



# **Nutrient and sediment concentrations and corresponding loads during the historic June 2008 flooding in eastern Iowa**

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6/12/2008 Cedar Rapids 3rd Ave



6/13/2008 Cedar Rapids

6/12/2008 Cedar Rapids  
Photo by Jason McVay





6/13/2008 Cedar River at Hwy 30

Photo by Scott Strader



6/9/2008 Charles City, IA (Cedar River)

Photo by Jon Nania

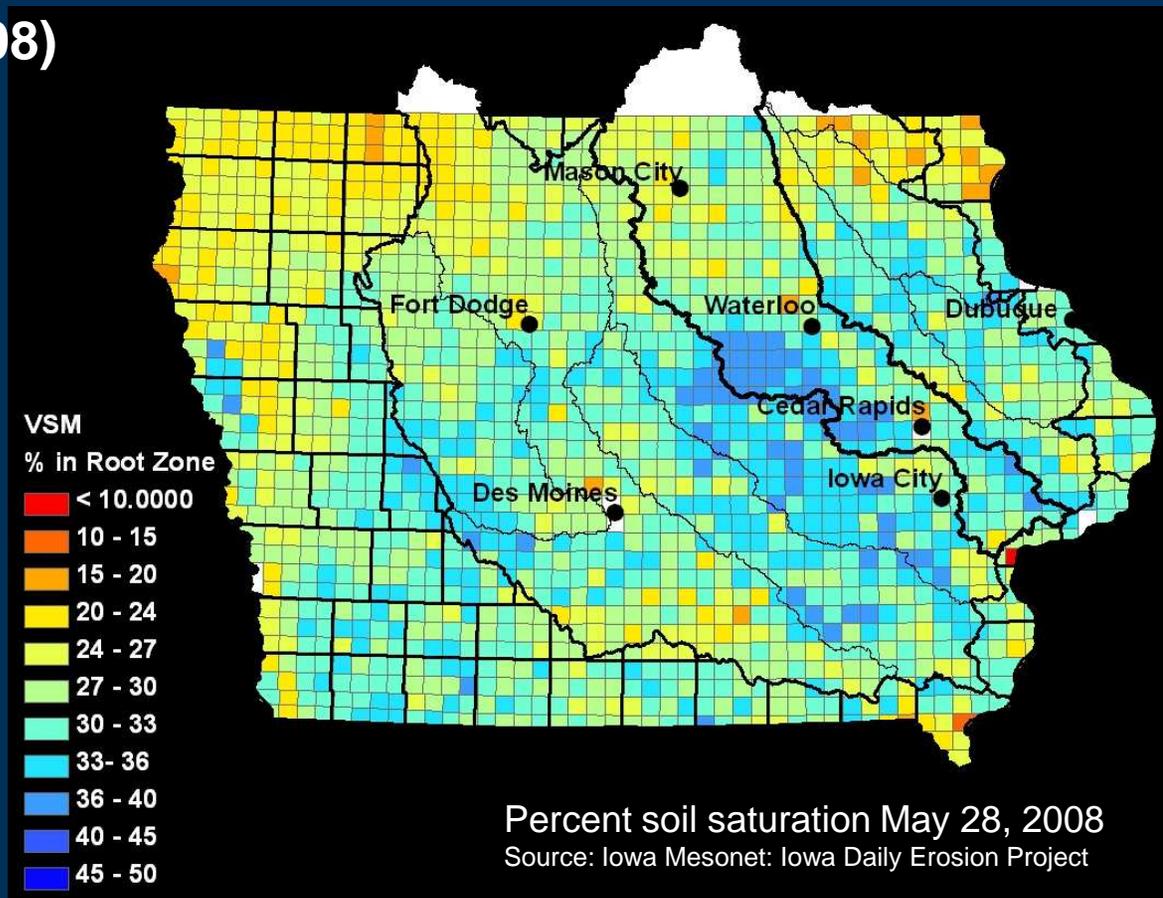


Coralville, IA (Iowa River)



# Background

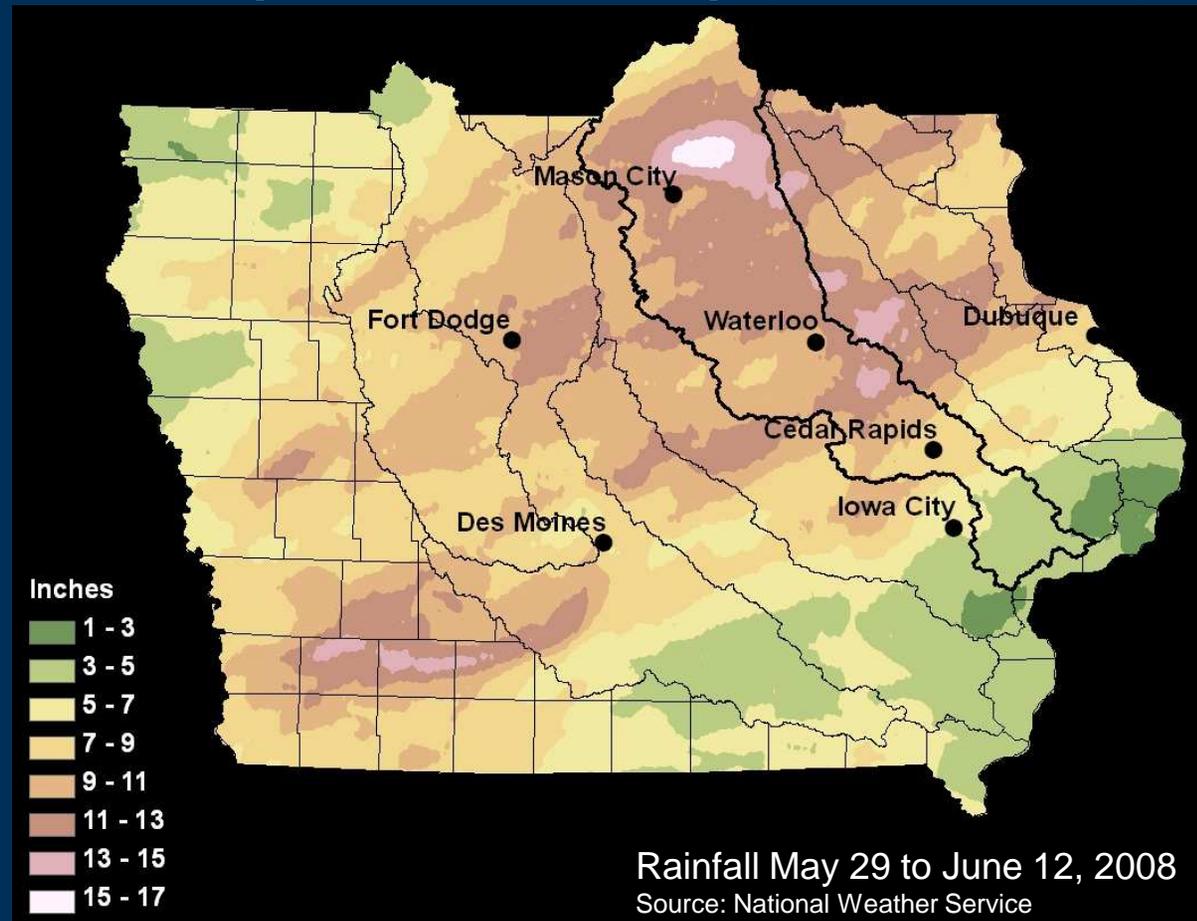
- December 2007 to May 2008 - 2<sup>nd</sup> wettest in the period of record for eastern Iowa (1895 to 2008) (NCDC, 2008)



Map by Kasey Hutchinson

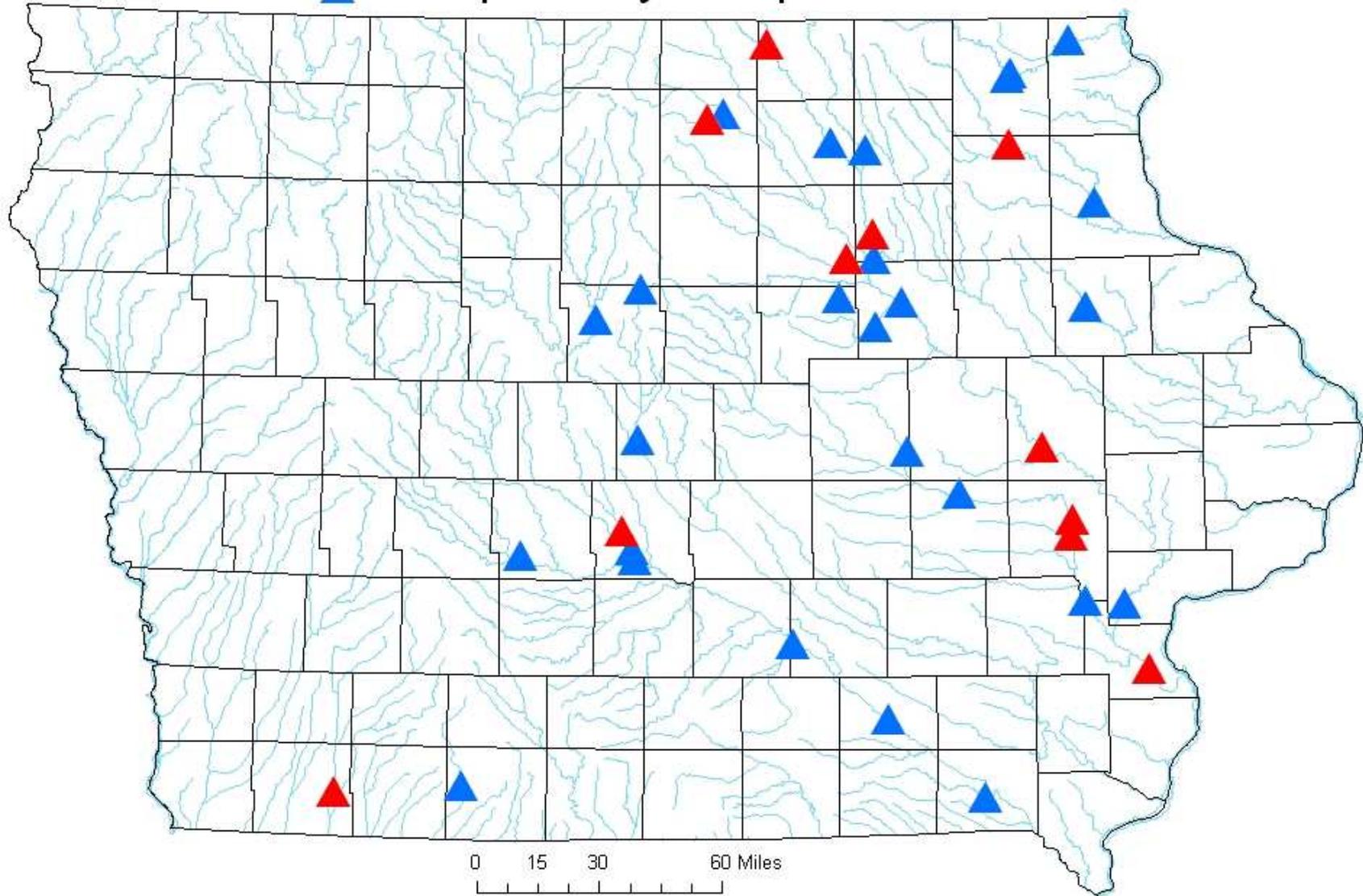
# Background

- June 2008 - the 2<sup>nd</sup> wettest June in the period of record for Iowa (1895 to 2008) (NCDC, 2008)



Map by Kasey Hutchinson

- ▲ Flood probability < 0.2 percent
- ▲ Flood probability 0.2 - 1 percent



**Map showing location of 37 USGS streamgages with flood probability estimates for the 2008 flood less than 1 percent.**

Map by Dave Eash

# Background

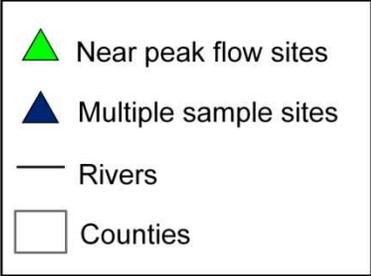
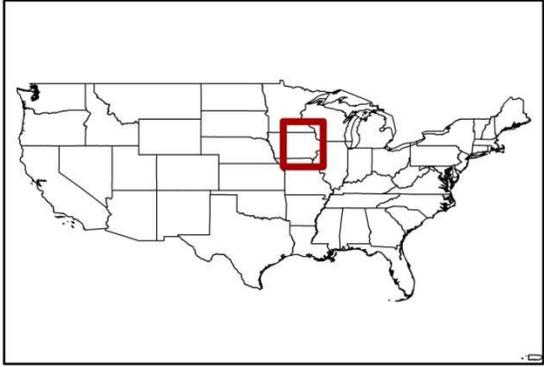
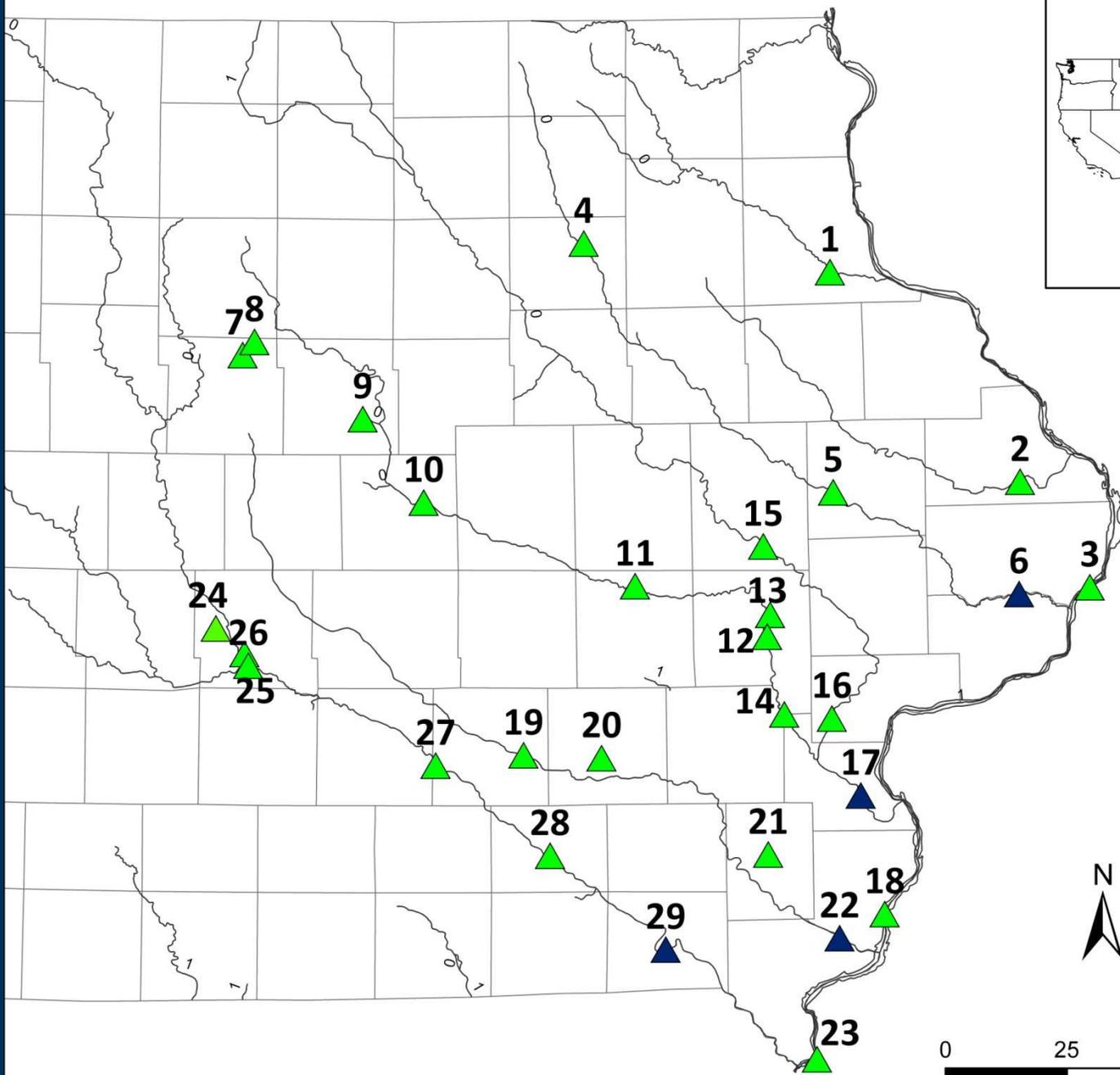
- Iowa 1<sup>st</sup> in harvested acreage and corn for grain production; 2<sup>nd</sup> in soybean production (2004) (USDA NASS, 2005)
- Over 59% of Iowa is used for corn and soy production (USDA NASS, 2008)
- Iowa is a major contributor of nutrients/sed. to the Mississippi River (Goolsby et al, 1999; Royer et al., 2006; Alexander et al., 2008)
- 1993 flood - a missed opportunity

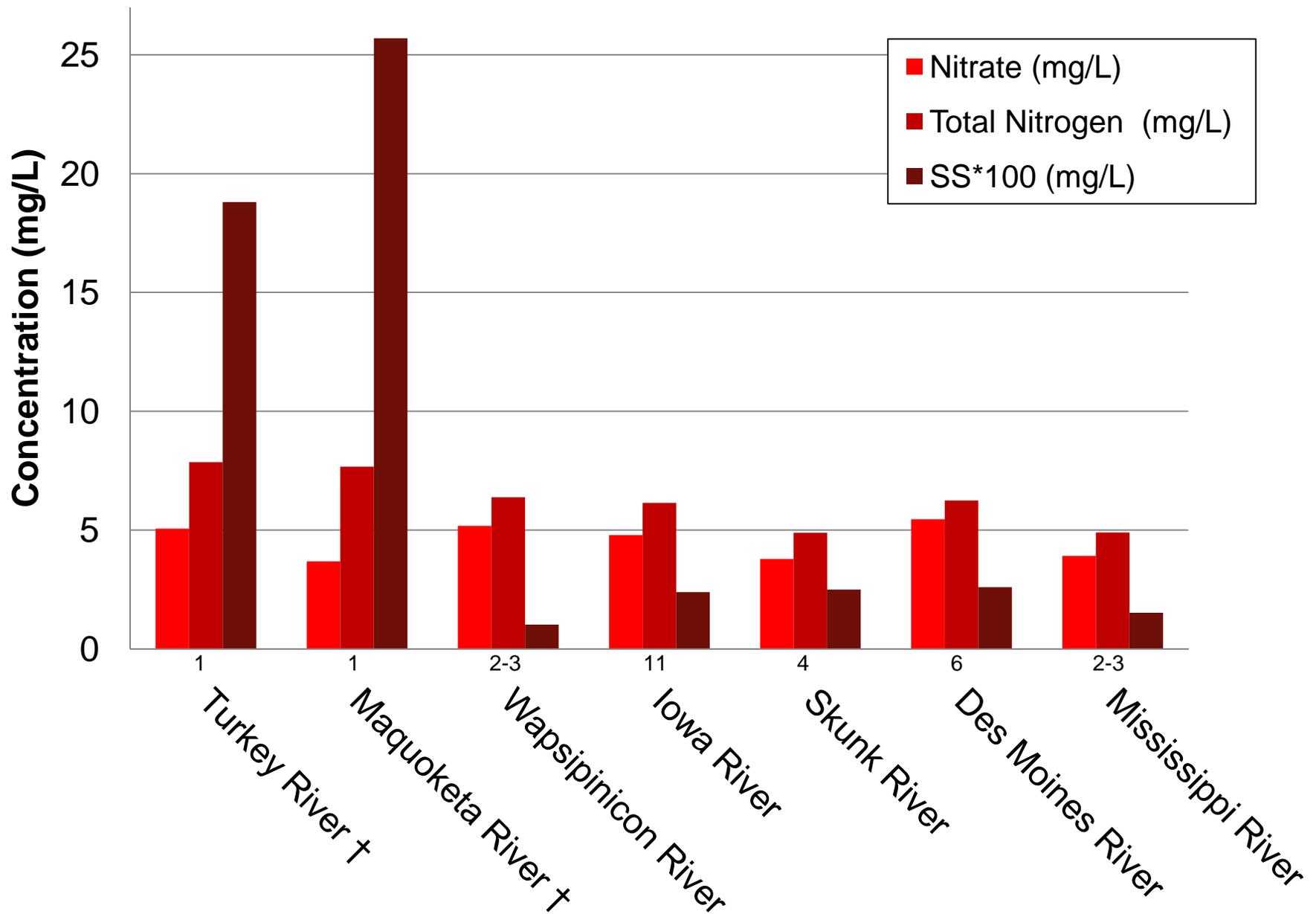
# Sampling

- Near peak-flow (within 24 hrs) water samples collected at 29 locations in Iowa during June 2008; many locations had multiple samples
- Grab samples from the centroid of flow –
  - weighted bottle sampler and a 1 Liter baked amber glass bottle; 2 samples Equal Width Increment (EWI) (USGS, 2006)
- Concurrent grab samples and EWI were collected at two sites at different discharges to document sample bias

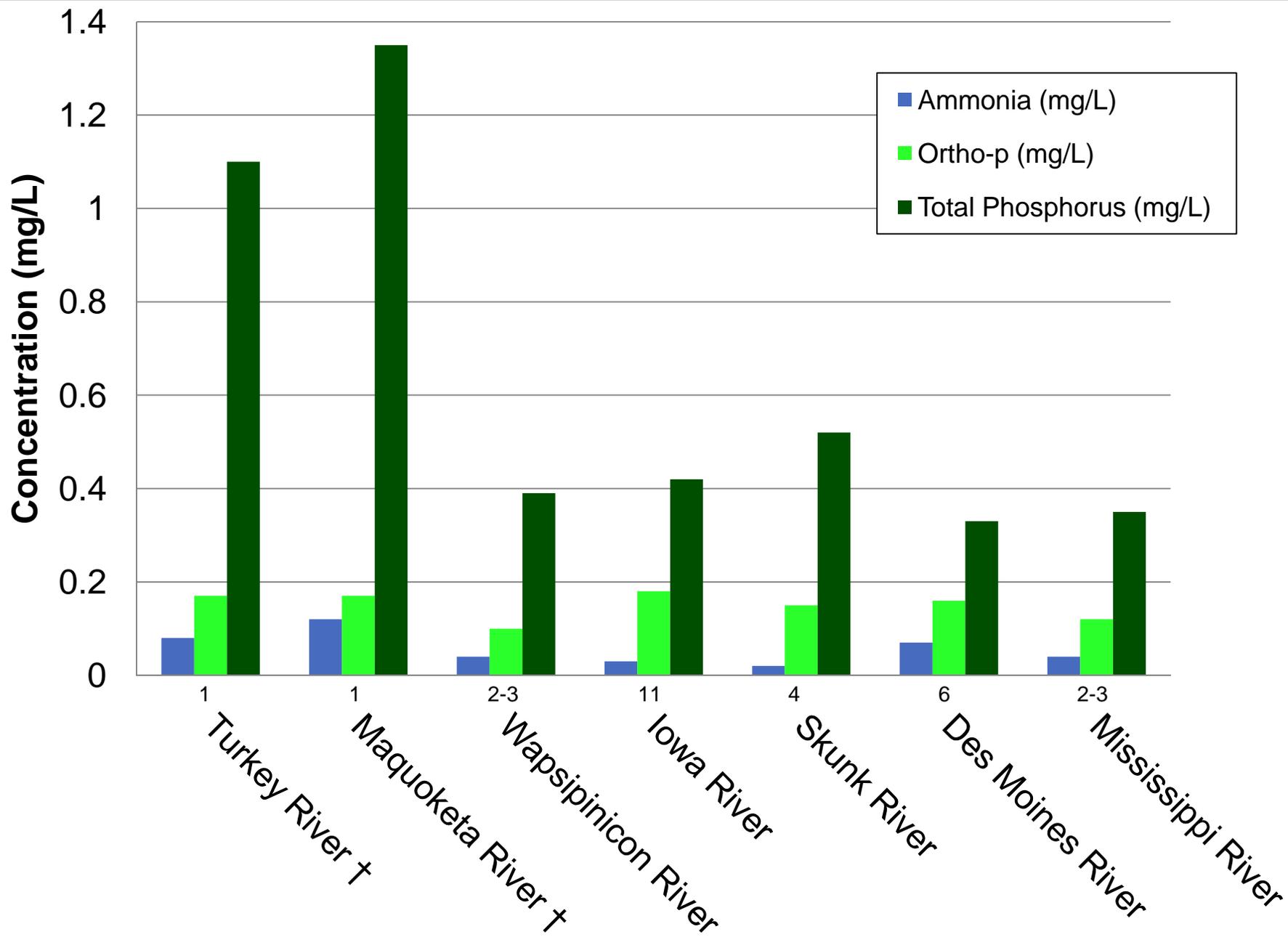
# Methods

- Samples were analyzed for total phosphorus (TP), total nitrogen (TN), nitrate, ammonia, orthophosphate (ortho-P), and suspended sediment (SS)
- Data Analysis
  - Concentrations and Instantaneous loads
  - 16-day transport yields - four Mississippi River tributaries
  - Percentage of the annual yield - three sites according to two different study estimates.



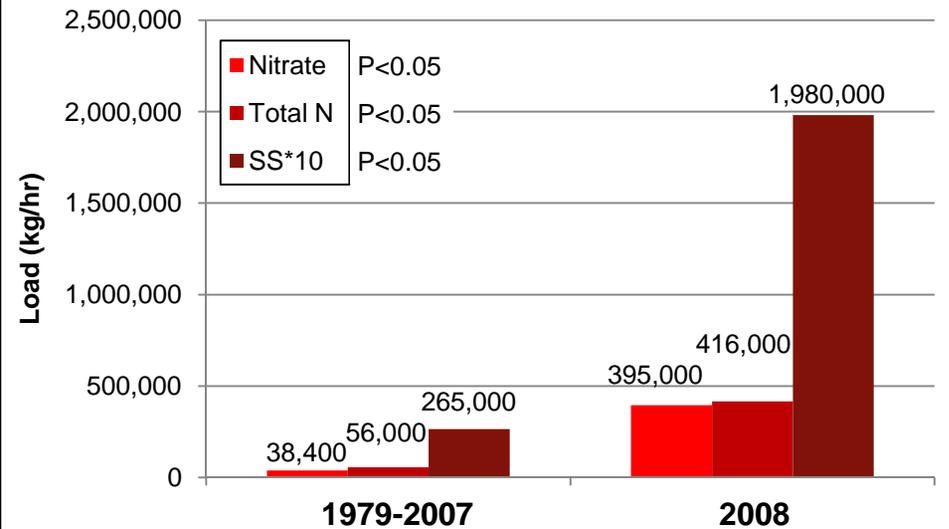
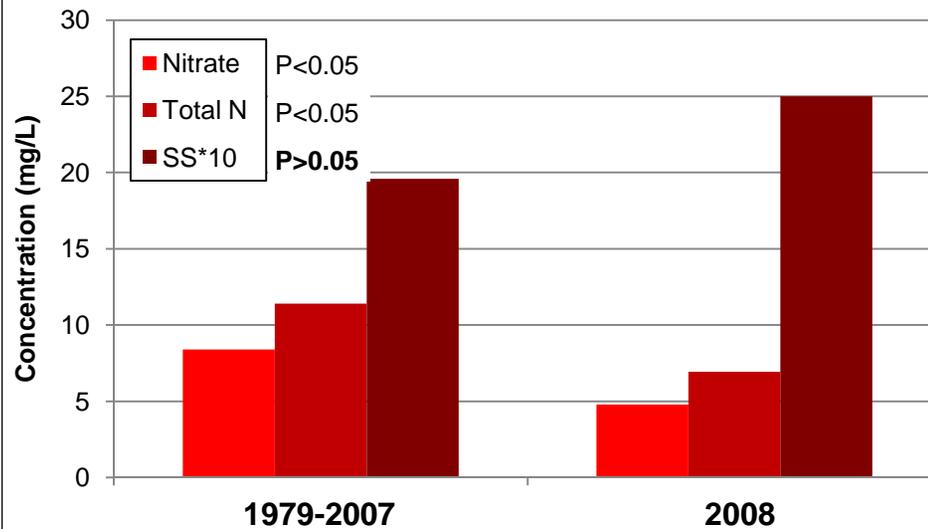
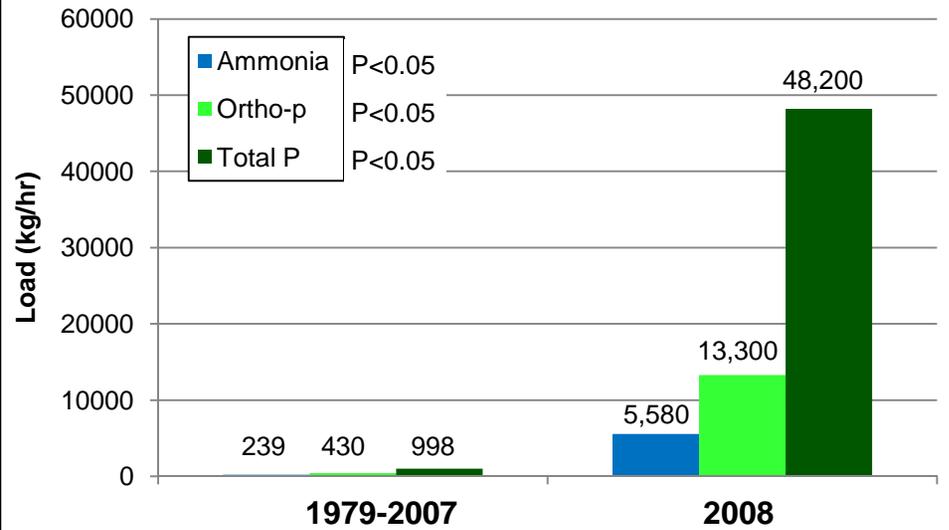
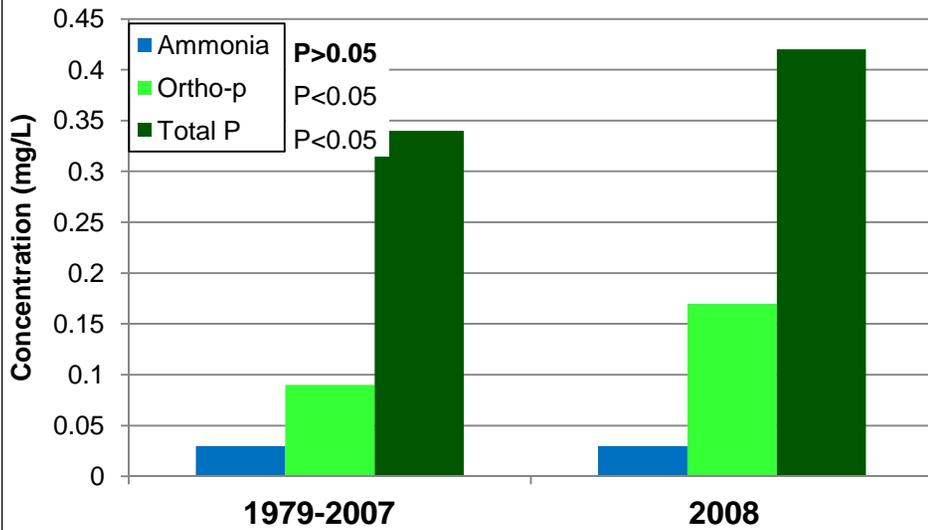


† indicates EWI sample

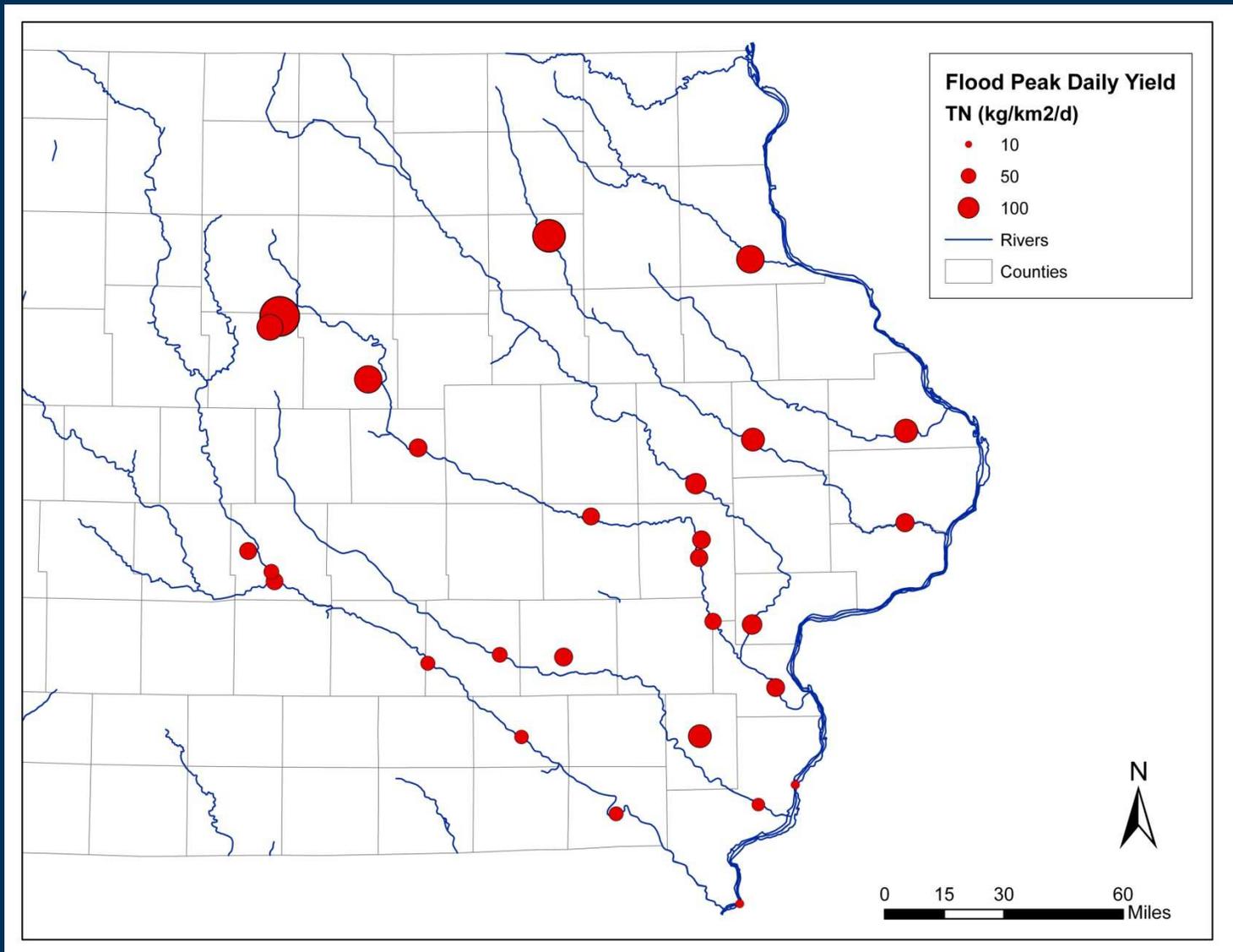


† indicates EWI sample

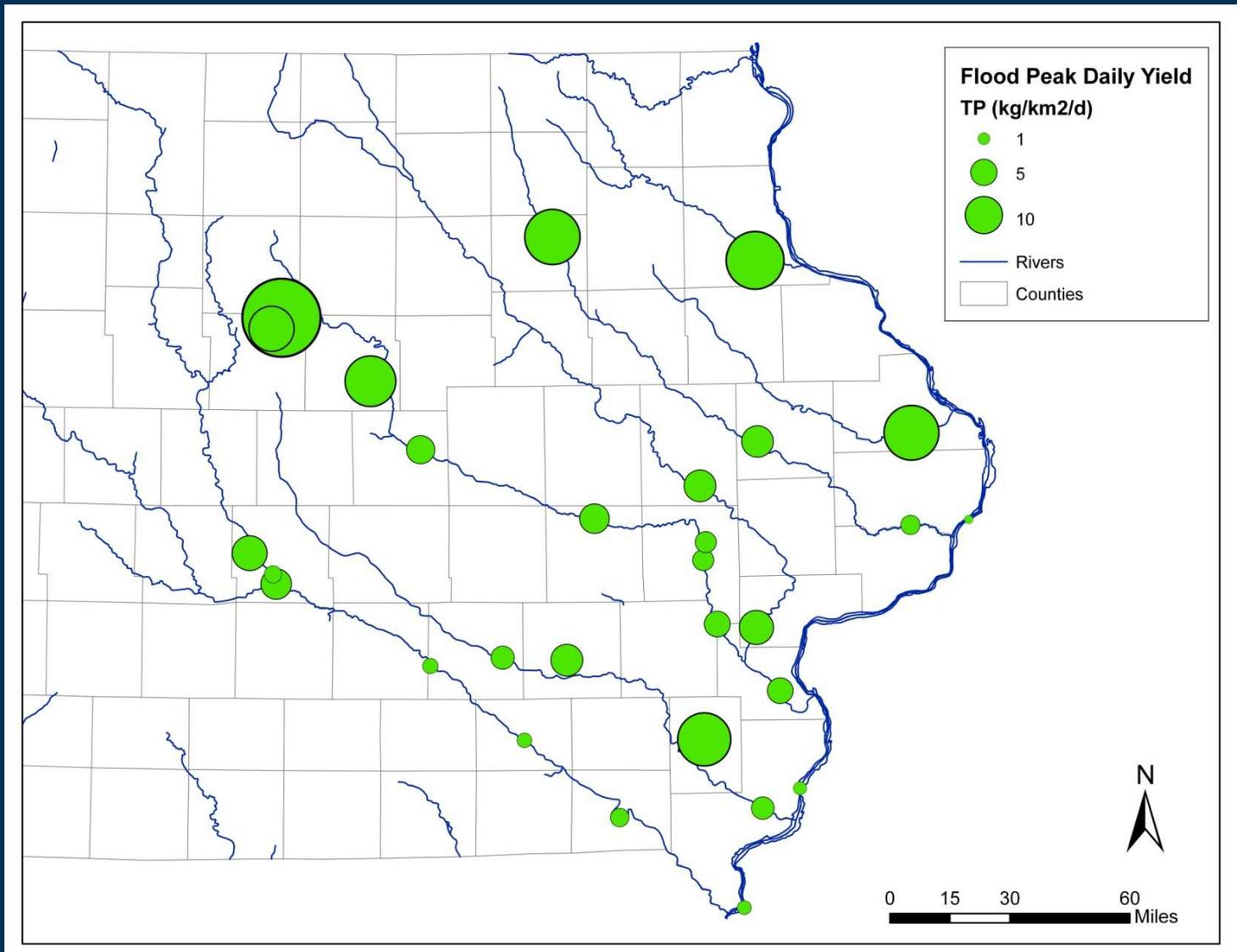
# Results



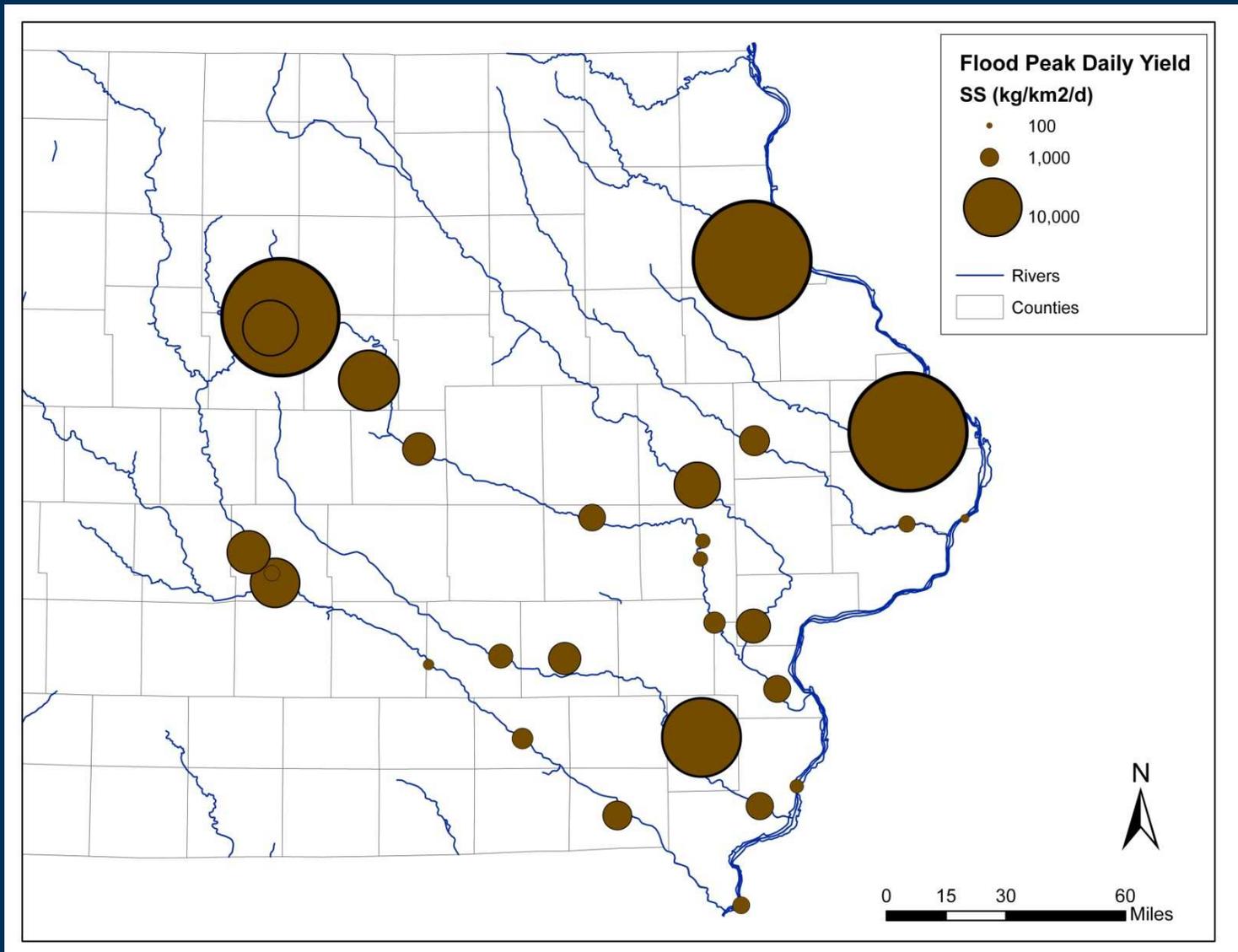
# Results – TN Near Peak Daily Yields



# Results – TP Near Peak Daily Yields



# Results – SS Near Peak Daily Yields



# Results

- 16-day TN transport load could fertilize 843,000 acres of cropland – over 6 counties
- 16- day TP could fertilize 152,000 acres
- 16-day SS could fill 143,000 dump trucks

Site Name STAID	Discharge (m <sup>3</sup> /s)	TN (kg)	TP (kg)	SS (kg)
Wapsipinicon River near De Witt, IA 05422000	8,870	4,860,000	163,000	7.48 E7
Iowa River at Wapello, IA 05465500	42,600	22,000,000	1,300,000	5.64 E8
Skunk River at Augusta, IA 05474000	12,600	4,990,000	408,000	2.72 E8
Des Moines River at Keosauqua, IA 05490500	33,900	17,700,000	1,040,000	1.04 E9
Total	<b>98,000</b>	<b>49,500,000</b>	<b>2,900,000</b>	<b>1.95 E9</b>



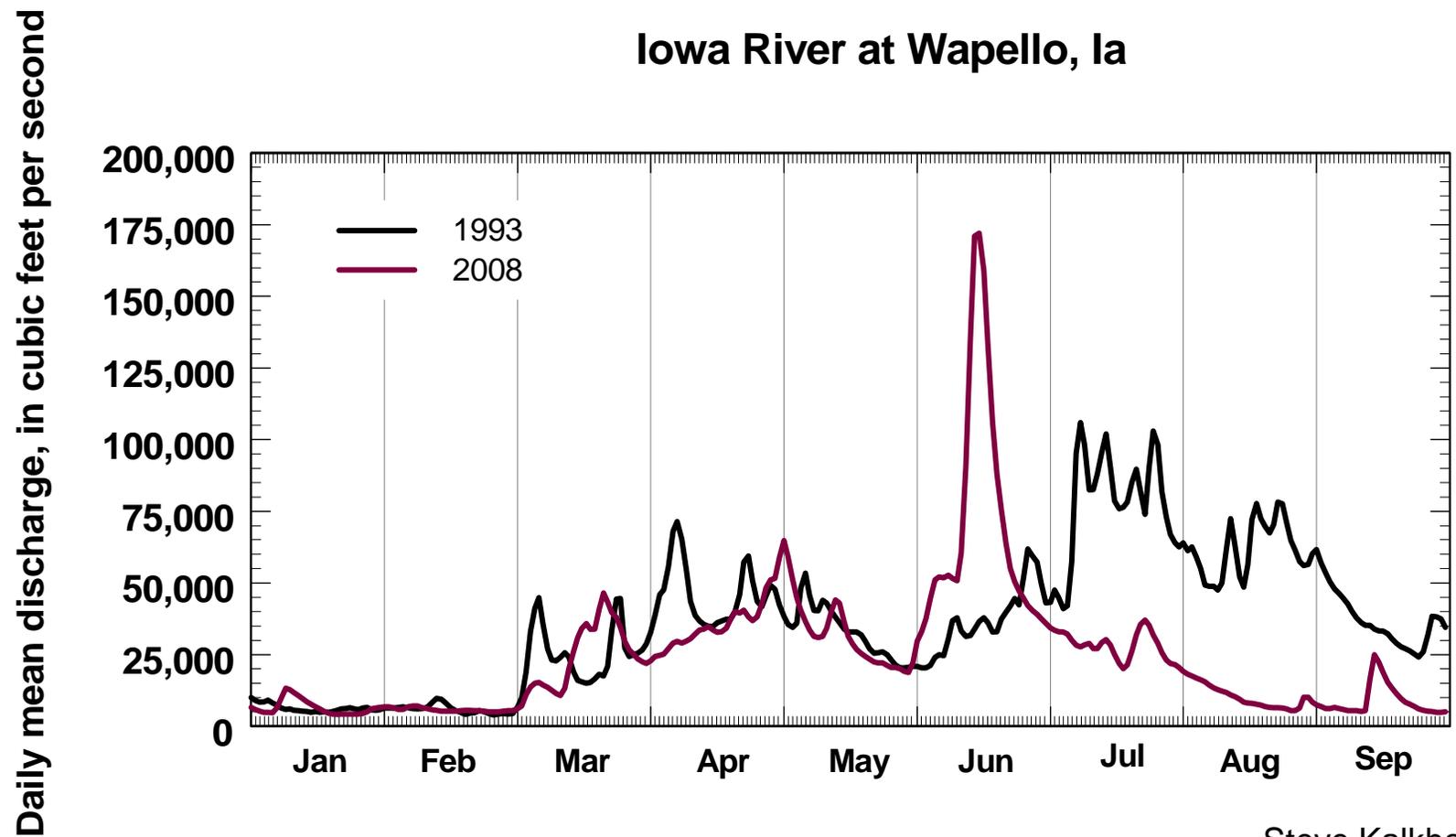
# Results – 16-day Yields

Note: the Des Moines River site used in Goolsby et al. (1999) is Des Moines River at Francisville, MO (05490600), approximately 50 km downstream of Keosauqua, IA

Site Name STAID	2008 WY (m3/s)	WY Annual Mean (m3/s)	Constituent	Flood 16-day Yield	Annual Yield			
				Yield (kg/km <sup>2</sup> )	Goolsby (1999)*		Robertson et al. (2009)	
					Yield (kg/km <sup>2</sup> )	Flood % of annual yield	Yield (kg/km <sup>2</sup> )	Flood % of annual yield
Des Moines River at Keosauqua, IA 05470500	529	244	TN	486	1,850	26	1,910	26
			TP	28.7	64.1	45	73.7	39
			Nitrate	421	1,690	25	-	-
			Ortho-p	11.3	37.1	30	-	-
Iowa River at Wapello, IA 05465500	616	267	TN	679	2,290	30	2,210	31
			TP	40.1	94.9	42	87.2	46
			Nitrate	546	1,770	31	-	-
			Ortho-p	17.6	62.3	28	-	-
Skunk River at Augusta, IA 05474000	198	74	TN	447	2,020	22	2,060	22
			TP	36.5	120.5	30	111.7	33
			Nitrate	400	1,560	26	-	-
			Ortho-p	14.0	41.7	34	-	-

# 1993 vs. 2008

- Daily peak-flow was higher in 2008
- Different hydrographs



Steve Kalkhoff

# Summary

- Concentrations may be similar to average concentrations but loads are much larger during extreme events
- Floods very important to average annual yield
  - 2008 flood up to 46% of average annual yield!
- Implications of Midwest flooding to the Gulf of Mexico hypoxic zone
  - Lasting effects of 1993 on the Gulf hypoxic zone
  - July 2008 hypoxic zone ranks 2<sup>nd</sup>

# Future Work

- Each flood is different
- Need more data – characterizing floods and modeling
- Concentrate on one basin next flood?

# Questions?

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