NUTRIENT MANAGEMENT

Permeable Reactive Barrier

STRATEGY SCALE

THREATS ADDRESSED

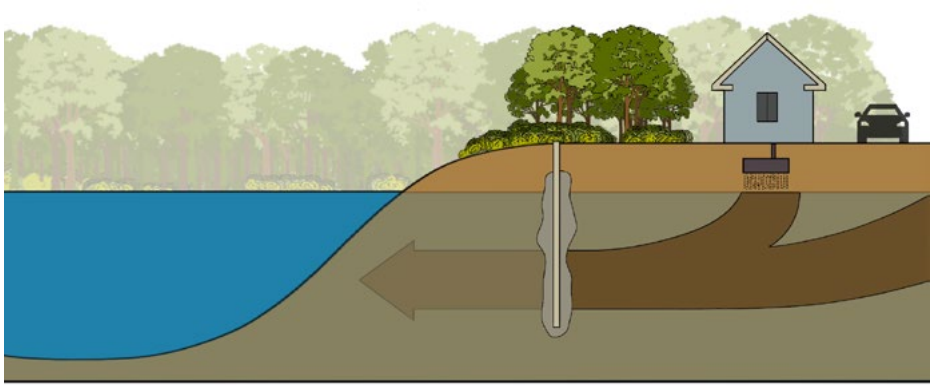
- ✓ Excess Nutrients
- ✓ Pollutant Inputs
- ✓ Algal Blooms
- ✗ Erosion
- ✗ Invasive/Nuisance Species

STRATEGY GOALS

- Protect ✓
- Manage ✓
- Rehabilitate ✓

STRATEGY CO-BENEFITS

- Habitat – Neutral
- Aesthetics – Neutral
- Recreation – Neutral



- ✓ **Permittable in Massachusetts**
  A MassDEP Underground Injection Control permit may be required. List of potential permits available here.
- ✓ **Implemented on Cape Cod**
  See examples of pond projects implemented on Cape Cod here.
- ✓ **Listed in 208 Plan Technologies Matrix**
  Learn more about the nutrient management strategies in the Tech Matrix here.
- ✓ **Can be Performed at Homeowner Scale**
  Local review and permitting may be required.
- ✗ **Nature-based Solution**

DURATION OF BENEFITS

- Less than one month ○
- One season or year ○
- Multiple seasons or years ●

MAINTENANCE REQUIREMENTS

- Monthly ○
- Annually ●
- Infrequent ○

DESCRIPTION

A permeable reactive barrier (PRB) is a wall created below ground to intercept and treat contaminated groundwater and may be used to prevent nutrients (mainly nitrogen and phosphorus) from entering freshwater ponds via groundwater. The wall is permeable, allowing groundwater to be treated as it flows through. The reactive materials that make up the wall can remove contaminants through different processes: contaminants can sorb (stick) to the surface of the reactive material; be converted to less harmful forms by reacting with the reactive material; be chemically immobilized by forming solid precipitates; and can be biodegraded by microbes in the PRB. A PRB is typically built by digging a long, narrow trench perpendicular to the path of contaminated groundwater flow which is filled with a reactive material, such as iron or mulch. PRBs may also be constructed by installing a series of injection wells to introduce the reactive material into the subsurface. Trench and injection methods may also be used in combination.

ADVANTAGES

- Relatively low capital and operating costs
- No above ground structures
- Potential for high nutrient (or other pollutant) removal rates
- Improves energy savings / nutrient recovery / recycling
- Improves management of flooding / extreme events

CONSTRAINTS

- Need ample land to site and siting can be limited due to wetlands, public utilities and abutter concerns
- Need detailed knowledge of local groundwater hydrology and chemistry
- Projects may require extensive groundwater modeling and monitoring
- Permitting requirements may be extensive and time consuming

Permeable Reactive Barrier

CAPE COD COMMISSION

IMPLEMENTATION

POTENTIAL ACTORS

- **Towns:** Towns may propose to install PRBs on town-owned properties around ponds and provide a supportive role through permitting and education
- **Pond Groups:** May propose or support the use of PRBs around public or private ponds and provide a supportive role through education
- **Private Landowners:** May install or support the use of PRBs
- **Land Trusts:** Land trusts may provide a supportive role through education

SITING REQUIREMENTS

- Ponds with upgradient development on Title 5 or other non-nutrient treating septic systems
- Ponds where groundwater is a known source of nutrient or pollutant loads
- Ponds with suitable areas in close proximity to pond and perpendicular to groundwater flow for PRB installation
- Works best when the source or reservoir of nutrient or pollutant is well defined

INFORMATION NEEDS

- Survey of existing septic systems
- Groundwater flows and flow direction
- Groundwater chemistry data
- Nutrient or other pollutant sources, travel times, and distances
- Projects may require a hydrogeologic investigation and groundwater modeling to estimate effectiveness of PRB

IMPLEMENTATION EXAMPLES

In 2006, the Town of Mashpee and partners installed a PRB in Ashumet Pond to help address algal blooms from elevated phosphorus levels. More information about the project can be found in the *2009 USGS report: Distribution of Treated-Wastewater Constituents in Pore Water at a Pond-Bottom Reactive Barrier, Cape Cod, Massachusetts*.

The Towns of *Orleans* and *Eastham* have also installed PRBs and maintain information on their websites regarding these projects.

RESOURCES

- The U.S. Environmental Protection Agency developed a *Community Guide to Permeable Reactive Barriers*.
- The Massachusetts' Department of Conservation and Recreation's *Lakes and Ponds Program* provides related resources.

COST ESTIMATE

Variable

Varies depending on scope of project and PRB method used

ADDITIONAL FINANCIAL CONSIDERATIONS

Assessment: Planning, design, and permitting, including groundwater modeling studies

Implementation: Equipment, supplies, and installation

Maintenance: Annual monitoring, operations and maintenance

POTENTIAL FUNDING SOURCES

- **Community Preservation Act**
- **Capital Budget**
- **Grants**
- **Private Funding**

Additional information regarding potential funding sources is available ***here***.