Climate Change Teach-In

Manure Matters

April 22, 2021

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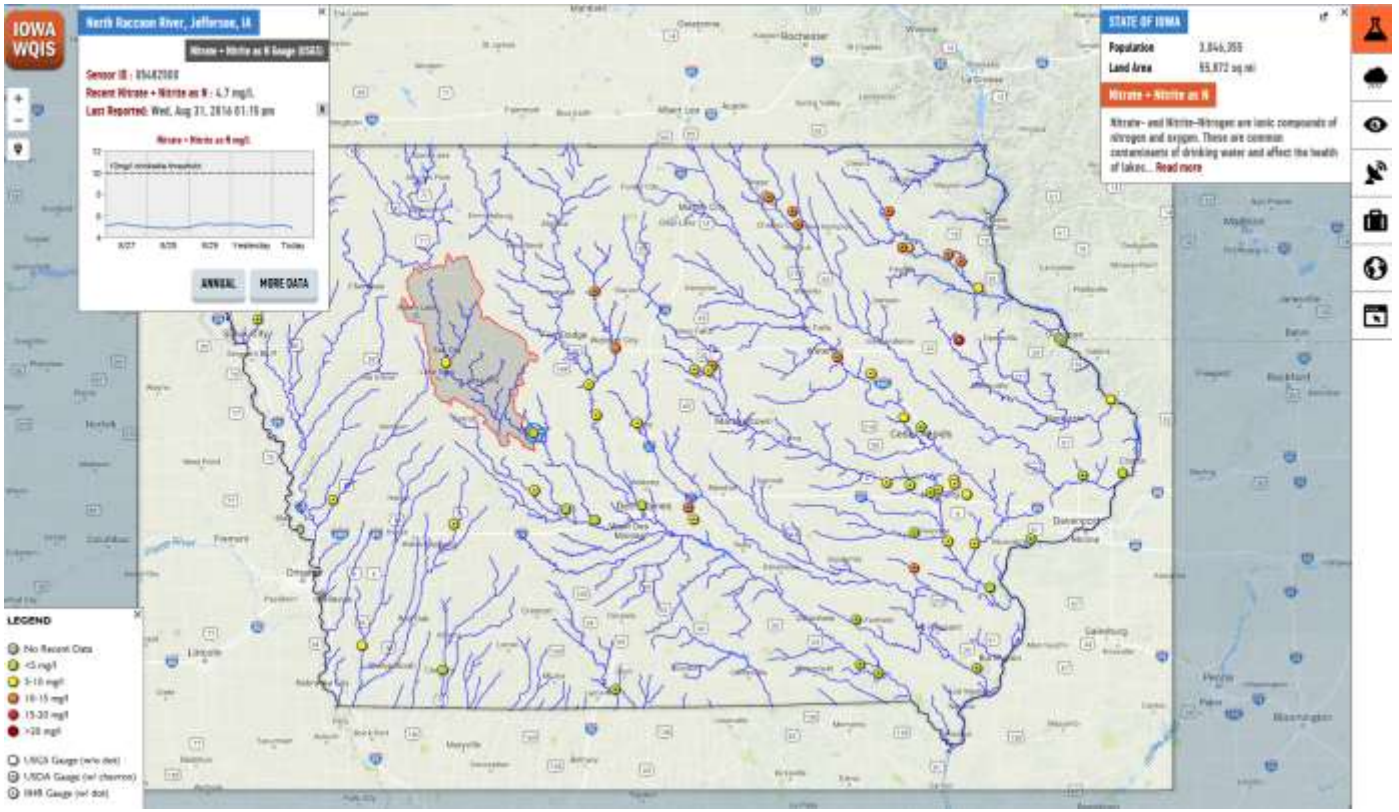
IIHR Hydroscience & Engineering
The University of Iowa College of Engineering

Slides Available at:

https://www.iihr.uiowa.edu/cjones/welcome/

Iowa Water Quality Information System



iwqis.iowawis.org/

http://iwqis.iowawis.org/app/?datetime=2017-06-06T13:00

IIHR Hydroscience & Engineering
The University of Iowa College of Engineering

IIHR Water Quality Sensor Network

Site infrastructure

Climate

Millett, B., Johnson, W.C. and Guntenspergen, G., 2009. Climate trends of the North American prairie pothole region 1906–2000. *Climatic Change*, *93*(1-2), pp.243-267.

Fig. 1 Map of the Prairie Pothole Region (PPR) of North America based on ecoregion classificati (Omernik 1987, 1995)

The Problem:

- 70% of land in corn-soy rotation
- 25 million hogs
- 4 million beef cattle
- 80 million laying chickens
- 5 million turkeys
- 4 million broiler chickens
- 220,000 dairy cows

1941

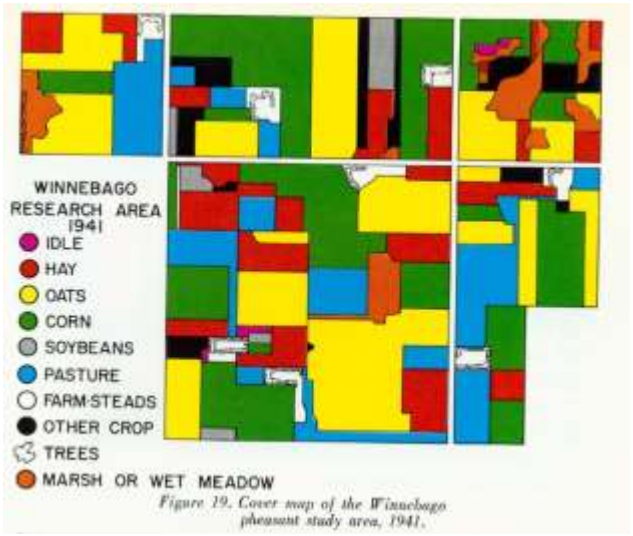


Figure 19. Cover map of the Winnebago pheasant study area, 1941.

1976

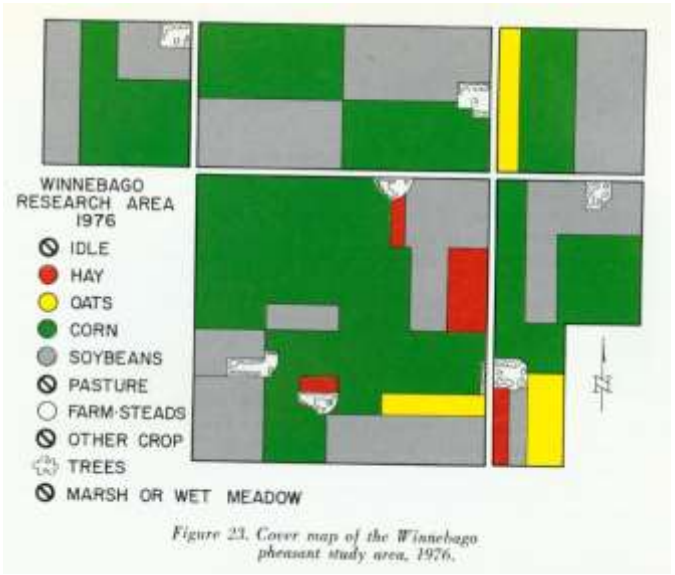
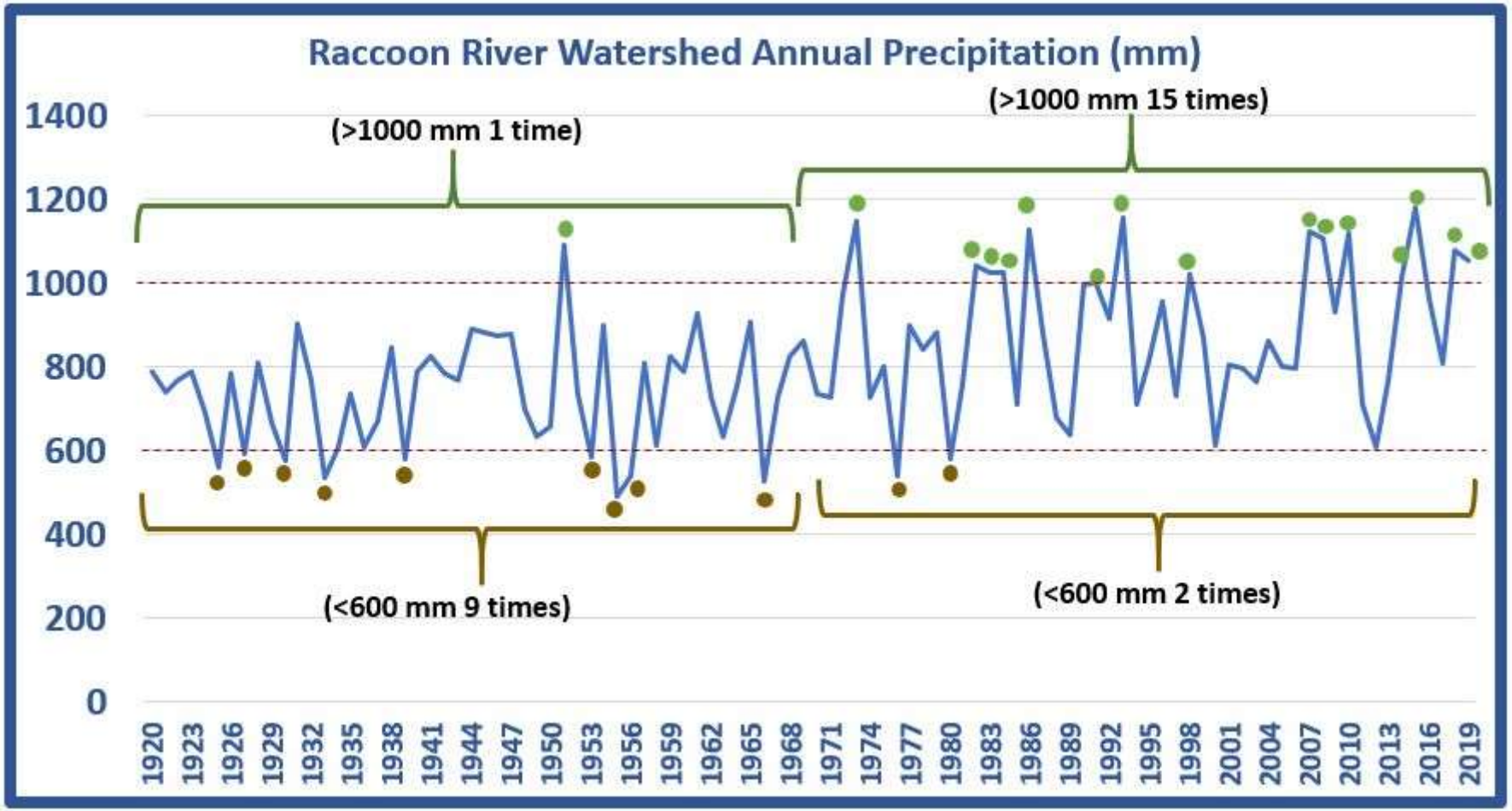


Figure 23. Cover map of the Winnebago pheasant study area, 1976.

LEAKY SYSTEM

Last Century: Raccoon Watershed



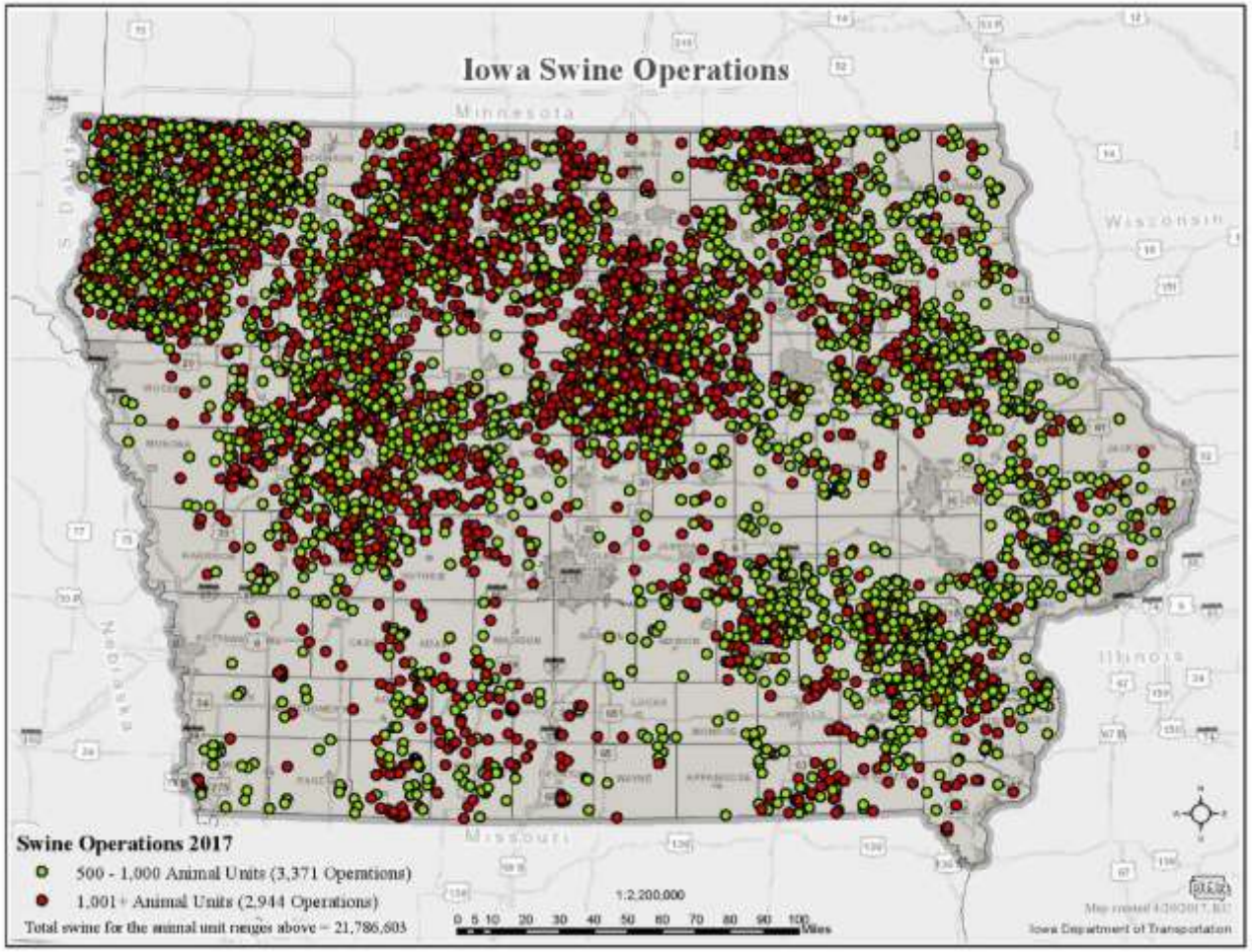
Potential Impact of Climate Change on Subsurface Drainage in Iowa's Subsurface Drained Landscapes

R. Singh[1]; M. J. Helmers[2]; Amy L. Kaleita[3]; and Eugene S. Takle[4]

JOURNAL OF IRRIGATION AND DRAINAGE ENGINEERING © ASCE / JULY/AUGUST 2009 / 459

Perry, Iowa

- **24-32% increase in annual precipitation**
- **2.3-2.7°C increase in temperature**
- **Increase tile drainage flows**
- **Change distribution of flows within the calendar year**


Iowa Swine Operations
Minnesota
Wisconsin
Illinois
Missouri
Swine Operations 2017
500 - 1,000 Animal Units (3,371 Operations)
1,001+ Animal Units (2,944 Operations)
Total swine for the animal unit ranges above = 21,786,803
1:2,200,000
0 5 10 20 30 40 50 60 70 80 90 100 Miles
Iowa Department of Transportation

1980: 65,000 Iowa farmers raised 13 million hogs

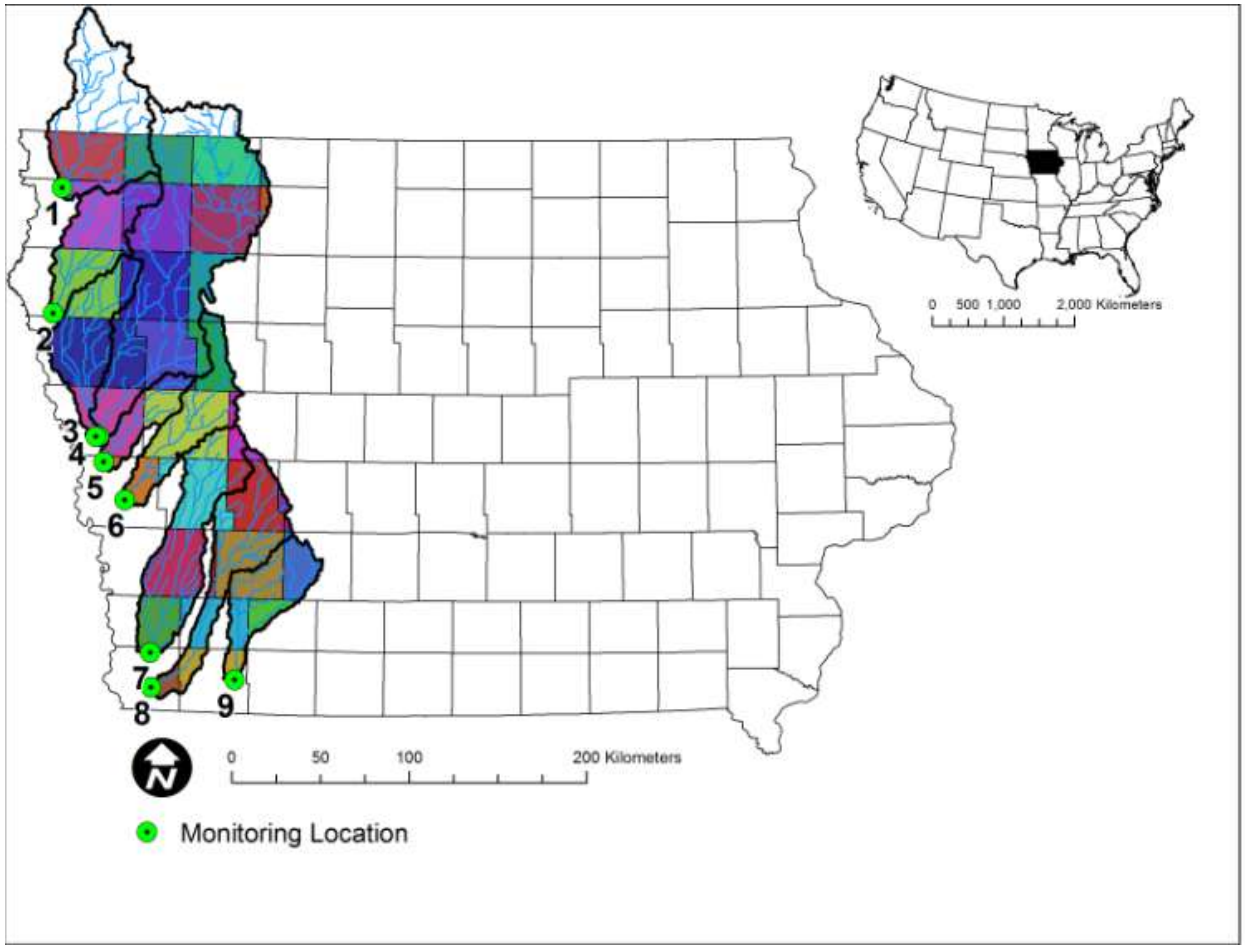
2002: 10,000 Iowa farmers raised 14 million hogs

Sociological and Economic Consequences for Rural Iowa

Commercial vs Manure Fertilizer

- Organic material in manure can improve soil
- Recycling of nutrients
- Saves farmer money

- Nutrients less concentrated in manure (hauling, storage)
- Nutrient availability (organic nitrogen vs NH_3 and NO_3)
- More difficult to apply to emerged crop
- Timing issues


1
2
3
4
5
6
7
8
9
0 500 1,000 2,000 Kilometers
N
0 50 100 200 Kilometers
Monitoring Location

USGS
science for a changing world

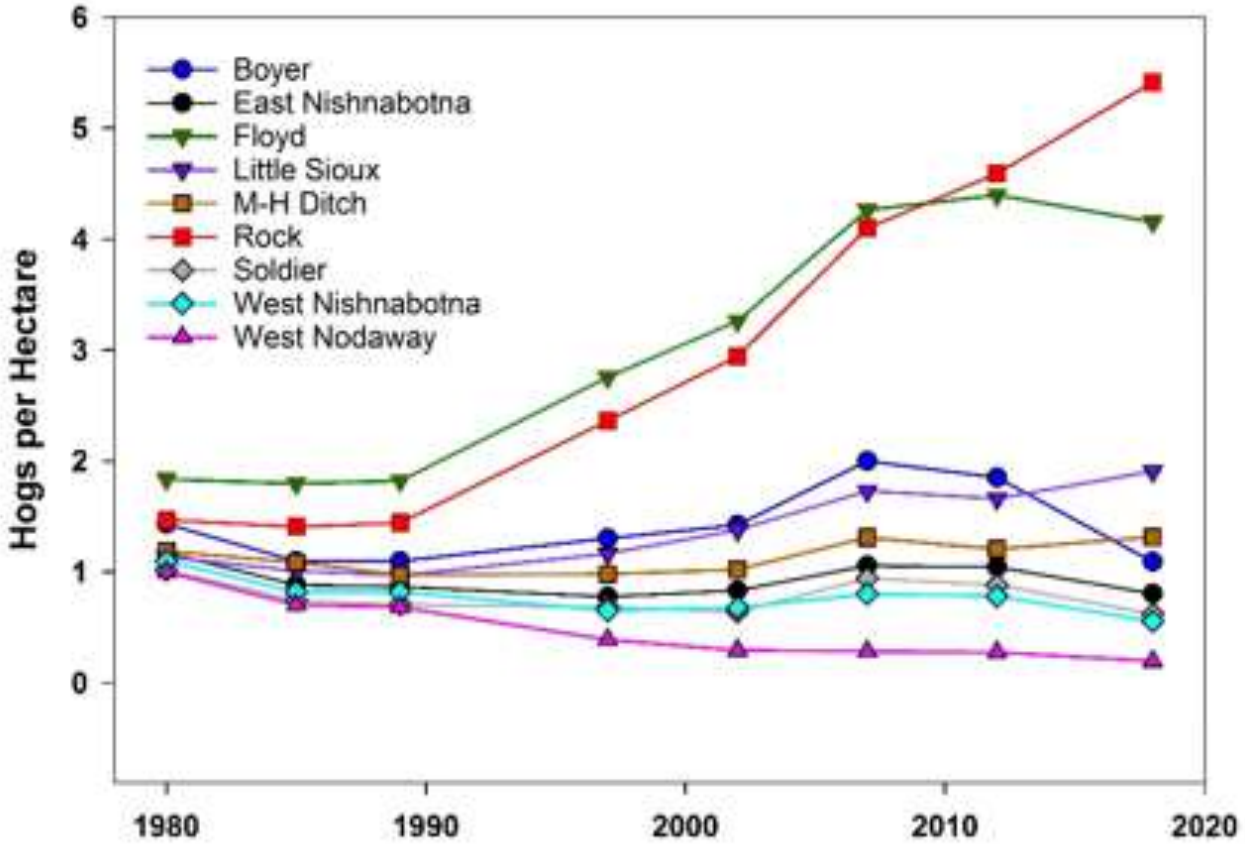
ScienceBase-Catalog Communities Help

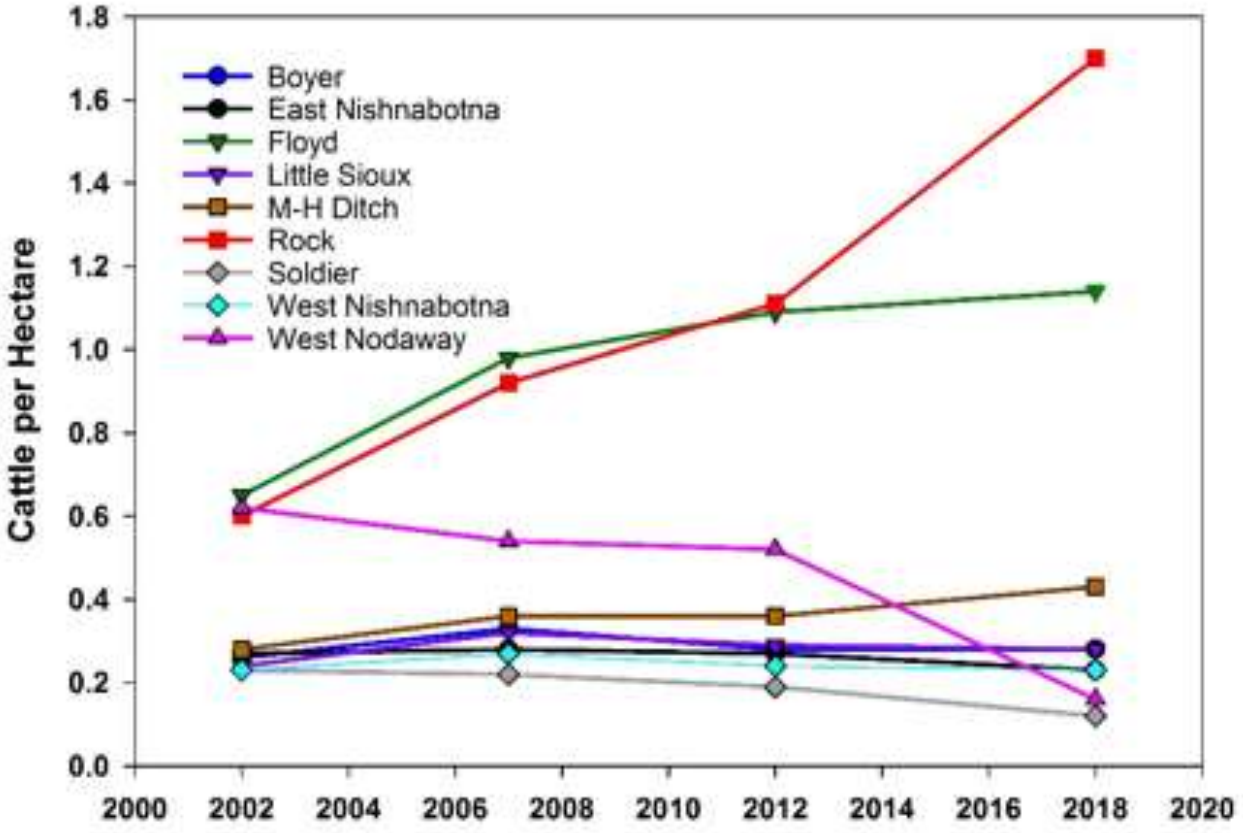
ScienceBase Catalog → USGS Data Release Products → County-Level Estimates of N...

County-Level Estimates of Nitrogen and Phosphorus from Commercial Fertilizer for the Conterminous United States, 1987-2012

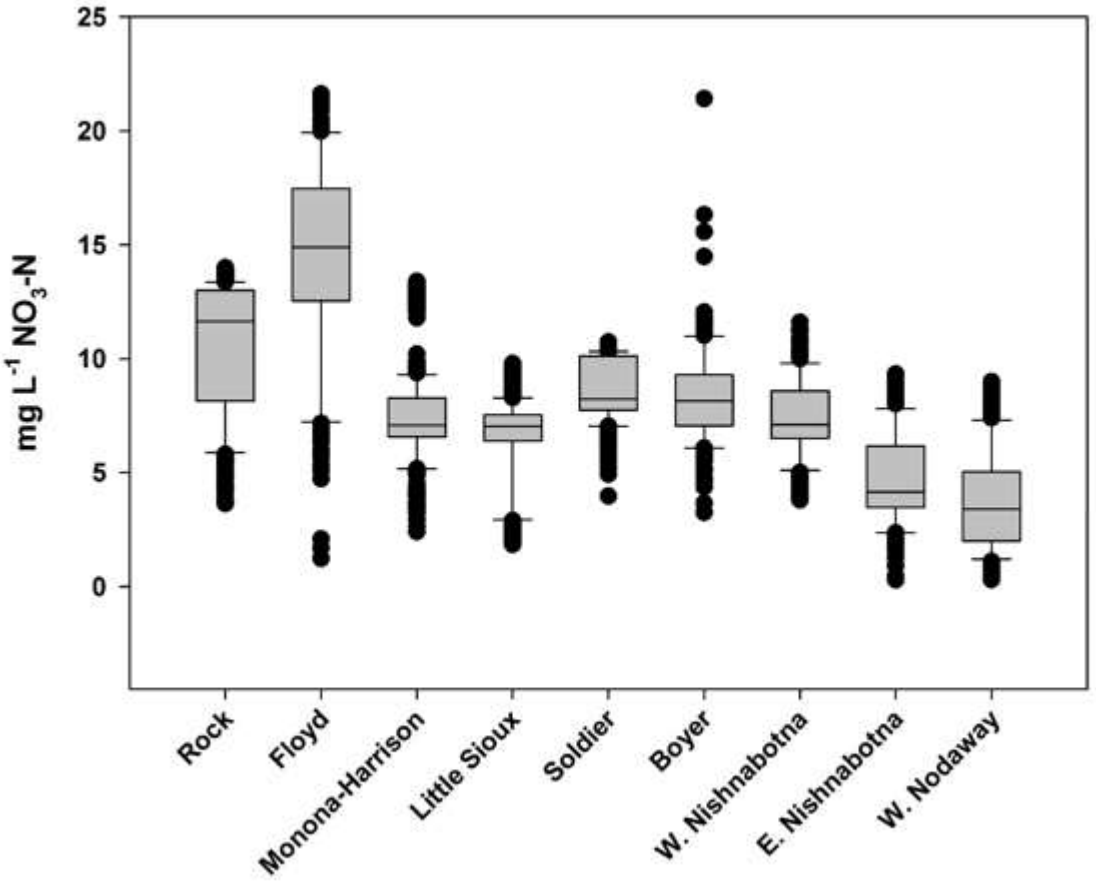
USGS
science for a changing world

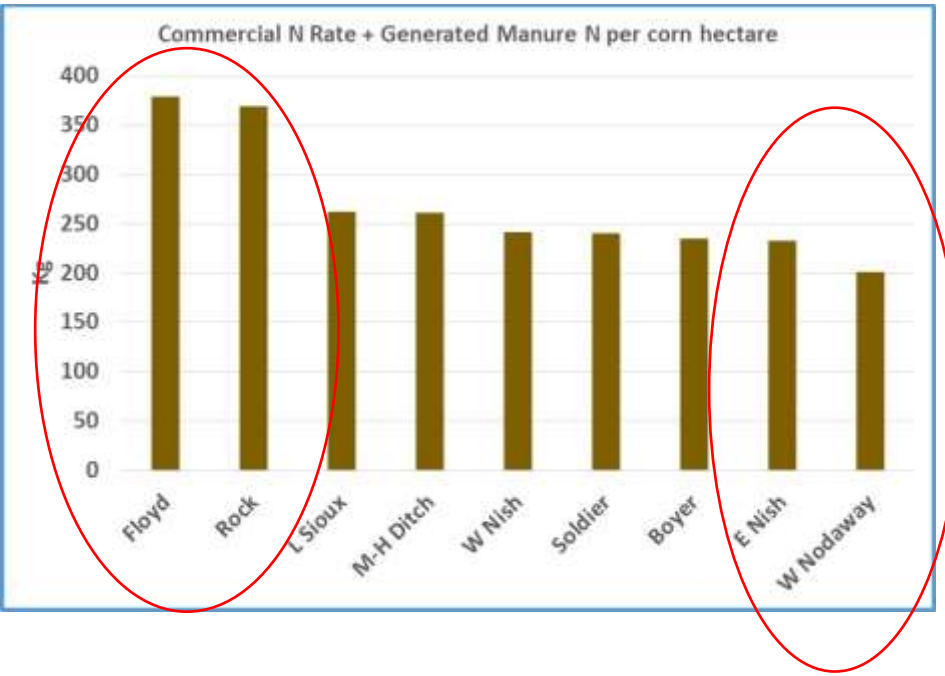
County-Level Estimates of Nitrogen and Phosphorus from Animal Manure for the Conterminous United States, 2007 and 2012

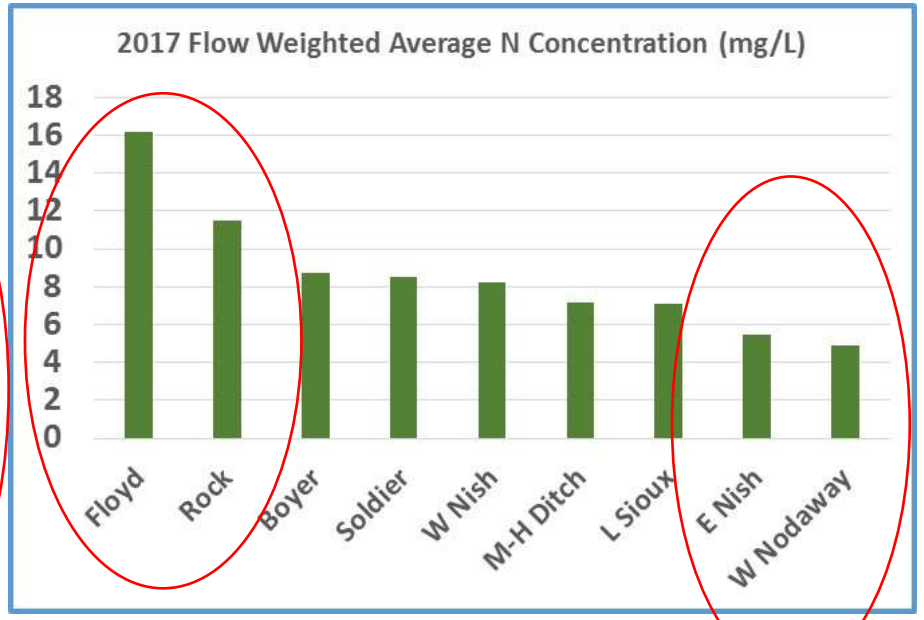

Hogs per Hectare
0
1
2
3
4
5
6
1980
1990
2000
2010
2020
Boyer
East Nishnabotna
Floyd
Little Sioux
M-H Ditch
Rock
Soldier
West Nishnabotna
West Nodaway


Cattle per Hectare
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Boyer
East Nishnabotna
Floyd
Little Sioux
M-H Ditch
Rock
Soldier
West Nishnabotna
West Nodaway

Stream Nitrate







Input amounts to corn calculated assuming statewide average of 15.7 kg/ha to soybeans applies. (USDA 2014).

IOWA NUTRIENT REDUCTION STRATEGY

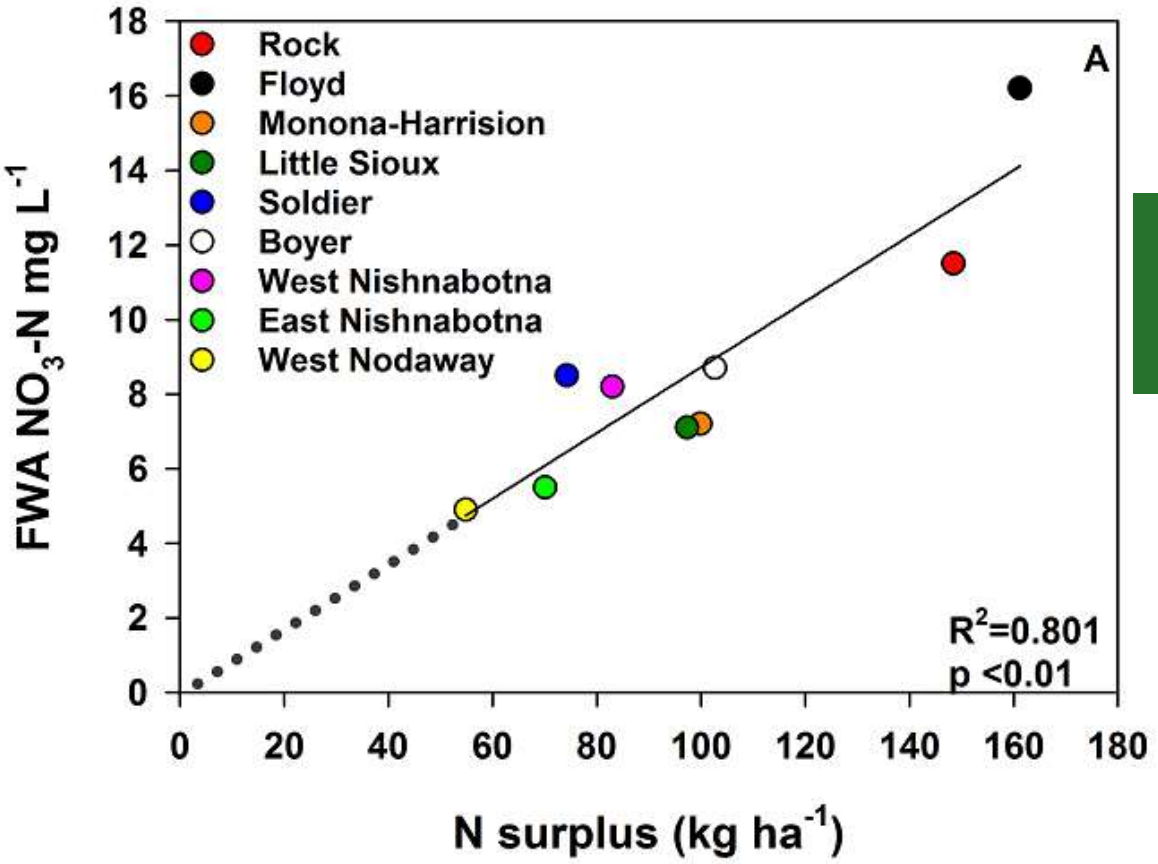
A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico

Nonpoint Source Policy

The approach to addressing the diverse and weather-driven nutrient transport from Iowa nonpoint sources involving Iowa's 90,000 farmers must be different from the approach to address the controlled and relatively constant nutrient discharge from Iowa's 130 major cities and industries.

Prepared by:
Iowa Department of Agriculture and Land Stewardship
Iowa Department of Natural Resources
Iowa State University College of Agriculture and Life Sciences

Updated December 2017

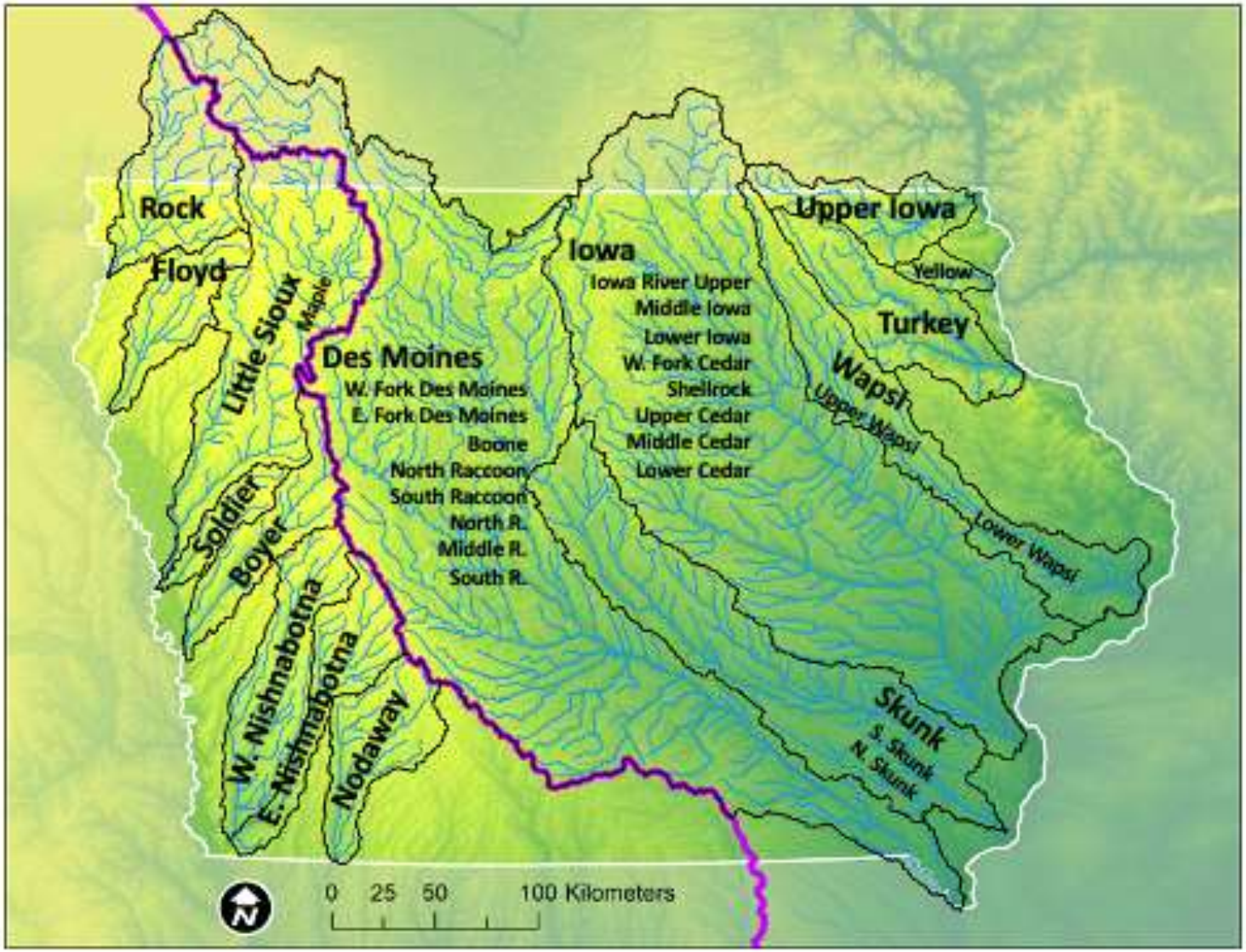


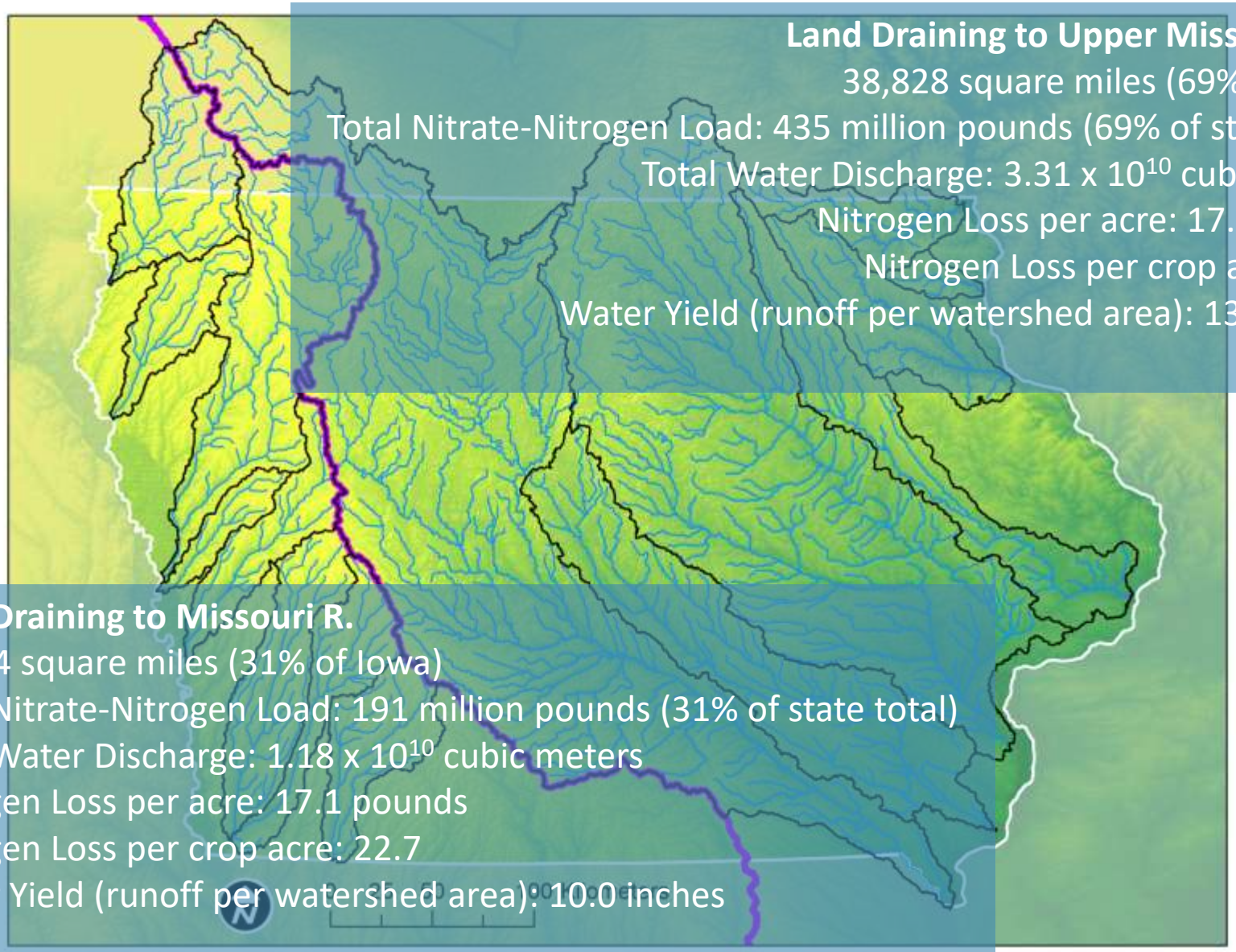
Supply is important!

Surplus = Commercial N + Manure N + Fixation N – Grain N

Statewide N Loading 2020

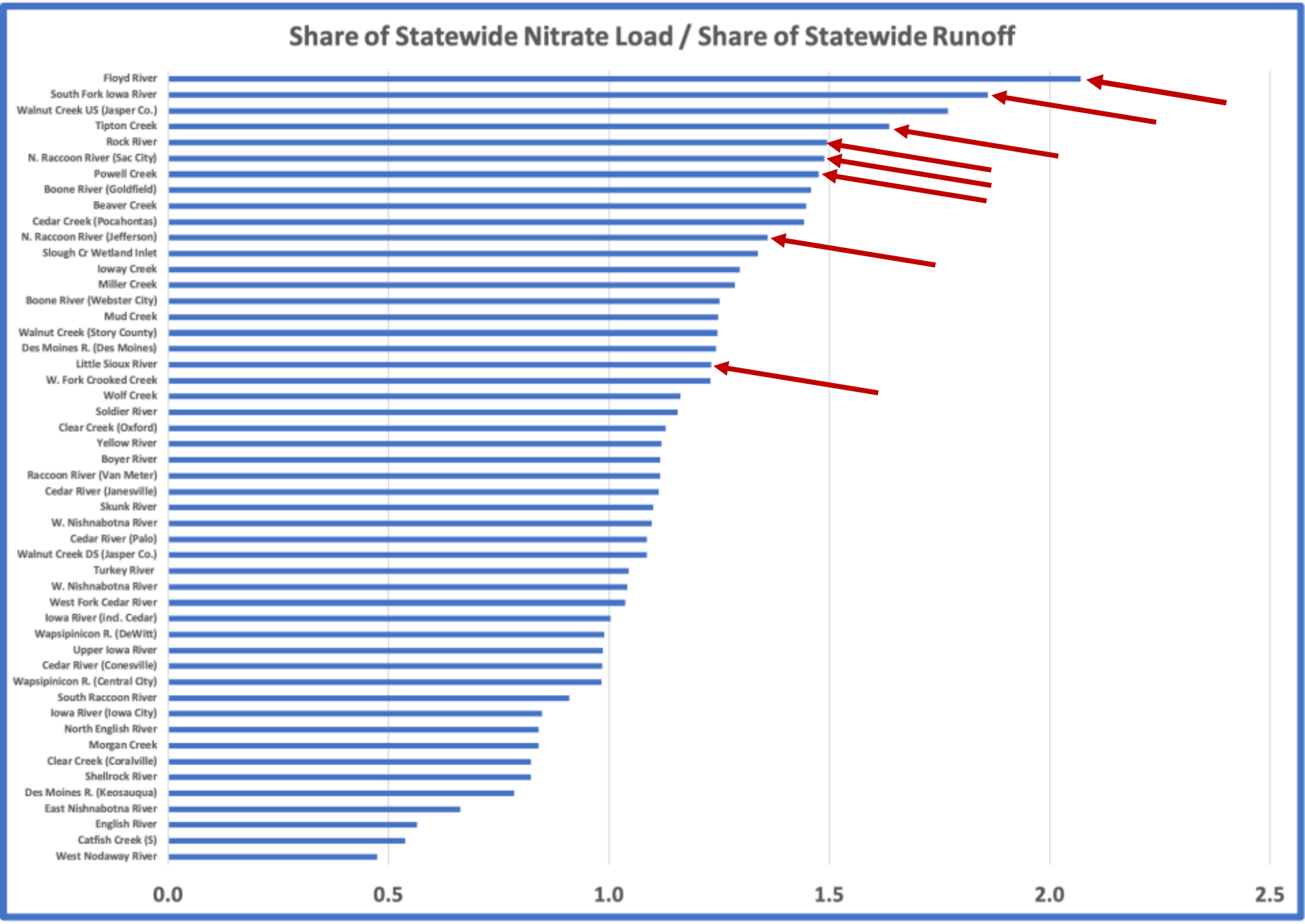
2020 Stream Nitrate Data

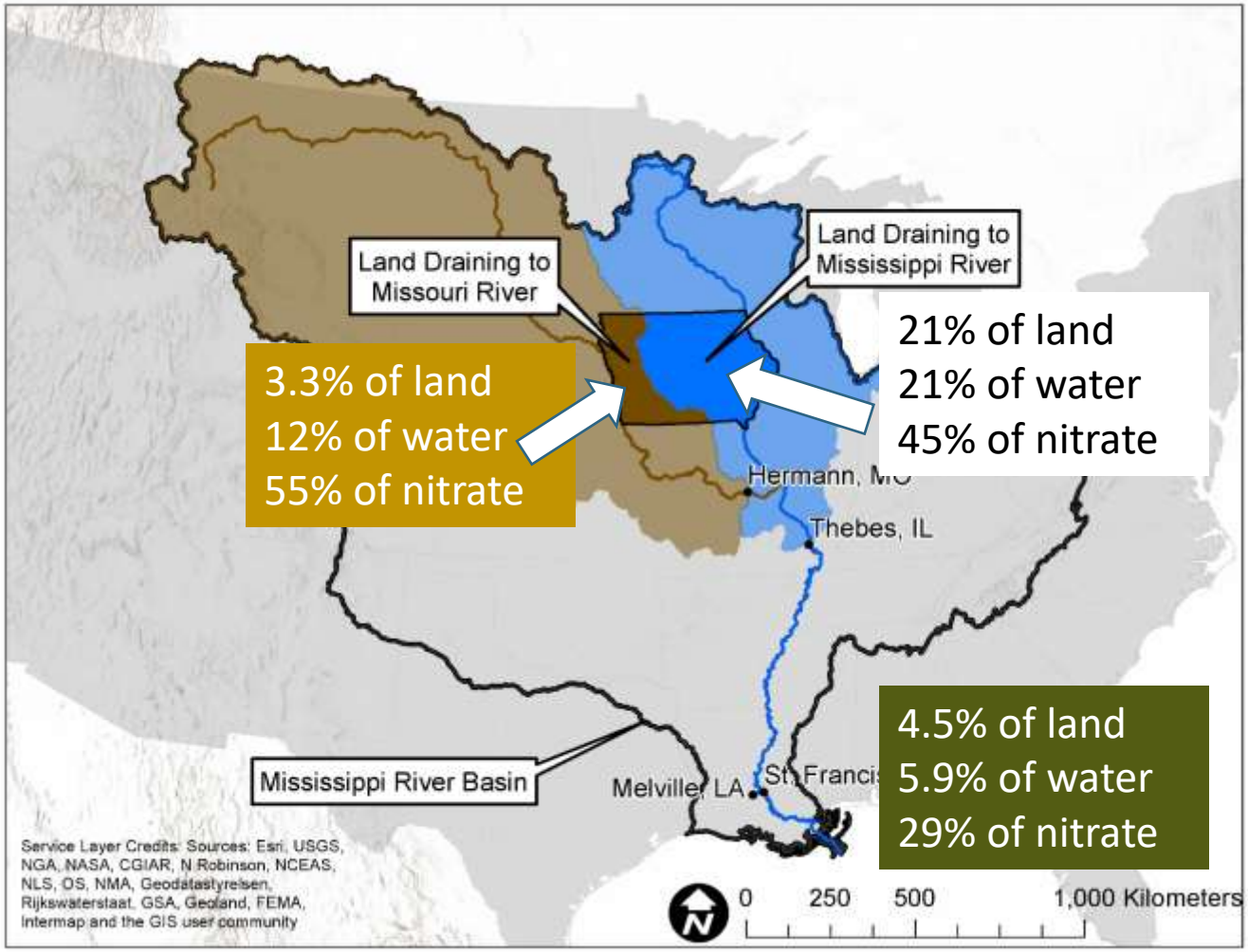




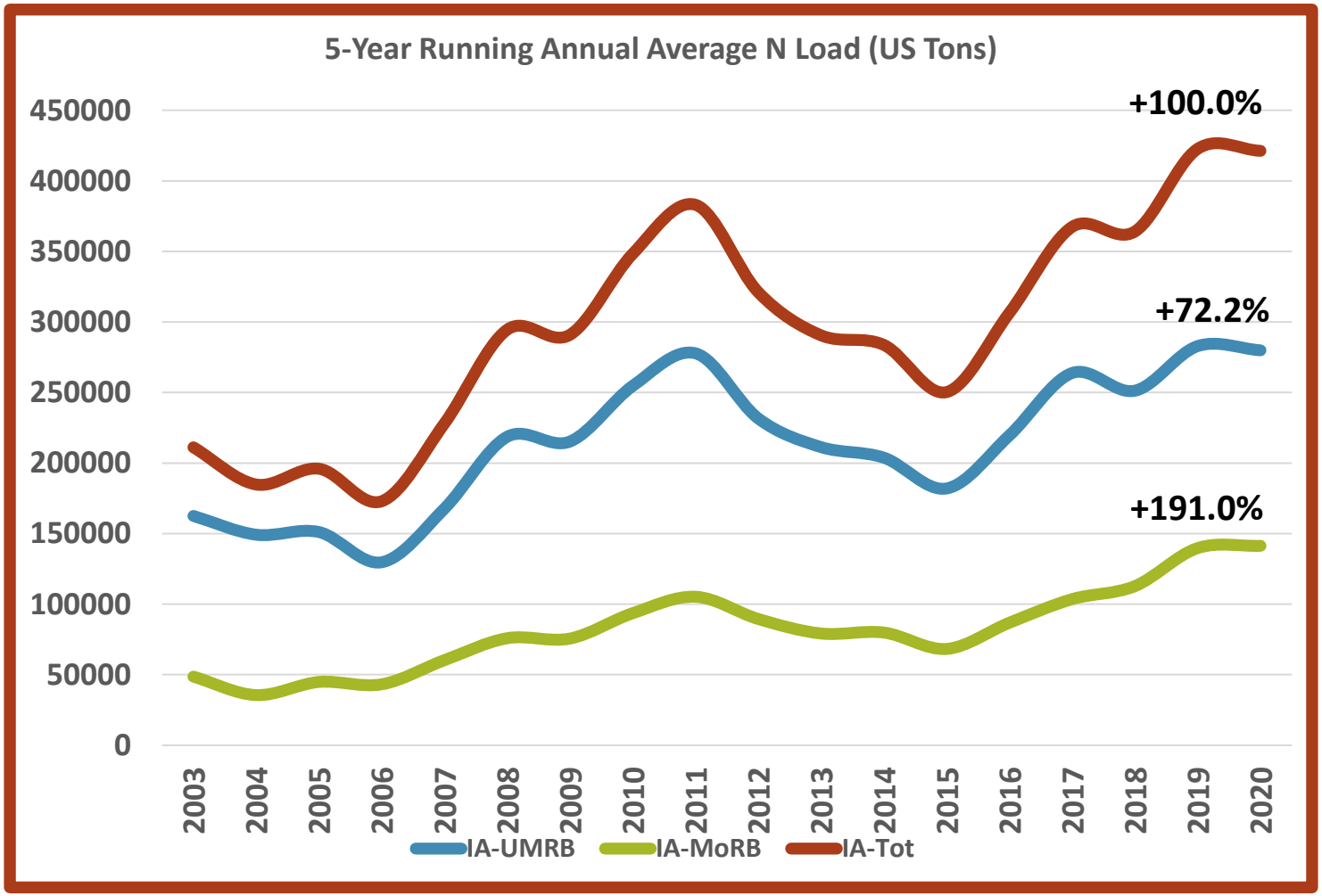
Land Draining to Upper Mississippi R.
38,828 square miles (69% of Iowa)
Total Nitrate-Nitrogen Load: 435 million pounds (69% of state total)
Total Water Discharge: 3.31 x 10^{10} cubic meters
Nitrogen Loss per acre: 17.5 pounds
Nitrogen Loss per crop acre: 27.0
Water Yield (runoff per watershed area): 13.0 inches

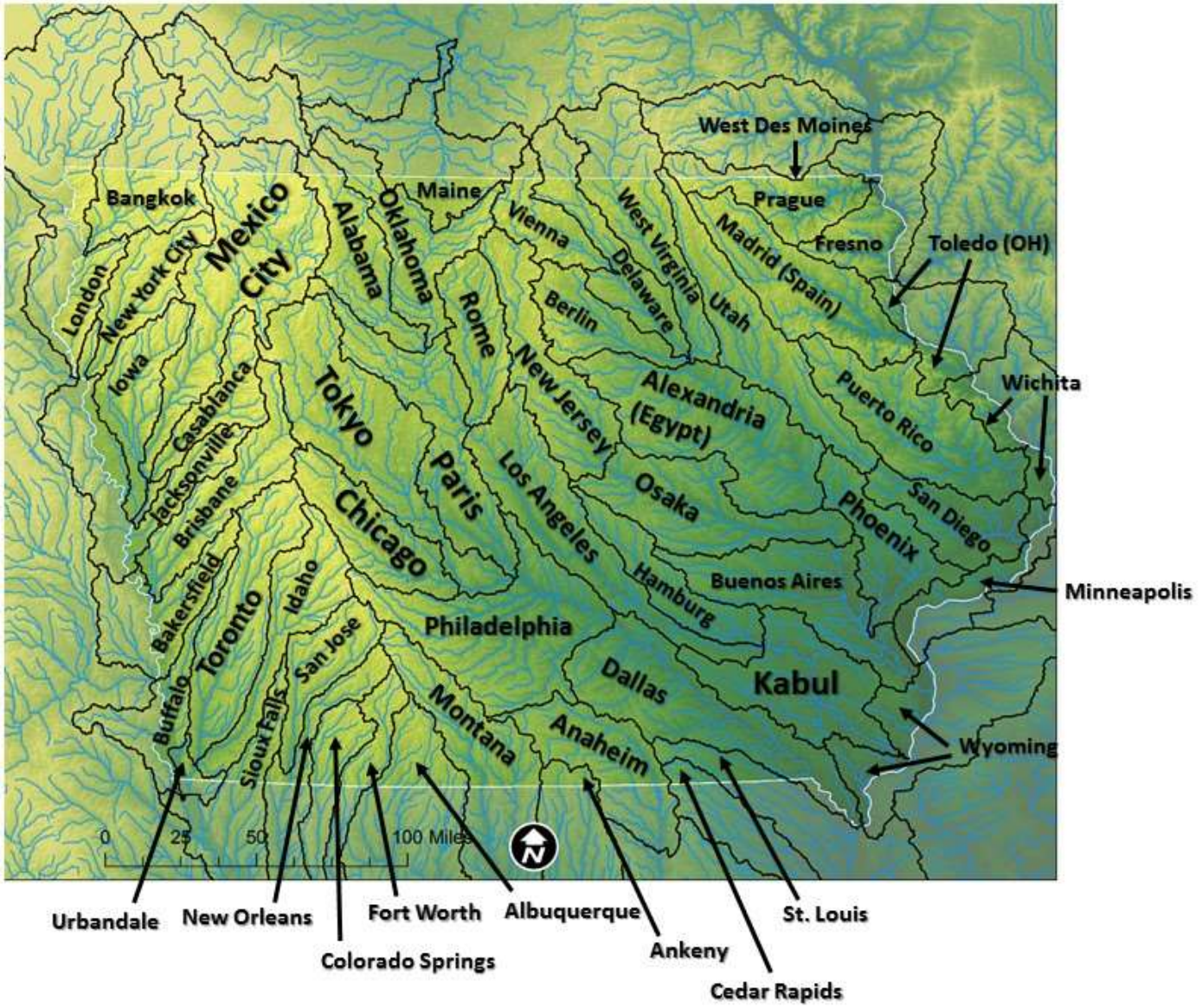
Land Draining to Missouri R.
17,444 square miles (31% of Iowa)
Total Nitrate-Nitrogen Load: 191 million pounds (31% of state total)
Total Water Discharge: 1.18 x 10^{10} cubic meters
Nitrogen Loss per acre: 17.1 pounds
Nitrogen Loss per crop acre: 22.7
Water Yield (runoff per watershed area): 10.0 inches


Share of Statewide Nitrate Load / Share of Statewide Runoff
Floyd River
South Fork Iowa River
Walnut Creek US (Jasper Co.)
Tipton Creek
Rock River
N. Raccoon River (Sac City)
Powell Creek
Boone River (Goldfield)
Beaver Creek
Cedar Creek (Pocahontas)
N. Raccoon River (Jefferson)
Slough Cr Wetland Inlet
Ioway Creek
Miller Creek
Boone River (Webster City)
Mud Creek
Walnut Creek (Story County)
Des Moines R. (Des Moines)
Little Sioux River
W. Fork Crooked Creek
Wolf Creek
Soldier River
Clear Creek (Oxford)
Yellow River
Boyer River
Raccoon River (Van Meter)
Cedar River (Janesville)
Skunk River
W. Nishnabotna River
Cedar River (Palo)
Walnut Creek DS (Jasper Co.)
Turkey River
W. Nishnabotna River
West Fork Cedar River
Iowa River (ind. Cedar)
Wapsipinicon R. (DeWitt)
Upper Iowa River
Cedar River (Conesville)
Wapsipinicon R. (Central City)
South Raccoon River
Iowa River (Iowa City)
North English River
Morgan Creek
Clear Creek (Coralville)
Shellrock River
Des Moines R. (Keosauqua)
East Nishnabotna River
English River
Catfish Creek (S)
West Nodaway River
0.0
0.5
1.0
1.5
2.0
2.5


Land Draining to Missouri River
Land Draining to Mississippi River
3.3% of land
12% of water
55% of nitrate
21% of land
21% of water
45% of nitrate
Hermann, MO
Thebes, IL
Mississippi River Basin
Melville, LA
St. Francis
4.5% of land
5.9% of water
29% of nitrate
Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
0 250 500 1,000 Kilometers

How Much Nitrogen Leaves Iowa?




West Des Moines
Bangkok
Maine
Prague
Vienna
Fresno
Toledo (OH)
Mexico City
Alabama
Oklahoma
West Virginia
Madrid (Spain)
London
New York City
Delaware
Utah
Berlin
Rome
Iowa
Tokyo
New Jersey
Alexandria (Egypt)
Puerto Rico
Wichita
Casablanca
Jacksonville
Paris
Los Angeles
Osaka
Brisbane
Chicago
Phoenix
San Diego
Buenos Aires
Minneapolis
Bakersfield
Idaho
Hamburg
Toronto
Philadelphia
San Jose
Dallas
Kabul
Buffalo
Sioux Falls
Montana
Anaheim
Wyoming
0
25
50
100 Miles
N
Urbandale
New Orleans
Fort Worth
Albuquerque
St. Louis
Colorado Springs
Ankeny
Cedar Rapids

What Can Be Done?

1. Ban cropping in the 2-year Flood Plain
2. Ban fall tillage
3. Ban manure on snow and frozen ground
4. Make farmers adhere to ISU fertilization guidelines
5. Reformulate CAFO Regulations


https://www.iihr.uiowa.edu/cjones/welcome/