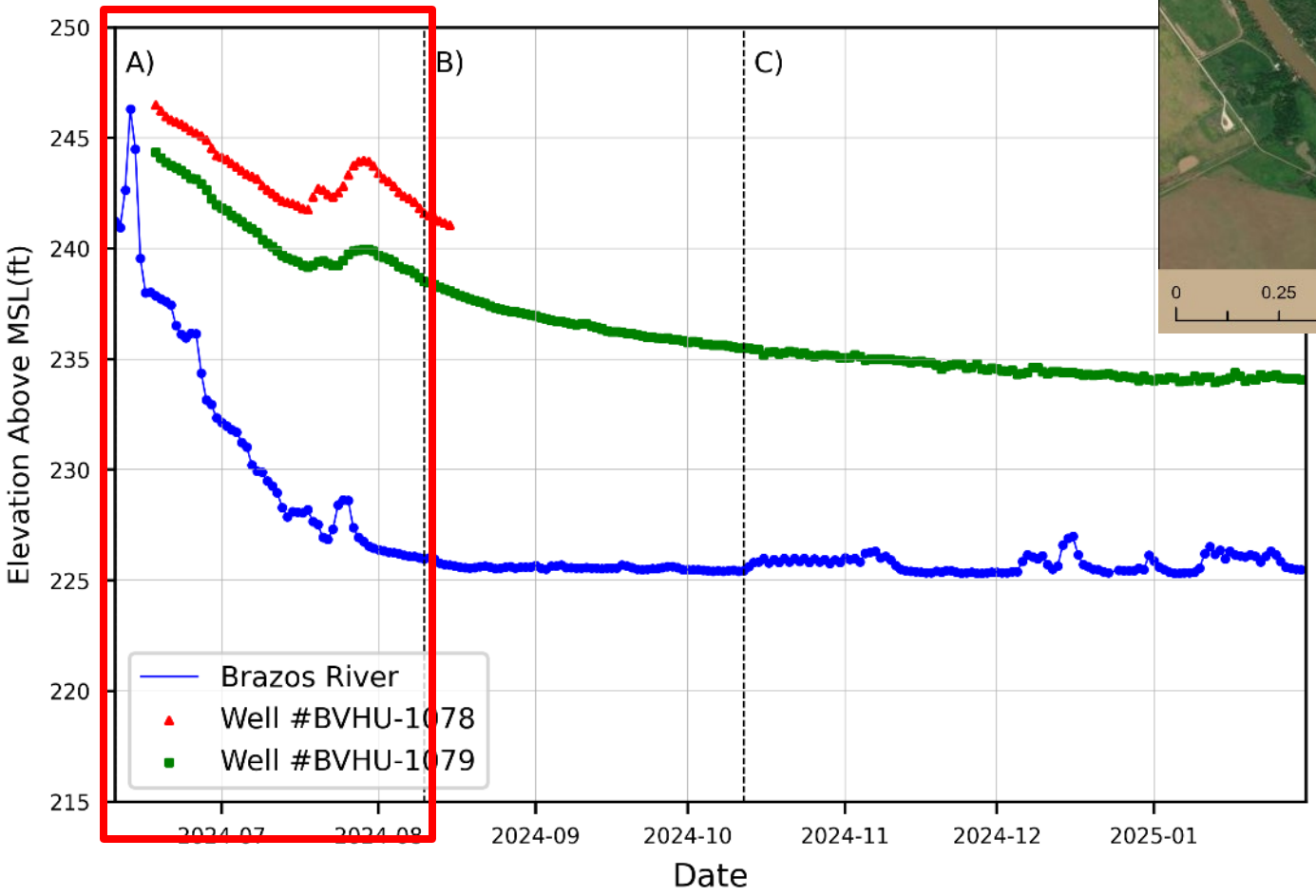


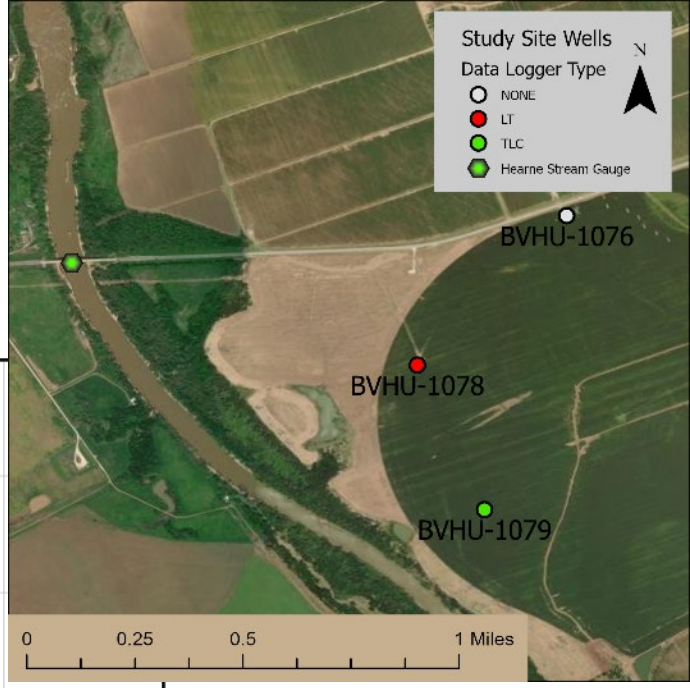
Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

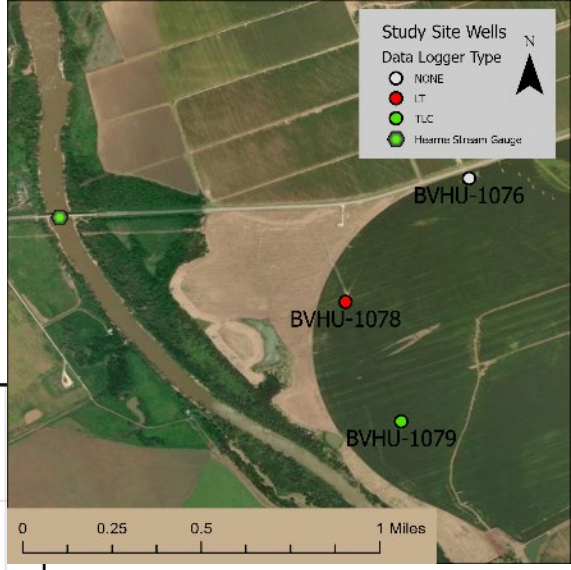
New Data: Hydraulic Head



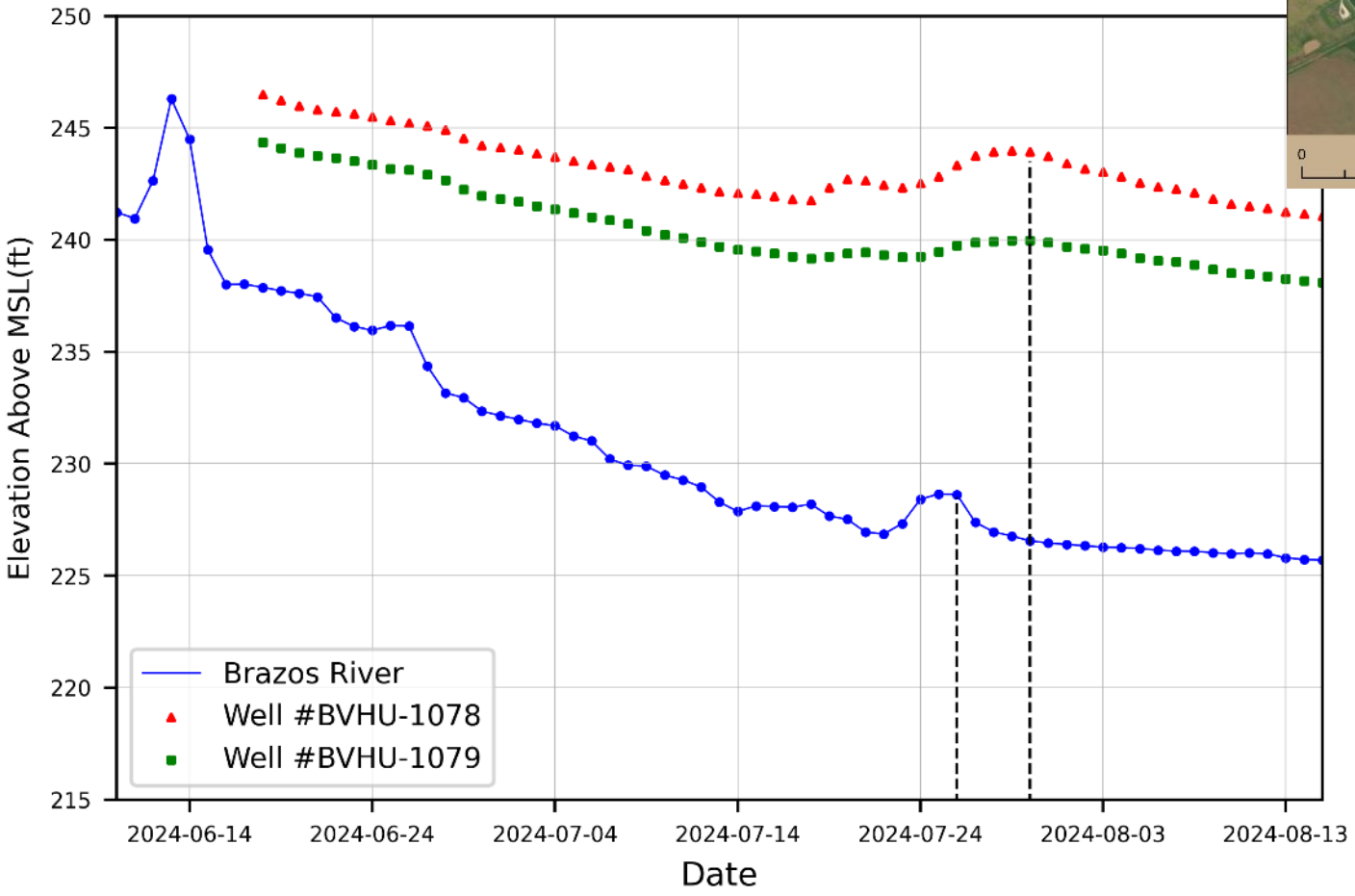
Hearne Data Logger Data



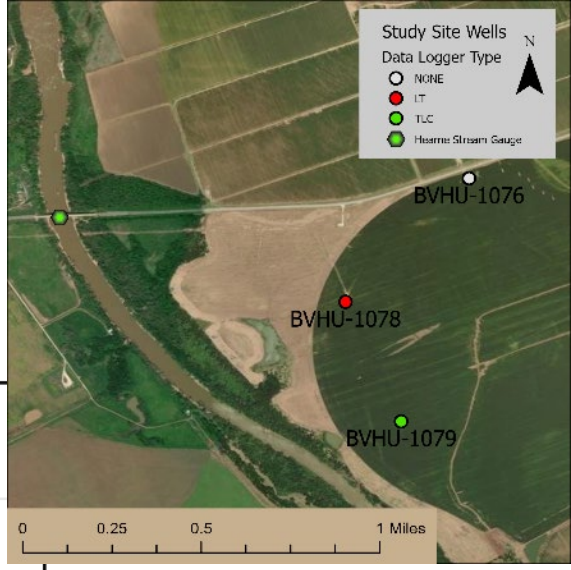




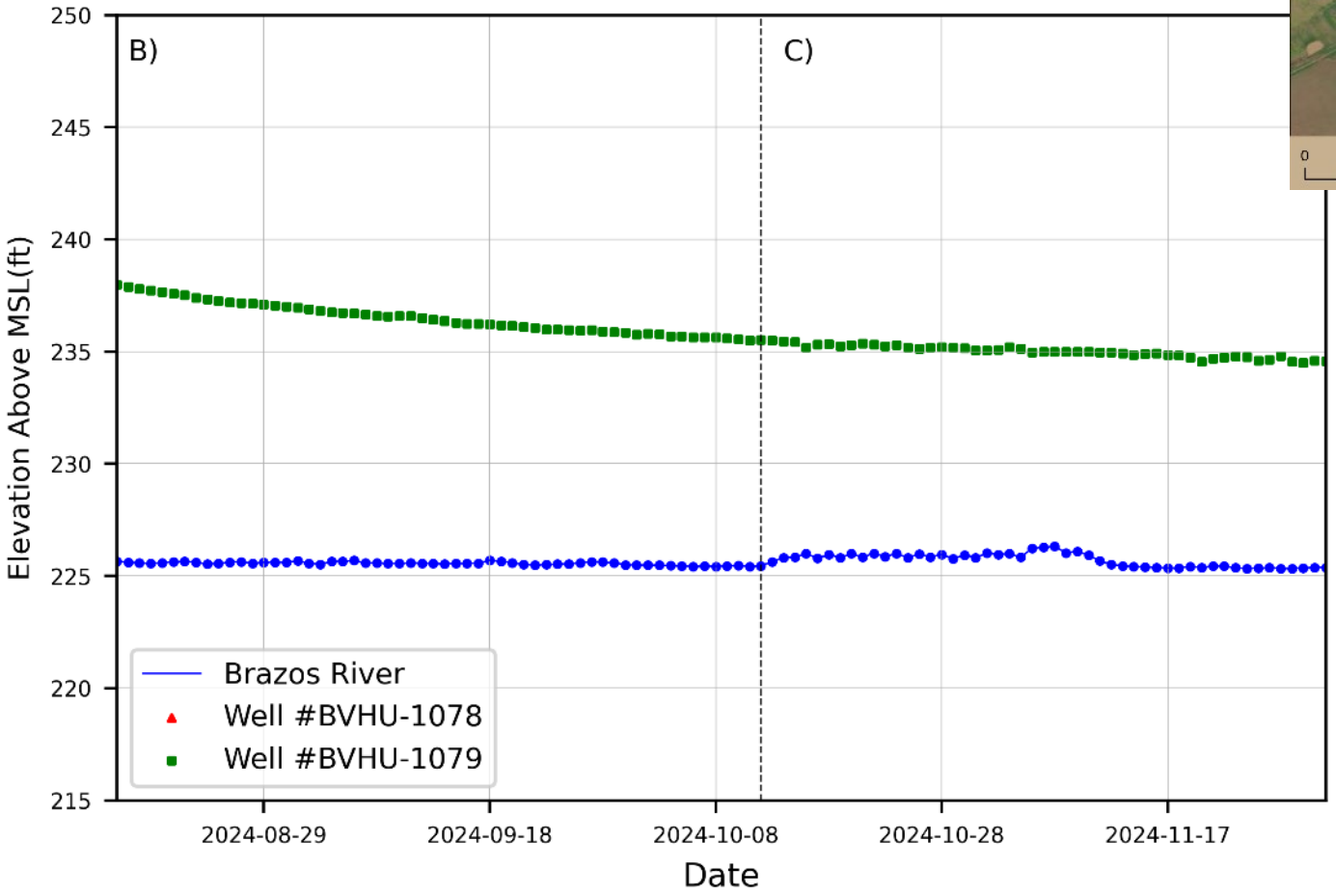
Hearne: Section A (Jun. 10th - Aug. 15th)



Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences



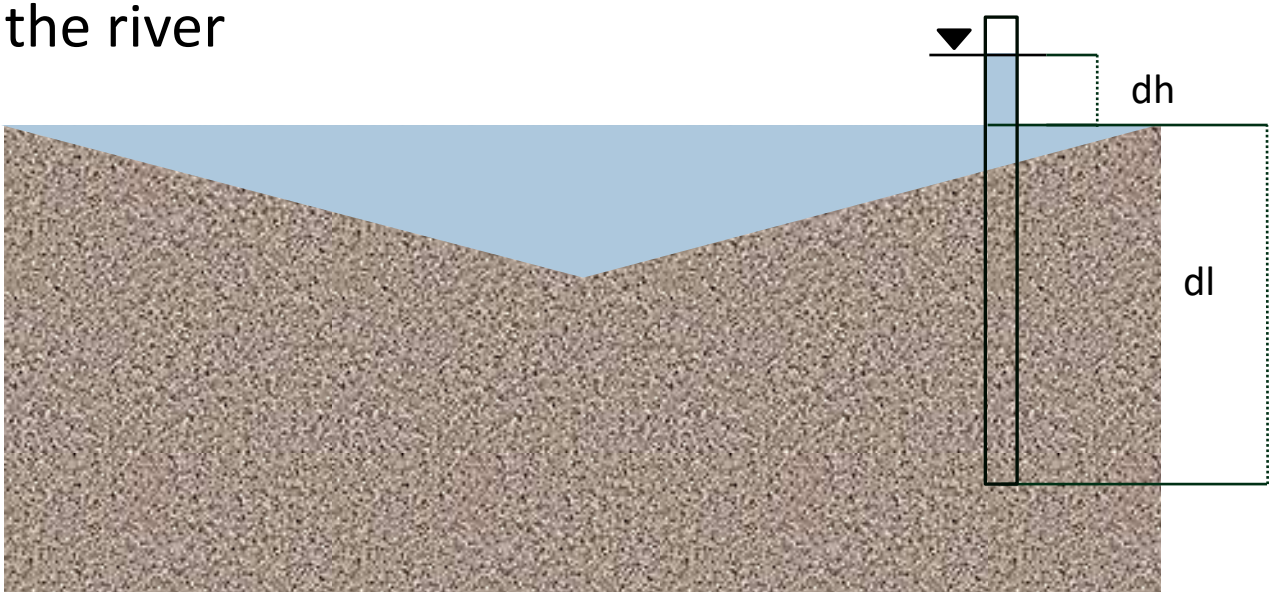
Hearne: Section B (Aug. 16th - Dec. 1st)



Baylor University
COLLEGE OF ARTS & SCIENCES
Department of Geosciences

Mini-Piezometers

- Mini-Piezometers
  - Hydraulic gradient between the riverbed sediment and the river



Mini-Piezometers

- Mini-Piezometers
  - Two geographic locations on separate locations.
  - Both locations showed positive head gradients
- Limitations
  - Small distance and small gradients make accurate measurement difficult
  - Subject to bank heterogeneity
  - Low-K sediments take a long time to equalize

Conclusions

1. The groundwater in the mBRAA flows toward the Brazos River most of the time.
2. The groundwater in most of the mBRAA flows toward the Brazos River all the time.
3. Certain groundwater characteristics are distinctly different from the water in the Brazos River.
4. The interconnections between the mBRAA and the Brazos River are spatially variable due to the variations in aquifer sediments along the channel bed and banks.
5. The flow rates (average linear flow velocities) in the mBRAA are slow.

Acknowledgements

- **Alan Day**, Brazos Valley GCD
- **Elena Muir**, M.S. Candidate Baylor University
- **Wayne Hamilton**, Baylor University
- **Dr. Joe Yelderman**, Baylor University
- Landowners: Will Vaughn, Mark Hoelscher, and Laura de Asarta

Questions?