Peconic Estuary Partnership Nitrogen Load Reduction Cost Assessment - Project Update

ANCHOR QEA

Peconic Estuary Partnership Technical Advisory Committee

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Nitrogen Load Reduction Cost Assessment - Objective and Approach

- **Objective**: Support the Peconic Estuary Partnership (PEP) and stakeholders achieve nitrogen load reductions to groundwater within the Peconic Estuary watershed
- **Approach**: Assess the cost per pound of nitrogen reductions for an approved list of nature-based best management practices (BMPs)

Nitrogen Load Reduction Cost Assessment - Project Overview

- Quality Assurance Project Plan - **complete**
  - Guides the quality review of nitrogen removal data for the various best management practices (BMPs) assessed
- Baseline cost-benefit analysis of BMPs
  - Compile list of nature-based technologies that reduce nitrogen groundwater inputs and determine their cost per-pound pound of nitrogen reduction
    - Develop list of BMPs - **complete**
      - PEP review and approval of BMPs
    - Develop Cost-Benefit Source Documentation Memorandum - **complete**
      - PEP review and approval of data and information sources
    - Develop Draft Cost-Benefit Summary Memorandum – **in progress**

Nitrogen Load Reduction Cost Assessment Project Overview – Cont'd

- Online information dissemination - **pending**
  - Create a publicly accessible online web application for stakeholders to learn about nitrogen-reduction BMPs and to visualize the cost and impact of various nature-based technologies on nitrogen load reduction
    - Develop online tool design and format
      - PEP online platform approval
    - Develop draft online tool
      - PEP online tool review and approval
    - Final online tool
- Final report – **pending**
  - Develop a final report that documents the methods and results of the nitrogen reduction BMP cost-benefit analysis and the online dissemination tool

BMP List Development Approach

- Draft list of BMPs
  - RFP
    - Agricultural buffer zones, residential fertilizer reductions, green infrastructure, water re-use, bioremediation, permeable reactive barriers
  - Suffolk County Reclaim Our Water initiative
  - New York State Center for Clean Water Technology
  - Cape Cod and Chesapeake Bay nutrient reduction programs
  - Institutional knowledge and literature
- PEP and partner review and comment

BMP Categorization Approach

- Categories
  - Septic waste
    - Approved
    - Experimental
  - Surface runoff
  - Groundwater
  - Non-point source control
  - Water re-use
  - Bioextraction

Septic Waste BMPs

- Approved
  - Innovative and Alternative Onsite Treatment System (I/A OWTS)
    - Actively treats raw sanitary wastewater on-site
    - Reduces nitrogen to a greater extent than traditional system
    - Individual or cluster
  - Sewering
- Experimental
  - Nitrogen Reducing Biofilter (NRB)
    - Passively treats raw sanitary wastewater on-site
    - Lined, unlined, and wood chip
  - Constructed wetland
    - Shallow pond or channels with aquatic plants, that relies on natural microbial, biological, physical, and chemical processes to treat wastewater

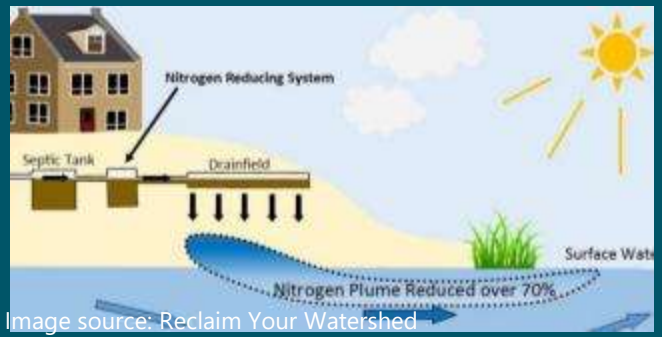


Image source: Reclaim Your Watershed

I/A OWTS

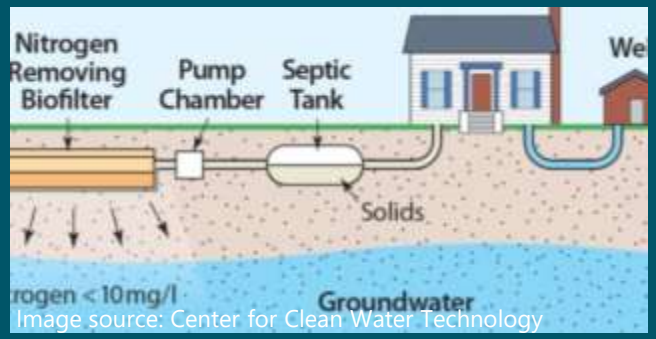


Image source: Center for Clean Water Technology

NRB


Image source: The Nature Conservancy

Constructed Wetland

Considerations for Individual Septic Waste BMPs

- Factors affecting implementation
  - I/A OWTS
    - Cost
      - Suffolk County grants are available to offset
        - 70 pts - Suffolk County Priority Critical Areas (groundwater travel < 2 years or w/in 1000 ft of water body)
        - 30 pts - System failure
      - Towns of East Hampton and Southampton offer rebate programs
      - New construction, system replacement, or addition to existing septic tank
    - Depth to groundwater, current and future flood risk
      - Shallow drainfield versus leaching pool

Considerations for Individual Septic Waste BMPs

- Factors affecting implementation
  - NRB
    - Lower cost but pending approval
    - Long-term performance is unknown
    - Reduced performance in cold-weather
  - Constructed wetland
    - Experimental, needs to be paired with a pretreatment system
    - Hydraulic residence time, size, soil type, substrate, and types of vegetation has a large impact on nitrogen removal efficiency
    - Land availability

Surface Runoff BMPs

- Infiltration basin
  - Retention pond (dry and wet)
    - Basin that intercepts stormwater runoff and empties slowly
  - w/ Nitrogen reducing biofilter
- Buffer zones
  - Wetland
  - Forest, or riparian
  - Grass
  - Rain garden

Infiltration basin with NRB

Riparian Forest Buffer

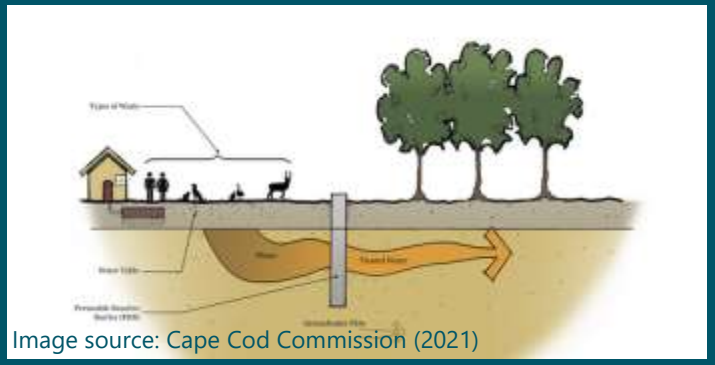
Rain Garden

Considerations for Surface Runoff BMPs

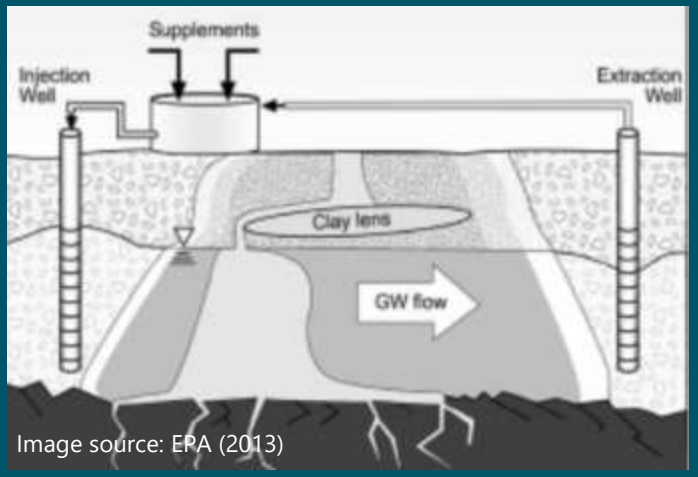
- Buffer zones
  - Hydraulic residence time, size, soil type, substrate, and types of vegetation has a large impact on nitrogen removal efficiency
    - Reference NYS stormwater management guidance
  - Land availability
    - Crop loss
    - Open space
  - Type of buffer zone affects nitrogen removal (i.e., wetland, forest, or grassland)

Groundwater BMPs

- Permeable reactive barrier
  - Trenches filled with a carbon substrate for passive microbial denitrification of groundwater
- Bioremediation (carbon addition)
  - Carbon amendments are injected into the soil to support microbial denitrification



Permeable Reactive Barrier



Bioremediation

Considerations for Groundwater BMPs

- PRBs
  - Still in research stage, requiring extensive monitoring
  - Must intercept groundwater, requires detailed knowledge of local groundwater hydrology
  - Hydraulic residence time, determined by width of installation and type of substrate, affects nitrogen removal efficiency
- Bioremediation
  - Must be below vadose zone
  - Nitrogen removal rates based on groundwater gradient
  - Subject to biofouling, and may have limited lifespans

Non-Point Source Control BMPs

- Agricultural
  - Cover crops
  - Controlled release nitrogen fertilizer
  - Soil health
  - Buffer zones
  - Water re-use
- Residential
  - Fertilizer recommendations

Cover Crop: Rye Grass

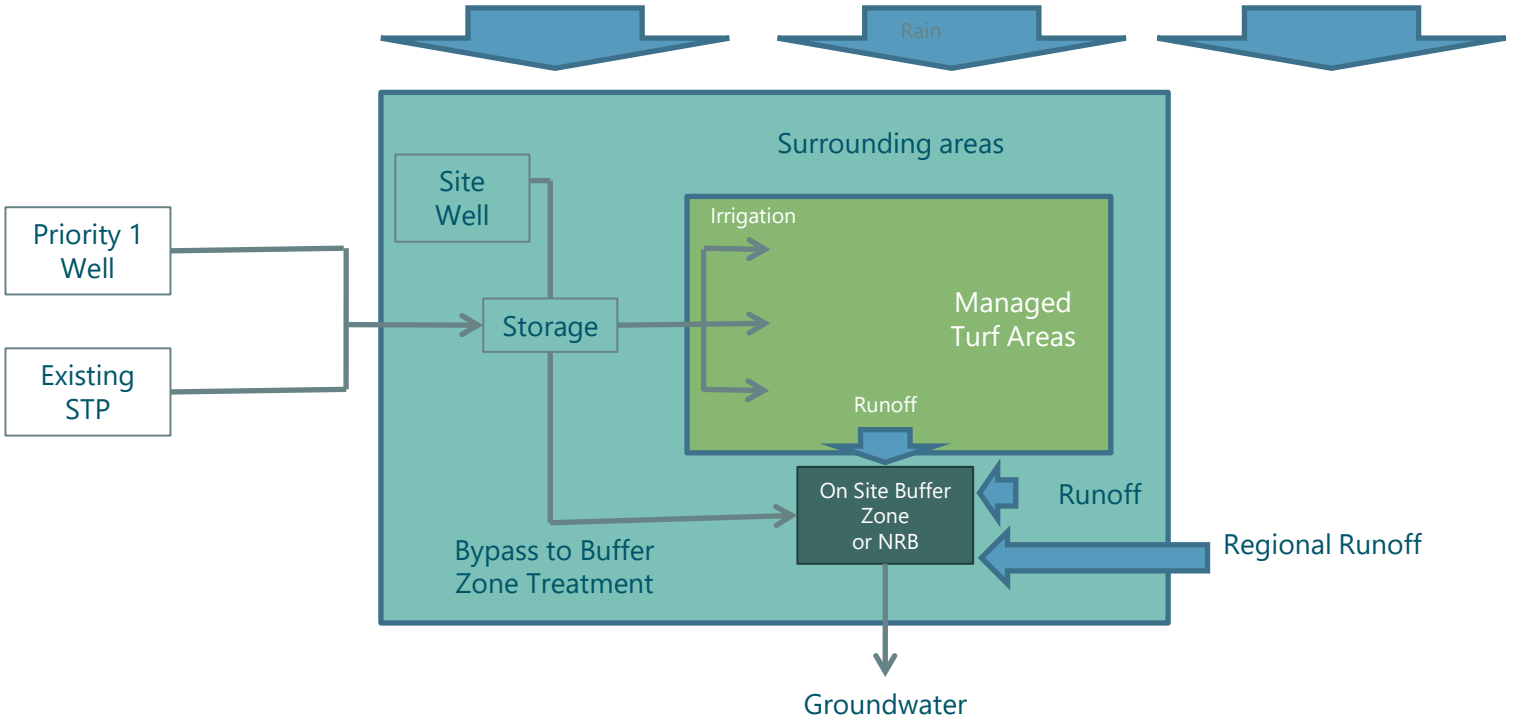
Forest Buffer

Considerations for Source Control BMPs

- Agricultural considerations
  - Nitrogen reduction benefit for various BMPs dependent on crop type
    - Over 100 crop types in the Peconic Estuary watershed, confounding precise assessment of nitrogen reduction benefit
  - Nitrogen removal efficiency dependent upon numerous factors such as soil type, temperature, and soil moisture content
  - Implementation of nutrient management practices are costly
    - Funding is available from NRCS EQIP and NYS Agricultural Nonpoint Agricultural Source Abatement and Control program, Suffolk County, and CCE, but always a cost share

Water Re-Use

- Groundwater
  - Enhanced irrigation of vegetated open space, with nitrogen-containing groundwater or sewage treatment plant effluent



Water Re-Use Considerations

- Require a feasibility study to determine the best source of water both to achieve water conservation and to reduce nitrogen in the groundwater
- A number of considerations will factor into the cost
  - Existing infrastructure
  - Routing to surface runoff BMP when irrigation demand met

Bioextraction

- Nutrients removed from an aquatic ecosystem through the harvest of enhanced biological production, including the aquaculture of marine macro algae (seaweeds).

Image source: Cornell Cooperative Extension (2019)

Bioextraction Considerations

- Seasonal nitrogen uptake coincident with natural cycle and algal blooms
- Aquaculture citing is important
- Requires removal of vegetation to obtain nitrogen removal benefit
- Requires monitoring
  - Health
  - CHN (carbon, hydrogen, and nitrogen)
- Subject to fouling
- NYS permitting hurdles

Next Steps

- Develop Cost-Benefit Analysis
  - Cost per pound nitrogen reduction
- Online Dissemination Tool
  - Modeling after Cape Cod Commission Tool
    - https://www.watershedmvp.org/start
- Final Report

Permeable Reactive Barriers (PRBs) - Trench Method(Aquifer Thickness - 30 feet)

Innovative and Resource-Management Technologies

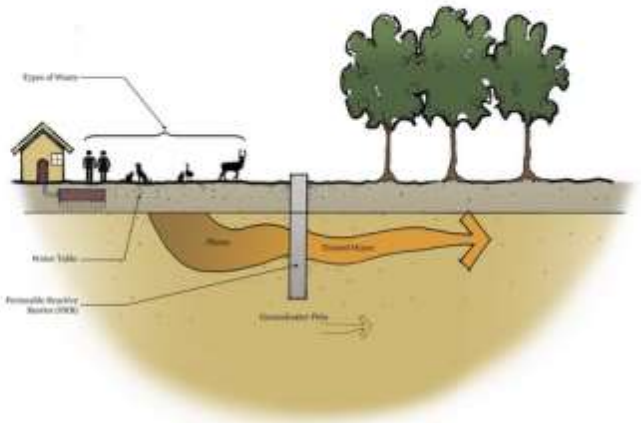
Scale: Site, Neighborhood,

Nitrogen Removal (%)

70% - 75%

Phosphorus Removal (%)

88% - 96%



Description

A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source (the PRB medium), microbes in the groundwater uptake the nitrogen, denitrifying the groundwater.

The trench method PRB uses large trenching equipment to install a mixture of coarse sand, wood chips, compost and/or other materials (medium) in the trench created by the trencher. The vertical wall can be installed to a depth of 40 feet with a width of 1.5 to 3 feet; PRBs can also be installed in large diameter columns.

As groundwater flows through the wall, the medium provides a carbon source for microbes living in the groundwater. The microbes consume the carbon source as well as oxygen, developing an anaerobic environment which releases nitrogen gas to the atmosphere, reducing the groundwater nitrogen load before reaching the estuary.

Description

Advantages/Disadvantages

Advantages

- Relatively low capital and operating cost.
- No above ground structures.
- High removal efficiency.
- Improves Energy Savings / Nutrient Recovery / Recycling.
- Improves management of Flooding / Extreme Events.

Disadvantages

- Siting can be limited by wetlands, public utilities and abutter concerns.
- Detailed knowledge of local groundwater hydrology.
- Projects may require a hydrogeologic investigation and groundwater modeling to estimate effectiveness of PRB.
- Permitting requirements may be extensive and time consuming.
- Projects may require extensive groundwater monitoring early in the project to quantify nitrogen load reduction.
- Projects may require groundwater monitoring near or in embayments as well as monitoring of vegetation and benthic monitoring where groundwater surfaces in the receiving estuary.

Treatment Details

Costs

Monitoring

Other Characteristics

References

Questions/Discussion