

EXECUTIVE SUMMARY
COMPREHENSIVE WASTEWATER MANAGEMENT PLANNING PROJECT
ALTERNATIVES SCREENING ASSESSMENT REPORT
TOWN OF BARNSTABLE, MASSACHUSETTS

ES.1 PROJECT BACKGROUND

The purpose of the Comprehensive Wastewater Management Planning (CWMP) Project is to provide an environmentally and economically sound plan for wastewater treatment and nutrient management in the Town of Barnstable (Town) for the next 20 years and with a vision for the Town's buildout projections. The CWMP Project will assess the wastewater and nutrient-related needs in the Town; evaluate appropriate mitigation measures for those needs; and develop a recommended plan for improved management systems. This Plan is meant to be consistent with the Town's Local Comprehensive Plan (LCP) which has the goals of:

- Preserve, protect and enhance sensitive natural habitats and systems.
- Provide Town services and infrastructure through an efficient, planned and prioritized process.
- Sustain diverse villages and livable neighborhoods for year round residents while providing housing opportunities for all.

This Alternatives Screening Analysis Report documents the third of five major phases of the CWMP. The first phase was the development of nutrient limits for the Town's coastal estuaries, which has been underway for several years and was summarized in the Needs Assessment Report and is briefly recapped in this report. The second phase was the needs assessment, which was documented in the April 2011 Needs Assessment Report, and evaluated and identified wastewater needs in Barnstable. The third phase is the identification and screening of alternative solutions to meet these wastewater needs, documented in this Alternatives Screening Analysis Report.

The last two phases of the Project consist primarily of the development of a draft recommended plan and a final recommended plan. These last two phases also include summary of the detailed

evaluations to develop the recommended plan, environmental impact analyses, and significant public outreach to inform the public on the details of the plan.

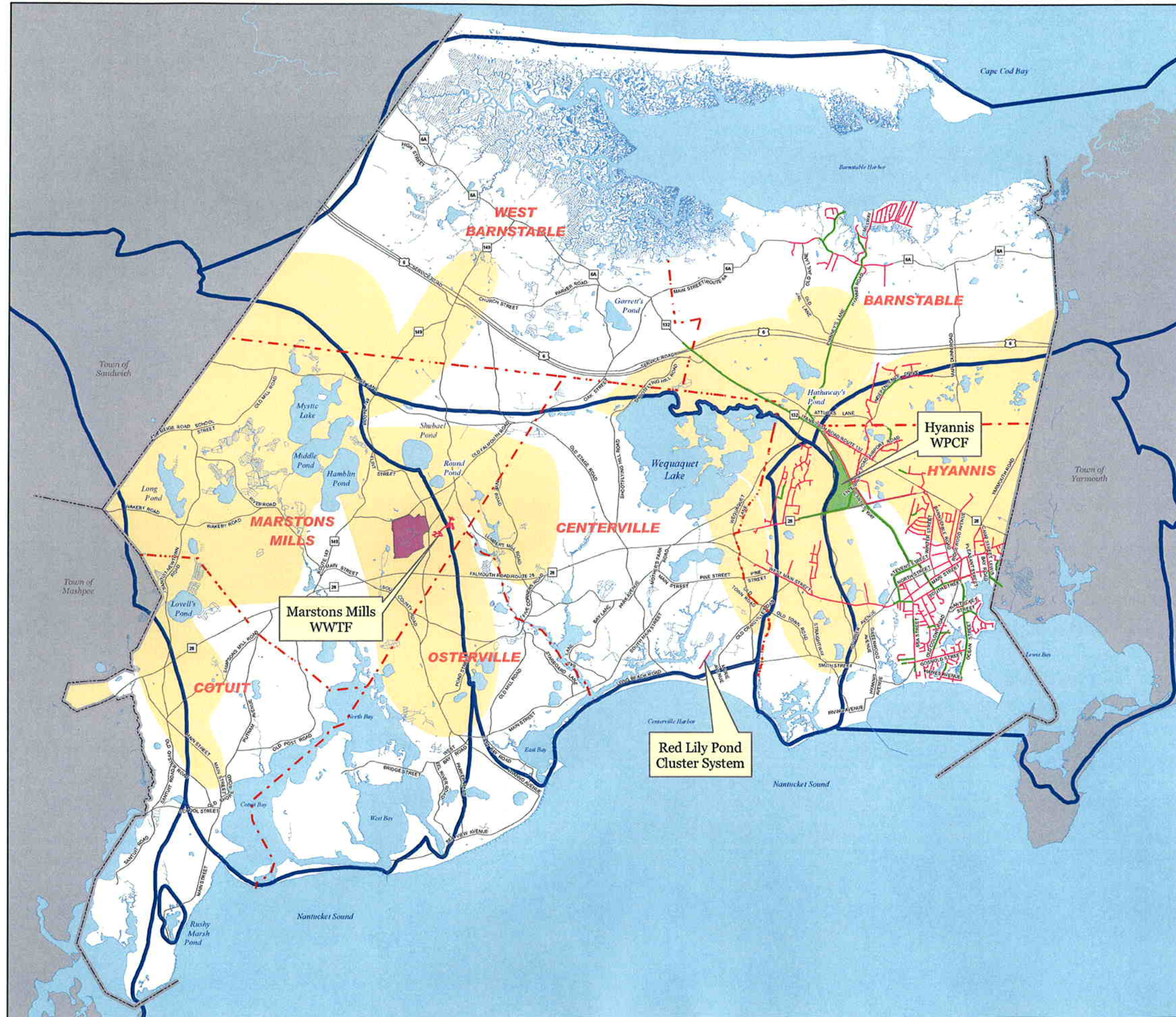
The design year for this planning project is 2035 which is 20 years after 2015 which is envisioned to be the starting point of the implementation of this Plan. We hope to complete this planning project and be started with implementation by 2015.

This Alternatives Screening Analysis Report was completed through the coordinated efforts of the Town of Barnstable Department of Public Works and Growth Management Department, and Stearns & Wheeler GHD serving as the project consultant. Valuable assistance has been provided from the Town's Geographic Information System Department, the Cape Cod Commission, and the Massachusetts Department of Environmental Protection (MassDEP) as well as several working groups comprised of Town staff, Stearns & Wheeler GHD staff and Town volunteers.

The Town of Barnstable is located in the middle portion of Cape Cod as shown in Figure ES-1. This figure also identifies the watersheds to Popponesset Bay, Rushy Marsh, Three Bay System, Centerville River System, Halls Creek, Lewis Bay, and Barnstable Harbor which are the primary estuarine waters in Barnstable. This figure also illustrates the many freshwater ponds that will be considered in this planning project; and it illustrates the seven villages that comprise the Town: Hyannis, Barnstable, Centerville, Osterville, Marstons Mills, Cotuit, and West Barnstable. It also illustrates the wastewater management facilities owned and operated by the Town.

The Town's water resources: groundwater, drinking water, pond water, and estuarine water form the basis of the Town's human health, environmental health, and economic prosperity. All of these water resources are interconnected and must be properly managed for sustainable development and to meet the three LCP goals listed above.

The Town is faced with several nutrient management and wastewater-related problems as it plans to protect its water resources and plans for growth and economic development. Nitrogen loadings into the Town's coastal watersheds are causing an overproduction of algae in several coastal estuaries and are impacting the water quality and marine resources in the estuaries. Recently completed studies by the Massachusetts Estuaries Project (MEP) indicate most (75 to 85 percent) of the nitrogen originates from wastewater sources. The other sources that comprise the remaining 15 to 25 percent include lawn and agricultural fertilizers, road and roof runoff, and precipitation from the sky. These reports have recommended extensive wastewater nitrogen

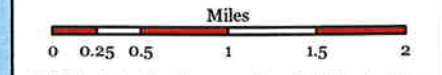


- Zones of Contribution to Public Water Supply**
- NOTE: this layer is a combination of the State Approved Zone II and the Town Approved GP and WP Overlay Districts.
- Marine Watersheds
 - Sanitary Landfill
 - Hyannis W.P.C.F.
 - Existing Force Main
 - Existing Sewer
 - Fire District / Village Lines
 - Major Roads
 - Town Boundary
 - Water Bodies

TOWN OF BARNSTABLE MASSACHUSETTS

Comprehensive Wastewater and Nutrient Management Plan

Project Location Figure ES-1



CWNMP_ProjectLocation_11x17_b.mxd J.A.B. 7/27/2010

TOWN OF BARNSTABLE GEOGRAPHIC INFORMATION SYSTEMS UNIT

FIGURE PREPARED FOR STEARNS & WHEELER GHD

removal to meet specific nitrogen limits that have been developed for the water bodies. The limits are called Total Maximum Daily Loads (TMDLs).

The Town draws its public water supplies from the groundwater system under the land area of the Town. This groundwater system (for all of Cape Cod) has been designated as a Sole Source Aquifer by USEPA, and as such is a highly protected resource. Current discharges from individual septic systems and from wastewater treatment facilities have the potential to impact this drinking water supply, and there are new MassDEP regulations that must be met to protect the resource. The Hyannis Water pollution Control Facility and the Marstons Mills Wastewater Treatment Facility are both located in groundwater water-supply areas (Zone II areas) and are expected to need to meet stringent treatment limits for total organic carbon in the future.

The Town has many freshwater ponds and lakes which provide fishing, swimming, and other aesthetic resources. Phosphorus loadings into the pond watershed areas (mainly from individual septic systems) are causing an overproduction of algae in several ponds and are impacting the water quality in these ponds. Recently completed studies have documented these impacts and the need to remediate them.

ES.2 SUMMARY OF ALTERNATIVE TECHNOLOGIES AND SOLUTIONS

Alternative technologies and solutions were identified and screened in the following major categories:

- ▶ Individual on-site system and cluster system alternatives
- ▶ Secondary/advanced treatment technologies to attain Biological Nitrogen Removal (BNR) and/or Enhanced Nitrogen Removal (ENR) standards of 6 and/or 3 mg/L total nitrogen (respectively) in the effluent on average
- ▶ Technologies to achieve less than 3 mg/L Total Organic Carbon in the effluent on average
- ▶ Technologies to achieve less than 3 mg/L total nitrogen in the effluent on average
- ▶ Phosphorus removal technologies/processes
- ▶ Disinfection technologies
- ▶ Residuals management technologies and reuse/disposal alternatives
- ▶ Treated water recharge technologies
- ▶ Potential sites for recharge facilities as well as for treatment facilities

- ▶ Collection system technologies
- ▶ Wastewater flow and loading reduction technologies
- ▶ Additional non-wastewater nutrient mitigation alternatives

Many technologies and solutions were evaluated for each of these categories, as detailed in following chapters. The following list identifies the alternative technologies and scenarios that are most feasible and will be further evaluated and discussed in the next phase of the study.

1. Individual On-Site System and Cluster System Alternatives

- ▶ Decentralized treatment alternatives that are approved by the MassDEP as part of their innovative and alternative (I/A) technology program for areas outside satellite or centralized sewer service areas in Barnstable.

2. Secondary/Advanced Treatment Technologies to attain Biological Nutrient Removal (BNR) and/or Enhanced Nitrogen Removal (ENR) standards of 6 and/or 3 mg/L total nitrogen (respectively) in the effluent on average:

- ▶ Multiple stage processes (Modified Ludzack-Ettinger, Bardenpho, etc.) for nitrogen and phosphorus, or nitrogen removal
- ▶ Membrane bioreactors utilizing many of these same multiple stage processes
- ▶ Oxidation ditches
- ▶ Sequencing batch reactors
- ▶ Denitrifying filters
- ▶ Biological aerated filters
- ▶ Amphidrome® process (only for small satellite systems)
- ▶ Fixed-film enhanced processes

3. Technologies to achieve less than 3 mg/l Total Organic Carbon in the effluent on average:

- ▶ Granular activated carbon adsorption
- ▶ Membrane filtration of reverse osmosis and nano filtration
- ▶ Advanced oxidation as a polishing step or for side stream treatment

4. Technologies to Achieve less than 3 mg/L total nitrogen in the effluent on average.

- ▶ Granular activated carbon adsorption
- ▶ Ion exchange
- ▶ Membrane filtration
- ▶ Advanced oxidation for side stream treatment

5. Phosphorus removal technologies/processes.

- ▶ Multiple stage biological processes for biological phosphorus removal
- ▶ Chemical precipitation processes
- ▶ Filtration processes to remove fine precipitates

6. Disinfection with ultraviolet light.

7. Residuals Management Alternatives.

- ▶ Appurtenant processes of screening and grit removal
- ▶ Septage and trap grease segregation from wastewater for thickening and transportation to a regional reuse/disposal facility
- ▶ Sludge thickening and transportation to a regional reuse/disposal facility
- ▶ Sludge minimization technologies

8. Treated water recharge technologies.

- ▶ Sand infiltration beds
- ▶ Subsurface infiltration
- ▶ Spray irrigation and drip irrigation
- ▶ Ocean outfall
- ▶ Well injection and wick well technologies as accepted by MassDEP and if total organic carbon treatment is provided to less than 1 mg/L
- ▶ Wetland restoration

9. Collection System Technologies.

- ▶ Gravity sewers and lift stations
- ▶ Pressure sewers and grinder pumps
- ▶ Vacuum sewers for possible expansion of existing vacuum system

10. Wastewater flow and loading reduction alternatives.

- ▶ Infiltration and Inflow (I/I) reduction to sewers
- ▶ Reduction of household water consumption
- ▶ Continued use of the existing groundwater rate structure to discourage greater water consumption and wastewater generation
- ▶ Wastewater reuse and recycling
- ▶ Wastewater loading regulations through reduced use of garbage disposal units and (as possible) industrial/commercial separation of non-sanitary wastes and disposal as solid waste
- ▶ Waterless toilets for isolated areas of Barnstable by informed individuals willing to take on the responsibility of these systems

11. Additional non-wastewater nutrient mitigation alternatives.

- ▶ Fertilizer management
- ▶ Pet/animal waste management
- ▶ Improved landscape design practices to minimize the need for fertilizer, pesticides, and herbicides
- ▶ Watershed modifications and constructed wetlands for nutrient management
- ▶ Stormwater management and treatment
- ▶ Estuarine inlet modifications for increased tidal flushing
- ▶ Pond treatment to improve pond water quality
- ▶ Modified zoning or sewer use regulation to meet growth/flow neutral requirements/goals
- ▶ Expanded shellfish aquaculture

The feasible alternatives and technologies listed above have been combined and grouped into the following alternative plans:

1. Alternative Plan No. 1: Decentralized Plan A

This plan would be the first of 2 decentralized wastewater management approaches and would utilize the following main components:

- ▶ Continued use of Title 5 septic systems as allowed in areas where nitrogen TMDLs do not require wastewater nitrogen removal.
- ▶ Implementation of individual nitrogen removal systems to areas where 25% wastewater nitrogen removal (or less) is required
- ▶ Multiple satellite systems and development of remote recharge sites for the areas where additional nitrogen removal is needed.
- ▶ Expansion of Hyannis WPCF, sewer extension to eastern portions of Town, and development of remote recharge sites

2. Alternative Plan No. 2: Decentralized Plan B

This plan would be the second of two decentralized wastewater management approaches and would utilize the following main components:

- ▶ Continued use of Title 5 septic systems as allowed in areas where nitrogen TMDLs do not require wastewater nitrogen removal.
- ▶ Construction of up to two new satellite treatment facilities in the western part of Town, and development of associated sewer extensions and recharge sites.
- ▶ Expansion of the Hyannis WPCF, sewer extensions to eastern portions of Town, and development of remote recharge sites.

3. Alternative Plan No. 3: Centralized Plan A

This plan would be the first of 2 centralized wastewater management approaches and would utilize the following main components:

- ▶ Continued use of Title 5 septic systems as allowed in areas where nitrogen TMDLs do not require wastewater nitrogen removal.

- Expansion of the Hyannis WPCF, sewer extension to all portions of Town needing wastewater nitrogen removal, and development of remote recharge sites.

4. Alternative Plan No. 4: Centralized Plan B

This plan would be the second of the centralized wastewater management concepts and would utilize the following main components:

- Use of an ocean outfall from the Hyannis WPCF.
- Continued use of Title 5 septic systems as allowed in areas where nitrogen TMDLs do not require wastewater nitrogen removal.
- Expansion of the Hyannis WPCF and sewer extension to all portions of Town needing wastewater nitrogen removal.

5. Alternative Plan No. 5: Development of New Public Water Supply Sites to Mitigate Impacts to Current Water Supplies.

This plan would work to relocate water supplies in Town and would utilize components of the decentralized and centralized plans/approaches No 1-4. It would utilize the following main components:

- Development of new public water supply sites and Zone II Water Supply Protection Areas which would allow impacted water supply wells to be abandoned
- Possible use of the abandoned water supply areas for treated water recharge
- Continued use of Title 5 septic systems as allowed in areas where nitrogen TMDLs do not require wastewater nitrogen removal.
- Expansion of the Hyannis WPCF, sewer extension to portions of Eastern Barnstable needing wastewater nitrogen removal, and development of remote recharge sites.
- Development of up to 2 new satellite treatment facilities and associated sewer extensions and recharge sites in portions of Western Barnstable

6. Additional items Common to all Alternative Plans.

The following non-wastewater nitrogen management components would be part of all Alternative Management Plans:

- Fertilizer and pet waste management
- Stormwater management through best management practices and education to homeowners,
- Sediment removal at Mill Pond to increase Nitrogen Attenuation for the Marstons Mills River watershed
- Estuarine inlet opening and maintenance for Rushy Marsh Pond
- New zoning or land use regulations to create flow/growth neutral requirements for sewer extensions where Growth Centers are not identified. This will need to comply with MassDEP requirements to gain eligibility for 0% low interest loans as allowed by the 2009 Environmental Bond Bill legislation.
- Expanded use of aquaculture in the estuaries to reduce nitrogen concentrations and to promote local fisheries

ES.3 NO ACTION ALTERNATIVE

The No Action alternative was presented in the Draft Needs Assessment Report to identify the consequences of doing nothing. Under the No Action alternative, degradation of Popponeset Bay, Three Bay System, Centerville River System, and Lewis Bay will continue from the excessive nitrogen loading in the watersheds to these water bodies, primarily from the on-site septic systems. The MEP technical reports used colored maps to illustrate how the nitrogen concentrations would increase from their current levels to the projected buildout levels defined by current zoning. The increased nitrogen would promote further algal blooms, fish kills, eel grass loss, and other impacts to the habitat of the marine estuaries.

A portion of the Eastern side of Barnstable probably would be sewered as allowed by the 2007 Wastewater Facilities Plan.

If the Town did not demonstrate progress to meet the nitrogen TMDLs, MassDEP would most likely initiate an enforcement action against the Town as allowed by state law.

If the Town did not demonstrate progress to meet the new Total Organic Carbon discharge limits, MassDEP would most likely initiate an enforcement action against the Hyannis WPCF and the Marstons Mills WWTF as allowed by state law.

If progress is not made on the Barnstable Ponds Action Plan, pond water quality will decline.

ES.4 FUTURE EVALUATIONS TO IDENTIFY A RECOMMENDED PLAN

The first phase of the CWMP Project was the development of nutrient limits. The second major phase of the Project was the identification of the wastewater and nutrient management needs as documented by the Needs Assessment Report. This Alternatives Screening Analysis Report documents the third major phase. The next phase of the Project (Phase IV) will provide a detailed evaluation of the screened alternatives retained for further evaluation. Detailed evaluation will include cost effectiveness comparisons using present-worth evaluation and evaluation of non-monetary factors. Prior to initiating Phase IV, specific subtasks of Phase VI are needed. These tasks are listed below with the Phase IV tasks

A. Subtasks of Phase VI – Environmental and Public Review Process.

1. Prepare and conduct a public participation program.
2. Prepare, submit, and coordinate the public review of the Environmental Notification Form (ENF) and Development of Regional Impact (DRI) Document.

B. After review of the ENF and DRI Documents, proceed with Phase IV – Detailed Evaluation and Development of the Nutrient Management Plan.

1. Perform subsurface and/or environmental investigations and modeling for potential nutrient management sites.
2. Prepare a methodology of the planned detailed evaluations for project and regulatory review.
3. Perform present-worth evaluations of the alternative nutrient management scenarios.

4. Perform non-monetary evaluations of the alternative scenarios.
5. Perform an environmental impact analysis of the alternative scenarios.
6. Complete the present-worth analysis with the non-monetary evaluation and the environmental impact analysis to select the most appropriate management scenario.
7. Develop and present the recommended Nutrient Management Plan, and prepare the Nutrient Management Plan and Draft Environmental Impact Report (DEIR).
8. Submit the Nutrient Management Plan and DEIR for regulatory and public reviews.

Water quality modeling by the Massachusetts Estuaries Project (MEP) team will be integrated into these detailed evaluations. This modeling was recently initiated for Lewis Bay as part of regional evaluations to meet the nitrogen TMDLs in that water body. The water quality modeling for the other estuaries will typically be initiated in items 4 and 5 (listed above) to identify the nitrogen management performance of the alternative plans/approaches.

This water quality modeling work will be guided by a Working Group comprised of the following individuals and organizations:

- Dale Saad, Ph.D., Barnstable DPW
- Ed Eichner, UMass SMAST
- Brian Howes, Ph.D., UMass SMAST
- Tom Cambareri, Cape Cod Commission
- Nathan Weeks, P.E., GHD Inc.

ES.5 INTER-MUNICIPAL COOPERATION

Inter-municipal discussions and cooperation are ongoing between Barnstable and the towns of Yarmouth, Mashpee, and Sandwich who share the estuarine watersheds that have nitrogen TMDLs. These cooperative efforts include:

- Invitation of the three towns to be members of the Citizens Advisory Committee.

- ▶ Regional wastewater evaluations with the Town of Yarmouth as documented in Appendix 1-4 of the Needs Assessment Report.
- ▶ Water quality modeling of Lewis Bay as discussed above.
- ▶ Regional wastewater evaluations as part of the Mashpee Watershed Nitrogen Management Planning Project.

Additional discussion and cooperation is planned with the Town of Sandwich as they initiate their CWMP Project later in 2011.

The detailed evaluations of the CWMP Project will explore the possible inter-municipal agreements that may be needed for regional wastewater facilities, shared water quality monitoring, and TMDL compliance. These evaluations will include the Town's Growth Management and Legal Departments.