Effects of Conservation Practices on Environmental Quality in Small Watersheds

ARS’ Benchmark Watershed Research Network

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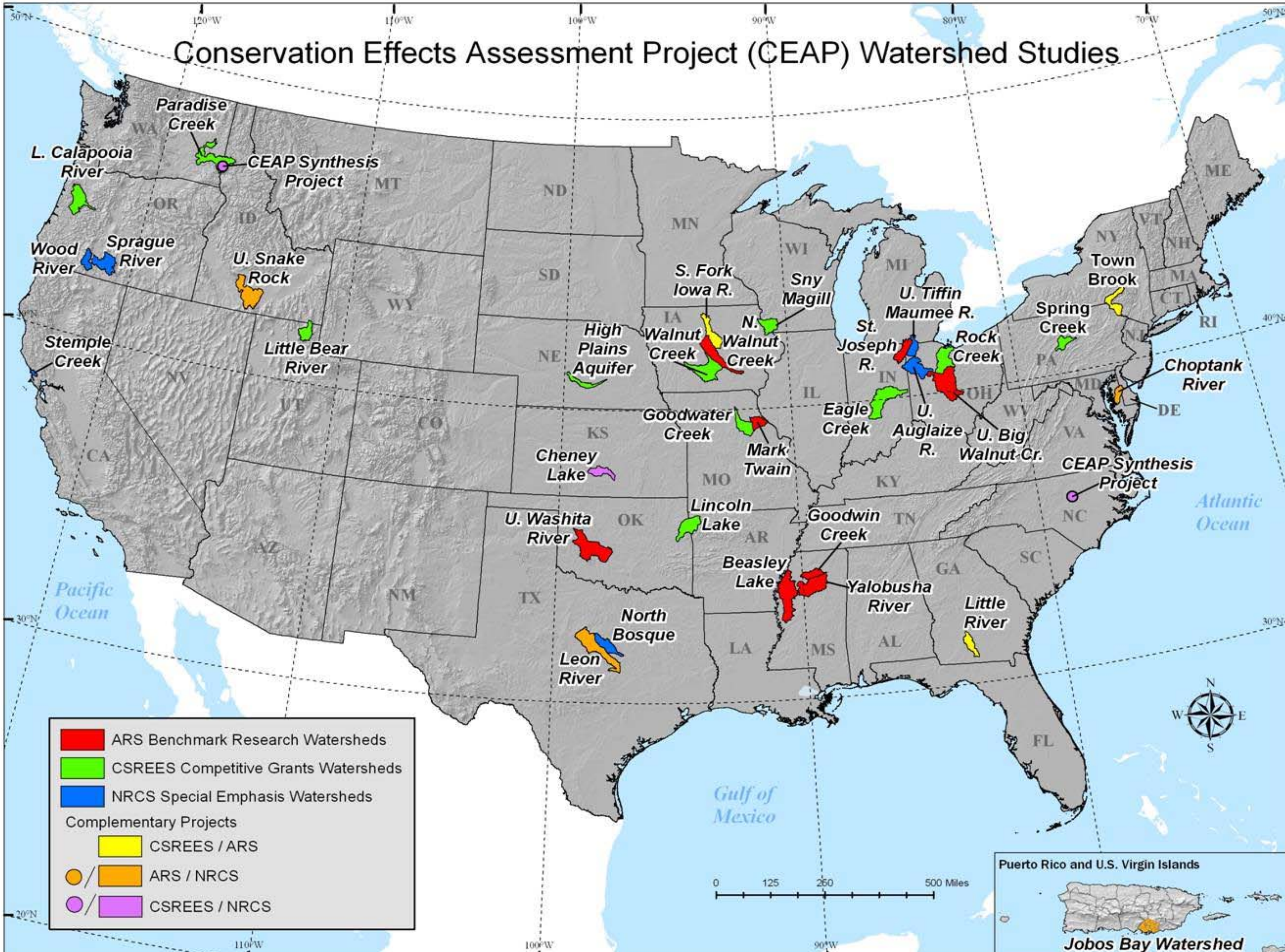
CEAP Watershed Studies

Objectives

- **Quantify the environmental benefits of conservation practices on croplands**
- **Determine how best to implement conservation practices in different regions of the US**
- **Produce a core body of scientific assessments that would help Farm Bill policy-makers and program managers optimize conservation investments to meet our nation's environmental, food, and fiber needs**

ARS' Benchmark Watershed Research Network

- **ARS established a network of 14 long term 'Benchmark' Watersheds that included:**
  - 12 existing ARS watersheds
  - 2 new watersheds [Choptank River, MD; Upper Snake Rock Creek, ID]
  - The size of existing watersheds was increased to conform to an 8-digit HUC scale
  - MO example: Goodwater Creek—originally 28 mi^2; Mark Twain > 2500 mi^2
- **Land use is primarily rain-fed agriculture except for Upper Snake Rock Creek, which is primarily irrigated agriculture.**
- **Most watersheds were selected in 2003/2004, became fully operational in 2004/2005, and now have 4-5 years of extant data.**


Conservation Effects Assessment Project (CEAP) Watershed Studies
Paradise Creek
CEAP Synthesis Project
L. Calapooia River
Wood River
Sprague River
U. Snake Rock
Little Bear River
Stemple Creek
High Plains Aquifer
S. Fork Iowa R.
Walnut Creek
N. Walnut Creek
Sny Magill
Goodwater Creek
Mark Twain
Cheney Lake
Lincoln Lake
U. Washita River
North Bosque
Leon River
Beasley Lake
Goodwin Creek
Yalobusha River
Little River
St. Joseph R.
U. Tiffin Maumee R.
Rock Creek
Eagle Creek
U. Auglaize R.
U. Big Walnut Cr.
Spring Creek
Town Brook
Choptank River
CEAP Synthesis Project
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
ARS Benchmark Research Watersheds
CSREES Competitive Grants Watersheds
NRCS Special Emphasis Watersheds
Complementary Projects
CSREES / ARS
ARS / NRCS
CSREES / NRCS
0 125 250 500 Miles
Puerto Rico and U.S. Virgin Islands
Jobos Bay Watershed

Specific Accomplishments

- **The Watershed Studies**
  - Theoretical and Empirical Assessment Of the Effects of Conservation Practices At the Watershed Scale
- **The STEWARDS Database**
  - ARS’ New Data Management & Storage System
- **The Future**

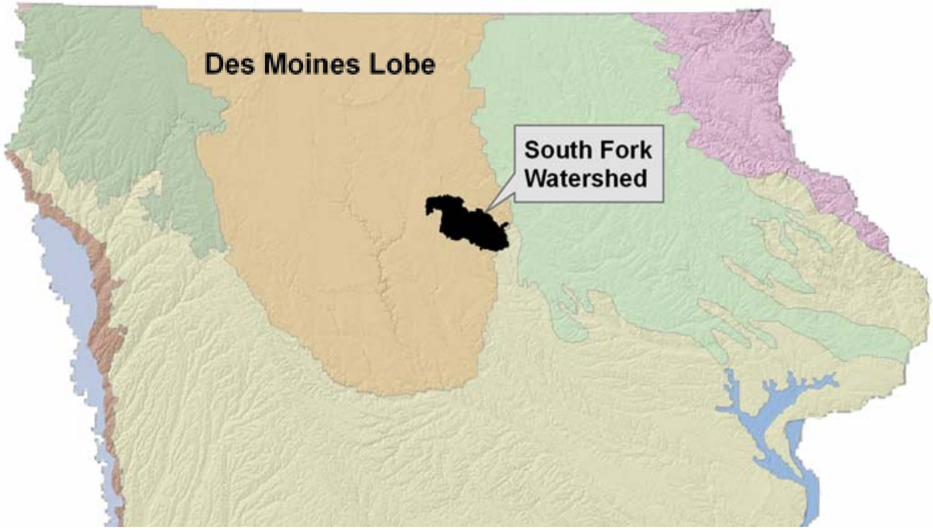
CEAP Special Issue
Nov-Dec 2008

Doug Karlen and Warren Busscher, Guest Editors

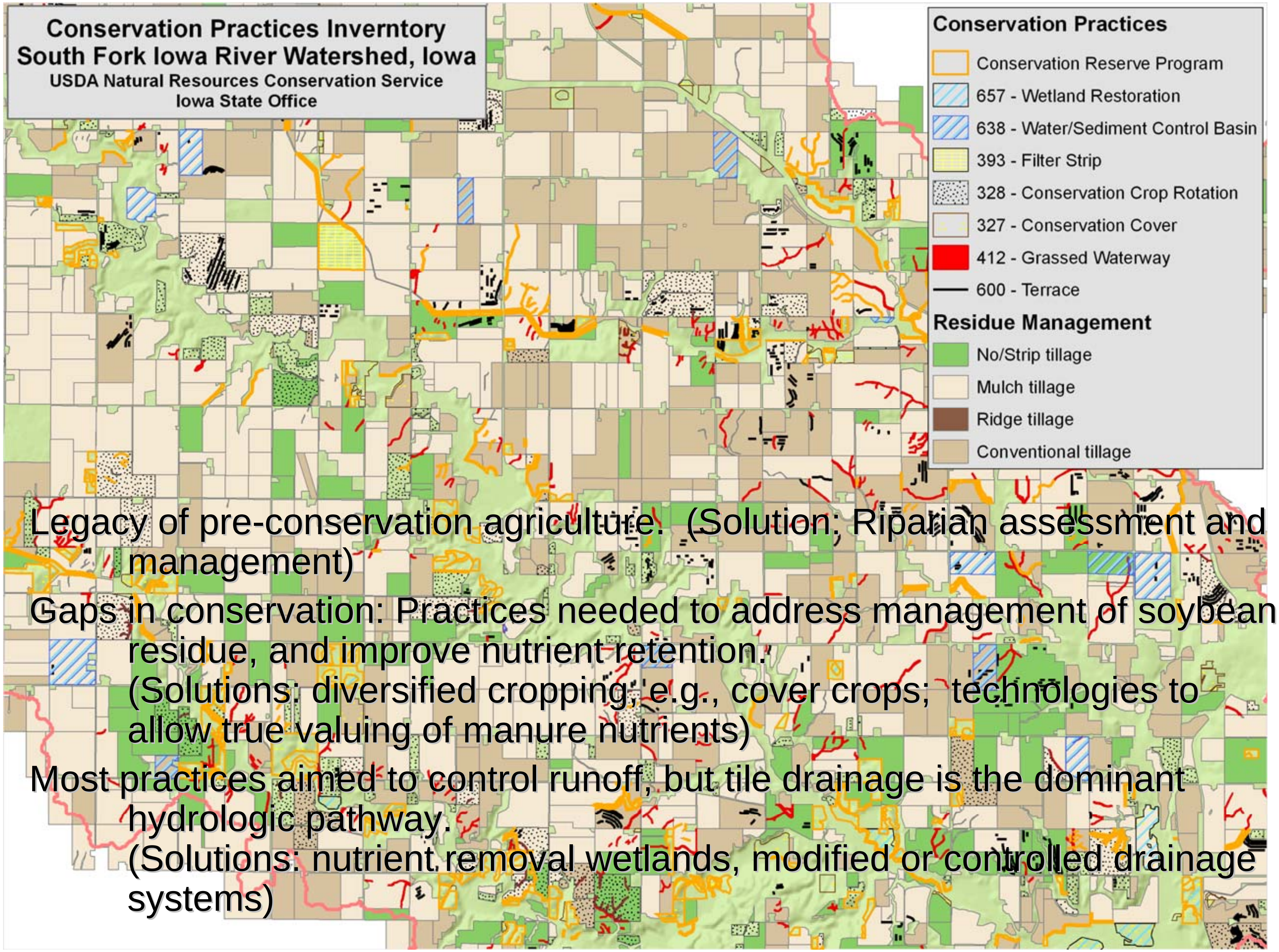
23 research and synthesis papers

South Fork of the Iowa River

Setting: recent glaciation; poorly drained soils; artificial drainage



An inventory of conservation practices in the South Fork Watershed revealed a nearly 80% rate of conservation-practice adoption, yet significant WQ problems.



- Legacy of pre-conservation agriculture. (Solution: Riparian assessment and management)
- Gaps in conservation: Practices needed to address management of soybean residue, and improve nutrient retention.
  (Solutions: diversified cropping, e.g., cover crops; technologies to allow true valuing of manure nutrients)
- Most practices aimed to control runoff, but tile drainage is the dominant hydrologic pathway.
  (Solutions: nutrient removal wetlands, modified or controlled drainage systems)

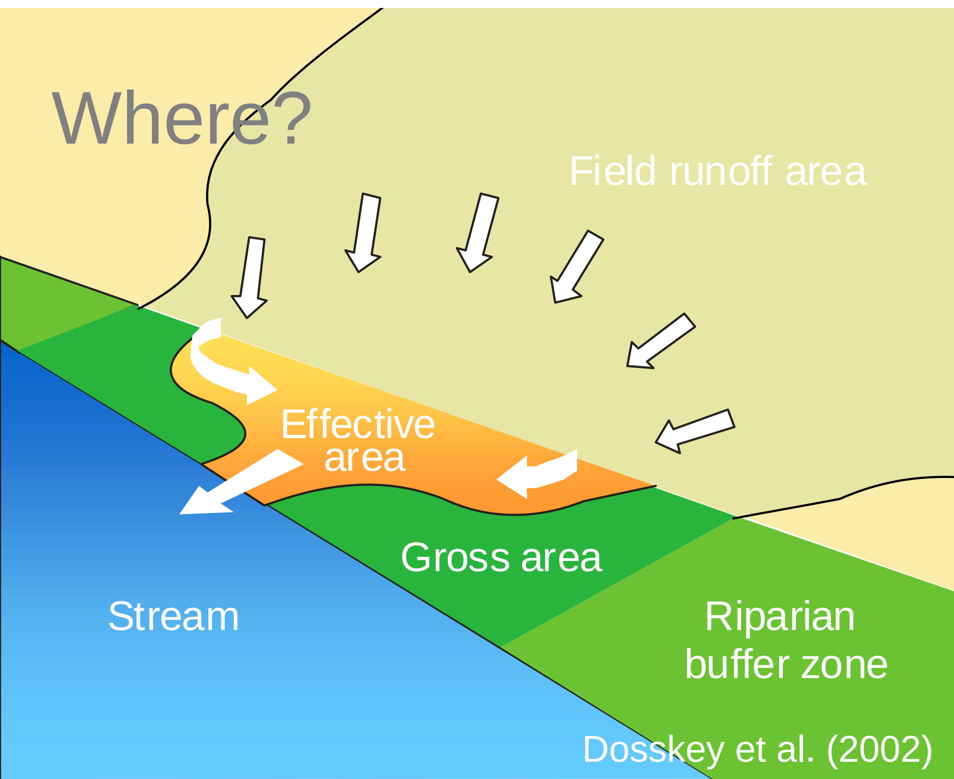
Requires knowledge of:

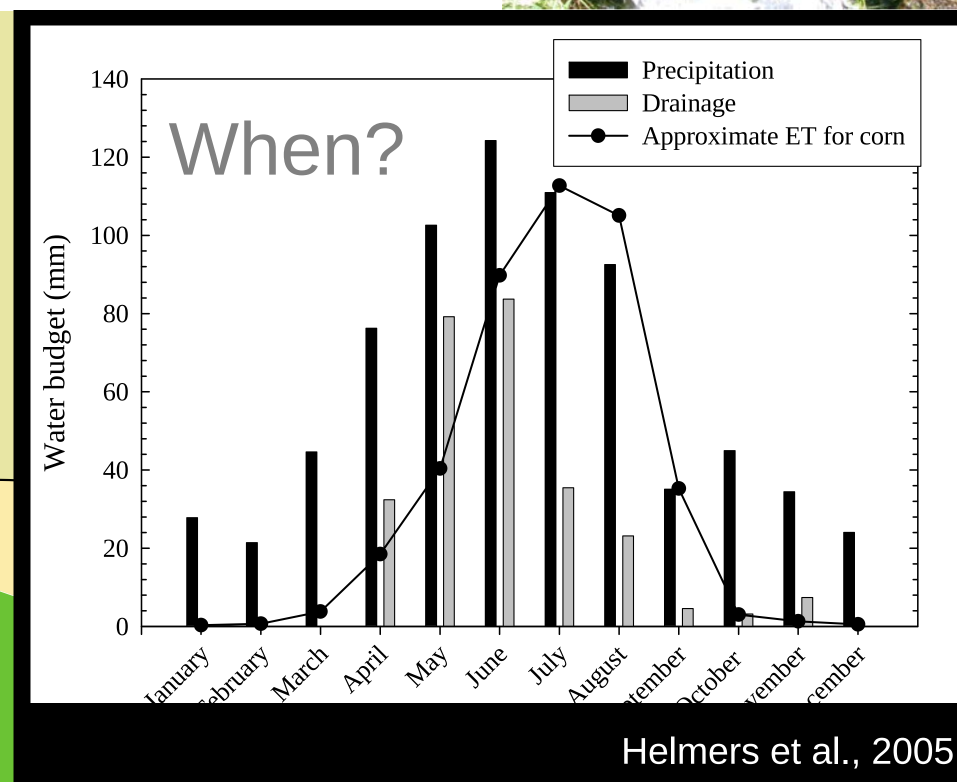
1) pollutants being transported
2) transportation pathways
3) timing of transport

Using this knowledge:

1) helps identify ways to trap or treat pollutants
2) ensures that conservation practices are as effective as possible

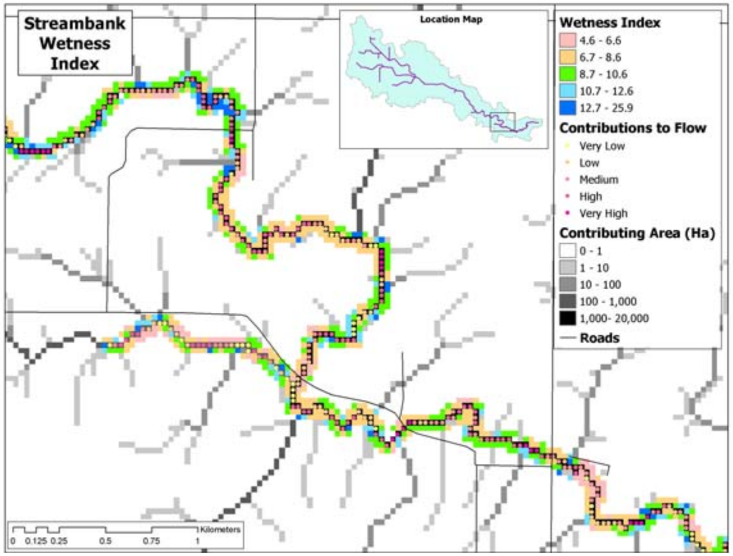
What pathway?

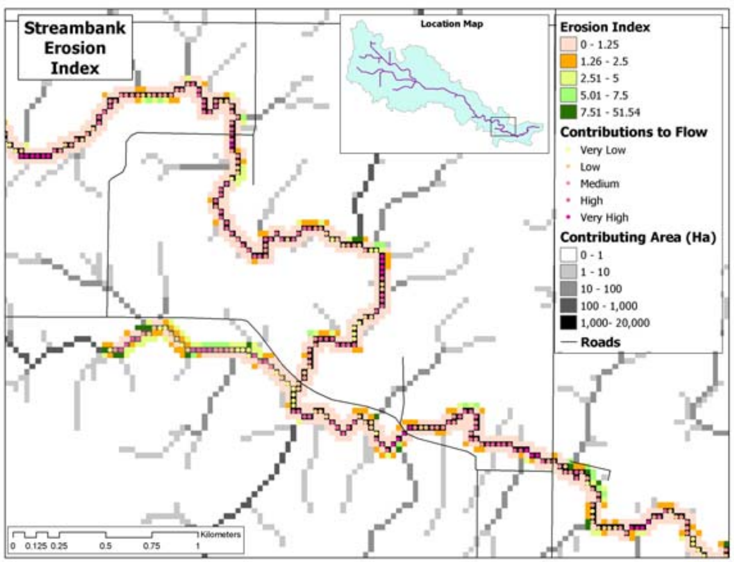




Precision Conservation Techniques

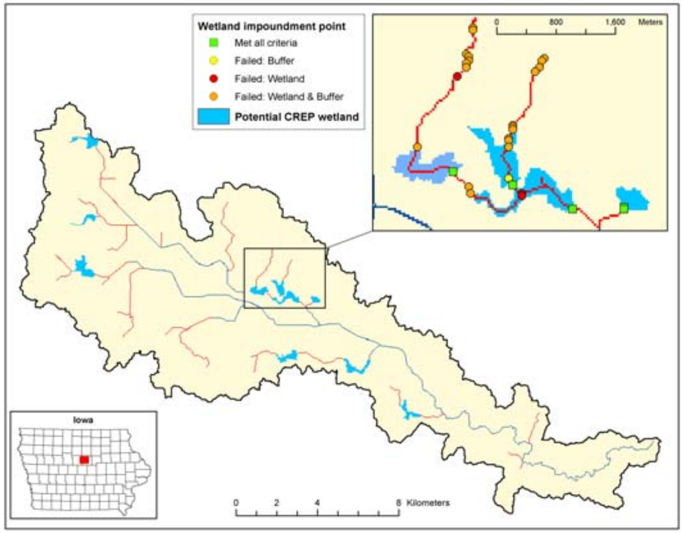
Placement of buffers



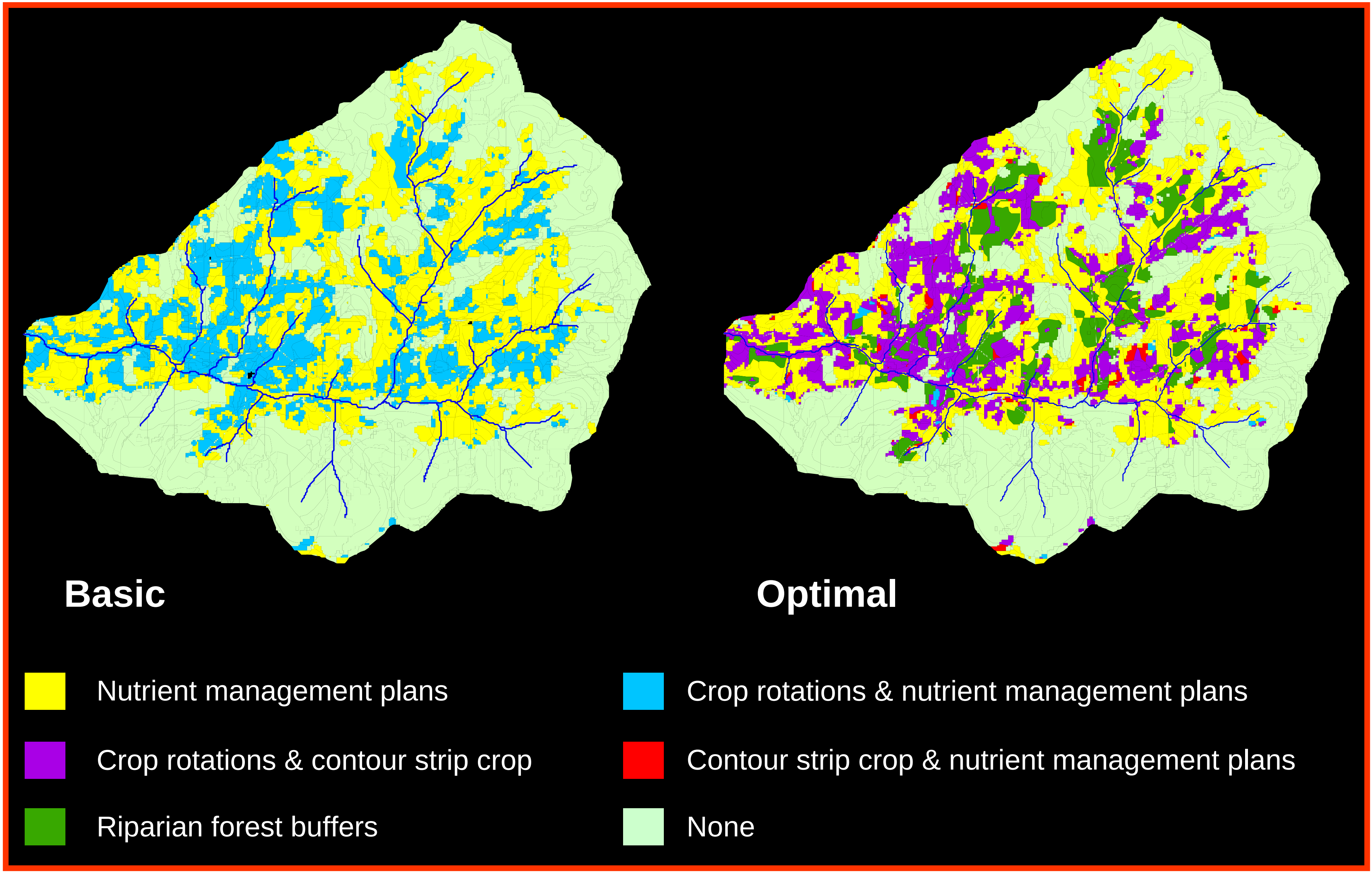


Conservation tools that target specific practices

Placement of wetlands



BMP placement in Town Brook lowers costs



Remote Sensing of Cover Crop Nutrient Uptake in the Choptank Watershed

- **Context:** Collaboration between USDA Agricultural Research Service (ARS) and Maryland Department of Agriculture (MDA)

- **Objective:** Evaluate the effects of cover crop implementation on nitrogen uptake and sequestration

MDA Cover Crop Programs

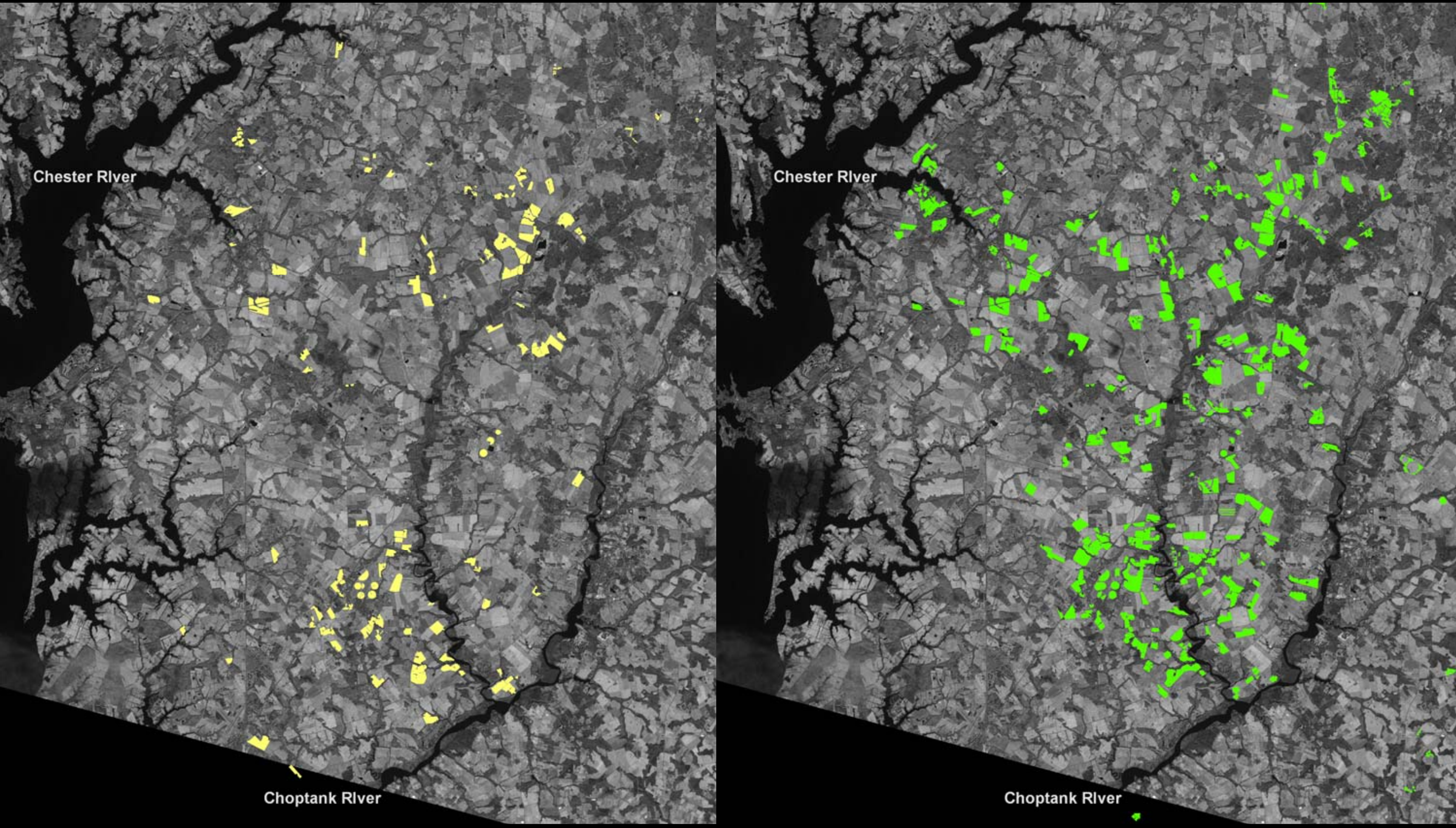
128,638 acres in 2005-6 ($4.7 million)
251,564 acres in 2006-7 ($8.5 million)
~250,000 acres in 2007-8 (~ $8 million)

Hulless barley cover crops can provide ethanol bioenergy and nutrient uptake – a double win for the environment and a new crop for the farmer

Nitrogen capture by winter cover crops reduces nutrient loss to the Chesapeake Bay ~ But, how much is actually captured?

Cover crop program implementation in the Choptank River Watershed

2005-2006 2006-2007



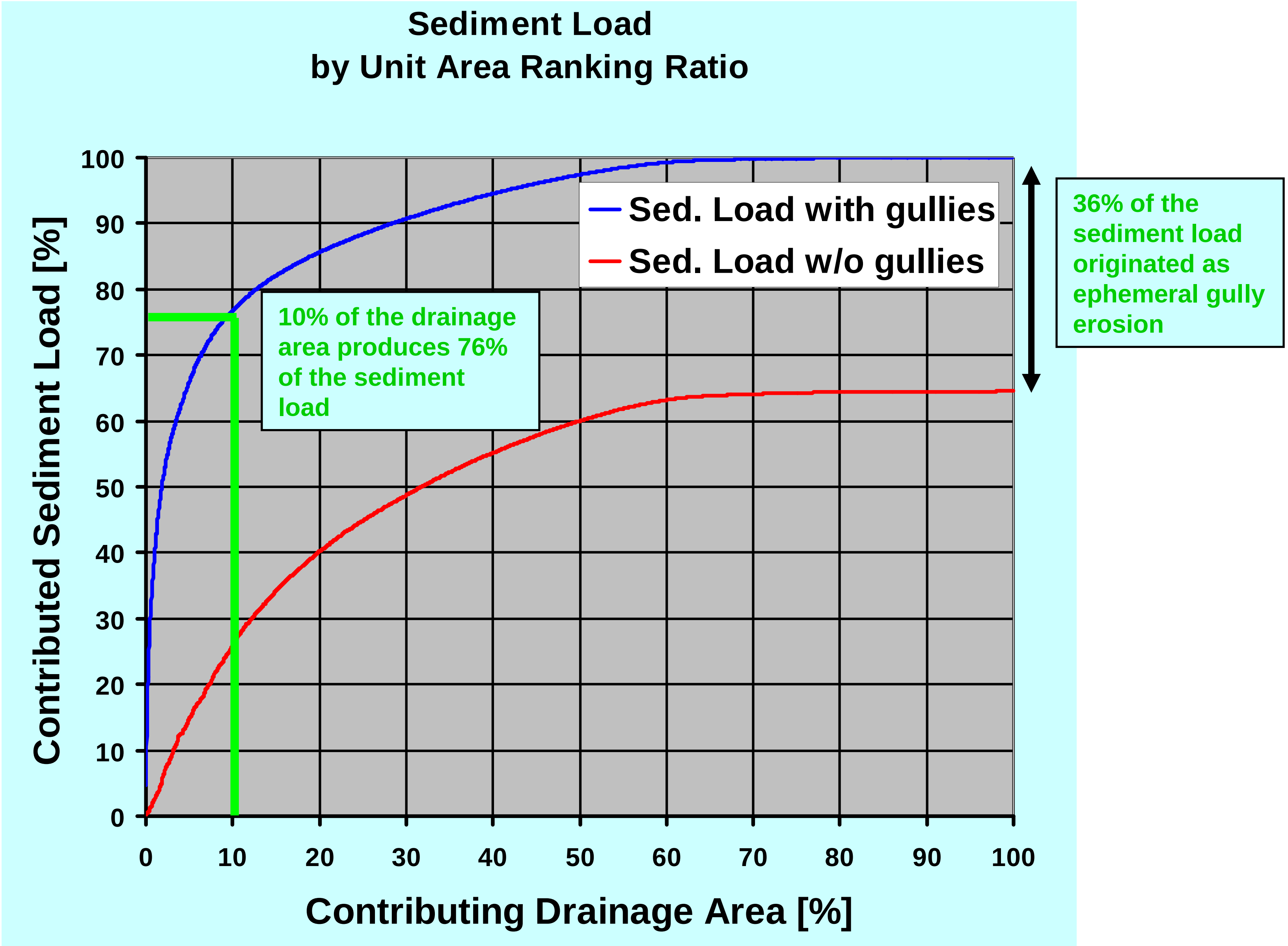
Identifying Sediment and Contaminant Sources and Transport Pathways Informs the Choice of Appropriate Conservation Practices

Concentrated Flow Sources--Major Contributor of Eroded Sediment

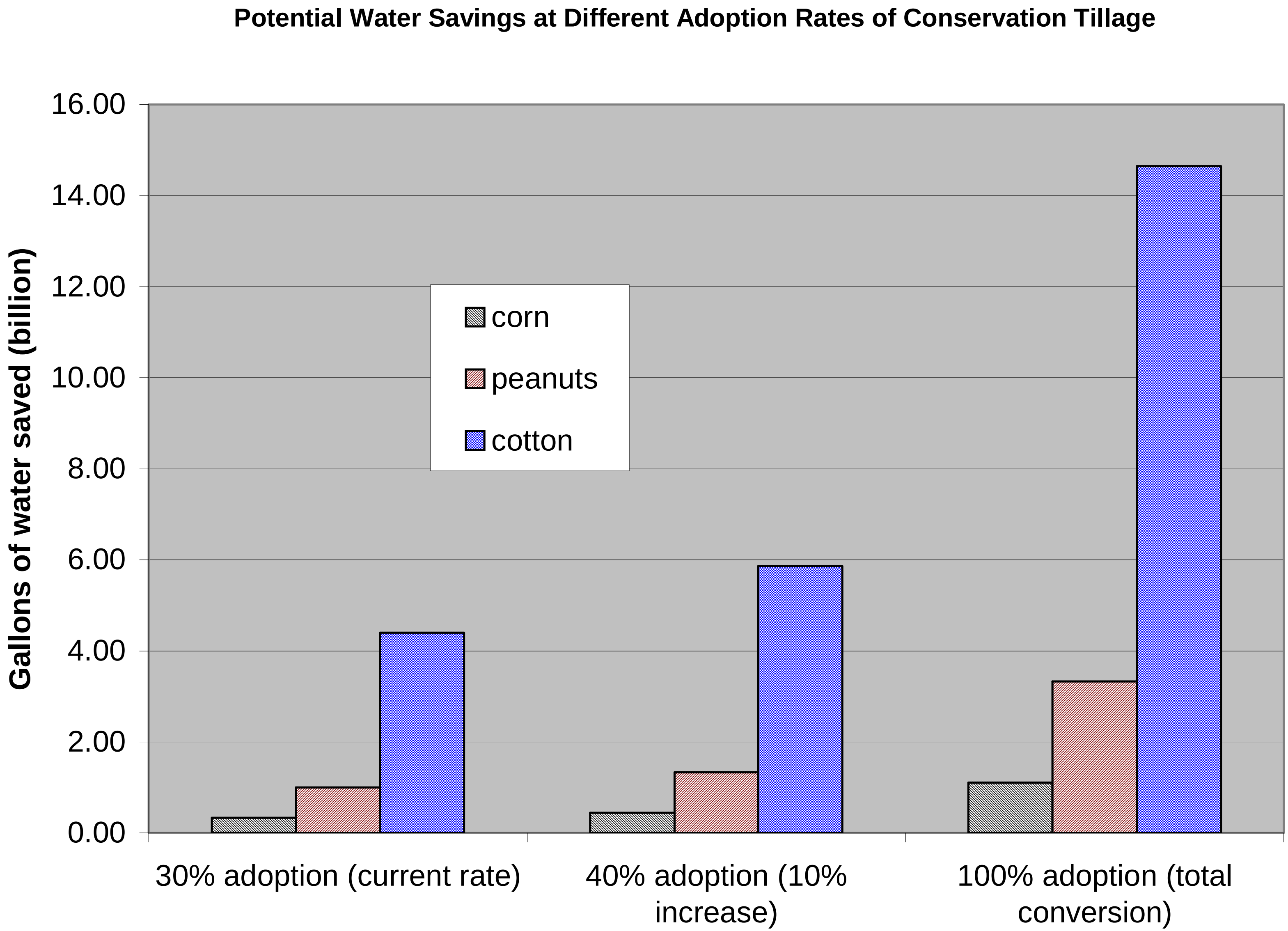
Sediment Sources Beyond RUSLE (Sheet & Rill Erosion) need to be Addressed

Watershed Physical Processes Research Unit – Oxford, MS

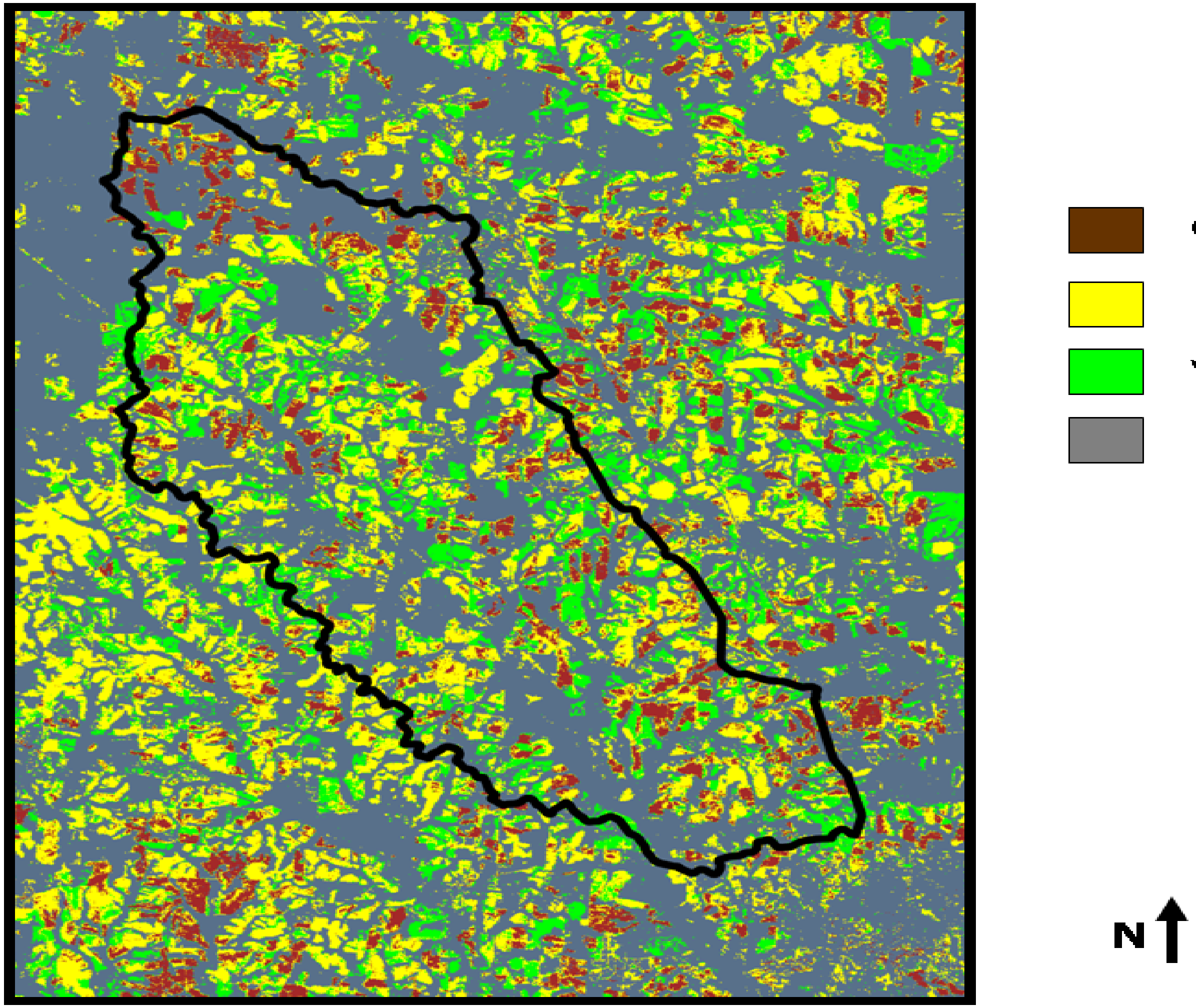
Kansas Cheney Lake CEAP Special Emphasis AGNPS Watershed Modeling



Conservation Tillage
Potential annual water savings—state of Georgia
Current adoption rate (30%) saves equivalent of 3-12 months of water used by city of Atlanta



Satellite-Derived Maps of Conservation Tillage could reduce efforts by >60% to verify producer compliance with cost-sharing programs



Satellite (Landsat5) derived conservation tillage map for the Little River Experimental Watershed and surrounding areas.

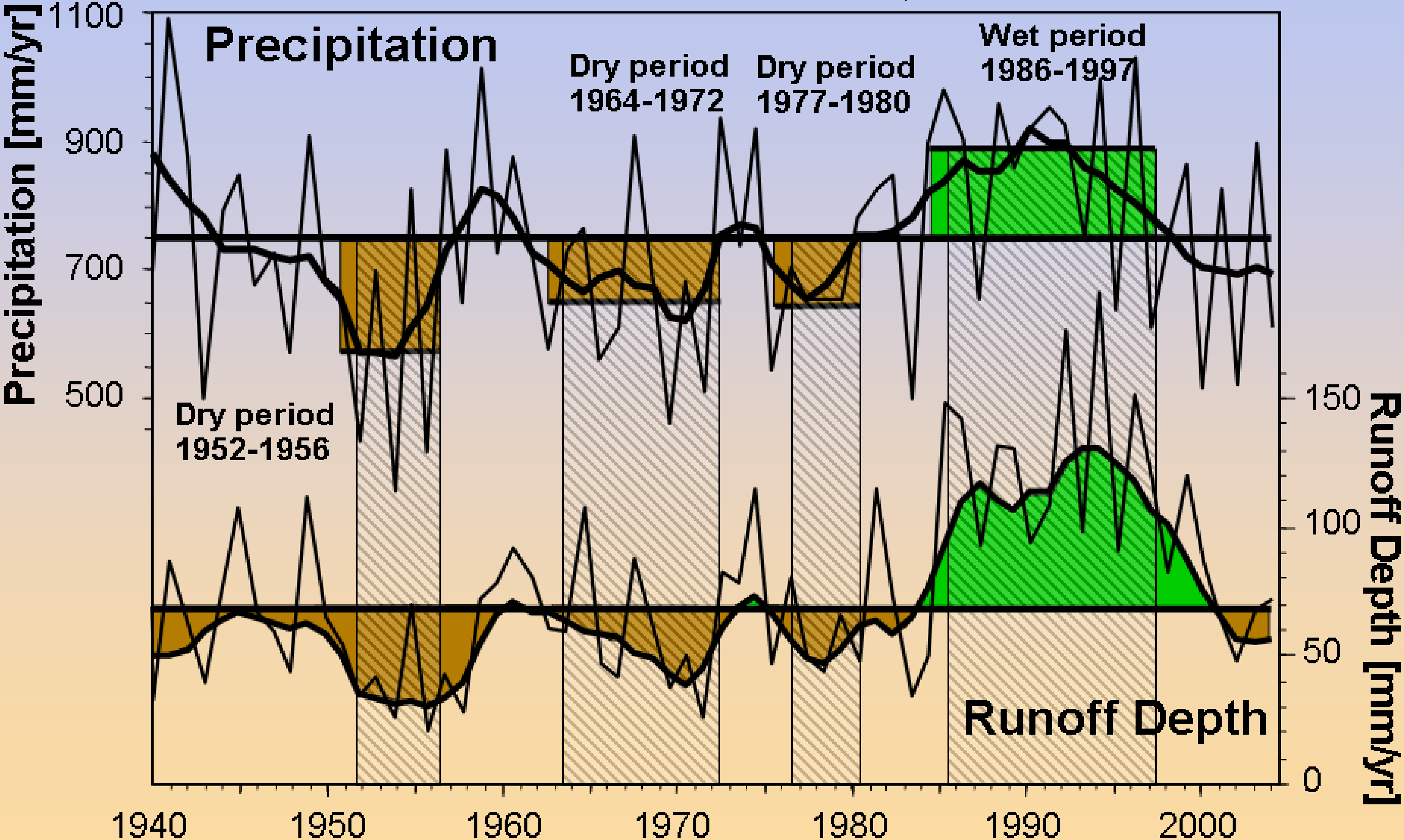
Importance Of Long-term Studies

Phenomena that are influenced by annual and/or inter-annual variability in hydrology or other factors require 8-10 years+ of data for accurate estimation/quantification.

No matter what else is needed in a watershed study, hydrology and weather will need long-term data for context

Dry and Wet Periods for Precipitation and Runoff Depth

Fort Cobb Reservoir Watershed; 1940-2005



Preliminary data, subject to revision

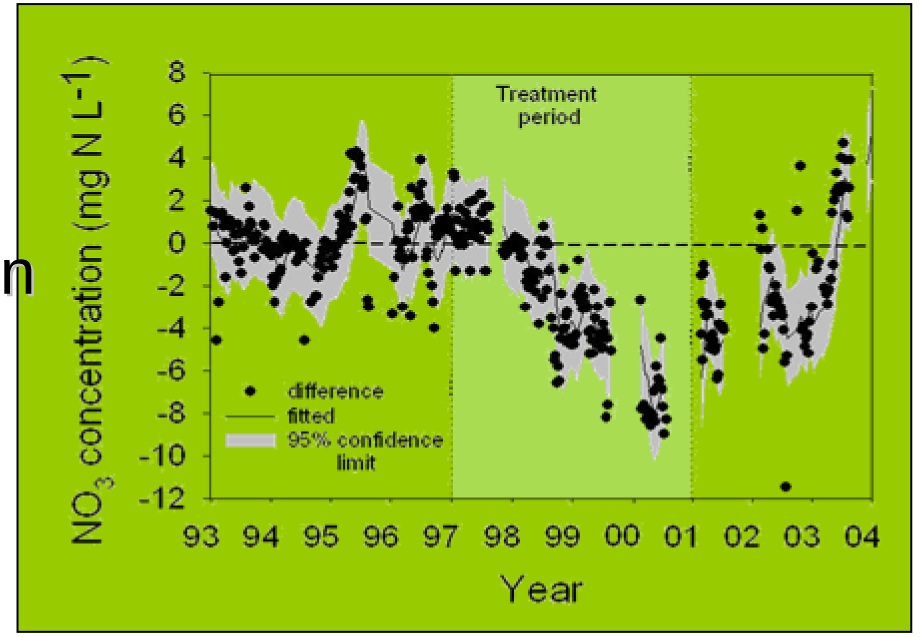
Atrazine Ecological Criteria at GCEW

Days Per Year Exceeding Levels of Concern

Year	14-d, 38 ppb	30-d, 27 ppb	60-d, 18 ppb	90-d, 12 ppb
1992	35	44	68	105
1993		6	34	66
1994				
1995	8	5		
1996	14	25	44	93
1997	18	30	56	89
1998				
1999				
2000				
2001	5	2		24
2002				16
2003				
2004		9	7	40
2005				59
2006	2	15	35	69

Quantify the impact of late spring nitrate test on NO_3 losses at watershed scale

- After 4 years managing N-fertilizer on 16 fields with LSNT, annual mean flow-weighted NO_3 concentrations in surface water reduced by ≥ 30% within a 366 ha watershed.



Sustaining the Earth's Watersheds

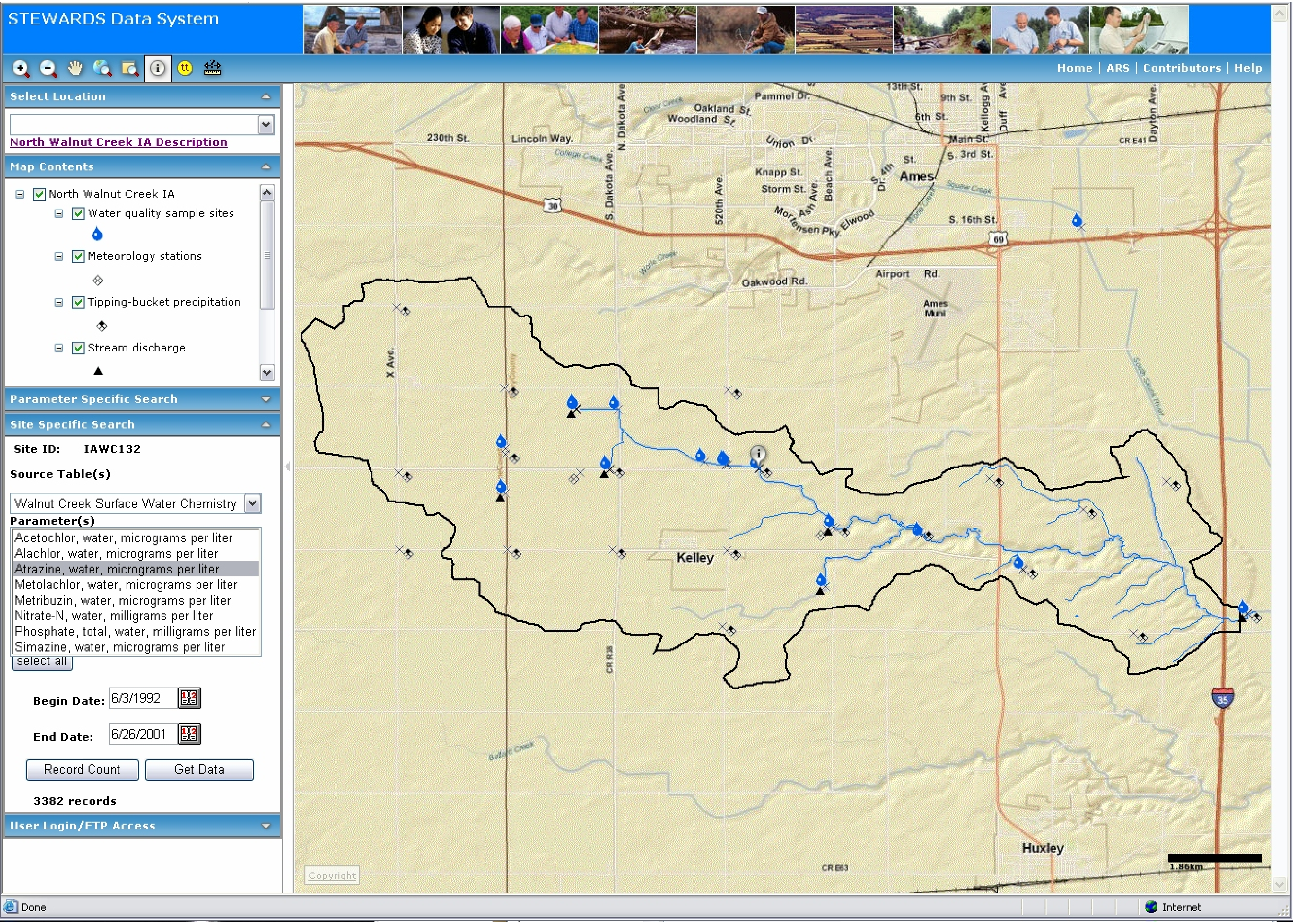
stewards

Agricultural Research Data System

○ 2002 Research Watersheds

□ CEAP Cropland Watersheds

⬭ Stewards development team


STEWARDS Data System
Home | ARS | Contributors | Help
Select Location
North Walnut Creek IA Description
Map Contents
North Walnut Creek IA
Water quality sample sites
Meteorology stations
Tipping-bucket precipitation
Stream discharge
Parameter Specific Search
Site Specific Search
Site ID: IAWC132
Source Table(s)
Walnut Creek Surface Water Chemistry
Parameter(s)
Acetochlor, water, micrograms per liter
Alachlor, water, micrograms per liter
Atrazine, water, micrograms per liter
Metolachlor, water, micrograms per liter
Metribuzin, water, micrograms per liter
Nitrate-N, water, milligrams per liter
Phosphate, total, water, milligrams per liter
Simazine, water, micrograms per liter
select all
Begin Date: 6/3/1992
End Date: 6/26/2001
Record Count
Get Data
3382 records
User Login/FTP Access
Ames
Kelley
Huxley
Lincoln Way
230th St.
Oakwood Rd.
Airport Rd.
S. 16th St.
Ames Muni
X Ave.
520th Ave.
S. Dakota Ave.
N. Dakota Ave
Oakland St.
Woodland St.
Pammel Dr.
Union Dr.
Knapp St.
Storm St.
Mortensen Pky.
Elwood
Main St.
S. 3rd St.
13th St.
9th St.
6th St.
Kellogg Ave.
Duff Ave.
Dayton Ave.
CR E41
CR R38
CR E63
30
69
35
1.86km
Copyright
Done
Internet

STEWARDS Benefits

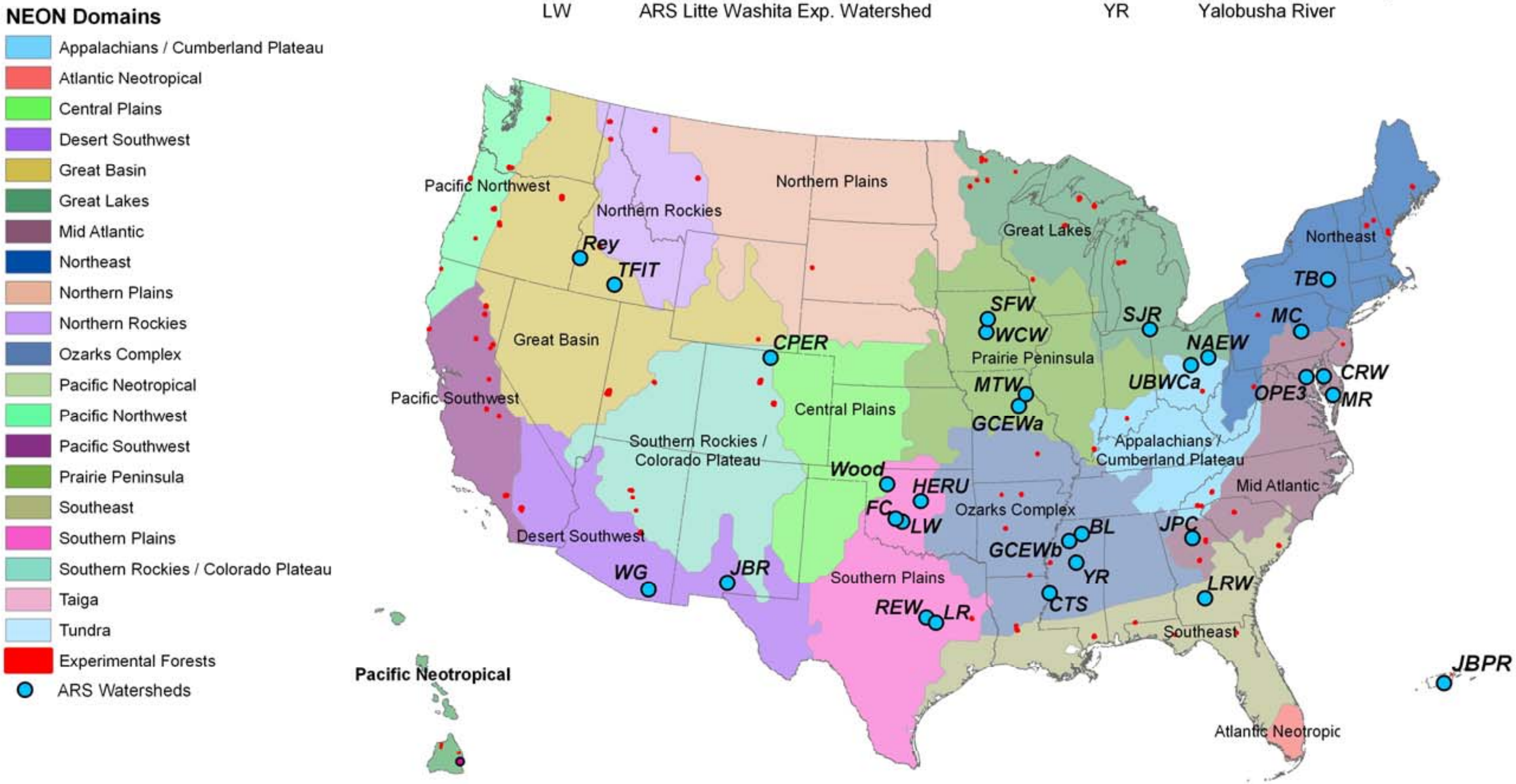
- **The STEWARDS collection of ARS data is much bigger, higher quality, more visible, and higher impact than any individual unit's presence could be**
  - i.e., **The whole is more than the sum of the parts (let alone any part)**
  - Metadata search engines add visibility to a wider audience
  - Metadata delivery and organization raise the confidence in the data and raise the chances it will be used properly
  - CUAHSI and NASA's database-to-database links are possible
  - STEWARDS has brand name recognition at agency and department level
- **STEWARDS has an extremely powerful interface**
  - The interface allows familiar and modern access
  - Search capabilities dwarf those of ASCII structures
  - Uniform visualization and queries speed multiple-location retrievals
  - Ease of use and retrieval should make STEWARDS the preferred method
- **Data delivery is a high ARS/USDA priority, and STEWARDS is a model**
  - CSREES and possibly NRCS watersheds are planning to go to STEWARDS
  - Similar databases for REAP, Gracenet, and air quality data
- **Local watersheds benefit from modern data management methods**
  - Example data structure simplifies decisions for new watersheds
  - Accrue efficiencies in future watershed data management operations
  - Data management training for staff is useful in other research projects

ARS' Benchmark Watershed Research Network

Watersheds	@30
States*	17
Established	1912 - 2007
Record (yrs)	1 - 93
Area (km^2)	0.2 - 5208
CEAP Croplands	15
CEAP Grazing Lands	2 (8)
CEAP Wetlands	2
2007 NEON RFP	3 (19)
LTER	2
WATERS	1
NEON Domains	12
ARS Management Areas	8
HUC Regions	12 (of 21)

ARS Benchmark Watershed Research Network

Code		Code	
BL	Beasley Lake	MC	ARS Mahantango Creek Exp. Watershed
CPER	Central Plains Exp. Range/Short Grass Steppe LTER	MR	Manokin River
CRW	ARS Choptank Watershed	MTW	Mark Twain
CTS	Cabin-Teele Sub-Watershed	NAEW	N. Appalachian Exp. Watershed
DLRS	Deep Loess Research Station	OPE3	ARS OPE3
FC	ARS Fort Cobb Reservoir Exp. Watershed	REW	ARS Riesel Exp Watersheds
GCEWa	ARS Goodwater Creek Exp. Watershed	Rey	ARS Reynolds Ck. Exp. Watersheds
GCEWb	ARS Goodwin Creek Exp. Watershed	SFW	South Fork of the Iowa River Watershed
HERU	Hydraulic Engineering Research Unit	SJR	St. Joseph River
JBPR	Jobos Bay, Puerto Rico	TB	Town Brook
JBR	Jornada Basin-Range	TFIT	Twin Falls Irrigation Tract
JPC	JPC	UBWCa	Upper Big Walnut Creek - A1
LRWa	Little River Watershed, GA	WCW	Walnut Creek
LRWb	Leon River	WG	ARS Walnut Gulch Exp. Watersheds
LW	ARS Litte Washita Exp. Watershed	YR	Yalobusha River



Solving Future Problems For Agriculture

- ‘Problem Solving’ Strategies That Draw Upon ARS’ Benchmark Watershed Research Network
  - Strengthening Rural Communities Through Market-Based Environmental Stewardship
  - Watershed-scale Restoration Efforts
  - Water Implications of Biofuel Production
  - Short- and Long-Term Effects of Climate Change on Water Availability
  - Increasing Water Use Efficiency/Water Reuse/Water Management
  - Large-scale Water Quality Problems (Gulf Hypoxia; Chesapeake Bay)
  - Agricultural Component of a National Water Census

Summary

- 30 Watersheds With Significant Geographic Extent Across the US and Important Linkages to Other Networks and Programs
- This Network Can Serve As a Research Platform To Help Solve Future Problems For US Agriculture

Acknowledgments

- All of the ARS Scientists and Locations That Contributed To This Presentation