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Common Terms and Acronyms	
303(d) List	State's list of impaired and threatened waters per CWA Section 303(d)
ACEC	Area of Critical Environmental Concern
ADD	Average (water) Demand per Day
BGS	Below Ground Surface
BMP	Best Management Practice (also a term for a generic stormwater treatment system)
BOD_5	5-Day Biochemical Oxygen Demand (measure of the organic strength of wastewater)
BoH	Board of Health
CFR	Code of Federal Regulations
CFU	Colony Forming Units (bacteria measurement)
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
CWMP	Comprehensive Wastewater Management Plan
DEIR	Draft Environmental Impact Report
DEP	Department of Environmental Protection
DO	Dissolved Oxygen
DRI	Development of Regional Impact
EIR	Environmental Impact Report
ENF	Environmental Notification Form
EOEEA	Executive Office of Energy and Environmental Affairs
EP	Environmental Partners Group, LLC
ESF	(Tisbury) Emergency Services Facility
FEIR	Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FIRM	Federal Insurance Rate Map
GIS	Geographic Information System
GWDP	Groundwater Discharge Permit
gpd	Gallons per Day
gpm	Gallons per Minute
I/A	Innovative and Alternative (reference to on-site wastewater systems that remove nutrients)
I/I	Infiltration and Inflow (groundwater and stormwater that enter a sewer system through defects or connections; neither should be allowed into a sewer system)
IMA	Inter-Municipal Agreement
IUP	Intended Use Plan (SRF program funding list)
LiDAR	Light Detection and Ranging (terrain and elevation data)
MassDEP	Massachusetts Department of Environmental Protection
MASSGIS	Massachusetts Office of Geographic Information Systems
MCL	Maximum Contaminant Levels
MEP	Massachusetts Estuaries Project
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
MG	Million Gallons

Common Terms and Acronyms	
MGD	Million Gallons per Day
mg/L	Milligrams Per Liter
MHI	Mean Household Income
MVC	Martha's Vineyard Commission
NEIWPCC	New England Interstate Water Pollution Control Commission
NEPA	National Environmental Policy Act
NHESP	National Heritage and Endangered Species Program
NPC	Notice of Project Change
NRCS	National Resources Conservation Service (source for soils data)
ppd	Pounds per Day
PPM	Parts per Million (equal to mg/L)
ppy	Pounds per Year
PRB	Permeable Reactive Barrier
SAS	Soil Absorption System (leaching field for septic system)
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition (process control and monitoring system)
SMAST	University of Massachusetts-Dartmouth School of Marine Science and Technology
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflow
Title 5	310 CMR 15.000 – State Environmental Code (Septic System Regulations)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TR-16	NEIWPCC Technical Report No. 16 – Guides for the Design of Wastewater Treatment Works (General for technical design criteria used by engineers)
TSS	Total Suspended Solids
UMDI	UMass Donahue Institute
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	Ultraviolet (method of disinfectant for wastewater effluent)
WPA	Wetlands Protection Act
WQS	Water Quality Standard
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Project Identification and Purpose

Tisbury's two signature embayments, Lake Tashmoo and Lagoon Pond, are impaired due to excessive nitrogen loading, and Vineyard Haven Harbor is impaired due to bacteria that could affect shell fishing. Tisbury has a long history of protecting its embayments by establishing Districts of Critical Planning Concern in conjunction with the Martha's Vineyard Commission, constructing a sewer system and wastewater treatment facility to resolve bacteria pollution in Vineyard Haven Harbor, and enacting Board of Health regulations to control nitrogen pollution from septic systems and fertilizers.

Wastewater management pressures have been mounting in Tisbury over the last several years as treatment facility capacity has become restrictive while there is an increasing need to provide wastewater service to accommodate multiple challenges within the community, such as:

- Nitrogen impairments and water quality degradation in Lake Tashmoo and Lagoon Pond;
- Wastewater service limitations in the Town's State Road (B2) district;
- Expansion of businesses and housing in the downtown area (the B1 and W/C Districts),
- Increased affordable housing proposals, and
- Other municipal priorities such as protection of the drinking water aquifer and improvement of Vineyard Haven Harbor water quality.

The Town's strategy for addressing these needs is developed through a Comprehensive Wastewater Management Plan (CWMP). The CWMP is a multi-phase program that ultimately articulates the Town's strategy for managing wastewater over a 20-year planning period. Tisbury's Select Board has created a Water Resources Committee to advise the Select Board in the areas of public policy and long-range planning related to water resources, which includes the development of the CWMP. This report is the culmination of the first phase, the Needs Assessment, which is an assessment of existing and future needs.

The Needs Assessment describes water quality in the Town's watersheds, identifies impacts associated with pollutant loadings from wastewater disposal and other sources under existing and anticipated future population levels, and identifies areas of need for wastewater disposal solutions based on each watershed's Total Maximum Daily Load (TMDL) goals, which were established by the Massachusetts Estuaries Project (MEP).

The comprehensive strategy will be for wastewater and nitrogen management for a 20-year time period effective 2023 – 2043, which is the estimated time period for full buildout and the next Master Plan update for growth and development.

The watershed that contributes groundwater and surface water to Lake Tashmoo includes areas of Tisbury, West Tisbury and a small segment of Oak Bluffs. Lagoon Pond's watershed includes Tisbury and Oak Bluffs, and small portions of West Tisbury and Edgartown. While the CWMP is a Town of Tisbury project, the CWMP will include recommendations for intermunicipal agreements between

Tisbury, Oak Bluffs, and West Tisbury to address water quality within the Lagoon Pond and Lake Tashmoo watersheds that are shared by Tisbury with these communities.

Public Participation Programs

There are to be public forums over the course of the CWMP planning effort, in addition to Water Resource Committee and Select Board meetings. Communications throughout development of the CWMP provide an opportunity for public education, outreach, and participation.

Existing Conditions – Natural Environment

The MEP's Linked Watershed-Embayment Approach models the effects of excessive nitrogen loading on the embayment systems. The MEP released the results of its modeling of Lagoon Pond and Lake Tashmoo watersheds in 2010 and 2015, respectively. After the MEP assessed the watersheds, MassDEP and MEP jointly issued TMDLs for Total Nitrogen for Lagoon Pond (2015) and Lake Tashmoo (2017).

The MEP found that the primary ecological threat to Lake Tashmoo and Lagoon Pond is from nutrient enrichment. The models show that both Lagoon Pond and Lake Tashmoo are at risk of cultural eutrophication (excessive richness of nutrients from human sources). The estuaries are already showing losses of eelgrass and infaunal (within sediments) habitat due to nitrogen enrichment.

The MEP distinguishes between non-controllable sources and controllable sources of nitrogen. Sources such as sediments and atmospheric deposition are not locally controllable. Sources such as fertilizers and septic systems are locally controllable.

The MEP selected sentinel stations as representative of the water quality in each embayment and established nitrogen concentration targets at the sentinel locations that would restore healthy eelgrass and habitat in the embayment.

In Lagoon Pond, the MEP set a tidally averaged nitrogen target of 0.35 mg N/l at the sentinel monitoring station. To reach this goal, 47% of the total nitrogen load to Lagoon Pond from septic systems must be removed. The nitrogen load from septic systems in the watershed would need to be reduced by 13,020 pounds per year (ppy).

In Lake Tashmoo, the MEP set a tidally averaged nitrogen target of 0.36 mg N/l at the sentinel monitoring station. The primary goal of the TMDL implementation will be to lower the concentration of nitrogen in Lake Tashmoo by reducing the load from on-site wastewater systems by 42.5%, which is a 31.9% reduction in overall nitrogen load to Lake Tashmoo. The septic system nitrogen load from the entire watershed would need to be reduced by 6,435 pounds of total nitrogen per year.

Tisbury's embayments and harbor waters are designated Class SA waters, defined as an excellent habitat for fish, other aquatic life and wildlife. The Division of Marine Fisheries (DMF) classifies shellfishing areas as Approved or Generally Approved in the Vineyard Have Harbor and embayments, except for prohibitions in the West Arm of Lake Tashmoo near Mud Creek and at the southern end of Lake Tashmoo, and seasonal prohibitions in Vineyard Haven Harbor.

Tisbury's three public bathing beaches (Lake Tashmoo Town Beach, Tisbury Town Beach, and Owen Park Beach) have experienced bacteria levels in excess of state water quality standards. In 2021, the Tisbury Town Beach and Owen Park Beach had water samples that exceeded the bacterial standard.

Soils are highly permeable throughout Tisbury, with groundwater well below the ground surface, which allows for quick draining of water, but the soils are a poor filter for pollutants such as nitrogen. Private and public wells could be at long-term risk from substandard septic systems.

Existing Conditions – Built Environment

Tisbury's master planning is critical to this CWMP. The Planning Board is currently preparing an updated Master Plan. The Master Plan will articulate planning and land use goals, including forecasts of current and future housing and commercial development, all of which have implications to the Town's wastewater needs.

A common and consistent theme throughout the Town's planning efforts is protecting the island's coastal resources from wastewater pollution while acknowledging how this focus affects affordable housing and economic development Tisbury's 2004 Community Development Plan acknowledged the constraints that on-site wastewater systems place on potential future development by stating, "Future development of land is limited by the lack of access to town sewer services within those parts of Tisbury not served by town sewer." In addition, because of the limitations of on-site systems, "If developable lots are located within wetlands or nitrogen sensitive areas, there are further limits to the development's size and density. In addition to stricter regulations that could require advanced de-nitrification systems, the installation cost and maintenance of these systems can be a financial constraint to the development of affordable housing."

The Tisbury Water Works (TWW) is the public water utility for the Town of Tisbury. The TWW has 2,571 accounts in its billing database, with 2,550 active accounts. Residential accounts are 89.5% of all accounts, with 83% of total usage.

Tisbury's population and economic growth will not be constrained by the Town's water supply. According to Environmental Partners' 2020 report, *Water Distribution System Capital Improvement Plan*, the Town's three well fields have sufficient capacity to meet maximum day demands for the next fifteen years. The following Table ES-1 compares the average day demand (ADD) forecasts as developed by the Division of Conservation and Recreation (DCR) and EP.

Table ES-1: Comparison of Average Day Water Demand Forecasts (Million Gallons per Day)

	2020	2025	2030	2035
DCR	0.77	0.80	0.83	N/A
EP	0.78	0.81	0.85	0.89

A Groundwater Protection Overlay District in the Town's Zoning Bylaws protects Tisbury's three public well fields; however, the wells are vulnerable to contamination because of the high transmissivity of the soils in the sole source aquifer. To date, the levels of all monitored contaminants, including nitrogen, from all three public drinking water sources are well below

regulatory thresholds. PFAS was non-detectable. MassDEP considers the susceptibility to contamination to be high, based on the following high threat land uses within the Water Supply Protection Area:

- Pesticide Storage or Use (quantity of 5)
- Bus and Truck Terminal at Carroll's Trucking on Edgartown Road
- Photo Processor Wooden Tent Photo (EP is unable to locate photo processors in the Zone IIs.)
- Hazardous Materials Storage (quantity of "few")
- Tisbury Town Landfill (capped)
- Residential Underground Storage Tanks (quantity of "some")

Tisbury's wastewater planning began in the 1970's in response to bacterial pollution in the harbor, which culminated in sewering of the B1 District in 2004. To date, the Town has targeted sewers for its commercial centers, now having plans to extend sewers to the B2 District.

The Town's wastewater system has limited capacity, and is not designed to accommodate long-term growth through expansion of the sewer service area. Instead, the system primarily accommodates some growth on parcels in the service area that, in 2004, expected to need additional wastewater capacity. An upcoming upgrade to the WWTF will provide additional capacity targeted for the B2 District.

The Board of Health (BoH) recognized the impact that nitrogen from on-site wastewater systems has on the sustainability of the Town's coastal ponds and water resources and to the health and safety of the public. The BoH has been proactively regulating on-site wastewater systems in relation to nitrogen since at least the 1980's. The BoH has instituted regulations that seek to limit the amount of nitrogen discharged by septic systems to the limit that is technologically feasible, and collaborated on a public/private pilot study of an enhanced innovative/alternative system.

While the TMDLs are focused on watershed-based flows and loads, Tisbury does not contribute the entire flow or load to the Lake Tashmoo or Lagoon Pond watersheds. One of the purposes of this CWMP is to establish the nitrogen load that is Tisbury's responsibility, and also to identify where communities in each watershed can collaborate to reduce nitrogen loading. According to a February 2015 letter report from Wright-Pierce, the Martha's Vineyard Commission prepared estimates of wastewater flow tributary to Lake Tashmoo and Lagoon Pond for each community. Tisbury, assuming nitrogen load is directly proportional to flow, contributes 80% of the nitrogen load to Lake Tashmoo, with West Tisbury responsible for almost 20%. The Lagoon Pond watershed nitrogen load is divided between the communities of Tisbury, West Tisbury, and Oak Bluffs, at 33%, 7%, and 60% respectively

Future Conditions

Climate change and the associated sea level rise and increased storm intensity are important planning concerns for any coastal community. Tisbury's long-term wastewater planning must be sustainable, without contributing to climate change, and with resilience the effects of climate change. In particular, coastal flooding and sea level rise will need to be considered while protecting the island's coastal waterbodies and planning for any new infrastructure. In addition, plans should

minimize climate change affects and be adaptable and resilient to the overall impact of climate change on the ecological balance, including the effect on estuaries, which could alter planning goals.

Tisbury has stringent BoH regulations for properties in the Coastal Zone and in the DCPCs for Vineyard Harbor and Lagoon Pond, which will help to reduce flooding impacts under existing conditions. However, climate change will cause sea level rise and more frequent flooding during dry and wet days, which can compromise on-site wastewater systems.

Tisbury's planning history has been consistent in its goal to maintain a small town character based on neighborhoods with designated economic centers (the B1, B2, and W/C zoning districts). However, the pressure for housing development, driven by vacation and owner-occupied (both market rate and affordable) housing is driving denser development. The density of development is challenging the Town's municipal wastewater system, which is near capacity, and the ability of on-site wastewater systems to accommodate the development.

Prior planning, through zoning and BoH regulations such as Districts of Critical Planning Concern, has restricted the construction and expansion of residential properties because of the potential for nitrogen pollution from septic systems. This has limited the diversity of housing that can support the Town's work force.

Wastewater Flows and Loads

To comply with the TMDLs, existing nitrogen loads must be removed in sufficient quantity, and all new nitrogen loads must be prevented from discharging to nitrogen-impaired watersheds, or existing nitrogen loads will need to be removed to offset the new loads.

In addition to the no growth scenario requested by the Planning Board, the CWMP uses the Planning Board's 2013 projections (24% growth in the Lake Tashmoo watershed, and 14% growth in the Lagoon Pond watershed) as the base growth estimate.

Since the trend in the recently proposed developments is to redevelop existing developed properties into uses with higher density housing units and higher wastewater flows than current conditions, population and nitrogen loads could surpass previous estimates. Therefore, the projected increase in nitrogen loads established by the MEP (38% increase in the Lake Tashmoo watershed, and 24% in the Lagoon Pond watershed) for each watershed will also be evaluated to provide an ultimate buildout scenario for comparison. For the watersheds, future loads may increase to:

- Lake Tashmoo 8,870 to 9,880 ppy
- Lagoon Pond 15,310 to 18,000 ppy

For Tisbury only, future loads may increase to:

- Lake Tashmoo 7,260 to 8,080 ppy (80% of the watershed's total)
- Lagoon Pond 5,380 to 6,330 ppy (33% of the watershed's total)

By assuming these growth scenarios, the Town can understand where the available avenues to restoring its estuaries may need to change direction. The intent of creating growth scenarios is not

to recommend a projected increase in development or nitrogen load, but to show how increases in either may affect the Town's decision-making. For example, the Town may want to plan to remove excess nitrogen in the short-term to allow for beneficial development, or if an unexpected development is proposed, the Town will have illustrative scenarios to understand the potential impact on its wastewater plans.

Wastewater Needs Assessment

The Town's most urgent wastewater need is to reduce nitrogen in the Town's embayments, with a long-term need to protect the Town's public and private drinking water supplies, all while protecting the community's public and environmental health.

The optimal solution to resolving the town's wastewater needs would complement the Town's planning objectives and priorities, support economic sustainability and affordable housing in areas designated for each, protect the sole source aquifer, avoid unintended development in neighborhoods, and meet the TMDL goals to restore the Town's estuaries.

Alternatives that could be considered for analysis include source control strategies such as enhanced on-site wastewater systems and wastewater treatment facilities, broad approaches such as fertilizer regulations and zoning restrictions, "end of pipe" or remediation technologies, or modifications to the embayments themselves through inlet widening.

The MVC's 2009 Island Plan presented sewering densely developed areas within 10,000 feet of the WWTF to optimize the cost of installing infrastructure, disposing of as much effluent as possible outside of the nitrogen sensitive watersheds, using enhanced I/A on-site systems (including technologies undergoing pilot phase studies), employing groundwater remediation such as permeable reactive barriers, and "end-of-pipe" solutions such as aquaculture.

From a wastewater focus, four general alternatives present the range of primary nitrogen mitigation strategies for wastewater sources:

1. Collect and treat wastewater at a centralized or satellite facility with all of the effluent discharged outside of a nitrogen sensitive watershed.
2. Collect and treat wastewater at a centralized or satellite facility with a portion of the effluent discharged into the Lake Tashmoo watershed as is the current practice.
3. Require enhanced I/A systems throughout both watersheds, whether individual on-site systems or in a cluster arrangement, in accordance with the new Board of Health regulations.
4. Combine some or all three of the above alternatives.

Because the recent Board of Health regulations do not allow conventional I/A onsite systems under most conditions in the nitrogen sensitive watersheds, they are not being considered for continued use as a primary solution, although they could be included as a secondary option where allowed by the Board of Health. Only alternative 1 completely removes nitrogen from the Lake Tashmoo and Lagoon Pond watersheds.

Table ES-2 presents the existing wastewater flows that would need to be mitigated under each discharge scenario to meet TMDL goals. The existing flows are identical to a No Growth scenario.

The table presents the total watershed flows as well as the flows from Tisbury's portion of each watershed. The values for the Lake Tashmoo watershed use 80% of the total nitrogen load, which is comparable to the MVC's estimated portion of Tisbury's overall wastewater flow in the watershed. The values for the Lagoon Pond watershed use 33% of the total nitrogen load to account for Tisbury's portion of the nitrogen load.

Table ES-2: Existing (No Growth) Wastewater Flows (gpd) needed to Meet Total Nitrogen TMDLs

Watershed	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Wastewater Flow from Enhanced I/A Onsite Systems
		Wastewater Flow	Lake Tashmoo Watershed Wastewater Flow to Offset Load from Lagoon Pond	
Entire Lake Tashmoo	89,500	92,900	--	130,600
Tisbury's Lake Tashmoo	73,300	76,000	--	106,800
Entire Lagoon Pond	168,100	168,100	41,300	245,100
Tisbury's Lagoon Pond	59,100	59,100	14,500	86,200

The growth (buildout) alternatives would require additional wastewater to be captured and treated. The following two tables list the flows that need to be mitigated under each growth scenario for Tisbury's share of the watershed loads in the Lake Tashmoo watershed and the Lagoon Pond watershed respectively.

Table ES-3: Tisbury's Share of Lake Tashmoo Wastewater Flows (gpd) under Each Growth Scenario to Meet the TMDL

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed	Wastewater Flow from Enhanced I/A Onsite Systems
Zero Growth	73,300	76,000	106,800
24% Growth	90,800	92,200	132,500
38% Growth	101,100	104,900	147,400

Table ES-4: Tisbury's Share of Lagoon Pond Wastewater Flows (gpd) under Each Growth Scenario to Meet the TMDL

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Wastewater Flow from Enhanced I/A Onsite Systems
		Flow	Lake Tashmoo Watershed Flows to Remove to Offset Load from Lagoon Pond	
Zero Growth	59,100	59,100	13,500	86,500
14% Growth	67,300	67,300	15,000	98,200
34% Growth	79,200	79,200	18,000	115,500

The alternatives analysis to be completed in Phase 2 will provide more insight into the various possible and feasible solutions, which might include a combination of these alternatives or modifications to these alternatives.

Since the MEP analysis determined that the controllable nitrogen load is predominately from septic systems, the evaluation of alternatives should focus on resolving the wastewater nitrogen loads at their source, supplemented by other technologies to address all avenues of nitrogen mitigation.

It will be important for the Tisbury Planning Board to create zoning regulations that allow the community to reach its overarching goals as the Town institutes changes to its wastewater infrastructure, including managing growth in areas that could be affected by improved nitrogen management.

SECTION 1 INTRODUCTION

SECTION 1.1 PROJECT IDENTIFICATION AND PURPOSE

Tisbury's embayments, Lake Tashmoo and Lagoon Pond, and Vineyard Haven Harbor are experiencing water quality threats from excess nitrogen and bacteria. Water quality in each waterbody has degraded to the point where they are experiencing algal blooms, loss of eelgrass and related habitat, shellfishing bed closures, and bathing beach closures. Restoring the water quality of the Town's important water bodies is of paramount concern to the community.

Wastewater management pressures have been mounting in Tisbury over the last several years as treatment plant capacity has become very restrictive while concurrently there is an increasing pressure to provide wastewater service to accommodate multiple needs within the community: supporting economic development in areas designated for growth such as the Town's business corridor in the State Road (B2) district, additional flows from existing connections in the downtown area (the B1 District), affordable housing proposals, and other municipal needs.

At the same time, the Department of Environmental Protection (DEP) has issued their reports on Lake Tashmoo and Lagoon Pond through the Massachusetts Estuaries Project (MEP), which sets nitrogen reduction goals to each of these embayments that the Town must also meet. A wastewater management program must therefore address two broad objectives: supporting economic and community priorities identified by the Planning Board and Select Board and established by Town Meeting vote, and meeting environmental goals for the two estuaries and harbor.

The Town's strategy for addressing these needs is developed through a Comprehensive Wastewater Management Plan (CWMP). The Town is formally undertaking their CWMP. This effort is led by the Select Board, appropriate because much of the decision-making is based on fundamental policymaking that is the Board's purview, and supported by an advisory Water Resources Committee appointed by the Select Board. The Water Resources Committee has representation from the Select Board, Planning Board, Board of Health, Sewer Advisory Committee, and Finance Committee.

The CWMP is a multi-phase program that ultimately articulates the Town's strategy for managing wastewater over a 20-year planning period. The phases consist first of an assessment of existing and future needs, the Needs Assessment, secondly an evaluation and screening of approaches for addressing these needs, and finally development and selection of a preferred alternative that is the basis of the long-term wastewater management program going forward. These phases are developed sequentially with acceptance by the community at each stage before proceeding with the next phase. Appendix A is a Plan of Study and Project Schedule for the overall CWMP program that was developed with the Water Resources Committee and Select Board and reviewed with MassDEP.

SECTION 1.2 PROJECT SCOPE AND PLANNING PERIOD

Section 1.2.1 Plan of Study and Schedule

This Phase 1 of the CWMP, the Needs Assessment report, describes the water quality in the Town's watersheds, identifies the impacts associated with pollutant loadings from wastewater disposal and other sources under existing and anticipated future population levels, and defines areas needing wastewater disposal solutions based on each watershed's Total Maximum Daily Load (TMDL) goals. The understanding developed through the Needs Assessment will provide the context of the alternative management and mitigation strategies developed in Phase II. Appendix A contains the full MassDEP approved Plan of Study and Project Schedule.

Section 1.2.2 Planning Period

The comprehensive strategy will be for wastewater and nitrogen management for a 20-year time period effective 2023 – 2043, which is the estimated time-period for full-buildout and the next Master Plan update for growth and development.

SECTION 1.3 PROJECT LOCATION AND STUDY AREA

Tisbury is located on the island of Martha's Vineyard. Tisbury is accessible from the mainland by ferry serviced through the year-round port of Vineyard Haven Harbor, the seasonal ferry terminal in Oak Bluffs, or the Martha's Vineyard Airport. Vineyard Haven is approximately 6 miles from Woods Hole in a direct line, and approximately 9 miles by ferry.

While the CWMP is a Town of Tisbury project, the CWMP will include recommendations for inter-municipal agreements between Tisbury, Oak Bluffs, and West Tisbury to address water quality within the Lagoon Pond and Lake Tashmoo watersheds that are shared by Tisbury with these communities.

Figure 1 shows the study area, which is the Tisbury town boundary established in 1892, and the contributing watersheds regardless of town boundaries. The watersheds considered in this Plan are the Lake Tashmoo, Lagoon Pond, West Tisbury Coastal and Tisbury Coastal (which includes Vineyard Haven harbor) watersheds. For readability, both the West Tisbury Coastal and Tisbury Coastal watersheds will be referenced as Coastal watersheds.

SECTION 1.4 PROJECT DRIVERS

Tisbury is developing this CWMP to assess and resolve environmental and public health risks, as well as socio-economic priorities. Among the drivers for the project are:

- Protecting the Town's public and private drinking water supplies from inadequate wastewater treatment
- Preventing unsanitary conditions from wastewater contamination of the Town's drainage system, local beaches, and shell fishing areas.
- The Massachusetts Estuary Project (MEP) assessed the Lagoon Pond and Lake Tashmoo embayment systems resulting in nitrogen TMDLs in the Lake Tashmoo and Lagoon Pond watersheds.
- Vineyard Haven Harbor has a pathogen TMDL.
- Tisbury shares watersheds with Oak Bluffs, which is actively engaged in CWMP planning, and West Tisbury.

- Affordable housing: The town has a shortfall in workforce/affordable housing and the capacity limits of the existing wastewater system curtail the ability of affordable housing to be situated within the Sewer District.
- Nitrogen loading from on-site wastewater systems are the impetus for the town to work with the MVC to establish Districts of Critical Planning Concern that inhibit the addition of housing in the Lagoon Pond watershed.
- Economic development: Capacity limits in the existing wastewater system are limiting private developments and expansion of the economy, and housing, in designated business areas within the B1, W/C, and B2 districts. A proposed mixed-use development on Beach Road has been denied access to the wastewater system because of a lack of wastewater treatment capacity.

Identifying the location and magnitude of Tisbury's wastewater needs will encompass each of these project drivers.

SECTION 1.5 TOWN GOVERNANCE

Tisbury is governed by the open town meeting form of government, led by an elected Select Board and appointed Town Administrator. Town meeting typically occurs during April, with a Special Town Meeting occurring in the fall as needed. Tisbury is a part of Massachusetts ninth congressional district, represented by William Keating. In State Legislature, Tisbury is represented as a part of the Barnstable, Dukes and Nantucket district, which includes all of Martha's Vineyard, Nantucket and most of Barnstable County.

The Board of Health (BoH) serves as the local arm of the Massachusetts Department of Public Health and the Massachusetts Department of Environmental Protection. On Martha's Vineyard, the Town Boards of Health also participate in an Island-wide Board of Health, working cooperatively on programs and goals. Tisbury's Health Department has three Town staff including a Health Agent, Assistant Health Agent and Administrative Secretary. The Tisbury BoH has three elected members who are responsible for disease prevention and control, and health and environmental protection, including regulation of on-site wastewater systems, and promoting a healthy community.

The Planning Board's primary responsibility is to establish goals and objectives for the Town's future growth and development. The Planning Board, by statute, accomplishes this by creating and maintaining a Master Plan. The Master Plan defines the Town's policies for growth management, which are implemented through the creation and adoption of planning tools such as the Zoning Bylaws, and the Subdivision Rules and Regulations. The Planning Board has just initiated a Master Plan study, which will be the first comprehensive effort to identify the Town's priority characteristics and quality of life objectives since the 2004 Community Development Plan prepared by the Martha's Vineyard Commission (MVC). The Planning Board has six members and one Planning Board Assistant on Staff.

The Department of Public Works (DPW) is a service organization, operating under the direction of the Select Board, responsible for providing essential services and maintaining the Town infrastructure. The DPW oversees the Wastewater Department, the Town's stormwater

infrastructure, maintenance of Town roads and facilities, and provides trash and recycling services for residents.

The Wastewater Department is an enterprise fund organization, which is a separate accounting and financial reporting mechanism for which revenues and expenditures are segregated into a fund with financial statements separate from all other governmental activities. The Wastewater Department manages, operates, and maintains the Town's public sewer and wastewater treatment system. The Department provides maintenance services to the Town on-lot grinder pumps, maintains lift stations, and is responsible for maintaining compliance with the treatment facility's groundwater discharge permit. The Select Board members are the Wastewater Commissioners responsible for approving rules and regulations and requests for connections to the system.

The Tisbury Water Works (TWW) is the public water utility for the Town of Tisbury (PWSID #4296000), and is an enterprise fund organization. The TWW has an elected three-member governing Board of Water Commissioners. Its two main purposes are to provide safe drinking water to all Tisbury consumers on the distribution system and to provide adequate fire flows for firefighting purposes.

SECTION 1.6 POPULATION DATA

The year-round population of Tisbury is approximately 4,500. The Vineyard communities collectively experience a seasonal population that increases to approximately 300% during the summer months. The Dukes County *Multi-Jurisdiction Hazard Mitigation Plan Update* (10/2021) estimates a total in-season population of approximately 13,200 in Tisbury.

SECTION 1.7 SUMMARY OF PAST REPORTS AND STUDIES

The earliest available documentation of water quality and wastewater issues in Tisbury is the 1979 *Environmental Impact Statement Wastewater Collection and Treatment Facilities* by USEPA. This document recommended a three-phase program for sewers in the "developed areas of Vineyard Haven", and an 85,000 gallons per day (gpd) wastewater treatment and nightsoil (e.g., septic system sludge) composting facility.

More recent studies and reports applicable to this CWMP, and summarized within this report, include:

Year	Title	Prepared By:
1999	1999 Draft Phase III Facilities Plan and Environmental Impact Report	Stone Environmental Inc. and Beta Engineering Inc.
2009	Island Plan (Section 10 - Water Resources)	Martha's Vineyard Commission (MVC)
2010	Martha's Vineyard Wastewater Management Study	MVC / Wright Pierce
2010	Lagoon Pond Linked Watershed-Embayment Model Report	MEP (UMass Dartmouth School for Marine Science and Technology (SMAST) and MassDEP)

Year	Title	Prepared By:
2011	Lagoon and Tashmoo Pond Case Studies	Wright-Pierce and MVC
2013	Tisbury Wastewater Management Planning – Updated Estimates of Wastewater Flow	Wright-Pierce
2015	Tisbury Wastewater Management Planning - Summary of Needs Assessment	Wright-Pierce
2015	Lake Tashmoo Linked Watershed-Embayment Model Report	MEP (UMass Dartmouth SMAST and MassDEP)
2015	Lagoon Pond TMDL	MEP (UMass Dartmouth SMAST and MassDEP)
2017	Lake Tashmoo TMDL	MEP (UMass Dartmouth SMAST and MassDEP)
2019	Multiple Installations of NitROE® System - Final Report for MassCEC	Town of Tisbury / KleanTu LLC
2019	Lagoon Pond Sampling Summary	MVC
2019	Lake Tashmoo Sampling Summary	MVC
2020	Climate Change Adaptation Context - Tisbury	MVC
2020	Final Pathogen TMDL for the Islands Watershed	USEPA / MassDEP

General planning & regulatory guidance documents include:

Year	Title	Prepared By:
1996	Guide to Comprehensive Wastewater Management Planning	MassDEP
2014	314 CMR 12.00 Operation, Maintenance and Pretreatment Standards for Wastewater Treatment Works	MassDEP
2016	Preliminary Guidance for Piloting, Monitoring, and Evaluating Non-Traditional Water Quality Improvement Technologies on Cape Cod	Cape Cod Commission
2016	314 CMR 5.00 Groundwater Discharge Permit Program	MassDEP
2017	310 CMR 15.00 Title 5 of the State Environmental Code	MassDEP

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SECTION 2 PUBLIC PARTICIPATION PROGRAMS

Communications throughout development of the CWMP provide an opportunity for public education, outreach, and participation. Announcements of the public workshops and meetings provide the meeting date, location, and agenda. There are to be public forums over the course of the CWMP planning effort, excluding Water Resource Committee and Select Board meetings. The Water Resource Committee will provide summaries of the planning progress for each of the CWMP phases, and will publish announcements of these summaries on the Town's webpage, local cable channel, and local newspapers, as well as distributed through emails. Figure 2 shows the public outreach program and scheduled meetings during the course of the plan development.

Description	2021											
Needs Assessment	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
Project Coordination and Meetings												
Water Resources Committee												
Select Board												
Martha's Vineyard Commission												
MassDEP / MEPA												
Public Information / Outreach / Hearing												
	2022											
Alternatives Analysis	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Project Coordination and Meetings												
Water Resources Committee												
Select Board												
Martha's Vineyard Commission												
MassDEP / MEPA												
Public Information / Outreach / Hearing	Planning Board				Public							Public
	2023											
Draft Recommended Plan	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23
Project Coordination and Meetings												
Water Resources Committee												
Select Board												
Martha's Vineyard Commission												
MassDEP / MEPA												
Public Information / Outreach / Hearing												
	2024											
Permitting and Final Recommended Plan	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24
Project Coordination and Meetings												
Water Resources Committee												
Select Board												
Martha's Vineyard Commission												
MassDEP / MEPA												
Public Information / Outreach / Hearing												
	2025											
Regulatory Approvals	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25
Project Coordination and Meetings												
Water Resources Committee												
Select Board												
Martha's Vineyard Commission												
MassDEP / MEPA												
Public Information / Outreach / Hearing												

Town Meeting

Figure 1: Schedule of Public Meetings and Workshop

SECTION 2.1 LOCAL INITIATIVES

Section 2.1.1 Water Resources Committee

The Select Board commissioned a Water Resources Committee that has several charges and objectives, including facilitating the development of this CWMP. The Water Resources Committee is comprised of representatives of the Select Board, Planning Board, Board of Health, Finance Committee and Sewer Advisory Committee. As described in the Committee's charter, it has responsibility for advising the Select Board on public policy and long-range planning in the Town's water resource related issues through the following activities:

- Work diligently to protect the town's Water Resources, both groundwater and surface waters;
- Recommend actions in the area of stormwater management to protect and to improve water quality in the Lagoon Pond and Lake Tashmoo Watersheds.
- Explore, evaluate and recommend enhanced wastewater systems that mitigate or eliminate nitrogen loading and other contaminants from entering our groundwater and surface water resources.
- Facilitate the coordination of efforts with other town officials;
- Identify and pursue grant opportunities;
- Receive comments and suggestions from the public, hold public meetings/hearings as appropriate, post agendas and publish minutes of their proceedings and file an Annual Report

The Water Resources Committee generally meets at least monthly to advance their objectives. During 2021, the following meetings were held prior to delivery of the Draft Needs Assessment report:

- February 25
- March 1
- March 4
- March 11
- April 8
- April 15
- May 13
- June 9
- June 17
- July 29
- August 19
- September 23
- October 21
- November 18

Following delivery of the Draft Needs Assessment report in November 2021, the WRC held meetings to discuss and compile feedback on the report. Meetings were held with the Planning Board in January 2022 and February 2022 to present the draft report and solicit feedback related to the ongoing Master Plan development. The Planning Board and the WRC committee members provided comments in March 2022. The formal feedback from the Planning Board is included in Appendix C. This Needs Assessment report was submitted to the WRC in April 2022 for a final Phase 1 meeting prior to presentation to the Select Board and a subsequent public presentation.

The WRC has a dedicated page on the Town's website at https://www.tisburyma.gov/water-resources-committee. Meeting agendas and minutes, a library of documents reviewed and created as part of the CWMP process, and links to online resources are located on the webpage. A dedicated

email, CWMP@tisburyma.gov, is available for compiling questions and feedback, and to solicit contact information for disseminating information such as public meeting schedules.

Section 2.1.2 Vision Forum

The Planning Board prepared the 2015 Vision Plan that proposed creating a Community Vision Council, with the purpose of educating and informing residents of initiatives and Town proposed projects. Oftentimes the topics presented and discussed at these Vision Forums are the subject of upcoming Town Meeting Warrant Articles. The Vision Forum will be part of the public outreach component of the CWMP as directed by the Select Board.

Section 2.1.3 Local Comprehensive Master Plan Survey

In 2005, the Tisbury Planning Board identified priority objectives for the community through an extensive survey to the Town's residents, both year-round and seasonal. The Planning Board has not used this survey to formally adopt a Master Plan, but through this effort the following eight priority objectives were developed:

1. Natural Resources
   - 1.1. Make protection and restoration of our natural environment our number one priority.
   - 1.2. Avoid sprawl and destruction of open spaces.
   - 1.3. Restore access to the town's harbor, beaches, woods and natural areas.
   - 1.4. Work to expand our inventory of protected lands and to make these lands a public resource open to all.
2. Cultural Resources
   - 2.1. Maintain Tisbury's New England town character by preserving and encouraging its small scale, tree-lined streets, historic structures and neighborhoods.
3. Municipal Services
   - 3.1. Locate, design and maintain our public buildings in a way that will reflect the traditional quality and character of the town while accommodating new functions, procedures and technologies.
   - 3.2. Protect the functional and symbolic heart of the town by retaining non-emergency municipal functions in downtown Vineyard Haven.
   - 3.3. Relocate fire and other emergency services to a site or sites out of the congested downtown area
4. Circulation
   - 4.1. Make access to and use of the waterfront an important part of the overall circulation system.
   - 4.2. Promote alternate means of transportation - pedestrian, bus, bike, and water transit with a special emphasis on pedestrian movements.
   - 4.3. Improve the road system by creating supplementary small-scale access ways to relieve the pressure on main roads. Avoid street widening.
   - 4.4. Promote the connectivity of streets. Avoid dead-ends and restricted access neighborhoods.
5. Housing

5.1. Encourage a greater variety of housing types (not just single-family detached units) in all parts of the town, especially smaller houses and rental units.
5.2. Allow greater densities and more mixed uses in the business districts particularly for affordable housing opportunities.
5.3. Discourage building in undeveloped areas.
5.4. Be careful about increasing densities in settled neighborhoods.

6. Energy
   6.1. Implement the policies incorporated in the Renewable Energy Island resolution passed at Town Meeting this year. These include:
   6.2. Promote energy conservation and renewable energy technologies both for the benefit of the environment and for their economic benefit to the town.
   6.3. See that municipal buildings, vehicles and operations adopt the most up-to-date energy conservation standards and technologies.
   6.4. Use life cycle cost calculations, not just initial cost, to estimate long-term building expenses.
   6.5. Explore changes to our building and zoning by-laws that will encourage more efficient use of our energy resources.
   6.6. Look for incentives to encourage more energy efficiency in our buildings and transportation systems.
7. Economic Development
   7.1. Work toward a sustainable, year-round employment pattern.
   7.2. Bolster the seasonal economy.
   7.3. Look at the economic impact of new populations and new technologies on the island both as an opportunity for new kinds of businesses and as a revision of existing practices.
   7.4. Encourage the development of aquaculture and agriculture as part of a long-term sustainable economy. Consider their additional contributions as attractions to visitors and as preservers of the overall quality and character of the island.
   7.5. Recognize that the visual quality of the town is an important component of its economic health.
8. Area Plans
   8.1. Using the above guidelines, develop a series of detailed plans focused on specific areas of interest. These include:
   8.2. Upper State Road and the Landfill area
   8.3. Downtown and the Waterfront – Public access, circulation, land use, zoning
   8.4. Historic preservation
   8.5. Restoration of the Waterworks Building at Tashmoo
   8.6. Renovation of the Cornell Theater
   8.7. Expansion of historic districts and/or designation of historic buildings
   8.8. Tree planting and landscape preservation strategies.
   8.9. Incorporate planting and landscaping provisions in the zoning by-laws.
   8.10. Expansion of our inventory of open spaces and preservation lands.
   8.11. Neighborhood street systems
   8.12. Standards for construction of town streets and byways.
   8.13. Connectivity of street grids, access to public spaces.

The Planning Board is currently working toward developing a new Master Plan.

Section 2.1.4 Stakeholder Groups

Tisbury and Martha's Vineyard have several active organizations engaged in protecting the Island's water resources and engaging the public in information and educational programs. In particular, three non-municipal groups have been especially active in water resource protection:

- The Tisbury Waterways, Inc. (TWI), https://www.tisburywaterways.org/, advocates locally for initiatives to improve and maintain the water quality in Tisbury's estuaries and harbor. The organization helps people seeking grant money for research, constructs stormwater controls, monitors water quality, and assisted with the development of the Town-Wide Drainage Master Plan.
- The Lagoon Pond Association, Inc. (LPA), https://www.lagoonpondassoc.org/, strives to preserve Lagoon Pond and adjacent areas and waters. LPA attempts to preserve the waterbody's resources and to cooperate with governmental agencies to solve environmental issues. The LPA also funds water quality monitoring for Lagoon Pond
- Martha's Vineyard Shellfish Group, http://www.mvshellfishgroup.org/, works to preserve, restore and expand shellfish resources. The Group operates three on-island shellfish hatcheries and engages in shellfish habitat restoration projects.

SECTION 2.2 REGIONAL INITIATIVES

In 2010, the Martha's Vineyard Commission (MVC) prepared the Martha's Vineyard Wastewater Management Study, supported by Wright-Pierce (WP). The study includes a preliminary needs assessment for the Island based on a high-level review of community assets, evaluation of the various wastewater management practices on the island, and provides generalized wastewater treatment opportunities for the Island communities to consider. The plan describes several wastewater management alternatives or tools together with generalized cost estimates associated with these alternatives. This plan was completed before the Massachusetts Estuaries Project (MEP) assessments of Lake Tashmoo and Lagoon Pond were completed, and does not develop nitrogen reduction strategies for these watersheds.

SECTION 2.3 PUBLIC PRESENTATIONS AND HEARINGS

Section 2.3.1 Public Workshops

The following public workshops were held as a part of the public participation schedule. Full presentation slides, sign in-sheets, posters presented and notes gathered are summarized in Appendix B for each meeting.

Table 1: 2021 Public Participation Schedule

#	Date / Venue	Title	Goals and Objectives	Key Takeaways
1	June 30, 2021 Public Presentation in person at Emergency Services Facility	Introduction to CWMP and Needs Assessment to general public	• Introduce residents to Project Team • Introduce CWMP process and TMDLs • Understand community concerns about watershed needs	• Need more public education about public health impacts of nitrogen • Bring CWMP to neighborhood groups • Costs are paramount issue
2	January 19, 2022 Planning Board – remote	Needs Assessment report out and request for feedback	• Present and review needs assessment	• General introduction to CWMP process and request for feedback on growth projections
3	February 16, 2022 Planning Board – remote	Needs Assessment Feedback	• Further discussion of needs assessment • Detailed feedback	• Schedule for delivery of feedback • Coordination with Master Plan schedule

Section 2.3.2 Stakeholder Group Engagement

In addition to Town departments and staff, the following local committees and stakeholder groups received CWMP information from the WRC and invitations to the public workshops, and many were directly solicited for input. Many of these organizations have contributed expertise, funds, and labor towards improving water quality in Tisbury:

- Tisbury Select Board
- Tisbury Board of Health
- Tisbury Planning Board
- Tisbury Waterways, Inc. (TWI)
- Lagoon Pond Association
    - The WRC attended and presented at the annual meeting on August 14, 2021
- MV Shellfish Group
- Tisbury Town Library
- Tisbury Sewer Advisory Committee
- Tisbury Vision Forum
- Vineyard Conservation Society

In addition to the local stakeholder groups, the project team has met with MassDEP and the MEPA office to present and discuss the Plan of Study, and discuss the progress of the CWMP. The MEP team was consulted to understand the process for evaluating proposed alternatives within the context of the MEP models. The Martha's Vineyard Commission has provided important GIS data and support related to buildout projections, parcel data, and other planning data.

SECTION 3 EXISTING CONDITIONS – NATURAL ENVIRONMENT

SECTION 3.1 INTRODUCTION

This section describes the conditions of the natural environment that affect water quality, which includes groundwater and coastal waters, with a focus on the MEP process and subsequent TMDLs. Specific topics include shellfishing, surficial geology, soils, and watershed delineations.

Current wastewater nitrogen loading rates and septage/wastewater flows are estimated on a watershed and town-wide basis using the Massachusetts Estuaries Project process, namely using standard values for nitrogen concentrations from septic systems and average water use to calculate nitrogen loads to groundwater from wastewater.

SECTION 3.2 TMDLS AND MASSACHUSETTS ESTUARIES PROJECT

Tisbury's three coastal waterbodies, Lake Tashmoo, Lagoon Pond, and Vineyard Haven Harbor, are all subject to TMDLs. Lake Tashmoo and Vineyard Haven Harbor are entirely located in Tisbury, and Lagoon Pond is shared with Oak Bluffs. MassDEP and the MEP are addressing TMDLs on a watershed basis, which often extends beyond municipal boundaries. The CWMP's study area is within Tisbury's municipal boundaries to focus on the impacts of existing and future conditions within Tisbury. However, the CWMP will consider aspects of water quality on a watershed basis to align with MassDEP and MEP efforts. The Lake Tashmoo watershed includes West Tisbury and a small segment of Oak Bluffs. Lagoon Pond's watershed includes Tisbury and Oak Bluffs, and small portions of West Tisbury and Edgartown.

Section 3.2.1 MEP Watershed Modeling and Subsequent TMDLs

The MEP assessed Lagoon Pond and Lake Tashmoo watersheds in 2010 and 2015, respectively. The MEP's Linked Watershed-Embayment Approach models the effects of excessive nitrogen loading on the embayment systems. The models found that both Lagoon Pond and Lake Tashmoo are at risk of cultural eutrophication (excessive richness of nutrients from human sources) from nitrogen loads primarily originating from developed watersheds. The MEP found that the primary ecological threat to Lake Tashmoo and Lagoon Pond is from nutrient enrichment. The estuaries are already showing losses of eelgrass and infaunal (within sediments) habitat due to nitrogen enrichment.

The MEP distinguishes between controllable sources and non-controllable sources of nitrogen. Sources such as sediments and atmospheric deposition are not locally controllable. Sources such as fertilizers and septic systems are locally controllable.

The MEP selected sentinel stations as representative of the water quality in each embayment and established nitrogen concentration targets at the sentinel locations that would restore healthy eelgrass and infaunal habitat in the embayment.

After the MEP assessed the watersheds, MassDEP and MEP jointly issued TMDLs for Total Nitrogen for Lagoon Pond (2015) and Lake Tashmoo (2017).

Lagoon Pond

In 2010, MEP released its report, *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Lagoon Pond Embayment System, Oak Bluffs and Tisbury, Massachusetts.* MassDEP and MEP subsequently jointly released the *Final Lagoon Pond Estuarine System Total Maximum Daily Loads for Total Nitrogen* (July 2015).

The MEP study found that 56% of all nitrogen sources, such as sediments and atmospheric deposition, effectively cannot be controlled or mitigated. Controllable sources and their percentage contribution to Lagoon Pond are:

- Septic Systems 76%
- Runoff 11%
- Agriculture 8%
- Fertilizer 5%
- Other 1%

The MEP set a tidally averaged nitrogen target for Lagoon Pond of 0.35 mg N/l at the sentinel station. To reach this goal, 47% of the total nitrogen load to Lagoon Pond from septic systems must be removed. The nitrogen load from septic systems was 34.4 kg/day, which would need to be reduced to 18.24 kg/day, a reduction of 13,020 pounds per year (ppy), to meet the TMDL's goals.

The TMDL presents a scenario where the Lagoon Pond (East Arm) and West Arm (South End Basin) remove 50% of the nitrogen load, and the Upper Lagoon Pond sub-embayment does not remove any total nitrogen (TN) load to achieve the overall 47% reduction required. While this is one scenario to meet the sentinel station's goal, the MEP allows alternatives to reach 0.35 mg/l nitrogen at the sentinel station.

Lake Tashmoo

In 2015, the MEP released its report, *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Lake Tashmoo Estuary, Towns of Tisbury, West Tisbury ad Oak Bluffs, MA.* MassDEP and MEP subsequently jointly released the *Final Lagoon Pond Estuarine System Total Maximum Daily Loads for Total Nitrogen* (July 2017).

The MEP determined that the TMDL of nitrogen to meet the target nitrogen concentration of 0.36 mg/l at the sentinel station (Brown Point Channel) is 35.55 kg N per day,

Controllable sources and their percentage of overall controllable sources to Lake Tashmoo are:

- Septic Systems 80%
- Runoff 8%
- Agriculture 5%
- Fertilizer 5%
- WWTF/Landfill 2%

The primary goal of the TMDL implementation will be to lower the concentration of nitrogen in Lake Tashmoo by reducing the load from on-site wastewater systems by 42.5%, which is a 31.9% reduction in overall nitrogen load to Lake Tashmoo. The TMDL determined that the septic nitrogen load of 18.8 kg/day must be reduced to 10.8 kg/day, a reduction of 6,435 pounds of total nitrogen per year.

The TMDL document calls for the CWMP to assess the most cost-effective options that will meet the target concentration at the sentinel station. Further, "The CWMP should include a schedule of the selected strategies and estimated timelines for achieving those targets."

Section 3.2.2 2020 Final Pathogen TMDL for the Islands Watershed (Vineyard Haven Harbor)

Vineyard Haven Harbor has been the focus of bacterial (pathogen) pollution since the 1970's, which resulted in the sewering of Vineyard Haven in 2004 and its inclusion in the April 2020 Final Pathogen TMDL for the Islands Watershed. The TMDL designates the harbor as a medium priority based on fecal coliform concentration and other factors. The bacteria concentrations were not high enough to meet the medium priority range of 1,000 to 9,999 CFU/100ml. However, the TMDL adjusted the priority upward to medium priority to reflect the higher water quality standards associated with shellfishing areas.

Interestingly, the TMDL lists its data sources as MassDEP 2003 and the *Islands Watershed 2000 Water Quality Assessment Report*, both prior to the sewering of Vineyard Haven. Recommended TMDL implementation measures include elimination of potential wastewater and stormwater sources such as leaking sanitary sewers and stormwater controls to mitigate bacteria and runoff volume.

SECTION 3.3 WATER QUALITY CLASSIFICATIONS AND IMPAIRED WATERWAYS

Section 3.3.1 Massachusetts Surface Water Quality Classifications

The Massachusetts Surface Water Quality Standards (314 CMR 4.00) classify the coastal waters of Martha's Vineyard as Class SA waters. These waters are designated as an excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation.

Section 3.3.2 Clean Water Act – Section 303(d)

Under Section 303(d) of the CWA, states are required to develop, and update every two years, lists of waters - rivers, lakes, coastal waters and estuaries - that are impaired (or threatened) by one or more pollutants. Impaired waters are waters that do not meet Water Quality Standards.

MassDEP's surface water monitoring program provides data and information to assess the status of Massachusetts waters, evaluate pollution control strategies, develop policies, identify emerging issues, and measure the effectiveness of the existing water quality management programs. In 2011,

MassDEP initiated a five year, statewide assessment of streams, followed by a three year program assessing lakes and ponds. In 2016, the waterbodies assessment included streams and rivers, and in 2020, expanded to coastal areas.

Categories 4 and 5 contain waterbodies that are impaired by one or more pollutants, requiring the development and implementation of TMDLs to restore them.

- Lake Tashmoo (MA97-12) is a Category 5 waterbody on the 2016 303(d) list, requiring a TMDL. The impairments include dissolved oxygen, estuarine bio-assessments, total nitrogen and nutrient/eutrophication biological indicators. The Draft 2018 303(d) still lists Lake Tashmoo as a Category 5 waterbody, despite the 2017 TMDL for nitrogen.
- Lagoon Pond (MA97-11) is a Category 4a waterbody with a TMDL for nitrogen.

Section 3.3.3 MVC Water Quality Monitoring Program

An island-wide water quality monitoring program was initiated in the summer of 2016 with the goal to assess the status of the ecological health of each system and nutrient-related trends in the waterbodies.
Martha's Vineyard Commission (MVC) staff collect field measurements and water samples during the summer months in order to determine water quality of the ponds. Field sample parameters assessed include temperature, oxygen levels, salinity, conductivity, pH and the time, depth and weather conditions of sampling. Water samples are sent for nutrient testing at the UMass School of Marine Science and Technology (SMAST). MVC has been monitoring water quality parameters in Lagoon Pond and Lake Tashmoo since 2016. Water Quality Indicators can range from zero to 100, with 100 signifying high (good) water quality. The 2019Water Quality Indicators for the Town's two embayments are:

- Lake Tashmoo 77
- Lagoon Pond 63

The following two charts are excerpted from the MVC's 2019 Sampling Summary, comparing sampling results from 2016 through 2019. Both charts indicate generally good water quality, but with nitrogen concentrations in excess of the MEP's threshold for each water body.

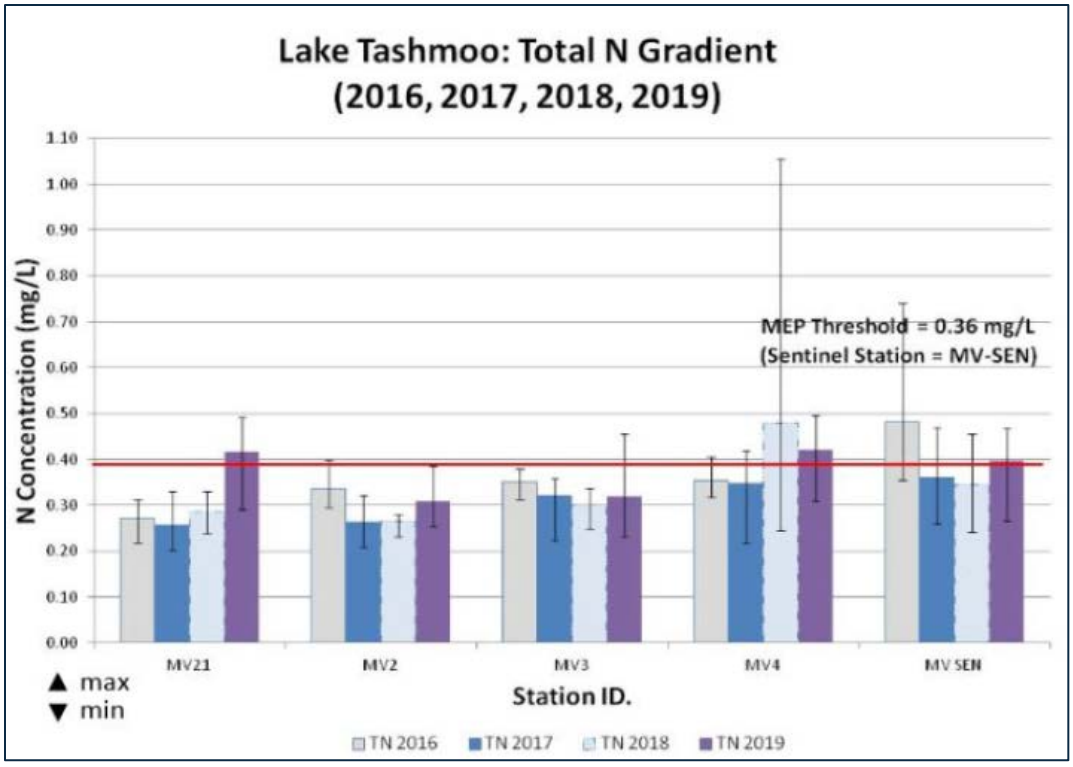

Figure 2: Lake Tashmoo Water Quality Sampling– Total Nitrogen

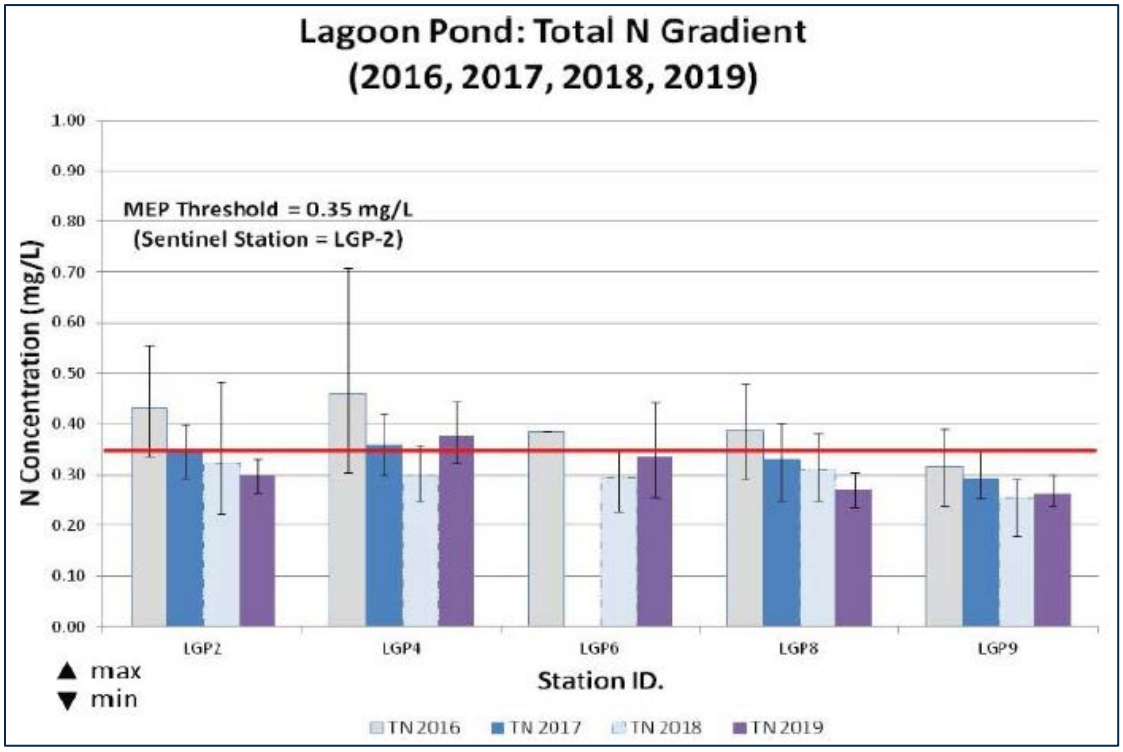

Figure 3: Lagoon Pond Water Quality Sampling – Total Nitrogen

Section 3.3.4 Tisbury Beaches

The Town of Tisbury has three public bathing beaches: Lake Tashmoo Town Beach, Tisbury Town Beach, and Owen Park Beach. Water at bathing beaches is sampled weekly to ensure safe water conditions for swimming. The samples are tested for indicator organism enterococci. Significant amounts of enterococci in a water body can negatively affect water quality and cause beach closures, swimming and boating bans, and closures of fishing and shellfishing areas.

EP gathered data on public beach sampling from the MA Department of Public Health's Bureau of Environmental Health, and excerpted the following graphs (Figures 5, 6, and 7) showing exceedances of beach water quality standards (104 CFU/ml of enterococci), which require beach closures.

Owen Little Way Beach

Owen Little Way Beach samples exceeded the bacterial standard twice in 2021 and exceeded the geometric mean standard (> 35 CFU/ml) in August 2021. The August 9 sample is associated with a rain event.

- 8/9/21 2,000 CFU/100 ml
- 6/21/21 161 CFU/100 ml

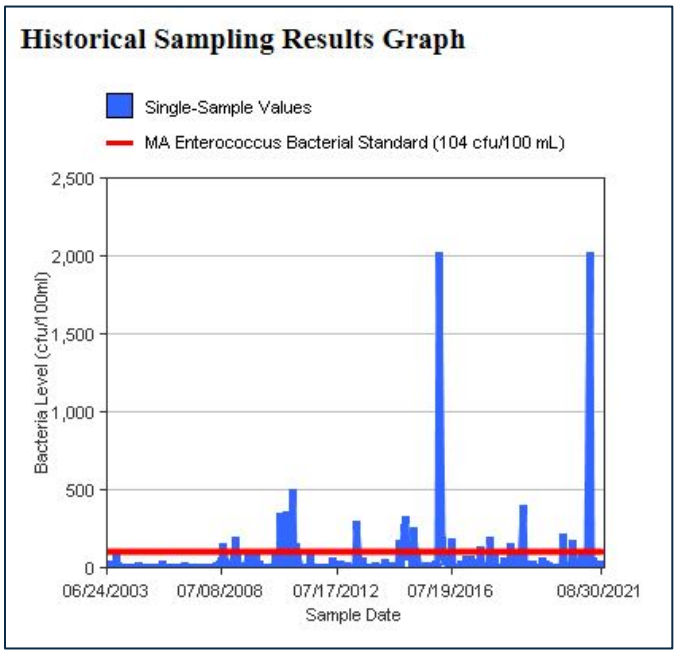

Figure 4: Owen Little Way Beach

https://ma-beaches.healthinspections.us/beaches.cfm?bID=12407&func=details

Owen Park Beach

Owen Park Beach samples exceeded the bacterial standard twice in 2021. The August 9 sample is associated with a rain event.

- 8/9/21: 1,872 CFU/100 ml
- 6/21/21: 152.9 CFU/100 ml

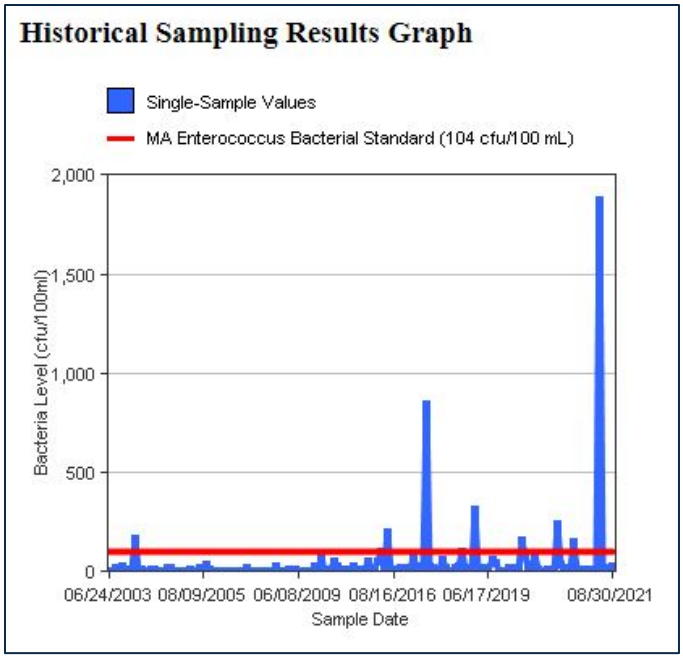

Figure 5: Owen Park Beach

https://ma-beaches.healthinspections.us/beaches.cfm?bID=12408&func=details

Tashmoo Beach

Tashmoo Beach samples have not exceeded the bacterial standard since June 17, 2019

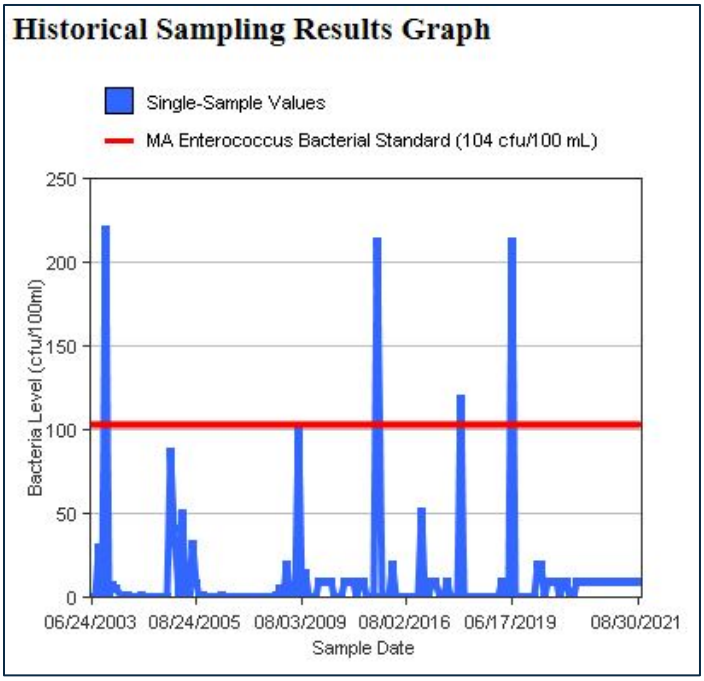

Figure 6: Tashmoo Beach

https://ma-beaches.healthinspections.us/beaches.cfm?bID=12524&func=details

Section 3.3.5 Shellfishing

Background

The Division of Marine Fisheries (DMF) classifies areas for shellfish harvesting into five categories:

- APPROVED: Open to shellfish harvesting for direct human consumption subject to local rules and regulations; closed only during major coast-wide events (e.g., hurricane, oil spill, red tide event).
- CONDITIONALLY APPROVED: Closed some of the time due to rainfall or seasonally poor water quality or other predictable events. When open, it is treated as an Approved area.
- RESTRICTED: Contains a limited degree of contamination at all times. When open, shellfish can be relayed to a less contaminated area or harvested for depuration.
- CONDITIONALLY RESTRICTED: Contains a limited degree of contamination at all times. Subject to intermittent pollution events and may close due poor water quality from rainfall events or season. When open, only commercial harvesting of soft shell clams for depuration is allowed.
- PROHIBITED: Closed to the harvest of shellfish under all conditions, except the gathering of seeds for municipal propagation programs under a DMF permit.

Detailed maps for determining the classification are available at the following website: https://www.mass.gov/service-details/shellfish-classification-areas

Existing Conditions

Tisbury's two coastal ponds and harbor have restrictions to shellfishing:

- Lake Tashmoo: Generally Approved or Conditionally Approved, except for the most southern end in Drew Cove, where shellfishing is prohibited. A stormwater outfall in this area is under review by the Board of Health after Tisbury Waterways, Inc. collected samples with high fecal coliform counts.
- Lagoon Pond: Generally Approved or Conditionally Approved except shellfishing is prohibited at the outlet of Mud Creek in the West Arm.
- Vineyard Haven Harbor: Generally Approved and Conditionally Approved in the mooring areas of the inner harbor and outside of the breakwater.

In addition to the Prohibited areas, the mooring fields in the Town's shellfishing areas are typically closed or restricted seasonally because of the number of boats in the shellfishing areas.

In July 2021, Lake Tashmoo was temporarily closed to shellfishing after the discovery of a toxic algae bloom.

In October 2021, Tisbury Waterways, Inc. sampled the stormwater outfall from West Spring Street into Lagoon Pond. This outfall discharges to the Prohibited shellfishing area. The laboratory at the University of New Hampshire identified high levels of human-associated markers, as well as bacterial contribution from other species,

SECTION 3.4 GEOLOGY AND SOILS

The island as a whole is largely comprised of glacial outwash plain and moraines created by the last ice age approximately 15,000 to 20,000 years ago. Terminal moraines begin in southwest Tisbury and lie south and southwest. Thrust-moraine deposits occur in these areas. Figure 8 shows that glacial meltwater created outwash plains of glacial stratified deposits, ranging from fine to coarse gravel, sand, and silt that are highly permeable.

Figure 9 presents the topography of Tisbury, which is gently rolling terrain with a high point on High Point Lane, the location of the Town's water tanks.

Rolling hills to the south and west abut West Tisbury. The terrain slopes down to the coastal ponds of Lake Tashmoo and Lagoon Pond. The watershed boundary for Lake Tashmoo generally follows the north-south ridge to the east and the rolling hills, including Pilot Hill, to the west. The Lagoon Pond watershed's western boundary generally follows the north-south route of Edgartown Road.

Figure 10 shows that the vast majority of Tisbury soils are Carver Loamy Coarse Sand (239).

Carver Loamy Coarse Sand is categorized as hydrologic Group A, "soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

SECTION 3.5 GROUNDWATER CONSTRAINTS

Section 3.5.1 Zone IIs

The Tisbury Water Works (TWW) operates three supply wells: the Sanborn, Tashmoo, and Manter Wells as shown on Figure 11.

All sources are groundwater supplied from the Island's sole source aquifer. The TWW's sources share an approved Zone II delineation. The wells share a Zone II with distinctive nodes at the Tashmoo and Sanborn wells. The Zone II extends from Tisbury to Oak Bluffs and southwesterly into West Tisbury, MA. Each well also has a 400-foot radius Zone 1 protecting the area closest to each well. Section 4 provides specifics on drinking water quality.

Section 3.5.2 Groundwater Monitoring

The wastewater treatment facility (WWTF) staff report monitoring well data to MassDEP as a part of regular facility reporting. The Groundwater Constraints figure (Figure 11) shows the location of monitoring wells. Wells are described in reporting as:

- A-1 – Lake St
- A-2 – Pine St
- A-3 – Spring St
- EW-1 – DPW (behind auto garage)
- W-2 – Olga Way (in front of DPW building)
- W-3 – Plant (upper disposal field)
- T-102 – LDO (Behind landfill)

The following Table 2 presents the monitoring well data from February 8, 2021.

Table 2: WWTF Groundwater Monitoring Data

	TKN	Nitrate-N	Nitrite-N	Alkalinity	VOC	Ortho-P	Total-P
A-1	BRL	3.40	BRL	9.3	ND	0.056	0.067
A-2	BRL	3.60	BRL	24	ND	0.236	0.22
A-3	BRL	1.30	BRL	21	ND	0.058	0.091
EW-1	BRL	2.30	BRL	56	ND	0.087	0.31
W-2	2.5	0.12	BRL	102	ND	BRL	0.45
W-3	0.64	1.40	BRL	53	ND	0.102	0.15
T-102	BRL	0.61	BRL	13	1.93*	0.041	0.055

(*) Chloroform; TKN = Total Kjeldahl Nitrogen (ammonia + organic nitrogen); BRL = Below Reportable Limit; ND = < Method Detection Limit

Well A-3 is up gradient of the WWTF's lower disposal field, and well W-3 is up gradient of the WWTF's upper disposal field. The levels of all monitored constituents, especially nitrate, are well below regulatory thresholds.

SECTION 3.6 WATER RESOURCES

Figure 12 shows that Tisbury's water resources are dominated by its harbor, impaired coastal ponds, and the Vineyard Sound shoreline. The nitrogen-impaired waters of Lagoon Pond and Lake Tashmoo are a primary water quality concern as is the pathogen TMDL for the harbor.

The Beach Road area and Water Street to the Five Corners intersection have a history of flooding.

Wetland resource areas are few. Potential vernal pools are mostly located in the moraines near West Tisbury, but one potential vernal pool is located off West Spring Street near Lake Tashmoo, and another is located near the Hines Point area of Lagoon Pond.

SECTION 3.7 NATURAL HERITAGE & ENDANGERED SPECIES PROGRAM

The Massachusetts Endangered Species Act (MESA) protects rare species and their habitats by prohibiting the "take" of any species listed as Endangered, Threatened, or of Special Concern.

A Priority Habitat is based on the habitat of all state-listed rare plants and animals. Habitat alteration within Priority Habitats may result in a taking of a state-listed species, and is subject to review by the Natural Heritage & Endangered Species Program (NHESP).

Massachusetts Endangered Species Act and the Wetlands Protection Act protect state-listed wetland wildlife species. Estimated Habitats are based on the habitat of state-listed rare wetlands wildlife. Figure 13 shows that the area west of Lake Tashmoo has an extensive NHESP Priority Habitat.

Smaller areas are located along the eastern shore of Lake Tashmoo and at Lagoon Pond. A sliver of NHESP Estimated Habitat is located along Smith Brook near Lamberts Cove Road to the mouth of Lake Tashmoo and along the northwest coastline.

Threatened Species include:

- Northern Long-eared Bat (*Myotis septentrionalis*)
- Piping Plover (*Charadrius melodus*)

The Roseate Tern (*Sterna dougallii dougallii*) is listed as an endangered species. The Monarch Butterfly (*Danaus plexippus*) is a candidate species.

Construction in these areas would be subject to permitting through the NHESP.

SECTION 3.8 EXISTING NATURAL CONDITIONS SUMMARY

This Section discussed Tisbury's existing natural environment to set the foundation for projections to the end of the planning period. Tisbury's natural resources, especially its coastal ponds and harbor, are an important component of Tisbury's identity and character.

These waters are designated Class SA waters, defined as an excellent habitat for fish, other aquatic life and wildlife. To meet this water quality standard, the MEP and MassDEP have identified the total maximum daily load (TMDL) of pollutants for three coastal water bodies. Lake Tashmoo and Lagoon Pond have nitrogen TMDLs, and Vineyard Haven Harbor has a pathogen TMDL.

Tisbury's three public bathing beaches (Lake Tashmoo Town Beach, Tisbury Town Beach, and Owen Park Beach) have all experienced bacteria levels in excess of state water quality standards. In 2021, the Tisbury Town Beach and Owen Park Beach had water samples that exceeded the bacterial standard.

Soils are highly permeable throughout Tisbury, with groundwater well below the ground surface, which allows for the quick draining of water, but is a poor filter for pollutants such as nitrogen and newly regulated contaminants such as PFAS compounds. Private and public wells could be at long-term risk from substandard septic systems.

However, all three public drinking water sources are groundwater supplied from the Island's sole source aquifer and the levels of all monitored constituents, especially nitrate, are well below regulatory thresholds.

Shellfishing is Approved or Generally Approved in the Vineyard Haven Harbor and embayments, except for prohibitions in the West Arm of Lake Tashmoo near Mud Creek and at the southern end of Lake Tashmoo, and seasonal prohibitions in Vineyard Haven Harbor.

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SECTION 4 EXISTING CONDITIONS – BUILT ENVIRONMENT

SECTION 4.1 INTRODUCTION

Tisbury's master planning is critical to this CWMP. The Master Plan will articulate planning and land use goals, including forecasts of current and future housing and commercial development, all of which have implications on the Town's wastewater needs.

The Town's zoning and BoH regulations control the type and size of structures that can be built on a lot. This prescribes the resulting wastewater flows. When wastewater flow data or BoH records are not available for a parcel, zoning is used to allocate the water use and wastewater flows.

This section describes the Town's planning efforts that have led to the existing zoning and regulations used to manage land use and growth. This section also summarizes previous water, wastewater, and stormwater data and reports, and describes existing systems and regulations. Protecting Tisbury's drinking water supply from potential contamination is especially important.

This Section also discusses the Town's stormwater infrastructure and Town efforts to mitigate stormwater pollution. Coordination with the Oak Bluffs CWMP Needs Assessment report is also discussed.

SECTION 4.2 PLANNING AND LAND USE

Section 4.2.1 Local Master Planning

Tisbury currently does not have a Local Comprehensive (or Master) Plan; however, the Town's Planning Board is initiating a new Master Plan process that was authorized at the Town's 2021 Annual Town Meeting. The Town will engage with the Master Planning process on a schedule that will not produce a finished product prior to the completion of this Phase 1 of the CWMP.

Section 4.2.2 Planning History

Tisbury's current master planning dates from the 2004 Community Development Plan prepared by the Martha's Vineyard Commission (MVC) in conjunction with the Tisbury Planning Board. By examining previous planning documents, the Town's historical goals can be considered and included in wastewater planning.

Tisbury has the least amount of land area of the island towns, with 4,142 acres. At the time that the 2004 Plan was prepared, Tisbury had 29% (1,245 acres) available for development. The Plan identified that 64% of this developable land is located within either the Lagoon Pond or Lake Tashmoo watersheds. The plan highlighted the concern that excess nitrogen from septic systems could pose a threat to the "vitality of the island's coastal ponds".

The theme of protecting the island's coastal resources while acknowledging the constraints on affordable housing and economic development is common and consistent through the Town's planning efforts. The 2004 Plan pondered whether growth should be limited in the nitrogen-impaired watersheds to maintain water quality.

The Plan acknowledged the constraints that on-site wastewater systems place on potential future development by stating, "Future development of land is limited by the lack of access to town sewer services within those parts of Tisbury not served by town sewer." In addition, because of the limitations of on-site systems, "If developable lots are located within wetlands or nitrogen sensitive areas, there are further limits to the development's size and density. In addition to stricter regulations that could require enhanced de-nitrification systems, the installation cost and maintenance of these systems can be a financial constraint to the development of affordable housing."

In 2005, the Planning Board published *Master Plan Principals and Objectives*, comprised of eight main goals: Natural Resources, Cultural Resources, Municipal Services, Circulation, Housing, Energy, Economic Development, and creation of Area Plans. The report's number one priority was to protect and restore the Town's natural environment.

Section 4.2.3 Town Zoning and Land Use

Tisbury has nine zoning districts, identified for this report by compiling GIS (geographic information system) data from the Town's assessor database and MassGIS. Figure 14 shows these zoning districts. Table 3 shows that over 90% of the properties in Tisbury are zoned for residential use.

Table 3: Summary of Zoning Districts

Zoning District	Map / Database Symbol	Minimum lot size (Square Feet)	Number of Parcels
Residential District 10	R10	10,000	1,462
Residential District 20	R20	20,000	389
Residential District 25	R25	25,000	341
Residential District 50	R50	50,000	620
Residential District 3A	R3A	3 acres	287
Business District 1	B1	0	85
Business District 2	B2	0	122
Waterfront / Commercial	W/C	0	87
Lagoon Harbor Park	LHP	0	2
No Data	<Null>	-	23
Total			3,418

The B1, B2, and W/C districts are the year-round areas of commerce for the town, while still being subject to seasonal variations in commercial activity. The Zoning Bylaws also provides minimum lot sizes for residential uses in the B1 and B2 districts.

- B1 and B2: Single Family 10,000 square feet
- B1and B2: Hotel/Motel 20,000 square feet
- B2: Multi-Unit 30,000 square feet

Each of the zoning districts supports some form of residential use, whether permitted directly or through the Board of Appeals.

Residential Districts

Zoning Bylaw Section 04 limits Residential Zone parcels to renting of rooms to not more than three persons, and limits accessory uses to uses normally incidental to a permitted use (e.g., garages).

Under Section 04.03, Uses Requiring Permit from the Board of Appeals, the bylaw allows, with restrictions on setbacks and other dimensional requirements:

- One detached guest house (04.03.08),
- Multiple up to two (2) dwelling units and structures (04.03.12), and
- Accessory apartments (04.03.13).

Under Section 04.04, Uses Requiring a Permit from the Planning Board, the bylaw allows

- Cluster developments (04.04.01) and
- Multiple dwelling units and structures (04.04.02) with spatial restrictions.

Zone 3A is located west of Lake Tashmoo but also within the Zone II area of the public wells. R3A zoning supports the protection of the Town's drinking water with restrictions on siting of wastewater disposal, private wells, and specific land uses compatible with the Groundwater Protection Overlay District described in Bylaw Section 09.09.11. The Groundwater Protection Overlay District is described in detail in this report's Section 4.

Business Districts

The B1 and B2 districts differ in permitted uses.

In the B1 District, Zoning Bylaw Section 05 permits any wholesale or retail business, service, office, public utility and light manufacturing. Residential uses require a permit from the Board of Appeals, as do hotels, motels, rental rooms, and food service establishments. Recently, the Town has allowed mixed-use (commercial and residential) development in the B1 District.

In the B2 District, the Zoning Bylaws allow any use permitted in the B1 district, but also allow multiple dwelling units, including apartments, without a special permit. Special permits may grant approval for automotive or welding shops, lumberyards, and other small service and manufacturing uses.

Waterfront / Commercial District

The purpose of the Waterfront/Commercial District, as stated in the Zoning Rules and Regulations, is to "manage the character, function and integrity of Vineyard Haven's waterfront by: maintaining and enhancing the existing marine character and water dependent uses of the area; encouraging year-round businesses; improving water quality, promoting public access to the water front, and implementing the goals and objectives of the Waterfront Land Use Study, dated June 1994."

In addition to waterfront businesses, the Waterfront Management Area permits aquaculture facilities, mixed use, and wildlife habitats. The Commercial Management Area permits waterfront businesses, commercial businesses, and detached single family dwellings.

Special overlay districts are described in Section 9.00 of the Town's Zoning Bylaws and include:

1. Coastal District
2. Tisbury Island Road District
3. Special Ways Districts
4. Scenic Roads
5. Flood/Storm Districts
6. Flood Plain Districts
7. Historic Districts
8. Wetlands Restrictive Act
9. Wetlands Protection Act
10. Marine Districts and Designated Channels
11. Groundwater Protection District
12. Wild and Scenic North Shore District

Other Districts

Lagoon Harbor Park, on Beach Road abutting the bridge over the Lagoon Pond outlet, is comprised of three parcels owned by the Town that have zoning bylaw restrictions on building and uses to maintain "un-improved" conditions unless the Town votes to make any improvements. (Note: the Assessor's database lists two properties under the LHP category, but Zoning Bylaw Section 7 lists three specific parcels.)

Districts of Critical Planning Concern

The 2000 Annual Town Meeting established regulations for the Vineyard Haven Harbor District of Critical Planning Concern (DCPC). The purpose of the regulations is to maintain Vineyard Haven Harbor as a working waterfront for marine and maritime businesses, allow public access, and protect beaches, the natural environment, and water quality.

The Martha's Vineyard Commission designated the Lagoon Pond DCPC in 1988 because of anticipated development that had the potential to affect areas outside of the District, specifically the pollution of groundwater and surface waters in the Lagoon Pond watershed. Concerns included threats to shellfishing, recreational use, lobster and shellfish hatcheries, and the public water supply. Within the Lagoon Pond watershed lies the Oak Bluffs Lagoon Pond Well located off Barnes Road at the upper reaches of Lagoon Pond. The well is comprised of seven (7) gravel-packed wells that are capable of pumping 850 gallons per minute (gpm) total.

The guidelines in the 1988 DCPC document presaged environmental regulations that would become commonplace. The guidelines require septic systems to be inspected prior to a property transfer, required Boards of Health to monitor septic systems within 500 feet of the shore, prohibited runoff from subdivisions, recommended vegetative swales along public rights-of-way, restricted lawn fertilizers, and set a goal to remove stormwater outfalls from Lagoon Pond. The DCPC is regulated through the Boards of Health in Tisbury and Oak Bluffs.

Tisbury BoH Regulations Section 09.10 creates a special Sanitary Control District Overlay in the Vineyard Harbor DCPC and Lagoon Pond DCPC. Under these regulations, the BoH reviews the installation of new or enlarged wastewater and sewage disposal and handling systems. All building remodeling or additions require a permit from the BoH. The application must include an evaluation of the septic system by a registered professional engineer. Mounded systems are prohibited.

Section 4.2.4 Lot Density and Size

Lot density and lot size will be a critical factor in evaluating the appropriateness of on-site wastewater treatment options and for the feasibility of extending wastewater infrastructure. The dense lots are generally in the State Road, Edgartown Road, Franklin Street, and Vineyard Haven areas.

Figure 15 presents the parcel density, which generally follows the zoning regulations in most locations. In the R-50 areas, only a handful of legacy parcels are less than 50,000 square feet. The R10 area exhibits the densest development.

Zoning and lot sizes tend to follow the Lagoon Pond DCPC restrictions. Zoning in the Lagoon Pond DCPC is R20 or R50.

Section 4.2.5 Land Use

The GIS data for each parcel from the Assessor's database includes land use codes (LUCs), also called Property Type Classification Codes, as defined by the Massachusetts Division of Local Services. The LUCs present the actual use of the property, not the Zoning classification. Figure 16 provides an overview of the land use, which can be compared to the Zoning figure (Figure 14).

A LUC is normally represented by a three-digit number; however, Tisbury makes liberal use of a fourth digit to provide more detail for the many variations of property types. Table 4 provides a detailed breakdown of the 3,418 three-digit and four-digit LUCs in Tisbury.

Table 4: Developed and Undevelopable Parcels According to Land Use Codes

LUC Group	LUCs Included	Number of Parcels	Percent of Total Parcels
Single Family Residential	101, 1010, 1011, 1013, 1014, 1021, 1030	2,246	65.7%
Multi-Family Residential	104, 109, 111, 111C, 112C, 1040, 1050, 1090, 1110, 1211, 1250	307	9.0%
Developable Land Residential / Commercial	1300 / 3900	147	4.3%
Potentially Developable Land Residential / Commercial	1310 / 3910	17	0.5%
Undevelopable Land Residential / Commercial	1320 / 3920	93	2.7%
Accessory Use	1060	36	1.1%
Industrial (Utilities)	431V, 433C, 4230, 4240, 4300, 4310, 4500	14	0.4%

LUC Group	LUCs Included	Number of Parcels	Percent of Total Parcels
Commercial	302, 310, 310I, 313, 313I, 316, 316I, 316V, 321, 322, 322I, 325, 326, 326I, 340, 342, 361, 362, 375V, 381V, 384I, 386, 1400, 3000, 3010, 3020, 3031, 3100, 3101, 3131, 3140, 3150, 3161, 3210, 3221, 3240, 3250, 3260, 3320, 3330, 3340, 3370, 3400, 3401, 3410, 3750, 3840, 3880,	237	6.9%
Agricultural / Forest / Chapter 61	601, 712, 713, 718, 720, 7160, 7170, 7180, 7200, 7220	24	0.7%
Recreation	803, 805, 811, 8010, 8030, 8050, 8110	21	0.6%
Mixed Use	010J, 011C, 013C, 032I	10	0.3%
Tax Exempt (Municipal, Conservation Restriction, Housing Authority, Open Space, Charity)	900, 902, 905, 908, 929, 931, 934, 935, 939, 940, 951, 954, 958, 959, 960, 961, 995, 9000, 9032, 9050, 9100, 9150, 9290, 9300, 9320, 9380, 9500, 9590, 9600, 9600, 9800	248	7.3%
Other / Unassigned		18	0.5%

The R-3A district is primarily west of Lake Tashmoo and includes Chapter 61A agricultural land, as well as large tracts of protected open space and some multi-family properties, which are not densely developed but are large parcels with multiple buildings (compounds). Within the Lake Tashmoo watershed, parcels generally follow the zoning size limits, and are larger than parcels to the east of Lake Tashmoo.

Most of the open land shown in the “triangle” south of State Road is owned by the Town of Tisbury as LUC 930, exempt land, which it acquired for aquifer protection. Other open land belongs to the Martha’s Vineyard Land Trust, which protects open spaces.

The open land to the east of the triangle and south of State Road has less stringent protections. Land owned by the Town includes the Park and Ride on the landfill and a solar array. The Martha’s Vineyard Hospital also owns a lot in the area.

Developable or Potentially Developable Residential and Commercial land is less than 5% of the total parcels, which indicates the lack of potential build-out on currently undeveloped land, and indicates that future buildout may take place primarily through redevelopment.

SECTION 4.3 HISTORICAL AND ARCHAEOLOGICAL SITES

Impacts to historical and archeological sites must be evaluated when considering alternatives to address wastewater needs. The first step is to identify these important cultural sites. EP compiled

the following historical sites from
https://www.nationalregisterofhistoricplaces.com/ma/dukes/state.html

- The MVC, https://www.mvcommission.org/historic-resources, identifies the William St Historic District as a locally designated historic district, which offers some legal protections. It has been on the National Register of Historic Places since 1983.
- The West Chop Club Historic District has been on the National Register since 2007 without local designation.
- The Ritter House (also known as Jireh Luce House) on Beach Street
- Tashmoo Springs Pumping Station (Also known as the Tisbury Waterworks Spring Building) at 325 W. Spring Street
- West Chop Light Station on West Chop Road

SECTION 4.4 DRINKING WATER

Section 4.4.1 Tisbury Water Works

As shown in Figure 17, the Tisbury Water Works (TWW) supplies water to the most densely developed areas of Tisbury, generally located to the east of Lake Tashmoo.

The TWW operates three supply wells: the Sanborn, Tashmoo, and Manter Wells. All sources are groundwater supplied from the Island's sole source aquifer. The TWW's sources share an approved Zone II delineation with distinctive nodes at the Tashmoo and Sanborn wells. The previous Figure 11 shows that the Zone II extends from Tisbury to Oak Bluffs and southwesterly into West Tisbury, MA. Each well also has a 400-foot radius Zone 1 protecting the area closest to each well.

There is an emergency interconnection with the Oak Bluffs Water District on Edgartown Road.

Two water storage tanks are located on High Point Lane. The TWW constructed a 1.2 million gallon standpipe in 1979 and an elevated 350,000 gallon composite storage tank, adjacent to the standpipe in 2013.

Drinking water is distributed to the TWW's water system customers through 49 miles of pipe. The water system consists of one pressure zone. The ability of the TWW to distribute water for general use and fire protection is dependent on the storage volume, system pressure, and diameter of the pipes in the network, in which half the total length of pipe is 6-inches in diameter or less.

Section 4.4.2 Drinking Water Quality

In 1999, Tisbury superimposed a Groundwater Protection Overlay District in the Town's Zoning Bylaws (Section 09.09.11) on the R-10, R-20, R-50, R3A, and B-2 Zoning Districts that encompasses the Zone II of the Town's public water supply wells. The Overlay District's permitted and prohibited uses apply to all new construction, reconstruction, or expansion of existing buildings, and new or expanded uses. Tisbury's Overly District has water supply protection requirements that meet MassDEP's Groundwater Supply Protection regulations 310 CMR 22.21(2), *Wellhead Protection Zoning and Nonzoning Controls*.

Table 5 presents data from the TWW 2020 Water Quality Report. PFAS testing showed NO DETECTION in all wells.

Table 5: 2021 TWW Water Quality Report Data

Contaminant	Units	MCL	MCLG	Detected Level
Nitrate	ppm	10	2	0.40
Nitrite	ppm	1		ND
Barium	ppm	2	10	0.011
Asbestos	MFL	7	0	4.00
Sodium	ppm	--	20	15
Gross Alpha Activity	pCl/L	15	0	0.75
Radium 226 & 228	pCI/L	5	0	0.56
Di(2-Ethylhexyl) phthalate	ppb	6	0	2.5
Chloroform	ppb			2.84
Tetrachloroethylene (PCE)	ppb	5	0	ND
		AL		
Lead	ppm	0.015	0	0.006
Copper	ppm	1.3	1.30	.0260
		SMCL		
Sulfate	ppm	250		3.3
Iron	ppm	0.26		0.35
Manganese	ppm	0.009		0.018
Hardness	ppm	n/a		7.4
Alkalinity	ppm	n/a		25

Notes:

- ppm = parts per million; ND = non-detect; MFL = million fibers per liter; ppb = parts per billion; pCI/L = picocuries per liter; n/a = not applicable; ND = non-detect
- AL = action level; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; SMCL = secondary maximum contaminant level
- Lead and Copper samples are from 31 homes throughout the service area
- In October 2020, the TWW detected total coliform in the water system. After flushing and chlorinating the system, subsequent samples were negative.

The most recent Source Water Assessment and Protection (SWAP) report from MassDEP is dated 2003, when Tisbury had two wells online, Sanborn Well #1 and Tashmoo Well #2. The SWAP states, "The wells are located in an aquifer with a high vulnerability to contamination due to the absence of hydrogeologic barriers (i.e. clay) that can prevent contaminant migration."

The only MassDEP regulated facility in the water supply protection area is the Tisbury Landfill (DEP Facility Number 39804). MassDEP considers the susceptibility to contamination to be high, based on the following high threat land uses within the Water Supply Protection Area:

- Pesticide Storage or Use (quantity of 5)

- Bus and Truck Terminal at Carroll's Trucking on Edgartown Road
- Photo Processor Wooden Tent Photo (EP is unable to locate photo processors in the Zone IIs.)
- Hazardous Materials Storage (quantity of "few")
- Tisbury Town Landfill (capped)
- Residential Underground Storage Tanks (quantity of "some")

Section 4.4.3 Tisbury Public Water Supply Master Plan

In 2020, Environmental Partners (EP) completed a supply, storage, and distribution system analysis of the Town of Tisbury's water system to determine deficiencies and recommend capital improvements.

The assessment consisted of the following:

- A description of the water system;
- An evaluation of the Town's current and future water demand;
- An assessment of distribution system storage, including its ability to meet current and future demands and fire requirements;
- An update to the water system hydraulic model and an assessment of distribution system hydraulics;
- Recommendations for storage, and distribution facilities improvements; and,
- Preparation of a Capital Improvement Program.

EP's 2020 Report, *Water Distribution System Capital Improvement Plan*, concluded that:

- The Town's three groundwater supplies have sufficient capacity to meet maximum day demands for the next fifteen years, even if the largest supply (Manter Well) is offline.
- The TWW delivers high quality water from its groundwater supplies, which require minimal treatment (pH adjustment for corrosion control).
- There is currently a deficit of distribution storage of approximately 280,000 gallons.
- EP identified 12 locations of fire flow deficiency. In general, undersized water mains cause the deficiencies.

EP developed a 15-year capital improvement program consisting of five 3-year phases based on the priority of each improvement.

Section 4.4.4 Wells and Treatment

The total permitted aquifer withdrawal under the Massachusetts WMA is 3,254,400 gpd (2,260 gpm). Under its current permit, the District may withdraw an annual average of 0.77 million gallons per day (MGD) until the year 2026.

The Town's three (3) wells are gravel-packed wells. Table 6 presents the construction and capacity details for each well.

Table 6: Tisbury Water Works Well Construction and Capacity Data

Well	Location	Depth	Year On-Line	Maximum Pumping Rate (gpm)	Approved Daily Volume (MGD)	Approved Daily Volume (gpm)
Sanborn	Edgartown Road	222	1952	950	0.82	570
Tashmoo	West Spring Street	225	1965	850	0.708	490
Manter	Old Holmes Hole Road	220	2004	1,000	1.73	1,200

The Manter Well, Sanborn Well, and Tashmoo Well each have treatment facilities that supply finished water directly to the distribution system. The treatment facilities add sodium hydroxide (25% NaOH) to each of the wells to increase the pH level and for control corrosion.

Section 4.4.5 Pumping Records

Table 7 provides a 5-year history of the total volume pumped by each well (2016 through 2020):

Table 7: TWW Total Volume Pumped (Million Gallons)

Well	2016	2017	2018	2019	2020
Sanborn	117.9	112.7	94.0	79.1	98.5
Tashmoo	109.1	98.0	69.6	69.6	81.2
Manter	80.7	63.4	98.9	98.9	116.2
Totals	307.7	272.1	247.6	247.6	295.6

Table 8 provides the number of pumping days and the maximum pumping day for each well in 2020:

Table 8: TWW 2020 Pump Operating Days and Maximum Day Flow

Well	Number of Days Pumped	Maximum Day (MGD)	Maximum Day Date
Sanborn	365	0,694	July 29, 2020
Tashmoo	260	0.718	July 28, 2020
Manter	365	0.794	August 14, 2020

Section 4.4.6 Water Use Records

The TWW has 2,571 accounts in its billing database, with 2,550 active accounts from 2018 to 2020, inclusive. The TWW designates its accounts by three billing categories, Commercial, Town and Residential, which are not related to the Land Use Codes in the assessor's database.

Residential water usage, for all residential properties (single family and multi-family), averages 261 gpd per account, which is well above typical residential usage. The state's goal is less than 65 gallons per capita per day (gpcd). Tisbury's household occupancy rate is 2.37 persons per household, which results in a per capita rate of 110 gpcd. Buildings with heavy water use can overwhelm a septic system and cause surface breakouts on the leaching fields

The median daily water use rate is 177 gpd, a per capita rate of 75 gpd, which indicates that a number of large residential water users are skewing the average higher. Residential accounts are 89.5% of all accounts, with 83% of total usage. The quantity of accounts and the average and median values for average day demand are presented in Table 9.

Table 9: Summary of Water Usage 2017-2020 by TWW Billing Category

	Commercial	Town	Residential	Total Active Accounts
Accounts	240	23	2,287	2,550
Percent of Accounts	9.4%	0.9%	89.7%	
Percent of Usage	15.5%	1.7%	82.8%	
Average Day Demand (ADD) (gpd)	466	536	261	280
Median Day Demand (gpd)	232	178	177	178

Table 10 presents the water system overview for each watershed. The Lagoon Pond and Lake Tashmoo watersheds draw approximately 20% of the water demand each.

Table 10: Quantity of Parcels Connected to Public Water Supply and Average Daily Water Use by Watershed

	Lagoon Pond	Lake Tashmoo	Coastal	Total
Developed Parcels with Active TWW Connection	560	611	1,379	2,550
Average Day Demand (gpd)	144,670	150,830	418,176	713,675
Average Day Demand per Parcel (gpd)	258	247	303	280
Percent of Total Use	20.3%	21.1%	58,6%	

Of the 3,418 parcels in Tisbury, 3,057 are developed, and 2,550 have an active TWW account. The following Table 11 illustrates the breakdown per watershed.

Table 11: Parcel Breakdown by Watershed

	Lagoon Pond	Lake Tashmoo	Coastal	Total
Total Parcels	700	915	1,803	3,418
Developed Parcels	621	815	1,621	3,057
Developed Parcels with Active TWW Connection	560	611	1,379	2,550

Table 12 provides the water usage for single family properties as noted in the MEP reports, compared to the water usage for the most recent 3-year period.

Table 12: Single Family Residential Water Use (MEP Compared to TWW 2018–2020 usage)

Watershed	Single Family Water Use Data Source	Single Family (gpd)
Lake Tashmoo	MEP Average (Water use from 2002 to 2005)	190
	Watershed 2018-2020 TWW Average	226
Lagoon Pond	MEP Average (Water use from 2002 to 2005)	175
	Watershed 2018-2020 TWW Average	244

The MEP model used an average water use for single family residences of 190 gpd in the Lake Tashmoo watershed and 175 gpd in the Lagoon Pond watershed. EP combined TWW records from 2018 through 2020 with the assessor's database to create a breakdown of water use by zoning and especially for single family residences. The Lake Tashmoo watershed's water use for single family properties increased 19% from the MEP's estimate. In the Lagoon Pond watershed, the increase is 40% over the MEP's estimate. The MEP estimated that the average watershed-wide (all zoning) water use for Lagoon Pond would be 160 gpd. Because the MEP based its nitrogen load calculations on water usage, the increase in water has the potential to increase the existing nitrogen load to groundwater. Once the town selects nitrogen reduction alternatives to evaluate, this discrepancy in water use, and nitrogen loads, should be reconciled.

Table 13 presents the wastewater use, which MEP assumes is 90% of the average water use, for single family properties in the two nitrogen-impaired watersheds.

Table 13: Estimated Residential Wastewater Use

Watershed	TMDL Average Basis (gpd)	2018 – 2020 TWW Average Basis (gpd)
Lake Tashmoo	171	203
Lagoon Pond	158	219

SECTION 4.5 WASTEWATER

Section 4.5.1 Tisbury Reports and Programs

Reviewing the history of wastewater planning helps to understand the preferences of the community towards overall planning and wastewater needs. It also presents a context in which to conduct future planning. For example, the USEPA's 1979 *Environmental Impact Statement Wastewater Collection and Treatment Facilities* focused its recommendations on a limited sewer service area in downtown Tisbury, followed by two more phases that are dependent on the effectiveness of a program of water conservation and septic system maintenance outside of the downtown area.

As shown in the following Figure 18, Phase 1 and Phase 2 service areas approximately match the existing B1 Sewer District. Phase 3 would extend the sewers to the Lagoon Pond watershed (Skiff Ave and Causeway Road neighborhoods), along State Road, and to the Lake Tashmoo watershed at High Point Lane and to the neighborhoods along Spring Street and Lake Street to Midland Ave. The Town has continued with a phased and cautious approach to major infrastructure changes.

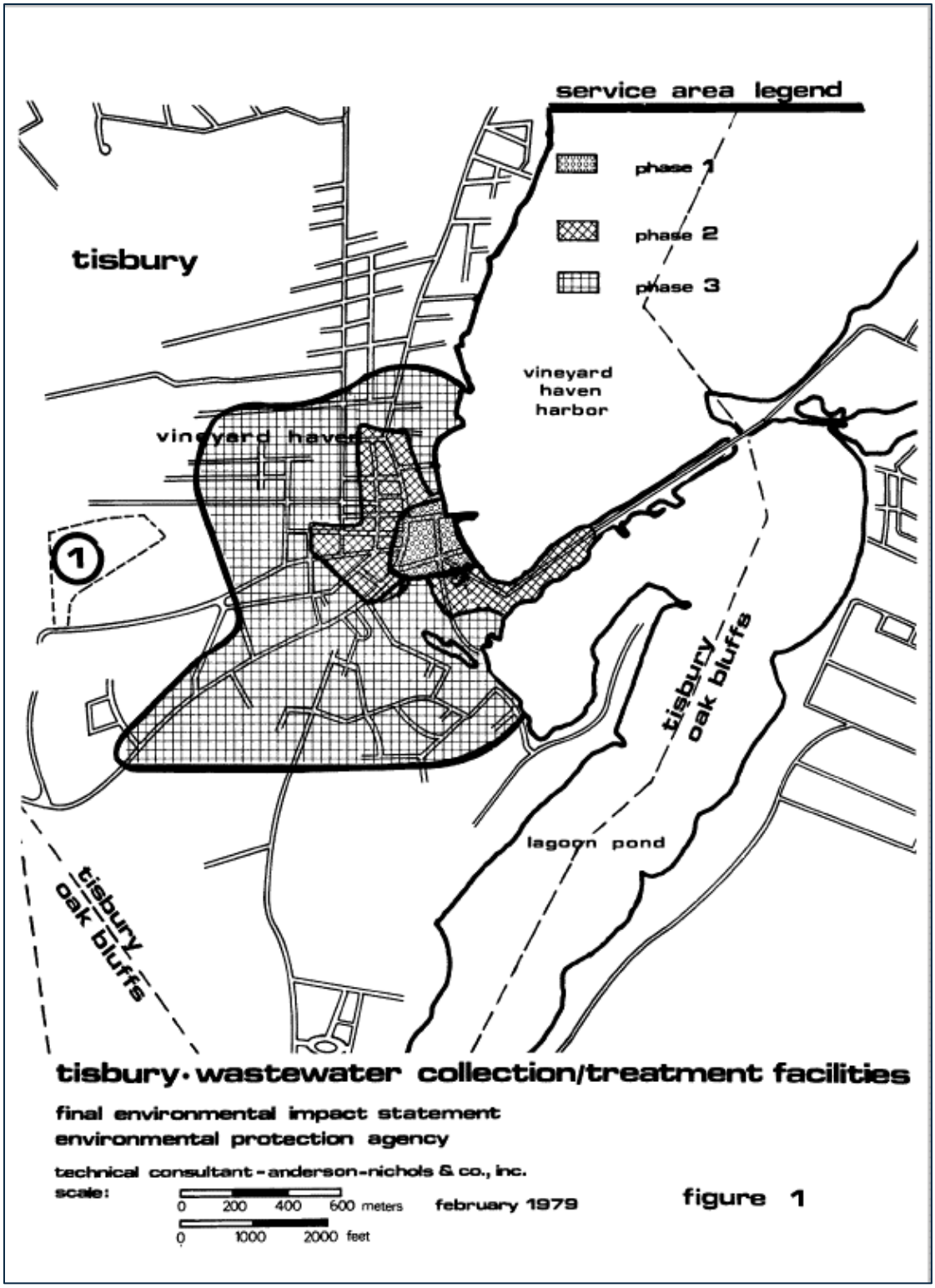

Figure 7: 1979 EPA Report – Sewer Phases

1999 Draft Facilities Plan and Environmental Impact Report

The precursor to the existing municipal wastewater system was the July 1999 *Draft Phase III Facilities Plan and Environmental Impact Report* by Stone Environmental Inc. and Beta Engineering Inc. The study concluded, "A decentralized approach was not a practical option due to final flows and capacity of available treatment and disposal sites." The final plan recommended a centralized system serving 112 customers with over 88,000 gpd from the Vineyard Haven area, conveyed through a pump station and forcemain to a wastewater treatment facility, with two discharge sites. The estimated cost for the system was $4.8M (equivalent to $9.2M in Jan 2021 dollars).

2011 Martha's Vineyard Wastewater Management Study: Case Studies for Lagoon Pond and Tashmoo Pond

A June 2011 study by Wright-Pierce, in conjunction with the MVC, estimated existing and future wastewater flows from septic systems in the Lake Tashmoo and Lagoon Pond watersheds. The study became an addendum to the 2010 Regional Plan discussed in the next Section of this report.

The MVC used land use data and water use records to estimate the existing wastewater flows in each watershed. For Lagoon Pond, the MVC estimated Tisbury's wastewater flow to be 33% of the total flow, with Oak Bluffs contributing 60%, and West Tisbury 7%. For Lake Tashmoo, Tisbury's flow was approximately 80%, with the remainder mostly from West Tisbury.

The study explored options for Tisbury, Oak Bluffs, and West Tisbury to share responsibility for nitrogen mitigation in the Lagoon Pond watershed that may be useful as Tisbury and Oak Bluffs proceed with their CWMPs. The study cited four options for controlling nitrogen, aimed at finding a "least cost" alternative, and based on the wastewater flow in each community:

1. Responsibility for nitrogen control would be based on the "pro-rata" share of wastewater flows for each community.
2. Oak Bluffs would collect, treat and dispose of the entire nitrogen load.
3. Tisbury would sewer its entire portion of the watershed, with Oak Bluffs capturing the remainder of the nitrogen load.
4. Wastewater would be collected from the most densely developed areas in the watershed, regardless of community.

Table 14 presents the options on a flow basis:

Table 14: 2011 Study – Flow Allocation for Lagoon Pond Nitrogen Mitigation Options

Option	Tisbury	Oak Bluffs	West Tisbury
1. Pro-Rata Share	56,000	104,000	13,000
2. Oak Bluffs – Entire TN Load	0	173,000	0
3. Tisbury Full Sewer	113,000	60,000	0
4. Sewer Densely Developed Areas	57,000	116,000	0

Recognizing that the costs of new infrastructure could be shared among the watershed communities independent of where the infrastructure was built, the memorandum presented cost-sharing strategies for the Lagoon Pond Watershed. Table 15 lists the three cost sharing options.

Table 15: 2011 Study – Cost Sharing Allocation for Lagoon Pond Nitrogen Mitigation Options

Cost Sharing Basis	Tisbury	Oak Bluffs	West Tisbury
Watershed Area	22%	56%	22%
Current Wastewater Flow	29%	61%	10%
Length of Shoreline	60%	40%	0%

2014 W-P Hydrogeological Report (WICKS)

Wright-Pierce produced a final report (*Hydrogeological Report – Groundwater Discharge Permit, Elementary School Site, Town of Tisbury*) detailing the field work and testing done along the Tisbury Elementary School property on West William Street to develop an effluent disposal wick system. The wick system is comprised of two 24-inch-diameter cylinders, filled with gravel pack and screened. The system's goal is to relieve the perceived limitations in the available treated wastewater disposal capacity. The technology significantly reduces the land area needed for effluent disposal compared to conventional leaching fields. However, wicks are a new approach in New England that has very little operational history in the geology typical to this area.

The Report included a discussion of the geologic setting, hydrogeological investigations, and a regional survey of drinking water supplies, surface waters, sensitive receptors, and soil/geologic data that led to the selection of the site for the wick system demonstration and testing.

The construction of two full-size test wicks was completed in fall 2013. Testing include step and long-term load tests and monitoring of groundwater elevations, with groundwater modeling. The testing loaded each wick at over 170,000 gpd. Both wicks were loaded a combined 316,000 gpd. Groundwater modeling indicated that minimal effluent would reach the Lake Tashmoo or Lagoon Pond watersheds at 200,000 gpd. At 300,000 gpd, the Lagoon Pond watershed may receive effluent.

These loading capacities help establish the potential effluent discharge capacity at the wick site, or nearby, for future expansion of the municipal wastewater system, The Report recommended further monitoring once the wicks are accepting WWTF effluent.

Further discussion centered on the effluent water quality needed to reduce the risk of clogging the wicks, including near zero suspended solids and a chlorine dosing system to prevent biofouling. The report also discussed the need for a consistent flow of effluent, which would require equalization tanks and pumps to supplement the WWTF.

2015 Tisbury Wastewater Management Planning – Summary of Needs Assessment

The 2015 Report by Wright-Pierce is an update of the 2011 Case Studies and the 2014 Hydrogeological Report. Tables 16 and 17, reproduced from the 2015 report, provide the conclusions succinctly.

Table 16: 2015 Report Tisbury Flows Needing Nitrogen Control (gpd)

	Vineyard Sound	Lake Tashmoo	Lagoon Pond	Total
Current	0	63,000	58,000	121,000
Increase in future	0	35,000	17,000	52,000
Total	0	98,000	75,000	173,000

Table 17: 2015 Report Relative Contributions of Current Nitrogen Load by Town

Community	Lake Tashmoo	Lagoon Pond
Tisbury	80%	33%
West Tisbury	19%	7%
Oak Bluffs	1%	60%
Total	100%	100%

Section 4.5.2 Regional Reports and Programs

2009 Island Plan (Section 10.0 Water Resources)

The MVC's 2009 Island Plan identified higher density residential areas within the Lagoon Pond and Lake Tashmoo watersheds and within 10,000 feet of existing wastewater treatment facilities. According to the MVC, "…wastewater treatment in these areas is the most cost-effective way to reduce nitrogen loading". The areas within 10,000 feet of the Tisbury wastewater treatment include:

- Lagoon Pond watershed, approximately encompassing:
  - East of Edgartown–Vineyard Haven Road:
    - The area defined by Winyah Lane and Hines Point to the existing Sewer District and,
    - Oklahoma Avenue to Park Ave
  - West of Edgartown –Vineyard Haven Road:
    - The area enclosed by Canterbury Lane and Carroll's Way
    - The Oak Bluffs neighborhood of Sea Glen Road
- Lake Tashmoo watershed, approximately encompassing:
  - West of Franklin Street to Lake Tashmoo from West Spring Street to Norton Avenue
  - The B2 District along upper State Road
  - Upper State Road and Snake Hollow Road

Areas to the east of Lagoon Pond in Oak Bluffs are also within 10,000 of the Tisbury WWTF. Tisbury's Lagoon Pond areas also are mostly within 10,000 feet of the Oak Bluffs WWTF.

2010 Martha's Vineyard Wastewater Management Study – MVC

According to the 2010 Martha's Vineyard Wastewater Management Study, the primary wastewater management need is the control of septic nitrogen loading to coastal embayments. The report was published prior to the final TMDLs for the Lagoon Pond and Lake Tashmoo watersheds. The report estimated the wastewater flows from island communities by using 90% of the average water use.

The Study explored installing public sewers to the extent needed to reach nitrogen thresholds that were determined by the MVC, with a flow allowance for sewering for other needs. Growth was estimated at 52% of current wastewater flows. The specific percentage of growth was supported only by the statement, "Future wastewater flows were computed for watershed-specific growth rates based on the Commission's analysis of growth potential."

The Study presented a preliminary needs assessment and discussed options for wastewater treatment (on-site and off-site) in the context of:

- Wastewater management structures
- Wastewater treatment approaches, and
- Regulatory tools.

The Study did not recommend a specific path forward, but presented a set of alternatives and criteria for consideration once the MEP program completed the TMDLs. Alternative structures for management programs included:

- Individual towns acting alone
- Host towns and IMAs with other towns
- Single regional public entity
- Single wastewater or nutrient management district
- Single regional private entity
- Combined water and wastewater entity
- Regional Health District

The inclusion of the regional alternatives points to a comprehensive watershed based approach instead of a single community approach. The Study included criteria that can be used to evaluate each management structure:

- Ease in implementation
- Political acceptability
- First costs (capital costs) to implement
- Potential for long-term cost savings
- Ability to raise money
- Loss of local control
- Impact on community growth
- Potential for optimizing watershed-based solutions
- Interface with local programs

- Ability to obtain grants and loans
- Public accountability

The Study's wastewater treatment approaches included individual on-site systems, cluster systems, satellite systems, and centralized wastewater systems. The Study compared each for nitrogen removal efficiency and for generalized costs to construct and operate.

For cost estimates, the Study assumed the existing municipal wastewater treatment plants and effluent disposal fields have sufficient capacity to serve extended areas. As a worst-case scenario, the report assumed that any new sewer service area would be responsible to recover the proportional capital costs of the existing treatment plant. With no new treatment and disposal costs included, the centralized option proved to be the least expensive on a nitrogen removal basis when including capital and annual costs.

Section 4.5.3 Oak Bluffs CWMP Coordination

Oak Bluffs Draft Needs Assessment Report – Existing Conditions

The *Needs Assessment Report - DRAFT 2018 for the Town of Oak Bluffs, MA*, completed by GHD, was based on a planning period from 2020 through 2040. This section presents a summary of pertinent data for development of the Tisbury CWMP and coordination with Oak Bluffs on watershed-wide initiatives.

Existing Wastewater Infrastructure

The Oak Bluffs WWTF's MassDEP Groundwater Discharge Permit #2-674M (July 20, 2015) authorizes a discharge of up to 340,000 gpd to the Ocean Park subsurface disposal area and up to 250,000 gpd to the Leonardo sand beds adjacent to the WWTF. Total discharge was limited to 370,000 gpd. Permit limits are:

- BOD5 30 mg/l
- TSS 30 mg/l
- Total Nitrogen 10 mg/l
- Nitrate-Nitrogen 10 mg/l

The Ocean Park disposal area originally had a design capacity of 370,000 gpd, but two beds were taken out of service because of concerns over surface breakout of effluent. MassDEP reduced the permitted capacity of the field to 340,000 gpd.

The WWTF and sewer system began operation in 2002. The WWTF is a sequencing batch reactor (SBR) process, with four SBRs, two tertiary effluent sand filters, and ultraviolet (UV) disinfection. The WWTF is equipped with an influent mechanical screen, primary clarifier, and sludge thickening storage tanks. Sludge is thickened by gravity only and hauled off-site for disposal.

The loading rate to each of the disposal areas is:

- Leonardo sand beds 5 gpd/sf
- Ocean Park subsurface beds 3 gpd/sf

The Leonardo sand beds are in the Lagoon Pond watershed. If the two off-line beds in the Ocean Park disposal area can be restored to full function, the entire permitted flow could be discharged outside of a nitrogen-impaired watershed.

The WWTF's effluent average daily flow (ADF) is 98,400 gpd, per the facility's January 2014 – December 2016 WWTF effluent data. The maximum day effluent flow to date (pre-2017) was 270,000 gpd, with a maximum month effluent flow of 205,000 gpd. The SBR design limit is 320,000 gpd. Based on the maximum day effluent flow and the SBR design limit, the plant has reached approximately 85% capacity. It is likely that process upgrades and system expansion will be needed to serve new sewer areas constructed to address TMDL goals.

In 2017, GHD completed an assessment of the Oak Bluffs WWTF, the "*Town of Oak Bluffs Wastewater Treatment Facility Evaluation Final Draft Report*". Major findings of the report are:

- The WWTF is at 85% capacity based on the capacity of the SBRs.
- The facility does not have redundant effluent filtration systems.
- Wastewater process and pumping infrastructure will reach the design life in 2022.

Growth Projections

GHD based growth projections on the University of Massachusetts Donahue Institute projections through 2030, which anticipates an approximately 5% growth in population every five years. GHD extended this through the planning period, using the 2010 census data as a base. For comparison, the Tisbury CWMP is using the recently released 2020 census data.

GHD's process estimates a population increase of 1,050 in Oak Bluffs by 2040. Approximately 70% of developable residential properties (130) are in nutrient sensitive watersheds. To estimate population growth in the nitrogen sensitive watersheds, GHD applied 70% of the population increase (70% of 1,050 = 735) to Oak Bluffs' nitrogen sensitive watersheds. The report does not specify growth projections in each watershed.

Data Coordination

A comprehensive watershed plan could include an inter-municipal agreement to reduce nitrogen loads, which must be based on a common understanding and alignment of the underlying load calculations. Therefore, EP collected data related to nitrogen loading from the Oak Bluffs Needs Assessment report to coordinate the upcoming Alternatives Analysis and the Recommended Plan for inter-community watershed planning.

Table 8-1 of the Draft Needs Assessment includes water usage, and estimated wastewater usage based on 90% of water use. Table 18 reproduces the GHD Table 8-1.

Table 18: Wastewater Flow by Property Type (From Oak Bluffs Needs Assessment Table 8-1)

Property Type	Average Water Usage (gpd)	Average Wastewater Flow (gpd)
Single Family Residential	160	144
Multi-Family Residential	243	219
Commercial	452	407
Industrial	69	62

Table 8.3 of the Final Draft Report lists existing wastewater flows that need to be removed to meet the Lake Tashmoo and Lagoon Pond TMDLs. For the Lake Tashmoo watershed, the total land area in Oak Bluffs is less than 1% of the total watershed area, so GHD assumes Oak Bluffs should remove 1,000 gpd of the total wastewater flow.

For the Lagoon Pond watershed, GHD assumes Oak Bluffs is responsible for removal of 50% of the septic load in the Lagoon Pond East Arm watershed. Therefore, Oak Bluffs would need to remove 69,000 gpd from the watershed. Tisbury would be responsible for removing 100% of the wastewater flow from the West Arm, or 24,000 gpd, as well as 50% of the wastewater flow from the East Arm. Previous studies by Wright-Pierce estimate the necessary nitrogen removal from each community based on wastewater flow at:

- Tisbury 33% of the nitrogen load
- Oak Bluffs 60%, and
- West Tisbury 7%.

Lagoon Pond Coordination

The Towns of Oak Bluffs and Tisbury have jointly developed regulations for on-site wastewater disposal. Through the MVC, island communities have established fertilizer applications regulations. Oak Bluffs and Tisbury worked together through their Boards of Health to install a permeable reactive barrier pilot project and several pilot innovative/alternative (I/A) on-site wastewater treatment systems.

SECTION 4.6 MUNICIPAL WASTEWATER INFRASTRUCTURE

Section 4.6.1 Introduction

The Town of Tisbury's Wastewater Department, under the Department of Public Works, is responsible for the operation and maintenance of the Tisbury WWTF, located at 155 Highpoint Lane, and the associated sewage collection system, located mostly in downtown Vineyard Haven and Beach Road (B1 Sewer District).

The majority of the Town's wastewater systems are on-site (septic) systems regulated by the Board of Health. This Section describes the town-wide wastewater management systems, and highlights the performance of each type, centralized treatment, conventional septic systems, I/A onsite wastewater systems, and enhanced I/A systems.

Section 4.6.2 Vineyard Haven (B1) Sewer District

The collection system has been expanded on the margins of the system since 2004, and includes the elementary school and the recently constructed Emergency Services Facility on Spring Street. The existing sewer system parcels are shown in Figure 19.

Tisbury's municipal sewer system, serving the downtown commercial and harbor front area in the B1 District, began operation in May 2004. The sewer system was installed to help mitigate the adverse effects of septic system runoff into Lagoon Pond and Vineyard Haven Harbor. The system's capacity is limited, not designed to accommodate long-term growth through expansion of the sewer service area. Instead, the system primarily accommodates some growth on lots in the service area that, in 2004, expected to need additional wastewater capacity.

In 2004, 130 properties paid a betterment to be included in the B1 Sewer District. As of October 2021, 121 properties are connected to the sewer system, including 16 connections that did not pay an initial betterment or other fee designed to recoup capital costs of the system. Therefore, 105 properties that paid a betterment have connected, leaving 25 possible connections from bettered properties. Some of these properties are parking lots owned by an adjoining property or one of several adjacent properties owned by a single owner, which will share flow between them. Including newly proposed developments that have not yet contributed wastewater flows, approximately 20 properties may be connected in the planning period, with a Title 5 flow of approximately 9,000 gpd.

The collection system is comprised of 8-inch and 10-inch PVC gravity sewer and 1.5-inch to 3-inch low pressure sewer. Details of the gravity and low pressure system are provided in the following 2 tables.

A single lift station conveys the raw wastewater through a 6-inch diameter force main to the WWTF. The station is located off Water Street near the Police Station and equipped with two submersible pumps driven by 25 horsepower motors. The pumps are rated for 250 gpm at 140-feet of total head.

Table 19: Gravity Sewer Details

SMH to	SMH	Diameter (inches)	Length (feet)
#1 at Pump Station	#2 Main Street	12	155
#2 Main Street	#3 Main Street	12	160
#3 Main Street	#4 Main Street	12	268
#2 Main Street	#5 Main Street	12	50
#5 Main Street	#6 Main Street	12	148
#6 Main Street	#7 Main Street	12	102
#7 Main Street	#8 Main Street	12	170
#8 Main Street	#8A Main Street	12	25
#3 Main Street	#3A Spring Street	12	21
#3A Spring Street	#12 Spring Street	8	255
#12 Spring Street	#13 Spring Street	8	265

SMH to	SMH	Diameter (inches)	Length (feet)
#5 Main Street	#9 Center Street	8	155
#7 Main Street	#10 Church Street	8	373
#10 Church Street	#11 William Street	8	115
#1A, #1B, #1C at Pump Station	Pump Station	8	100
	Total		**2,207**

Table 20: Low Pressure Sewer Details

Beginning Location (Street, Structure, etc.)	End Location (Street, Structure, etc.)	Diameter (inches)	Length (feet)
Union Street	Main Street	1.5	225
Water Street	Water Street	1.5	310
Water Street	Main Pump Station	1.5	270
3-inch line (State Road)	Main Pump Station	3	400
End of Line at Main St	3-inch line (State Road)	3	298
Terminal Flushing Manhole	3-inch line (State Road)	2	215
Post Office grinder pump	State Road	3	290
Easement Turn Lagoon Pond Rd	Post Office GP	3	690
Flushing MH (Lagoon Pond Rd)	Easement Turn Lagoon Pond Rd	3	635
STA 44+00 (34 Beach Road)	Flushing MH (Lagoon Pond Rd)	3	500
STA 38+00 (95 Beach Road)	STA 44+00 (34 Beach Road_	3	600
3x2 Reducer (~STA 32 + 50)	STA 38+00 (95 Beach Road_	3	512
Terminal Flushing Manhole	3x2 Reducer (~STA 32 + 50)	2	950
29 Breakdown Lane	WWTF	3	2,785
Marina Extension	Lagoon Pond Road	1.5	500
Martha's Vineyard Museum	Lagoon Pond Road	1.5	1,000
	Total		**10,180**

Section 4.6.3 Collection System Condition and Infiltration and Inflow (I/I) Program

In 2015, EP completed an assessment of Tisbury's wastewater collection system and interviewed Wastewater Operations staff to assess the operations and maintenance procedures and administrative effectiveness of the collection system. The system was evaluated relative to:

System Management

- Organization & Staffing
- Legal Authority
- Information Management
- Training & Safety
- Contingency Planning

Operations & Maintenance

- Gravity System
- Low Pressure System
- Pump Station
- Force Main

Administrative Functions

- Rates
- Budgeting
- Complaint Management

The assessment created a capital improvement plan that focused on the Main Lift Station, which lacked a bypass connection and had noticeable concrete deterioration. The Town installed the bypass connection in 2021, and the Wastewater Department bid repairs to the wet well concrete in spring 2022 and is the process for contracting for the repair.

The Wastewater Department has performed work to minimize infiltration, which is mostly groundwater entering the sewer through pipe and manhole defects, and inflow, which is mostly rainwater and pumped groundwater in the wastewater system. Infiltration and inflow are not intended to be conveyed and treated by the wastewater system. Inflow from private sources is illegal.

The Wastewater Department self-performed inspection of the interior of the gravity sewer and manholes in November 2020. The gravity sewer system is in good condition with no signs of excessive infiltration or direct inflow in the gravity pipes or manholes. A few manholes on Main Street are targeted for minor repairs.

Inflow inspections in 2020 and 2021 uncovered sump pump systems connected to the sewer system. In May 2020, a major sump pump system was discovered to be contributing approximately 20,000 gpd of groundwater to the sewer system. The sump pump flows were a constant presence in the overall system. The Wastewater Department and the Town Administration secured the removal of the sump pump system in December 2020.

Another sump pump on Lagoon Pond Road, which drained localized flooding on private property, was removed in 2020. A third sump pump system was located during a September 2021 SSO event on Beach Road. This sump pump pumped groundwater and periodic flood waters into the low pressure system. This system has also been removed. A fourth inflow source in the Beach Road area was found by camera inspection that detected a broken joint on a building service prior to the grinder pump chamber, which was repaired in November 2021. The Wastewater Department continues to investigate the grinder pump systems located in the often-flooded area of Beach Road and Lagoon Pond Road.

The flow from these sources used pipe volume and treatment capacity that should have been available for wastewater. The illicit flows were conveyed through the treatment system and discharged to the effluent disposal fields. Although the groundwater and runoff flows are not intended to be combined with wastewater, the treatment facility measured the flows and is required to report the measurements to MassDEP. This gives the illusion that the treatment facility has less treatment capacity available. Based on the removal of these inflow sources, the Wastewater Department has recalculated the existing capacity available in the wastewater system.

Section 4.6.4 Sewer System Regulations

The Attorney General approved Tisbury's sewer by-Law in 2000. The wastewater regulations mostly date to the construction of the system (i.e., prior to 2004). The rules and regulations have proved to be deficient in regards to enforcement, management of flows and fees, and construction details. The Wastewater Department has drafted new rules and regulations to replace the current regulations. The new rules and regulations are anticipated to be finalized and approved in 2022.

Section 4.6.5 Marine Vessel Pump-Out Requirements

The Town of Tisbury Waterways Regulations set standards for sanitation devices on vessels and facilities serving vessels in Vineyard Haven Harbor, Lagoon Pond, and Lake Tashmoo. Specifically, the Waterways Regulations state, "Any business providing services to transient boaters, including dockage and mooring rental, must provide pump-out services for their customers, effective January 1, 2015." Managing the harbor pump-out connections to the sewer system is an important component of the draft wastewater rules and regulations. The Wastewater Department has included new pump-out regulations as part of its revisions to the overall regulations.

Section 4.6.6 Wastewater Treatment Facility

The WWTF is a Grade 6 wastewater treatment facility approved for a maximum daily flow of 139,000 gallons per day, pending upgrades that are anticipated to be complete in early 2023. The facility discharges its treated effluent into two leaching fields, located behind the DPW building at 115 Highpoint Lane and behind the Emergency Services Facility (ESF) on Spring Street.

The WWTF, initially constructed in 2004, contains dual sequencing batch reactor (SBR) treatment processes with a sludge holding tank, dual tertiary filters upgraded in 2013, and ultra-violet disinfection. The existing facility was designed and permitted to treat 100,000 gpd of mixed residential and commercial wastewater and approximately 4,000 gpd of septage (warm weather limit) for a total treatment capacity of 104,000 gallons per day. Typically, septage deliveries are infrequent and inconsistent. Currently, the facility does not plan to accept its maximum allotment of septage.

The specific liquid stream unit processes at the WWTF include:

- Screening and grit removal (headworks complete plant unit)
- Septage receiving system and holding tank
- Pre-SBR equalization (Pre-SBR EQ)
- Activated sludge treatment by sequencing batch reactors (SBRs)
- Post-SBR equalization (Post-SBR EQ)
- Filtration (dual drum filters)
- UV disinfection, with standby chemical (sodium hypochlorite, NaOCl) feed system
- Effluent storage and pumping
- Effluent disposal (leaching/disposal fields)

The solids handling unit processes include:

- Sludge storage tank mixed by coarse bubble aeration
- Centrifuge dewatering
- Dewatered sludge storage (roll-off container) and hauling

Groundwater Discharge Permit

The facility has a non-industrial groundwater discharge permit (SE 2-732) regulated by MassDEP in accordance with the provisions of 314 CMR 5.00. In April 2016, MassDEP increased the permit limits to 200,000 gpd annual average flow (352,000 gpd maximum daily flow) pending MassDEP approval of WWTF upgrades and an operational wick well disposal system.

The pending Tisbury WWTF discharge permit has the following restrictions:

- Maximum Daily Flow without use of the wick wells 139,000 gpd
    - This is an increase from 104,000 gpd pending upgrades to the WWTF that will increase the biological and hydraulic capacity of the facility
- BOD5 30 mg/l
- TSS 30 mg/l
- Total-N 10 mg/l
- Nitrate-N 10 mg/l
- TDS 1000 mg/l
- Oil & Grease 15 mg/l
- Fecal Coliform 200 colonies/100 ml
- Total Residual Chlorine 4 mg/l

The increase in hydraulic capacity of the effluent disposal beds is based on a hydrogeological study performed by EP in 2019 that showed that the existing disposal fields can accept increased loading without groundwater mounding or surface breakout. This increase has received preliminary approval from MassDEP.

Operating History (Flows)

Pending the new discharge permit, the WWTF has been limited to 104,000 gpd. The flow to the WWTF has been increasing until the 2020 pandemic reduced the overall flow to the WWTF. However, the 2020 flows included the sump pump discharges described above that increased the recorded effluent flows by approximately 20,000 gpd.

The removal of the single large sump pump discharge has significantly reduced the capacity restraints at the WWTF by dropping the maximum day flow by almost 35,000 gpd from the 2018 maximum day flow. As a result, the 2021 peak flows, despite a return of tourism and commercial activity from the 2020 pandemic year, are less than during the pandemic year. Yearly data in Table 21 show that the frequency of high flows, as measured at the effluent of the WWTF, has dropped to pre-2017 levels.

Table 21: WWTF Effluent Flow Data for 2017 through September 2021

Flow Threshold (gpd)	2017	2018	2019	2020	2021
Average Day	51,533	60,606	60,799	52,405	44,860[1]
Maximum Day	97,900	101,380	112,710	89,933	78,211
Days with Flow > 104000	0	0	2	0	0
Days with Flow > 100,000	0	3	4	0	0
Days with Flow > 90,000	2	14	18	0	0
Days with Flow > 80000	9	36	50	7	0
Days with Flow > 70000	9	96	97	47	12

[1] 2021 average day flow is an estimated average over 12 months based on a nine-month average from January through September and comparison of previous flows from October through December.

A direct comparison of historical flows to 2021 flows show a significant reduction of peak daily flows. The following Figure 20 shows the variation in daily flows for 2019 and 2021. In 2021, flows are less than pre-pandemic (2019) flows. The average day flow, maximum day flow, and the number of days with flow of at least 80,000 gpd is less in 2021 than in any of the past 5 years. Despite the record rainfall in July 2021, the WWTF's effluent flow remained below 2019 levels. A severe storm event on October 31, 2001 caused flooding on Beach Road and increased flow at the WWTF by approximately 20,000 gpd for two days. The singular event supports the Wastewater Department's continued scrutiny of the Beach Road and Lagoon Pond area.

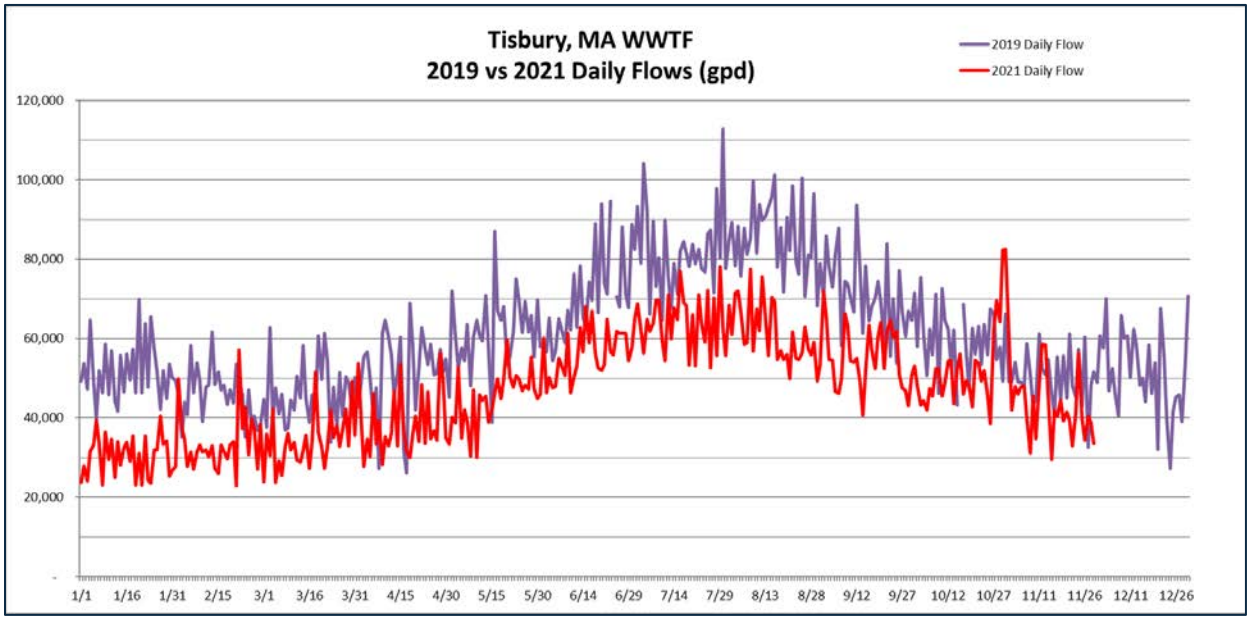

Figure 8: Comparison of WWTF Daily Effluent Flows 2019 and 2021 (gpd)

Figure 21 "smooths" the daily variation by graphing the 30-day average flow and shows the gap between the 2019 flows and the 2021 flows. The graph shows a reduction of 30-day flows by at least 10,000 gpd, and a reduction of 22,000 gpd during peak flow periods, with the exception of the extreme weather event on October 31, 2021.

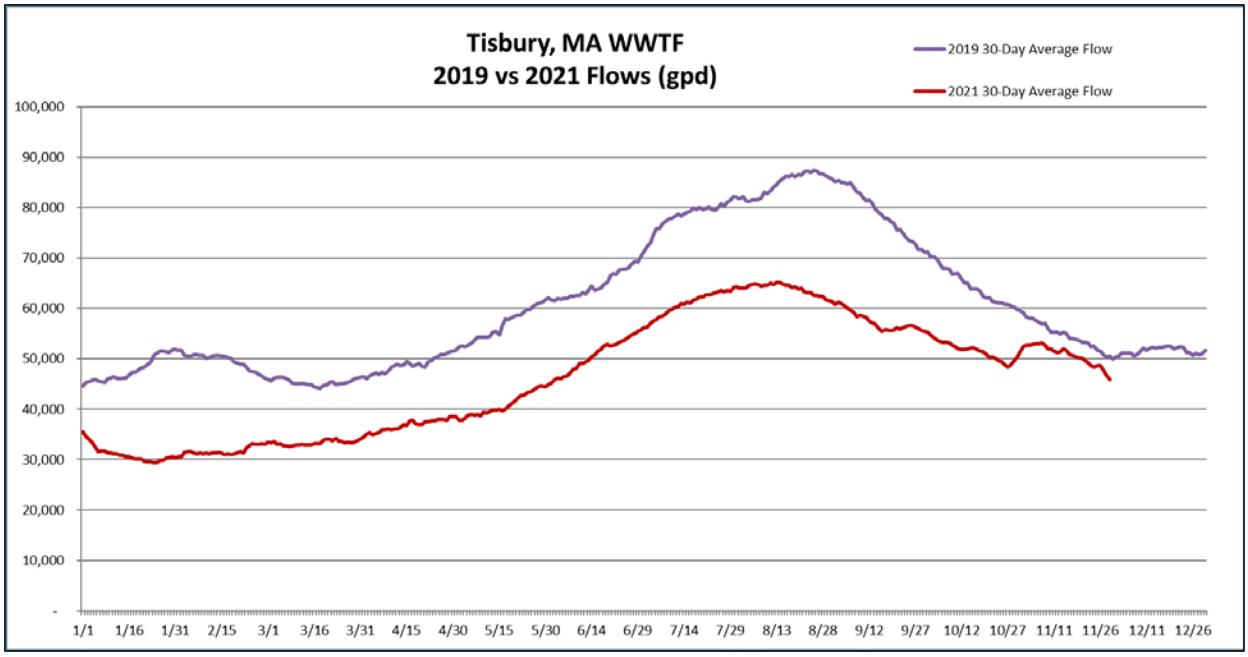

Figure 9: Comparison of WWTF 30-Day Average Effluent Flows for 2019 and 2021

Operating History (Loads)

Because of the significant reduction in flows to the WWTF in 2021, resulting from the permanent elimination of illicit sump pump discharges, the project team is using the 2021 WWTF flow and load data as a baseline for CWMP planning. If 2022 data are significantly different from 2019 data, the 2020 data will be used for analysis, or a factor will be added to the 2021 data.

Table 22 presents the average of the WWTF's 2021 monthly reporting data and the efficiency of removal through September.

Table 22: 2021 WWTF Average Influent and Effluent Concentrations and Removal Efficiency for Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD) and Total Nitrogen (TN)

TSS in (mg/l)	TSS out (mg/l)	% TSS Removed	BOD in (mg/l)	BOD out (mg/l)	% BOD Removed	TN in (mg/l)	TN out (mg/l)	% TN Removed
321	3.36	98.85%	400	3.64	99.09%	61.18	3.68	93.97%

Existing WWTF Nitrogen Load to the Lake Tashmoo Watershed

The Lake Tashmoo MEP Final Report identifies that discharges from the WWTF are evenly split between the two effluent disposal beds at the Emergency Services Facility (ESF) and the DPW, and that effluent from the bed at the ESF contributes to the Lake Tashmoo watershed whereas those from the DPW discharge to Vineyard Haven harbor.

An estimate of the nitrogen loading to Lake Tashmoo from the WWTF was calculated based on average flow and nitrogen concentrations of the effluent discharges. Based on data through September 2021 and historical ratios for the months of October through December, EP estimates that the WWTF's average daily flow through 2021 is 44,860 gpd and the average N concentration in

the WWTF effluent is 3.68 mg/l. Therefore, the calculated TN load discharged by the WWTF to the Lake Tashmoo watershed is approximately 250 pounds per year.

This is slightly greater, by approximately 15 pounds of nitrogen/year, than is estimated in the MEP Final Report of 236 pounds nitrogen/year). The discrepancy is because the MEP analysis used is based on data from 2007-2009 versus 2021 for flow (35,944 gpd vs. 44,860 gpd, respectively) and nitrogen concentrations of the effluent (4.2 mg/l versus 3.68 mg/l, respectively).

The estimate of nitrogen loading to Lake Tashmoo from the WWTF is based on the more recent data for the purposes of assessing existing conditions in this CWMP.

WWTF Nitrogen Reduction Strategy for the Tashmoo Watershed

Prior to the most recent Discharge Permit, each of the two WWTF effluent disposal fields is permitted to receive up to 52,000 gpd. The WWTF operators historically alternated effluent dosing to each disposal field so that each field received approximately half of the daily flow. The overall WWTF flows are typically less than 52,000 gpd for about six to seven months per year, usually from October to May.

The MEP Final Report, to be conservative, assumed that the WWTF's discharge to the ESF field is within the Lake Tashmoo Watershed. In an effort to reduce effluent nitrogen discharges to Lake Tashmoo, the WWTF operators piloted discharging the entire effluent flow to the DPW disposal field, which is outside of any nitrogen sensitive watersheds. From January 14, 2021 through April 1, 2021, all of the treatment plant effluent was directed to the DPW field, effectively reducing the total nitrogen load to the Lake Tashmoo watershed by approximately 40 pounds. The WWTF operators plan to continue this practice for all periods that flows are consistently below 52,000 gpd. This effort continued into late 2021 and early 2022, and is expected to be common practice.

The Town requested an increase in the disposal capacity at each field to 69,500 gpd/field in response to the most recent draft Groundwater Discharge Permit, which MassDEP granted, and the operators will continue to prioritize use of the DPW field as part of a larger nitrogen reduction strategy for Lake Tashmoo.

WWTF Upgrades and Improvements History

By 2012, the WWTF was experiencing hydraulic and biological treatment capacity limitations that prevented the plant from processing flows up to the 104,000 allowed under their Groundwater Discharge Permit. EP performed an evaluation of the treatment plant, identified the causes of these limitations and made recommendations for correcting them.

The Town implemented a four-phased program for restoring treatment capacity of the facility as follows:

Phase 1: Relieve flow and process restrictions; completed with the addition of the centrifuge in 2012 and effluent drum filters in 2014.

Phase 2: Correct equipment and facility deficiencies and maintain the facility at a sufficient level of maintenance and operations. The headworks (screen and grit removal), HVAC, and SCADA improvements were completed in 2021.

Phase 3: Optimize the process and hydraulics to gain as much capacity as possible with the existing SBR structures, up to 139,000 gpd. Design is complete, and the Town anticipates soliciting bids in early 2022.

Phase 4: Expand or replace the treatment facility to meet pending and long-term needs if recommended by the CWMP and approved by Town Meeting.

SECTION 4.7 ON-SITE WASTEWATER SYSTEMS

Section 4.7.1 Regulations and Special Considerations

State Regulations

Title 5 of the Massachusetts Environmental Code, 310 CMR 15.00, defines on-site wastewater treatment flow restrictions for new construction in Nitrogen Sensitive Areas (310 CMR 15.214). Nitrogen Sensitive Areas are defined as either "nitrogen sensitive embayments or other areas that have been designated as nitrogen sensitive", interim wellhead protection areas, or MassDEP approved Zone II's of public water systems. On-site wastewater system design flows in these areas are limited to 440 gallons per day per acre (equivalent to four bedrooms per acre) unless an enhanced nitrogen removal system is installed. This restriction is also applicable for new construction with both an on-site wastewater disposal system and a drinking supply well.

Conventions used by MEP and MassDEP

The Cape Cod Commission, MEP and MassDEP have established an accepted a discharge nitrogen concentration of 35 mg/l from a conventional septic tank and 26.25 mg/l to groundwater when including the removal of 25% of the total nitrogen in the soil absorption system (SAS, or leaching field). The MEP and TMDL reports estimate wastewater use on each parcel as 90% of water use. With a 75% reduction of nitrogen in the disposal field, total nitrogen to groundwater is estimated to be 23.625 mg/ l. The process can be described as:

- Wastewater flow = 0.9 x average water use
- Nitrogen in septic tank effluent = 35 mg/l
- Reduction of total nitrogen in conventional SAS = 75%

Therefore: 0.9 x 35 mg/l x0.75 = 23.625 mg/l total nitrogen concentration to groundwater
23.625 mg/l x water use gives the nitrogen load to groundwater

Tisbury Board of Health On-Site Wastewater Regulations

The Tisbury BoH has been proactively regulating on-site wastewater systems in relation to nitrogen since at least since the establishment of the Lagoon Pond DCPC. The BoH recognized the impact nitrogen from on-site wastewater systems has on the sustainability of the Town's coastal ponds and water resources and to the health and safety of the general public. The BoH General Policy 09.0.8 PROHIBITION OF NEW OR EXPANDED SYSTEMS IN SEWER DISTRICT states, "No new septic system shall be constructed and no septic system shall be upgraded or expanded, if it is feasible to connect the property to the municipal sewer system".

In 2016, the BoH adopted a regulation titled, "*Deployment of Enhanced De-Nitrification Technologies within the Lake Tashmoo and Lagoon Pond Watershed Nitrogen Management District*s" (Nitrogen Regulations). These Nitrogen Regulations required that new on-site wastewater treatment systems and upgrades to existing systems "employ 'best available de-nitrification technology', removing significantly more wastewater nitrogen than standard Title 5 septic systems." At the time of the regulations, the 'best-available de-nitrification technologies' Approved for General Use by MassDEP could claim effective nitrogen treatment to 19 mg/l of TN. Some technologies on the MassDEP official list of Uses Approved for General Use are noted as "TN < (not more than) 19 mg/l". The Nitrogen Regulations also allow the BoH to review new technologies that may lower the 19 mg/l threshold.

An innovative element of the Nitrogen Regulations includes technologies approved for piloting under the Title 5 Regulations, 310 CMR 15.000. The piloting category is intended to provide field-testing and proof of technology for further testing in "real world" conditions. This innovative component of the Nitrogen Regulations allows the Town to assist promising technologies in installing the required number of systems to meet the Piloting requirements, which can be a burdensome task for new technologies, while the Town identifies technologies that will allow it to lower the nitrogen in the watersheds at a quicker pace.

In 2022, the Tisbury BoH revised the 2016 regulations with the Board of Health Regulations, *Deployment of Enhanced De-Nitrification Technologies within the Lake Tashmoo and Lagoon Pond Watershed Nitrogen Overlay Districts,* requiring that on-site wastewater systems discharge a nitrogen concentration lower than conventional I/A systems. The regulations require enhanced de-nitrification technology "that meets a nitrogen groundwater discharge standard of not more than 13 mg/liter of nitrogen from septage waste or removes 75% of septic nitrogen waste."

Tisbury Board of Health Special Districts

In 1989, the BoH established a Special Sanitary Control District Overlay for the Lagoon Pond DCPC (Regulations Section 09.10.01) to institute the MVC's DCPC guidelines and add specific new requirements to meet the DCPC goals. The regulations require erosion control from all construction sites, coordinate with the Coast District requirements on fertilizers and insecticides, and require a certificate of consultation with the BoH for commercial hydroseeding and fertilizing.

The BoH implemented an inspection and monitoring program for septic systems in the DCPC. Several systems were upgraded to meet Title 5 criteria based on the program. The BoH also requires that all systems be pumped out at 3-year intervals. Mounded disposal system are prohibited.

The impaired water quality that prompted the BoH regulations limits development and expansion of uses on properties in the DCPC. New construction is limited to one bedroom per 15,000 square feet of total lot area. For existing unbuilt lots, a maximum of three bedrooms are allowed on lots less than 45,000 square feet. The regulations recognize that the restrictions are necessary because approved on-site wastewater treatment technological alternatives are not available at the time the regulations were approved, and allows for the review of new and approved technologies.

The Oak Bluffs BoH has established comparable regulations in the Lagoon Pond DCPC. The Tisbury BoH's Coastal District and Barrier Beach Regulations also limit newly constructed or enlarged septic systems, and prohibit mounded disposal fields in the regulated area.

Regional Nitrogen Removal Programs

The MVC Water Quality Policy provides guidance to development applicants seeking approval of Development of Regional Impact (DRI) Projects with regards to nitrogen loading and its effects on water quality. The Policy establishes nitrogen mitigation goals for each nitrogen impaired watershed on Martha's Vineyard. If a proposed project cannot meet the nitrogen load limit calculated for the project, the MVC can require modifications to the proposal or the applicant can consider offsite mitigation to offset the excess nitrogen load.

The MVC Water Quality Policy also requires all I/A systems approved by the MVC DRI process to have ongoing maintenance and monitoring contracts.

Section 4.7.2 On-Site Wastewater Systems

Privately owned on-site wastewater systems are the primary method of wastewater treatment and disposal in Tisbury and on Martha's Vineyard. In total, the Town of Tisbury has approximately 2,860 on-site wastewater systems outside of the sewered area that are listed in the BoH's database as of November 2020. The on-site systems range from cesspools to compliant conventional Title 5 systems, to I/A and enhanced I/A systems in various stages of MassDEP approval that are designed to remove nitrogen.

Prior to 1995, Title 5 regulations did not require an inspection of on-site systems prior to a property being sold or enlarged. Septic systems older than 1996 typically do not meet current standards. The BoH database lists 245 systems with a permit date prior to 1996 and an additional 205 systems listed as cesspools but without a permit date.

In 2008, the BoH created and implemented an on-site wastewater system inspection program to supplement the Title 5 regulations. The BoH inspected 2,070 on-site wastewater systems from 2008 through 2020. The database shows 85 other systems inspected prior to 2008, for a total of 2,145 systems inspected.

The BoH has implemented regulations to require the use of (innovative/alternative) I/A wastewater technologies, as defined by MassDEP, in nitrogen-impaired watersheds upon sale or expansion of use on the property. Systems on the MassDEP list for Approved for General Use are approved for a maximum effluent nitrogen concentration of 19 mg/l.

The location of Tisbury's parcels with a permit data prior to 1996 or without a permit data is shown in Figure 22. Some parcels shown as not having a septic system permit since 1995 are obviously not developed. These parcels have a land use code identifying the property as developed residential. These lots will not factor in the further evaluation of parcels as suitable for Title 5 compliant septic systems. On-site wastewater systems are shown on Figure 22 and listed by watershed in the following Table 23. I/A systems are highlighted on the figure.

To date, 33 of the 49 I/A systems Approved for General Use are FAST or MicroFAST systems, with a few Bioclere units, Waterloo Biofilters, Amphidrome systems, and recirculating sand filters.

The Town conducted a pilot program of an additional I/A systems, NitROE®, to compare their nitrogen removal capabilities compared to other onsite system technologies. The Town collaborated with KleenTu LLC to conduct this pilot program, which was partially funded through a grant from the Massachusetts Clean Energy Technology Center (MA CEC).

Table 23: Quantities of Conventional and I/A Septic Systems by Watershed

Watershed	Tax Parcels Served by Conventional Septic Systems	Number of MassDEP I/A Systems Approved for General Use	Number of Pilot Program I/A Systems
Lake Tashmoo	719	24	10
Lagoon Pond	566	22	5
Coastal	1,407	8	1
Totals	2,672	54	16

[1] Other Watersheds are the West Tisbury Coastal Basin and Tisbury Coastal Basin, which includes Vineyard Haven Harbor.

Performance of I/A Systems Approved for General Use

The proper operation of onsite systems is critical to public and environmental health. Systems designed to remove nitrogen should perform to standards set by MassDEP. The Barnstable County Department of Health and Environment has collected testing data through its Septic Management Program, and the performance data for those systems installed in Tisbury were compiled for the period from March 2018 through December 2020. The analytical results of the nitrogen concentrations in samples collected of the effluent from each system are presented in Table 24.

Table 24: Barnstable County Department of Health and Environment – Effluent Nitrogen Constituents of I/A Systems (mg/l)

Watershed	Parcel	I/A Technology	Average TN	Average Nitrate	Average TKN	Average Ammonia	Number of Samples
Lagoon	**16-N-2**	**Fast 0.5**	**12.40**	**8.67**	**3.66**	**N/R**	**5**
Lagoon	19-A-14.1	Waterloo Biofilter	60.54	9.43	47.65	N/R	3
Lagoon	19-A-14	Waterloo Biofilter	70.59	8.59	63.78	N/R	4
Lagoon	19-A-12.1	Waterloo Biofilter	55	12.63	40.31	N/R	6
Tashmoo	27-A-53	MicroFAST	39.80	22.84	26.09	19.10	5
Tashmoo	36-A-4	Fast 0.5	30.63	13.86	16.57	N/R	4
Tashmoo	**59-C-4**	**Fast**	**15.59**	**3.89**	**11.7**	**N/R**	**1**
Tashmoo	**54-C-4**	**Fast**	**7.76**	**6.56**	**1.2**	**N/R**	**1**

Watershed	Parcel	I/A Technology	Average TN	Average Nitrate	Average TKN	Average Ammonia	Number of Samples
Tashmoo	39-B-2.15	Waterloo Biofilter	42.34	12.10	38.92	25.84	12

TN = total nitrogen
TKN = total Kjeldahl nitrogen (ammonia plus organic nitrogen)
N/R = no results

All of the I/A systems in Table 24 are Approved for General Use with an expected TN discharge to the SAS of 19 mg/l or less.

Of the 41 testing results, the average effluent TN is 41.68 mg/l. The median is 33.8 mg/l TN. Only 14 of the 41 test results were less than 19 mg/l. The average results from five of the nine technologies indicate a TN concentration in excess of a typical conventional septic system. Only three of the systems, shown in bold in Table 24, have an average TN value under 19 mg/l. Unfortunately the data do not include sampling at the influent of the systems, so the actual influent loading, and therefore the system's removal percentage, cannot be determined.

High effluent TKN or ammonia concentrations indicate a lack of nitrification, which usually is a result of insufficient aeration, or an abnormally high influent concentration that overwhelmed the process. High nitrate concentrations, combined with low TKN and ammonia concentrations indicate a lack of denitrification, which usually is a result of a lack of carbon to sustain the microorganisms.

While these systems are all Approved for General Use by MassDEP for 19 mg/l, the test results show the need for active operations, monitoring, and troubleshooting of I/A systems to maintain the expected effluent quality.

The conclusion that active operations is important for proper operation of on-site I/A systems is supported by the results of the NitROE® piloting, where the system's designer was actively engaged in operating, monitoring, troubleshooting, adjusting and upgrading the systems to get better effluent test results.

Enhanced I/A System Pilot Study

Among the nitrogen reducing onsite systems are the enhanced I/A systems piloted in Tisbury. The final report to MA CEC, *Multiple Installations of the NitROE® Waste-Water Treatment System Technology for Enhanced Nitrogen Removal from Title 5 Septic Systems*, (NitROE® Report) was delivered in May 2019. By the end of the grant period, the Town had 8 of 10 installed systems operating with sampling data. To date, 16 NitROE® or the larger SanTOE® systems have been installed in Tisbury.

The NitROE® systems are installed between the septic tank and the SAS, and therefore treat septic tank effluent. Any removal of BOD, TSS or TN by the NitROE® system is in addition to the septic tank removal. The NitROE® Report cites that after the installation and modifications to the first 3 systems, the NitROE® systems achieved at least 85% reduction in TN. According to the NitROE® Report, the eight NitROE® installations removed almost 16 pounds of TN per year per installation. Based on this, the NitROE® Report extrapolated that 635 installations would remove 10,000 pounds

of TN. These results are based on the active operation, maintenance, and modifications to the 8 systems over the grant period and on the influent conditions in the tested systems.

The BoH provided additional effluent data in December 2021 for the November sampling of the 10 systems in Tisbury. Influent TN data was not provided. The data for the problematic first system installed was not included. The data from one system appears to have been from the influent due to a TSS concentration of 1,800 mg/L. Average TN of the effluent from the remaining 8 systems was 18.8 mg/L.

The mean value for effluent TN was 9.7 mg/l. The difference in the average value and the mean value can be explained by one system with higher effluent TN, most likely due to minimal, if any, nitrification. The TN and TKN were both 73 mg/l.

The remaining 7 systems' effluent nitrate averaged 7.2 mg/l, while the effluent TN averaged 11 mg/l. Effluent TKN averaged 3.8 mg/l and TSS averaged 19.6 mg/l.

Two points should be noted:

1. The Lake Tashmoo MEP model used a TN load to groundwater from a conventional septic system of 13.7 pounds per year. The Lagoon Pond MEP model used a TN load to groundwater of 12.6 pounds per year (ppy). The calculation used the commonly accepted value for nitrogen from a septic system to groundwater of 26.25 mg/l, and an average single family residential wastewater flow rate of:
    a. 171 gpd (90% of 190 gpd average water use) in the Lake Tashmoo Watershed.
    b. 158 gpd (90% of 175 gpd average water use) in the Lagoon Pond Watershed.
2. The nitrogen concentrations in the effluent from the septic tanks (influent to the NitROE® pilot systems) were all much greater than the conventional value of 35 mg/l TN. Therefore, the mass of nitrogen available for treatment and removal was greater than the MEP models.

Sampling for influent nitrogen did not continue after the first (approximately) six weeks of each systems testing program. All reported TN removal percentages are estimated based on the average of these first few weeks of influent data. Once the enhanced I/A systems are deployed in greater number, the measured nitrogen input to the systems should trend toward the conventional nitrogen values used by the MEP.

The challenge in comparing alternative nitrogen mitigation solutions is quantifying a consistent TN load discharged to the groundwater from on-site systems. The high variability in septic tank effluent nitrogen causes a high variability in the nitrogen discharged to groundwater. While the NitROE® units can remove a high percentage of the TN, a consistent numerical value for effluent nitrogen loads will be difficult to determine without long-term testing data. To maintain consistency with the MEP and TMDLs, and with adjacent communities, a nitrogen management program should assume:

1. I/A systems discharge a nitrogen concentration equal to the MassDEP approved limit for systems approved for general use.
2. Enhanced I/A systems discharge a nitrogen concentration equal to the MassDEP goal for provisional or pilot systems.
3. 90% of the average water use, using the Land Use Code for each parcel, represents wastewater flow.

4. Septic tank effluent nitrogen equals the conventionally accepted value of 35 mg/l TN.

In 2020, MassDEP granted Provisional Use Approval of the NitROE® wastewater treatment system for units sized up to 2,000 gpd. Provisional Use is granted to conduct a performance evaluation of the system during three years of operation of at least 50 units. The goal of the performance evaluation is to determine if the NitROE® system is capable of consistently meeting a TN effluent concentration of less than 11 mg/l.

Assuming the standard 25% reduction of TN in the SAS holds true for the lower nitrogen loading, a groundwater discharge concentration of 8.25 mg/l of TN could be possible, versus 26.25 mg/l for a conventional septic system. This equates to an approximate 70% reduction in TN.

Using a wastewater flow rate of 171 gpd (Lake Tashmoo MEP value) for a single family residence, 8.25 mg/l is equivalent to 4.29 ppy. Therefore, an enhanced I/A system could remove up to an additional 9.4 pounds of TN per year compared to a conventional septic system (13.7-4.3=9.4).

The Tisbury BoH recently passed new regulations that would require that on-site wastewater systems discharge a nitrogen concentration lower than conventional I/A systems. The regulations require enhanced de-nitrification technology, “that meets a nitrogen groundwater discharge standard of not more than 13 mg/liter of nitrogen from septage waste or removes 75% of septic nitrogen waste.”

Given the poor results of the I/A systems reported to the Barnstable County Septic Management Program, the Town should consider adding a factor of safety to the nitrogen load that is assumed to reach groundwater, at least until a comprehensive and consistent management program for on-site systems is in place and a sufficient number of systems have been proven to meet the goal of meeting less than the enhanced systems’ goals (13 mg/l TN or less to the SAS). For planning, EP recommends using 11 mg/l TN to the SAS and 8.25 mg/l of TN to groundwater for enhanced I/A system effluent.

Nitrex™ Filter and Other Innovative On-site Wastewater Treatment Systems

The Nitrex™ Filter system uses a treatment concept similar to the NitROE system. It has gained Provisional Use designation from MassDEP for units with design flows of 330, 440, 550, 660, 2000, 3000 and 6000 gpd. The purpose of the Provisional Use period is to demonstrate whether the Nitrex system can consistently produce an effluent TN concentration of 10 mg/l or less for systems with less than 2,000 gpd of flow, and 25 mg/l for systems with flow between 2,000 gpd and 10,000 gpd.

In other I/A systems approved by MassDEP for General Use for less than 19 mg/l effluent TN, the carbon source is the influent wastewater, which may be limited in carbon to optimize denitrification. The Barnstable County Septic Test Center is testing several alternative technologies that provide a consistent source of carbon to enable more complete denitrification process. EP expects the new technologies to continue to evolve and the number of systems able to achieve lower TN concentrations to be more abundant over time. For further reference, any I/A system that projects to remove TN to less than 19 mg/l, such as 10 to 13 mg/l, will be referenced as enhanced I/A systems.

Because on-site systems, including I/A systems, are receiving flow from a single source (residence or business) the systems are susceptible to sources with highly variable flow and loads. The I/A system may remove a large percentage of the load, but still may not meet the thresholds intended and permitted by MassDEP. A cluster treatment system or a centralized treatment system that receives flow from several or many sources can often absorb a few high load sources by blending the flows from all sources.

SECTION 4.8 STORMWATER

Section 4.8.1 Drainage Master Plan

EP completed a Drainage Master Plan in 2018 that created a town-wide drainage system map. The DPW and its Stormwater Committee created a prioritization plan to resolve stormwater issues throughout the Town. The Committee members represented the DPW, the Select Board, the Planning Board, and Tisbury Waterways, Inc. The Committee established a top tier of problem areas, which primarily focused on flooding but also included addressing the nitrogen limitations of Lake Tashmoo and Lagoon Pond. EP provided a detailed recommended plan of action for these top six priority areas:

1. Five Corners – flooding at Beach Street Extension, Beach Road, and Beach Street
2. Main Street / Union Street – Temporary flooding on Union Street to the Steamship Authority Terminal
3. Delano Road – Localized flooding and nitrogen mitigation for Lagoon Pond
4. Spring Street / West Spring Street – Localized flooding and nitrogen mitigation for Lake Tashmoo
5. Lake Street – Nitrogen mitigation for Lake Tashmoo
6. Grove Ave – Localized flooding and erosion of beach

Section 4.8.2 Impervious Cover Disconnection Study

The Town of Tisbury, the MVC, the University of New Hampshire (UNH), and the USEPA partnered in a study, *Tisbury MA Impervious Cover Disconnection (ICD) Project: An Integrated Stormwater Management Approach for Promoting Urban Community Sustainability and Resilience*. The Tisbury ICD Project was completed in March 2020.

The project identified Tisbury's priorities for stormwater management, specifically flooding concerns at Beach Street Extension (Five Corners intersection), erosion control, and nutrient loading in the Lake Tashmoo and Lagoon Pond watersheds. The project evaluated various strategies focused on impervious cover disconnection. Specifically, the project identified mitigation strategies for the following:

1. Outfall Pipe at Beach Street Extension (Five Corners).
2. Subsurface gravel filters under the former fire station parking lot on Beach Street and linear gravel wetland establishing a new outfall to Mud Creek.
3. Infiltration catch basins and subsurface gravel filter designs for Grove Ave and Harborview Drive.

4. Concept design for media box filters for West Spring Street and the Tisbury School to resolve pathogen and nutrient levels measured at the outfall.
5. A bio-retention control measure to disconnect flow at the bus turnaround at the ferry terminal.
6. Stormwater controls at the end of Lake Street similar to those at Grove Ave and Harborview.

According to the UNH project team, MassDOT has discussed furthering the Beach Street extension and the gravel filters at the former fire station parking lot on Beach Street. To date, the follow-up phases have not been completed. The UNH team is working with the MVC and Tisbury to further the concepts for West Spring Street and Grove Avenue.

Section 4.8.3 Stormwater Sampling

In October 2021, Tisbury Waterways, Inc. sampled the stormwater outfall from West Spring Street into Lake Tashmoo. TWI delivered the samples to the University of New Hampshire (UNH). UNH performed PCR (polymerase chain reaction) and qPCR (quantitative PCR) testing that identified high levels of human-associated genetic markers in the sample DNA, as well as bacterial contribution from other species. According to TWI's summary of results, qPCR tests results were 112,000 copies of human-associated markers per 100 ml at the outfall. The BoH is developing a plan to locate the source of the bacteria.

The BoH regularly samples for bacteria at Tisbury's bathing beaches, including at outfalls. Beach sampling was discussed in Section 3.

SECTION 4.9 NUTRIENT REMOVAL PROGRAMS

Section 4.9.1 Fertilizer

The MEP Final Reports for Lagoon Pond and Lake Tashmoo included an estimate of nitrogen loads from fertilizer. The MEP estimated that lawns would be fertilized at a rate of 3 pounds of nitrogen per 1,000 square feet, and estimated the nitrogen loading rates by fertilizers to groundwater and embayments based on average lawn sizes. MEP estimated that the fertilizer component of nitrogen to groundwater is 1.08 pounds per residential lawn.

Boards of Health on Martha's Vineyard worked with the MVC and the MV Lawn Fertilizer Working Group to establish fertilizer regulations for island communities. In 2015, the Town of Tisbury established the *Town of Tisbury Board of Health Regulations – The Content and Application of Fertilizer for Turf on Martha's Vineyard*. The regulations limit the application of nitrogen and phosphorus in fertilizers. Phosphorus fertilizer is prohibited unless a need is indicated by a soil test.

Specific nitrogen fertilizer regulations include:

- No fertilizer application on impervious surfaces
- No fertilizer application between November 15 and the following April 15
- No more than 0.5 pounds of nitrogen per 1,000 square feet per application, and 3 pounds of nitrogen per 1,000 square feet per year (*Identical to MEP estimate*)
- A minimum of 50% of the nitrogen must be in slow release type

- Prohibits fertilizer application within 10 feet of a Resource Area, and limits nitrogen application with the Buffer Zone.
- For golf courses:
    - No fertilizer application between December 15 and the following April 15
    - Maximum of biweekly liquid fertilizer applications

Section 4.9.2 Lagoon Pond PRB

The Towns of Tisbury and Oak Bluffs collaborated with the MVC and the University of Massachusetts-Dartmouth (SMAST) on a Southeast New England Program (SNEP) grant from the EPA to install a permeable reactive barrier (PRB) on Lagoon Pond Road in Tisbury. A PRB is an underground "wall" of permeable material made up of carbon-based materials that allow naturally occurring bacteria to convert the nitrate in groundwater to nitrogen gas. The PRB was installed in November 2020 and will be evaluated over a 2-year period.

SECTION 4.10 OTHER CONSIDERATIONS

Section 4.10.1 Tisbury Environmental Justice Community

Massachusetts has an Environmental Justice policy and regulation, managed by the Executive Office of Energy and Environmental Affairs (EOEEA), whose objective is to ensure that high-minority, low-income neighborhoods are provided the opportunity to participate in policy decision making in the areas of environmental, energy, and climate change. Environmental justice populations are those segments of the population that EOEEA has determined to be most at risk of being unaware of or unable to participate in environmental decision-making or to gain access to state environmental resources. EOEEA identifies environmental justice populations and areas based on US Census data on median household income, minority concentration, and English language proficiency.

EOEEA recently updated its environmental justice map, which changed the designated Environmental Justice Community that was located in the Lagoon Pond watershed based on the annual median household income. According to the EOEEA data, Tisbury overall has a median household income of $51,456 which is 59.9 % of the Massachusetts MHI.

Figure 23 delineates the two Environmental Justice Communities within Tisbury based on the new data from EOEEA. The communities are described by EOEEA as follows:

- Block Group 1, Census Tract 2001, predominately in West Chop and east of Lake Tashmoo and north of Daggett Avenue, is an environmental justice population under the Income criteria. Environmental justice characteristics of this block group are a median household income of $41,684, which is 48.6% of the state median, and a total minority population of 10.0%. In 2019 this block group had a population of 806 in 476 households.
- Block Group 4, Census Tract 2001, located along State Road spanning West Spring Street to Edgartown-Vineyard Haven Road and south to the Oak Bluffs town line, is an environmental justice population under the Income criteria. Environmental justice characteristics of the block group are a median household income of $34,909, which is 40.7% of the state median

and a total minority population of 17.2%. In 2019 this block group had a population of 955 in 373 households.

To comply with EOEEA's policy and regulations, the Town will need to ensure that these areas have been provided appropriate notice and opportunities to participate in the CWMP planning process.

Section 4.10.2 Public and Private Ways

To extend municipal sewer or manage private on-site wastewater systems requires access to private property. Figure 24 shows the streets that are accepted for maintenance by the Town versus private roads that are not under the Town's jurisdiction.

Most of the roads to coastal areas from the main thoroughfares are private. Private roads are unimproved, mostly dirt/gravel, and not constructed to municipal standards. Most of these areas are served by water from the TWW.

SECTION 4.11 SUMMARY

Tisbury currently does not have a Local Comprehensive (or Master) Plan but the Town's 2021 Annual Town Meeting authorized a new Master Plan. The Town will engage with the Master Planning process on a schedule that will not produce a finished product prior to the completion of this Phase 1 of the CWMP. Therefore, the CWMP project team has established interim buildout models and identified proposed developments in various stages of permitting to move forward while the Planning Board develops its Master Plan.

Tisbury's drinking water supply is of high quality. A Groundwater Protection Overlay District in the Town's Zoning Bylaws protects Tisbury's three public wells; however, the wells are vulnerable to contamination because of the high transmissivity of the soils in the sole aquifer. To date, the levels of all monitored contaminants, including nitrogen, from all three public drinking water sources are well below regulatory thresholds. PFAS was non-detectable.

Tisbury's wastewater planning began in the 1970's in response to bacterial pollution in the harbor, and culminated in sewers in the B1 District and now extending to the B2 district. To date, the Town has targeted sewers in its commercial centers.

Since the 1988 Lagoon Pond DCPC, the Town's planners have pondered whether growth should be limited in the nitrogen-impaired watersheds to maintain water quality and acknowledged the constraints that on-site wastewater systems place on potential future development.

The Town wastewater system's capacity is limited, not designed to accommodate long-term growth through expansion of the sewer service area. Instead, the system primarily accommodates some growth on lots in the service area that, in 2004, expected to need additional wastewater capacity. An upgrade to the WWTF will provide additional capacity targeted for the B2 District.

The Tisbury BoH has been proactively regulating nitrogen pollution, working with the MVC and other island communities to limit nitrogen fertilizer, and enhancing on-site wastewater systems to limit nitrogen since at least since the establishment of the Lagoon Pond DCPC. The BoH recognized the impact nitrogen from on-site wastewater systems has on the sustainability of the Town's coastal

ponds and water resources and to the health and safety of the public. The BoH has instituted regulations that seek to limit the amount of nitrogen discharged by septic systems to the limit that is technologically feasible, collaborating with a pilot study of an enhanced I/A system.

Collaborative efforts are underway to located and remove the source of bacterial contamination of two Town beaches and the stormwater outfall rom West Spring Street to Lake Tashmoo.

Important pending work includes the Master Plan effort led by the Planning Board, and updates underway for the wastewater rules and regulations, upgrades to the WWTF to gain new capacity, and the construction of the State Road sewer in the B2 District.

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SECTION 5 FUTURE CONDITIONS

SECTION 5.1 INTRODUCTION

The CWMP must incorporate planning for expected future conditions in Tisbury. The Town's history of planning activities will help guide the development of projections of natural and human-built environmental conditions. The Town's goals, as expressed in these planning documents, will inform the wastewater planning work by including overall planning goals in discussions, deliberations, and decisions related to the selection of alternatives that address wastewater needs.

SECTION 5.2 NATURAL ENVIRONMENT

Section 5.2.1 Municipal Vulnerability Preparedness Planning

In 2018, Tisbury conducted a Municipal Vulnerability Preparedness (MVP) workshop with the goal to identify hazards exacerbated by climate change, and to prioritize actions to prepare for those hazards.

The priorities climate change hazards were hurricanes and nor'easters, coastal flooding and storm surge, sea level rise, and intense rain and flooding. Action items from the workshop (verbatim from the report) are:

1. Conduct a comprehensive supply chain vulnerability assessment.
2. Identify and initiate harbor improvements (e.g., breakwater extensions) to protect downtown areas and the harbor.
3. Identify and undertake roadway improvements that improve resiliency to coastal flooding,
4. storm surge and sea level rise in locations including, but not limited to:
    - Water Street from Five Corners to Union Street.
    - Beach Road from Five Corners to the Bridge.
    - Lagoon Pond Road from Five Corners to Hines Point.
5. Develop a comprehensive stormwater management plan for the community.
6. Review and update the Tisbury section of the Dukes County Hazard Mitigation Plan.
7. Increase community education and outreach with regards to climate change hazards, emergency preparedness and sheltering options.
8. Review Town regulations and identify changes that could mitigate future impacts of climate change

These action items should be included in all Town planning efforts, including this CWMP.

Section 5.2.2 Hazard Mitigation Planning

The 2021 Dukes County *Multi-Jurisdiction Hazard Mitigation Plan Update* (MVC and Dukes County communities) rates future vulnerabilities for hazards related to floods, wind, fire, geologic-related, ice, and sea level rise. A hazard index ranks the hazards based on frequency of occurrence and impacts. The top projected hazards are flooding and wind damage caused by coastal storms/nor'easters and hurricanes.

Section 5.2.3 Climate Change and Sea Level Rise

The 2020 *Climate Change Adaptation Context for Tisbury* (MVC) projected climate-change hazards, including:

- Sea levels on the Vineyard have risen approximately 6" since 1970, and are expected to rise another 6" by 2050. Figure 25 shows the extent of sea level rise based on MassGIS data.
- Projections from the Woods Hole tide gauge show an increase of 1.5–6.5 feet by 2100 relative to mean sea level in 2000.
- "Sunny-day coastal flooding days" is projected to increase to 35 to 135 days per year by 2050, as opposed to 3 to 7 days in 2020.
- Annual average temperatures on Martha's Vineyard are projected to increase by 2.4 to 5.2°F by 2050 and 3.0 to 9.1°F by 2100.

SECTION 5.3 PLANNED BUILT ENVIRONMENT

Section 5.3.1 2017 Housing Production Plan

Under Massachusetts General Laws (MGL), Chapter 40B, Section 20-23 (C.40B), the Commonwealth's goal is for all Massachusetts municipalities to have 10 percent of housing units affordable to low/moderate income households or affordable housing on at least 1.5 percent of total land area.

The Town's 2017 Housing Production Plan seeks to support the creation of at least 50 low/moderate income (LMI) units over five years (an average of 10 LMI housing units per year). The plan would support the Town in reaching its goal of 10 percent of total housing stock considered affordable. If the 2017 housing goal is realized, the new housing could create approximately 8,000 gpd of wastewater over 5 years.

The town's year-round households in 2020 totaled 2,140 units. As of December 2020, the Department of Housing and Community Development Chapter 40B Subsidized Housing Inventory (SHI) included 5.5 percent of Tisbury's year-round housing base (118 units). Therefore, the Town's goal is to gain 96 more SHI units. The units could produce approximately 16,000 gpd of wastewater.

Section 5.3.2 B2 District

The 2004 Tisbury Community Development Plan, developed by the MVC, identified the B1 District as "most suitable" for economic development and the B2 District as a "suitable" for economic development. One of the factors that limited the B2 District from reaching a "most suitable" designation for economic development was the limitation on nitrogen discharges from wastewater systems in the B2 area.

The 2015 Special Town Meeting established the Lagoon Pond Watershed Nitrogen Management District and the Lake Tashmoo Watershed Nitrogen Management District, which includes the B2 District along upper State Road.

The 2018 Annual Town Meeting approved the establishment of the State Road Sewer District, which includes most of the B2 District. Figure 26 shows the location and limits of the State Road Sewer District.

The properties encompassed by the State Road Sewer District were designated on the basis of wastewater flows that match the new capacity available from the WWTF upgrades that increase capacity from 104,000 gpd to 139,000 gpd. The District consists 73 properties, of which 65 are developed. The estimated average daily wastewater flow of the District based on Title 5 flow is approximately 35,000 gpd. The estimated average daily wastewater flow, using 90% of average water use, is approximately 17,700 gpd.

In 2020, Town Meeting authorized funds for the design and construction of upgrades to the WWTF tied to the extension of sewers to the State Road Sewer District. EP has recently completed the design of upgrades to the WWTF and the sewer system in the State Road Sewer District. The Town has also submitted a Groundwater Discharge Permit (renewal) application to MassDEP for expanded capacity to 139,000 gpd. The public comment period on the draft permit was completed in February 2022. The Town is awaiting MassDEP's final issuance of the permit.

The WWTF upgrades and sewer construction are scheduled to be complete in fall 2023 and spring 2024 respectively.

SECTION 5.4 BUILD-OUT ANALYSIS

Growth projections can be derived from several sources, including the MEP/MVC growth projections used for the TMDL analysis, the US Census Bureau, MassDOT, and others. This report's growth estimates are derived for Tisbury only, and extrapolated to the other watershed communities to conservatively estimate buildout wastewater flows and nitrogen loads.

For growth estimates, this CWMP will use growth estimates to 2040 to be consistent with the Oak Bluffs CWMP planning period, with whom the Town shares the Lagoon Pond watershed. While the overall CWMP for Tisbury will establish a plan for wastewater needs through 2043, the additional population growth over a three year period will not measurably change Tisbury's wastewater forecasts.

Section 5.4.1 Water Demand Projections

The *Water Distribution System Capital Improvement Plan (EP, 2020),* extrapolated population forecasts to 2035 based on the 2010 UMass Donahue Institute (UMDI), which estimated a less than 3% growth every 5 years, and the US Census Bureau's Population Division (USCBPD) population projections, which estimated a 4.8% population growth every 5 years. Assuming water demand increases in direct proportion to population increases, EP used a population increase of 4.8 percent every five years, matching the higher population projection by the USCBPD.

The Office of Water Resources within the Department of Conservation and Recreation (DCR) provides water needs forecasts for water supply systems. The most recent demand projections were completed in 2010 and take into account baseline levels for unaccounted for water (UAW) and residential usage per capita per day, as well as seasonal population data and labor workforce

projections. The following Table 25 compares the average day demand (ADD) forecasts as developed by the Division of Conservation and Recreation and EP.

Table 25: Comparison of Water Demand Forecasts (Million Gallons per Day)

	2020	2025	2030	2035
DCR	0.77	0.80	0.83	N/A
EP	0.78	0.81	0.85	0.89

Based on project average and maximum day demands, the available capacity of the three existing groundwater supplies is adequate throughout the study period (through 2035).

Section 5.4.2 Previous MVC Growth Projections

In 2013, the Tisbury Wastewater Planning Committee reviewed the MVC's build-out forecasts for each of the Town's watershed, supported by Wright-Pierce, Inc. (WP). MVC's build-out predicted the following growth rates in each watershed:

- Lake Tashmoo 70%
- Lagoon Pond 54%
- Vineyard Sound 41%
- Overall 51%

WP states that the Planning Board recommended reducing the MVC's buildout by half, and planning for infrastructure for half of that, except for the B1 and B2 Districts, which the Planning Board designated as growth areas. It is unclear whether the reference to infrastructure planning relates only to public infrastructure or on-site solutions, or both. Applying the Planning Board recommendation to the build-out rates above resulted in the following build-out percentages:

- Lake Tashmoo 24%; 17.5% except for the B2 District growth of 70%
- Lagoon Pond 13.5%
- Vineyard Sound 10.3%
- Overall 12.75%

Table 26 summarizes the resulting wastewater flow forecasts developed in this 2013 evaluation when including the growth areas and the Planning Board's modified build-out assumptions.

Table 26: 2013 WP Letter – Increase in Flow Based on MVC Growth Projections

Watershed	Current Flow (gpd)	Increase in Flow (gpd)	Projected Future Flow (gpd)	Percent Increase
Lake Tashmoo	146,862	35,210	182,072	24%
Lagoon Pond	122,822	16,581	139,403	13.5%
Vineyard Sound	295,052	30,033	325,385	10.3%
Town-wide	564,736	82,123	646,859	~15%

Section 5.4.3 MEP / TMDL Growth Projections

Lake Tashmoo

The MEP's 2015 Lake Tashmoo Linked Watershed-Embayment Model Final Report assumes that the build-out potential within the Lake Tashmoo watershed will increase the unattenuated system-wide nitrogen loading by 38%, from 10,553 kg/yr to 14,593 kg/yr.

The Final Report shows that the majority of parcels identified for potential development are developed parcels that could sub-divide. Large parcels west of Lake Tashmoo are incorrectly shown as residential, but are Chapter 61A agricultural land; and some large parcels on the east side of Lake Tashmoo are Chapter 61 forestry land. A change in use on these properties involves a lengthy regulatory process and is subject to a 5-year roll-back of taxes. If a property is proposed for conversion, the town has a right of first refusal to purchase the land. The town may purchase the land and use it for affordable housing, open space or other uses. It is unlikely that all of these parcels will be converted in use in the next 20 years, as most are historically used for agriculture or forestry and not in locations that would be easily converted to housing developments.

Notable changes from the 2015 MEP report for Lake Tashmoo are:

- The Martha's Vineyard Land Bank's (MVLB) Ripley's Field area has effectively removed parcels designated as having development potential.
- The Island Housing Trust's Kuehn's Way development proposes a 40 bedroom housing project on a parcel identified as developable.

Lagoon Pond

According to the MEP's 2010 *Lagoon Pond Linked Watershed-Embayment Model Final Report*, build-out within the Lagoon Pond watershed will increase the unattenuated TN loading rate by 34%, from 20,470 kg/year to 27,479 kg/year. Minor attenuation in Upper Lagoon Pond reduces the build-out nitrogen load to 27,010 kg/year.

The Final Report shows that many parcels identified for potential development are already developed and are able to be sub-divided. However, the majority of land area with development potential is vacant or currently in use for agricultural activities. The potential development in the West Arm watershed is entirely derived from the potential sub-division of existing develops parcels within Tisbury.

Notable changes from the 2010 Final Report are:

- The MVLB acquired developable parcels on Stoney Hill Road, a parcel along Edgartown Road, and a narrow parcel on Edgartown Road that extends to Lagoon Pond.
- The MVC has approved, through the DRI process, a commercial property, Carroll's Trucking on Carroll's Way off of Edgartown Road, to add workforce housing.

Section 5.4.4 Growth Based on US Census Data

According to the 2020 US Census, Tisbury's year-round population increased by 100% in the past 50 years. The following figure presents this growth, with an extrapolation to 2040 based on a trend line (dotted line in graph) of the historical data.

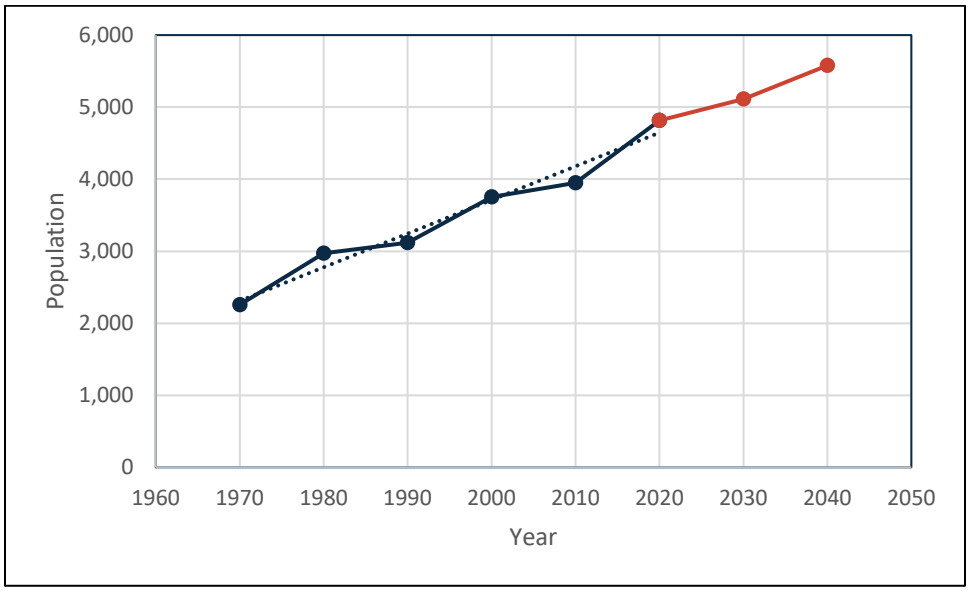

Figure 10: Tisbury, MA Growth Rate 1970 to 2040

Between the 2010 census and the 2020 census, Tisbury added 866 year-round residents. The trend line estimates an additional 763 year-round residents in 2040 as compared to 2020, a 16% increase. An estimation using the trend from just the last two decades predicts a growth of 950 residents, a 20% increase from 2020. Table 27 presents the existing and expected population in decade increments based on the 1970-2020 trend line.

Table 27: US Census Data (1970-2020) - Estimated Tisbury Population and Growth

Year	1970	1980	1990	2000	2010	2020	2030	2040
Population	2,257	2,972	3,120	3,755	3,949	4,815	5,111	5,578
Growth %*	--	31.7%	5.0%	20.4%	5.2%	21.9%	6.1%	9.1%

(*) Over 10 years

Section 5.4.5 MassDOT and UMDI

In 2018, the Massachusetts Department of Transportation (MassDOT) worked with the UMass Donahue Institute (UMDI) and the Metropolitan Area Planning Commission (MAPC) to update MassDOT's Socio-Economic Projections for 2020 Regional Transportation Plans.

Table 28 shows that, based on the updated data, MassDOT/UMDI projected that the population in Tisbury in 2040 would increase to 4,481 persons.

Table 28: MassDOT and UMDI Population Projections

	Census 2000	Census 2010	2020	2030	2040
Population	3,755	3,949	4,250	4,483	4,481
Households	1,646	1,806	1,951	2,082	2,113

The UMDI/MassDOT projections did not anticipate the population shifts due to the pandemic between 2018 and 2020 that could partially explain the increase in population in Tisbury to 4,815. UMDI/MassDOT's forecasted growth rate from 2020 to 2040 is 5.44%. If population growth follows the forecast, the projection results in an increase of 264 people, to a total population of 5,145 people by 2040.

Notable is the change in occupancy rate from 2010 to 2020. According to the US Census the year-round to seasonal housing occupancy ratio has been mostly consistent from 1980 to 2010: 62% year-round occupancy in 1980, 58% in 1990, 61% in 2000, and 58,4% in 2010. The increase in year-round occupancy to 66.3% of 3,226 households in 2020 could account for the increase of approximately 750 year-round residents.

Section 5.4.6 Identified Potential Development

Figure 28 shows parcels that are designated by Land Use Code as developable and undevelopable, and the location of potential development projects based on a listing of proposals actively undergoing or anticipated to be submitted for the MVC DRI process, as well as input from the Tisbury Planning Board. The developments' details are presented in the following table.

Figure 28 illustrates the lack of undeveloped and developable land in Tisbury, and shows that the proposed development projects, with the exception of Kuehn's Way, are denser redevelopments of previously developed land. In most cases, the redevelopment is or will be seeking a waiver or modification to zoning rules to include housing.

With a focus on affordable/workforce housing, these proposed developments have the potential to exceed the population growth projections that are based on US Census data or other population growth estimation tools. Table 29 is a summary of the most recent development proposals:

Table 29: Potential Development Projects

Project	Address	MVC Status	Watershed	Residential Units	Title 5 Proposed Flow (gpd)[2]
Kuehn's Way	Kuehn's Way	Construction	Lake Tashmoo	20 units	4,400
Island Cove 40B	355 State Rd	On Hold	Lake Tashmoo	54 / Mixed Use	9,300
Main St Medicinals	65 Mechanics St	Under Review	Lake Tashmoo	N/A	--
EduComp[1]	4 State Rd	Under Review	Vineyard Haven	15 / Mixed Use	1,922
Old Stone Bank Condos Old Stone Bank Restaurant[1]	75 Main St	Approved Under Review	Vineyard Haven	15 / Mixed Use	3,486

Project	Address	MVC Status	Watershed	Residential Units	Title 5 Proposed Flow (gpd)[2]
Tisbury Marine Terminal[1]	190 Beach Rd	Approved	Vineyard Haven	N/A	200
IFP 40B	225 Edgartown Rd	Pre-Permitting	Lagoon Pond	80 units	17,000
Harborwood 40B[1]	61 Beach Rd	On Hold	Lagoon Pond	52 / Mixed Use	18,240
MV Shipyard[1,3]	159/173 Beach Rd	On Hold	Lagoon Pond	N/A	--
Vineyard Wind Maintenance Bldg	69 Beach Rd	Under Review	Lagoon Pond	N/A	455
Totals				**236 units**	**55,003**

[1] Proposed projects in the B1 Sewer District would add nitrogen to the Lake Tashmoo watershed via WWTF effluent: Harborwood most likely removed from proposed development list

[2] 314 CMR 15.00 (Title 5) flow

[3] MVC Staff Report states project will reduce nitrogen from the property by 3.41 kg/yr.

Potential new wastewater flows from these proposed developments, regardless of the likelihood the projects will move forward, for the Lake Tashmoo and Lagoon Pond watersheds are:

- Lake Tashmoo 13,700 gpd
- Lagoon Pond 35,695 gpd (mostly from projects on hold or in pre-permitting phase)

Section 5.4.7 Summary of Build-Out Estimates

Included with the Planning Board's feedback on the Draft Needs Assessment was a request to assume zero growth as a future condition. Therefore, this condition is added to the discussion. Table 30 presents a summary of build-out scenarios discussed in this Section.

Table 30: Summary of Growth / Build-out Projections

Sub-Section	Method	Lake Tashmoo Watershed	Lagoon Pond Watershed
	Residential and Commercial Growth		
5.4.1	Water Demand Projections[1]	22%	22%
5.4.2	MVC – 2013	70%	54%
5.4.2	WP / 2013 Planning Board Modifications	24%[2]	14%
5.4.3	MEP Nitrogen Load	38%	34%
	Residential Growth Only		
5.4.4	US Census 1970-2020 (EP Projection)[1]	16%	16%
5.4.5	UDMI Population[1]	5.44%	5.44%
5.4.7	Planning Board 2022	0%	0%

[1] 5% growth every 5 years town-wide; not determined on a watershed basis

[2] 24% = 17.5% growth by 2040, with 70% growth in the B2 District

The Planning Board in 2013 understood the practical limitations of the MVC's estimates of the full build-out potential in that the MVC included all developed parcels that could be sub-divided to the

maximum extent, and treated parcels that are designated as Chapter 61 land as fully developable residential properties.

The town-wide build-out estimates are based on generic indices and past trends, but the watershed-specific buildout projections are based on detailed land use information and local Planning Board experience. Therefore, the CWMP will use the Planning Board modified projections as the base growth estimate. Since the trend in the recently proposed developments is to redevelop existing developed properties into denser uses, population and nitrogen loads could surpass previous estimates. Therefore, the projected increase in nitrogen loads established by the MEP reports for each watershed will also be evaluated to provide an ultimate buildout scenario for comparison.

Section 5.4.8 Coordination with the Oak Bluffs Needs Analysis – Future Conditions

Growth in Oak Bluffs will impact the nitrogen loads in Lake Tashmoo and especially in Lagoon Pond where Oak Bluffs contributes the majority of the wastewater nitrogen load. When developing a watershed plan in coordination with Oak Bluffs, Tisbury must understand the impact of this growth. The Oak Bluffs CWMP Needs Assessment assumes a 5% growth rate every 5 years, which is approximately 22% over 20 years, which is in line with the estimates for Tisbury.

An August 2019 presentation by GHD cited nitrogen removal requirements for each Oak Bluffs watershed compared to the number of existing houses and total number of parcels in each watershed. The data for watersheds of interest to the Tisbury CWMP, is presented in Table 31.

Table 31: Oak Bluffs Nitrogen Removal Required for Lake Tashmoo and Lagoon Pond Watersheds

Watershed	Estimated 2040 Nitrogen Removal Required in Oak Bluffs (kg/yr)	Estimated Equivalent Households	Total Existing Households	Total Parcels in Watershed
Lake Tashmoo	71	14	9	24
Lagoon Pond	5,873	1,170	1,320	1,750

With only 9 existing households, Oak Bluffs cannot meet its portion of the Lake Tashmoo watershed nitrogen goals under current conditions. This indicates that Tisbury or West Tisbury could supplement its nitrogen removal goals to include the Oak Bluffs shortfall. In the Lagoon Pond watershed, Oak Bluffs could sewer households in excess of the quantity needed to meet estimated nitrogen removal goals. However, Oak Bluffs does not have capacity in the WWTF to treat wastewater from 1,170 households, nor does it have the capacity to discharge treated effluent from these households entirely out of the Lagoon Pond watershed.

From a slide in the August 2021 presentation, Oak Bluffs listed challenges similar to Tisbury's to resolve its existing and future wastewater needs.

Nutrient Management Needs (as identified in MEP reports):

- Meet TMDLs for impaired estuaries
- Accommodate population growth in problem areas

Centralized wastewater treatment facility:

- Accommodate infill properties and consider development within existing collection system (business district and commercial areas)
- Address wastewater infrastructure approaching design capacity
- Address equipment near end of its design life

Collection System:

- Address pump station equipment near end of design life
- Address pump station vulnerability (3 stations, 100-year flood)

Oak Bluffs' long term outlook assumes that the ultimate disposal capacity is a combination of the Ocean Park and Leonard disposal areas. Oak Bluffs is working with the assumption that the existing wastewater disposal capacity is a limiting factor in extending sewers.

Oak Bluff's recommended priority is TMDL compliance achieved by optimizing non-sewer alternatives to remove nitrogen, such as enhanced I/A systems capable of reliably meeting an effluent concentration of 10 mg/l TN, in conjunction with inlet widening and PRBs, and paired with centralized collection and treatment, and cluster wastewater treatment systems.

SECTION 5.5 SUMMARY OF FUTURE CONDITIONS

Climate change, and the associated sea level rise and increased storm intensity, are an over-riding planning concern for any coastal community. Tisbury's long-term wastewater planning must be sustainable, without contributing to climate change, and resilient, to function while experiences the effects of climate change. In particular, coastal flooding and sea level rise will need to be considered while protecting the island's coastal waterbodies and planning for any new infrastructure.

Tisbury has stringent BoH regulations for properties in the Coastal Zone and in Vineyard Harbor and Lagoon Pond DCPCs, which will help to reduce flooding impacts under existing conditions. However, climate change will cause sea level rise and more frequent flooding during dry and wet days, which can compromise on-site wastewater systems.

Much of Tisbury's planning history centers on maintaining a small town character based on less dense neighborhoods and designated economic growth centers (the B1, B2, and W/C zoning districts). However, recent housing proposals are aimed at more dense development. The density of development is challenging the Town's municipal wastewater system, which is near capacity, and the ability of on-site wastewater systems to accommodate the developments.

Prior planning, through zoning and BoH regulations, has restricted the construction and expansion of residential properties because of the potential for nitrogen pollution from septic systems. This has limited the diversity of housing that can support the Town's work force.

In addition to the Planning Board's recommendation to examine zero growth for future conditions, the CWMP will use the Planning Board's 2013 modified projections (24% growth in the Lake Tashmoo watershed, and 14% growth in the Lagoon Pond watershed from Section 5.4.2) as the base growth estimate. Since the trend in the recently proposed developments is to redevelop existing

developed properties into higher density uses, population and nitrogen loads could surpass previous estimates. Therefore, the projected increase in nitrogen loads established by the MEP reports for each watershed (38% increase in the Lake Tashmoo watershed, and 34% in the Lagoon Pond watershed from Section5.4.3) will also be evaluated to provide an ultimate buildout scenario for comparison.

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SECTION 6 WASTEWATER FLOWS AND LOADS

SECTION 6.1 WASTEWATER FLOWS AND LOADS

Section 6.1.1 Introduction

To comply with the TMDLs, existing nitrogen loads must be removed in sufficient quantity and 100% of new nitrogen loads must be prevented from discharging to nitrogen sensitive watersheds or existing nitrogen loads will need to be removed to offset the new loads. EP has updated the TMDL nitrogen loads based on existing conditions in each watershed. For future conditions, EP added planned future flow in the B1 Sewer District and potential developments identified by the Planning Board and pending MVC DRIs. EP then used two buildout scenarios to determine the total nitrogen that needs to be removed from each watershed.

Section 6.1.2 Conventions Used in Flow and Load Calculations

The MEP studies of Lake Tashmoo and Lagoon Pond, published in 2015 and 2017 respectively, used water use data from 2002 to 2005, and also used different per capita usage rates for each watershed. The Lake Tashmoo study assumed 190 gpd/single family residence, whereas the Lagoon Pond study used 175 gpd/single family residence. Because it is assumed that 90% of water usage becomes wastewater flow, these two studies therefore assigned different TN loads to wastewater discharges. However, both MEP studies assume that 25% of the wastewater nitrogen load is removed in the soil absorption system (leach field).

Although more recent water use measurements show a higher average day demand as compared to the MEP reports, the median water usage is similar to the MEP values, which indicates that high volume water users have skewed the average higher.

For continuity with the MEP process, all estimates and calculations for wastewater nitrogen loading and nitrogen balance within the nitrogen sensitive watersheds will use the MEP conventions for water use and nitrogen discharge concentration from septic systems. .

Section 6.1.3 Existing Wastewater Flows and Nitrogen Loads

The MEP-calculated nitrogen loading from wastewater in the Lake Tashmoo and Lagoon Pond watersheds was updated to include changes within each watershed that have occurred since the MEP analyses were completed. The Town has experienced increased population and occupancy rate, its wastewater system is now approaching full capacity, and Board of Health regulations have led to an increased use of on-site systems that remove nitrogen.

A new baseline has been established to account for the following, which is summarized in Table 32:

- Septic Systems
    - Each watershed's wastewater average daily flow is 90% of each MEP Report's stated water usage.

    - Approximately 225 households were added since the last year of the MEP's water use data. Assuming the household distribution is proportional to the number of parcels in each watershed, the Lagoon Pond watershed will gain 21% (46) of the households and the Lake Tashmoo watershed will gain 27% (60) of the households.
- I/A and Enhanced I/A Adjustment
    - Assume all I/A and enhanced I/A systems listed in the BoH database replaced conventional septic systems except if the database noted it as new construction.
    - Assume a well-managed monitoring program for all on-site systems.
    - The Lake Tashmoo watershed has had 9 I/A systems and 9 enhanced I/A systems installed since the publication of the MEP final report.
    - The Lagoon Pond watershed has had 18 I/A systems and 5 enhanced I/A systems installed since the publication of the MEP final report.
    - For I/A systems approved for general use, assume TN to groundwater is 75% of the MassDEP approved limit for the on-site wastewater technology (19 mg/l x 0.75).
    - For enhanced I/A systems approved for provisional testing or pilot testing, assume TN to groundwater is 75% of the limit approved by MassDEP for further testing (11 mg/l x 0.75).
- WWTF Adjustment
    - Discharge flow is based on the 2021 average effluent flow of 44,860 gpd versus the TMDL's flow of 35,944 gpd.
    - The existing average monthly TN concentration in the effluent is 3.68 mg/l compared to the TMDL's value of 4.2 mg/l.
    - Effluent is discharged to the Lake Tashmoo watershed for 7 months per year (70% of total yearly flow).
    - The 2021 WWTF flows would increase the nitrogen load to the Lake Tashmoo watershed by 20 ppy, except that the WWTF operators have diverted flow normally sent to the Lake Tashmoo disposal area to outside of the watershed. The nitrogen load is now reduced by 54 ppy.
- Unconnected Properties in the B1 District
    - The B1 Sewer District has 21 properties that have not connected to the sewer system that should be added to the WWTF discharge load. These properties are not included in growth or build-out projections because it is existing capacity reserved under the WWTF's capacity. These properties would add flow and loads to the WWTF and the Lake Tashmoo watershed. EP estimates the average daily flow from these properties is 6,200 gpd, which would contribute almost 30 ppy of total nitrogen to the Lake Tashmoo Watershed.

Table 32 summarizes this discussion:

Table 32: Sources and Estimates of New and Reduced Nitrogen Loads from Tisbury

Source of New Load	Load to Lake Tashmoo[1] (TN-ppy)	Load to Lagoon Pond[1] (TN-ppy)
Septic Systems[2]	820	580
I/A Adjustment	-55	-105
Enhanced I/A Adjustment	-75	-45
WWTF Adjustment / Diversion	-55	--
B1 Unconnected Loads	30	--
Total Added to TMDL Load	**665**	**430**
Total Added (kg/year)	300	195

[1]Tisbury only

[2]Assumes new occupied households are all new residences

Because these loads have occurred, or likely will occur, after the publication of the TMDLs, 100% of the new loads must be removed from the watersheds.

Section 6.1.4 Future Wastewater Flows and Nitrogen Loads

Identified Potential Development

The BoH has finalized regulations requiring that any new onsite wastewater system within a nitrogen sensitive watershed must be an enhanced I/A wastewater system. Therefore, the additional nitrogen load that could be contributed to the groundwater in each watershed from the potential developments in Table 29 is:

- Lake Tashmoo 230 ppy
- Lagoon Pond 590 ppy

For long-term planning under this CWMP, the likely loads are well within the projections for future growth; therefore, these developments are considered to be included in the projected build-out percentages.

State Road (B2) Sewer District Nitrogen Load

The Town plans to construct and connect the State Road Sewer District to the WWTF by the end of 2024. Only half of the WWTF's discharge is considered to be in the Lake Tashmoo watershed, and the WWTF operators plan to divert the effluent from the Lake Tashmoo watershed for at least five months of the year, when WWTF effluent flows do not surpass the permitted limit for a single disposal field. The existing TN load to the Lake Tashmoo watershed from septic systems in the State Road District is approximately 1,375 ppy. Sewering the State Road District will remove approximately 1,300 ppy of the septic system TN load now discharged to the Lake Tashmoo watershed when accounting for the TN load from the WWTF, assuming all properties will connect to the sewer.

Watershed-Based Buildout Nitrogen Loads

In addition to the zero growth scenario, CWMP planning should include buildout scenarios to provide magnitude of scale scenarios:

1. 2013 Planning Board
    a. 24% growth in the Lake Tashmoo watershed
    b. 14% growth in the Lagoon Pond watershed
2. MEP Nitrogen Load Projections
    a. 38% added to the existing TN load in the Lake Tashmoo Watershed
    b. 34% added to the existing TN load in the Lagoon Pond Watershed

Table 33 presents the current and future TN loads to be mitigated from each watershed. This data reflects the entire watershed, without consideration for municipal boundaries.

Table 33: Growth Scenarios – Total Wastewater Loads to Remove from Watersheds (ppy)

Watershed	Current and Zero Growth Load to Remove	Growth Scenarios	Total Growth Load to Remove
Lake Tashmoo	7,160	24%	8,870
		38%	9,880
Lagoon Pond	13,440	14%	15,310
		34%	18,000

The 2015 *Tisbury Wastewater Management Planning – Summary of Needs Assessment* states that the nitrogen load from Tisbury is 33% of the total load to Lagoon Pond, and 80% of the Lake Tashmoo total load. This CWMP assumes that Tisbury's Lagoon Pond watershed load is 33% of the total TN load, with Oak Bluffs load of 60% and West Tisbury's load of 7% accounting for the remainder. For Lake Tashmoo, Tisbury accounts for 80% of the total load, with West Tisbury accounting for the remainder. Table 34 presents Tisbury's share of the watershed TN loads, with the current TN load to be mitigated, and the total load for both growth scenarios.

Table 34: Growth Scenarios – Tisbury's Share of Wastewater Loads to Remove from the Lake Tashmoo and Lagoon Pond Watersheds (ppy)

Watershed	Current and Zero Growth Load to Remove	Growth Scenarios	Tisbury's Growth Load to Remove
Lake Tashmoo (Tisbury has 80% of total load)	5,850	24%	7,260
		38%	8,080
Lagoon Pond (Tisbury has 33% of total load)	4,725	14%	5,380
		34%	6,330

Section 6.1.5 Summary - Wastewater Flows and Nitrogen Loads

To comply with the TMDLs, existing nitrogen loads must be removed in sufficient quantity and 100% of new nitrogen loads must be prevented from discharging to nitrogen sensitive watersheds or existing nitrogen loads will need to be removed to offset the new loads. This section updates the MEP nitrogen loads to 2021 to set the baseline for growth and build-out projections.

Future loads are based on the 2013 Planning Board recommendations for infrastructure planning and the MEP's projected increases in nitrogen loading. The existing total nitrogen loads for both watersheds is slightly greater than the MEP loads. For the watersheds, future loads may increase to:

- Lake Tashmoo 8,870 to 9,880 ppy
- Lagoon Pond 15,310 to 18,000 ppy

For Tisbury only, future loads may increase to:

- Lake Tashmoo 7,260 to 8,080 ppy (80% of the watershed's total)
- Lagoon Pond 5,380 to 6,330 ppy (33% of the watershed's total)

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SECTION 7 WASTEWATER NEEDS ASSESSMENT

SECTION 7.1 INTRODUCTION

The wastewater needs assessment identifies locations where wastewater treatment and disposal are likely insufficient to meet regulatory standards or could pose a threat to public health or the environment, especially for populations and resources that may be sensitive to environmental stressors.

The intent of this exercise is to highlight general areas that may need improved wastewater treatment and disposal systems, and not to highlight specific properties. The compiled data cannot always be aligned completely, and undoubtedly has some inaccuracies due to original database entry errors or inaccurate information.

SECTION 7.2 GIS WASTEWATER NEEDS IDENTIFICATION PROCESS

The GIS-based Needs Assessment includes the collection and analysis of data based on the Tisbury Assessor's database from February 2021, with the Tisbury BoH and TWW data imported into the database. The BoH and TWW data are mapped onto the Assessor's maps for a visual representation of the data.

Section 7.2.1 Septic System Age

The GIS process estimates the age of the septic system to determine if the system is likely to meet the most current Title 5 standards. Prior to 1995, Title 5 regulations did not require an inspection of on-site systems prior to a property being sold or enlarged. However, in Tisbury this evaluation is not as revealing as in other communities because the BoH's proactive inspection program has helped to reduce the number of systems that do not function properly. The BoH database identifies 450 parcels with permits dated prior to 1996 or without a permit date and noted as a cesspool.

Section 7.2.2 Restrictive and Transmissive Soils

Soil characteristics are evaluated for septic system suitability. The vast majority of Tisbury soils are Carver Loamy Coarse Sand. The soil is categorized as hydrologic Group A, which has a high rate of water transmission, and therefore not restrictive to onsite septic systems. The highly transmissive nature of Carver Loamy Coarse Sand soils in Tisbury are detrimental to septic system soil absorption systems if the discharge could impact a nearby well or if the septic system is within the watershed of nitrogen or phosphorus impaired waters. Any parcel with a conventional onsite wastewater system within the Lake Tashmoo and Lagoon Pond watersheds could be considered in need of an upgrade. For the majority of septic systems in Tisbury, the poor filter ensures that the system does not cause a breakout to the surface.

Section 7.2.3 GIS Spatial Process

The process also examines the spatial characteristics of each parcel to determine if an on-site wastewater system can be constructed on the parcel and meet all regulatory setbacks.

Administrative Setbacks

The Administrative Setback analysis is comprised of establishing the following regulatory buffers on each parcel and determining if there is enough remaining space for a soil absorption system:

- 15-ft buffer around all building footprints
- 10-ft buffer around all parcel boundaries

This assessment is idealized in that it only assesses whether there is sufficient space for a septic system to be sited on the parcel after all the buffers are applied, and does not determine where the actual system is located. In practicality, parcels of less than 0.25 acres often cannot accommodate a conventional septic system because of other parcel attributes such as trees or the general shape of the parcel. According to the Assessor's database, Tisbury has almost 800 parcels with a land area of less than 0.25 acres, located mostly in the in-town locations highlighted in Figure 15: Parcel Density.

Private Well Setbacks

To examine whether the highly transmissive soils may cause an interaction between a septic system and an onsite well, the Private Well Setback analysis estimates whether a private well and a septic system soil absorption system can be sited on a parcel. The placement of the wells is arbitrary and therefore only assesses whether a well could be sited outside of the buffers, not whether the actual well is located outside of the buffers. Regulatory setbacks used in the analysis are:

- 15-ft buffer around all building footprints
- 10-ft buffer around all parcel boundaries
- 25-ft buffer around roads (off edge of surface, not centerline)
- 100-ft buffer around all potential well locations
    - The analysis only applies to parcels with on-site septic systems and private well water

The majority of parcels east of Lake Tashmoo are connected to the Tisbury Water Works system; therefore, smaller parcels with onsite wells are infrequent.

Environmental Resources Setbacks

The Environmental Setback analysis identifies where soil absorption systems may be within regulatory setbacks to sensitive environmental resources, including special district regulations:

- Any parcel intersected by Zone I well
- 50-ft buffer around all beach/dune, open water, & wetland
    - Incl. streams
- 100-ft buffer around all vernal pools (potential or certified)
- Coastal District parcels
    - Any parcel w/ 50% or more of its total acreage at or below 20-ft elevation
    - 100-ft buffer around slopes of 33.3% or greater within 20-ft elevation
- Designated Barrier Beach parcels
    - "includes all of lots 29A1 through 4, 30A1 through 10, 30B1 through 3, 31A1 through 6, 31B1 through 13.1, 32A1 through 1.2, 32B1, 32C1 through 8.1, 32D1 through 8.1, 59A1 through 3, 59B1 through 3"

- "includes that portion of lots 30C1 and 31C1 through 3 which lie below the ten (10) foot elevation contour line."

The parcels with potential violations of environmental setback restrictions are largely within the Coastal District and Designated Barrier Beach parcels.

GIS Spatial Process Summary

The processes are combined to create Figure 29 showing the results of the setback analysis for conventional septic systems.

The GIS spatial process shows that the majority of parcels in Tisbury, under ideal conditions, can meet Title 5 and BoH setback requirements for conventional systems.

Section 7.2.4 Drinking Water Protection

Development in the Zone II's of Tisbury's public drinking water supplies pose a risk to the continued high quality of Tisbury's drinking water. Zone II's for Tisbury's three wells mostly lie outside of Tisbury, but development is abutting the Zone 1 of the Tashmoo and Sanborn wells. In Tisbury, much of the Zone II land towards West Tisbury is land protected from development. The Manter Well is located in this area and is surrounded by land owned by Tisbury or the Martha's Vineyard Land Bank.

The Tashmoo Well's Zone 1 abuts Lantern Lane. The upper end of the B2 Sewer District is adjacent to the Zone 1 and completely within the Zone II boundary. Properties include several commercial entities and multi-unit housing owned by the Dukes County Regional Housing Authority. Holmes Hole Road and Breakdown Lane are immediately upstream.

Tisbury residences within the Sanborn Well Zone II and near the Zone 1 include Sanborn Way, Canterbury Lane, Clover Hill Drive, Carroll's Way, and multi-unit Island Elderly Housing. Commercial entities within the Zone II and close to the Zone 1 include Island Food Products, which is also the site of a proposed residential redevelopment presented to the Select Board on October 29, 2019. However, the proposal has not progressed to the MVC DRI process (Table 29). Oak Bluffs residences in the Sea Glen Road area are also within the Zone II.

Since Tisbury has predominantly highly transmissive soils, the proximity of developed parcels could pose a risk to the public wells.

Section 7.2.5 Sensitive Receptors

Sensitive environmental receptors are those natural resource areas that are susceptible to contaminants and pollutants. These include vernal pools, wetlands, impaired waters, NHESP habitats, and flood-prone areas. Figure12: Water Resources and Figure 13: Environmental Resources show these areas.

Sensitive human receptors include hospitals, schools, daycare facilities, elderly housing, assisted living facilities, and convalescent facilities. These are locations where the occupants are more susceptible to the effects of exposure to contaminants and pollutants. Figure 30 presents the following receptors in Tisbury.

- Seniors:
    - Council on Aging Center
    - Havenside
    - Island Elderly Housing
    - Hillside Village
    - Martha's Vineyard Center for Living
- Assisted Living:
    - Henrietta Brewer House
- Medical:
    - Vineyard Medical Care
    - Health Imperatives
- Youth:
    - Tisbury School
    - Vineyard Montessori
    - Grace Preschool
    - Garden Gate Child Development Center
    - First Light Child Development Center
    - Martha's Vineyard Family Camping
    - Veteran's Memorial Park
    - Tisbury Town Beaches

Sensitive receptors, being more at risk from the deleterious impacts of pollution, should be included in any criteria to mitigate pollution. Further, sensitive receptors should be protected to prevent the effects of unintended consequences from the potential solutions.

Section 7.2.6 Wastewater Nitrogen

Nitrogen sensitive watersheds encompass approximately 60% of the Town's total area. Table 35 provides a summary of existing and potential TN loads (from Section 6) that exceed the targeted watershed loads by watershed.

Table 35: Nitrogen Loads to be Removed to Meet TMDL Goals

Watershed	Existing TN Load to Remove (ppy)	Growth Scenarios TN Loads to Remove (ppy)
Lake Tashmoo – Total Watershed	7,160	8,870 to 9,880
Lake Tashmoo – Tisbury Only	5,850	7,260 to 8,080
Lagoon Pond – Total Watershed	13,440	15,310 to 18,000
Lagoon Pond – Tisbury Only	4,725	5,380 to 6,330

SECTION 7.3 PREPARATION FOR PHASE 2 – ALTERNATIVES ANALYSIS

Section 7.3.1 Needs Criteria and Priorities

Every potential solution to wastewater issues will have implications to the quality of life in Tisbury. Alternatives may provide ancillary benefits such as improved roadways or have unintended consequences such as suburban sprawl or higher density development. Therefore, before selecting criteria to compare alternatives, the overall values of the community should be articulated to guide the selection of criteria.

As discussed in Section 2, in 2005 the Tisbury Planning Board surveyed residents and identified priority quality of life objectives for the Town. The priorities that directly apply to this wastewater needs assessment are:

1. Natural Resources: Protection and restoration of natural environment is the number one priority, including maintaining and expansion of open spaces and protected land.
2. Cultural Resources: Maintain the town's character as a small-scale small town.
3. Municipal Services: Reflect the town's character.
4. Circulation (Transportation): Improve pedestrian movement and avoid street widening, but improve the road system with small-scale access ways to relieve traffic congestion and connect neighborhoods.
5. Housing: Expand housing to include various housing types throughout town, including higher density and mixed uses in commercial areas while avoiding sprawl and increased density in neighborhoods.
6. Energy: Adopt the most up-to-date energy conservation standards and technologies for all municipal uses.
7. Economic Development: Develop sustainable, year-round employment while bolstering the seasonal economy, including aquaculture and agriculture, without compromising the visual quality of the town.
8. Area Plans: Develop specific plans on areas of interest such as the B2 District and the waterfront. Specifically, focus on the Natural Resources objectives to expand the inventory of open spaces and preservation lands, with improved connectivity to access public spaces.

These objectives indicate a strong desire to maintain the town's small town character and connectedness while providing an economy that sustains a year-round population. Affordable housing is a burgeoning concern to support the sustainable economy with a focus on mixed use in the business districts while keeping the quite nature of neighborhoods.

As the CWMP progresses to the Alternative Analysis phase, the Town must establish the criteria that it will weigh as it compares alternatives. In addition to the costs of any alternative, the non-financial criteria of importance to Tisbury will help guide the discussion and establish the criteria important to the community as it discusses its future. For an example of criteria that may be useful as the town deliberates its future wastewater program, and as described in Section 4.5.2, the Martha's Vineyard

Wastewater Management Study (MVC, 2010) recommended criteria to compare various wastewater management structures.

- Ease in implementation
- Political acceptability
- First costs (capital costs) to implement
- Potential for long-term cost savings
- Ability to raise money
- Loss of local control
- Impact on community growth
- Potential for optimizing watershed-based solutions
- Interface with local programs
- Ability to obtain grants and loans
- Public accountability

Section 7.3.2 Nitrogen Mitigation Alternatives

The residents of Tisbury, through public meeting dialogue, should select the values that are important for their vision of the Town in the next 20 years. Based on those values, specific benefits and detriments of each proposed alternative can be compared to select the most promising solutions for the community.

EP selected primary alternatives to present the scope of possible nitrogen mitigation strategies. For this exercise, the Town could:

1. Collect and treat wastewater at a centralized or satellite facility with all of the effluent discharged outside of a nitrogen sensitive watershed.
2. Collect and treat wastewater at a centralized or satellite facility with a portion of the effluent discharged into the Lake Tashmoo watershed as is the current practice.
3. Require enhanced I/A systems throughout both watersheds, whether individual on-site systems or in a cluster arrangement, in accordance with the new Board of Health regulations.
4. Combine some or all three of the above alternatives.

Because of the recent Board of Health regulations, conventional I/A onsite systems are not being considered for continued use as a primary solution in the nitrogen sensitive watersheds, although they could be included as a secondary option where allowed by the Board of Health. In Phase 2 of the CWMP, alternative approaches will be evaluated for the most efficient, effective, and cost-effective solution with respect to their feasibility and implications for the Town.

Several other technologies have been developed that may be able to contribute to the nitrogen mitigation effort, but lack the magnitude of scale to remove the necessary nitrogen loads. Permeable reactive barriers, stormwater controls, aquaculture, and a host of other alternatives are supplementary solutions in that they can contribute to nitrogen mitigation but would not solve the nitrogen problem on their own.

Section 7.3.3 Existing Conditions

The following table presents the guidelines used for nitrogen concentration and nitrogen load to groundwater from the three basic wastewater management alternatives using the MEP's flows for single family septic systems for each watershed.

Table 36: Nitrogen Factors for Single Family Residences Used for Wastewater Management Alternatives

	WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed	Enhanced I/A Onsite Systems
Total Nitrogen Concentration to Groundwater in Nitrogen Impaired Watershed (mg/l)	0	1.4	8.25
Lake Tashmoo: Total Nitrogen Removed versus Conventional Septic System (ppy)	13.67	12.94[1]	9.37
Lagoon Pond: Total Nitrogen Removed versus Conventional Septic System (ppy)	12.59	12.59[2]	8.63

[1] Includes a deduction for WWTF discharge into Lake Tashmoo watershed.

[2]For any Lagoon Pond wastewater effluent discharged to the Lake Tashmoo watershed, an equivalent amount of load must be removed from the Lake Tashmoo watershed.

The equivalent number of single family residential septic systems is used to compare the effectiveness of wastewater treatment systems. The results are not meant to infer an equivalent number of parcels because, for example, a dense residential development may have the equivalent of many single family residences on a single parcel. Table 37 presents the number of single family systems that would need to be removed watershed-wide to satisfy the TMDLs for each of the treatment technologies.

The 2015 *Tisbury Wastewater Management Planning – Summary of Needs Assessment* states that the nitrogen load from Tisbury is 33% of the total load to Lagoon Pond. The values in the third row of Table 37 and Table 38 use 33% of the entire Lagoon Pond watershed's TN load to reflect Tisbury's share of the watershed load.

If the Lagoon Pond watershed is sewered to address the TMDL, and the WWTF discharges to the Lake Tashmoo watershed, additional septic systems must be removed from the Lake Tashmoo watershed to offset the load from the Lagoon Pond watershed.

Table 37: Comparison of Equivalent Single Family Systems Needed to Meet TMDLs Based on Treatment Technology under Existing (Zero Growth) Conditions

Watershed	Systems with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Enhanced I/A Onsite Systems to Install
		Systems with WWTF Discharge	Lake Tashmoo Watershed Septic Systems to Connect to WWTF to Offset Load from Lagoon Pond	
Entire Lake Tashmoo	525	545	--	765
Tisbury's Lake Tashmoo	430	445	--	625
Entire Lagoon Pond	1,070	1,070	260	1,555
Tisbury's Lagoon Pond	375	375	90	550

Table 38 presents Tisbury's existing wastewater flows that need to be treated under each technology to meet the TMDL goals under existing conditions for each watershed.

Table 38: Reduction in Existing Wastewater (Zero Growth) Flows (gpd) to Meet TMDLs

Watershed	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Wastewater Flow from Enhanced I/A Onsite Systems
		Wastewater Flow	Lake Tashmoo Watershed Wastewater Flow to Offset Load from Lagoon Pond	
Entire Lake Tashmoo	89,500	92,900	--	130,600
Tisbury's Lake Tashmoo	73,300	76,000	--	106,800
Entire Lagoon Pond	168,100	168,100	41,300	245,100
Tisbury's Lagoon Pond	59,100	59,100	14,500	86,200

Section 7.3.4 Growth Conditions

Lake Tashmoo Watershed (Entire Watershed)

If a new single family parcel is developed with any type of on-site system, it will discharge nitrogen to the groundwater. Since all new TN loads must be removed or offset from the Lake Tashmoo and Lagoon Pond watersheds, a load equivalent to the new onsite system load must be removed to

remain net nitrogen neutral. Table 39 presents the number of single family conventional septic systems that must be addressed for each treatment technology under Lake Tashmoo's growth scenarios.

Table 39: Lake Tashmoo Watershed: Comparison of Equivalent Single Family Systems to Convert to Meet the TMDL Goals Based on Treatment Technology under Each Growth Scenario

Growth Scenario	Systems to Remove with WWTF Discharge to Coastal Watershed	Systems to Remove with Partial WWTF Discharge to Lake Tashmoo Watershed	Enhanced I/A Onsite Systems to Install
Zero Growth	525	545	765
24% Growth	650	675	950
38% Growth	725	750	1,055

Table 40 presents the Lake Tashmoo Watershed wastewater flows based on the equivalent single family systems in Table 39.

Table 40: Lake Tashmoo Watershed: Comparison of Wastewater Flows to Convert to Meet the TMDL Goals Based on Treatment Technology under Each Growth Scenario

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed	Wastewater Flow from Enhanced I/A Onsite Systems
Zero Growth	89,500	92,900	130,660
24% Growth	111,000	115,100	161,800
38% Growth	123,600	128,200	180,300

Tisbury's Lake Tashmoo Watershed

For Tisbury's Lagoon Pond watershed, Table 41 shows the number of equivalent single family residences to be converted that represents Tisbury's share (80%) of the TMDL.

Table 41: Tisbury's Lake Tashmoo Watershed: Tisbury's Share of Single Family Systems to Convert to Meet the Lake Tashmoo TMDLs Goals Based on Treatment Technology under Each Growth Scenario

Lake Tashmoo Watershed Growth Scenario	Systems to Remove with WWTF Discharge to Coastal Watershed	Systems to Remove with Partial WWTF Discharge to Lake Tashmoo Watershed	Enhanced I/A Onsite Systems to Install
Zero Growth	430	445	625
24% Growth	530	550	775
38% Growth	590	615	860

For Tisbury's Lake Tashmoo watershed, Table 42 presents the flows that represent Tisbury's share of the total watershed flow, which is 80% of the total flows in the entire watershed.

Table 42: Tisbury's Share of Lake Tashmoo Wastewater Flows (gpd) under Each Growth Scenario to Meet TMDLs

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed	Wastewater Flow from Enhanced I/A Onsite Systems
Zero Growth	73,300	76,000	106,800
24% Growth	90,800	92,200	132,500
38% Growth	101,100	104,900	147,400

Lagoon Pond Watershed (Entire Watershed)

For the entire Lagoon Pond watershed, if the treated wastewater discharge is within the Lake Tashmoo watershed, additional onsite systems must be removed from the Lake Tashmoo Watershed. Table 43 presents the number of conventional onsite systems that must be removed from the Lagoon Pond watershed (all communities) for the sewering and onsite scenarios. Table 43 also includes the quantity of single family septic systems that must be removed from the Lake Tashmoo watershed if Lagoon Pond wastewater is partially discharged to the Lake Tashmoo watershed.

Table 43: Entire Lagoon Pond Watershed: Comparison of Equivalent Single Family Septic Systems to Convert to Meet the TMDL Goals Based on Treatment Technology under Each Growth Scenario

Growth Scenario	Systems to Remove with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Enhanced I/A Onsite Systems to Install
		Systems to Remove	Lake Tashmoo Watershed Systems to Remove to Offset Load from Lagoon Pond	
Zero Growth	1,070	1,070	240	1,555
14% Growth	1,215	1,215	275	1,635
34% Growth	1,430	1,430	325	2,085

Table 44 presents the Lagoon Pond Watershed wastewater flows based on the equivalent single family systems in Table 43.

Table 44: Entire Lagoon Pond Watershed: Comparison of Wastewater Flows to Convert to Meet the TMDL Goals Based on Treatment Technology under Each Growth Scenario

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Wastewater Flow from Enhanced I/A Onsite Systems
		Flow	Lake Tashmoo Watershed Flows to Remove to Offset Load from Lagoon Pond	
Zero Growth	168,100	168,100	38,000	245,100
14% Growth	191,600	191,600	43,500	257,300
34% Growth	225,200	225,200	51,000	328,400

Tisbury's Lagoon Pond Watershed

For Tisbury's Lagoon Pond watershed, Table 45 shows the number of equivalent single family residences to be converted that represents Tisbury's share (33%) of the TMDL.

Table 45: Tisbury's Lagoon Pond Watershed: Tisbury's Share of Single Family Septic Systems to Convert to Meet the Lagoon Pond TMDLs Goals Based on Treatment Technology under Each Growth Scenario

Growth Scenario	Systems to Remove with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Enhanced I/A Onsite Systems to Install
		Systems to Remove	Lake Tashmoo Watershed Systems to Remove to Offset Load from Lagoon Pond	
Zero Growth	375	375	85	550
14% Growth	430	430	100	625
34% Growth	505	505	115	735

For Tisbury's Lagoon Pond watershed, Table 46 presents the flows that represent Tisbury's share of the total watershed flow, which is 33% of the total flows in the entire watershed.

Table 46: Tisbury's Share of Lagoon Pond Wastewater Flows (gpd) under Each Growth Scenario to Meet TMDLs

Growth Scenario	Wastewater Flow with WWTF Discharge to Coastal Watershed	Partial WWTF Discharge to Lake Tashmoo Watershed		Wastewater Flow from Enhanced I/A Onsite Systems
		Flow	Lake Tashmoo Watershed Flows to Remove to Offset Load from Lagoon Pond	
Zero Growth	59,100	59,100	13,500	86,500
14% Growth	67,300	67,300	15,000	98,200
34% Growth	79,200	79,200	18,000	115,500

SECTION 7.4 SUMMARY AND CONCLUSIONS

The quantity of conventional systems and volume of wastewater flows in the previous tables should be considered representative values for comparing technologies and buildout scenarios, not as precise calculations. These values are intended to be used as a guide to the development of alternative scenarios that would then be evaluated using the full MEP model to determine the effect on nitrogen concentrations in the estuaries.

The Town's most urgent wastewater need is to reduce nitrogen to the Town's embayments, with a long-term need to protect the Town's public and private drinking water supplies, all while protecting the community's public and environmental health. The areas in need of enhanced or alternative wastewater management are the two nitrogen sensitive watersheds and along the coast.

The optimal solution to resolving the town's wastewater needs would help achieve the Town's planning objectives and priorities, support a sustainable year-round economy and new affordable housing in areas designated for each, avoid unintended development in neighborhoods, and meet the TMDL goals to restore the Town's waterways.

Alternatives that could be considered for analysis include source control strategies such as enhanced on-site wastewater systems and wastewater treatment facilities, broad approaches such as fertilizer regulations and zoning restrictions, "end of pipe" or remediation technologies such as permeable reactive barriers and aquaculture, or modifications to the embayments themselves through inlet widening.

It will be important for the Tisbury Planning Board to create zoning regulations that allow the community to reach its overarching goals as the Town institutes changes to its wastewater infrastructure, including managing growth in areas that could be affected by improved nitrogen management.

MassDEP prefers that a CWMP focuses on source reduction and will require that the CWMP include conventional source control solutions for downstream remediation alternatives. The Town is free to consider innovative alternatives, as long as a proven traditional/conventional technology is included that will resolve the excess TN load. Since the MEP analysis determined that the controllable nitrogen load is predominately from septic systems, the evaluation of alternatives should focus on resolving the wastewater TN loads at their source, supplemented by other technologies to address all avenues of nitrogen mitigation.

APPENDIX A
FIGURES

APPENDIX B

CWMP PLAN OF STUDY AND SCHEDULE

APPENDIX C

PLANNING BOARD COMMENT LETTER

APPENDIX D

PUBLIC PRESENTATION MATERIALS