

PLEASANT BAY ALLIANCE

2020 Annual Report pursuant to MassDEP Watershed Permit dated August 3, 2018

BACKGROUND

The Pleasant Bay Alliance has prepared this second 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 second 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. (That deadline was extended to October 3, 2020 due to the turmoil created by the ongoing corona virus pandemic.) Each annual report 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.

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 Capt GC fertigation Capt GC fert. reduction | 121 230 930 | Res. fertilizer control Muddy Creek Bridge | 247 | Muddy Creek Bridge | | Res. fertilizer control | 241 | 1,769 | | | | |
| All towns: develop TWMP; demonstrate 208 consistency; execute IMA; obtain Watershed Permit | | | | | | | | | | | | | | | |
| 1 ** | 1 to 5 | 2019 to 2023 | Develop denit plan Devel. conting. plan Strengthen GC plan | | Harwich connection | | Ph 2 sewers Res. fertilizer control | 2,672 200 | Amended CWMP Lonnie's Pond aqua. PRB evaluation | 273 | 3,145 | | | | |
| 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 Other aquaculture On-site denit systems | 2,014 1,516 674 | 5,887 | | | | |
| 3 *** | 11 to 15 | 2029 to 2033 | On-site denit systems | 118 | Frostfish Creek sewers Ryders Cove sewers | 803 2,605 | | | On-site denit systems Other aquaculture | 675 906 | 5,107 | | | | |
| 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 Bassing Harbor sewers Pleasant Bay sewers Chatham Harbor sewers | 1,214 511 901 5,181 | Ph 8 sewers Harwich effl. disposal | 970 (867) | **** | | 8,146 | | | | |
| | | | | 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.

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 2019 to August 2020.

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 between 2014 and 2019, along with the per-service residential and commercial use. The current version of Table 2 contains town-wide data. In future years, the Alliance will work with town water departments to explore the feasibility of reporting watershed-specific water consumption data. (Such data are 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 | 2019 | Avg |
|----------------------------------|--------|--------|--------|--------|--------|--------|-------|
| Number of Water Services | | | | | | | |
| Brewster | 7,403 | 7,421 | 7,426 | 7,491 | 7,249 | 7,287 | |
| Chatham | 7,083 | 7,143 | 7,200 | 7,236 | 7,236 | 7,277 | |
| Harwich | 9,805 | 9,858 | 9,890 | 9,929 | 9,969 | 9,983 | |
| Orleans | 5,266 | 5,279 | 5,249 | 5,262 | 5,257 | 5,266 | |
| Total | 29,557 | 29,701 | 29,765 | 29,918 | 29,711 | 29,813 | |
| Total Metered Water, Mgal/yr | | | | | | | |
| Brewster | 395 | 475 | 454 | 381 | 402 | 382 | 415 |
| Chatham | 413 | 481 | 473 | 408 | 464 | 422 | 444 |
| Harwich | 673 | 781 | 810 | 670 | 706 | 677 | 720 |
| Orleans | 303 | 334 | 340 | 299 | 303 | 279 | 310 |
| Total | 1,784 | 2,071 | 2,077 | 1,758 | 1,875 | 1,760 | 1,888 |
| Per-Service Residential Use, gpd | | | | | | | |
| Brewster | 129 | 157 | 149 | 119 | 138 | 132 | 137 |
| Chatham | 143 | 172 | 170 | 140 | 169 | 140 | 156 |
| Harwich | 175 | 205 | 212 | 174 | 185 | 177 | 188 |
| Orleans | 142 | 158 | 163 | 140 | 144 | 130 | 146 |
| Average | 147 | 173 | 174 | 143 | 159 | 145 | 157 |
| Per-Service Commercial Use, gpd | | | | | | | |
| Brewster | 393 | 423 | 375 | 419 | 451 | 391 | 409 |
| Chatham | 336 | 296 | 331 | 382 | 266 | 252 | 311 |
| Harwich | 394 | 440 | 468 | 396 | 378 | 367 | 407 |
| Orleans | 252 | 271 | 280 | 272 | 251 | 240 | 261 |
| Average | 344 | 358 | 364 | 367 | 337 | 312 | 347 |

Town-wide data shown above for illustrative purposes only

| | | | | | | | |
|--------------------------------------|-------|-------|------|--------|------|-------|-------|
| Rainfall at Chatham Airport, inches, | | | | | | | |
| in Jun, Jul, Aug, Sept | 10.46 | 10.88 | 6.80 | 17.43 | 9.66 | 13.49 | 11.45 |
| Deficit below 15 inches | 4.54 | 4.12 | 8.20 | (2.43) | 5.34 | 1.51 | 3.55 |

The calendar years 2018 and 2019 were relatively dry years. A review of water consumption data indicates that summer (June through September) rainfall below 15 inches may be correlated with higher water use for irrigation. Using summer rainfall below 15 inches as an indicator, the deficits in these two years were 5.3 and 1.5 inches respectively. (The 5-year period of water consumption data being used in the SMAST update---2011 to 2015---has an average deficit of 2.8 inches. The bases for the TWMP and Watershed Permit are 1.3 inches of deficit for Brewster, Chatham and Orleans, and 4.8 inches for Harwich.)

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 two years of the Watershed Permit, no new large-scale nitrogen removal projects went on line. Orleans removed 75 kg/yr in the Lonnie's Pond shellfish harvesting demonstration, and Chatham removed 100 kg/yr through sewer connections in the Frostfish Creek sub-watershed.

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 2020: | <u>1.0%</u> |
| Total load removed through FY 2020 | 11.0% |
| Targeted load removal through FY 2023 | 27.7% |

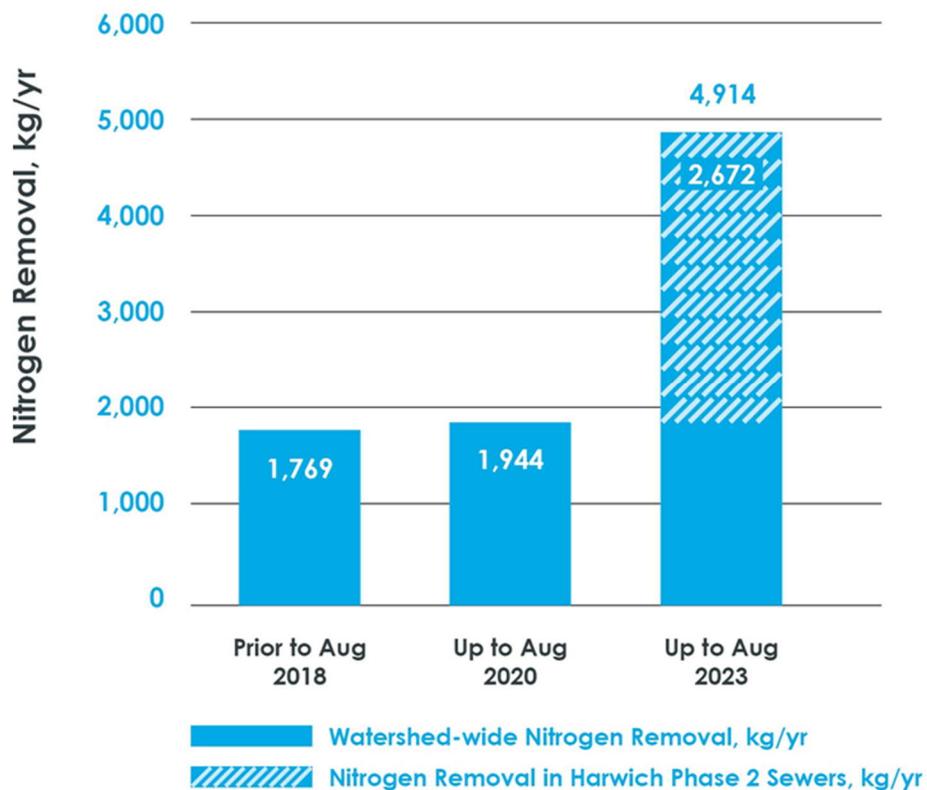
If Harwich completes its Phase 2 sewer program, the 2023 goal is achievable. Figure 1 illustrates the progress to date and shows the importance of Harwich's sewer project to achievement of the five-year goal. As of August 2020, Harwich has nearly completed two of the three construction contracts for 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 in place at the time of Watershed Permit issuance, Brewster had already accomplished its share of the 2023 watershed-wide goal. (Additional reductions in fertilizer use on fairways and roughs at the Captains Golf Course are planned for 2021.)
- **Chatham:** Its existing residential fertilizer control ordinance addresses all of Chatham's goal for the first 5 years of the permit. In constructing the connection with Harwich, Chatham will provide sewer service to about 150 homes in the Muddy Creek and Frostfish Creek subwatersheds, accomplishing another 500 kg/yr, allowing it to exceed its 2023 goal.

- **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 considering 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 in Lonnie’s Pond or at new sites.

Figure 1. Pleasant Bay Nitrogen Removal Progress



In its update of the Linked Model, SMAST has independently estimated that to-date nitrogen removals have been 1,852 kg/yr (draft), very close (in the aggregate) to the 1,944 kg/yr figure in Table 3.

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 are an important part of the towns’ adaptive management programs.

**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 and FY 2020, kg/yr | None | - | Frostfish Ck sewers | 100 | None | - | Lonnie's Pd demo | 75 |
| Cumulative Nitrogen Load Removals Accomplished by end of FY 2020, kg/yr | | 1,281 | | 347 | | - | | 316 |
| Goals, kg/yr | | | | | | | | |
| By 2023 | | 1,281 | | 247 | | 2,872 | | 514 |
| By end of program | | 2,262 | | 4,076 | | 4,399 | | 6,980 |

2-Oct-20

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 0.67% of oyster harvest weight is nitrogen (combined shell/flesh) and the Town has documented 75 kg nitrogen removal in 2019 and expects that 2020 data will confirm this amount.

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 suggested 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

For determining nitrogen removal credits for sewerage projects in Chatham and Harwich, 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 (adjusted for natural attenuation). No adjustment is needed for the nitrogen in the Chatham treatment plant effluent, since the discharge location is outside the Pleasant Bay watershed.

Harwich has measured the water use at homes and businesses that are about to be seweraged to be able to compute the nitrogen load removed from the watershed. Chatham is preparing a similar estimate. These estimates are expected to be completed in the fall of 2020. (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.)

A sensitivity analysis has been discussed for the future MEP modeling to address how several key input variables might change the estimated septic load and the overall watershed load. Those input variables include the 26.25-mg/l recharge concentration and the assumed consumptive use.

On-Site Denitrification

For estimating nitrogen removal credits, 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 (adjusted for natural attenuation).

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 that could potentially be used in Brewster.

Using SNEP funding, the Barnstable County Department of Health and Environment has completed an analysis of performance data for more than 15 proprietary treatment systems in use across the US. That analysis found no Massachusetts-approved system that is able to reliably reach the 12-mg/l goal established by Brewster. Further, that analysis found two systems in development that show the potential for better removals, albeit after completing the MassDEP approval process. Brewster continues to evaluate the availability of systems to meet this goal 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.

Captain's Golf Course Fertilizer Reduction

MEP modeling established baseline conditions for calculating golf course 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. Brewster previously documented the 930 kg/yr removal already taken by Brewster for fertilizer reductions at the Captain's Golf Course. In 2020, Brewster has conducted further studies that appear to indicate that further reductions are possible, with a potential additional removal of 362 kg/yr. 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.

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: 41,999,000 gallons in 2019
- Average nitrogen concentration: 2.3 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 293 kg of nitrogen was captured during 2019, compared with 282 kg in 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. Orleans has established a long-term target removal of 80% as the trigger for the renewal of the injected carbon source.

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 conducted its 21st monitoring season in 2020. 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 Coastal Systems Analytical Facility at 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*). Water quality data are being further reviewed as part of the updating of the SMAST linked model as funded by a grant from SNEP. Subsequent to this model update, the Alliance plans to resume updating of the statistical trend assessment on a five-year basis.

- **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, 2012 and 2019. The MassDEP reports for 1994 to 2012 can be found at:

https://docs.digital.mass.gov/dataset/massgis-data-massdep-eelgrass-mapping-project?_ga=2.170582688.1209249591.1560872870-1878295305.1557759152

The 2019 report is not yet available at this site.

The Alliance will work with the MassDEP and others to identify the schedule and extent of future mapping needed to effectively monitor future changes in Pleasant Bay eelgrass beds and to gauge restoration needs..

- **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 at a different time of year, 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>

The SNEP-funded SMAST model update will be based on assessments of water quality and eelgrass and will include the appropriate benthic infauna data needed for assessing ecological health in Pleasant Bay. That work is nearly complete and will be reported out in early 2021.

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' latest reporting of monitoring data related to the first two years of the Lonnie's Pond oyster growing project is expected in late 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.

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 approximately \$900,000 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.

The Town expects to spend between \$250,000 and \$400,000 in the next three years of the permit to move forward with one or more nitrogen reduction strategies including evaluating the leaching rates for fertilizers at the Captains Golf Course, evaluating potential use of onsite denitrification systems, and planning a traditional neighborhood wastewater treatment system.

**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 | \$59.1 M for sewer and WWTF constr. (ATM 2019, 2020) |
| 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 appropriatoins 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 currently under construction. This will serve as the connection for East Harwich in addition to serving 60 properties within the Muddy Creek sub-watershed of Pleasant Bay.

The Town also has two other sewer projects: Phase 1D-2: Route 137 – Morton Road Sewer Extension Project is in design, and Phase 1E – Stony Hill/Crowell Road Infrastructure Improvements Project is in the award stage. 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 640 parcels in this area. The area known as Phase 2 of the CWMP was designed to include two construction contracts. Contract 1 was awarded to the Robert B. Our Company which commenced work in summer of 2019. As a result of a bid overrun associated with Contract 1, Contract 2 was reduced in scope to maximize the Town’s existing appropriation. Contract 2 was awarded to RJV Construction which commenced work in January of 2020. The remaining Phase 2 parcels beyond the limits of Contracts 1 and 2 have been incorporated in to a third construction contract to be completed upon a supplemental appropriation. Accordingly, the schedule for Contract 3 is uncertain. 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 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 East Harwich work may be delayed until a future phase 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. At the 2019 and 2020 Annual Town Meetings, voters approved a total of \$59.1M for the construction of downtown sewers and the wastewater treatment plant. Construction began in September 2020. 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 results of a PRB demonstration 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 through FY 2020 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. This progress is well documented in the July 2020 report by the Horsley Witten Group, entitled *SNEP Task 1A: On-Site Denitrification System Summary Report*. That report was funded in part by SNEP.

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 Fertilizer Regulation in November 2014 and continues to support and enforce these requirements.

The Town, in cooperation with Harwich, completed construction of 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 changed out small culverts which limited flow with a clear span bridge to allow for increased tidal flow during each tide cycle.

Chatham is purchasing additional open space adjacent to Goose Pond as part of its Land Bank Open Space, and closing is expected by year-end 2020. A conservation restriction has been approved by the Conservation Commission and the Board of Selectmen and is awaiting final state approval. This purchase will 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

In 2020, the Town Meeting voted to acquire a 2.6-acre parcel fronting on Arey's Pond, preventing development of the parcel. 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 on Pleasant Bay was completed in 2006 and was supplemented with further analysis in 2010. That report formed the basis for the Pleasant Bay TMDLs, and with the updated information allowed the establishment of the nitrogen load removals requirements of each by towns. With funding from the EPA SNEP grant, the Alliance is overseeing the updating of the watershed loads and a re-modeling of 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 the end of 2020 and presented in early 2021 and will be a key factor in the towns' adaptive management programs.

In the spring of 2020, SMAST completed its preliminary re-evaluation of watershed loads based on water use data from the period of 2011 to 2015 and updated land use information. SMAST determined that:

1. There has been an increase in the overall watershed nitrogen load.
2. This estimated increase is the net effect of four factors:
 - Increased wastewater flows to previously-existing septic systems, and to new septic systems, all based on new water use data
 - Increased flow to 3 private wastewater treatment facilities and greater use of individual I/A systems
 - Changes in the estimating approach for certain portions of the nitrogen load
 - The implementation of nitrogen control measures that remove 1,800 kg/yr.

Tasks to be completed in the second half of 2020 are expected to include:

- Running the 2006 linked watershed-embayment model to confirm the effectiveness of current town nitrogen removal plans
- Conducting a sensitivity analysis on the watershed load estimates
- Compiling and evaluating recent water quality and habitat data
- Completing a re-evaluation of the Bay's hydrodynamics
- Updating the 2006 linked watershed-embayment model to predict new nitrogen removals to achieve water quality goals (the basis for Watershed Permit is an aggregate threshold load of 30,800 kg/yr)
- Developing a scenario of target watershed nitrogen removals to update the prior estimates of nitrogen removals needed (for each town) to meet the water-column nitrogen concentration in the TMDL
- Running the updated model to determine if there will be TMDL compliance based on the current set of nitrogen control plans
- Conducting further model runs in support of the nitrogen trading evaluation.

The results of the SMAST study will be reported in full in the third annual report due in August 2021.

PROPOSED CHANGES IN THE IMPLEMENTATION PLAN AND PERMIT

The Watershed Permit anticipates “mid-course corrections” in any of the towns’ nitrogen removal plans by allowing changes to the implementation schedule at the end of each 5-year segment of the permit term. After the first two years, there have been no formal announcements of proposed changes, but there have been informal discussions that changes are being contemplated.

The Town of Harwich is currently undergoing a review of its CWMP with a potential to re-sequence some of the future phases, due to the recent large increases in construction costs. Nitrogen removal activities in the Pleasant Bay watershed will likely be impacted 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 will 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.

Initial reporting by SMAST, under the SNEP-funded update of watershed nitrogen loads, indicates an approximate 10% increase in attenuated load between the 2006 SMAST technical report, and the 2011-to-2015 basis for the update.

GROUNDWATER DISCHARGE PERMITS

There are 14 Groundwater Discharge Permit holders in Brewster, Chatham, Harwich and Orleans. There are four facilities with GWD permits located in the Pleasant Bay watershed:

- 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
- Nickerson State Park (Brewster), 50,900 gpd permitted maximum

Each of the first three facilities 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.

The permit for Nickerson State Park allows Title 5 discharges up to the stated maximum and limits total nitrogen recharge to 2,120 kg/yr. Not all of the permitted activities are in the Pleasant Bay watershed.

As of August 2020, 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 has obtained 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: The counts of new Title 5 permits include both new systems and system repairs and upgrades.

| | All Title 5 Permits Issued Town-wide | New Title 5 Systems in Pleasant Bay Watershed | New Private Potable Wells in Pleasant Bay Watershed |
|----------|--------------------------------------|---|---|
| Brewster | 126 | | |
| Chatham | 71 | | 0 |
| Harwich | 135 | 5 | 30 |
| Orleans | 110 | 6 | 1 |

SMAST has reported that there are now 119 I/A systems in the watershed.

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 third 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

Chatham is well into implementation of Phase 1 of its Comprehensive Wastewater Management Plan that was completed in 2009. The Town has had many successful votes at Town Meetings to support multiple projects (totaling over \$110 million to date), 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 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 as an active member of the Pleasant Bay Alliance, the Cape Cod Water Protection Collaborative, and the Cape Cod and Islands Water Protection Fund Management Board.

In addition, the Town actively engages the public through its Board of Selectmen meetings, Town Meeting process, and the Water & Sewer Advisory Committee, who provide advice and recommendations to the Water & Sewer Commissioners (Board of Selectmen) regarding the water and sewer systems of the Town, and neighborhood meetings related to 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, formally-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 2020-2021.

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 this second annual report have been accomplished:

- Compliance documentation
- Compilation of information to inform adaptive management

While only two years have transpired under the Watershed Permit, and much is to be done in years 3 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.