



PLEASANT BAY
ALLIANCE

Mr. Martin Suuberg
Commissioner
MassDEP
One Winter Street
Boston, MA 02108

July 30, 2019

Ms. Kristy Senatori
Executive Director
Cape Cod Commission
3225 Main Street
Barnstable, MA 02630

Re: Pleasant Bay Watershed Permit 2019 Annual Report

Dear Ms. Senatori and Commissioner Suuberg:

I am pleased to submit the enclosed Pleasant Bay Watershed Permit 2019 Annual Report. This report encompasses activities undertaken during the first twelve months of the Pleasant Bay Watershed Permit issued by Massachusetts Department of Environmental Protection to the Towns of Brewster, Chatham, Harwich and Orleans (August 3, 2018).

The annual report is intended to respond to the reporting requirements of section VI.J of the Permit, as well as the Determination of Consistency with the Cape Cod Area Wide Water Quality Management Plan Update issued by the Cape Cod Commission (June 21, 2018).

This report has been developed in consultation with staff and technical consultants from the four towns, and letters of endorsement from the towns are enclosed.

Thank you for your review and consideration of this annual report. Please let me know if additional information or clarification is required.

Sincerely,

Carole Ridley
Coordinator

Cc (via email):

Massachusetts DEP
Millie Garcia-Serrano
Brian Dudley
David Johnston

Cape Cod Commission
Erin Perry
Tim Pasakarnis

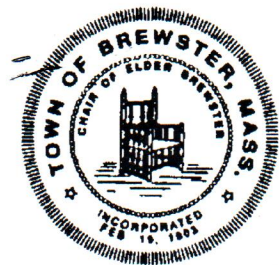
Town of Brewster
Peter Lombardi
Chris Miller
Ryan Bennett

Town of Chatham
Jill Goldsmith
Bob Duncanson

Town of Harwich
Christopher Clark
Heinz Proft

Town of Orleans
John Kelly
George Meservey

US EPA
Mary Jo Feuerbach
Bryan Dore



Town of Brewster

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Office of:
Select Board
Town Administrator

Mr. Martin Suuberg
Commissioner
MassDEP
One Winter Street
Boston, MA 02108

Ms. Kristy Senatori
Executive Director
Cape Cod Commission
3225 Main Street
PO Box 226
Barnstable, MA 02630

Re: Pleasant Bay Watershed Permit 2019 Annual Report

Dear Ms. Senatori and Commissioner Suuberg:

I am writing to convey the Town of Brewster's endorsement of the enclosed Pleasant Bay Watershed Permit 2019 Annual Report.

The annual report has been prepared by the Pleasant Bay Alliance with input from Town of Brewster staff and consultants. It contains an accurate representation of the activities undertaken by the Town of Brewster individually and in coordination with the Alliance and other member towns, to meet the nitrogen removal targets identified in the Watershed Permit.

Thank you for your review and consideration of this report.

Sincerely,

Peter Lombardi
Town Administrator



Town of Chatham

Office of the Selectmen
Town Manager
549 Main Street
Chatham, MA 02633



Jill R. Goldsmith
TOWN MANAGER
jgoldsmith@chatham-ma.gov

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July 12, 2019

Mr. Martin Suuberg
Commissioner
MassDEP
One Winter Street
Boston, MA 02108

Ms. Kristy Senatori
Executive Director
Cape Cod Commission
3225 Main Street
PO Box 226
Barnstable, MA 02630

Re: Pleasant Bay Watershed Permit 2019 Annual Report

Dear Ms. Senatori and Commissioner Suuberg:

I am writing to convey the Town of Chatham's endorsement of the enclosed Pleasant Bay Watershed Permit 2019 Annual Report.

The annual report has been prepared by the Pleasant Bay Alliance with input from Town of Chatham staff and consultants. It contains an accurate representation of the activities undertaken by the Town of Chatham individually and in coordination with the Alliance and other member towns, to meet the nitrogen removal targets identified in the Watershed Permit.

Thank you for your review and consideration of this report. If you have any questions regarding any of the foregoing, please contact me at jgoldsmith@chatham-ma.gov or 508-945-5105.

Sincerely,

Jill R. Goldsmith
Town Manager

OFFICE OF THE TOWN ADMINISTRATOR

Christopher Clark, *Town Administrator*

Phone (508) 430-7513

Fax (508) 432-5039

732 MAIN STREET, HARWICH, MA



July 15, 2019

Mr. Martin Suuberg
Commissioner
MassDEP
One Winter Street
Boston, MA 02108

Ms. Kristy Senatori
Executive Director
Cape Cod Commission
3225 Main Street
PO Box 226
Barnstable, MA 02630

Re: Pleasant Bay Watershed Permit 2019 Annual Report

Dear Ms. Senatori and Commissioner Suuberg:

I am writing to convey the Town of Harwich's endorsement of the enclosed Pleasant Bay Watershed Permit 2019 Annual Report.

The annual report has been prepared by the Pleasant Bay Alliance with input from Town of Harwich staff and consultants. It contains an accurate representation of the activities undertaken by the Town of Harwich individually and in coordination with the Alliance and other member towns, to meet the nitrogen removal targets identified in the Watershed Permit.

Thank you for your review and consideration of this report.

Sincerely,

Christopher Clark
Town Administrator



TOWN OF ORLEANS

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BOARD OF
SELECTMEN

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Mr. Martin Suuberg
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Ms. Kristy Senatori
Executive Director
Cape Cod Commission
3225 Main Street
PO Box 226
Barnstable, MA 02630

Re: Pleasant Bay Watershed Permit 2019 Annual Report

Dear Ms. Senatori and Commissioner Suuberg:

I am writing to convey the Town of Orleans' endorsement of the enclosed Pleasant Bay Watershed Permit 2019 Annual Report.

The annual report has been prepared by the Pleasant Bay Alliance with input from Town of Orleans staff and consultants. It contains an accurate representation of the activities undertaken by the Town of Orleans individually and in coordination with the Alliance and other member towns, to meet the nitrogen removal targets identified in the Watershed Permit.

Thank you for your review and consideration of this report.

Sincerely,

Liana Surdut
Acting Town Administrator

PLEASANT BAY ALLIANCE

2019 Annual Report pursuant to MassDEP Watershed Permit dated August 3, 2018

BACKGROUND

The Pleasant Bay Alliance has prepared this first annual report in accordance with the August 3, 2018 Pleasant Bay Watershed Permit issued to the Towns of Brewster, Chatham, Harwich and Orleans. This report is intended to address the annual reporting requirements identified in the Watershed Permit, the Pleasant Bay Targeted Watershed Management Plan (TWMP) and the Cape Cod Commission 208 Consistency Determination on the TWMP. This report was authorized by the four towns.

The Watershed Permit sets forth aggressive goals for achieving nutrient reductions over the twenty-year term of the permit. Adaptive management is one of the fundamental aspects of the Watershed Permit. It is expected that every five years there will be an updated permit that reflects progress already made toward nitrogen removal goals, as well as changes in the watershed that may modify those goals. An annual report is required under the permit so that key data are assembled as the five-year period unfolds.

The technical heart of the Watershed Permit is the May 2018 Targeted Watershed Management Plan. Section 15 of the TWMP Plan contains a list of 10 items that were recommended be included in the annual report. When the Cape Cod Commission issued its Certificate of 208 Compliance for the TWMP, it requested information in 8 areas, some of which are the same as contained in the TWMP. There are 14 items contained in one or both documents, and each item is addressed below.

A key part of the Watershed Permit is the one-page Implementation Schedule, which is reproduced in this report as Table 1. It shows the specific nitrogen removal projects included in each Town's plan, and the associated nitrogen removal expectations. The projects are shown in each of four five-year segments of the 20-year term of the agreement. This annual report covers the first year of the first five-year segment.

The Annual Report required by the Watershed Permit is due to DEP on or before the anniversary date of the Permit, August 3. It is to contain information and data for the previous calendar year. Given the fact that significant actions are typically taken at annual town meetings in May, this report includes such information even though it is several months beyond the end of the previous calendar year. Further, some data are regularly reported on a fiscal year basis, that is through the end of June. Therefore, this annual report contains information spanning from August 2018 to June 2019.

Table 1
Implementation Plan as Contained in the 2018 TWMP
(Expected Project Completion and Potential Annual Nitrogen Removals)

Phase	Years		Brewster		Chatham		Harwich		Orleans		Total kgN/yr*			
			Activity	kgN/yr*	Activity	kgN/yr*	Activity	kgN/yr*	Activity	kgN/yr*				
	up to 2018		Res. fertilizer control	121	Res. fertilizer control	247	Muddy Creek Bridge		Res. fertilizer control	241	1,769			
			Capt GC fertigation	230	Muddy Creek Bridge									
			Capt GC fert. reduction	930										
All towns: develop TWMP; demonstrate 208 consistency; execute IMA; obtain Watershed Permit														
1 **	1 to 5	2019 to 2023	Develop denit plan		Harwich connection		Ph 2 sewers	2,672	Amended CWMP		3,145			
			Devel. conting. plan				Res. fertilizer control	200	Lonnie's Pond aqua.	273				
			Strengthen GC plan						PRB evaluation					
All towns: update monitoring data, re-model Bay, evaluate nitrogen trading options, prepare plan for next 5 yr														
2 ***	6 to 10	2024 to 2028	On-site denit systems	118			Ph 3 sewers	1,565	MtgHouse Pond sewers	2,014	5,887			
									Other aquaculture	1,516				
									On-site denit systems	674				
3 ***	11 to 15	2029 to 2033	On-site denit systems	118	Frostfish Creek sewers	803			On-site denit systems	675	5,107			
					Ryders Cove sewers	2,605			Other aquaculture	906				
4 ***	16 to 20	2034 to 2038	On-site denit systems	118	Muddy Creek sewers	1,597			On-site denit systems	675	2,390			
	after year 20	after 2038	On-site denit systems	236	Crows Pond sewers	1,214	Ph 8 sewers	970			8,146			
					Bassing Harbor sewers	511	Harwich effl. disposal	(867)	****					
					Pleasant Bay sewers	901								
					Chatham Harbor sewers	5,181								
			Total	1,871	Total		13,059		Total		4,540	Total	6,974	26,444

- * Removals pertain to current nitrogen loads without growth, and represent estimates of removal potential.
- ** First Phase (Years 1 to 5) includes activities that are firm commitments by the towns and are necessary to gain DEP enforcement discretion.
- *** Phases 2 through 5 (Years 6 to 20) include activities that are now planned and considered enforceable until such time as they may change depending on the outcomes of Phase 1 and application of each town's adaptive management program, as per the Watershed Permit.
- **** The discharge of Harwich effluent within the Pleasant Bay watershed may become necessary if alternative disposal sites are not developed.

WATER CONSUMPTION

Water consumption is the most important indicator of septic nitrogen load. Table 2 presents water consumption data for the four towns in a format that shows the total metered water in any year, along with the per-service residential and commercial use. The current version of Table 2 contains town-wide data. In the coming year, the Alliance will work with town water departments to explore the feasibility of reporting watershed-specific water consumption data. (Such data is not intended to be the basis for a new estimate of watershed nitrogen load each year, but instead should be a straightforward way to identify trends in the largest sources of load (residential and commercial septic flows).

Table 2
Summary of Water Consumption Data

	2014	2015	2016	2017	2018	Avg
Number of Water Services						
Brewster	7,403	7,421	7,426	7,491	7,249	
Chatham	7,083	7,143	7,200	7,236	7,236	
Harwich	9,805	9,858	9,890	9,929	9,969	
Orleans	5,266	5,279	5,249	5,262	5,257	
Total	29,557	29,701	29,765	29,918	29,711	
Total Metered Water, Mgal/yr						
Brewster	395	475	454	381	402	421
Chatham	413	481	473	408	464	448
Harwich	673	781	810	670	706	728
Orleans	303	334	340	299	303	316
Total	1784	2071	2077	1758	1875	1913
Per-Service Residential Use, gpd						
Brewster	129	157	149	119	138	138
Chatham	143	172	170	140	169	159
Harwich	175	205	212	174	185	190
Orleans	142	158	163	140	144	149
Average	147	173	174	143	159	159
Per-Service Commercial Use, gpd						
Brewster	393	423	375	419	451	412
Chatham	336	296	331	382	266	322
Harwich	394	440	468	396	378	415
Orleans	252	271	280	272	251	265
Average	344	358	364	367	337	354

Town-wide data shown above for illustrative purposes only

Rainfall at Chatham Airport, inches, in Jun, Jul, Aug, Sept	10.96	14.59	7.05	16.71	8.76	11.61
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STATUS OF NITROGEN REMOVAL ACTIVITIES AND ESTIMATES OF REMOVALS TO DATE

Table 3 summarizes the nitrogen removals accomplished to date for each town. In the first year of the Watershed Permit, no new large-scale nitrogen removal projects went on line, but Orleans removed 60 kg/yr in the Lonnie's Pond shellfish harvesting demonstration.

The MEP reports have estimated that a load removal of 17,717 kg/yr is needed to restore water quality. Watershed-wide, the four towns removed 1,769 kg/yr prior to the Watershed Permit issuance. In the first five years of the permit, the towns have committed to another 3,145 kg/yr, most of which (2,872 kg/yr) is attributable to Phase 2 of Harwich's sewer program.

Compared to the target load removal of 17,717 kg/yr, the overall status of TMDL compliance is:

Load removed prior to Watershed Permit issuance:	10.0%
Additional load removed through FY 2019:	<u>0.4%</u>
Total load removed through FY 2019	10.4%
Targeted load removal through FY 2023	27.7%

With completion of Harwich's Phase 2 sewer program, the 2023 goal is achievable. Figure 1 illustrates the progress to date and shows the importance of Harwich's project to achievement of the five-year goal. As of June 2019, Harwich has awarded the first of three construction contracts for Pleasant Bay sewerage, an important step toward achievement of the 5-year goal.

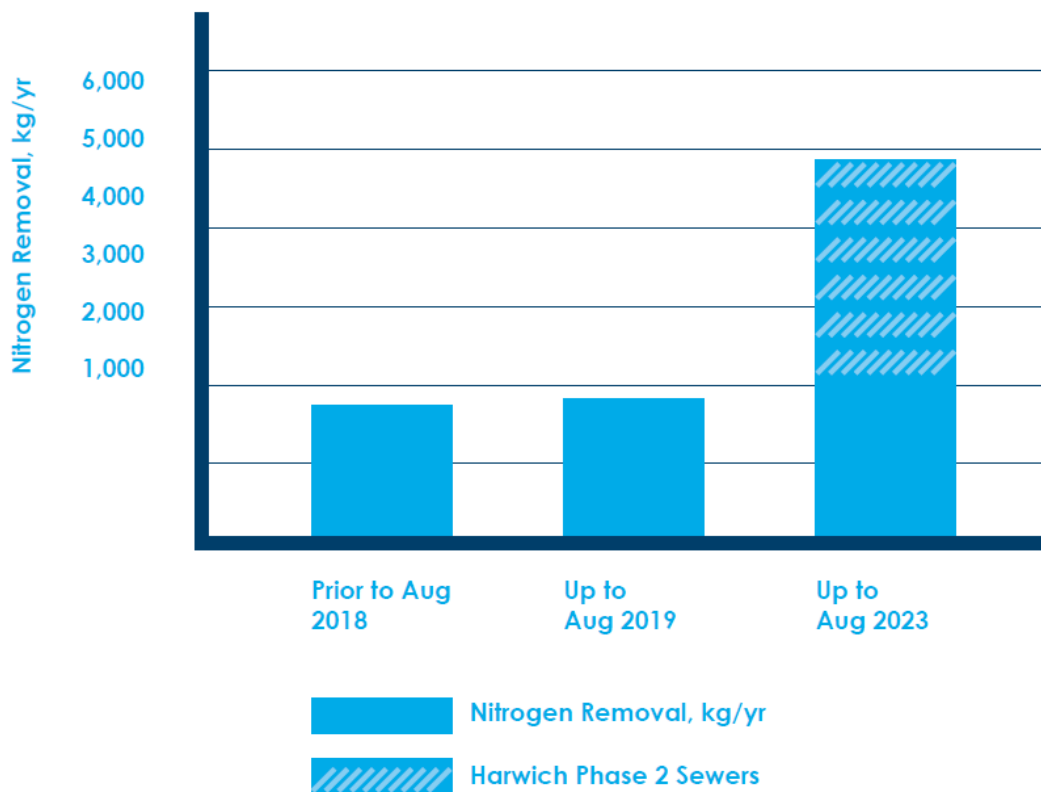
Individual town performance toward the 2023 goal is listed in Table 3 and summarized as follows:

- **Brewster:** With residential and golf course fertilizer controls, Brewster has accomplished its share of the 2023 watershed-wide goal.
- **Chatham:** Its existing residential fertilizer control ordinance addresses all of Chatham's goal for the first 5 years of the permit.
- **Harwich:** To accomplish its share of the required nitrogen removal, Harwich should put in place a residential fertilizer control ordinance and complete Phase 2 of its proposed sewer system (East Harwich). Harwich has already reached agreement with Chatham to receive the wastewater collected from the Pleasant Bay Watershed and is developing a fertilizer ordinance.
- **Orleans:** Through its residential fertilizer control ordinance and the Lonnie's Pond shellfish harvesting demonstration, Orleans has addressed about 60% of its 2023 target. The remainder is expected to be achieved through additional shellfish harvesting at Lonnie's Pond or at new sites.

**Table 3
Summary of Nitrogen Removal Achievements and Goals**

	Brewster		Chatham		Harwich		Orleans	
	Activity	Load	Activity	Load	Activity	Load	Activity	Load
Nitrogen Load Removals Previously Accomplished, kg/yr	Res fertilizer controls	121	Res fertilizer controls	247	None	-	Res fertilizer controls	241
	GC fertilizer controls	1,160						
New Nitrogen Load Removals Accomplished in FY 2019, kg/yr	None	-	None		None	-	Lonnie's Pd demo	60
Cumulative Nitrogen Load Removals Accomplished by end of FY 2019, kg/yr		1,281		247		-		301
Goals, kg/yr								
By 2023		1,281		247		2,872		514
By end of program		2,262		4,076		4,399		6,980

**Figure 1.
Pleasant Bay Nitrogen Removal Progress**



PERFORMANCE OF SPECIFIC NITROGEN REMOVAL TECHNOLOGIES

Each town’s plan is based on a set of nitrogen removal technologies. The nitrogen removal associated with each technology is determined by a few key parameters, as outlined in the appendices to the TWMP. Findings to date are reported below. Monitoring and reporting these key factors is an important part of the towns’ adaptive management programs.

Shellfish Harvesting

Orleans is evaluating the regulatory, ecosystem, and private business issues of using aquaculture to remove nitrogen and improve water quality. Issues have included size and age of oysters, their marketability, the nitrogen removal in shell and flesh, nitrogen removal rates, sediment denitrification, and overall water quality impacts. After three years of using a demonstration project in Lonnie’s Pond to identify and evaluate these parameters, the Town has contracted with an aquaculture firm to move this effort to the next step. Monitoring has shown that approximately 0.3% of oyster harvest weight is nitrogen (combined shell/flesh) and the Town has initially targeted 75 kg nitrogen removal in 2019.

On-going monitoring will quantify the nitrogen removal and water quality improvements, as well as continuing to develop information on denitrification in the sediments below the aquaculture beds. Monitoring during the demonstration project phase showed that this denitrification removed up to 36% additional nitrogen, but further discussions are necessary with DEP to determine the amount of that removal that can be applied to the overall goals. Technical assistance to the Lonnie's Pond project is partially supported by the funding from EPA's Southern New England Program (SNEP).

Public Sewering

The operative variables are the measured water use at a given home or business, the estimated 10% consumptive use (water used outside the building that does not become wastewater), and the 26.25-mg/l estimate of septic system impact on the embayment. No adjustment is needed for the nitrogen in the treatment plant effluent, since the discharge location is outside the Pleasant Bay watershed.

A sensitivity analysis is proposed in future MEP modeling to address the assumed consumptive use. Harwich is prepared to measure the water use at homes and businesses that are sewered to be able to compute the nitrogen load removed from the watershed. (A wastewater flow measuring device is proposed at the Harwich connection point into the Chatham sewer system. Flow measurement can be used as a check against the computation above, once adjusted for infiltration/inflow and the nitrogen removal that would have occurred in the abandoned septic system.)

On-Site Denitrification

The key variables are the measured water use at a given home or business, the estimated consumptive use (water used outside the building that does not become wastewater), and the effluent concentration compared to the 26.25-mg/l estimate of septic system impact on the embayment.

Research conducted under the SNEP grant on behalf of Brewster has determined that on-site denitrification systems would need to produce an effluent nitrogen concentration no greater than 12 mg/l to achieve the TMDL for the major subwatersheds in the Town. This indicates that a 14.25-mg/l removal is available for systems proposed in Brewster. Brewster continues to evaluate the availability of systems to meet this strict effluent standard in a reliable and cost-effective fashion. Brewster will use the information on these systems developed under the SNEP grant over the next one to two years to finalize a plan on how and where they will be utilized and whether or not other options may be more cost effective over time.

Golf Course Fertilizer Reduction

MEP modeling established baseline conditions for calculating fertilizer impacts, including application rates and nitrogen leaching. Nitrogen removals from that baseline are computed based on the reduction in applied nitrogen and the assumed 20% fertilizer leaching rate. No new information is available to adjust the 930 kg/yr removal already taken by Brewster for

fertilizer reductions at the Captain's Golf Course. The Town is working with the Golf Course to collect fertilizer data from the last few years and to develop a standardized process for recording and analyzing the information. This information will be presented in the next annual report.

Captain's Golf Course Fertigation

The key variables are the annual volume of groundwater withdrawn for golf course irrigation and the average nitrogen concentration of that groundwater. Brewster has estimated that an annual load reduction of 230 kg can be accomplished with this approach.

Brewster has compiled the following data in support of that estimate:

- Volume of irrigation water withdrawn: 44,429,000 gallons in 2018
- Average nitrogen concentration of: 2.1 mg/l

Based on these data, and assuming a 20% leaching rate for the nitrogen applied to the ground surface from the irrigation water, a total of 282 kg of nitrogen was captured during 2018.

Permeable Reactive Barriers

PRB performance is determined by the groundwater nitrogen load entering and leaving the reactor. Orleans has installed a PRB at the Nauset Middle School (located in the Town Cove watershed) and has monitored its performance through an on-going demonstration project; preliminary performance has indicated total nitrogen concentrations of 1 to 2 mg/l on the downgradient side of the PRB. Additional monitoring is necessary to resolve other related issues, such as quantification of overall nitrogen removal, predominant groundwater flow directions and the portion of wastewater nitrogen flowing through the PRB.

WATER QUALITY MONITORING DATA AND HABITAT ASSESSMENTS

Embayment Monitoring

The focuses of ongoing monitoring programs are:

- **Water column nitrogen and dissolved oxygen:** The Alliance's Water Quality Monitoring Program will conduct its 20th monitoring season in 2019. Monitoring occurs at approximately 24 stations selected to track TMDL compliance. A DEP-approved Quality Assurance Project Plan (QAPP) is in place and includes the following parameters: nitrogen (DON, PON, DIN, TON, TN), oxygen, temperature, salinity, and phytoplankton pigments. Sample collection occurs five times annually from July through September. Water samples are analyzed by the UMass Dartmouth School for Marine Science and Technology (SMAST) and results are reported to the Alliance. The Alliance issues periodic reports reviewing the sampling results and conducts in-depth statistical trend assessments on a five-year basis. The most recent statistical trend assessment was further evaluated by SMAST to recommend assessment improvements to better address ecological and regulatory implications. The Alliance monitoring program is funded annually by the towns and will continue.

The most current report on statistical trends in water quality data is the Cadmus Group report, July 2015 (*Pleasant Bay Alliance Water Quality Monitoring Program: Statistical Analysis of 2000-2014 Water Quality Monitoring Data*). The Alliance plans to update the statistical trend assessment on a five-year basis, with the next report expected in 2020.

- **Eelgrass coverage and vitality** – Eelgrass coverage is a key parameter for TMDL compliance. The Alliance and its member communities have utilized eelgrass surveys conducted by the MassDEP Eelgrass Mapping Project. The project conducted mapping using aerial imagery and field verification methods. Data are available for the following years: 1994, 2001, 2006, 2010 and 2012. DEP intends to conduct some additional mapping in the summer of 2019, to be available in 2020. The specific schedule and extent of future mapping to be conducted by the program need to be identified, to determine whether additional data collection will be necessary to monitor future changes in Pleasant Bay eelgrass beds. The MassDEP report for 2012 can be found at:
https://docs.digital.mass.gov/dataset/massgis-data-massdep-eelgrass-mapping-project?_ga=2.170582688.1209249591.1560872870-1878295305.1557759152
- **Benthic infauna health and diversity** – The diversity and species in the sediment animal population is a key indicator of ecosystem health in Pleasant Bay. As part of the integrated MEP assessment, quantitative sediment sampling for benthic animals was completed at 34 locations throughout the Bay and this information was compared with water quality and eelgrass measurements. This information was utilized in the characterization of ecosystem health and the development of Pleasant Bay TMDLs. In 2008, as part of the Muddy Creek inlet improvement plan, SMAST conducted an updated assessment of benthic infauna at six locations. In 2014, the Center for Coastal Studies (CCS) collected benthic infauna samples at all MEP locations except Muddy Creek. (The samples were collected using different protocols from prior MEP work.) This effort was undertaken in concert with a benthic mapping project for the Cape Cod National Seashore. The results of this CCS study are provided in a report entitled *Below the Surface of the Bay, Marine Ecosystem Assessment of Pleasant Bay, Cape Cod, MA*, and is available at:
<https://fopb.wildapricot.org/resources/Documents/FCRV/FoPB-Below%20the%20Surface-CLEAN.pdf>

Recently the Alliance asked SMAST to assess the water quality, eelgrass, and benthic infauna data needed for assessing ecological health in Pleasant Bay through updated MEP modeling.

Project-Specific Monitoring

Monitoring programs related to mitigation measures for specific projects are:

- **Orleans** worked with SMAST to develop a management plan and monitoring program for an oyster growing pilot project in Lonnie's Pond. Orleans' reporting of

monitoring data related to the first year of the Lonnie's Pond oyster growing project is expected in early 2020.

- **Brewster** has agreed to monitor groundwater irrigation water quality at the Captains Golf Course and to evaluate the ongoing reductions from fertilizer management at the golf course. Initially it was proposed to conduct the field evaluation in year 1 of the permit but given funding constraints it will take place in years 2 to 5 of the permit.
- **Chatham and Harwich** are undertaking bacterial and nitrogen-related water quality monitoring and vegetation monitoring to evaluate changes in water quality resulting from the Muddy Creek Restoration Bridge Project. The first Muddy Creek comprehensive monitoring report, and a vegetation monitoring report, are available at <http://pleasantbay.org/programs-and-projects/wetlands-protection/muddy-creek-restoration/muddy-creek-restoration-monitoring-results>.

Copies of Alliance-sponsored reports are available on the PBA website, www.pleasantbay.org. Such data will also be available Cape-wide through the Cape Cod Commission by mid-2020.

CAPITAL COMMITMENTS AND EXPENDITURES

The four towns' financial commitments and intentions are summarized in Table 4. The high points are as follow:

Brewster

Since 2011 Brewster has invested over \$750,000 in the development and implementation of the Town's Integrated Water Resource Management Plan (IWRMP). The IWRMP evaluates all the water resources in town, including management of the nitrogen load to Pleasant Bay from Brewster's portion of the watershed.

Work related to the Pleasant Bay Watershed includes the development of the 2015 Pleasant Bay Nitrogen Management Alternatives Report. More recently it has included analyses and implementation planning for the use of alternative onsite septic systems to remove nitrogen. A portion of this work was funded under a \$25,000 DLT A grant issued to the Town by the Cape Cod Commission to focus on the implementation of a municipal alternative septic system program.

The Town expects to spend between \$250,000 and \$400,000 in the next four years of the permit to move forward with the onsite denitrification program, and evaluate the nitrogen loading reductions at Captains Golf Course. This includes \$75,000 approved at the May 2019 Town Meeting. Expenditures for the following five years will be determined once the extent of the onsite septic system program, or an alternative approach, are clarified.

**Table 4.
Summary of Capital Commitments**

		Brewster	Chatham	Harwich	Orleans
Prior to July 2018					
	Funds expended	\$0.75 M for IWRMP	\$75 M for sewers and WWTF	\$2.265 M paid to Chatham for capacity	>\$1 M for planning
	Funds appropriated but not expended		\$47.5 M for sewers	\$22.45 M for sewer project (ATM 2018)	\$2.7 M for sewer and WWTF design
FY 2019 to FY2023 <i>Permit Yr 1 to 5</i>					
	Funds expended		\$1M for sewers		\$6.1M for downtown sewers (portion)
	Funds appropriated	\$0.075 M for on-site program (ATM 2019)	\$7.15 M for sewers	\$4.50 M to be paid to Chatham for capacity	\$47.7 M for sewer and WWTF constr. (ATM 2019)
	Anticipated future appropriations	\$0.175 M to \$0.325 M for on-site program	\$10-20 M every 2 to 3 years for sewers		2021--\$0.85M Mtghse survey 2022--\$1.5M Mtghse design 2023--\$17M Mtghse constr.
FY 2024 to FY 2028 <i>Permit Yr 6 to 10</i>					
	Anticipated future appropriations		\$15-20 M every 2 to 3 years for sewers		2024--\$3.4M PRB constr.

Note: Chatham expenditures and appropriatoin are town-wide, not just Pleasant Bay

Chatham

The Town of Chatham has an approved CWMP that partitioned the Town into two phases; Phase 1 includes areas to be sewerred to achieve TMDL compliance in all Chatham watersheds (including Pleasant Bay), and Phase 2 calls for sewerred of the remainder of the Town not needed to meet TMDLs. To date, the Town has appropriated over \$130 million dollars toward these goals, and most recently appropriated approximately \$15 million to address areas targeting the Pleasant Bay Watershed, including support of the Harwich CWMP through the connection project that will allow portions of East Harwich to be sewerred and treated at the Chatham Water Pollution Control Facility (WPCF).

The Chatham-Harwich Regionalization Connection Project (Phase 1D-1) is out for bids in July 2019 and is anticipated to start construction in fall of 2019. This will serve as the connection for East Harwich in addition to serving over 60 properties within the Muddy Creek Watershed, a subwatershed to Pleasant Bay.

The Town also has two other sewer projects (Phase 1D-2: Route 137 – Morton Road Sewer Extension Project and the Phase 1E – Stony Hill/Crowell Road Infrastructure Improvements Project) that are both anticipated to begin construction late fall 2019 or early spring 2020. The Phase 1D-2 project will sewer 30 properties within sub-watersheds to Pleasant Bay (whereas the bulk of this project addresses the Town’s southern facing estuaries), and the Phase 1E project will sewer 10 properties in the Frost Fish Creek sub-watershed and provide stormwater improvements to a discharge to that same sub-watershed.

Harwich

The Town of Harwich has an approved Comprehensive Wastewater Management Plan (CWMP) that calls for sewerred large sections of the Pleasant Bay watershed located in East Harwich. Town Meeting in 2018 approved over \$20 million of spending on the construction of a sewer system hooking in approximately 650 parcels in this area. The area known as Phase 2 of the CWMP has gone out to bid in various phases known as Contract 1, Contract 2 and Contract 3. Contract 1 has been awarded to the Robert B. Our Company who will commence work in the summer of 2019 with an anticipated two-year construction schedule. Contract 2 will be advertised for bid during the summer of 2019 and it is anticipated that Contract 3 will be out for bid in the late summer or early fall of 2019. The Phase 2 sewer system will connect into the Chatham wastewater treatment facility upon completion. Harwich was successful in obtaining a state revolving fund (SRF) loan at a 0% interest due to its nitrogen removal efforts as well as regional cooperation with the town of Chatham.

The Town of Harwich is currently undergoing a review of its CWMP with a potential to re-sequence some of the phases of the plan. Phase 3 was anticipated to also be in the Pleasant Bay watershed, but this may be delayed until Phase 4 due to progress of another multi-town effort in a separate watershed. The Towns of Dennis, Harwich and Yarmouth are working closely together to form the DHY Clean Waters Community Partnership that anticipates the construction of a treatment facility in the town of Dennis with all three towns utilizing that facility and effluent recharge sites in all three towns.

Orleans

Prior to the Watershed Permit issuance, Orleans spent \$3.4M on the design and installation of downtown sewers in the area of a Mass DOT construction project to avoid a road opening prohibition. Another \$2.7M was spent in the design of a new WWTF. While these expenditures do not immediately accrue to the benefit of Pleasant Bay, they are part of the infrastructure that will eventually serve portions of Orleans in the Pleasant Bay watershed.

In FY 2021, the Town expects to spend \$0.85M on survey and preliminary design of sewers in the Meetinghouse Pond sub-embayment of the Pleasant Bay system. Final design (at \$1.5 million) would be completed in FY 2022, enabling the \$17M construction to begin in FY 2023. Upon completion in FY 2025, septic nitrogen from households in the Meetinghouse Pond sub-watershed would be removed from this area and treated/disposed outside the Pleasant Bay watershed, at the WWTF mentioned above. The goal is the removal of an annual load of 2,015 kg, or about 30% of Orleans' share of the TMDLs. Under the current plan, those removals would begin in the second 5-year segment of the Implementation Schedule, consistent with the Watershed Permit.

Orleans has continued with its shellfish harvesting demonstration project in Lonnie's Pond. The Town has established an initial nitrogen removal target of 75 kg/yr through the Lonnie's Pond Management Plan. The Plan is implemented through an aquaculture contractor and a monitoring contractor. Ward Aquafarms of Buzzards Bay was selected as the aquaculture contractor, while SMAST was selected as the monitoring contractor. The Plan provides the option to place 5.5 million small oysters or 2.1 million larger oysters in the Pond to achieve the nitrogen removal target. The oysters will be grown for the summer and removed by the end of the growing season in the same year. Oysters will be grown to market size in another location. In CY 2018, the demonstration project removed 60 kg of nitrogen from the Pleasant Bay Watershed. This represents about 3% of the Town's overall goal for multiple shellfish harvesting operations in the Pleasant Bay watershed. The Watershed Permit's Implementation Schedule calls for 273 kg/yr removal in place by the end of FY 2023, which translates to three other harvesting area of comparable size to the Lonnie's Pond operation.

Based on the success of a PRB at the Middle School, Orleans is now planning to add this technology to its plan, and its 5-yr CIP includes \$3.4 million in FY 2024 for constructing one or more PRBs in the Pleasant Bay Watershed.

The Orleans Amended CWMP is in draft form and the Town plans to complete it before the end of FY 2023, consistent with the Implementation Schedule.

(The Commission has requested annual documentation of each town's ability to support the level of funding that is proposed, as well as the financial impact on users. That request will be addressed in subsequent annual reports.)

PROGRESS IN NON-STRUCTURAL AND NON-SEWERING OPTIONS

Non-structural options include such techniques as residential lawn fertilizer controls, land set-asides, rezoning, etc. Non-sewering approaches include on-lot denitrification, inlet widening, etc. Progress in FY 2019 includes:

Brewster

Brewster developed the framework for an advanced onsite septic system program and evaluated the level of treatment needed from each septic system in the main subwatersheds that are located within the Town. The framework includes recommendations for a general bylaw and Board of Health regulation to implement the onsite system requirements. It also includes initial approaches for managing the operation, maintenance and monitoring of systems that would be installed for nitrogen removal.

In addition, since 2008, the Town, along with the Brewster Conservation Trust has permanently preserved approximately 250 acres of open space in the Pleasant Bay watershed, removing land from development that would impact the buildout nitrogen load to the Bay. Preserving this land reduces the impact of buildout development on the future nitrogen load to Pleasant Bay

Chatham

Chatham continues to investigate opportunities to address stormwater infrastructure improvements throughout the town as part of its MS4 program. The Town adopted its revised fertilizer bylaw in November 2014 and continues to support and enforce these requirements.

The Town, in cooperation with the Town of Harwich, completed upgrades and renovations to the Muddy Creek Bridge several years ago. The two towns in coordination with the Pleasant Bay Alliance are monitoring the success of that project. The project basically changed out small culverts which limited flow with a clear span bridge to allow for increased tidal flow during each tide cycle.

Chatham is also seeking to purchase additional open space adjacent to Goose Pond as part of its Land Bank Open Space. This would preserve an additional 4.17 acres within the Pleasant Bay Watershed.

Harwich

In 2016, the Town, in cooperation with the Town of Chatham, removed an earthen dike and culvert structure that blocked tidal flow between Muddy Creek and Pleasant Bay, and replaced it with a new Muddy Creek Bridge. The two towns in coordination with the Pleasant Bay Alliance are monitoring the success of that project. The project allows for increased tidal flow during each tide cycle.

The Town of Harwich relies heavily upon the updated state regulations for fertilizer control. The Health Department monitors the state regulations carefully and through a campaign of education tries to insure environmentally responsible use of fertilizer. The Health Department in coordination with the Conservation Department are considering additional regulations on the local level to supplement state regulations. Said review is still underway.

The Town of Harwich, working through its Board of Selectmen and its Conservation Commission, works closely with Harwich Conservation Trust to purchase property or obtain the necessary conservation restrictions to protect environmental resources throughout the town. Over the past fifteen years this partnership has led to the purchase of the 43-acre Monomoy River Woodlands and the 49-acre Pleasant Bay Woodlands properties in the Pleasant Bay watershed. More recently this partnership led to the protection of the 17-acre Marini property adjacent to Muddy Creek in the Pleasant Bay Watershed.

Orleans

Annual Town Meeting in May 2019 was asked to appropriate funds to acquire the 26-acre Sipson's Island and a one-acre parcel within the Lonnie's Pond watershed. There are no current zoning changes anticipated in the Pleasant Bay watershed, although 2017 rezoning in the downtown area is expected to help concentrate growth there, outside the Pleasant Bay watershed.

MODELING OF WATERSHED LOADS AND EMBAYMENT WATER QUALITY

The SMAST/MEP technical report that forms the basis for the Pleasant Bay TMDLs, and the nitrogen load removals by town, was completed in 2006. With funding from the EPA SNEP grant, the Alliance is overseeing a re-modeling of the watershed loads and receiving water quality. This effort allows the input of additional water quality and habitat data accumulated since the early 2000s. This remodeling is expected to be complete by 2020 and will be a key factor in the towns' adaptive management programs. Updated estimates of watershed nitrogen load should be available for inclusion in the second annual report.

PROPOSED CHANGES IN THE IMPLEMENTATION PLAN AND PERMIT

The Watershed Permit anticipates "mid-course corrections" in any of the town's nitrogen removal plan by allowing changes to the implementation schedule at the end of each 5-year segment of the permit term. After the first year, there are no reported intentions of modifications to the implementation schedule, other than informal discussions.

The Town of Harwich is currently undergoing a review of its CWMP with a potential to re-sequence some of the phases of the plan. Nitrogen removal activities in the Pleasant Bay watershed are not likely to be affected in the first 5 years of the Watershed Permit.

The Town of Chatham may be providing sewer service to some homes in the Pleasant Bay watershed earlier than first anticipated. If so, Chatham will remove about 10% of the load that the Watershed Permit shows occurring in the last 10 years of the permit term.

The Alliance is investigating “nitrogen trading”, whereby one town could remove more than its share of nitrogen load on behalf of another town that would remove less than its share. The second town would pay the first town for the nitrogen load removed on its behalf. That investigation is funded in part by the EPA SNEP grant. The study would be concluded during the third year of the Watershed Permit. Any changes in the Implementation Schedule that potentially could emerge from that study are unlikely to proceed in the first 5 years of the permit.

Each annual report will contain an update on possible modifications to the implementation schedule. Expect further reporting on these potential changes next year.

GROWTH IN NITROGEN LOAD

Growth in the watershed nitrogen load, to the extent not already accounted for in a town’s plan, represents both a financial burden and the need to expand/modify the plan. Growth is defined as increased nitrogen load since the baseline years that are part of the 2006 MEP report and 2010 update related to Muddy Creek. Those baseline years are:

Brewster: 2002 to 2004
Chatham: 2002 to 2003
Harwich: 2004 to 2007
Orleans: 2002 to 2003

A broad assessment of trends is possible through analysis of the water use data described above and in Table 2. That assessment will be included in later-years’ annual reports once watershed-specific data are available.

NEW GROUNDWATER DISCHARGE PERMITS

There are 11 Groundwater Discharge Permit holders in Brewster, Chatham, Harwich and Orleans. There are three facilities with GWD permits located in the Pleasant Bay:

- Pleasant Bay Health & Living Center (Brewster), 26,500 gpd permitted maximum
- Chatham Bars Inn (Chatham), 60,000 gpd permitted maximum
- Wequassett Inn (Harwich), 45,000 gpd permitted maximum

Each facility has a total nitrogen discharge limit of 10 mg/l of total nitrogen. The Pleasant Bay Health & Living Center regularly meets its permit requirements. The Chatham Bars Inn has experienced some excursions in effluent nitrogen concentration. The Wequassett Inn has experienced some minor excursions, but generally produces very good effluent.

As of June 2019, there are no applications pending for new GWD permits in the watershed.

There are two other GWD permits of note in the region. The municipal wastewater treatment facility in Chatham discharges outside the Pleasant Bay watershed but is soon to receive wastewater and nitrogen load from the Pleasant Bay watershed in Harwich.

Similarly, the Town of Orleans is seeking a GWD permit for the proposed Orleans municipal WWTF discharge at a site off Lots Hollow Road Those Orleans facilities will receive and treat wastewater and nitrogen load from at least the Meetinghouse Pond sub-watershed.

Each Town’s Health Department has provided data on new Title 5 systems and new private wells in the Pleasant Bay watershed, as follows:

	All Title 5 Permits Issued Town-wide	New Title 5 Systems in Pleasant Bay Watershed	New Private Potable Wells in Pleasant Bay Watershed
Brewster	148		
Chatham			
Harwich	195	12	3
Orleans	110	6	1

DATA FROM BUILDING DEPARTMENTS AND ASSESSORS

In future annual reports, town departments will provide information on development and redevelopment as derived from the towns’ traditional annual reports that are released before Town Meetings. The Commission has also requested data on the location and square footage of new structures and the number of new bedrooms in the watershed. The Alliance and the towns will work with Commission staff during the second year of the permit to develop a practical cost-effective approach toward meeting this reporting goal.

STAKEHOLDER INVOLVEMENT

Since the issuance of the Watershed Permit in August 2018, the following public meetings and hearings have been conducted related to Pleasant Bay nitrogen reductions:

Brewster

Meetings were held with the Select Board and Board of Health to discuss implementation of the Town’s IWRMP, including the actions proposed for Pleasant Bay.

Chatham

As the Town of Chatham is well into its implementation program, the Town has used Town meetings to support these projects, including the most recent vote of an additional \$7.15 million dollars for wastewater authorization and debt exclusion that passed in May 2019. A portion of these funds is for work in the Pleasant Bay watershed.

The Town also maintains a detailed site on its webpage that provides information regarding the approved plan and links to current sewer infrastructure projects.

<https://www.chatham-ma.gov/comprehensive-wastewaternutrient-management-plan>

In addition, the Town through its consultant GHD provides a construction implementation webpage to inform residents of ongoing work related to the sewer implementation that can be found at:

<https://chathamscproject.info/>

Harwich

The Town's wastewater project is actively covered on the Town website. The Town hired Weston & Sampson (whose representative is Charlie Sumner a former administrator in the town of Brewster) to assist in outreach efforts along with CDM Smith pertaining to the Pleasant Bay watershed area improvements contained in Phase 2. The Board of Selectmen, Board of Health and the recently approved by town meeting (pending) Water/Wastewater Commission will continue outreach efforts throughout this project.

Orleans

Orleans developed a Consensus Plan to move forward with wastewater management solutions through a comprehensive public process involving local boards, citizens, and regional & state officials. The public process was critical to a successful program. Since adopting a plan for limited public sewers augmented by non-traditional remediation technologies, the Town has continued to make all wastewater planning decisions at the Board of Selectmen level, with opportunity for public input at every step.

With approval of a downtown public sewer system in May 2019, responsibility for implementing the construction program was transferred to the Board of Water & Sewer Commissioners. The Town is presently working to develop sewer regulations and will seek public input before they are approved.

Lonnie's Pond residents have been advised of the Town's ongoing demonstration project to grow oysters in Lonnie's Pond. All pond abutters were notified as part of the Conservation Commission approval process.

Alliance

The Alliance made public presentations on the Pleasant Bay watershed permitting approach at well-attended conferences:

- The Cape Cod Commission's OneCape conference in Harwich in August 2018 (an update presentation is scheduled for the 2019 OneCape conference.)

- WBNERR's Cape Coastal Conference in Hyannis in December 2018, and
- The Annual Conference of the New England Water Environment Association in Boston in January 2019.

In the upcoming year, additional stakeholder involvement will occur as follows

Brewster

Additional meetings with the Select Board, Board of Health and the public are planned in 2019 and 2020 to discuss the implementation of the Watershed Permit and how Brewster will meet its nitrogen reduction goals. The options for using advanced onsite systems will be presented and input will be solicited on issues related to the implementation of the Town program, including financing options and the requirements of the operation, maintenance and monitoring of the onsite treatment system.

Chatham

The Town continues to be an active member on the Pleasant Bay Alliance, and also the Cape Cod Water Protection Collaborative as hosted by the Cape Cod Commission.

In addition, the Town actively engages with the public through its Board of Selectmen meetings and Town Meeting process, the Water & Sewer Advisory Committee, who provide advice and recommendations to the Water & Sewer Commissioners regarding the water and sewer systems for the Town of Chatham, and neighborhood meetings related to implementation of various stages of the implementation of the CWMP.

Harwich

The Town's past efforts will continue to be modified and improved to seek additional input from the various stakeholders involved in the town's compliance with its Comprehensive Wastewater Management Plan. The town continues to be an active member on the Pleasant Bay Alliance and will continue to learn from the group of efforts made throughout the region on the wastewater permitting side.

Orleans

The Board of Water & Sewer Commissioners will hold regular, noticed meetings to review progress on public sewer construction. Regular reporting to the Town regarding the Lonnie's Pond oyster project will be made to the Water Quality Committee, and all reports will be posted on the Town website. The Town's engineering consultant will meet with the Board of Selectmen to report on progress of a demonstration Permeable Reactive Barrier currently installed at Nauset Middle School. Planning for future installation of PRBs at strategic locations will take place during 2019-2020.

Alliance

A public outreach program is part of the watershed permit implementation activities funded by EPA under the SNEP grant and now ongoing. That outreach program will occur in 2020 and 2021.

Key issues for the public are:

- The large cost of nitrogen removal programs
- Fairness in allocation of costs among users and non-users and between residential and commercial property owners.
- Proper incorporation of non-traditional approaches to nitrogen removal.

DISCUSSION AND CONCLUSIONS

The two basic goals of the annual report have been accomplished:

- Compliance documentation
- Compilation of information to inform adaptive management

While only one year has transpired under the Watershed Permit, and much is to be done in years 2 through 5, it is fair to say that:

- The towns are proceeding under the terms of the permit, and
- The towns are on track to meet the nitrogen removals stipulated under the permit.