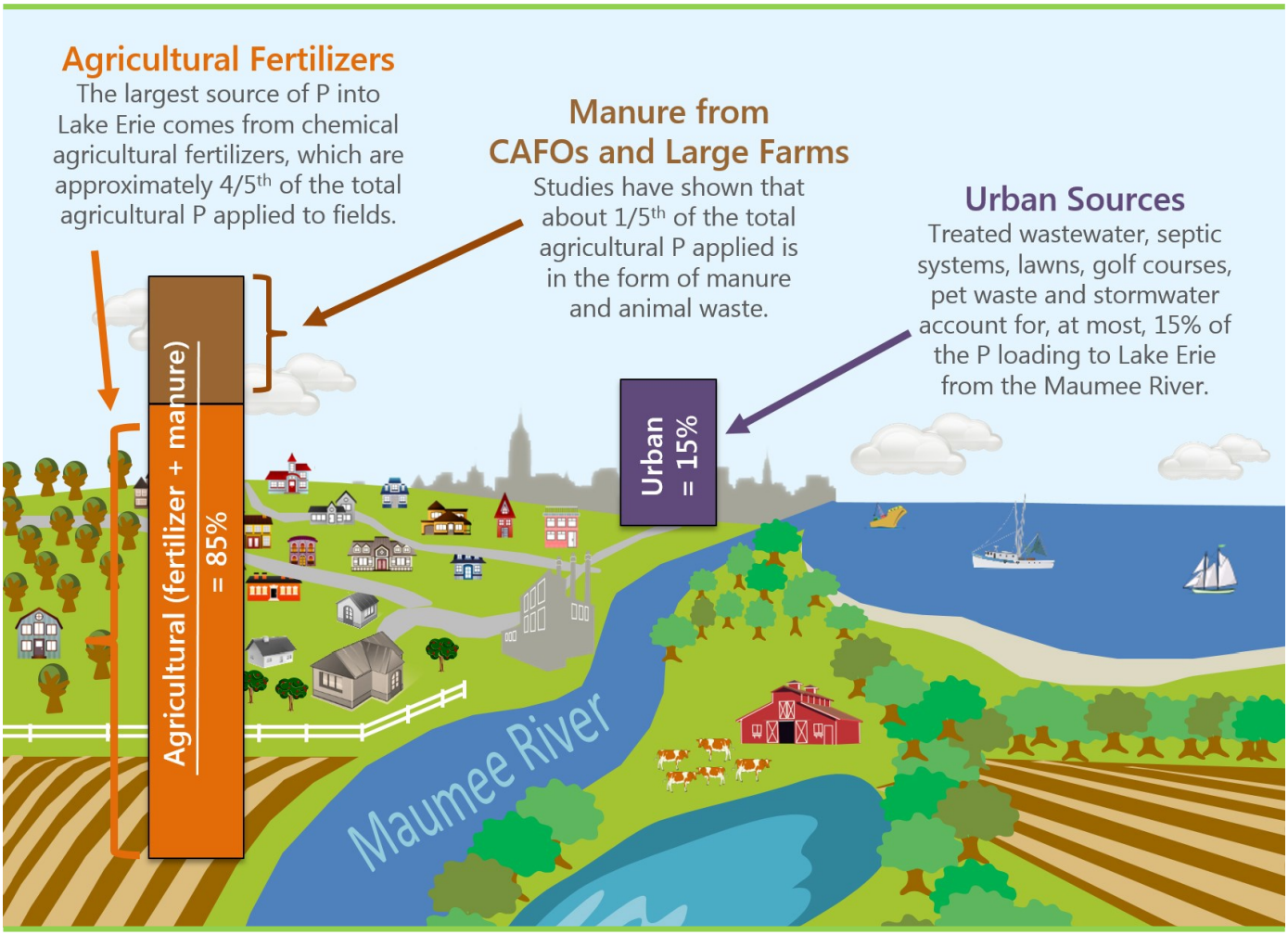
Great Lakes HABs Collaboratory

Linking Science and Management to Reduce Harmful Algal Blooms

Phosphorus (P) and HABs: Sources of P Discharged from the Maumee River into Lake Erie



More information and definitions are provided on the back of the page.

Why P?

P has been shown to be the main driver of HABs and hypoxia - because of this, P load reduction targets have been set for Lake Erie by the Great Lakes Water Quality Agreement (GLWQA). In freshwater systems, the availability of P typically determines the amount of algal growth as there is enough nitrogen in the system to maintain growth. While P is the focus here, nitrogen is also an important factor in bloom growth and toxicity. For more information about nitrogen, see the companion nitrogen fact sheet.

Does P timing matter?

The season that P enters the lake is very important for ecosystem processes. The algae that form HABs prefer warmer temperatures; therefore, the P entering during the spring (which typically has more rain and is when fertilizer is applied to farm fields) is thought to drive HABs. For hypoxia, the effects from P are driven by how much P is loaded into the Lake over the year, not by what happens season to season. This is why the GLWQA requires different targets for springtime phosphorus inputs and annual inputs.

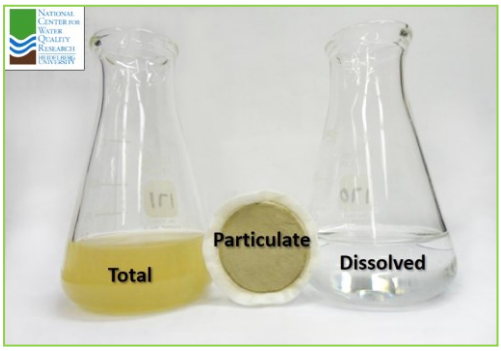
What about other P sources?

Internal loading in the lake is recycled P from sediments and plants. It is believed to be a small source of P (1/10th of the load from the Maumee River). This is shown by small HABs that have occurred in drought years like 2012. Dredging impacts are too small to detect.

The Detroit and Maumee Rivers provide almost equal annual average loads of P into Lake Erie. However, the *concentration* of P from the Detroit River is much lower than the Maumee River. The concentrations from the Detroit River are not high enough to stimulate HABs; however, they contribute to hypoxia.

Glossary

- **Phosphorus (P):** an essential nutrient needed for algal growth.
  - Total phosphorus (TP): all phosphorus within a sample, including DRP and particulate-bound P (see below).
  - Dissolved reactive phosphorus (DRP): phosphorus that passes through a 0.45µm filter and reacts with specific color indicators used to test the water. DRP is the form of P that is most readily available for algal growth.
  - Particulate-bound P: phosphorus that is bound to suspended particles in the water. Only about 30% of particulate-bound P can be taken up by algal cells.
- **Harmful algal blooms (HABs**): excessive growth of algae or cyanobacteria causing nuisance conditions and sometimes also producing toxins that can reach concentrations that are dangerous for humans and animals.
- **Hypoxia/hypoxic:** condition in a water body when the dissolved oxygen concentration is very low and harmful to aquatic organisms, especially those on the bottom that cannot swim to water with more oxygen near the surface.
- **Concentrated animal feeding operation (CAFO):** a farm containing a large number of livestock; such as cattle, swine, or poultry, concentrated in an industrial facility. (For example, a medium-sized dairy CAFO in Ohio has between 200 and 699 mature cows.)



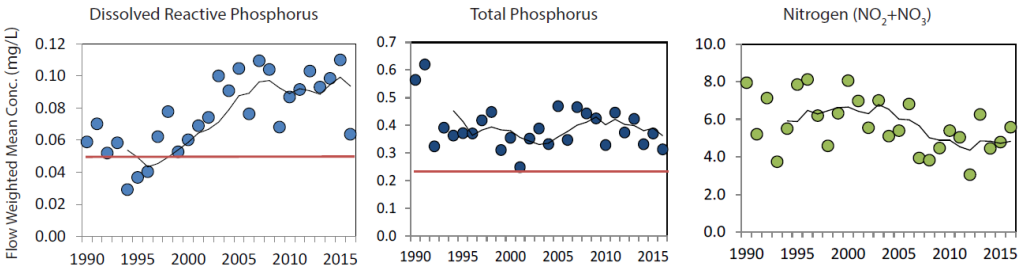
Water samples depicting the different forms of P

Application vs. downstream delivery of phosphorus

- Only a fraction of the phosphorus applied to the landscape makes its way into Lake Erie. That fraction varies among sources of phosphorus: some phosphorus inputs may more readily reach surface waters.
- Most of the P in the fertilizers and manure applied to fields is taken up by crops, some remains in the soil, and only a small fraction (often less than 5%) is transported from the fields to nearby streams. Additionally, some of the P that reaches a stream is deposited in streambeds, bays, and reservoirs or used by aquatic plants, and therefore never makes it to Lake Erie.
- Most P that remains in effluent from sewage treatment plants after treatment is directly discharged into streams. While Toledo effluent is discharged at the mouth of the Maumee River, some P discharged from wastewater treatment plants farther upstream is captured by plants or absorbed onto soil particles before reaching Lake Erie.
- Managers are working to understand and prioritize the sources of P to Lake Erie in the most cost-effective manner.

Trends in total and dissolved phosphorus

- In heavy agricultural watersheds around the western Lake Erie basin, such as the Maumee, Sandusky, and Raisin River watersheds, DRP concentrations have increased about two-fold since the mid-1990s (see below). This increase in DRP concentrations correlates in time with the return of large algal and cyanobacteria blooms to the western basin of Lake Erie.
- In contrast, TP has changed little or even decreased slightly, and nitrogen has decreased since the early 2000s.
- The red lines on the figure below are the target flow weighted mean concentrations for DRP and TP set by the Nutrient Annex of the GLWQA. Achieving that target is thought to reduce HABs to an acceptable size, about the size of 2012 or smaller.
- For more information on monitoring results in waters that flow to Lake Erie, see the Water Monitoring Fact Sheets posted here: http://lakeerie.ohio.gov/.



Flow weighted mean nutrient concentrations for the Maumee River. Data from the National Center for Water Quality Research.

Contact • gl.habs.collaboratory@gmail.com • http://www.glc.org/work/habs-collaboratory