Water Quality Monitoring and Parameter Load Estimations in Lake Conway Point Remove Watershed, L'Anguille River Watershed, and Bayou Bartholomew

Presented by:

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09/19/2014

Acknowledgements and Special Thanks

- EPA Region 6
- ANRC; Tony Ramick and Robbie Alberson
- Wesley Griffin
- Ouachita Baptist University
- Dr. Tim Knight
- Clark Kyper
- Dr. Joe Nix
- Natural State Streams
- Ecological Design Group
- Entergy, Inc.
- HDR, Inc.

Projects Primary Goal

By collecting, analyzing and reporting water quality and discharge data; provide monthly and annual parameter loadings, as well as unit area loadings in numerous 12 digit HUCs.

- **Monitoring Structure** – Similar activities are implemented in each monitored watershed that support each project's primary goal.

- **Water Quality Requirements** – Incorporates project design, collection methodology and analytical methodology to generate representative data and allow for an evaluation of water chemistry within the selected watersheds.

- **Discharge Requirements** – Estimate the volume of water that passes the monitoring station during the sampling period.

- **Data Compilation and Statistical Analysis** – Compile and statistically analyze the collected data to provide monthly, annual, and unit area loadings, as well as, compare results between monitoring stations.

- **Reporting Requirements** – Provide the project participants with the project outcomes and make the results readily available to the natural resource and watershed professionals and the general public.

Equilibrium's Water Quality Monitoring Requirements

- **Sample Types** – Discrete grab samples, when possible we collect depth integrated samples at the mid point of the stream

- **Collection Frequency** – Once per week

- **In-situ Parameters** – Temperature, dissolved oxygen, specific conductance, pH, and stage.

- **Record Field Notes** – documentation that includes type of sample, time and date, site location, name of sampler, climatic characteristics during site visit, recognized problems, and corrective actions required or taken.

Equilibrium's Water Quality Monitoring Requirements (Continued)

- Laboratory Parameters – TSS, Turbidity, Total Phosphorus, Total Kjeldahl Nitrogen, Nitrate-Nitrogen, Ammonia-Nitrogen, Total Nitrogen, Chloride and Sulfate.

- QAQC Samples – Samples taken to insure representativeness of collected data. (include replicate, field blanks, split and spiked samples)

Equilibrium's Discharge Requirements

- Monitoring Station Location – When possible, locate monitoring stations where existing USGS stations are located. Unfortunately only 2 of 25 stations are located at USGS stations…

- Discharge Parameters – Stage, Profile, and Velocity

  - Stage – Utilize pressure transducers to measure stage every 30 minutes. Additionally, manually measure stage at the time of water quality collection.

  - Profile – survey and record the stream's cross sectional profile

  - Velocity – utilize numerous instruments (electromagnetic and acoustic doppler methodologies) to calculate stream velocities

Equilibrium's Discharge Requirements (Continued)

- Discharge Measurements – Stream discharge is measured at numerous points throughout the hydrograph. We attempt to measure discharge at a minimal of three different stages of each categorical flow.

    Low Flow, Mid Flow, High Flow

- Develop the Stage Rating Discharge Curve – determine the mathematical relationship between stage and discharge for the measured discharge points.

- Utilize the Stage Rating Discharge Curve – estimate daily discharge from the continuously collected stage data.

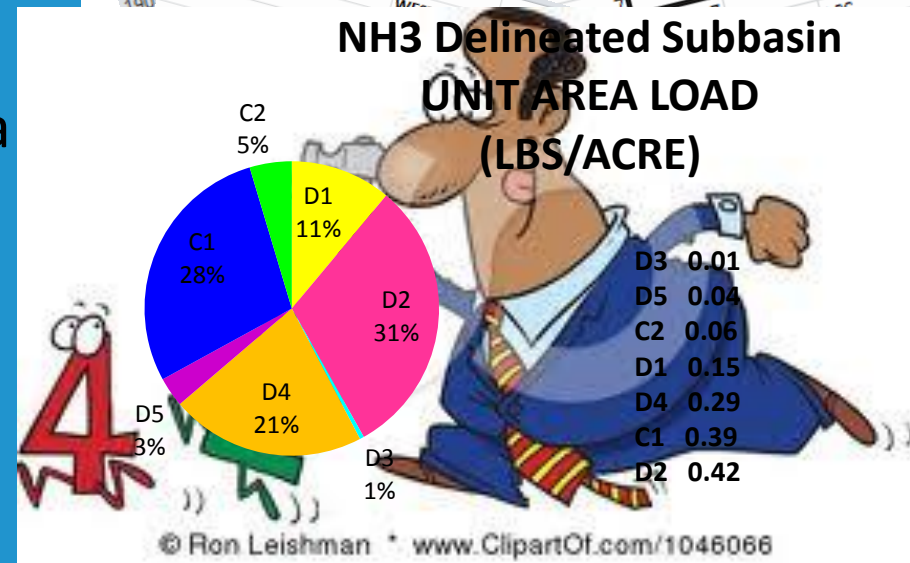# Data Compilation and Statistical Analysis

- Compilation of collected data
  - ➢ Laboratory Water Quality Data
  - ➢ In-situ Water Quality Data
  - ➢ Historical Water Quality Data
  - ➢ QAQC Water Quality Data
  - ➢ Stage Data
  - ➢ Discharge Data
  - ➢ Historical Discharge Data
  - ➢ Precipitation Data
- Statistical Analysis
  - ➢ Statistical relationship between stage and discharge
  - ➢ Calculation of parameter loadings
  - ➢ Statistical comparison between monitoring stations.

NH3 Delineated Subbasin UNIT AREA LOAD (LBS/ACRE)

Pie chart:
- C2 5%
- D1 11%
- C1 28%
- D2 31%
- D4 21%
- D5 3%
- D3 1%

D3	0.01
D5	0.04
C2	0.06
D1	0.15
D4	0.29
C1	0.39
D2	0.42

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Reporting

- Provide all project participants with a final report.

- Provide public access of our data through WQX.

- Our collected data and analysis can be beneficial to numerous persons working in fields related to water quality and water quantity.
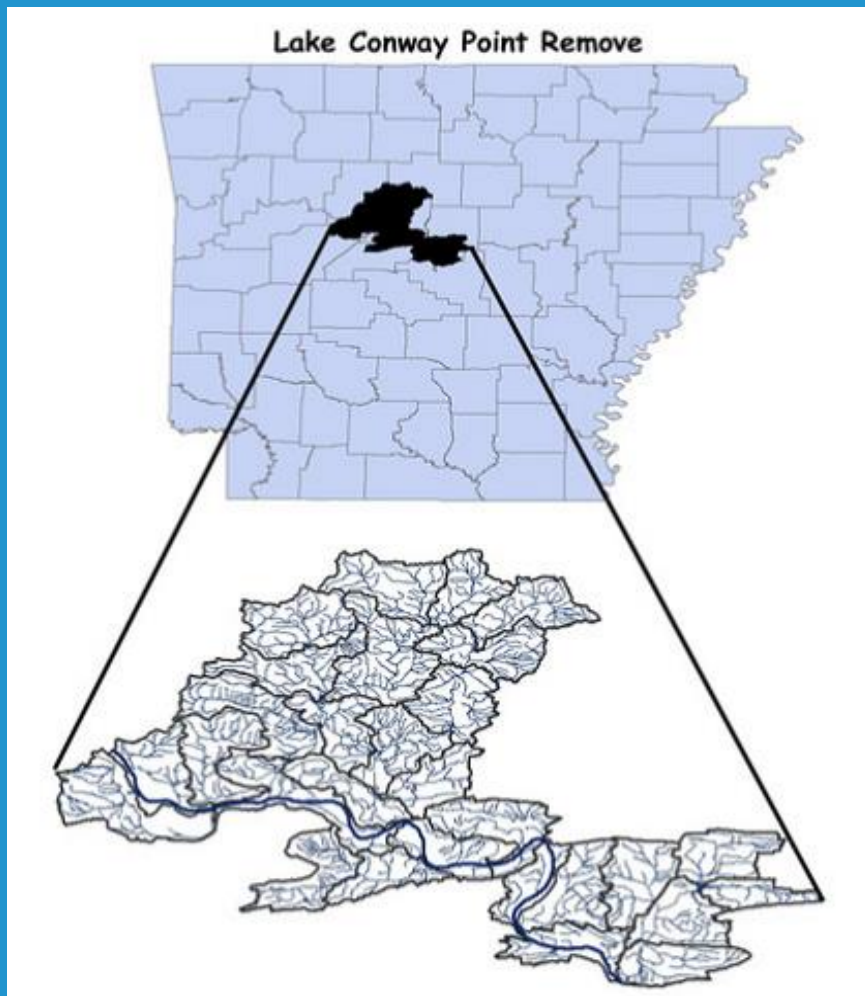
Lake Conway Point Remove Watershed

Ten monitoring stations

Project Period is July 2011 – October 2014

Monitoring the "outfalls" of 12 digit HUC

Completing data collection phase, preparing Final Report

LCPR scored 91 in the Final Risk Assessment Matrix Percentile of the Arkansas' Nonpoint Source Pollution Watershed Risk Matrix and has been selected as a priority watershed.

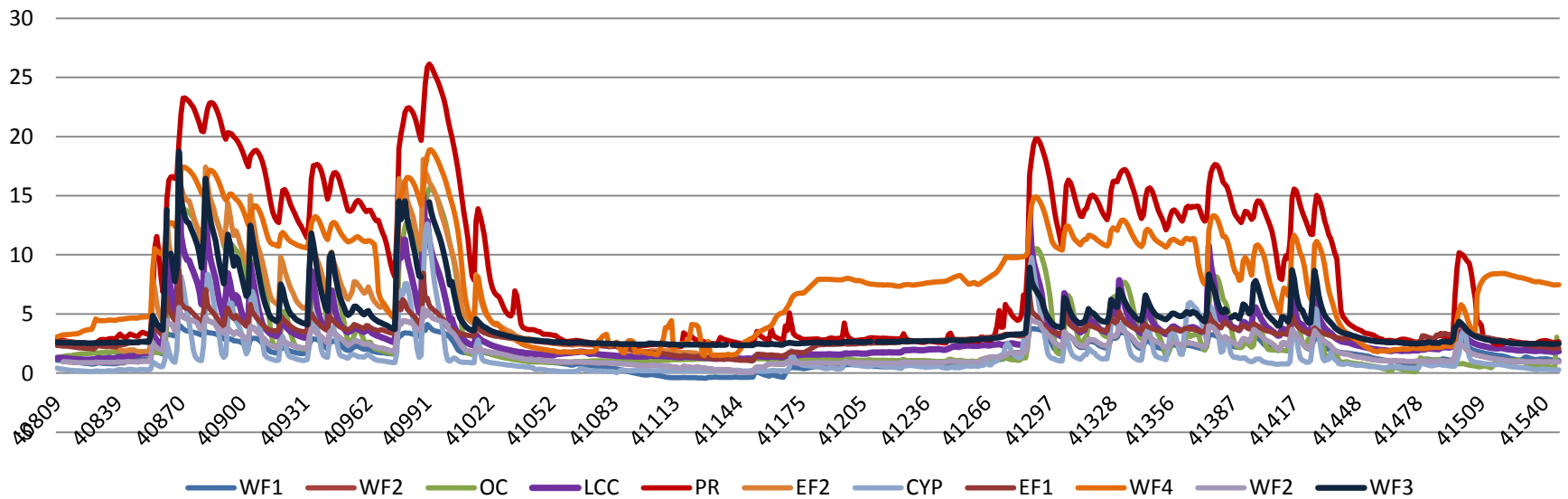NRCS identified LCPR as a priority in the Mississippi River Basin Healthy Watershed Initiative.

7.9mi

Hydrograph LCPR (Stage)

Legend: WF1, WF2, OC, LCC, PR, EF2, CYP, EF1, WF4, WF2, WF3
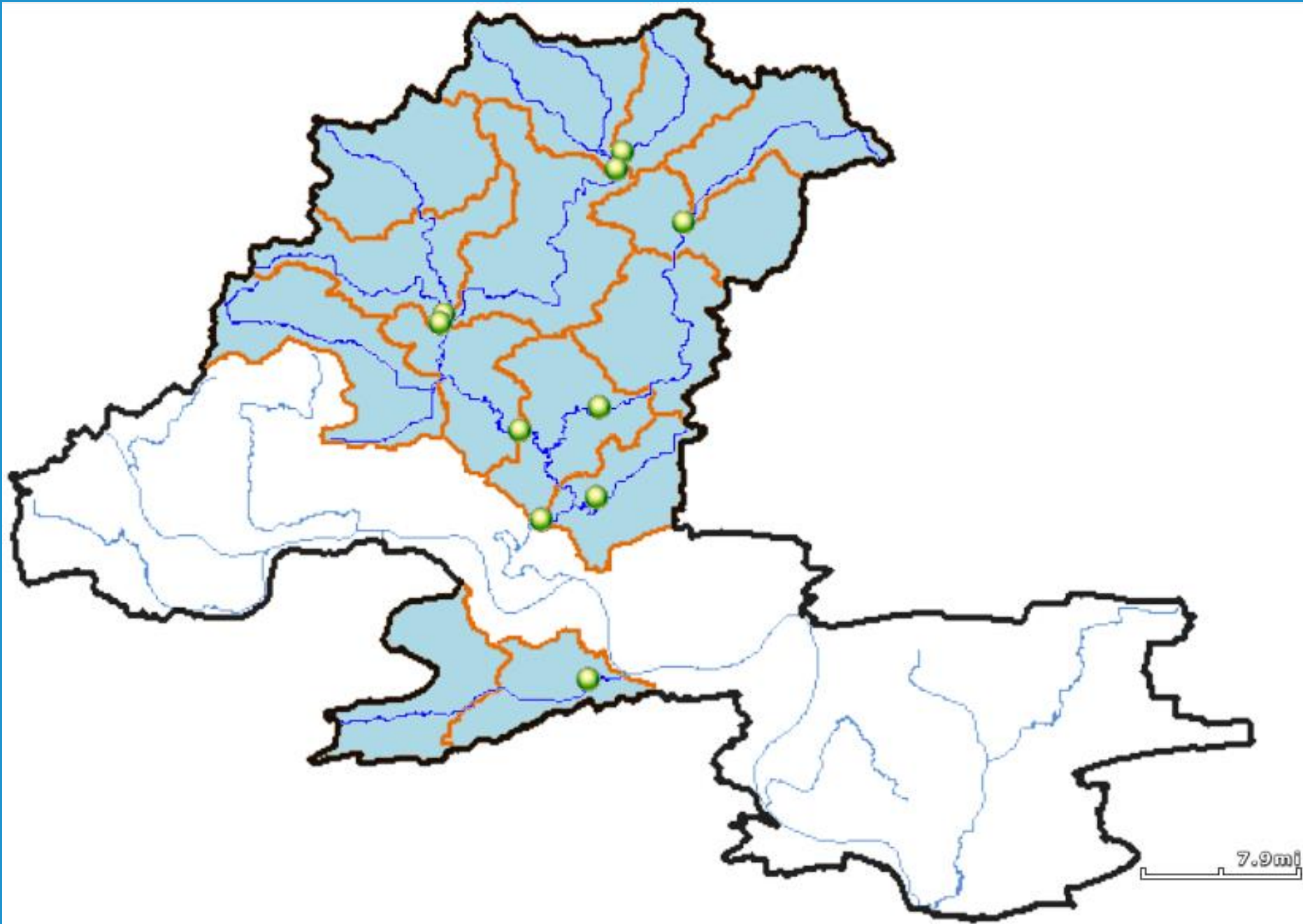
Lake Conway Point Remove Watershed

| Mean Parameter Concentrations (MG/l)										
	WF1	**WF2**	**WF3**	**WF4**	**EF1**	**EF2**	**PR**	**CYP**	**LCC**	**OC**
TP	0.069	0.039	0.049	0.121	0.047	0.09	0.103	0.131	0.067	**0.151**
TKN	**1.138**	0.424	0.398	0.661	0.399	0.682	0.677	0.741	0.472	1.066
Ammonia	**0.245**	0.038	0.031	0.038	0.023	0.114	0.063	0.061	0.032	0.102
Turbidity (NTU)	13.689	17.269	9.397	22.173	11.942	16.034	24.415	24.018	10.148	**70.406**
TSS	8.522	7.124	7.036	18.64	7.832	13.022	17.883	14.65	7.664	**42.548**
NO$_3$-N	1.065	0.65	0.924	1.055	1.163	1.141	1.192	1.227	1.221	**2.728**
Chloride	3.834	2.048	3.935	**16.27**	4.027	5.324	9.707	6.159	5.172	8.265
Sulfate	6.176	3.525	2.586	7.879	4.324	3.099	6.119	4.712	2.978	**13.051**

L'Anguille River Watershed

Five monitoring stations

Current Project Period
July 2012 – September 2015

Monitoring the "outfalls" of 12 digit HUC

Currently in data collection phase
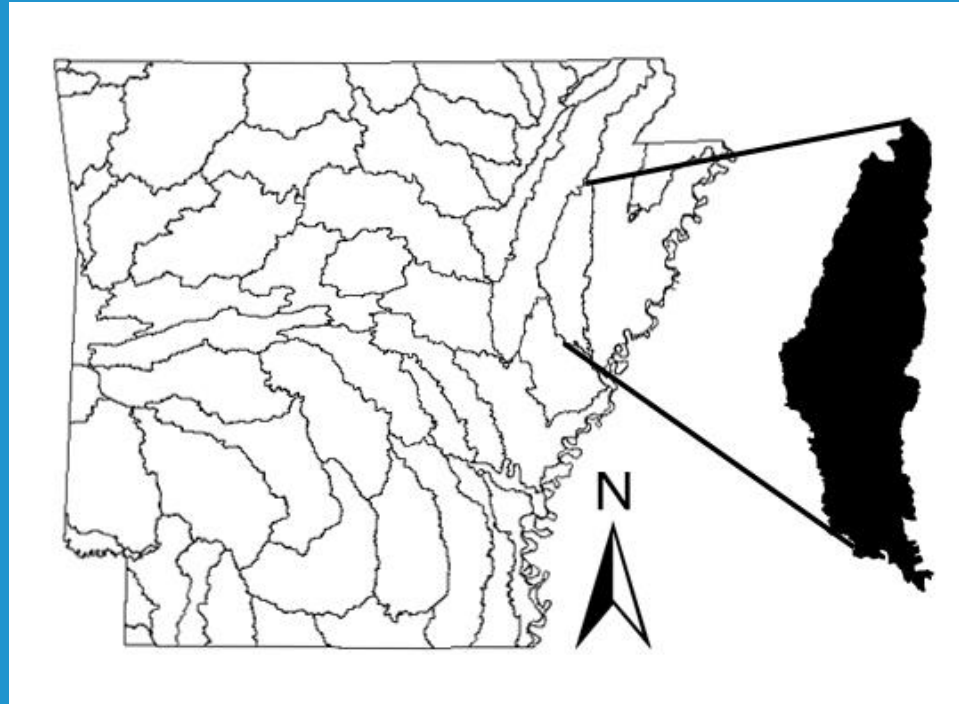
- The L'Anguille River was included on the Arkansas 1998 303(d) list for not supporting aquatic life due to siltation/turbidity and has been on each subsequent 303(d) list.
- ANRC has designated the watershed as a priority watershed.
- NRCS also identified the L'Anguille River as a priority in the Mississippi River Basin Healthy Watershed Initiative.

Priority Subwatersheds- Percentile Basis
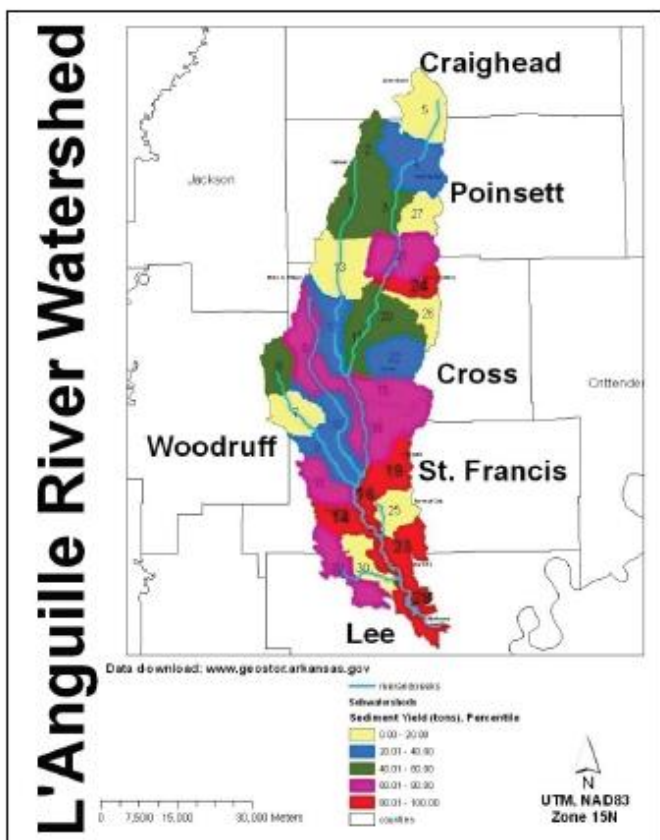
Area: approx.12.%
Sediment contribution: approx. 34%
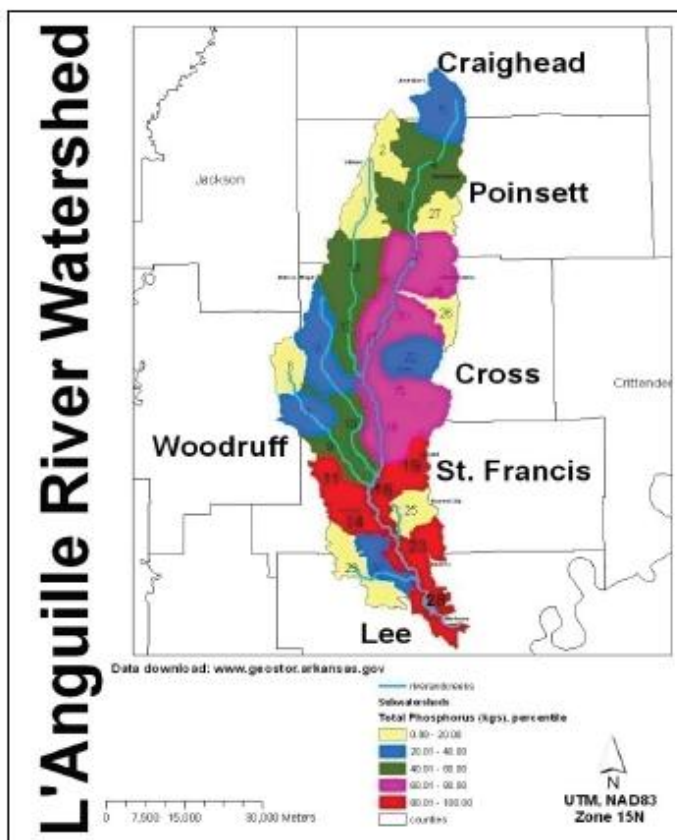
Area: approx. 6%
TP contribution: approx. 60 %

Priority Ranking by SWAT Model

12-Digit HUC Name	Drainage Size (Acres)	Sediment Load (Percentile)	Total Phosphorus Load (Percentile)	Erosion Rate	Cartographic Score
Copper Creek	12,056	80-100	60-80	Critical	Critical
Prairie Creek	11,626	0-20	0-20	Critical	Critical
Indian Creek	21,034	20-40	20-40	Moderate	Critical
Upper Brushy Creek	21,718	40-60	0-20	Slight	Slight
Middle Brushy Creek	31,947	0-20	40-60	Slight	Slight

Saraswat, et.al
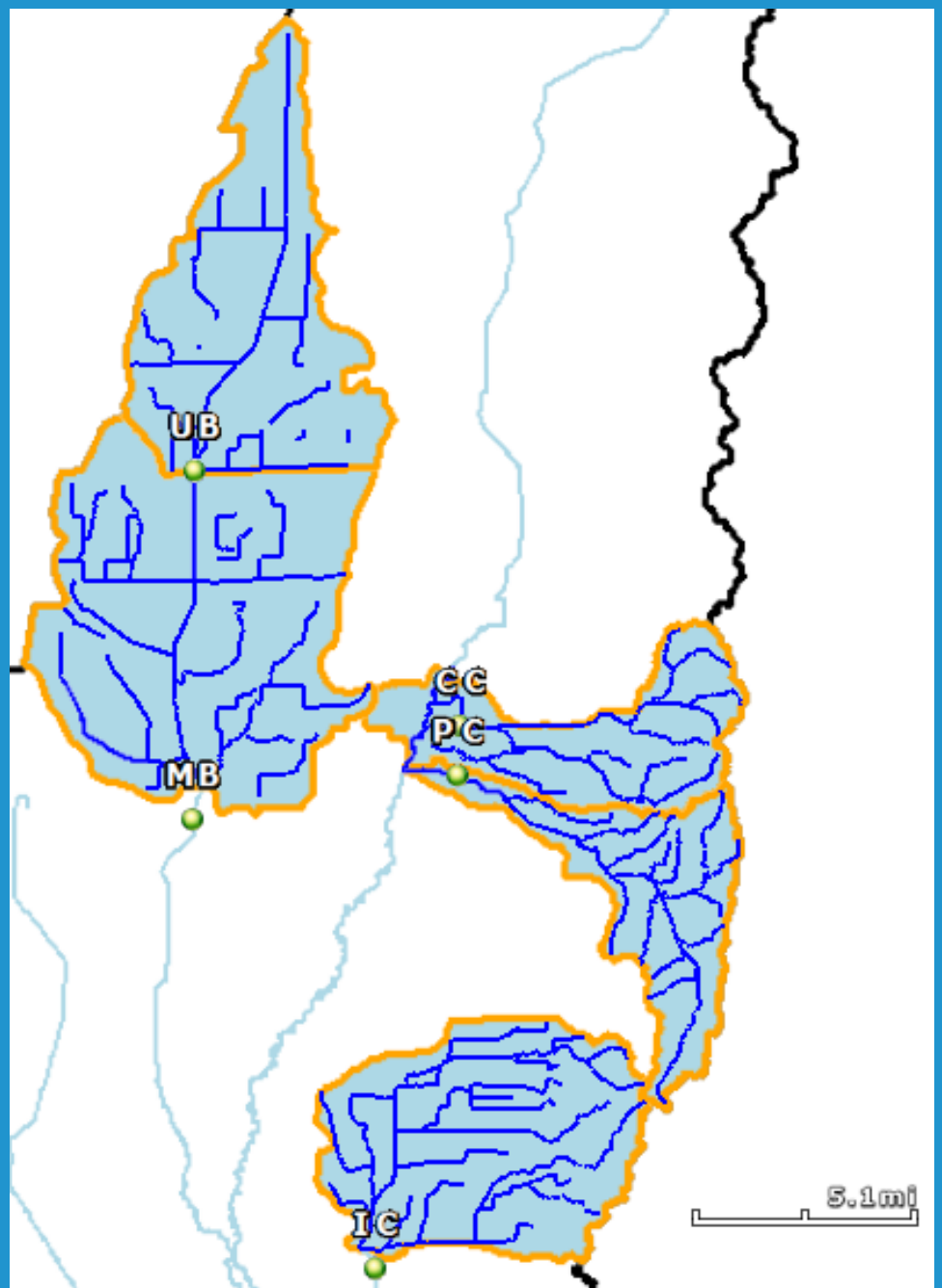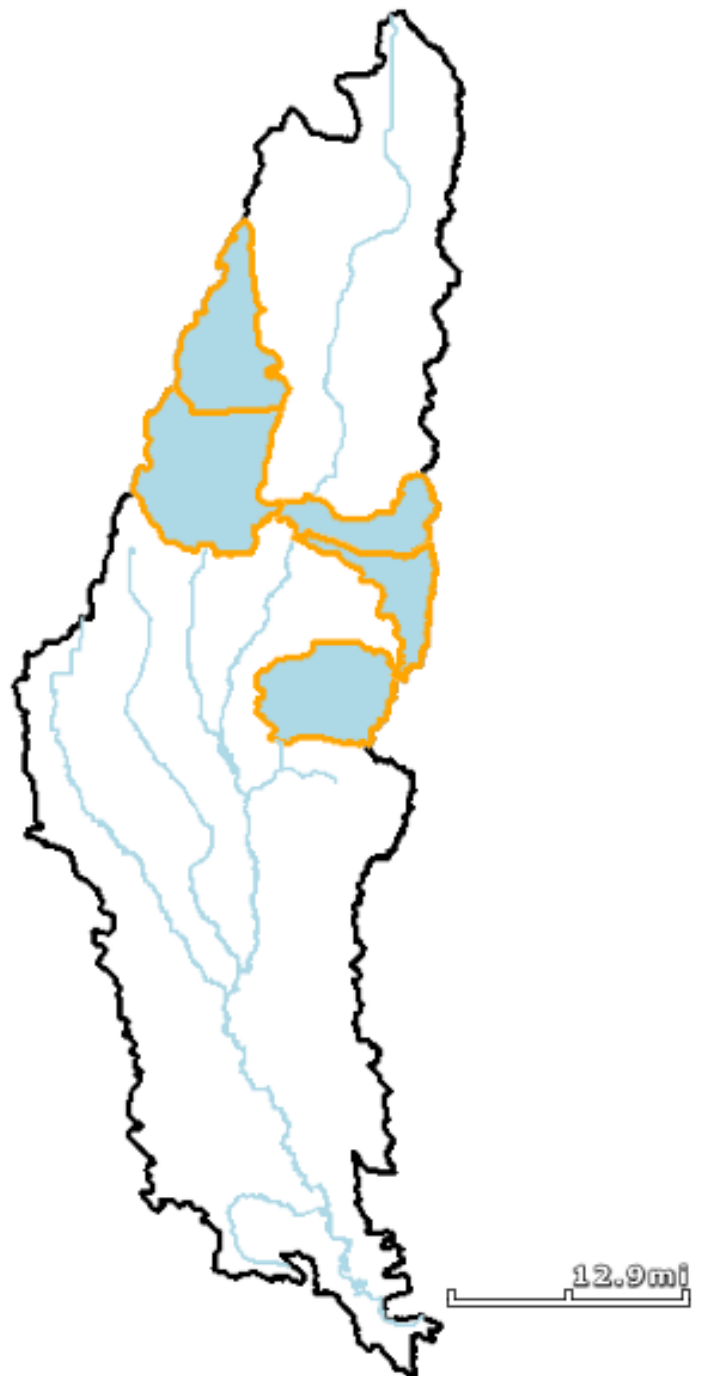
Hydrograph L'Anguille (Stage)
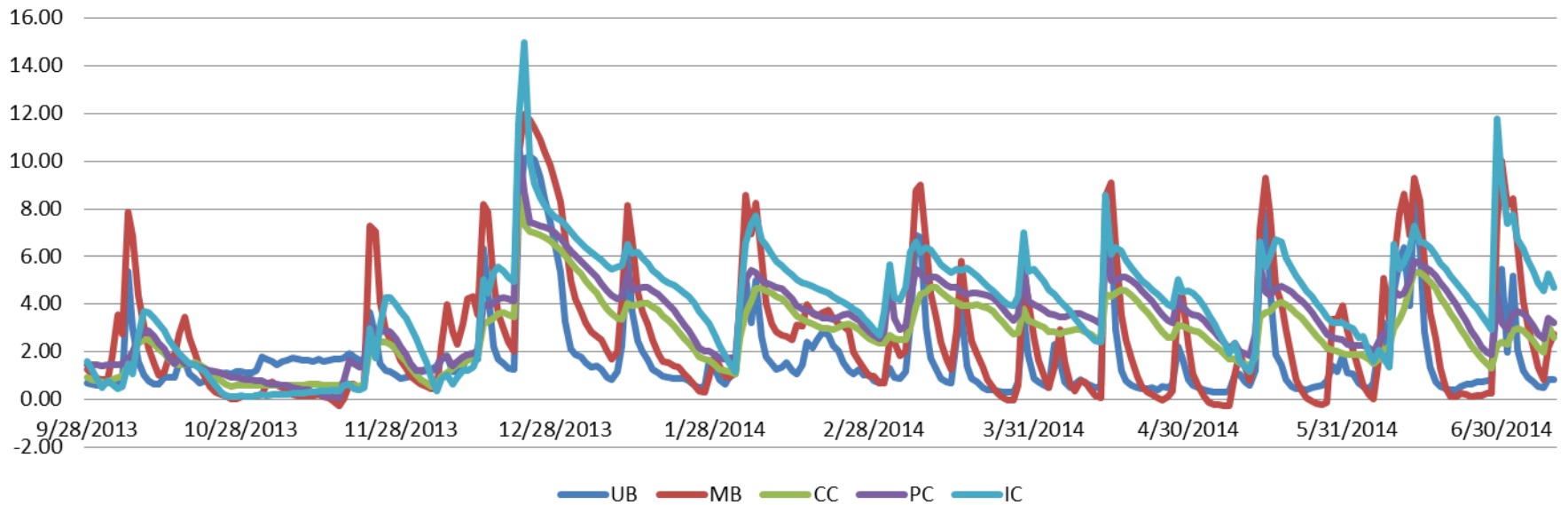
L'Anguille Watershed

| Mean Parameter Concentrations (MG/l)					
	UB	**MB**	**CC**	**PC**	**IC**
Acres	21,718	31,947	12,056	11,626	21,034
TP	0.44	0.43	**0.45**	0.36	0.41
TKN	**1.58**	1.52	1.54	0.99	1.35
Ammonia	0.16	0.09	**0.26**	0.05	0.11
Turbidity (NTU)	113.03	**138.45**	58.15	108.61	82.43
TSS	74.60	**89.16**	42.24	87.03	52.56
NO_3-N	1.45	1.81	**2.95**	2.91	1.85
Chloride	**20.71**	19.97	10.99	11.44	14.72
Sulfate	10.58	11.58	12.48	13.54	**17.85**

Bayou Bartholomew Watershed

Ten monitoring stations

Current Project Period
July 2013 – September 2017

Focusing on the Deep Bayou and Cousart Bayou Sub-watersheds
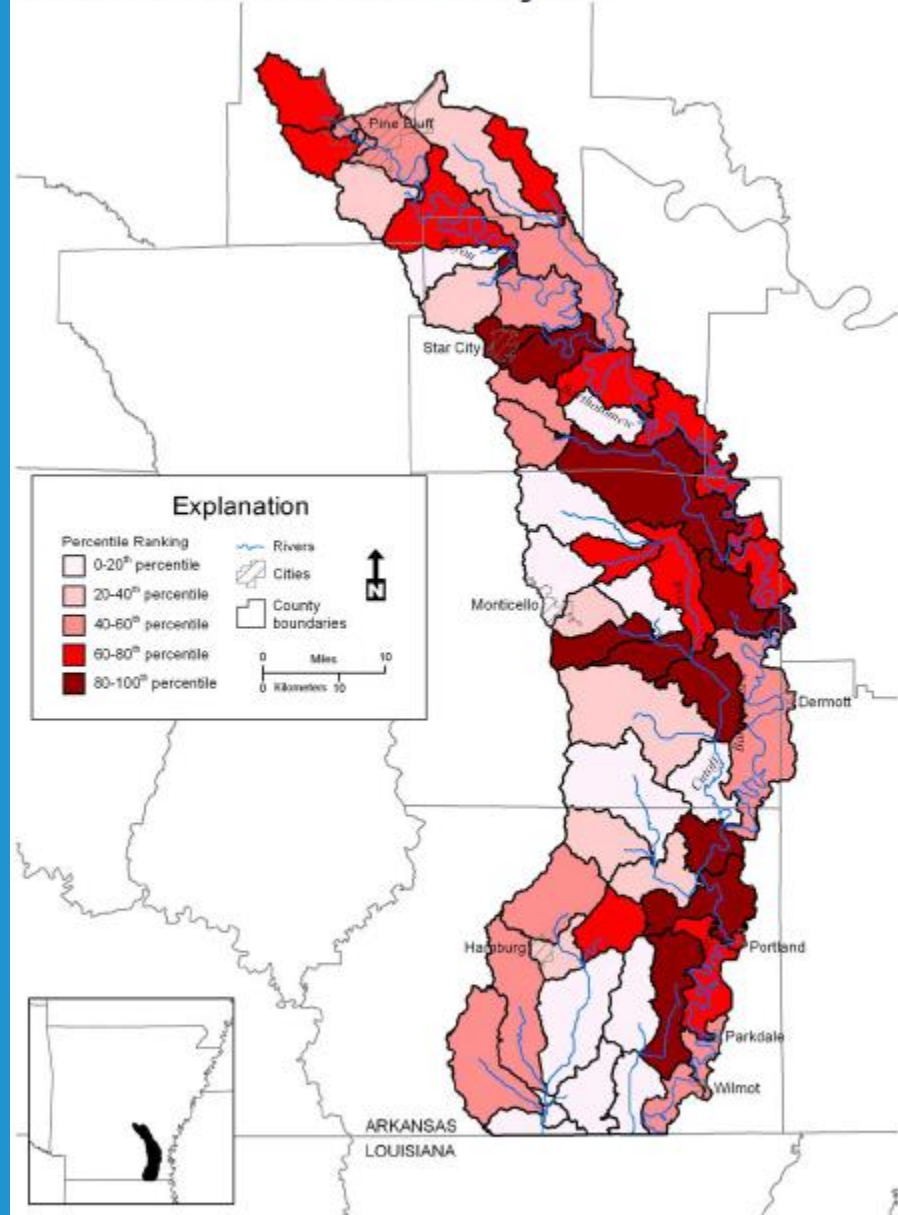
Currently in data collection phase
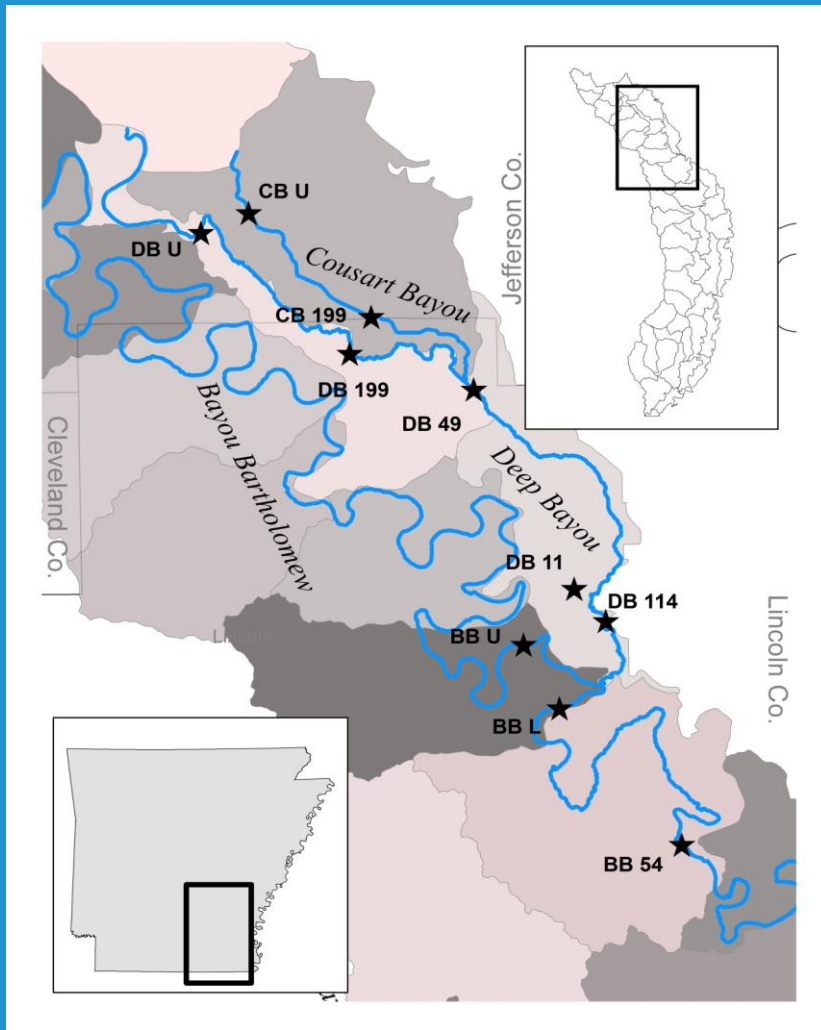
- The Bayou Bartholomew was included on the Arkansas 2012 303(d) for not supporting designated uses.
- ANRC has designated the watershed as a priority watershed.
- NRCS also identified the L'Anguille River as a priority in the Mississippi River Basin Healthy Watershed Initiative.

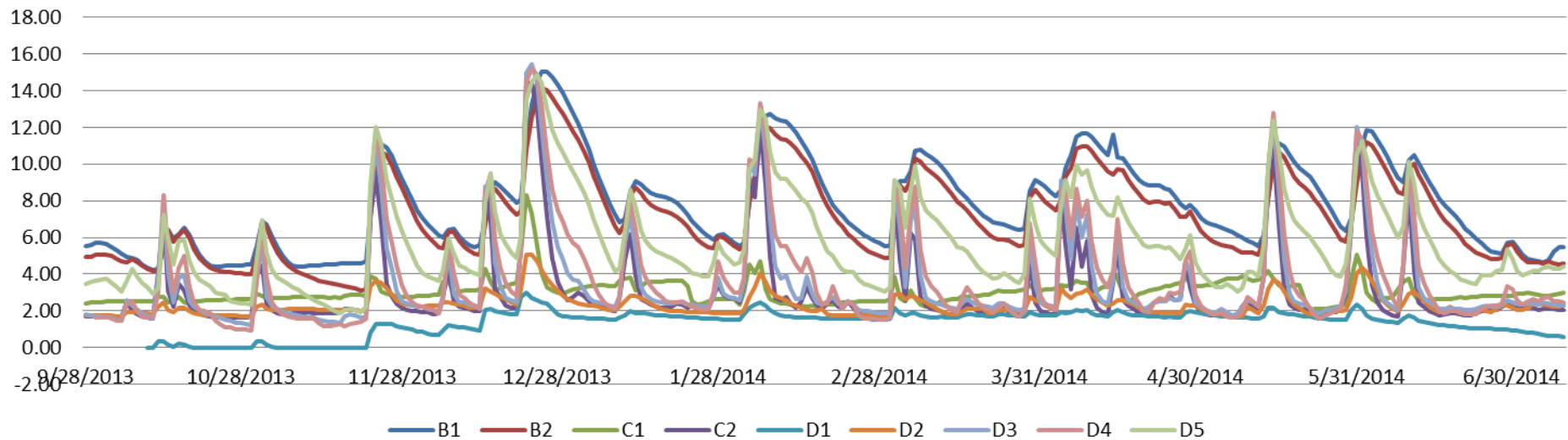Figure 9.2a: Relative estimates of contribution of Bayou Bartholomew sub-watersheds to total estimated runoff using SWAT
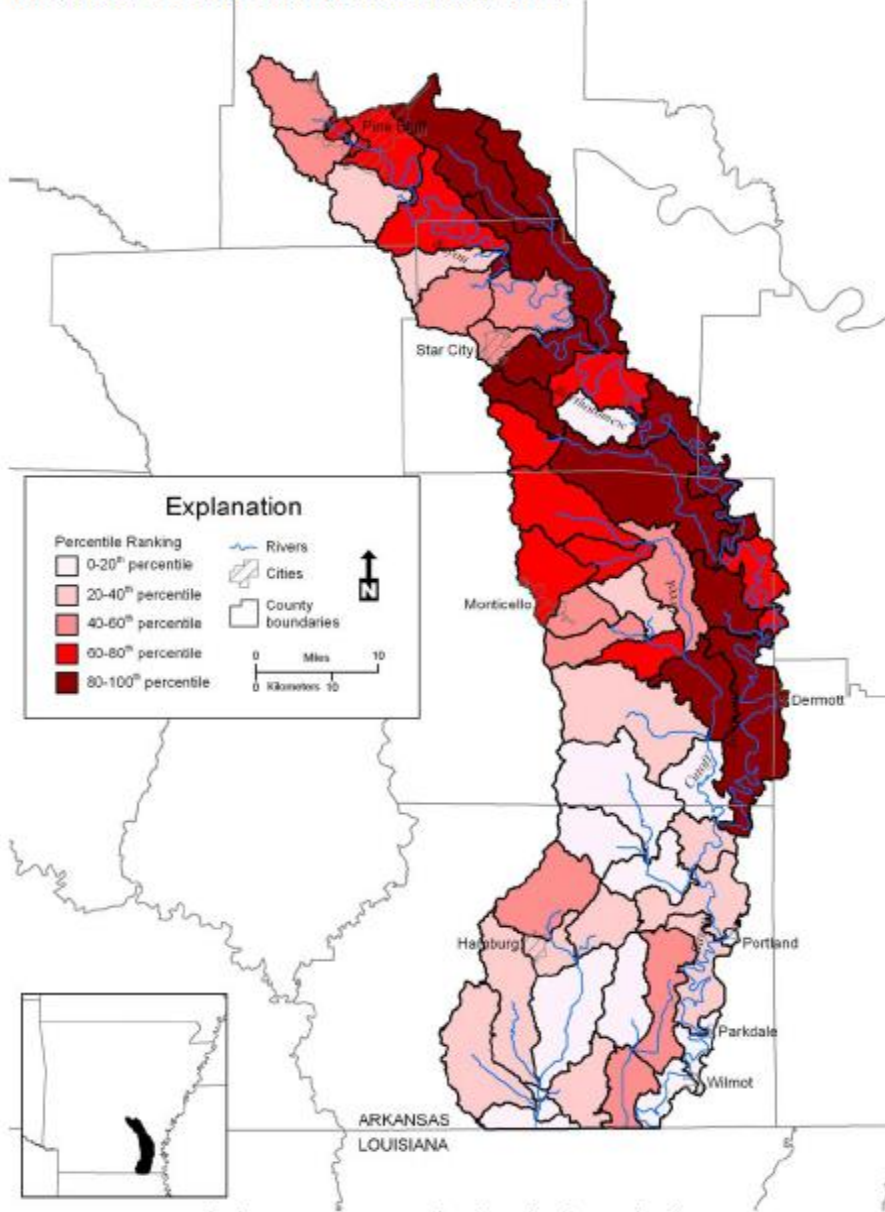
Figure 9.2b: Relative estimates of contribution of Bayou Bartholomew sub-watersheds to total estimated sediment using SWAT

Explanation

Percentile Ranking
- 0-20th percentile
- 20-40th percentile
- 40-60th percentile
- 60-80th percentile
- 80-100th percentile

Rivers
Cities
County boundaries

Source: University of Arkansas, Department of Biological and Agricultural Engineering, 2005

Bayou Bartholomew Priority Watershed
Arkansas 2006-2010 NPS Management Program Update
Effective Date: October 1, 2005

9.16

Source: University of Arkansas, Department of Biological and Agricultural Engineering, 2005

Bayou Bartholomew Priority Watershed
Arkansas 2006-2010 NPS Management Program Update
Effective Date: October 1, 2005

9.17

Hydrograph Bayou Bartholomew (Stage)

Legend: B1, B2, C1, C2, D1, D2, D3, D4, D5

Bayou Bartholomew Watershed

Mean Parameter Concentrations (MG/l)										
	B1	**B2**	**B3**	**C1**	**C2**	**D1**	**D2**	**D3**	**D4**	**D5**
TP	0.26	0.34	0.37	**0.80**	0.47	0.45	0.45	0.43	0.42	0.49
TKN	0.94	1.17	1.12	**1.89**	1.41	1.41	1.34	1.34	1.29	1.39
Ammonia	0.05	0.08	0.07	**0.42**	0.13	0.11	0.18	0.11	0.13	0.12
Turbidity (NTU)	52.16	87.48	103.59	96.31	116.03	19.59	69.50	106.34	115.05	**155.01**
TSS	26.29	48.06	45.54	54.56	60.51	9.67	38.00	57.74	53.40	**79.26**
NO_3-N	4.21	4.11	4.11	2.89	7.23	0.94	1.28	**8.73**	5.59	5.00
Chloride	5.33	8.03	8.40	4.98	**24.46**	2.57	5.32	18.95	18.35	17.71
Sulfate	2.49	3.10	3.22	4.20	**6.66**	1.92	1.54	4.73	4.04	4.00

TSS TOTAL WATESHED LOAD(LBS)

D1	65,700
D2	24,000
C1	22,000
C2	2,890,000
D3	4,670,000
D4	5,070,000
D5	8,710,000

D1 0% · D2 2% · C1 2% · C2 13% · D3 21% · D4 23% · D5 39%
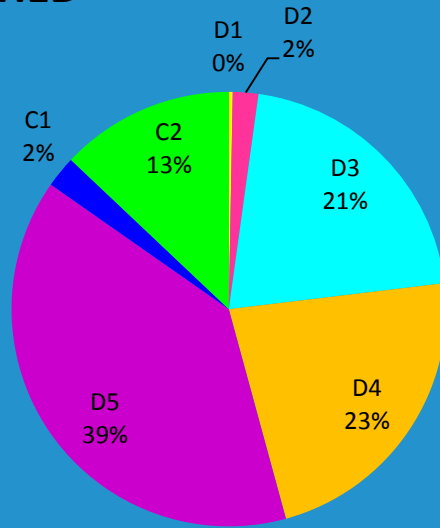
TSS TOTAL UNIT AREA LOAD (LBS/ACRE)

D1	13.2
D2	48
C1	58.4
D4	75.9
D3	77.6
C2	83.6
D5	116

D1 3% · D2 10% · C2 18% · C1 12% · D3 16% · D4 16% · D5 25%
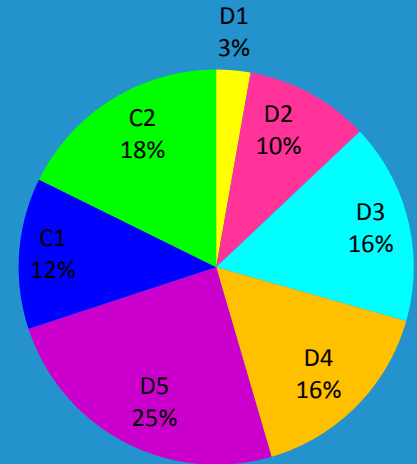
TSS Delineated Subbasin TOTAL DAILY LOAD (LBS)
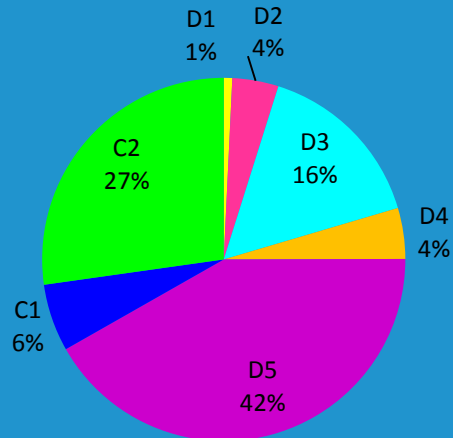
D1	65,700
D2	358,000
D4	395,000
C1	522,000
D3	1,350,000
C2	2,370,000
D5	3,640,000

D1 1% · D2 4% · C2 27% · D3 16% · D4 4% · C1 6% · D5 42%

TSS Delineated Subbasin UNIT AREA LOAD (LBS/ACRE)
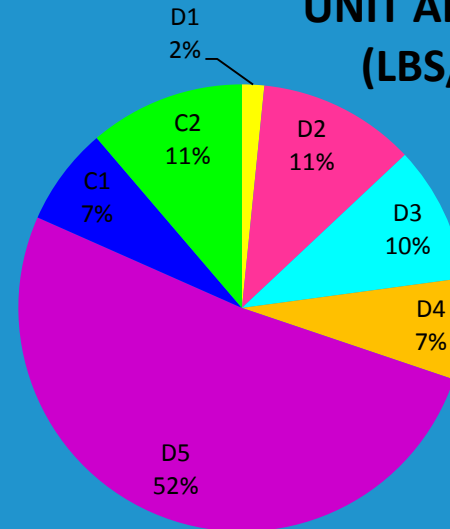
D1	13.2
C1	58.4
D4	60
D3	81
C2	92.4
D2	93.5
D5	422

D1 2% · D2 11% · C2 11% · C1 7% · D3 10% · D4 7% · D5 52%

Project Difficulties

- Harsh Winter
- In Stream Activities
- Unnatural Discharges
- Equipment loss
- Discharge Measurements

at 12 digit level