7th Biennial Meeting of the
Lake Erie Millennium
October 29-31,2013

Status of Lake Erie Phosphorus Loads and Concentrations

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September 12, 1949-
June 18, 2013

“scholar, researcher, family man, friend, and gentleman”

“contributions in the calculation of phosphorus loads has left an influential, indelible, and long-lasting mark on the management of Great Lakes”

Great Lakes Water Quality Agreement Protocol of 2012

Annex 4 – Nutrients (Emphasis on Lake Erie)

Ecosystem Objectives:

- Minimize the extent of hypoxia
- Maintain:
  - levels of algal biomass below nuisance conditions,
  - algal species consistent with healthy aquatic ecosystems
  - cyanobacteria biomass at levels without producing toxins
  - mesotrophy (western and central); oligotrophy (eastern)

Substance Objectives:

- Establish Substance Objectives for Phosphorus Concentrations in Open and Nearshore Waters
- Update Loading Targets Consistent with Substance Objectives
- Determine Appropriate Phosphorus Loading Allocations Apportioned by Country
- Establish load reduction targets for priority watersheds that have significant localized impact
- Account for Bioavailability of Various Forms

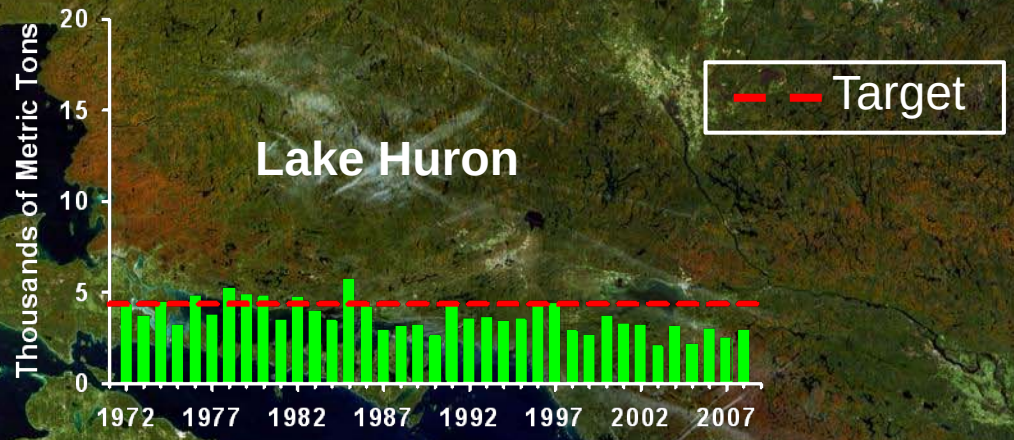
Target Phosphorus Loads and Associated Endpoints for the Great Lakes

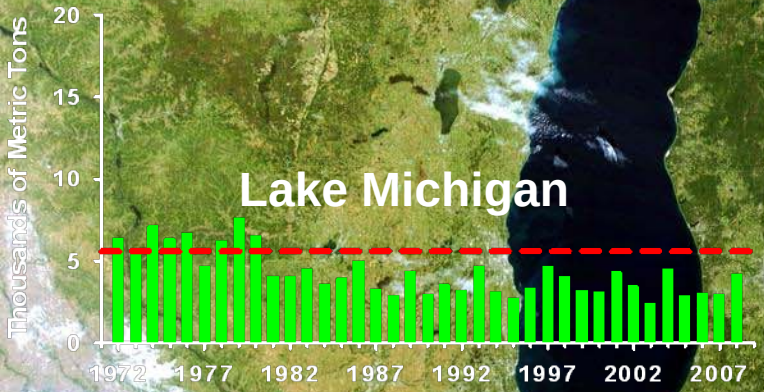
	Target P* Load (MTA)	Target P** Concentration (µg/L)	CHL A** Concentration (µg/L)	Secchi (m)	Trophic Status
Lake Superior	3400	5	1	8	oligo
Lake Michigan	5600	7	1 - 3	9 - 12	oligo/meso
Lake Huron	2800	5	0.5 – 1.5	8	oligo
Georgian Bay	620	5			
North Channel	520	5			
Saginaw Bay	440	15	5 - 10	1 - 3	eutro
Lake Erie	11000				
Western Basin		15	5 - 10	1 - 3	eutro
Central Basin		10	3 - 6	4 - 8	meso
Eastern Basin		10	1 - 3	6 - 9	oligo/meso
Lake Ontario	7000	10	1 - 3	6 - 9	oligo/meso

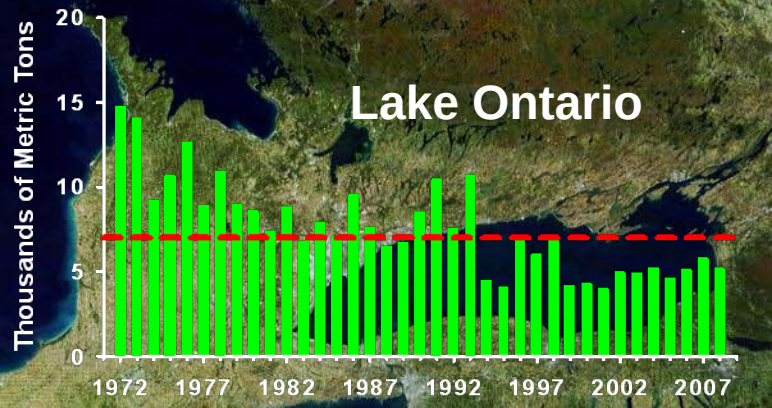
* Great Lakes Water Quality Agreement, 1972; 1978; 1983; 1987

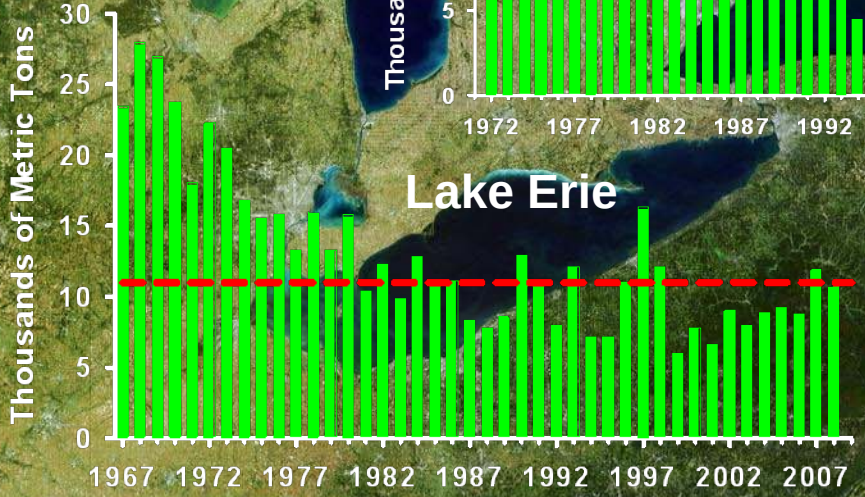
** Great Lakes Water Quality Board, IJC, 1978

Great Lakes Annual Total Phosphorus Loads thru 2008
(Thousands of Metric Tons/Year - MTA)





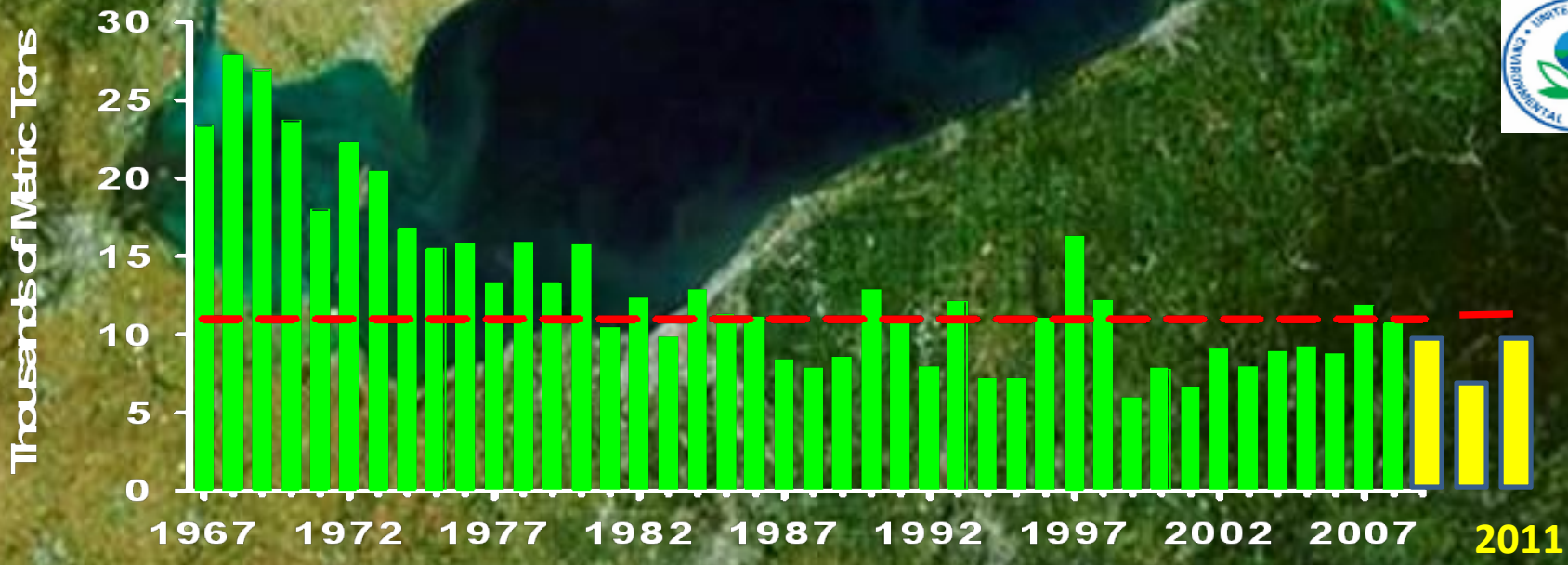




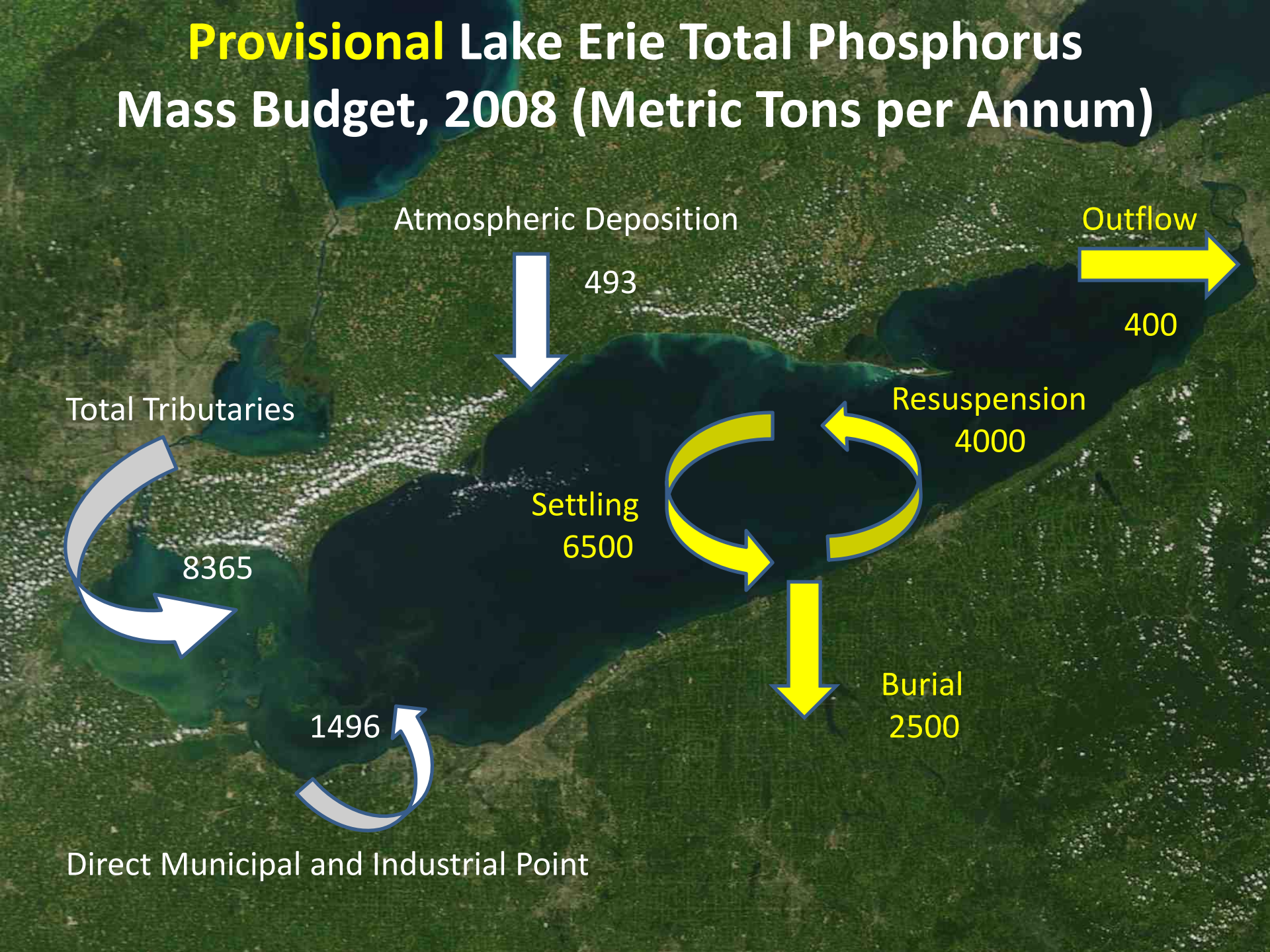
University of Wisconsin Green Bay

United States Environmental Protection Agency

Lake Erie Annual Phosphorus Loads (Thousands of Metric Tons/Year – MTA)

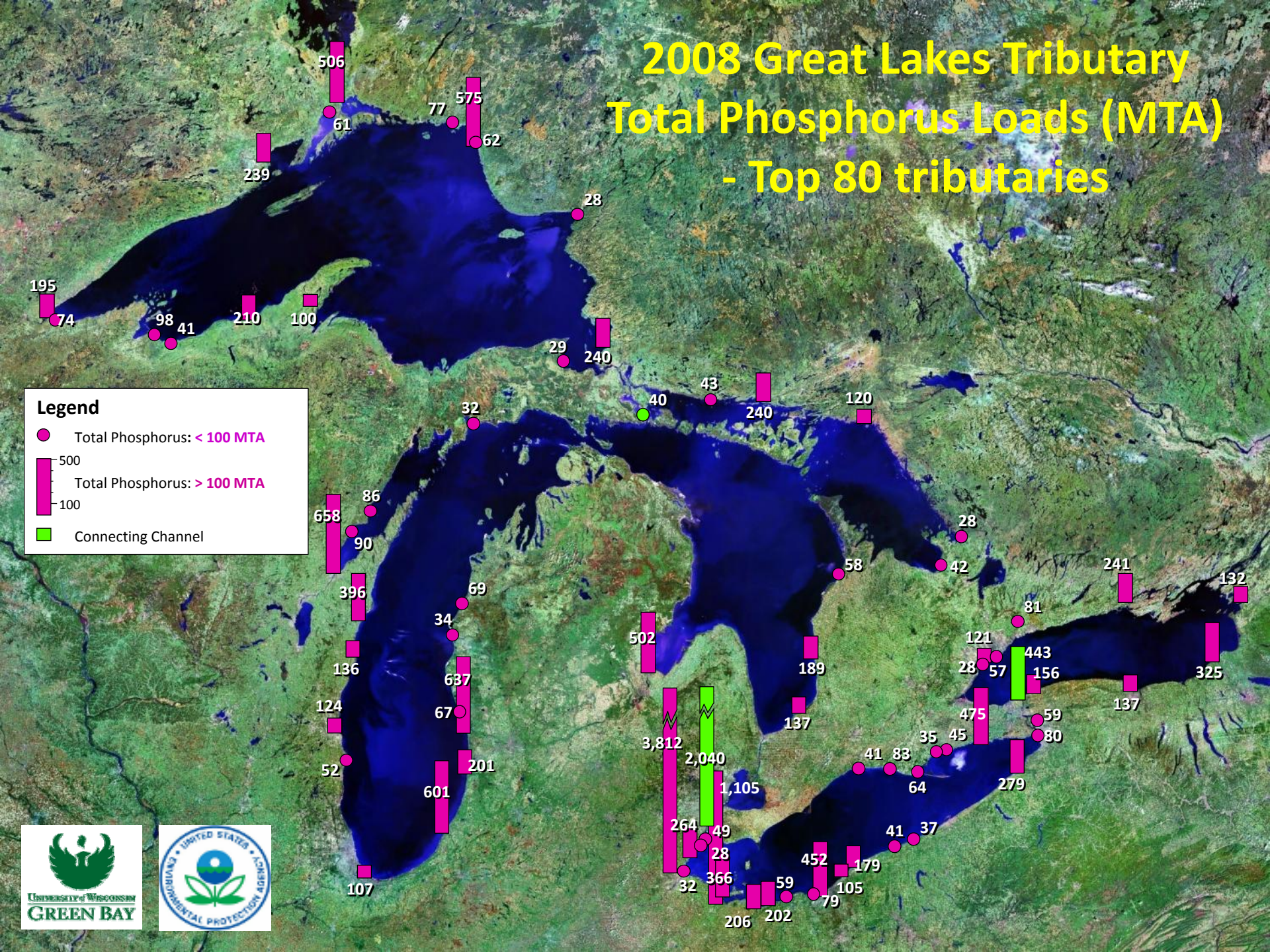


Provisional Lake Erie Total Phosphorus Mass Budget, 2008 (Metric Tons per Annum)



Potential Concerns for External Loadings

- Confined Animal Feedlot Operations (CAFOs)
- Open Lake Dredge Disposal
- Combined Sewer Overflows (CSOs)


2008 Great Lakes Tributary Total Phosphorus Loads (MTA) - Top 80 tributaries
Legend
Total Phosphorus: < 100 MTA
500
Total Phosphorus: > 100 MTA
100
Connecting Channel
506
61
77
575
62
239
28
195
74
98
41
210
100
29
240
43
40
240
120
32
86
658
90
396
69
34
136
637
124
67
52
201
601
107
28
58
42
241
132
81
121
28
57
443
156
325
137
502
189
137
475
59
80
35
45
41
83
64
279
3,812
2,040
1,105
264
49
28
32
366
59
206
202
452
179
105
79
41
37
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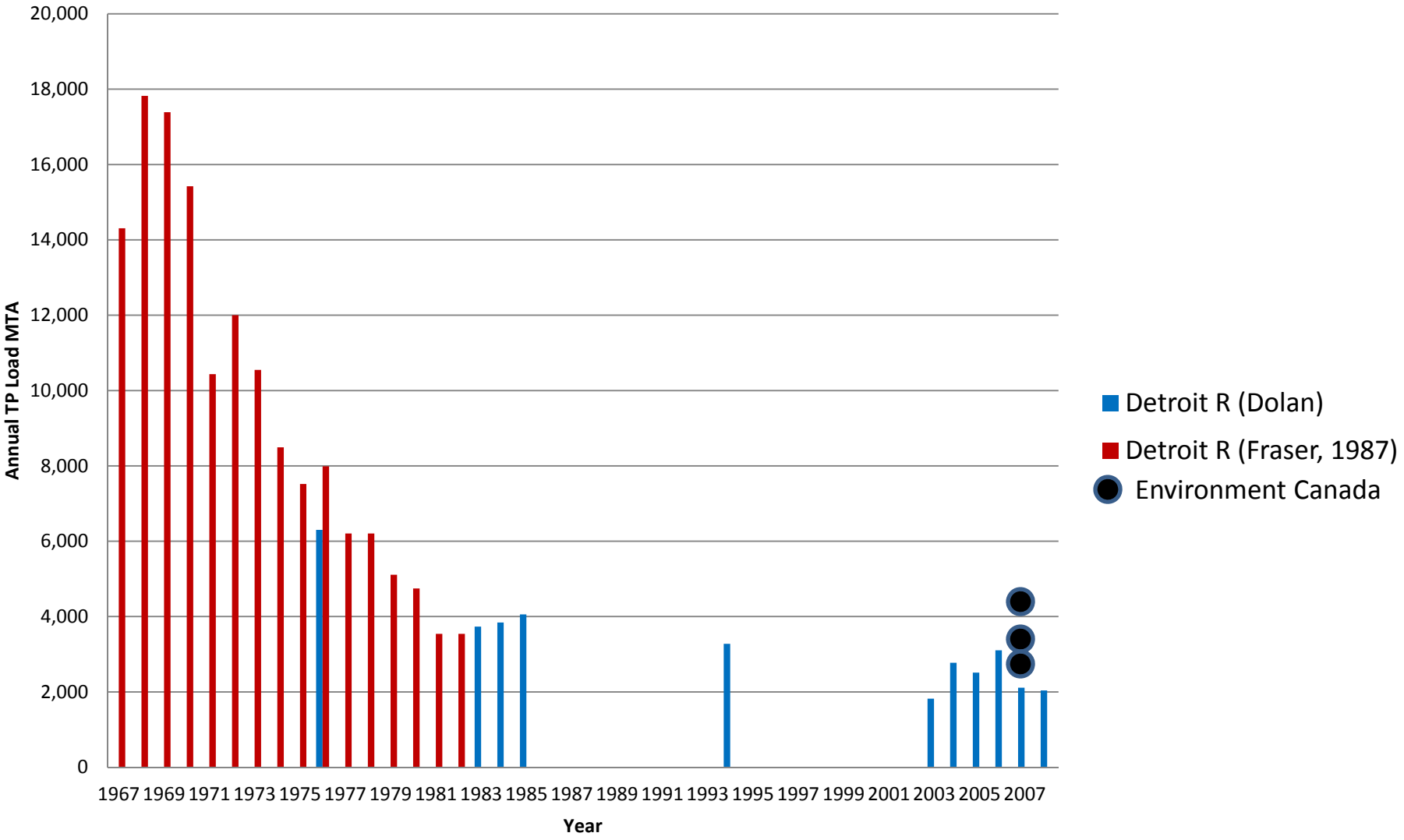
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Detroit River Total Phosphorus Loading

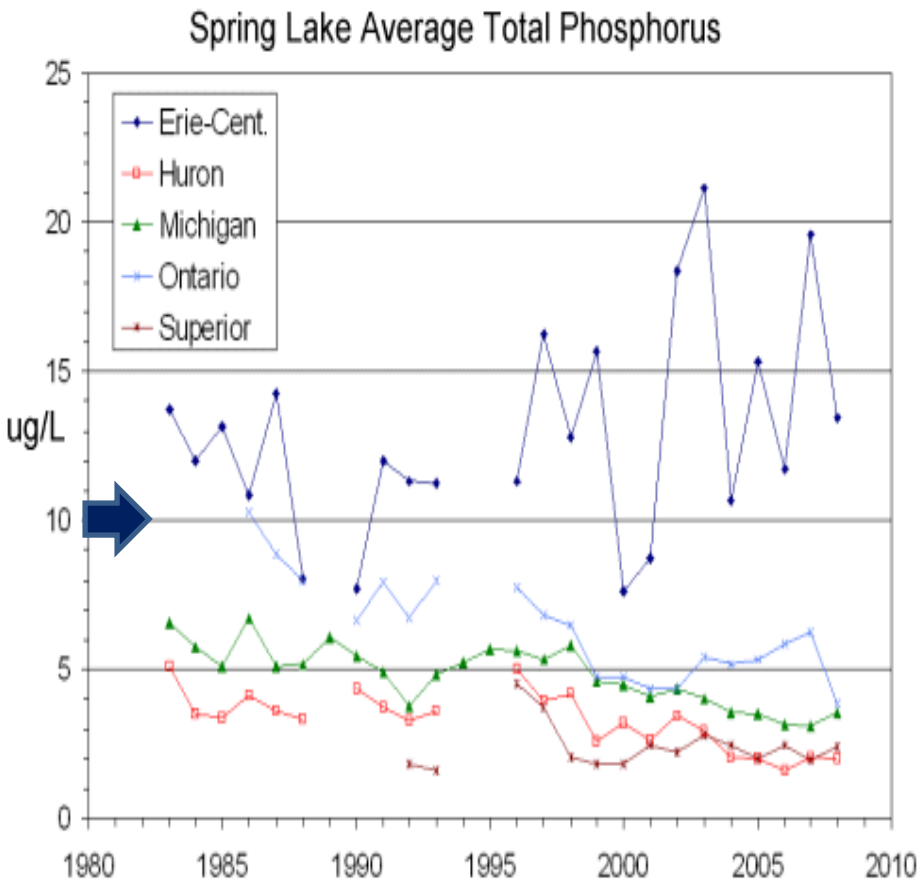


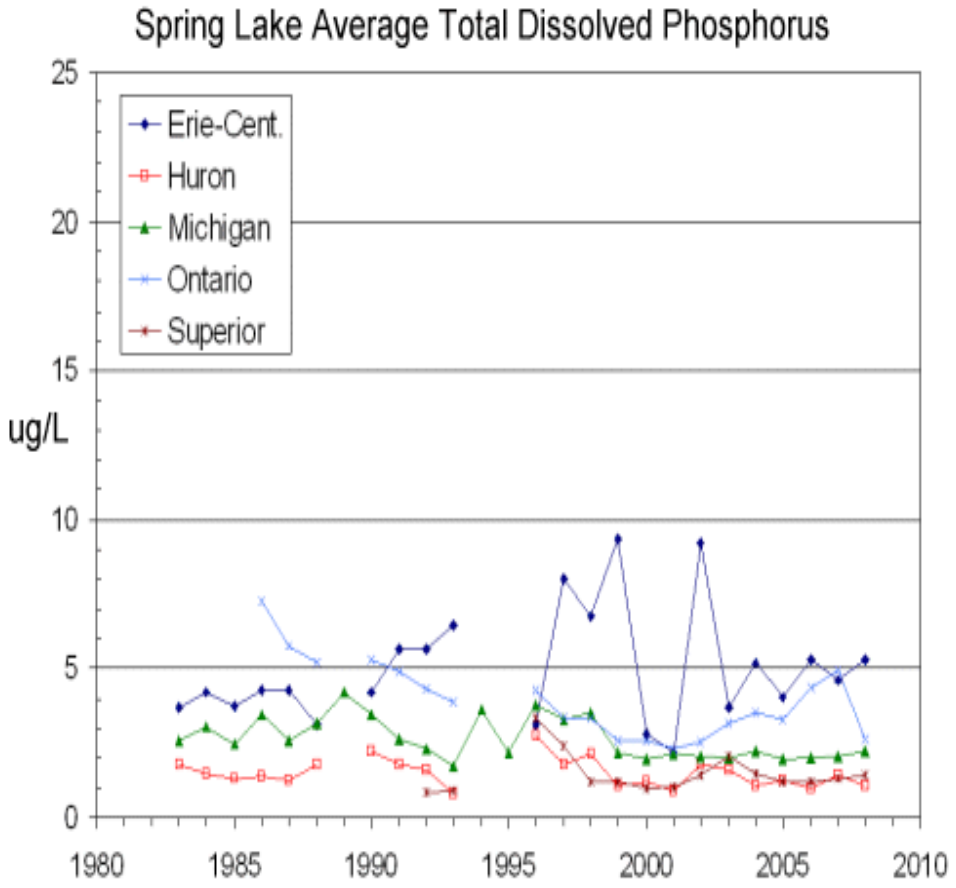
Total Phosphorus Loading from Detroit Wastewater Treatment Plant, 1966 – 2003

Detroit DWSD Total Phosphorus Load (2003 – 2011)

Year	Flow (MGD)	Load (MTA)
2003	642	591
2004	650	624
2005	688	662
2006	705	669
2007	672	696
2008	721	762
2009	730	623
2010	616	549
2011	771	504

Great Lakes Spring Total and Dissolved Phosphorus Trends, 1983-2008 (USEPA-GLNPO)

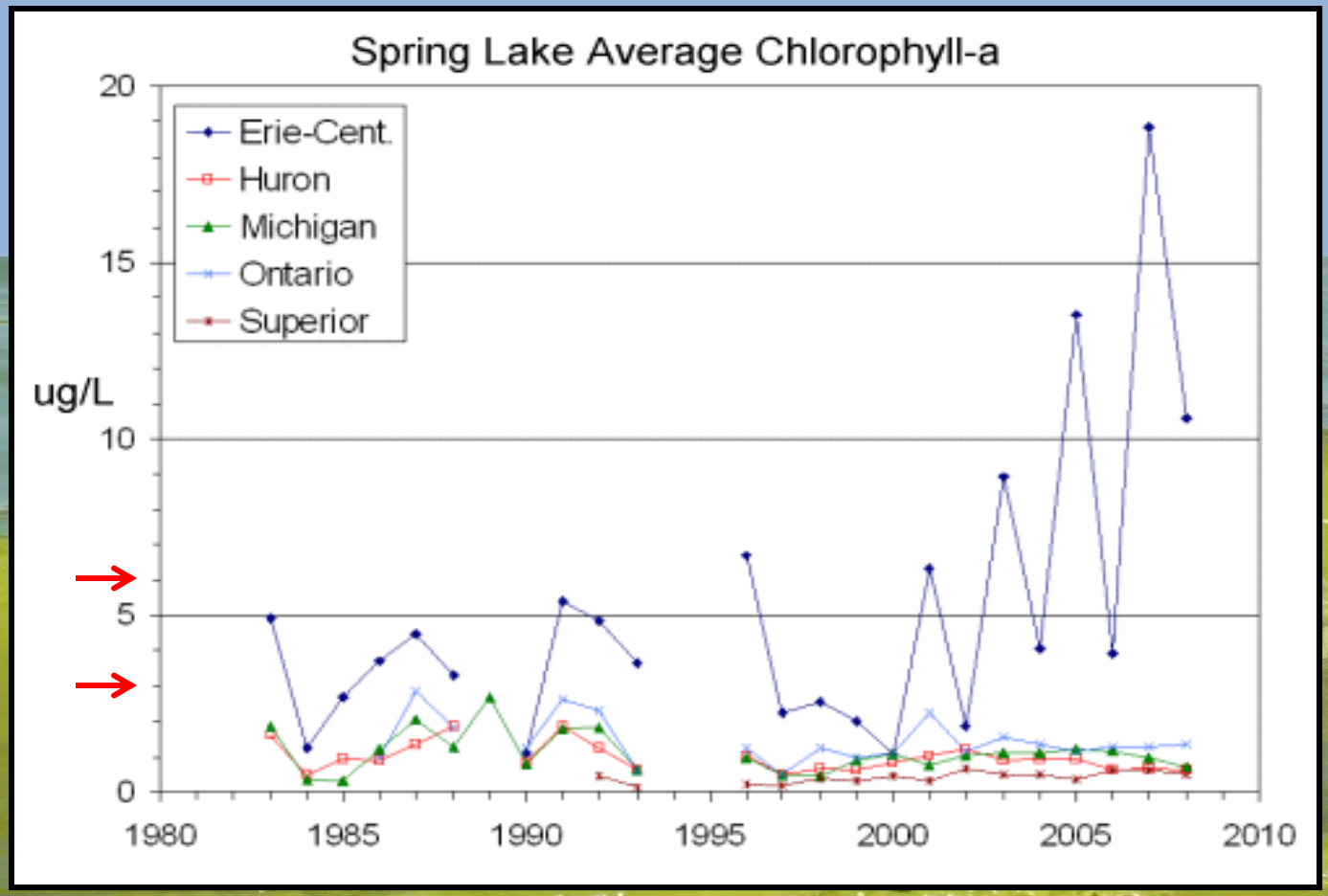




Relative Contributions to Lake Erie DRP Loadings in 2011

Source	Load (MTA)	Percent of Total
Maumee River	702	26.4 %
Detroit WWTP	353	13.3 %
Sandusky River	245	9.2 %
Atmospheric	173	6.5 %
Cuyahoga River	96	3.6 %
Other Sources	1,091	41.0 %
TOTAL	2,660	100 %

Great Lakes Spring Chlorophyll-a Trends 1983-2008 (USEPA-GLNPO)

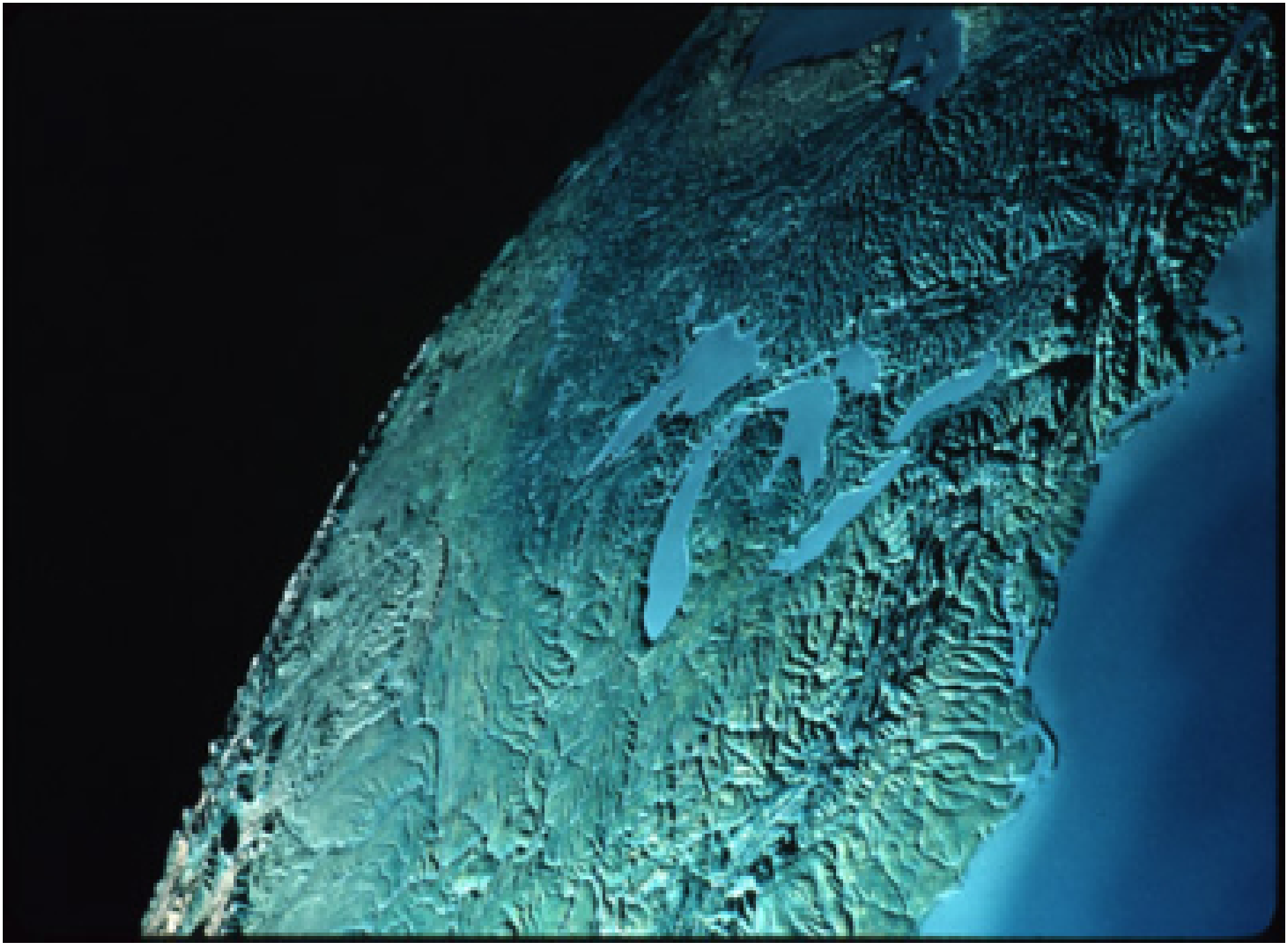


Summary

- GLWQA Target of 11,000 MTA of Total Phosphorus is generally met and was exceeded 1 time in the past decade; less than during the previous 10 years.
- Tributary/Non-point sources of Total Phosphorus dominate total loadings.
- The Maumee, Detroit, Sandusky Rivers exhibit the greatest Total Phosphorus Loads to Lake Erie.
- Point Sources continue to be important for nutrients.
- In-lake concentrations of Total Phosphorus and Chlorophyll *a* typically are greater than objectives.

Challenges/Opportunities

- Continue Calculation of Phosphorus and other Constituent Loads Consistent with Methods that have been Historically Used.
- Continue Offshore and Nearshore Monitoring.
- Further investigate the Total Phosphorus Mass Budget with particular emphasis on the Dynamic Interaction of Water and Sediment.
- Construct Loading Trends and Mass Budgets of Soluble Reactive Phosphorus, Nitrogen, Carbon and Suspended Solids.
- Fulfillment of Annex 4 of the GLWQA 2012 will be Complex and Require Multiple Efforts and Approaches.



Relative Contributions to Lake Erie TP Loadings in 2011

Source	Load (MTA)	Percent of Total
Maumee River	3,000	35.2 %
Sandusky River	1,129	13.3 %
Detroit WWTP	504	5.9 %
Atmospheric	493	5.8 %
Cuyahoga River	336	3.9 %
Other Sources	3,056	35.9 %
TOTAL	8,518	100 %

Estimated Lake Huron Output (2003 – 2008)

Year	Flow (km^3/yr)	Input from Lake Huron (MTA)
2003	149	436
2004	158	437
2005	156	430
2006	154	410
2007	150	387
2008	152	321

Great Lakes Spring Nitrate+Nitrite Trends, 1983-2008 (USEPA-GLNPO)