



# Comprehensive Wastewater Management Plan and Final Environmental Impact Report, and Targeted Watershed Management Plan

Little Pond, Great Pond, Green Pond,  
Bournes Pond, Eel Pond, and Waquoit Bay  
Watersheds and Recommendations for  
West Falmouth Harbor Watershed

Volume #1, Report Text and Tables



September 16, 2013



# TOWN OF FALMOUTH

Office of the Town Manager & Selectmen

59 Town Hall Square, Falmouth, Massachusetts 02540  
Telephone (508) 495-7320  
Fax (508) 457-2573

September 26, 2013

Mr. Richard K. Sullivan, Secretary  
Executive Office of Energy & Environmental Affairs  
MEPA Office  
100 Cambridge Street – Suite 900  
Boston, MA 02114

RE: Comprehensive Wastewater Management Plan for Town of Falmouth EEA# 14154

Dear Mr. Sullivan:

Attached for your review is the Final Comprehensive Wastewater Management Plan (CWMP), Final Environmental Impact Report, and Targeted Watershed Management Plan for Little Pond, Great Pond, Green Pond, Bournes Pond, Eel Pond, and Waquoit Bay Watersheds, and Recommendations for West Falmouth Harbor Watershed.

The Town of Falmouth has worked diligently during the last year to develop this document and its adaptive management approach that is key to our environmental and economic sustainability. This document also addresses the various issues raised in the Secretary's Certificate approving the Draft CWMP. We have consulted with the Massachusetts Department of Environmental Protection, the Cape Cod Commission, US EPA, and many other stakeholders on this document and on our overall planning process, and have responded to their input. The Town of Falmouth voters have approved \$5.6 million in design funds for three key elements of this CWMP: sewerage of the Lower Little Pond watershed, upgrades to the Wastewater Treatment Facility in West Falmouth, and widening of Bournes Pond Inlet.

We look forward to the MEPA review of this document so that we can proceed to implementation. If you have any questions, please contact Jerry Potamis, P.E., Falmouth Wastewater Superintendent at 508.457.2543 ([jpotamis@falmouthmass.us](mailto:jpotamis@falmouthmass.us)) or Nathan C. Weeks, P.E., GHD Senior Project Manager at 774.470.1633 ([nate.weeks@ghd.com](mailto:nate.weeks@ghd.com)).

Sincerely,

Julian M. Suso  
Town Manager

Cc: Board of Selectmen  
Water Quality Management Committee  
Other Appropriate Agencies



## Executive Summary

### ES.1 Background

The Town of Falmouth (Town) is completing this Comprehensive Wastewater Management Plan and Final Environmental Impact Report and Targeted Watershed Management Plan (CWMP/FEIR/TWMP) to provide a Wastewater Management Plan for Little Pond, Great Pond, Green Pond, Bournes Pond, Eel Pond, and Waquoit Bay Watersheds, as well as recommendations for the West Falmouth Harbor Watershed. This Planning Area is illustrated in Figure ES-1. The main components of this Plan include:

1. Sewer extension to the lower watershed area of Little Pond to begin mitigation of that water body.
2. Upgrade of the existing Blacksmith Shop Road Wastewater Treatment Facility (WWTF) to address the current effluent discharge permit requirements and needed facility upgrades.
3. Treated water recharge of up to 0.26 million gallons per day (mgd) outside of the West Falmouth Harbor Watershed at a new treated-water recharge site.
4. Development of an Adaptive Management Plan.
5. Implementation of Demonstration Projects to investigate the feasibility of the following non-traditional nitrogen management processes:
  - a. Shellfish Aquaculture Demonstration Project to harvest/mitigate excessive nitrogen in the estuaries
  - b. Inlet Widening of Bournes Pond
  - c. Eco-Toilet Demonstration Project: composting and urine-diverting toilets
  - d. Permeable Reactive Barriers (PRBs)
  - e. Stormwater management initially to be evaluated for the Little Pond Watershed

Two other initiatives (not demonstration projects) that are expected to provide additional nutrient management include:

- f. Development and recent Town passage of a comprehensive Nitrogen Control Bylaw (for fertilizer)
- g. Information-gathering on the feasibility and performance of individual property and clustered nitrogen removal (denitrifying) septic systems

These demonstration projects and other initiatives have been funded by Town Meeting and are underway. Their progress to date is summarized in this document. They will become evaluations independent of this CWMP/FEIR/TWMP and will enter the Massachusetts Environmental Policy Act (MEPA) review process at a later time if they trigger MEPA review thresholds. If these evaluations (and possible MEPA reviews) demonstrate feasibility, the Town plans to add them to this Plan through the Adaptive Management Plan component of this CWMP/FEIR/TWMP.

The Targeted Watershed Management Plan (TWMP) terminology has recently emerged to describe watersheds that are located completely within one town. The TWMP is a required component to meet new regional (Cape Cod Commission) planning guidance. The TWMP component (and added title) of this document refers specifically to the planned sewer extension to the lower watershed area of Little Pond that has been targeted for nitrogen mitigation.



This CWMP/FEIR/TWMP summarizes the many evaluations that were completed for this project. It plans for sewerage of the lower watershed area of Little Pond, which is the recommended plan for the wastewater management components, as well as documents the demonstration projects listed above, and the recently passed Town-wide Nitrogen Control Bylaw (for fertilizer) which are the recommendations for the non-wastewater management components. This CWMP/FEIR/TWMP provides an environmental impact analysis that shows the significant environmental benefits of the Little Pond sewer extension, and demonstrates that there will be no significant impact of the treated-water recharge.

This Plan will need to be implemented through Adaptive Management to provide the most effective nitrogen mitigation and the most cost-effective implementation. The implications of this approach are as follows:

- The Plan is in a flexible format, allowing for changes in implementation as new technologies prove their feasibility.
- Performance testing will evaluate the actual effectiveness of the installed facilities.
- Environmental monitoring will quantify improvements in the marine water quality.
- New regulations/laws/building codes may need to be passed to allow new approaches.

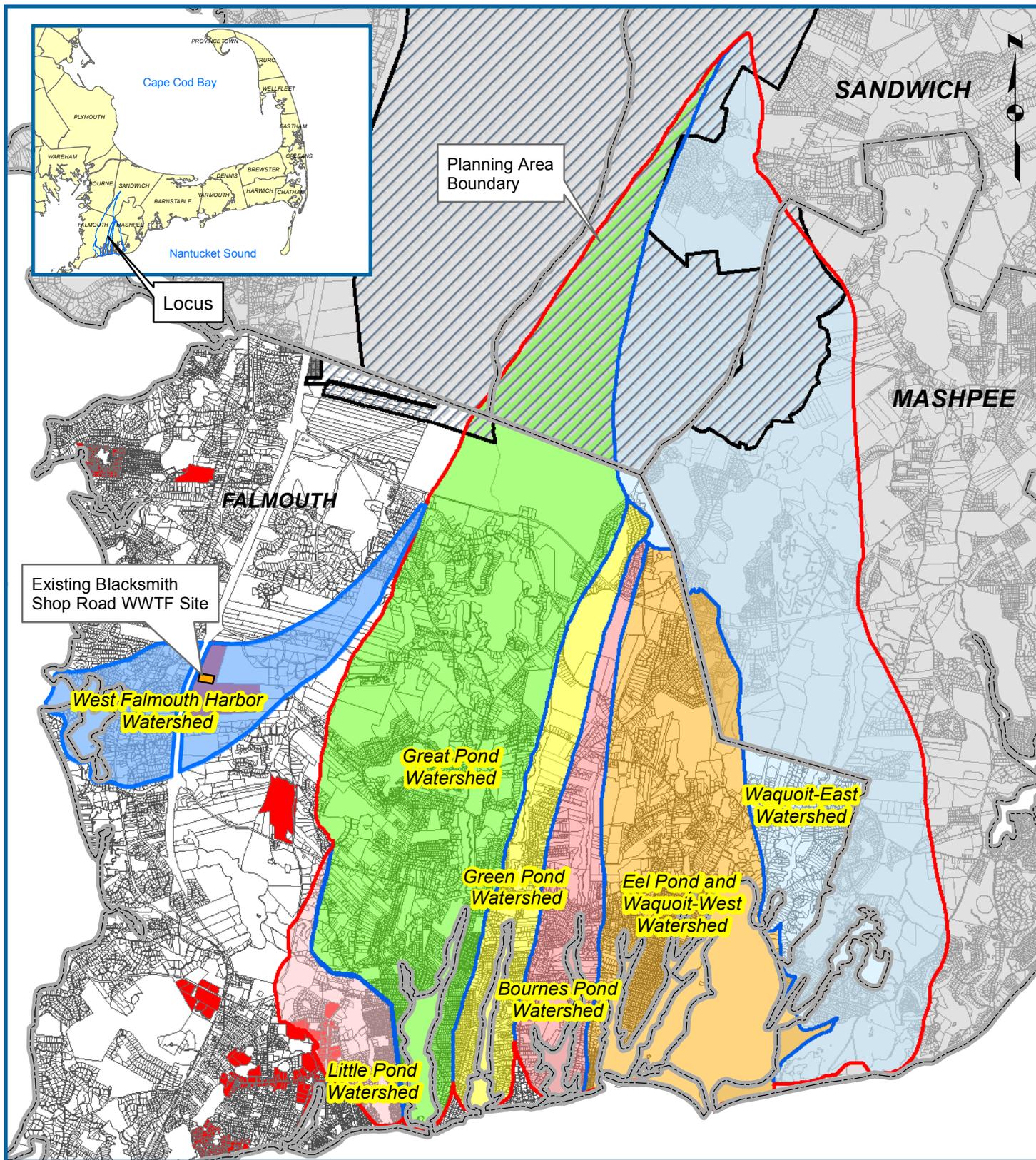
It is well understood that watershed and wastewater management encompass many aspects of science, public policy, regulatory compliance, and public acceptability. The development of a CWMP must include flexibility regarding the timing of project implementation to deal with scientific and regulatory compliance unknowns, and issues related to public acceptance and municipal financial capacity. The concept of Adaptive Management is embraced by the Town of Falmouth as an approach to minimize the costs associated with wastewater treatment and nitrogen management to restore surface water quality. Successful implementation of both traditional and non-traditional wastewater management solutions includes retrofitting all buildings with low-flow devices to significantly increase water conservation.

This document is prepared for review by MassDEP, and as part of the MEPA and Cape Cod Commission (CCC) Development of Regional Impact (DRI) joint review process.

## **ES.2 Summary of Past Studies: 1981 to Present**

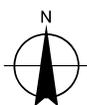
A history of two previous wastewater studies conducted between 1981 and 2007 relating to portions of the Planning Area can be found in Appendix 2-1. This CWMP Project was initiated in 2007 and included many detailed evaluations which are summarized in Appendices 2-3 through 4-36. Previous project reports are available at the Town Wastewater Department web page at [www.falmouthmass.us](http://www.falmouthmass.us), in the Town's libraries, and as appendices to this report.

UMass School of Marine Science and Technology (SMAST) has now finished its studies for all of the estuaries in the Planning Area. The Total Maximum Daily Load (TMDL) limits have been set for each estuary except Waquoit Bay. This TMDL limit is expected in 2014. Figure ES-2 shows the estimated wastewater removal percentages at build-out to meet the TMDLs for the watersheds in the nitrogen management planning areas.



<b>Legend</b>	Planning Area	Waquoit-East Watershed	Great Pond Watershed	West Falmouth Harbor
	MEP Watershed Boundary	Bourmes Pond Watershed	Green Pond Watershed	Sewered Parcel
	Eel Pond & Waquoit-West Watershed	Little Pond Watershed	Town Boundary	Parcel Boundary
	Parcel Boundary			

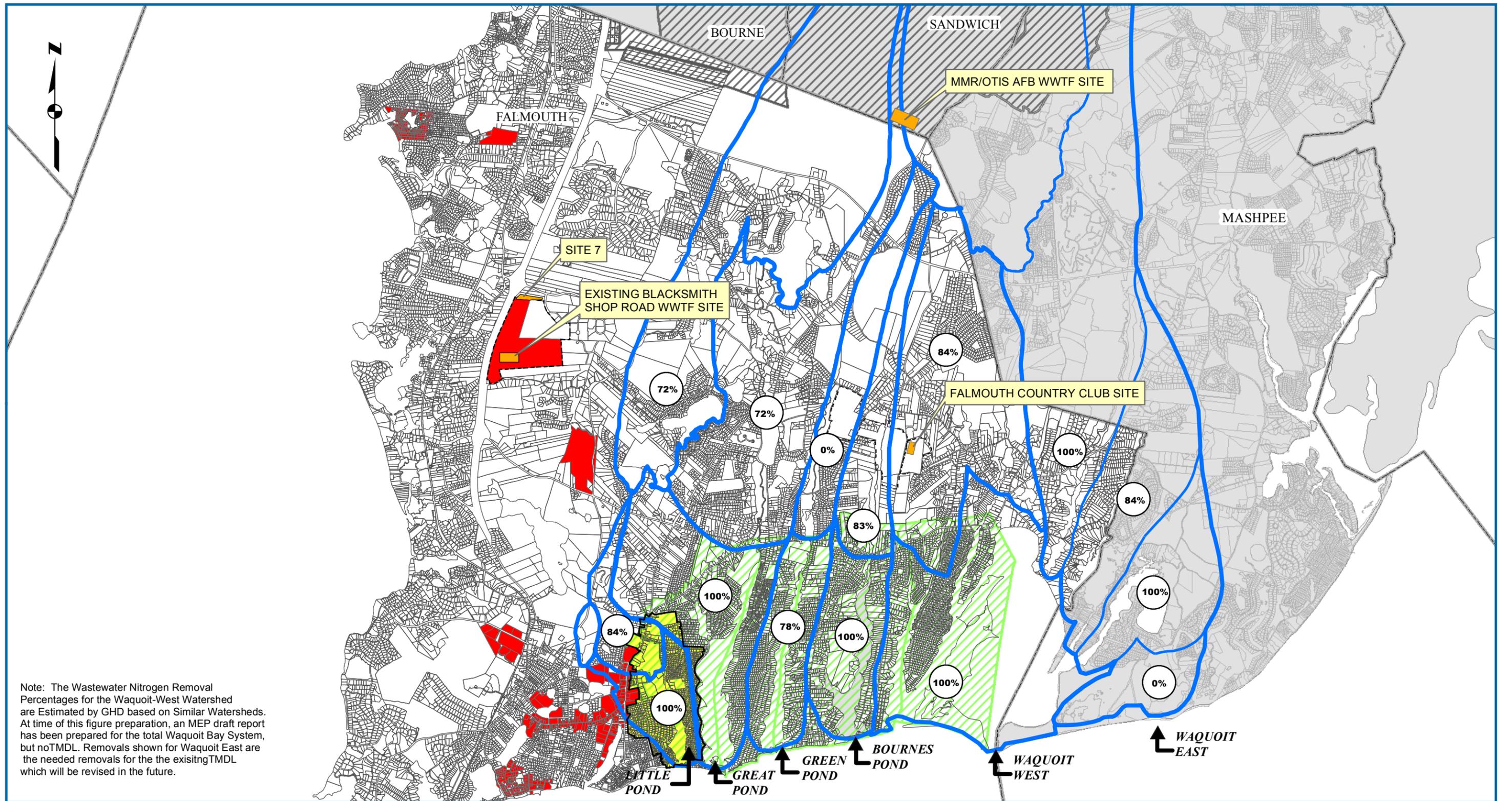
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TOWN OF FALMOUTH, MASSACHUSETTS Job Number 86-12163  
 CWMP Revision A  
 Date 23 Sep 2013

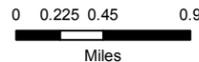
**LOCATION MAP**

**FIGURE ES-1**



Note: The Wastewater Nitrogen Removal Percentages for the Waquoit-West Watershed are Estimated by GHD based on Similar Watersheds. At time of this figure preparation, an MEP draft report has been prepared for the total Waquoit Bay System, but no TMDL. Removals shown for Waquoit East are the needed removals for the existing TMDL which will be revised in the future.

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Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1927  
Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



**LEGEND**

- Sub-Watershed Boundary
- Parcel Boundary
- Town Boundary
- MMR

- High Priority Nitrogen Mitigation Area
- Sewered Parcel
- Little Pond Sewer Service Area

Estimated Future Wastewater Nitrogen Removal Percentage



TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

Job Number | 86-12163  
Revision | A  
Date | 23 Sep 2013

**ESTIMATED FUTURE WASTEWATER REMOVAL PERCENTAGES TO MEET TMDLS** Figure ES-2



These TMDLs and related Massachusetts Estuaries Project (MEP) technical reports document the following problems in the salt ponds of the Planning Area:

- High concentration of nitrogen in the marine water that has led to excessive algae production and eutrophic conditions.
- Loss of water clarity from the suspended algae which has led to loss of rooted eel grass on the floor of the estuaries.
- Deposition of algae in the estuaries which has further damaged eel grass beds, smothered shellfish resources, and depleted dissolved oxygen concentrations in the estuary and severely impacted the benthic communities on the estuarine floor.

These reports and TMDLs identified threshold nitrogen concentrations for these salt ponds and calculated the amount of wastewater nitrogen at build-out that would need to be removed to meet the threshold concentrations as illustrated in Figure ES-2. This figure also illustrates the existing areas of Town served by sewers, the three potential wastewater treatment plant sites evaluated, the proposed new treated-water recharge facility at Site 7, the Little Pond Lower Watershed Area recommended for sewer extension (Little Pond Sewer Service Area), and the portion of the Planning Area (High-Priority Nitrogen Mitigation Area) proposed for nitrogen reduction either through sewerage or non-traditional means in the first 20-year period.

The large nitrogen management effort required to meet these TMDLs presents a significant challenge to the Town and will be a large expense to the Town and its residents. The Wastewater and Nutrient Management Vision articulated by the Selectmen states:

“By comprehensively and effectively managing its wastewater and other nutrient sources, Falmouth will improve water quality, protect public health and enhance the Town’s economic vitality. Falmouth will offer its residents, visitors and future generations healthy waters in order to sustain the Town’s property values and vibrant economy.”

In carrying out this Vision, it is the intent of the Selectmen, the advisory Water Quality Management Committee (WQMC), Town Meeting, and the voters to extend sewers to the Little Pond Sewer Service Area, to fully explore the usefulness of non-traditional alternatives and apply that knowledge through Adaptive Management, to work cooperatively with neighboring Towns and the regional planning agency where watersheds are shared, in particular Waquoit Bay and Megansett Harbor, and to minimize the financial impact of large projects by funding them only when new debt can be issued to replace retiring debt.

### **ES.3 Summary of Recommended Plan**

The Recommended Plan is the Town’s strategy: (1) to implement cost-effective wastewater and nutrient management for a 20-year period, with a 40-year perspective on the build-out of the Town; and (2) to meet the nitrogen TMDLs in cooperation with the neighboring Towns of Bourne, Mashpee, and Sandwich that share some of these watersheds.

The 20-year period is from 2015 to 2035, which is the estimated time-period for the Little Pond sewer extension, WWTF upgrades, new treated-water recharge facility implementation, completion of the demonstration projects, and implementation of the feasible non-traditional technologies in the High-Priority Nitrogen Mitigation Areas.



The primary Recommended Plan components are summarized below:

### **ES.3.1 Sewer Extension to the Lower Watershed of Little Pond**

The proposed Little Pond Sewer Service Area is illustrated on Figure ES-3, and the system would collect wastewater from approximately 1,400 existing parcels. It would be a combination of gravity and low-pressure sewers and would include two new wastewater lift (pump) stations to convey the wastewater to the existing collection system and ultimately to the Blacksmith Shop Road WWTF.

This sewer extension would significantly reduce the nitrogen loading to Little Pond. Water quality modeling indicates that this reduction would reduce the nitrogen concentration at the sentinel station of Little Pond from 0.837 mg/L to 0.495 mg/L. Although this reduction is not enough to meet the TMDL threshold concentration of 0.450 mg/L, it is a major reduction. It will be augmented by additional removals provided by the non-traditional nitrogen methods to be proven by the demonstration projects such as the aquaculture project started in 2013.

### **ES.3.2 Upgrade of the Blacksmith Shop Road WWTF**

The Blacksmith Shop Road WWTF has recently received a new effluent discharge permit which requires several improvements to its flow-metering system and nitrogen removal optimization. The WWTF has a capacity of 1-million gallons per day (mgd) which is sufficient for the additional flow that would be collected from the Little Pond Sewer Service Area. The WWTF Site is illustrated on Figure ES-4.

This upgrade will provide the improvements needed for current and future operations for the new discharge permit.

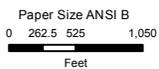
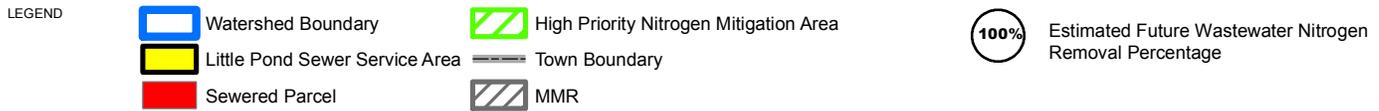
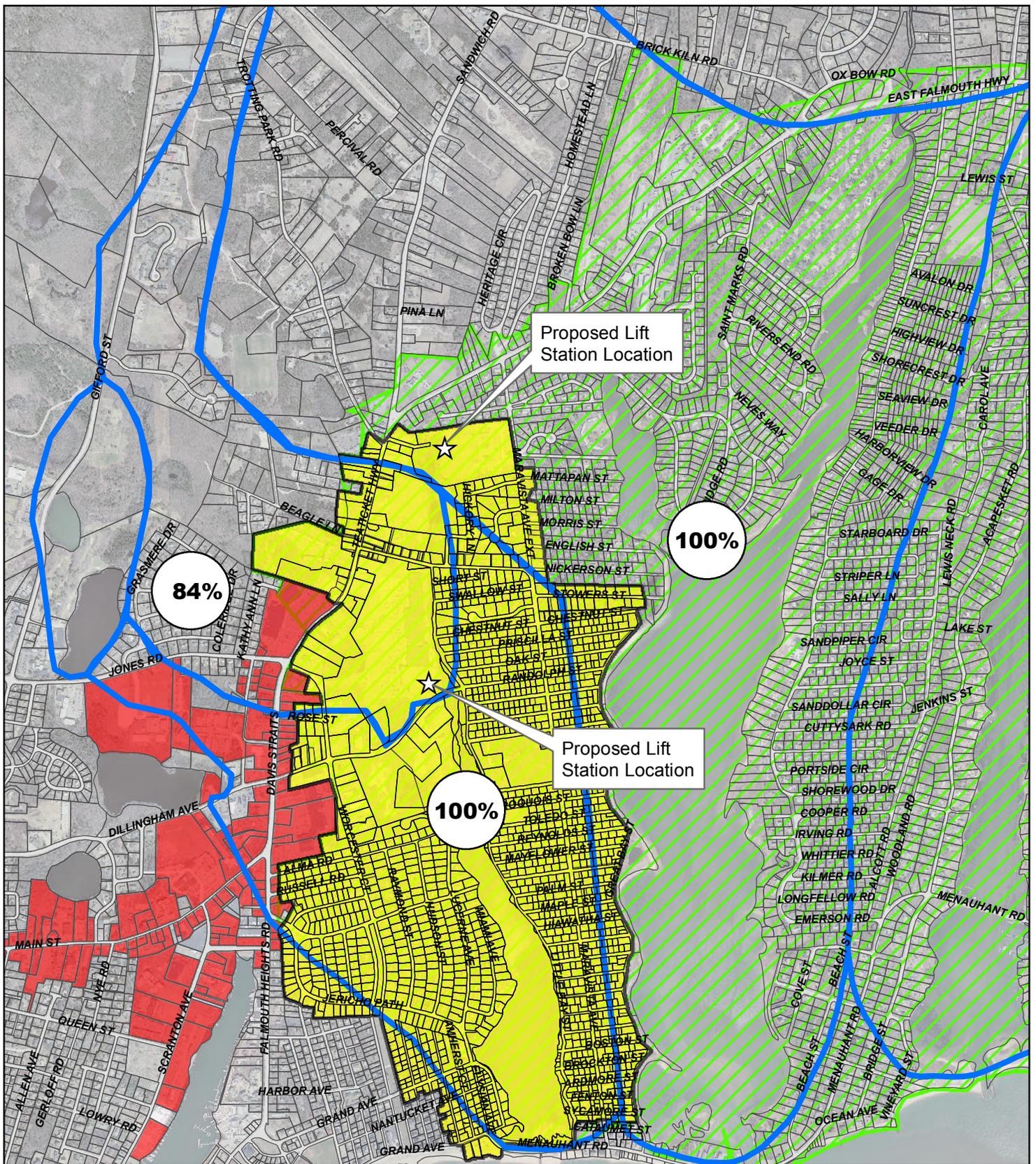
### **ES.3.3 Construction of the New Treated-Water Recharge Site**

A new treated-water recharge site is recommended at Site 7, which is north of the West Falmouth Harbor Watershed. The eastern portion of the site is planned specifically for development to provide up to 0.26 mgd of capacity for the flow that would come from the Little Pond Sewer Service Area. The proposed facility at the east end of the site is illustrated in Figure ES-5.

### **ES.3.4 Implementation of Nitrogen Control Bylaw for Fertilizer**

Fall 2012 Town Meeting adopted a Town-wide Nitrogen Control Bylaw that codified a focused approach to minimize nitrogen and phosphorus loading to marine and fresh water bodies (respectively).

This bylaw prohibits the application of nitrogen within 100-feet of Resource Areas as defined in Falmouth's Wetlands Regulations, FWR 10.02 (1)(a - d), as well as on impervious surfaces. The bylaw also prohibits the application of fertilizer anywhere in Town from October 16th to April 14th. During the growing season of April 15th to October 15th, fertilizer application is banned during heavy rain. There are exceptions for agriculture and horticulture. Regarding golf courses, on greens and fairways only, no more than one pound of nitrogen per 1000 square feet may be applied over the entire growing season. Furthermore, 85-percent or more of this fertilizer must be in an organic, slow-release, water-insoluble form, and can be applied on greens and fairways only. There are also allowances for the application of organic constituents applied to improve the physical condition of the soil, and the establishment of turf. Enforcement is through the Department of Marine and Environmental Services (a merging of the Harbormaster's Office and the Department of Natural Resources). A copy of this Nitrogen Control Bylaw can be found in Appendix 3-8.



TOWN OF FALMOUTH, MASSACHUSETTS CWMP

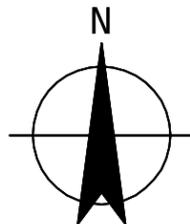
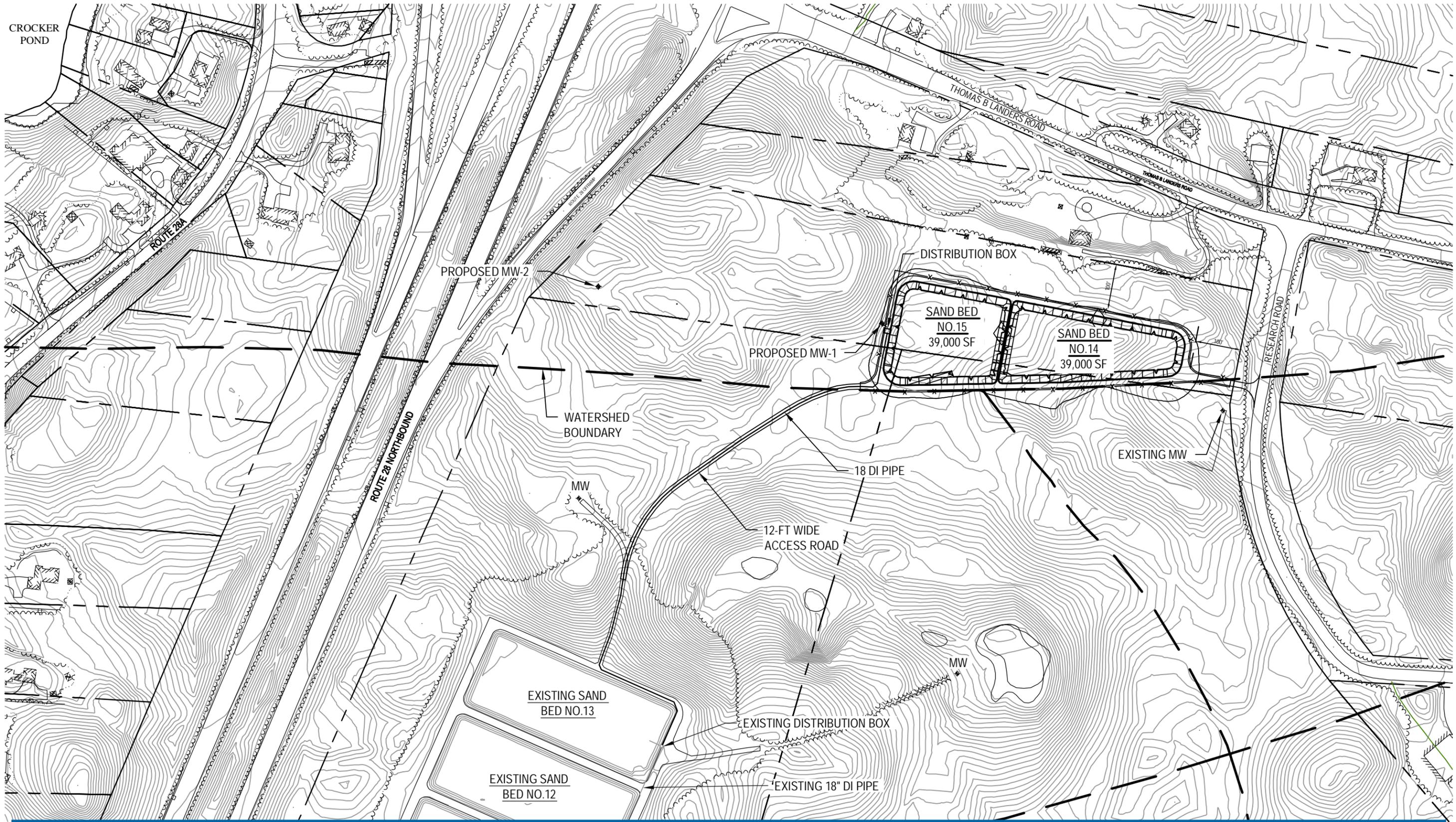
Job Number 86-12163  
Revision A  
Date 24 Jun 2013

## PROPOSED LITTLE POND SEWER SERVICE AREA

Figure ES-3



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 1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com  
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FALMOUTH CWMP IMPLEMENTATION  
SITE 7 DEVELOPMENT

INFILTRATION BEDS @ SITE 7

Job Number | 86-14629

Revision | A

Date | 9/13

Figure ES-5



On May 15, 2013, the Attorney General disapproved the new bylaw stating that the Legislature has vested the regulatory authority over fertilizers with the Department of Agricultural Resources. The Town's legislative delegation has filed corrective legislation which recently passed allowing the Town's Nitrogen Control Bylaw to remain in effect. A full description is provided in Section 3.7.

### **ES.3.5 Evaluation of Non-Traditional Wastewater and Nutrient Management Alternatives through Demonstration Projects**

A group of five demonstration projects has been funded by Town Meeting. These projects have been initiated and are ongoing. Their progress as of June 30, 2013, is summarized below. These demonstration projects are evaluations independent of this CWMP/FEIR/TWMP and will enter the MEPA review process at a later time if they trigger MEPA thresholds. If proven feasible, these technologies and management processes will be added to this plan through the Adaptive Management component.

#### **ES.3.5.1 Shellfish Aquaculture Demonstration Project to Harvest/Mitigate Excessive Nitrogen in the Estuaries**

This technology and nitrogen management concept would promote nitrogen uptake in the estuaries by shellfish that could be harvested to remove nitrogen from the system. The first phase of the project has been scoped, and Woods Hole Group (WHG) has been engaged as the project consultant. The following initial tasks have been completed:

- Viability Test (summer 2012).
- Conservation Commission Notice of Intent (NOI) hearing and Order of Conditions issued on May 10, 2013.
- Staffing, equipment and shellfish purchased, and seed installed in Town upweller.
- Installation of oysters into Little Pond for first year of demonstration project expected by June 30, 2013.
- Monitoring Plan formalized with MassDEP and Falmouth Conservation Commission.

A full description of this project is provided in Chapter 3.

#### **ES.3.5.2 Inlet Widening of Bournes Pond and Little Pond**

These two estuaries are the only ones that were identified by the Massachusetts Estuaries Project as being able to benefit from inlet opening. This technology would increase tidal exchange with Vineyard Sound to reduce the amount of nitrogen that would need to be removed from the watersheds through sewerage or other wastewater or nitrogen management approaches. A focused demonstration project has been developed for Bournes Pond, and the first phase of the project has been scoped. GHD (supported by Applied Coastal Research & Engineering and BETA Group) has been engaged as the project consultant, and has completed a Technical Memorandum which presents preliminary design evaluations for an enlarged inlet and new bridge over Bournes Pond, as well as an analysis of the nitrogen-removal benefits of a larger inlet as determined by water-quality modeling.

A full description of this project is provided in Chapter 3. Design funds were approved at Spring 2013 Town Meeting.



### **ES.3.5.3 Eco-Toilet Project: Composting and Urine-Diverting Toilets**

This wastewater management approach will segregate the fecal and urine components from the wastewater at individual properties for transport outside the watershed and/or reuse of these materials in an environmentally beneficial way. The first phase has been scoped, and Science Wares, Inc. has been engaged as the project consultant. The first phase of the Eco-Toilet Demonstration Program is underway, with approximately 15 property owners committed to replacing all of their standard fixtures with either composting or urine-diverting toilets. The Barnstable County Department of Health and Environment has been contracted to provide baseline and ongoing monitoring of these installations.

A full description of this project is provided in Chapter 3.

### **ES.3.5.4 Permeable Reactive Barriers (PRBs)**

This technology provides nitrogen treatment in the groundwater system by having it flow through a reactive barrier that converts soluble nitrogen to nitrogen gas, which is released into the atmosphere. The first phase of the project has been scoped, and CDM Smith has been engaged as the project consultant. The following initial tasks have been completed:

- Delivery of Technical Memorandum (TM) #1 detailing the evaluation criteria and TM #2 outlining preliminary site selection (18 sites).
- From 18 sites, two have been short-listed—one in West Falmouth and one in Seacoast Shores, East Falmouth.

A full description of this project is provided in Chapter 3.

### **ES.3.5.5 Improved Stormwater Management**

This stormwater and nitrogen management approach would provide hydraulic retention, bioretention, infiltration, and other best management practices (BMPs) to mitigate the nutrients, sediments, and biological vectors (pathogens, fecal coliform, etc.) discharged by stormwater to the waterbodies and to their watersheds. The Town Engineering Department and Conservation Commission are in the process of developing a Town-wide approach to stormwater management. Within the next year, the WQMC will work with appropriate Town departments and boards to determine the most appropriate location within the Little Pond watershed for a stormwater demonstration project.

A full description of this process is provided in Chapter 3.

### **ES.3.5.6 Adaptive Management throughout the 20-Year Planning Period**

The Town of Falmouth is taking an innovative approach to incorporating non-traditional nitrogen and wastewater management technologies and approaches with the incorporation of demonstration projects into the Recommended Plan. If these technologies and/or approaches prove to be feasible and cost-effective, the Town's Water Quality Management Committee will oversee the Adaptive Management process to incorporate them into the planned remediation of the High-Priority Nitrogen Mitigation Area. Each would be added to the Plan through a Notice of Project Change in accordance with MEPA review and approval.



### **ES.3.5.7 Coordination with County Regional Planning and Neighboring Towns on Shared Watersheds**

The Waquoit Bay estuary system has a watershed that is shared with Mashpee and Sandwich, and this shared watershed is a focus of the County's regional waste management planning project (208 Plan) which was initiated in May 2013. Falmouth will continue to work with these Towns and the County to explore the most cost-effective ways to meet the nitrogen limits in this water body, and incorporate cost-effective solutions into this plan through the Adaptive Management component.

### **ES.3.6 Ocean Outfall**

The Water Quality Management Committee will continue to investigate the long-term option of discharge of treated effluent through an ocean outfall. As described more fully in Chapter 3, Section 3.9, tertiary treatment of wastewater produces an effluent with very low nitrogen, and the flow volume is quite small in proportion to the natural discharge of millions of gallons of groundwater to marine waters on a daily basis. An outfall discharge has the advantage of bypassing already-impacted watersheds, estuaries, and coastal ponds where the addition of more nitrogen from a land discharge site has a greater environmental impact.

## **ES.4 Estimated Costs and Financing Plan**

### **ES.4.1 Background**

The Town of Falmouth is committed to the lengthy process of achieving TMDL limits in the coastal ponds within the High-Priority Nitrogen Mitigation Area and in West Falmouth Harbor, using a variety of approaches to manage nitrogen inputs. All management alternatives have engineering, permitting, and construction costs. Financing the capital costs of these projects poses a major hurdle to any municipality in the current economic times. The ensuing operation and maintenance costs will add further expense to already strained annual budgets.

The Town of Falmouth has comprehensive and varied capital needs involving both critical infrastructure and equipment replacement. These needs underscore the importance of viewing long-term capital financing in a broad, responsible context, and maintaining a healthy financial balance on behalf of the Town's taxpayers. In order to fund the capital costs of the various nitrogen management projects identified in this CWMP as well as responsibly addressing the Town's other primary capital responsibilities; Falmouth proposes to use two strategies. The first and fundamental strategy is to consider issuing "new" debt when an "old" debt is paid off. In past decades, Falmouth voters have approved various "debt exclusions" under the provisions of Proposition 2 1/2, so called. As that excluded debt is paid off, "new" excluded debt can be issued after a two-thirds vote of Town Meeting and a majority vote by ballot, this without raising the tax rate. The capital projects funded by the "new" debt would be carefully selected given Falmouth's comprehensive capital needs.

The illustration of "Estimated Costs and Financing Plans" shown in Table ES-1 simply illustrates a financial opportunity. Projects within the CWMP including sewer extension to the Little Pond Sewer Service Area, shellfish aquaculture, permeable reactive barriers, eco-toilets, denitrifying septic systems, stormwater remediation, and other capital investment in nutrient removal will be sequenced as the regulatory, design, construction, voter authority, and fiscal opportunities allow.

The second funding strategy is to use the State Revolving Fund (SRF) loan program for the construction costs of the nitrogen management projects. The SRF loan process has specific eligibility requirements, a



fixed annual timetable for deciding awards, a competitive selection procedure to receive an award, and a limit as to how much can be awarded to a given community in any one year. All of these constraints need to be taken into account in planning projects to improve water quality.

The SRF loans are of two types: a zero-percent loan that has significant additional eligibility requirements, or the standard 2-percent loan, an interest rate that is less than most municipalities would have to pay if borrowing on their own. Falmouth will explore the benefits and drawbacks of applying for the zero-percent loan versus the 2-percent loan. It should be stressed that without those loans, it is certain that Falmouth will not be able to finance the necessary construction costs to meet TMDLs in the coastal ponds within the Planning Area of this CWMP. The timing of issuing-new-debt-to-replace-old-debt and the receipt of an SRF loan are key to Falmouth's capacity to fund the various projects needed to meet the TMDLs.

#### **ES.4.2 Financial Planning and Key Milestones: 2011 to 2020**

Table ES-1 Estimated Costs and Financing Plans lays out the big picture on financing, ballot votes and the State Revolving Fund process. Although the Table focuses on the events that must take place between 2011 and 2020, Table ES-1 also provides the necessary information for financing improvements for all the coastal ponds within the Planning Area out to the year 2040. Within all of these timeframes, the Town intends to act as quickly as possible, using Adaptive Management, to implement alternatives that have proven capable of reducing nitrogen loads in a consistent and cost-effective manner.

Items 1 through 16 on Table ES-1 list all of the presently-identified critical milestones that must be met in order to design, permit, and construct the first stage of projects to meet the TMDLs in the Planning Area. Item 1 was already voted in 2011: \$2.77 million dollars of excluded debt in Article 17 to fund planning and design of demonstration projects for permeable reactive barriers, inlet widening, eco-toilets, aquaculture, baseline monitoring of water quality, preliminary sewer design, de-nitrifying septic systems, some additional MEP studies, and a Draft CWMP for Oyster Pond watershed.

Item 2 has already been accomplished: submittal of a Draft CWMP/DEIR to MEPA and the Cape Cod Commission in September 2012. The Secretary issued his Certificate on November 14, 2012 and determined that the Draft was "adequate".

Item 3: The Town issued Requests for Proposals for an engineering firm to complete the CWMP process; and provide preliminary design services and evaluations for the sewer system for Little Pond Lower Watershed, the widening of Bourne's Pond, and the preparation of the SRF application. The contract was awarded to GHD in November 2012.

Item 4: On April 10, 2013 Town Meeting approved Article 24, \$5.6 million of excluded debt to fund design of a wastewater collection system for Little Pond Sewer Service Area, widen Bourne's Pond inlet from 50-feet to 90-feet, make improvements to the Wastewater Treatment Plant, some of which were required by the DEP Settlement, and develop a discharge site for the treated effluent. On May 21, 2013, the voters passed the ballot question.

Item 5 is the subject of this CWMP/FEIR/TWMP, a process that will unfold over the next twelve months: completion of this document, submittal to MEPA/CCC, issuance of the Secretary's Final Certificate, and a hearing before the Cape Cod Commission as part of the joint review process. As part of the funding strategy for nutrient management, Falmouth will file a SRF Project Evaluation Form (PEF) by August 31, 2013, seeking a low-interest loan from the State.

Item 6 is the submittal of the SRF PEF discussed above.

**TABLE ES-1**

**Estimated Costs and Financing Plans**

Item	Action Item	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020												
1	\$2.77M for Design and Demonstration Projects; Ballot Vote	X																					
2	Draft CWMP/DEIR Submittal		X																				
3	Execute Contract, selected engineering firm		X																				
4	\$5.6M Construction Design, Ballot Vote			X																			
5	Final CWMP/FEIR/TWMP; Sec Certif; CCC Hearing																						
6	SRF PEF Application Submittal			X																			
7	Comparative Cost Evaluations																						
8	Flow Neutral Bylaw; Checkerboarding Article			X																			
9	Twn Mtg Sets Betterment %; Special Legislation			X																			
10	Obtain Listing on the SRF Intend Use Plan				X																		
11	\$90M Town Vote 30 year Bond for Construction Contingent on 0% or 2% SRF loan; Ballot Vote				X																		
12	Town Meeting vote to accept CH 312, Acts of 2008, Sec. 10				X																		
13	SRF Full Application Submitted - all required items must be in place					X																	
14	Detailed Design for Bid Documents																						
15	State SRF Commitment; Bid Approval Little Pond					X																	
16	SRF-Funded Construct'n Projects; Adaptive Mgmt																						
<b>Program Funding and Timetable 2020 - 2040</b>		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
	Evaluate Results of Remediation to Date: Plan Next Construction Projects																						
	\$60M Town Vote - Spring 2025																						
	Town Construction of \$60M (2025-2030)																						
	\$40M Town Vote - Spring 2030																						
	Town Construction of \$40M (2030-2035)																						
	\$100M SRF Town Vote - Spring 2035																						
	Town Construction of SRF \$100M (2035-2040)																						

Notes CWMP = Comprehensive Wastewater Management Plan  
 DEIR = Draft Environmental Impact Review  
 TWMP = Targetted Watershed Management Plan  
 SRF = State Revolving Fund  
 PEF = Project Evaluation Form



Item 7 is an important part of the current and long-range thinking of how the Town addresses its nitrogen issues, both inside and outside of the Planning Area. There will be an on-going program of Comparative Cost Evaluations of all the nutrient management strategies that the Town can employ. These evaluations will specifically look at the cost per pound of nitrogen removed by various technologies: eco-toilets, permeable reactive barriers, inlet widening, aquaculture, sewers, and any other technologies that may be developed. This evaluation will be an iterative process, folding in new data and information as it becomes available. Conclusions will be based on solid data, gathered as part of the monitoring program.

Items 8 and 9 are planned as four Articles for the 2013 Fall Town Meeting Warrant. They are part of the overall nutrient management project and will be the subject of public meetings during the summer and fall of 2013. In order to qualify for a zero-percent State Revolving Fund loan, Town Meeting must pass a “flow neutral” bylaw. Town Meeting will also consider whether homes within the sewered area can be exempted from connecting to the sewer if they install eco-toilets, the so-called ‘checkerboarding’ concept. Town Meeting must vote a “betterment” percent for capital costs associated with installation of the sewer collection system. This vote will determine what percent of the capital costs will be paid by the property owner directly ‘bettered’ by the sewer, and what percent will be paid by the taxpayers of the Town. The last Article will ask for authorization to file Special Legislation so that the homeowner’s portion of a betterment can be tailored to the specific needs of Falmouth’s Plan. This legislation would lower the yearly payments of the homeowner. The last Article will also ask for authorization to file Special Legislation so that costs borne by the homeowner can be lessened by paying a reduced interest rate, over a longer period of time, at an equal amount per year like a mortgage. The Town's goal is to make the wastewater costs as affordable as possible.

Item 10: In January 2014, the State will publish the SRF list of projects that it intends to fund in the next funding cycle. The Falmouth projects will be ranked along with all other projects in the State seeking funding assistance. Falmouth will be asking for funding for a ‘multi-year’ project.

Item 11 focuses on the next ‘window of opportunity’ for issuing new debt to replace old debt. The ‘window’ may be used for a variety of needed Town projects. Town Meeting will vote the construction dollars for a 20-year bond for Little Pond Lower Watershed and widening of Bourne’s Pond Inlet, *contingent on receiving a SRF loan*. Depending on whether the ‘flow-neutral bylaw’ passes or not, the SRF loan request will be at zero-percent or 2-percent. A ballot vote is also necessary to approve the bonding as debt exclusion. The tax rate will remain stable.

Item 12 focuses on the Town’s need to pass Chapter 312, Acts of 2008, Section 10 as part of the plan to receive SRF loans. This vote will be on the April 2014 Warrant along with the construction bonding request.

Item 13 - 15: By October 15, 2014 a full SRF application [Item 13] will be submitted with all required items in place. Detailed design and bid documents will be in progress [Item 14] with submittals to the State as progress reports. In January 2015, [Item 15] the State will decide to commit funds and issue an Approval to Bid for construction of the Little Pond Lower Watershed sewer system and associated upgrades at the WWTF.

Item 16: Construction will begin July 2015, first on the Little Pond Sewer Service Area for an estimated two years, and subsequently on the Bourne’s Pond Inlet Widening when the permitting for that project is complete.



### **ES.4.3 Financial Planning and Key Milestones: 2020 to 2040**

By 2020, construction of the projects chosen to manage nitrogen in some of the coastal ponds of the Planning Area should be completed. Falmouth will then evaluate the results of the various projects constructed so far, decide on priorities for the next project, and prepare design and seek SRF funding if it exists. Construction would start in 2025. The same process would continue with funding opportunities in 2030 and 2035. The success of the projects constructed during the decade from 2011 to 2020 will help to determine the best course of action to take in subsequent years until the nitrogen management issues of all of Falmouth's coastal ponds have been addressed.

## **ES.5 CWMP Project Completion and Implementation Timing**

### **ES.5.1 Background**

The information provided in Table ES-2 is a more detailed accounting of the many projects that will take place during the decade from 2011 to 2020. The 'start' and 'finish' dates are best estimates,--not exact dates—of the mini-steps needed to complete each task or project. The WQMC and the Falmouth Board of Selectmen will make their best efforts to meet this timetable, but there is always the potential for unforeseen delays or missing information. The timetable for some projects is also dependent on timely feedback from agencies and regulators. This timetable will be used as a tool to track progress on the various water quality management initiatives underway in Falmouth.

### **ES.5.2 Process of Approving the CWMP/EIR/TWMP (Items 1 through 8)**

The Town submitted a Draft Comprehensive Wastewater Management Plan/Draft Environmental Notification Form (DCWMP/DEIR) to the Executive Office of Energy and Environmental Affairs (EOEEA) in September of 2012. A Certificate from the Secretary of Environmental Affairs was issued on November 14, 2012. The Town responded to comments and has revised the document accordingly.

The process will continue as outlined in Table ES-2, items 4 through 8.

### **ES.5.3 Nitrogen Control Bylaw for Fertilizer (Items 9 through 13)**

In July 2012, the WQMC began working with their technical consultant from Science Wares, Inc. to draft a Fertilizer Bylaw. This bylaw was developed through a process that included multiple meetings with stakeholder groups (landscapers, environmentalists, golf course superintendents) as well as coordination with the State's Department of Agricultural Resources. This bylaw was adopted at Fall 2012 Town Meeting.

Subsequent to the adoption of this bylaw, the lawn care lobby launched a campaign to defeat its acceptance by the State Attorney General's Office (AGO). The AGO rejected Falmouth's bylaw on May 15, 2013. The Town's legislative delegates filed corrective legislation that enabled the AGO to approve the Nitrogen Control Bylaw.

### **ES.5.4 Baseline Monitoring Plan for Water Quality (Items 14 through 19)**

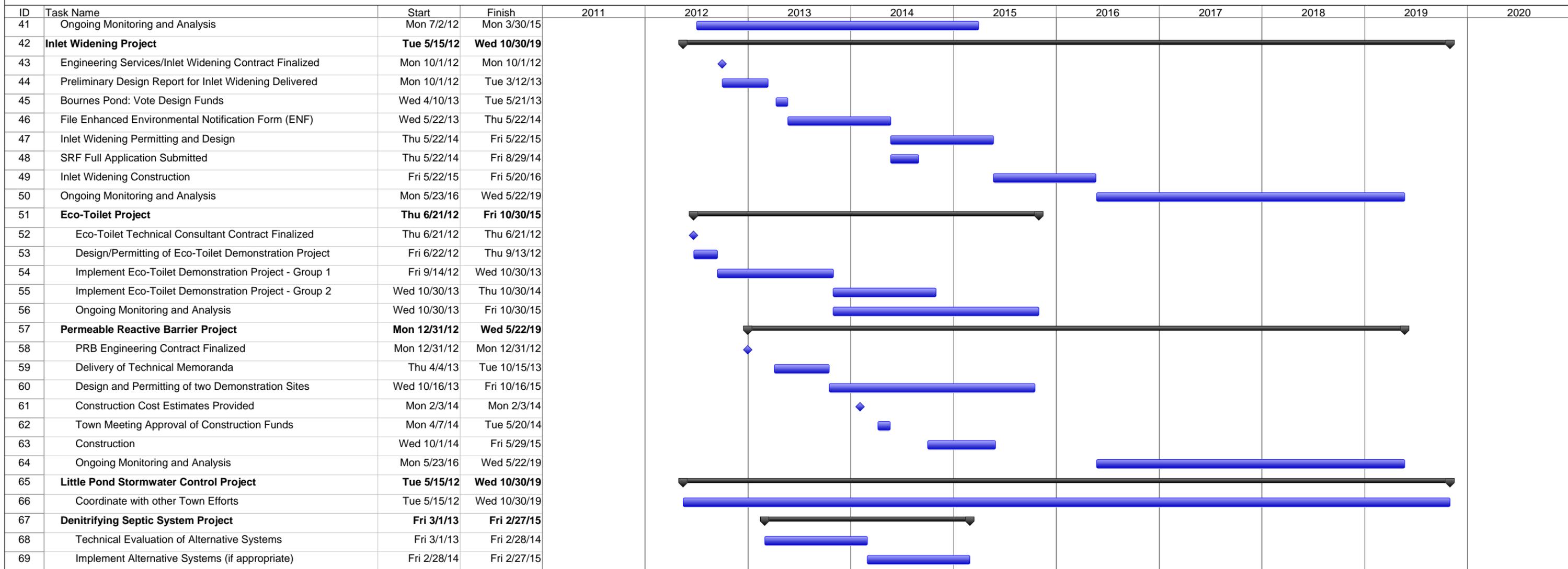
Article 17 of the spring 2011 Annual Town Meeting (Article 17) provided funding to review existing data and conduct additional baseline monitoring as needed. Data on the environmental health of Falmouth's south coast estuaries has been collected subsequent to the dataset used for the MEP Reports for West Falmouth Harbor (2004), Little Pond (2004), as well as Great, Green, and Bourne Pond (2003) up to 2011.

**TABLE ES-2  
PROJECT COMPLETION AND IMPLEMENTATION TIMETABLE**

ID	Task Name	Start	Finish	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	<b>Process of Approving the CWMP/EIR/TWMP</b>	<b>Wed 8/15/12</b>	<b>Tue 7/22/14</b>		[Timeline bar from 2012 to 2014]								
2	Town Submits DCWMP/DEIR/TWMP to EOEEA	Wed 8/15/12	Wed 11/7/12		[Bar]								
3	EOEEA Issues Certificate and Comments	Wed 11/7/12	Wed 11/7/12		◆								
4	WQMC sends Final CWMP to Selectmen	Wed 11/7/12	Tue 7/16/13		[Bar]								
5	Selectmen Approve Final CWMP	Fri 7/19/13	Mon 9/30/13			[Bar]							
6	Submit Final CWMP to EOEEA	Tue 10/1/13	Mon 10/7/13			[Bar]							
7	Secretary Issues Certificate	Tue 10/8/13	Fri 3/21/14			[Bar]							
8	Cape Cod Commission Hearing Process	Mon 3/24/14	Tue 7/22/14				[Bar]						
9	<b>Nitrogen Control Bylaw for Fertilizer</b>	<b>Thu 7/19/12</b>	<b>Mon 4/7/14</b>		[Timeline bar from 2012 to 2014]								
10	Develop and Vote Fertilizer Bylaw	Thu 7/19/12	Tue 11/13/12		[Bar]								
11	Attorney General Rejects Bylaw	Wed 5/15/13	Wed 5/15/13			◆							
12	Corrective Legislation Implemented	Wed 7/17/13	Wed 7/17/13			◆							
13	Town Votes Revised Bylaw - NOT USED	Mon 4/7/14	Mon 4/7/14				◆						
14	<b>Baseline Monitoring Plan for Water Quality</b>	<b>Thu 10/4/12</b>	<b>Mon 12/31/18</b>		[Timeline bar from 2012 to 2018]								
15	Contract SMAST for Baseline Data/Analysis (up to 2011)	Thu 10/4/12	Fri 8/30/13		[Bar]								
16	Scope of Work/Implement Little Pond Monitoring	Thu 10/4/12	Fri 3/28/14		[Bar]								
17	Scope of Work/Implement Bourne Pond Monitoring	Thu 1/2/14	Fri 10/31/14				[Bar]						
18	Scope of Work/Implement Great and Green Pond Monitoring	Fri 1/2/15	Fri 10/30/15					[Bar]					
19	Ongoing Evaluation of Monitoring Results	Fri 11/1/13	Mon 12/31/18					[Bar from 2013 to 2018]					
20	<b>Sewer Extension to the Lower Watershed of Little Pond</b>	<b>Mon 10/1/12</b>	<b>Wed 10/30/19</b>		[Timeline bar from 2012 to 2019]								
21	Engineering Services Contract Finalized	Mon 10/1/12	Mon 10/1/12		◆								
22	Preliminary Design Report for LLP Sewer Delivered	Mon 10/1/12	Fri 12/28/12		[Bar]								
23	Little Pond Sewer: Vote Design Funds	Wed 4/10/13	Tue 5/21/13			[Bar]							
24	Little Pond Sewer System Design	Wed 5/22/13	Thu 5/22/14			[Bar]							
25	File SRF Project Evaluation Form	Mon 9/2/13	Mon 9/2/13			◆							
26	Develop and Vote Flow Neutral Bylaw	Wed 5/22/13	Thu 11/7/13			[Bar]							
27	Develop and Vote Betterment	Wed 5/22/13	Thu 11/7/13			[Bar]							
28	Develop and Vote Special Legislation for Betterment	Wed 5/22/13	Thu 11/7/13			[Bar]							
29	File Special Legislation for Betterment	Fri 11/8/13	Fri 11/7/14				[Bar]						
30	Develop and Vote "Checkerboarding"	Wed 5/22/13	Thu 11/7/13			[Bar]							
31	Vote Construction of Little Pond Sewer	Mon 4/7/14	Wed 5/21/14				[Bar]						
32	SRF Full Application Submitted	Thu 5/22/14	Fri 8/29/14				[Bar]						
33	Detailed Design for Bid Documents	Thu 5/22/14	Tue 6/30/15				[Bar]						
34	State SRF Commitment: Bid Approval for Little Pond	Thu 1/15/15	Thu 1/15/15					◆					
35	SRF Construction Project of Little Pond Sewer	Wed 7/1/15	Fri 6/30/17					[Bar from 2015 to 2017]					
36	Ongoing Monitoring and Analysis	Mon 5/2/16	Wed 10/30/19						[Bar from 2016 to 2019]				
37	<b>Shellfish Aquaculture Demonstration Project</b>	<b>Mon 7/2/12</b>	<b>Mon 3/30/15</b>		[Timeline bar from 2012 to 2015]								
38	Shellfish Consulting Contract Finalized	Fri 10/5/12	Fri 10/5/12		◆								
39	Design/Permitting of Shellfish Demo Project	Fri 10/5/12	Fri 5/10/13		[Bar]								
40	Implementation of Shellfish Demo Project - Year 1	Wed 5/22/13	Wed 10/30/13			[Bar]							

Project: Draft Schedule 6-4-2012 with u Date: Wed 7/24/13	Task		Rolled Up Progress		Inactive Task		Manual Summary Rollup		Deadline	
	Milestone	◆	Split		Inactive Milestone	◇	Manual Summary			
	Summary		External Tasks		Inactive Summary		Start-only			
	Rolled Up Task		Project Summary		Manual Task		Finish-only			
	Rolled Up Milestone	◇	Group By Summary		Duration-only		Progress			

**TABLE ES-2  
PROJECT COMPLETION AND IMPLEMENTATION TIMETABLE**



Project: Draft Schedule 6-4-2012 with u Date: Wed 7/24/13	Task	[Blue bar]	Rolled Up Progress	[Thick black bar]	Inactive Task	[White bar]	Manual Summary Rollup	[Blue bar]	Deadline	↓
	Milestone	◆	Split	[Dotted bar]	Inactive Milestone	◇	Manual Summary	[Thick black bar]		
	Summary	[Thick black bar]	External Tasks	[Grey bar]	Inactive Summary	[White bar]	Start-only	[C-shape]		
	Rolled Up Task	[Blue bar]	Project Summary	[Grey bar]	Manual Task	[Green bar]	Finish-only	[J-shape]		
	Rolled Up Milestone	◇	Group By Summary	[Thick black bar]	Duration-only	[Light blue bar]	Progress	[Thick black bar]		



Falmouth has contracted with SMAST to provide this historic baseline data and provide a Technical Report. This report will evaluate the data, present and discuss data analysis, identify data gaps, assess trends, discuss implications of the different water quality parameters, and gauge the present state of each estuary relative to the MEP nitrogen thresholds analysis. Where relevant, the baseline and trends related to TMDL compliance will be discussed.

In addition, Falmouth has developed a Scope of Work in conjunction with SMAST and the Falmouth Conservation Commission for Little Pond as part of the Shellfish Demonstration Project. This monitoring includes both bi-weekly sampling analysis of: temperature, total nitrogen (nitrate + nitrite, ammonia, dissolved organic nitrogen, particulate organic nitrogen), chlorophyll-a, pheophytin-a, orthophosphate, salinity, dissolved oxygen, transparency (secchi depth), and other parameters as specified in the in the Quality Assurance Project Plan (QAPP) developed for the MEP reports, as well as hourly monitoring of dissolved oxygen (DO), turbidity, chlorophyll-a (via fluorescence), temperature, and pH, for a two-month period using in-situ data collection instrumentation.

SMAST has been continuing baseline monitoring of Bournes Pond, Great Pond, and Green Pond in 2012 and beyond through PondWatch. In addition, a Scope of Work and Implementation Plan for monitoring at Bournes, Great, and Green Pond that is tailored to the implementation of demonstration projects will be developed.

MassDEP has indicated that three years of monitoring will be required to assist in the determination of a nitrogen-reduction credit for each demonstration project. In addition, Adaptive Management decisions will be made based on monitoring results. For each of the demonstration projects, the Town will be tracking the data carefully, and evaluating the monitoring results as soon as they become available. For example, the Town will begin looking at Little Pond in November 2013, when the data from the monitoring for the Shellfish Demonstration Project has been collected. It is expected that after the three years of monitoring, MassDEP will be able to formalize nitrogen-removal credits for each alternative.

#### **ES.5.5 Sewer Extension to the Lower Watershed of Little Pond (Items 20 through 36)**

Article 17 provided funding for preliminary sewer design and engineering. The contract with GHD Inc. for Engineering Services and Inlet Widening was finalized on October 1, 2012. Preliminary Design for the sewer extension to the lower watershed of Little Pond was completed on December 30, 2012.

At Spring 2013 Town Meeting, funds for design of the Little Pond sewer extension were unanimously approved. The May 21, 2013 ballot vote also passed. Design of that sewer extension will proceed to allow the design documents to be submitted for SRF review by the October 2014 timeframe.

#### **ES.5.6 Shellfish Aquaculture Demonstration Project (Items 37 through 41)**

Article 17 provided funding to develop a Shellfish Demonstration Project. The purpose of this project is to determine the effectiveness of oyster aquaculture to attenuate the excessive nitrogen load in Little Pond, one of the Town's most heavily impacted estuaries. Through a water-quality monitoring program, combined with assessments of nitrogen uptake into oyster growth, an estimate will be made of the nitrogen-reduction attributable to oyster aquaculture. MassDEP has indicated that three years of monitoring will be required to assist in the determination of a nitrogen-reduction credit for oyster aquaculture. Once established, these credits could be used to implement oyster aquaculture projects to meet nitrogen TMDL thresholds for both Little Pond and other degraded estuaries.



Woods Hole Group was hired as a consultant to the Shellfish Demonstration Project. WHG has prepared Technical Memoranda including presenting the results of the shellfish viability test that was conducted in the summer of 2012, presenting the results of a Standing Stock Assessment of Little Pond, and providing planning estimates of the nitrogen uptake of various shellfish species. WHG also provided a TM outlining project specifications and cost estimates.

All permits were obtained prior to implementation of the three-year Shellfish Demonstration Project. A total of 2.5 million oysters will be grown in two batches (early and late) during the summer of 2013. This project is currently underway, with the first batch of seed oyster installed in the Town upweller on June 3, 2013. These seed were grown, tested, and relayed to Little Pond beginning on July 3, 2013. The second batch of seed was installed in the upweller on July 22, 2013 and will be grown, tested, and relayed to Little Pond in mid-August, 2013.

A Monitoring Plan for the first year has been developed that has been reviewed by MassDEP, which has no objections. In addition, the Falmouth Conservation Commission reviewed this plan as part of the Notice of Intent hearing, and formalized its approval within their Order of Conditions (MassDEP Permit #25-3915). See Appendix 3-1.

#### **ES.5.7 Inlet Widening Project (Items 42 through 50)**

Article 17 provided funding to investigate inlet widening at Bournes and/or Little Pond. A Contract with GHD Inc. for Engineering Services and Inlet Widening was finalized on October 1, 2012.

GHD has completed a Technical Memorandum (BP-TM-1) which presents preliminary design evaluations for an enlarged inlet and new bridge over Bournes Pond, as well as an analysis of the nitrogen removal benefits of a larger inlet as determined by water-quality modeling. GHD is assisted by Applied Coastal Research and Engineering (ACRE) who is providing hydrodynamic and water-quality modeling to determine the optimized size of the proposed new inlet and identify the nitrogen removal benefits of a larger opening; and BETA Group Inc. who provided preliminary design information on the proposed new bridge and roadway changes.

Design and permitting costs of a widening of Bournes Pond inlet is estimated to be \$700,000, of which \$400,000 will be paid from Article 17. Spring 2013 Annual Town Meeting unanimously approved funding the balance (\$300,000). Ballot approval was on May 21, 2013.

The following tasks have been completed:

- Evaluation of alternative designs for a new Bournes Pond inlet opening and bridge.
- Cost development for the preferred alternative, which is an opening with a new bridge with a 90-foot opening as opposed to the current 50-foot opening.
- Hydrodynamic and water quality modeling to estimate the effective nitrogen removal of the new inlet.
- Cost comparison with traditional wastewater management to remove the same amount of nitrogen.
- Conclusion that this non-traditional nitrogen management method is very cost-effective. Inlet opening is less than half of the cost of sewer extension and wastewater treatment to remove the same amount of nitrogen.



The next steps of this project include:

- Coordination with a broader group of stakeholders.
- Development and review of the needed documents to gain MEPA and local approvals.
- Development and review of additional needed local, State, and Federal permits.
- Project implementation.
- Monitoring of water quality changes attributable to the new opening.

#### **ES.5.8 Eco-Toilet Project (Items 51 through 56)**

Article 17 provided funding to investigate the use of composting and urine-diverting toilets (eco-toilets) and denitrifying septic systems in order to determine the cost and feasibility of their installation and operation, their public acceptability, and the achievable level of nitrogen removal. The Falmouth Board of Selectmen have authorized \$80,000 to provide incentives for an initial set of up to 15 eco-toilet installations (Demonstration Group I), and the Town has signed a Memorandum of Agreement with the Barnstable Department of Health and Environment (BCDHE) to establish the pre-installation nitrogen concentration of the septic tank effluent, and perform monthly monitoring of the septic tank effluent that results after an eco-toilet has been installed. Falmouth has also contracted with Science Wares, Inc. as a technical consultant to assist in the design and implementation of an eco-toilet demonstration program.

A significant barrier to implementation was identified. Urine-diverting fixtures, source separators, and other pilot-stage urine-diverting toilet technologies do not currently have a Product Acceptance number from the State Board of Plumbers and Gas Fitters, and are therefore illegal to install in the State. Science Wares worked with the local plumbing inspector, State plumbing board, and BCDHE to obtain a variance for Test Site Status for up to 40 test sites to enable urine-diverting fixtures to be installed. This has paved the way for significantly more installations than would have been feasible with composting toilets alone.

The first phase of this program (Demonstration Group I) is well underway. Approximately 15 property owners have committed to replace all of the standard toilets in their home with eco-toilets and allow two years of monitoring. Board of Health and building permits have been granted for three standard composting-toilet installations, with more to be approved by the end of June. In addition, approximately six urine-diverting installations are in the design and permitting stage. All installations are expected to be complete by December 2013, with monthly monitoring by BCDHE to commence concurrently. MassDEP has suggested that data from a total of 62 installations will be necessary to establish regulatory credit for the nitrogen-removal capacity of eco-toilets. The Town is actively identifying additional participants to meet this regulatory requirement.

#### **ES.5.9 Permeable Reactive Barrier Project (Items 57 through 64)**

Article 17 provided funding to develop a demonstration project for Permeable Reactive Barriers. On December 31, 2012, CDM Smith was hired to design and permit PRBs in up to two locations, one in the West Falmouth Harbor watershed and the other in the High Priority Mitigation Area in East Falmouth.

CDM Smith has completed two Technical Memoranda (TMs) and has presented their findings to the WQMC working group, State and local regulatory agencies, and at a public meeting of the WQMC. These TMs include the evaluation criteria and preliminary site selection for the PRB pilot project. Subsequent TMs will address details of permitting, and surface and groundwater monitoring. Two sites have been



selected for conceptual design, one in West Falmouth, and the other in Seacoast Shores in East Falmouth.

#### **ES.5.10 Little Pond Stormwater Control Project (Items 65 through 66)**

Falmouth's Engineering Department is responsible for implementing the Phase II requirements for the Town's National Pollutant Discharge Evaluation System (NPDES) permit and has been moving forward with compliance. Efforts within the Little Pond watershed include updating outfall maps for the Little Pond watershed to identify all of the stormwater run-off into Little Pond, a public education campaign, and street cleaning.

Preliminary evaluations have begun to determine appropriate Best Management Practices for this watershed, such as bio-retention. This evaluation process is being informed by the Environmental Protection Agency's (EPA) Green Infrastructure objectives and other current research results such as University of New Hampshire Stormwater Center (UNHSC) project to optimize nitrogen removal from stormwater treatment systems. The Town, through its Engineering Department, other appropriate departments and boards, as well as technical consultants, will pursue feasible BMP solutions as part of the sewer construction for this watershed.

In addition, the Falmouth Conservation Commission is revising their Stormwater Regulations. Nitrogen-reduction BMP requirements will be part of this update. Data on the nitrogen loading from the outfall at Narragansett Street within the Little Pond watershed will be collected as part of the Shellfish Demonstration Project.

#### **ES.5.11 Denitrifying Septic System Project (Items 67 through 69)**

Article 17 provided funding to investigate the use of composting and urine-diverting toilets (eco-toilets), and denitrifying septic systems. The WQMC is working closely with Barnstable County Department of Health and Environment to evaluate technologies that are promising based on published studies, and results from the BCDHE database of Innovative/Alternative (I/A) septic systems. In addition, BCDHE is planning to implement a pilot project for a passive, non-proprietary denitrification system. The findings of this project as well as the technical evaluations will guide future efforts to implement I/A systems.

### **ES.6 Summary**

This CWMP/FEIR/TWMP is the result of many years of work by the Town of Falmouth and its Water Quality Management Committee, CWMP Review Committee, Nutrient Management Committee, Board of Selectmen, and Town Departments led by the Department of Public Works. It has been greatly assisted by the efforts of the Massachusetts Estuaries Project (comprised of MassDEP, SMAST, the Cape Cod Commission, and others) to develop the nitrogen limits and TMDLs for the estuaries in the Planning Area.

This plan is developed to remediate the current nitrogen loading problems of the estuaries in the Planning Area and in West Falmouth Harbor. It represents a strong commitment by the Town to maintain a healthy environment in Falmouth for regulatory compliance and for the Town's people to enjoy for generations to come.

**COMPREHENSIVE WASTEWATER MANAGEMENT PLANNING PROJECT  
SOUTH COAST WATERSHEDS AND RECOMMENDATIONS FOR  
WEST FALMOUTH HARBOR WATERSHED  
TOWN OF FALMOUTH, MASSACHUSETTS  
MEPA Unit/Cape Cod Commission  
Joint Review Process**

**Final Comprehensive Wastewater Management Plan (CWMP) and  
Final Environmental Impact Report (FEIR), Document Distribution List**

A copy of the FINAL CWMP/FEIR/TWMP Document will be sent to the following:

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Affairs  
251 Causeway Street, Suite 900  
Boston, MA 02114  
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Cape Cod Commission  
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Boston, MA 02108  
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Massachusetts Department of  
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Boston, MA 02108 (Full Set)

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Attn: Alison Leschen

Massachusetts Historical Commission  
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220 Morrissey Boulevard  
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Buzzards Bay Coalition  
114 Front Street  
New Bedford, MA 02740 (Full Set)

Deputy Base Engineer  
971 South Outer Road  
Otis ANG Base, MA 02542-133  
(ES Set)

Executive Office of Transportation  
10 Park Plaza, Room 3510  
Boston, MA 02116-3969  
Attn: Environmental Reviewer (ES Set)

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Boston, MA 02109-3912 (Full Set)

Coastal Zone Management  
251 Causeway Street, Suite 800  
Boston, MA 02202  
Attn: R. Boeri (Full Set 2 copies)

Brian Howes, Ph.D. of SMAST  
70 Summersea Road  
Mashpee, MA 02649 (ES Set)

Coastal Zone Management  
3195 Main Street, Route 6A  
PO Box 220  
Barnstable, MA 02630  
Attn: Steve McKenna (Full Set)

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1213 Purchase Street  
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Department of Conservation and Recreation  
Division of State Parks and Recreation  
251 Causeway Street, Suite 600  
Boston, MA 02114-2104 (ES Set)

Massachusetts Division of Fisheries & Wildlife  
One Rabbit Hill Road  
Westborough, MA 01581  
Attn: Thomas W. French, Ph.D.(ES Set)

Department of Agricultural Resources  
16 West Experiment Station  
University of Massachusetts  
Amherst, MA 01003  
Attn: MEPA Coordinator (ES Set)

Natural Heritage and Endangered  
Species Program  
Commonwealth of Massachusetts  
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Director of Environmental Health  
250 Washington Street  
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Massachusetts Highway Department  
Public/Private Development Unit  
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Sandwich Library  
142 Main Street  
Sandwich, MA 02563  
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Taunton, MA 02780  
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Nathan C. Weeks, P.E.  
GHD Inc.  
1545 Iyannough Road; Route 132  
Hyannis, MA 02601 (Full Set)

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Massachusetts National Guard  
Environmental Readiness Center  
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Town of Mashpee Public Library  
64 Steeple Street  
PO Box 657  
Mashpee, MA 02649  
Attn: Kathleen Mahoney (Full set)

Town of Bourne  
24 Perry Avenue  
Buzzards Bay, MA 02532  
Attn: Thomas M. Guerino, Town  
Administrator (ES Set)

Town of Mashpee  
16 Great Neck Road North  
Mashpee, MA 02649  
Attn: Tom Fudala, Town Planner  
(ES Set)

Town of Falmouth DPW  
59 Town Hall Square  
Falmouth, MA 02540  
Attn: Jerry Potamis, P.E

Lombardo Associates, Inc.  
49 Edge Hill Road  
Newton, MA 02467  
(DISK)

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Michael B. McGrath, P.E., P.L.S.  
125 Cliffwood Lane  
Falmouth, MA 02540  
(DISK)

**Commenters list: 10 total (All Receive Full Set)**

Patricia Handley  
(pamhan2011@hotmail.com)  
PO Box 739  
West Falmouth, MA 02574-0739

Robert F. Murphy  
Chair, Cape Cod and Islands Group-Sierra  
Club  
P.O. Box 128  
Cataumet, MA 02534-0128

Kate Bunker-Neto  
18 Skehan Street  
Somerville, MA 02143

Christina Rawley  
8 Fay Road  
Woods Hole, MA 02543

**Final CWMP and FEIR Document Distribution List (continued)**

Andrew Bunker  
11 Westmoreland Drive  
Falmouth, MA 02540

David Dow (ddow420@comcast.net)  
18 Treetop Lane  
Falmouth, MA 02540

Hilde Maingay and Earl Barnhart  
28 Common Way  
East Falmouth, MA 02536

Janet Kluever  
447 Currier Road  
East Falmouth, MA 02536

Molly Bang  
43 Drumlin Road  
Falmouth, MA 02540

The Association for Crocker' s Pond  
c/o  
MATTHEW WATSKY  
ATTORNEY AT LAW  
East Brook Executive Park  
30 Eastbrook Road, Suite 301  
Dedham, MA 02026



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## Glossary of Common Acronyms

ACEC	Area of Critical Environmental Concern
ACRE	Applied Coastal Research and Engineering, Inc.
AFB	Air Force Base
AGO	Attorney General's Office
APCC	Association to Preserve Cape Cod
ARRA	American Recovery and Reinvestment Act
ASAR	Alternatives Screening Analysis Report
BBC	Buzzards Bay Coalition
BCDHE	Barnstable County Department of Health and Environment
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BOH	Board of Health
BOS	Board of Selectmen
BSR	Blacksmith Shop Road
CCC	Cape Cod Commission
CCWPC	Cape Cod Water Protection Collaborative
CDAG	Community Development Action Grant
CDM	Camp, Dresser & McKee, Inc.
CEC	Contaminants of Emerging Concern
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CMAST	Center for Marine Science and Technology
CMR	Code of Massachusetts Regulations
CRWG	Coastal Resources Working Group
CVI	Coastal Vulnerability Index
CWMP	Comprehensive Wastewater Management Planning
CWMP/FEIR/TWMP	Comprehensive Wastewater Management Plan and Final Environmental Impact Report, and Targeted Watershed Management Plan
CWQCA	Conceptual Water Quality Compliance Area
CZM	Coastal Zone Management



DCPC	District of Critical Planning Concern
DCR	Department of Conservation and Recreation
DCWMP/DEIR	Draft CWMP and Draft Environmental Impact Report
DIN	Dissolved Inorganic Nitrogen
DMF	Division of Marine Fisheries
DO	Dissolved Oxygen
DOER	Department of Energy Resources
DON	Dissolved Organic Nitrogen
DPW	Department of Public Works
DRI	Development of Regional Impact
DSS	Denitrifying Septic System
ECM	Energy Conservation Measures
EEA	Energy and Environmental Affairs
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ENF	Environmental Notification Form
ENR	Enhanced Nitrogen Removal
EOEEA	Executive Office of Energy and Environmental Affairs
EPA	Environmental Protection Agency
FACES	Falmouth Association Concerned with Estuaries and Saltponds
FCC	Falmouth Country Club
FCWG	Falmouth Coastal Working Group
FCWMP/FEIR	Final Comprehensive Wastewater Management Plan and Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FFL	Falmouth Friendly Lawn
GAC	Granular Activated Carbon
GHD	GHD Inc.
GHG	Greenhouse Gas
GIS	Geographic information System
gpd	Gallons per day
gpd/sf	Gallons per day per square foot
GWDP	Groundwater Discharge Permit Program
HDPE	High Density Polyethylene



I/A	Innovative and Alternative
IGA	Investment Grade Audit
I/I	Infiltration/inflow
kW	Kilowatt
LCP	Local Comprehensive Plan
LID	Low Impact Development
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MEP	Massachusetts Estuaries Project
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
mgd	million gallons per day
mg/L	milligrams per liter
M.G.L.	Massachusetts General Law
MHC	Massachusetts Historical Commission
MLSS	Mixed Liquor Suspended Solids
MMR	Massachusetts Military Reservation
MSL	Mean Sea Level
MSX	Multinucleated Sphere Unknown
MWRA	Massachusetts Water Resources Authority
NAAQS	National Ambient Air Quality Standards
NAR	Needs Assessment Report
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NHESP	Natural Heritage and Endangered Species Program
NMWG	Nutrient Management Working Group
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Evaluation System
NRCS	National Resource Conservation Services
NWI	National Wetlands Inventory
N <sub>2</sub>	Nitrogen Gas



OH	Hydroxyl
OSDS	Onsite Sewage Disposal System
OSHA	Occupational Safety and Health Administration
O&M	Operations & Maintenance
PAL	Public Archaeology Laboratory
PEF	Project Evaluation Form
PON	Particulate Organic Nitrogen
ppm	parts per million
PRB	Permeable Reactive Barrier
psi	pounds per square inch
PV	Photovoltaic
PWED	Public Works Economic Development
QAPP	Quality Assurance Project Plan
RO	Reverse Osmosis
ROW	Right-of-Way
SCDHS	Suffolk County Department of Health Services
sf	Square Foot
SMAST	School of Marine Science and Technology
SRF	State Revolving Fund
SW	Science Wares Inc.
SWPPP	Stormwater Pollution Prevention Plan
S&W	Stearns & Wheler, LLC
TAG	Technical Advisory Group
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TWMP	Targeted Watershed Management Plan
UCWSC	Upper Cape Water Supply Cooperative
UD	Urine Diverting
UMass	University of Massachusetts
UNHSC	University of New Hampshire Stormwater Center
USDA	United States Department of Agriculture



USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet
VFD	Variable Frequency Drive
WBNERR	Waquoit Bay National Estuarine Research Reserve
WHG	Woods Hole Group
WHOI	Woods Hole Oceanographic Institute
WPA	Wetlands Protection Act
WPCF	Water Pollution Control Facility
WQMC	Water Quality Management Committee
WWTF	Wastewater Treatment Facility
ZOC	Zone of Contribution

### **Additional Items:**

Draft Report	Draft Comprehensive Wastewater Management Plan and Draft Environmental Impact Report, and Notice of Project Change, July 30, 2012
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# 1 Introduction

## 1.1 Report Background and Purpose

This Comprehensive Wastewater Management Plan and Final Environmental Impact Report and Targeted Watershed Management Plan (CWMP/FEIR/TWMP) Document is the fifth of five reports to be produced for the Town of Falmouth (Town) Comprehensive Wastewater Management Planning (CWMP) Project and submitted for regulatory review. The first of these reports was the Needs Assessment Report (NAR) dated October 2007, which documented the wastewater and nitrogen-management needs for the Planning Area and related areas of Falmouth. The second report was the Alternatives Screening Analysis Report (ASAR) dated November 2007, which identified possible solutions to address the wastewater and nitrogen-management needs and then “screened” these alternative solutions to retain the most feasible ones for cost development and detailed evaluation. The third was the Environmental Notification Form (ENF) document dated December 17, 2007 that summarized the findings of the Needs Assessment Report to initiate environmental review of the project (as part of the Massachusetts Environmental Protection Act or MEPA review process). The fourth was the Draft Comprehensive Wastewater Management Plan and Draft Environmental Impact Report and Draft Notice of Project Change (Draft Report) dated July 30, 2012 which presented the draft plan, and further advanced MEPA review of the project.

The purpose of this CWMP/FEIR/TWMP is to summarize the detailed evaluations and the changes made since the review of the Draft Report, and to present the Recommended Plan to address the wastewater and nitrogen management needs. It also presents the estimated environmental impact (and benefits) of the Recommended Plan as compared to the consequences of not acting on the wastewater needs (also called the No-Action Alternative).

There are components of this Plan which need further coordination and agreement. The CWMP proposes an Adaptive Management Plan to implement several demonstration projects and other initiatives to determine the feasibility of several non-traditional wastewater and nitrogen management technologies and approaches.

These demonstration projects and other initiatives have been funded by Town Meeting (Article 17 Town Meeting Vote is attached as Appendix 1-1) and are underway. Their progress to date is summarized in this document. They will become evaluations independent of this CWMP/FEIR/TWMP and will enter the MEPA review process at a later time as Notices of Project Change if they trigger MEPA review thresholds, or as general project updates. If these evaluations and subsequent MEPA reviews demonstrate feasibility, the Town plans to add them to this Plan through the Adaptive Management Plan component of this CWMP/FEIR/TWMP.

The Targeted Watershed Management Plan (TWMP) terminology has recently emerged to describe watersheds that are located completely within one town. The TWMP is a required component to meet new regional (Cape Cod Commission) planning guidance. The TWMP component (and added title) of this document refers specifically to the planned sewer extension within the lower watershed to Little Pond that has been targeted for nitrogen mitigation.

After MEPA review of this document, the project will be reviewed as a Development of Regional Impact (DRI) as part of the Cape Cod Commission regulatory process, and will proceed to permitting and implementation.



## 1.2 Project Background and Planning Area

The CWMP Project is being completed to provide an environmentally and economically sound approach for wastewater and nitrogen management in the Planning Area and with recommendations for West Falmouth Harbor for the next 20 years and with a perspective on the buildout conditions. The Project evaluates the Town's existing wastewater treatment facilities; assesses the wastewater and nitrogen-related needs in the Planning Area; evaluates appropriate mitigation measures for those needs; and develops a Recommended Plan for improved wastewater and nitrogen management systems. The primary focus of the project is to identify and evaluate cost-effective and appropriate technologies and approaches for the Planning Area and West Falmouth Harbor, and initiate a plan to meet the nitrogen Total Maximum Daily Load (TMDL) limits for the marine waters in these areas.

The Town of Falmouth is located in the southwestern portion of Cape Cod as shown in Figure 1-1. This figure also identifies the Planning Area as the watersheds to Little, Great, Green, Bournes, and Eel Ponds, and Waquoit Bay as well as the West Falmouth Harbor Watershed. All of the estuarine waters in the Planning Area are impacted by excessive nitrogen loadings in the watersheds to these waters.

The Town of Falmouth is committed to improving the water quality of its estuaries, and in November 2006, prepared its "Wastewater and Nutrient Management Vision and Strategies," as contained in Appendix 1-2. The Town's vision statement from this document is:

"Vision - By comprehensively and effectively managing its wastewater and other nutrient sources, Falmouth will improve water quality, protect public health and enhance the Town's economic vitality. Falmouth will offer its residents, visitors and future generations healthy waters in order to sustain the Town's property values and vibrant economy."

The Town of Falmouth is faced with several wastewater-related problems in this Planning Area and Town-wide as it plans to protect its coastal environment and plans for growth. Nitrogen loadings from the Town's coastal watersheds are causing an overproduction of algae in several coastal estuaries, and these loadings are impacting the water-quality and marine resources in the estuaries. The Massachusetts Estuaries Project has recently completed several studies that indicate most of the nitrogen originates from wastewater sources. These reports have recommended extensive wastewater and non-wastewater nitrogen management. These wastewater and nitrogen management systems are identified in this document and their implementation is recommended through an Adaptive Management approach.

## 1.3 Wastewater Planning Project Scope

The project has been divided into five phases. A brief listing of the tasks associated with each phase of this project follows, and a more detailed Plan of Study for the project as submitted for MassDEP review is included in Appendix 1-3.

### 1.3.1 Phase I – Needs Assessment

1. Review and summarize Town issues and project background.
2. Initiate identification and evaluation of potential treated water recharge sites.
3. Review and summarize regulatory issues affecting wastewater management planning.
4. Evaluate, summarize, and describe existing conditions in Town, including nitrogen limits.



5. Identify the goals and objectives of the Town related to wastewater management.
6. Evaluate, summarize, and describe future conditions in Town.
7. Identify wastewater areas of concern and prepare CWMP Needs Assessment Report.

#### **1.3.2 Phase II - Identification and Screening of Alternative Solutions and Sites**

1. Identify, review, and summarize alternative solutions to meet the Town's wastewater management needs.
2. Screen the alternative solutions to identify the most feasible for detailed evaluation.
3. Further identify and screen potential sites for wastewater management facilities.
4. Group feasible solutions and sites into alternative wastewater management scenarios.
5. Prepare the wastewater Alternatives Screening Analysis Report by summarizing the tasks of this phase.
6. Prepare the Environmental Notification Form (ENF) to initiate the MEPA and CCC Development of Regional Impact (DRI) Joint Environmental Review Process.

#### **1.3.3 Phase III – Detailed Evaluation and Development of the CWMP**

1. Continue with subsurface and/or environmental investigations for potential wastewater management sites.
2. Prepare a methodology of the planned detailed evaluations for project and regulatory review.
3. Perform present-worth evaluations of the alternative scenarios.
4. Perform non-monetary evaluations of the alternative scenarios.
5. Perform an environmental impact analysis.
6. Evaluate the present-worth, non-monetary factors, and the potential environmental impacts (and benefits) of the alternative management scenarios.
7. Develop and present the recommended Wastewater Management Plan, and prepare the Draft CWMP and Draft Environmental Impact Report (DCWMP/DEIR).
8. Submit the DCWMP/DEIR for regulatory and public reviews.

#### **1.3.4 Phase IV - Resolution of Remaining Issues and Project Completion**

1. Resolve remaining issues. (This will involve addressing questions and comments raised during the DCWMP/DEIR review process.)
2. Prepare the Final Comprehensive Wastewater Management Plan and Final Environmental Impact Report (FCWMP/FEIR), and submit it for public and regulatory review.
3. Complete the CCC DRI review process.



### **1.3.5 Phase V – Environmental and Public Review Process. (These tasks occur during Phases I, II, III, and IV)**

1. Utilize the Falmouth Working Groups and Committees for project reviews and public outreach.
2. Prepare and conduct a public participation program.
3. Submit and coordinate public review of the ENF.
4. Submit and coordinate public review of the DCWMP/DEIR (and NPC).
5. Submit and coordinate public review of the FCWMP/FEIR.
6. Coordinate the needed public meetings and hearings to comply with State and regional regulations as well as meet the informational needs of the community.

### **1.4 Public Review and Public Participation Program**

The Town has conducted an active public participation and outreach program involving but not limited to the following components and features:

1. Formation of a Nutrient Management Working Group comprised of interested citizens, volunteer board members, and Town staff.
2. Formation of a Technical Advisory Group (TAG) as a sub-set of the Nutrient Management Working Group for more detailed project reviews.
3. Development of a Town website dedicated to all of the Town's wastewater projects.
4. Updates to the Wastewater Department webpage.
5. Production and dissemination of project newsletters.
6. Televised presentations to the Board of Selectmen and other groups.
7. Collaboration with Falmouth Association Concerned with Estuaries and Saltponds (FACES), a Falmouth advisory group dedicated to improving the water quality in the coastal waters, to conduct a series of community meetings called "Sewer Socials".
8. Active coordination with the local newspaper to distribute the newsletters and to review public opinion on intermediate stages of the plan.
9. Formation of the CWMP Review Committee to review and provide recommendations on the 2009 Preliminary DCWMP/DEIR. The Committee greatly enhanced the Public Participation Program with a series of televised Committee Meetings, as well as facilitated Public Meetings.
10. Formation of the Water Quality Management Committee (WQMC) to implement the recommendations of the CWMP Review Committee. Again, this Committee greatly enhanced the Public Participation Program with their ongoing televised Committee Meetings and support for multiple specialty workshops to investigate non-traditional approaches to wastewater and nitrogen management.

These components are described and documented in greater detail in Chapter 5.



## **1.5 Environmental Review Process**

The environmental review process was initiated in December 2007 with the filing of an ENF with the MEPA office of the Executive Office of Energy and Environmental Affairs (EOEEA) as well as with the Cape Cod Commission. The ENF summarized the findings of the Needs Assessment and Alternatives Screening Reports and identified the evaluation process for the selected alternatives. A public hearing was convened to receive comments on the ENF and a bus tour was organized to visit the Planning Area as well as the alternative treatment and recharge sites identified for evaluation.

A certificate of the Secretary of Energy and Environmental Affairs (EEA) approved the Project ENF on January 30, 2008.

Several alternative management plans were then evaluated and the Draft Report was submitted for MEPA review in September 2012. A second certificate of the EEA Secretary was issued on November 14, 2012 along with several comment letters that are attached in Appendix 1-4. A comment response memorandum (also contained in Appendix 1-4) has endeavored to address these comments. The Draft Report has been revised to this CWMP/FEIR/TWMP based on these comments and further decision-making of the Town.

The environmental review process will continue with the MEPA and CCC review of this CWMP/FEIR/TWMP document. A Secretary's certificate will be received at the end of this review. After a successful MEPA review, the CCC will complete their DRI review.

## **1.6 Planning Period**

The Comprehensive Wastewater Management Plan will provide a Recommended Plan for wastewater facilities in the Planning Areas for the 20-year planning period of 2015 to 2035. The starting year (2015) of this planning period is estimated as the approximate period to initiate implementation of proposed wastewater facilities. Planning for several demonstration projects was already started in 2012: shellfish aquaculture, eco-toilets, and widening of Bournes Pond inlet. Implementation of these and other demonstration projects will begin as soon as the relevant permits are in hand. The results of each demonstration project will be monitored for at least three years. Expansion of promising technologies will be folded into the CWMP through Notices of Project Change as part of the Adaptive Management Plan. Where shared watersheds are involved, planning will be coordinated with the CCC. The plan will also be developed with a planning horizon based on the estimated potential buildout of the Planning Area and the need to meet the nitrogen TMDLs. Falmouth will coordinate with abutting Towns and the Massachusetts Military Reservation (MMR) in the Planning Area. This larger planning horizon extends from 2035 to 2055.

## **1.7 Blacksmith Shop Road WWTF Settlement Agreement and Proposed Effluent Discharge Permit**

In June 2012, the town of Falmouth, MassDEP, and the Buzzards Bay Coalition Inc. entered into a Settlement Agreement following an appeal by the Town and the Coalition of a Groundwater Discharge Permit issued by the MassDEP on November 2, 2011. The Agreement and Effluent Discharge Permit are attached as Appendix 1-5 and are incorporated into this CWMP by reference.

Under the terms of the Agreement, the Town agreed to submit a scope of work, plan, and schedule to implement a nitrogen removal optimization plan at the Wastewater Treatment Facility; to evaluate and—if necessary—provide a plan and schedule to upgrade its flow measurement mechanism at the plant; and to



use its best efforts to achieve an average annual effluent total nitrogen concentration of 3 mg/L and an annual load of 5,204 pounds associated with an average annual flow of 0.57 mgd.

In accordance with the Settlement Agreement, this CWMP includes a plan for the Town to exercise its best efforts to bring West Falmouth Harbor into compliance with the West Falmouth Harbor TMDL and the Surface Water Quality Standards by December 2, 2016.

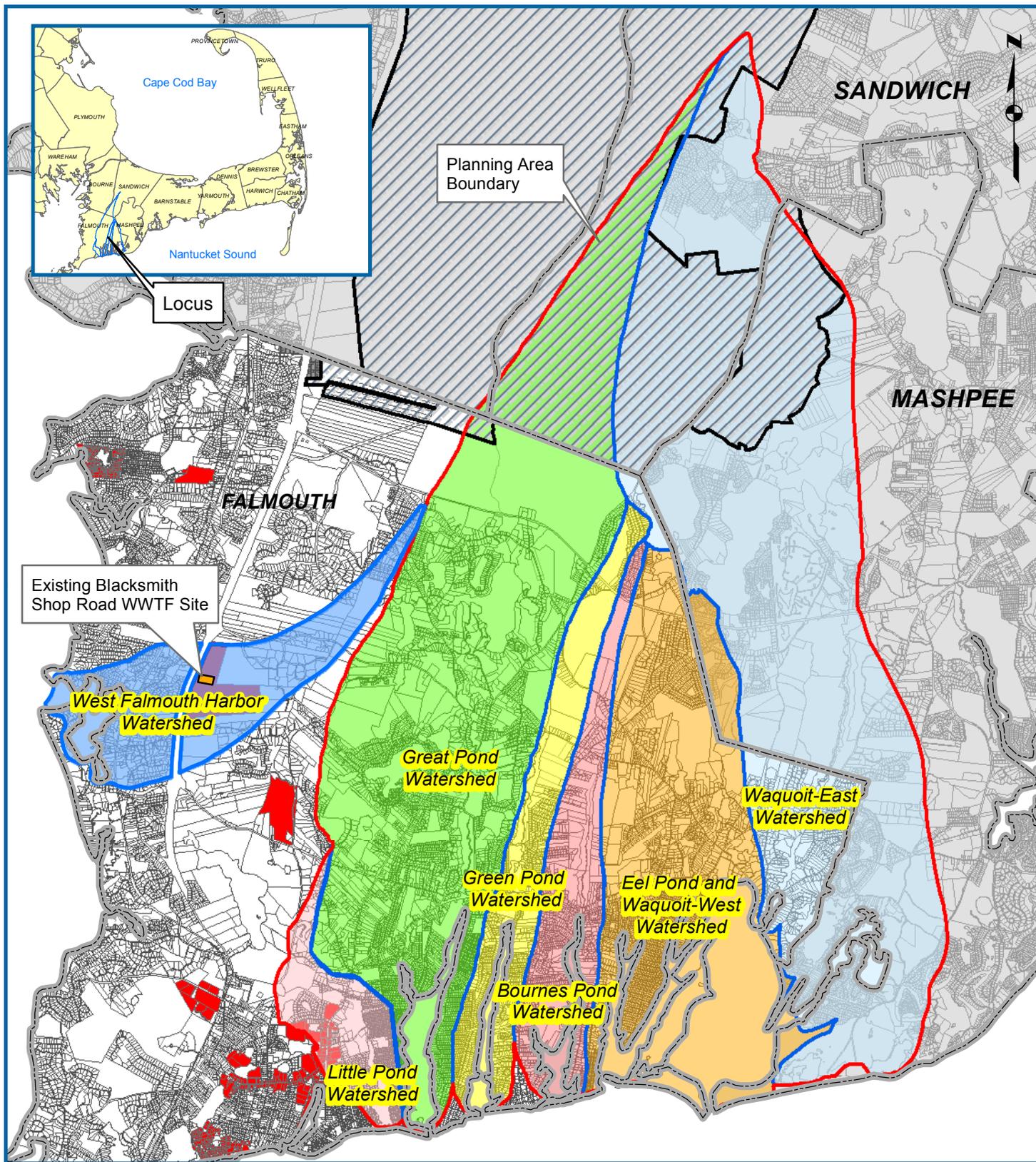
Those efforts shall include a plan and schedule to remove 30,000 gallons per day (gpd) of infiltration and inflow from the wastewater collection system by December 2, 2016; the potential installation of a Permeable Reactive Barrier (PRB) Demonstration Project in the West Falmouth Harbor Watershed; the exploration of alternative nitrogen reduction remedies through various demonstration projects; and passage of a Comprehensive Nitrogen Control Bylaw for Fertilizer at the Fall 2012 Town Meeting.

## **1.8 Organization of this CWMP/FEIR/TWMP**

The Comprehensive Wastewater Management Plan and Final Environmental Impact Report and Targeted Watershed Management Plan (DCWMP/DEIR/TWMP) is written to summarize Phase III and Phase IV of the Project Scope. The report text and tables are contained in Volume 1 of this document. Volume 2 contains the report figures and appendices to make reference to these items as easy as possible.

This Report is divided into eight chapters:

1. Chapter 1 presents general introductory information about the CWMP Project.
2. Chapter 2 briefly summarizes the previous wastewater and nitrogen management planning evaluations and reports that occurred before this CWMP/FEIR/TWMP document.
3. Chapter 3 summarizes the evaluations and Town decision-making for non-traditional nitrogen management technologies.
4. Chapter 4 summarizes the evaluations and Town decision-making for the traditional wastewater management technologies.
5. Chapter 5 identifies the public participation program implemented as part of the CWMP to gain public understanding and support of Project efforts to find the best solution for the Town's wastewater and nitrogen problems.
6. Chapter 6 presents the Recommended Plan, and identifies the implementation schedule and financial considerations.
7. Chapter 7 presents a summary of the environmental impact and benefit analysis.
8. Chapter 8 presents the "Draft Section 61 Findings for all State Agencies" which is a required format for all environmental impact reports.



<b>Legend</b>	Planning Area	Waquoit-East Watershed	Great Pond Watershed	West Falmouth Harbor
	MEP Watershed Boundary	Bournes Pond Watershed	Green Pond Watershed	Sewered Parcel
	Eel Pond & Waquoit-West Watershed	Little Pond Watershed	Town Boundary	Parcel Boundary
	Parcel Boundary			

Paper Size 8x11  
 0 0.475 0.95 1.9  
 Miles



TOWN OF FALMOUTH, MASSACHUSETTS  
 CWMP

Job Number 86-12163  
 Revision A  
 Date 18 Sep 2013

LOCATION MAP

Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1927  
 Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001

FIGURE 1-1



## **2 Summary of Previous Wastewater and Nitrogen Management Planning Evaluations and Reports**

### **2.1 Introduction**

The purpose of this chapter is to briefly summarize the many evaluations and reports that have been completed before this CWMP/FEIR/TWMP Document. The brief descriptions are generally presented in chronological order to “tell the story” of the evaluations and decision processes, and there are references to appendices that contain more detailed summaries of the evaluations.

### **2.2 Falmouth Wastewater and Nitrogen Management Planning Projects Completed Before this CWMP Project**

Several wastewater facility plans and environmental evaluations have summarized wastewater and nutrient management problems in the Planning Area and are briefly identified below:

#### **2.2.1 1981 Wastewater Facilities Plan**

This planning project that ended in 1981 evaluated several wastewater and nitrogen related problems and provided the basis for the implementation of the following management steps and facilities:

- Elimination of the Woods Hole outfall that had served a collection system in Woods Hole.
- Construction of the Blacksmith Shop Road Wastewater Treatment Facility (WWTF).
- Sewer extension to Main Street and South Davis Straits, portions of Falmouth Village, Surf Drive Beach area, and additional areas of Woods Hole.

A Phase 2 portion of this plan recommended sewer extensions to portions of Falmouth Heights and Maravista Peninsula (portions are in the Planning Area and Little Pond watershed) but were never implemented. Additional detail on this 1981 Facilities Plan is included in Appendix 2-1.

#### **2.2.2 2001 Wastewater Facilities Plan**

This planning project that ended in 2001 evaluated several wastewater and nitrogen related problems and provided the basis for the implementation of the following management steps and facilities:

- Upgrade of the Blacksmith Shop Road WWTF to 1.2 million gallons per day (mgd) and to produce a well-treated effluent with nitrogen concentrations of 3 mg/L or less.
- Connection of the Falmouth High School to the WWTF.

This plan also recommended sewer extensions to an area along North Davis Straits (most of this area is in the Planning Area and Little Pond watershed), portions of Scranton Avenue, and portions of the West Falmouth Harbor watershed. These sewer extensions were never implemented. Additional details on this plan are included in Appendix 2-1.

#### **2.2.3 Ashumet Plume Nitrogen Offset Program**

This watershed and nitrogen management assessment evaluated nitrogen impacts to Great, Green, and Bourne Ponds; and recommended that engineered nitrogen mitigation efforts (sewers) be focused around Perch Pond and the middle portions of the watersheds to Great, Green, and Bourne Ponds (these



areas are within the Planning Area). These recommendations never proceeded due—in part—to the need for nitrogen Total Maximum Daily Loads (TMDLs) for these water bodies.

## **2.3 Massachusetts Estuaries Project Evaluations and Resultant Nitrogen TMDL Limits**

The Massachusetts Estuaries Project (MEP) has completed technical reports for all of the estuaries in the Planning Area; and MassDEP and United States Environmental Protection Agency (USEPA) have adopted nitrogen TMDL limits on all of these except Waquoit Bay. The TMDL on this estuary is expected in the next one to two years. A detailed description of the MEP and their work on the estuaries in the Planning Area is attached in Appendix 2-2.

The main findings of the MEP reports indicate that significant quantities of nitrogen must be removed from the watersheds to restore the water-quality and habitat of these estuaries. These reports also indicate that most of the nitrogen comes from individual septic systems in the watersheds. Figure 2-1 illustrates the percentage of existing wastewater nitrogen that needs to be removed from the watershed (and sub-watersheds) to meet the TMDLs. It is noted that these percentages represent only one of the many possible nitrogen removal scenarios that could be used to meet the nitrogen concentration threshold, but it is the scenario that was suggested by the MEP and used in the TMDL. It is noted that the TMDL has not yet been completed for the Waquoit Bay and Eel Pond watersheds (expected in 2013 or 2014). In an effort to proceed with the wastewater planning for the total Planning Area, GHD used the existing wastewater nitrogen removal percentages from the adjacent Bourne Pond watershed as a planning assumption of the removals needed for these two water bodies that we reference as Waquoit West.

The wastewater removals shown on Figure 2-1 are for the “existing conditions” in the approximate time period of 2003 to 2004 as documented by the Massachusetts Estuaries Project. Additional land use growth has occurred and is expected in this area; and when the ultimate buildout is projected for this area, the needed wastewater nitrogen removals are even greater. Figure 2-2 illustrates the percentage of future wastewater nitrogen loadings that need to be removed to meet the nitrogen limits. These are very stringent limits. As part of the Section 208 planning process, it is anticipated that the CCC will take the lead in establishing a plan for the shared Waquoit Bay watershed.

These wastewater needs are a very large problem for the Town, and solutions to meet these needs will be a large expense to the Town and its residents.

These wastewater and nitrogen management needs are a primary focus of this CWMP Project as documented in the October 2007 Needs Assessment Report.

## **2.4 Previous Evaluations and Reports Completed as Part of this CWMP Project**

### **2.4.1 CWMP Plan of Study**

This report identified the expected steps (Project Scope) that the CWMP would take to identify the Recommended Plan. The Project Scope was summarized in Chapter 1 and the full Plan of Study is attached in Appendix 1-3.



#### **2.4.2 Needs Assessment Report, October 2007**

This report summarized the wastewater and nutrient-related needs of the Planning Area focusing on the following topics:

- Towns existing data and wastewater planning history.
- Evaluation of the Blacksmith Shop Road WWTF, its capacity, and performance.
- Evaluation of the existing centralized wastewater collection system.
- Wastewater and nitrogen related problems in the Planning Area.
- Evaluation of the No Action Alternative.
- Summary of Needs Assessment.

A more detailed description is provided in Appendix 2-3 and the complete Needs Assessment Report is provided in Appendix 2-4.

#### **2.4.3 Alternatives Screening Analysis Report, November 2007**

This report summarized the many possible alternative solutions that were identified and screened for use in the alternative wastewater management plans. Many alternatives were identified as detailed in Appendix 2-5. It resulted in three alternative management plans that were recommended for detailed evaluation. The full Alternatives Screening Analysis Report is contained in Appendix 2-6.

#### **2.4.4 Environmental Notification Form (ENF) Document, December 2007**

The ENF Document summarized the findings of the Needs Assessment and Alternatives Screening Analysis Reports and submitted these findings with the ENF to initiate MEPA review of the Project. The Secretary of EEA provided a Project Certificate dated January 30, 2008 with comment letters. The ENF Document is attached as Appendix 2-7.

#### **2.4.5 Draft Comprehensive Wastewater Management Plan and Draft Environmental Impact Report and Notice of Project Change (Draft Report), July 30, 2012**

The Draft Report was prepared after several years (February 2008 to July 2012) of detailed evaluations, including the preparation of a preliminary draft in December 2009 that did not go forward. The draft that was submitted for MEPA review was completed in July 2012 and submitted in September 2012, and on November 14, 2012 the EEA Secretary provided a Project Certificate and comment letters from interested Project Stakeholders. This certificate and the comment letters are attached in Appendix 1-4 with the Comment-Response Memo that describes how the comments were addressed.

The CWMP/FEIR/TWMP is the Final Report and is the revision of the Draft Report to present the detailed evaluations and the Recommended Plan as detailed in following sections and chapters of the document.

### **2.5 Regional Wastewater and Nitrogen Management Efforts that Have Influenced this CWMP**

There are many regional wastewater and nitrogen management efforts that have influenced this CWMP. The Town has worked closely with CCC, MassDEP, Cape Cod Water Protection Collaborative (CCWPC),



and the neighboring towns to coordinate their efforts. A complete list of these activities as they pertain to Falmouth is attached as Appendix 2-8.

The most recent regional activity is the CCC development of regional wastewater management guidelines for towns completing CWMPs. Due to the CCCs current effort to complete a 208 Regional Wastewater Management Plan (208 Plan), the CCC has defined a type of plan called a Targeted Watershed Management Plan (TWMP) that refers to CWMPs that focus on watersheds that are wholly contained in the Town (i.e. they are not shared or regional watersheds). The Town has met several times with CCC staff and it has been decided that the Falmouth CWMP will become a TWMP in addition to the State's definition of a CWMP.

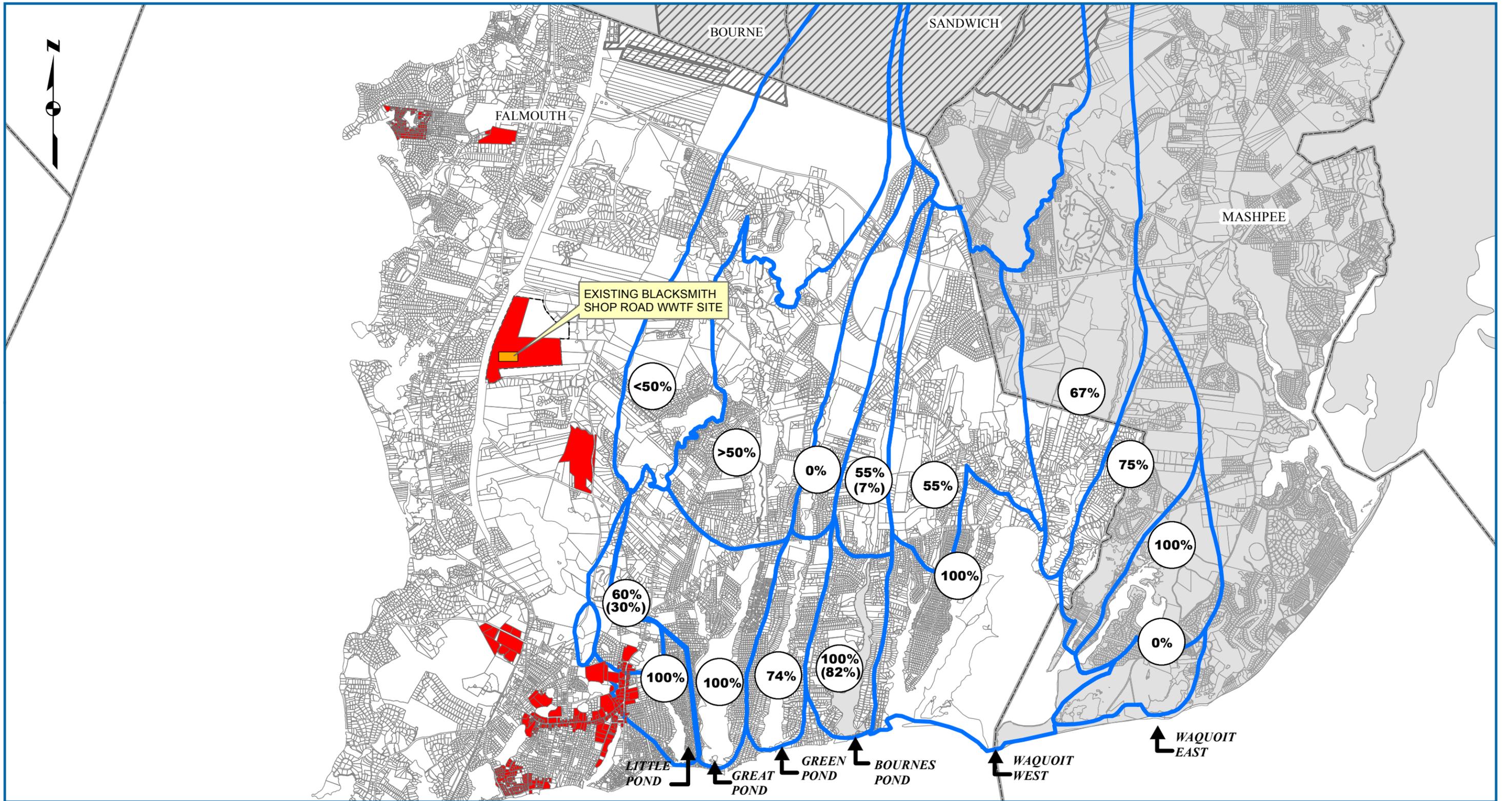
Another recent regional evaluation that developed information relative to Falmouth wastewater planning is the Appraisal Consulting Services for the Wastewater Treatment Systems at the Massachusetts Military Reservation (MMR). This evaluation was prepared by CH2MHill in December 2012 for the Massachusetts Development Finance Agency, with some funding from the Office of Economic Adjustment, Department of Defense. The wastewater treatment system at MMR is owned by the United States Air Force. The purpose of the study was to define and evaluate all possible courses of action to reduce or eliminate costs to the owner related directly to the operation and maintenance of the system. A secondary goal of the study was to identify options for operating the system that might provide regional benefits to neighboring towns, either near-term or long-term. One regional scenario completed for Falmouth was the potential recharge of treated water from the Blacksmith Shop Road WWTF site at MMRs infiltration beds on the northwest side of the MMR. The main findings are:

- Falmouth would need to construct a pumping station and force main to deliver the treated wastewater to the MMR pipeline.
- Under the current conditions, the MMR system could accommodate about 200,000 gallons per day from Falmouth.
- The estimated capital costs including contingency was \$9.55 million.

This document is available from the Massachusetts Development Finance Agency.

## **2.6 Overview of Detailed Evaluations Completed as Part of this CWMP/FEIR/TWMP**

Many detailed evaluations were completed in the six-year period between the approval of the ENF in January 2008 and the submittal of this CWMP/FEIR/TWMP in late 2013. Many were summarized in the Draft Report that was submitted for MEPA review in September 2012, and several more have been completed since then. These evaluations are categorized into groups: Non-Traditional Nitrogen and Wastewater Management Technologies and Evaluations in Chapter 3; and Wastewater Management Evaluations in Chapter 4. The Town is proceeding on a 'parallel' path to evaluate and implement both traditional and non-traditional nitrogen management technologies.



Paper Size ANSI B



Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1927  
 Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



LEGEND

- Sewered Parcel
- Sub-Watershed Boundary
- Town Boundary
- Parcel Boundary
- MMR

- 75% Existing Wastewater Nitrogen Removal Percentage Suggested by MEP
- (30%) Possible Existing Wastewater Nitrogen Removal Percentage Based on an Enlarged Pond Inlet



CLIENTS | PEOPLE | PERFORMANCE

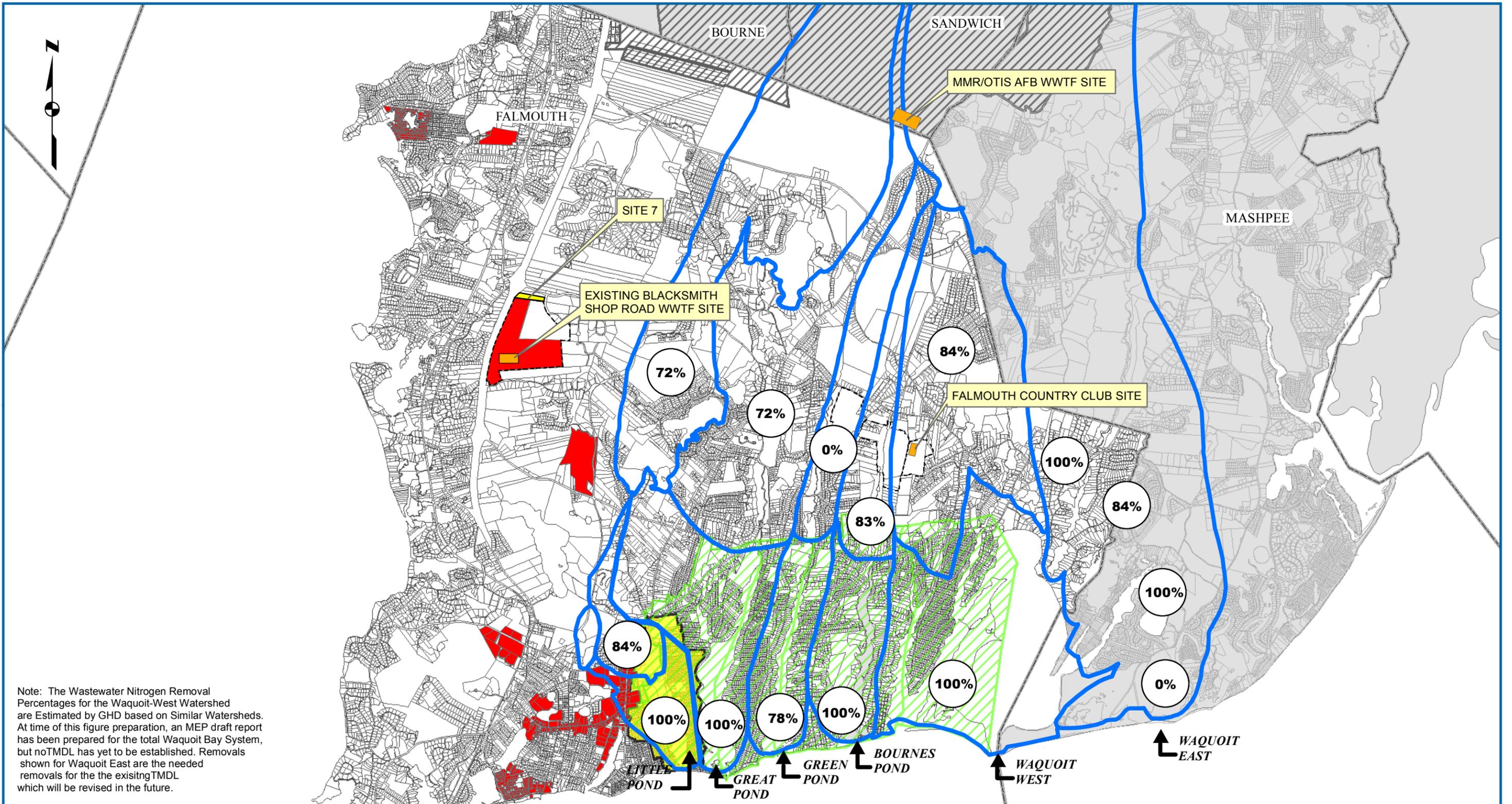
TOWN OF FALMOUTH, MASSACHUSETTS  
 CWMP

ESTIMATED EXISTING WASTEWATER  
 NITROGEN REMOVAL PERCENTAGES  
 TO MEET TMDLS

Job Number | 86-12163  
 Revision | A  
 Date | 26 Jun 2013

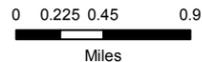
Figure 2-1

© 2011. While every care has been taken to prepare this map, GHD makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Note: The Wastewater Nitrogen Removal Percentages for the Waquoit-West Watershed are Estimated by GHD based on Similar Watersheds. At time of this figure preparation, an MEP draft report has been prepared for the total Waquoit Bay System, but noTMDL has yet to be established. Removals shown for Waquoit East are the needed removals for the existingTMDL which will be revised in the future.

Paper Size ANSI B



Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1927  
Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



**LEGEND**

- Sub-Watershed Boundary
- Town Boundary
- Parcel Boundary
- MMR

- High Priority Nitrogen Mitigation Area
- Little Pond Sewer Service Area
- Sewered Parcel

Estimated Future Wastewater Nitrogen Removal Percentage



TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

Job Number | 86-12163  
Revision | A  
Date | 26 Jun 2013

**ESTIMATED FUTURE WASTEWATER  
REMOVAL PERCENTAGES TO MEET TMDLS**

**Figure 2-2**

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### **3 Non-Traditional Nitrogen and Wastewater Management Technologies and Evaluations**

#### **3.1 Introduction**

During the six-year period of detailed evaluations, there evolved an increasing focus on non-traditional nitrogen and wastewater management technologies as a way to implement more economically viable and environmentally sustainable wastewater and nitrogen management solutions. Many of these technologies had not been used in the United States as part of a municipal-scale wastewater management plan and their feasibility was uncertain. After much Town decision-making led by the CWMP Review Committee, Article 17 (attached in Appendix 1-1) was presented and adopted at the 2011 Annual Town Meeting. Since then, the Town's WQMC has implemented this directive by initiating a group of Demonstration projects to investigate the feasibility of the following non-traditional nitrogen management technologies and processes:

- Shellfish Aquaculture Demonstration Project to harvest/mitigate excessive nitrogen in the estuaries.
- Inlet Widening of Bournes Pond.
- Eco-Toilet Demonstration Project which investigates the use of composting and urine-diverting toilets.
- Permeable Reactive Barriers (PRBs).
- Stormwater management initially to be evaluated for the Little Pond watershed.

Two other initiatives (not demonstration projects) have commenced detailed evaluations and are expected to provide additional nutrient management and include:

- Development and recent Town passage of a Comprehensive Nitrogen Control Bylaw (for fertilizer).
- Information-gathering on the feasibility and performance of individual property and clustered nitrogen removal (denitrifying) septic systems.

The eco-toilet, PRB, and on-site denitrifying septic system technologies had previously been screened from further evaluations in the 2007 Alternatives Screening Analysis Report and the ENF Document. They were formally added back into the detailed evaluations through the filing of the 2012 Draft Report that had a Notice of Project Change to evaluate these—and other—items.

Two other non-traditional technologies (management concepts) were evaluated but were not identified in Article 17 for demonstration projects and include:

- Ocean Outfall Discharge for Treated Water.
- Potential Watershed Modifications for Increased Nitrogen Attenuation.

The ocean outfall concept had been previously screened from further evaluation in the Alternatives Screening Analysis Report and the ENF Document. It was added back into the detailed evaluations through the filing of the 2012 Draft Report and Notice of Project Change.



The demonstration projects and other non-traditional nitrogen and management initiatives are proceeding. Further efforts will continue independent of this CWMP Project. Once they are determined to be feasible and cost-effective, they will be submitted as part of a Notice of Project Change for review by MEPA, and integrated into the CWMP Project for implementation. These detailed evaluations are summarized below with progress summaries and expected next steps.

The Town also identified that a key component of its successful implementation of any of these approaches (non-traditional or traditional) would be to significantly increase water conservation by retrofitting all structures within the Town (public and private) with low-flow devices.

### **3.2 Shellfish Aquaculture Demonstration Project to Harvest/Mitigate Excessive Nitrogen in the Estuaries**

Shellfish aquaculture is an established industry on Cape Cod. It employs many producers, and yields a valuable end product. Applying shellfish aquaculture to nitrogen management is a non-traditional approach for improving water quality in estuaries. Oysters have been selected for the demonstration project because they remove significant amounts of nitrogen due to their relatively fast growth over other endemic shellfish. In addition, culture techniques are well known and oysters have a high market value.

Oysters are highly efficient filter feeders, consuming the plankton which grows on dissolved nitrogen and other nutrients in the water. The plankton proliferates excessively because of the high nutrient inflows to the pond. These algae then die and decompose, releasing more nutrients such as hydrogen sulfide that causes odors and can lead—in some instances—to fish kills. In addition, the algal blooms increase the biological oxygen demand in the estuaries that can approach nearly anoxic conditions. This also stresses the fish and other aerobic organisms living in the water. By feeding, oysters manage the concentration of plankton that continues to regenerate and grow on dissolved nutrients. In this way, oysters improve water quality. It has also been shown that shellfish waste products may augment denitrification of bottom sediments, thereby releasing nitrogen in the form of nitrogen gas to the atmosphere, 78-percent of which is already nitrogen gas.

Working through the WQMC and the Department of Marine and Environmental Services, the Town has achieved a number of milestones and has launched the full-scale implementation of the demonstration project. The goal is to establish and quantify the causal relationship between shellfish cultivation and improved water quality. Accomplishments to date include:

- Viability Test Completed (summer 2012).
- Conservation Commission Notice of Intent (NOI) hearing, and Order of Conditions issued on May 10, 2013.
- Department of Marine Fisheries permit approval.
- Oyster Aquaculture Demonstration Program (Demonstration) Plan developed.
- Staff hired, and equipment and shellfish purchased.
- Seed installed in Town upweller.
- Floating nursery and grow-out bags established in Little Pond.



- Installation of first batch of oysters into Little Pond for first year of demonstration project expected by June 30, 2013 with second batch for the first year by July 31, 2013.
- Monitoring Plan formalized with MassDEP and Falmouth Conservation Commission.

By the end of the first year, the following will have been achieved:

- First batch relayed to other Falmouth estuaries for six-month depuration, further growth, and harvest by recreational and commercial shellfishers.
- Second batch prepared for and moved to overwintering site in Little Pond.

### **3.2.1 Shellfish Aquaculture Demonstration Project Description**

Implementation of the Oyster Aquaculture Demonstration Project began in the spring of 2013. The plan is to grow two batches of 1.25 million juvenile oysters each, for a total of 2.5 million. 1.25 million oysters were purchased and installed in the Town upweller on May 28. This batch will be moved to Little Pond in late June. Immediately after that, the second batch will be installed in the upweller and moved to Little Pond at the end of July. These will be grown in approximately 2,000 floating bags. The June batch will be transferred to other estuaries in Falmouth for clean-out and further growth at the end of summer. The July batch will be overwintered by submerging it in the pond for further growth in 2014. Oyster growing in 2014 and 2015 will also use the late batches of oysters overwintered from the previous year, supplemented by a single batch of early seed put in the pond at the beginning of the growing season. Thereby, two year classes will be cultured simultaneously. The floating bags will be of the same type that was used for the oyster survival test in Little and Green Ponds during the summer of 2012.

A water quality monitoring program has been established in close coordination with MassDEP and Falmouth Conservation Commission. MassDEP has indicated that three years of water quality data is needed to form the basis of a TMDL-credit for nitrogen removal that is attributable to oyster aquaculture. Appendix 3-1 contains the Scope of Services for this Monitoring Plan as well as other documents referenced in this section. In general, water samples will be taken twice monthly from June through October. This monitoring protocol includes nutrients as well as other water quality parameters<sup>1</sup> and surveys of benthic organisms. This suite of water quality factors is based on those analyzed as part of the Little Pond MEP Report. In addition, during July and August, data will be collected in 1-hour intervals using two continuous monitoring buoys. Sampling parameters include dissolved oxygen, salinity, temperature, pH and turbidity. Discharge from a storm drain near the project site will also be monitored. The purpose of this monitoring plan is to develop an estimate of the amount of nitrogen that can be removed from the water through plankton consumption and incorporation into oyster growth.

The demonstration project plans to have public information sessions from time-to-time to seek input, particularly from residents in the Little Pond area, during the set-up and production stages.

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<sup>1</sup> Total nitrogen (nitrate, nitrite, ammonia, dissolved organic nitrogen, particulate organic nitrogen), temperature, pH, chlorophyll-a, pheophytin-a, orthophosphate, salinity, dissolved oxygen, transparency (Secchi depth), benthic condition (periodical), other parameters as specified in the Quality Assurance Assessment Plan, as well as shellfish weight (periodic).



### 3.2.2 Background Research and Analysis

In the summer of 2012, a Shellfish Viability Test was conducted by the Town to demonstrate initial feasibility. A complete write-up of this milestone is in Technical Memorandum OA-TM-2. This Test included the following test methods and results:

- Three oyster bags in Little Pond.
- Three oyster bags in Green Pond.
- Use of oysters as the shellfish for the viability test.
- Seed and gear was donated to the Town by a local oyster grower.
- Work was under the direct oversight of the Town through the Shellfish Constable.
- Viability Test was done utilizing volunteers—so there is no initial cost.
- Examine/check oysters roughly weekly and measure the survival and growth rates at the end.
- Oysters from Little Pond grown as part of the viability testing were destroyed—landfilled or equivalent—as they were not for consumption or relay.
- Oysters were tested for health/disease.

While the expectation was that there will be roughly a 50-percent survival rate, the results of the viability study show much lower mortality rates (only 1 out of 1,247 individuals). This is likely due to a combination of factors: good husbandry, resilient genes, lack of predation, and low stocking densities. Subsequent disease testing of a sample of the Little Pond oysters revealed no Multinucleated Sphere Unknown (MSX) or Dermo. Part of the finding of the demonstration will be an assessment of the mortality of larger-scale oyster cultivation. Based on the success of this test, the Town hired Woods Hole Group to assist with the planning for this project. Their research and analysis can be found in Technical Memoranda 1 through 4,. These reports include:

- Stock Assessment Report.
- Technical Memorandum No. 1 (OA-TM-1): Little Pond Viability Test Review.
- Technical Memorandum No. 2 (OA-TM-2): Program Planning Estimates and Discussion of Findings.
- Technical Memorandum No. 3 (OA-TM-3): Management Plan: Project Specifications and Cost Estimate.
- Technical Memorandum No. 4 (OA-TM-4): Implementation Plan.
- Educational Brochure.

The Stock Assessment Report and Little Pond Viability Test Review (OA-TM-1) confirmed that oysters are likely to survive and grow in Little Pond.

Selecting oysters from the range of options available was based on the information provided in OA-TM-2. The following species of shellfish were considered:

- Oysters (*Crassostrea virginica*).



- Quahog Clams (*Mercenaria mercenaria*).
- Soft Shell Clams (*Mya arenaria*).
- Mussels (*Mytilus edulis*).
- Bay Scallops (*Argopecten irradians*).
- Ribbed Mussels (*Geukensia demissa*).

In addition to the nitrogen assimilation capacity, of particular importance to species selection, was the likelihood of grow-out success. Once oysters were chosen, the data on nitrogen removal and cost were carefully considered by the WQMC.

Technical Memoranda OA-TM-2 and OA-TM-3 provide information on several key variables that significantly impact the cost and nitrogen removal of shellfish, including:

- Seed starting size (2mm, 6mm, 12mm, 18mm).
- Initial number of seed (0.5M, 1.0M, 1.5M, 2.0M).
- Gear choice (floating bags or submerged cages).
- Nitrogen-removal capacity as percent of total nitrogen load.

A critical demonstration criterion is to be able to measure a change in nitrogen in the water after oyster installation and growth. The total nitrogen load for Little Pond came from the Little Pond Massachusetts Estuaries Project (MEP) Final Report (2006). In addition, a model calculation of the likely daily mass of nitrogen that would be present in the water column was developed. These values and information on the standard deviation of the data in the MEP Report for Little Pond were compared to validate that the quantity and starting size of oysters could remove a mass of nitrogen that is likely to be measurable through each growing season over the 3-year project duration. In particular, the percentage change of nitrogen over seasonal (May-October) load when the MEP studies indicated the nitrogen Sentinel Threshold would need to be achieved and daily flux were used as the basis for determining how many oysters to grow in order to be able to measure a change in nitrogen concentration. For the colder months of the year, the MEP reports indicated that dissolved nutrients in the water would be of little consequence to the health of the ecosystem since there is relatively low or negligible biological activity in the estuaries during that mostly dormant period. Tables 1, 8, 9, 12, and 13 in OA-TM-3 present the values for percent nitrogen removal for the warmer months of the year. Scenarios for intermediate seed start-size were also evaluated. The specifications and a cost estimate for the demonstration for three years included seed, gear, and labor costs organized by varying quantities of seed of different starting size. Tables 2-7 and 2-11, found in OA-TM-3 present this cost information.

The WQMC identified several issues that needed to be balanced in the final design of the demonstration, evaluating a number of different implementation scenarios to fit within the following constraints:

- Economic/budget constraints.
- Area/aesthetic constraints and competing uses of Little Pond for paddling and passive enjoyment.
- Scientific constraints—the need for measurable results over statistical variations in background nitrogen.



- Permitting requirements and compliance.

The final design came through an iterative process of discussion and analysis. Input from a broad range of stakeholder groups was also carefully considered. These groups include Division of Marine Fisheries (DMF), Department of Environmental Protection (DEP), Falmouth Department of Natural Resources (now the Department of Marine and Environment), Falmouth Conservation Commission, local community members and abutters, local shellfish growers and commercial harvesters, the town of Mashpee Shellfish Constable, and several individuals who have either interest in or experience with shellfish cultivation and nitrogen bioextraction methods. While the plan was developed with the intent that the demonstration will be managed by the town, the advantages and disadvantages of a town-sponsored versus private aquaculture grant was also assessed.

Shellfish aquaculture was not considered in the 2009 Alternatives Screening Analysis Report. It is now a key demonstration project in this CWMP. The Monitoring Plan for this Oyster Aquaculture Demonstration Project ensures careful tracking of costs and water quality improvements. If it proves to be a successful nitrogen management method, the CWMP will be modified through Adaptive Management to incorporate shellfish aquaculture more broadly in the Planning Area.

The Woods Hole Group (WHG) calculated that the oyster demonstration project's two-acre culture area, which is approximately 4.4-percent of the total Little Pond area, would assimilate 26-percent of the seasonal nitrogen load (1,250 kg) to the estuary—spring to fall. This value is based on a desktop estimate of published literature for oyster growth and nitrogen-content on Cape Cod. This value assumes that 1.25 oysters of approximately 20-mm (~.75-inch) are over-wintered and begin growing in Little Pond in May of the subsequent spring. Growth to almost 70-mm (almost 3-inches) within this growing season is further assumed. In addition, 1.25 million seed are installed in the spring and reach a size of 20-mm. These WHG calculations are being evaluated under the demonstration project. Indicative results should be available by the end of 2015.

Potentially, 4- to 5-acres of oyster aquaculture can mitigate the seasonal nitrogen load in Little Pond.

Funding for the Shellfish Aquaculture Demonstration Project came from an allocation of \$200,000 in Article 17 of the Spring 2011 Town Meeting. This amount was sufficient to conduct the viability testing, purchase the equipment and seed for the first two years, and contract for staff support of the project for two years. The cost of the monitoring for the first year is also funded out of Article 17. New funding or re-allocation of existing funds will be needed for monitoring for two years and seed for the third year of the demonstration project.

### **3.3 Inlet Widening of Bournes Pond with Considerations for Little Pond**

Inlet Widening had been evaluated for Bournes Pond and Little Pond before the passage of Article 17. This analysis indicated that widening these two inlets could provide an immediate and cost-effective improvement in water quality, and reduce the amount of sewerage required for traditional wastewater nitrogen management in this watershed. These evaluations are summarized in Appendix 3-2. In addition, a Technical Memorandum (dated March 2008) with more detailed evaluations is attached in Appendix 3-3.

Concurrently, the CCWPC (a Barnstable County organization) had been working to streamline the permitting process for non-traditional wastewater and nitrogen management concepts, with a focus on inlet widening projects. Working with the Town of Falmouth, the CCWPC hired a consultant to prepare and file an Environmental Notification Form and Waiver for the Bournes Pond Inlet Opening in a project called



the Bournes Pond Restoration and Improvement Project. The project proposed augmentation of the existing 50-foot bridge over the inlet with an additional 50-foot bridge. Little quantitative information was provided on the benefits and cost of such a project. The regulatory community raised many questions about the proposed project and the ENF was withdrawn.

After the passage of Article 17, the WQMC revisited this option and considered which inlet opening to study further. Bournes Pond was chosen based on the significant gains in tidal flushing and nitrogen removal that seemed to be likely, as well as public support from residents in the Bournes Pond area. Moreover, neighbors in the Little Pond area opposed widening of the Little Pond inlet.

In late 2012, the Town's WQMC initiated the Bournes Pond Inlet Opening Demonstration Project to evaluate this option quantitatively and to obtain greater detail on the implications of such a project. A consultant team (GHD, Applied Coastal Research and Engineering, and BETA Group) was hired to determine optimal inlet opening size, alternative bridge types to maintain the opening, capital and O&M costs of the revised opening, nitrogen management benefits, the effective nitrogen removal that would be provided by the new inlet opening, and potential cost savings of the inlet opening as compared to removing the same amount of nitrogen through conventional wastewater nitrogen management methods. The evaluations and findings are summarized in detail in Appendix 3-4 and briefly listed below:

- The optimal opening size is estimated to be approximately 90-feet as determined by hydrodynamic modeling procedures of the accepted MEP water quality model.
- Four alternative openings and bridge conceptual designs were evaluated to replace the existing 50-foot span bridge and opening, and to extend an additional 40-feet to the east. From the evaluation, a two-span bridge was selected as the most practical and cost-effective at a total capital cost of \$5,520,000.
- The accepted MEP water quality model estimated the effective nitrogen removal of the new inlet to be 1,995 kg of nitrogen per year.
- The cost to remove this same nitrogen load through conventional wastewater nitrogen removal (sewering and advanced treatment) was estimated to be from \$12,830,000 to \$19,130,000 depending on the assumptions used. This indicated a significant saving compared to the \$5,520,000 cost of the new bridge and opening. The new bridge and opening would be 43- to 29-percent of conventional wastewater nitrogen mitigation.

Based on these findings, the WQMC and Town have decided to proceed with the following next steps:

- Advance this demonstration project independently of the CWMP Project.
- Continue with permitting and design evaluations, estimated to cost \$700,000: (Town Meeting appropriated \$300,000 in spring of 2013 and a balance of \$400,000 remains in Article 17 funding from 2011 from unspent engineering and inlet widening allocations).
- Submit a Notice of Project Change for this project to have it reviewed by MEPA.
- Proceed with the many permits (local, regional, Commonwealth, and Federal) that would be needed once MEPA approval is obtained.
- Evaluate the effects/benefits of inlet opening through monitoring and implementation.



The estimated capital cost to widen Bournes Pond Inlet is \$5,520,000. The Town plans to include this project in its SRF Project Evaluation Form submittal in August 2013, and to include the construction cost in the bond issue to be authorized by Town Meeting in Spring 2014.

### **3.4 Eco-Toilet Demonstration Project: Composting and Urine-Diverting Toilets**

Eco-toilets separate human feces and urine from the wastewater system of a house or business. Once this source separation occurs, it is able to be composted on-site, or treated in a centralized facility. These human-derived components are then useable as a soil amendment that is rich in nutrients.

There are significant environmental advantages to such a system including:

- Eco-toilets divert the nitrogen that is in the feces and urine, so it does not enter groundwater. This decentralized approach replaces traditional wastewater management methods that are capital and resource intensive.
- Eco-toilets use minimal amounts of energy to operate, in most cases a 5-watt exhaust fan for venting is the only energy requirement.
- Water supply infrastructure and current plumbing paradigms first treat water to drinking water standards, then pipe it to homes where thousands of gallons per person per year are flushed down the toilet. This use of drinking water is wasteful of significant amounts of financial and energy resources. Eco-toilets replace this costly approach with technologies that do not use large amounts of drinking water to flush human excrement.
- Human feces and urine can be composted, or treated in other ways, and then used as fertilizers and soil conditioners that are rich in a wide variety of micro and macro nutrients. This conserves valuable natural resources, particularly phosphorus.

The implementation strategy for eco-toilets involves installations in individual homes, as well as commercial buildings. The 2007 Alternatives Screening Analysis Report (attached in Appendix 2-6) includes a preliminary review of these technologies in Chapter 7. These technologies were eliminated (screened) from further detailed evaluation due to the uncertainty of their performance and acceptability. Additional information on the efficacy and suitability of eco-toilets has become available, warranting their inclusion in the CWMP process. The Notice of Project Change in Chapter 9 of the Draft Report re-introduced eco-toilets to this CWMP Project.

To deploy eco-toilets as a nitrogen-reduction solution, the actual nitrogen removal rates must be determined by sampling. Nitrogen derived from households comes from both human excrement and urine, as well as from showers, sinks, dishwashers, and laundry water. To assess the use of eco-toilets as a non-traditional wastewater management strategy, Falmouth has launched the Eco-Toilet Incentive Program. A key objective of this demonstration is to measure the actual amount of nitrogen that remains in a household waste stream both before and after urine and feces have been removed. There are also a number of questions regarding the cost and feasibility of installing eco-toilet system in existing structures (retrofits), long-term systems operation and maintenance, and overall public acceptance of eco-toilets. Before eco-toilets can become a long-term nitrogen mitigation strategy, these questions must be answered.

This demonstration should assist the town to systematically develop answers to these questions, so that costs and nonmonetary factors can be compared with other traditional and non-traditional methods. The



WQMC, working through its Eco-toilet Subcommittee developed a Memorandum of Agreement with the Barnstable County Department of Health and Environment (BCDHE) to perform sampling and monitoring (see Appendix 3-5) and hired Science Wares, Inc. to design, implement, and manage the demonstration. Details and milestones of the Eco-Toilet Demonstration Program are described in the following sections.

#### **3.4.1 Eco-Toilet Incentive Program Description, Goals, and Objectives**

Falmouth's Eco-Toilet Incentive Program will establish how much nitrogen eco-toilets remove from the human waste stream, in order to determine how useful these fixtures will be in TMDL-compliance. A key, long-term objective of the demonstration is to work closely with regulatory agencies to determine the nitrogen removal credit of eco-toilets. MassDEP has provisionally suggested that a total of 62 installations will need to be tested in order to quantify eco-toilets' nitrogen removal credits for regulatory purposes. Based on the results of this first group of installations, further refinement of this number may be possible. Further, these installations will document the technical details of these fixtures, both in terms of installation as well as operation and maintenance. This demonstration will also verify the installation costs and user-experience with eco-toilets. The cost and practicality of retrofitting existing structures with eco-toilets is critical to an evaluation of whether these toilets are a viable alternative to more traditional wastewater management techniques. This demonstration is endorsed by the Cape Cod Commission, and the results of this research will be used to quantify the effectiveness of these toilets in their planning tool entitled "Regional Wastewater Planning Matrix".

Numerous installations of eco-toilets in Europe/Scandinavia and Australia have been documented. Falmouth's demonstration may be unique in that it will include specific measurements and analysis of nitrogen-removal. In addition, participation is completely voluntary. In many international programs, the end-user was not the person responsible for deciding to install an eco-toilet. Finally, the bulk of Falmouth's installations are as retrofits to existing buildings. This allows the Town to assess the particular issues involved with installing eco-toilet in a preexisting stock of homes and businesses.

This demonstration differs from most others in that it includes many different types of eco-toilets from many manufacturers. Most other pilot and demonstration programs test either composting or urine-diverting toilets but not both, and often use only toilets from a single manufacturer. This demonstration was designed to determine the nitrogen removal characteristics of a diverse range of eco-toilets, and to enable the installation of different toilets to fit different retrofit situations. As a result, at the end of the testing period, the Town will have documentation on a wide spectrum of circumstances and challenges encountered when installing and using eco-toilets.

#### **3.4.2 Eco-Toilet Incentive Program Funding**

On July 16th, 2012, the Falmouth Board of Selectmen approved \$80,000 for Group I of the Eco-Toilet Incentive Program. This demonstration envisions incentive payments of up to \$5,000 for a home or business in Falmouth that participates as well as a septic system pump-out valued at approximately \$300. This payment comes after all permitting has occurred, and the full cost of installation has been paid by the property owner. The WQMC expects approximately 16 participants in this first effort to quantify the cost, feasibility, and actual nitrogen removal capacity of both composting and urine-diverting toilet technologies. Participants must install eco-toilets in all of their bathrooms, and agree to a year-long testing program through the BCDHE. Participants must also agree to several requirements that are outlined in the Eco-Toilet Incentive Program application forms (Appendix 3-5). Going forward, the WQMC expects to request



a release of additional funds by the Board of Selectmen to enable incentive payments to additional participants in the demonstration.

### **3.4.3 Public Outreach/Enrollment**

A significant public education campaign was launched to inform the community about the potential benefits of eco-toilets. Part of this effort began as part of the campaign to promote passage of funding for the demonstration of alternatives at the Spring 2011 Town Meeting. With the passage of Article 17, the WQMC was formed and included representatives of the community group interested in promoting this option. The following lists the broad approach taken to public education:

- Workshops.
- Flyer in the Water Bill.
- Attendance at community events (2012 concert, Falmouth Farmers Market).
- Public Meetings.
- Eco-Toilet Conference sponsored by the WQMC, Waquoit Bay National Estuarine Research Reserve, The Green Center, and the Cape Cod Commission.
- Ongoing press coverage.

An initial list of interested citizens came out of early meetings and discussions. Additional public outreach broadened this list to over 150 residents. All were contacted to discuss the opportunity to install eco-toilets in their home and be a part of the demonstration. Over 40 residents were interested enough to schedule a site visit. During this site visit, a detailed analysis of the feasible eco-toilet options was completed. Pricing for the possible options was also provided.

A critical component to the success of the demonstration's enrollment is the contribution made by the Cape Cod Eco-Toilet Center in Falmouth. This facility houses almost all of the models being considered by potential participants. In the same way that homeowners visit design showrooms to help select bathroom fixtures for conventional remodeling projects, the Eco-Toilet Center enables a potential participant to see eco-toilets in real life. In addition, the Center offers tours and informational sessions weekly. Every participant in Group I of Falmouth's Eco-Toilet Incentive Program visited the Center prior to making the final decision to proceed with an installation.

### **3.4.4 Implementation: Permitting and Other Issues**

In most cases, installing composting and urine diverting toilets in existing homes requires modifications to existing plumbing and venting. Building permits must be granted for these changes, and plumbing work must be code-compliant and be done by a licensed plumber. Any plumbing fixture installed in Massachusetts must have a Product Acceptance number. Several composting toilets have this approval.

However, urine-diverting fixtures, source separators (Aquatron), and other pilot-stage urine-diverting toilet technologies do not currently have a Product Acceptance number from the State Board of Plumbers and Gas Fitters, and are therefore illegal to install in the state. This was identified as a significant barrier to implementation. Science Wares worked with the local plumbing inspector, State plumbing board, and BCDHE to obtain a variance for Test Site Status for up to 40 test sites to enable urine-diverting fixtures to be installed. This was granted at a regular meeting of the State Board of Plumbers and Gas Fitters on March 27th, 2013 and paved the way for significantly more installations than would have been feasible



with composting toilets alone. The State approval for an entire class of eco-toilets overcame a significant obstacle.

Another obstacle to the implementation of the Eco-Toilet Incentive Program has been overcome. At the inception of the demonstration, there were no local installers with expertise in all permitted composting systems and no local plumbers were familiar with urine-diverting fixtures. Each manufacturer of composting systems has a different sales model. Two use direct sales to end users through hardware stores and large distributors of building supplies. However, local stores did not already carry these eco-toilets. A different manufacturer has an online form, where a property owner can fill in baseline information and receive a materials quote electronically. The lack of a local presence, and the focus on the “do-it-yourself” market was not a good fit for the property owners interested in participating in the demonstration. Only one manufacturer has a regional sales representative who is able to conduct site visits. This representative was not in a position to give advice on all the possible eco-toilet configurations.

As part of the implementation of the demonstration, regular contact with manufacturers of composting toilets with Product Acceptance is maintained to encourage a local presence. A local hardware store now carries the products of one manufacturer and has the units displayed in the window of their Main Street location. Other manufacturers now communicate directly with potential participants, pricing out their products. Education of local plumbers about urine-diverting fixtures continues.

Selecting the best eco-toilet system is an iterative process involving the physical constraints of the built environment as well as cost considerations. A site visit from someone capable of making these kinds of assessments is a critical component for many people, providing unbiased information on the full-range of eco-toilet configurations. Growing the eco-toilet industry on Cape Cod is the ultimate goal. Until that industry has robust representation, the demonstration will continue to provide property owners with information on all systems that have Product Acceptance or Test Site Status.

**3.4.5 Eco-Toilet Incentive Program Statistics as of June 30, 2013**

Number of people contacted: .....	152
Number of people with site visits: .....	44
Number of people who have agreed to participate:.....	21
Installations permitted through Board of Health:.....	4
Permits completed but not submitted: .....	1
Participants working through final details of installation: .....	11
Participants who are beginning to work through installation details:....	5
Number of people who have asked to be contacted later—timing is not good now, but is expected to be better at a later time: .....	10
Number of near-installations (waiting for final plumbing inspection): .....	3
Number of pre-installation sites sampled (BCDHE): .....	3
Types of installations/eco-toilets chosen:	
Full range, including central composters, self-contained units, urine-diverting fixtures	



### 3.4.6 Next Steps

- Continue to work with Group I participants to specify and permit installations.
- Begin post-installation sampling (BCDHE).
- Process incentive payments.
- Analyze installation cost data as it becomes available as part of the incentive payment applications.
- Review sampling data as it becomes available, discuss with regulatory agencies.
- Assess installations.
- Evaluate the need for additional installations and incentive authorization (beyond first \$80,000).
- Continue to develop a database of potential participants.
- Work with other communities to include their installations in the database.
- Begin planning for residuals collection, processing, and end-use marketing.
- Coordinate with others involved in testing the attenuation of Contaminants of Emerging Concern (CEC) in eco-toilets.

### 3.4.7 Technology Overview

This section describes the range of eco-toilets that are part of Falmouth's Eco-Toilet Incentive Program. Eco-toilets are to be installed only in a household or small business with a standard septic system.

Installation, operation, and maintenance manuals for each of the eco-toilets described below are in Appendix 3-5. These manuals provide details from each manufacturer on their products.

The energy use of the fans and heaters associated with each individual composting eco-toilet ranges from 120 to 540 watt-hours per day, or between 44 and 197 kilowatt-hours per year. Urine-diverting fixtures that discharge into a holding tank do not have any fans/heaters associated with them at present. However, the energy used to transport the stored urine should be considered. This will vary by distance. Product information, as well as the energy associated with different reuse end-points for the urine will be verified during the demonstration. This information will also be used as part of the comparative energy analysis for each wastewater treatment solution. Composting and urine diverting systems may be combined, and remote composting systems may be combined with stand-alone composting toilets.

#### 3.4.7.1 Self-Contained Toilets

Self-contained toilets are not connected to household plumbing. These fixtures are easy to install, and are particularly useful in places where it is not feasible to connect the existing toilet to a central composting system. Such toilets are often found in basements, or where there is no space available for a central composting unit.

The following units have obtained Product Acceptance from the Massachusetts State Board of Plumbers and Gas Fitters and are approved alternative systems under 248 CMR 10.10:

- Envirolet/Santerra Green: A stand-alone composting toilet in which urine and feces are composted in the same built-in rotary composting unit. Compost is emptied by hand, typically at



intervals of four to six months, depending on use. Various models are available. For more information, see [www.envirolet.com](http://www.envirolet.com) and Appendix 3-5.

All Envirolet 120VAC electric models use a maximum of 540 watt-hours per day.

120VAC models have two 20W fans and one 500W heater. According to the manufacturer, the fans should be operated all of the time when the system is in use. For optimum performance, the fans should also be running when the unit is not in use for up to two weeks. When the system is in “Fans Only” mode, the power consumption is 40W (two fans x 20W each). The 500W heater should be run when the system is in use, or a Drain Kit must be installed. The heater is thermostatically controlled to operate approximately 25- to 30-percent of the time. Therefore, run-time is approximately six hours a day.

- Sun Mar self-contained unit: A stand-alone composting toilet in which urine and feces are composted in the same built-in rotary composting unit (biochamber). Compost is emptied by hand, typically at intervals of four to six months, depending on use. Various models are available. For more information, see [www.sun-mar.com](http://www.sun-mar.com) and Appendix 3-5. 125 watts/day (includes fan and heater, and assumes 50-percent operation)
- BioLet: A stand-alone composting toilet in which urine and feces are composted in the same built-in rotary composting unit. Compost is emptied by hand at intervals. Various models are available. For more information, see [www.biolet.com](http://www.biolet.com), and Appendix 3-5.

The following units have Test Site Status from the Massachusetts State Board of Plumbers and Gas Fitters for the demonstration. Up to 40 test sites have been authorized.

- Separett: A stand-alone urine diverting toilet normally set up for hand disposal of both urine and feces that must/will be composted outside the home. The urine chamber of the Separett may also be connected to a large urine tank. For more information, see [www.separett.com](http://www.separett.com), and Appendix 3-5.

The following unit can be used in conjunction with a composting system that has Product Acceptance.

- Pacto Toilet: Urine and feces collected together in a sealed plastic sack that can be taken out of the toilet periodically and taken to a composting facility. Requires no electricity or bulking agent. For more information, see [www.pacto.se](http://www.pacto.se), and Appendix 3-5.

#### **3.4.7.2 Composting Toilet Systems with Remote Composting Bin(s)**

Composting Toilet Systems with Remote Composting Bin(s) may consist of a central composting unit with either a single chamber, or a series of chambers filled consecutively. Multiple interchangeable composting units are also available. Composting systems can typically accommodate one or more toilet fixtures. Several different types of toilet fixture may be used. Waterless (dry) composting toilet fixtures as well as waterless (dry) urine-diverting fixtures are typically used when a bathroom toilet can be located directly above, or nearly above the composting unit. Human waste is moved by gravity through a 10- to 14-inch diameter pipe, from the toilet fixture into the composting unit. Foam flush, micro flush, and vacuum flush toilet fixtures can be used in locations that are not directly above the central composting unit. Some composting toilet systems require connection to a water supply.



The following units have obtained Product Acceptance from the Massachusetts State Board of Plumbers and Gas Fitters and are approved alternative systems under 248 CMR 10.10:

- **Advanced Composting Systems (ACS)/Phoenix:** Up to four toilets may be connected to a single composting container. Several types of toilet may be connected to the central composting container. Normally the toilet fixture will be a single chamber type with a wide opening through which both urine and feces are transferred to the composting container and processed into compost. A urine diverting dry toilet may also be used with a separate connection to a large urine storage tank. In difficult situations where a toilet is too far away from the composting container, a foam flush toilet may be used. A dedicated vent stack must be installed. For more information see [www.compostingtoilet.com](http://www.compostingtoilet.com) and Appendix 3-5. The system requires a 5-watt fan that runs 24 hours/day = 120 watt-hours per day.
- **Clivus Multrim:** The manufacturer recommends that only single chamber toilets that transfer both urine and feces to the central processing unit be used. Clivus Multrim markets its own foam-flush toilet (Neptune) for situations where the toilet is too far away from the composting chamber for gravity discharge to the compost bin. A dedicated vent stack must be installed. For more information see [www.clivusmultrim.com](http://www.clivusmultrim.com) and Appendix 3-5. The system requires a 5-watt fan that runs 24 hours/day = 120 watt-hours per day.
- **Envirolet/Santerra Green Central Units:** Both direct-discharge dry toilets, as well as vacuum flush units are available. Several toilets may be connected to a single composting container. A high capacity double tank is also available. FlushSmart™ VF™ is a vacuum flush and composting toilet system combination that is recommended for installations on rock or with little or no room below, basements, garages, workshops, pool cabanas, yurts, and applications where a smaller toilet is needed or desired. A dedicated vent stack must be installed. For more information, see [www.envirolet.com](http://www.envirolet.com) and Appendix 3-5. Central models use a maximum of 540W per day. A detailed description is provided in the technical description of the self-contained unit.
- **Sun Mar Central Units:** Several dry toilets may be connected to a single composting container. For locations where a direct gravity feed is not feasible, the manufacturer recommends use of a Sealand 510 or 511 marine toilets. This is an ultra-low flush toilet that may be installed either directly above or up to 15-feet away from the central composting unit. A dedicated vent stack must be installed. For more information, see [www.sun-mar.com](http://www.sun-mar.com) and Appendix 3-5. 125 watts/day (includes fan and heater, and assumes 50-percent operation).
- **Eco-Tech Carousel:** Several types of composting toilets, including urine diverting dry toilets and foam flush toilets, may be connected to this set of bins in a rotating chamber. The urine diverting toilet will require connection to a large urine tank and the foam flush toilet must be connected to the household water line. There are two sizes of rotating chamber and each rotating chamber has four separate bins, only one of which is in use at a time. For more information, see [www.ecological-engineering.com/carousel.html](http://www.ecological-engineering.com/carousel.html) and Appendix 3-5. This system requires a 5-watt fan that runs 24 hours/day = 120 watt-hours per day.

The following unit has Test Site Status from the Massachusetts State Board of Plumbers and Gas Fitters for the demonstration. Up to 40 test sites have been authorized.



- Full Circle: A 55 gallon wheelie bin is connected to a single dry composting fixture with urine-diversion. The bin collects feces for composting, with a separate storage container for urine. Each bin serves only one toilet. A dedicated vent stack must be installed for each bin. For more information, see [www.fullcirclecompost.org](http://www.fullcirclecompost.org) and Appendix 3-5.

### 3.4.7.3 Summary of the Toilet Fixtures used with Composting Systems

Worldwide, many toilet fixtures are being produced for use with composting systems. Manufacturers specify which toilet fixtures are compatible with their composting systems.

Dry composting toilets (with and without urine-diversion) are installed as part of a composting system. See manufacturer's recommendations for dry composting fixtures that are compatible.

Ultra-low Flush Composting Toilets: The Sealand 510 and 511 models are the only examples mentioned, and they are recommended for use on Sun Mar central units where toilets must be offset from the central unit.

Foam Flush Toilets: These function and look much like conventional toilets. Using a mix of biocompostable soap and water, the foam-flush moves waste through a 4-inch pipe to a composting tank below. The foam mixture cleans the toilet bowl with every flush but uses only about three ounces of water, making it fully compatible with the composting process. Since the foam flush is using water to carry the waste, toilets can be offset by up to 45-degrees from the composting bin. This facilitates installations where there is not space for a composting bin directly under a current fixture. These toilets are connected to a home's water supply.

Vacuum Flush Toilets: The flushing action on these fixtures opens a valve in the toilet, enabling the contents of the toilet to be sucked with pressure, instead of gravity alone. There are a number of different types of vacuum toilets, ranging from toilets connected to vacuum sewer systems to toilets with a vacuum assist, which creates pressure to help flush the contents of a toilet with minimal water usage. Vacuum toilets are common on airplanes and are also used on boats and in personal homes. Because the vacuum involved can exert a substantial force, a vacuum toilet requires little to no water. Some use sanitizing liquids instead of water to keep the toilet relatively clean. Vacuum toilets are often very low-odor.

### 3.4.7.4 Urine-Diverting Flush Toilet Systems

Urine-diverting (UD) flush toilet systems connect to the household water and wastewater systems. Each toilet bowl has two chambers, one for feces and toilet paper and the other for urine. The urine chamber is connected to a large urine tank, the larger chamber to the household wastewater line. The following units have Test Site Status from the Massachusetts State Board of Plumbers and Gas Fitters for the demonstration. Up to 40 test sites have been authorized. The urine-diverting tanks are typically installed outside the home, and must be DEP-approved septic tanks with provision for pump-out and sealed against air intrusion. The entire UD system must be installed by a licensed plumber to ensure there is proper venting and traps. A key concern is to avoid blockages and odors from the urine line.

- Dubbletten "double flush" toilet: The urine and feces/toilet paper chambers flush separately, the urine chamber with very little water. The user need not flush the urine chamber after every use. To save water, it is recommended that paper used after urinating is disposed of in a separate receptacle near the toilet, and not flushed. For more information, see [www.dubbletten.nu](http://www.dubbletten.nu) and Appendix 3-5.



- Wostman Eco-Flush toilet: The urine and feces/toilet paper chambers flush separately, the urine chamber with very little water. The user need not flush the urine chamber after every use. To save water, it is recommended that paper used after urinating is disposed of in a separate receptacle near the toilet, and not flushed. For more information, see <http://wostman.se/en/> and Appendix 3-5.
- Aquatron Centrifuge composting system: Wastewater from the feces/toilet paper chamber of one or more urine diverting toilets passes through a gravity-driven centrifuge that separates solid matter from wastewater going to the septic system. Solid matter drops out into a composting container. The Aquatron centrifuge may be used with any flush toilet, but for our demonstration it will be used with urine diverting flush toilets such as the Dubbletten or Wostmann toilets. For more information, see [www.aquatron.se/index-2.php](http://www.aquatron.se/index-2.php) and Appendix 3-5.

Waterless (or very low flush urinals): There are many models that may be used in conjunction with UD toilets in any UD system. Any fixture that has Product Acceptance may be installed as part of the demonstration.

#### **3.4.7.5 Urine Tanks Used with Urine-Diverting Toilets and Waterless or Ultra-Low Water Urinals**

Any MassDEP-approved septic tank may be installed as part of the demonstration to hold urine. Tanks with a 500-gallon capacity are being used in the demonstration.

#### **3.4.8 Site Installation Review/Checklist (to be completed for each installation)**

The following information will be developed for each installation and is expected to be formatted in a checklist.

Pre-installation Information:

- Number/type/location of each toilet (floor plan)
- Type and size of septic system drain-field
- Type of home/lot size
- Number of occupants and days per year of occupancy
- Average nitrogen in septic tank effluent pre-installation of eco-toilet(s)

Purchasing details:

- Manufacturer/Make/Model
- Major additional components
- Local vendor
- Materials costs (delivered prices)

Current permitting status:

- Product Acceptance versus Variance/Test Site Status
- Falmouth BOH and local issues



Installation/Engineering Details:

- Space required
- Piping and venting
- Electrical connections
- Handling of excess liquid
- Installation cost
- Noteworthy complications

Installation/Engineering details for urine collection and storage system (if applicable):

- Space required
- Piping and venting
- Electrical connections
- Handling of excess liquid
- Cost (materials and labor)
- Noteworthy complications

Records of use, cleaning, maintenance and repair, and emptying residuals:

- Use
- Cleaning
- Maintenance and repair
- Removal of residuals
- Handling of urine
- Noteworthy issues and complications that have emerged from pilot study

Sustainability:

- Energy use
- Reduction in water use
- Nutrient capture
- Resistance to flooding

Effects on the operation of other elements of the waste system:

- Compatibility with grey water treatment systems
- Compatibility with residuals collection systems
- Life and health of septic system
- Other documentation elements



- Any special requirements
- Total cost summary

As with the other demonstration projects, if this method of wastewater management proves feasible and acceptable in the future and is less expensive, the CWMP will be modified through Adaptive Management to proceed with its large-scale implementation. To date \$190,000 has been committed to the first phase of this demonstration project. A balance of \$310,000 remains in Article 17 for additional phases.

### **3.5 Permeable Reactive Barriers**

#### **3.5.1 Overview of Permeable Reactive Barriers**

Permeable Reactive Barriers (PRB) were described in Chapter 9 of the 2007 Alternatives Screening Analysis Report (attached in Appendix 2-6). At that time they were called Nitrate Barrier Walls and were identified as a possible method to treat the nitrogen in groundwater before it recharges to the marine waters. That nitrogen could be from any number of sources: septic systems, fertilizers, stormwater, atmospheric deposition, etc.

The concept involved the construction of a “permeable wall” of reactive material that would allow the groundwater to flow through but would react with the nitrate in the groundwater and convert it to nitrogen gas. In 2007, the technology was experimental and the reactive material was a patented media called NITREX™. This material would reduce the dissolved oxygen in the groundwater and supply organic carbon to a level at which biological denitrification could occur. The barrier would need to be deep enough to prevent any nitrogen-laden groundwater from flowing under the wall. If the technology were used alone to help an estuary meet its TMDL, the barrier would need to be constructed the full length of the peninsulas bordering the estuary.

In 2007, the technology was being studied by a group of scientists led by Dr. Joseph Vallino and Dr. Kenneth Foreman of the Marine Biological Laboratory. Two pilot studies in the Waquoit watershed were under way: a 50-foot barrier on a beach, and a shorter barrier on a private lot bordering the estuary. Several issues had emerged:

1. Effects of salt water flooding of the NITREX™ media during storms due to proximity to the marine water.
2. Feasibility of installing the wall deep enough to prevent nitrogen-laden groundwater from flowing under the wall.
3. A need for full understanding of the nitrogen removal mechanism occurring in the barrier.
4. A need for long-term monitoring both upstream and downstream of the barrier to measure results.
5. Permitting issues because of the proximity to lands subject to the Wetlands Protection Act.
6. Problems of access to private property for either installation or monitoring.

The assessment in the Alternatives Screening Analysis Report was that this method was not ready for full-scale application due to technical issues and regulatory feasibility, and it was screened out. In 2010, the CWMP Review Committee re-examined the technical and regulatory issues, and the current monitoring data showing continued success in removing nitrate from the groundwater. The Committee noted that the patent on the reactive media had expired, that carbon sources such as woodchips could be tried, and that a demonstration project could be designed to address the issues that had been raised. The Board of Selectmen adopted this recommendation and PRB's were added back into the mix of possible



technologies described in the Draft Report and Notice of Project Change. Town Meeting agreed in April 2011 to fund a possible demonstration project by passing Article 17, a bond issue, and the voters agreed.

### **3.5.2 Current Status of PRB Demonstration Project**

In 2012, the WQMC, working through its PRB subcommittee, developed a request for proposals to hire an engineering firm to assist in the development of the PRB demonstration project. The scope of work included:

1. Research existing PRB knowledge base.
2. Identify anticipated permitting requirements related to the use of PRBs as a long-term municipal wastewater solution.
3. Identify potential impact to the environment down-gradient of a PRB.
4. Evaluate sub-watershed areas for a PRB in the selected estuarine watersheds [West Falmouth Harbor Watershed, and all the watersheds in the High Priority Nitrogen Management Area].
5. Identify up to two dozen potential PRB locations in the sub-areas.
6. Define permitting requirements and other neighborhood factors for each selected sub-area.
7. Screen down to five locations for consideration for a full demonstration, one in West Falmouth and the remaining four in the East Falmouth coastal area; prepare a preliminary design and cost estimate for each.
8. Recommend two sites for PRB demonstration projects, one in West Falmouth and one in East Falmouth.

In 2013 the Request for Proposals was issued, and CDM Smith was awarded the contract. Technical Memoranda Nos. 1 and 5a can be found in Appendix 3-6. As of June 30, 2013, the contractor has screened down to one location in West Falmouth called Site 5, and two promising locations in East Falmouth.

CDM Smith has been authorized to proceed with preliminary design for a PRB demonstration installation at Site 5 in West Falmouth and Site 4b in Seacoast Shores. Site 4b was the High Priority Mitigation Area because groundwater data was already available from the Cape Cod Commission, and the USGS is currently gathering more data in the area.

Engineering for the preliminary design of the PRB Demonstration Project cost \$185,000. A balance of \$65,000 remains in Article 17 allocated to PRBs. The estimated capital cost to construct one or two PRBs should be known by the end of 2013. This cost could be included in the bond issue planned for the Spring 2014 Town Meeting.

### **3.6 Stormwater Management for the Little Pond Watershed**

The stormwater nitrogen loadings to the South Coast are summarized below:



**Table 3-1 Summary of Stormwater Nitrogen Loadings to the Planning Area Watershed**

<b>Estuary</b>	<b>Nitrogen Loading (kg/yr)</b>
Little Pond	500
Great Pond	2,300
Green Pond	700
Bournes Pond	500
Waquoit West	3,300
Waquoit East	2,900

Reference: Data from Table 1 of March 5, 2008 Technical Memorandum by Stearns & Wheeler as attached in Appendix 3-7.

The nitrogen loading associated with road and roof runoff is based on the following factors summarized in the MEP Technical Reports:

- Stormwater flow and recharge from impervious surfaces is developed based on a recharge rate of 40-inches per year.
- Nitrogen loads to the groundwater system from stormwater are based on the following concentrations:
  - 1.5 mg/L for road runoff
  - 0.75 mg/L for roof runoff

A summary of all the nitrogen loadings to the watersheds is attached in Appendix 3-7 with figures illustrating the percent contributed from the various sources. The figures show that stormwater runoff contributes 5- to 9-percent of the controllable nitrogen sources entering the Little, Great, Green, and Bournes Ponds watersheds. The stormwater loading factors and loading values may be considered high based on the following:

- The loading values assume that all of the nitrogen in the runoff is transported to the groundwater system.
- No nitrogen removal (attenuation) credit is given for nitrogen uptake by vegetated areas.
- No nitrogen removal credit is given for nitrogen attenuation by stormwater leaching systems.

It is also noted that there is no practical way to monitor if the stormwater nitrogen loads calculated by MEP are really occurring, and there will be no way to monitor if there are quantified improvements with future stormwater management procedures. As a result, there may not be the ability to quantitatively utilize stormwater management to meet a nitrogen TMDL. Even with the above stated problem of quantitatively managing stormwater nitrogen loading, the Town is taking steps to improve stormwater controls for nitrogen management.

### **3.6.1 Summary of Previous Evaluations of Current Stormwater Surface Discharges**

In the past, the main focus of stormwater management was to eliminate direct discharges to surface waters in order to reduce sediment and fecal coliform loading to the surface waters. A draft final report



was developed in October 1995 by Muramoto and Polloni Wetland Studies titled “Inventory of Falmouth’s Wetlands Damaged by Direct Road Runoff conducted for the Town of Falmouth.” This report identified 117 potential direct discharge sites and prioritized 20 sites based on discussions with Town personnel and remediation feasibility (see Appendix 3-7). In addition to this study, the Town Department of Public Works (DPW) through the Town Engineering Department maintains an “Inventory of Direct Stormwater Discharges” through its Coastal Drainage Program which tracks dates of completion as they occur (see Appendix 3-7). The DPW also maintains the DPW Drainage List which tracks where improvements to the drainage collection systems are necessary and when they are made (see Appendix 3-7). The Town also holds a National Pollutant Discharge Evaluation System (NPDES) Phase II Stormwater General Permit which is designed to prevent harmful pollutants from entering local water bodies.

Falmouth’s Engineering Department is responsible for implementing the Phase II requirements for the Town’s NPDES permit and has been moving forward with compliance. The Engineering Division maintains an active list of drainage concerns for this permit. Each site is evaluated for repair, including best management practices (BMP’s), water quality, and accessibility for maintenance. Work is ongoing to correct the stormwater issues. A copy of a recent annual report for this permit is attached in Appendix 3-7, and actions related to Little Pond are summarized below.

### **3.6.2 Little Pond Stormwater Control**

Several key aspects of the NPDES compliance program that relate directly to Little Pond watershed include:

- Development of an all-inclusive Public Works Stormwater Regulation including NPDES compliance requirements. This regulation was developed by the Engineering Department and is currently under review by the Board of Selectmen, with adoption expected in FY2014.
- Updating the outfall maps Town-wide and the Little Pond watershed in particular. Information on structures, connections between structures, and stormwater contribution areas are being collected and mapped. Field inspections include identifying any illicit discharges such as basement sump pumps draining to catch basins. The current focus is identifying outfalls and roadway runoff areas that impact Little Pond directly.
- Ongoing Public Education campaign for the Town, including the Little Pond watershed. The following outreach tasks have been accomplished by working with an Americorps Cape Cod employee:
  - Initiate a storm drain marker installation program within the Lower Little Pond watershed. Storm drain markers stating “NO DUMPING, DRAINS TO WATERWAY” have been installed.
  - Develop and initiate a storm drain stenciling program in the Lower Little Pond watershed, where there are no curbs to install the storm drain markers.
  - Design, print, and distribute door hangers aimed at public education to reduce fertilizer use, car washing, pet waste, and littering.
  - Develop a “Homeowner Stormwater Education Kit” containing information on composting, stormwater education, and homeowner tips. The kit will be distributed in the summer of 2013 to sites within the Lower Little Pond watershed.
  - Ongoing evaluation, review, and update of the current Public Outreach and Participation Program.



- The Town Driveway Permit forms have been modified to include NPDES stormwater requirements. Modifications include:
  - Statement “No driveway shall be constructed directing stormwater onto roadways.”
  - Bonding of permits ensuring all site work is constructed according to the driveway permit and attachments.
- A Stormwater Committee (Selectmen/DPW) has been formed. Monthly meetings are held regarding improvement of all coastal ponds and reduction in nitrogen. Several community groups are moving forward with seeking Town funding and grants to improve the salt and fresh waters of Falmouth.
- Street cleaning is performed in the spring after snow removal operations, and in the fall after the hurricane and storm season. Main arteries are swept on a weekly basis. A catch basin cleaning truck and crew has been dedicated to full time basin cleaning from April to October. The Town no longer applies sand/salt mixtures to the roadways during the winter season. The roads are pretreated with a salt brine mixture that is applied prior to inclement weather. Street sweeping and catch basin sediment removal amounts are tracked in an asset management program.

Preliminary evaluations have begun to determine appropriate BMPs for the Little Pond watershed, such as bio-retention. This evaluation process is being informed by EPA’s Green Infrastructure objectives and other current research results such as University of New Hampshire Stormwater Center (UNHSC) project to optimize nitrogen removal from stormwater treatment systems. The Town, through its Engineering Department, other appropriate departments and boards, as well as technical consultants, will pursue feasible BMP solutions as part of the sewer construction for this watershed. This analysis will include:

- Summarize findings of previous studies, reports, and information related to the NPDES Phase II requirements.
- Coordinate with the Engineering Department and USEPA to gain USEPA support in remediation efforts.
- Define New Stormwater Management Project for Little Pond including:
  - Identify additional needed structural controls including location and expected effectiveness.
  - Identify new non-structural controls such as by-laws, ordinances, etc., and coordination with local stakeholders to gain support.
  - Evaluate advantages and disadvantages of these controls with respect to Little Pond.
  - Estimate expected nitrogen reduction.
  - Develop conceptual designs for each with capital and O&M costs.
  - Define an implementation plan for each.
  - Coordinate with stakeholders to gain support.
  - Coordinate with MassDEP to define needed monitoring and reporting for Little Pond TMDL compliance.
  - Summarize findings for Town and stakeholder review.

The intent of the initial phase of this analysis is to identify and evaluate the full range of stormwater management technologies for nitrogen reduction that are appropriate at Little Pond. These alternative



methods will then be compared to other methods, with respect to feasibility and cost and incorporated into the CWMP through Adaptive Management.

In addition, the Falmouth Conservation Commission is revising their Stormwater Regulations. Nitrogen-reduction BMP requirements will be part of this update. Treatment BMPs such as bioretention areas, rain gardens, constructed stormwater wetlands, extended dry detention basins, sand and organic filters, and wet basins are being reviewed for appropriateness. Examples of Low Impact Development (LID) include porous pavement sidewalks and swales, bioretention parking dividers, and permeable paving. Where space limitations exist, infiltration BMPs such as infiltration basins, infiltration trenches, leaching catch basins, and subsurface structures should be incorporated into the design where possible to mitigate stormwater runoff.

### **3.6.3 Further Recommendations for Stormwater Management**

Stormwater management is a Town-wide issue and requires action by both the government and residents. In addition to the Conservation Commission, other Town departments can assist in stormwater management by reviewing their current bylaws for stormwater management related sections, and requiring that new development or any areas incentivized for planned growth utilize stormwater BMPs and integrate LID features into designs prior to local approval. Homeowners need to provide stormwater management at their respective properties. Small changes such as directing rain runoff from roofs and driveways to lawn areas or other biologically active areas such as gardens or flowerbeds can benefit the environment. Rain barrels can also be utilized to store runoff from roofs for use in watering landscaping or other non-potable activities. Driveway runoff can be mitigated through the use of stone, porous pavement, or by installing vegetated filter strips. It is intended that the Conservation Commission regulations will become a template for a Town-wide bylaw to prevent stormwater pollutants from entering the Town's estuaries.

### **3.7 Development and Recent Town Passage of a Comprehensive Nitrogen Control Bylaw (for fertilizer)**

The extent of nitrogen loading from fertilizer was identified in MEP Technical Reports and subsequent TMDL reports prepared by MassDEP for Little Pond, Great Pond, Green Pond, Bournes Pond, and the Waquoit East and West watersheds. The existing fertilizer nitrogen loads to these watersheds are summarized below:



**Table 3-2 Summary of Fertilizer Nitrogen Loadings to the Planning Area**

<b>Estuary</b>	<b>Nitrogen Loading (kg/yr)</b>
Little Pond	700
Great Pond	1,700
Green Pond	900
Bournes Pond	500
Waquoit Bay East	900
Waquoit Bay West	2000

Based on information included in Table 1 of the February 29, 2008 Technical Memorandum by Stearns and Wheeler as attached in Appendix 3-8.

Fertilizer contributes 5- to 10-percent of the controllable nitrogen sources entering these watersheds. A summary of the nitrogen loads to the watersheds from all sources is attached in Appendix 3-8, and includes figures that illustrate percent contributions from various sources.

The application of too much fertilizer is a problem throughout Falmouth's south coast watersheds. Education on proper fertilizer types, application techniques, and frequency of use can help reduce over-fertilization, which is the most common cause of fertilizer leaching into the groundwater system. From 2002 through 2005, the Falmouth Ashumet Plume Committee initiated and ran a significant public education campaign entitled Falmouth Friendly Lawns (FFL). This group investigated ways that fertilizers could be managed and promoted more appropriate lawn care. The campaign rewarded the organizations and individuals that followed the FFL guidelines and limited their use of fertilizer nitrogen. The FFL Program certified approximately 100 participants with public-relations and "honor roll" events. In 2006, the Falmouth Ashumet Plume Committee recommended that the Town take over the FFL campaign, estimating that the cost of administering the current campaign would be approximately \$80,000 to \$134,000 for a 3-year period depending on the number of new initiatives added. Due to financial constraints, the Town did not take over the program.

As part of developing this CWMP, both voluntary programs such as Falmouth Friendly Lawns, as well regulatory approaches were carefully evaluated. A Fertilizer Options Analysis Matrix was prepared to summarize the findings of several reports completed for other coastal communities on this topic. This Matrix is in Appendix 3-8. The following two-pronged approach was selected for implementation:

- Town adoption of a Nitrogen Control Bylaw to regulate fertilizer use.
- Educational campaign to support the Nitrogen Control Bylaw coordinated through citizens' groups.

As part of the CWMP process, the Town determined that adoption of a Nitrogen Control Bylaw (for fertilizer) would be the most effective approach to limiting nitrogen from fertilizer applications, because it would both create an enforceable regulation and it would galvanize public education campaigns. Another advantage of this approach is the provision of explicit fertilization limits and clear standards for fertilizer use in Falmouth's watersheds. As is the case with most of Falmouth's bylaws, enforcement will be complaints-driven. The Town expects this approach to be effective. The main challenge to the success of



the Town's approach is establishing a method to monitor its efficacy. MassDEP indicates that it would support a bylaw but would only be able to provide a nitrogen reduction credit if it could be monitored or verified. This dialogue occurred during the 2001 Falmouth Wastewater Planning Project evaluations for the West Falmouth Harbor watershed.

Given the fact that a Nitrogen Control Bylaw coupled with local educational efforts will lead to the removal of some portion of the controllable watershed load of nitrogen attributed to fertilizer, the WQMC authored a Nitrogen Control Bylaw for fertilizer. Fall 2012 Town Meeting adopted this Town-wide bylaw. This bylaw prohibits the application of nitrogen within 100-feet of resource areas as defined in Falmouth's Wetlands Regulations, FWR 10.02 (1)(a - d), as well as on impervious surfaces. The bylaw also prohibits the application of fertilizer anywhere in Town from October 16th to April 14th. During the growing season of April 15th to October 15th, fertilizer application is banned during heavy rain. There are exceptions for agriculture and horticulture. Regarding golf courses, on greens and fairways only, no more than one pound of nitrogen per 1,000 square feet may be applied over the entire growing season. Furthermore, 85-percent or more of this fertilizer must be in an organic, slow-release, water-insoluble form on greens and fairways only. There are also allowances for the application of organic constituents applied to improve the physical condition of the soil, and the establishment of turf. Enforcement is through the Department of Marine and Environmental Services (a merging of the Harbormaster's Office and the Department of Natural Resources). A copy of this Nitrogen Control Bylaw can be found in Appendix 3-8.

On May 15, 2013, the Attorney General disapproved the new bylaw stating that the Legislature has vested the regulatory authority over fertilizers with the Department of Agricultural Resources. The Town's legislative delegation filed corrective legislation that recently passed, reinstating the Town's Nitrogen Control Bylaw.

Falmouth Association Concerned with Estuaries and Saltponds (FACES), an active local citizen's group, has offered to assist with a public outreach campaign. This education campaign will be patterned after the FFL program. To initiate the educational component, past participants in the FFL will be contacted, and additional participants sought. Working through the Chamber of Commerce and trade associations for the lawn care and turf management industry, best practices for meeting the regulations in the bylaw will be explained. In addition, point-of-sale promotions to increase public and business awareness of the new bylaw will be done. An outreach campaign to broaden volunteer involvement will be formalized. Future educational initiatives will focus on landscape design practices that minimize negative environmental impacts. Certain landscape design practices can reduce fertilizer needs, reduce impervious area, and increase runoff control. Recommended landscape practices will include pesticide and fertilizer alternatives, composting, and low maintenance plants.

A notable difference between this new initiative and the FFL program is that with a Nitrogen Control Bylaw in place, the program will not be purely voluntary. The Town believes that regulation coupled with education will reduce the nitrogen-loading attributable to fertilizer use in a way that is measurable and verifiable. The Town is actively implementing this approach.

### **3.8 Information Gathering on Individual-Property and Clustered Nitrogen-Removal Septic Systems**

Technical aspects of on-site and cluster denitrifying septic systems have been detailed in Chapter 7 of the 2007 Alternatives Screening Analysis Report (attached in Appendix 2-6). These systems are closely



regulated by MassDEP as part of their Title 5 regulations. This Report states that “decentralized treatment alternatives approved by the MassDEP as part of their innovative and alternative technology program can be used for areas outside the sewer area as currently allowed by MassDEP regulations.” It is now noted that recent test data (data up to 2012) from several newer denitrifying technologies show nitrogen removal greater than 90-percent. To meet TMDL thresholds in the Town’s impaired estuaries, the Town wants to implement the full range of acceptable technologies that cost-effectively remove nitrogen adequately. As such, denitrifying septic technologies will be investigated further and the cost per pound of nitrogen removal will be calculated. Issues surrounding ongoing performance monitoring, maintenance, and permitting will also be addressed. As advantageous technologies are identified, they will be incorporated into the CWMP through Adaptive Management. The WQMC has developed a Roadmap to assist in the identification of promising technologies. This Roadmap includes:

### **3.8.1 Survey Existing Knowledge Base for Both Individual as Well as Cluster Denitrifying Septic Systems (DSS)**

- Coordinate with the Oyster Pond CWMP process that is currently underway to avoid duplication of effort. This CWMP project includes technologies that are approvable in Massachusetts. Promising technologies that have a short pathway to regulatory approval may also be discussed.
- Summarize results of key prior studies, including:
  - Suffolk County Department of Health Services (SCDHS) Innovative/Alternative On-Site Sewage Disposal Systems (OSDS) Study: Suffolk County has begun a formal evaluation of innovative/alternative onsite sewage disposal systems capable of denitrification, ranging from individual home systems to small plants capable of servicing up to 100 dwelling units (30,000 gallons per day). The study is being performed by a consultant, Holzmacher, McLendon, & Murrell, P.C. (H2M), The study is expected to be completed by December 2013.
  - Environmental Protection Agency, Guidance for Federal Land Management in Chesapeake Bay Watershed, Chapter 6: Decentralized Water Treatment Systems (May 12, 2010).
  - Maryland Bay Restoration Fund (BRF): Best Available Technology for Removing Nitrogen from Onsite Systems  
[http://www.mde.state.md.us/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/Water/cbwrf/osds/brf\\_bat.aspx](http://www.mde.state.md.us/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/Water/cbwrf/osds/brf_bat.aspx)
  - Report to New Jersey Pinelands Commission on Pilot Program (November 2009).
  - Barnstable County Department of Health and Environment: Innovative and Alternative Onsite Septic Systems Performance, 1999-2007.
  - Final Report: La Pine National Demonstration Project, 1995–2005.

### **3.8.2 Characterize Performance of 15 DSS Systems**

Characterize the performance of the 15 DSS systems that have received nitrogen removal credit (as listed by MassDEP <http://www.mass.gov/dep/water/wastewater/techsum.htm>). Include relevant information from Chapter 7 of Falmouth’s Alternatives Screening Analysis Report (Stearns and Wheeler). This effort should include:

- Price quotes from vendors.
- Other reported performance and price points.



- Input from Barnstable County Department of Health and Environment.
- Discussions with Cape-wide engineering firms to learn of practical experience with DSS.
- Identification of installations that are required to achieve near 5 mg/L nitrogen removal or better.
- Site visits to operational DSS systems that achieve 5 mg/L nitrogen removal and that are reasonably nearby.
- Other independent research.

### **3.8.3 Prepare Comprehensive List of Commercial Denitrifying Septic Systems**

Prepare a comprehensive list of commercial or near commercial denitrifying septic systems that have some level of DEP approval and/or achieve nitrogen removal rates down to treated effluent levels of near 5 mg/L or less and are currently in operation (either commercially or at test centers) and characterize their efficacy in the long term. Estimate capital and operating cost per unit and cost per pound of nitrogen removed over the projected useful life of the DSS (either individual or cluster). Discuss aspects of monitoring and operation that are expected to be required for long-term operation at desired nitrogen removal thresholds.

- Identify permitting issues and any other barriers related to implementation for above technologies.
- Describe monitoring protocols that have been developed for installed DSS.
- Note the ability of any DSS to sequester phosphorus for reuse or treat chemicals of emerging concern. Use information from BCDHE publication entitled “Contaminants of Emerging Concern from Onsite Septic Systems”. Chapter 7 of Falmouth’s Alternatives Screening Analysis Report (Stearns and Wheeler) listed inability to remove phosphorus and CECs as a shortcoming of DSS systems.

### **3.8.4 Present this Information in a Summary Table for Consideration of Next Steps**

These efforts are ongoing and will be completed within the next 12 months.

## **3.9 Ocean Outfall Evaluations**

### **3.9.1 Overview Discussion on an Ocean Outfall for Falmouth**

Falmouth lies on the southern, down-gradient side of a sole source aquifer, the Sagamore Lens. This aquifer feeds multiple Falmouth watersheds that flow to coastal embayments on Buzzards Bay and Vineyard and Nantucket Sounds. This geology poses the greatest challenge to addressing the nutrient levels in our coastal ponds—where to discharge treated wastewater in our upper watersheds so that it does not affect freshwater and coastal ponds down gradient. We all now appreciate what happened to West Falmouth Harbor when secondary treated wastewater from our main treatment plant was discharged to groundwater in the West Falmouth Harbor watershed. As part of our current wastewater planning process (discussed later in the following Chapter), over 20 potential upland discharge sites throughout town have been evaluated. With few exceptions, they have been problematic because they ultimately impact our coastal estuaries.

One solution to discharge treated wastewater would be an ocean outfall. Historically, this solution has been widely used. It is still employed, for example, in Fall River, New Bedford, and Boston; and it was used in Woods Hole from 1946–1985. New outfalls were outlawed in Massachusetts coastal waters with



the passage of the Ocean Sanctuaries Act, primarily to prevent poorly treated wastewater from being discharged into marine waters. That prohibition is still in place. A revision to the Act or new State legislation would be required to allow Falmouth to construct and use an outfall.

As part of reevaluating ocean outfalls, the Buzzards Bay Coalition sponsored a January 2013 meeting (Appendix 3-12) attended by 35 scientists and representatives from environmental organizations. The consensus of that meeting was that ocean outfalls should be considered as part of wastewater discharge solutions, provided that the wastewater receives tertiary treatment (e.g., total nitrogen at 3mg/L) and that careful evaluation of both the affected aquifer and receiving waters showed that an outfall would be ecologically sustainable.

In the case of Falmouth, which has a land area of 44.2 square miles and annual rain recharge between 21 and 25 inches per year, the groundwater flows toward the coastline where it discharges between 45 and 50 million gallons of freshwater per day. The Coonamessett River, for example, has an average discharge of 9 million gallons per day in March and 6 million gallons per day in June. Given these figures, a 2 million gallon per day discharge from an ocean outfall would have minimal impact on the recharge characteristics of the Sagamore Lens. In fact, average existing withdrawal of 4.4 million gallons per day of drinking water to be piped all over Town has a far greater impact on our aquifer than would discharge through an ocean outfall.

The Boston outfall, which began operation in September of 2000, provides a good example of the impact of an outfall on marine receiving waters. That outfall discharges on average 350 million gallons per day of secondary treated wastewater to Cape Cod Bay. Secondary treatment does not remove nitrogen, with the result that the Boston outfall discharges 11,000 metric tons of nitrogen per year—or 190 pounds of nitrogen for each million gallons discharged. This is the equivalent concentration of 23 mg/L nitrogen. The Boston outfall has been modeled and monitored extensively for years, both before and since operation began. To date, that monitoring has shown no significant impacts to the ecology of Cape Cod Bay. Thus, a two million gallon per day discharge of tertiary treated wastewater from Falmouth, containing 25 pounds of nitrogen per million gallons discharged, should have little effect on our receiving waters.

Further development of a scientific case for an outfall from Falmouth would require additional modeling of our aquifer by the U.S. Geological Survey and modeling of our receiving waters using 3D models developed at UMass Dartmouth and Woods Hole Oceanographic Institute (WHOI) to evaluate the ecological impacts on both systems. The science notwithstanding, the greatest hurdle to an ocean outfall in Falmouth will be the necessity to change regulations at the State level, which will require political will from Falmouth and the support of our State delegation.

### **3.9.2 History**

Falmouth operated an ocean outfall for the village of Woods Hole from 1946-1985 that discharged chlorinated raw sewage into Great Harbor. During the 1970s as part of wastewater planning efforts, the possible use of an outfall from Nobska Point in Woods Hole extending approximately 2,000 feet into Vineyard Sound was evaluated. A series of papers were published in the Journal of the Boston Society of Civil Engineers that described these evaluations (Bumpus & Vaccaro, 1971; Bumpus, Wright & Vaccaro, 1971; Meade & Vaccaro, 1971). These papers are attached in Appendix 3-10. Town Meeting at that time approved this approach but it failed at a subsequent ballot vote. Falmouth ultimately built the Blacksmith Shop Treatment Facility which discharges through infiltration beds into the West Falmouth Harbor watershed.



### 3.9.3 Preliminary Evaluation of a Potential Outfall at Nobska Point in Woods Hole

A preliminary evaluation of potential ocean outfall at Nobska Point in Woods Hole was completed in 2011 when the CWMP Project was evaluating wastewater collection, treatment, and recharge scenarios to address the complete High Priority Nitrogen Mitigation Area as illustrated in Figure 2-2. Though the wastewater flow has changed, this preliminary evaluation reviewed issues of an ocean outfall at Nobska Point that would still be valid for a smaller flow. The ocean outfall treatment and discharge alternative is called Scenario 1D and would have the following components:

- Wastewater collection from the Planning Area.
- Conveyance to the existing Blacksmith Shop Road WWTF and treatment to the current standards (advanced nitrogen and solids removal) followed by filtration and disinfection.
- Possible discontinuance of the current groundwater recharge at the existing WWTF site and conveyance of the total flow (from existing sewered area and needed sewered area in the Planning Area) to an additional disinfection facility in Woods Hole.
- Final disinfection and discharge through the outfall.

The proposed outfall location is illustrated on Figure 3-1 which is the same location as discussed in the Boston Society of Civil Engineers Journal articles. Costs for this scenario are summarized in Appendix 3-11 and are further discussed in Chapter 4, Section 4.4, and presented in Table 4.4. Again, these costs are dated and for a larger flow.

The costs are based on the following factors:

- Wastewater collection from the High Priority Nitrogen Mitigation Area as illustrated in Figure 2-2 with additional portions south of Route 28 to the Mashpee border and to Inner Harbor to the west.
- Wastewater treatment at the Blacksmith Shop Road WWTF to the current low-effluent nitrogen standard of 3 mg/L total nitrogen.
- Force main to be placed next to the existing wastewater force mains that extend from Woods Hole to the Blacksmith Shop Road WWTF (approximately 7.3 miles).
- Final disinfection facility and (possible) pump station.
- Three foot diameter high density polyethylene (HDPE) ocean outfall extending 2,000 feet from Nobska Point into Vineyard Sound.
- Outfall would be buried and armored as needed.
- The outfall would extend directly into the sound from Nobska Point to a tee and the outfall diffusers would be placed at right angles to the currents to maximize mixing.
- Costs are based on actual unit costs for the 1,300-foot long outfall constructed at the Seabrook WWTF in 1994. This is believed to be the last new ocean outfall (of this size) constructed in New England. Costs were adjusted based on differences in diameter, length, depth, and date of construction.



Evaluation of the non-monetary factors indicates the following findings:

- An outfall at this location with water treated to Enhanced Nitrogen Removal (ENR) standards would most likely not have an adverse environmental impact on the marine environment, but additional scientific studies would be needed to address questions and concerns of the local, regional, State, and Federal stakeholders that would need to approve it.
- An outfall at this location could have an environmental benefit because it would move the treated water (with its low nitrogen concentration of less than 3 mg/L total nitrogen) beyond the near-shore environment into a well-mixed zone of Vineyard Sound. It is noted that groundwater recharge of treated water eventually reaches the same off-shore environment; but in doing so, it moves through the near-shore environment where it causes eutrophication in the estuaries.
- By eliminating recharge of treated water within any watershed, the outfall option would reduce the amount of upper watershed sewerage required to meet the TMDLs.

#### **3.9.4 Regulatory Considerations**

The Ocean Sanctuaries Act as presently constituted precludes the use of ocean outfalls in Cape Cod waters. Further consideration of this option will require changes to the Act or a Home Rule Petition. The Town would like to continue with these considerations and has begun to reach out to local stakeholders through a meeting held in January 2013 in collaboration with the Buzzards Bay Coalition (described previously) and to State officials at a meeting on May 8, 2013 held in Senator Therese Murray's office that was attended by the Senator's aide Jackie Horigan, Barry Moran from DEP, Bruce Carlisle and two staff members from Coastal Zone Management (CZM), and John Waterbury representing Falmouth.

The following list of items characterized the May 8<sup>th</sup> meeting discussion:

1. There was consensus that a solid scientific case can be made for outfalls (as defined at the Buzzards Bay Coalition meeting described earlier).
2. It was thought that it might make sense to treat ocean outfalls as part of the overall tool kit for wastewater disposal rather than having them require a special variance.
3. The case for ocean outfalls should be developed as part of the Cape Cod Commission's process to update the Section 208 area-wide water quality plan.

#### **3.9.5 Next Steps**

The following next steps are planned/recommended:

- Schedule technical meetings with representatives from DEP, CCC, Buzzards Bay Coalition, CZM, interested towns, WHOI, and others to begin to establish the criteria a municipality would need to meet in order to qualify for an outfall.
- Ask the CCC to evaluate the regional potential for outfalls at appropriate locations Cape-wide. Are there other Cape towns that cannot discharge treated effluent on land without impacting some already impaired watershed?
- Ask the CCC to model potential impacts to the various aquifers on Cape Cod from outfall discharges, such as lower groundwater elevations. Some aquifers may be more sensitive to outfall discharge than others.



- Continue to keep an outfall as an option as the Town moves forward in implementing the CWMP. Active pursuit of an outfall location would be added to the CWMP through a Notice of Project Change.

### **3.10 Potential Watershed Modifications for Increased Nitrogen Attenuation**

Nitrogen discharged to the upper portions of watersheds travels with groundwater through fresh surface water systems (ponds, streams, wetlands, bogs, etc.). These freshwater systems provide natural nitrogen removal (also called nitrogen attenuation) before the groundwater moves into marine waters where the remaining nitrogen may contribute to water quality problems. Nitrogen recharged to the lower portions of the watershed does not flow through fresh surface waters and therefore does not benefit from such nitrogen attenuation. The separation between the upper and lower portions of the watershed is illustrated in Figures 2-1 and 2-2 for the Little, Great, Green, Bournes, Waquoit West, and Waquoit East watersheds by the horizontal line that tends to run across the top of these marine water bodies. Because some of the nitrogen discharged north of the horizontal line is removed as a function of the groundwater flow through the fresh surface water, it is believed that modifying the watershed in this area will enable a greater percentage of nitrogen to be naturally attenuated.

The nitrogen is removed due to the fundamental biochemistry that exists at the interface of the porous sandy aquifer and the freshwater system. This interface typically has an organic-rich zone populated with heterotrophic bacteria. These bacteria can use either oxygen or nitrate as their electron donor (oxygen) source for respiration as part of their metabolism. When they use nitrate for respiration, they excrete nitrogen gas ( $N_2$ ) that goes off to the environment. This organic-rich zone typically has low dissolved oxygen (due to the bacteria consuming it) and the bacteria will then consume the nitrate from groundwater as it flows through the interface. Some aquifer/freshwater system interfaces have better organic-rich conditions than others; therefore, some freshwater systems are better at nitrogen attenuation than others. There are other denitrification mechanisms at work in these freshwater systems; but this is the major one.

#### **3.10.1 Findings From the November 2007 Alternatives Screening Analysis Report**

The November 2007 Alternatives Screening Analysis Report identified that significant nitrogen attenuation (40- to 60-percent) has been documented by SMAST as part of the MEP evaluation for various fresh water bodies. This report also developed the following three alternatives for more evaluation:

1. Freshwater pond construction and impoundments in the cranberry bog systems.
2. Constructed wetlands in the cranberry bogs.
3. Constructed wetland/reactor with Nitrex™ media.

These alternatives focused on the Coonamessett River area because it is a Town-owned area but they could be applied to the Backus Brook bog system, the Bournes Brook bog system, or other low-lying wetland areas after further study and implementation in the Coonamessett. These alternatives are described in detail in Appendix 3-14.

#### **3.10.2 Summary of Considerations for the Watershed Modification Alternatives**

The three alternatives identified for the Coonamessett River watershed hold promise for relatively cost-effective nitrogen mitigation. The “Constructed Wetlands” and the “Constructed Wetland/Reactor with Nitrex™ Media” alternatives both use pump-and-treat technologies that are believed to be unacceptable to



the environmental regulators and would have long-term operation responsibilities for the Town that would be costly and problematic. The “Freshwater Ponds Impoundments” alternative is a more passive/natural concept that will be more acceptable to the regulators and it has minimal operation requirements and costs. This is the concept/alternative that should be pursued.

### **3.10.3 Discussions with the Coonamessett River Restoration Committee**

The Coonamessett River Restoration Committee was contacted to consider this water-quality improvement goal and the possible implementation of freshwater ponds/impoundments as part of their restoration efforts. Also, Dr. D. Michael Ball of ENSR/AECOM (the environmental consultant engaged by the Coonamessett River Restoration Committee) was contacted in January 2008. He indicated that ENSR/AECOM had recently completed a Draft Restoration Concept Report (December 2007). A conceptual river modification plan from that report is attached in Appendix 3-14. The plan illustrates the addition of flow deflectors and rocks to the stream to improve the fish habitat, and the re-vegetation of the bog to recreate more of a natural wetland. The main goal of this restoration plan was to restore the wetland and fish run.

A meeting was held with Greg Pinto, Chairman of the Coonamessett River Restoration Committee; George Hampson of the Town’s Nutrient Management Committee; and Jerry Potamis, Falmouth Wastewater Superintendent on April 15, 2008 to review the findings of these watershed-modification evaluations and to learn if the goals of the watershed modification to improve water quality could be incorporated into the Committee’s goals of wetland restoration to restore fisheries habitat. After discussions of how freshwater ponds and impoundments could be utilized to meet these goals, the group agreed to incorporate the water-quality goal with the Committee’s goal to restore fisheries.

It was understood that large ponds could increase the temperature of the water which could defeat the Committee’s main goal of trout restoration to the stream. It was believed that this potential conflict of goals could be addressed by keeping the ponds/impoundments small in size, located to the sides of the bog systems, and designed to encourage shading through plantings.

The Coonamessett River Restoration Committee has completed its work and has been disbanded.

### **3.10.4 Considerations on Modifications in the Backus Brook Bog System, Bournes Brook Bog System, and Low Lying Areas North of Eel Pond and Childs River**

The Backus Brook Bog system is north of Green Pond, extends from Route 28 to Carriage Shop Road, and is actively farmed. This bog system has a tail-water pond (Mill Pond) at its southern end and provides significant nitrogen attenuation (67-percent for the Backus Brook system versus 51-percent for the Coonamessett River System per MEP, April 2005). This is the type of pond/impoundment that is recommended for bog systems to promote nitrogen attenuation. The nitrogen attenuation through this pond is believed to be a major factor in the lower wastewater nitrogen removal percentage that is needed for this watershed versus the other watersheds in the Planning Area. No modifications to the Backus River Watershed are recommended at this time. It is possible that on-going research and water-quality monitoring at the pond or at the watershed will indicate benefits of modifying these systems for nitrogen attenuation. At that time (and with the possible benefit of positive findings with the Coonamessett Bog restoration work) possible watershed modifications can be considered for Backus Brook and Mill Pond.



The Bournes Brook Bog system (also called the Hammond Bog) is north of Bournes Pond, extends from Route 28 to the Falmouth Country Club site, and is actively farmed. The cranberry farmers have been working with the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) on a resource assessment for the bog and the following items are being considered for water quality and management improvements:

- Route 28 culvert modification.
- Modification of the lower bog cell to a natural wetland or to tail-water pond.

Final determination of these items has not been made. As with the Backus Brook bog system, it is possible that on-going research and water quality monitoring at the watershed will indicate benefits of further modifying this system for nitrogen attenuation. At that time (and with the possible benefit of positive findings with the Coonamessett River restoration work) possible watershed modifications can be considered for the Bournes Brook bog system.

There are wetland areas north of Eel Pond and Childs River that may be providing significant nitrogen attenuation. These areas are in the Waquoit West watershed that is still being evaluated by the MEP for nitrogen limits.

### **3.10.5 Additional Applications of Vegetative Treatment**

The WQMC will continue to consider new ways in which the use of vegetative swales and related technologies—either ‘high tech’ or ‘low tech’—could effectively and economically remove nitrogen. Promising technologies will be incorporated into the CWMP through Adaptive Management and a Notice of Project Change as needed.

### **3.11 Baseline Monitoring**

An over-arching concern and key aspect for all the demonstration projects in this chapter as well as the sewerage project described in Chapter 4 is Baseline Monitoring: How will the Town and the Regulators know what environmental improvements have occurred as a result of particular actions taken to intercept nitrogen currently flowing into a given water body.

The Town’s approach is proposed as follows:

1. Water quality data collected by SMAST for the MEP reports forms the baseline picture on which the TMDLs are set. These data were gathered during the first half of the 2000-2010 decade.
2. Water quality data collected by the Pond Watchers annually since the MEP reports (roughly 2006 to present) has been accumulated by SMAST but not analysed or reported.
3. The WQMC has contracted with SMAST to have the data for Little, Great, Green, and Bourne’s Ponds, Eel River, and West Falmouth analysed and reported.
4. DEP has stated that the monitoring plan to establish a causal link between a demonstration project and water-quality improvements must include one year of baseline data prior to project installation and at least three years of active monitoring of the project.
5. As demonstration projects move forward, estuary by estuary, a monitoring plan specific for that project will be developed with input from the appropriate regulating agencies. As examples:
  - a. The monitoring plan for Little Pond Aquaculture Project was developed with input from the Falmouth Conservation Commission, the Division of Marine Fisheries, SMAST, and others; and then formalized in an Order of Conditions.



- b. The Monitoring Plan for Bourne's Pond inlet will be developed during the design and permitting process, involving all agencies that have jurisdiction, and following the MEPA/DRI process.
  - c. Whichever estuary is selected for installation of a Permeable Reactive Barrier will need a monitoring plan for the groundwater prior to installation, both upstream and downstream of the proposed location, as well as near-shore monitoring of the coastline of the particular estuary affected. The Falmouth Conservation Commission is likely to play an important part in developing the plan.
6. It is likely that each estuary will ultimately end up with its own particular baseline monitoring plan, followed by on-going monitoring, tailored to the nutrient management technologies planned for that estuary.
  7. Any demonstration project that enters the MEPA process will need to prepare a monitoring plan as part of that process.
  8. To establish the nitrogen removal credit of eco-toilets, the Eco-Toilet Demonstration Project includes a year-long testing program administered through Barnstable County Department of Health and Environment. Once an eco-toilet has been installed, thus diverting human urine and feces, this monitoring program tests the nitrogen and phosphorus content of a household's greywater on a monthly basis for 12 months.
  9. On-going monitoring of the demonstration projects will be dictated by the nature of the project, regulatory requirements, and the need for more or less data depending on the consistency of the monitoring data as it is collected.
  10. In the case of sewerage a peninsula, the expected reduction in nitrogen should be evident first in the groundwater under the peninsula before it reaches the estuary. Some consideration should be given to sampling groundwater in Maravista and/or Falmouth Heights before sewerage and then afterwards.

Ultimately, long-term monitoring of each estuary will be needed to prove that the Town is continuing to meet the TMDL's. Consideration should be given to simplifying the monitoring protocol so that the necessary 'indicator' data are collected, without spending time or money on secondary parameters.





## **4 Detailed Evaluations of Traditional Wastewater Management Alternatives**

### **4.1 Introduction**

As discussed at the end of Chapter 2, many detailed evaluations have been completed for the CWMP Project. Chapter 3 summarized the evaluations completed for the Non-Traditional Nitrogen and Wastewater Management Technologies. The purpose of this chapter (Chapter 4) is to summarize the detailed evaluations completed for the more Traditional Wastewater Management Technologies and Practices.

It should be noted that, as shown by the length of time surrounding the various detailed evaluations, several of the findings and recommendations included in Section 4.2 through 4.5 have been superseded, and therefore the most recent and relevant findings are identified in Section 4.6.

### **4.2 First Group of Detailed Evaluations Recommended from ENF: 2007 to 2008**

#### **4.2.1 Feasible Technologies Identified**

A group of feasible alternative technologies, solutions, and sites were selected for detailed evaluation through the Alternatives Screening Analysis process (detailed in Appendix 4-1). These items were grouped and evaluated, and these evaluations are summarized below.

#### **4.2.2 Collection System Evaluations**

After review of the Environmental Notification Form, there was general agreement that a sewer system was needed for the southern portions of the Planning Area. These portions of the watersheds (as illustrated by the watershed delineations in Figure 2-1 and 2-2) have groundwater systems that drain the current septic system nitrogen loads directly to the marine water bodies and have little natural nitrogen attenuation as estimated for the northern portions of the watersheds that drain through fresh water systems before reaching the marine water bodies. This north-south demarcation of the watersheds is very close to Route 28.

Sewer service areas were developed using a SewerCAD computer model for each of the peninsular areas A through F in Falmouth as illustrated in Figure 4-1. These sewer service areas were later revised to delete the eastern end of Area F and the western end of Area B to develop revised sewer service areas A through E as illustrated in Figure 4-2. These revised sewer service areas A through E became the High Priority Nitrogen Mitigation Area illustrated in Figure 2-2.

Capital and Operation and Maintenance (O&M) costs were then developed for these collection system areas as summarized later in this Chapter for specific Alternative Wastewater Management Scenarios.

The collection system layout and conceptual design utilized the following approaches that were the basis of cost development:

- Mixture of gravity sewers and small diameter, low pressure systems that would lead to one main lift station per area that would pump to the treatment facility.
- The use of gravity sewers was maximized as allowed by the topography and road layouts to minimize the need for low pressure systems and the increased power usage that may be needed. When properties were too low in the service area to be served by gravity sewers, they would have



their own grinder pump unit (located in their yard) that would feed a low pressure sewer in the road layout and discharge to the nearest gravity pipe.

This sewer modeling procedure is a detailed way to develop cost estimates and develop a computer model that can be used in the future as planning becomes more refined.

#### **4.2.3 Alternative Treated Water Recharge Sites Evaluated**

The Alternatives Screening Analysis Report summarized the identification and screening of 25 sites for their feasibility/availability for treated water recharge. Appendix 4-2 summarizes this evaluation. Figure 4-3 illustrates these 25 sites.

Three sites were selected for subsurface evaluations as summarized in Appendix 4-2, and the Falmouth Country Club Site (Site P) was identified as the best site to pursue for treated water recharge.

This site was the main focus for treated water recharge during the early part of the detailed evaluations.

A second set of site evaluations was initiated in 2010 to investigate additional sites and to relook at other sites. These sites are illustrated on Figure 4-4. This site evaluation is described in detail in Technical Memorandum No. 2 which is attached in Appendix 4-3. For this evaluation and subsequent decision-making, Site 7 located north of the WWTF property was selected as the best treated water recharge site to pursue.

These sites and subsequent evaluations are detailed in following sections of this Chapter.

#### **4.2.4 Sludge Management Evaluations**

Several sludge management technologies were evaluated including:

- Sludge processing methods:
  - thickening
  - dewatering
  - stabilization and potential resource recovery including:
    - composting
    - digestion (aerobic and anaerobic)
    - alkalinity stabilization
    - heat treatment and drying
- Groupings of sludge processing methods to form the following sludge management alternatives:
  - sludge thickening and transport to a regional facility for disposal or reuse<sup>1</sup>
  - sludge dewatering and transport to a regional facility for disposal or reuse
  - sludge dewatering, composting (or other stabilization process), and distribution to the public
  - sludge thickening and/or dewatering and land application

Appendix 4-4 summarizes the sludge management evaluations in detail and a side-by-side comparison is further summarized in Table 4-1.

The main findings indicate sludge thickening is a relatively simple process with lower capital costs and lower operation, maintenance, and energy requirements than any of the other alternatives. Thickened sludge can be disposed of (or reused) at a number of regional facilities. Sludge thickening is the first step

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<sup>1</sup> Reuse is the recovery of nutrients, soil conditioning properties, or energy content of the sludge.

**Table 4.1 Summary of Sludge Management Alternatives**

Alternative	Regulatory Requirements	Effluent Quality	Maintenance Requirements and Complexity of Operation	Flexibility	Energy Use	Land Requirements	Potential for Air Emissions	Public Acceptance	Ease of Implementation	Relative Capital Costs	Relative O&M Costs	Recommend
Sludge thickening and disposal or reuse at a regional facility.	Siting, design, and permitting requirements for new facilities.	Responsibility of regional facility and not applicable to disposal evaluation.	Town depends on outside source for reliable disposal. Thickening equipment is typically reliable.	Variety of disposal facilities accept thickened sludge both on and off-Cape.	Low.	Low.	Odor control facilities are often required.	Thickening facilities would be part of a new large facility, or use/expansion of the existing Falmouth facility.	Easiest. Many regional facilities accept liquid sludge.	Relatively low compared to other management alternatives.	Relatively low compared to other management alternatives.	Yes, due to the desire for flexible operations, and lower costs.
Sludge dewatering and disposal or reuse at a regional facility.	Siting, design, and permitting requirements for new facilities.	Responsibility of regional facility and not applicable to disposal evaluation.	Town depends on outside source for reliable disposal. Dewatering equipment is typically reliable.	Limited number of facilities receiving dewatered sludge.	Moderate due to operation of dewatering equipment.	Low.	Odor control facilities are often required.	Dewatering facilities would be part of a large centralized facility.	Relatively easy due to the existence of few facilities that except sludge cake.	High due to dewatering equipment and building.	Disposal costs can be reduced because solids are consolidated. Equipment maintenance costs are higher.	No at this time due to higher costs and fewer disposal and/or reuse locations.
Sludge thickening, dewatering, and composting (or alkaline stabilization, digestion, and/or heat treatment).	Siting, design, and permitting requirements for new facilities. Regular sampling, analysis, and reporting to MassDEP.	Capable of producing a material that can be distributed to the public. Must be closely monitored.	Previous installations on Cape Cod were shut down due to odors and poor economics.	Limited options for disposal if public interest in taking material is low.	High due to extensive equipment and odor control facilities.	High for covered structures, storing, and loading areas.	High potential for odors. Previous facilities on Cape Cod shut down due to odors.	Adjacent property owners may challenge this process due to potential for odors, large land requirements, and visual impacts.	Difficult due to construction of new facilities and extensive permitting.	High compared to thickening.	High due to purchase of materials, operation and maintenance of equipment, and operator requirements.	No at this time due to higher costs, greater potential for odors, and the low sludge flows that are expected in the next 10 to 15 years. This evaluation should be reconsidered as WW and sludge flows increase. <sup>1</sup>
Sludge thickening and/or dewatering and land application.	Siting, design, and permitting requirements for new facilities. Regular sampling, analysis, and reporting to MassDEP.	There is a risk that nitrogen will leach from the sludge and enter the groundwater system.	Relatively simple in agricultural areas, but expected to have difficult permit requirements in Falmouth.	Can be flexible if there is sufficient land area.	Low.	High.	High.	Low.	Extremely difficult due to extensive permitting requirements and minimal locations for the land application.	Low if there is a nearby agricultural economy.	Low if there is a nearby agricultural economy.	No, this method is not appropriate for Falmouth because there are few expansive agricultural areas.

Notes:

1. These methods are expected to be considered again during the 20-year planning period as costs and reuse options change.



required for the more complicated sludge management processes of sludge dewatering and composting and other stabilization processes; therefore these additional processes should be added in the future if desired as sludge flows increase.

Thickened sludge is believed to be the most practical sludge disposal/reuse alternative and is the recommended sludge management alternative. As the wastewater flows increase, and if energy costs and disposal costs increase significantly, this strategy could be re-evaluated for the higher flows.

Costs for the sludge management facilities are included in the cost summaries for the alternative wastewater management scenarios.

#### **4.2.5 Evaluation of Three Alternative Scenarios (1A, 2A, and 3A) Identified in the Alternatives Screening Analysis Report and Environmental Notification Form (ENF)**

Three Alternative Wastewater Management Scenarios (1A, 2A, and 3A) were identified in the Alternatives Screening Analysis Report and ENF for detailed evaluations. These scenarios utilized wastewater collection as discussed previously; utilized the Falmouth Country Club Site as the treated water recharge site; and made use of the following three different treatment facility sites as identified on Figure 4-5:

- The existing Blacksmith Shop Road WWTF Site;
- The Falmouth Country Club Site; and
- The Massachusetts Military Reservation (MMR) Site.

These evaluations are described in detail with a cost summary comparison in Appendix 4-5.

#### **4.2.6 Groundwater Modeling and Watershed Nitrogen Balance**

The Town was awarded a grant from the Cape Cod Water Protection Collaborative to complete groundwater modeling for the proposed recharge at the Falmouth Country Club Site. The modeling developed a calibrated sub-regional model based on the USGS regional model of the Sagamore Lens. Several model runs evaluated groundwater mounding to determine if the site had the hydraulic capacity to infiltrate the estimated flows. The model runs also evaluated flow particle tracking to determine which surface water bodies would ultimately “receive” the recharged water. That evaluation and the Guidance Document and Case Study Report that resulted is attached as Appendix 4-6. The main findings are summarized below.

- Based on the model calibration criteria, the groundwater flow model simulated existing and potential groundwater conditions at the site reasonably well.
- The groundwater mounding analysis conducted under high groundwater conditions for the Expanded High Priority Nitrogen Mitigation Area<sup>2</sup> flows indicates no flooding impacts. This same analysis for the upper watershed and potential Mashpee/Sandwich flows indicates that the low elevation portions of Site A would need to be raised in order to meet the 4-foot separation criteria, and this change could be made when the beds were constructed. There may also be some intermittent groundwater recharges (seeps) to the low swale south of Site A for this model run.

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<sup>2</sup> The Expanded High Priority Nitrogen Mitigation Area is the original Areas A through F that extended to Inner Harbor and the Mashpee border as illustrated in Figure 4-1.



- The results of the particle tracking analysis indicate that the ultimate fate of the treated water/groundwater will be primarily to the Bournes Pond watershed with significant flows to the Green Pond and Eel Pond watersheds. A small percentage of flow (10-percent or less) will be directed to the Waquoit Bay main watershed.

Hydraulic modeling results indicate that the recharge sites at the Falmouth Country Club property are feasible to recharge the flows from the Expanded High Priority Nitrogen Mitigation Area. The findings also indicate that the recharge sites at the Falmouth Country Club property may be feasible to recharge the flows from the upper watershed and Mashpee/Sandwich areas.

From a nitrogen loading perspective, the TMDLs for Little, Great, and Green Ponds could be met with ENR treatment and recharge as modeled at the Falmouth Country Club (FCC) site. The residual nitrogen concentration in the treated water (estimated at 3 mg/L total nitrogen) would cause the TMDLs for both Bournes Pond and Waquoit West to be exceeded even at 100-percent sewerage of these watersheds.

This finding indicates that the recharge of a successful wastewater plan needs to be distributed over a larger area and the treated water needs to be treated to lower nitrogen concentrations. This finding led to the next set of evaluations to investigate water reuse and well infiltration along the Route 151 right-of-way.

Subsequent to these evaluations, it was determined that these findings would not be carried forward as part of the Recommended Plan.

### **4.3 Second Group of Detailed Evaluations for Water Reuse Through Total Organic Carbon Treatment and Well Infiltration: 2008 to 2009**

Based on the finding that the nitrogen TMDLs could not be met for all the estuaries in the Planning Area when the recharge of 1.8 mgd was distributed as originally planned at the FCC site, and due as well to concern about the amount of land area required for surface infiltration; the project team investigated additional recharge sites and technologies with the understanding that the plan needs to efficiently and cost-effectively spread the recharge over a larger area and meet more stringent requirements.

#### **4.3.1 Well Infiltration Technology**

This technology was identified and screened in the November 2007 Alternatives Screening Analysis Report. It was added back into the detailed evaluation with the filing of the Draft Report and Notice of Project Change. With this technology, treated water is recharged to the groundwater by pumping it through wells into permeable, saturated geologic strata. This type of recharge can be compared to the reverse of extracting water from a well. Extensive treatment to remove the organic carbon from the water is needed to avoid plugging of the strata and to meet MassDEP's new effluent limits.

This technology has the advantage that it does not require the large land areas (cleared of trees and animal habitat) typically required for other infiltration technologies. As a result, it can be less expensive to implement and have significantly less environmental impact with respect to surface disruption and habitat damage.

The technology would be installed in the Route 151 right-of-way corridor (illustrated in Figure 4-4) to recharge it back into the Planning Area where it had originated. A detailed description of this recharge concept is attached in Appendix 4-7.



#### 4.3.2 Total Organic Carbon Treatment and Water Reuse

In early 2009, MassDEP revised their groundwater discharge regulations (314 CMR 5) to require removal of Total Organic Carbon (TOC) for treated water recharge into Zone II areas. They implemented this limit to protect drinking waters from a new class of contaminants called endocrine disruptors (discussed in the November 2007 Alternatives Screening Analysis Report starting on page 3-29). Endocrine disruptors, pharmaceuticals, and personal care products are included in a more general category of contaminants called “contaminants of emerging concern” or “CEC”. These CEC are being measured in water and wastewater at small concentrations because analytical methods have improved and use of pharmaceuticals and personal care products is becoming more widespread. They are considered “emerging” because there are no limits or standards on the amounts that might cause human or environmental health risk. These emerging contaminants are typically made of organic carbon compounds; therefore, if the TOC content is reduced to low values, the emerging contaminants are typically removed as well.

TOC is removed in biological treatment processes with long solids retention time and high mixed liquor suspended solids (MLSS). Additional advanced treatment processes are typically added to the biological process to meet low levels of TOC including:

- Membrane separation
- Advanced oxidation
- Granular activated carbon (GAC) adsorption

Conceptual designs for two advanced treatment processes to obtain low levels of TOC were developed as detailed in Appendix 4-8.

Treatment scenario type “B” utilizes GAC to attain a TOC concentration of <3 mg/L.

Treatment scenario type “C” utilizes GAC, Reverse Osmosis, and advanced oxidation to attain a TOC concentration of 1 mg/L or less.

Costs for these two treatment types based on a flow of 2.7 mgd at the MMR site are summarized in Appendix 4-8.

The high costs and complex operations of the type B and C treatment types renewed the interest in considering an ocean outfall alternative in more detail, and that evaluation was summarized Chapter 3.

This second group of detailed evaluations was identified for a Recommended Plan in 2009 and a Preliminary Draft CWMP was prepared dated December 2009. As this preliminary plan was being presented to the Board of Selectmen, there was strong concern that the Town could not afford these costs and that the CWMP Project had not sufficiently investigated non-traditional nitrogen and wastewater management strategies. This concern led to the Board of Selectmen to form a CWMP Review Committee who oversaw a third group of evaluations as summarized below.

Subsequent to these evaluations, it was determined that these findings would not be carried forward as part of the Recommended Plan.



## 4.4 Third Group of Detailed Evaluations Completed with the CWMP Review Committee: 2009 to 2010

### 4.4.1 Introduction

The CWMP Review Committee considered many changes to the 2009 Preliminary Draft DCWMP/DEIR and requested technical evaluations to develop more information to inform their decision-making process. The information requests and the resulting technical evaluations that were summarized in Technical Memoranda Nos. 1 through 7 (found in Appendices 4-3, 4-9 through 4-13, and 4-15) are described briefly in the following sections.

### 4.4.2 Development of Additional Scenarios

The CWMP Review Committee explored additional scenarios. The potential treatment and recharge sites which are part of these scenarios are illustrated on Figure 4-4, and the scenarios are briefly listed below:

- **Scenario 3C** includes the following components:
  - Advanced treatment at the MMR site with a treatment performance of less than 1 milligram per liter (mg/L) TOC and 1 mg/L total nitrogen on average.
  - Recharge of the treated water through infiltration wells placed in the Route 151 right-of-way (ROW) to distribute the recharge to the Planning Area watersheds.
  - This is the same Scenario 3C that was evaluated in the second group of detailed evaluations, and was the recommended alternative of the 2009 Preliminary Draft DCWMP-DEIR.
- **Scenario 3D** includes the following components:
  - Enhanced Nitrogen Removal treatment with treatment performance of 3 mg/L total nitrogen on average at the MMR site.
  - Discharge of the treated water at an outfall to the Cape Cod Canal.
- **Scenario 2A Modified** includes the following components:
  - Enhanced Nitrogen Removal treatment at the FCC site.
  - Subsurface recharge at the following sites:
    - Western portion of Falmouth Country Club site (Site 2B)
    - Southwest portion of Allen Property (Site 4)
    - Dupee Ball Field Property (Site 5)
- **Scenario 1A Modified** which includes the following components:
  - Advanced treatment at Blacksmith Shop Road (BSR) WWTF site to meet a treatment performance of 2 mg/L Total Nitrogen on average and less than 3 mg/L TOC.
  - Recharge of the treated water through infiltration wells placed at the northern edge of the BSR WWTF site (Site 7) and at the Land Swap Parcel (Site 10) located north of the BSR WWTF site.
- **Scenario 1D** which includes the following components:
  - Enhanced Nitrogen Removal treatment at the BSR WWTF.
  - Discharge of the treated water at an outfall to Vineyard Sound at Nobska Point.



These five scenarios are described in detail in Technical Memorandum No. 1 (attached in Appendix 4-9) with advantages and disadvantages and their costs. The costs were developed and summarized in a format that would allow future considerations of cost sharing and betterment development.

Subsurface investigations were completed for the treated water recharge components of these scenarios including:

- Site visits to all recharge sites.
- Test pits at sites 4 and 5.
- Groundwater modeling using the regional groundwater model developed as described earlier in this Chapter with the full report attached in Appendix 4-6. Model runs were developed for the following sites/technologies:
  - Injection wells north of the existing Blacksmith Shop Road WWTF at Sites 7 and 10 as part of Scenario 1A Modified.
  - Subsurface leaching systems at sites 2B, 4, and 5 as part of Scenario 2A.
  - Injection wells along Route 151 as part of Scenario 3C.
  - Potential groundwater draw-down as part of a possible ocean outfall for Scenarios 1D and 3D.

These subsurface investigations are described in detail in Technical Memorandum No. 2 as attached in Appendix 4-3. There are many detailed findings that are available to the interested reader. None of these scenarios were selected as the Recommended Plan; therefore these findings are not provided here. There were additional subsurface investigations completed as part of the new preferred scenario (1E) selected by the CWMP Review Committee as discussed later in this chapter.

#### **4.4.3 Cost Development for West Falmouth Harbor and Scranton Avenue**

The CWMP Review Committee also requested an update of capital costs to extend sewers to the West Falmouth Watershed and Scranton Avenue. These two sewer extension areas were recommended for connection to the Blacksmith Shop Road WWTF as part of the 2001 Wastewater Facilities Plan. Costs for the West Falmouth Sewer Extension area were estimated at approximately \$25 million as referenced to 2010 costs. Costs for the Scranton Avenue Sewer Extension area were estimated at \$790,000 (2010 cost reference).

Based on this cost development and other factors, the CWMP Review Committee decided that these two sewer extensions may be deferred to a later time.

These evaluations are summarized in detail in Technical Memorandum No. 3 as attached in Appendix 4-10.

#### **4.4.4 Options for Project Phasing**

Evaluations were completed and Technical Memorandum No. 4 (attached in Appendix 4-11) summarized the following main findings:

- An implementation plan is required as part of the CWMP, and its level of detail was discussed.
- The desire of most towns to maintain flexibility in their implementation plan was identified.



- Phasing and schedule information was provided for the MEPA review process to complete the CWMP, State Revolving Fund (SRF) processes, the Cape Cod Commission DRI review process, preliminary design, design, and construction implementation.

#### **4.4.5 Identification of Federal and State Funding Opportunities**

Technical Memorandum No. 5 (attached in Appendix 4-12) was developed to summarize these opportunities. The main opportunity that exists for the Town is the State Revolving Fund program for 2-percent and possibly zero-percent low interest rates. The following additional opportunities/funding mechanisms were discussed for various water quality improvement projects:

- American Recovery and Reinvestment Act (ARRA) funds (also known as “stimulus finds”) available in 2008 and 2009.
- USEPA funding through their 604b and 319 programs administered by MassDEP.
- Public Works Economic Development (PWED) grant program (this program has now been consolidated with other programs and is administered by MassWorks).
- Community Development Action Grant (CDAG) program.
- Massachusetts Coastal Zone Management (CZM) programs.
- United States Department of Agriculture Rural Utilities Program which is available for towns with year-round populations of less than 10,000 (unfortunately Falmouth does not meet this eligibility requirement).

#### **4.4.6 Costs and Non-Monetary Comparison for Centralized versus Cluster System Wastewater Management for Seacoast Shores Peninsula**

This evaluation was completed to consider comparable costs and non-monetary issues to provide improved wastewater management to this peninsula. Technical Memorandum No. 6 (attached in Appendix 4-13) was prepared to summarize the evaluations and found that multiple cluster systems were impractical and more expensive for this peninsula. This TM was peer reviewed by Fuss & O’Neill Inc. of Connecticut and met with general agreement.

#### **4.4.7 Committee Decision-Making and Selection of a Preferred Alternative**

As discussed above, the CWMP Review Committee was very active in its review of the previous 2009 Preliminary Draft CWMP and evaluation of additional wastewater management scenarios. The Review Committee Findings Document dated September 7, 2010 summarized their findings to that date. This document is attached in Appendix 4-14 and the key findings are listed below:

1. The 2009 Preliminary Draft CWMP Documents represent an excellent compilation of a broad spectrum of data and opportunities for wastewater management in Falmouth.
2. The Committee requested additional information that was provided by the Technical Memoranda.
3. The Committee does not share the conclusion of the December 2009 Preliminary Draft CWMP/DEIR that the MMR Site is the preferred option, with recharge in injection wells along Route 151.



4 – 6. Scenario 1E, the Preferred Option identified by the Committee includes:

- Treatment at the Blacksmith Shop Road WWTF to take advantage of existing treatment capacity at the facility and room to expand treatment facilities, and the economy of scale associated with construction and operation of only one major WWTF in Falmouth.
  - Discharge of additional flow outside the West Falmouth Harbor watershed using the following possible sites/technologies:
    - Land Swap Parcel (Site 10) with sand infiltration beds.
    - Parcel at northern edge of BSR WWTF (Site 7) with sand infiltration beds.
    - Dupee Ball Field property (Site 4) with subsurface leaching.
    - Allen Property (Site 5) with sand infiltration beds.
    - Western portion of Falmouth Country Club Site (Site 2B) with subsurface leaching.
    - Eastern portion of Falmouth Country Club Site (Sites A1 and B) with sand infiltration beds.
  - Suggested flow for recharge with the sand infiltration beds was 2.0 mgd.
  - Suggested flow for recharge with subsurface leaching was 1.0 mgd.
  - Ocean outfall at Nobska Point should continue to be considered as an option.
7. Sewer expansion in the High Priority Nitrogen Mitigation Areas (previously called Phase 1 and 2 areas) should start with the Little Pond watershed area and proceed to the east in several construction stages. MEP model runs should be used to help define sewer extensions.
8. Potential demonstration projects were proposed for the following alternative nitrogen management concepts:
- Pond inlet widening at Bournes, Little, and Perch Ponds with possible dredging.
  - Use of alternative toilets (composting, incinerating, or urine diversion).
  - Nitrogen uptake in the estuaries with oyster farming.
  - Cluster wastewater/permeable reactive barrier system.
  - Road runoff management.
  - Fertilizer control.
  - Tail ponds installed at the south ends of the cranberry bogs.
  - Ecological treatment systems.
  - Well injection treated water recharge at the BSR WWTF Site.
9. The Committee does not see the urgency for sewer extension to the Falmouth Heights area outside the Little Pond watershed; in the southerly part of Scranton Avenue; or in the West Falmouth Harbor watershed.
10. The High Priority Nitrogen Mitigation Areas (previously called Phase 1 and 2 sewer area) should extend from the Little Pond watershed to the eastern side of Seapit Peninsula.



11. The Committee believes that cluster systems are probable for the upper watershed areas, but not for the High Priority Nitrogen Mitigation Areas (previously called Phase 1 and 2 areas). The Committee also believes that the demonstration strategies listed in item 8 could bring new information to the Town.
12. A new standing committee should be formed to assist with the project in the future.
13. The treatment and recharge facilities should be expanded in a modular approach.

Based on these findings, GHD was asked to verify the costs and feasibility of this Preferred Option. This verification evaluation was summarized in Technical Memorandum No. 7 (attached in Appendix 4-15) as detailed below.

#### 4.4.8 Scenario 1E as the Preferred Alternative

The Preferred Option was identified as Scenario 1E with a total flow of 2.1 mgd. The revised sewer service area, as well as potential treatment and recharge sites are identified on Figure 4-6.

Projected future flows for this scenario are summarized in Table 4-2 with explanations in the notes at the end of the table.

**Table 4-2 Projected Future Flows for Scenario 1E**

Source	Wastewater Flow (mgd <sup>1</sup> )	Future Sewer Units <sup>2</sup>
Existing WWTF <sup>3</sup>	0.38	N/A
Infilling for Existing Collection Area <sup>4</sup>	0.09	530
Sewer Service Area A	0.08	470
Sewer Service Area B	0.40	2,350
Sewer Service Area C	0.22	1,290
Sewer Service Area D	0.30	1,760
Sewer Service Area E	0.23	1,350
Allowance for I/I <sup>5</sup>	<u>0.37</u>	<u>N/A</u>
<b>Total</b>	<b>2.1</b>	<b>7,750</b>

Notes:

1. Million gallons per day rounded to two significant digits.
2. Based on Future Wastewater Flow for the Sewer Extension Area of the time divided by 170 gpd/residential properties as identified in the Needs Assessment Report.
3. From the October 2007 Needs Assessment Report.
4. From the 2001 WWFP/FEIR.
5. Estimated at 30% of the Planning Area flow as discussed in the Needs Assessment Report.

Sand infiltration beds were proposed for Sites 7, 10, 5, A1, and 2B as illustrated on Figure 4-6. Table 4-3 summarizes information developed in 2010 about each site and its estimated capacity.



**Table 4-3 Sand Infiltration Bed Site Summary**

Site <sup>4</sup>	Estimated Maximum Bed Area <sup>1</sup> (acre)	Estimated Design Infiltration Rate (gpd/sf <sup>2</sup> )	Estimated Maximum Capacity (mgd <sup>3</sup> )
7	5.4	5	1.2
10	10	5	2.2
5	12.6	7	3.8
2B	4.9	7	1.5
A1	6.6	7	2.0

Notes:

1. Assumes reasonable buffers to adjoining properties. This is typically 100-feet to an adjacent parcel with special considerations for buffers to other Town-owned parcels, and provides a 10-percent allowance for internal berms.
2. Gallons per day per square foot.
3. Million gallons per day.
4. The sites are listed with respect to their distance from the BSR WWTF Site (Site 7 is closest and Site A1 is furthest).

The following additional considerations are provided for these sites and estimates:

- The design infiltration rates for Sites 7 and 10 are estimated at 5 gpd/sf.
- The design load rates of 7 gpd/sf for Sites 5, 2B, and A1 is based on a hydraulic load test completed at the FCC Site and subsequent correspondence with MassDEP.
- Sites 7 and 10 are outside watersheds with nitrogen TMDLs, therefore, nitrogen removal to 3 mg/L total nitrogen (TN) on average (as currently designed at the BSR WWTF) is more than the 5 to 7 mg/L TN on average that would typically be required for this area.
- Sites 5, 2B, and A1 are in watersheds that have TMDLs (Great Pond and Bourne Pond watersheds) or in the Waquoit West watershed that is expected to have nitrogen limitations. Recharges at these locations are expected to need additional sewerage in the watershed to meet a TMDL at the end of the Phase 3 period.
- All of these sites are undisturbed, wooded sites. Significant land clearing would be needed and will need to be considered in a revised environmental impact analysis.

Subsurface leaching facilities have been proposed for Sites 4 and 2B and the following considerations are provided:

- Site 2B would be the preferred site because it is a large (relatively) flat golf course that was purchased for wastewater management purposes. It is also in the Upper Green Pond watershed which would have available nitrogen assimilation capacity if the Green Pond Lower Watershed Area was sewerage.
- Site 4 was evaluated as part of Technical Memorandum No. 2 (attached in Appendix 4-3).
- Phosphorus loading could be an issue for recharge at these sites.



Treated water transport to these sites could be provided by a pump station at the Blacksmith Shop Road WWTF and force main to Sites 7, 10, and ultimately to Site 2B. The distance to Site 10 is approximately 1.7 miles and the additional distance to Site 2B is 3.2 miles for a total distance of 4.9 miles. Most of the force main would be in the road layout except for the portion from the BSR WWTF to Site 7 at Research Road.

The costs for Scenario 1E are summarized in Appendix 4-17.

It is noted that Scenario 1E is different than the previous scenarios in the following ways:

- The High Priority Nitrogen Mitigation Area has decreased due to the Falmouth Heights and Waquoit East areas being removed.
- Scenario 1E makes use of excess treatment capacity at the BSR Site because that capacity is no longer allocated to the West Falmouth Harbor and Scranton Avenue sewer areas planned in the 2001 WWFP.
- Scenario 1E utilizes relatively inexpensive recharge capacity at Sites 7 and 10 using sand infiltration beds.

#### **4.4.9 Comparison of Costs with Other Scenarios**

Table 4-4 summarizes the costs for Scenario 1E with Scenarios 3C, 3D, 2A, 1A, and 1D as discussed in Technical Memorandum No. 1.

As discussed previously, the High Priority Nitrogen Mitigation Area for Scenario 1E is different than for the other scenarios which use the term Expanded High Priority Nitrogen Mitigation Area; therefore, the costs for sewer extensions are not an equal comparison. The costs for "Total Areas" are generally an equal comparison because they are all estimated to meet the TMDLs.

This table illustrates that Scenario 1E has the lowest cost. The next two lowest cost scenarios are ones that would use ocean outfalls.

Many of the recommendations of this group of evaluations were carried forward to the Recommended Plans as modified by the WQMC as described in the following section.

### **4.5 Fourth Group of Detailed Evaluations Completed with the WQMC to Develop the Draft Report: 2011 to 2012**

The WQMC continued the work of the CWMP Review Committee and oversaw several evaluations from 2011 to 2012 to develop the Draft Report which was submitted for MEPA review in September 2012 and received a MEPA Certificate in November 2012. These evaluations are summarized below.

#### **4.5.1 Hydraulic Load Tests at Sites 7 and 10 as Part of Scenario 1E**

Hydraulic loading tests were completed between July 25 and August 5, 2011 for sites 7 and 10. Testing was performed in a 10-foot diameter basin. Testing at each site was comprised of:

1. One day of saturating the soils beneath the basins for a 24-hour period by sustaining a water level in the basin.
2. One day of constant head testing, during which water was fed to the basin at the same rate that water drained from the basin, as indicated by a constant water level in the basin.

**Table 4.4 Summary of Costs for All Scenarios Evaluated for CWMP Review Committee**

Cost Component	Scenario 3C <sup>1</sup>			Scenario 3D <sup>2</sup>			Scenario 2A <sup>3, 11</sup>			Scenario 1A <sup>4</sup>			Scenario 1D <sup>5</sup>			Scenario 1E <sup>6</sup>		
	Expanded High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas	Expanded High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas	Expanded High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas	Expanded High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas	Expanded High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas	High Priority Nitrogen Mitigation Area	Upper Watershed Areas	Total Areas
<b>Capital Costs</b>																		
<i>Collection System</i>	\$200,000,000	\$110,000,000	\$310,000,000	\$200,000,000	\$110,000,000	\$310,000,000	\$190,000,000	\$140,000,000	\$330,000,000	\$200,000,000	\$110,000,000	\$310,000,000	\$200,000,000	\$110,000,000	\$310,000,000	\$170,000,000	\$130,000,000	\$300,000,000
<i>Treatment Site and Systems</i>	\$54,000,000	\$17,000,000	\$71,000,000	\$26,000,000	\$9,000,000	\$35,000,000	\$26,000,000	\$10,000,000	\$36,000,000	\$46,000,000	\$18,000,000	\$64,000,000	\$17,000,000	\$9,000,000	\$26,000,000	\$15,000,000	\$17,000,000	\$32,000,000
<i>Treated water Recharge</i>	\$8,000,000	\$1,500,000	\$9,500,000	\$21,000,000	\$0	\$21,000,000	\$46,000,000	\$28,000,000	\$74,000,000	\$4,400,000	\$1,400,000	\$5,800,000	\$38,000,000	\$0	\$38,000,000	\$25,000,000	\$0	\$25,000,000
<b>Total Construction Costs</b>	<b>\$262,000,000</b>	<b>\$129,000,000</b>	<b>\$391,000,000</b>	<b>\$247,000,000</b>	<b>\$119,000,000</b>	<b>\$366,000,000</b>	<b>\$262,000,000</b>	<b>\$178,000,000</b>	<b>\$440,000,000</b>	<b>\$250,000,000</b>	<b>\$129,000,000</b>	<b>\$379,000,000</b>	<b>\$255,000,000</b>	<b>\$119,000,000</b>	<b>\$374,000,000</b>	<b>\$210,000,000</b>	<b>\$147,000,000</b>	<b>\$357,000,000</b>
Contingency (25%)	\$66,000,000	\$32,000,000	\$98,000,000	\$62,000,000	\$30,000,000	\$92,000,000	\$66,000,000	\$45,000,000	\$111,000,000	\$63,000,000	\$32,000,000	\$95,000,000	\$64,000,000	\$30,000,000	\$94,000,000	\$53,000,000	\$37,000,000	\$90,000,000
Fiscal, Legal and Engineering (25%)	\$66,000,000	\$32,000,000	\$98,000,000	\$62,000,000	\$30,000,000	\$92,000,000	\$66,000,000	\$45,000,000	\$111,000,000	\$63,000,000	\$32,000,000	\$95,000,000	\$64,000,000	\$30,000,000	\$94,000,000	\$53,000,000	\$37,000,000	\$90,000,000
<b>Total Capital Costs (Notes 7-9)</b>	<b>\$390,000,000</b>	<b>\$190,000,000</b>	<b>\$580,000,000</b>	<b>\$370,000,000</b>	<b>\$180,000,000</b>	<b>\$550,000,000</b>	<b>\$390,000,000</b>	<b>\$270,000,000</b>	<b>\$660,000,000</b>	<b>\$380,000,000</b>	<b>\$190,000,000</b>	<b>\$570,000,000</b>	<b>\$380,000,000</b>	<b>\$180,000,000</b>	<b>\$560,000,000</b>	<b>\$320,000,000</b>	<b>\$220,000,000</b>	<b>\$540,000,000</b>
<b>Total O&amp;M Annual Costs (Note 10)</b>	<b>\$6,300,000</b>	<b>\$3,100,000</b>	<b>\$9,400,000</b>	<b>\$2,900,000</b>	<b>\$1,500,000</b>	<b>\$4,400,000</b>	<b>\$3,000,000</b>	<b>\$1,500,000</b>	<b>\$4,500,000</b>	<b>\$5,300,000</b>	<b>\$2,500,000</b>	<b>\$7,800,000</b>	<b>\$2,900,000</b>	<b>\$1,500,000</b>	<b>\$4,400,000</b>	<b>\$2,700,000</b>	<b>\$1,500,000</b>	<b>\$4,200,000</b>
Discount Rate of 5% (P/A for 5% and 20 yr = 12.4622)																		
<b>Present Worth of O&amp;M Costs</b>	<b>\$79,000,000</b>	<b>\$39,000,000</b>	<b>\$53,000,000</b>	<b>\$36,000,000</b>	<b>\$19,000,000</b>	<b>\$53,000,000</b>	<b>\$37,000,000</b>	<b>\$19,000,000</b>	<b>\$53,000,000</b>	<b>\$66,000,000</b>	<b>\$31,000,000</b>	<b>\$53,000,000</b>	<b>\$36,000,000</b>	<b>\$19,000,000</b>	<b>\$53,000,000</b>	<b>\$34,000,000</b>	<b>\$19,000,000</b>	<b>\$53,000,000</b>
<b>Total Present Worth Costs</b>	<b>\$470,000,000</b>	<b>\$230,000,000</b>	<b>\$700,000,000</b>	<b>\$410,000,000</b>	<b>\$200,000,000</b>	<b>\$610,000,000</b>	<b>\$430,000,000</b>	<b>\$290,000,000</b>	<b>\$720,000,000</b>	<b>\$450,000,000</b>	<b>\$220,000,000</b>	<b>\$670,000,000</b>	<b>\$420,000,000</b>	<b>\$200,000,000</b>	<b>\$620,000,000</b>	<b>\$350,000,000</b>	<b>\$240,000,000</b>	<b>\$590,000,000</b>
General Notes:																		
1. Wastewater collection ( <b>Expanded</b> Nitrogen Mitigation High Priority Area); treatment at Otis WWTF/MMR site with MBR, reverse osmosis, and carbon adsorption technologies; and well injection in Route 151 right-of-way (ROW)																		
2. Wastewater collection ( <b>Expanded</b> Nitrogen Mitigation High Priority Area); treatment at Otis WWTF/MMR site with SBR and denitrification filter technologies; and ocean discharge/outfall to Cape Cod Canal.																		
3. Wastewater collection ( <b>Expanded</b> Nitrogen Mitigation High Priority Area); treatment at Falmouth Country Club (FCC) site with SBR and denitrification filter technologies; and subsurface recharge at 3 sites west of FCC WWTF site																		
4. Wastewater collection ( <b>Expanded</b> Nitrogen Mitigation High Priority Area); treatment at Blacksmith Shop Road (BSR) site with MBR and carbon adsorption technologies; and well injection at 2 sites north of BSR WWTF Site.																		
5. Wastewater collection ( <b>Expanded</b> Nitrogen Mitigation High Priority Area); treatment at Blacksmith Shop Road (BSR) site with SBR and denitrification-filter technologies; and ocean discharge/outfall at Nobska Point.																		
6. Wastewater collection (Nitrogen Mitigation High Priority Area); treatment at Blacksmith Shop Road (BSR) site with ENR and Phosphorus-removal technologies; and sand-infiltration-bed recharge at 2 sites north of BSR WWTF Site (Sites 7 and 10) and subsurface-leaching recharge at the Falmouth Country Club Site (Site 2B)																		
7. All costs are rounded to two significant digits except Total Construction Costs which are rounded to 3 significant digits to reduce rounding error																		
8. All cost are referenced to January 2010 costs (Engineering News Record Index 8660). These cost will need to be adjusted for inflation in the future. Costs for Scenarios 3C, 3D, 2A, and 1A are from Technical memorandum No 1 where they are presented in greater detail.																		
9. These costs do not include house connection costs observed at \$2,000 to \$5,000 per connection at the New Silver Beach Project.																		
10. These O&M costs represent the incremental increase to existing O&M Costs at the BSR WWTF to allow a comparison of Present Worth Costs of other Scenarios as completed in TM-1.																		
11. The costs for this scenario do not include phosphorus removal facilities.																		



3. One day of falling head testing, recording the rate at which the water level in the basin dropped. This was repeated multiple times throughout the day of testing.

For the constant head testing, an average infiltration rate of 103 gpd/sf was calculated. Applying the USEPA design factor of 10-percent to that result, an appropriate design rate is 10 gpd/sf.

In the falling head testing, an average infiltration rate of 72 gpd/sf for the Site 7 basin and 84 gpd/sf for the Site 10 basin was calculated. If the more conservative number is used and the USEPA design factor of 10-percent is applied to that result, a design rate of 7 gpd/sf is indicated.

Based on this analysis, a design rate of 7 gpd/sf is planned to be used to calculate the land areas needed for the two infiltration facilities and to be used in the groundwater modeling. This rate is consistent with the rate approved by MassDEP for the Falmouth Country Club Site, and is an increase over the 5 gpd/sf rate that the State would allow if a hydraulic load test was not completed.

Additional cost savings could be attained if a higher rate is used, and discussions with MassDEP indicate that the design loading rate can be increased (and the facility capacity increased) once a facility is operated and there is a proven record of higher infiltration rates. The Town should verify the effluent infiltration rate of the first site constructed before developing a second site.

A more detailed description of the hydraulic load testing is provided in Technical Memorandum No. 8 which is attached as Appendix 4-19.

#### **4.5.2 Initial Groundwater Modeling for Sites 7 and 10**

Several recharge flow scenarios were developed and modeled using the sub-regional groundwater model developed from the USGS regional model for the Sagamore Lens as described in Technical Memorandum No. 9 attached in Appendix 4-20.

The modeling evaluations for this scenario indicate that the total average annual flow of 2.1 mgd projected for the High Priority Nitrogen Mitigation Area in combination with the existing wastewater collection areas (identified in Table 4-2) could be recharged at the existing WWTF and at Sites 7 and 10 north of the WWTF site. The average annual flows would be distributed to the sites as follows:

- 0.5 mgd at the existing WWTF site through existing Infiltration Beds 9 – 13.
- 0.9 mgd at Site 7 at new infiltration beds.
- 0.7 at Site 10 at new infiltration beds located in the western half of the site.

These recharges were not expected to cause exceedances of the nitrogen TMDL at the West Falmouth Harbor.

Table 4-5 summarizes the modeled fate of the recharged water for these initial groundwater modeling runs.



**Table 4-5 Scenario P12AAB, Fate of Treated Water Recharge Expressed as Percentage of Total Recharge**

<b>Ultimate Location Where Treated Water/Groundwater Surfaces</b>	<b>WWTF Recharge of 0.5 mgd</b>	<b>Site 7 Recharge of 0.9 mgd</b>	<b>Site 10 Recharge of 0.7 mgd</b>
Wing Pond	0%	0%	81%
Herring Brook	0%	8%	0%
Bay at Herring Brook	0%	0%	16%
Bay Between Herring Brook and West Falmouth Harbor	0%	92%	3%
West Falmouth Harbor	86%	0%	0%
Bay Beyond West Falmouth Harbor	14%	0%	0%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Figure 4-7 illustrates this fate with modeled particle tracks.

Technical Memorandum No. 9 (attached as Appendix 4-20) provides a detailed summary of these modeling evaluations. It is noted that Crocker Pond was not identified on Table 4-5 due to the modeling result that the particles do not end in Crocker Pond. This modeling result and oversight were corrected in subsequent groundwater modeling runs.

#### **4.5.3 Archaeological Sensitivity Assessment for Sites 7 and 10**

The Public Archaeology Laboratory (PAL) completed an archaeological assessment as summarized in their Due Diligence Report attached in Appendix 4-21.

Prior to the start of field work, the PAL team reviewed available documents and files including files at the Massachusetts Historical Commission (MHC). The file review indicated that no previously recorded archeological sites are located within or immediately adjacent to the two sites or on a potential pipeline route from the WWTF to Site 7.

The site work was completed in December 2011 and is well documented in Appendix 4-21. No archaeological resources were found, and several areas of site disturbance were noted.

A sensitivity assessment was completed and a moderate sensitivity ranking is indicated for the sites. This ranking indicates that it is possible that intact archeological deposits associated with Native American pre-contact campsites and/or hunting activities could be present in this area. The PAL team recommended that the Town consult with MHC to determine the need for and scope of an intensive (locational) archeological survey on areas that would be disturbed by excavation. The purpose of the survey, which would need to be completed in consultation with and under permit from the MHC, would be to identify any potentially significant archeological resources at the proposed disturbed site. This intensive (locational) archeological survey was performed in August 2013 and based on their investigation did not identify any potentially significant archaeological resources and determined that no additional archaeological investigations are necessary at Site 7. A copy of the Management Abstract regarding this work is included in Appendix 4-21.



#### **4.5.4 Natural Resources and Endangered Species Assessment for Sites 7 and 10**

On November 15, 2011 Michelle Ford of GHD, a certified wildlife biologist and registered professional soil scientist, visited the proposed infiltration bed areas identified as Site 7 and Site 10. The purpose of this visit was to identify any significant natural resource or natural resource features such as regulated wetland resources, potential rare, threatened or endangered species habitat, and to document the general natural resource communities present at the sites.

##### **4.5.4.1 Topography**

In general, the proposed infiltration areas are topographically very similar in that they both demonstrate frequent changes in elevation, ranging between 80+ and 120+ feet above mean sea level (MSL) at Site 10 and between 40+ and 80+ feet above MSL at Site 7. The varying topography appears to enhance small scale variations in the vegetative community; however such differences are too small to be classified as individual vegetative communities or habitat. The undulating topography at each site appears to be native and non-man altered with the exception of one or two areas at Site 7 where it appears some small-scale (<1,000 sf) historic excavation/earth moving had occurred. Several trails/dirt pathways exist at Site 10, however these generally follow the existing topography of the land. At each site large boulders are observed throughout the landscape.

##### **4.5.4.2 Geology and Soils**

Although no soils were explored during the visit to the site, the area appears to be formed in glacial moraine. According to the National Resource Conservation Service (NRCS) soil survey for Barnstable County, soils within Sites 7 and 10 are considered Plymouth Barnstable Complex, described as, 'undulating and rolling, very deep, excessively drained and well drained soils are on the side slopes of moraines.' The area is mapped as having stones and boulders cover 1- to 15-percent of the surface with slopes ranging from 3- to 15-percent.

The Plymouth Barnstable Complex is comprised of approximately 55-percent Plymouth soil, 20-percent Barnstable soil, and 25 percent other soils. Typically, Plymouth soil is covered with a thin (1+ inch) layer of loose, un-decomposed pine needles/debris, leaves, and twigs and 1+ inch layer of partly and well decomposed organic material. Typically, the subsoil is about 26-inches thick. According to NRCS, 'permeability is rapid in the subsoil of the Plymouth soil and very rapid in the substratum. Available water capacity is low.'

The surficial, organic layers of Barnstable soil are similar to that of Plymouth soils and the subsoil is typically 22-inches thick. According to NRCS, 'Permeability is moderately rapid in the subsoil of the Barnstable soil and rapid or very rapid in the substratum. Available water capacity is moderate.'

- Site 7: Soils within Site 7 are entirely Plymouth Barnstable Complex, hilly and extremely bouldery, with the exception of an approximately 0.9 acre inclusion of soils mapped as Plymouth Barnstable Complex, rolling hills and extremely bouldery.
- Although not currently being pursued as a recharge site, Site 10: Soils are entirely Plymouth Barnstable Complex, hilly and extremely bouldery, with the exception of an approximately 1.3 acre inclusion of soils mapped as Plymouth Barnstable Complex, rolling hills and extremely bouldery.



#### 4.5.4.3 Plant and Animal Species and Habitat

Flora and fauna at both Sites 7 and 10 are highly similar and are therefore described below in conjunction with one another. Please note the following summary is not meant to be interpreted as a full vegetative survey of the subject areas, but rather to provide a general overview of vegetative communities present. The areas consist of mature, mixed hard and soft wood species of oak (scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), white oak (*Quercus alba*) and pine (white pine (*Pinus strobus*) and pitch pine (*Pinus rigida*) with a well-established, predominately closed canopy. In general the mid-strata growth of saplings and shrubs is minimally developed throughout the areas. Groundcover is predominately patchy, in that there are areas of dense lowbush blueberry (*Vaccinium angustifolium*) and areas otherwise covered with not much more than leaf litter and organic debris. Groundcover species observed throughout each site include lowbush blueberry, spearmint (*Mentha spicata*), ground pine (*Lycopodium obscurum*), and mountain laurel (*Kalmia latifolia*).

Wildlife in the area was relatively sparse during the site visit, likely due to both the time of day (late afternoon) and season (mid-November). Several common species were observed however, including blue jay (*Cyanocitta cristata*), dark eyed junco (*Junco hyemalis*), and American crow (*Corvus brachyrhynchos*). White-tailed deer (*Odocoileus virginianus*) scat was observed at Site 10 and a bat (unidentifiable) was observed in flight in the clearing near Site 10.

Prior to the November 15 Site visit, current Natural Heritage and Endangered Species Program (NHESP) mapping for the area was reviewed and, according to the most recent (September 2008) information on mapped protected species habitat from the Massachusetts Division of Fisheries, NHESP, the entirety of Site 7 and Site 10 lie within mapped Estimated and Priority habitat of State protected flora and/or fauna.

Based on correspondence from NHESP dated November 21, 2011, the species of concern at the Sites is the eastern box turtle (*Terrapene carolina*). According to NHESP, this species is a terrestrial turtle, inhabiting many types of habitats including both dry and moist woodlands, brushy fields, thickets, marsh edges, bogs, swales, fens, stream banks, and well-drained bottomland. Eastern box turtles overwinter in upland forest, several inches below the soil surface. Females nest in June or early July in early successional fields, meadows, utility right of ways, woodland openings, roadsides, cultivated gardens, residential lawns, mulch piles, beach dunes, and abandoned gravel pits. Habitat for eastern box turtles can be found in the entirety of Sites 7 and 10 which are each upland forest. Although no wetlands are present, the forested areas may be used by the turtles as overwintering grounds and possibly for nesting in any open canopy or road-side areas.

Any construction/timber clearing activities should therefore be coordinated appropriately to minimize potential contact with this species. Exclusionary barriers and periodic inspections during Site activities would also be recommended to minimize impact. The surrounding area consists of relatively contiguous upland forest which likely offers similar habitat and resources. An assessment of the surrounding was not undertaken as a part of this assessment.

#### 4.5.4.4 Wetlands

No wetland resources or other surficial water resources including inland freshwater wetlands, vernal pools, or watercourses were observed at either site at the time of the site visit.



#### 4.5.4.5 Rare or Unique Features

No features that could be classified as unique or significant, such as abandoned structures, surficial historic landmarks, or unique landforms, were readily observed at either site.

#### 4.5.5 Initial Evaluations for Sewershed Delineation and Capital Cost Development for the Little Pond Area

The CWMP Review Committee recommended that sewer extension in the High Priority Nitrogen Mitigation Area start with the Little Pond watershed in the west and proceed to the east during the 20-year planning period. The initial detailed evaluations of sewershed delineation and capital costs for the Little Pond area are summarized in Appendix 4-22. These are the evaluations and costs that were submitted in the Draft Report and have now been superseded to address MEPA comments.

### 4.6 Fifth Group of Detailed Evaluations Completed with the WQMC to Address MEPA Comments and Develop the CWMP/FEIR/TWMP: 2012 to 2013

#### 4.6.1 Response to MEPA Comments

Good comments were received from various regulators that are tasked with reviewing CWMP projects of this type as well as from members of the Town public. These comments are attached with the Secretary's Certificate (November 14, 2012) in Appendix 1-4. This appendix also contains a Response to Comments memorandum that responds to each major comment and indicates how the comment was addressed.

#### 4.6.2 Preliminary Design of Proposed Little Pond Sewer Extension, Upgrades to the WWTF, and Proposed Site 7 Recharge Facility

Preliminary design of proposed Little Pond sewer extension, upgrades to the WWTF, and proposed Site 7 recharge facility were completed in March 2013. Several preliminary design evaluations were completed to decide on the wastewater collection system technology and to develop more accurate capital O&M costs.

These evaluations led to a group of Technical Memoranda (TM) that are attached as appendices to this CWMP/FEIR/TWMP as listed below.

- **TM S-0 Collection System Technology Comparison:** This TM summarizes the various collection system technologies available and reviewed the advantages and disadvantages of each technology. This TM is attached as Appendix 4-23.
- **TM S-1 Little Pond Sewer Service Area Evaluation:** This TM summarizes the evaluations to apply the various collection system technologies identified in S-0 to the Little Pond Sewer Service Area. The findings of these evaluations were presented to the Water Quality Management Committee (WQMC) and the Town's Department of Public Works (DPW) who concurred with the technologies selected. This TM is attached as Appendix 4-24.
- **TM S-2 Preliminary Design For Little Pond Service Area:** This TM outlines the basis of the preliminary design and summarizes the infrastructure proposed based on the recommended technology. This TM is attached as Appendix 4-25.
- **TM S-3 Existing Collection System Evaluation:** This TM summarizes the reviews of the existing collection system and evaluates existing capacity and potential connection points for the Little Pond Sewer Service Area, and potential future connection areas and flows within the system to identify the highest priority area for inflow and infiltration (I/I) removal. This TM is attached as Appendix 4-26.



- **TM S-4 Hydraulic Balance:** This TM provides an updated water balance on the existing collection system based on existing 2011 water records and pumping station meter readings. This TM is attached as Appendix 4-27.
- **TM PS-1 Pumping Stations Condition Assessment:** This TM provides a summary of the review of the existing pumping stations with the DPW/WWTF staff to assist in the prioritization of possible maintenance and repair activities and potential long-term improvements at these stations. This TM is attached as Appendix 4-28.
- **TM WW-1 Existing WWTF and Vent Evaluation:** This TM provides an evaluation of the existing Falmouth Wastewater Treatment Facility and service vent in order to determine the treatment capacity of the facility, identify operational limitations, and address issues raised in the new effluent discharge permit. This TM is attached as Appendix 4-29.
- **TM TW-1 Preliminary Design Evaluations for Site 7 Development:** This TM summarizes preliminary design evaluations for the development of a new treated water recharge facility at Site 7. This TM is attached as Appendix 4-30.
- **TM BP-1 Bournes Pond Inlet Opening Evaluations and Preliminary Design:** This TM summarizes the preliminary design evaluations for an enlarged inlet to Bournes Pond and a new bridge to go over that inlet as discussed in Chapter 3 and attached as Appendix 3-4.

The preliminary design evaluations exceeded the level of detail that is typically developed for a CWMP and they developed more precise construction, design, permitting, and O&M costs to inform the CWMP Process as referenced in following sections.

#### **4.6.3 Re-Delineation of Little Pond Sewer Service Area and Estimated Costs**

The MEPA comments and the preliminary design process provided input to finalize the delineation of the Little Pond Sewer Service Area as illustrated in Figure 4-8. This area is a slight modification to the one provided in the Draft Report and picks up additional properties requested to be included by MassDEP. It is also a slight modification to the delineation evaluated in the preliminary design, but very close to that area and concept. The collection system is recommended to be a combination of gravity sewers and low pressure sewers (served by grinder pumps on individual properties) to convey the wastewater through the existing collection system to be conveyed to the Blacksmith Shop Road WWTF. Two Town municipal lift (pumping) stations are recommended; one located behind the Teaticket Elementary School at the northern end of the sewer service area, and the other at the Falmouth Mall located in the central portion of the service area. Costs for the sewer extension are summarized below:



**Table 4-6 Cost Summary for Little Pond Sewer Service Extension**

<b>Collection System Component</b>	<b>Cost <sup>1</sup></b>
Collection Pipe and Road Reconstruction	\$22,000,000
Lift Stations	\$1,800,000
General Conditions	\$3,800,000
<b>Total Construction Costs</b>	<b>\$28,000,000</b>
Contingency	\$5,500,000
Engineering During Design <sup>2</sup> :	\$4,200,000
Survey and Soil Borings	\$1,100,000
Fiscal, Legal, and Permitting	\$280,000
Design	\$2,800,000
Engineering During Construction	\$3,300,000
<b>Total Capital Cost with Contingency (July 2016)<sup>3</sup></b>	<b>\$41,000,000</b>

1. Rounded to two significant figures.
2. This cost was funded by Article 24 of the April 2013 Town Meeting.
3. Based on 3-percent increase per year from July 2012 to an estimated midpoint of construction of July 2016.

**4.6.4 Projected Wastewater Flows from the Little Pond Sewer Service Area**

The service area flow is based on 150 gallons per day for future residential properties and non-residential flows increasing as allowed by zoning. This is a modification from the original buildout evaluation and estimate of future flow presented in the Needs Assessment Report for the total Planning Area. The projected future wastewater flow for this area is 0.26 mgd. The existing water consumption in this area (an indication of existing wastewater flow) is approximately 0.18 mgd. The increase from existing to projected flow is based on estimates of additional land use as the area moves toward redevelopment and possible changes in occupancy rates. This evaluation is summarized in Appendix 4-31 and this design flow is characterized as a “preliminary future flow” for the area. There is a need for a revised buildout analysis for this area once further evaluations are completed on a Flow Neutral Bylaw.

**4.6.5 Recommended Improvements at the Blacksmith Shop Road WWTF and the Service Road Vent**

The new effluent discharge permit and settlement agreement identified several improvements that are needed at the Blacksmith Shop Road WWTF. Technical Memorandum WW-1 (Appendix 4-29) completed a detailed assessment of facility condition, capacity, and performance, and identified additional improvements. These improvements are summarized on Table 4-7 with estimated costs.



**Table 4-7 Summary of WWTF Improvements and Estimated Costs**

<b>Phase 1 Improvements</b>	<b>Cost</b>
Effluent Flow Measurement Improvements <sup>1</sup>	\$360,000
Design and Bid Phase Engineering and Permitting Allowance	\$440,000
<b>Total Construction Cost with Contingency (December 2012 dollars; ENR = 9412)<sup>1</sup></b>	<b>\$800,000</b>
<b>Phase 2 Improvements</b>	<b>Cost</b>
Alkalinity System Improvements	\$210,000
Methanol System Improvements	\$130,000
Sludge Processing Improvements	\$850,000
Sequencing Batch Reactor Improvements	\$310,000
Denitrification Filter Improvements	\$500,000
Service Vent Improvements	\$390,000
Ultraviolet Disinfection Improvements	\$60,000
Septage Receiving Improvements	\$130,000
Influent Wet Well Improvements	\$70,000
Operations Building Improvements	\$210,000
Other Areas Improvements	\$20,000
<b>Subtotal of Construction Cost Estimate</b>	<b>\$2,900,000</b>
Contingency	\$730,000
<b>Total Construction</b>	<b>\$3,600,000</b>
Legal, Fiscal, and Construction Engineering Allowance	\$470,000
<b>Total Construction Cost with Contingency (December 2012 dollars; ENR = 9412)</b>	<b>\$4,100,000</b>
Inflation Increase to December 2014 <sup>2</sup>	\$250,000
<b>Total Construction Cost with Contingency (Expected Construction Cost—December 2014 dollars)</b>	<b>\$4,400,000</b>
<b>Total Capital Costs</b>	<b>\$5,200,000</b>

1 Funded by Article 24 of the April 2013 Town Meeting.

2 Based on 3-percent increase per year from July 2012 to an estimated construction date of December 2014



These improvements are required to comply with the Town's groundwater discharge permit (as modified through the 2012 Settlement Agreement), to improve consistency and stability of the wastewater treatment system, to ensure sufficient treatment capacity for the added wastewater load from the Little Pond Service Area, and to address the odor at the Service Road vent. These improvements have been evaluated to make the most of existing facilities and to focus on the most essential improvements.

The most expensive of the recommended improvements—sludge processing facility improvements—is expected to pay for itself within approximately 13 years by reducing the volume of sludge hauled from the facility, thereby reducing the sludge hauling portion of the Wastewater Division annual operating budget by as much as \$60,000 from \$210,000 per year to as little as \$150,000 per year (all costs are based on the Town's current sludge hauling contract and are in 2012 dollars).

#### **4.6.6 Additional Groundwater Modeling of the Treated Water Recharge at Site 7**

Additional groundwater modeling was completed for potential treated water recharges at Site 7. Four alternative flows were modeled as listed below:

- 0.82 mgd which is the calculated maximum flow that could be recharged at Site 7 as allowed by land area and conventional engineering recharge rates.
- 0.30 mgd which was an early estimate of wastewater flow that could come from for the Little Pond Sewer Service Area.
- 0.28 mgd which is estimated to be the maximum flow that could be recharged at the site without any of the recharge flow moving to Herring Brook located northwest of Site 7.
- 0.26 mgd which is the projected wastewater flow that could come from the Little Pond Sewer Service Area at the buildout condition.

A particle track figure for the 0.26 mgd recharge is illustrated in Figure 4-9. It is noted that this figure also illustrates the potential future recharge of up to 0.5 mgd at the WWTF that is allowed by the new effluent discharge permit. The modeled fate of the recharged water for this groundwater evaluation is summarized in Table 4-8.



**Table 4-8 Scenario 7\_0.26, Fate of Treated Water Recharge Expressed as Percentage of Total Recharge**

<b>Ultimate Location Where Treated Water/Groundwater Surfaces</b>	<b>WWTF Recharge of 0.5 mgd</b>	<b>Site 7 Recharge of 0.26 mgd</b>
Wing Pond	0%	0%
Herring Brook	0%	0%
Bay at Herring Brook	0%	0%
Bay Between Herring Brook and West Falmouth Harbor	0%	100%
West Falmouth Harbor	86%	0%
Bay Beyond West Falmouth Harbor	14%	0%
<b>Total</b>	<b>100%</b>	<b>100%</b>
Percentage of Flow that Passes Through Crocker Pond	0%	TBD

This groundwater evaluation is described in Appendix 4-32.

Due to the flow that passes through Crocker Pond, and the flow that ultimately surfaces at Buzzards Bay, the following additional evaluations were completed as listed below and described in following sections:

- Evaluation of potential phosphorus attenuation of the soils between Site 7 and Crocker Pond.
- Evaluation of potential WWTF improvements to polish the effluent phosphorus from 2.5 mg/L to 0.2 mg/L.
- Evaluation of potential nitrogen impacts to Buzzards Bay, two bordering wetlands down-gradient of Site 7, and Herring Brook via Crocker Pond.

**4.6.7 Evaluations of Soil Attenuation of Possible Phosphorus Migration from Site 7 to Crocker Pond**

Evaluations were completed by EcoLogic, LLC to document the existing water quality and trophic state of Crocker Pond, develop a monitoring plan for the pond, and evaluate the potential phosphorus attenuation provided by the soils between Site 7 and Crocker Pond for a flow of 0.26 mgd. These evaluations are attached in Appendix 4-33 and summarized below. Figure 4-11 provides an aerial view of Crocker Pond and its surrounding land use.

The water quality in Crocker Pond was found to be generally fair to good depending on the water quality criteria used to judge it. The Cape Cod Commission criteria are the most stringent and this criteria characterizes the water quality as “impacted”. USEPA criteria are less stringent and characterize the water quality as “non-impacted” for all parameters except phosphorus. Though a pond watershed evaluation was not completed to identify current sources of pollutant loads that may be causing the impacts; the MassDOT stormwater discharge from Route 28A is evident as well as a dozen developed properties around the pond with septic system discharges and possible plant fertilizer uses.



Phosphorus impact is the main concern for fresh water ponds. Evaluation of the ratio of nitrogen to phosphorus concentrations in Crocker Pond indicates that this pond is a phosphorus-limited ecosystem. Therefore, the addition of nitrogen to the pond will not affect pond productivity and water quality.

The previous accepted science on phosphorus transport in the groundwater generally indicated that the phosphorus readily adsorbs to soil particles and would not be transported with the groundwater. Recent studies indicate that phosphorus can flow with the groundwater system under extreme situations. The concentrated discharge from the old Otis Air Force Base (AFB) WWTF is one of those extreme cases and is well documented. This case study, as well as other scientific data, was used to estimate the attenuation capacity expressed as the number of years a treated water recharge could occur before theoretical phosphorus travel to Crocker Pond from the recharge could be predicted (Soil Attenuating Capacity Time Period). Soil samples were evaluated from Site 7 as well as a location in the Route 28A road layout upgradient of Crocker Pond. Based on these soil analyses and the current soils science, the Soil Attenuation Capacity Time Periods were calculated for several recharges and treatment alternatives as summarized below.

**Table 4-9 Phosphorus Attenuation Capacity Time Periods**

Phosphorus Treatment Level	Soil Attenuation Capacity Time Period (years) for 0.26 mgd Flow	
	Unsaturated zone	Saturated zone
Existing 2.5 mg/L Concentration	4.2	108
Polished Concentration of 1 mg/L	10.5	270
Polished Concentration of 0.2 mg/L	52.7	1350

These are theoretical values based on conservative assumptions as outlined in the “Crocker Pond, Falmouth: Potential Soil Attenuation of Phosphorus Migration from Infiltrating Treated Wastewater at Site 7”, Ecologic LLC, August 2013 (found in Appendix 4-33).

Groundwater monitoring data was investigated for possible phosphorus transport in the groundwater system down-gradient of the current WWTF recharge that has been in operation since 1986—a total of 27 years. No phosphorus transport with the groundwater is evident at any monitoring well.

The evaluations indicate large theoretical attenuation capacities associated with Site 7.

**4.6.8 Evaluation of Potential WWTF Facilities to Polish Effluent Phosphorus**

Phosphorus removal at centralized WWTFs that discharge to fresh water bodies is an accepted technology; and treatment (phosphorus polishing) to meet effluent concentrations of 0.04 mg/L is possible depending on the technology selected. There are high capital and O&M costs required as the effluent concentration gets lower. MassDEP typically requires phosphorus treatment to 0.2 mg/L as a practical technology limit for many surface water discharge limits. The Town is currently in the preliminary evaluation phase of phosphorus removal technologies for the Blacksmith Shop Road WWTF including cost to provide phosphorus polishing for two effluent concentrations of 1 mg/L and 0.2 mg/L.



The evaluations will consider the following technologies:

- Innovative Phosphorus Removal Process
  - Permeable reactive barrier
- Phosphorus removal to achieve 1 mg/L effluent total phosphorus
  - Metal salt addition
- Technologies to achieve 0.2 mg/L effluent total phosphorus
  - Ballasted flocculation (Siemens CoMag™)
  - Ballasted flocculation (Kruger ACTIFLO®)
  - High rate flocculated settling (IDI DensaDeg®)
  - Sand filtration
  - Adsorptive type filtration (BluePro®)
  - Tertiary membrane filtration
  - Cloth filtration

These phosphorus facilities could be added to the WWTF if additional attenuation capacity (in years) is needed.

#### **4.6.9 Evaluation of Potential Nitrogen Impacts to Buzzards Bay from the Treated Water Recharge at Site 7**

The treated water recharge of up to 0.26 mgd will have a maximum concentration of 3 mg/L total nitrogen. Although most of this nitrogen is refractory and not biologically available, a conservative assumption projects that the 3 mg/L will travel with the groundwater system to Buzzards Bay. Groundwater modeling indicates that none of this flow will go to West Falmouth Harbor. Approximately 42-percent of the flow from Site 7 is estimated to pass through Crocker Pond and based on additional evaluations; a portion of that flow from the pond will end up in Herring Brook. Crocker Pond's contribution to the watershed flow of Herring Brook is estimated to be about 3.7% of the total contribution. Based on the proposed recharge at Site 7, the future load is estimated to be 0.8 lb/d (0.36 kg/d, 131 kg/yr), up from 0.3 lb/d (0.14 kg/d, 50 kg/yr), which is considered to be very small to insignificant given the size of the Herring Brook watershed.

Targeted evaluations of the two small wetland areas: Old Silver Beach (OSB) and Nemasket Road (NR) and Buzzards Bay were completed by UMass Dartmouth SMAST led by Brian Howes, Ph.D. to investigate if this recharge would create a significant impact to Buzzards Bay or to these two bordering wetlands down-gradient of Site 7. These evaluations are attached in Appendix 4-35 and key findings are summarized below:

- Old Silver Beach (OSB) was identified as a freshwater to slightly brackish water system that is unlikely to be negatively impacted by the possible nitrogen effluent that may enter this system from a Site 7 recharge of treated effluent at 3 mg/L and 0.26 mgd. The SMAST report recommended that the collection of water samples for nitrogen, phosphorus, and salinity levels would reduce any uncertainty regarding the characteristics of this open water system.
- Nemasket Road (NR) was identified as a freshwater system that is unlikely to be negatively impacted by the possible nitrogen effluent that may enter this system from a Site 7 recharge of treated effluent at 3 mg/L and 0.26 mgd. The SMAST report recommended that the collection of



water samples for nitrogen, phosphorus, and salinity levels would reduce any uncertainty regarding the characteristics of this open water system.

- Buzzards Bay impacts were considered largely undetectable within the main body of Buzzards Bay considering the nitrogen attenuation anticipated in Crocker Pond, OSB and NR even when considering an assumption that all the load with no attenuation would make it to the Bay directly.

#### **4.6.10 Evaluations of Site 7 Layout and Estimated Costs**

As discussed earlier, preliminary design evaluations were completed for potential infiltration facilities at Site 7 to infiltrate up to 0.26 mgd. These evaluations are summarized in Appendix 4-30 and briefly summarized below.

Figure 4-12 illustrates how two infiltration beds would be sited for the 0.26 mgd flow. Both beds are needed for standard engineering design criteria and operations flexibility. Flow could be to both beds at the same time or to only one bed.

Treated water would flow by gravity from the WWTF to a distribution box at the west end of the beds, and this box would distribute to the two beds.

The western edge of the two beds is approximately 1,860-feet from the edge of Crocker Pond, and the center of the two beds is approximately 2,100-feet from Crocker Pond.

The total capital costs for these facilities are \$2,850,000 as summarized in Appendix 4-30. These facilities could be constructed in a phased manner to save additional costs.

#### **4.6.11 Considerations and Evaluations About Contaminants of Emerging Concern**

Contaminants of Emerging Concern (CEC) are a new category of contaminants that are comprised of three sub-groups: endocrine disruptors, pharmaceuticals, and personal care products. These CECs are being measured in water and wastewater in extremely small concentrations because analytical methods have improved, and use of pharmaceuticals and personal care products have become more widespread. They are considered “emerging” because there are no limits or standards on the amounts that might cause human or environmental health risk. These emerging contaminants are typically comprised of organic carbon; therefore, if the total organic carbon (TOC) of the water is reduced to low levels, the CEC concentration is reduced. MassDEP requires advanced wastewater treatment to low levels of TOC when treated water is recharged to public water supply recharge areas. There are no public water supplies downgradient of the proposed Site 7 recharge.

The potential CEC concentration in the treated water recharge may be a concern for environmental health in Crocker Pond, West Falmouth Harbor, and/or Buzzards Bay. There is no practical way to evaluate this concern and water quality monitoring is recommended to develop a baseline and investigate if trends occur in the future.

The Barnstable County Health and Environment Department is currently conducting research and monitoring of groundwater downgradient of septic systems and WWTF recharges on Cape Cod. They are developing lists of CEC components/groupings observed and tracked. They should be consulted for CEC groundwater and surface water monitoring parameters when the groundwater discharge permit is being developed.



#### 4.6.12 Meetings with Stakeholders and Members of the Town Public

Several meetings and telephone conferences have been convened with regulators and stakeholder groups to gain input on the CWMP. These meetings are briefly listed below and meeting items are attached in Appendix 4-36.

1. December 12, 2012 meeting with stakeholders from Massachusetts Military Reservation and neighboring Towns to discuss the findings of the December 2012 Appraisal Consulting Services as described in Section 2.5.
2. January 22, 2013 joint meeting with the Mashpee Sewer Commission in Mashpee with the Falmouth WQMC.
3. June 10, 2013 meeting with J. Patton of Massachusetts Historic Commission. A follow-up letter dated June 17, 2013 is attached in Appendix 4-36.
4. June 10, 2013 meeting with J. Leddick of NHESP of Massachusetts Division of Fisheries and Wildlife.
5. June 10, 2013 meeting with J. Ballam of Massachusetts Division of Energy Resources (DOER).
6. June 10, 2013 meeting with N. Zavalas of MEPA.
7. June 12, 2013 meeting with MassDEP, Cape Cod Commission (CCC), Buzzards Bay Coalition (BBC), and Massachusetts Division of Marine Fisheries (DMF) with the following people attending:
  - MassDEP: Brian Dudley
  - Cape Cod Commission: T. Cambareri and P. Daley
  - Buzzards Bay Coalition: R. Jakuba and M. Rasmussen
  - MassDMF: K. Ford
  - Town of Falmouth: R. Jack, A. Lowell, E. Turkington, V. Valiela
  - Science Wares, Inc.: A. Karplus
  - GHD: N. Weeks, J. Gregg

Follow-up correspondence was received as attached in Appendix 4-36.

8. June 11, 2013 telephone call with S. McCurdy of MassDEP State Revolving Fund (SRF) Program.
9. June 13, 2013 meeting with A. Leschen of Waquoit Bay National Estuarine Research Reserve. Follow-up correspondence was received as attached in Appendix 4-36.
10. May 8, 2013 meeting with Massachusetts Coastal Zone Management (CZM) with the following people attending:
  - Senator Murray's Office: J. Horigan
  - MassDEP: B. Moran
  - CZM: B. Carlisle and two staff members
  - Town of Falmouth: J. Waterbury

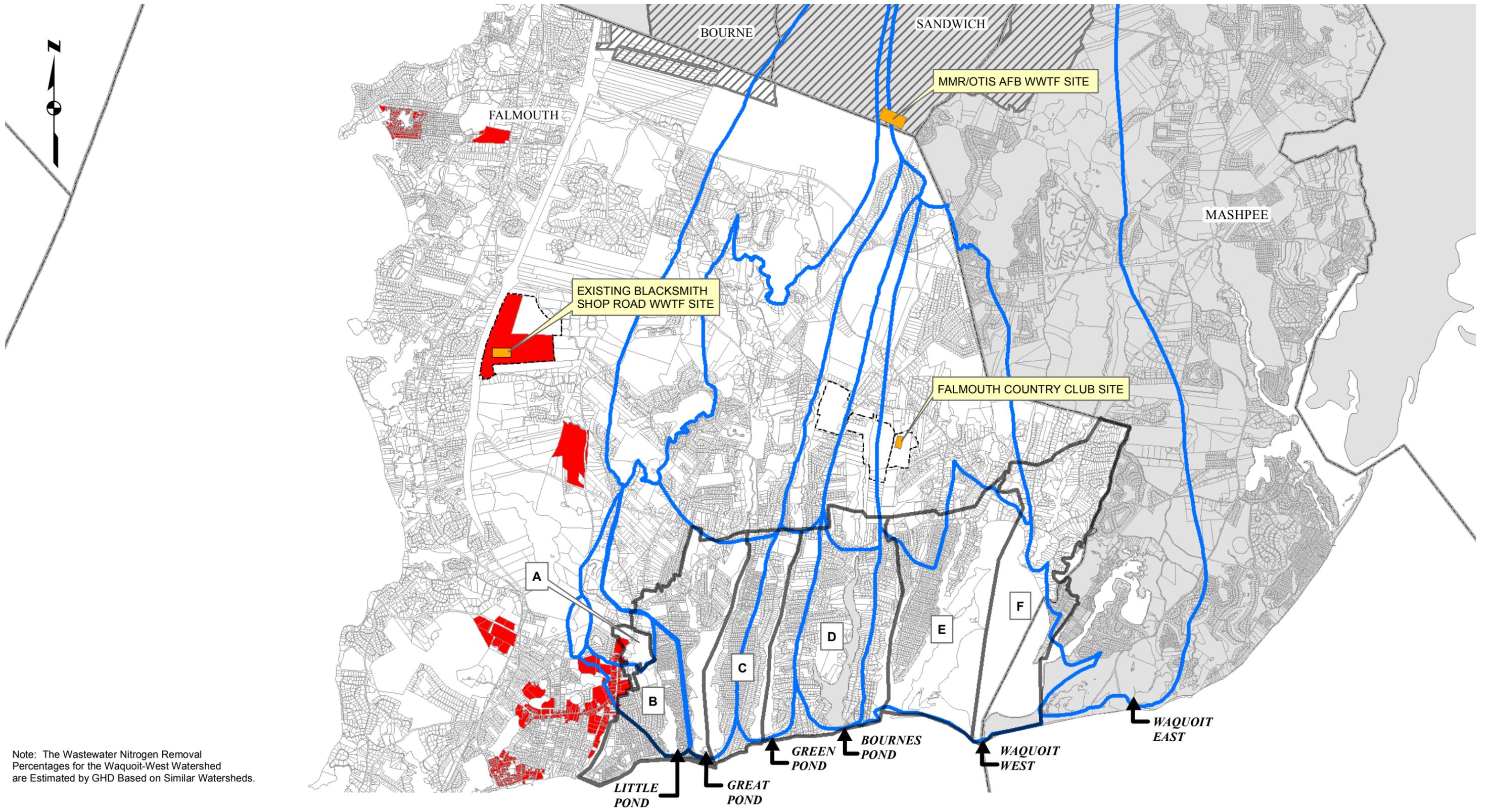
This meeting and recommended next steps are described in Chapter 3, Section 3.9 Ocean Outfall Evaluations.



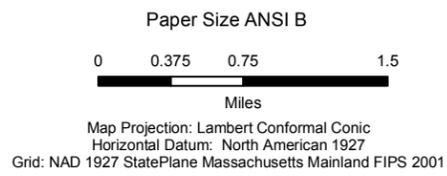
#### **4.6.13 Additional Evaluations Identified for Consideration During Adaptive Management Evaluations**

Additional wastewater management evaluations have been considered and identified as possible steps to be completed during the Adaptive Management portion of implementation. These evaluations are listed below:

- Ocean outfall evaluations as discussed in Chapter 3.
- Evaluations of additional treated water recharge sites.
- Evaluation of additional nitrogen polishing treatments to allow a greater recharge flow (at a lower nitrogen concentration) in the West Falmouth Harbor Watershed.



Note: The Wastewater Nitrogen Removal Percentages for the Waquoit-West Watershed are Estimated by GHD Based on Similar Watersheds.



LEGEND

- Sub-Watershed Boundary
- Town Boundary
- Parcel Boundary
- MMR
- Existing Sewered Parcel
- Initial Sewer Service Area



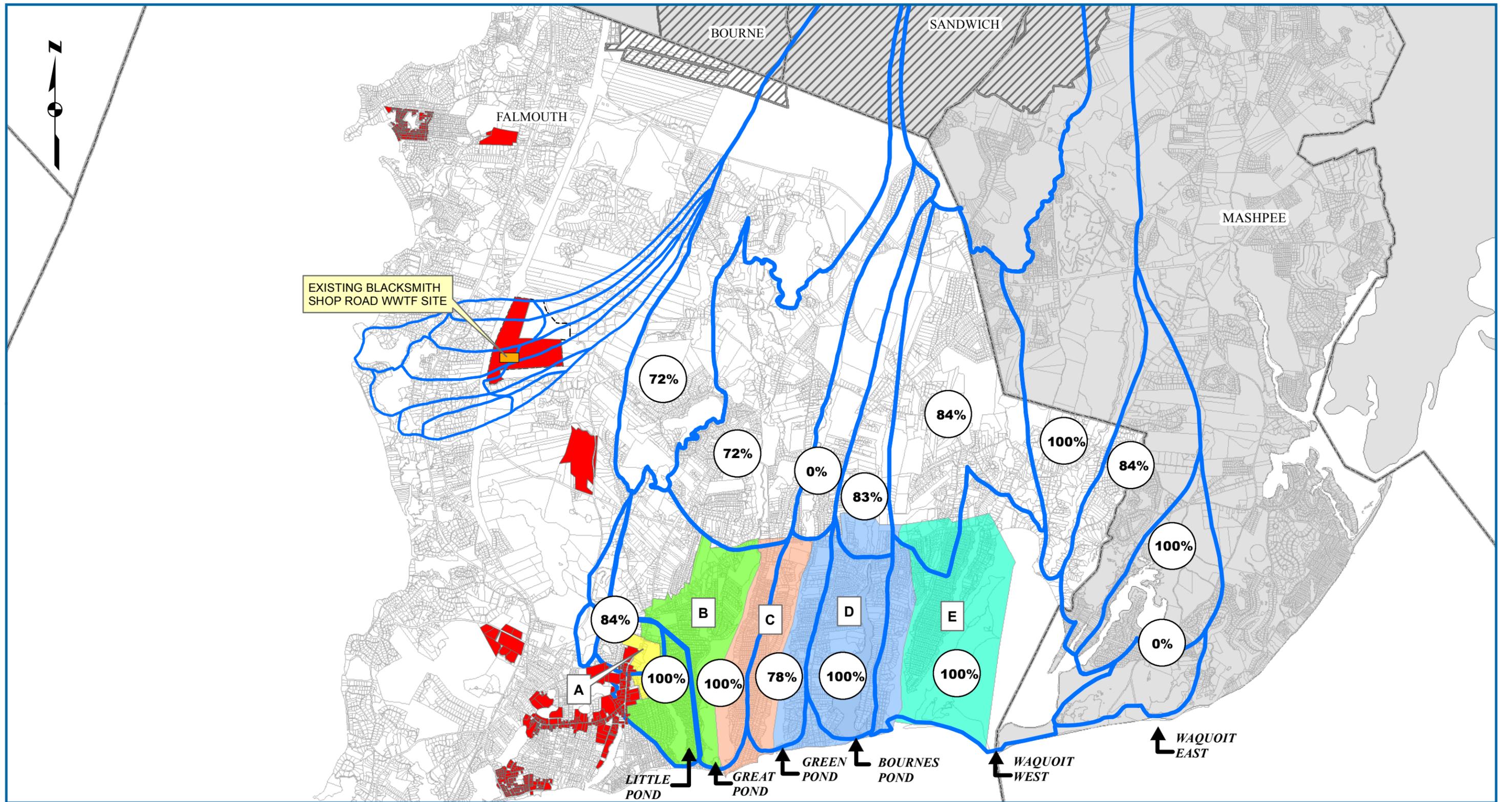
TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

ORIGINAL PLANNED SEWER SERVICE  
AREAS FOR PHASE 1 AND 2

Job Number | 86-12163  
Revision | A  
Date | 28 Jun 2013

Figure 4-1

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Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1927  
Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



LEGEND

- Estimated Future Wastewater Nitrogen Removal Percentage Suggested by MEP
- MMR
- Sub-Watershed Boundary
- Sewered Parcel
- Town Boundary
- Parcel Boundary

HIGH PRIORITY NITROGEN MITIGATION AREAS

- A
- B
- C
- D
- E



CLIENTS | PEOPLE | PERFORMANCE

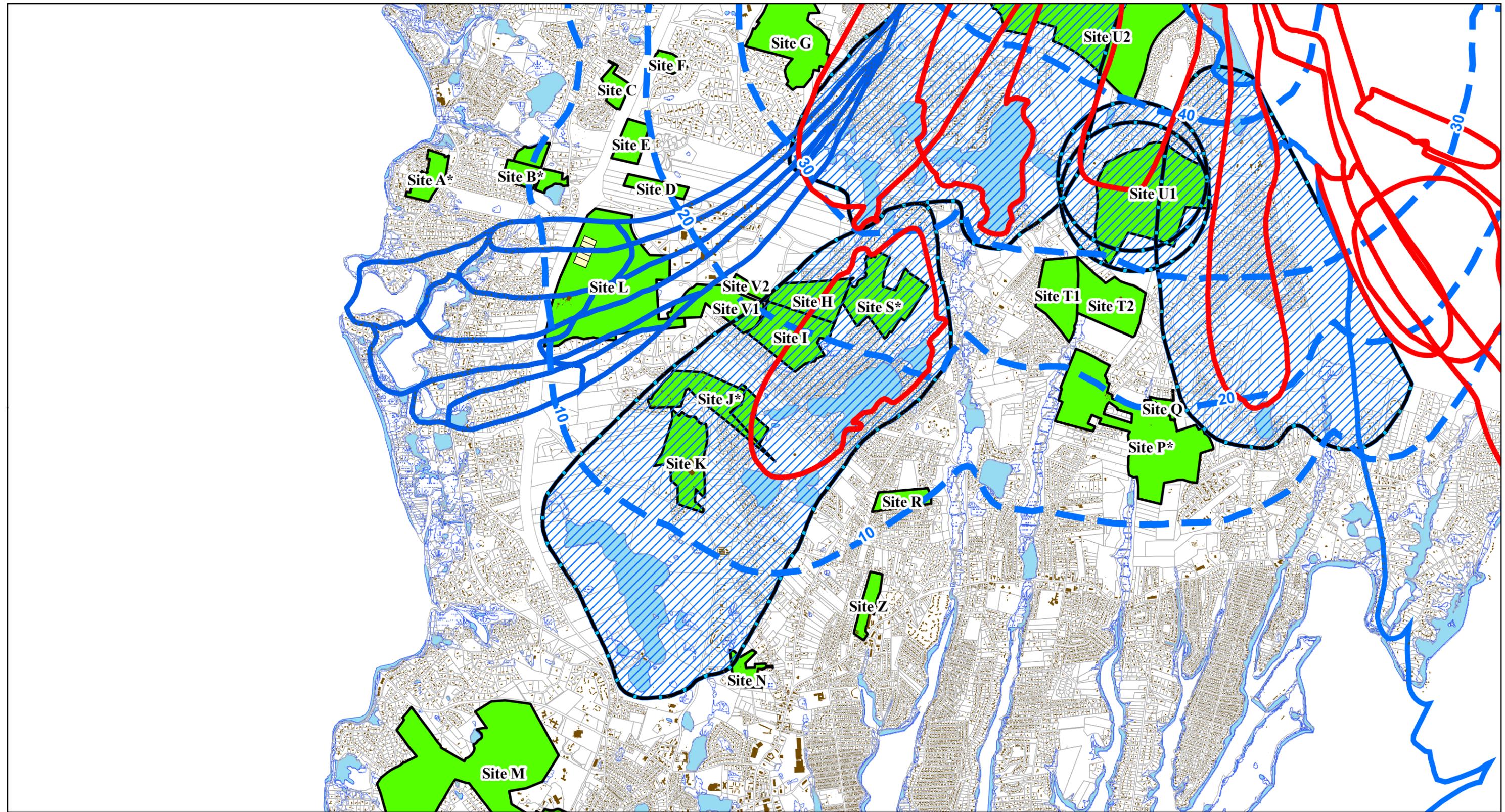
TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

NITROGEN MANAGEMENT AREAS  
FOR PHASE 1 AND 2

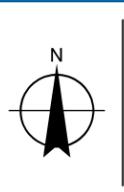
Job Number | 86-12163  
Revision | A  
Date | 26 Jun 2013

Figure 4-2

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 Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1927  
 Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



- LEGEND
- Zone II Area
  - Estimated Groundwater Table Contour
  - Buildings
  - Watershed Boundaries
  - Water Protection District
  - Potential Treated-Water Recharge Site
  - State Wetland
  - Parcel Boundary



TOWN OF FALMOUTH, MA  
 CWMP

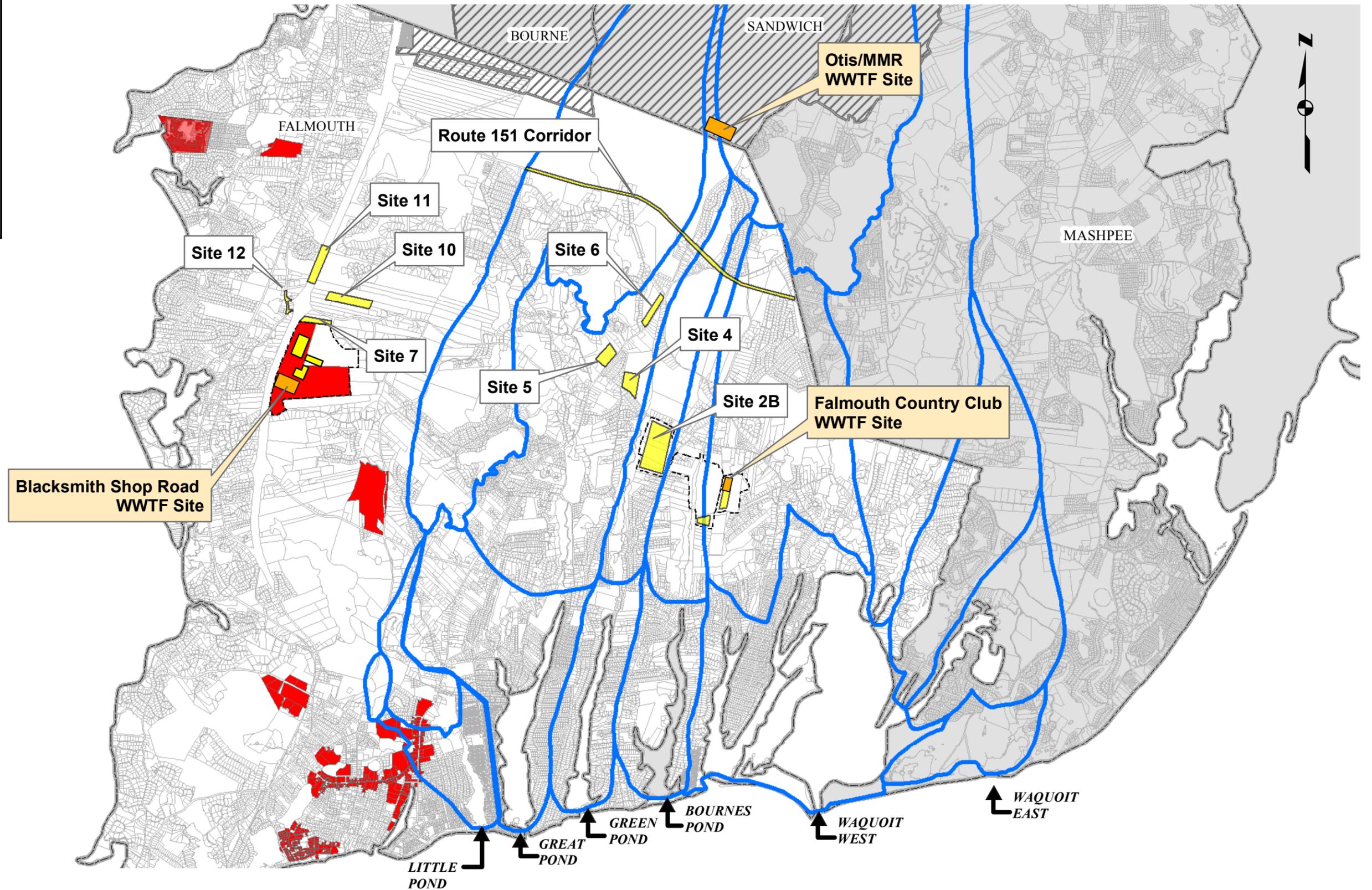
Job Number 86-12163  
 Revision A  
 Date 27 Jun 2013

**ORIGINAL SITES SCREENED FOR TREATED WATER RECHARGE SITES** Figure 4-3

G:\86\12163\GIS\71045 FalmouthData from Town\3\_29\_07\71045FA-1\_new.mxd  
 © 2012. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.  
 Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: jjobrien

**Legend**

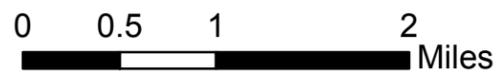
- Existing and Potential WWTF
- Potential Recharge Site
- Existing Sewered Parcel
- Sub-Watershed Boundary
- Town Boundary
- Parcel Boundary
- MMR



Paper Size ANSI B



Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1927  
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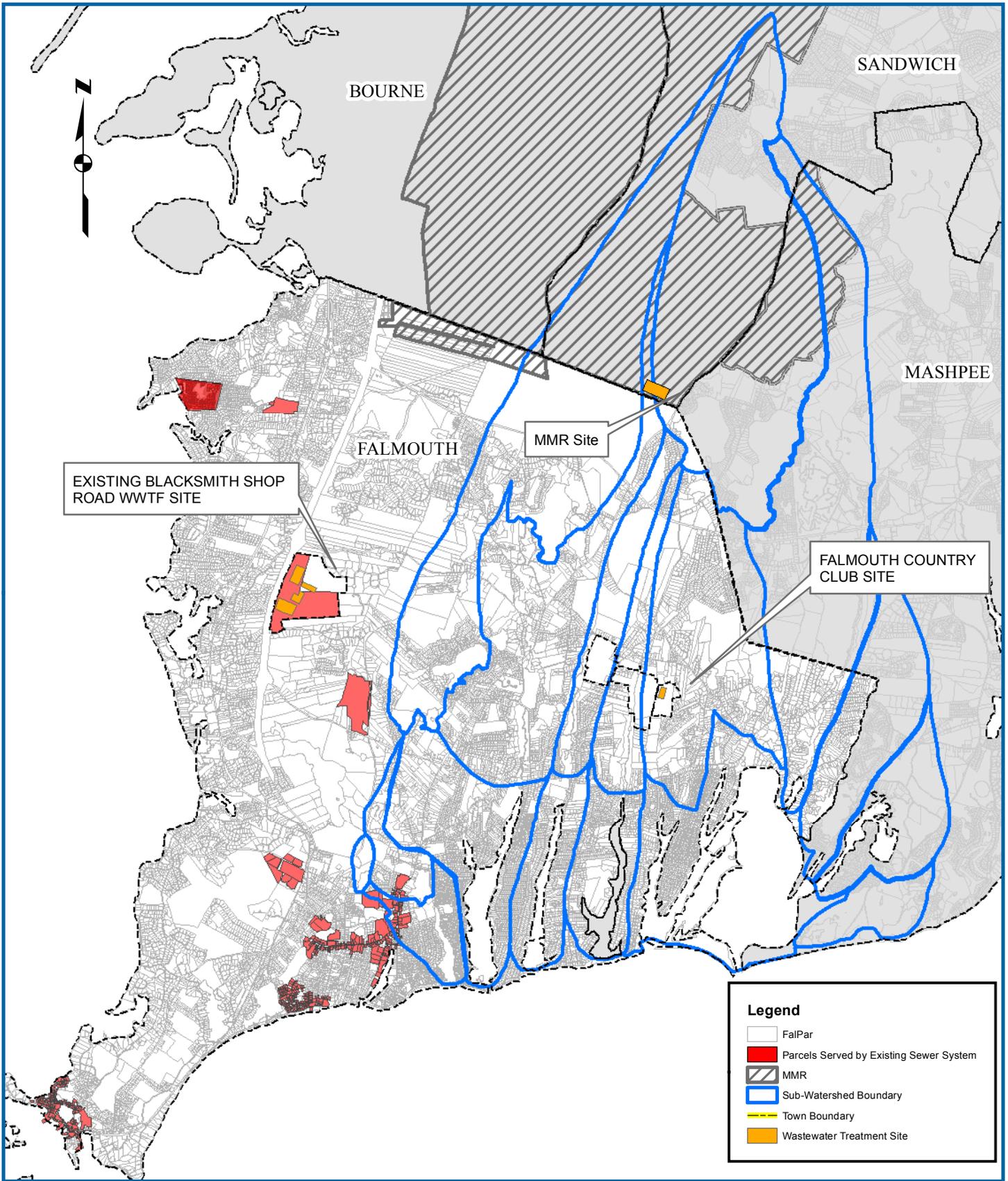


TOWN OF FALMOUTH, MASSACHUSETTS  
 CWMP

ADDITIONAL POTENTIAL  
 RECHARGE & TREATMENT SITES

Job Number	86-12163
Revision	A
Date	24 Sep 2013

**Figure 4-4**



Data Source: MassGIS/Town of Falmouth  
GIS Department

Paper Size 8x11  
0 0.5 1 2 Miles

Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1927

Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP  
Wastewater Treatment Sites Considered  
for Alternative Scenarios 1A, 2A and 3A

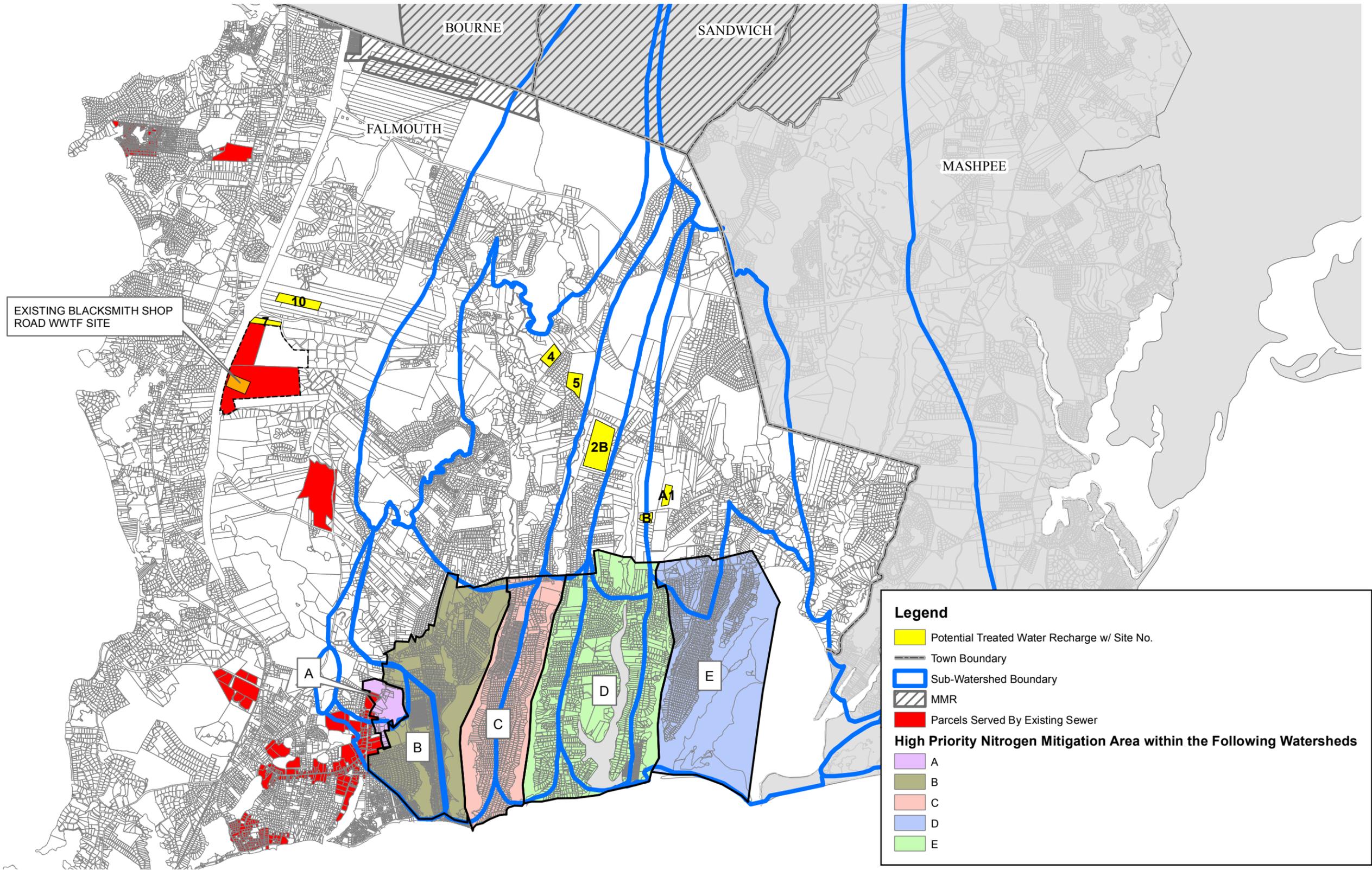
Job Number 86-12163  
Revision A  
Date 26 Jun 2013

**FIGURE 4-5**

1545 Iyannough Road, Hyannis Massachusetts 02601 USA T 1 508 362 5680 F 1 508 362 5684 E hyamail@ghd.com W www.ghd.com

G:\86\12163\GIS\Figures2013\EXECUTIVE SUMMARY REVISIONS\8612163F 4-5.mxd

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0 0.225 0.45 0.9

Miles  
Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1927

Grid: NAD 1927 StatePlane Massachusetts Mainland FIPS 2001



0 0.5 1 2  
Miles



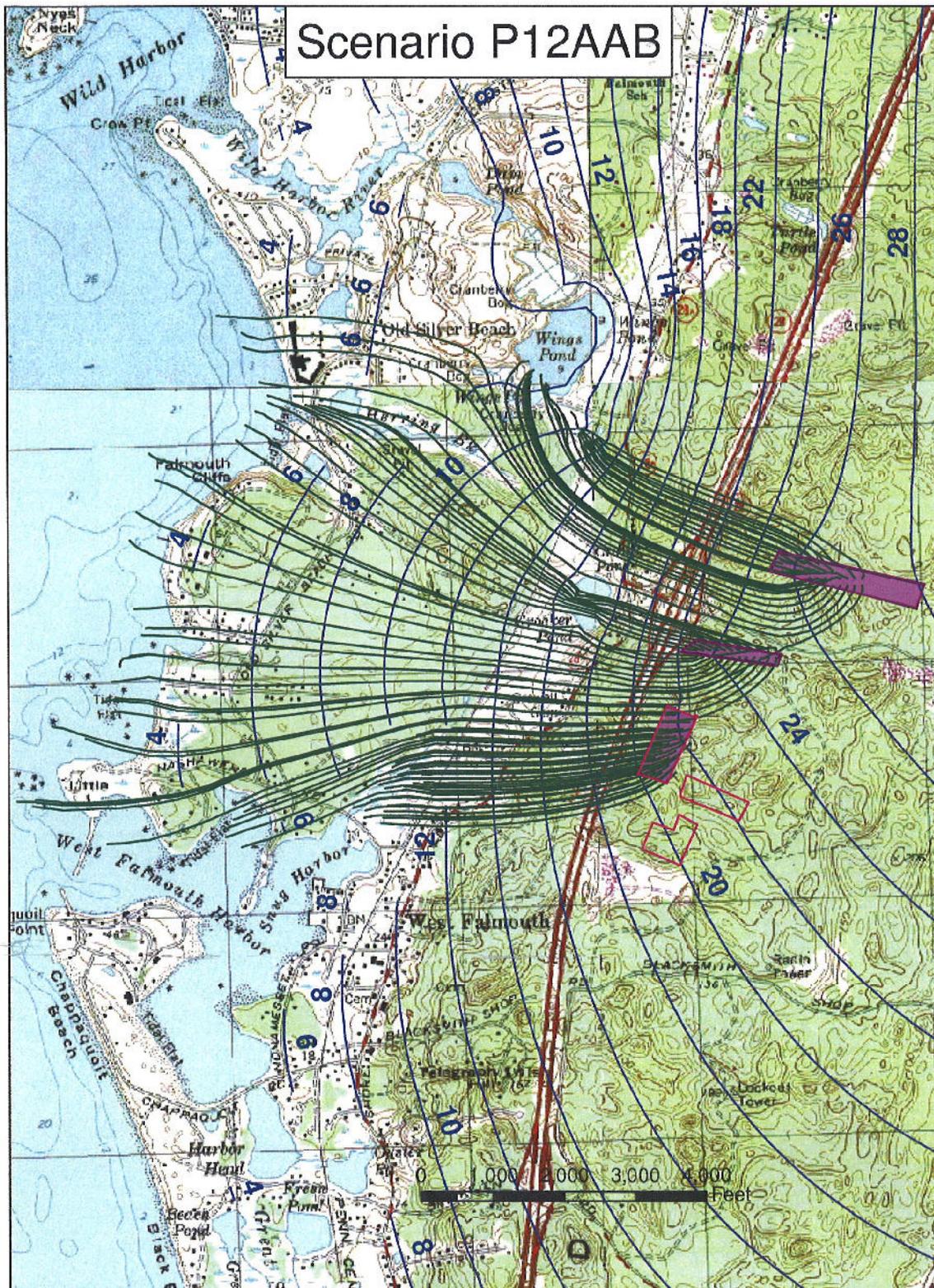
CLIENTS | PEOPLE | PERFORMANCE

TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

REVISED HIGH PRIORITY NITROGEN  
MANAGEMENT AREAS AND  
PREFERRED ALTERNATIVE SCENARIO 1E

Job Number 86-12163  
Revision A  
Date 26 Jun 2013

Figure 4-6



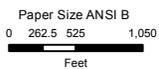
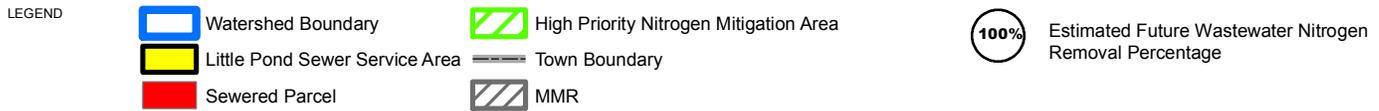
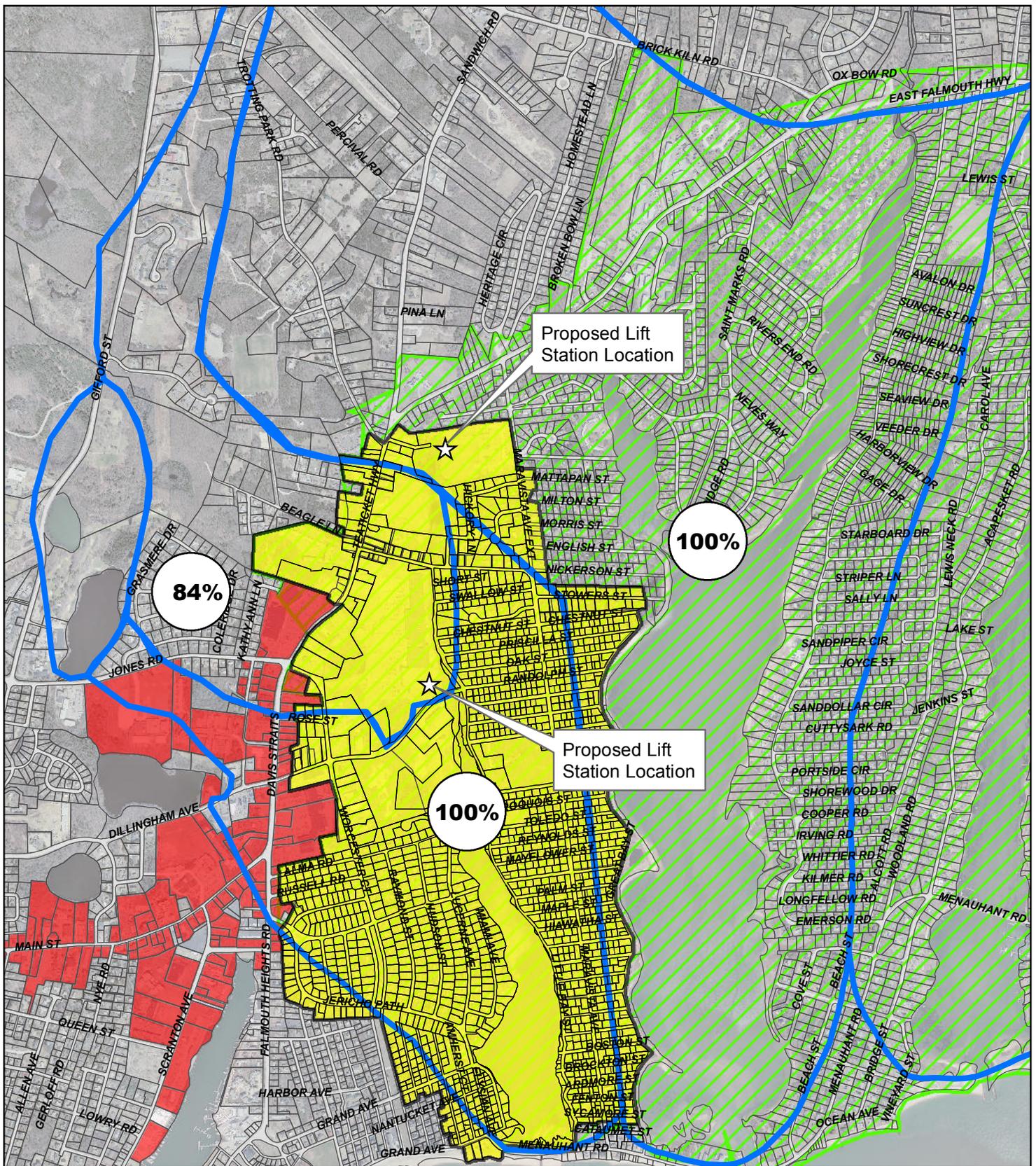
CLIENTS | PEOPLE | PERFORMANCE

TOWN OF FALMOUTH  
CWMP

Job Number 86-12163  
Revision A  
Date 26 Jun 2013

PARTICLE TRACKS FOR  
SCENARIO P12AAB

Figure 4-7

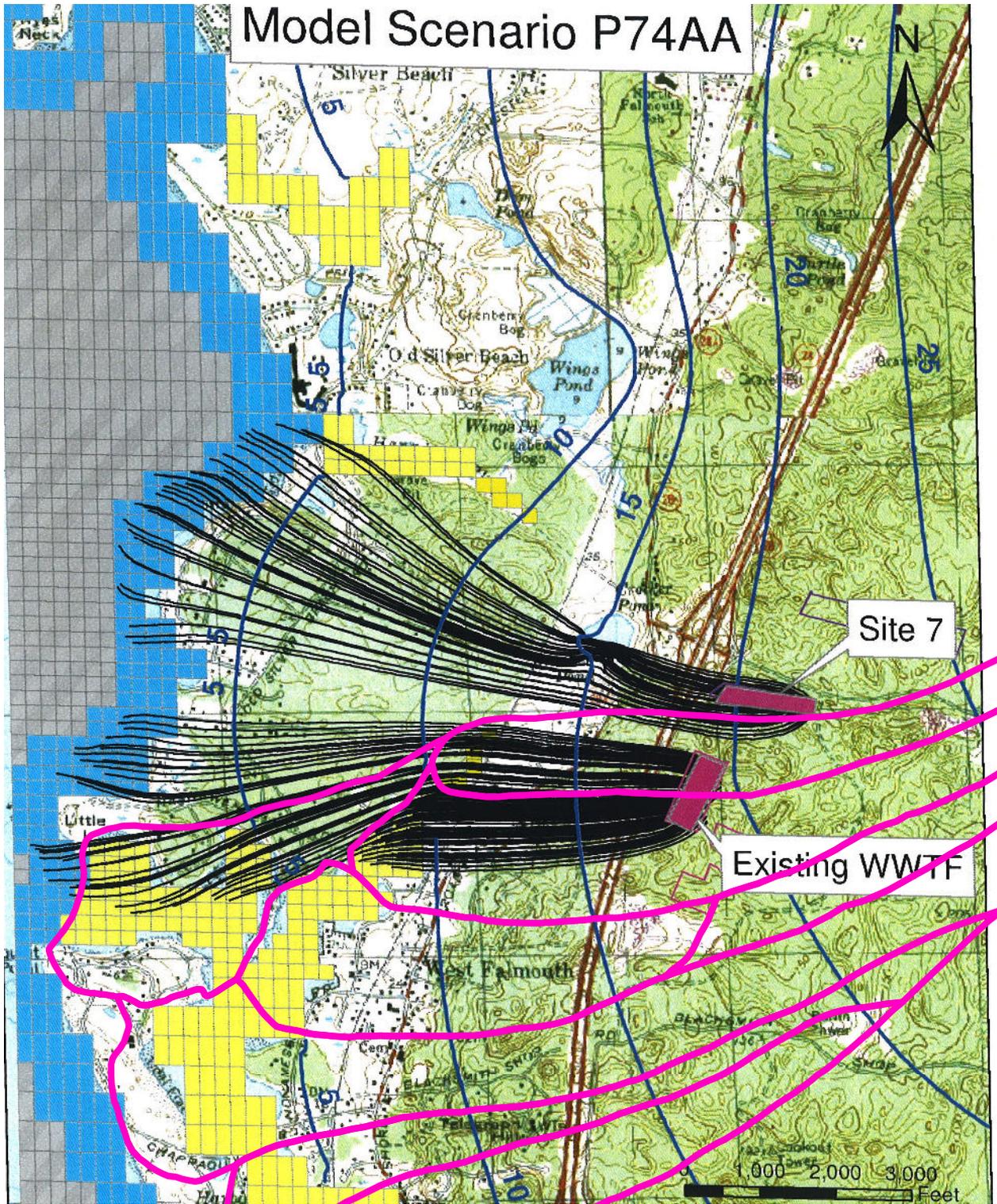


TOWN OF FALMOUTH, MASSACHUSETTS CWMP

Job Number 86-12163  
Revision A  
Date 27 Jun 2013

### PROPOSED LITTLE POND SEWER SERVICE AREA

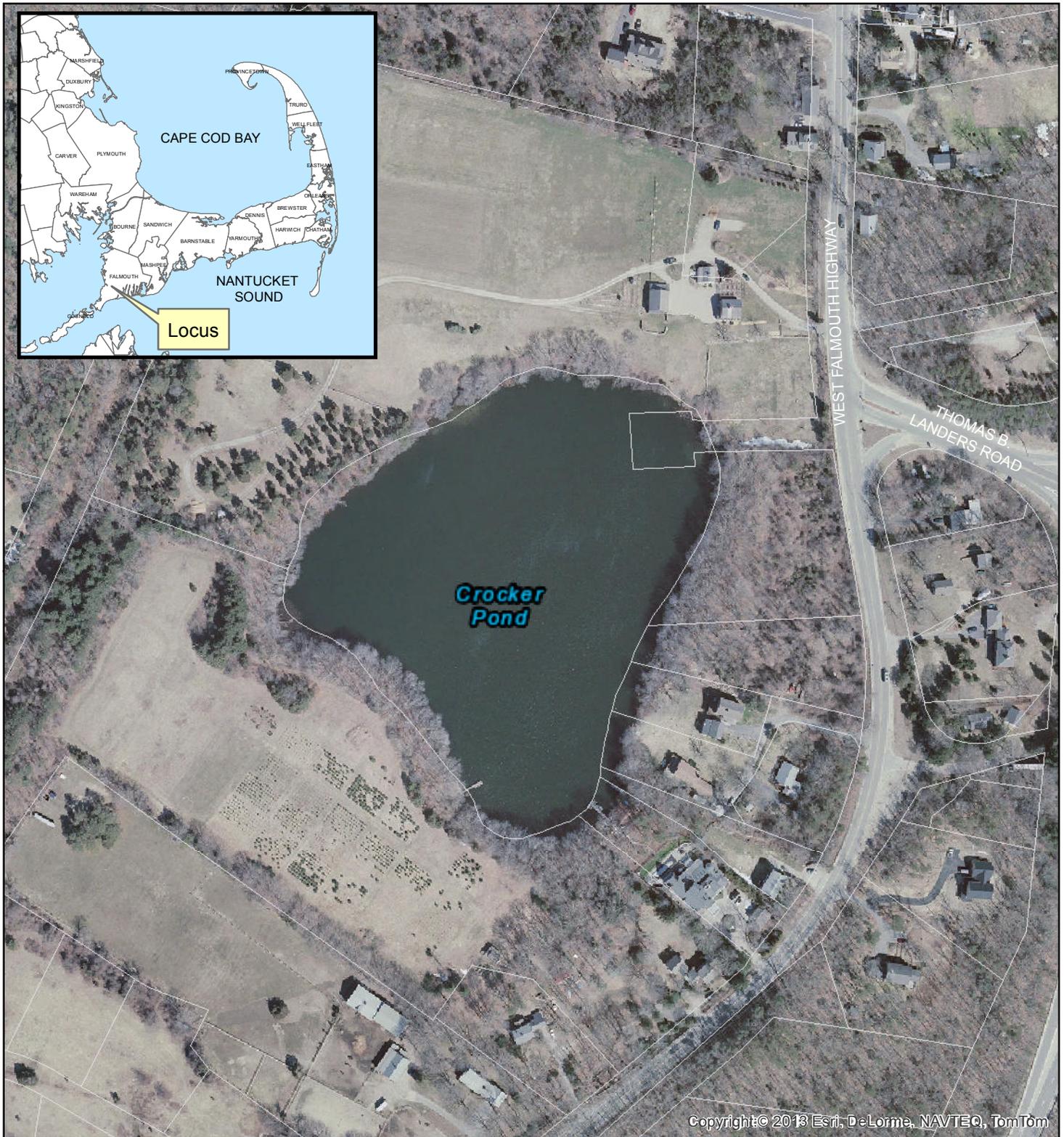
Figure 4-8



Note: See Figure 3 of Appendix 4-32 for legend items

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Figure 4-9



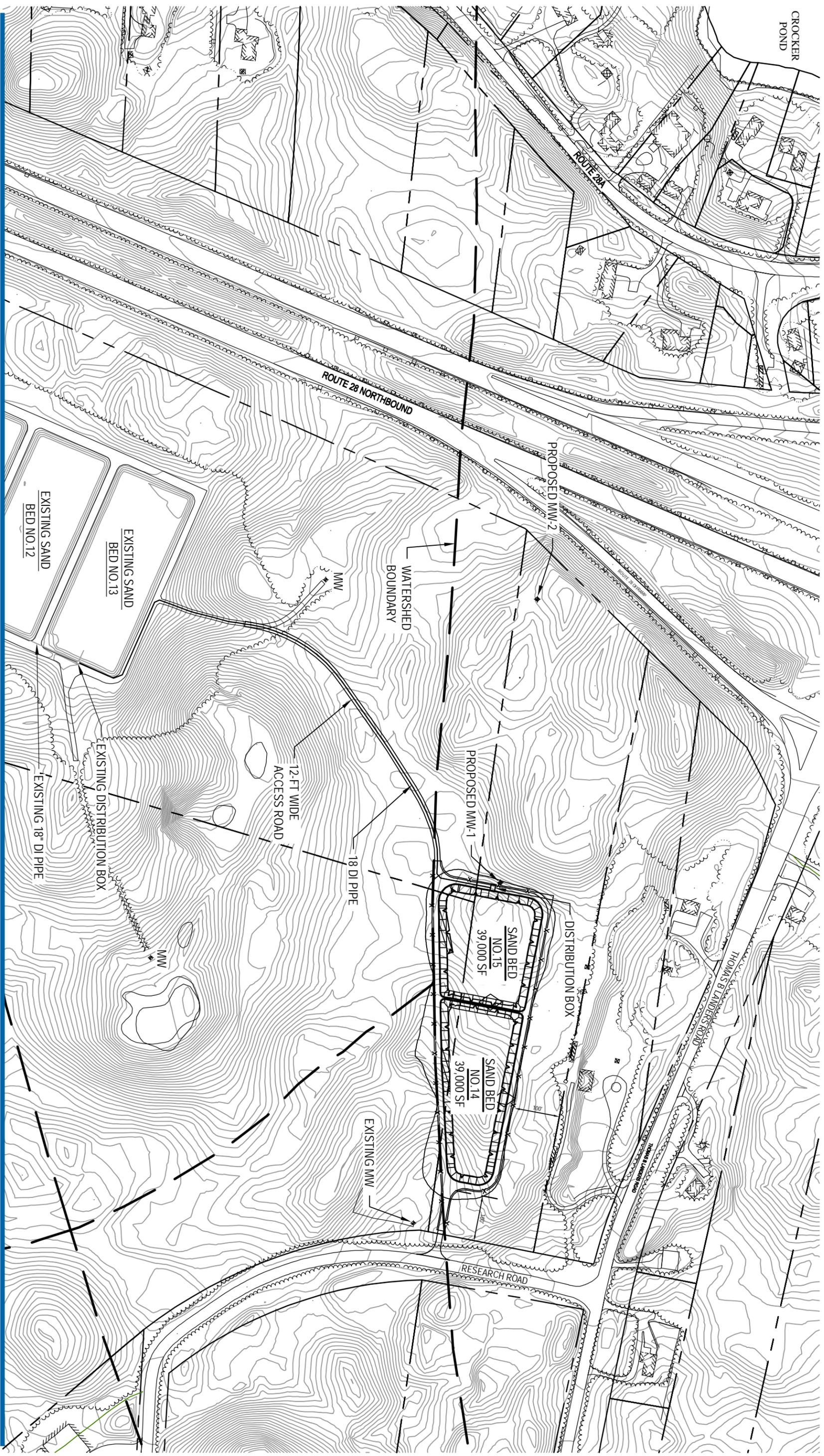
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 Grid: WGS 1984 Web Mercator Auxiliary Sphere



Town of Falmouth, MA  
 Project Name  
 Crocker Pond Location

Job Number 86-12163  
 Revision A  
 Date 24 Sep 2013

Figure 4-11



CROCKER POND

ROUTE 28A

ROUTE 28 NORTHBOUND

PROPOSED MW-2

WATERSHED BOUNDARY

12-FT WIDE ACCESS ROAD

18 DI PIPE

PROPOSED MW-1

SAND BED NO.15  
39,000 SF

SAND BED NO.14  
39,000 SF

DISTRIBUTION BOX

THOMAS B. LANDERS ROAD

RESEARCH ROAD

EXISTING MW

EXISTING SAND BED NO.12

EXISTING SAND BED NO.13

EXISTING DISTRIBUTION BOX

EXISTING 18" DI PIPE

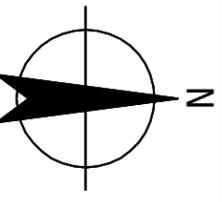
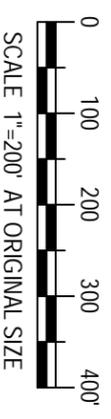
FALMOUTH CWMP IMPLEMENTATION  
SITE 7 DEVELOPMENT

Job Number 86-14629

Revision A  
Date 9/13

INFILTRATION BEDS @ SITE 7

Figure 4-12





## 5 Public Participation and Outreach Program

### 5.1 Introduction

An extensive public participation program has been on-going for the Comprehensive Wastewater Management Planning Project (Project) to insure that the Town's residents, Town leaders, and regulatory community are informed and provided ample opportunity for questions and discussion. This Chapter describes the public participation process that has been implemented as part of the project. The main components are:

- Formation of a Nutrient Management Working Group (NMWG) with regular meetings (2007 to 2009).
- Formation of a Technical Advisory Group (TAG) as a sub-group of the NMWG to provide detailed reviews of the CWMP (2009).
- Regular televised presentation of CWMP findings to the Board of Selectmen.
- Development of public education materials including:
  - A project website at [www.falmouthwastewaterprojects.org](http://www.falmouthwastewaterprojects.org) which has migrated to <http://www.falmouthmass.us/depart.php?depkey=wastewater>
  - Development and distribution of public education materials including project newsletters
  - Development of a Project Kiosk that is located at the entrance to Town Hall and taken to outreach meetings
- Informal meeting with community organizations (called "Sewer Socials") to discuss the issues related with the CWMP Project.
- Coordination with the Town local newspaper to distribute newsletters, provide project information and updates, and provide public opinion.
- Development of the CWMP Review Committee to review the 2009 Preliminary Draft DCWMP/DEIR. This was a major public participation effort which included regular televised committee meetings and three facilitated public meetings (2009 to 2010).
- Development of the Water Quality Management Committee (WQMC) to implement the recommendations of the CWMP Review Committee. This is the on-going committee that is advisory to the Board of Selectmen. This committee has regular televised committee meetings and supports and/or coordinates special events or workshops on wastewater and nutrient management (2011 to present).
- Participation in the formal MEPA/CCC environmental review process which has included MEPA ENF review meetings and bus tour, CCC hearing at the time of the ENF review, Draft Report review, and CCC hearing at the time of the Draft Report review.

### 5.2 Nutrient Management Working Group

The Nutrient Management Working Group was established in 2009 to provide technical input for wastewater and nutrient management projects in Falmouth. Participants in this group (and their affiliations or titles) are listed as follows:



1. Gerald Potamis, Wastewater Superintendent
2. Amy Lowell, Assistant Wastewater Manager
3. Robert L. Whritenour, Town Manager
4. Heather Harper, Assistant Town Manager
5. Raymond Jack, Director of Public Works
6. Peter McConarty, Acting Town Engineer
7. Brian Currie, Town Planner
8. Ken Forman, Planning Board and ZBA
9. David Carignan, Health Agent
10. John Waterbury, non-affiliated
11. George Heufelder, Barnstable County Health Department
12. Jennifer McKay, Conservation Administrator
13. Steve Fassett, Finance Committee
14. Chris Neill, FACES
15. George Hampson, Falmouth Coastal Ponds Management Committee
16. Jim Viera, Board of Health

This group met on a monthly basis and reviewed information on all the Town's nutrient and wastewater related projects and provided input. The group was active from 2007 through 2009.

### **5.3 Technical Advisory Group (TAG)**

The Technical Advisory Group is a sub-group of the NMWG and was created to provide more detailed review of the CWMP reports. Participants in this group are listed below:

1. John Waterbury, Board of Health
2. George Heufelder, Barnstable County Health Department
3. Chris Neill, FACES
4. Paul Ketchum

This group met to review the 2009 preliminary draft DCWMP/DEIR and provide direction to the NMWG on the findings of the evaluation. As discussed earlier in this report, the preliminary Draft DCWMP/DEIR was not accepted by the Board of Selectmen.

### **5.4 CWMP Review Committee**

This committee was charged with reviewing the 2009 Preliminary Draft DCWMP/DEIR. The committee was very active in 2010 and was comprised of the following participants:

1. Virginia Valiela, Chairman
2. Peter Boyer, Vice-chairman
3. Doug Brown
4. Patricia Favulli
5. George Huefelder
6. Priscilla Moor
7. Stephen Rafferty
8. Eric Turkington
9. John Waterbury



10. Stephen Fassett, Finance Committee Liaison
11. Gerald Potamis, Wastewater Superintendent and DPW Staff Technical Liaison

This committee oversaw the development of Technical Memoranda Nos. 1 to 7 which provided further guidance to this CWMP Project.

This committee held televised meetings and three facilitated public meetings to gather public information and review committee findings. They produced several newsletters and summary documents; several of which are attached in Appendix 4-14.

## **5.5 Water Quality Management Committee**

This committee was formed as one of the recommendations of the CWMP Review Committee and has been very active, meeting bi-weekly in recorded/televised meetings. They have overseen additional technical evaluations (Technical Memoranda 8 – 11) which provided guidance to this CWMP Project. They have directed the revisions to the CWMP/FEIR/TWMP, and committee members have written sections of summary text for this plan. They have also overseen the scoping and RFP development for the demonstration projects. They have provided a valuable public forum to discuss issues and recommend direction to the Board of Selectmen.

This committee has the following participants:

1. Eric Turkington, Chairman
2. Stephen Rafferty, Vice-chairman (retired in June 2013)
3. Virginia Valiela, Vice-chairman
4. Matt Patrick
5. Ronald Zweig
6. Winthrop Munro
7. Steve Leighton
8. John Waterbury (joined in July 2013)
9. George Heufelder (resigned 2012)
10. Paul Dreyer, Liaison from Planning Board

The WQMC is assisted and supported by Gerald Potamis, Wastewater Superintendent and DPW Staff Technical Liaison, and Anastasia Karplus, Professional Technical Consultant to DPW from Science Wares, Inc.

## **5.6 Televised Presentations to the Board of Selectmen (BOS)**

At each key milestone, the WQMC has presented its findings and recommendations to the Board of Selectmen for their review and action. The BOS meetings are televised live, and reach a wide audience, thereby informing interested citizens about the progress being made on nitrogen management issues. These presentations are typically followed by newspaper interviews and summary articles in the local paper.



## 5.7 Development of Public Education Materials

Several public education materials and websites have been developed and distributed:

- A project website ([www.falmouthwastewaterprojects.org](http://www.falmouthwastewaterprojects.org)) was created in 2007 and provided project documents and brief summaries for public review and download. This site has since migrated to the Town website as listed below.
- The Town's website ([www.falmouthmass.us](http://www.falmouthmass.us)) has been updated regularly to contain much project information on the Wastewater Department webpage.
- A webpage for the CWMP Review Committee with much information collected and developed by the Committee. This website also provided a Public Comments Forum. Even though this committee has finished its work, their website is still on the Town's website and can be viewed at: <http://www.falmouthmass.us/depart.php?depkey=cwmprc> and is easily located below the Board of Selectmen on the Department's page of the Town website.
- A webpage for the WQMC Committee posts key information for this committee and can be viewed at <http://www.falmouthmass.us/depart.php?depkey=water> and is also easily located near the bottom of the Department's page of the Town website.
- Several project newsletters and findings documents have been created and distributed to provide updates on the project.
- A Project Kiosk (table-top display) was developed and sits at the entrance to Town Hall. It provides a location for disseminating project information and a public focus on the basic information about the project.
- An informational flier was inserted into the Fall 2012 water bills to publicize the start-up of the Eco-Toilet Demonstration Project, provide education materials on reduced fertilizer use, and seek volunteers for the project.

## 5.8 Meetings with Community and Regional Groups

Progress meetings have been convened with interested community groups in the Planning Area, in the Town as a whole, and in the region. The Town has collaborated with the FACES to convene and attend many neighborhood meetings (also called "sewer socials").

Some of the groups that have requested and had these meetings include:

- Several meetings with FACES
- Old Stone Dock Association
- Rotary Club
- Chamber of Commerce breakfast meeting
- MMR staff
- Cape Cod Water Protection Collaborative
- Mashpee Sewer Commission
- Great Harbors
- West Falmouth Village Association
- East Falmouth Village Association



- Oyster Pond Environmental Trust
- Salt Pond Home Associations
- East Falmouth Wastewater Committee
- Unitarian Universalist Fellowship of Falmouth
- League of Women Voters
- 300 Committee
- Seacoast Shores Association
- Shorewood Drive Beach Association
- Congregational Church
- New Comers Club
- Bourne, Mashpee, and Sandwich Selectmen
- Teaticket Civic Association
- Falmouth Heights/Maravista Civic Association

## **5.9 Coordination and Outreach to Neighboring Towns and the MMR**

Much attention has been focused on the most effective ways to coordinate and reach out to the neighboring towns of Bourne, Mashpee, and Sandwich and the MMR. Much of this outreach was made to develop the 2009 Preliminary Draft DCWMP/DEIR, and the plan at that time to site a regional WWTF facility at the MMR site. Even though that plan has been revised to expand the Blacksmith Shop Road WWTF, Falmouth continues to coordinate with the neighboring towns with participation at the Mashpee Wastewater Planning meetings, participation at the Cape Cod Water Protection Collaborative meetings, and DPW staff coordination led by Gerald Potamis. The Cape Cod Commission has recently formed a Cape-wide Advisory Board to act as a sounding board on Commission plans and actions relative to the Section 208 Water Quality Plan update. Virginia Valiela represents Falmouth on that Board.

## **5.10 Coordination with the Town's Local Newspapers**

The newspaper has done an excellent job of reporting BOS meetings, WQMC meetings, unfolding demonstration projects, providing public opinion and editorial comment, and generally being a vehicle for project feedback. This reporting feedback and public discussion has been instrumental in producing the revisions to the 2009 Preliminary Draft and Town Meeting discussions to find a broader approach to wastewater and nitrogen management problems.

The newspaper articles produced from 2007 to the present are too numerous to attach in an appendix.

## **5.11 Participation in the Formal MEPA and DRI Review Process**

As discussed in Chapter 1, the project is being reviewed by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Massachusetts Environmental Policy Act (MEPA), and Cape Cod Commission (CCC) Development of Regional Impact (DRI) joint review process. Phase reports (such as the Needs Assessment Report, Alternatives Screening Analysis Report, the Draft Report, and this CWMP/FEIR/TWMP) have been produced throughout the project to allow interim reviews of the project efforts and public and regulatory comment. The Environmental Notification Form, which summarized (and contained) the Needs Assessment and Alternatives Screening Analysis Reports, was reviewed by this process.

The Draft DCWMP/DEIR was reviewed in the fall of 2012. This Final CWMP/FEIR/TWMP document is



submitted for MEPA review to finalize and address comments on that report. The CCC DRI review will be the last review of the formal environmental review process and will take place after the Secretary issues his Certificate.



## **6 Recommended Plan**

The Recommended Plan is a comprehensive strategy for wastewater and nitrogen management for a 20-year period with a 40-year perspective on the ultimate build-out for the Town and the need to meet the nitrogen TMDLs in cooperation with the neighboring towns that share the Waquoit Bay watershed. The 20-year period is from 2015 to 2035, which is the estimated time-period for the Little Pond sewer extension, WWTF upgrades, new treated-water recharge facility implementation, completion of the demonstration projects, and implementation of the feasible non-traditional technologies in the High-Priority Nitrogen Mitigation Areas.

The Recommended Plan is summarized below:

### **6.1 Demonstration Projects of Non-Traditional Wastewater and Nitrogen Management Technologies and Approaches**

A group of five demonstration projects has been funded by Town Meeting. These projects have been initiated and are ongoing. Their progress as of June 30, 2013, is summarized below. These demonstration projects are evaluations independent of this CWMP/FEIR/TWMP and will enter the MEPA review process at a later time if they trigger MEPA thresholds. If proven feasible, these technologies and management processes will be added to this Plan through the Adaptive Management component.

#### **6.1.1 Shellfish Aquaculture Demonstration Project to Harvest/Mitigate Excessive Nitrogen in the Estuaries**

This technology and nitrogen management concept would promote nitrogen uptake in the estuaries by shellfish that could be harvested to remove nitrogen from the system. The first phase of the project has been scoped, and Woods Hole Group has been engaged as the project consultant. The following initial tasks have been completed:

- Viability Test (summer 2012).
- Conservation Commission Notice of Intent (NOI) hearing, and Order of Conditions issued on May 10, 2013.
- Staffing, equipment and shellfish purchased, and seed installed in Town upweller.
- Installation of oysters into Little Pond for first year of the Demonstration Project began on July 3, 2013, and is ongoing.
- Monitoring Plan formalized with MassDEP and Falmouth Conservation Commission.

A full description of this project is provided in Chapter 3, Section 3.2.

#### **6.1.2 Inlet Widening of Bournes Pond**

This technology would increase tidal exchange with Vineyard Sound to reduce the amount of nitrogen that would need to be removed from the watersheds through sewerage or other wastewater or nitrogen management approaches. A focused demonstration project has been developed, and the first phase of the project has been scoped. GHD (supported by Applied Coastal Research & Engineer and BETA Group) has been engaged as the project consultant, and has completed a Technical Memorandum which



presents preliminary design evaluations for an enlarged inlet and new bridge over Bournes Pond, as well as an analysis of the nitrogen-removal benefits of a larger inlet as determined by water-quality modeling.

A full description of this project is provided in Chapter 3, Section 3.3. Design funds were approved at Spring 2013 Town Meeting.

### **6.1.3 Eco-Toilet Project: Composting and Urine-Diverting Toilets**

This wastewater management approach will demonstrate the nitrogen-removal capability as well as installation feasibility and cost-effectiveness of eco-toilets. These technologies separate the fecal and urine components from the septage stream of an individual property, enabling transport outside the watershed and/or reuse of these materials in an environmentally beneficial way. The first phase has been scoped, and Science Wares, Inc. has been engaged as the project consultant. The first phase of the Eco-Toilet Demonstration Program is underway, with approximately 15 property owners committed to replacing all of their standard fixtures with either composting or urine-diverting toilets. The Barnstable County Department of Health and Environment has been contracted to provide baseline and ongoing monitoring of these installations.

A full description of this project is provided Chapter 3, Section 3.4.

### **6.1.4 Permeable Reactive Barriers (PRBs)**

This technology provides nitrogen treatment in the groundwater system by having it flow through a reactive barrier that converts soluble nitrogen to nitrogen gas, which is released into the atmosphere. The first phase of the project has been scoped, and CDM Smith has been engaged as the project consultant. The following initial tasks have been completed:

- Delivery of Technical Memorandum (TM) #1 detailing the evaluation criteria and TM #2 outlining preliminary site selection (18 sites).
- From 18 sites, two have been short-listed, one in West Falmouth and one in Seacoast Shores, East Falmouth.

A full description of this project is provided in Chapter 3, Section 3.5.

### **6.1.5 Improved Stormwater Management**

This stormwater and nitrogen management approach would provide hydraulic retention, bioretention, infiltration, and other best management practices (BMPs) to mitigate the nutrients, sediments, and biological vectors (pathogens, fecal coliform, etc.) discharged by stormwater to the waterbodies and to their watersheds. The Town Engineering Department and Conservation Commission are in the process of developing a Town-wide approach to stormwater management. Within the next year, the WQMC will work with appropriate Town departments and boards to determine the most appropriate location within the Little Pond watershed for a stormwater demonstration project.

A full description of this process is provided in Chapter 3, Section 3.6.

### **6.1.6 Baseline Monitoring**

Non-traditional wastewater management strategies will require baseline monitoring to demonstrate success. MassDEP has indicated that three years of monitoring will be required to assist in the determination of a nitrogen-reduction credit for each demonstration project. In addition, Adaptive



Management decisions will be made based on monitoring results. For each of the demonstration projects, the Town will be tracking the data carefully, and evaluating the monitoring results as soon as they become available. For example, the Town will begin looking at Little Pond in November 2013, when the data from the monitoring for the Shellfish Demonstration Project has been collected. It is expected that after the three years of monitoring, MassDEP will be able to formalize nitrogen removal credits for each alternative.

A full description of this process is provided in Chapter 3, Section 3.11.

## **6.2 Traditional Wastewater Management**

### **6.2.1 Sewer Extension to the Lower Watershed of Little Pond**

The proposed Little Pond Sewer Service Area is illustrated on Figure 4-8, and the system would collect wastewater from approximately 1,400 existing parcels. It would be a combination of gravity and low-pressure sewers and would include two new wastewater lift (pump) stations to convey the wastewater to the existing collection system and ultimately to the Blacksmith Shop Road WWTF.

This sewer extension would significantly reduce the nitrogen loading to Little Pond. Water quality modeling indicates that this reduction would reduce the nitrogen concentration at the sentinel station of Little Pond from 0.837 mg/L to 0.495 mg/L. Although this reduction does not meet the TMDL threshold concentration of 0.450 mg/L, it is a major reduction. It will be augmented by additional removals provided by the non-traditional nitrogen methods to be proven by the demonstration projects, such as the aquaculture project started in 2013.

### **6.2.2 Upgrade of the Blacksmith Shop Road WWTF**

The Blacksmith Shop Road WWTF has recently received a new effluent discharge permit which requires several improvements to its flow metering system and nitrogen removal optimization. The WWTF has a capacity of 1.2-million gallons per day (mgd) which is sufficient for the additional flow that would be collected from the Little Pond Sewer Service Area. This upgrade will provide the improvements needed to current and future operations for the new discharge permit.

### **6.2.3 Construction of the New Treated-Water Recharge Site**

A new treated-water recharge site is recommended at Site 7, which is north of the West Falmouth Harbor watershed, as illustrated on Figure 2-2. The eastern portion of the site is planned specifically for development to provide up to 0.26 mgd of capacity for the flow that would come from the Little Pond Sewer Service Area as outlined in a Technical Memorandum included in Appendix 4-32. The proposed facility at the east end of the site is illustrated in Figure 4-12.

### **6.2.4 Ocean Outfall**

The WQMC will continue to investigate the long-term option of discharge of treated effluent through an ocean outfall. As described more fully in Chapter 3, Section 3.9, tertiary treatment of wastewater produces an effluent with very low nitrogen, and the flow volume is quite small in proportion to the natural discharge of millions of gallons of groundwater to marine waters on a daily basis. An outfall discharge has the advantage of bypassing already-impacted watersheds, estuaries, and coastal ponds where the addition of more nitrogen from a land discharge site has a greater environmental impact.



## 6.3 Estimated Costs and Financing Plan

### 6.3.1 Summary of Capital Costs for Wastewater Management Facilities

Capital costs for the wastewater management facilities component of the CWMP as evaluated and discussed in Chapter 4 are summarized below.

**Table 6-1 Capital Costs for Recommended Wastewater Facilities**

Cost Component	Capital Costs <sup>1</sup> (\$)
Collection System	\$28,000,000
Recharge Facilities	\$2,000,000
Total Construction Costs	\$30,000,000
Contingency	\$6,000,000
Fiscal, Legal, and Engineering	\$8,000,000
Collection/Recharge Capital Costs	\$44,000,000
WWTF Improvements Capital Costs <sup>2</sup>	5,200,000
<b>Total Capital Costs</b>	<b>\$49,000,000</b>

1. Costs rounded to two significant figures, and adjusted for estimated mid-point of construction (which varies for collection, recharge, and WWTF) as identified in Chapter 4 tables, and provides an update to Table 7-1 as presented in the Draft CWMP/DEIR.
2. Costs developed since the July 2012 Draft CWMP/DEIR was prepared, and include design, construction, construction engineering, and contingency.

It is noted that Article 24 of the April 2013 Town Meeting funded \$4.5 million for engineering during design, and \$800,000 for WWTF improvements. Balance of Capital Costs to be voted: \$43,700,000.

### 6.3.2 Financing Plan

#### 6.3.2.1 Background

The Town of Falmouth is committed to the lengthy process of achieving Total Maximum Daily Load (TMDL) limits in the coastal ponds within the High-Priority Nitrogen Mitigation Area and in West Falmouth Harbor, using a variety of approaches to manage nitrogen inputs. All management alternatives have engineering, permitting, and construction costs. Financing the capital costs of these projects poses a major hurdle to any municipality in current economic times. The ensuing operation and maintenance costs will add further expense to already strained annual budgets.

The Town of Falmouth has comprehensive and varied capital needs involving both critical infrastructure and equipment replacement. These needs underscore the importance of viewing long-term capital financing in a broad, responsible context, and maintaining a healthy financial balance on behalf of the Town's taxpayers. The Town's most recent Capital Improvement Plan (CIP) is attached in Appendix 6-1. In order to fund the capital costs of the various nitrogen management projects identified in this CWMP as well as responsibly addressing the Town's other primary capital responsibilities; Falmouth proposes to use two strategies. The first and fundamental strategy is to consider issuing "new" debt when an "old" debt is paid off. In past decades, Falmouth voters have approved various "debt exclusions" under the provisions of Proposition 2 ½, so called. As that excluded debt is paid off, "new" excluded debt can be issued after a



two-thirds vote of Town Meeting and a majority vote by ballot, this without raising the tax rate. The capital projects funded by the “new” debt would be carefully selected given Falmouth’s comprehensive capital needs.

The illustration of “Estimated Costs and Financing Plans” shown in Table 6-2 simply identifies a financial opportunity. Projects within the CWMP including sewer extension to the Little Pond Sewer Service Area, shellfish aquaculture, permeable reactive barriers, eco-toilets, denitrifying septic systems, stormwater remediation, and other capital investment in nutrient removal will be sequenced as the regulatory, design, construction, voter authority, and fiscal opportunities allow.

The second funding strategy is to use the State Revolving Fund (SRF) loan program for the construction costs of the nitrogen management projects. The SRF loan process has specific eligibility requirements, a fixed annual timetable for deciding awards, a competitive selection procedure to receive an award, and a limit as to how much can be awarded to a given community in any one year. All of these constraints need to be taken into account in planning projects to improve water quality.

The SRF loans are of two types: a zero-percent loan that has significant additional eligibility requirements, or the standard 2-percent loan, an interest rate that is less than most municipalities would have to pay if borrowing on their own. Falmouth will explore the benefits and drawbacks of applying for the zero-percent loan versus the 2-percent loan. It should be stressed that without those loans, it is certain that Falmouth will not be able to finance the necessary construction costs to meet TMDLs in the coastal ponds within the Planning Area of this CWMP. The timing of issuing-new-debt-to-replace-old-debt and the receipt of an SRF loan are key to Falmouth’s capacity to fund the various projects needed to meet the TMDLs.

### **6.3.2.2 Financial Planning and Key Milestones: 2011 to 2020**

Table 6-2 Estimated Costs and Financing Plans lays out the big picture on financing, ballot votes, and the State Revolving Fund process. Although the Table focuses on the events that must take place between 2011 and 2020, Table 6-2 also provides the necessary information for financing improvements for all the coastal ponds within the Planning Area out to the year 2040. Within all of these timeframes, the Town intends to act as quickly as possible, using Adaptive Management, to implement alternatives that have proven capable of reducing nitrogen loads in a consistent and cost-effective manner.

Items 1 through 16 on Table 6-2 list all of the presently-identified critical milestones that must be met in order to design, permit, and construct the first stage of projects to meet the TMDLs in the Planning Area. Item 1 was already voted in 2011: \$2.77 million dollars of excluded debt in Article 17 to fund planning and design of demonstration projects for permeable reactive barriers, inlet widening, eco-toilets, aquaculture, baseline monitoring of water quality, preliminary sewer design, de-nitrifying septic systems, some additional MEP studies, and a Draft CWMP for Oyster Pond watershed.

Item 2 has already been accomplished: submittal of a Draft CWMP/DEIR to MEPA and the Cape Cod Commission in September 2012. The Secretary issued his Certificate on November 14, 2012 and determined that the Draft was “adequate”.

Item 3: The Town issued Requests for Proposals for an engineering firm to complete the CWMP process; and provide preliminary design services and evaluations for the sewer system for Little Pond Lower Watershed, the widening of Bourne’s Pond, and the preparation of the SRF application. The contract was awarded to GHD in November 2012.



Item 4: On April 10, 2013 Town Meeting approved Article 24, \$5.6 million of excluded debt to fund design of a wastewater collection system for the Little Pond Sewer Service Area, widen Bourne's Pond inlet from 50-feet to 90-feet, make improvements to the WWTF, some of which were required by the DEP Settlement, and develop a discharge site for the treated effluent. On May 21<sup>st</sup>, the voters passed the ballot question.

Item 5 is the subject of this CWMP/FEIR/TWMP, a process that will unfold over the next 12 months: completion of this document, submittal to MEPA/CCC, issuance of the Secretary's final Certificate, and a hearing before the Cape Cod Commission as part of the joint review process. As part of the funding strategy for nutrient management, Falmouth will file a State Revolving Fund (SRF) Project Evaluation Form (PEF) by August 31, 2013, seeking a low-interest loan from the State.

Item 6 is the submittal of the SRF PEF discussed above.

Item 7 is an important part of the current and long-range thinking of how the Town addresses its nitrogen issues, both inside and outside of the Planning Area. There will be an on-going program of Comparative Cost Evaluations of all the nutrient management strategies that the Town can employ. These evaluations will specifically look at the cost per pound of nitrogen removed by various technologies: eco-toilets, permeable reactive barriers, inlet widening, aquaculture, sewers, and any other technologies that may be developed. This evaluation will be an iterative process, folding in new data and information as it becomes available. Conclusions will be based on solid data, gathered as part of the monitoring program.

Items 8 and 9 are planned as four Articles for the 2013 Fall Town Meeting Warrant. They are part of the overall nutrient management project and will be the subject of public meetings during the summer and fall of 2013. In order to qualify for a zero-percent State Revolving Fund loan, Town Meeting must pass a "flow neutral" by-law. Town Meeting will also consider whether homes within the sewered area can be exempted from connecting to the sewer if they install eco-toilets, the so-called 'checkerboarding' concept. Town Meeting must vote a "betterment" percent for capital costs associated with installation of the sewer collection system. This vote will determine what percent of the capital costs will be paid by the property owner directly 'bettered' by the sewer, and what percent will be paid by the taxpayers of the Town. The last Article will ask for authorization to file Special Legislation so that the homeowner's portion of betterment can be tailored to the specific needs of Falmouth's Plan. This legislation would lower the yearly payments of the homeowner.

Item 10: In January 2014, the State will publish the SRF list of projects that it intends to fund in the next funding cycle. The Falmouth projects will be ranked along with all other projects in the State seeking funding assistance. Falmouth will be asking for funding for a 'multi-year' project.

Item 11 focuses on the next 'window of opportunity' for issuing new debt to replace old debt. The 'window' may be used for a variety of needed Town projects. Town Meeting will vote the construction dollars for a 20-year bond for the Little Pond Sewer Service Area and widening of Bourne's Pond Inlet, *contingent on receiving a SRF loan*. Depending on whether the 'flow-neutral bylaw' passes or not, the SRF loan request will be at zero- or 2-percent. A ballot vote is also necessary to approve the bonding as debt exclusion. The tax rate will remain stable.

Item 12 focuses on the Town's need to pass Chapter 312, Acts of 2008, Section 10 as part of the plan to receive SRF loans. This vote will be on the April 2014 Warrant along with the construction bonding request.

**TABLE 6-2**

**Estimated Costs and Financing Plans**

Item	Action Item	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	\$2.77M for Design and Demonstration Projects; Ballot Vote	X									
2	Draft CWMP/DEIR Submittal		X								
3	Execute Contract, selected engineering firm		X								
4	\$5.6M Construction Design, Ballot Vote			X							
5	Final CWMP/FEIR/TWMP; Sec Certif; CCC Hearing										
6	SRF PEF Application Submittal			X							
7	Comparative Cost Evaluations										
8	Flow Neutral Bylaw; Checkerboarding Article			X							
9	Twn Mtg Sets Betterment %; Special Legislation			X							
10	Obtain Listing on the SRF Intend Use Plan				X						
11	\$90M Town Vote 30 year Bond for Construction Contingent on 0% or 2% SRF loan; Ballot Vote				X						
12	Town Meeting vote to accept CH 312, Acts of 2008, Sec. 10				X						
13	SRF Full Application Submitted - all required items must be in place					X					
14	Detailed Design for Bid Documents										
15	State SRF Commitment; Bid Approval Little Pond						X				
16	SRF-Funded Construct'n Projects; Adaptive Mgmt										
Program Funding and Timetable 2020 - 2040											
	Evaluate Results of Remediation to Date:										
	Plan Next Construction Projects										
	\$60M Town Vote - Spring 2025										
	Town Construction of \$60M (2025-2030)										
	\$40M Town Vote - Spring 2030										
	Town Construction of \$40M (2030-2035)										
	\$100M SRF Town Vote - Spring 2035										
	Town Construction of SRF \$100M (2035-2040)										

Notes CWMP = Comprehensive Wastewater Management Plan  
 DEIR = Draft Environmental Impact Review  
 TWMP = Targetted Watershed Management Plan  
 SRF = State Revolving Fund  
 PEF = Project Evaluation Form



Item 13 - 15: By October 15, 2014 a full SRF [Item 13] application will be submitted with all required items in place. Detailed design and bid documents will be in progress [Item 14] with submittals to the State as progress reports. In January 2015, [Item 15] the State will decide to commit funds and issue an Approval to Bid for construction of the Little Pond Sewer Service Area and associated upgrades at the WWTF.

Item 16: Construction will begin July 2015, first on the Little Pond sewer extension project for an estimated two years, and subsequently on the Bourne's Pond Inlet Widening when the permitting for that project is complete.

### **6.3.2.3 Financial Planning and Key Milestones: 2020 to 2040**

By 2020, construction of the projects chosen to manage nitrogen in some of the coastal ponds of the Planning Area should be completed. Falmouth will then evaluate the results of the various projects constructed so far, decide on priorities for the next project, and prepare design and seek SRF funding if it exists. Construction would start in 2025. The same process would continue with funding opportunities in 2030 and 2035. The success of the projects constructed during the decade from 2011 to 2020 will help to determine the best course of action to take in subsequent years until the nitrogen management issues of all of Falmouth's coastal ponds have been addressed.

## **6.4 CWMP Project Completion and Implementation Timing**

### **6.4.1 Background**

The information provided in Table 6-3 is a more detailed accounting of the many projects that will take place during the decade from 2011 to 2020. The 'start' and 'finish' dates are best estimates, not exact dates—of the mini-steps needed to complete each task or project. The Water Quality Management Committee (WQMC) and the Falmouth Board of Selectmen will make their best efforts to meet this timetable, but there is always the potential for unforeseen delays or missing information. The timetable for some projects is also dependent on timely feedback from agencies and regulators. This timetable will be used as a tool to track progress on the various water quality management initiatives underway in Falmouth.

### **6.4.2 Process of Approving the CWMP/EIR/TWMP (Items 1 through 8)**

The Town submitted a DCWMP/DEIR to EOEEA in September of 2012. A Certificate from the Secretary of Environmental Affairs was issued on November 14, 2012. The Town responded to comments and has revised the document accordingly.

The process will continue as outlined in Table 6-3, items 4 through 8.

### **6.4.3 Nitrogen Control Bylaw for Fertilizer (Items 9 through 13)**

In July 2012, the WQMC began working with their technical consultant from Science Wares, Inc. to draft a Fertilizer Bylaw. This bylaw was developed through a process that included multiple meetings with stakeholder groups (landscapers, environmentalists, golf course superintendents) as well as coordination with the State's Department of Agricultural Resources. This bylaw was adopted at Fall 2012 Town Meeting.

Subsequent to the adoption of this bylaw, the lawn care lobby launched a campaign to defeat its acceptance by the state Attorney General's Office (AGO). The AGO rejected Falmouth's bylaw on May 15,



2013. The Town's legislative delegates filed corrective legislation that recently passed enabling the Town's Nitrogen Control Bylaw to remain in effect.

#### **6.4.4 Baseline Monitoring Plan for Water Quality (Items 14 through 19)**

Article 17 of the spring 2011 Annual Town Meeting (Article 17) provided funding to review existing data and conduct additional baseline monitoring as needed. Data on the environmental health of Falmouth's south coast estuaries has been collected subsequent to the dataset used for the MEP Reports for West Falmouth Harbor (2004), Little Pond (2004), as well as Great, Green, and Bourne Pond (2003) up to 2011.

Falmouth has contracted with SMAST to provide this historic baseline data and provide a Technical Report. This report will evaluate the data, present and discuss data analysis, identify data gaps, assess trends, discuss implications of the different water quality parameters, and gauge the present state of each estuary relative to the MEP nitrogen thresholds analysis. Where relevant, the baseline and trends related to TMDL compliance will be discussed.

In addition, Falmouth has developed a Scope of Work in conjunction with SMAST and the Falmouth Conservation Commission for Little Pond as part of the Shellfish Demonstration Project. This monitoring includes both bi-weekly sampling analysis of: temperature, total nitrogen (nitrate + nitrite, ammonia, dissolved organic nitrogen, particulate organic nitrogen), chlorophyll-a, pheophytin-a, orthophosphate, salinity, dissolved oxygen, transparency (Secchi depth), and other parameters as specified in the in the Quality Assurance Project Plan (QAPP) developed for the MEP reports, as well as hourly monitoring of dissolved oxygen (DO), turbidity, chlorophyll a (via fluorescence) temperature and pH, for a two-month period using in-situ data collection instrumentation.

SMAST has been continuing baseline monitoring of Bourne Pond, Great Pond, and Green Pond in 2012 and beyond through PondWatch. In addition, a Scope of Work and Implementation Plan for monitoring at Bourne Pond, Great Pond, and Green Pond that is tailored to the implementation of demonstration projects will be developed.

MassDEP has indicated that three years of monitoring will be required to assist in the determination of a nitrogen-reduction credit for each demonstration project. In addition, Adaptive Management decisions will be made based on monitoring results. For each of the demonstration projects, the Town will be tracking the data carefully, and evaluating the monitoring results as soon as they become available. For example, the Town will begin looking at Little Pond in November 2013, when the data from the monitoring for the Shellfish Demonstration Project has been collected. It is expected that after the three years of monitoring, MassDEP will be able to formalize nitrogen-removal credits for each alternative.

#### **6.4.5 Sewer Extension to the Lower Watershed of Little Pond (Items 20 through 36)**

Article 17 provided funding for preliminary sewer design and engineering. The contract with GHD Inc. for Engineering Services and Inlet Widening was finalized on October 1, 2012. Preliminary Design for the sewer extension to the lower watershed of Little Pond was completed on December 30, 2012.

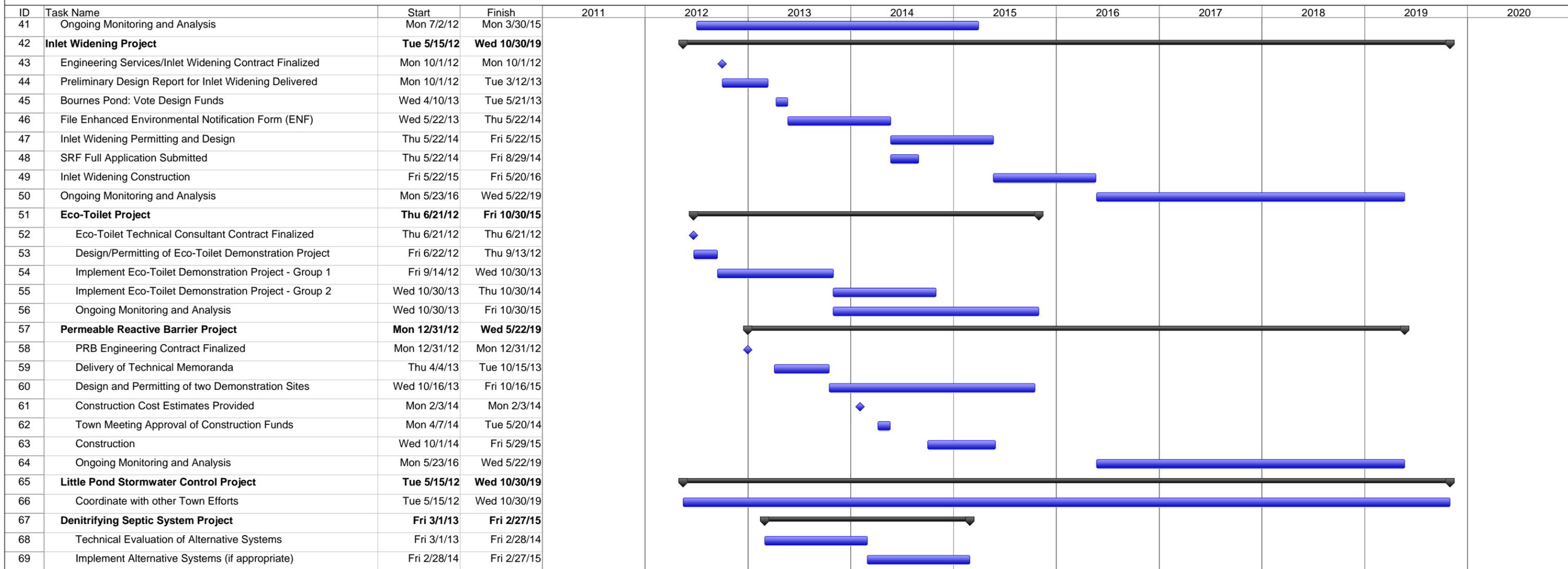
At Spring 2013 Town Meeting, funds for detailed design of the Little Pond Sewer Service Area were unanimously approved. The May 21, 2013 ballot vote also passed. Design of that sewer extension will proceed to allow the design documents to be submitted for SRF review by the October 2014 timeframe.

**TABLE 6-3  
PROJECT COMPLETION AND IMPLEMENTATION TIMETABLE**

ID	Task Name	Start	Finish	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	<b>Process of Approving the CWMP/EIR/TWMP</b>	<b>Wed 8/15/12</b>	<b>Tue 7/22/14</b>		[Timeline bar from 2012 to 2014]								
2	Town Submits DCWMP/DEIR/TWMP to EOEEA	Wed 8/15/12	Wed 11/7/12		[Blue bar]								
3	EOEEA Issues Certificate and Comments	Wed 11/7/12	Wed 11/7/12		◆								
4	WQMC sends Final CWMP to Selectmen	Wed 11/7/12	Tue 7/16/13		[Blue bar]								
5	Selectmen Approve Final CWMP	Fri 7/19/13	Mon 9/30/13			[Blue bar]							
6	Submit Final CWMP to EOEEA	Tue 10/1/13	Mon 10/7/13			[Blue bar]							
7	Secretary Issues Certificate	Tue 10/8/13	Fri 3/21/14			[Blue bar]							
8	Cape Cod Commission Hearing Process	Mon 3/24/14	Tue 7/22/14				[Blue bar]						
9	<b>Nitrogen Control Bylaw for Fertilizer</b>	<b>Thu 7/19/12</b>	<b>Mon 4/7/14</b>		[Timeline bar from 2012 to 2014]								
10	Develop and Vote Fertilizer Bylaw	Thu 7/19/12	Tue 11/13/12		[Blue bar]								
11	Attorney General Rejects Bylaw	Wed 5/15/13	Wed 5/15/13			◆							
12	Corrective Legislation Implemented	Wed 7/17/13	Wed 7/17/13			◆							
13	Town Votes Revised Bylaw - NOT USED	Mon 4/7/14	Mon 4/7/14				◆						
14	<b>Baseline Monitoring Plan for Water Quality</b>	<b>Thu 10/4/12</b>	<b>Mon 12/31/18</b>		[Timeline bar from 2012 to 2018]								
15	Contract SMAST for Baseline Data/Analysis (up to 2011)	Thu 10/4/12	Fri 8/30/13		[Blue bar]								
16	Scope of Work/Implement Little Pond Monitoring	Thu 10/4/12	Fri 3/28/14		[Blue bar]								
17	Scope of Work/Implement Bourne Pond Monitoring	Thu 1/2/14	Fri 10/31/14				[Blue bar]						
18	Scope of Work/Implement Great and Green Pond Monitoring	Fri 1/2/15	Fri 10/30/15					[Blue bar]					
19	Ongoing Evaluation of Monitoring Results	Fri 11/1/13	Mon 12/31/18					[Blue bar]					
20	<b>Sewer Extension to the Lower Watershed of Little Pond</b>	<b>Mon 10/1/12</b>	<b>Wed 10/30/19</b>		[Timeline bar from 2012 to 2019]								
21	Engineering Services Contract Finalized	Mon 10/1/12	Mon 10/1/12		◆								
22	Preliminary Design Report for LLP Sewer Delivered	Mon 10/1/12	Fri 12/28/12		[Blue bar]								
23	Little Pond Sewer: Vote Design Funds	Wed 4/10/13	Tue 5/21/13			[Blue bar]							
24	Little Pond Sewer System Design	Wed 5/22/13	Thu 5/22/14			[Blue bar]							
25	File SRF Project Evaluation Form	Mon 9/2/13	Mon 9/2/13			◆							
26	Develop and Vote Flow Neutral Bylaw	Wed 5/22/13	Thu 11/7/13			[Blue bar]							
27	Develop and Vote Betterment	Wed 5/22/13	Thu 11/7/13			[Blue bar]							
28	Develop and Vote Special Legislation for Betterment	Wed 5/22/13	Thu 11/7/13			[Blue bar]							
29	File Special Legislation for Betterment	Fri 11/8/13	Fri 11/7/14				[Blue bar]						
30	Develop and Vote "Checkerboarding"	Wed 5/22/13	Thu 11/7/13			[Blue bar]							
31	Vote Construction of Little Pond Sewer	Mon 4/7/14	Wed 5/21/14				[Blue bar]						
32	SRF Full Application Submitted	Thu 5/22/14	Fri 8/29/14				[Blue bar]						
33	Detailed Design for Bid Documents	Thu 5/22/14	Tue 6/30/15				[Blue bar]						
34	State SRF Commitment: Bid Approval for Little Pond	Thu 1/15/15	Thu 1/15/15					◆					
35	SRF Construction Project of Little Pond Sewer	Wed 7/1/15	Fri 6/30/17					[Blue bar]					
36	Ongoing Monitoring and Analysis	Mon 5/2/16	Wed 10/30/19						[Blue bar]				
37	<b>Shellfish Aquaculture Demonstration Project</b>	<b>Mon 7/2/12</b>	<b>Mon 3/30/15</b>		[Timeline bar from 2012 to 2015]								
38	Shellfish Consulting Contract Finalized	Fri 10/5/12	Fri 10/5/12		◆								
39	Design/Permitting of Shellfish Demo Project	Fri 10/5/12	Fri 5/10/13		[Blue bar]								
40	Implementation of Shellfish Demo Project - Year 1	Wed 5/22/13	Wed 10/30/13			[Blue bar]							

Project: Draft Schedule 6-4-2012 with u Date: Wed 7/24/13	Task		Rolled Up Progress		Inactive Task		Manual Summary Rollup		Deadline	
	Milestone	◆	Split		Inactive Milestone	◇	Manual Summary			
	Summary		External Tasks		Inactive Summary		Start-only			
	Rolled Up Task		Project Summary		Manual Task		Finish-only			
	Rolled Up Milestone	◇	Group By Summary		Duration-only		Progress			

**TABLE 6-3  
PROJECT COMPLETION AND IMPLEMENTATION TIMETABLE**



Project: Draft Schedule 6-4-2012 with u Date: Wed 7/24/13	Task	[Blue bar]	Rolled Up Progress	[Thick black bar]	Inactive Task	[White bar]	Manual Summary Rollup	[Blue bar]	Deadline	↓
	Milestone	◆	Split	[Dotted blue bar]	Inactive Milestone	◇	Manual Summary	[Thick black bar]		
	Summary	[Thick black bar]	External Tasks	[Grey bar]	Inactive Summary	[White bar]	Start-only	[C-shape]		
	Rolled Up Task	[Blue bar]	Project Summary	[Grey bar]	Manual Task	[Green bar]	Finish-only	[J-shape]		
	Rolled Up Milestone	◇	Group By Summary	[Thick black bar]	Duration-only	[Light blue bar]	Progress	[Thick black bar]		



#### **6.4.6 Shellfish Aquaculture Demonstration Project (Items 37 through 41)**

Article 17 provided funding to develop a Shellfish Demonstration Project. The purpose of this project is to determine the effectiveness of oyster aquaculture to attenuate the excessive nitrogen load in Little Pond, one of the Town's most heavily impacted estuaries. Through a water-quality monitoring program, combined with assessments of nitrogen uptake into oyster growth, an estimate will be made of the nitrogen reduction attributable to oyster aquaculture. MassDEP has indicated that three years of monitoring will be required to assist in the determination of a nitrogen reduction credit for oyster aquaculture. Once established, these credits could be used to implement oyster aquaculture projects to meet nitrogen TMDL thresholds for both Little Pond and other degraded estuaries.

Woods Hole Group (WHG) was hired as a consultant to the Shellfish Demonstration Project. WHG has prepared Technical Memoranda (TM) including presenting the results of the shellfish viability test that was conducted in the summer of 2012, presenting the results of a Standing Stock Assessment of Little Pond, and providing planning estimates of the nitrogen uptake of various shellfish species. WHG also provided a TM outlining project specifications and cost estimates.

All permits will be obtained prior to implementation of the three-year Shellfish Demonstration Project. A total of 2.5 million oysters will be grown in two batches (early and late) during the summer of 2013. This project is currently underway, with the first batch of seed oyster installed in the Town upweller on June 3, 2013. These seed will be grown, tested, and relayed to Little Pond in late June 2013. The second batch of seed will be tested, grown in an upweller, and relayed to Little Pond by late July 2013.

A Monitoring Plan for the first year has been developed that has been reviewed by MassDEP, which has no objections. In addition, the Falmouth Conservation Commission reviewed this plan as part of the Notice of Intent hearing, and formalized its approval within their Order of Conditions (MassDEP Permit #25-3915). See Appendix 3-1.

#### **6.4.7 Inlet Widening Project (Items 42 through 50)**

Article 17 provided funding to investigate inlet widening at Bournes and/or Little Pond. A contract with GHD Inc. for Engineering Services and Inlet Widening was finalized on October 1, 2012.

GHD has completed a Technical Memorandum (BP-TM-1) which presents preliminary design evaluations for an enlarged inlet and new bridge over Bournes Pond, as well as an analysis of the nitrogen removal benefits of a larger inlet as determined by water-quality modeling. GHD is assisted by Applied Coastal Research and Engineering (ACRE) who is providing hydrodynamic and water-quality modeling to determine the optimized size of the proposed new inlet and identify the nitrogen removal benefits of a larger opening; and BETA Group Inc. who provided preliminary design information on the proposed new bridge and roadway changes.

Design and permitting costs of a widening of Bournes Pond inlet is estimated to be \$700,000, of which \$400,000 will be paid from Article 17. Spring 2013 Annual Town Meeting unanimously approved funding the balance (\$300,000). Ballot approval was on May 21, 2013.

The following tasks have been completed:

- Evaluation of alternative designs for a new Bournes Pond inlet opening and bridge.
- Cost development for the preferred alternative, which is an opening with a new bridge with a 90-foot opening as opposed to the current 50-foot opening.



- Hydrodynamic and water quality modeling to estimate the effective nitrogen removal of the new inlet.
- Cost comparison with traditional wastewater management to remove the same amount of nitrogen.
- Conclusion that this non-traditional nitrogen management method is very cost effective. Inlet opening is less than half of the cost of sewer extension and wastewater treatment to remove the same amount of nitrogen.

The next steps of this project include:

- Coordination with a broader group of stakeholders.
- Development and review of the needed documents to gain MEPA and local approvals.
- Development and review of additional needed local, State and Federal permits.
- Project implementation.
- Monitoring of water quality changes attributable to the new opening.

#### **6.4.8 Eco-Toilet Project (Items 51 through 56)**

Article 17 provided funding to investigate the use of composting and urine-diverting toilets (eco-toilets) and denitrifying septic systems in order to determine the cost and feasibility of their installation and operation, their public acceptability, and the level of nitrogen removal achievable. The Falmouth Board of Selectmen have authorized \$80,000 to provide incentives for an initial set of up to 15 eco-toilet installations (Demonstration Group I), and the Town has signed a Memorandum of Agreement with the Barnstable Department of Health and Environment (BCDHE) to establish the pre-installation nitrogen concentration of the septic tank effluent, and perform monthly monitoring of the septic tank effluent that results after an eco-toilet has been installed. Falmouth has also contracted with Science Wares, Inc. as a technical consultant to assist in the design and implementation of an eco-toilet demonstration program.

A significant barrier to implementation was identified. Urine-diverting fixtures, source separators and other pilot-stage urine-diverting toilet technologies do not currently have a Product Acceptance number from the State Board of Plumbers and Gas Fitters, and are therefore illegal to install in the State. Science Wares worked with the local plumbing inspector, State plumbing board, and BCDHE to obtain a variance for Test Site Status for up to 40 test sites to enable urine-diverting fixtures to be installed. This has paved the way for significantly more installations than would have been feasible with composting toilets alone.

The first phase of this program (Demonstration Group I) is well underway. Approximately 15 property owners have committed to replace all of the standard toilets in their home with eco-toilets and allow two years of monitoring. Board of Health and building permits have been granted for three standard composting-toilet installations, with more to be approved by the end of June. In addition, approximately six urine-diverting installations are in the design and permitting stage. All installations are expected to be complete by December 2013, with monthly monitoring by BCDHE to commence concurrently. MassDEP has suggested that data from a total of 62 installations will be necessary to establish regulatory credit for the nitrogen removal capacity of eco-toilets. The Town is actively identifying additional participants to meet this regulatory requirement.



#### **6.4.9 Permeable Reactive Barrier Project (Items 57 through 64)**

Article 17 provided funding to develop a demonstration project for Permeable Reactive Barriers (PRBs). On December 31, 2012, CDM Smith was hired to design and permit PRBs in up to two locations, one in the West Falmouth Harbor watershed and the other in the High Priority Mitigation Area in East Falmouth.

CDM Smith has completed two Technical Memoranda (TMs) and has presented their findings to the WQMC working group, State and local regulatory agencies, and at a public meeting of the WQMC. These TMs include the evaluation criteria and preliminary site selection for the PRB pilot project. Subsequent TMs will address details of permitting, surface and groundwater monitoring, and final site selection and design.

#### **6.4.10 Little Pond Stormwater Control Project (Items 65 through 66)**

Falmouth's Engineering Department is responsible for implementing the Phase II requirements for the Town's NPDES permit and has been moving forward with compliance. Efforts within the Little Pond watershed include updating outfall maps for the Little Pond watershed to identify all of the stormwater runoff into Little Pond, a public education campaign, and street cleaning.

Preliminary evaluations have begun to determine appropriate Best Management Practices (BMP) for this watershed, such as bio-retention. This evaluation process is being informed by EPA's Green Infrastructure objectives and other current research results such as University of New Hampshire Stormwater Center (UNHSC) project to optimize nitrogen removal from stormwater treatment systems. The Town, through its Engineering Department, other appropriate departments and boards, as well as technical consultants, will pursue feasible BMP solutions as part of the sewer construction for this watershed.

In addition, the Falmouth Conservation Commission is revising their Stormwater Regulations. Nitrogen-reduction BMP requirements will be part of this update. Data on the nitrogen loading from the outfall at Narragansett Street within the Little Pond watershed will be collected as part of the Shellfish Demonstration Project.

#### **6.4.11 Denitrifying Septic System Project (Items 67 through 69)**

Article 17 provided funding to investigate the use of composting and urine-diverting toilets (eco-toilets) and denitrifying septic systems. The WQMC is working closely with Barnstable County Department of Health and Environment (BCDHE) to evaluate technologies that are promising based on published studies, and results from the BCDHE database of Innovative/Alternative (I/A) septic systems. In addition, BCDHE is planning to implement a pilot project for a passive, non-proprietary denitrification system. The findings of this project as well as the technical evaluations will guide future efforts to implement I/A systems.

### **6.5 Embayment Monitoring**

The overriding need to provide improved wastewater and nitrogen management is to remediate the current nitrogen loading to coastal estuaries as identified by the nitrogen TMDLs. MassDEP will require embayment monitoring, which may include monitoring of water quality, eel grass coverage, and benthic infauna habitat, to verify that the wastewater and nitrogen management efforts are effective. These monitoring programs are developed as part of the Discharge Permit Application Process which occurs after approval of the FCWMP/FEIR.



Discussions with MassDEP have recognized the following key items about such a program:

- The ultimate goal is to restore the marine habitat to the levels that are the basis of the TMDLs.
- The attainment of the threshold nitrogen concentrations at the estuary sentinel stations are an indicator of the condition that habitat can repair itself.
- Some aspects of habitat restoration, such as re-growth of eel grass, may not be possible due to other factors such as past deposition of organic solids, on-going boat traffic, etc.
- The embayment monitoring will be a long-term effort and will need to be a team effort between the communities within the embayment watersheds and MassDEP.
- MassDEP plans to continue its eel grass survey program which provides aerial surveys every five years.

The embayment monitoring program is expected to be subject to MassDEP review. The following are an indication of possible monitoring requirements based on requirements in another Cape Cod town:

- Five sample events per summer season (two in July, two in August, and one in September), at one to three sample locations per estuary, for the following parameters:
  - Particulate Organic Nitrogen (PON)
  - Dissolved Organic Nitrogen (DON)
  - Dissolved Inorganic Nitrogen (DIN)
  - Dissolved Oxygen (DO)
  - Chlorophyll-a
  - Secchi Depth
  - Salinity
  - Total Suspended Solids (TSS)
- Benthic infauna survey of the estuaries conducted approximately at a five-year frequency.

This is the embayment monitoring that is expected for TMDL compliance. It is possible that more detailed water quality monitoring could be required to demonstrate the feasibility of one or more demonstration projects. These monitoring programs will be reviewed as part of the demonstration project independently of this CWMP/FEIR/TWMP.

## **6.6 Groundwater Monitoring**

A Groundwater Monitoring program will also be developed as part of the Groundwater Discharge Permit Process. The Blacksmith Shop Road Site has an extensive groundwater monitoring system. Additional groundwater monitoring will be placed at new facilities at Site 7 and an appropriate monitoring plan will be established at that time. This plan may include evaluating Contaminants of Emerging Concern.



## 6.7 Crocker Pond Monitoring

Historic monitoring data for Crocker Pond were evaluated as discussed in Chapter 4 and detailed in Appendix 4-33. The following baseline water quality monitoring is recommended for Crocker Pond for the conventional nutrient-related and aquatic habitat parameters.

**Table 6-4 Baseline Monitoring for Crocker Pond**

Parameter	Rationale	Sampling Protocol
Water Temperature and Dissolve Oxygen (DO) Profile	Aquatic habitat, evidence of DO depletion	Sample at 1-meter intervals at deepest point in pond (June, July, and August)
Nearshore (littoral zone) habitat plant community, algal abundance, sediment types	Establish baseline, consider whether recreational access is impaired	Single survey, July
Trophic state parameters: total P, total N, chlorophyll-a, Secchi disk transparency	Baseline productivity level, extend data set (last sampling in 2007)	Two depths: surface and deep water (7 meters). Sample in August for consistency with existing data
Current recreational access points and protected lands	Document how resource is currently used	Field observations and mapping

Water quality monitoring as part of the Cape Cod Commission Ponds and Lakes (PALs) program is also recommended.

## 6.8 Adaptive Management Plan

This CWMP and its implementation as illustrated in Tables 6-2 and 6-3 is designed for Adaptive Management. As the demonstration projects are implemented and demonstrate nitrogen removal performance and costs, they will be evaluated for more extensive use. If they prove to be feasible to be used for TMDL compliance, the CWMP will be modified for their inclusion.

A standard set of evaluation criteria will be used to compare all wastewater and nitrogen management methods (traditional and non-traditional) on a “level playing field.” The WQMC conducted a workshop on April 7, 2012 to consider expanding/modifying the criteria to be used during Adaptive Management evaluations from the criteria used as part of the Alternatives Screening Analysis. The criteria were grouped for several themes as summarized in the following Table 6-5.



**Table 6-5 Evaluation Criteria Summary from WQMC Workshop in April 2012**

Evaluation Criteria Theme	Previous Criteria Used	Proposed Criteria for Adaptive Management Evaluations
Social	<ul style="list-style-type: none"> <li>• Anticipated public acceptance</li> <li>• Potential land requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Achieves multiple benefits including public health, jobs, tourism, economy, ecology</li> <li>• Open to alternatives</li> <li>• Public acceptability including perception of impacts to property value</li> <li>• Voter acceptability</li> <li>• Level of disruption to individual properties</li> <li>• Institutionally viable (planning, engineering &amp; finance)</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Effluent quality to protect aquatic ecosystems</li> <li>• Potential for air emissions (odor and noise)</li> </ul>	<ul style="list-style-type: none"> <li>• Protect ecological value: restoration of water quality and habitat in ponds and estuaries</li> <li>• “Robustness” for meeting standards: attention to nitrogen, phosphorus, emerging constituents, carbon and other alterations and stressors</li> <li>• Avoid externalization</li> <li>• Work up from the estuary biological metrics for a health aquatic environment</li> <li>• Energy efficiency - life cycle energy use</li> </ul>
Economic	<ul style="list-style-type: none"> <li>• Capital cost</li> <li>• Operating costs</li> </ul>	<ul style="list-style-type: none"> <li>• Capital and operating costs</li> <li>• Cost per pound of nitrogen removed</li> <li>• Advance the low-hanging fruit</li> <li>• Affordability within available tax limits</li> <li>• Indirect costs and benefits (e.g. job creation)</li> <li>• Total property owner cost</li> <li>• Capacity to pay taxes</li> <li>• Amenability to types of financing (e.g. betterment)</li> <li>• Ease of distributing costs</li> </ul>
Ease of Implementation	<ul style="list-style-type: none"> <li>• Ease of implementation</li> <li>• Ease of operation and maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Don’t be constrained by current regulations</li> </ul>
Resource Use	<ul style="list-style-type: none"> <li>• Energy use</li> </ul>	<ul style="list-style-type: none"> <li>• Maximize resource recovery and minimize non-renewable resource use (water, nutrients, energy)</li> </ul>



Evaluation Criteria Theme	Previous Criteria Used	Proposed Criteria for Adaptive Management Evaluations
Ease of Regulatory Approvals	<ul style="list-style-type: none"> <li>Meeting regulatory requirements</li> </ul>	<ul style="list-style-type: none"> <li>Compliance with regulations and TMDL as a floor</li> <li>Measure compliance at the sentinel level not by percentage of properties sewered</li> <li>Necessary regulatory changes identified for each alternative</li> </ul>
Resilience/Adaptability	<ul style="list-style-type: none"> <li>Flexibility</li> </ul>	<ul style="list-style-type: none"> <li>Resilience to climate change/aging population</li> <li>Able to manage uncertainty (modular, spaced)</li> <li>Flexible to growth</li> </ul>

It is noted that the Cape Cod Commission DRI review process that will follow the FEIR review process typically requires the development of a separate Adaptive Management Plan. These criteria will be refined as part of that development process. The financing and implementation plans presented earlier in this Chapter will form the basis of that plan.

### 6.9 Considerations on Town Plans for TMDL Compliance at West Falmouth Harbor

The Modified Groundwater Discharge Permit (attached in Appendix 1-5) requires that the CWMP include a plan and schedule for bringing water quality in West Falmouth Harbor into compliance with the West Falmouth TMDL and Surface Water Quality Standards by December 2, 2016 or as soon thereafter as possible.

Water quality modeling by S Mast as contracted by Buzzards Bay Coalition and completed in February 2007 (described in Chapter 7, section 7.6.3) found that approximately 0.5 mgd (at 3 mg/L total nitrogen) could be recharged at the WWTF and still meet the nitrogen TMDL even if no sewer extension is made to portions of the watershed west of Route 28. Subsequent to this evaluation, the WWTF effluent discharge permit (Appendix 1-5) was approved to allow a recharge up to 0.57 mgd at 3 mg/L total nitrogen. The Town plans to limit the recharge to the watershed as allowed by the discharge permit with the goal of not discharging more than 0.5 mgd to the watershed on an average annual basis.

The Town plans to proceed with a PRB in West Falmouth Harbor Watershed as part of the PRB Demonstration Project as identified in Chapter 3. This is expected to provide further nitrogen mitigation.

The Town also envisions the use of expanded aquaculture in West Falmouth Harbor as a holding area (with further nitrogen uptake) for the oysters raised in Little Pond as part of the current demonstration project.

The Town plans to meet the TMDL water quality standards in West Falmouth Harbor as soon as possible and will work with MassDEP and Buzzards Bay Coalition to meet that goal.

### 6.10 Mitigation of Potential Construction Impacts

Even though this Plan is developed to address the serious environmental impact of septic tank effluent causing eutrophication in the estuaries, possible environmental impacts could occur during construction of



new wastewater management facilities. Chapter 8 describes the proposed mitigation measures during construction to minimize any environmental impacts of this plan.



## **7 Summary of Environmental Impact Analysis**

### **7.1 Introduction**

In accordance with the MEPA review process, an Environmental Impact Report (EIR) is required as part of the Town of Falmouth's Comprehensive Wastewater Management Planning Report (CWMP). The Code of Massachusetts Regulations (301 CMR 11.00) provides the outline for the information required for the EIR and this information is presented as part of the CWMP/FEIR/TWMP Document. The purpose of this Chapter is to outline the existing conditions of the Town; and provide an analysis of effects for the Town of Falmouth's Recommended Plan and the "No Action" alternative.

The main focus of this environmental impact analysis is to address the nitrogen TMDLs developed (and planned) for Falmouth's estuaries in the Planning Area. As discussed in previous chapters of this document, addressing these nitrogen TMDLs will be initiated during the 20-year planning period of this CWMP planning time period (2015 to 2035). The Recommended Plan is detailed in the preceding chapter and includes the following items:

1. A group of demonstration projects that are independent of this CWMP/FEIR/TWMP and will enter the MEPA review process at a later time if they trigger MEPA thresholds.
2. Traditional wastewater management implementation steps including:
  - Sewer extension to the Little Pond Sewer Service Area as delineated on Figure 4-8 and described in Chapters 4 and 6.
  - Improvements at the existing Blacksmith Shop Road WWTF. These improvements will take place within the existing facilities as described in Chapters 4 and 6.
  - Construction of a new treated-water recharge site at Site 7 as illustrated in Figure 4-12 and described in Chapters 4 and 6.

The traditional wastewater management implementation steps are planned to begin remediation of water quality in Little Pond.

The wastewater for this sewer extension would be transmitted to the existing Blacksmith Shop Road Site for advanced treatment (total nitrogen concentration of 3 mg/L or less) and recharged at Site 7.

The demonstration projects are envisioned to be used to augment the water-quality improvements in Little Pond and be used in the High Priority Nitrogen Mitigation Area as illustrated in Figure 2-2.

### **7.2 Existing Environment**

#### **7.2.1 Introduction**

To properly assess the potential site impacts, background information regarding the physical, biological, chemical, economic, and social conditions of the Planning Area and immediate surroundings must be outlined. Much of this information was reviewed in the October 2007 Needs Assessment Report (NAR) which provides the background for this Chapter.

Figure 1-1, Project Location Map, illustrates the project location, Planning Area, and watersheds. Figure 2-1 illustrates the project estimates of existing wastewater nitrogen that needs to be removed from these watershed to meets the nitrogen TMDLs. Figure 2-2 illustrates the estimates of future wastewater nitrogen that needs to be removed to meet the TMDLs. Figures 7-1 through 7-10 provide detailed illustrations of the existing conditions in the Planning Areas. Figures 7-1 through 7-10 illustrate Site 7 as a long site that



extends from Research Road in the east to Route 28 in the west. Only the eastern half will be developed as part of the Recommended Plan as illustrated in Figure 4-8.

## **7.2.2 Topography, Geology, and Soils**

### **7.2.2.1 Topography**

The topography of the Planning Area is presented as Figure 7-1.

In general, the proposed infiltration area of Site 7 demonstrates changes in elevation, ranging between 40± and 80± feet above mean sea level (MSL). Surficial geology throughout the area is typical glacial moraine.

Topography at the WWTF property is generally the same as Site 7 with the exception of the building footprints and immediately developed areas which have been graded to accommodate the development.

### **7.2.2.2 Geology/Soils**

The Town of Falmouth Open Space and Recreation Plan describes the Town as being divided into two major geologic units: the Buzzards Bay (Falmouth) moraine and the Mashpee outwash plains. The line dividing these two geologic formations runs approximately along Gifford Street Extension through Long Pond, down Palmer Avenue, and through Salt Pond. Figure 7-2 illustrates the surficial geology of the Planning Area. The majority of the Planning Area is identified as “glacial stratified deposits, coarse. ”

According to the National Resource Conservation Service (NRCS) soil survey for Barnstable County, soils within the Planning Area (Figure 7-3) are all considered Plymouth-Barnstable Complex which is described as being, ‘undulating and rolling, very deep, excessively drained and well drained soils are on the side slopes of moraines.’ Of the categories of Plymouth-Barnstable Complex at the WWTF, stones and boulders cover 1- to 15-percent of the surface with slopes ranging from 3- to 15-percent. Mapped areas of Plymouth-Barnstable Complex are irregular in shape and generally range from 20 to 600 acres in size.

The Plymouth-Barnstable Complex is comprised of approximately 55-percent Plymouth soil, 20-percent Barnstable soil, and 25-percent other soils. Typically, Plymouth soil is covered with a thin (1+ inch) layer of loose, un-decomposed pine needles/debris, leaves, and twigs and 1+ inch layer of partly and well decomposed organic material. Typically, the subsoil is about 26-inches thick. According to NRCS, ‘permeability is rapid in the subsoil of the Plymouth soil and very rapid in the substratum. Available water capacity is low. Depth to the seasonal high water table is more than 6-feet. ’

The surficial, organic layers of Barnstable soil are similar to that of Plymouth soils and the subsoil is typically 22-inches thick. According to NRCS, ‘Permeability is moderately rapid in the subsoil of the Barnstable soil and rapid or very rapid in the substratum. Available water capacity is moderate. Depth to the seasonal high water table is more than 6-feet.

**WWTF:** Soils within the WWTF property are predominantly Plymouth-Barnstable Complex, with a 14± acre inclusion of soil mapped as pits, sand and gravel, located in the southwestern portion of the property. With the exception of the pit, sand and gravel area, the entire property is classified as Plymouth-Barnstable Complex and varies between rolling, extremely bouldery in the northeastern portion of the site to hilly, extremely bouldery in the west, south and eastern portion of the site.



**Infiltration Bed Site 7:** Soils within Site 7 are entirely Plymouth-Barnstable Complex, hilly and extremely bouldery, with the exception of an approximately 0.9 acre inclusion of soils mapped as Plymouth-Barnstable Complex, rolling hills and extremely bouldery.

A hydraulic load test was completed at Site 7 as discussed in Chapter 4 and detailed in Appendix 4-19. Soil profile information is provided in the Appendix, and the evaluation of a design loading rate of 7 gallons per day per square foot is summarized.

### **7.2.3 Surface and Groundwater Hydrology and Quality**

In the vicinity of the WWTF and Site 7, no surface waters are present. A brief discussion of these water bodies in the Planning Area follows including floodplains and velocity zones. The groundwater in Falmouth provides drinking water supplies and recharges the ponds, wetlands, and coastal estuaries. The groundwater resources on Cape Cod are classified as a sole-source aquifer by USEPA. Groundwater details such as flow direction and elevation, public water supplies, and protected areas are discussed below.

#### **7.2.3.1 Embayment Water Quality**

Embayment water quality for each of the watersheds, specifically the infaunal communities (benthic organisms), eelgrass distribution, and water quality in the Planning Area is discussed in greater detail in Chapter 5 of the NAR and summarized in Appendix 2-3. As documented in the MEP Technical Reports, the excessive nitrogen loading to the Town's embayments is damaging these water resources and could impact property values and ultimately the tourist and summer home economy of many portions of Falmouth. As discussed through all CWMP Project reports, restoration of embayment water quality is the main goal of the CWMP.

#### **7.2.3.2 Lakes, Ponds, and Rivers**

There are 21 great ponds and three rivers within the Planning Area, most of which are located in Falmouth. A great pond is defined by the MassDEP as any pond or lake of 10 or more acres. Ashumet Pond, Flax Pond, Hamblin Pond, Jehu Pond, Johns Pond, and Snake Pond are located either in Mashpee or Sandwich or shared with Falmouth. The Great Ponds and smaller ponds in the Planning Area were listed and illustrated in Chapter 5 of the NAR; see Figure 7-4 for a map of the ponds.

According to the CCC Pond and Lake Atlas, there are 141 ponds in Falmouth totaling 1,016 acres. The atlas serves as a status report on the Cape Cod Pond and Lake Stewardship (PALS) program and reviews water quality data collected by volunteers during the 2001 PALS snapshot in order to gain Cape Cod specific nutrient indicators of pond impacts. Of the 141 ponds located within the Town of Falmouth, only seven ponds were sampled (or 5-percent) and only two were located within the Planning Area (Deep Pond and Fresh Pond). Of the seven ponds sampled, six were considered impacted by the CCC for chlorophyll-a and total phosphorus, and all seven were considered impacted for total nitrogen.

Additional evaluation of Crocker Pond has been completed as detailed in Chapter 4 and Appendix 4-33.

#### **7.2.3.3 Wetlands**

Wetlands are identified as both fresh and salt water. In 1993, the Falmouth Wetlands Action Committee performed a wetland survey to account for unidentified wetland areas. This information was then incorporated into the Falmouth Local Comprehensive Plan (LCP) (Open Space, 1996). Also as part of the



Town's wetland regulations, a 100-foot upland review area, commonly referred to as an upland buffer area, was defined, surrounding each identified wetland area. Each of the Planning Areas has wetlands within their boundaries and in some cases, these wetland areas and freshwater ponds provide natural attenuation of nitrogen.

Wetlands result from both salt water and fresh water and are valuable for a variety of reasons. As documented in the U.S. Army Corps of Engineers New England Division Highway Methodology Workbook Supplement, wetlands provide a variety of functions and values, including groundwater recharge/discharge, floodflow alteration (storage and desynchronization), fish and shellfish habitat, sediment/toxicant retention, nutrient removal/retention/transformation, nutrient production export, sediment/shoreline stabilization, wildlife habitat, recreation (consumptive & non-consumptive), educational scientific value, uniqueness/heritage, visual quality/aesthetics, and endangered species habitat/use. Wetlands are protected under Wetlands Protection Act (WPA) (310 CMR 10.00) which, in Massachusetts, is administered and enforced by MassDEP's Wetlands Program under the Bureau of Resource Protection. As stated in the WPA (310 CMR 10.02(2)), wetlands are protected from activities which will remove, fill, dredge, or alter any area designated as a wetland. Wetlands within the Planning Area are shown on Figure 7-5.

According to State GIS information, two wetland areas are located within the WWTF property. The first wetland is approximately 0.3 acres in size, located in the northeast portion of the WWTF property, and is classified by the State as being a 'wooded swamp deciduous'. Although this wetland is not mapped by the National Wetlands Inventory (NWI), which identifies Federal wetland resources, it likely qualifies as both a State and Federally-regulated wetland. The second wetland is approximately 1.4 acres in size, located in the southeast corner of the WWTF property, and is classified by the State as being a 'shrub swamp' wetland. This wetland is mapped as being a freshwater forested/shrub wetland by the NWI. No State or Federal wetlands are mapped within Site 7.

#### **7.2.3.4 Vernal Pools**

Vernal pools are defined in the WPA 310 CMR 10.04 as being, 'confined basin depressions which, at least in most years, hold water for a minimum of two continuous months during the spring and/or summer, and which are free of adult fish populations, as well as the area within 100 feet of the mean annual boundaries of such depressions.' The regulations also note that vernal pools are essential breeding habitat, and provide other extremely important wildlife habitat functions during non-breeding seasons as well, for a variety of amphibian species such as wood frog (*Rana sylvatica*) and the spotted salamander (*Ambystoma maculatum*).' More than 50 vernal pools have been identified by the Natural Heritage & Endangered Species Program (NHESP) in the Town of Falmouth alone. The vernal pools located within the Planning Area are shown on Figure 7-5. The majority of the vernal pools located within the Town of Falmouth are within the Great Pond watershed, and the ones in the Town of Mashpee are within the Waquoit-East watershed. No vernal pools are located within the WWTF property or Site 7.

#### **7.2.3.5 Floodplains and Velocity Zones**

Floodplains are nature's way of buffering land areas from excessive storm events because they act to dissipate the wind and wave action generated during these storms. V-Zones are designated by the Federal Emergency Management Agency (FEMA) and are defined as areas susceptible to 100-year coastal flooding with high velocity wave action.



Also designated by FEMA, A-Zones are areas where flooding is predicted to occur once every 100 years. This flooding occurs with minimal associated wave action, and these areas are typically located landward of the V-Zones, typically in salt marshes and low elevation areas of Falmouth and Mashpee. The surface elevations in these areas typically lie below 10-feet MSL. The WWTF property and Site 7 are outside of all FEMA mapped flood zone areas as shown on Figure 7-6.

#### **7.2.3.6 Groundwater Flow Direction and Elevation**

Generally, the groundwater system (Sagamore Lens) is at its historically highest elevation within MMR (located in the Town of Sandwich). Groundwater flows in a radial direction. However, for the south coastal embayments, it generally flows in a southerly direction for this part of the lens and eventually drains into Nantucket Sound. In the area of West Falmouth Harbor, flow direction is towards Buzzards Bay. Figure 7-4 illustrates the generalized groundwater contours and elevations (based on USGS evaluations) and indicates the direction of flow.

#### **7.2.3.7 Public Water Supplies**

As discussed in Chapter 4 of the NAR, approximately 90-percent of Falmouth is serviced by public water, which comes from the Sagamore Lens. Residents in the remainder of the Planning Area also receive drinking water from the Sagamore Lens. There are currently five groundwater source wells in Falmouth; Fresh Pond well, Coonamessett well, Mares Pond well, Crooked Pond well, and Ashumet well. Of these, only the Ashumet well is currently inactive. These four active wells account for 40-percent of the water used in Falmouth. The Coonamessett, Mares Pond, and Crooked Pond wells are located within the Great Pond watershed, the Ashumet well is located in the Green Pond watershed, and the Fresh Pond well is located outside the Planning Area.

In addition, the Town of Falmouth receives drinking water (approximately 10-percent of its total usage) from the Upper Cape Water Supply Cooperative (UCWSC), located on the MMR. Portions of the MMR are located within the Great Pond watershed and Waquoit-East watershed.

The Town of Falmouth also receives water from Long Pond, a surface water supply located between Route 28 and Gifford Street. This water supply provides approximately 50-percent of the Town's consumption and is outside of the Planning Area, just west of the Little Pond Watershed.

#### **7.2.3.8 Protected Areas**

The Town of Falmouth's LCP discusses the zoning bylaw set forth by the Town which allows for the protection of the Town's water resources. By-laws have been adopted that ensure that the water quality of the coastal ponds and potable water sources is preserved. There is a coastal pond overlay district that regulates developments which contribute runoff and wastewater flow to the recharge areas of the Town's coastal ponds. Also, there are water resource protection districts that preserve existing and potential sources of drinking water to ensure adequate quality and quantity of water. Also, a Coastal Pond Management Committee was established late in 2004 to study a broad range of issues to be addressed for individual ponds. Furthermore, the Town is participating with the Cape Cod Water Protection Collaborative to work on a regional approach to protecting the Cape's water supply (Falmouth LCP, 2005). Figure 7-4 illustrates the Zone I and II areas and wellhead protection areas in the Planning Area.



The existing WWTF, Site 7, and the Little Pond Sewer Service Area are not located within DEP wellhead protection areas, as illustrated on Figure 7-4. These areas are however located within the Cape Cod sole source aquifer, as designated by the EPA.

## **7.2.4 Air Quality and Noise**

### **7.2.4.1 Air Quality**

Air quality data are limited with respect to Falmouth, as no major studies on air quality have been identified. However, Falmouth has a limited number of industries located inside its boundaries, and no major point sources of air pollution are evident. Automobile traffic in Falmouth is likely the largest major non-point source of air pollution. Carbon monoxide pollution results from the incomplete combustion of fossil fuels.

The USEPA has limited air trends data regarding peak air quality statistics for ozone and other pollutants. During the years of 2004 through 2006, Barnstable County met the 8-hour ozone National Ambient Air Quality Standards (NAAQS).

### **7.2.4.2 Noise**

The Steamship Authority ferry services at the Woods Hole terminal including shuttle buses from various parking lot areas, chartered passenger buses, motor vehicles, and motorcycles are some of the Town's major sources of noise. Downtown Falmouth also experiences increased noise in association with high traffic volume and high visitor population during the summer season. The ferries also generate noise from loading and docking ships and vehicle traffic generated by Island bound travelers.

No major studies on noise have been identified, thus no site-specific data exist for the Planning Area.

## **7.2.5 Plant and Animal Species and Habitat**

According to the most recent (September 2008) information on mapped protected species habitat from the Massachusetts Division of Fisheries, NHESP, the entirety of Site 7 and all the undeveloped portions of the WWTF property lie within mapped Estimated and Priority Habitat of State protected flora and/or fauna. NHESP protected habitat, as well as State wetland resources, including vernal pools, are shown in Figure 7-5.

In November 2011, GHD submitted an information request to NHESP in order to ascertain which protected species were known to occur within the proposed project area. A response, dated November 21, 2011, was received by GHD on November 22, 2011 indicating the species of concern was the eastern box turtle (*Terrapene carolina*), a species listed as being of Special Concern within the State. Prior to construction, a permit must be filed with NHESP in order to obtain a site-specific determination from NHESP with respect to the eastern box turtle. NHESP will also identify whether any mitigation effort is necessary.

On June 10, 2013, project team members met with J. Leddick of the NHESP at the MEPA offices to provide an update on the project and describe how Site 10 is no longer a proposed recharge site, and Site 7 has been reduced to half of its original size. It was a productive meeting and NHESP will review the FEIR when it is submitted to MEPA review.

According to NHESP and Massachusetts Endangered Species Act (MESA), there are 59 State protected (endangered (E), threatened (T) or of special concern (SC)) species documented to occur, or have potential to occur, within the Town of Falmouth (Table 7-1). Two of the 59 species listed by NHESP are



also listed as federally protected species and include the shortnose sturgeon (*Acipenser brevirostrum*), Federally endangered, and the piping plover (*Charadrius melodus*), Federally threatened.

**Table 7-1 Endangered, Threatened, or Species of Special Concern in the Town of Falmouth**

<b>Taxonomic Group</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>MESA Status</b>	<b>Federal Status</b>	<b>Most Recent Observation</b>
Amphibian	Scaphiopus holbrookii	Eastern Spadefoot	T		1970
Beetle	Cicindela purpurea	Purple Tiger Beetle	SC		2006
Bird	Ammodramus savannarum	Grasshopper Sparrow	T		2007
Bird	Asio flammeus	Short-eared Owl	E		Historic
Bird	Bartramia longicauda	Upland Sandpiper	E		2005
Bird	Charadrius melodus	Piping Plover	T	T	2006
Bird	Gavia immer	Common Loon	SC		1921
Bird	Poocetes gramineus	Vesper Sparrow	T		2005
Bird	Sterna dougallii	Roseate Tern	E	E	2007
Bird	Sterna hirundo	Common Tern	SC		2007
Bird	Sternula antillarum	Least Tern	SC		2007
Butterfly/ Moth	Callophrys irus	Frosted Elfin	SC		2005
Butterfly/ Moth	Catocala herodias gerhardi	Gerhard's Underwing Moth	SC		1998
Butterfly/ Moth	Cingilia catenaria	Chain Dot Geometer	SC		2004
Butterfly/ Moth	Cycnia inopinatus	Unexpected Cycnia	T		1998
Butterfly/ Moth	Faronta rubripennis	The Pink Streak	T		1998
Butterfly/ Moth	Hemileuca maia	Barrens Buckmoth	SC		2006
Butterfly/ Moth	Itame sp. 1 nr. inextricata	Pine Barrens Itame	SC		1998
Butterfly/ Moth	Papaipema sulphurata	Water-willow Stem Borer	T		1986
Butterfly/ Moth	Satyrrium favonius	Oak Hairstreak	SC		1996
Butterfly/ Moth	Zale sp. 1 nr. lunifera	Pine Barrens Zale	SC		1998
Crustacean	Eulimnadia agassizii	Agassiz's Clam Shrimp	E		1970



Taxonomic Group	Scientific Name	Common Name	MESA Status	Federal Status	Most Recent Observation
Crustacean	<i>Limnadia lenticularis</i>	American Clam Shrimp	SC		1890
Dragonfly/Damselfly	<i>Anax longipes</i>	Comet Darner	SC		2006
Dragonfly/Damselfly	<i>Enallagma laterale</i>	New England Bluet	SC		2006
Dragonfly/Damselfly	<i>Enallagma pictum</i>	Scarlet Bluet	T		1999
Dragonfly/Damselfly	<i>Enallagma recurvatum</i>	Pine Barrens Bluet	T		2006
Fish	<i>Acipenser brevirostrum</i>	Shortnose Sturgeon	E	E	1871
Fish	<i>Notropis bifrenatus</i>	Bridle Shiner	SC		1952
Mussel	<i>Leptodea ochracea</i>	Tidewater Mucket	SC		2007
Reptile	<i>Terrapene carolina</i>	Eastern Box Turtle	SC		2008
Vascular Plant	<i>Amelanchier nantucketensis</i>	Nantucket Shadbush	SC		2007
Vascular Plant	<i>Aristida purpurascens</i>	Purple Needlegrass	T		1894
Vascular Plant	<i>Asclepias purpurascens</i>	Purple Milkweed	E		2007
Vascular Plant	<i>Asclepias verticillata</i>	Linear-leaved Milkweed	T		1884
Vascular Plant	<i>Corema conradii</i>	Broom Crowberry	SC		1932
Vascular Plant	<i>Crocanthemum dumosum</i>	Bushy Rockrose	SC		2000
Vascular Plant	<i>Dichanthelium dichotomum</i> ssp. <i>mattamuskeetense</i>	Mattamuskeet Panic-grass	E		1894
Vascular Plant	<i>Dichanthelium wrightianum</i>	Wright's Panic-grass	SC		2001
Vascular Plant	<i>Gamochaeta purpurea</i>	Purple Cudweed	E		1884
Vascular Plant	<i>Hydrocotyle verticillata</i>	Saltpond Pennywort	T		2005
Vascular Plant	<i>Lachnanthes carolina</i>	Redroot	SC		2004
Vascular Plant	<i>Leptochloa fusca</i> ssp. <i>fascicularis</i>	Saltpond Grass	T		1985
Vascular Plant	<i>Liatris scariosa</i> var. <i>novae-angliae</i>	New England Blazing Star	SC		2007



Taxonomic Group	Scientific Name	Common Name	MESA Status	Federal Status	Most Recent Observation
Vascular Plant	<i>Linum intercursum</i>	Sandplain Flax	SC		1984
Vascular Plant	<i>Lipocarpha micrantha</i>	Dwarf Bulrush	T		1990
Vascular Plant	<i>Malaxis bayardii</i>	Bayard's Green Adder's-mouth	E		1911
Vascular Plant	<i>Myriophyllum pinnatum</i>	Pinnate Water-milfoil	SC		1919
Vascular Plant	<i>Ophioglossum pusillum</i>	Adder's-tongue Fern	T		1971
Vascular Plant	<i>Opuntia humifusa</i>	Prickly Pear	E		2007
Vascular Plant	<i>Polygonum glaucum</i>	Sea-beach Knotweed	SC		1901
Vascular Plant	<i>Polygonum puritanorum</i>	Pondshore Knotweed	SC		1997
Vascular Plant	<i>Rhynchospora nitens</i>	Short-beaked Bald-sedge	T		2002
Vascular Plant	<i>Rhynchospora scirpoides</i>	Long-beaked Bald-sedge	SC		1995
Vascular Plant	<i>Sabatia kennedyana</i>	Plymouth Gentian	SC		2003
Vascular Plant	<i>Sagittaria teres</i>	Terete Arrowhead	SC		2002
Vascular Plant	<i>Scleria pauciflora</i>	Papillose Nut Sedge	E		2005
Vascular Plant	<i>Setaria parviflora</i>	Bristly Foxtail	SC		1990
Vascular Plant	<i>Utricularia resupinata</i>	Resupinate Bladderwort	T		2002

Source: Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife (Species Info. by Town, 7/29/09)

### 7.2.6 Traffic, Transit, and Pedestrian and Bicycle Transportation

In general, the towns of Cape Cod experience a large tourist population and summer residential influx in the summer which creates high traffic and greater transit volume. The Town of Falmouth experiences significant traffic and additional transit volume on the major roadways such as Route 151, Route 28, and Route 28A. Entrance and exit pathways specifically along Rt. 28 during the summer months have the potential to back up and cause significant delays in local traffic. Delays may also exist in major shopping and eating areas in Falmouth, such as in plazas along Rt. 28, Main Street, Falmouth Harbor, and Woods Hole. Woods Hole attractions include the Marine Biological Laboratory, National Marine Fisheries, National Oceanographic and Atmospheric Administration, Woods Hole Oceanographic Institution, the



United States Coast Guard, and the Steamship Authority. Major lodging areas, scenic beach areas, and roads may also experience greater volume in the summer months.

The Town of Falmouth experiences the heaviest traffic during the months of June, July, and August. Current and future population increases in Falmouth may contribute to the year-round volume as well. For instance, the percent increase in population was 16.8 percent from 1990 to 2000 according to the U.S. Census Bureau.

In terms of pedestrian and bicycle transportation, many of the major routes in the Planning Areas are not heavily used for pedestrian and bicycle transportation. However, coastal and beach areas generally have more pedestrian and bicycle transportation, including the Shining Sea Bikeway which also provides linkages from neighborhoods to beaches, conservation land, and local villages as well as a connection between the ferry parking and Woods Hole.

## **7.2.7 Scenic Qualities, Open Space, and Recreational Resources**

### **7.2.7.1 Scenic Qualities**

According to the Town of Falmouth LCP Scenic Resources section, the Falmouth Historical Commission has compiled lists of approximately 50 scenic roads, 59 scenic vistas or areas, and 42 culturally significant landscapes (Falmouth LCP, 2005).

### **7.2.7.2 Open Space**

Based on 2005 State of Massachusetts Land use mapping, the proposed location of the Site 7 infiltration beds as well as the undeveloped portion of the WWTF property are designated as Forest. The developed portion of the WWTF property is classified as Waste Disposal area. The two wetlands on the WWTF property are classified as Forested Wetland (northern-most wetland) and Non-Forested Wetland. Land use in the vicinity of the WWTF and Sites 7 and 10 is predominantly classified as Forest. The residential properties located adjacent to Site 7 are identified as very low density residential development with nearly all other areas around the proposed project area being classified as Forest. Several areas classified as Industrial are located northeast of the WWTF property. Land use as described above is shown in Figure 7-7.

According to the Falmouth LCP, the Conservation Commission oversees approximately 1,775 acres, or 6.1-percent of the Town's total area. These areas include, but are not limited to, Beebe Woods (387 acres), the Coonamessett Reservation (380 acres), the Collins Woodlots (97 acres), Sea Farms Marsh (88 acres), Peterson Farm (88 acres), and 75 acres around Mares Pond well. Large tracts of unprotected Town land include 650 acres surrounding Long Pond, 280 acres at the WWTF, Falmouth High School (136 acres), and the Crooked Pond well site (98 acres). The total area of unprotected land is approximately 3,180 acres, or 11.2-percent (Falmouth LCP, 2005).

The Commonwealth of Massachusetts holds approximately 2,400 acres, or 8.6-percent within the Town, including the Frances A. Crane Wildlife Management Area (1,700 acres), the Hayway Road parcels (353 acres), and Washburn Island (333 acres) (Falmouth LCP, 2005).

There are also several privately protected areas in Falmouth. Groups such as the Conservation Trusts, including the 300 Committee, the Salt Pond Area Bird Sanctuaries, and the Massachusetts Audubon Society protect over 380 acres in Town. Approximately 490 acres (1.7-percent) is designated as Residential Open Space while 610 acres (1.3-percent) have Conservation Restrictions (Falmouth LCP,



2005). These conservation lands, both public and private, are used as open space and recreation areas and account for approximately 8,625 acres, or 30.5-percent of the Town (Falmouth LCP, 2005).

### **7.2.8 Historic Structures or Districts, and Archaeological Sites**

The Town of Falmouth has many historic sites, identified in several documents. The Historic Preservation and Community Character section of the Falmouth LCP (2005) provides the most complete listing of existing and recommended historic sites. Figure 7-4 shows the historic districts and sites for the Planning Area. NOTE: historic places are no longer available in GIS (<http://www.mass.gov/mgis/srhp.htm>). According to the LCP, Falmouth has 11 individual properties and four districts on the National Register of Historic Places, not including the Town's seven local historic district designations; of which four districts on this list are designated by both the National Register of Historic Places and the Town's local historic district. Several of the historical districts listed are within or are in proximity to the Planning Area.

According to the Falmouth LCP (2005), the National Register districts include:

1. Falmouth Village, with 79 contributing buildings, the Village Green, and the Old Burying Ground.
2. North Falmouth Village, with 43 contributing buildings.
3. West Falmouth Village, with 134 contributing buildings.
4. Waquoit Village, with 66 contributing buildings.

The Town of Falmouth local historic districts include:

1. North Falmouth along Old Main Road and part of 28A.
2. West Falmouth along 28A.
3. Woods Hole—Church Street to lighthouse, Water Street to Eel Pond Bridge, Woods Hole Road, School Street and Luscombe Avenue
4. Falmouth Village along Palmer, Locust, Main Street, and Shore Street, and Depot Avenue.
5. Davisville along a section of Davisville Road.
6. Waquoit around the Congregational Church on Route 28.
7. Quissett along Quissett Avenue and Quissett Harbor Road.

The individually listed properties are:

1. Josiah Tobey House, East Falmouth.
2. School Administration Building, Teaticket.
3. Central Fire Station, Falmouth Village.
4. Lawrence Academy, Falmouth Village.
5. Poor House, Falmouth Village.
6. Pumping Station, Falmouth Village.
7. The Elnathan Nye House, North Falmouth.
8. Bourne Farm, West Falmouth.
9. Nobska Lighthouse, Woods Hole.
10. Woods Hole School, Woods Hole.



## 11. Cleveland Light, Buzzards Bay

The Town of Falmouth also has a Historic Districts Commission which works to preserve the historical character of the buildings and the Historical Commission which works to preserve the historical parts of Town.

According to the Town of Falmouth LCP, an archaeological reconnaissance study performed in 1996 found approximately 50-percent of the town, specifically along the eastern coastal portion has a high potential of containing prehistoric materials and early industrial sites. However, the Massachusetts Historical Commission (MHC) has only 36 recorded prehistoric sites and nine historic sites in Falmouth. The MHC also has records of eight archaeological surveys conducted in Falmouth since 1981 (Falmouth LCP, 2005).

### 7.2.9 Built Environment and Demographics

#### 7.2.9.1 Land Use and Zoning

For the purpose of this project, an Open Space and Land Use Map (Figure 7-7) and a Zoning Map (Figure 7-8) were developed to illustrate the land use types and zoning in the Town of Falmouth and Planning Area. Based on State GIS land use/land cover mapping, there are 33 different land uses mapped within the Town of Falmouth as shown in Table 7-2. Based on this data, the three largest land cover types in the Town, excluding water, are forest, medium-density residential, and low and high density residential, each occupying approximately 72-percent (48,338 acres), 4.7-percent, (3,151 acres), and 3.2-percent (2,173 acres (high density development) and 2,129 acres (low density development), respectively.

**Table 7-2 Land Use**

Land Cover	Area (Acre)	Percent of Total Land Cover
Brushland/Successional	93.88	0.1
Cemetery	35.5	0.1
Commercial	480.93	0.7
Cranberry Bog	215.01	0.3
Cropland	128.84	0.2
Forest	48336.29	71.8
Forested Wetland	290.53	0.4
Golf Course	380.43	0.6
High Density Residential	2173.05	3.2
Industrial	113.85	0.2
Junkyard	37.35	0.1
Low Density Residential	2128.81	3.2
Marina	28.6	0
Medium Density Residential	3151.59	4.7
Mining	199.36	0.3
Multi-Family Residential	311.76	0.5



Land Cover	Area (Acre)	Percent of Total Land Cover
Non-Forested Wetland	331.39	0.5
Nursery	64.78	0.1
Open Land	330.58	0.5
Orchard	9.33	0.01
Participation Recreation	158.46	0.2
Pasture	315.12	0.5
Powerline/Utility	259.42	0.4
Saltwater Sandy Beach	565.7	0.8
Saltwater Wetland	454.98	0.7
Spectator Recreation	28.91	0
Transitional	204.54	0.3
Transportation	1200.83	1.8
Urban Public/Institutional	371.42	0.6
Very Low Density Residential	822.17	1.2
Waste Disposal	83.78	0.1
Water	3935.84	5.9
Water-Based Recreation	31.47	0.04
<b>Total</b>	<b>67,274.49</b>	<b>100</b>

The entirety of Site 7 is mapped as Forested. The WWTF property is mapped as both Forested and within the footprint of the existing treatment facility, as Waste Disposal. The mapped wetland areas in the north and eastern portions of the WWTF property are mapped as Forested and Un-Forested Wetlands, respectively.

Zoning within Falmouth includes agriculture, business, residential, light industrial, marine, and public use. Zoning outside of Falmouth includes residential, 201 (residential open land), commercial, industrial, recreational, exempt (charitable organization), and agricultural.

According to the Open Space & Recreation section of the Falmouth LCP, "Falmouth contains around 5,300 acres of permanently protected open space, which is owned by various public, non-profit, and private entities.

According to State GIS zoning maps from the Town, and dated April 1990, the existing WWTF property is, at least as of 1990, zoned as R2 for Single Family Residential. The proposed infiltration beds are, according to State GIS data, zoned as RA for Residential/Agricultural Mix. The existing WWTF is located within government owned land and, as shown on Figure 7-8, Site 7 is partially located within agriculturally zoned land with a portion in public use zoned land.

The land use in the Little Pond Sewer Service Area is predominantly residential with commercial properties to the north along Route 28. This area is very close to buildout with few vacant properties. Appendix 4-31 summarizes evaluations completed to develop a preliminary design wastewater flow for this area. The appendix contains attachments on demographics for this area.



### 7.2.9.2 Existing Infrastructure

The existing wastewater and water supply infrastructure of the Planning Area was described in Chapter 4 of the Needs Assessment Report. In summary; there is no significant sewer system in the Planning Area (a few properties in the western edge of the Little Pond Watershed are connected to the municipal sewer system) and nearly all properties are served by individual septic systems. These systems work well at protecting human health but do not remove much nitrogen or phosphorus and are the primary source of nitrogen causing exceedance of the nitrogen TMDLs in the Town's south coastal estuaries. The septic systems are also contributing phosphorus loads to the freshwater ponds. The Planning Area is served by public water supply and nearly all the properties in this part of Town are served by public water.

### 7.2.9.3 Population

Population and demographic data are presented in this section from U.S. Census Bureau 2010 data for the Town of Falmouth. In the State of Massachusetts there was zero to 5-percent increase in population while in the Cape there was a net population decline. The following summary outlines various data with regards to age, gender, race, education, and income for the State of Massachusetts and the Town of Falmouth as reported by the U.S. Census Bureau for the 2010 census effort.

#### U.S. Census Bureau Gender/Age Statistics:

	Massachusetts	Falmouth
Male population	48.4%	46.8%
Female population	51.6%	53.2%
Under 18 years old	21.7%	17.3%
Over 18 years old	78.3%	82.7%
20-24 years old	7.3%	4.0%
25-34 years old	12.9%	7.9%
35-49 years old	21.4%	17.9%
50-64 years old	19.9%	24.9%
65 and over	13.8%	26.0%

#### U.S. Census Bureau Race Statistics (in Percent of Total Population):

	Massachusetts	Falmouth
White	80.4%	91.9%
African American	6.6%	1.9%
Asian	5.3%	1.3%
American Indian and Alaska Native	0.3%	0.6%
Native Hawaiian & Pacific Islander	0.0%	0.0%
Other Race	4.7%	1.6%
Two or more races	2.6%	2.7%
Hispanic or Latino	9.6%	1.8%



The total U.S. Census population for the Town of Falmouth in 2010 was 31,531, down by approximately 1,129 people from the 2000 census (32,660 people). According to the 2000 Census data for the State of Massachusetts, the median household income in 2000 was \$45,933. The per capita income for the Town of Falmouth was \$27,548, and the percent of families living below poverty in 2000 was 4.5-percent.

## **7.2.10 Rare or Unique Features of the Site and Environs**

### **7.2.10.1 Areas of Critical Environmental Concern (ACECs)**

Located within the Planning Area, the Waquoit Bay and its surrounding environs were designated an ACEC in 1979. The area includes Washburn Island, South Cape Beach, and the Moonakis and Childs Rivers. This ACEC area is designated on Figure 7-5. A bylaw governs the ACEC as well as all areas within 50-feet of its bounds. According to the Town's LCP, "This bylaw prohibits both new construction (with the exception of accessory buildings) and the clear cutting of vegetation and habitat areas within the ACEC. ACEC regulations also protect various water areas that contain valuable shellfish and fisheries." The ACEC designation, along with coordination with the Waquoit Bay National Estuarine Research Reserve (WBNERR), actively work on protecting, researching, and monitoring this environmentally sensitive resource.

The designated ACEC described above is located approximately 4.5 miles from the existing WWTF and nearly five miles from the proposed Site 7 infiltration beds.

### **7.2.10.2 District of Critical Planning Concern (DCPC)**

Town of Falmouth established this DCPC to help protect the Black Beach/Great Sippewissett Marsh area of Falmouth. The DCPC was developed to protect the area from flooding, minimize erosion, and protect wildlife and vegetative habitats and the sensitive coastal ecosystem. The DCPC is located south of West Falmouth Harbor and west of Route 28A, approximately 0.7 miles from the existing WWTF. The DCPC is located within a different watershed than the proposed infiltration beds at Site 7.

## **7.3 Assessment of Impacts**

### **7.3.1 General**

An assessment of impacts is performed to provide a detailed description of the positive and negative potential environmental impacts as they pertain to the preferred plan and the No Action Alternative. The purpose of the EIR is to assess quantitatively, to the extent practicable, the direct and indirect potential environmental impacts of the planned project, as well as the short-term and long-term impacts.

A rating system was developed to aid in analyzing the two alternatives and their impacts on the existing conditions in the Planning Areas. The rating system examines the impact on each parameter discussed previously in this Chapter and assigns it a numerical value of -2, -1, 0, 1, or 2. Negative values represent the magnitudes of the negative impacts of the parameter on the environment, and the positive represent positive impacts. A rating of zero indicates that there is either no impact or it is negligible. Each of the parameters is described briefly in the following section of this chapter.

The ratings are summed for both alternatives to develop a total value and the final ranking of the alternative.



## Description of Environmental Features for the Preferred Alternative and No Action Alternative

### 7.3.2.1 Topography, Geology and Soils—Soil Disturbance

#### 1) **Recommended Plan.**

*Wastewater Treatment Facility:* The existing WWTF site is bordered by Route 28 to the west, Blacksmith Shop Road to the south, and Research Road to the northeast. The northern property bound abuts the rear of the properties located along the south side of Thomas B. Landers Road. No work is planned beyond the bounds of the existing WWTF footprint and therefore the area should be considered already disturbed.

*Site 7 Infiltration Bed:* Site 7 infiltration bed is located partially on the northern property bound of the WWTF property and on property which abuts the residential properties located along the south side of Thomas B. Landers Road. Site 7 is undeveloped, mixed hard and softwood (oak and pine) forest. Several off road vehicle trails are present in portions of Site 7 but otherwise no roads or trails are present. Establishment of infiltration beds at Site 7 will modify the topography and soils in that fill and excavation will take place in order to plane the landscape to a relatively level surface to accommodate infiltration. Surficial soils will be removed in order to expose the underlying sand. Existing boulders will also be removed to accommodate earthwork and later infiltration. Although the extent of impact to topography and soils will be limited to the site level, the overall, landscape level impact will be minimal given the proximity to and abundance of similar topographical and soil features in the surrounding area. Figure 4-12 illustrates the extent of soil distribution.

*Sewer Expansion to Little Pond Sewer Service Area:* This requires construction and expansion of the wastewater collection system, but the soil beneath the roadway is already considered disturbed and thus collection system construction is not considered a major impact.

#### 2) **No Action Alternative.** Presently, this alternative would not increase the level of soil disturbance in these areas.

### 7.3.2.2 Surface Hydrology and Quality

#### 1) **Recommended Plan.** The Town of Falmouth has approximately 20 ponds and three rivers within the Planning Area. With proper erosion controls in place during construction, it is expected that negative impacts will be minimized. Implementation of this alternative will greatly benefit these resources as proper wastewater management will decrease the nutrient loadings into the Town's surface water resources and improve quality.

Wetlands, bogs, ponds, and the Little Pond estuary represent the major surface water bodies potentially impacted (benefited) by wastewater collection and treatment.

Wastewater collection and treatment at the Blacksmith Shop Road WWTF will produce a higher quality effluent than achievable with on-site septic systems and will improve the water quality by reducing the nitrogen discharged as required by the nitrogen TMDLs. Contaminants of Emerging Concern (CEC) will also be removed if they are present. It is certain that wastewater collection and a high level of treatment will have only positive impacts to the health of Little Pond.

The treated water recharge at Site 7 has been identified to minimize impact to down-gradient surface waters. Groundwater modeling of a recharge up to 0.26 mgd described in Chapter 4 and detailed in Appendix 4-32 indicates:



- No treated water will flow to West Falmouth Harbor.
- All of the treated water will recharge out to Buzzards Bay.
- Approximately 42-percent of the treated water will move through Crocker Pond located approximately 2,000-feet down-gradient of Site 7. The scaled Figure 4-12 indicates that the western edge of Sand Bed No. 15 is 1,860-feet from Crocker Pond; and the eastern edge of Bed No. 14 is 2,470-feet from Crocker Pond.

A follow-up study by EcoLogic, LLC discussed in Chapter 4 and detailed in Appendix 4-33 indicates:

- The pond water-quality analysis indicates that the pond is a phosphorus-limited ecosystem; therefore the addition of nitrogen to the pond will not affect pond productivity and water quality.
- The soils between Site 7 and Crocker Pond have a great capacity to adsorb phosphorus in the treated water. The “Soil Attenuation Capacity Time Periods” was calculated (using conservative assumptions) for three different recharge scenarios. The time period is estimated to be over 100 years at the current phosphorus concentration in the treated water; and estimated to be over 1,400 years if the treated water was polished to an effluent concentration of 0.2 mg/L total phosphorus. An intermediate polishing treatment level of 1.0 mg/L is estimated to provide an attenuation capacity of 280 years.

A second follow-up study to investigate the feasibility and costs of polishing the treated water at two alternative add-on polishing processes at the WWTF is currently underway as discussed in Chapter 4.

A third follow-up study by the UMass S Mast group led by Dr. Brian Howes (who has developed the marine nitrogen limits for the Massachusetts Estuaries Project) indicates that the remaining low concentrations of nitrogen in the recharge at Site 7 are unlikely to negatively affect Buzzards Bay and two bordering wetlands (Old Silver Beach Wetland and Nemasket Road Wetland) that are down-gradient of Site 7 on the edge of Buzzards Bay. This work is discussed in Chapter 4 and detailed in Appendix 4-35.

The Site 7 recharge is not expected to provide a significant impact to Crocker Pond or Buzzards Bay. Adequate environmental monitoring will be provided to indicate if an impact could occur, with sufficient time to make a change through the Adaptive Management component of the CWMP.

- 2) **No Action Alternative.** This alternative will negatively impact the environment in terms of surface water hydrology and quality. Excess nitrogen loading and nutrient runoff have caused TMDL values to be assigned to subwatershed areas within the Planning Area. Without improved wastewater and nutrient management, current conditions will continue to contribute pollutants and degrade surface water conditions.



### 7.3.2.3 Groundwater Hydrology and Quality

- 1) **Recommended Plan.** The Town of Falmouth has four active and one inactive public drinking water supply wells within the Planning Area. The increase in treated water recharge has been planned to recharge the groundwater away from these wells. The recharge will be monitored as part of an approved groundwater monitoring plan.

This alternative will improve the groundwater quality, especially in areas of dense development of the Little Pond Sewer Service Area, because the groundwater is no longer being impacted by the nutrients and overall recharge from on-site septic systems.

The recharge at Site 7 is not into a public water supply recharge area and will be treated to the stringent nitrogen drinking water standards that will allow its recharge at this location.

The treated water recharge at Site 7 will have an unknown impact with respect to Contaminants of Emerging Concern (CEC) which are the pharmaceuticals, personal care products, and endocrine disruptors that have unknown impacts to humans and environmental health.

- 2) **No Action Alternative.** In terms of groundwater hydrology and quality, this alternative will likely negatively impact the future environmental condition. Currently, drinking water supplies in the Planning Area do not have concerns with wastewater-derived nitrogen. However, in the future condition, groundwater quality may be impacted from additional buildout and/or fluxes in seasonal living and tourism.

Contaminants of Emerging Concern have an unknown impact.

### 7.3.2.4 Air Quality and Noise

- 1) **Recommended Plan.** During any construction, dust is often generated onsite. Emissions generated by construction equipment also have negative impacts on air quality. To reduce these impacts, proper pollution control measures are necessary to limit these effects and provide a positive means to prevent airborne dust and reduce vehicle emissions.

Odors generated during operations at the WWTF and pumping stations can be limited by designing centralized treatment facilities with odor control units and tank covers. Onsite systems typically only generate odors during pump-outs, repairs, or system failures.

Organic emissions will be generated from the treatment of wastewater at a centralized facility through this alternative and are expected to equal the emission that would be generated from individual on-site systems. A greenhouse gas (GHG) evaluation on the WWTF is included at the end of this chapter.

The majority of noise impacts are generated during the construction phase of any project. The larger the extent of construction, the more noise associated with that work. In Falmouth, noise impacts from collection system construction will be greatest in the Planning Area with narrow streets and where buildings are in close proximity to both the road and each other.

Construction at the existing WWTF at the Blacksmith Shop Road Site will generate minimal noise impacts on neighboring properties. The existing properties have an adequate buffer from this site. Modifications to proposed wastewater treatment facilities will be engineered to minimize noise from pumps and blowers by designing the buildings accordingly.



- 2) **No Action Alternative.** This alternative would not decrease the air quality or increase noise due to the actual construction of the project. However, this alternative may actually decrease air quality in terms of odors from failing septic systems or surface waters that become eutrophic from the nitrogen and phosphorus in the septic system effluent.

#### 7.3.2.5 Plant and Animal Species and Habitat

- 1) **Recommended Plan.** As discussed above, GHD submitted an information request to NHESP in order to ascertain which protected species were known to occur within the proposed project area. A response, dated November 21, 2011, was received by GHD on November 22, 2011 indicating the species of concern was the eastern box turtle (*Terrapene Carolina*), a species listed as being of Special Concern within the State. Prior to construction, a permit will be filed with NHESP in order to obtain a site specific determination from NHESP with respect to eastern box turtle. NHESP will also identify whether any mitigation effort is necessary. It is expected that this alternative will have limited negative impacts on plant and animal habitat with proper notifications and planning. It is expected that the increase in environmental quality to surrounding habitat areas would outweigh the temporary construction impacts. Figure 7-5 illustrates the combined habitat areas that are present in the Planning Area.

Additionally, a preliminary site plan is shown in Figure 7-9, outlining various resources such as estimated habitat area, wetland delineations, 100-foot buffer zones, and flood zones.

It is expected that the increase in environmental quality to surrounding habitat areas would outweigh the temporary construction impacts. Figure 7-5 illustrates the combined habitat areas that are present in the Planning Area. Benefits to the health of Little Pond will be only positive with this alternative, and this benefit is expected to increase over time with the decreased nutrient loading to the environment.

- 2) **No Action Alternative.** This alternative would continue to increase the nutrient loading to the marine estuaries, rivers, and freshwater ponds in the area. The increase in nitrogen and phosphorus loading would have increased and possible irreversible adverse effects on the marine plant and animal species, specifically shellfish species.

#### 7.3.2.6 Traffic, Transit, and Pedestrian and Bicycle Transportation

- 1) **Recommended Plan.** This alternative is expected to have limited short-term negative impacts on traffic and transit, and minimal short-term effects on pedestrian and bicycle transportation. This alternative is likely to increase traffic during various phases of the construction project. However, with regulated traffic control measures and the effective management of the traffic, the public burden will be decreased.
- 2) **No Action Alternative.** This alternative would have no effects on the traffic, transit, and pedestrian and bicycle transportation aspect of the existing environment.



### 7.3.2.7 Scenic Qualities, Open Space, and Recreational Resources

- 1) **Recommended Plan.** With this alternative, it is unlikely that protected open space will be negatively disturbed. The implementation of this alternative would decrease overall negative environmental impacts to the protected open spaces in the Planning Area, specifically to recreational water body areas such as ponds and beaches. These adverse impacts would also be a direct contributor to scenic quality degradation.
- 2) **No Action Alternative.** With this alternative, no disturbance to protected open space is anticipated. However, by allowing the elevated nutrient loadings in the Planning Area to continue, they will increasingly impact the environment adversely in the long-term. With this alternative there is a potential that recreationally zoned resources or scenic qualities will be affected by the decreasing environmental health of the numerous public beaches and landings within Town.

### 7.3.2.8 Historic Structures or Districts, and Archaeological Sites

- 1) **Recommended Plan.** With this alternative, it is unlikely historic structures, historic districts, or archaeological sites located within the Planning Area will be adversely affected by collection system installation. The Massachusetts Historical Commission (MHC) has 36 recorded prehistoric sites in Falmouth and nine historic sites. The MHC also has records of eight archaeological surveys conducted in Falmouth since 1981. These were done for an affordable housing development in Maravista, the Poor House, the Central Fire Station, and the Candle House in Woods Hole, for Washburn Island, for two sewerage project areas, and for the Camp Edwards military training site. There are no known existing archaeological sites within the Town's Planning Area.

As noted of the Secretary's Environmental Notification Form issued on January 30, 2008; an archaeological survey may be required in archaeologically sensitive areas. The Public Archaeological Laboratory (PAL) completed an archaeological assessment as discussed in Chapter 4 (attached in Appendix 4-21). Prior to the start of field work, the PAL team reviewed available documents and files including files at the MHC. The file review indicated that no previously recorded archeological sites are located within or immediately adjacent to Site 7 and the potential pipeline route from the WWTF to Site 7. PAL conducted a second more intensive site investigation in August 2013 which did not identify any potentially significant archaeological resources and determined that no additional archaeological investigations are necessary at Site 7. A copy of the Management Abstract regarding this work is included in Appendix 4-21.

- 2) **No Action Alternative.** With this alternative, it is unlikely that historic structures, historic districts, or archaeological sites will be adversely impacted.

### 7.3.2.9 Built Environment and Demographics

- 1) **Preferred Alternative.** Improved wastewater treatment and extended collection systems may increase growth in the Planning Area if regulations are not in place to limit growth. Unregulated growth due to sewer expansion is considered a negative impact, unless an area has been identified as a growth incentive type zone. In addition, the Town of Falmouth may be required to acquire land or establish right-of-ways in order to expand the existing collection system. This result may be considered a negative impact to the current owners of those properties.



Adversely, increased growth in Falmouth has contributed to an added strain on the current environmental condition and the surrounding natural resources. This alternative provides an effective solution to this issue and manages wastewater nutrient loading positively.

The Little Pond Sewer Service Area is in an area that is very close to buildout, and the Route 28 corridor at the northern edge of the area is a likely location for increased and welcome redevelopment. The Town plans to develop a Flow Neutral Bylaw to manage future growth and wastewater flow.

- 2) **No Action Alternative.** With this alternative, population growth is likely the key contributing factor to the negative impacts of this alternative. Existing data shows multiple watersheds in the Planning Area with increased cumulative nitrogen levels. Growth is always a concern when working in towns on Cape Cod, and growth in Falmouth has continued over the years without extensive centralized wastewater treatment facilities. If population is assumed to continue to grow, the Town may see negative impacts to its resources.

#### 7.3.2.10 Rare or Unique Features of the Site and Environs

- 1) **Recommended Plan.** This alternative is not expected to impose any negative impacts on the unique features of the Town of Falmouth. The Waquoit Bay vicinity was designated as an ACEC by the Commonwealth in 1979 and as a National Estuarine Research Reserve by the United States in 1988 (see Figure 7-5 for ACEC designation area). The WBNERR is jointly managed by the Massachusetts Department of Conservation and Recreation (DCR) and the National Oceanic and Atmospheric Administration (NOAA). The designation is for the protection of representative natural resources, to facilitate research of the coastal environment, and promote education about management of coastal resources.

The entire 2,800-acre Reserve is within the project area, however no infrastructure installation is required in the ACEC. Wastewater management and effective nitrogen management will be a positive impact to the ACEC in that estuarine health will begin to improve.

With proper mitigation measures and inter-municipal/interagency coordination, this alternative will have a long-term positive impact on the rare or unique features of the site and environment.

- 2) **No Action Alternative.** With this alternative, there is no direct threat or impact to the Waquoit ACEC; however impairments to the area will contribute if no action is taken.

### 7.4 Regulation Standards

#### 7.4.1 General

A detailed outline of the Regulatory Issues associated with the Town of Falmouth's CWMP was discussed in Chapter 3 of the NAR developed for this project in 2007. This section summarizes the major regulatory issues associated with this phase of the CWMP and discusses in more detail any regulations which may have changed since the 2007 NAR. Draft Section 61 Findings for State Agency Actions are outlined in Chapter 8, which provides a summary of permits and approvals that will likely be required for implementation of the Recommended Plan.

Federal regulations are contained in the Code of Federal Regulations (CFR) and are enforced by the United States Environmental Protection Agency (USEPA). Massachusetts regulations are contained in the Code of Massachusetts Regulations (CMR) and Massachusetts General Law (M.G.L.) and are enforced



by the Massachusetts Department of Environmental Protection (MassDEP). There are also regional and local regulations which may be enforced by the Cape Cod Commission (CCC), the Falmouth Zoning Board, Falmouth Health Department, Falmouth Department of Public Works Administration, Falmouth Wastewater Department and/or other Falmouth Town Departments.

## **7.4.2 Federal Regulatory Issues**

### **7.4.2.1 NEPA**

The National Environmental Policy Act of 1970 (NEPA) provides the basis for the protection of the environment. The NEPA process is designed to aid public officials in the decision-making process regarding the use of Federal property and provide an understanding of the environmental consequences of that use. The NEPA process would require the filing of an Environmental Impact Statement (EIS) with regards to any proposed site usage on or adjacent to Federal property which could potentially impact that property.

### **7.4.2.2 TMDLs**

The Federal Clean Water Act requires states to develop a list of impaired waters, which are waters that are unable to meet state-established water quality standards for their intended use (i.e., drinking water supply, fishing, recreational swimming and boating, or healthy ecosystems for plants and animals). States are then required to develop TMDLs for the impaired waters that are affected by pollutants. A TMDL is a determination of the maximum amount of pollutants that a body of water can withstand.

Once TMDLs are determined, MassDEP develops a draft TMDL report, followed by a public review and comment period. After addressing public comments, MassDEP submits the TMDL report to USEPA for formal approval. The TMDL development process requires that communities develop plans to restore the health of water bodies and then make progress toward implementation of the plans. MassDEP monitors the progress of communities in achieving TMDLs. Restoration of water bodies is an extended process, so MassDEP looks for reasonable progress; if no reasonable progress is being made, enforcement actions may be taken.

## **7.4.3 State Regulations**

### **7.4.3.1 MEPA Environmental Review**

CWMP projects in Massachusetts include an environmental review process that is governed by the Massachusetts Environmental Policy Act (MEPA) and Cape Cod Commission's DRI review process. In general, the MEPA process, as described in 301 CMR 11.00, establishes thresholds, procedures, and timetables for a multi-level review process. If a project exceeds review thresholds or if State funding is requested for a project, the project proponent begins the review process by preparing and filing an Environmental Notification Form (ENF) with the Secretary of Environmental Affairs. A 30-day review period follows, during which the Secretary of Environmental Affairs receives agency and public comments, and holds a site visit and consultation session. At the close of the ENF review period, the Secretary of Energy and Environmental Affairs determines whether an Environmental Impact Report is necessary and issues a MEPA certificate. If an Environmental Impact Report is required, it is prepared by the proponent and submitted to the Secretary of Energy and Environmental Affairs. The Environmental Impact Report is reviewed at both draft and final stages by agencies and the public. After completion of the Secretary's review, state agencies may act on the project.



It should also be noted that an ENF is expected to be filed for the land transfer between the Town of Falmouth and the Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority of what is proposed as Infiltration Site No. 7 because it is considered State (Steamship Authority) owned land.

There are several more specific State regulations which apply to the Town of Falmouth's CWMP. These include: The Wetlands Protection Act (M.G.L. c.131, s.40) and parallel state regulations (310 CMR 10.00) and amendment (Massachusetts Rivers Protection Act); Title 5 of the Massachusetts State Environmental Code (310 CMR 15.00); MassDEP regulation of Water Resources, Treatment and Supply of Potable Water as they closely parallel the Federal regulations of 40 CFR 141, 142 and 143 which are maintained and enforced by the USEPA (310 CMR 22.00); Surface Water Discharge Permit Program (314 CMR 3.00); proposed revisions to the Ground Water Discharge Permitting Program Regulations (314 CMR 5.00) which will incorporate the Ground Water Quality Standards (314 CMR 6.00) which will eliminate the need for 314 CMR 6.00; Sewer Extension and Connection Permit Program (314 CMR 7.00); the proposed Reclaimed Water Permit Program and Standards Regulations (314 CMR 20.00); and the Massachusetts Natural Heritage & Endangered Species Program.

#### **7.4.4 Regional**

##### **7.4.4.1 The DRI Review Process**

In accordance with the Cape Cod Commission Act, Chapter 716, the Cape Cod Commission has the authority to review and regulate DRIs. This review is carried out by the Commissioners and the Cape Cod Commission staff in accordance with Administrative and Enabling regulations.

The project has entered the MEPA/CCC joint review process and will enter the DRI process after the project has received the Secretary's Certificate on the review of the CWMP/FEIR/TWMP document.

As discussed in Chapter 2, the CCC has recently published new guidelines for Targeted Watershed Management Plans and this project and document have been tailored to comply with those guidelines. Meetings with CCC staff have indicated CCC support for the CWMP/FEIR/TWMP process.

##### **7.4.4.2 Cape Cod Commission Regional Policy Plan**

The Cape Cod Commission Act calls for an update to the plan every five years (previous editions were released in 1991, 1996, and 2002). The current Regional Policy Plan went into effect October 30, 2008.

The minimum performance standards and other development review policies of the Regional Policy Plan are intended to be used by both the Cape Cod Commission and local regulatory authorities once they have adopted a LCP and it has been certified by the Cape Cod Commission. The goal of the water resources minimum performance standards is to preserve the high quality of the groundwater (the source of Cape Cod's drinking water) as well as the marine and fresh surface waters, which are connected to and dependent on the groundwater for ecological health and sustenance. The water resources classification system includes the following: drinking water, coastal embayments, ponds, sewage treatment facility standards, stormwater management standards, and natural resources standards. The reader is directed to the most current Regional Policy Plan for further information specifically relating to the minimum performance standards developed for each goal. Overall, the water resources minimum performance standards state a maximum nitrogen load of five parts per million unless there will be no adverse impacts on resources.



#### 7.4.5 Local

Several local regulations are applicable to the Town of Falmouth’s CWMP process including the Sewer Bylaws, Chapter 180 (Sewers and Septic Systems).

### 7.5 Alternative Ranking and Summary of Evaluations

The Preferred Alternative and the No Action Alternative were rated and ranked based on the criteria established previously in this Chapter as required by The Code of Massachusetts Regulations (301 CMR 11.07). Table 7-3 summarizes the ranking analysis for the two alternatives, and although this ranking system is subjective, it does allow decision-makers a quantitative analysis of the alternatives. Table 7-3 shows that overall, the Preferred Alternative has the least impact on the existing environment with a ranking of “1” indicating a positive environmental impact. The No Action Alternative shows a significant overall negative impact on the existing environment ranking with “-20”.

**Table 7-3 Environmental Impact Assessment**

Impacted Feature	No Action	Recommended Plan
<b>Soil Disturbance</b>		
Acquisition	0	-2
Development	-1	-2
Operation	0	0
<b>Surface &amp; Groundwater Quality &amp; Hydrology</b>		
Acquisition	0	0
Development	-2	2
Operation	-2	2
<b>Air Quality &amp; Noise</b>		
Acquisition	-1	-1
Development	-1	-1
Operation	-1	-1
<b>Plant &amp; Animal Species &amp; Habitat</b>		
Acquisition	0	0
Development	-1	-1
Operation	-1	2
<b>Traffic, Transit, and Pedestrian and Bicycle Transportation</b>		
Acquisition	0	0
Development	0	-1
Operation	0	0
<b>Scenic Qualities, Open Space &amp; Recreational Resources</b>		
Acquisition	-1	0
Development	-1	0
Operation	-1	0



Impacted Feature	No Action	Recommended Plan
<b>Historic Structures or Districts, and Archaeological Sites</b>		
Acquisition	0	0
Development	0	0
Operation	0	0
<b>Built Environment &amp; Demographics</b>		
Acquisition	0	-2
Development	-1	-1
Operation	-1	0
<b>Rare or Unique Features of the Site and Environs</b>		
Acquisition	-1	0
Development	-1	2
Operation	-2	2
<b>Public Health</b>		
Acquisition	0	0
Development	0	1
Operation	-1	2
<b>Total:</b>	<b>-20</b>	<b>1</b>
<b>RANK</b>	<b>2</b>	<b>1</b>

The largest ranking discrepancies between the Preferred Alternative and the No Action Alternative were associated with the following two factors: “Surface and Groundwater Quality and Hydrology” and “Rare or Unique Features of the Site and Environs”; with no ranking difference between “Air Quality and Noise” and “Historic Structures or Districts and Archaeological.”

Factors of cost and other non-monetary issues developed in the Alternative Screening Analysis Report (ASAR) and in previous chapters of this report must be used in combination with the Environmental Impact Analysis ranking.

## 7.6 Additional Considerations

The following is a discussion of additional considerations that were developed as a result of the Environmental Notification Form (ENF) Certificate received January 30, 2008 which includes climate change considerations, greenhouse gas evaluation, and initiation of estuarine water quality modeling to investigate benefits.

### 7.6.1 Climate Change Considerations

Consultation with WBNERR led to source references on the most recent studies and information available, including workshops held by WBNERR on climate change. The following is a summary of that information and how climate change may impact natural resources, infrastructure, and the economy on Cape Cod, and more specifically in the Town of Falmouth.



The following is a discussion of the impacts of climate change in Massachusetts and Cape Cod and more generally in the United States. In September 2011, the Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee of the State of Massachusetts published a report entitled Massachusetts Climate Change Adaptation Report, which looks not only at the predictions and impacts of climate change, but at mitigation and adaptation strategies to help the State become more resilient and ready to adapt to climate change in the region. The report notes that due to its vast coastline Massachusetts is particularly vulnerable to the compounded impacts of climate change effects such as thermal expansion of the oceans and the increased melting rate of sea and land ice in the Polar Regions.

Given the predicted impacts, many countries, including the United States, have established boards and committees to address regional impacts of climate change. In the United States, many states are addressing climate change impacts on a more local scale. For example, the University of Rhode Island put together a report entitled Summary of Coastal Program Initiatives that Address Sea Level Rise as a Result of Global Climate Change (2008) in order to identify what initiatives states have taken to address sea level rise. The report identifies survey results of 29 states (23 with ocean shoreline; 6 with no ocean shoreline) to identify which, and to what extent, have sea level rise policies and initiatives in place. Of the 23 states with ocean shoreline, 19 have some sort of initiative in place, ranging from working groups and commissions to implementable policy or regulation. The three inland states with plans in place include Michigan, Wisconsin, and Minnesota, all states which border on the Great Lakes. In reference to Cape Cod, many factors associated with climate change make the area particularly vulnerable to the impacts of climate change, including:

- The abundance of ocean shoreline;
- Extent of coastal development;
- Shoreline oriented tourism industry;
- Dependence on natural and engineered shoreline protection; and
- Dependence on and proximity of groundwater supplies to coastal areas.

The abundant shoreline can be viewed as one of the Cape's greatest resources; however, in terms of climate change, it may also be viewed as one of its greatest vulnerabilities. In 2003, the United States Geological Survey published a report entitled, Coastal Vulnerability Assessment of Cape Cod National Seashore to Sea-Level Rise (Hammar-Klose et. al. 2003) which looks at the vulnerability of the National Seashore to sea level rise. The report presents a coastal vulnerability index (CVI) which was used to rank the following in terms of their physical contribution to sea-level rise-related coastal change: geomorphology, regional coastal slope, rate of relative sea-level rise, shoreline change rates, mean tidal range, and mean wave height. The areas along the National Seashore most vulnerable to sea-level rise are those, "with the lowest regional coastal slopes, geomorphologic types that are susceptible to inundation, and the highest rates of shoreline change." According to the September 2011 Massachusetts Climate Change Adaptation Report, the Commonwealth is faced with several 'truths' of climate change in the region, including:

- Climate change is already happening and will continue;
- Climate change impacts are wide-ranging and affect many sectors of society;
- The cost of impacts will be high;



- Current and accurate information improves decision-making;
- Integrating mitigation and adaptation strategies provides double benefits;
- Adaptive management and forward-thinking goals should be built into current actions; and
- Actions addressing climate change may present opportunities [for growth/advancement].

The following is a discussion of the impacts of climate change as they relate to the Town of Falmouth. The Town of Falmouth lies along the southwest shore of Cape Cod, immediately north of Nantucket Sound and east of Buzzards Bay. Falmouth is comprised of North Falmouth, East Falmouth, Waquoit, West Falmouth, Falmouth Village, Teaticket, and Woods Hole. With approximately 68 miles of coastal shoreline, the vulnerability of the Town of Falmouth to the impacts associated with climate change is fairly significant. An evaluation of potential impacts of climate change to the natural resources, infrastructure, and economy to the Town of Falmouth is presented in the following paragraphs. Mitigation options for such impacts are presented in Chapter 8.

#### 7.6.1.1 Impacts to Natural Resources

**Beaches.** Coastal beaches are constantly changing shape with sand entering and leaving the system on a daily basis. Sand enters the system through both upland erosion and through migration along the beach from other areas. Sand leaves the system predominantly through the diagonal wave action which transports it to areas further down the shoreline. According to Town of Falmouth Coastal Working Group (FCWG), October 2010 report entitled, *The Future of Falmouth's Buzzards Bay Shore*, Falmouth's Buzzards Bay shoreline is severely sand starved. The report cites the installation of shoreline protection features such as stone seawalls, groins, jetties, and rip-rap revetments have restricted the movement of sand along the shoreline. According to the report, "The sand in front of a revetment continues to move in response to the waves, but no new sand replaces it. Consequently, the beaches become narrower, rockier, and steeper, and the water offshore gets deeper. Often this causes a property owner to build a groin to hold the remaining sand on the beach. The groin may hold the sand on that property, but by doing so it deprives other beaches downstream of sand."

The FCWG report notes that sea level in Falmouth has risen approximately 0.3-m (1-foot) in the last 100 years and is anticipated to rise an additional 2- to 3-feet in the next century. Such drastic changes in sea level elevation will only exacerbate the problem of beach sand deprivation. The sheer physical aspect of losing 0.6- to 1-m (2- to 3-feet) of shoreline due to elevated water levels will be compounded by accelerated erosion, and essentially a more rapid rate of sediment starvation to existing beaches. Under elevated sea level conditions, there will be a tendency for currently eroding shorelines to erode further and for stable shorelines to begin to erode (NCCOE, 2004).

**Coastal Wetlands.** Coastal wetlands provide both habitat to wildlife and fish as well as buffering protection to the adjacent upland against the erosional forces of waves and currents. A rise in sea level associated with climate change will impact coastal wetlands in several ways. As projected by the FCWG report, a 0.6- to 1-m (2- to 3-foot) rise in sea level will alter the hydrology of coastal wetlands; essentially "drowning" that portion of the wetland which cannot tolerate elevated water levels, and thus leaving less wetland area to provide buffering protection against incoming wave action. Adjacent upland areas may over time, transition to wetland areas; however, given the extent of development or otherwise restrictive natural features adjacent to many coastal wetlands in the Town, progression inland may not be a viable option. Increased inflow of nitrogen to coastal wetlands from the surrounding watershed will likely impact



the ability of salt marshes to sequester greenhouse gases such as carbon dioxide. According to an article by Reserve Manager Alison Leschen of the Waquoit Bay National Estuarine Research Reserve (WBNERR), WBNERR was awarded a \$1.3 million grant by the National Estuarine Research Reserve System to look at the role of salt marshes as carbon dioxide sinks and the potential impairment of such systems from increased nitrogen inflows. According to the article, coastal wetlands may sequester three to five times more carbon than temperate forest systems and thus play a more significant role in mitigating the impacts of greenhouse gases on climate change.

**Freshwater Resources.** According to the Town of Falmouth Water Department, freshwater is supplied to the Town via the following sources:

- Long Pond, located approximately 1.4 km (0.9 miles) east of the Buzzards Bay shoreline, supplies roughly 50-percent of the Town's freshwater;
- Coonamesett Well, Crooked Pond Well, Fresh Pond Well, Mares Pond Well produce roughly 2.1 million gallons of potable water for the Town per day; and
- Up to one million gallons per day is supplied from the Massachusetts Military Reservation supply wells, located immediately north of the Town of Falmouth.

A rise in sea level could allow saline water to penetrate farther inland. However, because the Falmouth potable water resources are placed far inland, the risk of salt water intrusion is low.

#### **7.6.1.2 Impacts to Infrastructure**

According to the September 2011 *Massachusetts Climate Change Adaptation Report*, nearly all aspects of municipal infrastructure will, to some degree, be impacted by the effects of climate change.

In July 2011, the U.S. Department of Transportation John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts prepared a report for the Federal Highway Administration, National Park Service, and Fish and Wildlife Service, entitled, "A Framework for Considering Climate Change in Transportation and Land Use Scenario Planning: Final Report". The report provides a framework for Federal, State, regional, and local agencies to work collaboratively to reduce Greenhouse Gas (GHG) emissions and to assess, mitigate, and adapt to sea level rise and other potential climate change effects and the impacts to transportation and land use planning through the utilization of scenario planning. More significantly however, the report includes a figure, entitled "Vulnerable Area Map and Key" which illustrates areas throughout the Cape vulnerable to storm surge and sea level rise. In the Town of Falmouth, vulnerable areas are located predominantly along the shoreline. The report describes that human management will likely dictate the severity of severe sea level impacts.

**Stormwater Management Systems.** Warmer winter and spring temperatures will likely lead to earlier and more rapid melting of winter snow and spring runoff, thus increasing the burden on stormwater management systems. The projected increase in extreme weather events associated with climate change will further burden existing stormwater infrastructure. Existing culverts, storm drains, catch basins, and other infrastructure associated with the management of stormwater in the Town may in fact be undersized and unable to manage the increased stormwater load each spring.

**Wastewater Systems.** Utilizing the information presented in the July 2011 U.S. DOT report on sea level rise, it appears the areas near the coast are most susceptible to even minimal sea level rise due to the existing elevation of the roads and the proximity to the water table; and should be carefully considered in



the planning for future or modifications to existing wastewater management facilities and pump stations. A March 2009 presentation by Stephen Estes-Smariassi, the Director of Planning for the Massachusetts Water Resources Authority, entitled, “Early Experiences in Climate Change Adaptation: Lessons from the MWRA [Massachusetts Water Resources Authority]” identifies several strategic planning initiatives taken by the MWRA in the design and construction of the Deer Island Wastewater Treatment Plant to address sea level rise. The presentation notes how the MWRA incorporated both existing information such as annual rainfall, historic sea level data, extreme storm event data, and LIDAR and GIS facility data, as well as projections and model data to predict not only sea level rise scenarios but also changes in sewer input, effluent discharge, regulatory changes related to wastewater treatment, and population changes. Although wastewater treatment facilities are unique to their locations, the utilization of information presented in studies such as the U.S. DOT report on sea level rise and the Deer Island Wastewater Treatment Plant can significantly aid the Town of Falmouth in proactively planning wastewater facility modifications which address sea level rise.

**Drinking Water Supply.** Given the Town of Falmouth’s dependence on groundwater as a major source of drinking water, a potential threat to drinking water supply as a result of climate change is saltwater intrusion. It is noted that the existing sources are all very far inland, and the likelihood of saltwater intrusion is low. Options to address saltwater intrusion if needed may include seeking alternate water supply sources such as alternate groundwater supplies further inland or desalinization facilities. The extent of mitigation to drinking water supplies will likely depend on the extent of groundwater impairment and in cases of minimal saltwater intrusion, additional treatment methodologies at existing facilities may be possible.

**Shoreline Residential and Commercial Development.** Rising sea levels, increased extreme weather events, and flooding associated with such events significantly threatens the sustainability of shoreline residential and commercial structures. Other influences on the vulnerability of coastal infrastructure will likely include reduced natural buffers, such as beaches and wetlands, increased shoreline erosion associated with rising sea levels and changing wave patterns, and dated infrastructure less suited to handling the predicted frequency and intensity of extreme weather events.

### 7.6.1.3 Impacts to the Economy

**Tourism.** The significance of tourism on Cape Cod and in the Town of Falmouth is well documented:

- Tourism on Cape Cod has increased annually since 2006, particularly in summer months (Cape Cod Chamber of Commerce, 2011);
- 48-percent of visitors to Cape Cod questioned as a part of a 1999-2000 poll cited beaches as the primary reason for visiting the Cape (Massachusetts Office of Travel and Tourism);
- In 2007 alone there were approximately 4.3 million visitors to the Cape Cod National Seashore;
- Tourism dollars accounted for approximately \$1.1 billion of revenue to Cape Cod in 2007;
- Room tax revenue (4-percent excise tax) in the Town of Falmouth for 2007 totalled \$1 million (Massachusetts Department of Revenue); and
- Approximately one-third of the Falmouth Chamber of Commerce members cite their business as being directly dependent on tourism (Falmouth Chamber of Commerce).



The loss of shoreline beaches from sea level rise and the increased frequency of extreme weather events will have a rippling effect on the tourism industry, starting with a reduction in the number of tourists traveling to the area, followed by decreased revenue to restaurants, hotels, and in goods and services in the area.

Potential mitigation measures for climate change are discussed in Chapter 8.

#### **7.6.1.4 Summary**

Climate change will have a large impact on Cape Cod and Falmouth as reviewed in the previous sections. The need to meet nitrogen TMDLs will continue; therefore the Town will still need to implement improved wastewater and nitrogen management methods. Wastewater pumping stations and treatment facilities need to be sited high enough that they are not exposed to wave action that could damage them in large storm events. They should also be protected from 100-year storm elevations plus a safety factor to accommodate the expected higher 100-year flood elevations associated with climate change. These evaluations and decisions are expected to occur during design of any new infrastructure. The properties in low elevation areas will still need to be served by roads, water supply, electric, and wastewater infrastructure. This infrastructure and the developed properties in these vulnerable areas are expected to be damaged with increased frequency as climate change continues. There may be a decision point in the future where some low lying areas will be identified as unsafe to live and the houses, roads, and utilities will be removed. This type of decision point is difficult to imagine or predict.

Future wastewater facilities for flood-prone areas should be designed for climate change to have as long a design life as possible. Additional mitigation measures are identified in Chapter 8 on this subject.

### **7.6.2 Greenhouse Gas Evaluation for WWTF**

#### **7.6.2.1 Background and Purpose**

This CWMP Project is subject to the GHG Emissions Policy and Protocol because the project is required to prepare an EIR in accordance with MEPA. Discussions with John Ballam, Greenhouse Gas Coordinator with the Massachusetts Department of Energy Resources (DOER), recommended the use of the USEPA Portfolio Manager for this evaluation because it is the standard process developed for WWTFs<sup>1</sup>. It is also suitable for WWTFs that are in a planning phase where preliminary or detailed design information has not yet been developed.

Discussions with Mr. Ballam indicate that the main purpose of a GHG evaluation at this time is to initiate plans to incorporate energy efficient components into a future facility. These GHG evaluations should be identified in the Section 61 Findings (in Chapter 8 of this report) to track them as any new or expanded facilities proceed to preliminary or detailed design.

The EPA Portfolio Manager was used in order to quantify the increase in carbon dioxide equivalent from the proposed upgrade.

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<sup>1</sup> GHD has been a contributor to USEPA in the development of this GHG evaluation tool.



### 7.6.2.2 Approach

The EPA Portfolio is an online tool designed to assess energy and water consumption at a facility. The tool provides a benchmark score which compares the performance of the facility analyzed with similar facilities. The tool also calculates GHG emissions for the facility based on the data entered.

For a municipal wastewater treatment plant, the following inputs are used to determine energy consumption at a facility:

- Zip code
- Average influent flow
- Average influent biological oxygen demand (BOD<sub>5</sub>)
- Average effluent biological oxygen demand (BOD<sub>5</sub>)
- Plant design flow rate
- Presence of fixed film trickling filtration process
- Presence of nutrient removal process
- Annual electricity and fuel usage

### 7.6.2.3 Current and Future GHG Emissions

The Recommended Plan is to expand the flow to the WWTF from 0.38 mgd up to 0.76 mgd on an average annual basis. This flow includes the 0.26 mgd projected to come from the Little Pond Sewer Service Area and to be recharged at new infiltration facilities at Site 7, as well as the 0.5 mgd that can come from the existing collection system to be recharged at the existing treatment facility site. The current WWTF does not need to be expanded to meet this additional flow because the existing WWTF is currently under-loaded. Also, there could be decreases in flow from the existing collection system due to planned remediation of inflow and infiltration (I/I) identified in the Woods Hole area. The proposed flow used to evaluate future GHG emission is 0.76 mgd. It is understood that this expansion would be modular and could occur in multiple steps. Estimated electricity consumption for the proposed facility is based on existing electrical consumption as well as projected consumption for the expanded ENR process. There are likely other electricity usage increases that have not been identified yet and were not included in the proposed upgrade electricity estimation.

The method of analysis was developed with guidance from John Ballam (DOER) and EPA. It was discussed that the EPA Portfolio Manager should be run for the current facility and also for the identified energy consumption increases for the proposed facility. The EPA had previously used the tool to evaluate the facility and obtained a benchmark score of 13.

The EnergyStar Portfolio Manager is only intended for facilities larger than 0.6 mgd. In order to obtain a benchmark score for the current facility an average flow rate of 0.61 was used. Increasing the flow rate to obtain a benchmark score did not change the current carbon emissions calculated for the facility.

Based on the EPA Portfolio Manager Analysis below, the increased capacity from the proposed upgrade raises the utility benchmark score from 13 to 21.



**Table 7-4 EPA Portfolio Manager Analysis of Falmouth WWTF**

Scenario	Utility Benchmark Score	Site kBTU/gpd	Source kBTU/gpd	CO2 Emissions (Short tons/yr)
Present Facility	13	9	25	325.2
Proposed	21	5	12	325.2

Computer output from this evaluation is attached in Appendix 7-1. The EPA Portfolio includes only purchased fuel. Power generated by the facility is not included.

The facility currently has two 1.65-megawatt wind turbines (Wind I and Wind II) installed on-site. Wind I started operation in March 2010 and Wind II started operation in January 2012. The energy produced by the wind turbines is used first to meet the facility's electrical energy demands. Any electricity in excess of the facility's needs is sent to the grid in a net metering arrangement with the local utility. Due to expected restrictions to the turbines operations in this analysis, it is assumed that the turbines are run at 50-percent of their expected capacity. The expected output of the turbines is 3,624 MWhrs/yr, which represents a carbon dioxide equivalent of 2,000 short tons annually and allows the facility to run as a **“net zero electricity facility”**.

#### 7.6.2.4 GHG Emissions Reduction Analysis

The analysis above details the expected GHG emissions from additional energy sources that have been identified in the CWMP. The options below will be considered in preliminary and final design in order to potentially reduce the GHG emissions at the Falmouth WWTF further.

It is noted that RISE Engineering has completed an energy audit as well as other evaluations and their findings are attached in Appendix 7-1 and referenced below.

Items discussed are considered either good practice or better than the standard practice. Each item is categorized below as one of the following options:

- Measure to be considered in preliminary and final design—More analysis is required on these items in order to determine whether these are recommended items.
- Not Recommended Measure—These items are not recommended for implementation.

##### 7.6.2.4.1 Incorporate On-Site Renewable Energy Systems to Provide Some of the Facility's Base Electrical Needs

Two 1.65-megawatt wind turbines are currently installed at the Falmouth WWTF. Due to expected restrictions to the turbines operations, the turbines are expected based on current operation to run at 50-percent capacity with an annual output of 3,624 MWhrs.

The Town could also consider solar photovoltaic (PV) systems to increase their renewable energy production on site. PV systems can either be roof-mounted or ground-mounted depending on site conditions. South facing roofs with minimal shadow interference provide the most ideal conditions for a roof-mounted solar array. Table 7-5 details the solar potential for the facility determined in the RISE assessment. **This is an item to be considered in preliminary and final design.**



**Table 7-5 RISE Assessment of Solar Potential at the Falmouth WWTF**

<b>RISE Assessment of Solar Potential at the Falmouth WWTF</b>	
Estimated Roof Space (sf)	10,200
Estimated Ground Space (sf)	54,000
Estimated Capacity (kW)	513.6

#### **7.6.2.4.2 Energy Recovery**

Typical wastewater effluent contains enough heat, extractable through a heat exchanger, to be considered as a building heating source. Effluent heat pumps have a relatively low impact on energy consumption at a facility. **This is an item to be considered in preliminary and final design.**

#### **7.6.2.4.3 Hydroelectric Potential**

If adequate head is present in an effluent pipe, a hydro-turbine could be utilized to recover a portion of the potential energy in the flow. The RISE assessment concluded the Falmouth WWTF has no potential head in its current effluent piping layout. The Town is planning further evaluation on a possible ocean outfall for Nobska Point as indicated in Chapter 3. The pipeline from the WWTF to Nobska Point would be suitable for a small in-pipe turbine. **This is an item to be considered in preliminary and final design if that plan proceeds.**

#### **7.6.2.4.4 System Monitoring**

Energy usage can be minimized through system monitoring. Sub-metering will allow the facility to track the energy usage of individual processes and equipment. Installing dissolved oxygen (DO) probes in aerations systems allows operators to closely match the air supplied by the blowers to the system's need, thereby reducing excess energy consumption. **This is an item to be considered in final design.**

#### **7.6.2.4.5 Optimize Lighting**

Energy efficiency measures to be considered for the lighting system include adding motion sensors on lights in non-process buildings, using high-efficiency fixtures, and maximizing the use of natural light through the use of windows, translucent panels, skylights, etc, to reduce reliance on artificial lighting. In order to limit light pollution, light sensors or light timers should be considered and exterior lighting should be limited to what is required by local codes or for safety. **This is an item to be considered in final design.**

#### **7.6.2.4.6 Reduce Ventilation & Heating Requirements**

Codes should be examined for provisions that allow for lower heating requirements and fewer air changes when an area is unoccupied in order to reduce energy consumption for ventilation and heating. **This is an item to be considered in final design.**

#### **7.6.2.4.7 Upgrade Existing Motors to Variable Frequency Drives**

Variable frequency drives (VFDs) have been installed on all major equipment at the facility. Trane, Inc. is currently conducting an assessment for additional energy efficiency recommendations. **This is an item to be considered in final design at the facility.**



#### **7.6.2.4.8 Process Optimization**

Most WWTFs are designed with oversized equipment in order to account for uncertainty in influent variations, to provide additional capacity for future growth and to meet State and local regulatory criteria. Process models can be used to develop operational strategies for the current influent flow conditions. **This is an item to be considered in final design.**

#### **7.6.2.4.9 Reducing infiltration and Inflow**

The report by RISE recommended evaluating the pumping station at Woods Hole to determine if reducing infiltration could result in a cost-effective energy savings. **This is an item to be considered in final design.**

#### **7.6.2.4.10 On-Going Investment Grade Audit of All Town Buildings**

The Town has finalized a contract with Trane, Inc. to conduct an Investment Grade Audit (IGA) of all Town buildings. The IGA will include the WWTF—as well as pumping stations—and is the first step in a Town decision-making process to select specific building improvements as part of a Town-wide Energy Performance Contract. This comprehensive audit will identify energy conservation measures (ECMs) across the Town's building inventory, including the WWTF. Trane inputs findings from an in-depth building site visit into a proprietary software tool. This tool then enables the Town to determine a mix of ECMs that best meet its energy-savings goals. Inputs to this software include building-specific technical measures, expected energy savings from the measure, as well as cost. The RISE Engineering audit will be superseded by the Trane IGA. A meeting was held with the Town Energy Coordinator to ensure that any measures proposed as part of the IGA for the WWTF are based on the most current sewer planning information. As ECMs are considered by the Town for inclusion in an Energy Performance Contract, the Wastewater Division and WQMC will coordinate as appropriate.

In addition, the Town installed two Vestas V82 wind turbines, located and net-metered at the WWTF. These 1.65 MW turbines are together capable of producing over 7,500 megawatt-hours annually. The WWTF annually uses less than this amount. Thus, the electricity used by the WWTF is generated completely by this renewable energy installation. Additional renewable energy installations will be evaluated as part of Trane's IGA for the Town.

### **7.6.3 Initiation of Estuarine Water Quality Modeling to Investigate Benefits**

As improved wastewater and nitrogen management is proposed for the Planning Area, the water quality model developed by SMAST as part of the Massachusetts Estuaries Project (MEP) (discussed in Section 1.2.D of the Needs Assessment Report contained in Appendix 2-4) can be run to evaluate the expected improvement to the marine water quality.

The Town has initiated this process by evaluating the resultant nitrogen concentration at the sentinel stations of West Falmouth Harbor, Little Pond, Great Pond, Green Pond, and Bournes Pond for two sewerage scenarios. (It is noted that at the time of these evaluations, MassDEP and the MEP had not yet released a technical report on nitrogen limits for Waquoit bay; therefore, no water quality models were completed for Waquoit Bay.)

These evaluations were completed with SMAST who performed the modeling. A detailed summary of these evaluations is found in Technical Memoranda Nos. 10 and 11 attached in Appendix 7-2 and 7-3.



The purpose of this section is to summarize the projected/needed water quality improvements and to identify how the model can be used in the future for additional wastewater and nitrogen management methods.

### 7.6.3.1 West Falmouth Harbor Model Scenarios

The West Falmouth Harbor Watershed and existing infiltration areas are illustrated in Figure 7-10.

Several previous nitrogen evaluations have been completed for West Falmouth Harbor that considered various treated water recharges (at 3 mg/L total nitrogen) and various sewer extensions to the western portions of the West Falmouth Harbor watershed. These evaluations and the reports in which they are documented are briefly summarized below:

- **2001 Wastewater Facility Plan.** This document summarizes the evaluations and plan completed in 2001 to upgrade the Blacksmith Shop Road WWTF to enhanced nitrogen removal (ENR) standards to meet 3 mg/L total nitrogen on average and to extend sewers to the portions of the West Falmouth Harbor watershed west of Route 28. This plan was based on water quality evaluations completed at the time by Brian Howes (and others) from the UMass Center for Marine Science and Technology (CMAST) which later became the School for Marine Science and Technology (SMAST). This plan was approved after State (MEPA) and regional (CCC DRI) regulatory review.
- **West Falmouth Harbor Technical Report by Massachusetts Estuaries Project (MEP) dated May 2006.** This document developed and summarized nitrogen limits for West Falmouth Harbor based on the MEP methodologies. This document (starting on page 104) also summarized evaluations of buildout conditions in the West Falmouth Harbor watershed that meet the nitrogen limits. These buildout conditions included:
  - Upgrade to the WWTF and recharge of 1 mgd at 3 mg/L total nitrogen at the WWTF.
  - Sewer extension to portions of the watershed west of Route 28.
  - Other standard buildout conditions used in the MEP methodology.
- **West Falmouth Harbor TMDL Report by Massachusetts Department of Environmental Protection (MassDEP) dated February 9, 2007.** This document summarizes the basis of the final TMDL for the harbor and is based on the nitrogen limits developed and summarized in the May 2006 Technical Report.
- **Technical Memorandum Dated February 22, 2007 from Brian Howes and Others from SMAST, Applied Coastal Research and Engineering Inc., and Cape Cod Commission (CCC) Prepared for the Coalition for Buzzards Bay (CBB) Regarding Scenario Runs of West Falmouth Harbor MEP Linked Model.** This document summarized three alternative nitrogen loading scenarios to the West Falmouth Harbor watershed and evaluations of TMDL compliance by these scenarios. This document also summarized an evaluation that found that approximately 0.5 mgd (at 3 mg/L total nitrogen) could be recharged at the WWTF and still meet the nitrogen TMDL if the sewer extension was not made to the portions of the watershed west of Route 28.
- **MassDEP Groundwater Discharge Permit for the WWTF Dated June 28, 2012.** This document allows a discharge of 0.57 mgd at a concentration of 3 mg/L total nitrogen at the WWTF site if sewers are not extended to the West Falmouth Harbor area.



- **CWMP Review Committee Findings (revised 9/7/10) Attached to Technical Memorandum No. 7.** This document indicates (item number 9 on page 3) that “the need for constructing sewers in West Falmouth may be deferred to a later date”.

Based on review of these documents, it was decided to model the following two scenarios for West Falmouth Harbor:

1. West Falmouth Harbor Scenario 1 (Scenario WF-1) which includes the following components:
  - Buildout conditions as developed by the MEP evaluation process.
  - No sewer extension to West Falmouth Harbor area.
  - Treated water recharge of 0.5 mgd at 3 mg/L total nitrogen recharged at infiltration beds 9 through 13 in Mashapaquit Creek sub-watersheds.

The recharge location was chosen to take advantage of the nitrogen attenuation allowed by the MEP model for nitrogen loadings in this area.

2. West Falmouth Harbor Scenario 2 (Scenario WF-2) which includes the following components:
  - Buildout conditions as developed by the MEP evaluation process.
  - Sewer extension to the West Falmouth Harbor watershed west of Route 28. This area is illustrated in Figures 1 and 2 of Technical Memorandum No. 10 as found in Appendix 7-2.
  - Treated water recharge of 1 mgd at 3 mg/L total nitrogen recharged at infiltration beds 9 through 13 in Mashapaquit Creek sub-watershed.

SMAST completed the modeling as detailed in their technical memorandum (Appendix 7-2) with the following main findings:

1. Compliance with the nitrogen TMDL is typically determined by the water quality modeling of reduced nitrogen loading to allow the modeled total nitrogen concentration at the sentinel station to be below the TMDL threshold concentration. For West Falmouth Harbor, the sentinel station is PWF5 in Snug Harbor (illustrated in Figure 7-10) and the sentinel concentration is 0.35 mg/L. The water quality model calculated total nitrogen (TN) concentrations for all of the sub-estuaries as summarized below:



**Table 7-6 Summary of Modeled Nitrogen Concentrations for Present Conditions and Scenarios WFH-1 and WFH-2<sup>1</sup>**

Sub-Estuary	Threshold TN Concentration mg/L	Present TN mg/L	Scenario WF-1 mg/L	Scenario WF-2 mg/L
Mashapaquit Creek		0.627	0.439	0.457
Harbor Head		0.437	0.384	0.336
Chapaquoit Basin		0.382	0.337	0.317
Inner West Falmouth Harbor		0.370	0.325	0.319
<b>Snug Harbor</b>	<b>0.350</b>	<b>0.464</b>	<b>0.364</b>	<b>0.363</b>
Outer West Falmouth Harbor		0.327	0.309	0.304
Outer West Falmouth Harbor		0.312	0.302	0.300
Oyster Pond		0.534	0.491	0.384

1. Based on Table 2 of SMAST Technical Memorandum dated October 7, 2011 as attached in Appendix 7-2.

2. Both scenarios did not meet the threshold concentration in Snug Harbor.
3. The results of Scenario WFH-2 were a surprise because this scenario was developed to duplicate the buildout model run that had previously met the TMDL threshold concentration as documented in the 2006 SMAST/MEP report. The modeled result of WFH-2 is 0.013 higher than the threshold. This exceedance appears to be small, but it is fairly large when compared to the allowable increase for this location. The allowable increase for this location is approximately 0.05 mg/L based on the ambient TN concentration in Buzzards Bay of approximately 0.3 mg/L and the threshold value of 0.35. The 0.013 mg/L exceedance is 26-percent over the allowable increase.
4. The result of WFH-2 is also a surprise because it indicates that recharging in the Mashapaquit Creek watersheds may not be an advantage to meet the TMDL. Recharge in this location was previously believed to be a way to gain nitrogen attenuation and save capital costs for nitrogen mitigation.
5. The result of WFH-1 was a similar surprise and had a similar exceedance of the threshold concentration.
6. Follow-up information provided by SMAST for future scenarios included suggestion that the treated water be recharged in other available locations at the Blacksmith Shop Road site to avoid total recharge to the Mashapaquit Creek sub-watersheds.

The recommended next steps for West Falmouth Harbor water quality modeling would be optimization modeling to identify an optimized Scenario No. 3 (WFH-3) that meets the TMDL with the following characteristics:

1. Buildout conditions.
2. No sewer extension to the West Falmouth Harbor area.



3. The WWTF effluent discharge permit and Settlement Agreement allowed a recharge of up to 0.57 mgd at 3 mg/L total nitrogen to the West Falmouth watershed. The Town plans to limit the recharge with a goal of not discharging more than 0.5 mgd at 3 mg/L on an average annual basis.

#### **7.6.3.2 Little, Great, Green, and Bournes Pond Model Scenarios for the High Priority Nitrogen Mitigation Area**

The estimated existing wastewater nitrogen removal (in percent) needed to meet the nitrogen TMDLs for these estuaries is illustrated on Figure 2-1. It is noted that the percentages apply to the sub-watershed delineations in which they are located. The higher removals are in the lower sub-watersheds because these areas drain directly to the marine water estuary without nitrogen attenuation. The upper watershed areas drain through freshwater wetlands that provide natural nitrogen attenuation. These removals were developed by the MEP as part of their technical reports for each estuary and watershed. It is also noted that Little Pond and Bournes Pond have reduced removals in their upper watersheds if the inlets to these ponds were enlarged and maintained to provide increased tidal flushing.

The estimated future wastewater nitrogen removals (in percent) needed to meet the nitrogen TMDLs for these estuaries in the buildout condition are illustrated on Figure 2-2. These removals were estimated by the MEP as part of their buildout evaluations for these estuaries and watersheds as documented in their respective technical reports. They did not calculate a reduced nitrogen removal for the future conditions if the inlets to Little and Bournes Ponds were enlarged.

Figure 4-2 identifies the High Priority Nitrogen Mitigation Area that was evaluated as potential sewer service areas A through E. Comparison of the removal percentage to the coverage of the sewer service area indicates the following:

1. Observations for Little Pond:
  - 100-percent wastewater nitrogen needs to be removed from the Little Pond lower watershed, and the High Priority Nitrogen Mitigation Area evaluated for sewerage (as well as the Little Pond Sewer Service Area illustrated in Figure 4-8) extends to most of this lower watershed area (a small un-sewered portion of the lower watershed extends as a “panhandle” to the west).
  - Approximately 84-percent wastewater nitrogen needs to be removed from the upper Little Pond watershed and the High Priority Nitrogen Mitigation Area evaluated for sewerage (as well as the Little Pond Sewer Service Area illustrated in Figure 4-8) extends to only about 20-percent of the area.
  - Sewerage of the High Priority Nitrogen Mitigation Area evaluated for sewerage (as well as the Little Pond Sewer Service Area illustrated in Figure 4-8) of the Little Pond watershed is not expected to meet the nitrogen TMDL unless additional nitrogen management reduction methods are implemented such as those described in Chapter 3.
2. Observations for Great Pond:
  - 100-percent wastewater nitrogen needs to be removed for the lower watershed, but the High Priority Nitrogen Mitigation Area evaluated for sewerage extends to only approximately 75-percent of this area.



- Approximately 72-percent wastewater nitrogen needs to be removed from the upper watershed and only a small portion of the High Priority Nitrogen Mitigation Area evaluated for sewerage extends to the upper watershed.
  - Sewerage of the High Priority Nitrogen Mitigation Area evaluated for sewerage of Great Pond watershed is not expected to meet the nitrogen TMDL unless additional nitrogen management methods are implemented.
3. Observations for Green Pond:
- Only 78-percent wastewater nitrogen needs to be removed from the lower watershed; but nearly 100-percent of the lower watershed is covered by the High Priority Nitrogen Mitigation Area.
  - None (zero percent) of the wastewater nitrogen needs to be removed from the upper watershed.
  - Sewerage the High Priority Nitrogen Mitigation Area of the Green Pond water is expected to meet the nitrogen TMDL.
4. Observations for Bournes Pond:
- 100-percent of the wastewater nitrogen needs to be removed from the lower watershed; and nearly 100-percent of the lower watershed is covered by the High Priority Nitrogen Mitigation Area.
  - Approximately 83-percent wastewater nitrogen needs to be removed from the upper watershed and only a small portion (~8-percent) of the High Priority Nitrogen Mitigation Area extends to the upper watershed.
  - Sewerage the High Priority Nitrogen Mitigation Area of Bournes Pond is not expected to meet the nitrogen TMDL if the inlet is not opened and maintained or unless additional nitrogen management methods are implemented.
  - Sewerage of the High Priority Nitrogen Mitigation Area of Bournes Pond might meet the nitrogen TMDL if the inlet is opened. This condition has now been modeled as described in Appendix 3-4.

SMAST modeled the four estuaries for the future conditions with the High Priority Nitrogen Mitigation Area evaluated for sewerage and all of the collected wastewater conveyed to the Blacksmith Shop Road WWTF. The scenarios were Little Pond Scenario 1, Great Pond Scenario 1, Green Pond Scenario 1, and Bournes Pond Scenario 1, and the results of this modeling are summarized in the following table.



**Table 7-7 Summary of Modeled Nitrogen Concentrations for Present Conditions and Scenario 1 (High Priority Nitrogen Mitigation Area Sewering) for Each Estuary and Watershed<sup>(1)</sup>**

Scenario	Threshold TN Concentration mg/L	Present TN mg/L	Scenario 1 TN Concentration mg/L
Little Pond Scenario 1	0.450	0.837	0.495
Great Pond Scenario 1	0.400	0.591	0.535
Green Pond Scenario 1	0.420	0.526	0.390
Bournes Pond Scenario 1	0.450	0.643	0.488

1. Based on information in Tables 5, 7, 9, and 11 of SMAST Technical Memorandum dated October 7, 2011 as attached in Appendix 7-2.

Similar to the observations (made above) on the High Priority Nitrogen Mitigation Area sewer coverage evaluated and the needed wastewater removals, Scenario 1 for Little, Great, and Bournes Pond did not meet the TMDL threshold concentration. This scenario for Green Pond does meet its TMDL threshold concentration. This modeling does give a sense of how close possible sewer extensions in the High Priority Nitrogen Mitigation Area could move the Town to TMDL compliance.

Under the Adaptive Management Plan, and if the non-traditional options are assigned nitrogen reduction credit by MassDEP and are more cost-effective, these alternatives can supplant or supplement the sewer option to meet the nitrogen TMDLs for all of the listed embayments.

**7.6.3.3 Little and Great Ponds Model Scenarios for Sewer Extension North of the High Priority Nitrogen Mitigation Area**

Additional model scenarios were developed for these two estuaries for an estimated sewer extension above the High Priority Nitrogen Mitigation Area to meet TMDL compliance. This hypothetical sewer area was identified based on estimated nitrogen wastewater removals needed, housing density, road access, and neighborhood location with respect to freshwater ponds and wetlands. This hypothetical Sewer Area is called the Conceptual Water Quality Compliance Area (CWQCA) as illustrated on Figure 7-11.

Data on this area was given to SMAST with other geographic information system (GIS) information and additional modeling was completed. Due to a problem transferring GIS data, this modeling had to be done twice; therefore, there are two Technical Memoranda that describe this work as attached in Appendix 7-2 and 7-3.

Findings of this modeling are summarized below.



**Table 7-8 Summary of Modeled Nitrogen Concentrations for Present Conditions and Scenario 2 for Little and Great Ponds<sup>(1)</sup>**

<b>Pond</b>	<b>Threshold TN Concentration mg/L</b>	<b>Present TN mg/L</b>	<b>Scenario 2 TN Concentration mg/L</b>
Little Pond Scenario 1	0.450	0.837	0.416
Great Pond Scenario 1	0.400	0.591	0.377

1. Based on information in Tables 2 and 4 of SMAST Technical Memorandum dated February 29, 2012 as attached in Appendix 7-3.

These model results for Scenario 2 are slightly less than the threshold TN values indicating that the sewer extension went too far. The needed sewer extension area to meet the TMDLs will be slightly less than the area indicated in Figure 7-11.

**7.6.3.4 Potential Future Modeling to Investigate Non-Traditional Wastewater and Nitrogen Management Methods for the South Coast Estuaries**

The MEP/SMAST water quality models for the estuaries and watersheds are powerful tools to investigate the ability of all types of wastewater and nitrogen management (traditional and non-traditional) methods to meet the nitrogen TMDLs. Use of this tool is recognized as a method to demonstrate TMDL compliance as part of Adaptive Management. Additional modeling scenarios are expected to be completed to investigate the non-traditional nitrogen management methods. The nitrogen removal assumptions/basis of the non-traditional nitrogen management methods used in the model should be reviewed and found to be acceptable by the regulatory agencies (MassDEP, MEPA, and CCC) that will need to review and approve a management plan using these methods.

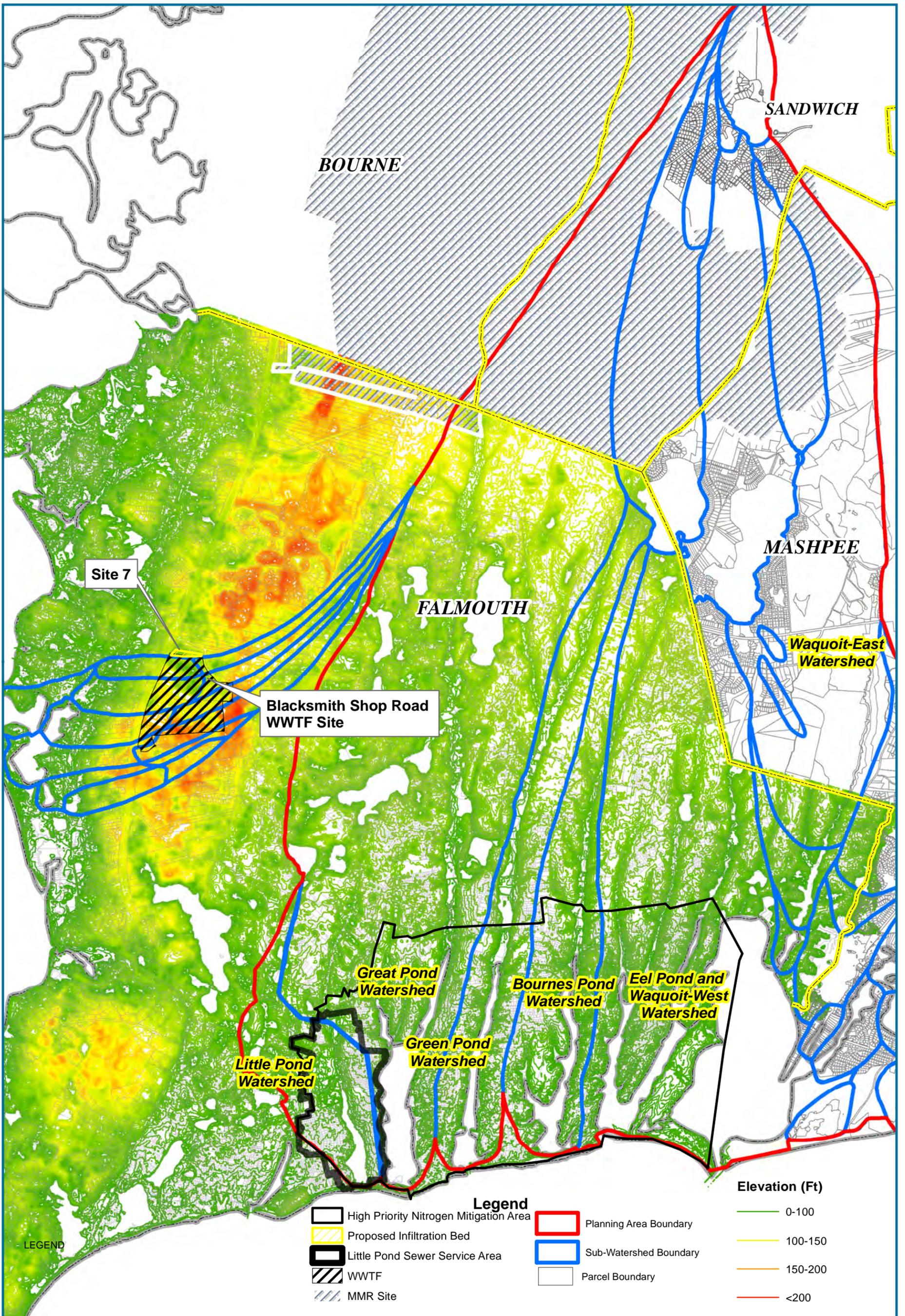
It is noted that Scenario 2 modeling for Green Pond is not needed because the sewerage evaluated in the High Priority Nitrogen Mitigation Area is projected to meet and exceed TMDL compliance. Scenario 2 for Bourne Pond is recommended to be completed with modeling assumptions associated with the recommended inlet opening as part of the demonstration project.

**7.6.3.5 Waquoit Bay Modeling**

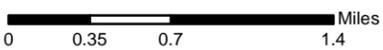
Once the TMDL report is released by MassDEP for this area, the following items should be gleaned from the report:

- Final watershed delineation.
- Percent removal of existing wastewater nitrogen needed for TMDL compliance.
- Percent removal of future wastewater nitrogen needed for TMDL compliance.
- Any benefits from inlet widening or other nutrient reduction techniques.

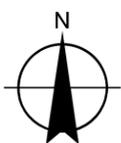
Once these items are understood, nitrogen management scenarios should be completed (with Mashpee's input for their portion of the watershed).



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Map Projection: Lambert Conformal Conic  
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CLIENTS|PEOPLE|PERFORMANCE

TOWN OF FALMOUTH, MA  
 CWMP

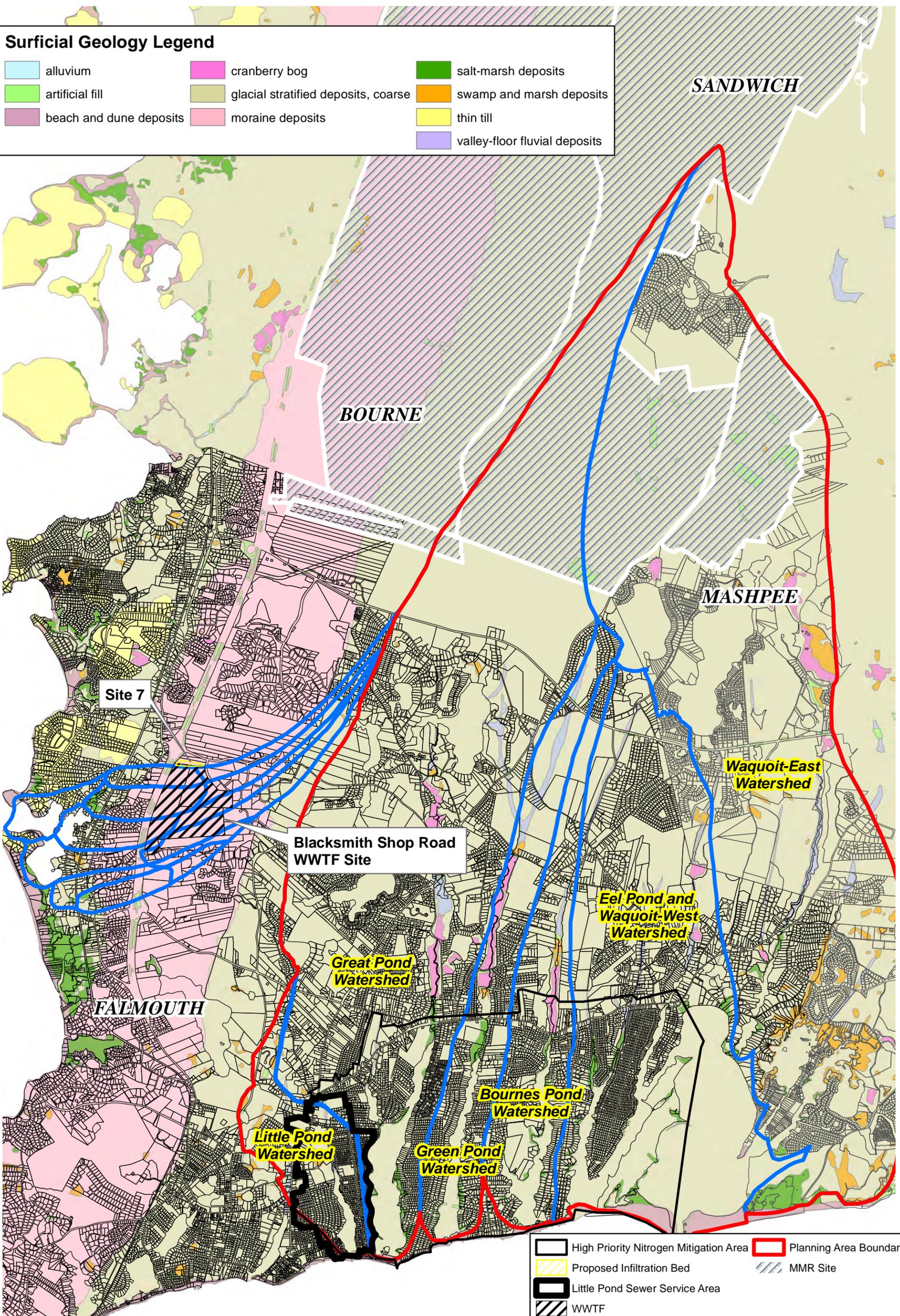
TOPOGRAPHIC MAP

Job Number 86-12163  
 Revision A  
 Date 03 Jul 2013

Figure 7-1

### Surficial Geology Legend

 alluvium	 cranberry bog	 salt-marsh deposits
 artificial fill	 glacial stratified deposits, coarse	 swamp and marsh deposits
 beach and dune deposits	 moraine deposits	 thin till
		 valley-floor fluvial deposits



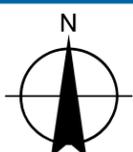
 High Priority Nitrogen Mitigation Area	 Planning Area Boundary
 Proposed Infiltration Bed	 MMR Site
 Little Pond Sewer Service Area	
 WWTF	

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Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983

Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet



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TOWN OF FALMOUTH, MA  
CWMP  
SURFICIAL GEOLOGY  
MAP

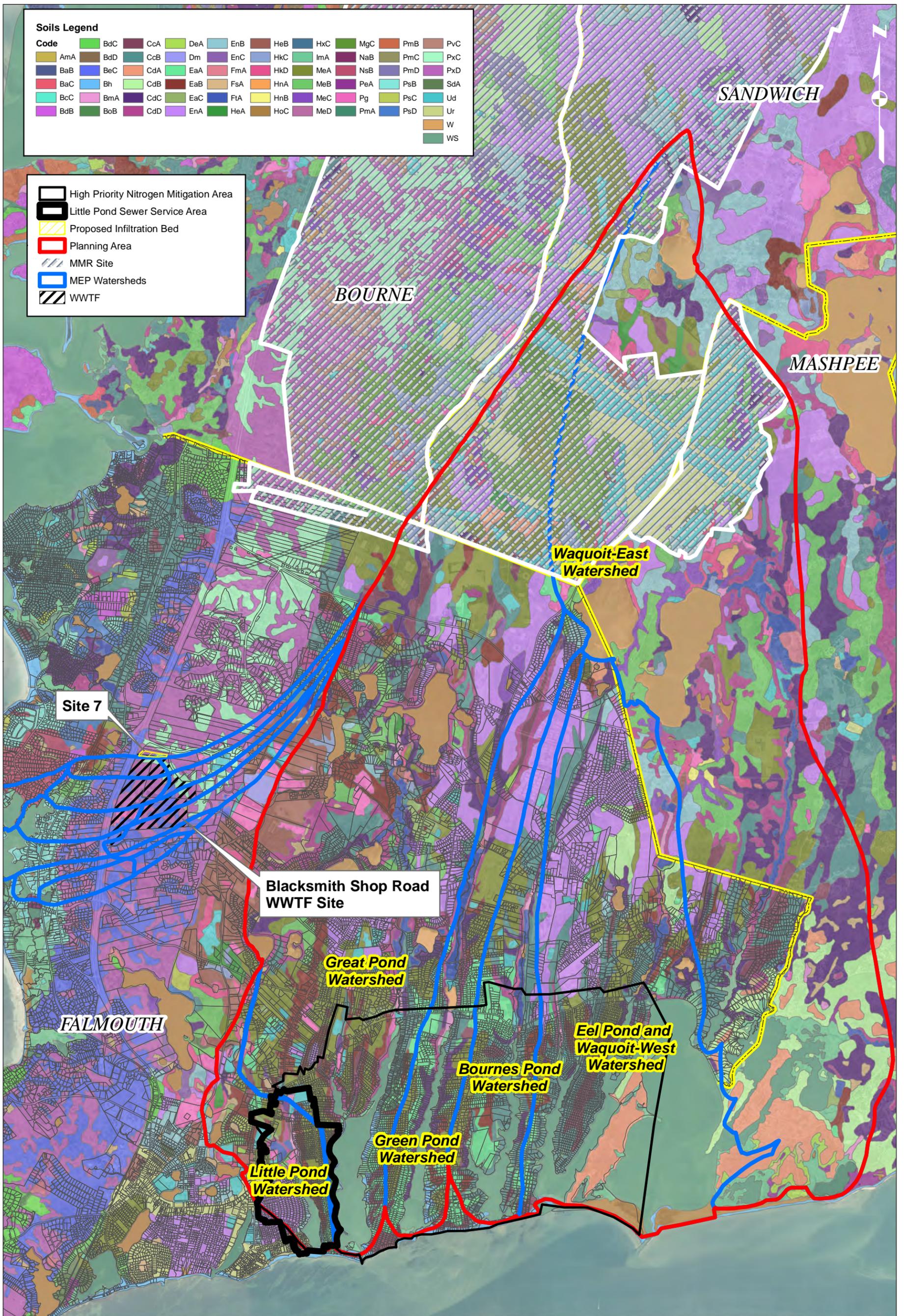
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Figure 7-2

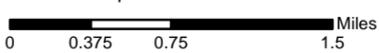
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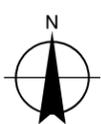
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Map Projection: Lambert Conformal Conic

Horizontal Datum: North American 1983

Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet



CLIENTS | PEOPLE | PERFORMANCE

TOWN OF FALMOUTH, MA  
CWMP  
SOILS MAP

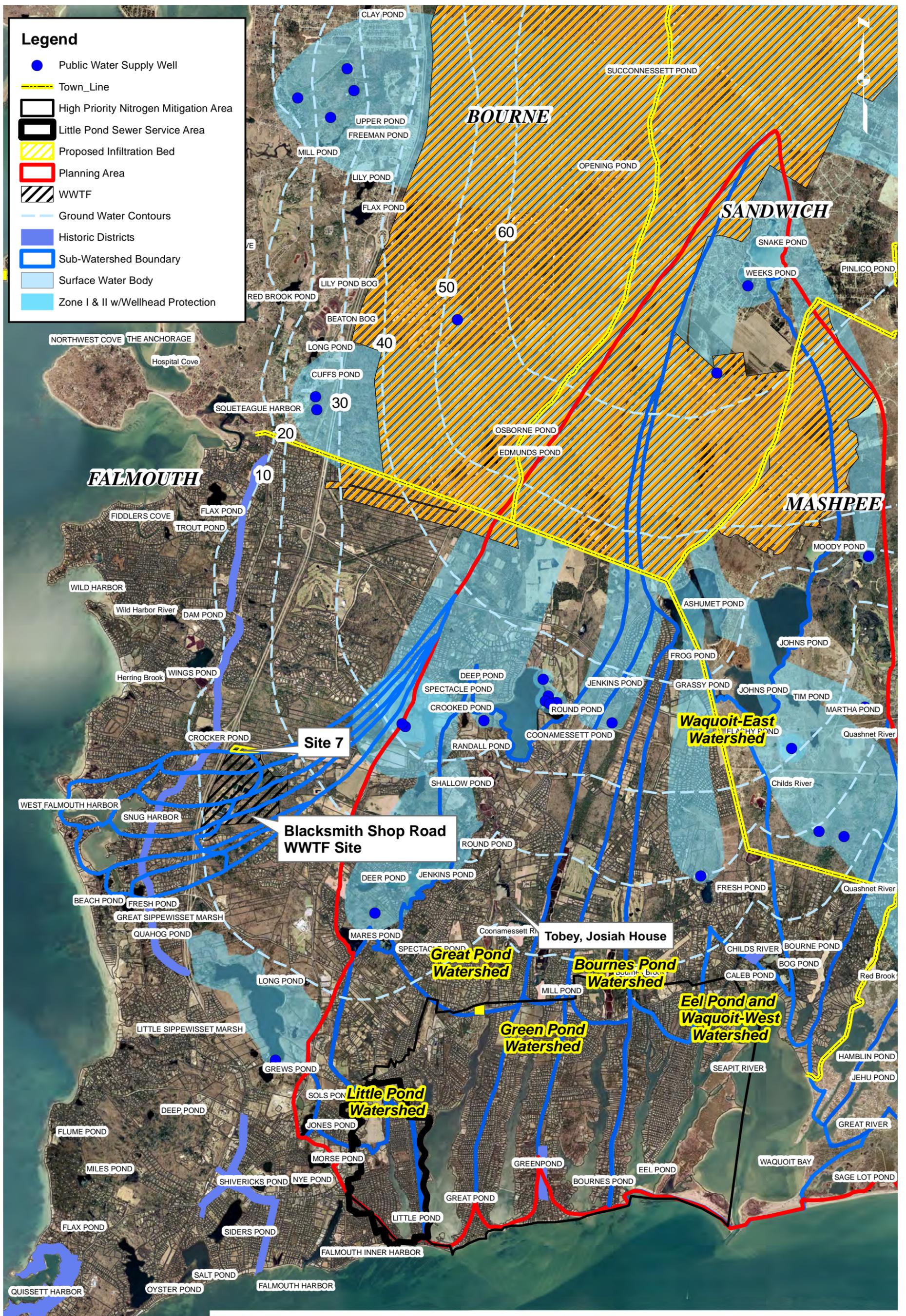
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Figure 7-3

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**Legend**

- Public Water Supply Well
- Town\_Line
- ▭ High Priority Nitrogen Mitigation Area
- ▭ Little Pond Sewer Service Area
- ▨ Proposed Infiltration Bed
- ▭ Planning Area
- ▨ WWTF
- Ground Water Contours
- Historic Districts
- ▭ Sub-Watershed Boundary
- Surface Water Body
- Zone I & II w/Wellhead Protection

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0 0.45 0.9 1.8 Miles

Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1983  
 Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001



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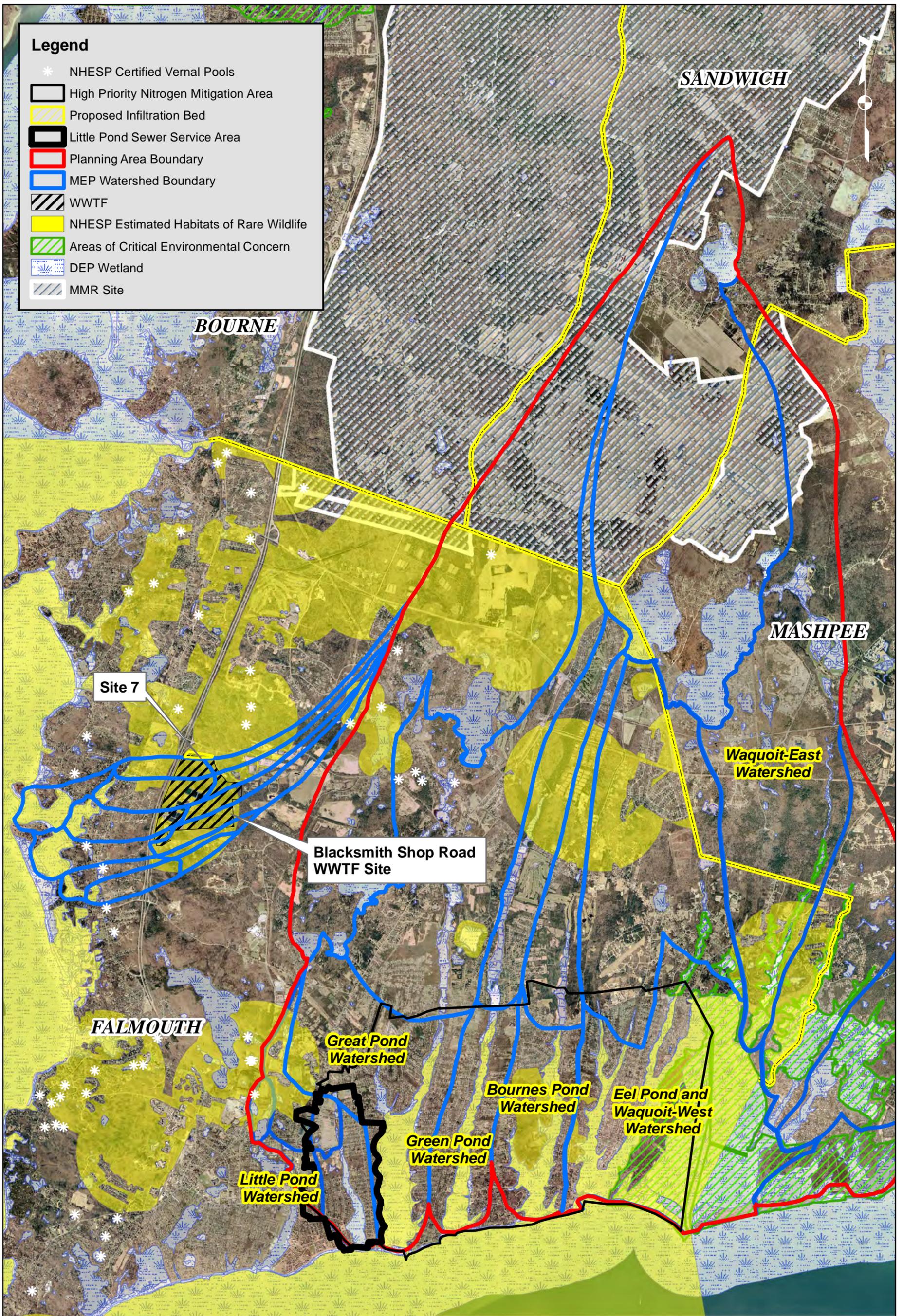
TOWN OF FALMOUTH, MA  
 CWMP

WATER RESOURCE AND HISTORIC  
 CONSIDERATIONS FOR PLANNING AREA

Job Number 86-12163  
 Revision A  
 Date 08 Jul 2013

**Figure 7-4**

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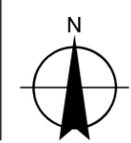
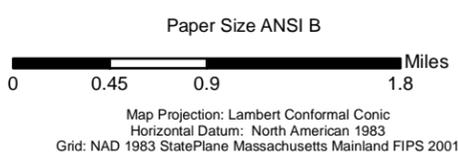
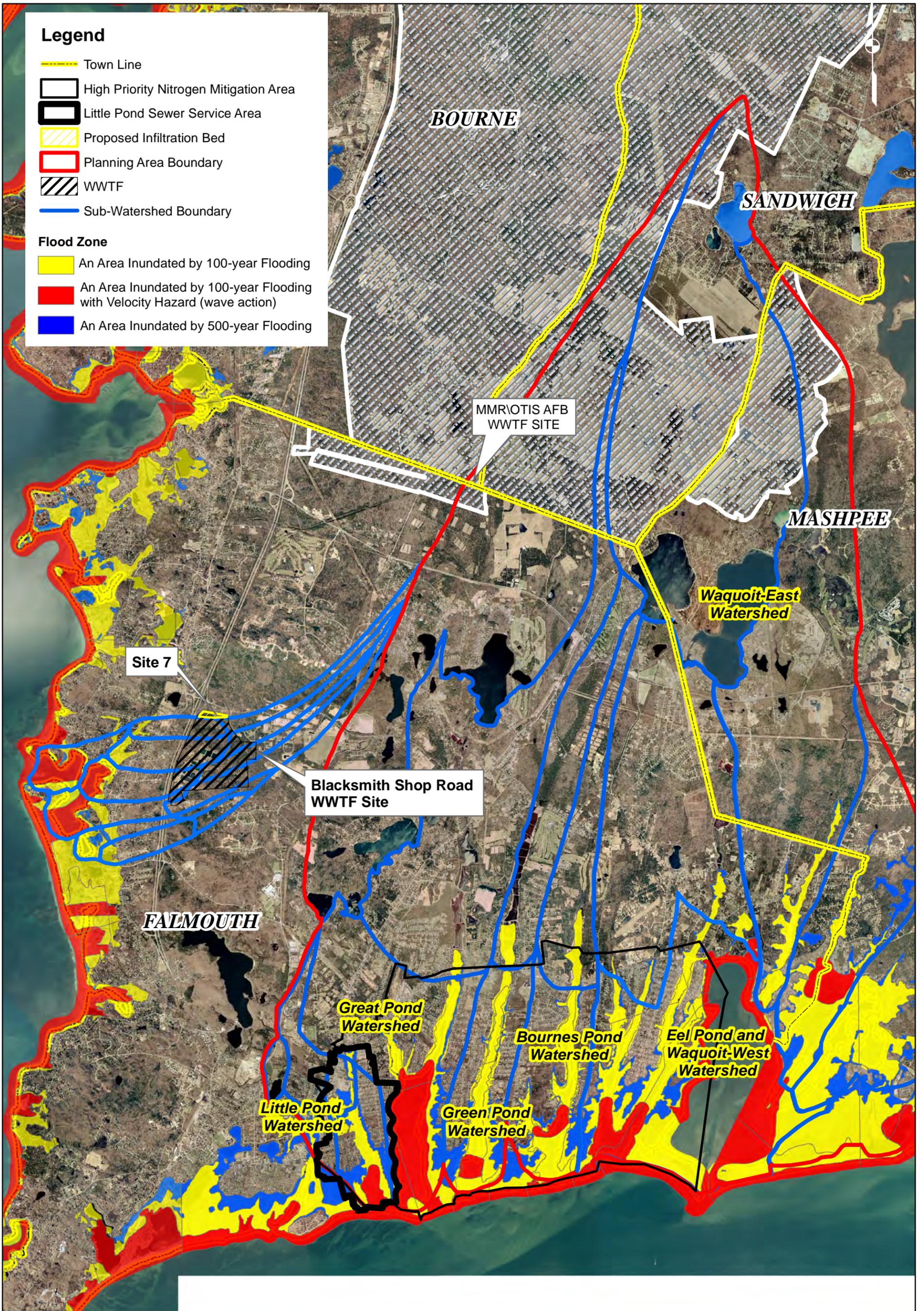


TOWN OF FALMOUTH, MA  
 CWMP

Job Number 86-12163  
 Revision A  
 Date 08 Jul 2013

SENSITIVE HABITAT AREAS

Figure 7-5



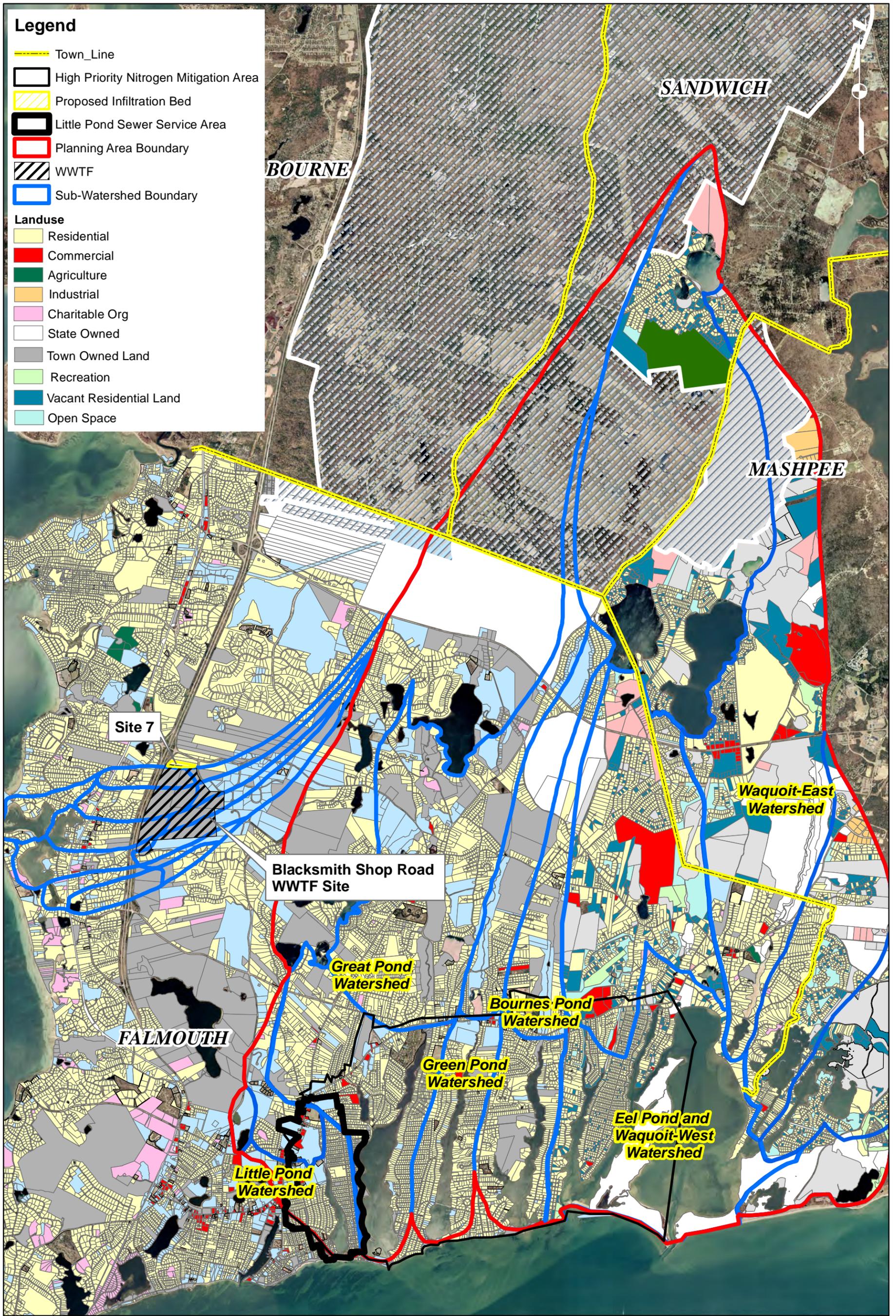
TOWN OF FALMOUTH, MA  
CWMP

Job Number	86-12163
Revision	A
Date	08 Jul 2013

FLOOD ZONES

Figure 7-6

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**Legend**

- Town\_Line
- High Priority Nitrogen Mitigation Area
- Proposed Infiltration Bed
- Little Pond Sewer Service Area
- Planning Area Boundary
- WWTF
- Sub-Watershed Boundary

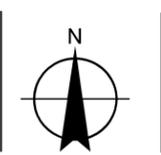
**Landuse**

- Residential
- Commercial
- Agriculture
- Industrial
- Charitable Org
- State Owned
- Town Owned Land
- Recreation
- Vacant Residential Land
- Open Space

Paper Size ANSI B

0 0.375 0.75 1.5 Miles

Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
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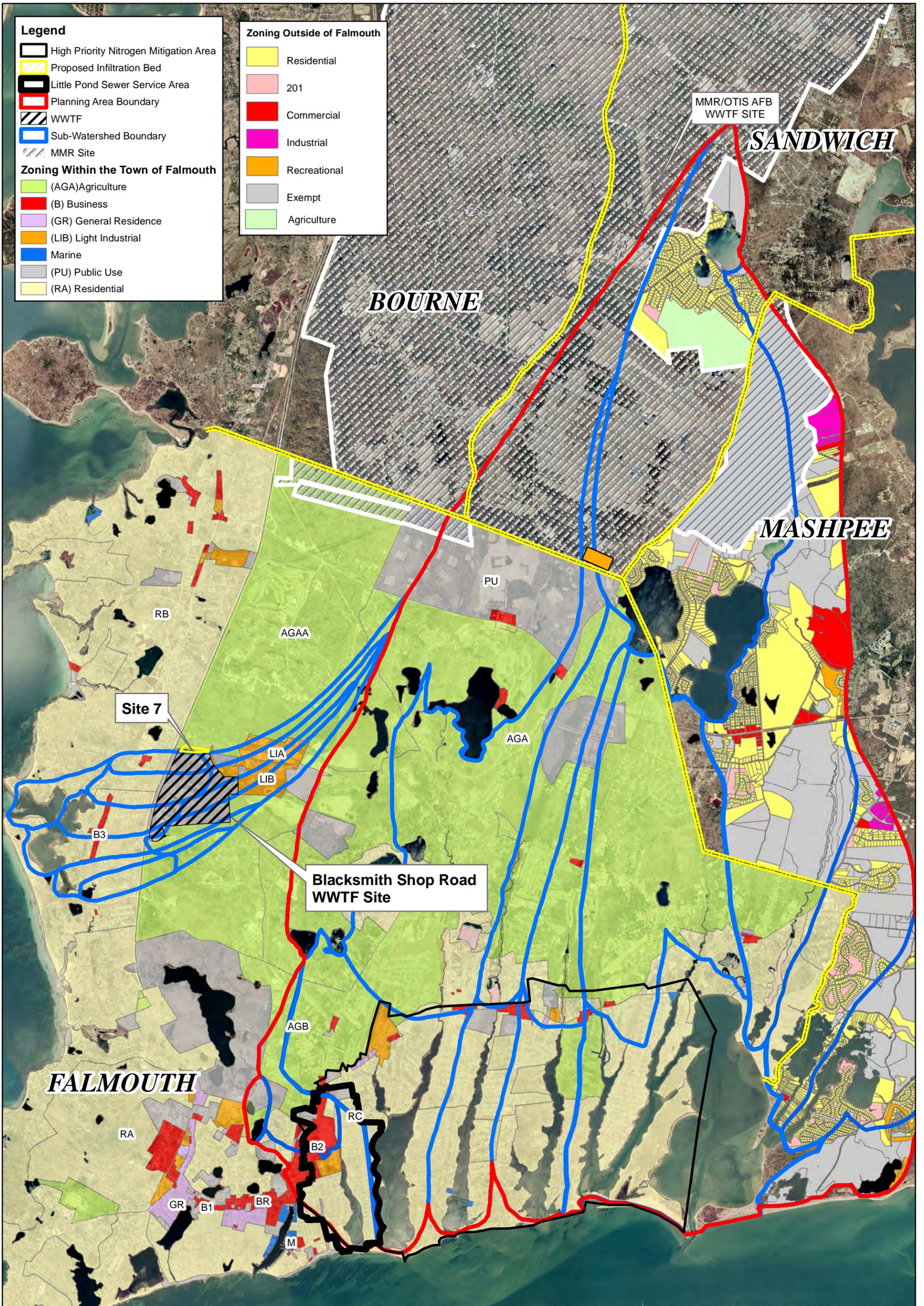


TOWN OF FALMOUTH, MA  
CWMP

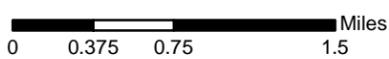
**OPEN SPACE &  
LAND USE PLANNING**

Job Number	86-12163
Revision	A
Date	08 Jul 2013

**Figure 7-7**

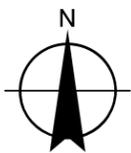


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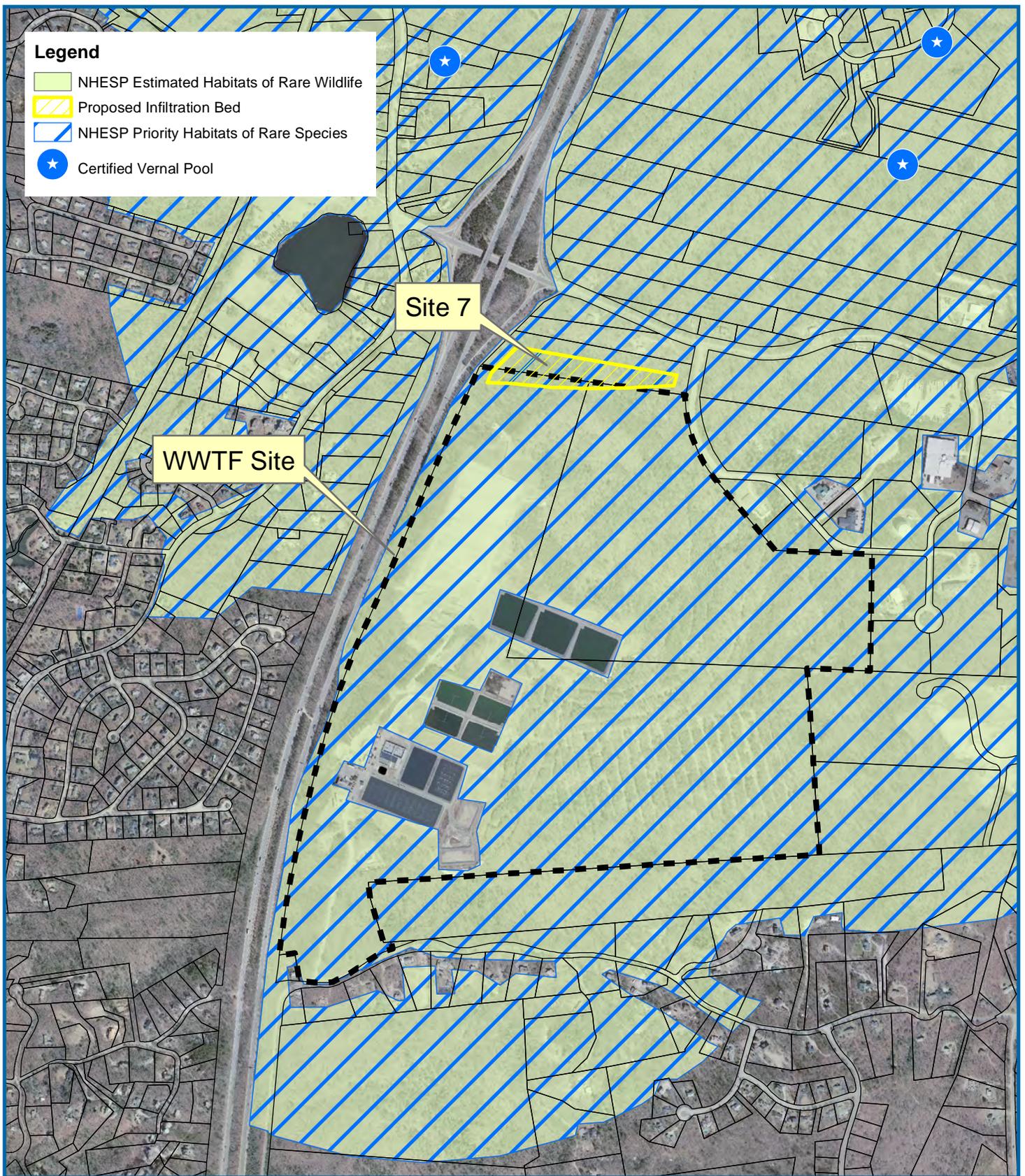
CLIENTS | PEOPLE | PERFORMANCE

TOWN OF FALMOUTH, MA  
CWMP

ZONING WITHIN  
PLANNING AREA

Job Number	86-12163
Revision	A
Date	03 Jul 2013

Figure 7-8

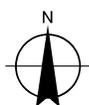


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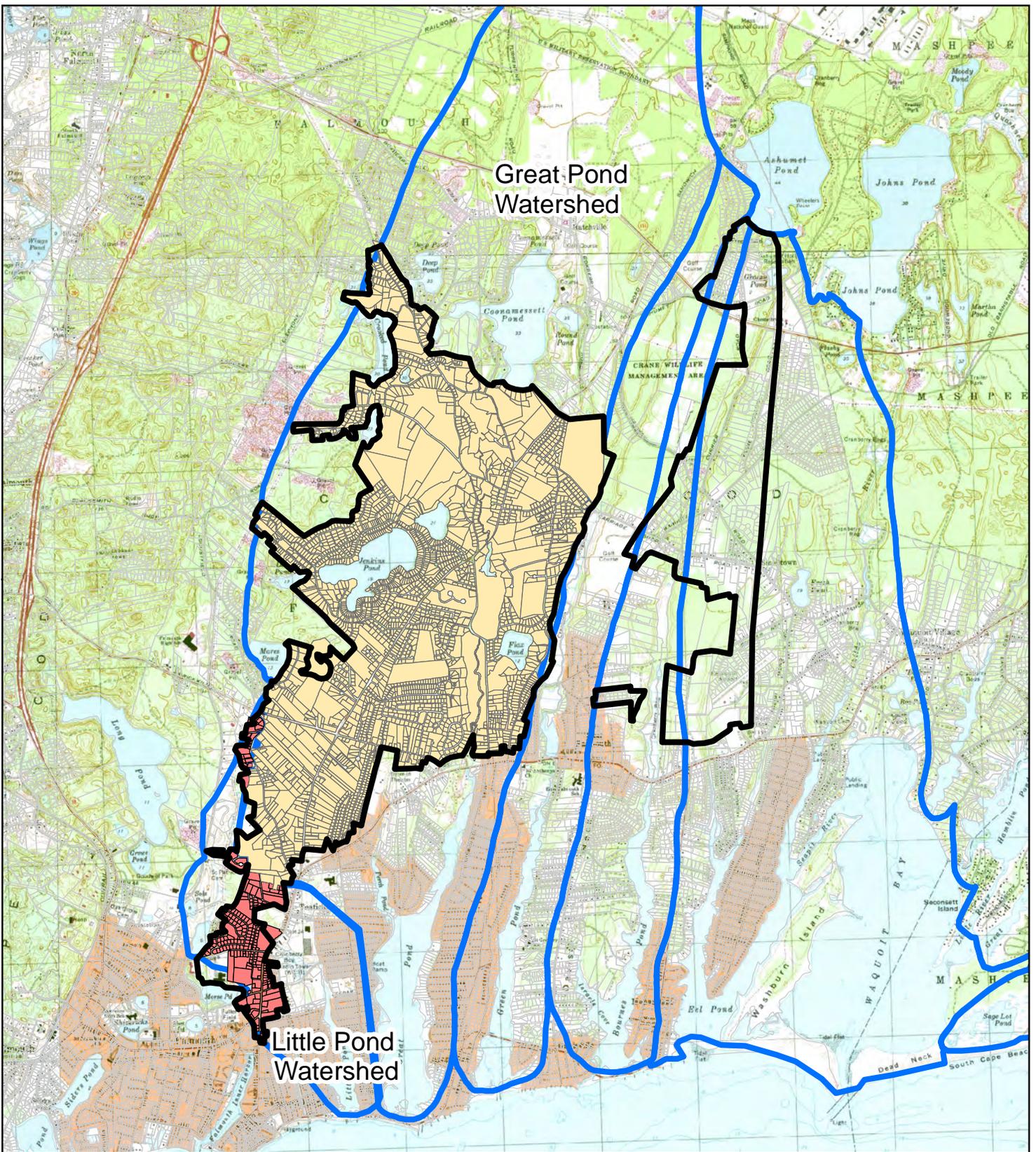


TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP  
EXISTING BLACKSMITH SHOP  
ROAD SITE & SITE 7

Job Number 86-12163  
Revision A  
Date 02 Jul 2013

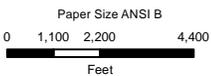
FIGURE 7-9





**Legend**

- CWQCA
- MEP Watersheds
- Great Pond CWQCA Parcels
- Little Pond CWQCA Parcels



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TOWN OF FALMOUTH, MASSACHUSETTS  
CWMP

**CONCEPTUAL WATER QUALITY  
COMPLIANCE AREA (CWQCA)**

Job Number	86-12163
Revision	A
Date	02 Jul 2013

**Figure 7-11**



## **8 MEPA Draft Section 61 Findings and Mitigation Measures**

### **8.1 Introduction**

The purpose of this Chapter is to identify and present the mitigation measures and Draft Section 61 Findings as part of the CWMP/FEIR/TWMP Document. Draft Section 61 Findings are outlined in the Massachusetts Environmental Policy Act (MEPA) Regulations 301 CMR 11.07, in accordance with M.G.L. c. 30, section 61 for all State agency actions. These regulations require that each agency, department, board, commission, and authority of the Commonwealth “review, evaluate, and determine the impact on the natural environment of all works, project or activities conducted by them and shall use all practicable means and measures to minimize damage to the environment.” The regulation also states that, “Any determination made by an agency of the Commonwealth shall include a finding describing the environmental impact, if any, of the project and a finding that all feasible measures have been taken to avoid or minimize said impact.”

The FEIR is required as part of the Certificate of the Secretary of Energy and Environmental Affairs to include a separate chapter on mitigation measures associated with the CWMP/FEIR/TWMP Document and that this chapter also includes Draft Section 61 Findings for all State agency actions. The Draft Section 61 Findings need to contain a clear commitment to implement mitigation, an estimate of the individual costs of the proposed mitigation, identification of the parties responsible for implementing the mitigation, and a schedule for the implementation of mitigation.

### **8.2 Draft Section 61 Findings for State Agency Actions**

The anticipated State agency actions are listed below. These actions summarize permits and approvals that will likely be required for implementation of the Recommended Plan.

- U.S. Environmental Protection Agency (USEPA), National Pollutant Discharge Elimination System (NPDES) Permitting Program (as applicable), under 40 CFR Chapter 1, Section 122.26 (15) for NPDES Stormwater Permit for Construction Activities and review of developed Stormwater Pollution Prevention Plan (SWPPP).
- Department of the Army, New England District, Corps of Engineers (as applicable), Permit requirement under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403); Permit requirement under Section 404 of the Clean Water Act; Massachusetts Programmatic General Permit (PGP) or Category II or III Individual Permit.
- Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) approval of the CWMP/FEIR/TWMP Document.
- Massachusetts Executive Office of Energy and Environmental Affairs approval for the land transfer between the Town of Falmouth and the Woods Hole, Martha’s Vineyard, and Nantucket Steamship Authority of what is proposed as Infiltration Site No. 7 because it is considered State (Steamship Authority) owned land. An Environmental Notification Form (ENF) filing is required and possibly an Environmental Impact Report (“EIR”) describing the environmental impacts of the Land Transfer in accordance with 301 CMR 11.02(2)(b).



- Massachusetts Department of Environmental Protection, Ground Water Discharge Permit Program, pursuant to M.G.L. c. 21 s. 43 and its regulations at 314 CMR 5.00, BRP WP 11, for facility modifications with plan approval and/or for a new effluent discharge permit.
- Massachusetts Department of Environmental Protection, Sewer System Extension and Connection Permit Program, pursuant to M.G.L. c. 21 s. 43 and its regulations at 314 CMR 7.00, BRP WP 13, 17, or 18.
- Massachusetts Department of Environmental Protection, Chapter 91 License (as applicable), pursuant to M.G.L. c. 91, the waterways licensing program.
- Massachusetts Department of Environmental Protection, Notice of Intent (NOI) Wetland Protection Act (WPA) Form 3 (as applicable) and Falmouth Conservation Commission approvals (as applicable) for work within the 100-foot buffer to a wetland, per the wetlands regulations at 310 CMR 10.00.
- Massachusetts Department of Environmental Protection, Air Quality Permits (as applicable), BWP AQ 04 - Asbestos Removal Notification that may be required for Asbestos Pipe removal and BWP AQ 06 Construction/Demolition Notification.
- Massachusetts Department of Environmental Protection, Emergency Engine and Emergency Turbine Compliance. The program applies to all new emergency or standby engines with a rated power output equal to or greater than 37 kW or emergency turbine with a rated power output less than one megawatt constructed, substantially reconstructed, or altered after March 23, 2006.
- Massachusetts Department of Environmental Protection, Air Quality Permit BWP AQ 14, 15, 16, 17 Operating Permits. These are mandated for major sources of air pollution by the Clean Air Act Amendments of 1990. Massachusetts has incorporated this program in 310 CMR 7.00 Appendix D of its Air Pollution Control Regulations. In some cases, emissions from WWTFs or odor control systems trigger this requirement.
- Massachusetts Department of Environmental Protection Bureau of Waste Site Cleanup, Filing of Utility Release Abatement Plan (as applicable), for excavation within known contaminated sites.
- Office of Coastal Zone Management (CZM) Federal Consistency Review, pre-consultation to determine applicability.
- Commonwealth of Massachusetts Department of Public Works Permit for work within State Highway Layouts. These will be required for any work along Route 28 required as part of the Recommended Plan.
- Massachusetts Division of Fisheries & Wildlife, The Natural Heritage & Endangered Species Program (NHESP), MESA (321 CMR 10.00) and/or the WPA (310 CMR 10.00) for work below mean high water line, in a fish run, or in priority or estimated habitats.
- Massachusetts Division of Marine Fisheries (DMF) as appropriate. DMF shall include consultation on potential impacts to diadromous fish species and mitigation measures as appropriate.
- Massachusetts Historical Commission (MHC) consultation/reviews for any collection system components and pump stations to be constructed outside of road right-of-ways.



- Cape Cod Commission (CCC) approval of the CWMP/FEIR/TWMP as part of the Development of Regional Impact (DRI) approval process.
- Town of Falmouth building permits for the construction of structures as part of the Recommended Plan.
- Town of Falmouth Wastewater Department for sewer connection permitting.

The assessment of impacts to the environment as they pertain to the Town of Falmouth's Recommended Plan are discussed in Chapter 7 of this CWMP/FEIR/TWMP, and the resulting planned mitigation measures are discussed in this Chapter. The following section summarizes mitigation commitments, and may be used as the basis of development of Section 61 Findings for Federal and/or State permits necessary for construction and operation of the Recommended Plan.

All mitigation measures will be funded and implemented by the Town of Falmouth, its agents, representatives, and/or contractors in addition to any State agency actions required above.

### **8.3 Planned Mitigation Measures Design and Construction**

As part of the EIR process outlined in 301 CMR 11.07, the following mitigation measures were identified. These measures were outlined and identified to limit negative environmental impacts and/or create positive environmental impacts during development and operation of the preferred plan. The schedule and costs for the implementation of mitigation are also discussed where appropriate.

#### **8.3.1 General Construction Measures**

During construction, the site(s) shall be secured to prevent unauthorized entry to the construction site, and to protect existing and adjacent facilities and properties. Supplemental lighting, signs, railings, and construction barriers shall be used as necessary to provide safety to employees, construction workers, visitors, and the general public during the construction process in accordance with Occupational Safety and Health Administration (OSHA) and other applicable regulations.

Water used during the construction process, and that generated from runoff on the site, will be controlled by proper site grading, and by providing temporary berms, drains, and other means to prevent soil erosion. These means will also be used to reduce puddling and runoff on the site. Existing and new catch basins will be protected from siltation using hay bales, siltation fence, and catch basin inserts. At no time will the pumping of silt-laden water to surface waters, stream corridors, or wetlands be allowed. Pollution controls will also be provided to prevent the contamination of soils, water, and the atmosphere from the discharge of noxious, toxic substances, and pollutants during the construction process.

Erosion control measures including hay bales, siltation fencing, and erosion control fabric will be used to provide sedimentation barriers where required. Temporary seeding and mulching may also be used to minimize soil erosion and provide soil stabilization on slopes. Diversion trenches may also be used on the uphill side of disturbed areas to divert surface runoff. Land disturbances will be kept to a minimum to reduce impacts and erosion. All erosion and stormwater control methods shall be in accordance with the USEPA National Pollution Discharge Elimination System (NPDES) General Permit requirements, Commonwealth of Massachusetts regulations, and the Town of Falmouth regulations. A Stormwater Pollution Prevention Plan (SWPPP) will be required as part of the NPDES General Permit.



The site will be maintained free of waste materials, debris, and trash following each day of work. Waste and other debris will be collected and disposed of off-site periodically. At no time during construction will the dumping of spoil material, waste, trees, brush, or other debris be allowed into any stream corridor, any wetland, any surface waters, or any unspecified location. The permanent or unspecified alteration of stream flow lines is not allowed during construction. Recycling of waste and construction debris will likely be mandated as well and should always be considered during construction.

Construction noise from heavy equipment will normally be limited to within normal operating hours of 7:00 a.m. to 5:00 p.m. Dust controls, including the use of street sweepers and/or watering trucks, will be used to minimize air-borne dust as necessary.

### **8.3.2 Sewer Expansion to Little Pond Sewer Service Area Construction**

In addition to the measures identified in the general construction section, police details and other traffic controls will be necessary to minimize traffic problems during sewer expansion construction. Detours and trucking routes will need to be identified prior to construction and these routes will need to be designed to minimize impacts to surrounding residential areas not accustomed to heavy construction and increased vehicle traffic. Construction within the Little Pond Sewer Service Area will have to allow for safe travel of both pedestrians and vehicle traffic.

Sewer extensions are planned in the road layouts to avoid impacts to animal habitats, wetlands, historic areas, or potential archaeological sites. Construction in these areas will impact traffic (vehicle, pedestrian, and bicycle) in the roadways during construction. Construction procedures for traffic control, erosion protection, dust control, noise prevention, and wetland protection will be implemented as appropriate. Use of trench boxes, bracing, and other shoring methods will be utilized to provide the necessary safety for workers and others at the construction site. To the extent practicable, any private property, including trees and vegetation, that is damaged during construction is to be repaired or replaced. All roads, both publicly and privately owned, impacted by construction associated with the implementation of the collection system shall be restored to condition safe and appropriate for vehicular traffic. Any collection system components and pumping stations to be constructed outside of road right-of-ways will be reviewed with the Massachusetts Historical Commission.

The collection system pumping stations need to be located in low-elevation areas to be able to utilize gravity pipes for collection and subsequent pumping. Wetland regulations and permitting will be followed to minimize impacts to any adjacent wetlands.

Stormwater and construction runoff will be managed through the implementation of construction SWPPPs established prior to construction and regulated under USEPA NPDES General Permits for Construction.

Areas requiring sewers located within parts of Town identified as barrier beach will have to be designed and constructed to meet specific State requirements for work within these areas (Executive Order 181), and will have the following stringent requirements for the construction of sewers on a barrier beach:

- 1) All infrastructure must be protected from coastal flood hazards.
- 2) The sewers cannot promote additional growth on the barrier beach that would not have otherwise been allowed.

Previous discussions held with Massachusetts Coastal Zone Management (CZM), the agency that upholds Executive Order 181, have identified that the water quality benefits provided by the collection



system extensions will greatly outweigh the slight risk that a catastrophic coastal hazard could damage some of the infrastructure. Collection system extensions will be designed to withstand reasonably expected coastal flood hazards; pumping stations will be designed to withstand a 100-year storm, and all pipes and equipment suitably protected from wave action. Pumping stations will be located outside of flood zones when possible and protected with a system of check valves in critical areas, and generally protected from floods and natural hazards to the extent reasonable.

The Town of Falmouth Code, Chapter 180 (Sewers and Septic Systems) includes a section (Article VII) related to growth management in the New Silver Beach Sewer Service Area. This regulation (attached in Appendix 8-1) could be used as a model for a growth-neutral approach to addressing potential growth in new sewer service areas. The Town is planning to develop a Flow Neutral regulation/bylaw for the Little Pond Sewer Service Area.

### **8.3.3 Wastewater Treatment Facility Site and Infiltration Area Improvements**

In addition to those mitigation measures identified previously, the following measures will be provided at the existing Blacksmith Shop Road WWTF and infiltration areas. The wastewater treatment system will process the wastewater collected from the Little Pond Sewer Service Area. Removal of this local source of nitrogen will significantly reduce the amount of nitrogen entering Little Pond in order to make substantial progress towards achievement of the TMDLs during the 20-year planning period.

The greatest mitigation measure is the operation of an improved advanced wastewater treatment system designed for consistent nitrogen removal to 3 mg/L total nitrogen. Improvements to the WWTF will also provide significant removal of suspended solids and BOD in the effluent. This system will increase the production of biosolids (sludge) and increase the volume of treated water recharged to the water table. The sludge will be disposed of or reused at an approved off-site facility in accordance with MassDEP guidelines. The recharge will be monitored as part of an approved groundwater monitoring plan. Odor and noise mitigation measures will also be considered as part of the final design to minimize the impacts to adjacent properties during construction and operation.

Energy efficient design features to minimize GHG release from the WWTF will be considered during preliminary and detailed design to maintain a high rating index of 50 or greater. GHG evaluations were completed as summarized in Chapter 7, Section 7.6.2 and these evaluations should be considered during design of any expansions of the WWTF. No facility expansion is planned as part of this CWMP. Future expansions should be designed to meet a rating index of 50 or higher.

The following mitigation measures will be observed to avoid or minimize adverse environmental impacts:

- The WWTF improvements will take place on a previously developed parcel (existing Blacksmith Shop Road WWTF) and in existing structures.
- Any new pumping stations will have exterior façades which will compliment and be consistent with neighborhood aesthetics.
- Vegetative screens will be employed if it is determined that they are necessary for aesthetic reasons.
- Consultation with expert agencies during the design phase and continued contact during construction if there is a resource that may be affected.



- Work will be halted if archaeological resources are uncovered during construction.
- The contractor will be required to thoroughly clean up the site before the contract is considered complete.
- Proper handling and storage of possible contaminants and hazardous substances will be required of the contractor, in addition to proper notifications.
- Access roads will be dampened to minimize construction dust if required.
- Debris will not be burned as a means of disposal.
- No construction work will normally be performed during evening, holiday, or weekend hours.
- A Resident Project Representative will be employed to ensure that the project area is kept clean and that mitigation measures are met.

## **8.4 Additional Mitigation Measures**

### **8.4.1 Response to Secretary's Certificate**

This section includes a discussion of additional items specifically identified in the Secretary's Certificate that resulted from review of the Draft Report. These mitigation measures will be implemented by the Town of Falmouth, its agents, representatives, and/or contractors in addition to any state agency actions required in Section 8.2.

### **8.4.2 Adaptive Management**

A significant additional mitigation measure will include an Adaptive Management approach. The Town of Falmouth's CWMP includes the implementation of an Adaptive Management process to consider the performance of the demonstration projects and to incorporate cost-effective non-traditional methods into the plan once they demonstrate feasibility. The Adaptive Management process will also monitor groundwater elevations, water quality, and performance at coastal embayments during construction and upon completion of the phased sewerage project. This Adaptive Management approach will enable the CWMP to be adjusted based on the monitoring results of the environmental and economic impacts associated with the construction of the new sewers in Falmouth. Coordination with MassDEP and the CCC will also be included and key factors incorporated into the Adaptive Management plan.

### **8.4.3 Climate Change Mitigation**

The following provides a broader view of mitigation measures that could be evaluated or implemented in preparation of climate change planning. Given the significance of the Town's beaches and coastal wetlands as both a tourism and revenue draw, but also as natural buffers to coastal wave action, it is in the Town's best interest to implement strategies to protect these areas from detrimental impacts associated with climate change. As presented in Lewsey et. al. (2003) and the September 2011, *Massachusetts Climate Change Adaptation Report*, several ways to protect beaches and coastal wetlands includes the following:

- Development of a Town-wide Hazard Mitigation Plan;
- Continue with long-term beach and coastal area monitoring;
- Strengthen regulations to protect ecological buffers such as coastal wetlands and estuaries;



- Use land acquisition and conservation restrictions to protect headwater streams and associated buffer areas in order to protect downstream conditions during periods of warming;
- Adapt permitting and regulatory criteria to protect and maintain natural stream flow as well as incorporate potential climate change impacts;
- Develop comprehensive land use plans which incorporate the protection of coastal natural resources such as beaches and wetlands;
- Employ land use protection tools to maintain, preserve, and restore ecological buffers; and
- Enhance engineered coastal protection systems where inland retreat or other accommodation is not an option.

As presented by Lewsey et. al. (2003), there are several ways in which the Town of Falmouth can protect shoreline residential and commercial infrastructure development, including:

- Introduce building codes that account for climate change effects such as sea level rise;
- Implement comprehensive land use planning to account for the impacts associated with sea level rise and climate change;
- Identify high hazard areas, i.e. those areas most likely to be subjected to detrimental effects of climate change such as sea level rise, and introduce regulations to phase out development in high hazard areas;
- Link coastal property insurance with construction quality, i.e. ability to accommodate sea level rise, increased flooding, more frequent storm events;
- Implement economic and market-based incentives that promote sustainable development in coastal areas and/or deter development from high hazard areas; and
- Enhance coastal protection where retreat or other accommodation is not an option.

The Town has not made final decisions on these options.

The Falmouth Board of Selectmen appointed the Coastal Resources Working Group (CRWG) and charged this Group to:

1. Identify key factors dictating the current condition of Falmouth's coastal sediment system;
2. Explore reasons for the current condition;
3. Develop future scenarios of the coastal zone based on physical processes and coastal management; and
4. Provide community outreach and recommendations concerning coastal processes and coastal management.

The CRWG was composed of volunteers with expertise in coastal geology, oceanography, coastal management, landowner issues, water quality, land use, ecology, and coastal navigation. This Group was active from May 2000 to October 2010, completing a study of Falmouth's south shore in 2003 entitled "The Future of Falmouth's South Shore" and finalizing a study of Falmouth's Buzzards Bay coast entitled "The Future of Falmouth's Buzzards Bay Shore" in 2010.