FINAL

Comprehensive Wastewater Management Plan/Single Environmental Impact Report

Town of Harwich, Massachusetts

March 2016

CDM Smith

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March 29, 2016

Secretary Matthew A. Beaton
Executive Office of Energy and Environmental Affairs
Attn: MEPA Unit
100 Cambridge St., Suite 900 (9th Floor)
Boston, Massachusetts 02114

Subject:

Final Comprehensive Wastewater Management Plan/ Single Environmental Impact Report
Town of Harwich, Massachusetts – Proponent
EEA Number: 15022

Dear Secretary Beaton:

On behalf of the Town of Harwich (Town), CDM Smith Inc. (CDM Smith) is pleased to submit this Final Comprehensive Wastewater Management Plan (CWMP) and Single Environmental Impact Report (SEIR) in accordance with the MEPA Regulations. This CWMP/SEIR is being filed concurrently with the Cape Cod Commission (CCC) for joint review pursuant to the November 1991 Memorandum of Understanding regarding joint MEPA/CCC review for Developments of Regional Impact.

The Town is pursuing a long-term, multi-phased wastewater management program with regional and centralized treatment solutions supplemented with nontraditional components to reduce nutrient loading to coastal waters, meet anticipated total maximum daily loads (TMDLs) for estuary/embayments along Nantucket Sound, and support viable smart growth in town centers. The attached Final CWMP is the culmination of planning begun in 2007 to achieve these identified goals.

In accordance with the April 12, 2013 certificate on the Expanded Environmental Notification form (EENF), the Town of Harwich and CDM Smith are pleased to submit this final document. We feel that this CWMP/SEIR addresses all of the comments raised in the certificate including the addition of the following sections to the CWMP: Environmental Impact Analysis and Mitigation, Cost Recovery Plan, Construction Management Plan, Chapter 61 Findings and a Response to Comments Section.

Please find two copies of the CWMP/SEIR attached. We look forward to continuing our coordination with MEPA on this important project. Feel free to contact Rob Musci at 617-452-6642 with questions regarding this document.

Sincerely,

David F. Young, P.E., BCEE
Vice President
CDM Smith Inc.

cc: Cape Cod Commission
Agencies and individuals identified on the attached Distribution List

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List of Acronyms

A

Adaptive Management Plan (AMP)
Administrative Consent Order (ACO)
Areas of Critical Environmental Concern (ACECs)

B

Best Management Practices (BMP)
Biochemical oxygen demand, decomposition over 5-day period (BOD)
Board of Health (BOH)
Board of Selectmen (BOS)
Bordering Land Subject to Flooding (BLSF)
Bordering Vegetated Wetland (BVW)

C

California Air Resources Board (CARB)
Cape and Vineyard Electric (CVEC)
Cape Cod Commission (CCC)
Carbon dioxide (CO2)
Citizens Advisory Committee (CAC)
Clean Water Act (CWA)
Clean Water State Revolving Fund (CWSRF)
Coastal Zone Management (CZM)
Code of Massachusetts Regulations (ma)
Colony forming units (cfu)
Community Development Partnership (CDP)
Community Preservation Act (CPA)
Comprehensive Wastewater Management Plan (CWMP)
Construction management plan (CMP)
County Home Ownership Fund (CHOP)

D

Department of Energy Resources (DOER)
Department of Public Health (DPH)
Department of Public Works (DPW)
Development of Regional Impact (DRI)
Digital elevation model (DEM)
District of Critical Planning Concern (DCPC)
Dissolved Oxygen (DO)

Diesel oxidation catalyst (DOC)
Diesel particulate filter (DPF)
Division of Fisheries and Wildlife (DFW)

E

Expanded Environmental Notification Form (EENF)
East Harwich Village Center (EHVC)
Energy Star Portfolio Manager (ESPM)
Engineering News Record (ENR)
Environmental Impact Report (EIR)
Environmental Impact Statement (EIS)
Environmental Notification Form (ENF)
Equivalent Dwelling Units (EDUs)
Equivalent Annual Cost (EAC)
Executive Office of Energy and Environmental Affairs (EOEEA)
Environmental Operating Solutions (EOS)
Environmental Results Program (ERP)

F

Fixed Activated Sludge Treatment (FAST)
Fiscal Year (FY)
Federal Emergency Management Authority (FEMA)

G

Gallons per capita per day (gpcd)
Gallons per day (gpd)
Gallons per day per inch-diameter-mile of new pipe (gpd/idm)
Geographic Information Systems (GIS)
Groundwater Discharge Permit (GWDP)

H

Harwich Ecumencial Council for the Homeless (HECH)
Housing Assistance Corporation (HAC)
Heating, ventilation, and air conditioning (HVAC)

I

Infiltration bed (IB)
Infiltration and inflow (I/I)
Innovative / Alternative (I/A)
Inter-Municipal Agreement (IMA)
Interim Wellhead Protection Area (IWPA)
Intended Use Plan (IUP)

Isolated Land Subject to Flooding (ILSF)

J

K

potassium hydroxide (KOH)

L

Lower Cape Cod Community Development Corporation (LCCCDC)
Land Subject to Coastal Storm Flowage (LSCSF)
Leadership in Energy and Environmental Design (LEED)
Licensed Site Professional (LSP)
Local Comprehensive Plan (LCP)

M

Manual on Uniform Traffic Control Devices (MUTCD)
Massachusetts Alternative Septic System Test Center (MASSTC)
Massachusetts Cultural Resource Information System (MACRIS)
Massachusetts Department of Environmental Management (MassDEM)
Massachusetts Department of Environmental Protection (MassDEP)
Massachusetts Department of Public Health (MDPH)
Massachusetts Department of Transportation (MassDOT)
Massachusetts Endangered Species Act (MESA)
Massachusetts Environmental Policy Act (MEPA)
Massachusetts Estuaries Project (MEP)
Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA)
Massachusetts General Laws (M.G.L.)
Massachusetts Historical Commission (MHC)
Massachusetts Office of Geographic and Environmental Information (MassGIS)
Maximum Contaminant Level (MCL)
Membrane Bioreactors (MBRs)
Milligrams per liter (mg/L)
Million gallons per day (MGD)
Mixed liquor suspended solids (MLSS)
Municipal Separate Storm Sewer Systems (MS4)

N

National Pollutant Discharge Elimination System (NPDES)
Natural Heritage and Endangered Species Program (NHESP)
Natural Resource Conservation Service (NRCS)
Natural Resource Protection District (NRPD)
New England Water Environment Association (NEWEA)
Nitrogen (N)

Not Applicable (N/A)
Notice of Intent (NOI)

O

Operations and maintenance (O&M)
Oxidation Ditch (OD)
Oil and/or hazardous material (OHM)

P

parts per million (ppm)
Permeable Reactive Barrier (PRB)
Photovoltaic (PV)
Pond and Lakes Stewards (PALS)

Q

R

Real Estate Transfer (RET)
Remedial Action Outcome (RAO)
Right-of-way (ROW)
Rotating Biological Contactor (RBC)

S

Safe Drinking Water Act (SDWA)
Septic Tank Effluent Gravity (STEG)
Septic Tank Effluent Pumping (STEP)
Sequencing Batch Reactor (SBR)
Single Environmental Impact Report (SEIR)
School of Marine Science and Technology at the University of Massachusetts Dartmouth (SMAST)
State Revolving Fund (SRF)
Storm Water Pollution Prevention Plan (SWPPP)

T

Technical Assistance Program (TAP)
Technical Review Committee (TRC)
Total kjeldahl nitrogen (TKN)
Total Maximum Daily Load (TMDL)
Total nitrogen (TN)
Total organic carbon (TOC)
Total phosphorus (TP)
Total suspended solids (TSS)

Trophic Status Index (TSI)

U

Ultra-low sulfur diesel (ULSD)
United States Department of Agriculture (USDA)
United States Environmental Protection Agency (USEPA) or (EPA)
United States Geological Survey (USGS)
University of Massachusetts (UMass)

V

W

Wastewater Implementation Committee (WIC)
Wastewater Management Subcommittee (WMS)
Wastewater Treatment Facility (WWTF)
Water Pollution Control Facility (WPCF)
Water Quality Management (WQM)
Water Quality Management Task Force in Harwich (WQMTF) or (HWQMTF)
Water Quality Review Committee (WQRC)

X

Y

Z

Zone of Contribution (ZOC)

Glossary

Anthropogenic – Human source of pollution.

Benthic – The lowest zone in a body of water, including the sediment surface.

Brackish – A mixture of fresh and saltwater creating water that has some salinity, but not as much as seawater.

Buildout – Allowed growth under current zoning.

Check station – Monitoring station used to check secondary water quality parameters within tributary basins at the point that the threshold level is attained at the sentinel station.

Economies of scale – The cost advantage of systems due to the increased size, output, or scale of operation.

Eelgrass – Type of plant that grows within embayments. Eelgrass serves as an indicator of the health of a waterbody. The presence of eelgrass is an indicator of healthy water quality.

Effluent – Treated wastewater that discharges from a wastewater treatment facility.

Embayment/subembayment – Waterbody formation in the shape of a bay. Embayments are further divided into subembayment areas.

Enterococci – Type of bacteria that is used as an indicator of the health risk from recreational contact of water bodies. Enterococci testing is particularly useful in saltwater applications.

Estuary – A partially enclosed brackish water body.

Eutrophic – Poor water quality. A water body have high levels of nutrients including phosphorous and nitrogen.

Eutrophication – Caused by high levels of nutrients in water bodies. Eutrophication leads to oxygen depletion and subsequent negative environmental impacts such as fish kills and increased algal growth.

Hypereutrophy – Classification of a water body which has extremely high levels of nutrients.

Infaunal – Aquatic species whose habitat is below a water body’s floor.

Kettle pond – A shallow body of water that was formed by receding glaciers or draining floodwaters.

Lens – The layer of fresh groundwater that lies on top of denser saltwater.

Marsh – Type of wetland. Plant life in marshes are dominated by herbaceous species as opposed to woody plant species.

Mesotrophic – Moderate water quality. A water body with a moderate level of nutrients present.

Mesotrophy - Classification of a water body which has moderate levels of nutrients.

Natural attenuation – The process by which the concentration of nitrogen in a water body is reduced by conversion to nitrogen gas, sediment absorption, and other biological processes when nitrogen-inundated water passes through natural systems such as streams, rivers and ponds.

Nitrogen – Typically the limiting nutrient for plant growth in estuarine waterbodies. The increased presence of nitrogen in saline and brackish waterbodies can lead to oxygen depletion, eutrophication and overall decline in water quality.

Nutrients – Integral components for plant growth, typically including nitrogen and phosphorus.

Oligotrophic – Good water quality. Water bodies with low algal production due to low levels of nutrients.

Oligotrophy – Classification of a water body which has low levels of nutrients.

Phosphorus – Type of nutrient. Phosphorus is a limiting nutrient for plant growth, typically in freshwater bodies.

Sentinel station – A monitoring station located within an estuary that acts as the indicator location for restored water quality, following established TMDL compliance within that estuary.

Smart Growth – Desired growth in focused areas supported by appropriate infrastructure (water and wastewater utilities, transportation, etc.)

Title 5 – Code within the Massachusetts State Environmental Code that regulates septic systems and disposal of sanity sewage.

Watershed/subwatershed - Contributing land area, including all associated surface and groundwater resources, to a water body. Watersheds are further divided into subwatershed areas, or sub-areas of land within a watershed.

Executive Summary

The Town of Harwich has been working diligently to develop a program to address wastewater management needs, protect drinking water sources, protect freshwater ponds, and restore valuable saltwater estuaries. Protection and restoration of these valuable water resources is extremely important to maintain the quality of life and economic wellbeing of the Town. Since 2007, these efforts have been coordinated predominantly by the Wastewater Implementation Committee (WIC) and the Board of Selectmen (BOS). The resultant recommended program for implementation by the community over the next 40 years is summarized in this Comprehensive Wastewater Management Plan (CWMP).

ES.1 Introduction

Purpose and Background

The Town of Harwich has undergone significant growth in the past 50 plus years. That growth has resulted in various water quality issues that must now be addressed. The population of Harwich increased nearly 400 percent from 1951 to 1999 as shown in **Figure ES-1**. As of 2012, the number of year- round residents is about 12,700 with an estimated seasonal increase to 37,000. With the exception of a few small package wastewater treatment facilities, the Town of Harwich does not have a municipal wastewater collection and treatment system.

In the past few years, nitrogen related issues have become a driving force in influencing several Cape Cod communities to begin considering wastewater programs. The Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), working through the Massachusetts Department of Environmental Protection (MassDEP) and the University of Massachusetts-Dartmouth School

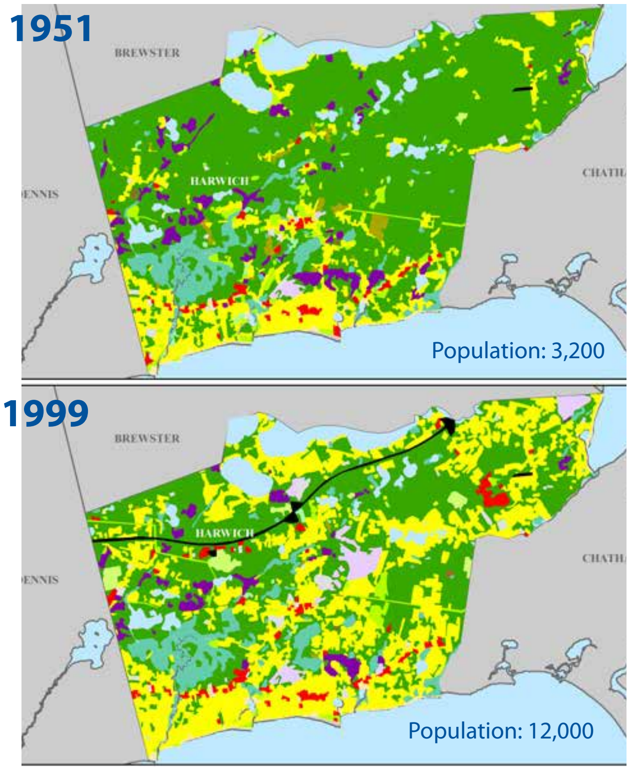


Figure ES-1
Harwich Land Use Development in 1951 and 1999

for Marine Science and Technology (SMAST), has been working with Coastal Zone Management, the Cape Cod Commission (CCC), and several municipalities to determine the nitrogen sensitivity of southeastern Massachusetts' coastal embayments and estuaries, an effort referred to as the Massachusetts Estuaries Project (MEP).

The recommended wastewater management program put forth in this CWMP is a guide for the Town to follow based on current conditions and regulations. Should the Town desire to make changes to the program in the future based on water quality monitoring feedback, changing community interests or other pertinent factors, it may do so using the appropriate regulatory review procedures.

Environmental Review Process

This CWMP has been prepared and submitted as part of an Environmental Impact Report (EIR) to the Massachusetts Environmental Policy Act (MEPA) Unit of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). An Environmental Notification Form (ENF) was submitted as part of the Draft CWMP in 2013 and that draft report received extensive review comments from MEPA in a Certificate issued on April 4, 2013. This Final CWMP addresses all of the MEPA comments. This Final CWMP and Single EIR is undergoing a joint review with the CCC. Once the Final MEPA certificate is issued, this document will then undergo additional review by the CCC as a Development of Regional Impact (DRI) and for consistency with the county's wastewater plan.

ES.2 The Issue Harwich is Facing

Key Drivers

Harwich, for the most part, has relied upon traditional Title 5 on-site septic systems for its wastewater management. However, with the growth experienced throughout the Town over the past 50 years, the nitrogen leaching from those on-site systems into the groundwater has resulted in negative impacts to valuable saltwater estuaries and embayments. Those negative impacts are affecting the quality of life of Harwich residents and are beginning to impact the tourist economy the Town relies on. Thus, addressing the nitrogen issue is the key driver in developing the CWMP. The Massachusetts Estuaries Project helped analyze the issues in the five Harwich embayments

All water resources need to be addressed, however, as development has shown some early signs of impacting water quality of both drinking water and freshwater ponds. Impacts to existing Title 5 septic system compliance and providing appropriate wastewater management for desired economic development are also of concern. Lastly, taking advantage of regional opportunities for wastewater management can help take advantage of economies of scale. Each of these issues is a driver in the Town's revised approach to a more comprehensive wastewater management program. These drivers are briefly discussed below.

MEP Results

Since 2002, the MEP has developed and published a series of reports that assess the nature and extent of nutrient influence within the studied saltwater embayments. Results of these assessments will require Wastewater Management Authorities (WMA) in municipalities to remediate excessive nutrient input to restore water quality in estuaries, largely through expanded wastewater management.

Conclusions from the MEP reports include nitrogen loadings, and reduction percentages of nitrogen loading required to meet established thresholds in the MEP watershed reports. These thresholds were reviewed by the Massachusetts Department of Environmental Protection (MassDEP) and have been, or are being turned into, enforceable nitrogen Total Maximum Daily Load (TMDL) permits that the Towns will be required to meet for each impacted watershed.

All five of the Harwich MEP report evaluations have been published:

1. **The Allen, Wychmere and Saquatucket Harbor reports** – Combined into one report and published in June 2010

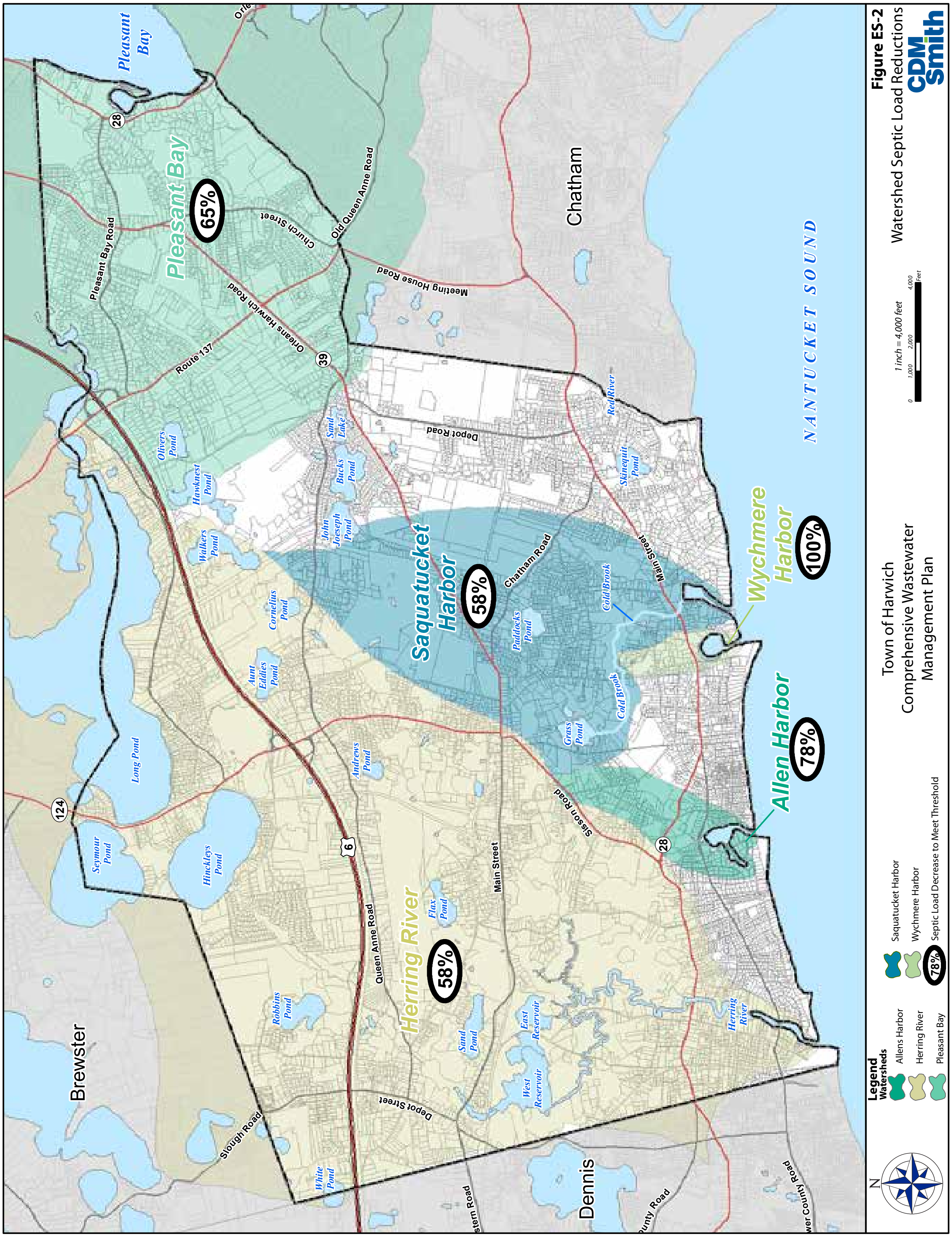


Figure ES-2
Watershed Septic Load Reductions

2. **The Pleasant Bay Report** – Published May 2006 with two technical memorandum updates in 2010

3. **The Herring River Report** – Published March 2013

Figure ES-2 presents the MEP Watersheds in Harwich with the percent of buildout septic system nitrogen required to be removed to meet the TMDL.

Allen Harbor – 78% Reduction in Septic Nitrogen

The MEP report identified the Allen Harbor estuary as a moderate-to-significantly impaired system beyond its natural capacity to process additional nutrients without further degrading ecological health. While eelgrass is typically an indicator species of overall health, there is no evidence that the basin has ever supported it in this man-made harbor.

Allen Harbor Algae Bloom, Summer 2007

Total septic system nitrogen loading to Allen Harbor must be reduced by 78percent in order to restore ecological conditions in the harbor and meet the MEP established threshold of 0.50 mg/l total nitrogen to support healthy infaunal habitat.

Wychmere Harbor – 100% Reduction in Septic Nitrogen

The MEP report identified the Wychmere Harbor as moderate-to-significantly impaired and beyond its natural capacity to process additional nutrients without further degrading ecological health. While eelgrass is typically used as an indicator species of overall health, there is no evidence it ever existed historically in Wychmere Harbor since this is a man-made harbor.

Total septic system nitrogen loading to Wychmere Harbor must be reduced by 100percent in order to restore ecological conditions in the harbor and meet the MEP established threshold of 0.50 mg/l total nitrogen to support healthy infaunal habitat.

Saquatucket Harbor – 58% Reduction in Septic Nitrogen

The MEP report identified the Saquatucket Harbor estuary as a moderate-to-significantly impaired system beyond its natural capacity to process additional nutrients without further degrading ecological health. While eelgrass is typically an indicator species of overall health, there is no evidence that the basin has ever supported it in this man-made harbor.

The Saquatucket system was modeled with the understanding that the Cold Brook would be modified to increase natural nitrogen attenuation (reduction) through possible flora and physical restructuring of this system to maximize the residence time of groundwater in the system. With the enhanced attenuation, total septic system nitrogen loading to the Saquatucket Harbor must be reduced by 58percent to restore ecological conditions in the harbor and meet the MEP established threshold of 0.50 mg/l total nitrogen to support healthy infaunal habitat. Without the increase in natural nitrogen attenuation the total septic nitrogen reduction at buildout would be around 65 percent.

Pleasant Bay – 65% Reduction in Septic Nitrogen

Water quality within the Pleasant Bay system varies from healthy to degraded, depending on the level of nitrogen enrichment at a particular location. For the purposes of assessing water quality indicators, Upper Muddy Creek and Round Cove were classified as small enclosed basins and received similar results for key habitat indicators, while Lower Muddy Creek was categorized as a moderate sized tributary sub-embayment.

The Pleasant Bay system was modeled with the understanding that the current inlet to the Muddy Creek would be expanded to increase flushing by using a larger, 24-foot opening. By increasing the natural tidal flushing, the residence time of harmful nutrients (such as nitrogen) in the bays and estuaries can be significantly reduced. The result is an overall reduction in exposure to nitrogen which benefits both the benthic animal populations and eelgrass in terms of overall health.

Eel Grass in 2006 (above) and 2013 (below)

With the updated opening in Muddy Creek, total septic system nitrogen loading to the Pleasant Bay subwatersheds in Harwich must be reduced by 65percent in order to meet the MEP established threshold of 0.21 mg/l (Lower Muddy Creek) for total nitrogen to support a healthy habitat.

Herring River – 58% Reduction in Septic Nitrogen

The MEP report identified the Herring River system as one of the largest tidal wetland systems on Cape Cod. It functions essentially as two systems. North of Route 28 is a wetland-dominated habitat of salt marsh and tidal channels which is considered to be a healthy ecosystem. South of Route 28 is an historic eelgrass habitat supporting benthic animal community's characteristic of more open water basins. This lower tidal reach is significantly impaired. The ecological difference between the two systems results in a greater sensitivity to nitrogen in the lower tidal river area. That greater sensitivity impacts the whole watershed.

Total septic system nitrogen loading to the Herring River watershed must be reduced by 58percent in order to restore ecological conditions in the estuary and meet the MEP established threshold of 0.48 mg/l total nitrogen to support healthy infaunal habitat and eelgrass in the lower tidal basin.

CDM Smith

MEP Watershed	Threshold Septic Load (kg/day)	Present Day Loading		Buildout Scenario Loading	
		Present Septic Load (kg/day)	Septic Load Decrease to Meet Threshold (% change)	Buildout Septic Load (kg/day)	Septic Load Decrease to Meet Threshold (% change)
Allen Harbor	1.48	5.64	74%	6.71	78%
Wychmere Harbor	0.00	3.21	100%	3.30	100%
Saquatucket Harbor	5.28	13.25	60%	12.51	58%
Pleasant Bay (Round Cove)	1.87	5.18	64%	5.78	68%
Pleasant Bay (Muddy Creek)*	6.89	13.32	48%	16.28	58%
Pleasant Bay	6.51	16.69	61%	21.84	70%
Herring River	23.75	38.59	38%	56.59	58%
Loading information according to Table 2 of the October 5, 2010 MEP Technical Memo: MEP scenarios to evaluate water quality impacts of the addition of a 24-foot culvert in Muddy Creek inlet.					
Values in RED indicate that the value is above the threshold and must be reduced.					

Table ES-1
Decrease in attenuated septic system nitrogen loading required at buildout to meet established TMDL thresholds.

Table ES-1 below presents the decrease in attenuated septic system nitrogen loading required at buildout to meet established TMDL thresholds.

The MEP reports present nitrogen loads under present conditions and at buildout conditions. Buildout essentially has no timeline but reflects the maximum nitrogen loading that can be generated in that watershed under current or proposed zoning. The CWMP presents a plan that removes sufficient nitrogen at buildout to meet the proposed TMDL for each embayment. The percent removal by watershed is shown for present and buildout conditions in Table ES-1. Each watershed at present conditions requires nitrogen removal to meet the TMDL so any nitrogen resulting from future growth must be removed.

Drinking Water Supplies

Municipal drinking water supply is generally available throughout the Town using source water from 14 gravel packed groundwater supply wells. Wellfields are located in southeast, northeast and northwest areas of Harwich, which draw water from the Monomoy Lens Aquifer. A small percentage of properties (approximately 7percent or about 250 properties) use private onsite wells for drinking water. Therefore, all of Harwich's residents and businesses are reliant on the groundwater supply for drinking water, whether through public or private sources of supply.

Figure ES-3 shows the municipal well zones of contribution and Zone IIs located in Harwich. Drinking water quality data to date has shown that nitrate concentrations in the Town's drinking water wells are relatively low at around 1.0 mg/l nitrate. Some Town wells in the Pleasant Bay watershed have recently been over 2.0 mg/l nitrate which indicates greater density development in their contributing areas since concentrations above 1.0 mg/l nitrate are considered above background levels. Overall the quality of Harwich drinking water is excellent and well below the 10.0 mg/l nitrate drinking water standard. Note that standard is well above the typical healthy estuary threshold value of 0.5 mg/l nitrate. As a result, protection of Town drinking water wells is not considered a significant driver for sewering a given area.

While the locations of public water supply wells in Harwich do not drive a need for sewering in any particular area of the Town, a reduction in onsite septic system inputs into the groundwater, especially in well zones of contribution, will result in a beneficial reduction of all of the compounds and contaminants contained in wastewater effluent. These include nutrients such as nitrogen and phosphorus, bacterial and viral constituents, and contaminants of emerging concern (CECs) such as pharmaceuticals and personal care products.

Hinkley Pond Algae Bloom
June 2009

Freshwater Ponds

The CWMP summarizes water quality data and the health status of freshwater ponds in Harwich for which data were available. An overabundance of phosphorus is the main concern in most freshwater systems, as phosphorus is typically the nutrient in limited supply. Therefore, an increase in phosphorus can result in significant plant and algae growth, which can cause a shift in health status from oligotrophic (healthy), to mesotropic (fairly healthy), to eutrophic (over-enriched, degraded) conditions.

Four ponds in Harwich were identified as eutrophic or at risk of moving toward a eutrophic condition. Table ES-2 summarizes the ponds considered and notes those where phosphorus over-enrichment is a concern for the health of the ecosystem via its health (trophic) status, and further notes where development (thus onsite systems) is the primary potential cause for concern. Figure ES-4 presents the information shown in Table ES-2.

Figure ES-4 also shows three specific developed areas around Paddocks Pond, John Joseph Pond, Bucks Pond, Sand Lake, Long Pond, Seymour Pond and Hinckleys Pond that are highlighted as areas of potential concern for pond health. Additional areas may be included at a later date, but at this time, the Town has identified these as the areas that need further study. Long Pond was recently treated for phosphorous with good results to date.

Name	Pond Trophic Status	Shoreline Development
Andrews Pond	Oligotrophic	Low
Aunt Edies Pond	Mesotrophic	Low
Bucks Pond	Oligo-mesotrophic	Med. to High
Cornelius Pond	Eutrophic	Low
Flax Pond	Oligo-mesotrophic	Low
Grass Pond	Meso-eutrophic	Low
Hawksnest Pond	Oligotrophic	Low
Hinckleys Pond	Eutrophic	Med. to High
Island Pond	*	*
John Joseph Pond	Mesotrophic	Med. to High
Littlefields Pond	*	*
Long Pond	Mesotrophic	Med. to High
Oilvers Pond	*	*
Okers Pond	*	*
Paddocks Pond	*	*
Robbins Pond	Mesotrophic	Low
Sand Pond	Mesotrophic	Low
Seymour Pond	Mesotrophic	Med. to High
Skinequit Pond	Eutrophic	Med. to High
Walkers Pond	Mesotrophic	Low
West Reservoir	*	*
White Pond	Oligo-mesotrophic	Low

Note: (*) No data available. Red Fields indicate impaired water quality.

Table ES-2
Freshwater Quality and Associated Health Status

Title 5

Areas along the southern coast and south of Route 28 represent challenges for long-term wastewater management. Dense development on small size lots and shallow depth-to-groundwater limit the ability to design and construct onsite system upgrades in compliance with Title 5 and local Board of Health regulations.

One of these areas is located east of Allen Harbor along Nantucket Sound and is known locally as "the Campgrounds." It generally consists of small lots with a significant percentage of seasonal occupancy. The other area is located along Route 28 north of Allen Harbor and was flagged primarily due to high groundwater conditions and the presence of mounded septic systems. Both of these areas were incorporated into the recommended plan.

The new Monomoy Regional High School is located at the site of the existing Harwich High School. This area is in the Saquatucket Watershed. Location of the septic system for the new larger school has been coordinated so that it was constructed in the Grass

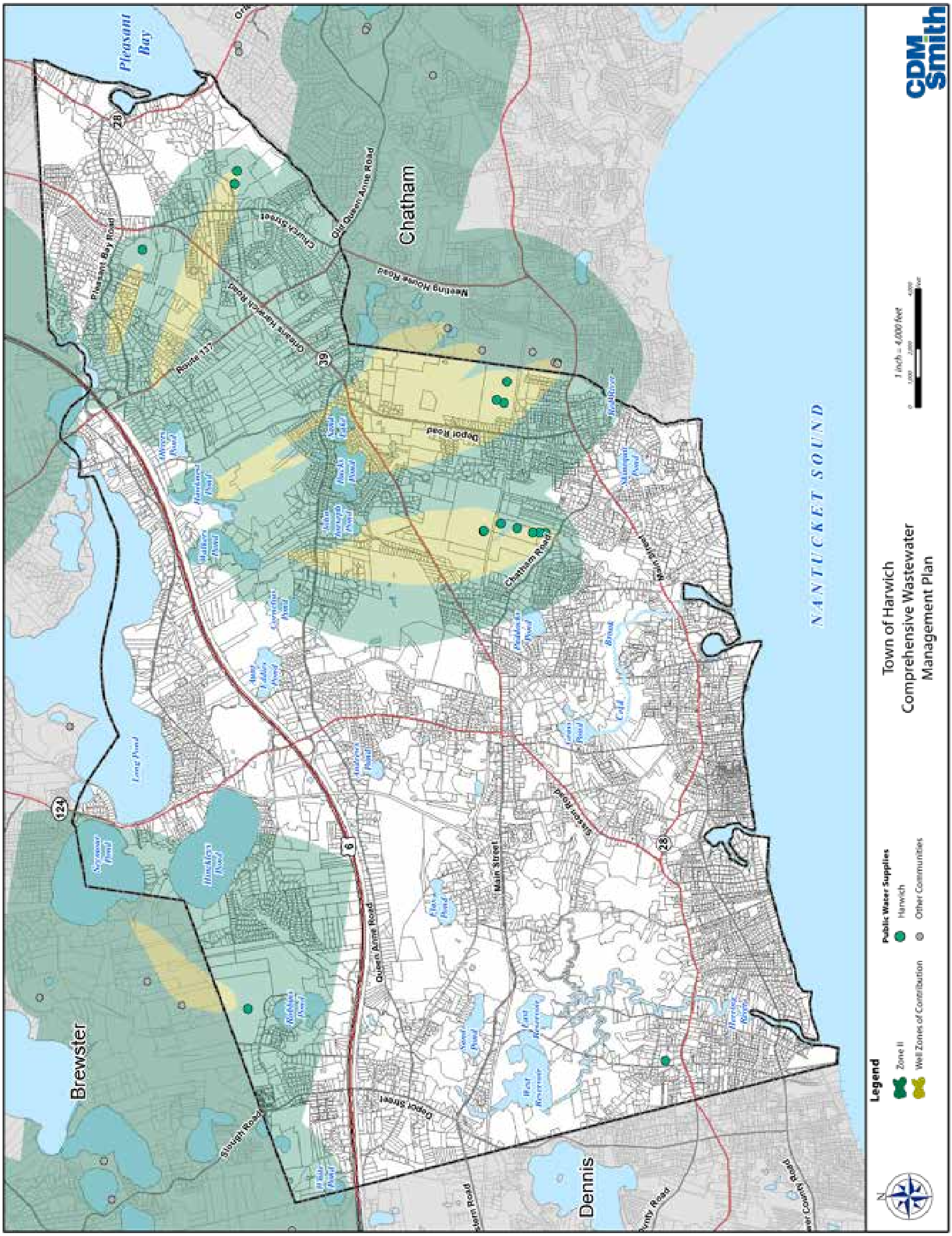


Figure ES-3
Municipal Wells

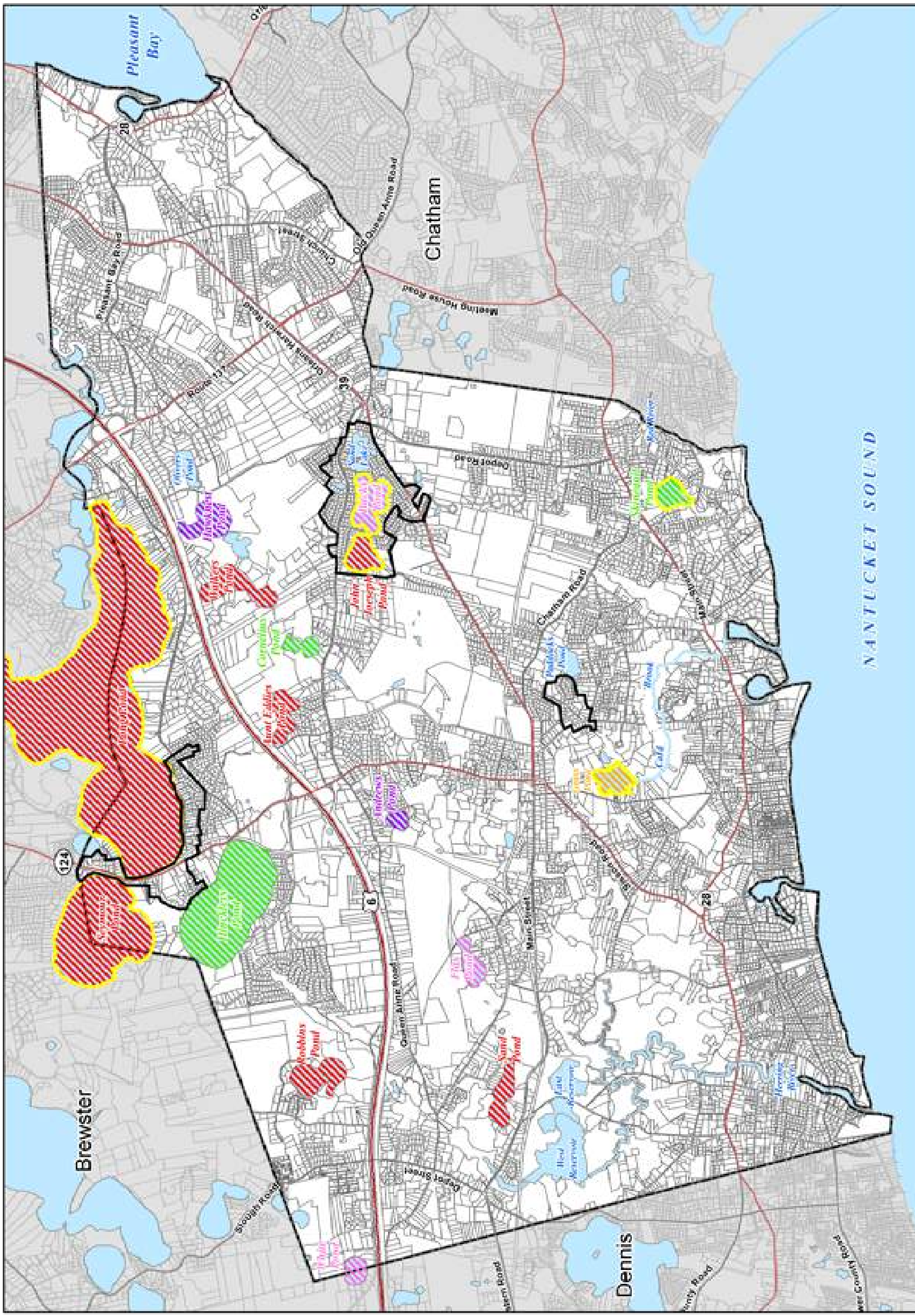


Figure ES-4
Freshwater Ponds

Pond subwatershed. That maximizes the amount of natural nitrogen attenuation as the groundwater flows through the down gradient freshwater ponds minimizing nitrogen impacts in Saquatucket Harbor. The nitrogen load from this new Title 5 septic system has been factored into the sewer system layout to meet the TMDL for the overall watershed. Due to its relatively small nitrogen load and physical location in the watershed, this wastewater system is not part of the proposed sewer service area for the Saquatucket watershed. If conditions change in the future, it could be connected to the adjacent sewers in the Herring River Watershed once they are constructed.

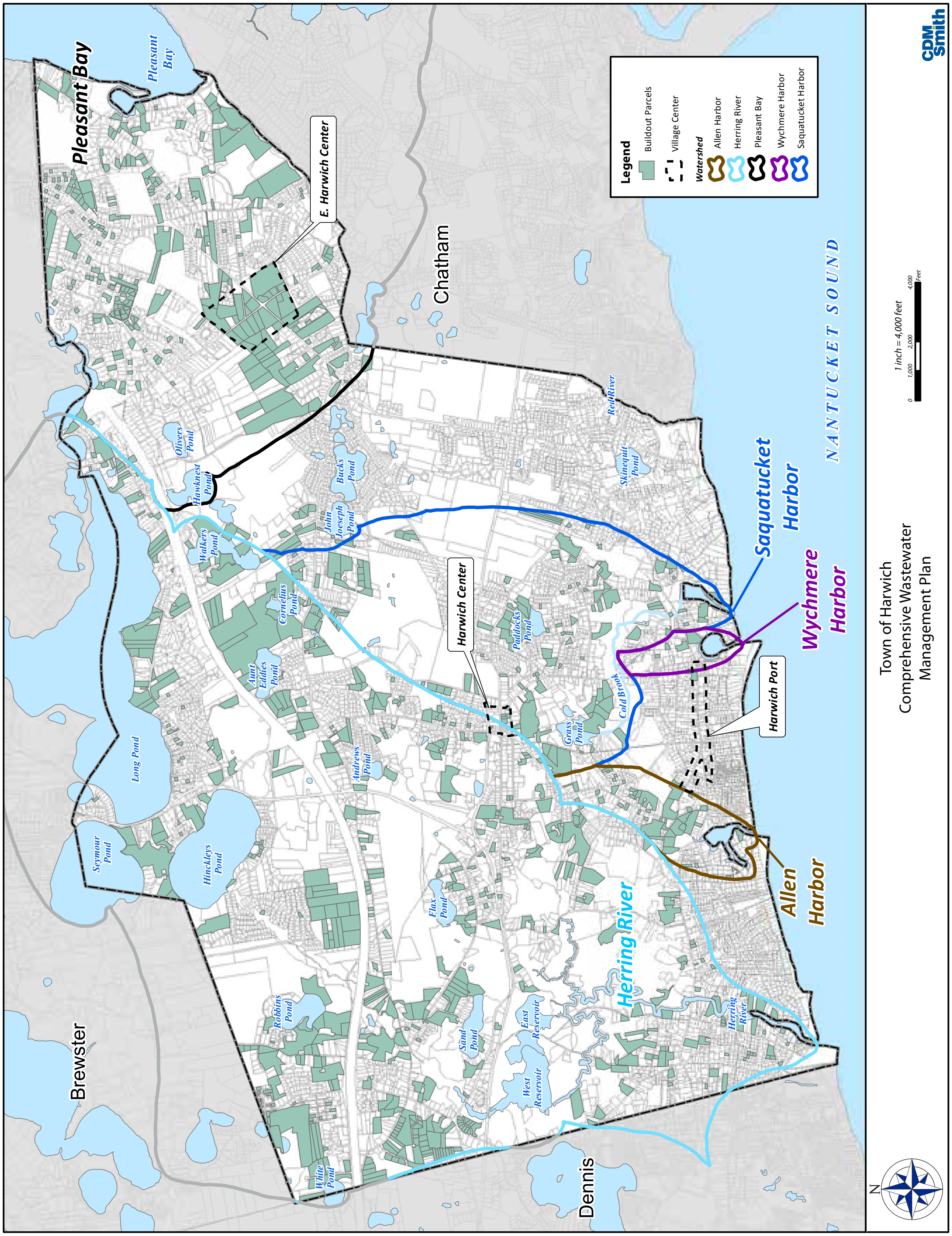
Economic Development

Growth and economic development are necessary components of any vibrant community. Harwich's preferred approach to growth management is to promote planned growth in targeted areas that enhance pedestrian culture and offer a positive experience for both residents, business owners, and visitors. Focusing growth in concentrated areas that include the appropriate supporting infrastructure (utilities, transportation, etc.) is a "smart growth" approach that allows for better protection of natural resources in Town. As such, Harwich has designated three "villages" in Town where planned growth and economic development are desired. These areas are the commercial districts known as the East Harwich Village Center, Harwich Port, and Harwich Center. Each of these areas has been undergoing independent planning for development and redevelopment appropriate to the character of the particular area.

Figure ES-5 shows the locations of the village centers. All of these areas are proposed for inclusion in the wastewater management program developed as part of this CWMP since higher density development is being proposed in each location.

ES.3 The Proposed Harwich Solution

The Town of Harwich evaluated several alternative solutions to addressing their water quality issues and presented them in the Draft CWMP in February 2013. Potential solutions included innovative and alternative (I/A) on-site treatment systems, package treatment systems, advance centralized treatment systems, permeable reactive barriers, an ocean outfall, natural nitrogen attenuation systems, regional solutions and many more. Those infrastructure systems were combined with non-infrastructure components to supplement means for reducing nitrogen and phosphorus loads. The Draft Recommended Program was presented in the Draft CWMP and comments from regulatory reviewers and local citizens were received. As described below, the Cape Cod Commission later that year began to develop a regional plan that considered a wide range of potential solutions. Many of those solutions had already been evaluated in the Draft CWMP but this report further considers some of those potential nutrient removal components.



Figures ES-5
Economic Centers and MEP Buildout parcels

Cape Cod Commission 208 Plan

In 2013, MassDEP directed the Cape Cod Commission (CCC) to prepare an update to the 1978 Water Quality Management (WQM) plan for Cape Cod to address the degradation of Cape Cod's water resources from excessive nutrients, with a primary focus on nitrogen. With this directive, the Massachusetts Water Pollution Abatement Trust committed to provide the CCC with $3.35 million to fund an update to the 1978 plan in accordance with Section 208 of the Federal Clean Water Act, referred to herein as the "208 Plan." The updated 208 Plan was developed as a resource to help communities better understand how to manage the TMDL thresholds established by the MEP reports.

In 2014, the Draft 208 Plan was released for comment and input by the CCC. This new plan is a watershed-based approach focused on the restoration of embayment water quality on Cape Cod. Unlike the 1978 plan which focused on water supply, this new plan refocuses its efforts on wastewater and recommends strategies, regulatory reforms and processes for communities to reduce or eliminate excess nitrogen. The plan is actually a framework that is designed to help each individual community on the Cape develop a strategy that fully meets the environmental goals set forth by the MEP and MassDEP.

The 208 Plan presents possible solutions at scales appropriate for on-site, neighborhoods, watersheds and Cape-wide. It also presents them in terms of nutrient reduction (treatment before disposal to ground), remediation (treatment in groundwater) and restoration (treatment in water body). The 208 Plan does a nice job of explaining the potential solutions and how they might work. It is a wonderful education document for communities to use in determining what set of solutions or strategy to use to solve their own community's needs. The Final 208 Plan approved by the Commonwealth in June 2015 and EPA in September 2015 also included some times for each community by watershed to develop and submit programs to meet the TMDL for the given watershed. That first submittal deadline is June 2016.

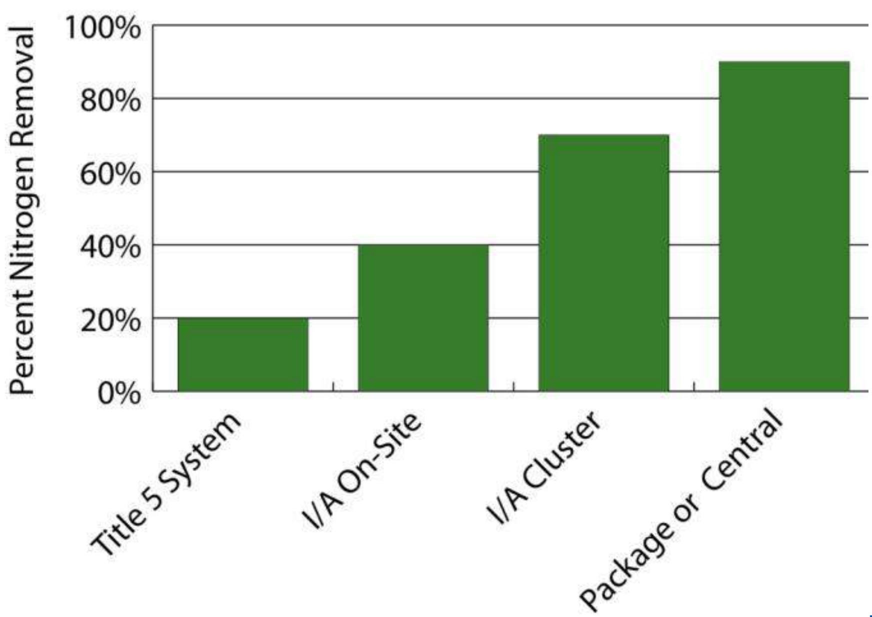
The Harwich Final CWMP/SEIR fully meets the requirements put forth in the 208 Plan, since Harwich's approach is based on the MEP nitrogen loading models with the goal of achieving the most cost-effective sewershed footprint while keeping costs to a minimum. The Town's wastewater scenarios use a hybrid approach similar to those suggested in the 208 Plan, combining both traditional and non-traditional technologies with an iterative process to develop the most cost-effective recommended plan with the intent of continually revisiting that plan using an adaptive management approach. Over the course of the entire implementation period, progress will be monitored and the plan will be updated accordingly.

Alternatives: Title 5 Systems, I/A Systems, and Treatment Plants

Over the course of the CWMP initiative, the Town considered many alternatives to the system layouts and locations, to the selection of appropriate technologies for wastewater conveyance and treatment, to effluent recharge sites and uses, and to cost-effective approaches. Each of these alternatives is discussed in detail in the pertinent sections of this report. This section focuses on the large-scale alternatives to the recommended program.

As shown in Figure ES-6, on-site treatment technologies today cannot reliably meet the stringent nitrogen reduction standards on thousands of individual lots that are possible with more centralized, municipally operated treatment facilities. One scenario evaluated in the CWMP demonstrated that, while possible for a portion of the solution, I/A systems would still need to be supplemented with conventional wastewater treatment in order to achieve the specific watershed TMDL permit. In that scenario, conventional wastewater treatment was minimized and the use of I/A systems was maximized. After reviewing that scenario for cost, institutional and environmental factors, the Town decided not to pursue the I/A scenario because the cost was the highest among all options considered. In reconsidering other options described in the 208 Plan, the Town representatives felt that urine diverting and compost toilets would not be appropriate for a town-wide solution and should only be considered for unique solutions as needed.

Percent Nitrogen Treatment



Removal of Various Technologies

Figure ES-6
Percent Nitrogen Removal of Various Treatment Technologies

Similarly, recent piloting of Passive Nitrogen Removal Systems (PNRS) has shown some promise for removing on-site nitrogen and this system should continue to be monitored. It may be able to supplement the recommended program in the later phases should continued testing in cold weather climates lead to positive results. These systems are much less operator intensive than typical I/A systems.

ES.4 Recommended Wastewater Program

4.1 Infrastructure Components

Wastewater Master Plan

The recommended sewer system master plan is shown on Figure ES-7. It provides a Town-wide plan of the areas recommended for sewering in order to meet each watershed TMDL.

The recommended plan provides collection and conveyance, treatment, and effluent recharge for about 1.26 mgd of annual average day wastewater flow from the MEP Watersheds and other selected needs areas of Harwich. This is a future buildout flow projection developed from the buildout analysis in the MEP models with assistance and updates from the Harwich Planning Department. The buildout flow is projected to be about a 25 percent increase over the current wastewater flow.

The recommended plan includes sewer collection areas in the MEP watersheds of the Allen, Wychmere and Saquatucket Harbors, the Pleasant Bay, and the Herring River, plus it includes some other wastewater needs areas located outside of MEP studied watersheds as discussed above.

Recommended Treatment Components

Natural Attenuation

Since natural attenuation of nitrogen is part of a natural freshwater system, the Allen, Saquatucket, Pleasant Bay and Herring River watershed systems all have some degree of natural attenuation associated with them. In the Allen Harbor watershed, the Allen Harbor stream is estimated to have approximately 30 percent nitrogen attenuation. In the Saquatucket Harbor watershed, attenuation occurs in several ponds and streams including the Cold Brook. Both the Pleasant Bay and Herring River systems have natural attenuation in several ponds. The existing natural attenuation factors are already accounted for in the MEP nitrogen models and are considered to be existing conditions because they approximate actual field conditions as reported by the MEP.

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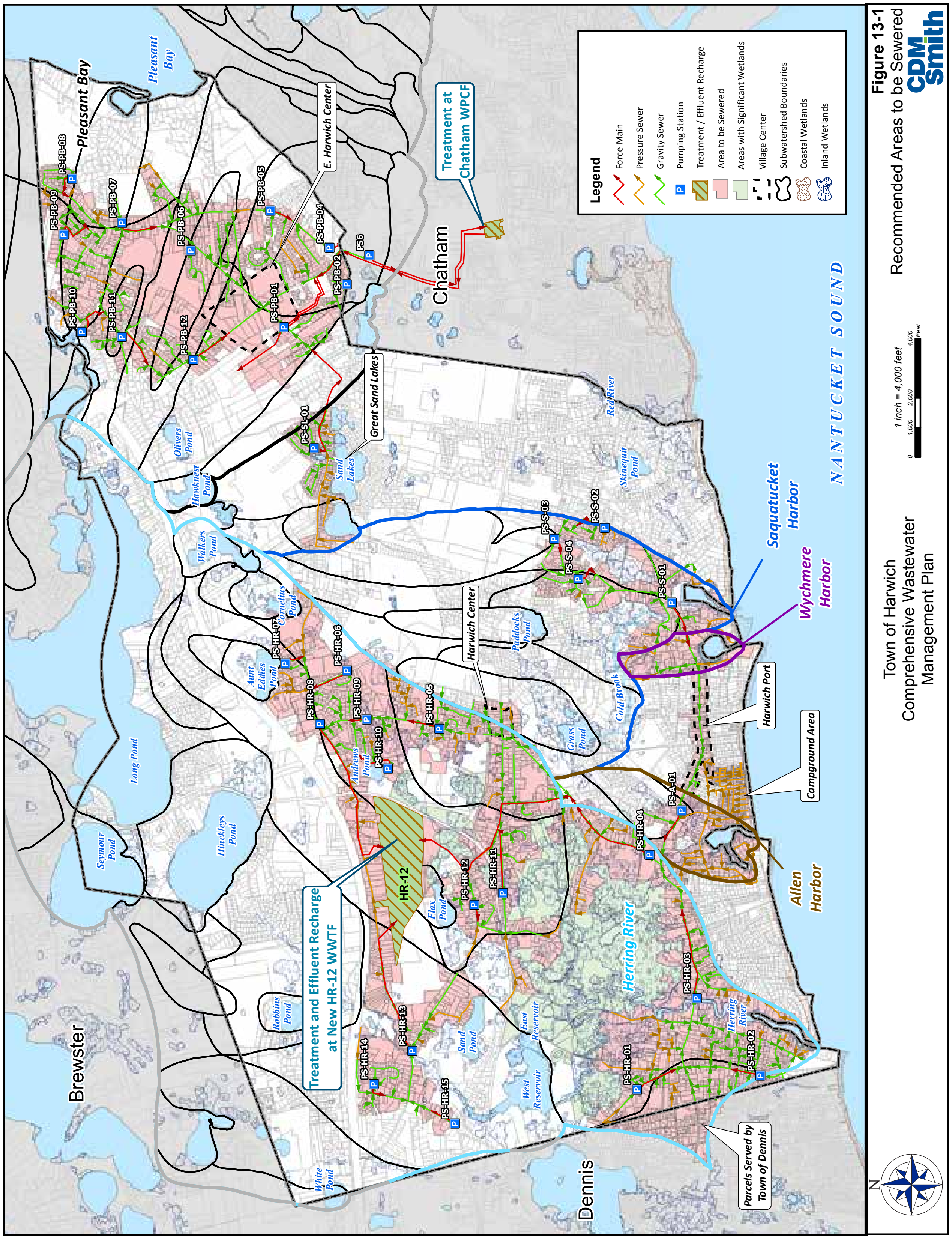


Figure ES-7
Recommended Wastewater Plan

The Town has initiated two projects that will enhance the existing natural attenuation in the Saquatucket Harbor watershed and at Muddy Creek in the Pleasant Bay watershed. The end result of implementing these projects is a cost-effective reduction in the total amount of sewering required in both the Saquatucket Harbor and Pleasant Bay watersheds while still meeting the MEP established TMDL requirements for nitrogen removal.

Chatham WWTP

Treatment Facility and Effluent Recharge

The recommended plan will use two treatment facilities: one located at HR-12 (the Harwich landfill site) and one being the existing Chatham Water Pollution Control Facility (WPCF). The Chatham WPCF will receive flow from the Pleasant Bay watershed and the HR-12 facility will essentially receive flow from the rest of the Town (outside of the Pleasant Bay). HR-12 will recharge the treated effluent onsite in infiltration basins located adjacent to the facility. The proportional Harwich effluent flow will initially be recharged in infiltration basins at the Chatham WPCF. A Pleasant Bay watershed effluent recharge site will only be used if Harwich effluent cannot be recharged in Chatham long-term.

It is important to note that while several feasible sites for effluent recharge have been identified and evaluated, any site in the Town identified for this project could still be considered as a potential effluent recharge site.

Typical Permeable Reactive Barrier

Permeable Reactive Barrier

The Town wants to evaluate further treatment optimization at Site HR-12 by piloting a permeable reactive barrier (PRB) around one of the infiltration basins. In limited studies to date, PRBs have provided additional denitrification removing additional nitrogen from wastewater effluent. The permeable reactive barrier is a trench excavated deep enough into the groundwater and filled with a woodchip/sawdust/compost/sand mixture to provide a carbon source for the denitrification process to occur. Once the applied effluent reaches the groundwater table, it flows through this barrier and reduces the nitrate levels from the 3 to 5 mg/l level down to even lower levels. This could cost-effectively increase capacity of the recharge site by allowing more flow to be recharged without adding more nitrogen to the watershed. If successful, a PRB would become part of the overall future wastewater treatment process to reduce effluent nitrogen at the treatment facility.

Regional Opportunities

Harwich and Chatham

The Town of Harwich has an opportunity to partner with the Town of Chatham by using the recently expanded and upgraded Chatham Water Pollution Control Facility for treatment of collected wastewater from the Harwich portion of Pleasant Bay. There are many details to work out in terms of using the Chatham facility but there have been several positive discussions to date and the two communities are actively negotiating an Inter-Municipal Agreement (IMA) for that purpose. There are cost benefits to both communities. In the long term, effluent recharge for the Harwich flow may in the future occur back in Pleasant Bay with construction of a pumping station that will convey the highly treated effluent back to Harwich. However, in the short term effluent will be recharged at the Chatham facility.

The two Towns are also working cooperatively to implement the Muddy Creek inlet widening project. This project is currently under construction with an expected completion date in summer 2016. Both of these programs will help address the wastewater issues in Pleasant Bay. As the Towns of Brewster and Dennis further develop their wastewater programs other regional opportunities may develop for Harwich which fully supports this concept.

Harwich and Dennis

Harwich has also conducted some preliminary discussions with the Town of Dennis who is in the process of developing their overall Comprehensive Wastewater Management Plan (CWMP). The two towns share small portions on the Herring River watershed and Swan Pond watershed. However, both communities are considering constructing wastewater treatment plants at their DPW Facility sites which are less than 3 miles from one another. Thus, discussions about constructing a joint facility to gain an economy of scale cost savings are ongoing and Harwich will continue that discussion as it has several years before it would need to construct its facility at Site HR-12.

Harwich and Brewster

Harwich and Brewster share portions of the Herring River watershed and Pleasant Bay watershed. Portions of Brewster contribute nitrogen into Harwich at the headwaters of the Herring River watershed and so further discussions between the two communities will need to occur to determine how Brewster might contribute to the Harwich solution for meeting that watershed TMDL. Currently, the Harwich program presented meets the TMDL. Discussions between the two communities have occurred for potential joint solutions in the Pleasant Bay watershed and currently it appears each community will implement their own solution for removing their share on nitrogen contribution to Pleasant Bay. The two communities have worked together previously to address phosphorus loadings in Long Pond and further discussions in this regard may occur for other freshwater ponds in the upper Herring River watershed.

4.2 Non-Infrastructure Components

Public Outreach

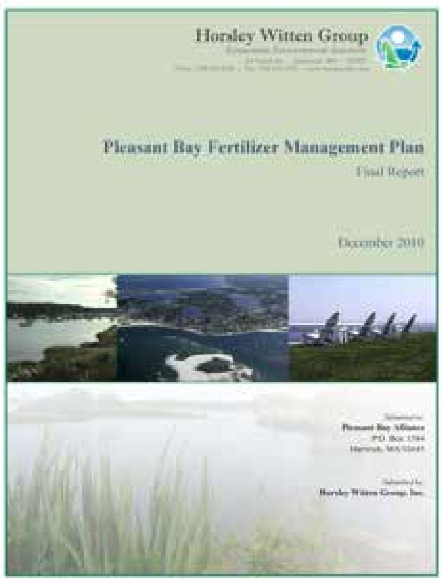
Public participation and outreach has been a priority during the CWMP process, starting in 2007 when informational public meetings were initiated to gain participation and feedback from residents and business owners. The public outreach program to date has focused on educating the public about the need to address nutrient pollution issues and informing residents about the ongoing wastewater program planning, the MEP and TMDL processes, and how wastewater planning will affect the overall community. Future aspects will include program implementation updates.


Harwich community meeting

Fertilizer Education

Fertilizer applied to golf courses, agriculture, Town properties and residential lawns are estimated to account for approximately 7 to 16 percent of the total controllable nitrogen load to the estuaries. While the recommended wastewater management plan focuses on reduction of septic system nitrogen which is the largest portion of controllable nitrogen, fertilizers will continue to affect local estuaries until steps are taken by residents, landscapers, golf courses, and cranberry bogs to reduce overall fertilizer use.

Educational programs have been initiated primarily through the Pleasant Bay Alliance, which Harwich is a member. Harwich's Conservation Commission has also actively enforced protection of buffer zones to minimize fertilizer movement to water bodies. The Town has elected to try to achieve this reduction through education instead of regulations.



Pleasant Bay Alliance Fertilizer Management Plan

Stormwater BMPs

Stormwater from runoff and impervious surfaces is similar to fertilizer in terms of the amount of total controllable nitrogen load to the estuaries. It accounts for about 5 to 9 percent of the controllable Nitrogen. It can also be a source of nutrients to the fresh water resources in Harwich. While wastewater planning will reduce pollutants, stormwater will continue to affect local water bodies. Steps will continue to be taken by the public works department to enact stormwater best management practices (BMPs) that help reduce the turbidity from stormwater and reduce the total pollutant (phosphorus, nitrogen and pathogens) load to both the fresh and salt water resources in Harwich. Several roadway projects are underway or planned to help eliminate direct stormwater discharges to water bodies and to install Best Management Practices.

All three of the above non-infrastructure components should be addressed on a continuing basis; however combined they do not achieve the required nitrogen reduction required to meet the estuary TMDLs. It is also difficult to monitor the long-term benefits of each component. Improved fertilizer management and stormwater management will result in improved water quality which will be observed via long-term water quality monitoring. That benefit will allow the Town to implement the wastewater program closer to the lower end cost range.

Stormwater swale

Freshwater Pond Evaluations

In this CWMP, the health of the Harwich freshwater ponds was evaluated and summarized. The sixteen Harwich ponds in this pond health assessment are quite diverse in both physical and water quality characteristics. Harwich's ponds provide important habitat for aquatic life and are important natural resources for the community. The growing number of pond restoration actions on Cape Cod suggests that many ponds are reaching their tipping points, where further alterations to the environment will result in sometimes dramatic changes in water quality.

Below are some preliminary steps that should be taken to protect or restore Harwich's ponds.

1. Perform an inventory of all storm water pipes draining to ponds
2. Continue sampling
3. Investigate other potential contaminant sources and develop solutions to restore
4. Implement programs to restore water quality

An evaluation of Hinckleys Pond was completed in July 2012 and similar assessments should be conducted on other eutrophic ponds in town to determine how best to restore them.

On-site System Support

The staff at the Harwich Health Department has several resources dedicated to the maintenance of septic systems and septic system maintenance. The Town's website lists several resources that a homeowner can use when selling their property or siting a new septic system. The website also gives guidelines on how to best maintain an existing septic system. They must be properly maintained in order to remove pathogens and bacteria.

Even after the wastewater program is fully implemented, there will still be a significant number of Title 5 septic systems functioning in Harwich. The health department will continue its efforts in supporting owners of these systems and will continue to oversee their operation and to evaluate potential new technologies such as Passive Nitrogen Reduction Systems.

Land Use and Open Space Acquisition

The Town should continue to review land use planning tools for applicability to this recommended program and for meeting other Town needs. Continued efforts such as those ongoing in the East Harwich Village Center area and other village centers should occur as they may result in changes to this program. Land use planning tools such as up-sizing of lots via zoning revisions, open space acquisitions and the like would result in lower nitrogen loadings in a given watershed requiring less sewering. Similarly, higher density development or expansion of commercial areas may result in higher nitrogen loadings potentially requiring more sewering. The percentage of growth currently included in each watershed varies significantly. There are several factors in play in this analysis (economics, open space, growth/no net growth, utilities, traffic, etc.) but clearly the Pleasant Bay and Herring River watersheds are the ones where any land use revisions and acquisition of land for open space will have the most impact.

Shellfish Program

The Town of Harwich has an active shellfish laboratory and a nursery facility that has been operating since 1994. Since the facility opened, more than 31 million shellfish were seeded in Harwich's waterways.

Since the shellfish program is active throughout the town, all of the nitrogen limited embayments including the Allen, Wychmere and Saquatucket Harbors, Pleasant Bay and Herring River have been seeded with shellfish to varying degrees over the past 20 years. The Town has recently taken an interest in determining if nitrogen reduction is a side benefit of this successful program and is trying to determine if the presence of shellfish populations will have a significant impact in the overall wastewater plan. Regular sampling of each nitrogen-sensitive embayment through the adaptive management plan will help to determine if the amount of sewering can be scaled back as a result of these and other non-traditional nitrogen reduction strategies.

Energy Strategy

The Town supports the use of alternative technologies and the use of high efficiency systems. Those criteria were used in selecting the type of collection, treatment and effluent recharge systems proposed for the recommended wastewater program. The Town has also recently installed a solar photovoltaic (PV) array at the former municipal landfill site which is adjacent to the proposed wastewater treatment facility site (HR-12). This PV array will be used to help offset the power needs of the Town for that facility.

Adaptive Management

One benefit of a phased sewering approach is the ability to modify the recommended wastewater program as needed during the implementation phases. This "adaptive management" strategy allows for modification to the phasing, the timing, or the exact areas to be sewered depending on the results of the earlier implementation phases. The phasing proposed plan allows for the adaptive management to be fully used if the total sewer service area changes or if new technologies arise that provide better or more cost-effective treatment than those presently proposed. The Town plans to continue revisiting the recommended program throughout its implementation to re-evaluate each phase prior to design and construction.

The proposed Adaptive Management Plan (AMP) components are described below.

1. Technical Review Committee: A technical review committee (TRC) will be established to review the progress of the CWMP Recommended Program. This task could be performed by the existing Wastewater Implementation Committee.

2. Water Quality Monitoring: Now that the MEP water quality monitoring program is complete, the Town plans to continue monitoring water quality at the sentinel and check stations.

3. Habitat Monitoring: The Town anticipates that MassDEP will continue eelgrass mapping, to assess the results of the Recommended Program's implementation.

4. Wastewater Treatment Plant/Groundwater Discharge Reporting: The Towns of Harwich and Chatham will be required through their groundwater discharge permits from MassDEP to develop regular compliance reports.

5. CWMP Implementation and Funding Status: The TRC will be provided an annual implementation progress report following each calendar year.

6. Community Growth Status: Each year, a written update will be prepared and submitted to the TRC describing community growth both in the community at-large and within the sewered areas.

7. CWMP Recommended Program Modifications: Based on the information provided, the TRC may recommend updates or modifications to the CWMP Recommended Program.

4.3 Governance

The Board of Selectmen (BOS) have been reviewing and discussing several models to help oversee the implementation of the recommended wastewater program. Currently they are the Wastewater Management Authority (WMA) for the Town and will submit the water quality plan to the CCC in June 2016. While no formal governance structure has been adopted by the Town to date the plan is for the BOS to oversee the planning, design and construction of each program phase and then once a specific phase is placed into operation, the day-to-day oversight would be turned over to the Board of Water (and Sewer) Commissioners. The Town continues to work out the details to formalize this structure.

4.4 No-Build Alternative

The No-Build Alternative involves the continued use of onsite Title 5 septic systems to meet the wastewater needs of the community. MassDEP indicates that the baseline, or No-Build Alternative, which focuses on optimization of existing facilities, should be evaluated "with respect to potential effects on surface water quality; groundwater quality (if applicable); land use limitations; and socio-economic factors (e.g., residential, industrial, and health hazards)." None of these factors can reach an acceptable level of service under the No-Build Alternative.

The No-Build Alternative also presents land use limitations, specifically in the East Harwich Village Center, the Campground Area, the Route 28 corridor including Harwich Port and other areas of desired growth throughout Town. Without off-site wastewater management options, desired land uses are expected to be severely restricted by Title 5.

The Town of Harwich relies on tourism for jobs and revenue which is the direct result of the high-quality natural resources on Cape Cod.

Furthermore, many residents choose to reside in Harwich due to its natural beauty and the recreational opportunities afforded by its beaches, ponds and scenic waterways. Protection of these resources is critical to the health and well-being of the Town. While the No-Build Alternative is obviously the least expensive option when only considering capital costs, the long-term impact on the economic viability of the Town must also be considered, along with the many qualitative factors related to aesthetics, quality of life, and environ- mental preservation. The No-Build Alternative would not adequately preserve these valuable resources, would be in violation of the

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TMDL requirements for the Town's five embayment's and is not considered a feasible option by state and local officials.

4.5 Discussion of Water Quality Regulations

The Harwich Comprehensive Wastewater Management Plan presents a recommended program that complies with current water quality regulations. However, due to the cost of this overall program some Harwich stakeholders have questioned the cost/benefit of full compliance and whether the appropriate standards are being applied to the specific scenarios encountered in the Town. The vast majority believe water quality is extremely important to the quality of life in Town and that a nutrient problem exists that must be addressed in the near future. The critical question is how far the program needs to go in order to adequately address the issue. The Herring River and Pleasant Bay watersheds are sensitive areas that have historically supported ecological diversity, including eelgrass, and should be protected based on current water quality standards. However, the Allen, Wychmere and Saquatucket Harbor watersheds are essentially man-made harbors/marinas that historically have exhibited less sensitive ecological diversity and no eelgrass. Establishing water quality parameters to be attained based on the highest and best use of the water body versus what the use is today is the current regulatory requirement.

Each of the five MEP watershed study areas in Harwich needs to have nitrogen removed and the program presented in this CWMP is designed to do so according to water quality regulations as they stand today. As the plan for nitrogen reduction is implemented, discussions about the ultimate water quality endpoints should continue and the recommended program modified in the later phases via adaptive management based on those discussions. That flexibility has been built into the program adopted by Harwich.

4.6 Phasing Plan

Based on the above discussion the proposed phasing program is shown in **Figure ES-8**. This figure shows the areas to be sewered by phase. Details of the proposed phasing program first presented in the Draft CWMP are described below. The Town has already begun to implement portions of Phase 1.

Phase 1

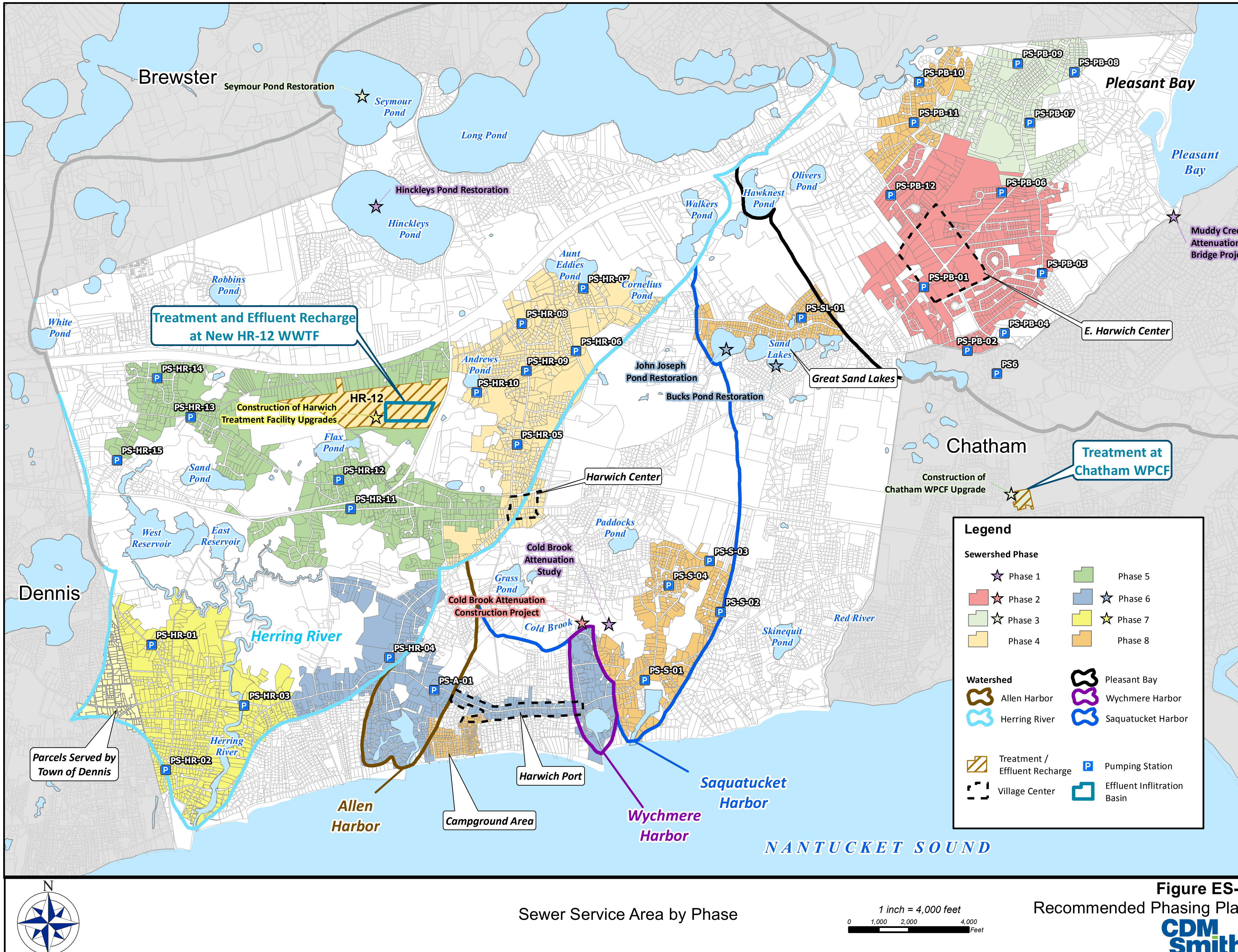
The focus of this phase is to implement the two natural nitrogen attenuation programs. The first is the Muddy Creek Bridge project which will increase the existing creek opening to 24-ft width. The inlet widening will increase the flushing in Muddy Creek and will help restore the ecological habitat. Harwich and Chatham funded this program and obtained several grants to help pay for construction. Project completion is expected in summer 2016. The second program is the evaluation of options to improve the natural attenuation in the Cold Brook former cranberry bog network off Bank Street. The goal is to increase the natural nitrogen attenuation from the existing 35 percent to 50 percent by adding ponds where denitrification can occur. Harwich funded this study in FY15 and FY16 with results expected in June 2016. The recommended plan developed in the study phase would be designed and constructed in Phase 2. Both of these projects will allow the Town to monitor and confirm water quality improvements in these watersheds and to adjust future programs as needed. The Town also sought to purchase a 21 acre parcel in site PB-3 for an effluent recharge facility but local neighborhood opposition helped defeat the purchase. Other sites in the Pleasant Bay watershed are now under consideration. Implementation of the Hinckleys Pond restoration project has not yet received funding.

Phase 2

The focus of this phase will be to design and install sewers in the Pleasant Bay watershed since this is the largest watershed with the highest percentage of septic system nitrogen removal required. This also allows the Town to work with Chatham, use a regional approach to wastewater treatment and recharge, and to provide further protection to some of the Harwich drinking water supply wells. Phase 2 also provides sewer service to the East Harwich Village Commercial District or East Harwich Village Center and surrounding areas to accommodate potential higher density development. Sewering these areas removes significant nitrogen towards meeting the Pleasant Bay TMDL. Delaying Pleasant Bay sewer construction in this area until this phase also helps avoid time restrictions on the recent roadway improvements done on state road Route 137. Collected wastewater will be pumped to the Chatham WPCF for treatment. Negotiations are ongoing but it appears Harwich would purchase treatment capacity in the newly upgraded and expanded Chatham facility. Effluent initially can be recharged at the Chatham facility site for a few years but ultimately may require an effluent pumping station to be constructed for pumping it back to Harwich for recharge at a site in the Pleasant Bay watershed. The recommended plan for the Cold Brook natural attenuation would also be implemented in this phase

Phase 3

The focus of this phase will also be the Pleasant Bay watershed to install additional sewers in the area north of the Harwich Village Commercial District. A portion of the collection system area on the west side of the Pleasant Bay Watershed will be delayed until Phase 8 to allow for water quality monitoring and evaluation of the impacts from sewering and the Muddy Creek bridge project. This delay will help to ensure that the extent of the wastewater collection is not overreaching, with respect to the TMDL compliance. This phase may also see the implementation of the potential Seymour Pond restoration project.



Sewer Service Area by Phase

Figure ES-8
Recommended Phasing Plan

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Phase 4

This phase will be done as two programs. Overall the phase will collect wastewater in the northeast part of the Herring River watershed. The collected wastewater will be pumped to the new treatment plant to be constructed at Site HR-12 (landfill site) where the treated effluent would be recharged. The sequencing batch reactor (SBR) treatment facility would initially be constructed for a capacity of about 0.45mgd which would treat collected flows from Phases 4, 5 and 6.

Phase 4A will include the construction of the HR-12 treatment plant. This facility must be constructed and ready to receive wastewater before sewers can be connected in the Herring River Watershed.

Ongoing regional discussions with Dennis would have concluded by this time and instead of constructing a treatment plant at HR-12, Harwich may convey collected wastewater to a shared facility in Dennis. If this options is selected then the sequence of the next phases may be revised.

Phase 4B will include the construction of the sewers in the Herring River Watershed as described above.

Phase 5

This phase will collect wastewater in the northwest part of the Herring River watershed and near Site HR-12. The collected wastewater will be pumped to the treatment plant at Site HR-12 where the treated effluent would be recharged.

Phase 6

This phase will collect wastewater in the southeast part of the Herring River watershed. This phase will also install some of the planned sewers in the Allen and Wychmere Harbor watersheds in order to begin meeting the TMDLs in those areas. Collected wastewater will be pumped to the HR-12 site for treatment and recharge.

The extent of the collection system constructed in this phase will be coordinated based on the capacity of the existing facility and its ability to accept additional wastewater flow from the homes and businesses served. This phase may also include implementation of the potential Bucks and John Joseph Pond restoration projects.

Phase 7

The focus of this phase will be to expand the HR-12 treatment plant and install the remaining required sewers in the Herring River watershed to meet the TMDL. The treatment plant at Site HR-12 will be expanded to the full 0.9 mgd capacity in this phase. Collected wastewater flows from the southwest area of the Herring River watershed will be pumped to the treatment and effluent recharge facility at Site HR-12.

Phase 8

The focus of this phase will be to install sewers in the Saquatucket watershed and remaining sewers in the Pleasant Bay watershed required to meet those TMDLs. Areas to be sewered near the Great Sand Lakes and the Campground will also be included in this phase. Collected wastewater from the Pleasant Bay area will be added to the flows pumped to the Chatham wastewater treatment facility and effluent recharged in Chatham or pumped back to Harwich for recharge as needed. Wastewater collected from the areas outside of the Pleasant Bay will be treated and recharged at HR-12.

Flow from the Great Sand Lakes area is currently programmed to go with the Pleasant Bay wastewater flows to Chatham but could be switched and conveyed to Site HR-12 for treatment and recharge.

Sewer service areas in Phases 5, 6, 7 and 8 can be adjusted as needed to meet local needs and based on feedback from water quality monitoring. The order in which these phases are implemented is also flexible and can be adjusted to meet those same needs. For instance areas along Route 28 may want to be sewered earlier than proposed to meet potential economic development needs or to help protect Allen Harbor which is in the process of being dredged.

ES.5 Recommended Cost Recovery Plan

The plan phasing is between $2.6 to $47.2 million for each phase of the program for a total program cost of $230 million. This total includes an additional allowance of $3.8 million for the Muddy Creek and Cold Brook attenuation projects and includes $1.3 million allowance for the study and restoration of Hinckleys Pond, Seymour Pond, Bucks Pond and John Joseph Pond. The initial HR-12 treatment facility will be built in Phase 4 and is proportionally more costly in its initial phase as it includes all the supporting buildings and common processes. It is proposed that this facility will be upgraded to accommodate the additional wastewater flow and increased treatment capacity in Phase 7. The adaptive management approach will allow the treatment facility expansion requirements and sewer service areas to be further evaluated and modified as needed between Phases 4 and 7.

Harwich's Wastewater Implementation Committee (WIC) evaluated various cost recovery models. The WIC received input from several Town representatives. During these discussions, three tenets developed. First, the WIC felt that everyone in the Harwich community will receive benefits from restored water quality and that everyone contributes in some manner to the biggest problem – nitrogen coming from onsite septic systems. Second, the committee agreed that a dedicated funding source should be established to help pay for wastewater program components. Third, the committee felt there should be a component that reflected the amount of water used and/or the amount of nitrogen contributed by a specific home or business owner. These three tenets ultimately evolved into the strategy the WIC adopted and the program recommended to the Board of Selectmen.

Once the WIC established the three tenets of wastewater recovery cost sharing, they put those concepts into a revenue-generating mechanism cost recovery model that includes the following three methods:

- **Infrastructure Investment Fund** – A real estate tax surcharge of up to 3percent can be set aside into a Municipal Water Infrastructure Investment Fund, outside of Proposition 2½, as allowed through recent state legislation. WIC recommended 1.5 percent of the annual property tax be utilized and lower CPA from 3percent to 1.5 percent. (2014 Legislation, M.G.L., Chap.40, Section 39m)

- **Town-wide Property Tax Fund** – Costs can be recovered from all property owners within the town through the general tax fund. WIC recommended 75percent of remaining costs be recovered utilizing the property tax.

- **User Fee/Sewer Enterprise Account Charges** – Surcharges on water bills, charged according to water usage, can be used to offset a portion of the capital costs and operating costs. WIC recommended 25percent of the remaining costs be recovered utilizing the user fee.

The above cost recovery model components and percentages were recommended by the WIC to the BOS. Based on rough estimates for the first three phases a homeowner on the sewer is estimated to pay about $244 plus $145 to $175 in operation and maintenance costs in the year 2026. A homeowner not on the sewer would pay $244 in year 2026 plus their septic system operation and maintenance costs.

The BOS held a Public Hearing on June 17, 2015 to receive community input on the proposed cost recovery model. At a subsequent Selectmen's meeting, the BOS voted to adopt the following motion as the Town's cost recovery policy.

Capital Outlay Committee Requirements for CWMP				
2013 Funding Request	Phase 1		Total =	$2,550,000
1	$250,000	For PB-3 Recharge Facility Land Purchase		
2	$500,000	For Hinckleys Pond Restoration		
3	$100,000	For Cold Brook Attenuation Study		
4	$1,700,000	For Muddy Creek Attenuation Bridge Project		
2016 Funding Request	Phase 2		Total =	$24,300,000
1	$22,300,000	For Design and Construction of Pleasant Bay Collection System (South)		
2	$2,000,000	For Cold Brook Attenuation Construction Project		
2021 Funding Request	Phase 3		Total =	$21,010,000
1	$12,600,000	For Construction of Pleasant Bay Collection System (North)		
2	$8,110,000	For Design and Construction of Chatham WPCF Upgrade		
3	$300,000	For Seymour Pond Restoration		
2026 Funding Request	Phase 4A		Total =	$34,400,000
1	$34,400,000	For Design and Construction of Harwich Treatment Facility HR-12		
2029 Funding Request	Phase 4B		Total =	$22,300,000
1	$22,300,000	Design and Construction of Herring River Collection System (Northeast)		
2033 Funding Request	Phase 5		Total =	$23,200,000
1	$23,200,000	For Design and Construction of Herring River Collection System (Northwest)		
2038 Funding Request	Phase 6		Total =	$21,200,000
1	$20,700,000	For Design and Construction of AWS and Herring River (SE) Collection Systems		
2	$250,000	For Bucks Pond Restoration		
3	$250,000	For John Joseph Pond Restoration		
2043 Funding Request	Phase 7		Total =	$47,200,000
1	$26,500,000	For Design of Harwich WWTF Upgrade and Design and Construction of Herring River Collection System (Southwest)		
2	$20,700,000	For Construction of Harwich Treatment Facility Upgrade		
2048 Funding Request	Phase 8		Total =	$33,900,000
1	$33,900,000	For Design and Construction of Campground Area, GSL and Final PB Area to Meet TMDL		
Total Funding Request	**Phases 1-8**		**Total (Rounded)=**	**$230,000,000**

Table ES-3
Details of Phasing Plan Costs by Phases 1-8
(ENR=9475)

CDM Smith

BOS Cost Recovery Policy

The Harwich Board of Selectmen endorse a cost recovery policy for wastewater program implementation that utilizes the combination of town wide property taxes, an infrastructure investment fund and a sewer enterprise account based on water consumption. Where appropriate, grant funds will be applied for and if awarded will be used to offset costs as applicable. This policy will be utilized to support the implementation of at least the first three phases of the eight phase program and is subject to change should other potential beneficial funding programs become available to the town and the actions of town meeting and subsequent ballot results.

The BOS specifically did not put percentages in their motion in order to allow flexibility depending on what was being constructed in a given phase.

Table ES-3 has been presented to the Capital Outlay Committee, the Finance Committee, the BOS and other Town representatives for planning purposes.

Components of Phase 1 have already been funded and the Muddy Creek bridge project costs for Harwich are about $912,500 (Harwich and Chatham split costs 50/50).

Based on discussions with Harwich representatives, the 40-year implementation has been divided into the timeline as shown in Table ES-4. The Town is evaluating and adjusting this timeline to help coordinate financing of other large capital projects in Town in order to minimize financing impacts.

Phase	Calendar Year	Duration (years)	Amount
1	2013 to 2015	3	$2,550,000
2	2016 to 2020	5	$24,300,000
3	2021 to 2025	5	$21,010,000
4A	2026 to 2028	3	$34,400,000
4B	2029 to 2032	4	$22,300,000
5	2033 to 2037	5	$23,200,000
6	2038 to 2042	5	$21,200,000
7	2043 to 2047	5	$47,200,000
8	2048 to 2052	5	$33,900,000
Total Program	**2013 to 2052**	**40**	**$180 Million to $230 Million**

Table ES-4
Timeline for Phasing Plan Costs by Phases 1-8
(ENR=9475)

The overall program to meet the nitrogen TMDLs and the other defined Town needs is estimated to be up to $230 million. However, the recommended program includes a buildout growth of about 26 percent which is a prudent projection that may not occur. It also does not take credit for any other non-infrastructure nitrogen reduction aspects of the program such as fertilizer reduction, improved stormwater controls, land purchase for open space and land use changes. Continued discussions regarding additional regional solutions may also yield economies of scale savings. Then, if only half the growth occurred and up to half of the nitrogen contributions from fertilizer and stormwater were achieved, then it is conceivable that a 25percent reduction in the recommended infrastructure could be realized resulting in a program cost of about $180 million. Thus, the cost of the recommended program is between $180 to $230 million.

Based on discussions with Harwich representatives, the 40-year implementation has been divided into the timeline as shown in Table ES-4. The Town will need to further evaluate and potentially adjust this timeline to help coordinate financing of other large capital projects in Town in order to minimize financing impacts.

The overall program to meet the nitrogen TMDLs and the other defined Town needs is estimated to be $180 to $230 million. However, the recommended program includes a buildout growth of about 25 percent which is a prudent projection that may not occur. It also does not take credit for any other non-infrastructure nitrogen reduction aspects of the program such as fertilizer reduction, improved storm- water controls and land use changes. Thus, if only half the growth occurred and up to half of the nitrogen contributions from fertilizer and stormwater were achieved then it is conceivable that a 25 percent reduction in the recommended infrastructure could be realized resulting in a program cost of about $180 million. Thus, the cost of the recommended program is about $230 million.

ES.6 WIC and Other Stakeholders

The Town contracted with CDM Smith Inc. in 2007 to work with the Water Quality Management Task Force – Wastewater Management Subcommittee (WQMTF-WMS) which was revised into the Wastewater Implementation Committee (WIC) in 2014 to develop this CWMP. The WIC has conducted almost monthly meetings during this process which have been open to the public as well as conducted several community information meetings. The WIC consists of five citizen members and two Town support staff along with liaisons from the BOS, Finance Committee and the Town Administrator all representing various Town interests.

The Town of Harwich has implemented a thorough public outreach program throughout the present wastewater planning initiative. The Town welcomes comments on this Final CWMP/SEIR and looks forward to continuing to work collaboratively with the community, the WIC and other interested parties as it implements the recommended program over the next 40 years.

ES.7 Organization of This CWMP

This report is divided into eighteen sections. The sections are as follows:

- **Executive Summary** presents an overview of the report and the findings.
- **Section 1** introduces the CWMP and details the purpose, the scope, existing conditions, and the organization of the report.
- **Section 2** discusses public participation programs, as well as ongoing projects and groups relevant to the CWMP development.
- **Section 3** summarizes past and present data related to the CWMP.
- **Section 4** provides a summary of existing water quality data in Harwich.
- **Section 5** discusses the health of the Town's freshwater ponds and associated wastewater needs identified to help protect these resources.
- **Section 6** describes the findings of the Massachusetts Estuaries Project for the five applicable watersheds in Harwich.
- **Section 7** summarizes the existing wastewater flow quantities in Harwich and establishes the baseline flow data for the evaluation of wastewater management alternatives.
- **Section 8** provides details of the wastewater needs assessment identifying the areas of Town likely to require off-site wastewater solutions.
- **Section 9** describes the Town-wide evaluation of potential effluent recharge sites and recommends specific sites to be carried forward for further analysis.
- **Section 10** presents eight feasible wastewater management alternative scenarios and a comparative analysis of them to screen down to three preferred alternatives.
- **Section 11** summarizes the hydrogeologic evaluations of the preferred effluent recharge sites.
- **Section 12** provides a detailed analysis of the three preferred scenarios from Section 10 resulting in a recommended program for wastewater management.

- **Section 13** presents the recommended program for wastewater management, incorporating the recommended alternative and other non-infrastructure strategies to enhance environmental protection and meet other Town goals.

- **Section 14** presents environmental impacts and mitigation pertaining to the implementation of the proposed recommended program.

- **Section 15** describes the Town's cost recovery plan proposed for financing the recommended program.

- **Section 16** presents a construction management plan detailing mitigation measures proposed to minimize construction-period community and environmental impacts.

- **Section 17** lists the Section 61 Findings applicable to permitting of the recommended program.

- **Section 18** provides a list of comments received on the February 2013 Draft CWMP/EENF and associated responses.

Section 1

Introduction

1.1 Project Identification

In 2007, the Town of Harwich, Massachusetts ("the Town") began the process of developing a Comprehensive Wastewater Management Plan (CWMP), to guide the decisions pertaining to wastewater management over the next 40 years. The wastewater planning performed during the course of this process has been completed with guidance and oversight from the Town's Wastewater Implementation Committee (WIC) and former Wastewater Management Subcommittee, working with the Town's consultant, CDM Smith. The information contained in this Final Comprehensive Wastewater Management Plan (CWMP)/Single Environmental Impact Report (SEIR) represents the results of this multi-year planning effort and the associated recommendations for long-term wastewater management in Harwich.

The planning to date has been performed with several town-wide goals in mind. These include:

- Achieving the levels of wastewater nitrogen removal required to restore local aquatic ecosystems, according to the goals established through the Massachusetts Estuaries Project (MEP),
- Reducing nitrogen inputs to the Town's drinking water supplies where necessary,
- Achieving phosphorus removal where needed to restore or stabilize the ecological health of the Town's freshwater ponds,
- Providing alternative wastewater management strategies to areas of town where Title 5 standards have historically been difficult to meet, and
- Providing infrastructure to support the planned growth outlined in the Town's Local Comprehensive Plan.

At the present time, Harwich has no large scale town-owned wastewater treatment facilities, and residents and businesses rely on on-site wastewater management systems regulated by the Massachusetts State Environmental Code, or Title 5. While Title 5 systems provide an adequate level of treatment for pathogens originating from wastewater, minimal nutrient (nitrogen) removal is achieved with a traditional Title 5 system. Furthermore, siting of a Title 5 system on each individual lot can restrict growth in areas of desired economic development. As the Town has increased in population and moved from a seasonal to a year-round community for many of its residents, continued reliance on Title 5 systems town-wide has become environmentally problematic. In order to meet the goals described above, alternative means of wastewater treatment and recharge are required.

This report describes existing conditions and wastewater needs in Harwich and concludes with the identification of a recommended wastewater management program, in conjunction with associated environmental impacts, mitigation measures, implementation phasing, and cost recovery.

1.2 Project Location

The Town is in the center of Cape Cod, as shown on Figure 1-1. The Town is bordered by Nantucket Sound to the south, the Town of Dennis to the west, the Town of Chatham to the east and the Town of Brewster to the north. The planning area for the CWMP encompasses the entire Town of Harwich, which is approximately 21 square miles. Harwich has approximately 11 miles of tidal shoreline, four harbors, 22 freshwater ponds, two reservoirs and two scenic river corridors (Herring River and Muddy Creek). Figure 1-2 shows Harwich and the surrounding communities, along with the major surface water bodies.

1.2.1 Existing Conditions

The Town is governed by an open town meeting form of government, led by a Town Administrator and a five-member Board of Selectmen. According to data from the 2010 U.S. Census, the Town has a population of 12,243 people, which is one percent less than the 2000 U.S. Census. The 2005-2009 American Community Survey 5-Year Estimates document 9,652 housing units, 58% occupied and 42% vacant. The vacant housing units most likely reflect seasonal homes considering that the total population of Harwich increases to approximately 37,000 people in the summer months. The median household income in 2009 was $53,607. Harwich is primarily residential, with a seasonal tourist population that accounts for a large portion of the local economy.

Figure 1-3 shows the level of development in Harwich in 1951 compared to 1999. As seen in this figure, the increase in development has been significant, causing marked increases in nutrient (mainly nitrogen) inputs to the local ground and surface water resources.

The Town's public drinking water is supplied from municipal groundwater wells located throughout town. The Town does not have any wastewater collection system or municipal wastewater facility. Based on data in the Town's Geographic Information System (GIS), there were approximately 9,000 developed parcels out of 11,600 in Harwich in 2011. This is the Town's best estimate of the number of on-site wastewater treatment and disposal systems in town. This number includes 28 parcels that have on-site package treatment facilities. Five of these parcels operate systems designed to handle over 10,000 gallons-per-day (gpd), the state's threshold for regulation by the Massachusetts Department of Environmental Protection (MassDEP) via a groundwater discharge permit. These five parcels are as follows:

- Snow Inn, 23 Snow Inn Road
- Cranberry Point Nursing Home, 111 Headwaters Drive
- Harwich Middle and Elementary Schools, 263 South Street
- Harwich Laundry and Cleaners, 2 Doane Road
- Wequassett Resort and Golf Club, 2171 Route 28

The remaining 23 systems are under the jurisdiction of the Harwich Board of Health Rules and Regulations. A complete list of these parcels can be found in Section 3.

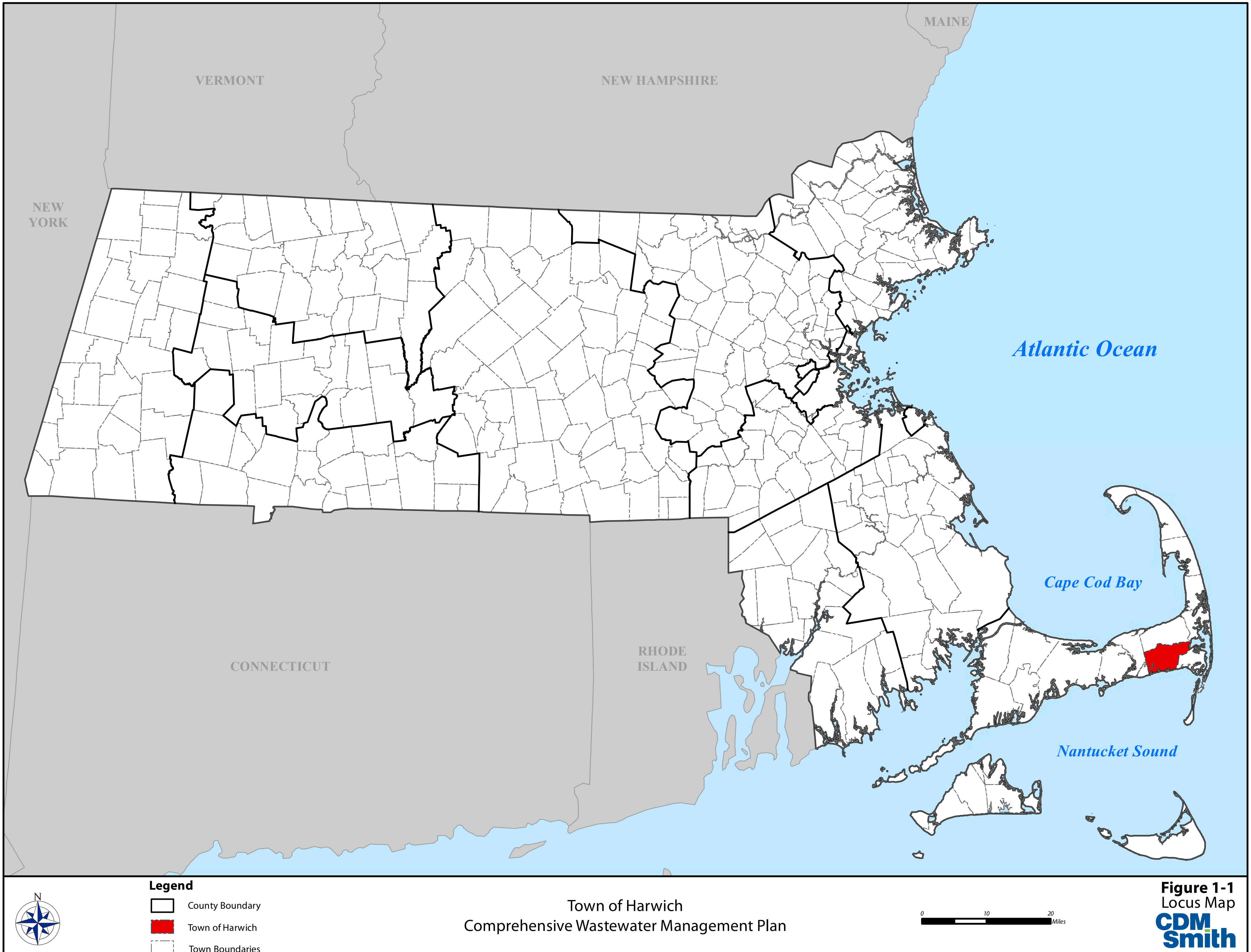

Figure 1-1
Locus Map

Town of Harwich
Comprehensive Wastewater Management Plan

CDM Smith

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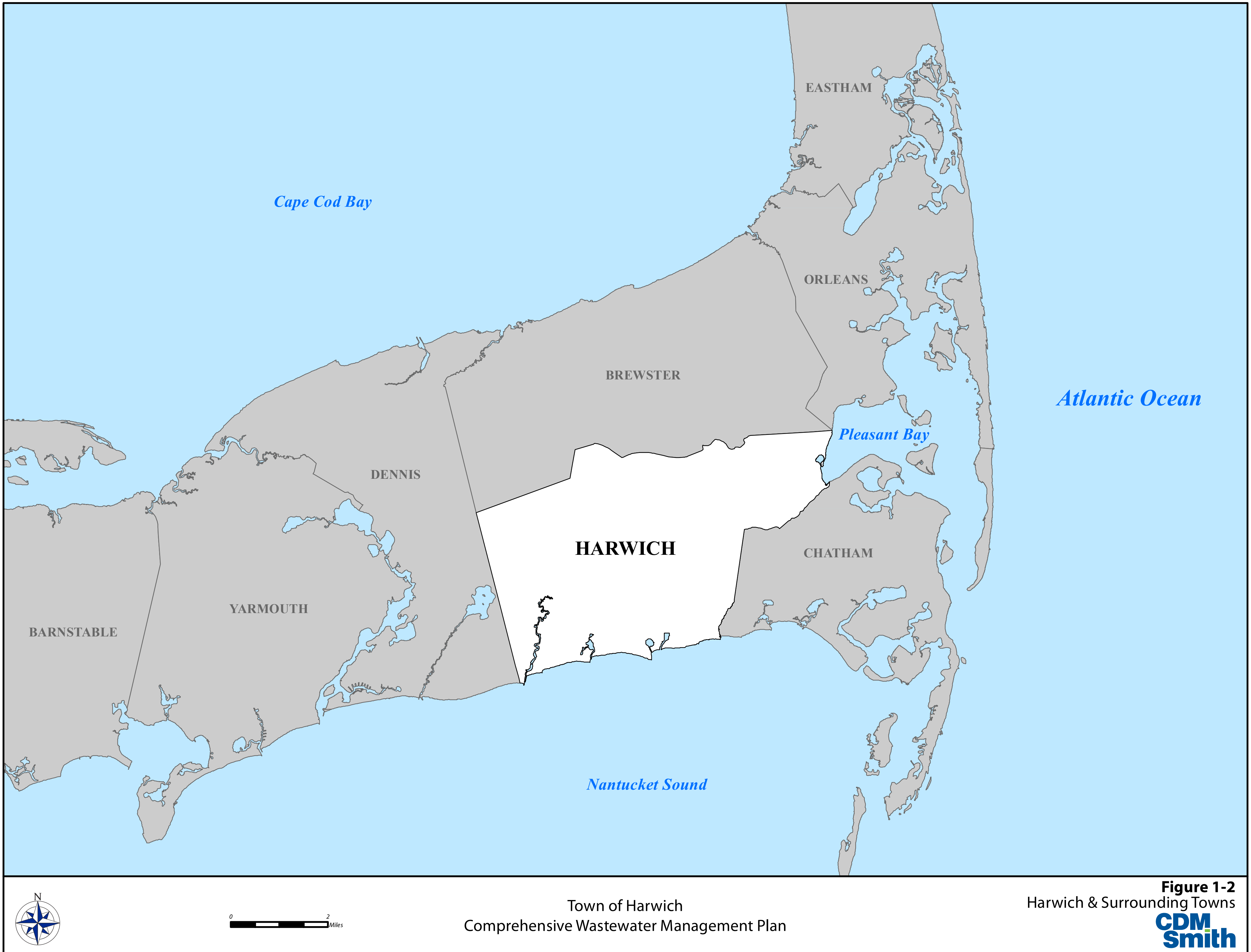

Town of Harwich
Comprehensive Wastewater Management Plan

Figure 1-2
Harwich & Surrounding Towns

CDM Smith

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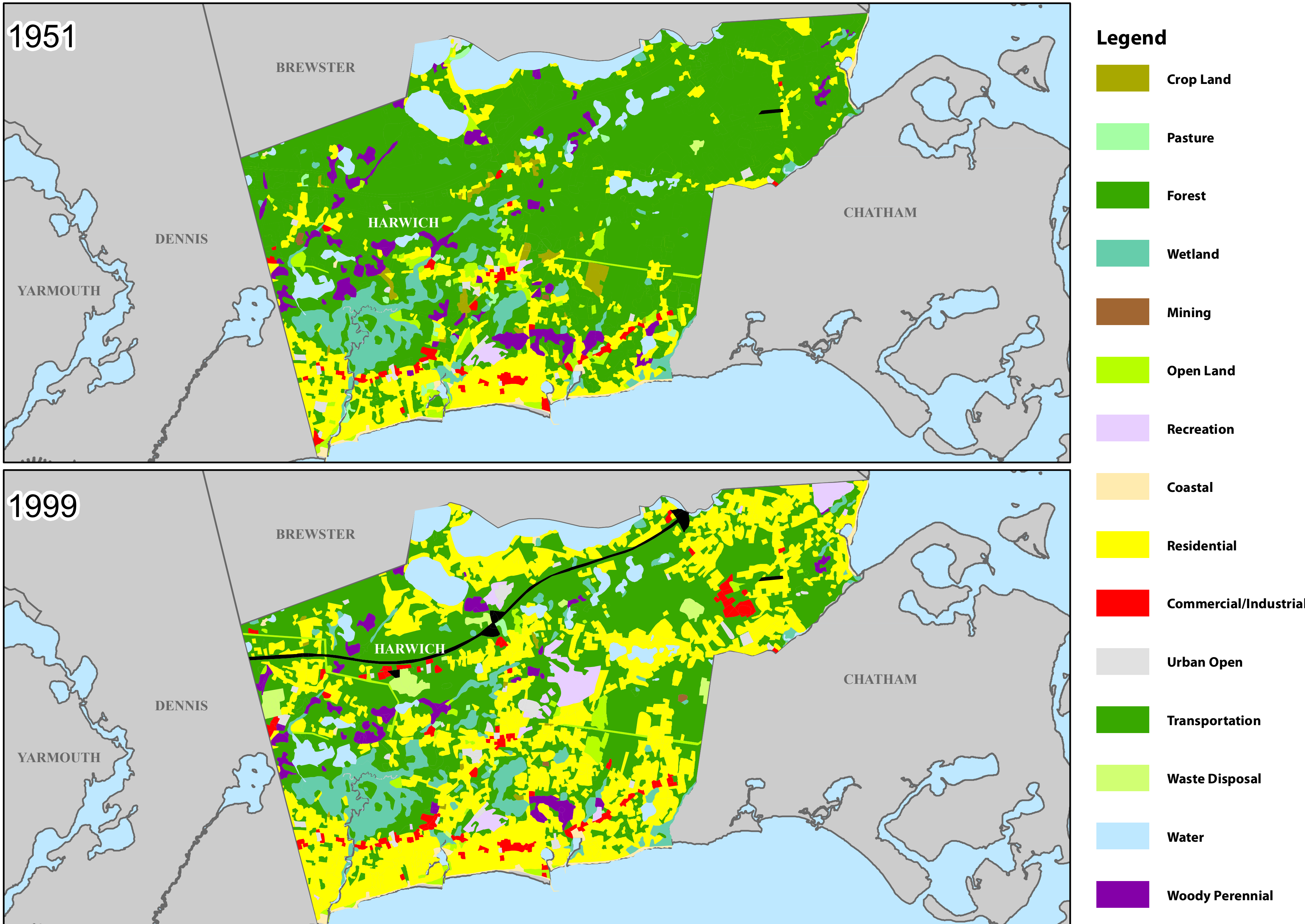


Town of Harwich
Comprehensive Wastewater Management Plan

Figure 1-3
Land Use 1951 and 1999

CDM Smith

1.2.2 Massachusetts Estuaries Project Watersheds

The Massachusetts Estuaries Project (MEP) is a multi-year study which evaluates the health of coastal bays and estuaries in southeastern Massachusetts, assesses nitrogen sources contributing to degraded conditions, and determines the nitrogen load reductions necessary to meet water quality standards. The University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST) is leading this effort by developing water quality models for approximately 89 Massachusetts estuaries. SMAST is working in conjunction with the MassDEP, the Cape Cod Commission (CCC), Coastal Zone Management, and other agencies and municipalities. The MEP uses comprehensive water quality testing and quantitative modeling to determine the specific levels and locations of nitrogen reduction required for the long-term preservation of surface and coastal water quality.

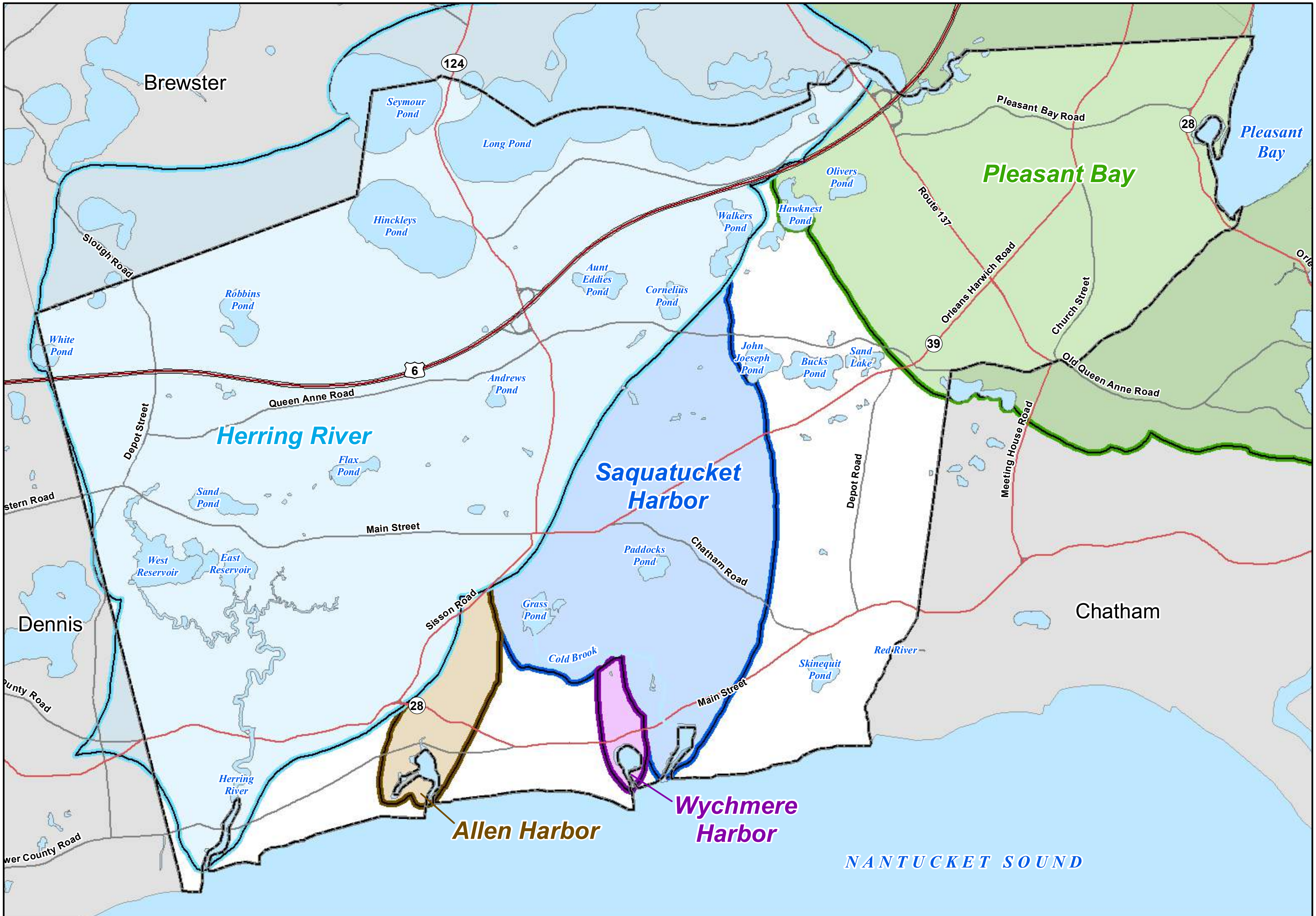
In Harwich, five embayments are being studied, as shown on Figure 1-4: Herring River, Allen Harbor, Wychmere Harbor, Saquatucket Harbor, and Pleasant Bay. All studies were initiated in 2004 and reports have been issued for each Harwich watershed. The Pleasant Bay system is a shared watershed with the towns of Brewster, Chatham, Harwich, and Orleans, and the Herring River system is shared with the towns of Dennis and Brewster. Based on the MEP studies, MassDEP has begun issuing Total Maximum Daily Load (TMDL) reports to the Town and surrounding communities which will ultimately need to be enforced, requiring the towns to remove sufficient quantities of nitrogen to meet the MEP goals in each embayment. Pertinent results from the MEP work are summarized in Section 6 of this report and are integrated into the recommended wastewater management program presented in Section 13.

1.2.3 Harwich Village Centers

The revitalization of Harwich's Village Centers, such as Harwich Port and Harwich Center, provides additional motivation for wastewater management planning. Land use, traffic, and wastewater planning efforts are intended to revitalize businesses and communities in these village centers. These properties are presently limited by how much wastewater they can adequately treat and dispose of on-site, with local or MassDEP approval. Planning efforts intend to direct growth in certain areas which will be supported by existing and planned infrastructure. Wastewater management improvements are necessary to provide off-site wastewater treatment and effluent recharge for the proposed revitalization and/or desired higher density growth.

1.3 Harwich Wastewater Management Subcommittee and Wastewater Implementation Committee

The Town's Wastewater Management Subcommittee (WMS) was formed in 2007 as a subcommittee to the town-wide Water Quality Management Task Force (WQMTF). The WMS was developed to oversee the development of the CWMP. The WMS also worked with a citizens Advisory Committee (CAC) who was charged with providing community input into the process. In 2014 the Board of Selectman merged with the WMS and CAC into a new Wastewater Implementation Committee (WIC). Each committee interacted and worked cooperatively with state and federal agencies, especially in relation to the MEP, and sought to understand the effects of wastewater discharges from septic systems and other nitrogen contributors on Harwich's estuaries and groundwater resources.



Legend
Watersheds
Allen Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor
Outside Watershed

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 1-4
Watershed Boundaries

CDM Smith

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The WIC is charged with more of a focus on finalizing the CWMP and implementing the recommended wastewater plan. The WIC is an active committee that meets almost monthly to review the progress of the initial phases of the CWMP including the natural nitrogen attenuation and enhanced estuary flushing projects, intermunicipal cooperation with neighboring communities, and evaluation of effluent recharge sites. The WIC is advisory to the BOS.

At present time, the WIC includes the following seven members supported by town representatives:

- Peter de Bakker, Chair
- Jeremy Gingras
- Danette Gonsalves (resigned 2016)
- Christopher Harlow
- Allin P. Thompson, Jr.
- Robert Cafarelli, Town Engineer
- Heinz Proft, Assistant Harbormaster/Natural Resources Officer

The Town and committee representatives providing support include the following members:

- Christopher Clark, Town Administrator
- Noreen Donahue, Finance Committee Liaison
- Michael D. MacAskill, Selectman Liaison

The WIC typically held monthly meetings throughout this process. All WIC meetings were open to the public and were publically advertised on the Town's website. Meeting agenda and minutes are also posted on the Town's website.

1.4 Purpose and Scope

1.4.1 Purpose

The primary purpose of this CWMP/SEIR is to evaluate the wastewater needs of the community and develop a recommended wastewater management program based on meeting the demands of the study areas considered to have the greatest need for wastewater solutions. The wastewater management alternatives evaluated consider the needs of residents, business owners, tourists and the local environment. The purpose of this CWMP effort is to ultimately restore degraded water bodies, allow the return of productive shellfish areas, encourage revitalization of the business areas, continue to protect drinking water supplies, and keep the beaches open for all to enjoy.

This report has been developed as a CWMP along with a Single Environmental Impact Report pursuant to the regulations of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Massachusetts Environmental Policy Act (MEPA) unit. Furthermore, it has been submitted for joint review by the Cape Cod Commission (CCC, or "Commission") under their Development of Regional

Impact (DRI) review process. Thus, it will undergo reviews by the EOEEA, MassDEP, the CCC, and other stakeholder groups and interested parties, via the public review and comment period associated with the MEPA process and subsequent DRI process.

Once the MEPA review process is complete the Town will formally begin the DRI review process with the Cape Cod Commission. This step is required even though the Cape Cod Commission will be involved throughout the MEPA process because the DRI cannot formally begin until the final MEPA certificate is issued. The Commission's early involvement in this planning process is beneficial for the Town to help ensure that issues raised by the CCC are addressed during the MEPA approval process to the extent feasible. The Commission's DRI process may undergo modifications resulting from the County's 208 Water Quality Plan (referred to herein as "the 208 Plan"). Harwich will work collaboratively with the Commission to complete this process within the new regulatory framework for watershed planning approvals, as applicable.

The steps presently anticipated during the regulatory review process are listed below:

1. Filed Draft CWMP/Expanded Environmental Notification Form (EENF), (February. 2013)
    a. Initiated Joint Review by the CCC, the EOEEA MEPA unit, and MassDEP (MEPA #15022)
2. Received certificate from the MEPA unit on the Draft CWMP/EENF (April, 2013)
3. Submit Final CWMP/SEIR (March, 2016)
4. Receive final Secretary's Certificate from the MEPA unit on the CWMP/SEIR
5. Begin formal DRI review process with the CCC

1.4.2 Scope

This CWMP/SEIR summarizes relevant data and previous projects relating to wastewater management, explains public participation programs and coordination with other projects, summarizes the wastewater needs assessment, estimates wastewater flows, evaluates effluent recharge sites, proposes possible wastewater management alternatives, and selects a recommended alternative based on a preliminary comparison of costs as well as technical, institutional and environmental criteria. The recommended alternative is then rolled into a complete recommended program for wastewater management in Harwich. The recommended program is then analyzed in detail with regards to hydrogeologic considerations, construction and environmental impacts, and program financing.

The recommended wastewater management program put forth in this CWMP/SEIR is a guide for the Town to follow based on current conditions and regulations. Should the Town desire to make changes to the program in the future based on water quality monitoring feedback, changing community interests, new pertinent options that may arise with adjacent communities, or other appropriate factors, it may do so utilizing the appropriate regulatory review procedures.

1.5 Water Quality Discussion

The Harwich CWMP/SEIR presents a recommended program that complies with current water quality regulations. However, due to the cost of this overall program, some Harwich stakeholders have questioned the cost/benefit of full compliance and whether the appropriate standards are being applied to the specific scenarios encountered in town. The vast majority believe water quality is extremely important to the quality of life in town and that a nutrient problem exists that must be addressed in the near future. The critical question is how far does the program need to go in order to adequately address the issue. The Herring River and Pleasant Bay watersheds are sensitive areas that have historically supported ecological diversity, including eelgrass, and should be protected based on current water quality standards. However, the Allen, Wychmere and Saquatucket Harbor watersheds are essentially manmade harbors or boat marinas which have historically exhibited less sensitive ecological diversity and no eelgrass. Establishing water quality parameters to be attained based on the highest and best use versus the current use is the current regulatory answer. The discussion below is intended to provide an overview of the key regulations governing this process and some of the issues to monitor during the initial phases of implementation of this plan.

The federal Clean Water Act (CWA) was enacted 40 years ago (October 18, 1972) to mainly address the raw discharge of sewage and other pollutants into our nation's waters. Point source pollution has been addressed through issuance of and compliance with National Pollutant Discharge Elimination System (NPDES) permits. Significant progress in cleaning up our waters has been achieved and many of these water bodies are once again used for fishing, swimming and more. While progress has been made, about 40 percent of the nation's lakes, ponds, rivers, wetlands and coastal waters remain impaired due to pollution. Thus, Massachusetts and other states are now addressing nonpoint sources of pollution including stormwater, septic systems and erosion to clean-up these waters. MassDEP is charged with issuing TMDLs on a watershed basis under the provisions of the CWA for a given water body. The TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards for protecting public health and maintaining the designated beneficial uses of those waters for drinking, swimming, recreation and fishing.

Pollution to waterbodies can be man-made or natural. It includes such things as stormwater run-off, nutrients in effluent from septic systems, effluent from wastewater treatment plants, applied chemicals, eroding soils, and naturally decaying organic matter. Pollutants include heavy metals, toxic chemicals, nutrients, fecal coliform bacteria and oil and grease.

The MassDEP has adopted several Code of Massachusetts Regulations (CMRs) that address Surface Water Quality Regulations (314 CMR 4.00), Groundwater Quality Regulations (314 CMR 5.00), and Ocean Sanctuaries (302 CMR 5.00). Each is briefly discussed below.

Surface Water Quality Regulations – designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained and protected; prescribe the minimum water quality criteria required to sustain the designated uses; and contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges. These regulations segment the waters of the Commonwealth into classes that are based upon the most sensitive, and therefore governing, water uses to be achieved and protected. Class A is the highest inland water quality class while Class SA is the highest coastal and marine class and the one most relevant to this CWMP. Waters designated as SA are designated as an excellent habitat for fish, other aquatic life and wildlife, including for reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. These waters may also be designated for shell fishing and shall have excellent aesthetic value. Water quality standards for Class SA waters mainly include dissolved oxygen (DO), solids, turbidity, temperature, bacteria, pH and oil and grease. The classification of a water body is set based on its highest and best use, rather than on its current use today. Thus, most coastal and marine waters are designated Class SA, with very few Class SB, and no current Class SC waters in the Commonwealth (B. Dudley, MassDEP, 12-15-10).

The MEP studies conducted for Harwich establish water quality criteria with the goal to restore each embayment back to full compliance with Class SA criteria. This results in significant nitrogen removal requirements in order to achieve those criteria requiring costly programs. This has led some to question the value of 100 % compliance. For instance many have questioned the value of restoring Allen, Wychmere or Saquatucket Harbors back to fishable and swimmable water quality when they in fact act as functioning marinas/ boat basins. Similarly, some have questioned whether the oil and grease, turbidity and DO criteria can truly be attained with the present uses of these harbors. These harbors are quite different than the Herring River Embayment system which includes a large marshland system to the north and the Pleasant Bay system which is a large open water body. Yet the Class SA criteria are the same for each. Some groups, such as the Cape Cod Collaborative, have begun to discuss ways to try and meet the intent of the regulations while modifying the regulations to account for specific uses. Harwich stakeholders understand they have a nitrogen related issue in their harbors and embayments but like many communities facing costly restoration programs they wonder how the regulations might be modified to account for specific uses. Should modifications be allowed in the future then the recommended program put forth herein can be revised via adaptive management. The recommended phasing plan for the wastewater program is designed to account for some of these discussions should potential changes occur.

Groundwater Discharge Permit Program Regulations – control the discharge of pollutants to the groundwater of the Commonwealth to assure that groundwater is protected for actual and potential use as a source of potable water, that surface waters are protected for their existing and designated uses, and to assure the attainment of the Surface Water Quality Regulations. As these regulations relate to the Harwich CWMP, they govern the criteria that must be attained in the liquid effluent resulting from treatment of wastewater at a treatment plant that receives 10,000 gallons per day or more. Criteria vary depending on the location of the effluent recharge to land and its relationship to a public water supply well. Criteria can include total suspended solids, turbidity, total organic carbon, biological oxygen demand, and total nitrogen and/or nitrate nitrogen. The parameters for these criteria change based on how close or far away the effluent recharge is to the well in terms of time of travel in the groundwater. Hydrogeologic studies must be done to help support the requirements established in the groundwater discharge permit. The level of nitrogen allowed in the effluent will also be linked to the receiving coastal or marine water so that the nitrogen TMDL is attained.

Ocean Sanctuaries Act – is designed to work through the Commonwealth's Coastal Zone Management Program to protect ecologically significant resource areas for their contributions to marine productivity and value as natural habitats and storm buffers. The Massachusetts Department of Environmental Management (MassDEM) is charged with enforcing 302 CMR 5.00: Ocean Sanctuaries which was promulgated to carry out the provisions of M.G.L. c. 132A, 13 through 16 and 18, the Ocean Sanctuaries Act. This Act created five ocean sanctuaries of which three relate to Cape Cod: Cape Cod Ocean Sanctuary, Cape Cod Bay Ocean Sanctuary and Cape and Islands Ocean Sanctuary. Per 302 CMR 5.08(9)(a) no municipal wastewater treatment discharge into these ocean sanctuaries shall be allowed. Potential variances include proving an ocean discharge would be the only feasible alternative which includes detailing there is no approvable method of land application for the effluent recharge and that the ocean discharge is of equal or greater effectiveness in avoiding degradation of the water quality of the affected ocean sanctuary. Several communities on Cape Cod have discussed trying to implement a regional ocean outfall mainly due to the very high quality of the treated effluent and the difficulty in finding acceptable land recharge sites. Harwich stakeholders remain interested in those discussions and could revise their recommended program in the later phases through adaptive management should this prohibition be overcome. An ocean outfall scenario for Harwich only has been included in the alternatives analysis herein for comparative purposes. In 2014 legislation was passed to M.G.L. Chapter 132A, Section 16G which allows for new or modified discharges to an ocean sanctuary if several conditions are met, including the effluent must meet the water quality standards of the receiving water body and the standards of the act to protect the appearance, ecology and marine resources of the waters in the sanctuary. Currently, the opinion of some stakeholder groups in Harwich is that effluent recharge to the land is the preferred approach as it helps replenish the groundwater table.

In summary, each of the five MEP watershed study areas in Harwich needs to have nitrogen removed and the program developed in this CWMP is designed to do so according to water quality regulations as they exist today. However, several groups and communities are discussing the ultimate criteria or endpoint standards that must be attained in these regulations since getting to that endpoint is a costly endeavor. Harwich stakeholders understand something needs to be done and that nitrogen needs to be reduced to help restore the water quality in its valuable marine waters. As that plan for nitrogen reduction is implemented, discussions about the ultimate water quality endpoints should continue and the recommended program modified in the later phases via adaptive management based on those discussions. That flexibility has been built into the program developed for Harwich.

1.6 Organization of this CWMP/SEIR

This report is divided into fourteen sections. The sections are as follows:

- Executive Summary presents an overview of the report and the findings.
- Section 1 introduces the CWMP project and details the purpose, the scope, existing conditions, applicable water quality regulations, and the organization of the report.
- Section 2 discusses public participation programs, as well as ongoing projects and groups relevant to the CWMP/SEIR development.
- Section 3 summarizes past and present data related to the CWMP/SEIR.
- Section 4 provides a summary of existing water quality data in Harwich.
- Section 5 discusses the health of the Town’s freshwater ponds and associated wastewater needs identified to help protect these resources.
- Section 6 describes the findings of the Massachusetts Estuaries Project for the five applicable watersheds in Harwich.
- Section 7 summarizes the existing wastewater flow quantities in Harwich and establishes the baseline flow data for the evaluation of wastewater management alternatives.

- Section 8 provides details of the wastewater needs assessment identifying the areas of town requiring off-site solutions.
- Section 9 describes the evaluation of potential effluent recharge sites and recommends specific sites to be carried forward into Section 10.
- Section 10 presents eight wastewater management alternative scenarios and a comparative analysis to narrow down to three preferred alternatives.
- Section 11 summarizes the hydrogeologic evaluations of the preferred effluent recharge sites.
- Section 12 provides a further analysis of alternatives, narrowing the three preferred alternatives from Section 10 down to one recommended alternative for wastewater management.
- Section 13 presents the recommended program for wastewater management, incorporating the recommended alternative from Section 12 and other components to enhance environmental protection and meet other town goals.
- Section 14 presents environmental impacts and mitigation pertaining to the implementation of the proposed recommended program.
- Section 15 describes the Town's cost recovery plan proposed for financing the recommended program.
- Section 16 presents a construction management plan detailing mitigation measures proposed to minimize construction-period community and environmental impacts.
- Section 17 lists the Section 61 Findings applicable to permitting of the recommended program.
- Section 18 provides a list of comments received on the February 2013 Draft CWMP/EENF and associated responses.

The appendices contain backup analyses, figures and documentation.

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Section 2

Public Participation Programs and Coordination with Other Projects

2.1 Introduction

This section summarizes ongoing projects being coordinated with the Comprehensive Wastewater Management Plan (CWMP) and Single Environmental Impact Report (SEIR), including local initiatives and public participation programs relevant to development of the CWMP/SEIR. The public participation program includes meetings of the Wastewater Implementation Committee (WIC) and Board of Selectmen (BOS), and other public presentations and hearings conducted as part of the environmental and community review process.

2.2 Local Initiatives

Harwich has a 5-year *Local Comprehensive Plan*. The Comprehensive Plan has an overarching vision to "have a superlative educational system for our students, rewarding activities for our seniors, and enhance[d] vitality of our cultural, recreational, and natural assets." The following summarizes the Comprehensive Plan components related to the CWMP initiative and the WMS task to complement the Town's development goals. A copy of the Local Comprehensive Plan can be found at the Town website: http://www.harwich-ma.gov/planning/pages/local-comprehensive-plan-2011.

2.2.1 Local Comprehensive Plan – Villages

The Town's most recent Local Comprehensive Plan was adopted on May 3, 2011. According to the Comprehensive Plan, the commercial districts of East Harwich, Harwich Port, and Harwich Center are each undergoing independent plans for development and redevelopment appropriate to the character of these cultural and commercial centers. Such spaces will continue to enhance the pedestrian culture and offer a positive experience for residents and visitors alike. The remaining commercial district abutting Route 28 should be encouraged to maintain its viability while the Town focuses on developing the existing centers and preserving the historic integrity of the area.

East Harwich, an area which has undergone rapid commercial development in the last 20 years, is located within the nitrogen-sensitive Pleasant Bay watershed. Development for this area is particularly focused on a pedestrian environment where new structures are located in the village center, preserving open space without overburdening existing infrastructure. The zoning framework includes increased residential density in the central village with density decreasing in surrounding areas, mixed commercial and residential areas, increased pedestrian infrastructure including sidewalks and bike lanes, a variety of housing units, and standard guidelines for site and building design. East Harwich is considered to be a center for year-round residential activity. Planning initiatives are ongoing in this area of town.

Harwich Port, the original economic center of the Town, will undergo development which protects its beaches and harbors along Nantucket Sound while "revitalizing its role as a village center." As with the eastern village, water quality in Harwich Port is an issue which must be addressed to achieve development goals. Wastewater treatment for this summer activity center is a priority, as local regulations designed to address water quality issues have limited commercial enterprises from expanding services. Residential septic systems, particularly in high-density development areas, are not meeting current local standards. Harwich Port abuts Wychmere and Squatucket Harbors, both of which require significant nitrogen removal based on the MEP studies. Pedestrian infrastructure, including sidewalks and bike paths, are in line to aid with parking constraints along the shore. Remote parking, complemented by shuttle connections, is also being considered for increased beach and waterway access.

Harwich Center houses a majority of historical buildings and municipal services including the Town Hall, Brooks Free Library, Brooks Park, and the Old Colony Bike Trail, along with nearby public schools and the Community Center. As with the other areas, pedestrian infrastructure is encouraged with expanded sidewalks and bikeways in addition to more accessible vehicular transport, parking, and wastewater treatment; however, all improvements are modest in nature and meant to focus primarily on enhancing rather than reconstructing this portion of town.

2.2.2 Water Quality Management Task Force

In response to the Town's Comprehensive Plan, the Harwich Water Quality Management Task Force (WQMTF) was established to develop a town-wide management plan which addresses current and future surface water quality of the Town's natural assets. In response to the charged responsibilities, the WQMTF established the Wastewater Management Subcommittee and subsequently the Wastewater Implementation Committee to accomplish the following scope of work:

- Define the water quality problem.
- Identify and define levels of acceptable water quality.
- Identify and characterize all potential sources of water quality infringement in each watershed.
- Determine the impact of future growth and development on water quality consistent with the Comprehensive Plan if no action is taken.
- Develop a comprehensive database for water quality management.
- Identify candidate solutions/remedies.
- Develop a cost benefit analysis for candidate solutions.
- Develop educational materials regarding water quality for use by the general public.
- Develop a clear, concise set of goals and objectives for water quality management.
- Develop a CWMP.
- Conduct public hearings on the CWMP.

- Revise the plan based upon public input.
- Submit a completed draft CWMP to the Board of Selectmen including an action plan, timetable, relevant cost estimates and approaches to funding prior to state agency review.
- Begin implementing the initial pieces of the Recommended Plan.

The Wastewater Management Subcommittee was tasked with developing this CWMP/SEIR in a manner that incorporates future development strategies, addresses current water quality concerns, meets state-mandated TMDLs, and balances the wastewater needs of the community with financially feasible solutions. Community meetings and coordination with the Board of Selectmen have helped to ensure that the process achieves the most appropriate solution for the residents of Harwich.

The WIC was charged with more of a focus on finalizing the CWMP/SEIR and implementing the recommended wastewater plan.

2.3 Regional Initiatives – 208 Plan

In 2013, MassDEP directed the Cape Cod Commission to prepare an update to the 1978 Water Quality Management (WQM) plan for Cape Cod to address the degradation of Cape Cod's water resources from excessive nutrients, with a primary focus on nitrogen. With this directive, the Massachusetts Water Pollution Abatement Trust committed to provide the Commission with $3.35 million to fund an update to the 1978 plan in accordance with Section 208 of the Clean Water Act, referred to herein as the "208 Plan."

The 1978 Section 208 Plan for the Cape Cod described the major water quality and wastewater management issues on Cape Cod at that time. That plan recommended land use controls, wastewater management, nonpoint source controls and institutional arrangements to improve water quality while attempting to address the summer population influx throughout Cape Cod that is cited as an additional source of water quality and wastewater management problems. Drinking water quality and quantity were the focus of the 1978 Plan, which included recommendations for Water Resource Protection Areas where residential density would be limited and major polluting uses would be prohibited in order to protect groundwater, surface waters, and coastal waters. The 1978 Plan generally concluded that septic systems in compliance with Title 5 of the Massachusetts Environmental Code (310 C.M.R 15.00) were an appropriate form of wastewater management for the existing and planned development on Cape Cod. At the time, about 90% of the Cape's year round population relied on on-site septic systems and the plan recommended that the majority of the population could continue to rely on this form of disposal for the 20-year planning period.

After the 1978 plan was issued, the population of Cape Cod continued to increase and the volume of nutrients entering its coastal waters and freshwater ponds increased. Most of the development associated with the most recent growth came largely from single family homes and summer residences. By the 1990s it became clear that maintenance of on-site septic systems would not protect Cape Cod's estuarine environments. Excessive nutrients, such as nitrogen and phosphorus, were documented as the cause of eutrophication (degraded water) in a majority of Cape Cod estuaries and freshwater ponds. In the estuarine systems, nitrogen from several sources was linked directly to the build-up and presence of thick mats of algae that replace eelgrass (a healthy water environment indicator), diminish shellfisheries, and decrease dissolved-oxygen concentrations. Most importantly, it was demonstrated that wastewater accounted for about 80% of the controllable nitrogen load entering Cape Cod's coastal waters.

In 2001, MassDEP implemented the Massachusetts Estuaries Project (MEP) to develop nitrogen limits for 89 embayments in Massachusetts. Rather than a simple planning document, the MEP project developed nutrient based reports that identify embayment-specific nitrogen loading limits based on sound science. The results of the MEP reports were then available to develop strategies to reduce nitrogen in specific embayments.

Following completion of each MEP report, MassDEP issues a Total Maximum Daily Load (TMDL) report for each watershed/estuary studied in the MEP program. In this case, the TMDL is the summary of the MEP report that specifies the maximum amount of a pollutant that a waterbody can accept and still meet the state's water quality standards for public health and healthy ecosystems. The MEP report forms the basis of the TMDL by documenting the MEP model results and identifying potential nitrogen reduction approaches. To determine the most cost-effective solutions, communities must understand the TMDL and how the pollutant loads are generated in the watershed. The updated 208 Plan was developed as a resource to help communities better understand how to manage those nitrogen reduction approaches.

The Status of the TMDL's for Harwich are listed below:

1) Allen, Wychmere and Saquatucket Harbors – Pending (Draft TMDLs issued April 2015).
2) Herring River – Pending (Draft TMDL issued April 2015).
3) Pleasant Bay – Final TMDL issued May 2007.

In 2014, the Draft 208 Plan was released by the Cape Cod Commission. This new plan is a watershed-based approach focused on the restoration of embayment water quality on Cape Cod. Unlike the 1978 plan which focused on water supply, this new plan refocuses its efforts on wastewater and recommends strategies, regulatory reforms and processes for communities to consider to reduce or eliminate excess nitrogen. The plan is actually a framework that is designed to help each individual community on the Cape develop a strategy that fully meets the environmental goals set forth by the MEP and MassDEP.

As part of the 208 Plan, the Cape Cod Commission developed a number of tools for use by communities; some are geared toward residents while most are geared toward those planning nitrogen reduction solutions for their respective towns or watersheds. These tools include:

- Watershed MVP – allows comparison of nitrogen removal capabilities of different technologies.
- Watershed Tracker – tracks nitrogen loads through sub-embayments.
- Watershed Calculator – tracks cumulative nitrogen reductions through layered application of technologies.
- Technologies Matrix – continually-updated source of information on all traditional and non-traditional technologies and their historic use and performance.

- Update to Barnstable County Cost Report – updated version includes cost estimates for the full range of traditional and non-traditional technologies included in the 208 Plan.
- Triple Bottom Line Model – considers social, economic, and environmental consequences of water quality investments.
- Triple Value Simulation – sustainability tool that considers environmental and societal costs of further water quality degradation.
- Site Screening Viewer for Non-Traditional Technologies – presents possible sites for select non-traditional technologies.
- Financial Model – includes four modules: cost, financing, affordability, and revenue.

According to the plan, towns are responsible for their "fair share" of nitrogen removal in each shared watershed (i.e., equivalent to the percentage of their contribution of nitrogen to the watershed). The CCC recommends that a full range of technologies be included in the public discussion about potential solutions including a "hybrid watershed planning approach," which includes the following steps:

- Identify Target Reductions and Goals – Based on the MEP reports, determine the amount of nitrogen reduction required in each watershed. For watersheds without complete MEP reports, 25% reduction has been used as a placeholder.
- Identify Areas of Concern or Need – These are areas that cannot continue to rely on Title 5 septic systems such as areas with Title 5 compliance issues (depth to groundwater, poor soils, inadequate space, etc.), desired higher-density growth areas, and pond recharge areas. These areas should be identified as priority wastewater collection areas for non-nitrogen reasons.
- Non-septic Controllable Nitrogen Load Management – Target stormwater and fertilizer nitrogen reduction to the extent feasible.
- Non-collection Remediation – Select from the broad range of innovative and non-traditional nutrient management options in the plan, explore their feasibility, and identify potential sites.
- Non-collection Source Reduction – Consider options for source reduction such as ecotoilets and I/A systems, and identify areas where these may be feasible or practical.
- Collection – If the cumulative nitrogen reductions from the preceding steps have not achieved the required nitrogen reduction, then consider additional sewering.

These tools are provided to the communities and their consultants with the intent of providing the smallest, most cost-effective sewershed footprint that will achieve the nutrient reduction goals of the MEP. This is intended to be an iterative process which is continually revisited using an adaptive management approach whereby progress is continually monitored and the plan is updated accordingly. Since travel time of nitrogen through groundwater is less than 10 years across almost half of the Cape's land area, once implemented, nitrogen management measures should show water quality improvements within a 5-10 year timeframe in most embayments.

Harwich's CWMP/SEIR is fully in line with the 208 Plan, since Harwich's approach is based on the MEP nitrogen loading models with the goal of achieving the most cost-effective sewershed footprint while keeping costs to a minimum. The Town's wastewater scenarios utilized a hybrid approach similar to that suggested in the 208 Plan, combining both traditional and non-traditional technologies with an iterative process to develop the most cost effective recommended plan with the intent of continually revisiting that plan using an adaptive management approach. Over the course of the entire implementation period, progress will be monitored and the plan will be updated accordingly.

2.4 Public Presentations and Hearings

The WIC and BOS have continued to engage the public throughout the development of this CWMP/SEIR. Public participation in the CWMP/SEIR development has primarily been through the Town's Board of Selectmen meetings, WMS meetings open to the public, and other community meetings.

CDM Smith has worked with the WIC and BOS through a series of monthly meetings to complete this Final CWMP/SEIR. All of these meetings were open to the public and meeting minutes are published on the Town's website. The committee has reviewed this report and developed informed decisions to best meet Harwich's needs.

The following is a summary of all meetings which have been held on this CWMP/SEIR to date:

- The WMS and WIC have collectively held approximately sixty monthly project status meetings since August 2007; these meetings were open to the public and meeting times and agendas were advertised and posted on the Town's website. All of the meeting minutes were posted with the town clerk throughout the project. Minutes from 2013 through 2016 are posted on the Town's website at: http://www.harwich-ma.gov/node/2541/minutes.
- Several community meetings have been held to help develop this CWMP including the following dates:
    - September 27, 2007. CWMP Community Meeting No. 1. Topics included: the need for a citizens advisory committee, what is a comprehensive wastewater management plan, description of the planning process, project schedule, and opportunities for public input.
    - January 10, 2008. CWMP Community Meeting No. 2. Topics included: an update on the town-wide Comprehensive Wastewater Management Plan and the Massachusetts Estuaries Project (MEP).
        - This community meeting included a presentation by Dr. Brian Howes from the School of Marine Science and Technology titled Estuaries in the Town of Harwich: Present Health and Steps toward Restoration.
    - March 27, 2008. CWMP Community Meeting No. 3. Topics included: an existing conditions report along with preliminary wastewater findings based on projected growth in the area.

- April 21, 2011. CWMP Community Meeting No. 4. Topics included: presentation and discussion of the site screening process for effluent recharge sites, sites identified, and next steps in site selection.

- March 29, 2012. CWMP Community Meeting No. 5. Topic included: three options to be evaluated for wastewater treatment. One option will be selected to meet the overall wastewater needs of the community.

- January 19, 2013. Board of Selectmen Workshop. Topic included: General overview of the CWMP and the Recommended Plan.

- April 3, 2013. Cape Cod Commission Hearing. Topic included: General overview of the CWMP and the Recommended Plan.

- December 18, 2004. Board of Selectman Presentation. Overview of Harwich's Proposed Wastewater Program.

- May 11, 2015. Board of Selectmen Presentation. Topic included: Recommended cost recovery model for the wastewater program.

- June 17, 2015. Board of Selectmen and WIC Presentation. Topic included: Joint Workshop on wastewater planning, the need to study wastewater, the proposed solution, and the proposed cost recovery model.

- August 10, 2015. Non-Residents Meeting. Overview of Wastewater Issues facing Harwich and Proposed Solutions.

Information from these public presentations can be found in Appendix A of this report.

Frequently Asked Questions can be found on the Town's website at:

As this project progresses through the review of this CWMP/SEIR, the Town will continue to solicit public input and provide outreach and educational opportunities to ensure that the final recommended program for wastewater management addresses the needs of the community.

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Section 3

Summary of Relevant Data

3.1 Introduction

The first step in assessing the wastewater needs of the Town was to compile available data from various sources including local, regional, and state resources to characterize existing conditions. This section summarizes the data obtained for this CWMP/SEIR from each data source and describes its relevance to the CWMP process.

3.2 Past Reports and Studies

The following reports and studies were gathered during the development of this CWMP/SEIR. These reports originated largely from either the Town or state environmental agencies.

- "Performance of Innovative/Alternative Onsite Septic Systems for the Removal of Nitrogen in Barnstable County, Massachusetts 1999 –2007," Barnstable County Department of Health and Environment;
- "Linked Watershed Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster, and Harwich, Massachusetts," May 2006, Massachusetts Estuaries Project;
- "Final Pleasant Bay System Total Maximum Daily Loads for Total Nitrogen," May 2007, MassDEP Bureau of Resource Protection;
- "MEP Technical Memo, Updated Water Use and Muddy Creek Nitrogen Attenuation and Nitrogen Loading to Pleasant Bay," June 25, 2010, Massachusetts Estuaries Project;
- "MEP Technical Memo, MEP Scenarios to Evaluate Water Quality Impacts of the Addition of a 24 foot Culvert in Muddy Creek Inlet," October 5, 2010, Massachusetts Estuaries Project;
- "Linked Watershed Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Allen, Wychmere and Saquatucket Harbor Embayment Systems, Harwich, Massachusetts," June 2010, Massachusetts Estuaries Project;
- "Linked Watershed Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Herring River Embayment System, Harwich and Dennis, Massachusetts," June, 2012 Massachusetts Estuaries Project;
- "Final Report – Natural Attenuation of Nitrogen in Wetlands and Waterbodies," April 2007, MassDEP;
- "Fecal Coliform Evaluation and the Mitigation Planning for the Allen's Harbor Watershed, Town of Harwich, Massachusetts," May 2003, Stearns & Wheler;
- "Technical Memorandum – Summary of USGS Modeling of Potential Effluent Recharge Sites," October 3, 2006, Stearns & Wheler, LLC;

- "Evaluation of Wastewater Management Options for Freshwater Ponds, Guidance Document and Case Study Report for The Great Sand Lakes," June 2007, Stearns & Wheler, LLC;
- "Comprehensive Site Assessment, Queen Anne Road Sanitary Landfill," May 1998, Weston & Sampson Engineers;
- "Ecologic Memorandum, Harwich Ponds," June 30, 2008, EcoLogic, LLC;
- "Ecologic Memorandum, Harwich Ponds, 2009-2010 Data Review," April 18, 2011, EcoLogic, LLC;
- "Skinequit Ongoing Pond Study," December 7, 2005, Harwich Natural Resources Department;
- "Review and Interpretation of Harwich Ponds Volunteer Monitoring Data, Final Report," December 2006, Cape Cod Commission Water Resources Program;
- "Brewster Freshwater Ponds: Water Quality Status and Recommendations for Future Activities, Final Report," September 2009, SMAST Coastal Systems Group and Cape Cod Commission Water Resources Program; and
- Town of Harwich Local Comprehensive Plan, latest plan adopted May 2011.

These reports were used to understand the existing conditions within the Town and within particular watersheds.

3.3 GIS Data

Geographic Information System (GIS) data layers used during the data accumulation phase were available from several sources. GIS coverages were obtained from MassGIS, the Cape Cod Commission (CCC), the U.S. Geological Survey (USGS), and the U.S. Department of Agriculture (USDA). Table 3-1 lists all GIS data sources including MassGIS, the USGS, and the USDA, along with the year the data were obtained. CCC data sources are described separately in the next subsection.

Table 3-1
Summary of GIS Data Sources

Information	Source	Date
Orthophotos (Aerial Photos)*	MassGIS	2005 & 2009
Wells & Zone IIs**	MassGIS	2007 & 2010
100-Year Floodplain	MassGIS	2007
Wetlands***	MassGIS	2006 & 2009
Natural Heritage and Endangered Species Program Priority Habitat Areas	MassGIS	2006 & 2008
Surficial Geology	MassGIS	2007
Soils	USDA	2011
Freshwater Ponds	USGS	2006
Estuaries	USGS	2008
Groundwater Contours	USGS	2008

*BING orthophotos have also been used during the course of the project.
**Zone II data were updated in 2010, but the majority of CWMP analyses were already performed using the 2007 data.
***No changes were made in Harwich between the 2006 and 2009 MassGIS wetlands data layers.

3.4 CCC Data

The Cape Cod Commission is the regional planning agency for Cape Cod, Massachusetts. Where MEP watersheds cross town boundaries, parcel information for adjacent towns was required to assess alternatives for meeting MEP goals. Watershed boundaries and parcel data for adjacent towns were provided by the CCC. Table 3-2 below lists the information obtained from the CCC and the date of the data.

Table 3-2
Data Obtained from the Cape Cod Commission

Information	Date
MEP watersheds and subwatersheds	various
Water use data (for Harwich)	2004
Harwich parcel information	2006
Brewster parcel data	2006
Orleans parcel data	2004
Chatham parcel data	2004
Dennis parcel data	2009

3.5 Groundwater

Groundwater contours in Harwich are shown on Figure 3-1. This figure was produced using USGS steady state current conditions modeling from early February 2008. The groundwater contours are shown in blue on a USGS topographic map to relate the groundwater contours to ground surface contours.

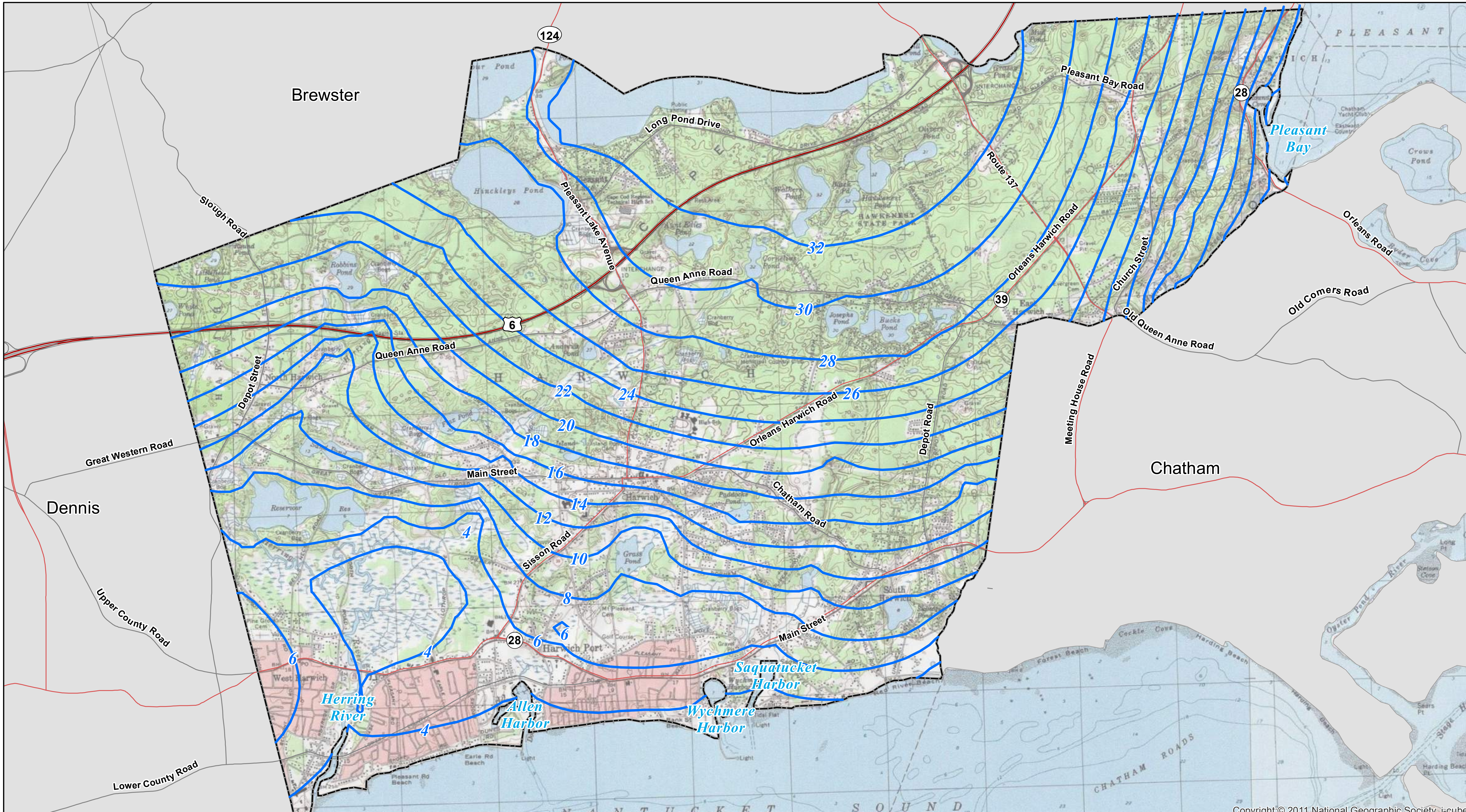
Figure 3-2 shows three ranges of depth-to-groundwater. Areas in orange are located where the depth-to-groundwater is expected to be 5 feet or less. Areas in light green depict locations where groundwater may be encountered at a depth of 5 to 15 feet. The dark green regions show areas where the groundwater is more than 15 feet below the ground surface. Note that groundwater levels are dependent on the season during which measurements are taken. The levels shown on this map are intended to reflect average annual conditions.

Generally, shallow depths to groundwater occur closer to the shore and adjacent to waterways. Interviews with Harwich Board of Health (BOH) officials and a local soil evaluation consultant report that especially shallow depths to groundwater are seen in areas along the bogs south of Great Western Road and near Cranberry Lane.

Developed properties in the areas with up to a 5-foot depth to groundwater may have on-site septic systems that are too close to the groundwater table at certain times of year and may provide less than adequate treatment. Alternatively, systems in these areas may require mounded systems to achieve the appropriate separation between groundwater and the leaching field.

3.6 Wetlands

Figure 3-3 shows the extent of wetlands coverage in Harwich as of 2007. As listed above, this information came from MassGIS and is dated 2006. MassDEP updated the wetlands layer again in 2009, but there were no changes identified in Harwich.



Legend

Groundwater Contours (ft)

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-1
Groudwater Contours

CDM Smith

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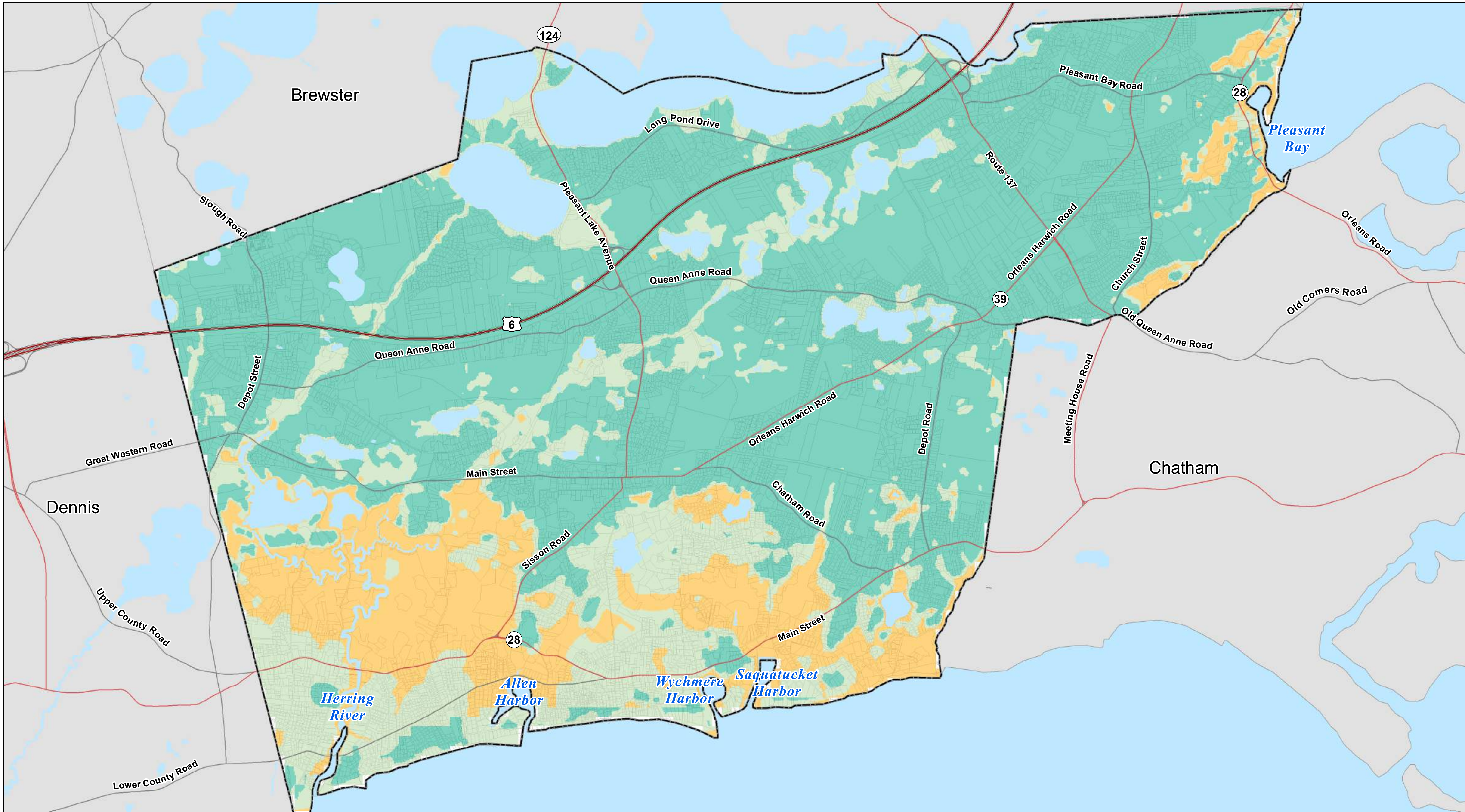

Legend

Water Table Distribution (feet below ground level)

- < 5 feet
- 5 - 15 feet
- > 15 feet

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-2
Depth to Groundwater

CDM Smith

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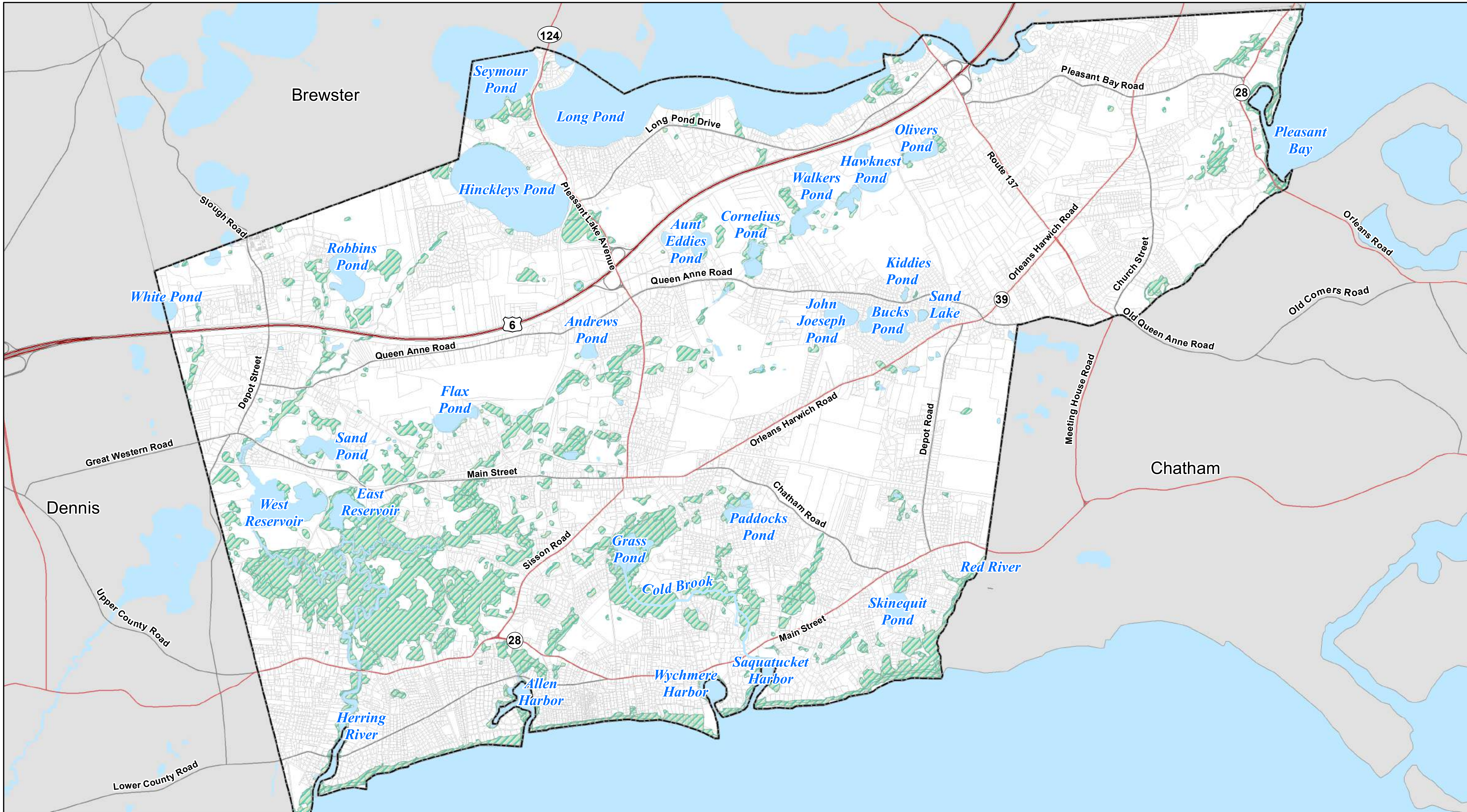

Legend

Wetlands

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-3
Defined Wetlands

CDM Smith

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Wetland locations are relevant in that setback requirements dictate the allowable proximity of on-site septic systems to wetland resource areas. Furthermore, wetland areas by definition have high groundwater conditions during the spring season and are indicative of less permeable and more organic soil types.

3.7 Floodplains

Areas of 100-year floodplain used for the alternatives analyses contained within this CWMP/SEIR are shown on Figure 3-4. Shoreline velocity zones (listed as VE zones) are also shown on this figure. MassGIS is the source of this information. This data layer shows the extent of the 100-year floodplain and velocity zones as of 2007 and is based on the Federal Emergency Management Agency's Flood Insurance Rate Maps. Note that new maps have been issued since 2007, which were considered in the assessment of environmental impacts included in Section 14. A map showing the updated floodplain boundaries is thus included in Section 14.

3.8 Natural Heritage and Endangered Species Program

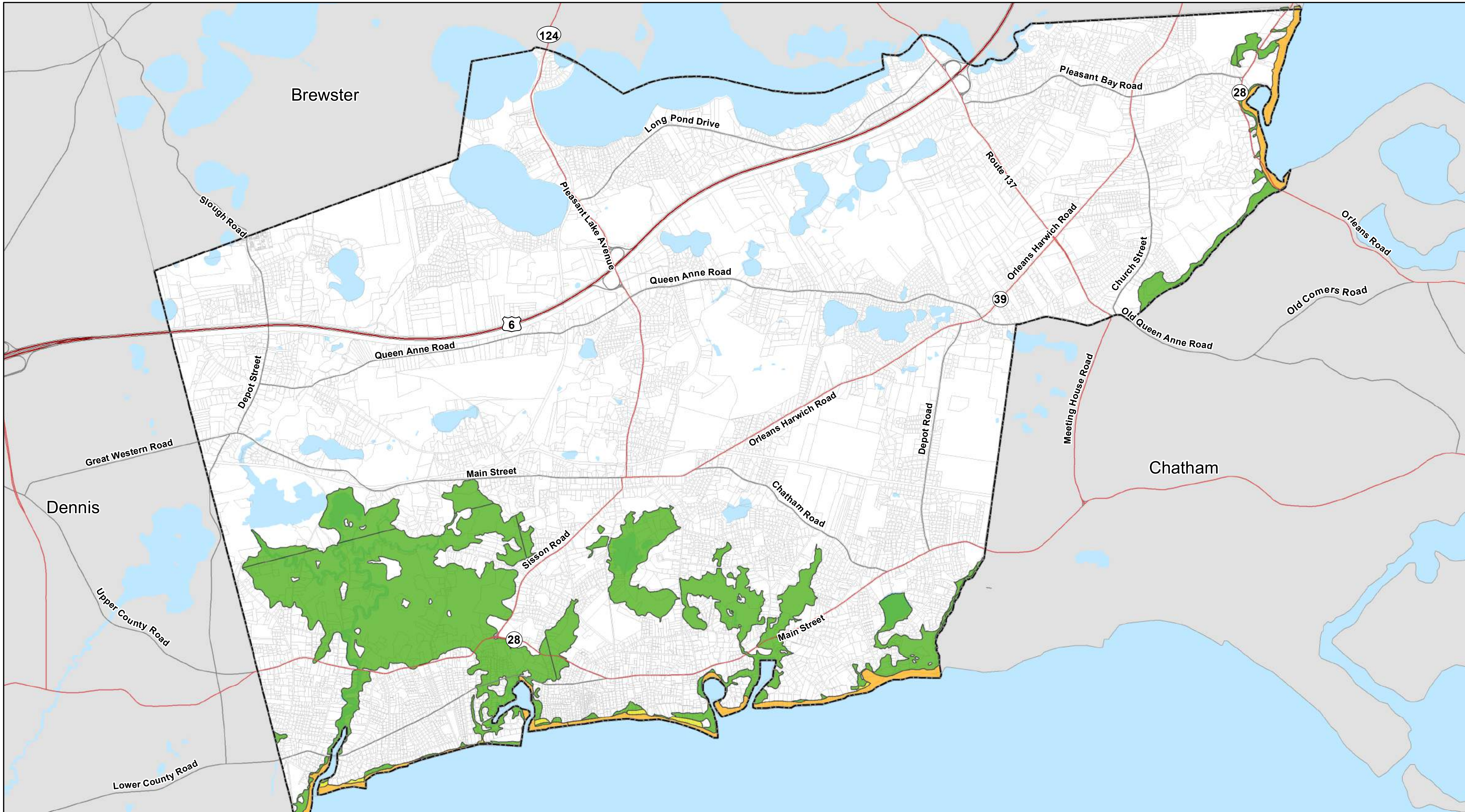
The Natural Heritage and Endangered Species Program (NHESP) is part of the Massachusetts Division of Fisheries and Wildlife. The priority of the NHESP is the protection of habitat for the animals and plants officially listed as "Endangered, Threatened, or of Special Concern" in Massachusetts. Boundaries of priority and estimated habitat areas are shown in the Natural Heritage Atlas. Work within the boundaries defined in the atlas requires regulatory review. The most recent edition of the Natural Heritage Atlas was published in 2008, and the boundaries were obtained for this project via data layers obtained through MassGIS in 2006 (previous edition) and 2008. The 2008 data is shown on Figure 3-5.

3.9 Soils

Understanding the general surficial and subsurface conditions in a community is an important component in formulating long-term wastewater management options. Soil conditions impact both the efficacy of individual on-site systems and the suitability of a site for effluent recharge from a larger scale treatment system. The following subsections describe the available soils and surficial geology data evaluated.

3.9.1 MassGIS Soils Data

General soil conditions in Harwich are shown on Figure 3-6. A significant majority of subsurface soils in Harwich are sands and gravels with rapid or high permeability. These areas are shown in light yellow on Figure 3-6. With a high infiltration rate, these soils act as poor filters from a wastewater treatment perspective. Soils with lower permeability are shown in the olive color. Very low permeability soils can make siting of a fully compliant on-site septic system even more challenging, due to restrictions in the leaching capability. Lower permeability soils generally exist along or within waterways or water bodies. The soils data on Figure 3-6 originated from 2007 MassGIS data layers.



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FEMA Q3 Flood Zones

- A
- AE
- AO
- VE

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Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 *Feet*

Figure 3-4
Overview of Flood Zones

CDM Smith

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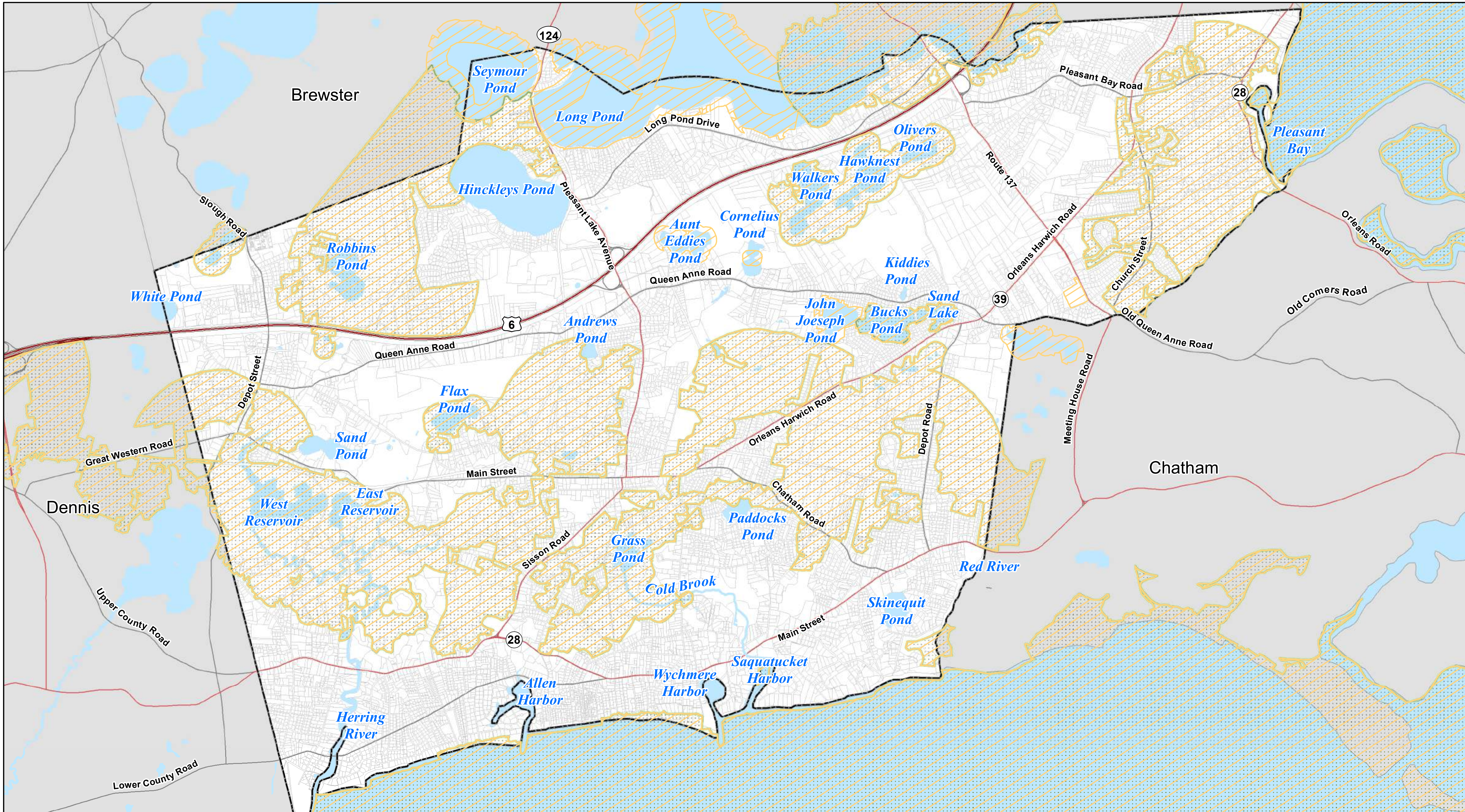

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NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

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Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-5
National Heritage and
Endangered Species Program

CDM Smith

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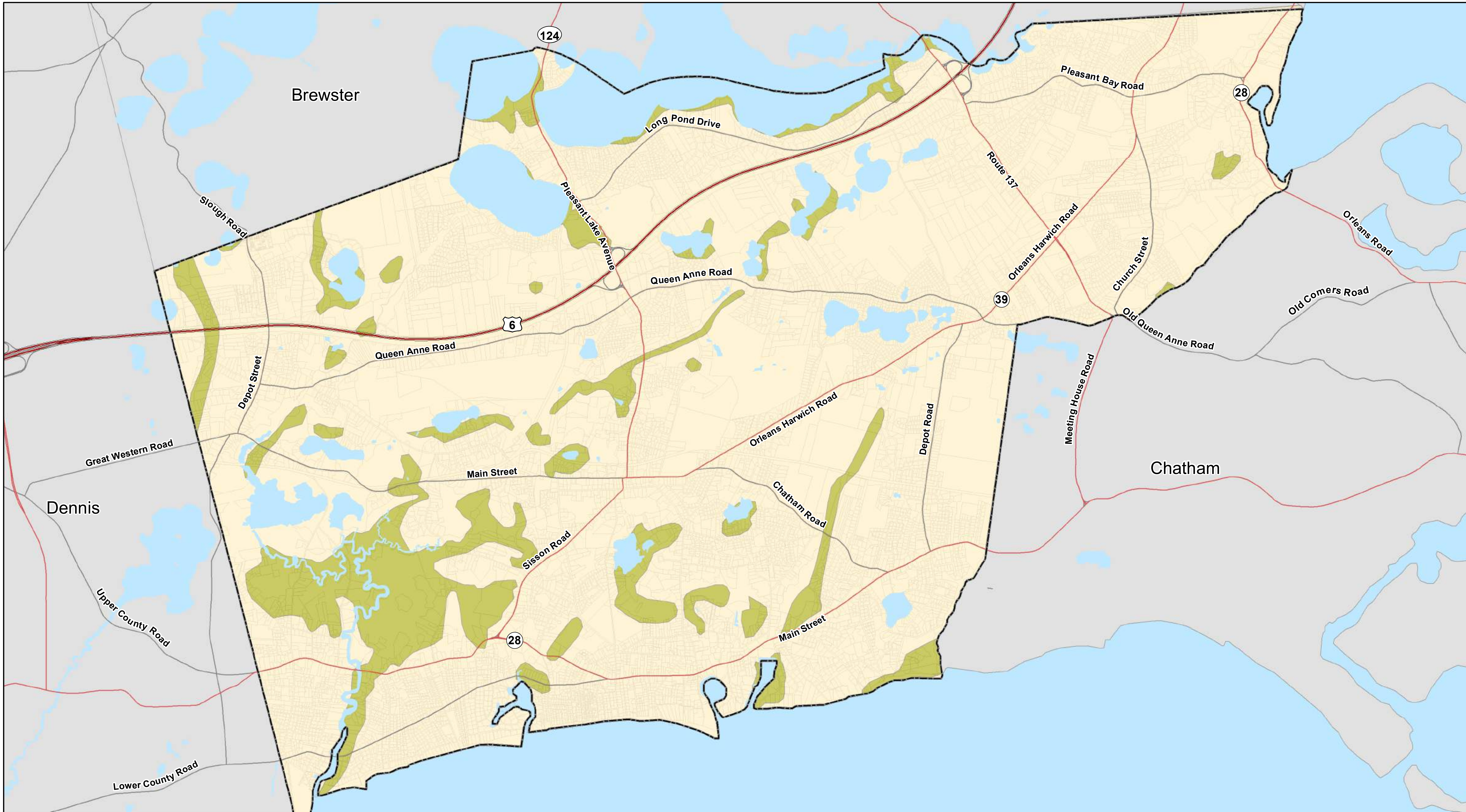

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Surficial Geology

- High Permeability
- Low Permeability

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1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-6
Surficial Geology

CDM Smith

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Certain areas, mainly in West Harwich within the Herring River watershed, consist of soil layers with silty loams and clays as reported by Harwich BOH officials and a local soils consultant. These layers restrict the downward movement of wastewater and cause a perched water level above the restrictive layers. Certain localized areas of Division Street, Kelley Road, and adjacent to Pleasant Lake Avenue within the Herring River watershed consist of these fine silts and clays.

3.9.2 Natural Resources Conservation Service Data

Natural Resources Conservation Service (NRCS) soil classification mapping indicates that the majority of Harwich consists of Carver type soils. A triangular area including Herring River and its watershed consists of Ipswich-Pawcatuck-Matunuck soils. This is consistent with the low-lying wetland and bog areas along the lower Herring River. The south coastal beaches are described as Hooksan-Beaches-Dune soils. These soil classifications are defined below and NRCS soil mapping for Harwich is shown on Figure 3-7.

Carver soils are nearly level to steep, very deep, excessively drained, sandy soils formed in glacial outwash and ice contact deposits, on outwash plains and kames. The soil description for Carver soils includes limitations for “septic tank absorption fields,” due to the rapid permeability. “The poor filtering capacity may result in [bacterial] pollution of groundwater. The degree of pollution rises with the density of housing.” Sand and gravel deposits with high permeability (shown in the tan color in Figure 3-6) dominate the Town, and floodplain alluvium soils with generally low permeability (shown in the olive color on Figure 3-6) follow waterways and waterbodies or exist in low, flat areas such as marshes and wetlands.

Ipswich-Pawcatuck-Matunuck soils are nearly level, very deep, very poorly drained peats formed in marine organic and sandy deposits, in areas sheltered from ocean waves along coastal shorelines, and adjacent to bodies of brackish water.

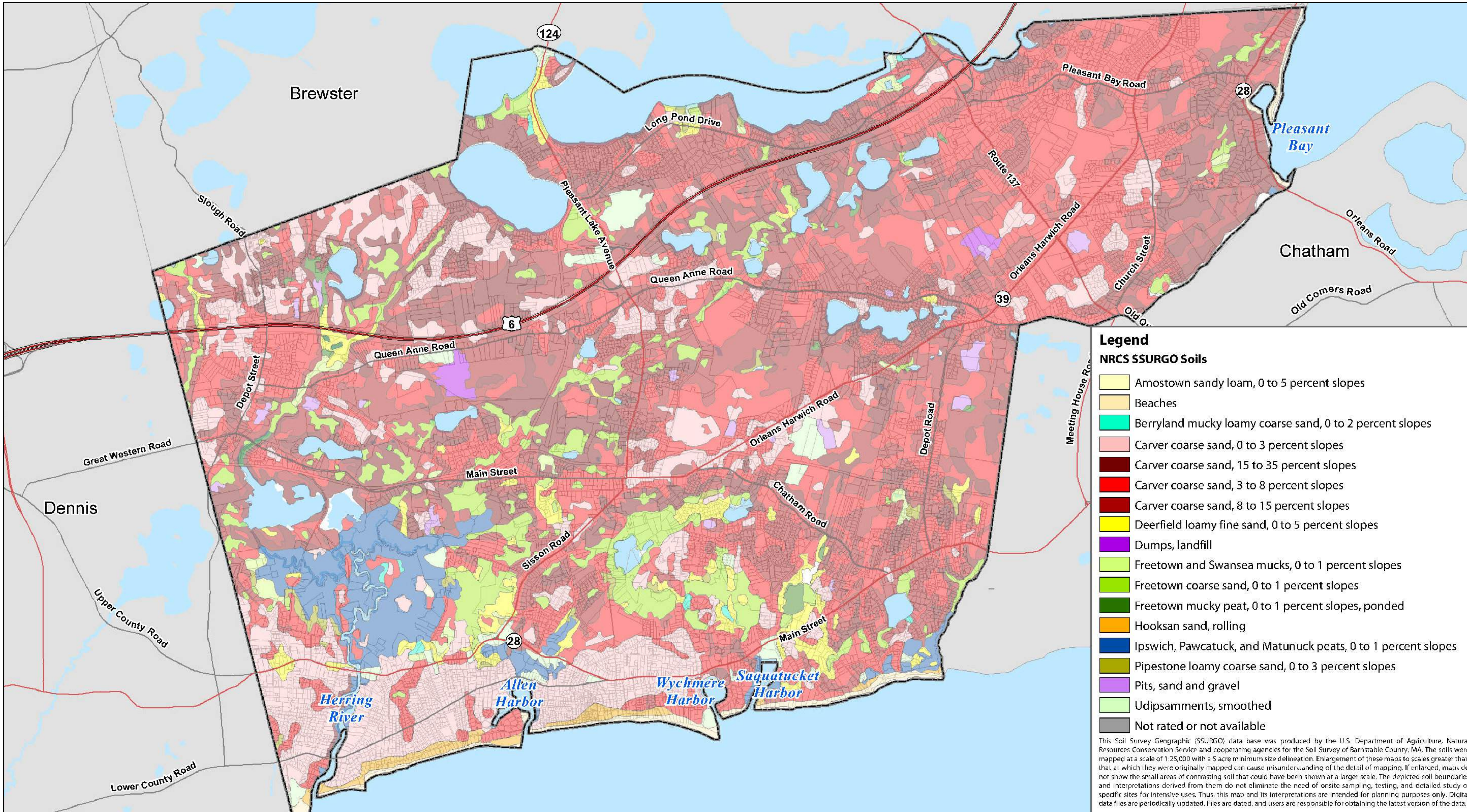
Hooksan-Beaches-Dune soils are beaches, dune land, and nearly level to steep, drained, sandy soils formed in windblown deposits along coastal shorelines.

3.10 Town Planning Data

3.10.1 Town and Parcel Zoning Data

A Harwich zoning map is provided as Figure 3-8. This map depicts the areas zoned for residential, business, and industrial uses in Harwich, along with overlay districts, using 2007 town data.

The source of specific parcel data used for this CWMP/SEIR was dependent upon where the data were used. In the original Pleasant Bay MEP report, 1999 parcel data were used to describe current conditions and relate them to buildout and water use. More up-to-date parcel data from 2006 were used in all subsequent Harwich MEP reports. For the purpose of performing site screening for potential effluent recharge sites, 2006 parcel data were used. Each set of parcel data were obtained from the CCC.



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Town of Harwich
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1 inch = 3,000 feet
0 2,000 4,000
Feet

Figure 3-7
NRCS Soil Classification

CDM Smith

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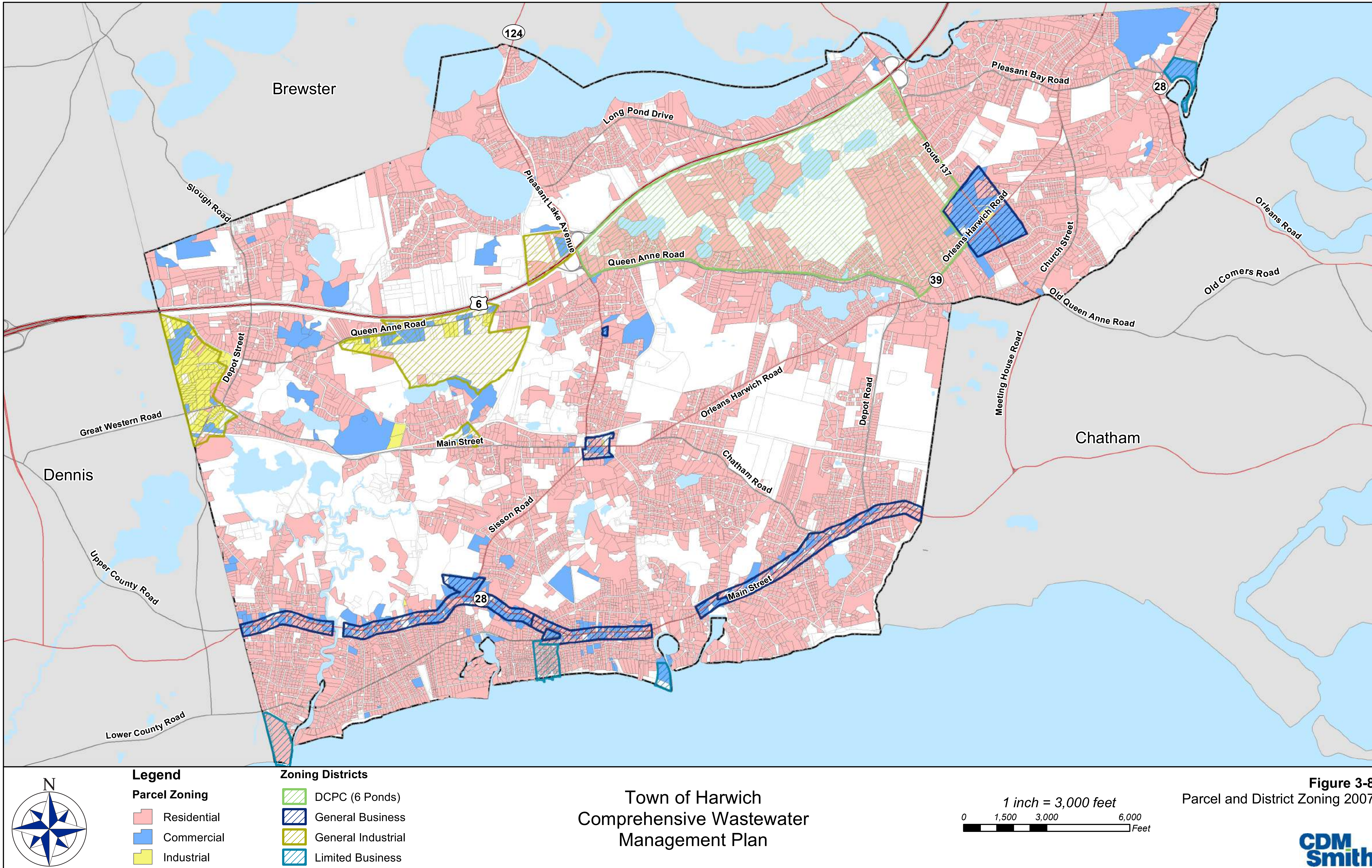


Figure 3-8
Parcel and District Zoning 2007

3.10.2 Lot Density and Size

Existing lot development density is depicted on Figure 3-9. Small lot sizes are shown in the more prominent colors. Properties with a lot size less than or equal to 5,000 sf are shown in orange. Purple illustrates lot sizes between 5,000 and 10,000 sf., and green indicates lot sizes between 10,000 and 20,000 sf. Properties 20,000 sf and one acre (43,560 sf) are brown and properties from 1 to 2 acres are pink. Properties greater than two acres are white. Concentrations of dense development are clearly evident in this figure as clusters of orange and purple lots, such as those seen along the shoreline and along prominent roadways.

Small lot size can restrict or preclude the ability to design, construct, or repair an on-site septic system in full compliance with state and local regulations. Furthermore, the overall density of development is also a function of lot size. Densely developed areas, with large numbers of on-site systems, are a potential threat to groundwater supplies. Even when performing correctly, on-site systems in densely developed areas can degrade groundwater quality through increased nitrogen loads, as traditional systems do not treat nitrogen effectively.

Using the Harwich Zoning By-Law as a starting point, the smallest lot size of 5,000 square feet was selected for consideration 1) to identify the small lots that were developed prior to zoning controls, and 2) because the Clean Water State Revolving Fund (SRF) uses lots smaller than 5,000 sf as an indicator of the potential for widespread on-site system failure in their project rating criteria.

The other lot size thresholds were chosen to illustrate the prevalence of lots as they generally double in size to 10,000 sf, 20,000 sf, 43,560 sf or one acre and two acres. These ranges for the first three gradations up to 20,000sf are shown in Table 3-3 below. Lot sizes above about ½ acre (20,000 sf) are generally considered acceptable for siting a septic system, although in some instances, more land may be required due to challenging soil conditions.

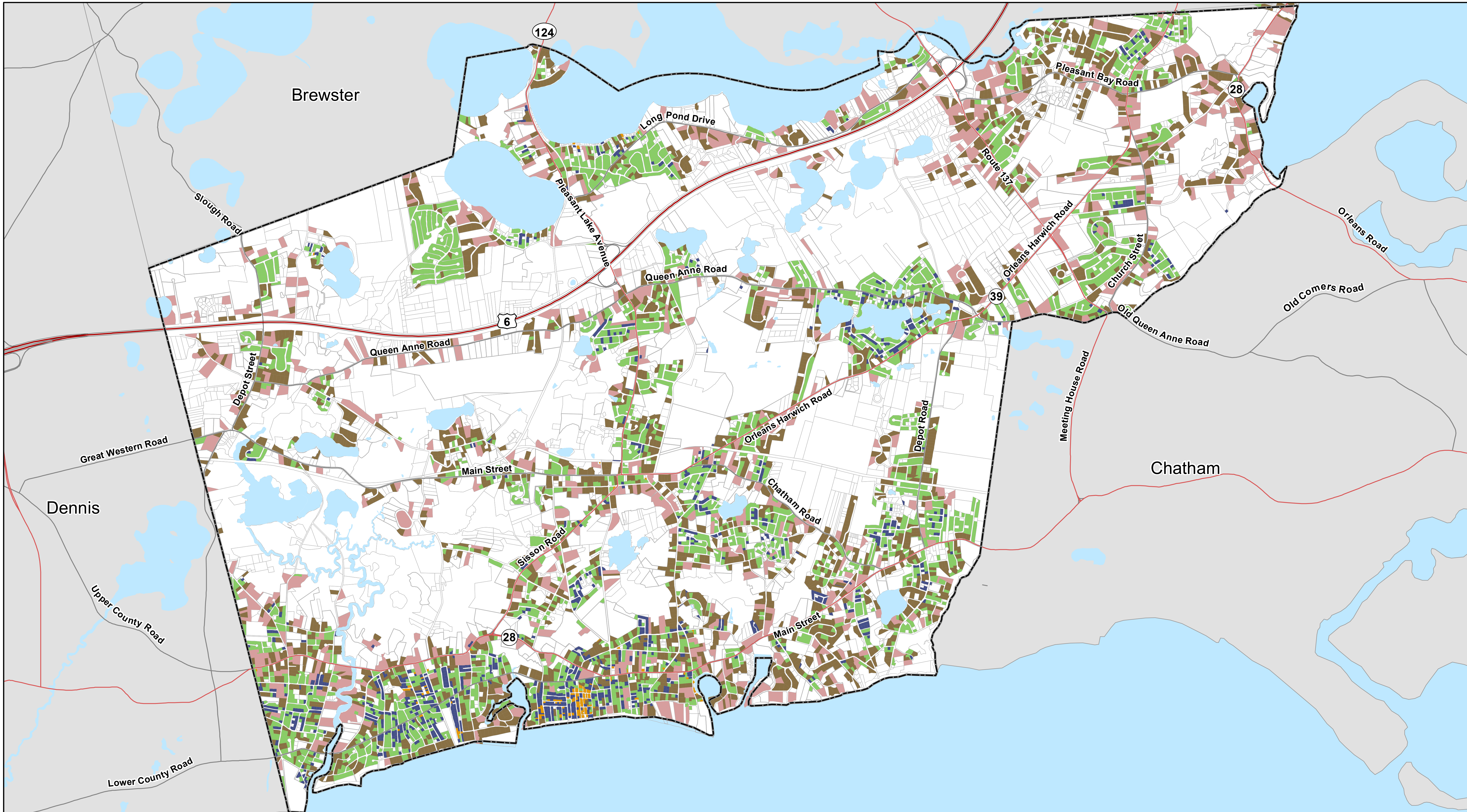
Table 3-3
Prevalence of Densely Developed Lots by Size

Lot size Condition	Number
Up to and including 5,000 sf	200
Between 5,001 sf and 10,000 sf	1225
Between 10,001 sf and 20,000 sf	3874

Approximately 46 percent of the parcels in Harwich are 20,000 square feet or less in size.

3.11 Water Department Data

Municipal drinking water supply is available throughout most of Harwich from fourteen gravel packed public groundwater supply wells. Well fields are located in the southeast, northeast and northwest areas of town. All of these wells draw water from the Monomoy Lens Aquifer. The Harwich public water system was recognized in 2006 for being within the top 5 percent of public water systems in the Commonwealth. A small percentage of properties (approx. 7%) use private on-site wells for drinking water.



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Harwich Developed Parcels

- 0 - 5,000 Sq Ft
- 5,000 - 10,000 Sq Ft
- 10,000 - 20,000 Sq Ft
- 20,000 Sq Ft - 1 Acres
- 1 - 2 Acres
- > 2 Acres or Non-Developable

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1 inch = 3,000 feet

0 1,500 3,000 6,000 *Feet*

Figure 3-9
Lot Development Density

CDM Smith

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Harwich drinking water resources are shown on Figure 3-10. This figure shows the locations of Harwich's public wells, along with their state-defined Zone II areas. Although not shown on the figure for readability purposes, for public water supply wells with an approved yield of 100,000 gpd or greater, a Zone I is defined as the area located within a 400 foot radius of the well.

A Zone II is the entire area of contribution to a well under the most severe pumping and recharge conditions that can realistically be anticipated. This equates to 180 days of pumping at the approved yield, with no recharge from precipitation. These areas were delineated by the MassDEP Drinking Water program in 2007 and again in 2010.

In addition to these two zones defined by MassDEP, the MEP defined well contribution zones based on historic pumping and recharge rates. These zones are also shown on Figure 3-10. Information on groundwater quality and zones of contribution to the municipal wells is described more fully in Section 4.

3.11.1 Water Pumping Records

Water pumping records show the volume of water pumped from each well in Harwich. The Town pumps approximately 2 million gallons per day (mgd) on an average annual basis. While this is valuable information, water use records from water meters on individual properties are most appropriate to use to estimate sewer flows, as the metered flow represents the actual usage, a percentage of which becomes wastewater flow.

3.11.2 Water Use Records

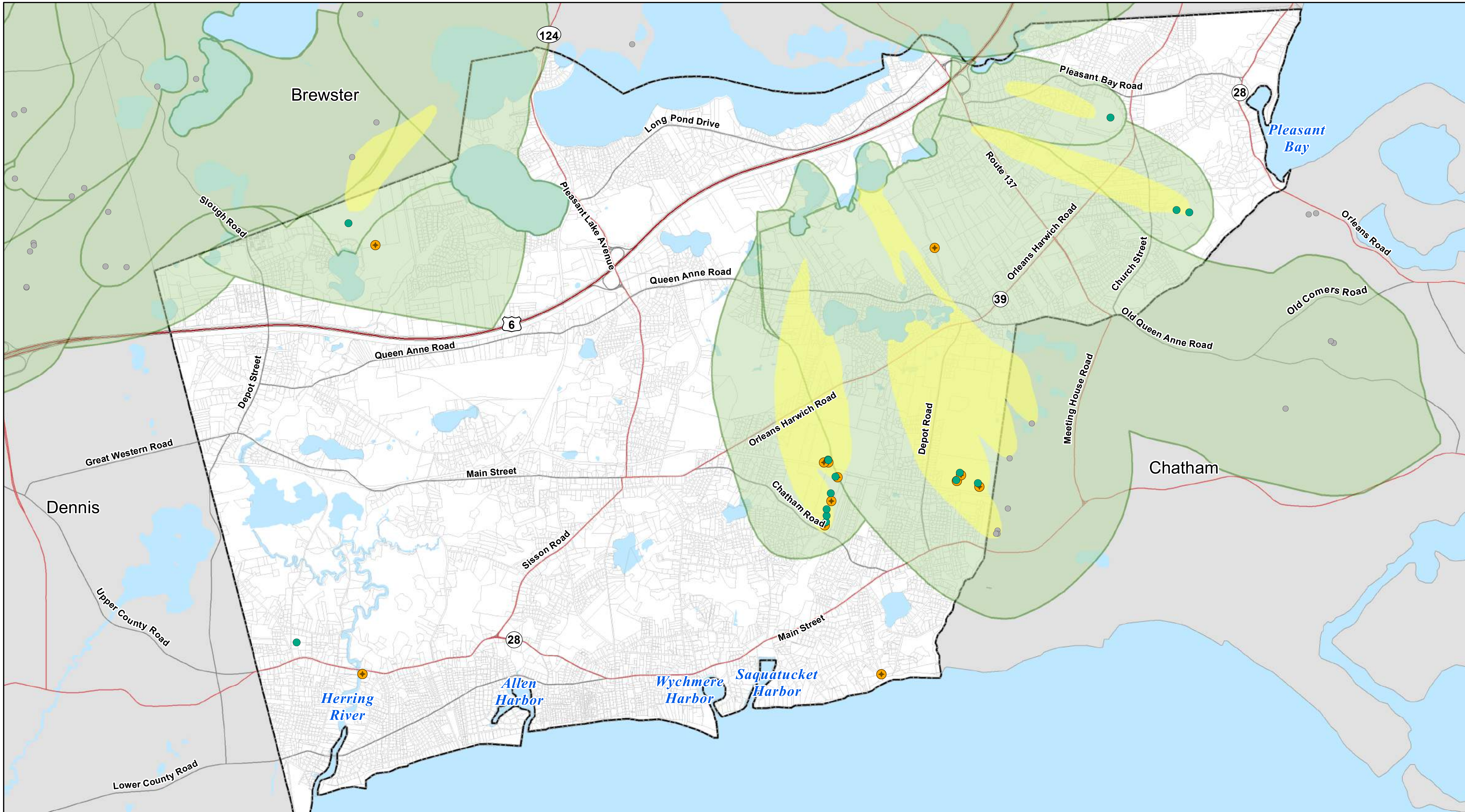
Water use records originate from water meters on individual properties. The Town presently reads water meters twice per year and is in the process of installing automatic meter reading units. The meter reading data is stored in a database from which water bills are produced. This information is also linked to the Town's GIS, allowing water usage to be queried for individual parcels or groups of parcels. Water use records from 2004 to 2007 were used in the analysis in this CWMP, for consistency with the data used in the MEP reports. Sewer use is typically about 90 percent of water use, due to uses such as lawn watering which do not result in water going down the drain. Estimates of water and sewer use associated with this CWMP are presented in Section 7.

3.12 Present Wastewater Management Data

Harwich relies on the use of on-site sanitary disposal systems (referred to as septic systems) for wastewater treatment and disposal. The Harwich Board of Health (BOH) is responsible for administering the State Environmental Code (Title 5) and local rules and regulations governing the use of subsurface disposal systems to protect groundwater quality and public health.

3.12.1 Title 5 – State Environmental Code

Title 5 (310 CMR 15.000: The State Environmental Code) provides minimum standards for the design, construction and maintenance of on-site systems. This regulation provides minimum standards including setback distances from system components to buildings, property lines, groundwater, and environmental resources. The standards also define the size of system components based on design wastewater flows, subsurface soil permeability and groundwater conditions. Title 5 requirements also include on-site system inspection and upgrade standards for real estate transfer.



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Public Water Supplies
- Harwich
- Other Communities
- USGS Groundwater Monitoring Wells
- Well Contribution Zones
- Zone II (Aquifer)

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1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-10
Drinking Water Supplies

CDM Smith

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Title 5 was originally instituted in 1978 and underwent significant revisions in 1995.

3.12.2 Local Sewage Disposal Guidelines and Regulations

Due to the reliance on on-site systems for wastewater management and the importance of protecting the Town's water supply, environmental resources, and public health, the Harwich BOH has been proactive in developing programs, policies and by-laws to enhance wastewater treatment requirements in town.

The BOH has adopted the following policies and procedures:

1. The Town enforces a local Board of Health "Regulation for the Subsurface Disposal of Sewage."

2. A Real Estate Transfer (R.E.T.) program was instituted in 1988 requiring inspections of existing systems prior to property transfer. (This also became a Title 5 requirement in 1995.)

3. Cesspools are not permitted. Property owners must upgrade to an on-site septic system in conformance with Title 5 and local requirements at the time of property transfer or when substantially improving the property.

4. The BOH rigorously enforces system upgrade standards. Upgrade provisions of Title 5 have a stated goal of "maximum feasible compliance." Relief from local and Title 5 standards is considered for applicants on rare occasions, and usually involves dimensional setback requirements that may limit the ability to be 100 percent in compliance with the regulations. Small lots (e.g. 5,000 square feet) are examples where dimensional waivers are considered due to parcel coverage and positioning of structures on the property.

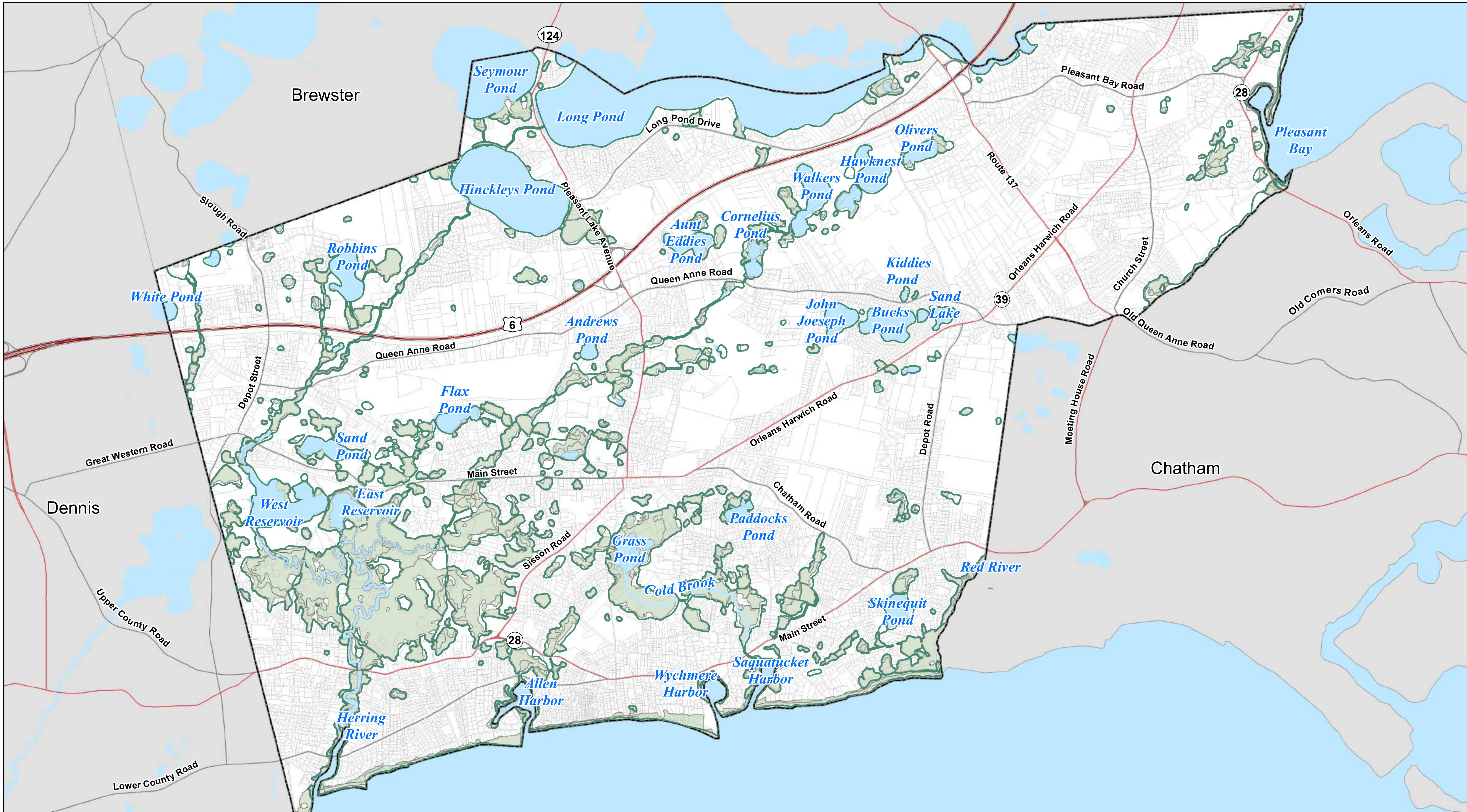
5. No waivers or variances from Title 5 or local BOH Rules and Regulations are allowed for new construction.

6. Upgrades or new construction projects consisting of 2,000 gpd or more wastewater flow may require enhanced treatment. These projects require a hearing before the BOH and, depending on the findings, "Innovative/Alternative" (I/A) or "package" treatment technologies may be required to reduce nitrogen and phosphorus loading to subsurface soils if located within the Pleasant Bay watershed.

7. "Environmentally sensitive areas" have been delineated with enhanced protection requirements and may require no net increase in nitrogen loading in that watershed. These areas are shown on Figure 3-11.

3.12.3 Board of Health Data

The Harwich BOH was used as the primary information source for Harwich septic systems. Harwich BOH personnel were interviewed, and pertinent records relating to wastewater management and surface and groundwater quality were reviewed.



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Title 5

Wetlands

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1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-11
Title 5 Environmentally
Sensitive Areas

CDM Smith

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Data are available in paper and electronic format, with paper documents filed by the year of permit issuance, and then by property address. Files generally include on-site system applications, site plans, reports on subsurface conditions (soils and groundwater), and inspection reports. Electronic information maintained by the BOH includes permit lists related to on-site systems, public swimming area water quality data, and package treatment system inspection reports.

3.12.4 Areas of Known Title 5 Concern

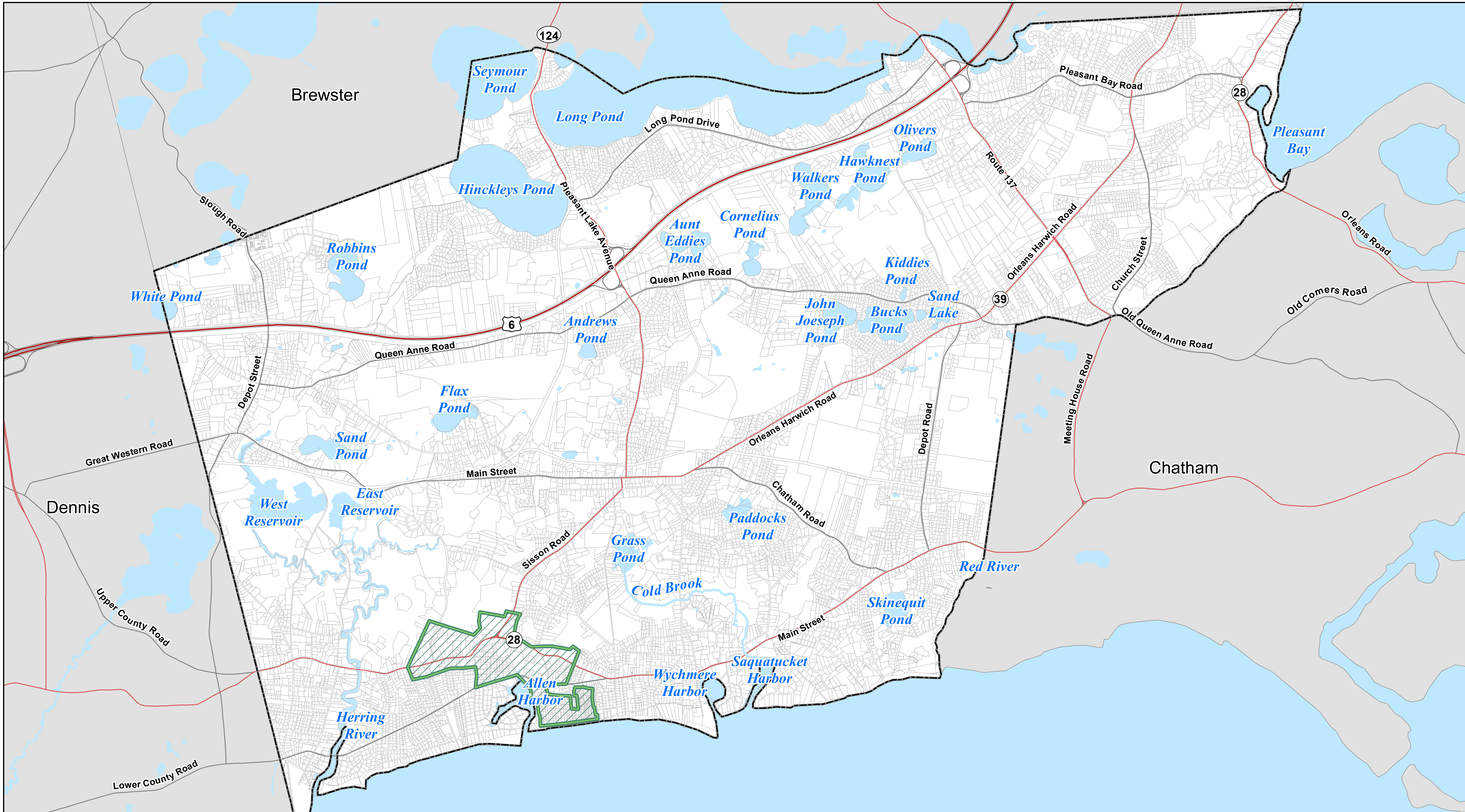
Areas along the southern coast and south of Route 28 represent challenges for long-term wastewater management. Dense development, small lot sizes and shallow depth-to-groundwater conditions can limit the ability to design and construct septic system upgrades in compliance with Title 5 and local regulations. Figure 3-12 shows the combination of these conditions in Harwich - areas which have been designated as "Areas of Title 5 Concern." One of these areas east of Allen Harbor, known locally as "the Campgrounds," generally consists of small lots with a significant percentage of seasonal occupancy. Many of these properties were developed prior to local zoning codes and prior to health standards for the design and construction of on-site systems. Many of these properties are believed to use cesspools for wastewater treatment and disposal due to the age of construction in this area. Septic system upgrades in this area usually require waivers or variances from Title 5 or local regulations. In some cases, limitations are placed on future expansion or increases to the number of bedrooms through deed restrictions.

3.12.5 Package Treatment Systems in Harwich

The term "package treatment system" refers to the assembly of various individual treatment process components such as settling tanks, aerators, and disinfection equipment into a compact, pre-packaged, and sometimes pre-assembled system. Package plants involve installation of pre-assembled equipment in buried tanks or in small buildings. These plants can achieve a high degree of treatment provided they are sited, designed, operated and maintained effectively. Other names sometimes used to describe package systems include decentralized facilities and innovative and alternative (I/A) systems. The term "decentralized" is used to reflect the differences between these systems and larger, more centralized facilities that serve entire municipalities or large portions thereof. Also, package plants are usually largely automated, so an operator only checks performance and conducts maintenance periodically, unlike municipal facilities that have greater staffing requirements.

Package treatment systems can be utilized to cover a wide range of wastewater flows such as:

1. Serving single family homes (e.g., 330 gallons per day);
2. Larger systems serving multiple homes (clusters), condominium complexes, or institutions; and
3. Decentralized or neighborhood systems serving areas accommodating flows up to about 200,000 gpd.



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Areas of Title 5 Concern

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1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 3-12
Areas of Title 5 Concern

CDM Smith

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Review and permitting of package treatment systems with Title 5 flows above 10,000 gallons-per-day is administered by MassDEP and requires a Groundwater Discharge Permit (314 CMR 5.00). Discharge and effluent treatment limits are assigned on an individual basis dependent upon the proposed use, site location, and environmental considerations. Enhanced treatment for these larger systems is required to limit priority effluent constituent loading including nitrogen, phosphorus, total suspended solids (TSS), and biochemical oxygen demand (BOD).

Package treatment systems with enhanced nitrogen removal capabilities are required by law for new residential construction with design flows in excess of 440 gpd/acre in "nitrogen sensitive areas" (310 CMR 15.214-15.216). These areas include:

- Interim Wellhead Protection Areas ("IWPAs") and Zone II areas contributing to public water supplies, and
- Nitrogen sensitive embayments (or estuaries) not regulated by MassDEP.

Individual municipalities may also promulgate more stringent criteria to protect local groundwater and environmentally sensitive areas. In addition to Title 5 requirements, the BOH has taken the proactive step to adopt regulations regarding the use of enhanced treatment systems with wastewater flows exceeding 2,000 gpd within the Pleasant Bay watershed. Specifically, a hearing is required before the BOH and, depending on the findings, I/A or package treatment technologies may be required to reduce nitrogen and phosphorus loading to subsurface soils. Also, I/A systems are currently required for new shared systems for five lots or more within the Pleasant Bay watershed. Nitrogen removal limits for I/A systems are required to be those approved by MassDEP for the technology proposed. Pressure distribution of effluent is considered on a case-by-case basis where environmental variances are involved.

At the time of analysis in 2013, the Harwich BOH had records of 28 package treatment systems at locations throughout Harwich. Twenty-three of these were under the jurisdiction of the Harwich BOH Rules and Regulations, while the other five exceed the state threshold and were thus regulated by MassDEP. The type of treatment system utilized is equally divided between two technologies: the FAST system (Fixed Activated Sludge Treatment) and the Bioclere system. Both systems are widely used in Massachusetts. The locations of these package treatment systems as of 2013 are shown on Figure 3-13. These systems are also summarized in Tables 3-4 through 3-6. Details of the specific treatment technologies are described further in Section 12 of this report.

3.13 Water Quality Data

Water quality data used in this CWMP/SEIR includes coastal water quality data evaluated through the MEP, local pond quality, the quality of local groundwater and drinking water supplies, and water quality for recreational purposes. Due to the extensive data obtained for each of these resource areas, water quality is described in detail in later sections of this report. Specifically, public swimming area and groundwater quality are described in Section 4, freshwater ponds are described in Section 5, and the MEP estuary and embayment data is provided in Section 6.

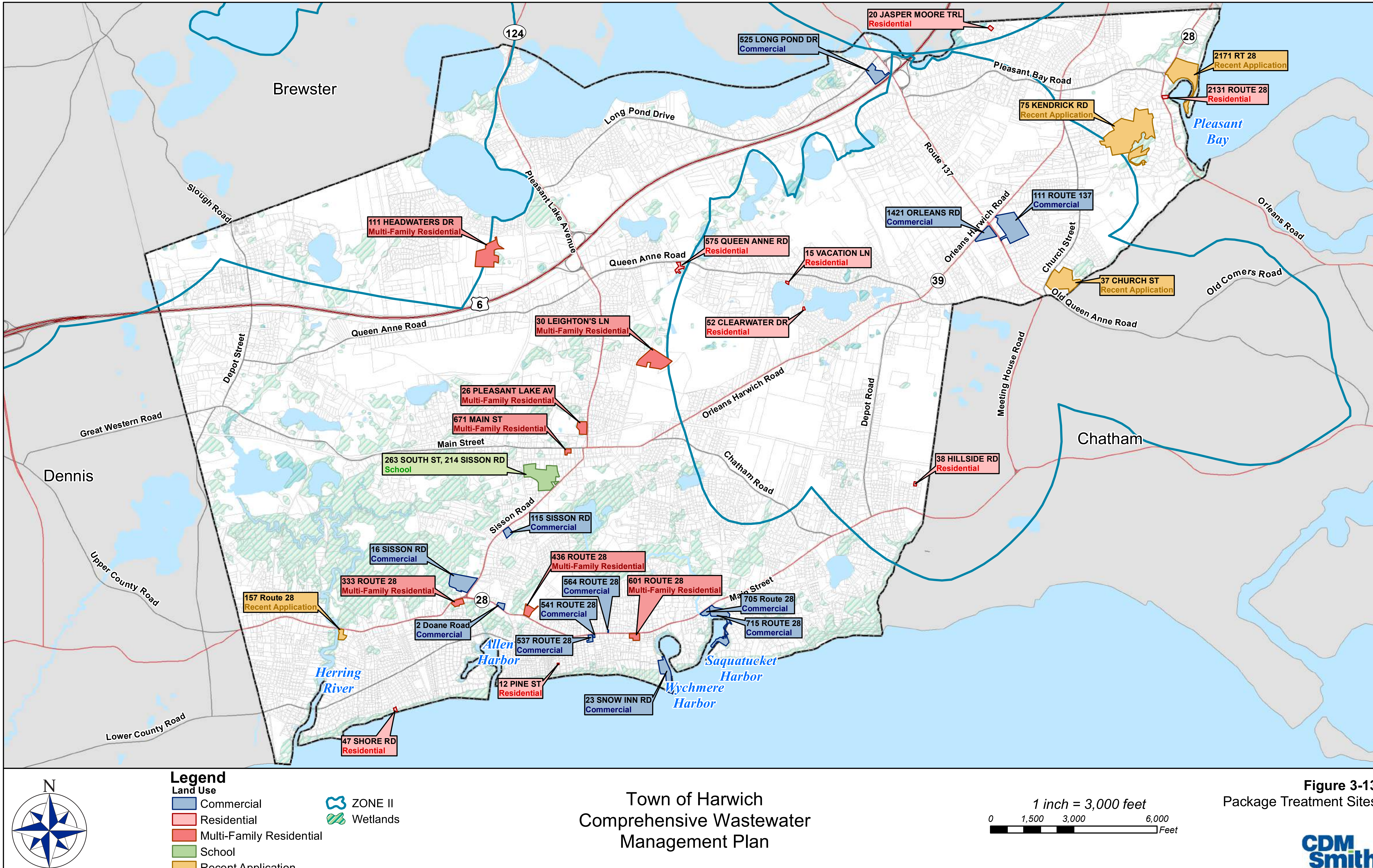

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Figure 3-13
Package Treatment Sites

CDM Smith

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Table 3-4
Groundwater Discharge Program Package Treatment Systems in Harwich

System Location (MassDEP Permit #)	Type of Treatment System	Wastewater Flow	
		Design (gpd)	Actual (gpd)
Snow Inn 23 Snow Inn Road (#324)	RBC[1]	80,000	22,500
Cranberry Point Nursing Home 111 Headwaters Drive (#357)	RBC	12,800	10,580
Harwich Middle & Elementary Schools 263 South Street & 214 Sisson Road (#631)	Bioclere/Tetra Technologies Denite	16,100	14,020
Harwich Laundry & Cleaners (#613)	Sand Filter	14,400	360
Wequassett Resort and Golf Club 2171 Route 28 (#851)	Amphidrome	27,390	(not in operation during subject months)

1. Rotating Biological Contact (RBC)

Table 3-5
FAST Systems in Harwich

System Location (Harwich BOH Tracking No.)	Type of Treatment System	System Performance	Comments
601 Route 28 (Main Street) Melrose House Condominium (HAR26801FMO)	Modular FAST	41 reports with exceedances of one or more of the permit limits (N, Ammonia, BOD, Total N, TSS, pH)	Component failure noted Period of record 9/96 to 6/07
705 Route 28 (Main Street) (HAR28705FAS)	FAST	7 intermittent reports with exceedances of one or more of the permit limits (N, Total N)	Period of record 3/04 to 6/07
20 Jasper Moore Trail (HAJas020FAS)	FAST	5 reports with exceedances of one or more of the permit limits (Ammonia, BOD, Total N, TSS)	Exceedances may be due to seasonal use. Period of record 10/01 to 6/07
564 Route 28 (Main Street) George's Pizza (HAR28564FAS)	FAST	8 reports with exceedances of one or more of the permit limits (Ammonia, BOD, Total N, TSS)	Period of record 2/03 to 6/07
12 Pine Street (HAPin012FAS)	FAST	8 reports with exceedances of one or more of the permit limits (N, Total N)	Period of record 7/99 to 6/07
52 Clearwater Drive (HACle052FAS)	FAST	1 exceedance including N, Total N, and BOD	Intermittent Inspection & Reporting Period of record 8/01 to 6/07
47 Shore Road (HASho047FAS)	FAST	8 reports with exceedances of one or more of the permit limits (N, Ammonia, Total N,)	Period of record 8/96 to 6/07
15 Vacation Lane (HAVac015FAS)	FAST	3 reports with exceedances of one or more of the permit limits (N, Total N)	Period of record 1/98 to 6/07
38 Hillside Raod (HAHil038FAS)	FAST		Component replacement or service needed Period of record 3/05 to 6/07
671 Main Street Rosewood Manor (HAMai671FAS)	FAST	5 intermittent reports with exceedances of one or more of the permit limits (N, Total N, BOD, TSS)	Component replacement or service noted Period of record 1/03 to 6/07
Saquatucket Harbor (HASaqFAS-A)	FAST	13 reports with permit limit exceedances (N, Total N, Ammonia, BOD, TSS, pH, and Fecal Coliform)	Component service noted Period of record 7/97 to 6/07
537 Route 28 (Main Street) (HAR28537FAS)	FAST	5 intermittent reports with permit limit exceedances (N, Total N, TSS, and Fecal Coliform)	Component replacement or service needed Period of record 1/01 to 6/07

Table 3-6
Bioclere Systems in Harwich

System Location (Harwich BOH Tracking No.)	Type of Treatment System	System Performance	Comments
541 Main Street The Port Restaurant (HAMai541Bio)	Bioclere	4 reports with exceedances of one or more of the permit limits (Total N, BOD, TSS)	Good System performance noted at 10 times Period of record 6/04 to 6/07
525 Long Pond Road Cape Cod Hospital (HALon525 Bio)	Bioclere	20 reports with exceedances of one or more of the permit limits (N, Total N, BOD, Ammonia, TSS)	Very Frequent reporting schedule Good System performance noted Period of record 5/05 to 6/07
26 Pleasant Lake Avenue (HAPle026 Bio)	Bioclere	29 reports with exceedances of one or more of the permit limits (N, Total N, BOD, Ammonia, TSS)	Good System performance noted at 8 times Period of record 10/95 to 7/07
575 Queen Anne Road (HAQue575Bio)	Bioclere	4 intermittent reports with exceedances of one or more of the permit limits (Total N, BOD, TSS)	Good System performance noted at 11 times Period of record 12/98 to 6/07
333 Main Street (HAMai333Bio)	Bioclere	3 intermittent reports with exceedances of one or more of the permit limits (N, Total N, BOD)	Good System performance noted Period of record 1/02 to 7/07
Rte. 39 & Rte. 137 Harwich East Plaza (HAR37000Bio)	Bioclere	16 reports with exceedances of one or more of the permit limits (N, Total N, BOD, Ammonia, TSS)	Good System performance noted Period of record 5/02 to 7/07
115 Sisson Road (HASis115Bio)	Bioclere		Period of record 12/05 to 8/06
2131 Route 28 (Main Street) (HAR28213Bio)	Bioclere	2 intermittent reports with exceedances of one or more of the permit limits (Total N, Fecal Coliform)	Period of record 4/00 to 7/07
Oak Street/30 Leighton's Lane Pine Oaks III (HAOak000Bio)	Bioclere	6 intermittent reports with exceedances of Total N permit limit	Period of record 4/03 to 7/07
436 Route 28 (Main Street) Seaport Village (HAR28436Bio)	Bioclere	5 intermittent reports with exceedances of one or more of the permit limits (Ammonia, Total N, BOD, TSS)	Period of record 11/01 to 7/07
16 Sisson Road Star Market (HASis018Bio)	Bioclere	7 reports with exceedances of one or more of the permit limits (N, Total N, Ammonia)	Good System performance noted Period of record 7/03 to 7/07
Rte. 39 & Rte. 137 Stop & Shop (HAR39000Bio)	Bioclere	11 reports with exceedances of one or more of the permit limits (N, Total N, BOD, Ammonia, TSS)	Very Frequent reporting schedule (~140) Period of record 4/06 to 7/07

3.14 Affordable Housing in Harwich

On May 2, 2000 the Town adopted the Local Comprehensive Plan which included a section on affordable housing. That section includes a housing strategy for the Town of Harwich and contains 19 recommendations with respect to affordable housing. One of the recommendations calls for an update of the affordable housing analysis every three years. A letter from the Massachusetts Department of Housing and Community Development dated August 27, 2002 notified the Town that in order to become housing certified by 2004 the Town must have a housing strategy in place. According to the letter, the housing strategy must contain sufficient information and unit production goals so as to be able to determine whether the units added are sufficient to grant future certifications.

The Town set the following goals for affordable housing at the annual Town Meeting held on May 5, 2003.

1. To promote the annual development, whether by new construction, acquisition, and/or conversion of existing buildings, by town action and action of others.

2. To promote the development of funding sources and income streams to support the development of affordable housing.

3. To continue to review town by-laws, and other regulations, and strive to remove barriers preventing the development of affordable housing.

The goals set at this Town Meeting highlighted Harwich's commitment towards the state's 10% affordability goal under Chapter 40B through a wide range of initiatives. From 2003 to 2008, Harwich added fewer than 30 units of affordable housing; however, as of July 2009, the Town had 40 affordable units permitted to proceed and another 92 affordable units in various stages of development. The Town is continuing to work to develop affordable properties to achieve its goal of 586 affordable units.

In 2009, the Town published their affordable housing production plan in partnership with Community Development Partnership (CDP), Housing Assistance Corporation, The Harwich Ecumenical Council for the Homeless (HECH), and Habitat for Humanity of Cape Cod. This plan gives an update on the progress of affordable housing and also discusses a plan for an affordable housing program into the future. The plan defines housing goals, demographic data, housing characteristics, housing needs, and obstacles to development and lists several properties that are being considered for affordable housing. The plan shows that Harwich is committed to the development of affordable housing and understands the importance of making progress towards the state's 10% affordability goal under Chapter 40B.

In addition to the affordable housing plan, the Town has worked with several local and regional agencies to achieve its affordable housing goals. The agencies are listed below along with a short description of the Town's involvement with them and with a description of funding initiatives, if applicable. Additional information is available in the Harwich Housing Production Plan dated October 2009, which is the source of the following list.

1. Harwich Housing Authority

The Harwich Housing Authority was established in 1986 and currently owns and manages 20 units of affordable housing including 12 family rental units.

- Loans - The Harwich Housing Authority recently introduced a Rental Assistance Revolving Loan Program to provide qualifying households with first, last and/or security deposits for rental units.

- The Harwich Housing Authority received funding of $100,000 through the Town's Community Preservation Fund towards the purpose of making it easier for households to access year-round housing and to build opportunities for lower income households to budget for homeownership.

- Buy-down Program - This program received $280,000 in funding from the Town's Affordable Housing Fund and $75,000 in HOME funds.

2. Harwich Community Preservation Committee

The Community Preservation Act (CPA) was enacted to provide Massachusetts cities and towns with another tool to conserve open space, preserve historic properties and provide affordable housing. This allows municipalities to create a community preservation fund by surcharging 3% of the property tax with a corresponding state match of up to 100%. In November 2004, the Harwich Town Meeting adopted the CPA and ballot approval occurred in May 2005, with the support of 82% of all voters. Estimates indicate that the surcharge will raise approximately $900,000 from local funds annually.

To date, the Town has allocated the following for housing:

- $90,000 for Habitat for Humanity's development at Gomes Way.

- $100,000 for the Rental Assistance Revolving Loan Program operated by the Harwich Housing Authority.

- $70,000 in support of HECH's South Harwich development.

- $100,000 for predevelopment work on the Portuguese Men's Club and CDP's sponsored housing development.

- $30,000 in predevelopment funding for the Housing Authority's and CDP's Main Street Extension development and another $300,000 to further subsidize the affordable units.

- $25,000 sponsored by the Harwich Housing Committee towards the Harwich Housing Authority's administration of the American Dream Program I and an additional $20,000 towards down payment costs.

- $200,000 towards the Housing Authority's Infrastructure Development Fund that is available to developers who are in the beginning stages of producing rental housing. The funds can be used for predevelopment activities or small gap financing needs.

- A total of $296,750 in five articles in 2006, 2007 and 2008 towards the Rec. Building West Harwich School Cultural/Housing Mixed-Use Development.

3. Harwich Housing Committee

The Harwich Housing Committee was established by the Board of Selectmen to further the Town's 10% affordable housing goal. The Board of Selectmen appoint five members that work with the Harwich Housing Authority.

4. Harwich Council on Aging

The Harwich Council on Aging is a town department that supports Harwich's elders. The Council on Aging and the Town enacted a tax rebate program for qualifying seniors. The Town currently allows seniors to work for the community and reduce their tax burden by $750 in exchange for volunteer hours. The Town has additional tax abatement programs for income-eligible seniors, veterans and surviving spouses geared toward reducing property tax bills.

5. Harwich Affordable Housing Fund

Harwich has an affordable housing fund designed to preserve, promote, and increase affordable housing within the community. The Board of Selectmen is authorized to expend fund monies to pay for a wide range of affordable housing activities associated with affordable housing projects. Under this fund, Harwich has allocated the following for housing:

- Two contributions of $325,000 and $185,000 to Habitat for Humanity of Cape Cod for the Gomes Way project.
- $143,000 to subsidize the resale price of two affordable homes where deed restrictions would have resulted in unaffordable prices (the deed restrictions were rewritten to insure that the resale price formulas were no longer tied to market values).
- Support for Barnstable County's homelessness prevention program.
- Additional funding for predevelopment work on potential developments including $260,000 to Harwich Ecumenical Council for the Homeless and $368,000 for the Community Development Partnership.
- $280,000 for Harwich's Buy-down Program.
- $20,000 for American Dream I.
- $15,000 for American Dream II.
- $20,000 for the Second Story Program.
- $5,000 towards the preparation of the Housing Production Plan.

6. Cape Cod Commission

The Cape Cod Commission was created as the regional planning and regulatory agency for the Cape. In addition to coordinating a wide range of planning and policy activities, the Commission administers the Technical Assistance Program (TAP), which provides funds for consultants to assist communities in promoting affordable housing. The Commission also manages the allocation of a number of housing subsidy funds that can be made available to communities to support affordable housing efforts including the oversight of HOME Program funds on behalf of the Barnstable County HOME Consortium, the Soft Second Loan Program to subsidize mortgages for first-time homebuyers, the DRI Fund Management, and the County Home Ownership Fund (CHOP).

7. Barnstable County HOME Consortium

This Consortium includes all municipalities in Barnstable County and provides federal HOME Program funding to support the financing of a wide variety of housing activities. These funds are available to all towns participating in the Consortium, including Harwich, and are administered by the Cape Cod Commission. HOME funding for Harwich included:

- $11,800 for the HECH duplexes at Uncle Willis Lane.
- $100,000 for HECH's Sisson Road development.
- $80,000 for Pine Oaks III.
- $117,286 for 836 Route 28 (Little Homesteads Project).
- $64,332 for the Down Payment/Closing Cost Program.
- $71,221 for nine (9) loans as part of the Homeowner Repair Program.
- $125,000 for CDP's Main Street Extension project.
- $75,000 for the Buy-down Program, and
- $125,000 for Habitat for Humanity of Cape Cod's Gomes Way project.

8. Harwich Ecumenical Council for the Homeless (HECH)

Harwich Ecumenical Council for the Homeless (HECH) was formed in 1991 by clergy and lay people from seven Harwich churches for the purpose of providing housing for homeless families with children. HECH has developed programs in homelessness prevention, mortgage foreclosure prevention, child care, and youth counseling. In 1996, HECH began purchasing its own rental housing and has purchased a house or condominium to keep a family housed. The organization raises funds from individual donors and through special events. To date the organization has produced 15 units of affordable housing units through its Sisson Road and Uncle Willis Lane developments and has another 14 affordable units (20 total units) underway, either under construction or in planning including a rental development in South Harwich and a rental project in West Harwich.

9. **Community Development Partnership (formerly called the Lower Cape Community Development Corporation)**

   The Community Development Partnership (CDP), formerly known as the Lower Cape Cod Community Development Corporation (LCCCDC), was established in 1992 to promote affordable housing and economic development in the towns of the Lower Cape. Through its housing development program it is creating new, year-round, affordable housing units by purchasing existing units or building new units.

10. **Habitat for Humanity of Cape Cod**

    Habitat for Humanity is an ecumenical, non-profit Christian ministry dedicated to building simple, decent homes in partnership with families in need that has grown over the past two decades into one of the largest private homebuilders in the world. The organization is in the process of developing 13 new affordable homes in Harwich on Gomes Way.

11. **Housing Assistance Corporation (HAC)**

    The Housing Assistance Corporation (HAC) has proclaimed its mission to "promote and implement the right of all people on Cape Cod and the Islands to occupy safe and affordable housing." This non-profit organization is working throughout the Cape as a sponsor of affordable housing developments and has a wide range of financial and educational resources available for renters, existing homeowners and first-time homebuyers including HOME Program funding and rental subsidies.

The Town is committed to implementing its affordable housing goals, and, in order to do so, appropriate infrastructure must be provided to support such initiatives. Therefore, the goals of the affordable housing initiatives in town have also been considered in the development of this CWMP/SEIR.

3.15 Summary of Relevant Data

The present wastewater management approach in Harwich is the use of on-site septic systems on individual properties. These systems rely mainly on primary treatment (settling) with distributed discharge to underlying soils that act as a filter of the effluent to remove some nutrients (mainly phosphorus) and pathogenic organisms (bacteria). The continued use of these systems town-wide is not feasible while meeting the goals developed by the MEP for nitrogen reduction to the Town's coastal embayments and other town planning and environmental objectives.

The data described above can collectively be used to target areas that are best suited for off-site wastewater management options. These areas are identified using a combination of existing data relating to soils, groundwater, wetlands, water resources, development density, areas of desired population and economic growth (such as affordable housing and village centers), proximity to town drinking water wells, and areas of known concern for achieving compliance with existing BOH and MassDEP on-site system regulations.

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Section 4

Existing Water Quality Data

4.1 Introduction

This section reviews and summarizes existing water quality data in Harwich in order to assess areas which may be impaired due to nutrient loading or other factors. This information is evaluated to help identify the critical needs in Harwich and guide the development of wastewater management scenarios. The focus of this section is on data that is not already incorporated into the freshwater ponds and MEP analyses, described in detail in Sections 5 and 6, respectively.

This section addresses the quality of the Town's groundwater resources and drinking water supply, recreational water quality at freshwater and marine beaches, MassDEP eelgrass mapping studies, and the attainment of designated uses in water bodies in Harwich.

4.2 Drinking Water Supply and Groundwater Quality

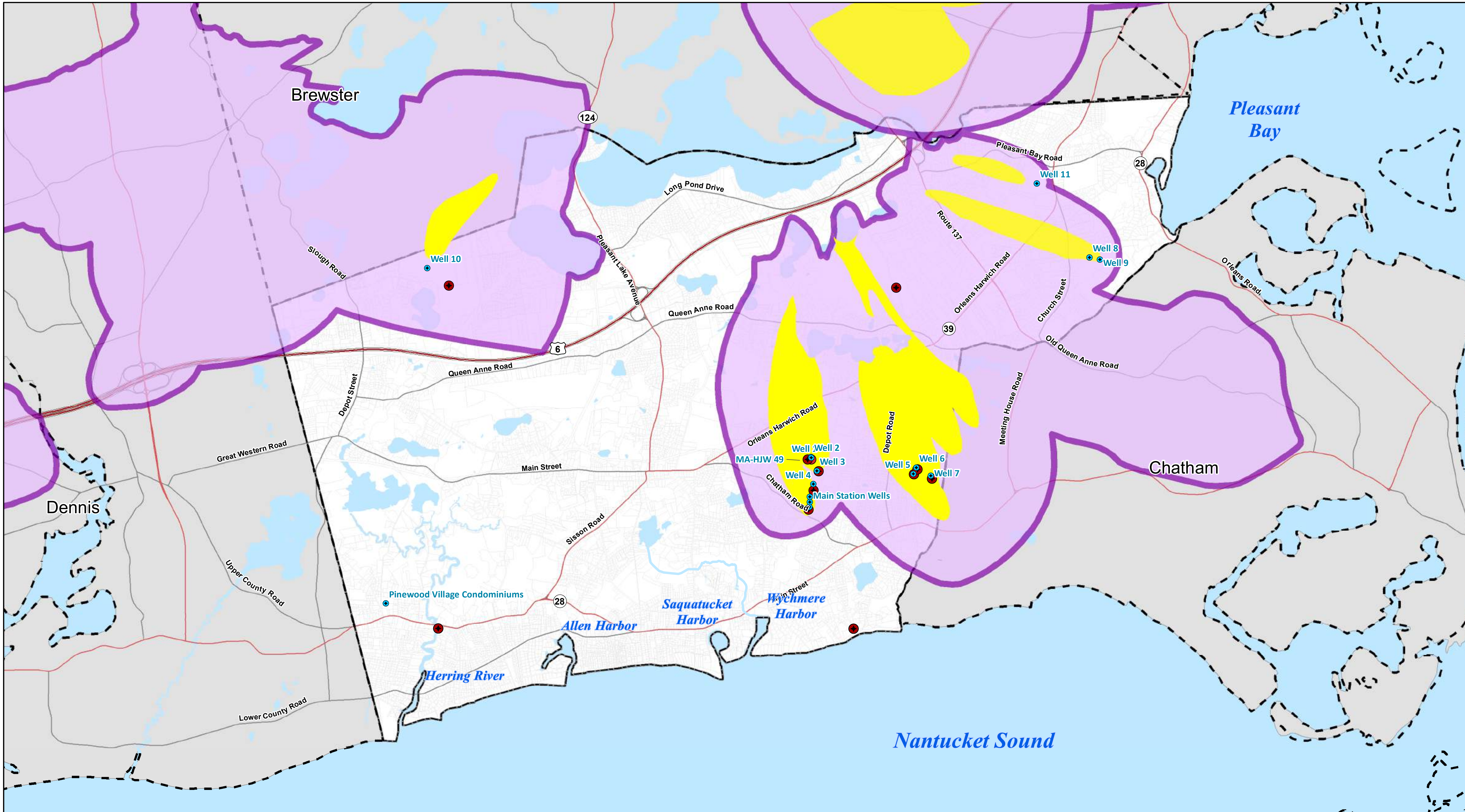
Information discussed in this section originates from the Harwich Water Department and the United States Geological Survey (USGS) National Water Information System (NWIS) Database (waterdata.usgs.gov/nwis).

4.2.1 Harwich Public Water Supply Wells and Treatment

Drinking water for the Town of Harwich is supplied from fourteen gravel-packed groundwater wells to more than 9,800 public water accounts. These wells are located in southeast, northeast and northwest areas of Harwich, as shown on Figure 4-1. Each well draws water from the Monomoy lens, one of six areas of elevated groundwater that comprise the Cape Cod Aquifer. In 2011, the fourteen wells pumped approximately 683 million gallons of raw water, and in 2010 they pumped approximately 770 million gallons which averages to around 2.0 mgd

Table 4-1 lists the fourteen public water supply wells and their locations. Seven of the fourteen wells are located off of Chatham Road in the southeastern portion of town, behind the Water Department's main office, in what is referred to as the "Main Station" tubular well-field. The other seven wells are spread among four different locations, as listed in Table 4-1 and shown on Figure 4-1. These include three wells off of Depot Road in South Harwich, two off of Bay Road in East Harwich, one in North Harwich off of Westgate Road on the Brewster town line, and one off of Pleasant Bay Road in East Harwich.

The fourteen supply wells are grouped into five Zone II Well Protection Areas. The Zone II is the primary recharge area for a supply well or wells. Specifically, a Zone II is defined as the contributing area to a well based on 180 days of pumping at the MassDEP approved yield (maximum pumping rate) for the well with no recharge from precipitation. MassDEP has approved the Town's Zone II delineations.



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Legend

- Public Water Supplies
- USGS Groundwater Monitoring Wells
- Zones of Contribution
- Zone II (Public Supply Well)

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,750 feet

0 2,500 5,000 10,000 Feet

Figure 4-1
Public Water Supply and Wells

CDM Smith

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Table 4-1
Harwich Drinking Water Wells

Source Name	Source ID	Location of Source
Wells 1 through 3	4126000-01G	Off Chatham Road
Well 2	4126000-02G	Off Chatham Road
Well 3	4126000-03G	Off Chatham Road
Main Station	4126000-04G	Off Chatham Road
Well 4	4126000-05G	Off Chatham Road
Well 5	4126000-06G	Off Depot Road
Well 6	4126000-07G	Off Depot Road
Well 7	4126000-08G	Off Depot Road
Well 8	4126000-09G	Off Bay Road
Well 9	4126000-10G	Off Bay Road
Well 10	4126000-11G	Off North Westgate Road
Well 11	4126000-12G	Off Pleasant Bay Road

Note: Insert text here

In addition to the Zone II delineations, the MEP estimated water supply well zones of contribution (ZOC's). These are based on the actual average annual pumping rates, which are less than the pumping rates used for the Zone II areas. Modeling to develop the ZOC areas also includes average annual recharge. The combination of the lower pumping rates and the inclusion of annual recharge means that the contributing areas are smaller than the Zone IIs as shown on Figure 4-1.

Harwich's raw groundwater supply is treated with potassium hydroxide (KOH) and sodium hypochlorite (chlorine). KOH is added at very low concentrations to increase the pH of the water and reduce its natural corrosivity. High pH can stain plumbing fixtures and degrade drinking water quality by leaching copper and lead out of private service lines.

Since 2004, Harwich has seen a steady increase in the concentrations of iron and manganese in its drinking water supply from the wellfield off of Chatham Road – the source of about 60 percent of the Town's water supply. While these constituents do not present health concerns, they create aesthetic issues that are displeasing to customers. As a result, in 2010, the Town began construction of the new Bruce Cahoon Water Treatment Facility, designed to treat 6.5 million gallons per day using green sand filtration to remove iron and manganese. This facility was completed and brought online in November 2011. With the operation of the new water treatment facility, Well No. 4, which had previously been removed from service due to high iron and manganese levels, is now back online.

4.2.2 Harwich Public Drinking Water Supply Quality

Quality of drinking water supply is regulated under the federal Safe Drinking Water Act (SDWA). As detailed below, water quality from Harwich's wells is very high, and the Town's drinking water has met or exceeded the requirements of the SDWA during the last five years.

The Town of Harwich provides information about water quality testing and results in their Annual Water Quality Report, which is sent to all public water supply customers. The 2011 Town of Harwich Annual Water Quality Report includes the measurements of 20 different compounds. These various compounds were measured at levels that met the parameters set forth in the SDWA. Table 4-2 summarizes the levels of the various constituents measured, as reported in the 2007 through 2011 Annual Water Quality Reports, to create a representative picture of the water quality of Harwich drinking water over a span of five years. Note that some parameters do not need to be tested every year, based on state regulation. Where the results reported on a particular annual water quality report are from a prior year, the year is indicated in parentheses. In earlier years, when tests were not taken for a particular parameter in that year, the data were not reported and are shown as such.

Table 4-2 represents an overall view of the high quality of drinking water in Harwich. Over the five year period shown, none of the parameters were in violation of the SDWA. Levels of iron and manganese in 2008 through 2011 exceeded the "recommended level" of those compounds, but the newly operational water treatment plant will bring these levels down in future years.

Table 4-2
Data Reported on Harwich's Annual Water Quality Reports, 2007 through 2011

Parameter	Source	MCL/ MCLG	Annual Range – Lowest to Highest Measured Value				
			2011	2010	2009	2008	2007
Inorganic Contaminants							
Nitrate as N (ppm)	Septic systems, fertilizers, erosion	10/10	1.40 – 2.00	1.40 – 2.00	0.58-1.80	ND – 2.30	0.1 – 0.1
Turbidity (NTU)	Soil runoff	TT/NA	ND – 0.86	ND – 0.86 (2009)	ND – 0.86	not reported	ND – 2.30
Sodium (ppm)	Road salt	NA/28	14.0 – 31.0	14.0 – 31.0	8.9 – 32.0	10.0 – 28.0	8.9 – 23.0
Radioactive Contaminants							
Gross Alpha Activity (pCi/L)	Natural erosion	15/NA	1.6 – 1.6 (2003)				
Radium-226 (pCi/L)	Natural erosion	5/NA	0.1 – 0.1 (2005)				
Radium-228 (pCi/L)	Natural erosion	5/NA	0.4 – 0.4 (2005)				
Microbiological Contaminants							
Total Coliform Bacteria (#/100 mL)	Naturally present	5% or <40/NA	0 – 1	0 – 1 (2009)	0 – 1	not reported	not reported
Disinfection Contaminants							
Haloacetic Acids (ppb)	Disinfection byproduct	60/NA	ND – 1.00	ND – 1.00	not reported	not reported	not reported
Total Trihalomethanes (ppb)	Disinfection byproduct	80/NA	ND – 7.70	ND – 7.70	ND – 3.40	ND – 5.70	2.0 – 5.80
Unregulated Contaminants							
Bromoform (ppb)	Disinfection byproduct	NA/NA	ND – 3.60	ND – 3.60	ND – 1.70	not reported	ND – 2.20
Chloride (ppm)	Weathering rocks	250/250	13.0 – 34.0	13.0 – 34.0 (2009)	13.0 – 34.0	10.0-30.0	not reported

Table 4-2 (Cont'd)
Data Reported on Harwich's Annual Water Quality Reports, 2007 through 2011

Parameter	Source	MCL/ MCLG	Annual Range – Lowest to Highest Measured Value				
			2011	2010	2009	2008	2007
Unregulated Contaminants (Cont'd)							
Chloroform (ppb)	Disinfection byproduct	NA/NA	ND – 1.80	ND – 1.80	ND – 3.50	0.6 – 4.00	0.540 – 3.20
Dibromochloro-methane (ppb)	Disinfection byproduct	NA/NA	ND – 1.70	ND – 1.70	ND – 0.66	not reported	ND – 0.76
Unregulated Contaminants (continued)							
Methyl Tertiary Butyl Ether (ppb)	Fuel additive	NA/NA	ND – 3.00 (2009)	ND – 3.00 (2009)	ND – 3.00	ND – 1.00	0.001 (2004)
Sulfate (ppm)	Natural	250/250	5.70 – 11.0	5.30 – 8.10 (2009)	5.30 – 8.10	5.00 – 8.70	4.20 – 9.30
Chlorine (free, ppm)	Disinfection		0.01 – 0.30	0.01 – 0.30 (2009)	0.01 – 0.30	0.01 – 0.30	0.010 – 0.50
Secondary Contaminants							
Total Iron (ppm)	Natural	300/0.3	ND – 1.40	ND – 0.33 (2009)	ND – 0.33	ND – 0.58	not reported
Total Manganese (ppm)	Natural	50/0.05	0.004 – 0.18	0.008 – 0.26 (2009)	0.008 – 0.26	ND – 0.19	not reported
Lead and Copper							
Lead (ppb)	Plumbing corrosion and natural erosion	15/0	0* (2009)	0* (2009)	0*	2*	2*
Copper (ppm)	Plumbing corrosion and natural erosion	1.3/1.3	0* (2009)	0* (2009)	0*	5*	0*

* = Number of tested sites above the EPA action level; these values do not constitute a violation of the standard

MCL = Maximum contaminant level, which is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

MCLG = Maximum contaminant level goal, which is the level of contaminant in drinking water below which there is no known or expected risk to human health. MCLGs allow for a margin of safety.

ND = Not detected

NA = Not applicable

TT = Treatment technique, which refers to a required process intended to reduce the level of a contaminant in drinking water.

Results presented in RED indicate a violation of the SWDA standard.

4.2.3 Nitrate in Drinking Water

Of particular interest for wastewater planning are nitrate concentrations. Of the many compounds tested for, detected levels of nitrate are important because they can serve as an indicator of fertilizer run-off, stormwater recharge, and leachate from septic tanks entering the water supply. As shown in Table 4-2, other constituents measured do not typically originate from septic systems and therefore cannot be managed by a change in wastewater handling methodology.

A June 2007 Stearns and Wheler report entitled, "Town of Harwich Evaluation of Wastewater Management Options for Freshwater Ponds" and a case study report for the Great Sand Lakes, reviewed 10 years of water supply monitoring data for Harwich Wellfields No. 1 and 2. These studies found an average of 0.58 mg/L of nitrate in the water pumped from Wellfield No. 1 and an average of 0.47 mg/L of nitrate in the water pumped from Wellfield No. 2. The report determined that these low concentrations, which are desirable, are due to the large amount of protected land in the supply well watersheds and may also be due to nitrogen removal (natural attenuation) that occurs as the groundwater flows through the Great Sand Lakes.

More recent data suggest a slight rise in nitrate levels, though still well below required and suggested regulatory limits. The 2012 average nitrate concentration in the wells in the same vicinity (off Chatham Road) was 0.73 mg/L. The average nitrate concentration detected in 2011 across all public water supply wells was 1.1 mg/L, and in 2010 it was 1.8 mg/L. Both values are well below the SDWA primary Maximum Containment Level (MCL) of 10 mg/L and the Cape Cod Commission goal of 5 mg/L.

Figure 4-2 shows the nitrate levels measured by the Harwich Water Department at each drinking water well in the period of 1987 through 2004, with additional data shown from March 2012. As seen in Figure 4-2, Pleasant Bay watershed sampling stations #8 and #9 (at Well Nos. 8 and 9) tend to have the highest nitrate concentrations, while all readings from other wells within the system have consistently been below 2.0 mg/L. The other Pleasant Bay watershed well (Well No. 11) has the next highest nitrate concentration indicating the contributing areas have more development within them.

4.2.4 USGS Groundwater Monitoring Wells

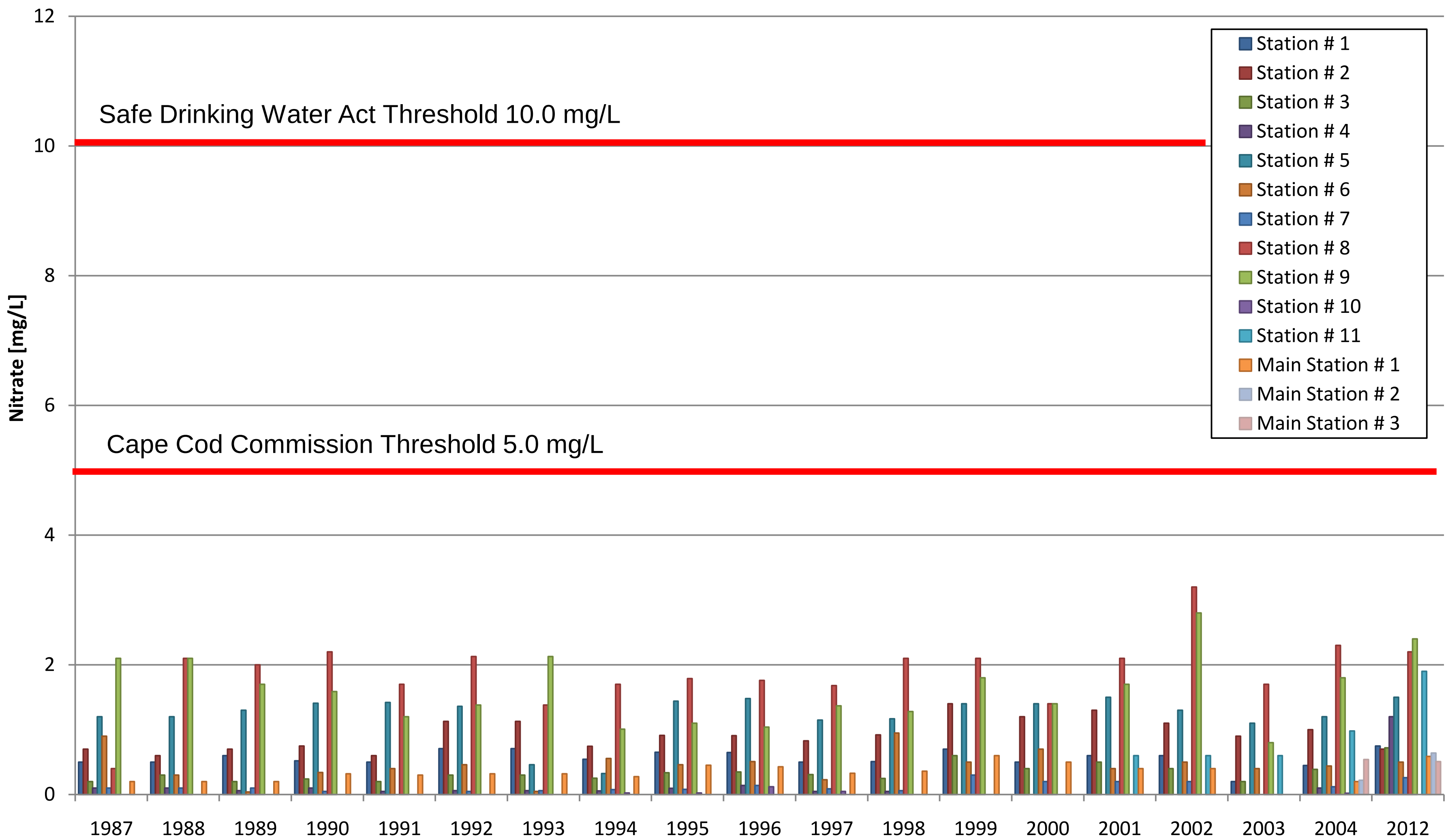
Historic groundwater data were obtained from the USGS NWIS Database for twenty-one groundwater monitoring wells in Harwich, as shown on Figure 4-3. Note that these are different from water supply wells and are located both within and outside of Zone II areas. Groundwater samples from nineteen of these wells were analyzed for nitrate. Sample frequency varies, but data is available between 1972 and 1986. The historic groundwater data are useful in providing a context and an understanding of past conditions. Nitrate concentrations ranged from non-detect to 3.8 mg/L, with a measured concentration of 6.2 mg/L in one water sample. The nitrate detection of 6.2 mg/L was measured in a water sample from well MA-HJW 49 (near wells 1 and 2 off Chatham Road) collected in January 1975. Nitrate was measured at a concentration of 1 mg/L in the most recent round of sampling conducted in March 1985 at this same well.

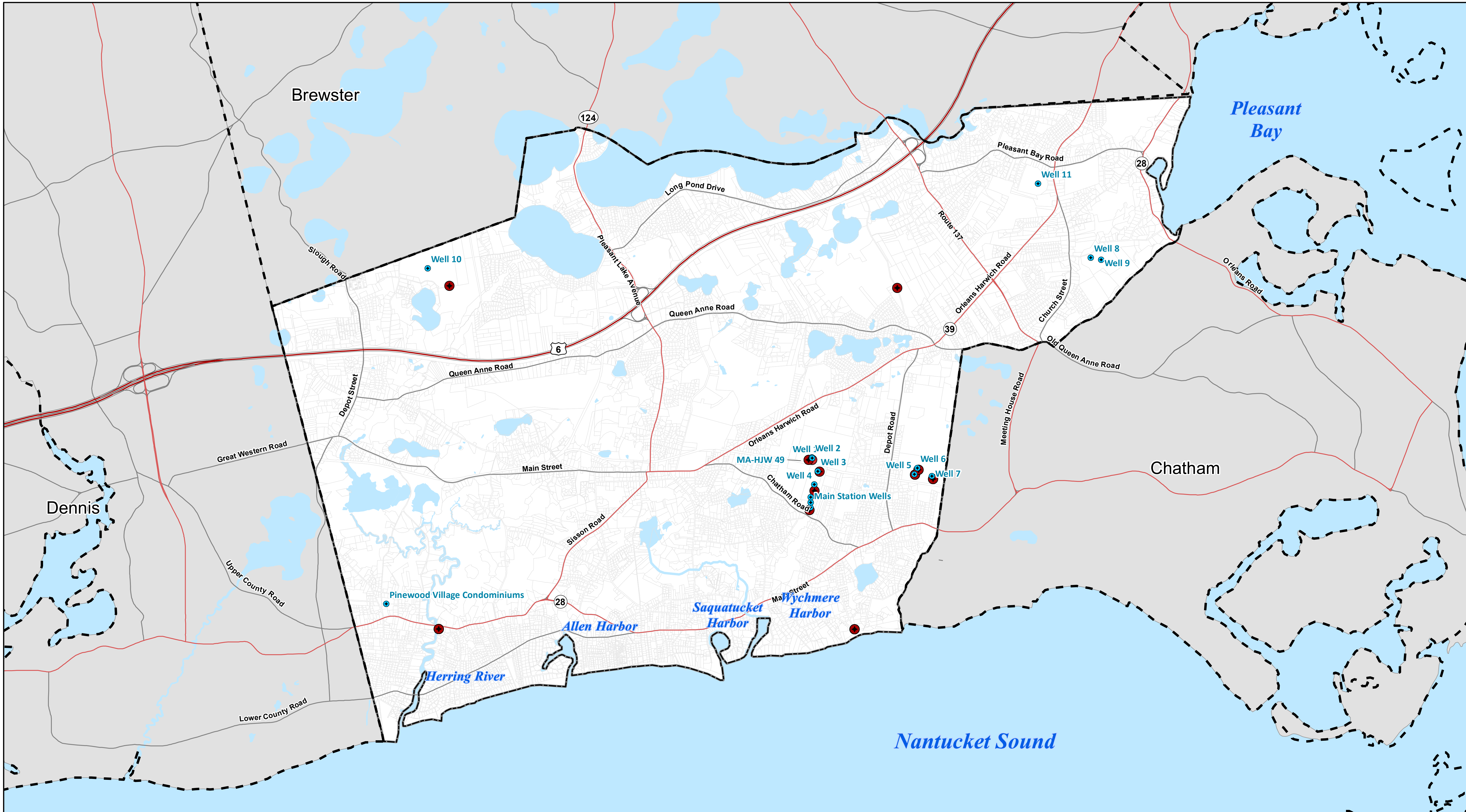
4.3 Harwich Beaches

The sources of the information discussed in this section are the Barnstable County Department of Health and Environment and the Harwich Water Quality Management Task Force, through their respective water quality data collection and reporting programs.

Beaches in Harwich consist of a mixture of saltwater beaches along the coastal shoreline and freshwater beaches that exist along the shores of Harwich's many freshwater ponds. Interviews with local Board of Health officials revealed that the water quality of Harwich's beaches is generally very good. Isolated instances have occurred where the bacterial limits have been exceeded, usually in response to a stormwater discharge after a rainfall event. However, beach water quality is good enough to have warranted a reduction in the sampling frequency of saltwater beaches in Harwich based on state regulations, as described below.

Figure 4-2. Nitrate Results for All Public Drinking Water Supply Wells
(data from Harwich Water Department)





Legend

- Public Water Supplies
- USGS Groundwater Monitoring Wells

Note: Only the Public Water Supplies within Harwich are shown on this map

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,750 feet

0 2,500 5,000 10,000 Feet

Figure 4-3
USGS and Groundwater Wells

CDM Smith

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4.3.1 Water Quality of Harwich Beaches

The Massachusetts Department of Public Health (MDPH) administers the "Beach Program" for all beaches in the Commonwealth. All beaches are sampled regularly during the bathing season as part of a three-tiered monitoring program. Sampling and monitoring twice weekly is required for beaches classified as Tier 1. Tier 2 beaches require weekly monitoring. A classification of Tier 3 signifies beach waters of "low health concern" and requires less frequent monitoring.

In June 2007, the MDPH determined that the sampling frequency could be reduced due to the good water quality of many of Harwich's saltwater beaches. These beaches meet Tier 3 requirements with no known pollution or health concerns. In MDPHs findings regarding the classification request, they concluded that, "there are no water quality concerns for the beaches. There were no single sample or geometric mean exceedances for the two seasons' worth of data provided with the sanitary surveys submitted by the Harwich Board of Health in support of the frequency reduction."

The beach sampling program measures colonies of *Escherichia coliform* ("E. coli") and enterococci as indicator organisms for water quality, per state regulations listed in 314 CMR 4.00. The maximum single-sample standard for marine waters is 104 colony forming units (cfu) of enterococci per 100 milliliters (100 mL), and the geometric mean of the five most recent bathing season samples cannot exceed 35 cfu/100 mL. For fresh water, either enterococci or E. coli bacteria are used as indicators. The E. coli single-sample limit for recreational fresh water is 235 cfu/100 mL, and the enterococci limit is 61 cfu/100 mL. In addition, the geometric mean cannot exceed 126 cfu/100 mL of E. coli or 33 cfu/100 mL of enterococci in the five most recent bathing season samples according to state regulations.

A list of all Harwich public and semi-public beaches and the sampling results for 2007 through 2011 are provided in Table 4-3. All beaches were tested from June through August, during the height of recreational use. The highlighted cells represent at least one exceedance of recreational water quality standards for a particular beach in a particular year.

Table 4-3
Harwich Beach Sampling Results, 2007 through 2011

Beach Name	Number of Samples/ Number of Exceedances				
	2011	2010	2009	2008	2007
Public Marine Beaches					
Earle Road Beach	13/0	14/1	4/0	4/0	3/0
Pleasant Bay	13/0	5/1	4/0	4/0	4/0
Red River Beach (East)	13/0	6/2	4/0	4/0	4/0
Red River Beach (West)	13/0	14/1	15/1	14/1	13/0
Red River Beach (Middle)	13/0	14/1	15/1	11/1	3/0
Marine Beaches Varianced as of 2011 (Reduced Sampling Frequency)					
Atlantic Avenue Beach	4/0	4/0	4/0	4/0	4/0
Bank/Bayview	4/0	4/0	4/0	4/0	5/0
Brooks Beach	4/0	4/0	4/0	4/0	4/0
Grey Neck Beach	4/0	4/0	4/0	4/0	4/0

Table 4-3 (Cont'd)
Harwich Beach Sampling Results, 2007 through 2011

Beach Name	Number of Samples/ Number of Exceedances				
	2011	2010	2009	2008	2007
Marine Beaches Varianced as of 2011 (Reduced Sampling Frequency) (Cont'd)					
Merkel Beach	4/0	4/0	4/0	4/0	4/0
Neel Road Beach	4/0	4/0	4/0	4/0	4/0
Pleasant Road Beach	4/0	4/0	4/0	4/0	4/0
Seabreeze Road	4/0	4/0	4/0	4/0	4/0
Wah Wah Taysee	4/0	4/0	4/0	4/0	4/0
Zylpha Road Beach	4/0	4/0	4/0	5/0	13/0
Freshwater Beaches					
Bucks Pond	16/3*	13/0	15/1	13/0	13/0
Hinckley's Pond	13/0	13/0	14/0	13/0	13/0
Long Pond 1 (Cahoon Street)	13/0	13/0	14/0	13/0	13/0
Long Pond 2 (Long Pond Drive)	13/0	13/0	14/0	13/0	13/0
Long Pond 3 (Route 124)	13/0	14/1	14/0	13/0	13/0
Robbins Pond	15/2*	13/0	14/0	13/0	13/0
Sand Pond	14/1	13/0	14/0	13/0	13/0
Seymour Pond	13/0	14/1	14/0	13/0	13/0
Skinequit Pond	13/0	13/0	14/0	13/0	13/0
TOTAL PUBLIC BEACHES	**228/6**	**212/8**	**209/3**	**195/2**	**194/0**
Semi-Public Marine Beaches					
Allen's Harbor Assoc. (Dunes Road)	13/0	12/0	12/0	12/0	11/1
Old Mill Point Assoc. (Seaway)	--	12/0	12/0	12/0	12/0
Old Mill Point Assoc. (Strand Way)	13/0	13/1	12/0	14/2	12/0
The Belmont	13/0	12/0	12/0	14/2	12/0
Wequassett Inn Resort	13/0	12/0	13/1	12/0	13/1
Stone Horse Yacht Club	13/0	--	--	--	--
Wychmere Harbor Club	13/0	--	--	--	--
Semi-Public Freshwater Beaches					
Great Sands (Buck's Pond/ Clearwater)	16/3*	13/1	12/0	12/0	12/0
Great Sands (Joseph's – Vacation)	17/3*	12/0	12/0	14/2	12/0
Great Sands (Lakeside Terrace)	2/0	--	12/0	12/0	12/0
Sandy Shore Assoc. (Aunt Edie's)	13/0	12/0	12/0	12/0	12/0
TOTAL SEMI-PUBLIC BEACHES	**126/6**	**98/2**	**109/1**	**114/6**	**108/2**

Note: *These sites were tested for Entercocci rather than E. coli during the exceedances shown, with the exception of one of the three exceedances at Buck's Pond, which was an E. coli exceedance.

Note that in 2011, between the dates of June 29th and July 13th, the testing methodology was changed to utilize enterococci rather than E. coli as the bacteriological water quality indicator for fresh water beaches. This resulted in a marked increase in the number of violations, which brought into question the validity of the indicator organism. Since that time, side-by-side testing has been performed for both E. coli and enterococci at fresh water beaches, which has supported the belief that the two indicators are not interchangeable, with E. coli measurements consistently low, while enterococci samples exhibit more variability.

As shown in Table 4-3, in 2011, of the 15 public saltwater beaches that were tested, all came back with acceptable results within the state limits. Out of the nine freshwater beach locations that were tested, six violations were registered by three separate beaches between mid-June and mid-July, largely attributable to the testing changes described above. Overall, Harwich has seen exceptional beach water quality over the last five years, with consistently low bacterial test results and infrequent closures, especially at public marine beaches.

4.3.2 Harwich Water Quality Management Task Force Bacterial Data

In addition to beach sampling conducted by Barnstable County, bacterial sampling has also been conducted for fecal coliform in Harwich harbors by the Harwich Water Quality Management Task Force. Detections in water samples in 2011 generally did not exceed the typical treated wastewater discharge threshold of 200 cfu/100 mL, although the Massachusetts shellfish harvesting threshold of 14 cfu/100 mL was exceeded in several locations. Fecal coliform sources to Harwich harbors include stormwater discharges, septic system failures, boat waste discharges, wildlife and other sources. Failed septic systems do not appear to be a major contributor to fecal coliform levels in Harwich harbors based on the data collected in 2011 and past years, as shown below.

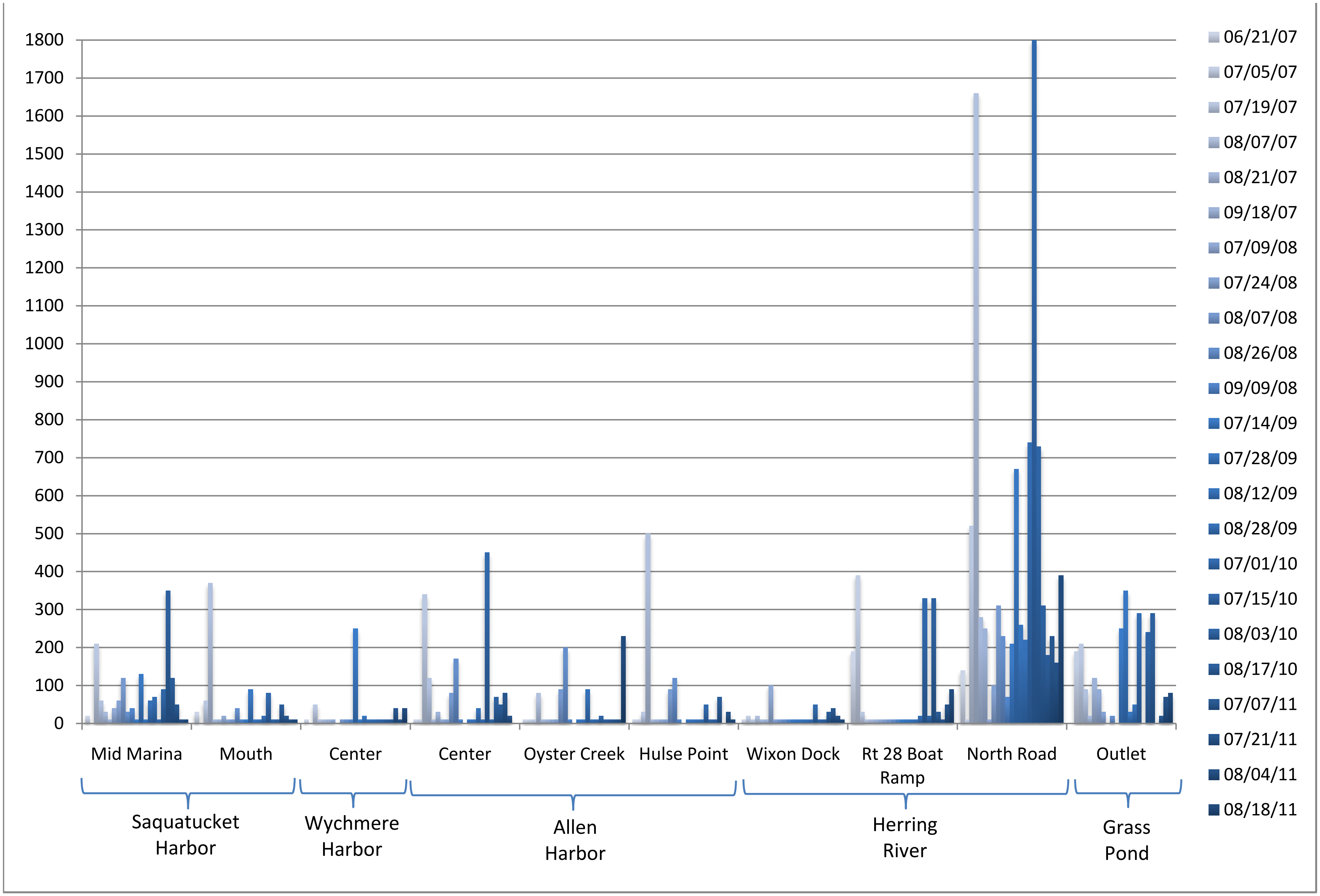
Figure 4-4 provides the long-term fecal coliform sampling results, and the text which follows summarizes the results for each of the MEP watersheds. Note that all samples reported as $\leq$10 cfu/100 mL are shown as 10 cfu/100 mL.

- ***Saquatucket Harbor –*** Based on fecal coliform data from 2007 through 2011, concentrations regularly exceed the shellfish limit and occasionally exceed the 200 cfu/100 mL wastewater discharge standard. Exceedences were sporadic and a detailed watershed evaluation would be required to identify the sources. A 2003 Harbors Interim Report indicated that wildlife is a possible source when high fecal coliform concentrations are measured.

- ***Wychmere Harbor –*** Based on fecal coliform data from 2007 through 2011, concentrations occasionally exceeded the shellfish limit and exceeded the 200 cfu/100 mL level once in 2009. Stormwater from Route 28 discharges to the harbor, but fecal coliform concentrations have remained low.

- ***Allen Harbor –*** Fecal coliform data from Allen Harbor had exceedences of both standards at all three sampling locations. A detailed study conducted prior to 2007 had concluded that wildlife appears to be the primary source of fecal coliform, as described in more detail below.

Figure 4-4. Long Term Fecal Coliform Sampling Results



CDM Smith

- ***Herring River –*** In 2011, the 200 cfu/100 mL standard was only exceeded at the North Road sampling location, while the shellfishing standard was also exceeded at all three locations sampled. Fecal coliform data from 2007 through 2011 had consistent exceedences of both standards at the North Road location and occasionally at the Route 28 boat ramp. The Wixon Dock sampling location consistently had very low fecal coliform levels. The 2003 Harbors Interim Report indicated that some exceedences in the Herring River appear to be connected to stormwater run-off, though wildlife is also a possible source. Further investigation would be needed to confirm coliform sources.

4.3.3 Allen Harbor Fecal Coliform Study

A study was conducted in 2003 to identify sources of fecal coliform in the Allen Harbor watershed. Results are documented in the *Fecal Coliform Evaluation and Mitigation Planning for the Allen Harbor Watershed* Report (Stearns & Wheler 2003). Water samples from Allen Harbor have been tested for fecal coliform since 1989. High fecal coliform values, typically 1,000 to 3,000 cfu/100 mL were measured north of the Lower County Road Bridge in 2002. The highest values in the study period occurred during the summer of 2002 at Route 28, with fecal coliform values of 5,000 to 38,000 cfu/100 mL. The study did not identify any septic system discharges which reached the harbor directly. According to the study, local wildlife appears to be the primary source of the fecal coliform in this location.

4.3.4 Conclusion for Bacterial Contamination

Wastewater has not been identified as a likely source of elevated levels of fecal coliform in Harwich's harbors, at marine bathing beaches, or in the upper Herring River. Bacteria and pathogens in marine waters are therefore not considered further in this CWMP/SEIR, as a change in wastewater management strategy does not appear to be necessary to control bacterial contamination. The sources of bacteria at Harwich's freshwater bathing beaches are not well studied. However, since the analysis of freshwater ponds in Section 5 recommends consideration of sewering in areas where other evidence exists of potential wastewater inputs due to nutrient loading, any bacterial inputs originating from septic systems in these areas should also be remedied.

4.4 MassDEP Eelgrass Mapping Program

Eelgrass is used as a biological health indicator to assess the impacts of nutrients on overall ecosystem health. As described further in Section 6, impacts to eelgrass beds were used to assess the health of Harwich's bays, estuaries, and rivers early in the MEP process. Much of this information was based on the MassDEP Eelgrass Mapping Program data described herein (www.mass.gov/dep/water/resources/maps/eelgrass/eelgrass.htm). Eelgrass beds in Harwich estuaries were delineated as part of the MassDEP program in 1995 and 2001. Mapping of this information is available through MassGIS (www.mass.gov/mgis/eelgrass.htm). Aerial photographs from 1951 were compared to the MassDEP maps to estimate the distribution of eelgrass prior to watershed development. Continued mapping of eelgrass beds in future years by MassDEP is anticipated.

Eelgrass was present in the Herring River in 1995 up to the limits of the mapping project at the Route 28 bridge. The eelgrass coverage in the Herring River declined in 2001 and had declined to a negligible amount in 2010. Eelgrass coverage in Nantucket sound at the Harwich beaches declined from 1995 to 2001 between the Herring River and Wychmere Harbor.

Eelgrass was not present in Allen Harbor, Wychmere Harbor, and Saquatucket Harbor in 1995 or 2001. Saquatucket Harbor is a manmade harbor. The area was dredged in the late 1960s by the Army Corps of Engineers to form the harbor which is used primarily as a marina. Wychmere Harbor was formed by dredging the outlet from a freshwater kettle pond to Nantucket Sound. Since all three harbors are regularly dredged, the presence or absence of eelgrass in the harbors is not a good indicator of ecosystem health in those locations.

A comparison of eelgrass mapping from 1951, 1995, and 2001 for Pleasant Bay reveals that eelgrass coverage has declined 24%. The MEP Pleasant Bay Report also reviewed an additional eelgrass survey by shallow draft boat conducted for the Town of Chatham in 2000. In this study, eelgrass was observed adjacent to the creek inlet in lower Muddy Creek, located on the boundary between Harwich and Chatham.

As stated above, this information was used in the initial MEP analyses and will continue to be used as improved wastewater management strategies are implemented to aid in assessing their success.

4.5 Water Quality Classifications and Impaired Waterways

4.5.1 Massachusetts Water Quality Classifications

Similar to the bacterial sampling described above, other water quality sampling of Harwich harbors and the Herring River has been conducted by the Harwich Water Quality Management Task Force since 2001. Water samples from various locations and depths in Nantucket Sound, Saquatucket Harbor, Wychmere Harbor, Allen Harbor, the Herring River, and West Reservoir were analyzed for nutrients. This data has been used extensively in the MEP evaluations described in Section 6 and is therefore not described in this section except as it pertains to the attainment of assigned water quality classifications and water body impairments.

As described in Section 1, tidal and marine waterbodies are divided into various classes according to Massachusetts water quality standards (314 CMR 4.00). For tidal waters, Class SA waters provide excellent habitat for wildlife and suitable water quality for shellfish growth and harvesting. A threshold value of 6 mg/L dissolved oxygen is set for Class SA waterbodies to support fish habitat. The following summarizes the water quality data pertaining to dissolved oxygen from the Harwich Water Quality Management Task Force data.

- ***Herring River*** – During the sampling period analyzed (2001 to 2006), dissolved oxygen in the Herring River was below 6 milligrams per liter (mg/L) – the Massachusetts standard for Class SA waters – in 74% of samples collected at Lower County Road, 91% of samples collected at Route 28, 97% of samples collected at North Road, and 96% of samples collected at Lothrop Road. The northern section of the Herring River is a naturally occurring wetland area. Low dissolved oxygen often occurs in wetland areas.

- ***Allen Harbor*** – Dissolved oxygen was below the 6 mg/L standard for Class SA waters in 87% to 92% of samples collected at sampling stations at Hulse Point, the harbor marina and Allen Harbor Creek.

- ***Wychmere Harbor*** - Dissolved oxygen was below 6 mg/L in 90% of samples collected from the bottom of the water column and 45% of samples collected in the middle of the water column within the harbor.

- ***Saquatucket Harbor*** - Dissolved oxygen in Saquatucket Harbor was below 6 mg/L in 97% of samples collected from the bottom of the water column and 55% of samples collected in the middle of the water column.

The values below the DO threshold of 6 mg/l are undesirable and indicate nutrient over-enrichment in these waterways, causing algal growth and depleted DO levels. These levels reinforce the needs presented in Section 6 to reduce nitrogen inputs to Harwich's marine waterways through improved wastewater management strategies.

For freshwater bodies, Class A waters are suitable for public water supply and provide excellent habitat for wildlife. Class B waters are similar to Class A waters but may require treatment before use as a public water supply. Dissolved oxygen standards are defined based on the class of water body and the type of fish habitat. Warm water fisheries have mean daily temperatures in the summer months greater than 68 °F and do not support trout. Most ponds in Harwich would be classified as warm water fisheries. Cold water fisheries have mean daily temperatures of less than 68 °F and support trout. The CCC review of pond data indicates that John Joseph Pond would be classified as a cold water fishery. Detailed discussion of DO sampling results in Harwich's freshwater bodies is provided in Section 5.

4.5.2 Impaired Waterways and Waterbodies

The 2006, 2010, and 2012 "Integrated List of Waters" were reviewed for the inclusion of water bodies in Harwich. These documents list the quality of waters in Massachusetts per Sections 303(d) and 305(b) of the Clean Water Act (CWA). Section 305(b) of the CWA formalizes the review process of waters and their ability to support the designated uses identified in each states' surface water quality standards. Section 303(d) identifies waterbodies in Massachusetts that are not expected to meet surface water quality standards and then schedules them for Total Maximum Daily Loads (TMDLs) to be assigned for specific contaminants or criteria. A TMDL establishes the maximum amount of a pollutant that may be introduced into a water body while still maintaining water quality standards. The formulation of the 303(d) List includes a more rigorous public review and comment process than does reporting under Section 305(b), and the final version of the list must be formally approved by the U.S. EPA. The 2012 list has been approved by EPA.

A review of the 2012 Integrated List of Waters identified the following seven water bodies in Harwich. The reasons for inclusion on the list are also shown below for each water body:

- ***Hinckleys Pond*** – listed as attaining some uses, others not assessed (was previously listed as "no uses assessed" in 2006 and 2010);

- ***Muddy Creek*** – listed due to total nitrogen and fecal coliform;

- ***Herring River*** – listed due to fecal coliform;

- ***Long Pond*** – listed due to organic enrichment and low dissolved oxygen;

- ***Saquatucket Harbor*** – listed due to fecal coliform;
- ***Round Cove*** – listed due to total nitrogen; and
- ***Pleasant Bay*** – listed due to total nitrogen.

All of the waterways listed above were investigated in more detail either as part of the freshwater ponds analysis in Section 5 or the MEP analyses in Section 6. Together with the information provided herein, these three sections provide a comprehensive summary of the water quality data gathered and analyzed during the development of this CWMP.

4.6 Conclusions

Based on the above information, the following conclusions can be drawn:

- Harwich public drinking water supply wells appear to be adequately protected from nitrate impacts coming from septic systems. All wells meet the drinking water standards. Three wells in the Pleasant Bay watershed exhibit the highest nitrate levels (2-3 mg/l range) but do not warrant sewering those areas solely for this issue. However, nitrogen reduction in this watershed to address meeting the TMDL should target zones of contribution in the three wells to help maintain nitrate concentrations.
- The water quality at Harwich fresh water and salt water beaches appears to be fine under normal conditions. Bacterial contamination from septic systems does not appear to be a concern. Stormwater best management practices should be employed. Impacts from boat wastes and adjacent wildlife habitats should continue to be evaluated.

Section 5

Assessment of Freshwater Ponds

5.1 Introduction

This section describes assessments conducted both as part of this CWMP/SEIR and by others over the last several years to evaluate the health of freshwater ponds in Harwich. The section concludes with recommendations for enhanced watershed management and further evaluation of specific ponds.

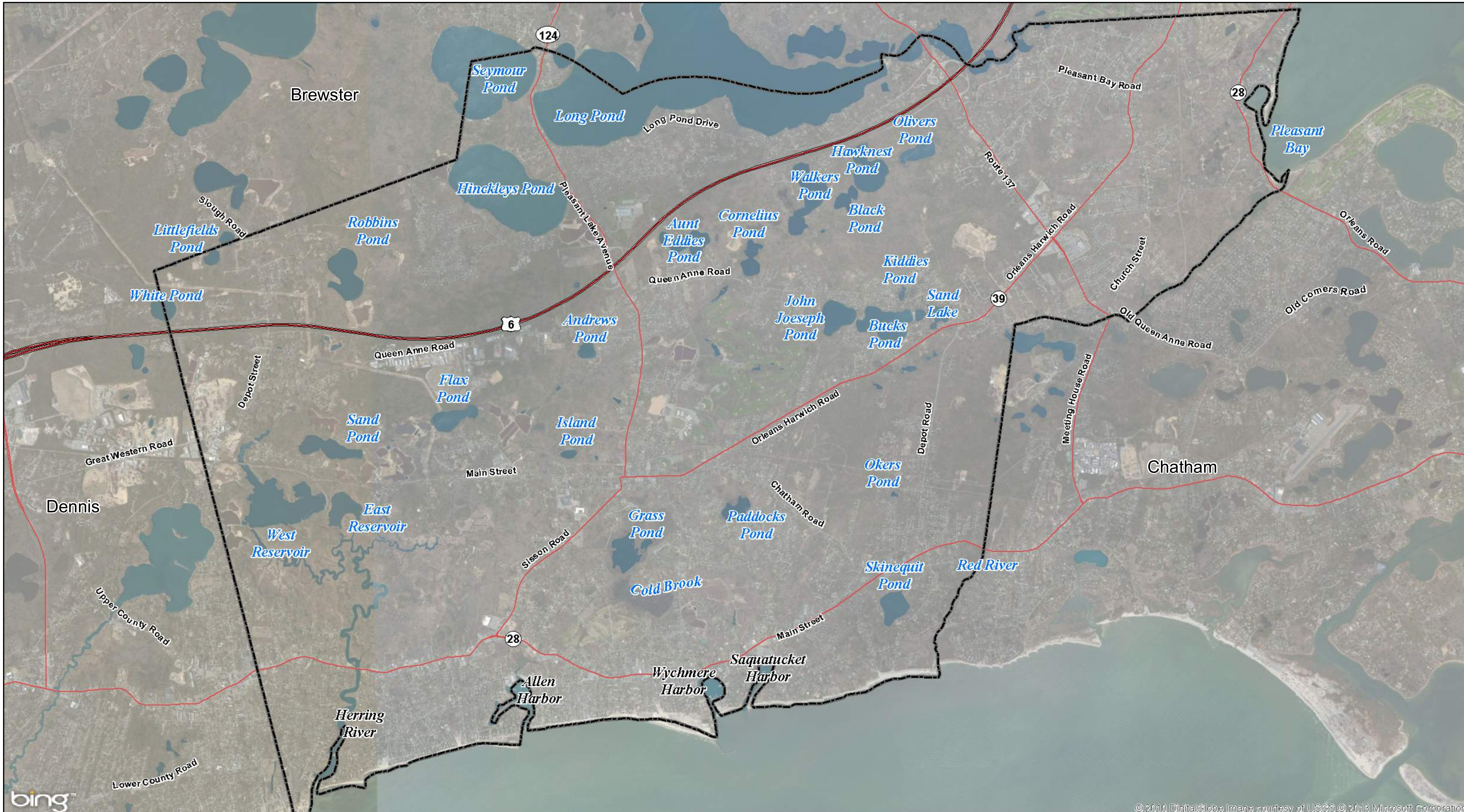
5.2 Pond Health Assessment

The Town of Harwich has approximately 22 ponds with a total area of several hundred acres. The Cape Cod Pond and Lake Stewardship (PALS) program has consistently sampled up to seventeen locations annually in sixteen of Harwich's ponds, typically in July, August, and/or September. Data from the PALS sampling program for 2006-2010 were reviewed for the analysis contained in this section. Discrete data for Long Pond and Seymour Pond were not provided for this assessment, but discussion regarding these ponds is included because they are partially within the town boundary of Harwich. Ponds with three years or more of sampling data are listed in Table 5-1. Figures 5-1 and 5-2 present several of the larger ponds in Harwich and show which ponds are impaired, high quality, or require additional data.

Table 5-1
Harwich Ponds Sampled by the PALS Program

Name	Area (Acres)	Max Depth (feet)	PALS Sampling Years for Data Provided
Andrews Pond	6.7	27	2006-2008
Aunt Edies Pond	22	7	2006-2010
Bucks Pond	34.3	30	2006-2010
Cornelius Pond	12.5	7	2006-2008
Flax Pond	17.3	20	2006-2010
Grass Pond	20.4	3	2007-2010
Hawksnest Pond	27.3	26	2006-2010
Hinckleys Pond	174.2	26	2006-2010
John Joseph Pond	21.8	55	2006-2010
Long Pond	734.7	66	*
Robbins Pond	33.1	12	2006-2010
Sand Pond	23	20	2006-2010
Seymour Pond	181.9	38	*
Skinequit Pond	18	32	2006-2010
Walkers Pond	35.6	26	2006-2010
White Pond	12.1	20	2006-2009

Note: (*) Data not provided



N

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 5-1
Harwich Ponds

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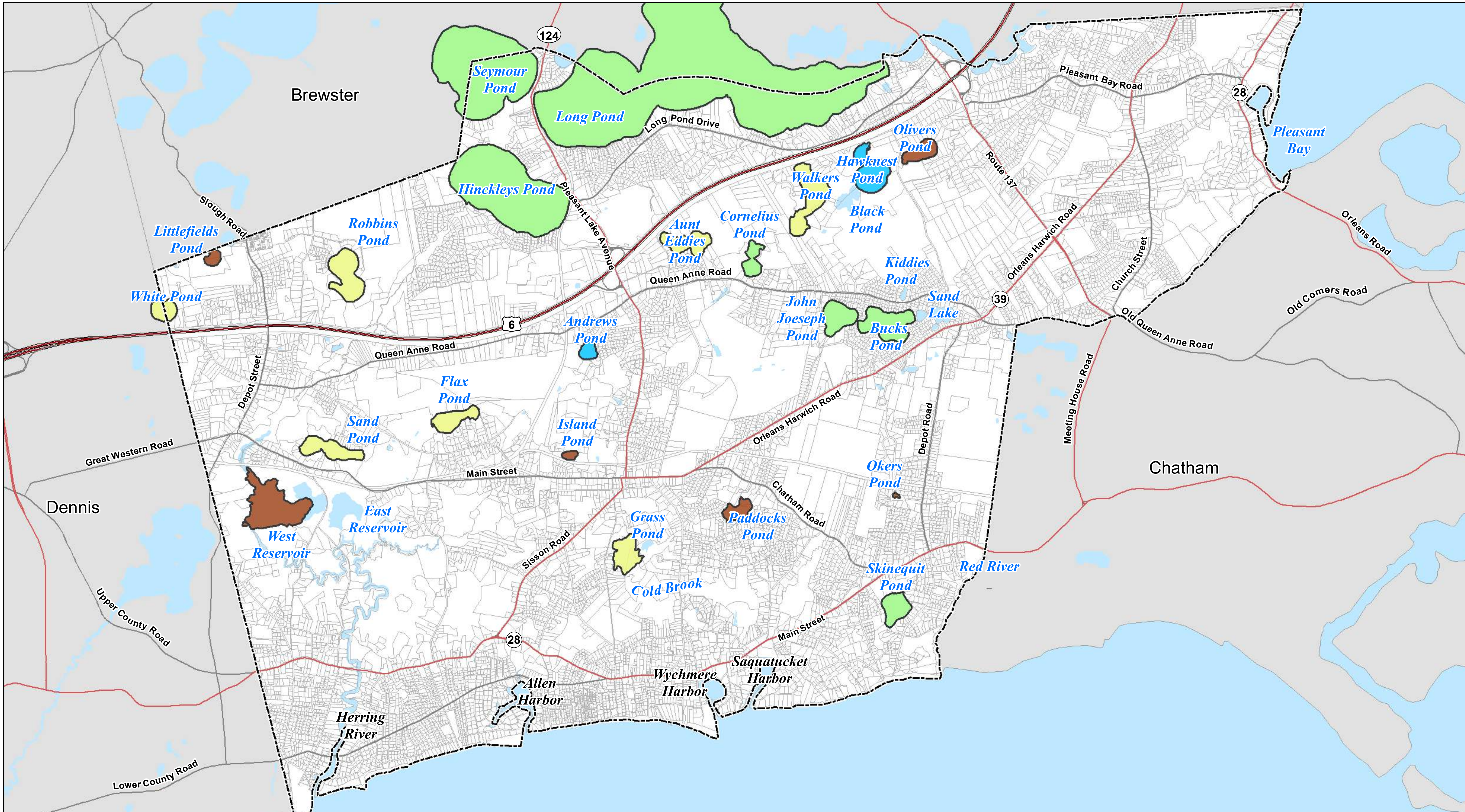

N

Legend

- Additional Data Required
- High Quality Pond
- Pond With Some Water Quality Impairment
- Impaired Pond Water Quality

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,000 feet

0 1,500 3,000 6,000 Feet

Figure 5-2
Impairment Status of
Fresh Water Ponds in Harwich

CDM Smith

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Data from the PALS program and previous water quality analyses have been reviewed to prepare an overall assessment of pond health. This assessment can be used to suggest if construction of a wastewater collection network in the vicinity of the ponds might improve pond health. As discussed below, data on pond water quality alone may not be sufficient to determine if sewering of properties near a pond will improve pond health. This is because wastewater is only one source of phosphorus, typically the limiting nutrient in freshwater ponds. Other potentially significant sources include runoff from impervious surfaces, excess fertilizer application, runoff from cranberry bogs, birds and other wildlife, and regeneration of phosphorus from the bottom sediments of ponds.

Thus, in this section, we consider available water quality data along with the degree of development near the pond to suggest if actions are needed to improve pond health. In general, actions are either watershed-based measures to address external sources of phosphorus, or in-lake measures to address internal loading (from sediment regeneration). It is important to understand the relative magnitude of internal versus external loads because action taken to address one may not successfully improve pond health if it is not the dominant load to a pond. In some instances it could be necessary to take both watershed and in-lake actions.

5.2.1 Water Quality in Kettle Ponds

The ponds in Harwich are primarily kettle ponds, formed as depressions left by ice blocks following the retreat of the glaciers. In their original state, the ponds on Cape Cod are naturally clear and acidic due to few sources of nutrients and soils of granitic origin. The pond water surface is often a reflection of the groundwater table.

The typical physical setting of the ponds on Cape Cod aids both to protect and threaten their water quality. The protection is offered by the relatively high permeability soils of the ponds' watersheds. These soils soak up precipitation resulting in limited runoff in an unaltered watershed. The soils also tend to bind phosphorus, making it unavailable for transport through groundwater into the ponds; though with sufficient time (several decades or longer) and/or with a very large source (such as a discharge of effluent from a wastewater treatment plant that does not treat for phosphorus), the binding sites will be occupied and continued addition of phosphorus will move through the soils.

The introduction of phosphorus to ponds is important because an increase in phosphorus will increase plant growth (typically as algae), which can lead to degraded water quality through loss of water transparency, noxious algal blooms, and impairment or death of aquatic life through loss of oxygen.

Kettle ponds are sensitive to anthropogenic phosphorus loadings, and it only takes a small increase in phosphorus to alter the pond's water quality. The physical setting is thus a threat to water quality because most kettle ponds have long residence times (slow flushing rates). This means that additional phosphorus that reaches the ponds will remain in the ponds unless lost through an outlet stream (for those few ponds with outlets) or by deep burial. Thus, many kettle ponds have their principal source of phosphorus generated from within the pond, typically through regeneration of phosphorus at the sediment-water interface under no oxygen (anoxic) conditions. In kettle ponds, historic sources of phosphorus (such as fertilizer runoff from agricultural activities or large waterfowl populations) can continue to affect pond water quality long after their input to the pond.

5.2.2 Indicators of Pond Health

The PALS sampling program involved collecting Secchi depth readings, vertical profiles (multiple readings with depth) of temperature, pH, and dissolved oxygen (DO), and two discrete samples (top and near bottom of the pond) for analysis of phosphorus, total nitrogen (TN), and chlorophyll-a concentrations. The use of these parameters in assessing pond health is discussed below.

- **Secchi depth**: Secchi depth is a measure of water clarity. It is the depth at which a Secchi disk can no longer be seen as it is lowered through the water column. Waters with low Secchi depth readings can occur naturally (e.g., if wind/waves suspend bottom sediment) or be an indicator of degraded pond health (e.g., high concentrations of algae). A Secchi depth of 4 feet or more generally indicates suitability for swimming based on water clarity.

- **Dissolved oxygen**: Adequate concentrations of dissolved oxygen are necessary to sustain fish and other aquatic organisms and prevent offensive odors.

  MassDEP's water quality standards require oxygen levels to be greater than either 5 or 6 mg/l depending on the characteristics of the pond. Some Harwich ponds are considered shallow ponds and thus must meet the 5 mg/l threshold to support warm-water fish.

  Waters are termed anoxic when oxygen levels drop below 1 mg/L. When a shallow pond has little to no oxygen at its bottom, this suggests that the decomposition of organic matter at the pond bottom is sufficient to use all available oxygen in between mixing. When a pond has anoxic bottom waters, phosphorus can be regenerated from the sediments to the overlying waters, which in shallow ponds is typically available to fuel algae or aquatic plant growth.

- **Phosphorus**: Phosphorus is a key nutrient influencing plant growth in ponds. Phosphorus is usually the limiting nutrient to freshwater ponds, such that increasing its concentration alone will result in greater plant productivity.

  Currently, MassDEP does not have a numerical criterion for phosphorus unless the water body is subject to a TMDL or site-specific criterion; however, discharges that result in excessive aquatic plant or algal growth (eutrophication) need to be controlled.

- **Nitrogen**: Nitrogen is an essential nutrient for plant growth; nitrogen is usually sufficiently abundant in freshwater systems and thus does not limit plant growth. In some highly eutrophic lakes (which have excess phosphorus – more than plants can use to grow), nitrogen can become the limiting nutrient for plant productivity. In these cases, an ecological advantage is afforded to certain blue-green algae that have the ability to obtain nitrogen from the atmosphere (called fixing nitrogen) and use this nitrogen as a nutrient source to fuel algal growth. Thus nitrogen limitation in ponds with excess phosphorus concentrations can be a factor in blue-green algal blooms.

  Currently, MassDEP does not have a numerical criterion for nitrogen unless the water body is subject to a TMDL or site-specific criterion; however, discharges that result in excessive aquatic plant or algal growth (eutrophication) need to be controlled.

- **Chlorophyll-a**: Chlorophyll-a is a direct measure of a green pigment that transforms light energy into chemical energy in photosynthesis. Chlorophyll-a indicates the presence of phytoplankton (algae) biomass; the trophic status of ponds is often determined from the summer mean chlorophyll-a concentration.

  Currently, MassDEP does not have a numerical criterion for chlorophyll-a unless the water body is subject to a TMDL or site-specific criterion. However, Mark Matteson of MassDEP indicated that the Commonwealth's water quality standards may be modified to include a new standard for chlorophyll-a. The standard would allow chlorophyll-a levels to exceed 16 µg/L only once during a growing season.

There are two additional methods for using water quality data to evaluate pond health: trophic status and the guidelines for pond health established by the CCC.

- **Trophic Status**: This is an integrative measure typically considering at least one of the following parameters: Secchi depth, seasonal average phosphorus concentration, and chlorophyll-a concentration. A common trophic status index (TSI) was derived by Carlson from work on northern temperate lakes. Table 5-2 (www.Secchidipin.org/tsi.htm) provides values used to evaluate the TSI and gives examples how fisheries and recreation in these lakes can be affected as the trophic status moves from oligotrophic to mesotrophic to eutrophic.

Table 5-2
Carlson Trophic Status Index Metrics

TSI	Chloro-phyll (ug/l)	Secchi Depth (feet)	Total Phosphorus (ug/l)	Attributes	Fisheries & Recreation
<30	<0.95	>26	<6	Oligotrophy: Clear water, oxygen throughout the year in the bottom waters	Salmonid fisheries dominate
30-40	0.95-2.6	26-13	6-12	Bottom waters of shallower lakes may become anoxic	Salmonid fisheries in deep lakes only
40-50	2.6-7.3	13-7	12-24	Mesotrophy: Water moderately clear; increasing probability of no oxygen in bottom waters during summer	Lack of oxygen in bottom waters results in loss of salmonids.
50-60	7.3-20	7-3	24-48	Eutrophy: No oxygen in bottom waters, macrophyte problems possible	Warm-water fisheries only. Bass may dominate.
60-70	20-56	1.5-3	48-96	Blue-green algae dominate, algal scums and macrophyte problems	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating
70-80	56-155	0.8-1.5	96-192	Hypereutrophy: (light limited productivity). Dense algae and macrophytes	*
>80	>155	<0.8	192-384	Algal scums, few macrophytes	Rough fish dominate; summer fish kills possible

Note: (*) Data not provided

- **CCC guidelines:** The CCC has established guidelines for pond health for phosphorus, nitrogen, and chlorophyll-a concentrations. The guidelines are based on the statistical analysis of data from 195 ponds in the first PALS snapshot in 2001, and they establish threshold values to "identify ponds minimally impacted by human activities." The threshold values were determined following a US EPA methodology for establishing eco-region reference values. The two threshold values developed by the CCC represent (1) the lower 25th percentile of all water quality data and (2) the upper 25th percentile of unimpacted ponds. The second reference value is based on 2001 water quality data of eight ponds across the Cape. The reference values are shown in Table 5-3 below.

Table 5-3
CCC Pond Water Quality Guidelines

Water Quality Indicator	Lower 25th Percentile of All Ponds	Upper 25th Percentile of Unimpacted Pond
Total Phosphorus (µg/l)	10	7.5
Total Nitrogen (mg/l)	0.31	0.16
Chlorophyll-a (µg/l)	1.7	1.0

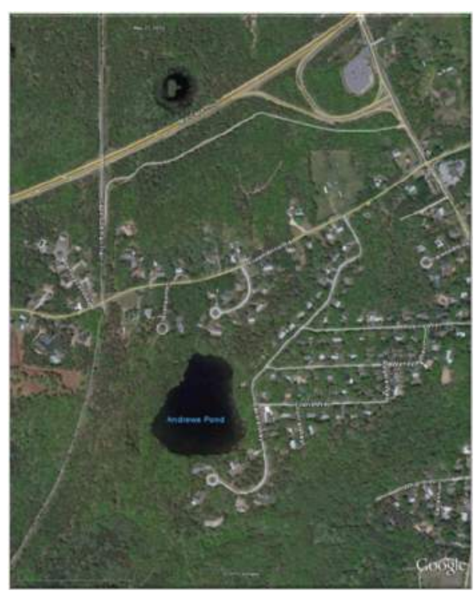
5.2.3 Assessment of Pond Health

The 2006-2010 PALS data for Harwich ponds were reviewed and compared to indicators of pond health. In addition, 2001-2005 PALS data were analyzed in the Review and Interpretation of Harwich Ponds Volunteer Monitoring Data Final Report (Eichner, 2006) herein referred to as the Harwich Ponds Report. Additional information from the following sources was included in this summary:

- Harwich Ponds Ecologic Memoranda (Moran, 2008 and 2011) herein referred to as the Ecologic Memos;
- Guidance Document and Case Study Report for The Great Sand Lakes (Stearns & Wheler LLC and Ecologic LCC, 2007) herein referred to as the GSL Report;
- Harwich Ponds Fact Sheets (Harwich Water Quality Task Force, 2006) herein referred to as the HWQTF Fact Sheets; and
- Brewster Freshwater Ponds: Water Quality Status and Recommendations for Future Activities (SMAST, 2009) herein referred to as the Brewster Ponds Report.

Andrews Pond

Andrews Pond is categorized as a deep, oligotrophic pond. The shoreline of Andrews Pond has fewer than ten housing units within a 300-ft buffer from the water's edge. The area upgradient of the pond is generally low density residential surrounded by minor roads. Limiting further development of the area upgradient of the pond and surrounding the western edge of the pond will help in protecting the water quality of Andrews Pond. In general, the water quality



Satellite Image of Andrews Pond, Harwich, MA

conditions of Andrews Pond appear stable based on PALS data available through 2008.

Discrete data from 2006-2008 are summarized below:

- 22 out of 23 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds, indicating healthy DO levels overall. The Harwich Ponds Report states that Andrews Pond had a low DO reading of 1 mg/L at the pond bottom, which qualifies the pond as being impaired for DO. However, the single DO measurement is likely an outlier and does not indicate a water quality trend or a cause for concern.
- Total phosphorus concentrations were generally low and were within the oligotrophic range.
- The average Secchi depth reading was 21 feet, which makes the pond's clarity exceptionally suitable for swimming.
- Concentrations of chlorophyll-a did not exceed 16 µg/l at any depth.

Aunt Edies Pond

Aunt Edies Pond is categorized as a shallow, mesotrophic pond. The Harwich Ponds Report states that the average TSI for Aunt Edies Pond is classified as mesotrophic, but the data variability for all indicators spans across oligotrophic and eutrophic categories. The northern, upgradient shoreline of Aunt Edies Pond has fewer than five housing units. The pond's westernmost edge is approximately 300 feet from Route 6, and road runoff may be a source of contamination. In addition, the WQMTF developed a fact sheet for Aunt Edies Pond and identified two abandoned cranberry bogs.

Satellite Image of Aunt Edies Pond, Harwich, MA

At one point in time in either the late 1980s or early 1990s, the Sandy Shore Association limed Aunt Edies Pond in an attempt to improve the pond's water quality. The residual impact of liming is difficult to quantify without information before and after the lime application. The pond water quality is not improving with reports of milfoil infestation and nuisance algal blooms.

Discrete data from 2006-2010 are summarized below.

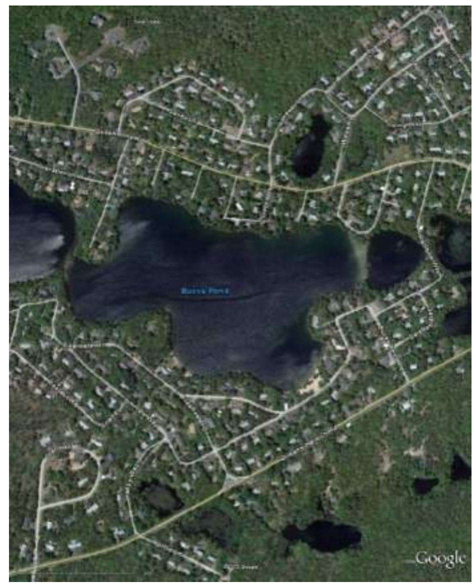
- 18 out of 18 DO measurements were greater than the state DO threshold of 5 mg/l for shallow, warm-water ponds.
- Total phosphorus concentrations were within the mesotrophic range. Average phosphorus concentrations at the pond bottom were higher compared to surface readings, indicating that bottom sediments may be an additional nutrient source.

- The average Secchi depth reading was 7 feet, which is approximately the total depth of the pond.

- Though concentrations of chlorophyll-a at any depth did not exceed 16 µg/l, the Ecologic Memo states that Aunt Edies Pond chlorophyll-a measurements did indicate a diminished water quality for recreational use because of concentrations averaging 7 µg/l compared to 4 ug/l in previous years. However, true data trends could not be identified due to the limited number of samples.

Bucks Pond

Bucks Pond is categorized as a deep, oligotrophic pond. The Harwich Ponds Report provides analysis of Bucks Pond to a depth of 26 feet, whereas the discrete data reports measurements up to a depth of 32 feet. Bucks Pond has the largest surface area of the four ponds in the Great Sand Lake system. It is directly connected on its eastern border with Kiddies Pond and its western border with John Joseph Pond. The entire pond system is surrounded by medium-to-high density residential development, connected by a network of minor roads.



Satellite Image of Bucks Pond, Harwich, MA

The Great Sand Lake pond system was extensively studied in June 2007 as part of the GSL Report. Detailed phosphorus loads were evaluated and specific recommendations for phosphorus reduction included educational materials to reduce private phosphorus inputs, management of water fowl, and design enhancements to septic systems. As a potential long-term option to address future phosphorus loading to the watershed, the implementation of a wastewater collection and treatment system was discussed. In order to protect this pond system from degradation, action towards phosphorus reduction must be taken.

Discrete data from 2006-2010 are summarized below. Inconsistencies in reporting of blank and non-detect measurements are a cause of data uncertainty.

- 78 out of 111 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds. Low DO measurements and non-detect readings were at depths of 23 feet and greater, indicating that approximately the bottom third of the pond strata can be anoxic. The Ecologic Memo states that Bucks Pond is weakly stratified and therefore has periods of both stratification and of complete mixing.

- Total phosphorus concentrations were generally low and were within the oligo-mesotrophic range. The Ecologic Memo states that there continue to be elevated total phosphorus concentrations towards the pond bottom due to sediment-bound phosphorus, which can be released during periods of mixing.

- The average Secchi depth reading was 16 feet, which makes the pond's clarity exceptionally suitable for swimming.

- Average concentrations of chlorophyll-a did not exceed 16 µg/l. The 2006-2010 dataset contained recorded measurements at the pond bottom that exceeded 30 µg/l, indicating the presence of plant life.

Cornelius Pond

The Harwich Ponds Report categorized Cornelius Pond as a shallow, oligotrophic pond based on the average TSI for chlorophyll-a, but stipulated that Cornelius Pond had a large TSI range across the typical indicators. The Ecologic Memo categorized Cornelius Pond as a eutrophic pond based on a mean TSI from chlorophyll-a, total phosphorus, and Secchi disk measurements.

Satellite Image of Cornelius Pond, Harwich, MA

The shoreline of Cornelius Pond is relatively undeveloped with all residential units on the southern, downgradient edge of the pond. Limiting development in the northern, upgradient area will help protect the water quality of Cornelius Pond. Based on an orthophotographic survey, there appear to be two bogs that are directly connected via a culvert or channel into the northern section of the pond. There also appears to be a slag or sediment dump location to the northwest of the pond. Historic orthophotography also reveals persistent algal blooms.

Discrete data from 2006-2008 supporting a degraded water quality are summarized below.

- 5 out of 14 DO measurements were greater than the state DO threshold of 5 mg/l for shallow, warm-water ponds.
- Total phosphorus concentrations were elevated and were within the eutrophic range.
- The average Secchi depth reading was 3 feet, which does not satisfy the state water clarity swimming standard.
- Average concentrations of chlorophyll-a did not exceed 16 µg/l. The 2006-2008 dataset did contain recorded measurements at the surface that exceeded 16 µg/l, which are likely due to existence of algae.

Flax Pond

Satellite Image of Flax Pond, Harwich, MA

Samples for Flax Pond were taken on both the western and eastern portions of the pond. The western portion of the pond is deeper than the eastern portion of the pond. Discrete data were summarized separately for each monitoring location and analyzed separately in the Ecologic Memo. The Harwich Ponds Report categorized Flax Pond as a deep, oligotrophic pond based on the average TSI for chlorophyll-a, but stipulated that there was a large TSI range across the indicators. The Ecologic Memo categorized Flax Pond as a mesotrophic pond based on an average calculated TSI.

Flax Pond is connected on both the western and eastern sides for irrigation of nearby cranberry bogs. Historic orthophotography of the pond shows evidence of algal blooms. The area north of the pond is a capped landfill. In the mid-1990s, the Town initiated a project to restore Flax Pond after it was identified that leachate from the landfill and septage lagoons were impacting the pond's water quality. Water quality in Flax Pond has improved since the 1990s, but monitoring data for Flax Pond indicates that it still has some significant water quality concerns.

Discrete data for Flax Pond West from 2006-2010 are summarized below. Inconsistencies in reporting of blank and non-detect measurements are a cause of data uncertainty.

- 33 out of 75 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds. Low DO measurements and non-detect readings were at depths of 13 feet and greater indicating an anoxic pond bottom.

- Total phosphorus concentrations were generally elevated and were within the mesotrophic range. Certain years of data exhibited higher total phosphorus concentrations at the pond bottom.

- The average Secchi depth reading was 10 feet, which makes the pond's clarity suitable for swimming.

- Average concentrations of chlorophyll-a did not exceed 16 µg/l. The Ecologic Memo determined that there was an outlier measurement in 2003 and that concentrations over time taken in the surface waters (between 2001-2005) were consistently less than 10 µg/l. The 2006-2010 dataset supports that finding.

Discrete data for Flax Pond East from 2006-2010 are summarized below.

- The Ecologic Memo indicated that Flax Pond East was undergoing a statistically significant decreasing trend of total phosphorus concentrations. Interpretation of the 2006-2010 dataset indicates insignificant fluctuation in total phosphorus concentrations.

- The average Secchi depth reading was 5 feet, which makes the pond's clarity suitable for swimming.

- Concentrations of chlorophyll-a at any depth did not exceed 16 µg/l.

Grass Pond

The Harwich Ponds Report and the 2008 Ecologic Memo categorized Grass Pond as a shallow, eutrophic pond, whereas the 2011 Ecologic Memo categorized the pond as mesotrophic. Flow from Grass Pond feeds the Bank Street Bogs Nature Preserve, which is a parcel preserved by the Harwich Conservation Trust. There is a small housing development to the north of the pond and a denser housing development to the west. Based on an orthophotographic survey, there appears to be at least one abandoned bog that is directly connected to the pond via a culvert or channel in the southern section of the pond. A second bog/marsh borders the northern edge of the pond. The pond's westernmost edge is approximately 100 feet from a minor arterial road, Forest Street. Road runoff may also be a source of contamination. Surface water from Grass Pond flows through a series of bogs and marshes until it reaches Saquatucket Harbor.

Satellite Image of Grass Pond, Harwich, MA

Discrete data from 2007-2010 supporting the assessment of water quality degradation are summarized below.

- 5 out of 8 DO measurements were greater than the state DO threshold of 5 mg/l for shallow, warm-water ponds.

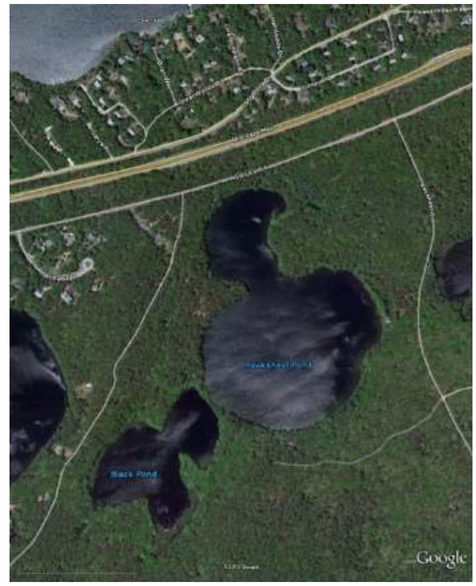
- Total phosphorus concentrations were elevated in Grass Pond and were within the eutrophic range. The Ecologic Memo stated that Grass Pond has consistently elevated total phosphorus concentrations but because of the limited number of measurements, a statistical trend could not be identified of improving or worsening water quality. The discrete 2007-2010 data does include measurements that were taken at the outlet and at locations where the sample depth was not recorded.

- Only one Secchi depth measurement was reported in the 2007-2010 data set at a depth of 4.4 feet, which just meets the 4 foot pond clarity threshold for swimming.

- There were two measurements of chlorophyll-a that were exceptionally high and were likely taken during a period of elevated algal activity. All other measurements at any depth did not exceed 16 µg/l.

Hawksnest Pond

The Harwich Ponds Report and the 2008 Ecologic Memo categorized Hawksnest Pond as a deep, oligotrophic pond, whereas the 2011 Ecologic memo categorized the pond as mesotrophic. Hawksnest Pond is completely within Hawksnest State Park. The shoreline is entirely undeveloped except for one small cottage belonging to the Rod & Gun club. Three minor roads surround Hawksnest Pond. Spruce Road is approximately 100 feet from the water's edge. The larger arterial road, Route 6, is approximately 350 feet from the water's edge. Road runoff from either road may be a source of contamination. Limiting development surrounding Hawksnest Pond and eliminating road runoff inputs will preserve and protect the water quality of Hawksnest Pond.



Satellite Image of Hawknest Pond, Harwich, MA

Discrete data from 2006-2010 supporting an oligotrophic status are summarized below. Hawksnest Pond was the only pond listed in the 2011 Ecologic Memo that fully met the Cape Cod criteria related to trophic status conditions as detailed in Table 5-3 above.

- 58 out of 64 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds.
- Total phosphorus concentrations were low and were within the oligotrophic range.
- The average Secchi depth reading was 19 feet, which makes the pond's clarity exceptionally suitable for swimming.
- Concentrations of chlorophyll-a were among the lowest of Harwich's ponds with an average of 1.4 µg/l. Recorded measurements did not exceed 16 µg/l at any depth.

Hinckleys Pond

Hinckleys Pond was categorized as a deep, borderline eutrophic pond. Hinckleys Pond is surrounded by medium to high density residential units. It is also bounded by two active cranberry bogs and is less than 100 feet from Route 124. Recently, the water quality in Hinckleys Pond has degraded. In 2009, Hinckleys Pond was closed when state and local officials determined that toxic cyanobacteria algae were found and that concentrations were five times the allowable level. During the fall of 2011, a diagnostic assessment was performed specifically for Hinckleys Pond and its watershed (Evaluation of Hinckley's Pond, Harwich, Massachusetts, July

Satellite Image of Hinkleys Pond, Harwich, MA

2012, by Water Resource Services in Conjunction with CDM Smith). The purpose of the study was to understand nutrient sources and to recommend actions to mitigate adverse impacts of excess phosphorus to improve the pond's water quality. The evaluation determined that the largest source of phosphorus is internal and recommended a phosphorous inactivation project be undertaken.

Discrete data from 2006-2010 supporting the degradation in pond water quality and eutrophic status are summarized below.

- 64 out of 106 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds. Low DO measurements and non-detect readings were at depths of 16 feet and greater indicating an anoxic pond bottom.
- Total phosphorus concentrations were elevated and were within the eutrophic range. There was evidence of a trend of internal recycling of phosphorus due to elevated concentrations in deeper waters.
- The average Secchi depth reading was 5 feet with a minimum measurement of 2 feet demonstrating poor water clarity. The readings were consistently at or below the swimming standard.
- Average concentrations of chlorophyll-a did not exceed 16 µg/l. However, there were 14 measurements of chlorophyll-a concentrations greater than 16 µg/l.

Long Pond

Long Pond was categorized as a deep, mesotrophic pond and is split by the Town boundary between Brewster and Harwich. It is surrounded by medium-to-high density residential development and is less than 100 feet from Route 124 and Long Pond Drive. A cranberry bog is located on the northwestern edge of Long Pond.

Satellite Image of Long Pond, Harwich, MA

Satellite Image John Josephs Pond, Harwich, MA

Long Pond was treated with alum in the fall of 2007 because of degrading water quality. The limited available water quality data since the alum treatment suggest that the water quality has not returned to the highly impacted condition prior to the pond treatment, but it also suggests that elevated phosphorus levels are still present in the pond. The *Treatment Summary for Phosphorus Inactivation in Long Pond* (AECOM, 2009) provides water quality monitoring data for the year following the alum treatment. The phosphorus data during this year are ambiguous. After the initial drop in phosphorus levels in the month following the treatment, AECOM (2009) reports "the pattern that arose after October 2007 was unexpected. In essence, TP and DP [dissolved phosphorus] increased gradually between October 2007 and April 2008, with TP reaching levels similar to those of the upper layer from September 2007 in April and May 2008. DP levels did not recover to pre-treatment levels, but did increase to more than half the pre-treatment concentration." While the overall pond water quality has improved, additional data is needed to understand the efficacy of the pond treatment and in which category to place Long Pond. Pending this additional data, Long Pond has been shown as impaired on Figure 5-2.

John Joseph Pond

John Joseph Pond was categorized as a deep, mesotrophic pond in the Brewster Pond Report. It is the second largest pond of four ponds in the Great Sand Lake pond system. It is directly connected on its eastern border to Bucks Pond. According to the USGS topographic map for the area, John Joseph and Bucks Ponds are at the same water surface elevation. This entire Great Sand Lake system is surrounded by medium-to-high density residential development with a network of minor roads. As mentioned above regarding Bucks Pond, John Joseph Pond was also studied in detail in June 2007 and identified as an area requiring phosphorus load reduction to improve water quality.

Discrete data from 2006-2010 are summarized below.

Satellite Image of Robbins Pond, Harwich, MA

- 137 out of 197 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds. Low DO measurements and non-detect readings were at depths of 16 feet and greater indicating an anoxic pond bottom.
- Total phosphorus concentrations were elevated and were within the mesotrophic range.
- The average Secchi depth reading was 18 feet, which makes the pond's clarity suitable for swimming.
- Average concentrations of chlorophyll-a did not exceed 16 µg/l.

Robbins Pond

Robbins Pond was categorized as a shallow, mesotrophic pond. It has a relatively undeveloped shoreline with fewer than ten houses within a 300-ft buffer surrounding its shoreline. There is a large cranberry bog to the west and a smaller bog to the south of the pond. There appears to be no direct connection from either bog to Robbins Pond, but water from the pond may be used as irrigation. Historic orthophotography also indicates that nuisance algal blooms do occur in Robbins Pond, especially in the thumb-like feature where mixing is limited.

Discrete data from 2006-2010 are summarized below.

- 23 out of 24 DO measurements were greater than the state DO threshold of 5 mg/l for shallow, warm-water ponds.
- Total phosphorus concentrations were elevated and were within the mesotrophic range. The Ecologic Memo indicates that Robbins Pond exhibited an increasing trend of annual average phosphorus in 2010 compared to data in 2000-2008. Inspection of the data indicates that the samples for total phosphorus taken in 2010 were primarily at depth whereas the average from past years included surface samples.
- The average Secchi depth reading was 7 feet, which makes the pond's clarity suitable for swimming.
- There was one measurement of chlorophyll-a concentration that was above the 16 µg/l threshold. All other measurements did not exceed 16 µg/l.

Sand Pond

Sand Pond was categorized as a deep, mesotrophic pond. The shoreline of Sand Pond has fewer than ten housing units within a 300-ft buffer from the water's edge. The northern area upgradient of the pond is generally low density residential connected by minor roads. Sand Pond has three direct connections from active cranberry bogs. Sand Pond is also approximately 300 feet from a minor arterial road, Great Western Road.

Satellite Image of Flax Pond, Harwich, MA

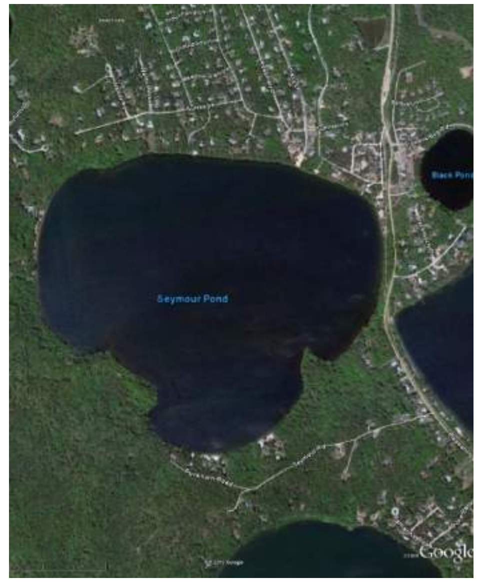
Discrete data from 2006-2010 are summarized below.

- 40 out of 74 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds.
- Total phosphorus concentrations were within the mesotrophic range.
- The average Secchi depth reading was 12 feet, which makes the pond's clarity suitable for swimming.
- Average concentrations of chlorophyll-a do not exceed 16 µg/l. However, there were 13 measurements of chlorophyll-a concentrations greater than 16 µg/l, most of which were taken at the pond bottom.

Seymour Pond

Seymour Pond was characterized as a deep, mesotrophic pond. The northeastern, upgradient watershed has a medium-to-high level of residential units with a network of minor streets. It is also less than 100 feet from Route 124. Seymour Pond is split by the Town boundary between Brewster and Harwich. The Brewster Ponds Report performed a detailed individual pond assessment for Seymour Pond and developed a water budget to account for flows entering and exiting the pond. They also performed a detailed phosphorus budget to determine the sources and magnitude of phosphorus loading.

The Brewster Ponds Report identified Seymour Pond as an impaired water body from analysis of PALS data from 2001-2007.



Satellite Image of Seymour Pond, Harwich, MA

- DO measurements show decreasing concentrations with increasing depth and regular anoxic conditions during the summer months. Based on average DO concentrations, the bottom 16 feet of the pond was less than the state DO threshold of 6 mg/l for deep, cold-water ponds.
- Total phosphorus concentrations were within the mesotrophic range. The average deep total phosphorus concentrations were three times greater than surface concentrations indicating that there is phosphorus regeneration from sediments.
- The average Secchi depth reading was estimated to be 9 feet, which makes the pond's clarity suitable for swimming. However, the Brewster Ponds Report carefully reviewed historic Secchi depth readings and suggested that clarity and water quality conditions are worsening.
- Average concentrations of chlorophyll-a do not exceed 16 µg/l.

Skinequit Pond

Skinequit Pond was categorized as a deep, eutrophic pond. It is surrounded by medium-to-high density residential units and a network of minor streets. The Town has also identified a manmade dam separating the pond from an abandoned cranberry bog to its northern border. Though Route 28 is approximately 700 feet from the pond's edge, it is suspected that road runoff can flow into the abandoned bog and eventually into Skinequit Pond. A study was conducted by the Harwich Department of Natural Resources on Skinequit Pond to mitigate the degradation of the pond's water quality. Currently, Skinequit Pond is being treated with Solar Bee technology to mix oxygenated water deeper into the water column.

Satellite Image of Skinequit Pond, Harwich, MA

The Ecologic Memo details observations regarding the total phosphorus concentrations. Skinequit Pond had a higher ratio of dissolved to total phosphorus, which suggests that a significant component of the water column is dissolved total phosphorus originating from the sediments. Surface concentrations may be lower because of the implementation of the Solar Bee technology. The water clarity in 2010 was an increase from previous years after installation of the Solar Bee based on Secchi depth measurements.

Discrete data from 2006-2010 are summarized below.

- 34 out of 68 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds. DO measurements on the pond bottom show a layer (at times, 9 feet or more) of anoxia.
- Total phosphorus concentrations were elevated across the entire water column and were within the eutrophic range. Total phosphorus concentrations at the pond bottom were exceptionally high.
- The average Secchi depth reading prior to the Solar Bee implementation was 4 feet. In 2010, the recorded Secchi depth ranged from 2 to 9 feet.
- The average concentration of chlorophyll-a for the discrete dataset was 37 µg/l. Skinequit Pond has much higher concentrations of chlorophyll-a than might be expected from the observed phosphorus concentrations, which diminishes suitability for recreational use.

Walkers Pond

The Harwich Ponds Report and the 2008 Ecologic Memo characterize Walkers Pond as a deep, oligotrophic pond, whereas the 2011 Ecologic Memo has characterized it as a mesotrophic pond. The Ecologic Memo states that Walkers Pond experienced nuisance algal blooms in 2007. The exact cause of the blooms was never determined. Historic orthophotos also show evidence of persistent algal blooms.

Satellite Image of Walkers Pond, Harwich, MA

The shoreline of Walkers Pond has approximately ten housing units within a 300-ft buffer from the water's edge. The northern area upgradient of the pond is low-to-medium density residential since residential units also surround Long Pond, which is just north of Walkers Pond. The pond's northernmost edge is less than 100 feet from Spruce Road and approximately 300 feet from Route 6. Road runoff from both roads may be a source of contamination. Based on an orthphotographic survey, there appears to be at least one bog that is directly connected to the pond via a culvert or channel in the southern section of the pond. There also appears to be another smaller bog that is connected to the west of the southern section of the pond.

Discrete data from 2006-2010 are summarized below.

- 50 out of 83 DO measurements were greater than the state DO threshold of 6 mg/l for shallow, warm-water ponds.
- Total phosphorus concentrations were within the mesotrophic range.
- The average Secchi depth reading was 14 feet, which makes the pond's clarity suitable for swimming.
- Concentrations of chlorophyll-a at any depth did not exceed 16 µg/l.

White Pond

The Harwich Ponds Report and the 2008 Ecologic Memo categorized White Pond as a deep, oligotrophic pond, whereas the 2011 Ecologic memo categorized the pond as mesotrophic based on an additional two years of data showing an increasing trend of total phosphorus. The shoreline of White Pond has approximately fifteen housing units within a 300-ft buffer from the water's edge. The northern area upgradient of the pond is relatively undeveloped except for a large horse stable approximately 500 feet from the water's edge.

Satellite Image of White Pond, Harwich, MA

Discrete data from 2006-2009 are summarized below.

- 9 out of 17 DO measurements were greater than the state DO threshold of 6 mg/l for deep, cold-water ponds.
- Total phosphorus concentrations were low and according to the Ecologic Memo, exhibiting an increasing trend within the past two years. The range of concentrations was within the oligio-mesotrophic range.
- The average Secchi depth reading was 17 feet, which makes the pond's clarity exceptional for swimming.
- Concentrations of chlorophyll-a at any depth did not exceed 16 µg/l.

5.3 Summary

The sixteen Harwich ponds in this pond health assessment are quite diverse in both physical and water quality characteristics. Harwich's ponds provide important habitat for aquatic life and are important natural resources for the community. The growing number of pond restoration actions on Cape Cod suggests that many ponds are reaching their tipping points, where further alterations to the environment will result in sometimes dramatic changes in water quality. These have included noxious and potentially harmful algal blooms at Hinckleys Pond and Skinequit Pond. The latter was treated by installing the Solar Bee mixing technology. The summary of water quality data herein was supported with previous analyses from the Town of Harwich, WQMTF, Ecologic, LLC, and Stearns & Wheler, LLC. Below are some preliminary steps that should be taken to protect or restore Harwich's ponds.

1. *Continue Monitoring*

It is recommended that monitoring of all current ponds continue. It is also recommended to expand the PALS program to collect at least one sample annually from other Harwich ponds without historic water quality data including:

- Paddocks Pond, a shallow pond
- West Reservoir, which experienced a toxic algal bloom in 2004 and East Reservoir, both of which feed the Herring River
- Olivers Pond and Black Pond, near Hawksnest Pond and currently in an area that may experience future residential development
- Smaller water bodies like Okers, Island, Abrams, and Littlefields Ponds to obtain a more detailed dataset to determine if these water bodies are experiencing noticeable trends in water quality

This expansion can be done gradually and adaptively. The additional monitoring of a handful of ponds each year would increase the knowledge database of the Town's ponds.

2. *Perform an Inventory of All Stormwater Pipes Draining to Ponds*

Road runoff as a potential source of contamination was identified in at least twelve ponds. Create an inventory incrementally with focus on ponds with water quality data. If found, divert or disconnect stormwater systems that directly discharge to ponds.

3. *Investigate Other Potential Contaminant Sources*

Phosphorus loads from the following sources should be considered: abandoned or active cranberry bogs, sediment dumping locations, farms, private impervious surface runoff, private landscape and fertilizer applications, and waterfowl.

Decreasing phosphorus loads to ponds that are currently affected by high phosphorus concentrations would improve pond health. For ponds that have evidence of phosphorus regeneration, expansion of monitoring points allows for a more accurate understanding of phosphorus regeneration. If phosphorus loads are coming from internal loading, then in-lake measures may be an option. For ponds that are on the border between mesotrophic and eutrophic conditions, it is important to act soon to determine the source(s) of phosphorus contributing to this degradation.

4. *Investigate the Feasibility and Applicability of Alternative Wastewater Management Practices*

Pond shorelines with medium-to-high levels of residential development could be candidates in determining the feasibility of alternative wastewater management practices. Pond areas with high-level upgradient development are more likely candidates for alternative wastewater management than downgradient areas. In general, these actions are watershed-based measures to address external sources of phosphorus to a pond. The GSL Report recommends initial suggestions for watershed management options, which include: reduction of phosphorus-containing detergents, elimination of sink garbage disposals to reduce phosphorus loads from food waste, and more rigorous enforcement of the Town Board of Health requirements for septic systems.

It is also extremely important to understand the relative magnitude of internal versus external loads. External actions taken to address one source of load may not successfully improve pond health if it is not the dominant load to a pond. In some instances it could be necessary to take both watershed and in-lake actions.

5. Determine Uses and Ponds to Support

Fostering stakeholder and public participation is a key component in determining which ponds and which uses for each individual pond should be prioritized to keep or meet a high quality designation. An example would be to prioritize the protection of Olivers, Hawksnest, and Black Pond to prevent water quality degradation from affecting fish populations, if that is a priority for the community. Table 5-4 summarizes the analysis and recommendations for each of the sixteen ponds examined.

Table 5-4
Harwich Ponds Health Assessment Summary and Recommendations

Name	Pond Trophic Status	Monitor	Investigate Road Runoff Contribution	Investigate Potential Contaminant Sources	Shoreline Development
Andrews Pond	Oligotrophic	X		X	Low
Aunt Edies Pond	Mesotrophic	X	X	X	Low
Bucks Pond	Oligo-mesotrophic	X	X	X	Medium to High
Cornelius Pond	Eutrophic	X		X	Low
Flax Pond	Oligo-mesotrophic	X	X	X	Low
Grass Pond	Meso-eutrophic	X	X	X	Low
Hawksnest Pond	Oligotrophic	X	X	X	Low
Hinckleys Pond	Eutrophic	X	X	X	Medium to High
Island Pond	*	X			*
John Joseph Pond	Mesotrophic	X	X	X	Medium to High
Littlefields Pond	*	X			*
Long Pond	Mesotrophic	X	X	X	Medium to High
Oilvers Pond	*	X			*
Okers Pond	*	X			*
Paddocks Pond	*	X			*
Robbins Pond	Mesotrophic	X		X	Low
Sand Pond	Mesotrophic	X	X	X	Low
Seymour Pond	Mesotrophic	X	X	X	Medium to High
Skinequit Pond	Eutrophic	X	X	X	Medium to High
Walkers Pond	Mesotrophic	X	X	X	Low
West Resevior	*	X			*
White Pond	Oligo-mesotrophic	X		X	Low

Note: (*) Data not provided
Red Fields indicate impaired water quality.

The highlighted ponds in Table 5-4 should be examined more closely to determine if providing sewers within the watersheds and thus removing septic system effluent phosphorus inputs would be appropriate to reduce degradation. Figure 5-3 presents several of the larger ponds in Harwich based on their trophic status.

Ponds that require additional analysis prior to determining sewering needs within their watersheds can be handled through an adaptive management approach during the implementation phase of the CWMP recommended program, as described in Section 13 of this report.

6. Implement Hinckley's Pond Recommendations

As detailed in the "Evaluation of Hinckley's Pond, Harwich, Massachusetts" July, 2012, report recommendations were made to restore the water quality including:

1. a phosphorous inactivation project (alum treatment);
2. address direct stormwater run-off into the pond;
3. improve fertilizer education for homeowners in the area; and
4. push for improved water quality engagement from the adjacent cranberry bog owners.

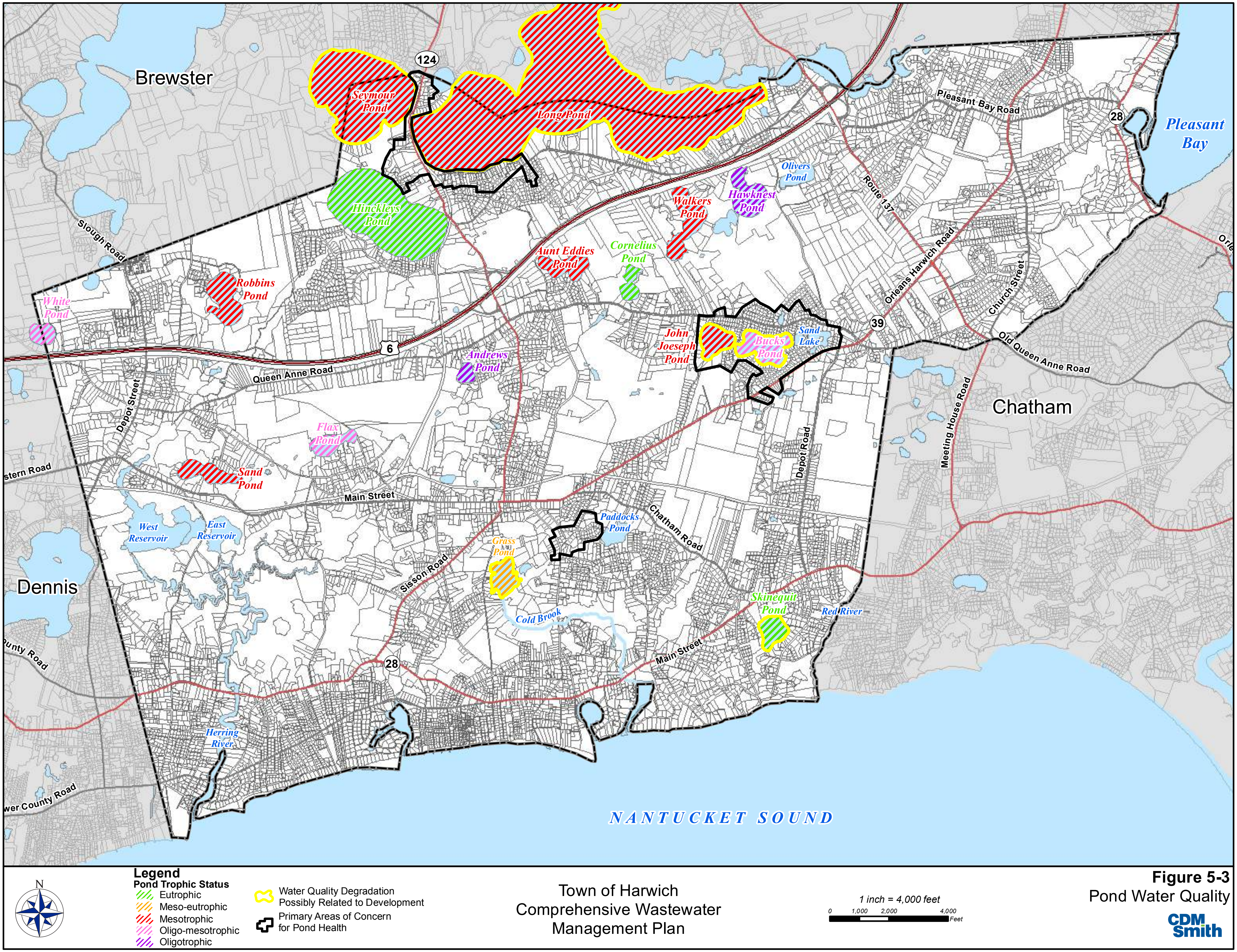


Figure 5-3
Pond Water Quality

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Section 6

Massachusetts Estuaries Project

6.1 Introduction

This section describes the Massachusetts Estuaries Project (MEP) and the MEP watershed investigations within the Town of Harwich. The results of the MEP evaluations are the significant driver in the CWMP process. The information presented here has a direct effect on the analysis of potential effluent recharge locations and evaluation of the sewering alternatives presented in Sections 9 and 10. Implementation of the Harwich CWMP/SEIR will ultimately lead to a reduction in nitrogen within the town's estuaries and aid in the restoration of ecological and community resources. The final recommended plan will reduce nitrogen in the most sensitive watersheds and estuaries to a level that no longer threatens these sensitive waterbodies and will meet the newly issued TMDLs. This section describes nitrogen impacts to the sensitive MEP watersheds and presents the allowable nitrogen loads for each watershed that cannot be exceeded if existing water quality goals are to be met.

6.2 Massachusetts Estuaries Project (MEP)

As described in Section 1, the MEP is a joint initiative of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), the Massachusetts Department of Environmental Protection (MassDEP), the United States Geological Survey (USGS), and the University of Massachusetts – Dartmouth, School of Marine Science and Technology (SMAST), along with Coastal Zone Management, the Cape Cod Commission (CCC), and numerous Massachusetts coastal communities. Funding support is shared between municipalities, and the State of Massachusetts.

The MEP seeks to assess the degradation of several priority estuaries along the southeast coast of Massachusetts including all of Cape Cod and the Islands which has resulted from rapid population growth throughout the region. The water resources of Cape Cod are a valuable cultural and natural resource for local communities and are essential to maintaining the tourism industry, which is a large source of revenue for the region. Excessive nutrient loading in surface and groundwater has migrated to many estuaries, particularly those downstream of highly developed or populated areas. Over time, nutrient counts build up within an estuary as a result of limited flushing. This degrades water quality and has led to fish kills, algal growth, disruption of benthic communities, and an overabundance of invasive weeds. As a result, beaches are periodically closed, productive shellfish areas have been damaged or destroyed, and the tourist industry and property values are at risk due to aesthetically displeasing water and high bacteria levels. The environmental and socio-economic effects of excessive nutrients and bacterial concentrations in estuaries have direct consequences to the culture, economy, and quality of life in these Massachusetts coastal communities.

Since 2002, the MEP has developed and published a series of reports which assess the nature and extent of nutrient influence within the program area. Comprehensive water quality sampling for these assessments has been conducted in partnership with community groups, and the data have been used to develop quantitative total maximum daily load modeling scenarios for each estuary. Results of these assessments will require municipalities to remediate excessive nutrient inputs to restore water quality in estuaries, largely through expanded wastewater management.

Conclusions from the MEP reports include nitrogen loadings and reduction percentages of nitrogen loading required to meet established thresholds in the MEP watershed reports. These thresholds have recently been incorporated by MassDEP into enforceable nitrogen TMDL reports. Mass DEP conducted a public hearing on them in Harwich on August 26, 2015. Formal issuance of the TMDL's from EPA is pending.

6.2.1 MEP Approach to Estuary Studies

The MEP team, starting in 2002, selected estuaries across Cape Cod and the Islands based on the level of degradation, need for improvement, community engagement in addressing estuary degradation, and available funds for the assessment. Once the estuaries were selected, each location was prioritized according to state and local planning needs, environmental concerns, and local issues.

The MEP approach to estuary studies incorporates estuarine processes into nitrogen loading scenarios to develop a TMDL for each estuary under Section 303(d) of the federal Clean Water Act. The TMDL is based on the link between nitrogen sources in the watershed and relative nitrogen concentrations in receiving embayments. In order to establish a relative TMDL value, MEP collaborators use sophisticated modeling and quantitative analysis to provide municipalities and regulatory agencies with guidance and technical expertise. Modeling tools support the development of alternative scenarios for nutrient controls, typically in the form of enhanced wastewater management. Municipalities use this information to make decisions on estuary management, protection, and restoration practices that will reduce total nitrogen loads.

The MEP assesses the health of each selected estuary ecosystem, determines which nitrogen sources contribute to ecosystem conditions, and determines the reductions in total nitrogen load necessary to restore ecosystem health and meet water quality standards. The following summarizes the MEP process.

The flow chart, Figure 6-1, was developed by the MEP to demonstrate their analytical approach to nutrient assessment.

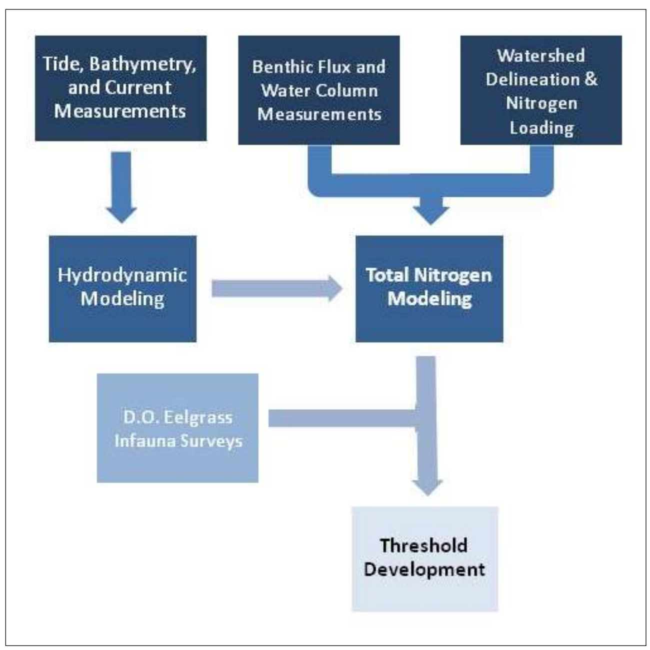


Figure 6-1
Flow Chart of MEP Study Assessment

Environmental Study

The first step in the MEP process is to conduct an environmental study of current land use and aquatic life conditions. Watershed and sub-watershed boundaries were developed by the USGS to delineate land area contributing nutrients to receiving waters for each estuary in the program. A watershed is the contributing land area, including all associated surface and groundwater resources, to an estuary. This includes contributing areas to ponds, water supply wells, tidal rivers, and bays. In Harwich, not all land area in the Town is located within a watershed contributing to an MEP study area.

Watersheds are further divided into subwatershed areas, or sub-areas of land within a watershed. These areas were defined based on groundwater velocity and the resulting time it takes for groundwater to reach a bay or river. A time of travel of 10 years was used to develop subwatershed boundaries.

Once watershed and subwatershed boundaries are delineated, land use is assessed to spatially evaluate the incidence and concentration of nitrogen sources. Typical anthropogenic nitrogen sources include septic systems, stormwater runoff, lawns, and other fertilized landscaped areas. Identifying these areas requires a parcel by parcel assessment linked to a geographic information system (GIS) database which contains data sets that estimate the nature and extent of nutrient sources. When displayed geographically, data patterns highlight targeted areas which require further analysis. In addition, surface water resources are noted for depth, extent, and total stream flow. This information can be used to assess natural nitrogen attenuation in freshwater ponds and predict estuary loading by subwatershed.

Ecosystem health is assessed through three indicators which reflect long-term habitat conditions: eelgrass, macroalgae, and benthic animals, in conjunction with water quality measurements. To assess these indicators each estuary is subject to a minimum of three years of regular sampling. Eelgrass and benthic animals inhabit stationary, long-term communities which react to local environmental changes. Changes in the presence, population, or distribution are an indication of an impaired local environment. Benthic activity, specifically benthic nitrogen flux, is also assessed to gain an understanding of denitrification processes occurring in embayment sediments, which suggests the estuary's ability to process nitrogen and supports determination of healthy nitrogen loading levels.

The aquatic habitat study includes data collection related to benthic community health, dissolved oxygen levels, eelgrass populations, and infaunal animal surveys. This portion of the study may require data spanning several years, based on the extent and complexity of the estuary. Water column monitoring, for example, requires years of nutrient sampling at designated locations to determine fluctuations and seasonal variability. Infaunal animal surveys also require sampling, monitoring, and collection over an extended period of time. Once animals are collected, they are counted, preserved, and categorized. The health, variety, and incidence of these animals are indications of the overall health of the benthic environment within an estuary.

Monitoring Stations

There are typically two types of monitoring stations within each estuary: sentinel stations and check stations. Sentinel stations are designated within each estuary as a discrete point where nitrogen testing will be conducted and where the TMDL will be established. Sentinel stations are situated such that achieving the nitrogen threshold target at each sentinel station should restore the benthic animal habitat. Thus, when this station reaches the target nitrogen concentration established for the estuary, it is assumed that water quality throughout the estuary has improved enough to restore ecological health throughout the estuary.

In addition to the sentinel station, check stations are selected to assist with the goals of restoring healthy eelgrass beds and benthic infaunal habitats and to assess water quality. The target concentrations at these check stations, referred to as secondary criteria, are not used for setting nitrogen thresholds, but rather to provide a check on the acceptability of conditions within the tributary basins at the point that the threshold level is attained at the sentinel station.

Estuary Hydrodynamics

The next part of the MEP process is a hydrodynamic assessment of the estuary, which involves gathering field data to develop a three-dimensional circulation model. In order to produce the model, embayment bathymetry is measured using sonar or remote sensing systems. A site specific tidal record is used to assess the variability of tidal flushing over time. In cases where an estuary is complex, current tidal records may also be used. Once all data is gathered, the three-dimensional hydrodynamic model is developed. This model physically demonstrates tidal flushing within the estuary and assesses embayment basin structure, measurement of basin depth relative to water level, tidal variations, and nutrient dispersion within the water column.

Total Watershed Nitrogen Loading

Nitrogen sources within each subwatershed are determined based on land type, parcel data, water use, and fertilization rates and presented in terms of total and controllable loading. Total loading includes all loads which enter the estuary from groundwater, sediment, and direct atmospheric deposition to the estuary surface. These include all sources of nitrogen within the watershed, such as: septic system discharge, treated wastewater effluent from larger treatment systems, lawn care fertilizers, agricultural fertilizers, and atmospheric deposition collected by runoff from impervious surfaces, waterbody surfaces, and natural surfaces. Controllable loading is the portion of total loading that could potentially be reduced and includes all elements of total loading with the exception of atmospheric deposition. Once nitrogen sources are determined, groundwater flow, subwatershed loading, flushing and hydrodynamic modeling, and natural attenuation are used to estimate total and controllable loading values for a receiving estuary.

The nitrogen concentration in ground and surface water is reduced as it passes through natural systems in streams, ponds, and rivers. This process is known as natural attenuation. In addition, to accurately calculate total load for a receiving water body, nitrogen load must be evaluated for the percent of natural degradation per subwatershed. This occurs through conversion to nitrogen gas, sediment absorption, and other biological processes. Thus, in some cases, a nitrogen load could theoretically be high in one watershed but the actual affect on receiving waters could be much lower due to both attenuation and degradation.

Total Maximum Daily Load (TMDL) Threshold Development

Once the nitrogen cycle is better understood throughout the watershed and its associated estuary, a TMDL is then developed. Criteria for establishing a TMDL are developed through the hydrodynamic models to achieve the desired level of ecosystem health. Modeling allows for optimization of loading reductions based on subwatershed area while gaining a better understanding of hydraulic interactions of flushing between estuaries. TMDLs are developed based on the target concentrations at the water quality monitoring stations described above. These standards are designed to allow for natural concentrations of nitrogen to be at a level which provides water quality that supports a healthy estuary.

6.2.2 Harwich MEP Water Resources

The population of Harwich saw significant growth from 1950 to 2010. There is currently no centralized wastewater treatment system located in the town. Thus, as development has increased, so has nutrient loading as a result of septic system discharge.

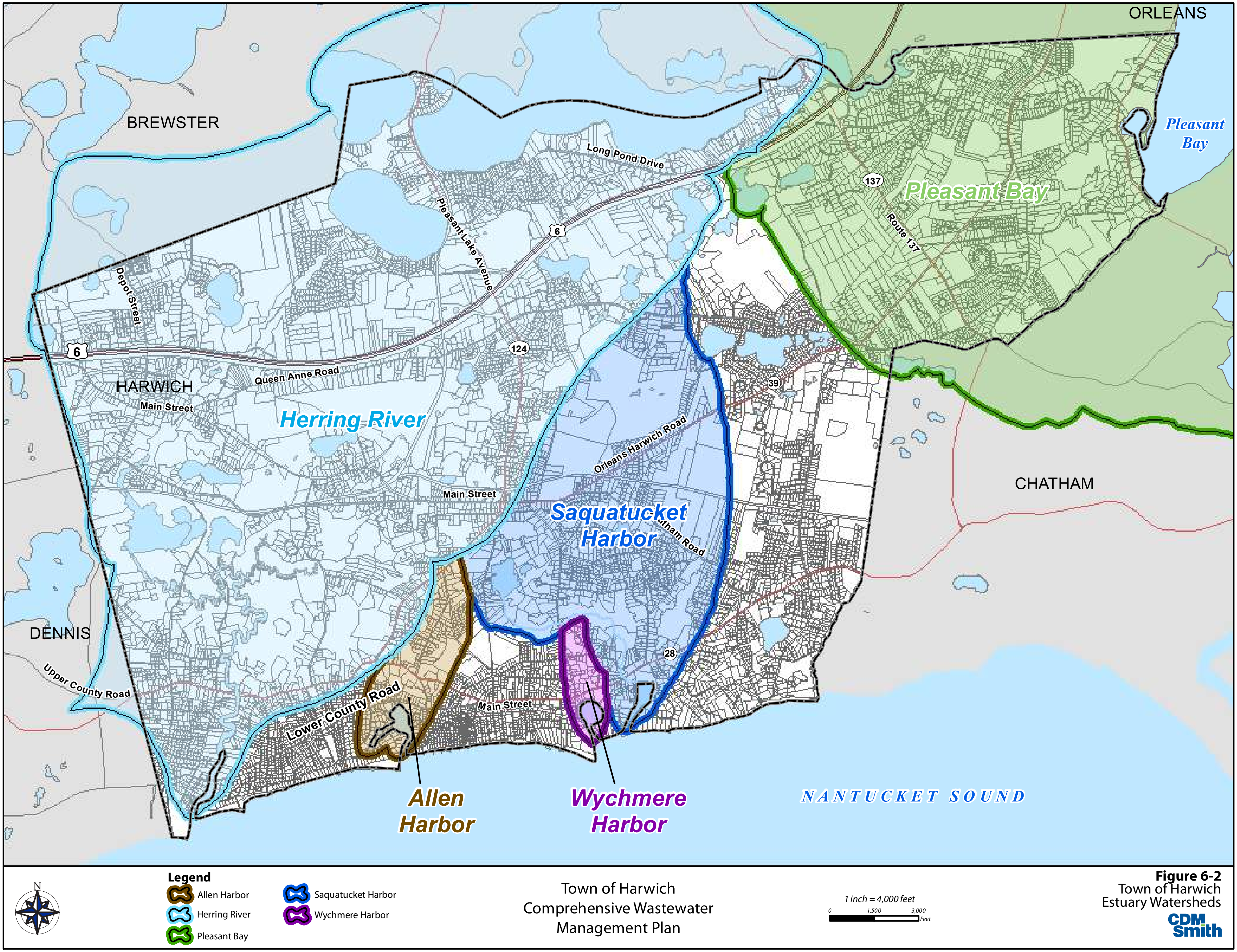
MEP studies have been conducted to evaluate the effects of development and identify nutrient contributing hot spots within Harwich, including all five Town estuaries and the associated contributing watershed land area. Future build-out conditions were calculated as part of the MEP based on current zoning, subdivision of large lots, and increased impervious area including new driveways and roofs. Higher-density village centers and development of the Route 28 corridor in Harwichport were not modeled in locations where they were not within the limits of an MEP studied watershed.

As part of the Harwich estuary studies, the MEP operated under certain assumptions to assess habitat and quality. Eelgrass distribution was based on state surveys conducted in 1951, 1995, and 2001. Watershed delineation was based on long-term steady-state conditions; however boundaries may be affected by water supply pumping rates, particularly during high-volume months. Annual water usage for each parcel included seasonal changes in population, consumptive use of water, and the nitrogen concentration of water which typically enters the groundwater from septic system use. Other nitrogen inputs, such as fertilizers used on golf courses, cranberry bogs, or landscaping and stormwater runoff were quantified using information from past estuary input studies.

6.3 Results of Published MEP Studies

The degrading conditions of estuaries in Harwich are a primary driver for reevaluating the Town's approach to wastewater management. Good water quality is paramount to the environmental and financial health of a resort community such as Harwich. As such, findings presented in the MEP studies are critical to developing a long-term sustainable water resources plan for the community.

As noted previously, Harwich has five estuaries located in the MEP study area: Allen Harbor, Wychmere Harbor, Saquatucket Harbor, Pleasant Bay, and Herring River (see Figure 6-2). The Pleasant Bay watershed is shared with the towns of Brewster, Chatham and Orleans and the Herring River watershed is shared with the towns of Brewster and Dennis. The Pleasant Bay watershed report was completed in May 2006 and the Allen Harbor, Wychmere Harbor, and Saquatucket Harbor report was completed in June 2010. The Herring River report was completed in 2013. The conclusions of each MEP report are described below. Additional MEP report information can be found in Appendix C along with web links to the full reports.



Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 6-2
Town of Harwich
Estuary Watersheds

CDM Smith

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6.3.1 Allen Harbor Watershed Results

The final report entitled "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Allen, Wychmere and Saquatucket Harbor Embayment Systems, Harwich, Massachusetts" was published by the Massachusetts Estuaries Project in June 2010. Allen Harbor is located in the Chatham Outwash Plain, which is comprised of sands, gravels, and chiefly pre-Wisconsin deposits. A permeable groundwater aquifer within the watershed contains aerobic waters.

Physical Description

Allen Harbor is a simple estuary located entirely within the Town of Harwich, comprised of a small tributary basin near the inlet, where tidal waters enter from Nantucket Sound. Open water area is 19 acres. Freshwater enters through direct groundwater discharge, precipitation, and a small creek which feeds the salt marsh to the northeast. The Harbor is naturally shallow, approximately 2 meters in depth, and was originally a muddy pond known as Oyster or Gray's Pond before the inlet was expanded to allow marine traffic access to Nantucket Sound. An extended jetty bounds the eastern portion of the access channel and a parallel jetty maintains the natural land barrier and beach to the west. Figure 6-3 shows the Allen Harbor system.

Land Use and Nitrogen Loading

Land use in the Allen Harbor watershed is primarily (54%) residential of which 85% are single family homes. High residential use, coupled with the fact that Harwich has experienced significant population growth since 1950, has resulted in moderate nitrogen loading in the harbor due to watershed inputs, and primarily due to nitrogen from septic system discharge. Figure 6-3 shows the Allen Harbor System.

Allen Harbor Algae Bloom
Summer 2007

Periodic summer phytoplankton blooms and depleted oxygen in bottom waters (hypoxia) are common. Dredging of the inlet has helped to sustain tidal exchange critical to nitrogen management.

Natural deposition of atmospheric nitrogen on water bodies and natural land surfaces accounts for only 4% of the total loading within the Allen Harbor system. Controllable sources, such as wastewater from septic systems and residential and commercial fertilizer applications, account for approximately 96% of the total nitrogen loading. Because septic system effluent accounts for such a large percent of nitrogen inputs, 86% of controllable nitrogen sources, reducing this source is a priority for improving overall estuary habitat. Figure 6-4 shows total nitrogen loading for the Allen Harbor watershed, including natural deposition, and Figure 6-5 shows the percent of controllable nitrogen loading sources within the watershed.

Figure 6-3
Allen Harbor System

Watershed
Allen Harbor
Allen Harbor Subsheds

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 800 feet

0 400 800 Feet

CDM Smith

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Figure 6-4
Total Nitrogen Loading in the Allen Harbor Watershed, Including Natural Deposition

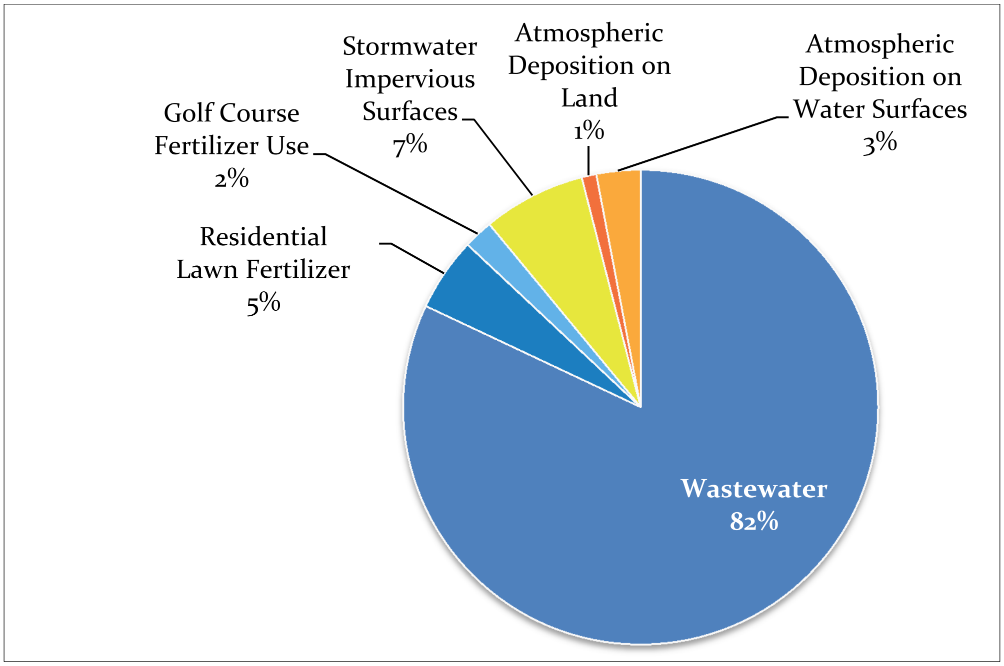
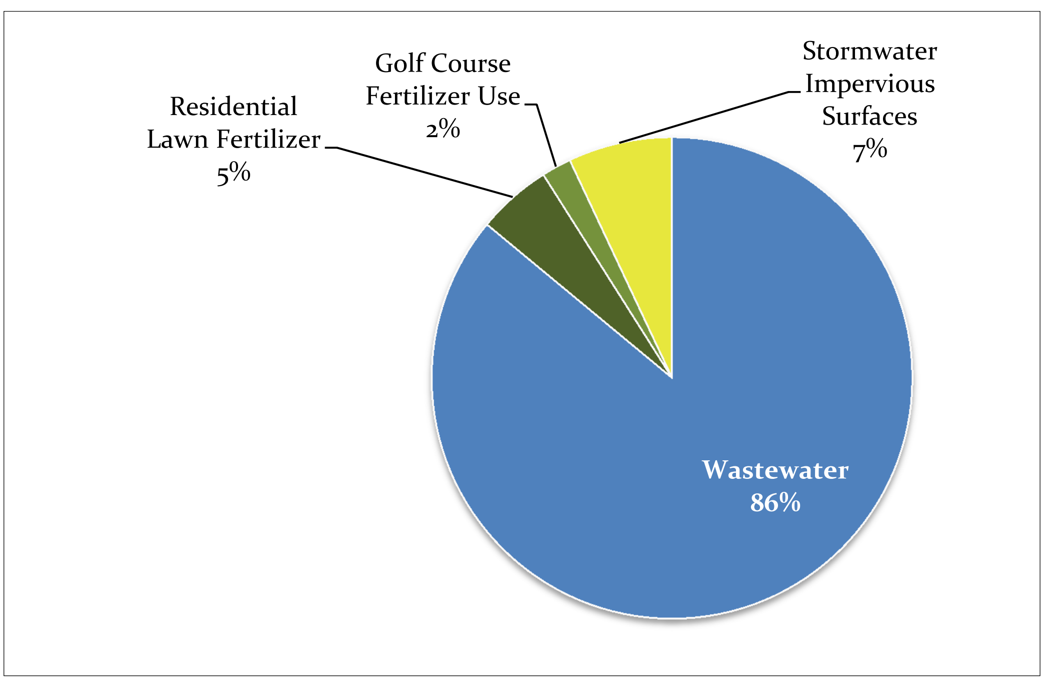


Figure 6-5
Total Controllable Nitrogen Loading in the Allen Harbor Watershed



Amphipods are typically used as an indicator species for benthic community health because of their response to changing conditions in an aquatic environment. In Allen Harbor, infaunal animals were observed with low diversity and high numbers of individual species. The individual species with high numbers were predominantly amphipods, which thrive in high organic enrichment environments. This result indicates intermediate stress and moderate impairment throughout Allen Harbor. In Allen Creek, less diversity and lower total counts indicated high organic enrichment in this tributary. All indicator species results were found to correlate directly with observed levels of low dissolved oxygen, high chlorophyll-a concentrations, and high macroalgal accumulations.

Monitoring Stations and Thresholds

The goal of the Allen Harbor sentinel station (HAR-4) is to identify a location where meeting a target nitrogen concentration would result in water quality throughout the water body sufficient to restore acceptable ecological health. In addition, two check stations (HAR-4A and HAR-5) were selected to assist with the goal of restoring healthy benthic infaunal habitats. The MEP report states that these check station target concentrations were not used for setting nitrogen thresholds in this embayment system. These values merely provide a check on the acceptability of conditions within the tributary basins at the point that the threshold level is attained at the sentinel station. The location of each of station is shown in Figure 6-6.

The threshold nitrogen concentration was determined based on the average concentration of nitrogen in the water column that will support a healthy benthic habitat. Table 6-1 shows present average total nitrogen concentrations observed at monitoring stations as part of the MEP study along with the recommended threshold concentration for Allen Harbor and the percent change necessary to meet the threshold concentration for each monitoring station. All of the available information on eelgrass indicates that the Allen Harbor system did not support eelgrass. The present monitoring data indicates that total nitrogen levels of 0.65 to 0.82 mg/l of nitrogen cannot support healthy benthic communities. The MEP concluded that an upper limit of 0.50 mg/l of nitrogen (tidally averaged) would support healthy infaunal habitat in Allen Harbor. The concentrations at the monitoring stations may be slightly different than the upper limit, but they are chosen so that the upper limit of 0.50 mg/l of nitrogen (tidally averaged) is achieved throughout the system.

Table 6-1
Sentinel and Check Monitoring Stations with Associated Nitrogen Limits For Allen Harbor

Embayment	Monitoring Station	Present total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Allen Harbor	HAR-4	0.679	0.498	-26.6%
Allen Harbor	HAR-4A	0.451	0.380	-15.9%
Allen Harbor	HAR-5	0.808	0.545	-32.5%

*Present and threshold average total N values according to Table VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

Watershed

Allen Harbor

Water Quality Monitoring Stations

Check Station

Sentinel Station

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 400 feet

0 200 400 Feet

Figure 6-6
Allen Harbor
Monitoring Stations

CDM Smith

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Determination of the threshold septic loading in a watershed is not as simple as determining the threshold concentration in the Allen Harbor. Determination of site-specific nitrogen thresholds for an embayment requires integration of key habitat parameters (infauna and eelgrass), sediment characteristics, and nutrient related water quality information. Nitrogen threshold development builds on these data and links habitat quality to summer water column nitrogen levels. To determine the total loading several factors must be considered including septic system effluent flow into the watershed, natural attenuation throughout the watershed, wastewater treatment facilities (if any exist), estuary flushing, stormwater sources, fertilizers applied throughout the watershed, and finally the threshold concentrations presented in the table above. The MEP evaluation of habitat quality supported by the harbor considers the natural structure of each system and its ability to support that habitat before determining the threshold septic load.

Because septic system loading accounts for most of the controllable nitrogen in the Harbor, septic nitrogen is the primary source which is recommended to be targeted for total reduction within the contributing watershed. Overall, 5.64 kg/day, or roughly 2,058 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. In order to meet threshold total nitrogen loads, it is estimated that the present total septic load in the Allen Harbor watershed would need to be reduced by 74%, as summarized in Table 6-2 below.

Table 6-2
Attenuated Septic Loading in the Allen Harbor Watershed*

Sub – Embayment	Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Septic Load Decrease (% change)
Allen Harbor	4.21	0.841	80.0%
Allen Pond Stream	1.43	0.642	54.9%
Total	**5.64**	**1.483**	**74%**

*Loading information according to Table VIII-2 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems.

Values in RED indicate that the value is above the standard and must be reduced.

The threshold septic loading for the Allen Harbor system is the sum of two threshold loads developed in the MEP report for the Allen Harbor sub embayment and the Allen Pond Stream sub-embayment. The Allen Harbor sub-embayment is the total estuarine reach which receives septic nitrogen inputs through direct groundwater discharge and is separate from surface water inflows. Together these two thresholds combine to give a total threshold septic load for the watershed. To meet the requirements of both the check and sentinel stations, the Allen Harbor sub-embayment will require at least 80% of the present septic load to be reduced, and the Allen Pond Stream sub-embayment will require at least 54.9% of the present septic load to be reduced. Together, the Allen Harbor watershed will require about 74% of the septic load to be reduced.

Part of the MEP watershed nitrogen loading modeling includes a buildout assessment of potential development within the study area watersheds. The buildout performed by the MEP is a straightforward buildout assessment that considers a buildout scenario for both residential and commercial parcels throughout the studied watershed. The buildout assessment is an attempt at estimating buildout in a watershed based on current zoning and any projected changes using local input. The estimates developed for the model allow modelers to run a "what if" scenario that considers nitrogen loading associated with future development.

Table 6-1A shows buildout average total nitrogen concentrations modeled at monitoring stations as part of the MEP study along with the recommended threshold concentration for Allen Harbor and the percent change necessary to meet the threshold concentration for each monitoring station.

Table 6-1A
Sentinel and Check Monitoring Stations with Associated Buildout Nitrogen Limits for Allen Harbor

Embayment	Monitoring Station	Buildout total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Allen Harbor	HAR-4	0.749	0.498	-33.5%
Allen Harbor	HAR-4A	0.478	0.380	-20.5%
Allen Harbor	HAR-5	0.896	0.545	-39.2%

*Buildout and threshold average total N values according to Table IX-5 and VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

In the buildout projection, septic system loading also accounts for most of the controllable nitrogen in the harbor. Thus, septic nitrogen is the primary source which is recommended to be targeted for total reduction within the contributing watershed. Overall, 6.71 kg/day, or roughly 2,449 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. This is about a 19% increase over present loads. In order to meet threshold total nitrogen loads, it is estimated that the current total septic load in the Allen Harbor watershed would need to be reduced by about 78%, as summarized in Table 6-2a below.

Table 6-2A
Attenuated Buildout Septic Loading in the Allen Harbor watershed*

Sub – Embayment	Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
Allen Harbor	4.86	0.841	82.6%
Allen Pond Stream	1.85	0.642	65.3%
Total	**6.71**	**1.483**	**78%**

*Loading information according to Table VIII-2 and the MEP Loading Spreadsheets (AKA Rainbow Tables) of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems.

Values in RED indicate that the value is above the standard and must be reduced.

6.3.2 Wychmere Harbor Watershed Results

Wychmere Harbor was evaluated under the same MEP initiative along with Allen Harbor. Results can also be found in the June 2010 final report entitled "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Allen, Wychmere and Saquatucket Harbor Embayment Systems, Harwich, Massachusetts." Wychmere Harbor is located in the Chatham Outwash Plain, which is comprised of sands, gravels, and chiefly pre-Wisconsin deposits.

Physical Description

Wychmere Harbor is a simple estuary located entirely within the Town of Harwich which is comprised of a small marina and a single outlet. Flushing with Nantucket Sound occurs through a canal bounded by jetties, which was dredged to be navigable in 1887. The harbor was formed as a great salt pond and originally had a small island or emergent bar within the tidal inlet. Open water area is 16 acres.

Freshwater enters through direct groundwater discharge and precipitation. Constructed jetties protect the natural land barriers which bound the channel, and the western jetty extends into Nantucket Sound. Figure 6-7 shows the Wychmere Harbor system.

Land Use and Nitrogen Loading

Major sources of nitrogen loading in the Wychmere Harbor watershed include: wastewater from residential septic systems, small onsite (package) wastewater treatment facilities, fertilizers from cranberry bogs, impervious surface stormwater runoff, and direct atmospheric deposition to water surfaces. Land use in the Wychmere Harbor watershed is primarily (55%) residential of which 94% are single family residences.

In the Wychmere Harbor watershed, high residential septic system use coupled with runoff containing fertilizers from residential lawns and cranberry bogs are the predominant sources of nitrogen loading, accounting for 92% of total nitrogen loading in the watershed. Other sources of nitrogen include road and roof stormwater runoff and atmospheric deposition. As a result of the combination of these sources, Wychmere Harbor experiences moderate nitrogen loading which leads to periodic summer phytoplankton blooms and depleted oxygen bottom waters (hypoxia), degraded sediment, and the limited variability and high numbers of benthic animal communities. Dredging of the inlet has helped to sustain tidal exchange critical to nitrogen management; however, continuation of current loading rates will lead to further degradation of the harbor. Because septic system effluent accounts for 83% of the controllable loading in this watershed, reduction of this nitrogen source could reduce total loading to within acceptable limits for the watershed. Figure 6-8 shows total nitrogen loading for the Wychmere Harbor watershed, including natural deposition, and Figure 6-9 shows the percent of controllable nitrogen loading sources within the watershed.

Watershed

Wychmere Harbor

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 500 feet

0 250 500 Feet

Figure 6-7
Wychmere Harbor System

CDM Smith

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Figure 6-8
Total Nitrogen Loading in the Wychmere Harbor Watershed Including Natural Deposition

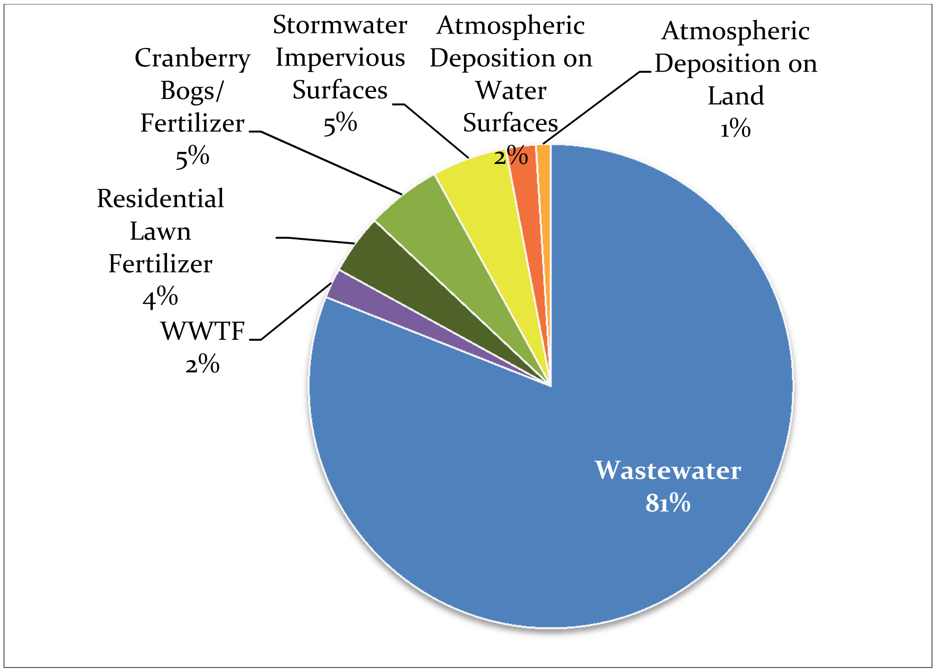
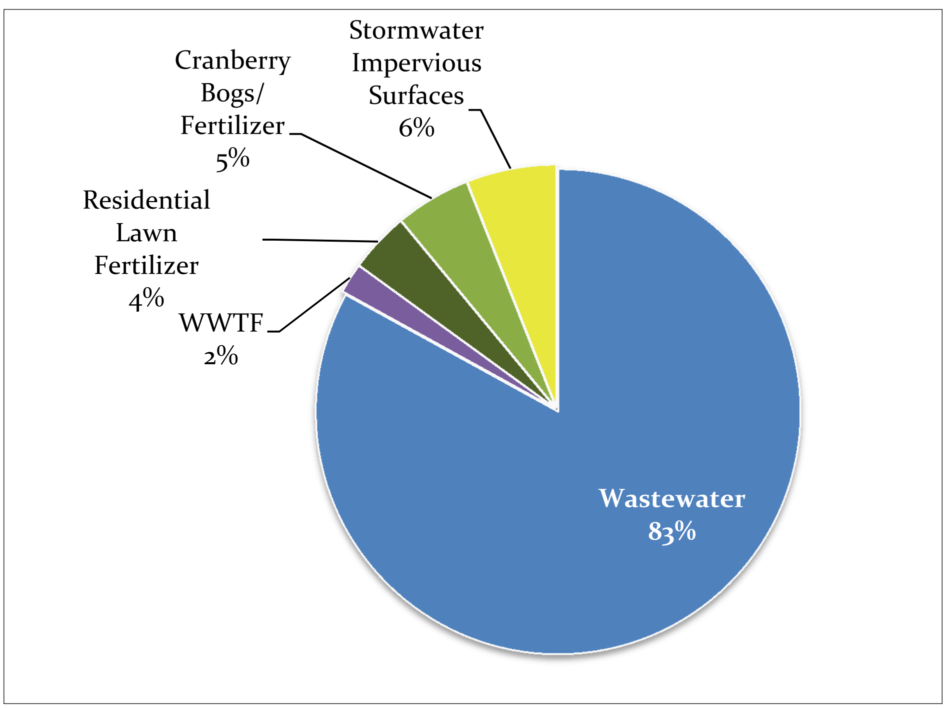


Figure 6-9
Total Controllable Nitrogen Loading in the Wychmere Harbor Watershed



Water Quality Indicators

As noted above, the MEP report identified the Wychmere Harbor system as moderately to significantly impaired and beyond its natural capacity to process additional nutrients without further degrading ecological health. While eelgrass is typically used as an indicator species of overall health, there is no evidence it existed historically in Wychmere Harbor. Instead, benthic communities were assessed as the indicator species for overall estuary health.

Infaunal animals were determined to have low diversity with high numbers of individuals, indicating a stressed benthic environment. Further assessment revealed indicator species which respond to high chlorophyll and moderate to high organic enrichment. Results were indicative of moderate nutrient loading in the main basin and moderate to high organic enrichment in the entire Wychmere Harbor system.

Monitoring Stations and Thresholds

Wychmere Harbor contains one sentinel station and one check station, as shown in Figure 6-10. The sentinel station, HAR-3, is positioned within Wychmere Harbor such that meeting the target nitrogen concentration would result in water quality throughout the harbor sufficient to restore ecological health with the goal of restoring healthy benthic infaunal habitats. Observed total nitrogen (TN) concentrations at the sentinel station HAR-3 ranged from an average upper limit of 0.812 mg/L to an average lower limit of 0.530 mg/L between 2001 and 2008.

The threshold nitrogen concentration was determined based on the average concentration of nitrogen in the water column that will support a healthy benthic habitat. Table 6-3 shows present average total nitrogen concentrations observed at monitoring stations as part of the MEP study along with the recommended threshold concentration for Wychmere Harbor and the percent change necessary to meet the threshold concentration for each monitoring station. All of the available information on eelgrass indicates that the Wychmere Harbor system did not support eelgrass. The present monitoring data indicates that total nitrogen levels of 0.65 to 0.82 mg/l of nitrogen cannot support healthy benthic communities. The MEP concluded that an upper limit of 0.50 mg/l of nitrogen (tidally averaged) would support healthy infaunal habitat in Wychmere Harbor. The concentrations at the monitoring stations may be slightly different than the upper limit, but they are chosen so that the upper limit of 0.50 mg/l of nitrogen (tidally averaged) is achieved throughout the system.

Table 6-3
Sentinel and Check Monitoring Stations with Associated Nitrogen Limits for Wychmere Harbor

Embayment	Monitoring Station	Present total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Wychmere Harbor	HAR-2A	0.453	0.367	-19.0%
Wychmere Harbor	HAR-3	0.813	0.500	-38.5%

*Present and threshold average total N values according to Table VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

*Values in RED indicate that the value is above the standard and must be reduced.

N

Watershed

Wychmere Harbor

Water Quality Monitoring Stations

Check Station

Sentinel Station

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 400 feet

0 200 400 Feet

Figure 6-10
Wychmere Harbor
Monitoring Stations

CDM Smith

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Determination of the threshold septic loading in a watershed is not as simple as determining the threshold concentration. Determination of site-specific nitrogen thresholds for an embayment requires integration of key habitat parameters (infauna and eelgrass), sediment characteristics, and nutrient related water quality information. Nitrogen threshold development builds on these data and links habitat quality to summer water column nitrogen levels. To determine the total loading several factors must be considered including septic system effluent flow into the watershed, natural attenuation throughout the watershed, wastewater treatment facilities (if any exist), estuary flushing, stormwater sources, fertilizers applied throughout the watershed, and finally the threshold concentrations presented in the table above. The MEP evaluation of habitat quality supported by the harbor considers the natural structure of each system and its ability to support that habitat before determining the threshold septic load.

Because septic system loading accounts for most of the controllable nitrogen in the harbor, that is the primary source which is recommended to be targeted for nitrogen reduction within the contributing watershed. Overall, 3.208 kg/day, or roughly 1,170 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. In order to meet threshold total nitrogen loads, it is estimated that the current total septic system load in the Wychmere Harbor watershed would need to be reduced by 100 %, as summarized in Table 6-4 below.

Table 6-4
Attenuated Septic Loading in the Wychmere Harbor Watershed

Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
3.208	0.00	100%

*Loading information according to Table VIII-2 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

*Values in RED indicate that the value is above the standard and must be reduced.

As noted previously, part of the MEP watershed nitrogen loading modeling includes a buildout assessment of potential development within the study area watersheds. The buildout performed by the MEP is a straightforward buildout assessment that considers a buildout scenario for both residential and commercial parcels throughout the studied watershed. The buildout assessment is an attempt at estimating buildout in a watershed based on current zoning and any projected changes using local input. The estimates developed for the model allow modelers to run a “what if” scenario that considers nitrogen loading associated with future development.

Table 6-3A shows buildout average total nitrogen concentrations modeled at monitoring stations as part of the MEP study along with the recommended threshold concentration for Wychmere Harbor and the percent change necessary to meet the threshold concentration for each monitoring station.

Table 6-3A
Sentinel and Check Monitoring Stations with Associated Buildout Nitrogen Limits for Wychmere Harbor

Embayment	Monitoring Station	Buildout total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Wychmere Harbor	HAR-2A	0.460	0.367	-20.2%
Wychmere Harbor	HAR-3	0.829	0.500	-39.6%

*Buildout and threshold average total N values according to Table IX-5 and VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

In the buildout projection, septic system loading also accounts for most of the controllable nitrogen in the Harbor. Thus, septic nitrogen is the primary source which is recommended to be targeted for total reduction within the contributing watershed. Overall, 3.30 kg/day, or roughly 1,206 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. This is about a 3% increase over present loads. In order to meet threshold total nitrogen loads, it is estimated that the total buildout septic load in the Wychmere Harbor watershed would need to be reduced by 100%, as summarized in Table 6-4A below to meet existing conditions.

Table 6-4A
Attenuated Buildout Septic Loading in the Wychmere Harbor Watershed*

Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
3.30	0.00	100%

*Loading information according to Table VIII-2 and the MEP Loading Spreadsheets (AKA Rainbow Tables) of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems.

Values in RED indicate that the value is above the standard and must be reduced.

6.3.3 Saquatucket Harbor Watershed Results

Saquatucket Harbor was evaluated under the same MEP initiative along with Allen and Wychmere Harbors. Results can be found in the June 2010 final report entitled "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Allen, Wychmere and Saquatucket Harbor Embayment Systems, Harwich, Massachusetts." Saquatucket Harbor is located in the Chatham Outwash Plain, which is comprised of sands, gravels, and chiefly pre-Wisconsin deposits. The harbor was formed by tidal flooding of channels within the outwash deposits of a stream.

Physical Description

Saquatucket Harbor is a simple estuary located in the Town of Harwich which is comprised of a small marina, long channel, and single outlet. Flushing with Nantucket Sound occurs through a dredged canal bounded by jetties. The canal was constructed in 1968. Prior to that, the harbor was a tidal salt marsh with a central tidal river known as Andrews River. The remnants of that tidal river can be found in the western shore of the harbor. Open water area is 12 acres.

Freshwater enters through direct groundwater discharge to the harbor perimeter, precipitation, and two significant surface water sources: Carding Machine Brook from the northwest and Cold (Bottom) Brook from the northeast, both of which feed the remaining salt marshes which bound the basin to the east and west. A moderately sized and relatively healthy salt marsh also exists in the northern region of the basin. Parallel jetties extend the channel into Nantucket Sound through shallow water along the barrier beach which bounds Harwich to the south. Figure 6-11 shows the Saquatucket Harbor system.

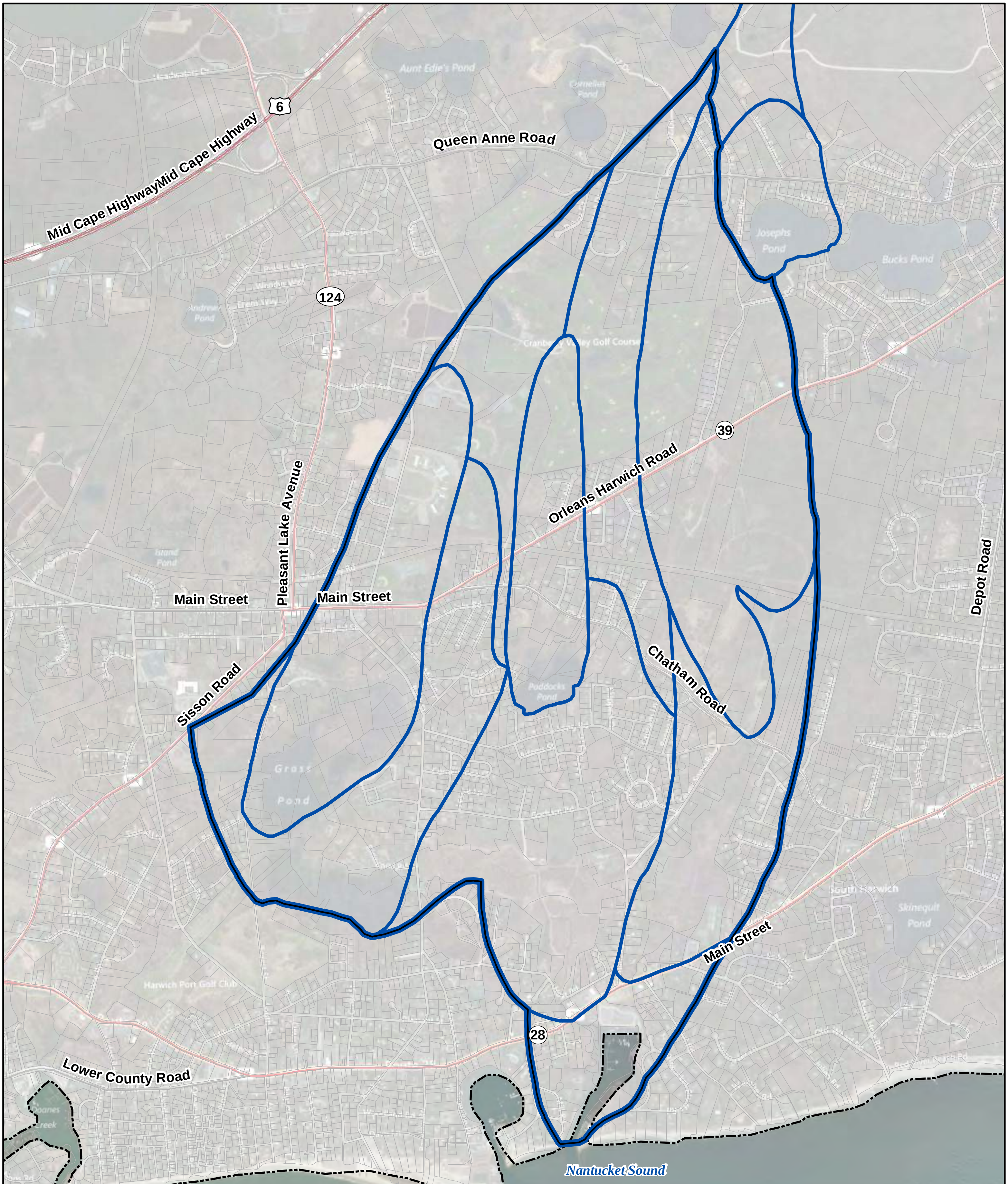
Land Use and Nitrogen Loading

Land use in the Saquatucket Harbor watershed is 41% public service, due to Town-owned preservation land, the publicly-owned Cranberry Valley Golf Course, and the former cranberry bog system now owned by Harwich Conservation Trust. Residential use is comparable at 36%, of which 97% is single family residences. It is estimated that there are approximately 30 private drinking water wells in use at single family residences in the Saquatucket watershed.

In the Saquatucket watershed, residential septic system use coupled with runoff containing fertilizers from golf courses, residential lawns, and cranberry bogs are the predominant sources of nitrogen loading, accounting for 92% of total nitrogen loading. Other sources of nitrogen loading include farm animals, road and roof runoff, and atmospheric deposition.

As a result of the combination of these sources, Saquatucket Harbor experiences moderate nitrogen loading which leads to periodic summer phytoplankton blooms and depleted bottom water oxygen (hypoxia), degraded sediment, and a limited variability and high numbers of benthic animal communities. Dredging of the inlet has helped to sustain tidal exchange which is critical to nitrogen management, however current loading will lead to continued degradation of the harbor. Septic systems account for 75% of total nitrogen loading in the watershed and 79% of controllable loading.

This will be the focus of future efforts to bring the harbor conditions to balanced levels such that benthic habitat may be restored. Figure 6-12 shows total nitrogen loading for the Saquatucket Harbor watershed, including natural deposition, and Figure 6-13 shows the percent of controllable nitrogen loading sources within the watershed.



Watershed

Saquatucket Harbor

Saquatucket Harbor Subsheds

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 1,800 feet

0 900 1,800 Feet

Figure 6-11
Saquatucket Harbor System

CDM Smith

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Figure 6-12
Total Nitrogen Loading in the Saquatucket Harbor Watershed, Including Natural Deposition

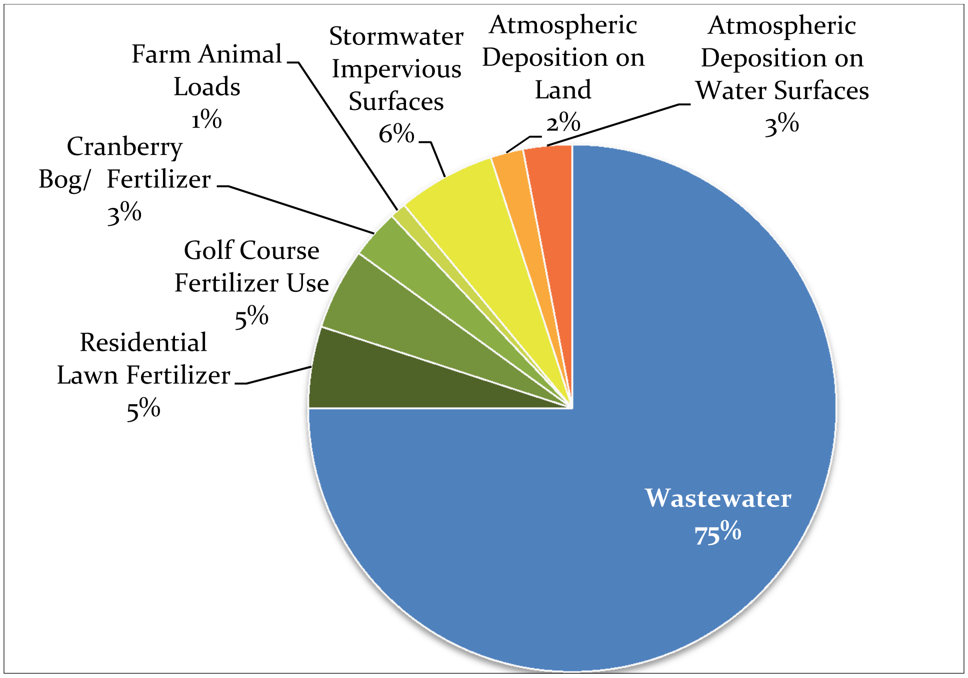
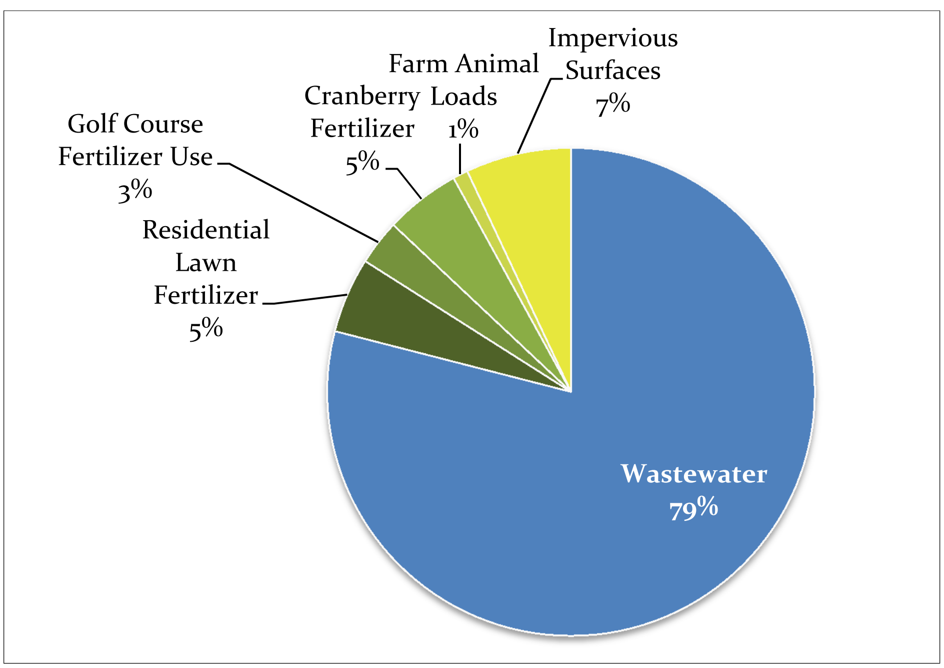


Figure 6-13
Total Controllable Nitrogen Loading in the Saquatucket Harbor Watershed



Water Quality Indicators

The MEP report identified the Saquatucket Harbor estuary as a moderate to significantly impaired system beyond its natural capacity to process additional nutrients without further degrading ecological health. While eelgrass is typically an indicator species of overall health, there is no evidence that the basin has ever supported it. In addition, current water quality conditions and nutrient levels would not support eelgrass populations. As a result, the MEP used the infaunal animal population as an indicator of overall health for this harbor.

In place of eelgrass, benthic animals were again used as the indicator species of overall harbor water quality. Low diversity of infaunal animals with high numbers of individuals, specifically amphipods, was observed. This observation is indicative of nitrogen enrichment and intermediate stress on the habitat; however, it is not indicative of severe degradation. The main basin maintained moderate numbers of species with high numbers of individuals, also indicative of habitat impairment. High chlorophyll and moderate to high organic enrichment indicator species are all indicative of moderate nutrient loading in the main basin and moderate to high organic enrichment in the overall Saquatucket Harbor system.

Dissolved oxygen was also used to indicate water quality. Frequent oxygen depletion was noted in the main basin of Saquatucket Harbor at values consistent with a nitrogen-enriched water body that is moderately to significantly impaired.

Monitoring Stations and Thresholds

In Saquatucket Harbor, one sentinel station entitled HAR-2 is located at the end of the marina, before the main harbor area, as shown in Figure 6-14. This location is positioned such that meeting the target criteria in this location will signify improved water quality throughout the harbor area sufficient to restore ecological health and restore healthy benthic infaunal habitats.

The threshold nitrogen concentration for Saquatucket Harbor sentinel station HAR-2 is 0.494 mg/L. Investigations between 2001 and 2008 have shown that the harbor has an average concentration of 0.652mg/L, and nitrogen loading increasing marginally between 2006 and 2008, though generally remaining relatively stable. Similar to the other two harbors (Allen and Wychmere), the available information on eelgrass indicates that the Saquatucket Harbor system did not support eelgrass and cannot support healthy benthic communities. The MEP concluded that an upper limit of 0.50 mg/l of nitrogen (tidally averaged) would support healthy infaunal habitat in Saquatucket Harbor. The concentrations at the monitoring stations may be slightly different than the upper limit, but they are chosen so that the upper limit of 0.50 mg/l of nitrogen (tidally averaged) is achieved throughout the system. This is summarized in Table 6-5 below.

Watershed

Saquatucket Harbor

Water Quality Monitoring Stations

Sentinel Station

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 400 feet

0 200 400 Feet

Figure 6-14
Saquatucket Harbor
Monitoring Stations

CDM Smith

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Table 6-5
Sentinel and Check Monitoring Stations with Associated Nitrogen Limits for Saquatucket Harbor

Embayment	Monitoring Station	Present total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Saquatucket Harbor	HAR-2	0.652	0.494	-24.2%

*Present and threshold average total N values according to Table VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

Determination of site-specific nitrogen thresholds for an embayment requires integration of key habitat parameters (infauna and eelgrass), sediment characteristics, and nutrient related water quality information. Nitrogen threshold development builds on these data and links habitat quality to summer water column nitrogen levels. To determine the total loading several factors must be considered including septic system effluent flow into the watershed, natural attenuation throughout the watershed, wastewater treatment facilities (if any exist), estuary flushing, stormwater sources, fertilizers applied throughout the watershed, and finally the threshold concentrations presented in the table above. The MEP evaluation of habitat quality supported by the harbor considers the natural structure of each system and its ability to support that habitat before determining the threshold septic load.

The primary source of nitrogen in the Saquatucket Harbor watershed is septic system effluent, which accounts for a majority of total and controllable nitrogen loading. For this reason, this source is the primary focus of nitrogen reduction to meet the threshold values. Overall, 13.25 kg/day, or roughly 4,836 kg/year, total nitrogen is estimated to originate from septic systems within the watershed. In order to meet threshold nitrogen loads, it is estimated that the current total septic load in the Saquatucket Harbor watershed would need to be reduced by 60 percent, as shown in Table 6-6.

Table 6-6
Attenuated Septic Loading in the Saquatucket Harbor watershed*

Sub – Embayment	Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
Saquatucket Harbor	2.545	0.507	80.1%
Cold Spring Brook	7.775	3.499	55.0%
E. Saquatucket Stream	2.926	1.274	56.5%
Total	**13.246**	**5.280**	**60%**

*Loading information according to Table VIII-2 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

The threshold septic loading for the Saquatucket Harbor system is the sum of three threshold loads developed in the MEP report for the Saquatucket Harbor sub-embayment, The Cold Brook (also known locally as Cold Spring Brook and/or Carding Machine Brook) sub-embayment and the East Saquatucket Stream sub-embayment. The Saquatucket Harbor sub-embayment is the total estuarine reach which receives septic nitrogen inputs through direct groundwater discharge and is separate from surface water inflows. Together these three thresholds combine to give a total threshold septic load for the watershed. To meet the requirements of both the check and sentinel stations, the Saquatucket Harbor sub-embayment will require at least 80.1% of the present septic load to be reduced, the Cold Brook sub-embayment will require at least 55.0% of the present septic load to be reduced, and the East Saquatucket Stream sub-embayment will require at least 56.5% of the present septic load to be reduced. Together, the Saquatucket Harbor watershed will require 60% of the septic load to be reduced.

As noted previously, the buildout assessment performed by the MEP is a straightforward buildout assessment that considers a buildout scenario for both residential and commercial parcels throughout the studied watershed. The buildout assessment is an attempt at estimating buildout in a watershed based on current zoning and any projected changes using local input. The estimates developed for the model allow modelers to run a “what if” scenario that considers nitrogen loading associated with future development.

Table 6-5A shows buildout average total nitrogen concentrations modeled at monitoring stations as part of the MEP study along with the recommended threshold concentration for Saquatucket Harbor and the percent change necessary to meet the threshold concentration for each monitoring station.

Table 6-5A
Sentinel and Check Monitoring Stations with Associated Buildout Nitrogen Limits for Saquatucket Harbor

Embayment	Monitoring Station	Buildout total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Saquatucket Harbor	HAR-2	0.691	0.494	-28.5%

*Buildout and threshold average total N values according to Table IX-5 and VIII-5 of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems

Values in RED indicate that the value is above the standard and must be reduced.

In the buildout projection, septic system loading also accounts for most of the controllable nitrogen in the Harbor. Thus, septic nitrogen is the primary source which is recommended to be targeted for total reduction within the contributing watershed. The buildout model run for the Saquatucket Harbor watershed septic load is actually lower than the present load because an enhanced attenuation factor was utilized in the Bank Street Bogs that changed the attenuation rate from 35% to 50% in the buildout assumptions. Overall, 12.51 kg/day, or roughly 4,566 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. This is about a 5.5% *decrease* over present loads. In order to meet threshold total nitrogen loads, it is estimated that the current total septic load in the

Saquatucket Harbor watershed would need to be reduced by 58%, as summarized in Table 6-6A below to meet existing conditions.

Table 6-6A
Attenuated Buildout Septic Loading in the Saquatucket Harbor Watershed*
with Enhanced Attenuation

Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
12.51	5.28	58%

*Loading information according to Table VIII-2 and the MEP Loading Spreadsheets (AKA Rainbow Tables) of the June 2010 MEP Final Report for Allen, Wychmere and Saquatucket Harbor Embayment Systems.

Values in RED indicate that the value is above the standard and must be reduced.

6.3.4 Pleasant Bay Watershed and Sub-Embayment Results

The final MEP report for the Pleasant Bay embayment, "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich, Massachusetts," was published in May 2006. Two additional memoranda were issued in October and June of 2010. These two memoranda update specific attenuation and flushing assumptions. The first memorandum was issued June 25, 2010 and updates the attenuation assumptions in Muddy Creek and nitrogen loading to Pleasant Bay. The second memorandum was issued October 5, 2010 and evaluates the additional scenario to the water quality impacts with the addition of a 24-foot opening to the Muddy Creek inlet. The updates in these memoranda are considered to be part of the final MEP report for the Pleasant Bay System and are used throughout this section.

Pleasant Bay is the largest embayment system on Cape Cod, comprised of large open water areas and small tributary sub-embayments. Four subwatersheds out of the 59 contributing subwatersheds assessed for the Pleasant Bay system are located within the town of Harwich. Those subwatersheds are Round Cove, Lower Muddy Creek, Upper Muddy Creek, and the Harwich portion of the Pleasant Bay subwatershed. This analysis focuses only on the portions of the Pleasant Bay system within Harwich.

The MEP report identified sub-embayments throughout Pleasant Bay as near or beyond their natural capacity to process additional nutrients without further degrading ecological health. Embayments often indicate the overall health of a watershed because water sources, both groundwater and surface water, carry nutrients from developed areas and deposit those nutrients into a water body. When nutrients are deposited in an estuary, or a water body with limited flow, they often build up faster than the natural systems can break them down, resulting in elevated nitrogen levels. Eutrophication and decreased eelgrass populations throughout the Pleasant Bay system have resulted in moderate impairment, according to the MEP. Because of groundwater and surface water from developed areas, the resulting eutrophication indicates that nutrient overload is not present just in the embayment, but throughout the watershed.

This MEP study, and subsequent updates as part of this CWMP/SEIR, sought to identify and further investigate the contributing factors which led to current conditions. For Pleasant Bay, nitrogen management is vital to ensure restoration of its natural systems. The solution must include source mitigation local to Pleasant Bay, as well as nitrogen management within the larger regional basins by limiting on-site disposal of wastewater. In order to address this, it is important to first understand the current conditions through ongoing assessment and then establish criteria for improvements.

Physical Description

The Pleasant Bay embayment system is comprised of drowned river valley estuaries, barrier beaches and islands, salt marshes, and flats which exchange tidal waters with a large lagoonal estuary. The large lagoonal estuarine basins, or open water areas, include Little Pleasant Bay, Pleasant Bay, and Chatham Harbor. The Pleasant Bay sub-embayment is bounded by Harwich and Brewster to the southwest and northwest, respectively, Orleans and Little Pleasant Bay to the North, and Chatham to the south. Nauset Spit is a natural sandy barrier island and marine protected area which bounds Chatham Harbor to the east and limits flushing between the embayment and the Atlantic Ocean. Figure 6-15 shows the Pleasant Bay embayment system and its associated estuarine basins. This also shows the sub-watersheds located in Harwich.

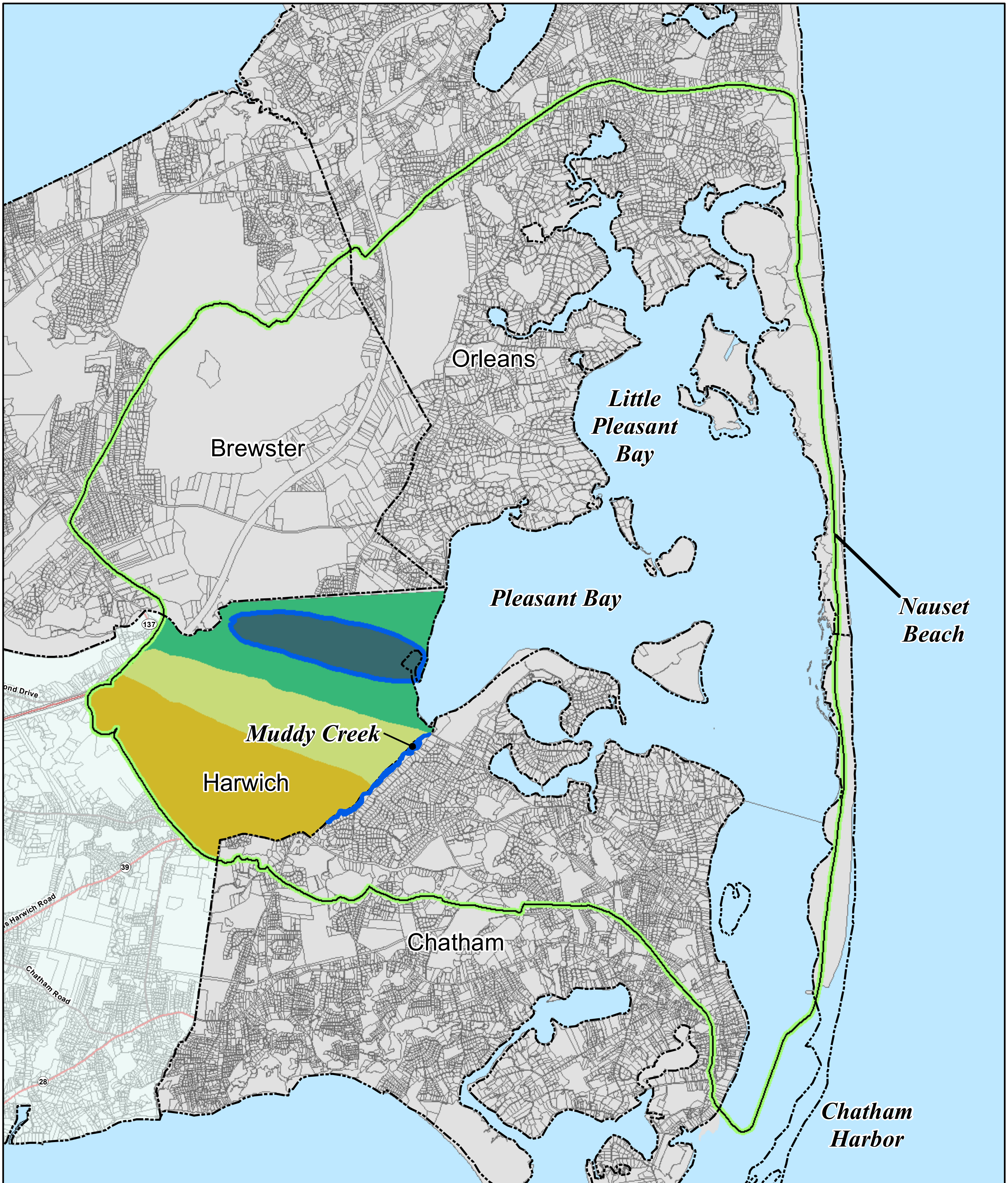
Land Use and Nitrogen Loading

Determination of the amount of nitrogen transported by freshwater sources to the Pleasant Bay embayment was made in three main steps: assessment of nitrogen accumulation and nitrogen sources; assessment of nitrogen transport through natural systems; and evaluation of natural denitrification processes which degrade concentrations over time.

The following subsection presents loading in Harwich for Upper and Lower Muddy Creek, Round Cove and the Pleasant Bay subwatersheds. Subwatershed nitrogen loading in Pleasant Bay and Round Cove is shared with the town of Brewster, and subwatershed nitrogen loading in both Upper Muddy Creek and Lower Muddy Creek is shared with the town of Chatham.

Determination of the existing nitrogen load for each subwatershed included regional loading factors and parcel by parcel land and water use data. Watershed-specific information regarding wastewater, fertilizers, stormwater runoff from impervious surfaces, and atmospheric deposition were also used.

Digital parcel and tax assessor data from 1999 and 2005 and updated land use coverages from 2006 were used for the Town of Harwich. These data generally consisted of land use information as well as Town-generated information. Land use was broken down into nine common and comparable categories: 1) residential, 2) commercial, 3) industrial, 4) undeveloped, 5) agricultural, 6) mixed use, 7) golf course and recreational, 8) public service/government, and 9) freshwater ponds. Across Pleasant Bay, the most common land uses were residential (38% of watershed area) and public service including government-owned lands, roads, and rights-of-way (37%).



N

Watershed

Pleasant Bay System

Sub-Watersheds in Harwich

Round Cove

Pleasant Bay

Lower Muddy Creek

Upper Muddy Creek

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 5,280 feet

0 2,640 5,280 Feet

Figure 6-15
Pleasant Bay
Sub-Watersheds in Harwich

CDM Smith

Water use information by parcel was obtained from the Harwich Water Department for the year 2004. Wastewater-based nitrogen loading from the individual parcels using on-site septic systems was based upon the measured water use, estimated nitrogen concentration, and assumed consumptive loss of water (i.e. irrigation, drinking water, etc.) before the remainder is treated in a septic system. Typical septic system removal of nitrogen is around 20%, however further nitrogen loss during aquifer transport is negligible. Average water use throughout the Pleasant Bay watershed was 166 gpd at the time of the MEP assessment.

Similar to the watersheds previously discussed, the Pleasant Bay watershed also has a high residential septic system use coupled with stormwater runoff containing fertilizers from golf courses and residential lawns. These sources are the predominant sources of nitrogen loading, accounting for 51% of total nitrogen loading within the watershed. Other sources of nitrogen loading include road and roof runoff and atmospheric deposition.

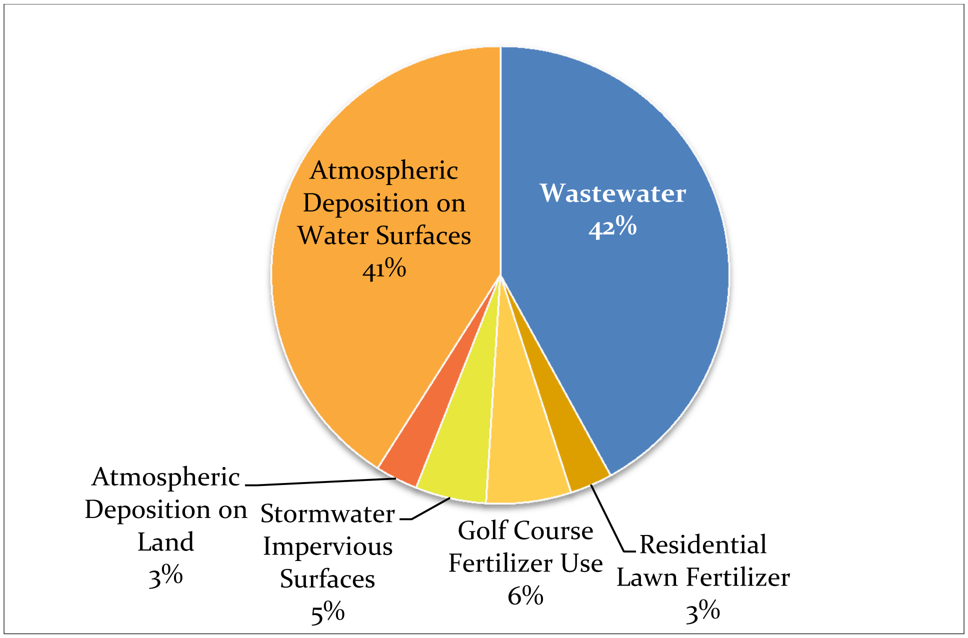
The primary ecological threat to Pleasant Bay resources is degradation resulting from nutrient enrichment. Loading of the critical eutrophying nutrient, nitrogen, to the embayment waters has been greatly increased over the past few decades with further increases certain unless nitrogen management is implemented.

The Pleasant Bay system is more complicated than many of the other embayments studied by the MEP because of the presence of a large shoreline with numerous sub-embayments. The large number of subembayments greatly increases the potential for direct discharges from homes situated on the shore and decreases the travel time of groundwater from the watershed recharge areas to bay regions of discharge.

The presence of enclosed embayments in areas with relatively high population densities creates a nutrient loading problem that is important since the protected marine shorelines are the same shorelines that are popular for boating, recreation, and land development. These enclosed bodies of water are often inadequately flushed of the pollutants that they receive due to the proximity and density of development near and along their shores.

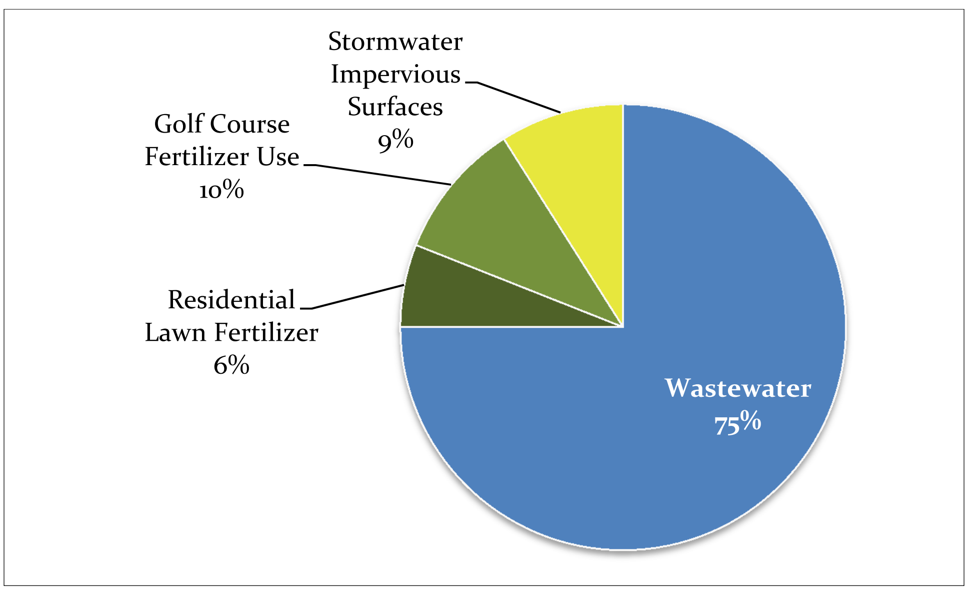
Septic system effluent, which accounts for 42% of total nitrogen loading in the Pleasant Bay watershed and 75% of controllable nitrogen loading, will be the focus of future efforts to bring the harbor conditions to balanced levels such that benthic habitat may be restored. Figure 6-16 shows total nitrogen loading for the entire Pleasant Bay watershed, including natural deposition, and Figure 6-17 shows the percent of controllable loading sources within the watershed.

Figure 6-16
Total Nitrogen Loading in the Pleasant Bay Watershed, Including Natural Deposition



Wastewater is the primary contributor of total nitrogen to the Pleasant Bay system. Other controllable sources contribute approximately 17% of the total load.

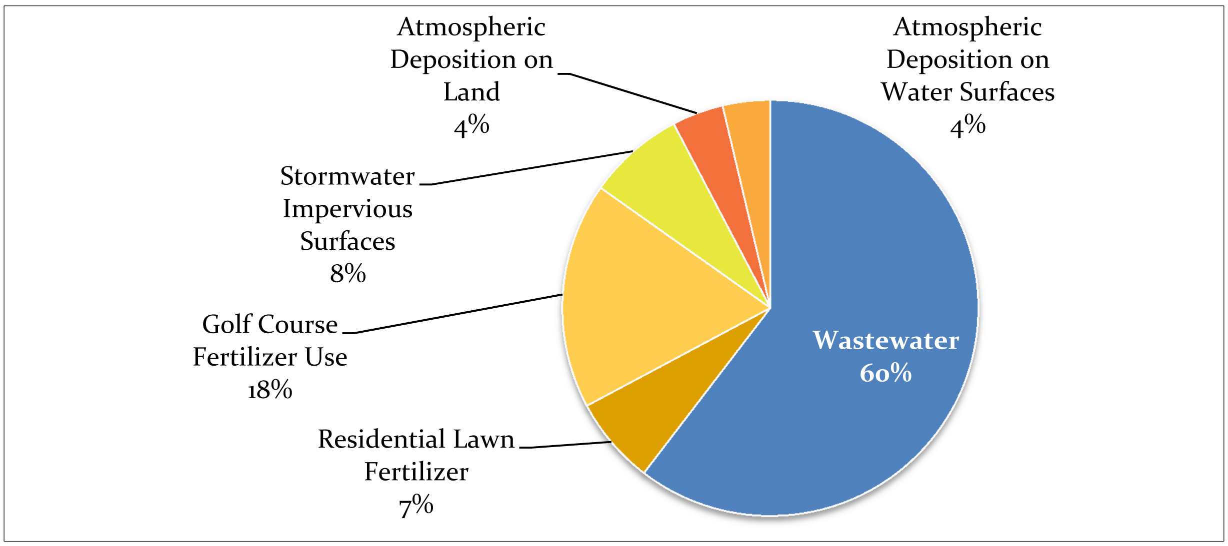
Figure 6-17
Total Controllable Nitrogen Loading in the Pleasant Bay Watershed



While wastewater is the major contributor to the controllable nitrogen load, fertilizers contribute another 16% to the system and stormwater contributes approximately 9% to the controllable load.

Since the Pleasant Bay system is so complex, the subwatersheds to the Pleasant Bay system such as Round Cove and Muddy Creek have slightly different distributions of nitrogen inputs due to the different types of development throughout the sub-watersheds. As an example, wastewater in Muddy Creek contributes 72% of total nitrogen loading and 79% of controllable loading. As a result of these differences, each subwatershed must be considered individually when deciding the appropriate amount of nitrogen that should be managed. Figure 6-18 shows total nitrogen loading for the Muddy Creek subwatershed, including natural deposition, and Figure 6-19 shows the percent of controllable loading sources within the subwatershed.

Figure 6-18
Total Nitrogen Loading in the Muddy Creek Subwatershed, Including Natural Deposition

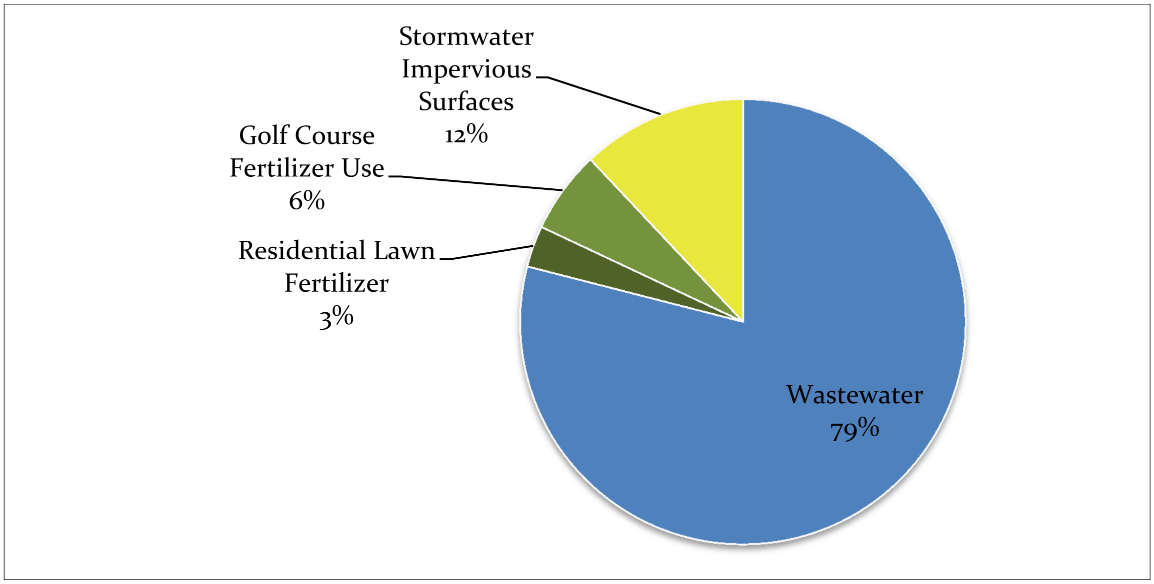


As noted above, for the Muddy Creek system, wastewater is the majority contributor at 60%, and fertilizers contribute another 25% of total nitrogen to the Muddy Creek subwatershed. Other sources contribute approximately 16% of the total load.

For controllable nitrogen loads, wastewater is again the major contributor and fertilizers contribute another 9%, while other sources contribute approximately 12% of the controllable load to the Muddy Creek system.

Once nitrogen sources are determined, the amount which they contribute to receiving waters depends on the time and method of transport as well as natural attenuation through freshwater ponds. For instance, nitrogen inputs which enter or pass through a pond are reduced by approximately 50% due to natural attenuation, while denitrification during groundwater transmissivity is considered negligible. For that reason, loads are further assessed according to subwatershed.

Figure 6-19
Total Controllable Nitrogen Loading in the Muddy Creek Subwatershed



Water Quality Indicators

Water quality within the Pleasant Bay system varies from healthy to degraded, depending on the level of nitrogen enrichment at a particular location. For the purposes of assessing water quality indicators, Upper Muddy Creek and Round Cove were classified as small enclosed basins and received similar results for key habitat indicators, while Lower Muddy Creek was categorized as a moderate sized tributary sub-embayment.

Key habitat indicators include infaunal animals, eelgrass population, and dissolved oxygen/chlorophyll-a levels. In Upper Muddy Creek, the benthic animal population is significantly depleted, indicating high nitrogen loading and oxygen stress. Results from Round Cove indicated intermediate stress species, including amphipods, however nutrient loading was considered to be only moderately beyond nitrogen loading limits.

Historically, eelgrass has not been supported in most of the small enclosed basins within Pleasant Bay, including Round Cove. However there is a small patch of eelgrass in the Lower Muddy Creek area. As a result, the MEP used the infaunal animal population as well as eelgrass populations as an indicator of overall health.

A high level of oxygen stress was observed in small enclosed basins, including the Upper Muddy Creek and Round Cove watersheds. These basins were also found to maintain higher nitrogen levels due to limited flushing. Round Cove was reported with mild hypoxia, a condition where dissolved oxygen levels are below 2 mg/L; however levels were typically above 4 mg/L or 5 mg/L during the field data collection period. In contrast, Upper Muddy Creek was frequently observed to be anoxic, where dissolved oxygen was not present. The area within Pleasant Bay between Round Cove and Upper Muddy Creek was typically reported to maintain dissolved oxygen levels of about 5 mg/L; however one event was reported as partially hypoxic, with dissolved oxygen levels reported between 2 and 4 mg/L.

Overall, Upper Muddy Creek, Lower Muddy Creek, and Round Cove were each separately ranked for level of stress according to several nutrient related health indicators, including: dissolved oxygen, chlorophyll-a, macroalgae, eelgrass, and infaunal animals. Round Cove was ranked moderately impaired to significantly impaired for dissolved oxygen levels, chlorophyll-a levels, and infaunal animal species, resulting in an overall ranking of significantly impaired to moderately impaired. Upper Muddy Creek was ranked significantly impaired to severely degraded in terms of dissolved oxygen levels, chlorophyll-a levels, and infaunal animal species, resulting in an overall ranking of severely degraded. Lower Muddy Creek was consistently ranked significantly impaired.

Muddy Creek Culvert Project

The Pleasant Bay Alliance recognized that the tidal flushing in Muddy Creek was both man made and limited by the presence of a tidal restriction (culvert) to Muddy Creek. Since both the Upper and Lower Muddy Creek were impaired, the Alliance realized that increased flushing in these subwateresheds could have a significant impact in the threshold concentrations. As a result, discussions were held with SMAST and a new scenario was developed that evaluated the Pleasant Bay system with a 24-foot wide culvert (opening) to Muddy Creek. The size of the 24-foot culvert was chosen because it was believed by SMAST that a culvert larger than that would not significantly increase flushing or have an effect on the thresholds based on the modeling results.

The effect of increasing the inlet opening to Muddy Creek on nitrogen throughout Pleasant Bay was evaluated using the Pleasant Bay model, as requested by the Pleasant Bay Alliance. This evaluation was conducted under both existing and buildout watershed loadings. The evaluation showed that replacing the existing inlet to Muddy Creek with a 24-foot culvert has little effect on the nitrogen levels throughout the Pleasant Bay System, since Muddy Creek represents only about 12% of the watershed load to the overall system, and the inlet has little effect on the amount of nitrogen leaving Muddy Creek. According to the evaluation, a small, but insignificant, lowering of concentrations will be realized from the larger tide range in Muddy Creek with the new inlet.

While there is a clear reduction in the nitrogen level at the Muddy Creek check station due to the wider opening, there is little or no change in the nitrogen concentrations at the other check stations and sentinel stations. The wider culvert results in a 20% drop in the difference between the existing conditions modeled nitrogen concentration and the threshold concentration (0.21 mg/l) at the Lower Muddy Creek check station (PBA-05). Additional nitrogen reductions are still necessary in the Muddy Creek watershed to meet the threshold concentration in Lower Muddy Creek, but the magnitude is reduced through the installation of the wider opening. All other stations throughout Pleasant Bay have insignificant changes in concentration (i.e., less than one percent). These results suggest that installing a 24-foot opening at the head of Muddy Creek will improve water quality in Muddy Creek and will not result in any significant changes in the rest of the Pleasant Bay system. The subsection below presents threshold concentrations and nitrogen reduction goals which were developed with the assumption that the 24-foot Muddy Creek opening will be implemented as part of the overall wastewater management program.

Monitoring Stations and Thresholds

Due to the relative size and extent of the Pleasant Bay estuary, the comprehensive MEP evaluation involved sampling at more than 20 monitoring stations throughout this complex estuary. Sampling locations were selected based on the subject data being evaluated and its relative location in comparison to the subject subwatershed. Figure 6-20 shows the selection of water quality check stations which were sampled during warm weather months from 2000 to 2005 that are discussed in this section, in addition to the three sentinel stations for Pleasant Bay.

As described previously, sentinel stations are locations within the embayment which, once restored, "will necessarily bring the other regions of the system to acceptable habitat quality levels." In the Pleasant Bay sub-embayment, three sentinel locations were used to determine the critical nitrogen threshold necessary to maintain a high-quality eelgrass habitat. Sentinel stations for Pleasant Bay included PBA-12 at the head of Little Pleasant Bay, PBA-03 at upper Ryders Cove, and CM-13 at lower Ryders Cove. These locations were selected because comparative conditions in other sub-embayments, where depth was similar, supported eelgrass growth. While each of these locations is positioned to capture the overall performance of the Pleasant Bay estuary, none are located near the subject sub-watersheds of concern in Harwich.

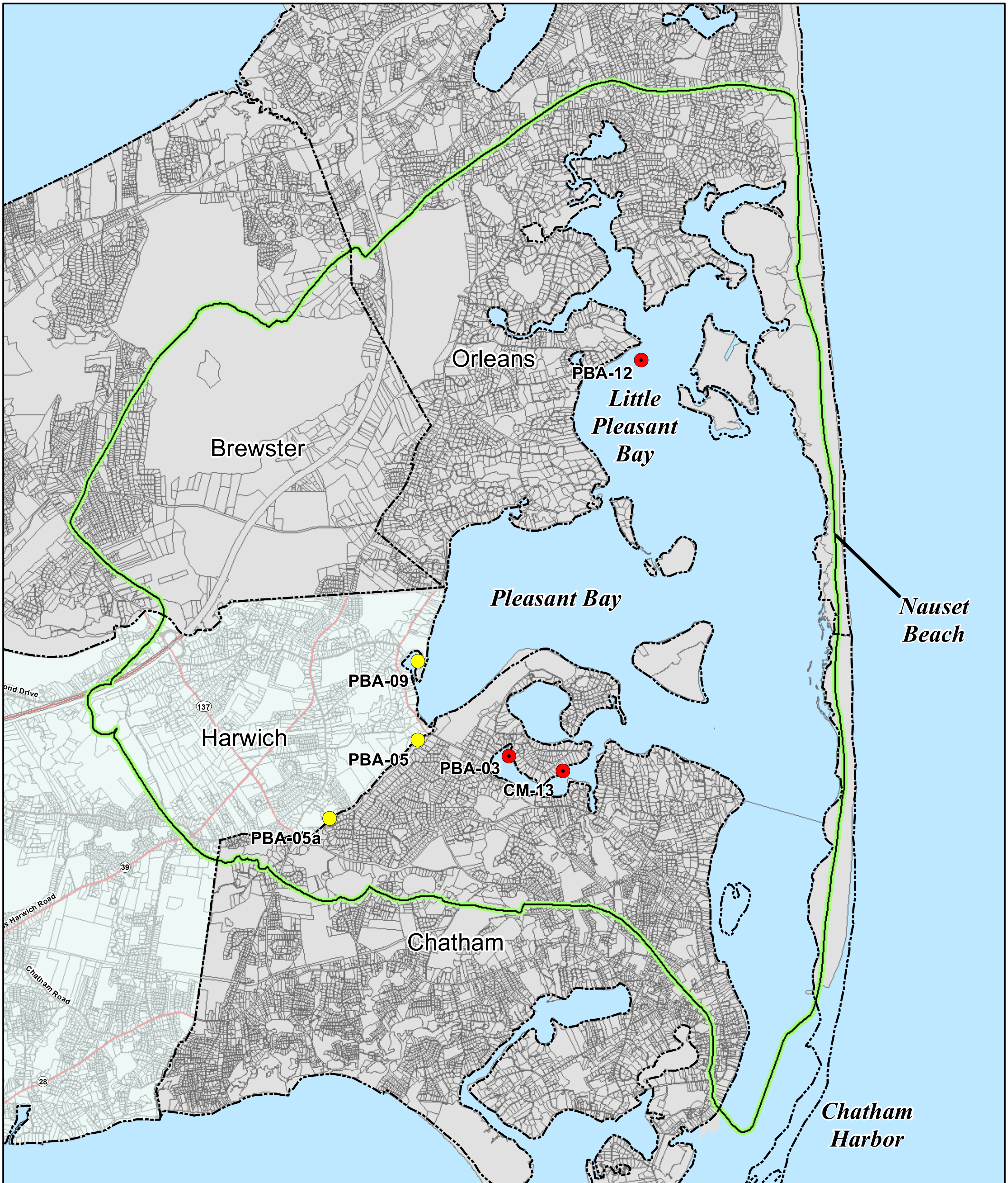
The sentinel station for the Pleasant Bay System is based on a nitrogen threshold that targets the restoration of eelgrass. This station was placed within the uppermost reach of Little Pleasant Bay (PBA-12). The total nitrogen level at the sentinel station (PBA-12) is 0.723 mg/l of nitrogen which was set to improve the eelgrass habitat throughout Little Pleasant Bay and the historic distribution in Pleasant Bay, which will see lower nitrogen levels when the threshold is reached.

While eelgrass restoration is the primary nitrogen management goal within the Pleasant Bay System, there are small basins which do not appear to have historically supported eelgrass habitat. For these sub-embayments, restoration and maintenance of healthy animal communities is the management goal. It should be noted that restoration of eelgrass is not the only criterion for restoration of habitat health throughout the Pleasant Bay System. Based upon the 1951 eelgrass analysis there are eight (8) sub-embayments to Pleasant Bay that are not likely to support eelgrass habitat for structural reasons. While these systems may not be supportive of eelgrass habitat, they are generally capable of supporting healthy benthic animal habitat. Infaunal animals are sensitive to the organic matter loading and resulting periodic oxygen depletions associated with nitrogen overloading.

Since these conditions typically occur at higher nitrogen loads than does the shading of the bottom by increased phytoplankton production (principal cause of eelgrass loss), the nitrogen threshold level for healthy benthic animal habitat is higher than for healthy eelgrass habitat. This has been found to be the case throughout the MEP study area.

Since the Pleasant Bay system is so complex and is shared by several towns, each individual community must understand how to reduce excess nutrients in the sub-embayments that fall within its town's boundaries while also coordinating to ensure that the combined solutions from each community will ultimately meet the overall water quality goals.

In order for Harwich to monitor progress in reducing its nitrogen contribution to Pleasant Bay, the town will need to monitor the check stations closest to the sub-embayments for which they are responsible. There are three check stations located near Harwich. These stations include PBA-09 at Round Cove, PBA-05a at Upper Muddy Creek, and PBA-05 at Lower Muddy Creek. The sentinel station PBA-12 should be monitored for the Pleasant Bay sub-embayment that discharges directly to Pleasant Bay. Table 6-7 summarizes the present and threshold nitrogen concentrations at these stations.



Watershed

Pleasant Bay System

Water Quality Monitoring Stations

Check Station

Sentinel Station

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 5,280 feet
0 2,640 5,280 Feet

Figure 6-20
Water Quality Monitoring Stations in Pleasant Bay

CDM Smith

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Present concentrations for each station were determined using total nitrogen concentration data collected during warm weather months from 2000 to 2005. The present concentration is the mean of the five annual average nitrogen concentrations collected during that time period. A summary of each monitoring station present and total nitrogen loading was captured for each sub-watershed. Table 6-7 shows present average total nitrogen concentrations observed at monitoring stations as part of the MEP study along with the recommended threshold concentration for the four sub-embayments.

Table 6-7
Sentinel and Check Monitoring Stations with Associated Nitrogen Limits for the Pleasant Bay System

Sub-embayment	Monitoring Station	Present Total N Concentration* With Existing Muddy Creek Opening (mg/l)	Threshold Concentration (mg/l)	% Change
Round Cove	PBA-09	0.255	0.207	18.8%
Upper Muddy Creek	PBA-05A	0.674	0.405	39.9%
Lower Muddy Creek	PBA-05	0.298	0.208	30.2%
Little Pleasant Bay - head	PBA – 12	0.178	0.160	10.1%

*Present and threshold average total N values according to Table 3 of the October 5th, 2010 MEP Technical Memo, and Table VIII-6 of the May 2006 Pleasant Bay Linked Embayment Model.

Values in RED indicate that the value is above the standard and must be reduced.

For comparison, Table 6-7A summarizes the present and threshold nitrogen concentrations at these stations with the enlarged culvert at Muddy Creek.

Table 6-7A
Sentinel and Check Monitoring Stations with Associated Nitrogen Limits for the Pleasant Bay System

Subwatershed	Monitoring Station	Present Total N Concentration* With Enlarged Muddy Creek Opening (mg/l)	Threshold Concentration (mg/l)	% Change
Round Cove	PBA-09	0.253	0.207	18.1%
Upper Muddy Creek	PBA-05A	0.674	0.405	39.9%
Lower Muddy Creek	PBA-05	0.255	0.208	18.4%
Little Pleasant Bay - head	PBA – 12	0.178	0.160	10.1%

*Present and threshold average total N values according to Table 4 of the October 5th, 2010 MEP Technical Memo, and Table VIII-6 of the May 2006 Pleasant Bay Linked Embayment Model.

Values in RED indicate that the value is above the standard and must be reduced.

Determination of site-specific nitrogen thresholds for an embayment requires integration of key habitat parameters (infauna and eelgrass), sediment characteristics, and nutrient related water quality information. Nitrogen threshold development builds on these data and links habitat quality to summer water column nitrogen levels. To determine the total loading several factors must be considered including septic system effluent flow into the watershed, natural attenuation throughout the watershed, wastewater treatment facilities (if any exist), estuary flushing, stormwater sources, fertilizers applied throughout the watershed, and finally the threshold concentrations presented in the table above. The MEP evaluation of habitat quality supported by each embayment considers the natural structure of each system and its ability to support that habitat before determining the threshold septic load.

Because septic effluent accounts for the majority of total loading to each watershed, septic system nitrogen loading is the primary focus of reduction efforts moving forward. The Round Cove watershed maintains an average septic load of 5.18 kg/day. A 63% reduction in total septic loading is required in the Round Cove watershed to meet threshold nitrogen loading and restore habitat in that sub-embayment. The Upper Muddy Creek watershed maintains an average septic load of 4.72 kg/day. A 45% reduction in total septic loading is required in the Upper Muddy Creek watershed to meet threshold nitrogen loading and restore habitat in that sub-embayment. The Lower Muddy Creek watershed maintains an average septic load of 8.60 kg/day. A 50% reduction in total septic loading is required in the Lower Muddy Creek watershed to meet threshold nitrogen loading and restore habitat in that sub-embayment.

The Pleasant Bay sub-embayment requires a 61% reduction in present septic load, therefore the watersheds contributing directly to the Pleasant Bay system should, at minimum, reduce septic nitrogen loading by 61%. Table 6-8 summarizes the septic loading concentrations and thresholds for Harwich sub-watersheds in Pleasant Bay. The individual reductions from each community contributing to a watershed will need to be coordinated on a sub-embayment by sub-embayment basis and as required by each community's long term planning needs.

Table 6-8
Attenuated Septic Loading in the Harwich Portion of the Pleasant Bay Watershed*
with Revised Muddy Creek Opening

Sub-Embayment	Present Septic Load (kg/day)	Threshold Septic Load With Enlarged Muddy Creek Opening (kg/day)	Septic Load Decrease (% change)
Round Cove	5.18	1.87	64%
Upper Muddy Creek	4.72	2.59	45%
Lower Muddy Creek	8.60	4.30	50%
Pleasant Bay	16.69	6.51	61%

*Loading information according to Table 2 of the October 5, 2010 MEP Technical Memo: MEP scenarios to evaluate water quality impacts of the addition of a 24-foot culvert in Muddy Creek inlet.

Values in RED indicate that the value is above the standard and must be reduced.

As shown in this section, the primary source of nitrogen in the Pleasant Bay system watershed is septic system effluent, which accounts for the highest percentage of total and controllable nitrogen loading. For this reason, this source is the primary focus of nitrogen reduction to meet the threshold values. Overall, 35.19 kg/day, or roughly 12,844 kg/year, total nitrogen is estimated to originate from septic systems within the above mentioned sub-embayments of the Pleasant Bay watershed, as shown in Table 6-9.

Table 6-9
Attenuated Septic Loading in the Pleasant Bay Watersheds (within the Town of Harwich Boundaries)

Present Septic Load (kg/day)	Threshold Septic Load With Enlarged Muddy Creek Culvert (kg/day)	Septic Load Decrease to Meet Threshold (% change)
35.19	15.27	57%

*Loading information according to Table 2 of the October 5, 2010 MEP Technical Memo: MEP scenarios to evaluate water quality impacts of the addition of a 24-foot culvert in Muddy Creek inlet.

Values in RED indicate that the value is above the standard and must be reduced.

The buildout performed by the MEP for the Pleasant Bay watershed is a straightforward buildout assessment that considers a buildout scenario for both residential and commercial parcels throughout the studied watershed. The buildout assessment is an attempt at estimating buildout in the watershed based on current zoning and any projected changes using local input.

Table 6-8A shows buildout average total nitrogen loads for Harwich sub-watersheds in the Pleasant Bay watershed and the percent change necessary to meet the threshold concentration in each sub-embayment.

Table 6-8A
Attenuated Buildout Septic Loading in the Harwich Portion of the Pleasant Bay Watershed*

Sub-Embayment	Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease to Meet Threshold (% change)
Round Cove	5.78	1.87	68%
Upper Muddy Creek	6.12	2.59	58%
Lower Muddy Creek	10.16	4.30	58%
Pleasant Bay	21.84	6.51	70%

*Loading information according to Table 2 of the October 5th ,2010 MEP Technical Memo : MEP scenarios to evaluate water quality impacts of the addition of a 24-foot culvert in Muddy Creek inlet.

Values in RED indicate that the value is above the standard and must be reduced.

Overall, 43.90 kg/day, or roughly 16,023 kg/year, total nitrogen is estimated to originate from septic systems at buildout within the Harwich sub-watersheds of Pleasant Bay. This is about a 25% increase over present loads. In order to meet threshold nitrogen loads, it is estimated that the buildout total septic load in the Pleasant Bay watersheds would need to be reduced by 65%, as shown in Table 6-9A. See Figure 6-21 for subwatershed boundaries in Harwich and the total buildout percent reduction required for each.

Table 6-9A
Attenuated Septic Buildout Loading in the Pleasant Bay Watersheds (within the Town of Harwich Boundaries)

Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease to Meet Threshold (% change)
43.90	15.27	65%

Values in RED indicate that the value is above the standard and must be reduced.

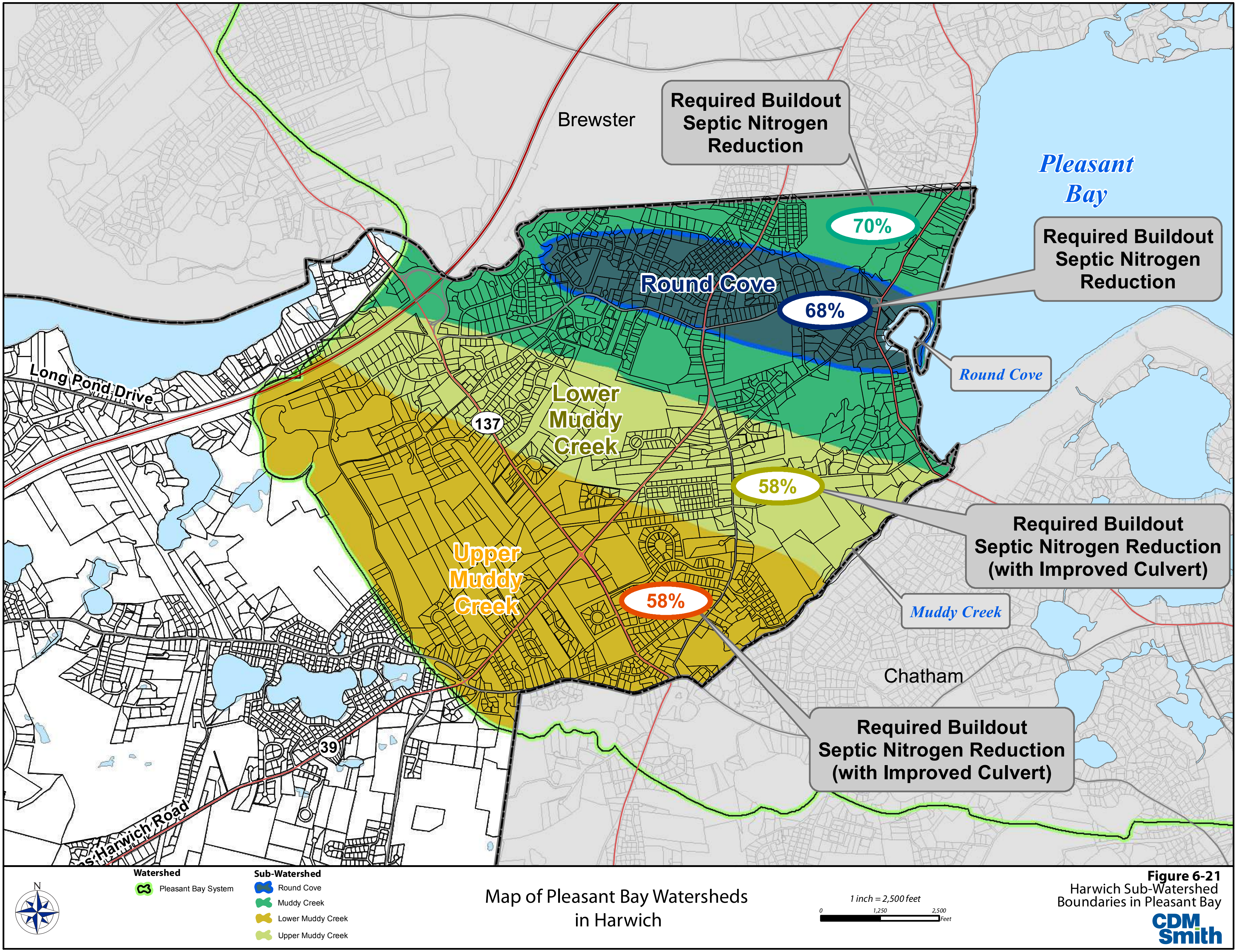

Figure 6-21
Harwich Sub-Watershed
Boundaries in Pleasant Bay

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6.3.5 Herring River Watershed Results

The final MEP report for the Herring River embayment, "Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Herring River Embayment System, Harwich, Massachusetts," was published in March 2013.

Physical Description

The Herring River Marsh / Embayment System is located within the Town of Harwich, however the watershed to the overall system extends into the Towns of Brewster and Dennis. The Herring River System is comprised of a main tidal channel and includes a west branch that extends up to a man-made freshwater reservoir and an east branch that extends up into a small brackish marsh.

The Herring River System is one of the largest functional wetlands on Cape Cod. This wetland is predominantly a freshwater marsh in the upper reaches and a salt marsh system in the lower reaches. Although most of the Herring River system is a tidal wetland system, the lower reaches closer to the inlet are considered to be a tidal river with limited wetland vegetation. Below the Route 28 bridge, the tidal channel is relatively wide and functions more like an open water basin than a marsh. Above Route 28, the channel narrows and then intersects with smaller tributary marsh creeks.

The differences in structure above and below the Route 28 bridge are significant. Historic eelgrass habitat and benthic animal communities of more open water basins exist in the lower tidal reach. However, minimal eelgrass is currently present in this area. Wetland dominated habitats exist in the upper system of salt marsh and tidal channels. This ecological difference results in a greater sensitivity to nitrogen in the lower tidal river portion than in the upper wetland dominated portions.

The Herring River System receives water from Nantucket Sound through a single tidal inlet. The inlet is relatively wide and navigable and functions more like an embayment rather than a marsh. Above Route 28, the channel narrows and quickly changes to a system that is dominated by salt marsh.

Overall, the Herring River Marsh/Embayment system is typical of a large New England tidal marsh system, with the lower regions composed of predominantly salt marsh dominated by a central tidal creek. The upper regions, furthest from the tidal inlet show the influence of the freshwater inflows from the surrounding watershed. Tidal exchange with Nantucket Sound is high with near complete drainage of tidal creeks in the upper most portions of the system at low tide. Observations by the USGS and the MEP indicate that the Herring River is a healthy functioning New England tidal wetland system north of the Route 28 bridge. The Herring River Marsh provides both wildlife habitat and a nursery to offshore fisheries, as well as serving as a storm buffer and nutrient sink for watershed derived nitrogen.

The primary ecological threat to the Herring River system is degradation from nutrient enrichment. This is particularly true within the lower tidal river reach. Nitrogen loading is primarily from on-site disposal of wastewater or disposal of treated effluent from municipal treatment facilities. Most areas of the Herring River watershed rely almost entirely on privately maintained on-site septic treatment and disposal of wastewater. As existing and likely increasing levels of nutrients impact the coastal embayments of the Town of Harwich, water quality degradation is expected to increase.

Land Use and Nitrogen Loading

Land use in the Herring River watershed is primarily (56%) residential of which 66% are single family homes. High residential use, coupled with the fact that Harwich has experienced significant population growth since 1950, has resulted in moderate nitrogen loading in the watershed due to watershed inputs, and primarily due to nitrogen from septic system discharge. Figure 6-22 shows the Herring River system.

Natural deposition of atmospheric nitrogen on water bodies and natural land surfaces accounts for 18% of the total loading within the Herring River system. Controllable sources, such as wastewater from septic systems and residential and commercial fertilizer applications, account for approximately 63% of the total nitrogen loading. Because septic system effluent accounts for such a large percent of nitrogen inputs, 68% of controllable nitrogen sources, reducing this source is a priority for improving overall estuary habitat. Figure 6-23 shows total nitrogen loading for the Herring River watershed, including natural deposition, and Figure 6-24 shows the percent of controllable nitrogen loading sources within the watershed.

Water Quality Indicators

High quality habitat in open water basins supports different communities than high quality habitat in tidal wetlands. These important differences are described in the MEP assessment of the wetland dominated upper region and open water dominated tidal river comprising the lower region of the Herring River system. This difference in structure above and below the Route 28 bridge created historic eelgrass habitat and benthic animal communities of more open water basins in the lower tidal reach and wetland dominated habitats in the upper wetland basin. Based upon the available information, tidal creeks of the upper reach do not appear to be able to support eelgrass habitat. The lower estuarine reach below Route 28 is structured to support eelgrass habitat.

The MEP report identified the Herring River system as one that can support high quality habitat. It is not presently impaired by their naturally high levels of nitrogen and organic matter enrichment. The open water basin of the tidal river is presently supporting high quality benthic animals which is consistent with its level of dissolved oxygen, organic matter, nutrient enrichment and flushing. This open water basin does, however, appear to be at or slightly below its threshold level of enrichment relative to benthic animal habitat in its upper most reaches. Any additional nutrient inputs are expected to further degrade ecological health.

Since the results of the infauna survey do not indicate clear impairment of benthic habitat within the Herring River system, the MEP recommends a nitrogen management analysis that focuses primarily on the recent losses of eelgrass habitat from the lower estuary's tidal river basin. The loss of eelgrass is the result of its sensitivity to nutrient loads. The upper wetland basin appears to be well below its nitrogen loading threshold level. Since infaunal habitat is less sensitive to the effects of nitrogen enrichment than eelgrass, protecting the more sensitive eelgrass habitat will, by default, enhance infaunal habitat within the tidal river portion of the estuary. Determining the nitrogen target to restore eelgrass habitat is therefore the focus of the nitrogen management threshold standards presented below.

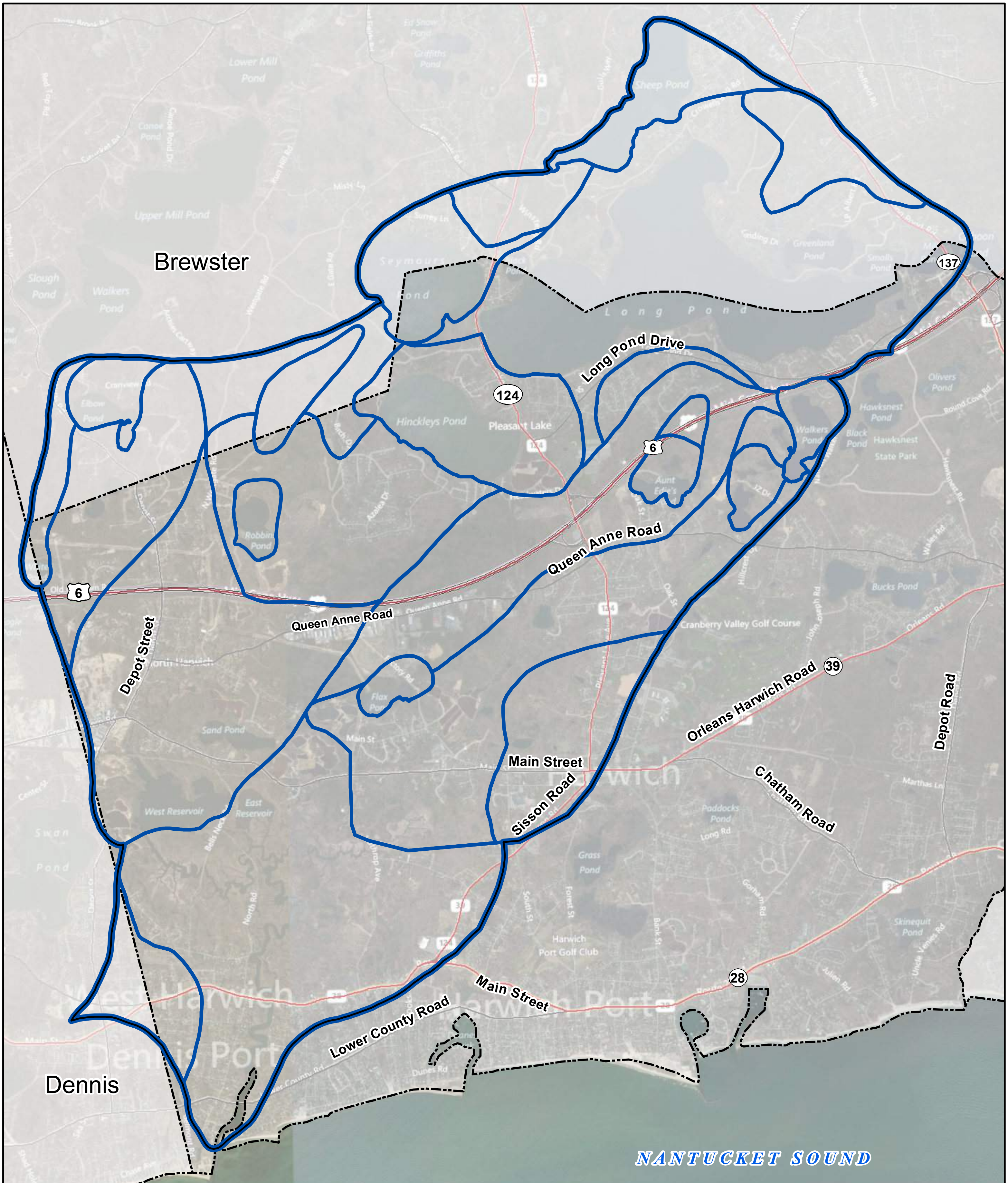

Figure 6-22
Herring River System

N

Watershed

Herring River

Herring River Subsheds

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 3,500 feet

0 1,750 3,500 Feet

CDM Smith

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Figure 6-23
Total Nitrogen Loading in the Herring River Watershed, Including Natural Deposition

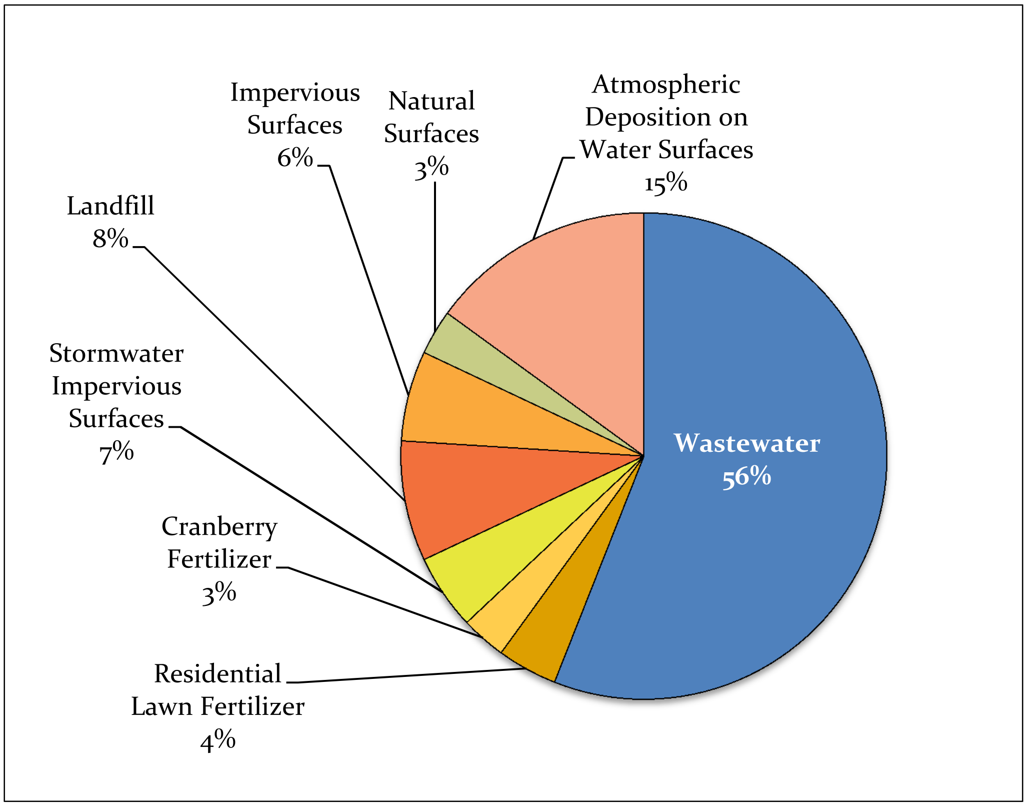
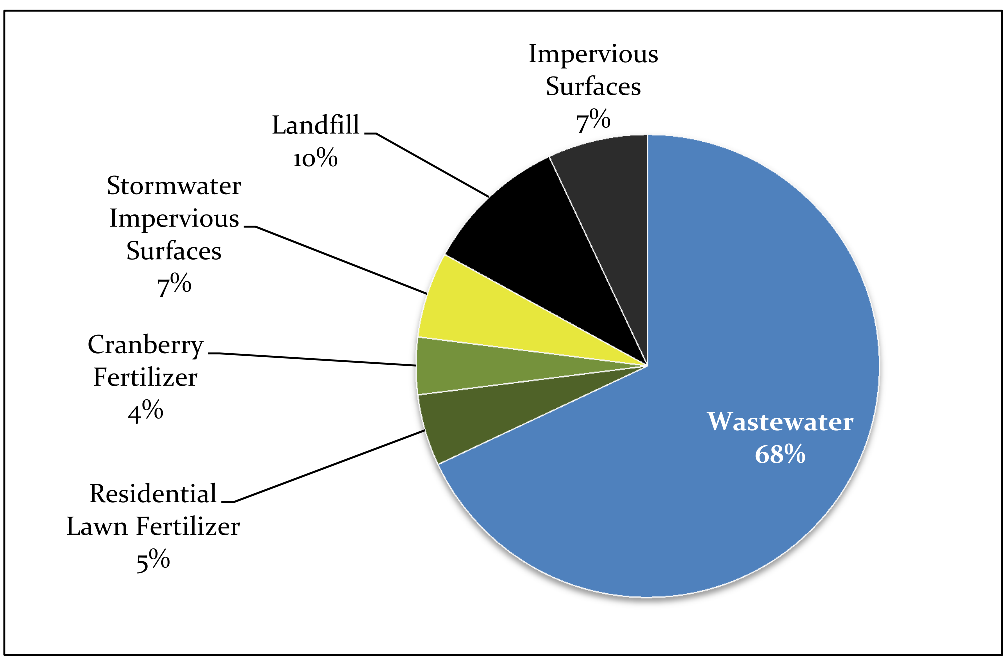


Figure 6-24
Total Controllable Nitrogen Loading in the Herring River Watershed



Monitoring Stations and Thresholds

In Herring River, one sentinel station identified as HAR-7 is located at the Route 28 Bridge (the upper most limit of the historic eelgrass within the system) as shown in Figure 6-25. This location is positioned such that meeting the target criterion in this location will signify improved water quality throughout the tidal area sufficient to restore eelgrass within the tidal portion of the estuary.

The threshold nitrogen concentration for the Herring River sentinel station HAR-7 is 0.479 mg/L. The MEP concluded that an upper limit of 0.479 mg/l of nitrogen would support both eelgrass and healthy infaunal habitat in the Herring River system. The concentrations at the monitoring stations may be slightly different than the upper limit, but they are chosen so that the upper limit of 0.48 mg/l of nitrogen (tidally averaged) is achieved throughout the system. This is summarized in Table 6-10 below.

Table 6-10
Sentinel Monitoring Station with Associated Nitrogen Limit for the Herring River system

Embayment	Monitoring Station	Present total N Concentration* (mg/l)	Threshold average total N Concentration* (mg/l)	% Change
Herring River	HAR-7	0.567	0.479	-15.5%

*Present and threshold average total N values according to Table VIII-5 of the March 2013 MEP Report for the Herring River Embayment System

Values in RED indicate that the value is above the standard and must be reduced.

Determination of site-specific nitrogen thresholds for an embayment requires integration of key habitat parameters (infauna and eelgrass), sediment characteristics, and nutrient related water quality information. Nitrogen threshold development builds on these data and links habitat quality to summer water column nitrogen levels. To determine the total loading several factors must be considered including septic system effluent flow into the watershed, natural attenuation throughout the watershed, wastewater treatment facilities recharge (if any exist), estuary flushing, stormwater sources, fertilizers applied throughout the watershed, and finally the threshold concentrations presented in the table above. The MEP evaluation of habitat quality supported by the Herring River system considers the natural structure of each system and its ability to support that habitat before determining the threshold septic load.

The primary source of nitrogen in the Herring River watershed is septic system effluent, which accounts for a majority of total and controllable nitrogen loading. For this reason, this source is the primary focus of nitrogen reduction to meet the threshold values. Overall, 38.592 kg/day, or roughly 14,086 kg/year, of attenuated nitrogen is estimated to originate from septic systems within the watershed. In order to meet threshold nitrogen loads, it is estimated that the current total septic load in the Herring River watershed would need to be reduced by 38 percent, as shown in Table 6-11.

Watershed

Herring River

Water Quality Monitoring Stations

Sentinel Station

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 1,000 feet

0 500 1,000 Feet

Figure 6-25
Herring River
Monitoring Stations

CDM Smith

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Table 6-11
Attenuated Septic Loading in the Herring River Watershed*

Sub – Embayment	Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
Lower Herring River	7.063	7.063	0.00%
East Reservoir	0.047	0.047	0.00%
Upper Herring River	10.468	0.0	100%
West Reservoir	12.137	12.137	0.00%
Lothrop Road	8.877	4.504	49.3%
Total	**38.592**	**23.751**	**38.4%**

*Loading information according to Table VIII-2 of the March 2013 MEP Report for the Herring River Embayment System.

Values in RED indicate that the value is above the standard and must be reduced.

The threshold septic loading for the Herring River system is the sum of five threshold loads developed in the MEP report for the Lower Herring River, East Reservoir, Upper Herring River, West Reservoir and Lothrop Road sub-embayments. Together these five thresholds combine to give a total threshold septic load for the watershed. To meet the requirements of check and sentinel stations, the system will require at least 38.4% of the attenuated present septic load to be reduced.

As noted previously, the buildout assessment performed by the MEP is a straightforward buildout assessment that considers a buildout scenario for both residential and commercial parcels throughout the studied watershed. The buildout assessment is an attempt at estimating buildout in a watershed based on current zoning and any projected changes using local input. The estimates developed for the model allows modelers to run a “what if” scenario that considers nitrogen loading associated with future development.

In the buildout projection, septic system loading also accounts for most of the controllable nitrogen in the watershed. Thus, septic nitrogen is the primary source which is recommended to be targeted for total reduction within the contributing watershed. Overall, 56.59 kg/day, or roughly 20,655 kg/yr, total attenuated nitrogen was estimated to originate from septic systems within the watershed. This is about a 46.6% *increase* over present loads. In order to meet threshold total nitrogen loads, it is estimated that the buildout septic load in the Herring River system watershed would need to be reduced by 58.0 %, as summarized in Table 6-11A below, to meet the MEP established threshold.

Table 6-11A
Buildout Attenuated Septic Loading in the Herring River System

Sub – Embayment	Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load Decrease (% change)
Lower Herring River	7.781	7.063	9.23%
East Reservoir	0.0048	0.0047	2.08%
Upper Herring River	13.945	0.0	100%
West Reservoir	23.592	12.137	48.55%
Lothrop Road	11.229	4.504	59.89%
Total	**56.59**	**23.751**	**58.03%**

*Loading information according to Table VIII-2 and the MEP Loading Spreadsheets (AKA Rainbow Tables) of the March 2013 MEP Report for the Herring River Embayment System

Values in RED indicate that the value is above the standard and must be reduced.

Each community's contribution to the Herring River system is summarized below in Table 6-12. This table presents the *unattenuated* buildout nitrogen contribution from each community and the percentage of the total unattenuated load to the system.

Table 6-12
Unattenuated Buildout Septic Loading in the Herring River System by Community

Town	Unattenuated Present Septic Load (kg/day)	Unattenuated Buildout Septic Load (kg/day)	Buildout % of Total Nitrogen Load
Harwich	58.5	77.5	82.8%
Dennis	1.8	2.4	2.5%
Brewster	9.1	13.7	14.7%

*Loading information according to the MEP Loading Spreadsheets (AKA Rainbow Tables) of the March 2013 MEP Report for the Herring River Embayment System

6.4 Summary

This section summarizes the findings of the MEP investigation of the five embayments within the Town of Harwich. Conclusions from these investigations were used to develop this CWMP/SEIR, including septic nitrogen loading, and reduction percentages of septic nitrogen loading required to meet established thresholds in the MEP reports. These thresholds have been reviewed by MassDEP and have been used as the basis for TMDLs for each of the Harwich watersheds.

Allen Harbor

Controllable sources of nitrogen in Allen Harbor include septic system discharge and residential and commercial fertilizer applications which account for approximately 89% of total nitrogen loading in the watershed. Using the MEP buildout assumptions, 6.71 kg/day, or roughly 2,449 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. Total buildout septic loading in Allen Harbor must be reduced by 78% in order to restore ecological conditions in the harbor and meet the MEP established threshold.

Wychmere Harbor

Controllable sources of nitrogen in Wychmere Harbor include septic system discharge and residential and commercial fertilizer applications (including to cranberry bogs) which account for approximately 90% of total nitrogen loading in the watershed. Using the MEP buildout assumptions 3.30 kg/day, or roughly 1,206 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. Total septic loading in Wychmere Harbor must be reduced by 100% under both existing and buildout scenarios in order to restore ecological conditions in the Harbor and meet the MEP established threshold.

Saquatucket Harbor

Controllable sources of nitrogen in Saquatucket Harbor include septic system discharge and residential and commercial fertilizer applications (including to cranberry bogs) which account for approximately 88% of total nitrogen loading in the watershed. Using the MEP buildout assumptions, 12.51 kg/day, or roughly 4,566 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. Total buildout septic loading in the Saquatucket Harbor must be reduced by 58% in order to restore ecological conditions in the harbor and meet the MEP established threshold.

Pleasant Bay

The Pleasant Bay system was modeled with the understanding that the current inlet to the Muddy Creek would be expanded to increase flushing by utilizing a larger, 24-foot opening. The modeling that was performed for the Pleasant Bay system showed that replacing the existing inlet to Muddy Creek with a 24-foot opening has little effect on the nitrogen levels throughout the Pleasant Bay system, but the wider opening results in a 20% drop in the difference between the existing conditions modeled nitrogen concentration and the threshold concentration at the Lower Muddy Creek check station. Additional nitrogen reductions are still required in the Muddy Creek watershed to meet the threshold concentration in Lower Muddy Creek, but the magnitude is reduced through the installation of the wider opening.

Controllable sources of nitrogen in the Pleasant Bay watershed include septic discharge and residential and commercial fertilizer applications which account for approximately 51% of total nitrogen loading in the watershed. For the subwatersheds within the Harwich town boundaries, 43.90 kg/day, or roughly 16,023 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed using buildout assumptions. Septic loading in the Pleasant Bay subwatersheds in Harwich must be reduced by 65% at buildout in order to meet the MEP established threshold.

Since the Pleasant Bay system is so complex and is shared by several towns, each individual community will need to develop a mutually beneficial plan aimed at reducing excess nutrients in the subwatersheds that fall within its boundaries. From a management perspective, each community will want to understand its individual contribution to these subwatersheds and develop a plan that will address their contribution to meet the established thresholds. Communities should be encouraged to develop regional solutions so that nitrogen reduction may be done in the most economical manner.

Herring River

Controllable sources of nitrogen in the Herring River watershed system include septic discharge and residential and commercial fertilizer applications which account for approximately 63% of total nitrogen loading in the watershed. Using the MEP buildout assumptions, 56.59 kg/day, or roughly 20,655 kg/yr, total nitrogen was estimated to originate from septic systems within the watershed. Since infaunal habitat is less sensitive to the effects of nitrogen enrichment than eelgrass, a reduction in the level of nitrogen to restore eelgrass is the main focus of the threshold in this system. Total buildout septic loading in Herring River watershed must be reduced by 58.0% in order to restore ecological conditions in the estuary and meet the MEP established threshold.

Overall Septic Load Reductions Required to Meet TMDLs

Table 6-13 provides a summary of the results for the MEP watersheds in Harwich and the percent wastewater nitrogen reduction that will be targeted in the development of wastewater management scenarios in later sections of this report. Table 6-13A provides a summary of the percent wastewater nitrogen reduction using the buildout assumptions developed by the MEP. These values are all based on meeting existing (highest and best use) water quality standards.

Table 6-13
Decrease in Present Attenuated Septic Loading Required to Meet Established TMDL Thresholds

MEP Watershed	Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Septic Load Decrease to Meet Threshold (% change)	Shared Communities
Allen Harbor	5.64	1.483	74%	None
Wychmere Harbor	3.208	0.00	100%	None
Saquatucket Harbor	13.246	5.280	60%	None
Pleasant Bay (Round Cove)	5.18	1.87	64%	Brewster, Chatham, Orleans
Pleasant Bay (Muddy Creek)*	13.32	6.89	48%	
Pleasant Bay	16.69	6.51	61%	
Herring River	38.592	23.751	38%	Dennis, Brewster

*Loading information according to Table 2 of the October 5, 2010 MEP Technical Memo: MEP scenarios to evaluate water quality impacts of the addition of a 24-foot culvert in Muddy Creek inlet.

Values in RED indicate that the value is above the standard and must be reduced.

Table 6-13A
Decrease in Buildout Attenuated Septic Loading Required to Meet Established TMDL Thresholds

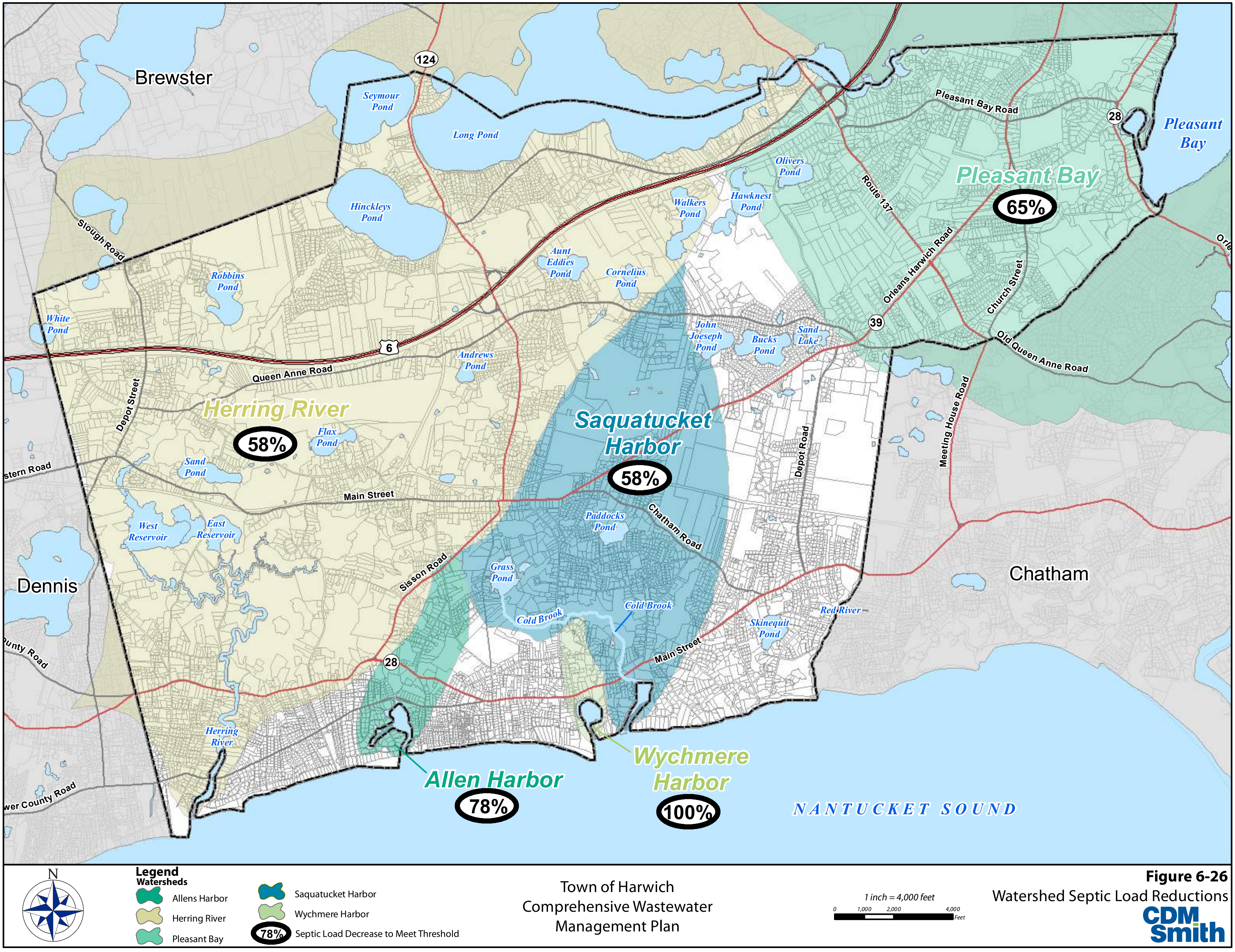
MEP Watershed	Buildout Septic Load (kg/day)	Threshold Septic Load (kg/day)	Septic Load Decrease to Meet Threshold (% change)	Shared Communities
Allen Harbor	6.71	1.483	78%	None
Wychmere Harbor	3.30	0.00	100%	None
Saquatucket Harbor*	12.51	5.28	58%	None
Pleasant Bay (Round Cove)	5.78	1.87	68%	Brewster, Chatham, Orleans
Pleasant Bay (Muddy Creek)*	16.28	6.89	58%	
Pleasant Bay	21.84	6.51	70%	
Herring River	56.59	23.751	58%	Dennis, Brewster

*Saquatucket Harbor and Muddy Creek Loads Include Enhanced Attenuation and / or Enhanced Tidal Flushing

Values in RED indicate that the value is above the standard and must be reduced.

See Figure 6-26 for the total buildout percent reduction required for each MEP watershed in Harwich.

Since the Pleasant Bay and the Herring River embayment systems are shared by several towns, each individual community will need to develop a mutually beneficial plan aimed at reducing excess nutrients in the subwatersheds that fall within its boundaries. From a management perspective, each community will want to understand its individual contribution to each subwatershed and develop a plan that will address their contribution and ultimately meet the established thresholds. Regional solutions are encouraged.



Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 6-26
Watershed Septic Load Reductions

CDM Smith

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Section 7

Estimated Wastewater Flows

7.1 Purpose

The purpose of this section is to develop wastewater flow projections for the entire town, including areas that are inside and outside of the Massachusetts Estuaries Project (MEP) watersheds, to be used in the development of a recommended wastewater management program. A comparison of public water supply well pumping records, town billing records, and MEP water consumption estimates will be presented. Since the MEP dataset is being used to develop the nitrogen loads for the sensitive watersheds throughout town, it is most appropriate to use that dataset whenever possible. However, the MEP dataset is only available for the five nitrogen sensitive watersheds and does not cover the entire town. The most appropriate wastewater solution will likely incorporate wastewater service areas that fall inside and outside of the MEP watersheds. The comparisons performed in this section will show that the MEP data can be used for areas inside the MEP watersheds, while the other sources of town-wide data can be used as a supplement in the areas outside of the MEP watersheds.

Using the available data, this section also presents a methodology for converting water usage to wastewater flow, estimates of seasonal flow variations, and a maximum month flow peaking factor. The estimates developed and presented in this section are intended to aid in the conceptual design and costing of Harwich wastewater treatment facilities.

7.2 Data Used

All data used for water and wastewater flow estimates including the data used in the MEP reports originates from the Town of Harwich Water Department. The Town provided annual drinking water supply well pumping records and water department billing records from 2004 to 2007, including water use data by parcel for the entire town. Specifically, the following datasets were used in the analyses which follow:

1. Well Pumping Records

Well pumping records were obtained for 2001 to 2007 from the Water Department's annual drinking water supply well pumping reports. These pumping reports give a monthly summary of the pumping history of the 14 public water supply wells located throughout the town.

2. Town Billing Records

Billing records were obtained from the Town's billing software and represent water consumption from 2004 to 2007 as calculated by that program. This information originates from individual water meter readings at all properties connected to the public water supply. The Town is currently in the process of installing an automatic meter reading system. However, previous annual readings are based on two manual reads per year.

3. MEP Dataset

The MEP dataset was obtained for this analysis and is applicable only to the Allen, Wychmere, Saquatucket, Pleasant Bay and Herring River watersheds. To develop the MEP dataset, the Town submitted water use records from the billing system from 2004 to 2007 to SMAST. Then, SMAST supplemented the Town's data with water use assumptions for parcels that were served by private wells. SMAST used this data in the Linked Watershed Embayment Models for eventual development into nitrogen reduction needs for each watershed. As the models were developed, SMAST returned each database to the Town.

Since the MEP dataset will be utilized to develop TMDL limits for the Town's embayments, that data should be used whenever possible to establish water use and wastewater flow estimates, to ensure consistency. In the areas outside of the MEP watersheds, the Town's billing records will be utilized.

7.2.1 Well Pumping Records

The Town's pumping records indicate that the Town pumped between 679 and 760 million gallons per year between 2001 and 2007. Figure 7-1 shows the average annual totals for monthly pumpage during that timeframe.

Figure 7-1
Average Annual Totals for Monthly Pumpage from the Harwich Municipal Water System between 2001 and 2007

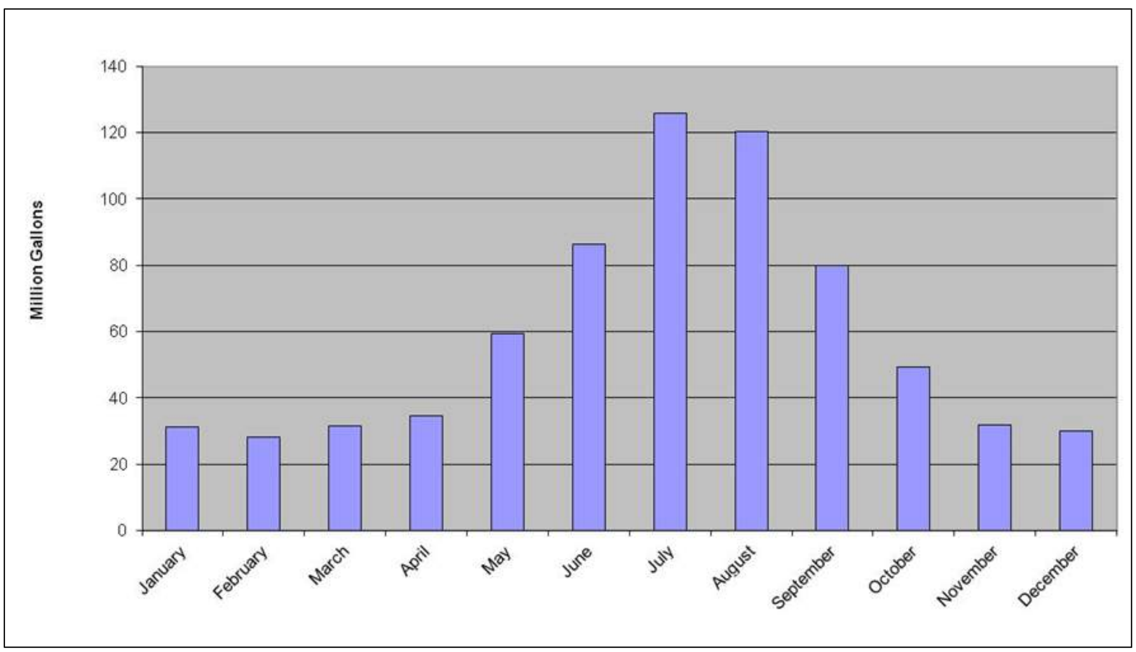

Figure 7-1 shows an expected trend indicating that the most water is used in the months of July and August. This trend is typical of water use patterns found on Cape Cod, due to seasonal population increases, and throughout the northeast due to outdoor water usage in the summer months.

7.2.2 Town Billing Records

The Town's billing records were tabulated to determine the number of residential and commercial parcels throughout the town and the average water use of the entire town, using a 2004 to 2007 dataset. From this data, the parcels with water use have an average of 75,100 gallons/year/parcel. The Town's GIS indicates there are 8,567 parcels with water use in the entire town, which is 88 percent of the 9,783 accounts reported in the 2007 Harwich Water Department Quality Report. Some of this discrepancy can be explained by single parcels containing multiple water meters/accounts. Table 7-1 summarizes the breakdown of water usage by land use type according to the GIS data. Town-wide water use records from this dataset indicate an average residential water use of 68,000 gallons/year/parcel and an average commercial water use of 280,600 gallons/year/parcel.

Table 7-1
Town of Harwich GIS Water Use Records (2004-2007)

Land Use	Number of Parcels*	Number of Parcels With Water Use	Average Annual Water Use (GPD)	Average Water Use (GPY/Parcel)	Average Water Use (GPD/Parcel)
Town-wide	11,583	8,567	1,761,600	75,100	206
Residential	9,914	8,212	1,528,800	68,000	186
Commercial	286	208	159,900	280,600	768
Other Uses (industrial, agricultural, municipal, etc)	1,383	147	72,900	181,000	495

*Includes undeveloped parcels and parcels with private wells

According to the 2007 Harwich Water Quality Report, the average water use in the Town is estimated to be 72,500 gallons per year per account as compared to 75,100 shown above.

7.2.3 MEP Dataset

Both the Town of Harwich billing records and MEP datasets include average water use from 2004 to 2007 for each parcel in each MEP watershed. The water use data from the MEP is similar to town billing data, as expected, because it was developed directly from the billing data. There are differences in the two datasets, however, because the MEP performed additional work on the Town's billing record dataset. As an example, the MEP data makes assumptions about properties served by private wells that are not considered in the Town's database. The MEP also makes assumptions concerning water use from private wells on lots that the Town records show as vacant. Finally, the MEP dataset includes an ultimate buildout estimate that is not a part of the Town's database. Table 7-2 presents the water use data for the five MEP watersheds in Harwich. The average water use in the Allen, Wychmere, Saquatucket, Herring River and Pleasant Bay watersheds is 59,300 gallons per year per parcel.

Table 7-2
Water Use Data for Five MEP Watersheds

Land Use	Number of Parcels	Average Annual Water Use (GPD)	Average Water Use (GPY/Parcel)	Average Water Use (GPD/Parcel)
5 MEP Watersheds	8,098	1,315,700	59,300	162
Residential	6,772	1,125,100	60,600	166
Commercial	292	121,700	152,100	417
Other	1,034	68,800	24,300	67

The MEP dataset estimates that residential water consumption is 86% of the total water consumption in the Allen, Wychmere, Saquatucket, Pleasant Bay and Herring River watersheds. Commercial water consumption is estimated at 9% of the total flow as shown in Table 7-3.

Table 7-3
Percentage of Water Use Consumption

Use	Number of Parcels	% of Total Flow
Residential	6,772	86%
Commercial	292	9%
Other	1,034	5%

7.3 Town Billing Records Compared to MEP Data

Table 7-4 presents the Town of Harwich average water use from 2004 to 2007 by watershed and parcel and the MEP average water use from 2004 to 2007 by watershed.

Table 7-4
Town of Harwich Billing Records Compared to MEP data by Watershed (2004-2007)

Watershed	Total Number of Parcels	Town Billing Records		MEP Dataset	
		Average Annual Water Use (GPD)	Average Water Use (GPD/Parcel)	Average Annual Water Use (GPD)	Average Water Use (GPD/Parcel)
Allen Harbor	358	77,832	217	69,836	195
Wychmere Harbor	123	24,117	196	23,601	192
Saquatucket	1,442	251,361	174	253,176	176
Pleasant Bay	1,932	316,351	164	296,611	154
Herring River	4,243	579,898	137	661,518	156

Overall, the datasets are very similar. For example, the Town billing records indicate an average water use of 164 gallons/parcel/day in the Pleasant Bay watershed and the MEP data shows an average residential water use of 154 gallons/parcel/day. The biggest discrepancy is in the Allen Harbor watershed, with an average water use of 217 gallons/parcel/day and the MEP water use showing an average residential consumption of 195 gallons/parcel/day. Overall, the discrepancies are minor and, as a result, both datasets are considered to be similar and appropriate for use in wastewater planning.

7.4 MEP Watershed Buildout Water Use Estimates

The MEP developed a database that was used in the Linked Watershed Embayment Models to determine the nitrogen loads from water use throughout each watershed. In the database, both current and buildout nitrogen loads are presented for each of the MEP watersheds.

The current loads are developed from actual water use that utilizes an assumed nitrogen concentration per gallon of water used. To develop the buildout loads, the modelers looked at both the water use for both residential and commercial properties in the watersheds. For the residential properties, a maximum number of homes, or dwelling units, were assigned to each property based on the current zoning regulations for that property. As an example, an existing two acre lot with a single family home would be assigned two single family homes or dwelling units in the buildout analysis if it was located in an area with one-acre zoning, since it was assumed to be possible to construct two homes on this property. Commercial properties were treated differently. A commercial property's buildout water use was developed based on the gallons of water used per square foot of building area. This flow per area for the commercial development was taken from existing flow patterns established within each particular watershed which can vary widely from watershed to watershed. The results of the buildout wastewater flow estimates are shown below in Table 7-5. The wastewater flow is estimated to be 90% of water use to account for irrigation, evaporation and other losses.

Table 7-5
Existing and Buildout Wastewater Estimates

Watershed	Existing Wastewater Flow (GPD)*	Buildout Wastewater Flow (GPD)	% Flow Increase
Allen Harbor	62,900	75,000	19
Wychmere Harbor	21,200	28,100	32
Saquatucket	227,900	261,200	14
Pleasant Bay	267,000	346,900	30
Herring River	595,400	786,700	32
All MEP Watersheds	1,174,300	1,497,900	28

*Existing wastewater flow is estimated to be 90% of existing water use.

Overall the flow increase percentage for the MEP watersheds ranges from 19 to 32 percent with an average increase of 28 percent. These increases are similar to the expected increase in wastewater flow in the final recommended plan which is twenty six percent.

7.4.1 Development of Residential Buildout Flows

The development of residential water use in the five MEP watersheds followed a simple formula based on the lot size and the maximum number of allowed single-family dwelling units per acre. This formula was used to establish a total number of dwelling units that a property could sustain based on zoning regulations.

To develop the water use per dwelling unit, existing residential water use was tabulated for the five MEP watersheds. The large amount of residential development throughout the Town of Harwich yielded a consistent data set among the five MEP watersheds that showed residential development between 148 and 181 gpd per dwelling unit (average of 165 gpd). This equates to approximately 2.5 people per dwelling unit at 65.8 gallons per person. Table 7-6 presents the estimated water use per capita in the five MEP watersheds.

Table 7-6
Residential MEP Water Use Estimates

Watershed	Per Dwelling Unit Residential Water Use (GPD)	Per Capita Residential Water Use (gallons per person)
Allen Harbor	166	66.4
Wychmere Harbor	166	66.4
Saquatucket	166	66.4
Pleasant Bay	148	59.2
Herring River	181	72.4

The water use presented above is in line with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs and the Water Resources Commission July 2006 publication of Water Conservation Standards. The publication states that 33% of Massachusetts communities are between 65 and 80 rgpcd (residential gallons per capita per day). Of the communities sampled, 23% are above 80 rgpcd and 44% are below 65 rgpcd.

The residential water use presented in Table 7-6 was applied to the number of dwelling units developed in the buildout analysis. This method was reviewed by the Town of Harwich Planning Department and is considered an acceptable method for estimating residential buildout water use.

7.4.2 Development of Commercial and Industrial Buildout Flows

The development of commercial and industrial buildout water use in Harwich utilized a formula based on the lot size and a percentage of building coverage on each lot. The commercial and industrial water use was developed from existing development which, when compared to the residential development, is a limited data set and is subject to greater variation.

The analysis considered the existing commercial water use and developed a flow per square foot of building for each of the five MEP watersheds. Table 7-7 presents the water use rate for commercial and industrial development.

Table 7-7
Commercial and Industrial MEP Water Use Estimates

Watershed	Commercial Water Use Per 1,000 square Feet of Building (GPD)	Commercial Building Coverage At Buildout	Industrial Water Use Per 1,000 square Feet of Building (GPD)	Industrial Building Coverage At Buildout
Allen Harbor	236	13.2%	78	14.5%
Wychmere Harbor	236	13.2%	78	14.5%
Saquatucket	236	13.2%	78	14.5%
Pleasant Bay	35	12.0%	35	12.0%
Herring River	236	13.2%	78	14.5%

At buildout, the MEP assumed that the commercial and industrial development in town would have a building coverage of 12.0% to 14.5% of the entire lot as presented in Table 7-7. This assumed building coverage is based on both zoning setbacks and typical commercial development allowing for parking and egress and entry to the building. To arrive at a buildout water use, the undeveloped and underdeveloped lots are brought to their full development potential using the stated building coverages and water use estimates.

Unlike the residential water use estimates developed in Table 7-6, the commercial and industrial water use presented above varies significantly among the watersheds. The commercial and industrial water use developed in these estimates is dependent on the existing development of only a few hundred commercial and industrial parcels in Harwich. As a result, the estimates in the Pleasant Bay watershed are very different than all of the other MEP watersheds.

The Harwich Planning Department recognized this inconsistency early on in the CWMP planning process and decided to modify the MEP commercial buildout estimates in the recommended plan. The Planning Department utilized the MEP buildout as a starting point and then updated, for planning purposes, the commercial development to suit the Town's needs. Those updates are presented Section 13 with the recommended plan for wastewater management and are utilized only for planning purposes.

7.4.3 Town-Wide Buildout Flows

Since the MEP buildout analysis only covers those areas of town within the five MEP watersheds, the Town supplemented this dataset with additional buildout flow estimates for the remainder of town. Ultimately, the buildout estimates from the MEP for areas within the applicable watersheds will be used for wastewater planning for consistency with the MEP models. In certain instances, however the Town's Planning Department modified and updated the MEP buildout estimates based on anticipated growth that was not accounted for in the MEP reports. Supplemental information for the remainder of town must then be added to the MEP dataset. The areas for which it is most critical to define buildout flows are those identified as having a high wastewater need, as presented in Section 8. These flows, with buildout updates, are presented in Section 13 with regards to the recommended program for long-term wastewater management.

7.5 Adjustments for Wastewater Flow

This subsection presents adjustments to water usage values to account for flow that does not ultimately become wastewater. Specifically, a rainfall adjustment is calculated to account for irrigation in the months of July and August, and a further adjustment is then performed to account for other factors such as consumptive uses and outdoor uses aside from July/August irrigation. These estimates are developed to aid in the design of wastewater collection and treatment infrastructure during the implementation phase of this CWMP.

7.5.1 Rainfall and Irrigation Adjustment

Irrigation flow in Harwich is important to consider in the months of July and August. These two months of the summer see a significant amount of lawn and garden watering which does not enter the wastewater stream. This flow must therefore be omitted from wastewater estimates to avoid over-sizing wastewater infrastructure.

In the summer months, rainfall can have a significant effect on the amount of water used for irrigation. Three methods of estimating summer irrigation use were analyzed to determine an appropriate seasonal adjustment for water use. Each method is described below.

Irrigation Adjustment – Method 1

The first method calculates the irrigation flows for the months of July and August from public water supply well pumping data from 2001 to 2007. These data were tabulated and then compared against the rainfall data for the two-month periods. The results are shown in Table 7-8 below.

Table 7-8
Rainfall Adjustment – Method 1

Year	July – Aug. Water Use (gpd)	Rainfall (inches)
2001 (Rounded)	3,590,000	6.22 (Wet Year)
2002 (Rounded)	4,710,000	3.69
2003 (Rounded)	3,770,000	6.07 (Wet Year)
2004 (Rounded)	3,660,000	7.53 (Wet Year)
2005 (Rounded)	4,490,000	4.48
2006 (Rounded)	3,790,000	8.87 (Wet Year)
2007 (Rounded)	4,270,000	3.43
Average	4,040,000	5.76
Average Wet	3,702,500	7.17
Average Dry	4,490,000	3.87
Variance	787,500	-3.31

To quantify the amount of water used for irrigation, the average daily water use in July and August of 2001 to 2007 was considered along with the average rainfall of 5.76 inches for that two-month period. Any year that had less than 5.76 inches of rain in that period was considered dry and any year that had greater than 5.76 inches of rain in that period was considered wet. The averages of the wet years and the dry years were then compared, and the variance was calculated by subtracting the wet year average from the dry year average. The result is an increase of about 790,000 gallons per day of water use during dry summers when compared to wet summers.

Irrigation Adjustment – Method 2

The second method utilizes a simple estimate of the number of residential properties, an estimated lawn area (square footage) and an estimated irrigation rate (0.5 in/week) for the July and August irrigation period in dry years. To account for the summer water use, this method assumes that one third of the residential properties in Harwich utilize an irrigation system. There are approximately 8,500 residential properties in Harwich with an estimated lawn area of 5,000 square feet each. Using this method, it is estimated that the Town supplies 630,000 gallons per day of irrigation water use during the dry months. The result is shown in Table 7-9 below.

Table 7-9
Rainfall Adjustment – Method 2

Irrigation Estimate		
Residential Properties With Irrigation Systems	2,830	Homes
Average Lawn Area	5,000	Square Feet
Total Area	14,150,000	Square Feet
Estimated Irrigation	0.5	Inches / Week
GPD	630,000	GPD

Irrigation Adjustment – Method 3

The third method compares the amount of water that the Town pumped between the wettest and driest two-month period between 2001 and 2007. For the wettest two months, July and August of 2006 are used. 2006 was a very wet year that received 8.87 inches of rainfall in the July to August time period. Since the average weekly rainfall for this two-month period was one inch of rain per week, it is assumed that lawn sprinklers were used minimally during that time. For the driest two months, the July and August of 2007 are used. 2007 was a very dry year that received 3.43 inches of rainfall for the two-month period. Since the average weekly rainfall for this two-month period was 0.4 inches of rain per week, it is assumed that lawn sprinklers were used frequently to supplement the lack of rain. Since a typical New England lawn is estimated to require one inch of water per week, it is assumed that minimal watering took place in 2006, and significant irrigation was used in 2007 to supplement the additional 0.6 inches per week that was not seen. The difference in the July and August water use from 2006 to 2007 is 480,000 gallons per day. The result is shown in Table 7-10 below.

Table 7-10
Rainfall Adjustment – Method 3

July and August Pumpage	Type	Gallons Pumped (MG)	Gallons Pumped (GPD)
2006	Wet / 8.9”	235	3,790,000
2007	Dry / 3.4”	265	4,270,000
Difference		30	480,000

7.5.2 Recommended Irrigation Adjustment for Water Use

The three methods for determining an irrigation adjustment for water use were considered and are summarized in Table 7-11. The average of the three is approximately 630,000 gpd. The real value is likely within the range of these estimates. Because of the limited data and to be conservative, the average value will be utilized.

The recommended result is shown in Table 7-11 below.

Table 7-11
Recommended Rainfall Adjustment for Dry Years

Recommended Rainfall Adjustment for the Entire Town (July – August)		
Method 1	790,000	gpd
Method 2	630,000	gpd
Method 3	480,000	gpd
Average of Methods 1, 2, and 3	**630,000**	**gpd**

Further refinements can be made during final design as the water department gains better flow data from its new meter reading system.

Recommended Rainfall Adjustment for All Years Wet and Dry

When applying the recommended method to estimate average annual water use over the long-term, only half of the dry year rainfall adjustment will be applied. This will account for the fact that some years are wet while others are dry. During the period examined, approximately half of the years were dry. Therefore, the recommended long-term adjustment is 315,000 gpd for the months of July and August.

7.5.3 Additional Adjustment to Convert Water to Wastewater Use

In addition to the irrigation adjustment described above, an adjustment is also needed to account for other water use that does not become wastewater, such as consumption and outdoor water use aside from irrigation in the July to August period. The typical industry standard for wastewater indicates that 90 percent of domestic water use becomes wastewater in the Northern United States (Metcalf and Eddy, Wastewater Engineering, fourth edition). With a 315,000 gpd adjustment to all July and August flows, the total long-term annual water use is reduced by approximately 3 percent. Therefore, in order to reach the industry standard of a 10 percent reduction from water to wastewater use, an additional 7 percent must be deducted. This is assumed to be spread evenly across the entire year.

The 93 percent annual adjustment coupled with the irrigation adjustment for July and August of 315,000 gpd averages to the industry standard of 90 percent. This adjustment is specific to the Town of Harwich and is considered a better estimate of average wastewater flow month to month, rather than using a 90 percent reduction across the entire year.

Figure 7-2 shows a graph of water and wastewater flow in 2004 through 2007 for the portion of Harwich served by the public water supply and accounts for both seasonal irrigation in the months of July and August and the annual reduction of 93 percent. Note that this figure does not account for private sources of water.

Figure 7-2
Monthly Water Use and Wastewater Estimate – 2004 to 2007

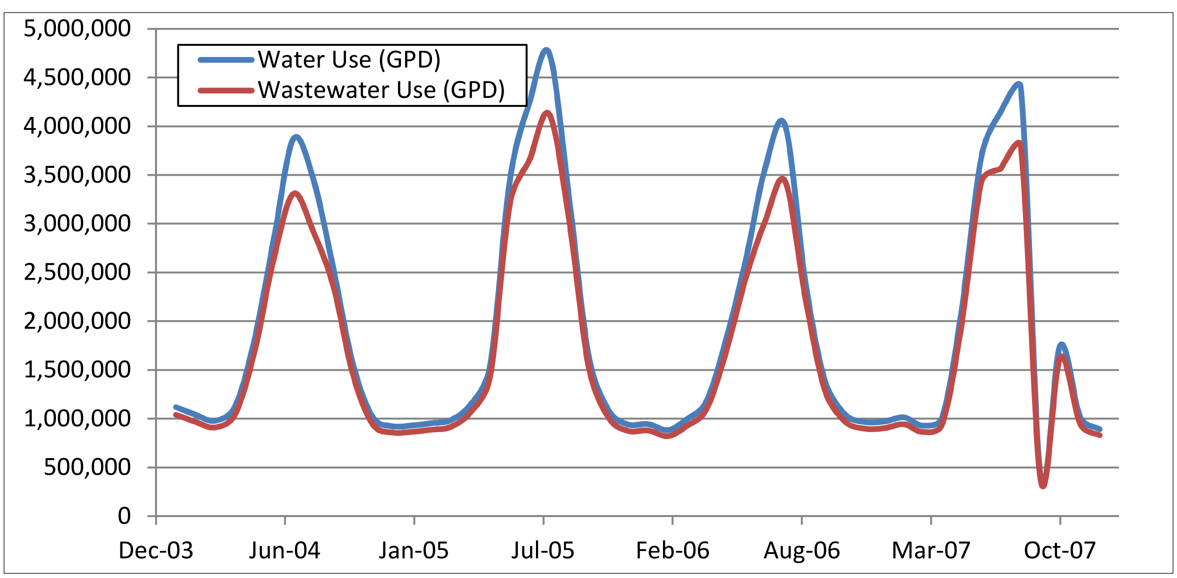

Table 7-12 shows the monthly average flow of both water and wastewater for Harwich using the 2004 to 2007 dataset and the adjustments described above. Again, these flows do not account for private sources of water.

Table 7-12
2004 to 2007 Monthly Annual Average Water and Wastewater Flow (MGD)

	January	February	March	April	May	June	July	August	September	October	November	December
Average Water Use	0.99	0.97	0.97	1.11	1.80	3.15	3.96	4.15	2.15	1.59	1.04	0.93
Average Wastewater Use	0.92	0.90	0.90	1.03	1.68	2.93	3.39	3.57	2.00	1.48	0.97	0.87

7.6 Seasonal Variations and Peaking Factors

7.6.1 Seasonal Wastewater Flow Ratios

Since daily flow data are not currently available from the Town, estimates of the high and low flow conditions that will be seen at a wastewater handling facility throughout the year are estimated here. Because Harwich is a seasonal community, the changes in flow conditions from winter to summer are large and must be carefully considered in facility design.

The predicted seasonal variations in wastewater flow were calculated by using the 2004 to 2007 well pumping data, converted to wastewater flow using the adjustments described above. The data were tabulated with the intent of acquiring seasonal wastewater ratios comparing the winter, summer, and spring/fall seasons to the total annual flow. The winter season is considered to be December to February, the summer season is considered to be June to August, and the spring/fall season includes September, October, November, March, April and May.

Table 7-13 presents the average winter, summer, spring/fall and total flow in million gallons per day, along with the seasonal ratios. These ratios are an important planning tool that can help to estimate winter and summer flow variations and aid designers in determining wastewater management strategies on a seasonal basis.

Table 7-13
Seasonal Wastewater Flow Ratios

Year	Winter Flow Average Dec - Feb (MGD)	Summer Flow Average June - Aug (MGD)	Spring/Fall Flow Average Mar-May, Sep-Nov (MGD)	Total Pumped Flow Average (MGD)	Ratio Winter Avg.: Total Flow Avg.	Ratio Summer Avg. : Total Flow Avg.	Ratio Spring/ Fall Avg. : Total Flow Avg.
2004	0.95	2.96	1.39	1.68	0.57	1.77	0.83
2005	0.88	3.66	1.49	1.88	0.47	1.95	0.79
2006	0.87	2.97	1.37	1.64	0.53	1.80	0.83
2007	0.89	3.60	1.12	1.68	0.53	2.14	0.66
Average (Rounded)	0.90	3.30	1.34	1.72	0.52	1.91	0.78

The total flow as well as the winter and summer ratios remained relatively constant from 2004 to 2007. The average total annual wastewater flow for the four year period was 1.72 MGD, with an average summer to total flow ratio of 1.91, an average winter to total flow ratio of 0.52, and an average spring/fall to total flow ratio of 0.78. The ratios shown here express a significant seasonal swing in flow from winter to summer, but are not unusual for a seasonal community like Harwich.

Figure 7-1 above showed the monthly well pumping flows in million gallons per month from 2004 to 2007. The seasonal variation of water consumption in Harwich is clearly seen in this figure. The irrigation adjustment dampens this trend to some degree, but the seasonal population increases in the summer months still result in a substantial difference in the ratios for winter versus summer.

7.6.2 Maximum Month Wastewater Flow

The ratio between maximum and average monthly flows is also an important planning tool that helps to estimate wastewater facility needs. The maximum month wastewater usage indicates the highest monthly flow expected at a wastewater collection or treatment facility. This value was estimated by using the 2004 to 2007 well pumping data, adjusted to wastewater use.

Within the four year dataset, August 2005 had the highest monthly pumpage of 147 million gallons, or 4.75 MGD. This month was used to establish the maximum month wastewater usage and peaking factor. Rainfall for this month was 0.89, which was the driest August recorded from 2004 to 2007. Therefore, the irrigation adjustment performed when considering this month alone is 630,000 gpd, estimated above as the irrigation adjustment for dry years using the average of the three methods presented. In addition, the 93 percent year-round adjustment is made to this value. These adjustments equate to 119 million gallons of wastewater flow during the month of August 2005, or 3.83 MGD. Based on this information, the following peaking factor is established:

- Average Estimated Wastewater Flow 2004 to 2007: 1.72 million gallons/day
- Maximum Month Wastewater Flow: 3.83 million gallons/day
- Maximum Month Peaking Factor for Wastewater: 2.2 million gallons/day

7.7 Summary

With an understanding of water consumption records, pumping records, wastewater flow adjustments, and seasonal swings in usage, reasonable estimates can be determined for wastewater flows. These estimates can be applied to any subset of the town and are considered to be reliable planning level estimates of wastewater usage.

7.7.1 Town Billing Records and MEP Dataset Conclusion

From the analysis presented in Section 7.3, the Town billing data and the MEP data were determined to be similar, as expected. The two datasets are within 5% of each other, due to broken GIS linkages, and are therefore both appropriate for long term wastewater planning. For planning purposes, the MEP dataset should be used whenever possible, and any areas outside of the MEP watersheds should utilize town water billing records.

The buildout estimates in the MEP dataset are considered to be rough planning level estimates. These estimates were reviewed by the Harwich Planning Department and were adjusted accordingly. The Town has also reviewed buildout estimates for the areas outside of the MEP watersheds identified as having wastewater needs, which are presented in Section 13 for incorporation into the total wastewater flow estimates.

7.7.2 Adjustments for Wastewater Flow

The adjustments to convert water to wastewater usage, the seasonal variations in flows, and the maximum month peaking factor were developed and presented in this section to aid in the preliminary design of the Town's wastewater conveyance and treatment facilities. Since Harwich is a seasonal community, the change in flow conditions from winter to summer is large and must be considered in the design of wastewater infrastructure. The adjustments developed in this section will be used in the preliminary design of proposed wastewater facilities for the Town to determine maximum and minimum flow rates and seasonal variations in wastewater flows.

Section 8

Wastewater Needs Assessment

8.1 Introduction

In March 2008, Harwich developed the preliminary wastewater needs in town based on the review of available data as presented in Sections 3 through 7 of this report. These needs were then further evaluated after all of the MEP reports were completed to develop the wastewater management scenarios presented in Section 10. This section describes the various key drivers for enhanced wastewater management in Harwich and their role in the development of the wastewater management scenarios.

Five categories of key wastewater needs drivers were evaluated, as follows:

- Drinking Water Quality
- Freshwater Lake and Pond Quality
- Onsite (Title 5) System Performance
- Nitrogen Management
- Socio-Economic Needs

8.2 Drinking Water Supplies

Municipal drinking water supply is generally available throughout the Town using source water from 14 gravel packed groundwater supply wells. Wellfields are located in the southeast, northeast, and northwest areas of Harwich, which draw water from the Monomoy Lens Aquifer. A small percentage of properties (approximately 7%) use private onsite wells for drinking water. Therefore, all of Harwich's residents and businesses are reliant on the groundwater supply for drinking water, whether through public or private sources of supply. The Harwich public water system was recognized for excellence in 2006 for being within the top 5% of public water systems in Massachusetts. Detailed information on groundwater quality and zones of contribution of the municipal wells was described in Sections 3 and 4 of this report.

Figure 8-1 shows the municipal well zones of contribution and Zone IIs located in Harwich. Note that both are mainly concentrated in the eastern portion of town, and the majority of development anticipated in town is outside of these areas. As described in Section 4, drinking water quality data to date has shown that nitrate concentrations in the Town's drinking water wells are low. The EPA drinking water threshold for nitrates, referred to as the maximum contaminant limit, or MCL, is 10 mg/L, and the Cape Cod Commission's guidance level is 5 mg/L. The average nitrate level observed in Harwich's drinking water wells in 2011 was approximately 1.0 mg/L, falling well below both of these thresholds. Nitrate values less than 1.0 mg/L are typical of undeveloped background areas on the Cape. The highest nitrate level seen in Harwich wells in this same period was 2.4mg/L, at sampling Station No. 9 in the Pleasant Bay watershed. The only wells showing nitrogen values regularly above background are well Nos. 8 and 9 in the Pleasant Bay watershed.

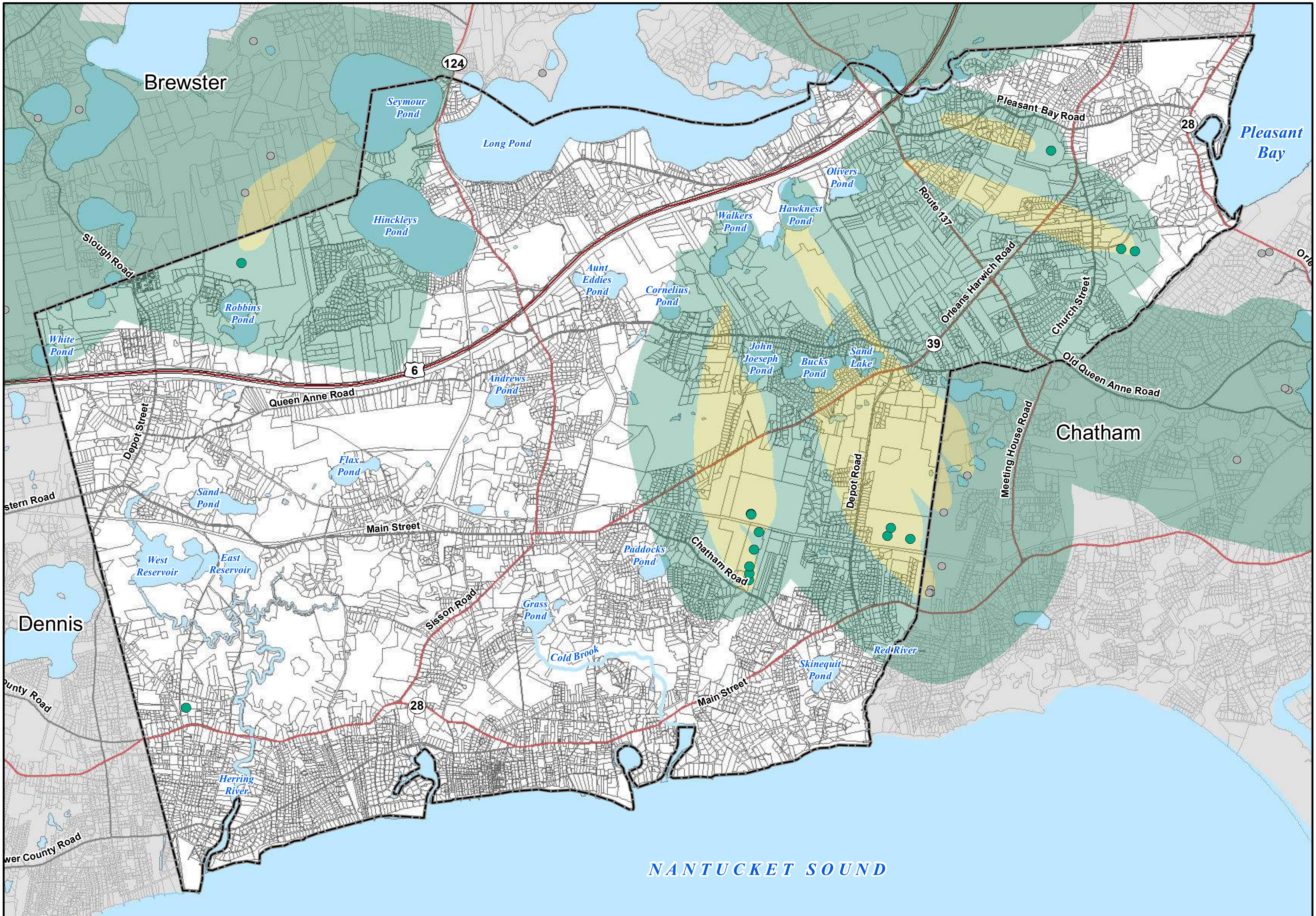

Figure 8-1
Drinking Water Sources

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Based on this information, protection of drinking water quality is not a significant driver for sewering. Should the Town continue to exclusively use onsite systems in the long-term, nitrates in some drinking water wells could show an increase; however, evidence does not show this to be a problem which would require sewering in any particular areas during the planning period for this CWMP. As a result, drinking water quality was determined to not be a driver for sewering at this time, and therefore sewering the locations of water supply wells was not considered for the development of the wastewater management scenarios in Sections 10 and 13.

While the locations of public water supply wells in Harwich do not drive a need for sewering in any particular area of town, a reduction in onsite septic system inputs into the groundwater, especially in Zone II areas, will result in a beneficial reduction of some compounds and contaminants contained in wastewater effluent. These include nutrients such as nitrogen and phosphorus, bacterial and viral constituents, and emerging contaminants such as pharmaceuticals and personal care products. The fate of this latter category of microconstituents in the environment is less well understood, and their impacts to drinking water supplies are increasingly being studied. Thus far, research has largely shown that levels of these microconstituents in drinking water supplies are extremely low and are typically well below US EPA action levels. However, any reduction in their inputs to the contributing areas of surrounding groundwater wells has the benefit of reducing their concentrations in the public water supply.

Another manner in which public water supplies are impacted by the wastewater management strategy implemented by the town is through the location(s) of groundwater recharge of treated effluent originating from a municipally operated treatment plant. Groundwater recharge of treated effluent over 10,000 gpd requires a Groundwater Discharge Permit issued by MassDEP. Typically, MassDEP requires standards to be met for several parameters including: biochemical oxygen demand (BOD), total suspended solids (TSS), and total nitrogen (TN). Depending on the location of the recharge basins, other parameters such as total phosphorus (TP) or total organic carbon (TOC) may also be regulated. Historically, MassDEP has required a TOC concentration of below 3 mg/L in effluent recharged within a Zone II, although in some instances where travel times are longer (greater than 2 years), MassDEP has indicated that TOC removal may not be required. This will be discussed further in reference to the recommended plan for wastewater management presented in Section 13 of this report.

8.3 Freshwater Lake and Pond Quality

Section 5 summarized water quality data and the trophic status of freshwater lakes and ponds in Harwich for which data were available. As described, an overabundance of phosphorus is the main concern in freshwater systems, as phosphorus is typically the nutrient in limited supply. Therefore, an increase in phosphorus can result in significant plant and algae growth, which can cause a shift in trophic status from oligotrophic, to mesotropic, to eutrophic (over-enriched) conditions.

Four lakes and ponds in Harwich were identified in Section 5 as eutrophic or at risk of moving toward a eutrophic condition. In the watersheds of those water bodies, when the predominant controllable phosphorus source is believed to be wastewater from onsite systems, sewers should be considered to limit phosphorus input into the groundwater. Table 8-1 summarizes the ponds considered, notes those where phosphorus over-enrichment is a concern for the health of the ecosystem via their trophic status, and further notes where shoreline development (thus onsite systems) is potentially a cause for concern. Section 5 notes where further sampling is needed to confirm if sewers are necessary. In those locations, sewers may be considered in the future via an adaptive management approach during the CWMP implementation phase, as described further in Section 13. Figure 8-2 is a map summarizing the information presented in Table 8-1.

Table 8-1
Freshwater Quality and Associated Needs

Name	Pond Trophic Status	Shoreline Development
Andrews Pond	Oligotrophic	Low
Aunt Edies Pond	Mesotrophic	Low
Bucks Pond	Oligo-mesotrophic	Medium to High
Cornelius Pond	Eutrophic	Low
Flax Pond	Oligo-mesotrophic	Low
Grass Pond	Meso-eutrophic	Low
Hawksnest Pond	Oligotrophic	Low
Hinckleys Pond	Eutrophic	Medium to High
Island Pond	*	*
John Joseph Pond	Mesotrophic	Medium to High
Littlefields Pond	*	*
Long Pond	Mesotrophic	Medium to High
Oilvers Pond	*	*
Okers Pond	*	*
Paddocks Pond	*	*
Robbins Pond	Mesotrophic	Low
Sand Pond	Mesotrophic	Low
Seymour Pond	Mesotrophic	Medium to High
Skinequit Pond	Eutrophic	Medium to High
Walkers Pond	Mesotrophic	Low
West Resevior	*	*
White Pond	Oligo-mesotrophic	Low

*No Data Available

Figure 8-2 also shows three specific developed areas around Paddocks Pond, John Joseph Pond, Bucks Pond, Sand Lake, Long Pond, Seymour Pond and Hinckleys Pond that are highlighted as areas of concern for pond health and should be considered for incorporation into the final wastewater plan. Additional areas may be included at a later date, but at this time, the Town has identified these as the "Primary Areas of Concern for Pond Health."

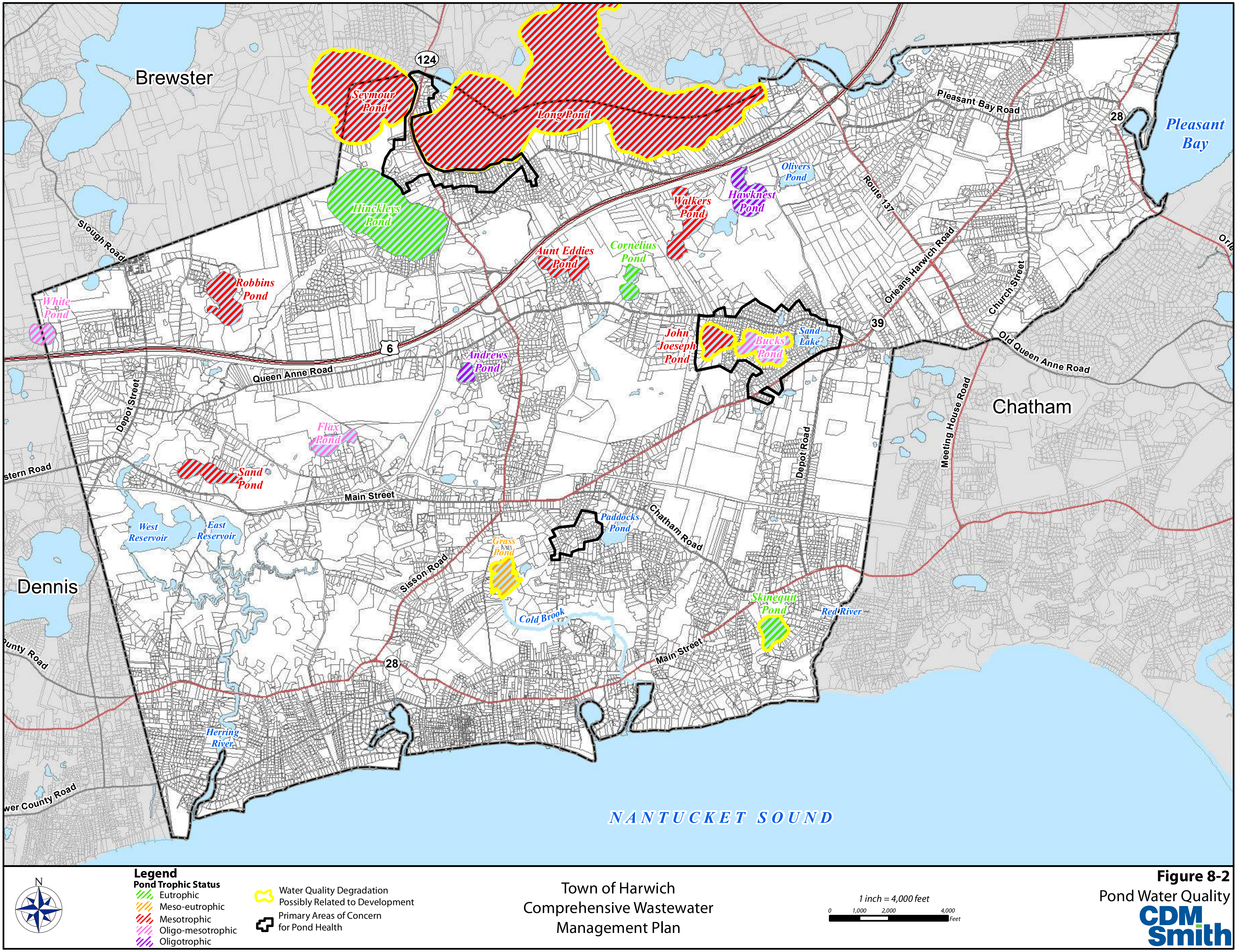

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Figure 8-2
Pond Water Quality

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The areas are as follows:

- The area to the west of Paddocks Pond: Even though Paddocks Pond has very little historic water quality data at this time, the Town considers this to be a shallow eutrophic pond which some in town believe may feed the meso-eutrophic Grass Pond. For this reason, it is included as a primary area of concern. This area was not included in the recommended plan, but may be added in the future when Wychmere Harbor, Saquatucket Harbor or Harwich Center are sewered. The developed areas surrounding the Great Sand Lakes, in the vicinity of Queen Anne Road and Route 39.

- In the 2007 Stearns and Wheler Case Study Report for the Great Sand Lakes, sewering was recommended as a possible long term phosphorus management option that should be evaluated in the CWMP/SEIR. Although sewering will not reverse the 50 years of phosphorus loading that was already deposited in the watershed, it will effectively reduce future phosphorus loading.

- While The Great Sand Lakes Case Study Report did perform a limited nutrient budget for the ponds, a more comprehensive water quality study should be completed that is similar in scope to the recent Hinckleys Pond Study that further details all sources of phosphorus. The adaptive management approach will allow this to be addressed in a future phase.

- An area between Hinckleys, Seymour, and Long Ponds, in the vicinity of Pleasant Lake Avenue: The area around these ponds has not been recommended for sewering at this time. Long Pond was recently treated for phosphorus in-activation as the phosphorus in the sediments is the largest source. A similar recommendation has been made for Hinckleys Pond based on a recent water quality study as the largest source of phosphorus is in the sediments. A water quality study needs to be conducted for Seymour Pond to determine phosphorus sources and determine appropriate actions. Thus, sewers to remove septic system phosphorus are not recommended at this time.

8.4 Onsite (Title 5) System Performance

Soil conditions in Harwich are described in Section 3 and summarized below in relation to the operation of onsite wastewater treatment and disposal systems. Understanding subsurface conditions in the community assists in formulating long-term wastewater management options by helping to identify areas where onsite systems are not likely to provide adequate wastewater treatment. These areas include sites where groundwater is too close to the surface or where soils are not permeable enough to allow adequate leaching rates. Also, areas with very rapid infiltration rates can limit the amount of treatment occurring as Title 5 system effluent moves through the soil to the groundwater below.

Generally, the dominant soil type in Harwich consists of medium sand material with rapid permeability. With rapid infiltration rates, these soils act as less suitable filters from a wastewater treatment perspective, which is especially of interest in relation to phosphorus removal. Certain areas, mainly in West Harwich within the Herring River watershed, consist of soil layers with silty loams and clays as reported by Harwich Board of Health officials and a local soils consultant. These layers restrict the downward movement of wastewater and cause a “perched” water level above the restrictive layers. Certain localized areas of Division Street, Kelley Road, and adjacent to Pleasant Lake Avenue consist of these less permeable fine silts and clays. The rest of the town typically has adequately permeable soils.

Areas along the southern coast and south of Route 28 represent challenges for long-term wastewater management. Dense development, small lot size and shallow depth-to-groundwater limit the ability to design and construct onsite system upgrades in compliance with Title 5 and local Board of Health regulations. Figure 8-3 shows the locations in town where these conditions coexist. One of these areas along the Route 28 corridor, known locally as “the Campgrounds,” generally consists of small lots with a significant percentage of seasonal occupancy. Many of these properties were developed prior to local zoning codes, and prior to health standards for design and construction of onsite systems. Also, many are believed to use cesspools for wastewater treatment and disposal due to the age of construction in the area. System upgrades in this area frequently require waivers or variances from Title 5 or local regulations. In some cases, limitations are placed on future expansion or increases to the number of bedrooms through deed restrictions.

Two areas have been designated by the town as “Areas of Title 5 Concern.” These areas are as follows and are called out on Figure 8-3:

- The area along Route 28 north of Allen Harbor – this area was flagged primarily due to high groundwater conditions and the presence of mounded septic systems.
- The Campground area immediately east of Allen Harbor, along the southern coast of Harwich. This area was flagged primarily due to dense development, high groundwater conditions and small lot sizes.

Based on the review of onsite systems and subsurface conditions in Harwich, along with discussions with the Board of Health, the following conclusions were drawn:

1. The town generally has subsurface conditions suitable for Title 5 compliant onsite systems (i.e., permeable soils and sufficient depth to groundwater).
2. The water quality of municipal drinking water wells, as noted above, is excellent, and properties adjacent to wells are protected.
3. Some areas of dense development provide challenges for Title 5 and local system regulation compliance; however the majority of these areas are outside the zones of contribution for the drinking water supply, limiting the cause for concern from a drinking water perspective. These areas have been designated “Areas of Title 5 Concern” and should be addressed in the long-term wastewater management program.
4. Nitrogen inputs from traditional Title 5 systems present the most significant challenge to Harwich water quality stemming from onsite systems, especially in areas of high permeability soils, as described further in Section 8.5 below.

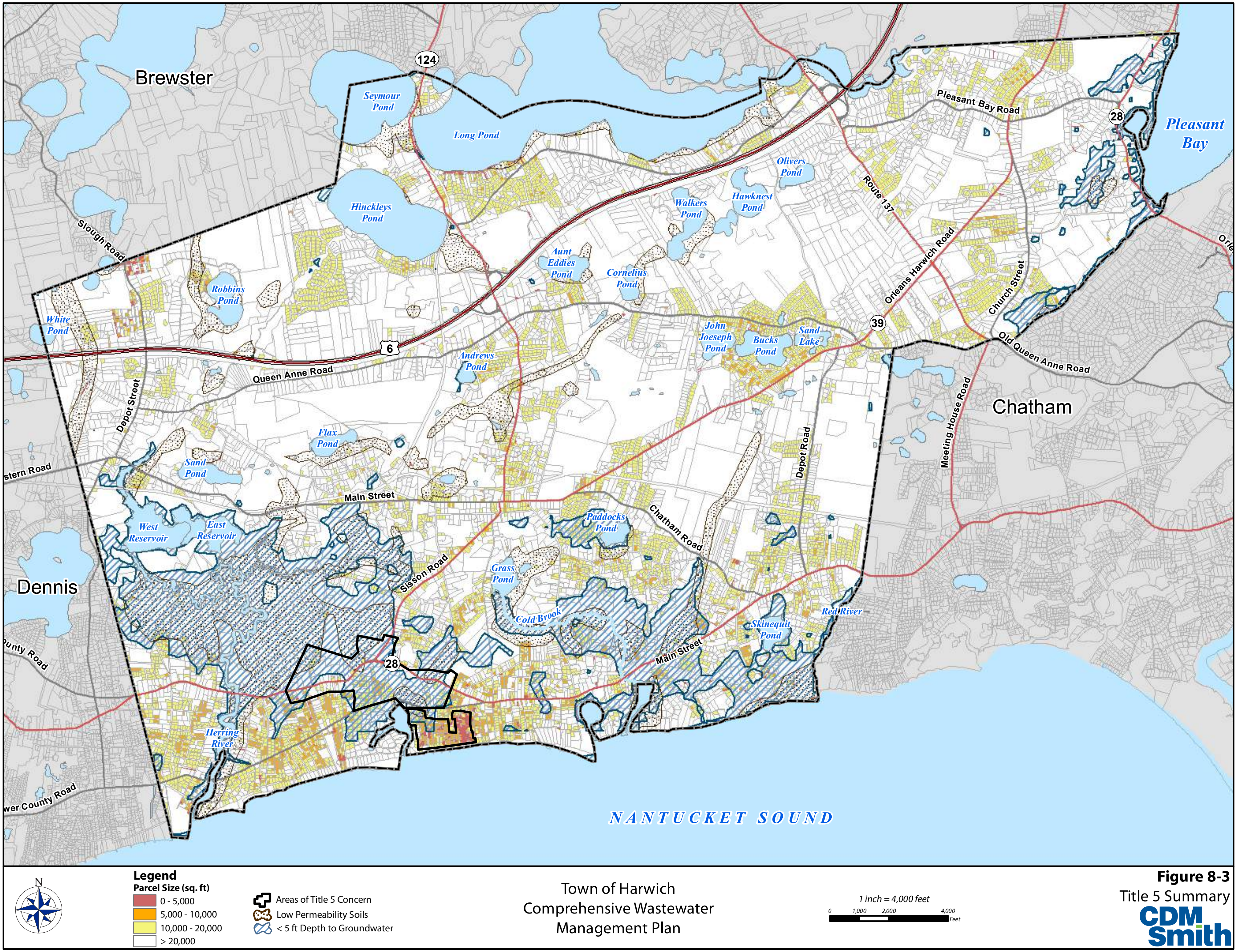

Figure 8-3
Title 5 Summary

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Based on these conclusions, the elimination of onsite systems is only deemed a high need in the Areas of Title 5 Concern and as it relates to nitrogen reduction in the context of the MEP goals for the receiving estuaries and embayments along Harwich's coastlines. In other areas, continued use of onsite systems is considered a feasible long-term wastewater management approach. Within the areas that continue to use onsite systems, regulatory waivers and/or mounded systems will still be required in certain cases where conditions do not allow for Title 5 and local compliance. However, by targeting sewering in the most densely developed and high groundwater areas within the regions where nitrogen reduction is required, the frequency of future waivers and mounded systems can be significantly reduced. These goals were incorporated into the development of the wastewater management scenarios presented in Section 13.

Monomoy Regional High School

During the development of the Draft CWMP, the creation of the new Monomoy Regional High School came to fruition. The new school is located at the site of the previous Harwich High School. This area is in the Saquatucket Watershed. Coordinating among school and town representatives resulted in the septic system for the new larger school being constructed in the Grass Pond subwatershed. This will maximize the amount of natural nitrogen attenuation as the groundwater flows through the down gradient freshwater ponds minimizing nitrogen impacts in Saquatucket Harbor. As flows for design of the system were not final when initially evaluating these loads, a wastewater flow of 10,000 gpd for five days per week for 10 months of the year and 5,000 gpd for five days per week for two months of the year was utilized for the purposes of this study. This resulted in an annual flow of about 6,500 gpd which was used to calculate a nitrogen load in the watershed. Natural nitrogen attenuation removes 50 percent of the load in Grass Pond and then 35 to 50 percent in Cold Brook resulting in less than a third of the nitrogen reaching Saquatucket Harbor. That load is equivalent to nine homes needing to be added to the sewer system in that area. Recent flow updates indicate the average annual flow from the school would be less than half that assumed or less than five additional homes to be sewered. Thus, the nitrogen load from this new Title 5 septic system has been factored into the sewer system layout for the Saquatucket watershed to meet the TMDL for the overall watershed. Due to its relatively small nitrogen load and physical location in the watershed, the school wastewater system is not part of the proposed sewer service area for the Saquatucket watershed. If conditions change in the future, it could be connected to the adjacent sewers in the Herring River watershed once they are constructed.

8.5 Nitrogen Management

As described in detail in Section 6, the MEP reports for five Harwich watersheds (Allen Harbor, Wychmere Harbor, Saquatucket Harbor, Pleasant Bay, and Herring River) estimate the nitrogen removal required to restore those waterbodies to support healthy aquatic ecosystems. Unlike freshwater systems, in saltwater environments, nitrogen is the nutrient of concern which can cause over-enrichment and long-term degradation of water quality, and unlike drinking water quality, a healthy saltwater environment requires nitrogen concentrations of less than 10 percent of what is safe for humans to drink. Table 8-2 provides a general overview of the water quality determination for each watershed from the MEP reports, and Table 8-3 summarizes the nitrogen loading in each watershed resulting from wastewater and the percent removal required to achieve the goals laid out in the MEP reports. Table 8-4 focuses on nitrogen loading under future buildout conditions.

Table 8-2
Water Quality Determination Based on MEP Findings

Watershed	Water Quality Determination
Allen Harbor	Moderately to Significantly Impaired System
Wychmere Harbor	Moderately to Significantly Impaired System
Saquatucket Harbor	Moderately to Significantly Impaired System
Pleasant Bay	Varies by Location from Healthy to Degraded
Herring River	Healthy Marshland Habitat above Route 28, Significantly Impaired System below Route 28 Close to Enrichment Threshold

Table 8-3
MEP Nitrogen Reduction Goals by Watershed – Present Conditions

Watershed	Present Attenuated Septic Load (kg/day)	Threshold Septic Load (kg/day)	% Nitrogen Reduction Required
Allen Harbor	5.64	1.483	74%
Wychmere Harbor	3.208	0.00	100%
Saquatucket Harbor	13.246	5.280	60%
Pleasant Bay – Round Cove	5.18	1.87	64%
Pleasant Bay – Muddy Creek	13.32	6.89	48%
Pleasant Bay	16.69	6.51	61%
Herring River	38.592	23.751	38%

*Saquatucket Harbor and Muddy Creek Loads include Enhanced Attenuation – Additional Information is provided in Sections 10 and 13

*The three Pleasant Bay watersheds listed will collectively require a 57% nitrogen reduction. The individual reductions from each community contributing to this watershed will need to be coordinated.

*Values in RED indicate that the value is above the standard and must be reduced.

Table 8-4
MEP Nitrogen Reduction Goals by Watershed – Buildout Conditions

Watershed	Buildout Attenuated Septic Load (kg/yr)	Threshold Septic Load (kg/yr)	% Nitrogen Reduction Required
Allen Harbor	6.71	1.483	78%
Wychmere Harbor	3.30	0.00	100%
Saquatucket Harbor	12.51	5.28	58%
Pleasant Bay – Round Cove	5.78	1.87	68%
Pleasant Bay – Muddy Creek	16.28	6.89	58%
Pleasant Bay	21.84	6.51	70%
Herring River	56.59	23.751	58%

*Saquatucket Harbor and Muddy Creek Loads include Enhanced Attenuation – Additional Information is provided in Sections 10 and 13

*The three Pleasant Bay watersheds listed will collectively require a 65% nitrogen reduction. The individual reductions from each community contributing to a this watershed will need to be coordinated.

*Values in RED indicate that the value is above the standard and must be reduced.

Figures 8-4 through 8-8 show an overlay of the watershed boundaries and aerial photographs of the town, illustrating the level of development in each MEP watershed. Figure 8-9 shows the percent nitrogen removal achievable using different types of wastewater treatment and disposal systems, and Figure 8-10 shows the resulting effluent nitrogen concentrations from each type of system.

As seen in Tables 8-3 and 8-4, the nitrogen removal requirements in all watersheds are significant enough to require a wastewater management approach beyond the sole use of Title 5 systems. Therefore, in order to meet the MEP goals, enhanced wastewater management strategies are required.

Based on the level of nitrogen removal required and the limitations of traditional onsite systems, sewering is required in some portion of the town to achieve the goals of the MEP in all five estuaries analyzed. Throughout the town, innovative/alternative (I/A) systems could be used along with conventional wastewater treatment to meet the goals of the MEP. Therefore, that option was also explored as (Scenario 7A) in the wastewater management scenarios presented in Section 10. While stormwater management methods could also be used to reduce nitrogen inputs into the subject watersheds, they have less of an impact in reducing nitrogen levels and cannot meet the MEP goals by themselves. This is illustrated in the pie charts presented throughout Section 6 which show the relative contributions of controllable nitrogen sources in each MEP watershed. Stormwater controls and best management practices (BMPs) are, however, included in the overall program for nitrogen management in Harwich. Similarly, fertilizer management and education are included in the overall program for nitrogen management, although the nitrogen issues in town cannot be addressed by these programs alone.

Based on the information from the MEP reports, the reduction of nitrogen to restore estuarine water quality is a significant need and thus the main driver in the development of the wastewater management scenarios presented in Section 10.

Legend

Watershed Boundary

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 1,000 feet
0 500 1,000 Feet

Figure 8-4
Allen Harbor
Watershed Development

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Watershed Boundary

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 750 feet

0 500 1,000 Feet

Figure 8-5
Wychmere Harbor
Watershed Development

CDM Smith

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Watershed Boundary

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 2,225 feet

0 1,000 2,000 Feet

Figure 8-6
Saquatucket Harbor
Watershed Development

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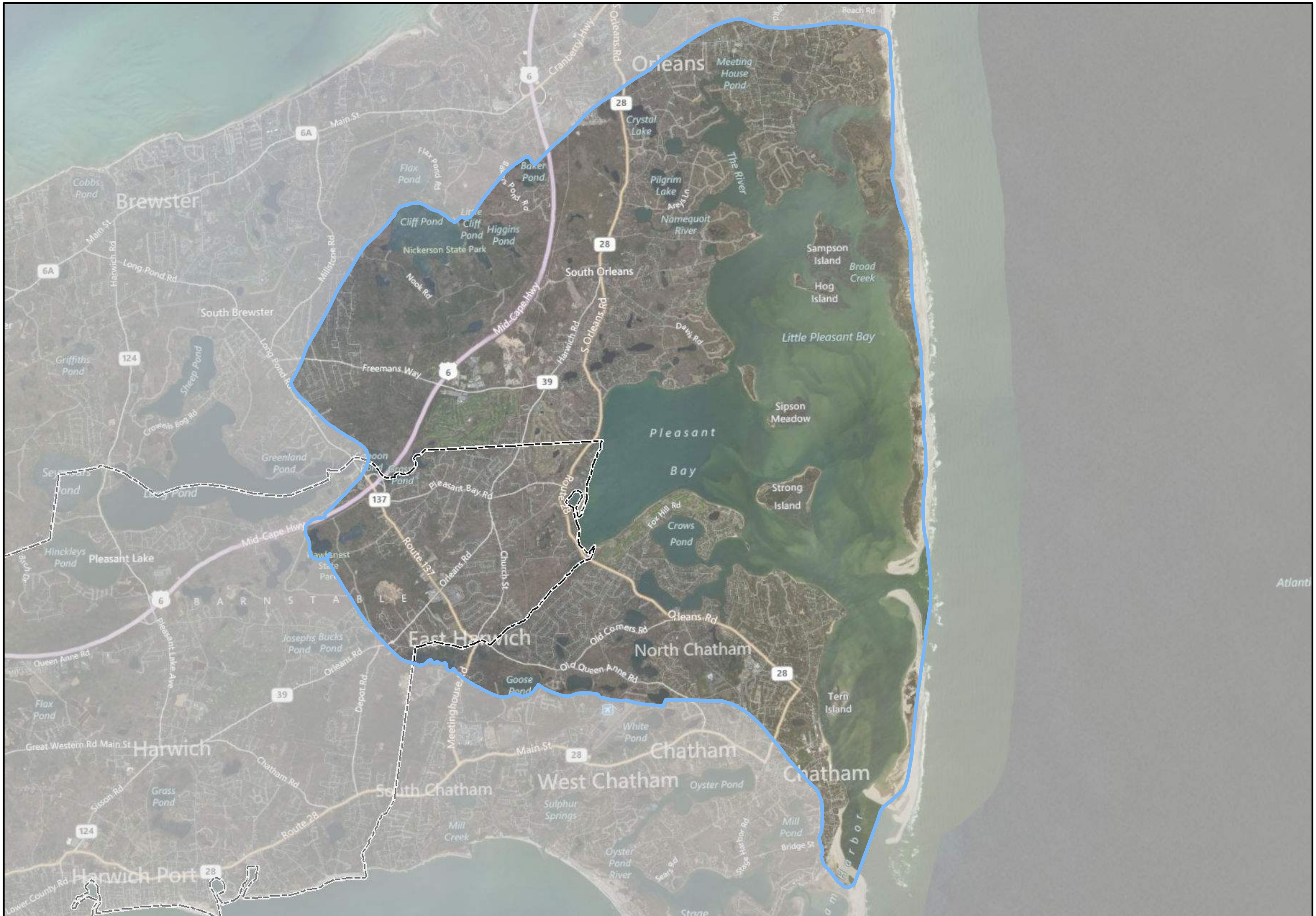

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Legend

Watershed Boundary

Harwich Town Boundary

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 6,500 feet

0 0.5 1 2 Miles

Figure 8-7
Pleasant Bay
Watershed Development

CDM Smith

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Legend

Watershed Boundary

Harwich Town Boundary

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,500 feet

0 0.5 1 Miles

Figure 8-8
Herring River
Watershed Development

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Figure 8-9
Percent Nitrogen Removal in Typical Nitrogen Treatment Systems

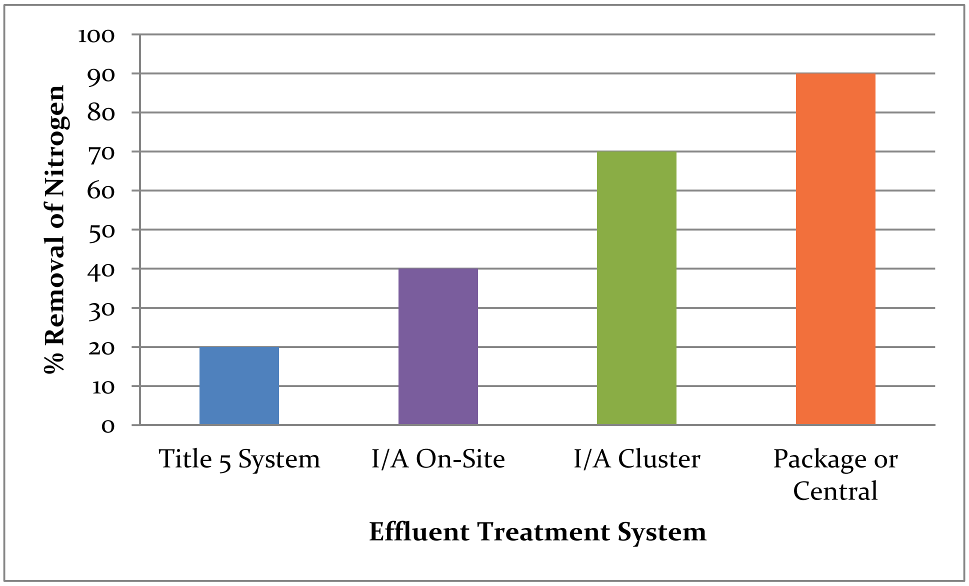
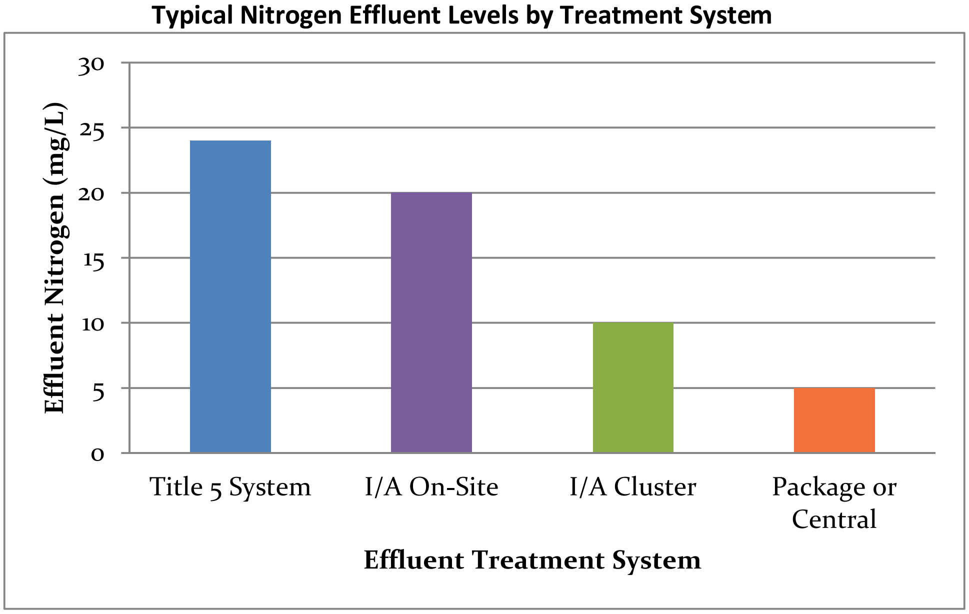


Figure 8-10
Typical Nitrogen Effluent Levels by Treatment System



8.6 Socio-Economic Needs

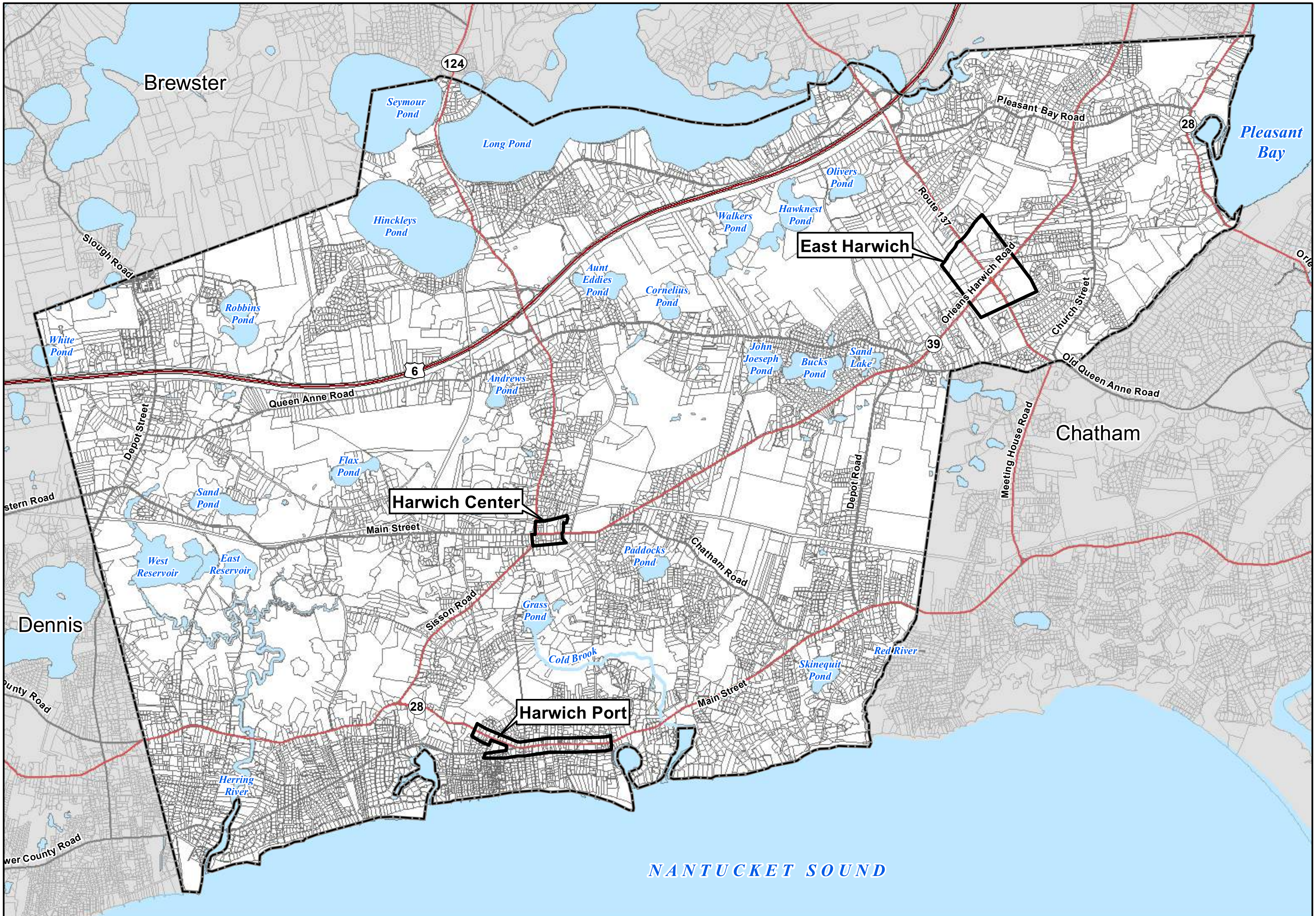
Growth and economic development are necessary components of any healthy community. Harwich's preferred approach to growth management is to promote planned growth in targeted areas which enhance pedestrian culture and offer a positive experience for both residents and visitors. Focusing growth in concentrated areas that include the appropriate supporting infrastructure (utilities, transportation, etc.) is a "smart growth" approach that allows for better protection of natural resources in town. As such, the town has designated three "villages" in town where growth and economic development are desired. These areas are the commercial districts known as the East Harwich Village Center, Harwich Port, and Harwich Center. As described in Section 2, each of these areas is undergoing independent planning for development and redevelopment appropriate to the character of the particular area.

To summarize the details provided in Section 2, East Harwich is a densely developed commercial center located within the nitrogen-sensitive Pleasant Bay watershed. The plans for this area include increasing residential density in the East Harwich Village Center with mixed commercial and residential development and increased pedestrian infrastructure including sidewalks and bike lanes. The East Harwich Village Center is presently the center of year-round commercial activity.

Harwich Port, the original economic center of the Town, is now a center for mainly summer activity. This area will undergo development which protects its beaches and harbors along Nantucket Sound while revitalizing its role as a village center. At the present time, Title 5 compliance issues have limited commercial enterprises from expanding their services. Residential septic systems, particularly in high-density development areas, have difficulty meeting current standards. Harwich Port abuts both Wychmere and Saquatucket Harbors which both need sewers. Pedestrian infrastructure, including sidewalks and bike paths, are in line to aid with parking constraints along the shore, along with remote parking and shuttle connections.

Harwich Center houses a majority of historical buildings and municipal services including the Town Hall, Brooks Free Library, Brooks Park, and the Old Colony Bike Trail, along with nearby public schools and the Community Center. As with the other areas, pedestrian infrastructure is encouraged with expanded sidewalks and bikeways, in addition to more accessible vehicular transport and parking; however, all improvements are modest in nature and meant to focus primarily on enhancing rather than reconstructing this portion of town.

All of these redevelopment efforts require a modified approach to wastewater management to provide the infrastructure necessary to support the town's goals. Figure 8-11 shows the locations of the town centers. All of these areas are proposed for inclusion in the wastewater management program developed as part of this CWMP/SEIR in order to assist in their desired smart growth.



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Harwich Town Centers

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet

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Figure 8-11
Town of Harwich Village Centers

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8.7 Wastewater Needs Categories

Following independent analysis, the five factors above were considered collectively to identify areas requiring a modified approach to wastewater management. Areas of town were split into two categories:

- Category 1: Areas requiring offsite wastewater management solutions; and
- Category 2: Areas that can remain with onsite systems using non-structural nutrient management solutions (such as improved stormwater controls and fertilizer management).

Using the five factors above, the following conclusions were drawn:

1. ***Drinking Water Supplies:*** Drinking water supplies are not a driver for requiring any offsite wastewater management solutions, therefore all well zones of contribution and Zone IIs are placed into Category 2, unless moved into Category 1 based on other factors.

2. ***Freshwater Lakes and Ponds:*** The upgradient lands with significant development of the following lakes and ponds were identified as potentially having over-enrichment issues due to phosphorus inputs from septic systems:

    a. Great Sand Lakes including:

        i. John Joseph Pond

        ii. Bucks Pond

        iii. Sand Lake

    b. Paddocks Pond

    The upgradient areas are placed into Category 1. All other upgradient lands near freshwater ponds are placed into Category 2 unless further research indicates a need for sewering in the future.

3. ***Onsite (Title 5) System Performance:*** The locations identified as "Areas of Title 5 Concern" were identified as requiring offsite solutions, and are thus included in Category 1. All other areas of town are placed into Category 2 from a Title 5 perspective.

4. ***Nitrogen Management:*** As described above, each of the MEP watersheds in Harwich has a specific nitrogen reduction goal that will require the provision of offsite wastewater treatment and effluent recharge for some portion of the watershed. The properties that can account for the required nitrogen loads in each watershed require an offsite solution and are placed into Category 1. There is flexibility, however, in the selection of which properties are included in Category 1 and which are placed in Category 2 to remain with onsite systems. Generally, the areas that are most cost-effective and efficient to sewer are the most densely developed areas with the highest water usage per acre. These areas tend to encompass village centers and areas with high density residential units. Areas with lower density are less cost-effective to sewer due

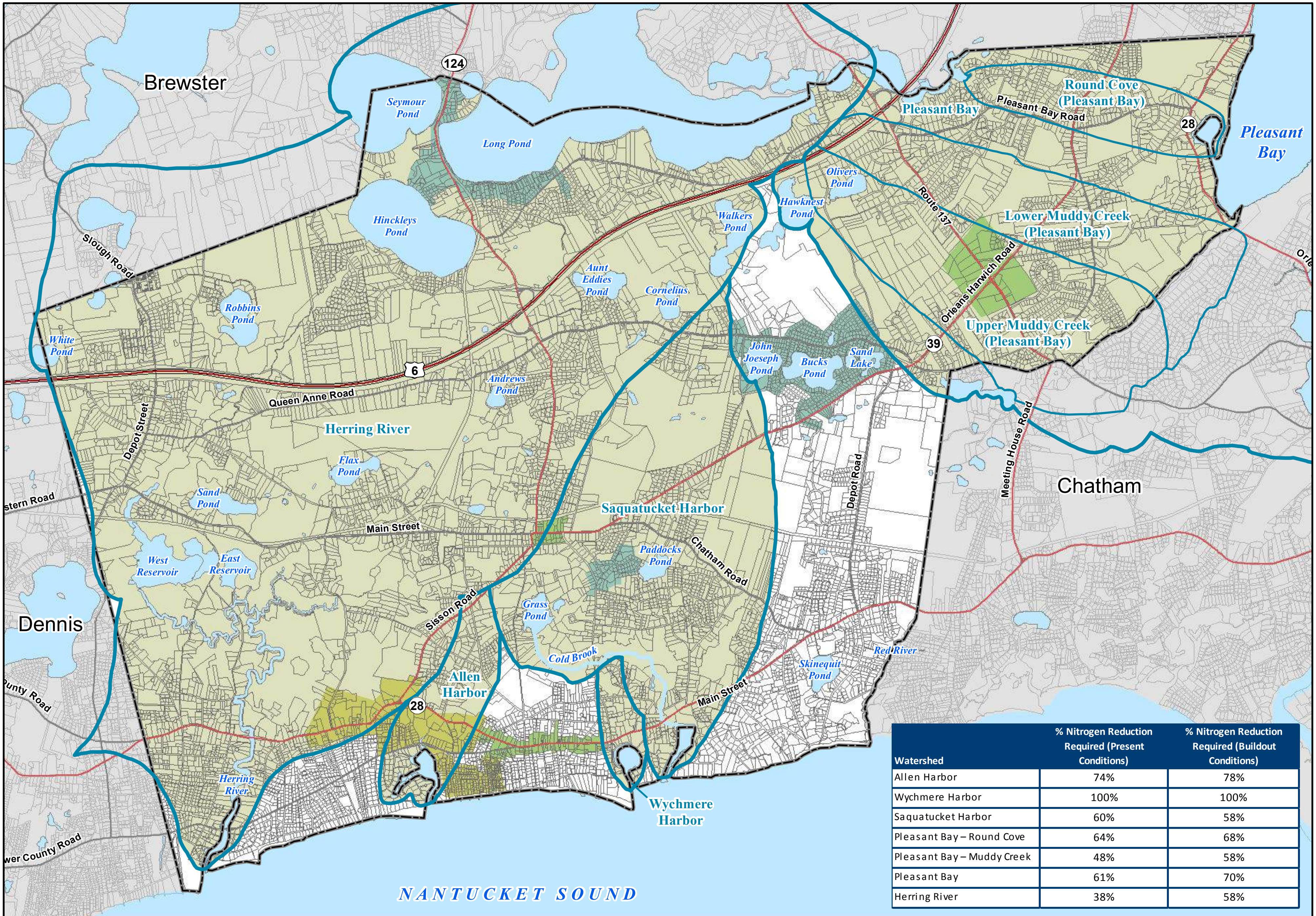
to the distance between properties which still requires infrastructure to convey wastewater to the treatment facility. Consideration was given to these issues when selecting the areas proposed for sewering within each watershed as presented in Sections 10 and 13.

5. ***Socio-Economic Needs:*** Each of the three village centers in town requires inclusion in Category 1 to provide the necessary infrastructure to support the town's economic development goals. Specifically, these areas include the commercial centers of East Harwich, Harwich Port, and Harwich Center.

Figure 8-12 shows each of the areas placed into Category 1 using the five factors described above. For the watersheds requiring a percentage of properties to be sewered, the outline of the entire watershed is shown, with an indication in the adjacent table as to what percentage of the watershed requires an offsite solution.

8.8 Summary and Conclusions

As shown in Figure 8-12, the majority of the areas in town requiring offsite wastewater management solutions are driven by the need to meet the MEP nitrogen reduction goals. As such, the wastewater management scenarios presented in Section 10 focus on the MEP goals as the main driver for the locations and layouts of offsite solutions. Where areas included in Category 1 based on freshwater pond quality, Areas of Title 5 Concern, or socio-economic needs fall within the MEP watersheds, these areas were targeted first to help meet the required percentage nitrogen reduction in the development of the scenarios. Areas that fall outside the watersheds or outside the proposed sewered areas will need to be further evaluated by the town in terms of meeting overall town-wide goals. Some of these areas are included in the overall sewer service areas shown in the recommended plan in Section 13 of this CWMP/SEIR but, due to lower priority needs, may be included in later phases of sewering. Since those needs areas are considered common to all options, they are not deemed necessary to include in the comparative analysis of alternatives as they would not impact the evaluation of scenarios. However, the final recommended program includes wastewater infrastructure improvements for all of the areas identified in Category 1 based on each of the factors described above.



Watershed	% Nitrogen Reduction Required (Present Conditions)	% Nitrogen Reduction Required (Buildout Conditions)
Allen Harbor	74%	78%
Wychmere Harbor	100%	100%
Saquatucket Harbor	60%	58%
Pleasant Bay – Round Cove	64%	68%
Pleasant Bay – Muddy Creek	48%	58%
Pleasant Bay	61%	70%
Herring River	38%	58%

Legend

Category 1 Areas

- Area of Concern for Pond Health
- Area of Title 5 Concern
- Socio-Economic Needs
- Nitrogen Management

Watershed Boundaries

N

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 8-12

Harwich Wastewater Needs Summary

CDM Smith

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Section 9

Effluent Recharge Site Screening

9.1 Overview

This section describes the effluent recharge / wastewater treatment facility site screening evaluation in Harwich. As part of the CWMP/SEIR process, a site screening of available land to identify the parcels best suited to accepting wastewater effluent recharge was performed. The physical features of each parcel, as well as the ownership and designated land uses, were evaluated to determine the best candidate sites. The most feasible and appropriate sites were selected for inclusion in the scenario screening and evaluations detailed in Section 10 of this CWMP/SEIR.

The initial analysis identified four sites – selected out of all parcels in town – that offer the greatest potential to receive the Town's treated wastewater effluent and potentially accommodate a treatment facility.

The four sites identified are:

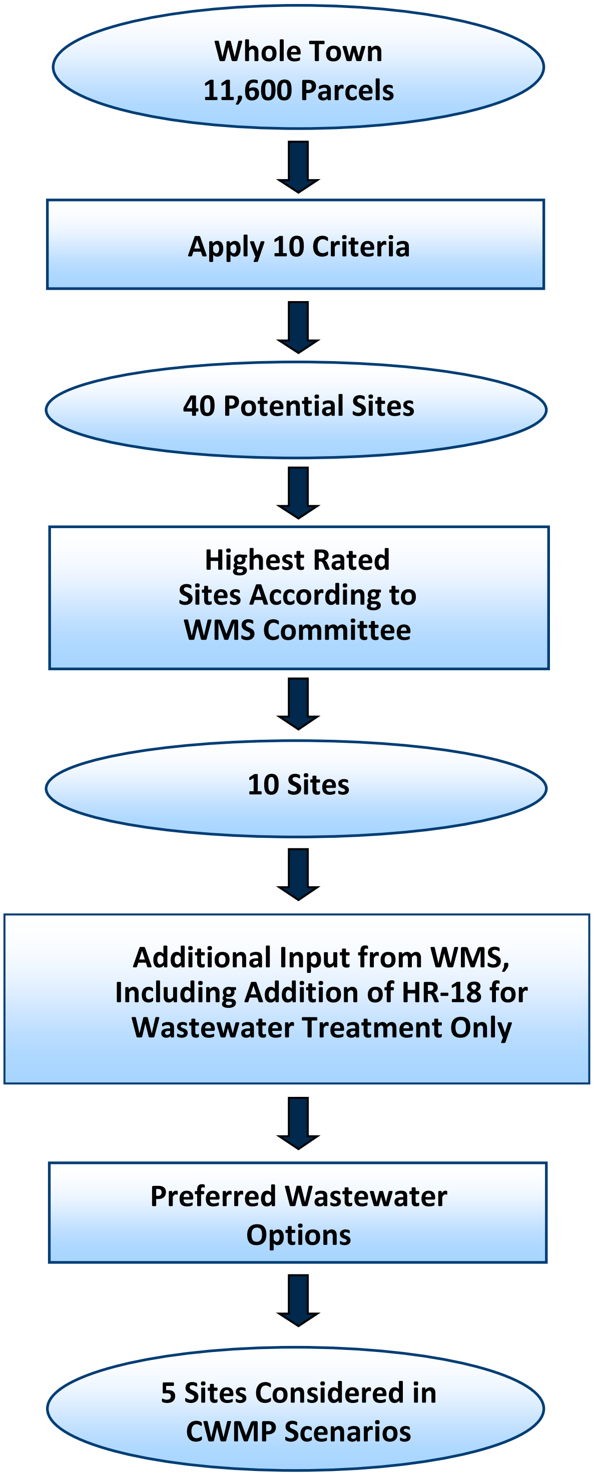
- **HR-12** – Former landfill site and current Department of Highways and Maintenance property in the Herring River watershed
- **PB-3** – Gravel pit in the Pleasant Bay watershed consisting of several parcels
- **SH- 2** – Monomoy Regional High School in the Saquatucket Harbor watershed
- **OW-2** – The Harwich Port Golf Course, located within Harwich but outside MEP listed watersheds

In addition, Site HR-18 was added to the final potential site list as a possible location for a wastewater treatment facility. This site is part of the ocean outfall scenario described in Section 10 and would not be used for effluent recharge in any capacity:

- **HR-18** – The town-owner gardens and sheep farm at 50 Sisson Road in the Herring River watershed

Identifying these five sites was done through a multi-step process as depicted in Figure 9-1. The first step applied 10 site-screening criteria to all town parcels, enabling the Town to narrow the list from approximately 11,600 parcels to a more manageable number – in this case 40. Further analysis, factoring in several additional considerations, reduced the number of potential sites to 10.

Figure 9-1
Flowchart of Site Screening Selection Process



Once the ten sites were identified based on the second level of screening, they were presented to the Town for further discussion. The Town then considered eight wastewater scenarios (presented in Section 10) along with the 10 sites identified in the screening process, with the intention of narrowing the final sites down even further. The result was the selection of five sites to be carried forward in the CWMP. As discussed above, four of the sites were considered for wastewater treatment and effluent recharge, while one site was only considered for wastewater treatment.

Site investigations were then performed on the two best sites considered for effluent recharge. The site investigations included additional fieldwork and site visits which provided further information for town planners, engineers and other interested parties. The site investigation collected detailed field data at the HR-12 site, along with a limited amount of field data at the PB-3 site.

The data from the site investigation was then used in predictive modeling to address the following:

1. The potential ability of the site to infiltrate the treated effluent through the unsaturated zone;
2. The capacity of the aquifer to carry the infiltrated flow away from the site without causing too much mounding below the infiltration basins, or in any nearby properties; and
3. In the case of HR-12, the avoidance of potentially negative impacts on the adjacent capped landfill.

Detailed information on the hydrogeologic study of the effluent recharge sites is presented in Section 11.

It is important to note that while the most feasible sites have been determined, any site in the Town identified for this project could still be considered as a potential site. The sections below summarize the criteria, selection process, and resulting wastewater treatment and effluent recharge sites that are considered to be the best candidates in Harwich.

Section 9.7 has been added to this CWMP/SEIR to provide an update on the status of identifying and acquiring potential effluent recharge sites.

9.2 Initial Site Screening Criteria

In order to determine the most feasible location for effluent recharge within the Town of Harwich, it was necessary to evaluate all possibilities and use selection criteria to identify sites which best meet the program objectives. For the initial screening, all parcels of land within the Town boundaries were considered, and many were eliminated through a series of applied selection criteria. Criteria were established based on the needs of the program, including continued water resource and rare and endangered species protection, favorable soil and groundwater conditions, minimum parcel size, and town ownership.

Each of the ten criteria is described below and shown, respectively, as Figure 9-2 through Figure 9-11 on the following pages. Generally, all of the criteria were applied across the whole town. A few parcels were not eliminated due to exceptional circumstances. Such parcels include previously identified recharge sites, golf courses and gravel pits. Some of these exceptions are further described below.

9.2.1 Data Sources

The most up-to-date Graphic Information System (GIS) data available in 2009 were used to conduct the site screening analysis. The sources are listed in the following table and further described in Section 3.

Table 9-1
GIS Database Sources Utilized during Site Screening Analysis

Information	Source	Date
Color Ortho Imagery (1:5000)	MassGIS	2005
Community Boundaries	MassGIS	2002
Parcel Information	Town of Harwich, Assessors Dept	2006
Watershed Delineations	Cape Cod Commission	2008
100-yr Flood Zones	MassGIS, FEMA Q3	2007
Surficial Geology	MassGIS	2007
Wetlands Delineations	MassGIS, MassDEP	2006
Priority Habitats of Rare Species	MassGIS, NHESP	2006
Wellhead Protection Areas (Zone II)	MassGIS, MassDEP	2007
Town-Owned Lands	Town of Harwich, Assessors Dept	2006

9.2.2 Outside Zone of Contribution

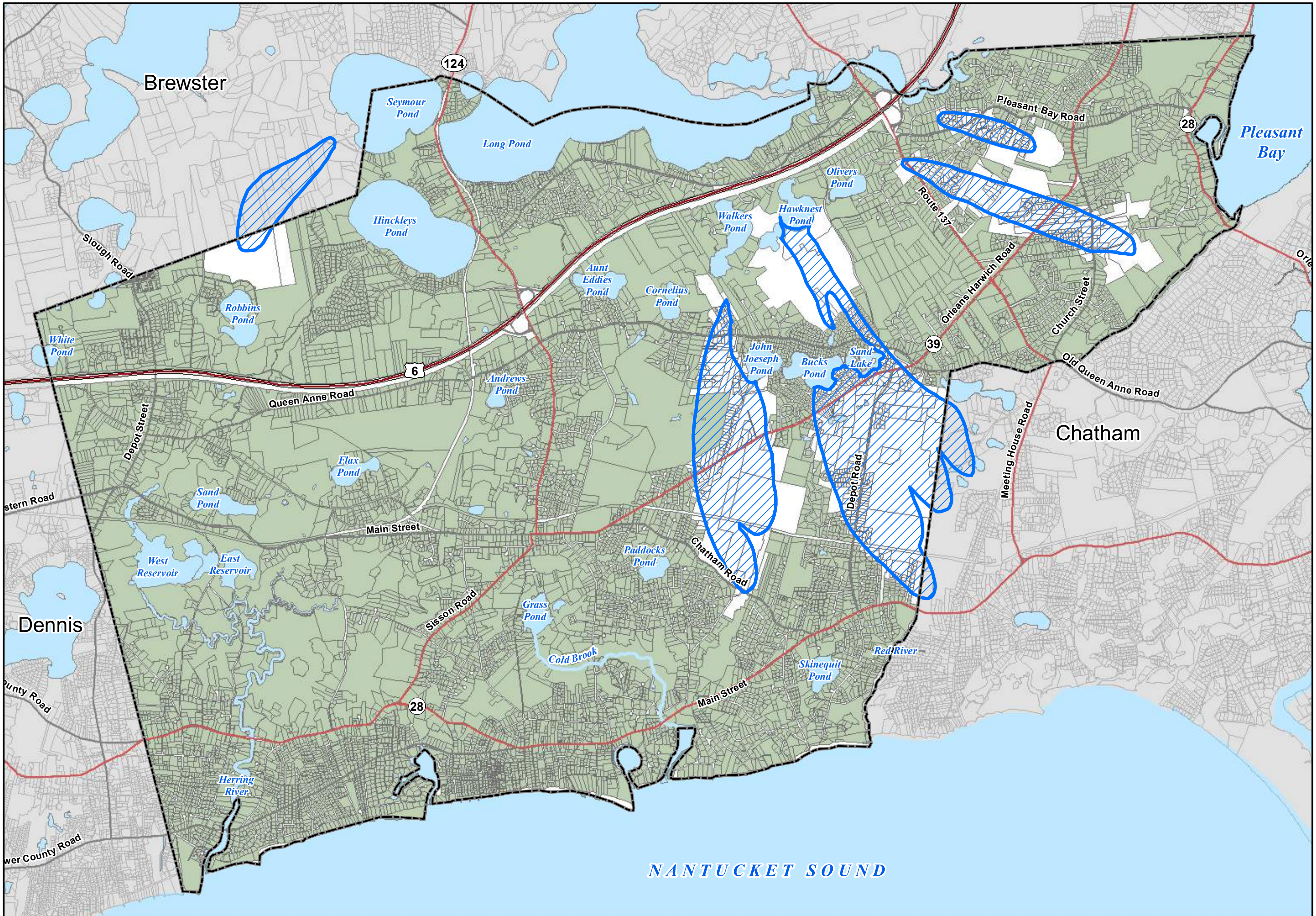
A well contribution zone is the groundwater area that regularly supplies water to a drinking water supply well. This area is calculated based on a variety of factors, including soil permeability, transmissivity within the aquifer and the rate of pumping based on past use.

The zone delineations used in this evaluation were developed by the Cape Cod Commission (CCC) and the UMass Dartmouth School for Marine Science and Technology (SMAST). SMAST calculated well contribution protection perimeters using a steady state model simulation of the area surrounding each well. Values are "based on average withdrawal rates [recorded] from 1995 through 2000 and an annual [rainfall] recharge rate of 27.75 inches/year."

As part of this investigation, all land parcels which were located within a zone of contribution were excluded from further consideration. Note that these zones differ from the MassDEP Zone II delineations which consider the most severe pumping rates for 180 days under drought (no recharge) conditions. See Figure 9-2 for well contribution zones within Harwich.

9.2.3 Parcel Size Greater than Five Acres

In order to account for current and future use, the minimum parcel size of land area which could be effectively utilized for effluent recharge was determined to be five acres. Therefore, this criterion eliminated all parcels less than five acres in size.



Legend

Zone of Contribution

Parcel Remaining After Site Screening

Site Screening Criterion 1
Zone of Contribution

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-2

CDM Smith

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One exception to this criterion was made based on land use. Gravel pits are generally smaller parcels of less than five acres. These pits often bound one another, however, and are typically located in remote areas or segments of land that are bordered by undeveloped parcels. Small bordering gravel pit parcels were grouped together to create an area of contiguous land of more than five acres. See Figure 9-3 for the outlined parcel areas which met this criterion.

9.2.4 Outside 100-year Floodplain Zones

Continuously recharging wastewater effluent requires highly permeable soils with sufficient depth to groundwater to account for groundwater mounding. Thus, areas with less permeable soils and shallow depth to groundwater are less desirable. Areas prone to flooding or which have limited soil permeability due to existing wet conditions were eliminated as part of this assessment.

The Federal Emergency Management Agency (FEMA) defines a 100-year floodplain as "an area inundated during a flood that has a 1-percent chance of being equaled or exceeded in any given year." Placing the effluent recharge zone outside of areas which have a probability of flooding will reduce the likelihood of backups in the recharge basins, odors, and worsening existing nearby flooding conditions. Figure 9-4 highlights parcels within the Town of Harwich which are outside of the 100-year floodplain as delineated in 2007. Note that more recent floodplain delineations do not include any of the final sites selected via this analysis and thus do not impact the site screening outcome.

9.2.5 Permeable Soils

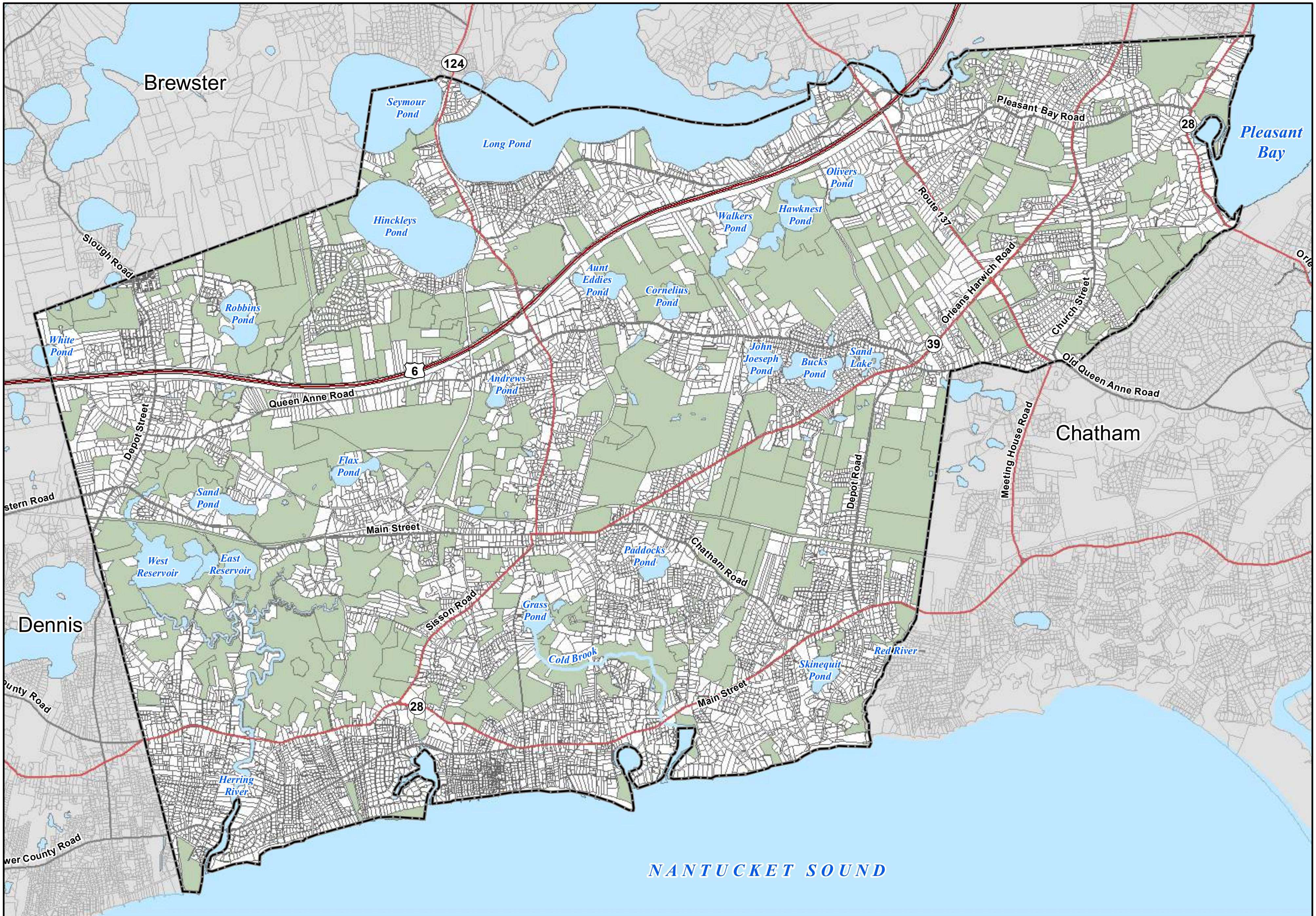
Soil permeability is one of the limiting factors which determines effective effluent recharge rates at a particular location. The higher the permeability of soil, the more water removal capacity a location can maintain. For a parcel to be a good candidate, at least five acres of the site must be outside a low-permeability soil zone. In this assessment, low-permeability soils were generally soils which formed through deposition from flowing water such as clays and silts. These soils are comprised of particles that are small and light enough to be carried by moving water, but large enough to settle out. Over time, the soils form as well sorted layers which, once settled, can be nearly impermeable.

Ideal soils for an effluent recharge site are poorly sorted, well drained sands and gravels that allow high permeability, and thus higher potential effluent recharge rates, within a 5-acre area. The parcels which met this criterion using NRCS and MassGIS soils data are shown in Figure 9-5.

9.2.6 Undeveloped Property

It is significantly more cost effective and resource efficient to develop an effluent recharge site from a parcel which is not currently developed. Developed property can be subject to zoning restrictions, tax assessments, or social issues. Thus, currently undeveloped property was surveyed as part of this investigation.

Some parcels which were not developed at the time of this assessment may not be considered developable land due to limited use restrictions, previous ownership, access, or other unspecified hazardous conditions. These parcels, when identified, were removed under this criterion. Privately owned developed sites were also excluded through this criterion due to the issues described above.



Legend

Parcel Area is Less Than 5 Acres

Parcel Remaining After Site Screening (Parcel Area > 5 Acres)

Site Screening Criterion 2
Minimum Parcel Size

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-3

CDM Smith

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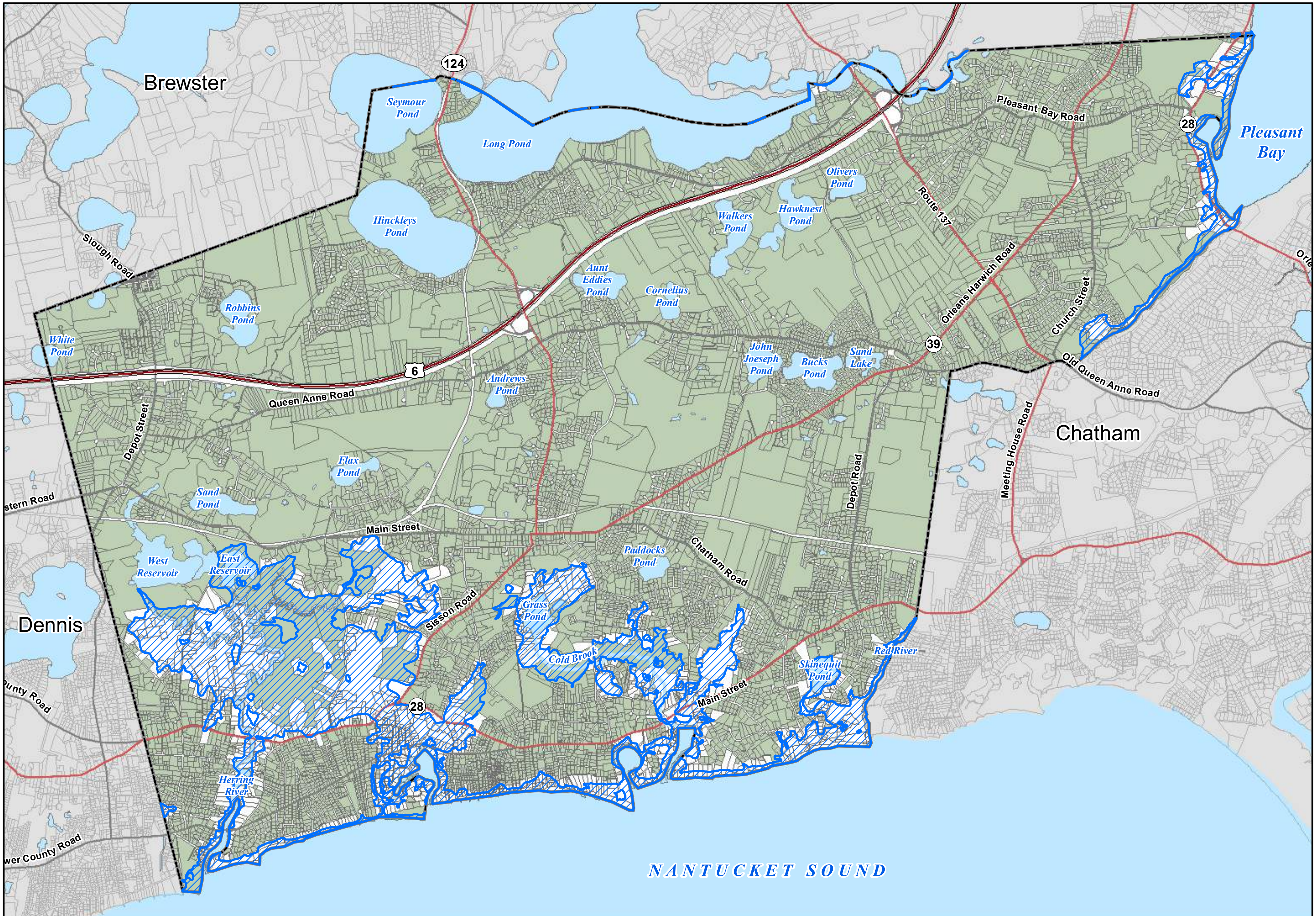

Legend

100 - Year Floodplain Boundary

Parcel Remaining After Site Screening

Site Screening Criterion 3

100-year Flood Zone

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-4

CDM Smith

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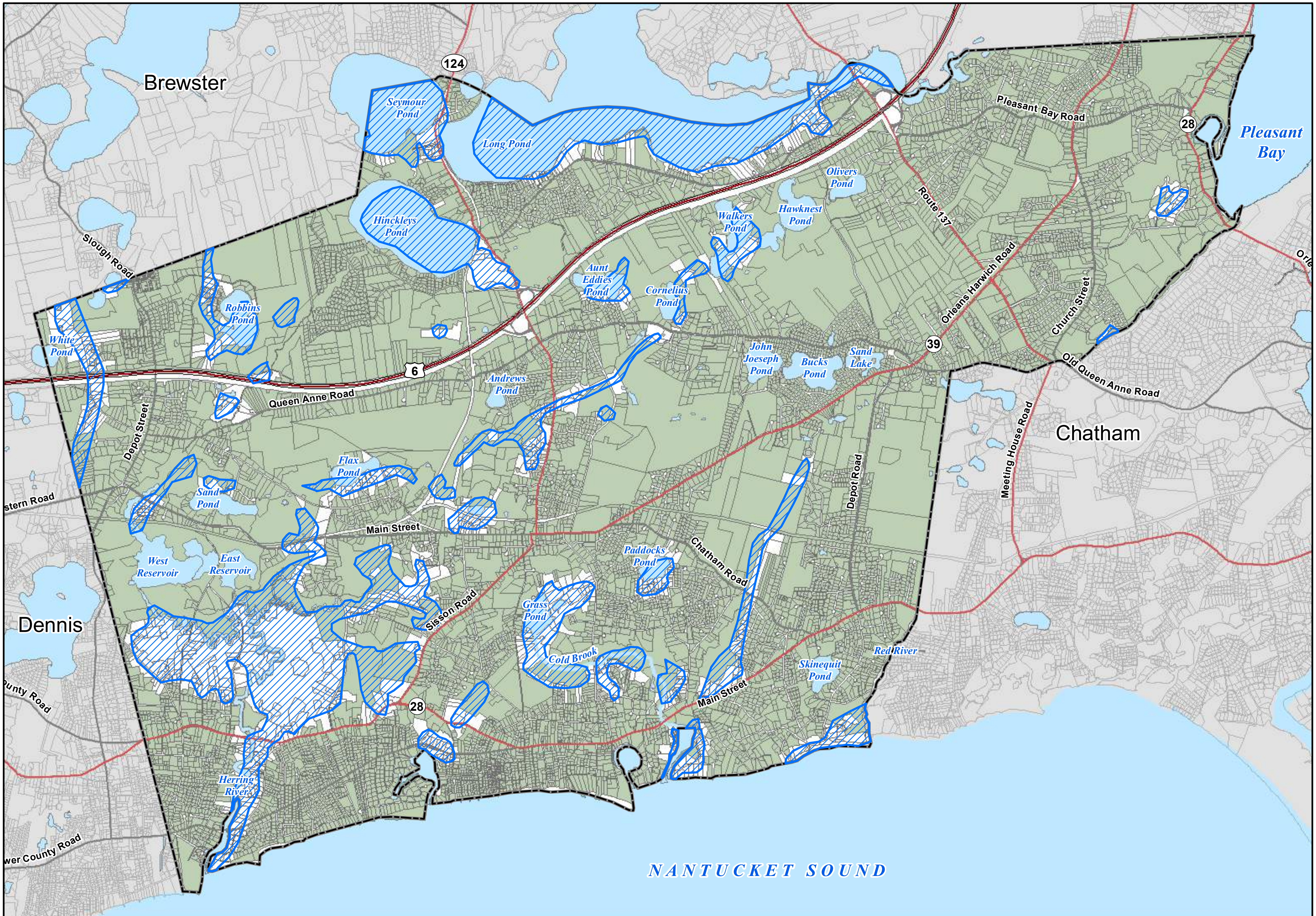

Legend

Low Permeability Soils

Parcel Remaining After Site Screening

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-5

Site Screening Criterion 4
Soil Permeability

CDM Smith

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Undeveloped town-owned land under the jurisdiction of the water department was excluded from consideration due to restrictions for well zones of contribution, as specified in Section 9.2.1 above. As water demand increases from Town resources, and as conditions change, restricting development in current water department land allows for potential future use. Protected conservation land was also excluded from consideration, as well as cemeteries, however most other town-owned parcels were retained. See Figure 9-6 for a map which outlines the parcels identified in this investigation.

9.2.7 Outside Wetlands

As described in Section 9.2.4 above, soil permeability is a key component to effective effluent recharge sites. Wetlands are typically areas where soils are fully saturated either seasonally or permanently. MassDEP defines wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Wetlands behave similarly to ponds, slowing groundwater flow, and leaving water to pool and stagnate on the surface. An ideal site would include a minimum of five acres of land which is not classified as wetlands and instead, as described in Section 9.2.4, contains soils that are highly permeable. Parcels which were identified as acceptable following this assessment are shown in Figure 9-7.

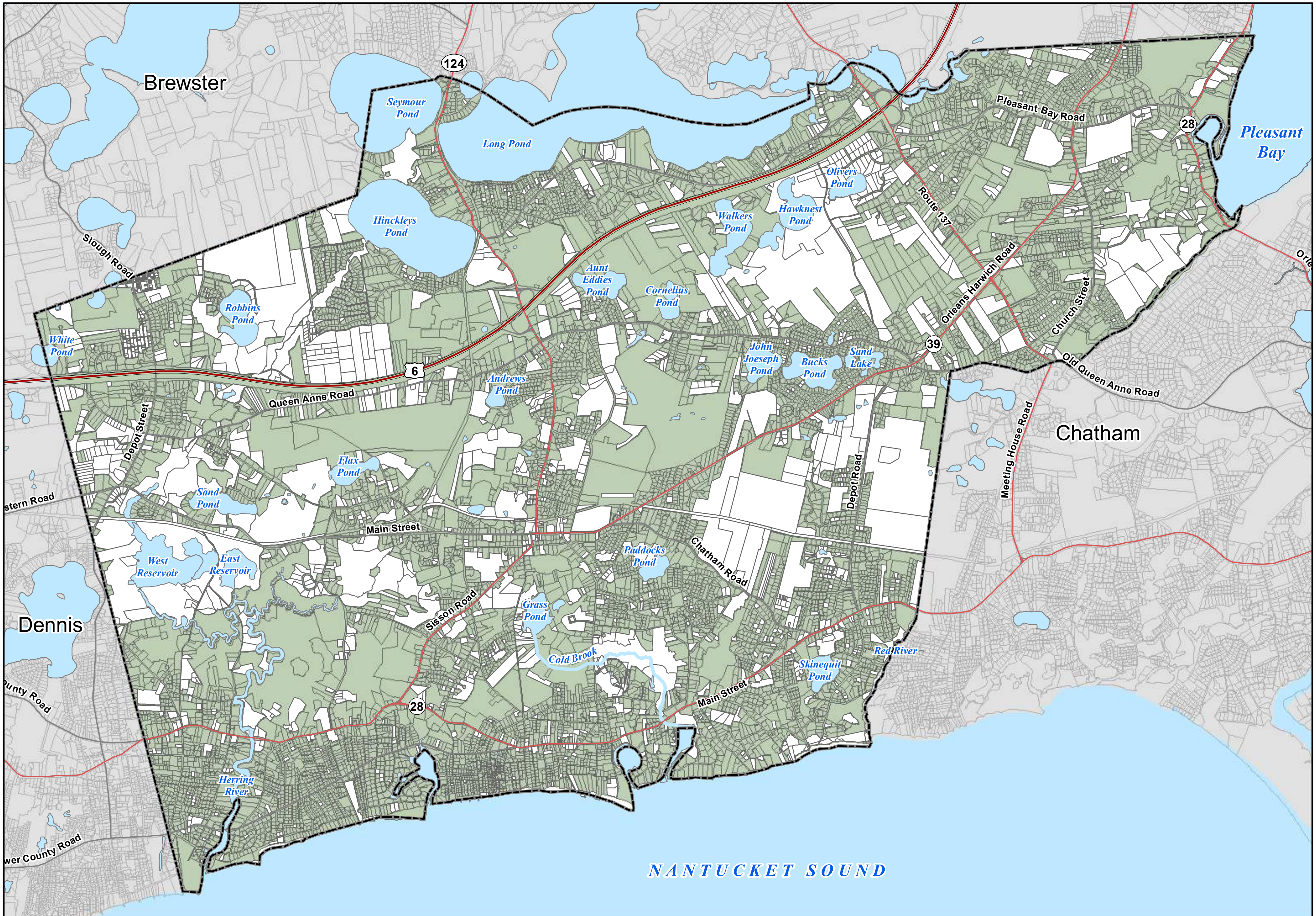
9.2.8 Favorable Depth to Groundwater

Estimated depth to groundwater is another measure of the capacity of receiving soils to accept effluent recharge. Portions of land which are not wetlands but maintain a high groundwater table may only be able to infiltrate a limited volume of additional water. Because wastewater effluent volume will be variable and groundwater mounding will occur as a result of effluent recharge, selecting a site with a minimum depth to groundwater of at least 5 feet below the ground surface will provide a reasonable buffer for this screening level of analysis.

Under this assessment, parcels where the estimated depth to groundwater was less than five feet were eliminated. The depth to groundwater calculations for parcels within the Town of Harwich were developed by CDM Smith in 2008 with information from USGS and MassGIS. Figure 9-8 shows all parcels within Harwich which maintain average depth to groundwater of at least 5 feet below ground surface.

9.2.9 Outside Priority Habitat Areas

Priority habitat areas refer to the geographical boundaries of known state-listed rare plant and animal species. Parcels which contain priority habitat areas would be subject to the Massachusetts Endangered Species Act (MESA) and regulatory review by the Natural Heritage and Endangered Species Program (NHESP) under the Massachusetts Division of Fisheries and Wildlife. NHESP defines priority habitats as "the geographic extent of Habitat for State-listed Species as delineated by the Division pursuant to 321 CMR 10.12."



Legend

- Developed or Undevelopable Town-Owned Parcel
- Parcel Remaining After Site Screening

Site Screening Criterion 5
Undevelopable Town Owned Property

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 9-6

CDM Smith

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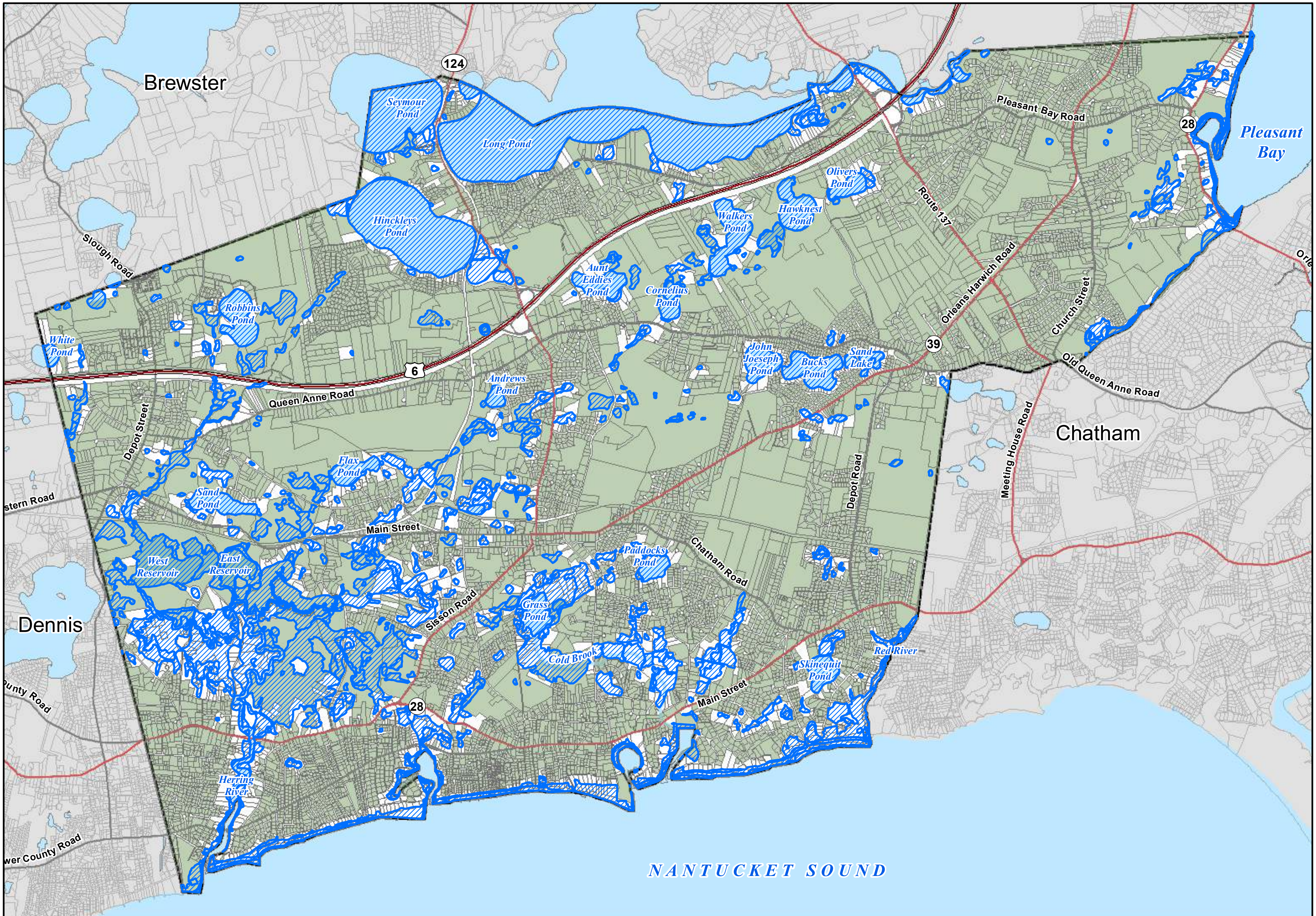

Legend

Wetlands

Parcel Remaining After Site Screening

Figure 9-7

Site Screening Criterion 6
Wetlands

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

CDM Smith

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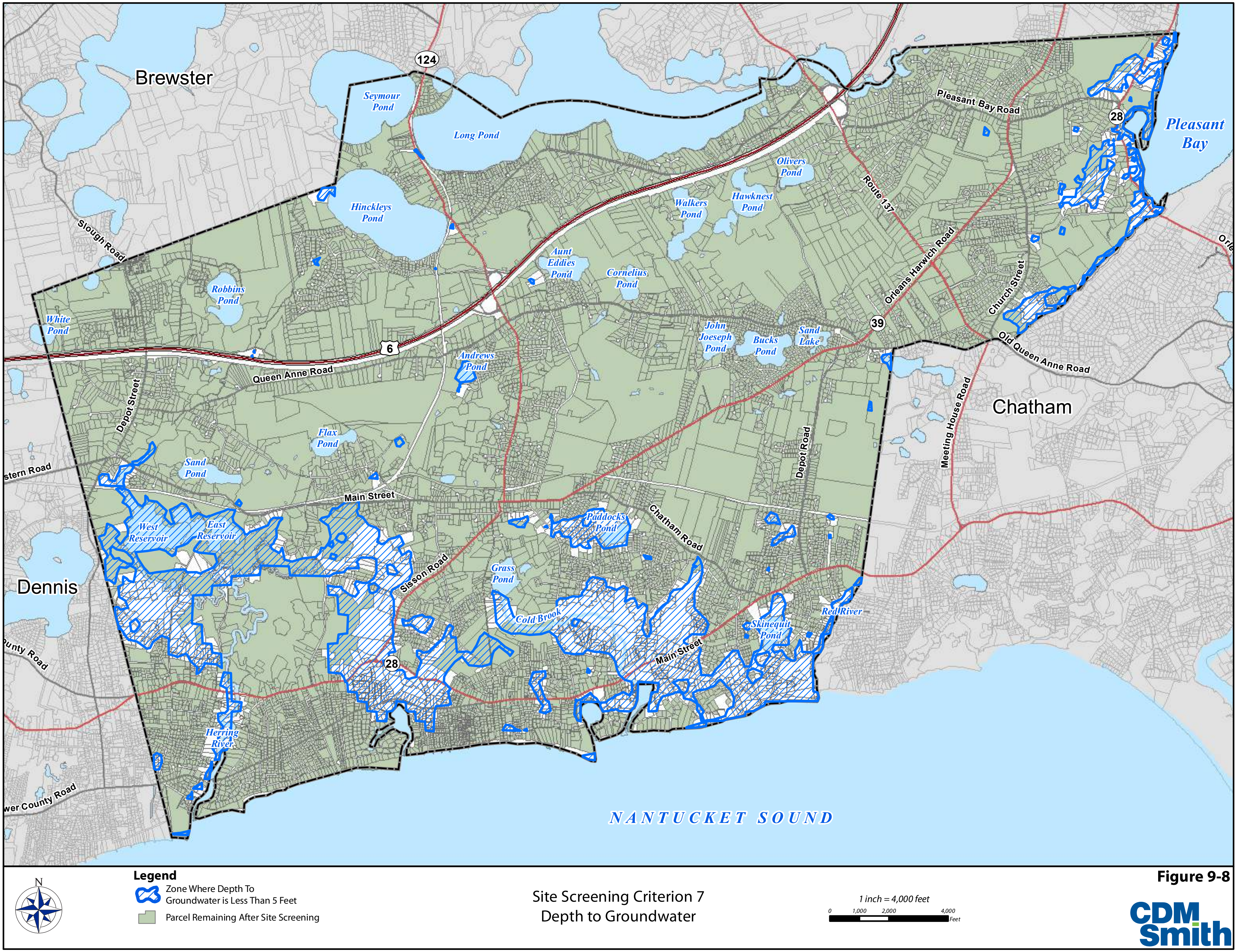

Figure 9-8

Site Screening Criterion 7
Depth to Groundwater

CDM Smith

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Parcels identified as being within a Priority Habitat of Rare Species zone were noted, but not excluded as potential effluent recharge sites in this analysis. Depending on the species and the extent of the habitat on the subject site, the existence of a priority habitat could eliminate a candidate site from the screening. Figure 9-9 shows all parcels located outside of Priority Habitat areas.

9.2.10 Outside Municipal Wellhead Protection Zone II

Wellhead protection zones are designated areas that are conservatively delineated to provide buffer space around the contribution zone for a public drinking water well. A Wellhead Protection Zone II, as defined by MassDEP, is "an area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation)."

Parcels within a Wellhead Protection Zone II area were noted as part of the initial screening, however, not excluded from this search. Sites that met other criteria but did not meet this criterion were evaluated to determine which portion of the property was outside the wellhead protection zone. See Figure 9-10.

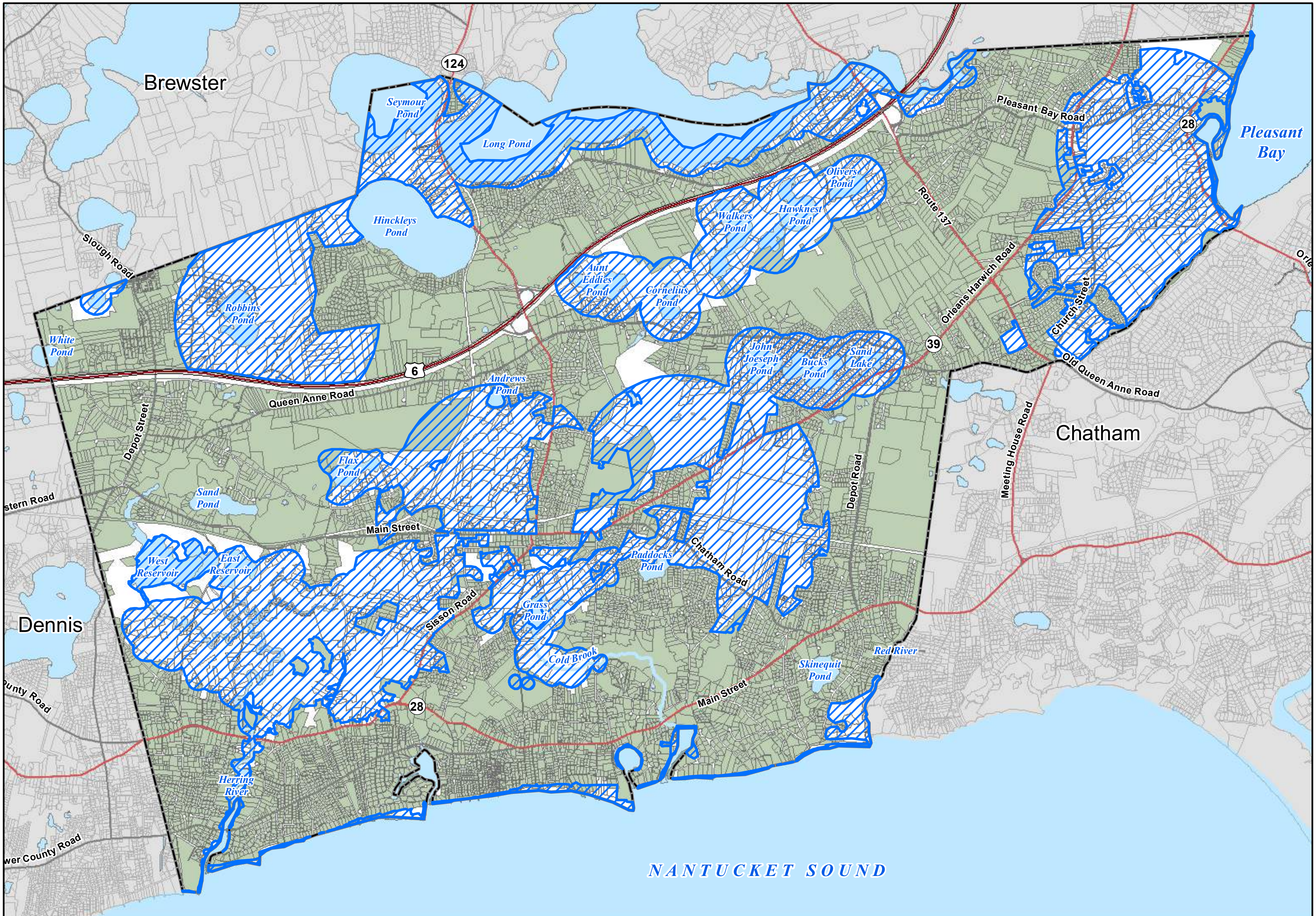
9.2.11 Town-owned Property

Property owned by the Town of Harwich was preferred in this assessment. Parcels already owned by the Town provide a significant financial, logistical, and legal advantage due to the relative ease by which access, development, and permitting could be obtained. If a parcel was privately owned, the Town would have to go through a legal process to obtain or purchase the property before it could be permitted and developed. Such processes may take months or years to complete, depending on the relationship with the owner, and may be expensive depending on the value of the parcel. For these reasons, parcels owned by the Town of Harwich were identified as particularly advantageous sites for effluent recharge. These properties are shown on Figure 9-11. For this criterion, acceptable town owned properties do not include cranberry bogs, conservation/protected lands, water department lands or cemeteries.

9.3 Initial List of Potential Effluent Recharge Sites

Using the ten criteria described, the initial screening reduced the approximately 11,600 parcels in Harwich to forty potential sites. Following this initial screening step, more investigation was necessary to ensure all reasonable locations were considered for further assessment.

Large parcels which initially did not meet criteria, generally because a portion of the property was located in a protected area, were further assessed for criteria eligibility. For parcels where at least 50 percent or five acres of land area met the criteria, parcel eligibility was adjusted. For instance, if half of the land in a 20-acre parcel is located in a wetland, the site was still considered eligible to meet that criterion because ten of the twenty acres were located outside the wetland. Table 9-2 shows the criteria analysis for each of the forty sites as well as the estimated acreage available for effluent recharge for all listed parcels. The amount of recharge modeled by the USGS for some of the sites in a previous evaluation performed in 2006 is noted in the table footnote.



Legend

NHESP Priority Habitats of Rare Species

Parcel Remaining After Site Screening

Site Screening Criterion 8
NHESP Areas

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-9

CDM Smith

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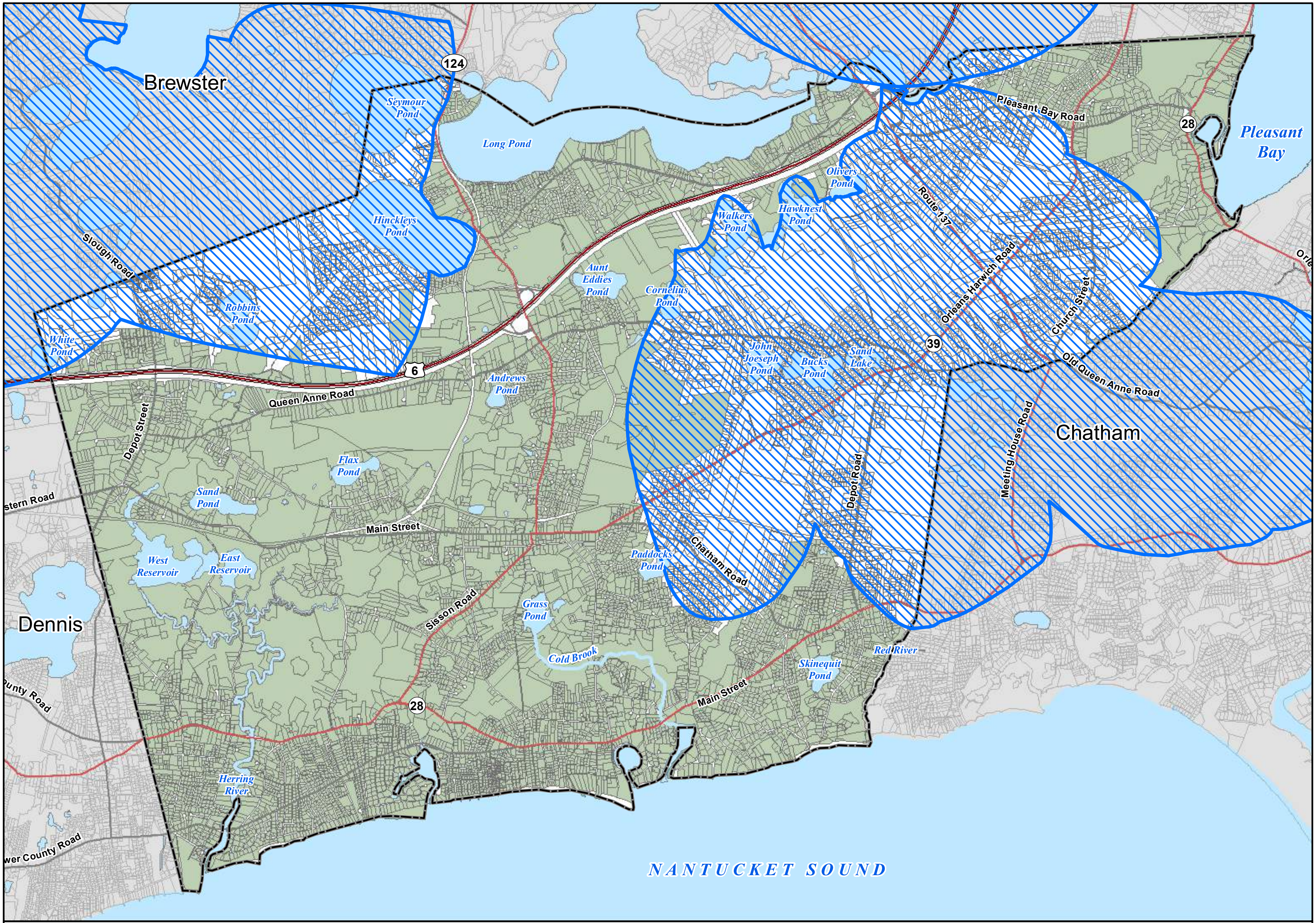

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Well Protection Zone II

Parcel Remaining After Site Screening

Site Screening Criterion 9
Zone II Areas

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-10

CDM Smith

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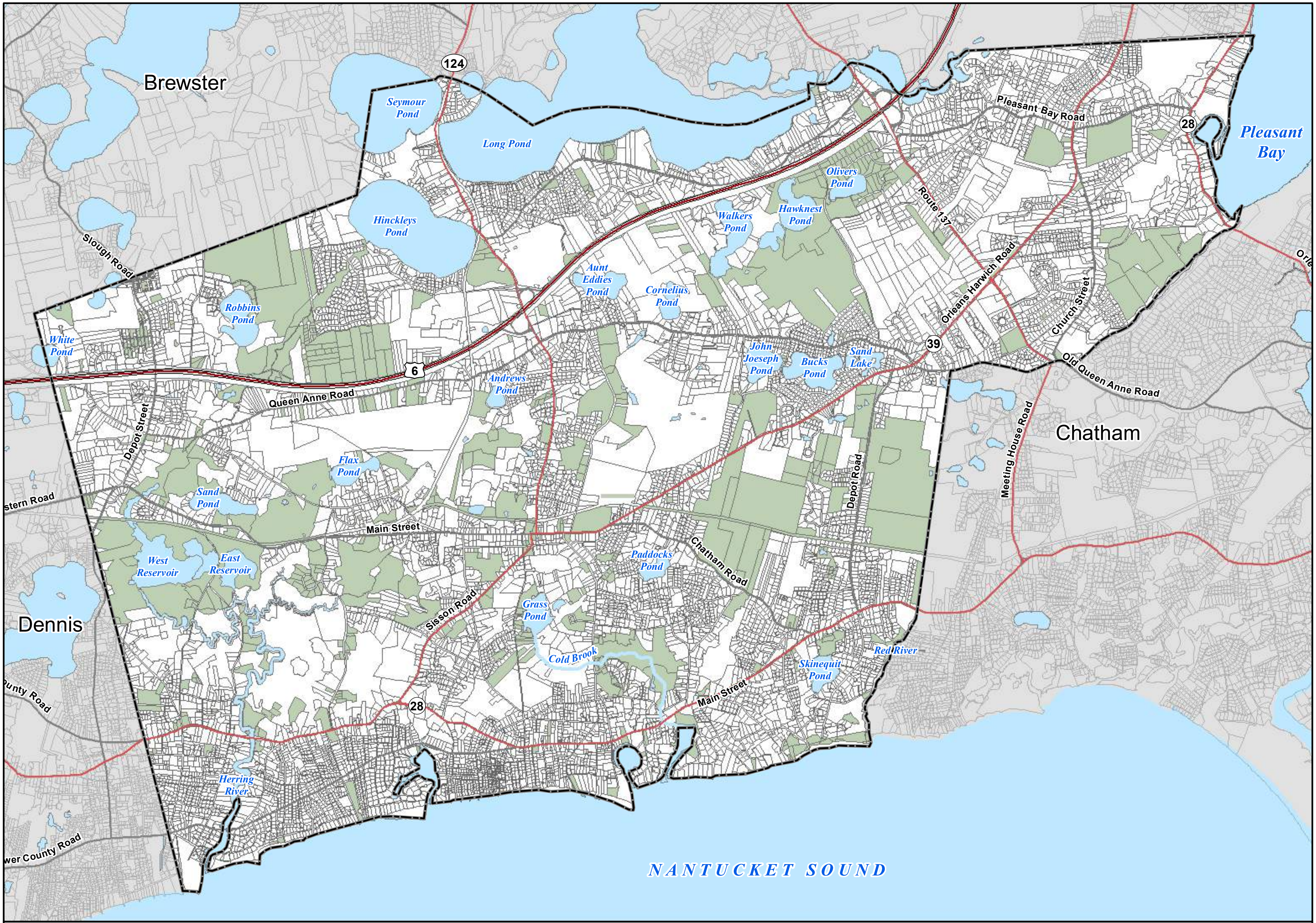

Legend

Parcel Remaining After Site Screening (Town Owned Land)

Site Screening Criteria 10
Town Owned Parcels

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 9-11

CDM Smith

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Table 9-2
Preliminary Effluent Recharge Site Screening Criteria Analysis

Number	Site Number	Outside Municipal well Contribution Zones	Parcel Size > 5 acres	Outside 100 Year Flood Plain	Permeable Soils	Un-Developed Property	Note	Outside of Wetlands	Favorable Depth to GW	Outside of Priority Habitat	Outside of a Zone II	Town Owned	# of Criteria Met	Acres	Notes
Herring River Watershed Sites															
1	HR-1	X	X	X	X	X	Gravel Pit	X	X	X	X	NO	9	54	
2	HR-2	X	X	X	X	NO	Structures / Woods	X	X	X	NO	NO	7	5	
3	HR-3	X	X	X	X	NO	Structures / Woods	NO	X	NO	NO	NO	5	14	
4	HR-4	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	X	NO	7	11	
5	HR-5	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	NO	NO	6	10	
6	HR-6	X	X	X	X	X	Undeveloped Woods	X	X	NO	X	X	9	14	
7	HR-7	X	X	X	X	X	Undeveloped Woods	X	X	NO	NO	X	8	39	
8	HR-8	X	X	X	X	NO	Structures / Woods	X	X	X	NO	X	8	5	
9	HR-9	X	X	X	X	NO	Structures / Woods	X	X	NO	NO	NO	6	18	
10	HR-10	X	X	X	X	NO	Large Area Undeveloped - Structures / Woods	X	X	NO	NO	NO	6	24	
11	HR-11	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	X	X	X	9	68	
12	HR-12	X	X	X	X	NO	Structures / Woods (Old Dump)	X	X	NO (3)	X	X	9	134	(1)
13	HR-13	X	X	X	X	X	Woods	X	X	X	X	NO	9	6	
14	HR-14	X	X	X	X	X	Woods	X	X	X	X	NO	9	6	
15	HR-15	X	X	X	X	X	Woods	X	X	X	X	X	10	8	
16	HR-16	X	X	NO	X	X	River Flats	NO	NO	NO	X	X	6	66	
17	HR-17	X	X	X	NO	X	Old Dump	X	NO	NO	X	X	7	22	(1)
18	HR-18	X	X	X	NO	NO	Structures / Woods (Sisson Road)	NO	NO	NO	X	X	5	30	(1)
19	HR-19	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	NO	X	X	8	17	
20	HR-20	X	X	X	X	NO	Structures/Woods (Area Undev. Behind Comm. Ctr.)	X	X	X	X	X	9	14	
Outside Watershed															
21	OW-1	X	X	X	X	NO	Woods / Parking (Beach Club)	X	X	X	X	X	9	6	
22	OW-2	X	X	X	X	NO	Fields - Golf course	X	NO	X	X	NO	7	58	(1)
23	OW-3	X	X	X	X	X	Woods / Gravel Pit	X	X	NO	X	NO	8	27	
24	OW-4	X	X	X	X	X	Woods	X	X	NO	NO	X	8	9	
25	OW-5	X	X	X	X	NO	Structures / Woods	X	X	NO	NO	NO	6	6	
Saquatucket Harbor Watershed Sites															
26	SH-1	X	X	X	X	NO	Golf Course	X	X	NO	NO	X	7	193	
27	SH-2	X	X	X	X	NO	Bldgs. / Sports Fields	X	X	NO	X	X	8	86	(1)
28	SH-3	X	X	X	X	NO	Sports Fields / Woods	X	X	NO	X	X	8	18	
29	SH-4	X	X	X	X	X	Woods	X	X	NO	X	NO	8	13	
30	SH-5	X	X	X	X	NO	Homes (Harwich Housing Authority)	X	X	X	X	X	9	9	
31	SH-6	X	X	X	X	X	Woods	X	X	X	NO	NO	8	7	
Pleasant Bay Watershed Sites															
32	PB-1	X	X	X	X	X	Woods	X	X	NO	NO	X	8	26	
33	PB-2	X	X	X	X	X	Woods	X	X	NO	NO	X	8	12	
34	PB-3	X	X	X	X	X	Gravel Pit / Woods (East Harwich Site)	X	X	X	NO	NO	8	117	(2)
35	PB-4	X	X	X	X	X	Woods	X	X	X	NO	NO	8	10	
36	PB-5	X	X	X	X	X	Woods	X	X	X	NO	NO	8	18	
37	PB-6	X	X	X	X	NO	Building	X	X	X	NO	X	8	6	
38	PB-7	X	X	X	X	X	Woods	X	X	X	X	NO	9	7	
39	PB-8	X	X	X	X	X	Woods	X	X	X	X	NO	9	5	
40	PB-9	X	X	X	X	NO	Golf Course	X	X	NO	X	NO	7	80	

Sites Highlighted in Blue are the Final Five Sites Selected For Additional Evaluations in the CWMP

Effluent Recharge - Modeled by United States Geological Survey (USGS) in a Previous Evaluation Performed in 2006

(1) **320,000 gpd** Was modeled at this site by USGS in 2006

(2) **80,000 gpd** Was modeled at this site by USGS in 2006

(3) **Upon further investigation a portion of this site is located within a NHESP area**

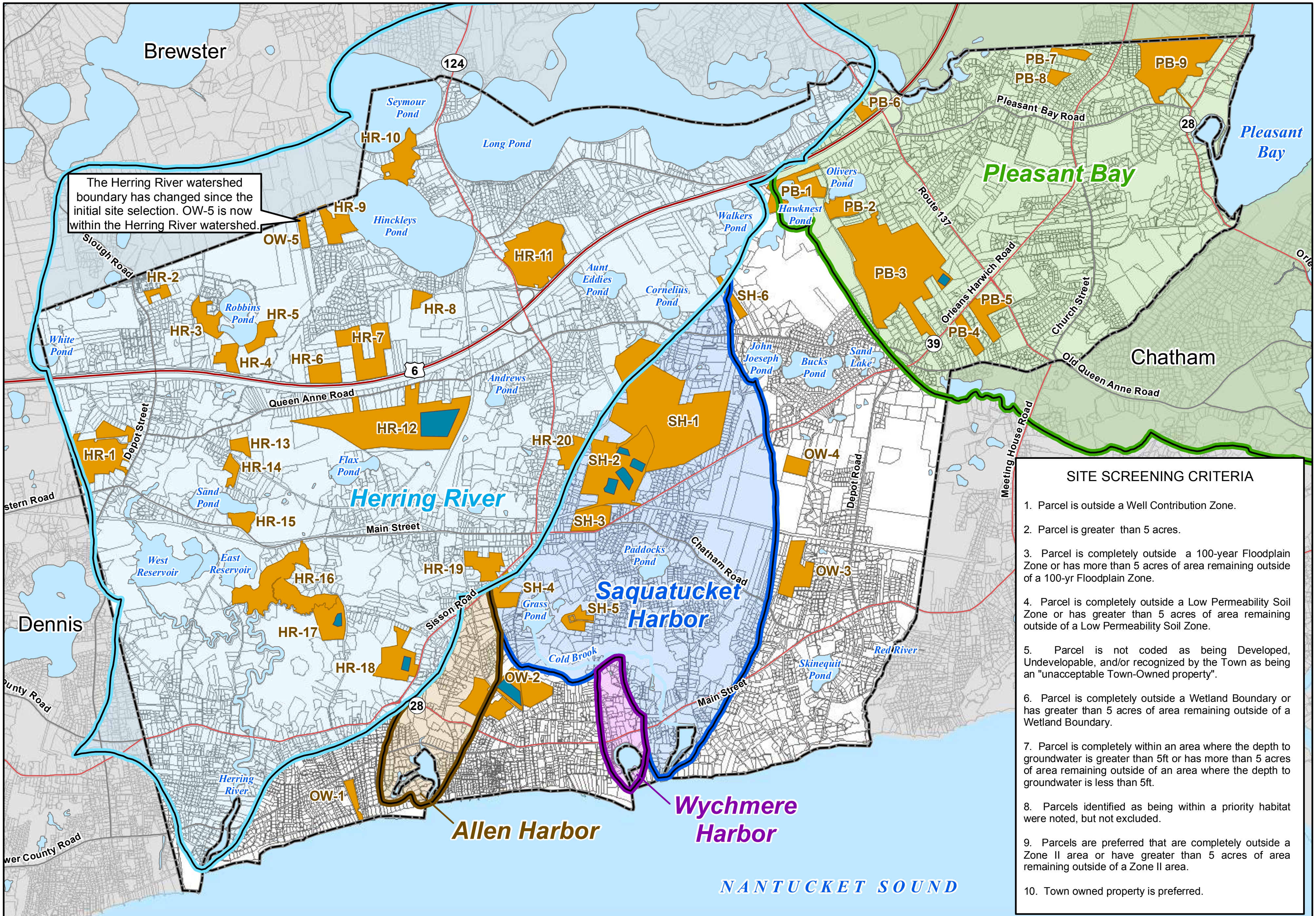
The subsections below outline the forty listed sites which were determined through the initial site screening process as meeting at least five of the ten criteria. The identified sites are organized by designated MEP watershed. Parcels are identified with a prefix acronym which distinguishes the associated watershed location, along with a reference number (e.g. a site in Herring River could be HR-1). No sites were identified in the Allen Harbor or Wychmere Harbor watersheds. Refer to Figure 9-12 for a map showing all 40 sites along with the MEP watershed boundaries.

9.3.1 Herring River Watershed

Herring River, located in the northwestern portion of the Town, is the largest MEP watershed in Harwich. The watershed contains a series of surface water resources including several ponds, two reservoirs, and the Herring River Estuary. The watershed includes portions of the Town of Brewster to the north and a small portion of the Town of Dennis to the west. The Mid-Cape Highway (Route 6) bisects the northern portion of the watershed.

Half of the forty potential wastewater recharge locations determined through the initial site screening criteria assessment are located within the Herring River watershed. The following is a description of each site. For further information, refer to Table 9-2 which outlines the criteria qualifications for all forty sites.

- Site **HR-1** is a group of 30 privately-owned adjacent parcels located on Depot Street in the northwestern portion of Harwich. Most of the site is zoned for general industrial use and it is primarily used as a gravel pit. This site passed 9 out of 10 site screening criteria.
- Site **HR-2** is a privately-owned property located in north Harwich. It passed 7 of the 10 site screening criteria but is located in a Zone II wellhead protection area.
- Site **HR-3** is a privately-owned property located in north Harwich. It passed 5 out of 10 site screening criteria but is located within a Zone II wellhead protection area, a Priority Habitat area, and a defined wetlands zone.
- Site **HR-4** is a privately-owned property in north Harwich. It passed 7 of the 10 site screening criteria but is within a Priority Habitat zone, and a portion of the parcel is within a Zone II wellhead protection area.
- Site **HR-5** is a privately-owned property in north Harwich. It passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and Zone II wellhead protection area.
- Site **HR-6** is composed of two adjacent town-owned properties in north Harwich. It passed 9 of the 10 site screening criteria, but it is within a Priority Habitat zone.
- Site **HR-7** is composed of five adjacent town-owned properties in North Harwich. It passed 8 of the 10 site screening criteria, but is partially within a Priority Habitat zone and partially inside a Zone II wellhead protection area.
- Site **HR-8** is a town-owned property in north Harwich. It passed 8 of the 10 site screening criteria, however a portion of the property is within a Zone II wellhead protection area.



SITE SCREENING CRITERIA

1. Parcel is outside a Well Contribution Zone.

2. Parcel is greater than 5 acres.

3. Parcel is completely outside a 100-year Floodplain Zone or has more than 5 acres of area remaining outside of a 100-yr Floodplain Zone.

4. Parcel is completely outside a Low Permeability Soil Zone or has greater than 5 acres of area remaining outside of a Low Permeability Soil Zone.

5. Parcel is not coded as being Developed, Undevelopable, and/or recognized by the Town as being an "unacceptable Town-Owned property".

6. Parcel is completely outside a Wetland Boundary or has greater than 5 acres of area remaining outside of a Wetland Boundary.

7. Parcel is completely within an area where the depth to groundwater is greater than 5ft or has more than 5 acres of area remaining outside of an area where the depth to groundwater is less than 5ft.

8. Parcels identified as being within a priority habitat were noted, but not excluded.

9. Parcels are preferred that are completely outside a Zone II area or have greater than 5 acres of area remaining outside of a Zone II area.

10. Town owned property is preferred.

Legend

- Allen Harbor
- Herring River
- Pleasant Bay
- Saquatucket Harbor
- Wychmere Harbor
- Parcel Remaining After Final Site Screening
- Previously Identified Potential Recharge Site (2006)

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Initial Site Screening Summary

Figure 9-12

CDM Smith

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- Site **HR-9** is composed of two adjacent privately-owned properties in north Harwich. It passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and a Zone II wellhead protection area.

- Site **HR-10** is a privately-owned property in north Harwich which passed 6 of the 10 site screening criteria but is within a Priority Habitat zone and inside a Zone II wellhead protection area.

- Site **HR-11** is the Cape Cod Regional Technical High School located at 351 Pleasant Lake Avenue. This town-owned 68.7-acre site passed 9 of the 10 screening criteria but is mostly developed, limiting available recharge space to subsurface areas below existing ballfields.

- Site **HR-12** is a town-owned property located adjacent to the former town landfill and the current location of Harwich Highways and Maintenance Department. A solid waste transfer station is located in the western portion of the property. This 137.6-acre site is south of the Mid-Cape Highway (Route 6) near Queen Anne Road. It is zoned for general industrial use and passed 9 of the 10 screening criteria. A portion of the site is within a Priority Habitat zone (NHESP).

- Site **HR-13** is a privately-owned property in north Harwich which passed 9 of the 10 site screening criteria.

- Site **HR-14** is a 6.4-acre privately-owned property located on Deacons Folly Road, north of Sand Pond, which passed 9 of the 10 site screening criteria.

- Site **HR-15** is an undeveloped area on Great Western Road, south of Sand Pond. The 8-acre site passed all 10 screening criteria.

- Site **HR-16** is adjacent to HR-17 and passed 6 of 10 screening criteria. However, this parcel is within a 100-year flood zone, consists of shallow depth-to-groundwater, and is within a Priority Habitat zone.

- Site **HR-17** is an abandoned burn dump on Lothrop Road. The property passed 7 of the 10 screening criteria but was found to be within a Priority Habitat zone.

- Site **HR-18** is the location of the town-owned gardens and sheep farm on Sisson Road. It passed 5 of the 10 site screening criteria, however it is located within a delineated wetland area, is coded as protected/conservation land in the Assessors index, and is within a Priority Habitat zone.

- Site **HR-19** is the Harwich Elementary School on South Street in central Harwich. This 17.4-acre site passed 8 of 10 screening criteria. The site has limited available capacity due to existing infrastructure, and effluent recharge would be limited to subsurface areas below existing ballfields. It is located near the Saquatucket Harbor and Allen Harbor watersheds.

- Site **HR-20** is the town-owned Harwich Community Center on Oak Street. The site passed 9 of 10 site screening criteria and is near the Saquatucket Harbor watershed. Effluent recharge would be limited to beneath the new ball fields.

9.3.2 Outside Watershed Sites

The following sites are located within the Town of Harwich, but not located within any of the MEP designated watersheds.

- Site **OW-1**, located near the Allen Harbor and Herring River watersheds, is owned by the Town. The narrow 6.2-acre site off Earle Road has beach access and a public parking lot on a small portion of the parcel. A small portion of the property is within a Priority Habitat zone. This site passed 9 of the 10 site screening criteria.

- Site **OW-2** is comprised of two privately-owned parcels and includes the Harwich Port Golf Course on South Street. The site passed 7 of the 10 site screening criteria, is privately owned, and is close to the Allen Harbor, Saquatucket Harbor, and Wychmere Harbor watersheds. Effluent recharge would be beneath the golf course fairways.

- Site **OW-3** is a privately-owned property which borders the Saquatucket Harbor watershed. It passed 8 of the 10 site screening criteria but is within a Priority Habitat zone and partially inside a Zone II wellhead protection area.

- Site **OW-4** is a town-owned property which borders the Saquatucket Harbor watershed. It passed 8 of 10 site screening criteria but is within a Priority Habitat zone and Zone II wellhead protection area.

- Site **OW-5** is a privately-owned property in north Harwich, partially located within the Herring River watershed. It passed 6 of 10 screening criteria but is within a Priority Habitat zone and inside a Zone II wellhead protection area.

9.3.3 Saquatucket Harbor

The Saquatucket Harbor (SH) watershed is located in central Harwich. The watershed includes Paddocks Pond and Grass Pond, in addition to small surface water streams and the Bank Street Bogs (Cold Brook), which may be enhanced in the future and utilized for additional nitrogen removal. The Saquatucket Harbor watershed is also the site of Harwich High School (now Monomoy Regional High School). There are six parcels for consideration in this watershed.

- Site **SH-1** is comprised of two adjacent properties owned by the Cranberry Valley Golf Course. While this parcel is partially located within a Zone of Contribution and a Priority Habitat area, it was retained because current site use allows for effluent recharge while maintaining golf course activities. This parcel passed 7 of 10 site screening criteria.

- Site **SH-2** is comprised of two adjacent town-owned properties, including Harwich High School (now Monomoy High School) and the athletic fields. This 103-acre site passed 8 of 10 site screening criteria, though a small portion is within a Priority Habitat zone and within a Zone II wellhead protection area. Because of the existing infrastructure and new school construction, effluent recharge would be limited to beneath existing and future recreational fields.

- Site **SH-3** passed 8 of 10 site screening criteria, though a large portion is located within a Priority Habitat zone.
- Site **SH-4** is a privately-owned property located in central Harwich. It passed 8 of 10 site screening criteria but is within a Priority Habitat zone.
- Site **SH-5** is town-owned property in central Harwich. It passed 9 of 10 site screening criteria, though a small portion of the property is located within a Priority Habitat zone.
- Site **SH-6** is a privately-owned property partially located within the Saquatucket Harbor watershed. This parcel passed 8 of 10 site screening criteria, though it is within a Zone II wellhead protection area, and half of the property is within a Priority Habitat zone.

9.3.4 Pleasant Bay

The Pleasant Bay (PB) watershed is in the eastern portion of Harwich and extends to the adjacent communities of Orleans, Brewster, and Chatham. The Pleasant Bay watershed includes river valley estuaries, barrier beaches and islands, salt marshes, and flats which exchange tidal waters with a large lagoonal estuary. The Pleasant Bay sub-embayment is bounded by Harwich and Brewster to the southwest and northwest, respectively, Orleans and Little Pleasant Bay to the North, and Chatham to the south.

- Site **PB-1** is a town-owned property which passed 8 of 10 site screening criteria, however it is located within a Zone II wellhead protection area and a Priority Habitat zone.
- Site **PB-2** is a town-owned property which passed 8 of 10 site screening criteria, but is located within a Zone II wellhead protection area and a Priority Habitat zone.
- Site **PB-3** is composed of 15 adjacent privately-owned properties. Most of the site is currently used as a gravel pit and passed 8 of the 10 site screening criteria, but it is within a Zone II wellhead protection area.
- Site **PB-4** is a privately-owned property which passed 8 of the 10 site screening criteria but is within a Zone II wellhead protection area.
- Site **PB-5** is composed of two adjacent privately-owned properties which passed 8 of the 10 site screening criteria, however they are located within a Zone II wellhead protection area.
- Site **PB-6** is a town-owned property which passed 8 of 10 site screening criteria, but is partially located within a Priority Habitat zone.
- Site **PB-7** is a privately-owned, undeveloped property in northeastern Harwich located on Halls Way, south of the Captain's Golf Course. This 7.3-acre site passed 9 of the 10 screening criteria.

- Site **PB-8** is a privately-owned property in the Pleasant Bay watershed. It passed 9 of 10 site screening criteria.

- Site **PB-9** is the privately-owned Cape Cod National Golf Course. The site passed 7 of the 10 site screening criteria but includes a portion of a Priority Habitat zone.

9.4 Recommended 10 Sites and HR-18

Input from the WMS, the Planning Department and other town representatives was sought at this stage to help further screen the 40 sites down to a feasible number that could be considered for detailed evaluation. Factors considered included environmental impacts, land-use patterns, proposed future development and institutional knowledge.

All of the criteria used to identify the 40 sites were applied with equal weighting. However, further discussions with the Committee and town representatives indicated that sites falling within a Zone II area to a municipal well or sites that are privately owned should not be rated as highly as sites outside of Zone II areas or town-owned sites. Both of these criteria would have the potential to increase the cost to utilize a given site for effluent recharge. It was also felt that it was important to identify sites within or near each of the major watersheds in town, as this would benefit the development of potential scenarios to deal with sewersheds within each watershed.

Utilizing the above guidance, the identified sites meeting the highest number of the 10 initial criteria (number met noted in parenthesis) are briefly discussed below with the recommendation to either carry into the next phase, or to drop at this stage.

- HR-1 (9): This privately owned site is a gravel pit operation located on the Dennis and Harwich town line. The site is well buffered from residential development. It may provide an opportunity for a regional alternative with Dennis. A portion of the site may have low permeability soils, but its large area may allow for location of infiltration basins on the eastern portion. The site is located about 2,000 linear feet upgradient of Reservoir Pond. This site was carried forward.

- HR-6 (9) and HR-7 (8): Both sites are town owned and located north of Route 6. The sites are in a Priority Habitat area and at the perimeter of an existing Zone II area. The sites are well buffered from residential areas since they abut the highway. The heavily wooded sites are combinations of several town owned parcels which were acquired for conservation purposes. The two sites were carried forward.

- HR-11 (9): This site is where Cape Cod Regional Technical School is located north of Route 6. The majority of the site is built upon and any recharge area would be limited to subsurface areas beneath parking lots and fields. This site was eliminated.

- HR-12 (9): This town-owned site is controlled by the Division of Highways and Maintenance and consists of a heavily wooded 20 acre section to the east where potential infiltration basins could be located. To the west of the site is the town's former capped landfill, and in the middle of the site is where the town is mining material for town projects. The site is located about a 1,000 feet upgradient of some cranberry bogs in the upper reaches of the eastern branch of the Herring River. This site was carried forward.

- HR-13 (9): This site is privately owned and relatively small versus other available sites in this watershed. This site was eliminated.
- HR-14 (9): This site is privately owned and relatively small versus other available sites in this watershed. The site is about a 1,000 feet upgradient from Sand Pond. This site was eliminated.
- HR-15 (10): This site is town owned and relatively small versus other available sites in the watershed. It is also surrounded within 1,000 feet by Sand Pond to the north and Reservoir Pond to the south. This site was eliminated.
- HR-20 (9): This site houses the Harwich Community Center, and the Town recently constructed ball fields in the wooded area behind the building and parking lots. Similar characteristics can be found at the sites to the east (SH-1 and SH-2). This site was eliminated.
- OW-1 (9): This site is a very narrow parcel surrounded by dense residential developments. It is part of a town-owned beach parking lot which would limit the recharge to subsurface systems. This site was eliminated.
- OW-2 (7): This site is the Harwichport Golf Course, which is privately owned. The majority of the course area has shallow depth to groundwater and recharge would be limited to subsurface recharge systems. However, it is the site located closest to the Allen and Wychmere Harbor watersheds and does have the potential for water reuse options during the growing season. This site was carried forward.
- SH-1 (7): This site is the town owned Cranberry Valley Golf Course, which is located on the perimeter of a Zone II to a municipal well. For that reason, the area of focus is the western portion of the site near the driving range. Subsurface recharge systems could be used beneath the driving range or adjacent fairways or water features added in those areas. It also has the potential for water reuse options during the growing season. This site was carried forward.
- SH-2 (8): This site is the Harwich High School parcel. The site contains several ballfields where subsurface recharge could be utilized or wooded areas which could be similarly used for new ballfields. Harwich and Chatham are now constructing the Monomoy Regional High School on this site which would need to be coordinated, and a portion of the site is identified as Priority Habitat area. This site was carried forward.
- SH-3 (8): This site is a town-owned recreation facility site and former water tower location. A large portion of the site is still densely wooded, and it has been identified as a Priority Habitat area. This site was carried forward.
- SH-5 (9): This site is the Harwich Housing Authority and is essentially built out with only limited subsurface recharge sites available. This site was eliminated.
- PB-3 (8): This site is a large privately owned gravel pit area located near East Harwich Center. The site is located within a Zone II to a municipal well. Sufficient area outside mined locations appears to exist to allow infiltration basin recharge to be utilized. This appears to be the best site in the Pleasant Bay watershed and thus was carried forward.

- PB-7 (9): This site is privately owned near the Brewster town line and a subdivision plan has been filed for it. The site is surrounded by densely developed residential areas. This site was eliminated.
- PB-8 (9): This site is also located near the Brewster town line and is completely surrounded by dense residential developments. The site is relatively small versus other available sites in the watershed. It also has the potential for water reuse options during the growing season. This site was eliminated.
- PB-9 (7): This site is partially located in Harwich and partially in Brewster and is the privately owned Cape Cod National Golf Course. The site is relatively high in elevation allowing for sufficient depth to groundwater for subsurface recharge systems that could be installed under some of the fairways. This site was carried forward.

At this stage in the selection process, the Town also considered a wastewater treatment site for an ocean outfall scenario. The HR-18 site, a town-owned property, was selected as a potential wastewater treatment site only. The site does not have to pass as many of the criteria as an effluent recharge site. This site was selected for its location near the proposed ocean outfall in Section 10.

- HR-18 (5) is the location of the town-owned gardens and sheep farm on Sisson Road. It passed 5 of the 10 site screening criteria, however it is located within a delineated wetland area, is coded as protected/conservation land in the Assessor's index, and is within a Priority Habitat zone. This site should be carried forward because it is a town-owned site and is only being considered for a wastewater treatment facility. If this site is utilized, all effluent will be sent to an ocean outfall, minimizing the impacts to sensitive resources on and around this site.

Table 9-3 summarizes the effluent recharge site screening analysis final screening (10 Recharge Sites + 1 WWTF site) noted above. Key environmental criteria are shown in the table.

Figures 9-13 through 9-22 show aerial views of the sites and the areas to be considered for effluent recharge.

9.5 Further Evaluation of Ten Recharge Sites

Further assessment was conducted on the final 10 effluent recharge sites presented in Table 9-3 to assess the size, available acreage, and effluent recharge rates for each location. In this assessment, consideration was made as to which criteria were met in order to determine the feasibility of effluent recharge. The amount of acreage and the type of effluent recharge for each site provides an initial estimate of the site's potential capacity to receive effluent flow.

9.5.1 Available Acreage

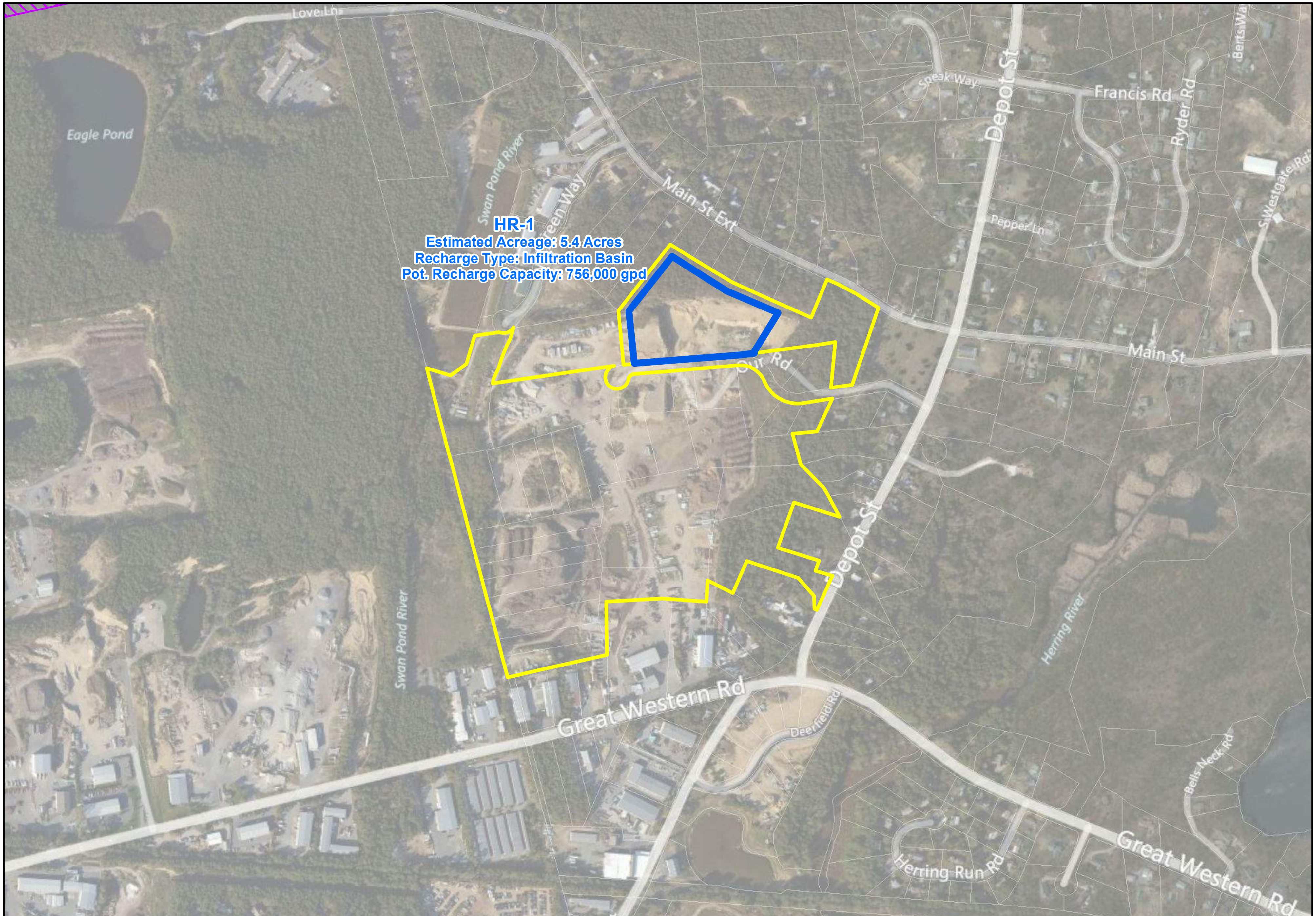
The initial estimates of available land area were based on the site screening criteria and input from the Town based on current and anticipated future uses of the site. The available acreage is only a planning level estimate that would need to be further refined during actual site investigations, including hydrogeological evaluations.

Table 9-3
Final Effluent Recharge/WWTF Site

	Site Number	Note	Watershed	Outside of a Priority Habitat?	Outside of a Zone II	Town Owned	Acres	Estimated Available Acreage	Recharge Type (IB), (SUB)	Potential Theoretical Recharge Capacity (gpd)
Recommended Sites										
1	**HR-1**	Gravel Pit	Herring River	X	X	NO	54	5.4	IB	756,000
2	**HR-6**	Undeveloped Woods (HR-6)	Herring River	NO	X	X	14	10.3	IB	1,442,000
3	**HR-7**	Undeveloped Woods (HR-7)	Herring River	NO	NO	X	39	14.2	IB	1,988,000
4	**HR-12**	Structures / Woods (Old Dump)	Herring River	NO (1)	X	X	134	20.0	IB	2,800,000
5	**Hr-18**	Structures / Woods (Sisson Road)	Herring River	NO	X	X	30	2.3	NONE	No Recharge Proposed
6	**OW-2**	Fields - Golf course	Outside Watershed	X	X	NO	58	6.9	SUB	276,000
7	**SH-1**	Golf Course (SH-1)	Saquatucket Harbor	NO	NO	X	193	4.3	IB	602,000
8	**SH-2**	Bldgs. / Sports Fields (SH-2)	Saquatucket Harbor	NO	X	X	86	12.0	SUB	480,000
9	**SH-3**	Sports Fields / Woods (SH-3)	Saquatucket Harbor	NO	X	X	18	3.4	SUB	136,000
10	**PB-3**	Gravel Pit / Woods (East Harwich Site)	Pleasant Bay	X	NO	NO	117	10.0	IB	1,400,000
11	**PB-9**	Golf Course	Pleasant Bay	NO	X	NO	80	1.6	SUB	64,000

Potential recharge estimated is based on: 140,000 gpd/acre for Infiltration basin (IB) and 40,000 gpd/acre for subsurface (SUB). These must be confirmed in the field.
(1) Portion of site is in NHESP area.

Sites Highlighted in Blue are the Final Five Sites Selected For Additional Evaluations in the CWMP



Legend

Recommended Effluent Recharge Site

Site Boundary

Zone II

Town of Harwich

Comprehensive Wastewater Management Plan

Preliminary Site HR-1

Figure 9-13

1 inch = 600 feet

0 300 600 Feet

CDM Smith

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Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-6

1 inch = 600 feet

0 300 600 Feet

Figure 9-14

CDM Smith

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Legend

Recommended Effluent Recharge Site

Site Boundary

Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-7

Figure 9-15

CDM Smith

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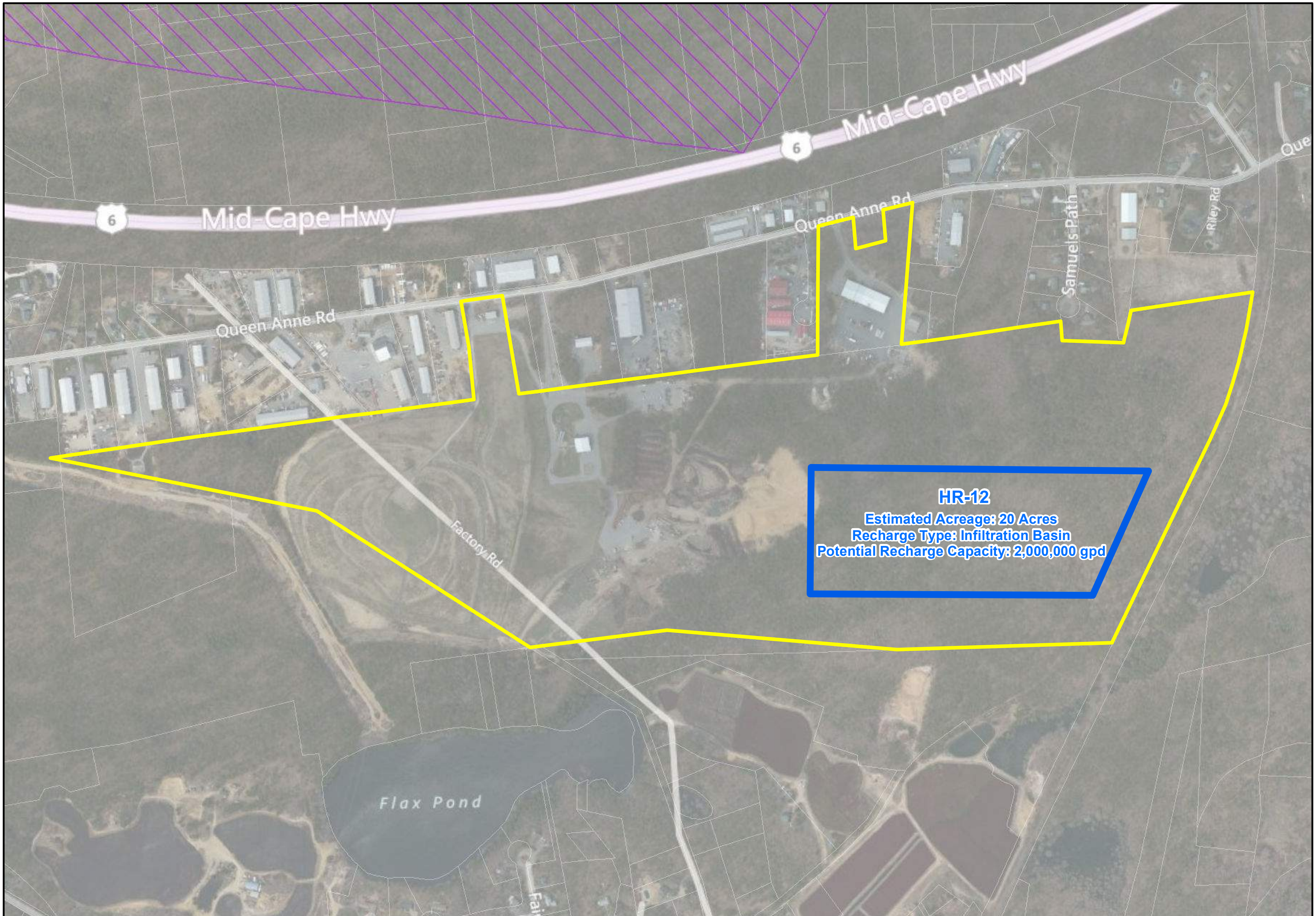

Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site HR-12

1 inch = 600 feet
0 300 600 Feet

Figure 9-16

CDM Smith

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Legend

Recommended Effluent Recharge Site

Site Boundary

Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary OW-2

1 inch = 600 feet
0 300 600 Feet

Figure 9-17

CDM Smith

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N

Legend

Recommended Effluent Recharge Site

Site Boundary

Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-1

1 inch = 600 feet
0 300 600 Feet

Figure 9-18

CDM Smith

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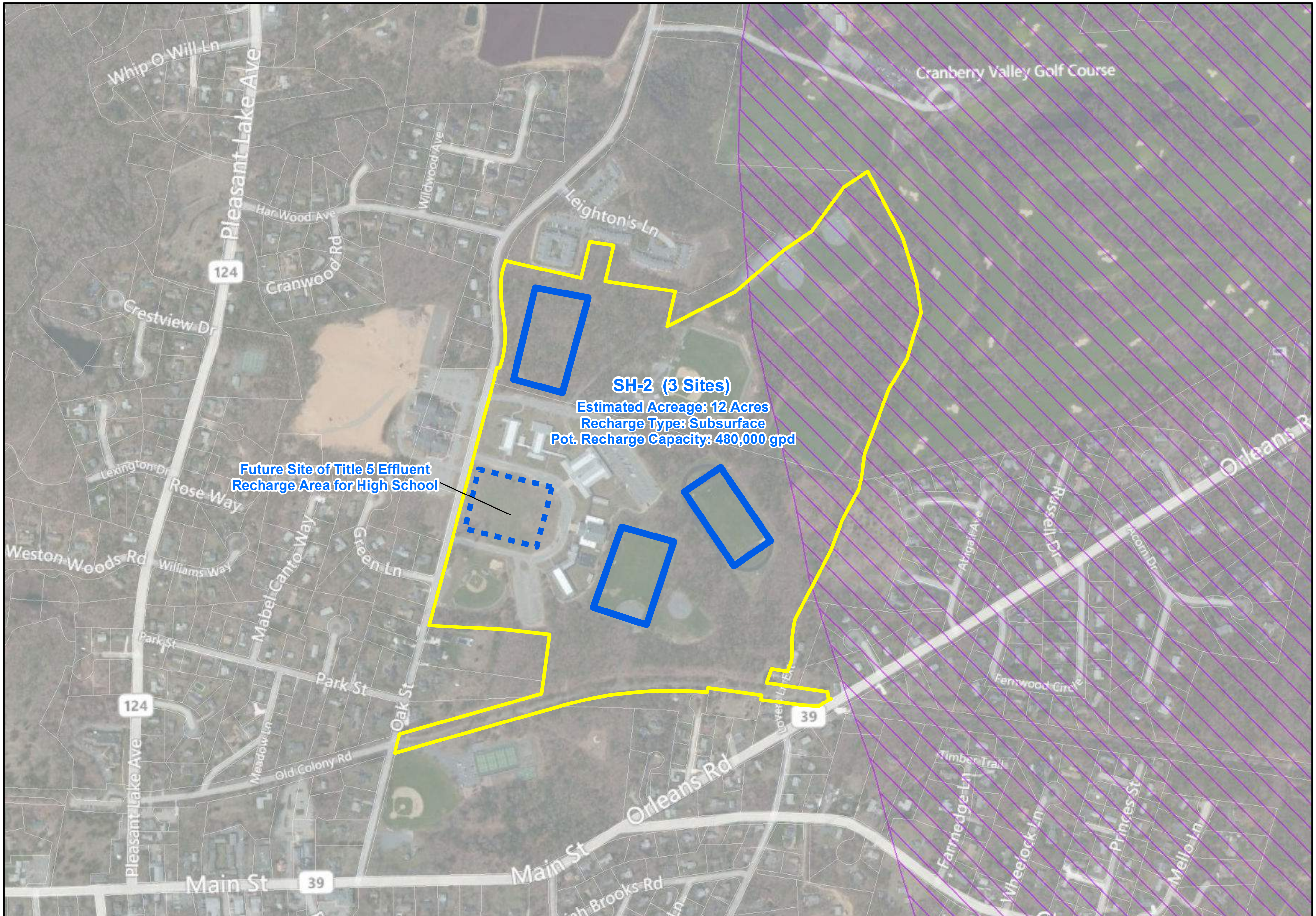

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-2

Figure 9-19

CDM Smith

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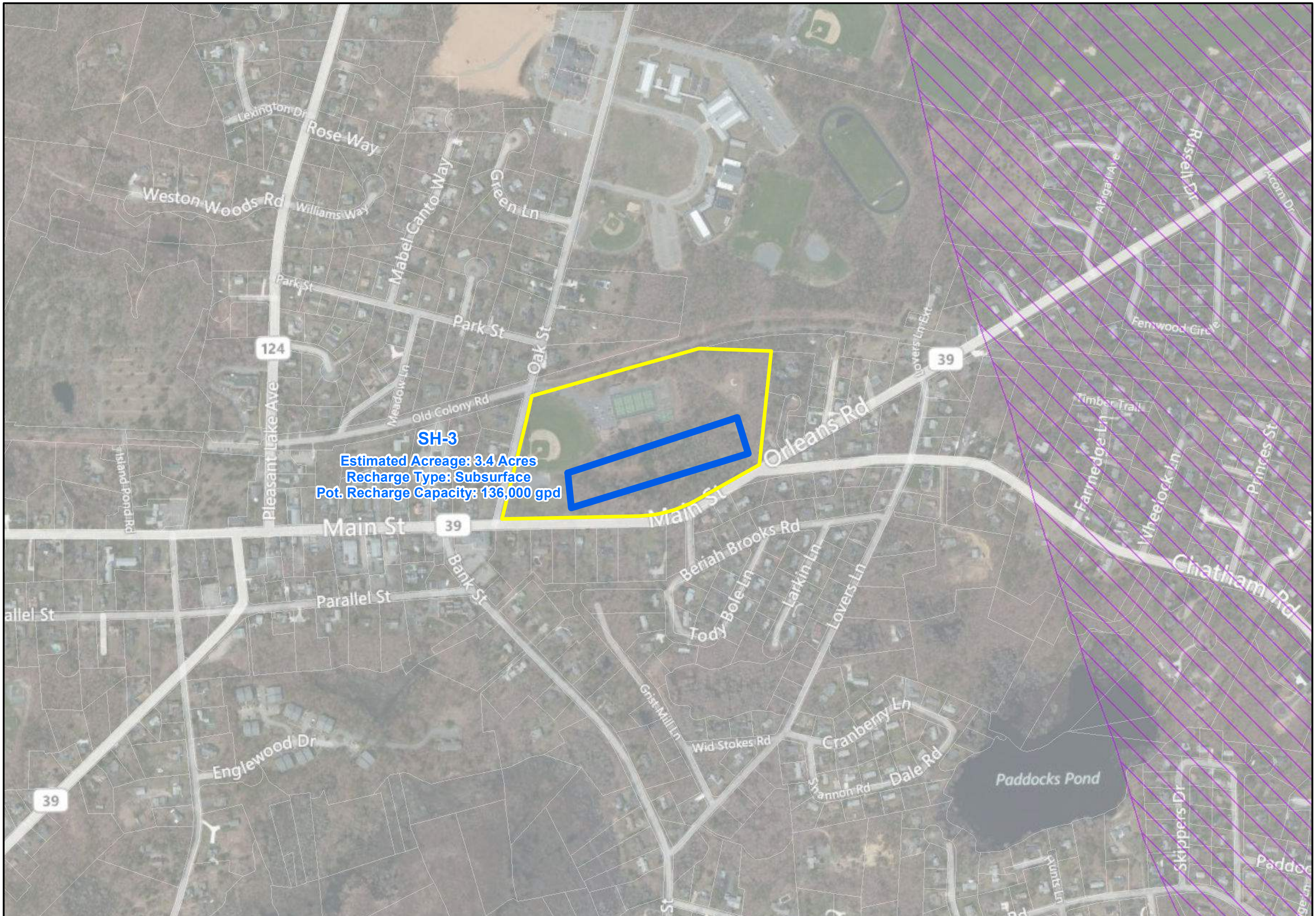

Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site SH-3

1 inch = 600 feet

0 300 600 Feet

Figure 9-20

CDM Smith

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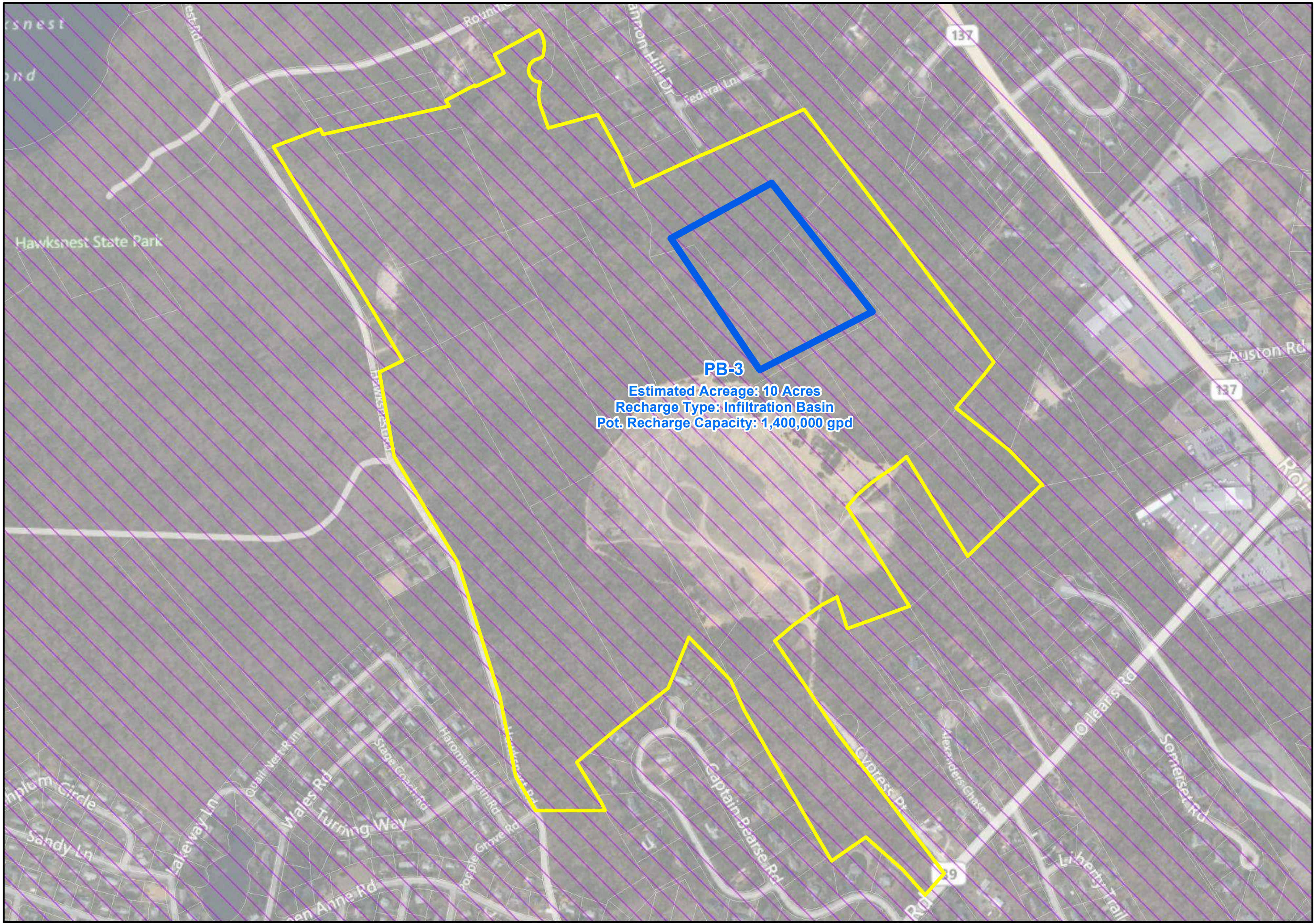

Legend

- Recommended Effluent Recharge Site
- Site Boundary
- Zone II

N

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site PB-3

1 inch = 600 feet
0 300 600 Feet

Figure 9-21

CDM Smith

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Legend

Recommended Effluent Recharge Site

Site Boundary

Zone II

Town of Harwich
Comprehensive Wastewater Management Plan
Preliminary Site PB-9

1 inch = 600 feet
0 300 600 Feet

Figure 9-22

CDM Smith

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9.5.2 Estimated Recharge Rate

The estimated infiltration rate for a site using open infiltration basins for recharge is expected to be in the range of 3 to 5 gallons per day per square foot (gpd/ft^2) of basin area. Using an average loading rate of 4 gpd/ft^2 amounts to approximately 174,000 gpd/acre. However, in order to conservatively account for basin berms, access roads, and other infrastructure within each acre, in addition to natural variations within the soil, the available land area per acre has been adjusted to 34,850 ft^2, or 80% of the 43,560 ft^2 within an acre. Therefore, as a planning-level estimate, one acre is estimated to receive approximately 140,000 gpd.

$$\text{Unit Loading}_{\text{Inf. basin}} = \frac{4\ \text{gpd}}{\text{ft}^2} \text{X} \frac{1\ \text{ft}^2\ \text{useable area}}{1.25\ \text{ft}^2\ \text{total area}} \text{X} \frac{43{,}560\ \text{ft}^2}{\text{acre}} = 140{,}000\ \frac{\text{gpd}}{\text{acre}}$$

Note: The 1/1.25 (80%) factor in this equation is used to account for berms, access roads, etc.

Unit Loading for Subsurface Recharge

In order to assess unit loading for subsurface recharge, the leaching field is assumed to be a trench system rather than an infiltration bed (IB) system. Each trench is assumed to be approximately 3 feet wide by 2 feet high by 100 feet long in a configuration to allow for 100 percent redundancy.

Trench systems are less efficient with space and require more land per gallon of recharge than infiltration bed systems. Base loading at a rate of 1 gpd/ft^2 equates to approximately 40,000 gpd of wastewater effluent per acre of disposal area. Although the infiltration rate is significantly lower than for open basins, the advantage of subsurface systems is the ability to locate other uses such as ballfields on top of the recharge areas.

Shown in the far-right column of Table 9-3 is a potential theoretical recharge rate for the 10 top-rated sites. The type of recharge assumed (open infiltration basin or subsurface recharge) and the resulting capacity are noted.

9.6 Selection of Top Five Sites for Further Investigation

Based on the information in Table 9-3 and the need to select sites in as many of the different MEP watersheds as possible, to accommodate the different options for sewering described in Section 10, the ten top sites were narrowed to four preferred sites: HR-12, OW-2, SH-2, and PB-3. As described previously, HR-18 was also retained, to be considered for wastewater treatment only, and not effluent recharge.

Section 11 presents more detailed site investigations of the sites which emerged as preferred following the analysis described in Section 10.

9.7 Additional Site Screening for Pleasant Bay Watershed Effluent Recharge

Phase 1 of the Recommended Wastewater Program for Harwich included acquisition of an effluent recharge site in the Pleasant Bay watershed to accommodate recharge of the highly treated wastewater should it need to be returned after treatment at the Chatham treatment facility. Several parcels within Site PB-3 had been considered and evaluated as being well suited for that purpose. After some discussion among local representatives an approximately 21 acre parcel was identified within the PB-3 site. This parcel is shown in Figure 9-23 and the proposed effluent recharge portion of the parcel is shown in Figure 9-24.

An article to acquire the site passed at the spring 2015 town meeting, however, it failed to garner approval at a subsequent tax levy override ballot vote. Neighborhood opposition helped defeat the ballot vote as there was concern there may be a wastewater treatment plant built on the site since there was no signed Inter-municipal Agreement with Chatham. There was also an issue with the zoning for the site that needed further clarity since it appears "municipal use" is only currently allowed in the commercial district and not in the residential district where this parcel is located.

So the Town directed the WIC to conduct an evaluation of other potential effluent recharge sites in that watershed and adjacent areas. A subgroup was formed including other town staff and citizens to bring sites to the WIC for consideration. Sites previously considered were included as were sites owned by the Harwich Water Department.

Table 9-4 summarizes the 28 potential parcels brought forward for consideration. The first column list the assessor's sheet and parcel number for each parcel. The parcels are shown on Figures 9-25, 9-26 and 9-27. The WIC considered the list of potential parcels presented by the subgroup at their September 16, 2015 meeting. Parcels that were located within a Zone of Contribution to a municipal well were dropped from further consideration. Preference was given to municipally controlled parcels. After some discussion, two sites were selected for preliminary hydrogeologic modeling and further site analysis. These sites are shown on Figure 9-28.

Results of the hydrogeologic modeling are presented in Section 11. Both sites have potential but they also have some items of concern that would need further evaluation. For instance Site 114-S5 has an identified vernal pool at the center of the 38.9 acre parcel. Detailed evaluation would need to be done to determine how much highly treated effluent could be applied to the site without impacting that vernal pool. Similarly, there are lower permeability soils identified near Site 52-N1 which could impact the flow patterns of the applied effluent and this site is located between two Zones of Contribution to Harwich drinking water wells.

As a result, the WIC and town representatives have not selected a final effluent recharge site in the Pleasant Bay watershed. All sites are considered to be in contention at this time. The Town is finalizing negotiations with Chatham for use of their treatment facility and at least initially use of their effluent recharge infiltration basins. Depending on results of monitoring of the effluent recharge, Harwich may or may not need to identify, acquire and develop an effluent recharge site in East Harwich. Sufficient notice would be provided if they do need to develop a recharge facility in the future. So for now the process is placed on hold.

Table 9-4
Potential effluent recharge Sites
CWMP – Harwich, Massachusetts
September 16, 2015

Site	Ownership	Parcel Site, AC	ZOC	Zone II	Estimated Time of Travel, Year	Six Ponds Distance	Soils	Wetlands	NHEPS	Comment
98-H1-5	Selectmen		5%	yes	<1	no	good	no	yes	Drop
52-N1-10	Selectmen	6.2	0%	yes	??	no	50% poor	no	yes	Consider w/11; Evaluate
52-N1-11	Selectmen	9.8	0%	yes	??	no	50% poor	no	yes	Consider w/10; Evaluate
63-N1-8	Selectmen		50%	yes	<1	no	good	no	no	Drop
63-N1-7	Selectmen		90%	yes	<1	no	good	no	no	Drop
63-J3	Selectmen		100%	yes	<1	no	good	no	yes	Drop
53-H1	Selectmen		100%	yes	<1	no	good	no	no	Drop
53-H3	Selectmen		100%	yes	<1	no	good	no	no	Drop
75-J3-6	Private/Tow n	12	0%	yes	??	no	good	no	yes	Verify status/Consider
62-W3	Water		70%	yes	<1	no	good	no	yes	Drop
51-A4	Water		100%	yes	<1	no	good	no	yes	Drop
52-D1	Water		60%	yes	<1	no	25% poor	no	yes	Drop
43-C3	Water		90%	yes	<1	no	good	no	yes	Drop
33-L3	Water		80%	yes	<1	no	75% poor	no	yes	Drop
33-L5	Water		50%	yes	<1	no	100% poor	no	yes	Drop
34-N5-7	Private		0%	yes	??	no	good	no	yes	Check adjacent wetlands/Consider
44-H5	Water		100%	yes	<1	no	good	no	no	Drop
44-H6	Water	17.2	70%	yes	??	no	good	adjacent	no	Drop

Table 9-4 (Con't)
Potential effluent recharge Sites
CWMP – Harwich, Massachusetts
September 16, 2015

Site	Ownership	Parcel Site, AC	ZOC	Zone II	Estimated Time of Travel, Year	Six Ponds Distance	Soils	Wetlands	NHEPS	Comment
107-E1-A	Water		15%	yes	<1	no	good	no	yes	Drop
114-S5	Water	38.9	0%	no	??	no	good	10%	yes	Contains vernal pool; Evaluate
98-X2	Water		35%	yes	<1	no	good	5%	yes	Drop
74-W4	Water	9.3	0%	yes	<5	no	good	no	no	Developed; Drop
87-P1-5	Water	7.4	0%	yes	<5	no	good	no	no	Use Restrictions; Drop
75-A-5,A7	Cemetery	16.5	0%	yes	<4	no	good	no	yes	Social issues; Drop
86-M2-1	Private	3.3	0%	yes	<5	no	good	no	no	Development Proposal; Drop
86-M7-A	Private	5.2	0%	yes	<5	yes	good	no	no	too expensive; Drop
97-X2	Private	2.9	0%	yes	<5	yes	good	no	no	Halls Path; Likely expensive; Drop
87-U1-1,2	Conservation	3.6	0%	yes	<3	no	good	no	no	Restricted; Drop

Legend

Parcel boundary

Town of Harwich
Comprehensive Wastewater Management Plan
21 Acre Parcel Within PB-3

Not to scale

Figure 9-23

CDM Smith

N

PB3 Infiltration Basin

Possible Effluent Recharge Site

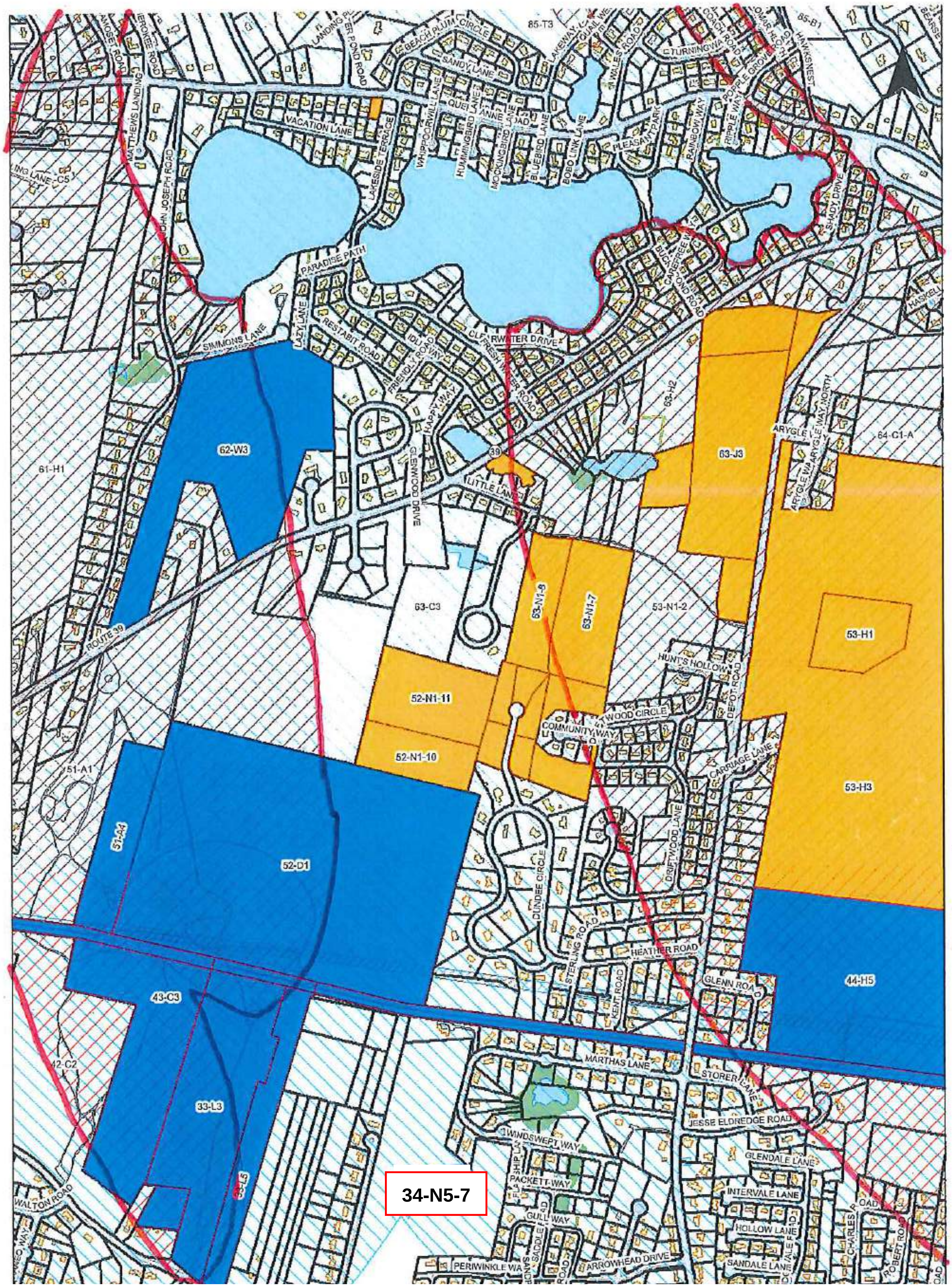
Harwich, MA

1 inch = 500 feet

0 250 500 1,000 Feet

Potential Infiltration Basin on East Harwich Recharge Site

Figure 9-24



Legend

Harwich Zones of Contribution

Zone II

Parcels of Interest

SELECTMEN

TREASURER

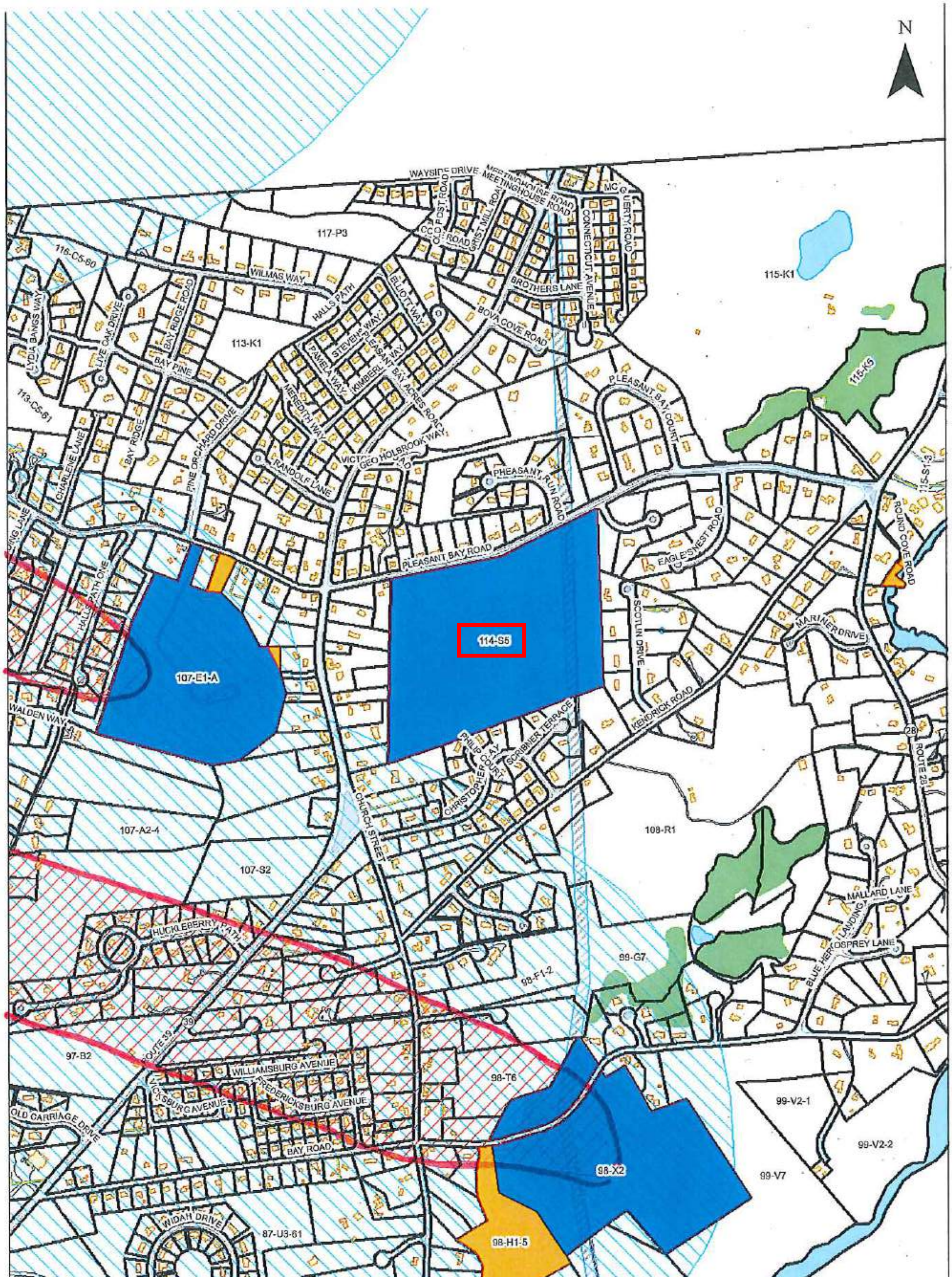
WATER DEPT

Town of Harwich
Comprehensive Wastewater Management Plan
Parcel 34-N5-7

Figure 9-25

CDM Smith

Scale: 1"= 600'



Legend

Harwich Zones of Contribution

Zone II

Parcels of Interest

SELECTMEN

TREASURER

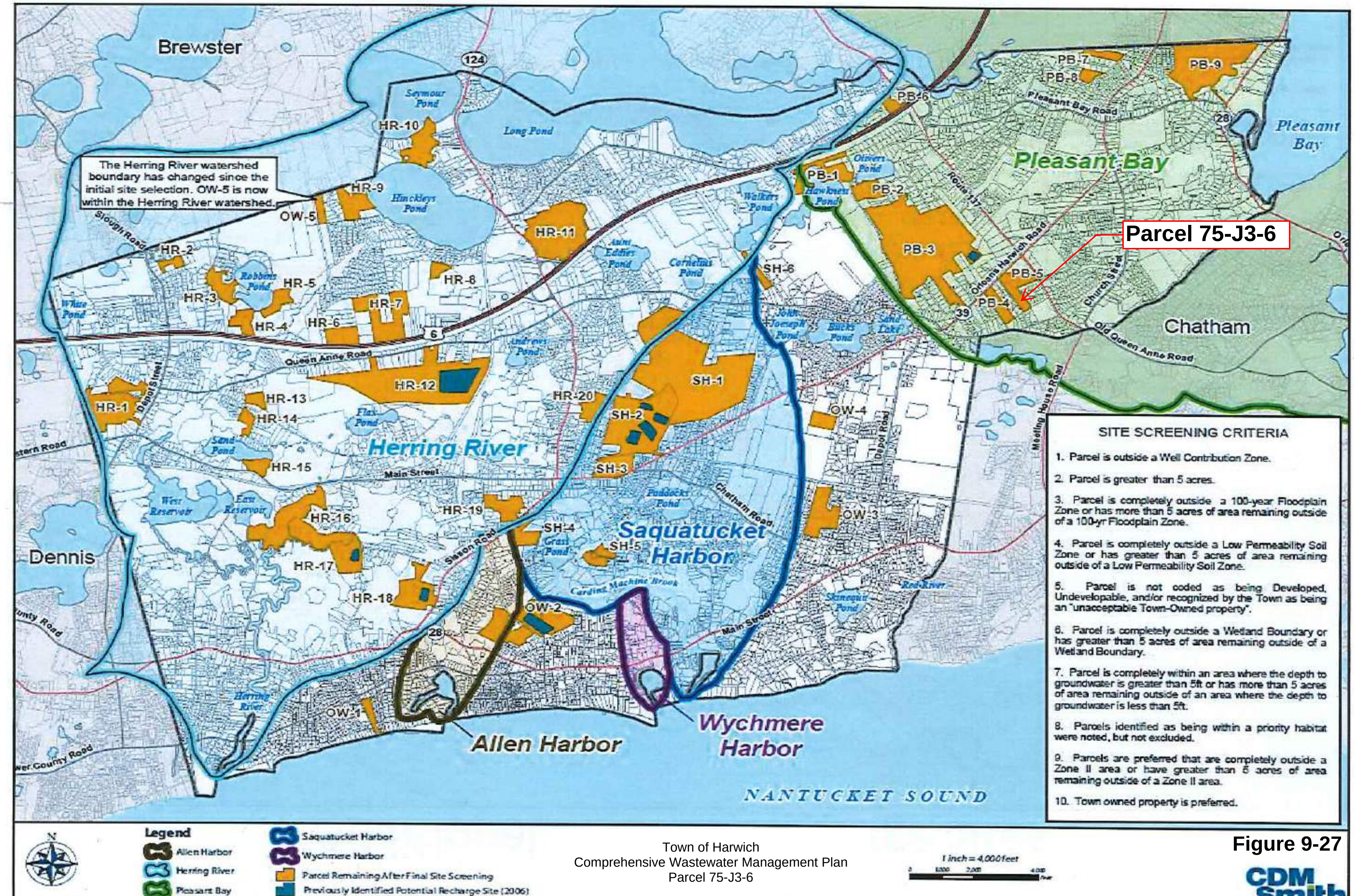
WATER DEPT

Town of Harwich
Comprehensive Wastewater Management Plan
Parcel 114-S5

Figure 9-26

Scale: 1"= 600'

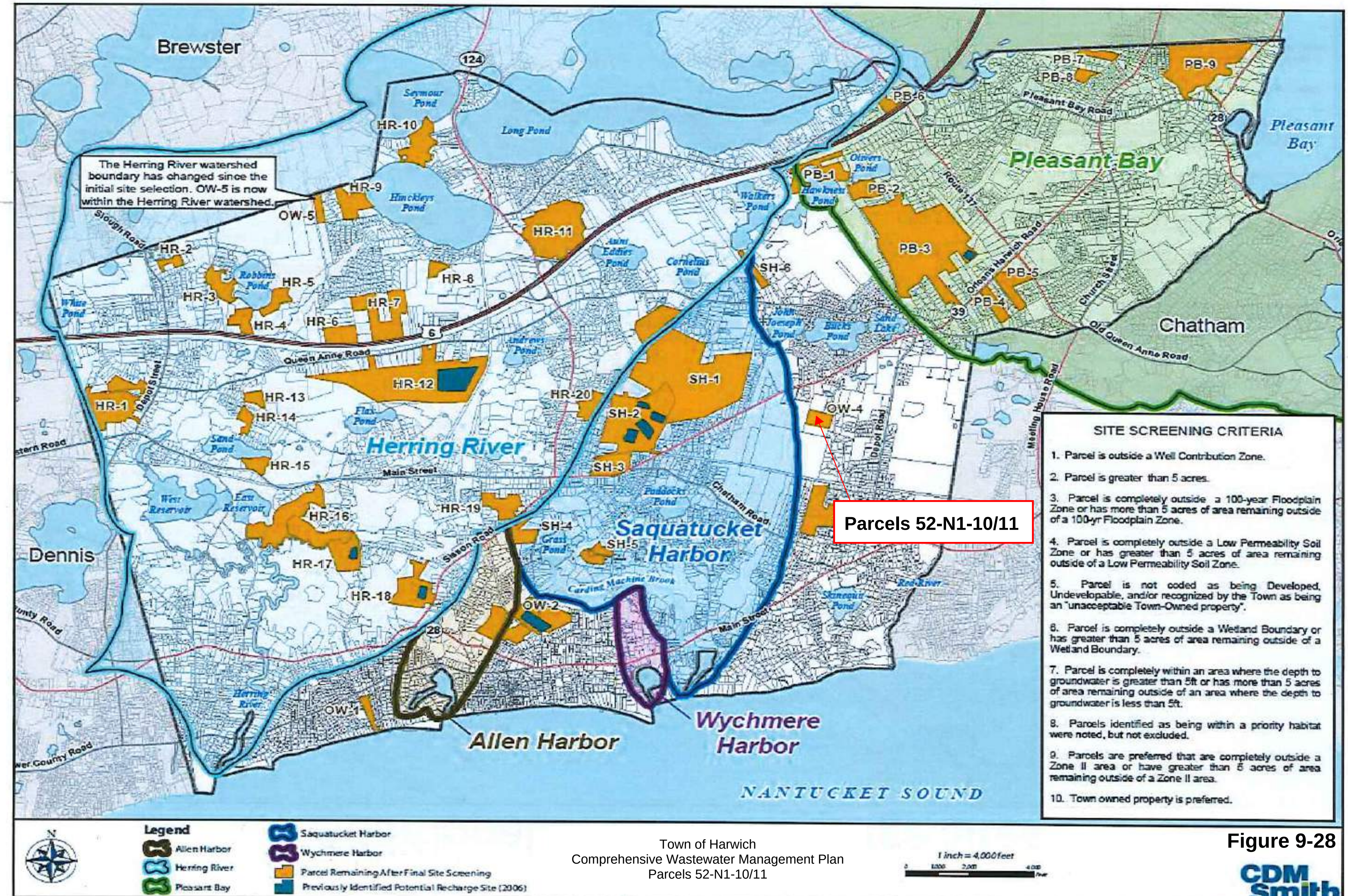
CDM Smith



Town of Harwich
Comprehensive Wastewater Management Plan
Parcel 75-J3-6

Figure 9-27

CDM Smith



Town of Harwich
Comprehensive Wastewater Management Plan
Parcels 52-N1-10/11

Figure 9-28

CDM Smith

Section 10

Wastewater Scenarios Assessment

10.1 Purpose and Scope

The wastewater needs assessment presented in Section 8 of this Comprehensive Wastewater Management Plan identified areas that need improved methods of wastewater treatment and recharge to meet current and future community development needs and nitrogen Total Maximum Daily Loads (TMDL) limits. This section discusses wastewater scenarios developed to address the identified areas of need.

The Cape Cod Commission (CCC) started (2013) and completed (2015) the 208 Water Quality Management Plan (208 Plan) after the draft Comprehensive Wastewater Management Plan (CWMP) was completed. However, the draft CWMP included several components that are put forth in the 208 Plan. Section 10.6 discusses how the 208 Plan relates to the Harwich CWMP and what modifications may be incorporated as a result in the future.

10.2 Massachusetts Estuaries Project Impact

The degradation of Harwich's estuaries and bays is the main reason that the Town is changing its approach to wastewater management. The Town understands that the environmental and financial impacts of good water quality in a resort community like Harwich are of paramount importance. Harwich's goal of maintaining a high quality of life for its residents and restoring its already degraded harbors and estuaries requires a systematic tool capable of evaluating each resource. The Massachusetts Estuaries Project (MEP) provides that tool. The outcome is a determination of where nutrient reductions are needed to preserve or restore long-term ecological health.

As described previously, Harwich has five embayments included in the MEP: Allen Harbor, Wychmere Harbor, Saquatucket Harbor, the Herring River, and Pleasant Bay. The Herring River watershed is shared with the Towns of Brewster, Dennis and Harwich. The Pleasant Bay watershed is shared with the Towns of Chatham, Harwich, Orleans and Brewster. The other three embayment watersheds are located within Harwich. The combined Allen, Wychmere and Saquatucket Harbor report was completed in June 2010. The Pleasant Bay report was completed in May 2006 with memo updates in June and October of 2010 that revised the land use, water use and natural attenuation in Muddy Creek and evaluated the water quality impacts of the addition of a 24 ft culvert in the Muddy Creek inlet. The Herring River report was completed in March 2013.

The MEP results and required nitrogen load reductions are discussed in more detail in Section 6. The results of these evaluations were used by the Town in developing the wastewater scenarios presented in this section. To achieve the required buildout nitrogen load reductions in the five embayments, the following approximate reductions in septic load were used, as shown in Table 10-1.

Table 10-1
Required Attenuated Nitrogen Load Reduction in MEP Watersheds

Watershed	Buildout Nitrogen Load Reduction Required
Allen Harbor	78%
Wychmere Harbor	100%
Saquatucket Harbor	58%
Pleasant Bay	65%
Herring River	25% (original assumption), revised to 58%

*Saquatucket Harbor and Muddy Creek Loads Include Enhanced Attenuation

Values in RED indicate the value that must be reduced to achieve the TMDL.

While the Title 5 areas of concern and desired development in village centers are of particular concern for the Town of Harwich, the need to meet the nitrogen reduction requirements established in the MEP is the main driving factor in the decision making process. Therefore, the primary focus of the wastewater scenarios developed is to reduce nitrogen in the sensitive watersheds.

10.3 Wastewater Management Scenarios

The Town developed several wastewater management scenarios that consider the five identified effluent recharge sites, the MEP nitrogen removal requirements, and natural nitrogen attenuation. Initially, baseline scenarios were developed. The baseline wastewater scenarios consider the possibility of removing wastewater from a particular watershed and transporting that wastewater outside of the watershed and into an area that is not nitrogen sensitive (i.e., not subject to MEP analysis or a TMDL). The two baseline scenarios (one with and one without enhanced nitrogen attenuation) are not realistic wastewater scenarios because they offer no solutions for treating and recharging the wastewater flows. They are useful however, because they establish a baseline that defines the minimum amount of sewering required to meet the TMDL requirements in a given watershed. The baseline scenarios do not consider any requirements other than the minimum TMDL nitrogen removal requirements. The baseline attenuation scenario goes one step further and assumes the simultaneous implementation of two town projects that would enhance natural attenuation of nitrogen: one in the Cold Brook and one for increased tidal flushing in the Muddy Creek. The successful completion of both of these projects will result in a reduced amount of sewering required to meet established TMDL requirements.

Based on the positive results of the comparison between the baseline option and the baseline option with attenuation, all of the scenarios discussed in this CWMP/SEIR (1A through 8A) utilize enhanced nitrogen attenuation along with various strategies for effluent recharge throughout the Town. These scenarios are considered to be implementable scenarios (unlike the baseline scenarios) and three of them were ultimately carried forward for detailed analysis. Note that Scenarios 1A to 8A presented in this section do not include all of the village centers and board of health areas of Title 5 concern, since the scenarios were developed for comparative purposes only. Those additional areas are assumed to be common to all scenarios. Once the comparative evaluations were completed, the final wastewater scenarios carried into the later phases of the CWMP were revised to include the village centers and the areas of Title 5 concern outside of nitrogen sensitive areas.

10.3.1 Nitrogen Balancing Methodology

Nitrogen balancing is an important consideration as implementable wastewater scenarios are developed. Since it is difficult to remove all of the nitrogen from treated wastewater, care must be taken to recharge treated effluent to a watershed that is capable of receiving the resulting nitrogen load without exceeding the MEP nitrogen requirements.

In the simplest of scenarios, it may be possible to remove wastewater flow and send the treated effluent to another watershed that is not nitrogen sensitive. In these scenarios, the nitrogen balance is a simple subtraction of the nitrogen removed, for a net nitrogen reduction. Unfortunately, it is not always possible to send treated effluent into a watershed that is not nitrogen sensitive. In these cases, the wastewater removed by sewering can be counted as a reduction, but the remaining nitrogen after treatment in the effluent recharge must be counted as a nitrogen addition. The amount of nitrogen removed and recharged to a watershed must be balanced so that the net removal meets the MEP reduction requirements.

Since septic system effluent is estimated to have a concentration of 26 ppm of nitrogen (23.63ppm if converted from water use to wastewater), the average household will contribute approximately 6.2 kg/year of nitrogen (63,000 gallons (typical) per year of water use flow x 26 mg/l of nitrogen x 3.785 liters per gallon/1,000,000 mg/kg). If the wastewater were treated to 5 mg/l of nitrogen and recharged to the same watershed, the post-treatment contribution of nitrogen from this household would be 1.2 kg/year for a net decrease of 6.2 – 1.2 = 5.0 kg/year. By today's standards, even with the most advanced wastewater treatment, wastewater effluent will have some nitrogen remaining and must be accounted for in the overall management strategy. Figure 10-1, below, illustrates this point. In this example, ten homes in the nitrogen limited watershed are connected to the wastewater treatment facility and an estimated 62 kg/year of nitrogen is removed from the watershed. In the wastewater treatment facility, 50 kg/ year of nitrogen is removed and 12 kg/year remain. This remaining load of 12 kg/year is recharged back into the watershed in the effluent. If the MEP TMDL requirement for nitrogen removal was 50 kg/year, then this example would satisfy the requirement.

Thus, when developing the overall wastewater scenarios, the removal of nitrogen from a watershed to meet the TMDL must also consider the addition of nitrogen from any effluent to be recharged in a given watershed by removing more than the baseline amount. This has been considered in developing the scenarios.

Nitrogen balancing can also be utilized for scenarios that remove wastewater from one watershed and recharge to another watershed.

In another example, 20 households are sewered within the watershed and treated effluent from 62 households (20 from within the watershed and 42 from outside) is recharged in the same watershed. Figure 10-2 illustrates this point. In this example, 20 households in the nitrogen limited watershed are connected to the wastewater treatment facility and an estimated 124 kg/year of nitrogen is removed from the nitrogen sensitive watershed. Another 42 homes from outside the watershed are also connected to the wastewater facility and contribute 260 kg/year to the facility. In the wastewater treatment facility, 334 kg/year of nitrogen is removed and 50 kg/year remain. This remaining load of 50 kg/year is recharged back into the watershed in the effluent. This example illustrates how an additional ten households sewered in the MEP sensitive watershed allow for an additional 42 households from other watersheds to be managed within the nitrogen limited watershed without changing the nitrogen balance in the nitrogen limited watershed.

Figure 10-1
Nitrogen Balance for a Typical Nitrogen Limited Watershed: 10 Households

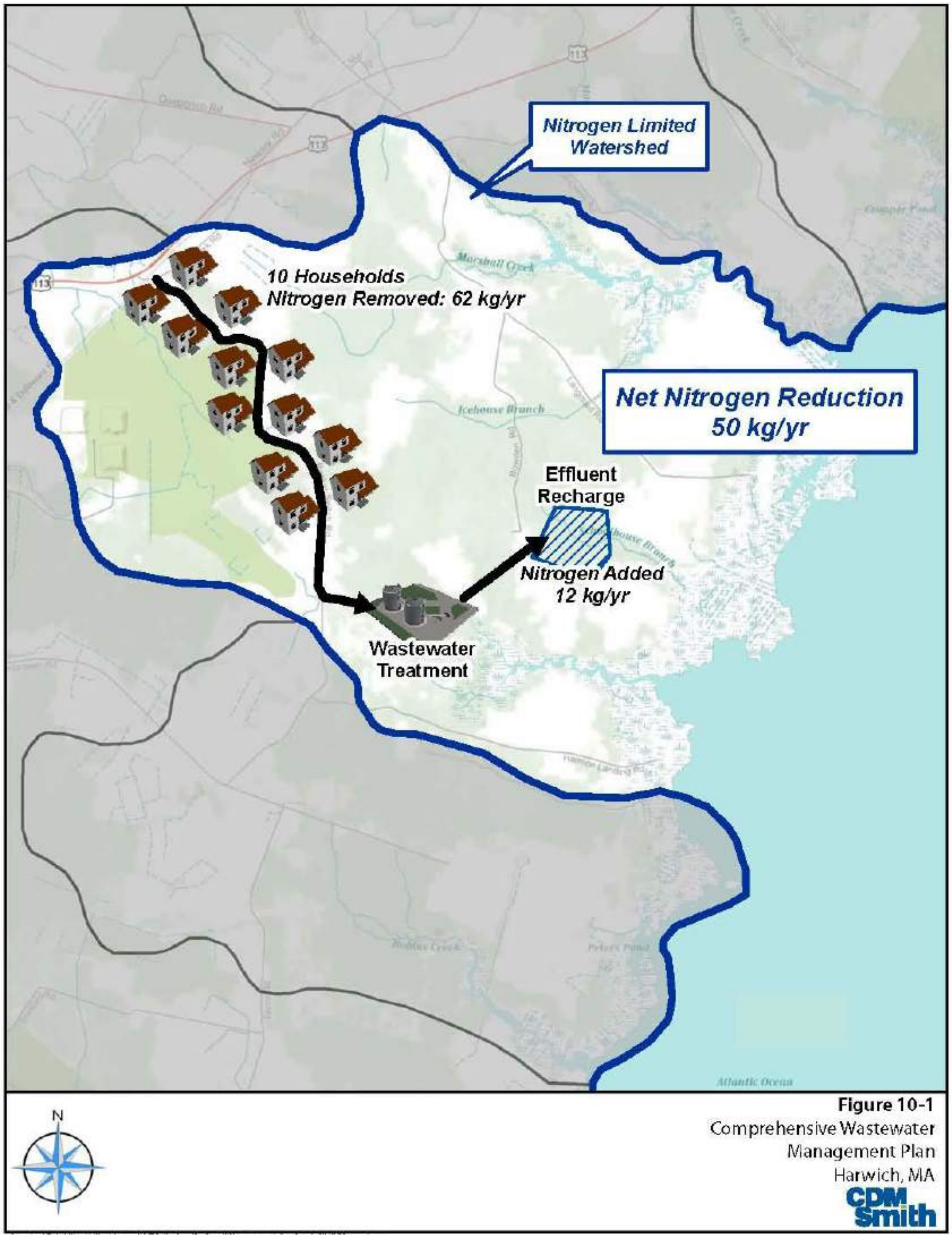
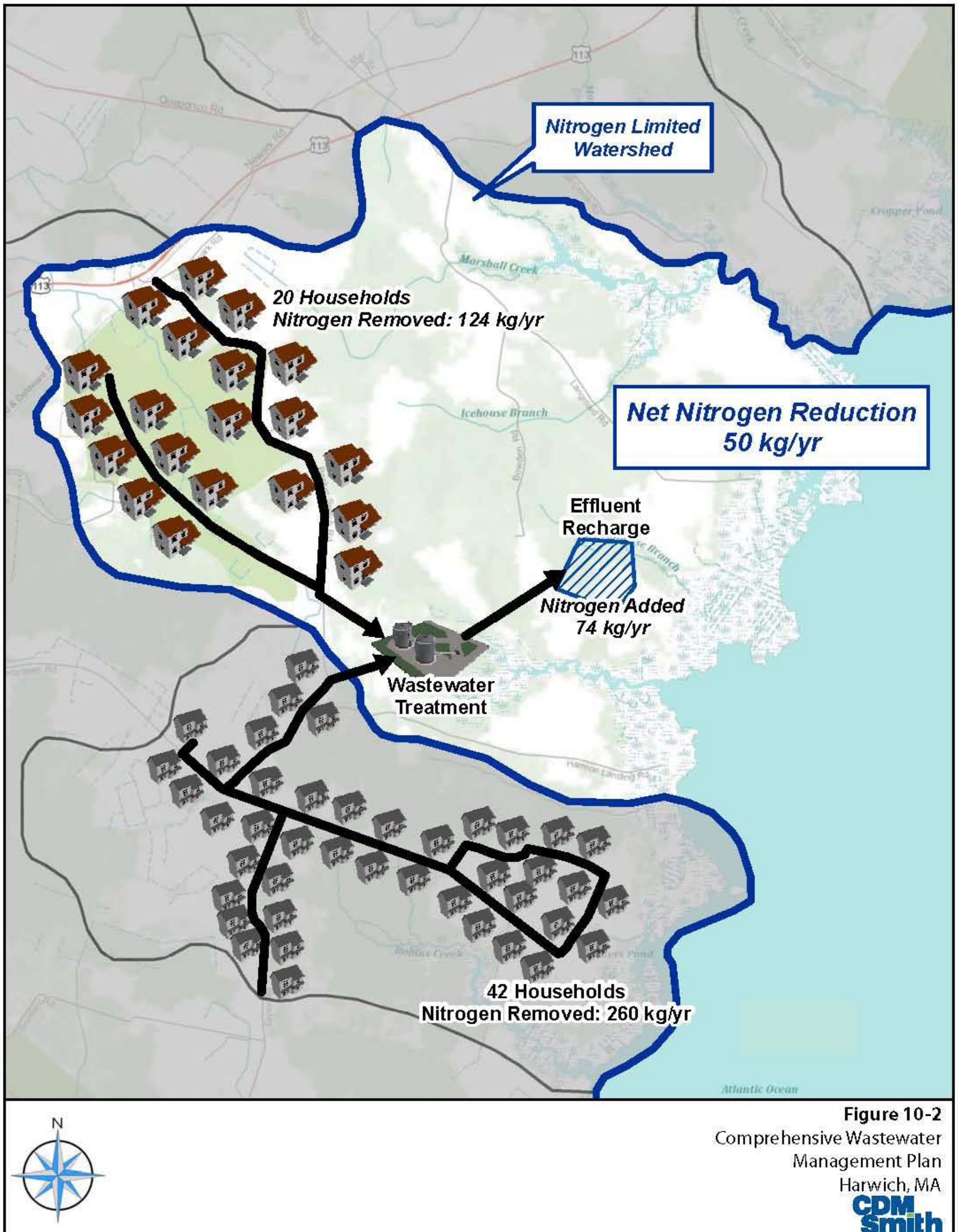


Figure 10-2
Nitrogen Balance for a Typical Nitrogen Limited Watershed: Multiple Watersheds



The result is a net nitrogen reduction of 50 kg/year of nitrogen in the nitrogen limited watershed. From a nitrogen balancing point of view, this watershed is considered to be identical to the example presented in Figure 10-1. This example illustrates how the balance of nitrogen can be used when deciding how to meet the MEP established TMDL requirements and the needs of the community while working within the constraints of the effluent recharge sites, both within and outside of nitrogen sensitive watersheds.

The use of conventional wastewater treatment and its ability to remove between 80 and 90 percent of the incoming nitrogen in a wastewater gives the Town several options when planning a wastewater solution.

10.3.2 Nitrogen Loading Spreadsheets

To create the wastewater scenarios, CDM Smith developed detailed nitrogen loading spreadsheets that closely approximate the nitrogen loading model used in the MEP reports. The spreadsheets are based on the septic component of nitrogen loading and, as a result, focus strictly on reductions from the wastewater component of the total nitrogen load. The much smaller percentage of nitrogen components from stormwater and fertilizer sources will be managed through a separate program under other aspects of this CWMP/SEIR.

The nitrogen loading spreadsheets are a tool that allows planners to develop wastewater scenarios using a systematic approach. The spreadsheets display all of the subwatersheds within an estuarine system. They also present all of the fresh water bodies (ponds and streams) that are modeled with natural attenuation. Since the spreadsheets are divided into subwatersheds and their potential for natural nitrogen attenuation, they allow planners to create sewersheds with a primary focus on the areas that will not receive any natural attenuation. By doing this, the Town can minimize the areas that require wastewater collection and maximize cost savings to the Town.

The nitrogen loading spreadsheets also allow the Town to reevaluate "what if" scenarios that are raised throughout the planning process. Table 10-2 below shows an example of a nitrogen loading spreadsheet for the Saquatucket Harbor watershed. While there are many behind-the-scenes calculations in the spreadsheets, the table shows some of the complexities that are involved in the overall nitrogen model including natural attenuation factors, nitrogen removal from sewering and the ability to follow the path of septic system effluent through each subwatershed until it reaches the embayment. Copies of the other spreadsheets are included in Appendix C.

From Table 10-2, it becomes clear that several factors can affect how nitrogen travels through a watershed. The MEP model attempts to simulate the most important factors and determine what the nitrogen concentrations will be throughout the watershed. These spreadsheets account for flow in and out of the watershed, natural attenuation (from ponds and streams), enhanced attenuation (from projects such as bog / wetlands restoration), wastewater treatment to various levels of treatment, and the removal of the nitrogen load from a particular watershed as a result of conventional sewering. The spreadsheet is a tool that helps consider all of these factors together in one logical place. The end result is a very powerful planning tool that is the basis for several of the decisions discussed in this CWMP/SEIR.

Table 10-2
Example Nitrogen Loading Spreadsheet for Saquatucket Harbor

Build-out											
Name	Watershed #	Total (kg/yr)	Septic (kg/yr)	Outflow %	Total (kg/yr)	Septic (kg/yr)	% Removal	Net Septic Load (kg/yr)	Attenuation %	Attenuated Septic Load (kg/yr)	Attenuated Septic Load (kg/day)
Grass Pond	13	1152	903	100%	1152	903	43%	515	50%	257	
Banks St Bogs LT10	12	2284	1941		2284	1941	10%	1747		1747	
Banks St Bogs GT10	11	322	175		322	175	1%	173		173	
Recharge to Upper Muddy Creek Watershed 13											
							Removed Septic (kg/yr)	Recharge Septic (kg/yr)			
Cold Spring Brook Recharge							1877				
John Joseph Recharge							0				
E. Saq Stream Recharge							989				
Harbor Load Recharge							1012				
Allen Harbor Load Recharge							0				
Wychmere Harbor Load Recharge							1206				
Total Septic Load From Harwich							5084				
Recharge at what Concentration.				5 mg/l				978	50%	488.8076923	
Banks St Bogs Total					**3758**	**3019**	**19%**	**2435**	**35%**	**1733**	
Paddocks Pond	14	898	648	100%	898	648	2%	635	50%	318	
Cold Spring Brook LT10	10	2825	2064		2825	2064	62%	784		784	
Cold Spring Brook GT10	9	1178	861		1178	861	0%	861		861	
Cold Spring Brook Total					**8659**	**6592**	**28%**	**4715**	**35%**	**2402**	
	Enhanced Attenuation									-978	**3.902**
Black Pond	5	18	6	14%	2	1	0%	1	50%	0	
John Joseph Pond GT10	6	109	89		109	89	0%	89		89	
John Joseph Pond LT10	7	500	335		500	335	0%	335		335	
John Joseph Pond Total		627	430	27%	164	114	0%	114	74%	30	
Chatham Road WELLS	8	1004	667	80%	803	534	0%	534		534	
Saq Harbor LT10N	15	1166	1009		1166	1009	98%	20		20	
E. Saquatucket Stream Total					**2133**	**1657**	**60%**	**668**	**15%**	**496**	**1.359**
Harbor LT10S	16	1113	1012		1113	1012	100%	0		0	0.000
Harbor Total					**11905**	**9261**		**5383**		**1920**	**5.261**
Treated Load						**3878**	**42%**				

CDM Smith
0324-0650-03-11

There are several paths that septic system effluent can take as it moves through the groundwater in the watershed. As an example, a drop of septic system effluent generated in the Grass Pond Subwatershed 13 (MEP report designation) would be attenuated by 50 percent due to the presence of the freshwater pond. Then it would move to the Bank Street Bogs in Subwatershed 12 where it would receive an additional 35 percent attenuation. From Subwatershed 12, the effluent would enter Subwatershed 10 and receive an additional 35 percent attenuation through the Cold Brook. Finally the effluent would enter Subwatershed 16 and eventually discharge to Saquatucket Harbor. Thus, a 100 kilogram load of nitrogen discharged to the Grass Pond Subwatershed in the Saquatucket watershed would be reduced to 21 kg (100kg x 0.50 x 0.65 X 0.65) of nitrogen as it entered the Harbor. The flowchart below illustrates this. Since the attenuation component is cumulative, it would be most efficient to sewer the highest density areas closest to the embayments since the farthest reaches in the watersheds have the highest potential for natural nitrogen attenuation if freshwater ponds are in the flow path. Figure 10-3 shows the path of groundwater in the Saquatucket Harbor watershed and the natural attenuation that occurs in the subwatersheds.

Flowchart of Natural Attenuation Pathway

Grass Pond
Subwatershed # 13
50 % Attenuation
100 kg TN Reduced to 50 Kg TN

Bank Street Bogs
Subwatershed # 12
35 % Attenuation
50 kg TN Reduced to 33 kg TN

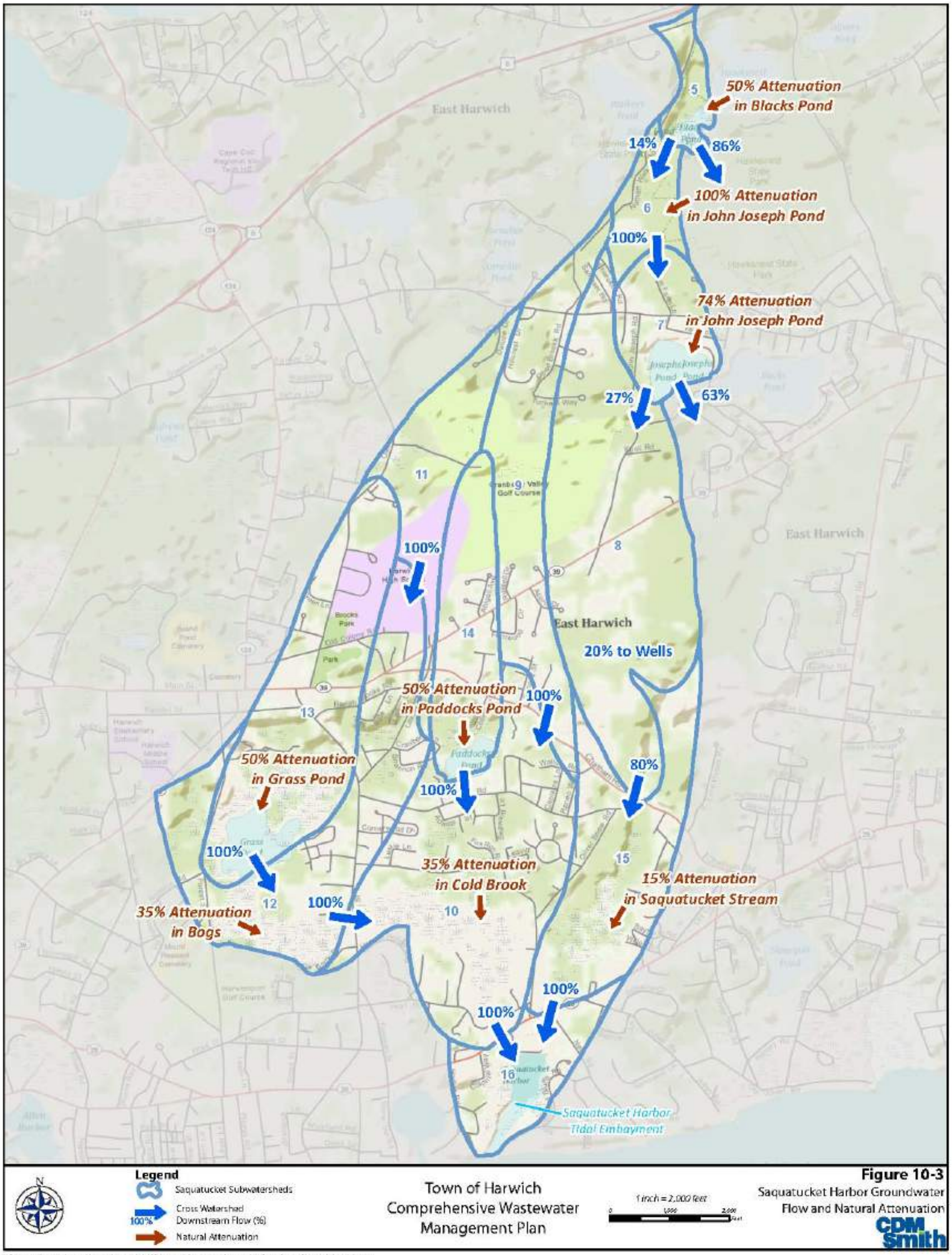
Cold Brook
Subwatershed # 10
35 % Attenuation
33 kg TN Reduced to 21 kg TN

Saquatucket Harbor
Subwatershed # 16
No Attenuation
21 kg TN (No Reduction)

21 kg TN Discharged to Saquatucket Harbor

(79 Kilograms Naturally Attenuated)

Figure 10-3
Saquatucket Harbor Groundwater Flow and Natural Attenuation



10.3.3 GIS Data Obtained from the MEP Data Disks

Once the nitrogen loading spreadsheets were completed, GIS was utilized to graphically create wastewater service areas that matched nitrogen load reductions required in the MEP reports. Data disks from the MEP contain useful information that is quickly loaded into the GIS database used throughout this CWMP/SEIR. The MEP data contains parcel boundary data, water use data for the years 2004 to 2007, build-out data, and the estimated annual nitrogen load from each parcel. A powerful feature of the GIS is that it has the capability of calculating an estimated annual nitrogen load for any parcel, street or user-defined wastewater service area and displaying it graphically. With this tool, sewer service areas were developed that match the nitrogen reductions required in the MEP reports. The result is the scenarios presented below that will meet the minimum requirements for nutrient reduction.

10.3.4 Baseline Scenario

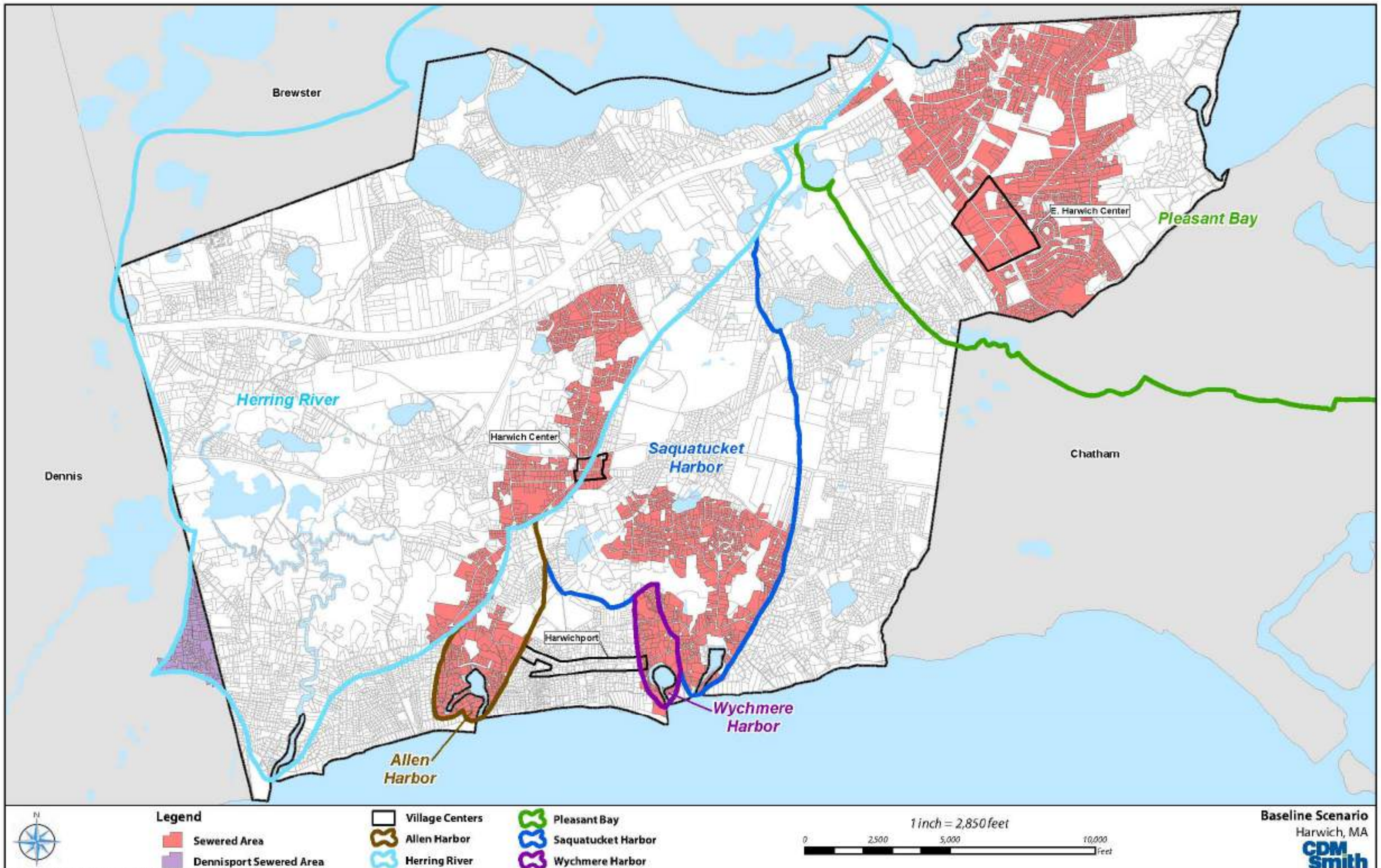
A baseline scenario was created that satisfies the minimum MEP established TMDL requirements for nitrogen removal in the five MEP watersheds in Harwich. Only the Allen, Wychmere, Saquatucket and Pleasant Bay MEP reports were complete during this initial scenario screening process. The Herring River MEP report was not complete and, therefore, the actual nitrogen removal requirements were estimated. Due to the extensive presence of freshwater wetlands in the Herring River watershed, it was believed that this watershed may only need a small amount of nitrogen reduction. The presence of freshwater wetlands indicates that a significant amount of natural attenuation may be present in the upper Herring River watershed and, as a result, less wastewater management was expected. For the purpose of developing these initial scenarios, it was estimated that the Herring River watershed required about 25 percent present septic system nitrogen removal. When the MEP results became available, the actual amount of nitrogen removal required was revised to 58 percent. The 25 percent assumption is utilized in this section, but the revision to 58 percent is incorporated in Section 12 where the highest rated wastewater scenarios were further evaluated. This is discussed further in Section 10.3.9.

Figure 10-4 shows the baseline scenario. The lots that are colored in red represent the minimum areas that must be sewered to meet the required TMDL nitrogen removals per the MEP using only a wastewater treatment management strategy. As stated earlier, the baseline scenario does not account for effluent recharge and assumes all septic system nitrogen removed will be recharged outside of nitrogen-sensitive watersheds. In all of the scenario figures, the Herring River watershed area known as Dennisport in the Town of Dennis is assumed to be sewered, treated and recharged within that small area. This area is colored in purple in the scenarios.

10.3.5 Enhanced Natural Attenuation Options

Natural attenuation of nitrogen is part of a natural freshwater system, and the Allen, Saquatucket and Pleasant Bay systems all have some degree of natural attenuation associated with them. In the Allen Harbor watershed, the Allen Harbor stream has a 30 percent nitrogen attenuation associated with it. In the Saquatucket Harbor watershed, attenuation occurs in several ponds and streams including the Cold Brook. The Pleasant Bay system has natural attenuation in several ponds as well as the Muddy Creek system. For the purposes of the wastewater scenarios, the existing natural attenuation factors that are accounted for in the model are considered the baseline conditions because they approximate actual field conditions as reported by the MEP. This is existing natural attenuation and has been accounted for in the baseline scenario presented above.

Figure 10-4
Baseline Scenario (No Attenuation)



The Town, however, also has the ability to initiate two projects that will enhance the existing natural attenuation in the Saquatucket Harbor watershed and tidal flushing in Muddy Creek in the Pleasant Bay watershed. The end result of implementing these projects is a reduction in the total amount of sewering required in the Saquatucket Harbor and Pleasant Bay watersheds while still meeting the MEP established TMDL requirements for nitrogen removal.

To see the effects of these two projects, the Town created a second baseline scenario that utilizes the Saquatucket natural attenuation project in the Cold Brook and the Pleasant Bay tidal flushing project in Muddy Creek. The result is the baseline attenuation scenario which directly compares the potential impacts of the two projects. This scenario is described below.

Saquatucket Harbor Natural Attenuation Project

The June 2010 final Linked Watershed Embayment Model presented in the MEP report for the Allen, Wychmere and Saquatucket Embayment Systems presents an alternative scenario that changes the attenuation rate in the Bank Street Bogs (Cold Brook) from 35 percent to 50 percent. Table IX-3 on Page 157 of the report presents the overall change to the watershed loads resulting from this alternative. For the Town to implement this project, additional study is needed, but the MEP modelers generally agree that the Bank Street Bogs (Cold Brook) can be enhanced to increase the residence time of freshwater flowing through the system by creating depositional basins (ponds) after determining specific sites within the bog system to increase the nitrogen removal. This modification is expected to result in the 50 percent attenuation.

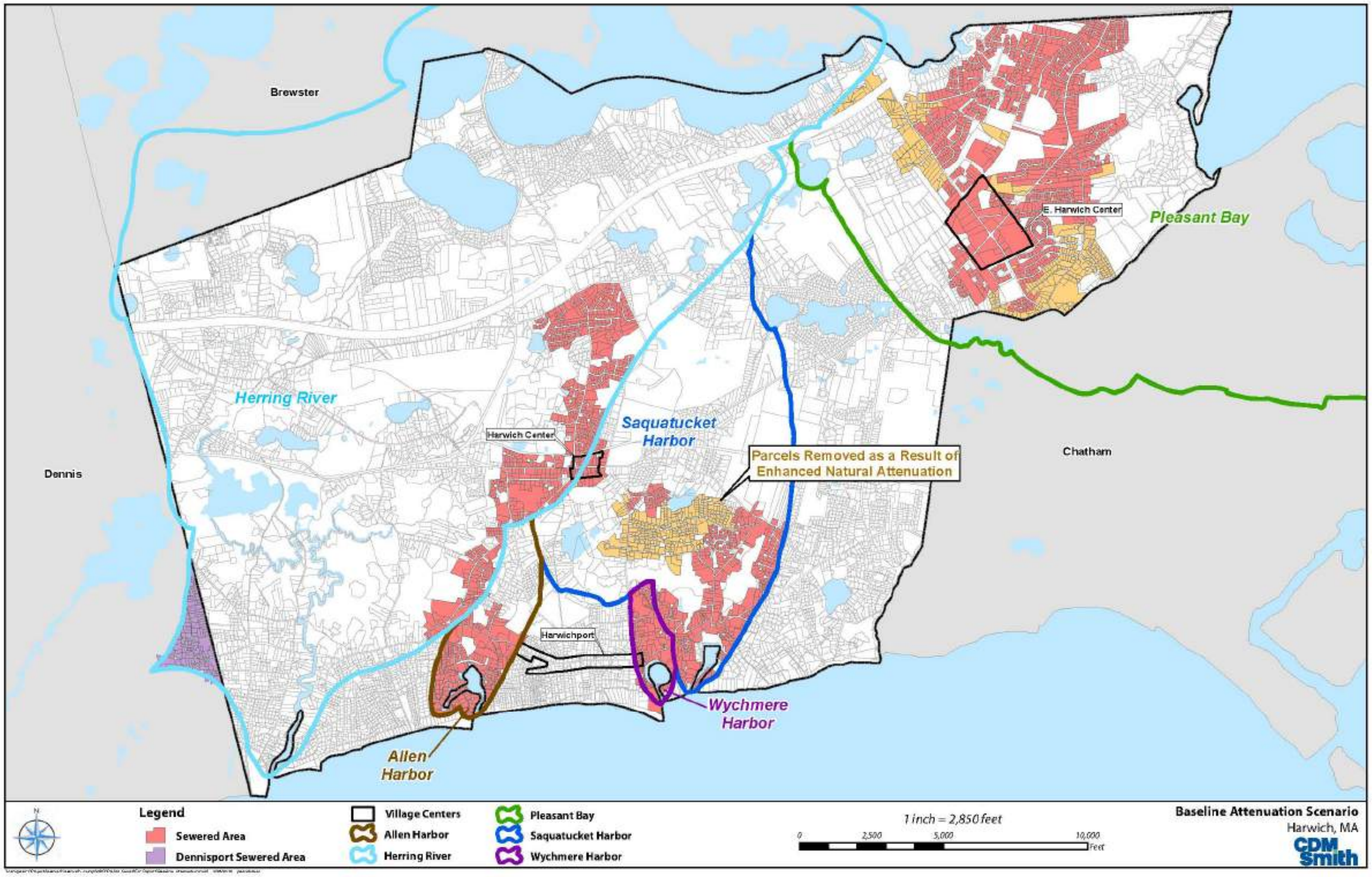
Pleasant Bay Natural Attenuation Project (Muddy Creek increased tidal flushing)

An October 5, 2010 MEP technical memorandum evaluates the water quality impacts of the addition of a 24-foot wide culvert in the Muddy Creek inlet. This technical memorandum presents an alternative scenario to the May 2006 final Linked Watershed Embayment Model for the Pleasant Bay system that reduces the threshold nitrogen concentrations in the upper and lower Muddy Creek sub-embayments as a result of increased flushing. For the Town to implement this project, the much smaller existing culvert would need to be increased in size to at least 24 feet. For this CWMP/SEIR, the Pleasant Bay system was modeled with the understanding that the current inlet to the Muddy Creek would be expanded to increase flushing by utilizing a larger, 24-foot culvert. The modeling that was performed for the Pleasant Bay system showed that replacing the existing inlet to Muddy Creek with a 24-foot culvert has little effect on the nitrogen levels throughout the Pleasant Bay system, but the wider culvert results in a 20% drop in the difference between the existing conditions modeled nitrogen concentration and the threshold concentration at the Lower Muddy Creek check station. Additional nitrogen reductions are still required in the Muddy Creek watershed to meet the threshold concentration in Lower Muddy Creek, but the magnitude is reduced through the installation of the wider culvert.

10.3.6 Baseline Attenuation Scenario

Similar to the baseline scenario, the baseline attenuation scenario satisfies the minimum MEP requirements for nitrogen removal in the five MEP watersheds in Harwich, but it utilizes the enhanced natural attenuation in the Saquatucket Harbor and Pleasant Bay systems described above. Specifically, the attenuation rate in the Bank Street Bogs is changed from 35 to 50 percent for the build-out nitrogen loading conditions in the Saquatucket Harbor watershed, and in the Pleasant Bay watershed, the addition of a 24-foot wide culvert at the outlet of Muddy Creek is estimated to reduce the target nitrogen concentration at the Lower Muddy Creek check water quality station (PBA-05). Figure 10-5 illustrates the baseline attenuation scenario.

Figure 10-5
Baseline Scenario (With Attenuation)



Based on the results of the baseline attenuation scenario, the amount of sewering required is significantly decreased in the Saquatucket Harbor and Pleasant Bay watersheds. The parcels highlighted in red show the parcels that would need to be sewered in order to meet the MEP requirements. The parcels colored in tan show the parcels that have been removed (do not need to be sewered) compared to the original baseline scenario.

10.3.7 Justification for Attenuation Scenarios (1A to 8A)

A preliminary cost evaluation of both of these enhanced attenuation options was conducted and it was concluded that the projects would be beneficial since the amount of sewering would be significantly reduced as a result of each project and the cost of these projects is a one-time capital expenditure, with minimal future operations and maintenance costs. Specifically, 470 fewer lots would require sewering with the enhanced natural attenuation offered by these two projects, approximately 230 in the Pleasant Bay watershed and approximately 240 in the Saquatucket Harbor watershed. With an estimated collection system cost of $25,000 per property for sewering, the total cost savings is $11.8 million. This savings does not even include the capital cost savings for construction of a transport system, a treatment facility, effluent recharge and the long term operation and maintenance of the entire system. Since the two proposed attenuation projects are expected to be around $3 million each or $6 million total, the cost savings are significant. Table 10-3 below shows the comparison.

Due to this significant cost savings, only the scenarios that incorporate the two natural attenuation projects are presented further in this report.

Table 10-3
Cost Comparison Between Baseline and Baseline Attenuation, Collection System Only

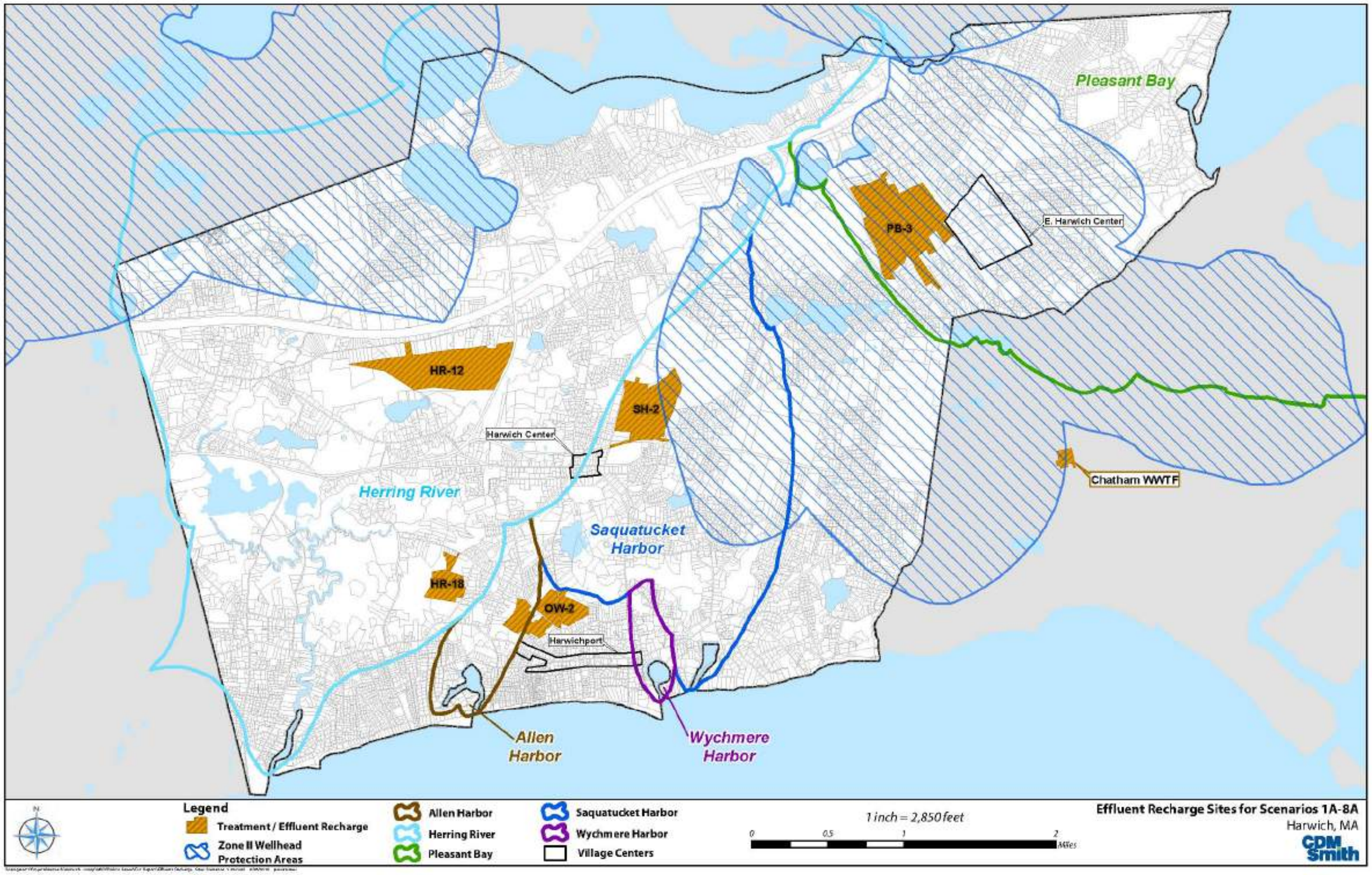
Scenario	# Of Parcels	Collection System Cost at $25K/lot
Baseline - No Attenuation	2,911	$72,775,000
Baseline With Attenuation	2,438	$60,950,000
Potential Cost Savings - Collection System Only	473	$11,825,000

10.3.8 Effluent Recharge Sites

As stated earlier, the baseline scenarios do not account for any effluent recharge in the watersheds and assume that treated wastewater is sent somewhere outside of the nitrogen sensitive watersheds. A baseline scenario would be considered viable if the Town had an acceptable candidate recharge site outside of the five MEP watersheds. Unfortunately, only one final candidate site was identified outside of these watersheds (OW-2), therefore in-watershed options needed to be considered.

As described in Section 9, the site screening analysis was initiated as a way to identify the best candidate sites for effluent recharge in Harwich. While the main focus was for effluent recharge sites, they were also considered to be acceptable wastewater treatment facility sites. This analysis was used to narrow down the final sites to be used in the wastewater scenarios. The eight wastewater scenarios (1A to 8A) presented below utilize four different effluent sites that were considered to be the best candidate sites based on the analysis in Section 9. (Note: HR-18 is only being considered as a treatment facility site.) Figure 10-6 shows the location of those sites. It also shows what MEP watershed the site is located in and whether they are within a Zone II area to a municipal well.

Figure 10-6
Effluent Recharge Sites for Scenarios 1A – 8A



The sites are as follows:

HR-12: This site is controlled by the Harwich Division of Highways and Maintenance. Only a portion of the site is being considered for recharge which consists of a heavily wooded 20-acre section to the east where potential infiltration basins could be located. To the west of the site is the Town's capped former landfill, and in the middle of the site, the Town is mining soil material for town projects. The site is located in the Herring River Watershed about a 1,000 lf upgradient of some cranberry bogs in the upper reaches of the eastern branch of the Herring River known as Coy Brook. A portion of the site is identified as a Priority Habitat area. This site is located outside any Zone II areas and is considered to be an excellent candidate site. It is therefore being considered by the Town in every scenario excluding the ocean outfall scenario.

HR-18: This site is the Town-owned gardens and sheep farm at 50 Sisson Road. This site is located outside any Zone II areas and is closest to the Allen Harbor watershed. It is considered only in the ocean outfall scenario as a wastewater treatment facility site.

OW-2: This site is composed of two privately owned parcels and includes the Harwich Port Golf Course at 51 South Street. It is close to the Allen Harbor, Saquatucket Harbor and Wychmere Harbor watersheds. This site is also located outside any Zone II areas and is considered in one scenario.

SH-2: This site is the Monomoy Regional High School site. The site contains several ball fields and open spaces where subsurface recharge could be utilized or wooded areas which could be used for new ball fields. A portion of the site is identified as a Priority Habitat area but is located outside any Zone II areas. This site is considered in four scenarios.

PB-3: This site is a large privately owned gravel pit area located near East Harwich Village Center. The site is located within a Zone II area to a municipal well. Sufficient area outside mined locations appears to exist to allow infiltration basin recharge to be utilized. This site appears to be the best location in the Pleasant Bay watershed and is being considered in six scenarios.

These locations are shown on the applicable figures for each wastewater scenario described below.

10.3.9 Wastewater Management Scenarios 1A through 8A

Based on the information presented in the previous sections, the information presented herein and discussions with the Wastewater Management Subcommittee, eight scenarios were defined and are referred to as Scenarios 1A through 8A. These scenarios are considered to be implementable because they not only account for nitrogen reduction, but they also account for effluent recharge. All of these scenarios utilize enhanced attenuation in the Saquatucket Harbor and Pleasant Bay systems to minimize the amount of required wastewater infrastructure. The areas with enhanced attenuation have the natural ability to tolerate higher nitrogen inputs from septic system discharges without negatively affecting the environment.

As discussed earlier, the goal of the wastewater scenarios was to define several logical and implementable scenarios to be screened down to a few preferred options to be further evaluated later in this CWMP/SEIR.

The attenuation component in each subwatershed is cumulative. As a result, the nitrogen component in wastewater can be attenuated or reduced several times as it travels through multiple watersheds capable of attenuating nitrogen. Thus, when deciding on areas to sewer, high density areas closest to the embayment were selected first. Title 5 areas of concern and socio-economic development areas were also considered when in the subject watersheds.

All of the scenarios were developed with the assumption that wastewater effluent would be treated to 5 mg/l total nitrogen except Scenario 5A and 7A. In Scenario 5A, wastewater is sent to Chatham for treatment. The Chatham wastewater facility already operates at an effluent concentration of 3 mg/l and the scenario reflects this. In Scenario 7A, the wastewater is treated to 3 mg/l to maximize the number of I/A systems that can be used in each watershed.

Throughout the scenarios, the effluent recharge is distributed among the five recharge sites discussed above. Scenario 8A utilizes an ocean outfall rather than an effluent recharge land site. Table 10-4 below summarizes the eight scenarios and their effluent recharge locations. Treatment is assumed to occur at the recharge site location. Note that each scenario uses water use as a basis for comparative purposes. For this analysis, buildout water use is considered to be a good estimate of the wastewater flow. Water use estimates for the eight scenarios is reported as buildout water use for all watersheds except the Herring River. Water use estimates from the Herring River utilize existing water use because the Herring River report was not published when this analysis was completed. The additional flow from the water use (typically wastewater use is estimated to be 90 percent of water use) is used to account for inflow and infiltration (I/I) estimates that must be considered with typical wastewater collection systems. The number of parcels required for sewering is also presented in this table. Following Table 10-4 is a detailed description and map for each of the eight scenarios.

Table 10-4
Summary of Treatment and Effluent Recharge Sites

	Herring River Watershed	Saquatucket Harbor Watershed	Pleasant Bay Watershed	Outside of an MEP Watershed	The Ocean	Number of Parcels Sewered	Scenario Water Use (Average)
Scenario	HR-12	SH-2	PB-3	OW-2	Outfall	Parcels	gpd
1A	HR	A, W, S	PB	None	None	2,992	670,000
2A	A, HR	W, S	PB	None	None	3,092	682,000
3A	A, W, S, HR, PB	None	None	None	None	3,198	697,000
4A	A, W, S, HR	None	PB	None	None	3,184	704,000
5A	A, W, S, HR	None	PB	None	None	3,094	680,000
6A	HR	W, S	PB	A	None	2,968	667,000
7A	HR and I/A	S and I/A	PB and I/A	A and I/A	None	1,643	417,000
8A	None	None	None	None	A, W, S, HR, PB	2,438	564,000

The scenarios presented in this section assumed that the Herring River watershed would require about 25 percent present septic system nitrogen removal. When the Draft MEP report for Herring River became available, that percentage rose to 58 percent. Since the Herring River results were published after this analysis was completed, the Town decided not to update these scenarios because all eight of them would need to be revised to a similar extent and the majority of those revisions needed to realize the 58 percent removal of nitrogen involves extending the collection system and little else. Because of this and the fact that these eight scenarios are a relative assessment aimed at determining if the Town should further develop more accurate planning level costs, it was decided to keep each scenario with the 25 percent nitrogen removal assumption. It is unlikely that the overall ranking of the eight scenarios would change if the updates to the Herring River were included. Once the highest ranked scenarios were chosen, a more detailed look at planning level costs including treatment facility size, collection system size and type, individual site conditions (state roads), and the need for specific infrastructure (such as pumping stations) was performed, as presented in Section 12.

Scenario 1A (670,000 gpd)

Scenario 1A is presented in Figure 10-7. In this scenario, effluent recharge utilizes the HR-12, SH-2 and PB-3 sites. In this option all of the flow from sewered areas of the Herring River and the Pleasant Bay watersheds are recharged within the watershed where the flow was generated. The Saquatucket Harbor watershed receives flows from the Allen Harbor and Wychmere Harbor watersheds. The total flow for this scenario is 670,000 gpd of water use.

Scenario 2A (682,000 gpd)

Scenario 2A is presented in Figure 10-8. In this scenario effluent recharge is again located at the HR-12, SH-2 and PB-3 sites. This scenario is similar to Scenario 1A, but the flow from the Allen Harbor watershed is conveyed to the Herring River watershed. The total flow for this scenario is 682,000 gpd of water use.

Scenario 3A (697,000 gpd)

Scenario 3A is presented in Figure 10-9. In this scenario, effluent recharge utilizes only the HR-12 site. The total flow for this scenario is 697,000 gpd of water use. Thus, wastewater is collected in each watershed and conveyed to HR-12 for treatment and recharge.

Scenario 4A (702,000 gpd)

Scenario 4A is presented in Figure 10-10. In this scenario, effluent recharge utilizes only the HR-12 and PB-3 sites. Flow from the Pleasant Bay watershed is collected, treated and recharged within the Pleasant Bay watershed, while the rest of the flow from the other watersheds is collected, treated and recharged to the Herring River watershed. The total flow for this scenario is 702,000 gpd of water use.

Scenario 5A (680,000 gpd)

Scenario 5A is presented in Figure 10-11. In this scenario, effluent recharge utilizes only the HR-12 and PB-3 sites. This scenario is similar to 4A, but the wastewater in this scenario is treated to 3 mg/l total nitrogen, since the flow from the Pleasant Bay watershed is collected and transported to the Chatham treatment facility. The treated effluent is then conveyed back to PB-3 for potential additional treatment (TOC removal may be required since the recharge site is in a Zone II) and recharge. The result of this additional nitrogen treatment is an overall reduction in the amount of wastewater that must be treated. The total flow for this scenario is 680,000 gpd of water use.

Figure 10-7
Scenario 1A

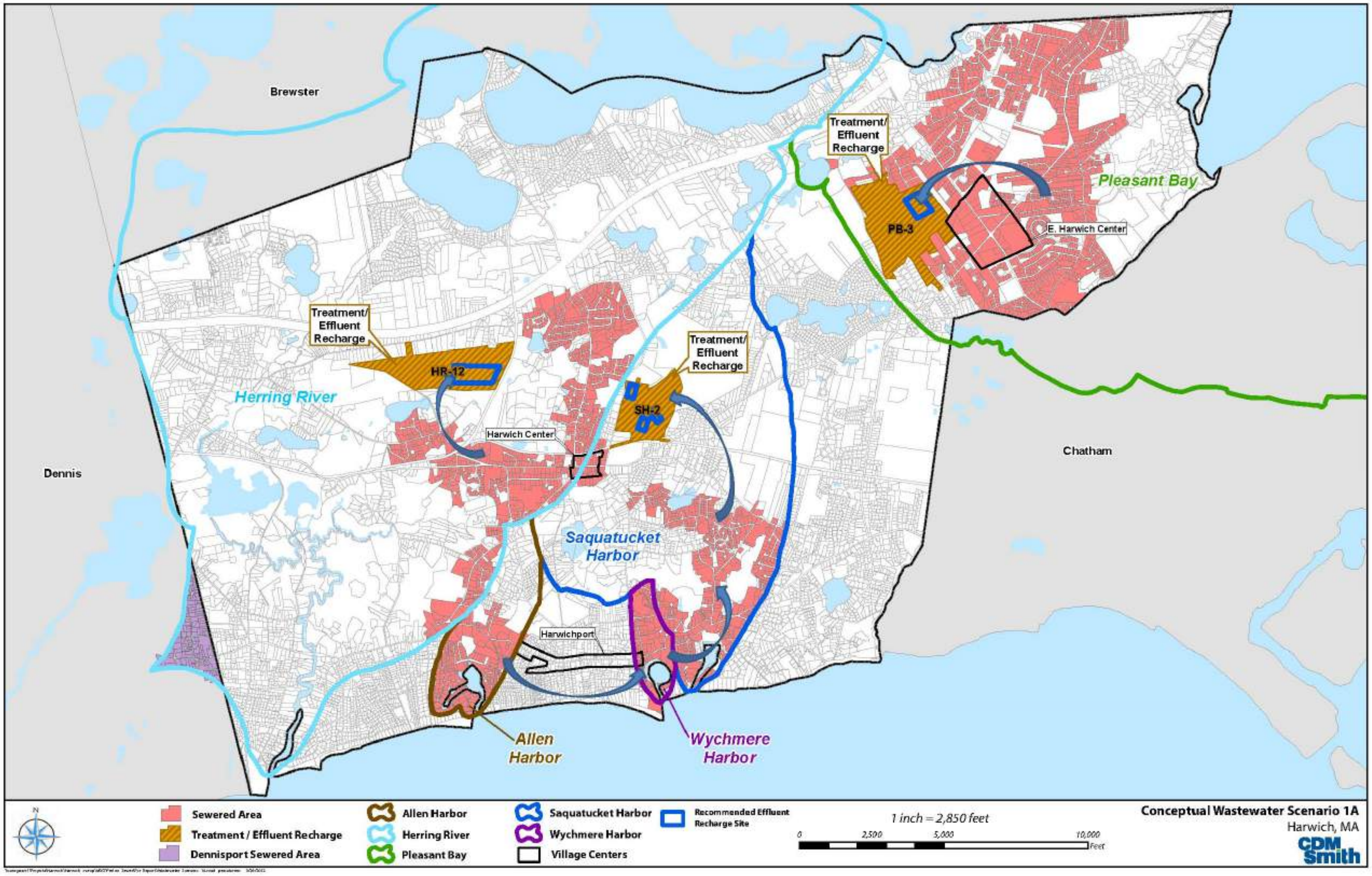


Figure 10-8
Scenario 2A

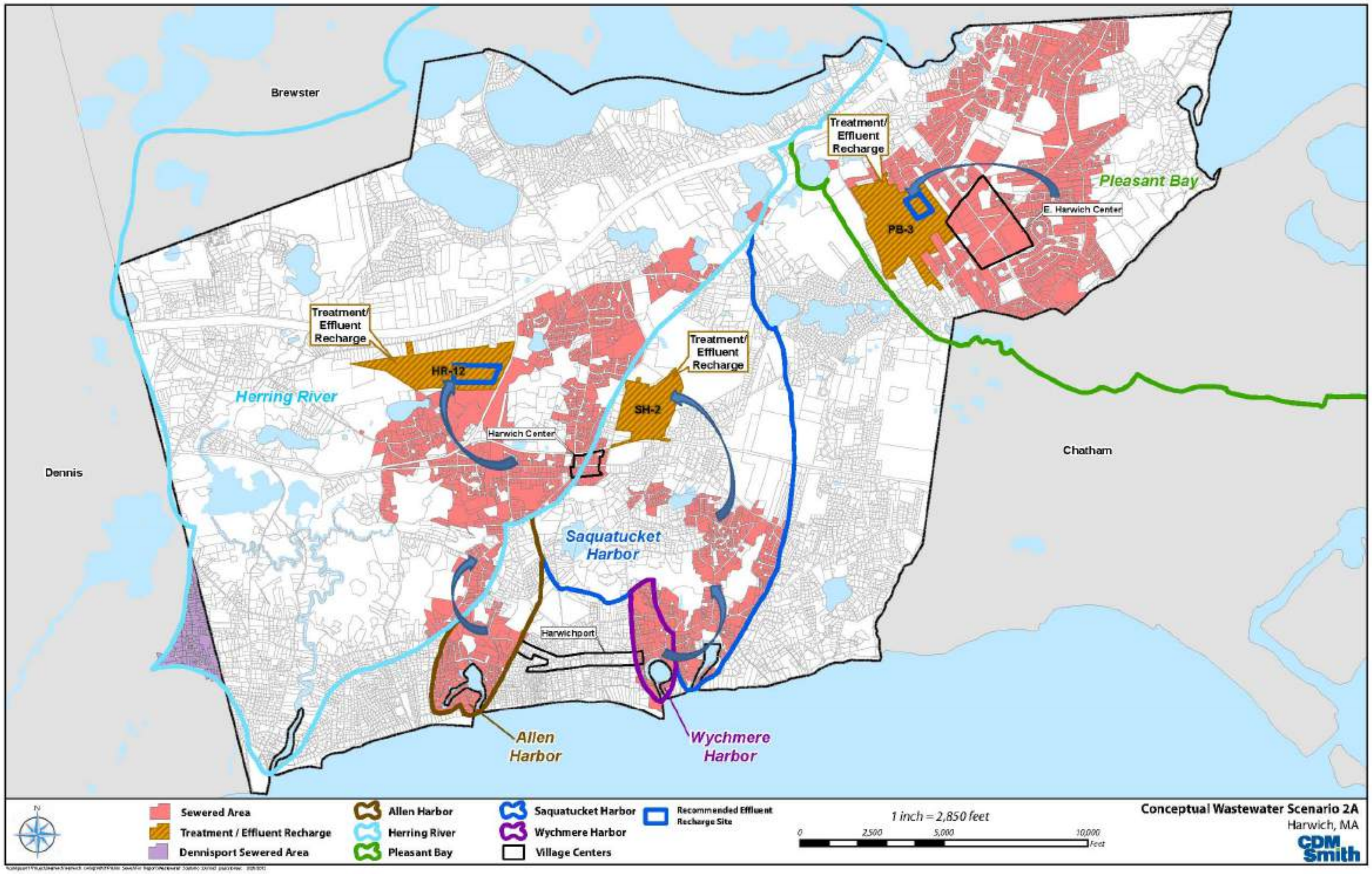


Figure 10-9
Scenario 3A

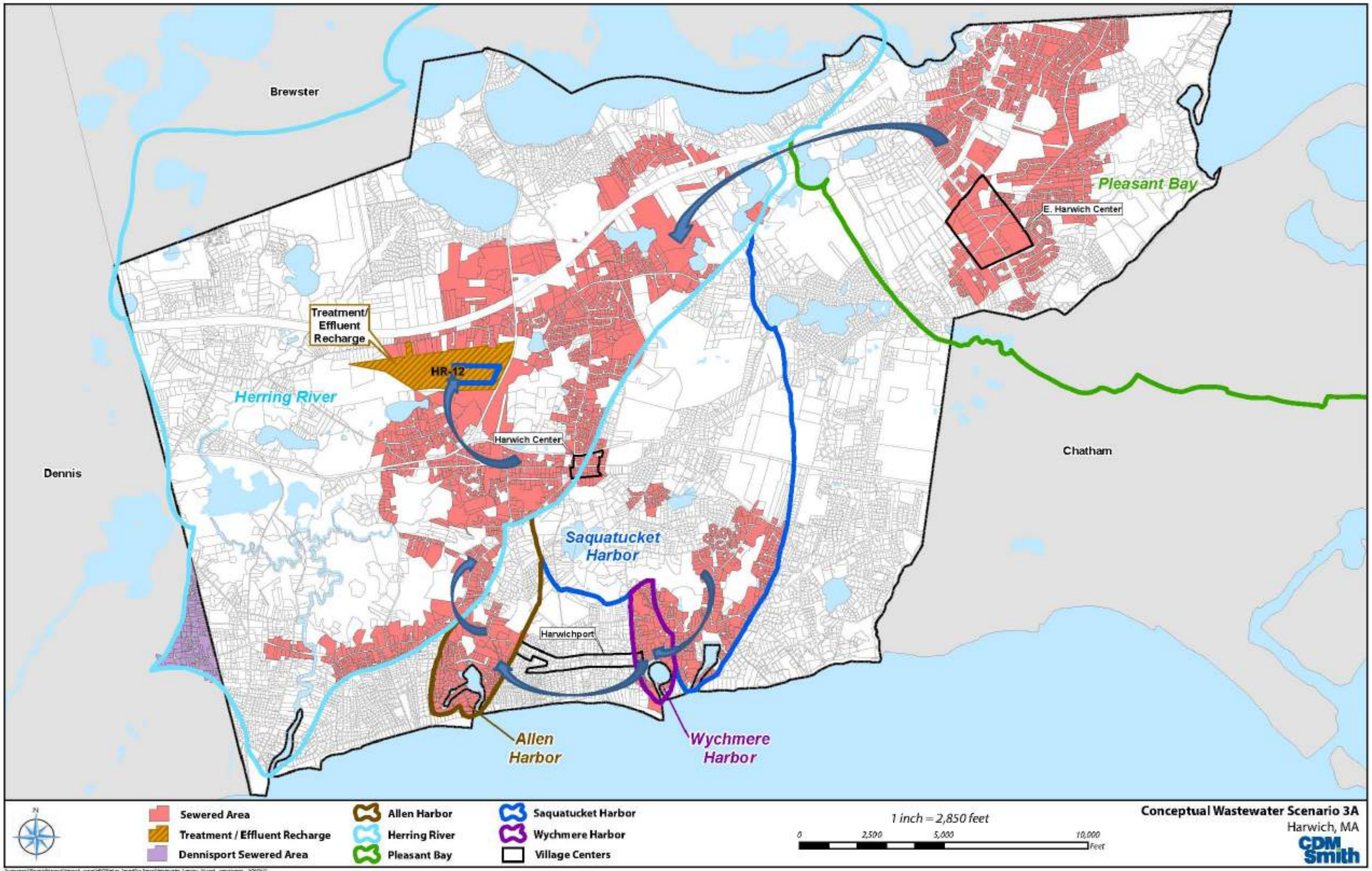


Figure 10-10
Scenario 4A

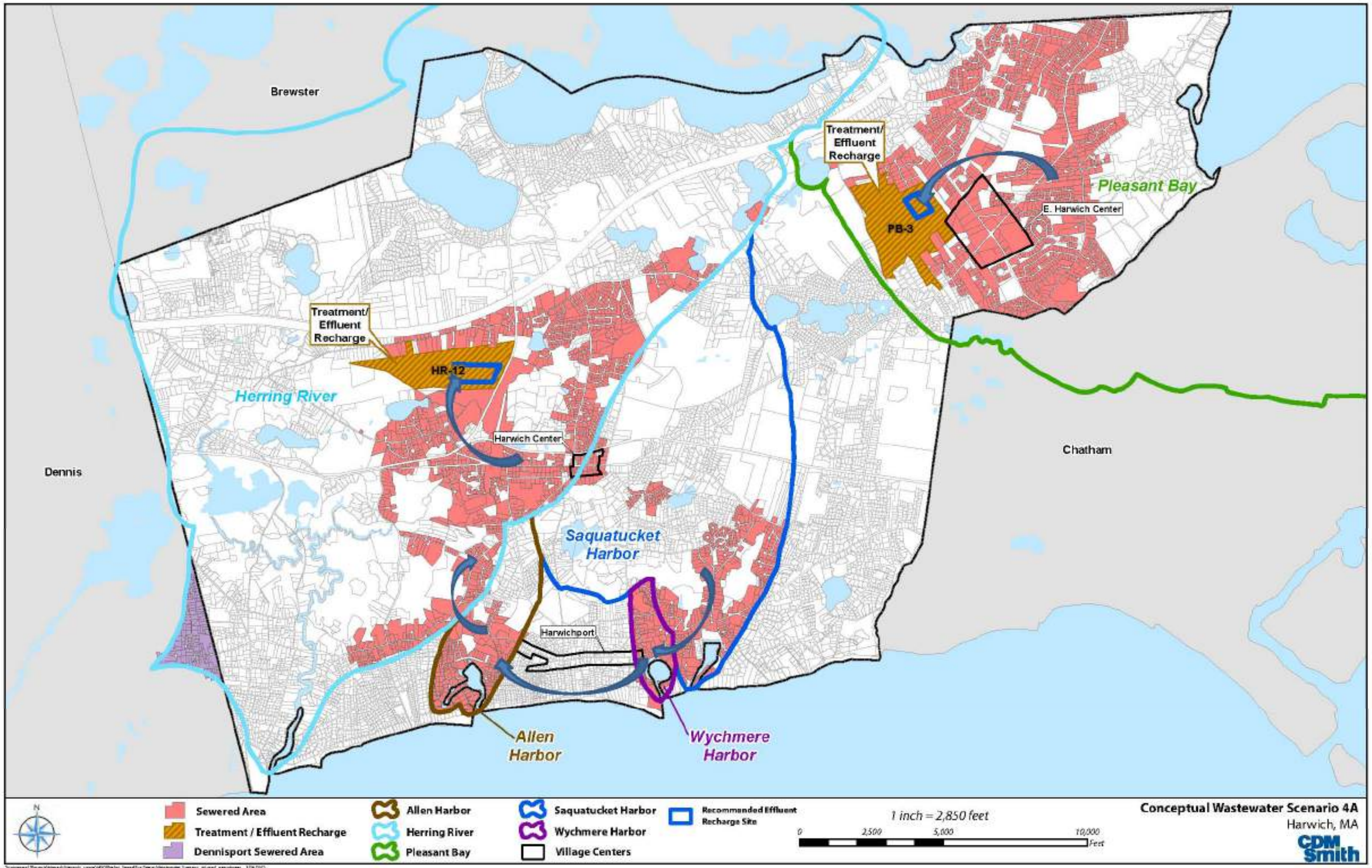
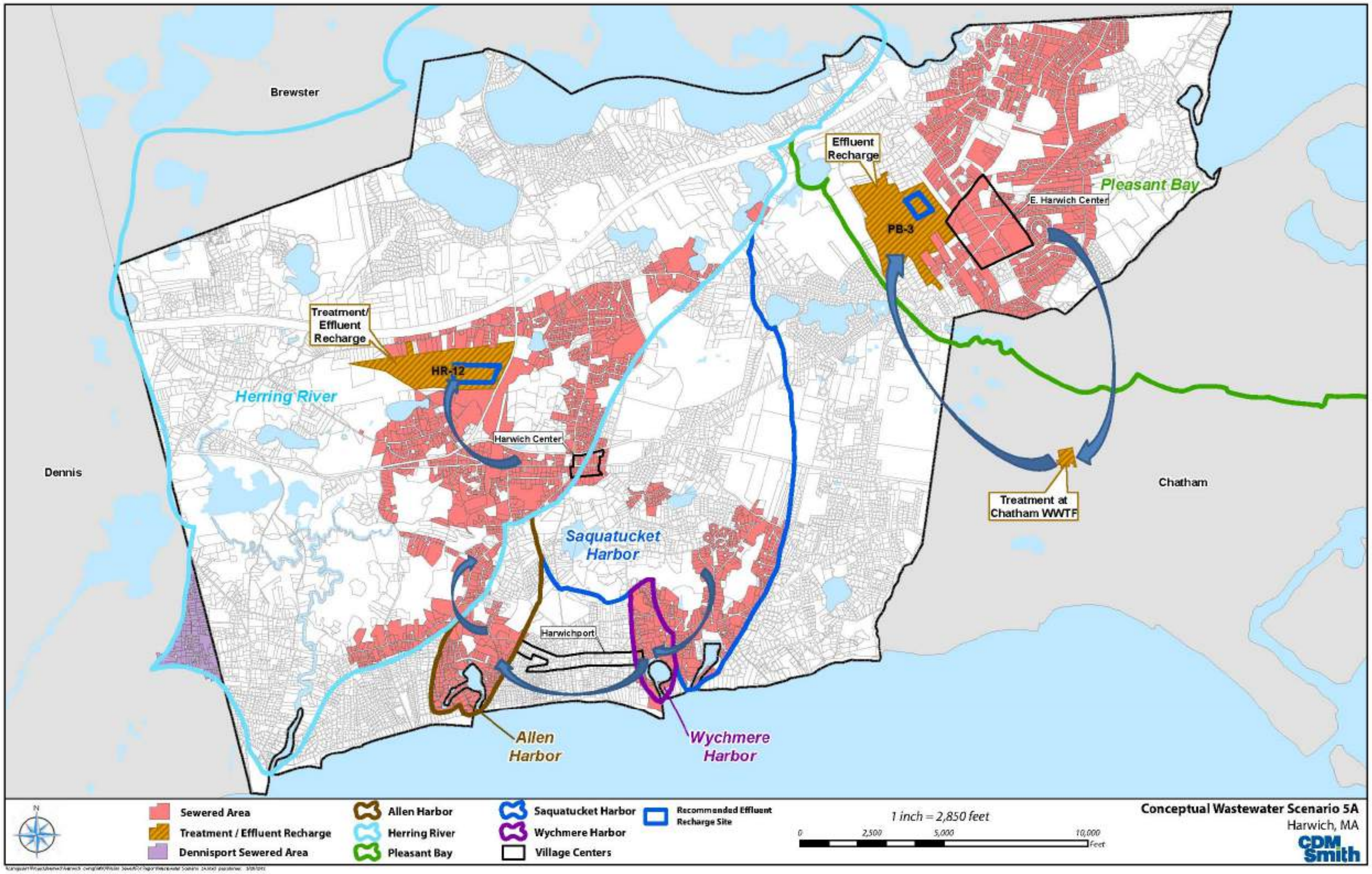


Figure 10-11
Scenario 5A



Scenario 6A (667,000 gpd)

Scenario 6A is presented in Figure 10-12. In this scenario, effluent recharge utilizes all four sites. This is the only scenario that utilizes the OW-2 site, which is expected to have a limited capacity for effluent recharge. As a result, this scenario only recharges the effluent flow from the Allen Harbor watershed at this site. The total flow for this scenario is 666,000 gpd of water use.

Scenario 7A (417,000 gpd)

Scenario 7A is presented in Figure 10-13. In this scenario innovative and alternative (I/A) treatment systems are utilized in four of the five MEP watersheds. I/A Systems are not used in the Wychmere Harbor watershed since 100 percent septic nitrogen removal is required in that watershed.

The I/A systems used in this scenario are individual systems that are typically sized for individual lots rather than cluster or centralized systems capable of treating wastewater from several lots/homes or businesses. A typical I/A system is capable of treating wastewater to a nitrogen effluent standard of 19 mg/l. These systems are used in the Allen Harbor, Saquatucket Harbor, and Herring River watersheds. To minimize the wastewater collection area in the Pleasant Bay watershed, enhanced I/A systems (capable of treating to a nitrogen effluent standard of 13mg/l) are used there. While the I/A systems can remove a significant amount of nitrogen from wastewater, alone they cannot remove enough nitrogen to fully satisfy the MEP TMDL requirements in Harwich. As a result, this scenario combines a limited amount of wastewater collection and treatment and supplements it with I/A systems to achieve a nitrogen reduction that does meet the MEP TMDL requirements. For this scenario 417,000 gpd of water use must be collected and treated using a sewer system and treatment facility. This alone does not meet the MEP threshold, so an additional 6,600 parcels will require some type of I/A system. Figure 10-13 shows the parcels that were chosen for conventional wastewater collection and treatment in red. The figure also shows the parcels that would receive an I/A system in green.

Scenario 8A (564,000 gpd)

Scenario 8A is the ocean outfall scenario presented in Figure 10-14. This scenario is similar to the baseline attenuation scenario because the nitrogen balancing that is required for effluent recharge within an MEP watershed is not needed. Since this scenario utilizes an ocean outfall, the wastewater is sent outside of a nitrogen sensitive watershed where it can be disregarded in terms of nitrogen balancing, similar to the baseline attenuation scenario. For this scenario, wastewater is collected, treated at the Town Gardens (HR-18) site to 5 mg/l and then ultimately discharged to the ocean 3.5 miles off of Allen Harbor. The total flow for this scenario is 564,000 gpd of water use.

10.4 Comparative Assessment of Scenarios

The eight wastewater management scenarios developed to address the environmental restoration goals of the Town were screened using an evaluation matrix developed to compare them by the criteria described in Section 10.4.3. First, a discussion of the methodology for developing preliminary comparative cost estimates is discussed.

Figure 10-12
Scenario 6A

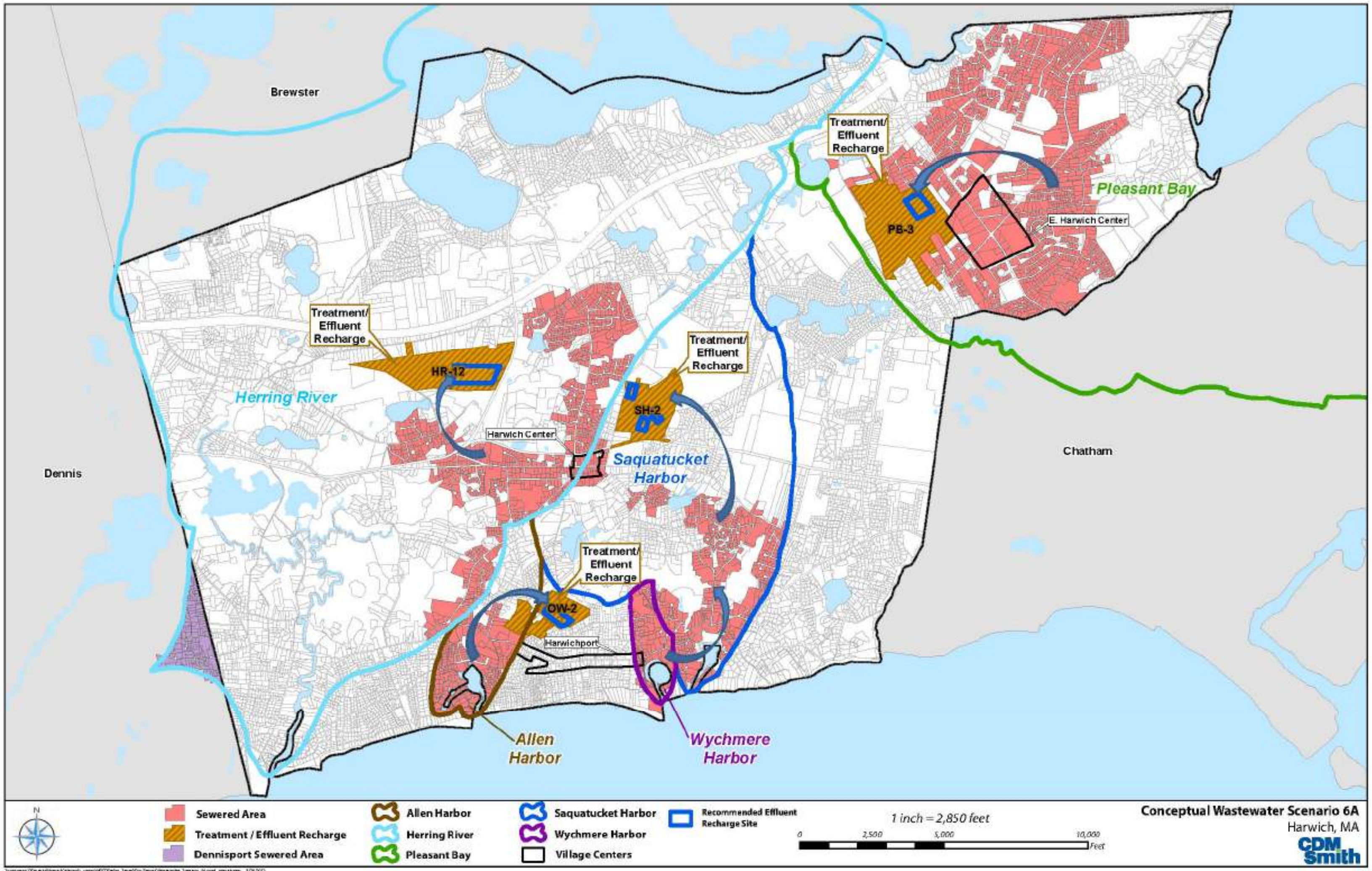


Figure 10-13
Scenario 7A

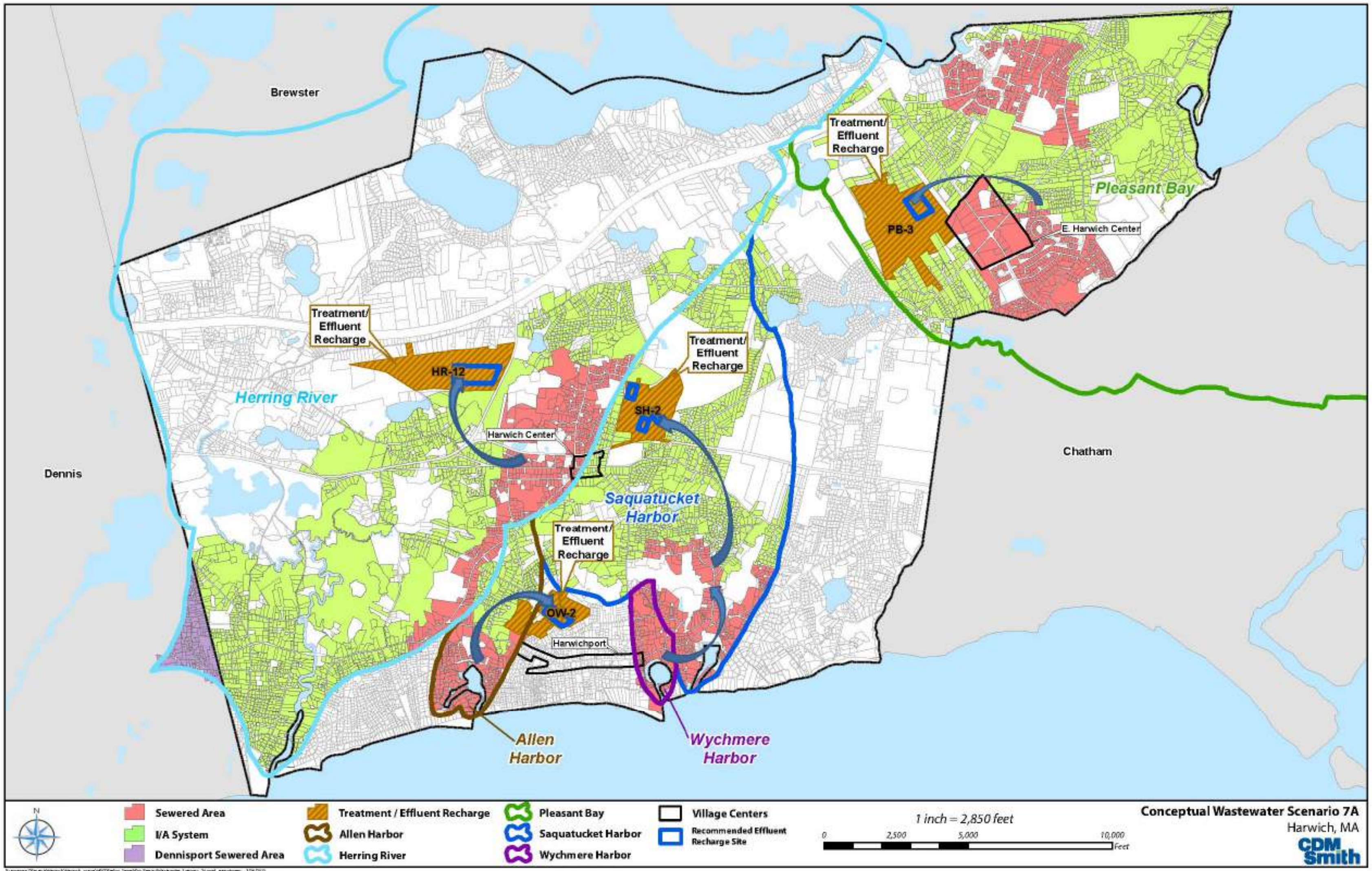
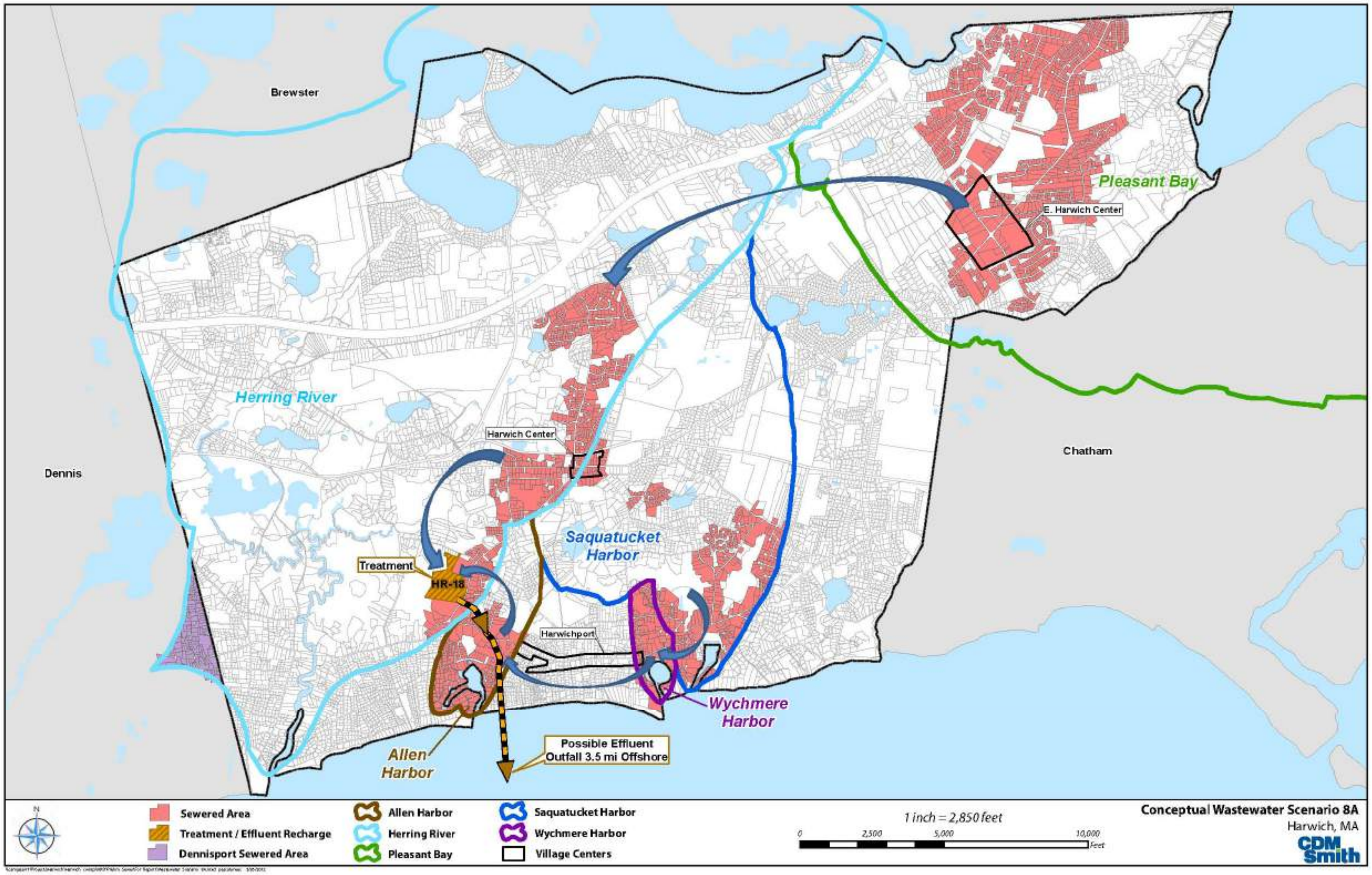


Figure 10-14
Scenario 8A



10.4.1 Cost Analysis

Comparative costs were developed using the tools presented in the Barnstable County Wastewater Cost Task Force's report entitled, "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod, Guidance to Cape Cod Towns Undertaking Comprehensive Wastewater Management Planning" dated April 2010. Capital costs were supplemented by CDM Smith for some unit costs not readily available in the Barnstable County report.

The Barnstable County report presents cost estimating tools for individual on-site systems, cluster treatment systems (defined as up to 30 homes or 10,000 gpd), satellite systems (30 to 1,000 homes, and 10,000 to 300,000 gpd), and centralized systems which meet most or all of a town's needs. Capital costs developed using the tools include collection, conveyance, treatment, and effluent recharge. Capital costs include design, permitting and land costs. Collection and transport costs are determined using a cost curve provided in the report which is based on the lot density of proposed sewered areas. For this analysis, the lot density information was estimated by dividing 90 percent of the linear feet of roadways within the area tributary to each proposed treatment facility by the total number of parcels proposed for sewering. The result from that calculation is the average number of feet of collection system required per lot, which can be used to determine a capital cost for collection and transport per lot being treated.

Treatment and recharge costs were determined using a separate curve in the report based on short-term peak flows at the proposed wastewater treatment facilities. A peaking factor of 2.2 was used to account for short term peak flows. Average water use for each sewered area is summarized in Table 10-5.

To supplement the Barnstable County capital cost data, CDM Smith added costs for force mains from the main pumping station for the collection area to each treatment facility location and, where applicable, force mains from the treatment facility to the recharge/outfall location. Force main costs were estimated at $175 per linear foot of force main. Ocean outfall costs were estimated at $2,500 per linear foot of outfall pipe.

O&M costs were also developed using the Barnstable County report. These costs include labor, chemicals, electricity, laboratory analysis, repairs, administrative costs and sludge removal. The O&M costs are determined separately for each proposed treatment facility based on a cost curve in the Barnstable County report which provides the annual cost per gallon treated, using the average daily flow of the facility. Average daily flows were taken directly from the water usage for each area tributary to each treatment facility.

For the I/A scenario, both capital and O&M costs reported for similar on-site systems on Cape Cod were used to establish cost estimates. Specifically, the Barnstable County report describes the cost of a standard Title 5 system as $15,000 for a new home, $8,000 for an upgrade, and up to $30,000 for a mounded system. For this analysis, an I/A system is estimated to cost $15,000 for a system that can treat to 19 mg/L TN, and $20,000 for a system that can treat to 13 mg/L TN. Annual O&M costs for Title 5 systems were reported as $100 for standard Title 5 systems, $1,500 for I/A systems with limited oversight capable of achieving 19 ppm of nitrogen, $2,500 for I/A systems with more appropriate oversight capable of achieving 13 ppm of nitrogen, and $3,200 for I/A systems where documentation of effluent limits is required for TMDL compliance.

Equivalent annual costs were developed using the capital cost of each scenario plus the annual O&M cost. These costs are presented in Section 10.4.2. Cost efficiency was then developed by dividing the equivalent annual cost by the pounds of nitrogen removed by each scenario, to arrive at an annual cost per pound of nitrogen removed.

10.4.2 Cost Results

All of the costs described above in Section 10.4.1 were tabulated into detailed spreadsheets that show several components of a wastewater system including collection, transport, treatment and effluent recharge. Detailed spreadsheets were created that tabulated all of the wastewater collection and treatment options into tables for a side by side comparison. The spreadsheets are provided in Appendix C. These tables presented costs for pumping stations, force mains, linear feet of roads, water use and the number of parcels sewered. They present costs for wastewater flows (including peak flows), treatment goals, amount of treatment required, Zone II treatment considerations, effluent recharge, and O&M costs. A summary of this information is tabulated for each scenario and is presented in Tables 10-5A to 10-5D, below.

The estimated total capital cost of each option is presented along with the estimated total O&M cost for each option. For comparison of costs on an annual basis, the Equivalent Annual Cost (EAC) is also presented. The EAC assumes that the capital cost is based on a 20 year loan with a 2% loan rate that assumes the State Revolving Fund (SRF) is the funding mechanism for the project.

From the summary table, the equivalent annual cost of Scenario 3A is the lowest among the scenarios since it utilizes the economy of scale from a single wastewater treatment facility to accomplish the Town's wastewater goals. However, Scenarios 4A and 5A at this screening level cost analysis can essentially be considered equal to Scenario 3A as they are within 10 percent of each other. Scenarios 4A and 5A utilize two treatment facilities. Scenario 7A is the most costly option since this scenario will require approximately 6,600 I/A septic systems, which is a significant portion of the cost.

Table 10-6 presents the cost per pound of nitrogen removed for each scenario and reflects similar results to the EAC.

This table shows that each scenario must remove between 48,500 and 67,000 pounds of nitrogen every year to meet the TMDLs for total nitrogen. The differing amount of nitrogen removed in each scenario is a result of natural attenuation variations throughout the subwatersheds, the particular areas chosen for wastewater collection, and the nitrogen balancing that is required for each scenario that recharges effluent within a nitrogen sensitive (limited) watershed. Scenario 8A requires the least amount of nitrogen removed since this scenario recharges to the ocean and requires no effluent recharge nitrogen balancing. All other scenarios (1A to 7A) recharge effluent to one or more nitrogen sensitive watersheds.

Table 10-5 A

Wastewater Scenarios Summary Table : Length of Force Mains

	Scenario							
	1A	2A	3A	4A	5A	6A	7A	8A
Length of Force Mains (feet)	32,000	26,000	47,000	29,000	36,000 + 17,000 (add.)	32,000	32,000	41,000 + 25,000 (add.)

*Force mains from treatment facilities in scenarios 5A and 8A are considered to be additional force mains. The cost for these additional force mains is included in the treatment and effluent recharge cost.

Table 10-5 B

Wastewater Scenarios Summary Table : Collection and Treatment Costs

	Scenario							
	1A	2A	3A	4A	5A	6A	7A	8A
Total Transport/Collection System Cost	$78,500,000	$82,300,000	$95,600,000	$86,800,000	$86,000,000	$78,100,000	$51,700,000	$73,300,000
Treatment and Effluent Recharge Cost	$42,400,000	$41,900,000	$28,100,000	$36,700,000	$37,000,000	$45,700,000	$139,100,000	$92,300,000
Total Capital Cost	***120,900,000***	***124,100,000***	***123,700,000***	***123,500,000***	***123,100,000***	***123,800,000***	***190,800,000***	***165,700,000***

Table 10-5 C

Wastewater Scenarios Summary Table : Total O&M Costs

	Scenario							
	1A	*2A*	*3A*	*4A*	*5A*	*6A*	*7A*	*8A*
Total O&M Cost	$4,000,000	$3,700,000	$2,200,000	$3,300,000	$2,700,000	$4,200,000	$14,200,000	$2,100,000

Table 10-5 D

Wastewater Scenarios Summary Table : Equivalent Annual Cost (includes Collection treatment and O&M Costs)

	Scenario							
	1A	*2A*	*3A*	*4A*	*5A*	*6A*	*7A*	*8A*
Equivalent Annual Cost (EAC) - 20 years @2% -	$11,300,000	$11,300,000	$9,800,000	$10,800,000	$10,200,000	$11,800,000	$25,900,000	$12,200,000

CDM Smith
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Table 10-6
Wastewater Scenarios Cost Per Pound of Nitrogen Removed

	Scenario							
	1A	2A	3A	4A	5A	6A	7A	8A
Pounds of Nitrogen Removed	57,000	59,000	67,000	62,000	60,000	55,000	58,000	48,500
Cost Per Pound of Nitrogen Removed (EAC)	$199	$192	$146	$175	$170	$215	$447	$252

10.4.3 Evaluation Criteria

To distinguish between these scenarios, a detailed evaluation matrix was developed. The following evaluation criteria were selected for analysis and divided into four major categories:

- Relative Costs
  - Capital costs
  - O&M costs
  - Cost efficiency
- Technical Criteria
  - Complexity of transport
  - Reliability
  - Effluent recharge issues
  - Future recharge capacity
- Institutional Criteria
  - Phasing
  - Regional opportunities
  - Regulatory considerations
  - Land ownership
- Environmental Criteria
  - Effluent recharge impacts
  - Water balance considerations
  - Sensitive receptors
  - Construction impacts

All criteria were ranked on a scale of 1 to 5, with 1 being the most favorable and 5 being the least favorable. The definition and ranking approach for each criterion is described below.

Each individual criterion was weighted individually by the Wastewater Management Subcommittee to reflect the preferences in Harwich. The relative costs category is weighted more heavily in this analysis since project costs are usually a deciding factor in determining whether or not a project can be implemented.

Relative Costs (50 Percent Weight)

Capital Costs: The cost of each alternative was estimated based on the Barnstable County Report discussed above. This tool enables communities to assess the relative planning-level costs of various alternatives to use in the scenario screening process. Capital costs were supplemented by CDM Smith for some unit costs not readily available in the Barnstable County report. The cost estimates developed using this tool are described in Section 10.4.1 and are presented in 2009 dollars. More detailed cost estimates were established during later phases of the CWMP process for the scenarios selected for further analysis. Capital costs include collection, transport, treatment and effluent recharge and were ranked as follows:

Rating	Range
1	<$120 million
2	$120 – 125 million
3	$125 – 130 million
4	$130 – 135 million
5	>$135 million

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	2	as project construction cost is estimated to be about $121 million
2A	2	as project construction cost is estimated to be about $124 million
3A	2	as project construction cost is estimated to be about $124 million
4A	2	as project construction cost is estimated to be about $124 million
5A	2	as project construction cost is estimated to be about $123 million
6A	2	as project construction cost is estimated to be about $124 million
7A	5	as project construction cost is estimated to be about $191 million
8A	5	as project construction cost is estimated to be about $166 million

Operations and Maintenance Costs: The operation and maintenance (O&M) costs of each alternative were also developed using the Barnstable County report, and were supplemented as needed by CDM Smith. O&M costs are shown on an average annual basis at 2009 dollars and were ranked as follows:

Rating	Range
1	< $ 2.5 million
2	$2.5 – 3.0 million
3	$3.0 – 3.5 million
4	$3.5 – 4.0 million
5	> $ 4.0 million

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	4	as annual O&M cost is estimated to be about $4.0 million
2A	4	as annual O&M cost is estimated to be about $3.7 million
3A	1	as annual O&M cost is estimated to be about $2.2 million
4A	3	as annual O&M cost is estimated to be about $3.3 million
5A	2	as annual O&M cost is estimated to be about $2.7 million
6A	5	as annual O&M cost is estimated to be about $4.2 million
7A	5	as annual O&M cost is estimated to be about $14.2 million
8A	1	as annual O&M cost is estimated to be about $2.1 million

Cost Efficiency: The cost efficiency is the Equivalent Annual Cost (EAC) of the system over a 20 year life cycle. The EAC calculated using the 20-year life cycle at an interest payment rate of two percent plus the annual O&M cost gives a good estimate of the annual cost for the system by accounting for both loan payments and O&M costs. The cost efficiency was then ranked as follows:

Rating	Range
1	< $ 10.0 million
2	$10 – 10.5 million
3	$10.5 – 11 million
4	$11 – 11.5 million
5	> $ 11.5 million

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	4	as the Equivalent Annual Cost is estimated at $11.3 Million
2A	4	as the Equivalent Annual Cost is estimated at $11.3 Million
3A	1	as the Equivalent Annual Cost is estimated at $9.8 Million
4A	3	as the Equivalent Annual Cost is estimated at $10.8 Million
5A	2	as the Equivalent Annual Cost is estimated at $10.2 Million
6A	5	as the Equivalent Annual Cost is estimated at $11.8 Million
7A	5	as the Equivalent Annual Cost is estimated at $25.9 Million
8A	5	as the Equivalent Annual Cost is estimated at $12.2 Million

Technical Criteria (18 Percent Weight)

Complexity of Transport System: The various scenarios involve collecting wastewater from sewer service areas and conveying the collected wastewater via pumping stations and forcemains to a treatment facility and effluent recharge area. The number of major pumping stations required to convey collected wastewater to the treatment facility and effluent recharge sites is a consideration as this will have short-term construction impacts and long-term operation and maintenance impacts. The complexity of each scenario's transport system was evaluated by considering the total length of forcemains required to convey wastewater to the treatment facility sites and effluent to the recharge sites (including outfall pipes) to arrive at the following rankings:

Rating	Range
1	requires 30,000 lf or less of forcemains
2	requires greater than 30,000 lf up to 40,000 lf of forcemains
3	requires greater than 40,000 lf up to 50,000 lf of forcemains
4	requires greater than 50,000 lf up to 60,000 lf of forcemains
5	requires greater than 60,000 lf of forcemains

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	2	as this scenario has about 32,000 lf of forcemains
2A	1	as this scenario has about 26,000 lf of forcemains
3A	3	as this scenario has about 47,000 lf of forcemains
4A	1	as this scenario has about 29,000 lf of forcemains
5A	4	as this scenario has about 36,000 lf of forcemains and 17,000 lf of FM to and from Chatham (53,000 lf total)
6A	2	as this scenario has about 32,000 lf of forcemains
7A	2	as this scenario has about 32,000 lf of forcemains
8A	5	as this scenario has about 41,000 lf of forcemains and 25,000 lf of outfall pipe (66,000 lf total)

Reliability Issues: Reliability issues explore the likelihood that permitted treatment facility effluent limits can be reliably met throughout the year. More stringent permit limits will reduce the potential reliability of a system. Multiple facilities will also reduce the overall reliability due to increased complexity of maintaining several different size facilities at once. Thus, the reliability criterion considers three overall factors and includes the permit level of total nitrogen (TN) that must be obtained, the requirement for total organic carbon (TOC) removal in drinking water Zone II effluent recharge areas, and the overall number of wastewater treatment facilities utilized in a given scenario. These criteria are used in the following rankings:

Rating	Range
1	Wastewater treatment to 5mg/l TN, one treatment facility, ocean outfall recharge
2	Wastewater treatment to 5mg/l TN, one treatment facility, land recharge
3	Wastewater treatment to 5mg/l TN, two to three treatment facilities, land recharge, additional TOC removal required for a Zone II area
4	Wastewater treatment to 3mg/l TN, two to three treatment facilities, land recharge, additional TOC removal required for a Zone II area
5	Wastewater treatment to 3mg/l or 5 mg/l TN, four treatment facilities, land recharge, additional TOC removal required for a Zone II area

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	3	as this scenario has treatment to 5 mg/l TN, three treatment facilities, land recharge in a Zone II with TOC removal
2A	3	as this scenario has treatment to 5 mg/l TN, three treatment facilities, land recharge in a Zone II with TOC removal
3A	2	as this scenario has treatment to 5 mg/l TN, one treatment facility and land recharge
4A	3	as this scenario has treatment to 5 mg/l TN, two treatment facilities and land recharge in a Zone II with TOC removal
5A	4	as this scenario has treatment to 3 mg/l TN two treatment facilities, land recharge in a Zone II with TOC removal
6A	5	as this scenario has treatment to 5mg/l TN, four treatment facilities, land recharge in a Zone II with TOC removal
7A	5	as this scenario has treatment to 3 mg/l TN, four treatment facilities, and land recharge in a Zone II with TOC removal
8A	1	as this scenario has treatment to 5 mg/l TN, one treatment facility and ocean outfall recharge

Effluent Recharge Issues: Effluent recharge issues from a technical perspective include the required hydrogeologic investigations and groundwater discharge requirements to approve each recharge site. Technical considerations are anticipated to relate directly to the number of effluent recharge sites, whether the site is located inside or outside of a Zone II drinking water supply and whether the site can utilize open infiltration basins or requires use of subsurface leaching areas or an ocean outfall. Based on those criteria the following rankings were defined as follows:

Rating	Range
1	One effluent recharge site utilizing open infiltration basins
2	Two or three effluent recharge sites utilizing open infiltration basins and one site within a Zone II area
3	Two or three effluent recharge sites with some requiring subsurface leaching areas and one site in a Zone II area
4	Four effluent recharge sites with some requiring subsurface leaching areas and one site in a Zone II area
5	An ocean outfall utilized for effluent recharge

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	3	as this scenario utilizes three sites with one in a Zone II and one requiring subsurface recharge
2A	3	as this scenario utilizes three sites with one in a Zone II and one requiring subsurface recharge
3A	1	as this scenario utilizes one site outside of a Zone II and with open infiltrations basins
4A	2	as this scenario utilizes two sites with one in a Zone II and one with open infiltrations basins
5A	2	as this scenario utilizes two sites with one in a Zone II and one with open infiltrations basins
6A	4	as this scenario utilizes four sites with one in a Zone II and two requiring subsurface recharge
7A	4	as this scenario utilizes four sites with one in a Zone II and two requiring subsurface recharge
8A	5	as this scenario utilizes an ocean outfall

Future Recharge Capacity: The future recharge capacity describes the ability to recharge additional effluent if the Town decided to expand its wastewater system and sewer additional areas in the future. This criterion looks at each wastewater scenario and considers the potential recharge capacity of the effluent recharge sites. For this analysis the ocean outfall is assumed to have significant capacity for expansion. The ratings for each scenario are listed below.

Rating	Range
1	Utilizes an ocean outfall with significant capacity
2	Utilizes more than three effluent recharge sites
3	Utilizes HR-12, PB-3, and SH-2; expansion of capacity at SH-2 is less likely
4	Utilizes HR-12 and PB-3 which have the most capacity of the land based recharge options; preliminary results indicate that additional recharge flow at these sites may be possible and could allow for future growth of a wastewater system
5	Utilizes only one site for effluent recharge

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	3	as this scenario utilizes three sites: HR-12, SH-2 and PB-3
2A	3	as this scenario utilizes three sites: HR-12, SH-2 and PB-3
3A	5	as this scenario utilizes one site: HR-12
4A	4	as this scenario utilizes two sites: HR-12 and PB-3
5A	4	as this scenario utilizes two sites: HR-12 and PB-3
6A	2	as this scenario utilizes four sites: HR-12, SH-2, PB-3, and OW-2
7A	2	as this scenario utilizes four sites: HR-12, SH-2, PB-3, and OW-2
8A	1	as this scenario utilizes an ocean outfall

Institutional Criteria (16 Percent Weight)

Phasing: The scenarios vary in their ability to be divided into suitable implementation phases and the associated ability to meet TMDL nitrogen reduction goals without creating temporary increases in nitrogen sensitive areas due to removal from one watershed and recharge in another. Also the ability to meet the Town's planning goals in addressing village center developments which will require sewers is factored in. The timeline to permit a given scenario was considered (ocean outfall not currently allowed by law). The availability of a logical phasing strategy for each scenario was compared and ranked as follows:

Rating	Range
1	Straightforward and logical phasing strategy is apparent since three or more wastewater facilities exist with distinct wastewater service areas
2	Straightforward and logical phasing strategy is apparent since two wastewater facilities exist with distinct wastewater service areas
3	Straightforward and logical phasing strategy is less apparent since one wastewater facility exists to service all wastewater service areas
4	Phasing strategy is more difficult since four wastewater facilities exist along with several I/A systems. Permitting the I/A systems to meet TMDL permit compliance will require additional regulatory efforts.
5	Ocean outfall is not currently allowed by law under the Ocean Sanctuaries Act

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	1	as this scenario utilizes three treatment facilities and effluent recharge sites that can be phased for each area to be addressed
2A	1	as this scenario utilizes three treatment facilities and effluent recharge sites that can be phased for each area to be addressed
3A	3	as this scenario relies on phasing one facility which can lead to construction sequencing issues and initial year operational issues due to the large variability in flows over time
4A	2	as this scenario relies on two treatment and effluent recharge sites
5A	2a	s this scenario relies on two treatment and effluent recharge sites
6A	1	as this scenario utilizes four treatment facilities and effluent recharge sites that can be phased for each area to be addressed
7A	4	as this scenario relies on multiple treatment facilities and recharge sites and utilizes on-site innovative alternative treatment systems
8A	5	as this scenario relies on phasing one facility which can lead to construction sequencing issues and initial year operational issues due to the large variability in flows over time and the utilization of an ocean outfall for effluent disposal

Regional Opportunities: Due to economies of scale, regional wastewater management solutions can be more cost effective if treatment and effluent recharge can be done together. At this time, all of the wastewater scenarios consider a small area in Dennisport (which is part of the Herring River watershed) as part of the wastewater solution, but Harwich is considering expanded regional opportunities with the neighboring communities of Chatham, Dennis and Brewster. The availability of regional opportunities associated with each scenario is ranked as follows:

Rating	Range
1	Includes potential for a regional solution with Brewster, Chatham or Dennis
2	Includes potential for a regional solution with both Dennis and Chatham
3	Includes potential for a regional solution with Dennis utilizing an ocean outfall
4	Includes potential for a regional solution with Dennis, Chatham and Brewster
5	Regional solutions do not appear feasible

Ratings for each Scenario:

Scenario	Rating	Explanation
1A	2	as PB-3 allows for discussions with Chatham and HR-12 allows for discussions with Dennis
2A	2	as PB-3 allows for discussions with Chatham and HR-12 allows for discussions with Dennis
3A	1	as HR-12 is the only treatment and effluent recharge site and allows for discussions with Dennis
4A	2	as PB-3 allows for discussions with Chatham and HR-12 allows for discussions with Dennis
5A	2	as PB-3 utilizes facilities at Chatham and HR-12 allows for discussions with Dennis
6A	2	as PB-3 allows for discussions with Chatham and HR-12 allows for discussions with Dennis
7A	5	as economy of scale is lost at multiple small decentralized facilities due to use of I/A systems
8A	3	as discussions with Dennis may be beneficial to help pursue the use of an ocean outfall

Regulatory Considerations: Regulatory considerations include the permitting required to both construct and operate the proposed facilities, which can depend on their locations, the number of facilities proposed, and the proximity to areas requiring additional regulatory review such as coastal zones, flood plains, sensitive habitats, etc. Regulatory considerations were ranked as follows:

Rating	Range
1	Few regulatory hurdles anticipated for one treatment facility with effluent recharge
2	Some regulatory hurdles anticipated for one to two treatment facilities and one to two effluent recharge locations with effluent recharge for one facility in a Zone II
3	Additional regulatory hurdles anticipated for three to four treatment facilities and three to four effluent recharge locations with effluent recharge for one facility in a Zone II
4	Several regulatory hurdles anticipated for three to four treatment facilities and three to four effluent recharge locations with effluent recharge for one facility in a Zone II and the use of several hundred I/A systems
5	Significant regulatory hurdle because the ocean outfall option is not allowed under the Ocean Sanctuaries Act

Ratings for each scenario:

Scenario	Rating	Explanation
1A	3	as three treatment facilities and three effluent recharge sites including one in a Zone II will need to be permitted
2A	3	as three treatment facilities and three effluent recharge sites including one in a Zone II will need to be permitted
3A	1	as this relies on only one treatment facility and one effluent recharge site
4A	2	as two treatment facilities and two effluent recharge sites including one in a Zone II will need to be permitted
5A	2	as two treatment facilities and two effluent recharge sites including one in a Zone II will need to be permitted
6A	3	as four treatment facilities and four effluent recharge sites including one in a Zone II will need to be permitted
7A	4	as four treatment facilities and three effluent recharge sites including one in a Zone II will need to be permitted along with permitting I/A systems
8A	5	as this scenario relies on use of an ocean outfall which is not allowed under current Ocean Sanctuaries Act regulations

Land Ownership: Implementation of a wastewater management alternative is most feasible and cost effective when all infrastructure is located on town-owned land, and land acquisition is not necessary. Municipal town-owned land is preferred over school department or conservation town-owned lands. Therefore, the alternatives were ranked based on the need for land acquisition as follows:

Rating	Range
1	All major transport, treatment, and recharge sites can be accommodated on existing municipal town-owned land
2	Most major transport, treatment, and recharge sites can be accommodated on existing town-owned land or one to two parcels owned by other towns or private entities
3	Most major transport, treatment, and recharge sites can be accommodated on existing town-owned land with one parcel designated as school property and one to two privately owned parcels
4	Most major transport, treatment, and recharge sites can be accommodated on existing town-owned land with one parcel designated as school property or two privately owned parcels along with several hundred permitted I/A systems recharging effluent on private property
5	This scenario utilizes the Town property for treatment, and the ocean outfall for effluent recharge

Ratings for each scenario:

Scenario	Rating	Explanation
1A	3	as scenario relies on acquisition of privately owned site PB-3, and the SH-2 school site to implement
2A	3	as scenario relies on acquisition of privately owned site PB-3 , and the SH-2 school site to implement
3A	1	as scenario relies on use of only municipal, town owned lands to implement
4A	2	as scenario relies on acquisition of privately owned site PB-3 to implement
5A	2	as scenario relies on acquisition of privately owned site PB-3 to implement and an agreement with Chatham for use of their treatment facility
6A	3	as scenario relies on acquisition of privately owned sites PB-3, OW-2 and the SH-2 school site to implement to implement
7A	4	as scenario relies on acquisition of privately owned sites PB-3, OW-2 and the SH-2 school site to implement. Includes the use of I/A systems on privately owned sites
8A	5	as site utilizes ocean outfall for effluent disposal and will require use of federal waters

Environmental Criteria (16 Percent Weight)

Effluent Recharge Impacts: Each scenario has one or more effluent recharge areas proposed. The potential challenges resulting from recharge in those locations include recharge into nitrogen sensitive watersheds and resultant mounding from recharge into areas with known high groundwater. The potential impacts from effluent recharge were ranked as follows:

Rating	Range
1	Impacts from recharge anticipated to be minimal due to the use of an ocean outfall for effluent recharge
2	Impacts from recharge anticipated to be minimal due to moderate to excellent depth to groundwater
3	Impacts from shallow depth to groundwater are anticipated to me moderate to surrounding areas but can be mitigated
4	Impacts at multiple recharge sites are anticipated and will require greater mitigation due to shallow depth to groundwater
5	Impacts at multiple recharge sites are anticipated and will require greater mitigation due to shallow depth to groundwater at several sites

Ratings for each scenario:

Scenario	*Rating*	*Explanation*
1A	2	as this scenario utilizes HR-12 and SH-2 which have moderate depth to groundwater and PB-3 which has excellent depth to groundwater
2A	2	as this scenario utilizes HR-12 and SH-2 which have moderate depth to groundwater and PB-3 which has excellent depth to groundwater
3A	3	as this scenario utilizes HR-12 which has moderate depth to groundwater
4A	2	as this scenario utilizes HR-12 which has moderate depth to groundwater and PB-3 which has excellent depth to groundwater
5A	2	as this scenario utilizes HR-12 which has moderate depth to groundwater and PB-3 which has excellent depth to groundwater
6A	4	as this scenario utilizes HR-12 and SH-2 which have moderate depth to groundwater, PB-3 which has excellent depth to groundwater and OW-2 which has shallow depth to groundwater
7A	4	as this scenario utilizes HR-12 and SH-2 which have moderate depth to groundwater, PB-3 which has excellent depth to groundwater and OW-2 which has shallow depth to groundwater
8A	1	as this scenario utilizes an ocean outfall for effluent disposal

Water Balance Considerations: Preserving a water balance between the many watersheds in Harwich may be a consideration if any of the existing sub-basins are perceived to be stressed from a water management perspective. The water balance criterion was ranked as follows:

Rating	Range
1	Scenario maintains water balance in all locations
2	Scenario maintains water balance to most locations, and transfers flow only from one watershed
3	Scenario maintains water balance in some locations but transfers water from two basins to other locations
4	Scenario transfers water to the greatest extent (three or more basins) to other watersheds
5	Scenario transfers water to the ocean

Ratings for each scenario:

Scenario	Rating	Explanation
1A	3	as this scenario recharges effluent within three watersheds
2A	3	as this scenario recharges effluent within three watersheds
3A	4	as this scenario collects all wastewater and recharges the effluent to only one watershed
4A	4	as this scenario recharges effluent within two watersheds
5A	4	as this scenario recharges effluent within two watersheds
6A	2	as this scenario recharges effluent within four watersheds
7A	2	as this scenario recharges effluent locally and within four watersheds
8A	5	as this scenario collects all wastewater and disposes of the effluent to the ocean

Sensitive Receptors: The presence of sensitive receptors (e.g., schools, residents, natural resources, etc.) in the vicinity of proposed treatment and effluent recharge system locations or other areas which could have significant construction or other perceived impacts must be considered. The potential impacts to sensitive receptors of each scenario were ranked as follows:

Rating	Range
1	No sensitive receptors located within 500-ft of the vicinity of the proposed treatment facilities
2	Limited sensitive receptors located within 500-ft of the vicinity of the proposed treatment facilities and mitigation available to minimize impacts
3	Several sensitive receptors located within 500-ft of the vicinity of the proposed treatment facilities requiring more mitigation
4	Several sensitive receptors located within 500-ft of the vicinity of the proposed treatment facilities that are likely to limit the construction of a wastewater facility
5	The utilization of an ocean outfall discharges effluent to a sensitive receptor as defined by the Ocean Sanctuaries Act

Ratings for each scenario:

Scenario	Rating	Explanation
1A	3	as scenario includes site SH-2 which has receptors (schools) within 500-lf and PB-3 which may have receptors close to 500-lf. This scenario also utilizes site HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
2A	3	as scenario includes site SH-2 which has receptors (schools) within 500-lf and PB-3 which may have receptors close to 500-lf. This Scenario utilizes site HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
3A	2	as scenario utilizes site HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
4A	3	as scenario includes PB-3 which may have receptors close to 500-lf and HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
5A	3	as scenario includes PB-3 which may have receptors close to 500-lf and HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
6A	4	as scenario includes sites SH-2 (schools) and OW-2 with several receptors within 500-lf and PB-3 which may have receptors close to 500-lf. This scenario utilizes site HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
7A	4	as scenario includes sites SH-2 (schools) and OW-2 with several receptors within 500-lf and PB-3 which may have receptors close to 500-lf. This scenario utilizes site HR-12 which is well buffered but has reported natural heritage species which have a special concern and threatened status.
8A	5	as scenario includes site HR-18 which has receptors within 500-lf. This site is within wetlands, is coded as conservation land and is within a Priority Habitat of Rare Species zone. The presence of the ocean outfall means that the effluent will be sent to a sensitive receptor.

Construction Impacts: Each scenario will involve some level of construction impacts. Scenarios anticipated to require deeper construction, more time consuming construction, more challenging construction methods (e.g., trenchless technologies or complex dewatering systems), or work in more challenging areas (e.g., major roads, wetland areas, etc.) are ranked less favorably due to the higher likelihood of impacts to surrounding areas than those for which construction is anticipated to be straightforward. The construction impacts were ranked as follows:

Rating	Range
1	Construction is anticipated to be relatively straightforward and impacts limited by mitigation and utilize one treatment facility and effluent recharge facility
2	Construction is anticipated to be more complex with a higher likelihood of impacts and utilize two facilities for treatment and effluent recharge
3	Construction is anticipated to be more complex with a higher likelihood of impacts and utilize three facilities for treatment and effluent recharge
4	Construction is anticipated to be more complex with a higher likelihood of impacts and utilize four facilities for treatment and effluent recharge
5	Construction is anticipated to be very complex or have impacts needing more significant mitigation

Ratings for each scenario:

Scenario	Rating	Explanation
1A	3	as this scenario requires three treatment facilities
2A	3	as this scenario requires three treatment facilities
3A	1	as this scenario requires one treatment facility
4A	2	as this scenario requires two treatment facilities
5A	3	as this scenario requires two treatment facilities
6A	4	as this scenario requires four treatment facilities
7A	5	as this scenario requires four treatment facilities and about 6,600 I/A on-site systems
8A	5	as this scenario requires one treatment facility, but the Ocean Outfall will contribute to significant construction impacts

10.4.4 Matrix Results

All of the factors described above in Section 10.4.3 were tabulated below into a matrix which shows the ranking for each evaluation criterion and respective assigned weight. The evaluation criteria are presented in Table 10-7. Each criterion is ranked from 1 to 5. Each criterion was weighted based on preference for that particular category. The relative costs are weighted higher than the other criteria because the Wastewater Management Subcommittee believes that the cost of the system will be a significant deciding factor in the outcome of the recommended wastewater plan. The end result is a matrix that ranks each of the eight options with a low score of 145 and a high score of 402. In this matrix, the low score of 145 is given to Scenario 3A and the high score of 402 is given to Scenario 7A. This is similar to the results in Table 10-6 and is not unexpected since the weighting factor is highest for the relative costs.

Table 10-7
Wastewater Scenarios Matrix

Evaluation of Alternatives - Harwich CWMP Wastewater Scenarios									
Evaluation Criteria	Criteria Weight	1A	2A	3A	4A	5A	6A	7A	8A
RELATIVE COSTS									
Capital Costs	15	2	2	2	2	2	2	5	5
O&M Costs	15	4	4	1	3	2	5	5	1
Cost Efficiency (EAC)	20	4	4	1	3	2	5	5	5
TECHNICAL CRITERIA									
Complexity of Transport	4	2	1	3	1	4	2	2	5
Reliability	4	3	3	2	3	4	5	5	1
Effluent Recharge Issues	4	3	3	1	2	2	4	4	5
Future Recharge Capacity	6	3	3	5	4	4	2	2	1
INSTITUTIONAL CRITERIA									
Phasing	4	1	1	3	2	2	1	4	5
Regional Opportunities	4	2	2	1	2	2	2	5	3
Regulatory Considerations	4	3	3	1	2	2	3	4	5
Land Ownership	4	3	3	1	2	2	3	4	5
ENVIRONMENTAL CRITERIA									
Effluent Recharge Impacts	4	2	2	3	2	2	4	4	1
Water Balance Considerations	4	3	3	4	4	4	2	2	5
Sensitive Receptors	4	3	3	2	3	3	4	4	5
Construction Impacts	4	3	3	1	2	3	4	5	5
TOTAL WITH WEIGHTING	*100*	270	266	145	223	204	321	402	366

The Wastewater Management Subcommittee raised the concern about whether another scenario should be evaluated that relied upon the utilization of several 100,000 gpd treatment and recharge facilities. In theory, this could help with phasing and potentially allow for standard modular treatment facilities. Scenario 6A is the closest scenario to this additional option as it utilizes four treatment facilities and associated recharge sites. On an equivalent annual cost basis, scenario 6A is 20 percent more costly than scenario 3A which is the least costly. Scenario 6A is also 100 to 150 points higher than the best rated scenarios in the evaluation matrix; thus adding more small scale treatment facilities to a new scenario would only make that option less competitive, and that is prior to locating additional acceptable effluent recharge sites.

All of the scenarios presented in this section assumed that the Herring River watershed required 25 percent septic system nitrogen removal. As noted previously, the scenarios were developed before the MEP report for Herring River was completed, which revised that percentage to 58 percent. The Town decided not to update these scenarios because all eight of them would require similar revisions to realize the 58 percent removal of nitrogen. Since these eight scenarios are a relative assessment aimed at determining if the Town should further develop more accurate planning level costs, it was decided to keep each scenario with the original 25 percent nitrogen removal assumption in the Herring River watershed. It is unlikely that the relative rankings of the eight scenarios would change if the nitrogen removal revisions to the Herring River had been included.

10.5 Recommended Scenarios for Further Analysis

The Wastewater Management Subcommittee discussed the evaluation results and recommended that Scenarios 3A, 4A and 5A be brought forward and evaluated in more detail since they were the best scenarios in terms of the relative costs, technical, institutional, and environmental criteria. Scenarios 4A and 5A are essentially the same, with Scenario 5A utilizing a regional treatment facility at the Chatham Water Pollution Control Facility. These three scenarios were evaluated in greater detail, as presented in Section 12 of this CWMP/SEIR, including more detailed planning level costs for treatment facility size and type, collection system size and type, individual site conditions (including considerations for state roads), and the need for specific infrastructure (such as pumping stations). Further analysis of these three scenarios also included the update to the nitrogen removal requirement in the Herring River watershed for TMDL compliance.

10.6 208 Water Quality Plan Discussion Related to Harwich

As discussed in Section 2.3, the Cape Cod Commission completed an update to the 208 Water Quality Plan (208 Plan) since the Harwich Draft CWMP had been filed with regulatory agencies in 2013. The Final 208 Plan was approved by the Commonwealth in June 2015 and EPA in September 2015. Below is a discussion about how that plan relates to the Harwich CWMP and whether any significant modifications need to be made as part of this Final CWMP.

The 208 Plan presents several nutrient removal options for a community to consider. Emphasis is placed on nitrogen removal systems. Options are presented in terms of scale: on-site systems, neighborhood cluster type systems, watershed conventional type systems and regional Cape-wide type solutions. Each of those options is then presented by location: source reduction – treatment before disposal to the ground, remediation – treatment in the groundwater, and restoration – treatment of the impacted water body. The potential list of options was then presented in a matrix style format and further categorized in non-traditional and traditional solutions.

The Harwich Wastewater Implementation Committee (WIC) reviewed this matrix of options and discussed how the non-traditional and traditional options might apply to their community and the specific nitrogen removal needs they face. The Draft CWMP included an analysis of on-site innovative/ alternative (I/A) systems which would be an on-site reduction solution. Scenario 7A herein evaluated that solution for Harwich and it did not prove to be beneficial versus other options. The WIC discussed other on-site reduction solutions such as urine diversion or compost toilets decided they would not be appropriate for widespread use in Harwich for cost and cultural reasons. The Harwich Draft CWMP evaluated multiple treatment plant and single treatment plant options and so watershed and neighborhood solutions had already been considered. Regional options with Chatham and now recently with Dennis have also been included. Remediation solutions like permeable reactive barriers (PRBs) were included in the HR-12 effluent recharge scenarios as a pilot program and continue to be recommended at that site. It may be included for a future Pleasant Bay watershed effluent recharge site depending on the site selected and if it is required. Stormwater best management practices (BMPs) have been recommended throughout the town. Restoration solutions such as inlet widening

(Muddy Creek), natural attenuation enhancement (Cold Brook) and aquaculture (Town shellfish seeding program) have been incorporated into the Harwich alternatives.

In summary, the Draft CWMP included many of the non-traditional and traditional solutions presented in the 208 Plan that were deemed appropriate for Harwich to consider. This just confirms that the Harwich CWMP has evaluated the feasible options for removing sufficient levels of nitrogen to meet the proposed TMDLs.

Section 11

Hydrogeologic Evaluations of Effluent Recharge Sites

11.1 Introduction

One of the most significant aspects of developing a CWMP is to find suitable effluent recharge sites to incorporate into the overall recommended program. Section 9 screened the whole town to identify the best available sites for this purpose and Section 10 evaluated the nitrogen balance issues associated with adding more nitrogen to a given watershed as a result of recharging effluent. This section evaluates the ability of the identified sites to accept the highly treated effluent from a hydrogeologic perspective. Thus, the original three highest rated effluent recharge sites are evaluated herein.

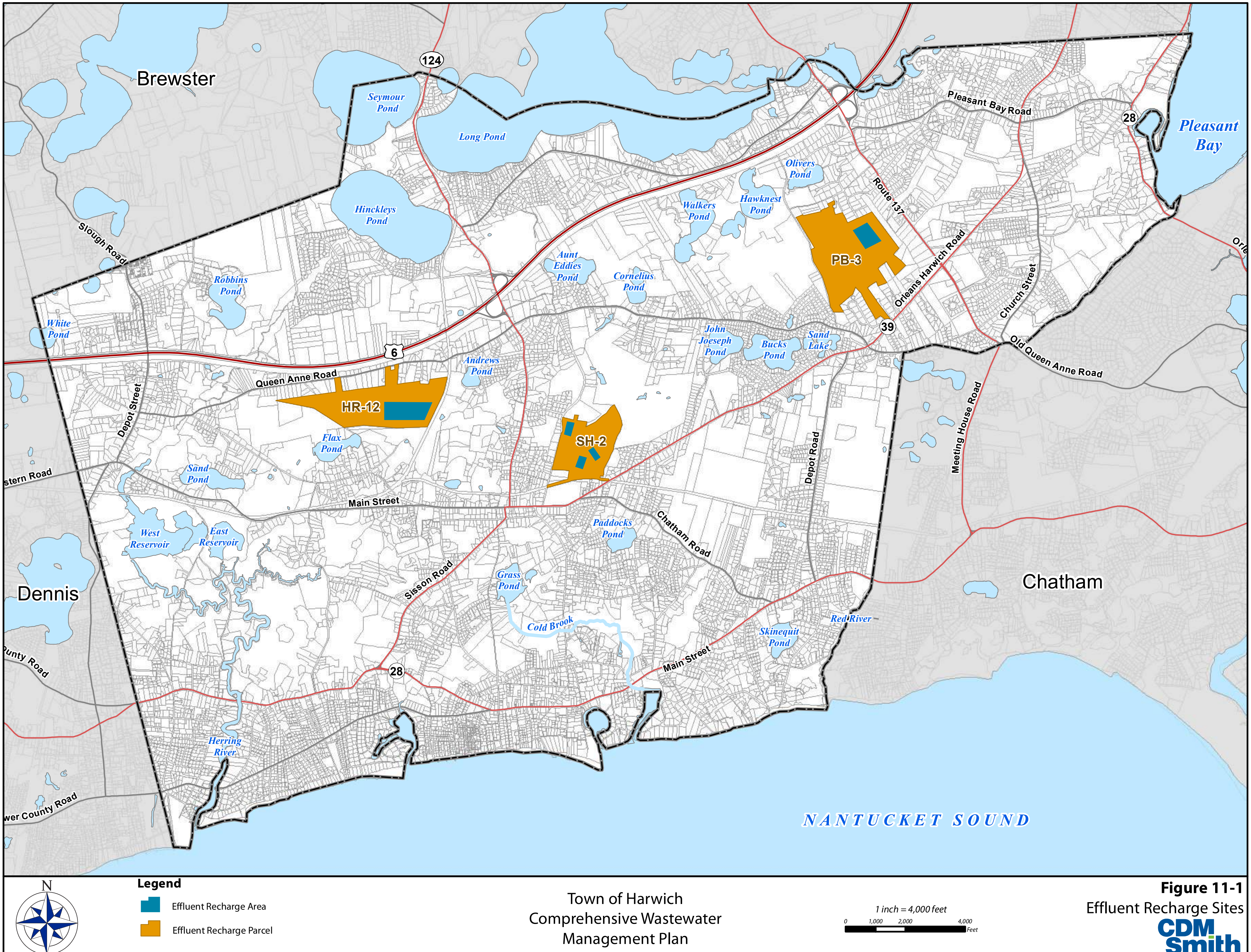
A complete hydrogeologic evaluation is presented in the Hydrogeologic Evaluation of Effluent Recharge Sites in Harwich, Massachusetts, dated July 2012, attached in Appendix D. The work plan and findings for this evaluation were coordinated with representatives of MassDEP and the Cape Cod Commission. The purpose of this section is to summarize the findings from that report.

In 2015 two additional sites were evaluated on a preliminary basis. These evaluations are presented in Section 11.5, however, no decisions regarding their suitability for efficient recharge have been made by the Town as each one would require additional study in the future.

11.2 Overview of Work

As part of this CWMP/SEIR, a program for hydrogeologic data-collection and groundwater flow modeling was conducted to predict the impacts of effluent recharge to groundwater at three potential sites in Harwich. The sites include an area near the capped Harwich Landfill off of Queen Anne Road (Site HR-12) within the Herring River watershed, sports fields at Monomoy Regional High School on Oak Street (Site SH-2) within the Saquatucket Harbor watershed, and a privately owned parcel identified off of the Orleans-Harwich Road (Site PB-3) within the Pleasant Bay watershed. The three sites are shown in Figure 11-1.

The Harwich Landfill site, HR-12, is a large municipally owned parcel which consists of a capped landfill area in the western end of the site with recycling and waste transfer facilities, and former sludge/septage disposal beds located to the south but north of Flax Pond, which is south of the overall site. Coy Brook is located east of the site near the bike path. The stream flow is controlled by structures in the cranberry bogs located southeast of the site. Additional cranberry bogs located south, east, and west of Flax Pond are fed by surface water pumped from the pond. Groundwater and surface water levels in the area are heavily influenced and controlled by operations of the cranberry bogs. Recharge would be via infiltration basins located in the existing wooded southeastern portion of the site. Flow from this site would ultimately surface in the Herring River.



Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 11-1
Effluent Recharge Sites

CDM Smith

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Subsurface recharge beneath playing fields is proposed for the municipally-owned Monomoy Regional High School site, SH-2. Surface water features near the site are primarily kettle ponds which reflect the groundwater table and likely have little impact on the overall flow patterns. Flow from this site would ultimately surface in Saquatucket Harbor.

The third site, PB-3, is privately owned and located within the Pleasant Bay watershed. The site is primarily uplands adjacent to a former gravel pit with no nearby surface water features. It is located within a Zone II area to municipal wells. Recharge would be via infiltration basins potentially located in the northeast portion of the overall site. Flow from this site would ultimately surface in Pleasant Bay.

The appended hydrogeologic report describes the data-collection efforts and the groundwater modeling performed to predict impacts from the proposed effluent recharge. Hydrogeologic data review and fieldwork, including USGS data, previous landfill site investigations (Site HR-12), 2011 supplemental CWMP investigations at sites HR-12 and PB-3, and other data are discussed in Section 2 of that report. Test analyses and results from the 2011 CWMP data collection efforts include boring logs, grain size analyses, infiltration test analyses, groundwater quality results, and a summary of site visits with cranberry bog owners located south of HR-12. The hydrogeologic data review and fieldwork further identified a clay layer at HR-12 which impacts groundwater flow rates and direction.

Based on the data review and fieldwork, revisions were made to an existing regional USGS groundwater flow model which had been calibrated for 2003 conditions. Section 3 of the hydrogeologic report provides information on the MODFLOW model and calibration, including the USGS model used as a basis for the groundwater model, grid and model refinements and adjustments to recharge, clay extent, hydraulic properties, and stream updates.

The model was calibrated to regional groundwater elevations and 2003 groundwater data from Site HR-12. Recent surface water and groundwater data from 2011 were used to refine the model near HR-12. The revised and recalibrated model was used to assess the flow direction and mounding for recharge flows at the three locations based on the CWMP scenarios.

11.3 Groundwater Model Simulations

Three model simulations were completed to assess groundwater recharge scenarios developed for this CWMP/SEIR. Model simulations and results are thoroughly discussed in Section 4 of the appended report.

- Simulation 1 is based on the upper end flow loadings for all scenarios of effluent recharge proposed in this CWMP/SEIR as presented in Section 10 and utilizes all three sites:
  - HR-12: 800,000 gpd at a loading rate of 3 gpd/ft^2,
  - PB-3: 400,000 gpd at a loading rate of 5 gpd/ft^2, and
  - SH-2: 210,000 gpd at a loading rate of 1 gpd/ft^2.
- Simulation 2 is the maximum loading over a 10-acre area at HR-12 which maintains a minimum four foot depth to the top of the groundwater mound from the infiltration basin surface, per MassDEP regulatory guidance.

- Simulation 3 is the same as Simulation 2, but with revisions to the simulation of water levels in the cranberry bogs and Flax Pond south of HR-12.

Model simulation results, shown in Table 11-1, indicate that the selected sites should be able to recharge the proposed CWMP scenario flows in an acceptable manner. Increased flow to Coy Brook near HR-12 would result in enhanced stream flow and would help to maintain a more reliable base flow beneficial for the local cranberry bog agricultural operations, especially during dry weather conditions.

Table 11-1
Simulation Results Summary

Site	Total Recharge (MGD)	Loading Rate (gpd/ft^2)	Basin Area (acres)	Model Sim. Head (ft NGVD29)	Est. Basin Elev. (ft NGVD29)	Est. Depth to GW Mound (ft)	Est. Mound Height (ft)	Est. Stream Inc. (cfs)	% Est. Stream Inc.
Simulation 1 (Upper End of Flow Loading)									
HR-12	0.8	3.0	6.1	36	40	4	10	1	59%
PB-3	0.4	5.0	1.8	34	50	16	3.2		
SH-2	0.21	1.0	4.8	30	46	16	1.9		
Simulation 2 (Maximum Loading)									
HR-12	1.2	2.7	10	36	40	4	10	1.2	69%
Simulation 3 (Maximum Loading With Revisions near Cranberry Bogs)									
HR-12	1.4	3.0	10	36	40	4	10		

These results are shown in Figures 11-2 thru 11-4.

11.4 Effluent Recharge

All of the effluent recharge sites analyzed herein are located in the Monomoy Lens which is one of six groundwater flow lenses under Cape Cod. The Monomoy Lens is located under the Towns of Dennis, Harwich, Brewster, Chatham, Orleans and a section of Yarmouth. The 14 drinking water wells that provide the municipal water supply to Harwich are located in the Monomoy lens. This lens can be thought of as a mound of groundwater bordered by marine waters at the edges and bedrock on the bottom. Surface features define watersheds that create different recharge points to the groundwater table within the lens area. The entire layer of fresh groundwater beneath the Cape is known as the Cape Cod Sole Source Aquifer and consists of the six separate lenses.

Recharge from various forms of precipitation is the sole source of water to the aquifer system. On the Cape, about 45 inches of precipitation falls during an average year (LeBlanc and others, 1986) with over half reaching the groundwater table. The rest is lost to evapotranspiration and some minor runoff (generally minimal on Cape Cod due to sandy soils). This results in about 27 inches per year of recharge to the aquifer or about 137 Mgal/d in the Monomoy Lens (USGS, 2004). Some have estimated that 5 to 10 percent of the water recharging the Cape Cod aquifer system is removed for water supply (Materson and others, 1997) but that most of the water is recharged back in the form of disposed wastewater from septic systems or point discharges.

Legend

Mounding Simulation 1
Height of Groundwater Mound

Effluent Recharge Parcel

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Comprehensive Wastewater
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1 inch = 2,500 feet

0 1,000 2,000 4,000 Feet

Figure 11-2

Mounding Simulation 1

CDM Smith

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Legend

Mounding Simulation 2
Height of Groundwater Mound

Effluent Recharge Parcel

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 1,000 feet
0 500 1,000 Feet

Figure 11-3
Mounding Simulation 2

CDM Smith

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N

Legend

Mounding Simulation 3
Height of Groundwater Mound

Effluent Recharge Parcel

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 1,000 feet
0 500 1,000 Feet

Figure 11-4
Mounding Simulation 3

CDM Smith

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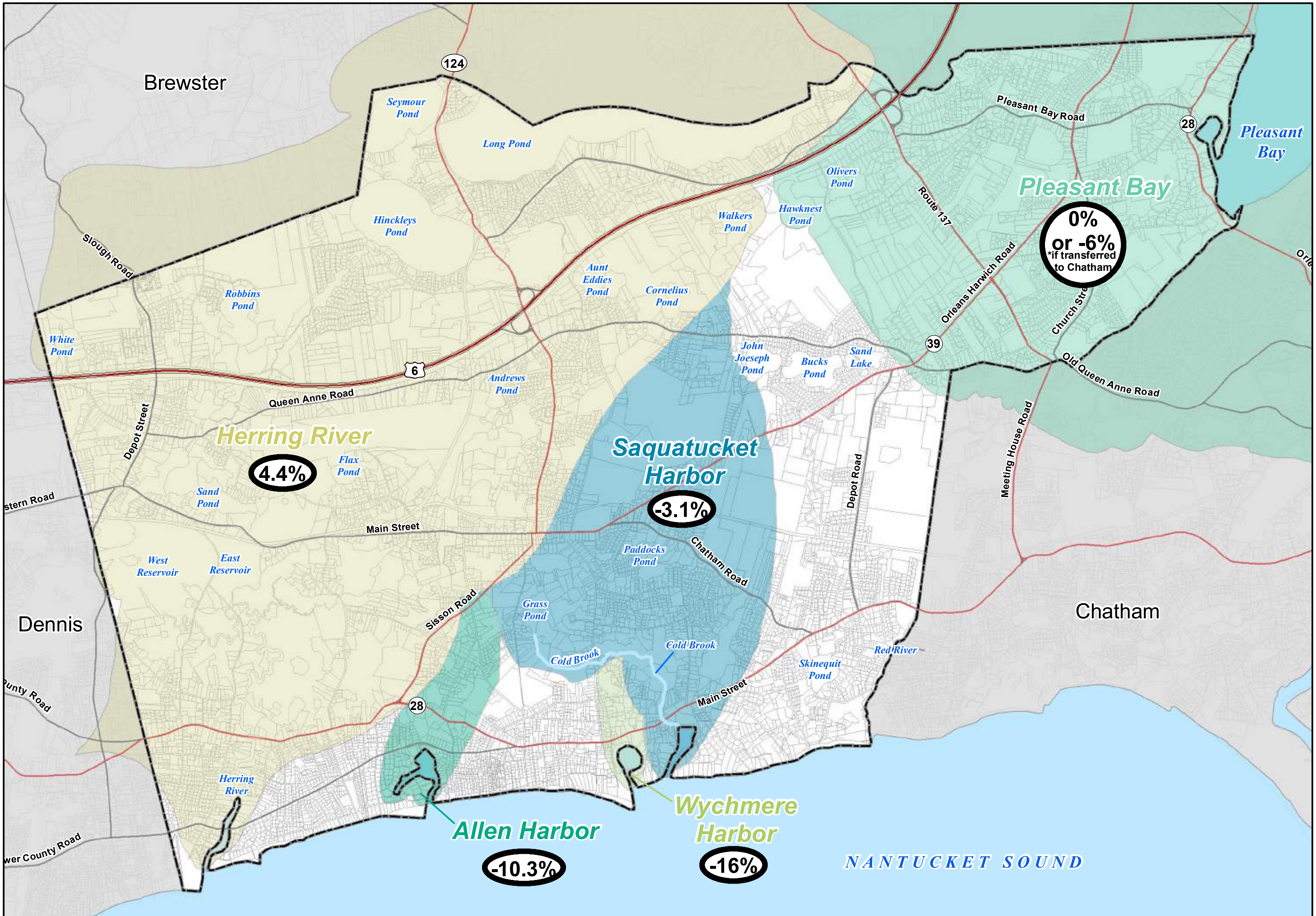
The five MEP watersheds in Harwich are all within the Monomoy Lens. Table 11-2 shows the amount of estimated average daily recharge per MEP watershed, the amount of wastewater proposed to be collected and transferred out of a given watershed, and the amount of wastewater effluent transferred into a given watershed based on the recommended plan presented later in Section 13. The resultant percent change for each watershed is then shown. The two smallest watersheds, Allen and Wychmere Harbors, have the largest projected change since these are densely developed and all wastewater is removed from these watersheds. Saquatucket Harbor shows an export of wastewater out of the watershed but at less than 5 percent. Herring River watershed shows a net import due to the location of the largest effluent recharge site (HR-12) being there. The Pleasant Bay watershed shows two values since the recommended plan calls for wastewater from that area to also be recharged there (0 percent change) or potentially recharged at the Chatham WPCF site (-6 percent). Overall the impact from this recharge is expected to be minimal on the Town's water supply wells since the amount of wastewater/effluent being moved among the watersheds is small.

Under this CWMP/SEIR, the Town of Harwich is proposing a recommended plan that falls well below the one million gallon per day threshold for interbasin transfers per MassDEP regulations and it is unlikely this regulation applies as all the recharge remains within the Mononomy Lens. It is important to note that under the recommended program presented in Section 13, the wastewater generated in the Pleasant Bay watershed may be recharged in Chatham in the first years of the wastewater plan. Ultimately, when Chatham's capacity to recharge wastewater flow becomes limited, the flow from the Pleasant Bay watershed may be recharged back in Harwich. Wastewater flow from the Great Sand Lakes, the Campground Areas and the small part of Route 28 outside of the MEP watersheds is considered to be negligible (0.025-0.035 gpd) when compared to the flow generated within the MEP watersheds. Table 11-2 and Figure 11-5 present the wastewater flow that will be transferred in and out of the MEP watersheds in the recommended plan. The percent change in the watersheds based on average annual rainfall is also shown on the table and the figure.

Table 11-2
Water Use Data for Five MEP Watersheds

MEP Watershed	Estimated Daily Recharge from Rainfall (MGD)	Wastewater Flow Transferred Out of the Watershed (MGD)	Wastewater Flow Transferred into the Watershed (MGD)	Percent Change in the Watershed
Allen Harbor	0.6	0.062	0.0	-10.3%
Wychmere Harbor	0.2	0.032	0.0	-16%
Saquatucket Harbor	3.6	0.113	0.0	-3.1%
Pleasant Bay*	5.3	0.33	0.33	0% / -6% *
Herring River	19.2	0.0	0.63	4.4%

*The first number represents the percent change if the effluent remains within the Pleasant Bay Watershed. The second number represents the percent change if the effluent is recharged at the Chatham WPCF.



Legend
Watersheds
Allens Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor
6% Percent Recharge Change within Watershed

Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 11-5
Percent Recharge Change

CDM Smith

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Table 11-2 shows that the flow transferred outside of the MEP watersheds is very low and does not trigger any threshold for an interbasin transfer. More importantly, the MEP watersheds are not considered to be separate basins under this rule since all of the MEP watersheds are part of the Monomoy Lens which is located under the Towns of Dennis, Harwich, Brewster, and Chatham, Orleans and a section of Yarmouth. Since this CWMP/SEIR is already being reviewed by MEPA, these threshold are likely to be reviewed but are not expected to trigger a determination from 313 CMR 4.00.

11.5 Additional Effluent Recharge Sites

As identified in Section 9.7, two additional effluent recharge sites were identified for preliminary analysis after the Town was unsuccessful in acquiring the parcel in Site PB-3. The two potential sites are shown in Figure 11-6. Zones of Contribution to municipal wells are also shown on that figure.

The preliminary assessments of each site was based on simulation modeling using the USGS Cape Cod groundwater flow model updated for the Harwich work in 2012. Conditions represent 2003 steady-state recharge and well pumping rates. An effluent recharge flow of 325,000 gpd was used for each site. Limited soils information from adjacent projects was utilized. No attempt was made to optimize any mitigating predicted impacts and/or improve accuracy of simulation results at this time until more accurate on-site soils and groundwater information is obtained.

Preliminary results at Site 52-N1-10/11 are as follows and shown on Figures 11-7 and 11-8:

- Mounding does not appear to be an issue as shown on Figure 11-7.
- Recharged effluent will primarily discharge to the Red River and Nantucket Sound as shown on Figure 11-8.
- Some recharge may be captured by municipal well 4126000-03G. Initial estimates of time of travel are about two years to that well. Seasonal recharge and pumping rates may better define these impacts once specific soil conditions are better known.
- There is a vernal pool south of the site near the 1-ft mounding contour. Further review will be required to better understand the seasonal groundwater fluctuations and impacts to that location. Moving the recharge area farther north may mitigate this issue.
- Performing sensitivity analyses once soil conditions are known will help determine how much effluent could be recharged at this site.

Preliminary results at Site 114-S5 are as follows and shown on Figures 11-9 and 11-10:

- Mounding may be an issue due to the increase in groundwater table height at the vernal pool located in the middle of the site as shown on Figure 11-9.
- Recharged effluent will primarily discharge to lower Muddy Creek as shown on Figure 11-10.
- The vernal pool being at the low point and in the middle of the site makes this location challenging. Further evaluation of the seasonal fluctuations in the groundwater table would be needed to conduct more transient modeling and sensitivity analysis of different volumes of recharge.

- A more sophisticated transient groundwater model would allow for better characterization of groundwater mounding, varying municipal well pumping rates and seasonal impacts.

Both of these sites have identified recharge issues based on preliminary groundwater modeling results. However, more sophisticated transient modeling may mitigate those issues once actual on-site soil profiles are understood and seasonal water tables are monitored. Both sites should remain under consideration along with other potential sites identified in the East Harwich area.

11.6 Summary and Conclusions

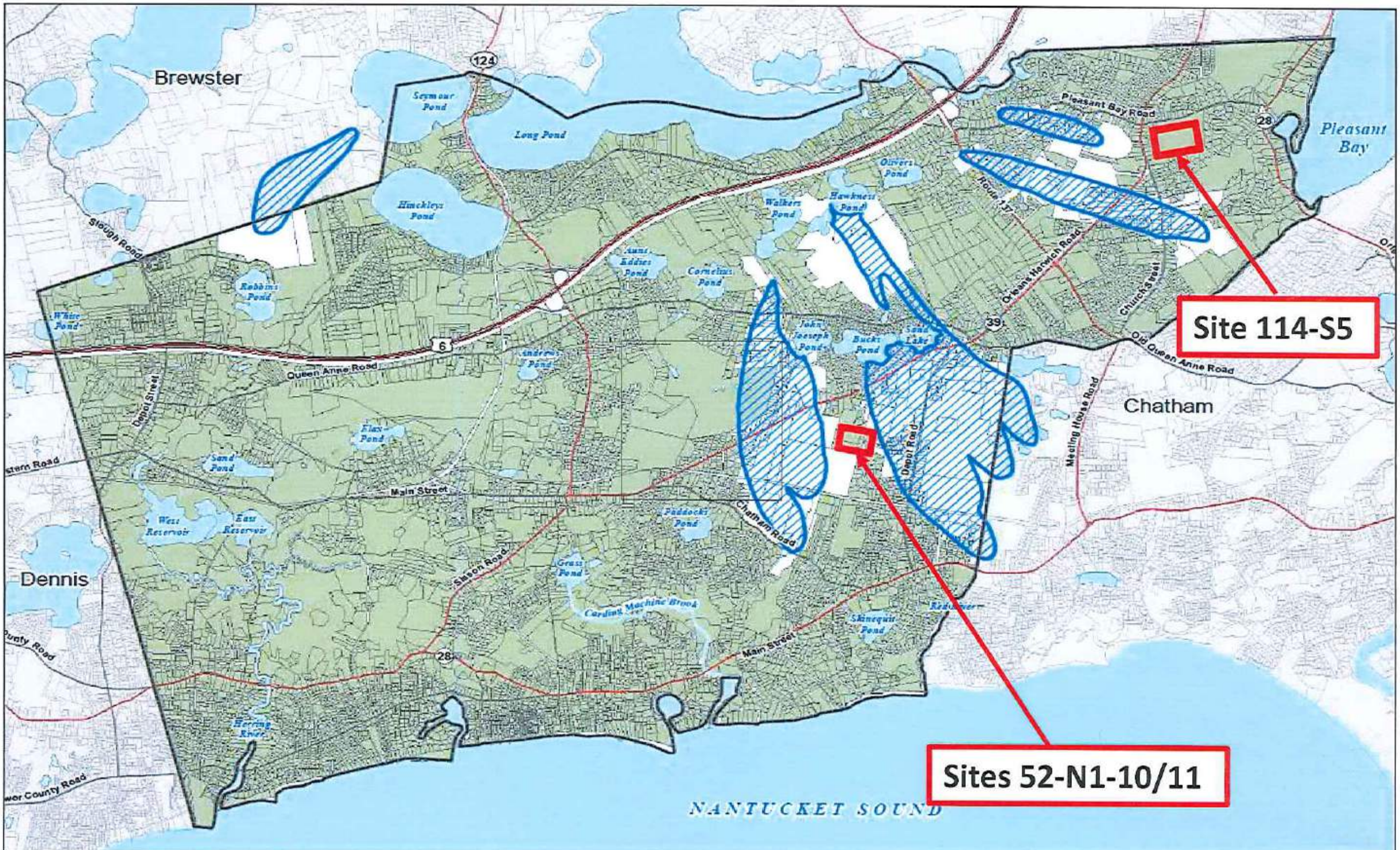
In summary, the modeling results indicate that the original three effluent recharge sites can accept the flows applied in the scenarios identified. The flow applied to HR-12 would result in enhanced flows to the cranberry bogs downgradient providing beneficial impacts to their operations. The flow applied to PB-3, while in a Zone II water supply protection area, would be outside of a five-year travel time to any municipal well and, thus, is not likely to require increased treatment levels. The flow applied to SH-2 would need to be coordinated with the Monomoy Regional High School, but application areas could be located beneath new or restored ballfields.

Based on the hydrogeologic findings and an associated meeting with MassDEP and the CCC, the following items are recommended as part of the implementation phase of the recommended program.

- Continue monitoring surface water and groundwater locations to determine seasonal impacts to groundwater, surface water levels and cranberry bogs.
- Develop an adaptive management approach which utilizes initial wastewater effluent flow as a loading test at the selected effluent recharge sites.
- Assess the flow capacity of existing hydraulic structures in Coy Brook, Flax Pond and the downstream cranberry bogs near HR-12 during the design phase to identify and mitigate the potential for blockages or limitations in flow. This analysis should include the culvert which carries Coy Brook under Great Western Road as it has been reported to have problems carrying existing flows at high groundwater periods.

Based on groundwater modeling and preliminary discussions with MassDEP, it is expected that additional treatment for removal of Total Organic Carbon (TOC) will not be required at PB-3 as the time of travel to the nearest municipal well is estimated to be over five years. Furthermore, the movement among MEP watersheds from wastewater collection and effluent recharge will have minimal impact on the town’s municipal water supply.

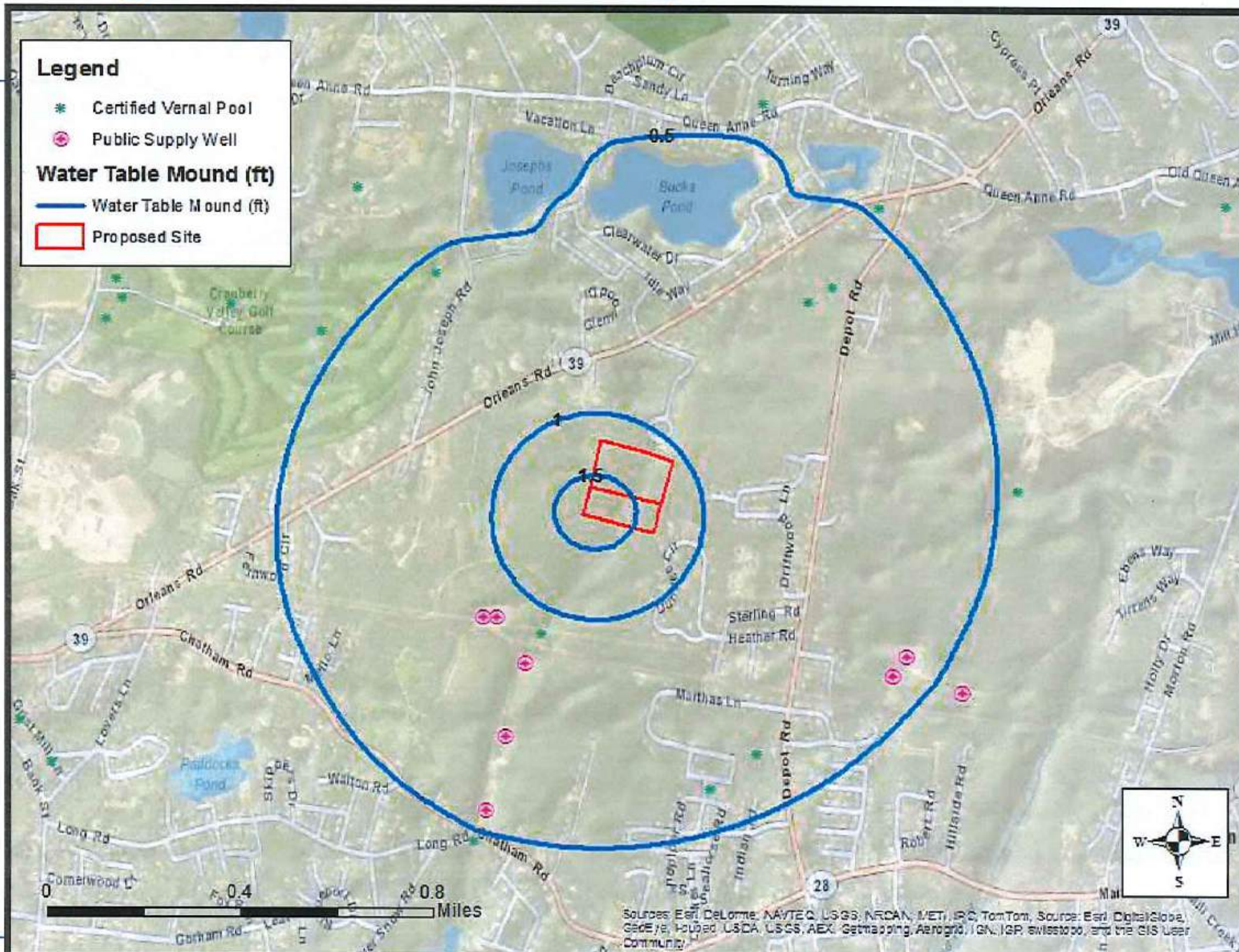
Since the Town has to date been unable to acquire the parcel in the PB-3 site area, it should continue to evaluate all potential effluent recharge sites in East Harwich so that an acceptable site is identified for use should Chatham as some point be unable to recharge Harwich effluent. Discussions to date indicate Chatham will recharge Harwich effluent in the initial years.



Town of Harwich
Comprehensive Wastewater Management Plan
Zones of Contribution near Parcels 52-N1-10/11 & 114-S5

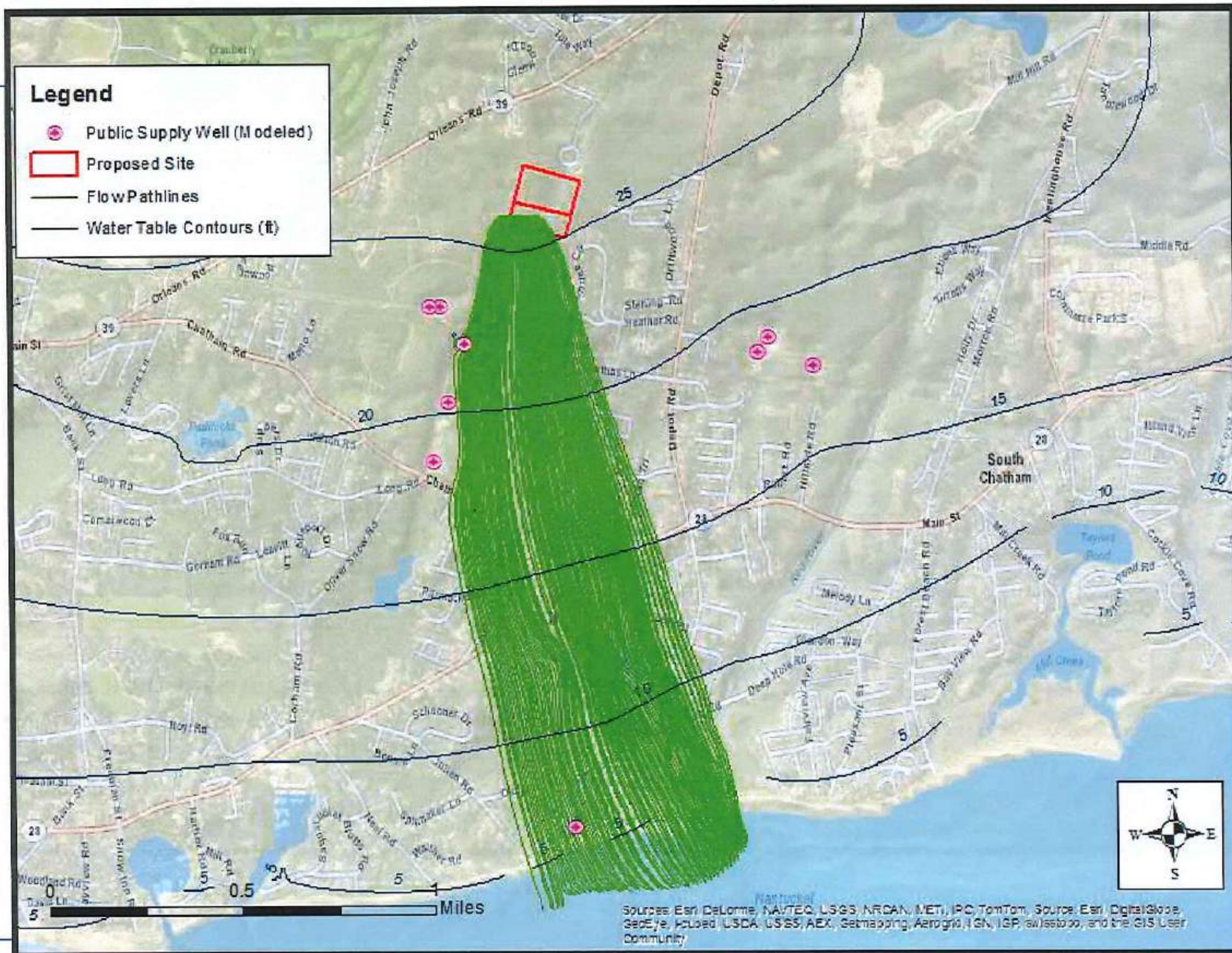
Figure 11-6

CDM Smith



CDM Smith
Figure 11-7

Town of Harwich
Comprehensive Wastewater Management Plan
Mounding at Parcels 52-N1-10/11



CDM Smith

Figure 11-8

Town of Harwich
Comprehensive Wastewater Management Plan
Flow Direction at Parcels 52-N1-10/11

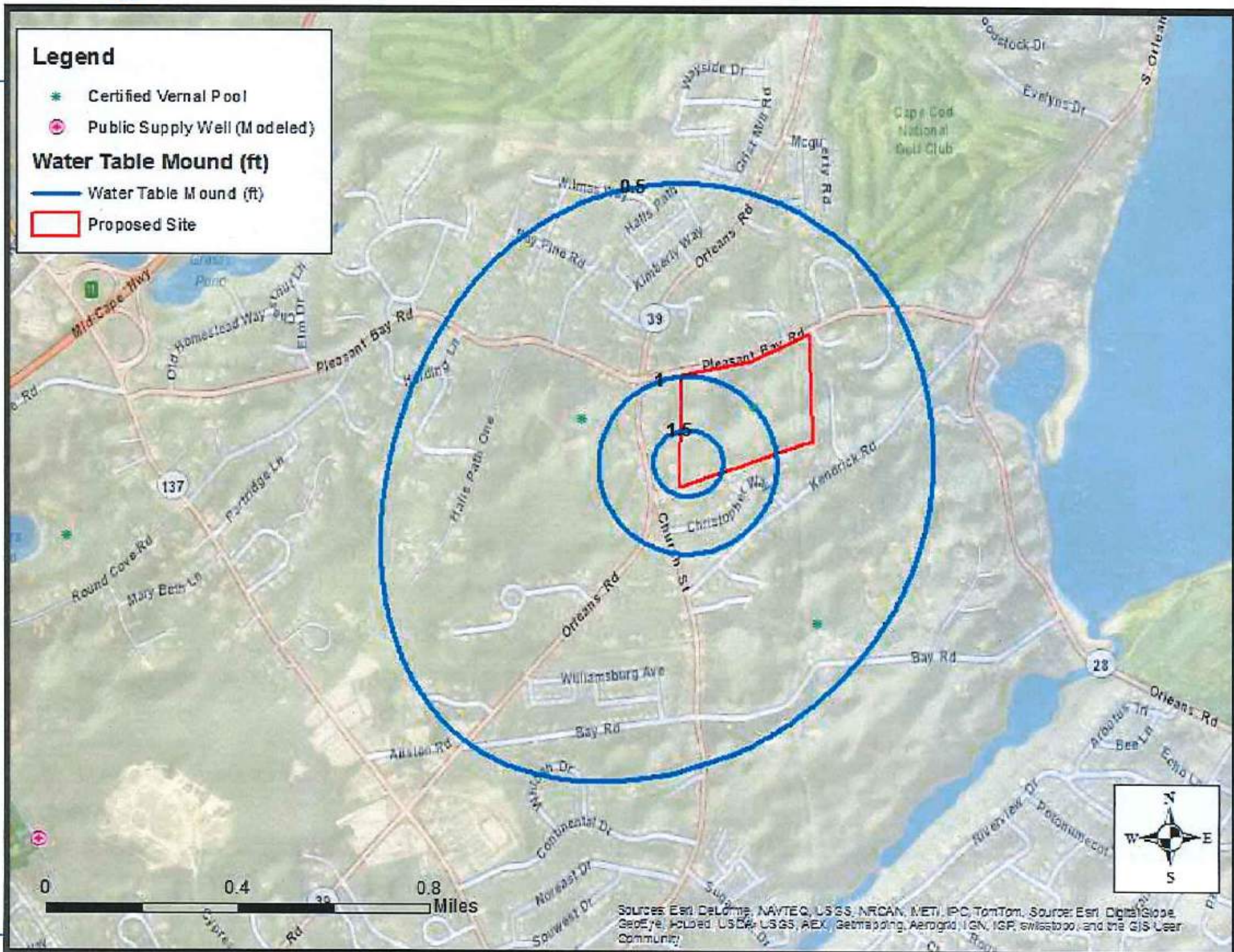
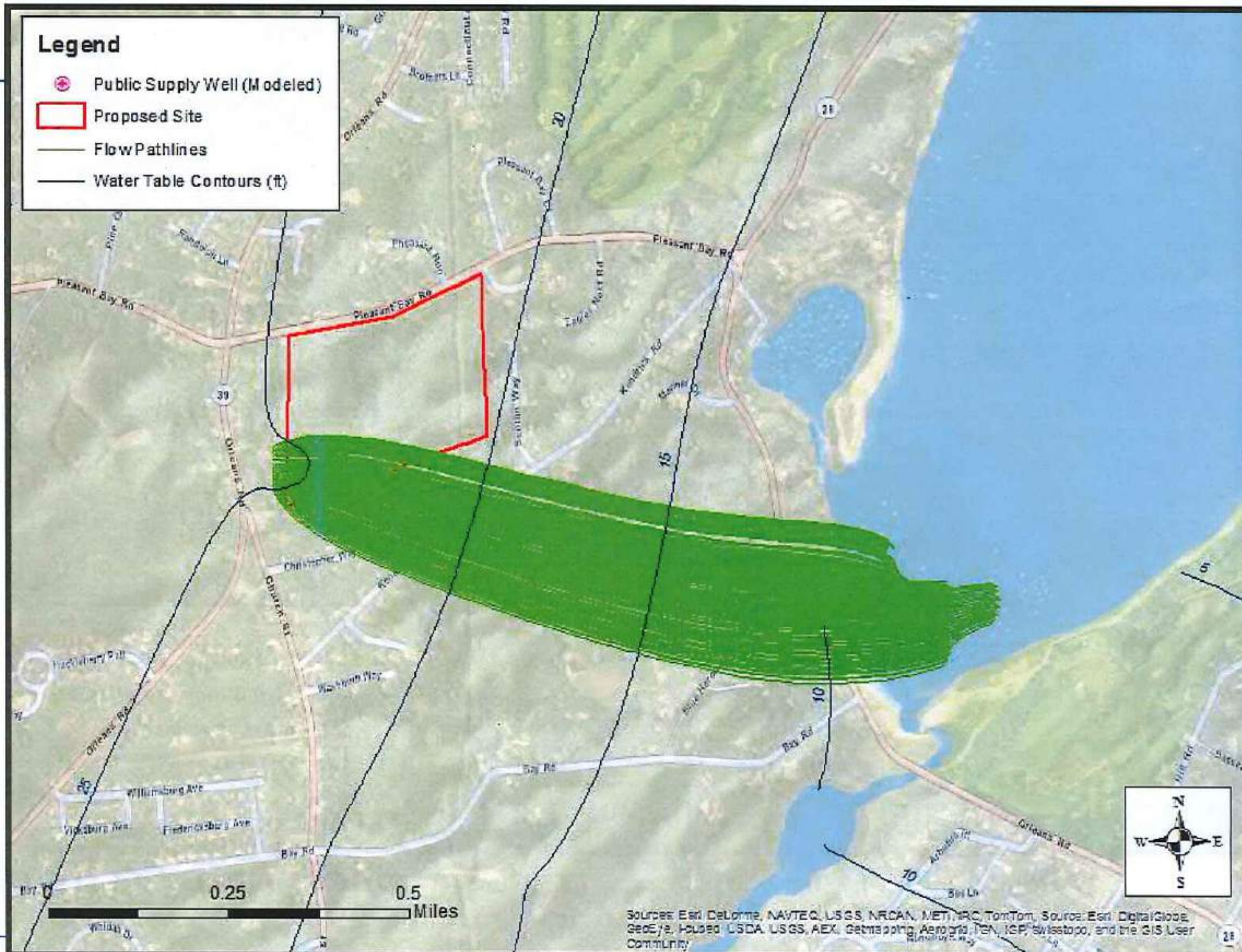


Figure 11-9

Town of Harwich
Comprehensive Wastewater Management Plan
Mounding at Parcel 114-S5



Town of Harwich
Comprehensive Wastewater Management Plan
Flow Direction at Parcel 114-S5

CDM Smith
Figure 11-10

Section 12

Collection and Treatment System Evaluations

12.1 Purpose and Scope

This section evaluates the three wastewater scenarios recommended for further study as identified in Section 10. The evaluation includes an analysis of various types of sewer collection systems and of various treatment systems that are considered suitable for the flows and treatment levels required in these scenarios. The three scenarios include: 3A - single treatment plant; 4A - two treatment plants; and 5A - two treatment plants utilizing a regional option with Chatham. Capital and operation and maintenance costs are generated for each scenario followed by a brief discussion on noncost factors for each. A final recommended scenario is identified based on the cost and noncost factors.

The scenarios presented in this section have been updated from those presented in Section 10 to reflect the MEP results from the June 2012 Herring River Embayment System Report. Section 10 assumed a 25 percent nitrogen removal percentage for the Herring River watershed since the purpose of that section was to screen potential feasible scenarios. Now that the actual nitrogen removal values are better known, the required sewer service areas required to remove 58 percent of septic system nitrogen in the Herring River watershed have been reflected in the three scenarios evaluated in this section.

12.2 Collection System Technologies

Harwich currently has no municipal sewers. So the type of sewer collection system needs to be evaluated as there are several variables that impact that decision. Now that the specific areas in Harwich needing collection have been defined, it is appropriate to consider which sewer system technologies will provide the best cost-effective long-term service. Some important variables to consider include the density of the area being sewered, the topography of the area, climatic conditions, whether high groundwater exists, the variability of the wastewater flows to be collected both daily and seasonally, and the amount of labor and associated equipment required to maintain a sewer system.

The intent of this section is to present some of the more common types of sewers in use, discuss the advantages and disadvantages of each type and then develop a sewer collection system for cost planning purposes. This provides a guide for implementing the overall system but final decisions on the type of sewer and the exact layout would not be made until the actual design phase.

12.2.1 Types of Sewer Collection System Technologies

There are several types of sewer collection system technologies in use throughout the world, however the ones that appear most feasible for consideration in Harwich are considered below. The advantages and disadvantages of each are discussed with the intent of screening down to the type to be utilized in developing the Harwich sewer collection system master plan.

The five sewer collection system types evaluated for Harwich are as follows:

- Conventional gravity sewers
- Low-pressure sewers
- Vacuum sewers
- STEP or STEG Systems
- Hybrid systems

12.2.1.1 Conventional Gravity Sewers

Conventional gravity sewers are the most common and simple form of wastewater collection. The technology relies on installing sewer pipes at constant downhill slopes. Pipe diameter sizes and slopes are designed to maintain adequate velocities that keep solids suspended within the conveyed wastewater. Conventional gravity sewers typically start with a minimum pipe diameter of 8 inches to ease equipment access during maintenance. Downstream pipe sizes increase proportionately as flow is collected. Gravity connections can be used from the house to the main sewer pipe in the road or right-of-way (ROW) and are typically 6 inches. Homes abutting a gravity sewer that cannot connect by gravity due to elevation differences can pump up to the gravity pipe using a 1 to 2 inch diameter forcemain as an alternate connection means. Most main sewer pipes are buried 8 feet deep to allow for mostly gravity house connections and to avoid other utilities in the road; however this depth changes with topography. Manholes are periodically located in the main sewer pipelines to allow for maintenance access. Flows collected at low points require a pumping station to be installed to convey the wastewater to another gravity sewer or to an appropriate treatment facility. Areas where topography changes frequently can significantly impact the cost and maintenance requirements for conventional gravity sewers.

Advantages:

- Typically requires the least amount of energy to operate and works during power outages
- Least amount of system maintenance required
- A well-designed system can handle greater flow fluctuations (seasonal and infilling)
- Can accept pressurized flows discharged to it
- Simple system to expand to service additional areas or receive flows from adjacent areas
- Most municipalities have staff familiar with this type of pipe construction and network

Disadvantages:

- Requirement for constant slope pipes in changing topographic areas can lead to a costly number of pumping stations
- Constant slope pipes can lead to deep sewer pipes.

- In high groundwater areas, infiltration into the pipes can lead to costly conveyance and treatment of clean water.
- In low flow periods, the potential for odors may occur.

An alternate to conventional gravity sewers is a system that essentially operates in the same manner but utilizes smaller diameter pipes and shallower slopes relying on peak flows to flush the system. This unconventional gravity sewer system has been utilized with limited success and is not recommended for widespread use in Harwich.

12.2.1.2 Low Pressure Sewers

Low pressure sewers require each home or small cluster of homes to have a grinder pump which moves wastewater into a low-pressure forcemain located in the road or ROW. Wastewater from the home flows by gravity into the pump chamber where the pump starts once the flow volume reaches a specific capacity and the wastewater is conveyed out into a smaller diameter (1.25 to 4 inch) pipeline network installed at a 5 to 6 foot depth. Rather than manholes, air release and flow isolation valves are installed within the mainline piping network. Typically, individual homeowners are responsible for the long-term maintenance of the grinder pump. Monthly power usage, which is also the responsibility of the property owner, is typically the same as that required to operate a small kitchen appliance. With grinder pump systems, extended power outages have the potential to cause sewer backups unless provisions for connection to a portable generator are incorporated into the design of the system.

Advantages:

- Cheaper pipeline system to install due to smaller diameter pipes at shallower depth
- Water tight system preventing infiltration/inflow (I/I) from occurring
- Can more readily service areas with changing topography or with minimal slopes
- Less disruption to areas during construction

Disadvantages:

- Requires a mechanical component (pump) at each major connection to discharge to and operate the sewer system
- Typically overall higher energy use
- Less flexibility in future system expansion
- Requires specialized operator training for the system and regular maintenance of the grinder pump units
- More sensitive to wastewater flow fluctuations (daily and seasonal)
- Prolonged power outages can lead to sanitary issues if backup power is not provided

12.2.1.3 Vacuum Sewers

Vacuum sewer collection system technology has been around for more than 100 years. In the late 1960s, vacuum technology was expanded to municipal wastewater collection systems and further development has continued more recently. More than 200 systems are in operation nationwide. On Cape Cod, the towns of Provincetown and Barnstable both use vacuum sewer system technology.

Vacuum sewer systems have three components: valve pits, vacuum pipelines, and vacuum/pumping stations. Wastewater flows from each property via gravity to a valve pit that usually serves one to four homes. When a sufficient volume of wastewater builds up in the valve pit, the valve opens and allows the wastewater to be drawn into the mainline. A vacuum pump located at a main vacuum/pumping station pumps air out of the pipeline network creating the vacuum inside the pipes. Vacuum mains typically range in size from 4 to 10 inches in diameter, depending on the number of homes served and the distance from the vacuum station. Similar to low-pressure sewers, vacuum mains can be installed at shallow depths and follow existing topography. Isolation valves are also installed periodically along main sewer lines for accessibility during maintenance of individual pipe segments.

The main component of a vacuum sewer conveyance system is a vacuum pumping station. This station must be centrally located within the system to minimize the length of vacuum mains. Equipment within the station includes vacuum pumps, a collection tank, and wastewater pumps. Vacuum pumps maintain suction in collection mains, delivering wastewater to the collection tank, while wastewater pumps convey sewage from the collection tank to another collection system segment or directly to the treatment facility. The only power demands for a vacuum system are at the vacuum/pumping station. Typical service areas range from 500 to 1,200 homes per vacuum station. This number is limited by the capacity of the vacuum pumps, which can produce enough vacuum to overcome 15 to 20 feet of hydraulic head in the collection system.

Typical maintenance issues for vacuum sewers include valve pits where valves may become clogged and stuck in the open position. This triggers a low vacuum pressure alarm at the pumping station and can easily be rectified. Since valve pits are normally installed in the town's right-of-way and are town-owned and maintained, this maintenance would be the responsibility of the Town. Property-owner responsibility is limited to the gravity connections on their individual lots, thereby being essentially equivalent to the responsibility with conventional gravity collection systems. The pressurized portion of vacuum systems is not susceptible to leaks from groundwater infiltration, because it is a closed system.

Advantages:

- Similar to low pressure sewers, typically less costly to install due to smaller pipes and shallower depths of pipe installation
- Fewer mechanical components than a low pressure sewer system
- Less potential for infiltration of groundwater unless system breaks occur
- The main vacuum/pumping station can be equipped with backup power during power outages allowing the overall sewer system to continue operating.
- Less disruption to areas during construction

Disadvantages:

- Less flexible and more sensitive to wastewater flow fluctuations
- Requires constant vacuum to be maintained for whole system to work properly
- Limited to relatively flat topographic areas
- Requires specialized operator training in order to provide adequate system monitoring and response times when problems develop
- Less flexible for future system expansion

12.2.1.4 STEP or STEG Systems

Most homeowners and businesses in Harwich currently have a Title 5 septic system on their property for wastewater disposal. Title 5 system regulations were enacted in 1977 and required a two part system consisting of a septic tank at the front end for solids removal followed by an effluent recharge or liquid disposal field. Thus, some communities have tried to utilize this existing infrastructure by incorporating it into the sewer system. Two different types of uses have emerged as discussed below.

A Septic Tank Effluent Pumping (STEP) system involves the installation of an effluent pump in the back end of the septic tank or in a separate pumping chamber after the septic tank. The pump conveys the lower solids wastewater to a pressurized piping network similar to a low pressure sewer system. Periodically, about every 3 to 5 years, the septic tank is inspected and the solids removed for treatment at the wastewater treatment facility. Regular maintenance of the pump is required by the homeowner.

A Septic Tank Effluent Gravity (STEG) system operates similar to a Title 5 system except that the effluent is conveyed by gravity to a smaller diameter unconventional gravity sewer system. Similar to a STEP system, about every 3 to 5 years, the septic tank is inspected and the solids removed for treatment at the wastewater treatment facility.

Advantages:

- Potential to re-utilize an existing new septic tank (must be water tight)
- Fewer solids are transported in the sewer system minimizing potential for blockages
- STEP has similar advantages to a low pressure sewer system.
- STEG has similar advantages to a gravity sewer system.

Disadvantages:

- The solids (septage) must be pumped periodically from the septic tanks.
- Treatment plant design is more difficult due to the dilute waste stream without organics needed for biological nutrient removal and the need to increase the size of septage receiving facilities.

- Difficult to assess water tightness of existing septic tanks
- STEP has similar disadvantages to a low pressure sewer system.
- STEG has similar disadvantages to a gravity sewer system.

12.2.1.5 Hybrid Systems

In many communities, the combination of wastewater flow fluctuations, hilly and flat areas, high and low groundwater conditions and the sequencing of sewer construction over several phases can result in a combination of sewer system technologies being utilized. This combination of sewer systems is commonly referred to as a hybrid system. It utilizes the most cost-effective and efficient technology in a given area.

Conventional gravity sewer systems are often the backbone of a hybrid system due to their ability to accept wider flow fluctuations and to be expanded in the future. Low pressure sewer systems or vacuum systems often supplement the gravity systems to help offset deep sewer construction, additional pumping stations and extraneous flows (I/I). STEP systems could be utilized in localized areas but STEG systems would not be used as it would be mixing flows with and without solids, negating the benefits of smaller pipes.

12.2.2 Recommended Collection System Technology – Hybrid System

Based on the knowledge of the areas requiring sewer service in Harwich and the discussion of advantages and disadvantages presented above, the recommended sewer system technology is a hybrid system. Conventional gravity sewers will be utilized as the main system technology due to their simple and reliable attributes. The gravity system will be supplemented with pumping stations and low pressure sewers in the areas where appropriate to help minimize costs. Typically, if an area with low pressure sewers exceeds more than 20 – 25 homes, a gravity system with a small pumping station will be utilized. In smaller neighborhoods, with fewer than 20 homes, or at the end of streets where topography drops down low pressure sewers will be utilized.

Vacuum sewers were considered in some areas throughout the five MEP watersheds in Harwich, but were eliminated as an option because of the change in topography in town. Flat terrain is most desirable for a vacuum system. Unfortunately, the topography in Harwich rises and falls more than 40 feet in several areas throughout the proposed collection system which is greater than the 12 to 15 feet of elevation that a vacuum system is able to accommodate. Also vacuum sewers would require another set of maintenance requirements versus the gravity or low pressure systems which does not seem justified for the few small areas where vacuum sewers might be considered applicable.

Similarly the STEP and STEG sewer systems were dropped from further consideration so as not to mix systems with solids and without solids in the wastewater and the need for organic matter in the waste in order to treat down to the low nitrogen levels required to meet the TMDLs.

12.3 Wastewater Flow Estimates

In Section 7, preliminary wastewater flow projections were developed for the entire town for the development of a recommended wastewater program. The wastewater flow estimates presented here are specific to the three wastewater options chosen for further evaluation. They are, in essence, a subset of the wastewater estimates presented in Section 7 since the wastewater service areas do not encompass the entire town and do not, in most instances, encompass the full extent of the MEP watersheds.

Existing and build-out wastewater flows were estimated for each area being proposed for sewers. As detailed in Section 7, the wastewater flows were estimated to be 93 percent of the water consumption for a given parcel excluding summer irrigation. Wastewater flows are similar to water consumption, but a certain percentage (7 percent used here) is typically removed from the water consumption records to account for evaporation and other consumptive uses such as irrigation systems or garden watering. The 93 percent annual adjustment coupled with the irrigation adjustment for July and August averages to the accepted industry standard of 90 percent. This adjustment is specific to the Town of Harwich and is considered a better estimate of average wastewater flow month to month, rather than using a 90 percent reduction across the entire year.

Build-out wastewater flows were calculated from the MEP model. The MEP, working with Harwich planning staff, developed a build-out estimate for the town as part of its nitrogen loading model. The build-out estimate took into account the town's planning projections and current zoning and land use classifications. In areas such as Harwichport, the East Harwich Village Center area and areas along Route 28, the Town of Harwich is updating the buildout estimates because the MEP buildout is considered to be a rough estimate and the town is working to further develop these areas into high density mixed use developments. If these areas are to be developed as mixed use developments in the future, the additional development will result in increased wastewater flow. The MEP buildout estimates were utilized in the comparison of Options 3A, 4A and 5A, but appropriate revisions for buildout estimates are incorporated into the recommended wastewater plan described in Section 13.

The subsections below present the wastewater flows estimated for each area proposed to be sewered, under both current and buildout conditions using best available data. The entire sewer service area is expected to have an initial daily average wastewater flow of between 0.76 to 0.79 MGD and a buildout daily average wastewater flow of 0.93 to 0.95 MGD. More detailed flow estimates are presented in Tables 12-1 to 12-3.

12.3.1 Infiltration and Inflow

Infiltration is only a concern in the gravity pipe sewer areas. Infiltration occurs due to groundwater entering the sewer through pipe joints over time, house service connections, defective pipes and manholes. Technical Review - 16, Guide for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, recommends an average estimate for gravity sewers at 250 gallons per day per inch-diameter-mile of new pipe (gpd/idm), and as the sewers age that estimate increases to 500 gallons per day per inch-mile of pipe. This is similar to the MassDEP CWMP guidelines, which suggest 200 and 500 gpd/idm for new and older sewers, respectively. The more conservative estimate has been used at this time due to high groundwater conditions in some areas to be sewered in Harwich. Actual infiltration flows will change as the groundwater table elevation fluctuates throughout the year.

Inflow can occur in older sewer systems due to illegal connections from roof leaders, sump pumps, cellar and foundation drains, and surface drains connected to the sewer. It can also occur due to cross-connections with storm drains and catch basins. Because the proposed sewer system will be a new sewer system, no inflow should occur. Efforts will be made to prevent these illegal connections during and after the start-up of the sewer system. Extensive public education regarding illegal inflow will accompany sewer connection information for residents and businesses to ensure the public understands the issue and the ramifications of making illegal connections. The town will require each parcel owner seeking a tie-in permit to sign a form acknowledging that they were informed about illegal connections and that they will not connect their sump pumps, downspouts, etc., to their sewer services. The form will also have them acknowledge that they were informed that it is against the State Plumbing Code, as well as local sewer use ordinances.

In addition to projected wastewater flows, Tables 12-1 to 12-4 below include the additional flow anticipated from infiltration for the entire sewer service area.

12.3.2 Summary of Flows

Tables 12-1 to 12-4 summarize the annual average daily flows associated with the three scenario collection systems.

Table 12-1
Scenario 3A Wastewater Flows

Watershed	Number of Parcels	Current Average Annual Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Buildout Average Annual Wastewater Use (GPD)	Buildout Average Estimated I/I Flow (GPD)
Allen	234	52,100	2,250	57,000	4,500
Wychmere	123	26,300	1,450	29,000	2,900
Saquatucket	415	90,700	9,000	95,200	18,000
Pleasant Bay	1,031	171,500	31,000	201,800	62,000
Herring River	2,502	420,800	56,000	555,600	112,000
Total	***4,305***	***761,400***	***99,700***	***938,600***	***199,400***

Table 12-2
Scenario 4A Wastewater Flows

Watershed	Number of Parcels	Current Average Annual Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Buildout Average Annual Wastewater Use (GPD)	Buildout Average Estimated I/I Flow (GPD)
Allen	234	52,100	2,250	57,000	4,500
Wychmere	123	26,300	1,450	29,000	2,900
Saquatucket	415	90,700	9,000	95,200	18,000
Pleasant Bay	1,295	224,300	38,000	258,000	76,000
Herring River	2,340	399,300	53,700	515,700	106,000
Total	***4,407***	***792,700***	***103,700***	***954,900***	***207,400***

Table 12-3
Scenario 5A Wastewater Flows

Watershed	Number of Parcels	Current Average Annual Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Buildout Average Annual Wastewater Use (GPD)	Buildout Average Estimated I/I Flow (GPD)
Allen	234	52,100	2,250	57,000	4,500
Wychmere	123	26,300	1,450	29,000	2,900
Saquatucket	415	90,700	9,000	95,200	18,000
Pleasant Bay	1,205	205,900	34,900	235,900	69,800
Herring River	2,340	399,300	56,000	515,700	112,000
Total	***4,317***	***774,300***	***103,600***	***932,800***	***207,200***

Table 12-4
Summary of Wastewater Flows

Scenario	Number of Parcels	Current Average Annual Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Buildout Average Annual Wastewater Use (GPD)	Buildout Average Estimated I/I Flow (GPD)	Total Buildout Flow (GPD)
3A	4,300	761,500	99,700	939,000	199,000	1,138,000
4A	4,400	793,000	103,700	955,000	207,000	1,162,000
5A	4,300	774,000	103,600	933,000	207,000	1,140,000

12.3.3 Peaking Factors

To develop flows for pipe and pumping station sizing, peaking factors were applied to the current and buildout wastewater flows for each area, using standard industry flow curves for determining the ratio between average daily and peak hour wastewater flows. In addition, the ratio of summer (June, July and August) to annual average daily flow was determined to be 1.91 from monthly municipal well pumping records. To evaluate low flows, the ratio of winter to annual average daily flow was determined to be 0.52. Peak hour infiltration was estimated at 1.75 times the average daily infiltration. Each of these factors will be used to refine collection system pipe sizing and pumping station selection and sizing.

12.4 Sewer System Layouts for Scenarios 3A, 4A, and 5A

Utilizing the recommended hybrid sewer system technology, preliminary layouts for wastewater program Scenarios 3A, 4A and 5A were developed. These layouts reflect the updated wastewater collection system areas as a result of the Herring River MEP Report and having treatment to 3mg/l total nitrogen in all three scenarios. As a result, the three layouts presented are different than the layouts presented in Section 10.

12.4.1 Sewer Collection System for Scenario 3A

Scenario 3A is presented in Figure 12-1. In this scenario, effluent recharge utilizes only the HR-12 site. The total number of parcels sewered for this scenario is approximately 4,300 and the total buildout flow, based on average wastewater use, is about 940,000 gpd. The amount of infiltration/inflow from the gravity pipes at buildout is estimated to be an additional 199,000 gallons per day.

Sewering for Scenario 3A would consist of collecting wastewater from each residential area through local pipe networks and conveying it through pumping stations to a final receiving facility in the Herring River watershed. A single treatment facility would process all collected wastewater for the Town and recharge at that site.

Collection System

The sewer system under this scenario utilizes conventional gravity pipes, pumping stations and low pressure sewers. The proposed gravity system utilizes 78 miles of gravity pipes and force mains ranging in size from 2-inches to 18-inches and utilizes 31 pumping stations. The low pressure sewer utilizes 23 miles of small diameter pressure pipe with no central pumping stations.

Treatment Facility and Effluent Recharge

This scenario will utilize one treatment facility, located at HR-12, the Harwich landfill site. This facility will receive flow from the entire town and will recharge the treated effluent onsite in infiltration basins located adjacent to the facility.

12.4.2 Sewer Collection System for Scenario 4A

Scenario 4A is presented in Figure 12-2. In this scenario, effluent recharge utilizes the HR-12 and PB-3 sites. The total number of parcels sewered for this scenario is approximately 4,400 and the total buildout flow, based on average wastewater use, is 955,000 gpd. The amount of infiltration/inflow estimated from the gravity pipes at buildout is estimated to be an additional 207,000 gallons per day.

Sewering for Scenario 4A would consist of collecting wastewater from each residential area in the Saquatucket, Wychmere, Allen, and Herring River watersheds through local pipe networks and conveying it with pumping stations and forcemains to a treatment facility at HR-12. A separate treatment facility located at PB-3 would be used for all wastewater collected within the Pleasant Bay watershed.

Collection System

The sewer collection system under this scenario utilizes a conventional gravity system, pumping stations and low pressure sewers. The proposed gravity system utilizes 78 miles of gravity pipes and force mains ranging in size from 2-inches to 16-inches and utilizes 32 pumping stations. The low pressure sewer utilizes 23 miles of small diameter pressure pipe with no central pumping stations.

Treatment Facility and Effluent Recharge

This scenario utilizes two treatment facilities; one located at HR-12, the Harwich landfill site and one at PB-3 in the Pleasant Bay. The PB-3 facility will receive flow from the Pleasant Bay watershed area and the HR-12 facility will receive flow from the other four watersheds. Both facilities will recharge the treated effluent onsite in infiltration basins located adjacent to the treatment facilities.

Proposed Sewered Area
Treatment / Effluent Recharge
Village Centers
Allen Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor

Scenario 3A
Updated Treatment and MEP Results in Herring River

1 inch = 1,250 feet
0 1,250 2,500 3,750 5,000 Feet

CDM Smith

Figure 12-1
Sewer Scenario 3A
Harwich, MA
August, 2012

Proposed Sewered Area
Treatment / Effluent Recharge
Village Centers
Allen Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor

Scenario 4A
Updated Treatment and MEP Results in Herring River

1 inch = 1,250 feet
0 1,250 2,500 3,750 5,000 Feet

CDM Smith

Figure 12-2
Sewer Scenario 4A
Harwich, MA
August, 2012

12.4.3 Sewer Collection System for Scenario 5A

Scenario 5A is presented in Figure 12-3. In this scenario, effluent recharge utilizes the HR-12 and PB-3 sites. This scenario is similar to 4A. For this option, the flow from the Pleasant Bay watershed is collected and transported to the existing Chatham treatment facility. Treated effluent is then conveyed back to PB-3 for recharge.

The total number of parcels sewered for this scenario is approximately 4,300 and the total buildout flow, based on average wastewater use, is 933,000 gpd. The amount of infiltration/inflow from the gravity pipes is estimated to be an additional 207,000 gallons per day.

Regional Option with Chatham

Under Scenario 5A, a regional option with Chatham was explored as a way to reduce cost for the Town of Harwich while utilizing capacity at the Chatham Water Pollution Control Facility (WPCF). At this time, the Chatham WPCF has additional capacity that is not being utilized because the planned collection system in Chatham will not be completed for several years. With an inter-municipal agreement, the Town of Harwich could utilize that additional capacity until it is needed by the Town of Chatham. For a long term solution, Harwich will need to pay for an expansion to the Chatham facility to accommodate the flow generated within the Pleasant Bay watershed under Scenario 5A. The long term regional wastewater solution between Chatham and Harwich is a treatment only option. Similar to Harwich, several watersheds in the Town of Chatham are also limited by nitrogen and have limited capacity for recharge. Thus, the regional option evaluated herein will assumes the Town of Harwich will recharge treated effluent back within the boundaries of Harwich at some point so both towns can maintain the nitrogen balance as required by the current MEP information.

To determine if a regional option was feasible, the Towns of Harwich and Chatham developed costs for conveying wastewater generated within the Pleasant Bay watershed in Harwich; treating the wastewater at the Chatham WPCF; and conveying the treated effluent back to Harwich for recharge. The agreement is for approximately 300,000 gpd of wastewater (annual average flow) to be conveyed from the Pleasant Bay watershed area in Harwich to the Chatham WPCF. Capital and O&M costs for conveyance from that location to the Chatham WPCF were also determined by Chatham and their engineer, GHD, using the planning level costs developed earlier in the Chatham CWMP. The results of this regional option were weighed against the other options presented in this section and are compared in Table 12-13. A copy of the technical memorandum detailing the regional connection alternative to Chatham is included in Appendix E. Table 12-4 below details the costs for Harwich to connect to the Chatham system.

Table 12-4
Town of Harwich Share of the Collection Treatment and O&M System Costs to connect to the Chatham System

Type	Option 5A
Collection System	$2,400,000
Treatment System	$9,200,000
Annual O&M Costs	$ 260,000

Proposed Sewered Area
Treatment / Effluent Recharge
Village Centers
Allen Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor

Scenario 5A
Updated Treatment and MEP Results in Herring River

1 inch = 1,250 feet
0 1,250 2,500 3,750 5,000 Feet

CDM Smith

Figure 12-3
Sewer Scenario 5A
Harwich, MA
August, 2012

The collection system under this scenario utilizes a hybrid conventional gravity system with pumping stations and low pressure sewers. The proposed gravity system utilizes 82 miles of gravity pipes and force mains ranging in size from 2-inches to 16-inches and utilizes 32 pumping stations in Harwich and 2 pumping stations in Chatham. The low pressure sewer utilizes 23 miles of small diameter pressure pipe.

Treatment Facility and Effluent Recharge

This scenario will utilize two treatment facilities, located at HR-12, the Harwich landfill site and the Chatham WPCF. The Chatham WPCF will receive flow from the Pleasant Bay watershed and the HR-12 facility will receive flow from the rest of town (outside of the Pleasant Bay watershed). HR-12 will recharge the treated effluent onsite at infiltration basins located adjacent to the facility. The effluent flow from the Chatham facility will be pumped back into Harwich for recharge at PB-3 in the Pleasant Bay watershed. For this scenario, PB-3 will only be utilized as an effluent recharge site.

12.5 Proposed Pumping Stations

The recommended collection system layouts include approximately 33 pumping stations which are fed by gravity sewers. Proposed pumping station locations shown on these layouts are only approximate and represent idealized locations, based on topography. As the town moves forward with the selected collection system, final pumping station sites will need to be reviewed and specific sites identified.

The final sites would be selected according to the following criteria:

1. Proximity to the low point in the collection system – gravity pumping stations should be located as close as possible to the low points.

2. Property ownership – ideally the selected parcels are already owned by the town.

3. Minimize permitting requirements – avoid work within wetland areas, the 100-foot buffer zone to wetlands, or the 200-foot riverfront area, where applicable.

4. The location of the 100-year floodplain – structures within the floodplain have to meet more stringent design and construction standards, to ensure that the stations continue to function properly during an anticipated flooding event, resulting in higher risks and more costly construction.

5. Location within EOEEA Article 97 sites – these sites are preserved as open space and require an act of the Massachusetts state legislature for the construction of any structures. If possible, Article 97 sites should be avoided.

6. Climate change – select locations that minimize design parameters as a result of climate change (sea level rise, etc.).

The approximate pumping station locations are shown on Figure 12-4. Since options 3A, 4A and 5A are similar, Figure 12-4 shows the approximate wastewater service area for the town and incorporates minor overlap for the three options. For planning purposes, this approach is appropriate since the locations will be better defined as each phase of the sewering plan is implemented. Table 12-6 lists the number of parcels immediately served by each station, along with the average daily flows each station will receive at full buildout. When each station is designed, these average daily flows will be used to calculate the peak design flows each station will need to accommodate.

Proposed Sewered Area
Treatment / Effluent Recharge
Village Centers
Allen Harbor
Herring River
Pleasant Bay
Saquatucket Harbor
Wychmere Harbor
Pump Stations

All Scenarios
Sewered Parcels

1 inch = 1,250 feet

0 1,250 2,500 3,750 5,000 Feet

CDM Smith

Figure 12-4
All Sewer Scenarios
Harwich, MA
August, 2012

Table 12-6
Pumping Stations and Estimated Flows for Options 3A, 4A and 5A

Pumping Station	Number of Parcels			Current Average Wastewater Flow Into Pump Stations (gpd)	Current Average Estimated I/I Flow into Pump Stations (gpd)	Build-out Average Wastewater Flow Into Pump Stations (gpd)	Build-out Average Estimated I/I Flow Into Pump Stations (gpd)
	3a	4a	5a				
PS-HR-01	143	143	143	25,800	2,100	31,200	4,200
PS-HR-02	254	254	254	45,800	3,700	55,400	7,400
PS-HR-03	411	409	409	145,400	11,800	176,000	23,500
PS-HR-04	468*	433	433	403,000	75,900	488,000	65,300
PS-HR-05	127	126	126	22,900	1,900	27,700	3,700
PS-HR-06	29	29	29	5,300	500	6,400	900
PS-HR-07	19	x	x	3,500	300	4,200	600
PS-HR-08 (Scenario 3A)	318	318	318	334,100	27,800	404,600	54,400
PS-HR-08 (Scenario 4A, 5A)	318	318	318	112,400	9,400	136,100	18,300
PS-HR-09	113	113	113	20,400	1,700	24,700	3,300
PS-HR-10	36	36	36	6,500	600	7,900	1,100
PS-HR-11	198	197	198	46,900	3,800	56,800	7,600
PS-HR-12	62	62	62	11,200	900	13,600	1,800
PS-HR-13	152	133	133	56,200	4,800	68,200	9,300
PS-HR-14	76	75	75	13,700	1,200	16,600	2,300
PS-HR-15	36*	11	11	17,300	1,500	21,000	2,900
PS-HR-16	60	x	x	10,800	900	13,100	1,800
PS-PB-01	413*	422	347	233,200	19,300	282,400	37,900
PS-PB-02	x	24	24	4,400	400	5,300	700
PS-PB-03	23	41	89*	36,600	3,100	44,300	5,900
PS-PB-04	x	36	26	16,100	1,400	19,500	2,600
PS-PB-05	x	83	33	10,500	900	12,700	1,700
PS-PB-06	28	28	28	5,100	500	6,200	900
PS-PB-07	130	131	130	57,600	4,800	69,700	9,400
PS-PB-08	83	84	84	15,200	1,300	18,400	2,500
PS-PB-09	104	104	104	18,800	1,600	22,700	3,100
PS-PB-10	61	55	55	10,300	900	12,500	1,700
PS-PB-11	117	114	114	31,000	2,600	37,600	5,100
PS-PB-12	115	158*	106	59,500	4,900	72,100	9,700
PS-A-01	251*	217	217	126,400	10,400	153,100	20,600
PS-S-01	228	209	209	61,500	5,100	74,500	10,100
PS-S-02	46	35	35	7,100	600	8,600	1,200
PS-S-03	20	20	20	10,700	900	13,000	1,800
PS-S-04	70	64	64	22,600	1,900	27,400	3,800
PS-W-01	117	104	104	81,200	6,700	98,300	13,300
Estimated Total to WWTP - Scenarios 3A - 5A				**761,000 - 774,000**	**61,000 - 64,000**	**933,000 - 955,000**	**121,000 - 128,000**

The pumping stations in the gravity system would mostly be submersible-type stations with on-site standby power. The stations would be predominately precast concrete underground stations, with the standby power and instrumentation and control panels above ground either in pedestal cabinets or housed in a prefabricated building. The larger stations, which will pump more than 2.5 mgd at peak flow to the wastewater treatment facility at buildout, will likely be a cast-in-place concrete wet pit/dry pit stations with a building to house electrical equipment and controls.

12.6 Collection System Costs

12.6.1 Collection System Capital Costs

Cost estimates were developed for the three collection systems. These estimates, including both piping and pumping stations, are shown in Table 12-7.

Table 12-7
Estimated Collection System Costs

	3A	4A	5A
Number of Properties Served	4,305	4,407	4,317
Collection System Cost	$124,900,000	$137,500,000	$144,200,000
Collection System Cost for Harwich (Chatham System)			$2,400,000
Homeowner Hookup Cost	$19,000,000	$18,900,000	$18,500,000
Total	$143,900,000	$156,400,000	$165,100,000

The cost for gravity piping includes pipe, manholes, wye connections for each parcel, 6-inch service connections extending an average of 20 feet for each lot (from the street to the property line), excavation support, state highway construction considerations where applicable (flowable fill, etc.), paving, police details, and some allowances for drainage and mobilization. Paving is assumed to include a 2-inch trench patch and a 1.5-inch full width overlay on all currently paved roads.

Collection system costs for Scenario 5A include $4.5 million for an effluent pumping station at the Chatham WPCF and a forcemain to site PB-3 area (12,000 linear feet (lf)).

The cost for individual homeowner hookups is also shown and includes an assumed cost for a service connection to the property line where the municipal collection system connects to the private service connection. For the homes or businesses with pressure sewers, an additional cost was included for the purchase and installation of a grinder pump.

All of these estimates include an allowance for planning level costs (25 percent), and for permitting, engineering and construction services (25 percent).

Similar to the cost analysis performed in Section 10, the collection system costs for the three options are similar and only differ less than 15 percent. The 4A and 5A scenarios are slightly higher in costs due to added conveyance costs for two treatment facilities, particularly with Scenario 5A since this scenario goes to Chatham and back.

It is important to note that these collection system costs include over 1,100 more parcels being sewered In the Herring River and are based on the conceptual sewer system master plan layout from pipe sizes and number of pumping stations versus Section 10 costs.

12.6.2 Collection System O&M Costs

Annual operation and maintenance costs for the three wastewater collection system alternatives under buildout conditions are shown below in Table 12-8. These costs have been divided into system wide costs and a summary of individual user costs that the property owner is required to pay. These costs are for operation of the collection system only and do not include operation and maintenance costs associated with the town's proposed wastewater treatment facilities.

Following the table is an explanation of the basis of the labor, equipment, power and other costs presented in the table.

Table 12-8
Operation and Maintenance Cost Summary for Buildout Conditions

Cost Category	Scenario 3A	Scenario 4A	Scenario 5A
Public Costs:			
Labor	$546,000	$561,000	$580,000
Power	$158,000	$162,000	$168,000
Miscellaneous Costs	$141,000	$145,000	$150,000
Total System Wide O&M	**$845,000**	**$868,000**	**$898,000**
Private User O&M Costs	$141,000	$123,000	$119,000
Total O&M	**$986,000**	**$991,000**	**$1,017,000**

[1]Does not include wastewater treatment charges.

12.6.2.1 Labor Costs

Typical Collection System O&M

The average cost for labor including salaries and fringe benefits is approximately $65,000 per employee per year. Scenarios 3A, 4A and 5A indicate that that Harwich's labor force will include a total of eight people for Scenario 3A and nine people for Scenarios 4A and 5A to maintain the collection system which includes thirty-one, thirty-two, and thirty-four pumping stations, respectively, at buildout.

Proposed Gravity System

To determine the number of personnel required for the gravity sewer system, the number of miles of sewer and the number of pumping stations were calculated. The proposed gravity system is expected to require a labor force of approximately six people for Scenarios 3A and 4A and seven people for Scenario 5A. These staff will be needed to perform operation and maintenance of thirty-one (31) pumping stations and forty-five (45) miles of sewer for Scenario 3A, thirty-two (32) pumping stations and forty seven (47) miles of sewer for Scenario 4A, and (34) pumping stations forty-eight (48) miles of sewer for Scenario 5A.

Proposed Pressure System

Similar to the gravity system, the pressure sewer alternative requires approximately two positions for all scenarios to maintain the pipelines. The majority of the pressure system maintenance cost is directly on the connection owner.

12.6.2.2 Power Costs

Power costs are based on connected horsepower and expected running times of pumps at the wastewater pumping stations. Annual costs are higher for pumping stations utilizing the gravity sewer option (main pumping station/three small collection system pumping stations). Pressure sewers have the lowest power costs as the town is only responsible for the main pumping stations and homeowners operate and maintain the grinder pumps.

12.6.2.3 Miscellaneous Costs

These costs include spare parts, vehicles, fuel and associated maintenance, training expenses and other miscellaneous costs. Since Harwich has no existing budget to review we estimated that miscellaneous costs are likely to represent 20 percent of the labor and power cost.

12.6.2.4 Private Costs

Pressure System

Every household served by a low-pressure system has a grinder pump that is owned, operated and maintained by the homeowner. The costs include $25/year for power and an allowance to purchase a service contract to maintain the system at $100/year for a total of $125/year per household. Scenarios 3A, 4A, and 5A have between 950 and 1,130 lots on pressure sewers that require grinder pumps.

12.6.2.5 O&M Costs Summary

The O&M costs for the collection systems of the three options are similar and reflect the similarity of the three collection systems. The increased public O&M cost for Scenario 5A reflects the costs for the additional pumping station in Chatham, but overall the costs are considered to be equal.

12.7 Treatment Technology Evaluations

Three types of treatment facilities were evaluated to determine the most appropriate treatment technology for Harwich. The technologies were ranked based on several criteria, including capital and O&M costs, operational flexibility and expandability.

12.7.1 Key Evaluation Criteria

Three treatment system technologies were selected from experience and deemed feasible to meet the proposed treatment levels for the size flows to be treated. The treatment technologies are evaluated herein. Then the selected technology is incorporated into the three wastewater scenarios and used to compare the costs of the proposed wastewater collection and effluent recharge systems under Scenarios 3A, 4A and 5A. Critical issues used to determine the technology selection of the wastewater treatment facility include:

- Ease of expandability
- Operational flexibility (ability to operate with seasonal variations in flows)
- Operability
- Capital Costs
- O&M Costs
- Space Requirements
- Process Performance - the ability to meet total nitrogen limits (TN) in effluent as outlined in the 314 CMR 05 Groundwater Discharge Regulations (considered 3 mg/L TN for Harwich discharges)

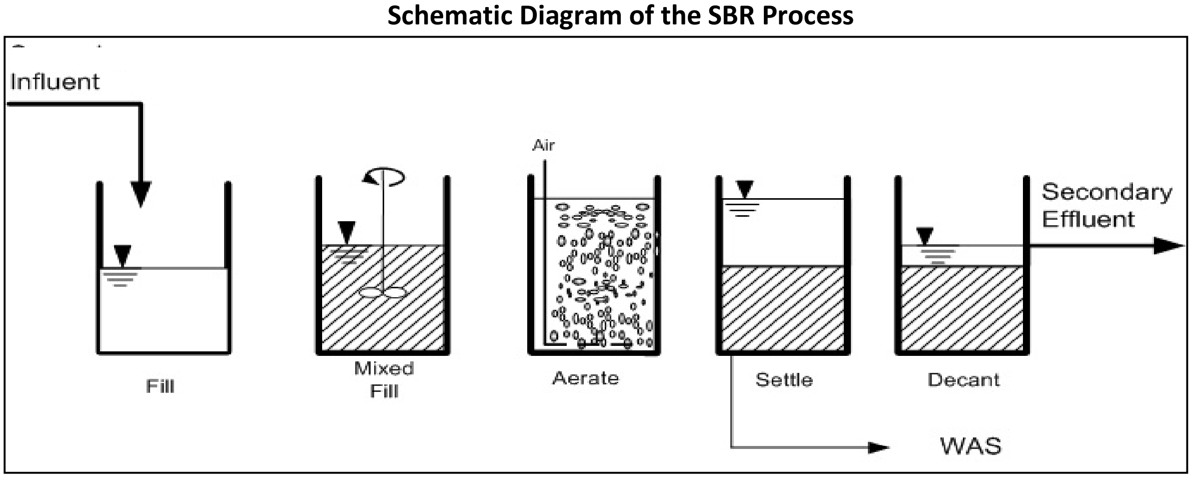
12.7.1.1 Description of Treatment Technologies

The three technologies selected for evaluation include sequencing batch reactors (SBRs), oxidation ditches (ODs) and membrane bioreactors (MBRs). Each is considered a biological process. These technologies were selected for their ability to remove total nitrogen down to low levels (3-5 mg/L annual average) and their ability to meet effluent criteria required for recharge to infiltration basins. Although the SBR, OD and MBR technologies can often achieve limits as low as 3 mg/L, it is assumed for this evaluation that an additional denitrification technology (along with supplemental carbon addition) will be necessary to achieve an annual average of 3 mg/L total nitrogen on a regular basis.

Sequencing Batch Reactors (SBRs)

Sequencing batch reactors function as a combined aeration tank and clarifier, where all the biological reactions and settling/separation occur in a single unit operating as a batch process. It is an activated sludge process and all the kinetics relationships apply that pertain to any other mode of activated sludge. The SBR operates between a constant low water level and a varying high water level, depending on the influent flow rate. Typically more than one reactor is required to allow for constant fill of one of the reactors. The SBR is operated under a predetermined cycle and typically follows the following six steps: Mixed Fill, Aerated Fill, React, Settle, Decant and Idle, as discussed below. Figure 12-5 presents a schematic diagram of the SBR process.

Figure 12-5
Schematic Diagram of the SBR Process



- ***Mixed Fill*** - Wastewater enters a partially filled reactor containing biomass. Bacteria biologically degrade the organics and use residual oxygen or alternative electron acceptors, such as nitrate. It is during this period that anoxic conditions are utilized for the selection of biomass with better settling characteristics.

- ***Aerated Fill*** - The influent flow continues under mixed and aerated conditions.

- ***React*** - Influent flow is terminated and directed to the other batch reactor. Mixing and aeration continue in the absence of raw waste.

- ***Settle*** - The aeration and mixing is discontinued after the biological reactions are complete and the biomass settles under quiescent conditions. Excess biomass can be wasted at any time during the cycle. The settling time is adjustable during operations to match prevailing process needs.

- ***Decant*** – After solid/liquid separation is complete during the settling period, the treated effluent is removed through a decanter. The reactor is then ready to receive the next batch of raw influent.

- ***Idle*** - The length of this step varies depending on the influent flow rate and the operating strategy.

Since clarification and aeration occur within the same tank there is no internal recycle or return activated sludge common to conventional activated sludge treatment processes. Sludge is typically removed and recycled during the decant phase. A crucial feature of the SBR system is the control unit, including the automatic switches and valves that sequence and time the different operations. Since the heart of the SBR system is the controls, automatic valves, and automatic switches, these systems require more sophisticated maintenance than a conventional activated sludge system.

An important consideration for the SBR system is that the effluent discharges only intermittently and therefore would greatly affect the size of the downstream process units. The decant rate is substantially higher than the plant inflow, hence requiring a post-equalization tank to dampen the peak flows so as not to require oversizing of downstream process equipment.

An SBR wastewater treatment facility (WWTF) is capable of handling the seasonal flow variations by fluctuating water levels, as well as changing cycle times as needed for nitrification and denitrification. Whereas proper operation and the potential use of a supplemental carbon source could result in meeting the 3 mg/L total nitrogen limit, provisions should be made for effluent filters to ensure compliance. Additionally, an SBR WWTF capacity can be increased in phases, with the typically square or rectangular shaped tanks lending themselves to common wall construction. Major components required for an SBR WWTF are listed below:

- Headworks Building – Coarse Screening and Grit/Grease Removal
- SBR Tanks
- Effluent Equalization Tank
- Effluent Filters
- Disinfection

- Odor Control
- Septage Receiving Facilities
- Administration/Process Building
- Residuals Processing and Storage
- Infiltration Basins for Recharge

The wastewater treatment facilities for the towns of Falmouth and Provincetown utilize SBR technology.

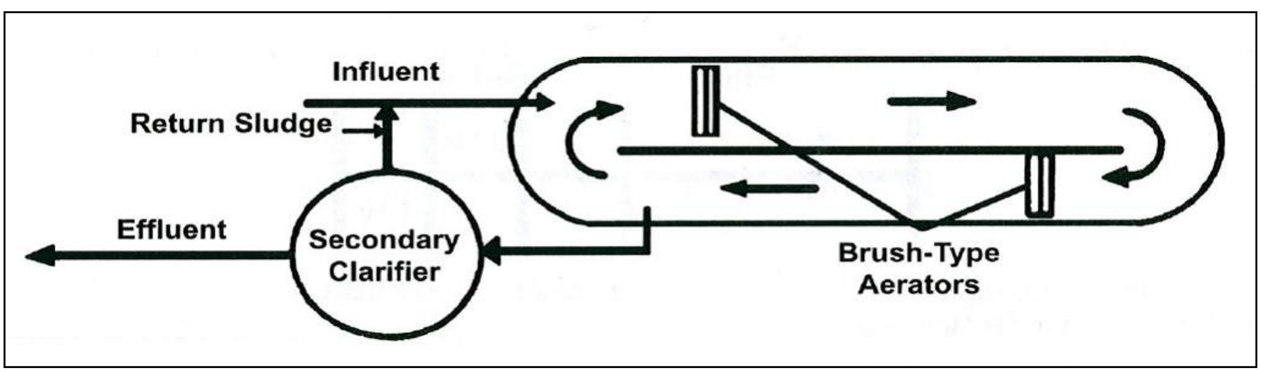
Oxidation Ditches (ODs)

The oxidation ditch is an activated sludge process in a ring- or oval-shaped channel that is equipped with mechanical aerators. Wastewater is aerated as it circulates around the perimeter of the ditch. For denitrification, anoxic zones can be created within the ditch but external anoxic tanks are recommended for low total nitrogen limits. These systems are typically designed without primary clarifiers and require secondary clarifiers to separate the activated sludge from the flow stream.

Typically, mechanical mixing and aeration devices are provided and in some cases a diffused air system is installed. Several varieties of mechanical equipment are commonly used, including horizontal brush rotors, rotating discs, or mechanical aerators, all of which should provide comparable performance. Flow is continuously moving in a circular motion around these tanks as influent is fed and effluent diverted off.

An oxidation ditch, operating as extended aeration, will generate less overall sludge and provide good buffering for peak flows and variations in loading. Because of the long sludge age, a larger tank is required compared to conventional activated sludge. Oxidation ditches have very simple operational requirements, and thus can be more favorable for smaller communities. However, because the process utilizes larger aeration tanks and requires longer solids retention time than the conventional process, the capital cost of the treatment structure is increased. In addition, depending on treatment requirements, oxidation ditch facilities may require supplemental aeration to the mechanical aerators to avoid low dissolved oxygen levels in the treatment unit. As with the SBR, provisions during the planning stage should be made for the use of effluent filters to ensure meeting the required 3 mg/L total nitrogen required for discharge. Major components required for an oxidation ditch WWTF are listed below. Figure 12-6 presents a schematic diagram of the oxidation ditch process.

Figure 12-6
Schematic Diagram of an Oxidation Ditch Process



- Headworks Building – Coarse Screening and Grit/Grease Removal
- Anoxic Tanks
- Oxidation Ditch
- Secondary Clarifier
- Effluent Filters
- Disinfection
- Odor Control
- Septage Receiving Facilities
- Administration/Process Building
- Residuals Processing and Storage
- Infiltration Basins for Recharge

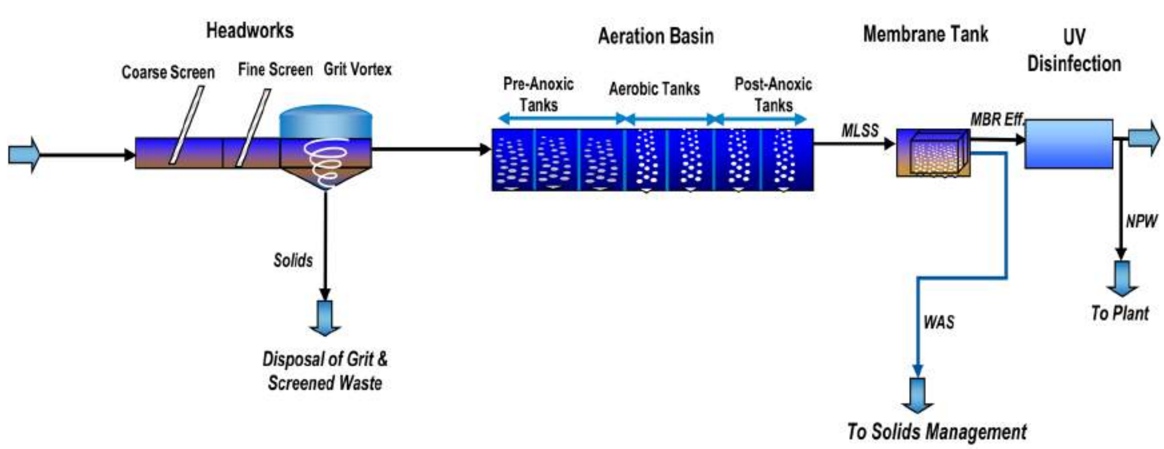
The wastewater treatment facilities for Chatham and the Massachusetts Military Reservation (MMR) in Bourne utilize oxidation ditch technology.

Membrane Bioreactor (MBR)

A membrane bioreactor used for nitrogen removal is an activated sludge reactor with membrane filtration downstream of anoxic and aerobic bioreactors. Influent enters the headworks and flows into the pre-anoxic zone, then to the aerobic zone, then the post-anoxic zone, and finally into the membrane tanks, where mixed liquor is re-aerated and solids separated from the process effluent. Effluent is then disinfected. Membrane tanks are aerated to provide final BOD removal and nitrification and to provide scour for prevention of membrane fouling. Membranes require fine screening down to less than 2 millimeters (mm) in addition to the coarse screening and grit removal. One hundred percent redundancy must be provided for screening and membrane tanks.

The membranes must be capable of physically passing the peak hour flow through the membrane modules, and therefore an influent equalization tank is recommended to dampen peak hour flow. Flow is recycled from the membrane tanks to the aerobic zone, and then back to the pre-anoxic zone in order to avoid recycling high quantities of dissolved oxygen to the anoxic zones. The treatment process requirements are similar to that of an oxidation ditch WWTF. Figure 12-7 presents a schematic diagram of the MBR process.

Figure 12-7
Schematic Diagram of the MBR Process



Below is a list of major process components associated with an MBR WWTF:

- Headworks Building (Coarse Screening)
- Grit/Grease Removal
- Fine Screening
- Pre-Anoxic Tanks
- Aerobic Tanks
- Post-Anoxic Tanks
- Membrane Tanks with Influent Equalization
- Disinfection
- Odor Control
- Septage Receiving Facilities
- Administration/Process Building
- Residuals Processing and Storage
- Infiltration Basins for Discharge

The wastewater treatment facility for the Town of Cohasset utilizes MBR technology.

12.7.1.2 Disinfection

There are three typical disinfection methods for wastewater: ozone, UV (ultraviolet irradiation) and chlorination. The ozonation process is very energy intensive for small facilities and there are significant costs associated with chemicals and tankage for chlorination/dechlorination required for groundwater recharge. For the purposes of this CWMP/SEIR, it is recommended that UV disinfection be utilized as the most appropriate option for disinfection.

12.7.1.3 Residuals Handling

Most wastewater treatment facilities today with flows under 5 mgd haul offsite the thickened solids created during the treatment process. Thus, any proposed treatment facility for Harwich which is well below that size facility will include solids thickening process equipment and storage tanks for unthickened and thickened residuals. It is recommended that thickened residuals be removed by establishment of a hauling/disposal contract with an approved off-site processing facility.

12.7.2 Biological Treatment Technology Comparison

All three technologies represent a feasible alternative for the new Harwich WWTF(s). Each technology has its own advantages and disadvantages based on the listed evaluation criteria. Table 12-9 presents those advantages and disadvantages.

Table 12-9
Comparisons of Three Treatment Technologies: Advantages and Disadvantages

Technology	Advantages	Disadvantages
Sequencing Batch Reactor (SBR)	▪ Able to meet strict effluent criteria for groundwater discharge standards ▪ Operationally flexible with respect to seasonal variations in flow. Cycle times may be adjusted as required to meet permit limits. ▪ Easily expanded with common wall construction for additional SBRs	▪ Expansion will be expensive as new large SBRs are constructed to handle the increase in flow. ▪ Requires effluent equalization ▪ May require filtration for discharge limits
Oxidation Ditch (OD)	▪ Simple process to operate ▪ Able to meet strict effluent criteria for groundwater discharge ▪ Resilient process to varied loadings and seasonal flexibility	▪ Process requires a lot of space ▪ Additional expansion requires more tankage than other processes (anoxic tanks plus OD plus clarifier) ▪ Mechanical aerators result in higher O&M costs for aeration process
Membrane Bioreactor (MBR)	▪ Able to meet strict effluent criteria for reclaimed water standards ▪ No additional filtration required ▪ Modular system is easily expandable. Cassettes can be easily dropped into membrane tanks as flow increases. ▪ Higher quality effluent	▪ Requires fine screening of less than 2 mm ahead of the membranes ▪ Peak hour flow rates must pass through membranes, which will likely only occur during summer months due to seasonal flow (influent equalization) ▪ Membranes must be replaced every seven years and are expensive to replace

In addition to the summary of advantages and disadvantages, a ranking system was developed to assist with technology screening that is based on the key evaluation criteria. Those criteria are listed below with associated rankings. These factors provide a qualitative method for ranking the treatment technologies and a means for making a recommendation. The following are the assessment criteria and rationale used in performing the comparison of technologies:

- ***Ease of Expandability*** – Assessment of these criteria depends on the alternative's ability to allow for future expansion as potential phased expansion of collection system and needs areas arises. Alternatives are ranked as follows:

  5 - Difficult to expand

  3 - Flexibility and expandability are likely to be average

  1 - Easily expandable

- ***Operational Flexibility*** – This step assesses the ability of the process to meet seasonal flow fluctuations anticipated for Harwich. Alternatives are ranked as follows:

  5 - Difficult to meet flow variations (need additional tankage)

  3 - Average flexibility

  1 - Very flexible

- ***Operability*** – The difficulty of operating a process will be considered. Some processes are complex and require a lot of attention for proper operation. Some processes require special skills and extensive training for the operators. Alternatives are ranked as follows:

  5 - Processes difficult to operate or requiring special skills

  3 - Processes require average attention and some additional staff and training

  1 - Less complex processes

- ***Capital Cost*** – Capital cost relates to the construction cost based on the facility needed for meeting build-out flows. Alternatives are ranked as follows:

  5 - High construction cost estimate

  3 - Medium cost when compared to other alternatives

  1 - Low construction estimate

- ***O&M Costs*** – O&M cost includes general maintenance, labor, supplies and power requirements. Mechanical equipment with high horsepower demands results in high O&M costs, and the need for replacement of components is also evaluated here. Alternatives are ranked as follows:

  5 - High O&M estimate

  3 - Medium O&M estimate when compared to other alternatives

  1 - Low O&M estimate

- ***Space Requirements*** — This evaluates the footprint needed for the main components of the biological process.

  5 - A large quantity of space required for the suggested alternative

  3 - Space required is likely to be average

  1 - Minimal space is required of the alternative

- ***Process Performance*** — All of these alternatives would provide secondary effluent water quality that meets groundwater discharge standards. Some processes can more easily meet these performance standards than others. Alternatives are ranked as follows:

  5 - Processes that need additional process steps to meet the discharge standards (i.e. additional filtration)

3 - Average process performance

1 - High process performance

Table 12-10 summarizes all criteria into a matrix for ease in comparing the different alternatives. Each is graded for its response to the respective criteria. A ranking of 1, 3 and 5 is provided with 1 being the most desirable. The alternative with the lowest total score is the recommended plan for secondary wastewater treatment in Harwich.

Table 12-10
Matrix Assessment for Recommending Harwich WWTP Technology

Criteria	Sequencing Batch Reactor (SBR)	Oxidation Ditch (OD)	Membrane Bioreactor (MBR)
Ease of Expandability	1	5	1
Operational Flexibility	1	1	3
Operability	5	1	3
Capital Cost	1	3	3
O&M Cost	1	3	5
Space Requirements	3	5	1
Process Performance	1	1	1
Total Score	***13***	***19***	***17***

12.7.3 Recommended Technology

The recommended treatment technology for Harwich is an SBR process, with the construction to be phased in coordination with the collection system work. The key reasons for constructing the SBR process initially are to minimize capital costs for the Town, to provide the best operational flexibility based on the anticipated plant flow variations, and to be easily expanded. Going forward, as the collection system grows and potential future permit regulations develop, the option to continue forward with SBR allows for maximum flexibility.

Supplemental Carbon Addition and Denitrification Filters

Based on the results of the MEP report for the Herring River watershed, the need for nitrogen removal within Harwich is greater than anticipated earlier in the CWMP process. Ultimately, the WWTF requirements for nitrogen removal will be an annual average nitrogen discharge concentration of 3 mg/L at ultimate buildout of the proposed collection system.

As the 3 mg/L concentration for discharge is based on the removal limits of technology, it is assumed for estimating purposes that an SBR treatment facility for Harwich will need additional denitrification. For the purposes of this evaluation, it is recommended that supplemental carbon addition and denitrification filters be used to meet these very stringent effluent total nitrogen concentrations.

Supplemental Carbon Addition

Supplemental carbon alternatives are recommended for use as part of any wastewater alternative for Harwich. There are a variety of supplemental carbon sources that are used in nitrogen removal, with the most common being methanol and a proprietary product like the MicroC product line, manufactured by Environmental Operating Solutions (EOS). Other options do exist, but are typically contingent upon the availability of the product in close proximity to the wastewater treatment plant. Based on the flammability, safety, transportation, storage and permitting issues associated with methanol, it is not recommended for this application and a proprietary product should be considered during preliminary and final design.

It is assumed that the biological treatment process selected would remove total nitrogen to 5 mg/L or less without the use of supplemental carbon addition. It should be noted that if the denitrification rates are less than typical values, it may be necessary to add supplemental carbon both during the biological treatment process and the final denitrification step. Controls will be provided that can modify dosage rates accordingly as results will vary based on seasonal temperature and flow variations associated with the annual population fluctuation in Harwich. In addition, since the effluent nitrogen concentration is based off of ultimate plant flows and nitrogen loadings, initial discharge concentrations as the sewer system is phased in may be greater than 3 mg/L. This could result in savings and minimize carbon dosing during initial phases of operation.

Denitrification Filters

As described above, the low total nitrogen effluent requirements of 3 mg/L on an average annual basis at buildout will require additional treatment to ensure compliance. It is recommended that denitrification filters be provided as an additional nitrogen removal process as they provide both the biological nitrogen removal and solids removal necessary to achieve low effluent total nitrogen concentrations. Denitrification filters are media filters that can operate in either a downflow or upflow mode depending on the manufacturer. The filters need to be backwashed periodically and the waste backwash water returned to an earlier process step for treatment. It is recommended during preliminary design to evaluate the need and point during the phased construction of the system at which to implement denitrification filters. This again will be based on the allowable loading at the selected recharge site.

12.8 Estimated Wastewater Treatment Flows and Loads

This section presents the flows and loads for Scenarios 3A, 4A and 5A.

Flows

Section 7 determined flow factors to account for seasonal variation in flows that result from the population changes that Harwich undergoes annually. Because of the seasonal fluctuations inherent to Cape Cod, wastewater treatment plant design conditions need to be evaluated to properly account for the change in flows. Using the annual flows calculated from the water use data, the average annual wastewater flows for Scenarios 3A, 4A and 5A are as follows:

- ***Scenario 3A – 1,138,000 gpd*** - This scenario would utilize one treatment facility, located at HR-12, the Harwich landfill site.
- ***Scenario 4A – 1,162,000 gpd*** - This scenario would utilize two treatment facilities, located at HR-12, the Harwich landfill site and PB-3 in the Pleasant Bay watershed. The PB-3 facility will receive flow from the Pleasant Bay watershed and HR-12 facility will receive flow from the rest of town outside of the Pleasant Bay area.

- ***Scenario 5A – 1,140,000 gpd*** - This scenario will utilize two treatment facilities, located at HR-12, the Harwich landfill site and the Chatham WPCF. The Chatham WPCF will receive flow from the Pleasant Bay area and the HR-12 facility will receive flow from the rest of town outside of the Pleasant Bay area. HR-12 will recharge the treated effluent onsite in infiltration basins located adjacent to the facility. It is assumed the effluent flow from the Chatham facility will be pumped back to Harwich for recharge at PB-3 in the Pleasant Bay watershed. For this scenario, PB-3 will only be utilized as an effluent recharge site. Based on groundwater modeling and preliminary discussions with MassDEP, it is expected that TOC limits will not be required at this site.

Based on the data analyzed and reviewed in Section 7, the seasonal peaking factors identified are 1.91 for summer flows, 0.78 for spring/fall flows and 0.52 for winter flows. Table 12-11 summarizes the seasonal flows in million gallons per day for Scenarios 3A, 4A, and 5A. Maximum day and peak hour flows are also included in this table.

Table 12-11
Buildout Seasonal Wastewater Flows and Peaking Factors

Scenario	Annual Average Flow (MGD)	Summer Average Flow (MGD)	Winter Average Flow (MGD)	Spring/Fall Average Flow (MGD)	Max. Day Flow (MGD)	Peak Hour Flow (MGD)
3A – HR12 Facility	1.14	1.99	0.69	0.93	3.97	6.30
4A – HR12 Facility	0.83	1.46	0.49	0.67	3.06	4.92
4A – PB3 Facility	0.34	0.57	0.21	0.28	1.31	2.20
5A – HR12 Facility	0.84	1.47	0.50	0.68	3.07	4.93
5A – Chatham, PB3 Effluent Recharge	0.31	0.52	0.19	0.25	1.20	2.01

Infiltration was added to average daily flows to calculate the total average daily flows.

Septage flows are considered to be minimal for each scenario evaluated. As described later in this section, the ability to receive limited hauled wastes will be incorporated into WWTF design but it is not anticipated to represent a significant volume of flow or constituent loading and will decline as the sewer system is implemented.

Loads

Design loads for wastewater flows are based on the constituent concentrations listed below. Depending on sewer construction phasing, initial loadings to the WWTF could represent a higher concentration of constituents depending on the make-up of the area being sewered. For comparison purposes, the buildout scenarios used for this evaluation focus on a more "typical" domestic wastewater strength as the majority of sewered areas represent residential connections. The residential loading concentrations were developed using values from the industry accepted Metcalf & Eddy, Wastewater Engineering text. Going forward into preliminary stages, a more detailed evaluation of initial sewer phase waste strength should be estimated based on data collected from other seasonal Cape Cod communities. Table 12-12 lists the estimated concentrations for the Harwich wastewater.

Table 12-12
Estimated Average Wastewater Concentrations

Criteria	Buildout Concentration
BOD (Biochemical Oxygen Demand)	245 mg/L
TSS (Total Suspended Solids)	260 mg/L
TKN (Total Kjehldahl Nitrogen)	45 mg/L

12.9 Treatment Facility Costs

The treatment facility costs presented here are for planning-level comparisons and are useful for giving a relative cost comparison for the three wastewater scenarios. Those costs were based on annual flows and account for the large seasonal flow swings characteristic of a seasonal community like Harwich. A cost for effluent recharge facilities was included and assumed that open infiltration basins will be utilized for effluent recharge at either HR-12 or PB-3. As stated in Section 9, planning level estimates indicate that each infiltration basin can receive approximately 140,000 gpd of effluent recharge flow from the treatment facilities. Additional costs (approximately $250,000) were also carried for effluent recharge at PB-3 to include the land purchase costs.

All of the treatment facility estimates include an allowance for planning level costs (15 percent), and for permitting, engineering and construction services (25 percent).

Costs were developed for Scenarios 3A, 4A and 5A based on actual project costs that were completed for other communities in New England. The estimated project costs are summarized below in Table 12-13.

Table 12-13
Treatment Facility Construction Costs

Scenario	Total Average Flow with I/I	Cost
3A	**1,138,000 gpd**	**$65.4 million**
4A (Facility PB-3)	334,000 gpd	$28.4 million
4A (Facility HR-12)	828,000 gpd	$53.2 million
4A Total	**1,162,000 gpd**	**$81.6 million**
5A (Chatham Facility Expansion)	306,000 gpd	$ 9.2 million
5A (Facility HR-12)	834,000 gpd	$53.4 million
5A Total	**1,140,000 gpd**	**$62.6 million (1)**

(1) – Includes $2.0 million for infiltration basins to recharge effluent at PB-3

12.10 Estimated Costs for Scenarios 3A, 4A and 5A

This section presents the total estimated costs for construction of the three wastewater alternatives under Scenarios 3A, 4A and 5A evaluated in this section. These estimated costs build on the scenarios that were presented in Section 10 and utilize updated information such as advanced levels of treatment (3 mg/l nitrogen is utilized in the Herring River and for all three options rather 5 mg/L that was considered in Section 10). As stated earlier, these estimates include an allowance for planning level costs (15 percent), and for permitting, engineering and construction services (25 percent).

Table 12-14 presents the capital costs for Scenarios 3A, 4A and 5A that were evaluated in this section.

Table 12-14
Estimated Collection and Treatment System Capital Costs

Option	Scenario 3A	Scenario 4A	Scenario 5A
Collection System	$124,900,000	$137,500,000	$145,900,000
Treatment System	$65,400,000	$81,600,000	$62,600,000
Total (rounded)	***$190 Million***	***$219 Million***	***$209 Million***
Homeowner Hookup Cost	*$19.0 Million*	*$18.9 Million*	*$18.5 Million*

Table 12-15 presents the O&M costs for options 3A, 4A and 5A that were evaluated in this section.

Table 12-15
Estimated Collection and Treatment System O&M Annual Costs

Option	Scenario 3A	Scenario 4A	Scenario 5A
Collection System Public O&M	$845,000	$868,000	$898,000
Collection System Private O&M	$141,000	$123,000	$119,000
Collection System Total O&M	$986,000	$991,000	$1,017,000
Treatment System Total O&M	$2,100,000	$2,680,000	$1,950,000
Total (rounded)	**$3.1 Million**	**$3.7 Million**	**$3.0 Million**

In Table 12-16, the estimated total capital cost of each option is presented along with the estimated total O&M cost for each option. For comparison, an Equivalent Annual Cost (EAC) is presented. The equivalent annual cost assumes that the capital cost is based on a 20 year loan with a 2% interest rate that assumes the State Revolving Fund (SRF) is the funding mechanism for the project.

Table 12-16
Estimated Collection and Treatment System Capital and O&M Annualized Costs

Option	Scenario 3A	Scenario 4A	Scenario 5A
Collection and Treatment Capital Costs	$190 Million	$219 Million	$209 Million
Equivalent Annual Capital Cost	*$11.7 Million*	*$13.4 Million*	*$12.7 Million*
Collection and Treatment O&M Cost	*$3.1 Million*	*$3.7 Million*	*$3.0 Million*
Total Equivalent Annual Cost	***$14.7 Million***	***$17.1 Million***	***$15.7 Million***

Scenario 4A is the most costly option because it requires the construction of two new treatment facilities and requires additional sewering in the Pleasant Bay. Scenario 4A is about 16 percent more than the cost of 3A, which realizes a cost savings due to an economy of scale utilizing one treatment facility. Scenario 5A is about nine percent less costly than 4A because it utilizes the existing Chatham Water Pollution Control Facility. Options 3A and 5A can both be considered equivalent costs at this planning level since they are within seven percent of each other.

To select between Scenarios 3A and 5A, the town weighed the pros and cons of several non-cost factors that are characteristic of these two scenarios. As a result, Scenario 5A appeared to have several benefits since it utilizes an existing facility and spreads out the effluent recharge into at least two watersheds. It also offers an opportunity for both Chatham and Harwich to implement a regional solution and share operations at the treatment works. Most importantly, Scenario 5A allows for easier phasing with delayed capital costs and reduces the overall size of the treatment facilities in Harwich.

Discussions to date between Chatham and Harwich representatives about implementing Scenario 5A have been positive and there are clearly additional benefits to both communities. The existing Chatham WPCF is constructed to treat a capacity of 1.3 mgd and is permitted for 1.0 mgd. The facility currently receives less than 0.2 mgd. It will take several years of sewer construction for Chatham to reach the permitted flow. Thus, accepting Harwich flow now will help improve facility efficiencies and spread the costs across more users. The expansion costs to Harwich can be pushed off for a few years. Similarly, Harwich effluent can be recharged at the Chatham WPCF during these initial years which may assist Chatham in addressing long term recharge capacity permit issues. Ultimately, Chatham is looking for 1.9 mgd of treatment and recharge capacity. So, while Scenario 5A was evaluated with Harwich paying for the expansion and recharging the effluent back into Pleasant Bay watershed, the initial capital costs associated with portions of these components could be delayed. Both communities are continuing to pursue a formal inter-municipal agreement for this scenario with general payment options being considered.

Section 13

Recommended Program

13.1 Introduction

The Town of Harwich's recommended wastewater program has sewered components but the core system includes a collection and conveyance system utilizing two centralized treatment facilities. Each of these components would be phased in over 40 years. The initial treatment option utilizes the existing facility in Chatham and the later option a new facility constructed in Harwich. The implementation of such a program will allow Harwich to meet its water resource management needs as defined throughout this report, including consistency with the MEP nitrogen reduction goals as well as the protection of freshwater resources including ponds and drinking water resources. This section describes the recommended program components for the collection and conveyance systems, wastewater treatment, and effluent recharge. It also presents a wastewater phasing plan for implementation. The recommended non-infrastructure program components which include fertilizer and stormwater management programs, potential land use changes, open space aqusition, and several community involved conservation and pollution reduction programs.

This section summarizes the final Comprehensive Wastewater Management Plan (CWMP)/Single Environmental Impact Report (SEIR) recommended program, includes a plan for an adaptive management strategy to meet and adjust to MEP goals, and provides a description of alternatives to this plan that were evaluated. The sections which follow describe the proposed cost recovery strategy and environmental impacts and mitigation associated with this proposed recommended program.

13.2 CWMP Recommended Program to Meet TMDL Requirements, Traditional Resource Management Needs, Other Town Needs, and 208 Plan Requirements

The CWMP Recommended Program is a comprehensive plan designed to address nitrogen loading to the local embayments along with other related issues such as drinking water supply protection, growth management and support of local planning and development initiatives. This program is proposed for implementation over a 40 year period due to the significant costs of the program.

In Section 10, eight collection and treatment scenarios (1A to 8A) were evaluated for their applicability in Harwich based on the current and future community development and the Total Maximum Daily Loads (TMDLs) for nitrogen in each of the five embayments. These evaluations considered a broad range of scenarios and screened them to three scenarios (3A, 4A and 5A) for further detailed evaluation. Section 12 provided that evaluation and considered the additional details for each scenario. It identified the most appropriate collection system and treatment technology and recommended a collection and treatment system that was used to develop planning level costs. Scenario 5A was ultimately recommended as the preferred scenario because it allows for multiple effluent recharge sites in different watersheds, allows for easier phasing with adaptive management, presents a regional solution between the Towns of Harwich and Chatham (and potentially Dennis in the future), and reduces the overall size of the facilities in Harwich. It also allows infrastructure components to be implemented, results monitored and the later program phases adapted as needed.

Highlights of Scenario 5A:

- Meets MEP and TMDL nitrogen reduction thresholds;
- Allows for effluent recharge sites in multiple watersheds (Herring River and Pleasant Bay);
- Provides a phasing plan that utilizes an existing treatment facility;
- Presents a regional solution between Harwich and Chatham;
- Supports desired smart economic development; and
- Reduces the size of new facilities in Harwich.

In addition to meeting existing needs, the recommended program allows for desired higher density development in the East Harwich Village Center, Harwich Center and Harwich Port areas and recommends continued maintenance of Title 5 systems in several areas of town including the areas north of Route 6 and east of the Saquatucket Harbor watershed. Each of these items is described in detail herein.

13.2.1 Recommended Sewer System Master Plan

The recommended sewer system master plan is shown on Figure 13-1. It provides a town-wide perspective of the areas recommended for sewering. Figure 13-2 shows the amount of septic system nitrogen required to be removed to meet the proposed TMDL in each watershed which is achieved by the recommended master plan. Figure 13-3 shows the phasing plan recommended for implementing the overall program.

The recommended plan provides collection and conveyance, treatment, and effluent recharge for about 1.26 mgd of annual average daily flow of wastewater from the MEP watersheds and other selected portions of Harwich. This is a future flow projection developed from the buildout analysis in the MEP models with assistance and updates from the Harwich Planning Department. The buildout flow is projected to be about a 25 percent increase over the current wastewater flow.

13.2.1.1 Scenario 5A with Additional Wastewater Collection Areas

The recommended plan utilizes Scenario 5A which includes sewer collection areas in the MEP watersheds of Allen, Wychmere and Saquatucket Harbors, Pleasant Bay, and the Herring River plus it includes some other wastewater needs areas located outside of MEP studied watersheds. Thus, this plan modifies the Scenario 5A plan evaluated in Section 12 by including updates to the existing MEP buildout estimates for the East Harwich Village Center in Pleasant Bay, the Route 28 corridor including the Harwich Port area, the Great Sand Lakes area and the campground area. Each of these modifications is described below in more detail.

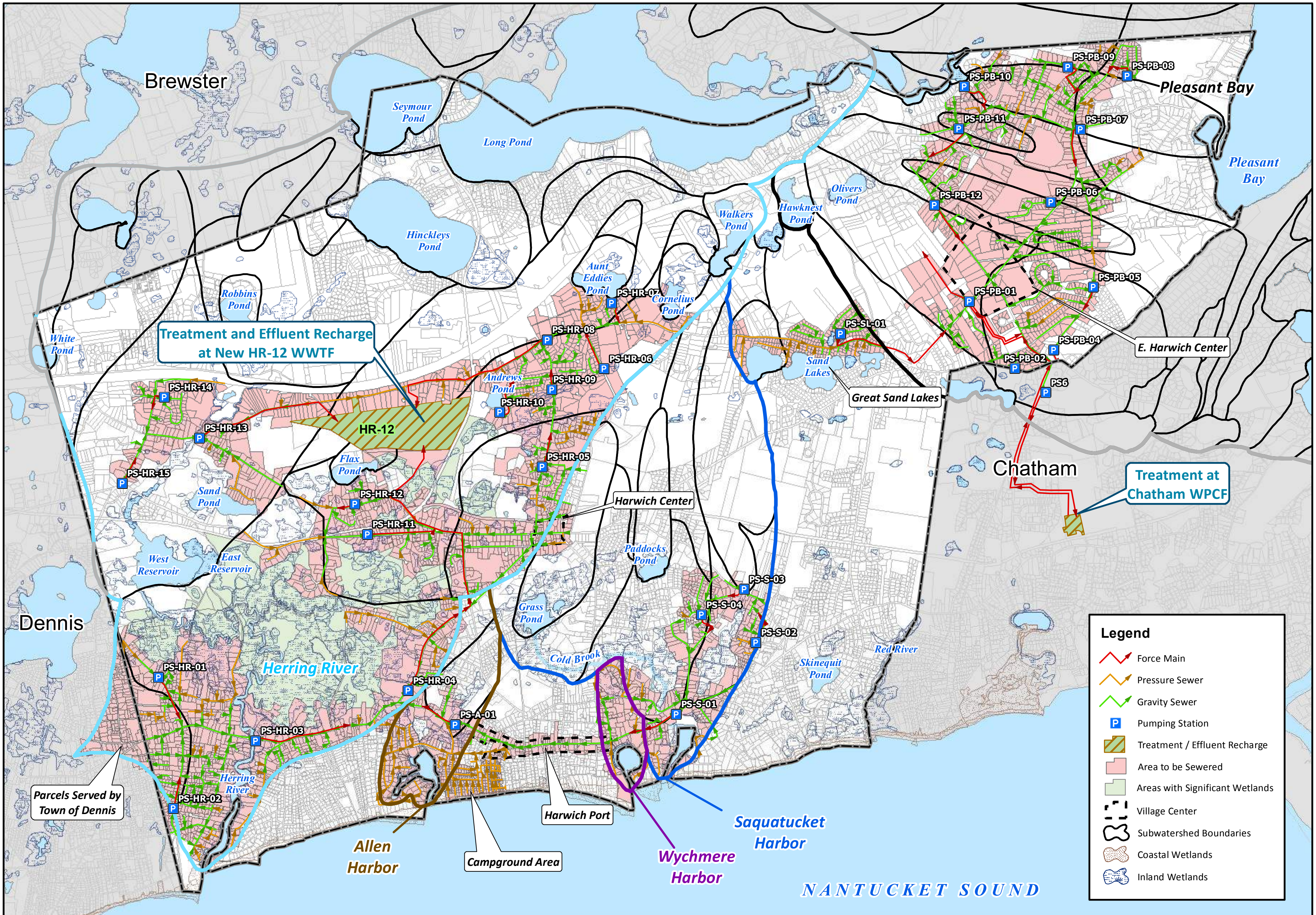
East Harwich Village Center (EHVC)

The East Harwich Village Center is already targeted for sewering under Scenario 5A, but the projected buildout wastewater flow determined for the MEP in this area does not account for the higher density village center planning concept. While the MEP included some additional flow for this area at buildout, it was not sufficient the Town has been considering for this area to accommodate the concepts for planned redevelopment of the EHVC.

The draft CWMP included an additional flow allowance for planning purposes in the EHVC. Wastewater flow generated from an additional 250 residential housing units and 500,000 square feet of commercial space was included for planning purposes in the final estimate of wastewater flow. That amounted to an additional 55,000 gallons per day of wastewater flow at buildout. Each of the 250 units was estimated to contribute approximately 150 gallons per day of wastewater flow to the system. The commercial space was expected to contribute 35 gallons per 1,000 square feet of commercial space based on existing Pleasant Bay MEP data.

Several comments were received during review of the draft CWMP indicating that the increased residential and commercial space estimates were too high and that using the Pleasant Bay commercial wastewater estimate was artificially low. The WIC consulted with the Harwich planning department and others in town to determine whether those estimates should be revised. Zoning revisions in the EHVC or Pleasant Bay do not appear to be forthcoming anytime soon.

In January, 2016 the planning department recommended the following revised growth projections be utilized for generating a wastewater flow allowance. An additional 200 residential units will be included at 150 gpd of wastewater per unit (90 percent of watershed average of 165 gpd/unit water use, Table 7-6) or about 30,000 gpd. Additional commercial space of 250,000 square feet of 100 gpd per 1,000 square feet of wastewater (about half the values of other Harwich watersheds) or about 25,000 gpd. Combining these revised estimates result in about the same wastewater allowance for planning purposes and so original flow projections will be maintained.



Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 13-1
Recommended Areas to be Sewered

CDM Smith

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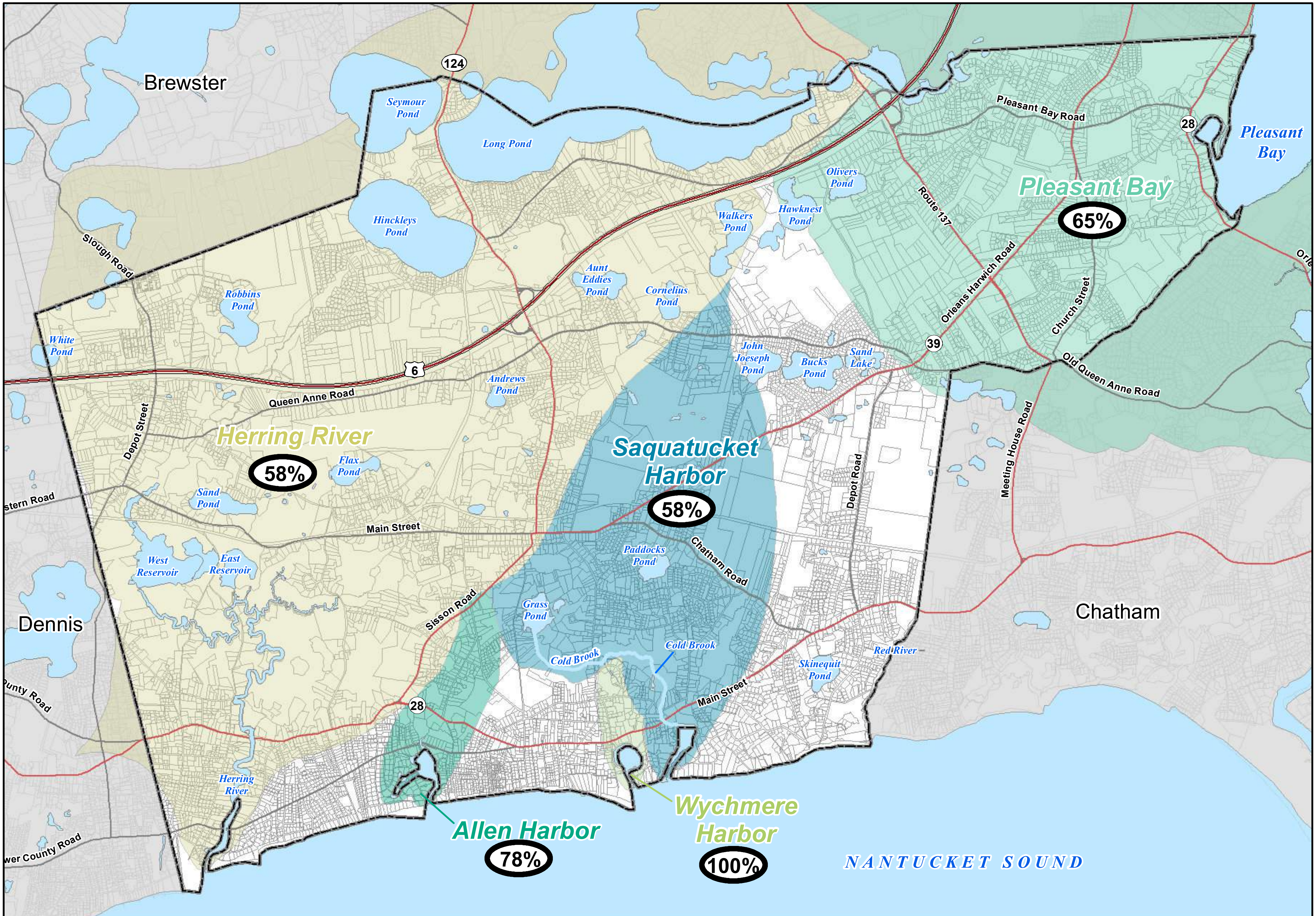

Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 13-2
Watershed Septic Load Reductions

CDM Smith

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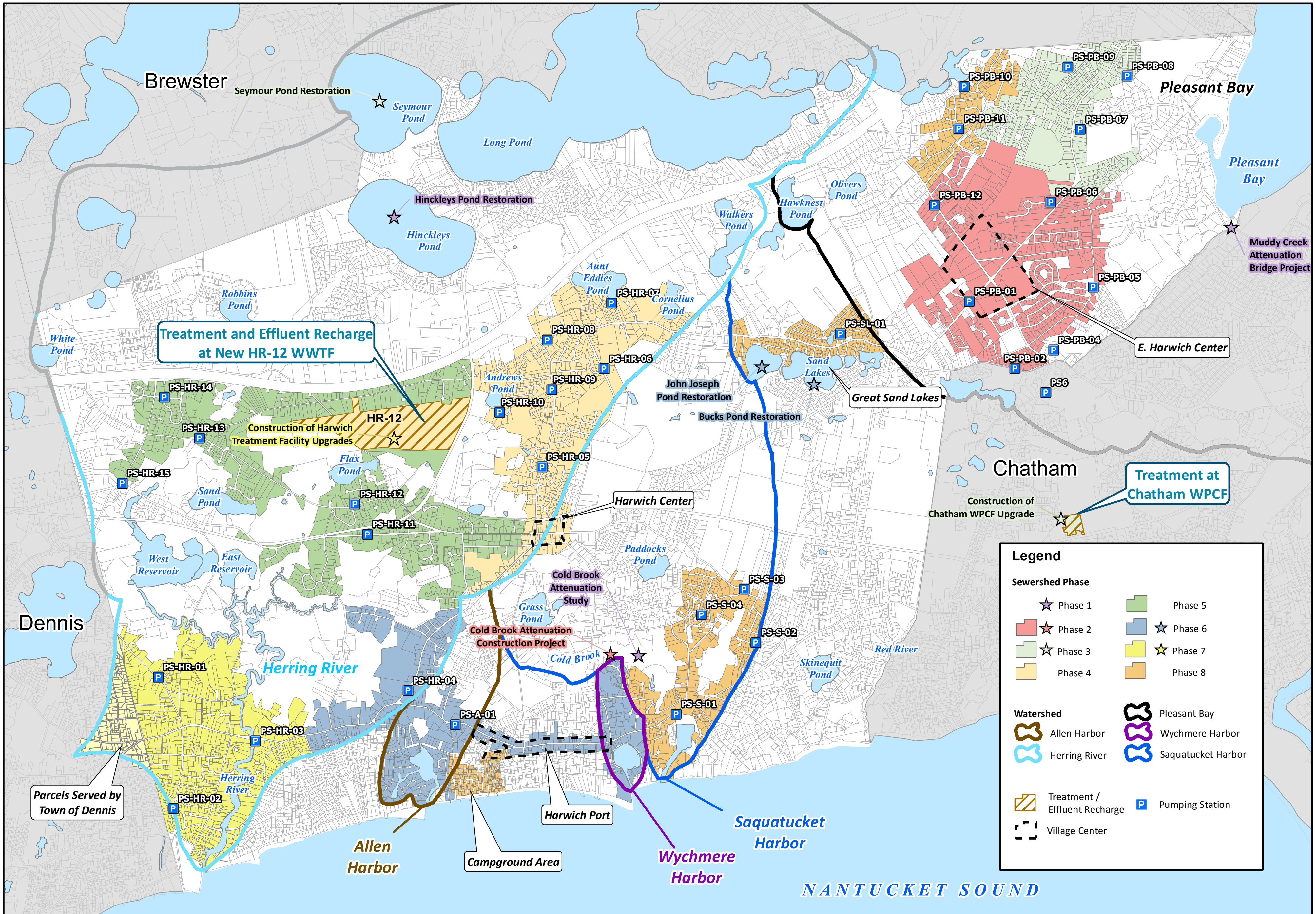

Sewer Service Area by Phase

1 inch = 4,000 feet

Figure 13-3
Recommended Phasing Plan

CDM Smith

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Route 28 (Including Harwich Port)

Similar to The East Harwich Village Center, a significant portion of Route 28 is already proposed for sewering under Scenario 5A. The future flow for this area, as determined by the Harwich Planning Department, indicates that the Route 28 corridor from Saquatucket Harbor to the Dennis town line is likely to experience a 20 to 25% increase in flow at buildout conditions. Similarly, higher density development is being considered for the Harwich Port Village area and in order to make that viable, sewers would be needed. Pipelines would be installed in that area anyway in order to connect the Wychmere Harbor area to the east over to the Allen Harbor area to the west. Thus, for planning purposes a 25% increase in flow along Route 28 in the MEP watersheds and the Harwich Port area have been included in the recommended plan.

Great Sand Lakes Area

The Great Sand Lakes area is not part of MEP studied watershed. The recommended plan includes this area as a way to protect Bucks Pond and John Joseph Pond as discussed in the pond management alternatives in Section 5 of this CWMP/SEIR. The upgradient areas of these ponds are densely developed, creating the potential for phosphorus to leach from the septic systems into the freshwater ponds resulting in degraded water quality. Because of the dense existing development in this area, only a 5% increase above existing flow has been carried for buildout conditions for the Great Sand Lakes area.

Campground Area

The Campground area also is not part of MEP studied watershed. The recommended plan includes this area as a way to deal with significant Title 5 issues that are frequently encountered as a result of the high groundwater and small lots in this area as discussed earlier in Section 8. As a result, the Harwich Health Department has had to issue several Title 5 waivers in this area to accommodate the existing development. By sewering this area, the Title 5 septic system waiver issues will be eliminated. Because of the dense existing development in this area, only a 5% increase above existing flow has been carried for buildout conditions for the Campground area.

13.2.2 Neighboring Towns with Shared MEP Watersheds

Harwich shares MEP watersheds with the Towns of Dennis, Brewster and Chatham. All share some responsibility for nitrogen inputs to either the Herring River and/or the Pleasant Bay embayment systems. Because of this, nitrogen management must be shouldered by all parties who contribute to the problem. In many cases it is considered inefficient for each town to separately manage its individual contribution of nitrogen to the impaired embayment. Typically, it is more efficient for the communities to work regionally to address the nitrogen issue within a given watershed. Brewster, as an example, shares the Herring River watershed with Harwich and is responsible for approximately 15% of the buildout septic nitrogen load in that watershed. Since the Herring River watershed within Brewster's town boundaries is located in a less developed part of Brewster, it is likely less efficient (from a wastewater collection and treatment perspective) to manage wastewater generated there than in the more densely developed areas of the Herring River watershed in Harwich. As an alternative for wastewater management, the Town of Brewster may want to partner with Harwich on the operation of their collection and treatment facilities to determine a solution that will benefit both towns and achieve regulatory compliance. Several solutions should be evaluated that may include nitrogen trading (if possible), one time infrastructure payments, long term nitrogen management payments or possible inter-municipal connections that convey wastewater and treated effluent across town lines for treatment and recharge at different locations.

The list below details how the Towns of Dennis, Brewster, and Chatham have been addressed within the context of the Harwich recommended plan and how it relates to the overall program. It is important to note that the Town has already initiated conversations with its neighboring communities to discuss wastewater management, but no formal agreements have been established at this time. While the recommended plan presented in this section addresses how to achieve the TMDL limits in the embayments of the Allen, Wychmere, and Saquatucket Harbors, Pleasant Bay, and Herring River, it does not completely address how each town will address its share of the responsibility. Those issues will be formalized at a later date.

Brewster

Brewster shares a portion of the Herring River and Pleasant Bay watersheds with Harwich. The recommended wastewater plan presented herein assumes that the Town of Brewster will not initiate any wastewater infrastructure management in the Herring River watershed. It also assumes that Brewster will address their own nitrogen load contribution to Pleasant Bay via a wastewater infrastructure management plan within their town boundaries. Since Brewster is currently developing their wastewater management strategy, these assumptions may change and will be verified as their master plan is further developed.

Dennis

Dennis shares a small portion of the Herring River watershed with the Town. The recommended plan presented herein assumes that the Town of Dennis will collect wastewater in their densely developed area and will recharge the treated effluent in a watershed outside of the Herring River watershed. Similar to Brewster, the Town of Dennis is also developing a wastewater management plan and this assumption will be verified as their wastewater program is developed.

Dennis and Harwich have had come preliminary communications about regional solutions. For example, instead of constructing a wastewater treatment plant at HR-12, Harwich may send their wastewater to a facility in Dennis with effluent returned to Harwich. Discussions will continue over the next few years.

Chatham

Chatham shares a significant portion of the two Pleasant Bay sub-embayments (Upper Muddy Creek and Lower Muddy Creek) with the Town. The recommended program presented herein assumes that the Town of Chatham will initiate wastewater collection and treatment for the septic load that is generated within the Pleasant Bay watershed. This assumption reflects the wastewater master plan presented in the approved Chatham CWMP. The two towns are already working regionally on widening the Muddy Creek bridge opening for habitat restoration and improved flushing and are in negotiations about using the recently upgraded and expanded Chatham wastewater treatment facility as part of the Harwich recommended plan.

13.2.3 Recommended Collection System Technology

As discussed in detail in Section 12, the recommended wastewater collection system for the Town is a hybrid system utilizing gravity sewers supplemented with pumping stations at low points and low pressure sewers in small areas. In this system, gravity collection would be utilized as much as possible to decrease the overall cost of conveyance and to best handle the large swing in seasonal and commercial/residential flows. The gravity system will be supplemented with pumping stations and low pressure sewers in the areas where appropriate to help minimize costs. Typically, if an area with low pressure sewers exceeded more than 20 to 25 homes, a gravity system with a small pumping station would instead be utilized. In smaller neighborhoods, with fewer than 20 homes, or at the end of streets where topography drops down, low pressure sewers will be utilized to collect the flow and then discharge into a gravity pipeline.

13.2.4 Recommended Treatment Technology

Harwich

The recommended treatment technology for the Harwich treatment plant to be built at Site HR-12 is a sequencing batch reactor (SBR) process as discussed in detail in Section 12. The SBR option is cost-effective, easily expandable, able to treat to stringent permit limits, and can handle seasonal fluctuations in flows and loads. As the collection system expands and potential future regulations are revised, the option to continue forward with the SBR processes maximizes flexibility. This process allows for the future option of adding more SBRs and operating as an SBR facility, or adding membranes, if required, downstream of the SBRs. This would allow the facility to operate as a hybrid SBR/MBR facility as regulations become stricter and advancements in technology lead to improved treatment options. This process will also allow Harwich to produce an effluent with a total nitrogen level of 3 mg/L and consider reuse options in the future if desired.

It is also recommended that when the initial phase treatment plant is built at Site HR-12, a pilot demonstration project be conducted utilizing a permeable reactive barrier (PRB) around one or more of the infiltration basins. PRBs provide a carbon source for denitrification to take place in the recharged effluent. The resultant nitrogen decrease may allow for a reduction in the size of the proposed Herring River watershed sewer service area.

Chatham

The wastewater treatment facility in Chatham was recently upgraded and expanded as part of their first phase wastewater program. It has a treatment design capacity of 1.3 mgd with the ability to expand to 1.9 mgd, which is the buildout flow needed for Chatham. The Chatham WPCF (Water Pollution Control Facility) utilizes an oxidation ditch treatment process to treat influent wastewater to a total nitrogen level of 3 mg/l. The existing Groundwater Discharge Permit limits the effluent recharged on-site in infiltration basins to 1.0 mgd. Existing flows are less than 0.2 mgd.

13.2.5 Revised System Wide Flows

Buildout wastewater flows were calculated from the MEP model, water use records and input from the Town. The MEP, working with Harwich planning staff, developed a buildout estimate for the Town as part of its nitrogen loading model. The buildout estimate took into account the Town’s planning data, zoning and land use classifications. In areas such as Harwich Port, the East Harwich Village Center, the Route 28 Corridor, and the Campground area the Town updated the buildout estimates as discussed earlier in Section 13.2.1. Those revisions are presented in Table 13-1 below.

Revised Flows in the East Harwich Village Center

In the East Harwich Village Center (EHVC), updates were made to the MEP buildout assumptions. The town is evaluating options to increase development in this area and several options remain under consideration. After discussions with local boards, committees and town staff it was decided for planning purposes to include 200 new residential units and 250,000 square feet of new commercial development *above* the existing MEP buildout estimates.

The MEP buildout estimates are the result of meetings with the Town planning staff that took place in 2006. The MEP staff developed the buildout estimates for the Pleasant Bay watershed based on the existing zoning and the Harwich Planning Department's understanding of potential future development. The MEP report detailing those estimates was then issued (in 2006). Then in 2011, the Town Local Comprehensive Plan was completed and approved by the Town. In the 2011 Local Comprehensive Plan, the EHVC was specifically targeted for zoning revisions that would result in updated buildout projections not found in the 2006 MEP report.

The approval of the Local Comprehensive Plan prompted the development of a new buildout scenario detailing the updated flows in the East Harwich Village Center. These updated buildout flows were endorsed by the Harwich Planning Department in 2012 and are incorporated into the recommended plan.

After discussions with the Planning Department and the Water Quality Management Task Force's Wastewater Management Subcommittee, it was decided to include the buildout flows developed in the Local Comprehensive Plan in addition to the buildout flows developed in the 2006 MEP report. The additional buildout flow allowance of 55,000 gpd is considered appropriate for planning purposes since any zoning revisions for the EHVC are not final at this time. Thus, the projected MEP buildout flow for the sewer service area in the Pleasant Bay of 235,900 gpd was increased by 55,000 gpd up to 290,900 gpd based on 200 additional residential units at about 150 gpd/unit and additional commercial development at 250,000 square feet at the existing 100 gpd/1,000 SF.

Table 13-1 presents the wastewater flows estimated for each area recommended to be sewered under both current and buildout conditions using the best available data. The entire sewer service area is expected to have an initial annual average daily wastewater flow of 0.86 MGD and a buildout annual average daily wastewater flow of 1.08 MGD. The resultant total wastewater flow including I/I is 0.97 mgd (0.86 + 0.11 mgd) for current annual average daily flow and 1.26 mgd (1.08 + 0.18 mgd) for buildout annual average daily flow. In the buildout scenario, the I/I for the Pleasant Bay area was not significantly increased because of the potential increased use of pressure sewers planned for this area.

Compared with Scenario 5A presented in Section 12, the recommended plan increases the buildout wastewater flow by about 150,000 gpd which represents a 16% increase in wastewater flow. The percent growth or buildout is shown in the table for each individual watershed or additional sewer service area. The overall buildout percent is about 26% or 220,000 gpd in wastewater.

The number of parcels in Table 13-1 presents the number of lots, by watershed, served by the wastewater collection and treatment system in the recommended plan. These lots were selected from a town GIS layer developed in 2006. It is the same GIS layer that was utilized in all of the Harwich MEP reports. Although some changes such as subdivisions have likely occurred between 2006 and 2012, the lots presented in the recommended plan are very similar to the map and lot database maintained by the Harwich Assessor's office.

Table 13-1
Recommended Plan Wastewater Flows (Scenario 5A with Additional Areas and Build-out Update)

Watershed	Number of Parcels	Percent Growth	Current Annual Average Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Build-out Annual Average Wastewater Use (GPD)	Build-out Average Estimated I/I Flow (GPD)
Allen Harbor	234	9.4	52,100	2,250	57,000	4,500
Wychmere Harbor	123	10.3	26,300	1450	29,000	2,900
Saquatucket Harbor	415	5.0	90,700	9,000	95,200	18,000
Pleasant Bay	1,205	41.3	205,900	34,900	290,900	35,000
Herring River	2,340	29.2	399,300	56,000	515,700	112,000
Route 28 (Harwich Port) – Outside MEP Watersheds	93	24.3	20,600	*800*	25,600	*1600*
Great Sand Lakes Area	269	3.3	32,900	*800*	34,000	*1600*
Campground Area	267	3.1	32,000	*800*	33,000	*1600*
Total (Rounded)	***4,950***	***26***	***860,000***	***110,000***	***1,080,000***	***180,000***

When the MEP developed buildout projections, it estimated future flows for each parcel but did not change the number of parcels in their GIS layer. As a result, the number of parcels in the recommended plan presented in this section is the same under both present day and buildout conditions. Therefore, while the MEP did not develop subdivision lots in its buildout estimates, several are expected which will change the total number of parcels in the buildout service areas. The associated flows and loads have, however, been accounted for in the MEP buildout flow and load totals.

13.2.6 Treatment Facility Flows and Nitrogen Limits

To develop the flows for the HR-12 treatment facility to be located in the Herring River watershed, peaking factors were applied to the anticipated annual average daily wastewater flows. The ratio of summer (June, July and August) to annual average daily flow was determined to be 1.91 from monthly well pumping records. To evaluate low flows, the ratio of winter to annual average daily flow was determined to be 0.52. Table 13-2 shows the design flows for the Harwich wastewater treatment facility at buildout. The buildout annual average daily flow to be treated is approximately 0.90 mgd, which is the 1.26 mgd minus the flow sent to Chatham from the Pleasant Bay and Great Sand Lakes areas (or about 0.36 mgd). The design flows for the Chatham WPCF are not presented here because that facility has adequate capacity at this time and any required upgrades are not anticipated for several years.

Table 13-2
HR-12 Facility Estimated Design Flows at Build-out

Flow Scenario	HR-12 WWTF at Build-out
Average Day Total Wastewater (MGD)	0.90
Peak Hour Flow (MGD)	5.34
Maximum Day Flow (MGD)	3.32
Summer Average Flow (MGD)	1.59
Winter Average Flow (MGD)	0.53

The Harwich wastewater treatment facility will be constructed in two phases as discussed in Section 13.4. The first phase of the facility will be designed to accommodate a flow smaller than the buildout flow and will need to be expanded in a later phase.

As described later in this section, Phase 1 of the recommended program does not involve any wastewater collection or treatment, and Phases 2 and 3 will utilize the Chatham WPCF. The initial HR-12 treatment facility in Harwich will be constructed in Phase 4 and will allow the Town to construct phases 4 through 6 of the wastewater collection system. An expansion will be needed at the Harwich facility to bring Phases 7 and 8 online. The annual average flow to the fully expanded HR-12 treatment facility is approximately 900,000 gpd (1.26 mgd minus flow to Chatham) and will serve about 3,500 parcels (see Figure 13-1).

As discussed earlier, the MEP reports and the recommended program indicate that the effluent recharge for the Herring River and Pleasant Bay watersheds must be treated to a total nitrogen concentration of 3 mg/l to minimize the extent of the wastewater collection system. As a result, the final treatment facilities will be designed with a 3 mg/l limit for total nitrogen. At HR-12, this will equate to 54,344 lbs/yr (24,650 kg/yr) of nitrogen removed from the areas tributary to that facility and will result in an ultimate discharge of 6,899 lb/year of total nitrogen (3,129 kg/year) that will be recharged to the HR-12 site in the Herring River watershed (0.76 mgd X 3 mg/l X 8.34 = 18.9 lbs/day). Addition of a PRB may help to further reduce the nitrogen load at this site.

At PB-3 or another Pleasant Bay watershed recharge site, the recommended program will equate to 23,370 lbs/yr (10,600 kg/yr) of nitrogen removed from the areas tributary to the Chatham facility (Harwich flow only) and will result in an ultimate discharge of 2,967 lb/year of total nitrogen (1,345 kg/year) that will be recharged in the Pleasant Bay watershed (0.32 mgd X 3 mg/l X 8.34 = 8.1 lbs/day).

13.2.6 Ability of Recommended Program to Meet CCC 208 Plan Intent

As discussed in Section 2, The Town of Harwich has reviewed the work performed by the Cape Cod Commission since the final 208 Plan was approved in 2015. Harwich's plan is in line with the 208 Plan since Harwich's approach is based on the MEP nitrogen loading models with the goal of achieving the most efficient sewershed footprint while keeping costs to a minimum. The town of Harwich's wastewater scenarios utilized a hybrid approach similar to that suggested in the 208 Plan, combining both traditional and non-traditional technologies with an iterative process to develop the most cost effective recommended program. This CWMP/SEIR also incorporates an adaptive management strategy, whereby ongoing monitoring and analysis will result in continually revisiting and updating the plan accordingly.

13.3 Updated Capital and O&M Costs

Cost estimates were developed for the final recommended collection and treatment systems, as described below.

13.3.1 Collection System Capital Costs

Cost estimates for the hybrid sewer collection system including piping, pumping stations, and low pressure pumping units are shown in Table 13-3.

Table 13-3
Estimated Collection System Capital Costs

Collection System Capital Costs	Recommended Plan
Number of Parcels Served	4,950
Collection System Cost	$154,400,000
Collection System Cost in Chatham (Harwich Share of System Developed by GHD)	$2,400,000
Total (rounded)	**$156,800,000**
Homeowner Hookup Cost	$21,900,000

The cost for gravity piping includes pipe, manholes, wye connections for each parcel, 6-inch service connections extending an average of 20 feet for each lot (from centerline of the street to the property line), excavation support, state highway construction considerations where applicable (flowable fill, etc.), paving, police details, and some allowances for drainage and mobilization. Paving is assumed to include a 2-inch trench patch and a 1.5-inch full width overlay on all currently paved roads. The cost for individual homeowner hookups (pressure and gravity) is also included, but it is not carried forward in the capital costs. For the homes or businesses with pressure sewers, an additional cost was included for the purchase and installation of a grinder pump. The approximate breakdown is 1,350 parcels at $7,000 per pressure sewer connections and 3,550 parcels at $3,500 per gravity connection. The town may decide to pay for the pressure pump unit which is about half of the $7,000 hook-up cost.

The collection system costs for facilities in Chatham were developed by GHD Consulting Engineers as they planned the system for the Town of Chatham. These costs are for the Harwich share of wastewater pumping stations and pipelines to convey the wastewater from the Harwich/ Chatham line to the wastewater treatment facility. Costs for conveying effluent back to Harwich are included in the collection system costs as detailed in Section 12.

13.3.2 Treatment Facility Capital Costs

The treatment costs are presented below in Table 13-4. Those costs were based on annual average flows but increased to account for the large seasonal flow swings characteristic of a resort community like Harwich. A cost for effluent recharge facilities was included and assumed that open infiltration basins will be utilized for effluent recharge at both Sites HR-12 and PB-3. Site HR-12 is Town owned so only a cost allowance of $250,000 to purchase a site in Pleasant Bay was carried ($25,000 per acre for back land).

Table 13-4
Estimated Treatment Facility Capital Costs

	Recommended Plan
Chatham Treatment Facility Expansion Cost	$9,200,000
HR – 12 and PB-3 Facility Cost	$56,300,000
Total	**$65,500,000**

All of these estimates include an allowance for planning level costs (15 percent), and for permitting, engineering and construction services (25 percent).

GHD Consulting Engineers developed the costs for the Chatham treatment plant expansion to accommodate about 300,000 gpd of flow from Harwich. The final flow value and net costs are still to be confirmed.

13.3.3 Treatment and Collection System Capital Cost Summary

In Table 13-5, the estimated total capital cost for collection and treatment is presented. The project costs presented in this table are from July of 2012 with an Engineering News Record (ENR) index of 9323.

Table 13-5
Estimated Collection and Treatment System Capital Costs

Option	Scenario 5A
Total Collection System Cost (Harwich and Chatham)	$156.8 Million
Total Treatment System Cost (Harwich and Chatham)	$65.5 Million
Total Cost	**$222.3 Million**

13.3.4 Chatham Treatment Facility O&M Costs

O&M costs for conveyance to and treatment at the Chatham WPCF were also determined by Chatham and their engineer, GHD Consulting Engineers, using the planning level costs developed earlier in the Chatham CWMP. Costs developed are shown in Table 13-6. A copy of the technical memorandum detailing the regional connection alternative to Chatham is included in Appendix E.

Table 13-6
Town of Harwich Share of the Collection and Treatment System Costs to connect to the Chatham System

Type	Recommended Plan
Annual O&M Costs	**$ 260,000**

13.3.5 Harwich Collection System O&M Costs

Annual operation and maintenance collection systems costs for the recommended plan under buildout conditions are shown below in Table 13-7. These costs have been divided into system wide costs and a summary of individual user costs that the property owner would normally pay. These costs are for operation of the collection system in Harwich only and do not include operation and maintenance costs associated with the Town's proposed wastewater treatment facilities.

Following the table is an explanation of the basis of the labor, equipment, power and other costs presented in the table.

Table 13-7
Annual Operation and Maintenance Cost Summary for Build-out Conditions

Cost Category	Recommended Plan[1]
Public Costs:	
Labor	$590,000
Power	$168,000
Miscellaneous Costs	$152,000
Total System Wide O&M	**$910,000**
Private User O&M Costs	$170,000

[1]Does not include wastewater treatment charges.

Labor Costs

The average cost for labor including salaries and fringe benefits is approximately $65,000 per employee per year. The recommended plan indicates that Harwich's labor force will include a total of nine people to maintain the fully constructed collection system which includes thirty-four pumping stations at buildout.

Proposed Gravity System

To determine the number of personnel required for the gravity sewer system, the number of miles of sewer and the number of pumping stations was calculated. The proposed gravity system is expected to require a labor force of approximately seven of the nine people mentioned above. These staff will be needed to perform operation and maintenance of thirty-four (34) wastewater pumping stations, and approximately fifty-one (51) miles of gravity sewers.

Proposed Pressure System

The majority of the pressure system maintenance cost is directly borne by the connection owner. The proposed pressure system is expected to require a labor force of approximately two public employees to maintain the system.

Power Costs

Power costs are based on connected horsepower and expected running times of pumps at all of the wastewater pumping stations. Annual costs were calculated for the 34 pumping stations utilizing the gravity sewer option. Operational costs for the pressure sewers were not considered in the power costs because the Town is only responsible for the main pumping stations, and homeowners operate and maintain the grinder pumps.

Miscellaneous Costs

These costs include spare parts, vehicles, fuel and associated maintenance, training expenses and other miscellaneous costs. Since Harwich has no existing sewer budget to review, miscellaneous costs were estimated to represent 20% of the labor and power cost.

Private Costs

Pressure Sewer System

Every household on the pressure system will have an on-site grinder pump that is owned, operated and maintained by the homeowner. The costs include $25/year for power and an allowance to purchase a service contract to maintain the system at $100/year for a total of $125/year per household.

13.3.6 HR-12 Treatment Facility O&M Costs

Estimated annual operation and maintenance costs for the Harwich HR-12 treatment facility is shown below in Table 13-8. These costs were developed based on engineering estimates and a review of a few communities in Eastern Massachusetts. They are also similar to the treatment facility O&M estimates presented in the "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" prepared by the Barnstable County Wastewater Task Force in April 2010.

Table 13-8

Estimated Annual HR-12 Treatment Facility O&M Costs

Item	O&M Cost
No. of Staff	7
Labor	475,000
Benefits	240,000
Maintenance	160,000
Chemicals	110,000
Electricity	450,000
Grit/Sludge Disposal	180,000
Other/Misc	175,000
Total (Rounded)	**$1,800,000**

13.3.7 Treatment and Collection System O&M Costs Summary

Annual operation and maintenance costs for the recommended plan are shown below in Table 13-9. These costs are for operation and maintenance of both the collection and treatment systems associated with the Town's proposed wastewater treatment facilities. These costs represent the estimated annual costs to operate both treatment facilities at 1.26 mgd of annual average daily buildout flow.

Table 13-9
Estimated Collection and Treatment System Annual O&M Costs

Option	Scenario 5A
Treatment System O&M (Chatham Facility)	$260,000
Collection System Public O&M	$910,000
Treatment System O&M (HR-12 Facility)	$1,800,000
Total Town Costs (rounded) (No Private O&M)	**$3.0 Million**

The assumptions used in this estimate for other costs are based on operations and maintenance experience at several similar facilities. A number of factors can affect these budget numbers such as specific town requirements or preferences, outsourcing to private operators, sharing of regional facilities, variations in wastewater quality, and specific treatment goals and guidelines for each individual facility.

13.3.8 Recommended Program Cost Summary

In Table 13-10, the estimated total capital cost is presented along with the estimated total O&M costs. In addition, an Equivalent Annual Cost (EAC) is presented. The equivalent annual cost assumes that the capital cost is based on a 20 year loan with a 2% interest rate that assumes the standard State Revolving Fund (SRF) is the funding mechanism for the project. Some SRF loans are now being done up to 30 year loans, and zero-percent interest financing may also be available for some phases of the project.

The project costs presented in Table 13-10 have been escalated with an Engineering News Record (ENR) index of 9475 to April 2013.

Table 13-10
Estimated Collection and Treatment System and O&M Annual Costs

Option	Scenario 5A
Collection and Treatment Capital Costs	$222.3 Million
Collection and Treatment Capital Costs (Escalated)	$226 Million
Capital Equivalent Annual Cost (EAC)	$13.8 Million
Collection and Treatment O&M Cost	$3.0 Million
Total Equivalent Annual Cost	**$16.8 Million**

Note that this annualized cost implies the entire project is constructed at once, under the same 20-year loan. This, however, is not actually the case, as presented in the phasing plan below.

13.4 Wastewater Phasing Plan

Since the overall wastewater plan in the CWMP cannot be constructed as one project and will take several years to construct, a phasing plan is required. This will ensure that the wastewater plan (which is a combination of several smaller projects) progresses efficiently while meeting the needs of the Town including economic development of town centers, dealing with financial impacts, minimizing traffic impacts, and addressing environmental protection.

13.4.1 Wastewater Phasing Plan Issues

There are several issues that need to be considered in developing the phasing plan for implementing the recommended wastewater program in the Town. The CWMP addresses many of these issues but conditions and priorities will change over the next 40 years that will impact current day decisions. Thus, the phasing plan will need to be constantly monitored and periodically modified as it is implemented via a process known as adaptive management.

Current issues that need to be considered in developing the phasing plan include:

1. Title 5 septic system issues
2. Freshwater ponds water quality
3. Drinking water wells water quality
4. Future growth and economic development potential
5. Regionalization opportunities
6. TMDL (MEP) issues
7. Program Costs

Title 5 Septic System Issues

As discussed in earlier sections (Sections 3 and 8), the Town has relatively good soils throughout for Title 5 subsurface disposal septic systems. With almost all parcels in Town on municipal water, the majority of septic system waivers are for setback requirements due to small lots in specific areas. Thus, only two areas were identified as Title 5 Areas of Concern and they include the area along Route 28 north of Allen Harbor and the Campground area just east of Allen Harbor. As Title 5 is not a main driver for sewering in town, these areas should be planned for sewering when adjacent areas are to be sewered.

Freshwater Ponds Water Quality

As discussed in earlier sections (Sections 5 and 8), there are 63 freshwater ponds and lakes in town. Some of them have been part of a water quality monitoring program for several years while others have little known data. Based on known data there are some areas that should be sewered to remove the phosphorus source from septic systems that is entering the nearby freshwater source. These areas include the Great Sand Lakes area, and potentially areas around Long Pond, Seymour Pond and Paddocks Pond. As data becomes available on other ponds, they may be added to this list. These areas should be considered for sewering when adjacent areas are being addressed. Local solutions may also be considered for higher priority ponds.

Drinking Water Wells Water Quality

As discussed in earlier sections (Sections 4 and 8), the Town overall has excellent water quality in their groundwater wells. The Town over the years has done a good job of protecting lands where their well zones of contribution are located. The only wells that show a slight increase above typical background levels for nitrogen are located in the Pleasant Bay watershed. Those areas should be considered for sewering in earlier phases when the Pleasant Bay watershed is sewered.

Future Growth and Economic Development Potential

As discussed in earlier sections (Sections 2 and 8), the Town is looking to create more of a village center in the East Harwich Commercial Development area and to a lesser degree in Harwich Center and in Harwich Port. This type of planning concept requires higher density development than can be supported by typical Title 5 septic systems and so appropriate infrastructure needs to be installed to support the change along with appropriate changes to zoning and other utilities (traffic, water, etc.). It is likely to take several years for these concepts to evolve and for appropriate development to then occur. Infrastructure improvements are often needed first to allow the development to take advantage of the changes; however, public and private partnerships can be utilized to achieve this purpose. Therefore, it would appear that the timing of when the infrastructure is needed in these areas in order to support the desired development along with when sewers are to be installed in adjacent areas will be the driving forces for when these areas are to be addressed in the phasing plan.

Regionalization Opportunities

As discussed in earlier sections (Sections 10 and 12), the Town has an opportunity to partner with the Town of Chatham by utilizing the Chatham Water Pollution Control Facility for treatment of collected wastewater from the Pleasant Bay area in Harwich. There are many details to work out in terms of phasing the use of the Chatham facility which has recently been upgraded and expanded as part of Chatham's wastewater program. Expansion may not need to occur immediately depending on how soon flows from Chatham and Harwich are developed and the return effluent pumping station may be delayed with interim use of recharge capacity in Chatham. At some point in the future, effluent recharge for the Harwich flow is expected to occur back in Pleasant Bay with construction of a pumping station to convey the highly treated effluent flow back to a site that has yet to be selected.

The two towns are also working cooperatively to implement the increased flushing of Muddy Creek via widening the existing inlet to 24-ft. Construction of this project is expected to be completed in Summer 2016. Both of these programs will help address the wastewater issues in Pleasant Bay.

Harwich has recently (March 2016) had preliminary communications with Dennis about potentially constructing a joint treatment facility at the Dennis Department of Public Works (DPW). This concept may have cost benefits to both communities. This option, for Harwich, would replace the proposed treatment plant at HW-12.

Total Maximum Daily Loads (TMDLs) from the Massachusetts Estuaries Project (MEP) issues

The MEP reports for the five watersheds defined in Harwich established the basis for how much nitrogen can be safely discharged to the estuaries and still maintain a healthy environment. The newly issued TMDLs require significant nitrogen removal in order to be attained as discussed in earlier sections (Sections 6 and 8). Ultimately, those TMDLs will become watershed permits enforced by appropriate regulatory agencies in which the Town will need to take action to meet those load limits. This phasing plan will need to take that into account even though at this time there is no mandatory timeline that has been issued. Therefore, it is in the Town's best interest to propose a timeline that meets their various needs but also focuses on meeting the nitrogen removal requirements within the watersheds. Thus, meeting the TMDLs is a significant driver in defining the phasing plan. The Allen, Wychmere, and Saquatucket Harbor watersheds require the highest percentage of nitrogen removal within their watersheds (70 to 100%) even though these watersheds are smaller than the other two. However, proposed effluent recharge, which has some nitrogen loading attached to it, needs to be addressed as well since the two recharge sites are located in the Pleasant Bay and Herring River watersheds. Therefore, an appropriate amount of sewering needs to take place in any watershed where recharge is to occur in order to maintain a no net increase in nitrogen balance within that watershed.

Program Costs

As discussed above, the collection and treatment cost is estimated to be about $225 million (ENR 9475) plus an additional $5 million for natural attenuation and pond restoration projects. This is a significant program for the Town to undertake. Thus, it needs to be implemented over many years so that as other municipally bonded projects are paid off, this program can move forward in a way that tries to minimize the financial impact and make it afforable. The number of phases proposed to implement the program must be weighed versus the need to meet the TMDLs. Initially an eight phase program for implementation is proposed with each phase being approximately five years in duration, averaging $32 million per phase (Phases 2 through 8). The cost per phase will vary depending on the specific infrastructure being built. The ultimate number of phases and timeline is likely to vary as well, as adaptive management is likely to result in adjustments to the later phases.

In summary, the program costs and attaining the TMDLs are considered to be the most important factors in developing the phasing plan for the wastewater program. Figure 13-2 shows the amount of septic system nitrogen required to be removed from each of the MEP watersheds as discussed earlier in Section 6. To receive regulatory approval the CWMP must present a wastewater program that conforms to the TMDLs. To receive local community approval the program costs must be deemed to be affordable. Providing infrastructure to assist with desired development and acting in a timely and coordinated manner to take advantage of regionalization are next in importance. Addressing Title 5 issues, freshwater pond issues and drinking water well issues are important but are not key drivers in developing the overall phasing plan.

13.4.2 Wastewater Phasing Program by Phase

Based on the above discussion the proposed phasing program is shown in Figures 13-3 and 13-4. Figure 13-3 shows the areas to be sewered by phase while Figure 13-4 shows the phased areas with the buildout or growth areas highlighted to indicate where growth is projected to occur. Details of the proposed phasing program are described below:

Phase 1

The focus of this phase will be to implement the two natural nitrogen attenuation programs. The first is the Muddy Creek bridge project which will increase the existing opening to 24-ft width. The inlet widening will increase the flushing in Muddy Creek and will help restore the ecological habitat. Harwich and Chatham funded this program and obtained several grants to help pay for construction. Project completion is expected in summer 2016. The second program is the evaluation of options to improve the natural attenuation in the Cold Brook former cranberry bog network off Bank Street. The goal is to increase the natural nitrogen attenuation from the existing 35% to 50% by adding ponds where denitrification can occur. Harwich funded this program in Fiscal Year (FY) 15 and FY16 with study results expected in June 2016. The recommended plan developed in the study phase would be designed and constructed in Phase 2. Both of these projects will allow the Town to monitor and confirm water quality improvements in these watersheds and to adjust future programs as needed. The Town also sought to purchase a 21 acre parcel at site PB-3 for an effluent recharge facility but local neighborhood opposition defeated the purchase. Other sites in the Pleasant Bay watershed are now under consideration. Implementation of the Hinckleys Pond restoration project has not yet received funding.

Phase 2

The focus of this phase will be to design and install sewers in the Pleasant Bay watershed since this is the largest watershed with the highest percentage of septic system nitrogen removal required. This also allows the Town to work with Chatham, utilize a regional approach to wastewater treatment and recharge, and to provide further protection to some of the Harwich drinking water supply wells. Phase 2 also provides sewer service to the East Harwich Village Commercial District or East Harwich Village Center and surrounding areas to accommodate potential higher density development. Sewering these areas removes significant nitrogen towards meeting the Pleasant Bay TMDL. Delaying Pleasant Bay sewer construction in this area until this phase also helps avoid time restrictions on the recent roadway improvements done on state road Route 137. Collected wastewater will be pumped to the Chatham WPCF for treatment. Negotiations are ongoing but it appears Harwich would purchase treatment capacity in the newly upgraded Chatham facility. Effluent initially can be recharged at the Chatham facility site for a few years but ultimately may require an effluent pumping station to be constructed for pumping it back to Harwich for recharge at a site in the Pleasant Bay watershed. The recommended plan for the Cold Brook natural attenuation would also be implemented in this phase.

Phase 3

The focus of this phase will also be the Pleasant Bay watershed to install additional sewers in the area north of the Harwich Village Commercial District. A portion of the collection system area on the west side of the Pleasant Bay watershed will be delayed until Phase 8 to allow for water quality monitoring and evaluation of the impacts from sewering and the Muddy Creek bridge project. This delay will help to ensure that the extent of the wastewater collection is not over reaching, with respect to the TMDL compliance. This phase may also see the implementation of the potential Seymour Pond restoration project.

Phase 4

This phase will be done as two programs. Overall the phase will collect wastewater in the Northeast part of the Herring River watershed. The collected wastewater will be pumped to the new treatment plant to be constructed at Site HR-12 (landfill site) where the treated effluent would be recharged. The SBR treatment plant would initially be constructed for a capacity of about 0.45mgd which would treat collected flows from Phases 4, 5 and 6.

Phase 4A will include the construction of the HR-12 treatment plant. This facility must be constructed and ready to receive wastewater before sewers can be connected in the Herring River watershed.

Phase 4B will include the construction of the sewers in the Herring River watershed as described above.

Ongoing regional discussions with Dennis would have concluded by this time and instead of constructing a treatment plant at site HR-12, Harwich may convey collected wastewater to a shared facility located in Dennis. If this option is selected then the sequence of the next phases may be revised.

Phase 5

This phase will collect wastewater in the Northwest part of the Herring River watershed and near Site HR-12. The collected wastewater will be pumped to the treatment plant at Site HR-12 where the treated effluent would be recharged.

Phase 6

This phase will collect wastewater in the Southeast part of the Herring River watershed. This phase will also install some of the planned sewers in the Allen and Wychmere Harbor watersheds in order to begin meeting the TMDLs in those areas. Collected wastewater will be pumped to the HR-12 site for treatment and recharge. The extent of the collection system constructed in this phase will be coordinated based on the capacity of the existing facility and its ability to accept additional wastewater flow from the homes and businesses served. This phase may also include implementation of the potential Bucks and John Joseph Pond restoration projects.

Phase 7

The focus of this phase will be to expand the HR-12 treatment plant and install the remaining required sewers in the Herring River watershed to meet the TMDL. The treatment plant at Site HR-12 will be expanded to the full 0.9 mgd capacity in this phase. Collected wastewater flows from the southwest area of the Herring River watershed will be pumped to the treatment and effluent recharge facility at Site HR-12.

Phase 8

The focus of this phase will be to install sewers in the Saquatucket Harbor watershed and the remaining areas of the Pleasant Bay watershed required to meet those TMDLs. Areas to be sewered near the Great Sand Lakes and the Campground area will also be included in this phase. Collected wastewater from the Pleasant Bay area will be added to the flows pumped to the Chatham wastewater treatment facility and effluent recharged in Chatham or pumped back to Harwich for recharge as needed. Wastewater collected from the areas outside of the Pleasant Bay watershed will be treated and recharged at HR-12.

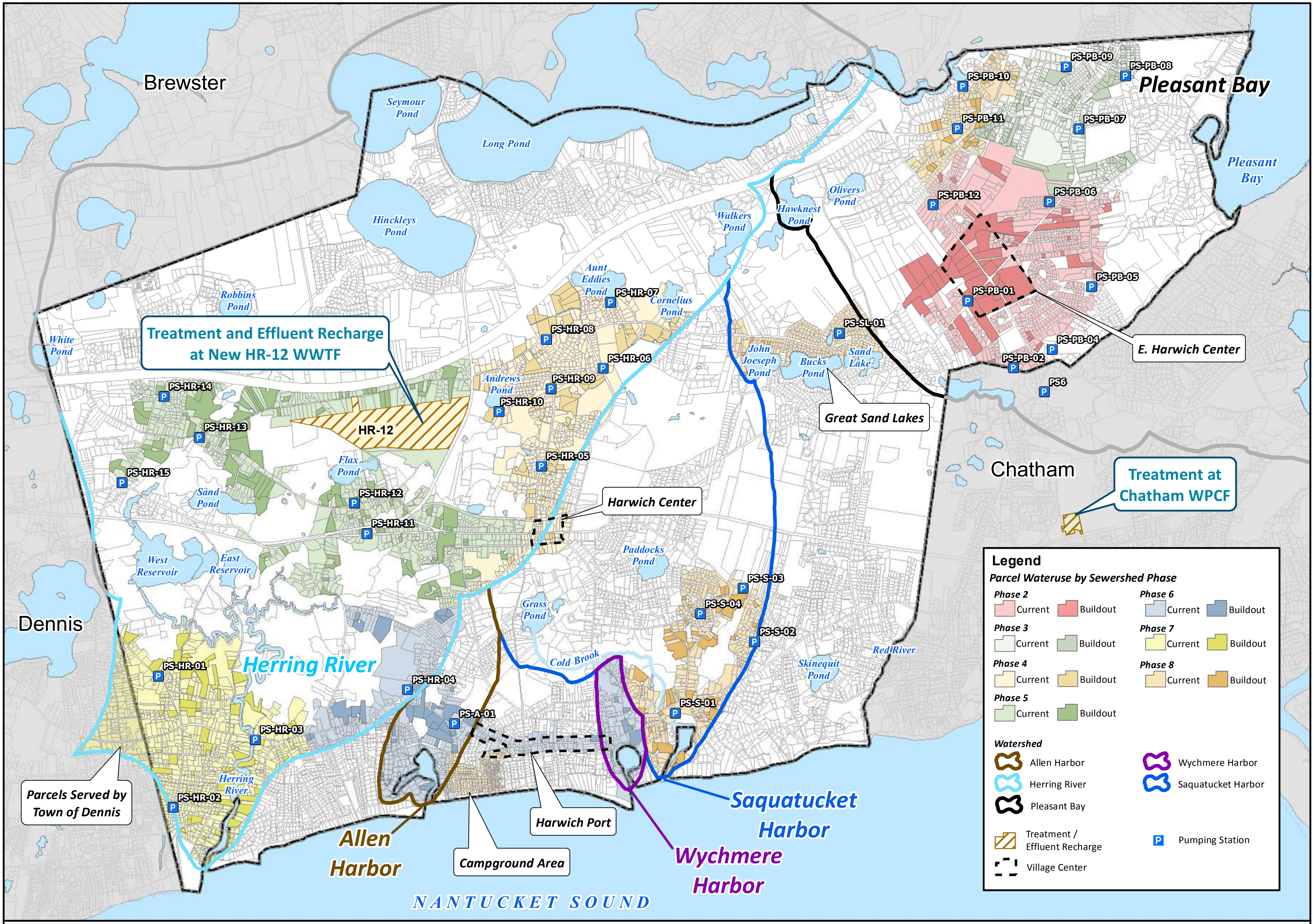
Flow from the Great Sand Lakes area is currently programmed to go with the Pleasant Bay wastewater flows to Chatham but could be switched and conveyed to Site HR-12 for treatment and recharge.

Sewer service areas in Phases 5, 6, 7 and 8 can be adjusted as needed to meet local needs and based on feedback from water quality monitoring. The order in which these phases are implemented is also flexible and can be adjusted to meet those same needs. For instance areas along Route 28 may want to be sewered earlier than proposed to meet potential economic development needs or to help protect Allen Harbor which is in the process of being dredged.

Table 13-11 below presents each phase of the wastewater plan, the estimated number of parcels served and the estimated buildout annual average daily flow (wastewater and I/I) for each phase.

Table 13-11
Wastewater Flows by Phase

Phase	Watershed	Number of Lots Served	Built-out Annual Average Wastewater Use (gpd)	Buildout Average Estimated I/I Flow (gpd)	Build-out Annual Average Wastewater Use With I/I (gpd)
1	None	0	0	0	0
2	Pleasant Bay	600	144,800	17,400	162,000
3	Pleasant Bay	440	106,200	12,800	119,000
4	Herring River	660	145,500	31,600	177,000
	Saquatucket	40	9,200	1,700	11,000
5	Herring River	730	160,900	34,900	196,000
6	Allen Harbor	234	57,000	4,500	62,000
	Wychmere Harbor	123	29,000	2,900	32,000
	Route 28 Outside of MEP	93	25,600	1,600	27,000
	Herring River	190	41,900	9,100	51,000
7	Herring River	760	167,500	36,400	204,000
8	Saquatucket Harbor	375	86,000	16,300	102,000
	Campground	267	33,000	1,600	35,000
	Pleasant Bay	165	39,800	4,800	45,000
	Great Sand Lakes	269	34,000	1,600	36,000
Total (Rounded)		4,946	1,080,400	177,200	1,259,000



N

Sewer Service Area by Phase
Existing and Buildout Parcels

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 13-4
Recommended Phasing Plan
Buildout Parcels

CDM Smith

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As discussed in Section 13.2.5, the MEP developed buildout flow projections without changing the number of parcels in their GIS layer. As a result, the number of parcels in the recommended plan does not change from present day to buildout conditions. If the Town develops a cost recovery strategy based on the number of parcels within the wastewater service area, it will need to develop an updated map/lot database to reflect additional property subdivisions that are expected under buildout conditions.

13.4.3 Wastewater Phasing Plan Costs by Phase

Based on the information provided in this CWMP/SEIR, preliminary project costs have been updated for the recommended plan by phase and are summarized below in Table 13-12. This table builds on the $225 Million cost presented in Table 13-10 and adds $5.1 Million for natural attenuation and pond restoration projects.

Table 13-12
Details of Phasing Plan Costs by Phases 1-8

Phase	Collection System	Treatment Facility	Design and Permitting Allowance	Natural Attenuation and Pond Restoration Projects	Total
1	$0	$230,000	$25,000	$2,300,000	$2,550,000
2	$18,800,000	$0	$3,500,000	$2,000,000	$24,300,000
3	$12,600,000	$7,300,000	$810,000	$300,000	$21,010,000
4	$20,000,000	$31,000,000	$5,700,000	$0	$56,700,000
5	$20,900,000	$0	$2,300,000	$0	$23,200,000
6	$18,600,000	$0	$2,100,000	$500,000	$21,200,000
7	$21,800,000	$20,700,000	$4,700,000	$0	$47,200,000
8	$30,500,000	$0	$3,400,000	$0	$33,900,000
Total	$143,200,000	$59,230,000	$22,535,000	$5,100,000	$230,060,000

These project costs include general construction, bidding, engineering design, permitting and support during construction, and contingencies. These costs were projected to April 2013 (ENR index 9475). Costs for design and permitting of the next phase are shown in the phase prior to the construction phase.

The phasing of this plan is between $2.6 to $47.2 million for each phase of the program - for a total of $230 million. This includes an allowance of $3.8 million for the Muddy Creek and Cold Brook attenuation projects and includes a $1.3 million allowance for the study and restoration of Hinckleys Pond, Seymour Pond, Bucks Pond and John Joseph Pond. The initial HR-12 treatment facility will be built in Phase 4 and is proportionally more costly in the initial phase as it includes all the supporting buildings and common processes. It is proposed that this facility will be upgraded to accommodate the additional wastewater flow and increased treatment capacity in Phase 7. The expansion is mainly for treatment processes and tankage expansion. The existing wastewater flow from Phases 4 to 6 will need to be verified to be within the initial treatment plant capacity and that buildout flows have not occurred. The adaptive management approach will allow the treatment facility expansion requirements and sewer service areas to be further evaluated and modified as needed between Phases 4 and 7.

13.4.4 MEP Issues Related to Wastewater Phasing

As described in Section 6, the MEP reports for the Allen, Wychmere, Saquatucket, Pleasant Bay, and Herring River watersheds describe the development of target nitrogen loads to meet the goals established for restoration of eelgrass and/or infaunal habitats in each embayment. Figure 13-2 summarizes what was shown in Table 6-10. As shown 58% to 100% of septic system nitrogen loading needs to be eliminated in order to meet the water quality goals in the five watersheds, if only focusing on nitrogen reduction from septic system loads. The reports note that these are attenuated loads, accounting for travel through the watershed prior to reaching the embayment.

In the MEP reports, there is a discussion on the possibility of increasing the inlet opening to the Muddy Creek in order to increase tidal flushing to the creek. The report suggests that if the inlet modifications are made, a 20% drop in the difference between the existing conditions modeled and the threshold concentration at the lower Muddy Creek check station will be realized. This change is significant and thus the Town decided to move forward with the assumption that the addition of a 24-foot opening at the head of the Muddy Creek would be implemented as part of the overall wastewater management program.

The proposed sewering plan involves removing more than 58% of the septic systems from the Allen, Wychmere, Saquatucket, Pleasant Bay, and Herring River watersheds over the course of the sewer installation phases. The proposed wastewater treatment plant and associated groundwater recharge sites are located within the Herring River and Pleasant Bay watersheds, so the nitrogen load from the treated effluent discharged to the ground on the proposed recharge sites will be considered a new input to the watershed.

Since the Herring River watershed will receive the majority of the effluent recharge flow, it is important to insure that the phasing of the wastewater treatment system (and associated effluent recharge) does not result in a net increase in nitrogen to any watershed.

In the Allen, Wychmere, and Saquatucket Harbor watersheds, all of the corresponding nitrogen will be removed from the watershed. The ability to meet the MEP goals for these watersheds will depend on the amount of septic nitrogen removed from them. In the Herring River and the Pleasant Bay watersheds, however, the ability to meet the MEP goals will depend on the corresponding nitrogen removed and the effluent recharge introduced back into the watershed. This nitrogen balancing is critical to the success of the program. For the program to be successful, the Town must demonstrate that the wastewater system phasing plan does not result in an increase in nitrogen to any watershed. The only acceptable scenario, from a regulatory point of view, will utilize a phasing plan that gradually decreases the nitrogen load to the watershed until the threshold load is achieved. This reduction must take place without increasing the load over present day values. In order for this to happen, the first phase of the wastewater plan must remove nitrogen from the watershed(s) that will receive effluent recharge. The proposed phasing plan achieves that goal.

Table 13-13 below presents the estimated load change for the nitrogen sensitive watersheds at the end of each phase. The loads from the Pleasant Bay watershed are only shown as removed since treated effluent from this watershed is recharged at the Chatham WPCF, which is outside of a nitrogen sensitive watershed.

Table 13-13
Total Estimated Load Change in Nitrogen Sensitive Watersheds at the End of Each Phase

Phase	Total Load Change	Allen Harbor (kg/day)	Wychmere Harbor (kg/day)	Saquatucket Harbor (kg/day)	Herring River (kg/day)	Pleasant Bay (kg/day)
1	No Load Change From Sewering (Natural Attenuation / Flushing Projects)					
	Phase 1 Net Load Change	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
2	Load Removed					-13.7
	Phase 2 Net Load Change	**0.0**	**0.0**	**0.0**	**0.0**	**-13.7**
3	Load Removed					-10.0
	Phase 3 Net Load Change	**0.0**	**0.0**	**0.0**	**0.0**	**-10.0**
4	Load Removed				-15.9	
	Load Added				2.0	
	Phase 4 Net Load Change	**0.0**	**0.0**	**0.0**	**-13.9**	**0.0**
5	Load Removed				-16.6	
	Load Added				2.1	
	Phase 5 Net Load Change	**0.0**	**0.0**	**0.0**	**-14.5**	**0.0**
6	Load Removed	-5.5	-2.9		-3.0	
	Load Added				14.8	
	Phase 6 Net Load Change	**0.0**	**0.0**	**0.0**	**11.8**	**0.0**
7	Load Removed				-17.2	
	Load Added				2.2	
	Phase 7 Net Load Change	**0.0**	**0.0**	**0.0**	**-15.0**	**0.0**
8	Load Removed			-10.1		
	Load Added			3.1		
	Phase 8 Net Load Change	**0.0**	**0.0**	**-7.1**	**0.0**	**0.0**
	Total Load Change	**-5.5**	**-2.9**	**-7.1**	**-31.6**	**-23.7**

Note : Some of the loads in the proposed sewershed are not within nitrogen sensitive watersheds and are, therefore, not counted in this table.

13.4.5 Effluent Recharge Related to Wastewater Phasing

Phase 1

No effluent will be recharged in this phase however water quality monitoring of the natural nitrogen attenuation programs should occur to confirm assumptions utilized herein.

Phases 2 and 3

The effluent recharge for these phases will utilize open infiltration basins at either the Chatham facility or the a site in the Pleasant Bay watershed to handle all of the Phase 2 and 3 flow. These phases address most of the service area in the Pleasant Bay watershed and will leave the Great Sand Lakes area for a later phase. A small part of the Pleasant bay service area will be delayed until Phase 8 to allow additional study of the Muddy Creek project that is expected to reduce the need for more sewers while achieving the TMDL.

Phases 4, 5 and 6

The effluent recharge for these phases will utilize open infiltration basins at the HR-12 site to handle the flow from the Herring River. A permeable reactive barrier (PRB) program will be conducted at Site HR-12 during Phase 4 in order to determine its applicability in future phases.

Phase 7

The effluent recharge for this phase will continue to utilize open infiltration basins at the HR-12 site and will handle the full service area in the Herring River watershed.

Phase 8

The effluent recharge for this phase will utilize open infiltration basins at the HR-12 site. This phase will handle the full service area in the Saquatucket Harbor watershed and the Campground area. The Great Sand Lakes area can be recharged in the Pleasant Bay Watershed or HR-12 depending on where it is ultimately treated.

This phasing plan was developed so that the service area in the Herring River and Pleasant Bay watersheds will ensure that the total nitrogen loading to each nitrogen sensitive watershed does not increase above present day levels. As the phasing plan progresses, the net nitrogen load in these two watersheds will gradually decrease until the recommended plan is complete. At that time all of the nitrogen sensitive watersheds will be in compliance with the TMDLs.

It is recommended that the Town coordinate with the Monomoy School Department in order to maintain access to potentially using Site SH-2 for effluent recharge only in the future in case impacts to the watersheds as estimated in this plan need to be revised or additional sewering is required resulting in the need for more recharge capacity. This site is in a third watershed which would beneficially spread the effluent recharge to another watershed, and the site is upgradient of the Cold Brook natural nitrogen attenuation area.

13.5 Natural Attenuation Projects Cold Brook and Muddy Creek

Since natural attenuation of nitrogen is part of a natural freshwater system, the Allen, Saquatucket, Pleasant Bay and Herring River watershed systems all have some degree of natural attenuation associated with them. In the Allen Harbor watershed, the Allen Harbor stream is estimated to have approximately 30 percent nitrogen attenuation. In the Saquatucket Harbor watershed, attenuation occurs in several ponds and streams including the Cold Brook. The Pleasant Bay system has natural attenuation in several ponds as well as the Muddy Creek system. For the purposes of the wastewater scenarios presented in Section 10, the existing natural attenuation factors were accounted for in the MEP nitrogen models and are considered to be existing conditions because they approximate actual field conditions as reported by the MEP.

The Town, however, also has the ability to initiate two projects that will enhance the existing natural attenuation in the Saquatucket Harbor watershed and at Muddy Creek in the Pleasant Bay watershed. The end result of implementing these projects is a cost-effective reduction in the total amount of sewering required in both the Saquatucket Harbor and Pleasant Bay watersheds while still meeting the MEP established TMDL for nitrogen removal.

To realize the benefits of these two projects, the Town developed the recommended wastewater plan based on the assumption that they will enhance the natural attenuation in the Saquatucket Harbor and Pleasant Bay watersheds by constructing both the Cold Brook project and the Pleasant Bay tidal flushing project. The result is this recommended plan relies on educated assumptions about the potential beneficial impacts of the two projects. Once these projects are completed and the results of the improvements can be measured, then regular water quality sampling (see Adaptive Management Plan (AMP)) will allow the Town to assess the true impacts of the project. After evaluation of that data the Town can adapt the recommended plan and adjust the sewer service areas to meet the TMDL and keep the wastewater collection area as small as possible.

The costs for these two projects are presented in Table 13-12. At this time the Town is pursuing multiple avenues for funding. Both projects are considered significant components of the recommended plan as they offset sewering in a cost-effective manner.

13.5.1 Saquatucket Natural Attenuation Project (Cold Brook)

The June 2010 final Linked Watershed Embayment Model presented in the MEP report for the Allen, Wychmere and Saquatucket Embayment Systems presents an alternative scenario that changes the attenuation rate in the Cold Brook from the existing 35% to 50%. Further analysis by the Town indicated that this change in attenuation is significant and would result in a reduction of the sewer service area while still meting the TMDL.

For the Town to implement this project, additional study is needed, but the MEP modelers generally agree that the Cold Brook can be enhanced to increase the residence time of freshwater flowing through the system by creating depositional basins (ponds) after determining specific sites within the bog system to increase the nitrogen removal. Preliminary discussions with the Harwich Conservation Trust, who owns the land in this area, has begun and future study efforts will be coordinated with them. The Harwich Conservation Trust is in support of this proposed project.

Additional nitrogen reductions are still required in the Saquatucket Harbor watershed to meet the threshold concentration in the harbor, but the magnitude is reduced because of the enhanced attenuation expected in the Cold Brook. This modification is expected to result in the 50 percent attenuation mentioned above and is expected to save roughly $6 million in collection system costs alone, at $25,000 per lot.

The Town funded this study in FY15 and FY16 with results expected in June 2016.

13.5.2 Pleasant Bay Natural Attenuation Project (Muddy Creek)

An MEP technical memorandum evaluated the water quality impacts of the addition of a 24-foot wide culvert in the Muddy Creek inlet. In this memorandum an alternative scenario is presented to the May 2006 final Linked Watershed Embayment Model for the Pleasant Bay system that reduces the threshold nitrogen concentrations in the upper and lower Muddy Creek sub-embayments as a result of increased flushing with the wider inlet. For the Town to implement this project, the two small existing culverts would need to be increased in size to at least a 24-foot opening. The modeling that was performed for the Pleasant Bay system showed that replacing the existing inlet is expected to result in a 20% drop in the difference between the existing conditions modeled and the threshold concentration at the Lower Muddy Creek check station. Additional nitrogen reductions are still required in the Muddy Creek watershed to meet the threshold concentration in Lower Muddy Creek, but the magnitude is reduced through the installation of the wider culvert. This modification is expected to save roughly $5.7 million in collection system costs alone, at $25,000 per lot.

The Town and Chatham continue working collaboratively to construct the new Muddy Creek bridge. By August 2015, the project funds were appropriated and the project entered into permitting and design. The project is currently under construction with completion expected in summer 2016.

13.6 Recommended Program Costs

The plan phasing is between $2.6 to $47.2 million for each phase of the program, for a total of $180 to $230 million. This total includes an additional allowance of $3.8 million for the Muddy Creek and Cold Brook attenuation projects and includes a $1.3 million allowance for the study and restoration of Hinckleys Pond, Seymour Pond, Bucks Pond and John Joseph Pond. The initial HR-12 treatment facility will be built in Phase 4 and is proportionally more costly in its initial phase as it includes all the supporting buildings and common processes. It is proposed that this facility will be upgraded to accommodate the additional wastewater flow and increased treatment capacity in Phase 7. The adaptive management approach will allow the treatment facility expansion requirements and sewer service areas to be further evaluated and modified as needed between Phases 4 and 7. Operation and maintenance costs at buildout are projected to about $3.0 million annually. A potential regional facility with Dennis may help lower both the construction and operation and maintenance costs.

Harwich's Wastewater Implementation Committee and Board of Selectman has evaluated various cost recovery models. The Selectman adopted a cost recovery policy which is described in Section 15 of this CWMP/SEIR.

Table 13-14 presents anticipated costs based on the phasing plan discussed earlier in this section.

Table 13-14
Details of Phasing Plan Costs by Phases 1-8

Capital Outlay Committee - Requirements for CWMP		
2013 Funding Request	**Phase 1**	**Total = $2,550,000**
1	$250,000	For PB-3 Recharge Facility Land Purchase
2	$500,000	For Hinckleys Pond Restoration
3	$100,000	For Cold Brook Attenuation Study
4	$1,700,000	For Muddy Creek Attenuation Bridge Project
2016 Funding Request	**Phase 2**	**Total = $24,300,000**
1	$22,300,000	For Design and Construction of Pleasant Bay Collection System (South)
2	$2,000,000	For Cold Brook Attenuation Construction Project
2021 Funding Request	**Phase 3**	**Total = $21,010,000**
1	$12,600,000	For Construction of Pleasant Bay Collection System (North)
2	$8,110,000	For Design and Construction of Chatham WPCF Upgrade
3	$300,000	For Seymour Pond Restoration
2026 Funding Request	**Phase 4A**	**Total = $34,400,000**
1	$34,400,000	For Design and Construction of Harwich Treatment Facility HR-12
2029 Funding Request	**Phase 4B**	**Total = $22,300,000**
1	$22,300,000	Design and Construction of Herring River Collection System (Northeast)
2033 Funding Request	**Phase 5**	**Total = $23,200,000**
1	$23,200,000	For Design and Construction of Herring River Collection System (Northwest)
2038 Funding Request	**Phase 6**	**Total = $21,200,000**
1	$20,700,000	For Design and Construction of AWS and Herring River (SE) Collection Systems
2	$250,000	For Bucks Pond Restoration
3	$250,000	For John Joseph Pond Restoration
2043 Funding Request	**Phase 7**	**Total = $47,200,000**
1	$26,500,000	For Design of Harwich WWTF Upgrade and Design and Construction of Herring River Collection System (Southwest)
2	$20,700,000	For Construction of Harwich Treatment Facility Upgrade
2048 Funding Request	**Phase 8**	**Total = $33,900,000**
1	$33,900,000	For Design and Construction of Campground Area, GSL and Final PB Area to Meet TMDL
Total Funding Request	**Phases 1-8**	**Total (rounded) = $230,000,000**

Based on discussions with Harwich representatives, the 40 year implementation has been divided into the timeline as shown in Table 13-15. The town will need to further evaluate and potentially adjust this timeline to help coordinate financing of other large capital projects in town in order to minimize financing impacts.

Table 13-15
Timeline for Phasing Plan Costs by Phases 1-8

Phase	Calendar Year	Duration (years)	Amount
1	2013 to 2015	3	$2,550,000
2	2016 to 2020	5	$24,300,000
3	2021 to 2025	5	$21,010,000
4A	2026 to 2028	3	$34,400,000
4B	2029 to 2032	4	$22,300,000
5	2033 to 2037	5	$23,200,000
6	2038 to 2042	5	$21,200,000
7	2043 to 2047	5	$47,200,000
8	2048 to 2052	5	$33,900,000
Total Program	**2013 to 2052**	**40**	**$180 Million to $230 Million**

The overall program to meet the nitrogen TMDLs and the other defined town needs is estimated to be $230 Million. However, the recommended program includes a buildout growth of about 26% which is a prudent projection but may not occur. It also does not take credit for any other non-infrastructure nitrogen reduction aspects of the program such as fertilizer reduction, improved stormwater controls and land use changes. Thus, if only half the growth occurred and up to half of the nitrogen contributions from fertilizer and stormwater were achieved, then it is conceivable that up to a 25% reduction in the recommended infrastructure could be realized resulting in a program cost of about $180 Million.

13.7 Non-Infrastructure Components

The subsections above describe mainly infrastructure related components of the recommended wastewater management program. However, there are several non-infrastructure related components that need to be implemented as well, as described below.

13.7.1 Public Outreach

Public participation and outreach has been a priority during the CWMP/SEIR process, starting in 2007 when informational public meetings were initiated to gain participation and feedback from residents and business owners. Several participants at those meetings included the Wastewater Management Subcommittee (WMS) (now the Wastewater Implementation Committee – WIC) Citizens Advisory Committee (CAC), Planning Board members, representatives from the Cape Cod Commission (CCC), and other representative members of the community, including town staff advisors and selectmen. Additional educational opportunities have been provided by CWMP partners including MEP and the Coastal Systems Program at the UMass Dartmouth School for Marine Science and Technology (SMAST) and the Department of Environmental Protection (MassDEP). The public outreach program to date has focused on educating the public about the need to address nutrient pollution issues and informing residents about the ongoing wastewater program planning, the MEP and TMDL processes, the nitrogen removal technologies available, and how wastewater planning will affect the overall community. Ultimately this valuable input was utilized to develop the recommended wastewater program described herein.

Harwich will continue to offer public outreach and educational opportunities through these collaborations during the implementation of the CWMP/SEIR recommendations. This will be particularly important during construction phases so that residents and business owners understand what is happening and when it will happen. Additional outreach efforts will include information about proper fertilizer application, low impact landscaping techniques, and water conservation practices. Programs will be designed to complement the needs of the community and will prioritize total nitrogen reduction through proven best management practices. Additional consideration will be given to developing nutrient management website resources on the Harwich website, printed educational materials, and participation in community events.

13.7.2 Fertilizer Education

Fertilizer applied to golf courses, agriculture, town properties and residential lawns are estimated to account for approximately 7 to 16 percent of the total controllable nitrogen load to the estuaries. While the recommended wastewater management plan focuses on reduction of septic system nitrogen, which is the largest component of the controllable nitrogen load in a watershed, fertilizers will continue to affect local estuaries until steps are taken by residents, landscapers, golf courses, and cranberry bogs to reduce overall fertilizer use. Educational programs have been initiated primarily through the Pleasant Bay Alliance, of which Harwich is a member. Harwich's Conservation Commission has also actively enforced protection of buffer zones to minimize fertilizer movement to water bodies.

The fertilizer education program will focus on ideal application types and rates of fertilizer and on awareness of the negative effects of over-fertilization or inappropriate use. The program will also target portions of Harwich located upstream from the most sensitive water sources and may include website resources, handout materials, collaboration with local landscaping companies, and other regional and County initiatives for the benefit of the community.

Harwich will also continue to participate in initiatives related to the Pleasant Bay Alliance Fertilizer Management Plan, which was proposed in December 2010. The management plan introduced six strategies to reduce nitrogen input from fertilizer use in the Pleasant Bay watershed:

1. Limit fertilizer use on municipal properties, such as athletic fields and parks.
2. Minimize fertilizer application on golf courses.
3. Enforce 50-foot buffer “no fertilization” zones around sensitive surface water resources and restore wetland buffers.
4. Provide outreach and education for a variety of property owners and property managers to encourage fertilizer best management practices.
5. Offer training for turf grass managers to encourage low-nitrogen landscaping practices.

6. Develop regulations which reduce lawn size in future development projects.

The Town will take each of the strategies into consideration and develop local outreach programs and/or practices, as needed, to address fertilizer contributions in sensitive watershed areas. The Town elected to utilize this approach to achieve nutrient reduction instead of adopting a fertilizer by law.

13.7.3 Stormwater BMPs

Stormwater from runoff and impervious surfaces is similar to fertilizer in terms of the amount of total controllable nitrogen load to the estuaries. It accounts for about 5 to 9 percent of the controllable nitrogen. It can also be a source of nutrients to the fresh water resources in Harwich. While wastewater planning will reduce pollutants, stormwater will continue to affect local water bodies. Steps will continue to be taken by the public works department to enact stormwater best management practices (BMPs) that help reduce the turbidity from stormwater and reduce the total pollutant (phosphorus, nitrogen and pathogens) load to both the fresh and salt water resources in Harwich.

All three of the above non infrastructure components should be addressed on a continuing basis however combined they do not achieve the required nitrogen reduction to meet the estuary TMDLs. It is also difficult to monitor the long-term benefits of each component. Improved fertilizer management and stormwater management will result in improved water quality which will be observed via long-term water quality monitoring. That benefit will allow the Town to implement the wastewater program closer to the lower end cost range.

The stormwater BMP program will focus on ideal application of BMPs at the drain features throughout Harwich. The program will target those portions of town located upstream from the most sensitive water sources and will include several stormwater controls and/or practices on all new work. As the program is developed, the town will decide which types of controls are most appropriate.

Listed below are five common BMP strategies to reduce pollutant input to the local water resources:

1. **Deep Sump Catch Basins**

   Deep sump catch basins are modified versions of the inlet structures typically installed in a piped stormwater conveyance system. They provide capacity for sediment accumulation.

2. **Detention Pond Infiltration Basins**

   Detention pond infiltration basins are used to manage stormwater runoff and improve water quality in adjacent water bodies. These are shallow artificial ponds designed to infiltrate stormwater into the ground versus direct discharge to a water body.

3. **Porous Pavement**

   Porous pavement is a permeable pavement surface with a stone reservoir underneath. Runoff from porous pavement infiltrates directly into the soil and receives some level of filtration. Porous pavement looks the same as traditional asphalt or concrete but is manufactured without "fine" materials, and instead incorporates void spaces that allow for infiltration.

4. Bioretention and Vegetated Basins

Bioretention basins utilize structures to physically remove contaminants and sediment from stormwater runoff. Stormwater is collected into the treatment area which consists of a ponding area. Runoff passes first over or through the ponding area which slows the runoff's velocity and distributes it evenly along the length of the basin. The vegetated basins allow pollutants to settle and filter out, and also provide the opportunity for the uptake of nutrients. A vegetated infiltration basin can also help fulfill site landscaping requirements.

5. Catch Basin Cleaning

According to the USEPA, catch basin cleaning is an efficient and cost effective method for preventing the transport of sediment and pollutants to receiving water bodies. This improves both the aesthetics and the quality of the receiving water body. Catch basins should be inspected regularly to determine if they need to be cleaned.

Harwich will consider these strategies and others and develop an appropriate town-wide BMP strategy to initially implement in the most sensitive watershed areas, and eventually throughout the entire town. Several roadway projects are underway or planned and will help eliminate direct discharges and allow these BMPs to be installed.

13.7.4 Freshwater Ponds Evaluation, Sampling and Restoration

In Section 5 of this CWMP, the health of the Harwich freshwater ponds was evaluated and summarized. According to the Cape Cod Pond and Lake Atlas (CCC, 2003), the Town has 63 ponds with a total area of 850 acres. The Cape Cod Pond and Lake Stewardship (PALS) program has consistently sampled up to seventeen locations annually in sixteen of Harwich's ponds, typically in July, August, and/or September. Data from the PALS sampling program for 2006-2010 were reviewed for that analysis.

The sixteen Harwich ponds in the pond health assessment included herein are quite diverse in both physical and water quality characteristics. Harwich's ponds provide important habitat for aquatic life and are important natural resources for the community. The growing number of pond restoration actions on Cape Cod suggests that many ponds are reaching their tipping points, where further alterations to the environment will result in sometimes dramatic changes in water quality. These have included noxious and potentially harmful algal blooms at Hinckleys Pond and Skinequit Pond. Below are some preliminary steps that should be taken to protect or restore Harwich's ponds.

1. Continue sampling

It is recommended that sampling of all current ponds continue. It is also recommended to expand the PALS program to collect at least one sample annually from other Harwich ponds without historic water quality data so that a baseline can be established.

2. Perform an inventory of all stormwater pipes draining to ponds

Road runoff as a potential source of contamination was identified in at least twelve ponds. Create an inventory incrementally with focus on ponds with water quality data. If found, divert or disconnect stormwater systems that directly discharge to ponds.

3. Investigate other potential contaminant sources

Phosphorus loads from the following sources should be considered: abandoned or active cranberry bogs, sediment dumping locations, farms, private impervious surface runoff, private landscape and fertilizer applications, and waterfowl. Decreasing phosphorus loads to ponds that are currently affected by high phosphorus concentrations would improve pond health. For ponds that have evidence of phosphorus regeneration, expansion of monitoring points allows for a more accurate understanding of phosphorus regeneration.

4. Determine uses and ponds to support

Fostering stakeholder and public participation is a key component in determining which ponds and which uses for each individual pond should be prioritized to keep or meet a high quality designation. An example would be to prioritize the protection of Olivers, Hawksnest, and Black Pond to prevent water quality degradation from affecting fish populations, if that is a priority for the community. Table 13-16 summarizes the analysis and recommendations for each of the sixteen ponds currently sampled and examined.

Table 13-16
Harwich Ponds Health Assessment Summary and Recommendations

Name	Pond Trophic Status	Monitor	Investigate Road Runoff Contribution	Investigate Potential Contaminant Sources	Shoreline Development
Andrews Pond	Oligotrophic	X		X	Low
Aunt Edies Pond	Mesotrophic	X	X	X	Low
Bucks Pond	Oligo-mesotrophic	X	X	X	Medium to High
Cornelius Pond	Eutrophic	X		X	Low
Flax Pond	Oligo-mesotrophic	X	X	X	Low
Grass Pond	Meso-eutrophic	X	X	X	Low
Hawksnest Pond	Oligotrophic	X	X	X	Low
Hinckleys Pond	Eutrophic	X	X	X	Medium to High
Island Pond	*	X			*
John Joseph Pond	Mesotrophic	X	X	X	Medium to High
Littlefields Pond	*	X			*
Long Pond	Mesotrophic	X	X	X	Medium to High
Oilvers Pond	*	X			*
Okers Pond	*	X			*
Paddocks Pond	*	X			*
Robbins Pond	Mesotrophic	X		X	Low
Sand Pond	Mesotrophic	X	X	X	Low
Seymour Pond	Mesotrophic	X	X	X	Medium to High
Skinequit Pond	Eutrophic	X	X	X	Medium to High
Walkers Pond	Mesotrophic	X	X	X	Low
West Resevior	*	X			*
White Pond	Oligo-mesotrophic	X		X	Low

Note: (*) Data not provided

The highlighted ponds in Table 13-16 should be examined more closely to determine the sources of phosphorus. The Town recently conducted an analysis of Hinckleys Pond (CDM Smith/WRS July 2012) and had previously done phosphorus inactivation in Long Pond. The Skinequit Pond Association has taken steps to improve water quality in their pond. Water quality studies should be done for Seymour Pond, Bucks Pond and John Joseph Pond to start. Actions plans to address phosphorus reduction near them should be developed. If adding sewers within their watersheds and thus removing septic system effluent phosphorus inputs would be appropriate to reduce degradation then it can be handled through an adaptive management approach during the implementation phase of the CWMP/SEIR recommended program.

13.7.5 Continued Salt Water Sampling

Now that the MEP water quality monitoring program is complete, the Town via the WQMTF oversight will continue monitoring water quality at the defined sentinel and check stations. Monitoring of each sentinel and check station within Harwich is proposed seasonally for the duration of the implementation phase. At this time, it is anticipated that regular sampling required by the future groundwater discharge permits will ensure that the health of the local estuaries improves as the program moves forward. As the program nears completion and is in the final phases, the sampling will become more important because the results may indicate, through adaptive management, that the extent of the sewer service areas can be reduced. The result could be a significant cost savings to the Town. This approach will be most important in the Pleasant Bay and Saquatucket Harbor watersheds where the two attenuation projects (Muddy Creek and Cold Brook) are to be implemented.

13.7.6 Low Impact Landscaping

As part of the nutrient management programs, the Town will encourage low impact landscaping. Low impact landscaping encourages the use of plantings that minimize the need for watering as well as the use of fertilizers. By utilizing these low impact plantings and reducing lawn areas, maintenance can be reduced while minimizing environmental impacts to the watershed.

13.7.7 Water Conservation Programs

Increased water use introduces a pathway for nitrogen to enter sensitive estuaries. Water conservation is a cost effective and environmentally sound way to reduce the demand for water, which is particularly important during warm weather months when overall water use increases by about 50 percent. The Harwich Water Department has a bylaw which limits outdoor water usage and maintains educational signage throughout the Town to remind residents of the rule. Further reductions in water use may be found through an education and outreach program which focuses on the benefits of water efficiencies.

Examples of residential and commercial water efficiencies include incorporating low flow plumbing fixtures such as faucets, shower heads, hoses, and toilets. Efficiencies can also be found in landscaping by utilizing native plants and grasses whenever possible, watering lawns and landscaping as-needed and for limited amounts of time, installing rain sensors into irrigation systems, maintaining pools to eliminate leaking, mulching around plants to insulate from evaporation, repairing leaky faucets and drains, and planning landscaped areas according to sun and water demand.

In addition to reducing nitrogen pathways, saving water also saves energy. Almost 90 percent of residents in Harwich receive water from eleven groundwater wells located throughout the Town.

Reducing overall water consumption will also reduce the amount of energy necessary to pump, filter, and treat water and that reduction will save costs.

The Harwich Water Department currently maintains a comprehensive list of resources related to water conservation, including several guidelines on consumer water conservation practices and preventing water waste. Through implementation of this CWMP/SEIR, the program could be expanded to include participation in community events, K-12 educational presentations, developing and/or distributing paper materials and fliers in a general campaign and a focused effort that targets the highest nitrogen-producing areas of the community.

13.7.8 Inflow Prevention Programs

An inflow prevention program will be implemented as soon as the first wastewater customers are tied into the new sewer system. Inflow prevention programs seek to ensure that water from street drains, sump pumps, driveway drains or any other clean water sources do not make their way into the wastewater collection system. When inflow sources are introduced into the wastewater collection system, the wastewater treatment facility is burdened with treating this extra flow. Unfortunately, these sources of inflow do not need to be treated at the wastewater facility. The result is an unnecessary burden on the collection system, pumping stations and effluent recharge facilities. This burden costs additional dollars in the form of maintenance and the cost of pumping and treating this extra flow. By implementing an inflow program from the very beginning, the Town can educate the public, monitor its system and minimize the amount of inflow to the collection system.

13.7.9 On-site System Support

The staff at the Harwich Health Department has several resources dedicated to the maintenance of septic systems. The Towns website: (http://harwichma.virtualtownhall.net/Public_Documents/HarwichMA_Health/Septic%20Systems%20and%20Title%205) lists several resources that a homeowner can utilize when selling their property or siting a new septic system. The website also gives guidelines on how to best maintain an existing septic system.

Even after the wastewater program is fully implemented, there will still be a significant number of Title 5 septic systems functioning in Harwich. The Health Department will continue its efforts in supporting owners of these systems and will continue to oversee their compliance.

Several resources listed on the Town's website include:

- Real estate transfers (Regulations, Inspection Addendum, Waiver form)
- List of local Engineers, Sanitarians, and Title 5 Inspectors
- Massachusetts Title 5 Inspection Forms
- Town Title 5 Inspection Addendum Form
- Sewage Disposal Permit Instructions
- List of Septic Installers Licensed in the Town
- Low-interest loan program for failed septic systems (through Barnstable County)
- Sewage Permit Application checklist for Septic Installers

- Installer's License Application (annual renewal)
- Trench Permit (test holes)
- Permit Fees

As part of the wastewater program, the Town will continue to regularly notify the property owners who remain on conventional septic systems of the importance of regular maintenance.

New technologies should also continue to be evaluated. The passive nitrogen reduction systems (PNRS) have shown some promise in warmer climate areas and may prove to be beneficial in some instances here in New England. These are being tested at the Barnstable County test center.

13.7.10 School Education Programs

The Town will initiate a school education program for primary and secondary age school children geared toward better understanding the recommended wastewater program. The program will introduce the concept that water is a precious resource that must be protected and will be dedicated to educating both students and the community about the environmental and economic benefits of using water efficiently. Understanding the full water cycle (water, wastewater, stormwater, etc.) and that water is a valuable resource is an important concept for all to know.

13.7.11 Land Use and Open Space

The Town should continue to review land use planning tools for applicability to this recommended program and for meeting other town needs. Continued efforts such as those ongoing in the East Harwich Village Center area and other village centers should occur as they may result in changes to this program. Land use planning tools such as up-sizing of lots via zoning revisions, open space acquisitions and the like would result in lower nitrogen loadings in a given watershed requiring less sewering. Similarly, higher density development or expansion of commercial areas may result in higher nitrogen loadings potentially requiring more sewering. The percentage of growth currently included in each watershed varies significantly as shown in Table 13-1. There are several factors in play in this analysis (economics, open space, growth/no net growth, utilities, traffic, etc.) but clearly the Pleasant Bay and Herring River watersheds are the ones where any land use revisions and acquisition of land for open space will have the most impact.

13.7.12 Innovative and Alternative Technologies Committee

Because of the high costs today of providing proven nitrogen removal treatment technology to the very stringent standards required to meet the proposed TMDLs, there are several innovative and alternative (I/A) technologies being tested. As described earlier, the available I/A technologies do not meet the nitrogen removal requirements or their use was not cost effective. However, development of new technologies should always be monitored and evaluated for incorporation into this recommended wastewater program. The Harwich program has been designed with significant flexibility such that it would allow potential technology improvements to be incorporated if appropriate. Harwich should develop a committee that monitors these systems going forward.

13.7.13 Boat Pump Out in Harwich Marinas

Currently the Allen, Wychmere and Sequatucket Harbors, along with the entire Nantucket Sound, are federally designated no-discharge areas. This designation prohibits the dumping of boat wastewater into the harbors and their tributaries. The Harwich Harbormaster and the Marine Water Quality Committee have worked extensively with Massachusetts Coastal Zone Management (CZM) and EPA officials to enhance a holding tank discharge system that is already available to boaters in Harwich. The Town provides this service for free and it is considered to be valuable and proactive program that protects the town's valuable coastal resources. To continue its effectiveness, the Town should regularly review its ability to effectively this provide this service in the marinas throughout Harwich.

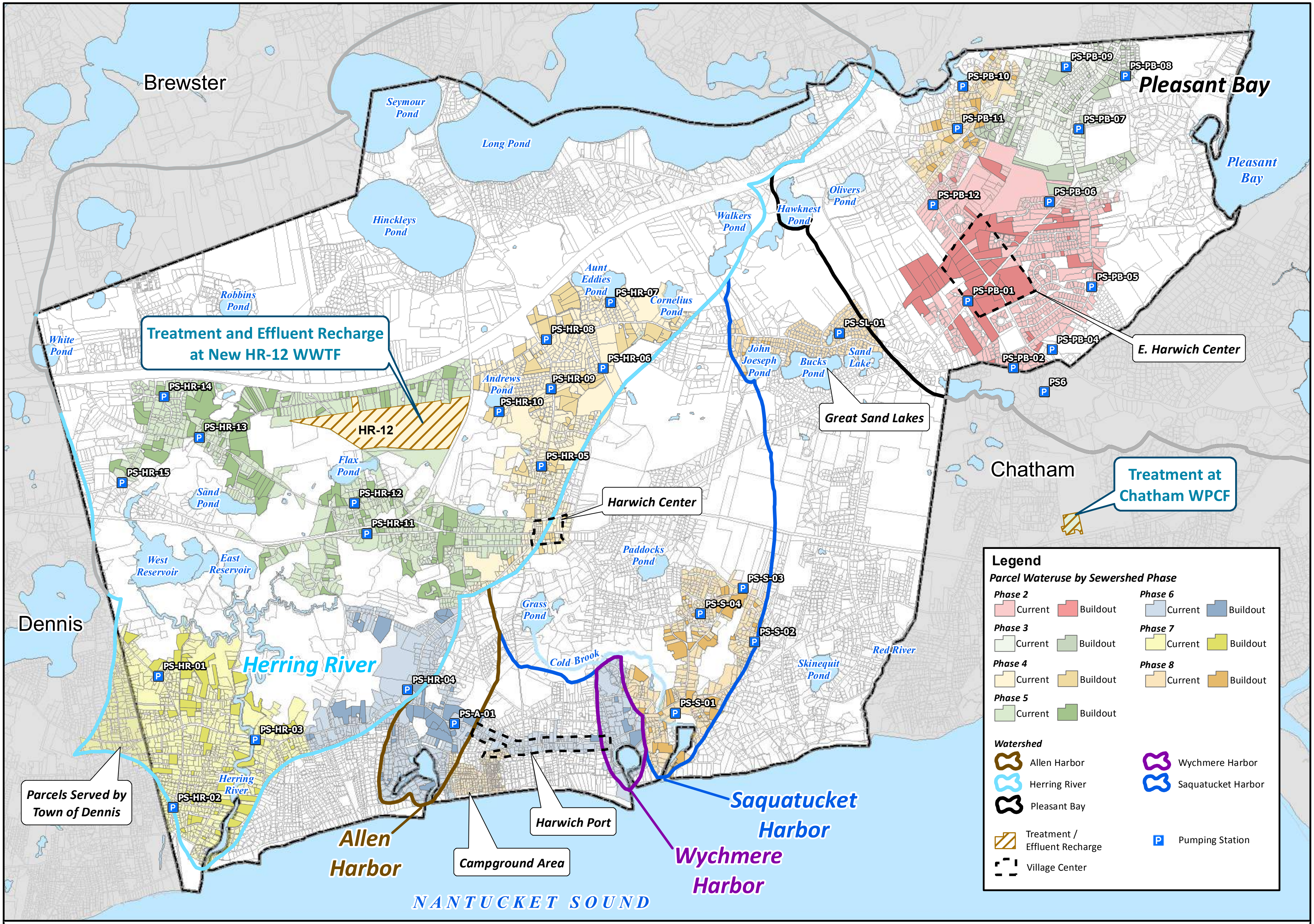
13.7.14 Harwich Shellfish Program

The Town of Harwich has an active shellfish laboratory and a nursery facility that has been operating since 1994. The facility typically grows hard clams but over the years the facility has grown softshell clams and mussels to varying degrees. Since the facility opened, more than 31 million shellfish were seeded in Harwich's waterways. Originally, the town initiated this program to enhance the recreational, educational and environmental benefits to the community by working to maintain a healthy shellfish population.

The shellfish laboratory and nursery facility are located at Wychmere Harbor where the shellfish are grown from May through October. In late October or early November, they are released into Harwich's waterways in the commercial and recreational areas that are best suited to supporting them throughout their life cycles. Figure 13-5 shows the seeded shellfish areas.

Since the shellfish program is active throughout the town, all of the nitrogen limited emabyments including the Allen, Wychmere and Saquatucket Harbors, Pleasant Bay and Herring River have been seeded with shellfish to varying degrees over the past 20 years. The Town has recently taken an interest in determining if nitrogen reduction is a side benefit of this successful program and is trying to determine if the presence of shellfish populations will have a significant impact in the overall wastewater plan. Regular sampling of each nitrogen-sensitive embayament through the adaptive management plan will help to determine if the amount of sewering can be scaled back as a result of these and other non-traditional nitrogen reduction strategies.

This program can have an impact since about 0.88 kg of nitrogen are typically removed on a daily basis per 1.0 million oysters (or 60 acres).



Sewer Service Area by Phase
Existing and Buildout Parcels

Figure 13-4
Recommended Phasing Plan
Buildout Parcels

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13.8 Adaptive Management Plan (AMP)

One benefit of a phased sewering approach is the ability to modify the recommended wastewater program as needed during the implementation phases. This "adaptive management" strategy allows for modification to the phasing, the timing, or the exact areas to be sewered depending on the results of the earlier implementation phases. The proposed phasing plan discussed earlier allows for adaptive management to be fully utilized if the total sewer service area changes or if new technologies arise that provide better or more cost-effective treatment than those presently proposed. The Town plans to continue revisiting the recommended program throughout its implementation to re-evaluate each phase prior to design and construction. The proposed Adaptive Management Plan (AMP) scope is described below.

13.8.1 Adaptive Management Plan Scope

The AMP associated with Harwich's recommended program will have several components to allow for systematic review of the implementation phase and the resulting changes to water quality, community growth, and economic viability. Specifically, the following items are proposed to comprise the AMP:

1. ***Technical Review Committee:*** A technical review committee (TRC) will be established to review the progress of implementing the CWMP recommended program and the potential need to modify the plan during the implementation phase. The TRC will include, but not be limited to, representatives from the Town, Chatham, MassDEP, and the CCC. Representatives from other towns may also be involved if they participate in regional solutions with Harwich. The TRC will meet as needed during the implementation phase, but not less than quarterly. The ultimate make-up and authority of the TRC will be determined by the town but the main purpose is to coordinate and monitor the various aspects of the recommended program. This task could be performed by the existing Wastewater Implementation Committee (WIC).

2. ***Water Quality Monitoring:*** Now that the MEP water quality monitoring program is complete, the Town plans to continue monitoring water quality at the sentinel and check stations. Monitoring will move from the detailed sampling program required for the MEP modeling to periodic monitoring to track the progress of the program's implementation. Monitoring of each sentinel and check station within Harwich is proposed seasonally for the duration of the implementation phase. Monitoring of freshwater ponds is also anticipated. The water quality monitoring plan will be formalized as a written document provided to the TRC for review and comment. This water quality monitoring, or a portion thereof, may also be required by the groundwater discharge permit for the effluent recharge site(s). The results of water quality monitoring will be reported to the TRC annually in writing.

3. ***Habitat Monitoring:*** The Town anticipates that MassDEP will continue eelgrass mapping, to assess the results of the recommended program's implementation. Benthic habitat monitoring may also be beneficial to evaluate the effects of the program's implementation. The feasibility and responsibility for such monitoring will be determined through discussion between the Town, CCC, and MassDEP.

4. ***Wastewater Treatment Plant/Groundwater Discharge Reporting:*** The Towns of Harwich and Chatham will be required through their groundwater discharge permits from MassDEP to develop

regular compliance reports. These reports, typically developed monthly, will be submitted to MassDEP. Information contained in these discharge monitoring reports will include monthly WWTP flow rates (average daily and monthly) and influent and effluent quality (including, at a minimum, biochemical oxygen demand, total suspended solids, and total nitrogen). In addition, the groundwater discharge permit will require monitoring at specific groundwater wells and possibly also surface water bodies downstream of the discharge. These requirements will be specified by MassDEP during development of the permit and are anticipated to include both water quality parameters and groundwater elevations. Groundwater and surface water monitoring reports, as well as monthly WWTP discharge reports from the previous calendar year, will be submitted annually to the CCC and the TRC. In addition, a baseline report will be submitted to the CCC and the TRC containing monitoring data prior to bringing the new WWTP online.

5. ***CWMP Implementation and Funding Status:*** The TRC will be provided an annual implementation progress report following each calendar year containing an update regarding the implementation of the recommended program and the status of the project's funding. This report will include the following items:

   - The total length of sewer main pipeline installed to date and the length installed during the reporting year;
   - The total number of parcels with sewer available and the increase during the reporting year;
   - The total number of parcels connected to the sewer system and the increase during the reporting year;
   - The number of parcels connected to the sewer system broken down by watershed, and the increase by watershed during the reporting year;
   - The average daily influent flow to the WWTP during the reporting year, and the long-term trend of average daily flow from the first year of operation of the WWTP through the reporting year;
   - The estimated nitrogen removal by watershed, based on the number of parcels sewered, the influent flow to the WWTP, and the effluent flow and nitrogen concentration to the recharge site(s);
   - A description and status update regarding any other infrastructure-related improvements undertaken during the reporting year, such as construction of the Muddy Creek bridge and structural stormwater controls, and an estimate of the associated nitrogen removal;
   - A description and status update of any non-infrastructure components of the recommended program implemented in the reporting year, such as public education, fertilizer use reduction, and stormwater management, and an estimate of the associated nitrogen removal;
   - Comparison of the estimated nitrogen removed to the results of water quality monitoring (with the understanding that due to groundwater travel times, results will not be immediate);

- The total dollar value of any funding approved during the reporting year for items associated with the recommended program;
- The approximate total dollar value of expenditures during the reporting year for items associated with the recommended program;
- An update regarding any regional initiatives; and
- The projects planned for the next two calendar years.

The previous year's Implementation Progress Report will be included with any Project Evaluation Forms submitted to MassDEP for CWSRF funding consideration.

6. ***Community Growth Status:*** Each year, concurrent with preparation of the implementation progress report, a written update will be prepared and submitted to the TRC describing community growth both in the community at-large and within the sewered areas. This report will list permitted renovations (building additions, redevelopment, etc.) both within and outside of the sewered areas, to assess if growth control strategies for the newly sewered areas are effective. Actual growth will be compared to the community buildout analysis. The report will also describe any changes to growth-management bylaws or regulations during the reporting year. This report will be used to determine if additional growth control or targeted growth strategies may be necessary.

7. ***CWMP Recommended Program Modifications:*** Based on the information provided, the TRC may recommend updates or modifications to the CWMP recommended program over the course of the implementation phase. This is the intent of the AMP, to assist the Town in evaluating compliance with TMDLs and identify the need for adjustments or mid-course corrections to subsequent phases of the structural or non-structural components of the recommended program. The proposed scope allows the recommendations to be periodically reviewed and updated to reflect the actual program results. This approach will result in the most efficient, cost-effective and successful implementation to achieve the necessary water quality results.

Note that the implementation of the 208 Plan and associated non-traditional technology piloting throughout Cape Cod may result in additional opportunities to reduce sewering through non-structural technologies, as discussed previously. Further consideration of such technologies will also be addressed via the adaptive management plan.

13.9 Alternative Technologies

The Town supports the use of newer alternative technologies. That concept has been incorporated into this program. The collection systems will utilize high efficiency motors and will be optimized for the expected wastewater flows. In addition, the wastewater treatment facility is proposed to use SBR and MBR technologies, which are newer technologies and provide advanced nitrogen removal compared to conventional activated sludge treatment facilities. In the past few years, the Town has explored the possibility of using a wind turbine and a solar photovoltaic (PV) array to offset a significant portion of the power needs of the Town. During the review process for solar and wind, the Town decided not to move forward with the installation of a wind turbine and instead decided to install a PV array at the Harwich Landfill which is also referred to as the HR-12 site in this CWMP/SEIR.

An update on the status of the solar PV project is provided below. Note that the renewable energy project is separate from the CWMP construction cost estimates and phasing contracts and will require a separate permitting and review process.

13.9.1 Solar Photovoltaic Array

The Town understands that it has a responsibility to continually look to improve its services, develop sustainable long-term solutions, and set a positive example for the community. In July of 2011, the Town entered into an energy management service agreement between Cape and Vineyard Electric, Inc. (CVEC) and Cape Solar Two. A copy of the executed solar power agreement is provided in Appendix F.

The Harwich photovoltaic (PV) project is a 3.96 MW solar electric generation facility that will be located at the closed landfill on the western portion of the HR-12 site. This site is also the site of the proposed wastewater facility in Harwich. The solar PV facility will consist of approximately 14,000 solar panels mounted on the ground. The system will be designed to meet all local state and federal codes and regulations.

The agreement was executed through the CVEC which was formed out of a strategic planning process commissioned and undertaken by the Cape Light Compact because it wanted to stabilize electric rates for all its members and ratepayers with renewable energy generation. At the time, neither the Cape Light Compact, nor its member towns/counties, could develop electric generation projects and enter into long-term power purchase agreements. The Cape Light Compact is an active member of CVEC.

The 20 year energy management service agreement specifies that the Town, through CVEC, is entitled to purchase 3,910,000 kWh/year at an energy price of 6.90 cents per kilowatt hour. The agreement also specifies that the Town will receive all net metering credits for the energy generated at the site.

The solar array has not been constructed at this time, but it will ultimately provide the Town with a significant energy savings over the life of the project.

It is estimated that the Harwich PV project could save the Town up to $300,000 per year in electricity costs. The Town's current electric bill is about $850,000 a year. This project will also realize a significant reduction in greenhouse gas emissions for the Town and is being included as part of the CWMP/SEIR recommended plan for greenhouse gas reduction. Further discussion of greenhouse gas reduction associated with this CWMP/SEIR is provided in Section 14.

13.10 Alternatives to the Recommended Program

Over the course of the CWMP development, the Town considered many alternatives to the system layouts and locations, to the selection of appropriate technologies for wastewater conveyance and treatment, to effluent recharge sites and uses, and to cost recovery approaches. Each of these alternatives is discussed in detail in the pertinent sections of this report. This section focuses on the large-scale alternatives to the recommended program. Specifically, the No-Build Alternative, regional alternatives, and options to sewering either more or less of the Town are discussed.

13.10.1 No-Build Alternative

The No-Build alternative involves the continued use of onsite Title 5 septic systems and innovative and alternative (I/A) systems where needed to meet the wastewater needs of the community. MassDEP indicates that the baseline, or No-Build, alternative, which focuses on optimization of existing facilities, should be evaluated "with respect to potential effects on surface water quality; groundwater quality (if applicable); land use limitations; and socio-economic factors (e.g., residential, industrial, and health hazards)." None of these factors can reach an acceptable level of service under the No-Build alternative.

As shown in Figure 13-6, on-site treatment technologies cannot reliably meet the stringent nitrogen reduction standards on thousands of individual lots that are possible with more centralized, municipally-run treatment systems. While some I/A systems exist which provide better nutrient reduction than a typical Title 5 system, they still fall short of the requirements since they do not remove the 50 to 100 percent of the septic nitrogen load that is required in the MEP reports for Harwich. In Section 10, it was demonstrated in Scenario 7A that I/A systems could be utilized in all of the MEP studied watersheds except Wychemere Harbor which requires 100% removal of septic nitrogen. The analysis of Scenario 7A demonstrated that, while possible, I/A systems would still need to be supplemented with conventional wastewater treatment in order to achieve the TMDL. In that scenario, conventional wastewater treatment was minimized and the use of I/A systems was maximized. After reviewing that scenario, the Town decided not to pursue the I/A scenario because the cost was the highest among all options considered.

As such, continued use of on-site systems town-wide would not be cost effective to achieve the nitrogen levels required to restore the local embayments to the highest and best use water quality goals described in the MEP documents. Based on this data, surface water quality cannot be adequately maintained using the No-Build alternative. In addition, the slightly elevated levels of nitrogen found in the town's drinking water supply and described in Section 10 suggest that nitrates in drinking water in Harwich could potentially become elevated over the long-term, particularly in areas where higher density development is desired. It is important to note that the need to protect drinking water quality in Harwich is not a significant driver for sewering at this time.

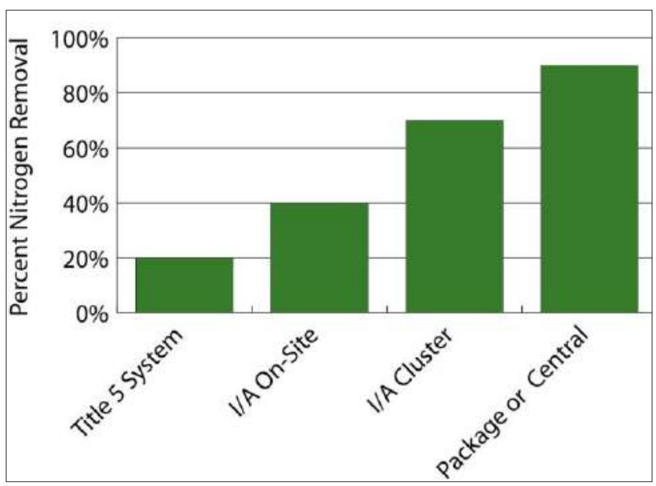


Figure 13-6
Percent Nitrogen Removal
For Several Treatment Technologies

The No-Build alternative also presents land use limitations, specifically in the East Harwich Village Center, the Campground area, the Route 28 corridor including Harwich Port and other areas of desired growth throughout town. Without off-site wastewater management options, desired land uses are expected to be severely restricted by Title 5.

The Town relies on tourism for jobs and revenue which is the direct result of the high quality natural resources on Cape Cod. Furthermore, many residents choose to reside in Harwich due to its natural beauty and the recreational opportunities afforded by its beaches, ponds and scenic waterways. Protection of these resources is critical to the health and well-being of the Town. While the No-Build Alternative is obviously the least expensive option when only considering capital costs, the long-term impact on the economic viability of the Town must also be considered, along with the many qualitative factors related to aesthetics, quality-of-life, and environmental preservation. The No-Build Alternative would not adequately preserve these valuable resources, would be in violation of the TMDL requirements for the Town's five embayments, and is not considered a viable option by state, county, and local officials.

13.10.2 Regional Solutions

In the recommended plan, the Town has explored the feasibility of a regional solution to address the wastewater needs identified in the Herring River and Pleasant Bay watersheds. The first is a regional treatment solution with the Town of Dennis for the western portion of the proposed sewer area that falls within the Town of Dennis limits. The recommended wastewater plan presented herein assumes that the Town of Dennis will collect wastewater in the Dennis Port area and will recharge the treated effluent in a watershed outside of the Herring River. This assumption is only preliminary and further discussions with the Town of Dennis will be required as the Town moves forward with development of their CWMP.

Harwich is also communicating with Dennis and Yarmouth about a potential regional treatment facility located at the Dennis DPW site. These discussions are in the preliminary stages.

The second is a regional solution with the Town of Chatham for areas within the Pleasant Bay watershed, which is shared among Brewster, Chatham, Harwich and Orleans. The recommended wastewater plan presented in this CWMP/SEIR assumes that the Town will collect wastewater from the Pleasant Bay watershed and will send it to Chatham for treatment to a total nitrogen concentration of 3 mg/l. The treated effluent will then be recharged in Chatham for the early phases of the project if timing and phasing of the projects permit. For the later phases of the project, the treated effluent may be required to be recharged back in the Pleasant Bay watershed to ensure that the TMDL limits are not exceeded. Discussions with the Town of Chatham are in process. At this time, both communities understand the benefits of utilizing a regional solution and both communities are actively pursuing an Inter-Municipal Agreement (IMA).

13.10.3 Construct a Smaller or Larger Sewer Service Area

Over the course of the CWMP process, the Town explored many alternatives to the two wastewater treatment plant program ultimately recommended. Smaller, decentralized service areas with smaller treatment facilities were explored in detail in Section 10, where the Town looked at the scenario of having four different wastewater treatment plants and four different effluent recharge sites. An option with one centralized facility with an ocean outfall was also explored. In Scenario 7A, hundreds of treatment and effluent recharge locations were considered under the highly decentralized on-site I/A scenario. The cost for these decentralized approaches to wastewater management was higher than scenarios 3A, 4A and 5A which utilized no more than two centralized treatment facilities and no more than two effluent recharge sites. It should be noted that the two treatment facilities in the recommended program are relatively small and are less than 1.0 mgd average daily flow. The Town also felt that the effluent recharge sites were ideal sites when compared with the other sites considered for effluent recharge. The other effluent recharge sites were more limited in terms of land use, land area redundancy and their potential to accept effluent flow.

The recommended program is already estimated to cost the Town $180 to $230 million over the course of the 40 year implementation period, and any increase in treatment and disposal cost was rejected in favor of a system that utilizes two treatment and two effluent recharge locations for simplicity. Furthermore, the benefit of decentralized treatment of promoting local recharge to groundwater is not inherently consistent with the MEP goal of reducing nitrogen inputs in specific locations. By providing centralized treatment and effluent recharge in only two sites, nitrogen loading to local waterways can be closely monitored and controlled. It also allows for future treatment of personal care products or other constituents should that be required.

On the other end of the spectrum is the remote possibility of sewering the entire town. Based on the analyses performed as part of this CWMP/SEIR, there are no documented reasons at this time with respect to environmental protection or public health to sewer areas beyond those currently proposed. Sewering areas beyond those necessary to protect the local embayments, to allow for additional growth in East Harwich Village Center, the Route 28 corridor including Harwich Port and to address limited Title 5 or pond water quality issues, is considered cost-prohibitive and would provide no apparent benefit at this time to the Town. The Town is confident that, based on several years of analysis, the CWMP recommended program strikes the proper balance between providing sewers in the areas where they are needed and promoting continued septic system use in the areas where lower cost and lower technology strategies remain appropriate.

Section 14

Environmental Impact Analysis and Mitigation

14.1 Introduction

The Town of Harwich ("the Town") is submitting this Comprehensive Wastewater Management Plan (CWMP) and SEIR concurrentfiguly, to coordinate review by MassDEP, the Executive Office of Energy and Environmental Affairs MEPA Unit, and the CCC. These documents were prepared based on the scope defined by MEPA in the April 12, 2013 Certificate on the Draft CWMP/Expanded Environmental Notification Form submitted in February 2013.

In 2007, the Town contracted with CDM Smith and began developing the CWMP to guide the decisions pertaining to wastewater management over the next 40 years, with a focus on mitigating nitrogen discharges to coastal waters. This work has been driven mostly by the significant population growth on Cape Cod and resulting development that has occurred since 1951. The population of Harwich increased 400 percent from 1951 to 1999; as of 2012, the number of year-round residents is about 12,700 with an estimated seasonal increase to 37,000.

With the exception of a few small package wastewater treatment facilities, the Town does not have a municipal wastewater collection and treatment system and instead relies on traditional Title 5 on-site septic systems for wastewater management. Nitrogen leaching from those on-site systems into the groundwater has resulted in negative impacts to the Town's saltwater estuaries and embayments; these negative impacts, in turn, affect the quality of life of residents and are beginning to impact the tourist economy. There have also been early signs of impacts to drinking water quality and freshwater ponds. Also of concern are Title 5 septic system compliance issues and the ability to provide appropriate wastewater management for desired economic development.

A major driver of this wastewater planning process is the Massachusetts Estuaries Project (MEP) that MassDEP and SMAST are conducting on 89 estuaries in southeastern Massachusetts. The goal of this program is to evaluate the pollutant status and sensitivity of the estuaries through comprehensive water quality testing and quantitative modeling, with the main focus on nitrogen. The results of the MEP assessments will require municipalities to remediate excessive nutrient inputs to restore water quality in estuaries, largely through expanded wastewater management. Upon review by MassDEP, thresholds for nitrogen loadings and reduction percentages needed for each watershed will be incorporated into Total Maximum Daily Load (TMDL) permits that municipalities will be required to meet.

MEP reports for five watersheds in Harwich are complete, and the recommended reductions in septic system nitrogen are as follows: Allen Harbor, 78 percent; Wychmere Harbor, 100 percent; Saquatucket Harbor, 58 percent; Pleasant Bay, 65 percent; and Herring River, 58 percent. Modeling for the Saquatucket Harbor watershed assumed modifications to abandoned cranberry bogs in the Cold Brook that will increase natural nitrogen attenuation by maximizing the residence time in the bog and stream network. Modeling for the Pleasant Bay watershed assumed that the inlet to Muddy Creek would be expanded to increase tidal flushing. (This project is currently under construction) Within the

Herring River watershed, the area north of Route 28 is considered to be a healthy ecosystem; however, the lower tidal reach south of Route 28 is significantly impaired.

Other drivers for the CWMP include protecting drinking water supplies, improving and protecting freshwater pond water quality, and Title 5 compliance. All of Harwich's residents rely on groundwater supplies for drinking water, with the majority relying on municipal supply wells. A reduction in onsite septic system inputs into the groundwater will result in a beneficial reduction of all of the compounds and contaminants contained in wastewater effluent including nitrogen, phosphorus, bacterial and viral constituents, and contaminants of emerging concern (CEC's) such as pharmaceuticals and personal care products.

Phosphorus is the nutrient of primary concern in freshwater systems, as it can result in significant plant and algae growth and can cause a shift in trophic status from oligotrophic (low nutrient) to mesotrophic (moderate nutrient) to eutrophic (overly enriched). Currently, four of Harwich's freshwater ponds are considered eutrophic or at risk of moving towards a eutrophic conditions; however, data is not available for many ponds. In addition, three developed areas of Harwich around Paddocks Pond, John Joseph Pond, Bucks Pond, Sand Lake, Long Pond, Seymour Pond, and Hinkleys Pond have been identified that are of potential concern for pond health. A waterbody assessment has been performed for Hinkleys Pond. None of the ponds in the CWMP have had a TMDL developed.

Areas along the southern coast and south of Route 28 present challenges for Title 5 compliance. Dense development on small lots and shallow groundwater limit the ability to design and construct onsite septic system upgrades in compliance with Title 5 and local Board of Health regulations.

14.2 Existing Environment

The Town of Harwich is in the center of Cape Cod and is bordered by Nantucket Sound to the south, the Town of Dennis to the west, the Town of Chatham to the east, and the Town of Brewster to the north. The town consists of 21 square miles and has approximately 11 miles of tidal shoreline, four harbors, 22 freshwater ponds, two reservoirs, and two scenic river corridors (Herring River and Muddy Creek).

According to the 2010 U.S. Census, the Town has a population of 12,243 people, which is one percent less than the 2000 Census. The 2005-2009 American Community Survey 5-Year Estimates document 9,652 housing units, 58 percent occupied and 42 percent vacant. The vacant housing units most likely reflect seasonal homes considering that the total population of Harwich increases to approximately 37,000 people in the summer months. The median household income in 2009 was $53,607. Harwich is primarily residential, with a seasonal tourist population that accounts for a large portion of the local economy.

Based on data in the Town's Geographic Information System (GIS), there were approximately 9,000 developed parcels out of 11,600 in Harwich in 2011. This constitutes the Town's best estimate of the number of on-site wastewater treatment and disposal systems in town. This number includes 28 parcels that have on-site package treatment facilities. Five of these parcels operate systems designed to handle over 10,000 gallons per day (gpd), the state's threshold for regulation by MassDEP via a groundwater discharge permit. The remaining 23 systems are under the jurisdiction of the Harwich Board of Health Rules and Regulations. A complete description of lot density and size and wastewater management data is presented in Section 3.

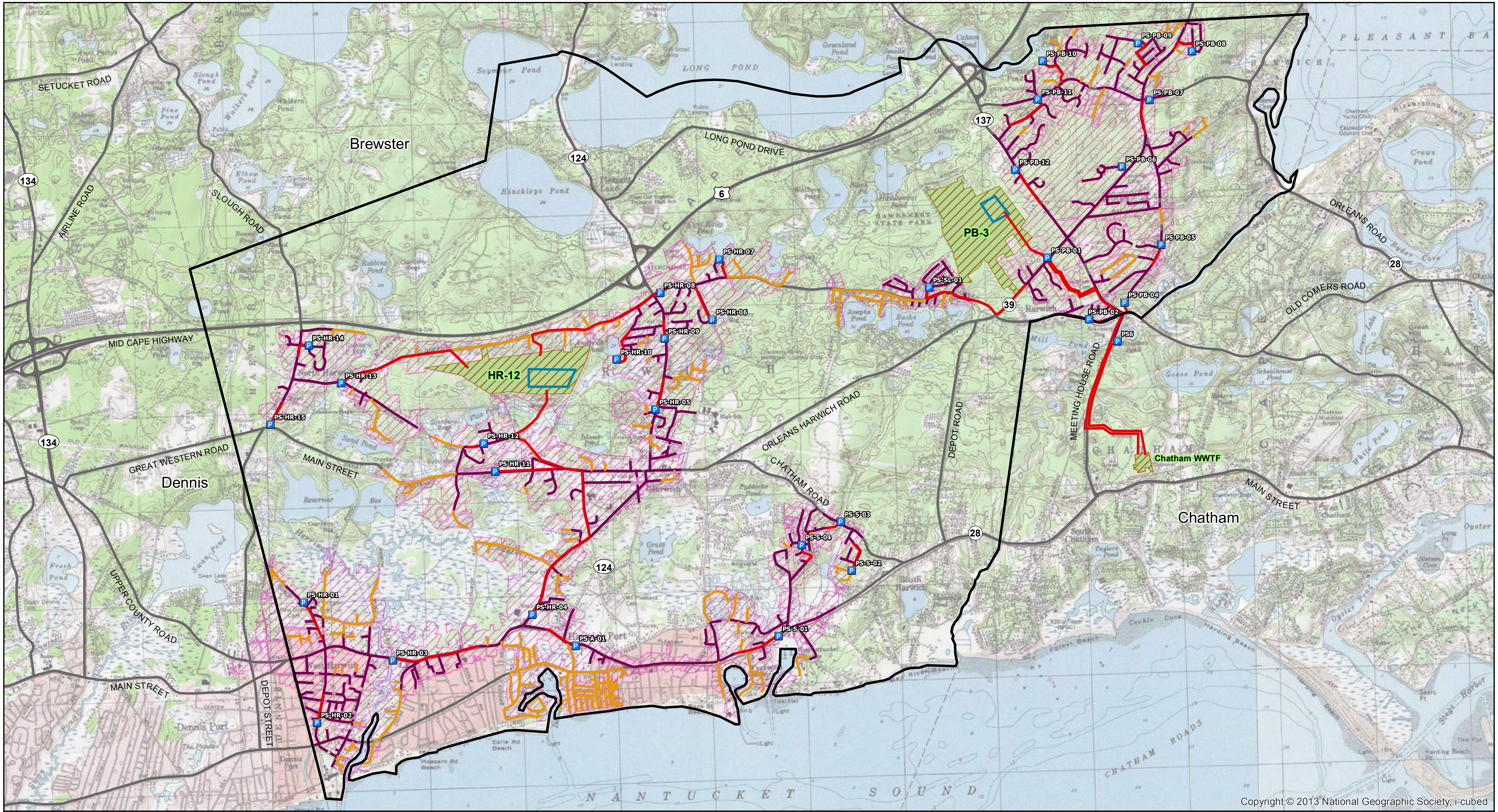
The landscape of Harwich, like most of Cape Cod, was formed by the last continental glacier and the rise in sea level that followed glaciations. The moving ice scraped the ground and picked up the bedrock of southern New England as glacial and postglacial drift. Natural Resources Conservation Service (NRCS) mapping indicates that the majority of Harwich consists of Carver type soils. These soils are nearly level to steep, very deep, excessively drained, sandy soils formed in glacial outwash and ice contact deposits, on outwash plains and kames. The NRCS soil description for Carver soils includes limitations for septic tank absorption fields due to rapid permeability which can result in bacterial pollution of groundwater. A triangular area including Herring River and its watershed consists of Ipswich-Pawcatuck-Matunuck soils (consistent with low-lying wetland and bog areas along the Herring River). These soils are nearly level, very deep, very poorly drained peats formed in marine organic and sandy deposits, in areas sheltered from ocean waves along coastal shorelines and adjacent to bodies of brackish water. The south coastal beaches in Harwich are described as having Hooksan-Beaches-Dune soils. These soils are beaches, dune land, and nearly level to steep, drained, sandy soils formed in windblown deposits along coastal shorelines.

Harwich contains both freshwater and coastal wetlands. Wetlands are concentrated in the southwest portion of the town, where there are large freshwater marsh, salt marsh, and wooded marsh complexes. Smaller areas of these wetlands are present in other areas of town as well, as are areas of cranberry bogs. Beaches and dunes occur along Nantucket Sound. Many ponds are present in Harwich as well.

14.3 Project Summary and Alternatives

This CWMP in its entirety consists of centralized wastewater collection and treatment, natural attenuation improvements, pond restoration/protection, improved stormwater management, public outreach, and continued on-site septic system support. The various components of the CWMP will be implemented in an eight phase approach over a minimum of 40 years, allowing for tailoring of these components using an adaptive management strategy. Below is a summary of the preferred alternative. A summary of the phasing of all of the components of the CWMP is presented in the Executive Summary; details of the phasing for each component are contained within the individual sections.

Wastewater collection and treatment represents the largest component of the CWMP. The Town proposes to collect and treat approximately 1.26 mgd of wastewater by constructing a new WWTF at parcel HR-12 and also sending flow to the existing WWTF in Chatham. Approximately 92 miles of sewer mains (as a combination of pressure and gravity sewers) would be constructed along with 33 pumping stations. Treated wastewater would be recharged to groundwater at the WWTF locations and at a new third location in east Harwich. The locations of the proposed sewer mains, WWTFs and recharge facilities are shown in Figure 14-1. The construction of the new WWTF, expanded WWTF in Chatham, recharge areas, and sewer mains will be implemented in seven phases (Phases 2 through 8); these phases are described in detail in Section 13.4. The WWTF has a preliminary estimated gross floor area of approximately 14,000 square feet based on other similar facilities; however, the Harwich WWTF has not yet been designed. The effluent recharge facilities will consist of open basins for infiltration. Pumping stations will be either constructed underground or constructed in a small building approximately 25 feet by 25 feet in size.



Legend

- Pump Station
- Force Main
- Pressure Sewer
- Gravity Sewer
- Roads
- Town Boundary
- Recharge Site
- Proposed Sewer Parcels
- Treatment / Effluent Recharge Parcels

Town of Harwich Comprehensive Wastewater Management Plan

0 1,250 2,500 5,000 Feet

Figure 14-1

USGS Map Background

CDM Smith

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Natural attenuation projects are planned for Cold Brook and Muddy Creek. The Cold Brook attenuation project involves increasing residence time of freshwater flowing through the system by creating depositional basins (ponds) within the Cold Brook bog system. Preliminary discussions with the Harwich Conservation Trust (which owns the land) and ongoing study efforts will determine specific sites where ponds could increase nitrogen removal via denitrification. As a result, the nitrogen attenuation rate in Cold Brook could be increased from 35 percent to 50 percent, thereby reducing the needed service area for sewers. The exact locations of the proposed created depositional ponds have not yet been determined, but they would be within the Bank Street former cranberry bogs, located on the east side of Bank Street.

The Muddy Creek natural attenuation project involves removing nitrogen from the system by increasing tidal flushing. The project would replace two 4-foot culverts with a 24-foot opening. This project will occur during Phase 1 (ongoing), for which a MEPA Phase 1 waiver has been granted.

Freshwater pond restoration/protection is included in the CWMP. This program will include continuing water quality sampling, developing an inventory of stormwater pipes draining to ponds, investigating other potential contaminant sources, and determining which uses and ponds should be supported by the program. Programs would then be implemented to restore water quality in the ponds studied. The Hinckleys Pond restoration project is proposed for implementation in Phase 1 of the CWMP, the potential Seymour Pond restoration project is proposed for implementation in Phase 3, and Bucks Pond and John Joseph Pond restoration projects are proposed for implementation in Phase 6. A detailed assessment of freshwater ponds in Harwich is presented in Section 5.

The CWMP includes improving stormwater management by using BMPs. The Stormwater BMP program will focus on the best application of BMPs at the drain features throughout Harwich and will target those portions of town located upstream from the most sensitive water sources. Several stormwater controls and/or practices will be used on all new work. The Town will decide which types of BMPs are most appropriate, but they may include deep sump drainage basins, detention pond infiltration basins, porous pavement, bio-retention and vegetated basins, and cleaning catch basins. These potential BMPs are further discussed in Section 13.7.

The public outreach component of the CWMP includes educating the public on the need to address nutrient pollution and the role that the wastewater program will play in reducing nutrients in the watersheds of Harwich. Fertilizer education is also a component aimed at reducing over-fertilization and fertilizer runoff. Other elements include low impact landscaping and water conservation. The public outreach and fertilizer education programs are further discussed in Section 13.7.

On-site septic system support by the Harwich Health Department will continue for the Title 5 septic systems that will remain after the wastewater program is fully implemented. This support will include guidelines for existing septic system maintenance and information on Title 5 inspections.

Throughout the CWMP initiative, the Town considered many alternatives to the system layouts and locations, appropriate technologies for wastewater conveyance and treatment, effluent recharge sites and types, and cost-recovery approaches. Each alternative is discussed in detail in the pertinent section of this report. Section 13.10 focuses on the large-scale alternatives to the Recommended Program. Specifically, the No-Build Alternative, regional alternatives, and options of sewering either more or less of the town are discussed.

14.4 Land Use

The population of Harwich has grown substantially since 1951, from 2,300 full-time residents to 12,700, representing an increase of over 400 percent. In 1951, residential areas were primarily clustered along the southern portion of the town, with other areas consisting of large tracts of forest. Today, areas of residential development are present over large portions of the Town. Economic centers are currently located in Harwich Center, East Harwich Center, and Harwich Port. Current land use patterns are shown in Figure 14-2, and lot development density is shown in Figure 14-3. Large tracts of conservation land are located west/southwest, south, and southeast of Sand Lakes, around the East Reservoir, at Cold Brook, and east of East Harwich Center. Smaller areas of conservation land are scattered throughout Harwich. The locations of conservation lands are shown in Figure 14-4.

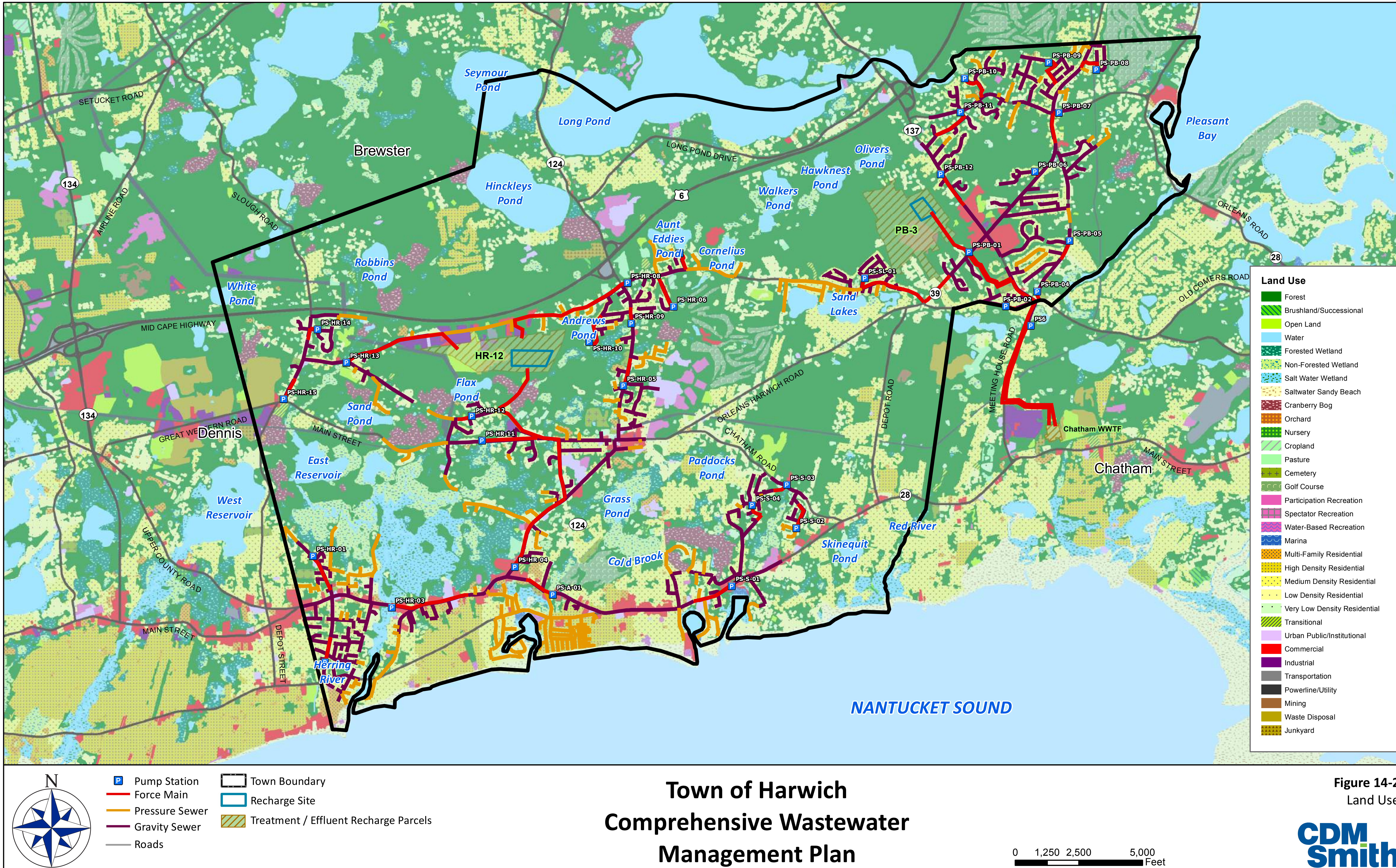
This CWMP was developed to be consistent with the Town of Harwich Local Comprehensive Plan. Facility sites were selected in part to be in keeping with the plan, and the proposed areas to be sewered will support existing land uses or areas targeted by the local comprehensive plan for additional development.

The proposed new WWTF to be located on parcel HR-12 would be situated on land that is currently mature pine-oak forest. The capped Harwich landfill is located on the western part of this parcel. The land to the east of HR-12 is also forested and to the south lies a mix of forest and cranberry bogs. To the north is a mix of commercial, industrial, and residential lots along Queen Anne Road. Slightly west on Queen Anne Road, north/northwest of the capped landfill, uses are mostly industrial in nature. Lots surrounding HR-12 are almost all greater than 2 acres in size. HR-12 is not adjacent to any conservation lands.

Development of a WWTF and associated groundwater recharge facility at HR-12 should not have a negative impact on surrounding land uses. It would be consistent with the nearby industrial development and the adjacent capped landfill. The small areas of commercial and residential uses to the north on Queen Anne Road will be buffered from the WWTF by forest. It is estimated that the recharge facility at HR-12 will be approximately 20 acres.

The proposed effluent recharge facility for PB-3 would be situated on land that is currently forested. The land immediately surrounding this facility is largely forested. A residential community is located to the north and northeast. East Harwich Center, a large commercial area, is located to the east and southeast. Additional residential communities are located beyond the adjacent forested area to the south and southwest (In the vicinity of Queen Anne Road and Orleans-Harwich Road). Lots surrounding the forested area at PB-3 vary from 10,000 to 20,000 sf in the residential community to the southwest and a mix of sizes (mostly 20,000 sf to larger than 2 acres) to the south, east, and north. To the west, lots are greater than 2 acres in size. This land to the west consists of state-owned conservation land.

Development of an effluent recharge parcel at PB-3 should not have a negative impact on surrounding land uses. While PB-3 is a large site, the recharge facility would be located on an approximately a 10-acre area parcel with infiltration basins occupying 2 to 4 acres. A forested buffer would remain between the recharge facility and surrounding land uses. Multiple parcels in PB-3 have been identified and to date, the town has been unsuccessful in acquiring one. Therefore, all potential effluent recharge sites in East Harwich are still under consideration.



Town of Harwich
Comprehensive Wastewater Management Plan

Figure 14-2
Land Use

CDM Smith

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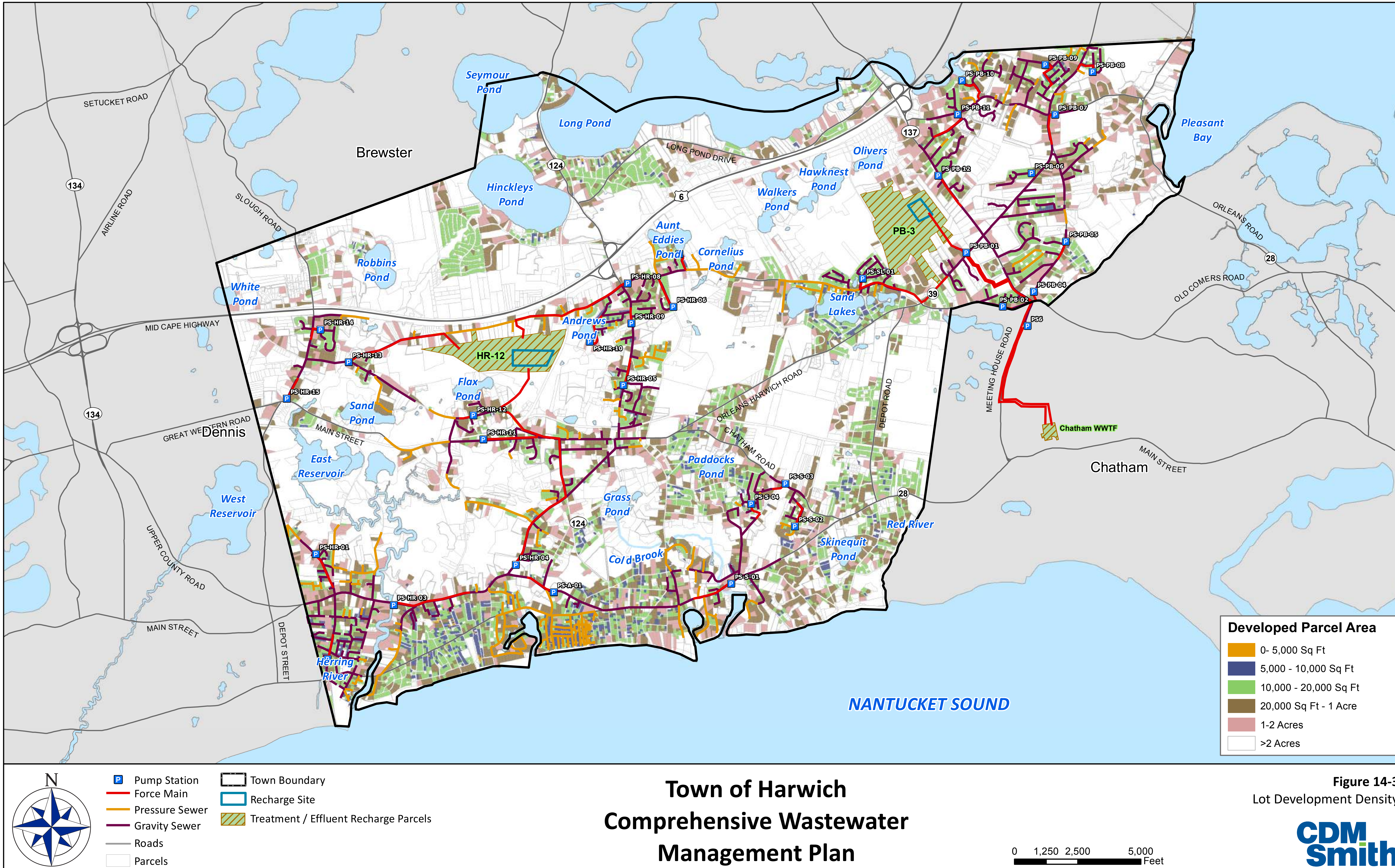

Town of Harwich
Comprehensive Wastewater Management Plan

Figure 14-3
Lot Development Density

CDM Smith

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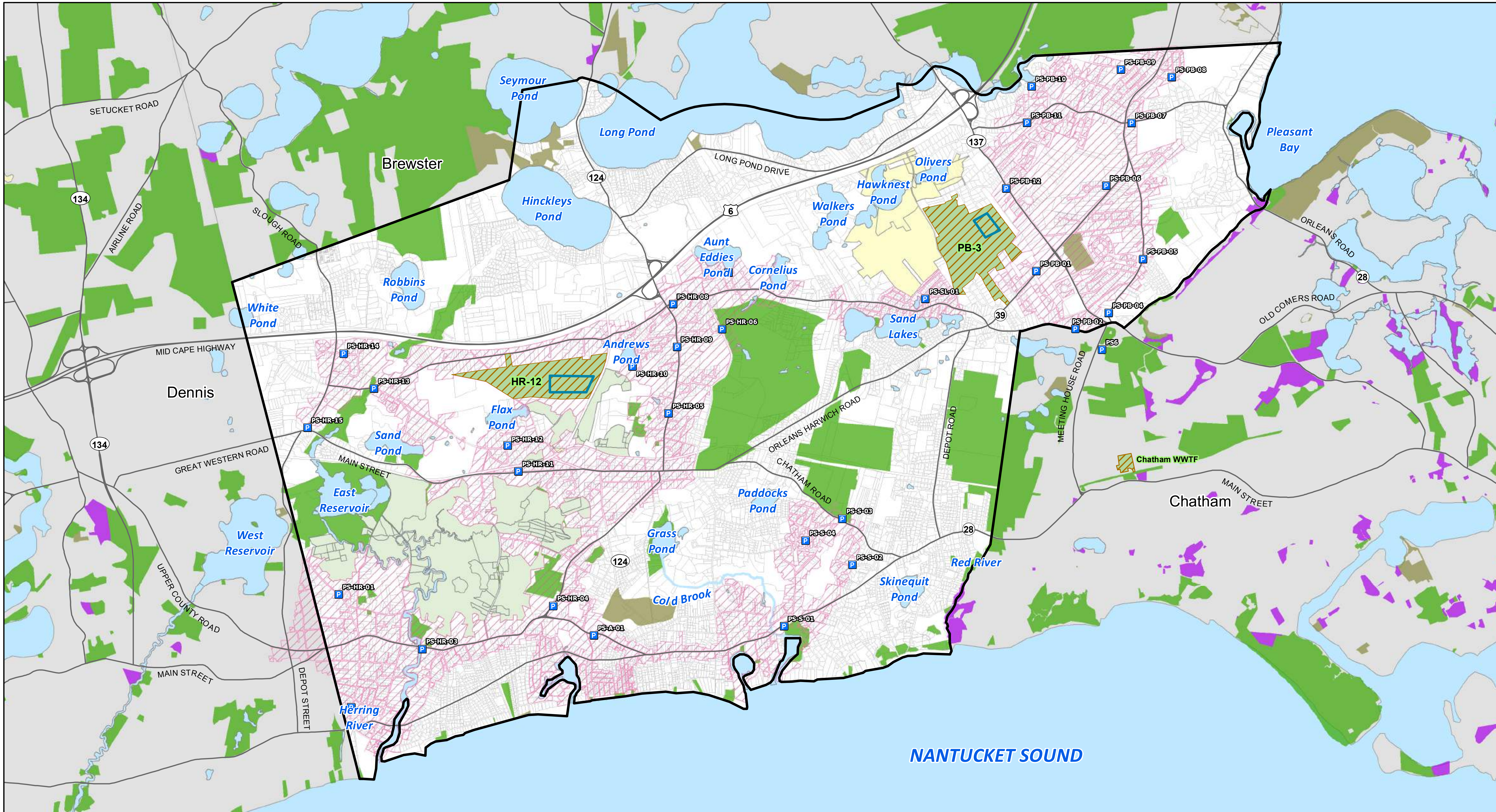

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Pump Station
Town Boundary
Recharge Site
Proposed Sewer Parcels
Treatment / Effluent Recharge Parcels

Conservation Lands

Land Trust
Municipal
Private
State

Town of Harwich Comprehensive Wastewater Management Plan

0 1,250 2,500 5,000 Feet

Figure 14-4
Conservation Lands

CDM Smith

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The existing Chatham WWTF is located east of a large industrial area. To the east is an open area beyond which is the Chatham capped landfill with a solar panel installation and Transfer Station and Recycling Center. To the north is a forested area, and to the northwest a small residential community. The WWTF is bordered to the south by the Old Colony Rail Trail; a few residences are located to the south on the other side of the trail. To the southwest is a junkyard.

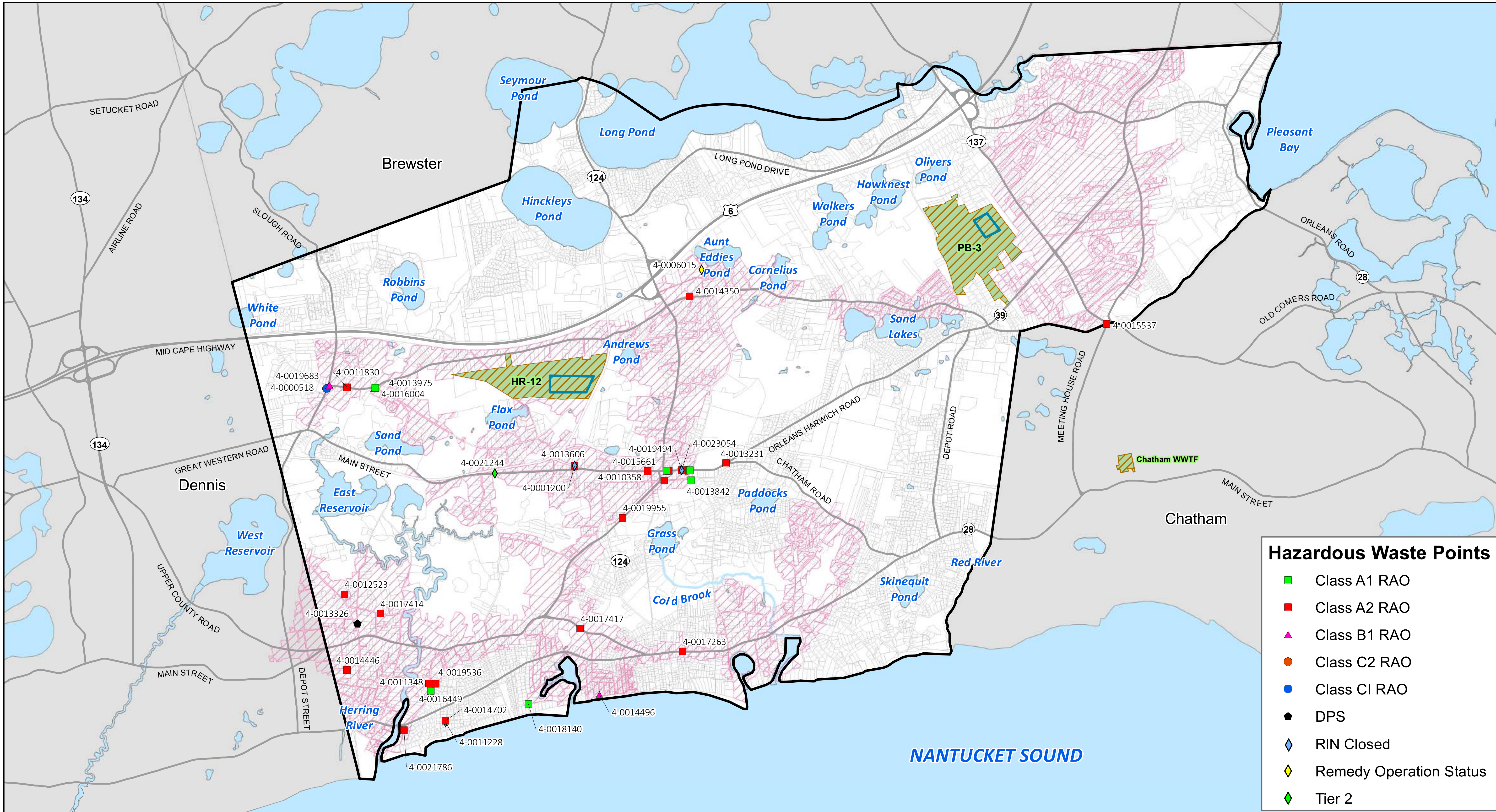
Eventual expansion of the Chatham WWTF should not have a negative impact on surrounding land uses, and will be consistent with the industrial/waste management uses that currently exist in this area. The expansion will be planned such that it will not interfere with uses of the Old Colony Rail Trail.

The proposed sewer lines will run through areas that are primarily residential. Since the sewer lines themselves will be located within the existing roads, they will not create a negative visual impact in these neighborhoods after construction is complete. The majority of the sewered areas in residential neighborhoods are near buildout condition, so the availability of sewers will not greatly affect land uses. The economic centers of Harwich represent an exception to this, however. Harwich Center, East Harwich Center, and Harwich Port are areas designated by the Town for planned growth and economic development in a manner that enhances pedestrian culture and a positive experience for residents, business owners, and visitors. The availability of sewers in these areas is consistent with supporting the type of growth desired by the Town.

The pumping stations planned within the areas to be sewered will generally be built within the road right-of-way. These stations will be small; many will be located underground. A large pumping station could be approximately 625 square feet in size.

14.4.1 Known Hazardous Waste Sites in Harwich

The Town considered the potential for encountering contamination during construction of the wastewater collection and treatment systems. The town has identified known hazardous waste sites governed by the Massachusetts Oil and Hazardous Material Release Prevention and Response Act (M.G.L. c. 21E) in the vicinity of the project areas. Figure 14-5 shows the location of the hazardous waste sites by number and includes a listing of each site's regulatory compliance status and Remedial Action Outcome (RAO) status. Table 14-1 outlines hazardous waste sites in Harwich, including an indication as to which sites are within the project area.



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Town Boundary
Recharge Site
Proposed Sewer Parcels
Treatment / Effluent Recharge Parcels
Parcels
Roads

Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-5
Hazardous Waste Sites

0 1,250 2,500 5,000 Feet

CDM Smith

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Table 14-1
MGL 21E – Hazardous Waste Site Listing Harwich, MA

Within Project Area	Release Tracking Number	Address	Site Name Location Aid	Compliance Status	Phase	RAO Class	Chemical Type
	4-0000095	WEST OF RTE 24	HARWICH SANI LANDFILL	ADEQUATE REG			
	4-0000096	OFF CHATHAM RD	THOMPSON FIELD FARM	DEPNFA			
	4-0000493	SNOW INN RD	WYCHMERE HARBOR	RAO	PHASE II	A2	
	4-0000494	PLEASANT LAKE AVE	CAPE COD TECH HIGH SCHOOL	DEPNFA			Oil
X	**4-0000518**	**622 DEPOT ST**	**RESIDENCE**	**RAO**	**PHASE IV**	**C1**	**Oil and Hazardous Material**
	4-0000842	731 MAIN ST RTE 28	MOBIL STATION 01 602 FMR	RAO		C2	Oil
	4-0000950	435 MAIN ST	SUNOCO SERVICE STATION	RAO	PHASE IV	A2	
	4-0001042	8 SATUCKET RD	DALE RESIDENCE	RAO	PHASE II	A2	
X	**4-0001200**	**570 MAIN ST**	**HARWICHPORT TEXACO STATION**	**RAO**	**PHASE V**	**A2**	
X	**4-0006015**	**321 OAK STREET EXT**	**PROPERTY**	**REMOPS**	**PHASE V**		
	4-0006063	81 RYDER RD	PROPERTY	RAO	PHASE II	A2	
	4-0010331	29 RED RIVER RD	OFF RTE 28 NEAR DEPOT RD	RAO	PHASE II	A2	Oil
X	**4-0010358**	**678 MAIN ST**	**AT WYCHMERE HARBOR DRIVE**	**RAO**		**A2**	**Oil**
	4-0010404	182 RTE 37	STAGGS AUTO CHEVY	RAO		A2	Oil
	4-0010422	37 AYER LN	OFF RTE 28	RAO		A2	Oil
	4-0010593	94 PARALLEL ST	NO LOCATION AID	RAO		A2	Oil
	4-0010748	715 MAIN ST	SAQUATUCKET HARBOR	ADEQUATE REG			Oil
	4-0010810	335 LOWER CTY RD	ALLENS HARBOR	RAO		B2	Oil
X	**4-0011228**	**RIN CLOSED**					
X	**4-0011348**	**69 CHASE ST**	**LOWER COUNTY RD**	**RAO**		**A2**	**Oil**
	4-0011443	709 MAIN ST	NO LOCATION AID	RAO		A2	Oil
	4-0011609	578 MAIN ST	RTE 28	RAO		A1	Oil
	4-0011728	21 PLEASANT PARK RD	CANTO RESIDENCE	TIER 2	PHASE II		Oil
X	**4-0011830**	**97 MAIN ST**	**BOX PTY**	**RAO**		**A2**	**Oil**
	4-0012092	219 MAIN ST	RTE 28 & GREY NECK RD	URAM			Oil
	4-0012130	219 MAIN ST	GAS STATION FMR	RAO		B1	Oil
X	**4-0012523**	**4 NEVINS AVE**	**NO LOCATION AID**	**RAO**		**A2**	**Oil**
	4-0013026	11 CRANBERRY LN	NO LOCATION AID	TIER1D			Oil
	4-0013191	120 FOREST ST	NO LOCATION AID	RAO	PHASE II	A1	Oil

Within Project Area	Release Tracking Number	Address	Site Name Location Aid	Compliance Status	Phase	RAO Class	Chemical Type
X	**4-0013231**	**805 MAIN ST**	**N/F KELSEYS GARAGE**	**RAO**	**PHASE V**	**A2**	**Oil and Hazardous Material**
X	**4-0013326**	**9 BELLS NECK RD**	**RTE 25 & DEPOT ST**	**DPS**			**Hazardous Material**
X	**4-0013606**	**570 MAIN ST**	**TEXACO STATION**	**RTN CLOSED**			**Oil**
	4-0013730	578 MAIN ST RTE 28	HARWICHPORT	RAO	PHASE II	A2	Oil
	4-0013838	10 MARISOL RD	VIAU RESIDENCE	RAO		A2	Oil
	4-0013842	327 BANK ST	HARWICH CTR	RAO		A1	Oil
X	**4-0013975**	**219 MAIN ST**	**ROUTE 28**	**RAO**		**B1**	**Oil**
X	**4-0014350**	**482 QUEEN ANNE RD**	**NO LOCATION AID**	**RAO**		**A2**	**Oil**
X	**4-0014446**	**20 ELWOOD RD**	**NO LOCATION AID**	**RAO**	**PHASE II**	**A2**	**Oil**
X	**4-0014496**	**5 COTTAGE AVE**	**NO LOCATION AID**	**RAO**		**B1**	**Oil**
X	**4-0014707**	**20 PLEASANT RD**	**OFF RTE 28 / TERN RD**	**RAO**		**A2**	**Oil**
	4-0014750	11 GORHAM RD	RESIDENCE	RAO	PHASE II	A2	Oil
	4-0014900	739 MAIN ST	BROOKS LIBRARY	RAO		A1	Oil
	4-0015090	5 HATHAWAY RD	NO LOCATION AID	RAO		A2	Oil
	4-0015286	9 ORTON RD	SUMMER HOME	RAO		A2	Oil
	4-0015315	994 QUEEN ANNE RD	NO LOCATION AID	RAO		A2	Oil
X	**4-0015537**	**RTE 137**	**NO LOCATION AID**	**RAO**		**A2**	**Oil**
X	**4-0015661**	**706 MAIN ST**	**HARVEST LIQUORS**	**RAO**		**A1**	**Hazardous Material**
	4-0015702	731 MAIN ST	MOBIL STATION FMR	TIER 1B			Hazardous Material
X	**4-0016004**	**QUEEN ANNE RD**	**POLE 67/115**	**RAO**		**A1**	**Oil**
	4-0016212	15 CRANBERRY LN	NO LOCATION AID	RAO		A2	
X	**4-0016449**	**4 HALL AVE**	**NO LOCATION AID**	**RAO**		**A1**	**Oil**
	4-0016820	14 SHANNON RD	YERKES RESIDENCE	RAO		A2	Oil
	4-0017062	42 SOUTH ST	NO LOCATION AID	RAO		A2	Oil
X	**4-0017263**	**565 RTE 28**	**MAIN ST**	**RAO**		**A2**	**Oil**
X	**4-0017414**	**54 SMITH ST**	**NO LOCATION AID**	**RAO**	**PHASE II**	**A2**	**Oil**
X	**4-0017417**	**397 RTE 28**	**HANDLER'S JUNK YARD**	**RAO**		**A2**	**Oil**
X	**4-0018140**	**MONOMY RD**	**NSTAR**	**RAO**		**A1**	**Oil**
	4-0018377	111 HEADWATERS DR	CRANBERRY POINT NURSING HOME	RAO		A2	
	4-0018827	4 MAIN ST	WEST HARWICH SUNOCO	RAO		A2	Oil
	4-0018836	69 DOANE RD	NO LOCATION AID	RAO	PHASE II	A2	Oil
	4-0019196	731 MAIN ST	FORMER EXXON MOBIL	RTN CLOSED			Oil
	4-0019422	731 MAIN ST	MOBIL GAS STA FMR NO 01-602	RTN CLOSED			Hazardous Material
X	**4-0019494**	**731 MAIN ST**	**MOBIL FMR**	**RTN CLOSED**			**Oil**

Within Project Area	Release Tracking Number	Address	Site Name Location Aid	Compliance Status	Phase	RAO Class	Chemical Type
X	**4-0019536**	**9 SHAGGY PINE RD**	**RESIDENTIAL**	**RAO**	**PHASE II**	**A2**	**Oil**
	4-0019589	51 OAK ST	RESIDENCE	RAO		A2	Oil
X	**4-0019683**	**4 MAIN ST**	**WEST HARWICH SUNOCO**	**RAO**	**PHASE II**	**B1**	**Hazardous Material**
X	**4-0019955**	**183 SISSON RD**	**HARWICH POLICE STA**	**RAO**	**PHASE V**	**A2**	**Oil**
	4-0020573	578 MAIN ST (RTE 28)	CUMBERLAND FARMS GAS STATION	RAO		A1	Oil
	4-0020797	861 ORLEANS RD	NO LOCATION AID	RAO		A2	Oil
	4-0021217	729 MAIN ST	SPEEDWAY GAS STATION	RAO		A2	Oil
X	**4-0021244**	**VIC 353 GREAT WESTERN RD**	**INTERS GREAT WESTERN RD+LOTHROP AV**	**TIER 2**	**PHASE V**		
	4-0021725	31 CHATHAM RD	RESIDENCE	RAO		A2	Oil
X	**4-0021786**	**2 RIVERWAY**	**HEALY RESIDENCE**	**RAO**		**A2**	**Oil**
	4-0021842	DEPOT RD	HARWICH SHOOTING RANGE	ADEQUATE REG			Hazardous Material
	4-0022766	THREE NAUTICAL MILES OUT OF	YAGHT ON FIRE	ADEQUATE REG			
X	**4-0023054**	**MILE MARKER 79.6**	**ROUTE 6**	**RAO**		**A2**	
	4-0024578	20 BAY ROAD	RESIDENCE	UNCLASSIFIED			Oil
	4-0024649	947 ROUTE 28	HARWICH CONSERVATION TRUST (HCT)	UNCLASSIFIED			Hazardous Material
	4-0024836	WYCHMERE HARBOR	JETTY	UNCLASSIFIED			Oil
	4-0024943	241 PLEASANT BAY RD	INTERSECTION RTE 39 & PLEASANT BAY RD	UNCLASSIFIED			Oil

Class A RAO = Remedial work was completed and a level of “no significant risk” has been achieved.
Class B RAO = Site assessment indicates that “no significant risk” exists. No remedial work was necessary.
Class C RAO = A temporary cleanup. Although the site does not present a “substantial hazard,” it has not reached a level of no significant risk.

No hazardous waste sites are known to exist at the proposed locations for the WWTF or effluent recharge facilities. Two pumping stations, PS-HR-01 and PS-HR-13, are in close proximity to hazardous waste sites. PS-HR-01 is near site 4-0012523; the Class A2 RAO status for this site indicates that remedial work has been completed and a level of “no significant risk” has been achieved, although contamination has not been reduced to background levels. PS-HR-13 is near sites 4-0013975 and 4-0016004. Site 4-0013975 has an RAO status of Class B1, indicating that a site assessment has been conducted and no remedial work was necessary because no significant risk exists. Site 4-0016004 has an RAO status of Class A1, indicating that remedial work was completed, a level of no significant risk has been achieved, and contamination has been reduced to background or a threat of release has been eliminated. Since there are no active hazardous waste issues known in the project area, the Town is not planning any hazardous waste remediation as part of the project. The Town understands that if oil and/or hazardous material (OHM) is encountered during project construction, notification pursuant to the MCP will be made to MassDEP when required. A Licensed Site Professional (LSP) will be retained to determine if notification is required and will be available during construction to render appropriate opinions as needed. Construction protocols and procedures will reflect the potential for discovery of OHM throughout the construction period. Other mitigation measures regarding the discovery and handling of hazardous materials are discussed as part of the Construction Management Plan (Section 16) and Section 61 Findings (Section 17).

14.5 Rare and Endangered Species, Natural Habitats, and Fisheries

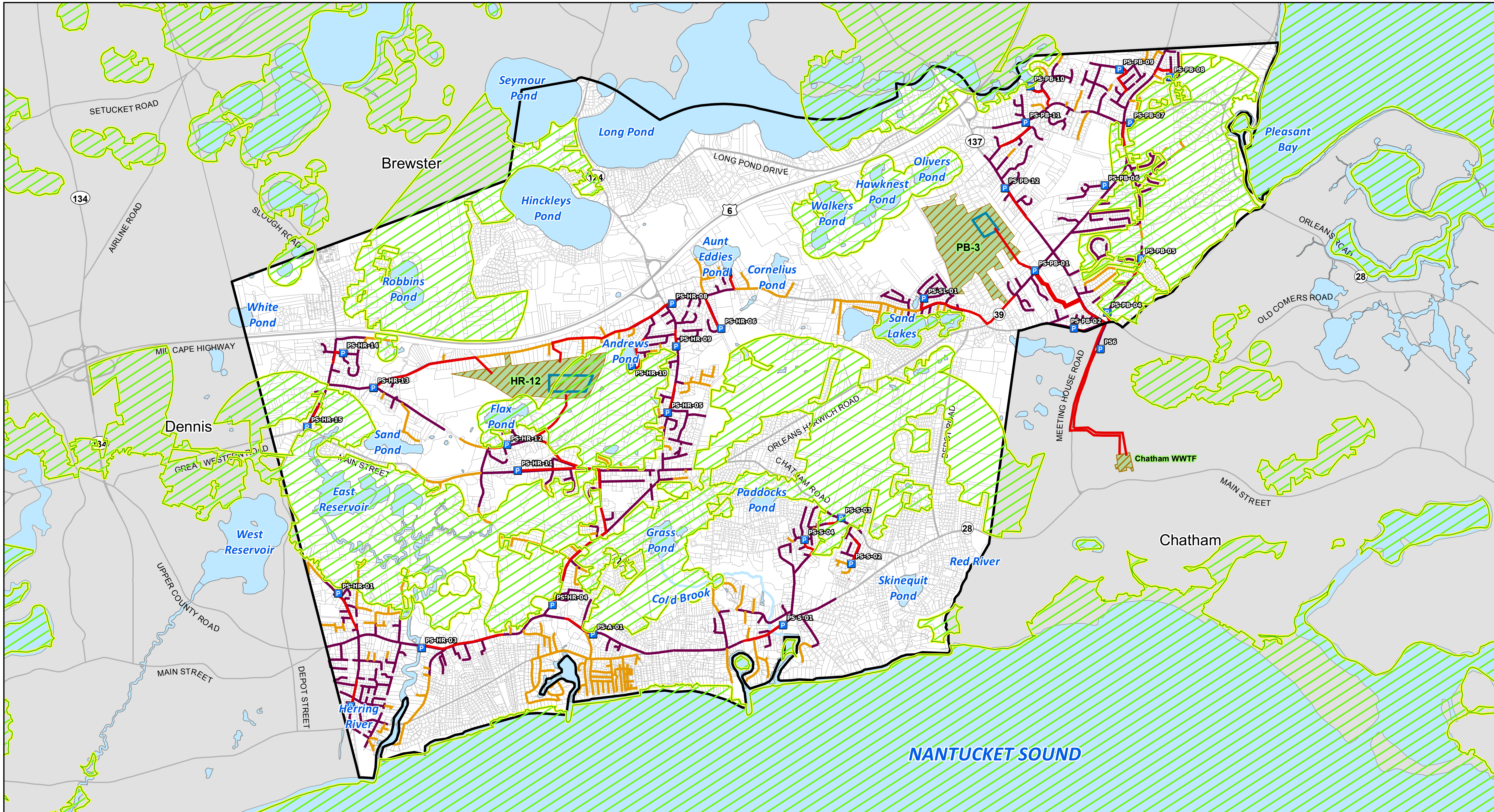
14.5.1 Rare and Endangered Species

In compliance with the Massachusetts Endangered Species Act (MESA), The Natural Heritage and Endangered Species Program (NHESP) was contacted and provided information about the proposed CWMP in September 2011 and again in February 2013. Relevant correspondence is included in Appendix I. NHESP identified whether the WWTF and the pump stations were located within Priority Habitats and Estimated Habitats, as well as which species were found in the vicinity. A Priority Habitat is the geographical extent of habitat for all state-listed plant and animal species as delineated by the Massachusetts Division of Fisheries and Wildlife. Estimated Habitats are subsets of Priority Habitats that include wetland-dependent wildlife. NHESP Estimated Habitats for rare wildlife are shown in Figure 14-6. Table 14-2 outlines rare species that have been found in the vicinity of the project area.

Table 14-2
Rare Species in the Vicinity of the Proposed WWTF and Pump Stations

CWMP Component(s)	Species	Common Name	Taxonomic Group	State Status
WWTF HR-12 PS-HR-03 PS-HR-10 PS-HR-15 PS-PB-04 PS-PB-05 PS-PB-07 PS-PB-08	*Terrapene carolina*	Eastern Box Turtle	Reptile	Special Concern
PS-HR-01	*Ixobrychus exilis*	Least Bittern	Bird	Endangered
PS-PB-10	*Enallagma recurvatum*	Pine Barrens Bluet	Plant	Threatened
PS-PB-10	*Sabatia kennedyana*	Plymouth Gentian	Plant	Special Concern
PS-PB-10	*Lachnanthes caroliana*	Redroot	Plant	Special Concern
PS-PB-04	*Crocanthemun dumosum*	Bushy Rockrose	Plant	Special Concern

The proposed WWTF, to be located on Parcel HR-12, and Pumping Stations PS-HR-03 PS-HR-10, and PS-HR-15 would be located within Priority Habitat 1424 and Estimated Habitat 19. NHESP indicated that the eastern box turtle (*Terrapene carolina*), a state special concern reptile, has been found in the vicinity of these facilities. Pumping Station PS-HR-01 would also be located in Priority Habitat 1424 and Estimated Habitat 19; the least bittern (*Ixobrychus exilis*), a state endangered bird has been found



Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-6
Estimated Habitat

CDM Smith

Z:\Harwich\Harwich_cwmp\MXD\Section_14\Fig14-5_Estimated_Habitat.mxd SHEETSJA 8/9/2013 in this vicinity. Pumping Station BS-PB-10 would be located within Priority Habitat 15 and Estimated Habitat 17; the pine barrens bluet (*Enallagma recurvatum*), a state threatened damselfly, and Plymouth gentian (*Sabatia kennedyana*) and redroot (*Lachnanthes caroliana*), both state special concern plants, have been found in this vicinity. Pumping Stations PS-PB-05, PS-PB-07, and PS-PB-08 would be located within Priority Habitat 269 and Estimated Habitat 162; the eastern box turtle has been found in the vicinity of these facilities. Lastly, Pumping Station PS-PB-04 would be located within Priority Habitat 269 and Estimated Habitat 162; the eastern box turtle and the bushy rockrose (*Crocanthemun dumosum*), a state special concern plant, have been found in this vicinity. Details regarding the resulting potential impacts and mitigation measures are provided in Section 14.5.2 below.

All sewer mains will be installed within town-owned roadways. Although portions of the phased sewer main installations within roadways are located near or within Priority Habitat and Estimated Habitat, these areas are exempt from MESA review for projects or activities in Priority Habitat pursuant to 321 CMR 10.18 through 10.23 (6), which reads, in part:

> *Installation, repair, replacement, and maintenance of utility lines (gas, water, sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads.*

In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. It should also be noted that specific comments from NHESP have not been requested for other components of the CWMP. However, as these components move forward, NHESP consultation will be required during permitting. For each phase that requires a Notice of Intent (NOI) from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information. For example, the Muddy Creek culvert improvements have been granted a Phase I waiver by MEPA will be located in Priority Habitat 269 and Priority Habitat 162. As such, permitting, design and construction which are outside the scope of this CWMP will be addressed as that project is implemented. Although the exact locations of the proposed Cold Brook ponds is not yet known, they will likely be within Priority Habitat 1424 and Estimated Habitat 19, so NHESP would be consulted during the design phase of this portion of the CWMP.

14.5.2 Rare Species Descriptions and Potential Impacts

Information regarding the life cycle and preferred habitat for the rare species found in the vicinity of the CWMP components was obtained from NHESP fact sheets. This information is helpful in determining potential impacts from the construction and operation of the project components.

Eastern Box Turtle: The eastern box turtle is a terrestrial species that ranges from southeast Maine south to northern Florida, and west to Michigan, Illinois, and Tennessee. In Massachusetts, it is found in dry and moist woodlands, brushy fields, thickets, marsh edges, bogs, swales, fens, streambanks, and well-drained bottomland. In the northern part of its range it hibernates from late October or November until mid-March or April. It overwinters in upland forest, a few inches below the soil surface, typically covered by leaf litter or woody debris. In summer, adult Box Turtles are most active in the morning and evening, particularly after a rainfall. During the heat of the day they often seek shelter under rotting logs or masses of decaying leaves, in mammal burrows, or in mud. They often spend the night in a small scooped out space in leaf litter, grasses, ferns, or mosses. Eastern box turtles are omnivorous and feed on small animals such as slugs, insects, earthworms, and snails, as well as mushrooms, berries, and fruits. Females reach sexual maturity at approximately 13 years of age; they can store sperm and lay fertile eggs up to four years after mating. Females nest in June or early July and can travel up to one mile to find appropriate habitat such as early successional fields, meadows, utility right of ways, woodland openings, roadsides, cultivated gardens, residential lawns, mulch piles, beach dunes, and abandoned gravel pits.

The population of the eastern box turtle is threatened in Massachusetts due to habitat destruction, road mortality, collection for pets, mowing of fields and early successional habitat during the active season, unnaturally inflated rates of predation in suburban and urban areas, disturbance of nest sites by ATVs, and genetic degradation due to the release of non-native (pet store) turtles.

Potential impacts to eastern box turtle habitat are greatest at the WWTF HR-12 site. During the design of this facility, NHESP will be consulted to minimize impacts to this species. Since eastern box turtle habitat includes early successional areas, utility right of ways, roadsides, gardens, and residential lawns, negative impacts will likely be restricted to building footprints, roads, and graveled areas. These may be able to be mitigated by discussing specific site design considerations with NHESP for maximizing or enhancing the habitat that will remain post-construction. Potential impacts from traffic and human interaction should be insignificant as the site will have minimal traffic. Likewise, potential impacts from the small footprint of the individual pumping stations and limited clearing of surrounding of vegetation should be minimal. The Muddy Creek Bridge and pond restoration projects are expected to improve the natural habitats of those areas, so negative impacts should similarly be minimal. Construction of the nitrogen attenuation ponds in the Cold Brook cranberry bogs has the potential to impact eastern box turtle habitat depending on the location of the proposed ponds; NHESP will be consulted during the design of these ponds to help minimize such impacts.

***Least Bittern*:** The least bittern is a small (approximately 13 inches long) wading bird that breeds from southeastern Canada through the central and eastern United States to Mexico and Costa Rica. They overwinter along the Atlantic Coastal Plain south to the Gulf Coast as well as Baja California and parts of Central America. They inhabit freshwater and brackish marshes with dense, tall vegetation interspersed with clumps of woody vegetation and substantial areas of open water. They are frequently found in marshes greater than 12.5 acres in size. They generally nest in Massachusetts beginning in mid to late May; nests are constructed close to water in dense vegetation. Eggs and fledglings have been observed in Massachusetts throughout June. The birds build platforms from bent reeds in order to forage in deeper water than their small size would otherwise allow. The birds migrate in the fall from late August to October or even later. The diet of least bitterns includes small fish, frogs, tadpoles, salamanders, small mammals, and invertebrates.

Major threats to the least bittern population include the alteration and degradation of habitats by the invasive plants common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*). Siltation and chemical pesticide runoff can degrade nesting habitats and reduce food supplies. Mortality above that which is from natural predation can come from collision with motor vehicles, barbed wire fences, and transmission lines, as well as through the swamping of nests by wakes from boats and jet skis. The least bittern does seem to be tolerant of human presence and it may persist in highly urbanized areas.

The NHESP recommends management of this species by protecting suitable habitat, especially wetlands greater than 25 acres in size consisting of dense vegetation, particularly cattails (*Typha* spp.) and areas of open water. These wetlands should be protected from siltation, chemical pollution, and invasive species both during construction and long-term. Ideally, wetlands would contain a range of microhabitats to buffer potential impacts of water level fluctuation. Wetlands created by beavers may be important habitats.

Pumping Station PS-HR-01 is located near recorded least bittern habitat. Since the pumping station will be constructed immediately adjacent to the proposed sewer and existing roadway, impacts to least bittern habitat would be minimal. Wetlands will be delineated in the field during the design and permitting of this phase of the project, and impacts to least bittern habitat will be minimized by avoiding wetlands as practicable. Additionally, due to the proximity of the road, construction of the proposed pumping station would not likely cause a significant impact to least bittern habitat.

In general, this CWMP has the potential to improve least bittern habitat in Harwich by helping reduce some of the potential threats to this species from invasive species. Such species are often able to gain a foothold in the natural environment due to excess nutrients from anthropogenic sources. By reducing the nutrient loading to waterways in Harwich, the spread of invasive species has the potential to be slowed.

***Common Tern*:** The common tern is a small (approximately 12-14 inches long) seabird that generally nests on sandy or gravelly islands and barrier beaches, but also occurs on rocky or cobbly beaches and salt marshes. It prefers areas with scattered vegetation, used as cover for chicks. They feed mainly on small fish, crustaceans, and insescts. These birds are present in Massachusetts from late April and early May to mid-October. They form gregarious nesting colonies of a few to thousands of pairs. Nests are made in depressions or scrapes in the substrate, and chicks are semi-precocial, meaning that they have characteristics of older birds at birth but still stay in the nest and are cared for by their parents until close to adult size. Predators of eggs include a variety of birds, mammals, snakes, ants, and land crabs. Mammalian predation often causes birds to abandon the site. As such, islands lacking predatory mammals or reptiles are preferred nesting sites. Populations in Massachusetts are threatened by predation by the above species as well as displacement by gulls. A lack of suitable nesting sites is a serious concern. Most colonies are protected by posting of signs, presence of wardens, and/or exclusion of visitors.

The common tern has been noted to occur near the Muddy Creek culvert improvement project. The birds most likely nest on the sandy/gravelly shore north of the culverts, slightly downstream, along the edge of Pleasant Bay (about 200 feet north or more). Due to the marshy habitat immediately surrounding the culverts, it is unlikely that the common tern nests in the immediate project area. Nevertheless, consultation with NHESP will occur during the permitting phase of the Muddy Creek project.

***Pine Barrens Bluet*:** The Pine Barrens bluet is a small semi-aquatic damselfly, averaging just over one inch in length. They are restricted to coastal plain ponds, typically those with sandy, shallow shores and large amounts of vegetation close to shore (especially military rush, *Juncus militaris*). In Massachusetts, they are primarily in Plymouth and Barnstable. Nymphs of the Pine Barrens bluet are aquatic and spend most of their time clinging to submerged vegetation. Eggs are laid in early summer and likely hatch in the fall. The nymphs overwinter and in early- to mid-summer climb up vegetation and transform into adults. Adults only live for approximately three or four weeks.

The major threat to the Pine Barrens bluet is degradation and destruction of the wetlands used for breeding and nymphal habitat. This includes adjacent upland areas used by the adult damselfly for roosting and hunting. Destruction of habitat can be from construction/development, artificial water drawdown, runoff, and sewage. Off road vehicles can also damage adjacent upland habitat, and wakes from boats can threaten emerging adults.

Pumping Station PS-PB-10 is the only CWMP component currently identified that would be near documented Pine Barrens bluet habitat. As is the case for least bittern habitat, impacts to Pine Barrens bluet habitat are expected to be minimal since the pumping station will be constructed immediately adjacent to the proposed sewer and existing roadway. Wetlands will be delineated in the field during the design and permitting of this phase of the project, and impacts to least bittern habitat will be minimized by avoiding wetlands as practicable. Additionally, due to the proximity of the road, construction the proposed pumping station would not likely cause a significant impact to Pine Barrens bluet habitat. In general, the CWMP has the potential to improve Pine Barrens bluet habitat in Harwich by reducing the threats of runoff to this species.

***Plymouth Gentian*:** The Plymouth gentian is a perennial herb that grows 12 to 28 inches tall, blooming between early July and mid-September. It grows in seasonally wet, sandy and peaty shorelines of low nutrient, acidic Coastal Plain ponds. It also prefers full sun and does not compete well with shrubs. Its range is limited to the coastal plain of Nova Scotia, Massachusetts, Rhode Island, North Carolina, South Carolina, and Virginia, and is locally rare. This species requires frequent water fluctuations, acidic, nutrient poor water and substrate, and an open, exposed shoreline.

Threats to the Plymouth gentian include any activity that alters the hydrologic regime, water quality, or soil integrity of the coastal plain pond. Protection of this species may require exclusion of new wells and septic systems as well as prohibitions on fertilizer use and recreational use at growing sites. Invasive exotic species also represent a threat to the Plymouth gentian as it is a poor competitor. The nutrient-poor conditions of its natural habitat tend to protect this species from competition.

Pumping Station PS-PB-10 is the only CWMP component currently identified that would be near documented Plymouth gentian habitat. Impacts to this habitat are expected to be minimal since the pump station will be constructed immediately adjacent to the proposed sewer and existing roadway. Wetlands will be delineated in the field during the design and permitting of this phase of the project, and impacts to Plymouth gentian habitat will be minimized by avoiding wetlands as practicable. Further coordination with NHESP during design will also help minimize impacts. Overall, the CWMP has the potential to improve habitat for the Plymouth gentian in Harwich by removing a large number of septic systems from service, thereby reducing nutrient inputs to waterways and helping to maintain and/or restore the low nutrient habitat that this species requires. Similarly, the proposed pond restoration projects would also likely improve potential Plymouth gentian habitat.

***Redroot*:** This species is a small (11.5 to 30 inches) perennial plant that grows in the sandy to peaty shores of Coastal Plain ponds. It depends on seasonal water fluctuations to inhibit growth of competing vegetation. Disjunct populations occur in Nova Scotia, southeastern Massachusetts, Long Island, southern New Jersey, and from Maryland to Florida, Louisiana, and Cuba. Threats to this species include lowering of water quality in ponds by runoff and leaky septic systems and alteration of the water table. Pumping Station PS-PB-10 is the only CWMP component currently identified that would be near documented redroot habitat. Potential impacts to the habitat of this species are the same as for the Plymouth gentian, as are potential positive effects of the CWMP.

***Bushy Rockrose*:** This is a globally rare species of perennial plant that grows in coastal herbaceous grasslands and heathlands. It is endemic to the northeastern United States, currently known in Massachusetts, Rhode Island, and New York. In Massachusetts, all occurrences are in the Coastal Plain in dry, sandy, acidic soils in full sun. It lives in early successional habitats and is frequently found in areas with mild disturbance. Threats to this species include habitat loss to development as well as development of later-successional habitats due to fire exclusion. Pumping Station PS-PB-04 is the only CWMP component currently identified that would be near documented redroot habitat Coordination with NHESP during the design of this portion of the project will help ensure minimal impacts to bushy rockrose habitat and populations.

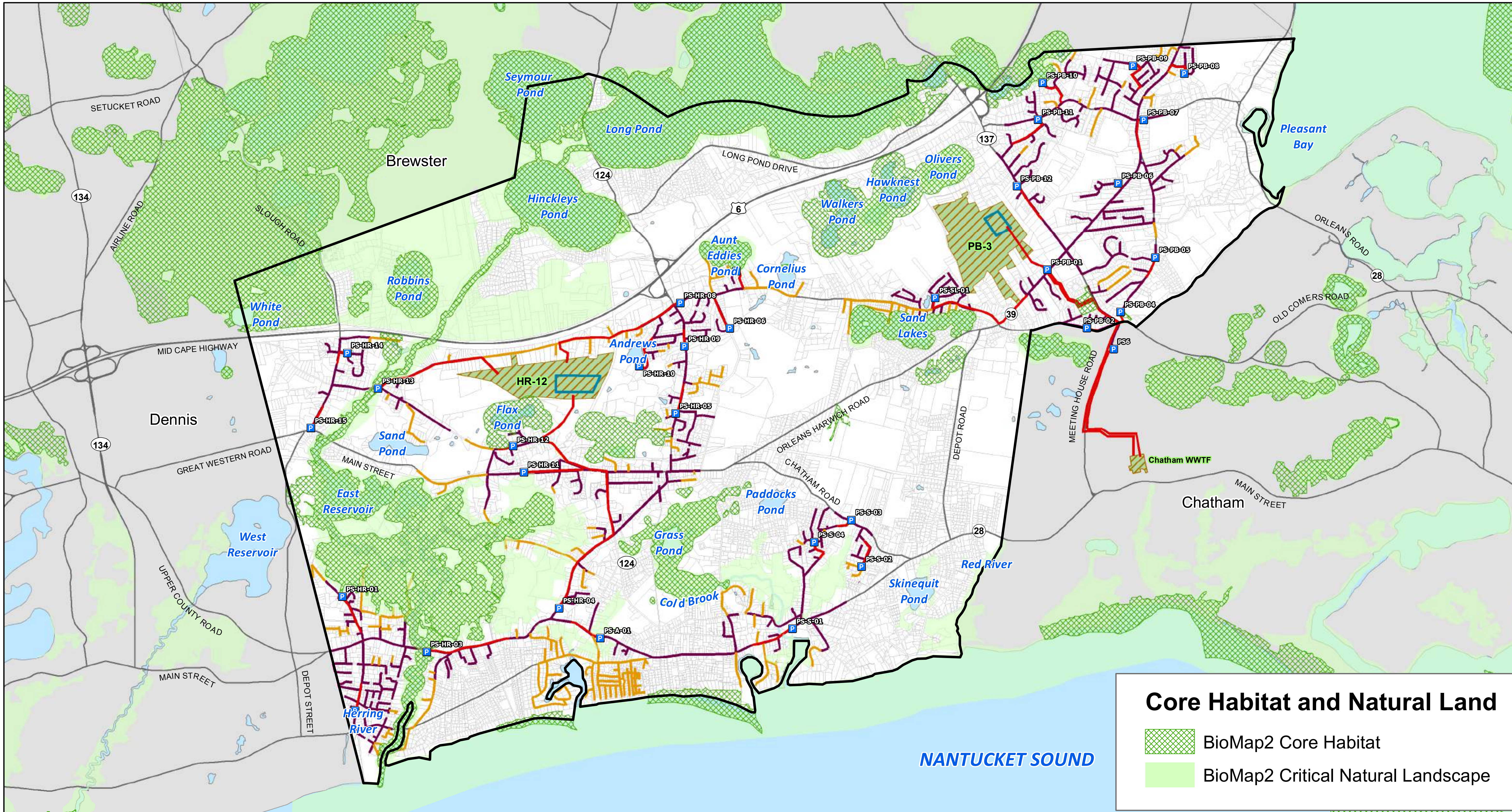
14.5.3 BioMap2 Habitats and Critical Natural Landscapes

NHESP BioMap2 Core Habitats and Critical Natural Landscapes are shown in Figure 14-7. BioMap2 Core Habitats are areas that have been identified as necessary to promote the long-term persistence of rare species, other species of conservation concern (from the State Wildlife Action Plan), exemplary natural communities, and intact ecosystems. BioMap2 Critical Natural Landscapes are areas that are better able to support ecological processes and disturbance regimes, and a wide array of species and habitats over long time frames. These areas include large areas of predominantly natural vegetation, upland buffers of wetlands and aquatic cores, and upland habitat to support coastal adaptation (upland areas adjacent to and up to one and a half meters above existing salt marshes).

The Cape Cod Commission, in its comments to the EENF, has recommended that the CWMP avoid sites mapped for rare species habitat or BioMap2 Core Habitat. The proposed WWTF at HR-12, effluent recharge facility at PB-3, and Chatham WWTF expansion are located outside BioMap2 Core Habitats and Critical Natural Landscapes. The Muddy Creek culvert improvements are also located outside these areas. Six of the 33 proposed pumping stations (PS-HR-01, PS-HR-03, PS-HR-12, PS-HR-13, PS-PB-04, and PS-PB-10) are located in or adjacent to BioMap2 Core Habitat areas, and six pumping stations (PS-HR-01, PS-HR-03, PS-HR-11, PS-HR-13, PS-PB-10, and PS-A-01) are located in or adjacent to Critical Natural Landscapes. During the design process, the exact locations for these pumping stations will be further identified and BioMap2 Core Habitats and Critical Natural Landscapes will be avoided to the extent practicable. Since these pumping stations will be small and located adjacent to existing roads, impacts to Core Habitats and Critical Natural Landscapes are expected to be minor.

The Cold Brook natural attenuation project, located on the east side of Bank Street in the former cranberry bogs, would likely be within areas mapped as Critical Natural Landscape by BioMap2. A small area (adjacent to Bank Street) is also mapped as Core Habitat. Since coordination with NHESP will occur during the piloting and design phases for this attenuation project, the ponds will be located and designed to avoid negative impacts to these habitats as practicable.

Hinckleys Pond, Seymour Pond, Bucks Pond, and John Joseph Pond are all located in areas mapped by BioMap2 as Core Habitat and Critical Natural Landscape. Since the goal of the restoration projects for these ponds would be to improve the natural habitats there, negative impacts are not expected.



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- Pump Station
- Force Main
- Pressure Sewer
- Gravity Sewer
- Roads
- Parcels
- Town Boundary
- Recharge Site
- Treatment / Effluent Recharge Parcels

Town of Harwich Comprehensive Wastewater Management Plan

0 1,250 2,500 5,000 Feet

Figure 14-7
BioMap2

CDM Smith

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14.5.4 Fisheries

In addition to coordination with the NHESP, the Town also received comments on the EENF/Draft CWMP from the Massachusetts Division of Marine Fisheries (Marine Fisheries). Marine Fisheries noted that it is very concerned about the aquatic health of coastal salt ponds, which are critical nursery areas for many marine species including winter flounder (Pseudopleuronectes americanus), anadromous fish, horseshoe crabs (Limulus polyphemus), and shellfish. Marine Fisheries also noted that both winter flounder and blue crab are sensitive to eutrofication. Since the CWMP's main goal is to decrease nutrient loading to area waterways, it should result in a positive effect on the aforementioned species. Overall, Marine Fisheries was supportive of the CWMP; recommendations were mostly related to water quality monitoring. These comments are discussed in Section 14.6 (Wetlands, Waterways, and Tidelands). Marine Fisheries did note that it would provide additional comments on the Muddy Creek culvert improvements when a Notice of Project Change is submitted and design has advanced to a stage that enables further MEPA review. (project reviewed and under construction)

Marine Fisheries requested in their comments on the EENF that monitoring within Pleasant Bay and Saquatucket Harbor be designed to determine if the natural attenuation projects in those watersheds are reducing nitrogen loads to the receiving waters. Continued water quality monitoring is proposed in the Adaptive Management Plan, as outlined in Section 13.8. This strategy allows for modification to the phasing, timing, and/or exact areas to be sewered depending on the results of the earlier implementation phases. The Town plans to continue revisiting the recommended program throughout its implementation to re-evaluate each phase prior to design and construction.

Marine Fisheries also requested that monitoring studies for the permeable reactive barrier study sites include other contaminants from wastewater not just nitrogen, such as endocrine disrupting compounds. Treatment for such compounds could be added to the WWTF at some point in the future if the technology becomes available and is required.

14.5.5 Areas of Critical Environmental Concern

Pleasant Bay is a designated Area of Critical Environmental Concern (ACEC). The area mapped as ACEC extends up Muddy Creek nearly to Old Queen Anne Road. Muddy Creek is noted to support herring migratory fish runs. In general, the water quality benefits of the CWMP should be beneficial to the Pleasant Bay ACEC. In particular, the water quality in Muddy Creek should benefit from the culvert replacement project, resulting in increased tidal flushing.

14.6 Wetlands, Waterways and Tidelands

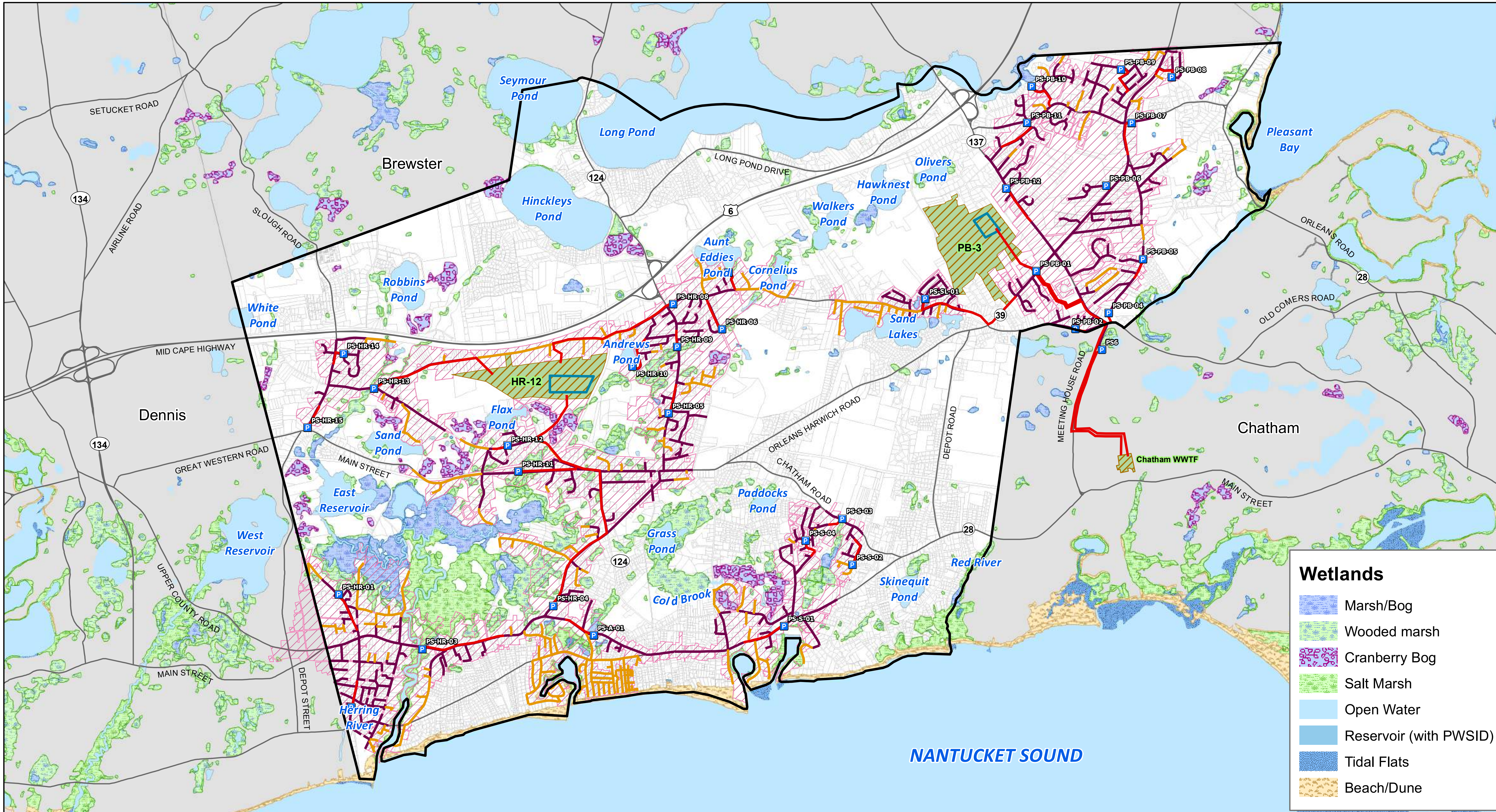
The main purpose for recommending a new wastewater treatment and recharge program for the Town of Harwich is to reduce environmental degradation which is occurring in the Town's coastal waters. This degradation is caused largely by nitrogen inputs into coastal waters originating from on-site septic systems. The degree of degradation and the nitrogen load reductions required to ameliorate the problem are described in great detail in the MEP reports for the Allen, Wychmere, and Saquatucket Harbor embayments (dated June 2010), the Herring River embayment (dated March 2013), the Pleasant Bay system (dated May 2006), and Stage Harbor, Sulphur Springs, Taylors Pond, Bassing Harbor, and Muddy Creek (dated December 2003).

Wetlands and floodplains in Harwich were identified using MassGIS. These areas and the proposed WWTF at HR-12, effluent recharge facility at PB-3, sewer lines, pumping stations, and Chatham WWTF are shown in Figure 14-8 for wetlands and Figure 14-9 for FEMA floodplains using the recently updated 2011 mapping. MassGIS indicates that there are no wetland areas at the proposed WWTF at HR-12, effluent recharge facility at PB-3, or the Chatham WWTF. Construction of the sewers within paved roadways will result in temporary impacts to approximately 26,000 square feet of Riverfront Area, 207,000 square feet of Land Subject to Coastal Flowage, and 30,000 square feet of Bordering Land Subject to Flooding. Construction of the pumping stations will permanently alter approximately 1,000 square feet of Riverfront Area. These impact areas will be flagged and further quantified during each phase as design and permitting under the Massachusetts Wetlands Protection Act occurs.

While the construction of some of the sewer lines will be within floodplains, as well as a few pumping stations, implementation of the CWMP is not expected to promote additional development within flood zones because the majority of areas to be sewered are at near buildout condition. Additionally, development on the seaward side of primary dunes should not be promoted as the parcels to be sewered near these areas are essentially built out. The sewer lines and any pumping stations to be built within flood zones will be designed to withstand flood conditions.

The CWMP was designed to comply with the performance standards of 310 CMR 9.00 and 10.00. Wherever feasible, wetland resource areas and associated buffer zones were avoided when laying out the project. The proposed sewer main installation will occur within Town-owned roadways, and pumping stations will be within Town-owned rights-of-way. Roads will be restored to pre-construction grades and paved after sewer construction. Any permanent structures constructed as part of the project in areas requiring review by the Harwich Conservation Commission will be designed to comply with MassDEP's Stormwater Management Standards. Since design of the WWTF, effluent recharge facilities, and pumping stations has not yet begun, estimates of impervious areas created by the project are not available. Construction of the various components of the CWMP will require registration for the EPA Construction Stormwater General Permit and preparation of Stormwater Pollution Prevention Plans (SWPPPs) for each construction contract. Erosion and sediment controls during construction will be constructed in accordance with the Department of Environmental Protection Stormwater Guidance Manual.

Potential impacts associated with the Muddy Creek culvert replacement were identified by Fuss & O'Neill in the Final Technical Memorandum, Muddy Creek Wetland Restoration, Chatham and Harwich, Massachusetts, dated February 2012. Potential impacts for four alternatives were identified. Table 14-3 summarizes these potential impacts from this report, and Table 14-4 summarizes the potential impacts from the wastewater conveyance and treatment components of the CWMP along with the estimated maximum potential impacts for the Muddy Creek bridge. The selected option for the Muddy Creek Bridge and associated impacts will be described in more detail in the Notice of Project Change submitted by others pursuant to the Phase 1 waiver for this project.



Pump Station
Force Main
Pressure Sewer
Gravity Sewer
Roads
Parcels
Town Boundary
Recharge Site
Treatment / Effluent Recharge Parcels
Proposed Sewer Parcels

Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-8
MassDEP Wetlands

0 1,250 2,500 5,000 Feet

CDM Smith

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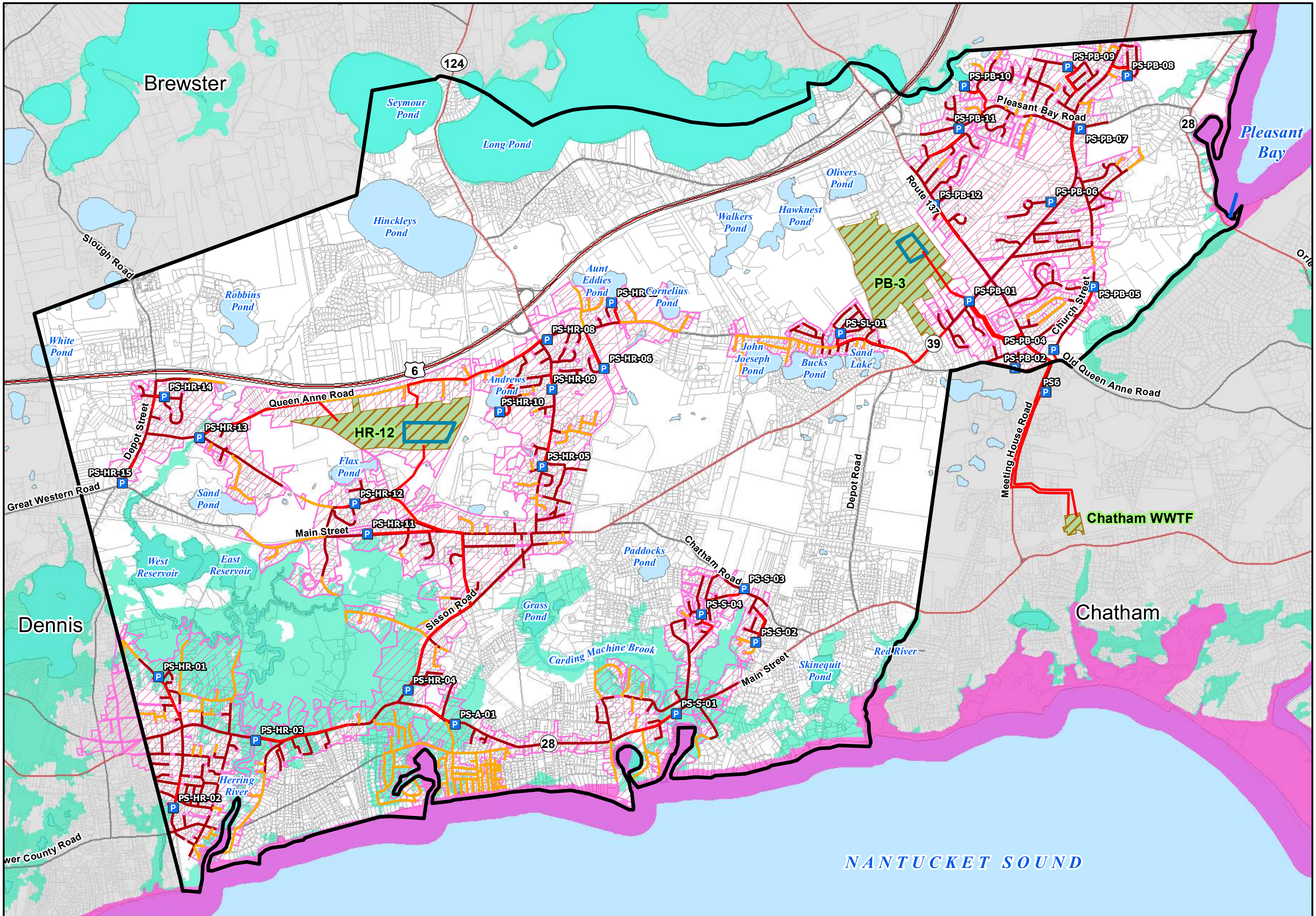

Town of Harwich
Comprehensive Wastwater
Management Plan

Figure 14-9
FEMA Floodplains

CDM Smith

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Table 14-3
Resource Area Impacts for Muddy Creek Bridge Alternatives

Parameter	Pre-Cast Concrete Box		Three-Sided Concrete Bridge		Short Span Adjacent Pre-Cast Concrete Deck Beam Bridge		Single-Span Adjacent Pre-Cast Concrete Beam Bridge	
	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.	Temp.	Perm.
Coastal Resource Areas								
Land Under Ocean (s.f.)	900	4,670	900	2,600	900	3,080	900	1,495
Salt Marsh (s.f.)	300	80	105	80	150	175	130	5
Land Containing Shellfish (s.f.)	900	5,050	900	2,790	900	3,400	900	1,635
Fish Run (s.f.)	900	4,670	900	2,600	900	3,080	900	1,495
Land Subject to Coastal Storm Flowage (s.f.)	11,445	1,450	9,815	1,450	9,965	2,145	7,025	2,985
Inland Resource Areas								
Bordering Vegetated Wetlands (s.f.)	1,890	70	1,560	70	1,665	330	1,780	10
Riverfront Area (s.f.)	41,850	3,570	40,045	3,565	40,430	4,150	32,360	8,570

Table 14-4
Estimated Maximum Resource Area Impacts for Wastewater Conveyance and Treatment and the Muddy Creek Bridge Improvements

Parameter	WWTF at HR-12, Effluent Recharge at PB-3, and Expanded Chatham WWTF		Sewers		Pump Stations		Muddy Creek Crossing Maximum Potential Impacts	
	Temp.	*Perm.*	*Temp.*	*Perm.*	*Temp.*	*Perm.*	*Temp.*	*Perm.*
Coastal Resource Areas								
Land Under Ocean (s.f.)	0	0	0	0	0	0	900	4,670
Salt Marsh (s.f.)	0	0	0	0	0	0	300	80
Land Containing Shellfish (s.f.)	0	0	0	0	0	0	900	5,050
Fish Run (s.f.)	0	0	0	0	0	0	900	4,670
Land Subject to Coastal Storm Flowage (s.f.)	0	0	207,000	0	0	0	11,445	2,985
Inland Resource Areas								
Bordering Vegetated Wetlands (s.f.)	0	0	0	0	0	0	1,890	330
Riverfront Area (s.f.)	0	0	26,000	0	0	1,000	41,850	8,570
Bordering Land Subject to Flooding (s.f.)	0	0	30,000	0	0	0		

Identification of the exact locations of wetland and surface water resources, including buffer zones, Riverfront Area, and Bordering land Subject to Flooding, will occur during the design stage of each phase of the CWMP. These will be shown on design plans and permitting for any impacts will occur during the design stage as outlined in Section 14.14. Wetland and related resource impacts have been avoided by locating the WWTF and effluent recharge facilities in upland locations, as well as locating sewers within paved roadways. The exact location of pumping stations will be determined during the design stage, and will avoid wetlands as much as practicable. Mitigation for specific wetland impacts will also be determined at that time.

Additional impacts to regulated wetland areas will occur as a result of the Cold Brook attenuation project and potentially for the restoration of Hinckleys Pond, Seymour Pond, Bucks Pond, and John Joseph Pond. However, an estimation of these impacts cannot be made until design of these components begins. The exact nature of the pond restoration projects is unknown at this time but may include the addition of alum for phosphorus control. Impacts to regulated resources will be minimized to the maximum extent practicable, and all impacts must be permitted or licensed in accordance with 310 CMR 9.00 and 310 CMR 10.00. Impacts to the Cold Brook cranberry bogs will occur as a result of the creation of ponds for denitrification as well as other impacts as may occur for the creation of a longer flow path within the system. These project components are intended to increase the potential for denitrification, which would increase water quality downstream. The proposed ponds at the Cold Brook cranberry bogs are being developed with support from the Harwich Conservation Trust and Harwich Natural Resources Division. The denitrification that will occur within these ponds will help treat water that is already within the wetland system.

Long term monitoring of water resources will occur as part of the Adaptive Management Plan, outlined in Section 13.8. Implementation of the different phases of the CWMP is expected to be tailored in part based on the results of this monitoring. Overall, the implementation of the CWMP is expected to positively affect wetland resources in Harwich by reducing nitrogen loading from septic systems to the area waterways. Water quality restoration and future protection is the primary goal of this CWMP and all related project phases.

14.7 Massachusetts Coastal Zone Policies

The following is a review of the enforceable Massachusetts Coastal Zone Management (CZM) policies, as outlined in the Massachusetts Office of Coastal Zone Management Policy Guide dated October 2011, relative to the CWMP Recommended Program for Harwich. Each enforceable CZM policy is presented in italics, and a description of how the proposed project complies with the policy follows in normal text. Enforceable CZM policies are those that are legally binding.

Coastal Hazards Policy #1: *Preserve, protect, restore, and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes, and land under the ocean.*

All components of the CWMP, when within the landforms identified by this policy, will be designed to preserve their storm damage prevention and flood control functions. The proposed WWTF at HR-12, effluent recharge facility at PB-3, and Chatham WWTF are outside these resources. Sewers will be installed within paved roadways which will be restored to existing grades. Pumping stations will be designed so as to not affect flood elevations or floodways. The Muddy Creek bridge improvements will impact some of the resources listed in this policy; however, these impacts are not expected to cause an increase in coastal hazards as this CWMP component is intended to improve and restore the ecological functioning and water flows in Muddy Creek. The Cold Brook attenuation project is located outside the resources listed in the policy, as are Hinckleys, Seymour, Bucks, and John Joseph Ponds.

Coastal Hazards Policy #2: *Ensure that construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Flood or erosion control projects must demonstrate no significant adverse effects on the project site or adjacent or downcoast areas.*

The proposed WWTF at HR-12, effluent recharge facility at PB-3, and Chatham WWTF are located outside of water bodies. Sewer lines will be constructed in existing paved roads and as such should not impact water circulation and sediment transport. Pumping stations will be located outside of water bodies. The purpose of the Muddy Creek bridge project is to improve circulation and tidal flushing within Muddy Creek. While the Cold Brook attenuation project will alter circulation patterns in the Bank Street bogs, this alteration will result in water quality benefits in terms of nitrogen reduction. The proposed restoration of Hinckleys, Seymour, Bucks, and John Joseph Ponds are not expected to alter circulation patterns or sediment transport.

Coastal Hazards Policy #3: *Ensure that state and federally funded public works projects proposed for location within the coastal zone will:*

- *Not exacerbate existing hazards or damage natural buffers or other natural resources.*
- *Be reasonably safe from flood and erosion-related damage.*
- *Not promote growth and development in hazard-prone or buffer areas, especially in velocity zones and Areas of Critical Environmental Concern.*
- *Not be used on Coastal Barrier Resource Units for new or substantial reconstruction of structures in a manner inconsistent with the Coastal Barrier Resource/Improvement Acts.*

The proposed WWTF at HR-12, effluent recharge facility at PB-3, and Chatham WWTF will not exacerbate existing hazards; these components of the CWMP are also outside of natural buffers and flood areas. Sewers will be constructed in existing paved roadways. Some areas to be sewered are within flood zones; however, the sewers will be designed to accommodate flooding in these areas. The Muddy Creek bridge project is expected to enhance natural resources and will be designed to accommodate coastal flooding. Likewise, the Cold Brook attenuation project and restoration of Hinckleys, Seymour, Bucks, and John Joseph Ponds will be designed to accommodate flooding.

Some of the parcels to be sewered are within flood zones; however, the majority of the areas to be sewered are near build-out condition. As such, the availability of sewers should not cause an increase of development in flood-prone areas. Although Harwich Center, East Harwich Center, and Harwich Port are areas designated by the Town for planned growth and economic development, these areas are outside mapped flood zones.

The CWMP components will not cause additional development in the Pleasant Bay ACEC. MassGIS indicates that there are no Coastal Barrier Resource Units within Harwich or in the area of the Chatham WWTF and the proposed force main that would connect it to the Harwich sewer system.

Energy Policy #1: *For coastally dependent energy facilities, assess siting in alternative coastal locations. For non-coastally dependent energy facilities, assess siting in areas outside of the coastal zone. Weigh the environmental and safety impacts of locating proposed energy facilities at alternative sites.*

Not applicable; the project does not include any coastally dependent energy facilities.

Habitat Policy #1: *Protect coastal, estuarine, and marine habitats—including salt marshes, shellfish beds, submerged aquatic vegetation, dunes, beaches, barrier beaches, banks, salt ponds, eelgrass beds, tidal flats, rocky shores, bays, sounds, and other ocean habitats—and coastal freshwater streams, ponds, and wetlands to preserve critical wildlife habitat and other important functions and services including nutrient and sediment attenuation, wave and storm damage protection, and landform movement and processes.*

The goal of the CWMP is to reduce nutrient (especially nitrogen) loading of coastal habitats, and as such is expected to increase the ecological qualities of the resources downstream of the various components. The components of the CWMP will be also be designed to minimize direct impacts to these resources. Additional consultation with NHESP will occur during the design phase of each component to ensure the protection of rare species. Permitting of impacts to wetlands, waterways, and tidelands will also occur during the design process; such impacts will be minimized to the extent practicable.

Habitat Policy #2: *Advance the restoration of degraded or former habitats in coastal and marine areas.*

The goal of the CWMP is to reduce nutrient (especially nitrogen) loading of coastal habitats, and as such is expected to increase the ecological qualities of the resources downstream of the various components. Components of the CWMP that take place within these habitats (such as the Muddy Creek bridge project) will be designed to minimize their ecological impacts in order to maximize their benefits.

Ocean Resources Policy #1: *Support the development of sustainable aquaculture, both for commercial and enhancement (public shellfish stocking) purposes. Ensure that the review process regulating aquaculture facility sites (and access routes to those areas) protects significant ecological resources (salt marshes, dunes, beaches, barrier beaches, and salt ponds) and minimizes adverse effects on the coastal and marine environment and other water-dependent uses.*

The Town currently has a limited aquiculture program where they seed shellfish areas. They are encouraged to continue this program as part of the recopmmended wastewater management plan. The CWMP's various components should indirectly support aquaculture by improving water quality within the Harwich embayments.

Ocean Resources Policy #2: *Except where such activity is prohibited by the Ocean Sanctuaries Act, the Massachusetts Ocean Management Plan, or other applicable provision of law, the extraction of oil,* *natural gas, or marine minerals (other than sand and gravel) in or affecting the coastal zone must protect marine resources, marine water quality, fisheries, and navigational, recreational and other uses.*

Not applicable; the CWMP does not propose the extraction of oil, natural gas, or marine minerals.

Ocean Resources Policy #3: *Accommodate offshore sand and gravel extraction needs in areas and in ways that will not adversely affect marine resources, navigation, or shoreline areas due to alteration of wave direction and dynamics. Extraction of sand and gravel, when and where permitted, will be primarily for the purpose of beach nourishment or shoreline stabilization.*

Not applicable; the CWMP does not propose offshore sand and gravel extraction.

Ports and Harbors Policy #1: *Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity, and public health and take full advantage of opportunities for beneficial re-use.*

In general, the CWMP does not propose any new dredging beyond maintenance to harbor entrances. Although not within a port or harbor, materials may be excavated from the Bank Street bogs for the construction of ponds as part of the Cold Brook attenuation project. This CWMP component will be designed and constructed to minimize adverse effects on water quality, physical processes, marine productivity, and public health, and will take advantage of opportunities for beneficial re-use if they are available.

Ports and Harbors Policy #2: *Obtain the widest possible public benefit from channel dredging and ensure that Designated Port Areas and developed harbors are given highest priority in the allocation of resources.*

Not applicable; channel dredging is not proposed as part of this CWMP beyond maintenance to harbor entrances.

Ports and Harbors Policy #3: *Preserve and enhance the capacity of Designated Port Areas to accommodate water-dependent industrial uses and prevent the exclusion of such uses from tidelands and any other DPA lands over which an EEA agency exerts control by virtue of ownership or other legal authority.*

Not applicable, the CWMP components will not be within Designated Port Areas.

Ports and Harbors Policy #4: *For development on tidelands and other coastal waterways, preserve and enhance the immediate waterfront for vessel-related activities that require sufficient space and suitable facilities along the water's edge for operational purposes.*

Not applicable; the CWMP does not propose development that will affect the immediate waterfront.

Protected Areas Policy #1: *Preserve, restore, and enhance coastal Areas of Critical Environmental Concern, which are complexes of natural and cultural resources of regional or statewide significance.*

The Muddy Creek bridge improvements will help to restore the water quality and tidal flushing of the Pleasant Bay ACEC. As such, the natural habitat of this area is expected to improve.

Protected Areas Policy #2: *Protect state designated scenic rivers in the coastal zone.*

Not applicable; there are no state designated scenic rivers in Harwich.

Protected Areas Policy #3: *Ensure that proposed developments in or near designated or registered historic places respect the preservation intent of the designation and that potential adverse effects are minimized.*

Harwich and its consultants will continue to work with the Massachusetts Historical Commission (MHC) to identify cultural resources within the project areas and minimize potential adverse effects to cultural resources.

Public Access Policy #1: *Ensure that development (both water-dependent or nonwater-dependent) of coastal sites subject to state waterways regulation will promote general public use and enjoyment of the water's edge, to an extent commensurate with the Commonwealth's interests in flowed and filled tidelands under the Public Trust Doctrine.*

The components of the CWMP are intended to improve water quality within the embayments of Harwich, thereby improving the ecological functions and aesthetic values of these areas. As such, general public use and enjoyment is expected to be indirectly supported by the improved conditions of these waterways.

Water Quality Policy #1: *Ensure that point-source discharges and withdrawals in or affecting the coastal zone do not compromise water quality standards and protect designated uses and other interests.*

Not applicable; the CWMP does not propose point-source discharges or withdrawals within or affecting the coastal zone.

Water Quality Policy #2: *Ensure the implementation of nonpoint source pollution controls to promote the attainment of water quality standards and protect designated uses and other interests.*

The goal of the CWMP is to improve water quality in the embayments of Harwich. The wastewater conveyance and treatment components, as well as public education components, are designed to reduce non-point sources of nutrients to Harwich waterways. Furthermore, Massachusetts Stormwater Standards will be met on properties containing new structures associated with this CWMP (WWTF and pumping stations), thereby further controlling non-point source pollution.

Water Quality Policy #3: *Ensure that subsurface waste discharges conform to applicable standards, including the siting, construction, and maintenance requirements for on-site wastewater disposal systems, water quality standards, established Total Maximum Daily Load limits, and prohibitions on facilities in high-hazard areas.*

The site screening process for the proposed effluent recharge facilities is explained in detail in Section 9. The CWMP does not propose subsurface discharge of untreated wastewater. The groundwater recharge facilities, using treated wastewater, will be designed to conform to all applicable standards and are intended to reduce nutrient loading to groundwater. These facilities will be subject to regulation under MassDEP Groundwater Discharge Permits.

14.8 Drinking Water Resources and Groundwater

Figure 14-10 shows the proposed collection, treatment, and recharge systems in relation to the Town's drinking water wells and the associated Zone II Well Protection Areas. All of Harwich's residents and businesses rely upon groundwater supply for drinking water. Approximately seven percent rely on private wells and the rest on public supplies. Nitrate concentrations in the Town's drinking water wells is relatively low at 1.0 mg/l, but some Town wells in the Pleasant Bay watershed have recently been over 2.0 mg/l due to greater density of development. Overall, Harwich's drinking water is well below the 10.0 mg/l drinking water standard for nitrate.

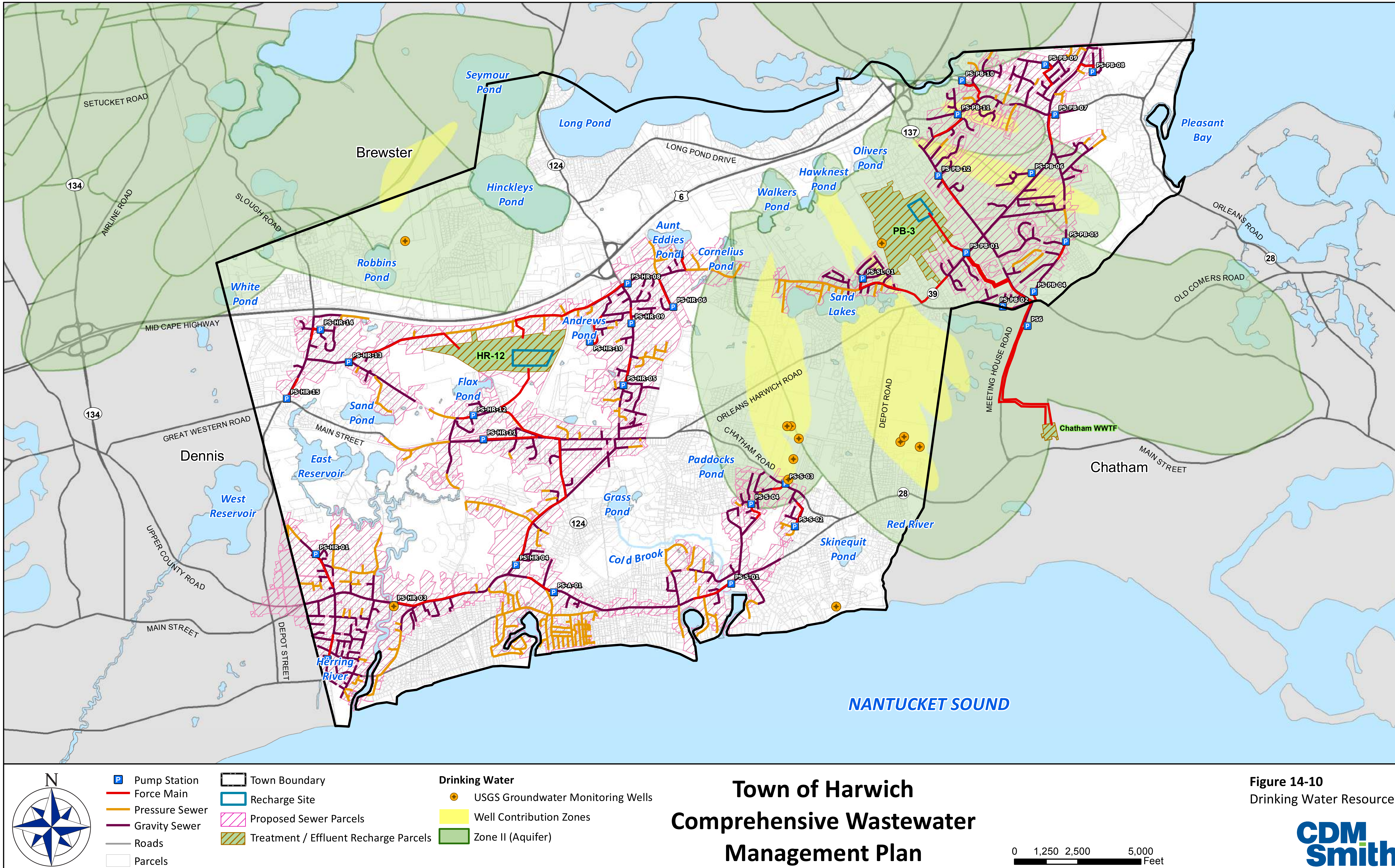
None of the proposed components of the CWMP are within the well contribution zones for Harwich's drinking water wells, with the exception of sewer lines and three pumping stations (PS-PB-06, PS-PB-11, PS-S-03). Potential recharge area PB-3 is located within the Zone II area for the Town's drinking water wells, as are a total of 12 pumping stations (including the aforementioned three), and sewer lines. Chatham's WWTF, proposed for eventual expansion, is at the edge of a Zone II area.

The CWMP is not expected to result in adverse impacts to Harwich's drinking water quality or quantity. Wastewater effluent that will be recharged into groundwater will be treated as outlined in Section 13. Nitrate will be treated to between 3 and 5 mg/l. Overall, implementation of the CWMP is expected to positively affect groundwater quality by removing many septic systems from service. This will result in lowered inputs of nitrogen and phosphorus into the groundwater, as well as lowering the potential for contamination of groundwater from pathogens associated with wastewater. Additional information regarding Harwich's groundwater quality is provided in Section 4 and additional information regarding the selection of recharge sites is available in Sections 9, 10, and 11.

Groundwater quantity is not expected to be negatively impacted by the implementation of the CWMP. By constructing recharge facilities at the HR-12 and East Harwich, groundwater recharge will be balanced between the Herring River and Pleasant Bay watersheds. Each of these facilities will be subject to regulation and the associated monitoring requirements under the adaptive management plan and the Groundwater Discharge Permits issued by MassDEP.

Construction activities are not expected to impact groundwater quality or quantity. Construction activities will need to comply with current erosion and sedimentation standards, applicable Massachusetts stormwater management standards, as well as obtain a federal general permit for construction-related stormwater discharges.

Indirect impacts are not expected to negatively impact groundwater quality or quantity. Most of the areas to be sewered are near buildout condition, so sewering of these areas is not expected to place significant additional demand on groundwater supplies. Although the availability of sewers will allow growth in the economic centers of Harwich Center, East Harwich Center, and Harwich Port, these areas are designated by the Town for planned growth and economic development. Since treated wastewater will be recharged into groundwater, additional water use in these areas should not result in a significant impact to groundwater supplies.



Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-10
Drinking Water Resources

CDM Smith

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Long term monitoring of water resources will occur as part of the Adaptive Management Plan, outlined in Section 13.8. Implementation of the different phases of the CWMP is expected to be tailored in part based on the results of this monitoring, and improvement to groundwater quality over the long-term is expected as septic systems are removed from service.

14.9 Wastewater

Currently wastewater in Harwich is handled by Title 5 septic systems, with the exception of a few small package wastewater treatment facilities. Since most of the areas to be sewered are near buildout condition, the construction of sewers is not expected to greatly increase wastewater generation. Some additional wastewater generation will occur as a result of the sewers allowing growth in the areas of Harwich Center, East Harwich Center, and Harwich Port. These areas are designated by the Town for planned growth and economic development; the design of sewerage facilities will take such growth into account.

As a project focused on wastewater solutions, this SEIR/CWMP extensively discusses the implications of wastewater handling. Specifically, estimated wastewater flows are described in Section 7, wastewater needs are described in Section 8, wastewater scenarios in Section 10, collection and treatment system evaluations in Section 12, and treated effluent disposal/recharge in Sections 9 and 11.

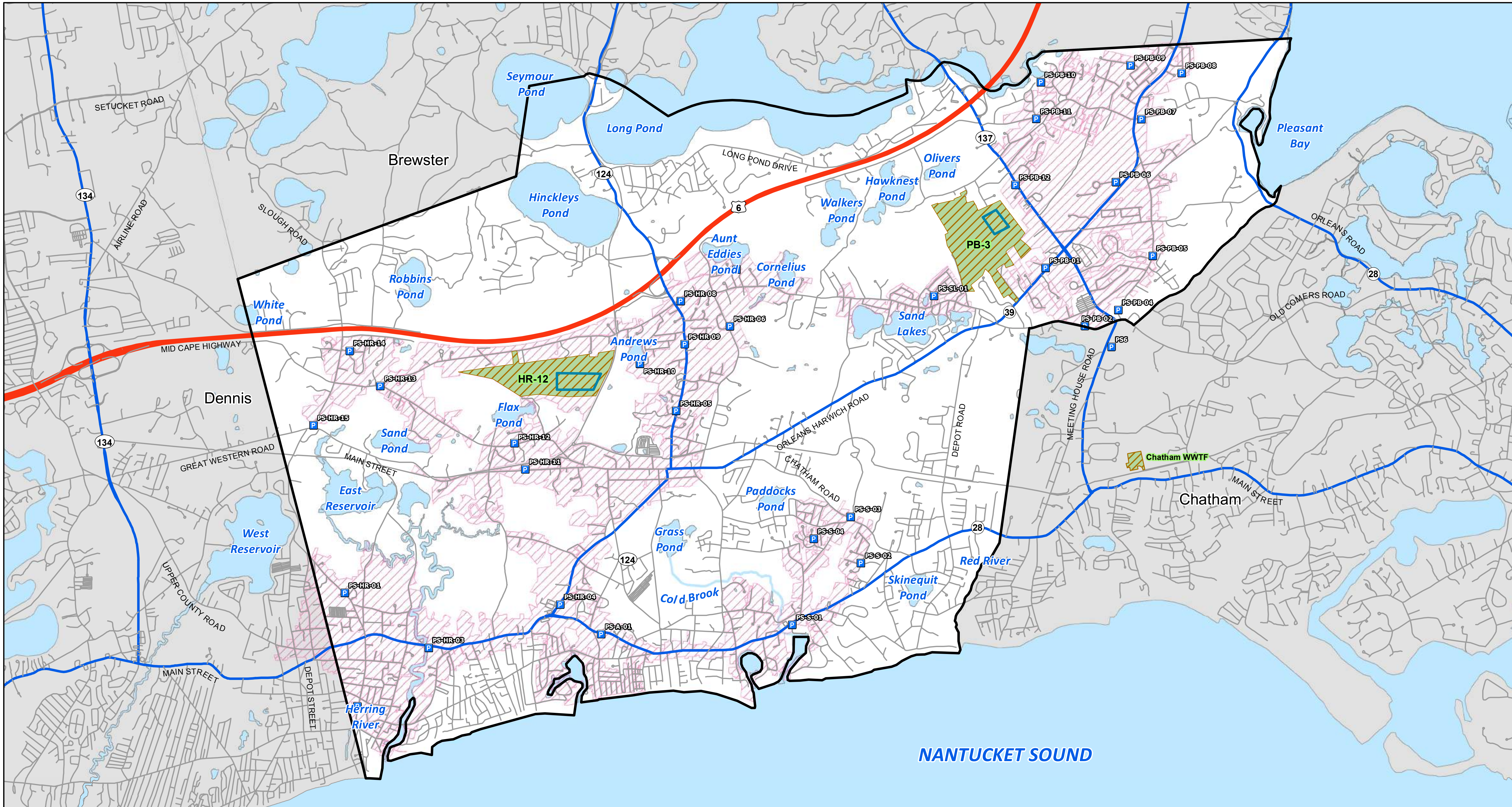
14.10 Transportation and Traffic Generation

The CWMP proposes approximately 92 miles of new sewer mains to be installed within existing roadways. Roads will not be widened and new roads will not be constructed as a part of this project, with the exception of access roads to the WWTF and effluent recharge facilities. The relationship between the proposed parcels to be sewered and MassDOT roadways is shown in Figure 14-11.

Construction of the WWTF at HR-12, the potential effluent recharge facility at PB-3, and the eventual expansion of the Chatham WWTF will require the addition of approximately 20 parking spaces. Estimated average traffic on roadways serving the proposed WWTF at HR-12, recharge facilities, or expanded Chatham WWTF is not expected to change.

The project requires installing sewer mains in state Routes 28, 39, 124, and 137. The Town understands that working in these roadways will present significant challenges for residents, businesses, and the construction crews tasked with the work. Such challenges include winter and summer construction restrictions, summer traffic from the tourist industry in Harwich, state highway construction requirements, and disruptions to local businesses and residents.

Proposed work on state-controlled roadways will occur outside of the summer months (Memorial Day to Labor Day) to minimize traffic impacts. Recent history indicates that MassDOT will prohibit construction in Route 28 from Memorial Day to Labor Day. However, MassDOT does not allow any construction on state roads from November to April, so a special waiver would be needed to proceed with off-season construction. In addition, paving would have to be delayed until the hot mix asphalt plants reopen in the spring.



N

P	Pump Station
	Force Main
	Pressure Sewer
	Gravity Sewer
	Parcels
	Town Boundary
	Recharge Site
	Proposed Sewer Parcels
	Treatment / Effluent Recharge Parcels

MassDOT Roads

- Interstate
- US Highway
- State Route
- Non-numbered route

Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-11
Transportation

0 1,250 2,500 5,000 Feet

CDM Smith

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Temporary traffic disruptions during utility construction will be mitigated in consultation with Mass DOT. There will be temporary disruptions in the use of transit, pedestrian, and bicycle facilities during construction of the sewers and pump stations.

The Cape Cod Commission has recommended that potential impacts on the transportation network related to construction or expansion of any treatment facilities be considered by the Town at the appropriate stage in the design process. It also recommended that the Town coordinate sewer construction activities with planned roadway improvement projects to minimize traffic disruptions and reduce overall costs. As such, potential traffic impacts and mitigation methods will be looked at in greater detail during the design of the individual CWMP components, including coordinating other needed roadway improvements with the sewer project where such coordination is logical and cost-effective for the Town.

14.11 Air Quality

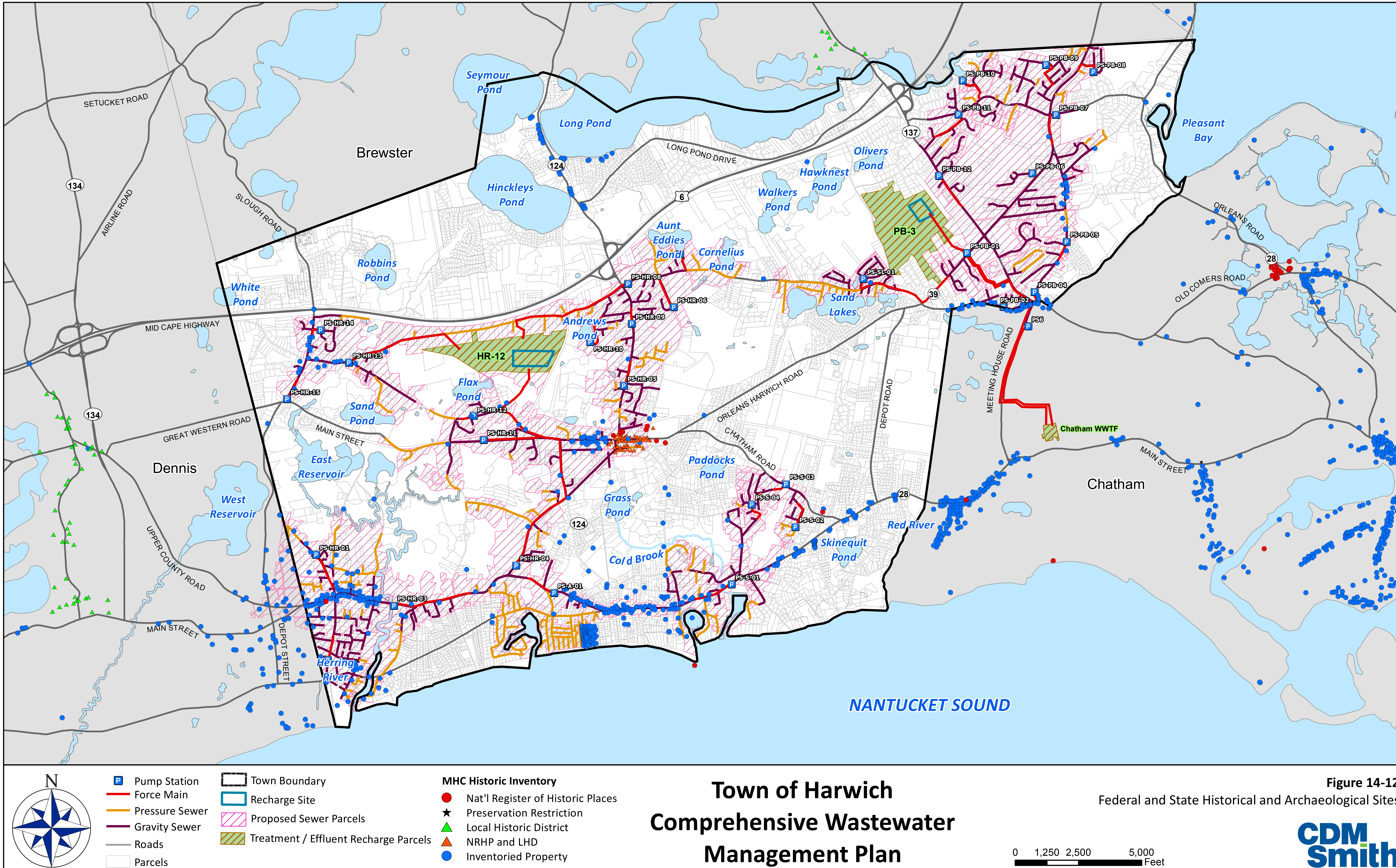
While emissions from the wastewater processes are not anticipated to require permits, combustion sources, specifically the new emergency generators that will combust either diesel or natural gas, will be required to comply with the Environmental Results Program (ERP). While this does not require a pre-construction permit, certification of the equipment will be required within 60 days of startup.

During the construction phase, the Town will require contractors to comply with MassDEP's Clean Air Construction Initiative and Diesel Retrofit Program, to mitigate diesel emissions to the maximum extent feasible. Project contractors will be required to use ultra-low sulfur diesel fuel in off-road engines. Specific requirements are included in the Construction Management Plan in Section 17.

14.12 Historical and Architectural Resources

The Massachusetts Cultural Resource Information System (MACRIS) from the MHC Web site was used to locate state listed historical and archeological sites within the project vicinity. Approximately 50 sites listed on the National Register of Historic Places were identified along the streets within the areas to be sewered, with many more properties having been inventoried. Figure 14-12 shows the proposed work in relation to federal and state listed historical sites. Work near registered historic or archeological sites will occur within Town-owned rights-of-way. All work adjacent to any federal or state listed site will occur as quickly as possible. No impacts are anticipated because construction of sewer mains will occur in streets or rights-of-way. Pumping stations will be designed to be small and are generally away from listed or inventoried properties.

MHC was consulted during the preparation of the EENF/Draft CWMP (associated correspondence is included in Appendix I). MHC indicated in their January 25, 2013 response letter that they prefer to perform their review during the design of each project phase. In compliance with MHC's response letter, scaled project plans will be submitted to MHC for a review of potential impacts to historical and archaeological resources during detailed design of each phase of the project for the "preferred alternative wastewater treatment plant location(s), recharge areas, pumping stations, equipment storage and materials staging areas and cross-country sewer right-of-ways."(Note that no cross-country sewers are presently proposed in this CWMP.) In addition, as requested by MHC, the Inventory of Historic and Archaeological Assets of the Commonwealth will be consulted during each project design phase to identify any resource areas that may be affected by the construction or operation of the CWMP components. The project designers will seek to minimize temporary or



Town of Harwich Comprehensive Wastewater Management Plan

Figure 14-12

Federal and State Historical and Archaeological Sites

Z:\Harwich\Harwich_cwmp\MXD\Section_14\Fig14-12_Historical_Sites.mxd SHEETSJA 8/9/2013 permanent impacts to such resources. Coordination with the MHC will continue throughout project planning and design.

The MHC requested that if above-ground pumping stations will be in historically significant areas that are significant for their setting, then considerations should be made for the structure design, materials, massing, landscaping, etc. to avoid or minimize adverse effects from the new construction. These considerations will be taken into account as the pump stations are designed.

14.13 Compliance with the MEPA Greenhouse Gas Policy

This project is subject to the MEPA Greenhouse Gas Emissions Policy and Protocol (the Policy). Comments on the EENF directed the Town to establish a baseline case and a mitigated case of the project using the EPA Energy Star Portfolio Manager (ESPM) for Wastewater Treatment Facilities (WWTF). The EENF established that the baseline case should have an EPSM Energy Performance Rank of 50 while the mitigated case should have an EPSM of over 50.

Since there is no design at this time for this facility, the as-proposed case was based on a similar WWTF designed by CDM Smith for another Cape Cod community. The estimated energy use at the plant was scaled from this design based on the difference in the two plants' annual flow. This as-proposed estimated design ranked 11 in EPSM. The inputs used for EPSM for the as-proposed case are summarized in Table 14-5.

Table 14-5
Inputs to the EPSM

Item	Value at Full Build out
Average Influent Flow (MGD)	1.08
Design Flow (MGD)	1.26
Average Influent Biological Demand (BOD) Concentration (mg/l)	245
Average Effluent Biological Demand (BOD) Concentration (mg/l)	10
Fixed Film Trickle Filtration System Process	No
Nutrient Removal	Yes
Facility Zip Code	02645

14.13.1 Baseline Conditions

The following is a list of direct and indirect sources of carbon dioxide (CO2) anticipated to be produced by the proposed conditions for wastewater handling in Harwich:

Direct Sources

- Emergency generator at the proposed WWTF
- Emergency generators at the larger proposed pumping stations
- Boilers at the proposed WWTF
- Boilers at the proposed pumping stations, where applicable

- Forklift at the proposed WWTF
- Employee trips to/from the proposed WWTF and pumping stations
- Chemical deliveries to the proposed WWTF
- Sludge hauling from the proposed WWTF
- Construction vehicle emissions

Indirect Sources

- Electricity usage at the proposed WWTF
- Electricity usage at the proposed pumping stations
- Potable water usage at the proposed WWTF

In addition to carbon dioxide, methane will be produced as part of the wastewater treatment process. This will be offset in part by the elimination of septage from newly sewered parcels, which currently requires treatment at a septage treatment facility. The proposed new facility is not proposed to include sludge digestion; therefore, methane capturing for use as a fuel source is not feasible.

14.13.3 Mitigation Measures

The Town reviewed the possible mitigation measures listed in the Policy and the conditions in the EENF comment letter from the Department of Energy Resources (DOER). To reach a baseline case of 50 in EPSM, the Town plans to incorporate applicable mitigation measures from the Policy into the design of the WWTF.

By incorporating these measures, the Harwich plant may achieve significant energy savings over the as-proposed design, as detailed below:

- Minimizing energy use from building orientation and proper landscaping and minimizing the building footprint may achieve a six percent reduction.
- Heating, ventilation, and air conditioning (HVAC) measures may save 20 percent.
- Lighting efficiencies and lightbulb selection may save as much as 75 percent.
- Particular wastewater processes equipment selection may show a 35 percent energy reduction.
- At least three percent of the energy use will be made up of on-site renewable generation and purchase of green energy or renewable energy credits.

These measures will allow the Town to reach a 50 ESPM rating for the baseline rating. The mitigated case will include all of these measures, plus additional on-site renewable generation and purchase of green energy or renewable energy credits to achieve an EPSM rating higher than 50, as required in the EENF comment letter. The outcome of the ESPM for the baseline and mitigated cases is shown in Table 14-6 and the detailed mitigation measures are listed in Table 14-7.

Table 14-6
Outputs from ESPM

Project Case	ESPM Energy Performance Rank	Site kBTU/gpd	Source kBTU/gpd	CO_2 Emissions (short tons per year)
As-proposed	11	4.32	13.56	531.2
Baseline	50	2.70	8.48	332.1
As-mitigated (Target Only)	51	2.65	8.33	326.4

Depending on specific conditions evaluated during detailed facility design and the availability and cost of additional renewable energy, the Town could opt to go beyond the as-mitigated case shown in Table 14-6 to achieve an ESPM rating higher than 51. This, however, is difficult to assess at this stage of planning-level analysis.

Table 14-7
Greenhouse Gas Emissions Policy and Protocol Mitigation Measures

Mitigation Measures to be Included	Related Equipment
Minimize energy use through proper building orientation and proper landscaping	LIGHTING HVAC
Minimize building footprint	LIGHTING HVAC
Increase roof insulation to at least 20% above the minimum required by the effective Mass Building Energy Code	HVAC
Increase boiler or furnace efficiency to at least 10% above the minimum required by code	HVAC
Include energy recovery ventilation for heated building areas	HVAC
Improve building envelope through higher R-value insulation in walls and, if appropriate, basement walls and ceiling	HVAC
Maximize the thermal mass of walls, roofs and floor to provide thermal damping	HVAC
Conduct inspection and comprehensive air sealing of building envelope to minimize air leakage	HVAC
Install lower U-value windows to improve envelope performance	HVAC
Incorporate window glazing to balance and optimize day lighting, heat loss and solar heat gain performance	HVAC
Evaluate use of high-albedo roofing materials to reduce heat absorption	HVAC
Prevent over-sizing of HVAC or other equipment by sizing only after efficiency measures have been incorporated to reduce HVAC, lighting and other electrical loads	HVAC
Install high-efficiency HVAC systems and premium efficiency motors	HVAC
Use demand control ventilation	HVAC
Use energy efficient boilers, heaters, furnaces, incinerators, or generators	HVAC
Seal and leak-check all supply air ductwork	HVAC
Incorporate motion sensors into lighting, day lighting, and climate controls where practicable as safety concerns and ventilation codes allow	HVAC
Provide automated energy management control system with the capacity to: ▪ Adjust and maintain set points and schedules ▪ Indicate alarms and problems	HVAC

Mitigation Measures to be Included	Related Equipment
▪ Provide information on trends and operating history ▪ Operate mechanical and lighting systems to minimize overall energy usage	LIGHTING
Use efficient, directed exterior lighting, such as LED technology	LIGHTING
Install high efficiency lighting, including CFLs and LED technology as appropriate	LIGHTING
Reduce Lighting Power Density to at least 15% below maximum allowed by the code; include occupancy on/off controls	LIGHTING
Process optimization: Mitigate the negative impact on the life-cycle efficiency and emissions of the WWTF treatment process due to the impact of equipment operating for a large fraction of the life-cycle at partial loads through phasing and consideration of efficient turn-down capacity.	All WWTF related equipment
Size piping systems to minimize pressure loss	
Design pumping, blower, filtration and associated control systems to achieve overall efficiency	
Select high efficiency equipment including pumps, blowers, and motors	
Evaluate process alternatives and select the least energy intensive option practical	
Specify and procure efficient equipment	
Include sufficient metering and controls for real-time monitoring and optimization of the process operations	
Incorporate appropriate on-site renewable energy systems	All
Purchase Renewable Energy Credits	All

Other Mitigation Measures to be Considered
Prepare a description of the business as usual case for the as-proposed pumping stations and projected annual MWH energy consumption and GHG emissions
Prepare a description of the proposed mitigated pumping stations and projected annual MWH energy consumption and GHG emissions
Demonstrate new tree planting
Install efficient water fixtures that exceed building code requirements such as waterless urinals, dual flush toilets, low-flow faucets and showerheads, sensor faucets, or plant water reuse
Plant only native species that need minimal watering and/or use xeriscaping
Develop a water management plan
Participate in EPA's WaterSense Program
Use low volatile organic compound (VOC) adhesives, sealants, paints, carpets, and wood
Track energy performance of the building and develop a strategy to maintain efficiency
Provide energy information systems to promote energy awareness to occupants
Conduct 3rd party building commissioning to ensure energy performance
Design for waste reduction (i.e. provide for storage and collection of recyclables (including paper, corrugated cardboard, glass, plastic, and metals) in building design
Reduce energy demand using peak shaving or load shifting strategies – if applicable, enroll in demand response program with the International Organization for Standardization (ISO)-New England
Purchase or generate additional green power or purchase Renewable Energy Credits
Specify and procure most efficient equipment
Implement a construction waste management plan
Implement and enforce no-idling policies
Incentivize use of public transportation and car/vanpools, for construction workers to reduce vehicle trips
Provide bicycle storage and showers/changing rooms

The measures summarized above have been included in the Section 61 Findings in Section 17 of this CWMP/SEIR.

14.14 Regulatory Standards and Permit Requirements

The following federal, state and local permits or reviews are anticipated to be needed at various stages of the CWMP's implementation, based on currently available site and design information:

- Environmental Notification Form and Environmental Impact Report pursuant to the Massachusetts Environmental Policy Act;
- Cape Cod Commission Development of Regional Impact (DRI) approval;
- National Pollutant Discharge Elimination System (NPDES) Construction Storm Water General Permit;
- US Army Corps of Engineers Section 10 and/or Section 404 Permits;
- Coastal Zone Federal Consistency Review (through Massachusetts Coastal Zone Management);
- Massachusetts Historical Commission Approval;
- Coordination with the Natural Heritage and Endangered Species Program;
- Groundwater Discharge Permit from MassDEP;
- Orders of Conditions from the Harwich Conservation Commission;
- Massachusetts Highway (MassDOT) Permits; and
- Air Quality Permits/Compliance with the Environmental Results Program.

This section discusses the applicability of the permits and approvals listed above. Clean Water State Revolving Fund (SRF) Project Evaluation Form and Loan Application requirements are also discussed at the end of this section. Review times indicate the approximate duration for agency review from submittal of applications to the issuance of permits. Typically, permits obtained by the Town are initiated around the 30 percent design milestone for each construction contract. At this stage, sufficient detail is available to allow reviewing agencies to understand the project, and sufficient time is left in the design phase to incorporate any changes that result from the permit review process. Permits applied for by the contractor are initiated once construction contracts have been signed.

Federal Permits

NPDES General Permit for Construction

A NPDES General Permit for Construction is required from the EPA, pursuant to Section 402 of the Clean Water Act, to address stormwater controls during project construction. This permit is needed for any construction exceeding one acre that will involve a point source discharge to wetlands or water bodies. Since construction of the plant, preparation of the effluent recharge site, and installation of sewer mains will exceed one acre, this permit is applicable. A Storm Water Pollution

Prevention Plan (SWPPP) addressing construction must be prepared, describing erosion and sedimentation controls and treatment and the ultimate discharge of storm water and uncontaminated groundwater during construction. Typically this permit is to be completed and submitted by the contractor for each phase of construction. EPA review time is approximately 2 to 4 weeks.

US Army Corps of Engineers Section 10 and/or Section 404 Permits

Work in wetlands and waterways is regulated by the U.S. Army Corps of Engineers (the Corps) under the authority of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. In Massachusetts, the Corps has developed the Massachusetts General Permit (GP) to expedite their evaluation of permit applications and streamline the permitting process. There are three categories associated with the GP, Category I, Category II and Individual Permits. Category I activities are projects that impact less than 5,000 square feet of a federally defined wetland or waterbody and require pre-construction notification, but do not require formal approval or a permit from the Corps. If impacts to wetlands are greater than 5,000 square feet, but less than 1 acre, a Category II permit application must be filed. The Corps, along with other federal resource agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, EPA and the Massachusetts CZM office), reviews this application and determines that either: 1) the project meets the criteria of the GP and can proceed with no changes and no additional Corps review is needed; 2) additional information is needed before making a permitting decision; or 3) the project does not meet GP criteria and an Individual Permit is required. An Individual Permit is generally reserved for large projects which exceed the established criteria for either Category I or Category II activities. Note, however, that the Corps may act at any time to exercise its discretionary authority and require an Individual Permit and/or a NEPA documentation, even if GP criteria are met. Projects where a Category II or Individual Permit is required must obtain 401 Water Quality Certification from MassDEP as well as CZM Consistency certification. Coordination with the Corps and MassDEP should take place on such projects prior to the submittal of a permit application so as to anticipate documentation, alternatives analysis, and mitigation requirements. Review times for Section 10 and Section 404 permits vary based on the size and complexity of the project, types of resources being impacted, and magnitude of the impacts.

State Permits

Massachusetts Environmental Policy Act (MEPA) Approval

The Massachusetts Environmental Policy Act, M.G.L. c.30ss61 through 62H, applies to projects in Massachusetts that exceed defined thresholds and involve some state agency action (i.e., projects that are either proposed by a state agency or require a permit, financial assistance, and/or land transfer from one or more state agencies). Projects that fall within MEPA jurisdiction are generally reviewed in a two-step process, beginning with the filing of an ENF, followed by an EIR if needed.

An ENF and EIR are required for this project because it includes a new WWTF with a capacity of more than 100,000 gallons per day, is located in an Area of Critical Environmental Concern, and will alter ½ acre or more of wetlands, as well the construction of more than 10 miles of sewer mains.

On February 25, 2013, the Town submitted an Expanded ENF/Draft CWMP for review by MEPA, the CCC, and other agencies. In that document, the Town requested approval from MEPA to prepare a Single Environmental Impact Report, rather than draft and final reports, given the level of detail submitted with the Expanded ENF/Draft CWMP. The Town also requested a Phase 1 waiver for the Muddy Creek culvert replacement project. A Certificate was issued by the EOEEA Secretary on April

12, 2013, approving the submittal of a Single EIR and granting the Phase 1 waiver. (See Appendix H) This document serves as both the Single EIR and the Final CWMP.

Review schedules are spelled out in the MEPA regulations and are approximately two months for an EIR.

Section 401 Water Quality Certification

Section 401 Water Quality Certification is required of all projects requesting an individual Section 404 or Section 10 permit under the Clean Water Act. MassDEP administers the 401 Water Quality Certification program. Projects with a cumulative loss of more than 5,000 square feet of bordering and isolated vegetated wetlands and land under water must apply for a Major Fill/Excavation Project Certification. A Minor Fill/Excavation Project Certification must be obtained for projects with a cumulative loss of more than 5,000 square feet of bordering and isolated vegetated wetlands if the project consists of routine maintenance meeting the criteria of 314 CMR 9.04(5), or if the project is a subdivision with a cumulative loss of up to 5,000 square feet, or if the project involves an agricultural limited product meeting the criteria of 314 CMR 9.04(10). Projects with a cumulative loss of not more than 5,000 square feet that are not listed above and for which a Final Order of Conditions has been issued by the local Conservation Commission are excluded from Section 401 review. Additionally, 401 Water Quality Certification is not required of projects in isolated vegetated wetlands not subject to the Wetlands Protection Act so long as the cumulative impacts to bordering and isolated vegetated wetlands and land under water are less than 5,000 square feet and the fill/excavation will not take place in any habitat for rare or endangered species or Outstanding Resource Water.

Particular phases of the work proposed under this CWMP may exceed these thresholds, such as the Cold Brook bog natural attenuation project. Thresholds will be evaluated under each design contract and permits filed as needed.

Coastal Zone Federal Consistency Review

The Massachusetts Office of Coastal Zone Management was established in accordance with the Federal Coastal Zone Management Act of 1972, as amended. The purpose of the Massachusetts CZM is to provide technical assistance to municipalities and state agencies with jurisdiction over coastal resources, ensure that responsibilities of the Executive Office of Energy and Environmental Affairs agencies are administered in a coordinated and consistent manner, and review projects proposed within the Coastal Zone for compliance with the CZM Policies established in 301 CMR 20.00.

CZM Consistency Review is required for any project which needs a federal permit for activities in the Coastal Zone and/or when a project located in the Coastal Zone is subject to MEPA review. A federal permit which requires a Consistency Statement from CZM is not valid until the Statement is issued. A CZM Consistency Review is often prepared as part of MEPA documenta¬tion or can be prepared as a stand-alone document. Because all of Cape Cod is mapped within the Coastal Zone, a review of CZM policies is provided in Section 14.7 of this SEIR.

Orders of Conditions under the Massachusetts Wetlands Protection Act

Under the state Wetlands Protection Act (M.G.L. c.131s.40) and its regulations (310 CMR 10.00), alterations of wetland resource areas, and work adjacent to certain resource areas, require issuance of an Order of Conditions by the local Conservation Commission. Work within the 100-foot Buffer Zone to certain resource areas can be approved via a Determination of Applicability. An Order of

Conditions is required for any work within a protected wetland resource area (including but not limited to Bordering Vegetated Wetlands, Bank, 200-foot Riverfront Areas and/or 100-year floodplains), or when the Conservation Commission determines that an Order of Conditions will be required for work in a 100-foot Buffer Zone area. The Conservation Commission holds a public hearing to review the proposed activities subject to jurisdiction of the Wetlands Protection Act and receives input from the public before issuing a permit decision. Abutters to the jurisdictional areas must be notified of the public hearing.

Orders of Conditions will likely be required from the Harwich Conservation Commission for work in jurisdictional areas during each phase of the project. The review time for a Notice of Intent is approximately 2 months.

Historic Preservation Act, MHC Section 106 and Chapter 254 Compliance

The MHC identifies, evaluates, and protects the state's significant cultural resources under Section 106 of the National Historic Preservation Act and Chapter 254 of the Acts of 1988 (950 CMR 71.00). Any new construction projects or renovations to existing buildings that require state funds, licenses, or permits are subject to MHC review requirements. The state regulations set up a review process to identify historic properties, assess effects, and consult interested parties to avoid, minimize, or mitigate any adverse impacts.

Construction of the proposed WWTF and appurtenant structures will require state and federal permits for work within previously undisturbed areas. As such, consultation with the MHC is required to determine whether potentially sensitive archaeological/historical features could be affected by construction. As described in Section 14.12, MHC has been notified of the project and has provided the comments included in Appendix H and Section 18, and further coordination will take place during each design phase of the CWMP's implementation.

Review by Massachusetts Division of Fisheries & Wildlife NHESP

A primary responsibility of the NHESP is the regulatory protection of rare species and their habitats as codified under the MESA (M.G.L. c 131A) and the Wetlands Protection Act (M.G.L. c.131s.40). Projects affecting rare species and/or habitats, and triggering specified requirements or permits, are reviewed by the NHESP.

As described in Section 14.5, NHESP has been contacted and has provided the comments attached in Appendix H and Section 18. Follow-up required as a result of NHESP's review is described in Section 14.5 and will take place during each design phase of the CWMP's implementation.

Sewer Connection and Extension Permit

Under 314 CMR 7.00, new connections to sanitary sewers, increases in flow to existing sanitary sewers, and discharges from businesses that are not considered to be "industrial wastewater" are subject to state requirements based on their expected discharge volume.

Sewer extensions are subject to state requirements in 314 CMR 7.00 based on their length. Note that sewer extension projects that obtain a Project Approval Certificate from MassDEP's Clean Water State Revolving Fund Program are exempt from permitting requirements, due to MassDEP's detailed review before the certificate is issued. Design plans for all phases funded by the State Revolving Fund will undergo MassDEP review and comment prior to receiving approval to advertise for construction bids.

Groundwater Discharge Permit

Any facility that discharges 10,000 gallons per day (gpd) or more into the ground must have a valid groundwater discharge permit from MassDEP pursuant to 314 CMR 5.00. There may also be instances, particularly in nitrogen sensitive areas, where a groundwater discharge permit will be required for flows less than 10,000 gpd. Each proposed site for recharge of treatment plant effluent will require such a permit.

An application to build a new treatment plant must include an engineering report along with a statement by a registered professional engineer that the plans and specifications have been prepared in accordance with the regulations. Along with the report, applications must include hydrogeologic studies of the recharge site and its surroundings as well as a groundwater monitoring plan. The plans and specifications must describe in detail the collection, treatment and recharge components of the facility.

Review time by MassDEP is approximately 3 months.

MassDOT (State Highway Permit)

Any utility that encroaches on the state highway layout or requires significant modification to traffic patterns will require a state highway permit. The application includes a description of the property and/or facility for which access is sought, a description of the work to be performed in the vicinity of the state highway layout, and a set of construction drawings including traffic control measures for the project. All work along Routes 28, 39, 124, and 137 will require a MassDOT permit.

Review time is approximately 4 to 6 months.

Air Quality Permit/Compliance with the Environmental Results Program

A pre-construction permit is not required, but a certification of the pertinent equipment will be required within 60 days of startup under the Environmental Results Program.

Local Approval

Cape Cod Commission Approval

The CCC is the regional planning and land use commission for Cape Cod. The Commission has jurisdiction over any Development of Regional Impact (DRI) - a development which, because of its magnitude or the magnitude of its impact on the natural or built environment, is likely to present development issues significant to or affecting more than one municipality, and which conforms to the criteria established in the applicable standards for DRIs pursuant to section twelve of their regulations.

An Applicant who is required to file an ENF must, at the same time, file a copy of the ENF with the Clerk. Any proposed development for which an EIR is required is automatically considered to be a DRI. The Applicant must file a DRI application for the proposed development to the Commission for review. DRI Applicants who are also subject to regulation under MEPA may seek a Joint Review Process under MEPA and the Act pursuant to a November 25, 1991 Memorandum of Understanding between the two agencies.

The joint review process was followed for the Expanded ENF/Draft CWMP and is again being followed for this SEIR/CWMP. This submittal is prepared to satisfy both MEPA and the CCC, and the review periods will begin simultaneously. The CCC will hold a public hearing within 45 days of the issuance of a MEPA Certificate on this SEIR/CWMP, followed by completion of the DRI approval process, which can last up to 6 months following issuance of the MEPA Certificate.

Clean Water State Revolving Fund (CWSRF) Loans

The Clean Water State Revolving Fund for water pollution abatement projects offers low-interest loans (0 percent interest for nutrient removal projects meeting certain criteria and 2 percent for most other projects) to assist municipalities in complying with federal and state water quality requirements. The program is administered by MassDEP and the Massachusetts Water Pollution Abatement Trust. A major goal is to encourage communities to undertake projects with meaningful water quality and public health benefits and which address the needs of communities and watersheds. Further discussion of use of the State Revolving Fund program is provided in Section 15 of this CWMP/SEIR.

14.15 Compliance with Cape Cod Commission Regional Plan

The EENF and draft CWMP were submitted for joint review by MEPA and the Cape Cod Commission (CCC). The project will be subject to a Development of Regional Impact (DRI) review by the CCC, which will formally begin after the MEPA review process is complete. A joint MEPA/DRI scoping session/public hearing was held on April 3, 2013, and the CCC commented on the EENF and draft CWMP on April 4, 2013. The CCC determined that the EENF in general addresses many of the parameters of the Regional Policy Plan and Regional Wastewater Management Plan (RWMP) Draft Guidance on CWMPs and suggested that the Phase 1 waiver for work on Muddy Creek was a reasonable and severable phase of the project. CCC requested that the Town not submit the final CWMP for review until it has completed the Regional 208 Water Quality Management Plan, for which a draft was issued in June 2014 and final approval in June 2015. Other comments made by the CCC are addressed in this document and summarized in the Response to Comments in Section 18.

Table 14-8,below reviews the applicable CCC Regional Plan provisions relative to water resources (general aquifer protection, drinking water quality and quantity, marine water embayments and estuaries, freshwater ponds and lakes, water quality improvement areas, public and private wastewater treatment facilities, and stormwater quality).

Table 14-8
Review of Cape Cod Commission Policies
General Aquifer Protection

Performance Standards		Compliance
WR1.1	Five-ppm Nitrogen Loading Standard: All development and redevelopment shall not exceed a 5-parts per million (ppm) nitrogen loading standard for impact on groundwater unless an alternative standard applies in accordance with the water resources classification system as described in the Water Resources planning section found on page 27. Guidance on methodology to meet this standard can be found in Cape Cod Commission Nitrogen Loading Technical Bulletin 91-001, as amended.	The WWTF is proposed to meet all applicable treatment and discharge requirements.
WR1.2	Identification of Drinking Water Wells: Development and redevelopment shall identify their proposed drinking water wells and existing private drinking water wells on abutting properties within 400 feet and assess the impact of the development on the water quality of these wells and all other existing wells that may potentially be affected by the proposed development. Septic systems and other sources of contamination shall be sited to avoid adversely affecting downgradient existing or proposed wells.	Protection of drinking water resources was a major consideration in the development of the CWMP. The CWMP aims to reduce loading from septic systems to groundwater resources.
WR1.3	Groundwater Study Requirement: Developments of Regional Impact that withdraw more than 20,000 gallons of water per day shall demonstrate through a groundwater study that the project will not have adverse impacts on groundwater levels or adjacent surface waters and wetlands. The study shall include mapping of surface water morphology and comparison of existing and affected water-table fluctuations.	Not applicable; the project does not propose additional water withdrawals.
WR1.4	Cluster Development: All residential subdivisions of five or more lots and all commercial subdivisions of land shall cluster the proposed development unless inconsistent with local bylaws. Cluster plans shall use site designs that maximize contiguous open space, respect the natural topography and character of the site, and employ shared wastewater treatment, community water supply alternatives and Low Impact Development (LID) landscaping to allow more compact development.	Not applicable; the project does not propose residential or commercial development.
WR1.5	Turf and Landscape Management Plan: Development and redevelopment shall adopt Best Management Practices such as a turf and landscape management plan that incorporates water conservation measures including the use of native and drought resistant plantings and the use of drip irrigation, and minimizes the amount of pesticides and chemical fertilizers.	Any landscaping at the WWTF or recharge facilities will comply with this requirement. In addition, the public outreach components of the CWMP will help reduce fertilizer use in Harwich via education.

Drinking Water Quality and Quantity

Performance Standards		Compliance
WR2.1	Five-ppm Nitrogen Loading Standard: The maximum nitrogen loading standard for impact on groundwater shall be 5 ppm for development and redevelopment unless a cumulative impact analysis indicates a more stringent loading standard is necessary.	The WWTF is proposed to meet all applicable treatment and discharge requirements.
WR2.2	Prohibition on Hazardous Materials/Wastes: Development and redevelopment that involves the use, treatment, generation, handling, storage, or disposal of Hazardous Materials or Hazardous Wastes, with the exception of household quantities, shall not be permitted in Wellhead Protection Areas, except as provided in WM1.2 and WM1.3.	The CWMP does not propose the use, treatment, generation, handling, storage, or disposal of Hazardous Materials or Hazardous Wastes in Wellhead Protection Areas with the exception of household quantities.
WR2.3	Restrictions on Public and Private Wastewater Treatment Facilities: Public and private wastewater or treatment facilities with Title 5 design flows greater than 10,000 gallons per day shall not be permitted in Wellhead Protection Areas, except as provided in MPS WR5.2 below and subject to MPS WR6.1 through WR6.9.	The proposed WWTF is not within a Wellhead Protection Area. Potential effluent recharge sites in East Harwich may be in Zone II areas but not zones of contribution. Site HR-12 is outside of a Zone II area. Further discussion is provided under MPS WR5.2 and MPS WR6.1-WR6.9. A major goal of the CWMP is to reduce loading from septic systems to groundwater resources.
WR2.4	Prohibited Uses under State Regulations: Uses prohibited in Zone IIs by state regulations shall not be permitted.	The CWMP does not propose uses prohibited in Zone IIs.
WR2.5	Future Well Site Restrictions: No development shall be permitted within 400 feet of an identified future well site.	This standard applies for areas mapped as Potential Public Water Supply Areas. The Commission may determine that this standard does not apply provided that supporting information from the Town or Water Department demonstrates to the Commission that the area will not be considered as potential water supply areas.
WR2.6	One-ppm Nitrogen Loading Standard: The maximum nitrogen loading standard for impact on groundwater shall be 1 ppm for development. Guidance on methodology to meet this standard can be found in Cape Cod Commission Nitrogen Loading Technical Bulletin 91-001, as amended.	This standard applies for areas mapped as Potential Public Water Supply Areas. The Commission may determine that this standard does not apply provided that supporting information from the Town or Water Department demonstrates to the Commission that the area will not be considered as potential water supply areas. Nitrogen reductions are proposed in all watersheds.

Marine Water Embayments and Estuaries

Performance Standards		Compliance
WR3.1	Critical Nitrogen Load Standard for Development: In watersheds to estuaries/embayments where a critical nitrogen load has been determined, through either a Total Maximum Daily Load (TMDL), or a Massachusetts Estuaries Project-accepted technical report, development and redevelopment shall not exceed the identified critical nitrogen loading standard for impact on marine ecosystems, except as provided in WR3.3. The Commission shall maintain a list and map of estuary/embayment critical nitrogen loading standards that shall be the basis for applying this MPS; the list and map will be updated on a regular basis as TMDLs are approved by the Massachusetts Department of Environmental Protection and the US Environmental Protection Agency.	The goal of the CWMP is to reduce nitrogen loading in estuaries and embayments, in order to meet MEP nitrogen loading thresholds and TMDL's through a combination of implementation of the proposed CWMP phases and continued monitoring via the adaptive management program.
WR3.2	Maintenance or Improvement of Nitrogen Loading: In watersheds to estuaries/embayments where there are documented marine water quality problems and a critical nitrogen load has not been developed, including but not limited to those embayments shown on the Cape Cod Water Resources Classification Map, development and redevelopment shall maintain or improve existing levels of nitrogen loading, except as provided in WR3.3 and WR3.1.	As noted above, the goal of the CWMP is to reduce nitrogen loading in estuaries and embayments, to meet MEP thresholds and TMDL's. In addition, areas of town with identified development or redevelopment goals are proposed to be provided with the necessary infrastructure to minimize future nitrogen loading. Other properties proposed to remain on on-site systems will be considered on a case-by-case basis by the Harwich Health Department.
WR3.3	Local Management Plans: In lieu of the requirements set forth in MPS 3.1 and 3.2, in watersheds with Commission-approved watershed nutrient management plans, or Commission-approved comprehensive wastewater management plans, nitrogen loading from development and redevelopment shall attain the nitrogen loading limit specified by the plan.	Upon approval the proposed CWMP will represent the nutrient management plan referenced in this standard.
WR3.4	Nitrogen Offset Contribution: In watersheds to estuaries/embayments where development and redevelopment must meet either WR3.1 or WR3.2, development and redevelopment may meet these standards by providing an equivalent nitrogen offset contribution to be used toward meeting the intent of WR3.1 or WR3.2 as provided in the following paragraph.	Not applicable.
WR3.5	Monetary Contribution: In watersheds where the critical nitrogen load has not been determined, development and redevelopment may be required to make a monetary contribution toward the development or implementation of appropriate nitrogen management strategies not to exceed $20 per gallon of design flow of wastewater per day.	Not applicable.
WR3.6	Public and Private Wastewater Treatment Facilities: Public and private wastewater treatment facilities may be used within Marine Water Recharge Areas subject to MPS WR5.2 and MPS WR6.1 through MPS WR6.9 below.	A major goal of the CWMP is to reduce nitrogen loading to marine water recharge areas. Further discussion is provided under MPS WR5.2 and MPS WR6.1-WR6.9.

Freshwater Ponds and Lakes

Performance Standards		Compliance
WR4.1	Limits on Subsurface Disposal Systems: In order to limit phosphorus inputs, no subsurface wastewater disposal systems shall be permitted within 300 feet of maximum high water of freshwater ponds, unless a groundwater study prepared by the applicant demonstrates to the satisfaction of the Commission that groundwater from the site does not discharge into the pond or a tributary. Guidance on the high groundwater adjustment methodology can be found in Estimation of High Groundwater Levels for Construction and Land Use Planning, Technical Bulletin 92-001, as amended. Redevelopment shall comply with this standard to the maximum extent possible.	The proposed effluent recharge facilities will be more than 300 feet from ponds and will discharge highly treated effluent. Some areas near freshwater ponds are proposed for sewering.
WR4.2	Monetary Contribution: If a fresh water pond has documented water quality problems, DRIs located in the pond's watershed shall be required to make a monetary contribution toward the development or implementation of appropriate water quality assessment work or management strategies.	Not applicable; as goal of the CWMP is to improve water quality in Harwich ponds.
WR4.3	Public and Private Wastewater Treatment Facilities: Public and private wastewater treatment facilities may be used within Freshwater Recharge Areas subject to Goal WR6 and MPS WR6.1 through MPS WR6.9 below.	A major goal of the CWMP is to reduce nitrogen loading to marine recharge areas and phosphorous from freshwater areas. Further discussion is provided under MPS WR6.1-WR6.9.

Water Quality Improvement Areas

Performance Standards		Compliance
WR5.1	Nitrogen Loading Standard: Development and redevelopment shall not exceed the nitrogen loading standards for Wellhead Protection Areas or an identified marine water quality standard as applicable. Where existing development within the watershed exceeds the identified loading standard or where there are documented marine water quality problems, nitrogen loading from development and redevelopment shall be maintained or improved.	The basic project purpose is to reduce nitrogen loading to coastal waters and groundwater, to meet MEP thresholds and improve long-term drinking water quality, while meeting the infrastructure needs of other town development goals.
WR5.2	Public and Private Wastewater Treatment Facilities: Use of public and private wastewater treatment facilities shall be as follows: Within Water Quality Improvement Areas that are in Wellhead Protection Areas, public and private wastewater treatment facilities may be used to remediate existing problems; within Water Quality Improvement Areas that are in Freshwater and/or Marine Water Recharge Areas, public and private wastewater treatment facilities may be used in conjunction with any development or redevelopment.	The proposed WWTF and associated facilities are proposed to remediate nitrogen loading to coastal waters and protect drinking water quality.
WR5.3	Monetary Contribution in Economic Centers/Growth Incentive Zones: Development and redevelopment in Economic Centers and Growth Incentive Zones within Water Quality Improvement Areas that have been identified as requiring comprehensive wastewater treatment solutions shall, in the Commission's discretion, be required to provide a monetary contribution, not to exceed $20 per gallon of design flow of wastewater per day, towards community wastewater facility planning or implementation efforts that may include infrastructure for wastewater management, if in the Commission's judgment, such contribution would assist in the planning or implementation of such infrastructure. In towns without designated Economic Centers, this MPS shall not apply.	Not applicable. This proposed CWMP includes the provision of infrastructure to support the future needs of the town's economic centers (village centers).
WR5.4	Nitrogen Loading Standard in Impaired Areas: For Impaired Areas outside of other mapped water resource areas, development and redevelopment shall generally meet a 5 parts per million (ppm) nitrogen loading standard for impact on groundwater, but the standard may be increased where it can be demonstrated to the Commission that such increase will cause no adverse impact on ponds, wetlands, marine waters, public or private drinking water supply wells, and potential water supply wells as identified under Goal WR2.	The proposed program is being developed in accordance with the MEP and to meet TMDLs for coastal waters.
WR5.5	Alternative Water Supply in Designated Mapped Areas: Development in designated Economic Centers, Industrial and Service Trade Areas, Villages, or Growth Incentive Zones in areas serviced by private water supplies shall connect to public water supply, and at the Commission's discretion, shall connect existing development to public water supply in the event that said development impacts such existing development. In towns without a Land Use Vision Map, this MPS shall apply only to Impaired Areas.	Not applicable.

Wastewater Treatment Facilities

Performance Standards		Compliance
WR6.1	Private Wastewater Treatment Facilities: Private treatment facilities shall be permitted only if the implementation timetable of an approved Comprehensive Wastewater Management Plan indicates that there are no feasible public treatment facility options available within three years of the proposed date of construction of a project	This CWMP provides the plan for implementing public infrastructure to meet both public and private needs in many areas of town.
WR6.2	Tertiary Treatment: All public and private wastewater treatment facilities with greater than a design flow of 10,000 gallons per day shall be designed to achieve tertiary treatment with denitrification that meets a maximum 5-ppm total nitrogen effluent discharge standard either through advanced treatment to achieve 5 ppm in the effluent or 5 ppm in groundwater at the downgradient property boundary. The standard may be increased to 10 ppm total nitrogen for redevelopment in Impaired Areas where it can be demonstrated to the Commission that such increase will cause no adverse impact on ponds, wetlands, marine waters, public or private drinking water supply wells, and potential water supply wells.	The WWTF is proposed to meet all applicable treatment and discharge requirements, including effluent total nitrogen levels of 5 ppm or lower.
WR6.3	Hydrologic Balance: Sewage treatment facilities and their collection and discharge areas shall maintain the hydrologic balance of the aquifer and demonstrate that there are no negative ecological impacts to surface waters.	The basic project purpose is to protect and improve the ecology of receiving coastal waters. Effluent recharge at HR-12 and potential East Harwich sites is intended to provide hydrologic balance.
WR6.4	Development Density Limitations: The construction of private wastewater treatment facilities shall not allow development to occur at a higher density than would be allowed by local zoning unless anticipated and approved through a Commission approved Comprehensive Wastewater Management Plan.	The proposed program is being developed by the Town and will be implemented in accordance with approved local zoning and planning. The build-out analysis contained herein sets a framework for anticipated growth in Harwich and associated infrastructure needs.
WR6.5	Ownership and Maintenance of Treatment Facilities: The construction of private wastewater treatment facilities shall be consistent with municipal capital facilities plans as applicable. Development and redevelopment using private wastewater treatment facilities shall specify that the municipality shall have the opportunity to assume ownership and maintenance responsibilities for such facilities where desired by the municipality.	Not applicable; this CWMP proposes a publicly owned treatment facility.

Performance Standards		Compliance
WR6.6	Restrictions in FEMA Flood Zones/Other Sensitive Areas: Public and private wastewater treatment facilities shall not be constructed in FEMA V-Zones and floodways, Areas of Critical Environmental Concern (ACECs), wetlands and buffer areas, barrier beaches, coastal dunes, or critical wildlife habitats. Public and private wastewater treatment facilities may be constructed in FEMA A-Zones only to remediate water quality problems from existing development within such A-Zones and consistent with MPS CR2.2 and CR2.8.	The WWTF is sited outside of FEMA flood zones and sensitive areas. Underground sewers are needed in flood zones to service existing homes and businesses with the flood plain.
WR6.7	Long-term Ownership of Treatment Facilities: The long-term ownership, operation, maintenance and replacement of private wastewater treatment facilities shall be secured as a condition of approval in accordance with Commission, state, and local guidelines.	Not applicable; this CWMP proposes a publicly owned treatment facility.
WR6.8	Sludge Disposal: Applications for approval of public and private wastewater treatment facilities shall include a plan for sludge disposal.	The final destination of the sludge from the wastewater treatment facility is anticipated to be and approved off-site location. This will be addressed during the facility final design stage.
WR6.9	Operation, Monitoring, and Compliance Agreement: Private wastewater treatment facilities greater than 2,000 gallons per day (gpd) design flow that require advanced treatment efficiencies greater than that allowed by a DEP permit to meet Commission Minimum Performance Standards, shall demonstrate operation, monitoring and compliance through a Operation, Monitoring and Compliance agreement between the Board of Health and the Cape Cod Commission.	Not applicable.

Stormwater Quality

Performance Standards		Compliance
WR7.1	No New Direct Discharges of Untreated Stormwater: New direct discharge of untreated stormwater, parking-lot runoff, and/or wastewater into marine and fresh surface water and natural wetlands shall not be permitted.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.2	On-Site Infiltration: Stormwater for all roadways and parking areas shall be managed and infiltrated on site, close to the source, to minimize runoff and maximize water quality treatment. Stormwater water quality treatment shall be provided for the first inch of rainfall (25-year 24-hour storm) consistent with 310 CMR and the Massachusetts Stormwater Management Handbook to attain 80-percent total suspended solids removal and to reduce nutrients. All designs shall provide for at least 44-percent total suspended solids removal shall be designed prior to discharge into structured infiltration systems.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.3	Roof Runoff: Roof runoff shall be managed separately and directly infiltrated unless there is an identified rooftop water quality concern that requires additional treatment or management.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.4	Biofiltration Practices: Stormwater design for the first inch of stormwater flow from development parking and roadways shall use biofiltration practices including, but not limited to, vegetated swales and filter strips, constructed wetlands, tree box filters, bio-retention basins and rain gardens for treatment of stormwater runoff. Bioretention areas shall be constructed in accordance with the Massachusetts Storm Water Management Volume One: Stormwater Policy Handbook, March 1997. Approved biofiltration areas may be counted as open space within Wellhead Protection Areas.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.5	Structured Infiltration Devices: Structured infiltration devices shall be used to accommodate frozen flow conditions and storms that exceed the 25-year 24-hour storm and designed to be consistent with the Massachusetts Stormwater Standards under 310 CMR10 and the Massachusetts Storm Water Management Handbook.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.6	Impervious Surfaces: Roadway and parking design shall limit impervious surfaces. Parking lots shall be designed for the minimum required by the town in accordance with MPS TR2.9. Overflow peak parking design shall be constructed from pervious materials such as porous pavement, permeable pavers, or biomaterial such as grass pavers unless inconsistent with local bylaws. Bioretention shall be incorporated into parking islands and roadway perimeters. Permeable paving shall be encouraged where appropriate.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).

Performance Standards		Compliance
WR7.7	Structured Infiltration Devices in Designated Mapped Areas: Structured detention basins, infiltration basins and galleries may be used for redevelopment in Impaired Areas, Economic Centers, Industrial and Service Trade Areas, Villages, and Growth Incentive Zones. In towns without a Land Use Vision Map, this MPS shall only apply to redevelopment in Impaired Areas.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.8	Minimum Two-foot Separation to Groundwater: New infiltration basins or other stormwater leaching structures shall maintain a minimum two-foot separation between points of infiltration and maximum high water table except as required under MPS CR3.4. Guidance on the high groundwater adjustment methodology can be found in Estimation of High Groundwater Levels for Construction and Land Use Planning, Technical Bulletin 92-001, as amended.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.9	Best Management Practices during Construction: Construction best management practices for erosion and sedimentation controls shall be specified on project plans to prevent erosion, control sediment movement and stabilize exposed soils.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6). In addition, each construction contractor will be required to develop erosion and sedimentation control measures under the required SWPPPs.
WR7.10	Stormwater Maintenance and Operation Plan: Development and redevelopment shall submit a Professional Engineer-certified stormwater maintenance and operation plan demonstrating compliance with the Massachusetts Stormwater Guidelines including a schedule for inspection, monitoring, and maintenance. The plan shall identify the parties responsible for plan implementation, operation and maintenance. The identified responsible party shall keep documentation of the maintenance and inspection records and make these available to the Commission or local board of health upon request. One year from completion of the system, a Professional Engineer shall inspect the system and submit a letter certifying that the system was installed and functions as designed.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).
WR7.11	Shut-off Valve in Wellhead Protection Areas: In Wellhead Protection Areas, stormwater systems for land uses that have a high risk of contaminating groundwater, such as vehicle maintenance areas and loading docks, shall install a mechanical shut-off valve or other flow-arresting device between the catch basin or other stormwater-capture structure draining this area and the leaching structures.	The WWTF and effluent recharge facilities will be designed to comply with CCC stormwater performance standards as well as those in 314 CMR 9.06(6).

Section 15

Cost Recovery Plan

15.1 Introduction

The Town of Harwich's recommended program for nitrogen management, as described in Section 13, is a costly town-wide program which includes two natural attenuation projects, sewer installation, wastewater treatment and effluent recharge, as well as a number of non-infrastructure solutions such as public education. To present the range of cost recovery options to the Town, a number of approaches were discussed during the development of this CWMP/SEIR. This section summarizes the cost recovery discussions and describes potential cost recovery approaches for implementation of the final CWMP recommended program.

This section specifically addresses the estimated costs of implementing construction Phases 1, 2 and 3 and includes the pros and cons of each method. Although the entire CWMP is scheduled for implementation over more than 40 years and eight phases, the first three phases were selected to reflect a planning horizon of ten years (to 2025). Presenting a cost recovery plan for the first three phases initiates a discussion on how best to apportion the costs and implement the CWMP. Expected changes resulting from the adaptive management approach, as well as potential changes to land use, regulations, etc., will present significant planning challenges throughout the implementation period. Because of this, Harwich feels that a ten year planning horizon is appropriate for analysis with regards to cost recovery strategies. The Town will continually look to modify its funding approach every few years to meet the needs of the community as the project evolves.

Several public forums were held with residents and business owners before the Board of Selectmen (BOS) evaluated the final options to pay for this program. In July 2015, the BOS approved a policy around the wastewater cost recovery model that is presented in this section. This policy is included in Appendix G. Because of the adaptive management strategy and the 40 year planning horizon, parts of the program are intentionally non-specific so the Town can remain flexible and utilize every means deemed appropriate to fund the program as opportunities arise. The approval of the cost recovery plan was focused on identifying funding sources rather than actual percentage allocations to taxes, user charges, etc. The plan includes the possibility of using a combination of town-wide property taxes, an infrastructure investment fund, and a fee based on water consumption. The BOS also fully supports the use of grants or principle forgiveness to offset costs wherever possible. The plan as adopted by the BOS will be utilized to support the implementation of at least the first three phases of the eight-phase program, pending the actions of town meeting and potential ballot override vote results, and is subject to change should other potentially beneficial funding programs become available.

Moving forward, the plan described in this section will act as the framework for developing Harwich's evolving cost recovery strategy for the next 40 years and beyond.

15.2 Strategy for Establishing a Cost Recovery Plan

The Wastewater Implementation Committee (WIC) conducted many discussions regarding methods available to recover costs as the wastewater program is implemented. During these discussions, three tenets developed as various members expressed their visions of the future of the community. First, the WIC felt that everyone in the Harwich community will receive benefits from restored water quality and that everyone contributes in some manner to the biggest problem – nitrogen coming from onsite septic systems. The overwhelming feeling throughout the committee was that everyone in town shares responsibility and should pay for a large part of the program's implementation costs. Second, the committee agreed that a dedicated funding source should be established to help pay for wastewater program components. It was important that this source of funding could not be utilized for other town programs but could be used to offset some costs for the larger infrastructure components as well as some of the later phases of the program. Third, the committee felt there should be a component that reflected the amount of water used and/or the amount of nitrogen contributed by a specific home or business owner. This water or nitrogen use component would help address the fact that smaller contributors should pay less while larger contributors should pay more. These three tenets ultimately evolved into the strategy the WIC utilized in developing the recommended cost recovery model.

15.3 Harwich's Preferred Cost Recovery Methods

Once the WIC established the three tenets of wastewater recovery cost sharing, they put those concepts into a revenue-generating mechanism that the town will use to fund the wastewater program. The net costs (total costs less grants or other subsidies) of building Harwich's wastewater program must be paid for by the Town.

After several discussions, the WIC members unanimously voted and approved a plan at their meeting on March 6, 2015. The following three cost recovery options are recommended and listed below based on the tenets mentioned above and the methods available to the town. These methods would be used to repay capital funds borrowed to implement the recommended program, which are typically borrowed via the Clean Water State Revolving Fund (SRF) for a 20 or 30 year period at up to 2 percent interest.

- **Town-wide Property Tax Fund** – Costs can be recovered from all property owners within the town through the general tax fund.
- **Water Bill Surcharges/Sewer Enterprise Account Charges** – Surcharges on water bills, charged according to water usage, can be used to offset a portion of the capital costs.
- **Infrastructure Investment Fund** - A real estate tax surcharge of up to 3% can be set aside into a Municipal Water Infrastructure Investment Fund, outside of Proposition 2½, as allowed through recent state legislation. (2014 legislation M.G.L. Chapter 40, Section 39M)

The net cost of the program will be recovered using one or all of these methods. If it is determined that a portion of the cost will be recovered through each method, the Town must decide what the appropriate proportion should be. The Town of Harwich envisions that a mix of cost recovery methods will be utilized whereby those facilities installed to service many customers (general benefit facilities, e.g., main sewer interceptors and treatment facilities) are paid for by the general fund, and those facilities required to provide service to individual customers or a single street (special benefit facilities, e.g., lateral sewers and service connections) are recovered through special fees. A general description of each of these three methods is included below, with pros and cons listed for each.

15.3.1 Town-wide Property Tax Fund

A tax based on property value is the simplest method of cost recovery and is widely used to recover a municipality's capital costs. All wastewater system costs not recovered elsewhere can be added to the municipality's total expenditures for all other purposes, thus factoring into the overall property tax rate for the town.

In Massachusetts, tax increases have become more difficult due to the constraints imposed by Proposition 2½. Therefore, the Town needs to consider the likelihood of requiring a tax override petition and/or a debt exclusion vote to raise taxes, depending on other concurrent initiatives in town. From a property owner's perspective, property taxes are deductible from federal income taxes, compared with user charges or betterment fees, which cannot be deducted.

The rationale for such a widespread sharing of the burden is premised on the public health and environmental benefits received by the whole community, the improvement to the quality of life, continued viability of tourism via a natural and healthy seaside community, the maintenance of property values by preserving the town's natural resources, and equity concerns. Pros and cons of this methodology are listed below.

Pros:

- Town-wide funding source which is consistent with the goal of the CWMP to implement a plan to protect the town's water resources (estuaries, embayments, ponds and drinking water) for the benefit of all residents
- Distributes expenses across all property owners, as all property owners contribute to the water quality degradation (and solution)
- Is fair since approximately half the town could potentially be sewered; only the required number of properties will be connected to a treatment plant to reach sufficient nitrogen removal required to meet TMDL requirements
- Simple to implement, as it is not tied to specific wastewater project sites, programs or implementation phases
- Collected tax would go to a dedicated CWMP Implementation Fund, not the Harwich General Fund
- Cost recovery is not contingent upon the total number of properties receiving sewers, which could change over time via adaptive management
- Property tax is progressive which helps align each property owner's ability to pay their fair share of the project cost

- Cost would be tax deductible
- Avoids penalizing "first adopters," i.e., those first on the system due to location within the town or a particular watershed
- Provides a funding mechanism not tied to construction so that non-infrastructure components of the CWMP recommendations can be implemented as well; this is relevant for Harwich as the initial phases include conducting mitigation studies to determine the best way of moving forward and to minimize long-term costs
- Can be used for paying operating costs as well

Cons:

- Increases property taxes
- All town property owners will help pay program costs whether connected or not connected to a sewer system
- Proposition 2½ capital exclusion vote is required (town-meeting vote and ballot approval)
- Those connecting to a sewer will pay additional costs to connect the sewer main to their houses/businesses and annual sewer operating and maintenance costs
- Those not connecting to a sewer will be responsible for future onsite system replacement costs
- Nitrogen contribution from a home is not directly proportional to a home's assessed (tax) value

15.3.2 Water Bill Surcharges/Sewer Enterprise Account Charges

This option involves adding a surcharge to water bills to help pay for the wastewater program capital and operating costs. Since the passage of tax limitation measures, user fees to recover capital costs have become more widespread in Massachusetts. User charges can be flat fees, charged periodically on a regular basis, or consumption fees, charged according to water or sewer use.

Since a town-wide public water supply system is already in place, existing users can be required to pay a portion of the capital cost based on their water use, which is directly tied to the amount of nitrogen discharged by each household or business.

Pros:

- Town-wide funding source dedicated to wastewater program
- Does not increase property taxes
- Can be used to pay both capital costs and operation and maintenance costs
- Relates fee to water use/sewer demand
- Water use is essentially proportional to the amount of nitrogen being contributed

- Can easily implement, track and bill users
- Can create and fund sewer enterprise funds with a dedicated funding source
- Could initiate collection before funds are needed to build a sewer reserve account
- A block rate structure could be used to shift more of this burden to seasonal users and offset low volume year-round users

Cons:

- May require special legislation or formation of a sewer district for all fees to apply to all water users, not just those connected to sewers
- Will require creation of a Wastewater/Sewer Enterprise Account
- Need to develop a means to capture the fee from approximately 250 residences on private wells in Harwich

15.3.3 Infrastructure Investment Fund

This new Massachusetts legislation, approved in August 2014, allows towns to impose a real estate tax surcharge of up to 3% to be set aside into a Municipal Water Infrastructure Investment Fund, outside of Proposition 2½. This program would operate similarly to Community Preservation Act (CPA) funding but would be available to the town exclusively for "maintenance, improvements and investments to municipal drinking, wastewater and stormwater infrastructure assets." The municipal treasurer would be the custodian of the fund. Acceptance of the surcharge would require "approval of the legislative body and the acceptance of the voters of a city or town on a ballot question at the next regular municipal or state election; provided, however, that this section shall take effect on July 1 of the fiscal year after such acceptance or a later fiscal year as the city or town may designate."

Pros:

- Town-wide program
- Creates an additional funding source
- Attractive if state participates as it does in CPA
- Progressive, as it is tied to assessed property values
- Does not count against Proposition 2½ cap
- Could shift some of the existing CPA percentage over to the infrastructure percentage to help offset the increase (i.e., could set up to not exceed a combined 3 percent total)
- Cost would be tax deductible

Cons:

- In essence, an additional property tax

15.4 Projected Cost Schedule for Phases 1 through 3

Table 15-1 shows the projected debt service schedule for bonding the capital to implement the first three phases of the CWMP recommended program. It is assumed that the SRF loan program would be used and that a 1.5 percent interest rate for a 20 year bond period would be received. Harwich should be eligible for a zero to 2 percent SRF loan and could bond for either 20 or 30 years.

Table 15-1
Projected Debt Service Schedule

Year	Phase 1	Phase 2	Phase 3	Total
2016	$165,750			$165,750
2017	$163,838			$163,838
2018	$161,925			$161,925
2019	$160,013			$160,013
2020	$158,100	$1,579,500		$1,737,600
2021	$156,188	$1,561,275		$1,717,463
2022	$154,275	$1,543,050		$1,697,325
2023	$152,363	$1,524,825		$1,677,188
2024	$150,450	$1,506,600		$1,657,050
2025	$148,538	$1,488,375		$1,636,913
2026	$146,625	$1,470,150	$1,365,650	$2,982,425
2027	$144,713	$1,451,925	$1,349,893	$2,946,530
2028	$142,800	$1,433,700	$1,334,135	$2,910,635
2029	$140,888	$1,415,475	$1,318,378	$2,874,740
2030	$138,975	$1,397,250	$1,302,620	$2,838,845
2031	$137,063	$1,379,025	$1,286,863	$2,802,950
2032	$135,150	$1,360,800	$1,271,105	$2,767,055
2033	$133,238	$1,342,575	$1,255,348	$2,731,160
2034	$131,325	$1,324,350	$1,239,590	$2,695,265
2035	$129,413	$1,306,125	$1,223,833	$2,659,370
2036		$1,287,900	$1,208,075	$2,495,975
2037		$1,269,675	$1,192,318	$2,461,993
2038		$1,251,450	$1,176,560	$2,428,010
2039		$1,233,225	$1,160,803	$2,394,028
2040			$1,145,045	$1,145,045
2041			$1,129,288	$1,129,288
2042			$1,113,530	$1,113,530
2043			$1,097,773	$1,097,773
2044			$1,082,015	$1,082,015
2045			$1,066,258	$1,066,258
TOTALS:	$2,951,625	$28,127,250	$24,319,075	$55,397,950

15.5 Cost Impacts from Harwich Recommended Cost Recovery Model (1.5% infrastructure fund, 75% taxes and 25% from sewer enterprise account)

The WIC ultimately recommended a division between the three cost recovery mechanisms described above of using a 1.5 percent tax increase via the infrastructure fund, then dividing the remainder of loan repayment amounts between general taxes (75 percent share) and a sewer enterprise account based on a water usage surcharge (25 percent).

Table 15-2 shows the cost impacts from implementing the recommended cost recovery model. The first two columns show the year and the projected tax revenue to be collected from property taxes using a 2016 base year of $47 million and escalating 2.5 percent annually. Next, the amount collected by creating a 1.5 percent Infrastructure Investment Fund is shown. That amount is then subtracted from the amount of total principal and interest owed annually to pay the bonds (from Table 15-1). To simplify this calculation, any remaining Infrastructure Investment Fund money would be placed in a stabilization fund to be available for future projects or lowering of sewer rates. The next column shows the amount of revenue needed if 75 percent of the remainder requiring funding is collected from annual property taxes. The additional tax in dollars per thousand dollars of valuation is then shown, followed by the annual tax increase on a home with an assessed value of $400,000. The next three columns show the remaining 25 percent that would need to be raised via the sewer enterprise account (water rate surcharge), the average total consumption in Harwich, and the associated cost per 1,000 gallons of water used. For simplicity, the average over the last four years of the water consumption was calculated and divided by the required annual funding amount to generate a cost per 1,000 gallons. This varies from the Harwich Water Department block rate structure which could be utilized in the future. An average homeowner uses around 70,000 gallons/year. The last two columns indicate the amount of money contributed to the sewer stabilization account that was collected and not re-allocated to a future project, and the resulting total balance of the Infrastructure Investment Fund.

An example calculation using this table is as follows. A homeowner not connected to a sewer in 2026 would pay an infrastructure fund fee of $54 (Tax rate at $8.97/$1,000 valuation FY15 X $400,000 home) to the infrastructure investment fund, $133 increase in taxes on their $400,000 home ($0.33190 per $1,000 valuation), and $57 ($0.81/1,000 gallons X 70,000 gallons average/year) more on their annual water bill to the sewer enterprise account for a total annual increase of $244. This is the highest finance year shown in the first three phases. The same person on a sewer would potentially still be paying for their initial hook-up cost loan and an operating cost based on their sewer use (water usage). Since the agreement for using the Chatham wastewater treatment plant is not yet final, the operating costs are not known but are expected to initially be in the $145 to $175 per year range. This would be added to other operations and maintenance costs associated with the sewer collection and conveyance systems. According to a 2012 rate survey by Tighe and Bond, the median annual sewer rate was $646 per household. Unsewered properties, on the other hand, would continue to pay fees for routine pumping of their septic systems, as well as long-term maintenance and replacement costs.

Table 15-2
WIC Recommendation – 1.5% Infrastructure Fund Plus 75% Taxes/25% Sewer Enterprise

Year	Property Tax	Infrastructure Investment Fund Amount	Debt Service	Remaining to Fund	Property Tax Funded	Property Tax Impact	Tax Increase on $400 K Property	Remaining to Sewer Enterprise Account	Average Consumption (1,000 gal)	$ per 1,000 gal	Annual Contribution to Investment Fund	Investment Fund Balance
2016	$47,000,000	$705,000	$165,750	-$539,250	$0	0.00000	$0	$0	638,331	$0.00	$539,250	$539,250
2017	$48,175,000	$722,625	$163,838	-$558,788	$0	0.00000	$0	$0	638,331	$0.00	$558,788	$1,098,038
2018	$49,379,375	$740,691	$161,925	-$578,766	$0	0.00000	$0	$0	638,331	$0.00	$578,766	$1,676,803
2019	$50,613,859	$759,208	$160,013	-$599,195	$0	0.00000	$0	$0	638,331	$0.00	$599,195	$2,275,999
2020	$51,879,206	$778,188	$1,737,600	$959,412	$719,559	0.15309	$61	$239,853	638,331	$0.38	$0	$2,275,999
2021	$53,176,186	$797,643	$1,717,463	$919,820	$689,865	0.14678	$59	$229,955	638,331	$0.36	$0	$2,275,999
2022	$54,505,591	$817,584	$1,697,325	$879,741	$659,806	0.14038	$56	$219,935	638,331	$0.34	$0	$2,275,999
2023	$55,868,230	$838,023	$1,677,188	$839,164	$629,373	0.13391	$54	$209,791	638,331	$0.33	$0	$2,275,999
2024	$57,264,936	$858,974	$1,657,050	$798,076	$598,557	0.12735	$51	$199,519	638,331	$0.31	$0	$2,275,999
2025	$58,696,560	$880,448	$1,636,913	$756,464	$567,348	0.12071	$48	$189,116	638,331	$0.30	$0	$2,275,999
2026	$60,163,974	$902,460	$2,982,425	$2,079,965	$1,559,974	0.33190	$133	$519,991	638,331	$0.81	$0	$2,275,999
2027	$61,668,073	$925,021	$2,946,530	$2,021,509	$1,516,132	0.32257	$129	$505,377	638,331	$0.79	$0	$2,275,999
2028	$63,209,775	$948,147	$2,910,635	$1,962,488	$1,471,866	0.31316	$125	$490,622	638,331	$0.77	$0	$2,275,999
2029	$64,790,019	$971,850	$2,874,740	$1,902,890	$1,427,167	0.30365	$121	$475,722	638,331	$0.75	$0	$2,275,999
2030	$66,409,770	$996,147	$2,838,845	$1,842,698	$1,382,024	0.29404	$118	$460,675	638,331	$0.72	$0	$2,275,999
2031	$68,070,014	$1,021,050	$2,802,950	$1,781,900	$1,336,425	0.28434	$114	$445,475	638,331	$0.70	$0	$2,275,999
2032	$69,771,764	$1,046,576	$2,767,055	$1,720,479	$1,290,359	0.27454	$110	$430,120	638,331	$0.67	$0	$2,275,999
2033	$71,516,058	$1,072,741	$2,731,160	$1,658,419	$1,243,814	0.26464	$106	$414,605	638,331	$0.65	$0	$2,275,999
2034	$73,303,960	$1,099,559	$2,695,265	$1,595,706	$1,196,779	0.25463	$102	$398,926	638,331	$0.62	$0	$2,275,999
2035	$75,136,559	$1,127,048	$2,659,370	$1,532,322	$1,149,241	0.24451	$98	$383,080	638,331	$0.60	$0	$2,275,999
2036	$77,014,973	$1,155,225	$2,495,975	$1,340,750	$1,005,563	0.21394	$86	$335,188	638,331	$0.53	$0	$2,275,999
2037	$78,940,347	$1,184,105	$2,461,993	$1,277,887	$958,415	0.20391	$82	$319,472	638,331	$0.50	$0	$2,275,999
2038	$80,913,856	$1,213,708	$2,428,010	$1,214,302	$910,727	0.19377	$78	$303,576	638,331	$0.48	$0	$2,275,999
2039	$82,936,702	$1,244,051	$2,394,028	$1,149,977	$862,483	0.18350	$73	$287,494	638,331	$0.45	$0	$2,275,999
2040	$85,010,120	$1,275,152	$1,145,045	-$130,107	$0	0.00000	$0	$0	638,331	$0.00	$130,107	$2,406,105
2041	$87,135,373	$1,307,031	$1,129,288	-$177,743	$0	0.00000	$0	$0	638,331	$0.00	$177,743	$2,583,848
2042	$89,313,757	$1,339,706	$1,113,530	-$226,176	$0	0.00000	$0	$0	638,331	$0.00	$226,176	$2,810,025
2043	$91,546,601	$1,373,199	$1,097,773	-$275,427	$0	0.00000	$0	$0	638,331	$0.00	$275,427	$3,085,451
2044	$93,835,266	$1,407,529	$1,082,015	-$325,514	$0	0.00000	$0	$0	638,331	$0.00	$325,514	$3,410,965
2045	$96,181,148	$1,442,717	$1,066,258	-$376,460	$0	0.00000	$0	$0	638,331	$0.00	$376,460	$3,787,425
	Total		**$55,397,950**		**$21,175,477**			**$7,058,492**				**$3,787,425**

Note: 2026 is highlighted as it is the year with the maximum loan repayment and is used in the examples herein.

15.6 Cost Impacts from 100% Property Tax Model

Table 15-3 is provided for comparison to Table 15-2 and shows what the cost impact to the tax rate would be if the program were funded 100 percent on property taxes. As shown, the increase to a homeowner of a $400,000 home in 2026 would be $254, which is similar to the recommended program at $244.

Table 15-3
100% from Property Taxes

Year	Property Tax	Debt Service	Property Tax Funded	Property Tax Impact	Tax; Average
2016	$47,000,000	$165,750	$165,750	0.03527	$14
2017	$48,175,000	$163,838	$163,838	0.03486	$14
2018	$49,379,375	$161,925	$161,925	0.03445	$14
2019	$50,613,859	$160,013	$160,013	0.03404	$14
2020	$51,879,206	$1,737,600	$1,737,600	0.36969	$148
2021	$53,176,186	$1,717,463	$1,717,463	0.36541	$146
2022	$54,505,591	$1,697,325	$1,697,325	0.36113	$144
2023	$55,868,230	$1,677,188	$1,677,188	0.35684	$143
2024	$57,264,936	$1,657,050	$1,657,050	0.35256	$141
2025	$58,696,560	$1,636,913	$1,636,913	0.34827	$139
2026	$60,163,974	$2,982,425	$2,982,425	0.63455	$254
2027	$61,668,073	$2,946,530	$2,946,530	0.62691	$251
2028	$63,209,775	$2,910,635	$2,910,635	0.61927	$248
2029	$64,790,019	$2,874,740	$2,874,740	0.61163	$245
2030	$66,409,770	$2,838,845	$2,838,845	0.60400	$242
2031	$68,070,014	$2,802,950	$2,802,950	0.59636	$239
2032	$69,771,764	$2,767,055	$2,767,055	0.58872	$235
2033	$71,516,058	$2,731,160	$2,731,160	0.58109	$232
2034	$73,303,960	$2,695,265	$2,695,265	0.57345	$229
2035	$75,136,559	$2,659,370	$2,659,370	0.56581	$226
2036	$77,014,973	$2,495,975	$2,495,975	0.53105	$212
2037	$78,940,347	$2,461,993	$2,461,993	0.52382	$210
2038	$80,913,856	$2,428,010	$2,428,010	0.51659	$207
2039	$82,936,702	$2,394,028	$2,394,028	0.50936	$204
2040	$85,010,120	$1,145,045	$1,145,045	0.24362	$97
2041	$87,135,373	$1,129,288	$1,129,288	0.24027	$96
2042	$89,313,757	$1,113,530	$1,113,530	0.23692	$95
2043	$91,546,601	$1,097,773	$1,097,773	0.23356	$93
2044	$93,835,266	$1,082,015	$1,082,015	0.23021	$92
2045	$96,181,148	$1,066,258	$1,066,258	0.22686	$91
Total		**$55,397,950**	**$55,397,950**		

Note: 2026 is highlighted as it is the year with the maximum loan repayment and is used in the examples herein.

15.7 Cost Impacts from 75% Property Tax and 25% Sewer Enterprise Model

Table 15- 4 is similarly provided for comparison and shows what the cost impact would be for using 75 percent on the tax rate and 25 percent from a sewer enterprise account. As shown, the tax increase in 2026 would be $190 and the sewer enterprise fee would be $82 ($1.17/ 1,000 gallons X 70,000gpyr), for a total of $272. This is 11.5 percent more than the WIC recommendation and 7 percent higher than just being on the tax rate, but it shares the costs based on volume of water used (and thus nitrogen contributed).

15.8 Cost Model Summary

Tables 15- 5, 15-6, and 15-7 provide a comparison of the previously discussed cost model scenarios that were approved by the Harwich BOS in 2015 as preferred methods of cost recovery. From these tables, it becomes clear that the approximate cost of the wastewater program to a typical property owner with a $400,000 residence would be between $240 and $275 in 2026, when the fees for the first three phases of the wastewater program are expected to be the highest.

Table 15-5 presents the expected cost of the wastewater program to a typical property owner in 2026 with a $400,000 residence using a 1.5 percent infrastructure fund and a 75 percent property tax, and a 25 percent sewer enterprise funding mechanism.

Table 15-6 presents the expected cost of the wastewater program to a typical property owner in 2026 with a $400,000 residence using a 100 percent property tax-based funding mechanism.

Table 15-7 presents the expected cost of the wastewater program to a typical property owner in 2026 with a $400,000 residence using a 75 percent property tax and a 25 percent sewer enterprise funding mechanism.

Moving forward, the Town of Harwich will further refine these selected cost recovery methods for the first three phases of the CWMP and finalize the best method to apportion the costs and implement the CWMP. Since the wastewater program must be flexible to accommodate the needs of the Town, expected changes in the program will present significant planning challenges after ten years, and the cost recovery mechanism will likely undergo changes throughout the implementation period. As noted previously, the Town will continually look to modify its funding approach every few years to meet the needs of the community as the project evolves.

15.9 Cost Policy

The Harwich Board of Selectmen endorse a cost recovery policy for wastewater program implementation that utilizes the combination of town wide property taxes, an infrastructure investment fund and a sewer enterprise account based on water consumption. Where appropriate, grant funds will be applied and if awarded will be used to offset costs as applicable. This policy will be utilized to support the implementation of at least the first three phases of the eight phase program and is subject to change should other potential beneficial funding programs become available to the town and the actions of town meeting and subsequent ballot results. The BOS specifically did not put percentages in their motion in order to allow flexibility depending on what was being constructed in a given phase.

Table 15-4
75% from Property Taxes and 25% from Sewer Enterprise Account

Year	Property Tax	Debt Service	Property Tax Funded	Property Tax Impact	Tax; Average	Water Bill Portion	Average Consumption (1,000 gal)	$ per 1,000 gal
2016	$47,000,000	$165,750	$124,313	0.02645	$11	$41,438	638,331	$0.06
2017	$48,175,000	$163,838	$122,878	0.02614	$10	$40,959	638,331	$0.06
2018	$49,379,375	$161,925	$121,444	0.02584	$10	$40,481	638,331	$0.06
2019	$50,613,859	$160,013	$120,009	0.02553	$10	$40,003	638,331	$0.06
2020	$51,879,206	$1,737,600	$1,303,200	0.27727	$111	$434,400	638,331	$0.68
2021	$53,176,186	$1,717,463	$1,288,097	0.27406	$110	$429,366	638,331	$0.67
2022	$54,505,591	$1,697,325	$1,272,994	0.27084	$108	$424,331	638,331	$0.66
2023	$55,868,230	$1,677,188	$1,257,891	0.26763	$107	$419,297	638,331	$0.66
2024	$57,264,936	$1,657,050	$1,242,788	0.26442	$106	$414,263	638,331	$0.65
2025	$58,696,560	$1,636,913	$1,227,684	0.26120	$104	$409,228	638,331	$0.64
2026	$60,163,974	$2,982,425	$2,236,819	0.47591	$190	$745,606	638,331	$1.17
2027	$61,668,073	$2,946,530	$2,209,898	0.47018	$188	$736,633	638,331	$1.15
2028	$63,209,775	$2,910,635	$2,182,976	0.46445	$186	$727,659	638,331	$1.14
2029	$64,790,019	$2,874,740	$2,156,055	0.45873	$183	$718,685	638,331	$1.13
2030	$66,409,770	$2,838,845	$2,129,134	0.45300	$181	$709,711	638,331	$1.11
2031	$68,070,014	$2,802,950	$2,102,213	0.44727	$179	$700,738	638,331	$1.10
2032	$69,771,764	$2,767,055	$2,075,291	0.44154	$177	$691,764	638,331	$1.08
2033	$71,516,058	$2,731,160	$2,048,370	0.43581	$174	$682,790	638,331	$1.07
2034	$73,303,960	$2,695,265	$2,021,449	0.43009	$172	$673,816	638,331	$1.06
2035	$75,136,559	$2,659,370	$1,994,528	0.42436	$170	$664,843	638,331	$1.04
2036	$77,014,973	$2,495,975	$1,871,981	0.39829	$159	$623,994	638,331	$0.98
2037	$78,940,347	$2,461,993	$1,846,494	0.39286	$157	$615,498	638,331	$0.96
2038	$80,913,856	$2,428,010	$1,821,008	0.38744	$155	$607,003	638,331	$0.95
2039	$82,936,702	$2,394,028	$1,795,521	0.38202	$153	$598,507	638,331	$0.94
2040	$85,010,120	$1,145,045	$858,784	0.18272	$73	$286,261	638,331	$0.45
2041	$87,135,373	$1,129,288	$846,966	0.18020	$72	$282,322	638,331	$0.44
2042	$89,313,757	$1,113,530	$835,148	0.17769	$71	$278,383	638,331	$0.44
2043	$91,546,601	$1,097,773	$823,329	0.17517	$70	$274,443	638,331	$0.43
2044	$93,835,266	$1,082,015	$811,511	0.17266	$69	$270,504	638,331	$0.42
2045	$96,181,148	$1,066,258	$799,693	0.17014	$68	$266,564	638,331	$0.42
	Total	**$55,397,950**	**$41,548,463**			**$13,849,488**		

Note: 2026 is highlighted as it is the year with the maximum loan repayment and is used in the examples herein.

Table 15-5
2026 Cost for a Typical Residence ($400,000 valuation) using a 1.5% Infrastructure Fund, 75% from Property Taxes and 25% from a Sewer Enterprise Account

Year	1.5% Infrastructure Fund Fee	75% Taxes	25% Sewer Enterprise	Total Payment for Typical $400,000 Home
2026	$54	$133	$57	$244

Table 15-6
2026 Cost for a Typical Residence ($400,000 valuation) using 100 % from Property Taxes

Year	100% Taxes	Total Payment for Typical $400,000 Home
2026	$254	$254

Table 15-7
2026 Cost for a Typical Residence ($400,000 valuation) using 75% from Property Taxes and 25% from a Sewer Enterprise Account

Year	75% Taxes	25% Sewer Enterprise	Total Payment for Typical $400,000 Home
2026	$190	$82	$272

15.10 Other Possible Revenue Sources

Other revenue sources discussed by the WIC but dismissed or left for consideration in the future included:

A. Occupancy Tax Increase - Raise Local Room Tax from 4% to 6%

Pros:

- Additional funding source
- Little impact on residents as room taxes are paid mostly by visitors
- Not a large overall amount of funding generated, but any amount helps

Cons:

- Possible negative effect on tourism
- About 18 companies in Harwich would be impacted by this tax, and each is already a major taxpayer
- The number of motel and bed and breakfast rooms has been declining, with a shift to private home rentals; therefore, collectable fees likely to decrease over time
- Could put Harwich businesses at a disadvantage to those in neighboring communities

B. Betterments (Charged to those Receiving Sewer Service Only)

Pros:

- The town may lien property and thus has a reasonable chance of insuring payment

- Appearance of fairness as the properties that get direct benefit from sewers would pay
- Low interest loans are available to property owners
- History of use for capital improvements (however not as much use in recent years)
- Can be invoiced on town tax bills (though not tax deductible)

Cons:

- Narrow base of funding for wastewater program that is applicable to the entire town
- Mismatch between benefits and those obligated to pay (i.e., few pay for benefit of everyone)
- Sewered areas selected based on least cost to town and higher density areas, not based on basic need or specific nitrogen contributions
- Must be based on uniform unit method (e.g., number of bedrooms, water use, frontage, equivalent dwelling units (EDUs), etc.)
- Sewer betterment assessments may be inequitable if based on phasing of each watershed sewering project
- Not tax deductible
- Perception that property has been "bettered" is open to debate (Town assessors do not increase the value of a home if it is on a sewer)

C. Impact Fees - New Construction

Pros:

- Extracts fees from new growth and new developments
- Town-wide fee

Cons:

- Discourages economic development (supports a no growth policy) and thus can have a negative impact on new construction. The WIC discussed the following proposed fees range:
    - $18K/home
    - $6K/addition
    - $6K/condo
    - $3K/commercial
- Must pass "Nexus" test set by Scotus in Koontz, Nolan & Dolan (i.e., the fee must be proportional to the cost; one can't shift costs to new construction as costs should be proportionally borne by all property owners)

- Must pass Emerson College test (i.e., one can't charge more than the expected benefit; the fee must be roughly equal to the cost of providing service)
- Not tax deductible

D. Flat Fee on all Parcels

Pros:

- Town-wide fee

Cons:

- Probably a tax as not specifically related to service (and thus contributes to Proposition 2½ cap)
- Must pass Emerson College test (see above)
- Special legislation needed
- Not tax deductible
- Requires designating a wastewater district

E. Increase in Beach Stickers/ Parking Fees

Pros:

- Paid for mainly by tourists
- Directly related to those using the Town's water resources and improving/restoring water quality
- Current fees are modest

Cons

- Relatively small overall revenue source

Ultimately, the Town is striving to arrive at a cost recovery approach that is equitable and justifiable to taxpayers, residents, business owners, and visitors. The approaches described in this section will form the basis for future cost recovery strategies, with each funding phase requiring applicable approvals from town meeting or ballot initiatives.

Section 16

Construction Management Plan

16.1 Purpose

A draft construction management plan (CMP) was developed for the implementation of the Harwich CWMP Recommended Program. This plan describes anticipated construction activities, scheduling and sequencing, and best management practices (BMPs) that are proposed to avoid and minimize both temporary and permanent construction period impacts. This draft CMP will be further refined as individual construction contracts are brought to final design and as contractors are retained to perform the work of each construction phase.

16.2 Construction Scheduling and Sequencing

As described in Section 13, the Harwich CWMP Recommended Program has been divided into eight construction phases, with a scheduling plan spanning approximately forty years. The first phase, Phase 1, includes two natural nitrogen attenuation projects – the increase in size of the opening at the Muddy Creek Bridge, and the evaluation of options to improve natural nitrogen attenuation in the Cold Brook abandoned cranberry bogs off of Bank Street. In addition, Phase 1 includes implementation of the Hinckley's Pond restoration project.

Phase 2 will be the first phase involving the installation of new sewers, specifically in the Pleasant Bay watershed, with flows directed to the existing Chatham WPCF. The new WWTF proposed for Harwich at the HR-12 site, along with the associated effluent recharge area, is included in the Phase 4 construction plan. Each of the other phases includes a combination of sewer and pumping station installation, continued monitoring of the results from previous phases, and additional smaller projects to meet the ultimate water quality goals of the CWMP. Each subsequent phase will proceed approximately five years following the previous phase, for a total forty year implementation duration. The breakdown of individual construction contracts will be determined as each phase is designed and funded.

Requirements of the contractor to be included in the specifications that pertain to construction scheduling and sequencing include the following measures to mitigate construction period impacts:

- Normal working hours are defined as approximately 7:00 a.m. to 3:30 p.m. on weekdays.
- The Contractor will notify DIGSAFE and private utility mark-out companies at least 72 hours before digging, trenching, blasting, demolishing, boring, backfilling, grading, landscaping or other earth moving operations in any public ways, rights of way and easements.
- Trenches may not remain open overnight.
- Test pits will be backfilled immediately after their purpose is satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

- To minimize disruptions to residents, final paving of each street will occur within one year of pipe installation, and to facilitate resident connections to the new sewers, the Contractor will be required to install mainline sewers, services, initial paving, invert construction, pipe testing, raising structures and cleanup of the site on individual streets within the contract before being allowed to commence construction in other streets of the contract. All pipe testing, including mandrel testing, will be completed within 120 days of pipe installation (mandrel testing will commence after a 90 day waiting period after pipe installation).

- Equipment will not be delivered to the site more than one month prior to installation without written authorization from the Engineer.

- Once the Contractor begins to install sewers and force mains within a street, the Contractor will complete the sewer and force main installation prior to moving to another street. Installing sewers, service connections and other work including paving can be performed on other streets by separate crews as approved by the Engineer.

16.3 Environmental Protection Requirements

Construction will be conducted in a manner to avoid, minimize, and mitigate impacts to the surrounding environment. The contract specifications will include extensive, detailed provisions for environmental protection to be followed by the Contractor, as listed below.

16.3.1 General Requirements

- The Contractor will be required to comply with all applicable federal, state and local laws and regulations concerning environmental pollution control and abatement.

- The Contractor will be notified in writing of any non-compliance of environmentally objectionable acts. After receipt of such notice, the Contractor will be required to take corrective action. If the Contractor fails or refuses to comply promptly, the Town may issue an order stopping all or part of the work until satisfactory corrective action has been taken.

- Prior to commencement of the work, the Contractor will meet with the Town to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control programs.

- Throughout the performance of the work required, the Contractor will be subject to environmental inspections of his/her equipment, routine daily operations and environmental protection procedures.

- At the completion of the work, a joint final field inspection will be made by the Town and the Contractor.

- The Contractor will not be permitted to use procedures, activities, or operations that may adversely impact the natural environment to the extent practicable or the public health and safety.

- For the duration of each contract, facilities constructed for pollution control will be maintained as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

16.3.2 Land Disturbance

- The Contractor will not be permitted to enter or occupy private land outside of easements, except by written permission of the landowner and the Town.

- The Contractor will be responsible for the preservation of all public and private property and must use every precaution necessary to prevent damage thereto, to the extent practicable. If direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, the Contractor will be required to restore such property to a condition similar or equal to that existing before the damage was done.

- No work will be permitted within permanent easements which may be required for pumping stations until written authorization is provided by the Town.

- Work areas will be restored to conditions that existed prior to construction. Land resources within the project boundaries and outside the limits of permanent work will be restored to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. All construction activities will be confined to areas shown on the contract drawings.

- The locations of the Contractor's storage and temporary buildings will be cleared portions of the job site and will require written approval of the Engineer. These sites will not be within wetlands or floodplains. The preservation of the landscape will be a consideration in the selection of all such sites.

- All signs of temporary construction facilities such as haul roads, work areas, structures, stockpiles of excess or waste materials, or any other vestiges of construction will be removed by the Contractor.

- All areas disturbed by the installation and removal of groundwater control systems and observation wells will be restored to their original condition.

- The Contractor will assume full responsibility for the protection of all buildings, structures, pavement, sidewalks, curbing, driveway aprons, fencing, landscaping, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the contract drawings. If necessary, curbing, driveway aprons and fencing will be removed and restored or replaced after backfilling. All existing facilities damaged by the construction will be promptly replaced with material equal to that existing prior to construction to the satisfaction of the Town.

- Topsoil will be stripped, stockpiled, and reused from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

16.3.3 Noise and Vibration

- The Contractor will be required to make every effort to minimize noises caused by the operations. Equipment will be equipped with silencers or mufflers designed to operate with the least possible noise level in compliance with state and federal regulations and Town of Harwich regulations, whichever are more stringent.

- During construction, the following measures will be used to control noise: 1) loud pieces of equipment will be substituted with quieter equipment, 2) effective intake and exhaust mufflers will be used on internal combustion engines, and 3) truck loading, unloading, and hauling operations will be conducted in a manner that keeps noise and vibration to a minimum.

16.3.4 Air Quality and Dust

- The Contractor will perform dust control operations, in an approved manner, whenever a nuisance or hazard occurs or when directed by the Engineer, even though other work on the project may be suspended.

- Methods of controlling dust will meet all air pollutant standards as set forth by federal and state regulatory agencies.

- All road surfaces will be broomed clean after backfilling.

- Paved streets adjacent to work areas will be swept regularly.

- Dump trucks will be covered with tarpaulins and have tightly fitting tailgates.

- The Contractor will be required to maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

- Dust control will be generally accomplished by the use of water. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted. Calcium chloride may be used if permitted by the Engineer and the Town. The use of petroleum products is prohibited.

- Sprinkling will be repeated at such intervals as to keep all parts of the disturbed area at least damp, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used.

Vehicle Emissions

During construction, vehicles and equipment will generate emissions. The EENF Certificate recommends compliance with MassDEP's Clean Air Construction Initiative and the Massachusetts Diesel Retrofit Program (MDRP). The 2008 MDRP guidance document defines measures to mitigate construction vehicle impacts, with requirements specific to the SRF program and recommendations for those projects reviewed by MEPA. As stated in this guidance document, project construction contracts must:

- Require contractors to install an emission control device on each piece of diesel construction equipment to reduce emissions, including a diesel oxidation catalyst (DOC) or diesel particulate filter (DPF). MassDEP's SRF program specifically requires that a verified DOC be installed on the equipment, meaning the device is proven to reduce emissions via standardized testing consistent with an EPA or California Air Resources Board (CARB) program;

- As of January 2010, require the use of ultra-low sulfur diesel (ULSD) fuel [sulfur content less than 15 parts per million (ppm)] in all diesel-fired construction equipment used on MEPA reviewed projects; and

- Prohibit motor vehicle engines from idling more than five minutes (in compliance with the Massachusetts 5-minute idle law, 310 CMR 7.11), unless the engine is being used to operate a lift or refrigeration unit.

It should be noted that as of January 1, 2008, MDRP retrofit requirements for the SRF program are applicable only for construction engines 50 or more horsepower (hp) and that will be used at least 30 days on the project site; however, retrofit recommendations for projects reviewed by MEPA are not limited to engines of a particular size. The SRF program requires that contractors fill out and file with MassDEP a formal Certification of equipment retrofits.

Consistent with these requirements, the contract documents will require the Contractor to comply with the MDRP by having all of the Contractor's off-road (non-registered) diesel vehicles and equipment used during construction equipped, or retrofitted, with after-engine emission controls that are EPA certified or their equivalent. Additionally, the Contractor will be required to use ULSD fuel in all off-road construction equipment, and the anti-idling law will be enforced at the construction sites.

16.3.5 Vegetation

- Outside of areas requiring earthwork for the construction of new facilities, the Contractor will not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys will be fastened or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, the trunk will first be wrapped with a sufficient thickness of burlap or rags over which softwood cleats can be tied before rope, cable, or wire is placed. The Contractor will be responsible for any damage resulting from such use.

- Trees will be protected by placing boards, planks, or poles around them where they may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's operations.

- Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations will be restored as nearly as possible to its original condition.

- All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter will be coated as soon as possible with an approved tree wound dressing. All trimming or pruning will be performed in an approved manner by experienced workmen with saws or pruning shears.

- Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.
- Trees that are to remain that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer will be removed and replaced.
- Areas outside easements or limits of clearing will be protected from damage and no equipment or materials shall be stored in these areas.
- All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material will be removed from the site and disposed of in an approved manner.
- The Contractor will be responsible for placing sod, topsoil, fertilizer, seed, and mulch, and maintaining all seeded and sodded areas. Seeding will be required where grass existed prior to construction including all areas disturbed by installing service connections.
- Loam will be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It will not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Stockpiled topsoil may be used where available.
- Seed will be from the same or previous year's crop; each variety of seed will have a percentage of germination not less than 90, a percentage of purity of not less than 85, and will have not more than one percent weed content and contain no noxious weed seed.
- The seed will be furnished and delivered premixed in the proportions specified above. Seed shall be delivered in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable state seed laws.
- Mulch will be a specially processed cellulose fiber containing no growth or germination-inhibiting factors.
- Sod will be as grown by an established sod grower, as approved by the Engineer and will consist of the following grasses:

Botanical Name	Common Name	Percent
Poa pratensis	Kentucky Bluegrass	40-60
Festuca rubra	Fine Fescue	20-30
Lolium perenne	Perennial Ryegrass	20-30

- Sod will be vigorous, well rooted, healthy turf, free from insect pests, disease, weeds, other grasses, stones, bare spots, burned spots and any other harmful or deleterious matter. Sod shall be machine stripped at a uniform soil thickness of approximately 1 in and not less than 3/4 in.

- Loam shall be placed to a minimum depth of 6 inches. Where loam exists prior to construction in depths greater than 6 inches, it will be replaced to the full depth.

- The Contractor will keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded.

- On slopes, the Contractor will provide against washouts by an approved method. Any washout which occurs will be regraded and reseeded until a good sod is established.

16.3.6 Traffic and Public Safety

Maintenance of traffic and pedestrian access, especially between Memorial Day and Labor Day, will be an essential component of construction management for all work in Harwich. The Town will work with MassDOT to develop a plan for working within Route 28 and other major state roadways that satisfies the needs of both residents and tourists while complying with, or seeking exemptions from, MassDOT standard requirements for work in state roadways where necessary to complete the work in a timely fashion and limit inconveniences. In addition to these special considerations for work on major roads, the following measures will be required by the Contractor under each construction contract:

- Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. The length or size of excavation will be controlled by the particular surrounding conditions, but will always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench or prohibiting stacking excavated material in the street.

- Take precautions to prevent injury to the public. Provide adequate light at all trenches, excavated material, equipment, or other obstacles, which could be dangerous to the public at night. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress.

- Unless permission to close a street is received in writing from the Harwich Police Department, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.

- Detours around construction will be subject to the approval of the Engineer, the Harwich Police Department and MassDOT (for work on state roadways). Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic.

- Under each construction contract, the Contractor will submit a traffic management plan for review and approval prior to any work commencing within the right of way. This plan will include phased plans showing the setup, number, and width of open lanes and a schedule for approval by the Engineer. Any detours will also be shown.

- Expedite construction operations while traffic is detoured. Periods when traffic is being detoured will be strictly controlled by the Town.
- All streets not subject to special restrictions may be closed between 7:00 AM and 4:00 PM subject to the approval of the Harwich Police Department.
- Affected property owners must be notified by the Contractor 48 hours prior to road closures or any work that will interfere with access to their residences or places of business. Residents will be provided access to their properties at all times.
- Work on roads in the immediate vicinity of schools must be performed either during school summer vacation or during restricted hours, subject to the approval of the Town.
- Emergency vehicles and school buses will be provided access to all streets at all times.
- All streets shall be plated, as necessary, every night. No open excavations will be allowed after working hours.
- All traffic control work performed by the Contractor must be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD).

16.3.7 Water Quality and Wetlands

Measures to protect water quality and wetlands in the vicinity of the construction areas include using appropriate dewatering procedures and sedimentation and erosion control BMPs. The Contractor's responsibilities as defined in the specifications for each construction contract will include the following items, broken down into regulatory and pre-construction provisions and other water quality and sedimentation/erosion prevention provisions.

Regulatory and Pre-Construction Provisions

- Necessary permits required for proper execution of the project will be obtained prior to commencement of work. A copy of each permit will be submitted to the Engineer.
- The Contractor will apply for and obtain a Construction General Permit from EPA pursuant to the National Pollutant Discharge Elimination System (NPDES) program. The permit requires preparing and submitting a Notice of Intent (NOI) for Storm Water Discharges and Notice of Termination Form and preparation of a Storm Water Pollution Prevention Plan (SWPPP).
- The Contractor will prepare an Erosion and Sedimentation Control Plan and submit to the Engineer for review and approval. Once approved by the Engineer, the Contractor will incorporate the Erosion and Sedimentation Control Plan into the SWPPP.
- The Contractor will update the Erosion and Sedimentation Control Plan and the SWPPP as necessary so that the documents are always current in accordance with the NPDES regulations and describe erosion and sediment control and storm water pollution prevention at all locations of construction and for all activities of construction.

- The requirements of any applicable Harwich Conservation Commission Order of Conditions will be followed. A preconstruction meeting will be held with the Conservation Agent.

- The Contractor will submit a dewatering plan for review and approval by the Conservation Commission prior to the start of work. The plan will include the methods and discharge points proposed to be used by the Contractor. The Contractor will be required to retain the services of a Professional Engineer registered in Massachusetts to prepare dewatering and drainage system designs and submittals.

- The Contractor will submit the location of proposed stockpile areas to the Conservation Commission for approval prior to the start of work.

- The Contractor will have a copy of the Order of Conditions and the approved SWPPP and Erosion and Sedimentation Control Plan on-site at all times.

Other Water Quality and Sedimentation/Erosion Prevention Provisions

- The Contractor will take sufficient precautions during construction to minimize the run off of polluting substances such as silt, clay, fuels, oils, bitumens and calcium chloride into the supplies and surface waters of the state. Special precautions will be taken in the use of construction equipment to prevent operations which promote erosion.

- Disposal of drainage will be in an area approved by the Town. Drainage will not be disposed of until silt and other sedimentary materials have been removed. Particular care will be taken to prevent the discharge of unsuitable drainage to a water supply, surface water body, or other resource area.

- Staked bales of hay and/or silt fence will be provided at points where drainage from the work site leaves the site, to reduce the sediment content of the water. Sufficient bales of hay will be provided such that all flow will filter through the hay. Other methods which reduce the sediment content to an equal or greater degree may be used as approved by the Engineer.

- When excavating in wetlands or floodplain, where no temporary diversion structure is required, excavated material will be placed on the uphill side of the trench so that the trench serves as a barrier between the excavated material and the wetland or floodplain.

- Erosion and sedimentation control will be installed prior to site preparation activities. The Contractor will be required to contact the Harwich Conservation Agent to inspect siltation controls prior to excavation.

- All work will be scheduled and conducted in a manner that will minimize the erosion of soils in the area of the work. Erosion control measures will be provided as required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc.

- Offsite surface water will be diverted around the site, to a downstream channel ahead of siltation barriers. Ditches around construction areas will also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches will be backfilled and the ground surface restored to original condition.

- Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in a surface water body, will not be directly returned to the water body. Such waters will be diverted through a settling basin or filter before being directed into water bodies.

- The Contractor will not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm water. Water from dewatering operations will be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels. Dewatering hose intakes will be kept off the bottom of the trench to minimize the pumping of silt.

- The Contractor will repair any damage caused by dewatering and drainage system operations.

- Existing or new sanitary sewers will not be used to dispose of drainage unless written permission is obtained from the Town.

- Crushed stone for sediment filtration devices, access ways and staging areas will conform to Mass Highway Department "Standards and Specifications for Highways and Bridges" Section M2.01.3.

- Hay bales will be placed around catch basins that discharge into wetlands, water supply or surface water bodies.

- Straw mulch will be utilized on all newly graded areas to protect areas against washouts and erosion.

- Silt fences will be positioned as necessary to prevent off site movement of sediment.

- Staging areas and access ways, which in the opinion of the Engineer will erode due to truck traffic, will be surfaced with a minimum depth of 4 in of crushed stone.

- The Contractor will visually inspect all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, the Contractor will promptly install additional devices as needed. Sediment controls in need of maintenance will be repaired promptly.

- Where silt fence is used, accumulated sediment will be removed once it builds up to 1/2 of the height of the fabric. Damaged fabric will be replaced or patched with a 2 ft minimum overlap. Other repairs will be made as necessary to ensure that the fence is filtering all runoff directed to the fence.

- In cross country areas, if applicable, brush and stumps will not be removed and the ground surface will not be disturbed until no more than one week prior to the start of pipe laying in that area.

- Loaming and seeding or mulching of cross-country areas will take place as soon after laying the pipeline as practicable.

- Temporary mulch will be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days.

- Once the site has been fully stabilized against erosion, sediment control devices and all accumulated silt will be removed and disposed of in a proper manner.

- All preventative measures will be taken to avoid the spillage of petroleum products and other pollutants. Routine vehicle and equipment maintenance and refueling will only occur in designated areas located more than 100-feet from wetland resource areas. At each staging area, spill clean-up equipment (shovels, brooms, absorbent pads and materials) will be maintained for use in the event of an accidental spill.

- All fuel, oil, solvents, etc. will be stored in original containers or in containers manufactured for storing such material that are clearly labeled as to the contents of the container. Fuel, oil and other potentially hazardous materials will be kept secured in a locked storage locker designed and properly vented for storing such material. Copies of Safety Data Sheets (formerly “MSDSs”) for all applicable materials will be maintained at the construction site and will be readily accessible for employees or inspection officials.

- The Contractor will immediately clean up any and all spills of fuel, oil, or other potentially hazardous materials. Any and all reportable spills will be reported to the proper authorities (Harwich Fire Department, Board of Health, MassDEP, and others as applicable).

16.3.8 Materials Management, Construction Debris, Solid Waste and Recycling

Since the proposed project primarily involves the construction of new pipelines and facilities, limited demolition will be involved. The following requirements will be included in the specifications with regards to materials handling, storage, cleanup, and disposal, to mitigate environmental impacts:

- Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter.

- During the course of the work, keep the site of operations in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

- Excavated material will be segregated for use in backfilling provided the material meets the requirements for its intended use.

- It is expressly understood that no excavated material will be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.

- Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material will be hauled and stored at a location provided. When required, it will be re handled and used in backfilling the trench.

- All debris and excess material will be disposed of in an environmentally sound manner. Dumping or disposal of debris or excess material in any stream corridors, any wetlands, any surface waters, any floodplains or at unspecified locations is prohibited. Discharging of solid waste deleterious to any public or private property not specified for said purpose is prohibited.

- Storing construction equipment and vehicles and/or stockpiling construction materials at locations not previously specified and approved by the Town for said purposes is prohibited.

- Dumping, disposing, or stockpiling of any material at any location within the Town of Harwich without approval of the Conservation Agent is prohibited.

- Burning at the project site for the disposal of refuse and debris or cleared and grubbed materials will not be permitted.

- All pieces of ledge and boulders which are not suitable for use in other parts of the work will be removed and disposed of in an approved manner.

- Surplus imported fill will be removed and disposed off site.

- The Contractor will either be, or employ the services of a Subcontractor, who is licensed in the Commonwealth of Massachusetts to perform asbestos abatement where applicable. All work associated with the handling of asbestos cement pipe will be conducted only by the licensed party.

16.3.9 Management of Hazardous Materials

The following mitigation measures will be employed to address potential impacts associated with subsurface contamination throughout the project area and will be included in the contract specifications:

- Excavated materials will be managed in accordance with applicable Massachusetts Contingency Plan (MCP) requirements. These provisions include identification of contaminated materials, segregation, proper stockpiling or containment, and sampling and analysis to determine the appropriate facility for reuse, recycling, or disposal of these materials.

- Dewatering discharges will be managed in accordance with MCP requirements, including identification of contaminated groundwater, proper containment and pretreatment, and required sampling and analysis.

- The Contractor will submit a Hazardous Material Health and Safety Plan detailing procedures and protocols to protect workers and the general public from potential hazards during the construction work.

- The Contractor will submit an Emergency Response Plan detailing procedures to address the discovery of hazardous materials that could pose an imminent hazard to workers and the public, and procedures to address emergencies that involve fires and/or explosions.

- Hazardous materials management activities will be conducted under the supervision of a Licensed Site Professional (LSP) in accordance with MCP Utility-Related Abatement Measure or Immediate Response Action provisions, as appropriate.

16.4 Coordination with Local Agencies

Construction of the CWMP Recommended Program will include extensive coordination with local agencies throughout each construction contract. Each contractor will be required to supply the Harwich Police Department, Fire Department, School Department, Conservation Commission, Water Department, and Public Works Department with the following information:

1. A list of streets and intersections where work will be in progress to be supplied at intervals as required by the Engineer.

2. Areas where approved detours are in effect.

3. Immediate notification of any drain, gas, buried electric or water main breaks.

4. A list of after-hours telephone numbers by which appropriate Contractor personnel may be contacted in the event of emergencies.

Section 17

Draft Section 61 Findings

17.1 Introduction

These Section 61 Findings for the Harwich CWMP/SEIR were prepared to comply with the requirements of Massachusetts General Laws Chapter 30, Section 61. Pursuant to M.G.L. c.30 s.61, any determination made by an agency of the Commonwealth must 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. Such environmental impacts include, but are not limited to*: "air pollution, water pollution, improper sewage disposal, pesticide pollution, excessive noise, improper operation of dumping grounds, reduction of groundwater levels, impairment of water quality, increases in flooding or stormwater flows, impairment and eutrophication of rivers, streams, flood plains, lakes, ponds, or other surface or subsurface water resources, destruction of seashores, dunes, marine resources, underwater archaeological resources, wetlands, open spaces, natural areas, parks, or historic districts or sites."*

These findings address the activities necessary to implement the Harwich CWMP Recommended Program, including both temporary (construction phase) and permanent impacts.

17.2 Project Schedule

The Recommended Program includes eight construction phases, to take place over the next 40 years. Phase 1 includes two natural attenuation projects as well as a pond restoration project. The Muddy Creek bridge widening project is currently under construction and the Cold Brook natural nitrogen attenuation study is in its second year. The Hinckley's Pond restoration project awaits funding. Phases 2 involves the installation of new sewers. All other phases involve a combination of new sewer and pumping stations, continued monitoring of the results from previous phases, and additional smaller projects to meet the ultimate water quality goals of the CWMP. Each phase will commence approximately five years following the completion of the previous phase.

17.3 Summary of These Section 61 Findings

These Section 61 Findings provide an overview of the mitigation program for implementation of the CWMP, describing measures to avoid, minimize, and/or mitigate identified impacts to the maximum extent practicable. The project construction involves components of two natural attenuation projects, approximately 51 miles of gravity sewer mains and 34 wastewater pumping stations. While most of the construction will occur within previously disturbed areas in existing roadways, some pumping stations will be outside of town and state roads. Careful layout of facilities was conducted to minimize impacts to the environment. Most impacts are construction-related and temporary. The most significant post-construction impact is beneficial – reducing nitrogen loading to protect and restore the coastal environment by meeting Total Maximum Daily Load (TMDL) limit and protecting public health by providing sewer service and enhanced wastewater treatment.

Mitigation measures for the project were developed and incorporated into the draft Construction Management Plan provided in Section 16. Additional mitigation measures are also described herein that pertain to the potential long-term impacts of the proposed facilities. The mitigation measures described in these findings are split into the following broad areas of concern:

- General Environmental Protection
  - Resiliency
  - Climate Change
- Land Disturbance
- Noise and Vibration
- Air Quality and Dust
  - Vehicle emissions
  - Greenhouse Gas Emissions
- Vegetation
- Traffic and Public Safety
- Water Quality and Wetlands
- Materials Management, Construction Debris, Solid Waste and Recycling
- Management of Hazardous Materials

17.4 Mitigation Measures

Mitigation Measure	Responsibility/Applicability
General Environmental Protection	
The Contractor will be required to comply with all applicable federal, state and local laws and regulations concerning environmental pollution control and abatement.	Town, Design Engineers, and Construction Contractors
The Contractor will be notified in writing of any non-compliance of environmentally objectionable acts. After receipt of such notice, the Contractor will be required to take corrective action. If the Contractor fails or refuses to comply promptly, the Town may issue an order stopping all or part of the work until satisfactory corrective action has been taken.	Construction Contractor
Prior to commencement of the work, the Contractor will meet with the Town to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control programs.	Construction Contractor, Town
Throughout the performance of the work required, the Contractor will be subject to environmental inspections of his/her equipment, routine daily operations and environmental protection procedures.	Construction Contractors and Resident Engineers/ Inspectors
At the completion of the work, a joint final field inspection will be made by the Town and the Contractor.	Town, Construction Contractors and Resident Engineers
The Contractor will not be permitted to use procedures, activities, or operations that may adversely impact the natural environment to the extent practicable or the public health and safety.	Construction Contractors
For the duration of each contract, facilities constructed for pollution control will be maintained as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.	Town
Structures and pipelines will be designed to minimize impacts to environmental resources wherever feasible.	Design Engineers
The town plans to adopt land use controls to limit growth by requiring a property to meet Title 5 requirements before it can be further developed, regardless of whether it is served by municipal sewer or an on-site septic system. This type of land use control will prevent existing unbuildable lots from becoming buildable as a result of new sewer service.	Town
Scaled project plans will be submitted to MHC for a review of potential impacts to historical and archaeological resources during design of each project phase for the “preferred alternative wastewater treatment plant location(s), recharge areas, pumping stations, equipment storage and materials staging areas and cross-country sewer right-of-ways.” In addition, as requested by MHC, the Inventory of Historic and Archaeological Assets of the Commonwealth will be consulted during each project design phase to identify any cultural resources that may be affected by the construction or operation of the project.	Design Engineers

Mitigation Measure	Responsibility/Applicability
Resiliency	
Following the completion of project phases, such aspects as water quality, groundwater elevations and impacts to coastal embayments will be reviewed. At this time, adjustments to the CWMP will be made to address those aspects accordingly, while also working the Massachusetts Department of Environmental protection (MassDEP) and the Cape Code Commission (CCC).	Design Engineers, Town
Climate Change	
Develop comprehensive land use plans to address protection, preservation and restoration of local beaches and coastal wetlands, including the use of protective best management practices (BMPs) and engineering controls.	To be considered in final design
The following areas of environmental regulation and permitting could be strengthened or created to address protection of beaches and coastal wetlands: Ecological buffers; Protection of headwater streams and associated buffer areas by focusing on land use acquisition and conservation restrictions in applicable areas; Protect and maintain natural stream flow.	To be considered in final design
Continue with regular comprehensive beach and coastal monitoring to be able to track how the areas are changing and being impacted by natural and manmade conditions.	To be considered in final design
The following measures can be taken to protect against negative impacts to both shoreline residential and commercial infrastructure development: Similar to beach and wetland protection, devise land use planning BMPs and tools to account for sea level rise and climate change; Prioritize protecting those locations that are the most susceptible to detrimental effect of climate change and potentially eliminate future development in those areas; Devise or revise building codes and require that coastal property insurance include provisions that account for climate change; Devise economic incentives for developers to use sustainable building practices when choosing sites to construct new developments in, which account for climate change including sea level rise.	To be considered in final design
Land Disturbance	
The Contractor will not be permitted to enter or occupy private land outside of easements, except by written permission of the landowner and the Town.	Construction Contractors
The Contractor will be responsible for the preservation of all public and private property and must use every precaution necessary to prevent damage thereto, to the extent practicable. If direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, the Contractor will be required to restore such property to a condition similar or equal to that existing before the damage was done.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
No work will be permitted within permanent easements which may be required for pumping stations until written authorization is provided by the Town.	Construction Contractors
Work areas will be restored to conditions that existed prior to construction. Land resources within the project boundaries and outside the limits of permanent work will be restored to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. All construction activities will be confined to areas shown on the contract drawings.	Construction Contractors
The locations of the Contractor's storage and temporary buildings will be cleared portions of the job site and will require written approval of the Engineer. These sites will not be within wetlands or floodplains. The preservation of the landscape will be a consideration in the selection of all such sites.	Construction Contractors
All signs of temporary construction facilities such as haul roads, work areas, structures, stockpiles of excess or waste materials, or any other vestiges of construction will be removed by the Contractor.	Construction Contractors
All areas disturbed by the installation and removal of groundwater control systems and observation wells will be restored to their original condition.	Construction Contractors
The Contractor will assume full responsibility for the protection of all buildings, structures, pavement, sidewalks, curbing, driveway aprons, fencing, landscaping, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the contract drawings. If necessary, curbing, driveway aprons and fencing will be removed and restored or replaced after backfilling. All existing facilities damaged by the construction will be promptly replaced with material equal to that existing prior to construction to the satisfaction of the Town.	Construction Contractors
Topsoil will be stripped, stockpiled, and reused from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.	Construction Contractors
When designing and laying out facilities, clearing and grading and alteration of natural topography will be minimized.	Design Engineers
During the design of each phase of the project, detailed construction plans will be provided to the Natural Heritage and Endangered Species Program to confirm the exemption status or indicate the need for further NHESP review.	Design Engineers
Noise and Vibration	
The Contractor will be required to make every effort to minimize noises caused by the operations. Equipment will be equipped with silencers or mufflers designed to operate with the least possible noise level in compliance with state and federal regulations and Town of Harwich regulations, whichever are more stringent.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
During construction, the following measures will be used to control noise: 1) loud pieces of equipment will be substituted with quieter equipment, 2) effective intake and exhaust mufflers will be used on internal combustion engines, and 3) truck loading, unloading, and hauling operations will be conducted in a manner that keeps noise and vibration to a minimum.	Construction Contractors
Effective intake and exhaust mufflers must be used on internal combustion engines.	Construction Contractors
All equipment to be installed, unless specified otherwise in the Technical Specifications, will be designed to insure that the sound pressure level does not exceed 85 decibels over a frequency range of 37.8 to 9600 cycles per second at a distance of three feet from any portion of the equipment, under any load condition, when tested using standard equipment and methods. Noise levels will include the noise from the motor. Mufflers or external baffles will not be acceptable for the purpose of reducing post-construction noise. Outdoor equipment at the pumps stations is anticipated to be limited to odor control fans and the standby generator, which will be located within an enclosure.	Design Engineers
Air Quality and Dust	
The Contractor will perform dust control operations, in an approved manner, whenever a nuisance or hazard occurs or when directed by the Engineer, even though other work on the project may be suspended.	Construction Contractors
Methods of controlling dust will meet all air pollutant standards as set forth by federal and state regulatory agencies.	Construction Contractors
All road surfaces will be broomed clean after backfilling.	Construction Contractors
Paved streets adjacent to work areas will be swept regularly.	Construction Contractors
Dump trucks will be covered with tarpaulins and have tightly fitting tailgates.	Construction Contractors
The Contractor will be required to maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.	Construction Contractors
Dust control will be generally accomplished by the use of water. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted. Calcium chloride may be used if permitted by the Engineer and the Town. The use of petroleum products is prohibited.	Construction Contractors
Sprinkling will be repeated at such intervals as to keep all parts of the disturbed area at least damp, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used.	Construction Contractors
Where necessary, carbon filters will be installed at the pumping stations to control odors.	Design Engineers

Mitigation Measure	Responsibility/Applicability
Vehicle Emissions	
Install an emission control device on each piece of diesel construction equipment to reduce emissions, including a diesel oxidation catalyst (DOC) or diesel particulate filter (DPF). Requires that a verified DOC be installed on the equipment.	Construction Contractors
Ultra-low sulfur diesel (ULSD) fuel [sulfur content less than 15 parts per million (ppm)] in all diesel-fired construction equipment.	Construction Contractors
Prohibit motor vehicle engines from idling more than five minutes (in compliance with the Massachusetts 5-minute idle law, 310 CMR 7.11), unless the engine is being used to operate a lift or refrigeration unit.	Construction Contractors
Contractors will be required to comply with the Massachusetts Diesel Retrofit Program and the Clean Construction Initiative. These provisions will be included in construction specifications.	Design Engineers
Greenhouse Gas Emissions	
Demonstrate new tree planting	To be incorporated into pumping station design
Minimize building footprint	The pumping station building footprints will be minimized
Minimize energy use through proper building orientation and use of appropriate landscaping (e.g. trees for shading parking lots or southern facing facades)	To be incorporated into final design
Building Design, Construction, and Operation	
BUILDING ENVELOPE	
Improve building envelope through higher R-value insulation in walls, roof, and if appropriate, basement walls and ceiling	To be incorporated into final pumping station design
Maximize the thermal mass of walls, roofs and floor to provide thermal damping	To be incorporated into final pumping station design
Conduct inspection and comprehensive air sealing of building envelope to minimize air leakage	To be incorporated into final pumping station design
Install lower U-value windows to improve envelope performance	To be incorporated into final pumping station design
Incorporate window glazing to balance and optimize daylighting, heat loss and solar heat gain performance	To be incorporated into final pumping station design
Design roofs at a minimum to be solar-ready	To be considered during final design
Construct green roofs to reduce heat load on roof, further insulate, and retain/filter rainwater	To be considered during final design
Evaluate use of high-albedo roofing materials to reduce heat absorption	To be incorporated into final design
Maximize interior daylighting through floor plates, and use of skylights, celestories and light wells	To be considered during final design

Mitigation Measure	Responsibility/Applicability
Consider a Net Zero building design	To be considered during final design
Participate in Energy Star for New Homes or U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) for Homes	Energy Star appliances will be used wherever possible
BUILDING MECHANICAL SYSTEMS AND LIGHTING	
Prevent over-sizing of HVAC or other equipment by sizing only after efficiency measures have been incorporated to reduce Heating, Ventilating, and Air Conditioning (HVAC), lighting and other electrical loads	To be incorporated into final pumping station design
Install high-efficiency HVAC systems and premium efficiency motors	To be incorporated into final pumping station design
Eliminate or reduce use of refrigerants in HVAC systems	To be considered during final design
Use demand control ventilation	To be incorporated into final pumping station design
Use energy efficient boilers, heaters, furnaces, incinerators, or generators	To be incorporated into final pumping station design
Seal and leak-check all supply air ductwork	To be incorporated into final pumping station design
Incorporate motion sensors into lighting, daylighting, and climate controls	To be incorporated into final pumping station design
Use efficient, directed exterior lighting, such as LED technology	To be incorporated into final pumping station design
Install high efficiency lighting, including compact fluorescent lamps (CFLs) and LED technology as appropriate	To be incorporated into final pumping station design
Provide automated energy management control system with the capacity to: Adjust and maintain set points and schedules Indicate alarms and problems Provide information on trends and operating history Operate mechanical and lighting systems to minimize overall energy usage	To be incorporated into final pumping station design
DISTRIBUTED GENERATION (ON-SITE)	
Incorporate appropriate on-site renewable energy systems into project	Wind or solar energy to be utilized
WATER CONSERVATION	
Re-use gray water and/or collect and re-use rainwater for landscaping and other non-potable uses	To be considered during final design
Plant only native species that need minimal watering and/or use xeriscaping	To be incorporated into final pumping station design

Mitigation Measure	Responsibility/Applicability
Develop a water management plan	Plant water (treated effluent) will be used in place of potable water wherever feasible
Consider participation in EPA's WaterSense Program	WaterSense fixtures will be used wherever possible
MATERIALS	
Use building materials with recycled content	To be considered during final design
Use building materials that are extracted and/or manufactured within the region	To be considered during final design
Use rapidly renewable building materials	To be considered during final design
Use wood that is certified in accordance with the Forestry Stewardship Council's Principles and Criteria	To be considered during final design
Use low volatile organic compound (VOC) adhesives, sealants, paints, carpets, and wood	To be incorporated into final pumping station design
ENERGY INFORMATION (Data Acquisition)	
Track energy performance of building and develop strategy to maintain efficiency	To be incorporated into final pumping station design
Install sub-meters on all floors and/or departments and/or for each specific tenant space	To be incorporated into final pumping station design
Provide energy information systems to promote energy awareness to occupants	To be incorporated into final pumping station design
Conduct 3rd party building commissioning to ensure energy performance	To be considered during final design
ONGOING OPERATIONS	
Purchase and install Energy Star-rated appliances that are the lowest energy rating	To be considered during final design. All appliances will be EnergyStar certified
Reduce energy demand using peak shaving or load shifting strategies – if applicable, enroll in demand response program with the International Organization for Standardization (ISO)-New England	To be incorporated into final pumping station design
Purchase green power	To be considered during final design
Other Industrial Process Systems and/or Facilities	
Evaluate process alternatives and select the least energy intensive option	To be incorporated into final pumping station design
Specify and procure most efficient equipment	To be incorporated into final pumping station design

Mitigation Measure	Responsibility/Applicability
Include sufficient metering and controls for real-time monitoring and optimization of the process operations	To be incorporated into final pumping station design
Construction Period Emissions	
Participate in MassDEP's Clean Air Construction Initiative	Incorporated into draft construction documents
Implement a construction waste management plan	To be incorporated into construction documents
Implement and enforce no-idling policies	Incorporated into draft construction documents
Incentivize use of public transportation, car/vanpools, for construction workers to reduce vehicle trips	To be incorporated into construction documents
Mobile Source Emissions	
Purchase alternative fuel and/or fuel efficient vehicles for fleet, including maintenance or operation vehicles on-site	To be considered during final design
Roadway Improvements to improve traffic flow and reduce vehicle congestion	Traffic improvements will be considered during sewer design
Make on- and off-site improvements to reduce vehicle miles traveled (VMT) including sidewalks, paths, traffic signals, bus shelters, lighting and landscaping	To be considered during final design
Implement idle reduction policies	To be incorporated in construction documents
Provide electric vehicle charging infrastructure	To be considered during final design
Vegetation	
Outside of areas requiring earthwork for the construction of new facilities, the Contractor will not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys will be fastened or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, the trunk will first be wrapped with a sufficient thickness of burlap or rags over which softwood cleats can be tied before rope, cable, or wire is placed. The Contractor will be responsible for any damage resulting from such use.	Construction Contractors
Trees will be protected by placing boards, planks, or poles around them where they may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's operations.	Construction Contractors
Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations will be restored as nearly as possible to its original condition.	Construction Contractors
Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations will be restored as nearly as possible to its original condition.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter will be coated as soon as possible with an approved tree wound dressing. All trimming or pruning will be performed in an approved manner by experienced workmen with saws or pruning shears.	Construction Contractors
Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.	Construction Contractors
Trees that are to remain that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer will be removed and replaced.	Construction Contractors, Resident Engineers
Areas outside easements or limits of clearing will be protected from damage and no equipment or materials shall be stored in these areas.	Construction Contractors
All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material will be removed from the site and disposed of in an approved manner.	Construction Contractors
The Contractor will be responsible for placing sod, topsoil, fertilizer, seed, and mulch, and maintaining all seeded and sodded areas. Seeding will be required where grass existed prior to construction including all areas disturbed by installing service connections.	Construction Contractors
Loam will be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It will not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Stockpiled topsoil may be used where available.	Construction Contractors
Seed will be from the same or previous year's crop; each variety of seed will have a percentage of germination not less than 90, a percentage of purity of not less than 85, and will have not more than one percent weed content and contain no noxious weed seed.	Construction Contractors
The seed will be furnished and delivered premixed in the proportions specified above. Seed shall be delivered in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable state seed laws.	Construction Contractors
Mulch will be a specially processed cellulose fiber containing no growth or germination-inhibiting factors.	Construction Contractors
Sod will be as grown by an established sod grower, as approved by the Engineer and will consist of the following grasses:	Construction Contractors, Resident Engineers
Sod will be vigorous, well rooted, healthy turf, free from insect pests, disease, weeds, other grasses, stones, bare spots, burned spots and any other harmful or deleterious matter. Sod shall be machine stripped at a uniform soil thickness of approximately 1 in and not less than 3/4 in.	Construction Contractors
Loam shall be placed to a minimum depth of 6 inches. Where loam exists prior to construction in depths greater than 6 inches, it will be replaced to the full depth.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
The Contractor will keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded.	Construction Contractors
On slopes, the Contractor will provide against washouts by an approved method. Any washout which occurs will be regraded and reseeded until a good sod is established.	Construction Contractors
Topsoil stripped from construction areas will be segregated from subsoils. Topsoil will be stockpiled in approved areas and reused onsite.	Construction Contractors
In sections where a pipeline passes through grassed areas, the disturbed area will be loamed and seeded.	Construction Contractors
Traffic and Public Safety	
Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. The length or size of excavation will be controlled by the particular surrounding conditions, but will always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench or prohibiting stacking excavated material in the street.	Construction Contractors
Take precautions to prevent injury to the public. Provide adequate light at all trenches, excavated material, equipment, or other obstacles, which could be dangerous to the public at night. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress.	Construction Contractors
Unless permission to close a street is received in writing from the Harwich Police Department, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.	Construction Contractors
Detours around construction will be subject to the approval of the Engineer, the Harwich Police Department and MassDOT (for work on state roadways). Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic.	Town, Design Engineers
Under each construction contract, the Contractor will submit a traffic management plan for review and approval prior to any work commencing within the right of way. This plan will include phased plans showing the setup, number, and width of open lanes and a schedule for approval by the Engineer. Any detours will also be shown.	Construction Contractors
Expedite construction operations while traffic is detoured. Periods when traffic is being detoured will be strictly controlled by the Town.	Construction Contractors, Town
All streets not subject to special restrictions may be closed between 7:00 AM and 4:00 PM subject to the approval of the Harwich Police Department.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
Affected property owners must be notified by the Contractor 48 hours prior to road closures or any work that will interfere with access to their residences or places of business. Residents will be provided access to their properties at all times.	Construction Contractors
Work on roads in the immediate vicinity of schools must be performed either during school summer vacation or during restricted hours, subject to the approval of the Town.	Construction Contractors
Emergency vehicles and school buses will be provided access to all streets at all times.	Construction Contractors
All streets shall be plated, as necessary, every night. No open excavations will be allowed after working hours.	Construction Contractors
All traffic control work performed by the Contractor must be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD).	Construction Contractors
Traffic and pedestrian access will be maintained on Route 28 during construction between Memorial Day and Labor Day.	Design Engineers and Construction Contractors
The Town will work with MassDOT to develop a plan for working within Route 28 that satisfies the needs of both residents and tourists while complying with, or seeking exemptions from, MassDOT standard requirements for work in state roadways.	Town, Design Engineers
No open excavations on roadways will be allowed after working hours.	Construction Contractors
Water Quality and Wetlands	
Necessary permits required for proper execution of the project will be obtained prior to commencement of work. A copy of each permit will be submitted to the Engineer.	Town, Design Engineers, Construction Contractors
The Contractor will apply for and obtain a Construction General Permit from EPA pursuant to the National Pollutant Discharge Elimination System (NPDES) program. The permit requires preparing and submitting a Notice of Intent (NOI) for Storm Water Discharges and Notice of Termination Form and preparation of a Storm Water Pollution Prevention Plan (SWPPP).	Construction Contractors
The Contractor will prepare an Erosion and Sedimentation Control Plan and submit to the Engineer for review and approval. Once approved by the Engineer, the Contractor will incorporate the Erosion and Sedimentation Control Plan into the SWPPP.	Construction Contractors
The Contractor will update the Erosion and Sedimentation Control Plan and the SWPPP as necessary so that the documents are always current in accordance with the NPDES regulations and describe erosion and sediment control and storm water pollution prevention at all locations of construction and for all activities of construction.	Construction Contractors
The requirements of any applicable Harwich Conservation Commission Order of Conditions will be followed. A preconstruction meeting will be held with the Conservation Agent.	Town, Design Engineers, Construction Contractors

Mitigation Measure	Responsibility/Applicability
The Contractor will submit a dewatering plan for review and approval by the Conservation Commission prior to the start of work. The plan will include the methods and discharge points proposed to be used by the Contractor. The Contractor will be required to retain the services of a Professional Engineer registered in Massachusetts to prepare dewatering and drainage system designs and submittals.	Construction Contractors
The Contractor will submit the location of proposed stockpile areas to the Conservation Commission for approval prior to the start of work.	Construction Contractors
The Contractor will have a copy of the Order of Conditions and the approved SWPPP and Erosion and Sedimentation Control Plan on-site at all times.	Construction Contractors
The Contractor will take sufficient precautions during construction to minimize the run off of polluting substances such as silt, clay, fuels, oils, bitumens and calcium chloride into the supplies and surface waters of the state. Special precautions will be taken in the use of construction equipment to prevent operations which promote erosion.	Construction Contractors
Disposal of drainage will be in an area approved by the Town. Drainage will not be disposed of until silt and other sedimentary materials have been removed. Particular care will be taken to prevent the discharge of unsuitable drainage to a water supply, surface water body, or other resource area.	Construction Contractors
Staked bales of hay and/or silt fence will be provided at points where drainage from the work site leaves the site, to reduce the sediment content of the water. Sufficient bales of hay will be provided such that all flow will filter through the hay. Other methods which reduce the sediment content to an equal or greater degree may be used as approved by the Engineer.	Construction Contractors
When excavating in wetlands or floodplain, where no temporary diversion structure is required, excavated material will be placed on the uphill side of the trench so that the trench serves as a barrier between the excavated material and the wetland or floodplain.	Construction Contractors
Erosion and sedimentation control will be installed prior to site preparation activities. The Contractor will be required to contact the Harwich Conservation Agent to inspect siltation controls prior to excavation.	Construction Contractors
All work will be scheduled and conducted in a manner that will minimize the erosion of soils in the area of the work. Erosion control measures will be provided as required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc.	Construction Contractors
Offsite surface water will be diverted around the site, to a downstream channel ahead of siltation barriers. Ditches around construction areas will also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches will be backfilled and the ground surface restored to original condition.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in a surface water body, will not be directly returned to the water body. Such waters will be diverted through a settling basin or filter before being directed into water bodies.	Construction Contractors
The Contractor will not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm water. Water from dewatering operations will be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels. Dewatering hose intakes will be kept off the bottom of the trench to minimize the pumping of silt.	Construction Contractors
The Contractor will repair any damage caused by dewatering and drainage system operations.	Construction Contractors
Existing or new sanitary sewers will not be used to dispose of drainage unless written permission is obtained from the Town.	Construction Contractors
Crushed stone for sediment filtration devices, access ways and staging areas will conform to Mass Highway Department "Standards and Specifications for Highways and Bridges" Section M2.01.3.	Construction Contractors
Hay bales will be placed around catch basins that discharge into wetlands, water supply or surface water bodies.	Construction Contractors
Straw mulch will be utilized on all newly graded areas to protect areas against washouts and erosion.	Construction Contractors
Silt fences will be positioned as necessary to prevent off site movement of sediment.	Construction Contractors
Staging areas and access ways, which in the opinion of the Engineer will erode due to truck traffic, will be surfaced with a minimum depth of 4 in of crushed stone.	Construction Contractors, Resident Engineers
The Contractor will visually inspect all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, the Contractor will promptly install additional devices as needed. Sediment controls in need of maintenance will be repaired promptly.	Construction Contractors
Where silt fence is used, accumulated sediment will be removed once it builds up to 1/2 of the height of the fabric. Damaged fabric will be replaced or patched with a 2 ft minimum overlap. Other repairs will be made as necessary to ensure that the fence is filtering all runoff directed to the fence.	Construction Contractors
In cross country areas, if applicable, brush and stumps will not be removed and the ground surface will not be disturbed until no more than one week prior to the start of pipe laying in that area.	Construction Contractors
Loaming and seeding or mulching of cross-country areas will take place as soon after laying the pipeline as practicable.	Construction Contractors
Temporary mulch will be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
Once the site has been fully stabilized against erosion, sediment control devices and all accumulated silt will be removed and disposed of in a proper manner.	Construction Contractors
All preventative measures will be taken to avoid the spillage of petroleum products and other pollutants. Routine vehicle and equipment maintenance and refueling will only occur in designated areas located more than 100-feet from wetland resource areas. At each staging area, spill clean-up equipment (shovels, brooms, absorbent pads and materials) will be maintained for use in the event of an accidental spill.	Construction Contractors
All fuel, oil, solvents, etc. will be stored in original containers or in containers manufactured for storing such material that are clearly labeled as to the contents of the container. Fuel, oil and other potentially hazardous materials will be kept secured in a locked storage locker designed and properly vented for storing such material. Copies of Safety Data Sheets (formerly "MSDSs") for all applicable materials will be maintained at the construction site and will be readily accessible for employees or inspection officials.	Construction Contractors
The Contractor will immediately clean up any and all spills of fuel, oil, or other potentially hazardous materials. Any and all reportable spills will be reported to the proper authorities (Harwich Fire Department, Board of Health, MassDEP, and others as applicable).	Construction Contractors
Wherever feasible, wetland resource areas and associated buffer zones were avoided when laying out the project. The majority of work will take place within roadways.	Design Engineers
The criteria for pumping station siting included avoiding floodplain areas wherever possible. During the design of each construction phase, pumping station siting will be refined, and avoiding LSCSF to the maximum extent feasible will continue to be a primary goal.	Design Engineers
To protect fisheries, no in-river work is permitted between March 15 and June 30.	Construction Contractors
Any permanent structures constructed as part of the project in areas requiring review of the Harwich Conservation Commission, including the proposed wastewater treatment plant, will be designed to comply with MassDEP's Stormwater Management Standards.	Design Engineers
Materials Management, Construction Debris, Solid Waste and Recycling	
Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter.	Construction Contractors
During the course of the work, keep the site of operations in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
Excavated material will be segregated for use in backfilling provided the material meets the requirements for its intended use.	Construction Contractors
It is expressly understood that no excavated material will be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.	Construction Contractors, Resident Engineer
Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material will be hauled and stored at a location provided. When required, it will be re handled and used in backfilling the trench.	Construction Contractors
All debris and excess material will be disposed of in an environmentally sound manner. Dumping or disposal of debris or excess material in any stream corridors, any wetlands, any surface waters, any floodplains or at unspecified locations is prohibited. Discharging of solid waste deleterious to any public or private property not specified for said purpose is prohibited.	Construction Contractors
Storing construction equipment and vehicles and/or stockpiling construction materials at locations not previously specified and approved by the Town for said purposes is prohibited.	Construction Contractors
Dumping, disposing, or stockpiling of any material at any location within the Town of Harwich without approval of the Conservation Agent is prohibited.	Construction Contractors
Burning at the project site for the disposal of refuse and debris or cleared and grubbed materials will not be permitted.	Construction Contractors
All pieces of ledge and boulders which are not suitable for use in other parts of the work will be removed and disposed of in an approved manner.	Construction Contractors
Surplus imported fill will be removed and disposed off site.	Construction Contractors
The Contractor will either be, or employ the services of a Subcontractor, who is licensed in the Commonwealth of Massachusetts to perform asbestos abatement where applicable. All work associated with the handling of asbestos cement pipe will be conducted only by the licensed party.	Construction Contractors
Management of Hazardous Materials	
Excavated materials will be managed in accordance with applicable Massachusetts Contingency Plan (MCP) requirements. These provisions include identification of contaminated materials, segregation, proper stockpiling or containment, and sampling and analysis to determine the appropriate facility for reuse, recycling, or disposal of these materials.	Construction Contractors
Dewatering discharges will be managed in accordance with MCP requirements, including identification of contaminated groundwater, proper containment and pretreatment, and required sampling and analysis.	Construction Contractors
The Contractor will submit a Hazardous Material Health and Safety Plan detailing procedures and protocols to protect workers and the general public from potential hazards during the construction work.	Construction Contractors

Mitigation Measure	Responsibility/Applicability
The Contractor will submit an Emergency Response Plan detailing procedures to address the discovery of hazardous materials that could pose an imminent hazard to workers and the public, and procedures to address emergencies that involve fires and/or explosions.	Construction Contractors
Hazardous materials management activities will be conducted under the supervision of a Licensed Site Professional (LSP) in accordance with MCP Utility-Related Abatement Measure or Immediate Response Action provisions, as appropriate.	Construction Contractors

17.5. Self-Certification

The mitigation measures in the table above will be implemented as described herein, to minimize, to the maximum extent feasible, the environmental impacts of the Recommended Program. Applicable federal, state, and local permits will be obtained during design and construction of each phase of the project.

Section 18

Response to Comments

This section addresses comments on the February 2013 Harwich draft Comprehensive Wastewater Management Plan/Expanded Environmental Notification Form (CWMP/EENF). The first comments addressed are those contained in the April 12, 2013 Certificate issued by MEPA. The subsections that follow include comments contained in the comment letters received by MEPA during the Expanded ENF review period.

Each comment is presented below in italics and is a direct quote from the applicable letter. Responses are provided below each comment in normal type face. Most comments or concerns are addressed in the body of this CWMP/SEIR in more detail, and reference is made below to the applicable sections where supplemental information can be found.

#1 - MEPA EENF Certificate- 04/12/2013

Comment 1-1:

…this project requires the preparation of an Environmental Impact Report (EIR)…. Pursuant to 301 CMR 11.06(8), the Town may submit a Single EIR (SEIR) in accordance with the Scope below…. In a Draft Record of Decision (DROD), also issued today, I have proposed to grant a Phase 1 Waiver with conditions allowing the Phase 1 component to proceed while the Single EIR is being prepared.

The project is undergoing review and requires the preparation of a Mandatory EIR pursuant to Section 11.03(5)(a)(3) of the MEPA regulations because it requires State Agency Action and it will involve the construction of one or more new sewer mains of ten or [more] miles in length. The project is also undergoing MEPA review pursuant to Sections 11.03 (5)(b)(1),11.03 (11)(b) and 11.03(3)(b)(1)(f) because it will involve the construction of a new wastewater treatment facility with a capacity of more than 100,000 gallons per day, is located in an Area of Critical Environmental Concern (ACEC) and will alter 1/2 or more acres of other wetlands.

Pursuant to the MEPA Certificate, the document herein constitutes the Single EIR meeting the scope included in the Certificate. The Phase 1 waiver for the Muddy Creek Bridgae widening has been addressed by others and is under construction.

Comment 1-2:

The project requires: an Order of Conditions from the Harwich Conservation Commission (and on appeal only, a Superseding Order of Conditions from the Massachusetts Department of Environmental Protection (MassDEP)); a Sewer Connection/Extension Permit and a Groundwater Discharge Permit from MassDEP; a State Highway Access Permit from the Massachusetts Department of Transportation (MassDOT); review under the Massachusetts Endangered Species Act (MESA) by the Natural Heritage Endangered Species Program (NHESP); review by the Massachusetts Historical Commission; and a National Pollutant Discharge Elimination System (NPDES) Construction General Permit from the U.S. Environmental Protection Agency. The project may require Federal Consistency Review by the

Massachusetts Coastal Zone Management Office and a Section 404 Permit from the U.S. Army Corps of Engineers. The project is subject to the EEA/MEPA Greenhouse Gas Emissions Policy and Protocol.

Section 14, Environmental Impacts and Mitigation, includes a description of permits anticipated to be sought with regards to the work proposed in this CWMP/SEIR over the course of the eight phases of design and construction. Several of these permits will be required with the implementation of each phase, and others will only be required for particular phases where applicable thresholds are triggered. Permitting requirements can be found in Section 14.14, and related draft Section 61 Findings can be found in Section 17.

Comment 1-3:

B*ecause the Town is seeking State Financial Assistance, MEPA jurisdiction is broad and extends to all aspects of the project that may cause Damage to the Environment, as defined in the MEPA regulations.*

All aspects of the environmental review as outlined by MEPA are addressed in this CWMP/SEIR. Please see Sections 14 and 15 for a detailed discussion of the environmental and financial impacts and benefits of the CWMP recommended program, including both short- and long-term considerations.

Comment 1-4:

I support the comprehensive planning for wastewater management and applaud the effort that has gone into the development of this draft CWMP. I also commend and support the intermunicipal approach and cooperative agreement between the Towns of Harwich and Chatham to advance wastewater management efforts in both communities.

Updated information pertaining to the intermunicipal efforts between the towns of Harwich and Chatham is provided in Sections 13.2 and 13.4.1. Potential future options between Harwich and Dennis may also be pursued.

Comment 1-5:

The Town should strive for additional intermunicipal partnering with Dennis and Brewster and any such efforts should be more fully explored and addressed in the SEIR. Given that there will be eight phases of the project, modifications to the existing plan can accommodate anticipated studies on regional alternatives that are being developed under the 208 Water Quality Management Plan for Cape Cod. Nonetheless, there is nothing in the first two phases of this plan that would jeopardize any future regional initiatives, in fact, several commenters believe that they serve as a strong foundation for future regional efforts.

As noted above, updated information on the status of intermunicipal agreements is detailed in Sections 13.2 and 13.4.1 of this CWMP/SEIR. The town of Dennis recently conducted a review of water quality throughout the town via a contract for consulting services with CDM Smith, working together with the town's Comprehensive Wastewater Management Task Force. Since Harwich is farther along in the planning process than Dennis, further development of regional alternatives with Dennis will continue to be considered as Dennis moves forward with its water quality planning efforts. Brewster is also not as far along in the wastewater planning process as Harwich. Despite this, both Brewster and Harwich have held informal discussions about possible regional wastewater solutions with a particular emphasis on Pleasant Bay. Brewster understands its contribution of nitrogen to Pleasant Bay and is currently developing a plan to reduce future nitrogen contributions. The Brewster Comprehensive Water Planning Committee is investigating a series of alternative solutions to reduce nitrogen loading and will be making a recommendation to the Town on the best approach to restore the Bay. Brewster's overall goal is to develop a plan for sustainable water resources both now and in the future. Regional options may be part of that plan, and Harwich is open and willing to discuss any regional options throughout the implementation process. Harwich and Brewster will also continue to hold discussions about the Brewster nitrogen contribution to the Herring River watershed.

Comment 1-6:

The Town should prepare the SEIR in accordance with the general guidance for outline and content found in Section 11.07 of the MEPA regulations, as modified by this Scope. The Town should use the SEIR as a tool to ensure appropriate planning for the full build-out of the site, analyze cumulative impacts, and provide an understanding of background conditions and resources present within project areas.

The SEIR should include a detailed executive summary explaining what is being proposed under the Town's Recommended Program. It should identify significant environmental benefits and impacts, and measures that will be taken to avoid, minimize and mitigate adverse impacts. The SEIR should describe the proposed schedule for the remaining phases of project planning, design, environmental permitting and review, and construction. Detailed information should be provided for each area where construction of new sewers or cluster systems are proposed, including maps that show where sewer lines, cross-country easements, pumping stations, and other facilities will be located. The SEIR should provide the best information currently available for the five sewer construction phases proposed under the Recommended Program, and explain what additional information is proposed for later collection and analysis. The SEIR should discuss the state permitting process for this project and describe how it will meet applicable performance standards.

A detailed executive summary is provided at the front of this CWMP/SEIR document. Section 14 of the SEIR addresses the environmental impacts and benefits of the recommended program, as well as measures proposed to be taken to minimize and mitigate adverse impacts. Sections 13 and 14 also include information about the anticipated timing of planning, design, and environmental permitting through the eight phases of construction. The figures in Section 14 show the recommended sewering plan, including gravity and low pressure sewer mains, pumping stations, force mains, and treatment and recharge sites, overlaid with a variety of town-wide environmental data to show the proximity of specific sensitive receptors to the proposed work. Note that there are no cross-country sewer easements proposed at this time, although detailed design could result in changes to the preliminary sewer main layout. Figures 13-1 and 13-3 show the recommended sewering plan and phasing plans. In addition, Section 16 presents a construction management plan including proposed mitigation measures, and Section 17 includes the draft Section 61 Findings for this project which apply to the state permitting process and related performance standards.

Comment 1-7:

The SEIR should contain a copy of this Certificate and a copy of each comment letter received on the EENF. In order to ensure that the issues raised by commenters are addressed, the SEIR should include a response to comments received to the extent they are within MEPA jurisdiction.

This section (Section 18) contains a response to all comments received as part of the MEPA review process, organized by comment letter. Copies of the EENF Certificate and comment letters are provided in Appendix H.

Comment 1-8:

The CWMP provides opportunities for regional cooperation along several fronts. The Water Pollution Abatement Trust recently provided the CCC with a $3.35 million grant to prepare an update to the 1978 Water Quality Management Plan for Cape Cod. The updated Federal Clean Water Act Section 208 Plan will be a regional, watershed-based plan designed to restore and protect water quality on the Cape….It is anticipated that a draft 208 plan will be completed in one year, and that a final plan will be issued within two years. I strongly encourage the Town of Harwich to become an active participant in this planning process and to coordinate the Town of Harwich's planning efforts with the Cape Cod Commission's regional efforts. This would help to ensure Harwich can take advantage of any proposals for regional solutions, cost efficiencies and/or cost-sharing opportunities the regional approach will yield.

Sections 2 and 13 of this report discuss Harwich's coordination with the CCC's 208 Plan. Harwich has actively followed the Commission's planning process and attended meetings and presentations during the plan's development. As outlined in Sections 2, 11 and 13, the Town has reviewed the work performed by the Commission as presented in the approved June 2015 208 Plan. Harwich's plan is in line with the 208 Plan since Harwich's approach is based on the MEP nitrogen loading models with the goal of achieving the most efficient sewershed footprint while keeping costs to a minimum. The town of Harwich's wastewater scenarios utilized a hybrid approach similar to that suggested in the 208 plan, combining both traditional and non-traditional technologies with an iterative process to develop the most cost effective recommended plan. An adaptive management strategy is also included with the intent of continually monitoring progress and revisiting and updating the plan accordingly.

Furthermore, Phase 1 of the Harwich plan is focused on this adaptive management approach. Since Phase 1 does not include any sewer infrastructure, the Town has the opportunity to reduce the extent of proposed sewering through adaptive management if further monitoring or technological developments indicate more desirable or cost-effective solutions to meet MEP nitrogen reduction goals.

Comment 1-9:

The Town of Harwich's CWMP does address the most significant watersheds and shared watersheds in the Town of Harwich and proposes partnering with Chatham to address those impairments. MassDEP has identified some remaining shared watersheds in need of additional inter-municipal planning before cost-effective solutions could be developed. The CWMP Phases 1 and 2 are appropriate first steps that will not jeopardize future opportunities for regional cooperation. As other studies evolve regarding regional approaches, these can inform the strategies and direction in future phases of the CWMP.

The Town agrees with this statement and will continue to pursue intermunicipal solutions via adaptive management as towns with shared watersheds complete their planning and as follow-up from the 208 Plan provides additional information to help guide intermunicipal opportunities. Harwich and Chatham are currently negotiating an intermunicipal agreement for wastewater treatment. Harwich and Dennis have held some preliminary discussions to evaluate sharing a joint treatment plant in the future instead of constructing separate facilities. Those discussions will continue over the next few years.

Comment 1-10:

The CWMP mentions the possibility of inter-municipal cooperation with Dennis, especially since a portion of the village of Dennisport lies within the Herring River watershed. The Town of Harwich should initiate discussions on the mutual benefit that could be realized by coordinating the respective Towns' wastewater planning. In addition, Harwich shares a small portion of the Swan Pond River watershed with the Towns of Brewster and Dennis and the Herring River watershed with Brewster. The EENF/Draft CWMP recognizes that the wastewater treatment facility proposed for the Herring River watershed may have the potential to serve portions of the watershed outside Harwich's boundaries. Harwich should open immediate discussions with Dennis and Brewster regarding how these Towns with shared watersheds can best approach watershed planning on an inter-municipal basis. With regard to Swan Pond River, very little of Harwich is in that watershed; however, the MEP report models a scenario showing that 100 percent of the septic load must be removed to achieve target thresholds. The Town of Harwich should work with the neighboring communities on this shared watershed to ensure that planning results in proposed solutions that address the entire watershed in a cost-effective manner.

Sections 13.2 and 13.4.1 provide an update on the status of intermunicipal options. Given the delay in constructing the proposed wastewater treatment facility and recharge basins at Site HR-12 until Phase 4, there are opportunities to adjust the size or scope of these facilities as planning continues in neighboring towns. The town of Harwich is open to mutually beneficial agreements with neighboring communities to arrive at the most cost-effective and sensible solutions for shared watersheds. Discussions between these communities are ongoing.

Comment 1-11:

The SEIR should clearly describe how the proposed wastewater management plan and its total nitrogen loads are consistent with the total nitrogen thresholds in these reports. The projected total nitrogen loads for each watershed should clearly describe the contributions and specific total nitrogen attenuation values for: 1) sewered parcels at build-out (including any increases in per parcel load attributed to increased parcel development), 2) unsewered parcels in the watershed of interest (including those in adjacent Towns), and 3) natural sources of total nitrogen. For example, the EENF suggests that at buildout, the proposed PB-3 infiltration basin alone will contribute 8 lbs/day of total nitrogen to the Muddy Creek watershed while the MEP threshold for Muddy Creek is only 3.9 lbs/day. Additional sources of total nitrogen from the parcels in Chatham's portion of the Muddy Creek watershed and from unsewered parcels in Harwich will increase the daily total nitrogen load even beyond 8 lbs.

As discussed in Section 13, the Town must demonstrate that the wastewater system phasing plan does not result in an increase in nitrogen to any watershed for the program to be successful. The only acceptable scenario, from a regulatory point of view, will utilize a phasing plan that gradually decreases the nitrogen load to sensitive watersheds until the threshold load is achieved. This reduction must take place without increasing the load over present day values in the interim. In order for this to happen, the early phases of the wastewater plan must remove nitrogen from the watershed(s) that will receive effluent recharge. The proposed phasing plan achieves that goal. Table

13-13 from the CWMP presents the estimated load change for the nitrogen sensitive watersheds at the end of each phase. As the plan is completed, the total nitrogen loads will achieve and even surpass the load reductions that are required in the MEP reports. A combination of natural attenuation, adaptive management and flexibility in the wastewater plan will ensure that the nitrogen thresholds are met in all of the sensitive watersheds.

Comment 1-12:

The SEIR should describe how build-out conditions are consistent with MEP in-watershed nitrogen thresholds and, if not, what methods of growth limitation the Town will employ to ensure that habitat restoration thresholds will be met. In some cases, this may require taking into account the build-out in adjacent communities (e.g., Brewster and Dennis along the Herring River and Chatham along Muddy Creek). In addition, the SEIR' s wastewater and nitrogen loading analysis should account for existing built parcels that may be increased in built size (and/or subdivided) once sewer services are provided.

The recommended program presented in Section 13 accommodates all buildout flows estimated by the MEP, with updates provided by the Harwich Planning Department where MEP estimates were felt to fall short of allowed, anticipated, or additional desired growth in particular areas. Using these buildout estimates, all MEP thresholds will be met via the proposed sewering program, and areas can be scaled back if non-structural solutions (e.g., fertilizer management) can provide a future component of the required nitrogen reduction. Parcels that could be subdivided are accounted for in the buildout projections, in that parcels exceeding their zoning district lot sizes which are able to be subdivided by present zoning regulations were assumed to be subdivided accordingly. While these additional parcels were not included in the parcel counts in Sections 12 and 13, the associated flows have been included in the flow estimates. Therefore, the proposed infrastructure is planned to handle those flows, and the associated nitrogen inputs from these developable parcels have been accounted for in the nitrogen balance.

Commercial parcels that could be increased in built size were also accounted for in the build-out projections. Flows associated with additions to existing residential parcels were not added in, but with a total projected buildout flow increase of 26%, these flows are likely to be accounted for within this conservative estimate, as not all developable parcels are anticipated to be developed over the next 40 years.

Comment 1-13:

The SEIR should include a discussion of institutional issues including, if applicable, the development of a sewer connection policy and plans, funding, and public education. The DEIR should describe potential impacts relating to secondary growth associated with proposed new sewering and discuss the town's growth management plans.

Sewer connection policies and plans have not been formally established, with sewering not proposed until Phase 2 of the recommended program. The Town has begun discussions about intended policies, but no formal policy has been established at the writing of this CWMP/SEIR. Funding and financing are discussed in detail in Section 15 of this CWMP/SEIR. Public education is discussed in Section 2 and is further discussed in Section 13.7 with reference to public outreach, fertilizer education, low impact landscaping, water conservation, inflow prevention programs, on-site system support, and school education programs. Growth management and land use and regulatory growth controls by the Harwich Board of Health are also discussed in Section 13.7.

As part of the intermunicipal agreement (IMA) between Harwich and Chatham, Harwich will need to adopt sewer use regulations and they are reviewing the Chatham regulations. So sewer connection timelines and flow controls are being developed to be incorporated into this IMA once completed.

Comment 1-14:

The SEIR should include a reevaluation of the study areas with respect to prioritization and re-categorization with a more accurate weighting factor. As further detailed in the comment letter from the CCC, the SEIR should include an update on the Needs Assessment that describes how the CWMP process will address water quality impacts to wells, ponds and river in the study area. Several commenters have recommended that evaluation of future impacts from build-out and shifts in seasonal occupancy and/or occupancy rates should be considered. The Town should address this issue and provide an update in the SEIR.

The needs assessment presented in Section 8 did not include weighting factors, as the conclusions were that the MEP nitrogen reduction goals were the primary driver for all decisions as to the locations and extent of proposed sewering, and other areas of need could be accommodated within the framework of meeting the MEP goals with slight adjustments to the final recommended program. For instance, the areas of Title 5 concern which were identified in Section 8 were able to be accommodated with proposed sewers using extensions to the areas planned for sewering to meet MEP thresholds. Similarly, the three village centers in Harwich will all be able to be sewered via the recommended program. Also, areas in the Pleasant Bay watershed that contribute to the drinking water wells where nitrate levels are seemingly increasing (though still well below regulatory and CCC thresholds) are proposed for sewering. The only potential areas of need that were not included in the recommended sewering program were those areas surrounding ponds where additional information is first needed to confirm that septic system nutrients are a significant factor in degraded pond health. Since all needs identified in Section 8 were accommodated via the recommended program presented in Section 13, a re-prioritization of needs does not appear to be necessary.

Buildout flows were used for the development of the recommended program in Section 13. Shifts in occupancy from seasonal to year-round have not been specifically discussed herein; however, the design of wastewater conveyance and treatment systems requires consideration of maximum flows to establish the appropriate hydraulic and treatment capacities. Therefore, the proposed infrastructure is designed to handle seasonal peaks and will be able to accommodate those same flows should they occur during seasons other than summertime. While a shift toward more year-round occupancy could result in increased average annual flows, and thus increased average annual nitrogen loading, this can be mitigated via the adaptive management approach whereby water bodies will receive continued monitoring over the course of the implementation phase, and additional areas can be added to the sewering program in later phases if ultimately deemed necessary.

Comment 1-15:

Modeling has shown that a 24-foot wide culvert will provide benefit to water quality in the Muddy Creek subwatershed. This may result in a reduction of the amount of conventional infrastructure that would ordinarily be needed to meet target thresholds within the subwatershed. In its comments, *MassDEP has stated that it will work with the Town to develop an appropriate monitoring plan to determine if the anticipated improvements in water quality can actually occur. If the project does not result in the projected water quality improvements, the SEIR should provide a discussion of the additional mitigation required to meet the target thresholds.*

When the initial wastewater management scenarios were developed, as described in Section 10, a baseline scenario was set up both with and without natural attenuation. These two baseline scenarios each allowed the MEP goals to be met, however not yet accounting for effluent recharge within the subject watersheds. As detailed in Section 10.3.7, 230 additional parcels would need to be sewered within the Pleasant Bay watershed if the Muddy Creek culvert widening project were not undertaken. Figure 10-5 (Baseline Scenario with Attenuation) shows the extent of additional sewering which could occur if necessary. While some of the areas shown in tan on this figure were ultimately included in the recommended program for sewering, other areas shown in either red or tan would likely be among the first to be added into the sewering program should additional sewering be deemed necessary based on the results of the Muddy Creek project. Even though effluent recharge was not accounted for in these baseline scenarios, these showed all of the required nitrogen removal coming from septic systems removal. Assuming the Muddy Creek project achieves some level of nitrogen reduction, even if it is not to the estimated levels, then the lack of accounting for effluent recharge would likely be resolved, and fewer than 230 additional parcels would likely require sewering. Note that the reverse is applicable as well – if the Muddy Creek project proves more successful than expected, the adaptive management approach allows for the proposed sewered areas to be scaled back.

Comment 1-16:

The second proposal is to modify or manipulate flow through the Bank Street cranberry bogs to increase nitrogen attenuation from a measure of 35% to a projected 50%. Enhanced natural attenuation at this site will be considered as a demonstration project which will require appropriate review and permitting under the Wetlands Protection Act and related regulations. The town and MassDEP should discuss permitting requirements at the earliest opportunity. Should the project be permitted, the town will need to develop a design and monitoring protocol with MassDEP so that the effectiveness of the modifications is adequately documented in order to secure credit for the anticipated additional nitrogen removal. The plan should provide a discussion of alternate mitigation strategies if the enhanced attenuation does not meet expectations.

The Town plans to continue working with MassDEP to establish the details of the adaptive management plan described in Section 13, including monitoring of the natural attenuation project to evaluate its effectiveness. Similar to the answer to Comment 1-15, above, Figure 10-5 (Baseline Scenario with Attenuation) showed a grouping of parcels in a tan color near Paddocks Pond that could be added into the sewering plan for Saquatucket Harbor should the reduction in nitrogen from the Bank Street (Cold Brook) project not prove as effective as predicted.

Comment 1-17:

The SEIR should provide more detail on the recommended discharge sites to allow for further evaluation.

Sections 9 and 11 and Appendix D provide detailed information about Sites HR-12 and PB-3, including hydrogeological investigations. To supplement this information, these sites are discussed in Section 14 with respect to environmental impacts and mitigation resulting from their conversion to wastewater treatment and/or effluent recharge sites.

In 2015, the Town of Harwich unsuccessfully tried to secure a parcel in site PB-3 to be used to recharge effluent brought back from the Chatham WPCF. The town has evaluated some additional sites since that time and will continue to consider all potential sites in East Harwich in the future. Initially effluent will be recharged at the Chatham WPCF.

Comment 1-18:

The SEIR should include a detailed description of the proposed wastewater treatment facility and discharge areas, any further hydrogeological analysis as raised in comment letters, and an evaluation of impacts associated with all aspects of the project including the proposed effluent discharge, sewering and facility construction. The SEIR should evaluate any limiting factors for the proposed discharge locations including the potential for interaction with existing contamination and the costs associated with permitting and constructing wastewater pipelines. The SEIR should describe measures to avoid and minimize, or mitigate impacts associated with the proposed project.

Section 14 provides a comprehensive environmental review of the recommended program, including details pertaining to the treatment and recharge sites, as well as the locations proposed for installation of sewer pipelines and pumping stations. Please see Section 14.4.1 for the discussion specifically pertaining to contamination and hazardous wastes.

Comment 1-19:

The SEIR should evaluate project impacts on groundwater hydrology, surface water and wetlands resources, wildlife habitat and other sensitive resources in the project area. The SEIR should discuss monitoring plans for groundwater and surface water to evaluate impacts and inform a long-term planning process.

As noted above, Section 14 provides a comprehensive environmental review of the recommended program, including details pertaining to the treatment and recharge sites, as well as the locations proposed for installation of sewer pipelines and pumping stations. This section includes subsections describing impacts and mitigation related to hydrology, water resources, wetlands, and wildlife habitat, as well as other sensitive resources identified in the MEPA regulations.

Monitoring plans for groundwater and surface water will be developed in conjunction with MassDEP and the CCC as part of the adaptive management plan. MassDEP and the CCC have recently indicated that they need to better define adaptive management and monitoring Cape-wide. Therefore, the Town anticipates that as the state and Commission develop their monitoring programs, the Town will use those as a guideline for establishing site-specific monitoring programs as necessary. Furthermore, a component of groundwater monitoring will also be established by the state via the Groundwater Discharge Permits to be sought for each of the effluent recharge sites. Therefore, the Town will not have a full understanding of the extent of such monitoring until permits are negotiated and issued.

Comment 1-20:

The Town should continue to work with the CCC on watershed analysis and other aspects of the CWMP development during preparation of the SEIR. The Town should also coordinate closely with MassDEP *regarding permitting issues and allowable removal rates. The SEIR should describe how the project will meet applicable MassDEP permit requirements, including requirements for disinfection of water proposed for recharge. The SEIR should provide an update on consultations with MassDEP regarding the groundwater discharge and other applicable permits.*

The Town has continued to work with MassDEP and the CCC on the CWMP/SEIR planning efforts, and this coordination will extend well beyond the conclusion of the MEPA and DRI processes, into the implementation phase, as project design, construction, and financing are pursued over the next several decades. Section 14 includes a detailed discussion of anticipated project permits, and Section 17 includes draft Section 61 Findings which pertain to state permitting conditions and mitigation measures. As noted in Section 12, disinfection of water proposed for recharge at the proposed Harwich WWTF will utilize UV technology. The Chatham facility currently uses UV technology for disinfection and is anticipated to continue to do so into the future.

Since the filing of the EENF/Draft CWMP, the Town met with Brian Dudley of MassDEP (March of 2013) to specifically discuss permitting issues and allowable removal rates presented in the CWMP. That discussion centered around specific text and language in the CWMP as well as nitrogen threshold loads and the recommended program's ability to meet those loads. According to MassDEP, the threshold loads presented in this CWMP/SEIR seem appropriate since they were derived from the MEP reports and the recommended program was primarily focused on meeting those loads. MassDEP also concluded that permit requirements for a treatment facility could only be conceptually discussed and not finalized until the actual permit application was initiated, since treatment rules and regulations are continually evolving.

Comment 1-21:

The plans to meet TMDL requirements for nutrient loading must always consider source reduction as the primary means of long-term nutrient control. Source reduction usually focuses on controlling watershed land use loads generated from human activity and can include but are not limited to constructing new sewer systems, upgrading existing sewer systems (e.g. providing higher levels of treatment and eliminating combined sewer outflows), eliminating fertilizers, constructing on-site systems with enhanced nutrient removal capability, reducing runoff from impervious surfaces, reducing impervious surfaces, and tightening standards for new and upgraded septic systems. In addition to source controls, successful nutrient management plans may include alternative nutrient control strategies to achieve the desired nitrogen concentrations specified in the TMDL and MEP reports. The EENF provided a detailed discussion of the source controls proposed. The SEIR should continue to evaluate and adopt additional source controls in the future to the maximum extent possible to reduce the need for alternative nutrient control strategies.

Source controls continue to be a goal of the Town, via better public education, stormwater management, enhanced fertilizer controls, and Board of Health intervention for onsite systems not meeting Title 5 standards. The Town intends to minimize the extent of sewering to the maximum degree possible except in areas where sewering is needed for purposes other than to meet MEP goals. The Town is evaluating the data produced by the CCC's watershed tools and guidelines to explore if other means of source control can be added into the recommended program through adaptive management moving forward.

Comment 1-22:

The SEIR should describe and quantify all impacts to wetlands resource areas. The SEIR should include an analysis of cumulative impacts, a breakdown of impacts for different project components, and a comparison of impacts among project alternatives.

All wetlands resource areas and buffer zones on and adjacent to the project site, including Riverfront Area and Bordering Land Subject to Flooding, should be clearly identified and delineated on site plans. Proposed project elements should be superimposed on a plan with existing conditions to facilitate review and assessment. Proposed areas of impact and replication areas should be identified on site plans, and described and quantified. The SEIR should describe measures that will be implemented to avoid and minimize, or mitigate adverse impacts to wetlands and buffer zones.

The recommended program does not involve any work directly within wetland resource areas other than Riverfront Area and Bordering Land Subject to Flooding, with the exception of the Muddy Creek culvert project and the Cold Brook natural attenuation project. These components of the recommended program will not destroy these resource areas but rather modify their hydrology. The Town will look for opportunities to enhance habitat values while enhancing natural attenuation in the design of the Cold Brook bog project.

The figures included in Section 14 detail the locations of wetlands and floodplains and the anticipated work in and/or around these areas. Section 14 also provides the breakdowns requested in this comment. A comparison of wetland impacts between alternatives is not discussed herein, as the recommended program does not involve any permanent destruction of wetland areas or buffer zones. Therefore, this alternative is considered to have minimal impact on wetland areas, and any temporary construction impacts will be mitigated as detailed in the construction management plan in Section 16.

Note that all of the data presented herein with respect to wetland delineations originates from MassGIS and is for planning purposes only. During the design of each construction phase, onsite wetland delineation will need to take place in advance of the required filings with the Harwich Conservation Commission and other regulatory agencies, as applicable.

Comment 1-23:

Although source reduction should be the primary focus of all nutrient control strategies, MassDEP details in its comment letter certain instances where historical alteration of a resource area from its natural condition has exacerbated nutrient enrichment. With the increased 24-foot opening, residence time of nitrogen is projected to be reduced, thus contributing to overall reduction in nitrogen loads in the Muddy Creek subwatershed.

Historical alteration, in the form of the installation of narrow culverts beneath Route 28 causing a flow restriction, is believed to have contributed to a decline in water quality in Muddy Creek north of the culverts. That historical alteration was not implemented with a more complete understanding of estuary dynamics as they are currently understood, today. In fact, it is likely that the historic alterations did not consider the health of the local environment, but instead considered convenience to the local community and costs. Today's environmental focus and understanding of estuarine systems have changed the approach to alterations in these estuaries.

Unlike prior alterations, the Town is now considering a restoration to a more natural condition which will allow for shorter nitrogen residence times and increased flushing. This proposed alteration is a more natural, more efficient, lower energy, and lower cost solution than many of the options described as “source reduction” in Comment 1-21. Therefore, the Town believes it is appropriate to pursue this project immediately, in advance of other types of nitrogen control (such as sewering). Further details of this project are provided in the Notice of Project Change associated with the components of this CWMP/SEIR for which the Phase 1 Waiver was granted. The project is under construction.

Comment 1-24:

In addition to the Muddy Creek culvert improvements, modifications to Cold Brook and associated wetlands to maximize residence time of groundwater are proposed to achieve 15% of the total nitrogen attenuation required in the Saquatucket Harbor estuary. Specifically, construction of depositional ponds in abandoned cranberry bogs off of Bank Street is proposed for the retention of pollutants. This strategy is concerning and may require a Wetland Variance. Therefore, the SEIR should explore other alternatives (e.g. natural succession, different restoration techniques and wetland creation) that may better meet both the goals of wetland protection and water quality restoration.

The Town has been working with the Harwich Conservation Trust and the Harwich Conservation Commission to plan the Cold Brook natural attenuation project and has full support of both entities. The wetlands in question are former cranberry bogs and have already been significantly altered from their natural state. In the planning and design of this project, the Town will strive to increase habitat and other values in the modified bogs, to create wetland areas that provide not only the proposed natural attenuation, but also other environmental benefits above the present condition of the abandoned bogs. The Town has discussed alternative locations for natural attenuation in this watershed and does not agree, at this time, that disturbing existing high quality upland areas is preferred over working within the already-disturbed, abandoned cranberry bogs. All necessary permits will be obtained prior to implementing this project. Furthermore, as the project moves forward, the Town of Harwich will continue to work with the Harwich Conservation Trust to determine if any additional natural attenuation projects can be developed. The trust is also working with the Department of Ecological Restoration (DER) to evaluate restoration options.

Comment 1-25:

The SEIR should also consider wetland creation as a viable alternative to the alteration of existing wetlands in and around the abandoned bog. There appear to be a number of upland areas that may allow for successful wetland creation in and around these abandoned cranberry bogs that should be investigated further.

The Town has been working with the Harwich Conservation Trust and the Harwich Conservation Commission to plan the Cold Brook natural attenuation project and will continue to coordinate evaluation efforts. The Towns study is expected in June 2016.

Comment 1-26:

The SEIR should analyze both direct and indirect impacts on wetlands and water bodies resulting from the project, and quantify the amount of direct wetland impacts. The analysis should also discuss the consistency of any proposed drainage and storm water management systems that are included in the *project with the MassDEP Stormwater Management regulations and the Wetlands Protection Act performance standards. Proposed activities, including construction mitigation, erosion and sedimentation control, phased construction, and drainage discharges or overland flow into wetland areas, should be evaluated.*

See Sections 14 and 16 for discussion of these topics and related mitigation.

Comment 1-27:

The SEIR should examine alternatives that avoid impacts to wetland resource areas, their associated buffer zones, riverfront protection areas and 100-year flood plain areas. Where it has been demonstrated that impacts are unavoidable, the SEIR should demonstrate that the impacts have been minimized, and that the project will be accomplished in a manner that is consistent with the Performance Standards of the Wetlands Regulations (310 CMR 10.00).

Section 14 of the CWMP details anticipated wetlands impacts. Wetlands and floodplains in Harwich were identified using MassGIS as presented in Section 14. These areas and the proposed WWTF at HR-12, proposed effluent recharge facility at PB-3 or other East Harwich sites, sewer lines, pumping stations, and Chatham WWTF are shown in Figure 14-8 for wetlands and Figure 14-9 for floodplains. MassGIS indicates that there are no wetland areas at the proposed WWTF at HR-12, effluent recharge facility at PB-3, or the Chatham WWTF. Construction of the sewers within paved roadways will result in temporary impacts to approximately 26,000 square feet of Riverfront Area, 207,000 square feet of Land Subject to Coastal Flowage, and 30,000 square feet of Bordering Land Subject to Flooding. Construction of the pumping stations will permanently alter approximately 1,000 square feet of Riverfront Area. These impact areas will be flagged and further quantified during each phase of design and permitting under the Massachusetts Wetlands Protection Act occurs.

While the construction of some of the sewer lines will be within floodplains, as well as a few pumpingt stations, implementation of this CWMP is not expected to promote additional development within flood zones because the majority of areas to be sewered are near buildout condition. Additionally, development on the seaward side of primary dunes should not be promoted as the parcels to be sewered near these areas are also essentially built out. The sewer lines and any pumping stations to be built within flood zones will be designed pursuant to industry standards to withstand flood conditions.

Comment 1-28:

The availability of sewer infrastructure in coastal areas subject to storm damage, flooding, and erosion could allow new or expanded development in these hazard-prone areas.

To specifically control growth, the Town of Harwich will continue to develop appropriate regulations on bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with appropriate town boards and committees before deciding whether regulations or zoning bylaws are the best approach for Harwich to implement this wastewater flow management requirement. In doing so, attention will be paid to hazard prone areas in an effort to minimize new or expanded development deemed inappropriate in these areas.

Comment 1-29:

The SEIR should contain a detailed analysis of specific planning considerations to be developed for areas located within mapped coastal flood zones and barrier beach areas. The comments from CZM provide details as to how the Town should address this issue.

See Section 14.7 for a detailed discussion regarding how CZM performance standards are intended to be met during the design and implementation of the recommended program. This section offers a comprehensive review of the enforceable Massachusetts Coastal Zone Management (CZM) policies, as outlined in the Massachusetts Office of Coastal Zone Management Policy Guide dated October 2011, relative to the CWMP recommended program for Harwich. Each enforceable CZM policy is presented with a description of how the proposed project complies with the policy.

Comment 1-30:

The Federal Emergency Management Agency (FEMA) has acknowledged that its Flood Insurance Rate Maps (FIRMs) need to be updated to more accurately reflect the extent of the floodplain. In 2011, FEMA began a study to update the FIRMs for Barnstable County with new analysis. One of the significant updates to the FIRMs will be to extend the velocity zone to the landward toe of the primary frontal dune. Therefore, CZM recommends that the Town's analysis of potential growth in hazard-prone areas also include, at a minimum, primary frontal dunes in addition to those areas shown on the current maps as flood zones. The SEIR should use the revised FIRMs, when they are available, to determine the extent of the flood zones.

The revised flood maps have been used in the discussion in Section 14.

Comment 1-31:

According to comments from the Massachusetts Natural Heritage and Endangered Species Program (NHESP) there are identified state-listed rare species in the vicinity of the Muddy Creek culvert replacement project including the Common Tern (Sterna hirundo) and the Eastern Box Turtle (Terrapene carolina). Additional estimated habitat of rare wildlife is located in the abandoned cranberry bog to the east of Bank Street. During implementation of the CWMP, the Town must comply with 310 CMR 10.59, 310 CMR 10.32(6) and related performance standards for other resource areas, and 310 CMR 10.37 to ensure that there are no short or long-term adverse effects on estimated habitats of rare wildlife.

The SEIR should analyze the impacts to rare or endangered species and evaluate avoidance/mitigation strategies and address the comments raised in NHESP' s comments on the EENF. I ask that the Town continue to work closely with NHESP and consult with the Harwich Conservation Commission during the preparation of this section of the SEIR. The final project design should include necessary project construction and post-construction conditions and commitments to avoid adverse impacts to resource area habitats of state-listed species located within and adjacent to the project areas. The SEIR should report on the results of the Town's consultations with NHESP.

Rare species descriptions and potential impacts are discussed in Section 14. In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. As each component of the CWMP moves forward, NHESP consultation will be required during permitting. For each phase that requires a Notice of Intent (NOI) from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information.

The Muddy Creek Bridge project moved forward under a separate project received appropriate permits, and is under construction.

Comment 1-32:

DMF states in its comments that it supports efforts to reduce nitrogen loading in coastal salt ponds, including efforts to remediate the current eutrophied state of these ponds.

Town supports as well.

Comment 1-33:

DMF has requested that the SEIR examine monitoring studies for the permeable reactive barrier study sites that include other contaminants from wastewater, not just nitrogen. For example, ecosystem quality will still be impaired if the barriers remove nitrogen but not endocrine disrupting compounds. In addition, the Town should commit to monitoring within Pleasant Bay and Saquatucket Harbor to determine if the natural attenuation projects in those watersheds are reducing nitrogen loads to the receiving waters. DMF recommends a stronger approach to Section 13.7 of the EENF, "Other Recommended Program Components." In particular, the Town should assess its carrying capacity to service boats for pumpout. I encourage the Town to work with DMF to ensure that these species are protected and that habitat impacts from the project are avoided or minimized.

Permeable Reactive Barrier (PRB) technology as described in the CCC 208 plan is generally focused on removal of nitrogen compounds from septic system effluent. With other types of reactive media, PRBs can be used to remove other contaminants such as endocrine disrupting compounds. The effectiveness of PRBs in removing other compounds would need to be further evaluated and endorsed by the Cape Cod Commission before it could be utilized in the final recommended program. As the technology is developed, the town of Harwich will reevaluate its effectiveness and determine if it can be used as a viable wastewater alternative. However, at this time, Harwich's recommended program does not include construction of PRBs to meet the MEP nitrogen goals but does recommend it be further evaluated to treat effluent applied at HR-12.

The Town plans to continue working with MassDEP to establish the details of the adaptive management plan described in Section 13, including monitoring of the natural attenuation projects to evaluate their effectiveness.

Updated information pertaining to boat pumpouts is included in Section 13.7. Finally, as discussed in the response to Comment 1-31, rare species descriptions and potential impacts are discussed in Section 14, and ongoing coordination will occur with NHESP as each design and construction phase is undertaken.

Comment 1-34:

The Town should provide Massachusetts Historical Commission (MHC) with a U.S. Geological Survey topographical map that clearly locates the phased project areas and scaled project plans showing existing and proposed conditions. These plans should be submitted to MHC as early as possible during the design of each of the proposed project development phases. The Town should coordinate with MHC to ensure review of any potential historic impacts from the project and the SEIR should provide an update on the status of these discussions. If MHC deems the project to have an "adverse effect" on historic or archaeological resources, the SEIR should include a discussion of mitigation measures that the Town will undertake to address the adverse effect.

All of the proposed sewering work is within existing roadways and therefore in previously disturbed areas. In addition, each of the proposed treatment and recharge sites has been previously disturbed, as one site has been used as a landfill and the other has been a gravel pit. As other potential effluent recharge sites are considered in East Harwich, reviews with MHC will be coordinated.

The Town began MHC coordination within the EENF phase. The Town will submit plans to MHC for review during the design stage of each phase of the project and plans to continue coordination to prevent and mitigate any adverse effects on historic or archaeological resources.

Comment 1-35:

The project is subject to the MEPA Greenhouse Gas Emissions Policy and Protocol ("the Policy"). The Policy requires projects to quantify carbon dioxide (C02) emissions and identify measures to avoid, minimize or mitigate such emissions. The Town will be required to quantify the direct and/or indirect C02 emissions associated with the project's stationary source energy usage (e.g., building energy use, process-related energy use) and transportation-related emissions (mobile sources), if applicable. To facilitate this evaluation, the GHG analysis should include a comparison of C02 emissions associated with an established project baseline to estimated C02 emissions associated with a final build condition that incorporates feasible mitigation measures to reduce C02 emissions. Unlike many projects reviewed under the Policy, wastewater treatment process energy loads and subsequent C02 emissions play a large role in the overall project's GHG emissions rather than the buildings that contain the facilities themselves. As outlined below, the Department of Energy Resources (DOER) has provided guidance to assist the Town in making a good faith effort to quantify project-related GHG emissions.

The analysis presented in Section 14 of this CWMP/SEIR follows the DOER recommendations described under Comment 1-37 below to assess and mitigate the impacts of the proposed wastewater treatment facility on greenhouse gas emissions.

Comment 1-36:

The EENF contained descriptions of project alternatives that include either modification of existing wastewater management systems, pump stations and discharge facilities and the construction of new WWTF. As noted above, these systems and facilities represent potential direct and indirect sources of GHG emissions due to related electrical and thermal loads. The Policy directs proponents to use applicable building codes to establish a project emissions baseline that is "code-compliant." However, there is no building energy code equivalent that applies specifically to WWTFs. Furthermore, there is no readily available energy use model (such as eQUEST) to estimate the projected energy use of the WWTF processing energy loads. According to discussions with the DOER, requiring Towns to estimate *energy consumption, particularly by process equipment, would involve a detailed design and selection of systems and equipment well in advance of the conceptual CWMP project planning information that is typically included in ENFs and DEIRs submitted for MEPA review. Therefore, DOER's comment letter provided an alternative method to estimate GHG emissions from the proposed WWTF. This analysis should be provided in the SEIR, including supporting data, graphics and narrative to demonstrate that GHG emissions have been avoided, minimized and mitigated to the extent feasible. The Town should arrange a meeting with representatives from MassDEP, DOER and the MEPA Office prior to preparing the analysis to confirm the proposed methodology and to discuss any questions the Proponent may have with regard to the content of the comment letters.*

The Town agrees that the level of detail available at the conceptual design phase included in a typical CWMP does not allow for the level of GHG analysis typically required by MEPA. Therefore, using the information available at this time, along with information from other similar facilities designed for Cape Cod communities, the analysis was performed as outlined by DOER in Comment 1-37 below and is presented in Section 14.

Comment 1-37:

The Town should use the EPA's Energy Star Portfolio Manager (ESPM) computer modeling program to quantify the energy usage associated with wastewater treatment technologies included in its Draft CWMP. Using EPA's ESPM will allow the Town to rank the estimated energy use of the proposed facilities included in the Draft CWMP and to compare this ranking with the energy usage of other wastewater management facilities that have similar fundamental operating parameters and are located in similar climate zones.

The Town should use the ESPM program together with the guidance and methodology cited specifically in the DOER comment letter to prepare a GHG analysis that demonstrates the Town's Draft CWMP's consistency with the Policy. The SEIR should clearly identify potential GHG reduction mitigation measures that will be adopted by the Town, or, those mitigation measures that will continue to be evaluated as project design advances. The Town should review EPA's BMP guidance document to identify additional GHG and energy reduction strategies that the Town should explore. The Town may wish to consider committing to minimum equipment performance standards as a method to meet GHG reduction goals at this stage of the project design. I also encourage the Town to consider the use of energy audits to assist in the identification of potential energy reduction measures that could be implemented into the existing portions of the wastewater treatment system.

The MEPA GHG Policy and Protocol requires that energy modeling be performed to establish the expected energy usage and corresponding GHG emissions for both the baseline and mitigated as-proposed cases. In this case, however, the DOER recommends that this requirement be waived for the actual WWTF building if certain conditions are met as detailed in DOER's comment letter because the loads and energy consumption for the buildings are included in the computation of the overall facility site kBTU/mgd. If the Town cannot meet these conditions as outlined in DOER's comment letter it will need to provide GHG analysis of the WWTF building as outlined in the Policy.

Section 14 of this CWMP/SEIR presents the GHG analysis as requested by DOER. The Town is committed to designing a facility that minimizes energy usage where feasible and exploring renewable energy options to offset additional usage, as described further in Section 14. Since there is no design at this time for a treatment facility in Harwich, the as-proposed case was based on a similar WWTF designed by CDM Smith for another Cape Cod community. The estimated energy use at the plant was scaled from this design based on the difference in the two plants' annual flows. The draft Section 61 Findings presented in Section 17 also address energy efficiency measures being considered.

This comment states to consider energy audits for existing portions of the wastewater treatment system. However, the Town does not have any centralized wastewater treatment facilities at this time. The Chatham facility, to which the Pleasant Bay sewers will be connected, already exists but is controlled by the Town of Chatham and was recently upgraded using energy efficient standards. Therefore, Harwich would not be in a position to initiate such an audit. However, energy efficiency will be considered in the design of any upgrades to the Chatham facility in later phases to accommodate Harwich flows.

Comment 1-38:

The SEIR should include a feasibility study of installation of the solar (photovoltaic (PV)), installation. Installation of PV systems on municipal properties may achieve cost-savings beneficial to the community and offset ongoing operational costs. The SEIR should include a separate analysis of PV systems in association with this project in order to calculate potential project cost, payback periods and returns on investment. The Town should consider both first party and third-party ownership/lease scenarios. The SEIR should state assumptions with regard to available area for PV equipment, efficiencies, etc.

Section 13 of this CWMP/SEIR describes a solar PV project implemented by the town on the HR-12 site (future WWTF site). This project was implemented through an energy management service agreement between Cape and Vineyard Electric Inc. and Cape Solar Two and is expected to generate 3.96 MW of renewable energy. The Town has not yet identified additional locations for municipal or public/private solar PV projects but will continue to seek suitable sites during the implementation phase of the project as described in Section 14, to further offset energy usage at the future WWTF.

Comment 1-39:

The SEIR should also clarify if the project will include measurable transportation-related C02 emissions in the form of delivery of septic sludge/waste from septic haulers for treatment at the facility. The Town should consult with the MEPA Office prior to preparation of the GHG analysis to discuss a potential methodology to calculate these GHG emissions if applicable.

The town has not yet decided if the proposed wastewater treatment facility will accept septage. However, any addition of sewering will reduce or eliminate septage hauling trips associated with homes that are presently on septic systems but are ultimately tied into the collection system as part of the recommended program. If the town's proposed wastewater treatment facility were designed to accept septage, this would also minimize the hauling distance of septage for the remainder of town who would continue to be served by onsite systems. Therefore, in each instance, truck trips would be reduced compared to existing conditions.

The final destination of the sludge from the wastewater treatment facility is a detail that would be considered at a later stage of planning and is therefore not able to be included in the greenhouse gas analysis herein.

Comment 1-40:

The Town should commit to continue to work closely with MassDEP and DOER during future final WWTF design and permitting to identify and incorporate appropriate energy efficiency measures into the buildings, treatment processes and operations for the future Harwich WWTF. It is anticipated that the Town will be required to provide a certification to the MEPA Office indicating that the mitigation measures identified in the MEPA process have been incorporated into the project. The proposed draft Section 61 Findings in the SEIR should include this self-certification requirement and incorporate the commitments listed in the EENF. For each of the considered mitigation measures, the Town should provide to MassDEP, as part of the facility permitting in conjunction with the submittal of the project manual for the facility permit documentation, which of these measures were incorporated into the final design, where the adoption of substitute measures of equal or greater efficiency took place, and an explanation and justification of the measures that were determined to be technically or financially infeasible to implement.

The Town is committed to continuing to work with MassDEP and DOER to identify further opportunities for energy reduction, energy efficiency, and renewable energy during the final design and implementation of the recommended program. The draft Section 61 Findings included in Section 17 of this report include self-certification that the commitments included in the EENF and herein will be met. Furthermore, during MassDEP’s review of final design documents for the proposed WWTF, the measures described herein will be revisited to identify which measures are being incorporated, which, if any, have been substituted by equal or greater efficiency measures, and which were determined to be technically or financially infeasible.

Comment 1-41:

The SEIR should quantify the total amount of alteration associated with the proposed project (including areas to be altered for sewer mains, wastewater treatment and disposal, and other project components). The SEIR should include a breakdown showing the amount of alteration for different project elements. The SEIR should clarify the location, type and amount of alteration in previously undisturbed areas.

The SEIR should clarify the amount of new impervious area associated with the construction of the components of the Town's Draft CWMP. The SEIR should describe how the Town's proposed stormwater management system will be designed and constructed to be consistent with MassDEP's stormwater management regulations and policy standards and avoid and minimize adverse impacts associated with any new impervious area. The SEIR should describe proposed measures to manage stormwater during project construction.

See Section 14 for quantification of impacts from land alteration and addition of impervious area. The ability of the project to meet stormwater management standards is described in Section 14.15. This section details each of the stormwater performance standards. In addition, the draft construction management plan in Section 16 details construction-period stormwater mitigation measures.

Comment 1-42:

The draft CWMP is based on a 40-year design horizon divided into eight phases. The SEIR should provide further discussion on the timetable required to arrive at the schedule for completion. For example, the northeast Herring River collection system (upper) is scheduled for Phase 4B and the *northwest (upper) Herring River collection system is scheduled for Phase 5 while the southwest (lower) Herring River collection system is scheduled for Phase 7. Because the lower Herring River collection system would likely have a more immediate effect on improving water quality due to its proximity to the marine portion of the Herring River watershed, it should be considered for Phase 4B or Phase 5 and the upper Herring River collection systems should be considered for later phases. I advise the Town to have further discussions with MassDEP before finalizing a phasing plan.*

The adaptive management approach described in Section 13 provides for adjustments in project phasing during the implementation phase. The lower Herring River collection system requires that some elements of the upper Herring River collection system, closer to HR-12, be constructed first. Pumping stations in the vicinity of HR-12 must be built first since they must be sized to convey larger flows from the most distant collection system areas. It is expected, however, that the phasing plan will be modified as the wastewater plan unfolds. The town of Harwich fully expects to continue discussions with MassDEP and the Cape Cod Commission regarding the phasing plan and to modify that plan as the wastewater system is built over time.

Comment 1-43:

The Town of Harwich is encouraged to work with MassDEP's State Revolving Fund (SRF) section to develop funding alternatives as project development proceeds. The SEIR should include an updated summary of the recommended program costs. The SEIR should document any assumptions concerning the probable cost of acquiring parcels for wastewater purposes. The Town should consult with MassDEP during the preparation of this section of the SEIR.

The Town has worked extensively on a cost recovery program since the Draft CWMP/EENF was issued. The results are presented in Section 15 of this CWMP/SEIR. State Revolving Fund loans have been assumed to be the funding mechanism for each phase of implementation with the exception of Phase 1, which does not include any grey infrastructure. Should more advantageous financing programs become available during project implementation, such as the 25-percent principle forgiveness loans that have been mentioned by the CCC during the 208 Plan development, these will also be sought for applicable implementation phases. The town also intends to meet all requirements to qualify for the SRF zero interest loans.

Comment 1-44:

The SEIR should include a discussion of the Town's public participation program activities completed and proposed.

Section 2 and Appendix A summarize the public participation program undertaken as part of this CWMP/SEIR effort. An additional hearing will be held during the review period of this CWMP/SEIR. Also, as funding authorizations are presented and brought to vote, additional community outreach and education will occur.

Comment 1-45:

MassDEP has indicated that the Town should consider the potential for encountering contamination during excavation. The SEIR should identify known hazardous waste sites governed by the Massachusetts Oil and Hazardous Material Release Prevention and Response Act (M.G.L. c. 21E) in the vicinity of the project area and provide an updated summary on the status of these sites consistent *with the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000). The Town should provide an overview of planned remediation efforts. The Town is advised that, if oil and/or hazardous material (OHM) is identified during the implementation of the project, notification pursuant to the MCP must be made to MassDEP, if necessary. A Licensed Site Professional (LSP) may be retained to determine if notification is required and, if need be, to render appropriate opinions. Construction protocols and procedures should reflect the potential for discovery of OHM during the construction period. I refer the Town to the comments from MassDEP for additional guidance on the prevention and management of potential releases of OHM.*

A map of reported hazardous waste sites within the project area was developed and is provided as Figure 14-11. Included are the location of the hazardous waste sites by number and a listing of each site's regulatory compliance status and Remedial Action Outcome (RAO) status, including Chapter 21E sites as well as reported locations of spills or other contamination. Associated text is provided in Section 14.4.1. Should contaminated soils be encountered during construction, appropriate measures will be taken to handle the materials and report conditions to the regulatory agencies. Associated construction mitigation measures are included in the draft Construction Management Plan included in Section 16 of this CWMP/SEIR. The construction procedures and protocols are also listed in the draft Section 61 Findings provided in Section 17 of this report.

Comment 1-46:

The SEIR should include a detailed draft Construction Management Plan (CMP) describing project activities and their schedule and sequencing, and BMPs that will be used to avoid and minimize adverse environmental impacts. The CMP should address potential demolition and construction period impacts (including but not limited to land disturbance, noise, vibration, dust, odor, nuisance, vehicle emissions, construction and demolition debris, impacts on trees and other vegetation, and construction-related traffic) and analyze and outline feasible measures that can be implemented to eliminate or minimize these impacts. The SEIR should outline potential measures to address materials management during the construction period. The CMP should discuss plans for reuse and recycling of construction materials including asphalt, brick and concrete (ABC). The CMP should include an erosion control component to address protection of water quality and wetlands resources. The project must comply with MassDEP' s Solid Waste and Air Quality Control regulations during construction.

A draft CMP was developed and is presented in Section 16. The provisions listed in this draft CMP are also incorporated into the draft Section 61 Findings in Section 17.

Comment 1-47:

I ask that the Town participate in MassDEP's Clean Air Construction Initiative (CACI) and the MassDEP Diesel Retrofit Program to mitigate the construction-period impacts of diesel emissions to the maximum extent feasible. The Town should consult with MassDEP during the preparation of the SEIR to develop appropriate construction-period diesel emission mitigation, which could include the installation of after-engine emission controls such as diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs). Project contractors are required to use ultra low sulfur diesel (ULSD) fuel (15 parts per million sulfur) in off-road engines and MassDEP can provide additional resources to assist with implementation of this program.

The draft CMP provided in Section 16 includes provisions to comply with MassDEP's Clean Air Construction Initiative and Diesel Retrofit Program. Specific requirements are provided in Section 16 and are included in the draft Section 61 Findings in Section 17 as well.

Comment 1-48:

The Town is required to prepare a Stormwater Pollution Prevention Plan (SWPPP), which must clearly and reasonably delineate all areas to be 'altered', and describe the practices that will be implemented to protect the resources during construction as well as upon completion of the project. This includes Erosion and Sedimentation Control Plans and design calculations to assess all drainage leaving-the construction areas. The SWPPP must also include designation of areas where stockpiling of material and operations are to occur. The Town should consult with MassDEP and others to ensure that the Project will meet any performance standards associated with a federal NPDES permit for all proposed project construction activities.

The preparation of SWPPPs, Erosion and Sedimentation Control Plans, and Dewatering and Drainage Plans are all the responsibility of the individual construction contractors, as described in the draft CMP in Section 16. The contractors will be required to have a Licensed Professional Engineer prepare such plans. Detailed requirements for stormwater controls are included in the draft CMP in Section 16. Note also that any permanent structures located in areas requiring review of the Harwich Conservation Commission, including the proposed WWTF, will be designed to comply with MassDEP's Stormwater Management Standards, as detailed in Section 14. Construction of the various components of the CWMP will require registration for the EPA Construction Stormwater General Permit and preparation of Stormwater Pollution Prevention Plans for each construction contract. Erosion and sediment controls during construction will be constructed in accordance with the MassDEP Stormwater Guidance Manual.

Comment 1-49:

The SEIR should include a separate chapter on mitigation measures, which should include a summary table of all mitigation commitments as well as detailed draft Section 61 Findings for all state permits. The draft Section 61 Findings should describe proposed mitigation measures, contain clear commitments to mitigation and a schedule for implementation based on the construction phases of the project, estimate the individual cost of each proposed measure, and identify parties responsible for funding and implementing the mitigation measures. The draft Section 61 Findings will serve as the primary template for permit conditions.

Section 17 of this CWMP/SEIR summarizes mitigation measures associated with both the construction and final implementation of the recommended program and includes draft Section 61 Findings for state permits. Note that construction mitigation is also described in the draft CMP in Section 16. Specific costs for mitigation measures are not able to be estimated at this planning-level phase of the project.

Comment 1-50:

The SEIR should be circulated in compliance with Section 11.16 of the MEPA regulations. Copies should be sent to those parties that submitted comments on the EENF, and to each federal, state and local agency from which the Town will seek permits or approvals. A copy of the SEIR should be made available for review at the Harwich Public Library.

This CWMP/SEIR is being distributed in accordance with Section 11.16 of the MEPA regulations and this comment.

#2 - Comment Letter from Harwich Conservation Trust, Association to Preserve Cape Cod, Friends of Pleasant Bay, East Harwich Community Association

Comment 2-1:

The plan contains insufficient information about underlying build-out assumptions and the costs of treating wastewater resulting from new development. It also lacks consideration of alternative methods of achieving community growth goals in ways that could reduce wastewater treatment costs.

The buildout assumptions for the analysis included herein originated first from a lot-by-lot review of current development and a comparison with allowable development based on present zoning. Any lots that could be subdivided under present zoning were assumed to be subdivided, and any undeveloped, developable lots were assumed to be developed. Using this as a baseline, the Harwich Planning Department then added site-specific information, especially in areas where planned growth is likely to result in zoning changes that allow for increased density over present zoning (i.e., village centers). Buildout estimates were adjusted accordingly to account for these potential revisions, to arrive at the final buildout numbers. These results are based on the best available information and provide the outside estimate of allowable development in Harwich to avoid undersizing infrastructure installed as a result of this project. If that growth does not occur, then the full infrastructure does not need to be constructed.

Comment 2-2:

In East Harwich, TMDLs for the Pleasant Bay watershed require a 65% reduction in septic nitrogen load. This means removing nitrogen from existing development and preventing any additional nitrogen from future growth.

The results of the MEP analysis showed that a 65% reduction in septic system nitrogen is required at buildout in the Harwich portion of the Pleasant Bay watershed. This assumes full buildout of this watershed. Sewers are proposed to be built in this area over three phases allowing for plan adjustment as needed.

Comment 2-3:

Sewers should be scaled to accommodate a level of growth that coincides with clearly defined community goals for growth and resource protection. All alternative measures to use land use tools to reduce the costs of sewers need to be fully considered. In making decisions about investments in sewers, communities should understand the resulting growth effects and costs associated with wastewater treatment designed to accommodate growth.

The recommended program presented herein shows the outer limits of sewering estimated to be required to meet the TMDLs for nitrogen at buildout. The adaptive management approach presented in Section 13 allows for adjustments to be made to the sewer service areas should non-structural nitrogen reduction methods prove more effective than estimated or should new, more cost-efficient technologies or means of nitrogen reduction be identified over time. With sewers proposed to be installed over a number of phases, there is ample opportunity for adjustments based on ongoing water quality monitoring.

Secondary growth impacts from sewering are a concern and will be a focus of the Harwich Planning Department as each phase of sewering is implemented. The town is presently working on identifying the best strategies for growth control. Since Phase 1 does not include the installation of any sewers, the town has time to carefully consider options for implementing growth controls prior to sewer installation. As each sewer implementation phase is brought to vote for construction funding, the community will have the opportunity to assess whether they feel growth controls are adequate or require revisions in the proposed sewered areas.

Comment 2-4:

The importance of in-depth public review of growth assumptions and associated wastewater costs is emphasized in the Cape Cod Commission's Guidance for Local Wastewater Management Plans (December 2012). The Guidance instructs towns in the earliest stages of planning to estimate the cost of wastewater treatment for mitigating wastewater flows based on current zoning, and to estimate the cost of wastewater treatment for new growth. Later stages of planning should not begin until the town has "addressed the potential cost of future growth (including presentation at public meetings) and concluded that the setting of the [proposed growth] flows is consistent with the community's willingness to expend capital for future growth needs."

As stated above, the intention of this CWMP/SEIR is to present the potential conditions at complete buildout under existing zoning, plus any zoning modifications being considered to increase density in planned growth areas, to ensure that anticipated nitrogen TMDLs can be met using the infrastructure outlined herein. It is the town's responsibility to plan for the outer limit of growth such that nitrogen inputs are not underestimated. The growth assumptions were originally quantified via the MEP analysis then adjusted based on site-specific information by the Harwich Planning Department. The projected buildout has been presented at numerous public meetings. If the extent of buildout presented herein is larger than the community's desired buildout, this growth is most appropriately controlled using standard growth control measures such as planning and zoning regulations, overlay districts, etc.

Comment 2-5:

Based on information provided in the DCWMP, the undersigned organizations are concerned that the growth effects of wastewater and the associated treatment costs for new growth are not fully described, particularly for the region of town with the highest growth potential, East Harwich.

The treatment costs associated with buildout have been included in the recommended program costs presented in Section 13 and in the cost recovery strategy presented in Section 15. Again, the town has the opportunity to implement growth controls consistent with town planning goals prior to the approval of construction funding for each area of town. The sewering of areas in East Harwich is proposed for Phase 2, projected to enter design before 2020; therefore, interested parties should continue working with appropriate town boards and departments to arrive at appropriate growth controls.

Comment 2-6:

Thus the additional 500,000 sf of commercial space and 250 new dwelling units in East Harwich, by generating 55,000 gpd of wastewater, accounts for approximately $20 million in wastewater costs.

It is also possible that projected wastewater flow resulting from an additional 500,000 sf of commercial growth in East Harwich could be significantly higher than the 55,000 gpd projected in the DCWMP. To estimate wastewater flow from new commercial development in the Pleasant Bay watershed, the DCWMP uses a factor of 35 gpd per 1000 sf of commercial development (Table 7 -7). However, the DCWMP uses a water use factor of 236 gpd per 1,000 sf of commercial development for every other watershed in Harwich (Table 7-7). A survey of commercial water use factors in Massachusetts Estuaries Project Technical Reports for commercial districts in other watersheds on Cape Cod shows factors in the range of 80-120 gpd per 1,000 sf. Thus, the amount of wastewater flow from new commercial development in the Pleasant Bay watershed could be two to six times what is currently estimated. There is no explanation given as to why water use and wastewater flow for commercial activity in East Harwich is so low compared to other watersheds in town, or to commercial areas in other watersheds on Cape Cod.

It is also important to note that the 55,000 gpd increase in wastewater flow in East Harwich is in addition to the 30,000 gpd that the DCWMP assumes would be generated at build-out under current zoning in the Pleasant Bay watershed. Thus the total wastewater flow at the higher density build-out scenario is 85,000 gpd. An estimate of wastewater flow under various development scenarios conducted by Wright-Pierce for APCC (February 2012) calculates wastewater flow at build-out under current zoning as 82,000 gpd, just 3,000 gpd less than the DCWMP high growth scenario. Thus the projections in the DCWMP could seriously underestimate wastewater flow and resulting costs from added development in East Harwich. If the estimated wastewater flow from added growth in East Harwich is higher than 55,000 gpd, then the cost of treating that added growth could be dramatically higher than $20 million.

Additional details regarding growth assumptions for the Pleasant Bay watershed are included in Section 13. The town of Harwich understands that buildout estimates are educated estimates based on the best available information. The buildout estimates for the East Harwich Village Center were developed only after extensive discussions with Planning Department and the Water Quality Management Task Force-Wastewater Management Subcommittee were complete. In those discussions, it was decided to include the buildout flows developed in the Local Comprehensive Plan along with the buildout flows developed in the 2006 MEP report. The additional buildout flow of 55,000 gpd is considered appropriate for planning purposes since any zoning revisions for the EHVC are not final at this time. Thus, the projected MEP buildout flow for the sewer service area in the Pleasant Bay of 235,900 gpd was increased by 55,000 gpd up to 290,900 gpd based on 200 additional residential units at about 150 gpd/unit and additional commercial development at 250,000 square feet at the existing 100 gpd/1,000 SF. These wastewater flow values are developed directly from the MEP model and are specific to the Pleasant Bay watershed.

The cost of wastewater collection is based on a conveyance system that would be similar regardless of the exact flows being conveyed, as the same extent of piping and pumping stations are likely to be required regardless of the specific uses of individual properties. The operations and maintenance costs of treatment could increase if additional flows must conveyed be treated. However, the Town believes that its estimates for the Pleasant Bay watershed are accurate.

Comment 2-7:

We are also concerned that land use management alternatives that could help to achieve growth goals and save wastewater costs have not been fully evaluated. The Commission's Guidance document recommends that, once a town has estimated wastewater treatment costs associated with growth, it should then "review its build-out analysis to consider possible growth restrictions in areas identified for sewering but not currently identified for future growth."

This type of analysis will occur as particular areas enter the implementation phase. At a conceptual, planning level, it is prudent to consider the outer extent of growth to achieve projected TMDLs. However, through the adaptive management strategy described in Section 13, the town will continue to look for ways to reduce sewering through non-structural solutions, including growth restrictions where appropriate.

Comment 2-8:

On page 13-36 of the DCWMP it is noted that the Pleasant Bay watershed is one of two areas in town where land use controls could be effective in bringing down treatment costs. Yet there is no evidence in the DCWMP that growth management tools have been evaluated as a way of achieving millions of dollars in potential cost savings.

See comment 2-7, above. These controls will be evaluated on an ongoing basis, and as means to reduce sewering are identified, if acceptable to the community, they can be implemented in advance of detailed sewer system design.

Comment 2-9:

In light of the information contained in the DCWMP, we are concerned that the impacts of proposed growth in development on wastewater flows and resulting wastewater collection, treatment and disposal costs in East Harwich have not been adequately represented. This information is essential for Harwich residents to have a full understanding of the wastewater-related costs associated with different decisions about growth, and the options available for accommodating growth in concert with land use management that could help to mitigate wastewater flows and reduce wastewater-related costs.

See response to Comments 2-6 through 2-8 above.

Comment 2-10:

Therefore, we are requesting that the Town of Harwich and its consultants be asked to provide the following analyses:

1. *A sensitivity analysis that projects wastewater flows from commercial growth in East Harwich based on a factor of water use that is consistent with other watersheds in Harwich, and other watersheds on Cape Cod.*

2. *A sensitivity analysis that projects wastewater flows and nitrogen loads from commercial and residential growth in East Harwich based on different growth assumptions including:*

   - *Growth at the level of build-out in the village center and remainder of the watershed under current zoning;*

   - *Growth in the village center that is beyond build-out at current zoning without offsets to that growth. Examples would be the addition of 500,000 sf and 250 units shown in the DCWMP, and a higher level of increase to reflect current zoning proposals put forward by the Planning Board (dated 12114/12).*

   - *Growth in the village center that is beyond build-out at current zoning with offsets to balance that growth. Examples would be the plan put forward by the East Harwich Collaborative (dated 9115111).*

   - *Growth under land use controls that reduce the amount of future commercial and residential growth below existing zoning for East Harwich.*

3. *Wastewater costs for each growth scenario noted above should be provided, including collection, treatment, effluent disposal costs and on-going operations and maintenance costs associated with that treatment. Assumptions underlying costs projections should be clearly stated.*

4. *Comparable analysis should be prepared for all areas of Harwich where future growth beyond build-out under current zoning is projected.*

Additional details regarding growth assumptions for the Pleasant Bay watershed are included in Section 13. See response to comments 2-6 through 2-8, above.

#3 - Comment Letter from Harwich Office of Selectmen

Comment 3-1:

Currently we have a Wastewater Implementation Advisory Committee that is reviewing potential cost recovery models for us to implement the program. A recommended cost model will be presented in the Final CWMP.

The recommended cost recovery approach adopted by the Harwich BOS is presented in Section 15 of this CWMP/SEIR.

Comment 3-2:

While the BOS remain concerned about the overall costs to implement the program presented in the Draft CWMP and will continue to work with local, county, state and federal officials to seek funding for this project, we voted on March 25, 2013, to further endorse the water resource protection defined needs and the recommended program to address them as presented in that plan which will be reviewed by MEPA.

The recommended cost recovery model is presented in Section 15 of this CWMP/SEIR. Throughout the implementation phase, the town will continue to pursue available sources of no- or low-interest loans, principle forgiveness loans, and grants.

The Harwich BOS have actively participated in the development of this CWMP/SEIR and their input is greatly appreciated.

#4 - Comment Letter from Town of Harwich Planning Department

Comment 4-1:

As Town Planner, I worked very closely with CDM-Smith in the development of growth projections for Harwich. All projections provided by me were based on planning and zoning discussions at the time among the Planning Board, the East Harwich Collaborative and others. These discussions continue and will ultimately result in an adopted zoning by-law based on growth assumptions which may change. While this planning work proceeds, it is critical not to delay valuable steps that address current wastewater issues.

As noted previously, the town has proposed an adaptive management strategy that will allow components such as changes to zoning bylaws to be enacted later in the project implementation phases and changes to the recommended program can then be made accordingly. Wastewater flows presented herein are conservative for planning purposes.

Comment 4-2:

The top priority of the Pleasant Bay Alliance should be to support construction of the Harwich connection to the Chatham plant at the earliest possible date.

The connection to the Chatham plant is proposed for Phase 2 of the project – the first phase in which sewers will be installed. Discussions with Chatham to develop an intermunicipal agreement are ongoing.

Comment 4-3:

I hope your final comment letter will include both support for immediate construction of the connection to the Chatham plant and continued review of other important issues through the Town's proposed adaptive management process. Thank you for the opportunity to comment on the Harwich Draft Comprehensive Wastewater Management Plan. I fully support that plan and hope that you give it your approval.

Harwich and Chatham are actively pursuing the i*ntermunicipal agreement.*

#5 - Comment Letter from the Cape Cod Commission

Comment 5-1:

As the project requires the preparation of an Environmental Impact Report (EIR), it is also subject to Commission Development of Regional Impact (DRI) review pursuant to Section 2(d)(i) of the Enabling Regulations (revised July 2012)

The Town has filed for joint review from MEPA and the CCC and fully expects to initiate the DRI process once they receive the MEPA certificate on the CWMP/SEIR. This will allow the DRI process to proceed within the context of a completed 208 Water Quality Management Plan.

Comment 5-2:

"Draft Guidance for Cape Cod Commission Review of Local Wastewater Management Plans" The Guidance requires consistency with the Barnstable County Regional Policy Plan, Local Comprehensive Plans and follows the general outline of the DEP Water Resources Management Planning Guidance, which includes sections on Shared Watersheds, Needs Analysis and Problem Identification, Alternatives Development, Plan Evaluation and Selection, Adaptive Management and Implementation.

This CWMP/SEIR has been developed in concert with the principles of the final 208 Plan, issued in June 2015. The approach is consistent with the hybrid planning methodology outlined by the CCC, and the town will continue to work with the CCC throughout project implementation to ensure consistency with the CCC's regulatory programs.

Comment 5-3:

The Commission supports the efforts of the Town of Harwich to develop a comprehensive plan to address wastewater management and recognizes the efforts the Town has made to coordinate its wastewater planning with its neighboring Towns of Chatham and Dennis. The Commission looks forward to partnering with the Town of Harwich as we proceed with the Joint MEPA/DRI review of the ENF and begin work on the 208 Area Wide Water Quality Management Plan.

The Town of Harwich thanks the Commission for their input during the development of the CWMP.

Comment 5-4:

Commission staff has reviewed the Expanded ENF for the project's possible impacts and in general finds that it addresses many of the parameters of our Regional Policy Plan and RWMP Draft Guidance on CWMPs, and suggests that the Phase 1 Waiver for proceeding with the Muddy Creek Culvert is a reasonable and severable phase of the project. Commission staff recommends that the Town address certain issues identified in this letter in preparation of its Final EIR/CWMP, but respectfully requests that the Town not submit the CWMP for formal review until the Commission has completed its Regional 208 Water Quality Management Plan, which is anticipated to be completed in the next year.

With the June 2015 final 208 Plan now approved by EPA, the town has complied with this request.

Comment 5-5:

The Harwich CWMP is a sequential and well thought out plan to deal with the town's wastewater needs. The CWMP provides an excellent summary of the public participation efforts and identifies the key stakeholders and decision makers. The Expanded ENF includes a needs assessment which provides the background and interpretation of the water quality conditions for drinking water, fresh water ponds, and coastal embayments, which are the three major water resource areas identified in the Cape Cod Regional Policy Plan and RWMP Draft Guidance.

Similar to the EENF, drinking water, fresh water ponds, and coastal embayments are discussed in Sections 4, 5, and 6, respectively, of this CWMP/SEIR.

Comment 5-6:

Commission staff suggests that the Town distinguish the parameters of the buildout modifications in the Final EIR and identify incremental infrastructure milestones in the description of the phasing of the project to accommodate potential buildout needs; Staff further recommends that the EIR address how the Town would demonstrate a flow-neutral condition for SRF zero percent loan eligibility.

Table 13-1 presents the recommended plan wastewater flows by watershed. This table presents both the current wastewater use and the buildout wastewater use. The wastewater phasing program presented in Section 13 is focused only on the buildout wastewater use and does not consider phasing in of infrastructure resources to accommodate a future buildout. At this time, it is assumed that pumping stations and wastewater treatment facilities will be sized so that flow swings between current flows, buildout flows, winter flows and summer flows will be accommodated. Infrastructure milestones to accommodate buildout needs are expected to be minimal.

The Town will continue to develop appropriate regulations and bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with several town boards and committees prior to deciding whether regulations or zoning are the best approach for Harwich to implement this wastewater flow management requirement.

Comment 5-7:

Phase I of the CWMP includes alum treatment of Hinckleys Pond as recommended in a detailed study by Water Resources Services dated March 2012. The Alum treatment of Hinckleys Pond is a reasonable Phase 1 CWMP project.

The Town is seeking ways to fund this project.

Comment 5-8:

Of particular note is the large increase of percent removal that occurs under buildout conditions in the Herring River Watershed. A majority of this future load comes from the West Reservoir sub-watersheds where the amount to be removed increases from zero at present conditions to 48% at buildout conditions. This results in the largest difference between percent removal for existing and buildout conditions in the table above. The CWMP in a later section indicates that the nitrogen thresholds for the three harbors on the south side could be revisited due to their use as major boat basins. Commission staff recommends that controls on future growth, including open space protection in the Herring River watershed be considered as an alternative/ complementary strategy for nitrogen management.

At this time, the recommended plan utilizes a natural attenuation project and an enhanced tidal flushing project coupled with the proposed sewering program to meet the TMDL's. The sewering program can and should be scaled back if non-structural solutions (e.g., fertilizer management, acquisition of open space and a subsequent decrease in buildout flows) can provide a future component of the required nitrogen reduction. The adaptive management program in Section 13 addresses potential future modifications of the recommended program based on non-structural solutions.

Comment 5-9:

The Campground area is not in a nitrogen management area and is not scheduled for action until Phase 8. A potential local solution for that area should be evaluated under adaptive management aspect of the CWMP.

The adaptive management approach described in Section 13 provides for adjustments in project phasing during the implementation phase. The Campground area is not located in a nitrogen sensitive watershed and therefore received a lower priority in terms of wastewater phasing. It is expected, however, that the phasing plan will be modified as the wastewater plan unfolds. A local, and possible short term solution could be implemented in the campground area if the town decided that an immediate wastewater solution was required.

Comment 5-10:

The CWMP identifies the PB-3 as a key site for effluent disposal. The site is in a Zone II which would require costly advanced treatment to comply with the DEP Groundwater Discharge Permit (GWDP) Total Organic Carbon limit of 3 ppm. The CWMP indicates that DEP might make a favorable determination that removal for TOC is not required. Such determination would be an important one for future wastewater planning and as such, Commission staff recommends the Town include a more thorough discussion of this issue in the Final EIR, provide particle flow tracking results and include Commission staff in the dialogue.

Sections 9 and 11 and Appendix D provide detailed information about Site PB-3, including hydrogeological investigations. To supplement this information, these sites are discussed in Section 14 with respect to environmental impacts and mitigation resulting from their conversion to wastewater treatment and/or effluent recharge sites. Appendix D specifically provides particle flow tracking results.

The town of Harwich fully intends to include Commission staff in all discussions related to groundwater discharge permits.

In 2015, the Town tried to acquire a parcel within the PB-3 site area to be used for effluent recharge. Other potential sites in East Harwich are now being considered should the Harwich portion of the Chatham effluent need to be recharged back in Harwich in the future.

Comment 5-11:

Commission staff recommends the criteria ranking process is a thorough and fair method. The total criteria score (as weighted) of the scenarios (shown below in Table 1) indicate that scenarios 3A, 4A and 5A are the most favorable.

The scenario including IA systems had the highest cost per nitrogen pound removal. The CWMP used an IA treatment efficiency of 19 ppm. The treatment efficiency for some IA technologies for smaller cluster and individual systems have better documented treatment efficiencies which Commission staff recommends should be considered.

The I/A treatment efficiency of 19 ppm is typical for available treatment systems. The town recognizes that some I/A technologies for smaller cluster and individual systems do have better documented treatment efficiencies. The CCC 208 Plan states that "The Massachusetts Department of Environmental Protection (MassDEP) approves I/A septic systems for 19 mg/L. This value is typically used when estimating nitrogen reduction for nutrient management plans." It does go on to state that enhanced I/A systems may achieve a greater reduction, but at this time, the town believes that the use of 19 ppm is appropriately conservative.

Comment 5-12:

Commission staff suggests that phasing in a more dispersed system could provide faster removal of nitrogen in targeted areas to produce demonstrable water quality improvements. Table 2 shows the number of parcels and flow to be captured and treated. The amounts for three of the smaller southern embayments range from 26,000 to 95,000 gpd at build out. Smaller treatment facilities, while incurring a cost premium, can potentially be deployed over a shorter time frame with more flexibility for siting. The identification of sites to treat and dispose of wastewater at these lower volumes could also include parcels that are smaller than 5 acres.

Section 10 included Scenario 6A. Scenario 6A utilizes four smaller treatment facilities and associated recharge sites. On an equivalent annual cost basis, Scenario 6A was not cost effective when compared to the three scenarios that were carried forward for further evaluation.

As part of the efforts to continually refine and improve the wastewater plan, the Town of Harwich is actively considering additional recharge sites that are smaller than five acres. Any promising sites that are found in these ongoing evaluations will be brought forward at the appropriate time.

Comment 5-13:

The CWMP used the percent septic nitrogen removal for the buildout condition. Commission staff suggests that the Town identify the extent of potential sewer collection areas for the existing development condition and identify how the system could be phased in through selected planning horizons as development proceeds from existing conditions to buildout conditions. This should also include the relative percent of nitrogen removed for each major watershed for phase of the plan.

Collection systems are typically constructed with a long term planning horizon. The recommended plan was completed with long term planning in mind and focused on the buildout wastewater flows rather than the present day wastewater flows. The same is true for the MEP watershed nitrogen reduction goals. The recommended plan focuses on the reductions at buildout since the plan has a 40 year implementation period and buildout could be approached within that planning period. The town does not feel that it would be efficient to construct a wastewater plan that is focused on existing development while phasing in portions of the system to accommodate future growth.

Table 13-13 provides the nitrogen reduction by watershed by phase.

Comment 5-14:

The Cape Cod Commission approved the Chatham CWMP as a DRI on March 29, 2009 with 41 Findings and 23 Conditions. Excerpted below is a finding and two conditions from that decision which are relevant to the Harwich CWMP.

FINDING WR 1. The Town of Chatham has been in discussions with the Town of Harwich on their potential shared use of Chatham's wastewater facility site. Because the Harwich CWMP has been delayed, fundamental information on which to base decisions is presently not available. Prior to proceeding with the potential shared use of the site, additional site characterization would need to be conducted to determine 1) if the treatment capacity could be expanded, 2) if the site has the capacity for expanded subsurface disposal and 3) if the assimilative capacity of the downgradient waters can receive the increase of nitrogen load.

CONDITION WR6. Regional inter-municipal agreements with Harwich to achieve TMDL compliance for Muddy Creek and/ or the potential shared use of the Chatham treatment and disposal site shall be concluded prior to any renewal of this permit per Condition G 1.

WR11. Implementation of Enhanced Natural Attenuation or tidal flushing to reduce Nitrogen loading to reduce the area of planned sewering as indicated in the CWMP shall require consultation with the Commission.

The FEIR should indicate how the DRI findings and conditions will be met. A shared watershed approach Inter-Municipal Agreement should include a time frame for each town to achieve its share of nitrogen removal. Meetings to coordinate progress on this aspect should include Cape Cod Commission staff.

Chatham shares a significant portion of the two Pleasant Bay sub-embayments (Upper Muddy Creek and Lower Muddy Creek) with the Harwich. The recommended program presented assumes that the Town of Chatham will initiate wastewater collection and treatment for the septic load that is generated within the Pleasant Bay watershed. This assumption reflects the wastewater master plan presented in the approved Chatham CWMP. The two towns are already working regionally on widening the Muddy Creek bridge opening for habitat restoration and improved flushing and are in ongoing discussions about using the recently upgraded and expanded Chatham wastewater treatment facility as part of the Harwich recommended plan.

A shared watershed approach Inter-Municipal Agreement is expected to include a time frame for each town based on the stated phasing plan from each community. Although the phasing plans are not set in stone and are expected to change, the plans represent each community's best understanding of how the plan will unfold over the next 40 years.

The town of Harwich intends to include Commission staff in all discussions related to intermunicipal agreements and groundwater discharge.

Comment 5-15:

The RPP prohibits impacts to wetlands and the 100 ft buffer to wetland resources with the exception of utility line installation where there is no other feasible alternative. During CWMP planning, project planners should avoid direct and indirect wetland and buffer impacts wherever possible. Indirect impacts include actions that may reasonably be expected to alter the natural functions of the wetland. Alterations that result in wetland restoration are typically supported in the RPP. The RPP also prohibits activities that would impact rare species or their habitats. To the extent feasible, utility lines should be located within the road rights of way and avoid overland crossings. Commission staff notes that rare *species habitat has been included in the evaluation criteria for wastewater treatment or disposal sites, discussed below.*

Section 14 indicates that all sewer mains are proposed to be installed within town-owned roadways.

The CWMP was designed to comply with the performance standards of 310 CMR 9.00 and 10.00. Wherever feasible, wetland resource areas and associated buffer zones were avoided when laying out the project. The proposed sewer main installation will occur within Town-owned roadways, and pumping stations are also proposed to be within Town-owned rights-of-way.

Although portions of the phased sewer main installations within roadways are located near or within Priority Habitat and Estimated Habitat, these areas are exempt from MESA review for projects or activities in Priority Habitat pursuant to 321 CMR 10.18 through 10.23 (6), which reads, in part:

> *Installation, repair, replacement, and maintenance of utility lines (gas, water, sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads.*

In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. It should also be noted that specific comments from NHESP have not been requested for other components of the CWMP. However, as these components move forward, NHESP consultation will be required during permitting. For each phase that requires a Notice of Intent (NOI) from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information or mitigation.

Comment 5-16:

It's unclear from the CWMP whether plan implementation would result in impacts to coastal resources. To the extent that infrastructure development needs to occur in proximity to coastal areas, sites located within existing roadways or disturbed areas are preferred over new disturbance in coastal resource areas. As a related but separate matter, restoration of tidal flows at the Muddy Creek culvert will clearly have some impacts on coastal resources; design and engineering of this project should strive to minimize resource impacts while achieving the tidal restoration goals.

Impacts to coastal resources are discussed in Section 14. The goal is to minimize impacts to coastal resources whenever possible.

Comment 5-17:

Commission staff supports recommendations on pg. 5-20 to improve water quality in Harwich Ponds. Stormwater discharges into ponds may present opportunities to treat storm water with LID /BMPs or other green infrastructure that will provide additional natural resource benefits.

The adaptive management approach presented in Section 13 allows for adjustments to be made to the sewer service areas should non-structural nitrogen reduction methods prove more effective than estimated or should new, more cost-efficient technologies or means of pollutant removal be identified over time. With sewers proposed to be installed over a number of phases, there is ample opportunity for adjustments based on ongoing water quality monitoring. LID /BMPs or other green infrastructure that will provide additional natural resource benefits are being continually evaluated by the Town and will be utilized where appropriate.

Comment 5-18:

One additional mapped data layer that would help distinguish viable sites and the environmental impact associated with wastewater disposal is the Natural Heritage and Endangered Species Program BioMap2 Core Habitat. This (nonregulatory) data layer identifies habitats that are crucial for the long-term viability of the state's endangered species. It also functions as a landscape-scale look at maintaining connectivity among the remaining undeveloped parcels in the Commonwealth.

Section 9 of the CWMP identifies the final five sites that were selected for additional evaluation in the CWMP. Each of these sites presents concerns due to possible impacts to rare species habitat, or fragmentation of habitat. While disposal beds likely could be permitted at these sites, it is preferable to select a site(s) that minimizes impacts to open space areas in Harwich that presently provide aesthetic, recreational, and habitat benefits. With these considerations in mind, Commission staff reviewed the forty sites that resulted from the site screening process, noting constraints and opportunities. Many of the screened sites have constraints with regard to impacts on natural resources; however, several of these sites present opportunities, particularly if the Town looks to further decentralize treatment and/ or disposal, or considers implementation of green infrastructure management systems.

As planning proceeds with the two sites identified as part of the preferred alternative, consideration should be given to the avoidance of impacts to natural resources, and minimizing fragmentation of intact landscapes. Specifically, siting of facilities at HR12 should take into consideration the rare species habitat at the eastern side of the parcel, as well as views from the rail trail which abuts the site. Development should be clustered as closely as possible to the existing disturbed portions of the property. The Hydrogeology report indicated that groundwater was too high to give consideration to utilizing the borrow pit area of HR12 for the treatment facilities and that the groundwater flow of treated effluent from the proposed site would flow towards Coys Brook rather than Flax Pond. PB3 is not mapped rare species habitat, though it may well serve as box turtle habitat given the woodland characteristics and protected land in the vicinity. PB3 currently provides buffers to Hawksnest State Park to the north and west, and serves several natural resource functions, including recreational open space and habitat. Siting treatment facilities in PB3 should balance minimizing fragmentation of this natural landscape, and providing adequate buffers to East Harwich Center.

Rare species descriptions and potential impacts are discussed in Section 14. A map of the recommended program showing BioMap2 core habitat areas is provided as Figure 14-7. In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. As each component of the CWMP moves forward, NHESP consultation will be required during permitting. For each phase that requires a Notice of Intent (NOI) from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information or mitigation.

Comment 5-19:

Commission staff recommends that the criteria identified in Section 12 for selecting pump station sites are appropriate. Commission staff would also recommend avoiding sites mapped for rare species habitat or as BioMap2 Core Habitat. To the extent possible, pump stations should be located near roads to minimize the footprint of additional disturbance. Also, as a general matter, the collection system network should be installed within existing road networks to the extent feasible, and avoid "overland" installations that will result in large additional areas of disturbance.

See response to Comments 5-15 and 5-18.

Comment 5-20:

Expanded ENF for Harwich's proposed CWMP does not address solid or hazardous waste other than to state that the project will not trigger MEPA thresholds for these issues.

Given the nature of the project, it is unlikely that the project will generate a significant amount of post-construction waste, recyclables or food wastes. However, Commission staff suggests the Town estimate how much solid waste, including land-clearing waste, will be generated from the preferred project alternative. This information should be available for the DRI phase of project review. Similarly, if a facility is located in a Zone II, a program to manage any Hazardous Wastes generated as a result of project construction, and a plan to address any Hazardous Wastes used in facility operations should also be addressed for the DRI phase of project review.

Section 14 of the CWMP/SEIR addresses environmental impacts and mitigation, including discussion of hazardous wastes. Sections 16 and 17 also address construction period mitigation.

Comment 5-21:

Commission staff suggests that potential impacts on the transportation network related to construction or expansion of any treatment facilities be considered by the Town at the appropriate stage in the design process. Additionally, the Commission staff recommends the Town, to the greatest extent feasible, coordinate sewer construction activities with planned roadway improvement projects to minimize traffic disruptions and reduce overall costs.

Potential traffic impacts and mitigation methods will be looked at in greater detail during the design of the individual CWMP components, including coordinating other needed roadway improvements with the sewer project where such coordination is logical and cost-effective for the Town.

Comment 5-22:

Commission staff recommends that the Town file with Massachusetts Historical Commission prior to DRI review to ensure there are no sensitive historical or archaeological resources located in the vicinity of the project site.

In compliance with MHC's response letter, scaled project plans will be submitted to MHC for a review of potential impacts to historical and archaeological resources during detailed design of each phase of the project for the "preferred alternative wastewater treatment plant location(s), recharge areas, pump stations, equipment storage and materials staging areas and cross-country sewer right-of-ways."(Note that no cross-country sewers are presently proposed in this CWMP.) In addition, as requested by MHC, the Inventory of Historic and Archaeological Assets of the Commonwealth will be consulted during each project design phase to identify any resource areas that may be affected by the construction or operation of the CWMP components. The project designers will seek to minimize temporary or permanent impacts to such resources. Coordination with the MHC will continue throughout project planning and design.

Comment 5-23:

Commission staff has reviewed the Expanded ENF for the project's possible impacts and in general finds that it addresses many of the parameters of our Regional Policy Plan and RWMP Draft Guidance on CWMPs and that the Phase 1 Waiver for proceeding with the Muddy Creek Culvert project is reasonable and a severable portion of the CWMP project. Although the Town should proceed to address the identified gaps for the preparation of its Final EIR/CWMP, the Commission has respectfully asked that the Town not submit it for formal review until the Commission has completed its Regional2o8 Water Quality Management Plan over the next year.

See response to Comment 5-4.

#6 - Comment Letter from the Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program

Comment 6-1:

The ponds, bays, and estuarine waters of Harwich's south and east coasts provide critical foraging, breeding, migration, and over-wintering habitats for a suite of state-listed rare species. We commend the Proponent for its efforts to improve water quality within these critical habitats.

No Comment.

Comment 6-2:

Based on a review of the information that was submitted and the information that is contained in our database, the Division anticipates that portions of the proposed project will occur within the habitat of various state-listed invertebrate, vertebrate, and plant species.

Portions of the proposed project that occur within Priority or Estimated Habitat for state-listed species, which are not otherwise exempt from MESA review pursuant to 321 CMR 10.14, will require a direct filing with the Division for compliance with the MESA and WPA. The Division notes that sewer systems proposed within ten (10) feet of the edge of existing paved roads may be exempt from MESA review, pursuant to 321 CMR 10.14 (10), which states: "[t]he following Projects and Activities shall be exempt from the requirements of 321 CMR 10.18 through 10.23 ... " [10] installation, repair, replacement, and maintenance of utility lines (gas, water, sewer, phone, electrical) for which all associated work is within ten feet from the edge of existing paved roads, and the repair and maintenance of overhead utility lines (phone, electrical) for which all associated work is within ten feet from the edge of existing unpaved roads, provided, however, that unpaved utility access roads associated with exempt activities under 321 C1v1R 10.14(11) shall be addressed in and subject to the Division-approved operation and maintenance plan required thereunder;

Section 14 states that all sewer mains are proposed to be installed within town-owned roadways.

The CWMP was designed to comply with the performance standards of 310 CMR 9.00 and 10.00. Wherever feasible, wetland resource areas and associated buffer zones were avoided when laying out the project. The proposed sewer main installation will occur within Town-owned roadways, and pumping stations are also proposed to be within Town-owned rights-of-way.

Although portions of the phased sewer main installations within roadways are located near or within Priority Habitat and Estimated Habitat, these areas are exempt from MESA review for projects or activities in Priority Habitat pursuant to 321 CMR 10.18 through 10.23 (6) as noted above.

In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. It should also be noted that specific comments from NHESP have not been requested for other components of the CWMP. However, as these components move forward, NHESP consultation will be required during permitting. For each phase that requires a Notice of Intent (NOI) from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information and mitigation.

Comment 6-3:

The Division would encourage the Proponent to examine design alternatives which avoid and minimize impacts to Priority and Estimated Habitat, and to consider a pre-filing consultation with the Division to evaluate and proactively address any concerns related to state-listed species. Upon submission of more detailed site plans, the Division will be able to provide additional guidance.

See response to Comment 6-2, above. The town of Harwich intends to work closely with the Division during all stages of the project to ensure that all appropriate design alternatives are considered.

#7 - Comment Letter from the Pleasant Bay Alliance

Comment 7-1:

The Alliance supports the bridge project and will participate as a commenter in the project design and permitting phases. The Alliance supports the Phase 1 waiver requested by the Town of Harwich for the DCWMP as it would allow the Muddy Creek Bridge project to move forward on its own path.

No Comment.

Comment 7-2:

It is noteworthy that a motivation for addressing nitrogen loads in Pleasant Bay prior to other watersheds in town is the opportunity for regional cooperation with the Town of Chatham. The Alliance supports such cross-town cooperative arrangements for their efficiency and cost savings in achieving TMDLs. Accordingly, wastewater from the Pleasant Bay watershed will be piped to the Chatham wastewater plant for treatment. In the short term, the treated wastewater also will be discharged at the Chatham site. Any impacts to groundwater resulting from relocation of wastewater out of the Pleasant Bay watershed should be identified and fully examined in light of any potential *changes in water use factors or other assumptions that may increase or decrease estimated wastewater flows and nitrogen loads from future development in the watershed, as discussed below.*

The groundwater impacts will be fully examined in all of the effluent recharge sites that are utilized in the CWMP. Understanding groundwater impacts is a requirement of MassDEP through their groundwater discharge permitting process. The Town of Harwich also expects the Cape Cod Commission to review the groundwater impacts through their DRI process.

Comment 7-3:

It is vital that treated wastewater disposed of at the PB3 site achieve a level of treatment appropriate for a Zone 2 and watershed to a nitrogen sensitive embayment.

Based on groundwater modeling and preliminary discussions with MassDEP, it is expected that additional treatment for removal of Total Organic Carbon (TOC) will not be required at PB-3. The Town is currently working with the regulatory agencies to determine the appropriate level of treatment for effluent recharge in a Zone II. The final decision is, however, dependent on MassDEP and the town of Harwich will comply with all rules and regulations once they are finalized. This applies to all sites being considered in East Harwich.

Comment 7-4:

Non-structural measures have the potential to reduce wastewater flows, nitrogen loads and, thereby, lower the costs of wastewater treatment required to meet thresholds. Lowering the cost of a wastewater system capable of achieving necessary nitrogen reductions increases the chances of that system being implemented. An added benefit is that many non-structural alternatives also may be implemented in less time than it takes to build treatment capacity. In light of these benefits, the Pleasant Bay Resource Management Plan supports full exploration of nonstructural approaches in order to supplement necessary wastewater treatment. The Alliance has developed and is implementing the Pleasant Bay Fertilizer Management Plan that identifies actions that could reduce nitrogen loading from fertilizers by up to 5% across the watershed. The 2013 resource management plan update supports measures to reduce nutrients from stormwater, which accounts for 9% of nutrient loading watershed-wide. Perhaps the greatest nitrogen reductions achievable through non-structural means are those made possible through changes in land use. The Alliance supports land acquisition and Smart Growth land use strategies such as the Natural Resource Protection District adopted in Brewster as tools to reduce and manage nutrient loading. In addition to their potential to reduce nitrogen load, these strategies protect open space and sensitive natural resources areas and provide cost effective opportunities for wastewater management. The DCWMP identifies a potential cost savings of $50 million due to the reduction of nutrient loads from fertilizer controls, smart growth, and stormwater management. However, little detail is provided as to the role each of these programs could play, particularly in the Pleasant Bay watershed, which has the highest projected growth potential in the Town. The Alliance encourages the Town to fully analyze and pursue these non-structural alternatives for their ability to reduce wastewater flow, nitrogen load and costs, and to provide this analysis and information to citizens and stakeholders. Analysis that shows the relationship between different land use scenarios and their effect on wastewater flows, nitrogen loads and wastewater system costs would help inform the Town's land use management discussion and help build a case for the CWMP.

At this time the recommended program will meet all MEP thresholds via the proposed sewering program. Moving forward, the Town will analyze and pursue non-structural alternatives. This is also a component of the proposed recommended program. Successful implementation of non-structural solutions (e.g., fertilizer management, stormwater BMPs, open space acquisition, etc.) can provide a future component of the required nitrogen reduction, to ultimately reduce sewering needs. The Town of Harwich supports these non-structural solutions in all town watersheds.

Comment 7-5:

The Alliance notes that assumptions in the DCWMP with regard to commercial water use in the Pleasant Bay watershed may underestimate wastewater flow and nitrogen load that is likely to be generated by future commercial development. Questions about water use assumptions were expressed in a letter from the Alliance to the Harwich Water Quality Task Force (November 15, 2012).

The DCWMP assumes that commercial development would generate wastewater at a rate of 35 gallons per day (gpd) per 1,000 square feet of development. A significantly higher factor of 236 gpd/1 ,000 sf is used for other commercial areas in town. MEP technical reports for other Cape Cod watersheds contain commercial water use factors of 80-120 gpd/1 ,000 sf, including 98 gpd/1 ,000 sf for Namskaket Marsh watershed in Orleans. It has been explained that the current assumption of 35 gpd/1 ,000 sf is based on historic water use in the commercial district. However, water use in the East Harwich commercial district has been kept low due to the water protection overlay district which has reduced overall commercial development density and restricted water intensive commercial uses such as restaurants. The DCWMP assumes future rezoning of this area to accommodate the addition of 500,000 square feet of commercial development beyond MEP build-out. It is reasonable to assume that, with sewers in place, the mix of commercial uses would include restaurants and other commercial uses that have been restricted by the water resources overlay district. Accordingly, we request that the Town conduct an assessment of wastewater flows and nitrogen loads based on a commercial water use factor that is more consistent with proposed growth patterns. This will enhance the reliability of wastewater flows and nitrogen loads tied to growth assumptions.

Additional details regarding growth assumptions for the Pleasant Bay watershed are included in Section 13. The Town understands that buildout estimates are educated estimates based on the best available information. The buildout estimates for the East Harwich Village Center were developed only after extensive discussions with Planning Department and the Water Quality Management Task Force-Wastewater Management Subcommittee were complete. In those discussions, it was decided to include the buildout flows developed in the Local Comprehensive Plan along with the buildout flows developed in the 2006 MEP report. The additional buildout flow of 55,000 gpd is considered appropriate for planning purposes since any zoning revisions for the EHVC are not final at this time. Thus, the projected MEP buildout flow for the sewer service area in the Pleasant Bay of 235,900 gpd was increased by 55,000 gpd up to 290,900 gpd based on 200 additional residential units at about 150 gpd/unit and additional commercial development at 250,000 square feet at the existing 100 gpd/1,000 SF. These wastewater flow values are developed directly from the MEP model and are specific to the Pleasant Bay watershed.

#8 - Comment Letter from the Association to Preserve Cape Cod

Comment 8-1:

While the Harwich plan is proactive, APCC is concerned that CWMPs continue to be developed and submitted based on town boundaries rather than on shared watersheds. APCC believes that this is a shortsighted approach that will cost the taxpayers of Cape Cod more and will result in less than optimum results. Prior to the submission of the EENF, the Cape Cod Commission published its Regional Wastewater Management Plan, and APCC believes that the Harwich CWMP and all Cape Cod CWMPs must be measured against that plan.

Underlying all of the work that APCC does is the understanding that Cape Cod is a single geographic and hydrogeological unit, and that the Cape's natural resources and economic vitality cannot be adequately protected based on arbitrary political borders.

The Town of Harwich has made significant progress toward regional, watershed based solutions in an effort to optimize the recommended program. Section 13 of the CWMP details some of the efforts and successes of the Town with regard to regional solutions with Chatham and potentially Dennis.

In the recommended program, the Town has explored the feasibility of a regional solution to address the wastewater needs identified in the Pleasant Bay and in Herring River watersheds. A regional solution with the Town of Chatham is proposed for areas within the Pleasant Bay watershed, which is shared among Brewster, Chatham, Harwich and Orleans. The recommended wastewater plan assumes that the Town will collect wastewater from the Pleasant Bay watershed and will send it to Chatham for treatment to a total nitrogen concentration of 3mg/l. The treated effluent will then be recharged in Chatham for the early phases of the project if timing and phasing of the projects permits. For the later phases of the project, the treated effluent may be required to be recharged back in the Pleasant Bay watershed to ensure that TMDL limits are not exceeded. Discussions with the Town of Chatham are in process. At this time, both communities understand the benefits of utilizing a regional solution and both communities are interested in achieving such a solution.

Further discussions will be held with the Town of Dennis regarding potential regional treatment options and for the Herring River and Swan Pond River watersheds as Dennis moves forward with development of their CWMP.

Comment 8-2:

In 2012, APCC convened an environmental summit of all of Cape Cod's nonprofit environmental organizations. Two noteworthy findings of that summit were:

> *Nutrient loading of Cape Cod's groundwater, ponds, and coastal waters caused by human activity and waste is the region's number one environmental priority. Immediate action on the part of government, business, and every citizen across Cape Cod is necessary.*
>
> *A regional wastewater plan would encourage and enable communities to work cooperatively with each other to reach and maintain total maximum daily loads (TMDLs) of nutrients and/or other objective water quality criteria for each watershed.*

APCC recommends to the Secretary that the town of Harwich specifically address compatibility of the subsequent Draft or Final CWMP with the Regional Clean Water Act Section 208 Water Quality Management Plan currently in development. We understand that this might cause some delay for Harwich but this action is certainly within the environmental interest of the region and the Commonwealth.

Sections 2 and 13 of this report discuss Harwich's coordination with the CCC's 208 Plan. Harwich has actively followed the Commission's planning process and attended meetings and presentations during the plan's development. As outlined in both Sections 2 and 13, the Town has reviewed the work performed by the Commission since the final 208 Plan was approved in 2015. Harwich's plan is in line with the 208 Plan since Harwich's approach is based on the MEP nitrogen loading models with the goal of achieving the most efficient sewershed footprint while keeping costs to a minimum. The town of Harwich's wastewater scenarios utilized a hybrid approach similar to that suggested in the 208 Plan, combining both traditional and non-traditional technologies, and also incorporates an adaptive management approach as suggested by the CCC.

Comment 8-3:

Within the subsequent draft or final EIR, the town should include a consistency chapter following the Guidance for Cape Cod Commission Review of Local Wastewater Management Plans detailing consistency of the local plan with the Regional Wastewater Management Plan (RWMP) and the Regional Policy Plan (RPP).

See response to Comment 8-2 above.

Comment 8-4:

Harwich is to be lauded for its cooperation with its neighbor Chatham, as described in the Draft CWMP. However, other narrative in the EENF indicates that Harwich is waiting for its other neighbors that share common watersheds with the town to act first. "As the Towns of Brewster and Dennis further develop their wastewater programs, other regional opportunities may develop for Harwich which fully supports the concept." (DCWMP 13-17.) Harwich should be required to coordinate activities with all of its neighbors instead of waiting for the other towns to initiate coordination with Harwich.

The Town of Harwich has reached out to all of its neighboring communities that share a nitrogen sensitive watershed. As the other towns define their wastewater plans and better understand their specific needs, Harwich remains open to the possibility of implementing other regional solutions beyond the regional solution with Chatham. Hartwich is now investigating a potential regional solution with Dennis. Harwich fully supports regional solutions.

Comment 8-5:

APCC has been engaged in some preliminary analysis of the impact of sea level rise on groundwater elevation. Groundwater infiltration is the number one cause of Title 5 system failure. Harwich should provide some analysis of the groundwater elevation and septic system locations for the area of town south of Route 28 in order to determine the probability of increased septic system failure in this area of town. An increased rate of failure in this area would necessitate readjusting phasing and overall priorities.

Figure 3-2 of this CWMP/SEIR shows the depth-to-groundwater throughout Harwich. Many of the parcels south of Route 28 which are shown to have a depth-to-groundwater of less than 5-feet are proposed for sewering as part of the town's current recommended program, including neighborhoods immediately adjacent to Herring River and the three southern harbors. However, an area that is not proposed for sewering in the southeastern corner of town is also shown to have shallow depth-to-groundwater. Should Title 5 issues arise in this area in the long term as a result of sea level rise and subsequent groundwater infiltration, a sewer extension further down Route 28 to the east could be considered. While this option would be available to the town, it is not incorporated into the recommended program herein as it is not necessary to meet nutrient reduction goals, and nothing in this plan precludes its consideration in the future.

Comment 8-6:

APCC supports adaptive management as a flexible and pragmatic model to embrace in wastewater treatment. However, documented failures of adaptive management across the country dictate a cautious and measured approach. Literature supports that all too often, adaptive management is either simply a buzzword, or utilized as a means to protect bad decision-making. APCC recommends that performance-based goals and early intervention be used as hallmarks to achieve a successful adaptive management plan. In order to better manage the project, nitrogen, phosphorus and emergent contaminant data needs to be collected throughout the process. APCC recommends an intense monitoring program be established to identify any unanticipated impacts, and that it include automatic steps such as growth and flow controls.

The adaptive management plan scope in Section 13 discusses two of the largest components of the program. Those components include water quality monitoring and habitat monitoring. Since the MEP thresholds are the biggest driver of the wastewater program, Habitat and estuary monitoring must be used to ensure the effectiveness of the MEP model and wastewater management program.

The Town plans to continue monitoring water quality at the sentinel and check stations. Monitoring will move from the detailed sampling program required for the MEP modeling to periodic monitoring to track the progress of the program's implementation. Monitoring of each sentinel and check station within Harwich is proposed seasonally for the duration of the implementation phase. Monitoring of freshwater ponds is also anticipated. The water quality monitoring plan will be formalized as a written document provided to the TRC for review and comment. This water quality monitoring, or a portion thereof, may also be required by the groundwater discharge permit for the effluent recharge site(s). The results of water quality monitoring will be reported to the TRC annually in writing.

The Town also anticipates that MassDEP will continue eel grass mapping, to assess the results of the recommended program's implementation. Benthic habitat monitoring may also be beneficial to evaluate the effects of the program's implementation. The feasibility and responsibility for such monitoring will be determined through discussion between the Town, CCC, and MassDEP. There has been some indication to date that the state or county may implement and become responsible for a Cape-wide ongoing monitoring program to measure progress toward meeting all 208 Plan goals.

Comment 8-7:

Lastly, Harwich has identified a number of so-called soft or non-infrastructure solutions. The draft CWMP has identified a potential overall savings of nearly $50 million dollars. However, so far the town *has shown an inability to carry out and implement these solutions, e.g. land use and zoning changes for East Harwich, which is in the Pleasant Bay watershed. The town should provide an implementation plan for these land use changes and other non-infrastructure solutions, including timetables, how to measure success, and sources of revenue to implement the programs described in the draft CWMP.*

The town has already identified two soft or non-infrastructure solutions and is continually seeking to identify and implement more of these types of solutions as a means to offset traditional sewering. The sewering program can and should be scaled back if non-structural solutions (e.g., fertilizer management, acquisition of open space and a subsequent decrease in buildout flows) can provide a future component of the required nitrogen reduction. The adaptive management plan in Section 13 addresses potential future modifications of the recommended program based on non-structural solutions. Based on the results of the 208 Plan and the many pilot projects for non-structural alternatives anticipated to occur throughout Cape Cod in the coming years, a specific timetable is difficult to establish at this stage and will depend on the collective results of this testing and on town funding. Therefore, the recommended program that is conservative in that it meets TMDL's without the non-infrastructure programs.

#9 - Comment Letter from the Massachusetts Division of Marine Fisheries

Comment 9-1:

A Notice of Project Change will be required for this culvert opening and will be reviewed at a later date once the project has advanced to a design phase sufficient to initiate MEPA review.

The permitting for the Muddy Creek bridge project was conducted outside this CWMP and the project is now under construction.

Comment 9-2:

MarineFisheries is very concerned about the aquatic health of coastal salt ponds. These are critical nursery areas for many marine species including winter flounder, anadromous fish, horseshoe crabs, and shellfish. Both winter flounder and blue crab are sensitive to eutrophication. There are several areas in Harwich where shellfishing is prohibited due to bacterial contamination including Bass River, Allen's Harbor, Saquatucket Harbor, Wychmere Harbor, and Muddy Creek. Therefore, the identification and application of water quality improvement goals is a considerable achievement. MarineFisheries agrees with efforts to reduce nitrogen loading in coastal salt ponds, including efforts to remediate the current eutrophied state of the ponds.

No comment.

Comment 9-3:

This is clearly a needed planning document, and we commend the Town for the efforts that they have undertaken to continue to work on this complicated issue.

No comment.

Comment 9-4:

Monitoring studies for the permeable reactive barrier study sites should include other contaminants from wastewater, not just nitrogen. For example, ecosystem quality will still be impaired if the barriers remove nitrogen but not endocrine disrupting compounds.

Permeable Reactive Barrier technology as described in the CCC 208 plan is generally focused on the removal of nitrogen compounds from septic system effluent. With other types of reactive media, PRBs can be used to remove other contaminants such as endocrine disrupting compounds. The effectiveness of PRBs in removing other compounds would need to be further evaluated and endorsed by the Cape Cod Commission before it could be implemented in the recommended program. As the technology is developed, the Town of Harwich will evaluate its effectiveness and determine if it can be implemented as an additional polishing site for the infiltration basins to be constructed at HR-12 in Phase 4.

Comment 9-5:

Monitoring within Pleasant Bay and Saquatucket Harbor should be designed to determine if the natural attenuation projects in those watersheds are reducing nitrogen loads to the receiving waters. This is especially important since the CWMP stated the expected benefits are based on some "educated assumptions about the potential beneficial impacts of the two projects" (p. 13-26).

See response to Comment 8-6.

Comment 9-6:

The town demonstrated the importance of non-septic system sources of nitrogen and bacterial contamination in Section 4. Therefore, Marine Fisheries recommends a stronger approach to Section 13.7, "Other Recommended Program Components." In particular, the town should assess its carrying capacity to service boats for pumpout. Marine Fisheries administers the Clean Vessel Act program in Massachusetts and can provide assistance.

Additional information has been added to Section 13.7 to assess Harwich's carrying capacity to service boats for pumpout.

Comment 9-7:

We are available to contribute technical expertise and review capabilities for water quality monitoring activities.

The Town of Harwich thanks DMF for their support.

#10 - Comment Letter from the Harwich Office of Selectmen (2nd Letter)

Comment 10-1:

If future growth occurs within the existing sewer service area, the additional cost is much less than if the sewers need to be expanded to the outer reaches of the service area.

The full extents of the collection system will be based on the results of the adaptive management plan. If the town can limit areas of population growth to the areas already sewered, the costs of expanding the wastewater system will be minimal. Phases 2, 3 and 6 of the recommended program focus on the Town's high density areas along Route 28, Harwich Center and the East Harwich Village Center. If density were focused in these areas, Phases 4, 5, 7, and 8 could see a reduction in the size of their service areas.

Comment 10-2:

The increase in wastewater flows included in the DCWMP are based on the best available information at this time and the projected increase in some instances such as the East Harwich area are "allowances" utilized for planning purposes. Our Water Quality Management Task Force working in conjunction with our consultant decided to include the documented allowances. As stated in several instances throughout the report, through adaptive management the wastewater flows and nitrogen removal results will be monitored and adjusted during the 40-year implementation period. The ultimate goal will meet the established TMDL for each of our five watershed embayments.

No Comment.

Comment 10-3:

The recommended program detailed in the DCWMP recommends a review of existing land use controls throughout the entire community. This effort will entail a comprehensive review of community, technical and fiscal issues. Lost tax revenues from limiting growth, costs to purchase land for open space and encouragement for public-private partnerships in developing certain areas are a few of the issues that need to be factored into the process. Perpetual evaluation in order to meet the varying needs of the community over the next 40 years will also be required.

No Comment.

Comment 10-4:

The model is still in development but will likely recommend that future developments require those developers to pay a share of the resultant wastewater costs attributed to their increased wastewater flow. The recommended cost recovery model will be presented in the Final CWMP.

See Section 15 for the proposed Cost Recovery Plan.

Comment 10-5:

The recommended plan described in the DCWMP addresses what we believe to be almost a worst case scenario based on expected TMDLs and existing water quality criteria. However, it is flexible in its implementation and identifies several areas where the town can pursue means to help lower the program costs. By implementing fertilizer management programs, stormwater controls and potential land use revisions, the recommended program costs could be reduced. That reduction is difficult to estimate at this time due to economy of scale and implementation phasing issues. As an example, if an area is to be sewered now but it is projected that a 25 percent increase in flow will occur in that area in the future, then the cost will not increase by 25 percent. The sewer pipe size might increase slightly but the main cost is installation of the pipes. Thus, via economy of scale there is a small incremental cost *increase. The costs presented in the comment letter do not take any of these factors into account and overstate estimated cost savings.*

No Comment.

#11 - Comment Letter from the Massachusetts Coastal Zone Management Office

Comment 11-1:

CZM recognizes that the impacts caused by the discharge of nitrogen through both private septic and municipal sewer systems to surrounding water bodies can be severe and that this is a significant issue for towns on Cape Cod. These impacts carry implications for not only the environment, but for economic development as well. CZM supports the comprehensive planning for wastewater management and applauds the effort that has gone into the development of this draft plan. CZM commends and supports the regional approach and cooperative agreement between the Town and Chatham to advance wastewater management efforts in both communities. The adaptive management approach proposed in this plan provides a flexible management framework that allows for changes to the planned implementation schedule, based upon future unknown variables, such as changes in water quality, future build-out rates in different watersheds, and economics. CZM is committed to working with the Town and assisting with the development of the final CWMP. CZM supports the Town's Phase I Waiver for the Muddy Creek Culvert Replacement Project and offers the following comments.

No comment.

Comment 11-2:

CZM is aware that the Cape Cod Commission recently signed a Memorandum of Understanding to initiate the development of a comprehensive water quality management plan with funding from the Massachusetts Water Pollution Abatement Trust. The goal of the plan is to reduce nutrient pollution in Cape Cod waterways in order to meet state and federal water quality standards. Once this regional plan is developed (a draft plan is slated to be completed by March 2014), CZM suggests that the FEIR explain how Harwich's proposed CWMP is consistent with the regional plan.

See response to Comments 5-2 and 5-4.

Comment 11-3:

The FEIR should clearly describe how the proposed wastewater management plan and its TN loads are consistent with the TN thresholds in these reports. The projected TN loads for each watershed should clearly describe the contributions and specific TN attenuation values for: 1) sewered parcels at buildout (including any increases in per parcel load attributed to increased parcel development), 2) unsewered parcels in the watershed of interest (including those in adjacent towns), and 3) natural sources of TN. For example, the EENF suggests that at buildout, the proposed PB-3 infiltration basin alone will contribute 8 lbs/day of TN to the Muddy Creek watershed while the MEP threshold for Muddy Creek is only 3.9 lbs/ day. Additional sources of TN from the parcels in Chatham's portion of the Muddy Creek watershed and from unsewered parcels in Harwich will increase the daily TN load even beyond 8 lbs.

See response to Comment 1-11.

Comment 11-4:

The FEIR should describe how buildout conditions are consistent with MEP in-watershed nitrogen thresholds and if not, what methods of growth limitation the Town will employ to ensure that habitat restoration thresholds are met. In some cases, this may require taking into account the buildout in adjacent communities (e.g., Brewster and Dennis along the Herring River and Chatham along muddy Creek). In addition, the FEIR's wastewater and nitrogen loading analysis should attempt to take into account that some existing built parcels will be increased in size (and/ or subdivided) once sewer services are provided.

The recommended program presented in Section 13 accommodates all buildout flows estimated by the MEP, with updates provided by the Harwich Planning Department where MEP estimates were felt to fall short of allowed, anticipated, or additional desired growth in particular areas. Using these buildout estimates, all MEP thresholds will be met via the proposed sewering program, and areas can be scaled back if non-structural solutions (e.g., fertilizer management) can provide a future component of the required nitrogen reduction. Parcels that could be subdivided are accounted for in the buildout projections, in that parcels exceeding their zoning district lot sizes which are able to be subdivided by present zoning regulations were assumed to be subdivided accordingly.

Commercial parcels that could be increased in built size were also accounted for in the build-out projections. Flows associated with additions to existing residential parcels were not added in, but with a total projected buildout flow increase of 26%, these flows are likely to be accounted for within this conservative estimate, as not all developable parcels are anticipated to be developed over the next 40 years.

Comment 11-5:

In general, CZM is supportive of culvert replacement projects, such as the one proposed for Muddy Creek, where the short-tern construction impacts are outweighed by the predicted long-term water quality and habitat improvements in the upstream estuary. However, CZM also recognizes that improved flushing does not reduce pollutant loads, only their concentrations. We encourage the Towns to not only improve the movement of nutrients down the Muddy Creek estuary, but also to enact appropriate constraints on the future input of nutrients to the estuary. In addition, while the flushing for the larger Pleasant Bay estuary has improved recently, we encourage the Towns of Harwich and Chatham to consider a future scenario where Pleasant Bay might not be as well flushed (e.g., after shifting and/ or reformation of barrier sand bars at the mouth of the Bay) and how future decisions to add increased nitrogen load to the Muddy Creek estuary (e.g., through the proposed infiltration basins at the top of the watershed and the future development and sewering of currently undeveloped properties) might impact a less well-flushed Pleasant Bay. Such a situation was anticipated and modeled in the MEP Pleasant Bay Report where it was found that residence time in Muddy Creek would increase 20-40%, thus reducing flushing capacity, if Pleasant Bay were to revert to its old inlet configuration (Pleasant Bay MEP Report Table IX-2). Under this scenario, bioactive nitrogen in Muddy Creek would increase by ~35% (Pleasant Bay MEP Report Table IX-3). As the Pleasant Bay inlet is an ever changing system, CZM encourages the Towns to not rely too heavily on the Rt. 28 culvert widening for long-term mitigation of nitrogen to Muddy Creek.

Changes to the configuration of Pleasant Bay and its ability to flush nutrients is one of the significant drivers behind the adaptive management approach. If the configuration of the Bay were to change in a way that reduced tidal flushing, several agencies would likely be involved, and future system modeling required. The proposed plan is based on best available information and results will be monitored. Based on those results, future program adjustments will be made as needed.

Comment 11-6:

The Draft CWMP proposes to increase the natural nitrogen attenuation of the Cold Brook bog area by modifying the old cranberry bogs to increase the residence time of freshwater flowing through this system. Watershed modeling suggests that the nitrogen attenuation rate for the Cold Brook area may be increased from the current 35% to as much as 50%. The concept is to construct depositional basins (ponds) within the bog system. CZM is supportive of non-traditional methods to attenuate anthropogenic nitrogen, however, we believe further, site-specific studies will be required to better evaluate the potential for impacts to wetlands functions and habitat quality for resident as well as any migrating species (e.g., American eel and river herring). The proponents should work closely with MassDEP to ensure that the proposed alterations can meet the requirements of state and local wetland regulations and performance standards. The proponents should also work with the Division of Marine Fisheries to ensure that any hydrology changes and subsequent water quality changes (e.g., increased nitrates and ammonia, decreased dissolved oxygen) do not adversely affect any migrating species.

The Town has been working with the Harwich Conservation Trust and the Harwich Conservation Commission to plan the Cold Brook natural attenuation project. The wetlands in question are former cranberry bogs and have already been significantly altered from their natural state. In the planning and design of this project, the Town will strive to increase habitat and other values in the modified bogs, to create wetland areas that provide not only the proposed natural attenuation, but also other environmental benefits above the present condition of the abandoned bogs.

Comment 11-7:

The availability of sewer infrastructure in coastal areas subject to storm damage, flooding, and erosion could allow new or expanded development in these hazard-prone areas. This development may also adversely impact natural buffers to storm waves and erosion, and compromise the storm protection provided to landward development, infrastructure, natural resources, and upland areas. The resulting impacts of development in these coastal areas could include loss of life and property, increased public expenditures for storm recovery activities, taxpayer subsidies for flood insurance and disaster relief, and risks to emergency personnel. CZM Coastal Hazards Policy #3 states that federally funded public works projects shall not promote growth and development in hazard-prone or buffer areas. In addition, State Executive Order 181 states that state and federal grants for construction projects shall not be used to encourage growth and development in hazard prone barrier beach areas. Executive Order 181 also seeks to minimize and mitigate potential storm damage by prohibiting development within flood velocity zones. Further, Executive Order 149 directs state agencies responsible for programs that affect land use planning to take flood hazards into account when evaluating plans. Therefore, CZM recommends that specific planning consideration be developed for areas located within mapped coastal flood zones and within barrier beach areas.

See Section 14 for a detailed discussion regarding how CZM performance standards are intended to be met during the design and implementation of the recommended program. This section offers a comprehensive a review of the enforceable CZM policies, as outlined in the Massachusetts Office of Coastal Zone Management Policy Guide dated October 2011, relative to the CWMP recommended program for Harwich. Each enforceable CZM policy is presented with a description of how the proposed project complies with the policy.

Comment 11-8:

As part of the planning process for this project, the Town and its consultants should use the best available information regarding the extent of the flood zones, and particularly the highest hazard zones, including the Velocity zone, AO zones, and the portion of the A zone designated as the MoWa (moderate wave action capable of structural damage). The Federal Emergency Management Agency (FEMA) has acknowledged that their Flood Insurance Rate Maps (FIRMs) need to be updated to more accurately reflect the extent of the floodplain. In 2011, FEMA began a study to update the FIRMs for Barnstable County with new analysis. One of the significant updates to the FIRMs will be to extend the Velocity zone to the landward toe of the primary frontal dune. Therefore, CZM recommends that the Town's analysis of potential growth in hazard-prone areas also include, at a minimum, primary frontal dunes in addition to those areas shown on the current maps as flood zones.

While the construction of some of the sewer lines will be within floodplains, as well as a few pumping stations, implementation of the CWMP is not expected to promote additional development within flood zones because the majority of areas to be sewered are at near buildout condition. Additionally, development on the seaward side of primary dunes should not be promoted as the parcels to be sewered near these areas are also essentially built out. The sewer lines and any pumping stations to be built within flood zones will be designed according to industry standards to withstand flood conditions.

Also, see response to Comments 1-30 and 11-7.

Comment 11-9:

Since the wastewater planning process will continue for many years, it is very likely that new FIRMs will be issued before the planning process is completed. CZM recommends that the Town use the revised FIRMs to determine the extent of the flood zones when they are available. The EENF included a map of the flood zones dated 2007. CZM recommends that the consultants for the Town stay in touch with the Harwich Emergency Manager regarding the schedule for the revised FIRMs. CZM is available to provide technical assistance and to advise the Town and its consultants regarding the delineation of flood zones and primary dunes.

See response to Comment 1-30. During detailed design of each phase, the most recent FIRM maps would be consulted for all permitting and to establish appropriate design parameters accounting for flood zone considerations.

Comment 11-10:

The EENF states that the Town implemented a Board of Health regulatory review, and will continue to develop regulations and bylaws to keep growth within the projected buildout as required by the SRF program for zero interest loans. CZM recommends this regulatory review be broadened to all *regulatory bodies, including zoning and conservation to help achieve this goal. As discussed above, in order to be consistent with the above-mentioned Executive Orders, growth controls are needed to ensure that the project does not increase growth or development in hazard-prone areas.*

To specifically control growth, Harwich will continue to develop appropriate regulations and bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with the Planning Board and Board of Health before deciding whether regulations or zoning regulations are the best approach for Harwich to implement this wastewater flow management requirement.

Comment 11-11:

CZM understands that extending sewage collection and treatment to areas currently utilizing on-site sewage treatment must be balanced with the potential risks in coastal areas subject to erosion, flooding, and storm damage. CZM believes that these storm damage risks can be minimized through careful design considerations. CZM recommends specific design considerations to address these risks, including the locating of pump stations and other critical infrastructure outside of the 100-year floodplain, protecting the collection system from potential wave action, and incorporating a system of check valves into sections of the collection system within flood zones. This can help minimize impacts from a storm related breach to the collection system. Given the historic rate of sea level rise (i.e., one foot over 100 years), the likelihood of the historic rate doubling in the next century, and the predicted life of wastewater treatment facilities, CZM recommends designing the pump stations and other critical infrastructure system facilities to accommodate at least two feet of sea level rise.

See response to Comment 11-9. As design proceeds of specific phases, consideration will be given to this two-foot design criterion. Several technical industry associations are also reiterating these design guidelines and will be considered.

Comment 11-12:

The proposed project may be subject to CZM federal consistency review. For further information on this process, please contact, Robert Boeri, Project Review Coordinator, at 617-626-1050 or visit the CZM web site at www.state.ma.us/czm/fcr.htm.

No Comment.

#12 - Comment Letter from the Department of Energy Resources

Comment 12-1:

The Harwich CWMP includes a Waste Water Treatment Facility (WWTF) and 33 pumping stations, it includes direct stationary indirect sources of GHG emissions, as well as possible stationary direct sources GHG emissions. As such, the proposed plan is subject to the terms and provisions of the MEPA GHG Policy and Protocol (the Policy).

See Section 14.13 for discussion of the CWMP's compliance with the greenhouse gas policy.

Comment 12-2:

However the DOER does not consider this to be a sufficient justification for the granting of a waiver for compliance with the policy for the following reasons:

- Because the solar energy system output will be distributed to all of the Town's municipal loads via net metering, it is difficult for the DOER to assess what fraction of the electrical loads projected for the WWTF and pumping stations proposed in the CWMP will be supplied with zero emissions electricity.
- Regardless of the source of energy, the as-proposed pumping stations and WWTF should be designed to a standard of efficiency that they will ensure that they will meet and hopefully will exceed that business as usual level.
- Use of the Energy Stare Portfolio Manager for WWTFs and relatively simple calculations related to pumping energy, will allow for a reasonable quantification of baseline and target values for energy consumption and associated GHG emissions, using information, which for the most part has already been developed in the CWMP process, with a relatively minor level of effort and resources.

See Section 14.13 for discussion of the CWMP's compliance with the greenhouse gas policy.

Comment 12-3:

In applying the Protocol to as-proposed WWTF, the DOER and MEPA have adopted use of the EPA Energy Star Portfolio Manager for WWTFs as a means for establishing both a proxy for, and an analogue to the building code in defining the minimum benchmark for the baseline case for stationary source energy consumption and GHG emissions for an as-proposed wastewater treatment facility. Using the ESPM in the "set energy performance target" mode in conjunction with the required WWTF specific inputs (see below) will allow the determination of the site energy consumption in kBtu per gpd which correlates to a ranking of 50, which is the median value for all regional WWTFs sharing the same design operating parameters.

Use of the ESPM for WWTF in this way will generate a well-founded metric that will be of use to MEPA by establishing a baseline benchmark, that will ensure that as-proposed WWTFs will be at least as efficient as the regional average for those with similar operating characteristics, as well as establishing an easily accessible performance reference metric to be used in the design, commissioning and operation phases of an as-proposed WWTF.

Section 14.13 establishes a baseline case and a mitigated case of the project using the EPA Energy Star Portfolio Manager (ESPM) for Wastewater Treatment Facilities (WWTF), as suggested by DOER.

Comment 12-4:

Baseline case: Defined by using the ESPM for WWTF tool in the "set energy performance target" mode to obtain the site kBTU/gpd and GHG emissions corresponding to a ranking of 50. For simplicity sake, set electricity as the only fuel (i.e. input only one electric meter)

Describe any energy conservation design measures (EDM) that have been included in the design; or are under consideration; or have been eliminated (with brief discussion of reasons).

Mitigated case: Based on an evaluation as to the likelihood of which EDMs will be adopted, propose a target goal ESPM WWTF ranking higher than 50 (i.e. a reduced site kBTU/gpd) and obtain the corresponding kBTU/gpd using the WWTF ESPM in the "set energy performance target" mode

Based on the site kBtu/gpd energy intensity (converted to kWh /gpd) compute the projected tons of GHG emissions using the projected average MGD at full build out for and the current grid emission factor for both the baseline and mitigated cases. Adjust the result by the estimated fraction energy projected to be supplied by as-proposed solar energy system.

See Section 14.13 for discussion of the CWMP's compliance with the greenhouse gas policy and implementation of the methodology suggested by DOER.

Comment 12-5:

WWTF Buildings:
The MEPA Policy and Protocol requires that energy modeling be performed to establish the expected energy usage and corresponding GHG emissions for both the baseline and mitigated as-proposed cases. In this case, however, the DOER recommends that this requirement be waived for the following reasons and subject to the following conditions:

Reasons:
The loads and energy consumption for the buildings are included in the computation of the overall facility site kBTU/mgd. The assumption that all heating fuel will be electricity while conservative, will not overly distort the results, as the process and building electrical loads will dominate the total energy usage. The new construction will be designed and built to meet the Mass. energy building code.

Conditions:
The modeling waiver is contingent upon the following conditions being met: All of the building EDMs listed below in the mitigation section of this letter will be evaluated and the results of the evaluation will be included in the Section 61 section of the EIR.

Mitigation:
Building Measures:
Increase roof insulation to at least 20% above the minimum required by the effective Mass Building Energy Code (the code)
Reduce Lighting Power Density to at least 15% below maximum allowed by the code.
Include occupancy on/off controls.
Increase boiler or furnace efficiency to at least 10% above the minimum required by code.
Include energy recovery ventilation for heated building areas.

Process Measures:
Process Optimization: Mitigation of the negative impact on the life-cycle efficiency and emissions of the WWTF treatment process due to the impact of equipment operating for a large fraction of the life-cycle at partial loads.

Pumping Stations:
Provide a description of the business as usual case for the as-proposed stations and projected annual MWH energy consumption and GHG emissions.
Provide a description of the proposed mitigated as-proposed pumping stations and projected annual MWH energy consumption and GHG emissions.

Section 61 Findings and Mitigation Measures:
An energy and GHG reduction section should be added to this chapter in the EIR and should include a discussion use of the ESPM WWTF rank of 50 as a baseline commitment and the following specific information:

- *A commitment that the final design for the as-proposed WWTF will achieve a ESPM WWTF ranking of not less than 50, and the corresponding site kBTU/gpd.*
- *A list of all the energy design mitigation measures that will be included to some degree in the as-proposed project.*

See Section 14.13 for discussion of the CWMP's compliance with the greenhouse gas policy and implementation of the methodology recommended by DOER. Section 17 includes the draft Section 61 Findings and mitigation measures.

#13 - Comment Letter from the Massachusetts Department of Environmental Protection- SERO

Comment 13-1:

MassDEP is encouraged that a cornerstone of the CWMP provides for inter-municipal cooperation with the Town of Chatham in order to reduce costs and help utilize more fully Chatham's new wastewater treatment facility while that community is in the initial phases of sewer construction. The CWMP also incorporates alternative strategies such as improved flushing at Muddy Creek and enhanced attenuation at the Bank Street bogs.

No Comment.

Comment 13-2:

MassDEP notes that the Water Pollution Abatement Trust recently provided the Cape Cod Commission with a $3.35 million grant to prepare an update to the 1978 Water Quality Management Plan for Cape Cod. The updated Federal Clean Water Act Section 208 Plan will be a regional, watershed-based plan designed to restore and protect water quality on the Cape. The plan will include a comprehensive analysis of all factors contributing to water quality degradation, but prioritize management of controllable nutrients due to the current conditions in the region.

No Comment.

Comment 13-3:

It is anticipated that a draft 208 plan will be completed in 1 year, and a final plan issued within 2 years. MassDEP strongly encourages Harwich to become an active participant in this planning process to coordinate Harwich's planning efforts with the Cape Cod Commission's regional efforts, and to ensure

Harwich can best take advantage of any proposals for regional solutions, cost efficiencies and/or cost-sharing opportunities the regional approach will yield.

The final (June 2015) 208 Plan has now been completed and approved. Harwich has been an active participant in this process. This CWMP/SEIR was updated to include sections that discuss how the CWMP complies with the intent of the 208 Plan. See Sections 2 and 13 for additional information.

Comment 13-4:

Further, it is encouraging that there is recognition of long term needs and preliminary plans for Harwich to consider funding a portion of the expansion of the Chatham facility when that need may arise in order to continue allowing Harwich access to the Chatham facility. The responsibility for implementing flushing improvements for Muddy Creek will be shouldered by Harwich with the knowledge that there will be benefit to both Harwich and Chatham, as the Muddy Creek subwatershed is shared by both towns. The CWMP mentions the possibility of inter-municipal cooperation with Dennis, especially since a portion of the village of Dennisport lies within the Herring River watershed. MassDEP would encourage both towns to initiate discussions on the mutual benefit which could be realized by coordinating the respective towns' wastewater planning. In addition, Harwich shares a small portion of the Swan Pond River watershed with the towns of Brewster and Dennis and the Herring River watershed with Brewster. The CWMP recognizes that the wastewater treatment facility proposed for the Herring River watershed may have the potential to serve portions of the watershed outside Harwich's boundaries. Harwich should open immediate discussions with Dennis, Harwich and Brewster regarding how these towns with shared watersheds can best approach watershed planning on an inter-municipal basis. In regard to Swan Pond River, very little of Harwich is in that watershed; however, the MEP report does model a scenario showing that 100% of the septic load needs to be removed to achieve target thresholds. Again Harwich should work with the neighboring communities on this shared watershed to ensure that planning results in proposed solutions that address the entire watershed in a cost effective manner.

As noted above, updated information on the status of intermunicipal agreements is detailed in Section 13 of this CWMP/SEIR. The town of Dennis has recently conducted a review of water quality throughout the town via a contract for consulting services with CDM Smith, working together with the town’s Comprehensive Wastewater Management Task Force. Since Harwich is farther along in the planning process than Dennis, further development of regional alternatives with Dennis will continue to be considered as Dennis moves forward with its water quality planning efforts. Brewster is also not as far along in the wastewater planning process as Harwich.

Comment 13-5:

As other studies evolve regarding regional approaches, these can inform the strategies and direction in future phases. The Department strongly recommends a regional watershed-based approach to addressing water quality impairment. An approach not based on municipal boundaries, but instead focused on cost effective solutions, cost sharing and innovation. Harwich's CWMP addresses the most significant watersheds and shared watersheds in the Town of Harwich and proposes partnering with Chatham to address those impairments. While MassDEP has identified some remaining shared watersheds in need of additional inter-municipal planning before cost effective solutions could be developed, CWMP Phases 1 and 2 are appropriate first steps that will not jeopardize future opportunities for regional cooperation.

See response to Comment 13-4 above.

Comment 13-6:

There are two proposals for alternative approaches for nutrient reduction described in the CWMP. One is to provide for improved flushing at the Muddy Creek culverts running under Route 28. Modeling through the MEP has shown that a 24 foot wide culvert will provide benefit to water quality in the Muddy Creek subwatershed which may result in a reduction of the amount of conventional infrastructure that would ordinarily be needed to meet target thresholds within the subwatershed. This project is planned for Phase I which is scheduled for between 2013 and 2015. MassDEP and the town will work together to develop an appropriate monitoring plan to determine if the anticipated improvements in water quality actually occur. If the project does not result in the projected water quality improvements, the CWMP should provide a discussion of the additional mitigation required to meet the target thresholds.

The second proposal is to modify or manipulate flow through the Bank Street cranberry bogs to increase nitrogen attenuation from a measure 35% to a projected 50%. Enhanced natural attenuation at this site will be considered as a demonstration project which will require appropriate review and permitting under the Wetlands Protection Act and related regulations. The town and MassDEP should discuss permitting requirements at the earliest opportunity. Should the project be permitted, the town will need to develop a design and monitoring protocol with MassDEP so that the effectiveness of the modifications is adequately documented in order to secure credit for the anticipated additional nitrogen removal. The plan should provide a discussion of alternate mitigation strategies if the enhanced attenuation does not meet expectations.

The Town plans to continue working with MassDEP to establish the details of the adaptive management plan described in Section 13, including monitoring of the natural attenuation project to evaluate its effectiveness. The overall plan is sufficiently flexible and is expected to change as the effectiveness of the culvert and natural attenuation projects are fully understood.

Comment 13-7:

The CWMP provides a hydrogeological report for the proposed infiltration sites HR-12, SH-2 and PB-3. MassDEP will need more time to thoroughly review the findings; however, the recommended discharge sites will be fully evaluated during the permitting process. As part of the recommended plan, only sites HR-12 and PB-3 were carried forward.

Site PB-3 is located in the Zone II of a public water supply well. Pursuant to 314 CMR 5.10(4A) a Total Organic Carbon (TOC) limit of 3 mg/L is required for discharges in a Zone II unless otherwise determined by the MassDEP. The CWMP does mention that it is expected that additional treatment for the removal of will not be required at site PB-3 since the estimated travel time to the nearest municipal well is over five years. Strictly speaking, the five year travel time does not factor into the evaluation of the TOC requirement, but rather whether the infiltration site is in the zone of contribution (as opposed to the Zone II) of a public water supply well. MassDEP has provided a preliminary opinion regarding TOC treatment; however, further evaluation during the permitting process is needed for a definitive determination. Additionally, it should be noted that site PB-3 will require a site assignment under MGL Chapter 83 Section 6. With regard to site HR -12, the entire parcel is under a site assignment by the Divison of Solid Waste. As described in another section of these comments, all provisions of the solid *waste program and its regulations will have to be met to allow siting of a wastewater treatment facility and disposal beds.*

Based on groundwater modeling and preliminary discussions with MassDEP, it is expected that additional treatment for removal of Total Organic Carbon (TOC) will not be required for site PB-3. The town is currently working with the regulatory agencies to determine the appropriate level of treatment for effluent recharge in a Zone II. The final decision is dependent on MassDEP input, and the town of Harwich will comply with all rules and regulations once they are finalized. Harwich is evaluating multiple sites in East Harwich, not just site PB-3 since an attempt to acquire a parcel in the PB-3 site failed in 2015.

Comment 13-8:

The report has provided a thorough evaluation of existing and buildout conditions. However, the CWMP should acknowledge that additional evaluation may be needed for buildout assumptions depending upon how proposed zoning changes, particularly for the East Harwich Village Center, are enacted.

To specifically control growth, Harwich will continue to evaluate appropriate regulations and bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with the Planning Board and Board of Health before deciding whether regulations or zoning regulations are the best approach for Harwich to implement this wastewater flow management requirement. Changes to zoning that increase or decrease buildout will need to be reevaluated for their ability to meet the MEP and subsequent TMDL load requirements.

Comment 13-9:

There has been some discussion of alternative treatment strategies that focused mainly on enhanced on-site treatment using so-called innovative/alternative technologies. The CWMP should provide an expanded discussion on how these and other "greener" on-site alternatives (e.g. composting toilets and urine diversion toilets) were evaluated and screened out.

Section 10 provides an evaluation on wastewater scenario assessments. Specifically, Scenario 7A is the innovative/alternative scenario that looks to maximize the use of the technology. Ecotoilets were not considered as part of this CWMP/SEIR, as the town focused on other non-traditional options. However, should piloting in other communities demonstrate that such options are advantageous, Harwich could reconsider their inclusion through adaptive management for future phases.

Comment 13-10:

The CWMP is based on a 40 year design horizon divided in eight phases. Traditionally, CWMPs have been based on 20 year horizons; however, the town argues that the scope and cost of the recommended alternative requires an extended timeframe for affordability and capital planning. MassDEP believes that further discussion on the timetable is required to arrive at a mutually acceptable schedule for completion. Regarding timetable for solution implementation, as noted above, the Water Pollution Abatement Trust recently provided the Cape Cod Commission with a $3.35 million grant to update Cape Cod's regional water quality management plan. It is anticipated that a draft regional plan will be completed in a year, with a final plan expected with 2 years. The Department *strongly encourages Harwich to coordinate with the Cape Commission and become an active participant in this planning process.*

See response to Comment 1-8. In addition, the Town is open to discussions on the phasing plan and the overall timetable of the CWMP, since it expects both to change several times throughout the implementation period.

Comment 13-11:

With regard to phasing, the northeast Herring River collection system (upper) is scheduled for Phase 4B and the northwest (upper) Herring River collection system is scheduled for Phase 5 while the southwest (lower) Herring River collection system is scheduled for Phase 7. Because the lower Herring River collection system would likely have a more immediate effect on improving water quality due to its closer proximity to the marine portion of the Herring River watershed, it should be considered for Phase 4B or Phase 5 and the upper Herring River collection systems should be considered for later phases. It is understood that cost factored into the phasing plan; however, habitat restoration also has to be a major consideration in the phasing plan. Further discussion between the town and MassDEP is warranted before finalizing a phasing plan.

The Town of Harwich is open to discussions on the phasing plan and the overall timetable of the CWMP, since it expects both to change throughout the implementation period. However, some phasing as presently laid out is required to allow the furthest downstream components of the sewer collection and conveyance system to be constructed first, so that upstream tributary areas can later be tied in.

Comment 13-12:

The Town of Harwich is encouraged to work with MassDEP's State Revolving Fund (SRF) section to develop funding alternatives as project development proceeds. The Draft CWMP clearly documents areas where nutrient enrichment needs control to improve water quality. As projects approach the funding stage, the Town will need to show the percentage of each project intended primarily to manage nutrients with reference to the final CWMP. Sewer regulations to be developed may need to comply with certain MassDEP and Department of Housing and Community Development requirements, depending on the funding program utilized. In particular, there is little discussion of growth neutrality in the CWMP. This item needs to be addressed if the town wishes to pursue 0% financing from the SRF.

See Section 13.7.11 for a discussion on future growth.

The town is actively working to address future growth neutrality in an effort to secure zero interest loan financing or principle forgiveness loans in the future. Harwich will continue to develop appropriate regulations and bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with the Planning Board and board of health before deciding whether health regulations or zoning regulations are the best approach for Harwich to implement this wastewater flow management requirement.

Comment 13-13:

Plans to meet TMDL requirements for nutrient loading must always consider source reduction as the primary means of long term nutrient control. Source reduction usually focuses on controlling watershed land use loads generated from human activity and can include but are not limited to constructing new sewer systems, upgrading existing sewer systems (e.g. providing higher levels of treatment and eliminating combined sewer outflows), eliminating fertilizers, constructing on-site systems with enhanced nutrient removal capability, reducing runoff from impervious surfaces, reducing impervious surfaces, and tightening standards for new and upgraded septic systems. In addition to source controls, successful nutrient management plans may include alternative nutrient control strategies to achieve the desired nitrogen concentrations specified in the TMDL and Massachusetts Estuary Project (MEP) reports. MassDEP is encouraged by the source controls proposed in the CWMP, and recommends that Harwich continue to evaluate and adopt additional source controls in the future to the maximum extent possible to reduce the need for alternative nutrient control strategies.

See response to Comment 1-21.

Comment 13-14:

The Harwich CWMP contains two proposed alternative nutrient control strategies that will result in direct alteration of wetland resource areas. The Town proposes to implement the CWMP in phases and Phase I includes the replacement of the two 4-foot wide existing culverts with a 24-foot wide culvert at Route 28 to increase flushing of Muddy Creek and restore ecological habitat. Although source reduction should be the primary focus of all nutrient control strategies, there are certain instances where historical alteration of a resource area from its natural condition has exacerbated nutrient enrichment. At Muddy Creek, where it flows under Route 28, culverts have restricted flow and impeded tidal flushing, which under natural conditions would allow for efficient transport of nutrients out of a system. In this instance, restoration to a documented historical condition is an appropriate consideration for management since it employs techniques widely used to restore, rehabilitate and/or create salt marshes. With the increased 24-foot opening, residence time of nitrogen is projected to be reduced thus contributing to overall reduction in nitrogen loads in the Muddy Creek subwatershed.

Therefore, MassDEP supports the issuance of a conditional Phase I waiver with a requirement that a Notice of Project Change be submitted for this project when the design is advanced such that wetland resource area impacts can be quantified. Such quantification should include the temporary and permanent alterations to wetland resource areas, as well as the predicted increase or decrease in bordering vegetated wetland, salt marsh and other wetland resource areas. In addition, an evaluation of low lying properties must be conducted to ensure that the improvement in tidal flushing will not result in flooding of properties in the vicinity. Mitigation should be provided for permanent alterations that are not offset by new resource area created as a result of the increased tidal flushing. A permitting strategy should be developed for MassDEP review. This permitting strategy should address specifically the regulatory language at 310 CMR 1 0.24(5)(b) which specifies that projects located within an Area of Critical Environmental Concern (ACEC) "shall have no adverse effect upon those interests, except as provided under 310 CMR 10.25(4) for maintenance dredging." Two other provisions that should be evaluated include the limited project provision found in 310 CMR 1 0.24(7)(c)2. for the "maintenance, repair and improvement (but not substantial enlargement) of structures, including ... bridges and culverts which existed on November 1, 1987 and 310 CMR 10.32(5) which states

"Notwithstanding the provisions of310 CMR 1 0.32(3), a project which will restore or rehabilitate a salt marsh, or create a salt marsh, may be permitted."

The Muddy Creek Bridge project was permitted and designed outside the scope of this CWMP and is currently under construction.

Comment 13-15:

It is important to note that MassDEP has made proposed revisions to 310 CMR 10.24(5)(b) and relevant provisions of the Waterways regulations at 310 CMR 9 .32(1)(e) to address the apparent prohibition on projects, including restoration projects, which lie within ACECs. That proposed Wetlands Regulation revision states, "When any portion of a designated Area of Critical Environmental Concern is determined by the Issuing Authority to be significant to any of the interests of M. G .L. c. 131, § 40, any proposed project in or impacting that portion of the Area of Critical Environmental Concern shall have no adverse effect upon those interests, except as provided under 310 CMR 10.25(4) for maintenance dredging, under 310 CMR 10.11 through 10.14, and 314 CMR 10.24(8) and 310 CMR 10.53(4) for Ecological Restoration Projects, and under 310 CMR 1 0.25(3) for improvement dredging conducted by a public entity for the sole purpose of the maintenance or restoration of historic, safe navigation channels or turnaround basins of a minimum length, width, and depth consistent with a Resource Management Plan adopted by the municipality(ies) and approved by the Secretary of the Executive Office of Energy and Environmental Affairs." Revisions are also proposed to the Waterways Regulations which would eliminate restrictions on the placement of fill or structures within jurisdiction of Chapter 91 within ACECs when necessary to accomplish ecological restoration projects. The Department hopes that the project proponent will consider these proposed revisions and their possible effect on the permissibility of the project.

During the design of each phase of the project, detailed construction plans will be provided to all appropriate agencies for review. This review is expected to confirm the appropriate permits for the project. The Town of Harwich intends to comply with all rules and regulations set forth by the appropriate agencies.

Comment 13-16:

In addition to the Muddy Creek culvert improvements, modifications to Cold Brook and associated wetlands to maximize residence time of groundwater are proposed to achieve 15% of the total nitrogen attenuation required in the Saquatucket Harbor estuary. Specifically, construction of depositional ponds in abandoned cranberry bogs off of Bank Street is proposed for the retention of pollutants. This strategy is concerning and may require a wetland variance. A wetland variance may require further evaluation of alternatives through the MEPA process. We believe that alternatives likely exist (e.g. natural succession, different restoration techniques and wetland creation) that better meet both the goals of wetland protection and water quality restoration. Some of these alternatives may also serve the purpose of expediting wetland permitting.

The Town has been working with the Harwich Conservation Trust and the Harwich Conservation Commission to plan the Cold Brook natural attenuation project. The wetlands in question are former cranberry bogs and have already been significantly altered from their natural state. In the planning and design of this project, the Town will strive to increase habitat and other values in the modified bogs, to create wetland areas that provide not only the proposed natural attenuation, but also other environmental benefits above the present condition of the abandoned bogs. The Town has discussed alternative locations for natural attenuation in this watershed and does not agree, at this time, that disturbing existing high quality upland areas is preferred over working within the already-disturbed, abandoned cranberry bogs. All necessary permits will be obtained prior to implementing this project. Furthermore, as the project moves forward, the Town of Harwich will continue to work with the Harwich Conservation Trust.

Comment 13-17:

Abandoned cranberry bogs, if left alone will revert to marshes and/or shrub/forested swamps through natural succession and provide pollution prevention benefits and promotion of other public interests. This can be directly observed by the succession of abandoned cranberry bogs to the east of Gorham Road to more natural wetland systems (see photo below). The succession of abandoned cranberry bogs to a natural shrub or forested system may provide nitrogen attenuation not currently considered in the proposed strategy.

See response to Comment 13-16, above.

Comment 13-18:

Strategies that would restore the bog and also increase retention time may also be considered. Acceptable restoration strategies include natural plantings of woody species, elimination of manmade ditches and increasing sinuosity of the main channel (and possibly creation of sinuous tributaries from some of the larger ditches). The project proponent should review the Watershed Assessment of River Stability & Sediment Supply (WARRS) river restoration method recommended by EPA. http://water.epa. gov/scitech/ datait/tools/warsss/

This document will be reviewed during detailed project design.

Comment 13-19:

Additionally, or instead of the restoration strategies described above, we strongly recommend that the project proponent consider wetland creation as a viable alternative to the alteration of existing wetlands in and around the abandoned bog. There appear to be a number of upland areas that may allow for successful wetland creation in and around these abandoned cranberry bogs that should be investigated further (see photo below).

See Comment 13-16, above.

Comment 13-20:

Areas with yellow hatch marks are potential wetland creation areas needing investigation.

See response to Comment 13-16, above.

Comment 13-21:

Any one strategy or combination of strategies described in the preceding paragraph may serve to achieve a similar or greater nitrogen attenuation increase of the 15% desired. Research has confirmed that wetlands provide good nitrogen attenuation which supports the goals of not only protecting existing wetlands for natural succession, but also for creating additional acreage. However, there *appears to be limited research on the nitrogen attenuation capability of specific wetland types, including cranberry bogs, marshes and shrub and forested wetlands, and on the amount of nitrogen attenuation that would result from acceptable restoration strategies that would increase retention time. MassDEP supports the phase 1 waiver provided that further justification for the percentage of nitrogen removal modeled be developed and provided to MassDEP for alternatives involving wetlands. Demonstration projects may be approved on a case by case basis to support development of data; however it is MassDEP's opinion that further examination of the nitrogen attenuation alternatives and their permissibility under state and federal law and regulation should be undertaken before proceeding to the permitting phase.*

The Town has been working with the Harwich Conservation Trust and the Harwich Conservation Commission to plan the Cold Brook natural attenuation project. Research from the MEP has shown significant potential for this project to be successful. Sampling through the adaptive management program as well as other sampling programs will be able to determine the full effectiveness of this pilot project.

Comment 13-22:

All strategies should be monitored to document actual nitrogen attenuation through a monitoring system designed to measure upgradient (inflow) and down gradient (outflow) nitrogen loads. Downgradient salt marshes should also be monitored before and after work using MassDEP/Coastal Zone Management's Salt Marsh Quality Assurance Project Plan (QAPP) protocol and monitoring data collected should be submitted to MassDEP Wetlands Program. http://www.mass.gov/dep/water/resources/wfieldwk.htm#qapps

MassDEP is willing to work with the project proponent prior to permitting to evaluate appropriate alternatives and a monitoring strategy to achieve the maximum nitrogen attenuation possible, in addition to and possibly instead of the currently proposed depositional ponds in the abandoned cranberry bog.

The Town will continue to work with MassDEP on the particular design details, permitting, and monitoring strategies.

Comment 13-23:

Finally, the Massachusetts Natural Heritage and Endangered Species Program (NHESP) identified state-listed rare species in the vicinity of the Muddy Creek culvert replacement project including the Common Tern (Sterna hirundo) and the Eastern Box Turtle (Terrapene carolina). Additional estimated habitat of rare wildlife is located in the abandoned cranberry bog to the east of Bank Street. During implementation of the CWMP, the project proponent must comply with 310 CMR 10.59, 310 CMR 10.32(6) and related performance standards for other resource areas, and 310 CMR 10.37 to ensure that there is no short or long term adverse effect on estimated habitats of rare wildlife.

Rare species descriptions and potential impacts are discussed in Section 14. In its comments on the EENF, NHESP noted that additional guidance regarding rare species would be provided upon submission of more detailed site plans. As each component of the CWMP moves forward, NHESP consultation will be required during permitting. For each phase that requires an NOI from the Harwich Conservation Commission and is within Priority Habitat and Estimated Habitat, the NOI will be sent to

NHESP for review. Furthermore, during the design of each phase of the project, detailed construction plans will be provided to NHESP to confirm the exemption status or determine the need for further information or mitigation.

Comment 13-24:

This plan has championed a regional approach, which is a MassDEP priority, in partnering with Chatham and utilizing its wastewater treatment facility to best advantage. MassDEP is of the opinion; however, that additional regional partnering with Dennis and Brewster should be more fully explored and addressed in the requested SEIR. MassDEP also recognizes that given the phasing, regardless of what timetable upon which the parties eventually agree, modifications to the existing plan can accommodate anticipated studies on regional alternatives. Nonetheless, there is nothing in the first two phases of this plan that would jeopardize any future regional initiatives; in fact, MassDEP believes that they serve as a strong foundation for regional efforts.

See response to Comment 1-5.

Comment 13-25:

MassDEP supports the request for an SEIR but would request supplemental information be included that would more fully evaluate inter-municipal options with Dennis and Brewster for the Herring River and Swan River watersheds. MassDEP also supports the Phase I waiver as requested.

Should an intermunicipal agreement be formed with either Dennis or Brewster that substantially alters the recommended program of this CWMP/SEIR, a Notice of Project Change would be required if triggering applicable MEPA NPC thresholds. The Town will continue to pursue such partnerships and will keep MassDEP involved throughout the process.

Comment 13-26:

Solid Waste Management Program Comments
The CWMP proposal describes approximately 92 linear miles of sewer mains (in Harwich), a 10-acre recharge facility (PB-3), effluent recharge basins, 30 pump stations and a Waste Water Treatment Plant (the "WWTP"). The proposed WWTP and one (of the two) effluent recharge basins are located on a town-owned parcel designated as site HR-12, which is presently site assigned for solid waste activities (only).

Accordingly, and as a result of the Department's review of the proposed ENF #15022, MassDEP-Solid Waste Program offers the following comments:

1. *Solid Waste Site Assignment Modification: The Town has two options regarding the solid waste site assignment at the HR-12 site parcel. Option one is that the Town could first relinquish the solid waste site assignment ("de-site assignment"). The Town would be required to maintain certain setbacks and egress for the Landfill property.*

OR

2. *Post Closure Use of a Landfill: Option two is that the Town could submit a Post Closure Use permit application (BWP SW36) leaving the WWTP within the jurisdiction of the solid waste program.*

Subsequently, any future changes/upgrades occurring on the HR-12 parcel would remain subject to approval(s) from the Solid Waste section.

The Town will consider these options as it proceeds with work on the HR-12 site and will determine which is more advantageous in terms of long-term operations and maintenance on the site.

Comment 13-27:

The project construction activities may disturb one or more acres of land and therefore, may require a NPDES Stormwater Permit for Construction Activities. The proponent can access information regarding the NPDES Stormwater requirements and an application for the Construction General Permit at the EPA website: http://cfpub.epa.gov/npdes/stormwater/cgp.cfm

See Section 14.14 for a discussion of regulatory standards and permit requirements, including stormwater permits.

Comment 13-28:

Based on the information provided in the ENF, the Bureau of Waste Site Cleanup (BWSC) searched its database for disposal sites and release notifications. (A disposal site is a location where there has been a release to the environment of oil and/or hazardous material that is regulated under M.G. L. c. 21E and the Massachusetts Contingency Plan [MCP- 310 CMR 40.0000]). The ENF has identified the following disposal sites located in the vicinity of the proposed project.

The files for these sites may be viewed at: http:/ /public.dep.state.ma. us/SearchableSites/Search.asp

The Project Proponent is advised that the discovery of oil and/or hazardous material during the implementation of this project may require notification to the Massachusetts Department of Environmental Protection pursuant to the Massachusetts Contingency Plan (3I 0 CMR 40.0000). A Licensed Site Professional (LSP) should be retained to determine if notification is required and, if contamination is encountered, to determine the necessary response actions. The BWSC may be contacted for guidance if questions regarding cleanup arise.

See Section 14.4.1 for a listing of known hazardous waste sites in Harwich and a discussion of these issues.

Comment 13-29:

Greenhouse Gas (GHG) Emissions Policy
The solar photovoltaic system proposed within the Harwich CWMP/EENF is a significant commitment to non - GHG emitting technologies and will contribute a substantial amount of clean power to the grid. The infrastructure related to the proposed Harwich WWTF system, however, includes a number of collection and treatment components that will be and/or may be subject to the protocols contained in the MEPA GHG Policy. The Policy requires that energy demands and associated GHG generation associated with wastewater collection and treatment for the two proposed service areas be evaluated.

This assessment is used to generate a minimum benchmark/baseline case for energy consumption and GHG emissions for WWTF systems with similar equipment and operating characteristics and establishes a performance reference metric for design.

The CWMP/EENF's ENERGY SECTION contained on p. 22 of the EENF makes no reference to the type of analysis contained in the Policy. Given the preliminary nature of the CWMP/ EENF at this time, however, it is expected that these issues will be addressed as the Chatham/Harwich collection system proceeds into design and will be continued as an Adaptive Management SOP throughout the life of the entire project.

MassDEP recommends that the Town of Harwich utilize the EPA Energy Star Portfolio Manager (ESPM) for WWTFs for these analyses. Information regarding this analytical tool is available from:

Jason Turgeon
US EPA,
Boston Office
617-918-1826.
turgeon.jason@epa.gov

See Section 14.13 for a discussion on the MEPA greenhouse gas policy. In this section, Harwich establishes a baseline case and a mitigated case for the project using the EPA Energy Star Portfolio Manager (ESPM) for wastewater treatment facilities.

Comment 13-30:

The "Certificate of the Secretary of Energy and Environmental Affairs on the Environmental Notification Form" may indicate that this project requires further MEPA review and the preparation of an Environmental Impact Report. Pursuant to MEPA Regulations 301 CMR 11.12(5)(d), the Proponent will prepare Proposed Section 61 Findings to be included in the EIR in a separate chapter updating and summarizing proposed mitigation measures. In accordance with 301 CMR 11.07(6)(k), this chapter should also include separate updated draft Section 61 Findings for each State agency that will issue permits for the project. The draft Section 61 Findings should contain clear commitments to implement mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and contain a schedule for implementation.

Section 17 of this SEIR includes the draft Section 61 Findings.