SOUTHAMPTON TOWN

CPF Water Quality Improvement Project Plan (WQIPP)

REDUCTION | REMEDIATION | RESTORATION | EXPECTED OUTCOMES

Acknowledgements:

This plan has been developed by utilizing the Cape Cod, Massachusetts 208 Area Wide Water Quality Management Plan Update as a guide and model. The Town of Southampton acknowledges the courtesy of the Cape Cod Commission and Staff for their sharing of information and initial groundwork for comprehensive approaches toward water quality improvement.

This plan was enabled by state legislation introduced and adopted by the effort of Assemblyman Fred W. Thiele, Jr. and State Senator Ken LaValle who are the champions of the Community Preservation Fund. The Town Board gratefully acknowledges their continued assistance toward protecting and preserving our community character and way of life.

Suffolk County, the NYS Department of Environmental Conservation, US Geological Survey (USGS), and US Environmental Protection Agency (EPA) are also acknowledged for their leadership in water quality improvement efforts as well as the work of many others including the Southampton Town Trustees, Peconic Estuary Program, The Nature Conservancy, Cornell Cooperative Extension, Peconic Baykeeper, Group for the East End, Defend H2O, Urban Harbors Institute (UHI), Peconic Green Growth, and the New York State Center for Clean Water Technology (CCWT).

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PLAN SUMMARY

I. PURPOSE AND NEED

The Town of Southampton, which features historic villages, rural landscapes, extensive bay and ocean coastlines, unique natural resources, and pristine groundwater, continues to face intense land development pressure. The Community Preservation Fund, established in 1999, has provided a great tool for conserving open space, agriculture, historic resources, recreational parks and community character on the East End. Water quality has also benefitted, as setting aside large contiguous tracts of land, re-connecting fragmented habitats, and linking natural areas has been crucial with respect to restoring and maintaining ecological integrity and hydrological functioning of our watersheds, wetlands, aquifers and surface waters.

This plan is about water quality improvement as a facet of community preservation. Recently, New York State Legislation Chapter 551 of the Laws of 2015 was enacted to extend the CPF through 2050 to ensure that additional funds are raised to help further protect lands and community character. Also included in this extension was a new provision allowing up to 20% of the revenues of the CPF program to be used toward water quality projects. If the public votes affirmatively toward this proposition in the upcoming referendum in November, this funding source would be utilized to fund projects that restore and maintain the critical sole-source aquifer upon which all residents depend for fresh potable drinking water as well as the health and vitality of the surface waters of the Town.

Consistent with State Law, this plan is therefore prepared to provide a blueprint toward how the percentage of CPF revenue would be applied in terms of a hierarchy of priorities and criteria for review and recommendation by an advisory committee and then ultimately approval of any expenditure by the Town Board.

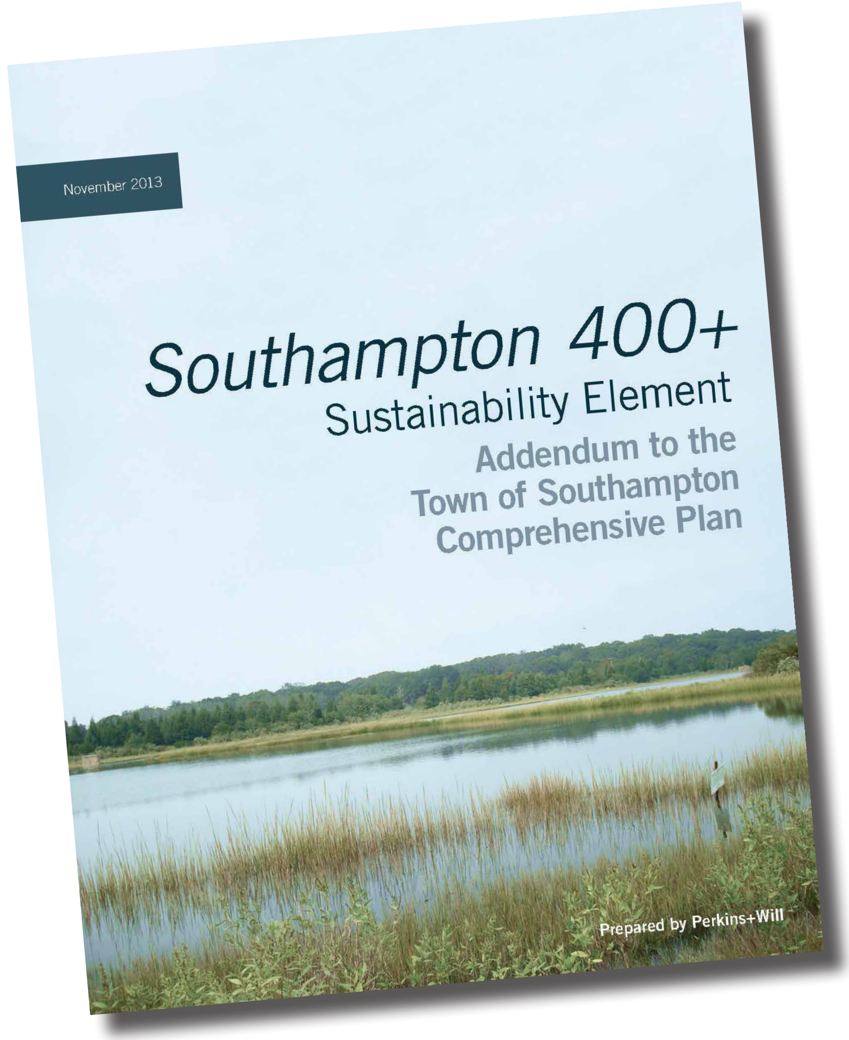
II. CONSISTENCY WITH COMPREHENSIVE PLAN

The 1999 Comprehensive Plan Update states: Southampton's natural resources are one of the Town's most precious commodities. Natural resources are critical to the economic health and vitality of the community. Along with all of the other components of the Comprehensive Plan, they are integral to the "fabric" of the Town. The health and vitality of the Town's water bodies and scenic views in a natural setting are in effect, the heart and soul of Southampton's economy. Any losses of these resources would directly impact the Town's second home and visitor market.

The Vision Goals for Natural Resources that relate to water quality are as follows:

1. Safeguard the ground water resources by protecting aquifer recharge areas in the eastern and western portions of the Town;
2. Improve the quality of surface and bay waters by reducing nutrient loading, toxins and sedimentation;
3. Preserve the diversity of Southampton's biotic communities;
4. Safeguard rare and/or endangered plant and animal species by protecting their habitat areas;
5. Protect and restore the Town's freshwater, tidal and brackish wetlands;

Nearly 4000 acres have been preserved to date via the CPF program, within the Town and the villages of Westhampton Beach, Quogue, Southampton, Sagaponack, North Haven and Sag Harbor. The use of a portion of the CPF revenues toward water quality is consistent with the Town's Comprehensive Plan guidance as well as the Town's "Southampton 400+" Sustainability Plan, which was adopted as an element to the Comprehensive Plan in December 2013. The Sustainability Plan again reiterates the same objectives, finding:



www.southamptontownny.gov/ComprehensivePlan

Clean water resources are important to everyone. But that's especially true in Southampton, with its water-dependent economy founded in maritime, agricultural and resort industries, as well as its reliance on sole source aquifers for drinking water. Regional water resources are degraded and new research pointing to inadequately treated sanitary waste as the leading culprit has brought a new sense of urgency to the issue — along with a focus for action on water quality improvement.

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.*

In the Southampton Town Coastal Resources and Water Protection Plan (adopted as a Comprehensive Plan element in April 2016), Policy five (5) is to **"Protect and improve water quality and supply"**. The stated purpose of this policy is to:

"Protect the quality and quantity of water in the Town of Southampton. Both water quality and water quantity are central to the Town's economy, culture, natural resources, and human health. Water quality considerations include contamination from uses of the land (e.g., on-site waste disposal, fertilizer application, pharmaceuticals, pesticides, and road runoff) as well as salt water intrusion from sea level rise. Consequences of water quality impairments in Southampton are significant and include (but are not limited to) harmful algal blooms; hypoxia; reduced populations of fish and shellfish; degraded habitats, including submerged aquatic vegetation such as eelgrass; closure days for beaches; the potential for reduced enjoyment of the shoreline; and groundwater contamination. The primary quantity consideration is the maintenance of an adequate supply of potable water in the region. Sea level rise is anticipated to pose additional quality and quantity problems such as salt water intrusion into the aquifer, impairment of septic system functioning, and shifting of the saline line in fresh and estuarine bodies".

The sub-policies related to water quality as well as the Water Quality Strategic Improvements that are encapsulated in that document provide many recommendations and considerations that may be determined to be viable projects for potential funding with water quality improvement program revenues, subject to Advisory Committee examination and recommendation.

Clearly the improvement of water quality is essential to sustaining the ecology and way of life in Southampton. The CPF Project Plan will continue to protect habitat values of the South Fork and Peconic Maritime Region through land preservation and the Town will continue to support smart growth techniques that direct development away from environmentally sensitive areas. However, the nitrogen from cesspools and septic systems on individual properties is currently leaching into the groundwater and surface waters of the Town to a point where remediation is needed. The decline in surface water quality is evidenced by an increase in brown and red tides, reduced levels of shellfish and other habitat impacts. We are at a critical point where swift and methodical action must be taken. The CPF Plan with this water quality addendum is therefore leading the way for a sustainable strategy to manage water resources one which will protect both our health and livelihoods as well as ensure clean surface and drinking waters for generations to come.

TRIPLE BOTTOM LINE *from Southampton 400+*

ECONOMICS–Water is the basis of the Town of Southampton's economy as water is the driver of the maritime, vacationing, and resort industries

SOCIAL–Protects the health and wellness of the citizens of Southampton.

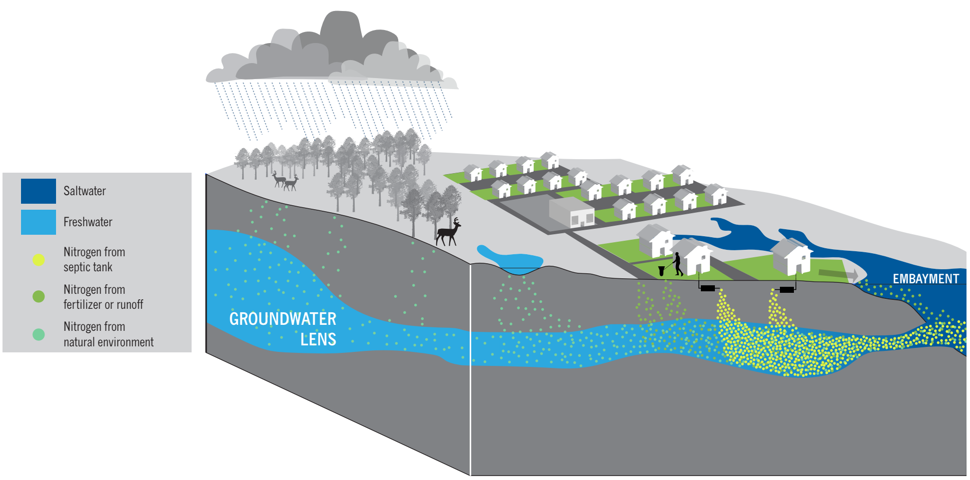
ENVIRONMENTAL–Clean water is critical to healthy ecosystems.

III. WATER QUALITY ISSUES

"While all sources of water pollution are concerning, nitrogen pollution from septic systems has clearly emerged as the most widespread and least well addressed of the region's growing list of water pollutants"
— Suffolk County Comprehensive Water Resources Management Plan (2015)

The key nutrient of concern for coastal embayments is nitrogen. A healthy coastal ecosystem needs some nitrogen to function properly. However, when too much nitrogen is added to an embayment, excessive algae are produced in a process known as eutrophication. The result produces large algal blooms that deplete oxygen supply and light attenuation, suffocating eelgrass beds and meadows that are havens for crabs, scallops, numerous species of important fish, and other wildlife. The loss of submerged aquatic vegetation/eelgrass habitat is a major factor in the decline of our fisheries and also leaves our shorelines vulnerable to erosion.

Nitrogen enters marine ecosystems from many different sources. For the purpose of this Plan the sources are classified as uncontrollable sources, such as the atmospheric deposition of nitrogen, and controllable sources, such as wastewater, fertilizer and collected stormwater. The nitrogen from wastewater is caused by septic systems and cesspools that leach sanitary waste into the surrounding soil which ultimately reaches our groundwater and surrounding coastal waters. Excessive nitrogen and other nutrients, such as phosphorus, are the cause of severe eutrophication in estuaries and freshwater ponds



This water quality improvement plan focuses on nitrogen loads from control-lable sources. The open space preservation associated with the Community Preservation Fund, through the preservation of wetlands, aquifer recharge areas, shorelines and rivers, has the added benefit of improving the ability of the natural environment to counteract nitrogen loads from atmospheric deposition. Despite this, the bays and estuary environments associated with Southampton Town still receive more nitrogen than what the waters can naturally assimilate. This is due to the fact that wastewater from both older and newer housing stock is predominantly treated by on-site septic systems that do not adequately remove nitrogen. Nitrogen from these systems is released to groundwater which ultimately discharges to the surrounding coastal waters. Thus nitrogen loading to watersheds of Southampton must be reduced in order to restore ecological health and maintain drinking water standards.

IV. PHYSICAL SETTING OF WATER RESOURCES

Similar to the rest of Long Island, the Town of Southampton was formed by a series of major continental glacial periods. The landforms created by the advance and retreat of these glaciers at different times in history have left glacial moraine ridges and the sloping outwash plains. The barrier beaches and associated tidal marshes of the south shore are of relatively recent geological development formed by oceanic littoral drift.

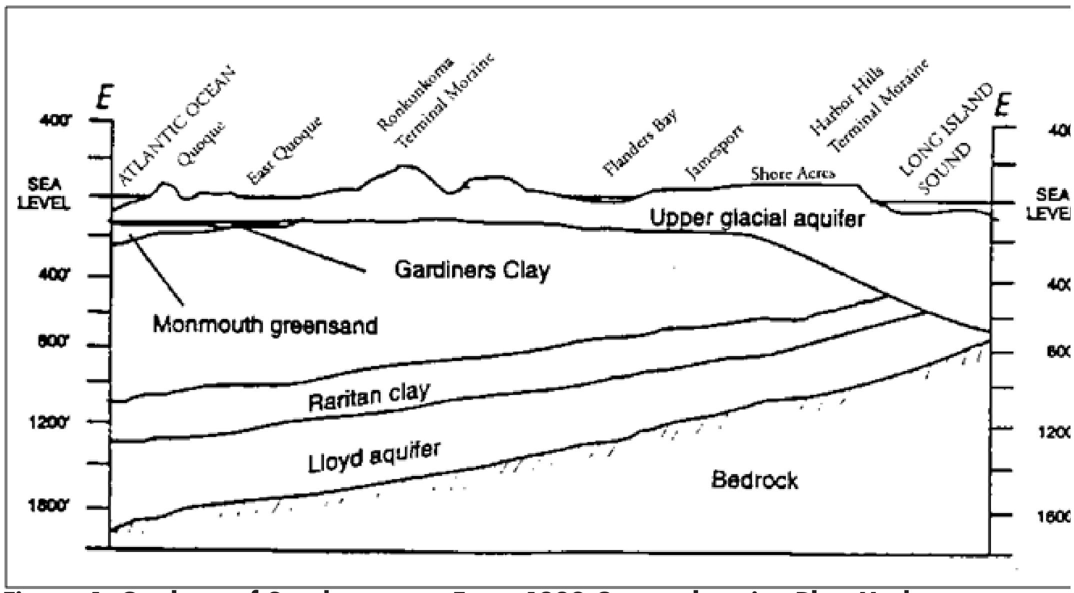


Figure 1. Geology of Southampton. From 1999 Comprehensive Plan Update

The undulating character of the moraine ridges, also known as 'kame-and-kettle' topography, is one of the qualities that adds to the scenic landscape of Southampton. This topography is characterized by a random series of knolls, mounds, and ridges interspersed with irregular depressions known as kettles that are often undrained, containing numerous swamps and ponds. The natural habitats created by these landforms support rich and abundant wildlife.

Southampton has two primary surface watersheds, one that drains north toward the Peconic Bays and another which drains south toward the Atlantic Ocean. On either side of the divide are a significant number of sub-watersheds. These sub-watersheds discharge into many different types of waterbodies including ponds, streams and/or embayments. Each sub-watershed's land uses (residential, agricultural, commercial, industrial, etc.) may produce different sources and levels of contaminants; and the differing amounts of impervious surface (paved areas, buildings, etc.) can affect the pathway of surface water by increasing runoff and decreasing infiltration to groundwater.

Surface waters in Southampton can be divided into two categories: tidal surface waters, and fresh (non-tidal) surface waters. Tidal surface waters constitute about 19,310 acres of tidal area alone which are distributed among major and minor bays, coves, ponds and creeks.

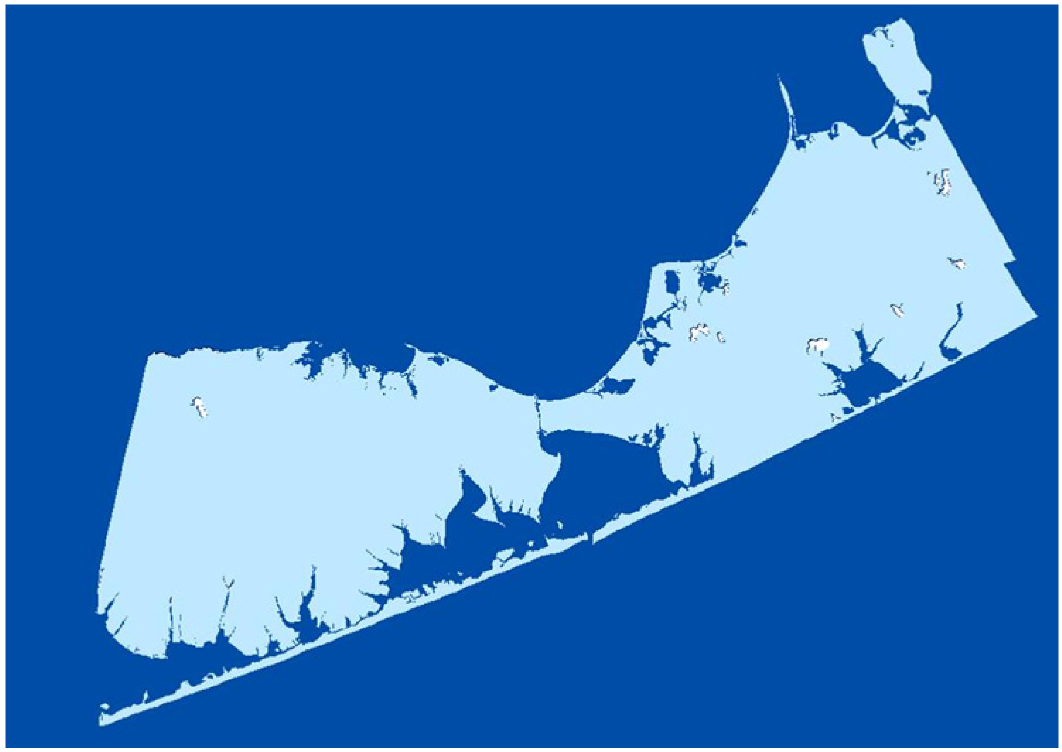


Figure 2. Freshwater Resources in the Town of Southampton

Water moves in three linked, but distinct pathways;

1. Surface water flow may be as a defined river or stream or as sheet flow of stormwater. Some of water in this pathway may infiltrate into the groundwater but most will remain on the surface as it moves downhill to the receiving water body.

2. Groundwater flow which has infiltrated, or percolated, into the ground following a precipitation event. As it percolates, it eventually reaches the settled level of the water table. Like surface water, groundwater also "flows downhill" from the upper reaches of the watershed towards the receiving waterbody. As it moves, some groundwater may intersect with a fresh water body like a kettlehole pond, wetland or a stream, but much will remain underground until reaching an embayment or the ocean.

3. Water may also move in the subsurface, above the normal ground water level, in a temporary flow related to short-term melting or storm conditions. The volume in this sort of flow is generally much less than the other two pathways.

Water movement through the various pathways (i.e., in surface water, groundwater, or subsurface water) will move at vastly differing rates of speed. It may also return to the atmosphere through evaporation or transpiration from plants. Surface water moves much more rapidly than groundwater—surface water flows are often measured in feet/second or feet/minute whereas groundwater movement is more typically measured in feet/day, even in the sandy soils found in Southampton. With groundwater flow at these rates, it may take years—or even decades—for groundwater and any contaminants it may contain to reach a receiving waterbody.[1]

V. WATER QUALITY STANDARDS

Referenced in the State Environmental Conservation Law (ECL)[2] , water quality standards are linked to the classification of the waterbody. All waters in New York State are assigned a letter classification that denotes their best uses. Letter classes such as A, B, C, and D are assigned to fresh surface waters, and SA, SB, SC, I, and SD to saline (marine) surface waters. Best uses include: source of drinking water, swimming, boating, fishing, and shellfishing. The letter classifications and their best uses are described in ECL regulation 6 NYCRR Part 701. The classification of individual bodies of surface water is in regulation 6 NYCRR Chapter X (Parts 800 - 941). Parameters such as pH, dissolved oxygen (DO), dissolved solids, total coliforms, and specific substance pollutants have numerical value limitations.

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDL's are useful in quantifying goals for reducing or eliminating pollutants that degrade conditions in a waterbody measured qualitatively as fishable and swimmable by the federal Clean Water Act.

Currently the substances related to nitrogen included in these standards are Ammonia and Ammonium, nitrate, nitrate and nitrite however; the standard is one for drinking water, not marine health. Since targets for nitrogen and phosphorus levels in surface waters are influenced by a complex set of parameters, such as size of the watershed compared to the size of the receiving waters, total loading volumes, flushing rates, and land use issues, more localized targets are usually developed. In addition, the marine habitat is roughly twenty times more sensitive to nitrogen loading than the drinking water maximum limits. For instance, the Peconic Estuary Program identifies

1 Maps in Berry (2011) show the groundwater to surface water influence zones and notes that nearly half (47%) of all residential development in the Peconic Estuary watersheds is located in the 0-2 year influence zone.
2 6 NYCRR Chapter X- Division of Water: Article 2, Parts 702-703

0.4 to 0.45 mg/L as the target maximum for a healthy marine environment, but the drinking water maximum contaminant level is 10 mg/L[3] .

Currently the Suffolk County Sanitation Code controls nitrogen loading in two ways:

- Establishing minimum lot sizes for residential use:
  - 40,000 sq. ft. or 300 gallons/day/ acre for Groundwater Management Zones III, V and VI, which are hydrological zones over deep, recharge aquifers. This lot size aims to dilute effluent to a range of 4-6 mg/L for total nitrogen.
  - 20,000 sq. ft. or 600 gallons/day/acre for Groundwater Management Zones other than Zones III, V and VI
- Requiring enhanced treatment within a new development site if densities exceed the minimum recommendations cited above. The treatment must reduce nitrogen/nitrates to a flow concentration of less than 10 mg/L (NYSDEC regulations).

As the regional regulatory agency for wastewater management, Suffolk County has recently issued a Comprehensive Water Resources Management Plan[4] (March 2015) and is currently working on a Subwatersheds Wastewater Plan (SWP) that will set the required nitrogen load reduction targets and/or ambient water quality nitrogen concentration targets to meet water quality goals.

In addition, the plan will identify the best means of sewage disposal on a parcel by parcel basis to meet nitrogen reduction targets. Possible treatment options that will currently meet County approval are (i) connection to a Sewage Treatment Plant (STP) or neighborhood cluster to meet wastewater effluent total nitrogen (TN) of <10mg/l, (ii) installation of an Innovative/Alternative Onsite Wastewater Treatment System (I/A OWTS) to meet a non-point source target of TN<19mg/l, or (iii) installation of a conventional system to replace outdated cesspools or failing systems. Under Article 19 of the Suffolk County Health Code, the County will remain the Responsible Management Entity (RMA) which will evaluate, approve, register and oversee all I/A OWTS and as new technologies emerge and consistently perform denitrification, the County will also periodically revise the standards for Nitrogen reduction. Thus, the Town will defer to the County approvals and requirements for treatment options and evaluation of performance standards.

3 From Berry 2015 Pilot Study of Clustered Decentralized Wastewater Treatment Systems in the Peconic Estuary
4 http://www.suffolkcountyny.gov/Departments/HealthServices/EnvironmentalQuality/WaterResources/ComprehensiveWaterResourcesManagementPlan.aspx

The NYSDEC and Long Island Regional Planning Council is currently formulating a Long Island Nitrogen Action Plan[5] (LINAP) to address common issues and near term management strategies that would be appropriate for implementation without waiting for the rigorous watershed analysis that is currently underway. This Community Preservation Water Quality Improvement Project Plan (CPF WQIPP) will build upon the strategies described in LINAP as well as the highly technical work of the SWP that identifies Nitrogen reduction targets by watershed and will incorporate the recommendations and priorities where appropriate and cost effective.

There are many recommendations and existing techniques to be examined and implemented for improving water quality in Southampton, with the main impetus and priority being the upgrading of sanitary systems within high and medium priority areas, which are those areas with groundwater travel of 0-10 years. While the SWP is completed, information from the SCDHS Comprehensive Groundwater Resources Management Plan, the Peconic Estuary Program, the Long Island Nitrogen Action Plan, and other similar technical studies will provide guidance.

VI. DRAFT LEGISLATION

The CPF Water Quality Improvement Project Plan (WQIPP) presented herein is designed to complement the existing CPF Project Plan, by markedly advancing efforts to foster aquatic habitat and watershed restoration, promote flushing in our bays and tidal systems, abate non-point source pollution and runoff, reduce sewage discharges and nitrogen inputs, and reverse or stem other activities threatening our coastal resources and drinking water aquifers.

The referendum and corresponding local law would allow for utilization of a maximum of 20% of the annual Community Preservation Fund revenue to fund local water quality improvement projects. Proposed CPF water protection priorities and expenditures must be transparent and predictable, based on the framework provided herein. The continued acquisition of land using CPF funds will supplement such efforts, by further advancing preservation and recovery of natural coastal and aquatic ecosystems. The key is to model approaches after natural processes and systems; since such tactics offer the best hope of achieving the desired water quality improvement. While the Town has realized some successes in accomplishing this goal, it clearly needs to go much further and begins here by developing a strategic water quality improvement plan.

5 See http://www.dec.ny.gov/lands/103654.html

To that end, this Plan seeks to fill in the gaps of current water protection efforts and launch new initiatives. The WQIPP presented herein is designed to complement the 2015 Town of Southampton CPF Project Plan, by markedly advancing efforts to foster aquatic habitat and watershed restoration, promote flushing in our bays and tidal systems, abate non-point source pollution and runoff, reduce sewage discharges and nitrogen inputs, and reverse or stem other activities threatening our coastal resources and drinking water aquifers.

The following definitions are from the State Law Chapter 551 which provides the guidance and limitations on the use of CPF revenues:

"Water quality improvement project" means: (1) wastewater treatment improvement projects; (2) non-point 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; (3) aquatic habitat restoration projects; (4) pollution prevention projects, and (5) 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.

"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.

"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.

"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.

“Stormwater collecting system” means systems of conduits and all other construction, devices, and appliances appurtenant thereto, designed and used to collect and carry stormwater and surface water street wash, and other wash and drainage waters to a point source for discharge.

“Vessel pumpout station” means a project for the planning, design, acquisition or construction of a permanent or portable device capable of removing human sewage from a marine holding tank.

The long term success of the WQIPP will not only require a sustained and concerted effort towards implementation, but also the continued cooperation and support of the public, government and private sectors for restoration of water quality, as well as for prevention of further damage and impacts. In the short term, elements of the plan and GIS maps will need to continue to be refined- especially with the technical data that the County is working on. Public outreach and coordination is essential in the effort to identify the best possible water quality recovery strategies, as well as a consensus as to priorities for 2016 and beyond.

PLAN FRAMEWORK

REDUCTION

REMEDIATION

RESTORATION

EXPECTED OUTCOMES

PLAN FRAMEWORK

If the mandatory referendum is approved, the water quality improvement program envisioned by the legislation invites its own set of challenges. Priorities need to be set with regard to how projects are selected for funding. The key to achieving consensus is cooperation and coordination among all government agencies, including the town, villages, New York State Department of Environmental Conservation (NYSDEC), New York State Department of State (DOS) and Suffolk County, as well as among private sectors, stakeholders and the public.

I. ADVISORY COMMITTEE

Critical to the success of the plan is the creation of an advisory committee. Therefore to implement this Plan, the Town Board will appoint an advisory panel consisting of five (5) to seven (7) members that will assess potential projects and recommend RFP's and actions to be initiated and/or approved by the Town Board. The advisory panel will be separate from the main CPF advisory board that currently assesses the purchase of properties in target areas. Members of the advisory committee shall not have a financial stake or indirectly gain funding for their organization as part of any outcome of this program. The Town will require a curriculum vitae/resume with requests or solicitations for appointment. Open government/ financial disclosure forms may also be required.

II. HIERARCHY OF PRINCIPLES AND PRIORITIES FOR WATER QUALITY IMPROVEMENT

The Town of Southampton intends to use its CPF resources wisely and systemically approach the nitrogen problem and other pollutants of concern in high priority areas by concentrating first on **REDUCTION** tactics (upgrading of systems to require treatment before disposal into the ground) and then considering **REMEDIATION** (treatment in groundwater) and **RESTORATION** (treatment in water body) tactics, where such projects are reviewed and found to be appropriate and cost effective. It is important to note that not every technology and approach is appropriate for every watershed and therefore the merits of each tactic in context with the watershed and surrounding habitat will require additional analysis as well as approvals from regulating authorities where required.

The following is a list for organizing and prioritizing actions for funding of water quality improvements in the Town of Southampton.

A. **Source Load reductions.** Data shows that the primary source of pollution to the Town's waters originates from onsite cesspool and septic systems. Therefore, the bulk of the attention at the onset of the program will be focused on reducing those loads. Preserving open space is certainly the most logical and efficient way to prevent the sources from increasing in the future and efforts to do so will continue. Projects which meet the criteria for sanitary upgrades in high priority areas will be considered for rebates/incentives toward septic system replacement, neighborhood cluster systems or other recommended wastewater denitrification solutions that will meet County Health Department approval. In addition, the CPF priority list will include "Water Quality Improvement Parcels" that may be obtained with the 20% funding in high priority areas for the purpose of planning for neighborhood cluster systems or for stormwater collection/abatement or restoration purposes.

   Rebate funding will be allocated to individuals in a comprehensive fashion utilizing a means test or other qualifiers to prevent potential fraud and waste. The Town Board will adopt a separate septic rebate resolution that defines the priority locations, rebate amounts, procedures and qualifications for reimbursement.

B. **Mitigation of the loads that are already within the groundwater system**. As the sources of pollution are being addressed in some areas there may be considerable lag time (less than 5 years to greater than 10 years depending upon how aggressively the sources are reduced) before those improvements are seen within the surface waters due to the fact that groundwater moves very slowly. In some instances, additional measures may speed up recovery particularly in areas where a high concentration plume is identified and can be intercepted. In these instances, practices such as installing permeable reactive barriers or fertigation wells can be extremely effective. These are intended as a stop-gap measure or to help accelerate recovery while the actual source of Nitrogen is being addressed. Stormwater Best Management Practices (BMPs) and treatment also fall into this category since stormwater is a conveyance of some other sources of nitrogen pollution such as fertilizers.

C. **Restoration of Coastal and Marine Habitats.** In many cases coastal habitats will respond on their own once the water quality improves. However, in those cases where restoration is necessary, funding should be allotted to those programs or projects that can document the area is indeed "Restoration Ready", which means that the circumstances of the physical environment and water quality are suitable to support the resource to be restored.

The guiding principle for efforts to restore wetland habitats and organisms is that they should be undertaken when (1) there is documentation the area being proposed for the project can sustain the resource proposed for restoration, based on relevant peer-reviewed science or established standards [e.g. in the case of shellfish and eelgrass, restoration should meet all of the parameters that would indicate the waters are within the survival and reproduction success range for Temperature, clarity, pH, salinity, Dissolved oxygen and food quality, etc] and (2) there is adequate documentation that the initial cause of decline has stopped or is in the process of being ameliorated. In addition, projects which propose dredging or other disturbance to bottom sediments will need to provide core sampling to determine that no unanticipated adverse impacts to water quality will occur.

III. PRIORITY AREAS

The Town of Southampton has preliminarily mapped priority areas for the purpose of this plan, based on the following criteria[6]:

- Locations with no public water (well water)
- Older communities, where many of the homes are likely to have cesspools instead of septic systems
- Homes that are built on small lots (less than half-acre)
- Sites that have shallow depths to groundwater (e.g. less than 10 feet)
- Sites that may be temporarily under threat of flooding or storm surge (FEMA Flood zones, SLOSH[7] zones)
- Soils that may be too porous or too impermeable for proper treatment of wastewater
- Areas where groundwater reaches surface water bodies relatively quickly
- Nearby water bodies listed as TMDL impaired or the site of restoration efforts

Parcels in each hamlet that meet one or more of these criteria are delineated on the maps as high or medium priority as follows:

High Priority: A combination of the parameters described above (SLOSH, FEMA, TMDL, Size, etc) and 0-2 year groundwater to surface water travel times.
Medium Priority: 0-10 year groundwater to surface water travel times excluding the areas in the High Priority above

In addition to prioritizing septic system rebates, proposals for innovative technologies and solutions for remediation/restoration as described in this Plan will be considered by priority area and highest potential for water quality improvement. However, as discussed, the stated goals and objectives of the Suffolk County subwatersheds plan are to:

- Establish first order nitrogen load reduction goals for all of the County's surface water, drinking water, and groundwater resources;
- Establish uniform and consistent set of subwatershed boundaries for all priority areas;
- Develop nitrogen load rates;
- Develop receiving water residence times;

6 From Berry 2015 Pilot Study of Clustered Decentralized Wastewater Treatment Systems in the Peconic Estuary
7 SLOSH is acronym for "Sea, Lake and Overland Surges from Hurricanes"

- Establish tiered priority areas;
- Establish preliminary load reduction goals;
- Recommend wastewater upgrades for each priority tier

Therefore the maps and strategies will be updated and refined as this information becomes available.

IV. PROJECT IMPLEMENTATION

The purpose of the implementation plan is to identify the types of projects that will guide subsequent solicitation and selection for funding and implementation. The Plan emphasizes reductions in nitrogen loading, stormwater abatement and aquatic habitat and watershed restoration priorities during years 1 through 5. In keeping with the intent of the legislation, implementation incorporates 1) public/local involvement in setting annual reduction, remediation and restoration priorities; 2) emphasis on water quality improvement in the design of projects; and 3) coordination and communication with other agencies and stakeholders, public and private.

A. RFP Process

In an effort to be proactive and in compliance with the Town's procurement policies, it is anticipated that the Town will solicit and secure professional services for the projects identified herein through the formal Request for Proposals (RFP) process to ensure that restoration initiatives are science-based, properly documented, and have a high likelihood of success in achieving their goals. The Town, in consultation with the advisory committee, will collectively seek proposals that are based on the hierarchy of principles and priorities and will identify the necessary environmental review requirements for aquatic habitat and watershed restoration projects. Proposals will be reviewed and ranked and a recommendation for selection made to the Town Board for formal adoption by resolution. The Town Board may elect to prioritize the types of projects that are eligible as part of an annual appropriation of funds.

B. State Environmental Quality Review Act (SEQRA) & Permits

To fund, undertake or approve an Unlisted or Type I action pursuant to this Plan will require full SEQRA analysis and a determination of significance. The Town Board will act as Lead Agency on applicable SEQRA assessments. Depending on the project type, short or long form

EAF's will be required and the Department of Land Management will coordinate the review among applicable agencies. Necessary permits must also be obtained from all involved agencies for funded projects.

C. Rebates and parcel acquisition

Based on the attached maps[8] parcels within high priority areas will be eligible to receive septic system rebates[9]; however, owners of failing sanitary systems or cesspools outside of these areas or those who wish to be proactive and meet all applicable requirements will also be considered for rebates. Note that commercial parcels in high priority areas will be eligible for sanitary system rebates as well. In high priority areas where neighborhood cluster systems are appropriate or where stormwater abatement or other solutions are appropriate, WQIPP funds may be allocated to purchase parcels for water quality purposes.

D. Inter-municipal agreements for data sharing, etc.

Because watersheds do not follow municipal boundaries, as part of the plan implementation the Town may seek to enter intermunicipal agreements with the Villages and/or the surrounding municipalities where appropriate and necessary for the purpose of data sharing, mapping, monitoring, etc. Additional agreements will be secured if needed for data sharing with the USGS, EPA, NYSDEC and Suffolk County as part of this effort.

E. Grants

The Town may seek to leverage its grant applications with the annual CPF Water quality revenue (up to 20%) in order to achieve water quality goals. For this purpose the State legislation also permits the Town to provide the Peconic Estuary Program with funds to match federal, state, county or other public/private funds not to exceed ten (10) percent of the annual amount appropriated for water quality projects.

F. Public/Private Projects

In some instances the Town may work in partnership with private property owners and stakeholders to achieve water quality goals provided that the allocation of these funds will not be for the purpose of accommodating new growth, as this is prohibited by State law.

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8 Initial maps will be amended as the County and USGS comprehensively map the subwatersheds and determine nitrogen reduction targets

9 Assuming compliance with all applicable rules and regulations; new construction or substantial renovations will not qualify for said rebates.

G. Monitoring

Restoration and remediation projects will require routine monitoring to determine efficacy on water quality improvements and a pre- and post-installation monitoring program/protocol must be made a part of each specific project. Installation of the innovative/alternative onsite disposal systems and cluster systems will be geo-referenced as part of the Town's GIS mapping effort.

H. Reporting

It is anticipated that annual reporting will occur to discuss progress with septic system upgrades, successes, lessons learned, etc. and to determine upcoming priority and focus areas.

I. Re-assessment of plan

At the time of this Plan, Suffolk County is poised to commence the subwatersheds plan. Once the subwatersheds are mapped and nitrogen reduction targets are established, this plan will likely need to be re-assessed and refined. In any event, a re-assessment of the Plan (based upon data from the prior year as well as new information) should occur at least every five years in accordance with the procedures for the CPF Project Plan.

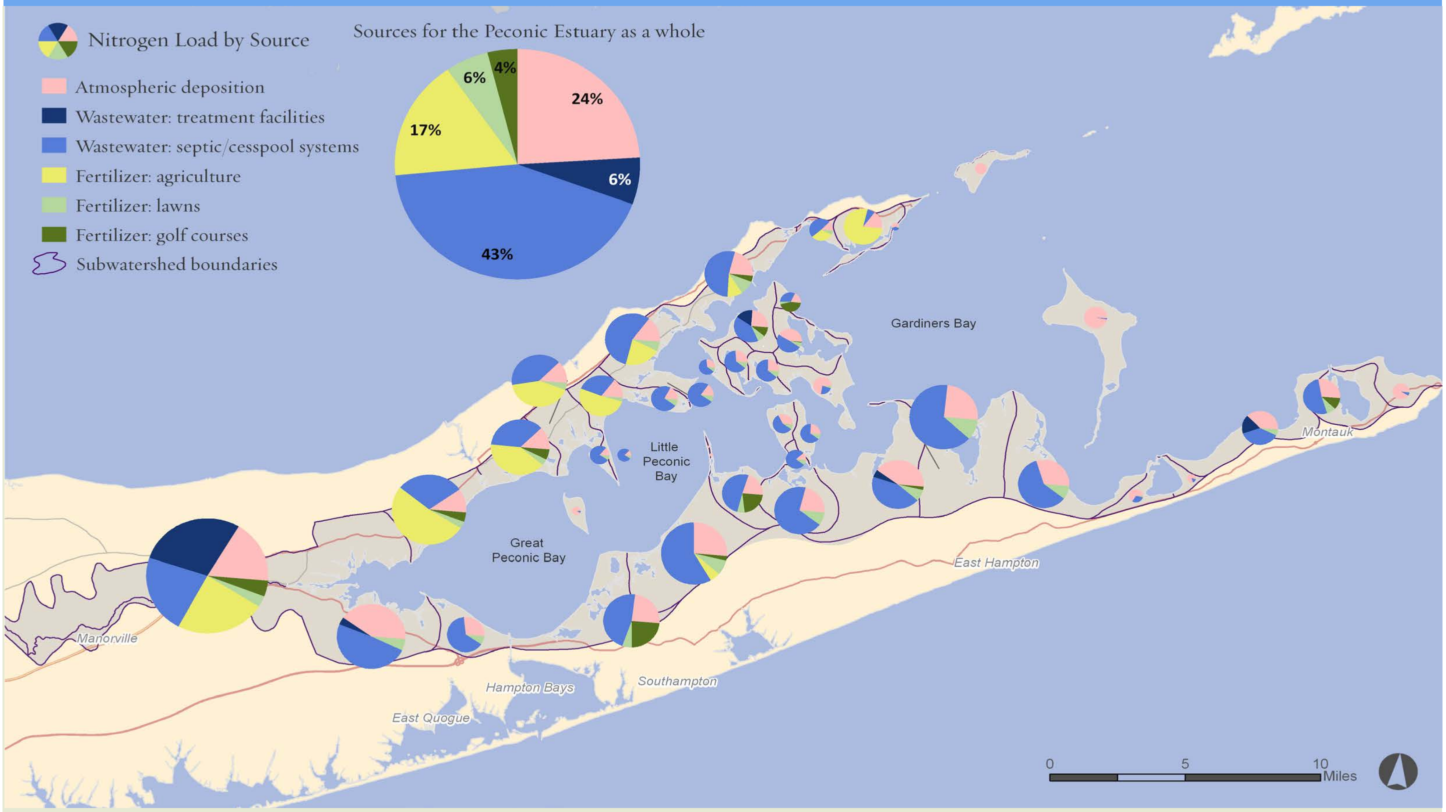
REDUCTION

SOURCE LOAD REDUCTIONS

Technologies identified as reduction tactics for the purpose of this Plan are those that reduce nitrogen before it enters the groundwater. Initial load reduction targets to protect both surface waters and public drinking water supplies will be developed as part of the Early Action LINAP, with more refined reduction targets also based on the County subwatershed modeling described earlier. The conceptual LINAP scope indicates that reductions are likely to be based on a target dissolved inorganic nitrogen (DIN) number that will be related to ecosystem response.

The major strategy to achieve reduction in this plan for years 1-5 is to incentivize private homeowners and businesses to upgrade existing sanitary systems to Innovative/Alternative onsite sewage disposal systems (I/A OWTS) or neighborhood collection/cluster systems that actively reduce nitrogen. As part of this incentive program, the Town of Southampton hopes to facilitate the phase out of pre-existing cesspool systems installed prior to 1973 as these are particularly problematic in areas with high water tables and in close proximity to surface waters. When flooded or submerged in groundwater, septic systems do not function as designed and they fail to adequately treat pathogens. Excess nitrogen from sewage threatens our valuable natural resources, coastal defenses, and human health and therefore must be reduced expeditiously.

Nitrogen Loading to the Peconic Estuary

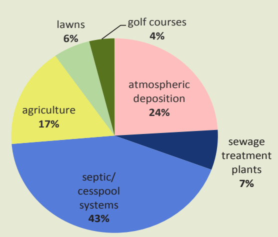


Major sources of nitrogen to the Peconic Estuary and its subwatersheds

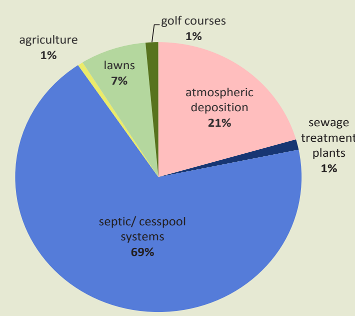
The Nature Conservancy on Long Island has been modeling the nitrogen load for 44 subwatersheds of the Peconic Estuary. This work expands off a previous analysis done in Great South Bay (GSB) by using the Nitrogen Loading Model (NLM) (Kinney and Valiela 2011). The purpose of this study is to better understand the magnitude, source, and location of nitrogen pollution and to serve as the basis for potential reduction strategies. While wastewater is the largest source of nitrogen for the estuary as a whole, agricultural fertilizer is the main contributor in a number of the subwatersheds along the North Fork. Atmospheric deposition is also a major source of nitrogen throughout the estuary, and even more so after direct deposition to the water surface is considered. *Note that the figures above and below only include land derived loads.

Comparison of nitrogen loading: Peconic Estuary and Great South Bay*

- The total nitrogen load to the Peconic Estuary is 29% of that to Great South Bay (GSB). This is in part due to the larger drainage area of the GSB (Peconic Estuary is about 60% of the land area).
- The Yield (kg N per year *per hectare*) is about half as much in the Peconic Estuary overall as compared to GSB.
- There are about 5 times as many residential buildings in GSB, leading to more nitrogen from lawns and wastewater, as well as from atmospheric deposition due to more impervious surfaces.
- The total load from all fertilizer is fairly comparable between the two study areas. (70-80,000 kg N/yr range).
- Total load from agricultural fertilizer is about 9 times higher in the Peconic Estuary as compared to GSB.



Peconic Estuary



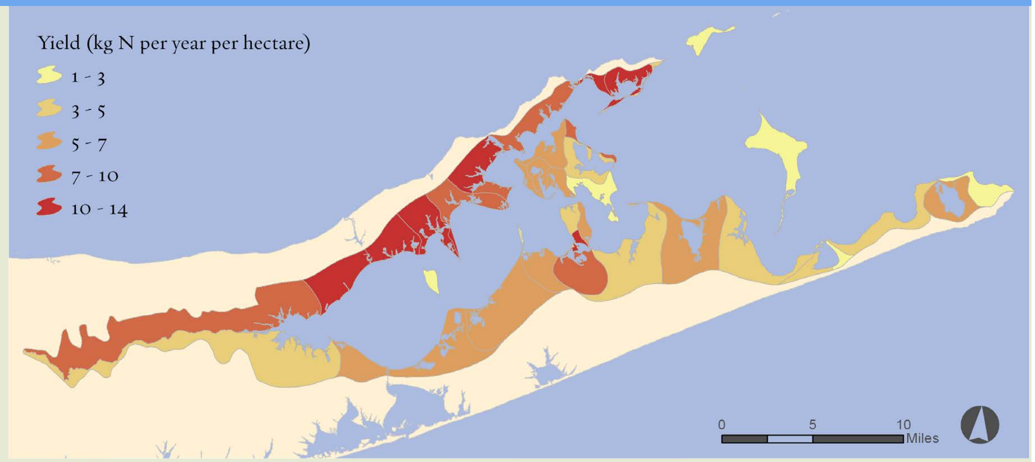
Great South Bay

Nitrogen Load (kg /year)

	Peconic Estuary	Great South Bay
Atmospheric deposition	**64,233**	**171,259**
Wastewater	**132,453**	**584,533**
septic systems/cesspools	114,737	574,179
sewage treatment plants	17,717	10,354
Fertilizer	**70,415**	**79,072**
lawns	15,350	62,139
golf courses	10,590	11,985
agriculture	44,475	4,947
TOTAL Nitrogen (kg/year)*	**267,101**	**834,864**
Subwatershed area (ha)	44,083	71,640
Yield (kg/year/ha)	6.1	11.0

Nitrogen Loading to the Peconic Estuary

As subwatersheds are not the same size, it is important to not only look at total load, but also nitrogen yield, which shows where the greatest impact is per unit area. In general, the nitrogen yield is highest along the North Fork, which is due in part to the additional presence of agriculture. The nitrogen yield from wastewater and atmospheric deposition is fairly comparable in magnitude across the subwatersheds.

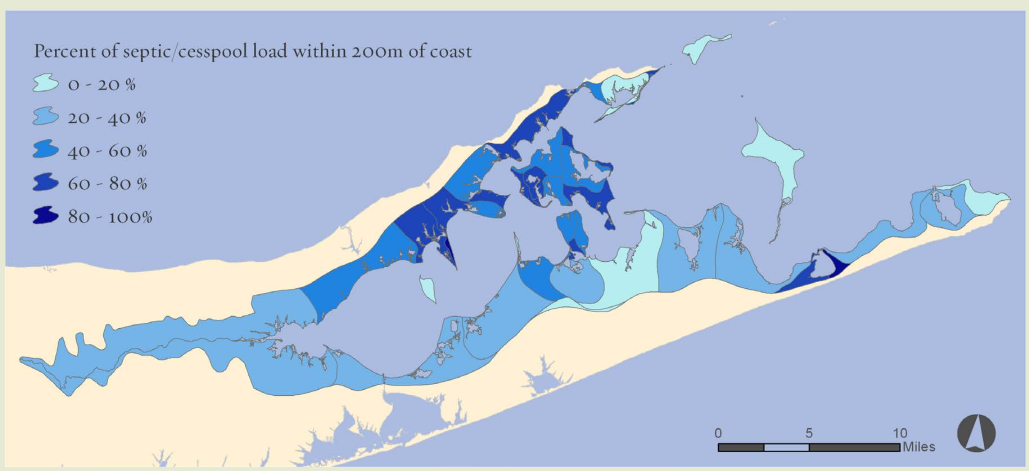


Nitrogen yield to Peconic Estuary subwatersheds

Using building footprint data and sewer district boundaries, we can estimate septic system density and visualize at a higher resolution where the highest concentration of nitrogen from septic systems originates from. Areas of highest concentration, (1 or more septic systems per ¼ acre lot), are primarily around Sag Harbor, Riverhead, and Montauk.

Density of unsewered residences

Half the overall nitrogen load from septic wastewater comes from homes within 1000 feet of the coastline in the Peconic Estuary. This is about 18% of the total load from all sources. In addition to being close to the coast, these are also properties that are likely to be closest to the water table and effected by sea level rise.

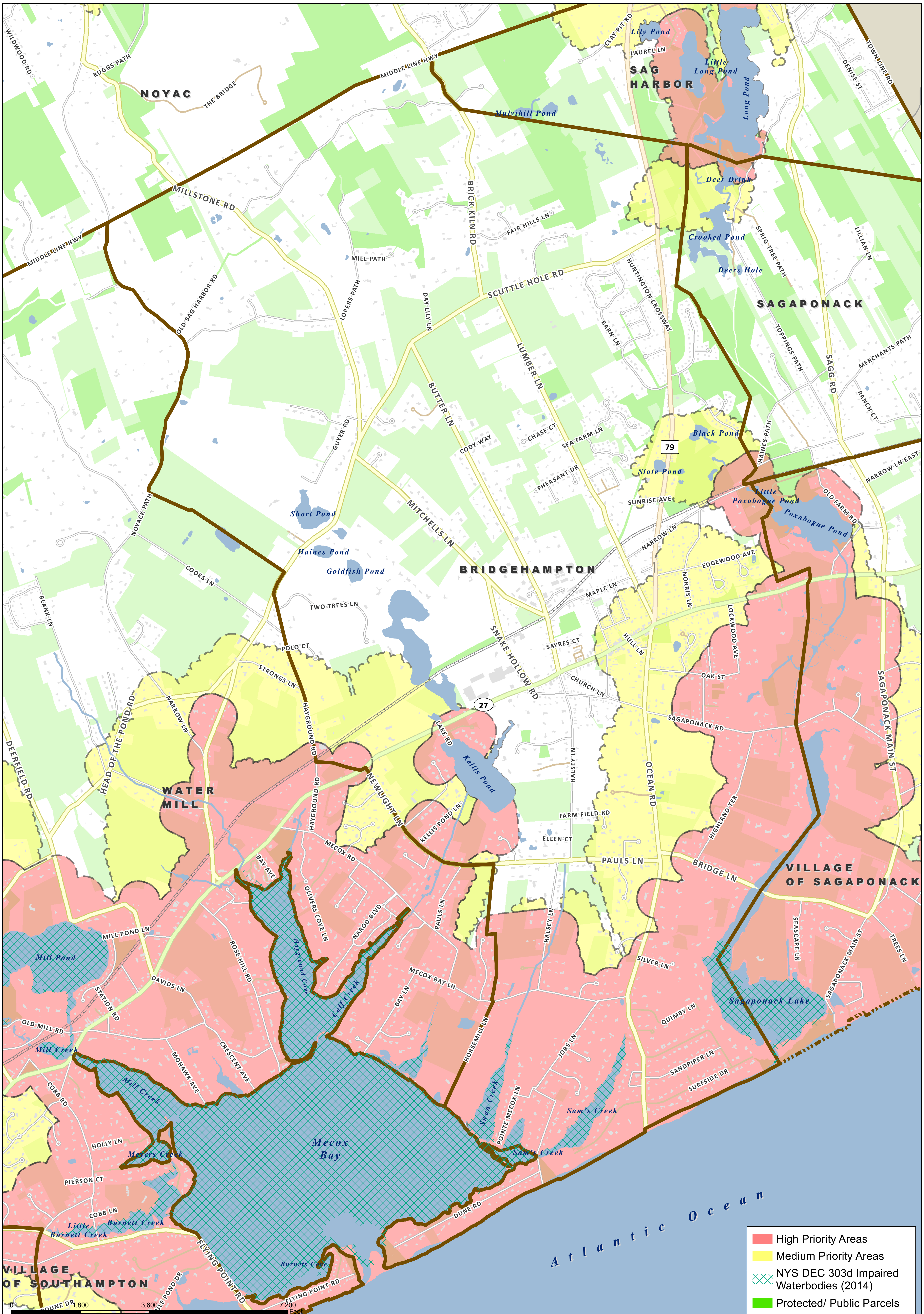


Percent of septic load from within 1000 ft of the coast

Data sources: U.S. Geological Survey, Suffolk County Division of Planning & Environment, Peconic Estuary Program, National Atmospheric Deposition Program, U.S. EPA, U.S. Census Bureau
References: Kinney, E. L. and I. Valiela. 2011. Nitrogen loading to Great South Bay: land use, sources, retention, and transport from land to bay. Journal of Coastal Research, 27(4), 672–686.
Kinney, E. L. and I. Valiela. 2011. Nitrogen loading to Great South Bay: Report on Phase 2 Management Scenarios. Report to the NY State Department of State Division of Coastal Resources.

TOWN OF SOUTHAMPTON CPF WATER QUALITY IMPROVEMENT PROJECT PLAN MAPS

- BRIDGEHAMPTON
- EAST QUOGUE
- EASTPORT
- HAMPTON BAYS
- NORTH SEA
- QUIOGUE
- SHINNECOCK INDIAN NATION
- SPEONK - REMSENBURG
- VILLAGE OF NORTH HAVEN
- VILLAGE OF SAGAPONACK
- WATER MILL
- WESTHAMPTON
- FLANDERS
- NORTHAMPTON
- NOYAC
- RIVERSIDE
- SAG HARBOR
- SAGAPONACK
- SHINNECOCK HILLS
- TUCKAHOE
- VILLAGE OF QUOGUE
- VILLAGE OF SAG HARBOR
- VILLAGE OF SOUTHAMPTON
- VILLAGE OF WESTHAMPTON BEACH
- VILLAGE OF WESTHAMPTON DUNES



Town of Southampton CPF Water Quality Improvement Project Plan

BRIDGEHAMPTON

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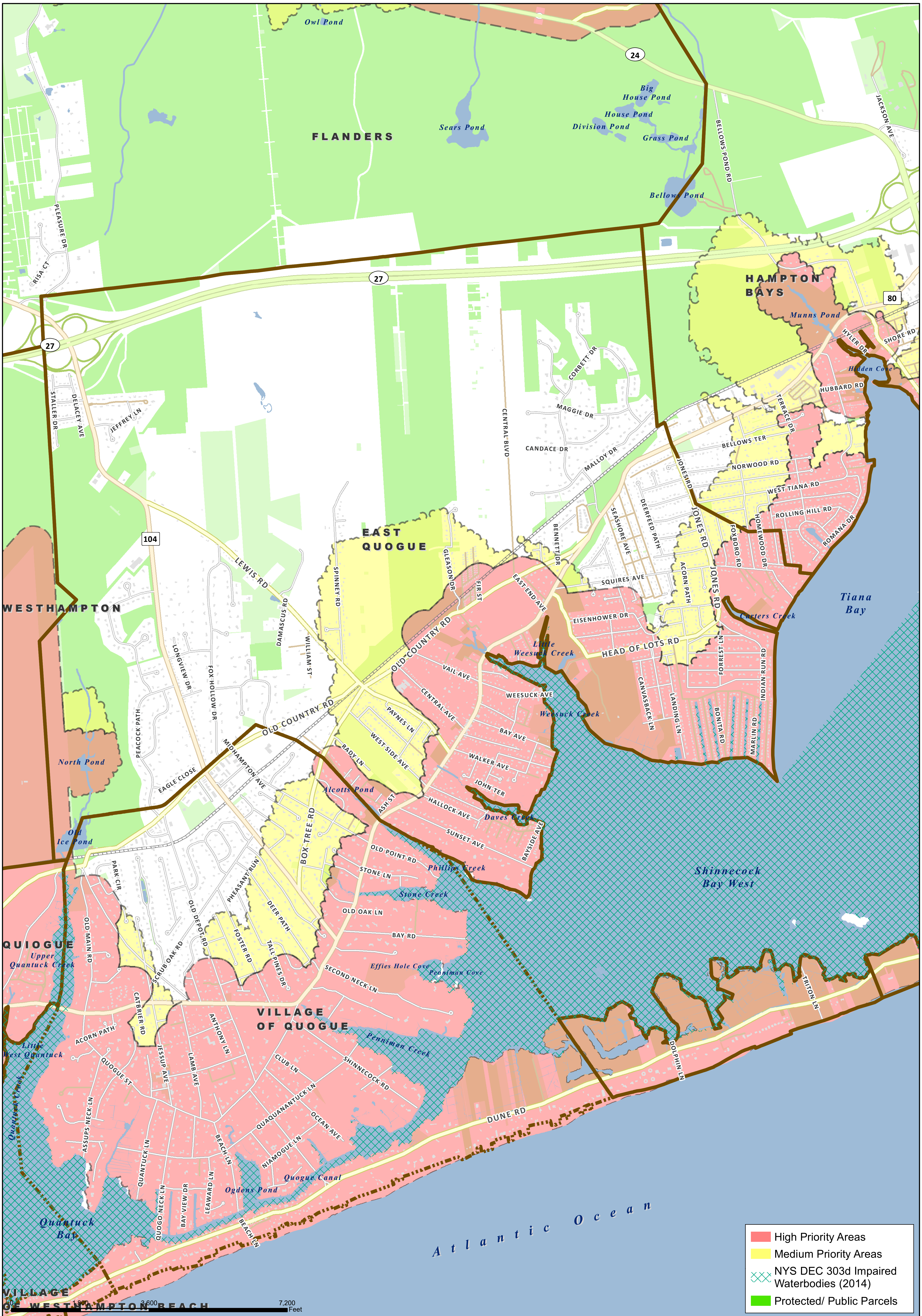

Town of Southampton CPF Water Quality Improvement Project Plan

EAST QUOGUE

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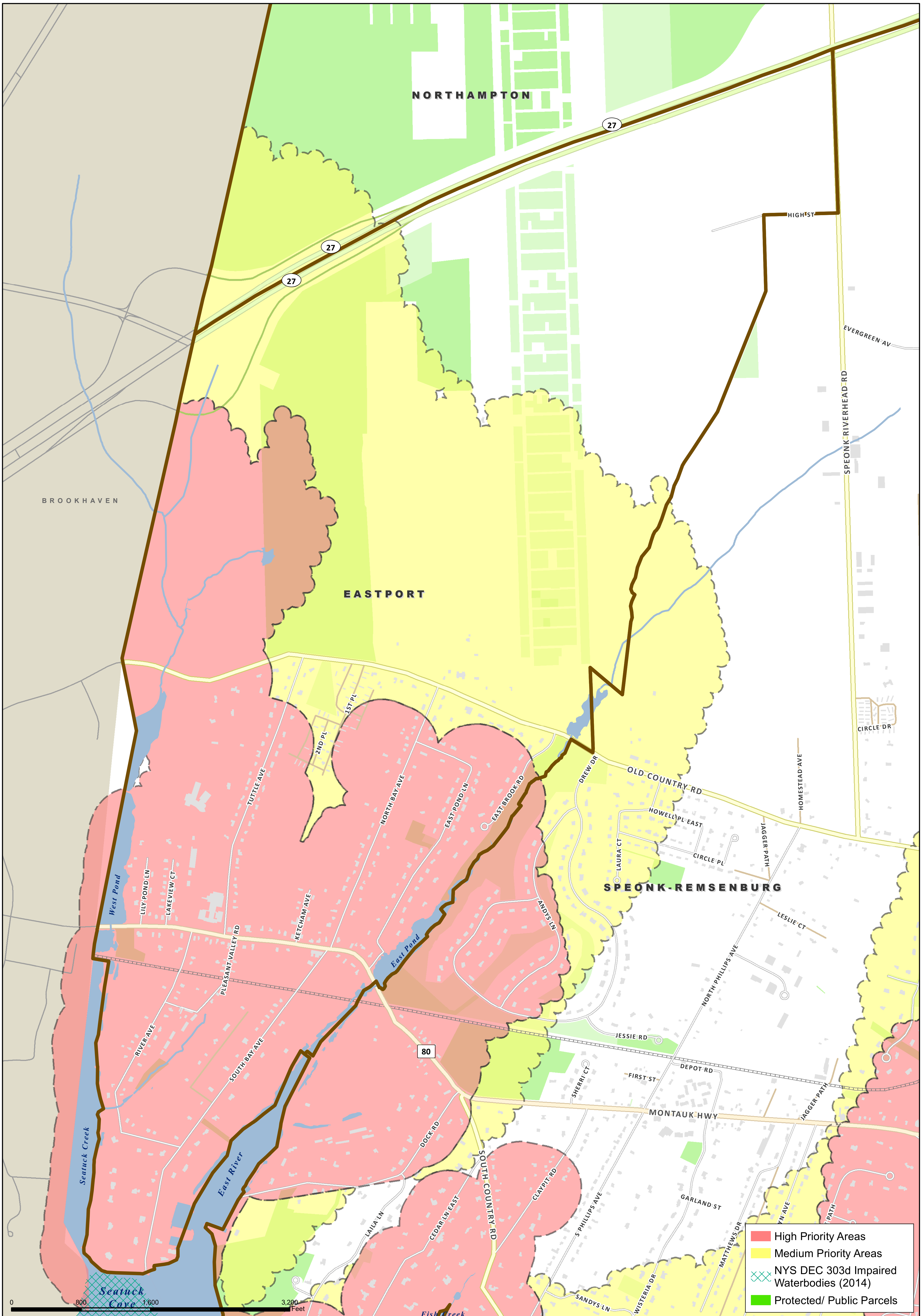

Town of Southampton CPF Water Quality Improvement Project Plan

EASTPORT

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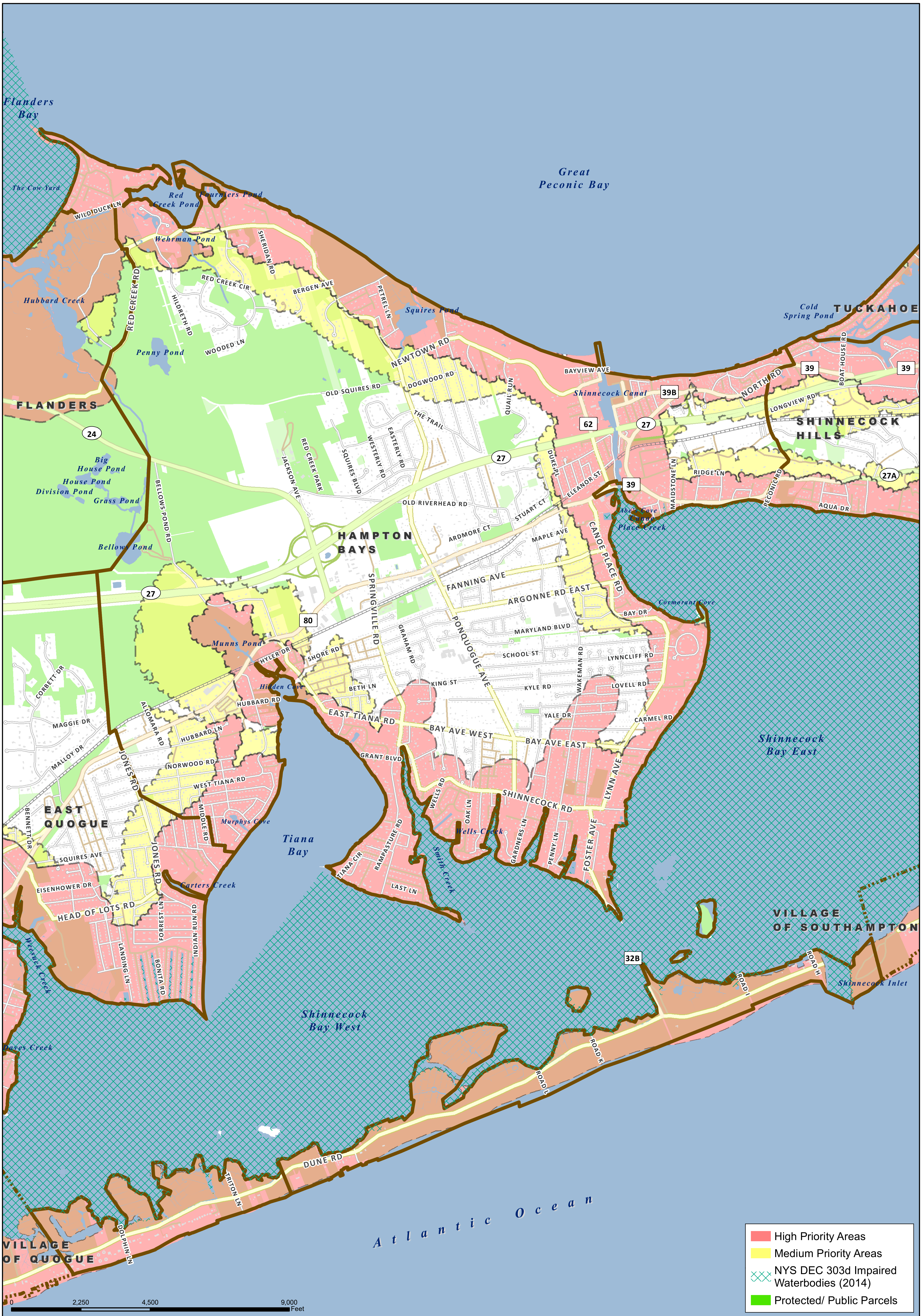

Town of Southampton CPF Water Quality Improvement Project Plan

HAMPTON BAYS

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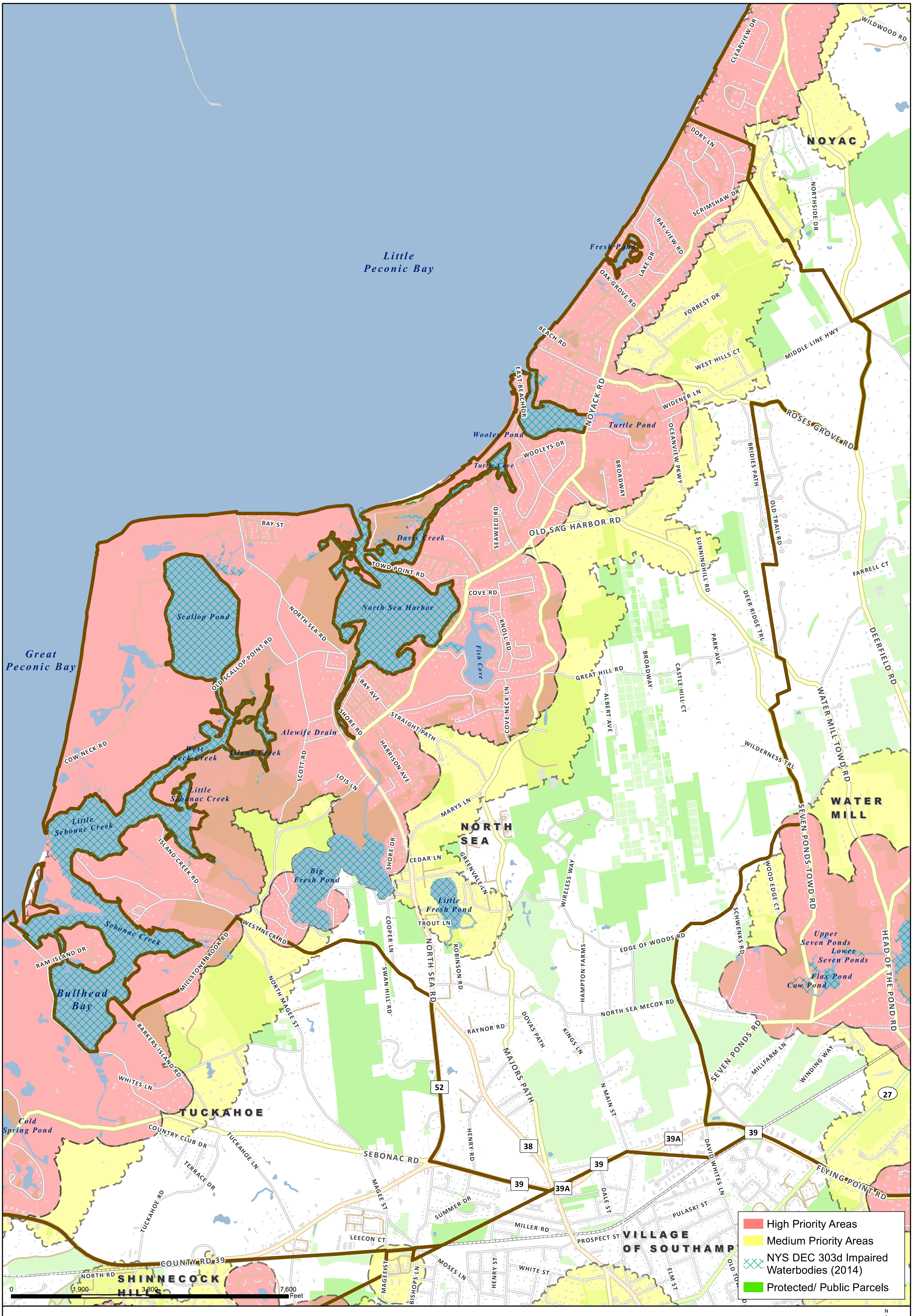

Town of Southampton CPF Water Quality Improvement Project Plan

NORTH SEA

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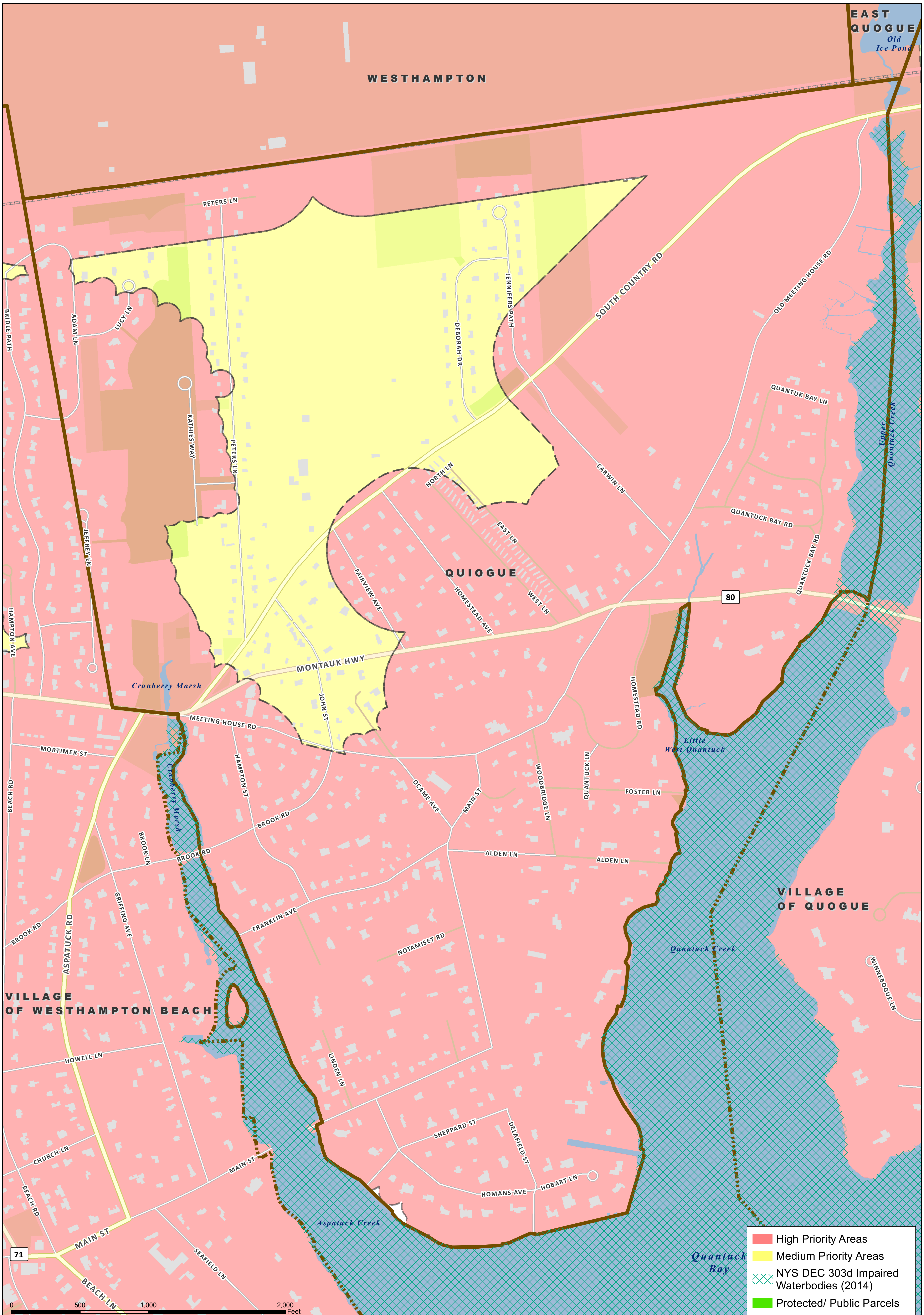

Town of Southampton CPF Water Quality Improvement Project Plan

QUIOGUE

N
W E
S

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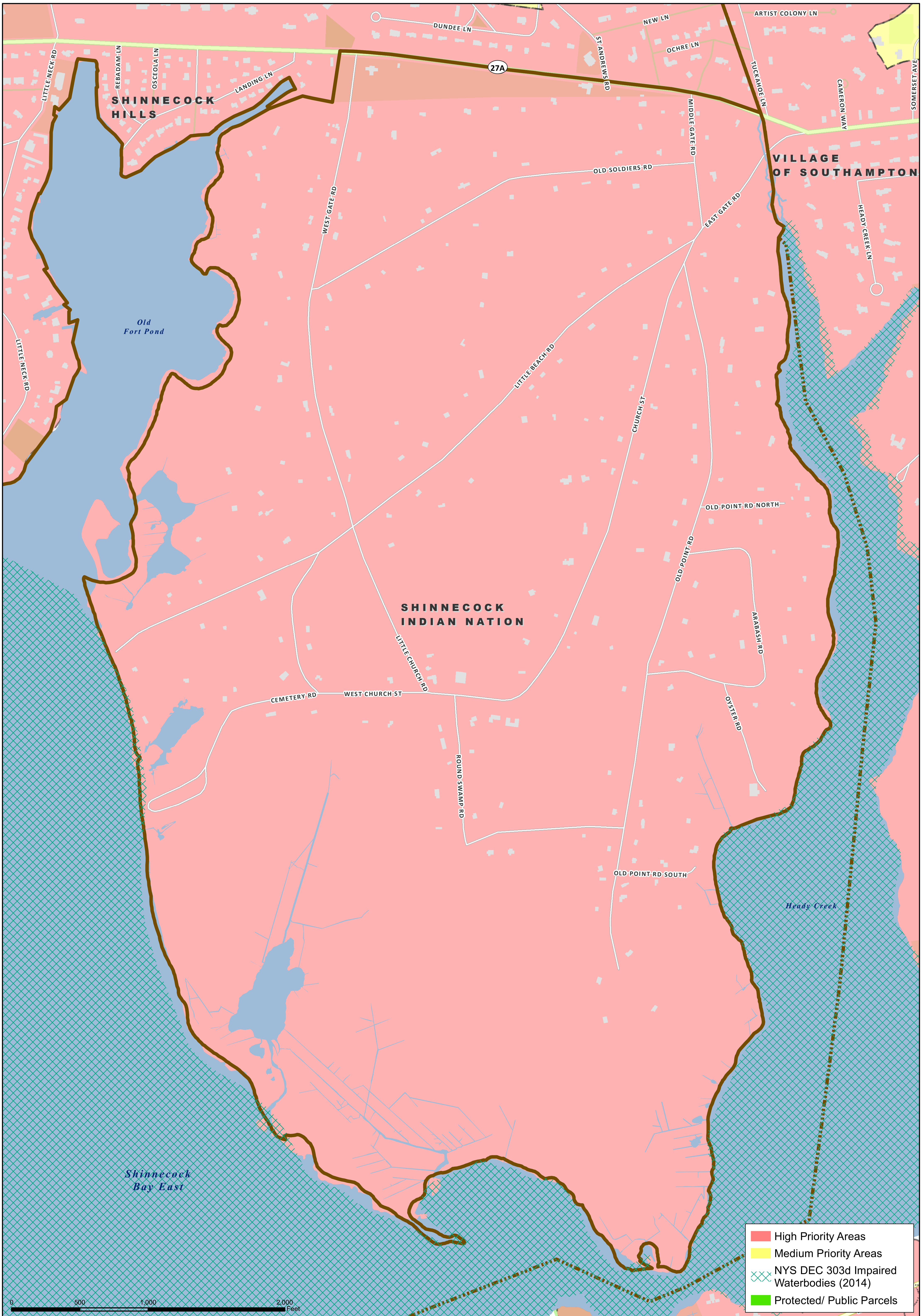

Town of Southampton CPF Water Quality Improvement Project Plan

SHINNECOCK INDIAN NATION

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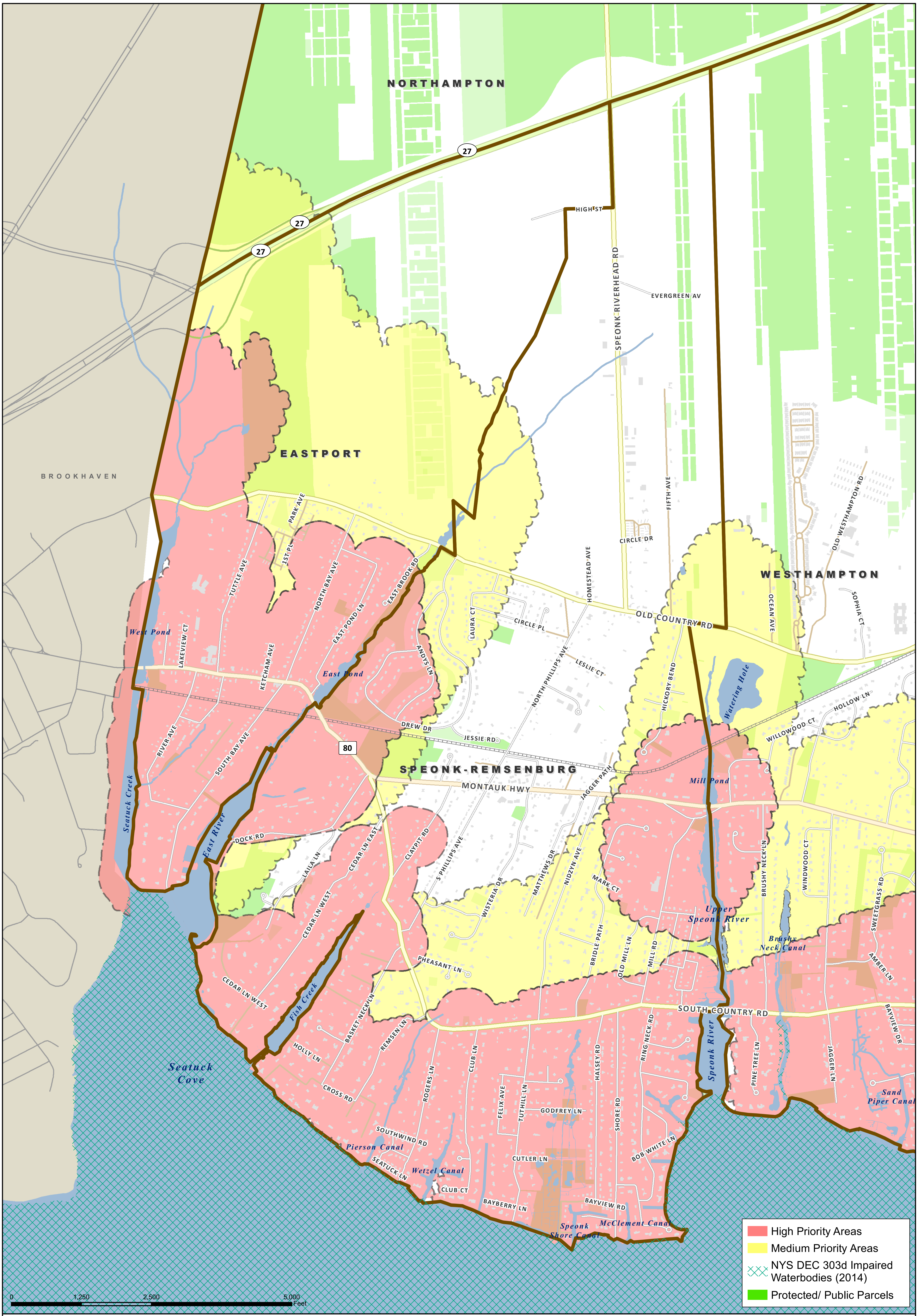

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SPEONK-REMSENBURG

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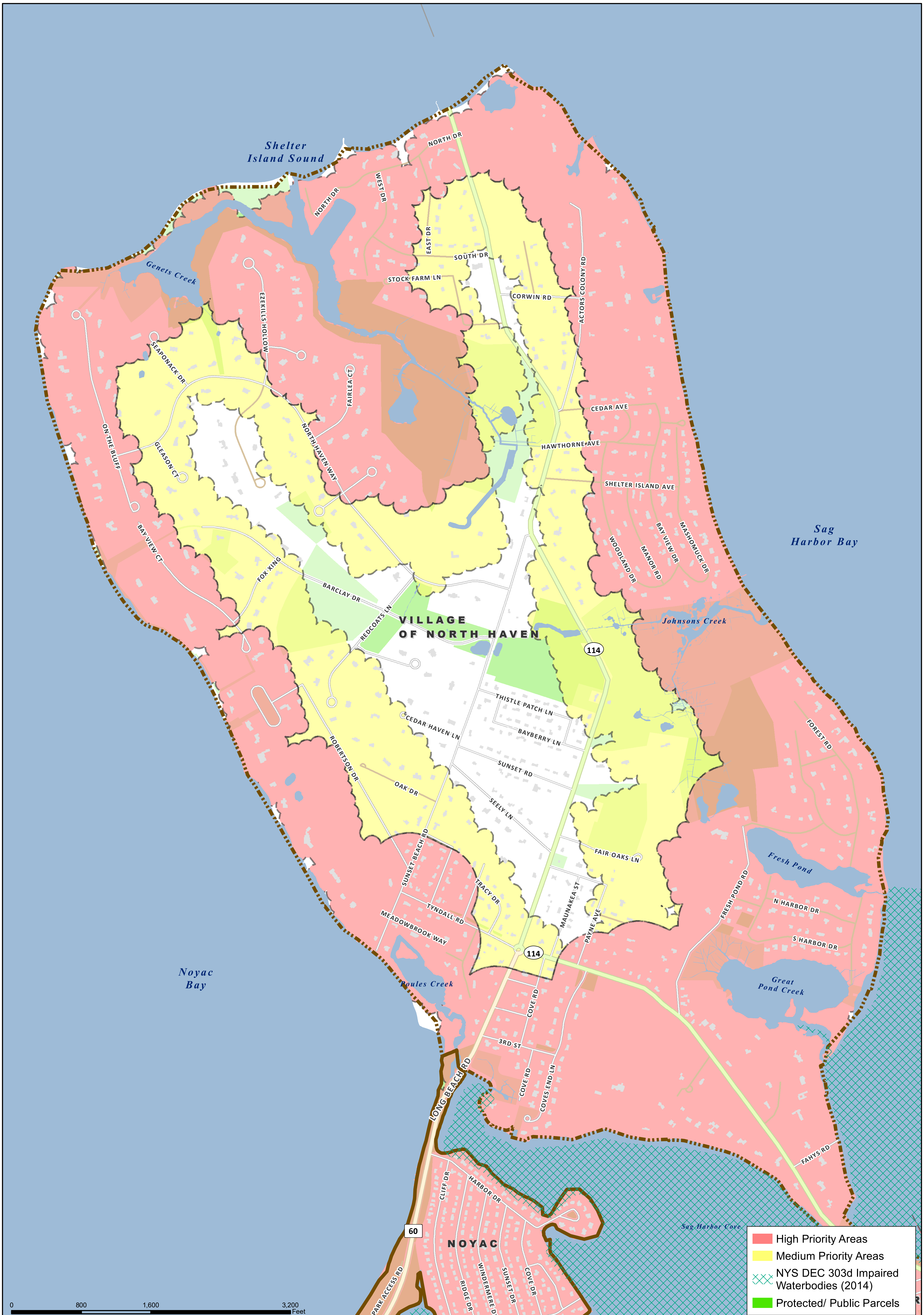

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF NORTH HAVEN

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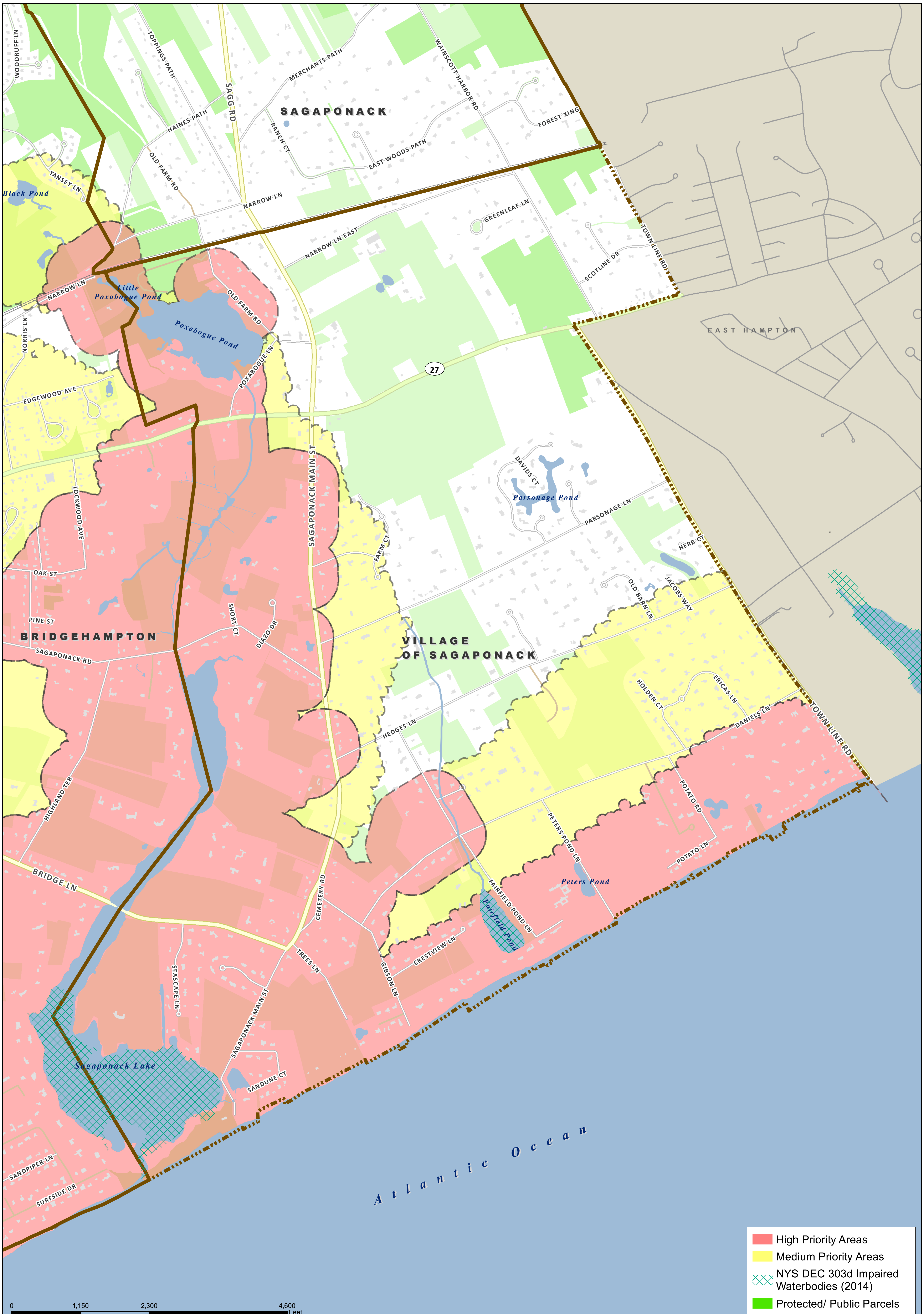

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF SAGAPONACK

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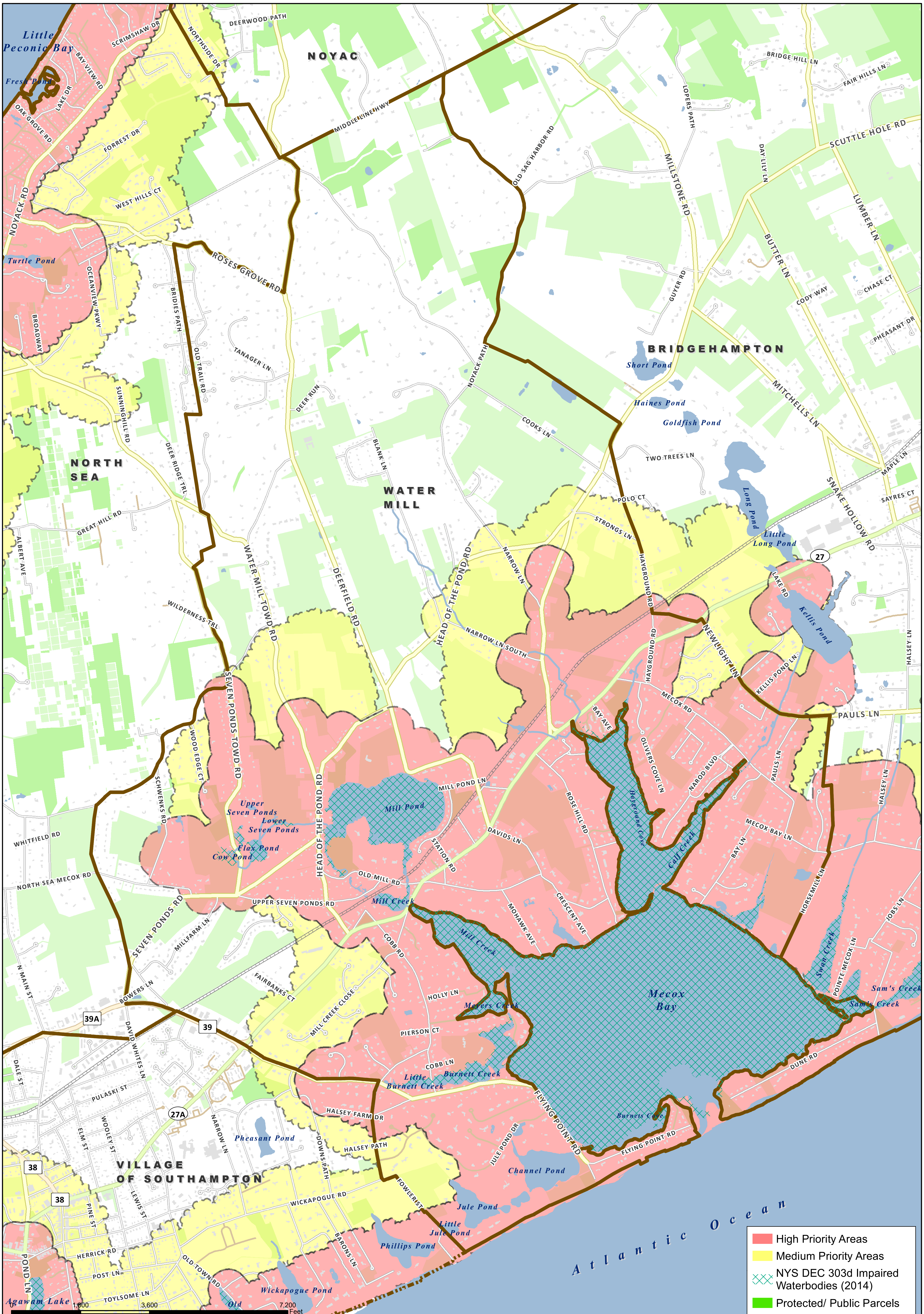

Town of Southampton CPF Water Quality Improvement Project Plan

WATER MILL

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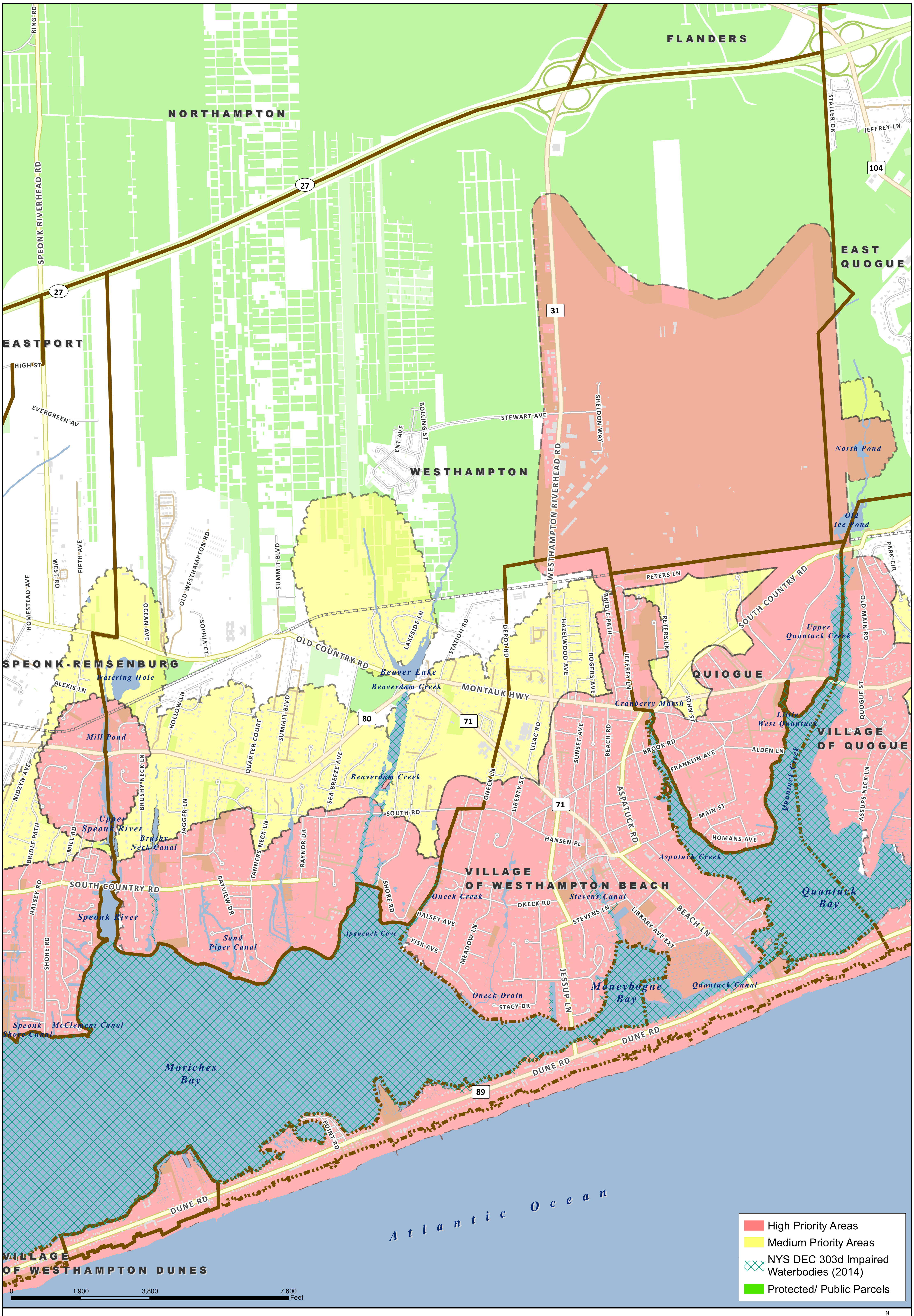

Town of Southampton CPF Water Quality Improvement Project Plan

WESTHAMPTON

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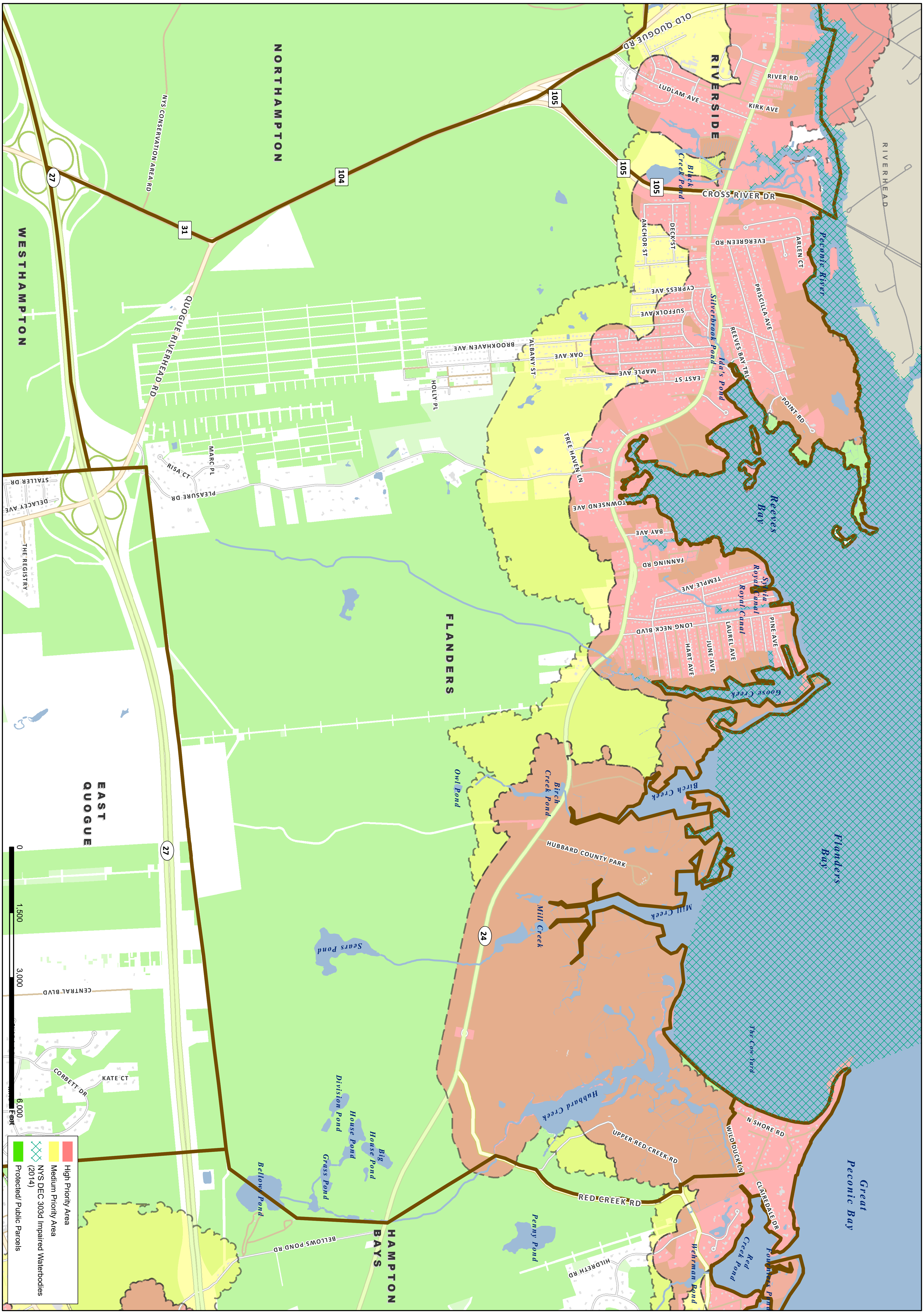

Town of Southampton CPF Water Quality Improvement Project Plan

FLANDERS

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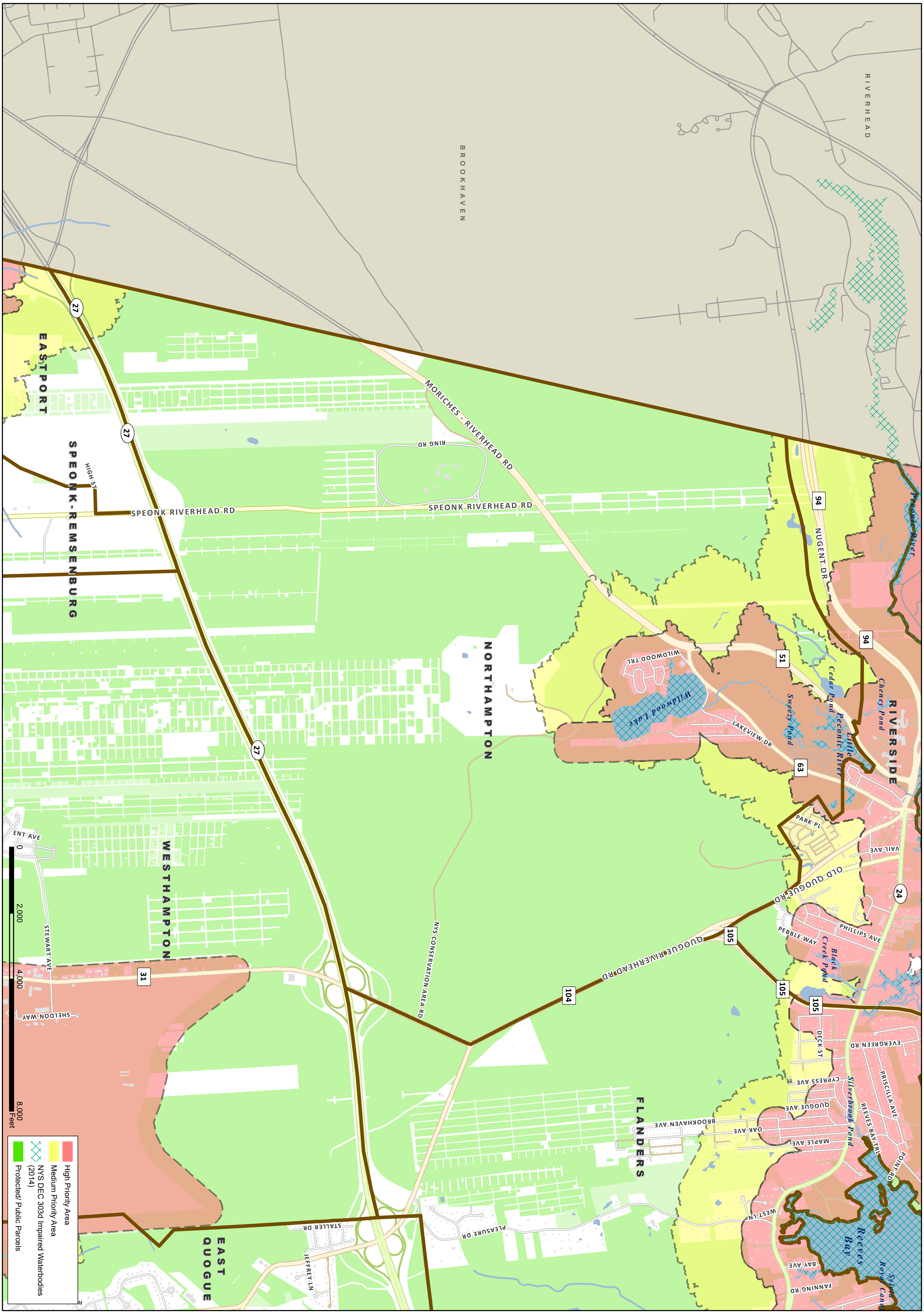

Town of Southampton CPF Water Quality Improvement Project Plan

NORTHAMPTON

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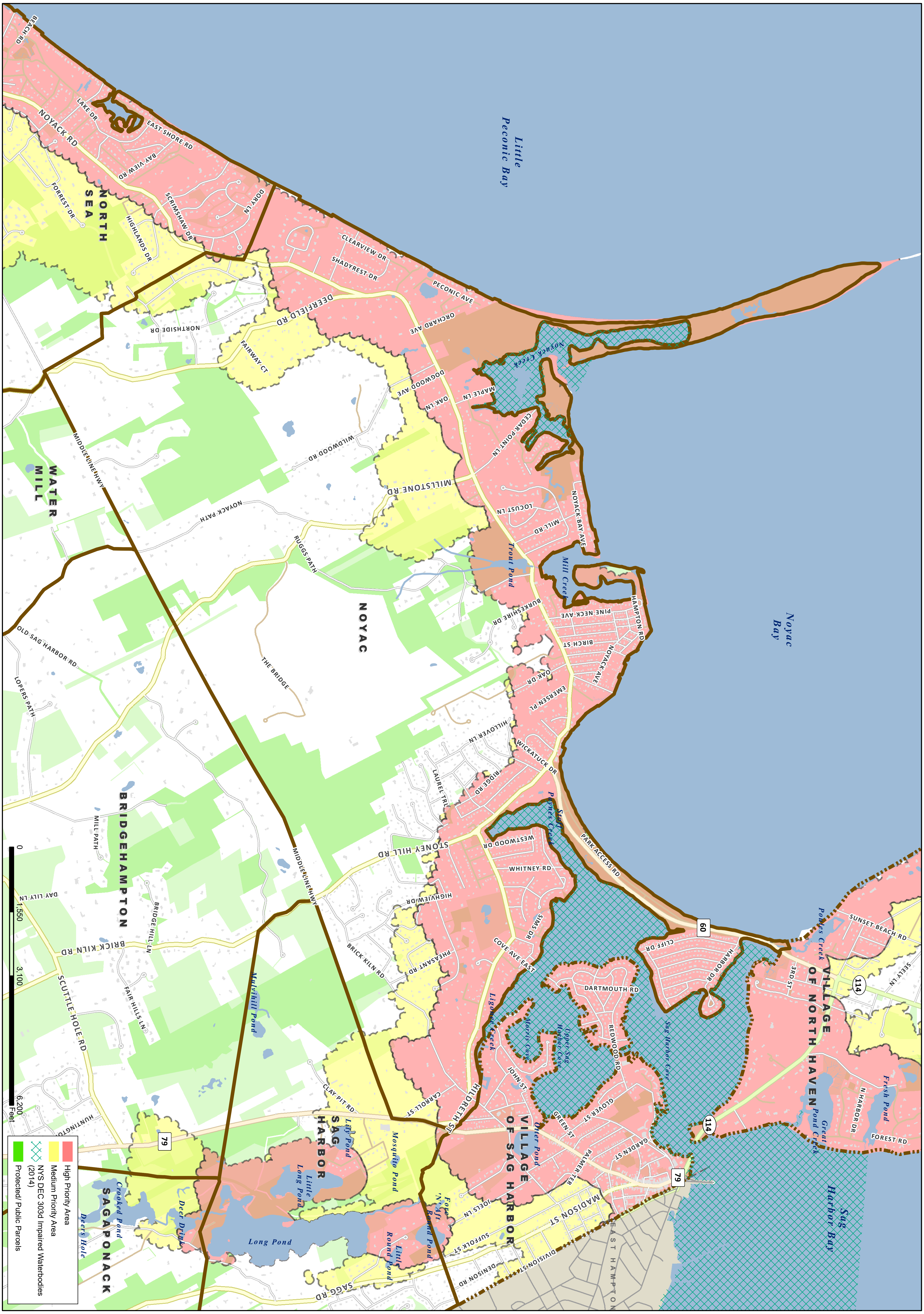

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NOYAC

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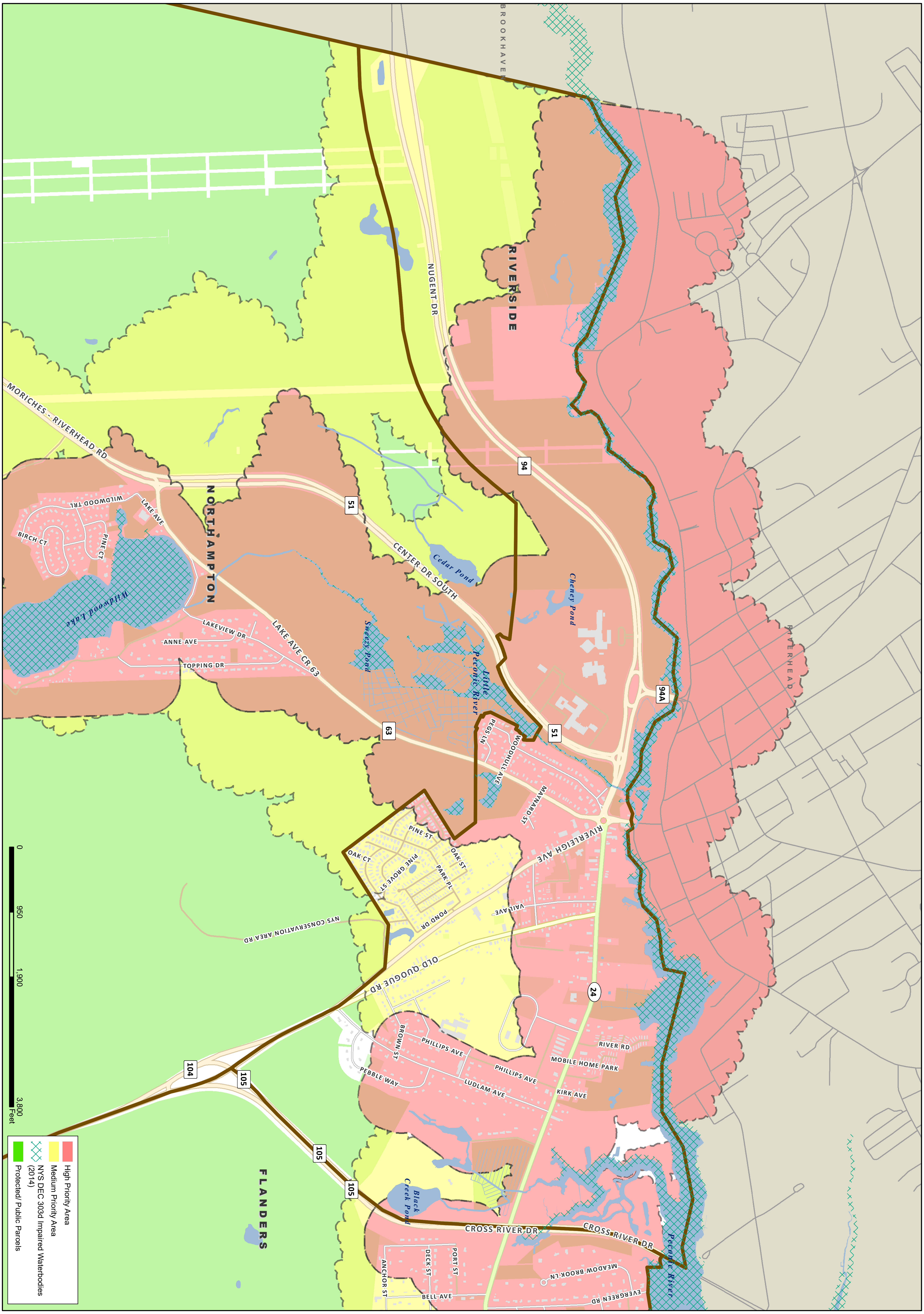

Town of Southampton CPF Water Quality Improvement Project Plan

RIVERSIDE

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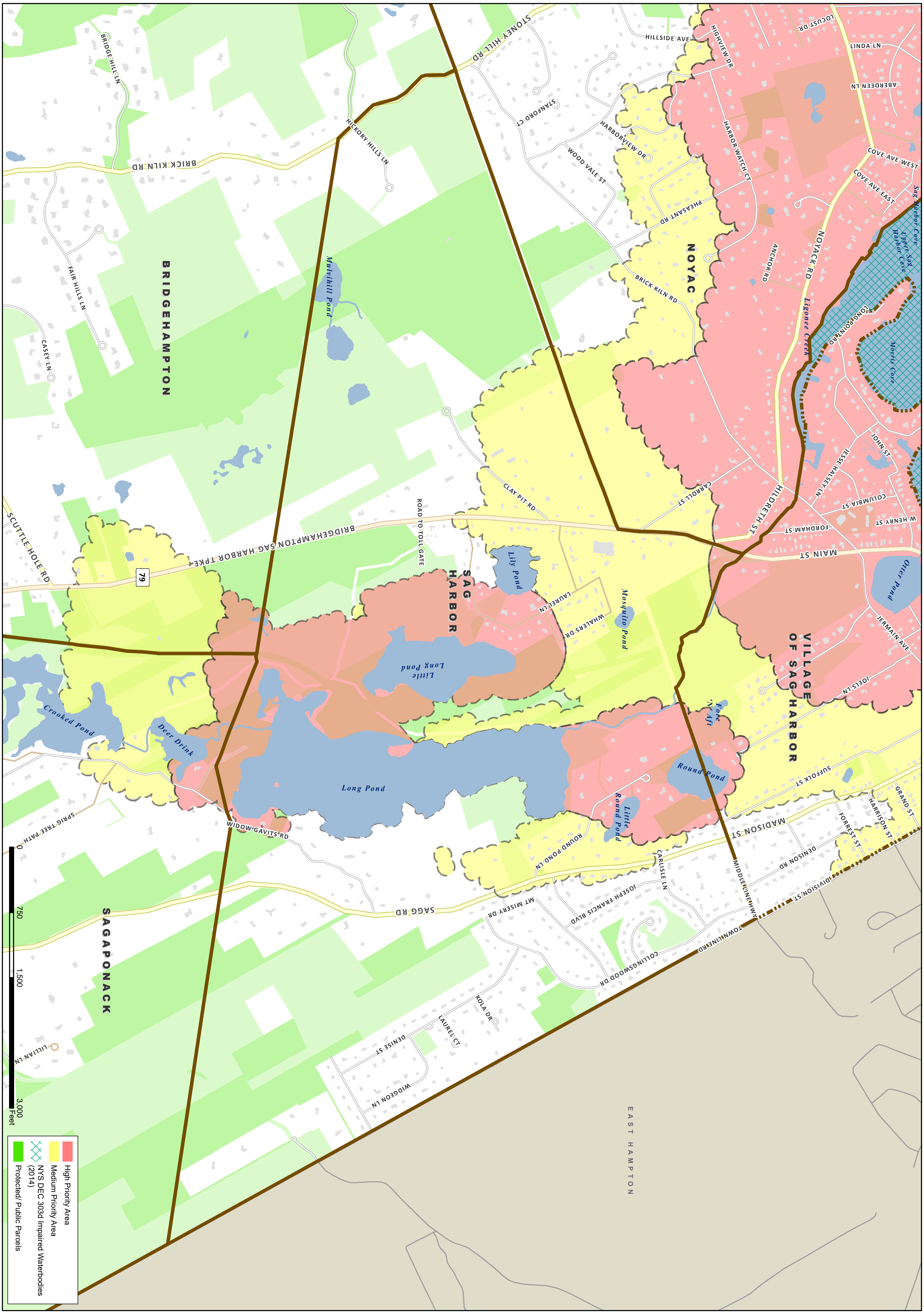

Town of Southampton CPF Water Quality Improvement Project Plan

SAG HARBOR

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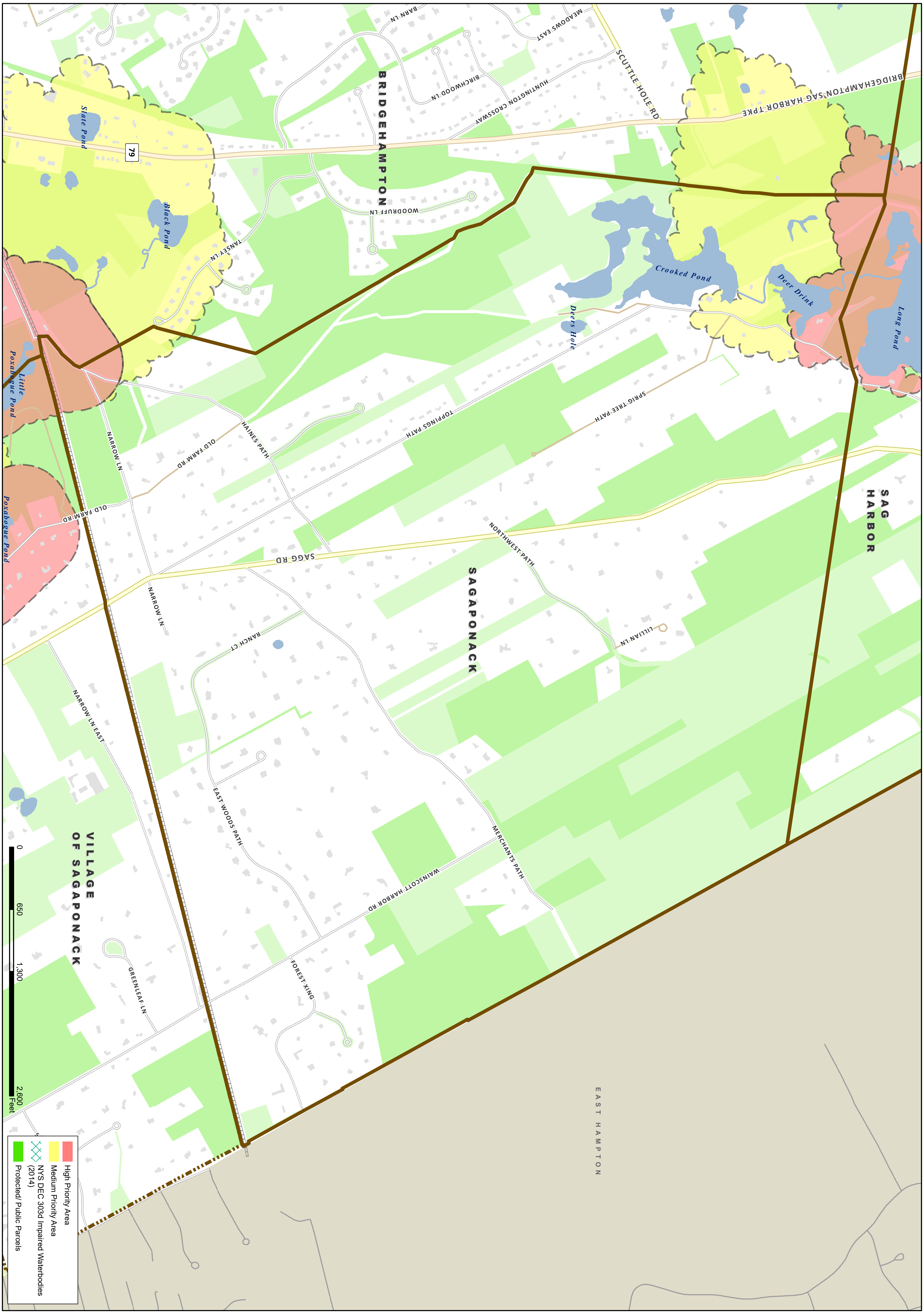

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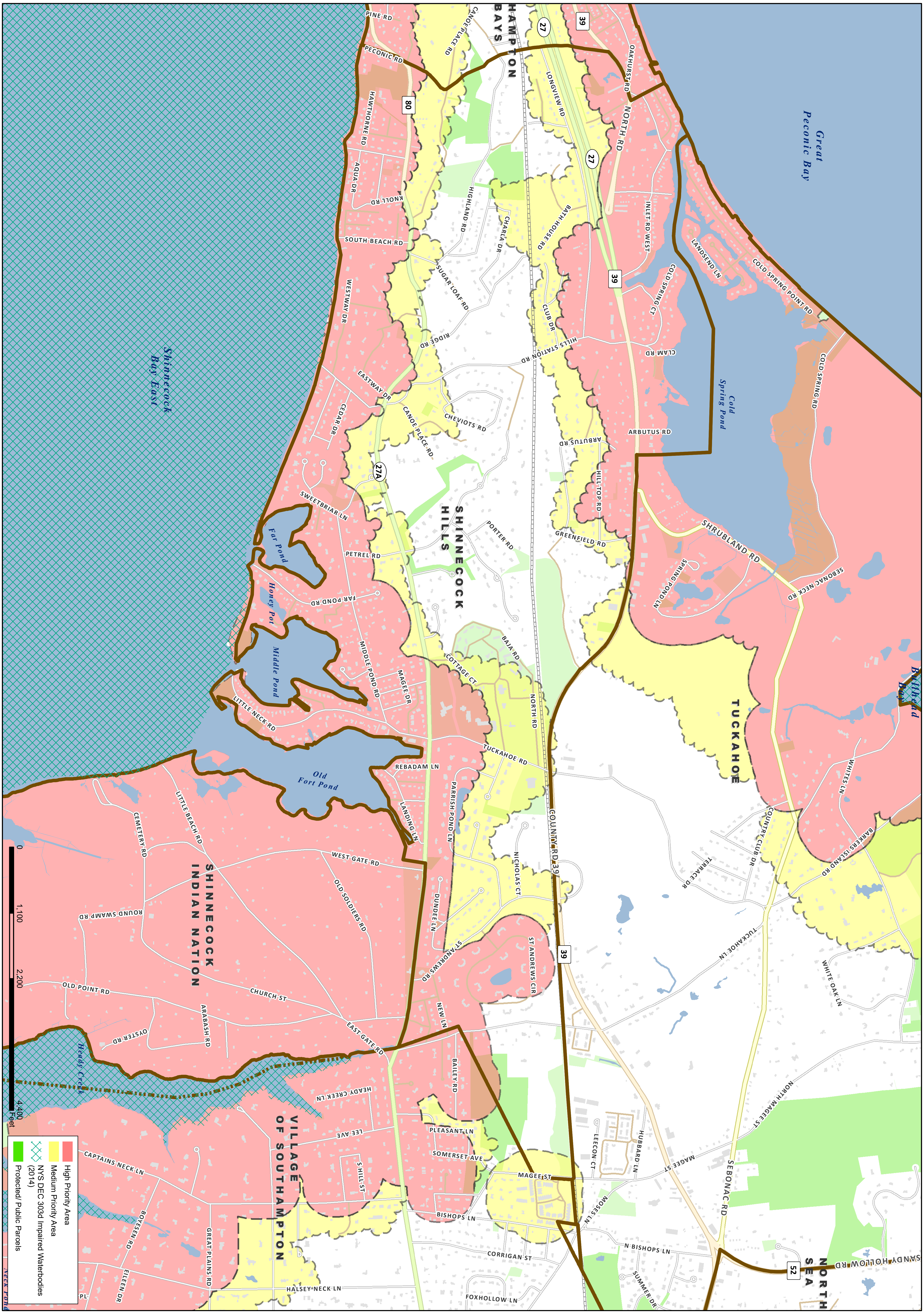

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SHINNECOCK HILLS

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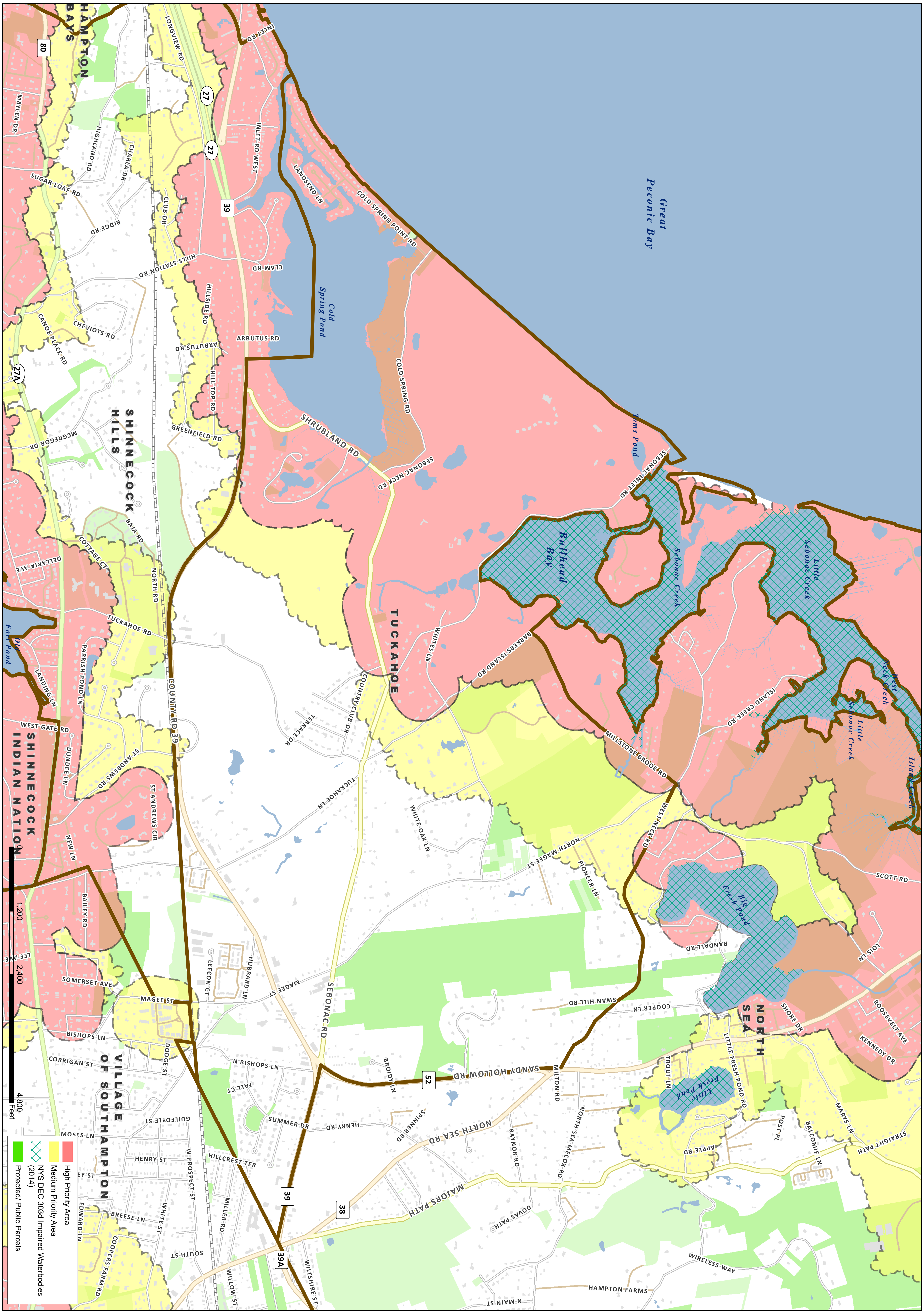

Town of Southampton CPF Water Quality Improvement Project Plan

TUCKAHOE

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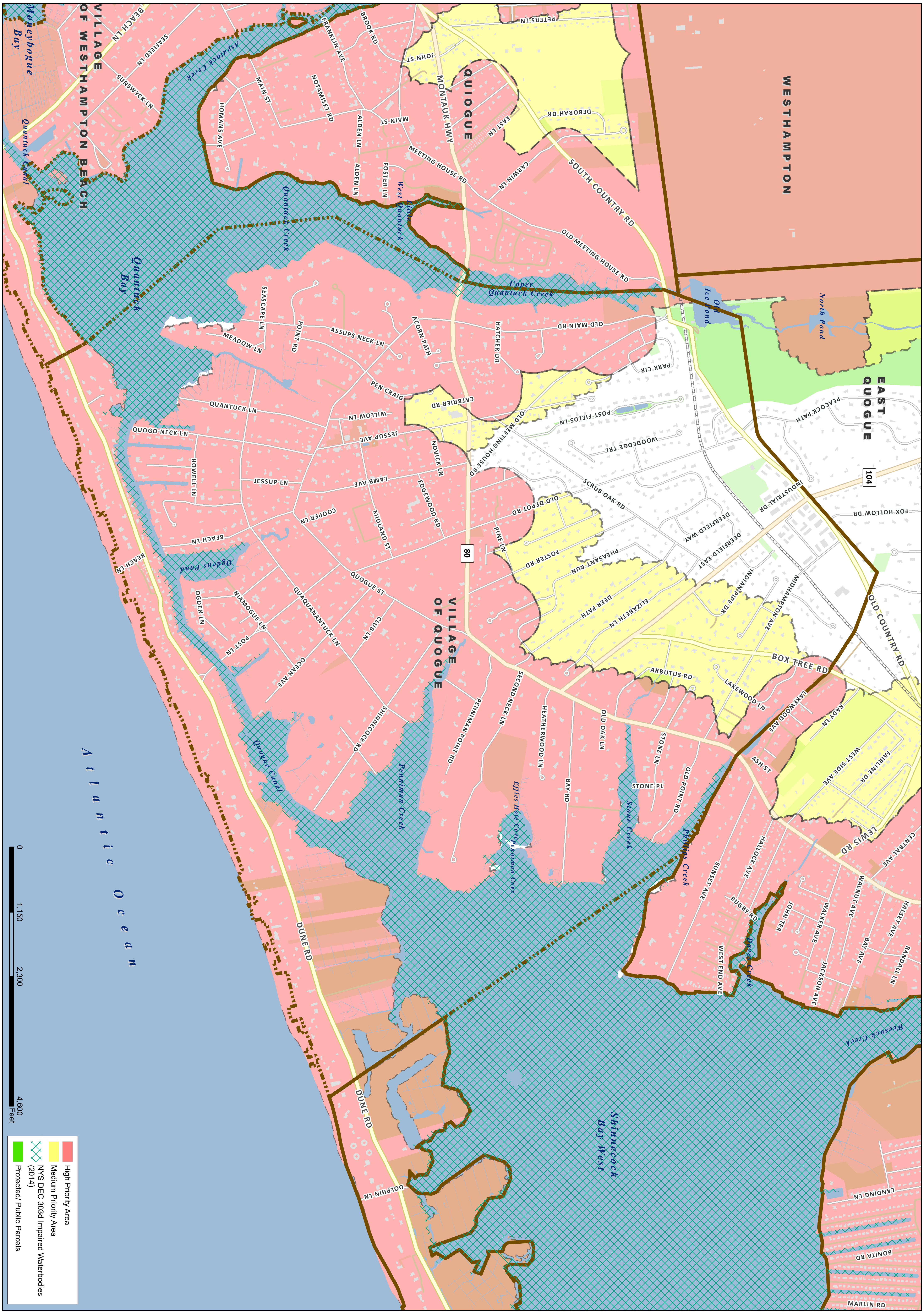

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VILLAGE OF QUOGUE

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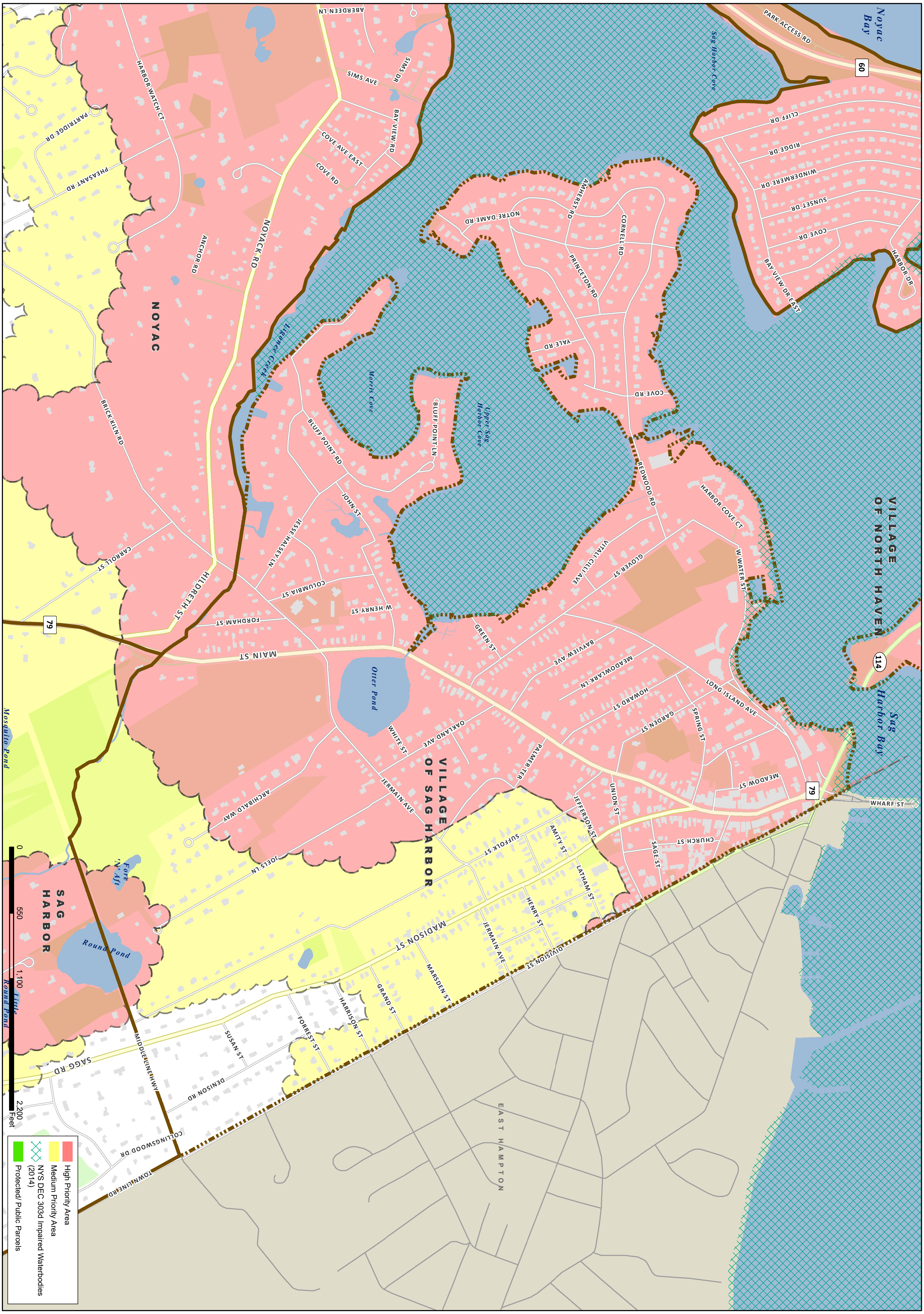

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF SAG HARBOR

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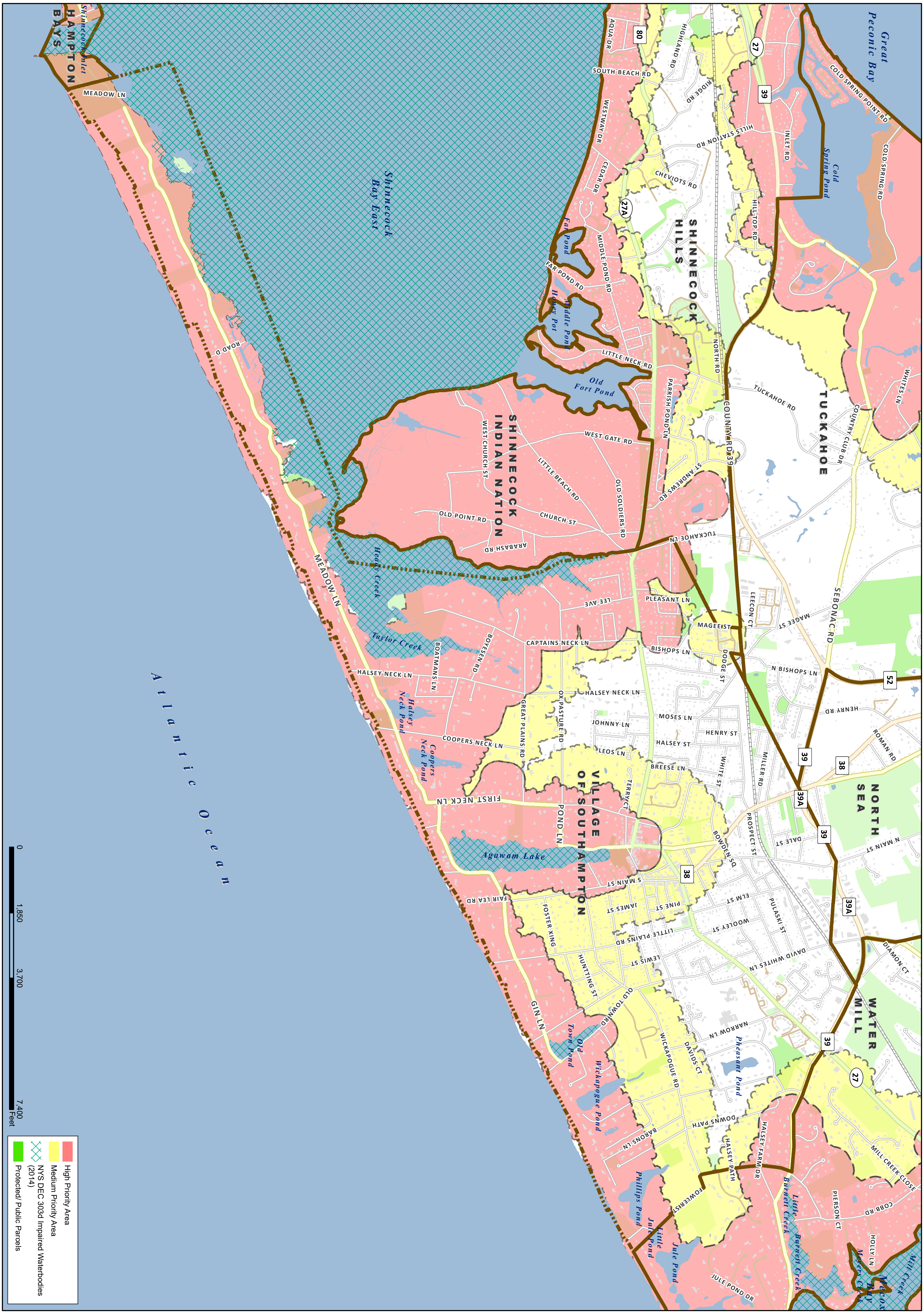

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF SOUTHAMPTON

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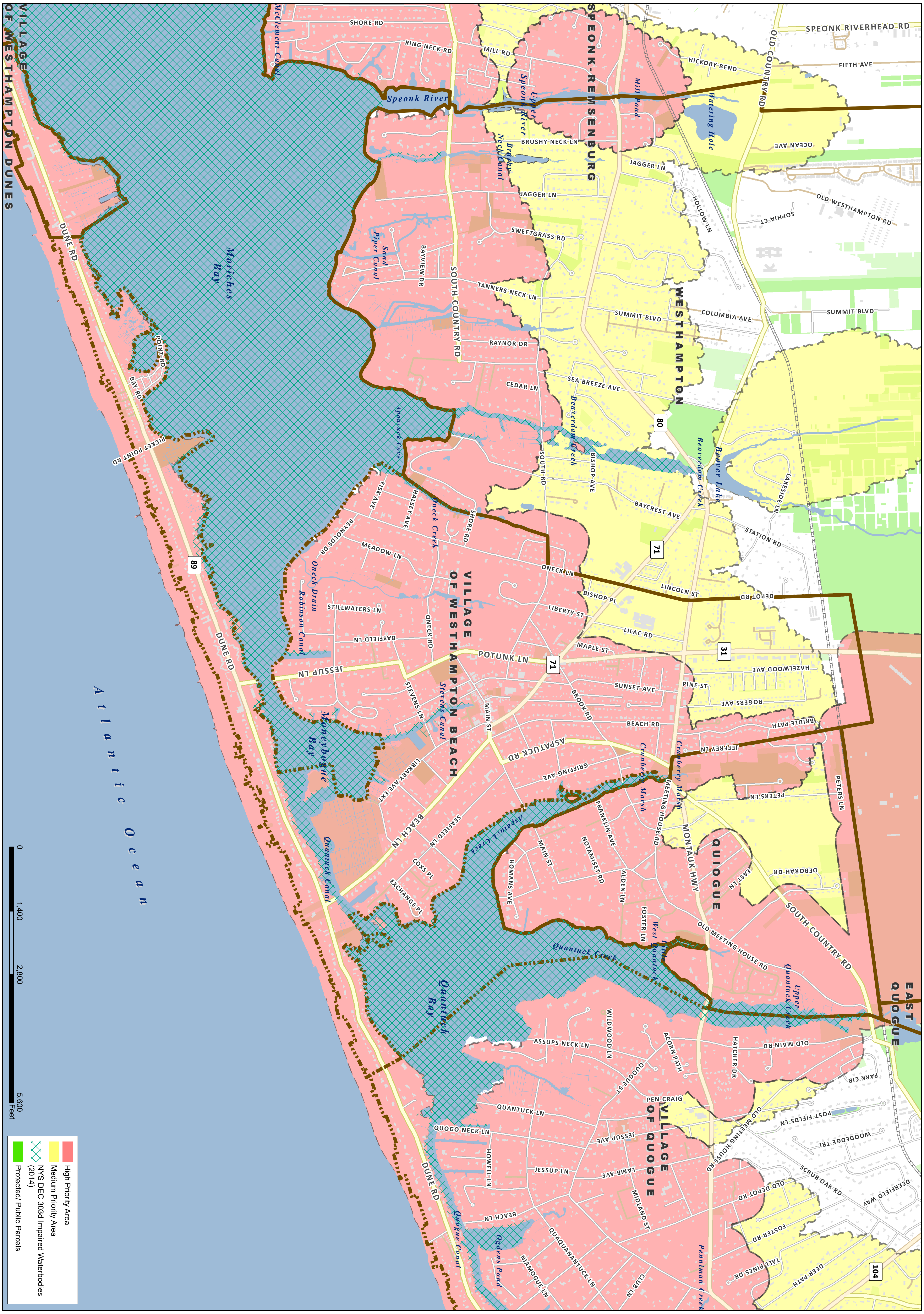

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF WESTHAMPTON BEACH

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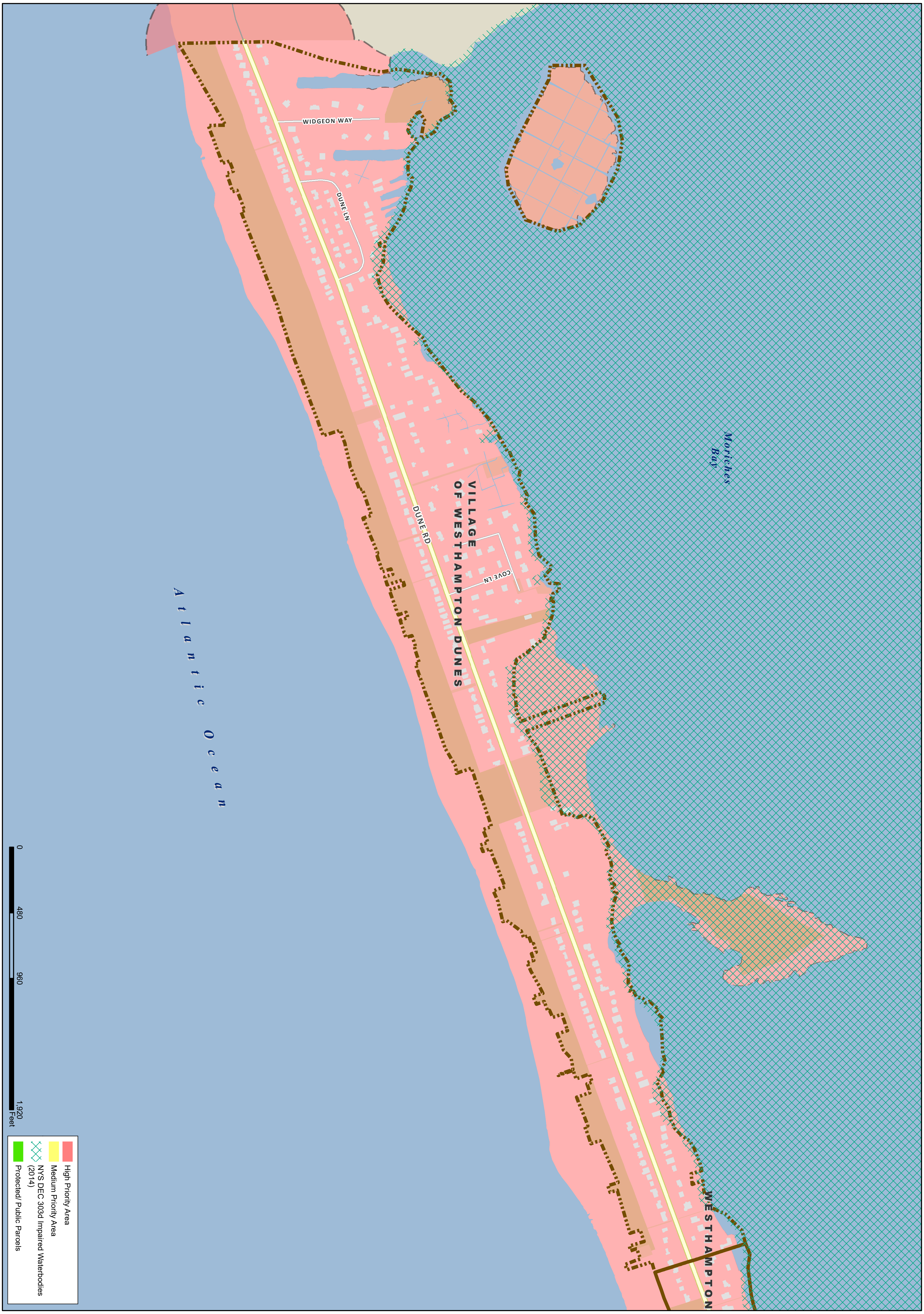

Town of Southampton CPF Water Quality Improvement Project Plan

VILLAGE OF WESTHAMPTON DUNES

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REMEDIATION

Technologies categorized as remediation are those that treat nutrient rich water as it travels through the groundwater, before it reaches a water body. Watershed Management Plans should address all water quality planning including remediation of nitrogen, phosphorus, pollutants of concern (POCs), and contaminants of emerging concern (CECs) such as pharmaceuticals. The remediation tactics identified herein are identified preliminarily as an example of the types of projects that may be eligible for WQIPP funding. In Section 1.15 of the Comprehensive Water Resource Management Plan framework, Suffolk County indicates the priority to *"Seek ways to remediate existing nitrogen pollution and its impacts"* by *"encouraging the development of pilot programs for the installation of permeable reactive barriers and other innovative in-situ water quality remediation techniques. Work to identify suitable locations for pilot installation, and support monitoring of effectiveness of nitrogen reduction".* This is also the intention of the Town of Southampton, who will work with all applicable agencies and academia to determine effective ways to remediate existing nitrogen concentrations as well as other pollutants as practicable prior to reaching surface waters.

To this end, the goal of remediation in terms of stormwater is to improve water quality by reducing contaminated stormwater runoff from entering surface water bodies, and to divert and treat stormwater through filtration practices from entering surface water bodies.

Stormwater Target Areas:

Those areas within developed areas of watersheds where best management stormwater practices can be implemented in a number of different practices to most effectively remove contaminants. These areas include older high and medium density residential, industrial, agricultural and commercialized waterfront locations. The Town has mapped watersheds associated with the total maximum daily load (TMDL) areas as well as those listed on the NYSDEC 303(d) impaired water body (Priority Waterbodies List) list. The Town has a number of municipal drainage outfalls located within these restricted, impaired, and non-impaired watersheds. There are also many land areas that do not include the Town's municipal separate storm system that drain to waterbodies that they Town may address through property acquisition and improvements with management practices. Priority areas for stormwater management projects should be tiered based on the location of such projects. The first level of priority would be those areas located in TMDL restricted water bodies followed by those on the 303(d) list and then others as listed below:

TMDL RESTRICTED	303(D) LIST	OTHER AREAS
Flanders Bay-east/center & Tributaries	Fresh Pond (Big & Little)	Wildwood Lake and tributaries
Reeves By and tidal tributaries	Shinnecock Bay and Inlet	Red Creek Pond
Sebonac Creek/Little Sebonac Cr.	Quantuck Bay	Squires Pond
North Sea Harbor and tributaries	Moriches Bay East	Great Peconic Bay & Little Peconic Bay
Wooley Pond	Scallop Pond	Cold Spring Pond
Noyac Bay & Creek	Phillips Creek Lower and Tidal Tribs	Mill Creek & tributaries
Sag Harbor & Sag Harbor Cove	Quogue Canal	Genets Creek
Northwest Creek & tidal tributaries	Mill and Seven Ponds	Johnsons Creek
Mecox Bay and tributaries	Beaverdam Creek	Great Pond Creek
Heady and Taylor Creeks		Otter Pond
Penniman Creek		Round Pond
Penny Pond & Smith Creek		Long Pond
Weesuck Creek		Little Long Pond
Ogden Pond		Lily Pond
Quantuck Bay		Deer Drink
Quantuck Canal/Moneybogue		Crooked Pond
Setuck Cove		Poxabogue Pond
Sagaponack Pond		Fairfield Pond
		Agawam Pond

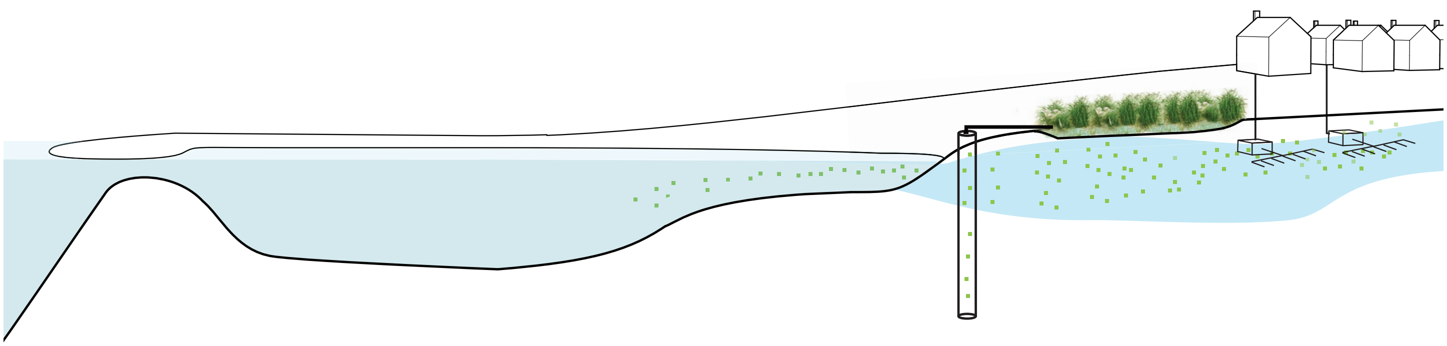
In addition, those areas currently on a total maximum daily load (TMDL) allocation area should be included in those practices pertaining to the Pollutants of Concern (POC) identified and should prioritize both reduction and treatment techniques for maximum water quality benefit. Watersheds listed on the NYSDEC 303(d) list should prioritize reduction techniques. Vacant parcels that receive and convey stormwater should be identified in each of the watersheds such that the parcel can be acquired, and improved to remove sediment from stormwater and infiltrate the remaining run-off. In areas where there are no vacant parcels, pretreatment and infiltration measures could be incorporated within the existing right of way of the road, to treat and reduce stormwater runoff from entering these waterbodies, thereby improving water quality of the runoff.

Practices and Practicality:
Projects shall be sited and designed in accordance with the New York State Stormwater Management Design Manual dated January 2015 or as amended/ updated. Designs should consider community and environmental factors, land use and practice selection factors and physical feasibility factors of practices to determine effectiveness. Stormwater projects to be developed in either a 303(d) or TMDL watershed should be designed to maximize pollutant removal for the POC stated in the respective regulatory document utilizing NYSSMDM Table 7.4. Generally speaking, projects located further inland of the waterbody should focus on reduction practices that infiltrate the stormwater to ground, as projects become closer to the waterbody more remediation and/or treatment practices should be incorporated to remove remaining pollutants from the stormwater prior to discharge into the surface waterbody system.

Considerations for Agriculture:
The agricultural industry has indicated that they would like to do their part to decrease nitrogen and pesticide levels even further by making the Agricultural Stewardship program more effective. Stakeholder groups are working together with government entities to establish a plan that will fulfill the requirements of the State Agricultural Environmental Management program and be accepted by New York State and Suffolk County as the stated plan for nitrogen and pesticide reduction for LI agriculture. The LINAP will also include a chapter on implementation of agricultural BMP's appropriate for Long Island agriculture, in coordination with the Long Island Farm Bureau and the Suffolk County Soil and Water Conservation District. Some of the remediation efforts identified in these plans plus others may be appropriate to offset fertilizers and pesticides from reaching surface waters, and the Town will continue to work with farmers to find cost-effective solutions that can mitigate impacts and provide a means to implement best management and monitoring practices.

The graphic representations[10] on the following pages are presented herein as a sampling of the types of projects that may be appropriate for CPF Water Quality Improvement funding in Southampton and are not meant to be exhaustive. Watershed practices included at this time are permeable reactive barriers (PRBs), constructed wetlands, phytoremediation, and permeable reactive barriers, among others.

10 Developed as part of the Cape Cod Area Wide Water Quality Management Plan Update; See www.CapeCodCommission.org



CONSTRUCTED WETLANDS GROUNDWATER TREATMENT

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: REMEDIATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

After collecting groundwater with higher nitrogen concentrations, groundwater is treated by pumping water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3″ to 8″ under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. These systems occasionally use additional treatment steps to remove nutrients from wastewater. The preferred disposal method is an infiltrator chamber system similar to a leach field but larger in size and designed for overflows. The reclaimed water is generally then discharged to the groundwater. The reclaimed water can also be discharged into a water body or used for open space irrigation after treatment. However, more strict permitting and water quality standards must be met if not discharging to groundwater.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	85% to 95%
Phosphorus Removal	50% to 90%
20 years -	Useful Life
1 to 10 years	See Results

CONSTRUCTED WETLANDS GROUNDWATER TREATMENT

SITING NEEDS

- Undeveloped land > 1 Acre
- Outside all wetlands resource areas
- Outside 100 year flood hazard zone
- Groundwater separation - GW depth > 4 feet
- Not within priority habitat areas
- Not within protected open space
- Benefit if site has clay based soils, has disturbed soils, parcel intersects with 50 to 100 foot Buffer zone, has municipal ownership
- No steep topography

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Higher maintenance in first few years
- May require carbon source initially
- Can become clogged over time
- Phosphorous removal may decline over time
- May require fencing and security measures
- May attract water fowl which could aggravate N issue
- In addition, on the Cape, these systems may need to be lined to prevent complete infiltration and allow time for N removal rather than just putting N into groundwater

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Mobilization of contamination as a result of failure of storage system
- Backflow of saline water into system causing overflows, increased degradation of materials and change in biological processes
- Destabilization of assets as a result of changes in groundwater levels or erosion
- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Locate infrastructure outside the flood hazard area that is anticipated for the life of the installation
- Select materials and coatings that are able to cope with an increasingly saline environment
- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets and health of vegetation)
- Backflow valves on outlets
- Anchoring of buried assets
- Project design and species selection to ensure adequate performance in increasingly saline environments

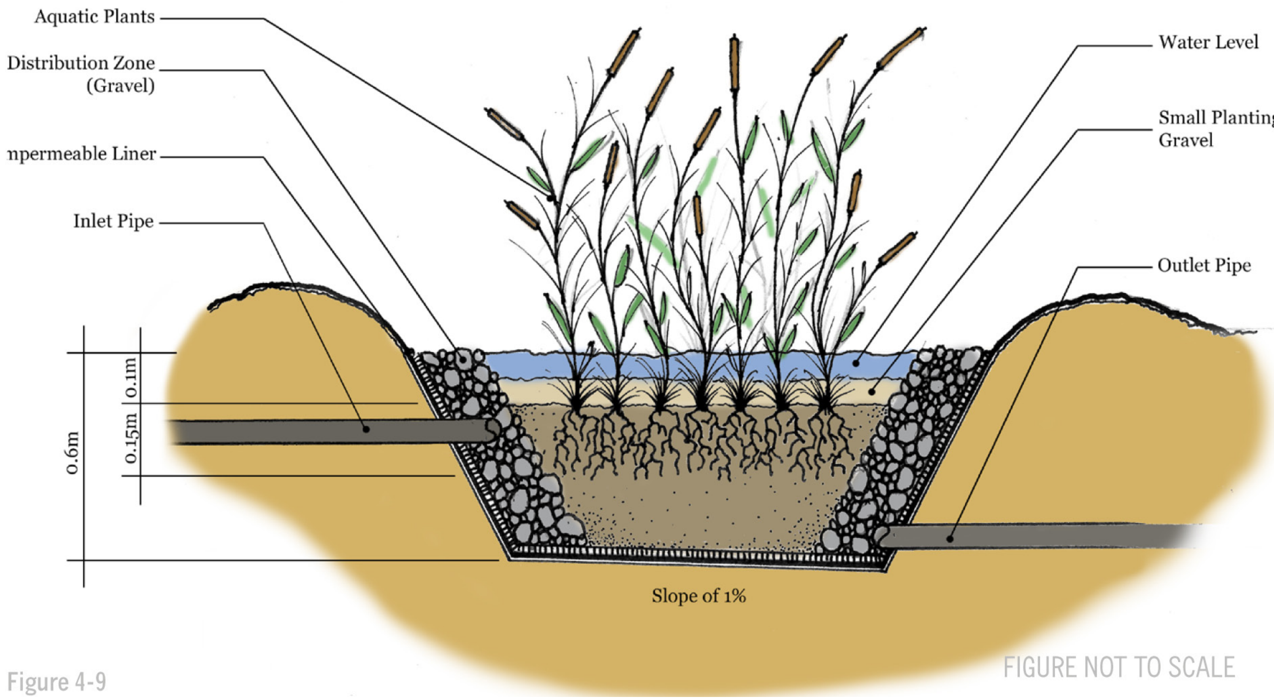


Figure 4-9

CONSTRUCTED WETLANDS SUBSURFACE FLOW

SCALE: NEIGHBORHOOD/WATERSHED

APPROACH: REMEDIATION

SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

After primary treatment in a septic tank or WWTF or secondary treatment at a WWTF, wastewater is treated by pumping water slowly through sub-surface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. The reclaimed water is generally discharged into a leach field or similar system for discharge to the groundwater. The reclaimed water can also be discharged into a water body or used for open space irrigation after treatment. However, more strict permitting and water quality standards must be met if not discharging to groundwater. This technology can be used as an alternative to conventional polishing (i.e. mechanical and/or chemical) of secondary and advanced wastewater treatment.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	85% to 95%
Phosphorus Removal	50% to 90%
20 years -	Useful Life
1 to 10 years	See Results

CONSTRUCTED WETLANDS SUBSURFACE FLOW

SITING NEEDS

- Undeveloped land > 0.5 Acre
- Outside all wetlands resource areas
- Outside 100 year flood hazard zone
- Groundwater separation - GW depth > 4 feet
- Not within priority habitat areas
- Not within protected open space
- Benefit if site has clay based soils, has disturbed soils, parcel intersects with 50 to 100 foot Buffer zone, has municipal ownership
- No steep topography

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

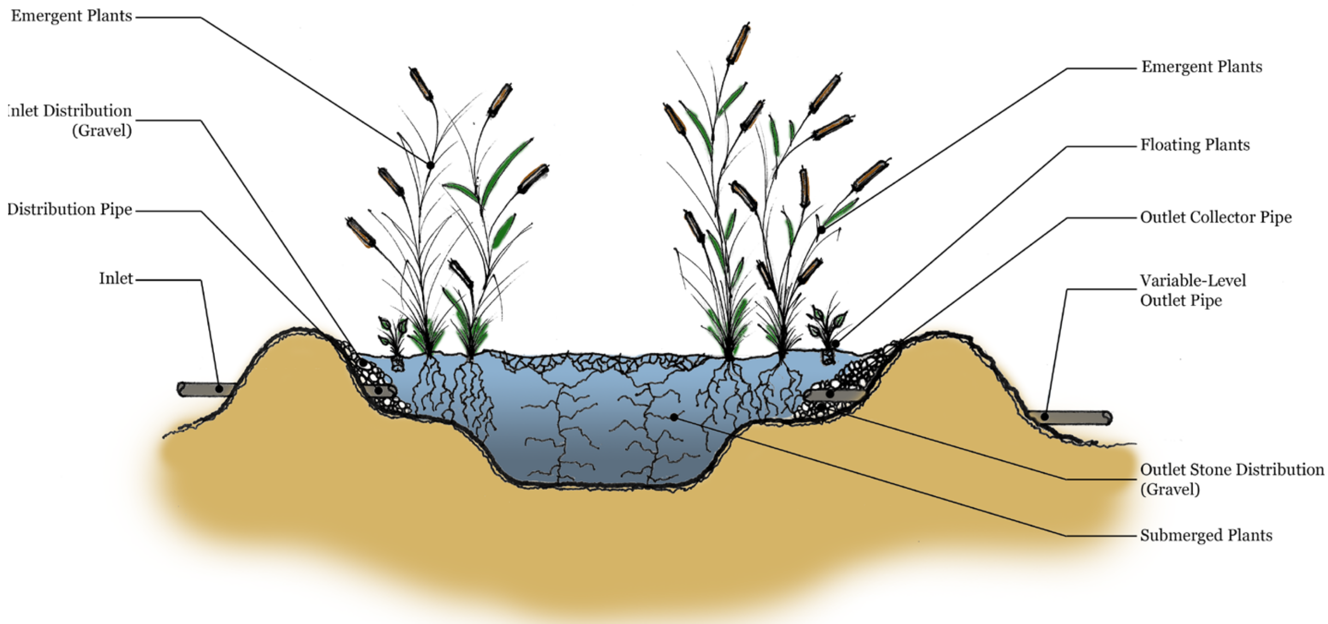
- Higher maintenance in first few years
- May require carbon source initially
- Can become clogged over time.
- Phosphorous removal may decline over time
- May require fencing and security measures
- May attract water fowl which could aggravate N issue
- In addition, on the Cape, these systems may need to be lined to prevent complete infiltration and allow time for N removal rather than just putting N into groundwater

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Mobilization of contamination as a result of failure of storage system
- Backflow of saline water into system causing overflows, increased degradation of materials and change in biological processes
- Destabilization of assets as a result of changes in groundwater levels or erosion
- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Locate infrastructure outside the flood hazard area that is anticipated for the life of the installation
- Select materials and coatings that are able to cope with an increasingly saline environment
- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets and health of vegetation)
- Backflow valves on outlets
- Anchoring of buried assets
- Project design and species selection to ensure adequate performance in increasingly saline environments



CONSTRUCTED WETLANDS SURFACE FLOW

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: REMEDIATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

After primary treatment in a septic tank or WWTF or secondary treatment at a WWTF, water is fed into a free water surface (FWS) constructed wetland. Free water constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. FWS wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water is generally discharged into a leach field or similar system for discharge to the groundwater. The reclaimed water can also be discharged into a water body or used for open space irrigation after treatment. However, more strict permitting and water quality standards must be met if not discharging to groundwater. This technology can be used as an alternative to conventional polishing (i.e. mechanical and/or chemical) of secondary and advanced wastewater treatment.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	85% to 95%
Phosphorus Removal	50% to 90%
20 years	Useful Life
1 to 10 years	See Results

CONSTRUCTED WETLANDS SURFACE FLOW

SITING NEEDS

- Undeveloped land > 5 Acre
- Outside all wetlands resource areas
- Outside 100 year flood hazard zone
- Groundwater separation - GW depth > 4 feet
- Not within priority habitat areas
- Not within protected open space
- Benefit if site has clay based soils, has disturbed soils, parcel intersects with 50 to 100 foot Buffer zone, has municipal ownership
- No steep topography

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

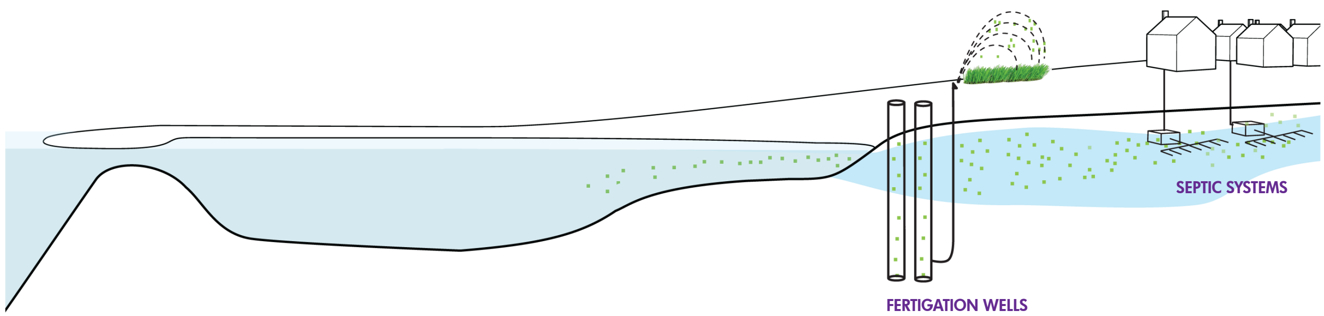
- Requires larger land area than tertiary treatment
- Disinfection of wetland influent may be required
- May require an NPDES permit
- May require a pilot study, long-term monitoring and reporting
- Vegetation harvesting may need to be performed periodically
- May require fencing and security measures
- May attract water fowl which could worsen N issue
- These systems on the Cape may need to be lined to prevent complete infiltration and allow time for N removal rather than just putting N into groundwater
- May need storage of effluent during non-growing season

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Mobilization of contamination as a result of failure of storage system
- Backflow of saline water into system causing overflows, increased degradation of materials and change in biological processes
- Destabilization of assets as a result of changes in groundwater levels or erosion
- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Locate infrastructure outside the flood hazard area that is anticipated for the life of the installation
- Select materials and coatings that are able to cope with an increasingly saline environment
- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion)
- and performance of technology (i.e. achieving nutrient removal targets and health of vegetation)
- Backflow valves on outlets
- Anchoring of buried assets
- Project design and species selection to ensure adequate performance in increasingly saline environments



FERTIGATION WELLS

SCALE:	NEIGHBORHOOD/WATERSHED
APPROACH:	REMEDIATION
SCENARIO PLANNING:	SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Fertigation consists of capturing nitrogen enriched groundwater via wells and using it to irrigate plants that use the nutrients. Fertigation wells can capture nutrient enriched groundwater and recycle it back to irrigate and fertilize turf grass areas, and to irrigate crops. Irrigated turf grass areas include golf courses, athletic fields and lawns, while irrigated crops. Fertigation can reduce nutrient loads to down gradient surface waters while reducing fertilizer costs to the irrigated areas.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	60% to 80%
Phosphorus Removal	60% to 80%
20 years	Useful Life
1 to 10 years	See Results

FERTIGATION WELLS

SITING NEEDS

- Fertigation wells should be located down gradient of nutrient source areas such as wastewater treatment plant disposal fields and compact development
- They can also be positioned down gradient of high-density subdivisions where they might capture nutrients derived from both septic systems and residential lawns
- The specific locations, depths and diameters can be optimized using standard hydrogeologic principles

ECO-BENEFITS

- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling

PERFORMANCE CHALLENGES

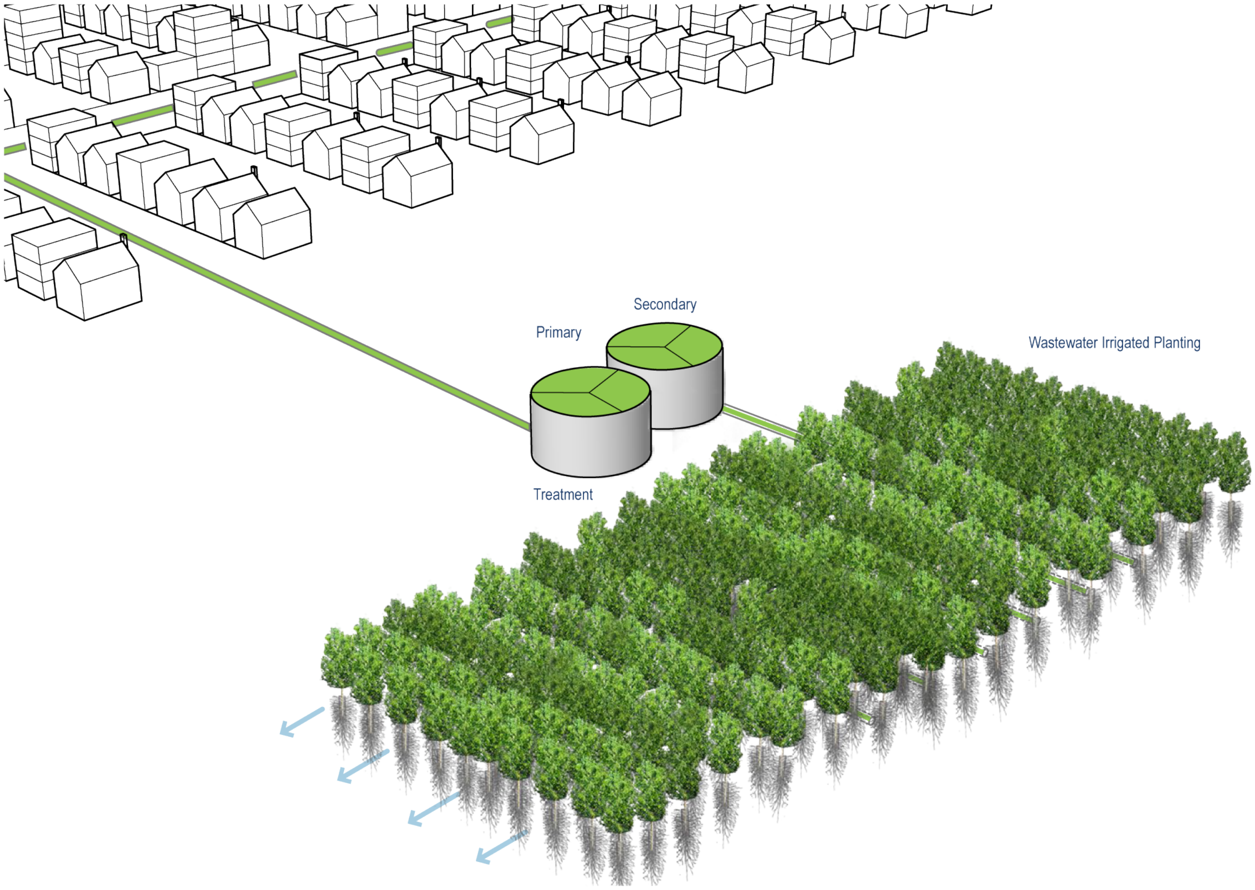
- Seasonal technology potentially requiring several capture wells to capture entire nutrient plume
- Most effective in areas where groundwater contains a “plume” of high concentration of nutrients (i.e. down gradient of a WWTF discharge, etc.)
- Need an area to irrigate for nutrient uptake May require monitoring

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Inundation leading to saltwater intrusion
- into groundwater potentially affecting reuse of water (e.g. irrigation)
- Destabilization of assets as a result of changes in groundwater levels or erosion

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets)
- Select materials and coatings that are able to cope with an increasingly saline environment
- Backflow valves on outlets
- Anchoring of buried assets
- Locate technology outside flood hazard area anticipated for the life of the installation



PHYTOIRRIGATION

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: REMEDIATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

After secondary treatment, WWTF effluent is irrigated onto plants to remove nutrients and other contaminants. Fast growing poplar and willow trees are typically used. Phytoirrigation requires periodic maintenance and removal of the
vegetation being irrigated.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	50% to 75%
Phosphorus Removal	50% to 75%
10 years	Useful Life
1 to 10 years	See Results

PHYTOIRRIGATION

SITING NEEDS

- Fertigation wells should be located down gradient of nutrient source areas such as wastewater treatment plant disposal fields and compact development
- They can also be positioned down gradient of high-density subdivisions where they might capture nutrients derived from both septic systems and residential lawns
- The specific locations, depths and diameters can be optimized using standard hydrogeologic principles

ECO-BENEFITS

- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling

PERFORMANCE CHALLENGES

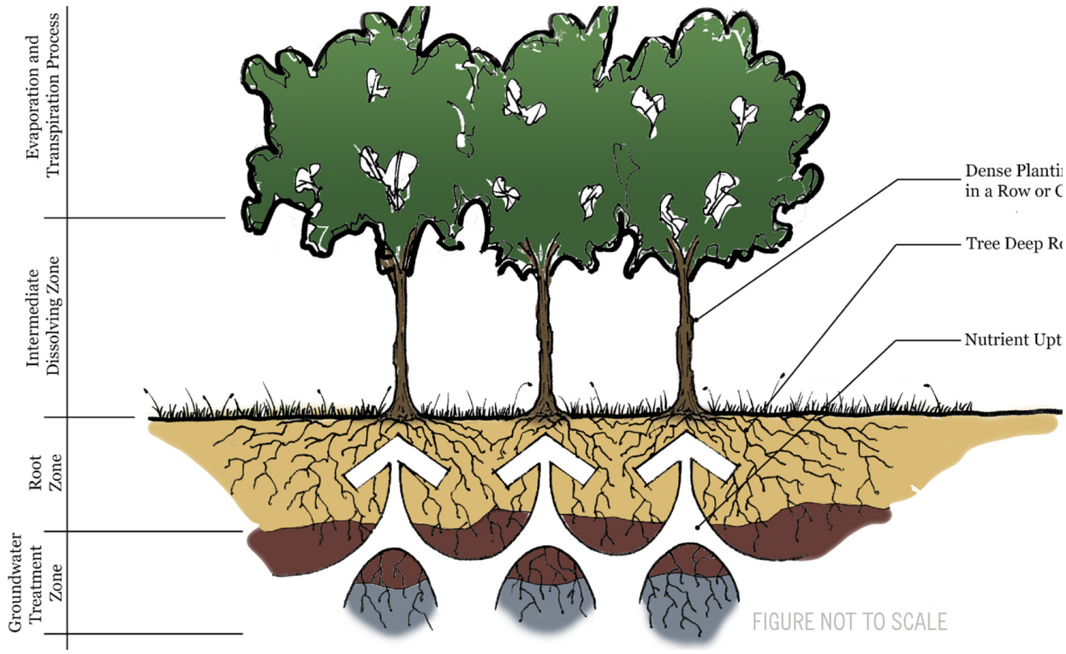
- Seasonal technology potentially requiring several capture wells to capture entire nutrient plume
- Most effective in areas where groundwater contains a “plume” of high concentration of nutrients (i.e. down gradient of a WWTF discharge, etc.)
- Need an area to irrigate for nutrient uptake May require monitoring

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Inundation leading to saltwater intrusion
- into groundwater potentially affecting reuse of water (e.g. irrigation)
- Destabilization of assets as a result of changes in groundwater levels or erosion

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets)
- Select materials and coatings that are able to cope with an increasingly saline environment
- Backflow valves on outlets
- Anchoring of buried assets
- Locate technology outside flood hazard area anticipated for the life of the installation



PHYTOREMEDIATION

SCALE: SITE/NEIGHBORHOOD

APPROACH: REMEDIATION

SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Green plants with deep tap roots are planted as a buffer to intercept high nitrogen (nitrogen enriched) groundwater. The plants and microorganisms in their root zone reduce/use the nitrogen, removing it from the groundwater and watershed. Phytoremediation can be used to redirect a plume of nitrogen enriched groundwater or pull it up from deeper in the aquifer, allowing the plants to treat the plume.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	50% to 90%
Phosphorus Removal	50% to 60%
20 years	Useful Life
1 to 10 years	See Results

PHYTOREMEDIATION

SITING NEEDS

- Permeable soils
- Depth to groundwater <10 feet
- Not within priority habitat areas
- Not within protected open space
- Benefit if site is located within a Zone II, has disturbed soils, parcel intersects with 50 to 100 foot wetland buffers, has municipal ownership, necessary nitrogen removal in groundwater filtering through parcel is high

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

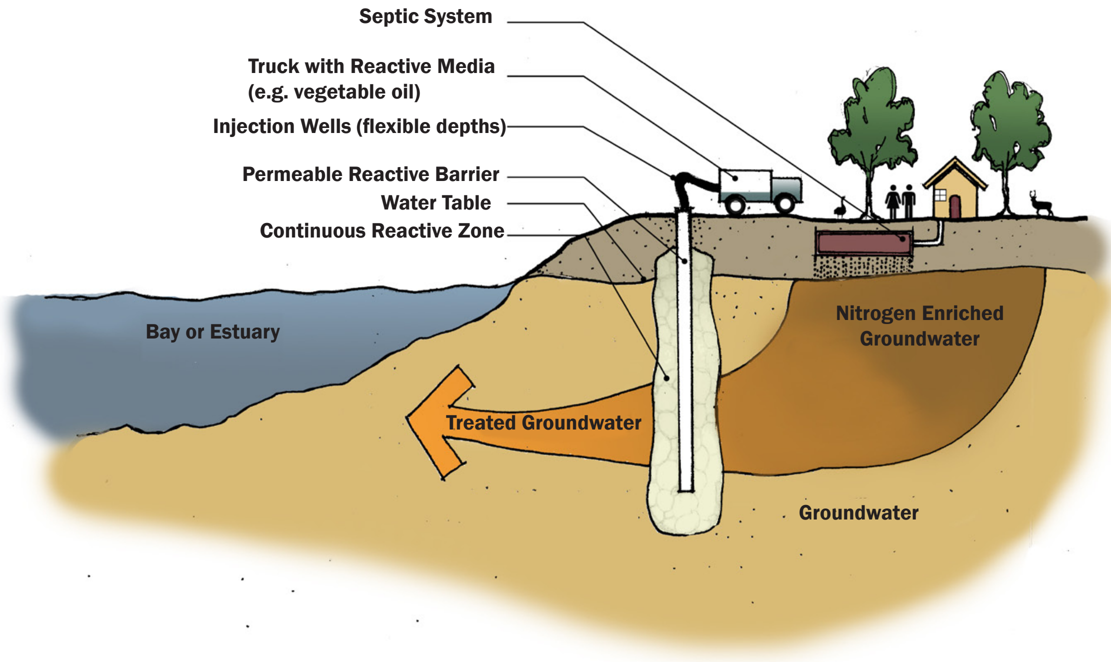
- In year one after planting, no remediation occurs because trees have not reached the groundwater. As the trees get larger and pump more water, nitrogen removal rates increase and plateau
- Plants can only be irrigated during the growing season, requiring use of holding ponds in non-growing season.

CLIMATE RESILIENCE: RISKS

- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor condition and performance of
- technology (i.e. achieving nutrient removal targets and health of vegetation)
- Species selection to ensure adequate performance in increasingly saline environments
- Preserve areas / buffers to allow migration of salt marsh to higher elevations as MHW rises



PERMEABLE REACTIVE BARRIERS (PRBS) INJECTION WELL METHOD

SCALE: SITE/NEIGHBORHOOD

APPROACH: REMEDIATION

SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

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, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. An injection Well PRB system typically uses a series of injection wells to introduce the carbon source (medium) into the groundwater.The injection wells can be installed to depth greater than the PRB trench method. The injection well PRB method can be used in combination with the PRB trenching method described previously. As groundwater flows through the medium, microbes naturally occurring in the groundwater consume the carbon source, as well as oxygen, developing an anaerobic environment. This process releases nitrogen gas to the atmosphere, reducing the groundwater nitrogen load before reaching the estuary.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	75% to 95%
Phosphorus Removal	50% to 95%
20 years	Useful Life
1 to 10 years	See Results

PERMEABLE REACTIVE BARRIERS (PRBS) INJECTION WELL METHOD

SITING NEEDS

- Suitable groundwater flow path (depth to intercept groundwater)
- Generally at least 20 feet of saturated aquifer thickness is desired
- In general, the injection well PRB can be installing areas with steeper topography than a trench PRB
- In general, the injection well PRB can be installing areas where utilities limit the installation of trench PRBs
- Ready access for construction
- Access to sites up gradient or down gradient to allow groundwater monitoring
- Permitting requirements if used in or near wetlands
- Construction cost based on 20-foot spacing between injection wells installed to an overall depth of 40 feet. Deeper installations are possible

ECO-BENEFITS

- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

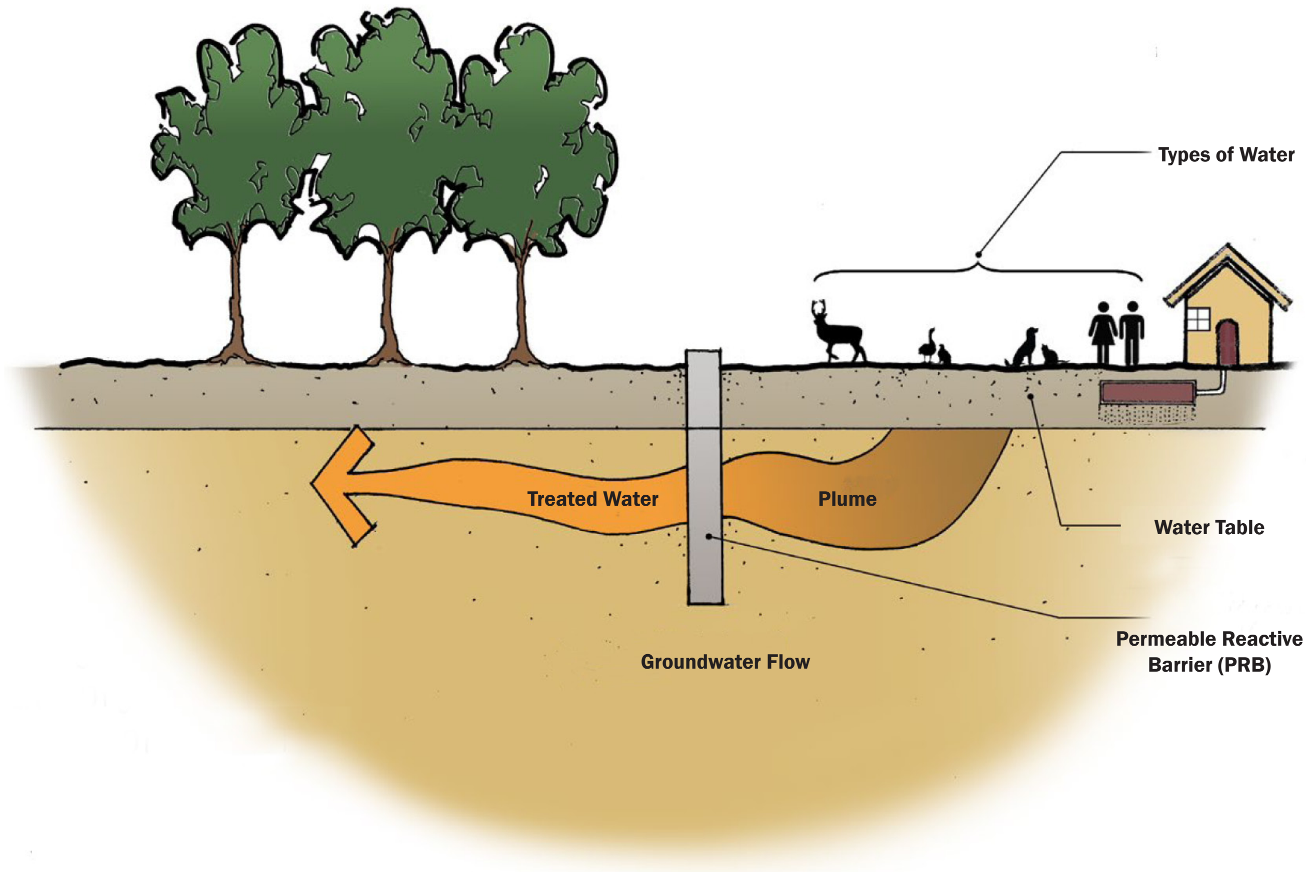
- Siting can be limited by wetlands, public utilities and abutter concerns
- Detailed knowledge of local groundwater hydrology needed
- Large projects may require a hydrogeologic investigation and groundwater modeling to estimate effectiveness of PRB
- Permitting requirements may be extensive and time 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

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Inundation leading to saltwater intrusion into groundwater potentially affecting reuse of water (e.g. irrigation)
- Destabilization of assets as a result of changes in groundwater levels or erosion

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets)
- Select materials and coatings that are able to cope with an increasingly saline environment
- Backflow valves on outlets
- Anchoring of buried assets
- Locate technology outside flood hazard area anticipated for the life of the installation



PERMEABLE REACTIVE BARRIERS (PRBS) TRENCH METHOD

SCALE: SITE/NEIGHBORHOOD
APPROACH: REMEDIATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

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.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	75% to 95%
Phosphorus Removal	50% to 95%
20 years	Useful Life
1 to 10 years	See Results

PERMEABLE REACTIVE BARRIERS (PRBS) TRENCH METHOD

SITING NEEDS

- Suitable groundwater flow path (depth to intercept groundwater)
- Generally at least 20 feet of saturated aquifer thickness is desired
- Relatively level site
- Ready access for construction
- Access to sites up gradient or down gradient to allow groundwater monitoring
- Limited vegetation, Limited public utilities
- Permitting requirements if used in or near wetlands
- Construction cost based on width of 3 feet width, and an overall depth of 40 feet (using existing trenching equipment - deeper in installations are possible using injection well PRBs described below)

ECO-BENEFITS

- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

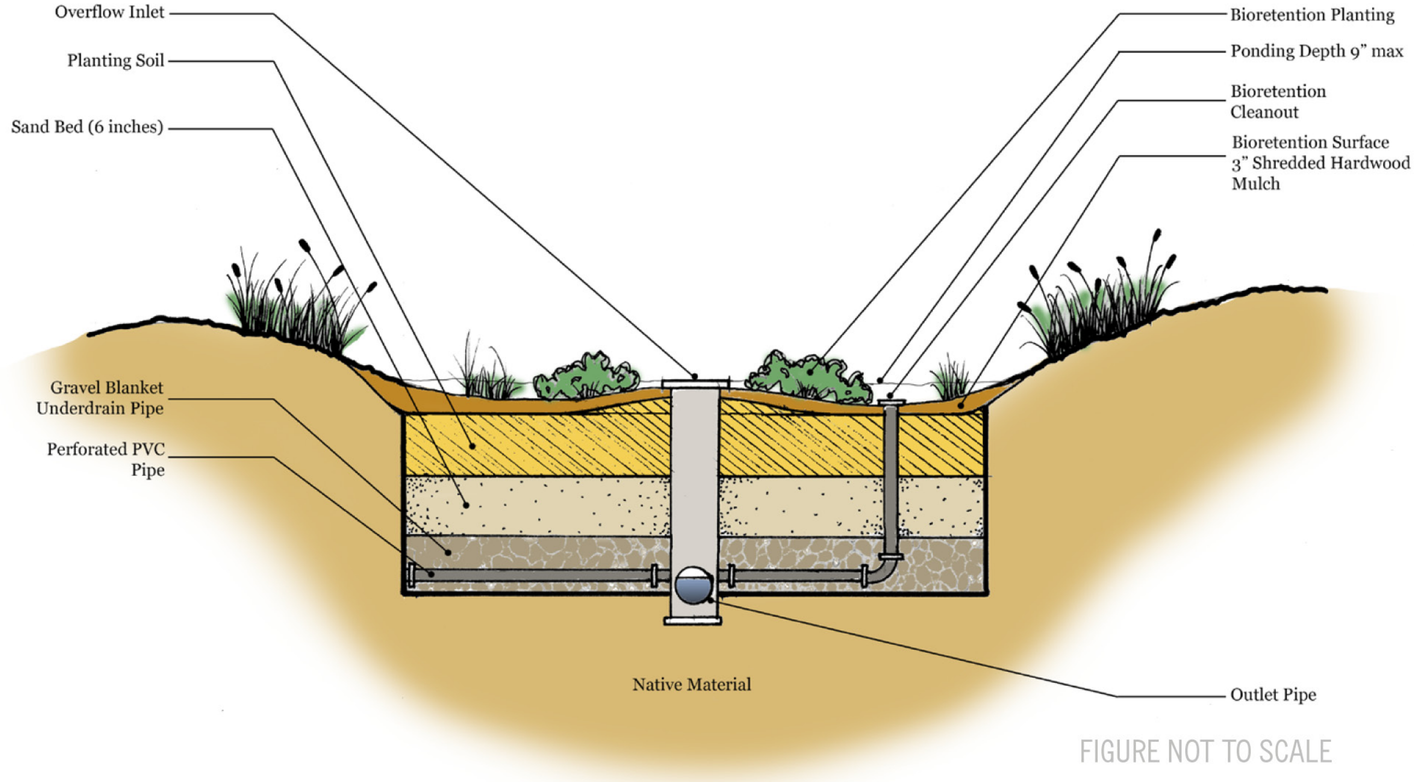
- Siting can be limited by wetlands, public utilities and abutter concerns
- Detailed knowledge of local groundwater hydrology needed
- Projects may require a hydrogeologic investigation and groundwater modeling to estimate effectiveness of PRB
- Permitting requirements may be extensive and time consuming
- Projects may require extensive groundwater monitoring early in the project toquantify 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

CLIMATE RESILIENCE: RISKS

- Degradation of materials and reduced asset lifespan due to more frequent inundation and increased exposure to saline water
- Inundation leading to saltwater intrusion into groundwater potentially affecting reuse of water (e.g. irrigation)
- Destabilization of assets as a result of changes in groundwater levels or erosion

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition (e.g. rate of corrosion) and performance of technology (i.e. achieving nutrient removal targets)
- Select materials and coatings that are able to cope with an increasingly saline environment
- Backflow valves on outlets
- Anchoring of buried assets
- Locate technology outside flood hazard area anticipated for the life of the installation



STORMWATER BIORETENTION SOIL MEDIA FILTERS

SCALE: SITE

APPROACH: REMEDIATION

SCENARIO PLANNING: NOT SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Bioretention is the process in which contaminants and sedimentation are removed from stormwater runoff through physical, biological and chemical treatment processes. Stormwater is collected into the treatment area which consists of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. Runoff passes first over or through a sand bed, which slows the runoff's velocity, distributes it evenly along the length of the ponding area, which consists of a surface organic layer and/or groundcover and the underlying planting soil. The ponding area is graded, its center depressed. Water is ponded and gradually infiltrates the bioretention area or is evapotranspired. The bioretention area is graded to divert excess runoff away from itself. Stored water in the bioretention area planting soil exfiltrates over a period of days into the underlying soils.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	25% to 45%
Phosphorus Removal	50% to 30%
20 years	Useful Life
1 to 10 years	See Results

STORMWATER BIORETENTION SOIL MEDIA FILTERS

SITING NEEDS

- Varies

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

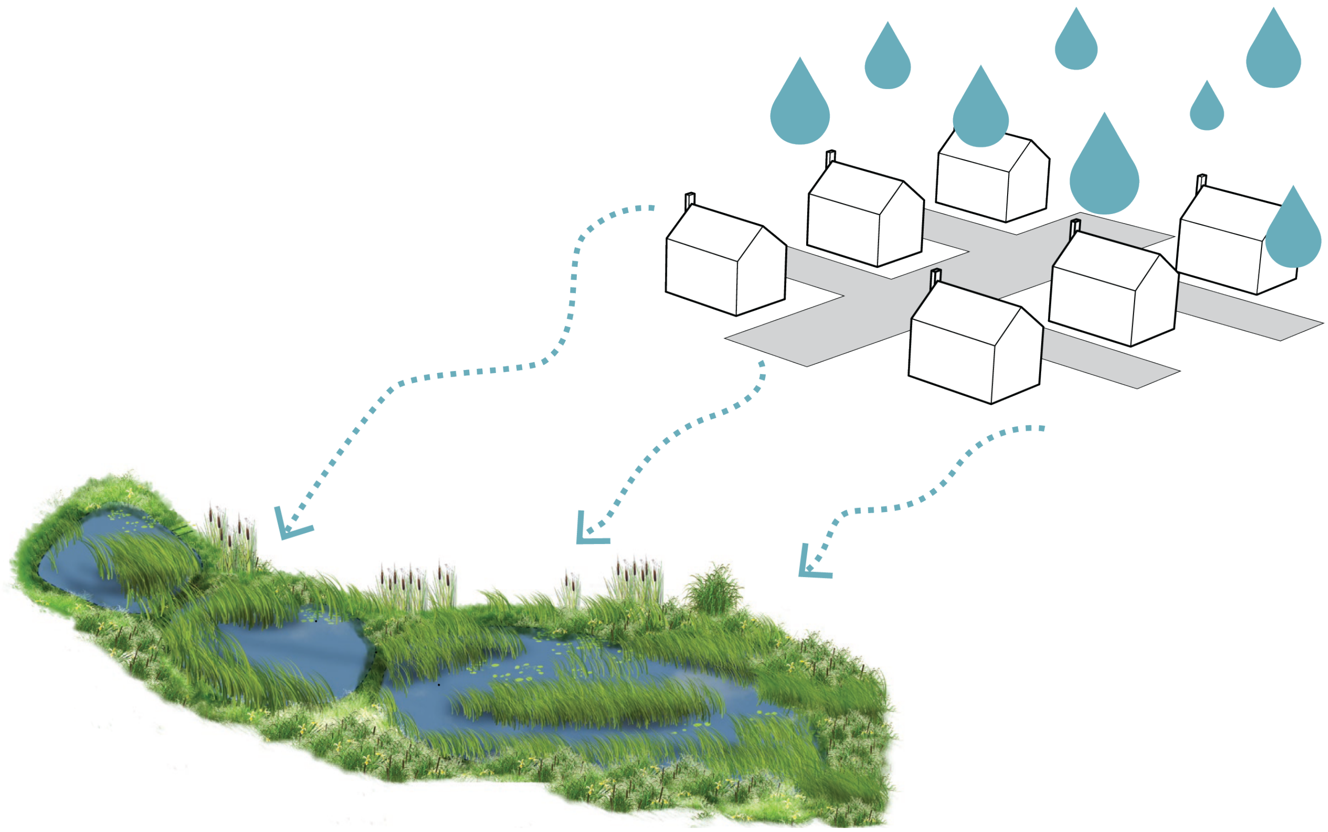
- Requires the creation and enforcement of stormwater regulations and policies

CLIMATE RESILIENCE: RISKS

- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor condition and performance of technology (e.g. achieving nutrient removal targets, health of vegetation)
- Project design and species selection to ensure adequate performance in increasingly saline environments



STORMWATER CONSTRUCTED WETLANDS, BMPS

SCALE: TOWNSHIP
APPROACH: REMEDIATION
SCENARIO PLANNING: SELECTED FOR USE PHYTOBUFFERS IDENTIFIED FOR PILOTING

DESCRIPTION

There are several types of structural stormwater BMPs, such as phytobuffers, vegetated swales, and constructed wetlands, which can contribute to nutrient removal. These approaches typically employ an excavated elongated basin engineered to accommodate the requirements of the site, together with components designed to enhance nutrient attenuation. These components may include: a swale to convey runoff; a system of chambers that allow for filtration, sediment settling, aerobic and anaerobic activity; and vegetation for nutrient uptake. Vegetated swales are typically grassed parabolic basins with relatively flat side slopes. Phytobuffers employ fast growing poplars and willow trees to remove nutrients and other contaminants. Constructed wetlands filter stormwater as it flows horizontally through a sediment forebay and a series of gravel-bottomed wetland cells, where algae and microbes grow in abundance. Constructed wetlands can be engineered to mimic natural systems, but designed to improve residence time within anaerobic chambers, allowing for year round nitrogen removal.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	25% to 90%
Phosphorus Removal	1% to 80%
20 years	Useful Life
1 to 10 years	See Results

STORMWATER CONSTRUCTED WETLANDS, BMPS

SITING NEEDS

- Varies

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Requires the creation and enforcement of stormwater regulations and policies

CLIMATE RESILIENCE: RISKS

- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor condition and performance of technology (e.g. achieving nutrient removal targets, health of vegetation)
- Project design and species selection to ensure adequate performance in increasingly saline environments

RESTORATION

Technologies sorted as restoration are those that address nutrient rich water within an affected water body. The aquatic habitat and watershed restoration component of this Water Quality Improvement Project Plan is designed to maintain, improve and increase aquatic and coastal terrestrial habitats, as well as to restore ecological and hydrological functions, in order to enhance water quality and support biodiversity. The thrust of this effort is to restore natural processes associated with filtration of contaminants, bay flushing, watershed functions, floodplains, and clean recharge to the town's drinking water aquifer.

Implementation of the aquatic habitat restoration program will be guided by an ecosystem-based approach. Goals and objectives are designed to produce measurable and progressive improvements to water quality. The initiatives and projects described herein are intended to accomplish significant improvement in water quality and ecological health through large scale approaches.

The pursuit of the aquatic habitat restoration goals and objectives will support achievement and implementation of other goals and projects voiced in the WQIPP. To this end, the participation of all stakeholders, including government agencies, private sectors, academia and the public, will be solicited and encouraged, both in the formulation of water quality improvement priorities and in carrying out aquatic habitat restoration projects.

The intent of this Plan is to provide a single blueprint for aquatic habitat and watershed restoration, as well as water quality recovery. The program, as a whole, recognizes the need to formulate regional strategies and actions and identifies nine regions of the town that are in particular need of aquatic habitat and watershed restoration. These include the following:

- The Shinnecock Bay Region
- The Moriches Bay Region
- The Peconic River
- Reeves Bay
- North Sea Harbor
- The Peconic Estuary
- The Long Pond Greenbelt
- Shinnecock Hills Watershed
- Mecox Bay

Initial aquatic habitat and watershed restoration objectives include restoration of aquatic, riparian, riverine, estuarine, and lacustrine habitat losses, as well as preservation and reclamation of watershed lands. Priority actions will focus on restoring and protecting natural wetlands and aquatic habitats, as well as watershed forests for sole source aquifers to support water quality improvement. Pilot projects that increase natural filtration of surface and groundwaters, improve estuarine hydrodynamics and improve and maintain ecological water quality are high priority initiatives. Projects that build upon previously successful pilot projects will especially be targeted. Actions that develop, test and evaluate estuarine wetland and aquatic habitat restoration and water quality improvement techniques, will also be emphasized. Likewise important is scientific and regional support for projects.

Strategic Goals

1. Rehabilitation of natural processes in order to support natural aquatic and associated terrestrial habitats, including watersheds, in ways that favor water quality improvement.

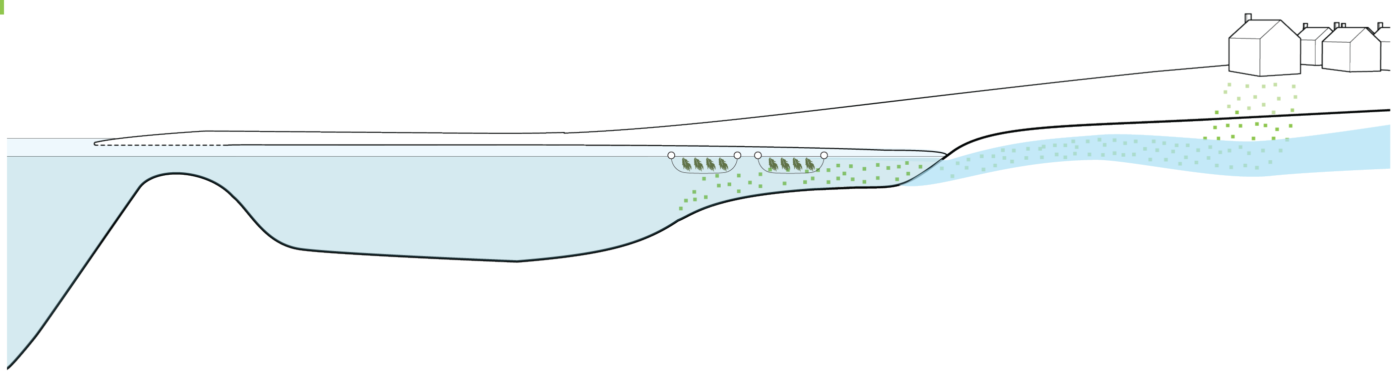
2. Maintenance and enhancement of biodiversity including fin and shell fisheries, wildlife, submerged aquatic vegetation, wetlands, marine life and native upland flora.

3. Protection and restoration of functional habitat types, including ecosystem benefits such as water purification.

4. Improvement of water quality conditions, including reduction of nitrogen and other pollutants of concern/contaminant inputs.

The following pages include a broad range of innovative and non-traditional nitrogen management strategies that are designed to intercept and treat nitrogen in the groundwater or to assimilate and treat in the receiving waters. Embayment treatment practices include, but are not limited to, shellfish bed restoration, floating wetlands, dredging and inlet modifications.

Among the actions needed to validate the efficacy of these approaches are piloting, monitoring and analyzing technology performance which must be built into each project as described in Section II and go hand in hand with defining watersheds, estimating watershed nitrogen loads, collecting water quality data, modeling tidal flushing and evaluating ecosystem interactions between embayment species. All technologies and tactics need continual refinement as new or more accurate information becomes available through research and field application.



SHELLFISH RESTORATION MARICULTURE

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: RESTORATION
SCENARIO PLANNING: SELECTED FOR USE PHYTOBUFFERS IDENTIFIED FOR PILOTING

DESCRIPTION

Seaweed and other marine vegetation remove nitrogen from their environment. The cultivation and removal of the marine vegetation can remove nitrogen from an estuary, reducing the estuary's nitrogen load. Mariculture can become a dual purpose project where seaweed can be harvested for market while there will be a local reduction in nitrogen in the overlying water column during the growth and maturation of the seaweed. This method of Shellfish Restoration cultivates marine vegetation such as seaweed to remove nitrogen. Harvesting a portion of the vegetation may be required to remove nitrogen. Mariculture can be used in combination with other types of Shellfish Restoration as well as floating constructed wetlands designed for brackish water.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	8% to 15%
Phosphorus Removal	N/A
20 years	Useful Life
1 to 3 years	See Results

SHELLFISH RESTORATION MARICULTURE

SITING NEEDS

- Suitable area within estuary to cultivate mariculture

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient
- Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

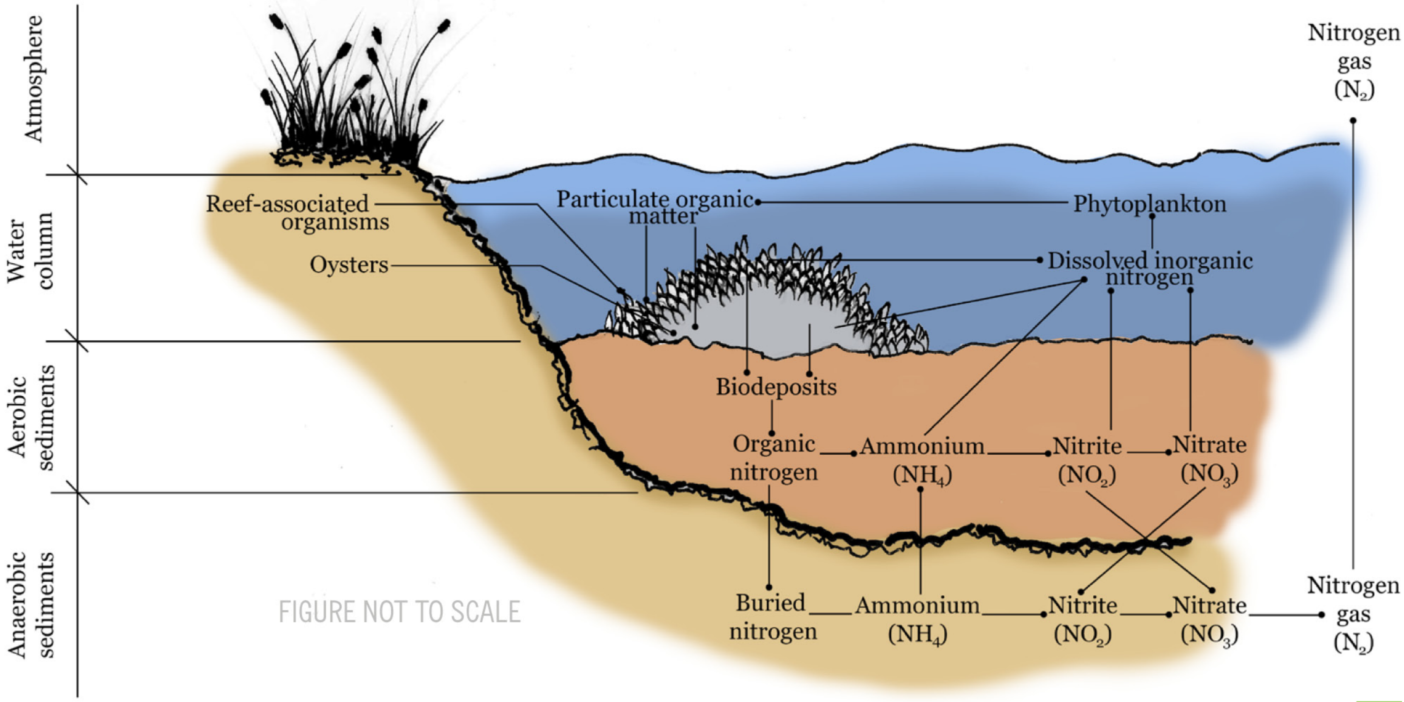
- Growing conditions, aesthetics or navigation may limit applicability
- Seasonal nitrogen uptake coincident with natural cycle and algal blooms
- Requires removal of vegetation in order to take credit for nitrogen removal
- Nitrogen uptake subject to possible disruption due to disease or other
- Growth and harvest monitoring is important to maintain persistence of the benefit

CLIMATE RESILIENCE: RISKS

- Damage to shorelines or subsurface structures from storm events (e.g. wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to reefs (e.g. wind walls)



SHELLFISH RESTORATION

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: RESTORATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Shellfish, specifically oysters, remove nitrogen from their environment. The growing and removal of the mature oysters can remove nitrogen from an estuary, reducing the estuary's nitrogen load. Shellfish Restoration can become a dual purpose project where shellfish are harvested for market while there will be a local reduction in nitrogen in the overlying water column during the growth and maturation of the oysters.

Shellfish may be cultivated above or within the estuary bed. The "in-estuary bed" method cultivates the shellfish in the benthic soils of the estuary. Shellfish may also be cultivated above the estuary bed in containers. With either approach, harvesting a portion of the oysters is required to remove nitrogen. Shellfish cultivation may be used in combination with other types of Shellfish Restoration (e.g mariculture), as well as floating constructed wetlands designed for brackish water.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	8% to 15%
Phosphorus Removal	N/A
20 years	Useful Life
1 to 3 years	See Results

SHELLFISH RESTORATION

SITING NEEDS

- Suitable area within estuary toseed and cultivate shellfish

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

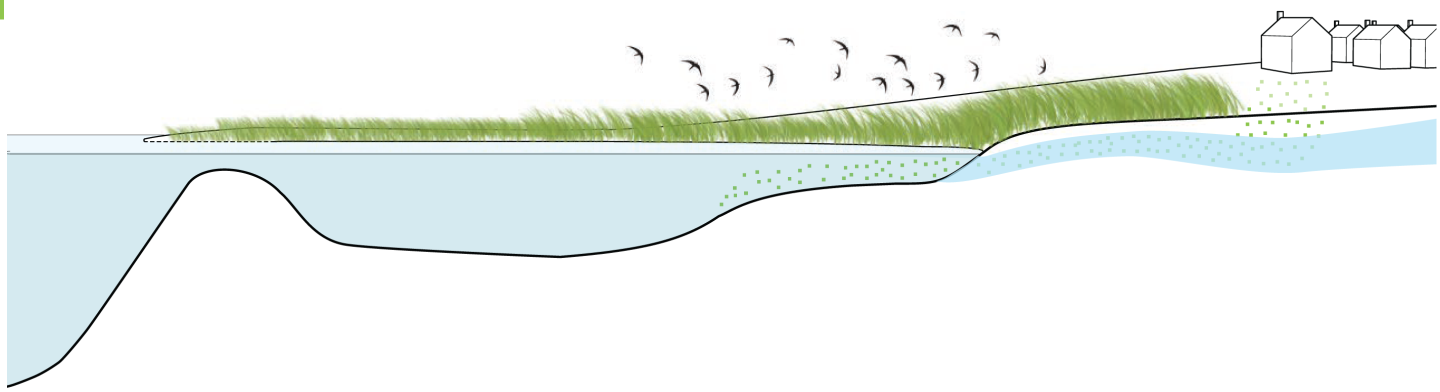
- Growing conditions, aesthetics or navigation may limit applicability
- Seasonal nitrogen uptake coincident with natural cycle and algal blooms
- Requires removal of shellfish in order to take credit for nitrogen removal
- Nitrogen uptake subject to possible disruption due to disease or population crash
- Population monitoring is important to maintain persistence of the benefit
- Large concentrations of shellfish can generate waste products, reduce dissolved oxygen levels, and possibly generate ammonia
- Shellfish will undergo rapid growth to a marketable size after which they must be harvested.
- Can require large areas to gain significant nitrogen removal
- If the waterbody is closed for shell fishing, management will be required to prevent the shellfish from getting into the food supply

CLIMATE RESILIENCE: RISKS

- Damage to shorelines or subsurface structures from storm events (e.g. wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to reefs (e.g. wind walls)



COASTAL HABITAT RESTORATION

SCALE: NEIGHBORHOOD/WATERSHED

APPROACH: RESTORATION

SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Restoration of coastal habitats includes establishing and/or enhancing estuary salt marshes, eel grass beds, as well as shellfish and oyster beds together as an ecosystem. When considering restoration of coastal habitats, implementing these ecosystems jointly should be considered. The installation of riparian buffer zones and Floating Constructed Wetlands should be considered when restoring coastal habitats. Habitat restoration should focus on creating or rehabilitating habitats, including creating communities that are natural to the area.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	5% to 12%
Phosphorus Removal	N/A
20 years	Useful Life
0.5 to 3 years	See Results

COASTAL HABITAT RESTORATION

SITING NEEDS

- Site specific requirements based on the characteristics of the estuary
- Suitable substrate in saltwater/estuarine environments
- Suitable area within estuary to seed and grow shellfish

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

CLIMATE RESILIENCE: RISKS

- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor condition and performance of
- technology (i.e. achieving nutrient removal targets and health of vegetation)
- Species selection to ensure adequate performance in increasingly saline environments
- Preserve areas / buffers to allow migration of salt marsh to higher elevations as MHW rises

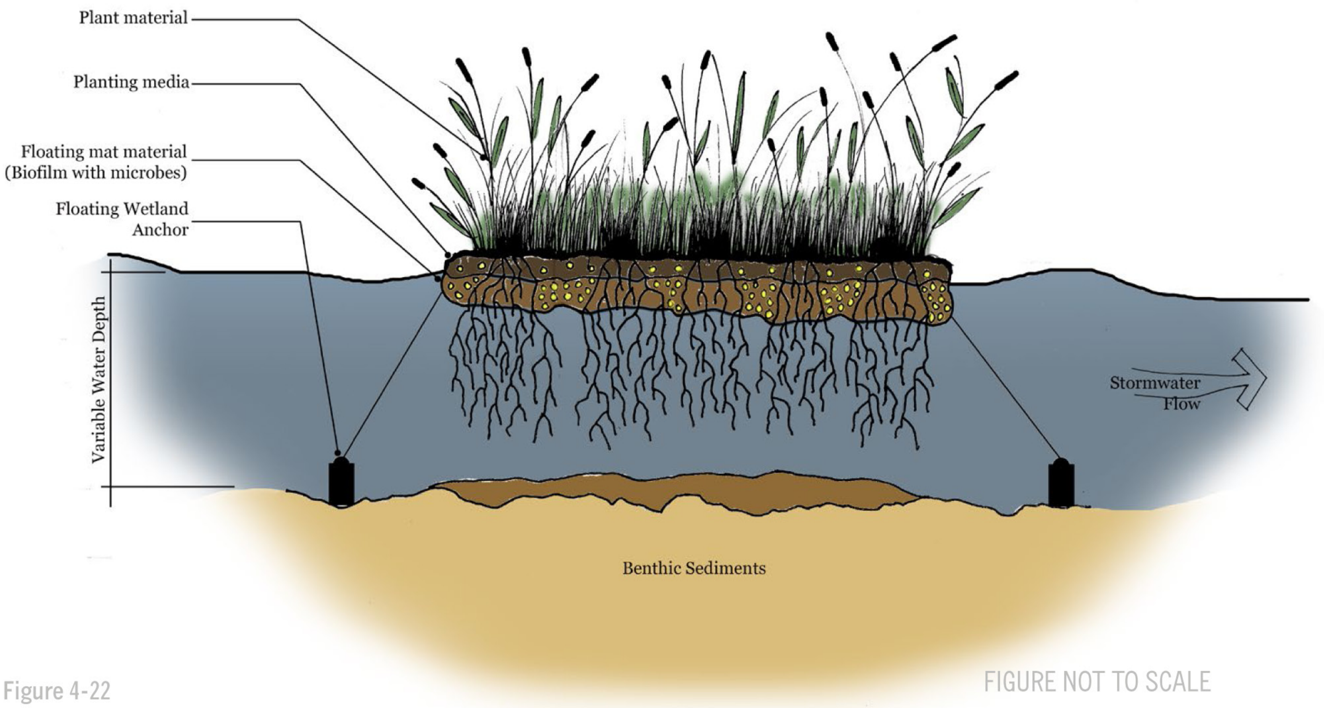


Figure 4-22

FLOATING CONSTRUCTED WETLANDS

SCALE: NEIGHBORHOOD/WATERSHED

APPROACH: RESTORATION

SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

FCWs are manmade floating "islands" that act as floating wetlands that treat waters within ponds and estuaries. The islands are made of recycled materials that float on ponds or estuaries, exposing the plant's roots to the pond and estuarine waters. The root zones provide habitat for fish and microorganisms while reducing nitrogen and phosphorus levels. The floating islands can also be designed to allow shellfish and seaweed to grow which can be harvested, offsetting some of the systems costs. Some systems circulate surface water through the island, exposing the water to the root zones of the plants. The islands can be installed with shellfish beds and/or salt marsh grasses potentially assisting with their establishment. The islands are generally stationary and can be installed with walkways to access and maintain the plants growing on the islands. The islands require little O&M and do not need to be removed during the winter months, even if freezing water is a concern.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	8% to 15%
Phosphorus Removal	0.5 to 1
20 years	Useful Life
0.5 to 3 years	See Results

FLOATING CONSTRUCTED WETLANDS

SITING NEEDS

- Site specific requirements based on the characteristics of the estuary or pond
- A location(s) within the estuary or pond to locate a floating island year around

ECO-BENEFITS

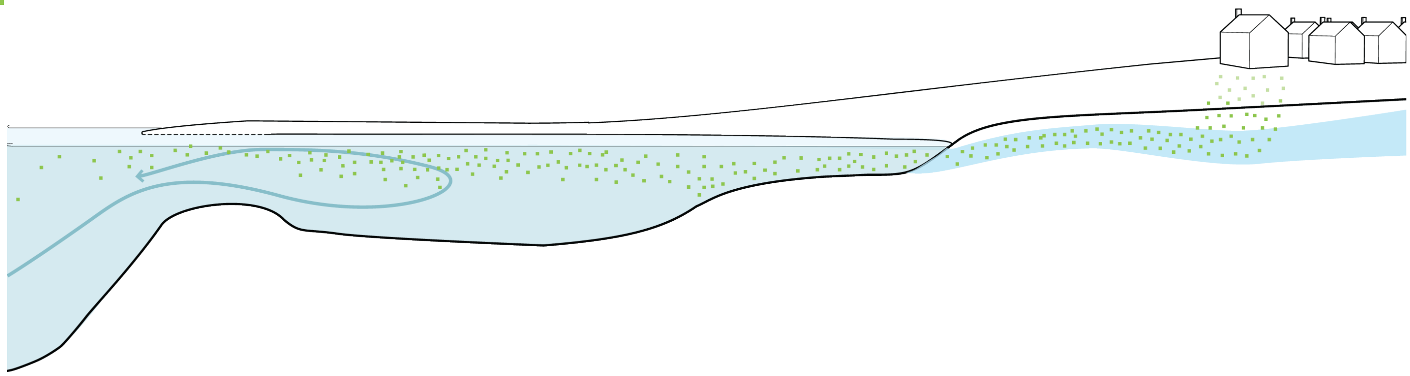
- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

CLIMATE RESILIENCE: RISKS

- Damage to structures from storm events (e.g. wind and wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to wetlands (e.g. wind walls)



INLET/CULVERT WIDENING/TIDAL EXCHANGE

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: RESTORATION
SCENARIO PLANNING: SELECTED FOR USE

DESCRIPTION

This approach considers re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. In the right settings, increasing the tidal flux can decrease the nitrogen residence time, lowering the nutrient concentration in the estuary and/or tidal marsh upstream of the widened inlet or culvert.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	8% to 15%
Phosphorus Removal	0.5 to 1
10 years	Useful Life
0.5 to 3 years	See Results

INLET/CULVERT WIDENING/TIDAL EXCHANGE

SITING NEEDS

- Site specific requirements, based on existing culvert bridge dimensions, hydraulics and other characteristics

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Widening a tidal culvert or bridge could increase the depth of flooding during high tides and storm surges in flood prone area and upstream of the structure.
- Disruption of coastal processes must be considered
- Can have significant construction impacts
- Permitting requirements may be extensive and time consuming
- Modeling is required to accurately predict the upstream tidal and coastal process impacts of the culvert/ bridge modifications
- Will only return an estuary to a more natural hydrologic regime if the original opening has been restricted

CLIMATE RESILIENCE: RISKS

- Damage to shorelines or subsurface structures from storm events (e.g. wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to reefs (e.g. wind walls)

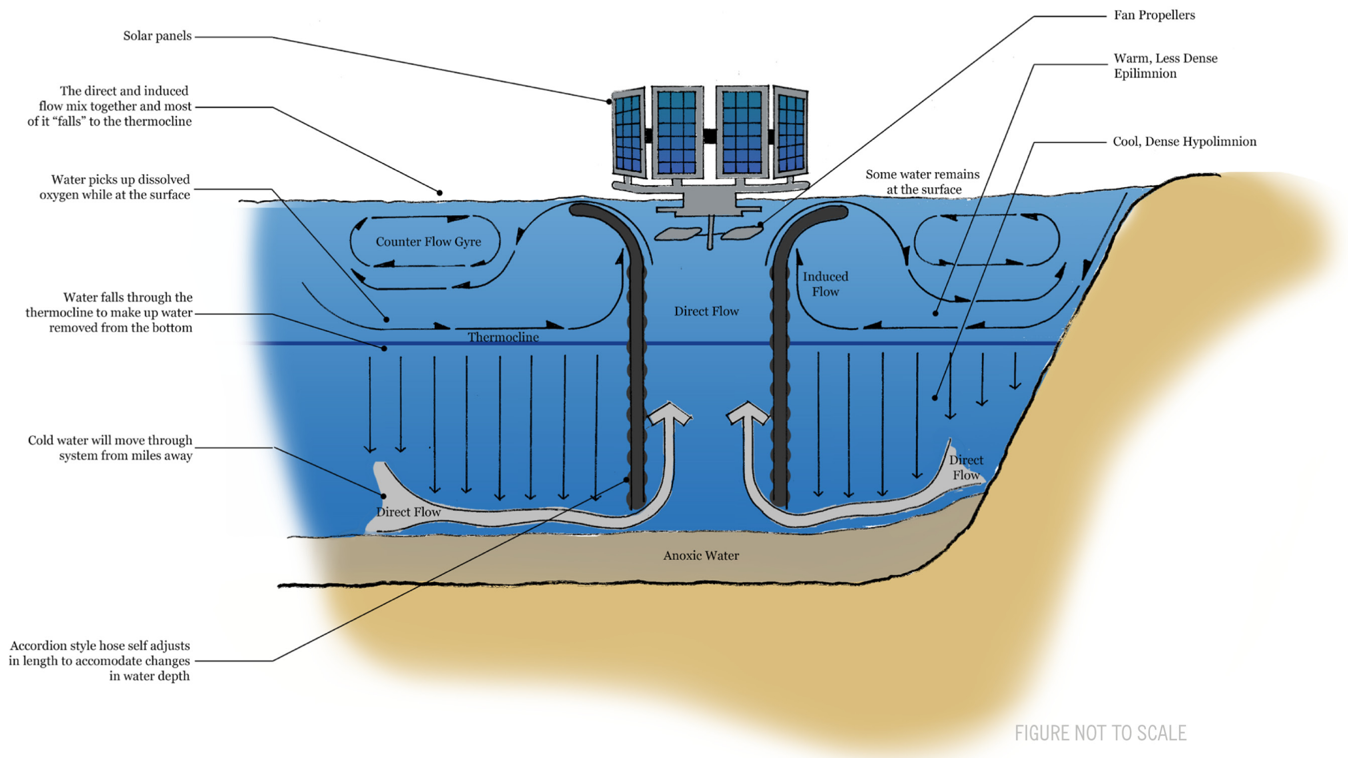


Figure 4-24

POND AND ESTUARY CIRCULATORS

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: RESTORATION
SCENARIO PLANNING: SELECTED FOR USE

DESCRIPTION

The circulation of pond and estuary water increases the oxygen concentration while reducing nutrients (nitrogen and/or phosphorus) concentrations, reducing odors, and enhancing fish habitat. The circulation is generally performed mechanically by installing solar or electric powered circulators.

Pond and estuary circulators work by reducing stratification in ponds and estuaries. Anoxic conditions can occur within the lower stratified layers leading to harmful algae blooms, fish kills and odors. Circulators mix these stratified layers, thereby
increasing dissolved oxygen concentrations throughout the pond depths.

TECHNOLOGY PERFORMANCE	
10 years	Useful Life
0.5 to 3 years	See Results

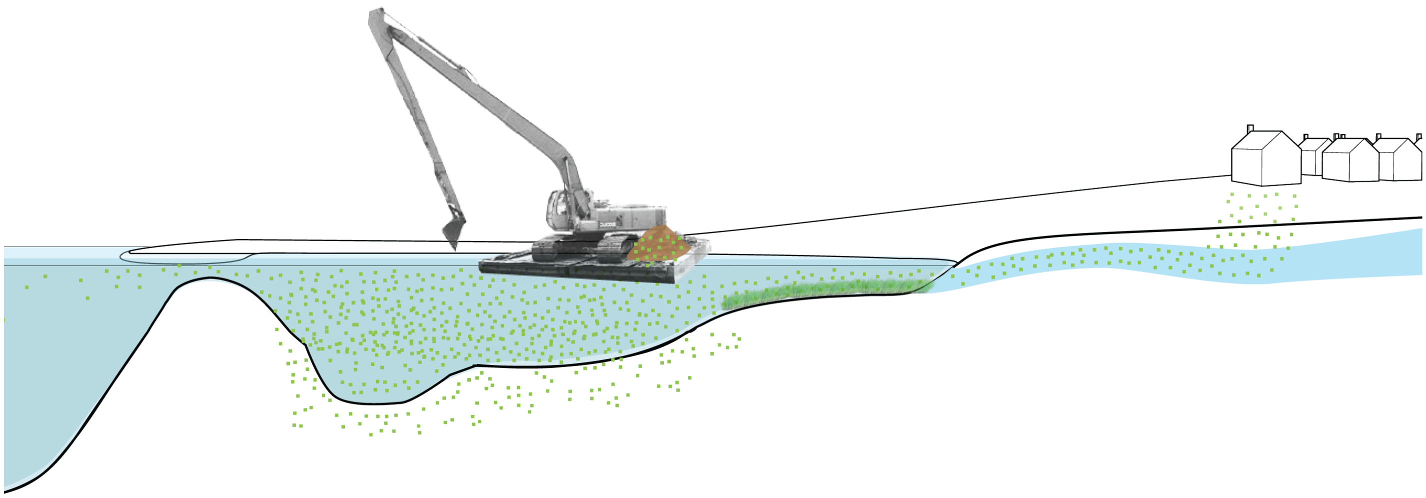
POND AND ESTUARY CIRCULATORS

SITING NEEDS

- Site specific requirements based on the characteristics of the estuary or pond
- A location(s) within the estuary or pond to permanently locate floating island

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Energy Savings / Nutrient Recovery / Recycling
- Improves Management of Flooding / Extreme Events



POND AND ESTUARY DREDGING

SCALE: NEIGHBORHOOD/WATERSHED

APPROACH: RESTORATION

SCENARIO PLANNING: SELECTED FOR USE

DESCRIPTION

Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be released into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	80% to 95%
Phosphorus Removal	80% to 95%
25 years	Useful Life
0.5 to 1 years	See Results

POND AND ESTUARY DREDGING

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Permitting requirements may be
- Extensive and time consuming
- Testing of sediment required
- Dredging can be highly disruptive
- To biological communities
- Depending on what other contaminants may be present in the sediments, disposal of the sediments may be costly

SITING NEEDS

- Site specific requirements, based on hydraulics and other characteristics

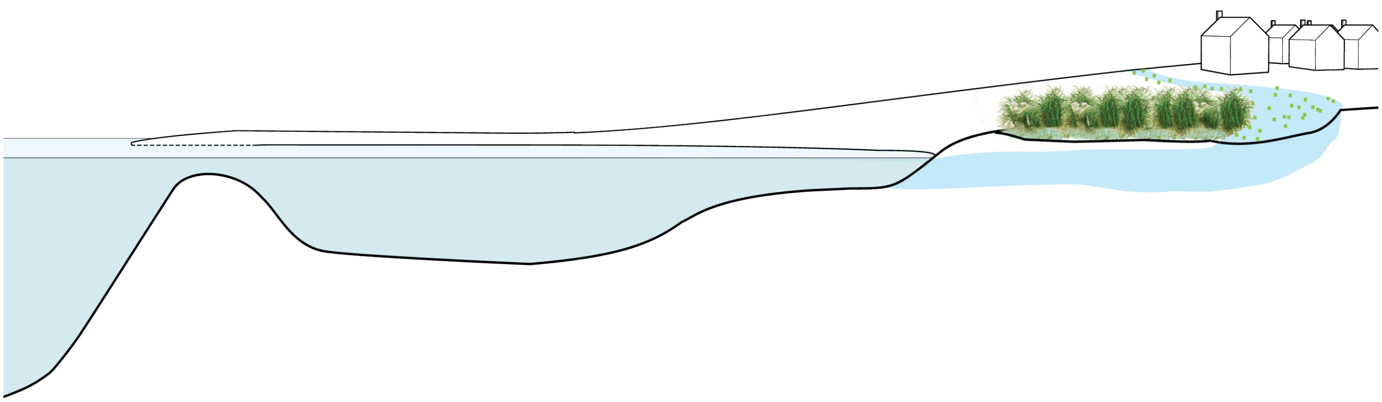
CLIMATE RESILIENCE: RISKS

- Damage to shorelines or subsurface structures from storm events (e.g. wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to reefs (e.g. wind walls)

RESTORATION



SURFACE WATER REMEDIATION WETLANDS

SCALE: NEIGHBORHOOD/WATERSHED
APPROACH: RESTORATION
SCENARIO PLANNING: SELECTED FOR USE IDENTIFIED FOR PILOTING

DESCRIPTION

Surface Water Remediation Wetlands are constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is directed or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with free water surface wetlands due to their larger size, and lower capital and O&M Costs.

TECHNOLOGY PERFORMANCE	
Nitrogen Removal	70% to 95%
Phosphorus Removal	40% to 95%
20 years	Useful Life
1 to 5 years	See Results

SURFACE WATER REMEDIATION WETLANDS

SITING NEEDS

- Site specific requirements, based on hydraulics and other characteristics

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Large land area required per amount of nitrogen removed
- Requires existing open space for construction

CLIMATE RESILIENCE: RISKS

- Damage to shorelines or subsurface structures from storm events (e.g. wave action)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor asset condition and performance of technology (i.e. achieving nutrient removal targets)
- Potential anchoring of structures
- Protective structures to reduce impacts to reefs (e.g. wind walls)

SUMMARY

TECHNOLOGY GROUPING	TECHNOLOGY / STRATEGY & EXAMPLES
Green Infrastructure/Remediation	Constructed Wetlands Groundwater Treatment
	Constructed Wetlands Subsurface Flow
	Constructed Wetlands Surface Flow
	Fertigation Wells
	Permeable Reactive Barriers (PRBs) Injection Well Method
	Permeable Reactive Barriers (PRBs) Trench Method
	Stormwater Bioretention Soil Media Filters
	Stormwater Constructed Wetlands, BMPs
Innovative and Resource-Management Technologies	Shellfish Restoration Mariculture
	Shellfish Restoration Shellfish
	Phytoirrigation
	Phytoremediation
System Alterations/Restoration	Coastal Habitat Restoration
	Floating Constructed Wetlands and Tidal Exchange
	Inlet/Culvert Widening
	Pond and Estuary Circulators
	Pond and Estuary Dredging
	Surface Water Remediation Wetlands

EXPECTED OUTCOMES

- Increased installations of Innovative/Alternative Systems or Neighborhood Cluster Systems that actively reduce nitrogen;
- Decreased amount and concentration of nitrogen in waterbodies of Southampton and by extension, Suffolk County;
- Expanded public awareness of the impacts of individual septic systems on collective water quality;
- Increased remediation and restoration projects to meet nitrogen reduction targets- each project would be vetted by a water quality committee and solicited by a competitive RFP process;
- Increased grant proposals for water quality improvement projects with the CPF revenue provided as a source of matching funds.