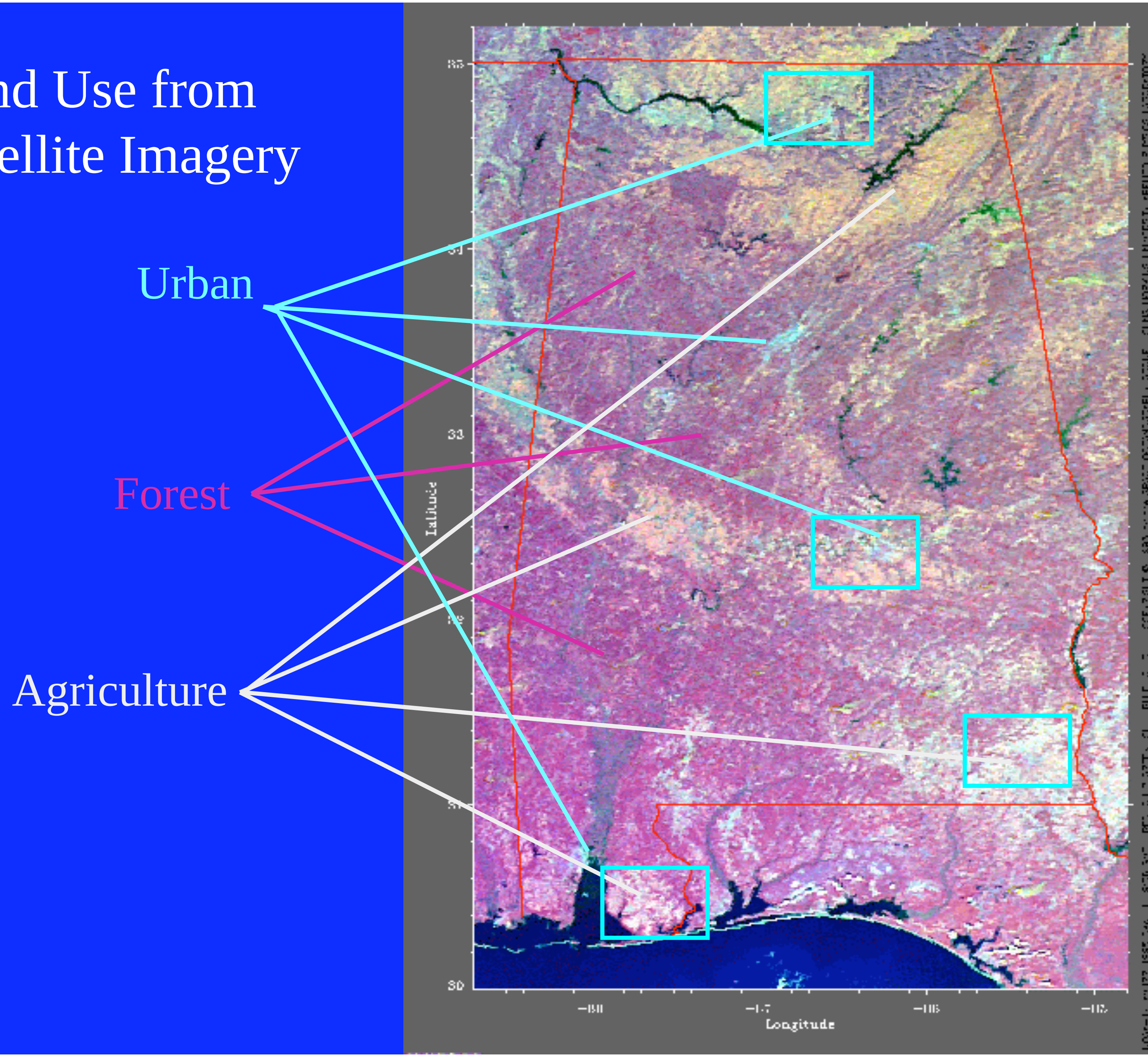
Land-Use Impacts on Water Resource Management

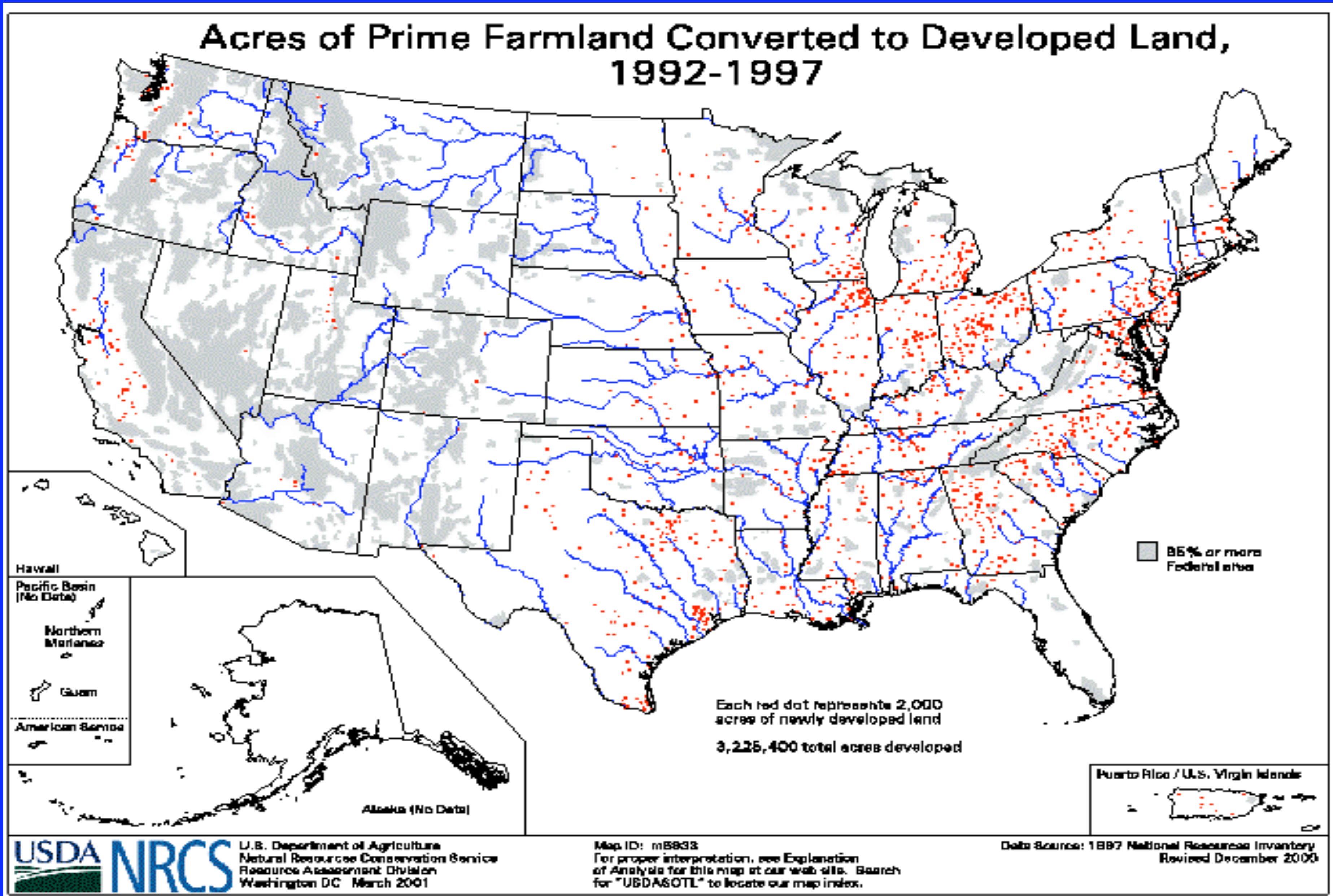
Marlon Cook
Geological Survey of Alabama

- Population and economic growth result in land-use change that has profound impacts on both ground- and surface-water resources. Climate amplifies these impacts.
- Surface water is impacted by construction, loss of vegetative cover, increased impervious surface, and increased runoff, sedimentation, and contaminant loading.
- Ground water is impacted by loss of recharge, increased use and demand, and increased contamination of shallow aquifers.

- Negative impacts of climate, economic growth and land-use change may be reduced or eliminated by <u>prudent water-resource management</u> based on <u>sound scientific data</u>.

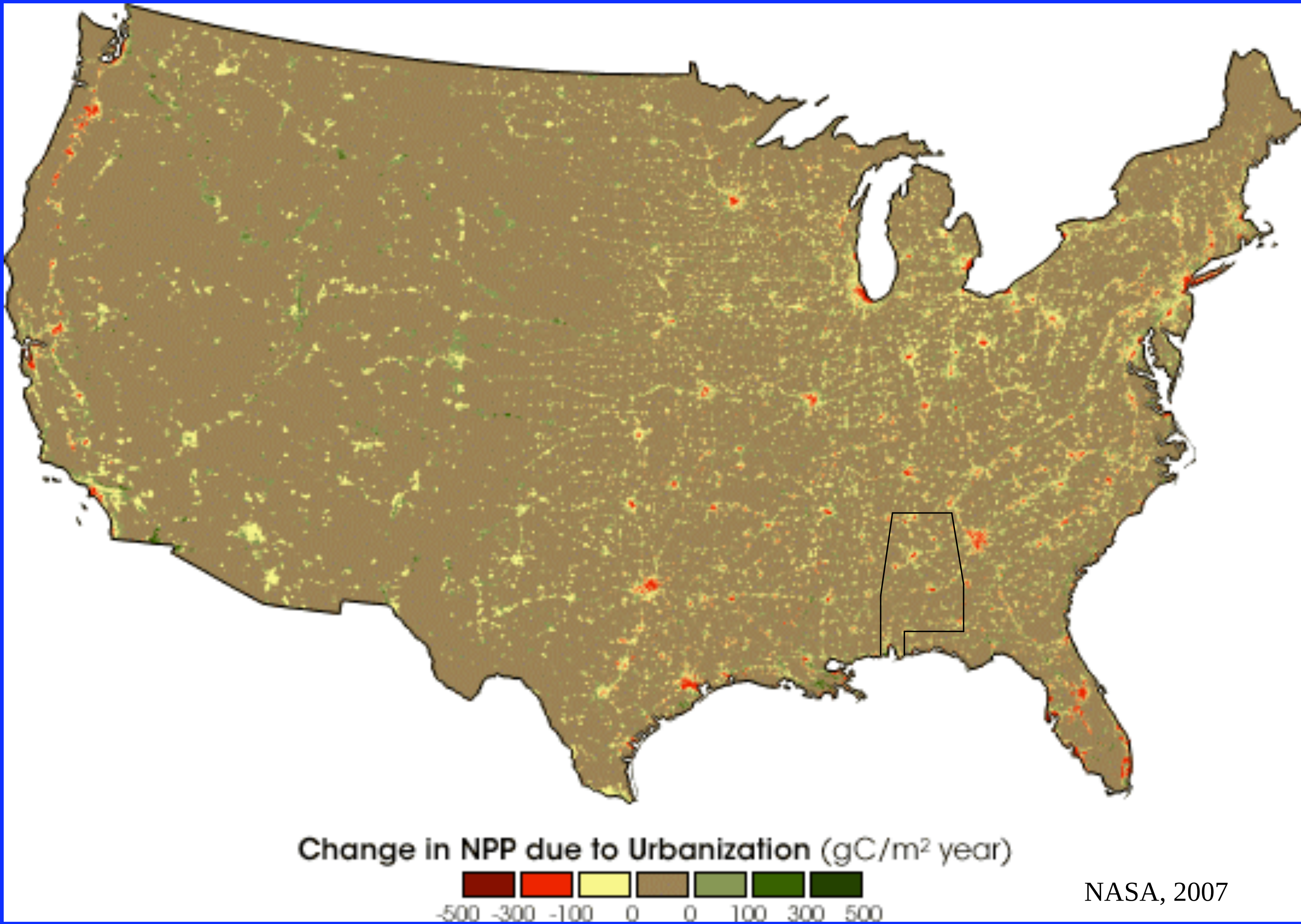
Land Use from Satellite Imagery





Alabama ranks #10 in states with lost prime farmland to developed land. (Source: Southeast Farm Press)

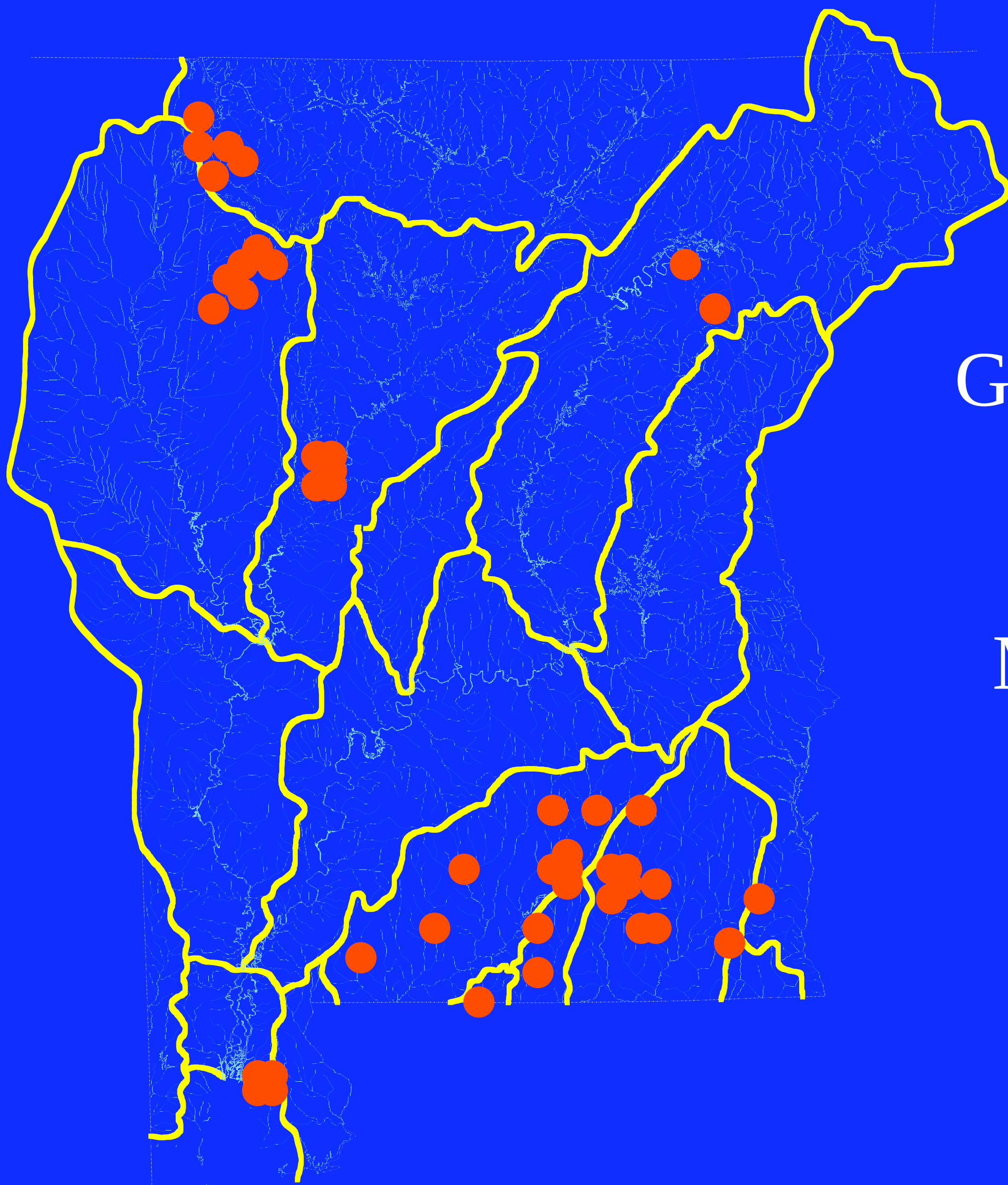
Annual Cropland Productivity Loss



NASA, 2007

- Surface Water

Sediment Monitoring



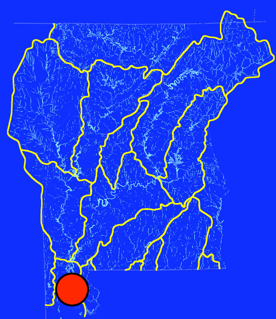
Geological Survey of Alabama Sedimentation Monitoring Sites

Stream Sec

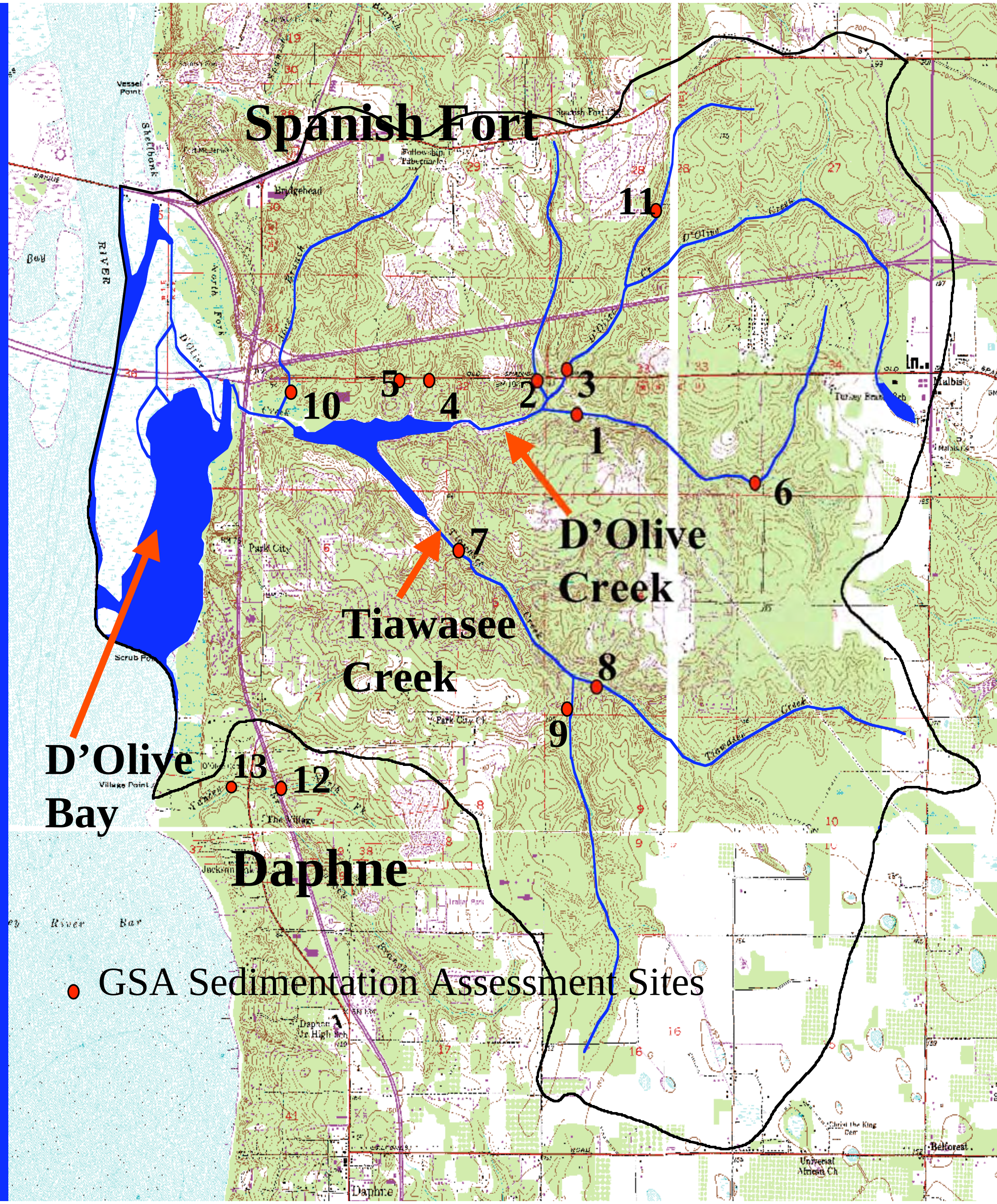
Stream Bed
with Bedload Se dim

Rolling Sediment
Particle

D'Olive Creek Watershed

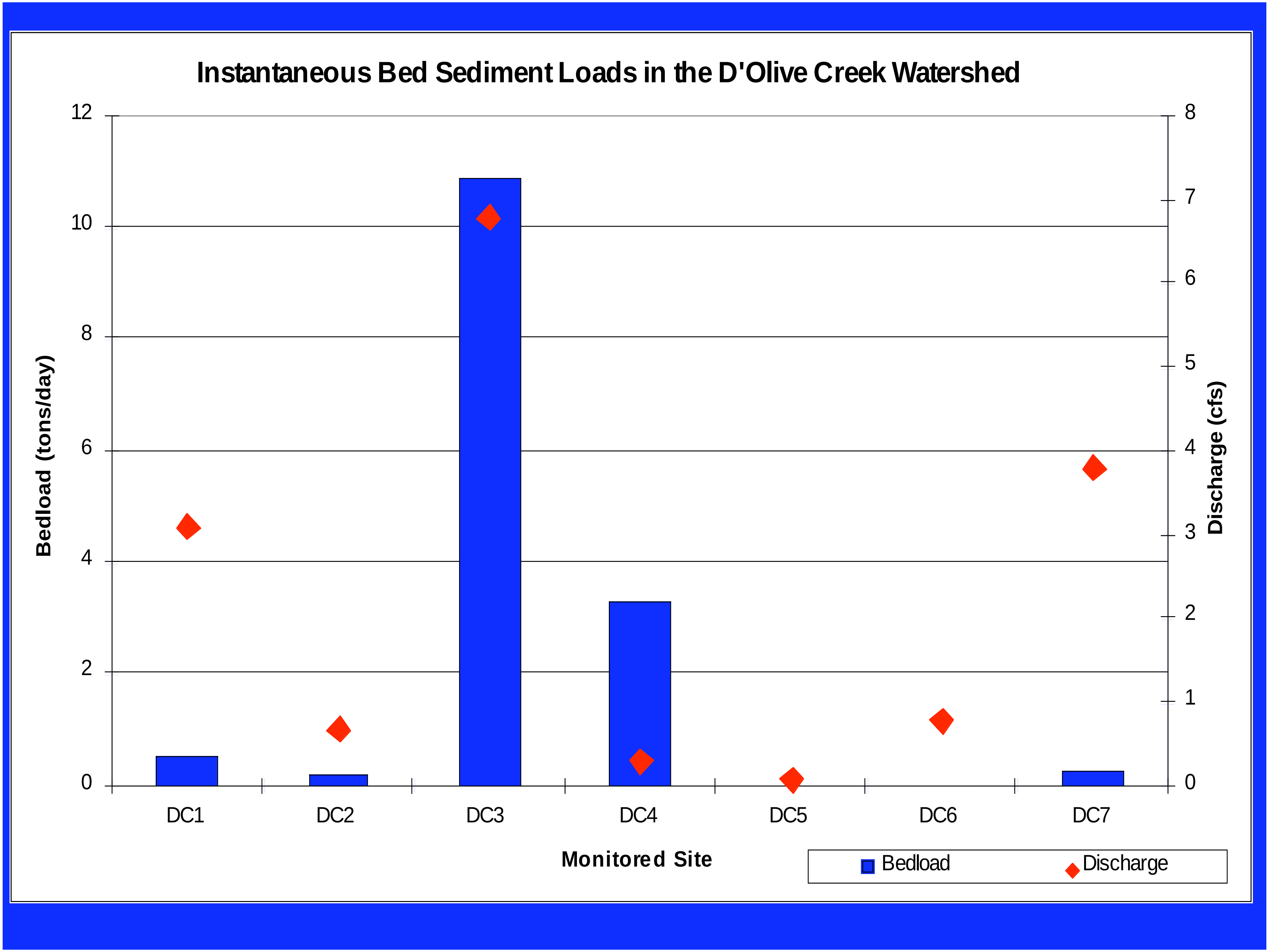


Cooperators:
MBNEP
ADCNR



Coastal Alabama

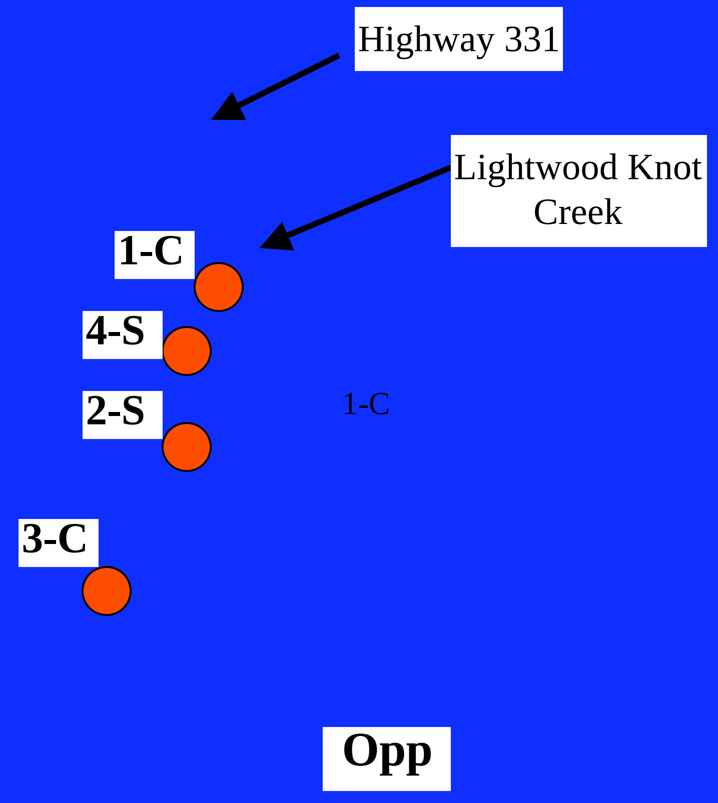
Geological Survey of Alabama
Founded 1848


Instantaneous Bed Sediment Loads in the D'Olive Creek Watershed
Bedload (tons/day)
0
2
4
6
8
10
12
Discharge (cfs)
0
1
2
3
4
5
6
7
8
DC1
DC2
DC3
DC4
DC5
DC6
DC7
Monitored Site
Bedload
Discharge

Geological Survey of Alabama Southeast Alabama Sedimentation Monitoring Sites

Lightwood Knot Creek National Monitoring Program Project Monitoring Sites

Cooperators:
ADEM
NRCS

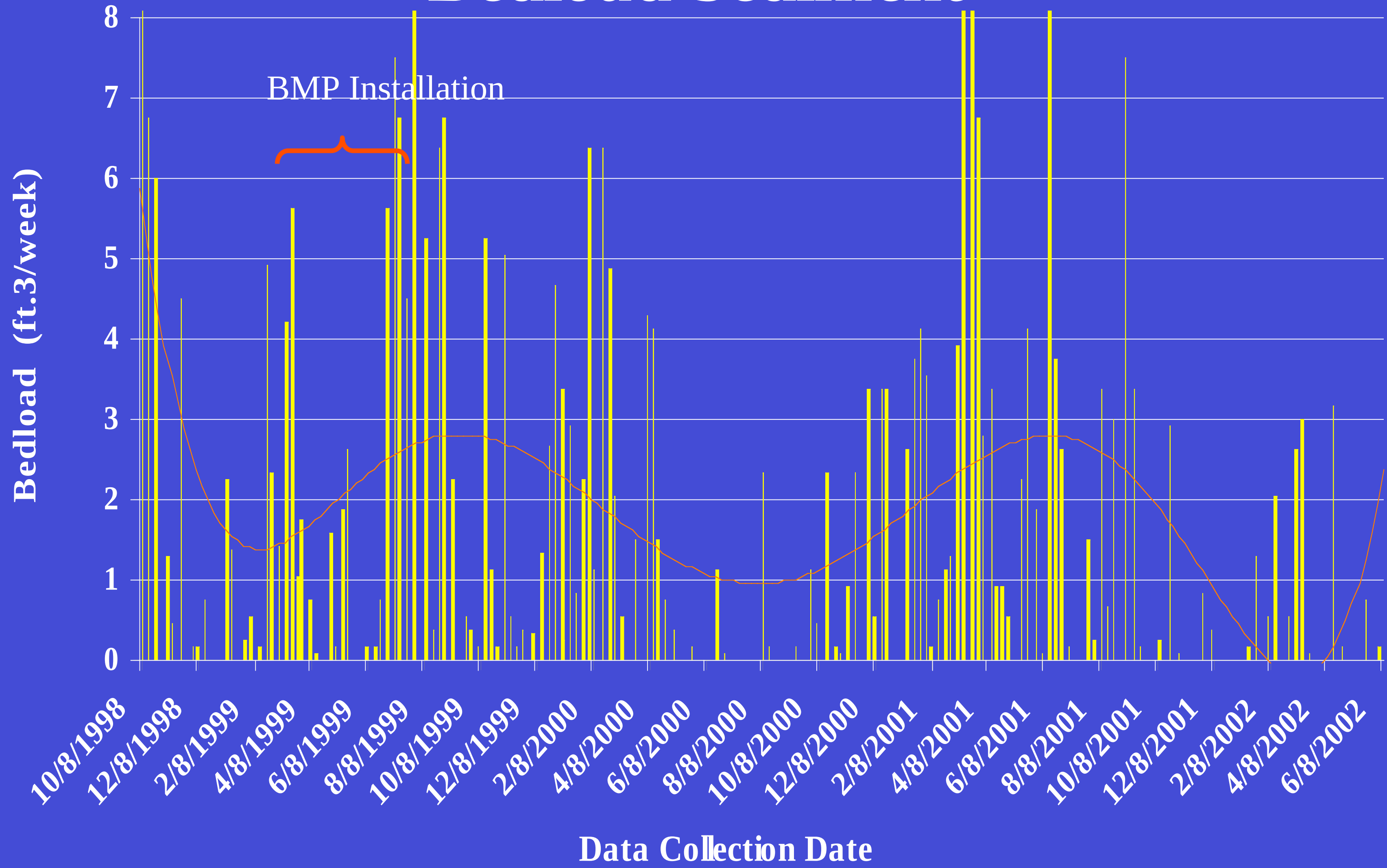


Before

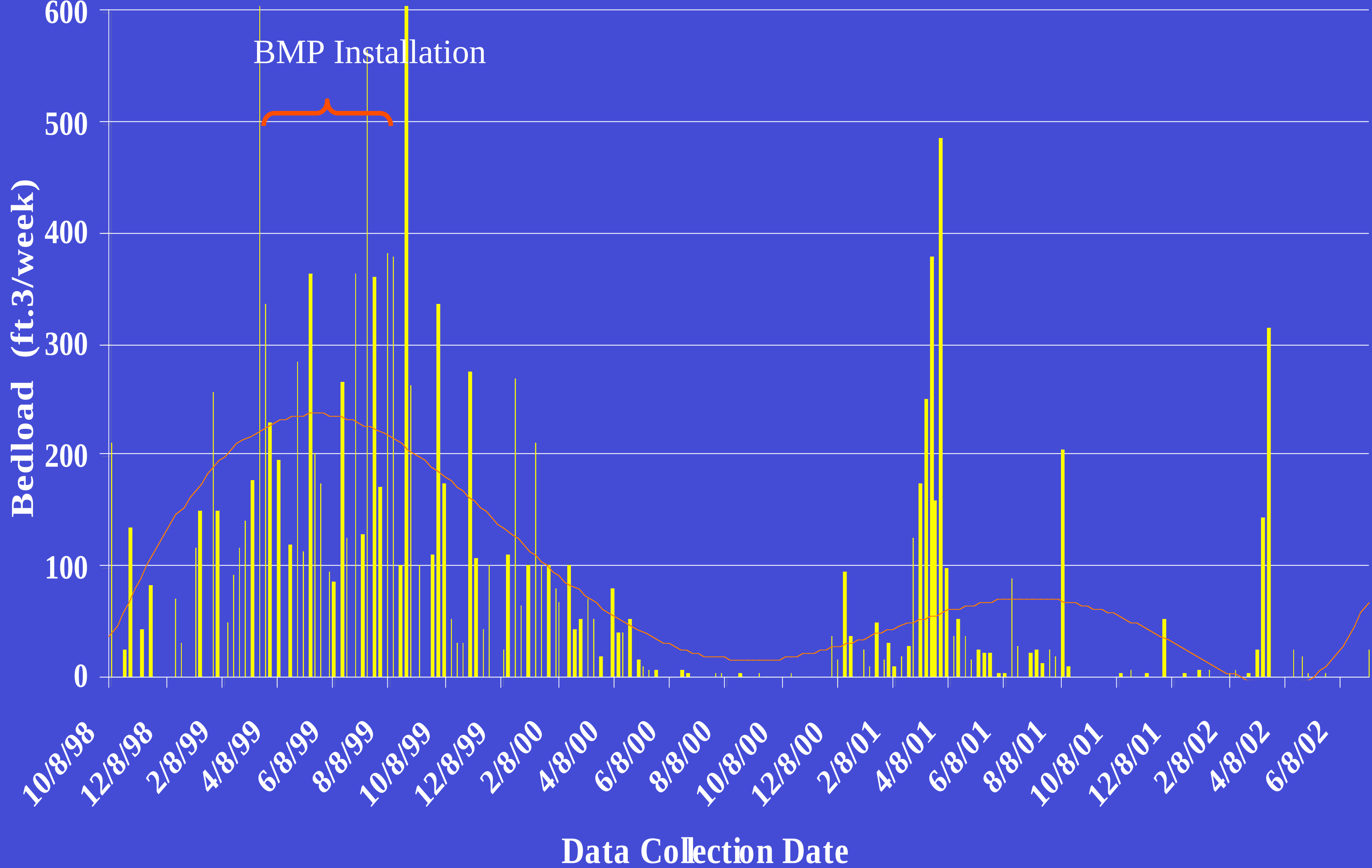
After

4-S Watershed BMP Implementation

Lightwood Knot Creek 3-C Watershed Bedload Sediment



Lightwood Knot Creek 4-S Watershed Bedload Sediment



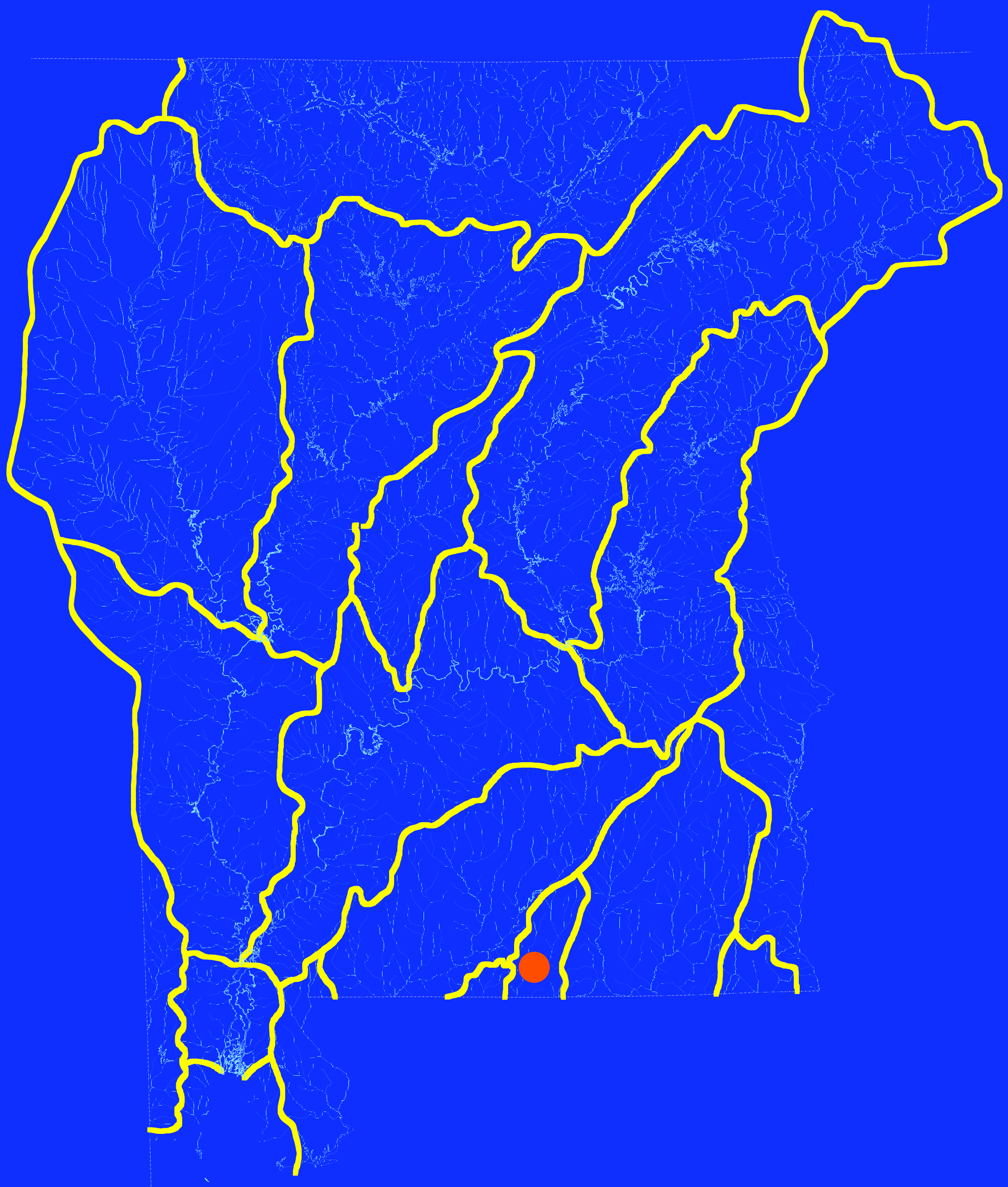
Results of Statistical Analysis of Water Quality Change

T-Test

- NO_3 as N =71% ↓
- Fecal C. Bacteria =14% ↑
- Total Phosphorus =20% ↓
- Fecal S. Bacteria =7% ↑
- T. Suspended Solids =18% ↑
- Bedload Sediment =87% ↓

Regression Analysis

- NO_3 as N =71% ↓
- Fecal C. Bacteria =11% ↓
- Total Phosphorus =7% ↑
- Fecal S. Bacteria =14% ↑
- T. Suspended Solids =18% ↑
- Bedload Sediment =92% ↓

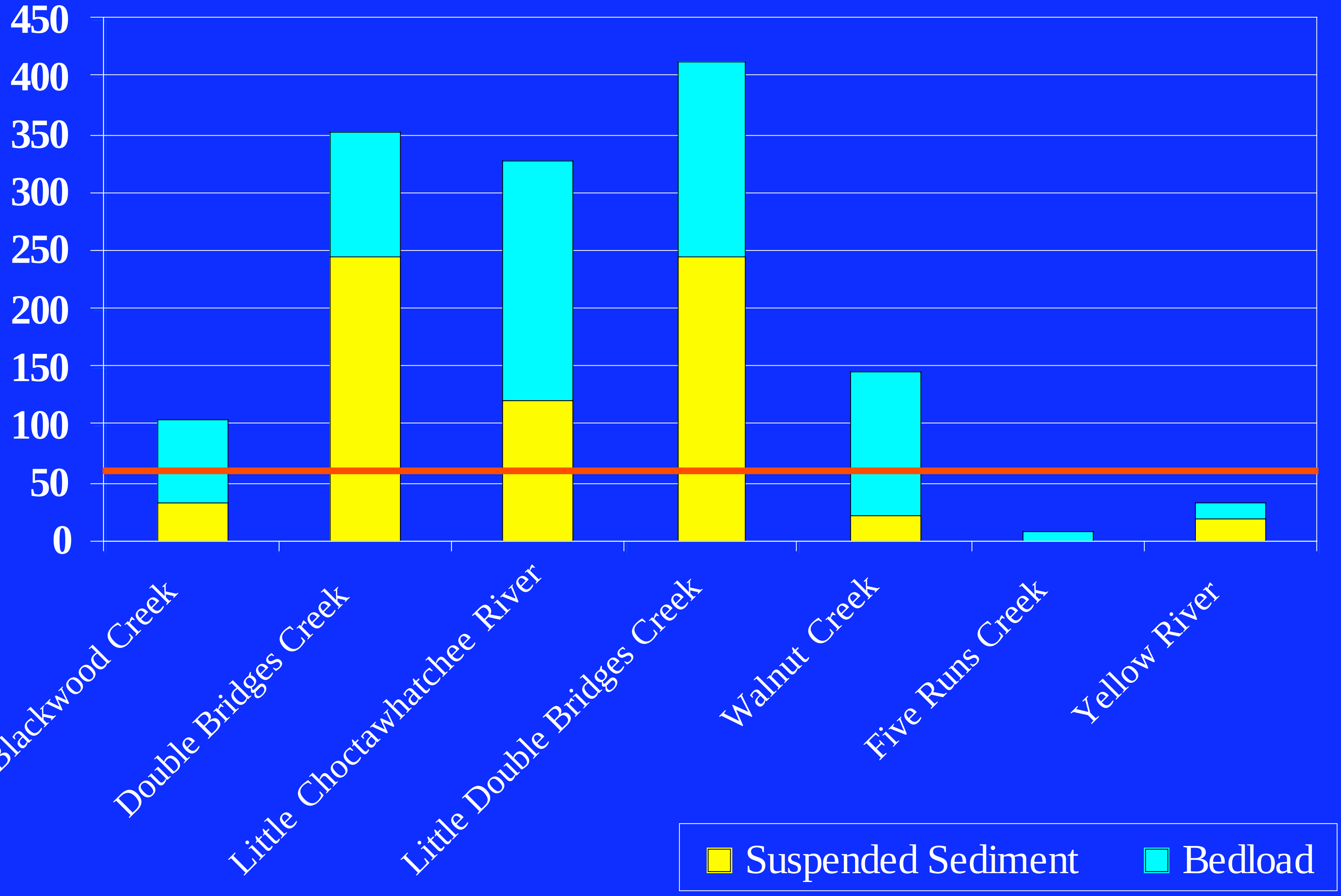


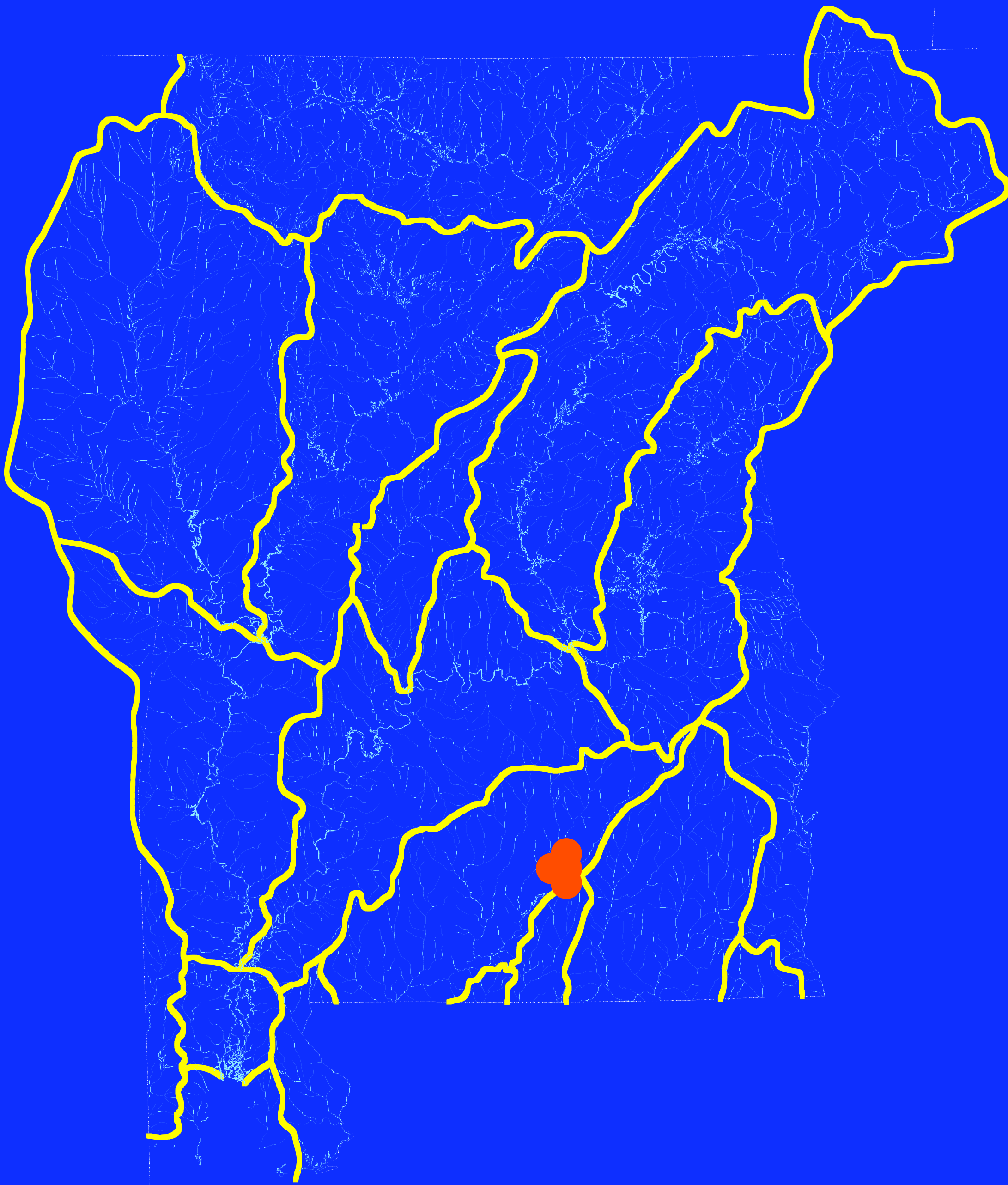
Geological Survey of Alabama Yellow River Sedimentation Monitoring Site

Cooperators:
CPYRWMA

Yellow River Bedload, Covington County Alabama

Total Sediment Loads





Geological Survey of Alabama Gantt-Point A Sedimentation Monitoring Sites

Cooperators:
ADEM
NRCS

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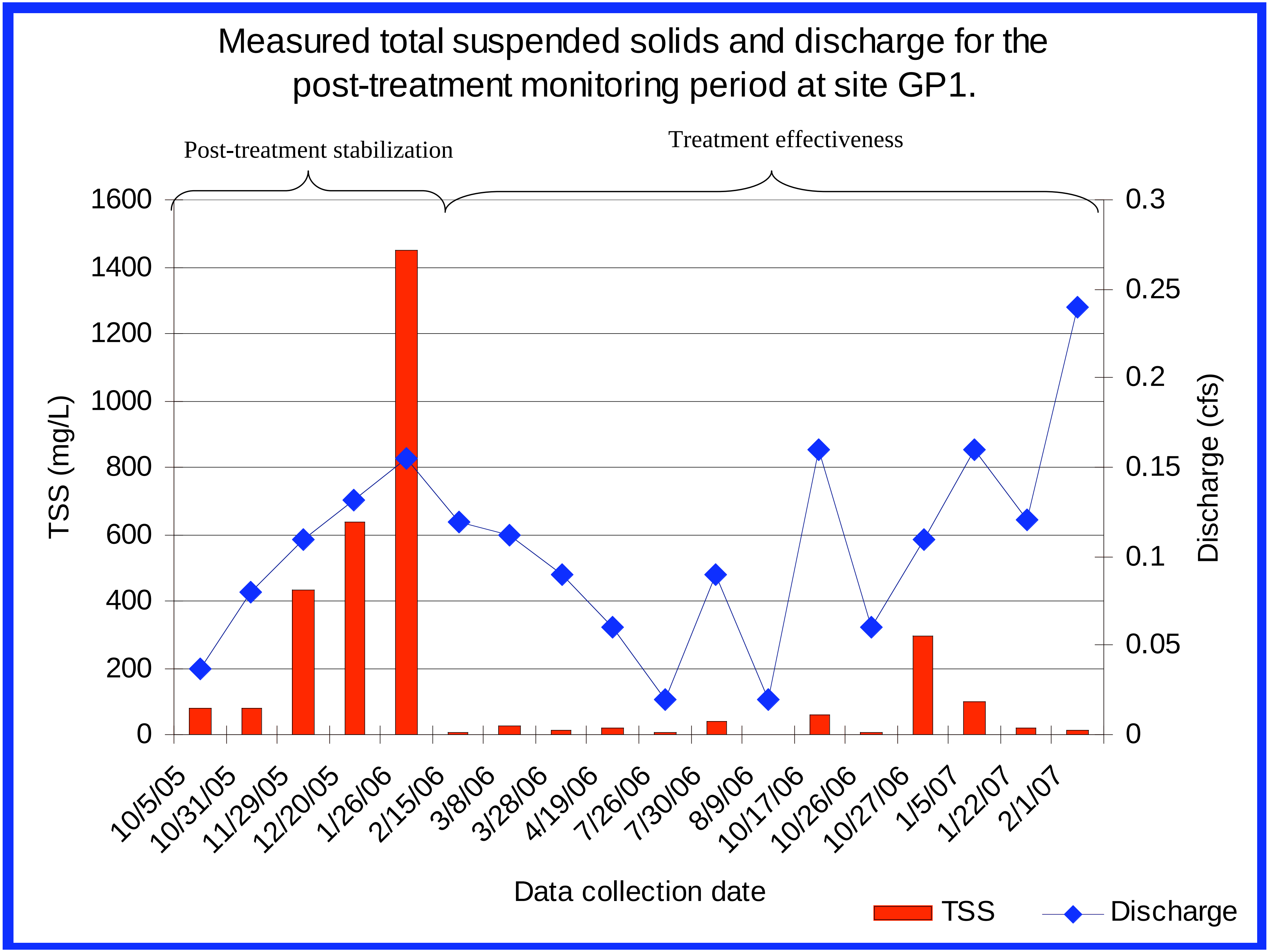
Sediment deposition into Point A Reservoir Covington Co. Alabama

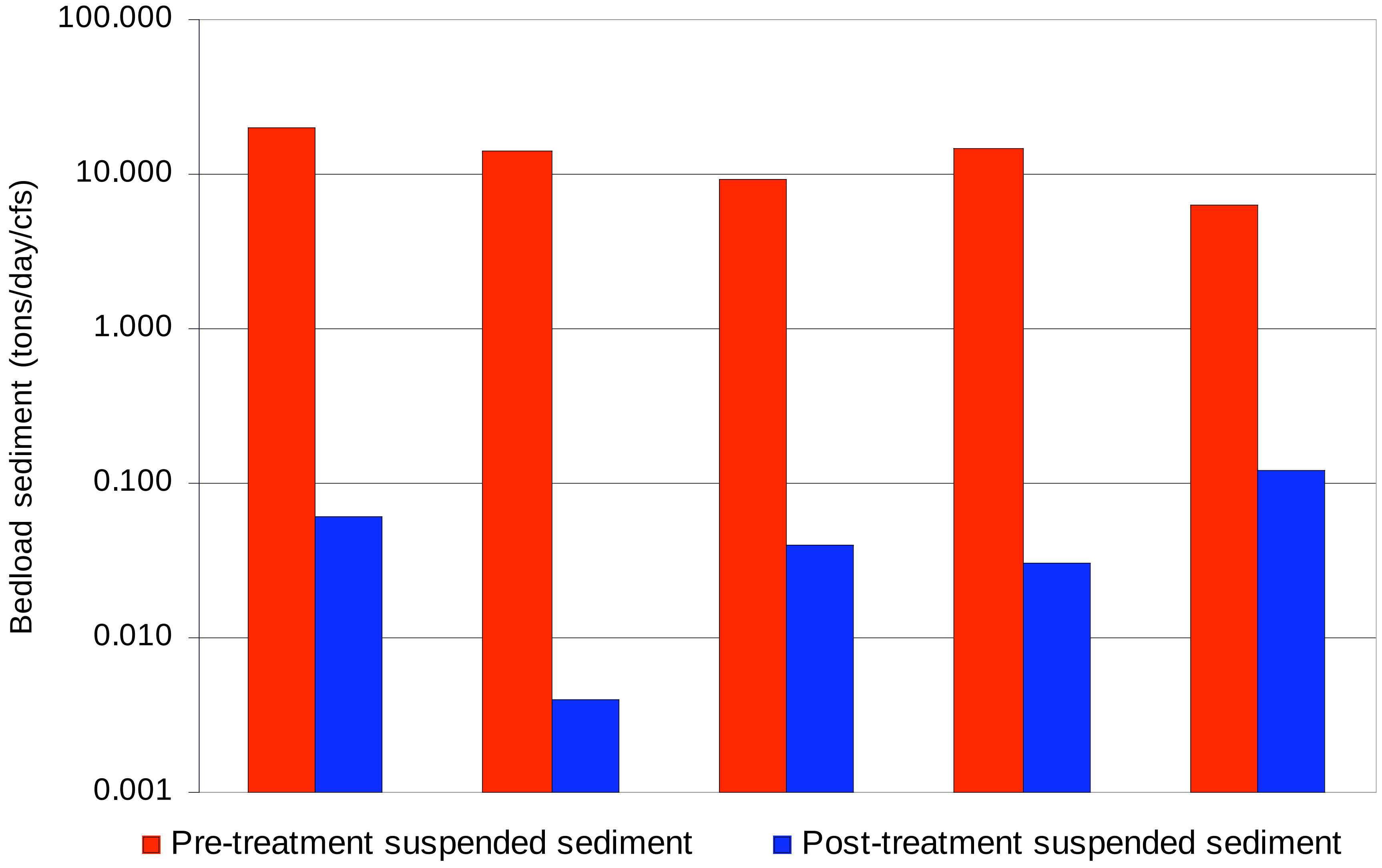
Stratification of sediment deposited into Point A Reservoir

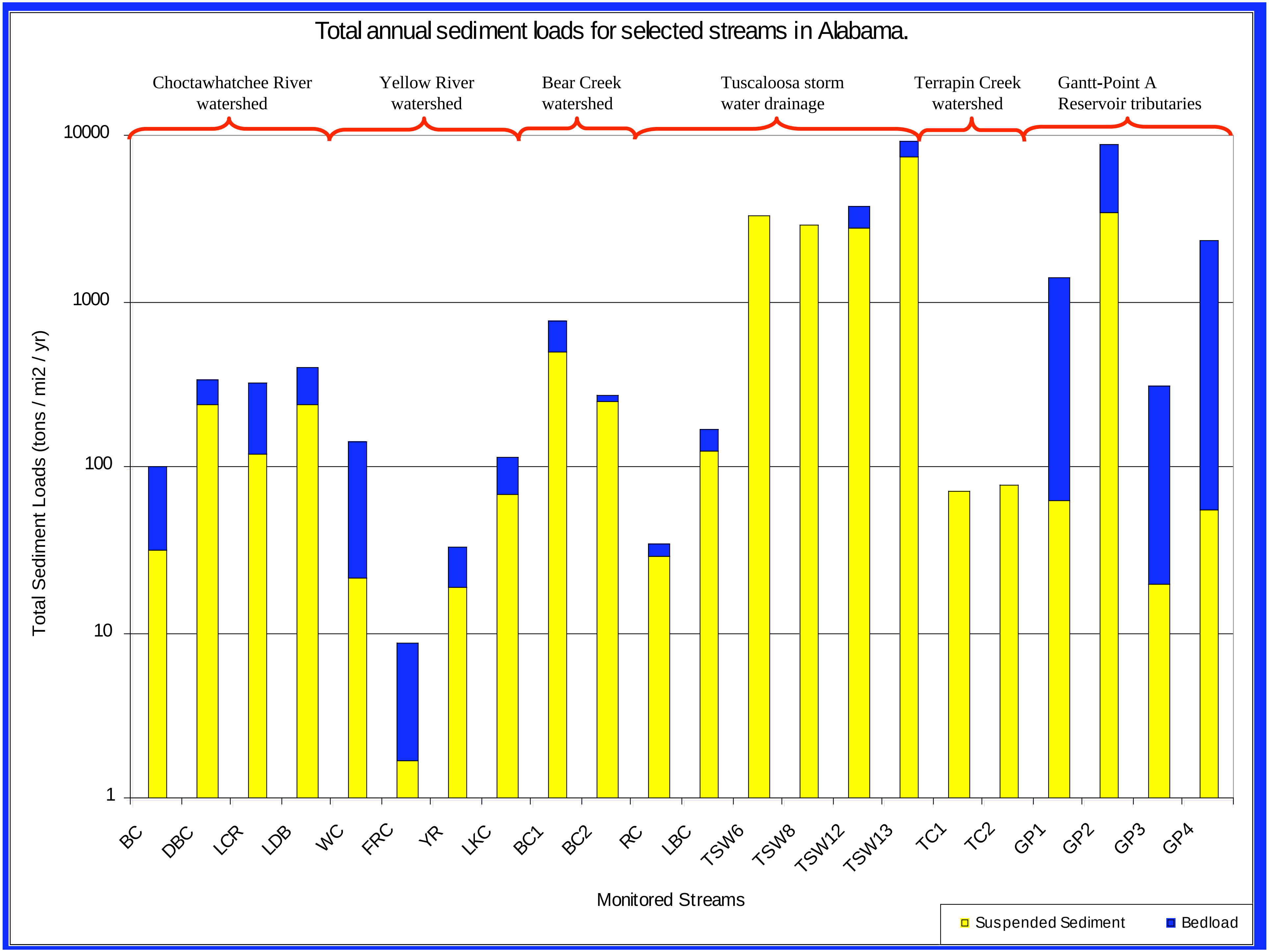
Sedimentation into Gantt Reservoir Covington Co. Alabama



Measured total suspended solids and discharge for the post-treatment monitoring period at site GP1.
Post-treatment stabilization
Treatment effectiveness
TSS (mg/L)
1600
1400
1200
1000
800
600
400
200
0
Discharge (cfs)
0.3
0.25
0.2
0.15
0.1
0.05
0
10/5/05
10/31/05
11/29/05
12/20/05
1/26/06
2/15/06
3/8/06
3/28/06
4/19/06
7/26/06
7/30/06
8/9/06
10/17/06
10/26/06
10/27/06
1/5/07
1/22/07
2/1/07
Data collection date
TSS
Discharge

Estimated pre- and post-treatment suspended sediment loads for site GP2, normalized with respect to discharge.



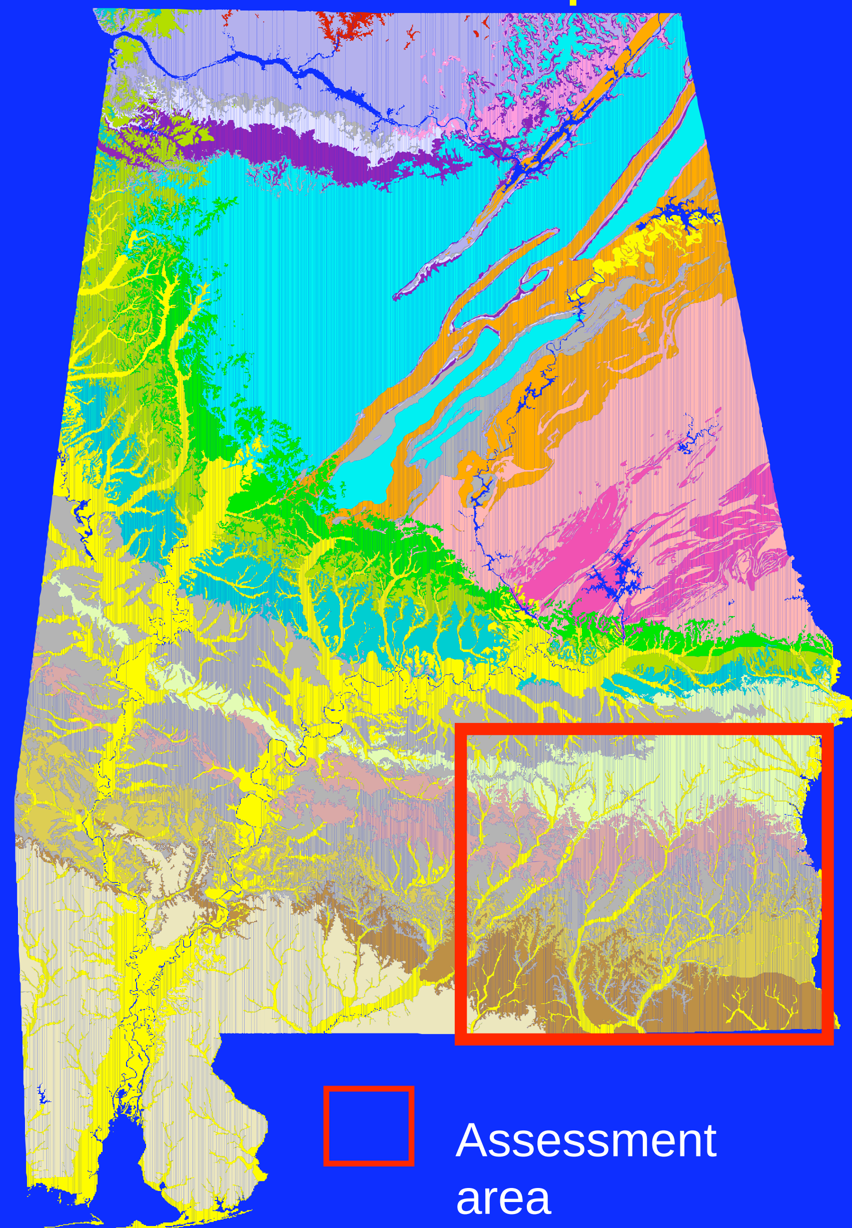

Total annual sediment loads for selected streams in Alabama.
Choctawhatchee River watershed
Yellow River watershed
Bear Creek watershed
Tuscaloosa storm water drainage
Terrapin Creek watershed
Gantt-Point A Reservoir tributaries
10000
1000
100
10
1
Total Sediment Loads (tons / mi2 / yr)
BC
DBC
LCR
LDB
WC
FRC
YR
LKC
BC1
BC2
RC
LBC
TSW6
TSW8
TSW12
TSW13
TC1
TC2
GP1
GP2
GP3
GP4
Monitored Streams
Suspended Sediment
Bedload

- Ground Water

Southeast Alabama Aquifer Stress and Future Ground-Water Development

Cooperators:
CPYRWMA
City of Dothan
City of Enterprise

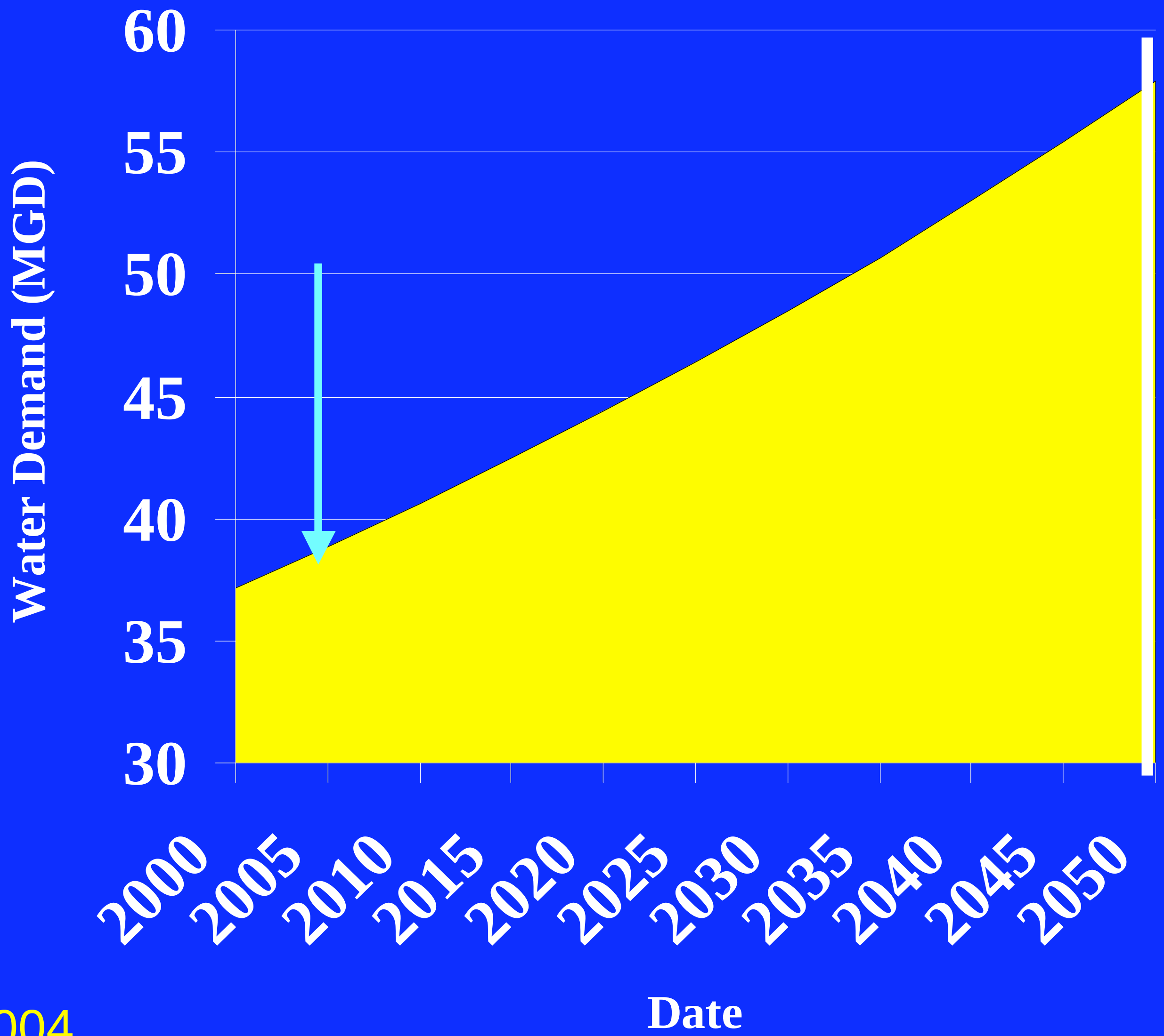
Alabama Aquifers



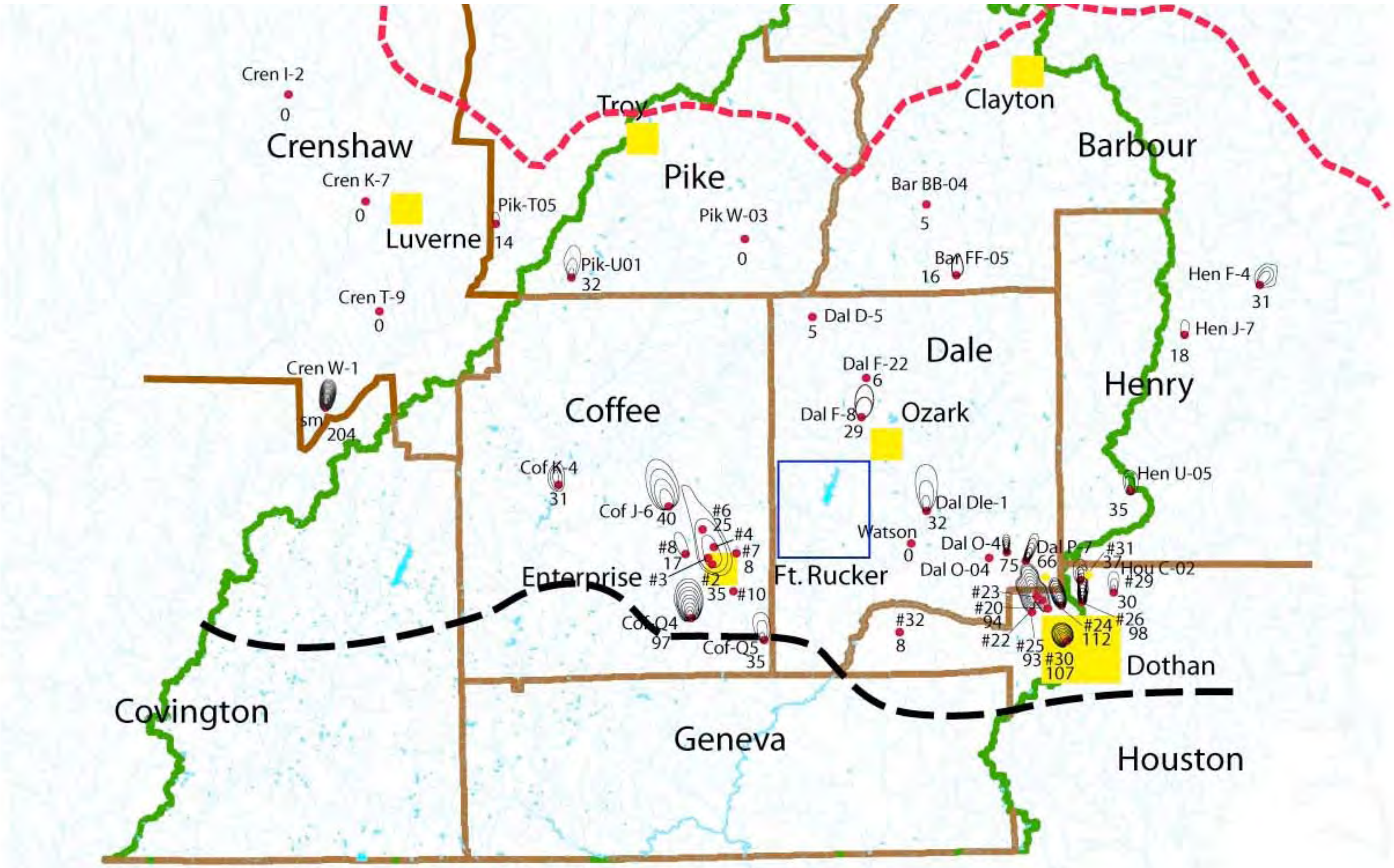
Southeast Alabama Aquifers

Aquifer	Geologic Series	City Supplied
Watercourse Aquifers	Holocene and Pleistocene	
Miocene	Miocene 2 MY	Brewton Chatom
Crystal River (Floridian)	24 MY Eocene	Florala Geneva
Lisbon		Andalusia Ft. Rucker Dothan
Tallahatta		Andalusia
Hatchetigbee		
Tuscahoma	Tertiary 55 MY Paleocene	Ft. Rucker
Nanafalia		Andalusia Ft. Rucker Dothan
Salt Mountain		Enterprise
Clayton		Ozark Ft. Rucker Dothan
Providence	65 MY Cretaceous	Ft. Rucker
Ripley		Greenville Luverne Ft. Rucker Troy
Eutaw		Union Springs Montgomery Selma Greensboro Demopolis
Tuscaloosa Group		Eufaula Troy Tuskegee Montgomery Prattville

Southeast Alabama
Projected Residential Water Demand



USACE 2004



Residual Drawdown
Clayton Aquifer

Legend

Cof K-4
31 — Measured well and residual drawdown

Reservoirs, lakes, and ponds

County lines

Choctawhatchee, Pea and Yellow Rivers Watershed

nhdutm route.rch

Scale

0 7 14 21

Miles

N
W E

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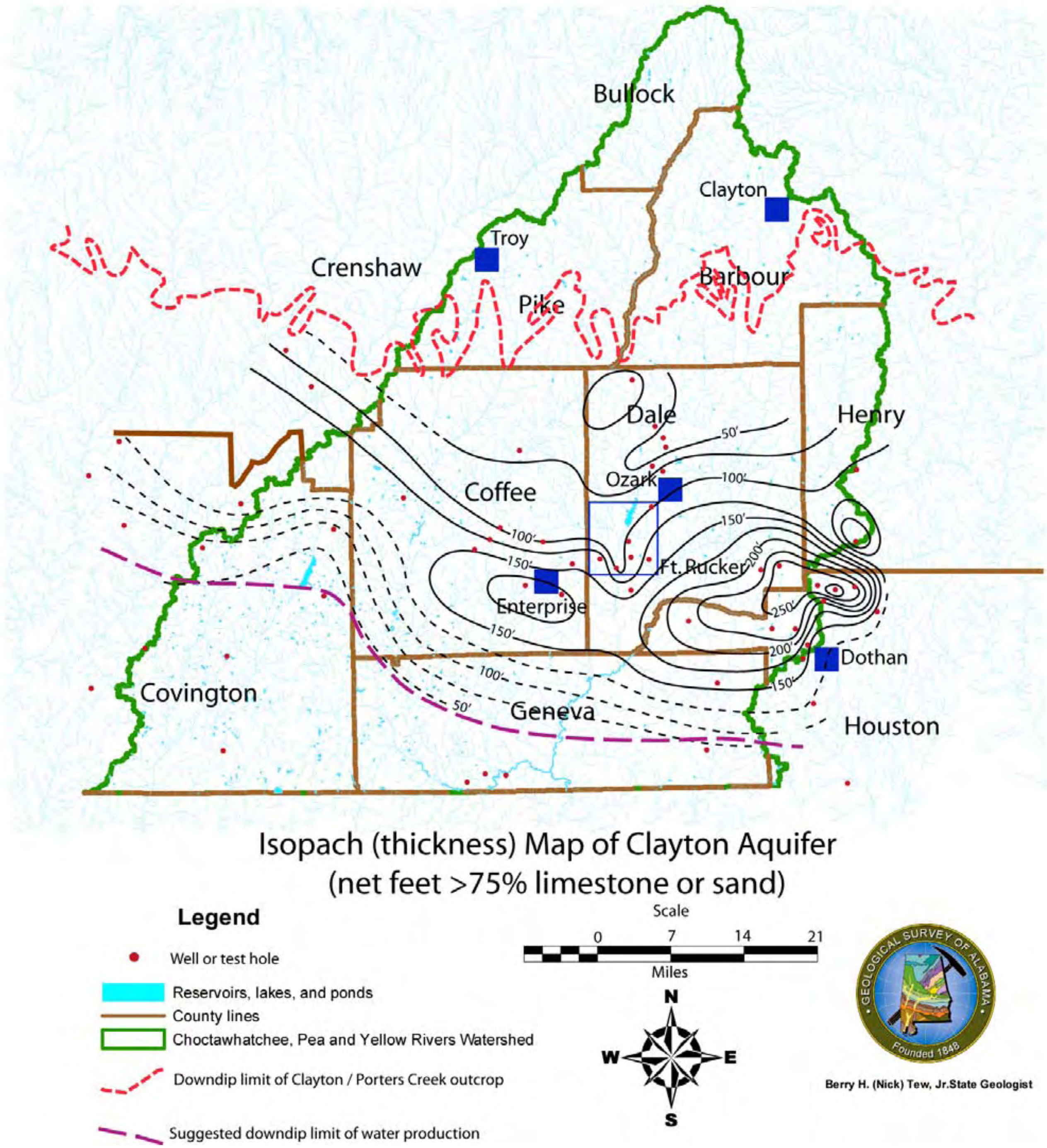
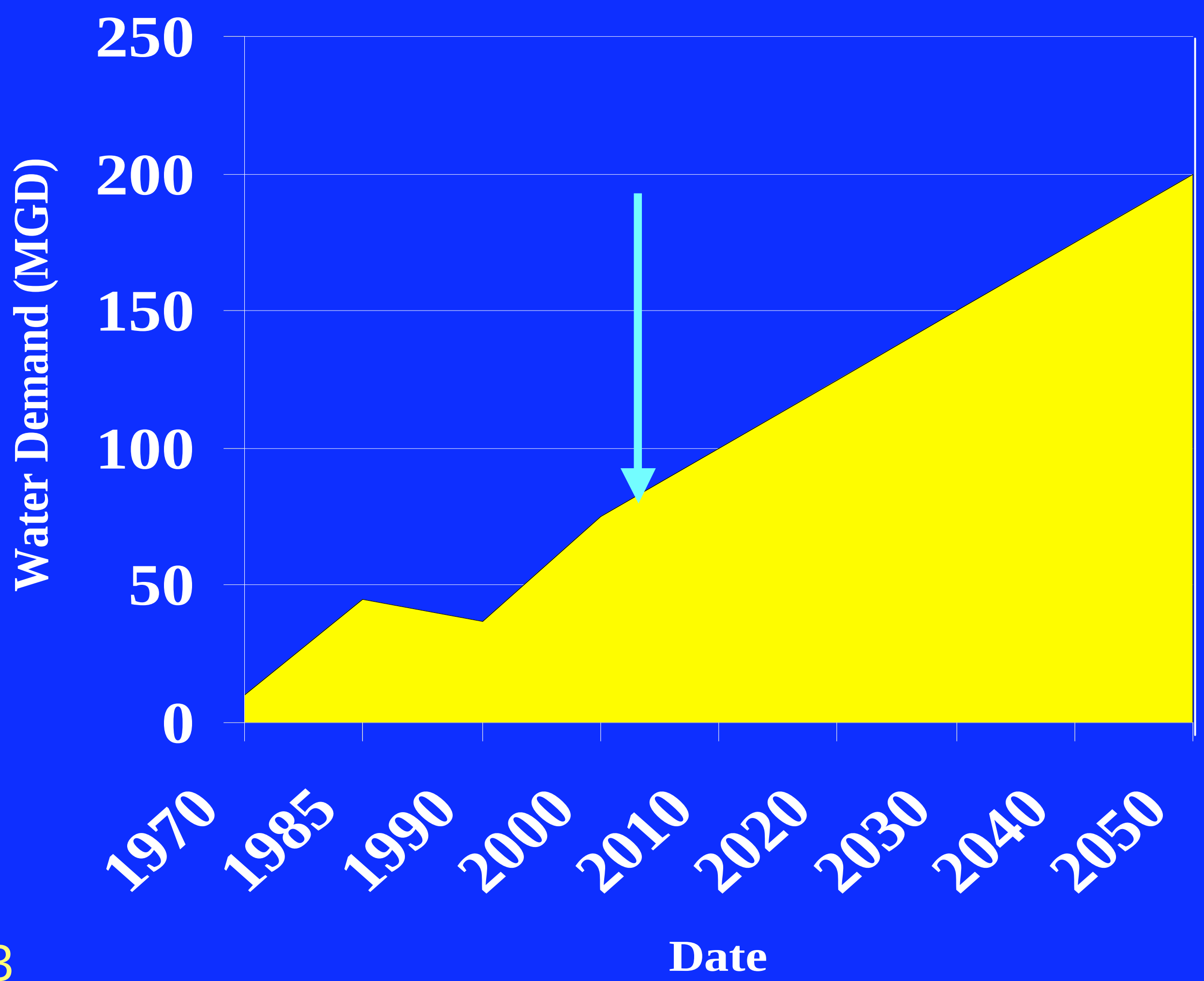
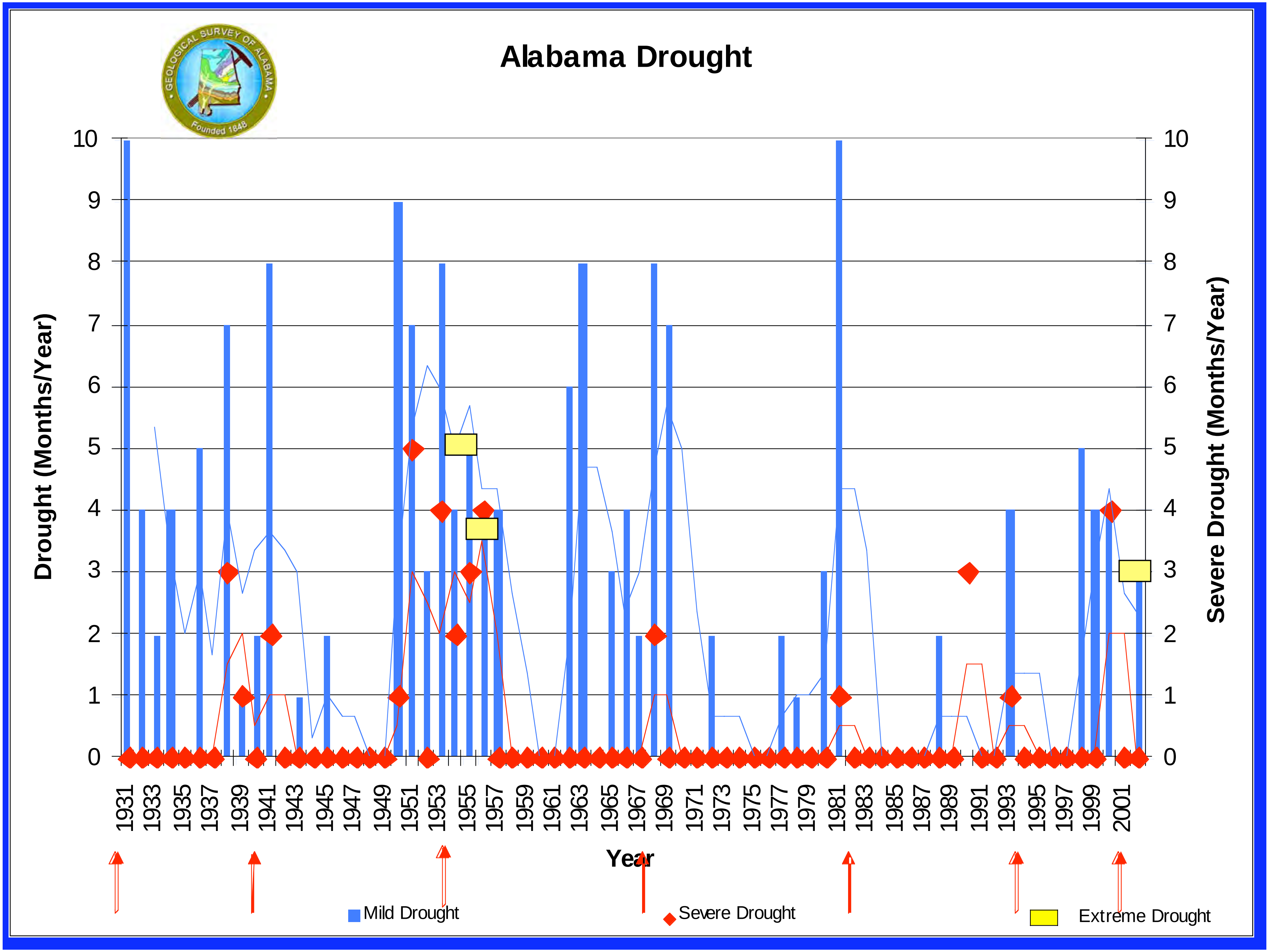
Future Clayton Aquifer Development



Southeast Alabama
Agricultural Water Demand



NRCS, 2003



Alabama Drought
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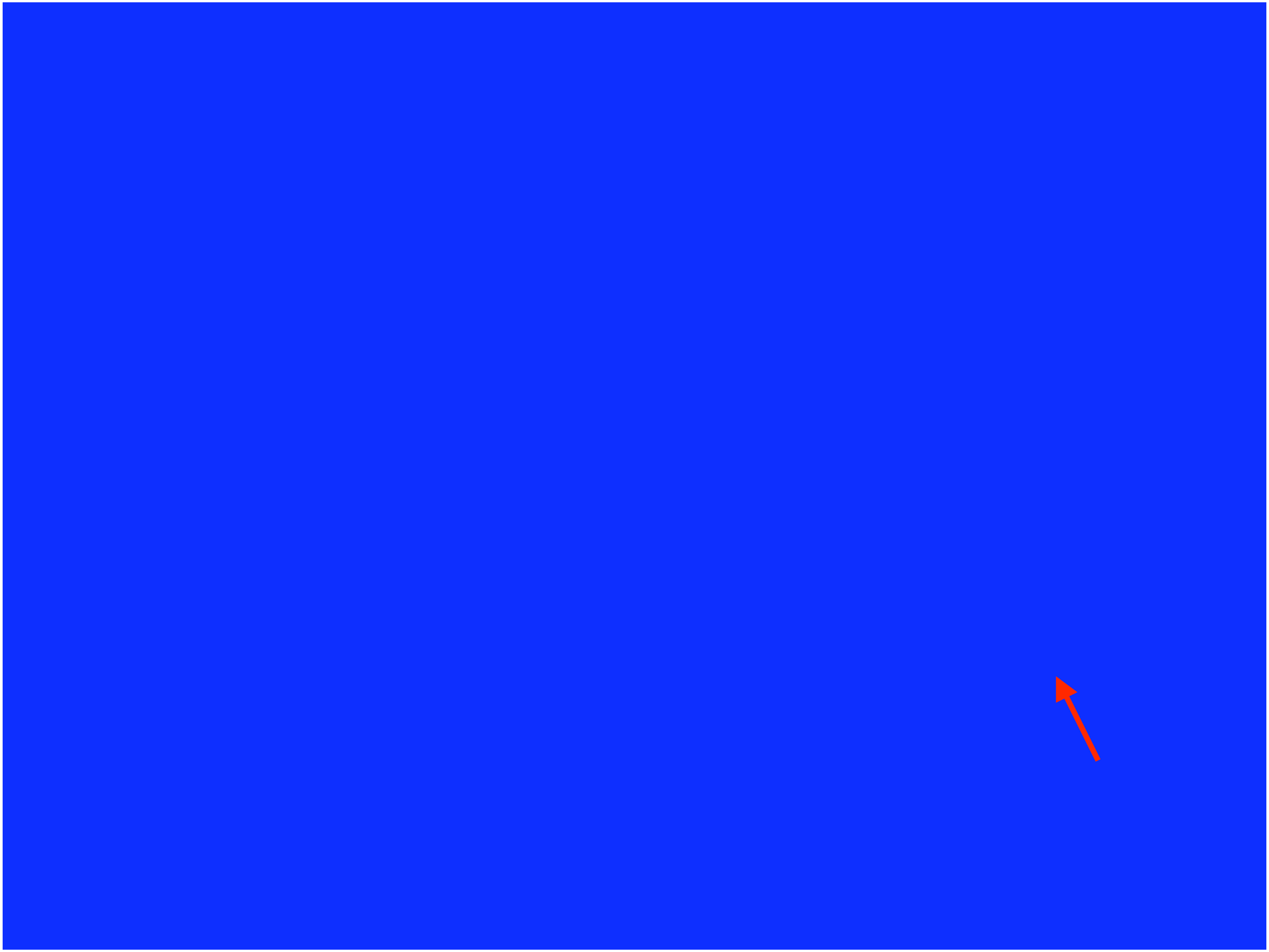
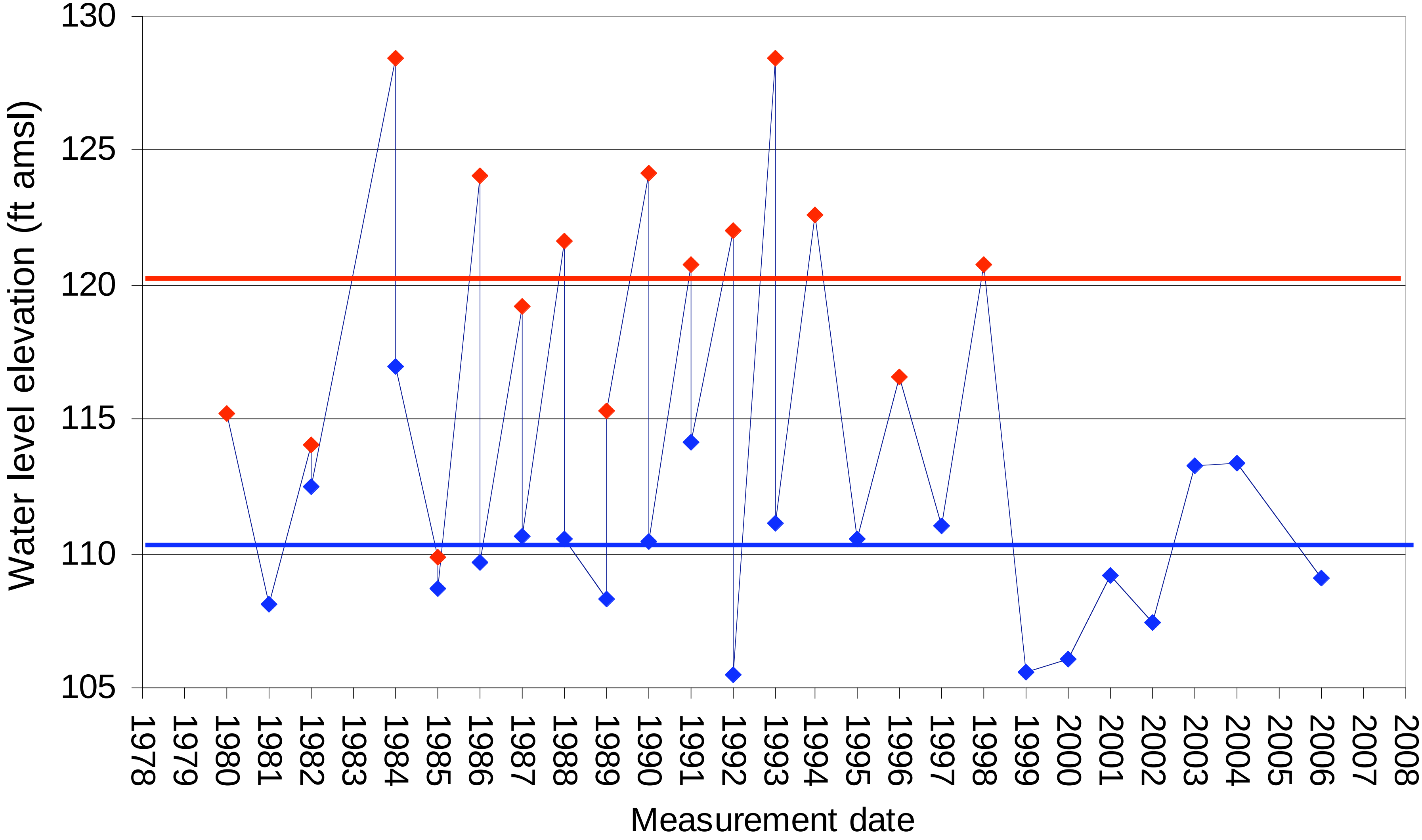
Drought (Months/Year)
Severe Drought (Months/Year)
Year
0
1
2
3
4
5
6
7
8
9
10
1931
1933
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
Mild Drought
Severe Drought
Extreme Drought



Hydrograph of Crystal River aquifer irrigation well X-2, Houston County, Alabama.



Where do we go from here?

- Population and economic growth result in land-use changes that may profoundly impact the quantity and quality of our water resources.
- Understanding these complex relationships between land use and water resources empowers us to manage and protect these vital resources while promoting economic growth and improvements in quality of life.
- Just as we now live in a world economy, we also live in an interjuristdictional natural resource setting.
- Development and protection of our water resources requires cooperation of municipal, county, and state governments, state and federal natural resource agencies, and universities and researchers.


Thank You!!
GEOLOGICAL SURVEY OF ALABAMA
Founded 1848
Photograph © Beth Maynor Young