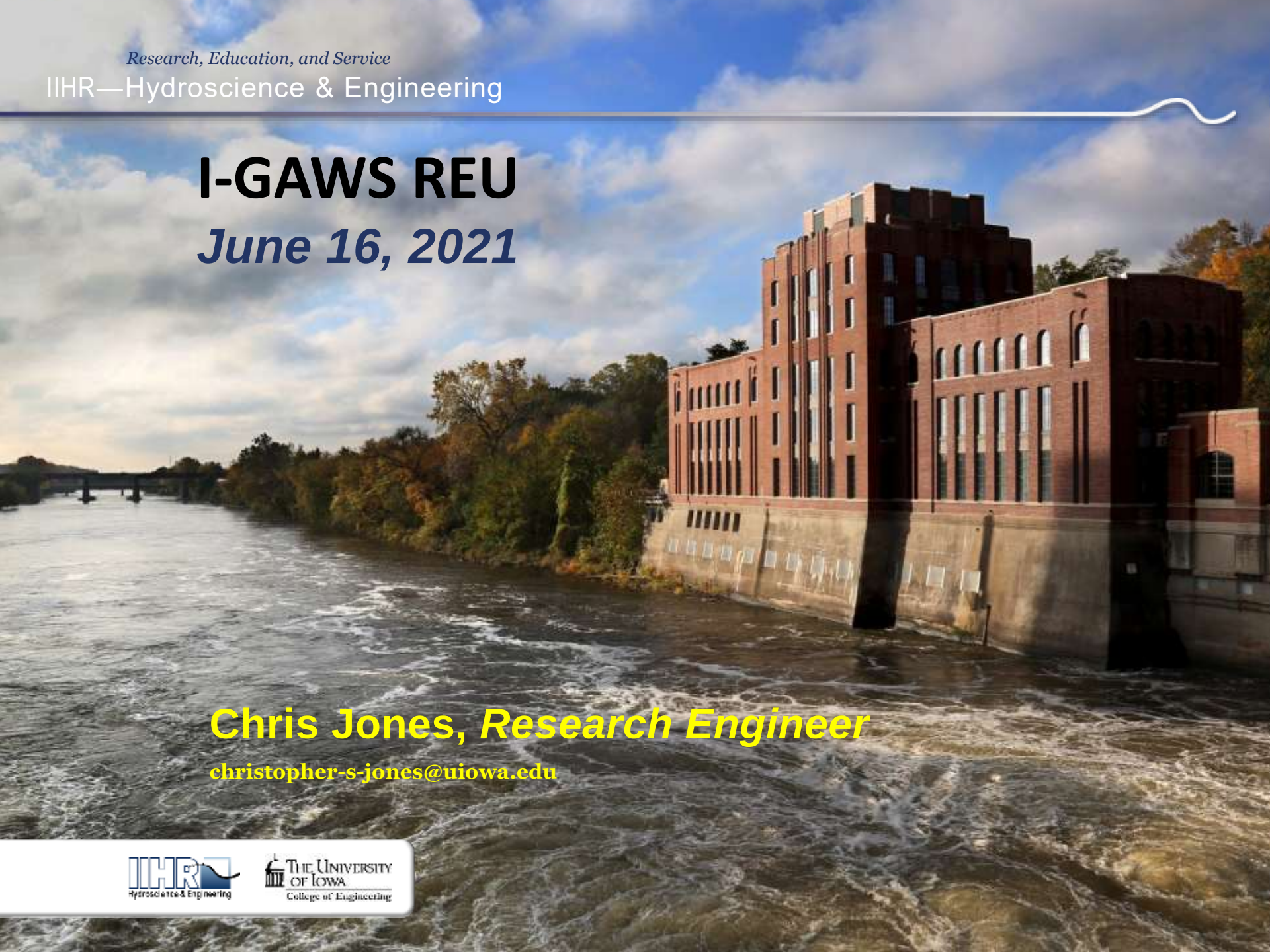
I-GAWS REU

June 16, 2021



Chris Jones, *Research Engineer*

christopher-s-jones@uiowa.edu

IIHR Hydroscience & Engineering
The University of Iowa College of Engineering

Slides Available at:

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

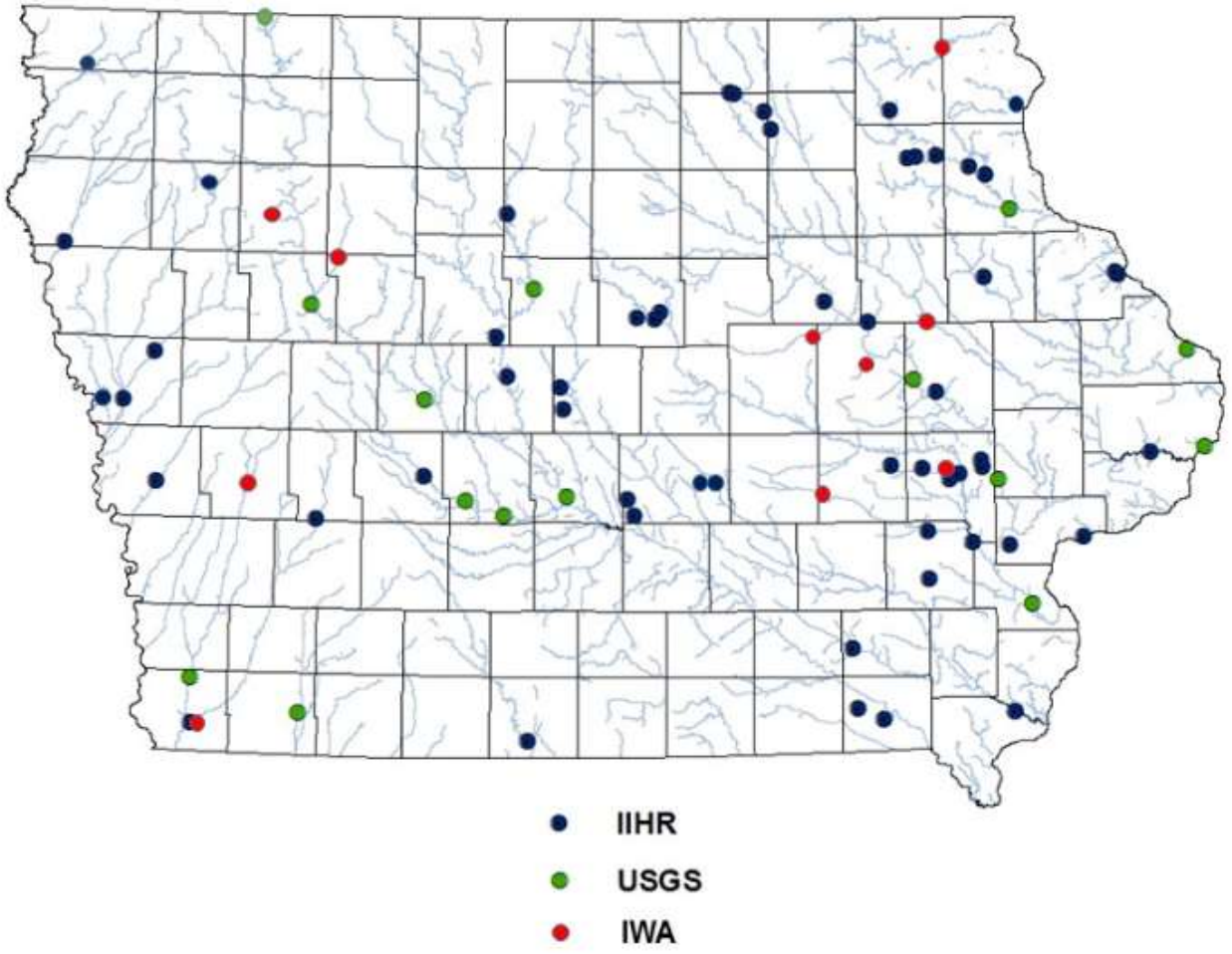
IIHR Water Quality Sensor Network

Sites

70+ sites Nitrate-N

20-25 sites

- Temperature
- pH
- SC
- DO
- Turbidity

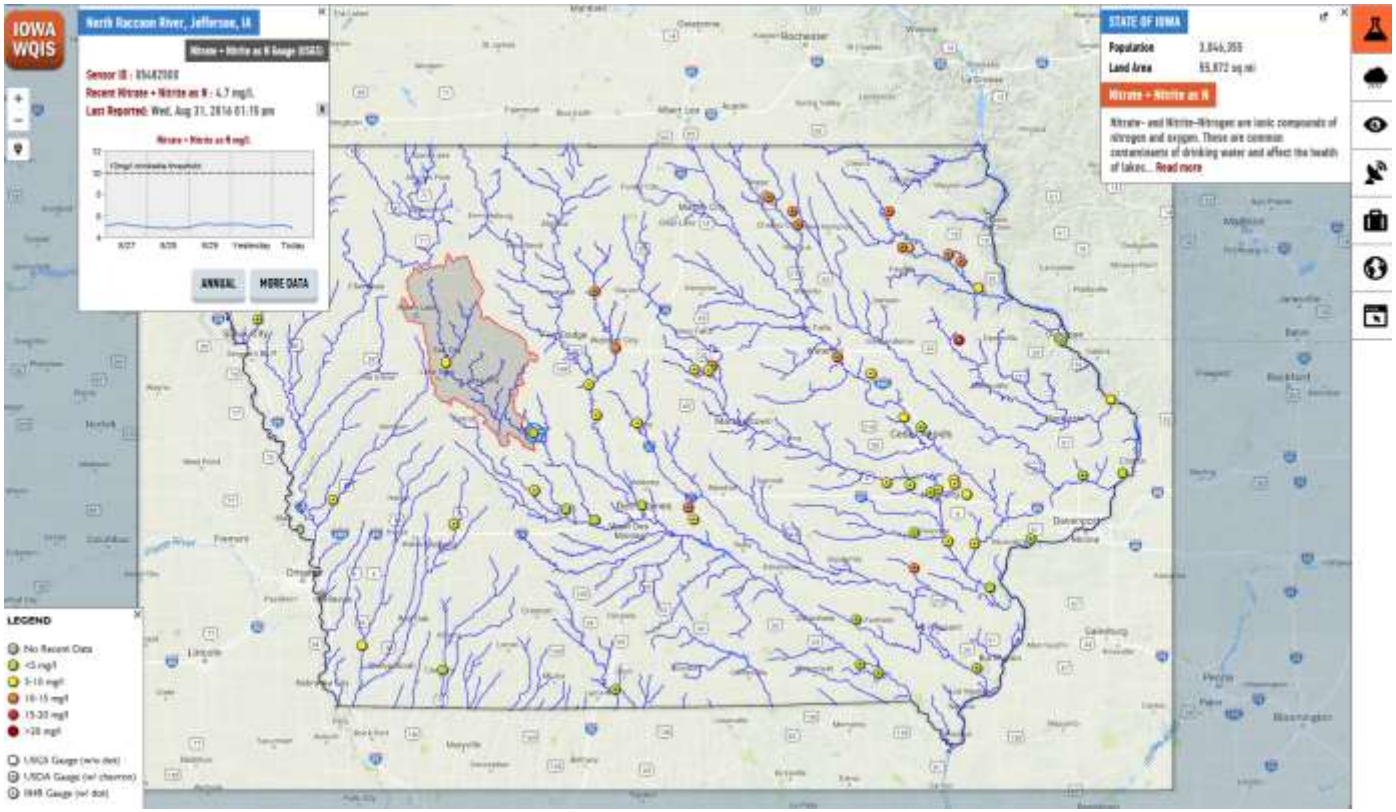


Site infrastructure

Small Streams

IIHR Water Quality Sensor Setup

Iowa Water Quality Information System



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Publications

- Practice Assessment: 11
- Wetland Research: 10
- Stream and Tile Drainage Hydrology: 6
- Nitrate Dynamics Within Streams and Reservoirs: 5
- Policy: 4
- Golf Course Soils and Nutrients: 3
- Phosphorus Transport: 4
- Watershed Nitrate Loading: 3
- Livestock and Water Quality: 1
- Groundwater Nitrate Dynamics: 1
- Carbon Transport in Tile Drainage: 1

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

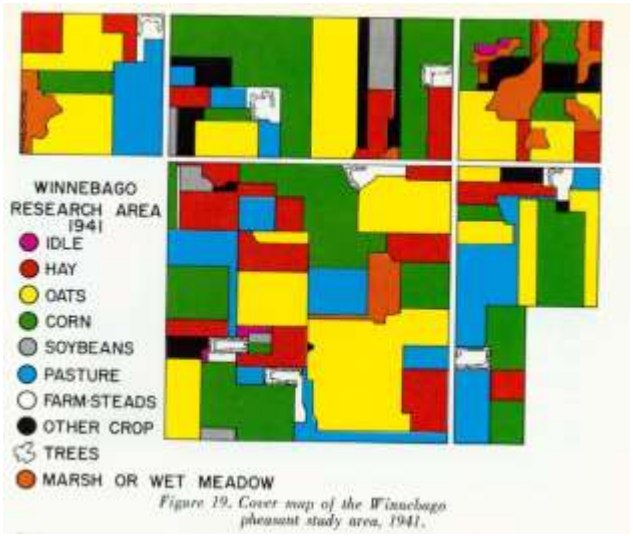


Figure 19. Cover map of the Winnebago pheasant study area, 1941.

1976

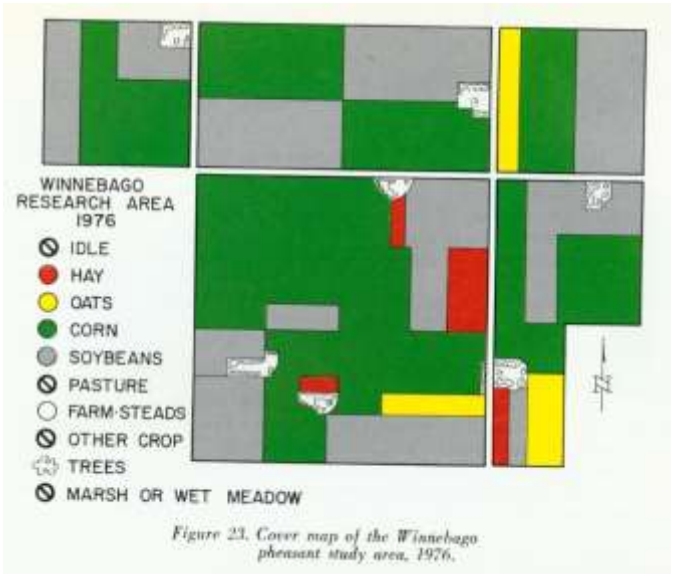
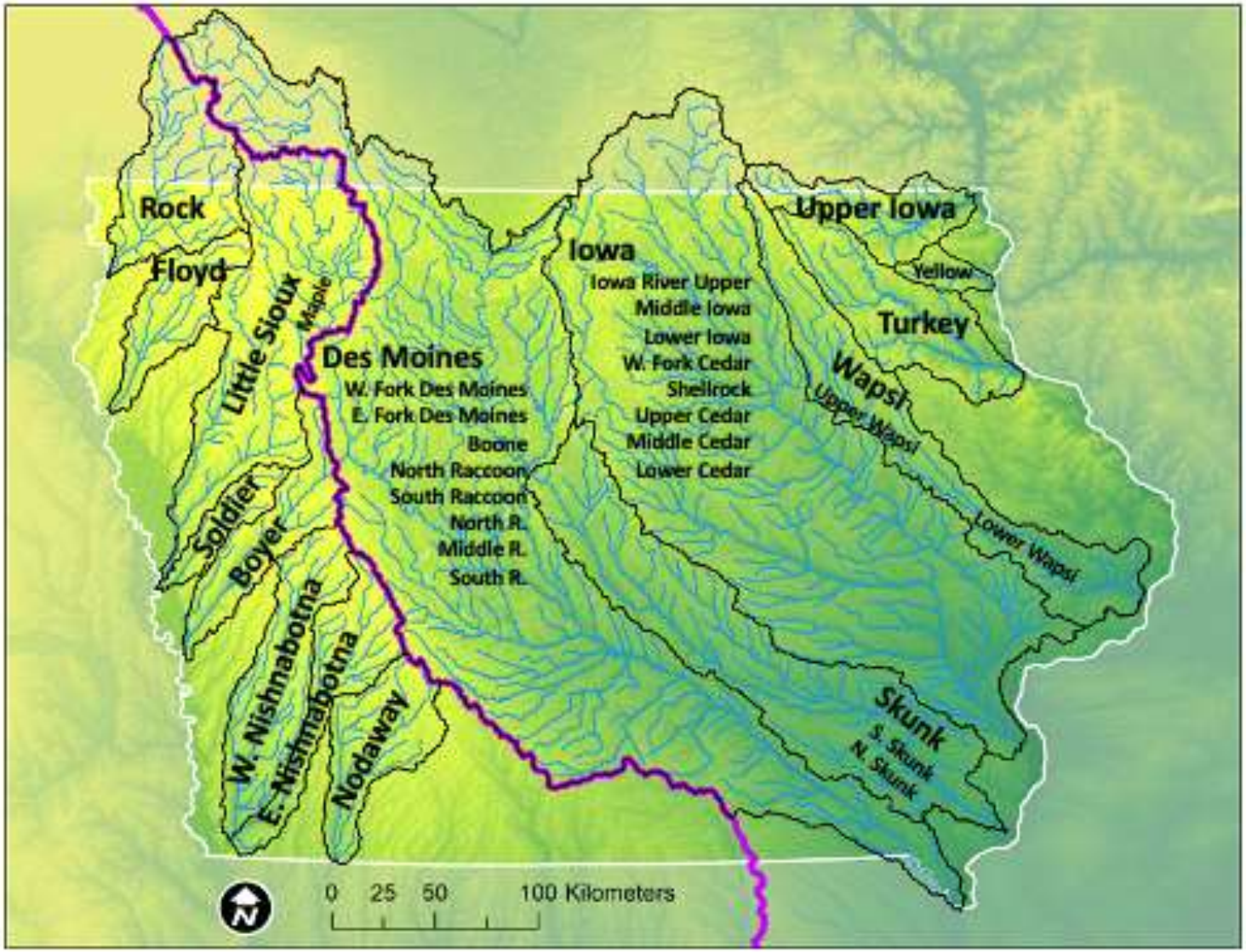


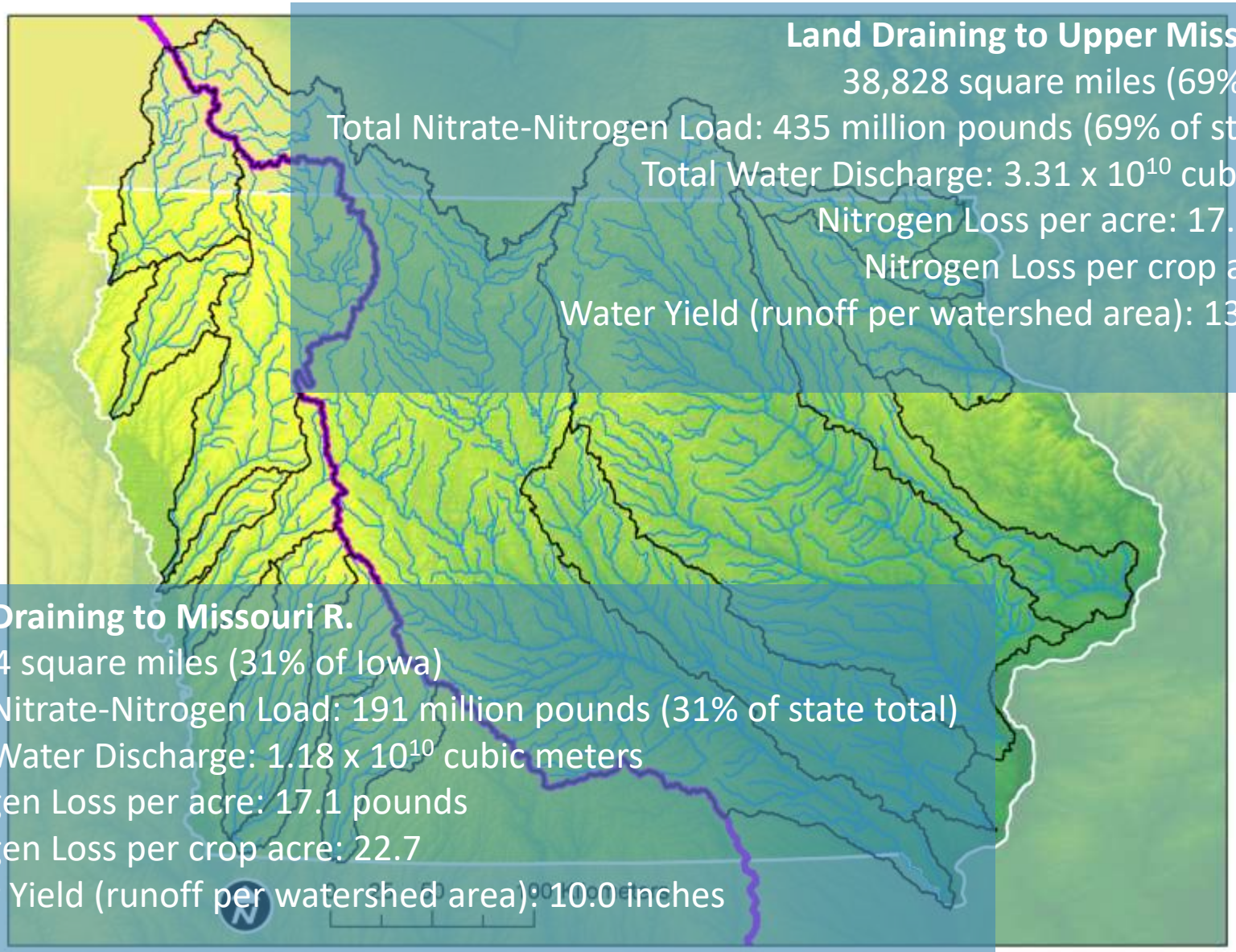
Figure 23. Cover map of the Winnebago pheasant study area, 1976.

LEAKY SYSTEM

Statewide N Loading 2020

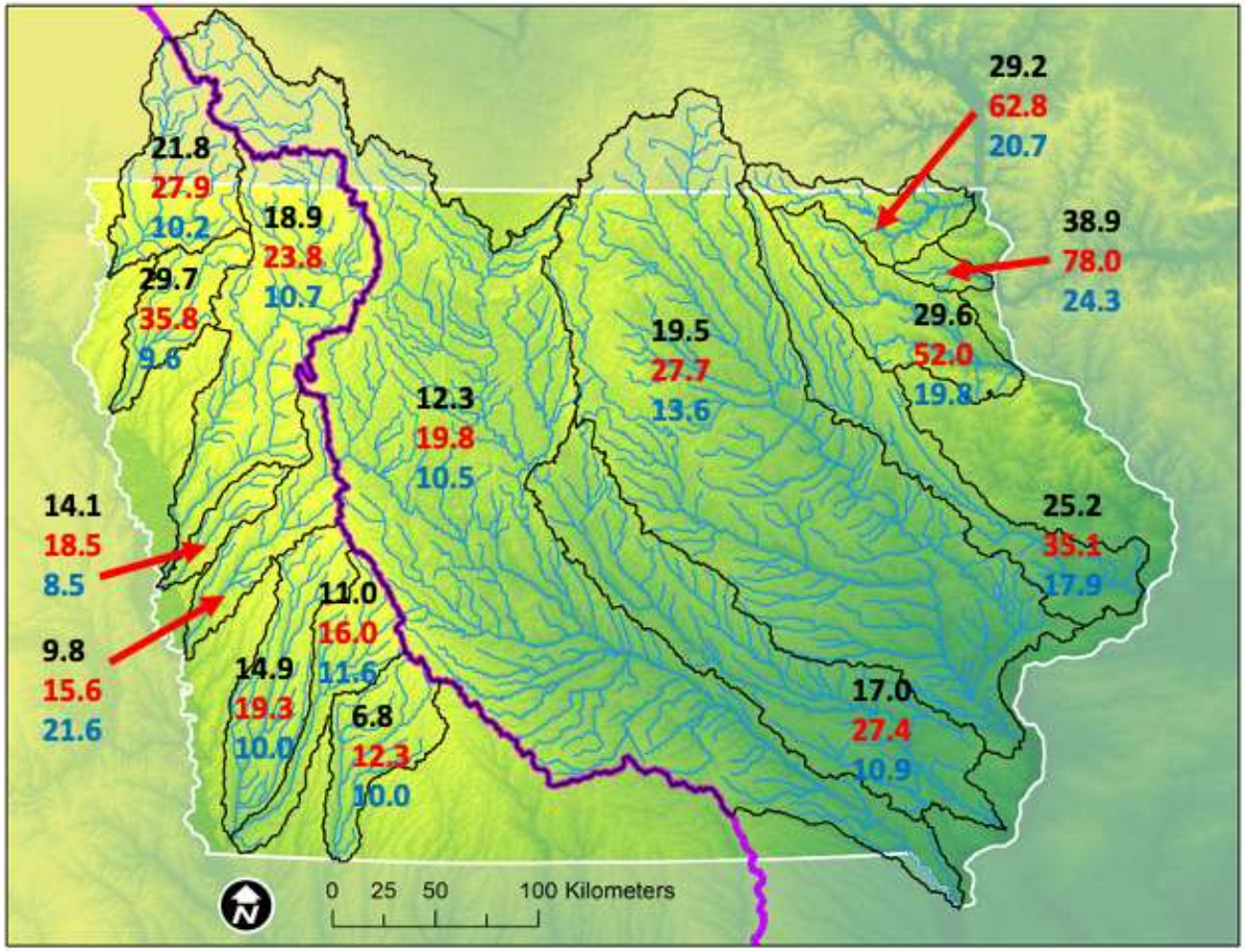
2020 Stream Nitrate Data





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

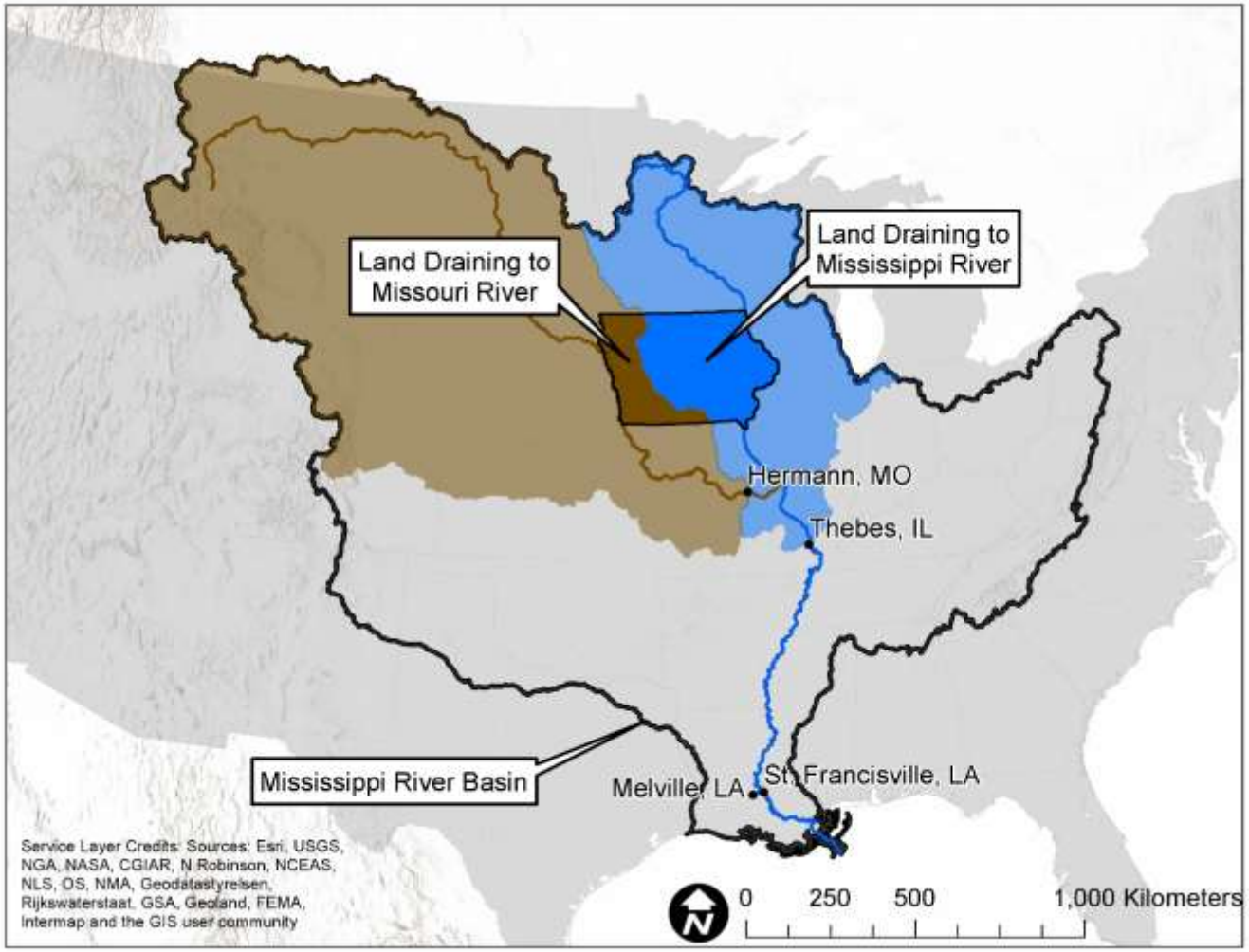


Black: lbs/acre

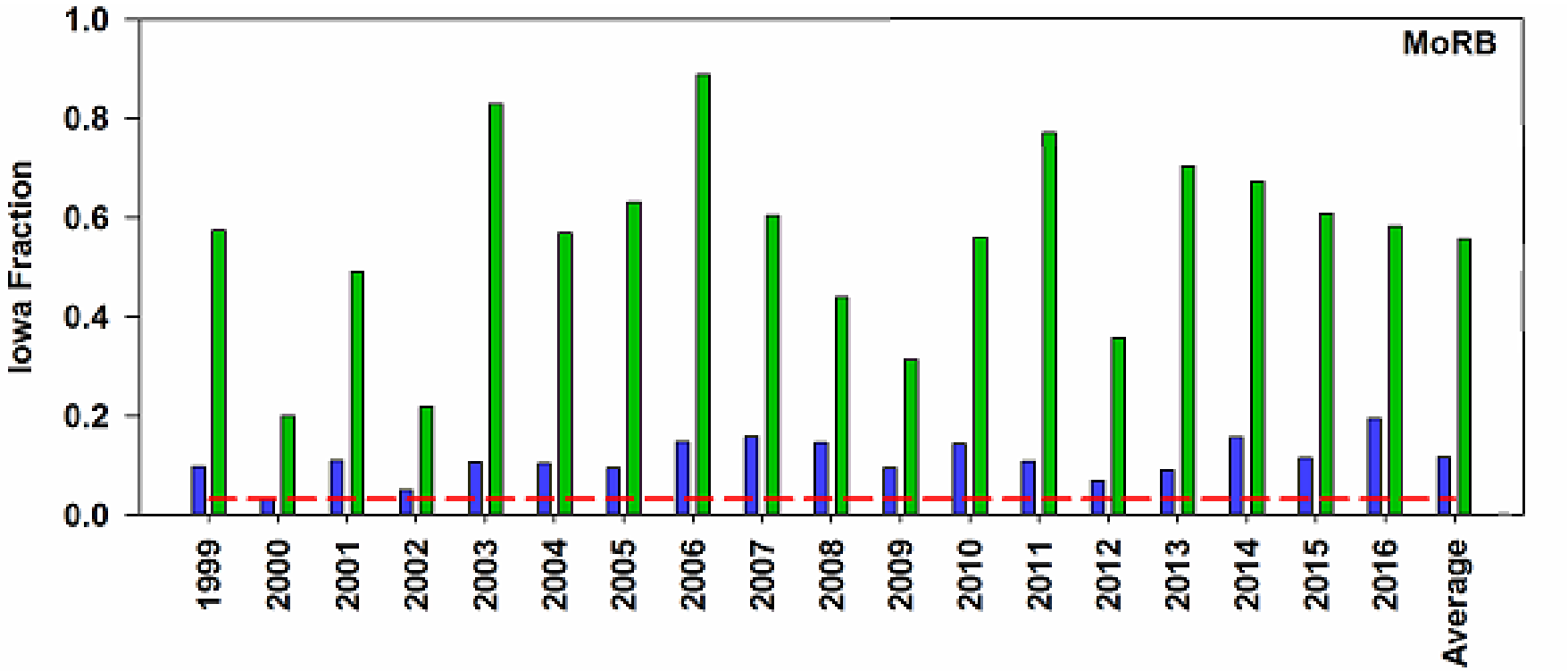
Red: lbs/crop-acre

Blue: Runoff (inches)


137661
5000

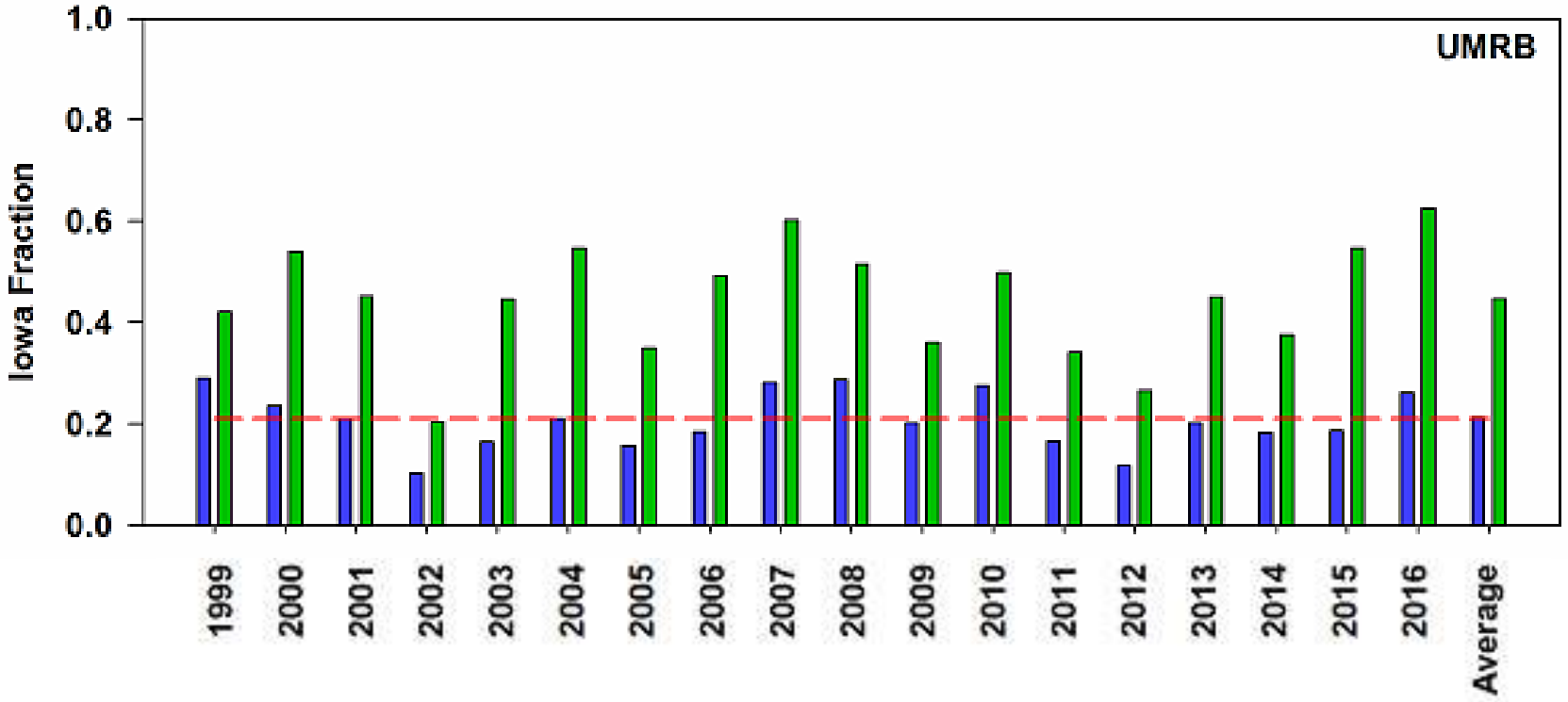


Missouri



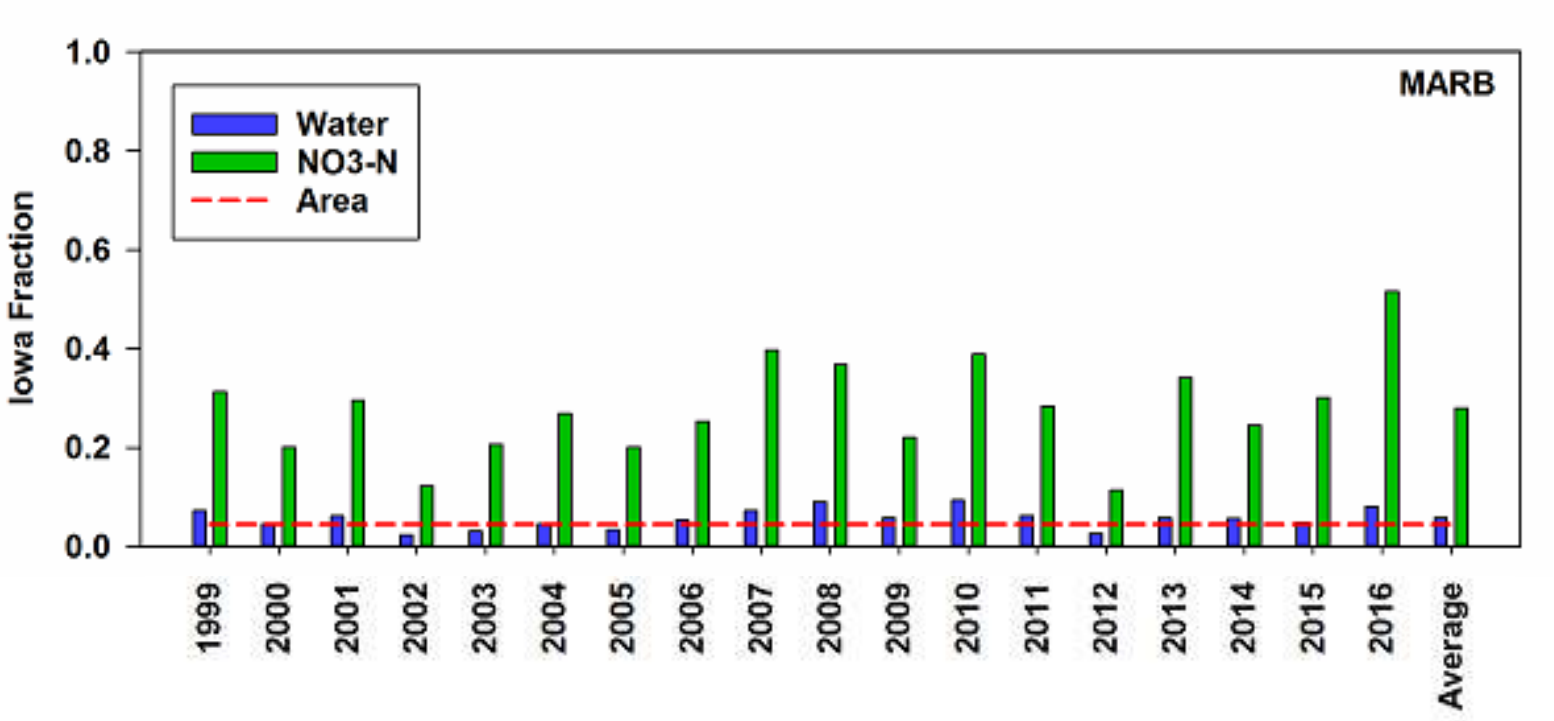
3.3% of the land
12% of the water
55% of the nitrate

Upper Mississippi



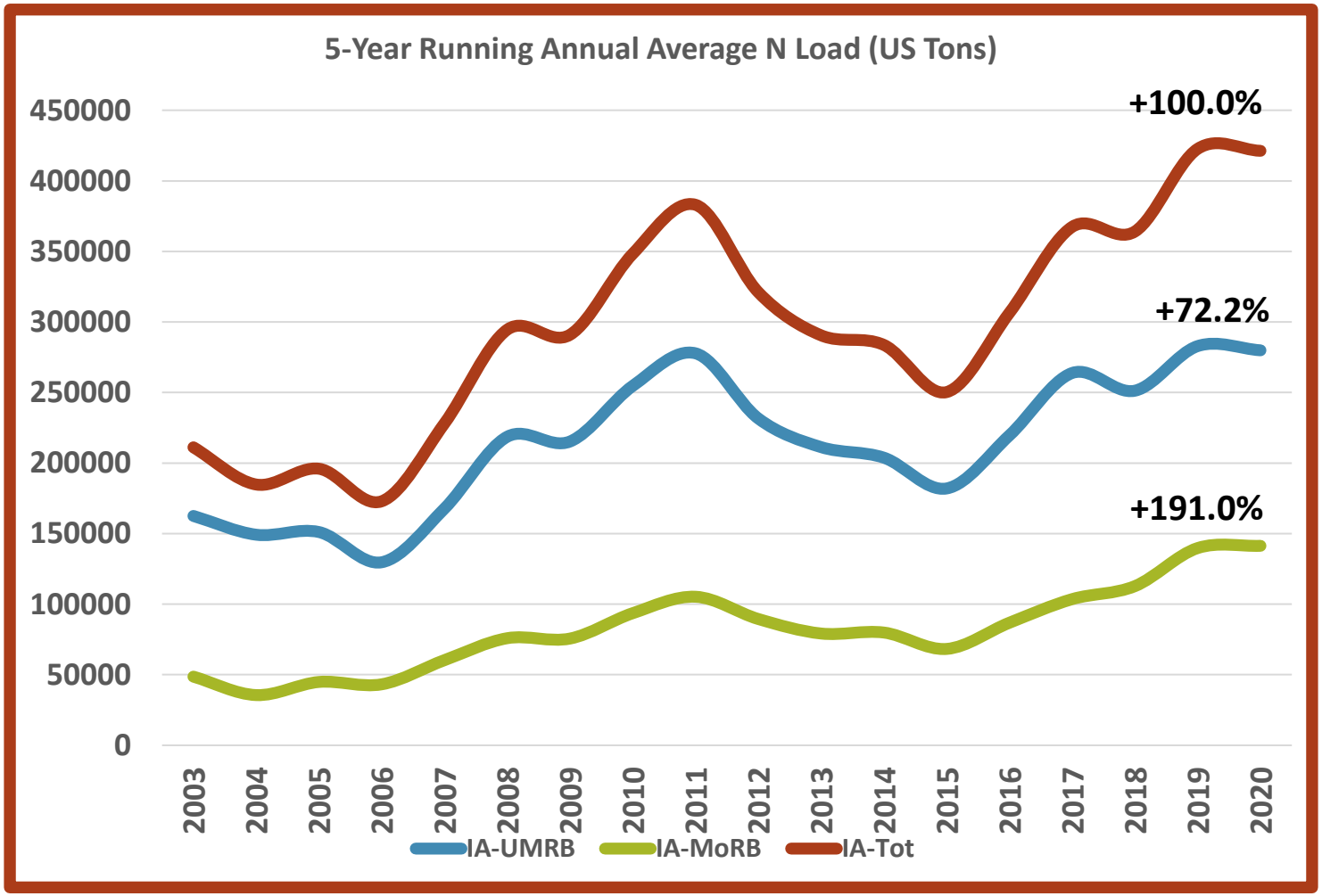
21% of the land
21% of the water
45% of the nitrate

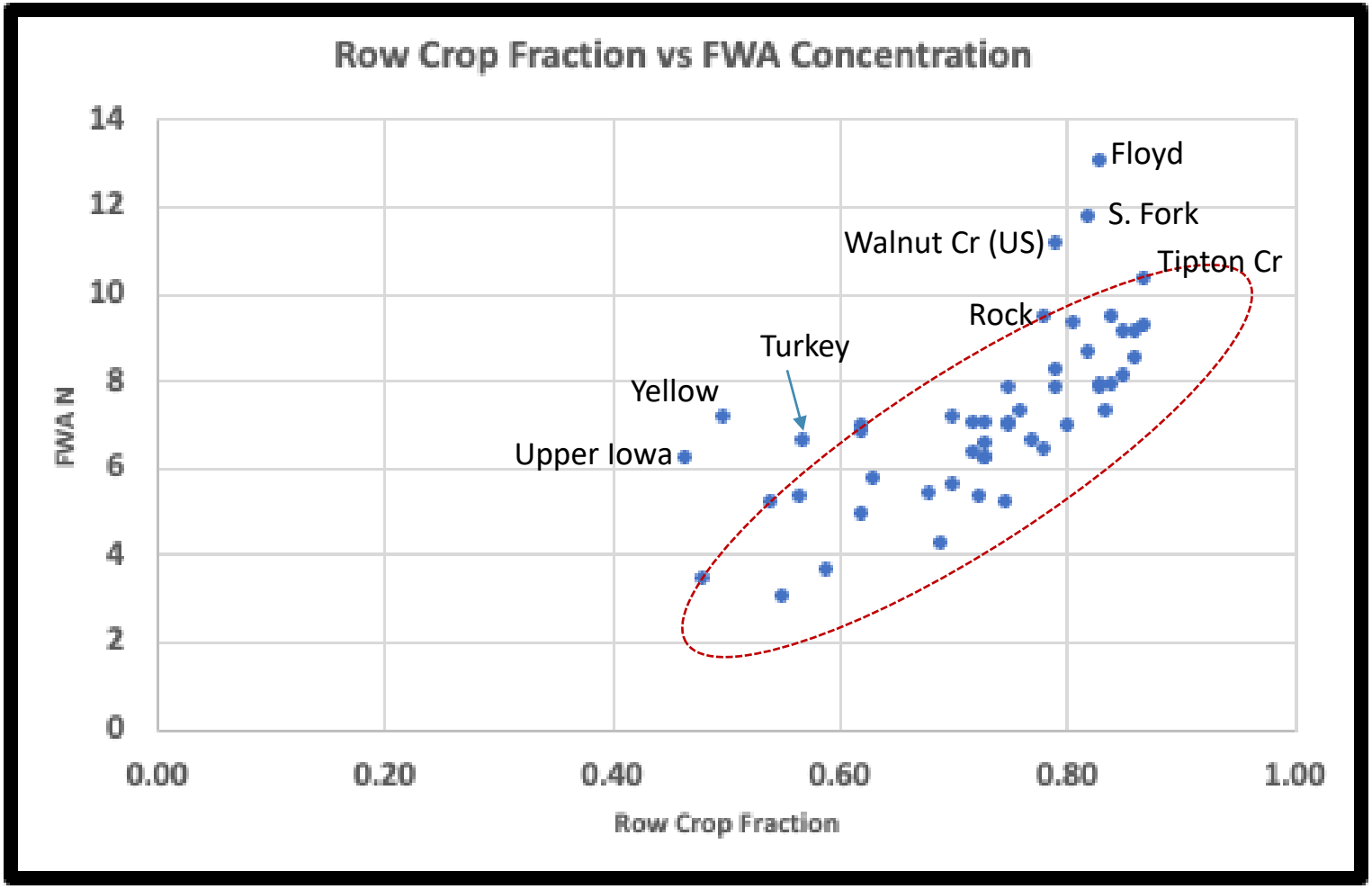
Mississippi-Atchafalaya-Gulf of Mexico

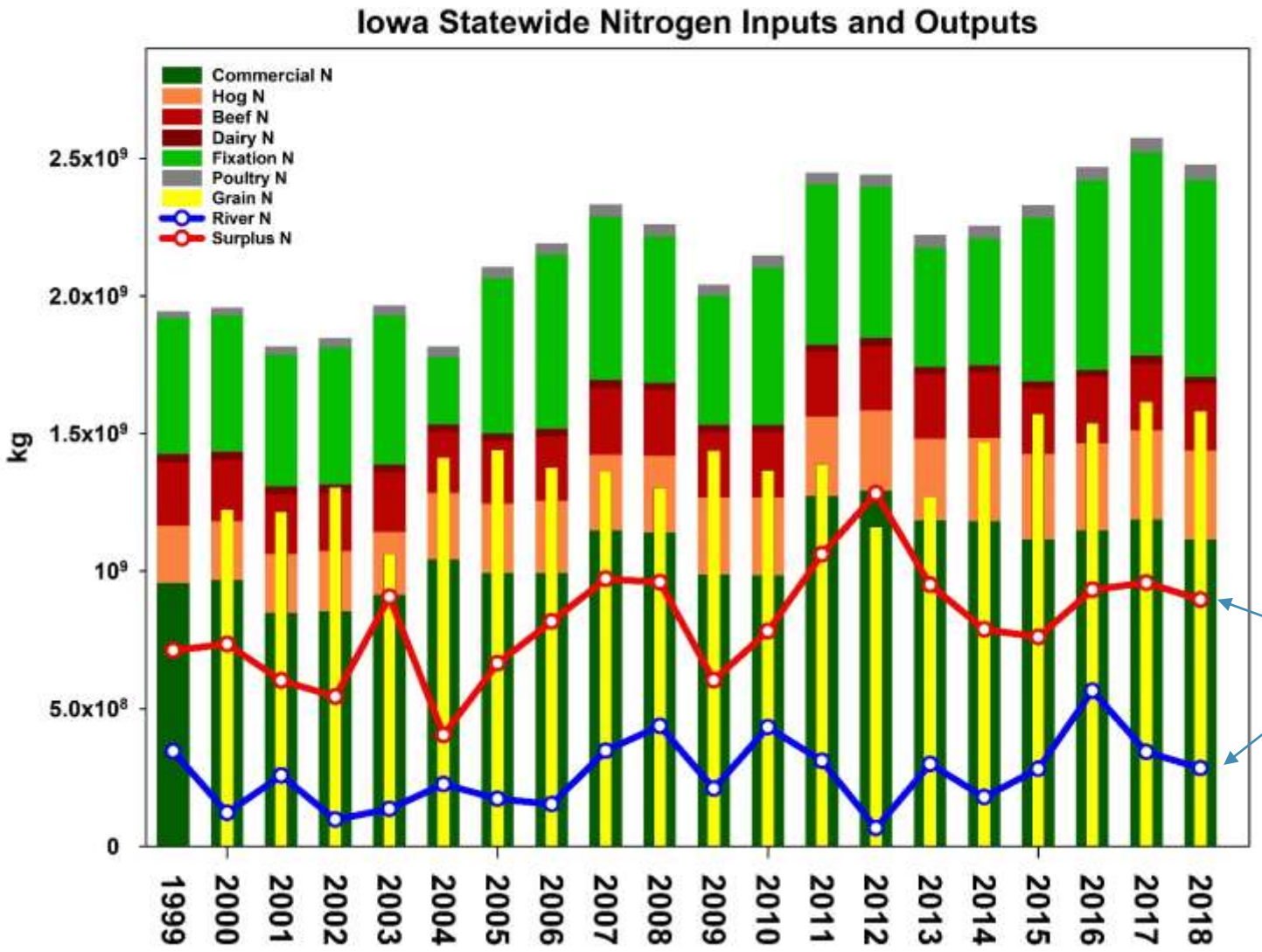


4.5% of the land
5.9% of the water
29% of the nitrate

How Much Nitrogen Leaves Iowa?




Row Crop Fraction vs FWA Concentration
FWA N
Row Crop Fraction
0
2
4
6
8
10
12
14
0.00
0.20
0.40
0.60
0.80
1.00
Floyd
S. Fork
Walnut Cr (US)
Tipton Cr
Rock
Turkey
Yellow
Upper Iowa

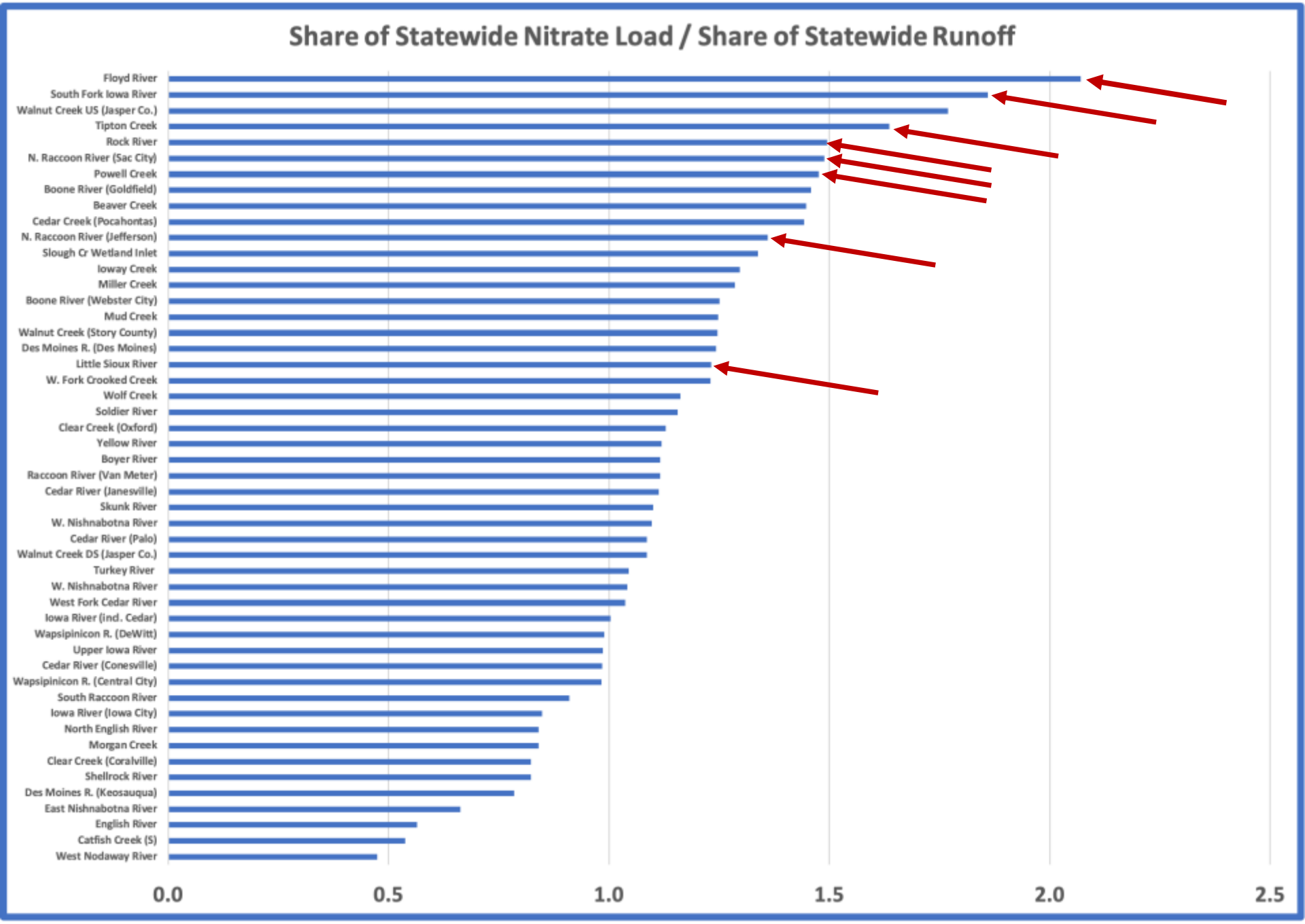


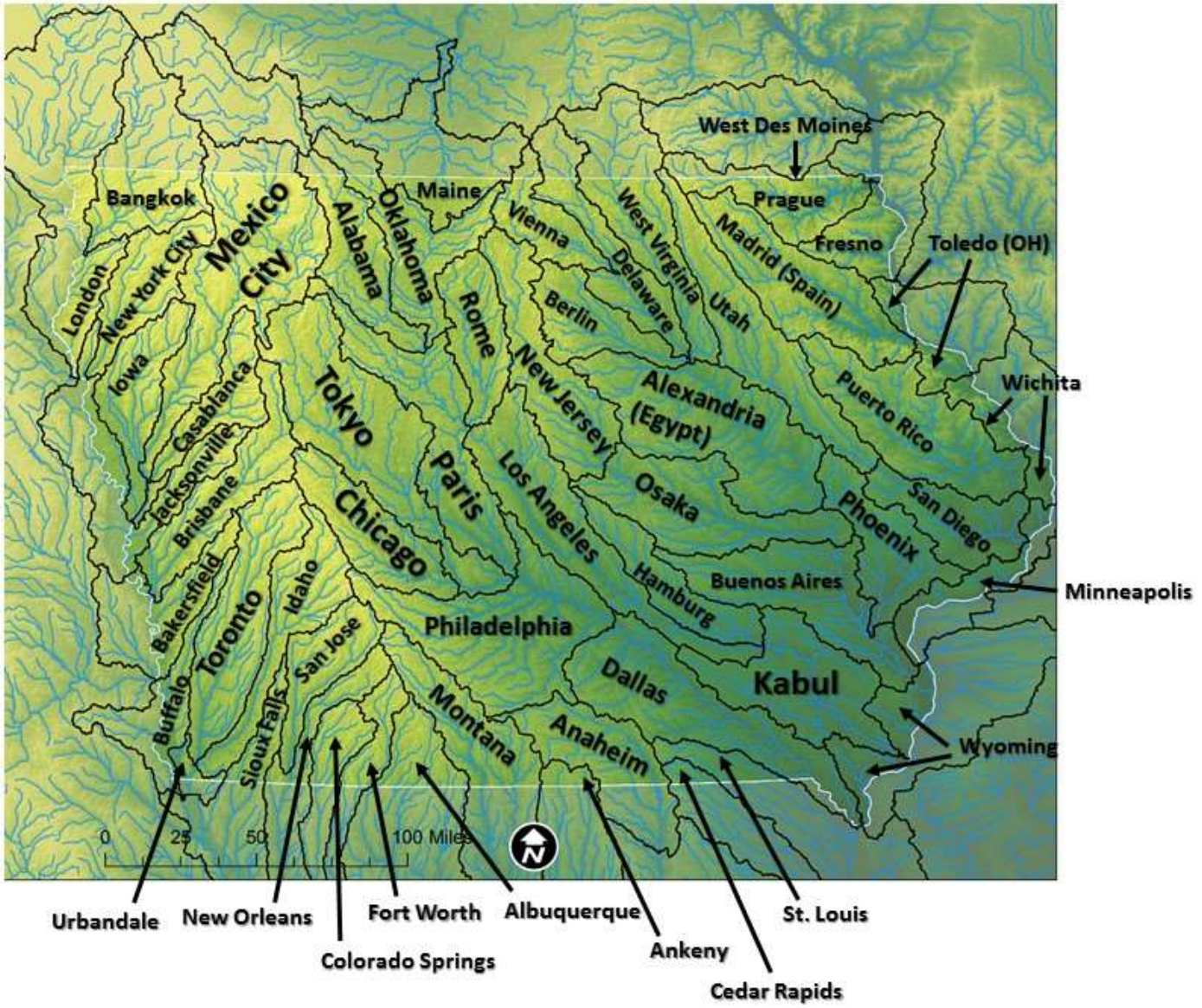
About 32% of "surplus" makes it to streams

Can we "soil health" our way out of this?

Nitrogen Change (%) Since 1999

N Category	% change
River	83
Chicken	76
Turkey	59
Hogs	59
Surplus	51
Fixation	41
total inputs	36
Commercial	34
Grain N	27
Beef	10
Dairy	-11


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


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