Executive Summary

February 2013

Over the last five years the Town of Harwich, through its Water Quality Management Task Force (WQMTF) Wastewater Management Subcommittee (WMS), has been working to develop a program to address wastewater management needs, protect drinking water sources, protect freshwater ponds, and restore valuable estuaries. Protection and restoration of these valuable water resources is extremely important to maintaining the quality of life and economic health of the Town. These efforts and the resultant recommendations for the community to implement over the next 40 years are summarized in this Draft Comprehensive Wastewater Management Plan (CWMP).

Purpose and Background

The Town contracted with CDM Smith in 2007 to work with the WMS in developing the CWMP. This work is driven mostly by the significant population growth and resulting development that has occurred since 1951 as shown in **Figure ES-1**. 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 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

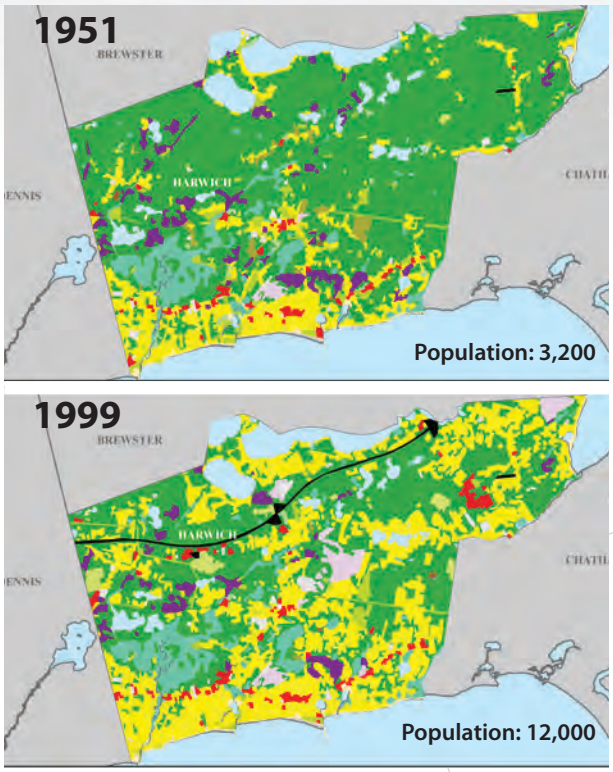

Figure ES-1
Harwich Land Use Development in 1951 and 1999

Cape Cod communities to begin considering wastewater collection and treatment. 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 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).

These areas are important ecosystems that provide habitat for shellfish and sea grasses as well as breeding grounds for offshore marine fisheries. Based on the MEP work, which includes water quality monitoring in Harwich, the Town became aware that reductions in nitrogen loading from on-site wastewater disposal systems would likely be instrumental in preserving the health of the Town's local coastal environments. Preserving each of these resources is a high priority for the quality of life that the Town's residents, business owners and tourists have come to expect and enjoy. All of the five MEP reports for Harwich are now available. As nitrogen reduction to estuaries and embayments is the most significant driver in the planning process, these reports provide sufficient information for the Town to move forward with a long-term recommended program.

The recommended wastewater management program put forth in this Draft 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 utilizing the appropriate regulatory review procedures.

Environmental Review Process

This CWMP has been prepared and submitted as part of an Environmental Notification Form (ENF) to the Massachusetts Environmental Policy Act (MEPA) Unit of the Massachusetts EOEEA. This document is undergoing review concurrently by the Cape Cod Commission as a Development of Regional Impact (DRI) and for consistency with the county's wastewater plan. The Draft CWMP has been included as part of the ENF, with the goal of receiving review comments from MEPA to eventually submit a Final Environmental Impact Report for approval.

The Town of Harwich has implemented a thorough public outreach program throughout the present wastewater planning initiative. The Town welcomes comments on this ENF/CWMP and looks

forward to continuing to work collaboratively with the community, the Town's WQMTF and WMS Committees, the Citizens Advisory Committee (CAC), Wastewater Implementation Advisory Committee (WIAC), the Cape Cod Commission, the MEP, MassDEP, adjacent communities, and other interested parties as it implements the recommended program over the next 40 years.

WQMTF, WMS and Other Stakeholders

The Town of Harwich's WMS Committee was formed in 2007 to oversee the wastewater planning initiative. The WMS's stated purpose is to develop a Town-wide management plan for improving the quality of Harwich's water resources, consistent with the local comprehensive plan for development. The CWMP will deal with potential sources of pollution to Town water resources and must be flexible enough to incorporate changing development patterns and technology updates. A major goal of the process is to promote the public's understanding of the issues and build consensus on the goals and alternative solutions including non-point source pollution management. The plan also balances the water resource needs with the ability to finance the recommended improvements. The Committee advises the Board of Selectmen on matters pertaining to the improvement and protection of water resources.

This WMS consists currently of seven members representing various Town interests, including water, health, planning and several Town departments. Through the multiple phases of wastewater planning, monthly meetings were held, all of which were open to the public. Several community meetings were also conducted.

Organization of This CWMP

This report is divided into thirteen 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.

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 developed for Harwich.

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 the past 50 years, the nitrogen leaching from those on-site systems into the groundwater has resulted in negative impacts to its valuable 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 has come to rely upon. 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.

Allen Harbor algae bloom, summer 2007

All water resources need to be addressed, however, as development has shown some early signs of impacting drinking water quality 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 utilize 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 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 will, upon review by the Massachusetts Department of Environmental Protection, be eventually subject to 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 of 2010
2. **The Pleasant Bay Report** – May 2006 with two technical memorandum updates in 2010
3. **The Draft Herring River Report** – June 2012

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.

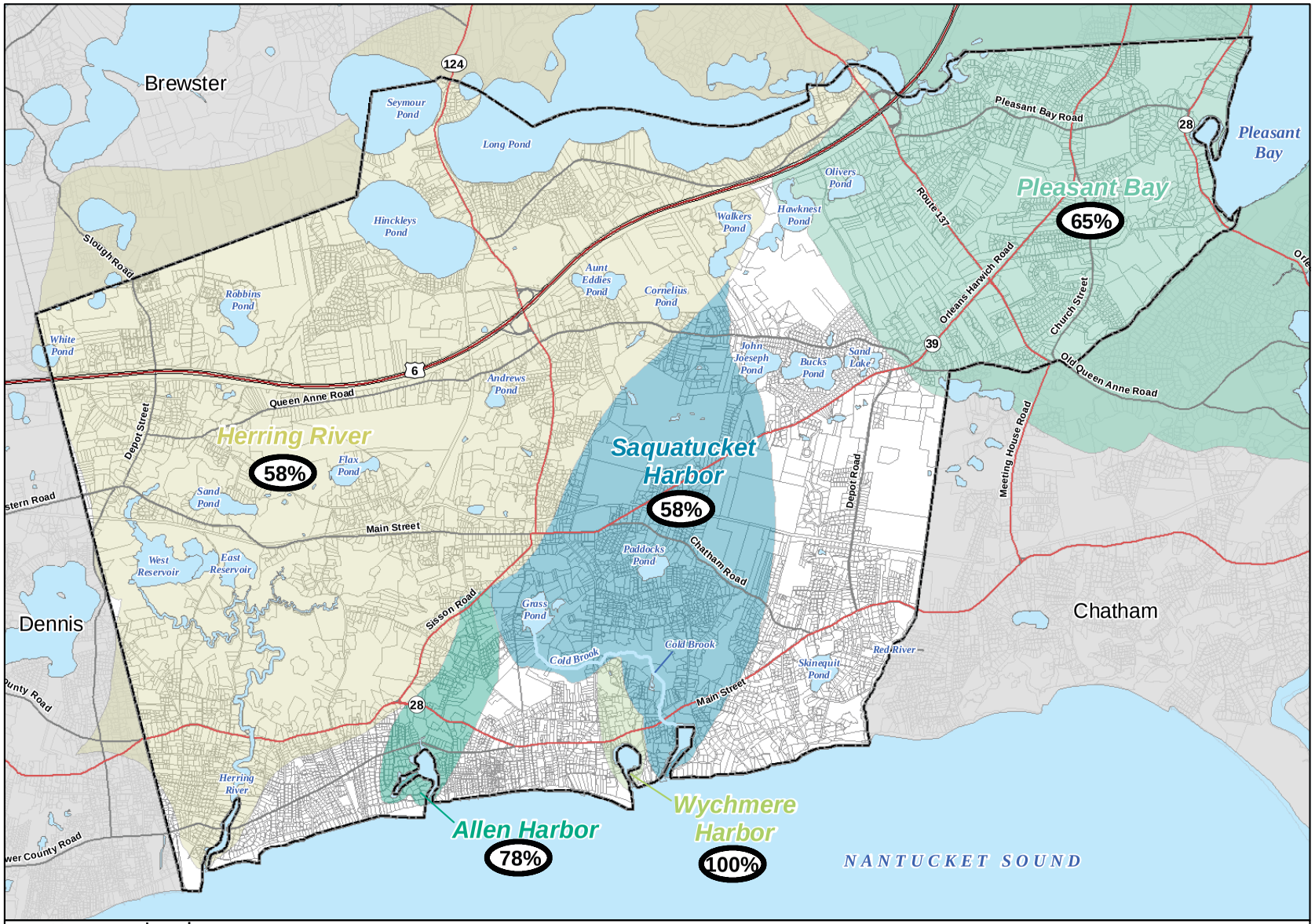

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Figure ES-2
Watershed Septic Load Reductions

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. As a result, the MEP used the benthic communities (organisms that live in and on the bottom of the ocean floor) as an indicator of overall health for this harbor, rather than eelgrass which is more sensitive to nitrogen.

Total septic system nitrogen loading to Allen Harbor must be reduced by 78% 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 also no evidence it ever existed historically in Wychmere Harbor since this is a man-made harbor. Instead, benthic communities were assessed as the indicator species for overall estuary health.

Total septic system nitrogen loading to Wychmere Harbor must be reduced by 100% 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. As a result, the MEP used the benthic communities as an indicator of overall health for this 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 58% 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.

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.

Key habitat indicators include benthic animals and eelgrass populations. 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 benthic animal populations as well as eelgrass populations as an indicator of overall health.

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. 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.

With the updated 24-foot opening in Muddy Creek, total septic system nitrogen loading to the Pleasant Bay subwatersheds in Harwich must be reduced by 65% in order to meet the MEP established threshold of 0.21 mg/l (Lower Muddy Creek) for total nitrogen to support healthy infaunal habitat and eelgrass.

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 a 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.

Since the results of the infaunal 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 south of Route 28.

Total septic system nitrogen loading to the Herring River watershed must be reduced by 58% 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. **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 needs to present 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.

		Present Day Loading		Buildout Scenario Loading	
MEP Watershed	**Threshold Septic Load (kg/day)**	**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%
*Saquatucket Harbor and Muddy Creek Loads include Enhanced Attenuation					
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.

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 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.

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. 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 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 emerging contaminants such as pharmaceuticals and personal care products.

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, 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 to be 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 will be constructed in the Grass Pond subwatershed. That will maximize 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 (proposed) 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.

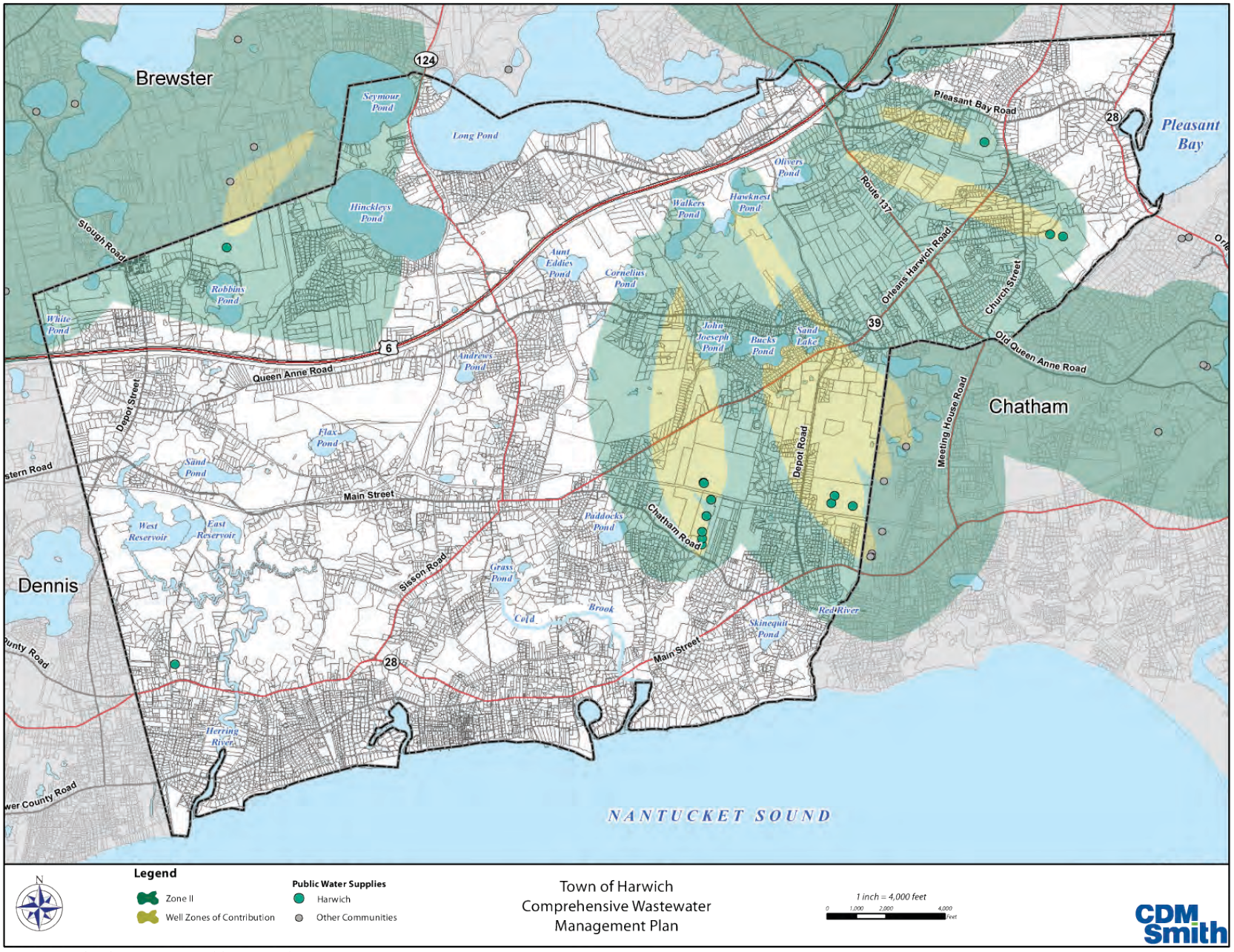

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Figure ES-3
Municipal Wells

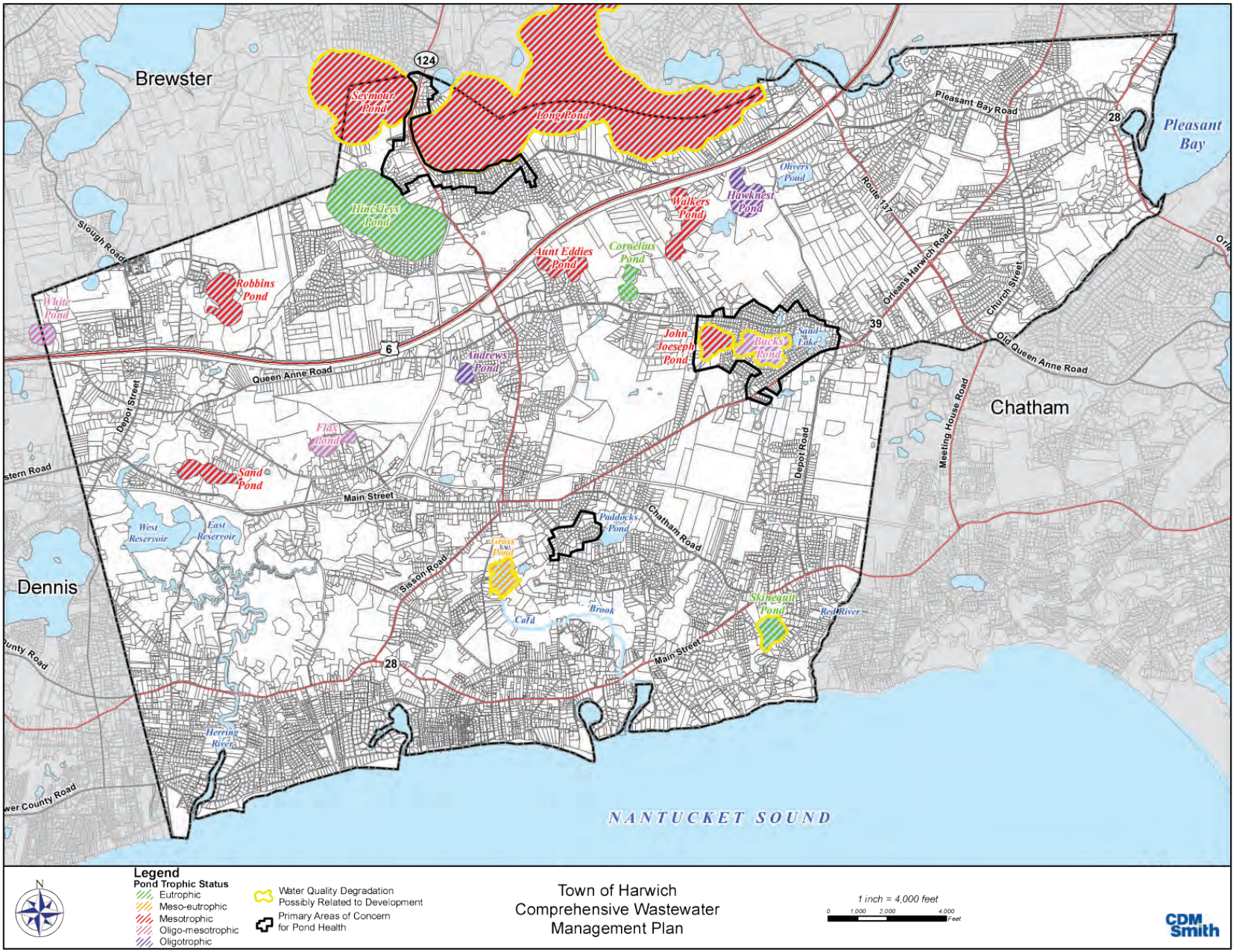

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Figure ES-4
Freshwater Ponds

Economic Development

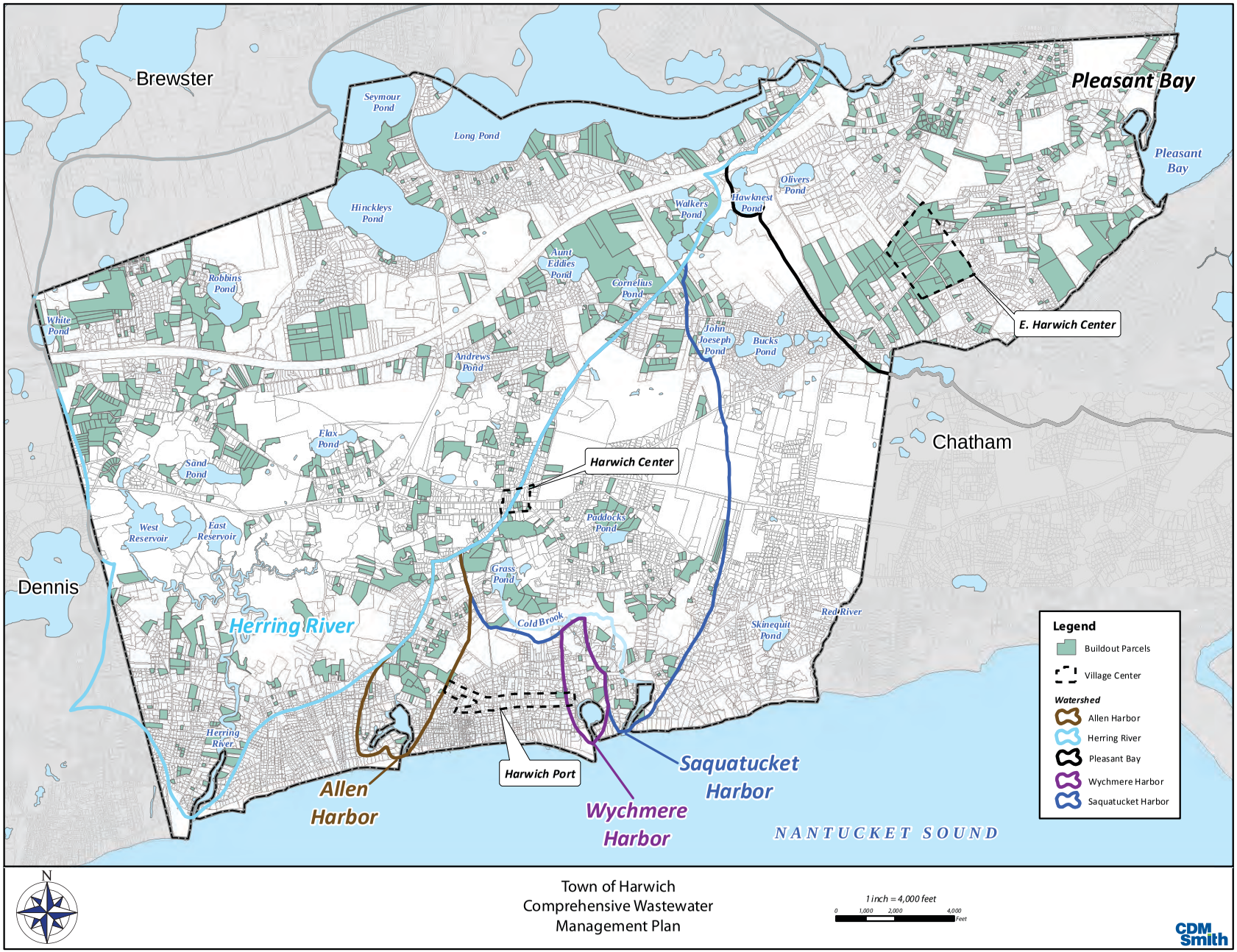
Growth and economic development are necessary components of any vibrant community. Harwich's preferred approach to growth management is to promote planned growth in targeted areas that enhance pedestrian culture and offer a positive experience for both residents, business owners, and visitors. Focusing 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 is 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. This figure also shows lots where the MEP included potential future development based on existing zoning and local input in order to reach buildout.

Regional Opportunities

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 phasing the use of the Chatham facility but there have been several positive discussions to date to include this opportunity in the recommended wastewater program. There are cost benefits to both communities. In the long term, effluent recharge for the Harwich flow is expected to 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 as discussed earlier. 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.



Figures ES-5
Economic Centers and MEP Buildout parcels

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.

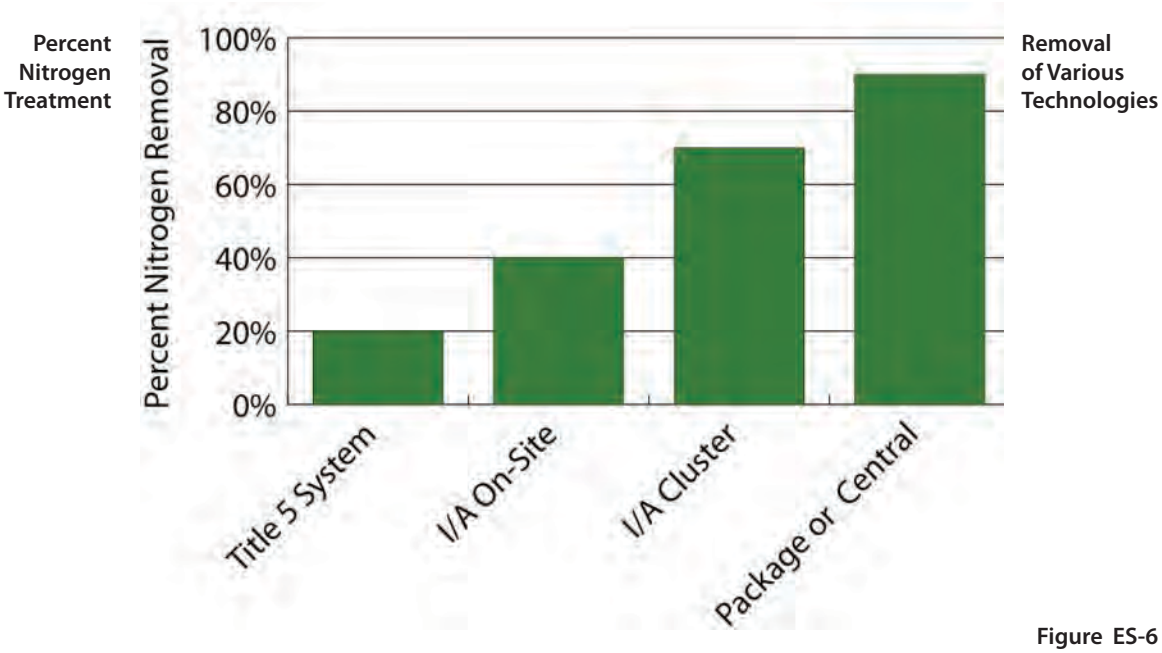


Figure ES-6
Percent Nitrogen Removal of Various Treatment Technologies

As shown in **Figure ES-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 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.

Recommended Wastewater Program

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 26 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.

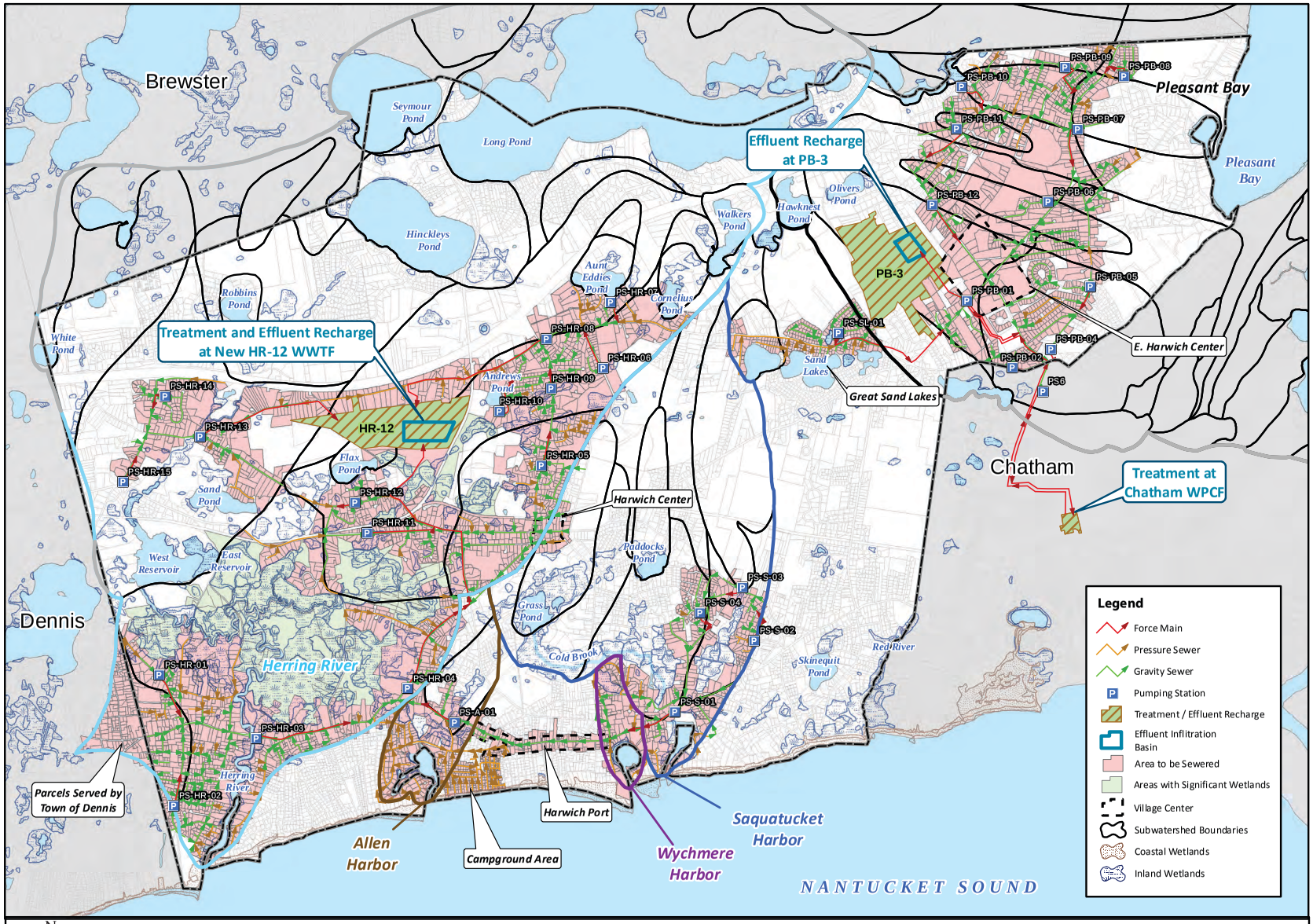


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Figure ES-7
Recommended Wastewater Plan

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.

The Town 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 requirements for nitrogen removal.

Treatment Facility and Effluent Recharge

The recommended plan will utilize two treatment facilities; one located at HR-12 (the Harwich landfill site) and one being the existing Chatham 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 effluent flow from the Chatham facility will be pumped back to Harwich for recharge at Site PB-3 in the Pleasant Bay watershed. Recharge initially will occur at the Chatham WPCF. Site PB-3 will only be utilized as an effluent recharge site.

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. Discussions with MassDEP will occur prior to implementing this pilot program.

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 are described below.

Phase 1

The focus of this phase will be to implement the two natural nitrogen attenuation programs. The first is to fund the construction phase of the Muddy Creek Bridge which will increase the existing creek opening to 24-ft width. This inlet widening will increase the flushing in Muddy Creek and will help restore the ecological habitat. 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. The recommended plan developed in the study phase would be 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. This phase will also include the purchase of land for the PB-3 effluent recharge facility and will include implementation of the Hinckleys Pond restoration project.

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. A future upgrade to the facility will be required, but that upgrade can be delayed since the Chatham WPCF will have some additional capacity into the future. Depending on timing between the two communities effluent potentially 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 Site PB-3. 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. The design and construction of the delayed (see above) Chatham WPCF expansion is also expected to be completed in this phase.

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.

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.

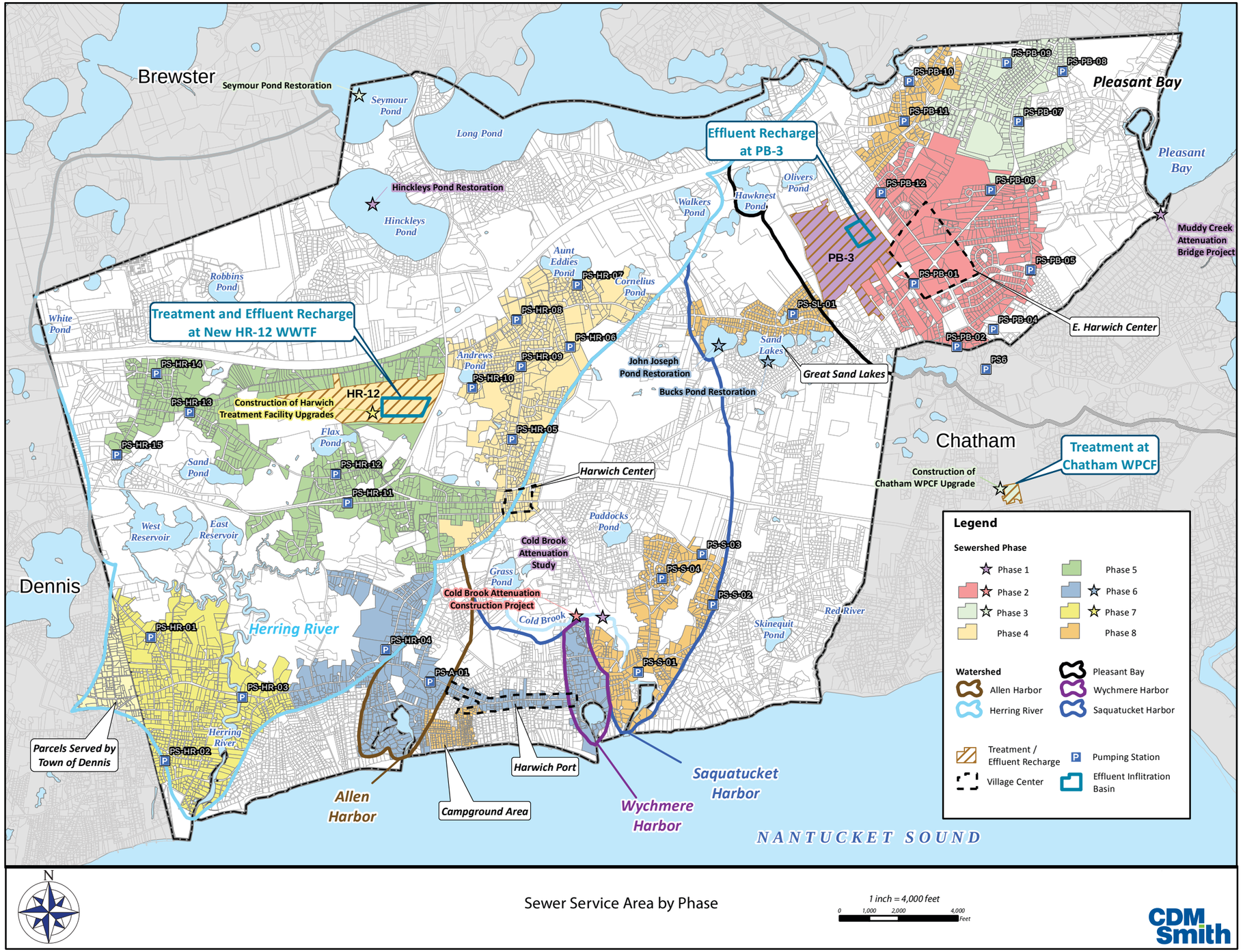

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Figure ES-8
Recommended Phasing Plan

Recommended Cost Recovery Plan

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 $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. Annual operation and maintenance costs at buildout are projected to about $3.0 million annually.

Harwich's Wastewater Implementation Advisory Committee (WIAC) is in the process of evaluating various cost recovery models. The WIAC is considering using a combination of methods including betterments, user fees, and the general tax base to pay for the multi-phase construction project and is currently discussing all of the options that can be implemented in a cost recovery program. Their goal is to not negatively impact any one Harwich area or residential group as they realize everyone in Town contributes to the nitrogen issue one way or another. Once the WIAC decides on a cost recovery model that it determines is fair and feasible, a recommended plan will be presented to the Board of Selectmen for review, modification and approval. The WIAC recommendation is targeted for June 2013 and that proposed program will be presented in the Final CWMP.

In the meantime, Table ES-3 has been presented to the Capital Outlay Committee and it is based on the phasing plan discussed earlier.

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 $230 million. However, the recommended program includes a buildout growth of about 26% 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

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

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 a 25% 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

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

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 $230 million. However, the recommended program includes a buildout growth of about 26% 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 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% 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.

Non-Infrastructure Components

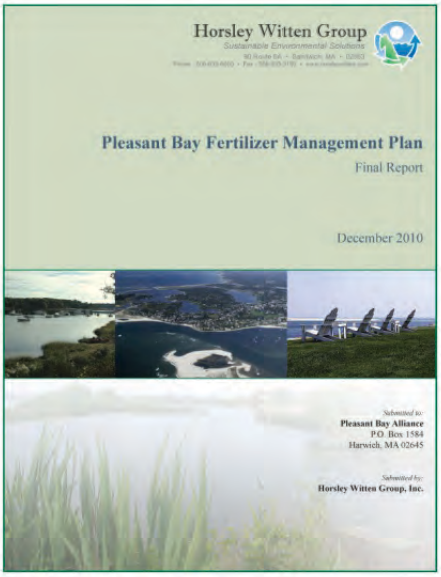
Harwich community meeting

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.

Fertilizer Education

Fertilizer applied to golf courses, agriculture, Town properties and residential lawns are estimated to account for approximately 7 to 13 percent of the total controllable nitrogen load to the estuaries. While the recommended wastewater mar tion 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.



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 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 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

Algae bloom in Hinkleys Pond

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.

4. Perform an inventory of all storm water pipes draining to ponds
5. Investigate other potential contaminant sources and develop solutions to restore
6. Implement programs to restore water quality

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 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 amount 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.

Land Use

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 signifi-

cantly. 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 will have the most impact.

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 plan discussed earlier allows for the 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) 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.

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.

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 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 embayment's and is not considered a feasible option by state and local officials.

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 utilized to help offset the power needs of the Town for that facility.