The Lake CONNECTION

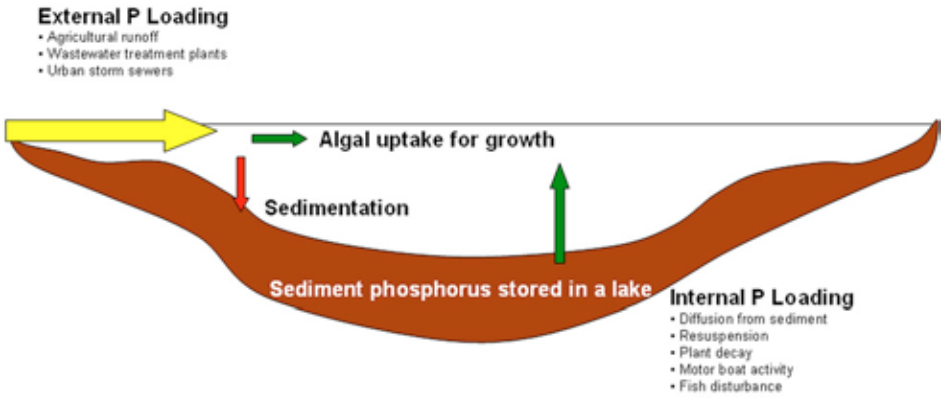
Internal phosphorus loading: the source from within

by Bill James, U.S. Army Corps of Engineers

Today's phosphorus runoff can be stored in lake sediments

Excessive external phosphorus loading from point and nonpoint sources in the watershed can cause undesirable nuisance algal blooms, low dissolved oxygen problems, and reduced water clarity in lakes. Some of the external phosphorus load is directly available for algal uptake and growth in lakes, while another portion, bound to soil particles that were eroded from the watershed, settles to the lake bottom and can be recycled (i.e., transformed) to a form that can be used for algal growth at a later date.

The term "internal phosphorus loading" is defined as the recycling of watershed-derived phosphorus that is stored in lake sediment. Over periods of decades and centuries, a considerable volume of sediment phosphorus can accumulate in a lake. For many lakes and reservoirs in North America, recycling of this bottom source of phosphorus can become more important in driving algal blooms in the summer than external phosphorus loading from the watershed.

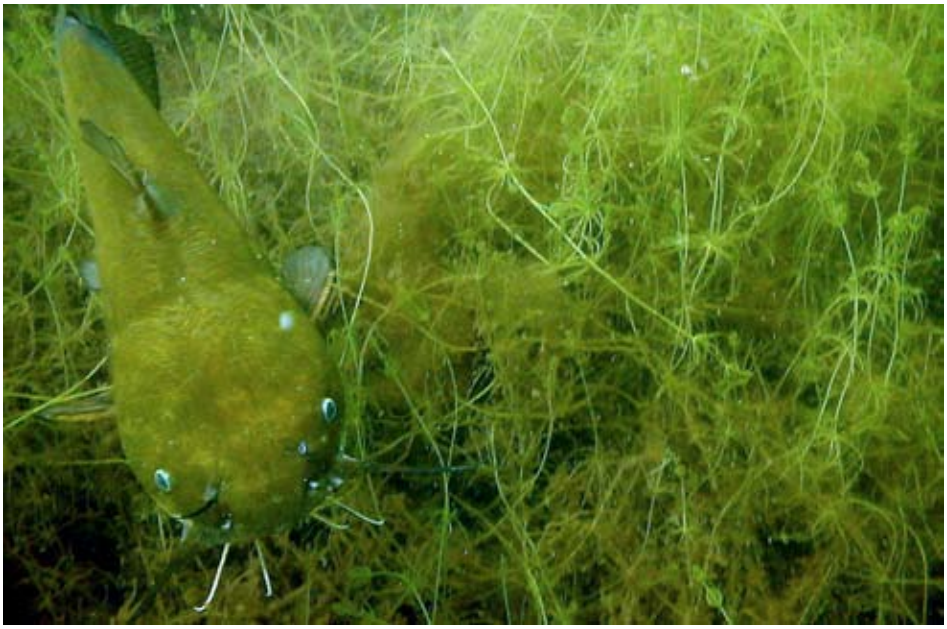


How internal phosphorus recycles back into the lake

Sediment phosphorus can be recycled back to the water through a variety of processes. Insect larvae, bottom feeding fishes, wave action, and boaters can physically stir and resuspend sediment and associated phosphorus into the water. Resuspended phosphorus can chemically release (i.e., desorb) from sediment particles and become available for algal uptake.

In lakes that have extensive weedbeds, aquatic plants can mobilize phosphorus from the sediment by taking it up through their roots and then leaching it into the water during decay. Phosphorus can also move directly from the sediments into the water through diffusion and turbulence. Phosphorus mobilized from the sediments can mix into the surface waters for uptake by algae via wind and other mixing processes. Some algae can even migrate downward toward the sediment using flagella and/or gas vacuoles to access internal phosphorus loads.

Lakes that experience stratification and decreases in dissolved oxygen in the bottom waters typically exhibit the buildup of high concentrations of phosphorus in deep regions due to internal phosphorus loading from the sediment. Accumulation is usually greatest immediately above



Bottom feeding fish like the bullhead pictured above can stir up lake bed sediiments, re-suspending phosphorus into the water. Photo: Scott Provost.

the lake bottom as phosphorus disassociates from the sediment and diffuses upward in the water toward the lake surface.

As summer progresses and more phosphorus is released from the bottom sediment, high concentrations of phosphorus can often be found just below the warmer surface waters where it is in closer proximity to algae growing near the lake surface. Strong winds that result from the passage of fronts can mix this sediment-derived phosphorus into the surface waters for direct uptake by algae. Thus, phosphorus that was originally stored as sediment in a lake as a result of spring snowmelt runoff can conceivably be remobilized in the summer to fuel algal growth.

Both phosphorus sources important in lake management planning

Lake and watershed management plans should consider the roles that sediment stored in a lake can play in driving algal blooms. Some early lake restoration efforts that focused primarily on reducing watershed inputs of phosphorus to improve lake water quality found that lake recovery was delayed due to internal loading of phosphorus that had been stored in the sediments over the years.

If it is determined that this source of phosphorus is contributing to degraded water quality, there are a variety of options for controlling internal loading of phosphorus from the sediments. These treatments include removing bottom-feeding carp that stir up sediment, introducing oxygen into the bottom waters with aeration devices to inhibit phosphorus release from sediment, removing internal phosphorus loads that accumulate in a lake by withdrawing bottom water, and inactivating phosphorus in the sediments with chemicals such as aluminum sulfate.

Phosphorus build up in our soils: a chronic problem

Fertilizers (both commercial and manure) and livestock feed supplements can add significantly more phosphorus to the soil than can be used by plants. This excess phosphorus can accumulate in the soils of a watershed.

Erosion can move phosphorus laden soil particles downhill into our lakes. Rain, snowmelt, and groundwater movement can dissolve phosphorus attached to soil and carry it to our lakes.

This phosphorus build up in lake watershed soils can cause chronic problems for our lakes for years, decades, even centuries.

Wisconsin Lakes Partnership

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