CHAPTER 3:
WATER QUALITY MONITORING

IMPLEMENTATION SUMMARY

RECOMMENDATION	STATUS
9.4.3 Implement a Bay-wide monitoring program	✓ A comprehensive Bay-wide monitoring program was designed. State approval of the quality assurance project plan was obtained. Funding comes from a combination of grants and annual appropriations. ✓ More than 150 volunteers have been recruited and trained by the Alliance and affiliated local groups. ✓ Three consecutive years of monitoring have been completed. ✓ Interim water quality reports were issued for the 2000 and 2001 seasons. ➢ Five new monitoring stations were added in 2002 to prepare for modeling through the *Southeastern Massachusetts Embayment Restoration Program.* ➢ Freshwater inflows monitored in 2002.
9.4.4 Study water quality issues	➢ A comprehensive water quality analysis and report will be conducted after a minimum of three to five years of data has been collected. ➢ Additional analysis of water quality issues may be pursued pending the outcome of the comprehensive analysis.

➢   CONTINUED   ✪ NEW RECOMMENDATION   ✓ COMPLETED

OVERVIEW

Healthy water quality is essential to the vitality of the Bay's natural resources, and the many ways residents and visitors enjoy the resources. The plan notes that the Bay's water quality overall is very good, but faces threats. The water quality picture emerging after three comprehensive years of monitoring is that several areas of the Bay are experiencing eutrophic conditions due to high levels of nutrients.

The original plan identifies nitrogen from septic systems and other sources as one of the major threats to the Bay's water quality. In response, the plan calls for a watershed

planning program to control nitrogen loading. The plan also recommends that a program to monitor water quality be undertaken, with particular attention to nutrient characteristics.

At the time the plan was written, the communities lacked any comprehensive, bay-wide data on water quality conditions in the Bay. The plan cites the lack of consistent, comprehensive and reliable water quality data as a serious gap in the information needed to effectively manage the Bay's natural resources, and public use of the Bay waters and shoreline. The plan set an initial goal of collecting three to five years of water quality data. This chapter examines the Alliance's progress and future directions in monitoring water quality conditions in the Bay.

CITIZEN WATER QUALITY MONITORING PROGRAM

PROGRAM DESIGN

In 1999, the Alliance designed the Pleasant Bay Citizen Water Quality Monitoring Program. Prior to the first monitoring season in 2000, the Alliance developed a comprehensive Quality Assurance Project Plan (QAPP), which outlines program goals, monitoring and analysis procedures, and quality control procedures. The QAPP subsequently received approval from the Massachusetts Department of Environmental Protection. With grant assistance from the Executive Office of Environmental Affairs, and the Friends of Pleasant Bay, Inc., the Alliance purchased state-of-the-art monitoring equipment. The Alliance, in cooperation with the Friends of Chatham Waterways, Orleans Water Quality Task Force, and Harwich Natural Resources Office recruited and trained more than 150 volunteers to monitor field conditions and collect water quality samples throughout the Bay.

The emphasis of the water quality program is on measuring the effects of nitrogen from surrounding land uses. Water quality data from the Pleasant Bay program is being used to:

- Provide comprehensive background data on water quality conditions in the Bay, with emphasis on nutrient levels resulting from surrounding land uses;
- Monitor nitrogen-loading trends by calculating the eutrophication index for each sampling location;
- Provide the eutrophication index and other data for use in policy, regulatory and educational applications; and
- Provide data necessary for analysis of Pleasant Bay within the Southeastern Massachusetts Embayment Restoration Program.

The Alliance has coordinated closely with wastewater planning efforts in the Alliance communities with regard to program protocols and sampling dates. Specifically, data from the Alliance program is being integrated into wastewater management plans underway in Chatham and Orleans.   A direct outgrowth of this cooperation is the dialogue with the Southeastern Massachusetts Embayment Restoration Program to proceed with

modeling of the entire Pleasant Bay system. The state program is designed to work with communities using actual water quality, hydrodynamic, and land use data in a model to determine critical nitrogen loads in embayments. The modeling is intended to lead communities to a clear definition of critical nitrogen loads and development of appropriate nitrogen management strategies. This program augments and does not replicate municipal wastewater planning studies.

Water quality samples are collected on pre-selected dates from June through September. Samples are collected at two depths (one-half meter below surface and one-half meter above bottom) for all but two stations, which are shallow and can only be monitored at one depth. On each monitoring date one station is randomly selected for duplicate sampling for quality control. Once collected, all samples are transported to the School for Marine Science and Technology (SMAST) Laboratory at the University of Massachusetts-Dartmouth campus for nutrient analysis.

PLEASANT BAY SAMPLING LOCATIONS

PBA-1. Chatham Harbor	PBA-9. Round Cove
PBA-2. Bassing Harbor	PBA-10. Quanset Pond
PBA-3. Inner Ryder's Cove	PBA-11. Paw Wah Pond
PBA-4. Crows Pond	PBA-12. Namequoit Point-South
PBA-5. Muddy Creek	PBA-13. Namequoit Point-North
PBA-6. Big Bay-Southwest	PBA-14. Arey's Pond
PBA-7. Big Bay-Mid	PBA-15. Kescayogansett Pond
PBA-8. Big Bay-Northeast	PBA-16. Meeting House Pond

In addition to the sixteen "PBA" stations shown above, two additional stations, Outer Ryder's Cove and Frost Fish Creek, were simultaneously monitored by the Town of Chatham.   In 2002 five stations were added to provide additional data necessary for modeling of the Bay through the Southeastern Massachusetts Embayment Restoration Program. The stations are:

- PBA 5A Muddy Creek – Upper,
- PBA18 Allen's Point – N,
- PBA 19 Nickerson's Neck,
- PBA 20 Strong Island, and
- PBA 21 Little Pleasant Bay.

WATER QUALITY PARAMETERS

Data from the Pleasant Bay program was used to calculate Eutrophication Indices. The index is widely accepted as a tool for assessing the impact of excessive nutrients from surrounding land uses and for monitoring the general condition of the Bay's water quality. The Buzzards Bay Baywatcher's program has used the index since 1992.

Parameters include: Chlorophylla, Pheophytin a, ammonium (NH_4), orthophosphate(PO_4), nitrate + nitrite (NO_3+NO_2), dissolved organic nitrogen (DON),

particulate organic nitrogen (PON), particulate organic carbon (POC), salinity, dissolved oxygen, temperature, transparency, total depth and weather observations. Most of the water quality parameters monitored by the Alliance are necessary to calculate the index. Total depth, salinity, and temperature, while not used in the index, are also important water quality indicators.

SUMMARY OF FINDINGS - EUTROPHICATION INDEX

Data from 2000 and 2001 have been analyzed and presented in two separate interim water quality reports issued by the Alliance. The interim reports were prepared based on a limited analysis of all the station data. A rigorous analysis to be conducted when additional years of data are available may result in changes to the results presented in the interim reports.

The eutrophication index is a generalized indicator of water quality. A figure at the end of this chapter shows the eutrophication index that has been calculated for each sampling station in the Bay in 2000 and 2001. The comparison of station indices each year, and from year to year, begins to show a comprehensive and comparable view of the Bay's water quality over time.

The index incorporates measures of oxygen saturation, water transparency (measured by Secchi depth), phytoplankton pigments, dissolved inorganic nitrogen, and total organic nitrogen. The index uses the means of the five parameters. Eutrophication Index calculations are then related to water quality conditions through the following scale.

As shown on the figure, seven stations yielded indices in the *eutrophic* range, eight in the *fair* range and three in the *good to excellent* range. Comparatively, eight stations were shown to be *eutrophic* in 2000, with the remaining nine in the *fair* range and no stations listed in the *good to excellent* range. In general, with three exceptions, the eutrophication indices in 2000 and 2001 are consistent in their rankings of the various embayments. For example, stations with the lowest indices last year continued to have the lowest indices in 2001. Three stations, Chatham Harbor, Bassing Harbor and Outer Ryder's Cove, yielded indices in 2001 that showed improvement over 2000. Additional years of data are needed to determine if these changes reflect actual water quality improvement or merely reflect natural year-to-year variability. Indices based on 2002 data will help to show whether the changes in 2001 indices will be sustained.

UPDATE RECOMMENDATIONS
Continue the citizen water quality monitoring program. Most successful water quality monitoring programs collect data for a decade or more. The Alliance should continue to build a base of reliable water quality data by implementing the Bay-wide water quality-monitoring program over the coming five years. The data is essential for local wastewater planning and for modeling of nitrogen inflows through the Southeastern Massachusetts Embayment Restoration Program. Water quality

monitoring will require continued financial support from the towns, recognizing that the Alliance will continue to seek non-municipal grant support.

Develop a comprehensive water quality report. The Alliance will prepare a full report on water quality conditions based on the analysis of a minimum of three to five years of water quality data. The report will begin to identify trends in water quality conditions throughout the Bay. It may also identify areas of special focus for further water quality study or remediation activities. The water quality analysis, as well as updated data on hydrodynamics and nitrogen loading, may be accomplished through the Alliance towns' participation in the Southeastern Massachusetts Embayment Restoration Program.