Hampton Hills Association
P.O. Box 1317
Hampton Bays, New York 11946

TOWN OF SOUTHAMPTON
Department of Community Preservation
24 W Montauk Hwy
Hampton Bays, NY 11946

July 12, 2018

To the Department of Community Preservation,

Hampton Hills Association began as Peekskill Hilltop Inc. on January 15, 1941. The name was changed to Hampton Hills Association on December 4, 1945.

Today we consist of 83 residential homes whose families have deeded rights to the 650 feet of waterfront property located on Shinnecock Bay. We have two general meetings a year with our members and Board of Directors meetings when necessary. Members pay an annual dues of $300.00 per year.

Hampton Hills Association is looking forward to rebuilding our bulkhead with a permeable reactive barrier design to lower the nitrogen entering Shinnecock bay. Our first denitrifying chamber was built when we completed phase one of the HHA bulkhead replacement. This sparked our interest in building a bulkhead that would maintain our property and improve the quality of Shinnecock Bay.

Our goal is to create a working denitrifying bulkhead for future improvements on Shinnecock Bay for other Town of Southampton residents to copy and build on their properties.

We look forward to this collaborative effort and the environmental benefits from this project.

Sincerely,
Richard Iannelli

HHA Board

Rich Iannelli	Ron Paulsen	Cathy Seabury	Linda Fabiano
President	Co-President	Treasurer	Secretary

Board Members

Mark Gregory Rich Lava Garin Toren Seamus Ward Grace Ward Marilyn Deutch Wender

NYSDEC Permit # 1-4736-01326/00011

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Ph: 631-287-5720 Fx: 631-728-1920
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COMMUNITY PRESERVATION FUND (CPF)
WATER QUALITY IMPROVEMENT PROGRAM
CHECKLIST/APPLICATION INSTRUCTIONS

The CPF Water Quality Improvement Project Plan (WQIPP) Fund follows the objectives in the adopted Water Quality Improvement Project Plan (see http://www.southamptontownny.gov/DocumentCenter/View/7318)

To apply for funding, an application must be **COMPLETED** and submitted along with detailed narratives and supporting information as described below. The Water Quality Advisory Committee will rank and score projects based on the Scoring Criteria contained in the application materials. Parcel acquisitions will be considered on an ongoing basis, independent of this application process.

A Public Hearing and Town Board Resolution will be required for individual or multiple projects in excess of $50,000.

WATER QUALITY IMPROVEMENT PROJECT MEANS:

[1] DEFINITIONS:

1. **Wastewater Treatment Improvement Project** means the planning, design, construction, acquisition, enlargement, extension, or alteration of a wastewater treatment facility, including alternative systems to a sewage treatment plant or traditional septic system, to treat, neutralize, stabilize, eliminate or partially eliminate sewage or reduce pollutants in treatment facility effluent, including permanent or pilot demonstration wastewater treatment projects, or equipment or furnishings thereof. Stormwater collecting systems and vessel pumpout stations shall also be included within the definition of a wastewater improvement project.

1. **Nonpoint source abatement and control program projects** developed pursuant to section eleven-b of the soil and water conservation districts law, title 14 of article 17 of the environmental conservation law, section 1455b of the federal coastal zone management act, or article forty-two of the executive law;

2. **Aquatic Habitat Restoration Project** means the planning, design, construction, management, maintenance, reconstruction, revitalization, or rejuvenation activities intended to improve waters of the state of ecological significance or any part thereof, including, but not limited to ponds, bogs, wetlands, bays, sounds, streams, rivers, or lakes and shorelines thereof, to support a spawning, nursery, wintering, migratory, nesting, breeding, feeding, or foraging environment for fish and wildlife and other biota.

3. **Pollution Prevention Project** means the planning, design, construction, improvement, maintenance or acquisition of facilities, production processes, equipment or buildings owned or operated by municipalities for the reduction, avoidance, or elimination of the use of toxic or hazardous substances or the generation of such substances or pollutants so as to reduce risks to public health or the environment, including changes in production processes or raw materials; such projects shall not include incineration, transfer from one medium of release or discharge to another medium, off-site or out-of-production recycling, end-of-pipe treatment or pollution control.

4. **The Operation of the Peconic Bay National Estuary Program**, as designated by the United States Environmental Protection Agency. Such projects shall have as their purpose the improvement of existing water quality to meet existing specific water quality standards. Projects which have as a purpose to permit or accommodate new growth shall not be included within this definition.

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COMMUNITY PRESERVATION FUND (CPF)
WATER QUALITY IMPROVEMENT PROGRAM
PROPOSAL SUMMARY

Project Proposal: Nonpoint source abatement and control

Project Applicant: Hampton Hills Association

Project Title: Installing a permeable reactive barrier to remove groundwater nitrogen behind a bulkhead in Shinnecock Bay. A community-based demonstration project for improving water quality.

Project Contact Information: Hampton Hills Association

Project Manager Name: Rich Ianelli

Project Manager Title: Co-President of Association

Project Manager Affiliation: Co-President of Association

Project Manager Address: 4 Bayview Drive

Project Manager Phone: 631-255-7207

Project Manager Email: rich_ianelli@yahoo.com

Property Owner Name: Hampton Hills Association

Property Owner Affiliation: Co -President

Property Owner Mailing Address: PO Box 13717, Hampton Bays, NY 11946

Property Owner Phone: 631-921-0198

Property Owner Email: rjp11cma@aol.com

Project Location: Hampton Bays

Project Location SCTM #(S): 900-269-01-12

Type of Project

Reduction

Remediation: Remediation of nitrogen in groundwater

Restoration

Project Summary (2-3 sentences): The Hampton Hills Association will add a permeable reactive barrier (PRB) behind proposed replacement of bulkhead for removal of nitrogen in groundwater. The association will fund the bulkhead replacement as per designed from previous replacement sections, and seeks funds to add the PRB green infrastructure and long-term monitoring to show efficacy & reductions. Permits in place & existing data show high potential for success.

Submittal date: July 13, 2018

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1. PROJECT TYPE (check all that apply)

Meets at least one of the definitions of "Water Quality Improvement Project" per State Law Chapter 551 cited above

- ☐ **Wastewater Treatment Improvement Project**
- ☑ **Non-point source abatement and control**
- ☐ **Aquatic habitat restoration**
- ☐ **Pollution prevention**
- ☐ **Stormwater collecting system**
- ☐ **Vessel Pump out station**
- ☐ **Operation of Peconic Bay National Estuary Program (Grant Match)**

2. PRIORITY AREA(S) (check all that apply)

- ☐ **High**
- ☑ **303(d) Impaired**
- ☐ **Medium**
- ☐ **Outside High and Medium priority areas***

*Narrative must explain how project is relevant to Water Quality Improvement Project Plan (WQIPP) goals

Project meets objectives of the Town of Southampton's Water Quality Improvement Project Plan by using innovative methods to reduce and remediate groundwater nitrogen loads. Specifically meets: Vision Goals for Natural Resources Goal #2: "Improve the quality of surface and bay waters by reducing nutrient loading, toxins and sedimentation" (pg 6), as well as Southampton 400 + Sustainability Goal Restore and protect the Town's ground and surface waters to ensure their ability to support public health and the maritime, recreational and resort activities that underpin Southampton's way of life and economy. (CPF WQIPP pg 7)

3. PROJECT DESCRIPTION

☑ **Narrative describes in detail existing conditions of applicable groundwater/sub-watershed/waterbody and includes most recent and relevant data available (provide sources)**

Please see attached Project Narrative that includes details of existing conditions, groundwater/waterbody and most recent and relevant data available from Graffam et al. 2018 (also attached).

☑ **Photos of exiting conditions are included** (Attach Photos)

☑ **Location map is included** (Attach Map)

☑ **Narrative describes in detail what the issue is and how the proposed solution addresses the issue in the context of Reduction, Remediation and/or Restoration as per the CPF Water Quality Project Plan**

Please see attached Project Narrative that includes details of proposed solution to address the nitrogen reduction in groundwater as per CPF WQIPP.

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☑ **Narrative describes proposed technology in sufficient detail and includes information on its demonstrated efficacy in similar setting (may include published data)** (Attach pages as needed)

Please see attached Project Narrative that includes details of existing conditions, groundwater/waterbody and most recent and relevant data available from Graffam et al. 2018 (also attached).

☑ **Narrative indicates how the project supports Town of Southampton, Suffolk County, NYSDEC Long Island Nitrogen Action Plan (LINAP) or other adopted goals/policies (provide references with pages numbers, etc.)** (Attach pages as needed)

This project supports Town of Southampton, Suffolk County and the NYSDEC Long Island Nitrogen Action Plan. Please see the attached Project Narrative that includes specific details.

☑ **A State Environmental Quality Review Act (SEQRA) Long or Short Environmental Assessment Form (EAF) is completed and included with application** https://www.dec.ny.gov/permits/6191.html

OTHER REQUIRED INFORMATION

☐ If Stormwater system or Drainage is proposed, the narrative and design specifications indicate compliance with the New York State Stormwater Design Manual (2015 and as updated)

☐ If project is related to farmland, the narrative addresses any Agricultural Stewardship Plan or other long term strategy for Nitrogen abatement

☐ If the project is for a municipal facility or infrastructure, information pertaining to Town or Village budgetary allocations for ongoing maintenance is provided

☐ If the project is for habitat restoration, the narrative addresses how underlying causes are being ameliorated and expected outcomes for local species populations or other ecological considerations are given

☐ If project is a Sewage Treatment Plant (STP) or cluster treatment system, fund allocation request is based on cost for reduction of pre-existing conditions and not for purpose of accommodating new density (describe pre-existing density and associated flow (gallons per day) and total projected nitrogen reduction in narrative). Include detailed information on how many homes the system would treat as well as potential for formation of Sewer District, if required by Suffolk County Health Department or Town Law

☐ If the project is requesting grant match for the Peconic Estuary Program, include information related to funding program source and purpose of application and any relevant items on this checklist. Note: A Town Board resolution will be required in order to encumber matching funds for grant applications

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4. WATER QUALITY BENEFIT

☑Yes	☐No	☐N/A	Nitrogen, Pathogen or Pollutant of Concern (POC) Existing Condition & Target Reduction is identified
☑Yes	☐No	☐N/A	Anticipated reduction by proposed technology is provided by utilizing EPA's Spreadsheet Tool for Evaluating Pollutant Load (STEPL) http://it.tetratech-ffx.com/steplweb/ or similar standardized methodology (provide)
☑Yes	☐No	☐N/A	Related to above, the narrative describes how data will be collected and reported over time
☑Yes	☐No	☐N/A	Narrative indicates how the useful life of the proposed technology will meet or exceed five (5) years
☑Yes	☐No	☐N/A	A total cost budget is included (see pages 6-7 for template) with a cost-benefit discussion and any details related to matching funds (e.g. in-kind services, pre-and post-monitoring, etc)

5. DURATION OF PROJECT

- ☑ Projected timeline is included (described any permits needed and time frame/status of required approvals)
- ☑ Narrative explains if project is multi-year or phased and includes budget/milestones for each year and Phase

6. PROJECT READINESS

- ☑ Narrative describes current stage of planning (e.g. conceptual, preliminary, full construction documents) and includes conceptual or sketch plans where applicable.
- ☑ Narrative describes community support for the project (attach letters of support, public hearing testimony, news coverage, community meeting minutes, other outreach as applicable) or addresses potential community opposition/educational needs.

7. MANAGEMENT, EXPERIENCE, ABILITY

- ☑ Narrative describes experience in completing similar projects
- ☑ Narrative describes project staffing, oversight and administration
- ☑ Narrative describes qualifications of project staff, consultants and contractors (as applicable)
- ☑ If Homeowner's Association or other community group, describe formal structure and responsibilities of members involved
- ☑ If private property (e.g. farmland), the narrative describes who is being contracted to do the work (qualifications, etc.)

8. REQUIRED CERTIFICATIONS

- ☑ Commitment is provided via Letter of Intent (LOI)* for non-municipal entities or adopted resolution for Incorporated Villages *
  Note: A LOI template is provided in the application packet
- ☐ Plans stamped by NYS licensed Engineer and/or surveyor, where applicable
- ☑ STEPL calculations or equivalent prepared by NYS licensed Engineer, where applicable
- ☑ Certify that request for proposed funding is not otherwise required by Local, State or Federal Law and intended benefits cannot be achieved without external funding
- ☑ Certify that the application will report on project outcomes, including monitoring results

9. MAINTENANCE, MONITORING & EVALUATION

- ☑ A plan related to ongoing maintenance, monitoring and evaluation (reporting to the Town) is provided
- ☑ The Monitoring Plan will provide water quality data at regular intervals for a minimum of five (5) years

10. EDUCATIONAL COMPONENT

- ☑ The project sponsor will erect signage displaying the intent and benefit of the project on site
- ☑ As part of the evaluation, the project sponsor will submit a write-up of lessons learned and future needs

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COMMUNITY PRESERVATION FUND (CPF)
WATER QUALITY IMPROVEMENT PROGRAM
BUDGET PROPOSAL

PLANNING/ENGINEERING/DESIGN	Town CPF Request	Matching Funds Committed	Matching Funds Pending	Estimated Total Project Costs
In-house labor (provide separate sheet with calculations)				
Task 1- PRB Site Characterization	$-41504	$-	$-39275	$-
Task 2- BPRB Design	$-5760	$-	$-	$-
Task 3- Construction of BPRB	$-22336	$-	$-70000	$-
Task 4- Monitoring of BPRB	$-200256	$-	$-78550	$-
Task 5- Public Education and Outreach	$-35040	$-	$-39275	$-
Task 6-	$-	$-	$-	$-
	$-	$-	$-	$-
In House Labor Total	**$-304896**	**$-0**	**$-227100**	**$-0**

Materials/Supplies				
Laboratory Analysis	$-128000	$-	$-	$-
Equipment	$-37550	$-	$-	$-
Material and Supplies	$-19500	$-	$-	$-
Travel	$-12910	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
Materials/Supplies Total	**$-197960**	**$-0**	**$-0**	**$-0**

Contractual Services				
Bulkhead Construction / Tidewater Company	$-45000	$-	$-	$-
Surveyor	$-3000	$-	$-	$-
Stony Brook	$-28500	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
Contractual Services Total	**$-76500**	**$-0**	**$-0**	**$-0**

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CONSTRUCTION AND SITE IMPROVEMENTS	Town CPF Request	Matching Funds Committed	Matching Funds Pending	Estimated Total Project Costs
In-house labor (provide separate sheet with calculations)				
Task 1-	$-	$-	$-	$-
Task 2-	$-	$-	$-	$-
Task 3-	$-	$-	$-	$-
Task 4-	$-	$-	$-	$-
Task 5-	$-	$-	$-	$-
Task 6-	$-	$-	$-	$-
	$-	$-	$-	$-
In House Labor Total	$-0	$-0	$-0	$-0

Equipment/Materials/Supplies				
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
Equipment/Materials/Supplies Total	$-0	$-0	$-0	$-0

Contractual Services				
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
	$-	$-	$-	$-
Contractual Services Total	$-0	$-0	$-0	$-0

ENGINEERING TOTAL	$-579356	$-0	$-227100	$-0

Total Project Cost	$-806456
Total CPF Funds Requested	$-579356

Applicant matching funds committed	$-
Applicant matching funds pending approval (e.g. grant request submitted pending determination)	$-227100

Source of matching funds	Amount
Cornell (CCE)	157100
Hampton Hills Association	70000

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COMMUNITY PRESERVATION FUND (CPF)
WATER QUALITY IMPROVEMENT PROGRAM
LETTER OF INTENT

CONTACT INFORMATION

Municipality: Hampton Hills Association

Contact First and Last Name: Rich Ianelli

Contact Address: 4 Bayview Drive

Contact Phone: 631-255-7027

Contact Email: rich_ianelli@yahoo.com

PROJECT INFORMATION

Project Title: Installing a permeable reactive barrier to remove groundwater nitrogen behind a bulkhead in Shinnecock Bay. A community-based demonstration project for improving local water quality.

Project Location: Hampton Bays

Project Description (1-3 sentences): The Hampton Hills Association (HHA) will add a permeable reactive barrier (PRB) behind proposed replacement of bulkhead for removal of nitrogen in groundwater. The association will fund the bulkhead replacement as per designed from previous replacement sections and seeks funds to add the PRB green infrastructure and monitoring to show efficacy and reductions. Permits are in place and existing pilot data show high potential for success.

ANTICIPATED PROJECT TIMELINE

Begin: October 2018

Complete: May 2024

Notes: A more detailed project timeline is available in the narrative. The timeline provided for site characterization and PRB construction is our best estimate and may change marginally.

Project Title: Installing a bulkhead permeable reactive barrier to remove groundwater nitrogen and mitigate nitrogen pollution in Shinnecock Bay. A community-based demonstration project for improving local water quality.

Project Summary:

The Hampton Hills Association (HHA) will add a permeable reactive barrier (PRB) behind proposed replacement of bulkhead for removal of nitrogen in groundwater. The association will fund the bulkhead replacement as per designed from previous replacement sections and seeks funds to add the PRB green infrastructure and monitoring to show efficacy and reductions. Permits are in place and existing pilot data show high potential for success.

Submittal Date: July 13, 2018

Introduction:

Shinnecock Bay is an important waterbody in the Town of Southampton. It provides many recreational and commercial opportunities to the residents and can be considered an important economic engine in this region. Shinnecock Bay has important natural resources and habitats that provide valuable ecosystem functions as well as aesthetic and economic benefits for the east-end economies. This bay, like many on Long Island, has experienced increased stress from human activities that has resulted in a decline in water quality as well as losses of important habitats and reduced ecosystem function. Excess nitrogen in coastal waters has been identified as one of the most urgent environmental problems on Long Island, as it relates to costal water eutrophication, hypoxia, harmful algal blooms, and in turn mass mortalities of marine fauna. Numerous initiatives are in place that focus on the reduction nitrogen input in the Long Island aquifer, such as improved on-site wastewater treatment systems. Nitrogen has also been identified as an important pollutant that is impacting water quality and Shinnecock Bay, which has resulted in listing as a NYS DEC 303d impaired waterbody. The majority of nitrogen input into the bay is known to be through groundwater discharge. The Town of Southampton's Water Quality Improvement Project Plan (WQIPP) identifies the Shinnecock Hampton Bays area as high priority, meaning the groundwater travel time is in the range of 0-2 years. Suffolk County has similarly focused on reducing nitrogen in wastewater throughout the County (Chapter 8, Suffolk County Comprehensive Water Resources Management Plan, 2015).

Sources of nitrogen in groundwater are primarily derived from fertilizers (both residential and agricultural) and wastewater from sanitary systems. Fertilizer reductions were initially targeted, but more recently, modeling indicates that sanitary systems may be the largest contributor to groundwater nitrogen. In other areas such as Cape Cod there have already similar switches from stormwater and fertilizer management actions to that of improving the treatment of residential wastewater (Valiela et al. 1997). Improved treatment of residential wastewater will ultimately provide a significant reduction of nitrogen in groundwater, but will take significant time to be implemented. Furthermore, due to the relative slow travel time of groundwater, it will take a considerable amount of time before any reductions are observed in the surface waters because legacy nitrogen in the aquifer will continue to seep into coastal waters over years and decades to come. Therefore, additional approaches to mitigate nitrogen pollution that remove nitrogen

before high nitrate groundwater enters coastal water bodies are desirable. There are other viable, green-solutions that may be effective if applied in targeted areas with high nitrogen loads and groundwater conveyances to provide rapid nitrogen reduction in impaired waterbodies. Passive Permeable Reactive Barriers (PRB) are one such green method that can treat quickly, require minimal maintenance, and has the potential to remain effective for decades.

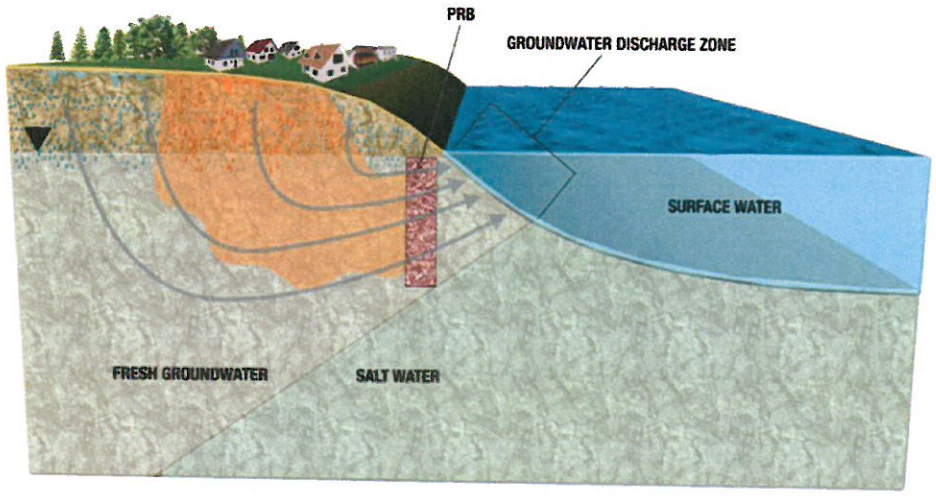


Figure 1. Conceptual diagram of a permeable reactive barrier (PRB) that is trenched into the ground to remove nitrogen in groundwater.

Permeable Reactive Barriers

PRBs are sub-surface barriers that intercept and provide passive remediation of groundwater (Figure 1). While there are various technical considerations (Barkle et al. 2008, Robertson et al. 2008, Ahmad et al. 2007, Robertson and Cherry 1995), they generally introduce a carbon source such as wood chips that provides a substrate for bacterial reduction of nitrate-N through denitrification (Robertson and Cherry 1995, Robertson et al. 2008). PRBs have been successfully used in freshwater ecosystems and have also been shown to successfully reduce nitrate-N in Waquoitt Bay in Cape Cod (Vallino and Foreman 2008). Permeable reactive barriers begin treating groundwater on the scale of days-weeks, making them an excellent solution for protecting surface waters in the short term. PRBs are most effective in areas with high groundwater nitrate coupled with high groundwater velocity so the PRB can intercept and remediate large volumes of groundwater before it disperses into coastal surface waters.

Performance of PRBs depends on the woodchip longevity, since dentrifying microbes rely on this external carbon source to continue converting nitrate to nitrogen gas. One of the longest studies available is on a PRB which was monitored for 15 years. The PRB was sacrificed to determine organic carbon content and 80% of carbon remained after 15 years, so less than 1.5% of carbon was used per year. Assuming half of the total carbon was available to microbes, the life of the PRB would exceed 30 years without any maintenance. Although there are significant upfront installation costs for a PRB, the anticipated treatment time is on the scale of decades, making it a worth-while investment.

Such innovative solutions are currently being tested on Long Island to evaluate their efficacy and suitability (see: ITRC report 2011). In 2015, a PRB test cell was installed behind a small section of a recently replaced section (150 linear feet) of bulkhead in Shinnecock Bay by HHA and Cornell Cooperative Extension. The PRB was installed on the landward side of a vinyl sheet piling during the bulkhead replacement. The PRB test cell is approximately 1 meter thick by 2 meters long by 2 meters deep and is filled with an oak/pine woodchip and pea gravel mixture (Fig. 1). Subsurface holes (0.5" diameter 4" apart) were drilled in the vinyl sheet, which allow treated water to leave the system. The subsurface holes are in contact with porewater on the seaward side of the bulkhead. Monitoring of the test PRB was performed in collaboration with Stony Brook University. Results indicated that on all sampling campaigns, the PRB test cell consistently removed 80-100% nitrate (see attached data report by Graffam et al. 2018). PRBs in association with seashore bulkhead constructions could be cost-efficient way to mitigate legacy nitrogen pollution on Long Island. Bulkhead walls are constantly replaced, which means heavy machinery is already in place during reconstruction and the addition of a PRB matrix would be relatively simple. The benefits of PRBs would be maximal in areas with high groundwater nitrate loading coupled with high groundwater velocities.

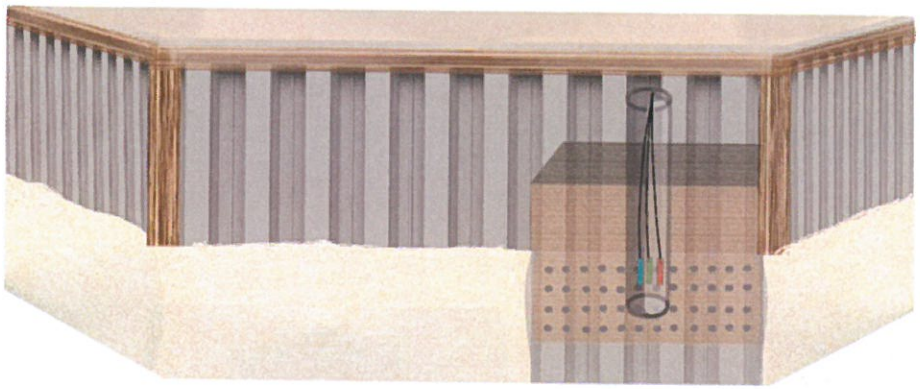


Figure 2. Schematic of bulkhead PRB test cell. Woodchip/gravel PRB matrix behind the bulkhead is indicated by the shaded brown box. Multiple autonomous sensors are deployed in the center of the PRB in a PVC pipe for continuous data. Holes in the bulkhead allow treated water to leave the system.

Given the level of success of this pilot demonstration behind the bulkheaded site, we are proposing to expand the PRB an additional 100 ft. during the proposed replacement of this 100 ft. section of bulkheaded shoreline. The HHA who owns this property is planning to repair and replace this additional 100' of bulkhead and would like to use it as a platform to further investigate treatment of groundwater by a PRB bulkhead treatment system and expand its benefits to Shinnecock Bay. The HHA homeowner's association has the necessary funding and permits to replace the existing bulkhead. We are seeking funding from the WQIPP grant to cover the costs of the PRB treatment that are beyond the costs of the existing bulkhead replacement. In addition, we are seeking funding to support comprehensive long-term monitoring of the PRB bulkhead treatment system to quantify its efficacy and to establish guidelines for design of bulkhead treatments. The HHA has formed a partnership with Cornell Cooperative Extension of Suffolk (CCE) and the Center for Clean Water Technologies (CCWT) at Stony Brook University to design, implement and monitor the PRB. This group is well versed and experienced in this type of applied research technology and is well suited to successfully complete this project. This is a unique and exciting opportunity where public and private partnership can help benefit the local environment since the homeowner's association would be providing approximately 40 % of the matching funds for the bulkhead replacement costs and the PRB would provide a public benefit by remediating nitrogen pollution and improving water quality.

Program Goal: The goal of this project is to demonstrate the effectiveness of a Bulkhead PRB (BPRB) treatment system at reducing nitrogen concentrations in groundwater before discharging into Shinnecock Bay. A secondary goal of the program is to collect the data and information that will provide "lessons learned" such as the measures for site characterization, design, construction and monitoring of future BPRB applications.

The following tasks will be implemented to complete the program:

Task 1 – PRB Site Characterization

Task 2 – BPRB Design

Task 3 – Construction of BPRB

Task 4 – Monitoring of BPRB

Task 5 – Public Education and Outreach

Task 1 – PRB Site Characterization

The subtasks associated with BPRB siting include pre-characterization monitoring wells that will enable the determination of nutrient loading in the groundwater, sediment characteristics, groundwater flow rates and other environmental conditions. This area in Hampton Bays is a

Figure 3. Aerial view of Hampton Bays with bulkhead PRB site indicated in red

relatively densely populated residential area (Figure 3) and it contains moderately elevated groundwater nitrogen, with high flow rates toward the bay (see attached report by Graffam et al. 2018), but a more thorough characterization is necessary. This includes installing monitoring well clusters that will enable us to sample groundwater at multiple depths to measure ambient nitrogen concentrations. In addition, soil samples will be used to determine geologic features and measurements of groundwater heads.

Construction of BPRBs depend on site-specific factors such as: groundwater flow rates, hydraulic conductivity, nutrient loading and geology. These different factors determine the depth of installation, PRB thickness, the excavation methods and choice of reactive media. Pre-installation site characterization is therefore critical, so the BPRB is constructed for efficient nitrogen removal. We are fortunate that the small-scale pilot test at the HHA site has proved to be effective and provided us with preliminary results, indicating that this site holds promise for developing a larger scale test platform. We still, however, require funds for site characterization to help design and construct the additional 100' of BPRB along the remaining bulkhead as wells as funds to assist with the long-term monitoring of the site.

Our preliminary data indicate there is potential for BPRBs to mitigate nitrogen pollution. The overall nitrogen removal potential of a BPRB bulkhead however is context-dependent and must be optimized for groundwater nitrogen loading and the hydraulic setting at a given site. Time-integrated nitrogen removal depends on the volume of groundwater treated per time and the nitrogen removal rates that are achieved while water is traveling through the PRB matrix. The latter largely depends on the residence time of water in the PRB matrix. Our preliminary field and laboratory studies suggest that with a residence of 2 days about 10 mg L^{-1} are removed in a 1m thick PRB matrix. The residence time depends on the combination of thickness of the PRB, the hydraulic head (difference between groundwater level and porewater saturation or seawater level on the seaward side that changes with tides), the % of open area in the bulkhead wall (size and spacing of holes), and the permeability of the soil, including both the PRB matrix and the seaward sediment. The PRB matrix permeability should be significantly higher than the landward soil matrix (to attract water) and the seaward sediment (to maximize the water that is

treated in a given time). Additionally, the PRB matrix permeability and matrix thickness should be chosen to achieve a > 1 day average residence time.

Before the installation we will perform the following measurements:

- Sub-task 1: Ground water level and nitrate loading will be measured at three sites about 3m upstream of the construction site. Three well clusters consisting of shallow, mid and deep screen zones will be installed along the 100 ft. BPRB. Wells will be constructed with 1" PVC risers and 2' screen zones. Slug tests will be performed on the wells to estimate soil hydraulic conductivity.
- Sub-task 2: Permeability of landward soil, marine sediment, and different sand or pea gravel/woodchip PRB mixtures will be measured in 1m long 1.5" ID clear PVC pipes using the constant head method. Cores will be taken at three stations approximately 25 m apart. Three cores per station will be taken (total of 18 cores plus triplicates of sand woodchip mixtures).
- Sub-task 3: Submarine Groundwater discharge (SGD) zone offshore will be evaluated to determine the magnitude and extent of seepage and nitrate concentrations in upwelling groundwater. Using conductivity and temperature measurements within the sediments along three offshore transects extending ~ 200 ft. offshore and separated by ~ 25 ft. will be used to determine the SGD zone. Seepage measurements will be made along each transect at select stations to determine the groundwater discharge rate (specific discharge). After initial SGD survey, porewater samples will be collected at three stations along each transect to determine nitrogen concentrations in offshore porewater.

Figure 4. Site location showing the recently replaced bulkhead (blue), the proposed replacement where the BPRB will be installed (red), and the old bulkhead which will require future replacement (orange). TC1-TC10 indicate treatment cells which may include different PRB treatments and controls.

Task 2 – BPRB Design

Once the site has been characterized, the team will utilize the hydrogeology information to plan the BPRB treatment to effectively reduce nitrogen levels in the groundwater seeping to Shinnecock Bay. To that end, it is essential that the configuration of the PRB (thickness of the matrix, and length, and depth of the PRB) are carefully considered with respect to bulkhead as well as selection of appropriate reactive media. The current proposed plan calls for ten tests cells to established along the 100' replacement section of bulkhead (Figure 4, 5). The returns will allow excavation of native material after new bulkhead is installed without compromising intergrity of the bulkhead and allow the PRB material to be proberly placed behind the bulkhead. Additionally these 10 cells will inform future BPRB designs.

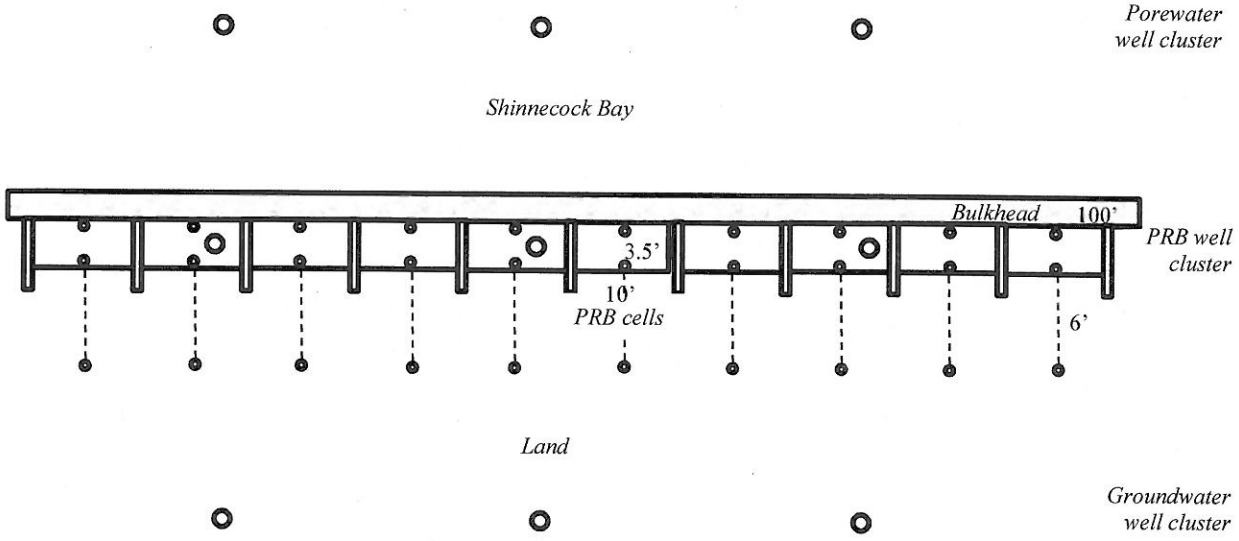


Figure 5. Aerial view of bulkhead design. Groundwater well clusters and groundwater piezometers are on the landward side of the bulkhead. Ten 10' long treatment cells will have upstream and downstream piezometers within the PRB. Porewater monitoring wells will be on the bay side of the bulkhead. The bulkhead design may be subject to change based on pre-installation site characterization.

Based on our experience with the pilot test at this site, the bulkhead will allow for a trench-construction type of PRB installation, using locally available wood-based media. Based on the initial measurements of hydraulic head and soil/sediment permeability, the PRB matrix mixture will be chosen to have significantly higher permeability than the sediment matrix on the seaward side of the PRB. Depending on the sediment permeability on the seaward side, either sand (C33) or pea gravel will be mixed into the woodchip material at proportions derived from permeability tests. This will be refined and further developed after the pre-characterization and more detailed groundwater flow and nutrient loading is completed.

Task 3 – BPRB Construction

The goal of Task 3 is to successfully install the BPRB. Installation of the BPRB will be done during the replacement of the bulkhead. The homeowner's association has the permits to install the bulkhead. The HHA has successfully worked with a local company, Tidewater Dock

Building Company, on the initial small-scale BPRB work when they previously repaired and replaced the bulkhead. The work is done carefully to minimize disturbance to the surrounding area. It is estimated that approximately 3.5 ft. thick woodchip-sand (or pea gravel) layer will be used throughout the 100' bulkhead (Figure 5). This design may change based on results of site characterization. Drain holes will be drilled in the lower ~ 7-10' of bulkhead material (Figure 2, 6). We will likely use the same hole size and spacing as the PRB test cell (0.5" diameter holes, 4" apart, 1.3% open area). This configuration allows good drainage without compromising the integrity of the bulkhead. First the backfill is excavated and material will be removed and placed in a containment area. Then the bulkhead sheathing that has been perforated with drain holes, will be driven into the sediment using standard pile-driving/vibratory techniques. There will be multiple returns, or bulkhead walls perpendicular to the main bulkhead, situated along the length of the 100' bulkhead which establish treatment cells 1-10 shown in Figure 3. Cells may be filled with different filling material including several controls to help determine treatment effectiveness. The wood chip media will be placed behind the bulkhead at the level between 10-12' depth. During this step, piezometers will be installed for performance monitoring. An upstream piezometer (UP) and downstream piezometer (DP) will be installed within each treatment cell (Figure 5). In addition, several 3-4" diameter wells will be installed for autonomous logger deployment. After the installation is complete, the bulkhead will be backfilled with the sand that was removed, all piezometers and wells will be capped and hidden below the sediment/soil surface, and the surface materials will be regraded. We anticipate that construction will take about 1 month and there will be minimal, or no changes to the present elevations, as well as no above surface features present.

Task 4 – Performance Monitoring

The goals of this task are to assess the effectiveness of the PRB in remediating elevated nitrogen levels in groundwater, and further characterization of the PRB system and impacts. The activities associated with this task include sample collection, sample analysis, data evaluation and documentation. The desired outcomes are reliable data, and concise reports presenting the results of the groundwater sampling and PRB function.

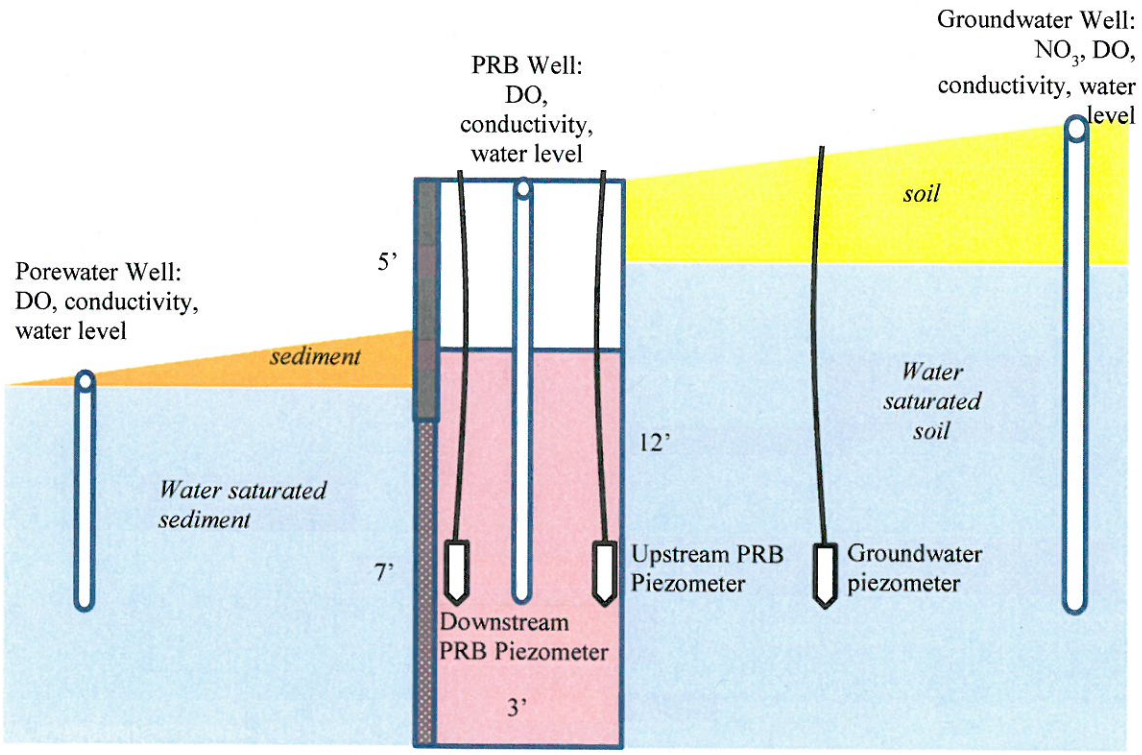


Figure 6. Side-view of a bulkhead PRB test cell with monitoring wells and piezometers sampling ports. The lower 7' of the bulkhead wall is perforated with drain holes.

To monitor BPRB performance in year 1 we propose a combination of autonomous data logging and discrete sampling on a bi-monthly schedule to cover seasonal trends in groundwater hydraulics and nitrogen removal. Samples will be retrieved within a 2 hour time window around low tide. Our preliminary data have shown that maximal rates of water treatment are achieved during this time. During each sampling campaign samples from test cells will be collected and analyzed for NO_3^-, NO_2^-, NH_4^+, and TKN. In addition, field measurements will include dissolved oxygen (DO), conductivity, pH, oxidation-reduction potential (ORP), total dissolved solids (TDS) and temperature. Several other analytes (hydrogen sulfide, metals, dissolved organic carbon) will be measured periodically although the nitrogen monitoring is of primary importance. Additionally, for each sampling campaign, autonomous sensors will be deployed in the monitoring wells to measure nitrate, dissolved oxygen, water level, conductivity, and temperature. We propose to start on a bi-monthly schedule and reduce to seasonal sampling in years 2-6. Additional analysis will be determined based on the results of year 1 sampling.

Analytical measurements: Primary analytes include the nitrogen series (NO_3^-, NO_2^-, TKN, NH_4^+). The nitrogen series will be measured for every sample on each sampling campaign. Nitrogen analysis will be performed by an ELAP approved laboratory (Pace Analytical /CCWT, Stony Brook University). Secondary analytes of interest include hydrogen sulfide (H_2S), Fe^{2+}, dissolved organic carbon (DOC), and nitrogen gas. Secondary analytes will be measured periodically for research purposes, as these analytes are not critical for nitrogen removal performance monitoring. Secondary analytes are useful for understanding the biogeochemistry of the PRB system and will be important for publications which may arise from the PRB monitoring. Although CCWT is not ELAP certified for these analytes, the Center is able to analyze them with high accuracy according to well-established methods.

Data analyses: Nitrogen removal performance will be estimated based on the differences in nitrate concentrations in the samples retrieved from the groundwater and downstream within PRB piezometers. If seawater enters the BPRB, nitrogen removal estimates will account for dilution by seawater as outlined in Graffam et al. 2018.

Task 5 - Public Education

Public education and outreach will be implemented using a variety of means. Cornell Cooperative Extension will host educational outreach to the public via traditional informal lecture on nitrogen and bulkhead PRBs. They will also host information about the project on their website. Stony Brook University will also provide information regarding the project on their Center for Clean Water Technology (CCWT) website and other media that reach the public. It is also anticipated that results from this study will be presented at the bi-annual CCWT symposium as well as at the annual "State of the Bays" symposium at SBU Southampton. Results will be published in a peer reviewed scientific journal. Finally, general guidance resulting from the long-term monitoring for construction of BPRBs will also be made public and presented to the Town of Southampton.

Nitrogen Removal Projections

The purpose of PRBs installed along the Southampton coast is to remove the nitrate load that is discharged predominantly from private septic system leaching fields and some nitrogen load from fertilizing private lawns. Preliminary nitrogen removal calculations indicate the Hampton Bays BPRB will remove approximately 0.8 lb-N/day or 300 lb-N/year.

The nitrogen removal estimate was calculated according to the following assumptions:

- PRB dimensions estimated at 100' length x 10' depth x 3.5' thickness
- PRB matrix porosity is ~0.5
- Water will have ~1 day residence time in the PRB
- Average groundwater concentration is 7 mg-N/L

This is a conservative estimate based on the assumption of 7 mg-N/L groundwater concentration. Groundwater nitrate concentrations in the area are patchy, ranging from 4-12 mg-N/L near the previously installed bulkhead PRB test cell. This is a realistic estimate given that medium-high density residential areas are expected to have 7-10 mg-N/L groundwater concentrations. According to the Suffolk County Comprehensive Water Resources Management Plan (2015), on average each person generates 10 lbs-N per person per year. If installed, the BPRB will remediate nitrogen input from 30 or more people in the surrounding residential area. Considering the cost of onsite wastewater treatment systems is in the range of ~20k per household, and the PRB could remove nitrogen input from ~10 households, the BPRB is a cost-efficient groundwater treatment technology.

Anticipated Benefits

The project meets the objectives for nitrogen reduction in Shinnecock Bay which is a priority waterbody (PWL) and will have many short and long-term benefits to the bay biota, ecosystem, and residents. The project will also provide considerable information for future guidance of bulkhead PRBs. It will help remove 300 lb-N/year of nitrogen to improve water quality, promote local recreation, as well as enhance resources and economy of the region. Furthermore, it is consistent with the following goals and policies important to New York State and the Town of Southampton:

a) Long Island Nitrogen Action Plan

- Primary Goal #3: Develop an implementation plan to achieve reductions including action plans which contain near term actions that will reduce nitrogen pollution to groundwater and surface waters (LINAP Scope pg. 7)

b) Southampton CPF Water Quality Improvement Project Plan (WQIPP)
   - Vision Goals for Natural Resources, Goal #2: Improve the quality of surface and bay waters by reducing nutrient loading, toxins and sedimentation. (CPF WQIPP pg. 6)
   - Southampton 400+ Sustainability Goal: Restore and protect the Town's ground and surface waters to ensure their ability to support public health and the maritime, recreational and resort activities that underpin Southampton's way of life and economy. (CPF WQIPP pg. 7)

c) Southampton Coastal Resources & Water Protection Plan
   - Policy 1: Foster a pattern of development in the Town of Southampton that enhances community character, preserves open space, makes efficient use of infrastructure, makes beneficial use of a coastal location, and minimizes adverse effects of development. (SCRWPP pg. 24)
   - Sub-policy 1.3: Protect established residential areas. Maintain established residential areas and allow for continued compatible residential and supporting infrastructure in, or adjacent to, such areas consistent with the need to minimize, over time, the risk of loss of development to flooding, erosion, storm surge, or sea level rise. (SCRWPP pg. 27)
   - Sub-policy 1.4: Maintain and enhance natural areas, recreation, open space, aquifer recharge areas, and agricultural lands. Avoid loss of economic, environmental, and aesthetic values associated with these areas (SCRWPP pg. 27)
   - Policy 3: Protect and, where possible, enhance the visual quality of the natural and man-made scenic resources throughout the waterfront area of the Town (SCRWPP pg. 44)
   - Sub-policy 3.1: Protect and improve visual quality throughout the waterfront area. Restore deteriorated, and remove degraded visual elements, and screen activities and views which detract from visual quality (SCRWPP pg. 44&45)

- Policy 4: In the interest of public health, safety and welfare, minimize storm damage to principal structures, infrastructure, and natural resources from flooding, erosion, and sea level rise (SCRWPP pg. 58)
- Sub-policy 4.1: In the interest of public health, safety and welfare, minimize storm damage to principal structures and infrastructure from flooding, coastal storms, erosion and sea level rise from present and expected future conditions. The use of erosion control structures such as bulkheads and seawalls are limited to exceptional circumstances or to allow for the efficient functioning of water-dependent uses (SCRWPP pg. 58&59)
- Sub-policy 4.5: Ensure that expenditure of public funds for flooding and erosion control projects results in a public benefit. (SCRWPP pg. 62)
- Policy 5: Protect and improve water quality and supply (SCRWPP pg. 70)
- Sub-policy 5.1: Reduce nutrients to levels necessary to support a healthy ecosystem; one that allows for harvestable, sustainable fish and shellfish populations, healthy submerged aquatic vegetation, and traditional human uses in the Town's waters. Employ effective means to reduce nutrients, such as, permeable reactive barriers. (SCRWPP pg. 71)

Schedule of Tasks

Task 1 – PRB Site Characterization

Task 2 – BPRB Design

Task 3 – Construction of BPRB

Task 4 – Monitoring of BPRB

Task 5 – Public Education and Outreach

Pre-installation

Task	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	x	x	x									
2				x	x	x						
3						x	x					
4												

5												

Year 1 Monitoring

Task	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1												
2												
3												
4		x		x		x		x		x		x
5						x						x

Years 2-5 Monitoring

Task	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1												
2												
3												
4			x			x			x			x
5			x			x			x			x

Project Team Professional Services: The project team includes Cornell Cooperative Extension of Suffolk County, Stony Brook University (CCWT and SoMAS) and Tidewater Marine Services. Cornell Cooperative Extension will serve to coordinate and manage all aspects of the project with the homeowner's association. Stony Brook University will help design and analyze monitoring protocol. Both organizations are recognized as leaders in the fields of marine science and in the construction and education services for groundwater and water quality mitigation related projects. Tidewater Marine is the local contractor that has installed the previous section of bulkhead and worked with CCE on the small-scale PRB test cell. They are ideally suited to handle the construction aspects of this project. We believe that the project team is the best fit for this project providing nationally recognized expertise, unique constructability, keen local knowledge and cost effectiveness to the project.

CCE and SBU team members include: Ron Paulsen P.G., Dr. Matthew Sclafani, Dr. Nils Volkenborn and Molly Graffam (doctoral graduate student). These four are experts in groundwater monitoring systems and nitrogen cycling in PRBs, including unique capabilities to evaluate offshore SGD discharges, coastal ecosystems and water quality analyses and have been working in Southampton for decades. In addition to technical contributions, the team will also provide the required matching funds of $227,100 over the 6 year period.

This team is capable to provide the full suite of technical and educational services that are required for this PRB project within the proposed budget, and have experience at this site with the small-scale pilot test. Design and installation of a PRB requires a firm understanding of the hydrogeology of Southampton and groundwater flow within the study area including evaluation of offshore impacted areas. In addition, use of the proper materials to effectively reduce nitrate is critical. The project team will conduct numerous tasks including: site characterization onshore and offshore (hyporheic zone), well-point geologic and water quality sampling to define the stratigraphic framework and nitrate concentrations, groundwater level monitoring, and educational outreach.

Community Support

Letters of support from public officials and local environmental groups are pending and will be submitted to CPF as soon as possible.

References:

Ahmad R., McGuire T., Lee R., and Becvar E. 2007. Considerations for the Design of Organic Mulch Permeable Reactive Barriers. Remediation 18: 59-72.

Barkle G., Schipper L., Burgess C. and Painter B. 2008. In Situ Mixing of Organic Matter Decreases the Hydraulic Conductivity of Denitrification walls in Sand Aquifers. Groundwater Monitoring & Remediation 28: 57-64.

Massachusetts Estuaries Project. (2005). Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Great/Perch Pond, Green Pond and Bournes Pond, Falmouth, Massachusetts. Falmouth.

Massachusetts Estuaries Project. (2006). Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for West Falmouth Harbor, Falmouth, Massachusetts. Falmouth.

Massachusetts Estuaries Project. (2012). Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Waquoit Bay and Eel Pond Embayment System Towns of Falmouth and Mashpee, Massachusetts. Falmouth.

MassDEP. (1999). DEP Nitrogen Loading Computer Model Guidance. Boston.

Robertson W. D. and Cherry J.A. 1995. In-Situ Denitrification of Septic-System Nitrate Using Reactive Porous Media Barriers: Field Trials. Groundwater 33: 99-111.

Robertson W.D., Vogan J.L., and Lombardo P.S. 2008. Nitrate removal rates in a 15-Year-Old Permeable Reactive Barrier Treating Septic System Nitrate. Groundwater Monitoring & Remediation 28: 655-72.

Robertson, W. D. (2010). Nitrate removal rates in woodchip media of varying age. Ecological Engineering 36: 1581-1587.

Suffolk County. 2015. Suffolk County Comprehensive Water Resources Management Plan.

The Interstate Technology and Regulatory Council PRB: Technology Update Team. 2011. Permeable Reactive Barrier: Technology Update. 234 pp, www.itrcweb.org

Vallino J. and Foreman K. 2008. Effectiveness of Reactive Barriers for Reducing N-Loading to the Coastal Zone. Final Report Submitted to the NOAA/UNH Cooperative Institute for Coastal and Estuarine Environnmental Technology (CICEET).

Valiela, I., et al. 1997. Nitrogen loading from coastal watersheds to receiving estuaries: New method and application. Ecological Applications 7: 358-380.

In preparation for publication, July 2018

Nitrogen Removal and Tidal Dynamics in a Bulkhead Permeable Reactive Barrier Test Cell in Hampton Bays, NY

Molly Graffam[1], Ronald Paulsen[2], Nils Volkenborn[1]
[1]School of Marine and Atmospheric Sciences, NYS Center for Clean Water Technology, Stony Brook University, Stony Brook, NY
[2]Cornell Cooperative Extension, Cornell University, Ithica, NY

Background

PRBs provide treatment via a microbially mediated reaction pathway called denitrification which involves converting nitrate to nitrogen gas. In addition, PRBs are passive and below ground, meaning they require minimal energy input and are aesthetically unobtrusive. The PRB matrix is designed to be more permeable than the surrounding soil so water preferentially flows through the treatment zone. PRBs, also called denitrification walls, are typically filled with organic material such as woodchips, and have been widely used for groundwater nitrate remediation. Due to factors such as existing infrastructure, property distinctions, and installation costs, PRBs will likely be increasingly installed as close to the shore as possible. Due to these considerations, a first of its kind bulkhead PRB test cell was installed in 2015 in Hampton Bays, New York by Hampton Hills Association in consultation with Cornell Cooperative Extension. This novel PRB design is a modified version of the PRB trench method. It was installed to provide proof of concept data and has proven to be effective for nitrogen removal.

Bulkhead PRB Test Cell Description

The bulkhead PRB (BPRB) was installed on the landward side of a vinyl sheet piling during the bulkhead replacement. The test cell is approximately 1 meter thick by 2 meters long by 2 meters deep and is filled with an oak/pine woodchip and pea gravel mixture. There are subsurface holes in the vinyl sheet, which allow treated water to leave the system. The subsurface holes are in contact with porewater on the bayward side of the bulkhead. There is a grid of approximately two hundred 1.2 cm diameter holes with 10 cm between rows and columns of holes.

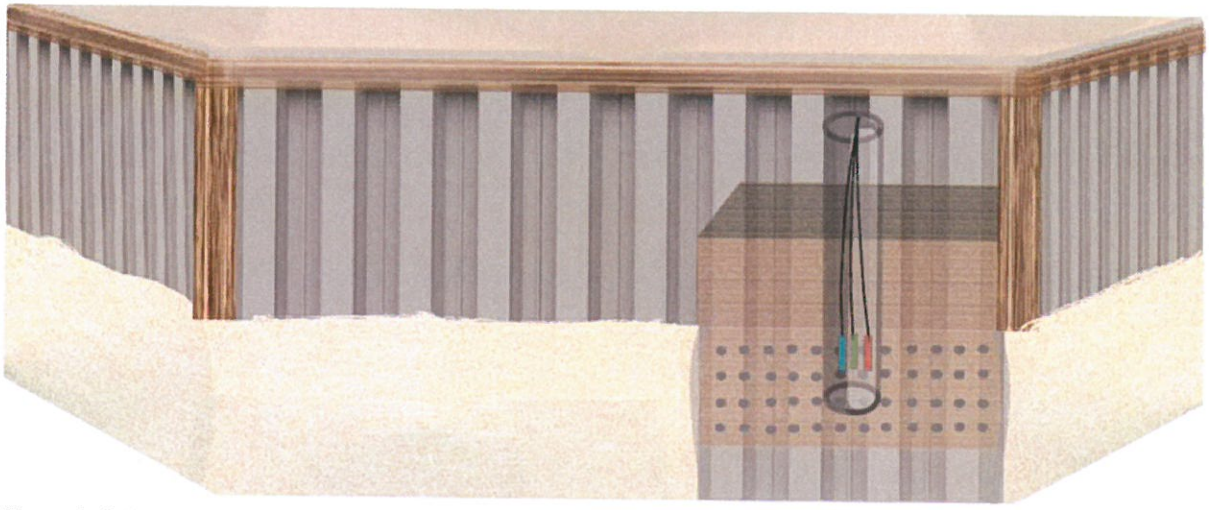


Figure 1: Schematic of bulkhead PRB test cell. Woodchip/gravel PRB matrix behind the bulkhead is indicated by the shaded brown box. Multiple autonomous sensors are deployed in the center of the PRB in a PVC pipe for continuous data. Holes in the bulkhead allow treated water to leave the system.

Field Monitoring

Samples from within the PRB were collected at multiple timepoints over a tidal cycle for NH_4^+, NO_x, and ΣH_2S. Oxygen, conductivity, and water level sensors were deployed in the center of the PRB in a polyvinyl chloride (PVC) pipe which was perforated to let water flow freely but prevent woodchips from contacting the sensors. Sensors were deployed at 1-minute logging intervals at approximately the same depth during each deployment.

Results

During all preliminary sampling campaigns water in the PRB was a mixture of groundwater and seawater. These end-member solutions have different salinities and nutrient concentrations, and the relative amounts of these solutions changes over time since the PRB experiences tidal fluctuations. To account for dilution by seawater, an expected nitrate concentration and % nitrate removal was calculated based on the % salinity. On all sampling campaigns, the PRB test cell consistently removed 80-100% nitrate. As shown in Figure 2, aquifer nitrate concentrations ranging from 4-6 mg-N/L were reduced to values below detection at the downstream sampling port within the treatment zone, indicating that the bulkhead PRB test cell successfully treated groundwater. On all sampling campaigns, PRB samples had <0.2 mg $N\text{-}NH_4^+$/L and <200 µM H_2S.

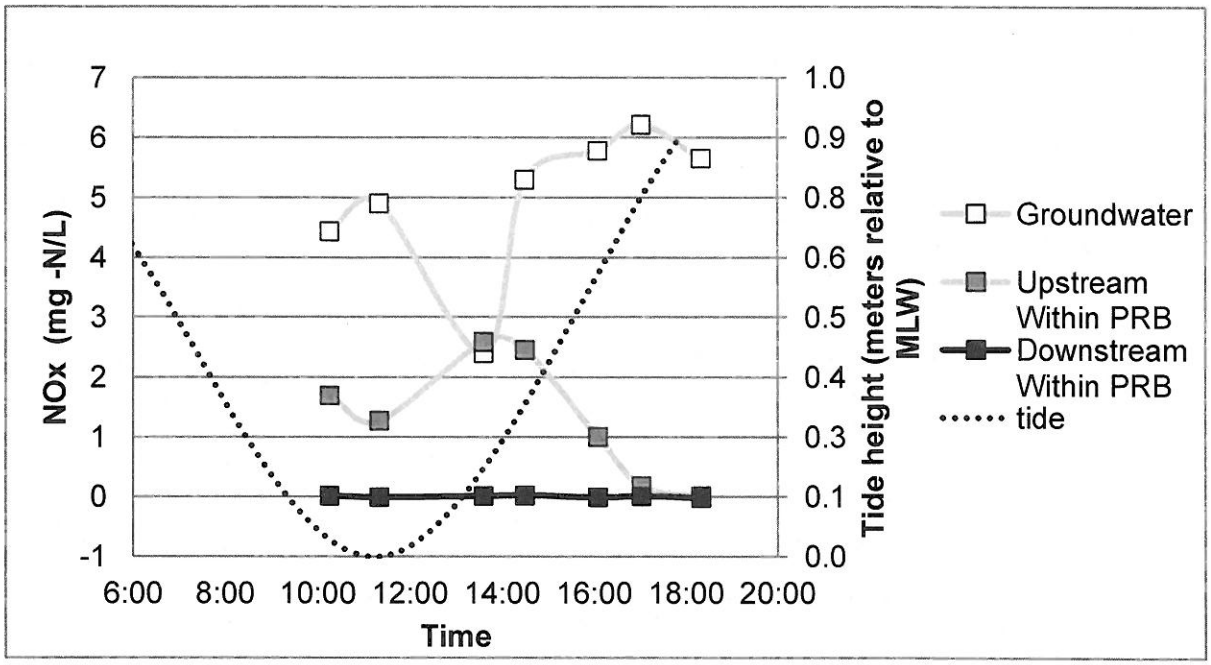


Figure 2: NOx over the tidal cycle from groundwater and PRB sampling ports from sampling campaign on 6/20/17 The dotted black line indicates the tidal cycle, with tide height on the secondary y-axis with units in meters relative to mean low water.

Continuous monitoring shown in Figure 3 reveals the PRB is a dynamic system with water level, salinity, and oxygen oscillating daily. Water level in the PRB fluctuates daily according to tide height and has a dynamic range of 60 cm of water. High and low tide timing matched the nearby Ponquogue Bridge tide gauge as shown in Figure 4. Dissolved oxygen (DO) concentrations within the PRB varied between 0 and 5 mg L^{-1}. Over 8 days of DO monitoring, conditions in the center of the PRB remained anoxic (≤ 0.1 mg L^{-1}) 22% of the time, and hypoxic (≤2 mg L^{-1}) 73% of time, indicating the conditions were optimal for denitrification. As shown in Figure 5, some H_2S was detected in the downstream within PRB sampling port, indicating sulfate reduction occurred. However, H_2S concentrations measured in the PRB were minimal compared to other saline environments such as salt marshes or mud flats.

In addition to field monitoring, laboratory experiments with aged BPRB matrix were performed. Data from this experiment suggests woodchip/ pea gravel matrix with an average residence time of 1 day is sufficient to treat groundwater with less than 5 mg $N\text{-}NO_x$ L^{-1} and increasing to 2 day residence time is sufficient to treat groundwater with 10 mg $N\text{-}NO_x$ L^{-1}. The range of salinities observed in the PRB test cell did not compromise the nitrogen removal efficiency.

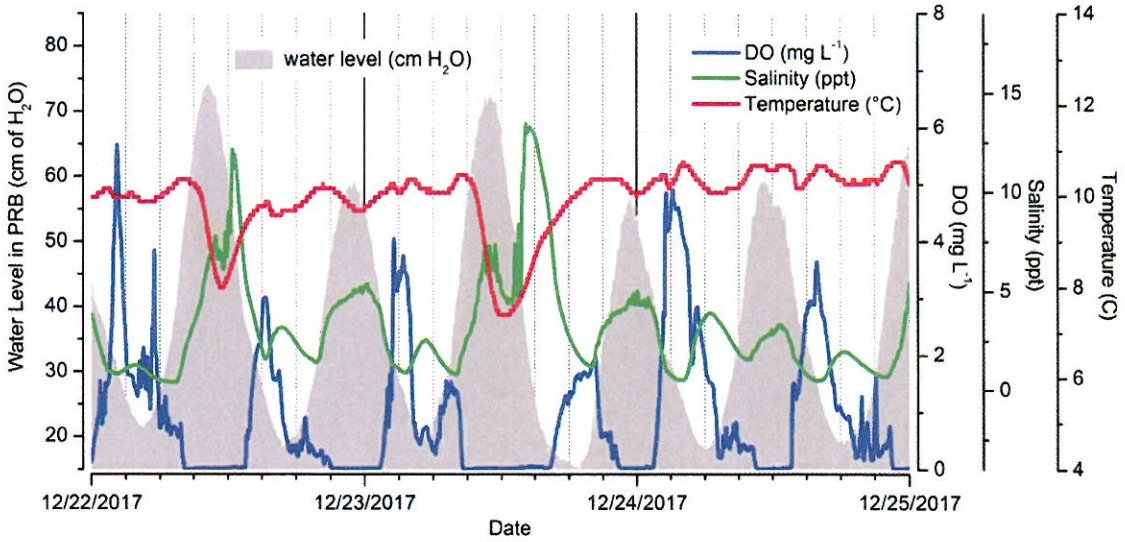


Figure 3: Salinity, temperature, oxygen, and water level measured in the center of the PRB. Data were recorded by autonomous sensors at a 1 minute logging interval.

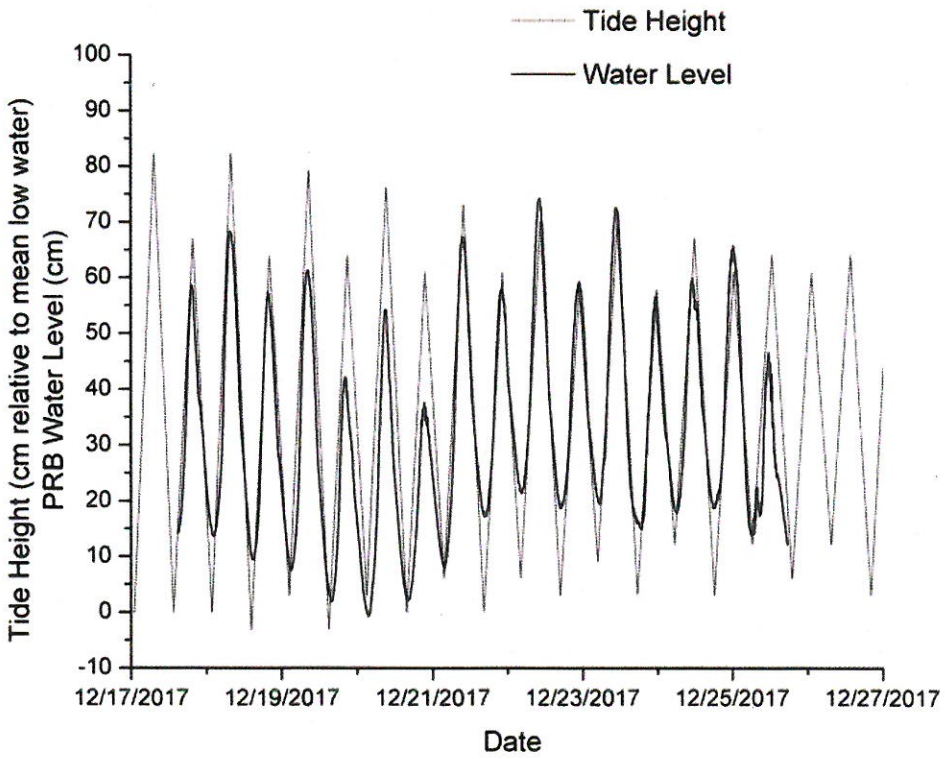


Figure 4: High and low tide water level measured within the PRB exactly matches the timing of high and low tide values measured at the nearby Ponquogue Bridge tide gauge.

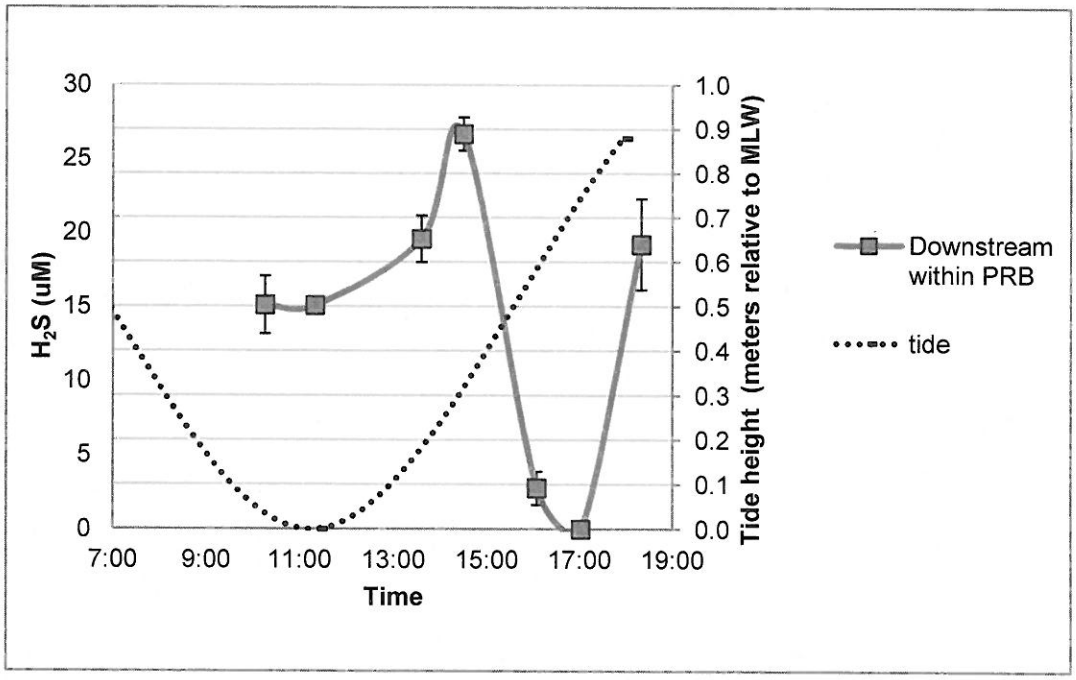
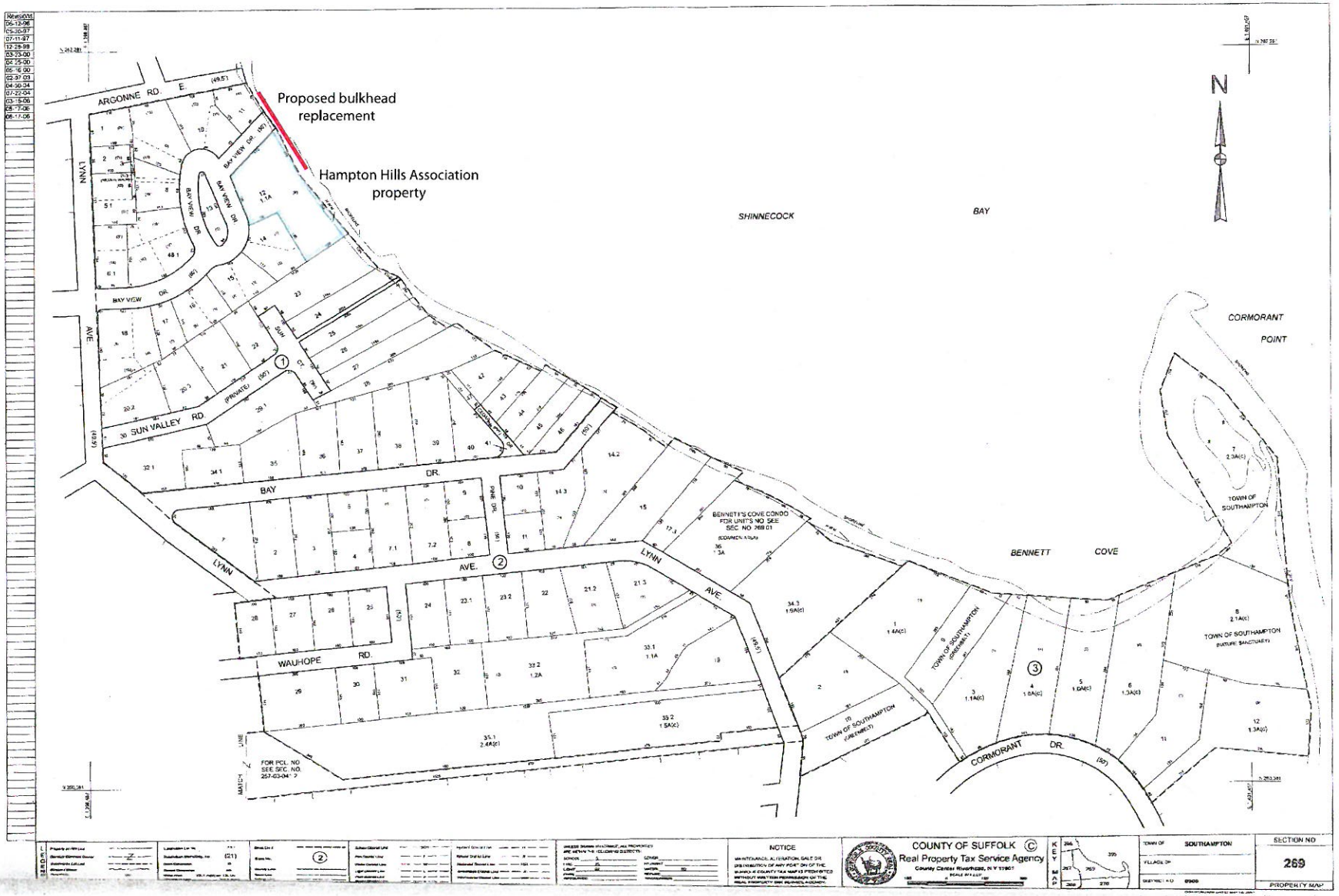


Figure 5: H_2S within the BPRB over the tidal cycle from sampling campaign on 6/20/17. The dotted black line indicates the tidal cycle, with tide height on the secondary y-axis with units in meters relative to mean low water.



NOTICE

COUNTY OF SUFFOLK ©
Real Property Tax Service Agency
County Center Riverhead, N.Y. 11901

TOWN OF SOUTHAMPTON
VILLAGE OF
DISTRICT NO 0900

SECTION NO
269
PROPERTY MAP

Budget

CPF Proposal- Nitrogen Remediation through Bulkhead PRB Treatment

Budget Summary Year 1

Budget Summary for year 1 that includes: Site Characterization, Design, Construction, Initial Year 1 Monitoring, Reporting and Outreach.

CPF Summary Budget Year 1			
	Days	Rate hr/ 8hr day	Total Salary
Labor/Engineer/Design			
Task 1- Site Characterization, Planning			
CCE principle Investigators	20	$60.00	$9,600.00
field tech	18	$26.00	$3,744.00
Task 2- Design			
principle Investigators	12	$60.00	$5,760.00
field tech		$26.00	$0.00
Task 3- Construction			
principle Investigators	24	$60.00	$11,520.00
field tech	52	$26.00	$10,816.00
Task 4- Post Construction Monitoring			
principle Investigators	78	$60.00	$37,440.00
field tech	67	$26.00	$13,936.00
Task 5- Education Outreach			
principle Investigators	9	$60.00	$4,320.00
field tech	15	$26.00	$3,120.00
		Total Salaries	**$100,256.00**
Equipment/Material supplies			
Wood Chip and aggregate Materials			$4,000.00
Pace/CCWT Laboratory Analyzing Samples (total cost)			$28,000.00
Geo-Probe rental ($4,000 per week)			$8,000.00
Well points (n=50)@ 150per			$7,500.00
myron meter probes			$1,500.00
Peristalitc Pump			$1,500.00
Equipment rental (Payloaders, chipper, dump trucks)			$4,000.00
Level Loggers			$2,500.00
Misc Equipment (coring tools, etc.)			$1,250.00
2 Hobo temp sensors ($150 each)			$300.00
Trident porewater probe/seep meter			$2,500.00
misc supplies(fittings, tubing,standards...			$3,000.00
		Total equip/suplies	**$64,050.00**
Travel/Boat		**Total travel**	**$2,535.00**
		Total CCE	**$166,841.00**
Contractual Services			
Tidewater Dock Company			$45,000.00
Surveyor			$3,000.00
Stony Brook			$6,000.00
Total Contractual		**Total Contractual**	**$54,000.00**
Total Project		**Total Project**	**$220,841.00**

Budget Summary Monitoring Years 2-6

This budget summary is for monitoring years 2-6 and includes all costs related to BPRB monitoring including sampling analytical costs, reporting and outreach.

CPF Summary Budget Years 2-6			
	Days	Rate hr/ 8hr day	Total Salary
Labor/Engineer/Design			
Task 1- Site Characterization, Planning			
CCE principle Investigators	10	$60.00	$4,800.00
field tech	4	$26.00	$832.00
Task 2- Design			
principle Investigators		$60.00	$0.00
field tech		$26.00	$0.00
Task 3- Construction			
principle Investigators		$60.00	$0.00
field tech		$26.00	$0.00
Task 4- Post Construction Monitoring			
principle Investigators	33	$60.00	$15,840.00
field tech	67	$26.00	$13,936.00
Task 5- Education Outreach			
principle Investigators	5	$60.00	$2,400.00
field tech	15	$26.00	$3,120.00
Total Salaries		**Total Salaries**	**$40,928.00**
Equipment/Material supplies			
Wood Chip and aggregate Materials			$0.00
Pace/CCWT Laboratory Analyzing Samples (total cost)			$20,000.00
Geo-Probe rental ($4,000 per week)			$0.00
Well points (n=50)@ 150per			$0.00
myron meter probes			$500.00
Peristalitc Pump			$500.00
Equipment rental (Payloaders, chipper, dump trucks)			$0.00
Level Loggers			$500.00
Misc Equipment (coring tools, etc.)			$0.00
2 Hobo temp sensors ($150 each)			$200.00
Trident porewater probe/seep meter			$1,500.00
misc supplies(fittings, tubing,standards...			$1,000.00
		Total equip/suplies	**$24,200.00**
Travel/Boat		**Total travel**	**$2,075.00**
Total CCE			**$67,203.00**
Contractual Services			
Tidewater Dock Company			$0.00
Surveyor			$0.00
Stony Brook			$4,500.00
Total Contractual		**Total Contractual**	**$4,500.00**
Total Year 2 monitoring/reporting		**Total Project**	**$71,703.00**
Total Years 2-6 monitoring/reporting		**Total Years 2-6**	**$358,515.00**

Overall Project Budget Summary and Match

Summary sheet includes over all budget for all years and match from CCE for fringe salaries and HHA construction and maintenance costs.

Nitrogen BPRB Project Total							
Organization	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Total**
Cornell	$166,841.00	$67,203.00	$67,203.00	$67,203.00	$67,203.00	$67,203.00	$502,856.00
Tidewater Marine	$45,000						$45,000.00
Stony Brook	$6,000	$4,500.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00	$28,500.00
Surveyor	3,000						$3,000.00
Project Total	$220,841.00	$71,703	$71,703	$71,703	$71,703	$71,703	$579,356.00
HHA Match	$38,000.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00	$53,000.00
Cornell Match	$49,883.30	$21,443.49	$21,443.49	$21,443.49	$21,443.49	$21,443.49	$157,100.76
Total Match	$87,883.30	$24,443.49	$24,443.49	$24,443.49	$24,443.49	$24,443.49	$210,100.76

Tide Water Dock Building Company Inc.
16 Sherwood Road
Hampton Bays, NY 11946
631-728-3364
www.tidewaterdockbuilding.com
www.tidewaterdock@gmail.com

PROPOSAL

Date: **7/11/18**

Submitted to: **Ron Paulsen** **(631) 921-0198**
Hampton Hills Assoc. **rjp11cma@aol.com**

We hereby submit proposal to rip out existing wall and replace with 100' of navy wall . Specifications are as follows:

100' Navy Wall

- Sheething will be SG425, 10 foot long
- Posts: 6x6 16' long placed every 8 foot on center
- Whaler: 6x6 top and bottom
- Tierods: ¾" x 14' foot long placed every 8 foot on center
- Clamp: 3x6 untreated
- Cap: 2x12 Doug Fir
- Deadmen system – 10" laylog and 8" pinned

Additional:

- (2) 30 yd dumpster @ approx. $1,500.00 each = $3000.00
- Backfill is necessary, it will be $30.00 per cubic yard approx. 100 yds needed = $4500.00

WE PROPOSE hereby to furnish materials and labor-complete in accordance with the above specifications, for the sum of: **$38,000.00**

$ to be paid as follows; $3,000 on signing; $20,000 upon commencement of work (Payable to Port Lumber) $7,000 upon commencement (payable to Tidewater); $6,000 at 50% completion; balance on completion.

All material is guaranteed to be as specified. All work is to be completed in a workmanlike manner according to standard practices. Any additional unforeseen charges will be invoiced at completion of job. All agreements contingent upon strikes, accidents or delays beyond our control. Any obstructions during installation will burden. We are not responsible for electrical, sprinkler or any other buried objects. Our workers are fully covered by Workmen's Compensation Insurance. We reserve the right to install shorter piles or sheeting if any obstructions are encountered during installation. There will be a 1.5% compounded interest charge per month on all unpaid balances; plus an additional 40% added to the contract price for legal fees. This proposal may be withdrawn if not accepted within 30 days of above date.

ACCEPTANCE OF PROPOSAL DATE

KENNETH HAHN, PRESIDENT DATE

Tide Water Dock Building Company Inc.
16 Sherwood Road
Hampton Bays, NY 11946
631-728-3364
www.tidewaterdockbuilding.com
www.tidewaterdock@gmail.com

PROPOSAL

Date: 7/11/18

Submitted to: **Ron Paulsen** **(631) 921-0198**
Hampton Hills Assoc. **rjp11cma@aol.com**

We hereby submit proposal to rip out existing wall and replace with 100' of navy wall and (12) 5' returns.

Specifications are as follows:

100' Navy Wall

- Sheething will be SG425, 12 foot long
- Posts: 6x6 16' long placed every 8 foot on center
- Whaler: 6x6 top and bottom
- Tierods: ¾" x 14' foot long placed every 8 foot on center
- Clamp: 3x6 untreated
- Cap: 2x12 Doug Fir
- Deadmen system – 10" laylog and 8" pinned

(12) 5' Returns

- Sheething will be SG425 12 foot long
- (10) corners
- Whaler: 6x6 top and bottom
- Posts: 6x6 8 foot long (2) per return

Remove soil behind bulkhead

Install woodchips (supplied by customer)

Drill out panels for treatment cells

****Additional:** (2) 30 yd dumpster @ $1,500.00
Backfill if needed $30.00 per cubic yard

WE PROPOSE hereby to furnish materials and labor-complete in accordance with the above specifications, for the sum of: **$73,000.00**

$ to be paid as follows; $3,000 on signing; $31,000 upon commencement of work (To Port Lumber) $14,000 upon commencement (To Tidewater); $11,000 at 50% completion; $11,000 @ 75% completion; balance on completion.

All material is guaranteed to be as specified. All work is to be completed in a workmanlike manner according to standard practices. Any additional unforeseen charges will be invoiced at completion of job. All agreements contingent upon strikes, accidents or delays beyond our control. Any obstructions during installation will burden. We are not responsible for electrical, sprinkler or any other buried objects. Our workers are fully covered by Workmen's Compensation Insurance. We reserve the right to install shorter piles or sheeting if any obstructions are encountered during installation. There will be a 1.5% compounded interest charge per month on all unpaid balances; plus an additional 40% added to the contract price for legal fees. This proposal may be withdrawn if not accepted within 30 days of above date.

_____ _____

ACCEPTANCE OF PROPOSAL DATE KENNETH HAHN, PRESIDENT DATE

Short Environmental Assessment Form
Part 1 - Project Information

Instructions for Completing

Part 1 - Project Information. The applicant or project sponsor is responsible for the completion of Part 1. Responses become part of the application for approval or funding, are subject to public review, and may be subject to further verification. Complete Part 1 based on information currently available. If additional research or investigation would be needed to fully respond to any item, please answer as thoroughly as possible based on current information.

Complete all items in Part 1. You may also provide any additional information which you believe will be needed by or useful to the lead agency; attach additional pages as necessary to supplement any item.

Part 1 - Project and Sponsor Information

Name of Action or Project:
Installing a permeable reactive barrier to remove groundwater nitrogen behind a bulkhead in Shinnecock Bay.

Project Location (describe, and attach a location map):
Bulkhead at the shoreline near Bayview Drive, Hampton Bays, Suffolk County, NY

Brief Description of Proposed Action:
The Hampton Hills Association (HHA) will add a permeable reactive barrier (PRB) behind proposed replacment of an existing bulkhead for removal of nitrogen in groundwater. The association will fund the bulkhead replacement as per designed from previous replacement sections and seeks funds to add the PRB green infrastructure and monitoring to show efficacy and reductions. Permits are in place and existing pilot data show high potential for success.

Name of Applicant or Sponsor:	Telephone: 631-255-7027
Rich Ianelli, Co-President of Hampton Hills Association	E-Mail: rich_ianelli@yahoo.com

Address:
4 Bayview Drive

City/PO:	State:	Zip Code:
Hampton Bays	NY	11946

	NO	YES
1. Does the proposed action only involve the legislative adoption of a plan, local law, ordinance, administrative rule, or regulation? If Yes, attach a narrative description of the intent of the proposed action and the environmental resources that may be affected in the municipality and proceed to Part 2. If no, continue to question 2.	☑	☐
2. Does the proposed action require a permit, approval or funding from any other governmental Agency? If Yes, list agency(s) name and permit or approval: NYS DEC Permit # XXX and Town of Southampton permit renewal	☐	☑

3.a. Total acreage of the site of the proposed action? 0.052 acres
b. Total acreage to be physically disturbed? 0.017 acres
c. Total acreage (project site and any contiguous properties) owned or controlled by the applicant or project sponsor? 1.1 acres

4. Check all land uses that occur on, adjoining and near the proposed action.
☐ Urban ☐ Rural (non-agriculture) ☐ Industrial ☐ Commercial ☑ Residential (suburban)
☐ Forest ☐ Agriculture ☑ Aquatic ☐ Other (specify): _____
☐ Parkland

	NO	YES	N/A
5. Is the proposed action, a. A permitted use under the zoning regulations?	☐	☑	☐
b. Consistent with the adopted comprehensive plan?	☐	☑	☐
6. Is the proposed action consistent with the predominant character of the existing built or natural landscape?	NO	YES	
	☐	☑	
7. Is the site of the proposed action located in, or does it adjoin, a state listed Critical Environmental Area?	NO	YES	
If Yes, identify: The site is located within the Town of Southampton Aquifer Protection Overlay District	☐	☑	
8. a. Will the proposed action result in a substantial increase in traffic above present levels?	NO	YES	
	☑	☐	
b. Are public transportation service(s) available at or near the site of the proposed action?	☑	☐	
c. Are any pedestrian accommodations or bicycle routes available on or near site of the proposed action?	☑	☐	
9. Does the proposed action meet or exceed the state energy code requirements?	NO	YES	
If the proposed action will exceed requirements, describe design features and technologies: The proposed action is not required to comply with the Energy Code. The permeable reactive barrier is a passive groundwater treatment system so after installation it requires no energy input	☐	☑	
10. Will the proposed action connect to an existing public/private water supply?	NO	YES	
If No, describe method for providing potable water: Potable water is not necessary for the proposed action	☑	☐	
11. Will the proposed action connect to existing wastewater utilities?	NO	YES	
If No, describe method for providing wastewater treatment: The proposed action has no need to connect to wastewater utility	☑	☐	
12. a. Does the site contain a structure that is listed on either the State or National Register of Historic Places?	NO	YES	
	☑	☐	
b. Is the proposed action located in an archeological sensitive area?	☑	☐	
13. a. Does any portion of the site of the proposed action, or lands adjoining the proposed action, contain wetlands or other waterbodies regulated by a federal, state or local agency?	NO	YES	
	☐	☑	
b. Would the proposed action physically alter, or encroach into, any existing wetland or waterbody?	☑	☐	
If Yes, identify the wetland or waterbody and extent of alterations in square feet or acres: The proposed permeable reactive barrier would not alter the water body. The barrier will be installed behind a bulkhead which is in contact with Shinnecock Bay. The barrier will provide groundwater treatment to improve water quality in the bay.			

14. Identify the typical habitat types that occur on, or are likely to be found on the project site. Check all that apply:

☑ Shoreline ☐ Forest ☐ Agricultural/grasslands ☐ Early mid-successional
☐ Wetland ☐ Urban ☐ Suburban

	NO	YES
15. Does the site of the proposed action contain any species of animal, or associated habitats, listed by the State or Federal government as threatened or endangered?	☑	☐
16. Is the project site located in the 100 year flood plain?	NO	YES
	☑	☐
17. Will the proposed action create storm water discharge, either from point or non-point sources?	NO	YES
If Yes, a. Will storm water discharges flow to adjacent properties? ☐ NO ☐ YES	☑	☐
b. Will storm water discharges be directed to established conveyance systems (runoff and storm drains)? If Yes, briefly describe: ☐ NO ☐ YES		

	NO	YES
18. Does the proposed action include construction or other activities that result in the impoundment of water or other liquids (e.g. retention pond, waste lagoon, dam)? If Yes, explain purpose and size: _____	☑	☐
19. Has the site of the proposed action or an adjoining property been the location of an active or closed solid waste management facility? If Yes, describe: _____	☑	☐
20. Has the site of the proposed action or an adjoining property been the subject of remediation (ongoing or completed) for hazardous waste? If Yes, describe: _____	☑	☐

I AFFIRM THAT THE INFORMATION PROVIDED ABOVE IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE

Applicant/sponsor name: Rich Ianelli Date: 7/12/18

Signature: Rich Ianelli

PRINT FORM

Part 1 - Individual Waterbody Segments with Impairment Requiring TMDL Development (con't)

Water Index Number		Waterbody Name (WI/PWL ID)	County	Type	Class	Cause/Pollutant	Suspected Source	Year
		Atlantic Ocean/Long Island Sound Drainage Basin (con't)						
(MW3.4) LIS (portion 2c)		Milton Harbor (1702-0063)	Westchester	Estuary	SB	Floatables	Urb/Storm, Municipl	2002
(MW3.4) LIS (portion 2c)		Milton Harbor (1702-0063)	Westchester	Estuary	SB	Pathogens	Urb/Storm, Municipl	2002
(MW3.4) LIS-11		Blind Brook, Lower (1702-0062)	Westchester	River	SC	Silt/Sediment	Urb/Storm Runoff	2002
(MW3.4) LIS-11		Blind Brook, Upper, and tribs (1702-0130)	Westchester	River	C	Silt/Sediment	Urb/Storm Runoff	2002
(MW3.6) LIS (portion 2d)		Port Chester Harbor (1702-0260)	Westchester	Estuary	SB	Floatables	Urb/Storm, Municipl	2002
(MW3.6) LIS (portion 2d)		Port Chester Harbor (1702-0260)	Westchester	Estuary	SB	Pathogens	Urb/Storm, Municipl	2002
(MW3.6) LIS-13		Byram River, Lower (1702-0132)	Westchester	Estuary	SC	Pathogens	Onsite WTS, Urb Runoff	2004
(MW4.2b) LIS-MB (portion 2)		Manhasset Bay, and tidal tribs (1702-0141)	Nassau	Estuary	SB	Pathogens	Urb/Storm Runoff	2002
(MW4.3a) LIS-HH		Hempstead Harbor, south, & tidal tribs (1702-0263)	Nassau	Estuary	SB	Pathogens	Urb/Storm Runoff	2002
(MW4.4a) LIS-OBH-MNC-45-P150a		Beaver Lake (1702-0152)	Nassau	Lake	C	Phosphorus	Urban/Storm Runoff	2012
(MW5.3) LIS-62-P296		Millers Pond (1702-0013)	Suffolk	Lake	C	Phosphorus/Low D.O. [2]	Urban/Storm Runoff	2002
(MW5.4c) LIS (portion 5)		Long Island Sound, Suffolk Co, Central (1702-0265)	Suffolk	Estuary	SA	Pathogens	Urban/Storm Runoff	2012
(MW6.1d) GB..GPB-P495		Mattituck/Marratooka Pond (1701-0129)	Suffolk	Lake	A	Phosphorus/Low D.O. [2]	Other (in-lake recycling)	2002
(MW7.1b) AO-P815		Agawam Lake (1701-0117)	Suffolk	Lake	C	Phosphorus/Low D.O. [2]	Onsite WTS, Urb Runoff	2008
(MW7.1b) AO-SB		Shinnecock Bay and Inlet (1701 0033) [11]	Suffolk	Estuary	SA	Nitrogen	Onsite WTS, Urb Runoff	2010
(MW7.1c) AO-QB		Quantuck Bay (1701-0042) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.2a) AO-MB (portion 1)		Moriches Bay, East (1701-0305) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.2a) AO-MB (portion 2)		Moriches Bay, West (1701-0038) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.2a) AO-MB-168a thru 175		Tidal Tribs to West Moriches Bay (1701-0312) [12]	Suffolk	Estuary	SC	Pathogens	Urban/Storm, Agric,OWTS	2006
(MW7.2a) AO-MB-168a thru 175	*	Tidal Tribs to West Moriches Bay (1701-0312) [12]	Suffolk	Estuary	SC	Nitrogen/Low D.O. [2]	Urban/Storm, Agric,OWTS	2006
(MW7.3) AO GSB (portion 1)	+	Great South Bay, East (1701-0039) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.3) AO GSB (portion 2)	+	Great South Bay, Middle (1701-0040) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.3) AO GSB (portion 3)	+	Great South Bay, West (1701-0173) [11]	Suffolk	Estuary	SA	Nitrogen/Low D.O. [2]	Onsite WTS, Urb Runoff	2010
(MW7.5) AO-GSB-185-P889		Canaan Lake (1701-0018)	Suffolk	Lake	B(T)	Phosphorus	Urban/Storm Runoff	2002
(MW7.5) AO-GSB-185-P889		Canaan Lake (1701-0018)	Suffolk	Lake	B(T)	Silt/Sediment	Urban/Storm Runoff	2002
(MW7.7) AO-GSB-193..P304	+	Lake Ronkonkoma (1701-0020)	Suffolk	Lake	B	Pathogens	Urban/Storm Runoff	2002
(MW7.7) AO-GSB-193..P304	+	Lake Ronkonkoma (1701-0020)	Suffolk	Lake	B	Phosphorus	Urban/Storm Runoff	2002
(MW7.8) AO-GSB-194		Champlin Creek, Upper, and tribs (1701-0019)	Suffolk	River	C(TS)	Thermal Changes	Urban/Storm Runoff	2002
(MW8.1a) AO-SOB-216 thru 219		Tidal Tribs to South Oyster Bay (1701-0200)	Nassau	Estuary	SC	Pathogens	Urban/Storm Runoff	2012