Stream Water Quality Modeling Using AQUATOX

By

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National Water Quality Meeting

Savannah, GA

January 28 to February 1, 2007

In northern Alabama

Cont'd

Row Crop Production

Poultry Litter

Overview: What is AQUATOX?

- Simulation model that links pollutants to aquatic life
- Integrates fate & ecological effects
  - fate & bioaccumulation of organics
  - food web & ecotoxicological effects
  - nutrient & eutrophication effects
- • Predicts effects of multiple stressors
  - nutrients, organic toxicants
  - temperature, suspended sediment, flow etc…

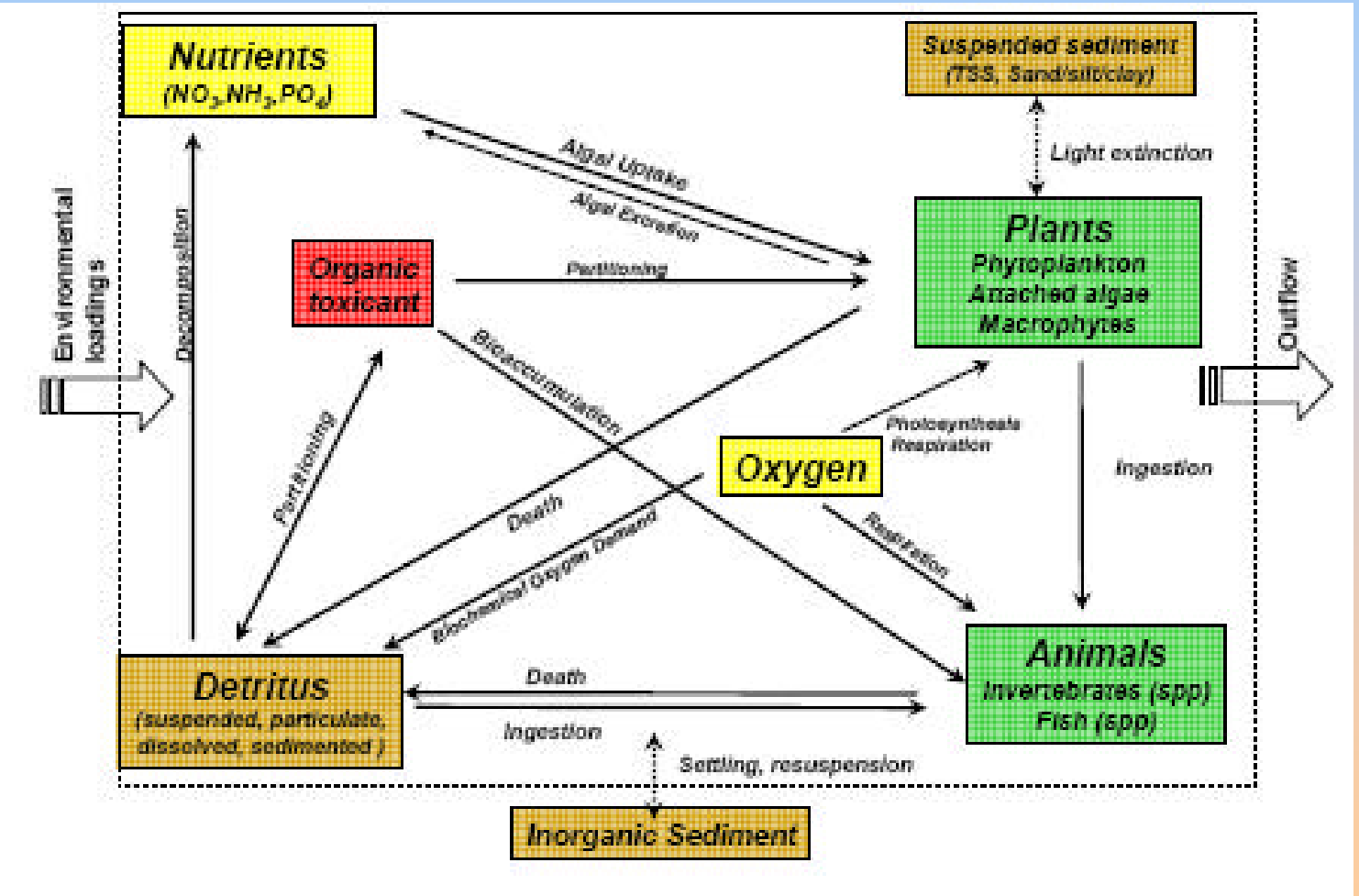
Source: AQUATOX Modeling, EPA

Why to use AQUATOX Model?

- Managers need to know:
  - Which of several stressors is causing the impairment?
- Will proposed pollution control strategy lead to restoration of desirable aquatic community, as well as to improved chemical water quality?
- Will there be any unintended consequences?
- How long will recovery take?

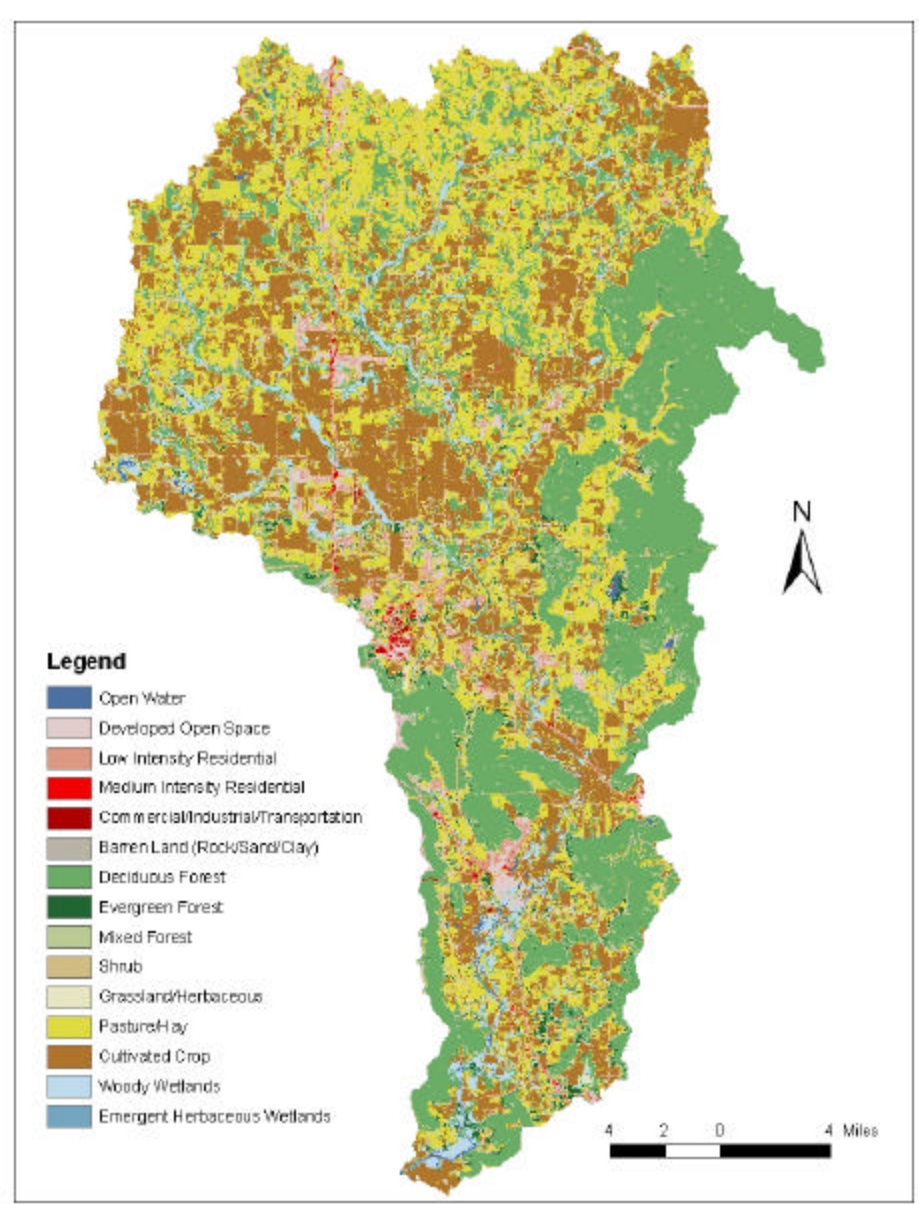
Source: AQUATOX Modeling, EPA

AQUATOX Simulates Ecological Processes & Effects within a Volume of Water Over Time



Source: AQUATOX Modeling, EPA

Flint River Watershed (FR)



Land use /cover types

Class_Name	FR
Open Water	1861
Developed Space	20467
Low Intensity residential	6905
Medium Intensity Residential	919
Commercial/Industrial/Transportation	307
Barren Land	116
Deciduous Forest	99018
Evergreen Forest	4995
Mixed Forest	6114
Shrub	12767
Grassland/Herbaceous	4212
Pastur/Hay	99975
Cultivated Crop	91970
Woody Wetlands	12864
Emergent Herbaceous Wetlands	75

Hester Creek, AL

Stream/River Site

LOCATION

Latitude 34°57'39", Longitude 6°27'49" NAD27

Madison County, Alabama ,
Hydrologic Unit 06030002

DESCRIPTION

Drainage area: 33.0 square miles
Contributing drainage area: 33.0 square miles,
Datum of gage: 756.34 feet above sea level NGVD29.

Flint River at Brownsboro, AL.

Stream/River Site

LOCATION

Latitude 34°44'57", Longitude 86°26'48" NAD27

Madison County, Alabama,

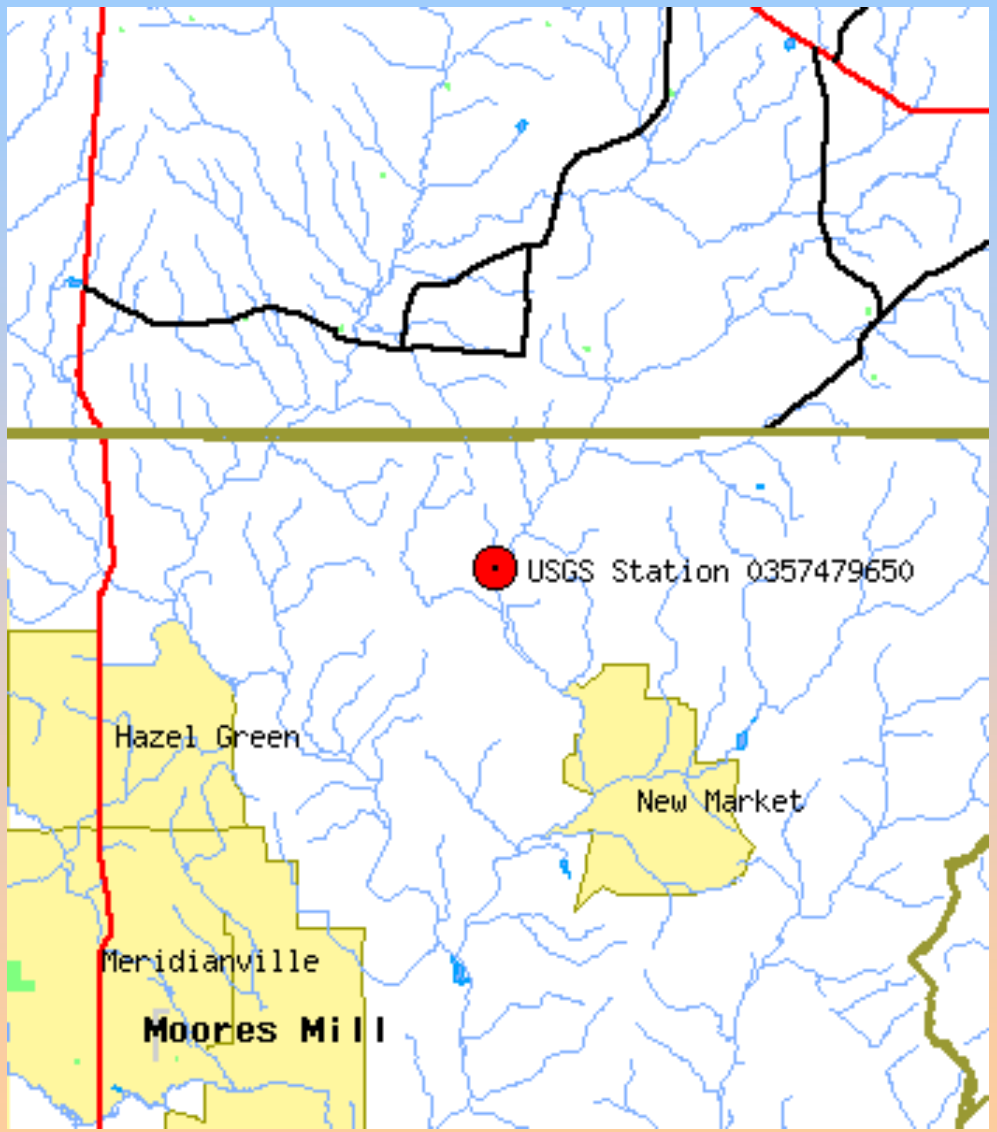
Hydrologic Unit, 06030002

DESCRIPTION

Drainage area: 375 square miles

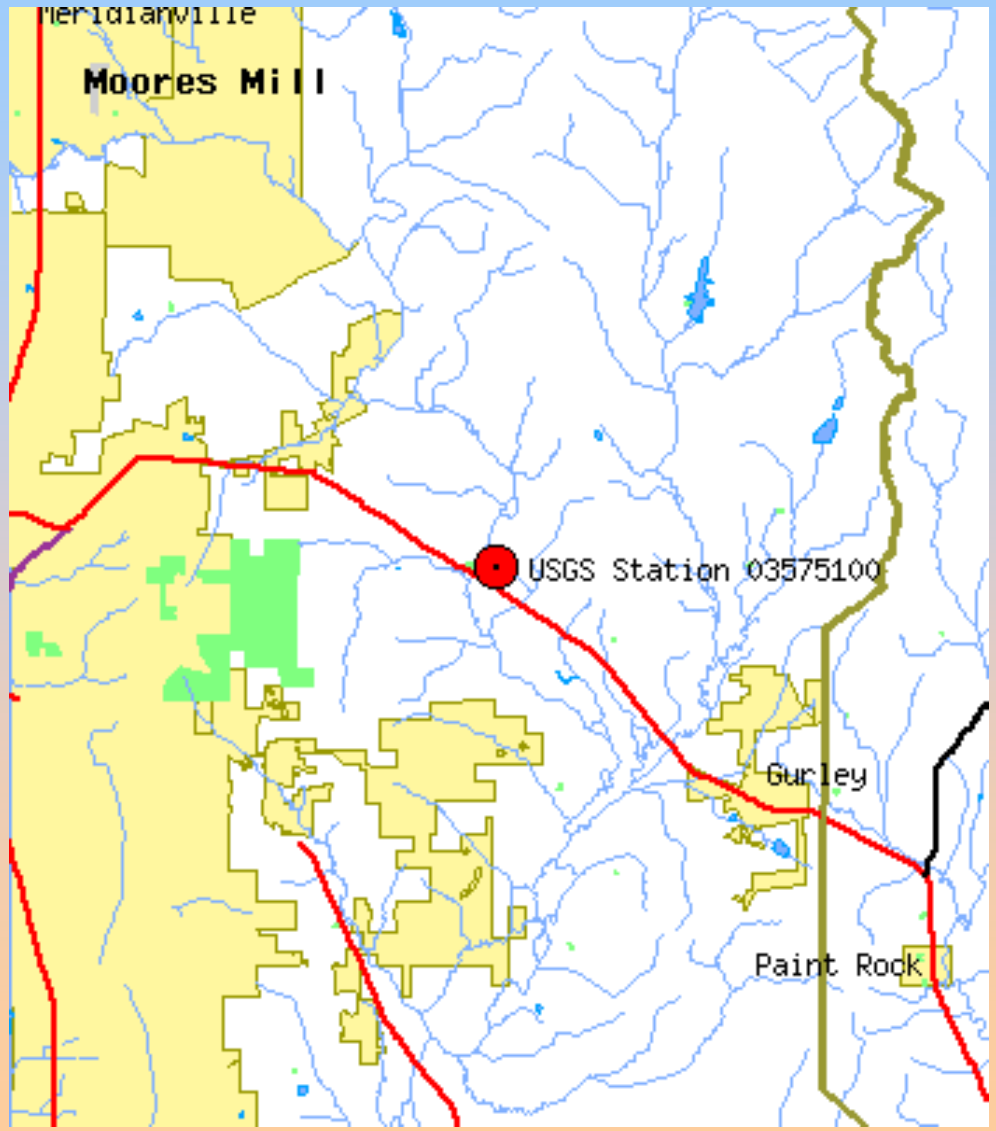
Contributing drainage area: 375 square miles,

Location of HC, AL

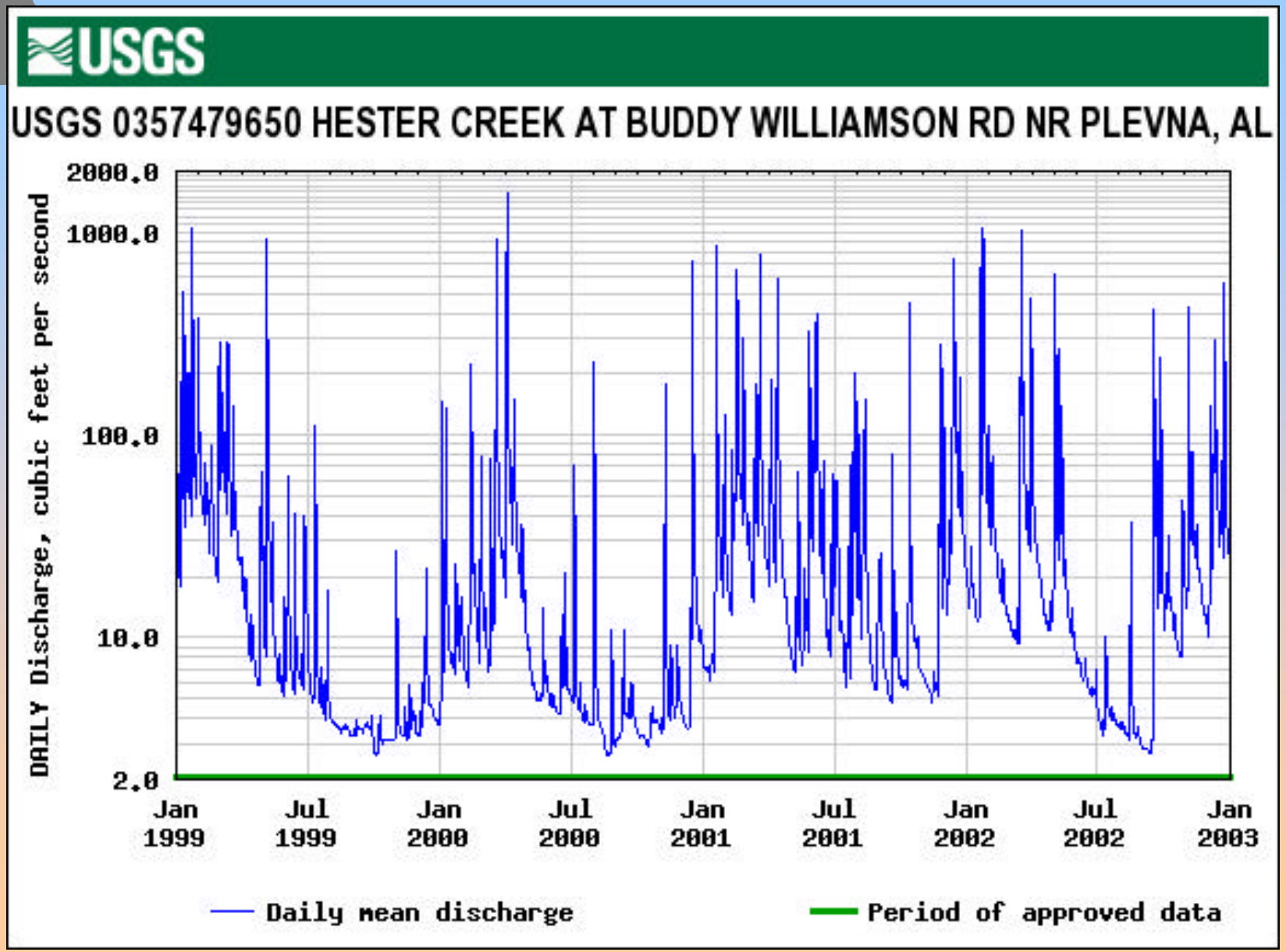


Source: US Census Bureau Tiger Mapping Service

Location of FRB, AL

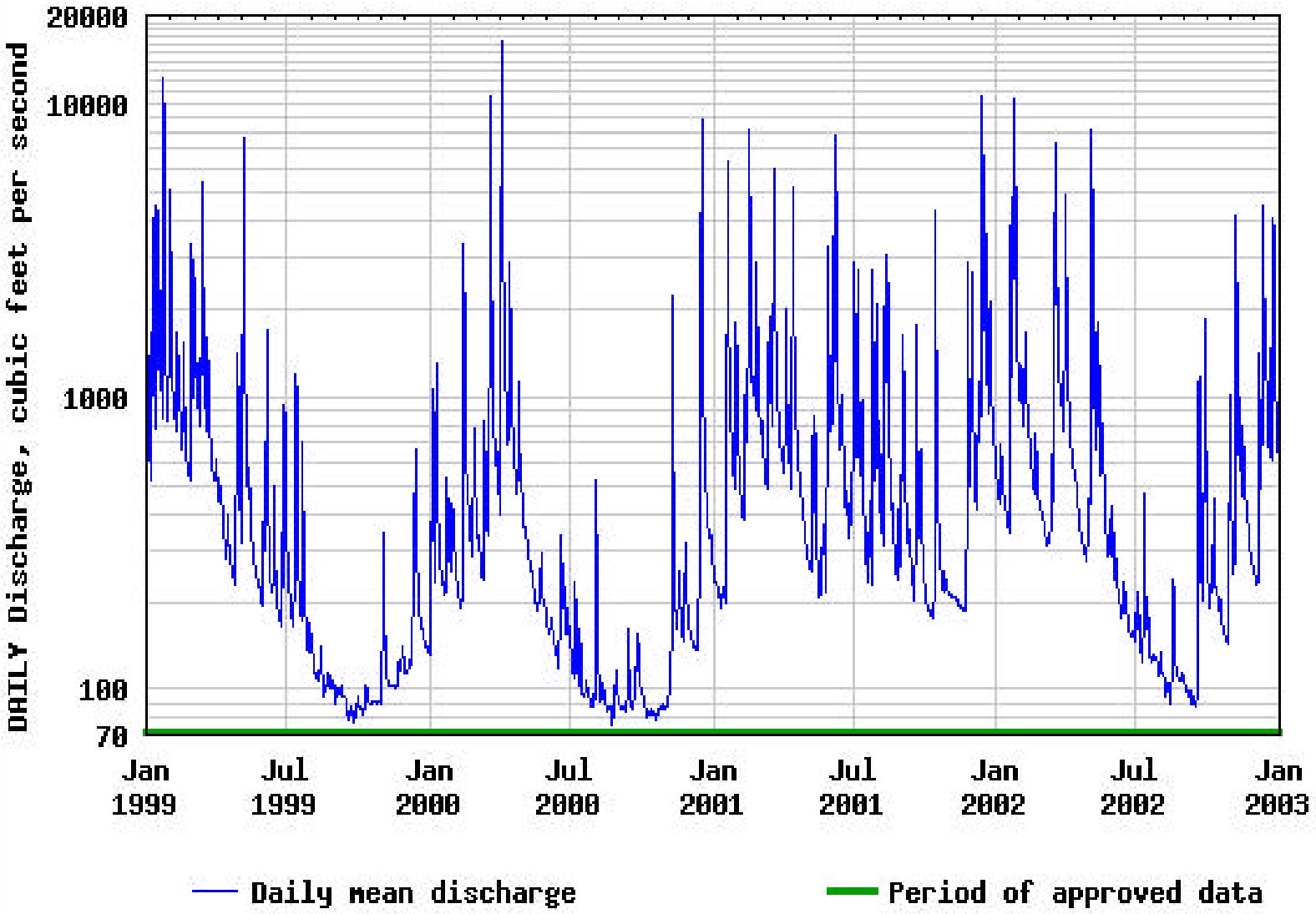


Source: US Census Bureau Tiger Mapping Service

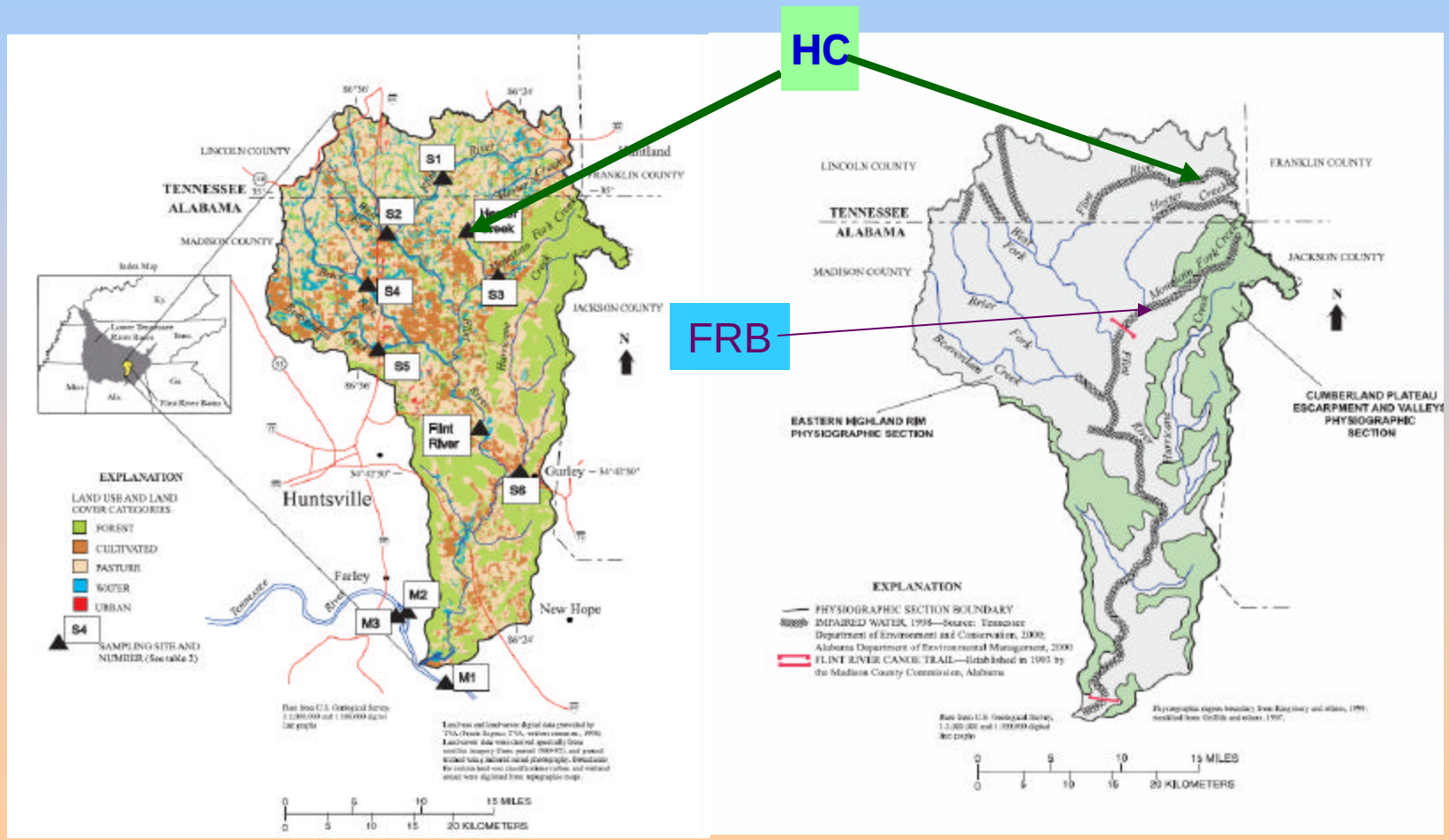

USGS
USGS 0357479650 HESTER CREEK AT BUDDY WILLIAMSON RD NR PLEVNA, AL
DAILY Discharge, cubic feet per second
2000.0
1000.0
100.0
10.0
2.0
Jan 1999
Jul 1999
Jan 2000
Jul 2000
Jan 2001
Jul 2001
Jan 2002
Jul 2002
Jan 2003
Daily mean discharge
Period of approved data

USGS

USGS 03575100 FLINT RIVER AT BROWNSBORO, AL.



Study Sites



Source: Hoos et al. 2000. USGS Report

Table 2. Watershed characteristics of stream sampling sites in the Flint River Basin and Tennessee River

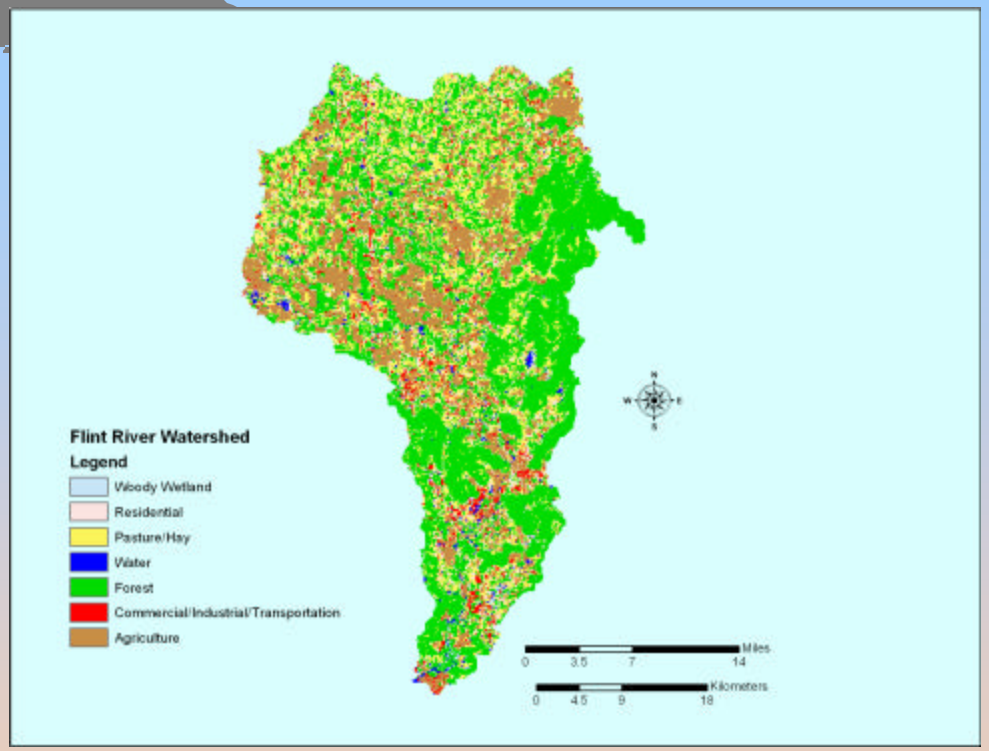
[mi^2, square miles; land-cover estimates from satellite imagery from period 1989-92 (provided by Frank Sagona, Tennessee Valley Authority, written commun., 1998); density of acreage of cotton, corn, and soybeans calculated based on estimates from 1998 from Joseph Berry (U.S. Natural Resource Conservation Service, written commun., 2000) and William Abbott (U.S. Natural Resource Conservation Service, written commun., 2000) and reported in percentage; density of failing septic systems and livestock calculated based on census estimates from 1998 for the Alabama part of the watersheds (Victor Payne, Alabama Soil and Water Conservation Committee, written commun., 1999) and reported in number per square mile, density estimates are subject to error because the areas for which census estimates were available do not correspond exactly with the watersheds for the sampling sites; site identification denotes monitoring network; <, less than; S denotes spatial network; M denotes main stem Tennessee River monitoring network; --, not estimated]

Site identification (fig. 1)	Surface-water station/Site location			Drainage area (mi^2)	Major land use, in percent					Cotton	Corn	Soybeans	Failing septic systems	Cattle and dairy cows	Chicken and hogs
	Number	Name	River mile		Forest	Pasture	Cultivated	Urban	Other						
Hester Creek	0357479650	Hester Creek at Buddy Williamson Road near Plevna, Ala.	4.6	29.3	27	50	15	< 1	8	9	7	13	11	150	570
Flint River	03575100	Flint River near Brownsboro, Ala.	27.6	374	25	45	20	< 1	10	8	4	11	9	70	150
S1	03574702	Flint River at Lincoln, Tenn.	56.5	52.1	19	59	11	< 1	11	3	6	11	25	30	0
S2	03574750	West Fork Flint River near Hazel Green, Ala.	1.3	39.6	18	52	17	1	12	3	6	11	25	30	0
S3	03574794	Mountain Fork Creek at New Market, Ala.	4.0	37.5	70	15	14	< 1	1	1	3	6	12	54	8
S4	03574823	Brier Fork near Hazel Green, Ala.	5.8	40.8	14	56	14	< 1	16	11	1	8	8	7	40
S5	03574870	Beaverdam Creek near Meridianville, Ala.	2.8	37.2	19	39	30	< 1	12	21	1	16	7	20	0
S6	03575200	Hurricane Creek near Gurley, Ala.	2.4	63.8	63	30	6	< 1	< 1	1	3	6	12	54	8
M1	03574680	Tennessee River near Morgan City, Ala.	340	24,960	--	--	--	--	–				--	--	–
M2	03575480	Tennessee River at State Docks, Ala. (also referred to as "right channel at Hobbs Island")	334[a]	25,610	--	--	--	--	–				--	--	–
M3	03575490	Tennessee River downstream from Hobbs Island, Ala. (also referred to as "left channel at Hobbs Island")	334[a]		--	--	--	--	–				--	--	–

[a] Streamflow in the Tennessee River at river mile 334 is divided by Hobbs Island into right and left channel, sites M2 and M3.

Source: Hoos et al. 2000. USGS Report

Land Use for the Flint River Watershed



- It is primarily agricultural and forested land in northern Alabama and south-central Tennessee (U.S. Geological Survey, 2002).

- Urban and residential land represent a small (less than 1%), but growing part of land use in the watershed, as residential growth from the City of Huntsville continues to spread.

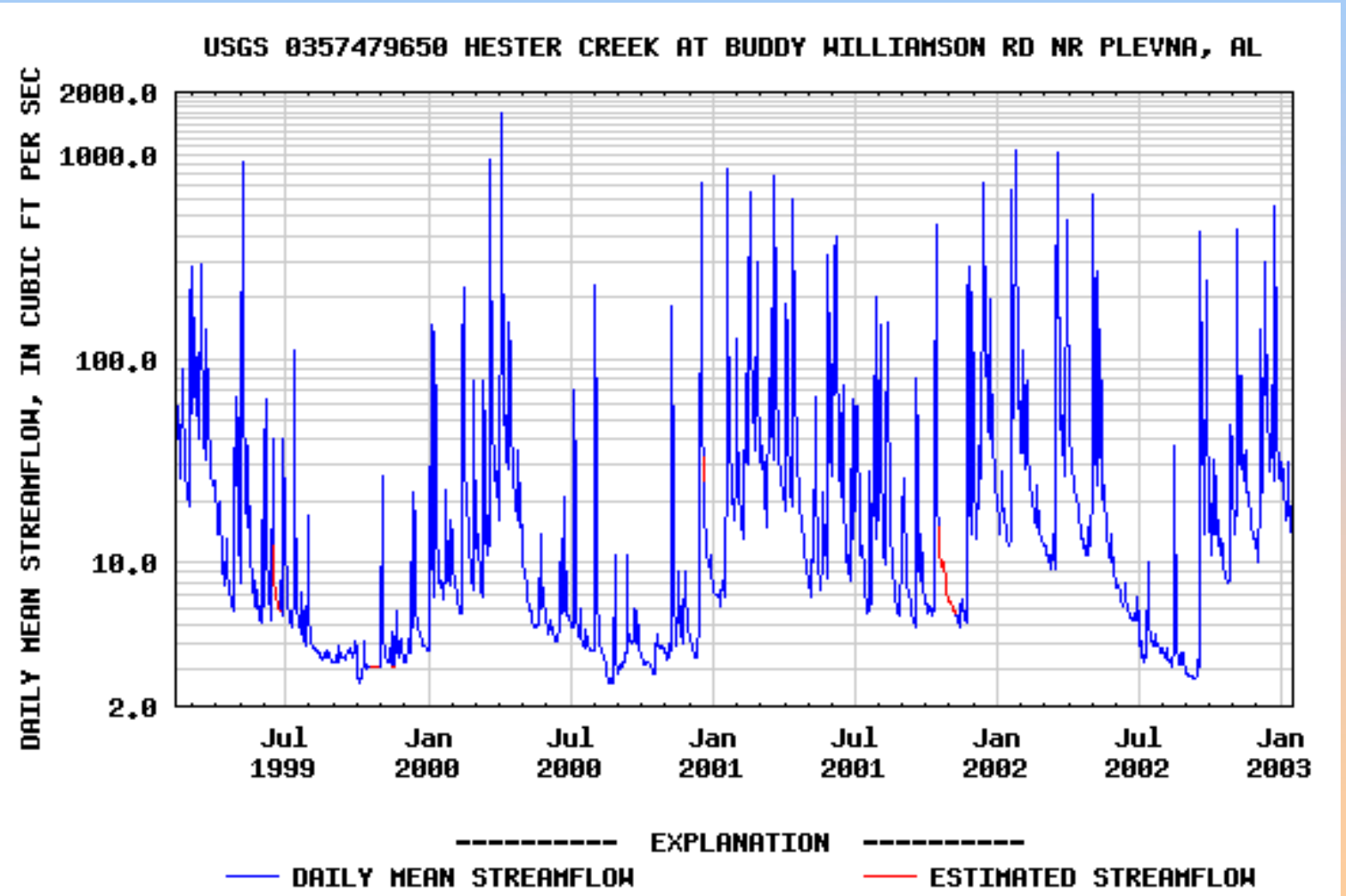
- The Flint River is an important recreational and scenic resource.

- Local agencies are conducting riparian restoration projects to protect and enhance habitat for the diverse aquatic life along the Flint River.

- Among the several threatened species of fish and aquatic invertebrates found in the basin are the slackwater darter, Tuscumbia darter, and southern cave fish.

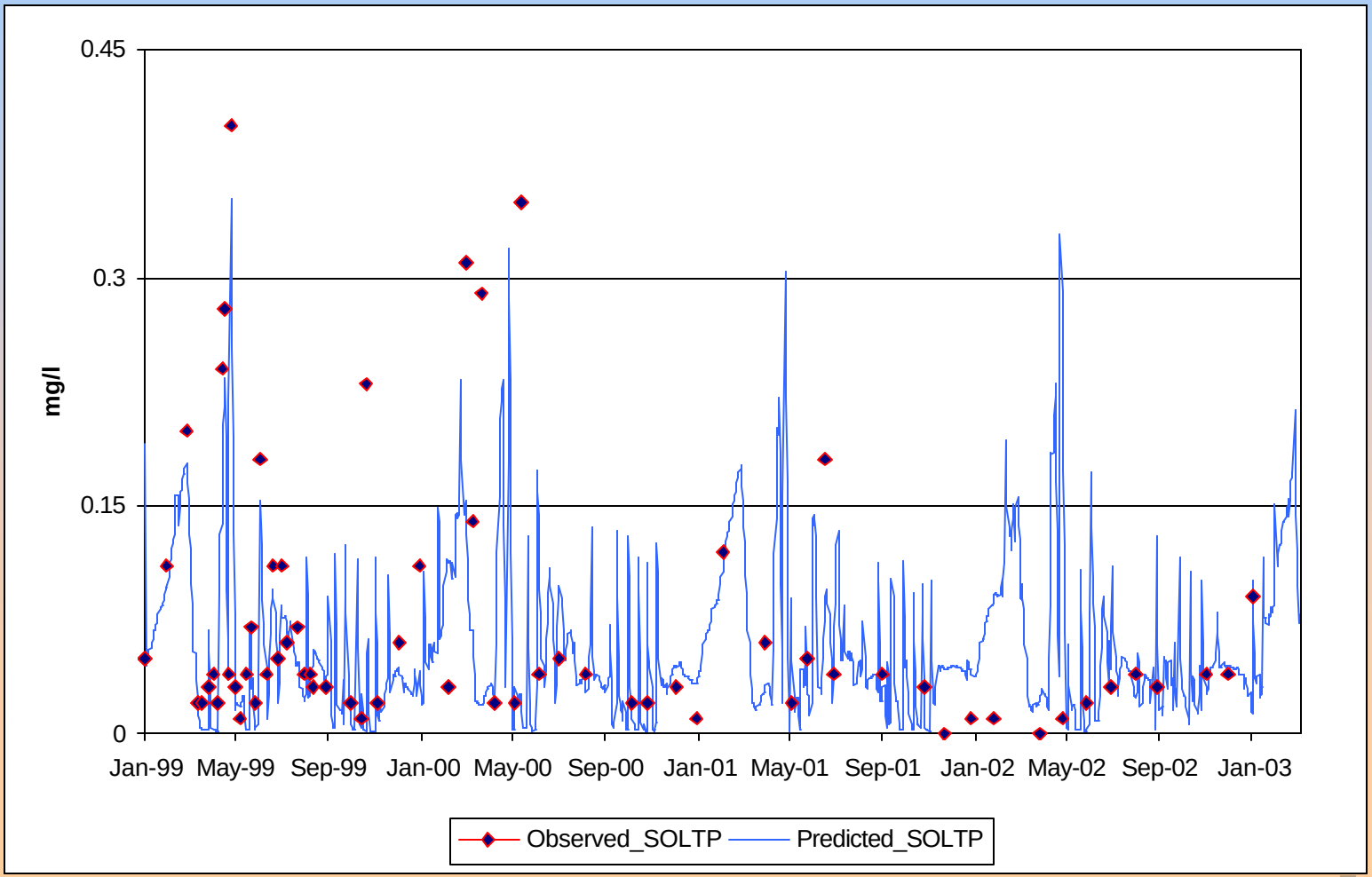
Daily Stream Flow

Hester Creek,1999-2003

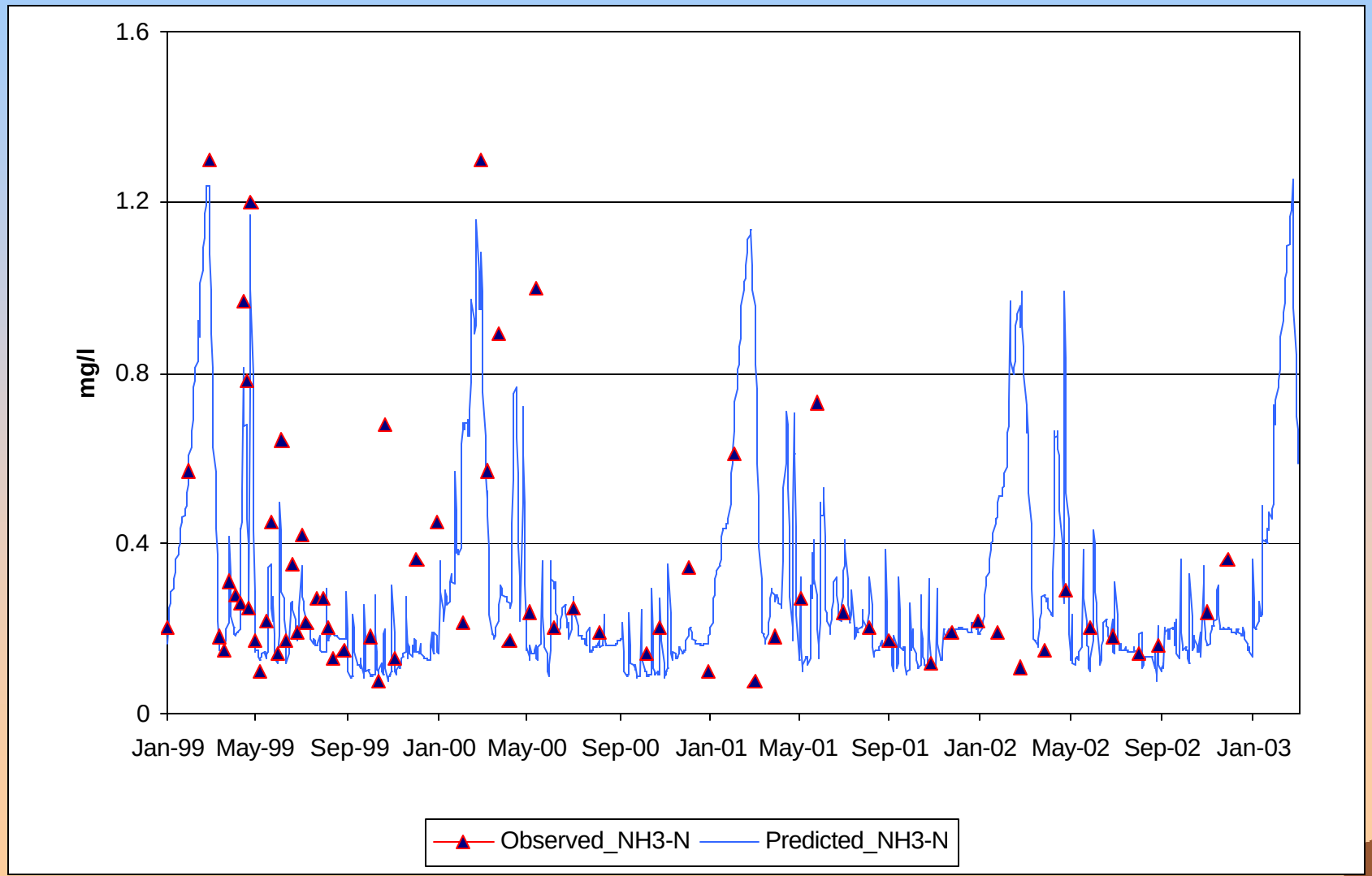


Observed and Model Predicted Total Soluble Phosphorous (mg/l)

Hester Creek,1999-2003

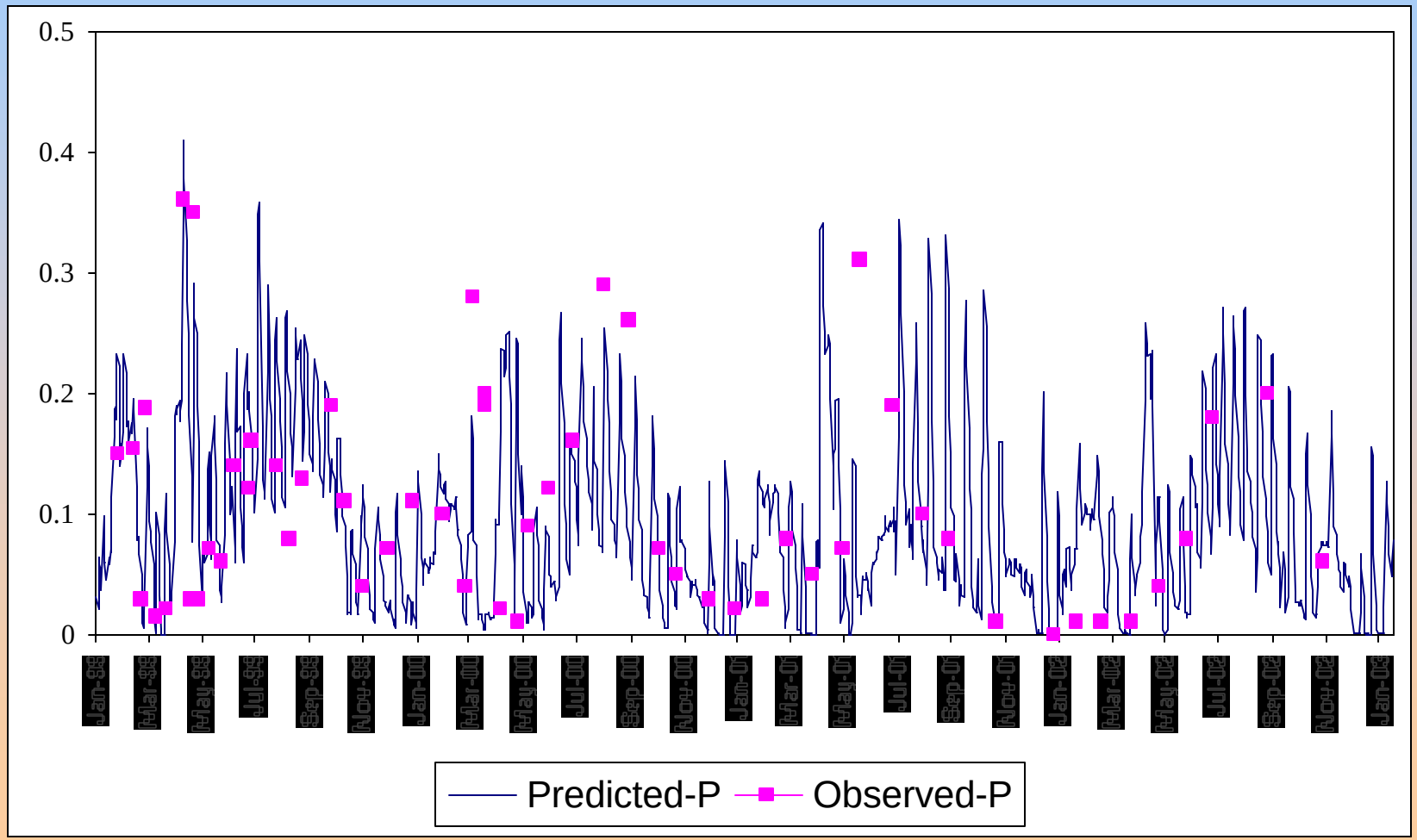


Observed and Model Predicted Total Ammonia-N Hester Creek, 1999-2003

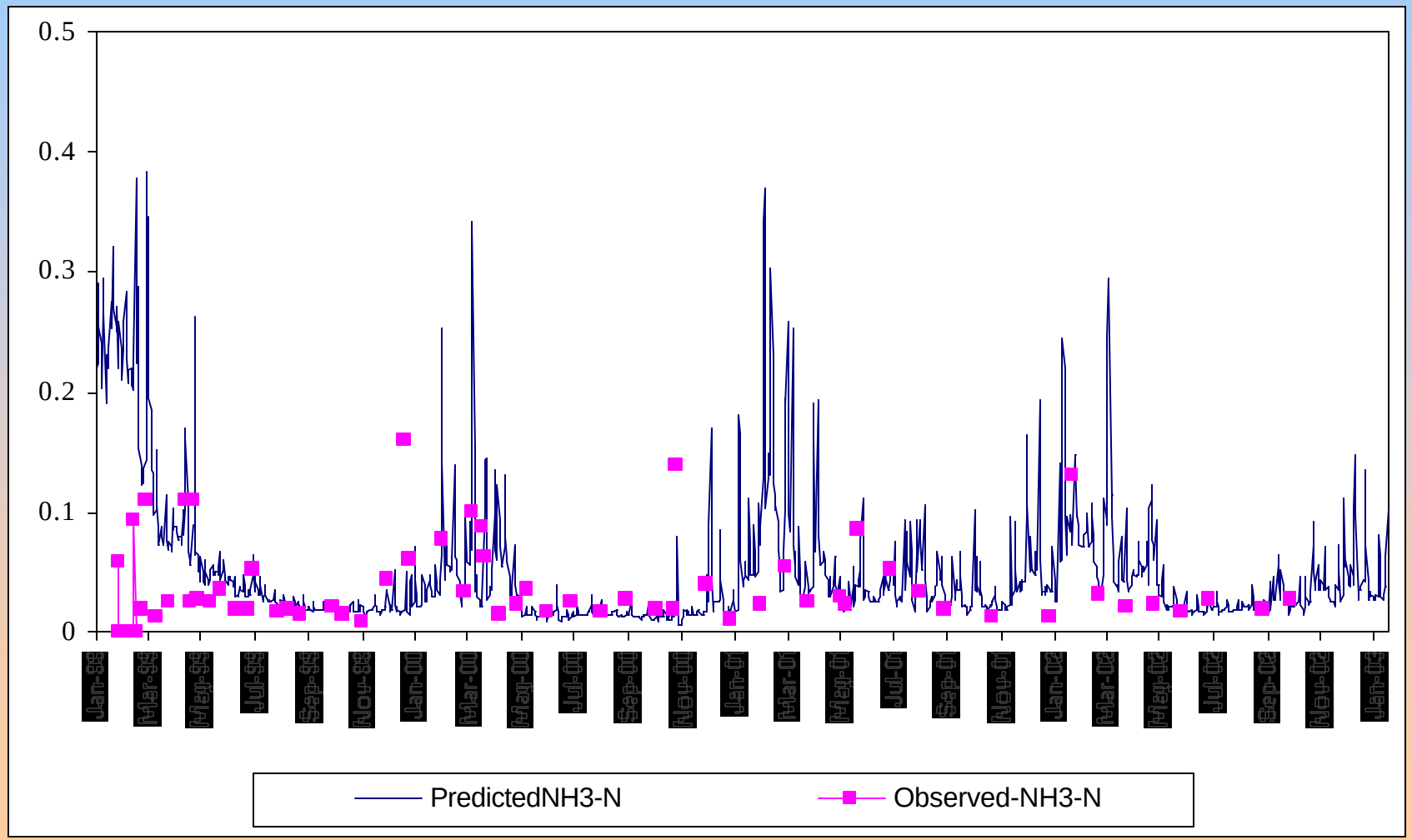


Observed and Model Predicted Total Soluble Phosphorous (mg/l)

Flint Brown,1999-2003



Observed and Model Predicted Total Ammonia-N
Flint Brown, 1999-2003



Conclusion

- AQUATOX can be used as tools for assessment of nutrient and sediment pollution. However, the AQUATOX model has large number of parameters that need to be adjusted for model.

- Measured data on discharge and other water quality parameters including NH3-N, TP, and TSS at multiple points in the watershed is critical for AQUATOX calibrations.

Cont'd

- The accuracy of the input parameters is critical for accurate model predictions.
- It has great potential to estimate recovery time for fish or invertebrates after reducing pollutant loads.

Thank you

Acknowledgements

-School of Agriculture and Environmental Science (AAMU)

-USDA-NRCS-SCAN-NWCC

-USDA-CSREES

-Southern Region Water Quality Program

-Alabama Agricultural Experiment Station

-All Collaborating Research Investigators and Students