

HOW MUCH WATER IS IN THE PEDERNALES?

Appendix B

Pedernales Regional Sampling Information

Special thanks to:

The Cynthia & George Mitchell Foundation

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**THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT**

APPENDICES

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I. PEDERNALES “HYDRO-BLITZ” SAMPLING INFORMATION (PHASE 1)

GIS data was collected from multiple sources to compile maps characterizing the Pedernales watershed. These data included local roads (TXDOT), local geology (Geologic Atlas of Texas), locations of springs (TWDB, USGS, TPWD), 1:100,000 series USGS maps of the area, locations of wells (TWDB), locations of watershed and subwatershed boundaries (TWDB), municipal locations such as city limits, county boundaries, and aquifer boundaries (TNRIS), locations of rivers, streams, and flowlines (NHD), state park boundaries (TPWD), aerial imagery (USGS), and land cover (NLCD 2011). After these data were compiled, the locations of all points where a TXDOT public road/right-of-way intersects a National Hydrography Dataset flowline, river or tributary, and the Pedernales River itself. Duplicate intersections where a road would cross a flowline at multiple nearby points were condensed into the most likely location where sampling access would be possible from the public right-of-way. After this condensing process, 931 sites were ultimately deemed suitable for ground truthing in the field. The sampling regions noted in the main report were drawn in an arbitrary fashion around major highways and roads, and were split evenly so each group would have 90-120 intersections to visit.

Each site was given a unique “Map ID” number to designate each site when recorded on field sheets. Hydro-Blitz volunteers were given regional maps and field sheets to record observe multiple relevant environmental parameters. The first parameter assessed for each site was whether there was water present in the stream channel. If water was not present, the intersection was noted as “dry” and no further observations were made, unless significant invasive plants or detrimental land practices were sighted. If water was present, volunteers would then record the date and military time of each sample, estimated stream flow (standing water, low, medium, high), whether a defined stream channel was present, the turbidity of the water (clear, cloudy, or muddy), whether invasive plant species and notable land management practices were present, and whether each site was accessible from the public road for water quality sampling within the stream.

The list of “least wanted” plants and land management practices included *Arundo donax* (river cane), *Tamarix ramosissima* (salt cedar), *Melia azedarach* (Chinaberry tree), *Colocasia esculenta* (Elephant Ears), *Triadica sebifera* (Chinese Tallow tree), *Ligustrum lucidum*, *Paliurus spina-christi* Mill (Christ thorn plant), feral hog activity, and overgrazing.

Calls for volunteers in the “Hydro-Blitz” were sent out from the Meadows Center and the Hill Country Alliance August newsletter. Volunteers and staff involved in the Hydro-Blitz included the Meadows Center staff, Texas State University Department of Biology professors and students. These fourteen individuals took part in the project throughout the days of Monday, August 10 and Tuesday, August 11.

Landowners across the Pedernales watershed were contacted via phone and e-mail with requests to access any springs and/or wells that they have on their property. Those efforts ultimately led to water quality sampling at multiple ranches, parks, and private properties throughout the watershed. The Meadows Center and Hydro-Blitz staff partnered with numerous organizations in various roles, such as data acquisition or project coordination. Those partner organizations include the Hill Country Alliance, The Nature Conservancy, Alamo Area Master Naturalists, Lower Colorado River Authority, Texas Parks and Wildlife, Hill Country Underground Water Conservation District, and the Texas State University’s Department of Biology.

Below are maps of each of the 931 Hydro-Blitz road-flowline intersections, overlaid with land cover and with and without the sampling regions delineated. Figure 3 denotes which of the intersections were dry (red), had standing water only (green), or had actively flowing water (blue).

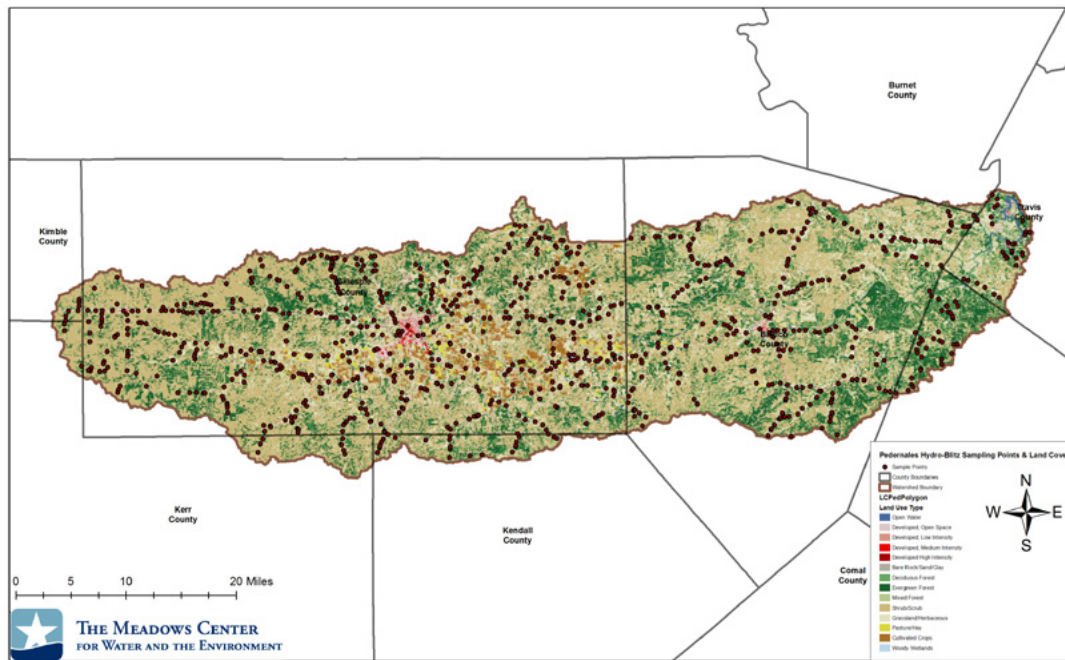


Figure 1 - Hydro-Blitz sampling points and land cover within the Pedernales watershed

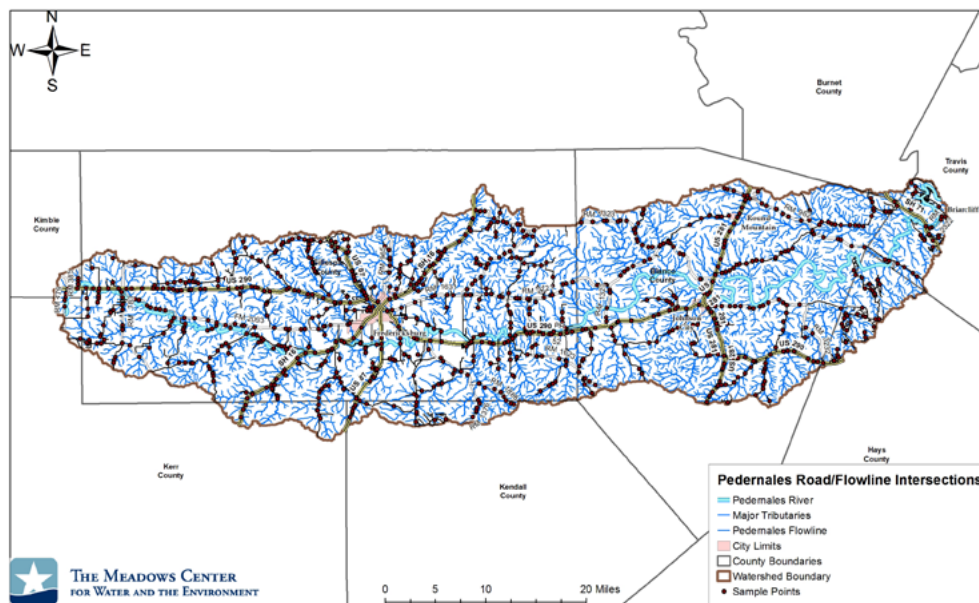


Figure 2 – Intersections between a public TXDOT road and an NHD-defined flowline

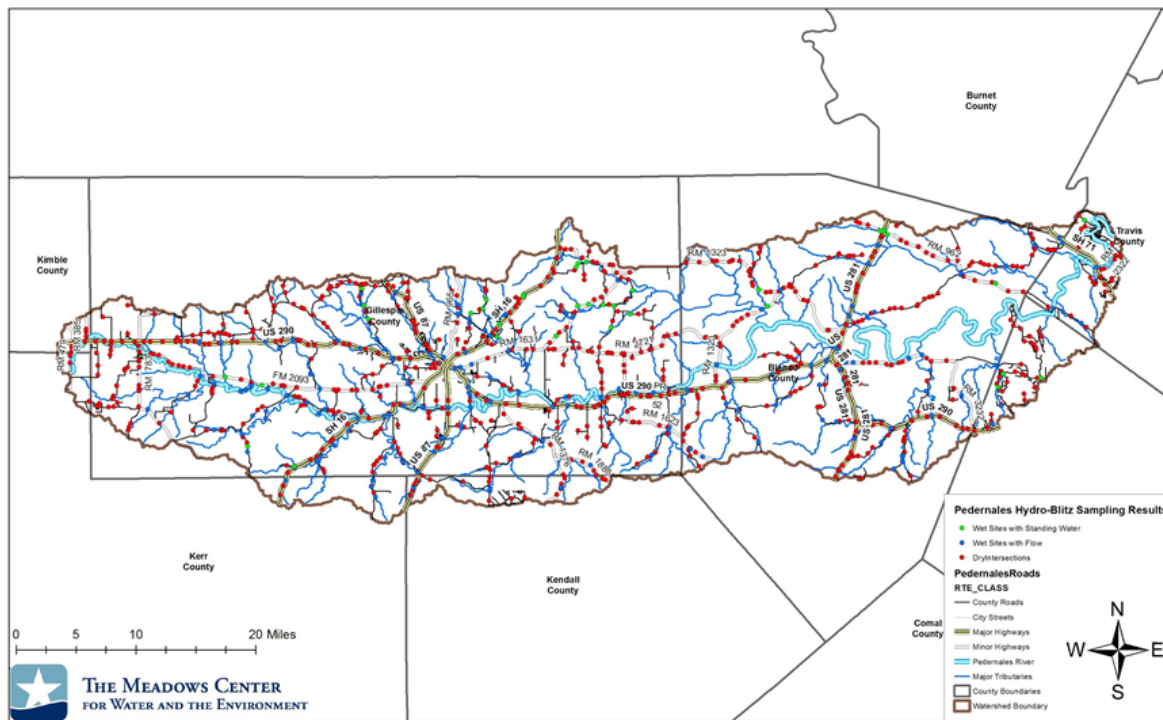


Figure 3 - Hydro-Blitz sampling locations (dry, standing water and flowing water)

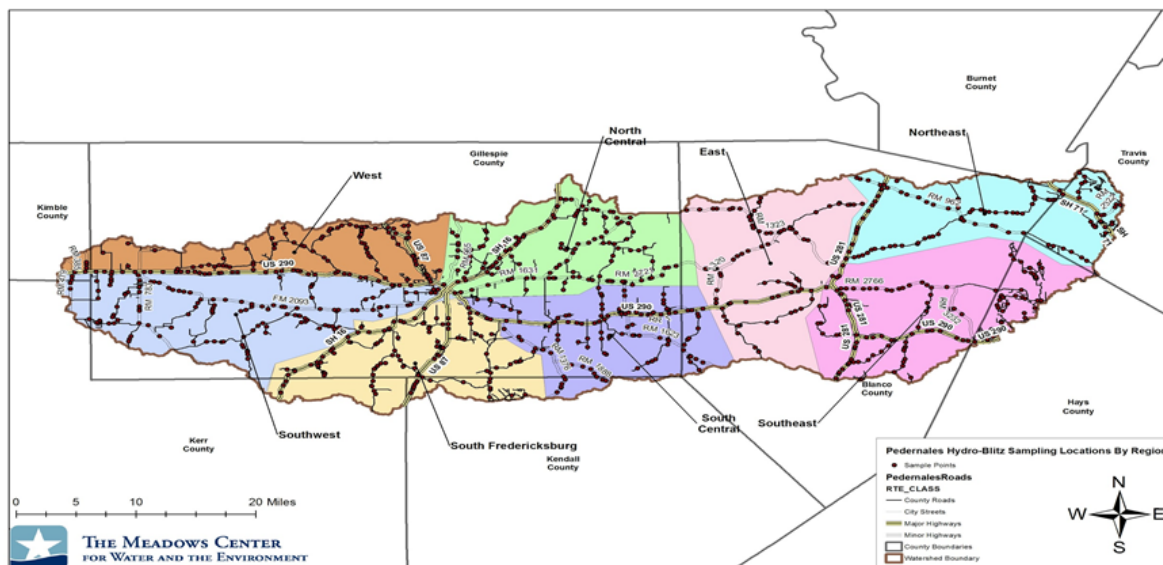


Figure 4 - Map displaying Hydro-Blitz sampling locations and arbitrary sampling regions

Region Name	Number of Sites	Sites with water	Sites with flow	% of sites with flow
Northeast	108	22	15	13.9
Southeast	120	29	29	24.2
East	86	12	8	9.3
South Central	121	23	23	19.0
Southwest	126	27	24	19.0
Northwest	126	17	12	9.5
South Fredericksburg	109	33	30	27.5
North Central	135	36	18	13.3
Total	931	199	159	

Table 1 - Sampling regions with water and sites with discernable flow within the Pedernales study area (Colors correspond with regions in the map above)

In regards to invasive species in the watershed, Arundo was common on the Pedernales and its tributaries around Fredericksburg, and Chinaberry was also common along the river and its tributaries to the south. For more detailed information, please see the results in Section III on the right.

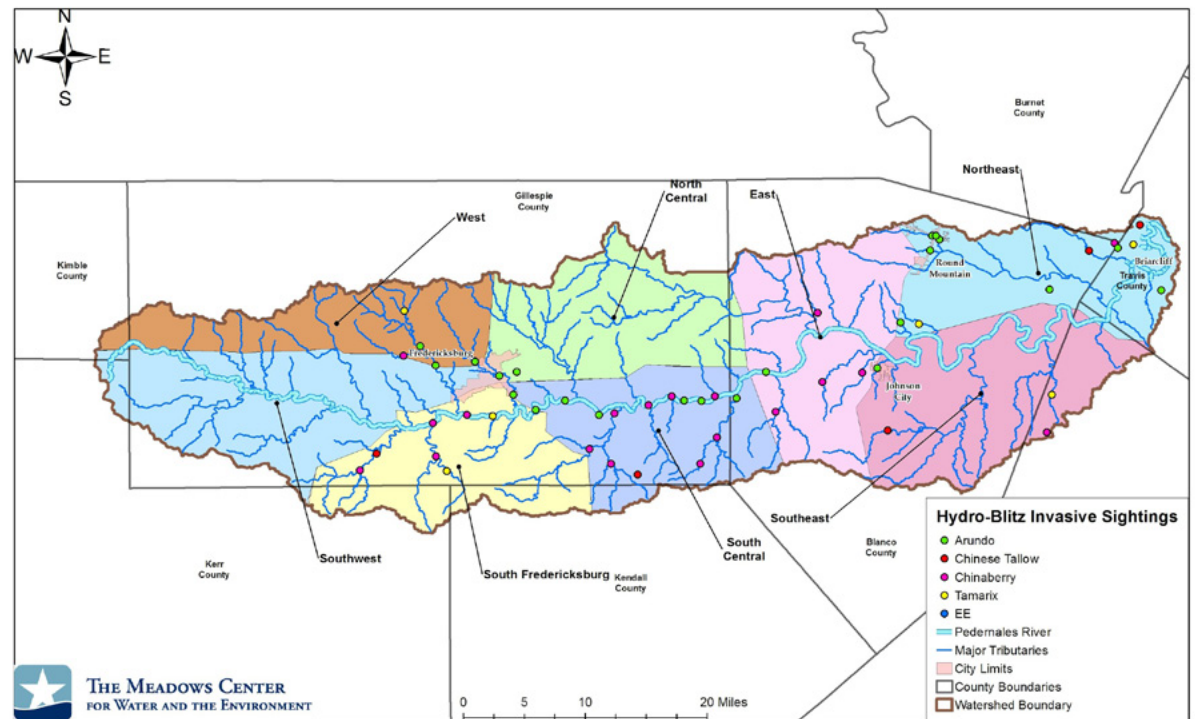


Figure 5 - Predominant invasive plant species observed at sampling

Figure 6 below displays individual Hydro-Blitz sites with water observed and noted flow level. Figure 7 shows the predominant flow classification determined for each sampling region. Flow levels often increased from west to east across the watershed, with the Pedernales especially gaining higher flow levels with an increase in water flowing in from tributaries. Figure 8 shows turbidity results across the watershed. These results were mixed across the watershed, with most areas having clear water but some regions having cloudy water on average. Figure 9 displays locations of sites over surface geology for comparison purposes. Please refer to Section II for additional results from these findings.

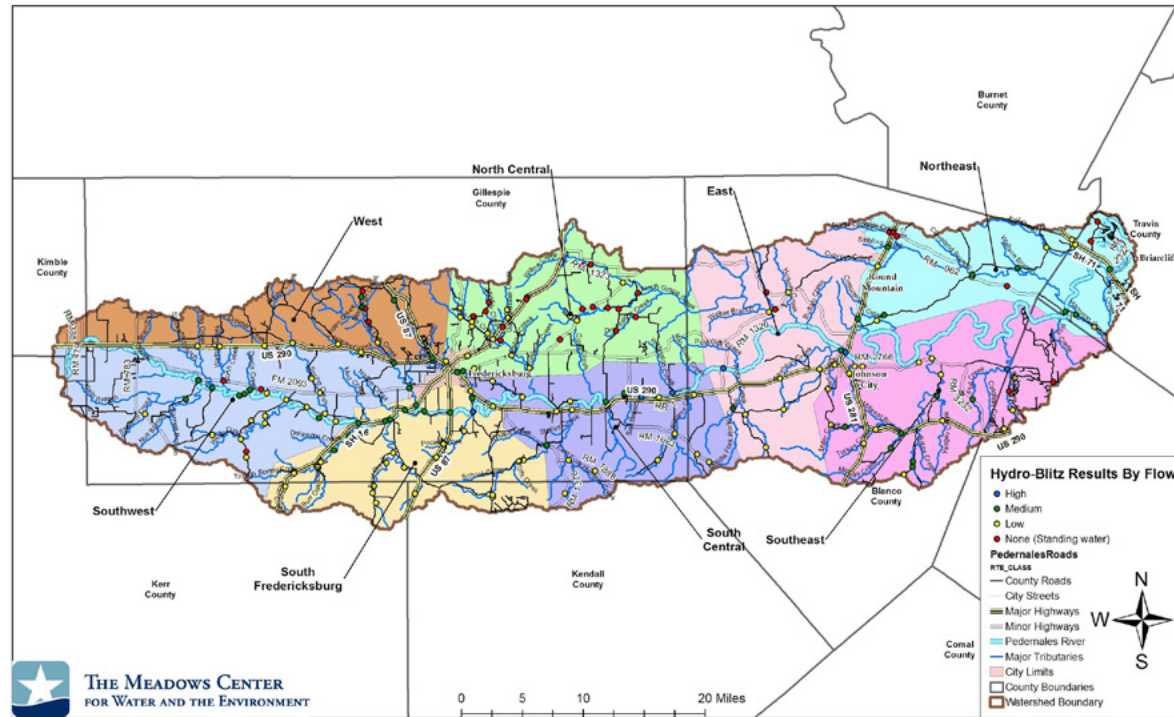


Figure 6 - Hydro-Blitz sites with water and flow observations

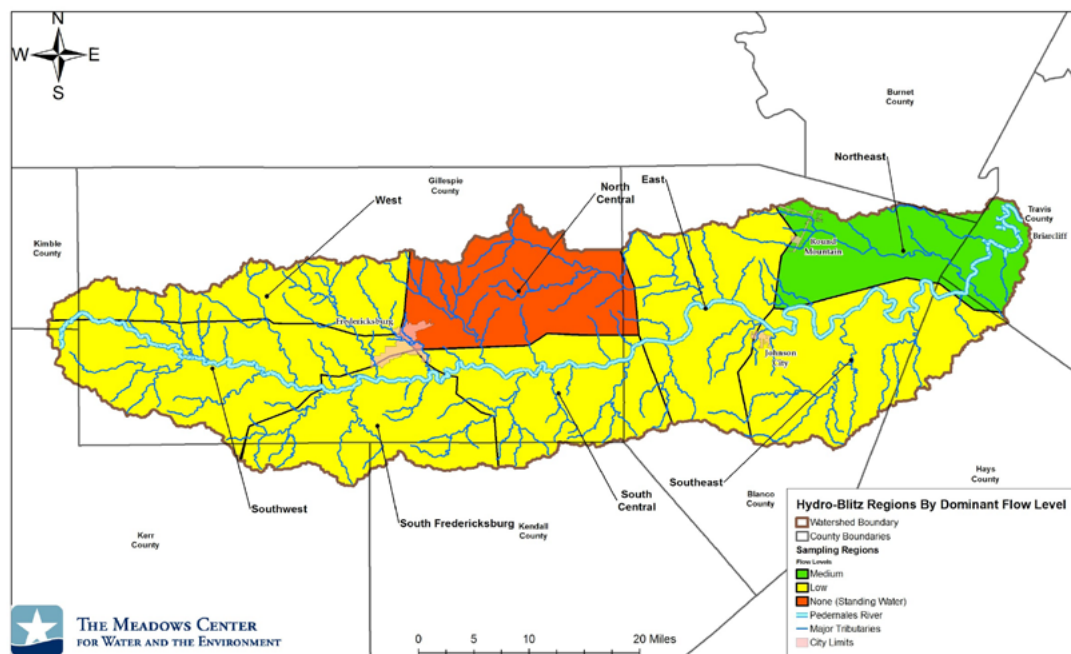


Figure 7 - Predominant flow classification for each sampling region

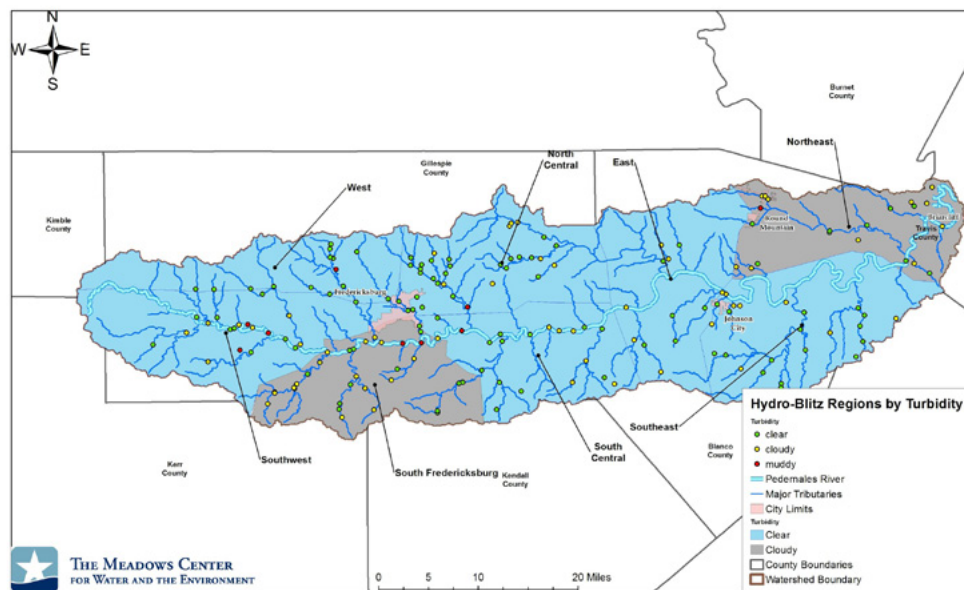


Figure 8 - Turbidity classifications at individual sites and the predominant turbidity classification by sampling region

II. WATER QUALITY SAMPLING METHODOLOGY AND INFORMATION (PHASE 2)

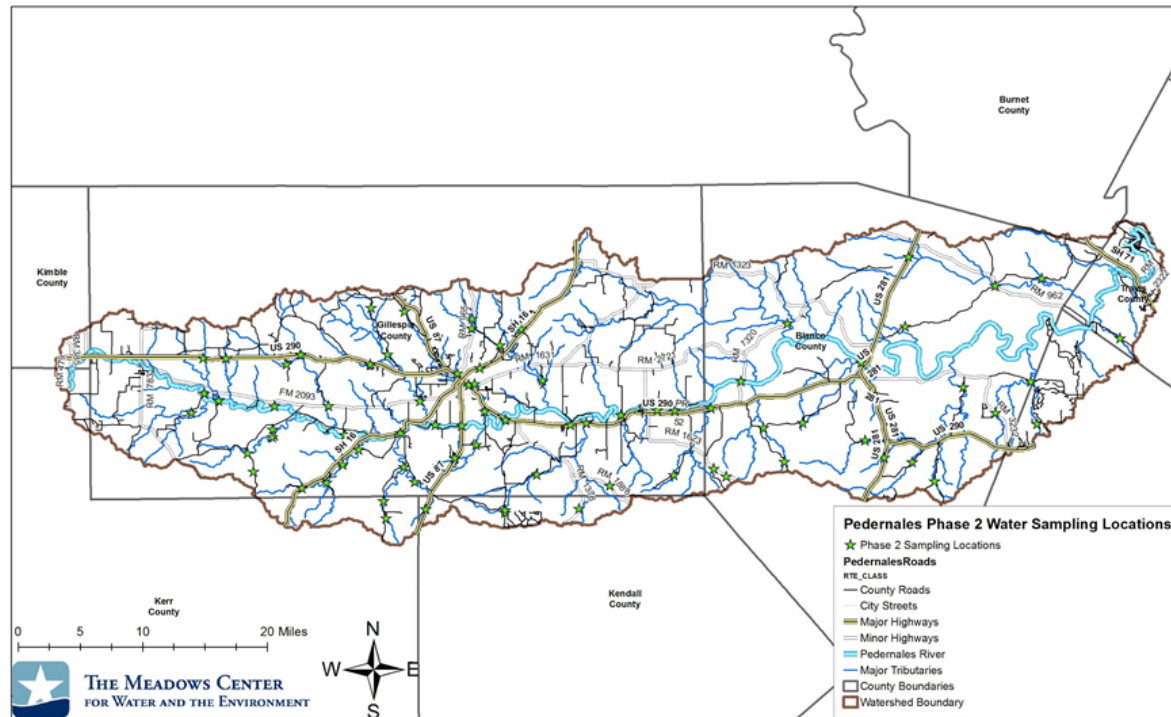


Figure 10 - Phase 2 water quality sampling locations

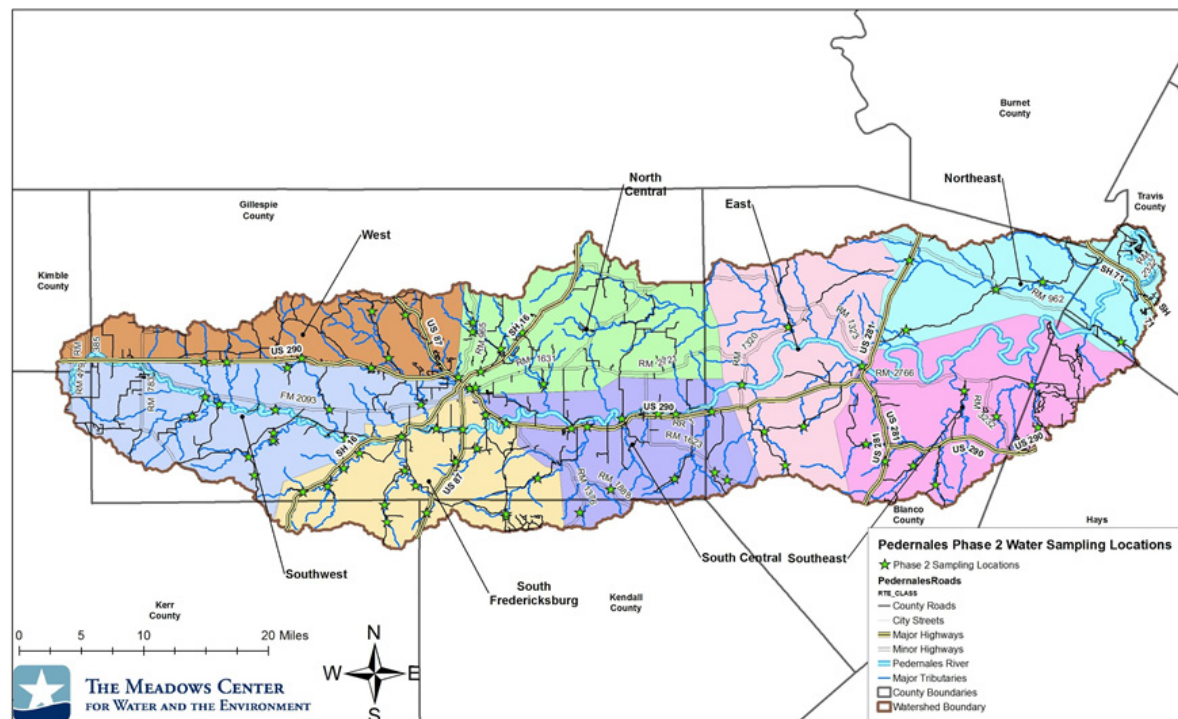


Figure 11 - Phase 2 sampling locations within Phase 1 sampling regions

Water quality samples were taken at 77 flowline/road intersections across the watershed for Phase 2. An additional 14 water quality samples were taken from springs on public and private property including Bamberger Ranch, Reimer's Ranch, Westcave Preserve, and Pedernales Falls State Park.

Region Name	Number of Phase 2 Sampling Points
Northeast	5
Southeast	9
East	5
South Central	12
Southwest	12
West	7
South Fredericksburg	18
North Central	9

Table 2 - Phase 2 water quality sampling points by region (Colors correspond with regions in the map above)

III. INITIAL SAMPLING RESULTS/INFORMATION BY REGION

Region Name	Number of Sites	Sites with water	Sites with flow	% of sites with flow
Northeast	108	22	15	13.9
Southeast	120	29	29	24.2
East	86	12	8	9.3
South Central	121	23	23	19.0
Southwest	126	27	24	19.0
Northwest	126	17	12	9.5
South Fredericksburg	109	33	30	27.5
North Central	135	36	18	13.3
Total	931	199	159	

Table 3 - Sites with water and discernable flow by sampling region

Region Name	Arundo	Tamarix	Chinaberry	EE	Tallow	Ligustrum	Overgrazing	Total
Northeast	8	2	2	0	3	0	3	18
Southeast	0	2	1	0	2	1	0	6
East	1	0	5	0	0	0	1	7
South Central	8	0	10	0	1	0	0	19
Southwest	0	0	0	0	0	0	1	1
Northwest	4	4	1	0	1	0	3	13
South Fredericksburg	0	2	5	1	3	0	3	14
North Central	1	0	0	0	0	0	0	1
Total	22	10	24	1	10	1	11	

Table 4 - Sites with invasive species and overgrazing practices by sampling region.

Region Name	Standing water	Low	Medium	High	Total
Northeast	6	7	8	0	21
Southeast	3	16	8	2	29
East	2	7	1	1	11
South Central	0	16	5	2	23
Southwest	3	15	9	0	27
Northwest	3	8	4	0	15
South Fredericksburg	1	19	10	1	31
North Central	18	16	2	0	36
Totals	36	104	47	6	193

Table 5 - Flow classification by sampling region

Region Name	Muddy	Cloudy	Clear	Total
Northeast	1	11	9	21
Southeast	0	9	18	27
East	0	5	6	11
South Central	1	7	13	21
Southwest	3	7	9	19
Northwest	1	0	14	15
South Fredericksburg	2	17	12	31
North Central	1	8	25	34
Total	9	64	106	179

Table 6 - Turbidity observations by region

IV. DESCRIPTIONS AND SUMMARY OF FINDINGS BY REGION

West/Northwest Sampling Region

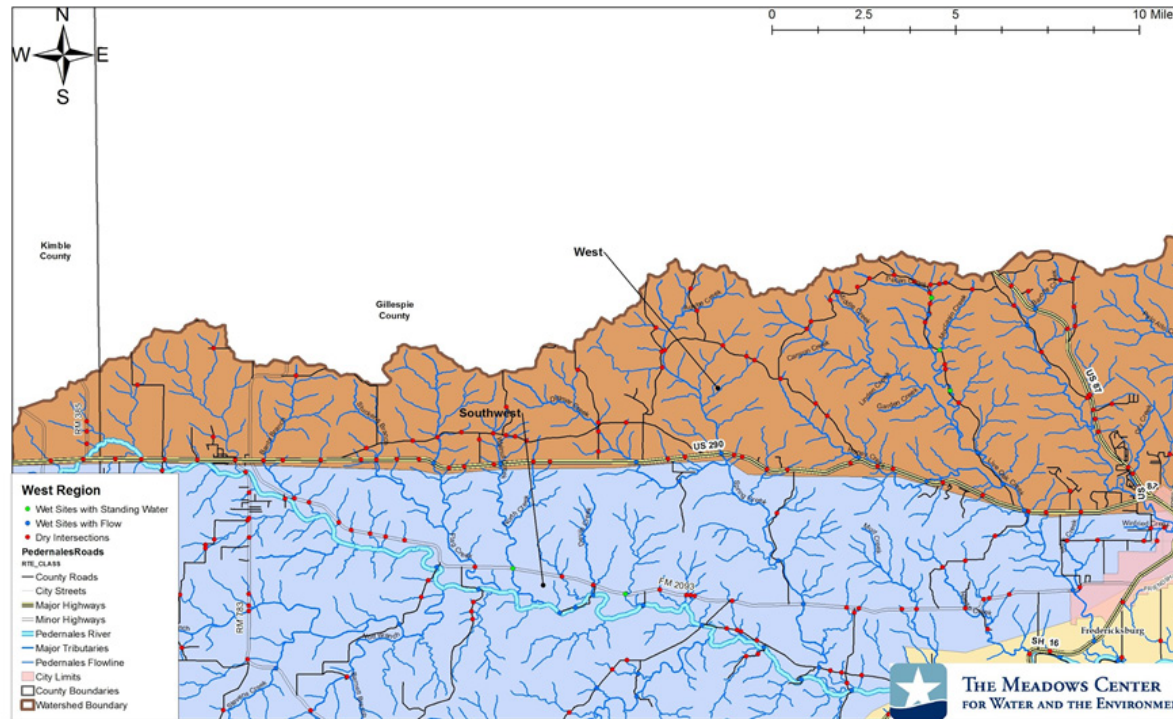


Figure 12 - West/Northwest sampling region

The **West/Northwest Region** comprised the stretch of US 290 west of Fredericksburg and running through Harper, TX, along with any roads immediately north of the main highway. This region had the second lowest rate of sites with flowing water, and most flowing creeks were seep-fed or spring-fed. Water was found at multiple sites on US 290 at Flag, Dittmar, Spring, Honey, Live Oak, and Baron's creeks, although not all the sites were accessible from the highway bridge. Additionally, rural roads passing through Baron's and Pecan/Live Oak creeks led to locations near or at the headwaters of those bodies. Seeps and springs could be found at these locations. On the rural side roads, land use was either light residential or heavy ranching, with livestock readily crossing the road and areas of overgrazing easily observed.



*Photo: Baron's Creek at Old Mason Road northwest of
Fredericksburg, TX (MCWE)*

Southwest Sampling Region

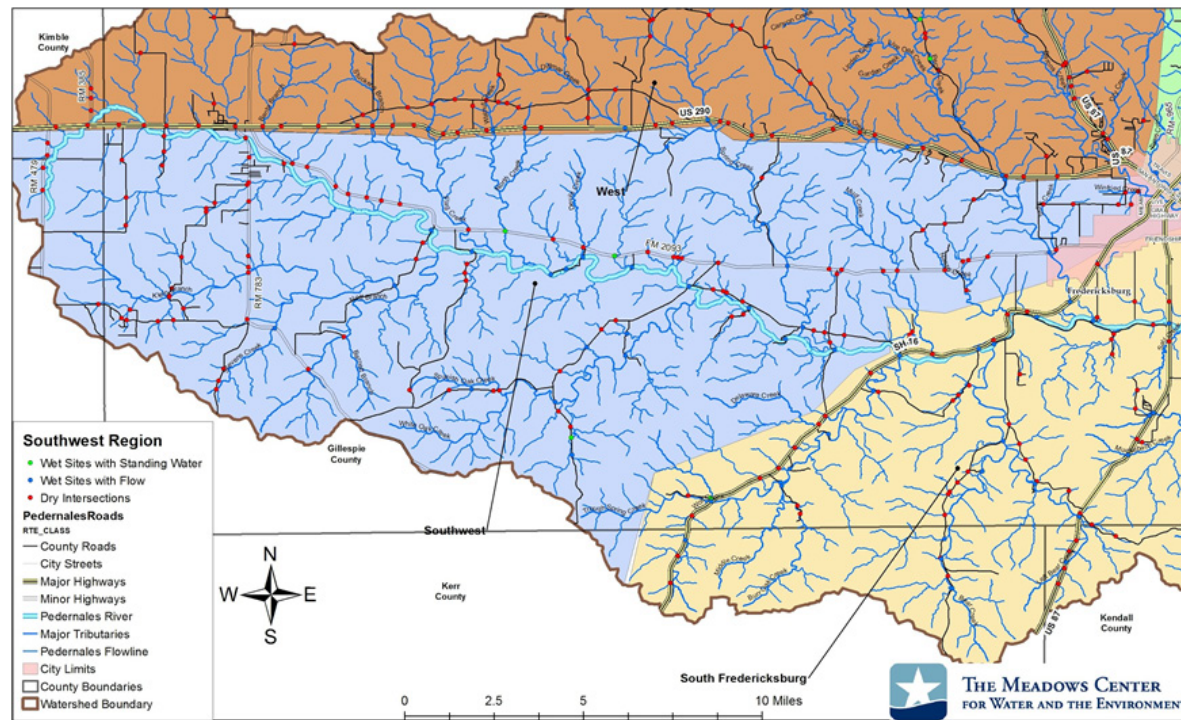


Figure 13 - Southwest sampling region

The **Southwest Region** comprises the area southwest of Fredericksburg on and around FM 2093, and includes the headwaters of the Pedernales River near Harper, TX. Most sites were dry with a defined channel. Water was found, however, in Live Oak, Spanish Oak, and White Oak creeks. The headwaters appear to be on a ranch between crossings of the Pedernales just southwest of FM 2093. Few invasives were present, although feral hog activity was present in some areas and livestock grazing in riparian areas was common.



Photo: Pedernales River at Frederick Street, Southwest sampling region (MCWE)

South of Fredericksburg Sampling Region

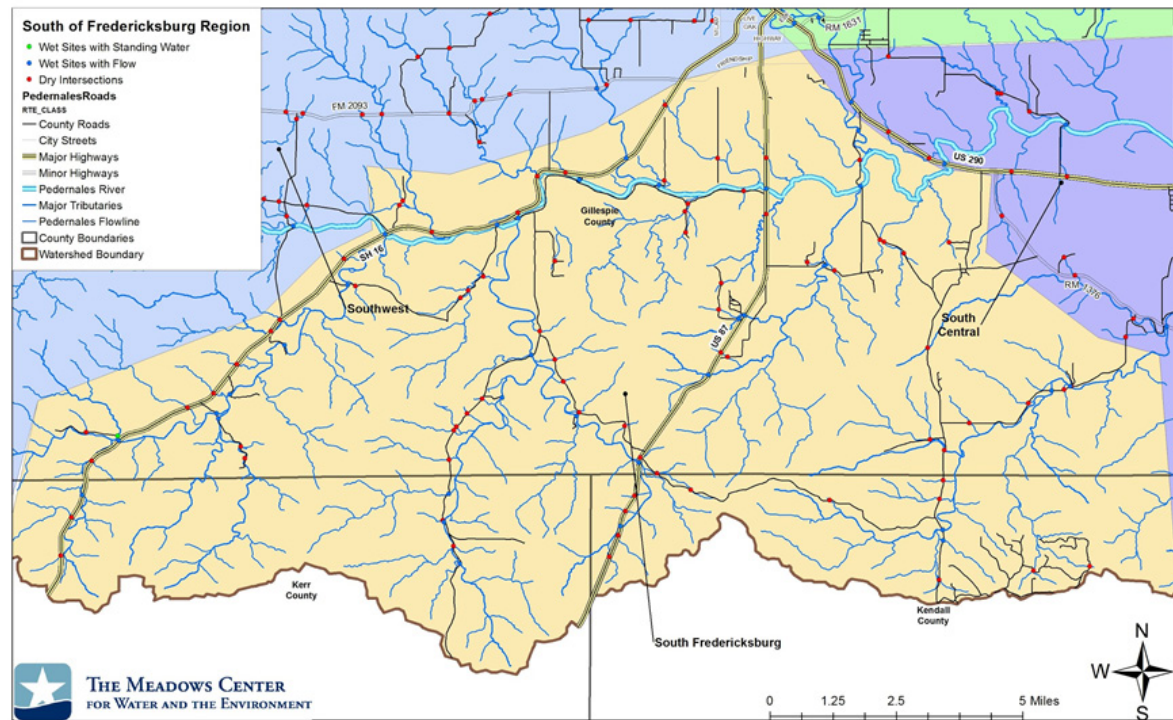


Figure 14- South of Fredericksburg sampling region

The “**South of Fredericksburg**” region, home to major Pedernales River tributaries such as Wolf Creek, Bear Creek, and the headwaters of South Grape Creek, contained the most sites with flowing water by percentage. It also contained numerous stands of Chinaberry and Chinese Tallow. State highway 16 and US highway 87 were used as primary landmarks with which to draw the region. There were many sites here that had easy access to water quality sampling from the road.

Hydro-blitz participants described the area as having a wide variety of stream types that were flowing, including everything from small streams where headwaters were likely present to medium-flow streams and several quiet river crossings. Invasive plants were sparse in the area, with Chinaberry being the primary plant present. The area also contains many ranches and ranchettes that ranged from responsibly grazed to overgrazed.



Photo: Muesebach Creek at SH 16, South of Fredericksburg sampling region (MCWE)

South Central Sampling Region

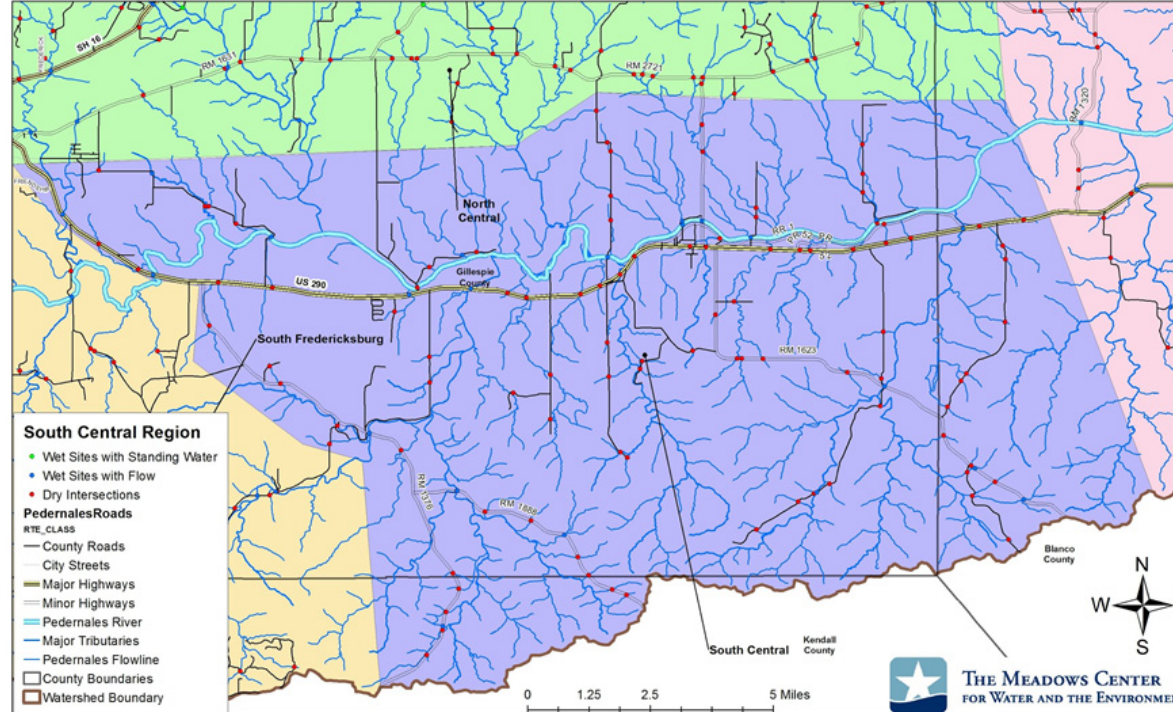


Figure 14- South of Fredericksburg sampling region

The **South Central region** centers around US 290 between Johnson City and Fredericksburg, and contains RM 1376 and RM 1888. The region also contains the small villages of Stonewall, Luckenbach, and Hye, as well as the Lyndon B. Johnson State Park and Historic Site. Flow levels ranged from low to medium, and turbidity was primarily clear. Invasives were common along the Pedernales, especially stands of Arundo and Chinaberry. Chinaberry was also common in the Pedernales's tributaries.



Photo: Pedernales River in the South Central sampling region (MCWE)

North Central Sampling Region

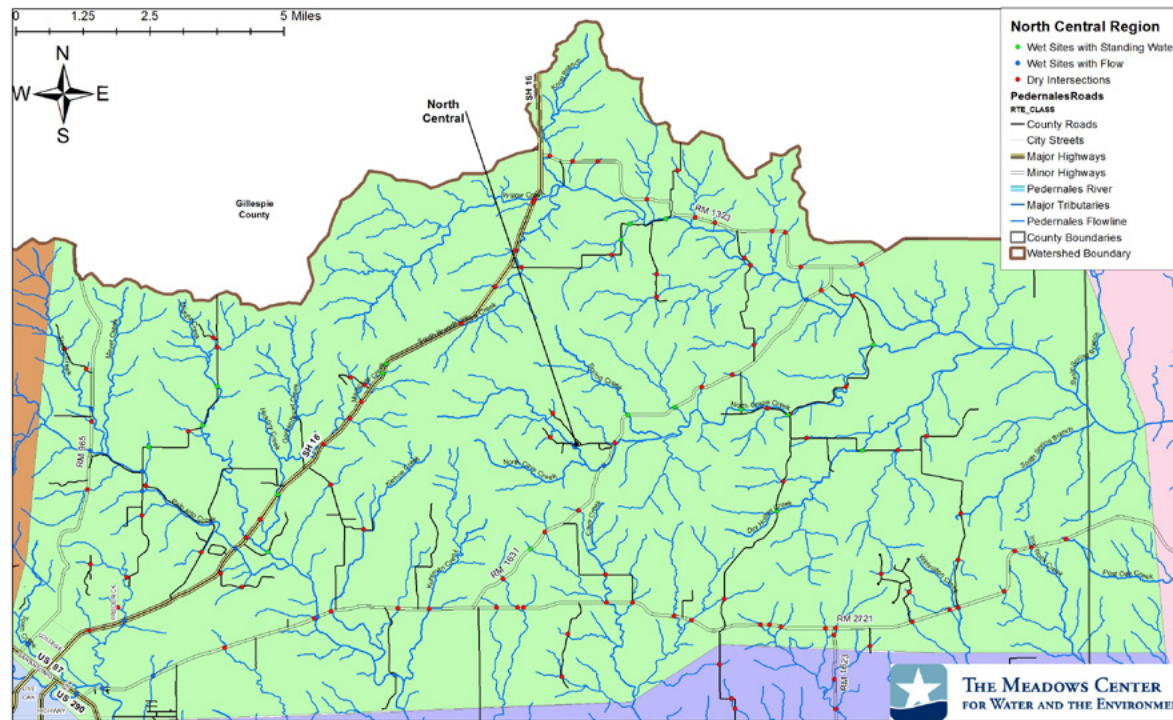


Figure 16- North Central sampling region

Although the North Central region had the highest number of intersects with water in them (36), all but two sites had either low flow or standing water only. Invasives were relatively uncommon, with the exception of a few sightings of *Arundo* near the eastern edge of the Fredericksburg city limits. Primary contributors to the Pedernales River included the North Grape and Palo Alto creeks.



Photo: Willow Creek at Sycamore Creek Road in the North Central sampling region (MCWE)

East Sampling Region

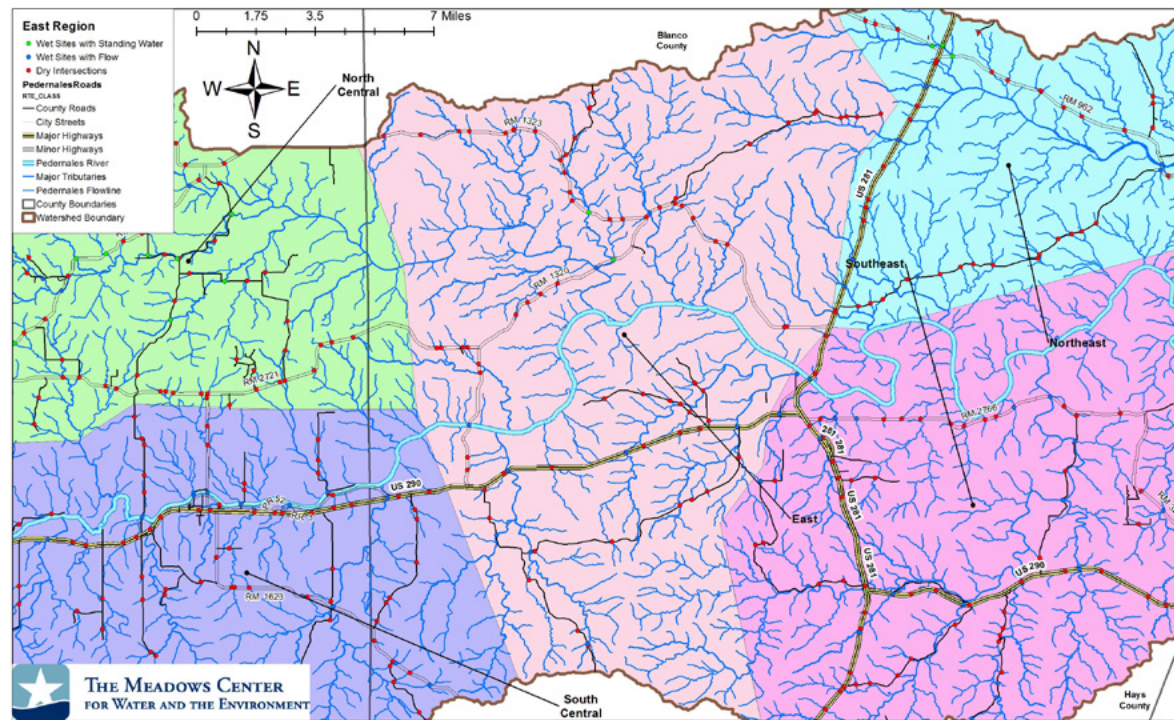


Figure 17- North Central sampling region

The East Region is centered around US highway 290 just west of Johnson City, TX to just east of the Lyndon B. Johnson National Historical Park, and also contains RM 1320 and RM 1323 as well as a section of the Pedernales River. This region had the fewest sites out of the eight (86) and also had the lowest rate of flowing water found at flowline-road intersections (9.3%). As such most of the sites were dry in this area, although water could be seen behind fences in some places. Ranching activity was highly common in the region and overgrazing was often observed. Primary tributaries with flow included Towhead, North Grape, and Hickory creeks.



Photo: South Grape Creek at Towhead Valley Road in East sampling region (MCWE)

Northeast Sampling Region

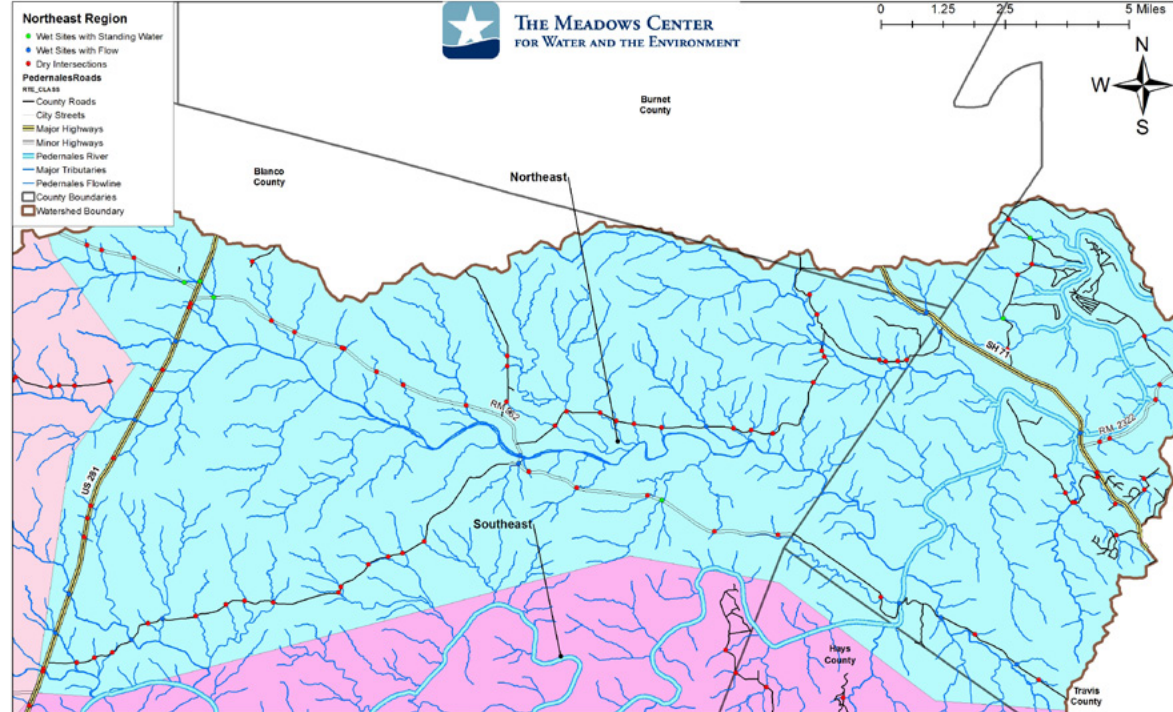


Figure 18- Northeast sampling region

The Northeast region encompasses portions of SH 71 to the east, US 281 to the west, and RM 962 in its center. This region also contains the Hamilton Pool Natural Area and a large segment of the Pedernales, although neither crossing of the river was readily accessible due to a lack of safe parking. Flow levels are relatively high, although turbidity levels are relatively cloudy. Most of the sites are in rural agricultural areas or along Hamilton Pool Road near the Pedernales and the Hamilton Pool Natural Area. Heavy grazing and overgrazing was common in the agricultural areas as cattle were often located near or in the streams.

Photo: Cypress Creek at FM 962, Northeast sampling region (MCWE)



Photo: Cypress Creek at FM 962, Northeast sampling region (MCWE)

Southeast Sampling Region

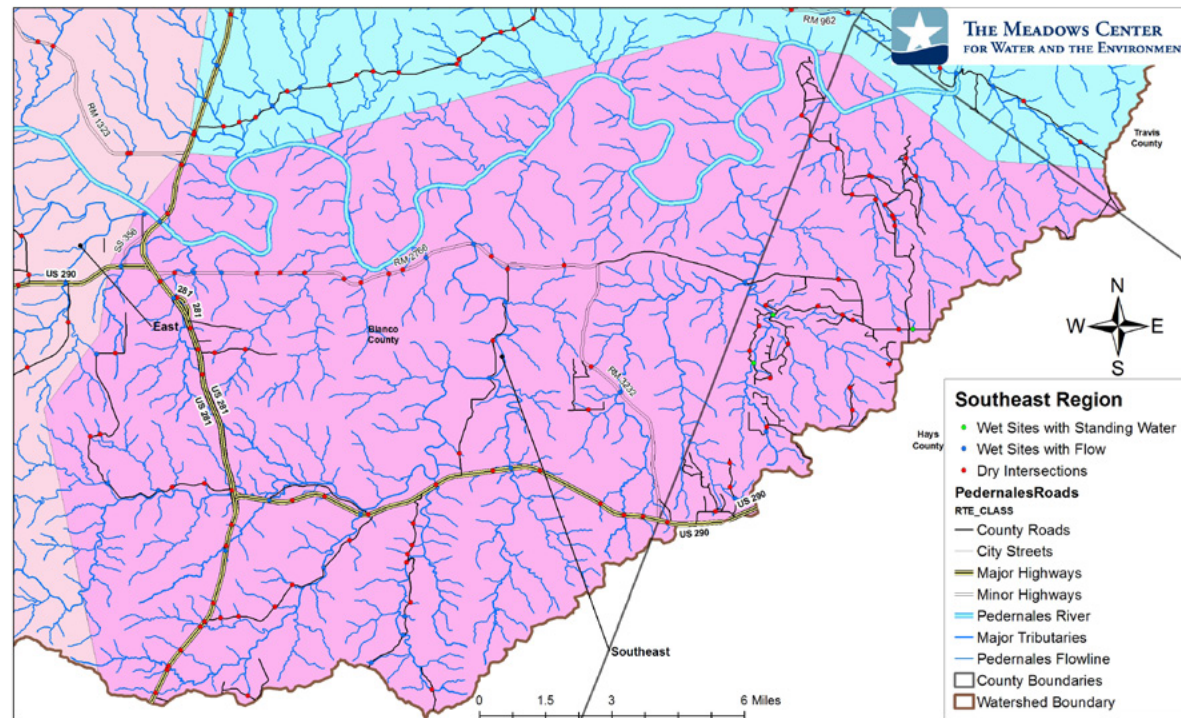


Figure 19- Southeast sampling region

The Southeast region had many sites with good quality water, relatively high water flow, and few invasives. As one gets closer towards Bamberger Ranch on the western end of the sampling region, the landscape becomes noticeably greener, more native plant species are present, a wider variety of species of fish can be observed, and there are numerous tributaries full of water where one wouldn't expect there to be any flow of consequence.



Photo: Towhead Creek at RM 1323 near Johnson City, TX in Southeast sampling region (MCWE)

V. LAND COVER CHANGE MAPS

Figure 20 below shows changes in land cover within Pedernales watershed from 2001-2011 and 2011. Figure 21, Land Cover in 2011 is provided for comparison. Land cover change has been evenly distributed throughout the watershed, although transportation corridors and urban adjacent areas have shown noticeable increases in developed land cover.

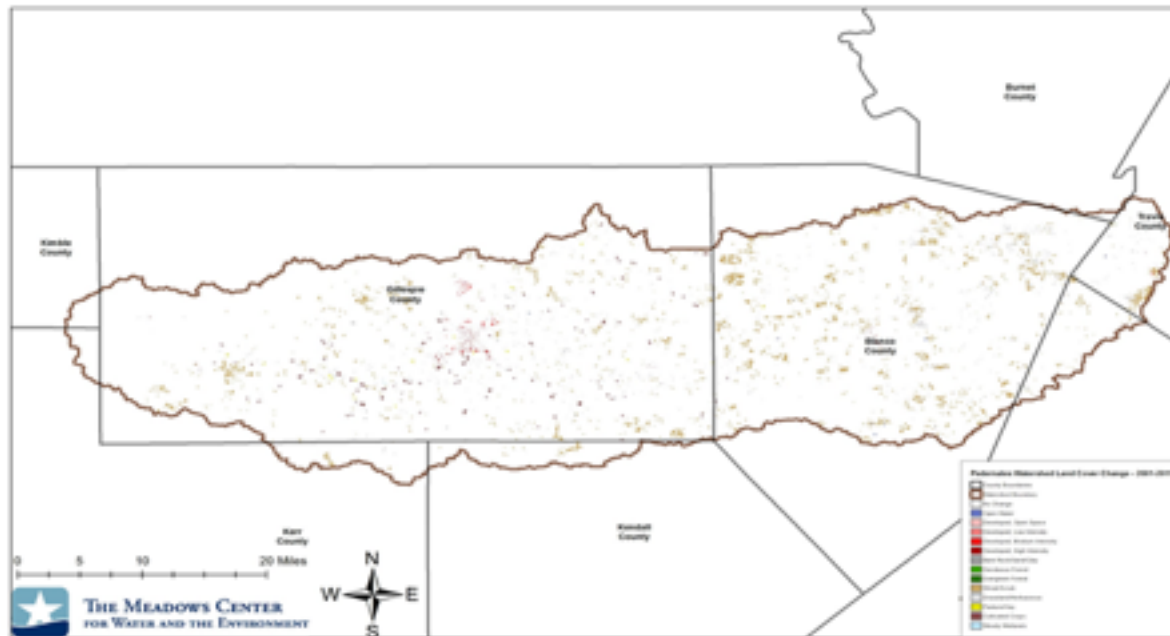


Figure 20 - Land cover change from 2001-2011

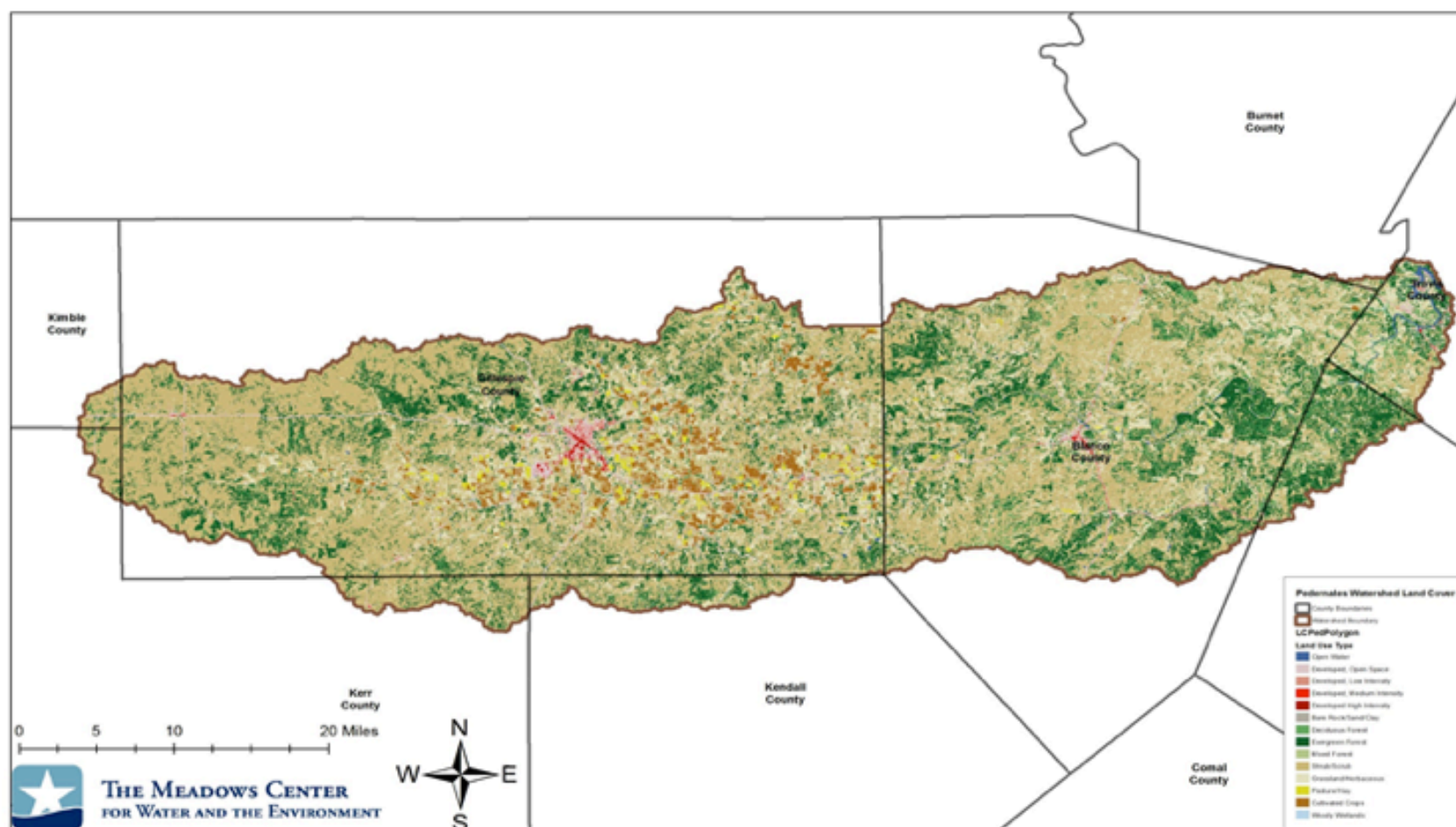


Figure 21 - 2011 Land Cover



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