# Pleasant Bay and Wellfleet Watershed Project

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# Purpose and Table of Contents

The purpose of this project is to highlight the importance of watershed management by municipalities and to compare two examples of watershed management plans on Cape Cod, the watershed management plans for Wellfleet and Pleasant Bay.

Information herein was compiled directly from publicly available documents. A list of sources is in the Appendix.

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# Watershed Basics

# Watershed Basics (1/2)

We all live in a watershed.

What is a Watershed?

- Every body of water (e.g., rivers, lakes, ponds, streams, and estuaries) has a watershed. The watershed is the area of land that drains or sheds water into a specific receiving waterbody, such as a lake or a river. As rainwater or melted snow runs downhill in the watershed, it collects and transports sediment and other materials and deposits them into the receiving waterbody.

What is Watershed Management?

- Watershed management is a term used to describe the process of implementing land use practices and water management practices to protect and improve the quality of the water and other natural resources within a watershed by managing the use of those land and water resources in a comprehensive manner.

What is Watershed Management Planning?

- Watershed management planning is a process that results in a plan or a blueprint of how to best protect and improve the water quality and other natural resources in a watershed. Very often, watershed boundaries extend over political boundaries into adjacent municipalities and/or states. That is why a comprehensive planning process that involves all affected municipalities located in the watershed is essential to successful watershed management.

# Watershed Basics (2/2)

Why is watershed management important?

- Runoff from rainwater or snowmelt can contribute significant amounts of pollution into the lake or river. Watershed management helps to control pollution of the water and other natural resources in the watershed by identifying the different kinds of pollution present in the watershed and how those pollutants are transported, and recommending ways to reduce or eliminate those pollution sources.

- All activities that occur within a watershed will somehow affect that watershed’s natural resources and water quality. New land development, runoff from already-developed areas, agricultural activities, and household activities such as gardening/lawn care, septic system use/maintenance, water diversion and car maintenance all can affect the quality of the resources within a watershed. Watershed management planning comprehensively identifies those activities that affect the health of the watershed and makes recommendations to properly address them so that adverse impacts from pollution are reduced.

- The watershed management planning process results in a partnership among all affected parties in the watershed since all partners have a stake in the watershed. Because watershed boundaries do not coincide with political boundaries, the actions of adjacent municipalities upstream can have as much of an impact on the downstream municipality’s land and water resources as those actions carried out locally.

- Comprehensive planning, participation and commitment from all municipalities in the watershed is critical to protecting the health of the watershed’s resources.

# Commonly Used Terminology

**Massachusetts Estuaries Project (MEP)** In 2001, the MEP was established to evaluate the health of 89 coastal embayment ecosystems across southeastern Massachusetts and identify nitrogen thresholds and necessary nutrient reductions to support healthy ecosystems.

**Adaptive Plans** "Adaptive plans" allow for flexibility in future years (generally 3-20 years ahead) based on the achievements in the early years of the plan.

**Source control:** Controlling and stopping pollution at the source (e.g. sewers, fertilizer reduction)

**Remediation:** Remediation techniques are considered non-traditional. They rely on natural processes (e.g. PRBs, Fertigation of golf courses, shellfish propagation)

**Traditional methods:** Include sewers and wastewater treatment plans, and fertilizer reductions efforts.

**Non-traditional methods:** Include innovative and alternative (I&A) septic systems and remediation techniques.

**Total nitrogen load:** the nitrogen load from the watershed contributed by septic, wastewater, fertilizer, stormwater, golf course, landfill, and natural sources.

**Attenuated nitrogen load:** the nitrogen load from the watershed that reaches the embayment after the effect of natural attenuation in wetlands, ponds or streams.

**Total Maximum Daily Loads (TDML)** the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant

**Threshold:** the amount of nitrogen that a water body can receive from its watershed and still meet water quality goals; this number is based on MEP technical reports or Total Maximum Daily Load (TMDL) reports.

**Reduction target:** an approximation of the amount of nitrogen that needs to be removed from the watershed to achieve the threshold; this number is calculated by subtracting the threshold number from the attenuated total watershed load and is for planning purposes only.

**Fertigation:** the injection of fertilizers into an irrigation system which offers nitrogen use and water use efficiency.

**I&A (Innovative and Advanced) Septic Systems:** systems designed to prevent excess nutrients, such as nitrogen, from entering estuaries and freshwater ponds

**Permeable Reactive Barrier (PRB):** a wall created below ground to clean up contaminated groundwater. The wall is "permeable," which means that groundwater can flow through it. Water must flow through the PRB to be treated.

# Wellfleet Targeted Watershed Plan

# Wellfleet Plan Summary

- The Wellfleet plan is a hybrid of traditional and non-traditional methods with a greater emphasis on non-traditional or remediation approaches compared to other towns. In addition, Wellfleet notes their prioritization of lower costs and quicker results.

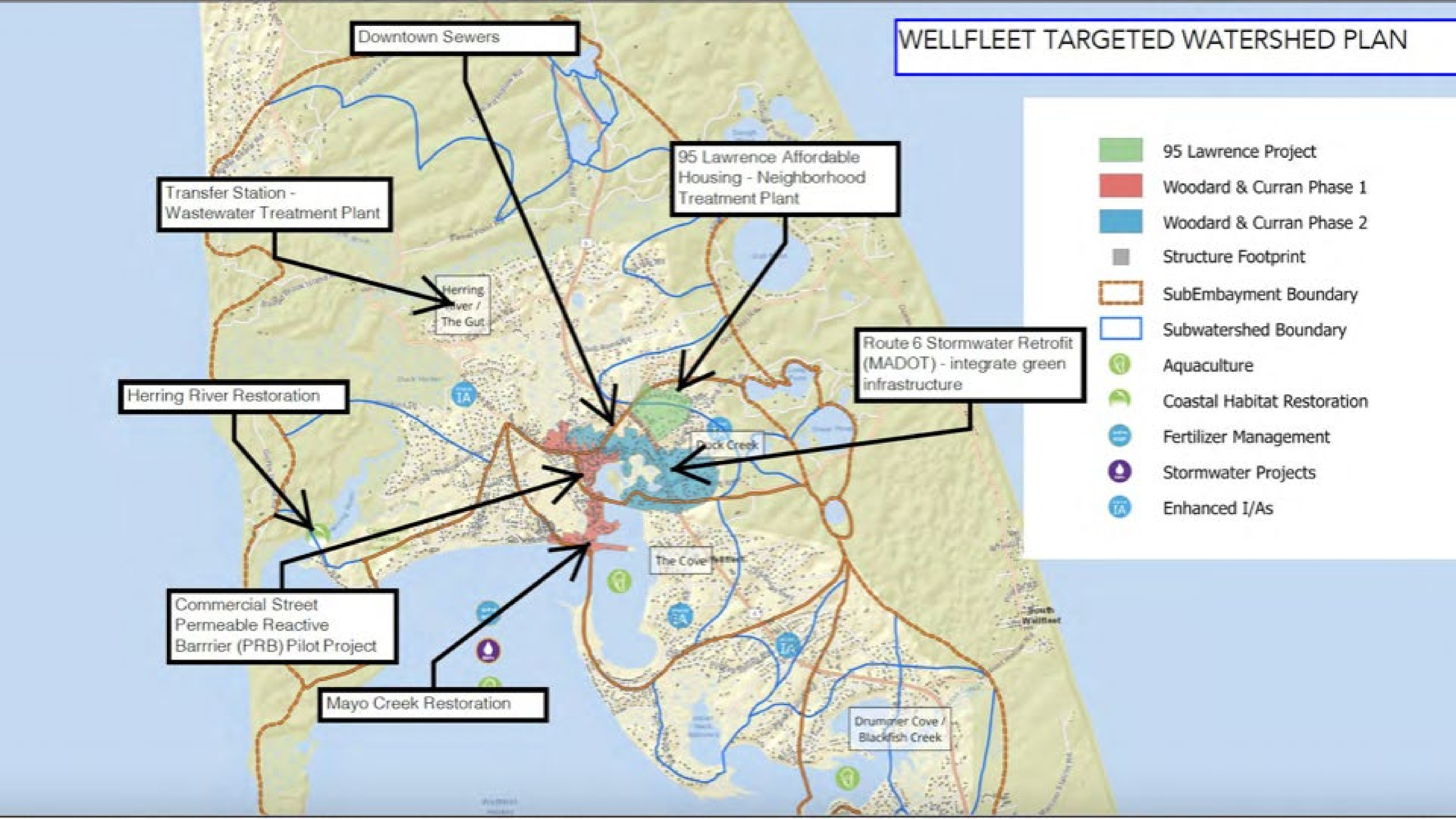
- The plan includes five phases (five years each) over a 25-year period, but importantly, it is an adaptive plan meaning the plan will be updated based on progress and learnings over time

- For reducing nitrogen load from wastewater, the plan includes
    - Enhanced innovative and alternative septic systems which are a cost-effective means to reduce nitrogen loading (non-traditional)
    - Construction of a neighborhood-scale wastewater treatment plant to facilitate an affordable housing project at 95 Lawrence Road (traditional)
    - The plan includes building an underground permeable reactive barrier (PRB) at Commercial Street which cleans contaminated groundwater as it flows through the barrier (non-traditional)
    - Includes development of a sustainable shellfish program (non-traditional)
    - For stormwater, the plan includes retrofits at Route 6 (traditional)
    - The plan also includes implementation of fertilizer controls and restoration of Mayo Creek which reduces nitrogen

- Subsequent phases of the plan build upon the phase I approaches

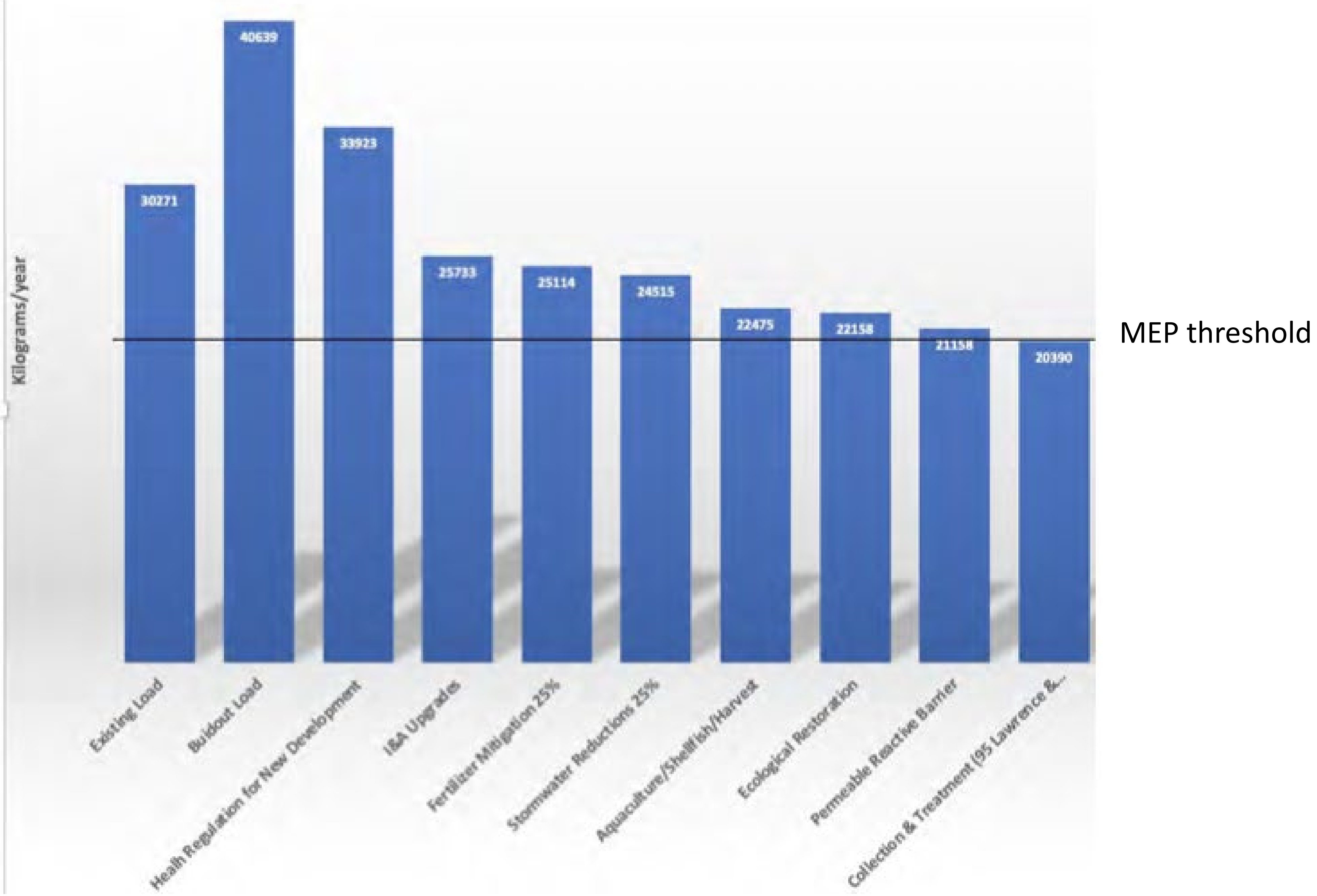
# Wellfleet Targeted Watershed Plan – 2022-2026

| **Nitrogen Reduction Strategies** | kg/yr |
|---|---|
| • Wastewater Treatment | |
|     • Establish Responsible Management Entity (RME) and Install 25 – 30 EIA (*) systems/year | 494 |
|     • 95 Lawrence – Permit, Design, and Construct Phase 1 (Housing and Municipal Properties) | 341 |
| • Stormwater | |
|     • Rte 6 MADOT integrate N attenuation | 102 |
| • Fertilizer | |
|     • Implement Fertilizer Controls | 98 |
| • Permeable Reactive Barrier | |
|     • Pilot Project Bank/Commercial Street (50 feet) | 20 |
| • Shellfish | |
|     • Sustainable growth at 94 kg/year | 462 |
| • Ecological Restoration | |
|     • Mayo Creek: Design, Permit, and Construction | 317 |
| Total | 1834 |



WELLFLEET TARGETED WATERSHED PLAN
Downtown Sewers
95 Lawrence Affordable Housing - Neighborhood Treatment Plant
Transfer Station - Wastewater Treatment Plant
Herring River / The Gut
Route 6 Stormwater Retrofit (MADOT) - integrate green infrastructure
Herring River Restoration
Duck Creek
The Cove
Commercial Street Permeable Reactive Barrier (PRB) Pilot Project
Mayo Creek Restoration
Drummer Cove / Blackfish Creek
South Wellfleet
95 Lawrence Project
Woodard & Curran Phase 1
Woodard & Curran Phase 2
Structure Footprint
SubEmbayment Boundary
Subwatershed Boundary
Aquaculture
Coastal Habitat Restoration
Fertilizer Management
Stormwater Projects
Enhanced I/As

# Continued Use Cumulative Nitrogen Loading Analysis – Wellfleet Harbor of Conventional Title 5 Systems



# Wellfleet Plan Supports Enhanced I&A Septic Systems

Purpose: To reduce nitrogen loading to Wellfleet's coastal waters by providing the best available technology.

The use of enhanced innovative & alternative (I&A) septic systems are required for new, repairs, upgrades, and property transfers.

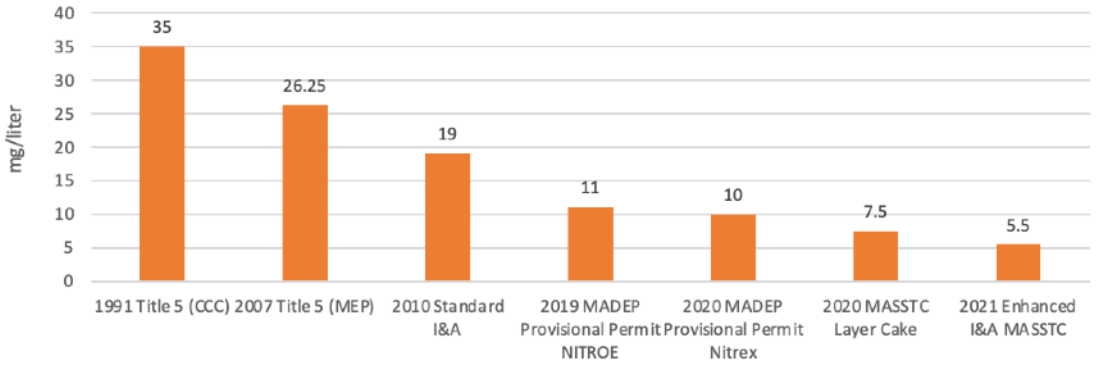
Enhanced I&A septic systems are defined as those technologies that have average nitrogen effluent concentrations less than 10 mg/liter or greater as demonstrated by third-party testing. Currently the Board of Health recognizes the following technologies as enhanced:

- NITRO and NITREX (use gravity)
- Sawdust-based system known as the "Layer Cake" technology (Heufelder, 2019).

The 2021 Wellfleet Town Meeting authorized $250,000 to assist property owners up to $12,500 per installation.

The Wellfleet Plan calls for $3.7 million capital investment in I&A Septic Systems over 5 years (60 systems/year at $12,500/system)

Wellfleet estimates that enhanced I&A is about 1/3 the cost of central sewer and treatment ($28k vs $90k)



# Wastewater Treatment at 95 Lawrence Road

- 95 Lawrence Road is a plot land being used for an affordable housing project. It is 9.26 acres of undisturbed land, a baseball field, and an elevated water storage tower

- The site is located within the Duck Creek watershed which ultimately discharges to Wellfleet Harbor and where a significant nitrogen reduction is required.

- A grant provided by the Cape Cod Commission On-Site Engineering evaluated wastewater options for the site:
    1. an innovative and alternative septic system for the housing project alone
    2. a wastewater treatment plant to service the housing development and the three adjacent municipal buildings
    3. a larger wastewater treatment plant to service the housing development, the municipal buildings, and a number of residential homes in the neighborhood

- The evaluation indicated that option 3 would provide the most significant nitrogen reduction benefit to Duck Creek and would provide a cost-effective solution

- This project will uniquely accomplish both affordable housing and water quality restoration.

# Permeable Reactive Barrier

A permeable reactive barrier, or “PRB,” is a wall created below ground to clean up contaminated groundwater. The wall is “permeable,” which means that groundwater can flow through it. Water must flow through the PRB to be treated. The “reactive” materials that make up the wall either trap harmful contaminants or make them less harmful. The treated groundwater flows out the other side of the wall.

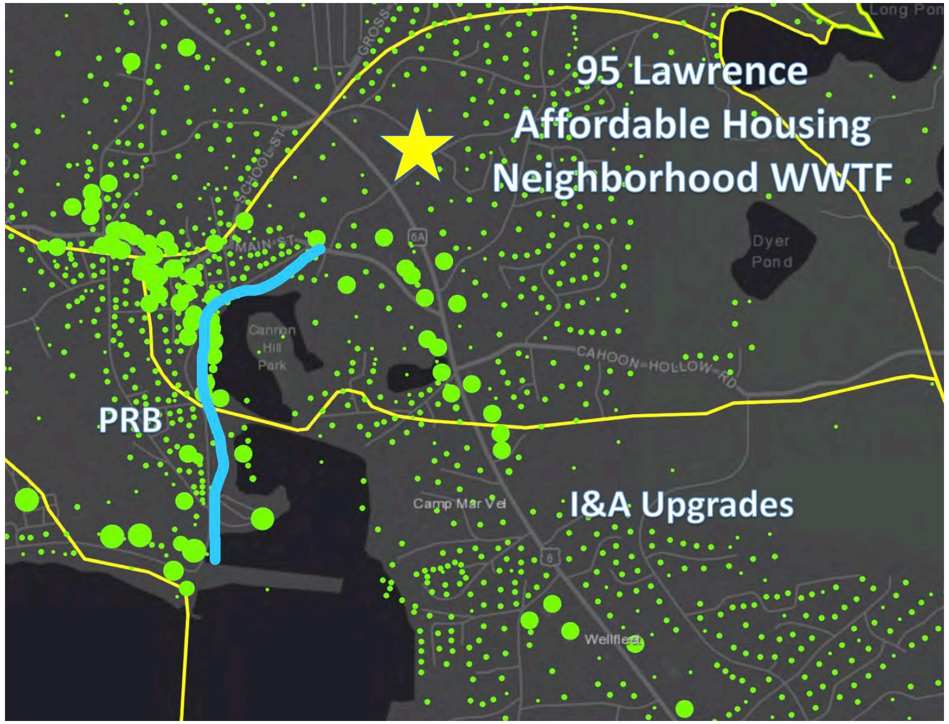
PRBs are usually built by digging a long, narrow trench in the path of contaminated groundwater flow. The trench is filled with a reactive material, such as iron, limestone, carbon or mulch, to clean up contaminants from groundwater.

Depending on the reactive material, contaminants are removed through different processes:

- Contaminants ***sorb*** (stick) to the surface of the reactive material
- Metals dissolved in groundwater ***precipitate***, which means they are removed from groundwater by forming solid particles that get trapped in the wall.
- Contaminants ***react*** with the reactive material to form less harmful ones
- Contaminants are ***biodegraded*** by microbes in the PRB.

PRBs are a relatively inexpensive way to clean up groundwater. No energy is needed because PRBs rely on the natural flow of groundwater.

The Wellfleet Plan calls for a $450,000 pilot PRB project at Commercial Street.



# Wellfleet Capital and O&M Plan (Yrs 1-5)

| | Capital / O&M |
|---|---|
| Innovative & Alternative (I&A) Septic Systems - | $3,750,000 / $100,000 |
| 95 Lawrence Neighborhood Wastewater Treatment Project - | $1,931,886 / $52,746 |
| Permeable Reactive Barrier (PRB) Pilot Project – Commercial St. - | $450,000 / $0 |
| Salt Marsh Restoration - | $300,000 / $0 |
| Shellfish Propagation - | $0 / $80,000 |
| Project Management - | $0 / $200,000 |

# Wellfleet's View of Benefits of their Plan

- Lower Cost
  - $28,000 per residence vs. over $90,000 under alternative methods
  - Likely $20-$40 million financed in increments over time vs. $100-$200 million immediately in tax base
- Greater financial control with annual financial discussion
- No risk of "overbuild"
- Maintains local control and local jobs
- 50% reduction in leachfields aids all residential and commercial permit applicants
- More immediate watershed benefits
- Lower energy, water and climate change impact required by 2020 ATM vote
- Very little long-term O&M

# Pleasant Bay Towns - Watershed Plans

Brewster, Chatham, Harwich, Orleans

# Pleasant Bay Plan Summary

- For close to two decades, the Pleasant Bay Alliance has coordinated actions among the four towns sharing the watershed of Pleasant Bay to address nitrogen enrichment, which is a danger to the health of Pleasant Bay.
- The four towns have collaborated to create a management plan to remove nitrogen from the water
- Chatham and Harwich plan to remove nitrogen by creating a sewer system that will treat wastewater in Pleasant Bay
- Orleans plans to use non-traditional solutions such as septic systems
- Brewster plans to reduce fertilizer use (both golf and residential) and is looking into non-traditional solutions
- Provided below is the estimate of the annual nitrogen removal responsibility per town

| | |
|---|---|
| Brewster | 2,262 kg/yr (13% of total removal responsibility) |
| Chatham | 4,076 kg/yr (23% of total removal responsibility) |
| Harwich | 4,399kg/yr (25% of total removal responsibility) |
| Orleans | 6,980 kg/yr (39% of total removal responsibility) |

# Nitrogen Removal Requirement and Removal Expectation Included in Town Plans

- Each town is required to remove a certain amount of nitrogen from Pleasant Bay.
- Brewster, Harwich, and Orleans each have a nitrogen removal plan which approximately equals their required levels of removal. Chatham, on the other hand, is only required to remove about 4,000 kgN/yr but is planning to remove about 13,000 kgN/yr because of sewering
- See the next 4 slides for a town-by-town summary of their plan.

**Figure 2. Comparison of Nitrogen Removal Requirements and Town Plans**

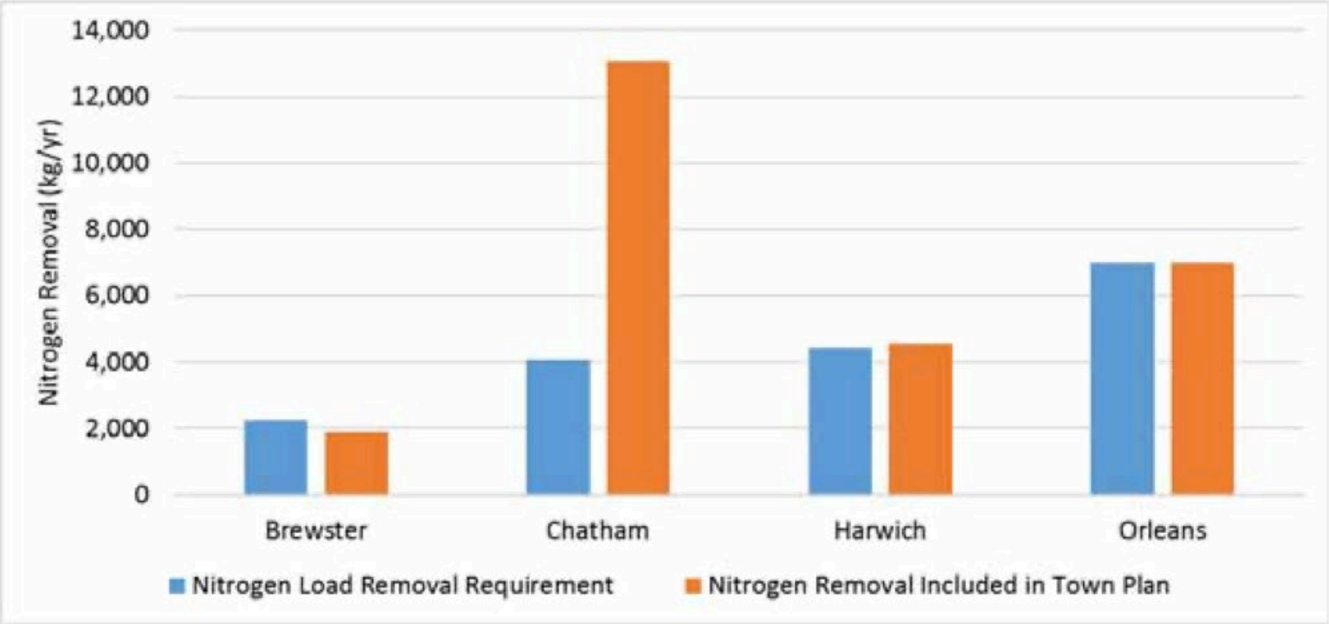



**Table 3. Comparison of Town Plans with Watershed Load Removal Requirements**

| | Brewster | Chatham | Harwich | Orleans | Total |
|---|---|---|---|---|---|
| Nitrogen Load Removal Requirement, kg/yr | 2,262 | 4,076 | 4,399 | 6,980 | 17,717 |
| Nitrogen Removal Included in Town Plan, kg/yr | 1,871 | 13,058 | 4,540 | 6,974 | 26,442 |
| Load Removal in Excess of TMDL, kg/yr | - | 8,982 | 141 | - | 9,123 |
| Load Removal Below TMDL, kg/yr | 390 | - | - | 7 | 397 |
| Load Removal Compared with TMDL | -17% | 220% | 3% | -0.1% | 49% |

# Brewster

- Brewster contributes approximately 13% of the attenuated wastewater nitrogen load to the Pleasant Bay watershed and is responsible for 13% of the aggregate removal.

- Brewster's Integrated Water Resources Management Plan (IWRMP) Phase II report was finalized and issued in January 2013 with assessments and recommendations addressing nitrogen loading to Pleasant Bay, existing and future drinking water, and stormwater and freshwater pond needs. Nitrogen management alternatives are further discussed in a March 2015 report.

- The Brewster Plan includes significant fertilizer reductions that have already taken place at the Captain's Golf Course, fertigation at the golf course, and reductions in residential fertilizer loads.

- Brewster considered shellfish propagation or aquaculture to meet the remaining nitrogen reduction.

- The Town is currently looking at new septic leachfield technologies for nitrogen reduction (since the shellfish management option may not be feasible) and is investigating potential pilot projects to test this option.

- On-site denitrification systems are planned to remove approximately 590 kg/yr of attenuated nitrogen load;

- Sewering of a residential neighborhood has been identified as a backup option, but the proposed location is at the upper end of the watershed, meaning it would take decades for there to be water quality improvement in the Bay.

# Chatham

- Chatham contributes approximately 34% of the attenuated wastewater nitrogen load to the Pleasant Bay watershed and is responsible for 23% of the overall removal.

- Chatham began implementing its Comprehensive Wastewater Management Plan (CWMP) in 2010. The CWMP includes the sewering of the entire town, with the implementation of later sewering phases being contingent upon results of on-going monitoring under the adaptive management plan.

- Chatham, in cooperation with Harwich, recently completed the construction of a new bridge to replace inadequate culverts that will provide increased tidal flushing and improved water quality in Muddy Creek.

- Chatham and Harwich agreed in 2017 to allow portions of Harwich, within the Pleasant Bay watershed, to be connected by sewer infrastructure to the Chatham Water Pollution Control Facility for treatment. Chatham and Harwich expect to receive state funds for implementation of joint sewering to accomplish this task.

- Chatham continues with future phases of sewer implementation according to the Town-wide plan.

- Chatham is proceeding under MEPA Certificate (EOEEA #11510) to implement Phase 1 of its plan to achieve TMDL compliance within all of its watersheds, including those related to Pleasant Bay.

# Harwich

- Harwich contributes approximately 22% of the attenuated wastewater nitrogen load to the Pleasant Bay watershed and is responsible for 25% of the overall removal.

- Harwich developed a recommended program to address nitrogen removal and meet other town needs in 2013. Upon further refinement, Harwich filed the final CWMP in March 2016 with MEPA and the CCC. MEPA issued a Certificate of Approval on May 13, 2016. The Commission gave Development of Regional Impact Individual (DRI) approval in August 2016.

- The CWMP recommends a community partnership with Chatham to treat wastewater generated and collected in the Pleasant Bay watershed at the existing Chatham treatment facility. Treated effluent would initially be recharged at the Chatham facility but may in the future be conveyed back to East Harwich for recharge, depending on water quality results.

- The Harwich CWMP also includes several nontraditional components such as the Muddy Creek inlet widening, and inclusion of stormwater best management practices (BMPs) throughout town.

- Several non-infrastructure components are included, such as review of potential open space acquisition parcels to minimize buildout, and fertilizer education programs (instead of a fertilizer control ordinance).

- The completion of Phase 2 of its plan eliminates septic systems in East Harwich and allows the transport of wastewater (and about 2,700 kg/yr of nitrogen) to Chatham for treatment and discharge outside the Pleasant Bay watershed.

# Orleans

- Orleans contributes 30% of the attenuated wastewater nitrogen load to the Pleasant Bay watershed and is responsible for 39% of the overall removal.

- Orleans’ CWMP was completed in 2010 and received approvals with conditions in 2011. The CWMP is a phased sewering plan supplemented with non-traditional solutions that may reduce the scale of sewering requirements.

- Orleans embarked on supplemental planning aimed at accelerating the use of non-traditional solutions to minimize sewering. In 2015, the Orleans Water Quality Advisory Panel recommended a strong emphasis on non-traditional technologies to meet the TMDL requirements for Pleasant Bay.

- In 2016, Orleans installed a demonstration oyster-growing project in Lonnie’s Pond and is planning another shellfish project in Quanset Pond. The plan now includes initiation of a full-scale aquaculture system in Lonnie’s Pond (to remove about 270 kg/y of nitrogen).

- Orleans seeks funds for a pilot project of four on-site septic systems with nitrogen removing biofilters.

- Under the Consensus Agreement, only the Meetinghouse Pond subembayment is scheduled for public sewering. If non-traditional methods are not found to be fully viable, Orleans will need to utilize additional sewer extensions to meet TMDL requirements.

- Orleans is evaluating PRBs for possible use in the Pleasant Bay watershed.

# Nitrogen Trading Allows for Flexibility Across Towns

- Nitrogen trading is a method whereby one responsible party compensates another responsible party for removing more than its' fair share of nitrogen to account for the paying town's nitrogen reduction requirement.

- There is a good opportunity for nitrogen trading between Harwich and Chatham as outlined below.

    - Chatham intends to remove all of its septic load in the Pleasant Bay watershed as part of a town-wide sewering program that is aimed at more than just nitrogen removal

    - Chatham's plan would remove substantially more than required to meet the TMDL

    - This "excess removal" is equivalent to about 40% of Harwich's responsibility

    - By nitrogen trading, Harwich could pay Chatham and avoid significant infrastructure built out

- Nitrogen trading, if used effectively, can allow groups of towns to remove greater amounts of nitrogen faster than they could on their own.

# Comparison of Plans

# Comparison of Wellfleet and Pleasant Bay

- Both Wellfleet and the towns around Pleasant Bay have developed adaptive watershed management plans. The summary below is based on stated plans and potential adaptations which have been discussed in town documents. They are subject to change in the future.

- Pleasant Bay
  - The towns' plan for 26,444 kg nitrogen removal per year by 2038
  - 76% of nitrogen removal in Pleasant Bay will be done using traditional methods and 26% using non-traditional methods
  - Harwich and Chatham are almost completely using sewering (traditional). Given the magnitude of the Chatham sewering contribution, the vast majority of the Pleasant Bay plan is driven by traditional methods and source control

- Wellfleet
  - Wellfleet plans for 12,091 kg nitrogen removal per year by 2051
  - The Wellfleet plan places a larger emphasis on non-traditional methods than the Pleasant Bay plan
  - Because the plan is adaptive, Wellfleet has illustrated the choice between installing sewer systems and EIA septic systems to reduce the nitrogen load over the next 30 years
    - The sewering approach results in a mix of 58% traditional and 42% non-traditional nitrogen removal methods
    - Using EIA septic systems results in 5% traditional and 95% non-traditional nitrogen removal methods
    - A hybrid of sewering and EIA septic systems will fall somewhere in middle, of course.

- See next page for details; these details are very likely to evolve over time as the towns adapt their watershed management plans based on progress in nitrogen reduction over time and local / regional dynamics (budgets etc).

| | | Pre 2018-2038 | | | | | | 2022-2051 | | 2022-2051 | | Delta - Wellfleet Over / (Under) Pleasant Bay | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Brewster | Chatham | Harwich | Orleans | Pleasant Bay Total | Percent of Total | Wellfleet | Percent of Total | Wellfleet | Percent of Total | Sewer Approach | EIA Approach |
| Source Control | | | | | | | | | | | | | |
| Sewering | Trad | 0 | 12,812 | 4,340 | 2,014 | 19,166 | 72% | 7,012 | 58% | 622 | 5% | | |
| EIA | Non-Trad | | | | | | | 494 | 4% | 6,884 | 57% | | |
| Residential fertilizer reduction | Non-Trad | 121 | 247 | 200 | 241 | 809 | 3% | 588 | 5% | 588 | 5% | | |
| Golf course fertilizer reduction | Trad | 930 | 0 | 0 | 0 | 930 | 4% | | | | | | |
| Onsite Denitrifying systems | Non-Trad | 590 | 0 | 0 | 2,024 | 2,614 | 10% | | | | | | |
| **Total Source Control** | | **1,641** | **13,059** | **4,540** | **4,279** | **23,519** | **89%** | **8,094** | **67%** | **8,094** | **67%** | | |
| ***Source Control Split*** | | ***7%*** | ***56%*** | ***19%*** | ***18%*** | ***100%*** | | | | | | | |
| Remediation | | | | | | | | | | | | | |
| Ecological Restoration | Non-Trad | | | | | | | 317 | 3% | 317 | 3% | | |
| Permeable Reactive Barriers | Non-Trad | 0 | 0 | 0 | 0 | 0 | 0% | 1,225 | 10% | 1,225 | 10% | | |
| Fertigation at Gold Courses | Non-Trad | 230 | 0 | 0 | 0 | 230 | 1% | | | | | | |
| Shellfish Propogation | Non-Trad | 0 | 0 | 0 | 2,695 | 2,695 | 10% | 2,772 | 23% | 2,772 | 23% | | |
| **Total Remediation Control** | | **230** | **0** | **0** | **2,695** | **2,925** | **11%** | **3,997** | **33%** | **3,997** | 33% | | |
| ***Remediation Control Split*** | | ***8%*** | ***0%*** | ***0%*** | ***92%*** | ***100%*** | | | | | | | |
| | | **1,871** | **13,059** | **4,540** | **6,974** | **26,444** | **100%** | **12,091** | **100%** | **12,091** | **100%** | | |
| **Source v Remediation** | | | | | | | | | | | | | |
| **Source Control** | | **88%** | **100%** | **100%** | **61%** | **89%** | | **67%** | | **67%** | | **-22%** | **-22%** |
| **Remediation Control** | | **12%** | **0%** | **0%** | **39%** | **11%** | | **33%** | | **33%** | | **22%** | **22%** |
| Traditional v Non Traditional | | | | | | | | | | | | | |
| Traditional | | 930 | 12,812 | 4,340 | 2,014 | 20,096 | | 7,012 | | 622 | | | |
| Non Traditional | | 941 | 247 | 200 | 4,960 | 6,348 | | 5,079 | | 11,469 | | | |
| **Traditional %** | | **50%** | **98%** | **96%** | **29%** | **76%** | | **58%** | | **5%** | | **-18%** | **-71%** |
| **Non Traditional %** | | **50%** | **2%** | **4%** | **71%** | **24%** | | **42%** | | **95%** | | **18%** | **71%** |

The two Wellfleet columns to the left illustrate the impact of choosing a sewering option vs EIA septic option on the total % traditional v. non-traditional plans.

Note: It is fully expected that the precise nature and timing of activities will be different from those shown in the table

# Appendix

# Data Sources


Community Guide to Permeable Reactive Barriers

Massachusetts Estuaries Project Linked Watershed-Embayment Modeling to Determine Critical Nitrogen Loading Thresholds for Stage Harbor, Sulphur Springs, Taylors Pond, Bassing Harbor and Muddy Creek, Chatham, MA

Pleasant Bay Alliance 2021 Annual Report pursuant to MassDEP Watershed Permit dated August 3, 2018

Pleasant Bay Resource Management Plan 2018 Update

Pleasant Bay Targeted Watershed Managaement Plan

Regional Watershed Permit Implementation Project for Pleasant Bay

Residential Development Wastewater System Evaluation 95 Lawrence Road Development for Town of Wellfleet, Massachusetts

The Advantages and Disadvantages of Fertigation - https://edis.ifas.ufl.edu/publication/HS1442

Watershed Report: Outer Cape Wellfleet Harbor

Wellfleet Targeted Watershed Plan Update - September 29, 2021

95 Lawrence Road Information

# Wellfleet Targeted Watershed Management Plan

| Phase | Years | Nitrogen Reduction Strategies | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wastewater Treatment | | | Stormwater | | Fertilizer | | Permeable Reactive Barrier | | Shellfish | | Ecological Restoration | | |
| | | | | kg/yr | | kg/yr | | k/gyr | | kg/yr | | kg/yr | | kg/yr | kg/yr |
| 1 | 2022 - 2026 | Establish Responsible Management Entity (RME) and Install 25 - 30 EIA systems/year | | 494 | Rte 6 MADOT integrate N attenuation | 102 | Implement Fertilizer Controls | 98 | Pilot Project Bank/Commercial Street (50 feet) | 20 | Sustainable growth at 94 kg/year | 462 | Mayo Creek: Design, Permit & Constructio n | 317 | 1834 |
| | | 95 Lawrence - Permit, Design & Construct Phase 1 (Housing & Municipal Properties) | | 341 | | | | | | | | | | | |
| 2 | 2027 - 2031 | 95 Lawrence - Design & Construct Phase 2 (Connect Neighborhood Homes) | | 281 | | | Adaptive Management | | | | | | | | |
| | | Adaptive Management<br>Install 66 - 77 EIA systems/year | Design & Construct Downtown Sewers Phase 1 | 1278 | Additional Stormwater Retrofits | 102 | Implement Fertilizer Controls | 98 | Construct Commercial Street/Duck Creek (1000 feet) | 235 | Sustainable growth at 94 kg/year | 462 | Herring River | | 2456 |
| 3 | 2032 - 2036 | Install 66 - 77 EIA systems/year | Design & Construct Supplemental Sewers and/or Neighborhood Cluster Systems | 1278 | Additional Stormwater Retrofits | 102 | Implement Fertilizer Controls | 98 | Construct The Cove PRB projects (2000 feet) | 970 | Sustainable growth at 94 kg/year | 462 | Sunken Meadow (Hatches Creek) | | 2910 |
| 4 | 2037 - 2041 | Install 66 - 77 EIA systems/year | Design & Construct Supplemental Sewers and/or Neighborhood Cluster Systems | 1278 | Additional Stormwater Retrofits | 102 | Implement Fertilizer Controls | 98 | Additional PRBs? | | Sustainable growth at 94 kg/year | 462 | Trout Brook (Upper Basin) | | 1940 |
| 5 | 2042 - 2046 | Install 66 - 77 EIA systems/year | Design & Construct Supplemental Sewers and/or Neighborhood Cluster Systems | 1278 | Additional Stormwater Retrofits | 102 | Implement Fertilizer Controls | 98 | Additional PRBs? | | Sustainable growth at 94 kg/year | 462 | Eastern Blackfish Creek | | 1940 |
| 6 | 2047 - 2051 | Install 66 - 77 EIA systems/year | Design & Construct Supplemental Sewers and/or Neighborhood Cluster Systems | 1278 | Additional Stormwater Retrofits | 102 | Implement Fertilizer Controls | 98 | Additional PRBs? | | Sustainable growth at 94 kg/year | 462 | | | 1940 |
| N reduction | | | | 7506 | | 612 | | 588 | | 1225 | | 2772 | | 317 | 13020 |

# Pleasant Bay Targeted Watershed Management Plan

**Table 5. Implementation Plan: Expected Project Completion and Potential Annual Nitrogen Removals**

| | | | Brewster | | Chatham | | Harwich | | Orleans | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase | Years | | Activity | kgN/yr* | Activity | kgN/yr* | Activity | kgN/yr* | Activity | kgN/yr* | kgN/yr* |
| | up to 2018 | | Res. fertilizer control<br>Capt GC fertigation<br>Capt GC fert. reduction | 121<br>230<br>930 | Res. fertilizer control<br>Muddy Creek Bridge | 247 | Muddy Creek Bridge | | Res. fertilizer control | 241 | 1,769 |
| | | | All towns: develop TWMP; demonstrate 208 consistency; execute IMA; obtain Watershed Permit | | | | | | | | |
| 1<br>** | 1<br>to<br>5 | 2019<br>to<br>2023 | Develop denit plan<br>Devel. conting. plan<br>Strengthen GC plan | | Harwich connection | | Ph 2 sewers<br>Res. fertilizer control | 2,672<br>200 | Amended CWMP<br>Lonnie's Pond aqua.<br>PRB evaluation | <br>273 | 3,145 |
| | | | All towns: update monitoring data, re-model Bay, evaluate nitrogen trading options, prepare plan for next 5 yr | | | | | | | | |
| 2<br>*** | 6<br>to<br>10 | 2024<br>to<br>2028 | On-site denit systems | 118 | | | Ph 3 sewers | 1,565 | MtgHouse Pond sewers<br>Other aquaculture<br>On-site denit systems | 2,014<br>1,516<br>674 | 5,887 |
| 3<br>*** | 11<br>to<br>15 | 2029<br>to<br>2033 | On-site denit systems | 118 | Frostfish Creek sewers<br>Ryders Cove sewers | 803<br>2,605 | | | On-site denit systems<br>Other aquaculture | 675<br>906 | 5,107 |
| 4<br>*** | 16<br>to<br>20 | 2034<br>to<br>2038 | On-site denit systems | 118 | Muddy Creek sewers | 1,597 | | | On-site denit systems | 675 | 2,390 |
| | after year 20 | after 2038 | On-site denit systems | 236 | Crows Pond sewers<br>Bassing Harbor sewers<br>Pleasant Bay sewers<br>Chatham Harbor sewers | 1,214<br>511<br>901<br>5,181 | Ph 8 sewers<br>Harwich effl. disposal | 970<br>(867) | **** | | 8,146 |
| | | | **Total** | **1,871** | **Total** | **13,059** | **Total** | **4,540** | **Total** | **6,974** | **26,444** |

* Removals pertain to current nitrogen loads without growth, and represent estimates of removal potential.

** First Phase (Years 1 to 5) includes activities that are firm commitments by the towns and are necessary to gain DEP enforcement discretion.

*** Phases 2 through 5 (Years 6 to 20) include activities that are now planned and considered enforceable until such time as they may change depending on the outcomes of Phase 1 and application of each town's adaptive management program, as per the Watershed Permit.

**** The discharge of Harwich effluent within the Pleasant Bay watershed may become necessary if alternative disposal sites are not developed.