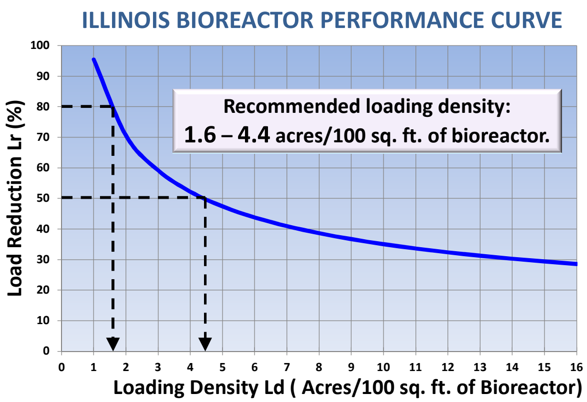


4. **Excavate the trench with a flat bottom and install a plastic liner.** The bottom of the trench should be at the same elevation as the bottom of the tile. The liner reduces seepage into, or out of, the system.

5. **Install the structure(s) and the inlet and outlet manifolds.** The manifolds should extend along the entire width of the trench on the inside of the liner. They should be separated from the structure by a minimum of 5 feet of non-perforated tile.

Manifold across width in lined bioreactor.

6. **Fill the trench with woodchips to within 12 to 18 inches of the ground surface, cover with plastic or geotextile material, and backfill with soil.** Mound the soil 12 to 18 inches above ground level since there will be some subsidence. If the system is located in an un-cropped area such as a filter strip, the trench may be filled with woodchips to the ground surface and left uncovered.

Bioreactor Operation

The capacity control stop logs should be set 3 inches to 12 inches below the diversion stop logs. The boards in the diversion structure should be set close to the tile invert from two weeks before planting until the end of spring cultivation and planting practices.

Recommended settings for diversion stop logs.

Date	Stop log setting in diversion structure
November 1	6 inches below the ground surface
Two weeks before planting (March 16 – April 16)	12 to 24 inches above tile invert
Two weeks after the end of spring agro-technical practices (May 16 – June 1)	24 to 36 inches above tile invert*

*: Diversion stop logs should be lowered during extremely wet periods to prevent the water table from rising into the crop root zone.

The link below is to an interactive routine that can be used to optimally determine size, cost and evaluate performance of a bioreactor installed in a field with a specified soil in a specified county in Illinois.

http://www.wq.illinois.edu/dg/Equations/Bioreactor.exe

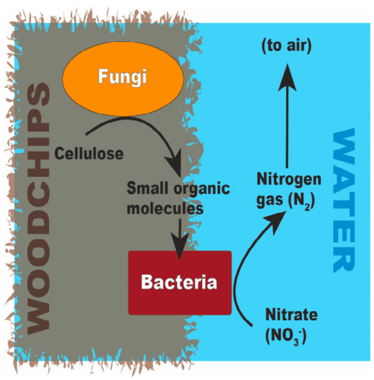
For more information contact:

Designing and Constructing Bioreactors to Reduce Nitrate Loss from Subsurface Drains.

Installing monitoring wells in a bioreactor in Illinois.

Nitrogen, along with phosphorus, are the main nutrients contributing to hypoxia in the Gulf of Mexico. Nitrogen, in the form of nitrate is very soluble, and is primarily transported in water. Systems that are designed to quickly remove water from cultivated fields, will also remove nitrate dissolved in the soil water.

Bioreactors have been developed to help remove nitrates leached into tile drains. Each bioreactor consist of a buried trench with woodchips through which the tile water flows before entering a surface water body.



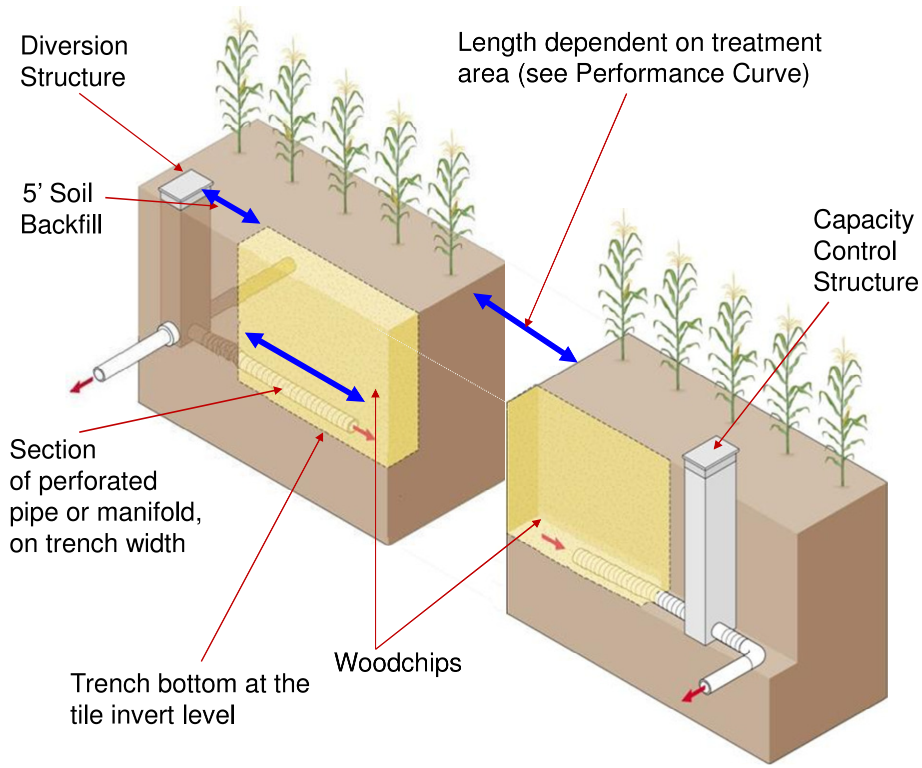
Organisms from the soil colonize the woodchips. Some of them break down the woodchips into smaller organic particles. Other microorganisms "eat" the carbon produced by the woodchips, and "breathe" the nitrate from the water. Just as humans breathe in oxygen and breathe out carbon dioxide, these microorganisms breathe in nitrate and breathe out nitrogen gas, which exits the bioreactor into the atmosphere. Through this mechanism, nitrate is removed from the tile water before it can enter surface waters.

According to 1985 estimates there are close to 80 million acres in the Midwest (Iowa, Illinois, Indiana, Ohio, Michigan, Minnesota, Missouri, and Wisconsin) that have some degree of subsurface drainage. Much of this area is suitable for the installation of bioreactors.

Bioreactor Installation

1. Determine the area contributing flow to the tile outlet (CA).

The contributing area can be determined from a tile map or estimated from the product of the cumulated length of the laterals and the tile spacing. An online tool for estimating contributing area is located in the Illinois Drainage Guide. **http://www.wq.illinois.edu/dg/Equations/Bioreactor.exe**



Bioreactor Layout

2. Determine the bioreactor loading density (L_d) based on relevant NRCS Practice Standards

Systems should be designed to remove 50% to 80% of the influent nitrate load. Based on the Performance Curve for Illinois, this corresponds to 4.4 to 1.6 acres treated by 100 square feet of bioreactor.

3. Specify bioreactor dimensions based on loading density (L_d) and contributing area.

The bioreactor surface area (sq. ft.) = $100CA/L_d$. Select a width that allows the bioreactor to fit into the selected location, and divide the surface area by this width to get the bioreactor length. Widths of 5 to 20 feet are recommended for efficient construction and the elimination of stagnant areas within the system.