II. PREVIOUS STUDIES RELATED TO NITROGEN MANAGEMENT

Nutrient additions to aquatic systems cause shifts in a series of biological processes that can result in impaired nutrient related habitat quality. Effects include: 1) excessive plankton and macrophyte growth (which leads to reduced water clarity), 2) organic matter enrichment of waters and sediments, with the concomitant resulting increased rates of oxygen consumption and periodic depletion of dissolved oxygen, (especially in bottom waters), and 3) the limitation of the growth of desirable species such as eelgrass. Even without changes to water clarity and bottom water dissolved oxygen, the increased organic matter deposition to the sediments generally results in a decline in habitat quality for benthic infaunal communities (animals living in the sediments). This habitat change causes a shift in infaunal communities from high diversity deep burrowing forms (which include economically important species), to low diversity shallow dwelling organisms. This shift alone causes significant degradation of the resource and a loss of productivity to both the local shell fisherman and to the sport-fishery and offshore fin fishery, all of which are dependent upon these highly productive estuarine systems as a habitat and food resource during migration or during different life cycle phases. This process is generally termed “eutrophication” and in embayment systems, unlike in shallow lakes and ponds, it is not a necessarily a part of the natural evolution of a system.

In most marine and estuarine systems, such as the Edgartown Great Pond System, the limiting nutrient, and thus the nutrient of primary concern, is nitrogen. In large part, if nitrogen addition is controlled, then eutrophication is controlled. This approach has been formalized through the development of tools for predicting nitrogen loads from watersheds and the concentrations of water column nitrogen that may result. Additional development of this management approach has generated specific guidelines as to what is to be considered acceptable water column nitrogen concentrations to achieve desired water quality goals (e.g., see Cape Cod Commission 1991, 1998; Howes et al. 2002).

These tools for predicting loads and concentrations tend to be generic in nature, and overlook some of the specifics for any given water body. The present Massachusetts Estuaries Project (MEP) analysis focuses on linking water quality model predictions, based upon watershed nitrogen loading and embayment recycling and system hydrodynamics, to actual measured values for specific nutrient species. The linked watershed-embayment model is built using embayment specific measurements, thus enabling calibration of the prediction process for specific conditions in each of the coastal embayments of southeastern Massachusetts, including the Edgartown Great Pond System. As the MEP approach requires substantial amounts of site-specific data collection, part of the program is to review previous data collection and modeling efforts. These reviews are both for purposes of “data mining” and to gather additional information on an estuary’s habitat quality, unique features or temporal trends.

Among the most critical studies available for this system is the Edgartown Great Pond Water Quality Monitoring Program, spearheaded by the MVC and supported by private, municipal, county and state funds (most recently Massachusetts 604(b) grant program) with technical assistance by the Coastal Systems Program at SMAST-UMD. This Program was conducted under a Quality Assurance Project Plan, approved by the USEPA and MassDEP, with chemical analysis by the Coastal Systems Analytical Facility at SMAST-UMass Dartmouth. Review of the Water Quality Program showed that its protocols have been consistent with the MEP QAPP. Therefore, data collected by the Edgartown Great Pond Water Quality Monitoring Program has been used to provide the quantitative watercolumn nitrogen data (1996-2006)

required for the implementation of the MEP's Linked Watershed-Embayment Approach used in the present study.

Since the initial results (Wilcox, 1998, Island Coastal Ponds Water Quality Survey, 1995-1996: Great Ponds Report. MV Shellfish, MV Commission, UMASS Extension) of the Water Quality Monitoring Program and the land-use studies indicated that parts of the Edgartown Great Pond system were presently impaired by land-derived nitrogen inputs, the Town of Edgartown and Martha's Vineyard Commission (MVC) undertook additional site-specific data collection related to the present MEP ecological assessment and modeling project. Some of these investigations were also related to the Town's Wastewater Treatment Facility upgrade effort. These investigations were generally management oriented and included both habitat assessments and studies relating to nitrogen loading, hydrodynamics and habitat health. However, none provided a holistic view of the Edgartown System or its many tributary coves (Wintucket, Mashacket, Turkeyland, Slough, Jobs Neck, Janes). These numerous reports and data sets have been reviewed by the MEP Technical Team for integration into this Technical Report.

The Town of Edgartown has been very active in collecting and compiling data on a variety of environmental and habitat health issues which have been helpful in the development of the MEP analysis. As reported regularly by the Town of Edgartown Shellfish Department, the Town of Edgartown has a substantial shellfishing enterprise that depends on the safeguarding of the estuarine environment of the Town (e.g. Edgartown Great Pond). By example in 2003 the Shellfish Department reported the 2003 Commercial Shellfish Catch in Edgartown was valued at $750,155.00 in the following categories:

- Clams 127 Bushels $16,510
- Quahogs 419 Bushels $38,020
- Oysters 285 Bushels $35,625
- Scallops 6,875 Bushels $660,000

The following (reported by the Shellfish Department in 2003 Town Report) is a breakdown by area and species of shellfish harvested, in bushels, both commercially and recreationally.

	Clams	Quahogs	Oysters	Scallops
Katama Bay	151	680	17	12
Cape Pogue	12	203	0	6,939
Eel Pond	7	17	32	5
Calebs Pond	2	50	0	0
Sengekontacket	26	27	9	34
Pocha Pond	0	3	0	0
Edgartown Harbor	4	3	0	95
Trapps Pond	20	23	0	0
Edgartown Great Pond	5	0	285	0
Oyster Pond	7	0	14	0

NOTE: Edgartown Harbor includes both inner and outer harbor.

In addition to the wild shellfish harvest, aquaculturists in Edgartown raised 500 bushels of oysters worth $162,500 in 2003. The Shellfish Department continually monitors shellfish diseases within Town waters and reported as far back as 2003 that for the first time juvenile

oyster disease was found in oysters received from the hatchery by aquaculturists in Edgartown. Moreover, the shellfish disease Dermo, another oyster disease, continued to be prevalent on Oyster Pond and Edgartown Great Pond as reported in 2003. In spite of the Demo infection, (which only harms the shellfish) Edgartown Great Pond has been able to support a small commercial fishery despite the effects of this disease. In a study funded by the Northeast Regional Aquaculture Center, Edgartown Great Pond oysters are currently being investigated as a potential disease resistant population, which would greatly benefit the shellfish industry.

The Town continues to work with the Massachusetts Division of Marine Fisheries to monitor all shellfishing areas to ensure public health. As reported in 2003 Edgartown Great Pond was able to be opened for year-round shellfishing because of improved water quality (indicator bacteria). The Town of Edgartown continues to actively manage this Great Salt Pond toward the goal of improving the quality of this resource. The periodic management openings through the barrier beach to provide tidal exchange with Atlantic Ocean waters appears to have helped in the observed lowering of bacterial counts in the pond. Additionally, working towards enhancement of circulation in Edgartown Great Pond, significant dredging was undertaken in the late 2000 / early 2001 time frame as the summer 2001 had a 70+ day opening. Touch up dredging occurred in November 2003 inside of Edgartown Great Pond for maintenance associated with the "opening" site and in the spring of 2003, the sluiceway to Crackatuxet Cove was rebuilt.

The most comprehensive management planning effort to date has been by the Martha's Vineyard Commission, as detailed in their report "Edgartown Great Pond: Nutrient Loading and Recommended Management Program 1996-1998". This effort included a review of nutrient loading to the Pond (including previous studies) and the Herring Creek Farm which is within the watershed of both Edgartown Great Pond and Crackatuxet Cove. The analysis included evaluating the loading terms and assumptions, checking calculations and reviewing the underpinnings of the nitrogen loading limits. Most of the analysis was based upon determining nitrogen loading to Edgartown Great Pond, primarily from its watershed. An attempt was also made to determine the nitrogen loading level to the Pond that would support a healthy resource. However, this survey approach does not include processes within the Salt Pond, and yields only approximate management loading levels. The MVC effort did reveal several major findings as they relate to watershed delineations, recharge or nitrogen loading and are as follows:

1) Watershed delineations based upon well data and topography, while generally correct, should receive further analysis, if possible employing groundwater modeling.

2) The lawn analysis suggests that a shift to mainland landscaping practices would cause a large increase in N load without any increase in development.

3) Prior efforts to determine the critical nitrogen loading limit to the Pond required more scientific data and modeling support. Some of the investigations indicated that Edgartown Great Pond could tolerate even higher nitrogen loadings (Appendix C. by A. Gaines), yet the 1999 N load to the Pond had resulted in loss of eelgrass and shellfish, algal blooms and possible periodic low oxygen conditions. It appeared clear that increasing the N loading at the water exchange rates of the time would further degrade the EGP ecosystem. However, the precise nitrogen loading target was still unknown and remained the critical information for proper management of this system.

In addition to the review of the Edgartown Great Pond: Nutrient Loading and Recommended Management Program 1996-1998, members of the MEP Technical Team also

conducted a review of the Herring Creek Farm Study (Horsley & Witten Inc). This report was a site-specific study, but as it contained some detailed analysis and data, the MEP reviewed the document for integration with the MEP analysis. This report was deemed to provide useful information on the hydrology related to the changing water levels of Edgartown Great Pond and Crackatuxet Cove, and potential small scale changes in watershed delineation in this region of the Great Pond watershed.

A number of other studies have been reviewed by the MEP Technical Team relative to the MEP assessment and modeling effort for Edgartown Great Pond. The most useful to the MEP effort are as follows:

- Data collected by the Town of Edgartown and the Martha's Vineyard Commission (funded by the Great Pond Foundation) regarding the status of the treated wastewater plume from the "old" Edgartown Treatment Facility which was discharged to the watershed. These data included nutrient measurements of groundwater and plume tracking and are presented as part of the watershed analysis in Chapter IV. Additional data from Main Engineers (Geohydrologic Study For the Edgartown Water Pollution Control Facility 1986) was also considered.

- Historical eelgrass and infaunal animal habitat surveys showing locations of eelgrass beds and animal community data (Gaines, A. 1993, Coastal Resources Planning and Management: Edgartown Great Pond. WHOI, Woods Hole, MA.; Pratt, S.D. and A. Gaines 1997, An environmental status report on Edgartown Great Pond: bottom habits and their flora and fauna).

- Earth Tech Inc., Groundwater Modeling, provided critical information for the delineation of the watershed to Edgartown Great Pond. The data and model was provided to SMAST and USGS as part of the task to determine the contributing watershed area (Chapter III). This effort also incorporated information from Llewellyn-Smith, (The Hydrogeology of Martha's Vineyard, Mass. MS Thesis, UMASS Dept. Geology and Geography 1987) and Anderson Nichols & Co.(Edgartown Water Resource Protection Program 1984)

As briefly discussed above, a wide variety of work has previously been undertaken on the Edgartown Great Pond system in advance of the MEP analysis. The most pertinent reports have been summarized above while other studies considered by the MEP are simply listed below:

Earth Tech (1998) Preliminary Data: Meeting House Golf LLC

Gaines, A. (1996) An Artificial Inlet for Application on a Seasonally High Energy Barrier Beach. Proposal to Boldwater Homeowners by Coast & Harbor Consultants

Martha's Vineyard Commission (1998) Data Report, Dukes County, MA. 1998

Mass. Division of Water pollution Control (1977) Martha's Vineyard Water Quality Study

Saunders Associates (1989) M. V. Landfill Monitoring Well Sampling Program: Final Report

Skomal, G.B. (1998) Finfish Survey: Edgartown Great Pond. Third Quarterly Report: Mass. Div. Of Mar. Fish.

Smith & Mahoney (1991) M. V. Landfill Groundwater Quality Monitoring Program: Final Report

Whitman & Howard (1994) A Numerical Groundwater Flow Model and Zone II Delineation for the Farm Neck Well, Oak Bluffs, Mass.. Wellesley, Ma.

Whitman & Howard (1996) Letter Report on Second Phase of Nitrate Plume Investigation

Wilcox, W.M. (1998) Island Coastal Ponds Water Quality Survey, 1995-1996: Great Ponds Report. MV Shellfish, MV Commission, UMASS Extension

Wilcox, W.M. (1986) Vineyard Farm Survey. Unpublished Survey.