Current monitoring of Lake Erie tributaries

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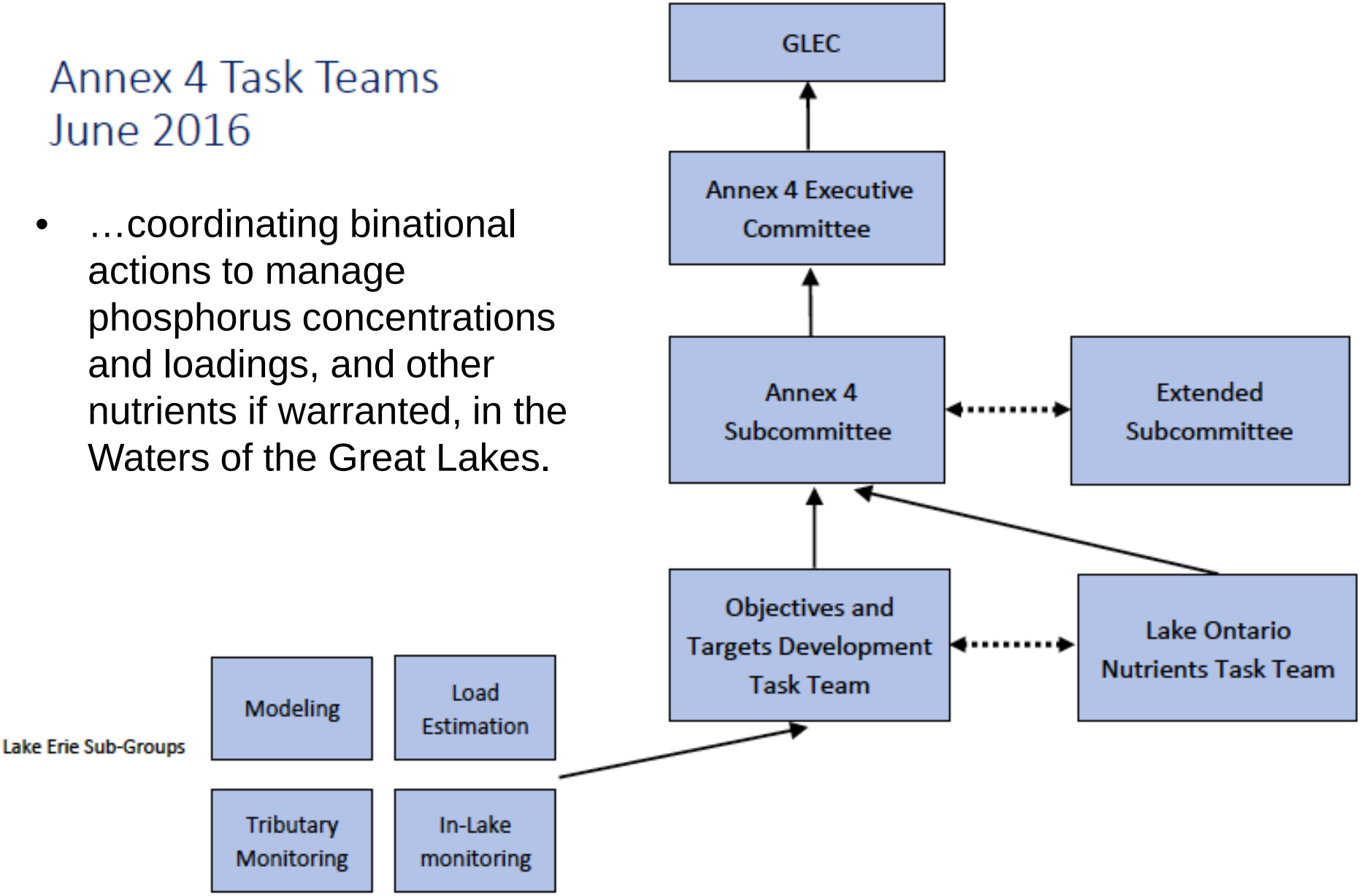
Annex 4 Task Teams
June 2016

- …coordinating binational actions to manage phosphorus concentrations and loadings, and other nutrients if warranted, in the Waters of the Great Lakes.

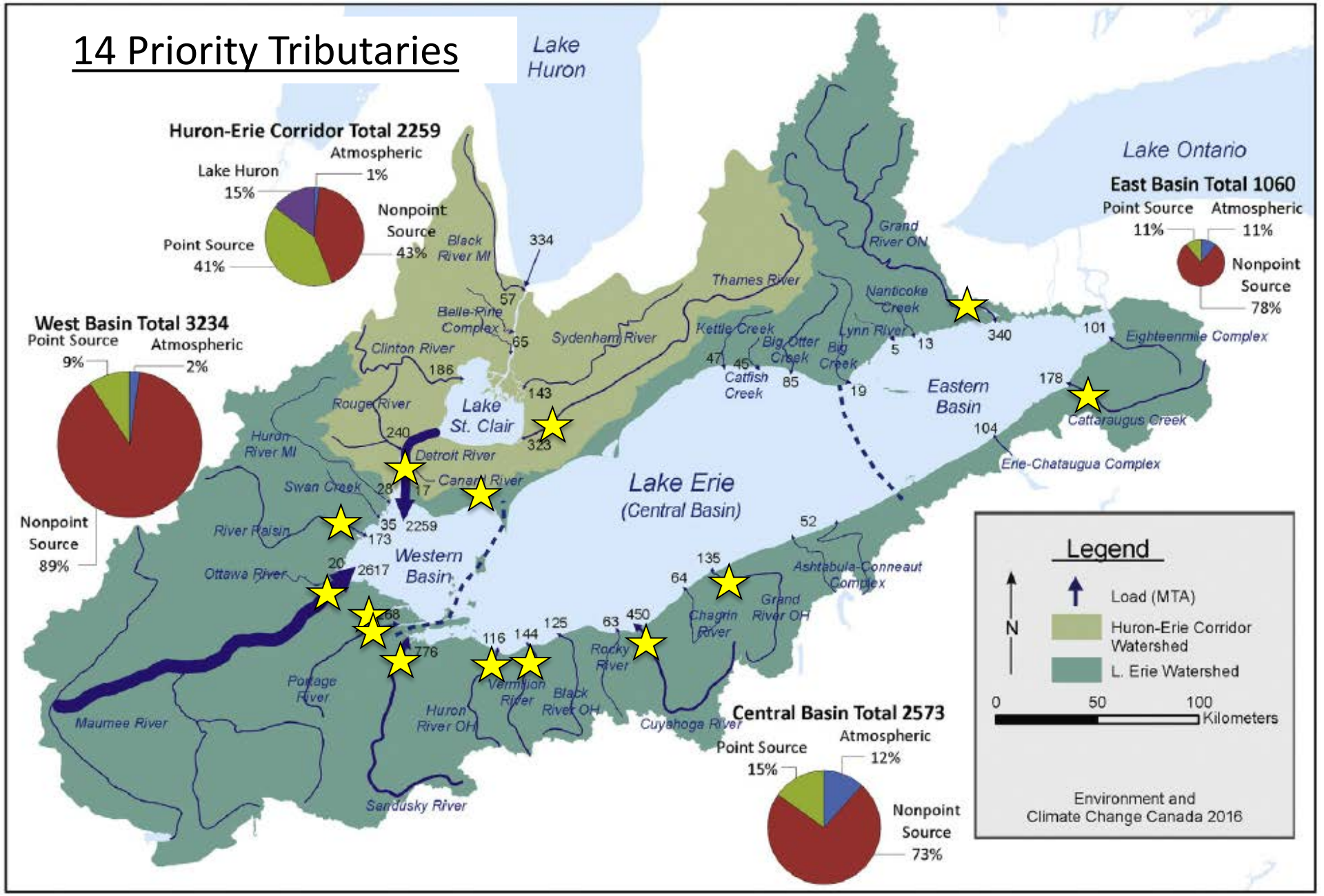


Tributary Monitoring subgroup

- Original objectives:
  - To develop collaborative and coordinated monitoring strategies for priority tributaries
  - To determine what parameters to monitor and frequency to estimate the annual and spring loads and FWMC (total P and DRP) at the mouths of priority tributaries and to understand the reasons for the observed changes in the loads and FWMC

- Realized objectives:
  - Monitoring coordination (inventory and summary)
  - Sample and data comparison
  - Information for adaptive management, DAPs, modelers
  - This symposium helps address original objectives!

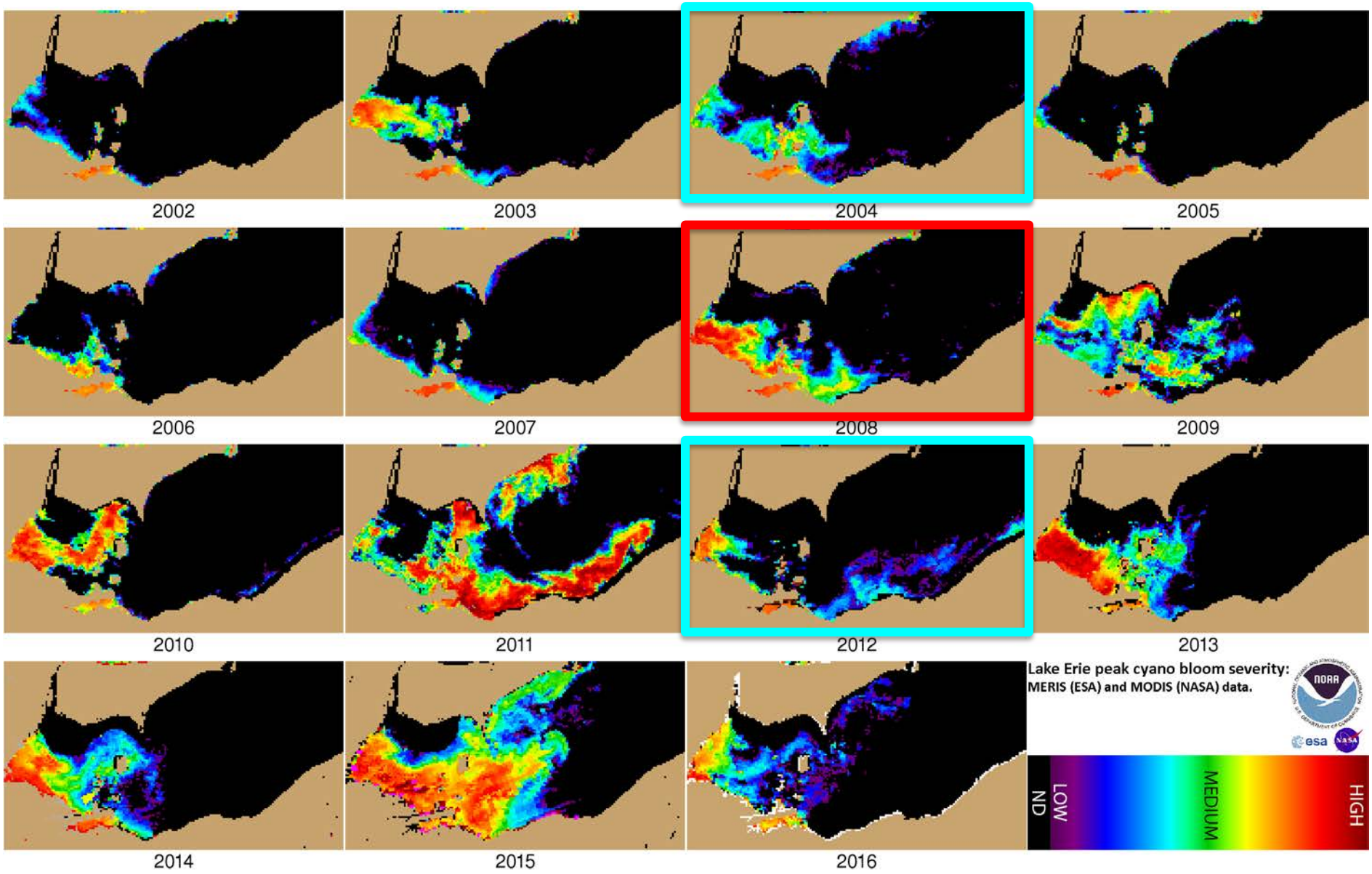
14 Priority Tributaries



Map from Maccoux et al. 2016

Target loads to reduce blooms

- Annex 4 Target is to achieve a bloom no greater than 2004 or 2012 90% of the time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Lake Erie peak cyano bloom severity:
MERIS (ESA) and MODIS (NASA) data.
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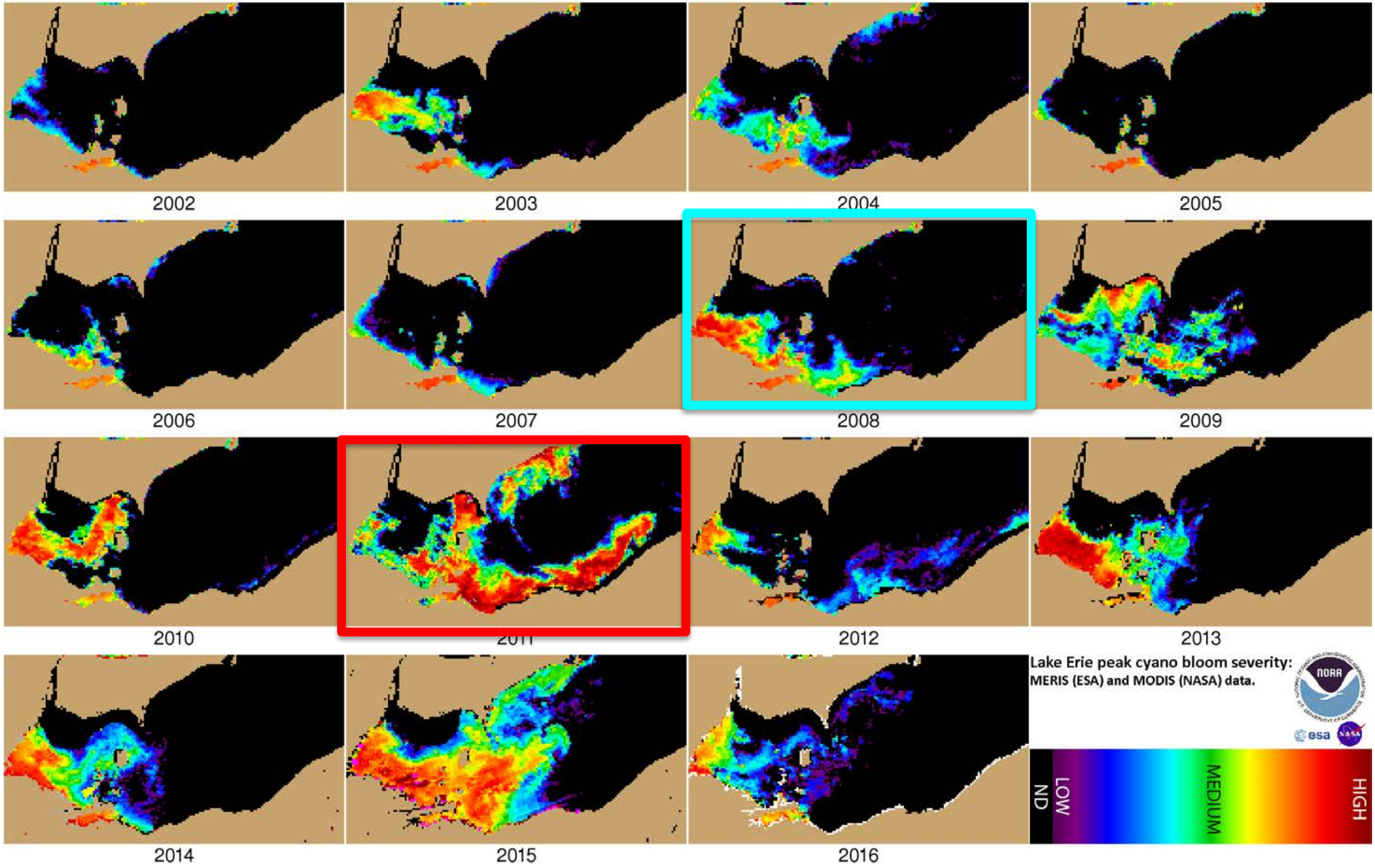
MEDIUM
HIGH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Target loads to reduce blooms

- Annex 4 Target is to achieve a bloom no greater than 2004 or 2012 90% of the time
- Target for the spring load from the Maumee:
  - TP load of 860 m tons, or 40% reduction from 2008 (FWMC 0.23 mg/L)
  - DRP load of 186 m tons, or 40% reduction from 2008 (FWMC 0.05 mg/L)
- 40% TP and DRP reduction in spring loads from Thames, Raisin, Portage, Toussaint, Leamington Tribs, Sandusky, Huron (OH)
- 40% reduction in annual TP load for Western and Central basin to reduce hypoxia

RECOMMENDATIONS FOR MONITORING, MODELING, RESEARCH AND REPORTING TO SUPPORT ADAPTIVE MANAGEMENT

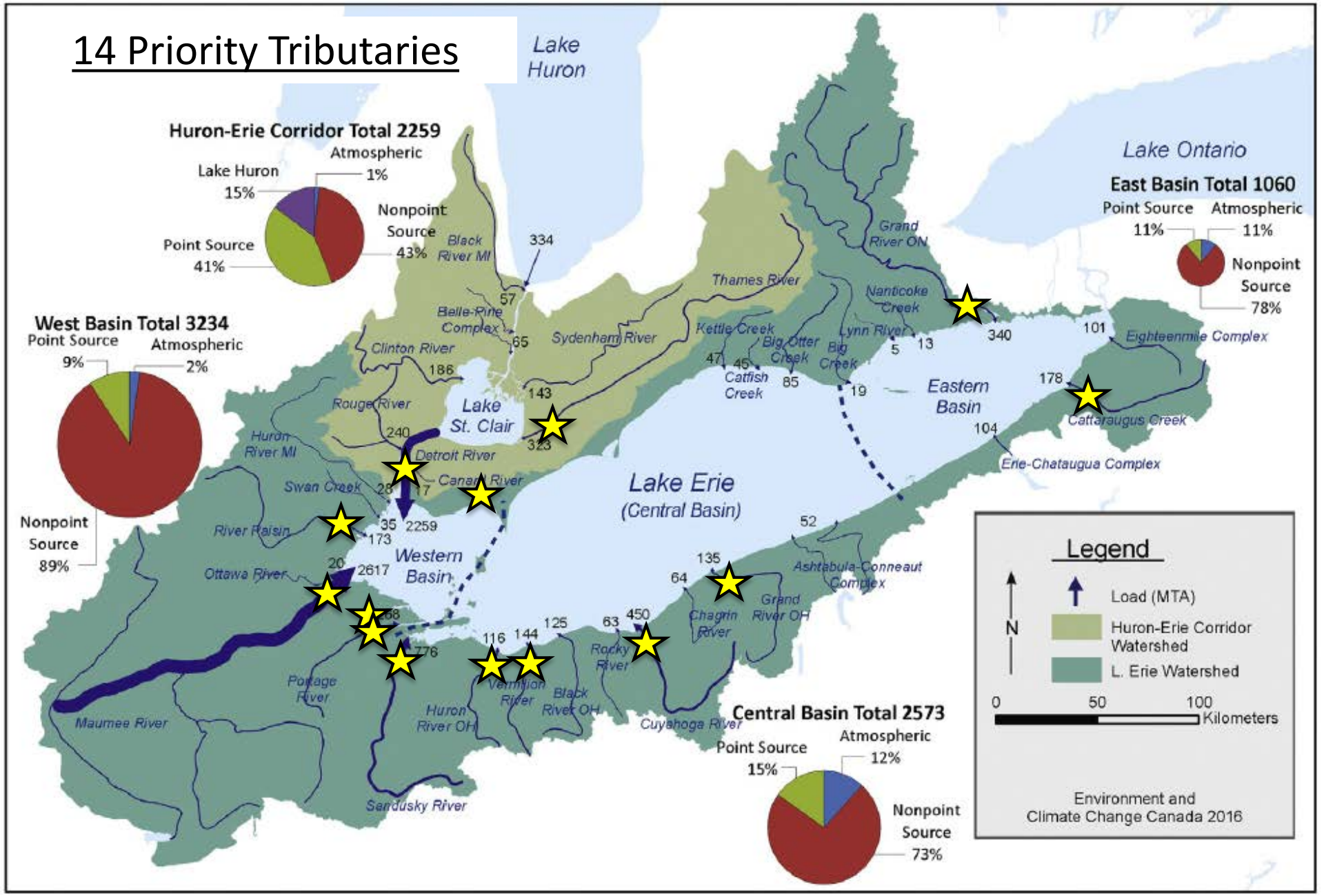
- Follow Heidelberg approach-
  - collect 400-500 samples per year
  - daily samples + higher frequency event sampling
- Alternatively, capture monthly ambient samples + daily or more higher event samples
  - 50-100 samples
  - Based on USGS research as well as Richards and Holloway 1987
- 10 to 20 years of sampling
- Sample 11 of the 14 priority tributaries
  - not Detroit, Toussaint, or Leamington at this frequency
- Suggested laboratory samples exchange to test comparability
- Minimum analytes: TP and DRP
- Other recommended analytes: NO_{2+3}, TKN, TSS, NH_4, Cl, SO_4, chl.*a*, DOC, POC, DON, sediment size, SOD, Si

RECOMMENDATIONS FOR MONITORING, MODELING, RESEARCH AND REPORTING TO SUPPORT ADAPTIVE MANAGEMENT

- Develop watershed-loading models for each of the 11 priority tributaries
- Implement a binational strategy for whole-lake load calculations
- Improve estimates of atmospheric P, loads from Lake Huron, and loads to Lake Ontario

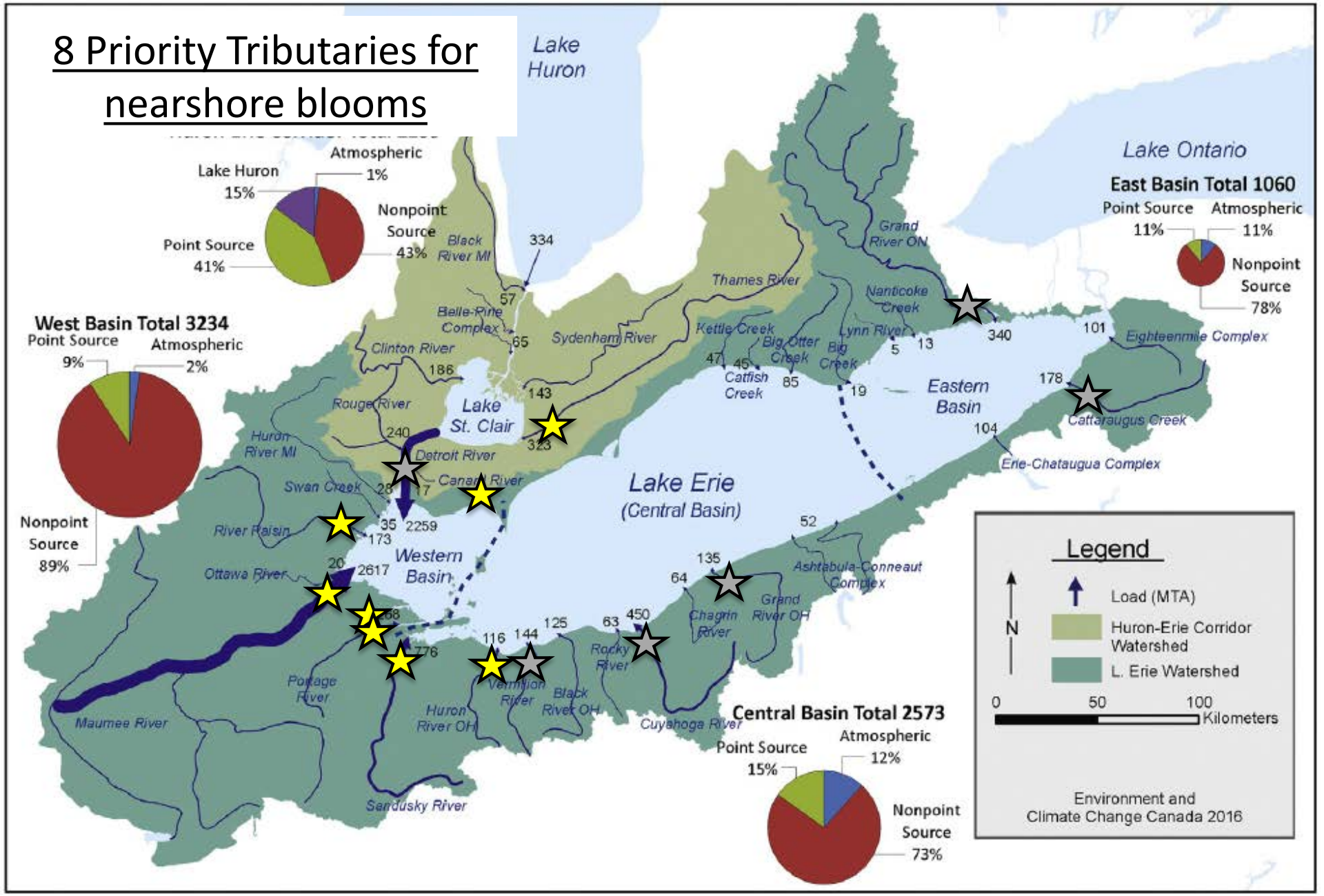
- Other recommendations include
  - Lake sampling for blooms, Cladophora, and hypoxia
  - Agricultural practice data collection
  - Urban stormwater management
  - Nitrogen and toxicity
  - Etc…

14 Priority Tributaries



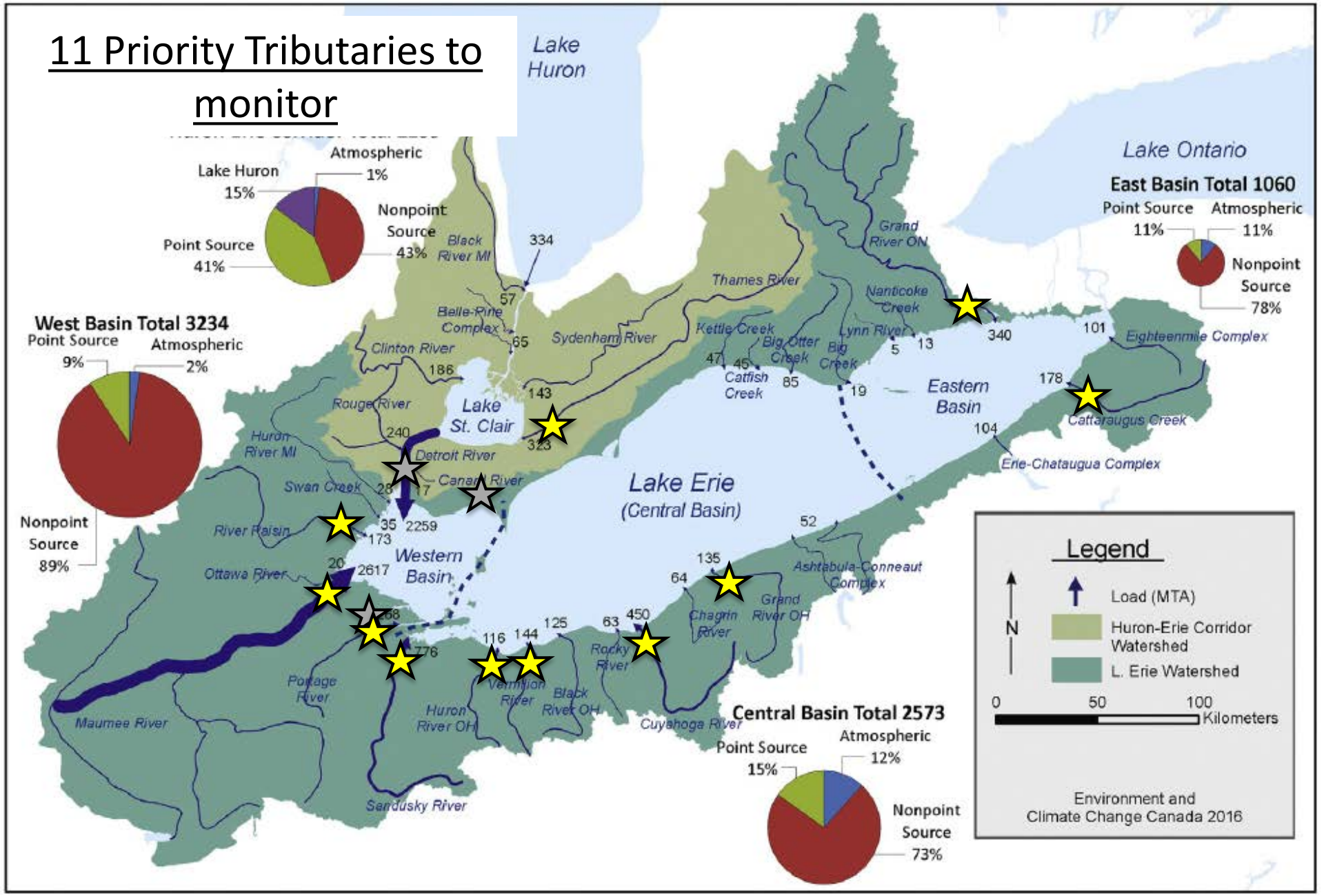
Map from Maccoux et al. 2016

8 Priority Tributaries for nearshore blooms



Map from Maccoux et al. 2016

11 Priority Tributaries to monitor



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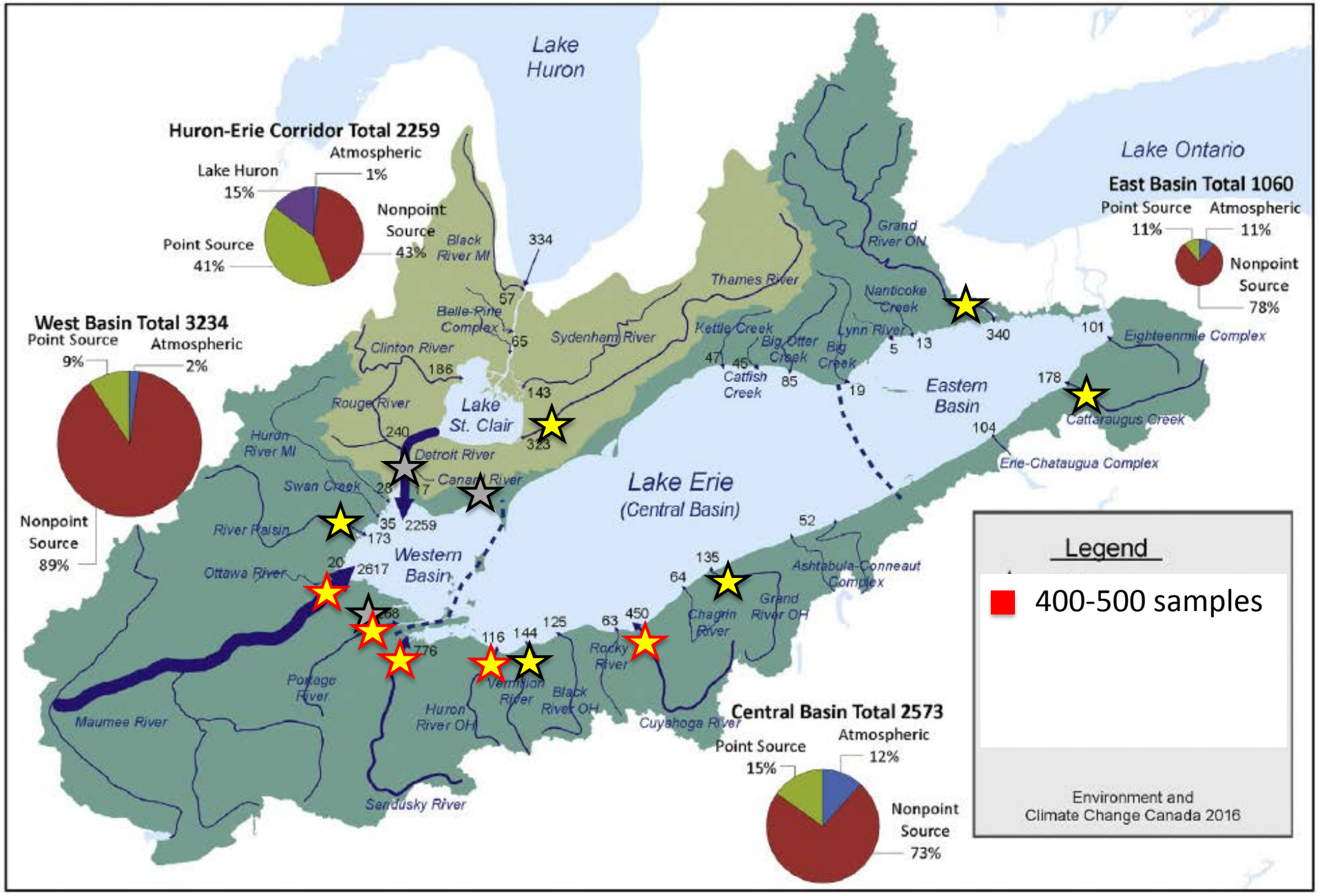

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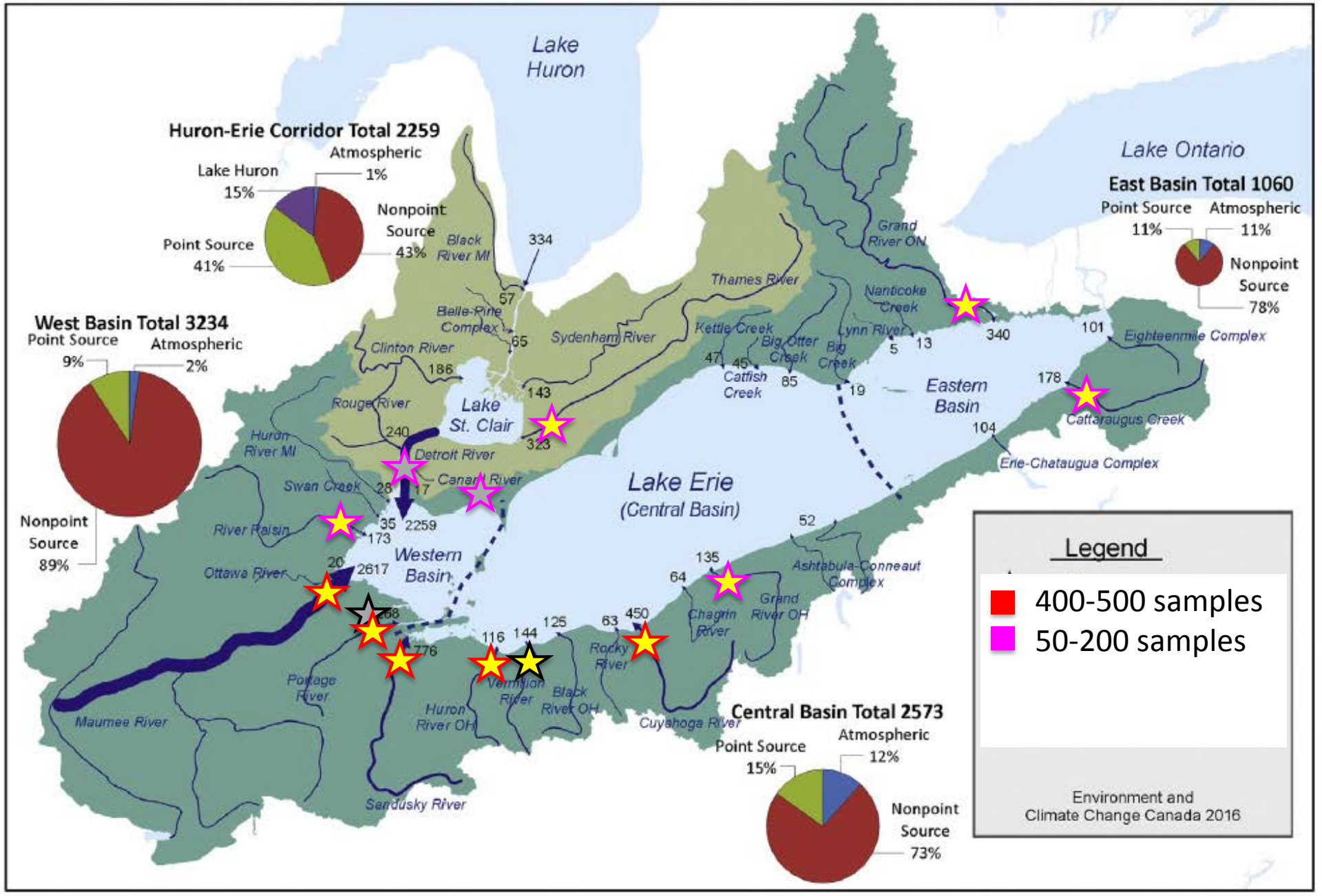

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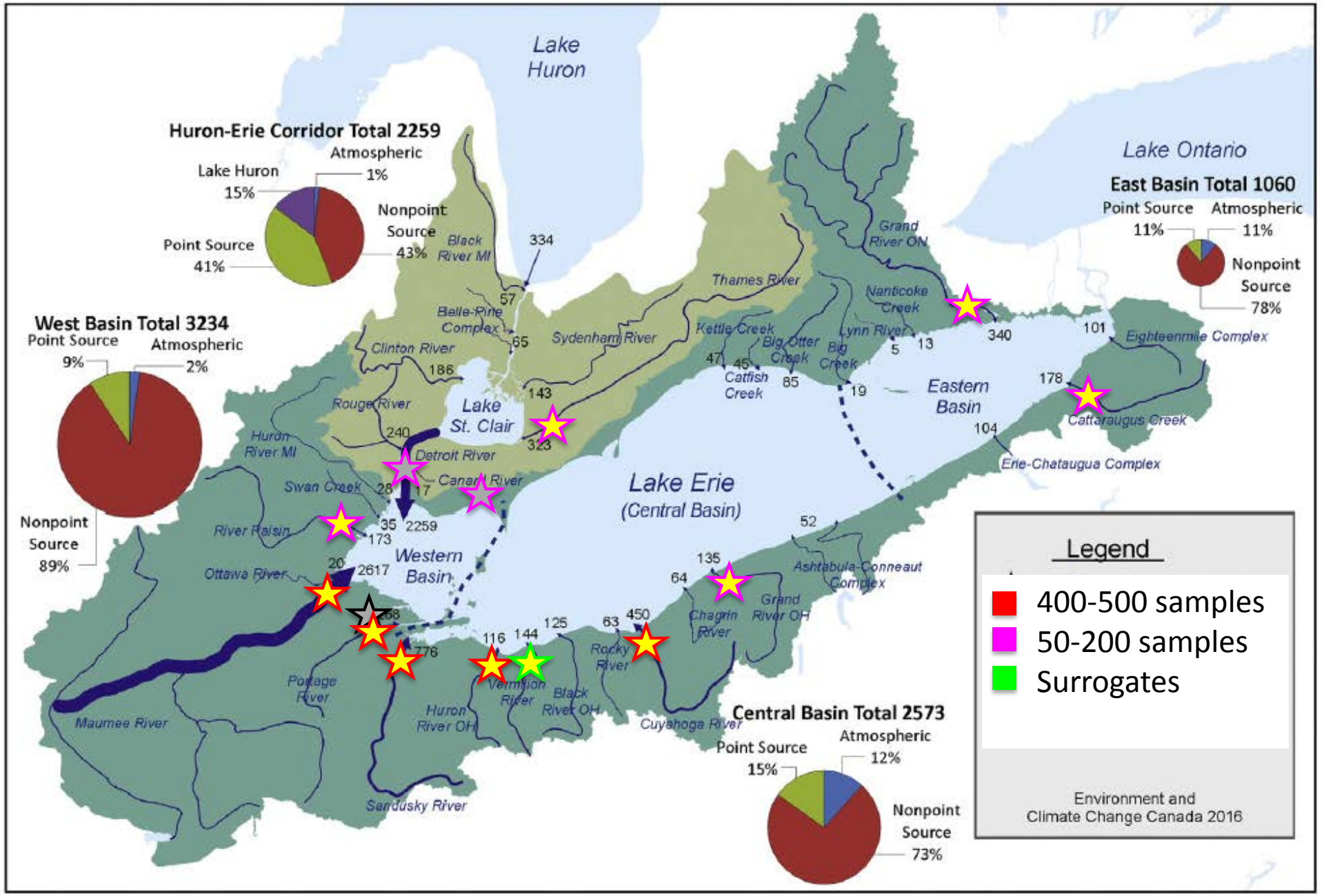

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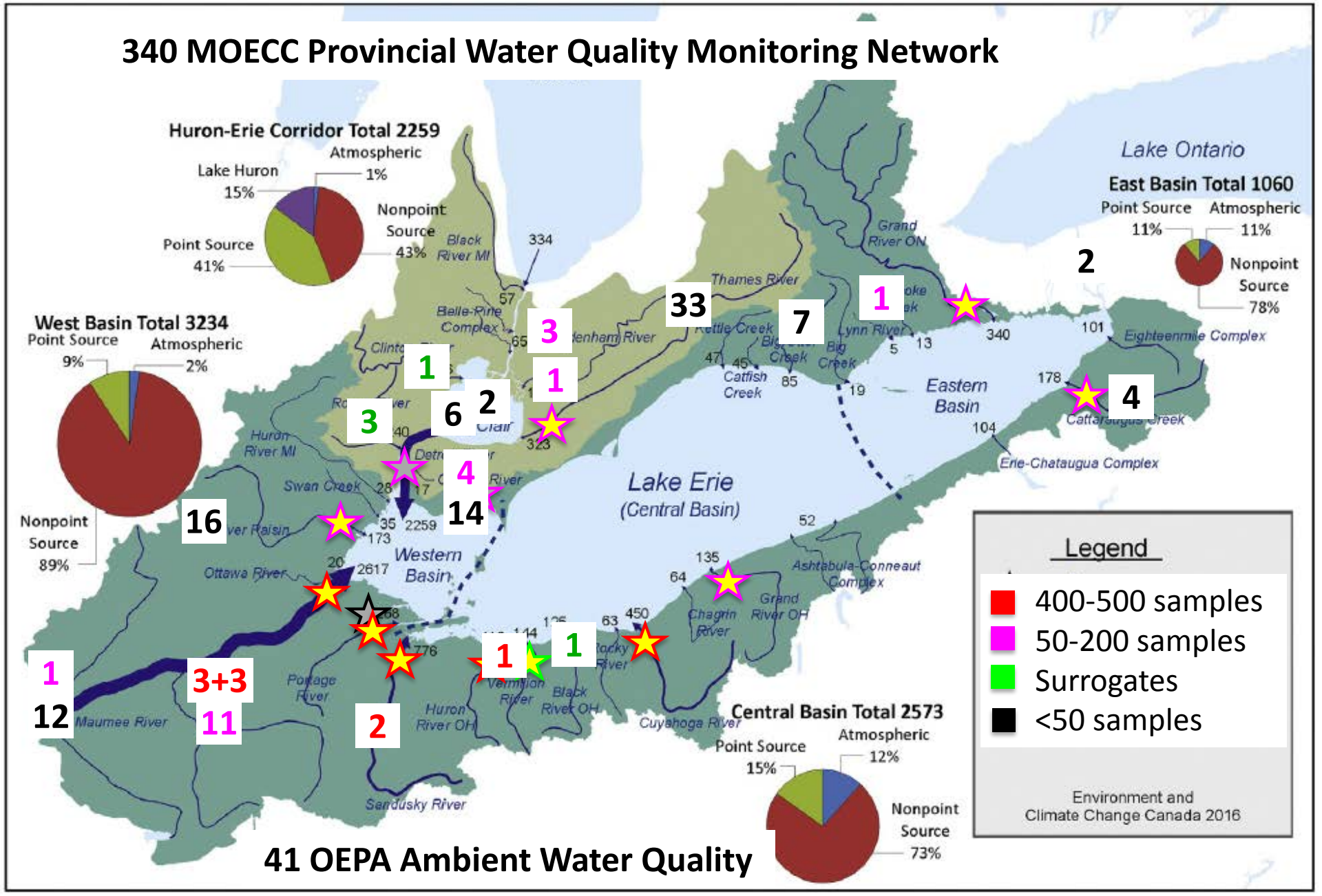

Map from Maccoux et al. 2016

Summary

Tributary	Monitoring for loads/FWMCs?	Monitoring all parameters?	Notes
Thames River	YES	YES	
River Raisin	YES	YES	
Maumee River	YES	YES	
Portage River	YES	YES	
Sandusky River	YES	YES	
Huron River	SOON	YES	Estimated start February 2017
Vermilion River	LIKELY	YES	Monthly with sondes as surrogates
Cuyahoga River	YES	YES	
Grand River (Ohio)	SOON	YES	Estimated start February 2017
Cattaragus Creek	YES	YES	After 2 years of storm sampling, monthly with sondes as surrogates
Grand River (Ontario)	YES	YES	

**all but chl.a, DOC, POC, SOD, sed't size*

- The 11 priority watersheds for monitoring are currently being monitored!
- There's a multitude of monitoring occuring throughout the watershed, ~35 locations are at a frequency appropriate for loading calculations or calculations via surrogates

For more information visit:

http://www. NCWQR.org

Or contact me at ljohnson@heidelberg.edu

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Questions?

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Annex 4 recommendations

Summary of Phosphorus Load Targets recommended to achieve desired thresholds for eutrophication response indicators in Lake Erie.

	Spring (Mar-July)	Annual
Western Basin Cyanobacteria – Bloom biomass less than or equal to 2004 or 2012 9 years out of ten, and/or reduce risk of nearshore localized blooms		
Maumee River		
Total Phosphorus load	860 MT#	
Dissolved Reactive Phosphorus load	186 MT#	
Other Western Basin Tributaries and Thames River		
Total Phosphorus load	40% reduction*	
Dissolved Reactive Phosphorus load	40% reduction*	
Central Basin Hypoxia – Aug –Sept Average Hypolimnetic Oxygen of 2 mg/L or more		
Total Phosphorus load to Western and Central Basins, including Detroit River and atmospheric load)		6000 MT**
Eastern Basin *Cladophora* – insufficient information to establish target		

#to be met 90% of the time based on inter-annual flow variability for the March-July period.
*Note: Percent reductions are based on 2008 loads
**This represents a 40% reduction of annual loads to the Western and Central Basins, including the Detroit River and atmospheric load.

Table 1. Summary of GLWQA commitments for Lake Erie. This table summarizes how the Nutrients Annex Sub Committee addresses the GLWQA commitments. It is important to note that the targets presented below, by basin, work in concert not in isolation. All tributaries to Lake Erie, including the Detroit River and the Huron-Erie Corridor contribute phosphorus loads to Lake Erie. In addition, the Western Basin loads contribute to the Central Basin loads which contribute to the Eastern Basin.

GLWQA Commitment	Recommended Target for Lake Erie	Comments
1. **for the Open Waters of the Great Lakes:** • **Minimize the extent of hypoxic zones associated with excessive phosphorus loading (1)** • **Maintain the levels of algal biomass below the level constituting a nuisance condition (2)** • **Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health (4)** • **Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie (6)**		
(a) review the interim Substance Objectives for phosphorus concentrations for each Great Lake to assess adequacy for the purpose of meeting Lake Ecosystem Objectives, and revise as necessary;	No new phosphorus concentration objectives for the open waters are recommended at this time.	With achievement of the loading targets, the following P concentrations for the open waters are expected: Western Basin -12 µg/L Central Basin - 6 µg/L Eastern Basin - 6 µg/L Flow-weighted mean concentrations at tributary mouths should be used as a benchmark to track progress in load reductions.
(b) review and update the phosphorus loading targets for each Great Lake;	**Target load to reduce cyanobacteria blooms in the Western Basin:** Reduce **spring TP** and **DRP** loads from Maumee by 40% from the 2008 spring loads. **Target load to reduce hypoxia in the Central Basin:** 6,000 metric tons TP annual loading to the Central Basin. This loading target represents a 40% reduction in loadings from 2008 levels. **Target load to reduce nuisance algal density in the Eastern Basin:** There is insufficient information/data at this time to recommend a loading target.	Achieving the Maumee target will reduce cyanobacteria blooms to non-severe levels (i.e. levels less than or equal to the 2004/2012 blooms) 90% of the time (i.e., nine years out of 10). While the models indicate the Maumee River spring loads drive the Western Basin bloom, we believe that when the Maumee loads are high the loads from other tributaries are also high and that they too contribute to the bloom. Therefore, we recommend a 40% reduction in spring TP and DRP loads to the other Western Basin tributaries, starting with the nearshore priority watersheds in the Western Basin. Achieving the 6000 MTA target will increase the average DO level in the hypolimnion (cold bottom layer) to greater than 2 mg/L Aug to Sept, thereby reducing hypoxia, increasing DO levels in surface sediment, reducing internal loading of phosphorus to the Central Basin, and improving fishery habitat.
(c) determine appropriate phosphorus loading allocations, apportioned by country, necessary to achieve Substance Objectives for phosphorus concentrations for each Great Lake	Allocation by country to be determined	Adaptive management will be used to evaluate the effectiveness of our targets and associated actions.

GLWQA Commitment	Recommended Target for Lake Erie	Comments
2. **for the Nearshore Waters of the Great Lakes:** • **Maintain the levels of algal biomass below the level constituting a nuisance condition (2)** • **Maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters (3)** • **Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health (4)**		
(a) develop Substance Objectives for phosphorus concentrations for nearshore waters, including embayments and tributary discharge for each Great Lake	No nearshore phosphorus concentration objectives are recommended at this time.	Flow-weighted mean concentrations at tributary mouths should be used as a benchmark to track progress in load reductions
(b) establish load reduction targets for priority watersheds that have a significant localized impact on the Waters of the Great Lakes.	Priority watersheds and targets to reduce nearshore algal blooms: Reduce spring TP and DRP loading by 40% relative to the 2008 spring loads in the following priority watersheds: **Lake St. Clair** Thames River - Cdn **Western Basin** Maumee River - US River Raisin - US Portage River - US Toussaint Creek - US Leamington Tribs – Cdn **Central Basin** Sandusky River - US Huron River, OH – US	In the nearshore areas of the priority watersheds there is evidence that blooms occur on a regular basis. Specific target loads for the Maumee River are: • 860 MT TP spring • 186 MT DRP spring Similar 40% reductions in spring loading (TP and DRP) relative to 2008 levels, are recommended for the other priority watersheds. Load reduction targets for the remaining priority watersheds will be established in the domestic action plans. For the Maumee River, the 2008 target load corresponds to a Flow Weighted Mean Concentration of 0.23 mg/L TP and 0.05 mg/L DRP.