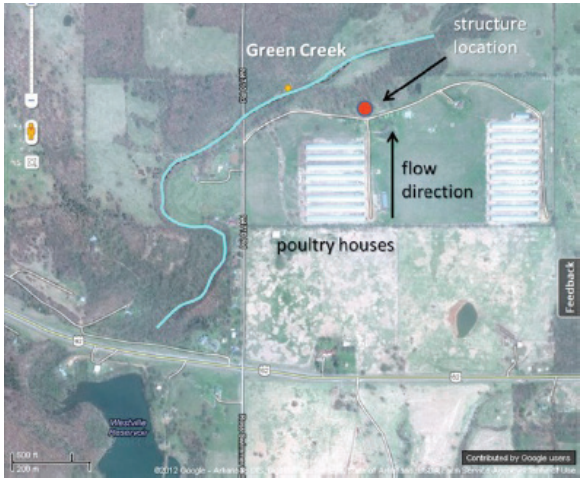
Example Structure and Design

A P removal structure was constructed on a poultry farm in eastern Oklahoma. Runoff originating from around the poultry barns contained elevated DP and drained into a tributary of the Illinois River. A P removal structure was constructed by intercepting run-off before it reached the creek, and channeling it into a single point where it could flow into the structure.



This confined bed filter contained 40 tons of sieved and treated steel slag. The structure was designed to remove 45 percent of the estimated annual DP load (20 lbs) and handle flow rates from a two-year/24 hour storm (16 cfs).

Cost

The cost of a P removal structure will vary depending on site characteristics, target removal, and PSM characteristics and location. However after several years of use, the total cost of P removal can be $30 to $100 per pound of P removed, which partly included profit from a company to provide the service. This cost is low compared to waste water treatment, which usually requires $50 to $200 per pound P removed. A nutrient credit trading program, combined with enforced non-point total maximum daily load limits, could potentially result in profit for those who build P removal structures.

Disposal

Spent PSMs are poor P sources since the P is usually tied up tightly. However, some materials such as slag, make excellent road construction materials. Other material may provide some or neutral benefit through disposal by land application to a suitable location.

EQIP Cost Share Program

The NRCS is currently developing a national standard for this new BMP so construction of P removal structures may be cost-shared.

Further information:

Penn, C.J., McGrath, J.M., J. Bowen, and S. Wilson. 2014. Phosphorus removal structures: a management option for legacy phosphorus. J. Soil. Wat. Cons. 69:51A-56A.

www.p-structure.blogspot.com

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Phosphorus Removal Structures

A new best management practice to help improve water quality

L-447

OKLAHOMA STATE UNIVERSITY RESEARCH

NRCS

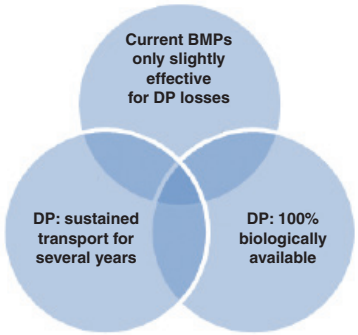
ILLINOIS River WATERSHED PARTNERSHIP

What is eutrophication?

Eutrophication is a condition that results in poor aquatic ecosystem health through decreased oxygen levels and excessive plant and algae growth.

What is the cause of eutrophication?

While eutrophication is a natural process, it is accelerated by increased inputs of phosphorus (P) and nitrogen (N) to surface waters. Of these nutrients, P tends to be the most damaging. The source of P to surface waters can be from point sources, such as wastewater treatment plants, and also from non-point sources such as urban and agricultural runoff and subsurface drainage. Non-point P sources can occur from soils that possess excessive P concentrations, or soils recently amended with chemical fertilizer or animal manure.



Poor water quality

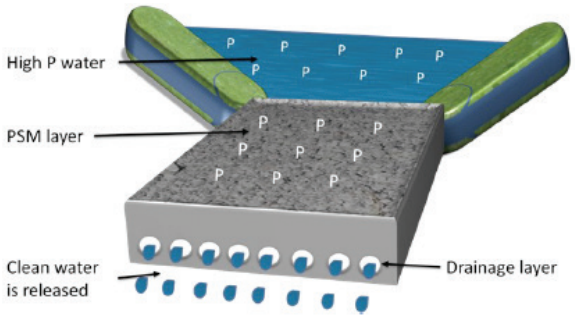
Phosphorus is transported to surface waters as both "particulate" and dissolved P (DP). Particulate P (PP) is P that is adsorbed onto transported sediments, while DP is already "free" in solution. Dissolved P is immediately 100 percent biologically available to aquatic life, its transport is sustained for many years in soils with excessive P concentrations, and conventional BMPs are only able to limit PP transport, not DP. For these reasons, the P removal structure was developed to trap DP in runoff.

The Phosphorus Removal Structure

A tool for trapping dissolved P

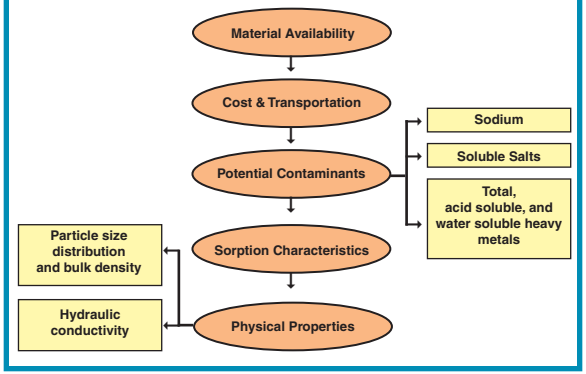
The P removal structure is a large, landscape scale filter for DP, intended to intercept and trap P from "hot spots" before reaching a surface water body. The P removal structure has four basic principles:

1. Contains solid media with high affinity for P, commonly known as a "P sorption material," or PSM.
2. PSM is contained and placed in a hydrologically active area with high dissolved P concentrations.
3. High DP water is able to flow through the contained PSM.
4. The PSM is able to be removed and replaced after it is no longer effective.



Phosphorus Sorption Materials:

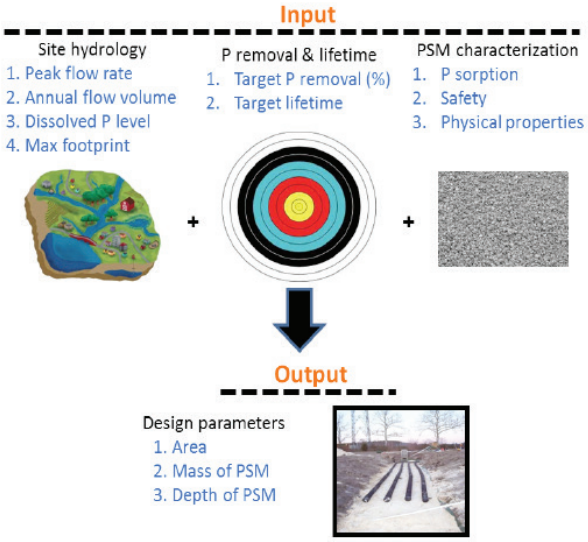
Many PSMs are by-products from different industries, and therefore can be obtained for low or no cost. However, all PSMs must first be screened for safety before use in a P removal structure. Some examples include steel slag and acid mine drainage treatment residuals.



Types of Phosphorus Removal Structures

A P removal structure can be constructed in many different ways and be effective, as long as they contain the four basic principles listed previously. Some options include a box structure, confined bed and tile drain structure.

Design and Construction of a Phosphorus Removal Structure



Software is currently being developed for design guidance and will be available online at: soil-chemistry.okstate.edu/phosphorus-removal-structures-1/design-a-structure.