

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

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Brazos Valley

GROUNDWATER CONSERVATION DISTRICT



Overview

1. Purpose and Motivation
2. Study Site Overview
3. Methods
4. Collected Data
5. Project Timeline

Purpose and Motivation



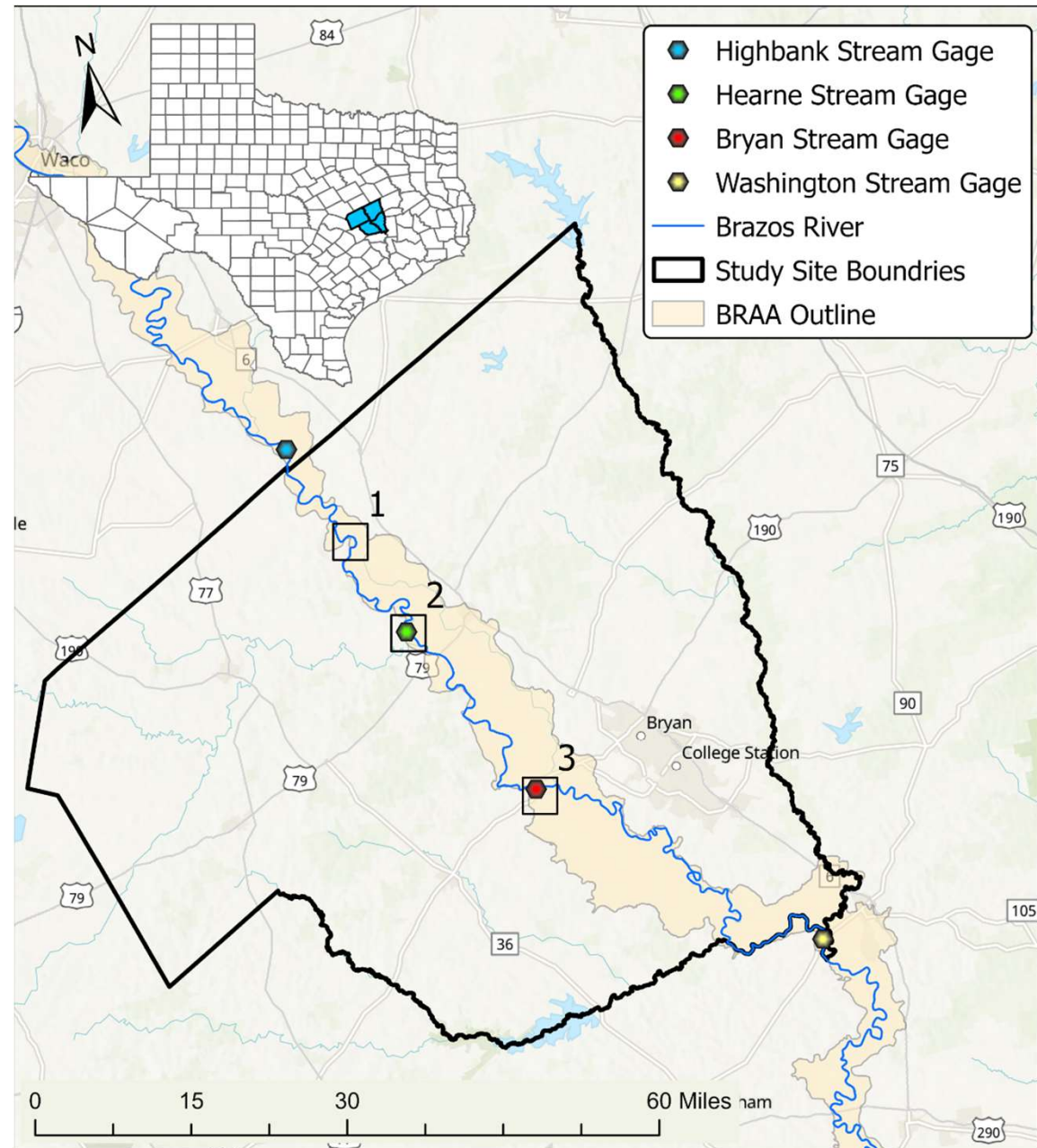
- The Brazos River Alluvium Aquifer (BRAA) is a vital resource for agricultural irrigation
- Current modeling has been limited
 - Assumed homogeneity
 - Assumed isotropy
 - Ill-defined river interaction
 - Poorly understood

Better define the interactions between Brazos River and the BRAA

- What is the influence of seasonality?
- What is the influence of irrigation?
- What are the long term impacts of high or low water?
- What is the difference in water chemistry between the river and alluvium?

Study Site

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



Local Study Sites

1. Calvert

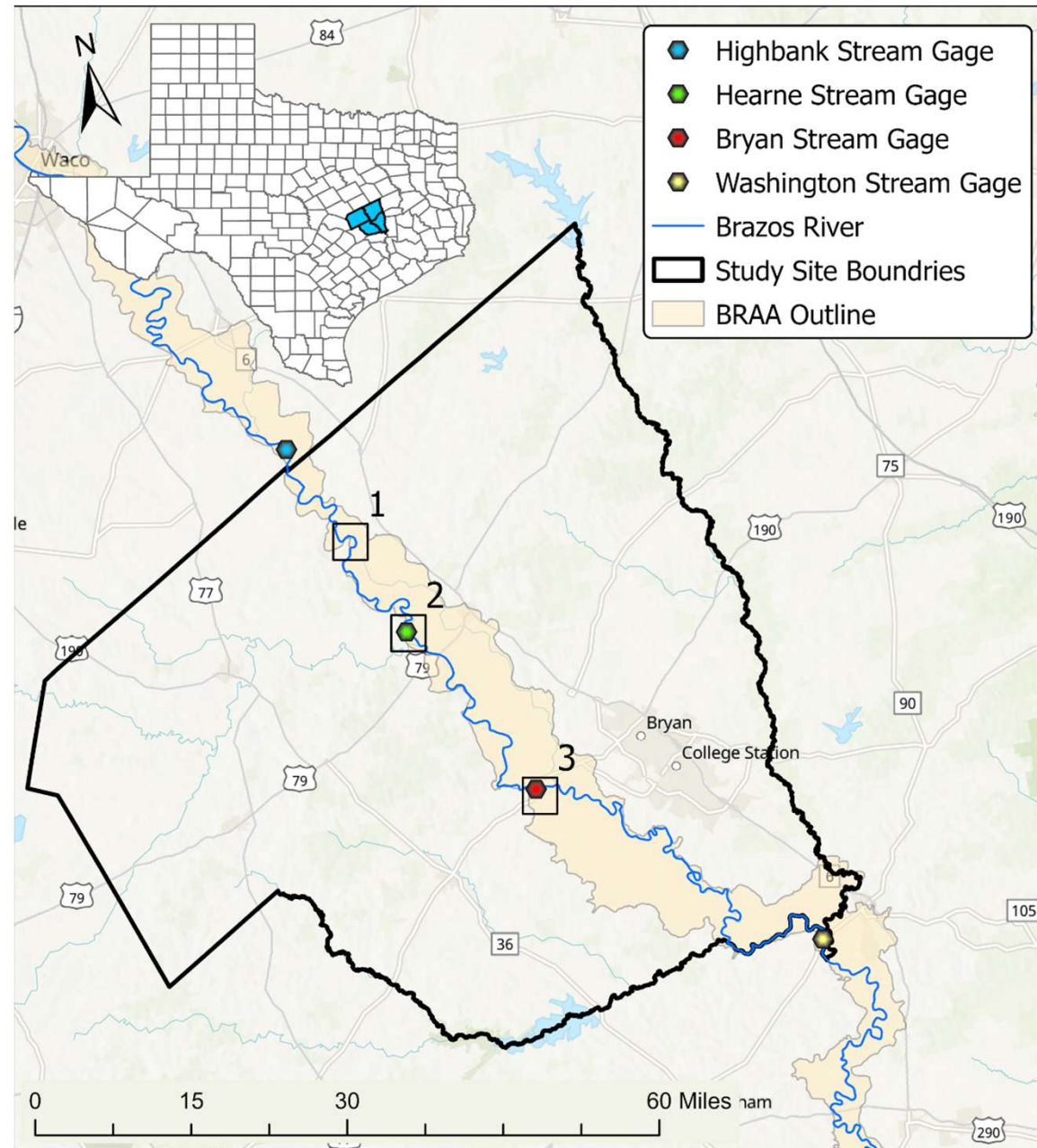
- Coordinate river level with AquaStrategies

2. Hearne

- USGS stream gage

3. Bryan

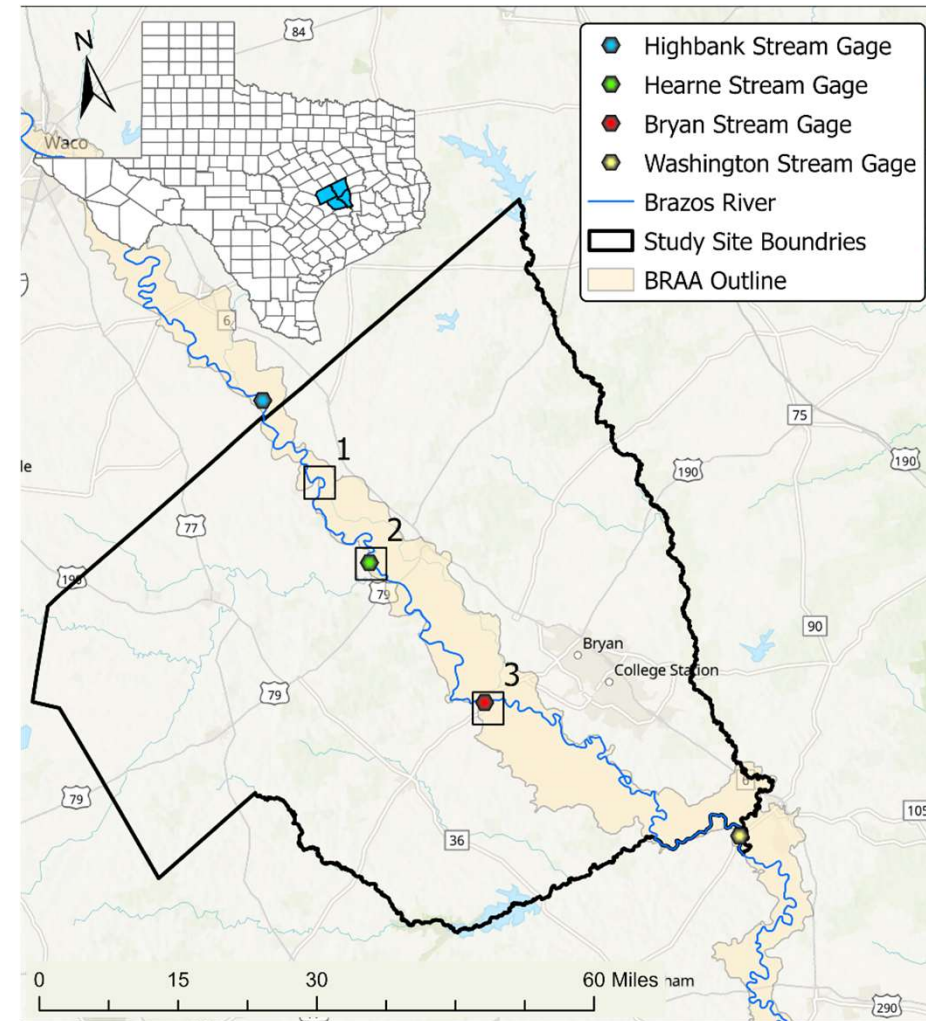
- USGS stream gage



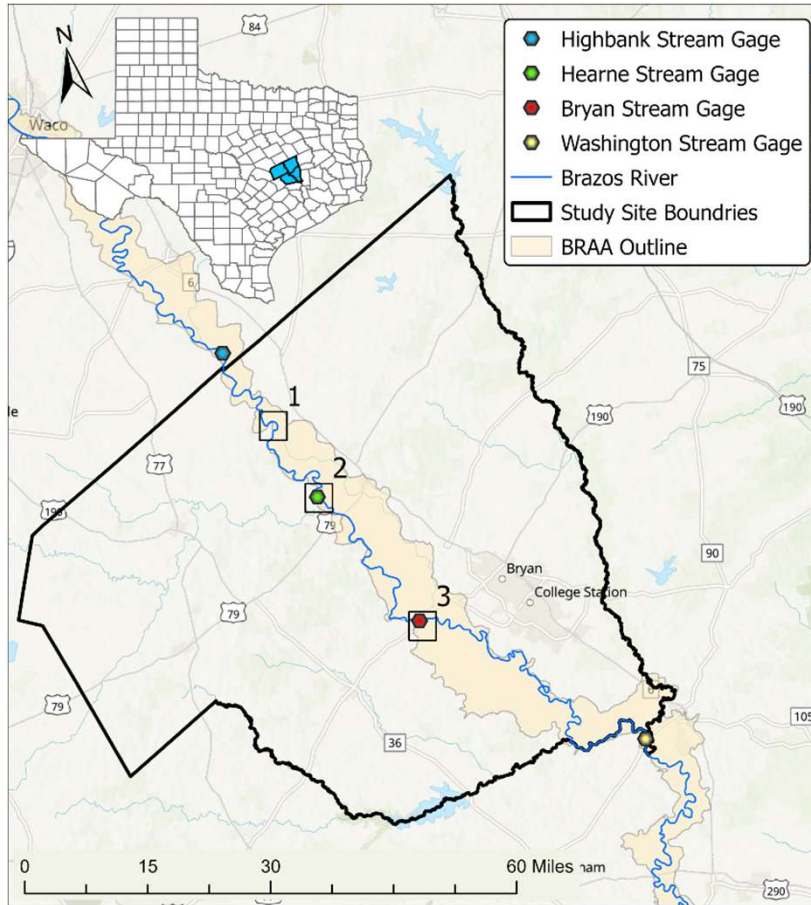
Local Study Sites

For each site:

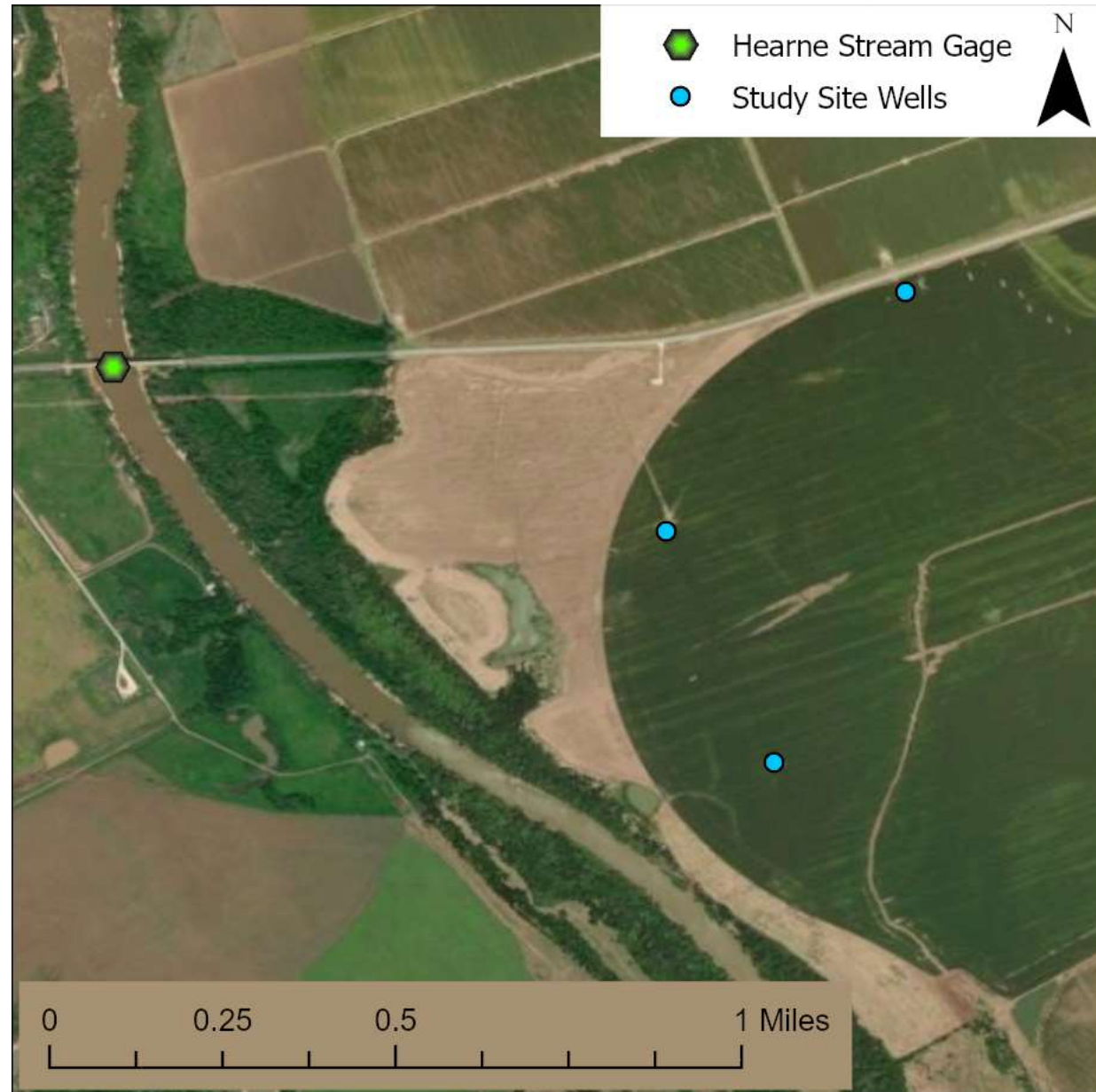
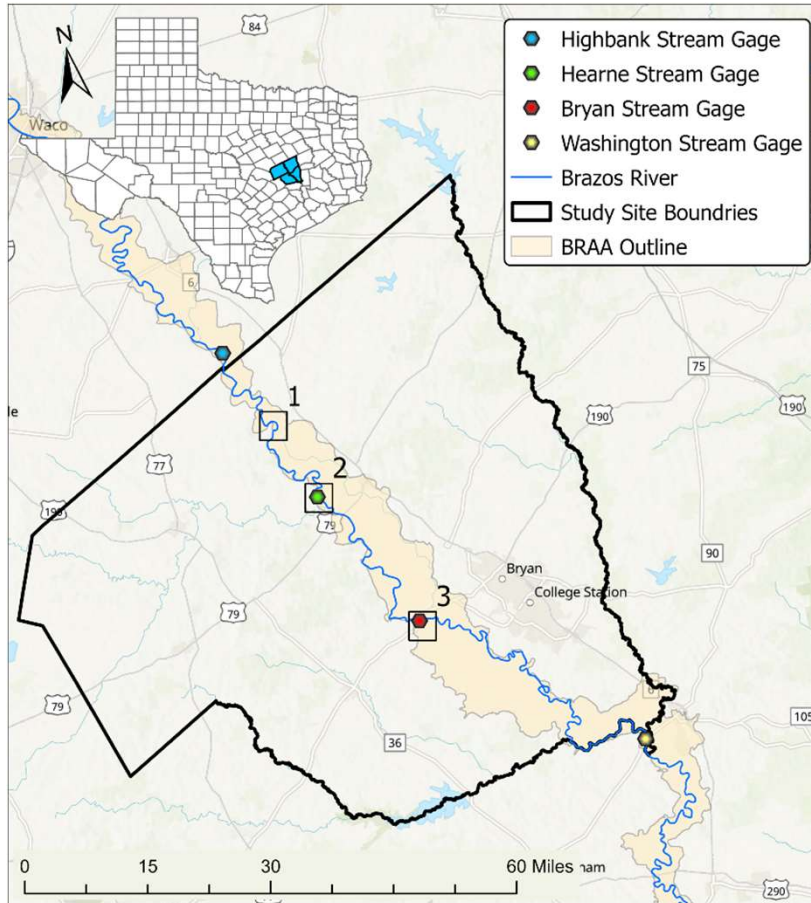
- 1 water level, temp., SpC datalogger
- 1 water level and temp. datalogger
- 1 barometer for corrections
- Water quality samples
- Isotope samples
- Field measurements (DO, pH, ect.)



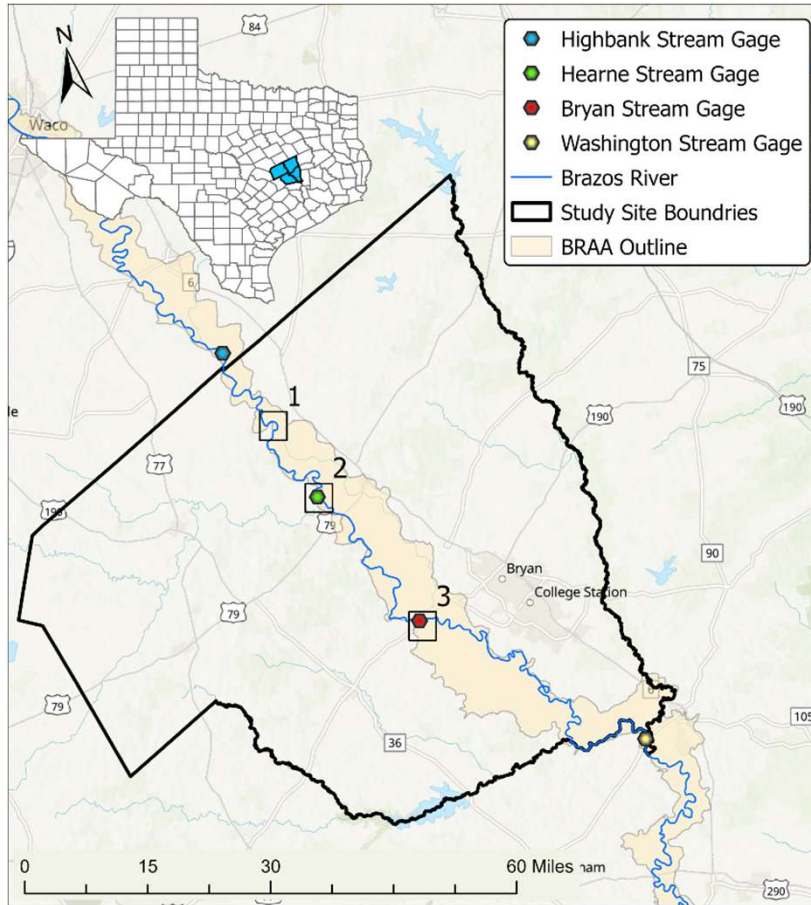
Local Study Site: Calvert



Local Study Site: Hearne



Local Study Site: Bryan



Methods: Overview

Data Science

River
Sampling

Groundwater
Sampling

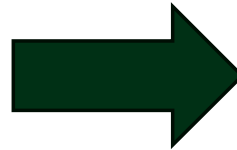
Methods: Data Science

Using data from:

- The Texas Water Development Board's (TWDB) Groundwater Database (GWDB)
 - Groundwater level
 - Groundwater quality
 - Drilling lithology
- Brazos Valley and Poast Oak Savana Groundwater Conservation Districts
 - Groundwater level
- Unites States Geological Survey's (USGS) National Water Information Service (NWIS)
 - River elevation
 - River discharge

Methods: Data Science

State	Well Number	County	Aquifer	Status	Measurement Month	Measurement Day	Measurement Year	Measurement Date	Measurement Time	Depth From S	entNumber	Measuring Agency	Method of Measurement	Remarks	Comments	Created Date	Last Update Date
01	140601	Dallam	Rita Blanca	Publishable	12	11	1998	1998-12-11		181.57	4692	Interpolated From Topo Map	4548	1	Registered Water Well Drill		
01	140601	Dallam	Rita Blanca	Publishable	12	7	1999	1999-12-07		188.79	4692	Interpolated From Topo Map	4503.21	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	5	2000	2000-12-05		190.4	4692	Interpolated From Topo Map	4501.6	1	Texas Water Developme		
01	140601	Dallam	Rita Blanca	Publishable	12	11	2001	2001-12-11		193.7	4692	Interpolated From Topo Map	4498.3	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	13	2002	2002-12-13		206.9	4692	Interpolated From Topo Map	4485.1	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	10	2003	2003-12-10		199.8	4692	Interpolated From Topo Map	4492.2	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	11	2004	2004-12-11		201.7	4692	Interpolated From Topo Map	4490.3	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	11	3	2005	2005-11-03		206.54	4692	Interpolated From Topo Map	4485.46	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	11	2006	2006-12-01		206.25	4692	Interpolated From Topo Map	4485.75	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	6	2007	2007-12-06		203.5	4692	Interpolated From Topo Map	4488.9	1	Texas Water Developme		
01	140601	Dallam	Rita Blanca	No Measurement	12	10	2008	2008-12-10		14692	Interpolated From Topo Map	1	1	Texas Water Development Boar	casing	2008-12-16	2008-12-16
01	140601	Dallam	Rita Blanca	No Measurement	11	3	2009	2009-11-03		14692	Interpolated From Topo Map	1	1	Texas Water Development Board	casing	2009-11-10	2009-11-10
01	140601	Dallam	Rita Blanca	Publishable	12	14	2010	2010-12-14		224	4692	Interpolated From Topo Map	4468	1	Texas Water Development		
01	140601	Dallam	Rita Blanca	Publishable	12	6	2011	2011-12-06		253.92	4692	Interpolated From Topo Map	4438.08	1	Texas Water Develop		
01	140601	Dallam	Rita Blanca	Publishable	12	6	2012	2012-12-06		229.51	4692	Interpolated From Topo Map	4462.49	1	Texas Water Develop		
01	140993	Dallam	Rita Blanca	Publishable	10	1937	176	4693	Digital Elevation Model -DEM	4617	1	Other or Source of Measurement Unkn					
01	140993	Dallam	Rita Blanca	Publishable	7	6	1988	1988-07-06		171	4693	Digital Elevation Model -DEM	4522	1	Texas Water Development		
01	140994	Dallam	Rita Blanca	Publishable	10	1937	176	4693	Digital Elevation Model -DEM	4617	1	Other or Source of Measurement Unkn					
01	140996	Dallam	Rita Blanca	Publishable	5	18	2004	2004-05-18		200.08	4699	Digital Elevation Model -DEM	4498.92	1	Texas Water Develop		
01	140997	Dallam	Rita Blanca	Publishable	12	12	1988	1988-01-12		150	4683	Digital Elevation Model -DEM	4533	1	Registered Water Well C		
01	140997	Dallam	Rita Blanca	Publishable	8	15	1991	1991-08-15		158.11	4683	Digital Elevation Model -DEM	4524.89	1	Texas Water Develop		
01	148302	Dallam	Rita Blanca	Publishable	4	10	1974	1121	4669	Interpolated From Topo Map	4548	1	Registered Water Well Driller	Unknown			



State	Well Number	County	Aquifer	Status	Measurement	Measurment	Measurment	Measurment	Depth	Land Elev	Land Elev	Water Elev	Measurment	Measuring Method	Off Remarks	Comments	Create	Del	Last Update	Lat	Long
01	3032701	Falls	Bracco Rvr	Publishable	3	20	1976	#####	26.4	309	Interpolation	334.4	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	23	1977	#####	26.48	309	Interpolation	333.92	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	17	1976	#####	22.6	309	Interpolation	333.6	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	26	1979	#####	24.2	309	Interpolation	334.8	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	19	1980	#####	26.2	309	Interpolation	334.8	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	27	1964	#####	20.21	309	Interpolation	339.79	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	19	1985	#####	26.38	309	Interpolation	332.62	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	4	11	1975	#####	20.47	309	Interpolation	333.93	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	4	9	1987	6/9/1987	21.97	309	Interpolation	337.93	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	2	8	1989	2/8/1989	26.38	309	Interpolation	332.62	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	2	23	1990	#####	25.94	309	Interpolation	333.96	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	21	1991	#####	24.88	309	Interpolation	334.12	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	2	13	1992	#####	22.12	309	Interpolation	335.08	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	2	26	1993	#####	23.41	309	Interpolation	335.59	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	22	1994	#####	24.6	309	Interpolation	334.4	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	26	1974	#####	20.85	309	Interpolation	339.15	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	17	1972	#####	23.87	309	Interpolation	335.13	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	3	22	1973	#####	22.54	309	Interpolation	335.06	1	Texas Water Street Paper						31.26096	-96.96384
01	3032701	Falls	Bracco Rvr	Publishable	7	18	1960	#####	24.24	309	Interpolation	334.76	1	Other or Source of Measurement Unkn	Accurately reflects water level conditions				31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	11	3	1960	#####	24.14	309	Interpolation	334.86	1	Other or Source of Measurement Unkn	Accurately reflects water level conditions				31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	3	2	1961	3/2/1961	19.21	309	Interpolation	339.79	1	U.S. Geologic Survey					31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	1	11	1963	#####	24.96	309	Interpolation	334.04	1	U.S. Geologic Survey					31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	3	19	1963	#####	25.26	309	Interpolation	333.74	1	U.S. Geologic Survey					31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	10	8	1963	#####	29.3	309	Interpolation	329.7	1	U.S. Geologic Survey					31.26096	-96.96384	
01	3032701	Falls	Bracco Rvr	Publishable	12	19	1963	#####	26.54	309	Interpolation	332.46	1	U.S. Geologic Survey					31.26096	-96.96384	

Data Cleaning Goals

- Add Lat/Long information
- Remove questionable data
- Remove duplicates
- Reorganize for usability
- Narrow to only study site

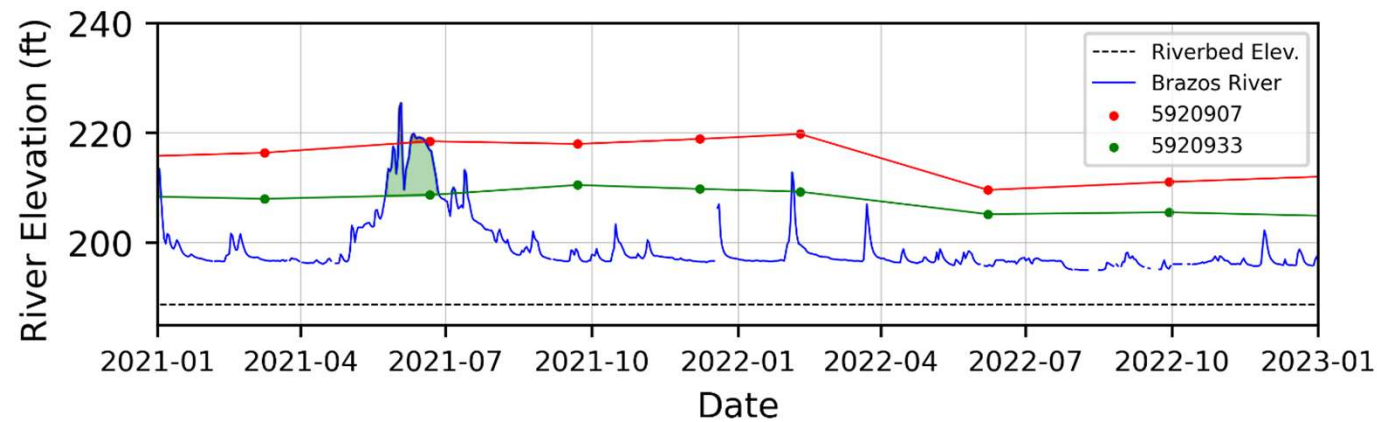
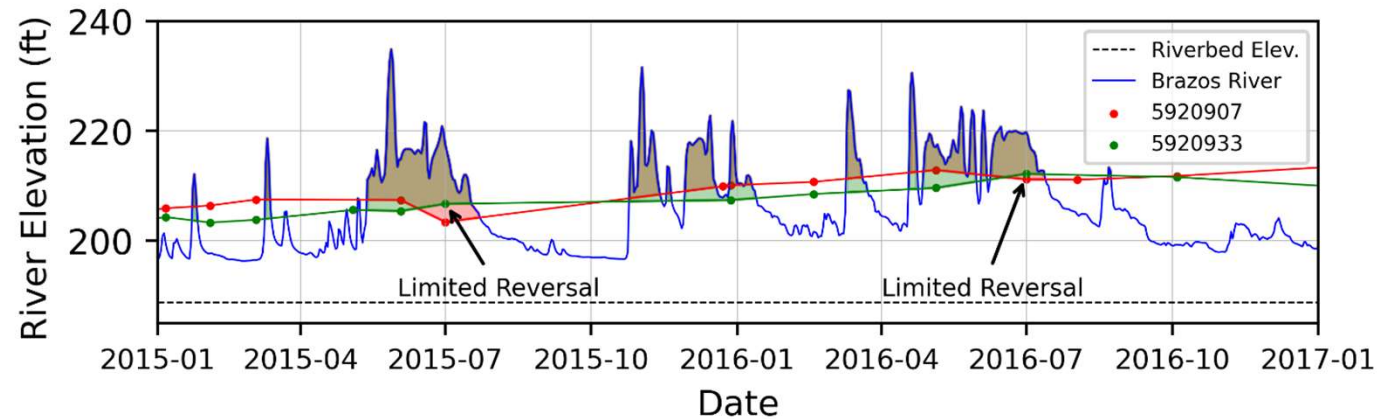
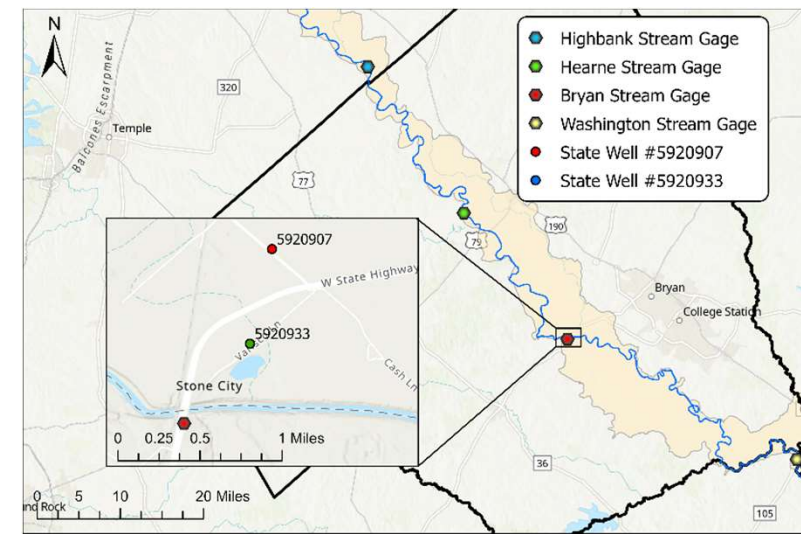
Analysis Goals

- Historical river/aquifer interactions
- Historical groundwater flow direction
- Historical water chemistry

Methods: Data Science

Analysis Goals

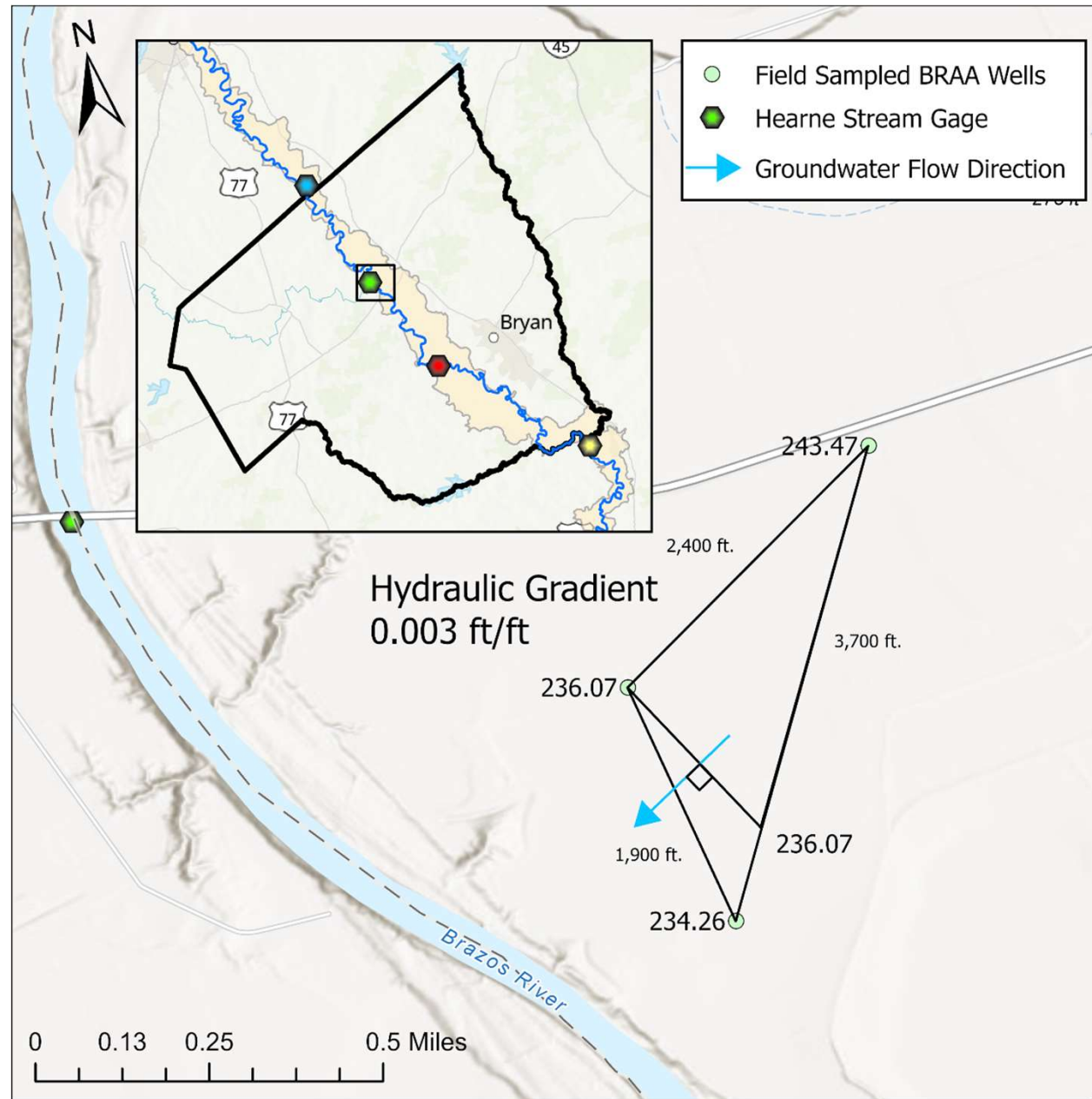
- Historical river/aquifer interactions
- Historical groundwater flow direction
- Historical water chemistry



Methods: Data Science

Analysis Goals

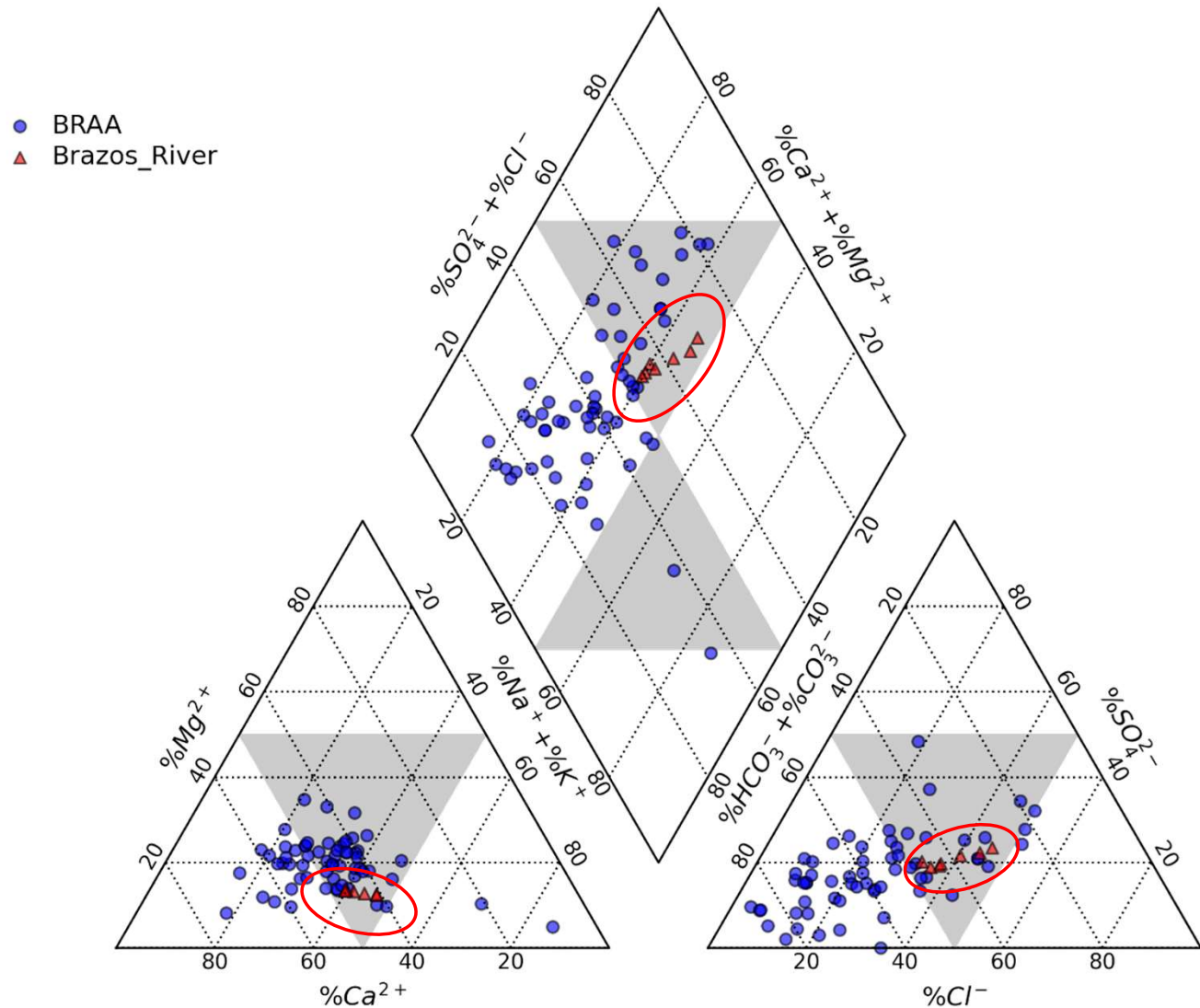
- Historical river/aquifer interactions
- Historical groundwater flow direction
- Historical water chemistry



Methods: Data Science

Analysis Goals

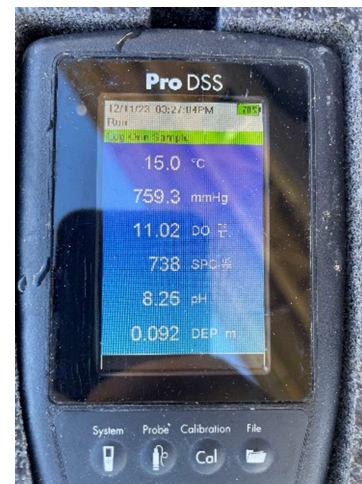
- Historical river/aquifer interactions
- Historical groundwater flow direction
- **Historical water chemistry**



Methods: River Sampling

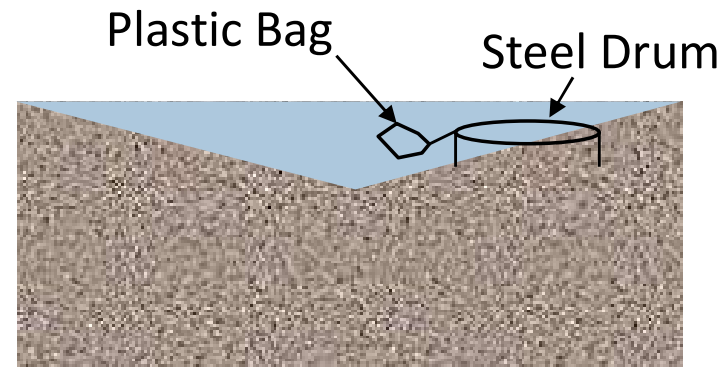
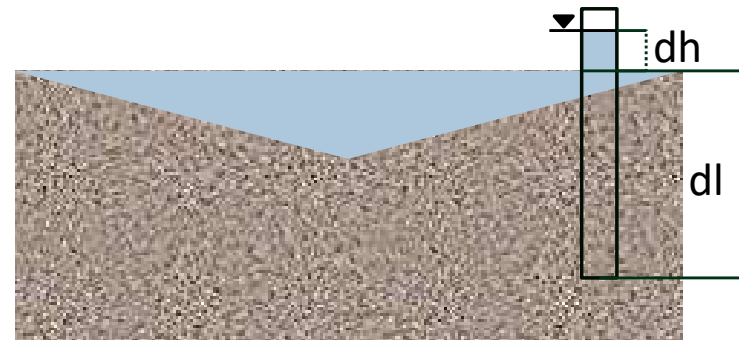
At each location:

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



Methods: Riverbank In/Out Flow

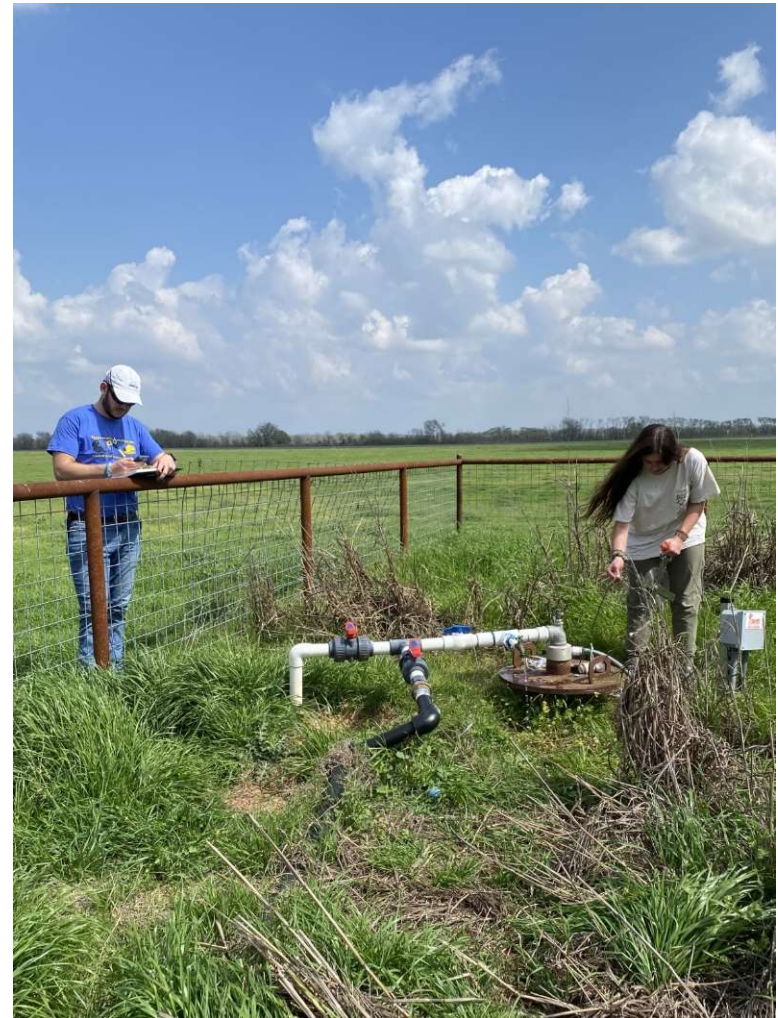
- Mini-Piezometers
 - Hydraulic gradient between the riverbed sediment and the river
- Seepage meters
 - Flow into or out of the riverbed sediments



Methods: Groundwater Sampling

At each location:

- Water level
 - Sonic and steel tape/E-Line
- Water chemistry samples
 - Ionic chemistry
 - Isotope
- Field measurements (bucket flow cell)
 - Temperature
 - Dissolved Oxygen (DO)
 - Specific Conductance (SpC)
 - pH
- Field alkalinity titrations



Data Collected

- December river trip
 - 7 locations with ionic, isotopic and field data
- March sampling trip
 - 52 wells sampled for water level in pairs (Vivian's study)
 - 11 wells sampled for water quality



Data Collected: River Chem.

Sample_ID	As	Ca	Cl	DO	Fe	HCO3	K	Mg	Mn	Na	NO3	pH	SO4	SpC	Temp
R1	0.0021	67.6	112	10.93	0	129	7.22	12.4	0.0078	83.5	1.16	8.52	77.9	732	13.5
R2	0.0022	68.3	125	10.63	0.1058	165	6.74	12.7	0.0087	85.1	0.85	8.29	86	782	13.7
R3	0.0022	71.6	109	11.02	0	177	6.8	12.9	0.0129	79.5	0.99	8.26	79.6	738	15
R4	0.0022	77.9	103	10.68	0	207	7.31	13.7	0.0174	72.1	2.1	8.28	72.5	742	15
R5	0.0023	81.9	111	11.14	0	220	7.6	14.6	0.0086	81.6	2.04	8.37	79.5	760	11.3
R6	0.0023	81.2	106	11.61	0	232	7.46	14.5	0.0088	75.6	1.98	8.61	75.9	796	13.2
R7	0.0024	74.8	85.9	10.6	0	207	6.96	12.9	0.0088	68.5	1.26	8.74	70.9	679	11

Data Collected: Aquifer Chem.

Site	Aquifer	HCO3	Cl	SO4	NO3	F	As	Ca	Fe	Mg	Mn	K	Na	Water Elevation
BVOP-0279	BRAA	683	39.9	52.9	<.1	<1	0.001	169	6.91	34.5	0.6544	3.38	37.8	211.52
BVR-3867	BRAA		178	141	6.82	<1	0.0011	109	1.57	21.5	0.4209	1.95	113	251.3
BVR-2441	Queen City	322	22.5	107	0.31	<1	<.0005	1.87	<.05	0.4095	0.0023	1.42	177	230.62
BVR-1451	Queen City	544	<5	32.1	<.1	<1	<.0005	4.52	<.05	0.9421	0.0044	1.3	238	255.62
BVR-4730	Queen City	861	143	91.5	<.1	<1	<.0005	7.33	0.0545	1.86	0.0064	2.91	448	208.92
BVDO-0019	Queen City	993												218.34
BVR-0202	Queen City	561												236.74
BVR-0985	Simsboro	464												149.78
BVR-0242	Simsboro	390												175.31
BVHU-1070	Simsboro		188	120	<.1	<1	<.0005	2.48	0.0641	0.5312	0.0067	0.0591	2.97	242.04
BVR-0841	Sparta	627	35.6	411	<.1	<1	<.0005	6.48	0.0637	1.64	0.0087	2.74	414	213.54

*Some data is still being processed by the lab.

Timeline

Task	Fall '23	Spring '24	Summer '24	Fall '24	Sprin '24
Literature Review					
River Sampling					
Aquifer Sampling					
Data Analysis					
Report and Thesis Composition					

Acknowledgements

- Alan Day, Brazos Valley GCD
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- Wayne Hamilton, Baylor University
- Dr. Joe Yelderman, Baylor University



Questions

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