Improving Water Quality Across the Landscape

Thomas J. Casadevall

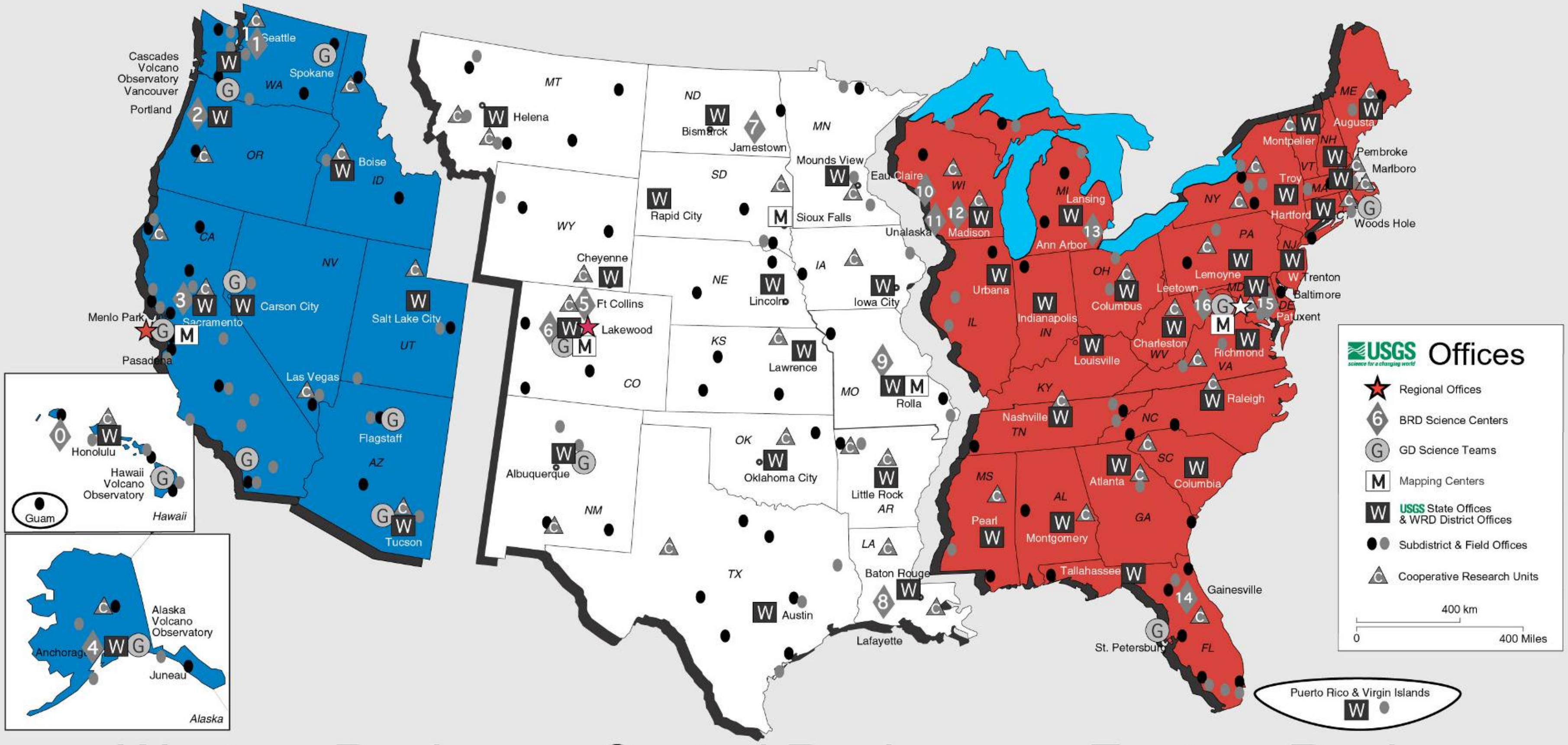
Regional Director

U.S. Geological Survey
Denver, Colorado

U.S. Department of the Interior
U.S. Geological Survey

US Geological Survey Regions

Location of Major Offices



Western Region

Menlo Park, CA

0. Pacific Island Ecosystems Research Ctr.
1. Western Fisheries Research Ctr.
2. Forest & Rangeland Ecological Science Ctr.
3. Western Ecological Researsch Ctr.
4. Alaska Biological Science Ctr.

G-Anchorage AK Alaska Volcano Observatory
G-Flagstaff AZ Flagstaff Field Center
G-Tucson AZ Tucson Field Office
G-Menlo Park CA Western Region
G-Hawaii Hawaii Volcano Observatory
G-Reno NV Reno Field Office
G-Vancouver WA Cascades Volcano Observatory
G-Spokane WA Spokane Field Office

Central Region

Lakewood, CO

5. Mid-Continent Ecological Science Ctr.
6. Ctr. for Biological Informatics
7. Northern Prairie Wildlife Research Ctr.
8. National Wetlands Research Ctr.
9. Columbia Environmental Research Ctr.

G-Lakewood CO Central Region
G-Golden CO National Earthquake Info Ctr.
G-Albuquerque NM Albuquerque Seismological Lab
M-Lakewood CO Rocky Mountain Mapping Center
M-Rolla MO Mid-Continent Mapping Center
M-Sioux Falls SD EROS Data Center

Eastern Region

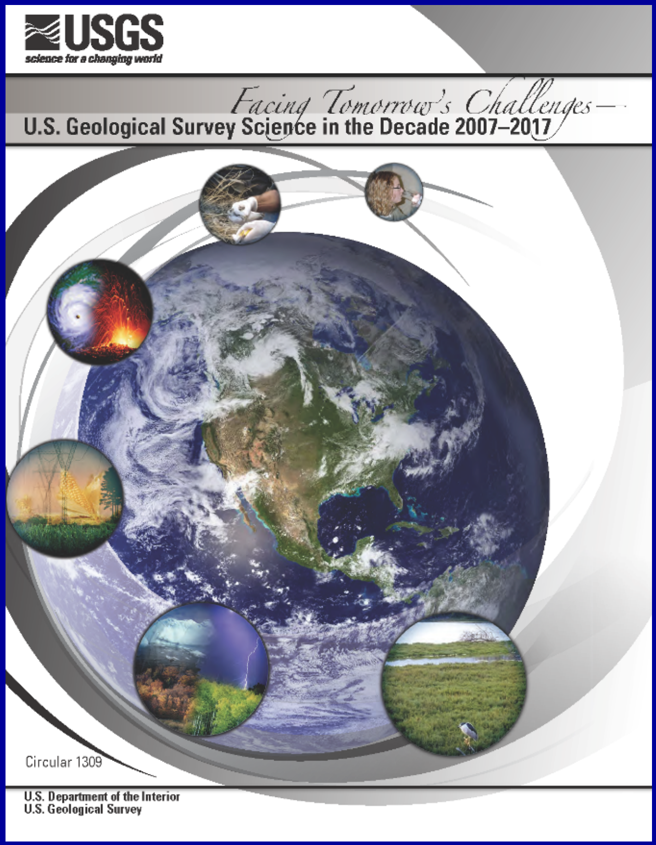
Reston, VA

10. Environ. Mgt. Tech. Ctr.
11. Nat'l Wildlife Health Ctr.
12. Upper Mississippi Science Ctr.
13. Great Lakes Science Ctr.
14. Florida & Caribbean Science Ctr.
15. Patuxent Wildlife Research Ctr.
16. Leetown Science Ctr.

G-Reston VA Eastern Region
G-St Petersburg FL Center for Coastal Geology
G-Woods Hole MA Woods Hole Field Center
M-Reston VA Mapping Applications Center

USGS Science Disciplines

- Biology
- Geology
- Geography
- Water
- Geospatial Information



Science Strategy 2007-2017

- Ecosystems
- Global Change
- Energy and Minerals
- Hazards
- Human Health
- Water Census
- Data Integration

USGS Research Interests related to Agriculture

- Evaluating Ag Effects on Terrestrial and Aquatic Ecosystems
- Watershed, Reservoir, Aquifer, and Wetlands Assessments
- Agricultural Contaminants (chemical, microbial)
  - Status and trends
  - Sources, transport, and fate
  - Predictive models
  - Emerging contaminants
  - Methods research and development
- Trends in Agricultural Land and Water Use
- Global Climate Change Research (Carbon Cycling)
- Geochemistry of Soils and Stream Sediments

USGS

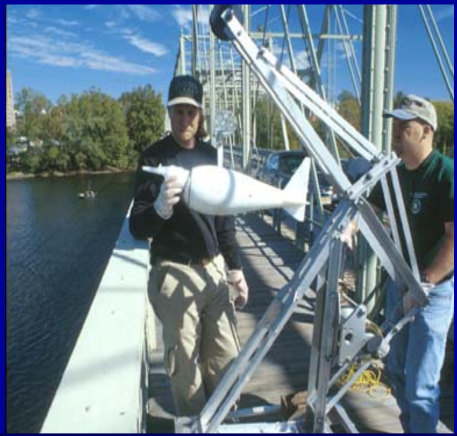
Assets USGS Brings

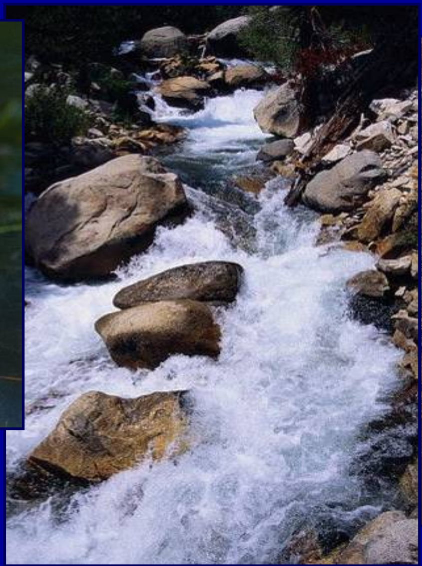
- Long-term monitoring, assessment, and research infrastructure for collaborative study
- Interdisciplinary expertise and capability nationwide, internationally
- Collaborations
  - Scientist to scientist
  - Program to program
  - Regional/National

USGS

Breadth of Studies

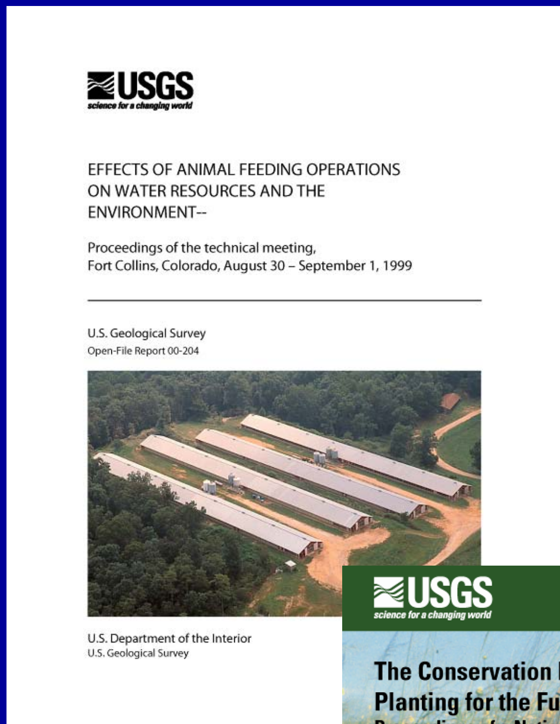
- Field Monitoring/Assessment
- Analytical Methods/Controlled Lab Research
- Source Pathways/Watershed Process, Transport, Fate
- Human/Biota Effects

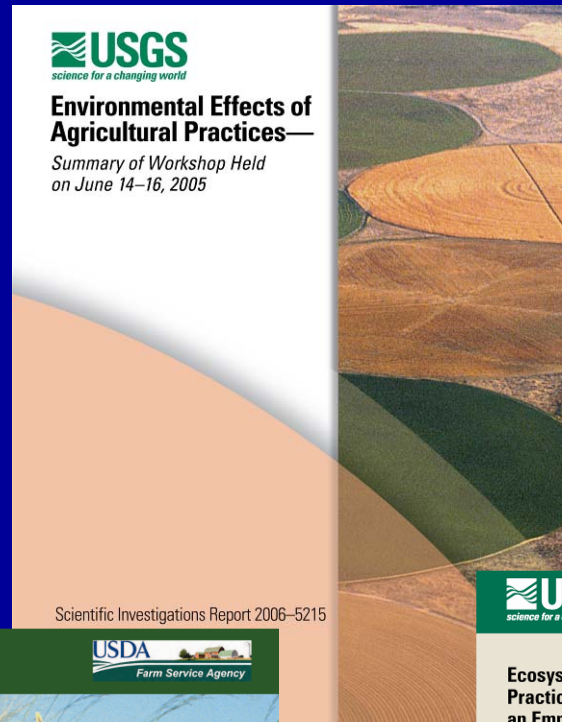


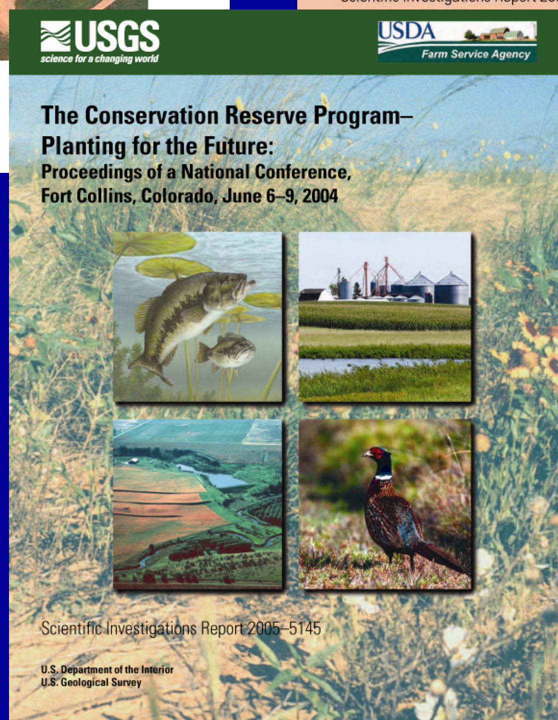


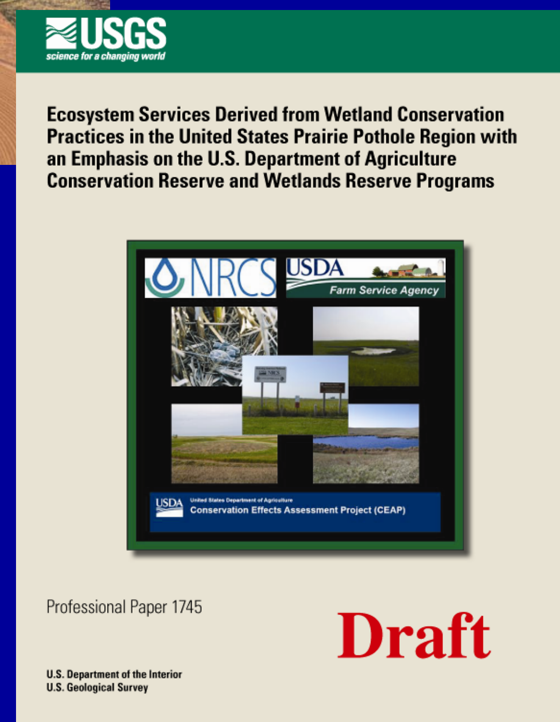
USGS

Reports









USGS

Fact Sheets


USGS science for a changing world — Natural Resources Canada / Ressources naturelles Canada

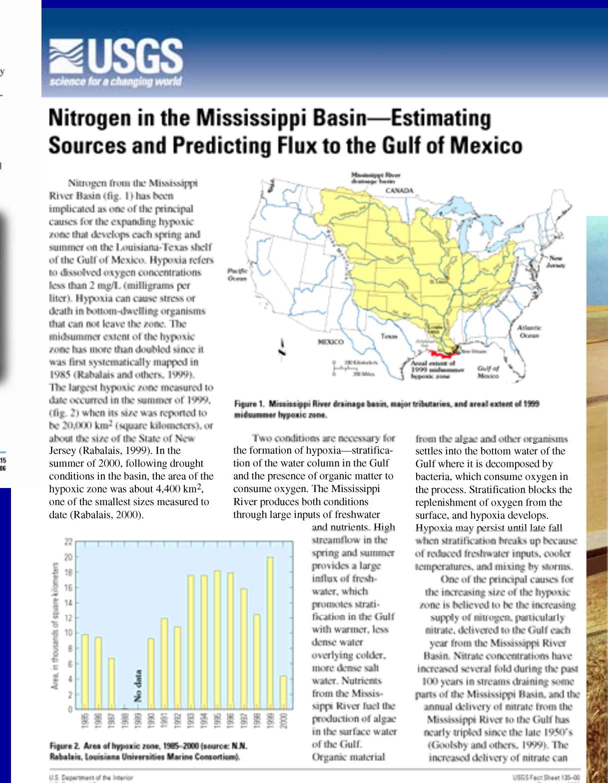
Natural and Man-Made Chemicals in North American Soils—Continental-Scale Pilot Study Completed

Introduction

Project Status

A USGS scientist collecting soil samples in southern New Mexico. Samples were collected approximately every 40 km along two transects.

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet 2006–3115
October 2006

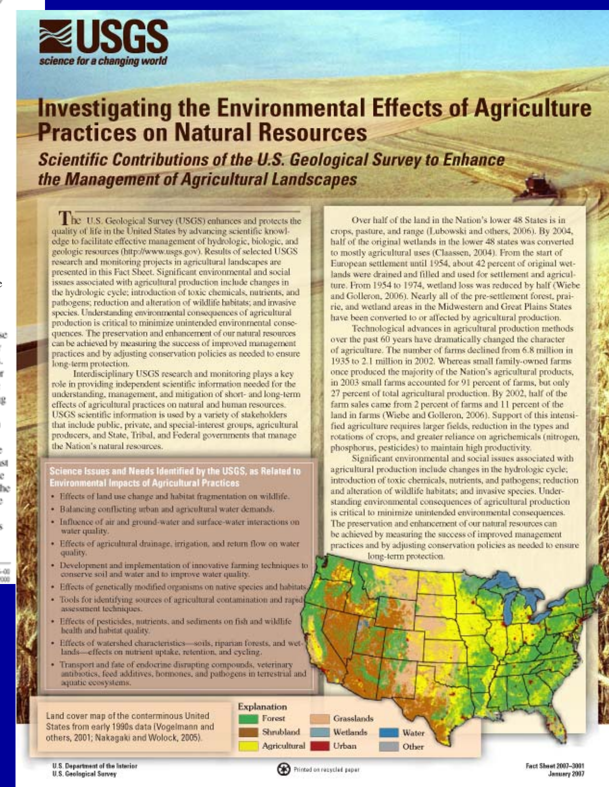

USGS science for a changing world

Nitrogen in the Mississippi Basin—Estimating Sources and Predicting Flux to the Gulf of Mexico

Figure 1. Mississippi River drainage basin, major tributaries, and areal extent of 1999 midsummer hypoxic zone.

Figure 2. Area of hypoxic zone, 1985–2000 (source: N.N. Rabalais, Louisiana Universities Marine Consortium).

U.S. Department of the Interior
U.S. Geological Survey
USGS Fact Sheet 135-00
December 2000


USGS science for a changing world

Investigating the Environmental Effects of Agriculture Practices on Natural Resources

Scientific Contributions of the U.S. Geological Survey to Enhance the Management of Agricultural Landscapes

Science Issues and Needs Identified by the USGS, as Related to Environmental Impacts of Agricultural Practices

Land cover map of the conterminous United States from early 1990s data (Vogelmann and others, 2001; Nakagaki and Wolock, 2005).

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet 2007–3001
January 2007

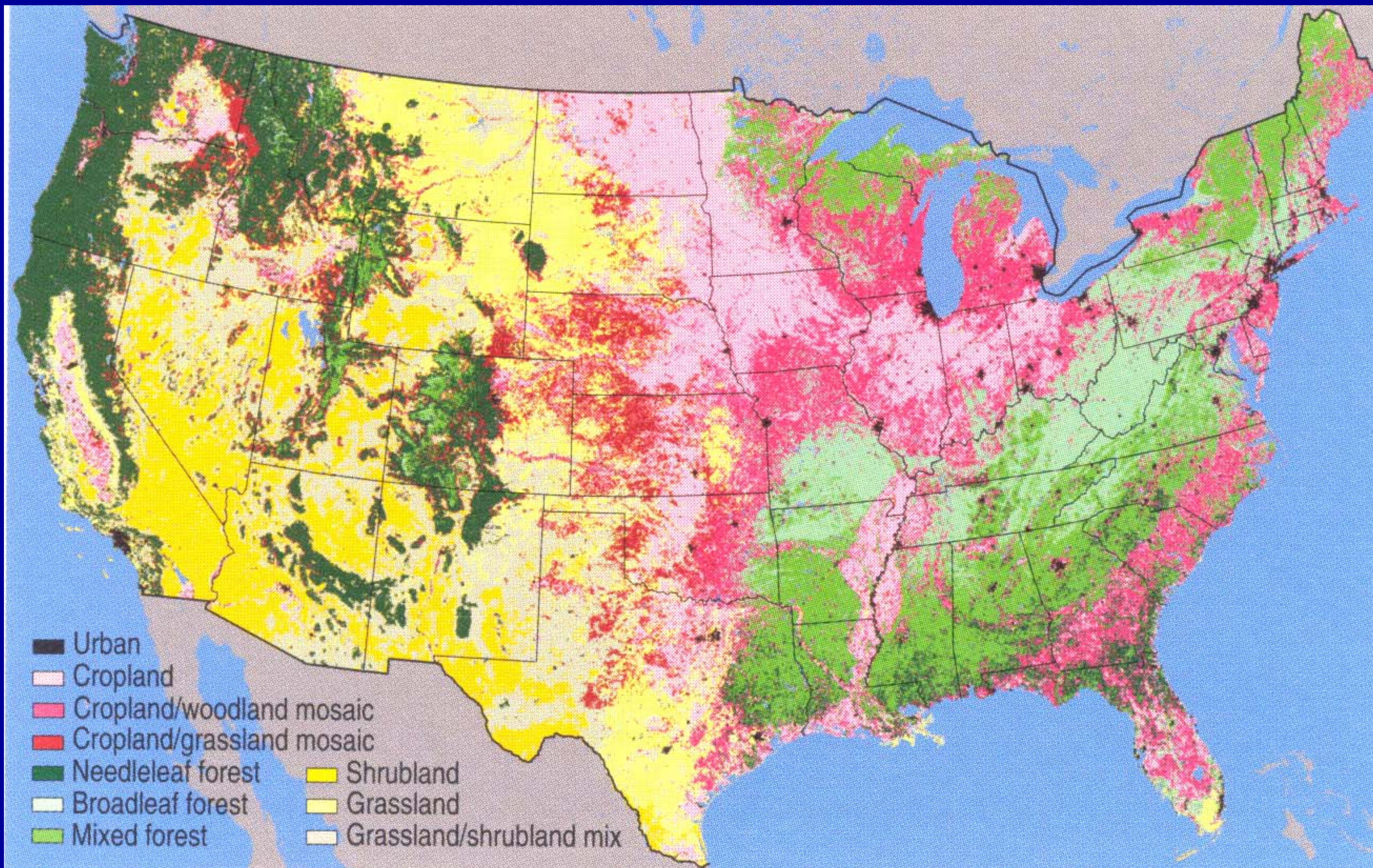
USGS

Stakeholders

- DOI Bureaus
- Tribes
- EPA
- USDA Bureaus
- Interstate Compact Organizations
- State Agencies and Organizations
- Farm Interest Groups

USGS

Land Use



USGS

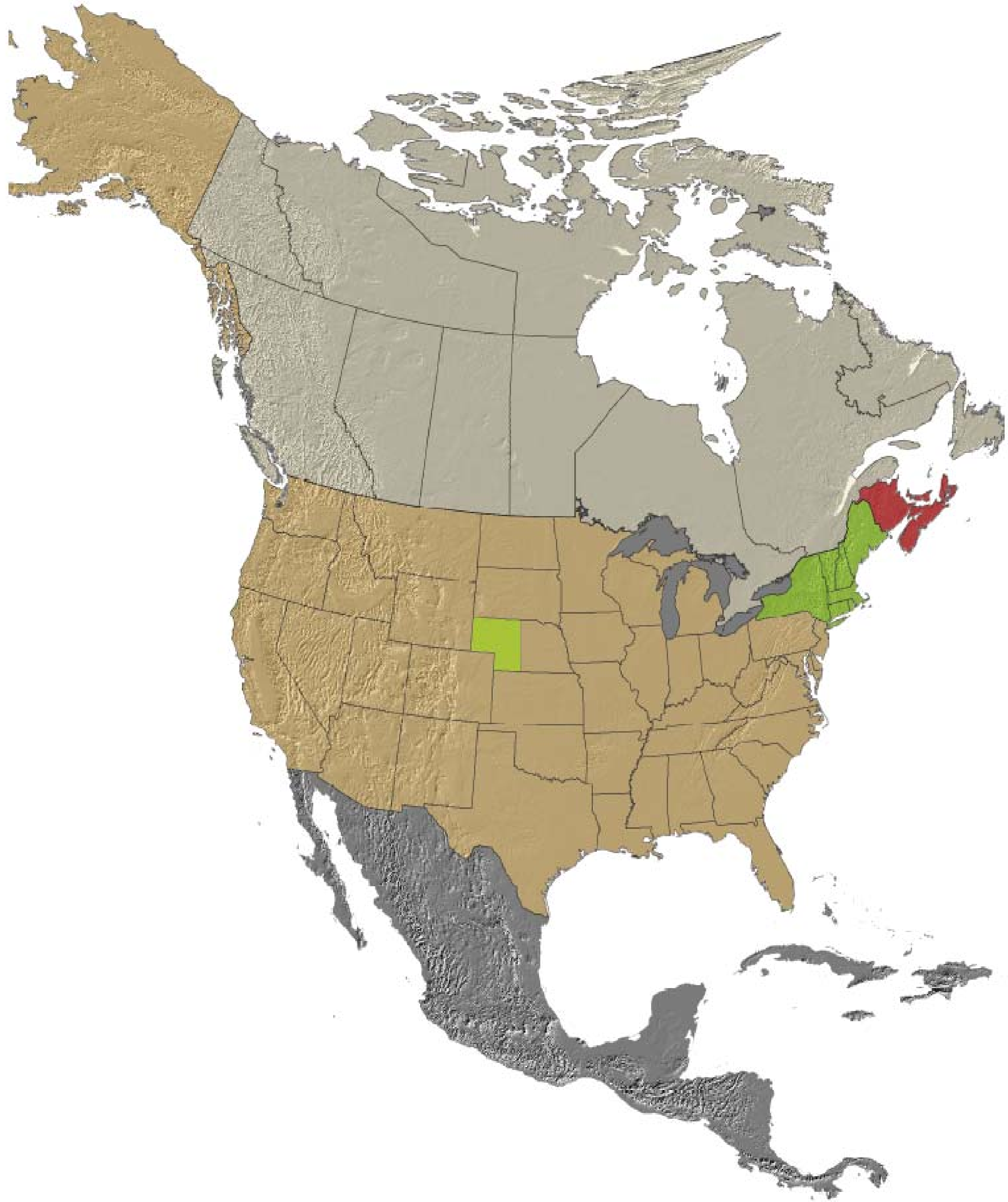
North American Soil Geochemical Landscapes Project

13,215 sites in N. America, density of 1 site/1,600 km^2

States/provinces completed in 2007:

NB, NS, PE in Canada

ME, NH, VT, CT, RI, MA, NY, ~50% of NE in US



USGS

Agricultural Water Use Trends 1950-2000

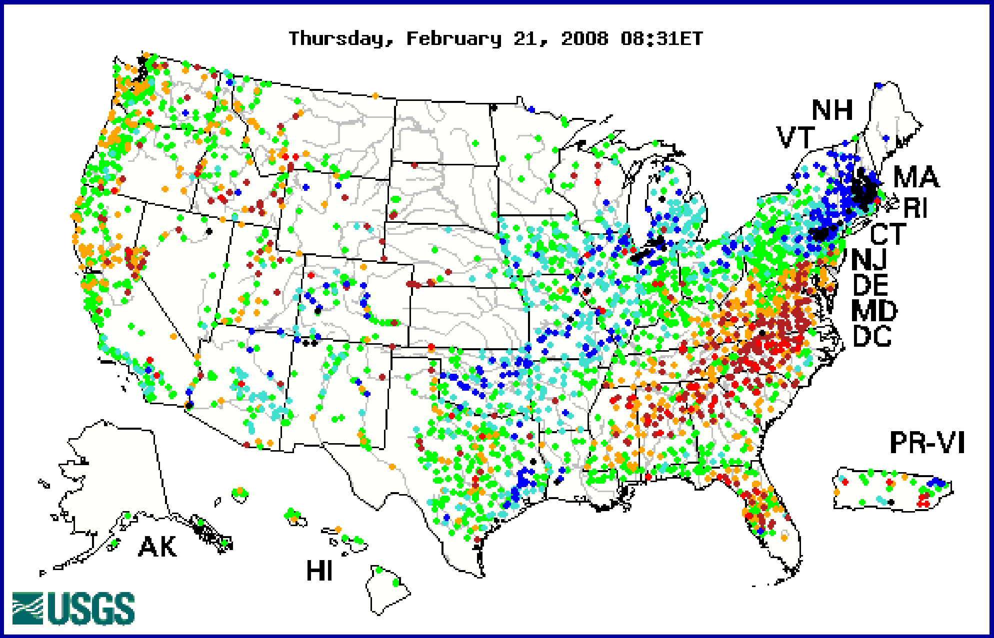
- Surface water for irrigation dropped 20%
  Ground-water use tripled
- Irrigated acres doubled from 1950 to 1980 and has remained constant since 1980
- Average irrigation rate dropped from 3.55 acre-ft/acre to 2.48 acre-ft/acre
- USGS *National Water Use Report* in mid-2008 breaking out use from urban growth vs. agricultural and ecosystem services

USGS

http://waterdata.usgs.gov/nwis

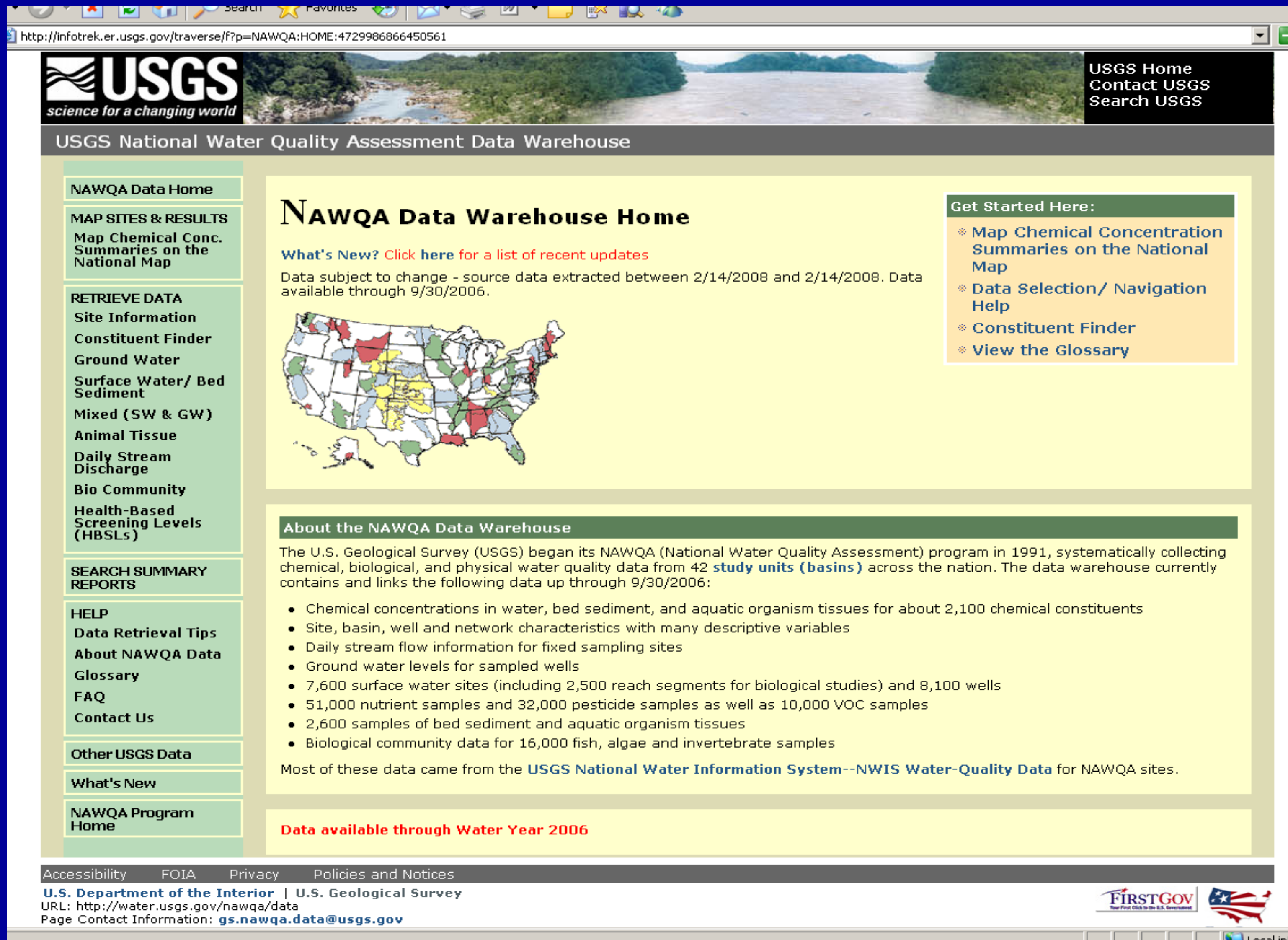
Real-time streamflow

Real-time Data
- **Surface water**
- **Ground water**
- **Water quality**



Water-Quality Data for Virginia--
- Real-time data at 111 sites
- Daily data at 167 sites
- Water quality, stream sediment, biological tissue samples at 3,308 sites

USGS NAWQA Data Warehouse
(many sites attributed to agricultural settings)



http://infotrek.er.usgs.gov/traverse/f?p=NAWQA:HOME:4729986866450561

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USGS Home
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USGS National Water Quality Assessment Data Warehouse

NAWQA Data Home

MAP SITES & RESULTS
Map Chemical Conc. Summaries on the National Map

RETRIEVE DATA
Site Information
Constituent Finder
Ground Water
Surface Water/ Bed Sediment
Mixed (SW & GW)
Animal Tissue
Daily Stream Discharge
Bio Community
Health-Based Screening Levels (HBSLs)

SEARCH SUMMARY REPORTS

HELP
Data Retrieval Tips
About NAWQA Data
Glossary
FAQ
Contact Us

Other USGS Data

What's New

NAWQA Program Home

NAWQA Data Warehouse Home

What's New? Click here for a list of recent updates

Data subject to change - source data extracted between 2/14/2008 and 2/14/2008. Data available through 9/30/2006.

Get Started Here:
- Map Chemical Concentration Summaries on the National Map
- Data Selection/ Navigation Help
- Constituent Finder
- View the Glossary

About the NAWQA Data Warehouse

The U.S. Geological Survey (USGS) began its NAWQA (National Water Quality Assessment) program in 1991, systematically collecting chemical, biological, and physical water quality data from 42 study units (basins) across the nation. The data warehouse currently contains and links the following data up through 9/30/2006:

- Chemical concentrations in water, bed sediment, and aquatic organism tissues for about 2,100 chemical constituents
- Site, basin, well and network characteristics with many descriptive variables
- Daily stream flow information for fixed sampling sites
- Ground water levels for sampled wells
- 7,600 surface water sites (including 2,500 reach segments for biological studies) and 8,100 wells
- 51,000 nutrient samples and 32,000 pesticide samples as well as 10,000 VOC samples
- 2,600 samples of bed sediment and aquatic organism tissues
- Biological community data for 16,000 fish, algae and invertebrate samples

Most of these data came from the USGS National Water Information System--NWIS Water-Quality Data for NAWQA sites.

Data available through Water Year 2006

Accessibility FOIA Privacy Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey
URL: http://water.usgs.gov/nawqa/data
Page Contact Information: gs.nawqa.data@usgs.gov

FirstGov

Iowa CREP

Iowa CREP

- Assess the effect of CREP treatment wetlands on water quality in Iowa
- Show how nutrient loadings from tile-drain agriculture can be reduced and how additional wetlands benefit wildlife
- Monitor the timing and concentrations of nutrients (link to spring pulses or when fertilizers are applied)
- Partner with FSA, FWS R-3, Iowa State agencies, USGS

USGS

CRP Studies at Northern Prairie Wildlife Research Center

Data from Northern Prairie's long-term study were used to predict changes in grassland bird populations if CRP grasslands in North Dakota were converted back to cropland.

CRP Field → Cropland

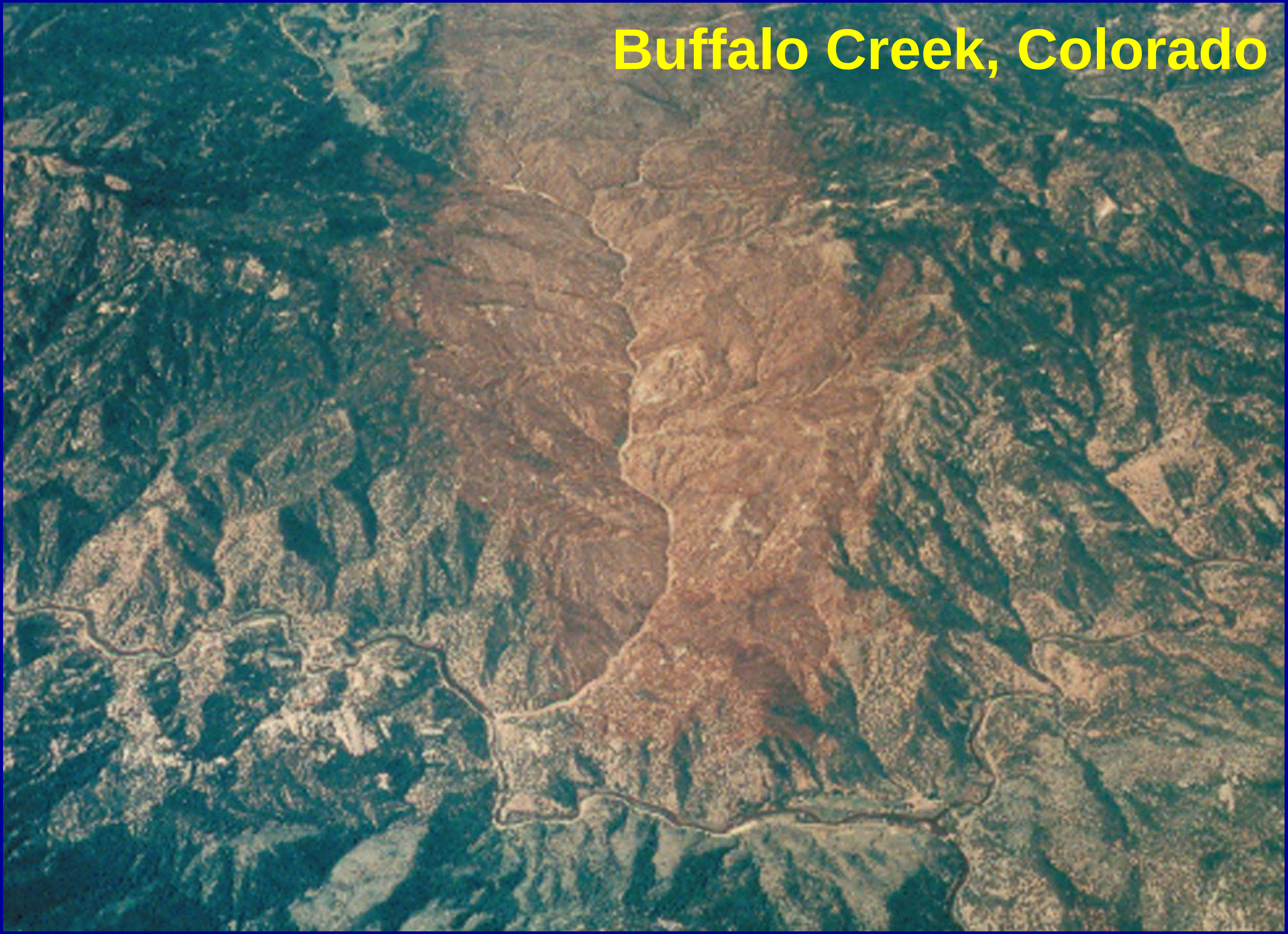
- Lark Bunting →
- Grasshopper Sparrow →
- Savannah Sparrow →
- Western Meadowlark →
- Bobolink →
- Clay-colored Sparrow →
- Dickcissel →
- Sedge Wren →

Declines by 9 to 26 %

- Killdeer →
- Horned Lark →
- Vesper Sparrow →

Increases by 2 to 10%

USGS science for a changing world


Buffalo Creek, Colorado

Buffalo Creek area, Colorado

- Buffalo Creek area, Pike National Forest, Colorado, has suffered several major fires in the past decade
- USGS and USFS scientists have monitored the impacts of stream runoff, sediment, and water quality in these fire-affected landscapes
- Evaluate post-fire treatments

USGS

Confined Animal Feeding Operations

USGS

CAFOs

- Develop analytical methods for:
  - Antibiotics and hormones used in animal agriculture
  - Indicator bacteria and pathogens linked to animal agriculture
- Research and studies to evaluate occurrence of antibiotics and hormones in streams and ground water from livestock areas, manure application to fields, and effects on aquatic life
- Research and studies to identify sources of bacteria (municipal or domestic sewage vs. animal agriculture)

USGS

Fort Cobb Reservoir and Drainage Basin

USGS

Fort Cobb drainage, Oklahoma

- Groundwater is highly contaminated and Ft. Cobb reservoir is eutrophic
- USGS studying impacts of agricultural practices (row crops, pasture grazing, CAFOs) on streams and reservoir quality
- Determining the sources of nutrients to the reservoir to guide management agencies in development of best management practices

USGS

Discovery Farms, Wisconsin

USGS

Discovery Farms, Wisconsin

- Working in partnership with Wisconsin State agencies, NRCS, dairy producers, and farm associations
- USGS is conducting water quality monitoring on various farms to understand how farming practices such as timing of fertilizer application affects water quality
- Just beginning a similar study in Nebraska

USGS

Sacramento River, California

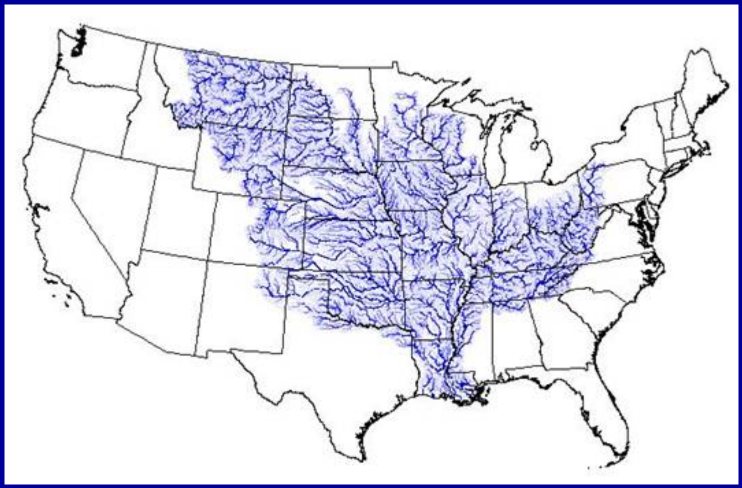
Sacramento River, California

- USGS, in cooperation with State agencies and local producers, is monitoring the impacts of agricultural practices in the Central Valley of California
- Quantifying the flow of nutrients into the San Jaoquin – Sacramento delta system

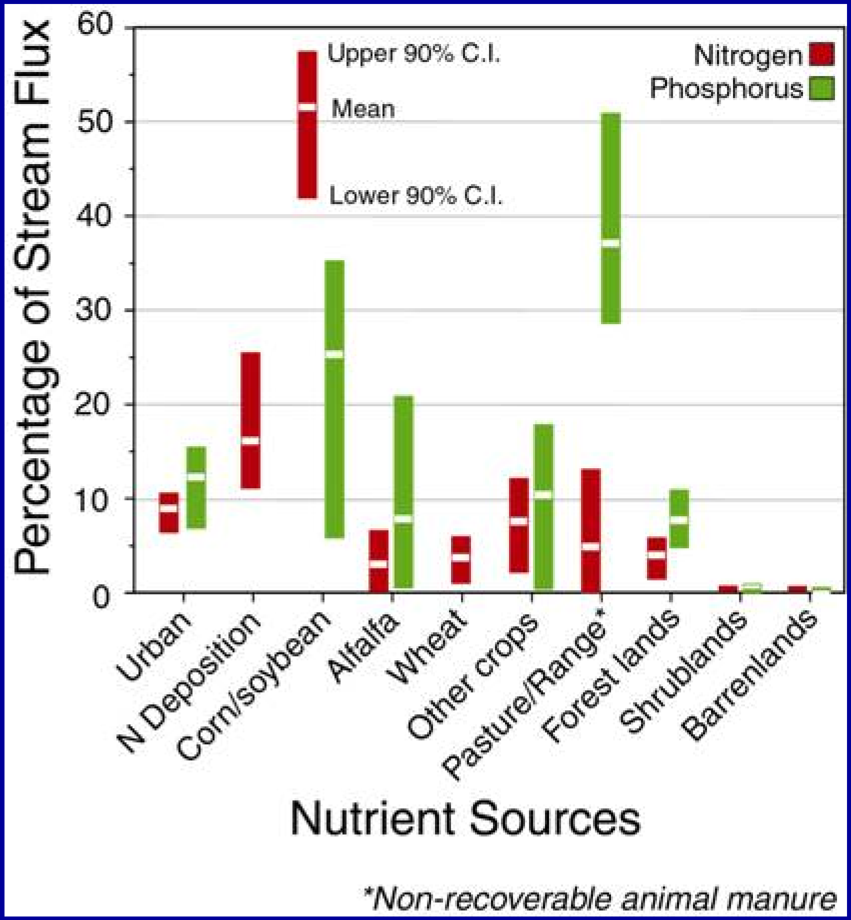
USGS

SPARROW Water-Quality Model
SPAtially Referenced Regression on Watershed Attributes

Mississippi/Atchafalaya River Basin

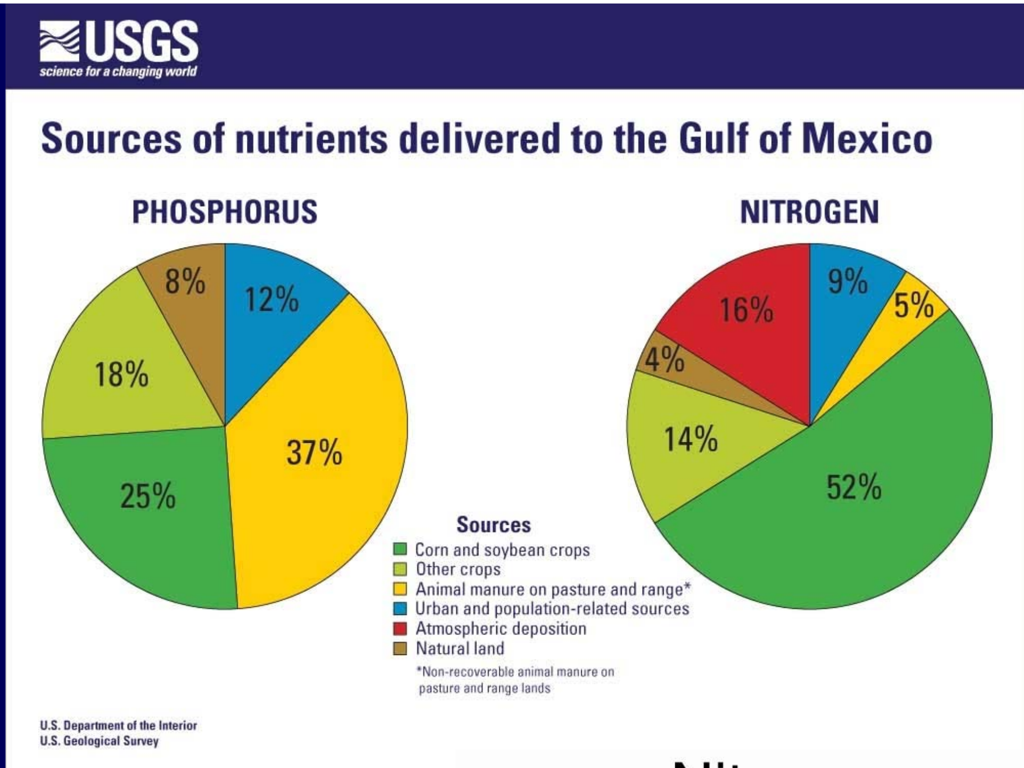


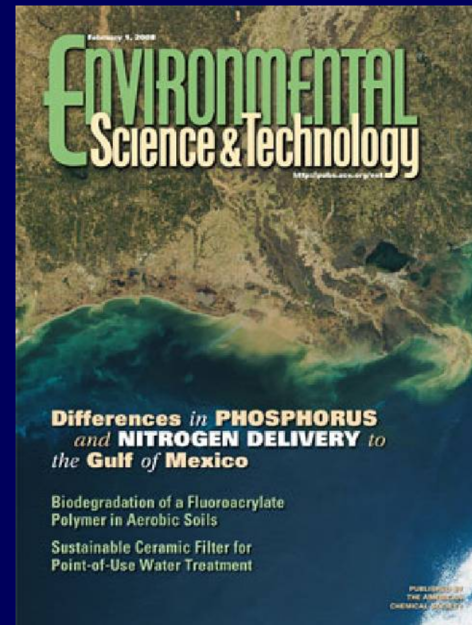
Nutrients Delivered to the Gulf

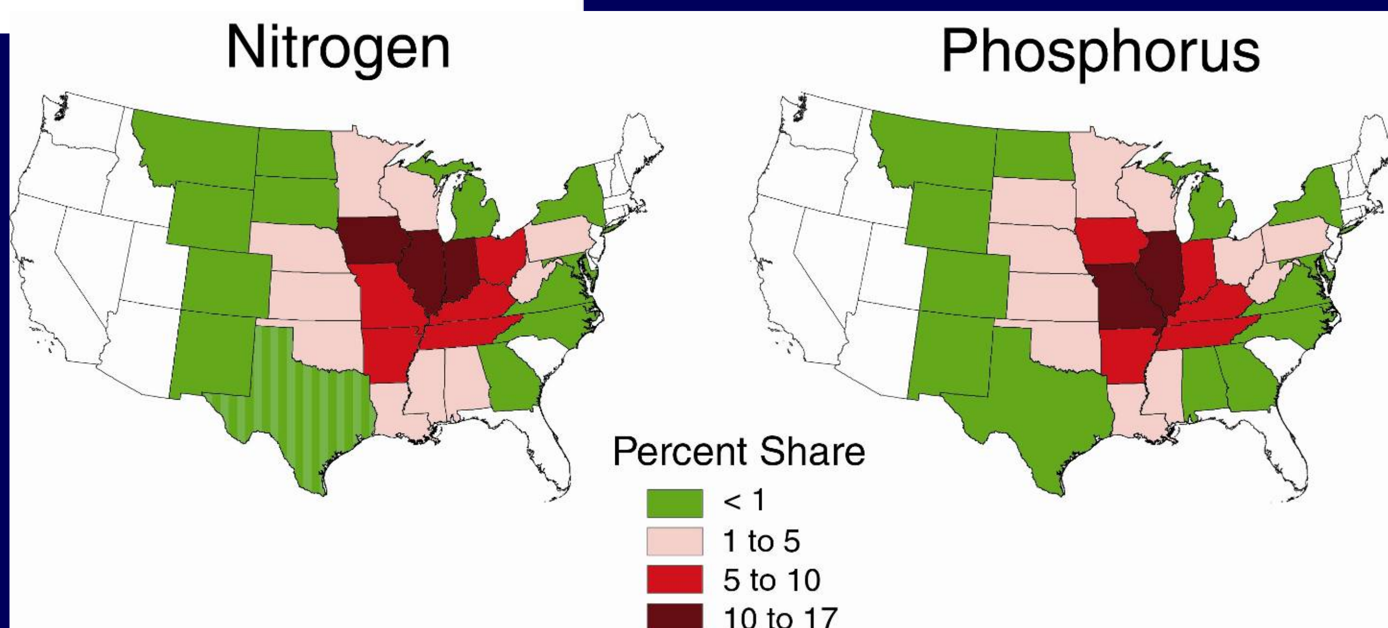


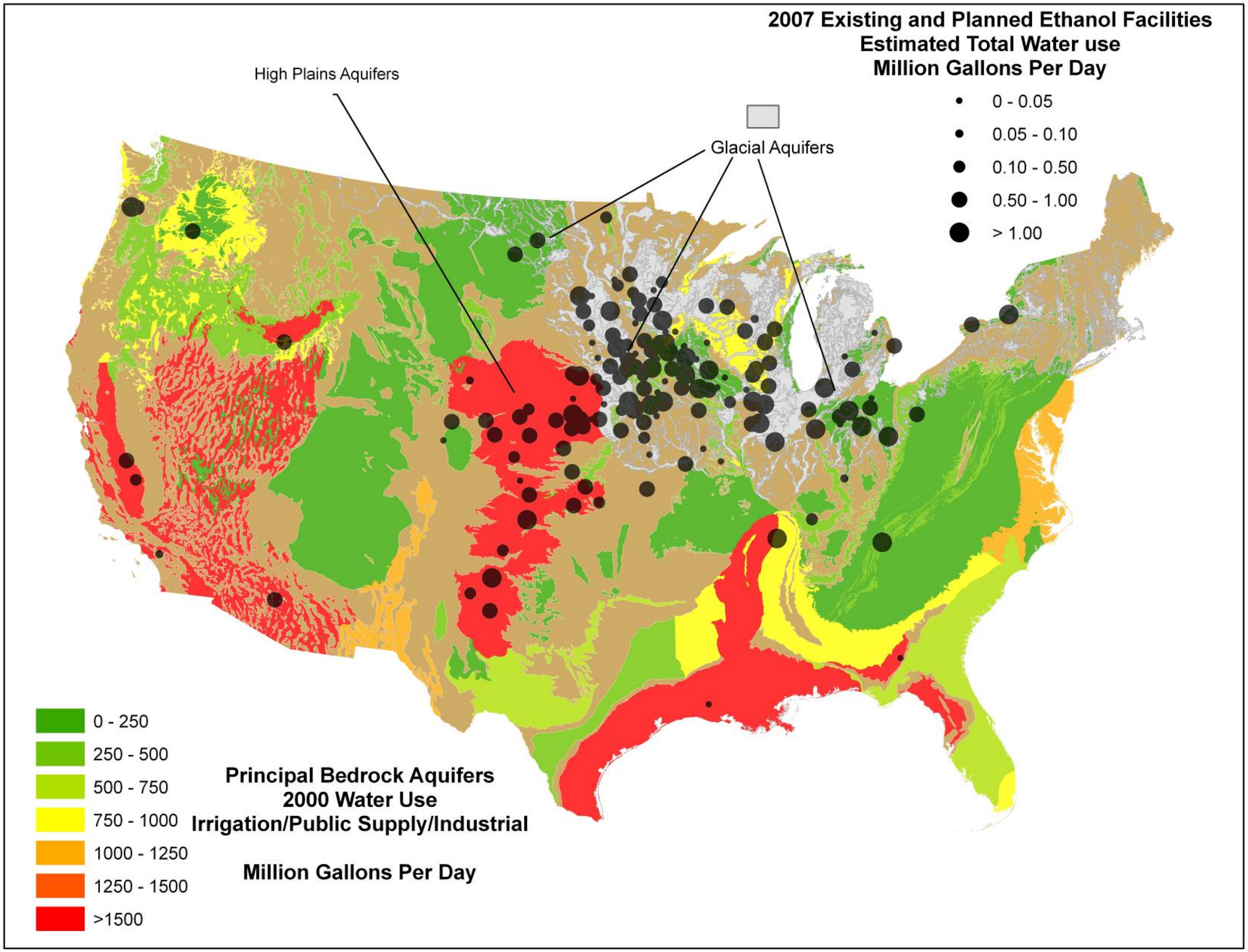
Nitrogen and phosphorus are affected by different sources and land uses and require different management practices

USGS


USGS
science for a changing world
Sources of nutrients delivered to the Gulf of Mexico
PHOSPHORUS
8%
12%
18%
37%
25%
NITROGEN
9%
5%
16%
4%
14%
52%
Sources
Corn and soybean crops
Other crops
Animal manure on pasture and range*
Urban and population-related sources
Atmospheric deposition
Natural land
*Non-recoverable animal manure on pasture and range lands
U.S. Department of the Interior
U.S. Geological Survey


Environmental
Science & Technology
Differences in PHOSPHORUS and NITROGEN DELIVERY to the Gulf of Mexico
Biodegradation of a Fluoroacrylate Polymer in Aerobic Soils
Sustainable Ceramic Filter for Point-of-Use Water Treatment


Nitrogen
Phosphorus
Percent Share
< 1
1 to 5
5 to 10
10 to 17



2007 Existing and Planned Ethanol Facilities
Estimated Total Water use
Million Gallons Per Day
0 - 0.05
0.05 - 0.10
0.10 - 0.50
0.50 - 1.00
> 1.00
High Plains Aquifers
Glacial Aquifers
0 - 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
>1500
Principal Bedrock Aquifers
2000 Water Use
Irrigation/Public Supply/Industrial
Million Gallons Per Day

USGS

Ethanol

- Ethanol plants are concentrated in the Corn Belt
- Water for processing ethanol and for growing more corn depend heavily on glacial aquifers and from the High Plains aquifers- already competing uses for this groundwater
- Water-quality concerns with increased corn acreage include degradation to streams from increased nutrient loading, pesticide loading, and decreased wildlife habitat
- Effects can be local and far downstream (Gulf of Mexico, Chesapeake Bay)

USGS

Responding to Agriculture Partners

"Sound scientific data and improved technology are increasingly necessary in order to effectively resolve the complex resource issues facing farmers and ranchers."

American Farm Bureau Federation, 2001

USGS

Thank you!

USGS

Summary Slide

- Ecosystem Services

Ecosystem Services

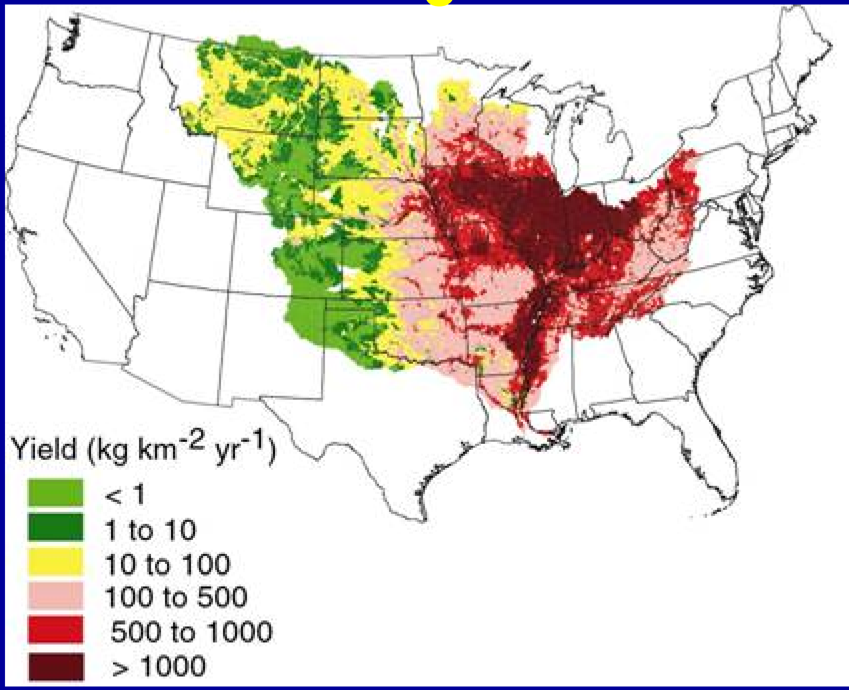
Services	**Studies**
Floodwater Storage	Estimate of water storage potential
Biodiversity/Habitat Quality	Floristic quality, taxon richness, habitat suitability
Erosion, Sedimentation and Nutrient Loading Potential	Sedimentation and nutrient loading for wetlands in cropland, restored grassland and native prairie
Carbon Sequestration	Estimates of soil and wetland vegetation carbon stocks
Greenhouse Gas Emissions Reduction	Comparison of rates of reduction greenhouse gas emissions from wetlands in cropland, restored grassland and native prairie

USGS

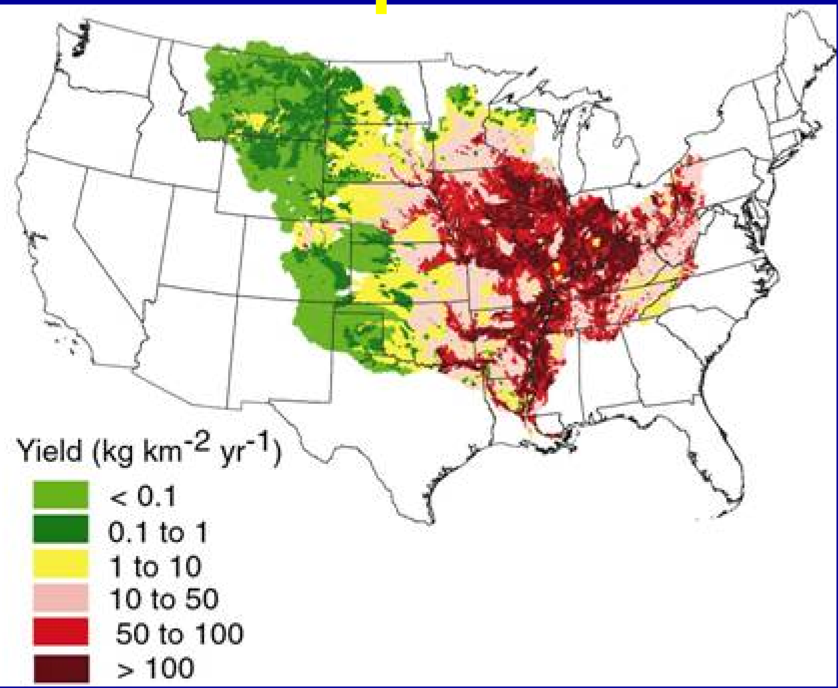
Nutrient mass delivered to the Gulf of Mexico

Many Midwestern and Eastern watersheds have higher "delivered yields"

Nitrogen



Phosphorus



USDA 84th Agricultural Outlook Forum

Energizing Rural America in the Global Marketplace

Conservation: Environmental Quality and Agriculture

USGS

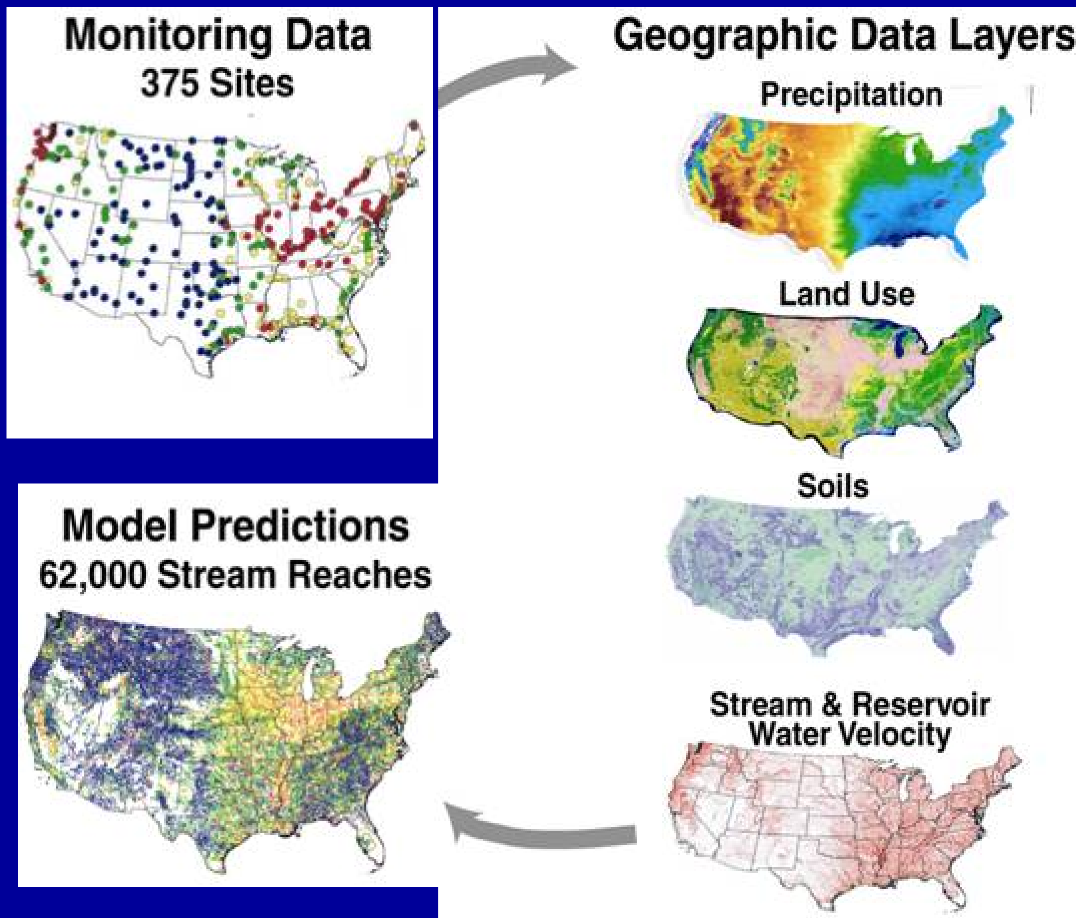
The North American Soil Geochemical Landscapes Project

Natural Resources Canada   Ressources naturelles Canada

SPARROW Water-Quality Model

SPAtially Referenced Regression on Watershed Attributes

http://water.usgs.gov/nawqa/sparrow



- **Depends on statistical regression of spatial data describing pollutant sources and in-stream water-quality measurements and a mass balance model of watersheds**
  - **agricultural land uses**
  - **nutrient inputs from crop and livestock production**
  - **urban land uses**
  - **atmospheric deposition**
- **Predicts mean annual loads/concentrations (and uncertainties) in streams for 1992 (and simulated 2002)**

Almond orchard, California

USGS

Almond orchard, California

- Peak impacts of agricultural practices on water quality often occur during flow events
- USGS NAWQA project uses a dye tracer study to estimate travel times of agricultural contaminants (spray pesticides and fungicides) to local creeks and into rivers

USGS