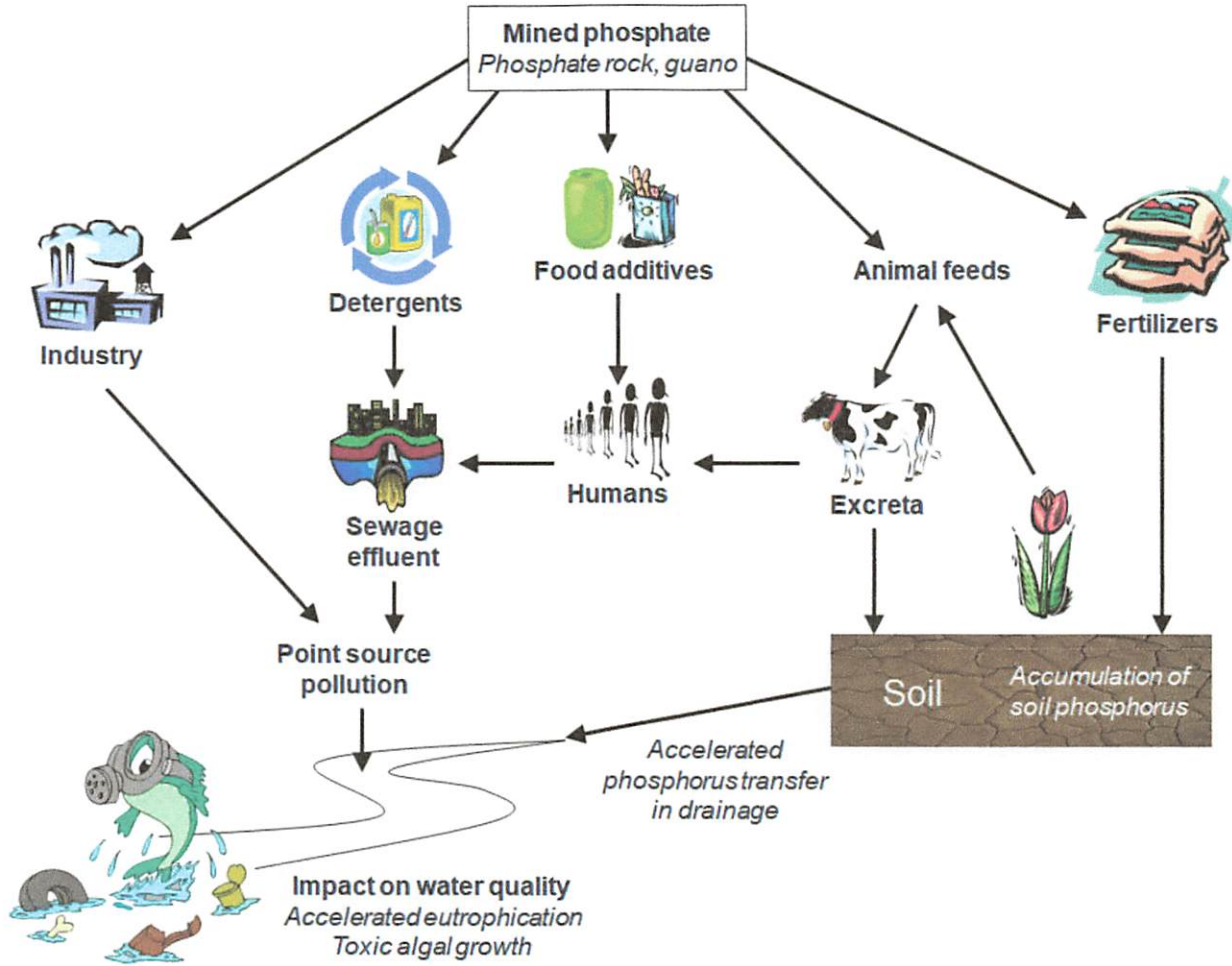


# Phosphate Cycle



## Nitrogen, Phosphorus and Chlorophyll

The following excerpt from the EPA's study of the effect excessive nutrients (total nitrogen and total phosphorus) on water quality:

The Department (EPA) finds that excessive nutrients (total nitrogen and total phosphorus) constitute one of the most severe water quality problems facing the State. It shall be the Department's policy to limit the introduction of man-induced nutrients into waters of the State. Particular consideration shall be given to the protection from further nutrient enrichment of waters which are presently high in nutrient concentrations or sensitive to further nutrient concentrations and sensitive to further nutrient loadings. Also, particular consideration shall be given to the protection from nutrient enrichment of those waters presently containing very low nutrient concentrations: less than 0.3 milligrams per liter total nitrogen or less than 0.04 milligrams per liter total phosphorus.

Taken From: [https://www.epa.gov/sites/production/files/2014-12/documents/fl\\_section62-302.pdf](https://www.epa.gov/sites/production/files/2014-12/documents/fl_section62-302.pdf)

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Agriculture, natural resources, and related food industries contributed \$130.37 billion to Florida's economy in 2011 (Hodges et al. 2013), the second largest after tourism. Water quality is an indispensable and critical element for both of these economically significant industries. More than 93% of Florida residents use groundwater for drinking (FDEP 2008). Streams, rivers, lakes, and ponds create healthy habitats to support ecosystems and wildlife, as well as recreational activities that provide tremendous business opportunities in the state. Overall water quality can be compromised when surface and groundwater water resources receive pollutants from various sources. Among nutrient pollutants, nitrates and phosphorus are the important contaminants for water quality purposes. Protecting the quality of water from contaminants, particularly nutrients, is a top priority for all agencies and stakeholders in the state. This discussion in this article is limited to phosphorus.

The paper highlights the role of phosphorus, interactions with the environment, and its potential impact on water quality. It is intended to serve audiences such as high school students, farmers, and the general public seeking information on the causes and mechanisms of potential negative effects of phosphorus on water quality.

**Why Phosphorus (P)?**

Phosphorus is the key element of concern because the natural occurrence of P in surface water bodies is minimal. Therefore, even a minute amount of phosphorus entering or becoming soluble in a water body can trigger a significant algal boom (although nitrogen (N) and carbon (C) are also required for algal growth), lowering light penetration and dissolved oxygen levels; it also causes aesthetic degradation of surface water bodies. In some extreme cases, algal blooms can be harmful to human health, for example, when they get into the eyes or when ingested.

## Eutrophication

Dissolved nutrients are normally present in small amounts in surface water and in limited concentrations in groundwater. The presence of nutrients, in even small amounts, enables submerged aquatic vegetation to grow and serve as food and habitat for aquatic animals including fish. If the nutrient concentrations in surface waters increase, the growth rate of microscopic algae accelerates and algal growth clouds the water bodies, making it difficult for the vegetation to receive sufficient sunlight and maintain adequate oxygen levels for supporting life. As a consequence, the natural waterborne vegetation may die, leading to a severe reduction in the available habitat area and food for other aquatic life. Also, the death and decomposition of algae during the normal lifecycle will reduce the dissolved oxygen levels in the water. The phenomenon of lowered oxygen levels in water bodies is called "hypoxia," which will negatively impact biological activity in the ecosystem. Survival rates of aquatic life often decrease as a result of hypoxia. This process of water quality degradation is called "eutrophication."

## Point and Non-Point Sources of Pollution

A contaminant such as P may enter the water systems at one specific point or one location. This is known as "point source" pollution. One example is discharge from industrial or waste water treatment plant pipelines. Similarly, pollution due to elevated P levels may occur from a large, diffuse area, and not from any one specific location. This is commonly called "non-point" source pollution. Examples of "non-point" source pollution include nutrient losses from manure and waste products spread over large agricultural fields, sediment from eroded soils, nutrient leaching or runoff from residential or agricultural areas, etc. Sediment particles may carry adsorbed P molecules along during runoff. Subsequently, this P may eventually detach and become soluble in water. Because most water bodies are P impoverished, even a minute amount of soluble phosphorus can result in algal blooms and become an environmental concern. Point sources are easily located and controlled, whereas non-point sources of pollution are often very difficult to control in spite of complex management practices. Therefore, prevention approaches are more effective solutions to the problem than post-occurrence management.

Taken From: <http://edis.ifas.ufl.edu/ss490>

## What is chlorophyll a?

Chlorophyll allows plants (including algae) to photosynthesize, i.e., use sunlight to convert simple molecules into organic compounds. Chlorophyll a is the predominant type of chlorophyll found in green plants and algae.



Blue-green algae bloom on the shore of Catawba Island, Ohio, in Lake Erie, summer 2009. Photo: NOAA.

## Why is chlorophyll a important?

Chlorophyll a is a measure of the amount of algae growing in a waterbody. It can be used to classify the trophic condition of a waterbody. Although algae are a natural part of freshwater ecosystems, too much algae can cause aesthetic problems such as green scums and bad odors, and can result in decreased levels of dissolved oxygen. Some algae also produce toxins that can be of public health concern when they are found in high concentrations.

## What can chlorophyll a tell us about the condition of the water?

One of the symptoms of degraded water quality condition is the increase of algae biomass as measured by the concentration of chlorophyll a. Waters with high levels of nutrients from fertilizers, septic systems, sewage treatment plants and urban runoff may have high concentrations of chlorophyll a and excess amounts of algae.

Taken from: <https://www.epa.gov/national-aquatic-resource-surveys/indicators-chlorophyll>