The Heidelberg Tributary Loading Program

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Workgroup for Water Resources Monitoring
Columbus, Ohio – 4 March 2015

National Center for Water Quality Research
Heidelberg University

Heidelberg University
Purpose with distinction.

Who We Are

- Heidelberg University
- The National Center for Water Quality Research
  - Heidelberg Tributary Loading Program
  - Cooperative Private Well Testing Program (agencies in 17 states)
  - Research grants from federal and state agencies, foundations
  - Water quality analysis for universities, private corporations
  - Participation in Heidelberg's B.S. curriculum in Environmental Science
  - Informal education and outreach
- The NCWQR Staff –

  6 Ph.D. scientists, 4 techs, 1 business manager
- Collaborations with agency staffs, and university, government, and corporate researchers

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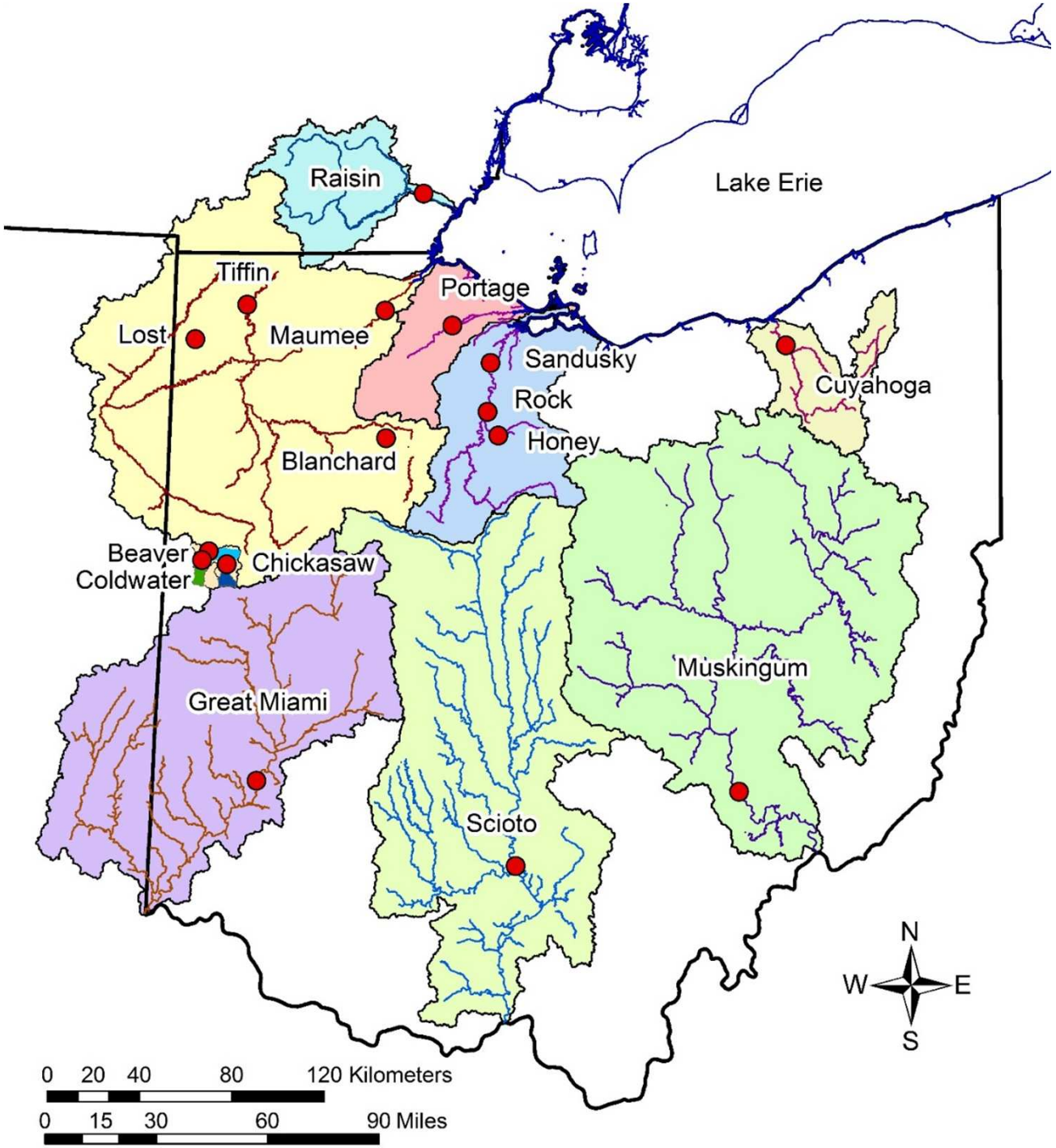
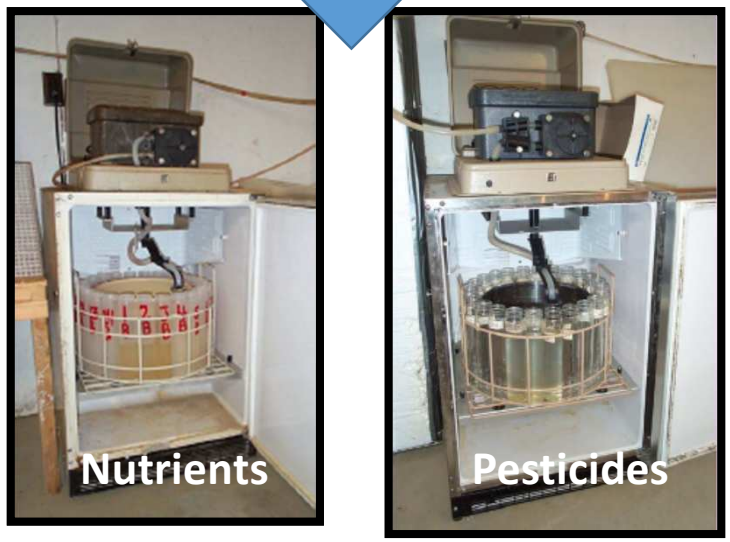
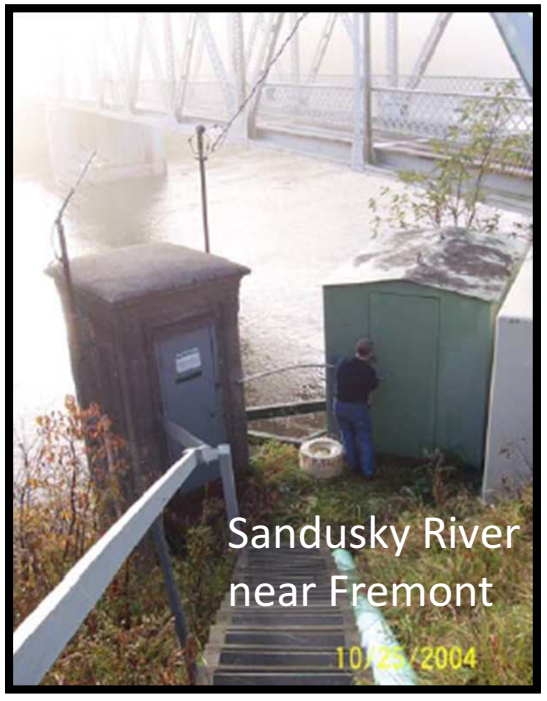


Heidelberg Tributary Loading Program

- **16 stations**
- **Paired with USGS gages**
- **Officially started in 1974**
- **Collaborating with Old Woman Creek NERR to reactivate 2 stations**





- Samples collected 3x a day
- All 3 samples analyzed during high flow

Analytical Capabilities of the NCWQR

- **Nutrients**
  - Colorimetric analysis: Seal AA3 autoanalyzers
  - Dionex Ion chromatographs
- **Metals** – Varian ICP/MS “Redtop”
- **Total Suspended Solids**

Analytical Capabilities of the NCWQR

- **Pesticides & Other Organics**
  - Bruker EVOQ LC-MS/MS
  - Varian 450 GC/Varian 220 MS
  - ELISA immunoassay

- **Algal Toxins** – ELISA immunoassay
- **Algal Pigments**
  - Varian 9010 LC (chorophyll *a*)
  - Aminco fluorometer (phycocyanin)

How the NCWQR and the Heidelberg Tributary Loading Program are Funded

- All NCWQR funding is from external sources (soft money).
- Many sources are short-term.
- Some sources are non-renewable.
- Heidelberg Univ. allows NCWQR to retain part of indirect costs.

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Heidelberg Tributary Loading Program: Funding Status (as of 3 March 2015)

Calendar		2012	2013 Calendar Year			2014 Calendar Year				2015 Calendar Year				2016 CY -->			
Water Year		12	2013 WY			2014 WY				2015 WY				2016 WY -->			
Ohio & HU FY			2013 Ohio FY			2014 Ohio FY				2015 Ohio FY				2016 Ohio FY			
Tributary Station	Start date		Jul – Sep	Oct - Dec	Jan - Mar	Apr – Jun	Jul – Sep	Oct - Dec	Jan - Mar	Apr – Jun	Jul – Sep	Oct - Dec	Jan - Mar	Apr – Jun	Jul – Sep	Oct - Dec	Jan - Mar	Apr – Jun
Lake Erie Drainage																		
Blanchard	2008		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Cuyahoga	1983		State of Ohio Line Item				NCWQR		NE Ohio Regional Sewer Dist.		NE Ohio Regional Sewer Dist.				NEORSD			
Honey	1976		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Lost Cr. Trib.	2008*		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Maumee	1976		NSF	NSF			NSF				NSF				State of Ohio Line Item			
			The Andersons				The Andersons				The Andersons				The Andersons			
			The Fertilizer Institute				The Fertilizer Institute				The Fertilizer Institute				The Fertilizer Institute			
Portage	2011*		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Raisin	1982		No cooperator		MDEQ		Michigan DEQ				Michigan DEQ				Michigan DEQ			
Rock	1983		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Sandusky	1975		Great Lakes Protection Fund				St. Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Tiffin	2008		State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item				State of Ohio Line Item			
Ohio River Drainage																		
Beaver	2013		No station				ODNR		ODNR		ODNR							
Chickasaw	2008		OWDA				OWDA		OWDA		OWDA							
Coldwater	2012				ODNR		ODNR		ODNR		ODNR							
Great Miami	1996		MCD				Miami Conservancy District		Miami Conservancy District		Miami Conservancy District							
Muskingum	1996		State of Ohio Line Item				NCWQR				Muskingum WCD							
Scioto	1996		OWDA	St. Ohio Line Item			NCWQR		City of Columbus		City of Columbus				City Columbus			

* Station was re-activated in year shown.

Gray – no station or no cooperator
Bright Yellow - funding pending but not committed
Red - no funding pending or committed

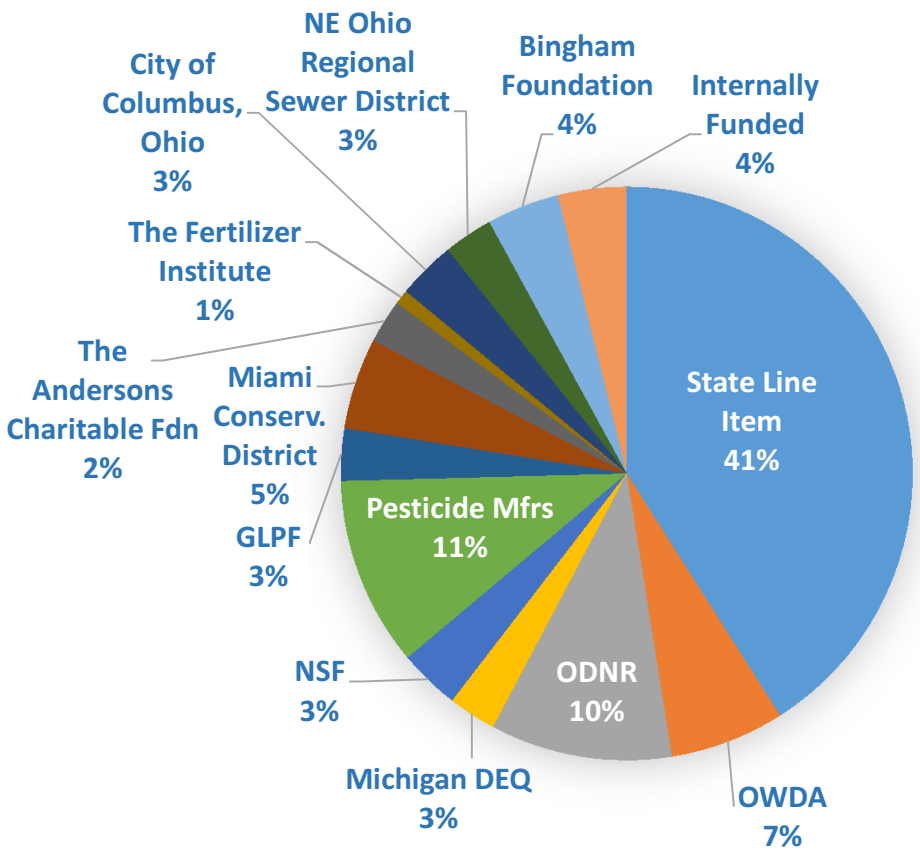
Contributors to the HTLP in FY 2014

Total Expenditures = $609,891

HTLP Funding in FY 2014

State Line Item (Maumee, Portage & Sandusky Basins) (7 stations)	$ 250,000
The Andersons, Inc. (Maumee at Waterville)	$ 15,000
The Fertilizer Institute (Maumee at Waterville)	$ 5,000
NSF (Maumee at Waterville)	$ 21,000
GLPF (Sandusky near Fremont, part of year)	$ 17,960
OWDA (Chickasaw)	$ 39,500
ODNR (Coldwater, Beaver)	$ 62,686
Miami Conservancy District (Great Miami)	$ 31,388
NE Ohio Regional Sewer District (Cuyahoga)	$ 17,000
City of Columbus (Scioto)	$ 20,000
Internal Funding (Muskingum)*	$ 23,689
Michigan DEQ (Raisin)	$ 16,528
William Bingham Foundation (general)	$ 25,000
Pesticide Mfrs (pesticide monitoring)	$ 65,141
	$ 609,891

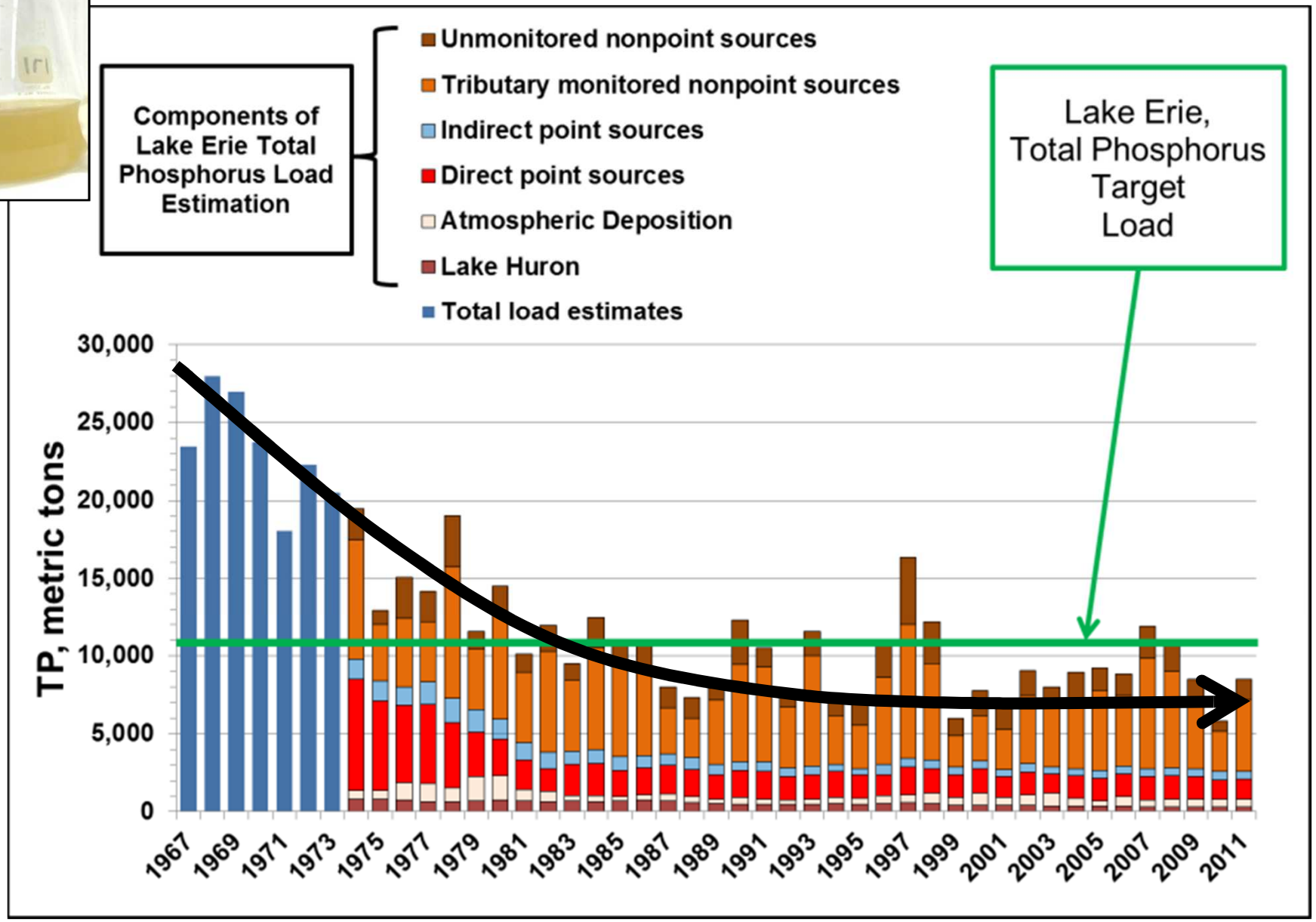
*Muskingum Watershed Conservancy District will contribute $16,000 for CY 2015



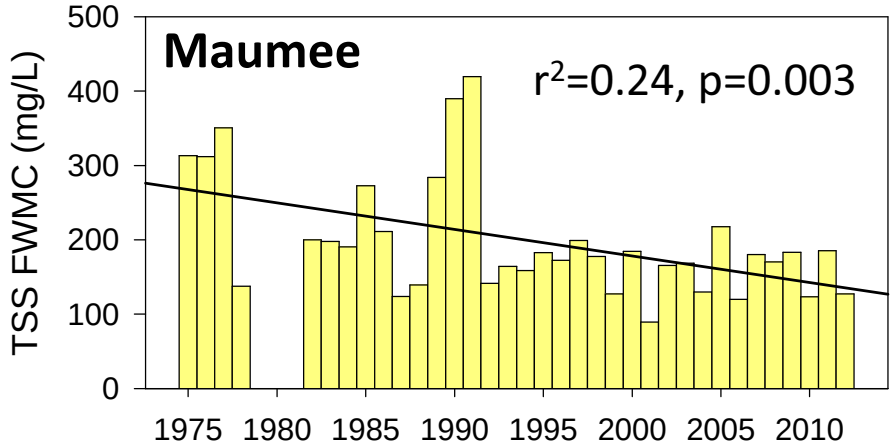
Note: Several contributors covered only part of FY 2014

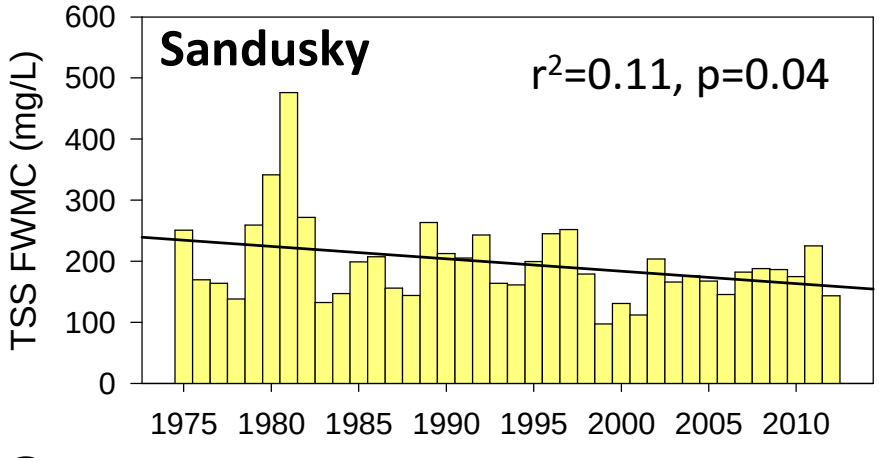
Examples of our data analysis

Trends in Lake Erie Total Phosphorus

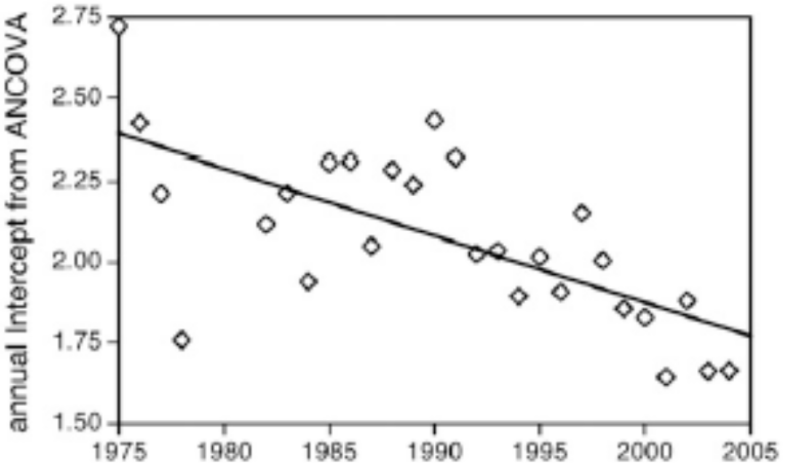


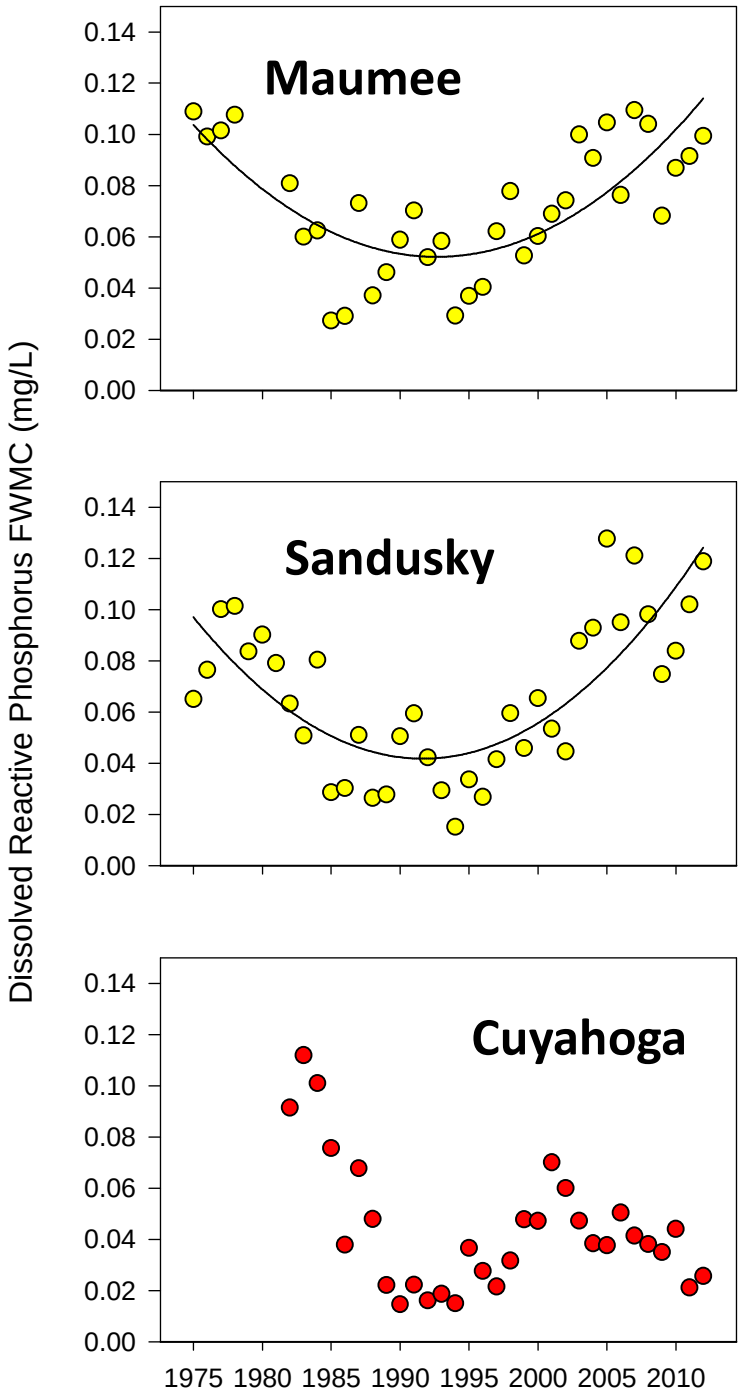
Suspended Sediments





- Sediments suspended in the water have decreased!
- Patterns are more apparent when corrected for weather variability



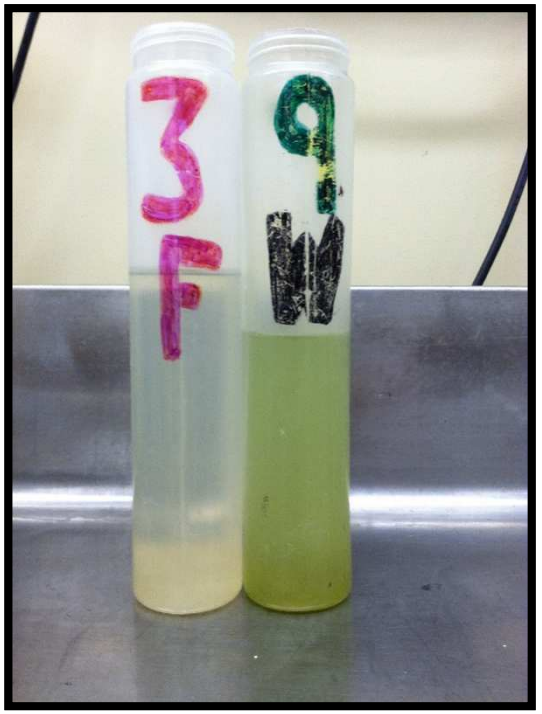


Dissolved phosphorus concentrations have been increasing from agricultural watersheds

River	% Agr.	% Urb.	% For.
Maumee	73	11	7
Sandusky	78	8	9
Cuyahoga	9	40	34

Grand Lake St Marys 2014 water year

- The lake is processing dissolved P and nitrate



For more information visit:
http://www.heidelberg.edu/NCWQR

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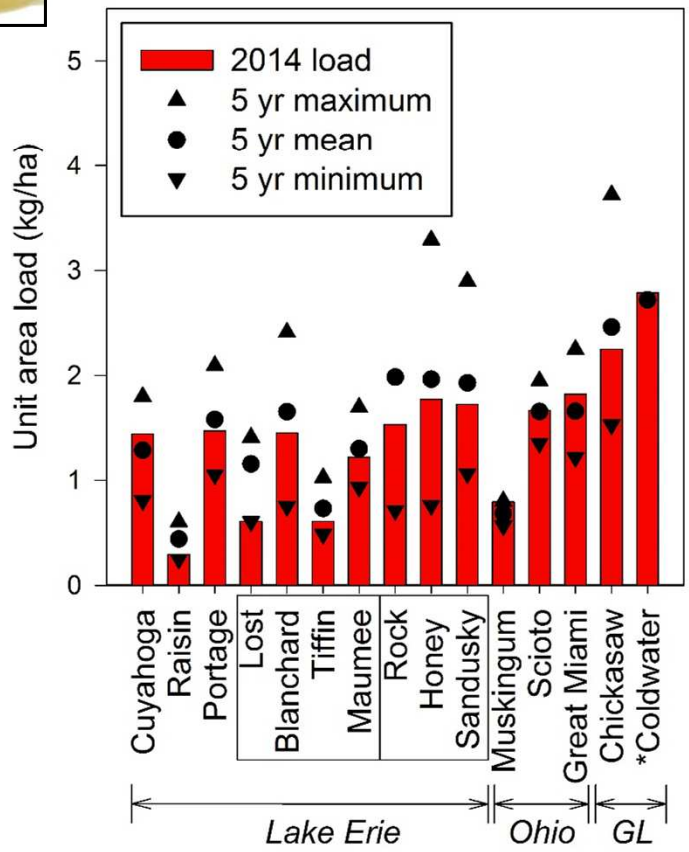
http://www.facebook.com/NCWQR

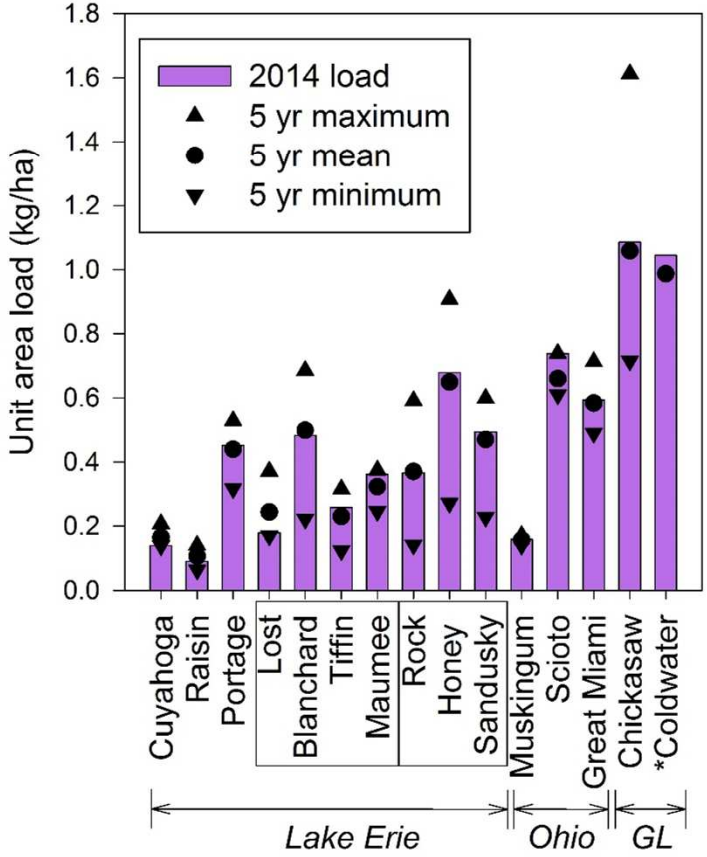
2014 Loads and Concentrations

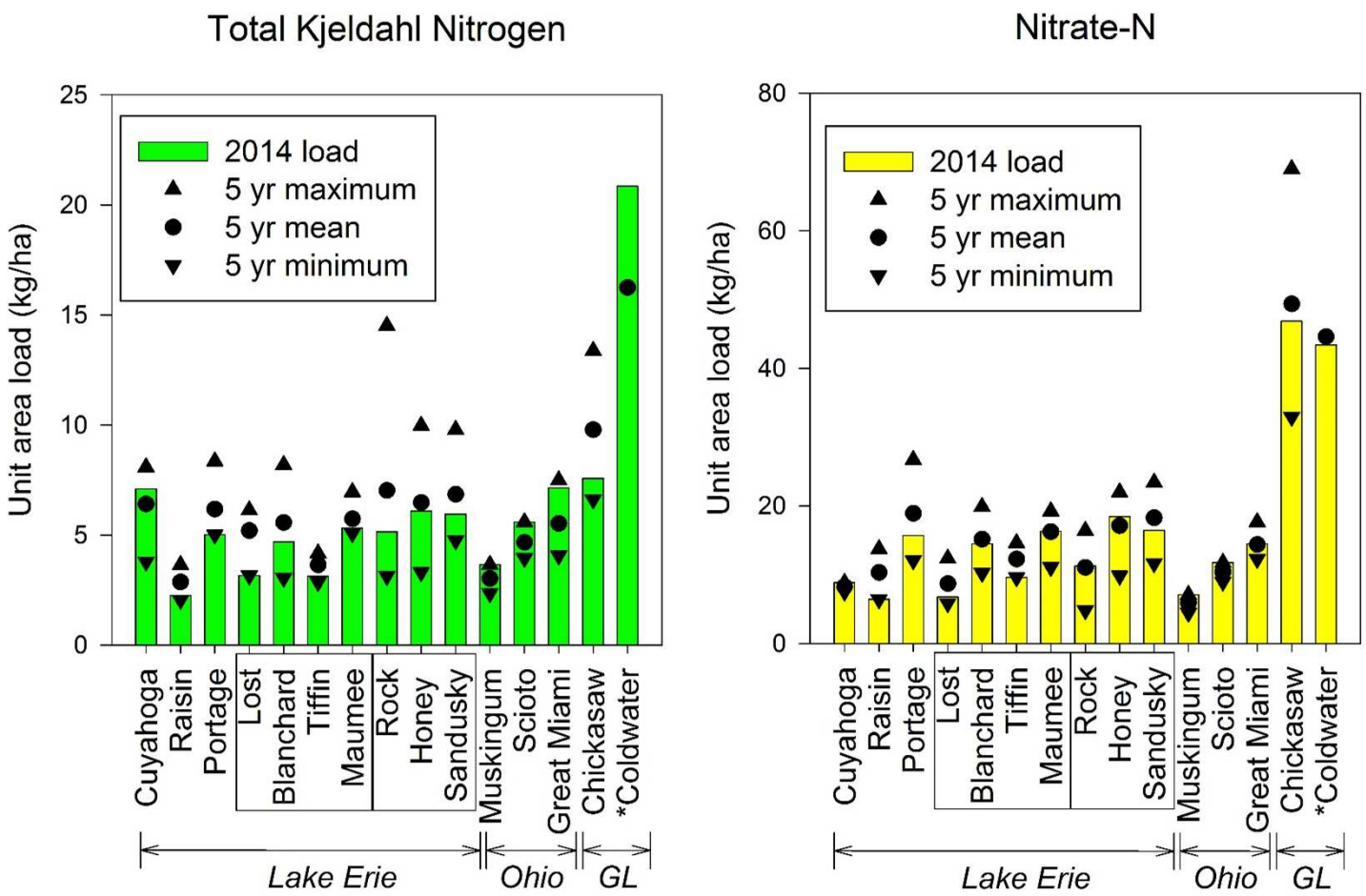
- Most rivers changed less than 30% compared to the 5 year average
  - Tiffin River SS loads and concentrations were substantially lower, even though discharge was slightly higher and all other constituents increased
  - Chloride concentrations last year were higher in all rivers

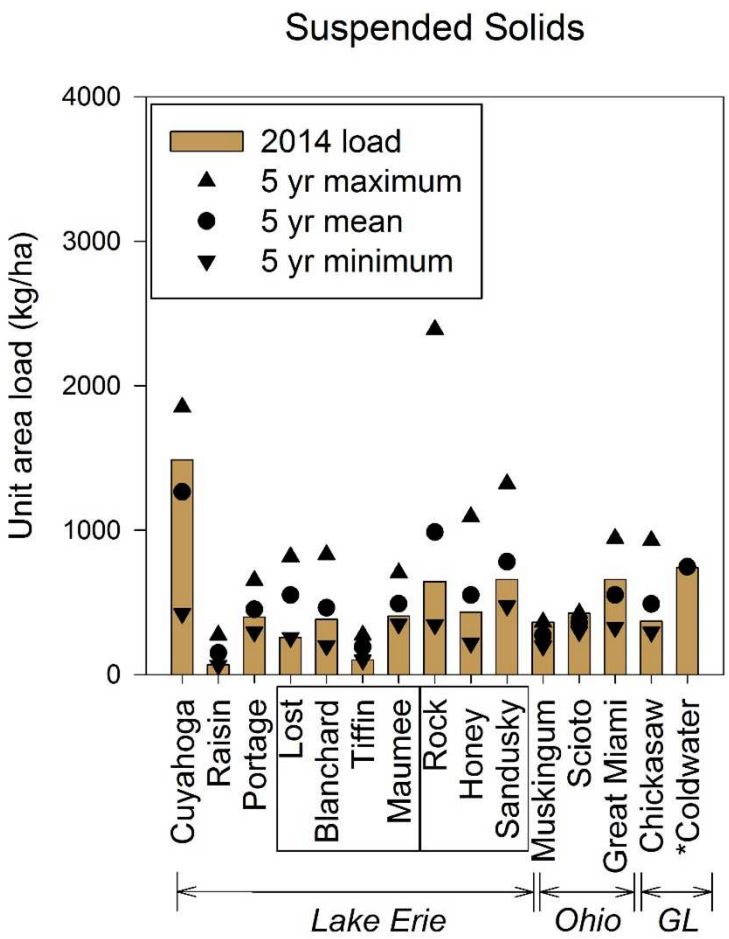
Total Phosphorus

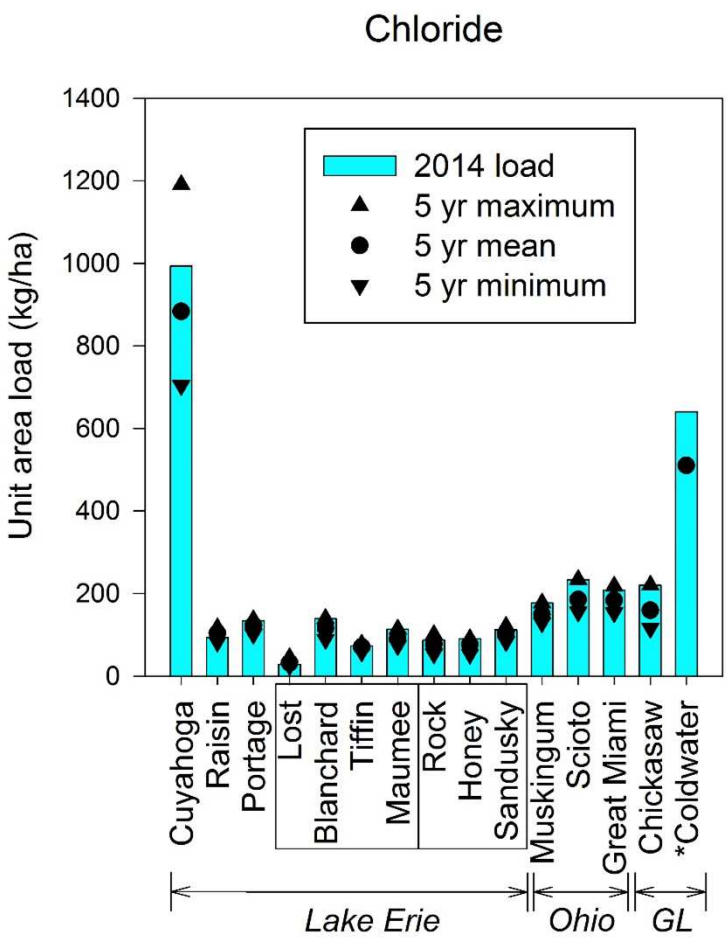


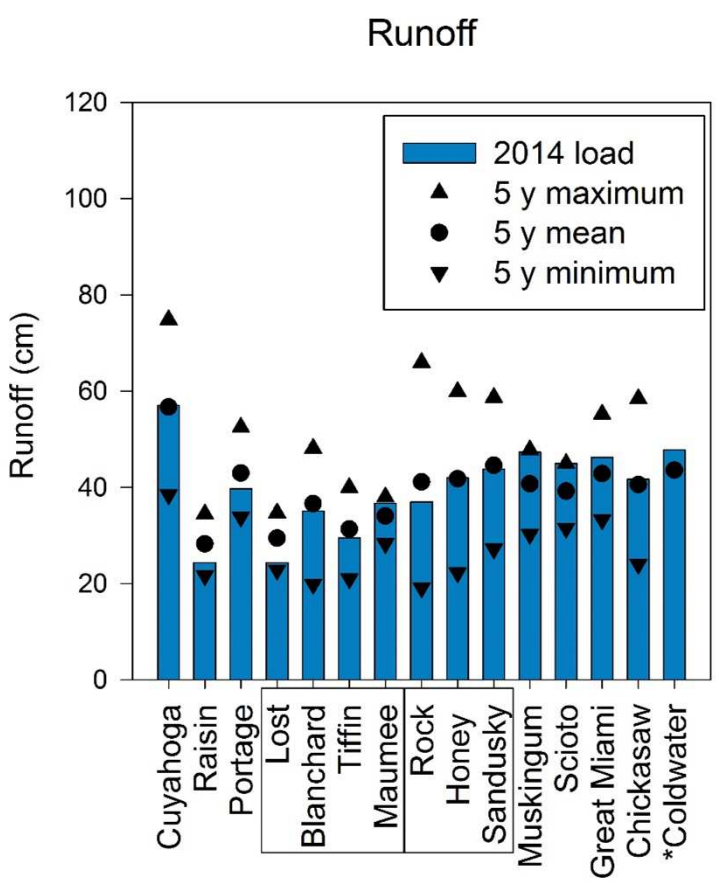
Dissolved Reactive Phosphorus



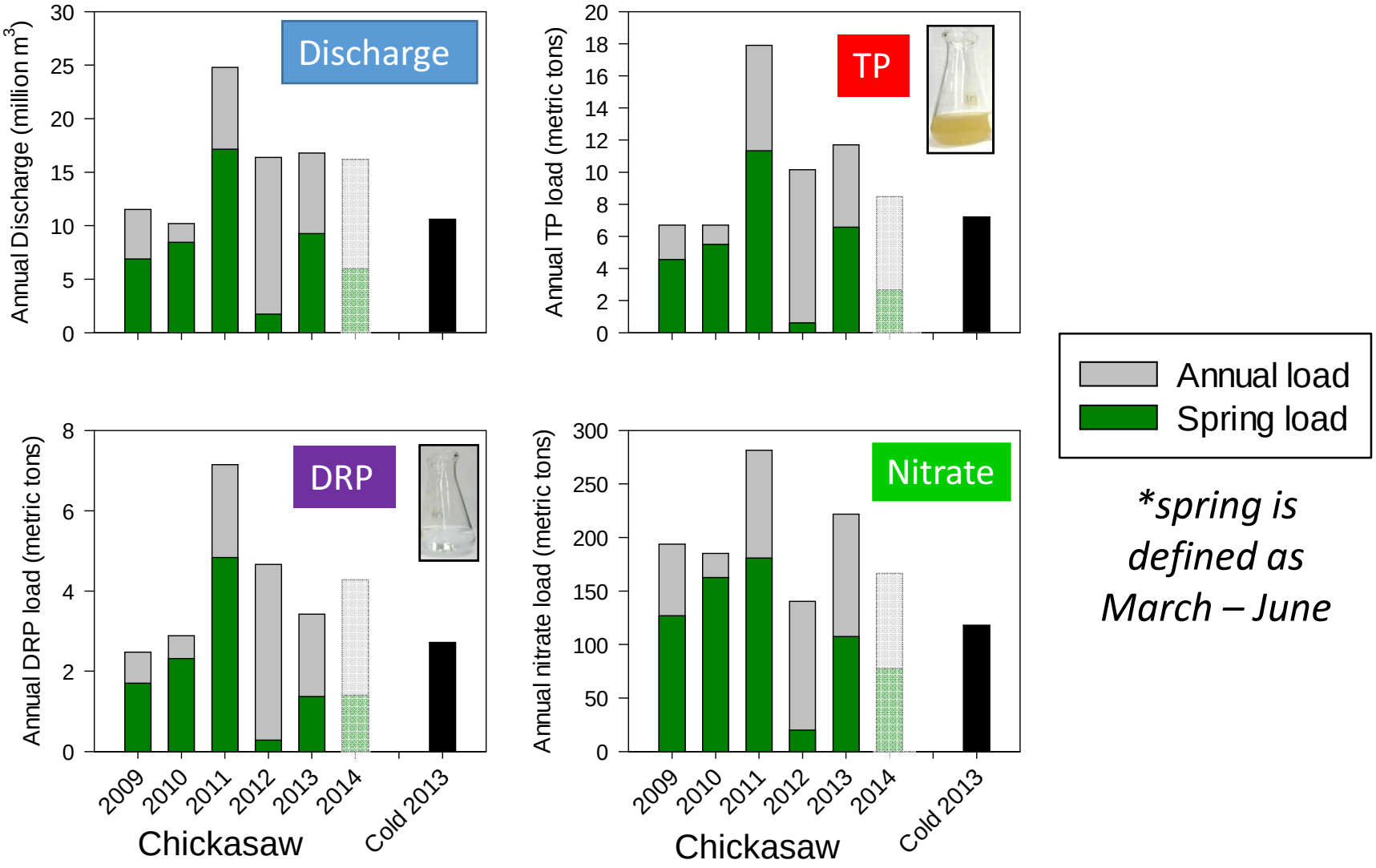

Total Kjeldahl Nitrogen
Unit area load (kg/ha)
25
20
15
10
5
0
2014 load
5 yr maximum
5 yr mean
5 yr minimum
Cuyahoga
Raisin
Portage
Lost
Blanchard
Tiffin
Maumee
Rock
Honey
Sandusky
Muskingum
Scioto
Great Miami
Chickasaw
*Coldwater
Lake Erie
Ohio
GL
Nitrate-N
Unit area load (kg/ha)
80
60
40
20
0
2014 load
5 yr maximum
5 yr mean
5 yr minimum
Cuyahoga
Raisin
Portage
Lost
Blanchard
Tiffin
Maumee
Rock
Honey
Sandusky
Muskingum
Scioto
Great Miami
Chickasaw
*Coldwater
Lake Erie
Ohio
GL


Suspended Solids
Unit area load (kg/ha)
4000
3000
2000
1000
0
2014 load
5 yr maximum
5 yr mean
5 yr minimum
Cuyahoga
Raisin
Portage
Lost
Blanchard
Tiffin
Maumee
Rock
Honey
Sandusky
Muskingum
Scioto
Great Miami
Chickasaw
*Coldwater
Lake Erie
Ohio
GL

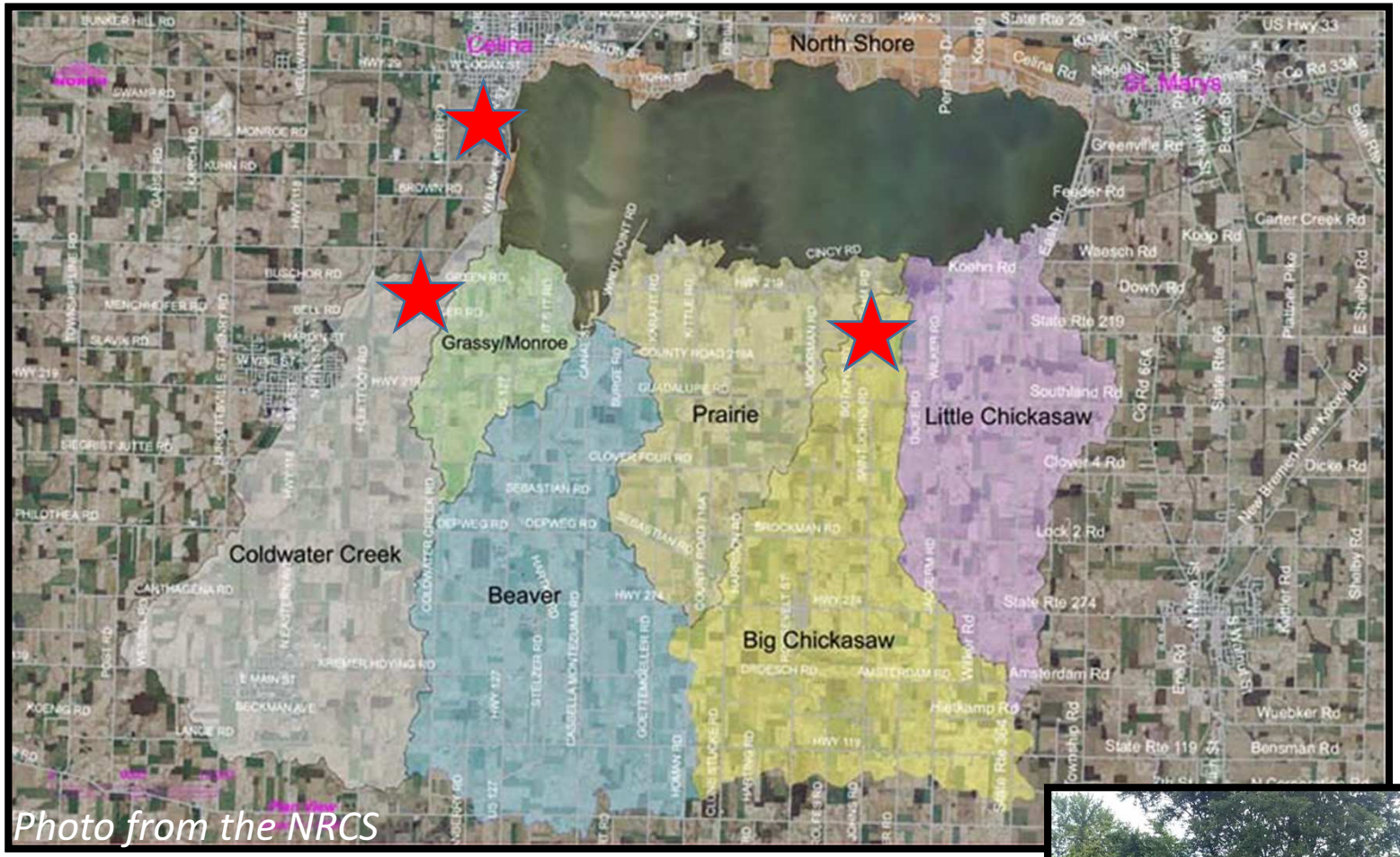

Chloride
Unit area load (kg/ha)
1400
1200
1000
800
600
400
200
0
2014 load
5 yr maximum
5 yr mean
5 yr minimum
Cuyahoga
Raisin
Portage
Lost
Blanchard
Tiffin
Maumee
Rock
Honey
Sandusky
Muskingum
Scioto
Great Miami
Chickasaw
*Coldwater
Lake Erie
Ohio
GL

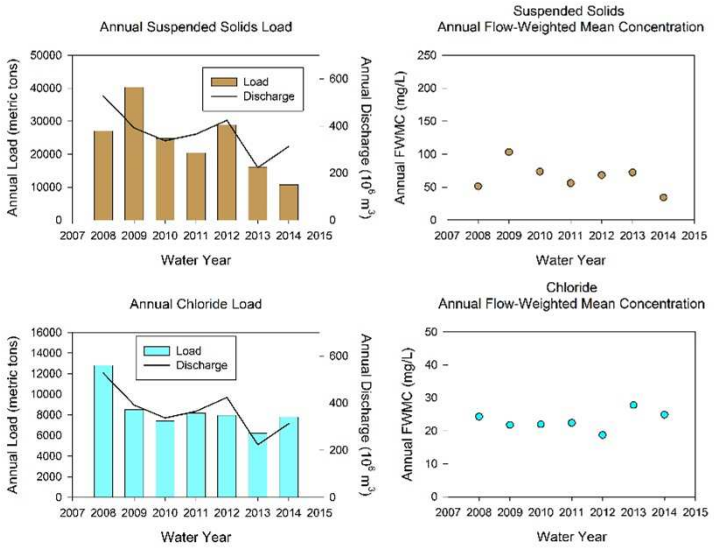

Runoff
Runoff (cm)
120
100
80
60
40
20
0
2014 load
5 y maximum
5 y mean
5 y minimum
Cuyahoga
Raisin
Portage
Lost
Blanchard
Tiffin
Maumee
Rock
Honey
Sandusky
Muskingum
Scioto
Great Miami
Chickasaw
*Coldwater

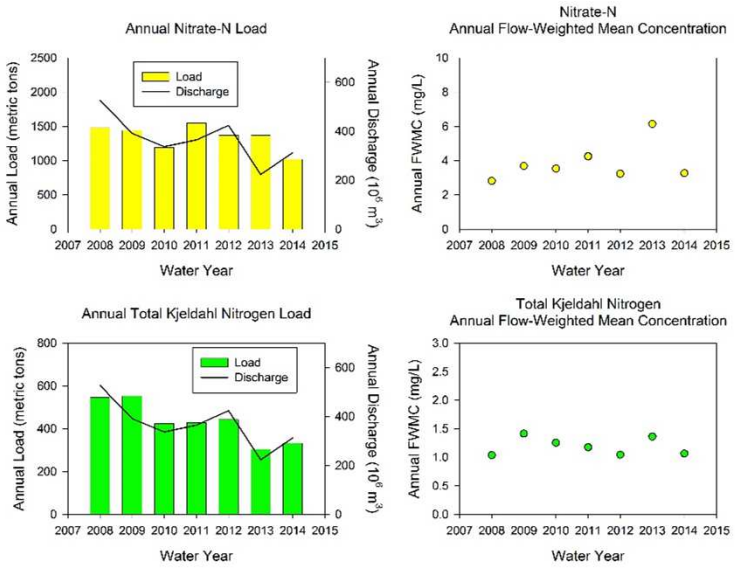
Trends in GLSM annual loads

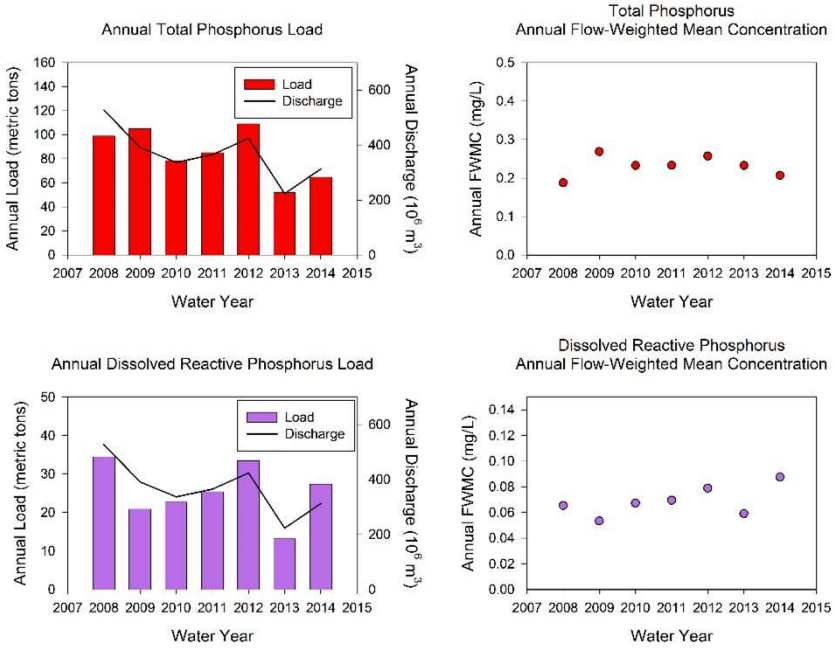


- Most loading tends to occur in the spring


North Shore
Celina
St. Marys
Grassy/Monroe
Prairie
Little Chickasaw
Coldwater Creek
Beaver
Big Chickasaw
Photo from the NRCS







Data are all for the Tiffin River,
from Laura Johnson
3 March 2015