96-AC-1

CAPE COD WATERSHED
WATER QUALITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS
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CAPE COD WATERSHED

WATER QUALITY ASSESSMENT REPORT

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Division of Watershed Management

Report Number:

96-AC-1

DWM Control Number:

CN 50.0

Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, Massachusetts

September 2002

ACKNOWLEDGEMENTS

Coordination of local, state and federal agencies and private organizations is fundamental to the success of the Massachusetts Watershed Initiative. We would like to thank Patti Kellogg, Executive Office of Environmental Affairs (EOEA); Courtney Armentrout, EOEA; and the Cape Cod Watershed Team for their efforts to facilitate that process.

Data and information used in this report was provided in part by the following agencies and organizations:

State

- Department of Environmental Protection (MA DEP):
  - Bureau of Strategic Policy and Technology Wall Experiment Station
  - Bureau of Resource Protection (BRP)
  - Bureau of Waste Prevention (BWP)
  - Bureau of Waste Site Cleanup (BWSC)
- Department of Public Health (MDPH)
- Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE)
  - Division of Fisheries and Wildlife (DFW)
  - Division of Marine Fisheries (DMF)
- Department of Environmental Management (MA DEM)

Federal

- United States Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)
  - Water Resources Division

Regional

- The Cape Cod Commission (CCC)
- Barnstable County Conservation Commissioner

Much appreciation is also extended to several MA DEP employees for their contributions: Richard Chase, Jane Colonna-Romano, Laurie Kennedy, Richard S. McVoy, PhD, Peter Mitchell, Katie O'Brien, Arthur Screpetis, and Mollie Weinstein.

It is impossible to thank everyone who contributed to the assessment report process: field, laboratory, data management, writing, editing, and graphics, as well as meetings, phone calls, and many e-mails. All of these contributions are very much appreciated.

Cover photo credit: Capt. Bob Avila, Hyannis Whale Watcher Cruises, Barnstable Harbor

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LIST OF ACRONYMS

7Q10	seven day, ten year low flow
ACEC	Area of Critical Environmental Concern
BMP	best management practice
BPJ	best professional judgment
BRP	Bureau of Resource Protection
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DFWELE	Department of Fisheries, Wildlife, and Environmental Law Enforcement
DMF	Division of Marine Fisheries
DO	dissolved oxygen
DQO	Data Quality Objective
DWM	Division of Watershed Management
DWP	Drinking Water Program
EOEA	Executive Office of Environmental Affairs
EPA	United States Environmental Protection Agency
MA DEM	Massachusetts Department of Environmental Management
MA DEP	Massachusetts Department of Environmental Protection
MassGIS	Massachusetts Geographic Information System
MDPH	Massachusetts Department of Public Health
NPDES	National Pollutant Discharge Elimination System
NSSP	National Shellfish Sanitation Program
ORW	Outstanding Resource Water
PALIS	Pond and Lake Information System
PALS	Pond and Lake Stewards
PCB	polychlorinated biphenols
PWS	public water supply
QA/QC	quality assurance/ quality control
R&D	Research and Demonstration
RBP	rapid bioassessment protocol
SWAP	Source Water Assessment Program
SDWA	Safe Drinking Water Act
SMAST	School of Marine Science and Technology
SWQS	Surface Water Quality Standards
TMDL	total maximum daily loads
TOC	total organic carbon
UMASS	University of Massachusetts
USGS	United States Geological Survey
VHF	Very High Frequency
WBID	Waterbody Identification Number
WBS	Waterbody System
WMA	Water Management Act

LIST OF UNITS

cfu	colony forming unit
gpm	gallons per minute
MGD	million gallons per day
µg/kg	microgram per kilogram
mg/L	milligram per liter
ng	nanogram
NTU	nephelometric turbidity units
ppb	parts per billion
ppm	parts per million
SU	standard units
T	temperature
TEQ/kg	toxic equivalents per kilogram

EXECUTIVE SUMMARY
CAPE COD WATERSHED
WATER QUALITY ASSESSMENT REPORT

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which surface waters in the Commonwealth shall be protected. The assessment of current water quality conditions is a key step in the successful implementation of the Watershed Approach. This critical phase provides an assessment of whether or not the designated uses are being met (support, partial support, non-support) or are not assessed, as well as basic information needed to focus resource protection and remediation activities later in the watershed management planning process. Thirty estuarine segments and ten ponds in the watershed are on the 1998 303(d) list of impaired waters. Total maximum daily load (TMDL) reports will be developed for five of the ten ponds upon completion of the C*ranberry Bog Phosphorus Dynamics TMDL Project* (DeMoranville, 2001)

This assessment report presents a summary of current water quality data/information used to assess the status of the designated uses as defined in the Massachusetts surface water quality standards. Each use, within a given segment, is individually assessed as 1*)* ***support***, 2) ***partial support***, or 3) ***non-support***. When too little current data/information exists or no reliable data are available the use is ***not assessed****.* However, if there is some indication of water quality impairment, which is not "naturally occurring", the use is identified with an "Alert Status". It is important to note that not all waters are assessed. Many small and/or unnamed rivers and lakes are currently ***unassessed***; the status of their designated uses has never been reported to the United States Environmental Protection Agency (EPA) in the Massachusetts 305(b) Report nor is information on these waters maintained in the Waterbody System (WBS) database.

The designated use status is presented for 38 named estuaries and 45 lakes, ponds or impoundments (the term "lakes" will be used hereafter to describe all) in the Cape Cod Watershed. Detailed information for 38 individual estuary segments totaling 31.69 square miles and 45 lakes totaling 4931.7 acres is presented for the following designated uses: *Aquatic Life, Fish Consumption, Drinking Water, Shellfishing, Primary* and *Secondary Contact Recreation* and *Aesthetics*.

ESTUARIES AND COASTAL EMBAYMENTS

The Cape Cod Watershed is a coastal river drainage area lacking the characteristic, large, mainstem rivers and associated tributary systems common to the other watersheds of Massachusetts. Larger coastal embayment segments are fed by smaller freshwater and estuarine recharge areas comprising tidal creek and marsh systems.

A summary of the *Aquatic Life, Fish Consumption, Drinking Water, Shellfishing, Primary* and *Secondary Contact Recreation,* and *Aesthetics* uses in these waters follows.

AQUATIC LIFE USE – ESTUARIES AND COASTAL EMBAYMENTS

The *Aquatic Life Use* is supported when suitable habitat (including water quality) is available for sustaining a native, naturally diverse, community of aquatic flora and fauna. Impairment of the *Aquatic Life Use* (non-support or partial support) may result from anthropogenic stressors that include point and/or nonpoint source(s) of pollution and hydrologic modification.

Due to the lack of sufficient data and guidance necessary to assess the complex nature of these tidal estuaries, the status of the *Aquatic Life Use* of the estuarine segments in the Cape Cod Watershed are not assessed.

Aquatic Life Use Summary – Estuaries and Coastal Embayments (square miles)				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
0	**0**	**0**	**31.69**	**31.69**

FISH CONSUMPTION USE – ESTUARIES AND COASTAL EMBAYMENTS

The *Fish Consumption Use* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions of fish. The assessment of this use is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MDPH), Bureau of Environmental Health Assessment (MDPH 2002). The MDPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species poses a health risk for human consumption; hence the *Fish Consumption Use* is assessed as non-support in these waters.

NOTE: In July 2001, MDPH issued new consumer advisories on fish consumption and mercury contamination (MDPH 2001). The MDPH "is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MDPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age."

Additionally, MDPH "is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury." MDPH's statewide advisory does not include fish stocked by the Massachusetts Division of Fisheries and Wildlife or farm-raised fish sold commercially.

Because of the statewide advisory, however, no waters can be assessed as support or partial support for the *Fish Consumption Use*. There are currently no MDPH-issued fish consumption advisories for any estuaries or coastal embayments in the Cape Cod Watershed. The status of the *Fish Consumption Use* in the Cape Cod Watershed is as follows:

Fish Consumption Use Summary – Estuaries and Coastal Embayments (square miles)				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
0	**0**	**0**	**31.69**	**31.69**

DRINKING WATER USE – Estuaries and Coastal Embayments

The term *Drinking Water Use* has been used to indicate sources of public drinking water. While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.state.ma.us/dep/brp/dws/dwshome.htm and from the Cape Cod Watershed's public water suppliers. These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. MA DEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act. DWP has also initiated work on its Source Water Assessment Program (SWAP), which requires that the Commonwealth delineate protection areas for all public ground and surface water sources; inventory land uses in these areas that may present potential threats to drinking water quality; determine the susceptibility of water supplies to contamination from these sources; and publicize the results. Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality), public water suppliers monitor their finished water (tap water) for major categories of contaminants (e.g., bacteria, volatile and synthetic organic compounds, inorganic compounds, etc.) and report their data to DWP.

SHELLFISHING USE – ESTUARIES AND COASTAL EMBAYMENTS

The *Shellfishing Use* is supported when shellfish harvested from Approved (Class SA or SB) or Conditionally Approved (Class SB) Shellfish Growing Areas are suitable for consumption without depuration and when shellfish harvested from Restricted (Class SB) Shellfish Growing Areas are suitable for consumption with depuration. The Division of Marine Fisheries (DMF) classifies shellfishing areas in the Cape Cod Watershed. The *Shellfishing Use* for this report was assessed using the DMF shellfishing closure list dated 1 July 2000 and published on MassGIS in October 2000. The status of the 395,641.79 acres of shellfishing beds in the entire Cape Cod Watershed (including areas that extend into open-water) is as follows:

DMF Classification Type	MA DEP Use Support Status	DMF Area (acres)	% of total DMF acreage
Approved	Support	389326.142 (SA)	98%
Conditionally Approved	Partial support Support	4235.607 (SA) 44.800 (SB) Total: 4280.407	1%
Restricted	Partial Support	182.406 (SA)	<1%
Prohibited	Non-support	1809.923 (SA)	<1%
Management Closure	Not Assessed	42.912 (SA)	<1%

Individual DMF management area classifications are provided in Appendix E of this report. It should be noted that DMF's areas are defined in acres of potential shellfishing habitat. Areas not specifically included in this assessment report are the Town of Bourne and the western shore of Falmouth as these areas are included in the Buzzards Bay Watershed.

PRIMARY* AND *SECONDARY CONTACT RECREATION USE – ESTUARIES AND COASTAL EMBAYMENTS

The *Primary Contact Recreation Use* is supported when conditions are suitable (fecal coliform bacteria densities, pH, temperature, turbidity and aesthetics meet the Surface Water Quality Standards) for any recreational or other water related activity during which there is prolonged and intimate contact with the water with a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing. The *Secondary Contact Recreation Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities.

The status of the *Primary* and *Secondary Contact Recreation Uses* in the Cape Cod Watershed is as follows (Figure 1):

Primary* and *Secondary Contact Recreation Uses Summary* *Estuaries and Coastal Embayments (square miles)				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
31.4	**0**	**0**	**0.29**	**31.69**

AESTHETICS USE – ESTUARIES AND COASTAL EMBAYMENTS

The *Aesthetics Use* is supported when surface waters are free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

The status of the *Aesthetics Use* in the Cape Cod Watershed is as follows:

Aesthetics Use Summary – Estuaries and Coastal Embayments (square miles)				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
0	**0**	**0**	**31.69**	**31.69**

RECOMMENDATIONS

The evaluation of current water quality conditions in the Cape Cod Watershed has revealed the need for the following.

- As part of the Water Management Act (WMA) 5-year review process, MA DEP should continue to evaluate compliance with registration and/or permit limits for withdrawals in the Cape Cod Watershed. Work with water suppliers to implement optimal water conservation measures that maintain or reduce water withdrawals and encourage the development and implementation of local watershed and wellhead protection plans

- Request CZM assistance to develop guidance for evaluating water quality conditions that emphasize the *Aquatic Life Use* in estuarine environments in support of the 305(b) assessments.

- Make estuarine resource protection efforts a priority for Cape Cod in support of the commercial and recreational fishing and tourism industries in this area that rely heavily on excellent water quality.

Cape Cod Watershed
Primary and *Secondary Contact Recreation Uses* Assessment Summary
Estuaries

Segment Number	Segment Name	Segment Number	Segment Name
MA96-01	Barnstable Harbor	MA96-20	Quashnet River
MA96-02	Bumps River	MA96-21	Waquoit Bay
MA96-03	Centerville Harbor	MA96-22	Herring River
MA96-04	Centerville River	MA96-23	Saquatucket Harbor
MA96-05	Hyannis Harbor	MA96-24	Mashpee River
MA96-06	Maraspin Creek	MA96-25	Red Brook
MA96-07	Prince Cove	MA96-26	Little Namskaket Creek
MA96-08	Shoestring Bay	MA96-27	Namskaket Creek
MA96-09	Quivett Creek	MA96-28	Nauset Harbor
MA96-10	Chatham Harbor	MA96-29	Provincetown Harbor
MA96-11	Stage Harbor	MA96-30	Scorton Creek
MA96-12	Bass River	MA96-31	Pamet River
MA96-13	Sesuit Creek	MA96-32	Duck Creek
MA96-14	Swan Pond River	MA96-33	Herring River
MA96-15	Boat Meadow River	MA96-34	Wellfleet Harbor
MA96-16	Rock Harbor Creek	MA96-35	Chase Garden Creek
MA96-17	Falmouth Inner Harbor	MA96-36	Lewis Bay
MA96-18	Great Harbor	MA96-37	Mill Creek
MA96-19	Little Harbor	MA96-38	Parkers River

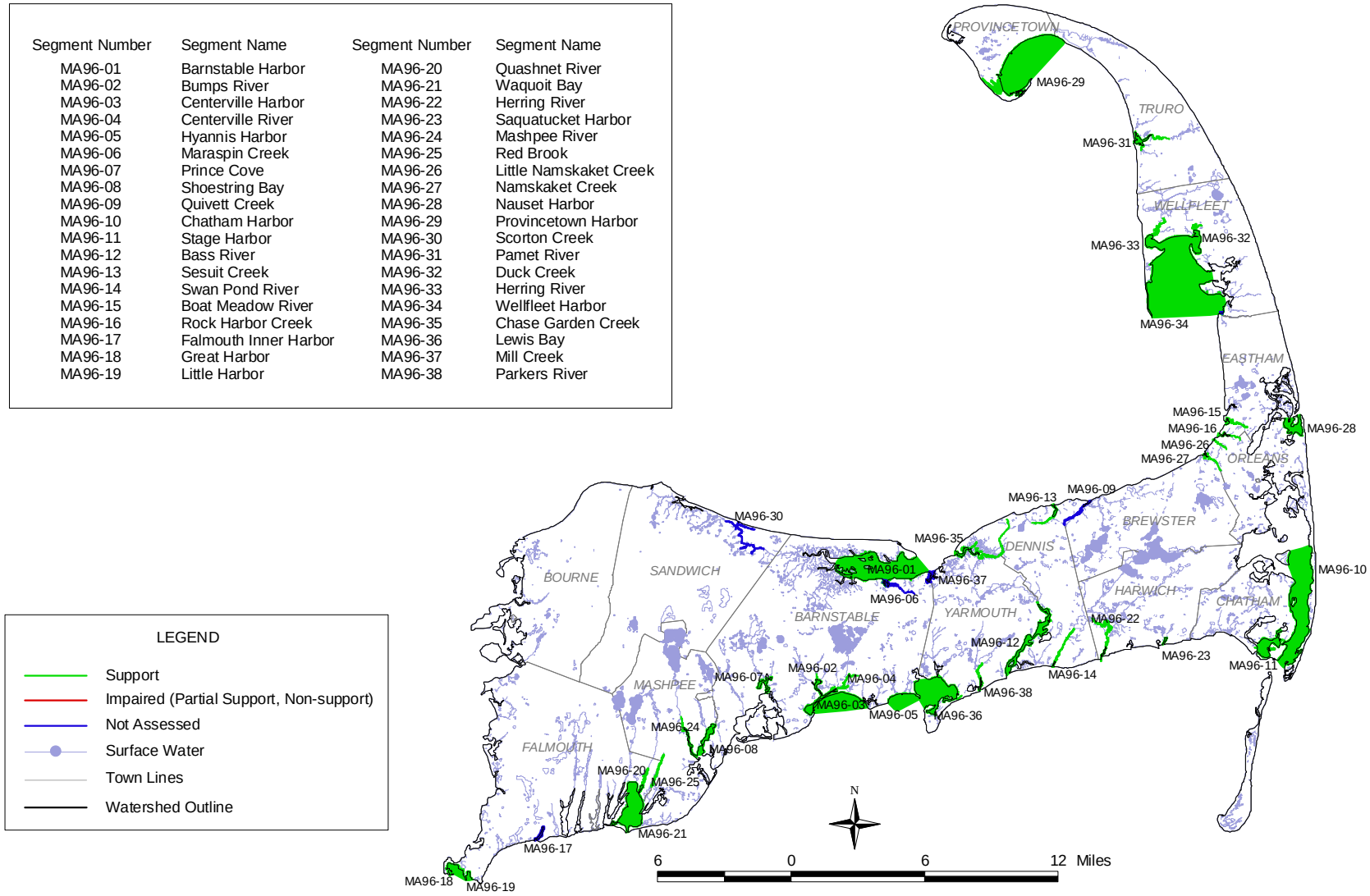

Figure 1. Cape Cod Watershed Primary and Secondary Contact Recreation Uses Assessment Summary – Estuaries.

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LAKES

Information on 46 lakes in the Cape Cod Watershed is presented in this report. These lakes represent approximately 45% (5058.7 of 11200 acres) of the watershed's total lake acreage. Lakes in the Cape Cod Watershed represent multiple stages of succession, as described in terms of trophic status estimates (Table 1). Excessive plant growth in lakes (both rooted aquatics and algae) was the most frequently recorded cause of impairment for multiple uses (*Primary* and *Secondary Contact Recreation* and *Aesthetics*).

Table 1. Cape Cod Watershed lake trophic status summary.

TROPHIC STATUS	NUMBER OF LAKES	ACRES
Oligotrophic	0	0
Mesotrophic	4	986.7
Eutrophic	3	73
Hypereutrophic	0	0
Undetermined*	39	3999
Not Attainable	0	0
Total	**46**	**5058.7**

* It should be noted that some lakes are listed as undetermined when indicators were not readily observable. With this approach, only the most obvious impairments are reported and, therefore, the assessment of lakes in the Cape Cod Watershed is limited to a "best case" picture. Potentially more of the lake acreage would be listed as impaired, or in a more enriched trophic status, if more variables were measured and more criteria assessed.

AQUATIC LIFE USE – LAKES

Two exotic aquatic plant species (*Hydrilla verticillata* and *Cabomba caroliniana*) were identified in lakes in the Cape Cod Watershed. These plants are particularly invasive species and reproduce vegetatively; therefore, they may spread readily between lakes by mechanical transport. Based on the presence of these exotic aquatic species, three lakes - Bearse Pond (MA96012), Long Pond (MA96184), and Wequaquet Lake (MA96333) - were assessed as partial support for the *Aquatic Life Use*. Approximately 22% of the lake acreage was supported for the *Aquatic Life Use*.

The status of the *Aquatic Life Use* for the assessed lakes in the Cape Cod Watershed is as follows:

***Aquatic Life Use* Summary – Lakes (acres)**				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
1104	**932**	**0**	**3022.7**	**5058.7**

FISH CONSUMPTION USE – LAKES

Because of health concerns associated with exposure to mercury, MDPH issued fish consumption advisories for Ashumet Pond (MA96004), Hamblin Pond (MA96126), John's Pond (MA96157), Mashpee-Wakeby Pond (MA96194-MA96346), Peters Pond (MA96244), Sheep Pond (MA96289), Snake Pond (MA96302), and Wequaquet Lake (MA96333) (MDPH 2002). Because of these advisories, the *Fish Consumption Use* was non-supported for 46% of the lake acreage assessed in the Cape Cod Watershed. The remaining acreage was not assessed due to MDPH's revised statewide advisory for mercury (see *Fish Consumption Use – Estuaries*) that encompasses all Massachusetts waters.

The status of the *Fish Consumption Use* for the lakes in the Cape Cod Watershed is as follows:

***Fish Consumption Use* Summary – Lakes (acres)**				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
0	**0**	**2331.2**	**2727.5**	**5058.7**

DRINKING WATER USE – LAKES

The *Drinking Water Use* has been used to indicate sources of public drinking water. While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.state.ma.us/dep/brp/dws/dwshome.htm and from the Cape Cod Watershed's public water suppliers. These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. The DWP has primacy for implementing the provisions of the federal Safe Drinking Water Act. DWP has also initiated work on SWAP, which requires that the Commonwealth delineate protection areas for all public ground and surface water sources; inventory land uses in these areas that may present potential threats to drinking water quality; determine the susceptibility of water supplies to contamination from these sources; and publicize the results. Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) public water suppliers monitor their finished water (tap water) for major categories of contaminants (e.g., bacteria, volatile and synthetic organic compounds, inorganic compounds, etc.) and report their data to DWP.

PRIMARY CONTACT RECREATION USE – LAKES

No lakes in the Cape Cod Watershed were assessed as supporting the *Primary Contact Recreation Use*. Portions or all of five lakes (419 acres) were impaired (partial or non-support) for this use. Because the data available to assess the *Primary Contact Recreation Use* focused on macrophyte cover and transparency, the major cause of impairment was noxious/overabundant plant growth. When no visual impairment was identified during the baseline or macrophyte surveys, it could not be assumed that water quality conditions met standards (i.e., no bacterial data) and, therefore, this use was not assessed for approximately 92% of the lake acreage in the Cape Cod Watershed.

The status of the *Primary Contact Recreation Use* for the lakes assessed in the Cape Cod Watershed is as follows:

***Primary Contact Recreation Use* Summary – Lakes (acres)**				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
0	**387**	**32**	**4639.7**	**5058.7**

SECONDARY CONTACT RECREATION* AND *AESTHETICS USES – LAKES

The following four waterbodies; Crystal Lake (MA96050), Long Pond (MA96183), Ryder Pond (MA96268) and Santuit Pond (MA96277) as well as a portion of Upper Shawme Lake (MA96326) in the Cape Cod Watershed supported the *Secondary Contact Recreation* and *Aesthetics* Uses. Four waterbodies, Upper Mill Pond (MA96324), Lower Mill Pond (MA96188), Lower Shawme Lake (MA96288), Walkers Pond (MA96331) and the remaining portion of Upper Shawme Lake, were impaired (partial or non-support) for these uses. Because the data available to assess the recreational uses focused on macrophyte cover and transparency, the causes of impairment were turbidity and noxious/overabundant plant growth. When no visual impairment was identified during the baseline or macrophyte surveys it could not be assumed that water quality conditions met standards and, therefore, the majority (72%) of the lake-acreage in the Cape Cod Watershed was not assessed for the *Secondary Contact Recreation* and *Aesthetics Uses*.

The status of the *Secondary Contact Recreation* and *Aesthetics Uses* for lakes assessed in the Cape Cod Watershed is as follows:

***Secondary Contact Recreation* and *Aesthetics Uses* Summary – Lakes (acres)**				
Support	**Partial Support**	**Non-Support**	**Not Assessed**	**Total**
974	**387**	**32**	**3665.7**	**5058.7**

RECOMMENDATIONS

The evaluation of current water quality conditions in the Cape Cod Watershed has revealed the need for the following.

- Review recommendations for long-term restoration and preservation found in lake diagnostic/feasibility studies and watershed management plans and effect their implementation.

- Implement recommendations from the nutrient total maximum daily load (TMDL) analysis currently being prepared by MA DEP.

- Monitor and control the spread and growth of exotic aquatic and wetland vegetation. Determine the effectiveness of herbicide treatments on the non-native, aquatic plant infestations. Prevent the further spread of these plants to unaffected areas (within individual lakes as well as to other lakes) by alerting lake-users to the problem and their responsibility in preventing the spread of these exotic species. Post boat access points with educational warning signs.

- Coordinate with the MA Department of Environmental Management (MA DEM) and/or other groups conducting lake and watershed surveys to generate quality-assured lake data. As part of any lake water quality evaluation include the identification of non-native species and mapping of macrophyte cover in order to evaluate the status of the *Aquatic Life*, *Recreational* and *Aesthetic* uses.

INTRODUCTION

The Massachusetts Watershed Initiative is a collaborative effort between state and federal environmental agencies, municipal agencies, citizens, non-profit groups, businesses and industries in the watershed. The mission is to improve water quality conditions and to provide a framework under which the restoration and/or protection of the watershed's natural resources can be achieved. Implementation of this project is underway in a process known as the "Watershed Approach". The five-year cycle of the Watershed Approach, as illustrated in Figure 2, provides the management structure to carry out the mission. This report presents the current assessment of water quality conditions in the Cape Cod Watershed. The assessment is based on information that has been researched and developed by the Massachusetts Department of Environmental Protection (MA DEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle in partial fulfillment of MA DEP's federal mandate to report on the status of the Commonwealth's waters under the Federal Water Pollution Control Act (commonly known as the Clean Water Act).

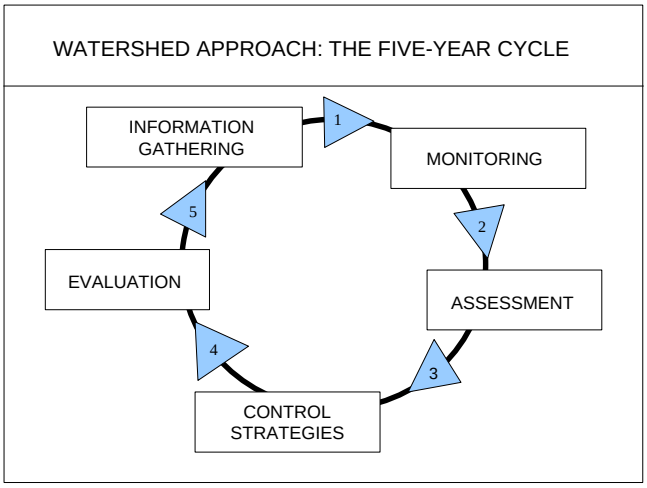

Figure 2. Five-year cycle of the Watershed Approach

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). To meet this objective, the CWA requires states to develop information on the quality of the Nation's water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public. Together, these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal Clean Water Act, every two years MA DEP must submit to the EPA a statewide report, which describes the status of water quality in the Commonwealth. The most recent 305(b) Report is the *Commonwealth of Massachusetts Summary of Water Quality 2000*. The 305(b) Report is based on the compilation of information for the Commonwealth's 27 watersheds. The 305(b) Report compiles data from a variety of sources, and provides an evaluation of water quality, progress made towards maintaining and restoring water quality, and the extent to which problems remain at the statewide level. At the watershed level, instream biological, habitat, physical/chemical, toxicity data and other information are evaluated to assess the status of water quality conditions. This analysis follows a standardized process described below (Assessment Methodology).

ASSESSMENT METHODOLOGY

WATER QUALITY CLASSIFICATION

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected; prescribe minimum water quality criteria required to sustain the designated uses; and include provisions for the prohibition of discharges (MA DEP 1996). These regulations should undergo public review every three years. The surface waters are segmented and each segment is assigned to one of the six classes described below. Each class is identified by the most sensitive and, therefore, governing water uses to be achieved and protected. Surface waters may be suitable for other beneficial uses, but shall be regulated by the Department of Environmental Protection to protect and enhance the designated uses.

Inland Water Classes

1. ***Class A*** *– These waters are designated as a source of public water supply. To the extent compatible with this use they shall be an excellent habitat for fish, other aquatic life* and *wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters (ORWs) under 314 Code of Massachusetts Regulations (CMR) 4.04(3).*
2. ***Class B*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.*
3. ***Class C*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife, and for secondary contact recreation. These waters shall be suitable for the irrigation of crops used for consumption after cooking and for compatible industrial cooling and process uses. These waters shall have good aesthetic value.*

Coastal and Marine Classes

4. ***Class SA*** *– These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfishing Areas). These waters shall have excellent aesthetic value.*
5. ***Class SB*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfishing Areas). These waters shall have consistently good aesthetic value.*
6. ***Class SC*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife and for secondary contact recreation. They shall also be suitable for certain industrial cooling and process uses. These waters shall have good aesthetic value.*

The CWA Section 305(b) water quality reporting process is an essential aspect of the Nation's water pollution control effort. It is the principal means by which EPA, Congress, and the public evaluate existing water quality, assess progress made in maintaining and restoring water quality, and determine the extent of remaining problems. In so doing, the States report on waterbodies within the context of meeting their designated uses (described above in each class). Each class is identified by the most sensitive and, therefore, governing, water uses to be achieved and protected. These uses include: *Aquatic Life, Fish Consumption, Drinking Water, Shellfishing, Primary* and *Secondary Contact Recreation,* and *Aesthetics*. Two subclasses of Aquatic Life are also designated in the standards: Cold Water Fishery (capable of sustaining a year-round population of cold water aquatic life, such as trout), and Warm Water Fishery (waters that are not capable of sustaining a year-round population of cold water aquatic life).

The SWQS, summarized in Table 2, prescribes minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be met (MA DEP 1996). In rivers, the lowest flow conditions at and above which criteria must be met are the lowest mean flow for seven consecutive days to be expected once in ten years (7Q10). In artificially regulated waters the lowest flow conditions at which criteria must be met are the flow equal or exceeded 99% of the time on a yearly basis or another equivalent flow that has been agreed upon. In coastal and marine waters and for lakes the most severe hydrological condition is determined by MA DEP on a case-by-case basis.

The availability of appropriate and reliable scientific data and technical information is fundamental to the 305(b) reporting process. It is EPA policy (EPA Order 5360.1 CHG 1) that any organization performing work for or on behalf of EPA establishes a quality system to support the development, review, approval, implementation, and assessment of data collection operations. To this end, MA DEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the Agency are of known and documented quality and are suitable for their intended use (MA DEP 2001a). For external sources of information, MA DEP requires the following: (1) an appropriate *Quality Assurance Project Plan* including a laboratory Quality Assurance /Quality Control (QA/QC) plan, (2) use of a state certified lab (certified in the applicable analysis), (3) data management QA/QC are described, and (4) the information be documented in a citable report.

Table 2. Summary of Massachusetts Surface Water Quality Standards (MA DEP 1996).
Note: Italics are direct quotations.

Dissolved Oxygen	Class A, BCWF*, SA : ≥ 6.0 mg/L and ≥ 75% saturation unless background conditions are lower Class BWWF**, SB: ≥ 5.0 mg/L and ≥ 60% saturation unless background conditions are lower Class C: Not ≤ 5.0 mg/L for more than 16 of any 24 –hour period and not ≤ 3.0 mg/L anytime unless background conditions are lower; levels cannot be lowered below 50% saturation due to a discharge Class SC: Not ≤ 5.0 mg/L for more than 16 of any 24 –hour period and not ≤ 4.0 mg/L anytime unless background conditions are lower; and 50% saturation; levels cannot be lowered below 50% saturation due to a discharge
Temperature (T)	Class A: ≤ 68°F (20°C) and Δ 1.5°F (0.8°C) for Cold Water and ≤ 83°F (28.3°C) and Δ 1.5°F (0.8°C) for Warm Water. Note: temperatures are maximum mean monthly Class BCWF: ≤ 68°F (20°C) and Δ3°F (1.7°C) due to a discharge Class BWWF: ≤ 83°F (28.3°C) and Δ3°F (1.7°C) in lakes, Δ5°F (2.8°C) in rivers Class C, SC: ≤85°F (29.4°C) nor Δ5°F (2.8°C) due to a discharge Class SA: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) Class SB: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) between July through September and Δ 4.0°F (2.2°C) between October through June
pH	Class A, BCWF, BWWF: 6.5 – 8.3 standard units (SU) and Δ0.5 outside the background range. Class C: 6.5 – 9.0 SU and Δ1.0 outside the naturally occurring range. Class SA, SB: 6.5 – 8.5 SU and Δ0.2 outside the normally occurring range. Class SC: 6.5 – 9.0 SU and Δ0.5 outside the naturally occurring range.
Fecal Coliform Bacteria Class A criteria applied to the *Drinking Water Use* Class B criteria applied to *Primary* and *Secondary Contact Recreation* uses	Class A: an arithmetic mean of < 20 organisms/100mL in any representative set of samples and < 10% of the samples > 100 organisms/100mL. Class B: a geometric mean of < 200 organisms/100mL in any representative set of samples and < 10% of the samples > 400 organisms /100mL. (This criterion can be applied on a seasonal basis at the discretion of the MA DEP.) Class C: a geometric mean of < 1000 organisms/100ml, and < 10% of the samples > 2000 organisms/100 mL. Class SA: approved Open Shellfish Areas: a geometric mean (most probable number method) of < 14 organisms/100 mL and < 10% of the samples > 43 organisms/100mL (most probable number method). Waters not designated for shellfishing: < a geometric mean of 200 organisms in any representative set of samples, and < 10% of the samples > 400 organisms /100mL. (This criterion can be applied on a seasonal basis at the discretion of the MA DEP.) Class SB: approved Restricted Shellfish Areas: < a fecal coliform median or geometric mean (most probable number method) of 88 organisms/100mL and < 10% of the samples > 260 organisms /100mL (most probable number method). Waters not designated for shellfishing: < a geometric mean of 200 organisms in any representative set of samples, and < 10% of the samples > 400 organisms /100mL. (This criterion can be applied on a seasonal basis at the discretion of the MA DEP.) Class SC: < a geometric mean of 1000 organisms/100mL and < 10% of the samples > 2000 organisms/100ml.
Solids	All Classes: *These waters shall be free from floating, suspended, and settleable solids in concentrations or combinations that would impair any use assigned to each class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.*
Color and Turbidity	All Classes: *These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.*
Oil & Grease	Class A, SA: *Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.* Class SA: *Waters shall be free from oil and grease and petrochemicals.* Class B, C, SB, SC: *Waters shall be free from oil* and *grease, petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course or are deleterious or become toxic to aquatic life.*
Taste and Odor	Class A, SA: *None other than of natural origin.* Class B, C, SB, SC: *None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to each class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.*
Aesthetics	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.*
Toxic Pollutants (EPA 19 November 1999a)	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife… The division shall use the recommended limit published by EPA pursuant to 33 USC 1251, 304(a) as the allowable receiving water concentrations for the affected waters unless a site-specific limit is established.*
Nutrients	*Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.*

*Class BCWF = Class B Cold Water Fishery, ** Class BWWF = Class B Warm Water Fishery, Δ criterion (referring to a change from ambient) is applied to the effects of a permitted discharge.

EPA provides guidelines to the States for making their use support determinations (EPA 1997). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered "historical" and used for descriptive purposes, they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table 2) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance in the literature may be applied in lieu of actual numerical criteria (e.g., freshwater sediment data may be compared to *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* (Persaud et al 1993). Water quality conditions that do not meet criteria but are "naturally occurring" (e.g., low pH in some areas) do not constitute violations of the standards.

Each designated use within a given segment is individually assessed as 1*)* ***support***, 2) ***partial support***, or 3) ***non-support***. The term ***threatened*** is used when a use is fully supported but may not support the use within two years because of adverse pollution trends or anticipated sources of pollution. When too little current data/information exists or no reliable data are available the use is ***not assessed.*** In this report, however, if there is some indication of the existence of water quality impairment, which is not "naturally occurring", the use is identified with an "**Alert Status**". Detailed guidance for assessing the status of each use follows in the Designated Uses Section of this report. It is important to note, however, that not all waters are assessed. Many small and/or unnamed ponds, rivers, and estuaries are currently ***unassessed***; the status of their designated uses has neither been reported to EPA in the Commonwealth's 305(b) Report nor is information on these waters maintained in the Waterbody System (WBS) database.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MA DEP 1996):

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna. Two subclasses of aquatic life are also designated in the standards for freshwater bodies: *Cold Water Fishery* - capable of sustaining a year-round population of cold water aquatic life, such as trout; *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life.
- *FISH CONSUMPTION* - pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption.
- *DRINKING WATER* - used to denote those waters used as a source of public drinking water. They may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3).
- *SHELLFISHING* (in SA and SB segments) – Class SA waters in approved areas (Open Shellfish Areas) shellfish harvested without depuration shall be suitable for consumption; Class SB waters in approved areas (Restricted Shellfish Areas) shellfish harvested with depuration shall be suitable for consumption.
- *PRIMARY CONTACT RECREATION* - suitable for any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water. These include, but are not limited to, wading, swimming, diving, surfing and water skiing.
- *SECONDARY CONTACT RECREATION* - suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities.
- *AESTHETICS* - all surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *AGRICULTURAL AND INDUSTRIAL* - suitable for irrigation or other agricultural process water and for compatible industrial cooling and process water.

The guidance used to assess the *Aquatic Life, Fish Consumption, Drinking Water, Shellfishing, Primary* and *Secondary Contact Recreation* and *Aesthetics* uses follows. The status of the *Agricultural and Industrial Use* is not reported to EPA.

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the MA DEP's data collection techniques dictate that a weight of evidence be used to make the assessment, with biosurvey results used as the final arbiter of borderline cases. The following chart provides an overview of the guidance used to assess the status (support, partial support, non-support) of the *Aquatic Life Use*:

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – Data available clearly indicates support. Minor excursions from chemical criteria (Table 2) may be tolerated if the biosurvey results demonstrate support.	***Partial Support*** – Uncertainty about support in the chemical or toxicity testing data, or there is some minor modification of the biological community. Excursions not frequent or prolonged.	***Non-Support*** – There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY			
Rapid Bioassessment Protocol (RBP) II or III (4)	Non-Impaired	Slightly Impaired	Moderately or Severely Impaired
Fish Community (4)	Best Professional Judgment (BPJ)	BPJ	BPJ
Habitat and Flow (4)	BPJ	BPJ	Dewatered streambed due to artificial regulation or channel alteration
Macrophytes (4)	BPJ	Exotic plant species present, but not dominant, BPJ	Exotic plant species dominant, BPJ
Plankton/ Periphyton (4)	No algal blooms	Occasional algal blooms	Persistent algal blooms
TOXICITY TESTS			
Water Column/Ambient (4)	>75% survival either 48 hr or 7-day exposure	>50 - ≤75% survival either 48 hr or 7-day exposure	≤50% survival either 48 hr or 7-day exposure
Effluent (4)	Meets permit limits	NOTE: if limit is not met, the stream is listed as threatened for 1.0 river mile downstream from the discharge or an estuary is threatened for an area based on BPJ.	
Sediment (4)	>75% survival	>50 - ≤75% survival	≤50% survival
CHEMISTRY - WATER			
Dissolved Oxygen (DO) (3, 6)	Criteria (Table 2)	Criteria exceeded in 11-25% of measurements.	Criteria exceeded >25% of measurements.
pH (3, 6)	Criteria (Table 2)	Criteria exceeded in 11-25% of measurements.	Criteria exceeded >25% of measurements.
Temperature **(**3, 6)[1]	Criteria (Table 2)[1]	Criteria exceeded in 11-25% of measurements.	Criteria exceeded >25% of measurements.
Turbidity (4)	Δ 5 NTU due to a discharge	BPJ	BPJ
Suspended Solids (4)	25 mg/L maximum, Δ10 mg/L due to a discharge	BPJ	BPJ
Nutrients (3) Phosphate-P (4)	Table 2, (Site-Specific Criteria; Maintain Balanced Biocommunity, no pH/DO violations)	BPJ	BPJ
Toxic Pollutants (3, 6) Ammonia-N (3, 4, 13) Chlorine (3, 6)[3]	Criteria (Table 2) pH and Temperature[2] dependent 0.011 (freshwater) or 0.0075 (saltwater) mg/L TRC[3]	BPJ	Criterion is exceed in > 10% of samples.
CHEMISTRY - SEDIMENT			
Toxic Pollutants (5)[4]	≤ Low Effect Level (L-EL)[4]	One pollutant between L-EL and Severe Effect Level (S-EL)	One pollutant ≥ S-EL
Nutrients (5)	≤ L-EL	Between L-EL and S-EL	≥ S-EL
Metal Normalization to Al or Fe (4)	Enrichment Ratio ≤ 1	Enrichment Ratio >1 but ≤10	Enrichment Ratio ≥10
CHEMISTRY - EFFLUENT			
Compliance with permit limits (4)	In-compliance with all limits	NOTE: if the facility does not meet their permit limits, the information is used to threaten the stream for 1.0 river mile downstream from the discharge or an estuary is threatened for an area based on BPJ.	
CHEMISTRY - TISSUE			
PCB – whole fish (1)	≤500 µg/kg wet weight	BPJ	BPJ
Dichlorodiphenyltrichloro-ethane (DDT) (2)	≤14.0 µg/kg wet weight	BPJ	BPJ
PCB in aquatic tissue (2)	≤0.79 ng TEQ/kg wet weight	BPJ	BPJ

[1]Maximum daily mean T in a month less than criterion (minimum six measurements evenly distributed over 24-hours). [2]Saltwater only. [3]The minimum quantification level for total residual chlorine is 0.05 mg/L. [4]For the purpose of this report, the S-EL for total PCB in sediment, which varies with total organic carbon (TOC) content, with 1% TOC is 5.3 parts per million (ppm) while a sediment sample with 10% TOC is 53 ppm.

Note: National Academy of Sciences/National Academy of Engineering (NAS/NAE) guideline for maximum organochlorine concentrations (i.e., total PCB) in fish tissue for the protection of fish-eating wildlife is 500µg/kg wet weight (parts per billion (ppb), not lipid-normalized). PCB data (tissue) in this report are presented in µg/kg wet weight (ppb) and are not lipid-normalized to allow for direct comparison to the NAS/NAE

FISH CONSUMPTION USE

Pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption. The assessment of this use is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MDPH), Bureau of Environmental Health Assessment (MDPH 2002). The MDPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species poses a health risk for human consumption. Hence, the Fish Consumption Use is assessed as non-support in these waters.

In July 2001, MDPH issued new consumer advisories on fish consumption and mercury contamination (MDPH 2001). The MDPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MDPH is expanding its previously issued statewide fish consumption advisory (MDPH 1994) which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age."

Additionally, MDPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week (MDPH 2001). This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury."

MDPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. Because of the statewide advisory, however, no waters can be assessed as support or partial support for the *Fish Consumption Use*. The following is an overview of the guidance used to assess the status (support, partial support, non-support) of the *Fish Consumption Use*.

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – No restrictions or bans in effect	***Partial Support*** – A "restricted consumption" fish advisory is in effect for the general population or a sub-population that could be at potentially greater risk (e.g., pregnant women, and children	***Non-Support*** – A "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species; or there is a commercial fishing ban in effect
MDPH Fish Consumption Advisory List (8,12)	Not applicable, precluded by statewide advisory (mercury)	Not applicable	Waterbody on MDPH Fish Consumption Advisory List

Other statewide advisories that MDPH has previously issued and are still in effect are as follows (MDPH 2001):

1. Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.

2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species.

DRINKING WATER USE

The term *Drinking Water Use* denotes those waters used as a source of public drinking water. These waters may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). They are designated for protection as Outstanding Resource Waters (ORWs) in 314 CMR 4.04(3). MA DEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the following major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The status of the supplies is currently reported on a statewide basis to EPA in the 305(b) Report. Below is EPA's guidance to assess the status (support, partial support, non-support) of the drinking water use.

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	***Partial Support*** – Is one or more advisories or more than conventional treatment is required	***Non-Support*** – One or more contamination-based closures of the water supply
Drinking Water Program (DWP) Evaluation	See note below	See note below	See note below

Note: While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.state.ma.us/dep/brp/dws/dwshome.htm and from the Cape Cod Watershed's public water suppliers.

SHELLFISHING USE

This use is assessed using information from the Department of Fisheries, Wildlife and Environmental Law Enforcement's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (listed below) with respect to shellfish harvest. Shellfish areas under management closures are *not assessed.*

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – SA Waters—Approved[1] SB Waters— Approved[1], Conditionally Approved[2] or Restricted[3]	***Partial Support*** – SA Waters— Conditionally Approved[2], Restricted[3], or Conditionally Restricted[4] SB Waters—Conditionally Restricted[4]	***Non Support*** – SA Waters—Prohibited[5] SB Waters— Prohibited[5]
Division of Marine Fisheries Shellfish Project Classification Area Information (11)	Reported by DMF	Reported by DMF	Reported by DMF

[1] **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

[2] **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

[3] **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

[4] **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

[5] **Prohibited -** Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support, partial support, non-support) of the *Primary Contact Recreation Use*.

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – Criteria are met, no aesthetic conditions that preclude the use	***Partial Support*** – Criteria exceeded intermittently (neither frequent nor prolonged), marginal aesthetic violations	***Non-Support*** – Frequent or prolonged violations of criteria, formal bathing area closures, or severe aesthetic conditions that preclude the use
Fecal Coliform Bacteria (3, 9) *	Criteria met OR Dry Weather Guidance If <5 samples are ≤400/100mL maximum Wet Weather Guidance Dry weather samples meet and wet samples ≤2000/100mL	Guidance exceeded in 11-25% of the samples OR Wet Weather Dry weather samples meet and wet samples >2000/100mL	Guidance exceeded in >25% of the samples
pH (3, 6)	Criteria exceeded in ≤10 % of the measurements	Criteria exceeded in 11-25% of the measurements	Criteria exceeded in >25% of the measurements
Temperature (3)	Criteria met	Criteria exceeded 11-25% of the time	Criteria exceeded 25% of the time
Color and Turbidity (3, 6)	BPJ, Δ5 NTU (due to a discharge) exceeded in ≤10 % of the measurements	BPJ, Guidance exceeded in 11-25% of the measurements	BPJ, Guidance exceeded in >25% of the measurements
Secchi disk depth (10) **	Lakes: ≥1.2 meters (≥ 4 feet)	Infrequent excursions from the guidance	Frequent and/or prolonged excursions from the guidance
Oil & Grease (3)	Criteria met	BPJ, criteria exceeded 11-25% of the time	BPJ, criteria exceeded >25% of the time
Aesthetics (3) Biocommunity (4)**	No nuisance organisms that render the water aesthetically objectionable or unusable, BPJ; Cover of macrophytes <50% within any portion of the lake area at maximum extent of growth.	BPJ, Cover of macrophytes 50-75% within any portion of the lake area at maximum extent of growth.	BPJ, Cover of macrophytes >75% within any portion of the lake area at maximum extent of growth.

Note: Excursions from criteria due to natural conditions are not considered impairment of use.

* Fecal coliform bacteria interpretations require additional information in order to apply this use assessment guidance. Small/limited datasets require an evaluation of survey conditions (i.e., interpretation of the amount of precipitation received in the subject region immediately prior to sampling and streamflow conditions) to determine whether the fecal coliform bacteria results are representative of dry or wet weather/storm water runoff conditions. When larger data sets are available, the frequency of standards/guidance exceedances is calculated.

**Any portion of a lake exhibiting impairment of the *Primary Contact Recreation Use* because of macrophyte cover and/or transparency (Secchi disk depth) is assessed as either partial or non-support. If no fecal coliform bacteria data are available and the lake (entirely or in part) met the transparency (Secchi disk depth) and aesthetics guidance, this use is not assessed.

For the *Primary Contact Recreation Use* the following steps are taken to interpret the fecal coliform bacteria results:

1. Identify the range of fecal coliform bacteria counts,
2. Calculate the geometric mean (monthly, seasonally, or on dataset), [Note: the geometric mean is only calculated on datasets with >5 samples collected within a 30-day period.]
3. Calculate the percentage of sample results exceeding 400 colony forming units (cfu)/100mL,
4. Determine if the samples were collected during wet or dry weather conditions (review precipitation and streamflow data),
   - Dry weather can be defined as: no/trace antecedent (to the sampling event) precipitation that causes more than a slight increase in stream flow.
   - Wet weather can be defined as: precipitation antecedent to the sampling event that results in a considerable increase in stream flow.
5. Apply the following to interpret dry weather data:
   - ≤10% of the samples exceed criteria (step 2 and/or 3, above) - assess as Support,
   - 11-25% of the samples exceed criteria (step 2 and/or 3, above) - assess as Partial Support,
   - >25% of the samples exceed criteria (step 2 and/or 3, above) - assess as Non-Support.
6. Apply the following to interpret wet weather data:
   - Dry weather samples meet criteria and all wet samples ≤2000 cfu/100mL - assess as Support,
   - Dry weather samples meet criteria and any wet samples >2000 cfu/100mL - assess as Partial Support.

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. Following is an overview of the guidance used to assess the status (support, partial support, non-support) of the *Secondary Contact Recreation Use*.

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – Criteria are met, no aesthetic conditions that preclude the use	***Partial Support*** – Criteria exceeded intermittently (neither frequent nor prolonged), marginal aesthetic violations	***Non-Support*** – Frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use
Fecal Coliform Bacteria (4) *	Dry Weather Guidance If <5 samples are <2000 cfu/100mL maximum If >5 samples are ≤1000 cfu/100mL geometric mean If ≤10% samples are ≥2000 cfu/100mL Wet Weather Guidance Dry weather samples meet and wet samples ≤4000 cfu/100mL	Wet Weather Guidance Dry weather samples meet and any wet samples >4000 cfu/100mL	Criteria exceeded in dry weather
Oil & Grease (3)	Criteria met	Criteria exceeded 11-25% of the time, BPJ	Criteria exceeded >25% of the time, BPJ
Aesthetics (3) Biocommunity (4)**	No nuisance organisms that render the water aesthetically objectionable or unusable, BPJ; Cover of macrophytes < 50% within any portion of the lake area at maximum extent of growth.	BPJ, Cover of macrophytes 50-75% within any portion of the lake area at maximum extent of growth.	BPJ, Cover of macrophytes >75 within any portion of the lake area at maximum extent of growth.

Note: Excursions from criteria due to natural conditions are not considered impairment of use.

* Fecal coliform bacteria interpretations require additional information in order to apply this use assessment guidance. Small/limited datasets require an evaluation of survey conditions (i.e., interpretation of the amount of precipitation received in the subject region immediately prior to sampling and streamflow conditions) to determine whether the fecal coliform bacteria results are representative of dry or wet weather/storm water runoff conditions. When larger data sets are available, the frequency of standards/guidance exceedances is calculated.

** In lakes if no fecal coliform data are available, macrophyte cover is the only criterion used to assess the *Secondary Contact Recreation Use*.

For the *Secondary Contact Recreation Use* the following steps are taken to interpret the fecal coliform bacteria results:

1. Identify the range of fecal coliform bacteria counts,
2. Calculate the geometric mean (monthly, seasonally, or on dataset), [Note: the geometric mean is only calculated on datasets with >5 samples collected within a 30-day period.]
3. Calculate the percentage of sample results exceeding 2,000 cfu/100mL,
4. Determine if the samples were collected during wet or dry weather conditions (review precipitation and streamflow data),
   - Dry weather can be defined as: no/trace antecedent (to the sampling event) precipitation that causes more than a slight increase in stream flow.
   - Wet weather can be defined as: precipitation antecedent to the sampling event that results in a considerable increase in stream flow.
5. Apply the following to interpret dry weather data:
   - ≤10% of the samples exceed criteria (step 2 and/or 3, above) - assess as Support,
   - >10% of the samples exceed criteria (step 2 and/or 3, above) - assess as Non-Support.
6. Apply the following to interpret wet weather data:
   - Dry weather samples meet criteria and all wet samples ≤4000 cfu/100mL - assess as Support,
   - Dry weather samples meet criteria and any wet samples >4000 cfu/100mL - assess as Partial Support.

AESTHETICS USE

All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. The aesthetic use is closely tied to the public health aspects of the recreational uses (swimming and boating). Below is an overview of the guidance used to assess the status (support, partial support, non-support) of the *Aesthetics Use*.

Variable (#) - Indicates reference provided at the end of the designated use section	***Support*** – 1. No objectionable bottom deposits, floating debris, scum, or nuisances; 2. No objectionable odor, color, taste or turbidity, or nuisance aquatic life	***Partial Support*** – Objectionable conditions neither frequent nor prolonged	***Non-Support*** – Objectionable conditions frequent and/or prolonged
Aesthetics (3)* Visual observation (4)	Criteria met	BPJ (spatial and temporal extent of degradation)	BPJ (extent of spatial and temporal degradation)

* For lakes, the *Aesthetics Use* category is generally assessed at the same level of impairment as the more severely impaired recreational use category (*Primary* or *Secondary Contact*).

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CAPE COD WATERSHED DESCRIPTION AND CLASSIFICATION

DESCRIPTION

The Cape Cod Watershed (Figure 3) is located in southeastern Massachusetts. It is bordered by the South Coastal Watershed to the north, the Buzzards Bay Watershed to the west and the Islands to the south. All or part of 15 communities (Barnstable, Bourne, Brewster, Chatham, Dennis, Eastham, Falmouth, Harwich, Mashpee, Orleans, Provincetown, Sandwich, Truro, Wellfleet, and Yarmouth) lie within the 410 square mile watershed. Cape Cod lacks the characteristic, large mainstem rivers and associated tributary systems common to the other watersheds of Massachusetts. Unconsolidated glacial material such as sand, gravel and boulders form the soil of Cape Cod. Beaches were formed as a result of debris released from melting ice (clay, silt, sand and boulders). Only a few small freshwater streams can be found in the Cape Cod Watershed, but lakes and ponds are abundant. These "kettle hole" ponds were formed when the receding glaciers left large ice formations partially buried in the surrounding sediments. As the ice melted, depressions remained filling with water forming the ponds that commonly intersect the groundwater table. The groundwater is naturally low in nutrients and is slightly acidic. The groundwater system is the most important freshwater resource on Cape Cod. Much of Cape Cod is filled with a variety of manufacturing activities, but the main economic activity is tourism, along with related services, which causes an extreme seasonal variation in the Cape's population.

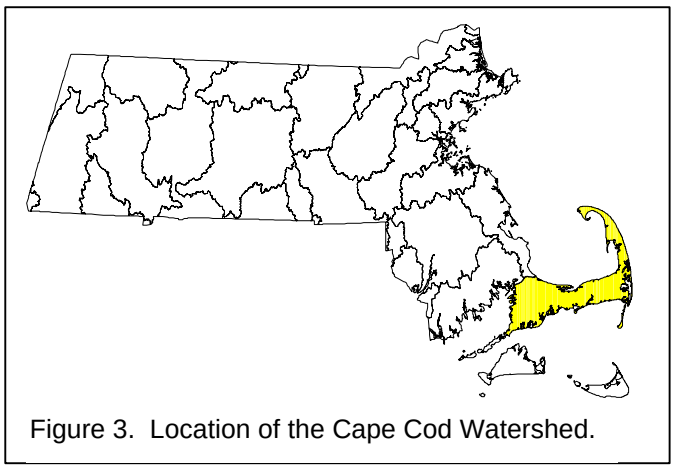


Figure 3. Location of the Cape Cod Watershed.

CLASSIFICATION

Consistent with the National Goal Uses of "fishable and swimmable waters", the classification of waters in the Cape Cod Watershed according to the SWQS, include the following (MA DEP 1996):

"Class A – These waters are designated as a source of public water supply. To the extent compatible with its use they shall be an excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters (ORWs) under 314 CMR 4.04(3)" (Rojko et al 1995). In the Cape Cod Watershed, the following waterbody is specifically designated as A:

- Long Pond, source to its outlet in Falmouth and those tributaries thereto

"Class B – These waters are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value." In the Cape Cod Watershed, no waters are classified as B (Cold Water Fisheries), however, the following are specifically designated as B (Warm Water Fisheries):

- Herring Pond and Cedar Pond (both ORWs)
- Stillwater Pond, Lovers Lake, Mill Pond, Ministers Pond and Crows Pond in Chatham (all ORWs)
- Pilgrim Lake, Quanset Pond, Crystal Lake, Paw Wah Pond, Uncle Seths Pond, Sarahs Pond, Areys Pond, Gould Pond, Kescago Gansett Pond and Meeting House Pond in Orleans (all ORWs)
- Bourne Pond, Bog Pond, Caleb Pond and Hamblin Pond in Falmouth (all ORWs)
- Flat Pond, Jehu Pond, Jim Pond, Little Flat Pond, Sage Pond, Lot Pond and Witch Pond in Mashpee (all ORWs)
- Freeman Pond, Mill Pond, Shop Pond and Upper Pond in Bourne (all ORWs)

"Class SA – These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfishing Areas). These waters shall have excellent aesthetic value." The following areas are specifically designated as SA in the Cape Cod Watershed:

- Barnstable Harbor, entire area excluding Freezer Point and the developed marina (ORW)
- Bass Creek, Brickyard Creek, Mill Creek and Wells Creek
- Broad Sound
- Namskaket Creek, Little Namskaket Creek, Rock Harbor Creek, Boat Meadow River and Herring River (all ORWs)
- Pleasant Bay and tributaries thereto (all ORWs)
- Scorton Harbor
- Scorton Creek and tributaries thereto
- *Waquoit Bay and tributaries thereto (all ORWs)
- *Waters in and adjacent (Area within 1,000 feet seaward of mean low water) to the Cape Cod National Seashore (all ORWs)

*Marine waters Class SA, fresh waters Class B

"Class SB – These waters are designated as habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfishing Areas). These waters shall have consistently good aesthetic value." In the Cape Cod Watershed, the following waters are specifically designated as SB:

- Cape Cod Canal, Sandwich (assessed as part of the Buzzard's Bay Watershed)
- Cape Cod Canal, Bourne (assessed as part of the Buzzard's Bay Watershed)
- Falmouth Inner Harbor, Falmouth

Unlisted waters in the Cape Cod Watershed not otherwise designated in the SWQS, are designated *Class B, High Quality Waters* for inland waters and *Class SA, High Quality Waters* for coastal and marine waters. According to the SWQS, where fisheries designations are necessary, they shall be made on a case-by-case basis.

The designation of ORW is applied to those waters with exceptional socio-economic, recreational, ecological and/or aesthetic values (Rojko *et al.* 1995). ORWs have more stringent requirements than other waters because the existing use is so exceptional or the perceived risk of harm is such that no lowering of water quality is permissible. ORWs include certified vernal pools and all designated Class A Public Water Supplies, and may include surface waters found in National Parks, State Forests and Parks, Areas of Critical Environmental Concern (ACEC) and those protected by special legislation (MA DEM 1993). Wetlands that border ORWs are designated as ORWs to the boundary of the defined area. In the Cape Cod Watershed, the designated ACECs are as follows (MA DEM 2002):

Sandy Neck/Barnstable Harbor (MA DEM 2002)

"The Sandy Neck/Barnstable Harbor ACEC includes 8850 acres covering Sandy Neck barrier beach, Scorton Harbor and Creek, Barnstable Harbor, surrounding saltmarsh, and uplands to the 10.5-foot elevation above mean sea level. With the exception of the Cape Cod National Seashore, this is the largest barrier beach complex between Rhode Island and Cape Ann. Thousands of acres of productive salt marsh backing the barrier beach support substantial shellfish beds and help maintain the high water quality noted here. The beaches, dunes, and saltmarshes also provide protection against storms for the low-lying inland areas. Much of the area is protected open space.

All of the resources of Sandy Neck are of an extremely high quality. Wildlife abounds within the marsh, dunes, and beach. Sightings of almost 300 species of birds have been made and over 160 species of vascular plants, including some 85 varieties of wildflowers, have been noted. The marsh and adjacent dunes are feeding and nesting areas for the endangered diamond-back terrapin. Several other rare, threatened, or endangered species also reside here.

Significant scientific studies have been conducted here, including major work on the terrapins and a classic study of the historical development of the saltmarsh. Residents and visitors also enjoy the active and passive recreational uses of Sandy Neck."

Waquoit Bay (MA DEM 2002)

"The approximately 2550-acre Waquoit Bay ACEC includes Washburn Island, South Cape Beach, and surrounding areas up to the 11-foot contour above mean sea level (the 100-year storm level). The Waquoit Bay and barrier beach complex is the most extensive, largely unaltered estuarine system on the south shore of Cape Cod. The beaches, dunes, and salt marshes provide protection against storms for the low-lying inland areas. "Waquoit" is the Wampanoag name used by the Mashpee tribe who originally settled here. Arrowhead and shellheap evidence can still be found.

High water quality and productivity are reflected in good shellfish crops and a high diversity of finfish. Several commercially important species, including winter flounder, spawn here and use the bay as a nursery. Migratory alewives and blueback herring pass through the bay to their up-stream breeding areas. The barrier beaches, bay, and marshes support many species of upland, shore, and aquatic birds.

Recreational activities swimming, boating, and fishing are also supported by the high water quality and scenic beauty of the area. Washburn Island is a rare coastal feature 333 acres of open space, including seven miles of sandy beaches, available for hiking and nature study. Numerous studies of the area by the Woods Hole Oceanographic Institute and other research groups have been conducted.

Since the ACEC was designated, Waquoit Bay was designated a National Estuary Research Reserve. The Massachusetts Department of Environmental Management manages the Reserve, as well as the South Cape Beach State Beach."

Inner Cape Cod Bay (MA DEM 2002)

"The 2550-acre Inner Cape Cod Bay ACEC covers the "inside corner" of Cape Cod Bay from First Encounter Beach in Eastham to Namskaket Creek in Brewster. Within this area are almost 900 acres of saltmarsh, hundreds of acres of highly productive shellfish beds, extensive undisturbed wildlife habitat, barrier beaches, salt ponds, and tidal rivers and creeks. The nine barrier beaches within the ACEC act as natural storm buffers to protect landward areas. The public shellfish harvesting, spawning sites for anadromous fishes in the tributaries and headwaters, and recreational enjoyment of the area are dependent on the high quality waters that are found here. The geology of the area is unique in that it includes the dividing line between the cliff-edged plains of Nauset and the kame fields of Eastham. Several areas of historical interest from early settlements are listed with the Massachusetts Historic Commission, including parts of the Old King's Highway Regional Historic District. This area is noted for its pristine character, including feeding and nesting grounds for the endangered diamond-back terrapin, exceptional coastal and estuarine ecosystem productivity, and important breeding, feeding, and resting areas for over 80 species of birds as well as many species of mammals."

Pleasant Bay (MA DEM 2002)

"The 9050-acre Pleasant Bay ACEC possesses outstanding natural resources on a regional and statewide level, including well-preserved and largely unaltered barrier beaches and islands, approximately 1200 acres of saltmarsh, and thousands of acres of tidal flats, numerous fresh and saltwater ponds, and a significant estuarine habitat. The barrier beaches also provide storm damage prevention.

Despite recent rapid growth and development in the area, most of the marshes and tidal flats have not yet experienced significant degradation from this activity. Because of this relatively unaltered state of the resources, the marshes, barrier beaches, and tidal flats can function at their maximum capacity as habitat areas, and nursery and spawning grounds. There are four anadromous fish runs and extensive shellfish beds. The 7000-acre estuary is a highly popular sport fishing area. Twelve threatened or endangered species occur within the Pleasant Bay area, with 16 more species listed as "special concern" in Massachusetts. Bird watchers have listed 248 species of birds annually.

Pleasant Bay is extremely important as a transitional area between two biogeographic provinces. As such, the biological communities of the Bay contain some species at their most northerly range and others at their most southerly range. This wealth of biodiversity and the sensitivity of the organisms living at the extent of their ranges require greater protection for such a unique resource area."

Wellfleet Harbor (MA DEM 2002)

"The 12,350-acre Wellfleet Harbor ACEC is characterized by well-preserved and largely unaltered barrier beaches, islands, fresh and salt marshes, tidal flats, salt ponds, rivers, bays, and tidal creeks. Because of the high quality of the resources, the marshes, tidal flats, and barrier beaches function at their maximum capacity as habitat areas, nursery and spawning areas, and, in the case of barrier beaches, for the purposes of storm damage prevention. Nearly all of the shoreline is subject to erosion and some parts are listed as "critical erosion" areas by the Massachusetts Coastal Zone Management Program.

The productivity of the system is exceptional, particularly for shellfish. The relatively high quality tributaries and headwaters provide spawning sites for anadromous fishes. Over half of the area of the ACEC lies within the estimated habitat of state-listed rare wetland wildlife species.

Portions of the area have been designated by the Department of Environmental Management as containing visual landscapes and cultural resources that place it in the top 5% of all landscapes in the Commonwealth. Many recreational and scenic sites abound within the area, with a significant portion belonging to the Cape Cod National Seashore and to the Massachusetts Audubon Society. Lesser known features such as the kettle ponds at the headwaters of the Herring River are unique to the area. Unusual archaeological resources, such as a Native American burial site, and evidence of prehistoric habitation as early as the Middle Archaic Period (8000-6500 B.C.), are also found within the ACEC. "

SUMMARY OF EXISTING CONDITIONS AND PERCEIVED PROBLEMS

According to the Commonwealth of Massachusetts Summary of Water Quality 1992 Appendix I Basin/Segment Information, water quality impairment in the Cape Cod Watershed was due primarily to the presence of pathogens (as measured by fecal coliform bacteria) in many areas and organic enrichment/low dissolved oxygen (MA DEP 1993). Sources of these contaminants, when known, included: urban runoff, onsite wastewater systems, highway maintenance and runoff, and recreational activities.

The Clean Water Act Section 303(d) requires states to identify those waterbodies that are not meeting Surface Water Quality Standards (SWQS). Table 3 identifies waterbodies in the Cape Cod Watershed that are on the 1998 Massachusetts Section 303(d) List of Waters (MA DEP 1999a).

Table 3. 1998 303(d) List of waters in the Cape Cod Watershed (MA DEP 1999a)

Name	Location	Pollutants/Stressors
Bearse Pond	Barnstable	Noxious aquatic plants
Great Pond	Eastham	Nutrients, Organic enrichment/low dissolved oxygen
Lower Mill Pond	Brewster	Nutrients, Noxious aquatic plants
Red Lily Pond	Barnstable	Nutrients, Pathogens, Noxious aquatic plants
Ryder Pond	Truro	Nutrients, Organic enrichment/low dissolved oxygen
Santuit Pond	Mashpee	Nutrients, Noxious aquatic plants
Shallow Pond	Barnstable	Noxious aquatic plants
Sheep Pond	Brewster	Organic enrichment/low dissolved oxygen
Upper Mill Pond	Brewster	Nutrients, Noxious aquatic plants
Walkers Pond	Brewster	Nutrients, Noxious aquatic plants

Name	Location	Pollutants/Stressors
Maraspin Creek	Barnstable	Pathogens
Mill Creek	Barnstable/Yarmouth	Pathogens
Chase Garden Creek	From just below Route 6 to mouth at Cape Cod Bay, Dennis/Yarmouth	Pathogens
Sesuit Creek	From Route 6A to mouth at Cape Cod Bay, Dennis	Pathogens
Quivett Creek	From just upstream of Route 6A to the mouth at Cape Cod Bay, Brewster/Dennis	Pathogens
Namskaket Creek	Source to mouth at Cape Cod Bay, Brewster/Orleans	Pathogens
Little Namskaket Creek	Source to mouth at Cape Cod Bay, Orleans	Pathogens
Rock Harbor Creek	Outlet Cedar Pond to mouth at Cape Cod Bay, Eastham/Orleans	Pathogens
Boat Meadow River	From the old Railway Grade to mouth at Cape Cod Bay, Eastham	Pathogens
Herring River	Griffin Island to Wellfleet Harbor, Wellfleet	Pathogens
Pamet River	Route 6 to mouth at Cape Cod Bay (Including Pamet Harbor), Truro	Pathogens
Herring River	Outlet Reservoir above Bells Neck Road to mouth at Nantucket Sound, Harwich	Pathogens
Swan Pond River	Dennis	Pathogens
Bass River	Route 6 to mouth at Nantucket Sound, Dennis/Yarmouth	Pathogens
Parkers River	Outlet Seine Pond to mouth at Nantucket Sound, Yarmouth	Pathogens
Centerville River	Includes Scudder Bay, Barnstable	Pathogens
Bumps River	Includes Scudder Bay, Barnstable	Pathogens
Mashpee River	Quinaquisset Avenue to mouth at Popponesset Bay, Mashpee	Pathogens
Hyannis Harbor	Barnstable	Pathogens
Prince Cove	Includes adjacent unnamed cove to mouth at Fox Island, Barnstable	Pathogens
Shoestring Bay	Quinaquisset Avenue to Ryefield Point, Barnstable/Mashpee	Pathogens
Falmouth Inner Harbor	Falmouth	Pathogens
Great Harbor	Falmouth	Pathogens
Little Harbor	Falmouth	Pathogens
Moonakis River	Falmouth	Nutrients, Organic enrichment/low dissolved oxygen
Waquoit Bay	Falmouth	Nutrients, Organic enrichment/low dissolved oxygen, Pathogens
Saquatucket Harbor	Harwich	Pathogens
Provincetown Harbor	Provincetown	Pathogens
Wellfleet Harbor	Wellfleet	Pathogens
Lewis Bay	Yarmouth	Pathogens

All freshwaters in Massachusetts are technically (by default) listed in 1998 as 303(d) waters with mercury as the associated pollutant/stressor due to the 1994 MDPH Interim Freshwater Fish Consumption Advisory (MDPH 1994). This fish consumption advisory was aimed at pregnant women only; the general public was not considered to be at risk from fish consumption and encompassed all freshwaters in Massachusetts.

In July 2001, MDPH issued a new, more inclusive, fish consumption advisory for both fresh and salt waters in the Commonwealth (MDPH 2001). Within the last decade, the northeastern United States has been identified as receiving elevated rates of mercury deposition from the atmosphere and high levels of mercury contamination in non-commercial freshwater fish (Tatsutani 1998). Mercury is a trace metal that exists in the earth's crust. It is a toxicant that, once mobilized in the environment, can be transformed into methylmercury, a particularly toxic form that can bioaccumulate. Most of the mercury contamination in the northeastern United States has been linked to air emissions (incinerators, fossil fuel combustion facilities) from both local and mid-western sources.

Currently there are MDPH site-specific fish consumption advisories for the following nine waterbodies in the Cape Cod Watershed because of elevated levels of mercury (MDPH 2002): Ashumet Pond, Hamblin Pond, Johns Pond, Mashpee-Wakeby Pond, Peters Pond, Sheep Pond, Snake Pond, and Lake Wequaquet. Details on each advisory are described below.

Ashumet Pond (Mashpee/Falmouth, Segment MA96004):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume largemouth bass from Ashumet Pond in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of largemouth bass from Ashumet Pond to two meals per month."

Hamblin Pond (Barnstable, Segment MA96126)

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Hamblin Pond in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of smallmouth bass from Hamblin Pond to two meals per month."

Johns Pond (Mashpee, Segment MA96157):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from John's Pond in order to prevent exposure of developing fetuses and young children to mercury."
2. "The general public should not consume any smallmouth bass caught from John's Pond."
3. "The general public should limit consumption of non-affected fish species from John's Pond to two meals per month."

Mashpee-Wakeby Pond (Mashpee/Sandwich, Segments MA96194 and MA96346):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Mashpee-Wakeby Pond in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of smallmouth bass from Mashpee-Wakeby Pond to two meals per month."

Peters Pond (Sandwich, Segment MA96244):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Peters Pond in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of smallmouth bass from Peters Pond to two meals per month."

Sheep Pond (Brewster, Segment MA96289)

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from Sheep Pond in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of all fish from Peters Pond to two meals per month."

Snake Pond (Sandwich, Segment MA96302):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from Snake Pond in order to prevent exposure of developing fetuses and young children to mercury."
2. "The general public should not consume smallmouth bass caught from Snake Pond."
3. "The general public should limit consumption of non-affected fish species from Snake Pond to two meals per month."

Lake Wequaquet (Barnstable, Segment MA96333)

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume largemouth bass from Lake Wequaquet in order to prevent developing fetuses and young children to mercury."
2. "The general public should limit consumption of largemouth bass from Lake Wequaquet to two meals per month."

SOURCES OF INFORMATION

Multiple local, state and federal agencies provided the information used in the water quality assessment of the Cape Cod Watershed. Within the Department of Environmental Protection (MA DEP) information was obtained from the Bureau of Resource Protection (BRP, see below). Specifically, baseline lake survey data were provided by MA DEP BRP Division of Watershed Management (DWM) Watershed Planning Program. Water withdrawal and wastewater discharge permit information was provided by the DWM Watershed Permitting Program (Water Management Act, and National Pollutant Discharge Elimination System), the MA DEP Southeast Regional Office Cape Cod Watershed Team, and EPA – New England, Region 1. [Note: The BRP DWM Drinking Water Program evaluates the status of the *Drinking Water Use* and this information is, therefore, not provided in this assessment report.] Projects funded through various MA DEP grant and loan programs also provide valuable information that may be used in the water quality assessment report. A summary of these projects for Cape Cod is provided in Appendix D.

Other state agencies contributing information to this report include: the Massachusetts Department of Public Health (MDPH), the Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE), and the Department of Environmental Management (MA DEM). Federal agencies contributing include: the EPA and United States Geological Survey (USGS).

The National Shellfish Sanitation Program (NSSP) includes federal and state governments cooperatively administering a battery of public health regulations designed to assure the sanitary integrity of shellfish and shellfish products (ISSC 2000). A key regulatory role assigned to coastal states by the NSSP is shellfish classification. According to methods, procedures and standards set forth in the NSSP *Guide For The Control Of Molluscan Shellfish*, a designated state agency must determine whether shellfish from coastal growing waters are safe or may be made safe for human consumption. The determination is based, in large part, upon the presence of fecal coliform bacteria within the growing waters.

In Massachusetts, the Division of Marine Fisheries (DMF) Shellfish Management Program maintains information used to classify (e.g., approved, conditionally approved, prohibited, etc.) their shellfish management areas (DFWELE 2000). These classifications are subsequently used to regulate the harvesting of various shellfish. DMF shellfish management areas include acreage in the Cape Cod Watershed not specifically designated as a segment in this report. Appendix E includes the complete listing of DMF shellfishing closures as of July 2000 in the Cape Cod Watershed.

DMF achieves public health protection as a result of their sanitary surveys of shellfish growing areas to determine each area's suitability as shellfish sources for human consumption (DFWELE 2002b). "The principal components of a sanitary survey include: 1) an evaluation of pollution sources that may affect an area; 2) evaluation of hydrographic and meteorological characteristics that may affect distribution of pollutants; and 3) an assessment of water quality." These surveys also include shellfish species identification, habitat location, relative abundance and documentation of related fisheries (Kennedy 2001). Supplementary analysis may be required for naturally occurring pathogens (e.g., *Vibrio* spp.), marine biotoxins (e.g., Paralytic Shellfish Poisoning) as well as hazardous wastes in growing areas with a known history of contamination by these harmful substances.

"Each growing area must have a complete sanitary survey every twelve years, a triennial evaluation every three years and an annual review in order to maintain a classification, which allows shellfish harvesting (DFWELE 2002b). Minimum requirements for sanitary surveys, triennial evaluations, annual reviews and annual water quality monitoring are established by the Interstate Shellfish Sanitation Conference (ISSC) and set forth in the NSSP. Each year water samples are collected at 2,320 stations in 294 growing areas in Massachusetts's coastal waters at a minimum frequency of five times while open to harvesting. Water and shellfish samples are tested for fecal coliform bacteria at two *MarineFisheries* laboratories located in Gloucester and Pocasset using a Most Probable Number method for classification purposes and a membrane filtration technique (usually M-tec) for pollution source identification." A growing area classification may be downgraded and management plans amended, based on the findings of annual and triennial reviews (Kennedy 2001). Classification upgrades can only be made based on the findings of a full sanitary survey.

The Cape Cod Watershed receives discharges of treated wastewater, contact and non-contact cooling water, etc. (Appendix E, Tables E1 and E2). The following types of National Pollutant Discharge Elimination System (NPDES) surface water discharges occur in the watershed:

- *Power Plants*: There is one major power generation facility located on Cape Cod. Canal Electric (NPDES Permit MA0004928) operates a 565 megawatt oil and gas-fired power generating unit (Babcock 2002). Although this facility is located in Sandwich, MA, the effluent discharge is to Cape Cod Canal, which is assessed as part of the Buzzards Bay Watershed.

- *Industrial and non-process discharges*: The Lobster Trap Company (NPDES Permit MA0029092) in Bourne is a fish processing operation. They operate under a permit issued in 1998 to discharge not more than 7456 gallons per day. Effluent limits are in place for pH, fecal coliform bacteria, total suspended solids, and biological oxygen demand (EPA 2002).

  Canal Marine (NPDES Permit MA0004979) has not been issued a permit since 1975 when they were permitted to discharge up to 144,000 gallons per day. EPA is currently working with the facility to submit a Notice for Intent for non-contact cooling water (Barden 2002b). Although this facility is located in Sandwich, MA, the effluent discharge is to Cape Cod Canal, which is assessed as part of the Buzzards Bay Watershed.

- *Institutional Discharges*: There is one permitted facility that discharges domestic wastewater in the Cape Cod Watershed. The Henry T. Wing School (NPDES Permit MA0101656) located in the town of Sandwich discharges wastewater after on-site treatment to Dock Creek, which flows north to Cape Cod Bay. However, the system is not compliant with MA DEP's Title V standards. An engineering firm has been contracted by the Town of Sandwich to plan a new septic management strategy in which the effluent discharge will be changed from surface water to groundwater (McFarden 2002).

- *Aquaculture and Fish Hatcheries*: There are several aquaculture and fish hatchery facilities in the Cape Cod Watershed. Aquaculture Research Corporation in Dennis (NPDES Permit MA0005576) is currently a shellfish production facility. The company also "bleeds" horseshoe crabs (Barden 2002a). Limulus Amebocyte Lysate (LAL), a product produced from the blood of horseshoe crabs, is used by the medical industry to test products for the presence of endotoxin, a bacterial substance that can be fatal to humans. Horseshoe crab blood extracts are also being tested for use in cancer therapy agents, leukemia diagnosis research and for detecting vitamin B_{12}-related deficiencies and diseases (ERDG 2002). For more information relevant to permit considerations, please refer to the Chase Garden Creek (Segment MA96-35) Assessment in this report.

  The Commonwealth of Massachusetts, Division of Fisheries and Wildlife operates the Sandwich State Fish Hatchery (NPDES Permit MA0110027) where up to 100, 000 pounds of trout are produced annually to be stocked into the State's public waters for recreational fishing. The hatchery is permitted to discharge up to 1.6 million gallons of wastewater per day to Dock Creek, which flows north to Cape Cod Bay. The trout are produced for stocking in public waters of the Commonwealth

of Massachusetts. The facility consists of two main operations, the indoor hatch house and the outdoor raceways. The hatch house is an enclosed room with 14 throughs. Water supplied to the hatch house is from four groundwater wells located on the hatchery property. This assures high quality, cool water. Certified disease-free eggs are placed in fiberglass trays for hatching. Once the eggs hatch and they are large enough, they swim out of the tray and into the tanks. Fry are contained in the tanks with fine mesh screens located on the base of the tank. They are kept in the hatch house until they reach fingerling size. Feeding is done by hand or by use of a battery-operated feeder using a floating feed. Wastewater from the hatch house is then typically goes through the hatchery pools/raceways. The main hatchery activity is outside and consists of 6 raceway series. The water level in each pool is maintained by a set of flash boards located on the downstream side of the raceway. Upstream of each set of flash boards is a screen that contains the fish within the pool, the screen also traps large objects and some of the solids in the pool. A quiescent zone is located between the screen and the flash boards of every other pool. Since there are no fish or other sources of turbulence in the quiescent zone, most of the solids produced by the fish settle out in this area. Any remaining solids are pumped and land applied on the adjacent grassy areas away from any surface water. The last raceway in the hatchery complex is used as a settling basin prior to discharge to Dock Creek. The fish are held at the hatchery for 18 months to 2 years. According to hatchery officials, the key to maintaining good fish health is to prevent disease from entering the hatchery and to maintain clean, healthy raceways (EPA 2001a).

Woods Hole Oceanographic Institution maintains the Environmental Systems Laboratory in Falmouth (NPDES Permit MA0005916). The facility sustains a variety of marine species for scientific research and study. Due to the research driven nature of the facility, the specifics of activities are subject to periodic modification and change. This permit is for the discharge of approximately 0.72 million gallons per day (MGD) and 500 gallons per minute (gpm) of salt water, which has been circulated through a series of culturing tanks and raceways. Salt water is supplied through parallel intakes located 420 feet and 520 feet offshore in Vineyard Sound. Approximately, 432,000 gallons (300 gpm) of salt water is pumped through a sand filter. The remaining 288,000 gallons (200 gpm) is untreated and is used as raw, ambient salt water which is required for some experiments. Of the filtered salt water, 144,000 gallons (100 gpm) are heated or cooled, dependent on influent water conditions, to 20°, 14° and 10° Celsius. The amount of water conditioned to each specific temperature is variable and difficult to measure. All of the water from the various activities is discharged to a settling basin and then ultimately back to Vineyard Sound. The discharge location is adjacent to the intakes, but is 220 feet offshore at a depth of 8.5 feet below mean low water. In the past, the effluent was chlorinated prior to discharge to the settling pond. The disinfection was necessary because at that time the facility was culturing a non-indigenous species, sea hares (*Aplysia Californica*). The permit issued during that operation had a total residual chlorine limit of 1.0 mg/L maximum daily. The sea hares project ended by December 1989. However, chlorination continued until January 1999, it was then discontinued at the direction of EPA (EPA 2001b).

A list of registered and permitted Water Management Act (WMA) withdrawals (both public water suppliers and other industrial users) is provided in Appendix C, Table C2 (LeVangie 2001). Registration and permit files (both public water suppliers and other industrial users) were reviewed to determine where stream segments might be affected by water withdrawal activities. The information is summarized in the segments where the withdrawals occur.

In addition to state and federal agencies, regional and local groups provide information for the watershed management process which may be used to indicate areas of both high and degraded water quality as well as causes and sources of contamination.

The Town of Orleans and citizen volunteers from the Orleans Water Quality Task Force requested and obtained grant funding from the Massachusetts Department of Environmental Management Lake and Pond Grant Program for Crystal Lake. The scope of work included a baseline water quality assessment, sediment analyses, wetland and aquatic plant surveys, a septic system survey and phosphorus loading assessment, and the development of an outline for a Draft Lake Management Plan for Crystal Lake. This lake monitoring study has provided valuable data on the trophic state of Crystal Lake and includes

recommendations for enhancing the health of this water body. The data was collected from May to August 2000 and presented in a final report in January 2001 (Town of Orleans, 2001).

MADEP and the EPA commissioned a project focusing on the nutrification (nitrogen) of Cape Cod coastal embayments (CCC 1996). The Cape Cod Commission, under the direction of Armando Carbonell, produced a report addressing this concern. The report assessed the effects of current and potential future nitrogen loads to nine embayments. Those embayments are: Round Cove, Allens Harbor, Saquatucket Harbor, Wychmere Harbor, Popponesset Bay, the Three Bay System (Yarmouth, Dennis, and Brewster), and the Nauset Marsh Estuary System. The four step process of assessment included: the delineation of each embayment's watershed, a "flushing" study of the water retention time within each embayment, an evaluation of the current and future steady state nitrogen loads to each embayment, and the development of management strategies for each embayment.

Although data were not available for use in this report, two studies useful to water quality interests on Cape Cod are *The Massachusetts Estuaries Project* (MA DEP 2002b) and *The Cape Cod Pond and Lakes Stewardship Project* (CCC 2002). "MA DEP and the UMASS/Dartmouth School of Marine Science and Technology (SMAST) are stepping up a collaborative project with Coastal Zone Management, the Cape Cod Commission and several municipalities to classify the nitrogen sensitivity of southeastern Massachusetts's coastal bays and estuaries in the Massachusetts Estuaries Project (MADEP 2002b). SMAST technical experts will work with MA DEP to evaluate the nitrogen sensitivity through comprehensive water quality testing, quantitative TMDL modeling, and preparation of technical reports allowing communities to consider how implementation of nitrogen management scenarios within watersheds will influence water quality in embayments. The major project goals are to: (1) develop a coastal TMDL working group for coordination and rapid transfer of results, (2) determine the nutrient sensitivity of each of the 89 embayments in southeastern Massachusetts, (3) provide necessary data collection and analysis required for quantitative modeling, (4) conduct quantitative TMDL analysis, outreach, and planning, and (5) keep each embayment's model "alive" to address future regulatory needs (MA DEP 2002c)."

"The Estuaries Project is comprised of four phases relating to project design, project development, implementation of approach, and application of management models to on-going management issues (MA DEP 2002c). The project phases are further described as: *Phase I* - Assemble a working group, design the project organizational framework, evaluate existing management models and select appropriate approach for regional implementation, and survey existing data sources with regard to potential to support selected approach; *Phase II* - Determine the prioritization procedure and select initial embayments, promote water quality data collection in embayments with insufficient baseline data, educate local stakeholders as to Project goals, approach, results and data needs and complete the assessment of existing data and data gaps. Also, establish necessary regulatory stakeholder committees and increase the analytical capability of the Project Team relative to collection of field data needed to support the management approach; *Phase III* - Implement embayment management approach on a 2-year cycle, which includes field data collection, modeling, reporting, and a significant level of public outreach. Year 1 focuses on site-specific data collection to fill data gaps, Year 2 focuses on modeling, synthesis, and evaluation of management options; *Phase IV* - Keep quantitative models and embayment specific management approaches "alive" for future DEP and other management/planning needs and to provide a platform (upon request) for tracking embayment changes."

"Rapid land development, wastewater, fertilizer runoff, metals, pesticides, and herbicides currently threaten the water quality of more than 400 kettle hole ponds and lakes on Cape Cod (CCC 2002). Recognizing the vital importance of these water resources to the region, the Cape Cod Commission formed a partnership with the Association for the Preservation of Cape Cod, the Compact of Cape Cod Conservation Trusts, the School of Marine Science and Technology at the University of Massachusetts-Dartmouth, and the Waquoit Bay National Estuarine Research Reserve to join *The Cape Cod Pond Stewardship Project*. The Massachusetts Executive Office of Environmental Affairs awarded a $30,000, two-year Watershed Initiative Grant to the Cape Cod Commission to fund the project. The Cape Cod Pond Stewardship Project will develop a new pond atlas and database, and citizen volunteers will help monitor the health of the region's ponds. One goal is to increase the knowledge base of pond associations. Citizen groups can enhance their watershed stewardship by making real environmental, recreational, and

open space improvements. A part of the project was a Cape-wide water quality sampling effort which was conducted in the summer of 2001 (Cambareri 2002). This monitoring consisted of secchi measurements in over 100 ponds by newly recruited Pond and Lake Stewards (PALS) and water quality sampling and dissolved oxygen profiling on over 180 ponds. The laboratory analysis was provided by the School of Marine Science and Technology of UMASS-Dartmouth, as a result of legislation filed by Henri Rauschenbach. The sampling was coordinated by the Cape Cod Commission with local organizers and a number of PALS. This information will be integrated into the Cape Cod Ponds Atlas that the Cape Cod Commission is preparing."

TOTAL MAXIMUM DAILY LOADS (TMDLs)

As part of the Federal Clean Water Act states are required to develop TMDL reports for lakes, rivers, and coastal waters not meeting the states surface water quality standards as indicated by the states 303(d) List of impaired waters. A TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet standards. Further information on the 303(d) List and the TMDL program are available on the MA DEP website at: http://www.state.ma.us/dep/brp/wm/tmdls.htm. There are 10 ponds in the Cape Cod Watershed on the Massachusetts 1998 303(d) List for which the causes of impairment include: noxious aquatic plants, nutrients, organic enrichment/low dissolved oxygen and pathogens (Table 3). Water quality monitoring was conducted in five of these lakes in 1999: Lower Mill Pond (MA96188), Ryder Pond (MA96268), Santuit Pond (MA96277), Upper Mill Pond (MA96324), and Walkers Pond (MA96331)

Baseline lake surveys for the development of TMDL reports included the preparation of a bathymetric map (if not already available), mapping of aquatic vegetation, secchi disc depth readings, in-situ water quality profile measurements (i.e. temperature, pH, dissolved oxygen, percent saturation, specific conductivity) at one or more stations, water quality sampling for total phosphorus analysis at MA DEP's Wall Experiment Station, algae (phytoplankton) counts and chlorophyll *a* determinations. Each of the ponds was visited on two separate occasions during the summer of 1999.

The single draft TMDL report for total phosphorus, which is being developed for these lakes, has been delayed until the C*ranberry Bog Phosphorus Dynamics TMDL Project* (DeMoranville, 2001) has been completed (Mattson, 2002). Additionally, MA DEP will need to produce a TMDL report for any remaining lakes and estuaries on the 303(d) List. This work is not specifically scheduled yet.

OBJECTIVES

This report summarizes information generated in the Cape Cod Watershed through *Year 1* (information gathering in 1998) and *Year 2* (environmental monitoring in 1999) activities established in the "Five-Year Cycle" of the Watershed Initiative. Data collected by DWM in 1999 are provided in Appendices A and B of this report. Together with other sources of information (identified in each segment assessment) these data were used to assess the status of water quality conditions of estuaries and lakes in the Cape Cod Watershed in accordance with EPA's and MA DEP's use assessment methods. Not all waters in the Cape Cod Watershed are included in the MA DEP/EPA WBS database or this report.
The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Cape Cod Watershed, defined as segments in the WBS database, currently support their designated uses (i.e., meet surface water quality standards),
2. identify water withdrawals (habitat quality/water quantity) and/or major point (wastewater discharges) and nonpoint (land-use practices, storm water discharges, etc.) sources of pollution that may impair water quality conditions,
3. identify the presence or absence of any non-native macrophytes in lakes,
4. identify waters (or segments) of concern that require additional data to fully assess water quality conditions,
5. recommend additional monitoring needs and/or remediation actions in order to better determine the level of impairment or to improve/restore water quality, and
6. provide information to the Cape Cod Watershed Team for use in its annual and 5-year watershed action plans.

REPORT FORMAT

ESTUARIES AND LAKES

The estuarine segments (Figure 4) in this assessment report are presented numerically by the segment Waterbody Identification Number (WBID). The assessed lakes (Figure 5), identified with their WBID code numbers and trophic status (Table 4), are listed alphabetically in the Lake Assessment Section of this report. The location, acreage, use assessments, and causes of impairment are then summarized for each individual lake in Table 5. Each estuarine segment summary is formatted as follows:

Segment identification

Name, waterbody identification number (WBID), location, size, classification.

Sources of information: EPA's Waterbody System Database, Massachusetts SWQS (MA DEP 1996), and USGS topographical maps.

Segment description

Major land-use estimates (the top three uses for the recharge area).

Sources of information: Geographic data from Massachusetts Geographic Information System (MassGIS) data layers, land use statistics from a geographic information system analysis using the MassGIS land use coverage developed at a scale of 1:25,000 and based on aerial photographs taken in 1990 (UMass Amherst 1999), descriptive information from USGS topographical maps.

Cranberry Bog Cultivation (O'Shea 2002):

For the purpose of this report, water use for cranberry cultivation within the recharge area has been estimated by using a volume of 10 acre-feet of water per acre of bog per year (1 acre-foot = 325,900 gallons). The acreage of cranberry bog within the recharge area has been estimated by using the MassGIS layer for Open Space – Cranberry Bogs. The figure of 10 acre-feet of water per acre of bog per year is based on a study conducted by the Cape Cod Cranberry Growers Association for the Massachusetts Water Management Act Program. It should be noted that this figure is used for "old style" bogs, those bogs that do not employ best management practices (BMPs) that conserve water. Most bogs constructed today, and many renovated older bogs, use BMPs, such as laser leveling, on-site reservoirs, tailwater recovery, etc., which result in reduced water usage (between 5 and 6 acre-feet of water per acre of bog per year). Therefore, the estimate of water usage within the subwatershed for cranberry cultivation is a conservative number.

Segment locator map

Estuary segment locations, recharge areas (gray shaded) and other geographic data.

Sources of information: Estuary segments and other geographic data from MassGIS data layers, recharge areas from Cape Cod Marine Water Recharge Areas Data layer (Barabe 1996 and CCC August 1996).

Water withdrawals and wastewater discharge permit information

Water withdrawal and NPDES wastewater discharge summaries.

Sources of information: WMA Database Printout (LeVangie 2001), WMA open permit files located in Lakeville MA DEP office (MA DEP 2001b), NPDES open permit files located in Worcester MA DEP office (MA DEP 2001c) and in EPA Boston office (Barden 2002a and Barden 2002b).

Use assessment

Aquatic Life, Fish Consumption, Shellfishing, Primary Contact, Secondary Contact, and Aesthetics.

Sources of information: MA DEP DWM 1999 Survey data (Appendix B). The MDPH Freshwater Fish Consumption Advisory Lists (MDPH 1994, MDPH 2001 and MDPH 2002) were used to assess the *Fish Consumption Use*. The DMF shellfish status report and bacteria data were used to assess the *Shellfishing, Primary and Secondary Contact Recreational* uses. Where other sources of information were used to assess designated uses, citations were included in the segment summary.

Use Summary Table

Uses, status, causes and sources of impairment

CAPE COD WATERSHED – ESTUARY SEGMENT ASSESSMENTS

The following estuary segments in the Cape Cod Watershed are included in this report.

Segment Number	Segment Name	Segment Number	Segment Name
MA96-01	Barnstable Harbor	MA96-20	Quashnet River
MA96-02	Bumps River	MA96-21	Waquoit Bay
MA96-03	Centerville Harbor	MA96-22	Herring River
MA96-04	Centerville River	MA96-23	Saquatucket Harbor
MA96-05	Hyannis Harbor	MA96-24	Mashpee River
MA96-06	Maraspin Creek	MA96-25	Red Brook
MA96-07	Prince Cove	MA96-26	Little Namskaket Creek
MA96-08	Shoestring Bay	MA96-27	Namskaket Creek
MA96-09	Quivett Creek	MA96-28	Nauset Harbor
MA96-10	Chatham Harbor	MA96-29	Provincetown Harbor
MA96-11	Stage Harbor	MA96-30	Scorton Creek
MA96-12	Bass River	MA96-31	Pamet River
MA96-13	Sesuit Creek	MA96-32	Duck Creek
MA96-14	Swan Pond River	MA96-33	Herring River
MA96-15	Boat Meadow River	MA96-34	Wellfleet Harbor
MA96-16	Rock Harbor Creek	MA96-35	Chase Garden Creek
MA96-17	Falmouth Inner Harbor	MA96-36	Lewis Bay
MA96-18	Great Harbor	MA96-37	Mill Creek
MA96-19	Little Harbor	MA96-38	Parkers River

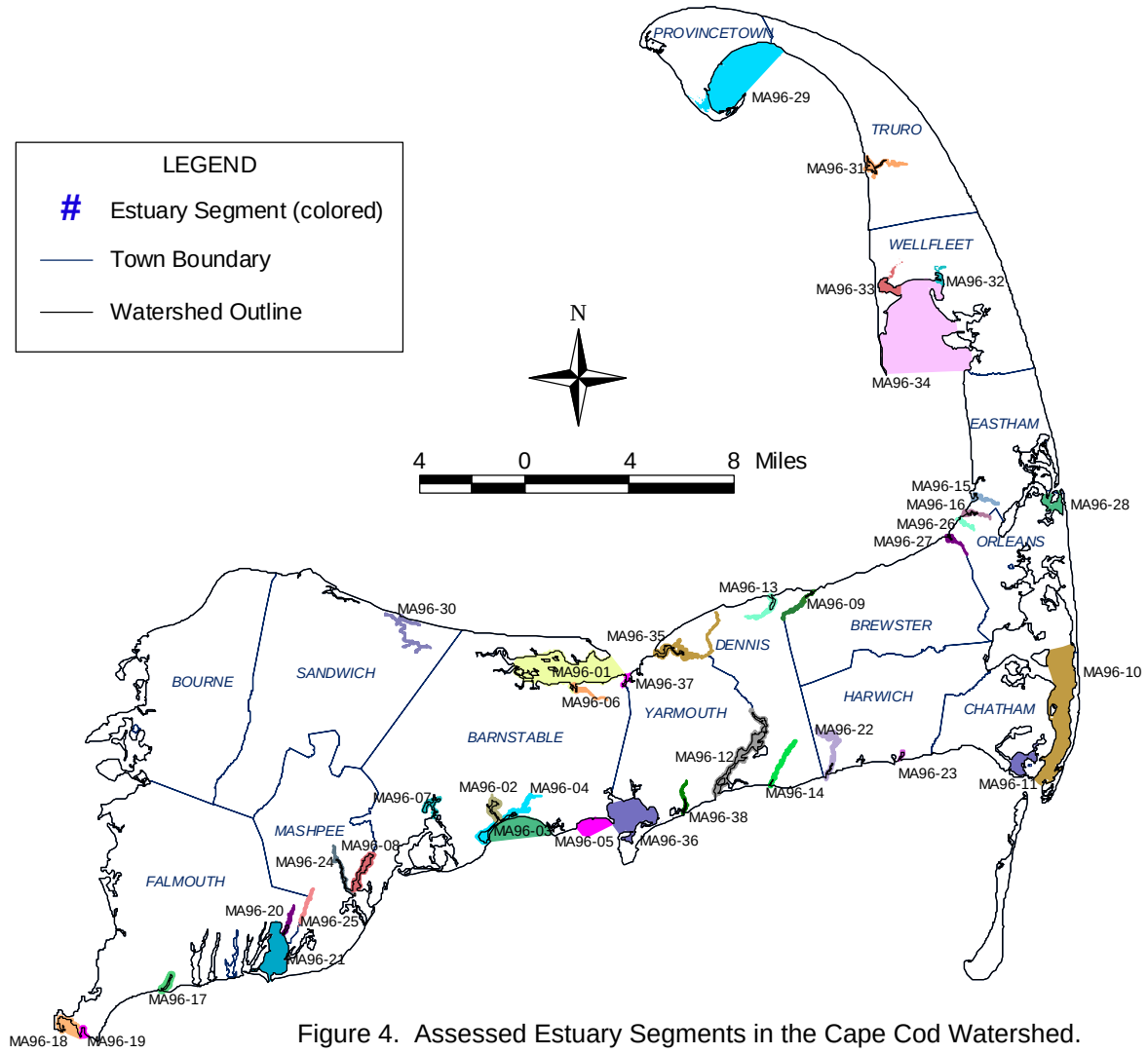
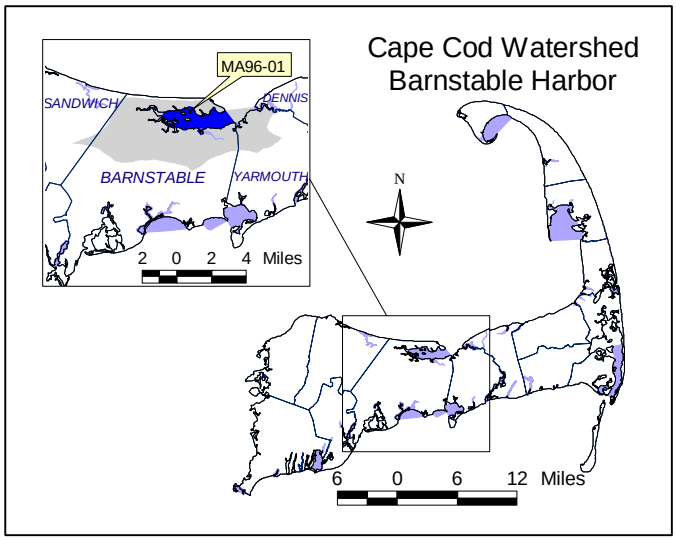


Figure 4. Assessed Estuary Segments in the Cape Cod Watershed.

BARNSTABLE HARBOR (SEGMENT MA96-01)

Location: From the mouths of Scorton and Spring Creeks east to an imaginary line drawn from Beach Point to the western edge of the Mill Creek estuary, Barnstable.
Segment Area: 2.56 square miles
Classification: Class SA, ORW



Land-use estimates (top 3, excluding water) for the recharge area of Barnstable Harbor (map inset, gray shaded area):

Forest	34%
Wetlands	26%
Residential	21%

The use assessment of Long Pond (MA96182), which is located in the recharge area for Barnstable Harbor, is provided in the Lakes Assessment section of this report.

A general access concrete boat ramp and parking for boat trailers (managed by the Town of Barnstable) is available at Blish Point in Barnstable Harbor.

There are 107.425 acres of cranberry bog open space in the Barnstable Harbor recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.959 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	Public Water Supply (PWS) ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Barnstable Fire District	4020000	9P242202001	42202015	4020000-01G (G) 4020000-03G (G) 4020000-04G (G)	0.34[2] reg 0.32[2] perm Total - 0.66[2]	0.51	0.58	0.56
Yarmouth Water Dept.	4351000	9P42235101	42235106	4351000-01G (G)	3.03[2] reg 1.92[2] perm Total – 4.95[2]	3.54	4.08	3.71
Iyanough Hills Golf Course[1]	NA	NA	42202022	Iyanough Hills Golf Course Well (G)	0.1[2]	0.14[3]	0.12[3]	0.06
Cummaquid Golf Club[1]	NA	NA	42235102	Well #2 (G) Well #3 (G)	0.1[2]	0.06	0.13[3]	0.01

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB31.0 (which includes 2.05mi^2 of this segment) and CCB31.20 (0.03mi^2) are approved; areas CCB31.1 (which includes 0.28mi^2 of this segment), CCB31.2 (0.09mi^2) and CCB33.0 (which includes 0.1mi^2 of this segment) are conditionally approved; and area CCB32.0 (which includes 0.01mi^2 of this segment) is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 2.08mi^2, partial support for 0.47mi^2, and non-support for 0.01mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from eight stations in Barnstable Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 63 cfu/100mL with a total of 280 samples collected of which 162 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for 2.55mi^2 of this segment. The additional 0.01mi^2 of this segment (DMF's shellfish growing area CCB32.0) described as an estuarine area west of Maraspin Creek and between Rendezvous Lane and Freezer Road, Barnstable is not assessed for these same uses.

BARNSTABLE HARBOR (MA96-01) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 2.08mi^2, PARTIAL SUPPORT 0.47mi^2, NON-SUPPORT 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT 2.55mi^2, NOT ASSESSED 0.01mi^2				
Secondary Contact		SUPPORT 2.55mi^2, NOT ASSESSED 0.01mi^2				
Aesthetics		NOT ASSESSED				

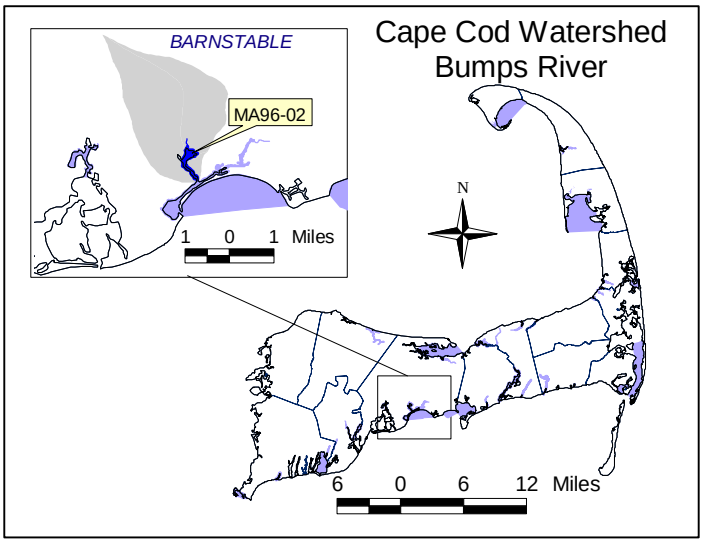
BUMPS RIVER (MA96-02)

Location: From outlet of pond at Bumps River Road through Scudder Bay to South Main Street bridge (confluence with Centerville River), Barnstable.
Segment Area: 0.1 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area of Bumps River (map inset, gray shaded area):

Residential	59%
Forest	28%
Open Land	6%

Bumps River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessment of Shubael Pond (MA96293), which is partially located in the recharge area for Bumps River, is provided in the Lakes Assessment section of this report.



There are 53.64 acres of cranberry bog open space in the Bumps River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.479 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Centerville-Osterville Water Dept	4020002	9P42202001	42202001	4020002-03G (G) 4020002-05G (G) 4020002-09G (G) 4020002-10G (G)	1.98[2] reg 1.59[2] perm Total – 3.57[2]	2.69	3.01	2.55

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC25.0 (0.03mi^2) is restricted and area SC25.1 (which includes 0.07mi^2 of this segment) is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.03mi^2 and non-support for 0.07mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between November 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from four stations in Bumps River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 312 cfu/100mL with a total of 77 samples collected of which 47 were collected during the primary contact recreation season (1 April through 15 October).

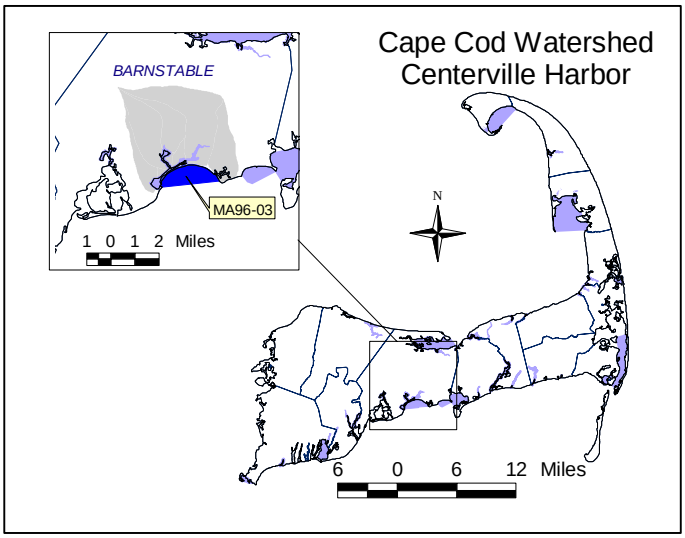
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

BUMPS RIVER (MA96-02) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.03mi^2, NON-SUPPORT 0.07mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

CENTERVILLE HARBOR (SEGMENT MA96-03)

Location: From an imaginary line that extends from Dowses Beach to Hyannis Point including all waters north to the shore, Barnstable.
Segment Area: 1.44 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Centerville Harbor (map inset, gray shaded area):

Residential	55%
Forest	22%
Open Land	6%

Bearse Pond (MA96012), Lake Elizabeth (MA96080), Red Lily Pond (MA96157), Long Pond (MA96184), Shallow Pond (MA96285), and Wequaquet Lake (MA96333) are located in the recharge area for Centerville River, which drains to this segment. The use assessments for these lakes are provided in the Lakes Assessment section of this report.

There are 61.025 acres of cranberry bog open space in the Centerville Harbor recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.545 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Centerville-Osterville Water Department	4020002	9P42202001	42202001	4020002-04G (G) 4020002-07G (G) 4020002-08G (G)	1.98[2] reg 1.59[2] perm Total – 3.57[2]	2.69	3.01	2.55
Barnstable Water Company	4020004	9P42202004	42202013	4020004-01G (G) 4020004-03G (G) 4020004-06G (S) 4020004-12G (G)	2.71[2] reg 0.71[2] perm Total – 3.42[2]	2.94	2.72	2.49
Hyannisport Club[1]	NA	NA	42202008	Golf Course Pond (S)	0.1 reg	U	0.13[3]	0.08

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; U = unknown (no metered withdrawal data available); [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

The recharge area for Centerville River is included as part of the recharge area for Centerville Harbor. See Segment MA96-04, Centerville River, for a list of water withdrawals that may also apply to this segment.

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. However, the Town of Barnstable is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

Additionally there is a self-service pump-out trailer unit located at the Oyster Harbor Marina, with a holding capacity of 250 gallons providing access for vessels up to 50 feet in length and a draft of four feet at mean low water (EPA, 29 November 2001). This facility is available daily from June 15 through September 15 from approximately 0800 to 1700 (8am to 5pm). A second pump-out facility is a pump-out boat operated by the Harbormasters Office, and docked at the Oyster Harbor Marina when not in use. The boat has a holding capacity of 300 gallons. The pump-out boat is available Wednesday through Sunday from 0930 to 1630 (9:30am to 4:30pm) from Memorial Day to Thanksgiving. The pump-out boat is accessible by VHF marine radio via Channel 9 and by calling the Oyster Harbor Marine and Environmental Affairs Division in Barnstable. The waste from the pump-out boat is off loaded to the trailer unit then transported to the Barnstable Water Pollution Control Facility. The Barnstable Board of Health issues a waste permit for this disposal.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC18.0, which includes this entire segment, is approved.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

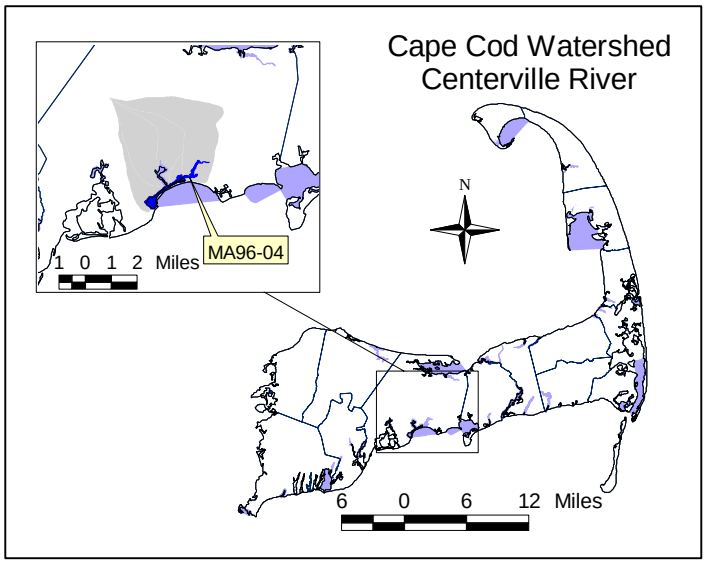
Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

CENTERVILLE HARBOR (MA96-03) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

CENTERVILLE RIVER (SEGMENT MA96-04)

Location: From headwaters in wetland west of Strawberry Hill Road to confluence with Centerville Harbor, including East Bay, Barnstable.
Segment Area: 0.3 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Centerville River (map inset, gray shaded area):

Residential	52%
Forest	21%
Open Land	4%

Centerville River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Bearse Pond (MA96012), Lake Elizabeth (MA96080), Red Lily Pond (MA96157), Long Pond (MA96184), Shallow Pond (MA96285), and Wequaquet Lake (MA96333), which are located in the recharge area for Centerville River, are provided in the Lakes Assessment section of this report.

There are 61.025 acres of cranberry bog open space in the Centerville River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.545 mgd.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX C, TABLE C2)

The recharge area for Bumps River is included as part of the recharge area for Centerville River. See Segment MA96-02, Bumps River, for a list of water withdrawals that may also apply to this segment.

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC24.0 (0.22mi^2) is restricted and area SC24.2 (0.08mi^2) is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.22mi^2 and non-support for 0.08mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

Between May 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from eight stations in Centerville River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 312 cfu/100mL with a total of 183 samples collected of which 122 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

CENTERVILLE RIVER (MA96-04) Use Summary Table

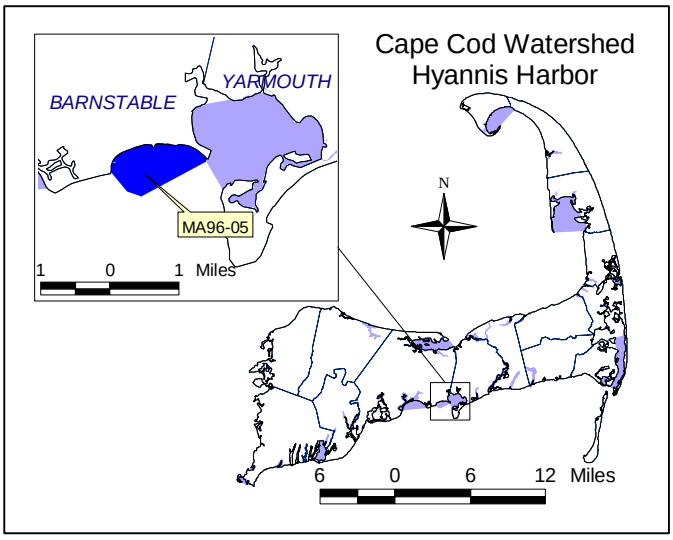
Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.22mi^2, NON-SUPPORT 0.08mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

HYANNIS HARBOR (SEGMENT MA96-05)

Location: The waters from the shoreline to an imaginary line drawn from the light at the end of Hyannis breakwater to the point west of Dunbars Point, Barnstable.
Segment Area: 0.47 square miles
Classification: Class SA

The recharge area for Hyannis Harbor has not been identified. Therefore land use estimates and cranberry bog water withdrawal information are not available.

Hyannis Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).



WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Sheraton Hyannis Resort – Twin Brooks[1]	NA	NA	V42202003	Golf Course Well (G)	0.07	U	0.06	0.03

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; U = Unknown (no metered withdrawal data available); [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas SC27.0 (which includes 0.37mi^2 of this segment) and SC27.22 (0.01mi^2) are approved and area SC27.3 (which includes 0.09mi^2 of this segment) is conditionally approved (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.38mi^2 and partial support for 0.09mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and September 2001 DMF collected dry weather fecal coliform bacteria samples from five stations in Hyannis Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 146 samples collected of which 92 were collected during the primary contact recreation season (1 April through 15 October).

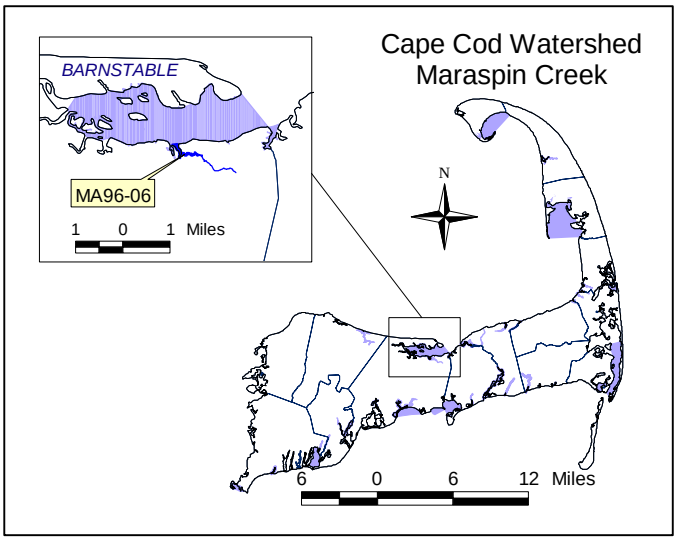
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

HYANNIS HARBOR (MA96-05) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.38mi^2, PARTIAL SUPPORT 0.09mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

MARASPIN CREEK (SEGMENT MA96-06)

Location: From headwaters just south of Route 6A to confluence with Barnstable Harbor at Blish Point, Barnstable.
Segment Area: 0.03 square miles
Classification: Class SA



The recharge area for Maraspin Creek is included as part of the recharge area for Barnstable Harbor. Land use estimates are not available for Maraspin Creek.

Maraspin Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX C, TABLE C2)

The recharge area for Maraspin Creek is included as part of the recharge area for Barnstable Harbor. See Segment MA96-01, Barnstable Harbor for a list of water withdrawals that may also apply to this segment.

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB32.0 (which includes this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

MARASPIN CREEK (MA96-06) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

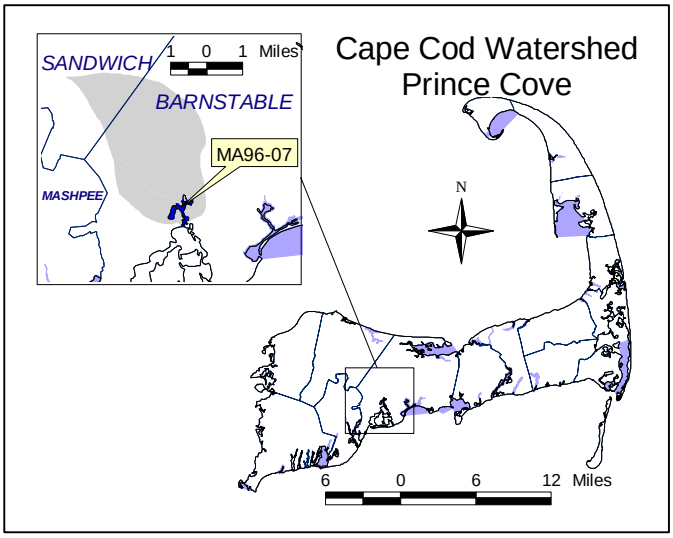
PRINCE COVE (SEGMENT MA96-07)

Location: Includes adjacent unnamed cove to mouth at Fox Island, Barnstable.
Segment Area: 0.1 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area of Prince Cove (map inset, gray shaded area):

Residential	41%
Forest	35%
Open Land	9%

Prince Cove is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Hamblin Pond (MA96126) and Shubael Pond (MA96293), which are completely or partially located in the recharge area for Prince Cove, are provided in the Lakes Assessment section of this report.



There are 237.636 acres of cranberry bog open space in the Prince Cove recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 2.122 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Centerville-Osterville Water Department	4020002	9P42202001	42202001	4020002-11G (G) 4020002-12G (G) 4020002-13G (G) 4020002-14G (G) 4020002-15G (G) 4020002-16G (G) 4020002-17G (G) 4020002-18G (G) 4020002-19G (G)	1.98[2] reg 1.59[2] perm Total – 3.57[2]	2.69	3.01	2.55
Sandwich Water District	4261000	9P242226101	42226108	4261000-08G (G) 4261000-11G (G)	0.77[2] reg 1.87[2] perm 2.64[2]	1.63[2]	0.28 0.32	1.68[2]
The Ridge Club	NA	9P42226102	NA	Ridge Club Well (G)	0.12 perm	0.1	0.12	0.07
Barnstable Municipal Golf Course[1]	NA	9P42202005	NA	Well #1 (G) Well #2 (G)	0.28[2] perm	0.07[2]	0.09[2]	0.07[2]

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Barnstable, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas SC23.1, SC23.2 and SC23.3 are conditionally approved. Portions of these growing areas comprise this entire segment.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and April 2001 DMF collected dry weather fecal coliform bacteria samples from five stations in Prince Cove as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 165 samples collected of which 30 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

PRINCE COVE (MA96-07) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

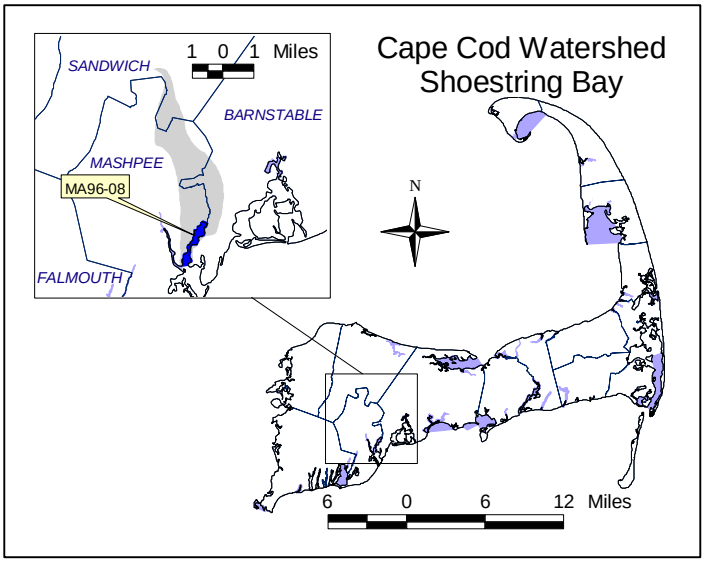
SHOESTRING BAY (SEGMENT MA96-08)

Location: Quinaquisset Avenue to Ryefield Point, Barnstable/Mashpee.
Segment Area: 0.4 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area of Shoestring Bay (map inset, gray shaded area):

Forest	43%
Residential	38%
Open Land	8%

Shoestring Bay is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessment of Santuit Pond (MA96277), which is located in the recharge area for Shoestring Bay, is provided in the Lakes Assessment section of this report.



There are 99.15 acres of cranberry bog open space in the Shoestring Bay recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.885 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Cotuit Water Department	4020003	9P42202002	42202014	4020003-04G (G) 4020003-06G (G)	0.27[2] reg 0.21[2] perm Total - 0.48[2]	0.43	0.50[3]	0.43
Mashpee Water District	4172000	9P42217202	42217201	Quaker Run Well (G)	0.14[2] reg 1.16[2] perm Total – 1.3[2]	U	0.45	U
Willowbend Development Corporation[1]	NA	9P242217201	NA	Pond (S) Well #1 (G)	0.27[2] perm	U	0.21	0.3[3]

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; U = Unknown (no metered withdrawal data available); [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Towns of Barnstable and Mashpee, however, are required to obtain Phase II general NPDES storm water permits for their municipal drainage systems. EPA is currently writing these general permits (with input from MA DEP). The drafts for public comment should be available by the end of July 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas SC20.2 and SC20.3 are prohibited. Portions of these growing areas compose this entire segment.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and March 2001 DMF collected dry weather fecal coliform bacteria samples from six stations in Shoestring Bay as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 100 samples collected of which 25 were collected during the primary contact recreation season (1 April through 15 October).

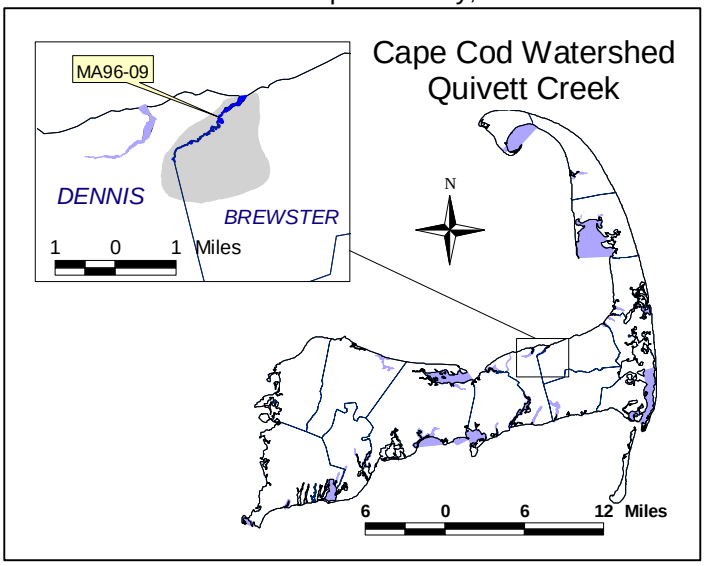
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

SHOESTRING BAY (MA96-08) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

QUIVETT CREEK (SEGMENT MA96-09)

Location: Outlet of unnamed pond just south of route 6A to the mouth at Cape Cod Bay, Brewster/Dennis.
Segment Area: 0.02 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Quivett Creek (map inset, gray shaded area):

Forest	45%
Residential	32%
Wetlands	19%

Quivett Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL SUMMARY
Based on the available information, there are no WMA regulated water withdrawals or cranberry bogs in the recharge area for Quivett Creek.

NPDES WASTEWATER DISCHARGE SUMMARY
There are no regulated wastewater discharges to this segment. The Town of Dennis, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT:

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB24.0 (which includes this entire segment) is prohibited.

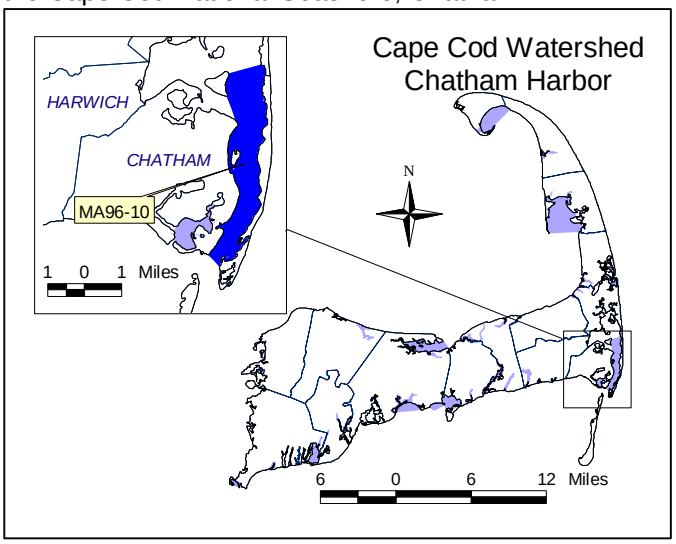
Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

QUIVETT CREEK (MA96-09) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

CHATHAM HARBOR (SEGMENT MA96-10)

Location: Harbor with northern extent as an imaginary line drawn northeast from northern tip of Strong Island to a point on the inner Cape Cod National Seashore and the western extent as an imaginary line drawn from the southern tip of Strong Island south to Allen Point including the waters south to an imaginary line drawn from Amos Point southeast to the Cape Cod National Seashore, Chatham.
Segment Area: 6.06 square miles
Classification: Class SA



The recharge area for Chatham Harbor has not been identified. Therefore land use estimates are not available.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Chatham Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas SC52.0, SC61.0, and OC1.0 are approved. Portions of these growing areas compose this entire segment.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this entire segment.

PRIMARY AND SECONDARY CONTACT RECREATION

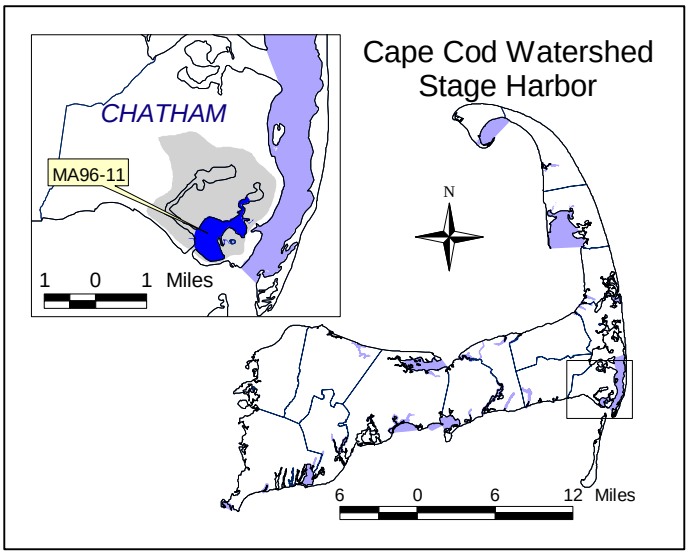
Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this entire segment.

CHATHAM HARBOR (MA96-10) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

STAGE HARBOR (SEGMENT MA96-11)

Location: The waters including Mitchell River from Mill Pond to Sears Point and Harding Beach Point, Chatham.
Segment Area: 0.86 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Stage Harbor (map inset, gray shaded area):

Residential	37%
Forest	14%
Wetlands	9%

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Stage Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC48.0 (which includes 0.81mi^2 of this segment) and area SC51.0 (which includes 0.04mi^2 of this segment) are approved and area SC48.4 (0.01mi^2) is conditionally approved.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.85mi^2 and partial support for 0.01mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and September 2001 DMF collected dry weather fecal coliform bacteria samples from six stations in Stage Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 50 cfu/100mL with a total of 169 samples collected of which 115 were collected during the primary contact recreation season (1 April through 15 October).

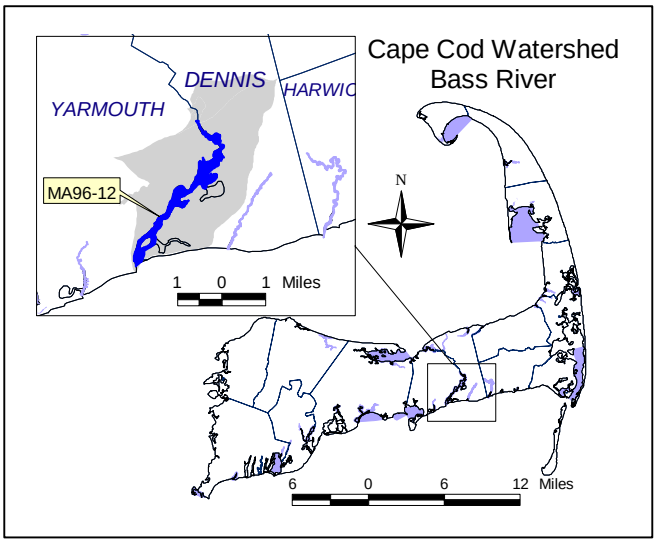
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

STAGE HARBOR (MA96-11) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.85mi^2, PARTIAL SUPPORT 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

BASS RIVER (SEGMENT MA96-12)

Location: Route 6 to mouth at Nantucket Sound, Dennis/Yarmouth.
Segment Area: 0.90 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Bass River (map inset, gray shaded area):

Residential	47%
Forest	27%
Open Land	10%

Bass River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

A general access concrete boat ramp, parking for boat trailers and a fishing pier (all managed by the Town of Yarmouth) is available off South Shore Drive and South Street at the mouth of Bass River.

Based on the available information, there are no cranberry bogs in the recharge area for Bass River (UMass Amherst, 1999).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Dennis Water District	4075000	9P42207501	42207502	4075000-01G (G) 4075000-02G (G) 4075000-03G (G) 4075000-04G (G) 4075000-05G (G) 4075000-06G (G) 4075000-07G (G) 4075000-08G (G) 4075000-09G (G) 4075000-10G (G) 4075000-11G (G) 4075000-12G (G) 4075000-13G (G) 4075000-15G (G) 4075000-16G (G) 4075000-17G (G) 4075000-19G (G) 4075000-20G (G)	2.1[2] reg 1.16[2] perm Total - 3.26[2]	2.69	3.01	2.57
Yarmouth Water Department	4351000	9P42235101	42235106	4351000-07G (G) 4351000-08G (G) 4351000-09G (G) 4351000-10G (G) 4351000-15G (G) 4351000-16G (G) 4351000-22G (G)	3.03[2] reg 1.92[2] perm Total – 4.95[2]	3.54	4.08	3.71
Davenport Realty Blue Rock G. C.[1]	NA	NA	42235101	Well (G) Cat Swamp Pond (S)	0.16[2] reg	0.19[3]	0.23[3]	0.16
Bass River Golf Course[1]	NA	NA	42235105	Turtle Pond (S) Bass River Well (G)	0.12[2] reg	0.41[4]	0.33[4]	0.32[4]

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Towns of Dennis and Yarmouth, however, are required to obtain Phase II general NPDES storm water permits for their municipal drainage systems. EPA is currently writing these general permits (with input from MA DEP). The final version of the Phase II storm water permits will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC33.1 (which includes 0.30 of this segment), area SC34.1 (which includes 0.52mi^2 of this segment), and area SC34.7R (which includes 0.07mi^2 of this segment) are conditionally approved and area SC34.3 (which includes 0.01mi^2 of this segment) is prohibited

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.89mi^2 and non-support for 0.01mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and May 2001 DMF collected dry weather fecal coliform bacteria samples from nine stations on the Bass River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 50 cfu/100mL with a total of 306 samples collected of which 105 were collected during the primary recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

BASS RIVER (MA96-12) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.89mi^2, NON-SUPPORT 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

SESUIT CREEK (SEGMENT MA96-13)

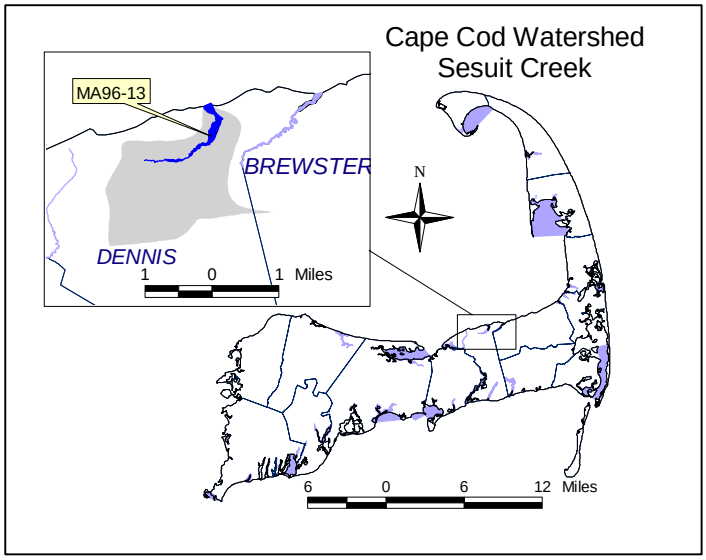
Location: From Route 6A to mouth at Cape Cod Bay, Dennis.
Segment Area: 0.06 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area (map inset, gray shaded area):

Residential	47%
Forest	26%
Open Land	10%

Sesuit Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

Based on the available information, there are no cranberry bogs in the recharge area for Sesuit Creek (UMass Amherst 1999).



WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Dennis Water District	4075000	9P42207501	42207502	4075000-18G (G)	2.1[2] reg 1.16[2] perm Total - 3.26[2]	2.69	3.01	2.57
Dennis Pines Golf Course[1]	NA	NA	42207501	Well #1 (G) Pumping Station #1 (S)	0.08[2] reg	0.09[3]	0.1[3]	0.07
Dennis Highlands Golf Course[1]	NA	NA	42207504	Well #1 (G) Pumping Station #1 (S)	0.14[2] reg	0.1	0.12	0.09

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Dennis, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB25.0 is conditionally approved. Portions of this growing area compose this entire segment.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for this entire segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and May 2001 DMF collected dry weather fecal coliform bacteria samples from four stations on Sesuit Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 90 samples collected of which 27 were collected during the primary contact recreation season (1 April through 15 October).

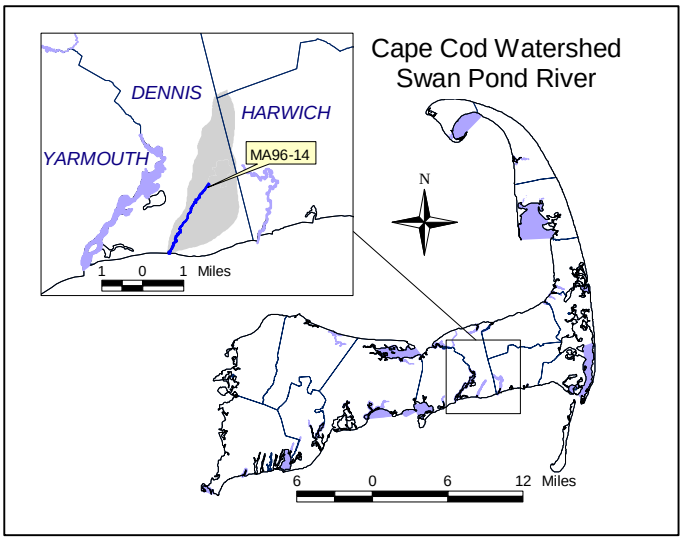
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support.

SESUIT CREEK (MA96-13) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

SWAN POND RIVER (SEGMENT MA96-14)

Location: outlet of Swan Pond to confluence with Nantucket Sound, Dennis.
Segment Area: 0.06 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Swan Pond River (map inset, gray shaded area):

Residential	42%
Forest	28%
Industrial	9%

Swan Pond River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

There are 22.343 acres of cranberry bog open space in the Swan Pond River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.199 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Dennis Water District	4075000	9P42207501	42207502	4075000-14G (G)	2.1[2] reg 1.16[2] perm Total - 3.26[2]	2.69	3.01	2.57

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Dennis, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC36.0 (which includes this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between February 1996 and February 2000 DMF collected dry weather fecal coliform bacteria samples from five stations on Swan Pond River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.8 and 51 cfu/100mL with a total of 100 samples collected of which 35 were collected during the primary contact recreation season (1 April through 15 October).

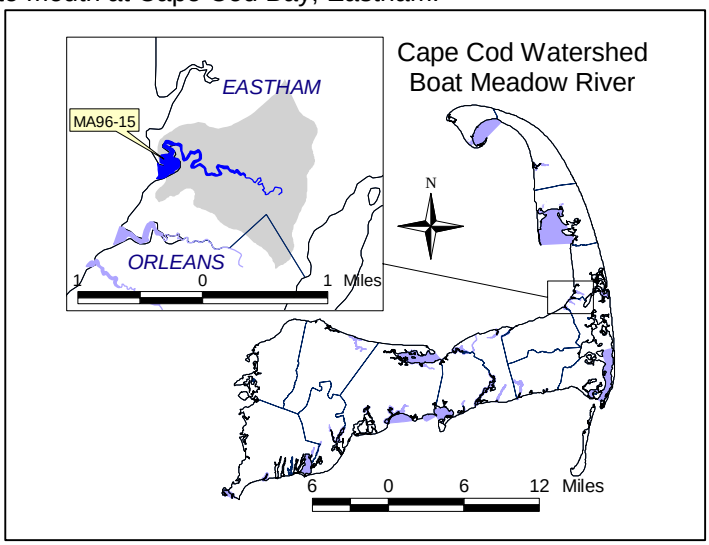
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

SWAN POND RIVER (MA96-14) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

BOAT MEADOW RIVER (SEGMENT MA96-15)

Location: Headwaters east of old Railway Grade to mouth at Cape Cod Bay, Eastham.
Segment Area: 0.09 square miles
Classification: Class SA, ORW



Land-use estimates (top 3, excluding water) for the recharge area of Boat Meadow River (map inset, gray shaded area):

Residential	42%
Wetlands	32%
Forest	15%

Boat Meadow River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Boat Meadow River.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB16.0 (which includes this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between April 1997 and February 1998 DMF collected dry weather fecal coliform bacteria samples from four stations on Boat Meadow River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 11 samples collected of which eight were collected during the primary contact recreation season (1 April through 15 October).

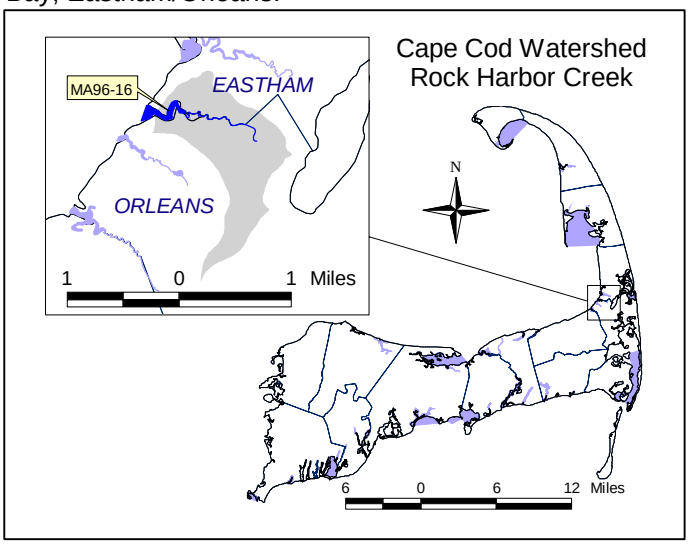
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

BOAT MEADOW RIVER (MA96-15) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

ROCK HARBOR CREEK (SEGMENT MA96-16)

Location: Outlet Cedar Pond to mouth at Cape Cod Bay, Eastham/Orleans.
Segment Area: 0.04 square miles
Classification: Class SA, ORW



Land-use estimates (top 3, excluding water) for the recharge area of Rock Harbor Creek (map inset, gray shaded area):

Residential	38%
Forest	18%
Commercial	15%

Rock Harbor Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Rock Harbor Creek.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB9.0 and CCB17.0 (which include 0.01mi^2 of this segment) are approved and area CCB18.0 (which includes this 0.03mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.01mi^2 and non-support for 0.03mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between September 1997 and May 1998 DMF collected dry weather fecal coliform bacteria samples from three stations on Rock Harbor Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 12 samples collected of which six were collected during the primary contact recreation season (1 April through 15 October).

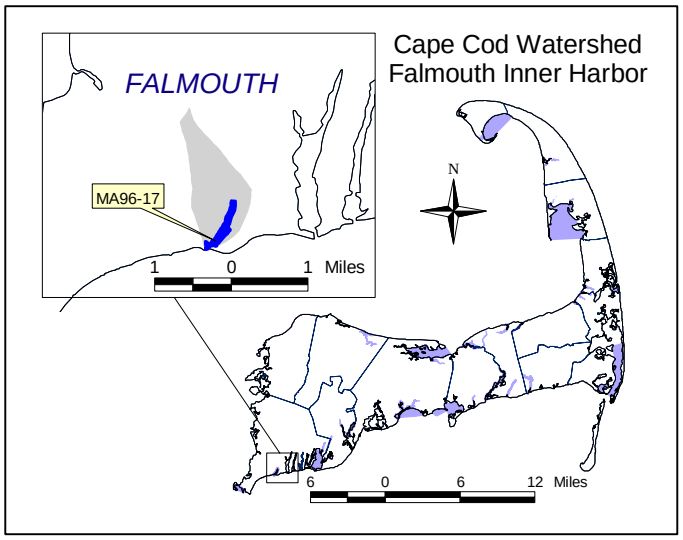
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

ROCK HARBOR CREEK (MA96-16) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.01mi^2, NON-SUPPORT 0.03mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

FALMOUTH INNER HARBOR (SEGMENT MA96-17)

Location: Waters included north of Inner Falmouth Harbor Light, Falmouth.
Segment Area: 0.07 square miles
Classification: Class SB



Land-use estimates (top 3, excluding water) for the recharge area of Falmouth Inner Harbor (map inset, gray shaded area):

Residential	40%
Commercial	22%
Open Land	16%

Falmouth Inner Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Falmouth Inner Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC9.0 (which includes this entire segment) is conditionally approved.

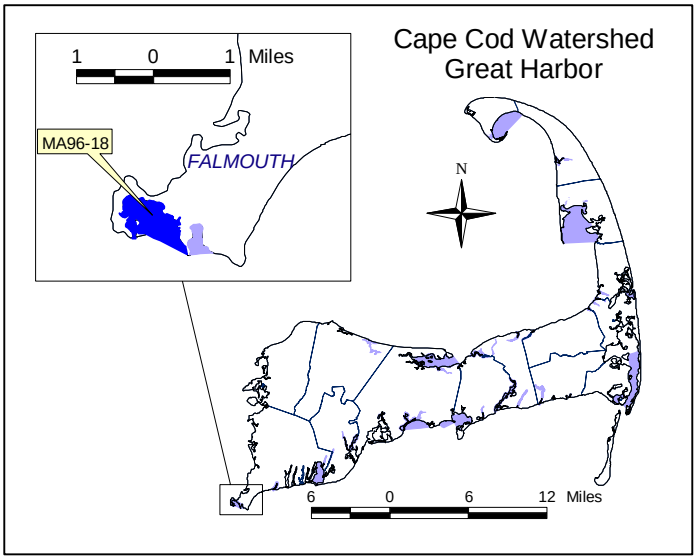
Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this segment.

FALMOUTH INNER HARBOR (MA96-17) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

GREAT HARBOR (SEGMENT MA96-18)

Location: The waters north of an imaginary line drawn southeast from Devils Foot to Juniper Point, Falmouth.
Segment Area: 0.35 square miles
Classification: Class SA



The recharge area for Great Harbor has not been identified. Therefore land use estimates are not available.

Great Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Great Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC2.0 (which includes 0.30mi^2 of this segment) is approved and SC2.1 (which includes 0.05mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.30mi^2 and non-support for 0.05mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and September 2001 DMF collected dry weather fecal coliform bacteria samples from six stations in Great Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 115 samples collected of which 79 were collected during the primary contact recreation season (1 April through 15 October).

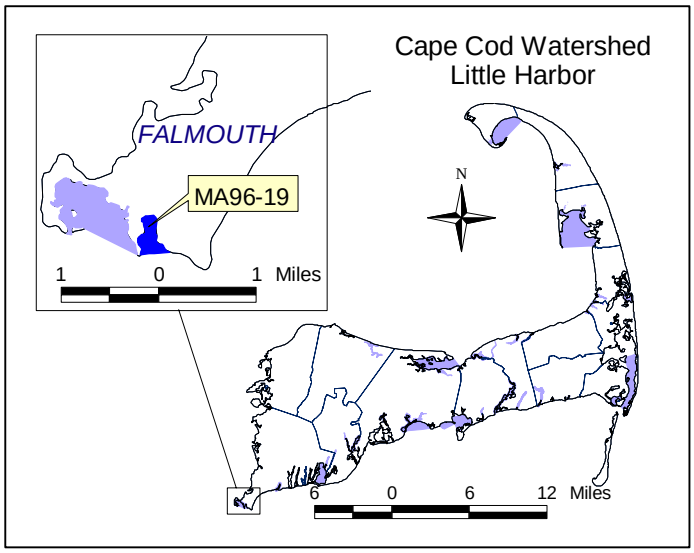
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

GREAT HARBOR (MA96-18) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.30mi^2 and NON-SUPPORT 0.05mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

LITTLE HARBOR (SEGMENT MA96-19)

Location: The waters north of an imaginary line drawn from Juniper Point east to Nobska beach, Falmouth.
Segment Area: 0.05 square miles
Classification: Class SA



The recharge area for Little Harbor has not been identified; therefore land use estimates are not available.

Little Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Little Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC4.0 (which includes 0.02mi^2 of this segment) is approved, area SC4.1 (which includes 0.02mi^2 of this segment) is conditionally approved and area SC4.2 (which includes 0.01mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.02mi^2, partial support for 0.02mi^2 and non-support for 0.01mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from four stations in Little Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 133 samples collected of which 63 were collected during the primary contact recreation season (1 April through 15 October).

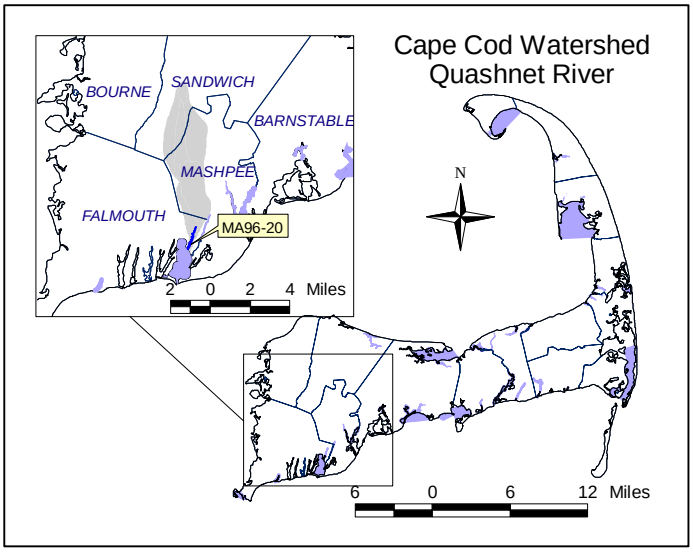
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

LITTLE HARBOR (MA96-19) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.02mi^2, PARTIAL SUPPORT 0.02mi^2, NON-SUPPORT 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

QUASHNET RIVER (SEGMENT MA96-20)

Location: Just south of Route 28 to mouth at Waquoit Bay, Falmouth. Also known as Moonakis River.
Segment Area: 0.1 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Falmouth Inner Harbor (map inset, gray shaded area):

Forest	45%
Transport	16%
Residential	15%

Quashnet River is on the Massachusetts 1998 303(d) List of impaired waters for nutrients and organic enrichment/low DO (Table 3). The use assessments of Ashumet Pond (MA96004), Johns Pond (MA96157), and Snake Pond (MA96302), which are completely or partially located in the recharge area for Quashnet River, are provided in the Lakes Assessment section of this report.

There are 62.748 acres of cranberry bog open space in the Quashnet River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.560 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Sandwich Water District	4261000	9P242226101	42226108	4261000-05G (G)	0.77[2] reg 1.87[2] perm 2.64[2]	1.63	1.83	1.68
Mashpee Water District	4172000	9P42217202	42217201	Turner Road Well (G)	0.14[2] reg 0.86[2] perm	U	0.55	U
Mashpee Water District	4172000	9P42217202	42217201	Proposed P-1 Site (G)	0.14[2] reg perm "To be assigned"	NA	NA	NA
Otis ANG Base[1]	4066001	NA	42222502	Well #1/J (G) Well #2/G (G)	0.54[2] reg	U	0.29	U

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; U = Unknown (no metered withdrawal data available); [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC15.0 (which includes 0.004mi^2 of this segment) is approved and area SC15.2 (which includes 0.096mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.004mi^2 of this segment and non-support for 0.096mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and September 2001 DMF collected dry weather fecal coliform bacteria samples from two stations in Quashnet River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 37 samples collected of which 20 were collected during the primary contact recreation season (1 April through 15 October).

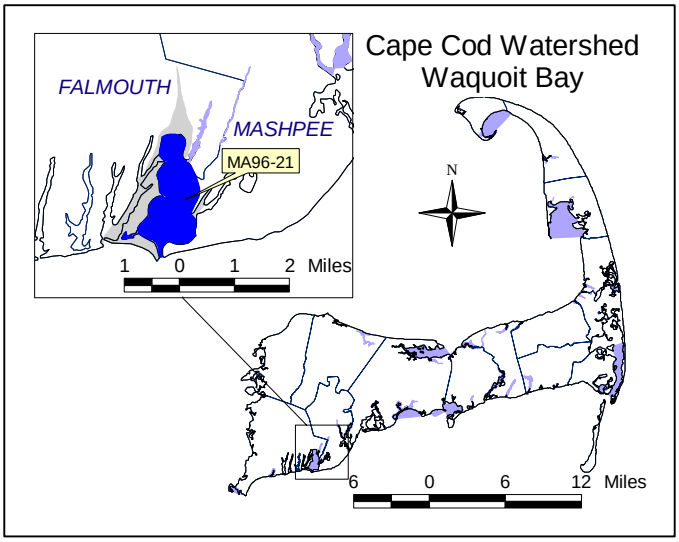
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

Quashnet River (MA96-20) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.004mi^2, NON-SUPPORT 0.096mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

WAQUOIT BAY (SEGMENT MA96-21)

Location: From mouths of Seapit River, Quashnet River, Little River and Great River to confluence with Vineyard Sound, Falmouth
Segment Area: 1.54 square miles
Classification: Class SA, ORW



Land-use estimates (top 3, excluding water) for the recharge area of Waquoit Bay (map inset, gray shaded area excludes the recharge area for Quashnet River which flows to this segment):

Forest	50%
Open Land	19%
Residential	17%

Waquoit Bay is on the Massachusetts 1998 303(d) List of impaired waters for nutrients, organic enrichment/low DO and pathogens (Table 3).

WMA WATER WITHDRAWAL SUMMARY

The recharge area for Quashnet River is included as part of the recharge area for Waquoit Bay. See Segment MA96-20, Quashnet River for a list of water withdrawals that may also apply to this segment.

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC15.0 (which includes this entire segment) is approved.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

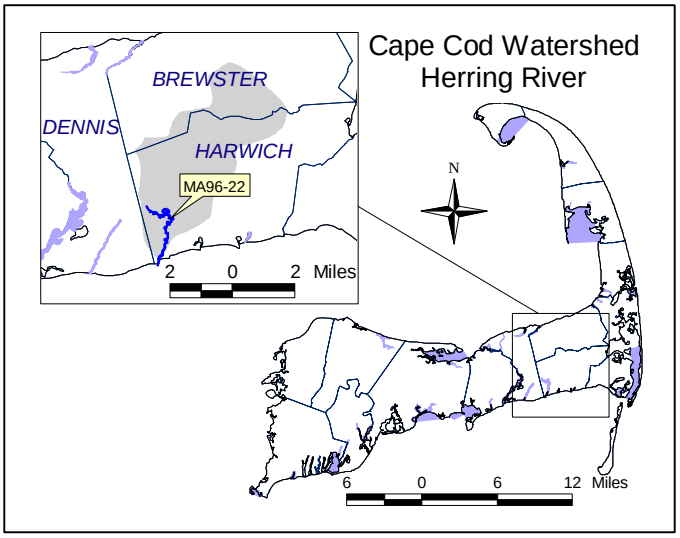
Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

WAQUOIT BAY (MA96-21) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

HERRING RIVER (SEGMENT MA96-22)

Location: Outlet of Reservoir northwest of Bells Neck Road to mouth at Nantucket Sound, Harwich.
Segment Area: 0.1 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Herring River (map inset, gray shaded area):

Forest	43%
Residential	24%
Wetlands	7%

Herring River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Hinckleys Pond (MA96140), Sheep Pond (MA96289), and Long Pond (MA96183), which are located in the recharge area for Herring River, are provided in the Lakes Assessment section of this report.

There are 256.583 acres of cranberry bog open space in the Centerville River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 2.291 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Harwich Water Department	4126000	9P42212601	42212601	4126000-11G (G)	1.2[2] reg 0.96[2] perm Total - 2.16[2]	1.70	1.95	1.77

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC38.1 (which includes 0.04mi^2 of this segment) is conditionally approved and area SC38.2 (which includes 0.04mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.04mi^2, non-support for 0.04mi^2, and not assessed for 0.02mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from three stations on Herring River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 93 samples collected of which 24 were collected during the primary contact recreation season (1 April through 15 October).

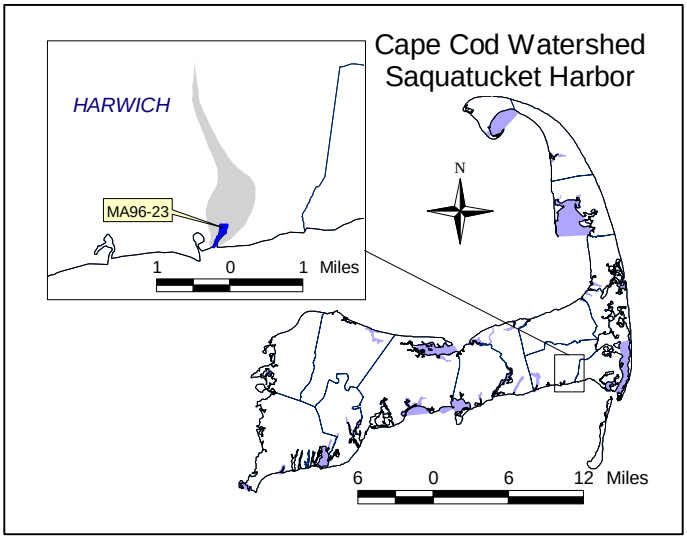
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

HERRING RIVER (MA96-22) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.04mi^2, NON-SUPPORT 0.04mi^2, NOT ASSESSED 0.02mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

SAQUATUCKET HARBOR (SEGMENT MA96-23)

Location: South of Route 28 to confluence with Nantucket Sound, Harwich
Segment Area: 0.02 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Saquatucket Harbor (map inset, gray shaded area):

Residential	46%
Forest	25%
Open Land	15%

Saquatucket Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

There are 33.343 acres of cranberry bog open space in the Saquatucket Harbor recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.298 mgd.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in the recharge area for Saquatucket Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC41.1 (which includes 0.01mi^2 of this segment) is conditionally approved and area SC41.2 (which includes 0.01mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.01mi^2 and non-support for 0.01mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from three stations on Saquatucket Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 116 samples collected of which 45 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

SAQUATUCKET HARBOR (MA96-23) Use Summary Table

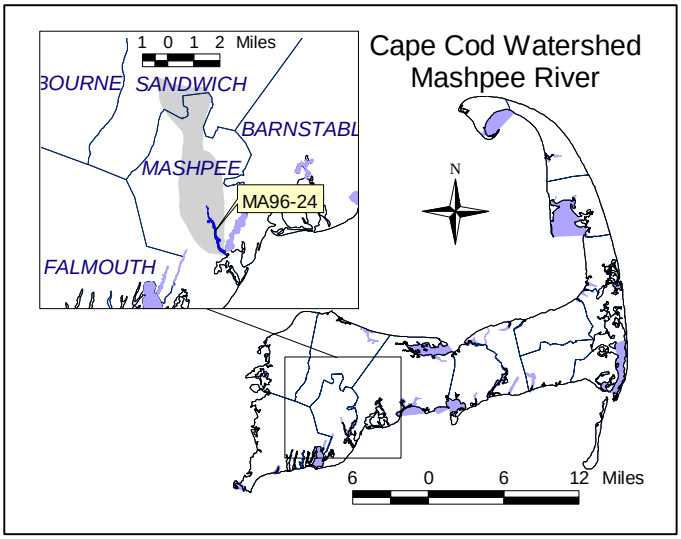
Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.01mi^2, NON-SUPPORT 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

MASHPEE RIVER (SEGMENT MA96-24)

Location: Quinaquisset Avenue to mouth at Popponesset Bay, Mashpee.
Segment Area: 0.1 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area of Falmouth Inner Harbor (map inset, gray shaded area):

Forest	54%
Residential	24%
Open Land	4%



Mashpee River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Mashpee Pond (MA96194) and Wakeby Pond (MA96346), which are located in the recharge area for Mashpee River, are provided in the Lakes Assessment section of this report.

There are 0.293 acres of cranberry bog open space in the Mashpee River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.003 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Quashnet Valley Golf Course[1]	NA	NA	42217202	Quashnet Valley Golf Course Pond (S)	0.09 reg	0.01	0.2[4]	0.07

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Mashpee, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC20.1 (which includes 0.04mi^2 of this segment) is conditionally approved and area SC20.4 (which includes 0.06mi^2 of this segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.04mi^2 and non-support for 0.06mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and March 2001 DMF collected dry weather fecal coliform bacteria samples from four stations on the Mashpee River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 80 samples collected of which 23 were collected during the primary contact recreation season (1 April through 15 October).

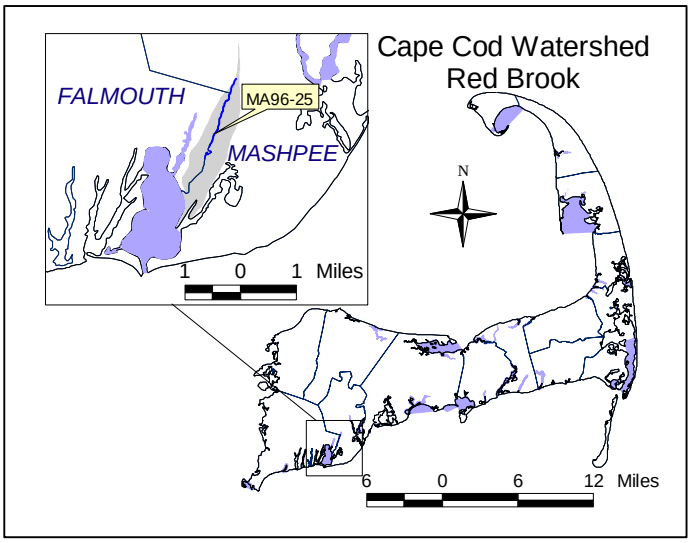
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

MASHPEE RIVER (MA96-24) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.04mi^2, NON-SUPPORT 0.06mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

RED BROOK (SEGMENT MA96-25)

Location: Source in Mashpee to Hamblin Pond, Falmouth/Mashpee.
Segment Area: 0.01 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Falmouth Inner Harbor (map inset, gray shaded area):

Residential	51%
Forest	31%
Wetlands	13%

There are 26.224 acres of cranberry bog open space in the Red Brook recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.234 mgd.

WMA WATER WITHDRAWAL SUMMARY

Based on the available information, there are no WMA regulated water withdrawals in the recharge area for Red Brook.

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Mashpee, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC16.0 (which includes this entire segment) is approved.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this entire segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Uses* are assessed as support this segment.

RED BROOK (MA96-25) Use Summary Table

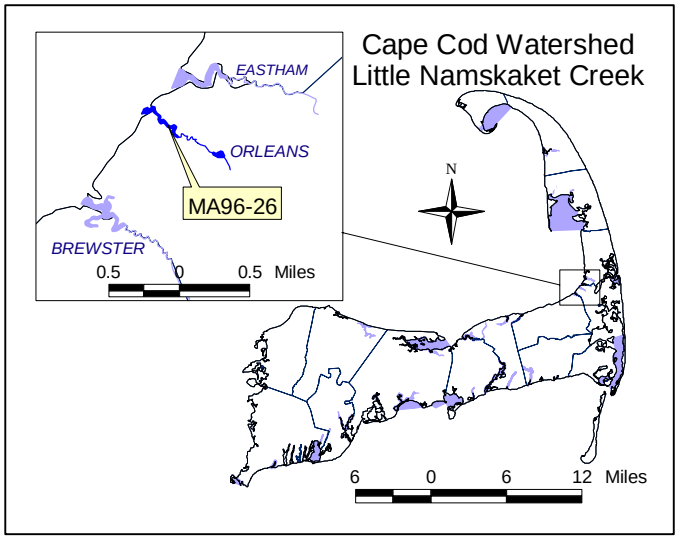
Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

LITTLE NAMSKAKET CREEK (SEGMENT MA96-26)

Location: Source to mouth at Cape Cod Bay, Orleans.
Segment Area: 0.02 square miles
Classification: Class SA, ORW

The recharge area for Little Namskaket Creek has not been identified; therefore land use estimates are not available.

Little Namskaket Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).



WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Little Namskaket Creek.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB19.0 (which includes this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between July 1997 and July 1998 DMF collected dry weather fecal coliform bacteria samples from two stations on Little Namskaket Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 18 cfu/100mL with a total of nine samples collected of which seven were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

LITTLE NAMSKAKET CREEK (MA96-26) Use Summary Table

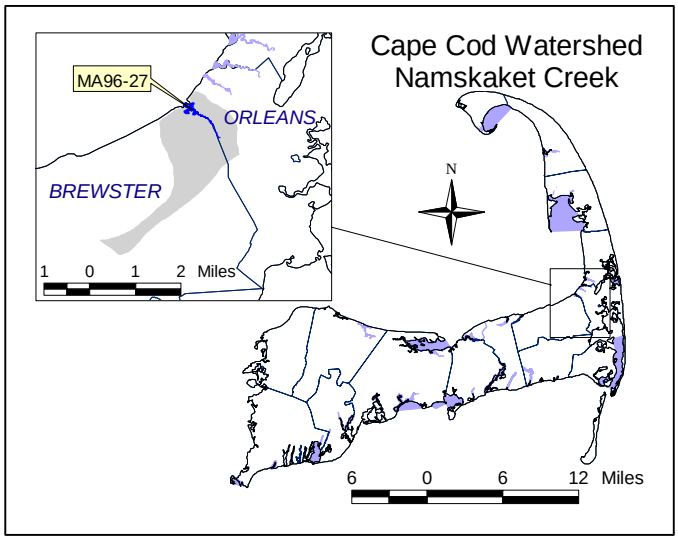
Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

NAMSKAKET CREEK (SEGMENT MA96-27)

Location: From outlet of unnamed pond north of Route 6A in Orleans to mouth at Cape Cod Bay, Brewster/Orleans.
Segment Area: 0.01 square miles
Classification: Class SA, ORW

Land-use estimates (top 3, excluding water) for the recharge area of Namskaket Creek (map inset, gray shaded area):

Forest	42%
Residential	27%
Wetlands	12%



Namskaket Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessment of Cliff Pond (MA96039), which is located in the recharge area for Namskaket Creek, is provided in the Lakes Assessment section of this report.

There are 7.149 acres of cranberry bog open space in the Nemskaket Creek recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area (inclusive but not limited to WMA registered growers) is 0.064 mgd.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX C, TABLE C2)

See above for WMA cranberry bog withdrawal information.

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB21.0 (which includes this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between July 1997 and July 1998 DMF collected dry weather fecal coliform bacteria samples from two stations on Namskaket Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 11 cfu/100mL with a total of ten samples collected of which eight were collected during the primary contact recreation season (1 April through 15 October).

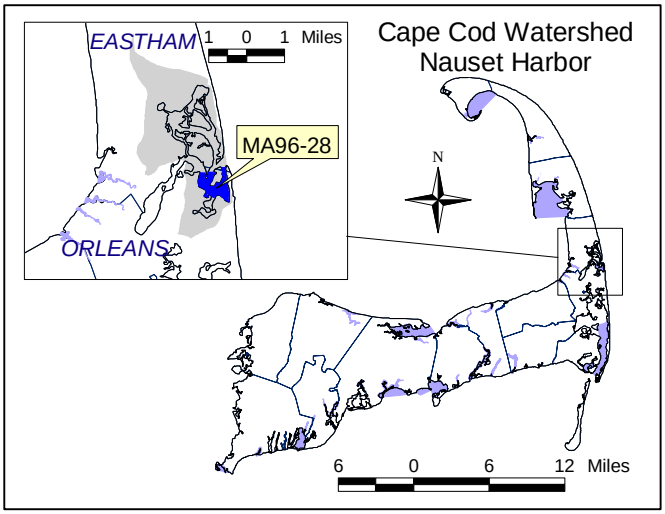
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

NAMSKAKET CREEK (MA96-27) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

NAUSET HARBOR (SEGMENT MA96-28)

Location: The waters south of an imaginary line drawn east from Woods Cove around the southern point of Stony Island, around the southern end of the unnamed island in the harbor to the Cape Cod National seashore point, excluding Mill Pond, Orleans.
Segment Area: 2 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Nauset Harbor (map inset, gray shaded area):

Residential	37%
Forest	24%
Wetlands	22%

The use assessment of Depot Pond (MA96061), which is partially located in the recharge area for Nauset Harbor, is provided in the Lakes Assessment section of this report.

There are 4.174 acres of cranberry bog open space in the Nauset Harbor recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.037 mgd.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in the recharge area for Nauset Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas OC2.0, OC3.0 and OC5.0 are approved. Portions of these growing areas compose this entire segment.
Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

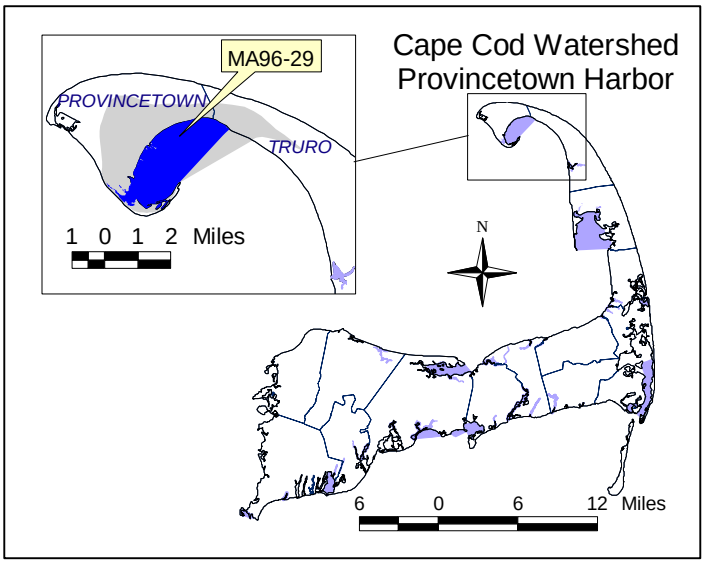
Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Uses* are assessed as support for this segment.

NAUSET HARBOR (MA96-28) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

PROVINCETOWN HARBOR (SEGMENT MA96-29)

Location: The waters northwest of an imaginary line drawn from the tip of Long Point to Beach Point Beach, Provincetown.
Segment Area: 3.82 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Provincetown Harbor (map inset, gray shaded area):

Open Land	27%
Forest	27%
Wetlands	16%

Provincetown Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessment of Clapps Pond (MA96035), which is located in the recharge area for Provincetown Harbor, is provided in the Lakes Assessment section of this report.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB4.0 (which includes 2.8mi^2 of this segment), CCB4.20 (0.056mi^2), and CCB5.0 (0.18mi^2) are approved, areas CCB4.2 (0.056 mi^2) and CCB4.4 (which includes of this 0.33mi^2 of this segment) are conditionally approved, and areas CCB4.1 (0.39mi^2), CCB4.3 (0.004mi^2) and CCB5.1 (0.003mi^2) are prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 3.03mi^2, partial support for 0.39mi^2 and non-support for 0.40mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between February 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from 11 stations in Provincetown Harbor as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 288 samples collected of which 175 were collected during the primary contact recreation season (1 April through 15 October).

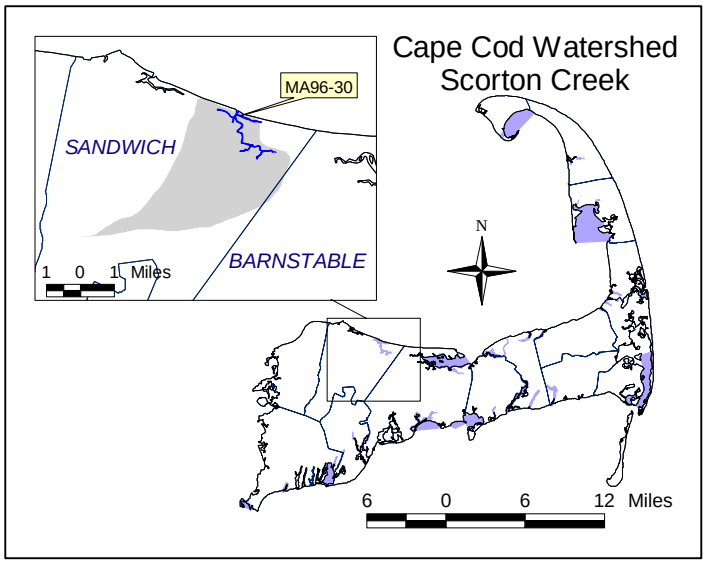
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

PROVINCETOWN HARBOR (MA96-29) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 3.03mi^2, PARTIAL SUPPORT 0.39mi^2, NON-SUPPORT 0.40mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

SCORTON CREEK (SEGMENT MA96-30)

Location: Jones Lane to mouth at Cape Cod Bay, Sandwich.
Segment Area: 0.05 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Scorton Creek (map inset, gray shaded area):

Forest	52%
Residential	26%
Open Land	8%

The use assessments of Hoxie Pond (MA96146), and Nye Pond (MA96228), which are located in the recharge area for Scorton Creek, are provided in the Lakes Assessment section of this report.

There are 86.010 acres of cranberry bog open space in the Scorton Creek recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.768 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Sandwich Water District	4261000	9P242226101	42226108	4261000-04G (G) 4261000-06G (G) 4261000-07G (G) 4261000-10G (G)	0.77[2] reg 1.87[2] perm 2.64[2]	1.63[2]	0.10 0.48 0.45 0.50	1.68[2]
Sandwich Hollows Golf Course[1]	NA	NA	42226112	Round Hill Well (G)	0.07 reg	0.05	0.04	0.04
Department of Fisheries and Wildlife	NA	NA	42226113	Nye Pond (S) E. Sandwich Fish Hatchery (G) E. Sandwich Fish Hatchery (G)	2.77[2] reg	1.42	0.11	0.12

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Sandwich, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). A final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB36.0 (which includes 0.04mi^2 of this segment) is prohibited.

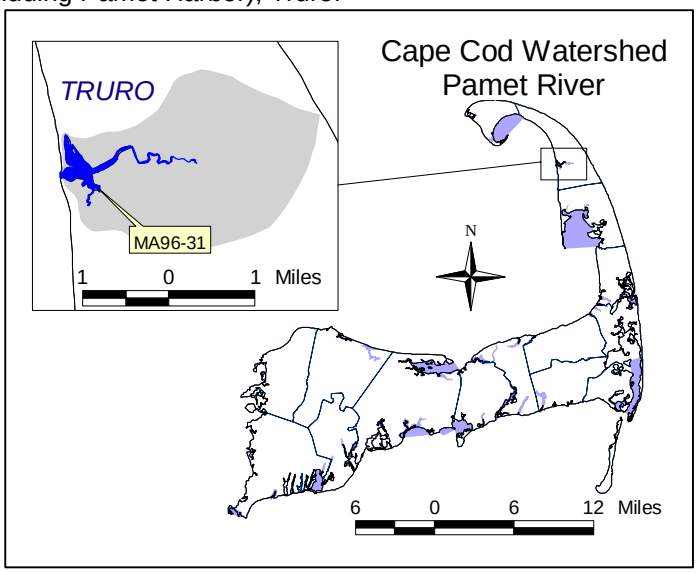
Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for 0.04mi^2 and not assessed for 0.01mi^2 of this segment.

SCORTON CREEK (MA96-30) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT 0.04mi^2, NOT ASSESSED 0.01mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

PAMET RIVER (SEGMENT MA96-31)

Location: Route 6 to mouth at Cape Cod Bay (Including Pamet Harbor), Truro.
Segment Area: 0.2 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Pamet River (map inset, gray shaded area):

Forest	56%
Residential	20%
Wetlands	17%

Pamet River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Pamet River.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB7.1 (0.13mi^2) and CCB7.2 (0.02mi^2) are conditionally approved and area CCB7.3 (0.05mi^2) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.15mi^2 and non-support for 0.05mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and April 2001 DMF collected dry weather fecal coliform bacteria samples from nine stations on Pamet River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 164 samples collected of which 43 were collected during the primary contact recreation season (1 April through 15 October).

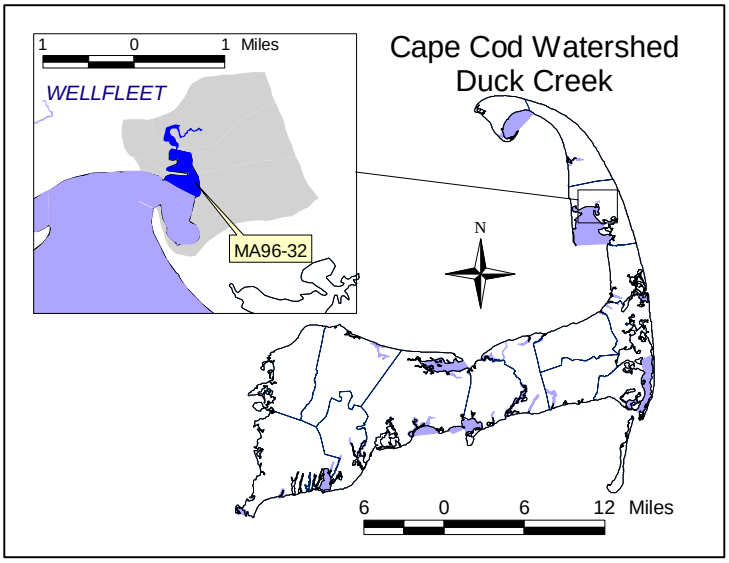
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

PAMET RIVER (MA96-31) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.15mi^2, NON-SUPPORT 0.05mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

DUCK CREEK (SEGMENT MA96-32)

Location: From Cannon Hill to Shirttail Point, Wellfleet.
Segment Area: 0.1 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Duck Creek (map inset, gray shaded area):

Forest	47%
Residential	36%
Open Land	9%

The use assessment of Long Pond (MA96179), which is partially located in the recharge area for Duck Creek, is provided in the Lakes Assessment section of this report.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Duck Creek.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB13.0 (which includes 0.02mi^2 of this segment) is approved, areas CCB13.2 (0.075mi^2) and CCB13.3 (0.001) are conditionally approved, and CCB13.1 (0.004mi^2) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.02mi^2, partial support for 0.076mi^2 and non-support for 0.004mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from four stations on Duck Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 188 samples collected of which 110 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

DUCK CREEK (MA96-32) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.02mi^2, PARTIAL SUPPORT 0.076mi^2, NON-SUPPORT 0.004mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

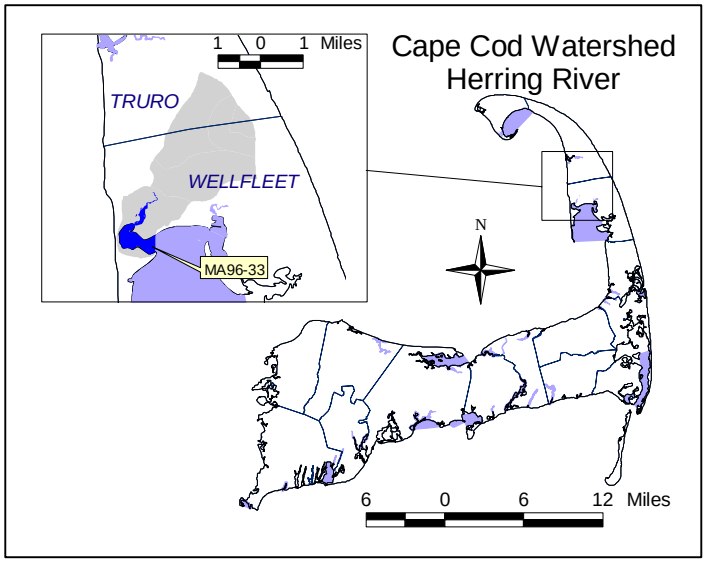
HERRING RIVER (SEGMENT MA96-33)

Location: Griffin Island to Wellfleet Harbor, Wellfleet.
Segment Area: 0.7 square miles
Classification: Class SA, ORW

Land-use estimates (top 3, excluding water) for the recharge area of Herring River (map inset, gray shaded area):

Forest	59%
Residential	18%
Wetlands	11%

Herring River is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Great Pond (MA96114), Gull Pond (MA96123), and Ryder Pond (MM96268), which are located in the recharge area for Herring River, are provided in the Lakes Assessment section of this report.



WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Herring River.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB12.1 (0.41mi^2) is conditionally approved, area CCB12.2 (0.15mi^2) is restricted, and areas CCB12.4 (0.13mi^2) and CCB12.5 (0.01mi^2) are prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for 0.56mi^2 and non-support for 0.14mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between March 1996 and August 2001 DMF collected dry weather fecal coliform bacteria samples from eleven stations on Herring River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 312 cfu/100mL with a total of 404 samples collected of which 283 were collected during the primary contact recreation season (1 April through 15 October).

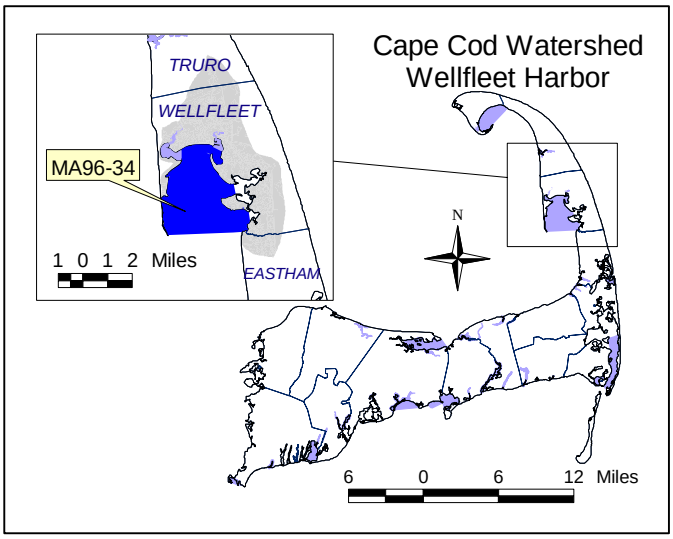
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

HERRING RIVER (MA96-33) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT 0.56mi^2, NON-SUPPORT 0.14mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

WELLFLEET HARBOR (SEGMENT MA96-34)

Location: The waters north of an imaginary line drawn west from Jeremy Point to Sunken Meadow, excluding the estuaries of Herring River, Duck Creek and Blackfish Creek, Wellfleet.
Segment Area: 7.27 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Wellfleet Harbor (map inset, gray shaded area):

Forest	47%
Residential	26%
Wetlands	13%

Wellfleet Harbor is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3). The use assessments of Great Pond (MA96114), Gull Pond (MA96123), Long Pond (MA96179), and Ryder Pond (MA96268), which are located completely or partially in the recharge area for Wellfleet Harbor, are provided in the Lakes Assessment section of this report.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information, there are no WMA regulated water withdrawals, cranberry bogs or NPDES regulated surface wastewater discharges in the recharge area for Wellfleet Harbor.

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas CCB11.0 (which contains 6.89mi^2 of this segment), CCB13.0 (0.23mi^2), and CCB14.0 (which contains 0.13mi^2 of this segment) are approved, and area CCB10.0 (0.02mi^2) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 7.25mi^2 and non-support for 0.02mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

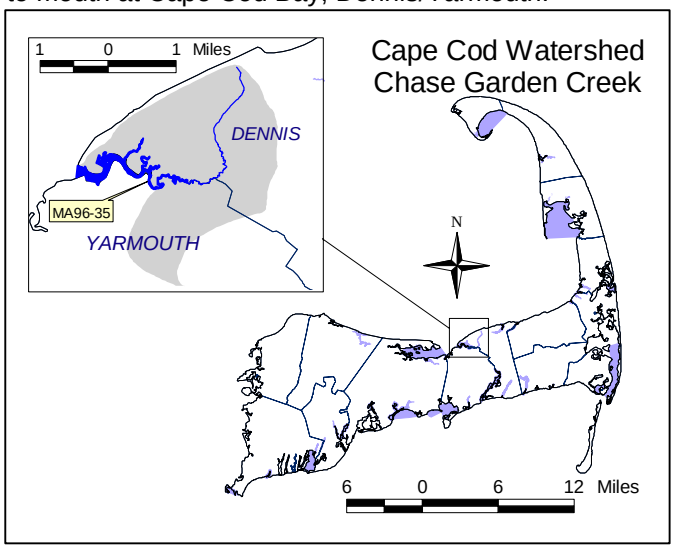
Based on the more stringent bacteria guidelines for shellfishing than for recreational uses, the *Primary* and *Secondary Contact Uses* are assessed as support for 7.25mi^2 and not assessed for 0.02mi^2 of this segment.

WELLFLEET HARBOR (MA96-34) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 7.25mi^2, NON-SUPPORT 0.02mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT 7.25mi^2 NOT ASSESSED 0.02mi^2				
Secondary Contact		SUPPORT 7.25mi^2 NOT ASSESSED 0.02mi^2				
Aesthetics		NOT ASSESSED				

CHASE GARDEN CREEK (SEGMENT MA96-35)

Location: Source west of Route 6A, Dennis to mouth at Cape Cod Bay, Dennis/Yarmouth.
Segment Area: 0.2 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Chase Garden Creek (map inset, gray shaded area):

Residential	43%
Wetlands	24%
Forest	22%

Chase Garden Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

There are 16.290 acres of cranberry bog open space in the Chase Garden Creek recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.145 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
King's Way Golf Course[1]	NA	9P42235104	NA	well (G) well (G)	0.1[2] perm	0.1	0.12[3]	0.1

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

Aquaculture Research Corporation is currently in the process of permit renewal. Their NPDES permit number MA0005576 was originally issued in 1975 and has expired. Product production and processing has changed and a revised permit will be necessary. A permit application was received by EPA during March 2001, however the application was deficient. Therefore, a letter was issued to the company from EPA during November 2001 requesting the additional information necessary to complete the application and issue a new permit.

Additionally, the Towns of Dennis and Yarmouth are required to obtain Phase II general NPDES storm water permits for their municipal drainage systems. EPA is currently writing these general permits (with input from MA DEP). The final version of the Phase II storm water permits will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB27.0 (which contains this entire segment) is conditionally approved.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as partial support for this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and June 2001 DMF collected dry weather fecal coliform bacteria samples from six stations on Chase Garden Creek as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 144 samples collected of which 53 were collected during the primary contact recreation season (1 April through 15 October).

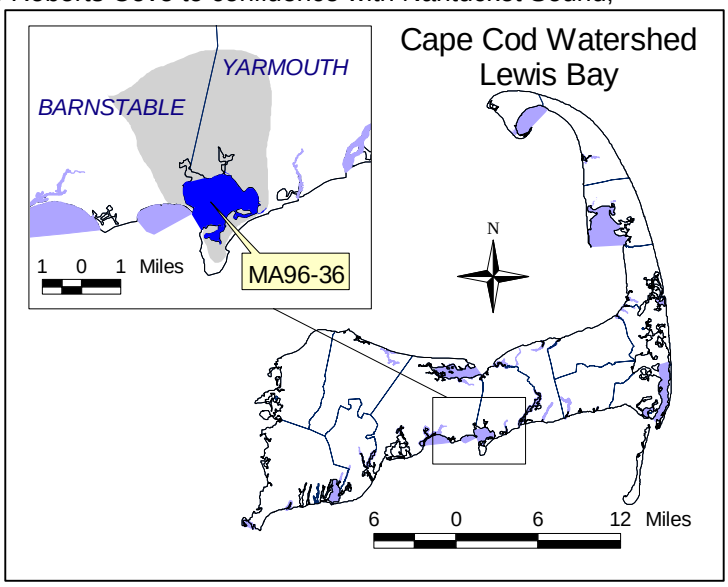
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

CHASE GARDEN CREEK (MA96-35) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		PARTIAL SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

LEWIS BAY (SEGMENT MA96-36)

Location: Includes Pine Island Creek and Uncle Roberts Cove to confluence with Nantucket Sound, Yarmouth.
Segment Area: 1.35 square miles
Classification: Class SA



Land-use estimates (top 3, excluding water) for the recharge area of Lewis Bay (map inset, gray shaded area):

Forest	34%
Residential	27%
Commercial	10%

Lewis Bay is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

There are 91.409 acres of cranberry bog open space in the Lewis Bay recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.816 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Barnstable Water Company	4020004	9P42202004	42202013	4020004-02G (G) 4020004-04G (G) 4020004-05G (G) 4020004-07G (G) 4020004-08G (G) 4020004-09G (G) 4020004-10G (G) 4020004-11G (G)	2.71[2] reg 0.71[2] perm Total – 3.42[2]	2.94	2.72	2.49
Yarmouth Water Department	4351000	9P42235101	42235106	4351000-02G (G) 4351000-03G (G) 4351000-04G (G) 4351000-13G (G) 4351000-14G (G) 4351000-17G (G) 4351000-18G (G) 4351000-19G (G) 4351000-20G (G) 4351000-23G (G) 4351000-24G (G)	3.03[2] reg 1.92[2] perm Total – 4.95[2]	3.54	4.08	3.71
Barnstable Fire District	4020000	9P42202001	42202015	4020000-02G (G)	0.34[2] reg 0.32[2] perm Total – 0.66[2]	0.51	0.58	0.56
Bayberry Hills Golf Course[1]	NA	9P42235103	NA	Well #2 (G) Well #3 (G)	0.12[2] perm	0.08	0.1	0.07

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Yarmouth, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that areas SC27.0, SC28.0 and 28.20 are approved and areas SC28.4, SC28.7, SC28.8, and SC28.10 are conditionally approved. Portions of these growing areas compose this entire segment.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 1.27mi^2 and partial support for 0.08mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and September 2001 DMF collected dry weather fecal coliform bacteria samples from ten stations on Lewis Bay as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 67 cfu/100mL with a total of 369 samples collected of which 176 were collected during the primary contact recreation season (1 April through 15 October).

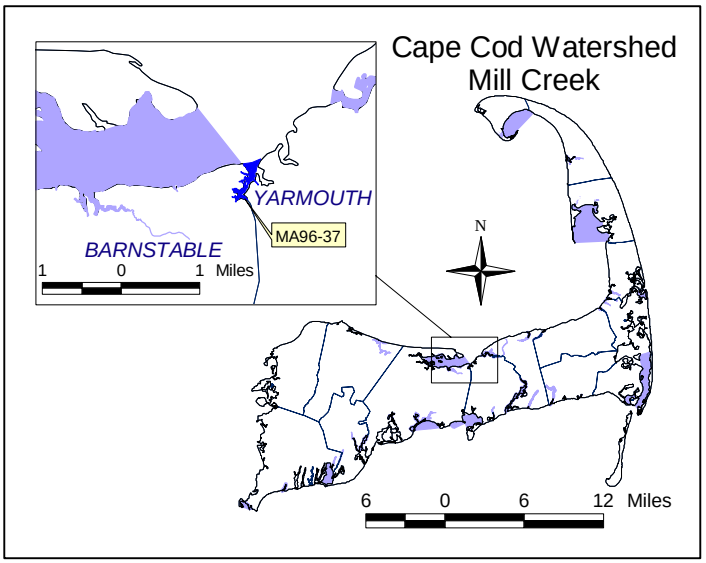
Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

LEWIS BAY (MA96-36) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 1.27mi^2, PARTIAL SUPPORT 0.08mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

MILL CREEK (SEGMENT MA96-37)

Location: From Keveny/Mill Lane north to confluence with Cape Cod Bay Barnstable/Yarmouth.
Segment Area: 0.09 square miles
Classification: Class SA



The recharge area for Mill Creek is included as part of the recharge area for Barnstable Harbor. Land use estimates are not available for Mill Creek.

Mill Creek is on the Massachusetts 1998 303(d) List of impaired waters for pathogens (Table 3).

WMA WATER WITHDRAWAL SUMMARY

The recharge area for Mill Creek is included as part of the recharge area for Barnstable Harbor. See Segment MA96-01, Barnstable Harbor, for a list of water withdrawals that may also apply to this segment.

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Towns of Barnstable and Yarmouth, however, are required to obtain Phase II general NPDES storm water permits for their municipal drainage system. EPA is currently writing these general permits (with input from MA DEP). The final version of the Phase II storm water permits will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area CCB29.0 (which contains this entire segment) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as non-support for this segment.

MILL CREEK (MA96-37) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		NON-SUPPORT (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

PARKERS RIVER (SEGMENT MA96-38)

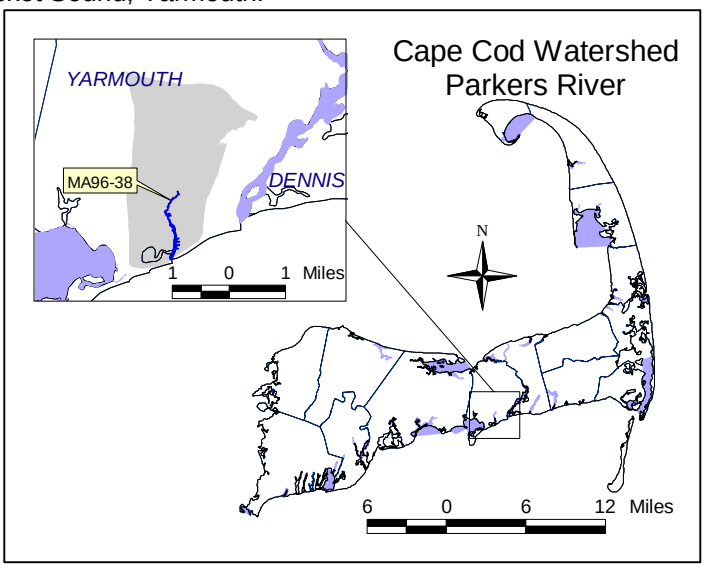
Location: Outlet Seine Pond to mouth at Nantucket Sound, Yarmouth.
Segment Area: 0.05 square miles
Classification: Class SA

Land-use estimates (top 3, excluding water) for the recharge area of Parkers River (map inset, gray shaded area):

Residential	58%
Forest	19%
Open Land	9%

Parkers River is on the 1998 303(d) List of impaired waters for pathogens (Table 3).

A sport fishing pier, managed by the Town of Yarmouth, is located on the Back River off Main Street/Route 28 in Yarmouth.



There are 105.289 acres of cranberry bog open space in the Parkers River recharge area (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 0.940 mgd.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX C, TABLE C2)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1998	1999	2000
Yarmouth Water Department	4351000	9P42235101	42235106	4351000-05G (G) 4351000-06G (G) 4351000-11G (G) 4351000-12G (G)	3.03[2] reg 1.92[2] perm Total – 4.95[2]	3.54	4.08	3.71
Bayberry Hills Golf Course	NA	9P42235103	NA	Well #1 (G)	0.12[2] perm	0.08	0.1	0.07

*summary excludes registered cranberry growers - see Appendix C, Table C2 for a list of all permitted and/or registered WMA users including cranberry growers; NA = not applicable; [1]indicates average withdrawal over less than 365 days; [2]indicates system-wide withdrawal, all sources are not necessarily within this segment; [3]withdrawal did **not** exceed registration amount by more than 0.1 MGD (WMA threshold); [4]withdrawal exceeded registration amount by more than 0.1 MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. The Town of Yarmouth, however, is required to obtain Phase II general NPDES storm water permit for their municipal drainage system. EPA is currently writing this general permit (with input from MA DEP). The final version of the Phase II storm water permit will be issued by December 2002. Permit applications from the towns must be submitted to EPA by March 2003 and coverage begins with the permit application (Scarlet 2001).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area SC30.0 (which includes 0.008mi^2 of this segment) is approved, areas SC30.3 (0.027mi^2) and SC30.4 (which includes 0.008mi^2 of this segment) are conditionally approved and area SC30.5 (0.007mi^2) is prohibited.

Based on the DMF shellfish growing area status, the *Shellfishing Use* is assessed as support for 0.008mi^2, partial support for 0.035mi^2, and non-support for 0.007mi^2 of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

Between January 1996 and June 2001 DMF collected dry weather fecal coliform bacteria samples from four stations on Parkers River as part of their shellfish growing area classification (Kennedy 2001). Counts ranged between 1.9 and 51 cfu/100mL with a total of 179 samples collected of which 36 were collected during the primary contact recreation season (1 April through 15 October).

Based on the low bacteria counts, both the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this segment.

PARKERS RIVER (MA96-38) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfishing		SUPPORT 0.008mi^2, PARTIAL SUPPORT 0.035mi^2, NON-SUPPORT 0.007mi^2 (For watershed-wide shellfish growing area data see Appendix E.)				
Primary Contact		SUPPORT				
Secondary Contact		SUPPORT				
Aesthetics		NOT ASSESSED				

CAPE COD WATERSHED – LAKE ASSESSMENTS

A total of 345 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) have been identified and assigned Pond and Lake Information System (PALIS) code numbers in the Cape Cod Watershed (Ackerman 1989 and MA DEP 2002a). The total surface area of the Cape Cod Watershed PALIS lakes is 11,200 acres. The majority of lakes are relatively small with 87% (301 lakes) less than 50 acres. The lakes range in size from one to 743 acres, with 27 greater than 100 acres, and of these, 2 are greater than 650 acres. This report presents information on 46 of the PALIS lakes (Figure 5). The 46 lakes assessed in this report represent 4,750 acres or 42% of the PALIS identified lake acreage in the Cape Cod Watershed. The remaining 299 lakes, which total 6,450 acres, are unassessed and are not currently included as segments in the Waterbody System (WBS) database.

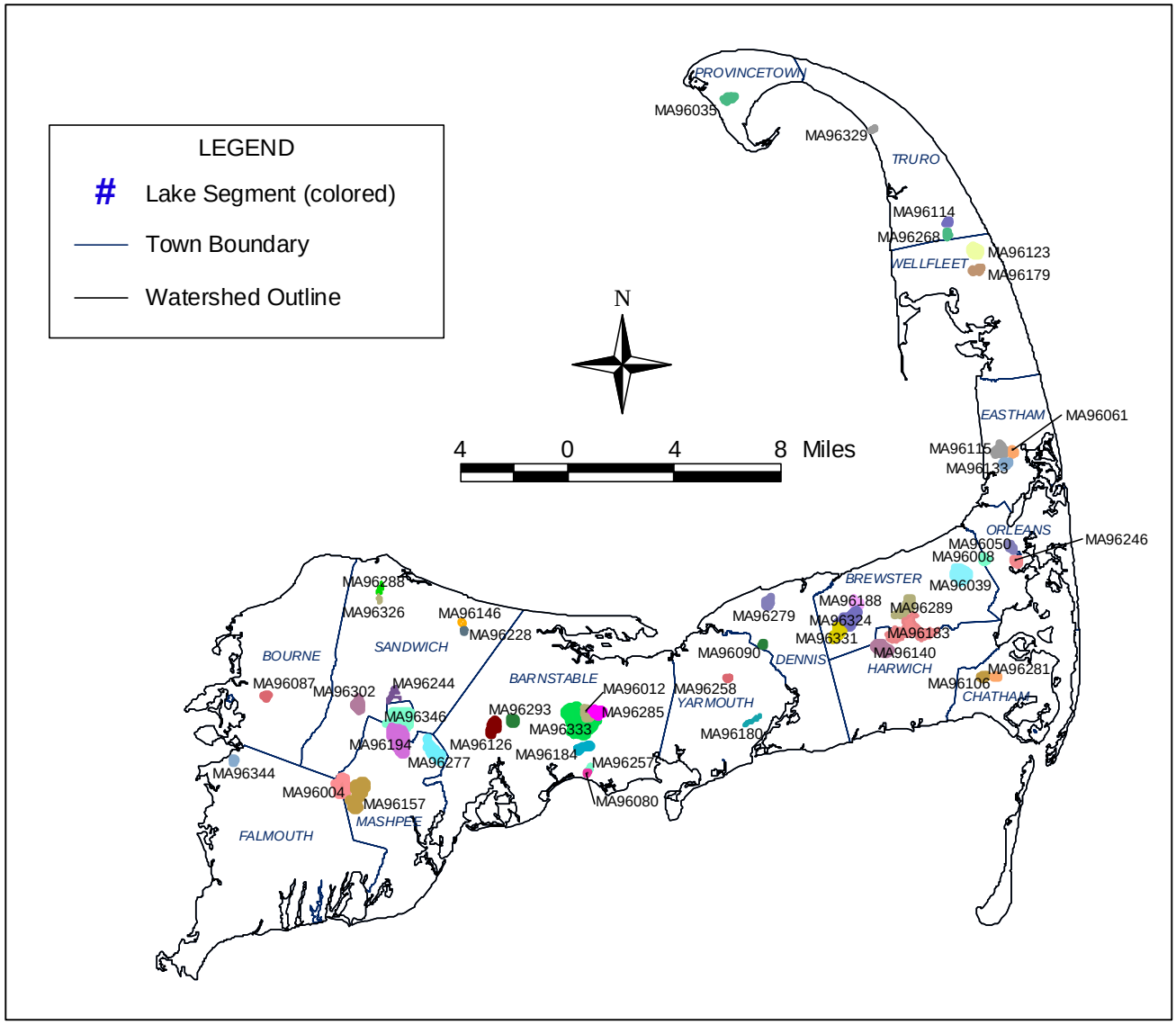


Figure 5. Assessed Lake Segments in the Cape Cod Watershed.

TROPHIC STATUS EVALUATION

Lakes are dynamic ecosystems that over time undergo a process of succession from one trophic state to another. Under natural conditions most lakes move from a nutrient poor (oligotrophic) condition through an intermediate (mesotrophic) stage of nutrient availability and biological productivity to a nutrient-rich or highly productive (eutrophic) state. For the purposes of this report trophic status was estimated primarily using visual observations of macrophyte cover and phytoplankton populations and water quality data collected in 1999 by MA DEP/DWM (Appendix B, Tables B2, B3, B4). Occasionally, data from more detailed studies were utilized (Town of Orleans, 2001; Eichner, et al, 1999). A more definitive assessment of trophic status would require more extensive collection of water quality and biological data. The trophic status estimates for the ponds assessed in the Cape Cod Watershed are presented in Table 4; 20% of the acreage was mesotrophic and 1% was eutrophic. The trophic status was undetermined for 79% of the pond acreage.

Table 4. Cape Cod Watershed lake trophic status estimates (**Bold indicates 1998 303(d) Listed**).

Lake	Waterbody Identification Number (WBID)	Class	Size (Acres)	Trophic Status Estimate
Ashumet Pond, Mashpee	MA96004	B	203	Undetermined
Baker Pond, Orleans	MA96008	B	25.6	Undetermined
Bearse Pond, Barnstable	**MA96012**	B	59	Undetermined
Clapps Pond, Provincetown	MA96035	B	38.1	Undetermined
Cliff Pond, Brewster	MA96039	B	177.1	Undetermined
Crystal Lake, Orleans	MA96050	B	33.6	Mesotrophic
Depot Pond, Eastham	MA96061	B	26.5	Undetermined
Lake Elizabeth, Barnstable	MA96080	B	8.9	Undetermined
Flax Pond, Bourne	MA96087	B	19.3	Undetermined
Flax Pond, Dennis	MA96090	B	15.9	Undetermined
Goose Pond, Chatham	MA96106	B	34.5	Undetermined
Great Pond, Truro	MA96114	B	17	Undetermined
Great Pond, Eastham	**MA96115**	B	110.5	Undetermined
Gull Pond, Wellfleet	MA96123	B	102.7	Undetermined
Hamblin Pond, Mystic/Barnstable	MA96126	B	149	Undetermined
Herring Pond, Eastham	MA96133	B	42.7	Mesotrophic
Hinckleys Pond, Harwich	MA96140	B	165.6	Undetermined
Hoxie Pond, Sandwich	MA96146	B	8.8	Undetermined
Johns Pond, Mashpee	MA96157	B	323	Undetermined
Long Pond, Wellfleet	MA96179	B	32.7	Undetermined
Long Pond, Yarmouth	MA96180	B	59	Undetermined
Long Pond, Brewster/Harwich	MA96183	B	743	Mesotrophic
Long Pond, Barnstable	MA96184	B	49	Undetermined
Lower Mill Pond, Brewster	**MA96188**	B	29	Eutrophic
Mashpee Pond, Mashpee/Sandwich	MA96194	B	378	Undetermined
Nye Pond, Sandwich	MA96228	B	6	Undetermined
Peters Pond, Sandwich	MA96244	B	127	Undetermined
Pilgrim Lake, Orleans	MA96246	B	38	Undetermined
Red Lily Pond, Barnstable	**MA96257**	B	4.4	Undetermined
Reservoir (Miss Thachers Pond), Yarmouth	MA96258	B	65.5	Undetermined
Ryder Pond, Truro	**MA96268**	B	18	Undetermined
Santuit Pond, Mashpee	**MA96277**	B	167.4	Mesotrophic
Scargo Lake, Dennis	MA96279	B	53	Undetermined
Schoolhouse Pond, Chatham	MA96281	B	18.6	Undetermined
Shallow Pond, Barnstable	**MA96285**	B	75.8	Undetermined
Shawme Lake (Lower), Sandwich	MA96288	B	24	Eutrophic
Sheep Pond, Brewster	**MA96289**	B	139.8	Undetermined

Lake	Waterbody Identification Number (WBID)	Class	Size (Acres)	Trophic Status Estimate
Shubael Pond, Barnstable	MA96293	B	54.9	Undetermined
Snake Pond, Sandwich	MA96302	B	81.4	Undetermined
Upper Mill Pond (Walkers Pond), Brewster	**MA96324**	B	253	Undetermined
Upper Shawme Lake, Sandwich	MA96326	B	20	Eutrophic
Village Pond, Truro	MA96329	B	6	Undetermined
Walkers Pond (Upper Mill Pond), Brewster	**MA96331**	B	105	Undetermined
Wequaquet Lake, Barnstable	MA96333	B	579	Undetermined
Cedar Lake, Falmouth	MA96344	B	19.4	Undetermined
Wakeby Pond, Mashpee/Sandwich	MA96346	B	351	Undetermined

LAKE USE ASSESSMENTS

Lake assessments are based on information gathered during DWM 1999 baseline lake surveys as well as pertinent information from other sources (e.g., abutters, herbicide applicators, diagnostic/feasibility studies, MDPH, etc.). The DWM macrophyte mapping surveys focused on observations of water quality and quantity (e.g., water level, sedimentation, etc.), the presence of native and exotic aquatic plants (both distribution and areal cover) and presence/severity of algal blooms (MA DEP 1999c). During 1999 more intensive sampling was conducted by DWM in five lakes in the Cape Cod Watershed as part of the TMDL Program. This sampling included: measurements of dissolved oxygen, pH, temperature, Secchi disk depth, nutrients, and chlorophyll *a*, and detailed macrophyte mapping (Appendix B, Tables B2, B3, B4). While these surveys provided additional information to assess the status of the designated uses, fecal coliform bacteria data were unavailable and, therefore, the *Primary Contact Recreational* Use was usually not assessed. To determine the status of the *Fish Consumption Use*, fish consumption advisory information was obtained from the Massachusetts Department of Public Health (MDPH 2002).

The use assessments and supporting information were entered into the EPA Water Body System database. Data on the presence of exotic plants were entered into the MA DEP DWM informal non-native plant tracking database.

AQUATIC LIFE

All or portions of seven of the 46 lakes presented in this report supported the *Aquatic Life Use*. Portions of three of these lakes, Crystal Lake (MA96050), Long Pond (MA96183) and Upper Mill Pond (MA96324), were impaired (partially supported) for the Aquatic Life Use due to organic enrichment/low dissolved oxygen. Additionally, three entire lakes, Bearse Pond (MA96012), Long Pond (MA96184) and Wequaquet Lake (MA96333), were impaired (partially supported) for this use due to the presence of exotic aquatic plant species.

Oxygen depletion occurred below 8 meters during the 2000 growing season in Crystal Lake (MA96050), Orleans (Town of Orleans, 2001). The *Aquatic Life Use* for the 10-acre area of Crystal Lake affected by oxygen depletion is impaired (partial support) by organic enrichment/low dissolved oxygen. The remaining 23.6 acres is supported for the *Aquatic Life Use*.

Oxygen depletion occurred below 11 meters during the 1997 growing season in Long Pond (MA96183), Brewster/Harwich (Eichner et al, 1999). The *Aquatic Life Use* for the 150-acre area of Long Pond affected by oxygen depletion is impaired (partial support) by organic enrichment/low dissolved oxygen. The remaining 593 acres is supported for the *Aquatic Life Use*.

Oxygen depletion occurred below a depth of 5.5m during September 1999 in Upper Mill Pond (MA96324), Brewster (Appendix B, Table B13). Since approximately 85 acres of Upper Mill Pond is greater than 5.5m (approximately 15% of the lake surface area estimated using the bathymetric map and MassGIS) the *Aquatic Life Use* for that area is impaired (partial support) by organic enrichment/low dissolved oxygen. The remaining 168 acres is supported for the *Aquatic Life Use*.

Exotic aquatic macrophytes were present in three of the 45 lakes assessed in this report; Bearse Pond (MA96012), Long Pond (MA96184), and Wequaquet Lake (MA96333) (Gatewood, 2001 and McVoy, 2001). The two exotic aquatic species observed in the Cape Cod Watershed lakes were *Cabomba caroliniana* (fanwort) and *Hydrilla verticillata*. The mere presence of these species is considered an imbalance to the native biotic community. Therefore, these lakes are listed as partial support.

FISH CONSUMPTION

In 2001 the Cape Cod Commission collected fish from Hamblin Pond (MA96126), Peters Pond (MA96244) and Sheep Pond (MA96289). MDPH issued the following advisories:

Hamblin Pond (Barnstable):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Hamblin Pond."
2. "The general public should limit consumption of smallmouth bass from Hamblin Pond to two meals per month."

Peters Pond (Sandwich):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Peters Pond."
2. "The general public should limit consumption of smallmouth bass from Peters Pond to two meals per month."

Sheep Pond (Brewster)

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from Sheep Pond."
2. "The general public should limit consumption of all fish from Sheep Pond to two meals per month."

In June 1999 fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in Ashumet Pond (MA96004) and Johns Pond (MA96157) at the request of the Cape Cod Watershed Team for human consumption considerations (Appendix B, Table B5). These sites are adjacent to the Massachusetts Military reservation and are of concern to MADEP's Bureau of Waste Site Cleanup (BWSC), as well. PCB was below the MDPH action levels of 2.0 parts per million (ppm) in both Ashumet and Johns ponds. Mercury concentrations were above the MDPH action level of 0.5 ppm in largemouth bass from Ashumet Pond and were elevated in four species of fish from Johns Pond. In addition to the statewide advisory, MDPH issued specific fish consumption advisories for these waterbodies in July 1999 due to mercury contamination (MDPH 2002). The advisories recommend the following:

Ashumet Pond (Mashpee/Falmouth):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume largemouth bass from Ashumet Pond."
2. "The general public should limit consumption of largemouth bass from Ashumet Pond to two meals per month."

Johns Pond (Mashpee):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from John's Pond."
2. "The general public should not consume any smallmouth bass caught from John's Pond."
3. "The general public should limit consumption of non-affected fish species from John's Pond to two meals per month."

In October 1994 fish toxics monitoring was conducted by DWM in Great Pond (MA96115), Mashpee Pond (MA96194), and Wequaquet Lake (MA96333), in response to a public information request (Appendix B, Table B6). PCB was below the MDPH action level of 2.0 ppm in all three lakes sampled. Mercury concentrations were below the MDPH action level of 0.5 ppm in fish from Great Pond. However,

MDPH issued the following fish consumption advisories due to mercury contamination for Mashpee-Wakeby ponds and Wequaquet Lake (MDPH 2002):

Mashpee-Wakeby ponds (Mashpee/Sandwich):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Mashpee-Wakeby Pond."
2. "The general public should limit consumption of smallmouth bass from Mashpee-Wakeby Pond to two meals per month."

Wequaquet Lake (Barnstable):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume largemouth bass from Lake Wequaquet."
2. "The general public should limit consumption of largemouth bass from Lake Wequaquet to two meals per month."

In 1992, DFWELE collected fish from Snake Pond (MA96302) in Sandwich. MDPH issued the following advisory for Snake Pond:

Snake Pond (Sandwich):

1. "Children younger than 12 years, pregnant women and nursing mothers should not consume any fish from Snake Pond."
2. "The general public should not consume smallmouth bass caught from Snake Pond."
3. "The general public should limit consumption of non-affected fish species from Snake Pond to two meals per month."

These nine lakes are impaired (non-support due to mercury contamination) for the *Fish Consumption Use* (Table 5). [NOTE: The MDPH fish consumption advisory list contains the status of each water body for which an advisory has been issued. If a water body is not on the list it may be because either an advisory was not warranted or the water body has not been sampled. MDPH's most current Freshwater Fish Consumption Advisory List is available online at http://www.state.ma.us/dph/beha/fishlist.htm.]

MDPH expanded its previously issued statewide fish consumption advisory, which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age. MDPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. The advisory encompasses all freshwaters in Massachusetts and, therefore, the *Fish Consumption Use* for lakes in the Cape Cod Watershed cannot be assessed as support or partial support.

PRIMARY* AND *SECONDARY CONTACT RECREATION* AND *AESTHETICS

Data were collected in five lakes - Lower Mill Pond (MA96188), Ryder Pond (MA96268), Santuit Pond (MA96277), Upper Mill Pond (MA96324), and Walkers Pond (MA96331) - by DWM in 1999 for the purpose of TMDL development. Additionally macrophyte mapping surveys were performed on two lakes, Upper and Lower Shawmee Lakes (MA96326 and MA96288). These data, combined with the 1998 303(d) List of impaired waters and information provided by the Cape Cod Commission (Eichner et al, 1999) and the Orleans Water Quality Task Force (Town of Orleans, 2001), were used to assess the recreation and aesthetics uses.

Three of the five TMDL lakes (Lower Mill, Upper Mill and Walkers ponds in Brewster) surveyed by DWM in the Cape Cod Watershed in 1999 violated the Secchi disk depth bathing beach criterion of four feet (Appendix B, Table B3). These three lakes, representing 387 acres, were impaired (partially supported) for the *Primary* and *Secondary Contact Recreation* and *Aesthetics* U*ses*.

A portion of Upper Shawmee Lake and all of Lower Shawmee Lake were non-supported for these same uses due to dense growths of submergent aquatic plants and filamentous algae. The open area of Upper Shawmee Lake, as well as the entire lake areas of Crystal Lake (MA96050), Long Pond (MA96183), Ryder Pond (MA96268) and Santuit Pond (MA96277) were not assessed for the *Primary Contact Recreation Use*

but supported the *Secondary Contact Recreation* and *Aesthetic Uses.* The remaining 36 of the 46 lakes in this report are currently not assessed for these uses.

SUMMARY

A total of 17 of the 46 lakes in the Cape Cod Watershed assessed in this report were impaired for one or more uses. Causes of impairment included: noxious (overabundant) plant growth (including both native and exotic vegetation), organic enrichment/low dissolved oxygen and mercury. No lakes supported all uses nor were any assessed as support for *Primary Contact Recreation* use. Twenty-eight lakes are currently not assessed for any uses. Table 5 presents the use assessments for the individual lakes in the Cape Cod Watershed. Lakes that are currently not on the 1998 303(d) list, but are impaired for at least one designated use will be evaluated for possible addition to the 2002 303(d) List.

Table 5. Cape Cod Watershed Lake Assessments.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Ashumet Pond, Mashpee	MA96004	203.0	Not Assessed	Non-Support (mercury)	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Ashumet Pond (K-V Associates and IEP, 1991). An Ashumet Pond Well Field Design Report and Phosphorus Execution Plan has been produced for the U.S. Air Force, Center for Environmental Excellence/Massachusetts Military Reservation (Jacobs Engineering Group Inc. 1998). Ashumet Pond was treated in 2001 with aluminum sulfate to inactivate phosphorus and control algae (DeCesare 2001). A concrete ramp fisherman's access for smaller boats and parking for boat trailers (managed by DFWELE) is located at Ashumet Pond (DFWELE 2002a).							
Baker Pond, Orleans	MA96008	25.6	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A cartop public access site managed by DFWELE, is available for small boats, canoes and kayaks at Baker Pond (DFWELE 2002a).							
Bearse Pond, Barnstable	MA96012	59.0	Partial Support (Exotic Species – *Cabomba caroliniana*)	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Bearse Pond (IEP and K-V Associates, 1989). Herbicide treatments using the chemical SONAR were performed during 2000 and 2001 to control nuisance infestations of the non-native weed, *Cabomba caroliniana,* as well as several other native plants (DeCesare, 2001).							
Clapps Pond, Provincetown	MA96035	38.1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Cliff Pond, Brewster	MA96039	177.1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A fisherman's access concrete pad ramp system for smaller boats and parking for boat trailers (managed by MA DEM) is located at Cliff Pond (DFWELE 2002a).							
Crystal Lake, Orleans	MA96050	33.6	Support - 23.6 acres Partial Support - 10 acres (Organic enrichment/Low dissolved oxygen)	Not Assessed	Not Assessed	Support	Support
An MA DEM Lakes and Ponds Grant baseline lake study is available for Crystal Lake (Town of Orleans 2001).							
Depot Pond, Eastham	MA96061	26.5	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Lake Elizabeth, Barnstable	MA96080	8.9	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Flax Pond, Bourne	MA96087	19.3	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Flax Pond, Dennis	MA96090	15.9	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Goose Pond, Chatham	MA96106	34.5	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
WMA Registration Number 42205502 is permitted to withdraw water for cranberry bog operations from Goose Pond (Appendix C, Table C2).							
Great Pond, Truro	MA96114	17.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Great Pond, Eastham	MA96115	110.5	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic and feasibility study is available on Great Pond (Baystate 1987). In 1994 MA DEP performed fish tissue toxics sampling on Great Pond (Appendix B). A fish advisory was not issued.							
Gull Pond, Wellfleet	MA96123	102.7	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Hamblin Pond, Mystic/Barnstable	MA96126	149.0	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A diagnostic and feasibility study is available on Hamblin Pond (Baystate 1993). A gravel ramp fisherman's access for smaller boats and parking for boat trailers (managed by the Town of Barnstable) is located at Hamblin Pond (DFWELE 2002a). WMA registration number 42226103 is permitted to withdraw water for cranberry bog operations from Hamblin Pond (Appendix C, Table C2).							
Herring Pond, Eastham	MA96133	42.7	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic and feasibility study is available on Herring Pond (Baystate 1991).							
Hinckleys Pond, Harwich	MA96140	165.6	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Hoxie Pond, Sandwich	MA96146	8.8	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
WMA registration number 42226110 is permitted to withdraw water for cranberry bog operations from Hoxie Pond (Appendix C, Table C2).							
Johns Pond, Mashpee	MA96157	323.0	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Johns Pond (McVoy, 1982). WMA registration number 42202019 is permitted to withdraw water for cranberry bog operations from John's Pond (Appendix C, Table C2). WMA registration number 42217205 is permitted to withdraw water from John's Pond (Appendix C, Table C2). A concrete ramp fisherman's access for smaller boats and parking for boat trailers (managed by DFWELE) is located at John's Pond (DFWELE 2002a).							
Long Pond, Wellfleet	MA96179	32.7	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Long Pond, Yarmouth	MA96180	59.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Long Pond (Metcalf & Eddy, 1986). A fisherman's access concrete pad ramp system for smaller boats and parking for boat trailers (managed by The Town of Yarmouth) is located at Long Pond (DFWELE 2002a).							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Long Pond, Brewster/Harwich	MA96183	743.0	Support – 593 acres Partial Support – 150 acres (Organic Enrichment/Low dissolved oxygen)	Not Assessed	Not Assessed	Support	Support
WMA Registration Number 42212602 is permitted to withdraw water for cranberry bog operations from Long Pond (Appendix C, Table C2).							
Long Pond, Barnstable	MA96184	49.0	Partial Support (Exotic Species – *Hydrilla verticillata*)	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Long Pond (IEP and K-V Associates, 1989).							
Lower Mill Pond, Brewster	MA96188	29.0	Support	Not Assessed	Partial Support (Turbidity)	Partial Support (Turbidity)	Partial Support (Turbidity)
Mashpee Pond, Mashpee/Sandwich	MA96194	378.0	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A general access concrete boat ramp and parking for boat trailers (managed by the Town of Mashpee) is located at Mashpee Pond (DFWELE 2002a).							
Nye Pond, Sandwich	MA96228	6.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
WMA registration number 42226110 is permitted to withdraw water for cranberry bog operations and WMA registration number 42226113 is permitted to withdraw water for fish hatchery operations from Nye Pond (Appendix C, Table C2).							
Peters Pond, Sandwich	MA96244	127.0	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
Pilgrim Lake (Dean Sparrows Pond), Orleans	MA96246	38.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Red Lily Pond, Barnstable	MA96257	4.4	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Red Lily Pond (K-V Associates and IEP, 1987).							
Reservoir, Yarmouth	MA96258	65.5	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Ryder Pond, Truro	MA96268	18.0	Support	Not Assessed	Not Assessed	Support	Support
Santuit Pond, Mashpee	MA96277	167.4	Support	Not Assessed	Not Assessed	Support	Support
WMA registration numbers 42202002 and 42217204 are permitted to withdraw water for cranberry bog operations from Santuit Pond (Appendix C, Table C2).							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Scargo Lake, Dennis	MA96279	53.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Schoolhouse Pond, Chatham	MA96281	18.6	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Shallow Pond, Barnstable	MA96285	75.8	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Shallow Pond (K-V Associates and IEP 1993).							
Shawme Pond (Lower), Sandwich	MA96288	24.0	Not Assessed	Not Assessed	Non-Support (Noxious Aquatic Plants)	Non-Support (Noxious Aquatic Plants)	Non-Support (Noxious Aquatic Plants)
A diagnostic and feasibility study is available for Upper and Lower Shawme Ponds (Lycott Environmental 1998). A synoptic aquatic macrophyte survey was performed by MA DEP/DWM for the Town of Sandwich during 1999 (DeCesare 2000).							
Sheep Pond, Brewster	MA96289	139.8	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Sheep Pond (IEP 1993). A concrete ramp fisherman's access for smaller boats and parking for boat trailers (managed by the Town of Brewster) is located at Sheep Pond (DFWELE 2002a).							
Shubael Pond, Barnstable	MA96293	54.9	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
A gravel ramp fisherman's access for smaller boats and parking for boat trailers (managed by the Town of Barnstable) is located at Shubael Pond (DFWELE 2002a).							
Snake Pond, Sandwich	MA96302	81.4	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
Upper Mill Pond (Walkers Pond), Brewster	MA96324	253.0	Support – 168 acres Partial Support – 85 acres (Organic Enrichment/Low dissolved oxygen)	Not Assessed	Partial Support (Turbidity)	Partial Support (Turbidity)	Partial Support (Turbidity)
Upper Shawme Lake, Sandwich	MA96326	20.0	Not Assessed	Not Assessed	Non-Support – 8 acres Not Assessed – 12 acres (Noxious aquatic plants)	Support – 12 acres Non-Support – 8 acres (Noxious aquatic plants)	Support – 12 acres Non-Support – 8 acres (Noxious aquatic plants)
A diagnostic and feasibility study is available for Upper and Lower Shawme Ponds (Lycott Environmental 1998). A synoptic aquatic macrophyte survey was performed by DEP/DWM for the Town of Sandwich during 1999 (DeCesare 2000).							
Village Pond, Truro	MA96329	6.0	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Walkers Pond (Upper Mill Pond), Brewster	MA96331	105.0	Support	Not Assessed	Partial Support (Turbidity)	Partial Support (Turbidity)	Partial Support (Turbidity)
Wequaquet Lake, Barnstable	MA96333	579.0	Partial Support (Exotic species – *Cabomba caroliniana*)	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A diagnostic/feasibility study is available for Wequaquet Lake (IEP and K-V Associates, 1989). A concrete ramp fisherman's access for smaller boats and parking for boat trailers (managed by the Town of Barnstable) is located at Wequaquet Lake (DFWELE 2002a).							
Cedar Lake, Falmouth	MA96344	19.4	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Wakeby Pond, Mashpee/Sandwich	MA96346	351.0	Not Assessed	Non-Support (Mercury)	Not Assessed	Not Assessed	Not Assessed
A general access concrete boat ramp and parking for boat trailers (managed by the Town of Mashpee) is located at Wakeby Pond (DFWELE 2002a). WMA Registration Number 42226102 is permitted to withdraw water from Wakeby Pond for cranberry bog operations (Appendix C, Table C2).							

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LIST OF APPENDICES, TABLE AND FIGURES

APPENDIX A – DATA VALIDATION REPORT FOR 1999 AND 1994 MA DEP/DWM CAPE COD WATERSHED MONITORING

The objective of DWM's data validation process is to ensure that the quality of monitoring data meets defined criteria for acceptability as "final", usable data. This is accomplished by thoroughly reviewing and evaluating all draft data and associated field and laboratory quality control information.

This report includes evaluation of all 1999 data collected in the Cape Cod watershed by DWM as part of Year-2 monitoring. In addition to 1999 fish toxics data, this report also includes evaluation of 1994 Cape Cod fish toxics data.

This Appendix is divided into seven sections as follows:

- A1. Introduction
- A2. The Data Validation Process for 1999 Cape Cod Data
- A3. 1999 QAPPs/SOPs Used in Cape Cod Monitoring
- A4. 1999 QA/QC Acceptance Criteria for Cape Cod Data
- A5. QC-Sample Data and Validation Decisions for Cape Cod Data (1999 water quality and 1999/1994 fish toxics)
- A6. 1999 Analytical Methods and MDLs
- A7. Conclusions

A1. INTRODUCTION

The following data were generated in 1999 by DWM for the Cape Cod watershed, and were used in this assessment:

In–situ Hydrolab® readings and associated lake and tributary water quality data (e.g. total phosphorus, chlorophyll *a*, alkalinity) at five lakes and several tributaries, fish tissue toxics data at two lakes, and aquatic macrophyte survey data at seven lakes

Other than selected inlets/tributaries, no stream or river sampling was performed by DWM in the Cape Cod watershed in 1999. A total of five ponds were sampled for TMDL development. For monitoring locations, parameters and dates, see Table B1 in Appendix B.

A2. THE DATA VALIDATION PROCESS FOR 1999 CAPE COD DATA

The procedures used to accept, accept with qualification or censor data were based on the draft DWM Standard Operating Procedure (SOP) for data validation (MA DEP 2001b). These procedures are supplemental to separate data quality assurance activities and laboratory validation performed by the analytical laboratory, Wall Experiment Station (WES).

The data validation SOP outlines specific criteria by which to evaluate data quality and acceptability. These criteria pertain to the following elements:

Conformance to DWM-project and DWM-programmatic Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs)

Precision (review of overall precision, including field precision and lab precision)

Accuracy (review of lab quality control data regarding analysis of blind performance evaluation samples, internal check standards, blanks and matrix spike samples)

Representativeness (review of field data sheets and field SOPs used to collect the data for the evidence of the potential for non-representative conditions at the time of sampling)

Holding Times and Preservation (review for conformance to method holding times and preservation requirements for samples)

Frequency of Field QC samples (review for conformance to standard DWM requirements for the number of field blank and split/duplicate samples taken per total number of samples taken)

Contamination of Field Blanks (review of blank analyses for detectable analyte concentrations)

Completeness (review of the amount of usable data in comparison to that intended to be collected)

Chain-of-Custody (review of sample handling and transfer records)

Data that fell outside QA/QC acceptance criteria were investigated and may have been subject to censoring or qualification. Specific symbols and qualifiers used to censor and qualify data are provided in Table A2.1.1.

Completion of 1999 data validation for Cape Cod data resulted in the entry of the "final" data into the DWM water quality database (WQD), and its use for assessment purposes.

Table A2.1.1. Data Symbols and Qualifiers.

Symbol/ Qualifier	Data Source	Definition
**	All	Censored or missing data
--	All	No data
<mdl	All	Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (e.g. <0.2).
c	Hydrolab®	Greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 µS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading).
i	Hydrolab®	inaccurate readings from Hydrolab® multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, or lack of calibration of the depth sensor prior to use.
m	Hydrolab®	method not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.
s	Hydrolab®	Field sheet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure.
u	Hydrolab®	unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.
?	Hydrolab®	Light interference on Turbidity sensor (Hydrolab® error message). Data is typically censored.
a	Discrete samples	accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.
b	Discrete samples	blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).
d	Discrete samples	Precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP.

Table A2.1.1. Continued. Data Symbols and Qualifiers.

Symbol/ Qualifier	Data Source	Definition
e	Discrete samples	Not theoretically possible; specifically, used for bacteria data where colonies per unit volume for E. coli bacteria > fecal coliform bacteria, and for lake Secchi and station depth data where a specific Secchi depth is erroneously reported as greater than the reported station depth.
f	Discrete samples	frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.
h	Discrete samples	holding time violation (usually indicating possible bias low)
j	Discrete samples	'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used by WES to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl).
m	Discrete samples	method SOP not followed or fully implemented, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), or additional steps taken by the lab to deal with matrix complications.
p	Discrete samples	Samples not preserved per SOP or analytical method requirements.
r	Discrete samples	Samples collected not **r**epresentative of actual field conditions.

A3. 1999 QAPPS/SOPS USED IN CAPE COD WATERSHED MONITORING

Quality assurance and quality control (QA/QC) planning/process documents in place and activities performed before, during and/or after 1999 Cape Cod monitoring included:

Production of a 1999 QAPP for Baseline Lake TMDL assessments (MA DEP 1999a; CN 22.0)

Production of an SOP for grab sample collection (MA DEP 1999b; CN 1.0). This included the use of bucket samplers (this technique has been discontinued).

Production of a 1999 Quality Assurance Project Plan (QAPP) for fish contaminant monitoring (MA DEP. 1999c; CN 13.0)

Implementation of field and lab quality control standard operating procedures, including that for Hydrolab® multiprobe use (MA DEP 1999d; CN 4.0) and fish collection/preparation for fish tissue analysis (MA DEP 1999e; CN 40.0)

Production of an SOP for apparent color determination (MA DEP 1999f; CN 2.0)

Production of an SOP for chlorophyll *a* collection (MA DEP 1999g; CN 3.0)

On-going coordination with the WES laboratory regarding sample delivery, analysis and reporting

Post-monitoring data review and validation

The majority of analytical methods used by WES in 1999 (and 1994 for fish toxics) were based on those contained in Standard Methods (Clesceri et al. 1998), as well as based on EPA (and AOAC) methods.

A4. 1999 QA/QC ACCEPTANCE CRITERIA FOR CAPE COD DATA

A4.1 QA/QC OBJECTIVES AND CRITERIA FOR 1999 IN-SITU HYDROLAB® MULTI-PROBE DATA

Trained DWM staff members conducted in-situ measurements using a Hydrolab® Series 3 Multiprobe instrument that simultaneously measures dissolved oxygen, temperature, pH, conductivity, and depth, and provides calculated estimates for total dissolved solids/salinity, and % saturation of oxygen.

To ensure the quality of the data, the following QA/QC steps were taken for Cape Cod surveys:

- Pre- Survey Calibration and Check: Standard pre-survey calibration of the Hydrolab® unit was conducted in accordance with the DWM SOP for Hydrolab® use. After the instrument was calibrated and before the instrument was released to field staff, an instrument check using both a low ionic standard and filtered de-ionized water was performed. The purpose of this check is to make sure that the instrument is providing stable readings as the waters in Massachusetts are typically of low ionic strength. If the instrument failed acceptance criteria, it was not released to field staff until the source of error was identified and corrected.

- Post Survey Check: A standard post survey check of the Hydrolab® unit was performed in accordance with the DWM SOP for Hydrolab® use. Upon return of the Hydrolab® unit to DWM's lab after a survey run, a visual inspection was performed to identify any physical damage that may have occurred in the field. The calibration of the unit was then checked against both a low ionic standard and filtered de-ionized water. The results of the post survey calibration check were compared to the pre-calibration results. If visual damage was observed and/or post calibration acceptance criteria were not achieved, the source of error was investigated and data collected in the field may have been subject to qualification or censoring.

- Data Reduction: The Hydrolab® Coordinator and Database Manager reviewed the Hydrolab® data for instability, instrument malfunction, operator error and aberrant trends. If any of these conditions were detected, the data were further investigated and may have been recommended for qualification or censoring. Measured data are specifically evaluated for the following:

- Consistency with the Hydrolab® SOP (specifically, the requirement for three (minimum)-five(preferred) sequential readings one-minute-apart at appropriate depths, proper field use, etc.).

- Accuracy and precision of readings, as assessed through review of pre-survey calibration/check and post-survey check data, as well as field notes for any information on faulty operation and/or unusual field conditions.

- Representativeness of data (review of field sheets and notes for any information that might indicate non-representativeness; e.g. not taken at the deep hole).

- Check for "outliers" or unreasonable data, based on best professional judgment. Outliers are identified and flagged for scrutiny. For lake depth profiles, it is recognized that thermal stratification can cause rapid changes in Hydrolab® parameters within the thermocline, often resulting in unstable readings (typically qualified with "u").

- In lieu of verifying in the electronic record that the Hydrolab® was depth-calibrated prior to use, both general and specific criteria are used to accept, qualify or censor of Hydrolab® Depth readings, as follows: General Depth Criteria: Apply to each OWMID#; For negative and zero depth readings: Censor (i), (likely in error); for 0.1 m depth readings: Qualify (i), (potentially in error); and for 0.2 and greater depth readings: Accept without qualification, (likely accurate). Specific Depth Criteria: Apply to entirety of depth data for survey date. If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, i.e. that all positive readings may be in error.).

• The criterion used for 1999 data to accept, qualify or censor Conductivity (and the dependent, calculated estimates for TDS and Salinity) readings was based on exceedance of the calibration standard concentration. For exceedances greater than two times the standard, the conductivity reading was typically censored. Readings were qualified for exceedances less than two times the calibration standard. Note: In cases where readings fell far below the calibration standard concentration (e.g. measured value of 100 µS/cm using 6668 calibration standard), no censoring or qualification was imposed. Turbidity data with respect to the calibration standard concentration was evaluated on a case-by-case basis without any set criteria.

• For D.O. values less than 1 mg/l, 1999 data were accepted without qualification and reported as "<1".

A4.2 QA/QC OBJECTIVES AND CRITERIA FOR 1999 CAPE COD DISCRETE WATER SAMPLE DATA

The collection and laboratory analysis of discrete water samples from the Cape Cod watershed followed the DWM Standard Operating Procedure for grab sampling (CN# 1.0) and analyte-specific WES SOPs. Using the following criteria, as well as other considerations and input from data reviewers, individual datum were accepted, accepted with qualification or censored. In cases where poor quality control (e.g. blank/cross contamination) affected batched analyses or entire surveys, censoring/qualification decisions were applied to groups of samples (e.g. a specific crew's samples, a specific survey's samples or all samples from a specific batch analysis).

- Sampling/Analysis Holding Time: Each analyte has a standard holding time that has been established to ensure sample/analysis integrity. Refer to DWM Standard Operating Procedure CN# 1.0 for a complete listing. If the standard holding time was exceeded, this criterion is violated and the data may be censored, depending on the extent of exceedance. For very minor exceedances (e.g. < than 10% of the holding time), the data is typically qualified with an "h" for holding time violation.

- Quality Control Sample Frequency: At a minimum, one field blank and one replicate must have been collected for every ten samples by any given sampling crew on any given date. If less than 10% blanks and/or replicates were collected, the data may be censored or qualified, based on a review of crew member experience, training and history, as well as other factors relevant to the specific survey.

- Field Blanks: Field blanks were prepared at the DWM Worcester Laboratory. Reagent grade water was transported into the field in a sample container where it was transferred into a different sample container and fixed where necessary using the same method as its corresponding field sample. All blanks were submitted to the WES laboratory "blind". If the field blank results were greater than the MDL, the analyte-specific data for that survey may be censored or qualified (determined on a case by case basis).

- Field Replicates: In 1999, field duplicate samples were taken as "split" samples, where two independent samples were created from a larger volume sample (not sequential duplicates or co-located duplicates). Both samples were submitted to WES laboratory "blind". In order for this data quality criterion to be met, the results must generally be:
- <20% Relative Percent Difference (RPD) for method detection limits >1mg/L, or
- <30% RPD for method detection limits <1mg/L.

or meet more specific criteria contained in a 1999 QAPP. If the criteria are not met, the data may be censored or qualified, depending on extent of exceedance and other factors. In most cases, poor precision of field split samples reflects potential poor reproducibility for entire surveys and/or analytical batch runs, and may lead to the censoring/qualification of same.

- Laboratory assessment of analytical precision and accuracy: The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. WES staff release discrete water sample data when their established QA/QC criteria have been met. When the following criteria cannot be met, data are qualified as "estimated" (using a "J" value) if appropriate, or no data ("ND") is reported:

• Low Calibration Standards – Checks the stability of the instrument's calibration curve; analyzes the accuracy of an instrument's calibration within a 5% range.

• Reference Standards – Generally, a second source standard (a standard different from the calibration stock standard) that analyzes the method accuracy.

• Laboratory Reagent Blank/Method Blank (LRB) – Reagent grade water (de-ionized) extracted with every sample set used to ensure that the system is free of target analytes (< MDL) and to assess potential blank contamination.

• Duplicate Sample – Measures the precision (as Relative Percent Difference or RPD) of the analytical process. The acceptable laboratory %RPD range is typically ≤ 25%.

• Spike Sample (Laboratory Fortified Blank - LFB, Laboratory Fortified Matrix - LFM) – Measures the accuracy (% Recovery) of an analytical method. The acceptable laboratory % recovery range is typically between 80 – 120% for LFB samples and 70 –130% for LFM discrete water samples.

• Range of Logs (bacteria data) – Acceptance limits established by WES for range of log-tranformed duplicate data.

A4.3 QA/QC OBJECTIVES AND CRITERIA FOR 1999 AND 1994 FISH TISSUE CONTAMINANT DATA

Fish from lakes in the Cape Cod watershed were collected and processed according to the DWM 1999 Standard Operating Procedure (SOP) for fish contaminant monitoring (now CN 40.0). This SOP adheres to EPA-approved laboratory QA/QC methodologies (EPA 823-R-95-007).

Laboratory data quality was assessed at WES by analyzing the following quality control samples:

• Laboratory Reagent Blank/Method Blank (LRB) – Clean clam tissue matrix extracted with every sample set to ensure that the system is free of target analytes (< MDL) and to assess the potential for blank contamination.

• Laboratory Fortified Blank (LFB) – Clean clam tissue matrix spiked with a low concentration of target compounds. LFB results are used to establish accuracy of system's performance. The acceptable laboratory % recovery range is typically 80 – 120%.

• Laboratory Fortified Matrix (LFM) – Tissue matrix spiked with a low concentration of a target compound. LFM and LFM duplicate results are used to establish accuracy of the extraction and analytical process. The acceptable laboratory % recovery range is typically between 70 – 130% for metal analysis and 60 – 140% for PCB/Organochlorine Pesticide analysis.

• Quality Control Standard (QCS) – A pre-spiked secondary tissue sample. QCS results are used to establish accuracy in the extraction and test methods. The acceptable laboratory % recovery range is typically between 80–120%.

• Laboratory sample duplicates – A second lab sample is taken the blended fish tissue slurry for analysis of all analytes. Used to estimate analytical precision, the acceptable laboratory relative percent difference (RPD) for lab duplicates is typically 80-120%.

A4.4 QA/QC OBJECTIVES OF 1999 DATA FOR BENTHIC MACROINVERTEBRATES, AQUATIC HABITAT AND OTHER BIOLOGICAL MONITORING (PERIPHYTON, AQUATIC MACROPHYTES, PHYTOPLANKTON)

Macroinvertebrate sampling and processing was conducted by DWM biologists, as described in the SOP Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates (CN 39.0), which is based on US EPA Rapid Bioassessment Protocols (RBP III). The QAPP for 1999 biomonitoring outlined general QC steps that included:

- Thorough rinsing of sampling equipment between stations to prevent inter-station effects.
- Duplication and checking (for transcription errors) of documentation and database entries.
- In-house spot-checking (among two DWM biologists) of taxa identifications for accuracy.

A5. QC-SAMPLE DATA AND VALIDATION DECISIONS FOR CAPE COD MONITORING

Data validation procedures, as now outlined in DWM's draft Data Validation SOP (MA DEP 2001b; CN 56.0) were applied to in-situ Hydrolab®, discrete water quality and fish tissue data. The 1999 Data Validation Report (MA DEP 2001a, CN 73.0) summarizing all 1999 data validation results is also available as a separate evaluation.

Assessment and validation of the benthic macroinvertebrate, periphyton, phytoplankton, aquatic macrophyte and habitat data collected from the Cape Cod watershed is not covered here. DWM QA/QC assessment of benthic/habitat data is general in nature (ie. adherence to the SOP and QAPP and discussions with primary staff on QAPP implementation).

A5.1 HYDROLAB DATA® VALIDATION

Review of 1999 Hydrolab® data and imposition of the data acceptance criteria identified in A4.1 resulted in specific validation decisions (censored, qualified or accepted without qualification), as follows in Table A5.1.1. All other data were accepted. See the 1999 Data Validation Report (CN 73.0) appendix for the complete Hydrolab® QC records (MA DEP 2001a).

Table A5.1.1. 1999 Cape Cod Censored/Qualified Hydrolab® Data.

Survey	Survey Date(s)	OWMID #s	Censored/ Qualified Parameters	Censored/ Qualified	REASON AND/OR CLARIFICATION
Lakes Baseline	15 September 1999	LB-0274	pH at 6.5 m	Qualify (u)	Unstable readings
Lakes Baseline	15 September 1999	LB-0278	D.O., pH and % SAT at 2.5 m	Qualify (u)	Unstable readings
Lakes Baseline	13 September 1999	LB-0284	Temp. at 10.0 m	Qualify (u)	Unstable readings
Lakes Baseline	13 September 1999	LB-0290	D.O. and % SAT at 1.5 m pH at 2.5 m	Qualify (u) Censor (u) (m)	Unstable readings Unstable readings (only 3) decreasing rapidly

A5.2 DISCRETE WATER SAMPLE DATA VALIDATION

A5.2.1 Quality Control Sample Results

Field blank (all DWM lake surveys) and field replicate (Cape Cod surveys) QC sample results for discrete water quality sample data are provided in Tables A.5.2.1 and A5.2.2. Quality control sample data are

stored and maintained in the Water Quality Data (WQD) Access Database. All baseline lake blank samples showed values at or below MDL. Split sample results for Cape Cod surveys showed RPD's less than 20%, except for alkalinity split samples on 15 September 1999 (Walkers Pond) that indicated 29% RPD, and an RPD of 46% for a non-Cape Cod lake that was run batched with Cape Cod samples. The latter resulted in qualification of associated Cape Cod samples with "d".

Table A5.2.1. 1999 MADEP/DWM in-lake physico-chemical QA/QC field blank data. (All units expressed in mg/L unless otherwise specified.)

Date	OWMID	QA/QC	Alkalinity (mg/L)	Color (PCU)	Total Phosphorus (mg/L)
Field Blank Sample					
08/03/99	LB-0078	BLANK	<2.0	<15	<0.005
09/29/99	LB-0229	BLANK	--	--	<0.005
08/05/99	LB-0105	BLANK	<2.0	<15	<0.005
09/28/99	LB-0405	BLANK	<2.0	<15	<0.005
08/31/99	LB-0380	BLANK	<2.0	<15	<0.005
09/29/99	LB-0234	BLANK	<2.0	--	--
07/29/99	LB-0053	BLANK	<1.0	<15	<0.005
08/25/99	LB-0203	BLANK	<2.0	<15	<0.005
09/23/99	LB-0354	BLANK	<2.0	<15	<0.005
08/04/99	LB-0096	BLANK	<2.0	<15	<0.005
09/01/99	LB-0241	BLANK	<2.0	<15	<0.005
10/05/99	LB-0390	BLANK	<2.0	<15	<0.005
09/02/99	LB-0256	BLANK	<2.0	<15	<0.005
07/28/99	LB-0065	BLANK	<1.0	<15	<0.005
08/26/99	LB-0216	BLANK	<2.0	<15	<0.005
09/22/99	LB-0365	BLANK	<2.0	<15	<0.005
08/05/99	LB-0415	BLANK	<2.0	<15	<0.005
08/12/99	LB-0187	BLANK	--	--	<0.005
07/15/99	LB-0029	BLANK	<2.0	<15	<0.005
08/12/99	LB-0183	BLANK	--	--	<0.005
09/13/99	LB-0329	BLANK	<2.0	<15	<0.005
07/27/99	LB-0041	BLANK	<1.0	<15	<0.005
08/24/99	LB-0191	BLANK	<2.0	<15	<0.005
09/21/99	LB-0341	BLANK	<2.0	<15	<0.005
07/14/99	LB-0023	BLANK	<2.0	<15	<0.005
08/11/99	LB-0171	BLANK	<1.0	<15	<0.005
09/09/99	LB-0316	BLANK	<2.0	--	<0.005
07/13/99	LB-0003	BLANK	2.0	**	<0.005
08/10/99	LB-0153	BLANK	<1.0	<15	<0.005
09/07/99	LB-0304	BLANK	<2.0	--	<0.005
09/13/99	LB-0281	BLANK	<2.0	<15	<0.005
08/11/99	LB-0120	BLANK	--	--	<0.005
09/15/99	LB-0267	BLANK	<2.0	--	<0.005

" ** " = Censored or missing data
" -- " = No data
"<mdl " = Less than method detection limit (mdl). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric mdl is typically specified (e.g. <0.2).

Table A5.2.2. 1999 MADEP/DWM Cape Cod physico-chemical QA/QC field replicate data. (All units expressed in mg/L unless otherwise specified.)

Date	OWMID	OWMID QA/QC	Alkalinity (mg/L)	Color (PCU)	Total Phosphorus (mg/L)
Ryder Pond (MA96268)					
Station: A	Description: deep hole in northwest quadrant of pond, Truro.				
9/13/1999	LB-0279	LB-0280	<2.0	<15	0.008
9/13/1999	LB-0280	LB-0279	<2.0	<15	0.008
	Relative Percent Difference (RPD):		*0.0%*	*0.0%*	*0.0%*
Walkers Pond (MA96331)					
Station: A	Description: deep hole, mid pond, Brewster.				
8/11/1999	LB-0118	LB-0119	--	--	0.074
8/11/1999	LB-0119	LB-0118	--	--	0.074
	Relative Percent Difference (RPD):				*0.0%*
9/15/1999	LB-0265	LB-0266	6.0	--	0.054
9/15/1999	LB-0266	LB-0265	8.0	--	0.054
	Relative Percent Difference (RPD):		*28.6%*		*0.0%*

" ** " = Censored or missing data
" -- " = No data
" **d** " = Precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.
" **m** " = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

A5.2.2 Censored/Qualified 1999 Cape Cod Discrete Water Sample Data

Data censored, qualified or accepted without qualification are summarized below. All other discrete water sample data were accepted.

Table A5.2.3. 1999 DEP Cape Cod (and relevant) Censored/Qualified Discrete Water Sample Data.

Watershed/ waterbody	Sample Date	OWMID #s	Analyte	Censored/ Qualified	Reason
Santuit Pond	15 September 1999	LB-0286	Color	Censor (m)	No analysis date provided.
Walkers Pond	15 September 1999	LB-0265 LB-0266	Alkalinity	Accept without qualification	Field split rpd's = 29% (minor exceedance of DQO)
Lower Mill Pond	15 September 1999	LB-0277	Chlorophyll *a*	Censor (m)	Sample not analyzed at lab; not reported
Gauawatte Farm Pond (primary; other lakes' samples in batch run affected)	13 September 1999	LB-0327 LB-0328 also LB-0279 LB-0280 LB-0281 LB-0282 LB-0285 LB-0286 LB-0328 LB-0329 LB-0330 LB-0333 LB-0334	Color	Qualify (d)	Field Split rpd = 46% (major exceedance of DQO; not enough justification to discard data, but batch run qualified

A5.3 1999 BENTHIC MACROINVERTEBRATE, HABITAT ASSESSMENT AND FISH POPULATION DATA

No DWM Benthic Macroinvertebrate, Habitat Assessment or Fish Population surveys were performed in the Cape Cod Watershed.

A5.4 1994 AND 1999 CAPE COD FISH TOXICS DATA

All fish tissue data from the Cape Cod watershed gathered in 1994 and 1999 are acceptable and usable. The results and conclusions contained in DWM's 1999 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys report are valid. See Tables A5.4.1 through A5.4.5 for QC sample data.

A5.4.1 1994 Cape Cod Fish Toxics Data

DWM finds all 1994 fish tissue data from the Cape Cod watershed to be acceptable and usable. All fish tissue data passed QC acceptance limits of the WES laboratory and lab-validated data were reported by WES without qualification. Users should take the age of the data into account.

All lab organics blanks showed non-detectable concentrations. Lab fortified matrix sample spike/spike duplicate recovery using PCB arochlor 1260 was 146%, and that for lindane, heptochlor, aldrin and DDT were 63%, 91%, 109% and 64%, respectively. This indicates potential significant error in the associated batch analysis of lindane, PCB arochlor 1260 and DDT. Lab duplicate data showed non-detectable concentrations for all analytes tested, and therefore, precision estimates are not possible.

Lab accuracy estimates for metals using lab-fortified blanks ranged from 75-132 % recovery, and for QC samples ranged from 90-110 % for Cape Cod samples (acceptable). Other fish tissue batch runs by WES in 1994 showed QC sample results for Pb of <MDL (on two occasions). This indicates that sample results for lead for the associated batched samples may have significant error. Lab accuracy estimates for metals using fortified sample matrix samples ranged from 72 to 116 % recovery for all analytes, except for one Se matrix sample at 64% recovery (batched with others). Lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) were generally 24% RPD or less, except for one batched sample for arsenic, where the RPD was 181% (.041 and <MDL). This sheds questions on the arsenic results for that batch run.

Although the metals and organics data have been accepted without qualification, potential users of data involving poor quality control (as referenced above) are advised to consider the potential error in sample data for specific analytes.

Relevant QC information for 1994 fish toxics data are also provided in the tables below.

A5.4.2 1999 Cape Cod Fish Toxics Data

All fish tissue data passed QC acceptance limits of the WES laboratory and lab-validated data were reported by WES without qualification.

Although detailed data quality objectives (DQOs) for the 1999 Cape Cod fish contaminant monitoring were not developed, the analytical QC data generally showed acceptable analyte spike recoveries when compared to typical DQOs for fish tissue analysis and WES' acceptance limits. For comparison, DWM's current, 2001 DQOs for overall precision of metal/PCB/pesticide monitoring are generally 30% RPD. The quality control acceptance limits of WES for analytical accuracy and precision were met for all samples. Sample holding times prior to analysis and extract holding times prior to GC injection were met for all samples.

All lab organics blanks showed non-detectable concentrations. Lab fortified blanks (LFB) for organics ranged from 95-128%, with exception of 67% for PCB Arochlor 1242. Lab fortified matrix samples using PCB arochlors and selected pesticides showed good recoveries, ranging from 94-120 % for LFM and LFM duplicates. Lab duplicate data for DDE, DDT and the congenor BZ#118 were acceptable. Since there were no field duplicates (additional three fish composite of one species) taken, estimates of overall

precision (as RPD) were not possible; precision data provided here is based on lab duplicates. Although DWM now typically collects two same-specie, three-fish composites from the same waterbody at a rate of 10% of waterbodies sampled (as a field "duplicate"), this was not performed in 1999 for the Cape Cod watershed. While this information would have been helpful in assessing in-lake/in-river variability in tissue concentrations for same-specie fish, lack of field duplicates does not affect fish tissue data validation.

Lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) were acceptable at 10% RPD or less. Lab accuracy estimates for metals using fortified blanks and QC samples were also acceptable ranging from 82 to 115 % recovery for all analytes. Lab accuracy estimates for metals using fortified sample matrix samples were acceptable, ranging from 73-117% for all samples, except for L990212-1 for Arsenic. Lack of precision data and a reported LFM of 50% for this QC sample undermines the usability of the associated batched sample data for Arsenic for Cape Cod samples.

Although the metals and organics data have been accepted without qualification, potential users of data involving poor quality control (as referenced above) are advised to consider the potential error in sample data for specific analytes.

Relevant QC information for 1999 fish toxics data is provided in the Tables A5.4.1 through A5.4.5 below.

Table A5.4.1. 1999 and 1994 MA DEP/DWM laboratory QA/QC blank data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g-wet weight unless otherwise noted.)

DATE ANALYZED	LABORATORY SAMPLE NUMBER	ANALYTE		
		% Lipid	Pesticides	PCBs
2 December 1999	BLANK - 1	0.07	ND	ND
3 December 1999	BLANK - 2	0.09	ND	ND
7 December 1999	BLANK - 3	0.09	ND	ND
8 December 1999	BLANK - 4	0.08	ND	ND
9 December 1999	BLANK - 5	0.07	ND	ND
10 December 1999	BLANK - 6	0.09	ND	ND
14 December 1999	BLANK - 7	0.07	ND	ND
15 December 1999	BLANK - 8	0.15	ND	ND
16 December 1999	BLANK - 9	0.16	ND	ND
17 December 1999	BLANK - 10	0.10	ND	ND
21 December 1999	BLANK - 11	0.12	ND	ND
22 December 1999	BLANK - 12	0.09	ND	ND
15 February 1995	BLANK - 50	0.19	ND	ND
16 February 1995	BLANK - 51	0.26	ND	ND
17 February 1995	BLANK - 52	0.17	ND	ND

ND - Not detected or the analytical result is at or below the established method detection limit (listed in section A6).
NOTE: Cape Cod Watershed samples were batched with others. These laboratory QA/QC blank data for organics in fish tissue are pertinent to Cape Cod Watershed samples.

Table A5.4.2. 1999 MA DEP/DWM Cape Cod Watershed and 1994 MA DEP/OWM laboratory QA/QC data for metals in fish tissue. (Data expressed in mg/kg-wet weight unless otherwise noted.)

Sample ID	Analyte	Precision			LFM Accuracy					Accuracy (% Recovery)		MDL	Analytical Method
		Sample	Duplicate	RPD	Spike Amount	Spike Recovered	Percent Spike Recovery (%) (WES LFM)	Sample Mean	LFM (spike + sample)	LFB	QCS		
L990212-1	Se	0.23	0.21	9.1	2.0	1.54	77	0.220	1.76	92	94	0.04	EPA 200.9
L990212-1	As	0.05	*	NA	2.0	NA	50*	NA	NA	90	82	0.04	EPA 200.9
L990212-1	Pb	<MDL	<MDL	NA	20	17	85	NA	NA	94	110	0.20	EPA 200.7
L990212-1	Cd	<MDL	<MDL	NA	20	18.2	91	NA	NA	95	100	0.02	EPA 200.7
L990213-1	Hg	0.82	0.92	NA	2.0	2.14	107	NA	NA	115	105	0.02	EPA 245.6
L990211-1	Hg	0.55	0.54	1.8	2.0	1.94	97	0.545	2.49	115	105	0.02	EPA 245.6
L990211-2	As	<MDL	<MDL	NA	2.0	1.46	73	NA	NA	96	92	0.04	EPA 200.9
L990211-2	Se	0.120	0.116	3.4	2.0	2.34	117	0.118	2.46	92	94	0.04	EPA 200.9
L990211-2	Pb	<MDL	<MDL	NA	20	18.0	90	NA	NA	95	105	0.20	EPA 200.7
L990211-2	Cd	<MDL	<MDL	NA	20	18.2	91	NA	NA	92	100	0.02	EPA 200.7
94-4636	As	<MDL	<MDL	NA	NR	NA	78	NA	NA	75	98	0.040	EPA 200.9
94-4636	Se	0.169	0.172	1.8	NR	NA	72	NA	NA	132	92	0.040	EPA 270.2
94-4636	Cd	<MDL	<MDL	NA	NR	NA	116	NA	NA	106	96	0.20	EPA 213.1
94-4636	Pb	<MDL	<MDL	NA	NR	NA	110	NA	NA	96	90	1.00	EPA 239.1
94-4254	As	<MDL	<MDL	NA	NR	NA	84	NA	NA	73	111	0.04	EPA 200.9
94-4254	Pb	<MDL	<MDL	NA	NR	NA	113	NA	NA	117	97	1.0	EPA 239.1
94-4254	Cd	<MDL	<MDL	NA	NR	NA	87	NA	NA	101	115	0.20	EPA 213.1
94-4254	Se	0.084	0.078	7.4	NR	NA	72	NA	NA	87	76	0.04	EPA 270.2
94-3967	Se	0.203	0.178	13.1	NR	NA	104	NA	NA	118	87	0.002	EPA 270.2
94-3967	As	0.041	<MDL	2.5	NR	NA	80	NA	NA	70	109	0.04	EPA 200.9
94-3967	Pb	<MDL	<MDL	NA	NR	NA	70	NA	NA	80	80	0.05	EPA 200.7A
94-3967	Cd	<MDL	<MDL	NA	NR	NA	110	NA	NA	80	100	0.03	EPA 200.7A
94-3613	As	<MDL	<MDL	NA	NR	NA	96	NA	NA	117	67	0.04	EPA 200.9
94-3613	Se	0.14	0.13	7.4	NR	NA	127	NA	NA	91	114	0.002	EPA 270.2
94-3613	Cd	<MDL	<MDL	NA	NR	NA	100	NA	NA	100	100	0.03	EPA 213.1
94-3613	Pb	<MDL	<MDL	NA	NR	NA	110	NA	NA	110	<MDL	0.05	EPA 239.1
94-2530	Se	<MDL	<MDL	NA	NR	NA	64	NA	NA	93	80	0.002	EPA 270.2
94-2529	As	<MDL	<MDL	NA	NR	NA	75	NA	NA	89	91	0.04	EPA 200.9
94-2529	Pb	<MDL	<MDL	NA	NR	NA	98	NA	NA	97	98	0.03	EPA 239.1
94-2529	Cd	<MDL	<MDL	NA	NR	NA	102	NA	NA	90	100	0.01	EPA 213.1
94-3064	As	<MDL	<MDL	NA	NR	NA	85	NA	NA	89	90	0.04	EPA 200.9
94-3064	Cd	<MDL	<MDL	NA	NR	NA	100	NA	NA	100	100	0.01	EPA 213.1
94-3064	Pb	<MDL	<MDL	NA	NR	NA	90	NA	NA	110	<MDL	0.03	EPA 239.1

LFB - Laboratory Fortified Blank
LFM - Laboratory Fortified Matrix
MDL - Method Detection Limit
NA - Not Applicable
QCS - Quality Control Sample
RPD – Relative Percent Difference

LFM Accuracy Calculations: SA x %SR = SR ;SR + SM = LFM

* QC out of acceptable limits. Final concentration determined using “Method of Standard Additions”.

NOTE: Cape Cod Watershed samples were batched with other watershed samples. These laboratory QA/QC data for metals in fish tissue are pertinent to Cape Cod Watershed samples.

Table A5.4.2. . 1999 MA DEP/DWM Cape Cod Watershed and 1994 MA DEP/OWM laboratory QA/QC data for metals in fish tissue. (Data expressed in mg/kg-wet weight unless otherwise noted.)

Sample ID	Analyte	Precision			LFM Accuracy					Accuracy (% Recovery)		MDL	Analytical Method
		Sample	Duplicate	RPD	Spike Amount	Spike Recovered	Percent Spike Recovery (%) (WES LFM)	Sample Mean	LFM (spike + sample)	LFB	QCS		
94-3064	Se	0.09	0.09	0	NR	NA	118	NA	NA	92	80	0.002	EPA 270.2
94-4228	Hg	1.07	1.05	1.9	NR	NA	98	NA	NA	104	110	0.0002	EPA 245.1
94-3062	Hg	0.064	0.063	1.6	NR	NA	96	NA	NA	100	110	0.0002	EPA 245.1
94-3540	Hg	0.082	0.102	21.7	NR	NA	88	NA	NA	99	115	0.0002	EPA 245.1
94-4160	Hg	0.373	0.333	11.3	NR	NA	90	NA	NA	110	120	0.0002	EPA 245.1
94-4650	Hg	0.090	0.115	24.4	NR	NA	92	NA	NA	105	110	0.0002	EPA 245.1
94-2530	Hg	0.112	0.100	11.3	NR	NA	99	NA	NA	90	100	0.0002	EPA 245.1

LFB - Laboratory Fortified Blank
LFM - Laboratory Fortified Matrix
MDL - Method Detection Limit
NA - Not Applicable
QCS - Quality Control Sample
RPD – Relative Percent Difference

LFM Accuracy Calculations: SA x %SR = SR ;SR + SM = LFM

* QC out of acceptable limits. Final concentration determined using “Method of Standard Additions”.

NOTE: Cape Cod Watershed samples were batched with other watershed samples. These laboratory QA/QC data for metals in fish tissue are pertinent to Cape Cod Watershed samples.

Table A5.4.3. 1999 MA DEP/DWM laboratory QA/QC lab fortified blank data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g-wet weight unless otherwise noted.)

Date Analyzed	Laboratory Sample Number	%Lipids	Analyte	Spike Amount	Spike Recovered	Spike % Recovery
2 December 1999	Laboratory Fortified Blank #1	0.10	PCB A1260 MDL 0.11	0.96	0.95	99
7 December 1999	Laboratory Fortified Blank #2	0.07	Chlordane MDL 0.11	0.98	1.0	102
8 December 1999	Laboratory Fortified Blank #3	0.10	PCB A1242 MDL 0.26	1.0	0.67	67
14 December 1999	Laboratory Fortified Blank #4	0.07	Toxaphene MDL 0.59	0.96	0.91	95
16 December 1999	Laboratory Fortified Blank #5	0.08	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011	Lindane 0.010 Heptachlor 0.010 Aldrin 0.010 DDT 0.020	Lindane 0.0098 Heptachlor 0.0115 Aldrin 0.0120 DDT 0.0255	Lindane 98 Heptachlor 115 Aldrin 120 DDT 128

MDL – method detection limit
NOTE: Cape Cod Watershed samples were batched with others. These laboratory QA/QC lab fortified blank data for organics in fish tissue are pertinent to Cape Cod Watershed samples.

Table A5.4.4. 1999 and 1994 MA DEP/DWM laboratory QA/QC duplicate data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g-wet weight unless otherwise noted.)

Date Analyzed	Laboratory Sample Number	Analyte		
		Pesticides*	**PCBs***	**% Lipid**
3 December 1999	L990067-7	DDE 0.012 DDT 0.012	BZ# 118 0.0030	0.22
	L990067-7 duplicate	DDE 0.012 DDT 0.014	BZ# 118 0.0027	0.19
	relative percent difference	DDE 0% DDT 15.4%	BZ# 118 10.53%	15%
10 December 1999	L990178-24	ND	ND	0.20
	L990178-24 duplicate	ND	ND	0.23
	relative percent difference	NA	NA	14%
15 December 1999	L990212-3	ND	ND	0.63
	L990212-3 duplicate	ND	ND	0.63
	relative percent difference	NA	NA	0%
16 February 1995	94-4164	ND	ND	1.1%
	94-4164 duplicate	ND	ND	1.1%
	relative percent difference	NA	NA	0%
17 February 1995	94-4653	ND	ND	0.68
	94-4653 duplicate	ND	ND	0.49
	relative percent difference	NA	NA	32

NA - not applicable
ND - not detected
* Fish tissue organic analytes (listed in Table A6) not appearing in the above table were included in the analysis and were not detected.
NOTE: Cape Cod Watershed samples were batched with others; these lab QA/QC data for organics are pertinent to Cape Cod Watershed samples.

Table A5.4.5. 1999 and 1994 MA DEP/DWM laboratory QA/QC lab fortified matrix and matrix spike duplicate data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g-wet weight unless otherwise noted.)

Date Analyzed	LABORATORY SAMPLE NUMBER	%Lipids	Analyte	Spike Amount	Spike Recovered	Spike % Recovery
21 December 1999	Matrix Spike L990227-2	0.20	PCB A1260 MDL 0.11	1.14	1.08	95
21 December 1999	Matrix Spike Duplicate L990227-2	0.19	PCB A1260 MDL 0.11	1.14	1.07	94
23 December 1999	Matrix Spike L990271-1	0.11	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011	Lindane 0.025 Heptachlor 0.025 Aldrin 0.025 DDT 0.050	Lindane 0.026 Heptachlor 0.024 Aldrin 0.026 DDT 0.052	Lindane 104 Heptachlor 96 Aldrin 104 DDT 104
23 December 1999	Matrix Spike Duplicate L990271-1	0.20	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011	Lindane 0.025 Heptachlor 0.025 Aldrin 0.025 DDT 0.050	Lindane 0.026 Heptachlor 0.027 Aldrin 0.028 DDT 0.060	Lindane 104 Heptachlor 108 Aldrin 112 DDT 120
14 February 1995	Laboratory Spike - 29	0.35	PCB A1260 MDL 0.16	NR	NR	146
15 February 1995	Laboratory Spike - 30	0.22	Lindane MDL 0.16 Aldrin 0.15 Heptachlor 0.08 DDT 0.25	Lindane NR Aldrin NR Heptachlor NR DDT NR	Lindane NR Aldrin NR Heptachlor NR DDT NR	Lindane 63 Aldrin 109 Heptachlor 91 DDT 64

MDL – method detection limit
NR – not reported
NOTE: Cape Cod Watershed samples were batched with others. These laboratory QA/QC lab fortified blank data for organics in fish tissue are pertinent to Cape Cod Watershed samples.

A6. ANALYTICAL METHODS

The laboratory analytical methods used at WES to generate data for 1994 and 1999 fish toxics for Cape Cod, as well as for other DWM data are provided in Table A6.1. (Data expressed in values reported in mass/mass wet weight unless otherwise noted.)

Table A6.1. 1994 and 1999 Analytical Methods.

Analytes	EPA Method*	SM Methods**	Other Methods	MDLs (1999)	MDLs (1994)
Discrete Water Sample Analytes:					
Fecal Coliform		SM 9222D		<6, <16 cfu/100ml	NA
E. coli, MTEC		SM 9213D		NA	NA
Enterococcus		SM 9230C		NA	NA
Alkalinity		SM 2320B		1.0, 2, 2.0 mg/L	NA
Chloride (4500)		SM 4500CL-B		1, 1.0 mg/L	NA
Hardness	EPA 200.7			0.6, 0.66 mg/L	NA
Turbidity	EPA 180.1			0.10, 0.1 NTU	NA
Ammonia-N	EPA 350.1			0.02 mg/L	NA
Nitrate/Nitrite-N	EPA 353.1			0.02 mg/L	NA
Suspended Solids		SM 2540D		1.0, 2.5 mg/L	NA
Total Kjeldahl Nitrogen	EPA351.2			0.10 mg/L	NA
Dissolved Reactive Phosphorus		SM4500P E		0.005 mg/L	NA
Total Reactive Phosphorus		SM4500P E		0.01 mg/L	NA
Total Phosphorus (Manual)		SM 4500P-E		0.01, 0.005 mg/L	NA
BOD (2,5,7,14,21day)		SM5210B		6.0 mg/L	NA
CBOD (2,5,7,14,21day)		SM5210B		2 mg/L	NA
Chlorophyll a (DWM lab)		SM10200H		ND	NA
Apparent Color (DWM lab)		SM2120B		15 pcu	NA
Fish Tissue Analytes:					
PCB Arochlor 1242			AOAC 983.21***	0.26 µg/g	0.06 µg/g
PCB Arochlor 1254			AOAC 983.21***	0.37 µg/g	0.17 µg/g
PCB Arochlor 1260			AOAC 983.21***	0.11 µg/g	0.16 µg/g
Chlordane			AOAC 983.21***	0.11 µg/g	0.11 µg/g
Toxaphene			AOAC 983.21***	0.59 µg/g	0.11 µg/g
a-BHC			AOAC 983.21***	0.009 µg/g	0.19 µg/g
b-BHC			AOAC 983.21***	0.011 µg/g	0.09 µg/g
Lindane			AOAC 983.21***	0.009 µg/g	0.16 µg/g
d-BHC			AOAC 983.21***	0.043 µg/g	0.02 µg/g
Hexachlorocyclopentadiene			AOAC 983.21***	0.33 µg/g	0.10 µg/g
Trifluralin			AOAC 983.21***	0.18 µg/g	0.11 µg/g
Hexachlorobenzene			AOAC 983.21***	0.18 µg/g	0.04 µg/g
Heptachlor			AOAC 983.21***	0.012 µg/g	0.08 µg/g
Heptachlor Epoxide			AOAC 983.21***	0.015 µg/g	0.59 µg/g
Methoxychlo			AOAC 983.21***	0.029 µg/g	1.07 µg/g
DDD			AOAC 983.21***	0.011 µg/g	0.13 µg/g
DDE			AOAC 983.21***	0.010 µg/g	0.39 µg/g
DDT			AOAC 983.21***	0.011 µg/g	0.25 µg/g
Aldrin			AOAC 983.21***	0.016 µg/g	0.15 µg/g
BZ#81			AOAC 983.21***	0.0005 µg/g	NA

Analytes	EPA Method*	SM Methods**	Other Methods	MDLs (1999)	MDLs (1994)
BZ#77			AOAC 983.21***	0.0005 µg/g	NA
BZ#123			AOAC 983.21***	0.0011 µg/g	NA
BZ#118			AOAC 983.21***	0.0025 µg/g	NA
BZ#114			AOAC 983.21***	0.0008 µg/g	NA
BZ#105			AOAC 983.21***	0.0019 µg/g	NA
BZ#126			AOAC 983.21***	0.0004 µg/g	NA
BZ#167			AOAC 983.21***	0.0009 µg/g	NA
BZ#156			AOAC 983.21***	0.0007 µg/g	NA
BZ#157			AOAC 983.21***	0.0007 µg/g	NA
BZ#180			AOAC 983.21***	0.0007 µg/g	NA
BZ#169			AOAC 983.21***	0.0003 µg/g	NA
BZ#170			AOAC 983.21***	0.0007 µg/g	NA
BZ#189			AOAC 983.21***	0.0007 µg/g	NA
Arsenic	EPA 200.9			0.04 mg/kg	0.040, 0.04 mg/kg 0.002 mg/L
Lead	EPA 239.1			NA	1.0, 1.00 mg/kg 0.03, 0.05 mg/L
	EPA 200.7			0.20 mg/kg	0.05 mg/L
Selenium	EPA 200.9			0.04 mg/kg	NA
	EPA 270.2			NA	0.04, 0.040 mg/kg 0.002 mg/L
Cadmium	EPA 200.7			0.02 mg/kg	0.03 mg/l
	EPA 213.1			NA	0.01, 0.20, 0.03 mg/kg
Mercury	EPA 245.6			0.02 mg/kg	0.0002 mg/L

**Methods for Chemical Analysis of Water and Wastes*, Environmental Protection Agency, Environmental Monitoring Systems Laboratory – Cincinnati (EMSL-CI), EPA-600/4-79-020, Revised March 1983 and 1979 where applicable.
**Standard Methods, Examination of Water and Wastewater, 20th edition
***WES SOP Determination of Chlorinated Pesticides, PCB Aroclor(s) and PCB congeners in Fish and Biological Tissue (modified AOAC 983.21)
ND – no data; NA – not applicable, not pertinent to data used in this report

A7. CONCLUSION

The Cape Cod data collected in 1999 (and in 1994 for fish toxics samples) were reviewed with regard to existing and perceived project data quality objectives (DQOs) and for adherence to DEP/DWM and WES Laboratory SOPs for collection and analysis. The primary DQO elements of precision, accuracy, representativeness, completeness and comparability (PARCC) were evaluated, as were associated quality control data.

Based on DWM's data validation process, the majority of sample data were accepted without qualification, due mainly to acceptable analytical accuracy and overall precision. For data that did not meet the objectives outlined in Section A4, data were censored or accepted with qualification in this report and in the DWM WQD database. These exceptions have been specifically noted in this appendix (refer to appropriate tables in Section A5). Where problems were evident for entire surveys or batched analyses, survey or batch data were censored or qualified, as appropriate.

The 1999 Cape Cod lakes data are comparable with past and future data collected by DWM and others, based on the use of standardized methods and procedures. Although buckets may have been used as necessary for sample collection at lake inlet/drop locations in 1999, this technique has been discontinued. Use of the bucket method has been noted and, while its use may affect data quality for solids-related analytes (e.g., TSS, turbidity, nutrients, etc.), the 1999 Cape Cod data are considered comparable to other data collected via other and current grab sampling methods.

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APPENDIX B - 1999 AND 1994 MA DEP/DWM CAPE COD WATERSHED SURVEY REPORT

INTRODUCTION

MA DEP/DWM performed monitoring in the Cape Cod Watershed during June, August and September 1999. Sampling components included fish tissue sampling for organic and metal toxins in edible fillets, lake monitoring that included in-situ Hydrolab® Multiprobe Series 3 analyzer (hereafter referred to as Hydrolab) measurements, secchi depth transparency, alkalinity, color, total phosphorus, and chlorophyll *a* sampling as well as macrophyte identification/density at the maximum extent of growth. Each sampling component is described in the sections that follow.

BASELINE LAKE SURVEYS

Five of the ten confirmed Massachusetts 303(d) listed ponds in the Cape Cod Watershed were selected for baseline lake surveys (Figure B1). Lakes were preferentially targeted for sampling based on the severity of the nutrient-related problem and the size of the lake (MA DEP 1999b). Those lakes that were listed solely for non-nutrient related issues (e.g., lakes listed for fish consumption advisories) and those with previous diagnostic/feasibility studies, regardless of the impairment, were not selected. Baseline surveys were conducted to provide information on the current chemical, physical and biological conditions of the lake system (i.e., in-lake and in the surrounding watershed). In addition to the examinations performed on the five 303(d) listed lakes, Upper and Lower Shawmee Ponds were also investigated for the type and extent of macrophyte cover.

Each baseline lake survey included a macrophyte survey conducted once during the summer at the peak of macrophyte growth in August. The survey data are used in several ways: 1) to determine if the macrophyte growth causes nuisance conditions such that the lake would be listed or delisted on the Massachusetts 303(d) List for violations of water quality standards; 2) to determine if the lake meets designed uses in the 305(b) assessments; 3) to monitor changes in density of plant growth following implementation of a TMDL; 4) to document invasive species distributions in the state; and 5) to suggest macrophyte management options for the lake.

Trophic status (an indicator of the productivity level of a lake) is based on the evaluation of data collected during baseline surveys. Parameters used to determine trophic status include; oxygen levels, chlorophyll *a* concentrations, total phosphorus levels, secchi disk measurements, and macrophyte density determinations.

The data are used to validate Total Maximum Daily Load (TMDL) phosphorus loading models and to document the present trophic conditions as well as assessing the status of each lake's designated uses. The total phosphorus data are used to evaluate accuracy of land use loading estimates of total phosphorus to lakes by comparing predictions of lake concentrations based on modeling to actual measured lake concentrations (Mattson, et al 1999). These may be used as a basis for estimation of internal loading or other unmeasured phosphorus sources. Concurrently a lake database will be developed for both 303(d) development and for 305(b) evaluation based on lakes that are on the current 303(d) list. The data contained in this database along with the other data collected are used in TMDL development or to monitor lakes for changes in water quality and nuisance plant growth after TMDL implementation.

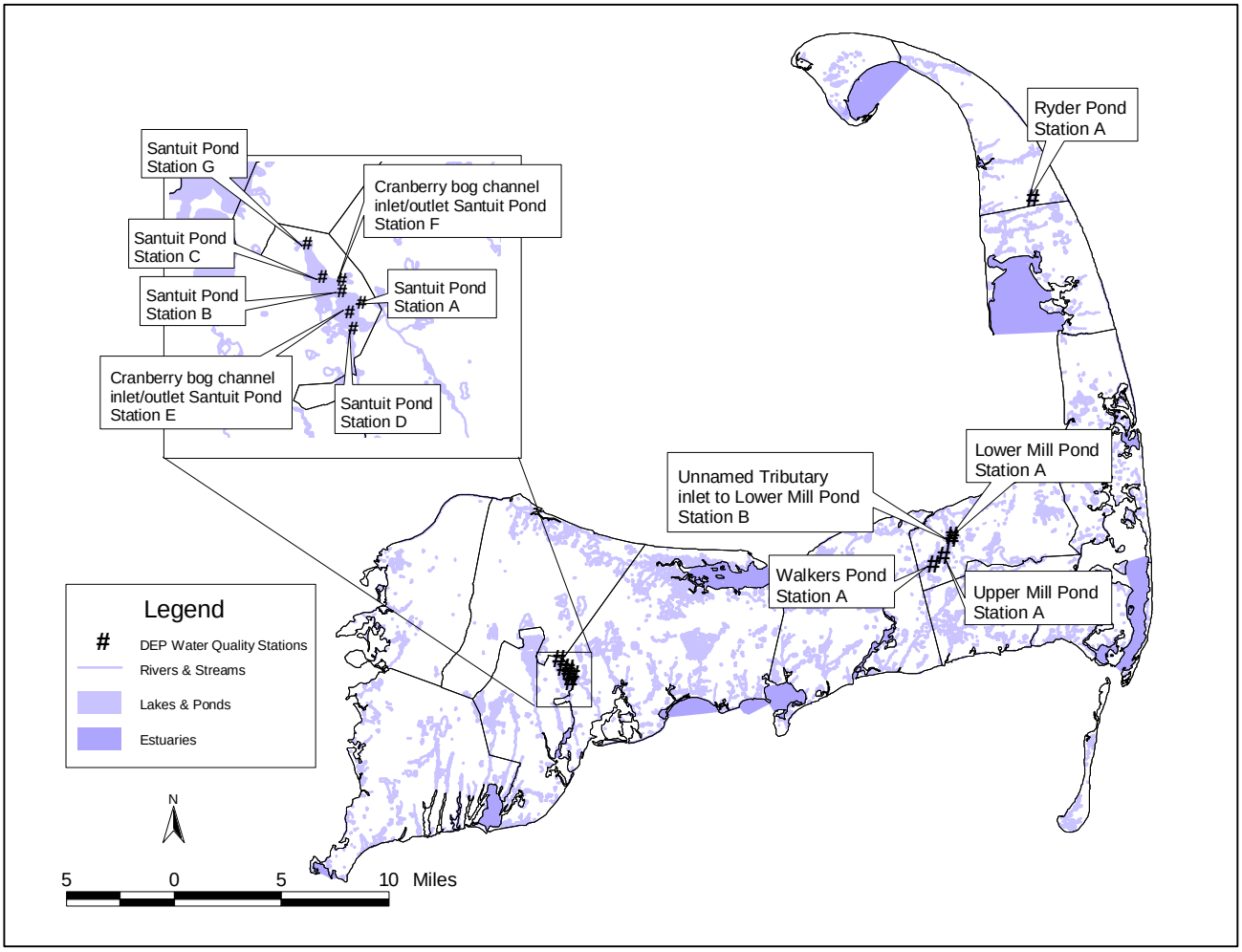

Figure B1. Location of 1999 TMDL sampling stations in the Cape Cod Watershed.

FISH TOXICS MONITORING

Fish toxics monitoring is aimed primarily at assessing human health risks associated with the consumption of freshwater fish. The program is a cooperative effort between three MA DEP Divisions/Offices, (Watershed Management, Research and Standards, and Environmental Analysis), the Department of Fisheries Wildlife and Environmental Law Enforcement (DFWELE), and the Department of Public Health (MDPH). Fish tissue monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish and identify waterbodies where those concentrations may pose a risk to human health. Fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), PCBs and organochlorine pesticides. These data are then used by the Massachusetts Department of Public Health in assessing human health risks associated with the consumption of freshwater fishes.

During 1999, MA DEP/DWM monitored two lakes in the Cape Cod Watershed for toxics in fish flesh as part of the Massachusetts Watershed Initiative Year 2 activities. Sampling was conducted in June 1999 at Ashumet Pond, Mashpee (F0071) and Johns Pond, Mashpee (F0072). During 1994, MA DEP's Office of Watershed Management (now MA DEP/DWM) monitored three lakes for fish tissue toxics; Mashpee Pond, Mashpee (F0089); Wequaquet Lake, Barnstable (F0090); and Great Pond, Eastham (F0091). Locations are depicted in Figure B2.

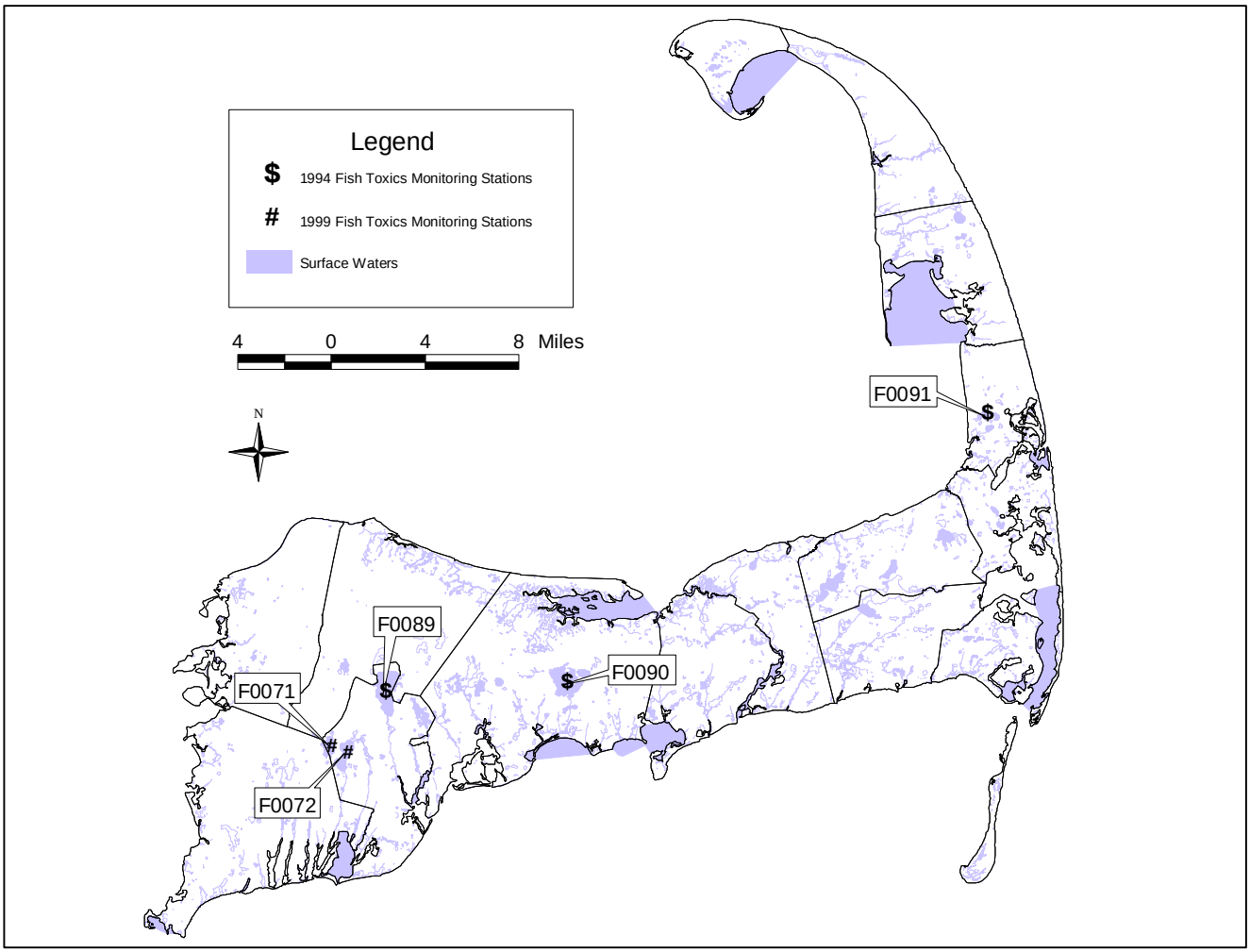

Figure B2. Locations of 1999 MA DEP/DWM and 1994 MA DEP/OWM Fish Toxics Monitoring stations in the Cape Cod Watershed.

MATERIALS AND METHODS

BASELINE LAKE SURVEYS

In the Cape Cod Watershed, baseline lake surveys were conducted on five ponds during August and September 1999 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Each lake was sampled twice (monthly intervals). The DWM sampling plan matrix for the Cape Cod Watershed is summarized in Table B1.

In-situ measurements using the Hydrolab were recorded at various depths (profile) at the deep hole station. Samples were also collected for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab Series 3 Multiprobe Standard Operating Procedure* (MA DEP 1999b and MA DEP 1999c). The Wall Experiment Station (WES) supplied all sample bottles and field preservatives, which were prepared according to the *WES Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES on each sampling date, and analyzed according to WES Standard Operating Procedures. The quality control protocol followed for field and equipment blank samples is described in Appendix A of this report. Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is also presented in Appendix A. Apparent color and chlorophyll *a* were measured

according to standard procedures at the MA DEP/DWM office in Worcester (MA DEP 1999e and MA DEP 1999f).

An aquatic macrophyte survey was conducted at each of the five TMDL ponds and at two additional lakes. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded. Details on procedures used can be found in the *Baseline Lake Survey Quality Assurance Project Plan* (MA DEP 1999b).

Three types of assessments were made from the information gathered during the baseline lake and aquatic macrophyte surveys. First, the lakes were assessed against the criteria for Designated Use support from the Commonwealth of Massachusetts Summary of Water Quality 1999 report (MA DEP 1999a). Next, the trophic status (level of nutrient enrichment) of each lake was evaluated. And last, the presence of non-native aquatic and/or wetland plant species was noted.

At each observation site the general water quality was noted and all aquatic and wetland macrophyte species were recorded along with their general abundance and an estimate of the total percent areal coverage of all species. Qualitative macrophyte observations were aided by conducting several hauls with a plant "rake", which was constructed by bolting two garden rakes back-to-back, the handles cut to about half length, and then attached to about a 50' length of rope. Each time the rake was thrown to its maximum extension and then retrieved along the lake bottom. The rake was thrown several times in different directions from the observation site to provide more thorough coverage.

Where possible, transparency was measured using a standard 20-centimeter diameter Secchi disk attached to a rope with metric calibrations. When Secchi disk measurements were not feasible, transparency was estimated as being above or below 1.2 meters (based on the four foot Secchi disk bathing beach standard).

All observations were recorded on standardized field sheets. Assessments of trophic status and use impairment were made on site. Later, the assessments and supporting information were entered into the EPA Water Body System database. Data on the presence of non-native plants were entered into a separate database intended for linking to the Massachusetts Geographic Information System (MassGIS).

Table B1. 1999 DEP-DWM Cape Cod Watershed sampling matrix.

Sampling Locations	Segment Number	Station[1]	June 1999	August 1999	September 1999
Lower Mill Pond, Brewster	MA96188	A		M, S, TP	*a*, C, H, S, TP
inlet to Lower Mill Pond		B		TP	TP
Upper Mill Pond, Brewster	MA96324	A		M, S, TP	*a*, C, H, S, TP
Walkers Pond, Brewster	MA96331	A		M, S, TP	*a*, C, H, S, TP
Ryder Pond, Truro	MA96268	A		M, S, TP	*a*, C, H, S, TP
Santuit Pond, Mashpee (mid-pond)	MA96277	A		M, S, TP	*a*, C, H, S, TP
South basin		B			TP
North basin		C			TP
cranberry bog canal		D			TP
cranberry bog canal		E			TP
cranberry bog canal		F			TP
cranberry bog canal		G			TP
Lower Shawme Lake	MA96288			M	
Upper Shawmee Lake	MA96326			M	
Ashumet Pond, Mashpee	MA96004	F0071	T		
Johns Pond, Mashpee	MA96157	F0072	T		

[1] Sampling did not necessarily occur at the same exact location although that which occurred in the general vicinity of the sampling station is listed together; *a* - Chlorophyll *a;* C - Chemistry (alkalinity, color, hardness, chlorides, suspended solids, turbidity); H - Hydrolab® mutliprobe meter (pH, dissolved oxygen, conductivity, temperature, total dissolved solids); M – Macrophytes; S - Secchi Disk Depth; T - Toxics in fish tissue (As, Cd, Hg, Pb, Se, % lipids, PCBs, organochlorine pesticides); TP - Total Phosphorous

FISH TOXICS

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish samples. The characteristics of each site determine the method(s) of sample collection. Electrofishing is performed by maneuvering the boat through the littoral zone and shallow water habitat of the waterbody and collecting stunned fish. Gill nets are set in various locations and checked every two hours. Fish were collected via electrofishing, gill netting and conventional angling techniques at Ashumet Pond (MA96004) on 7 June 1999. Electrofishing and gill netting were employed at Johns Pond (MA96157) on 8 June 1999. Fish collected were stored in a live well filled with site water until the completion of sampling. After removal from the live well, all fish to be included in the sample were stored on ice prior to sample preparation at the DWM laboratory in Worcester, MA. Live fish, which were not included as parts of the sample were released. Where possible, fish selected for analysis represented species and sizes desired by the angling public for consumption, as well as from different feeding guilds (i.e., top level predator, invertivore, omnivore). Samples were prepared for freezing and delivery to the WES Laboratory at the DWM office within 24 hours of collection. Lengths and weights were measured and fish were visually inspected for tumors, lesions, or other anomalies. Scale or pectoral fin spine samples were obtained from each fish to determine the age of the fish. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. During laboratory processing all equipment used in the filleting process was rinsed with tap water to remove slime, scales, and other fluids such as blood, then re-rinsed in deionized water before (and/or after) each sample. Composite fillet samples targeted for metals analysis were placed in VWR 32-ounce high-density polyethylene (HDPE) cups with covers. The opposite fillets (composites) were wrapped in aluminum foil for % lipid, PCB and organochlorine pesticide analyses. Samples were tagged and frozen for subsequent delivery to the MA DEP's Wall Experiment Station (WES).

Methods used at WES for metals analysis include the following:

Mercury is analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System) which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead are analyzed using a Perkin Elmer, Optima 3000 XL ICP – Optical Emission Spectrophotometer. Arsenic and selenium are analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace. Atomic Absorption Spectrophotometer PCB/organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector. Additional information on analytical techniques used at WES is available from the laboratory (MA DEP 1995).

RESULTS

BASELINE LAKE SURVEYS – MACROPHYTE MAPPING

Ryder Pond, Truro (MA96268)
Fifteen sites were surveyed for macrophytes on Ryder Pond. The pond was <10% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the dominant species occurring at greater than 50% of the observation sites was *Eriocaulon* sp. The trophic status is unknown at this time. There were non-native wetland species observed (*Phragmites* sp.), but no non-native aquatic species were observed.

Santuit Pond, Mashpee (MA96277)
Thirty sites were surveyed for macrophytes on Santuit Pond. The pond was approximately 75% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant (occurring at greater than 50% of the observation sites) species were *Potomogeton robbsinnii* and *Vallisneria americana.* The trophic status is mesotrophic. There were no non-native wetland species, nor non-native aquatic species observed.

Upper Mill Pond, Brewster (MA96324)
Thirty sites were surveyed for macrophytes on Upper Mill Pond. The pond was <10% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the dominant species occurring at greater than 50% of the observation sites was macroscopic algae. The trophic status is unknown at this

time. There were non-native wetland species observed (*Phragmites* sp.), but no non-native aquatic species were observed.

Lower Mill Pond, Brewster (MA96188)
Twenty-nine sites were surveyed for macrophytes on Lower Mill Pond. The pond was <10% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant species occurring at greater than 50% of the observation sites were *Decadon verticillatus* and *Vallisneria americana*. The trophic status is eutrophic. There were non-native wetland species observed (*Phragmites* sp.), but no non-native aquatic species were observed.

Walkers Pond, Brewster (MA96331)
Twenty-four sites were surveyed for macrophytes on Walkers Pond. The pond was <10% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the dominant species occurring at greater than 50% of the observation sites was *Vallisneria americana*. The trophic status is unknown at this time. There were no non-native wetland species, nor non-native aquatic species observed.

Upper Shawmee Lake, Sandwich (MA96326)
Twenty-seven sites were surveyed for macrophytes on Upper Shawmee Lake. The lake was approximately 80% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant macrophyte species occurring at greater than 50% of the observation sites were *Potomogeton robbsinnii*, and *Elodea* sp., as well as a heavy infestation of macroscopic algae. The trophic status is eutrophic. There were no non-native wetland species, nor non-native aquatic species observed.

Lower Shawmee Lake, Sandwich (MA96288)
Thirty-eight sites were surveyed for macrophytes on Lower Shawmee Lake. The lake was approximately 80% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the dominant species occurring at greater than 50% of the observation sites were macroscopic algae, *Elodea* sp., *Najas* sp., *Decodon* sp., and *Vallisneria americana*. The trophic status is eutrophic. There were non-native wetland species (*Lythrum Salicaria, Phragmites* sp.) observed; but no non-native aquatic species observed.

Table B2. 1999 MA DEP/DWM aquatic macrophyte observations at selected 303(d) listed lakes in the Cape Cod Watershed. Listed in descending order of frequency. Percentage of observation sites in which plants occurred is parenthetical. (n= total number of observation sites)

Upper Mill Pond MA96324 12 August 1999 n=30	**Lower Mill Pond MA96188 11 August 1999 n=29**	**Walkers Pond MA96331 11 August 1999 n=24**	**Ryder Pond MA96268 9 August 1999 n=15**	**Santuit Pond MA96277 9 August 1999 n=30**	**Upper Shawmee Lake MA96326 10 August 1999 n=27**	**Lower Shawmee Lake MA96288 10 August 1999 n=38**
macroscopic algae (57%)	Decadon verticillatus (76%)	Vallisneria americana (67%)	Eriocaulon sp. (53%)	Potomogeton robbsinnii (73%)	Potomogeton robbsinnii (93%)	macroscopic algae (92%)
Vallisneria americana (40%)	Vallisneria americana (69%)	Pontederia cordata (38%)	Pontederia cordata (47%)	Vallisneria americana (70%)	Elodea sp. (66%)	Elodea sp. (89%)
Decadon verticillatus (30%)	Pontederia cordata (24%)	Decadon verticillatus (25%)	Nymphaea sp. (33%)	Decadon verticillatus (37%)	macroscopic algae (52%)	Najas sp. (68%)
Iris sp. (20%)	Nuphar sp. (21%)	Elodea sp. (21%)	Juncus sp. (20%)	Nuphar sp. (30%)	Moss (48%)	Decodon sp. (61%)
Pontederia cordata (20%)	macroscopic algae (10%)	Nuphar sp. (8%)	Nuphar sp. (20%)	Nymphaea sp. (23%)	Spirodela polyrhiza (33%)	Vallisneria americana (61%)
Elodea sp. (17%)	Najas sp. (10%)	macroscopic algae (5%)	Eliocharis sp. (13%)	Utricularia sp. (20%)	Elatine (22%)	Potomogeton robbsinnii (39%)
Nitella sp. (13%)	Phragmites sp.[1] (7%)		Phragmites sp.[1] (13%)	Elodea sp. (17%)	Nitella sp. (22%)	Lemna sp. (16%)
Phragmites sp.[1] (10%)	Sagittaria sp. (7%)		Scirpus sp. (13%)	Nitella sp. (13%)	Utricularia sp. (22%)	Spirodela polyrhiza (16%)
Eleocharis sp. (7%)	Typha sp. (7%)		Gratiola sp. (7%)	Ceratophyllum sp. (7%)	Ceratophyllum sp. (15%)	Lythrum salicaria[2] (11%)
Gratiola sp. (7%)	Dulichium arundinareum (3%)		Lobelia dortmanna (7%)	Eliocharis sp. (7%)	Iris sp. (11%)	Utricularia sp. (8%)
Potamogeton epihydrus (7%)	Iris sp. (3%)			Juncus sp. (7%)	Decodon sp. (4%)	Ceratophyllum sp. (5%)
Dulichium arundinareum (3%)				Sagittaria sp. (7%)	Isoetes sp. (4%)	Phragmites sp.[1] (5%)
Isoetes sp. (3%)				Scirpus sp. (7%)	Lemna sp. (4%)	Typha latifolia (3%)
Najas sp. (3%)				Sparganium sp. (7%)	Vallisneria americana (4%)	
Nuphar sp. (3%)				Utricularia vulgaris (7%)		
Nymphaea sp. (3%)				Gratiola sp. (3%)		

[1] non-native wetland species [2] non-native aquatic species

Table B3 presents Secchi depth, alkalinity, color, total phosphorus and chlorophyll *a* data. The Hydrolab results are provided in Table B4. MA DEP/DWM water quality data is managed and maintained in the Water Quality Data Access Database

Table B3. 1999 MA DEP/DWM Cape Cod Watershed lake Secchi depth, alkalinity, color, total phosphorus and chlorophyll *a* data.

Date	Time (24hr)	Secchi Depth (m)	Station Depth (m)	OWMID	OWMID QA/QC	Sample Depth (m)	Alkalinity (mg/L)	Color (PCU)	Total Phosphorus (mg/L)	Chlorophyll *a* (mg/L)
Lower Mill Pond (MA96188)										
Station: A Description: deep hole, mid pond, Brewster.										
08/11/99	**	**	**							
				LB-0122		0.5	--	--	0.062	--
09/15/99	14:15	1.3	3.5							
				LB-0277		0 - 3.0	--	--	--	**m
				LB-0276		0.5	6.0	--	0.043	--
				LB-0275		3.0	8.0	--	0.098	--
Inlet to Lower Mill Pond										
Station: B Description: unnamed tributary, inlet from Upper Mill Pond, Brewster.										
09/15/99	**	--	**							
				LB-0296		0.5	--	--	0.13	--
Ryder Pond (MA96268)										
Station: A Description: deep hole in northwest quadrant of pond, Truro.										
08/09/99	**	**	**							
				LB-0115		0.5	--	--	0.009	--
09/13/99	9:30	4.4	11.5							
				LB-0283		0 - 11.0	--	--	--	1
				LB-0279	LB-0280	0.5	<2.0	<15	0.008	--
				LB-0280	LB-0279	0.5	<2.0	<15	0.008	--
				LB-0282		11.0	30	300	0.059	--
Santuit Pond (MA96277)										
Station: A Description: deep hole in mid pond "narrows", Mashpee.										
08/09/99	**	**	**							
				LB-0117		0.5	--	--	0.039	--
09/13/99	14:00	>2.3	3.0							
				LB-0287		0 - 2.5	--	--	--	1
				LB-0285		0.5	14	18	0.026	--
				LB-0286		2.5	12	23	0.035	--
Station: B Description: near center of southern basin, Mashpee.										
09/13/99	**	**	**							
				LB-0288		0.5	--	--	0.022	--
Station: C Description: near center of northern basin, Mashpee.										
08/09/99	**	**	**							
				LB-0116		0.5	--	--	0.049	--
09/13/99	**	**	**							
				LB-0289		0.5	--	--	0.034	--
Station: D Description: eastern edge of pond at cranberry bog inlet/outlet structure, northwest of Racquet Drive, Mashpee.										
09/13/99	**	**	**							
				LB-0291		0.5	--	--	0.020	--
Station: E Description: bog side of cranberry bog inlet/outlet structure at southern tip of Santuit Pond, Mashpee.										
09/13/99	**	--	**							
				LB-0292		0.5	--	--	0.025	--

Date	Time (24hr)	Secchi Depth (m)	Station Depth (m)	OWMID	OWMID QA/QC	Sample Depth (m)	Alkalinity (mg/L)	Color (PCU)	Total Phosphorus (mg/L)	Chlorophyll *a* (mg/L)
Station: F		Description: bog side of cranberry bog inlet/outlet culvert on northeastern shore of Santuit Pond, southeast of Cranberry Lane, Mashpee.								
09/13/99	**	--	**							
				LB-0293		0.3	--	--	0.87	--
Station: G	Description: on lake side of pump house for cranberry bog on northern tip of Santuit Pond, Mashpee.									
09/13/99	**	**	**							
				LB-0294		0.3	--	--	0.021	--
Upper Mill Pond (MA96324)										
Station: A		Description: deep hole, middle of south eastern lobe, Brewster.								
08/11/99	**	**	**							
				LB-0121		0.5	--	--	0.025	--
09/15/99	10:24	1.4	7.9							
				LB-0273		0 - 4.5	--	--	--	1
				LB-0272		**	12	--	0.12	--
				LB-0271		0.5	7.0	--	0.030	--
Walkers Pond (MA96331)										
Station: A		Description: deep hole, mid pond, Brewster.								
08/11/99	**	**	**							
				LB-0118	LB-0119	0.5	--	--	0.074	--
				LB-0119	LB-0118	0.5	--	--	0.074	--
09/15/99	9:30	1.0	2.2							
				LB-0269		0 - 2.0	--	--	--	2
				LB-0266	LB-0265	0.5	8.0	--	0.054	--
				LB-0265	LB-0266	0.5	6.0	--	0.054	--
				LB-0268		1.7	8.0	--	0.053	--

" ** " = Censored or missing data

" -- " = No data

" **m** " = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

Table B4. 1999 MADEP/DWM Cape Cod Watershed, Hydrolab data.

Date	OWMID	OWMID QA/QC	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond @ 25 °C (mS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
Lower Mill Pond (MA96188)										
Station: A	**Description: deep hole, mid pond, Brewster.**									
09/15/99	LB-0278		14:19	0.5	24.4	8.8	87.0	55.7	10.1	119
			14:23	1.5	23.9	8.9	87.0	55.7	10.2	119
			14:26	2.5	23.5	6.9 **u**	86.7	55.5	7.3 **u**	84 **u**
			14:30	3.0	23.4	6.7	86.9	55.6	7.0	81
Ryder Pond (MA96268)										
Station: A	**Description: deep hole in northwest quadrant of pond, Truro.**									
09/13/99	LB-0284		09:58	0.5	24.8	4.9	142	90.8	8.6	101
			10:04	2.1	24.7	5.0	142	90.8	8.6	101
			10:08	4.0	24.6	5.0	142	90.9	8.6	100
			10:12	6.0	24.5	5.0	142	90.9	8.6	100
			10:15	7.0	23.9	5.0	141	90.1	9.3	107
			10:19	7.9	23.0	5.3	137	87.9	7.5	85
			10:23	9.0	20.1	5.6	130	83.1	1.2	13
			10:27	10.0	16.7 **u**	6.1	173	111	<0.2	<2
			10:31	11.0	14.7	6.4	262	168	<0.2	<2
Santuit Pond (MA96277)										
Station: A	**Description: deep hole in mid pond "narrows", Mashpee.**									
09/13/99	LB-0290		14:07	0.5	25.1	8.5	93.9	60.1	9.3	110
			14:12	1.5	24.6	8.6	94.0	60.1	9.5 **u**	112 **u**
			14:18	2.5	24.1	** **mu**	94.7	60.6	6.7	78
Upper Mill Pond (MA96324)										
Station: A	**Description: deep hole, middle of southeastern lobe, Brewster.**									
09/15/99	LB-0274		10:26	0.5	23.8	8.9	82.8	53.0	9.5	110
			10:30	1.5	23.7	8.8	82.4	52.8	9.2	107
			10:34	2.5	23.6	8.7	82.4	52.7	9.1	104
			10:39	3.5	23.6	8.6	82.6	52.8	9.0	104
			10:43	4.5	23.6	8.5	82.2	52.6	8.9	103
			10:46	5.5	23.5	8.5	82.2	52.6	8.8	102
			10:50	6.5	23.0	6.4 **u**	84.0	53.7	2.8	31
			10:57	7.5	21.7	6.8	116	74.0	<0.2	<2
Walkers Pond (MA96331)										
Station: A	**Description: deep hole, mid pond, Brewster.**									
09/15/99	LB-0270		09:38	0.5	23.5	7.2	90.5	57.9	8.9	103
			09:42	1.5	23.5	7.0	90.7	58.1	8.0	93
			09:46	2.0	23.4	6.8	90.6	58.0	7.8	89

" **m** " = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.
" **u** " = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

1999 FISH TOXICS

Fish from Ashumet Pond and Johns Pond were analyzed for PCBs, organochlorine pesticides, and selected metals (As, Cd, Hg, Pb, and Se) to screen resident fish for potentially harmful levels of contaminants to human health. Results are presented in Tables B5 and B6 respectively.

Ashumet Pond, Mashpee
Samples of largemouth bass (Micropterus salmoides), brown bullhead (Ameiurus nebulosus), green sunfish (Lepomis cyanellus), and yellow perch (Perca flavescens) were collected. The lipids content ranged between 0.17 and 1.4%. Cadmium, Lead, arsenic, and PCBs were below minimum detection limits in the edible fillets of any sample analyzed for these analytes in Ashby Pond, Mashpee. Selenium levels ranged from 0.12 to 0.36 mg/kg wet weight. Brown bullhead were the only species to exhibit pesticide (DDD and DDE) concentrations in measurable amounts (0.014 and 0.025 mg/kg respectively). All other samples were below the minimum detection limits of 0.010 mg/kg for DDD, and 0.014 mg/kg for DDE. Mercury in the fish tissue ranged from 0.09 to 0.55 mg/kg wet weight.

Johns Pond, Mashpee
Samples of largemouth bass, smallmouth bass (Micropterus dolomieu), yellow perch, white perch (Morone Americana), bluegill sunfish (Lepomis macrochirus), and brown bullhead were collected. The lipids content ranged from 0.06 to 0.63%. Cadmium, Lead, PCBs and pesticides were below minimum detection limits in the edible fillets of any sample analyzed. Arsenic was detected only in the largemouth bass sample at a level of 0.05 mg/kg. Selenium levels ranged from 0.09 to 0.50 mg/kg wet weight. Mercury levels ranged from 0.20 to 1.2 mg/kg wet weight

Based on results of the mercury analysis in fish tissue from these two waterbodies, (using a trigger level of 0.5 mg/kg wet weight Hg) DPH has issued the following advisories;

Ashumet Pond:
1. “Children under 12, pregnant women and nursing mothers should not consume largemouth bass from Ashumet Pond in order to prevent developing fetuses and young children to mercury.”
2. “The general public should limit consumption of largemouth bass from Ashumet Pond to two meals per month.”

John’s Pond:
1. “Children under 12, pregnant women and nursing mothers should not consume fish from John’s Pond in order to prevent exposure of developing fetuses and young children to mercury.”
2. “The general public should not consume smallmouth bass caught from John’s Pond.”
3. “The general public should limit consumption of non-affected fish species from John’s Pond to two meals per month.”

1994 FISH TOXICS

The goal of the 1994 fish toxics monitoring was to screen resident fish for PCB, organochlorine pesticides, percent lipids, and selected metals (As, Cd, Pb, Hg and Se). Survey results are presented in Tables B7, B8 and B9.

Mashpee Pond, Mashpee
Samples of largemouth bass, yellow perch, white perch, white catfish (Ameiurus catus) and smallmouth bass were collected from Mashpee Pond in Mashpee. The lipids content ranged from 0.06 to 1.9%. Cadmium, lead, PCBs, and pesticides were below minimum detection limits in the edible fillets of any sample analyzed. Selenium ranged from 0.068 to 0.247 mg/kg wet weight. Arsenic was only detected in white perch at a concentration of 0.041 mg/kg wet weight. All other samples analyzed for arsenic were below the 0.04 mg/kg detection limit. Mercury in fish tissue ranged from 0.107 to 0.529 mg/kg wet weight.

Wequaquet Lake, Barnstable
Samples of brown bullhead, largemouth bass, and yellow perch were collected from Wequaquet Lake in Barnstable. The lipids content ranged from 0.08 to 1.4%. Cadmium, lead, arsenic, PCBs, and pesticides

were below minimum detection limits in the edible fillets of any sample analyzed for these analytes. Selenium ranged from 0.072 to 0.232 mg/kg wet weight. Mercury in fish tissues ranged from 0.103 to 0.544 mg/kg wet weight.

Great Pond, Eastham
Samples of white perch, brown bullhead, chain pickerel (Esox niger), and yellow perch were collected from Great Pond in Eastham. The lipids content ranged between 0.13 and 0.68%. Cadmium, lead, arsenic, PCBs, and Pesticide concentrations were below minimum detection limits in the edible fillets of any sample analyzed for these analytes. Selenium ranged from 0.069 to 0.209 mg/kg wet weight. Mercury ranged from 0.067 to 0.212 mg/kg wet weight.

Based on results of the mercury analysis in fish tissue from two of these waterbodies, (using a trigger level of 0.5 mg/kg wet weight Hg) MDPH has issued the following advisories;

Mashpee-Wakeby Pond (Mashpee/Sandwich):

3. "Children younger than 12 years, pregnant women and nursing mothers should not consume smallmouth bass from Mashpee-Wakeby Pond in order to prevent developing fetuses and young children to mercury."
4. "The general public should limit consumption of smallmouth bass from Mashpee-Wakeby Pond to two meals per month."

Lake Wequaquet (Barnstable):

3. "Children younger than 12 years, pregnant women and nursing mothers should not consume largemouth bass from Lake Wequaquet in order to prevent developing fetuses and young children to mercury."
4. "The general public should limit consumption of largemouth bass from Lake Wequaquet to two meals per month."

Table B5. 1999 MA DEP/DWM fish toxics monitoring data for Ashumet Pond, Mashpee. Results (mg/kg wet wt.) are from composite samples of fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Composite Sample ID (lab sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	Lipids (%)	PCB (µg/g)	Pesticides* (µg/g)
APF99-1	6/7/99	LMB	39.9	880	99230 (L990211-1)	<0.02	<0.20	0.55	<0.04	0.22	0.17	ND	ND
APF99-2	6/7/99	LMB	33.3	550									
APF99-3	6/7/99	LMB	34.4	600									
APF99-4	6/7/99	BB	34.2	580	99231 (L990211-2)	<0.02	<0.20	0.09	<0.04	0.12	1.4	ND	DDE 0.025 DDD 0.014
APF99-5	6/7/99	BB	33.7	530									
APF99-6	6/7/99	BB	35.0	520									
APF99-7	6/7/99	YP	32.5	440	99232 (L990211-3)	<0.02	<0.20	0.28	<0.04	0.32	0.19	ND	ND
APF99-8	6/7/99	YP	32.0	420									
APF99-9	6/7/99	YP	30.6	320									
APF99-10	6/7/99	GRS	23.0	300	99233 (L990211-4)	<0.02	<0.20	0.17	<0.04	0.36	0.20	ND	ND
APF99-11	6/7/99	GRS	18.4	140									
APF99-12	6/7/99	GRS	19.0	180									

[1]Species: BB = brown bullhead (Ameiurus nebulosus); GRS = green sunfish (Lepomis cyanellus); LMB = largemouth bass (Micropterus salmoides); YP = yellow perch (Perca flavescens)

ND - not detected or the analytical result is at or below the established detection limit (MDL). See Appendix A for MDL.
*Note: Analytes listed in Appendix A and not appearing in the table were included in the analysis and were not detected

Table B6. 1999 MA DEP/DWM fish toxics monitoring data for Johns Pond, Mashpee. Results (mg/kg wet wt.) are from composite samples of fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Composite Sample ID (lab sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	Lipids (%)	PCB (µg/g)	Pesticides* (µg/g)
JPF99-1	6/8/99	LMB	36.7	650	99224 (L990212-1)	<0.02	<0.20	0.59	0.05	0.23	0.06	ND	ND
JPF99-2	6/8/99	LMB	38.6	940									
JPF99-3	6/8/99	LMB	37.9	840									
JPF99-4	6/8/99	SMB	36.7	520	99225 (L990212-2)	<0.02	<0.20	1.3	<0.04	0.28	0.26	ND	ND
JPF99-5	6/8/99	SMB	40.4	880									
JPF99-6	6/8/99	SMB	31.1	320									
JPF99-7	6/8/99	WP	27.6	340	99226 (L990212-3) duplicate	<0.02	<0.20	0.68	<0.04	0.50	0.63 0.63	ND ND	ND ND
JPF99-8	6/8/99	WP	26.4	340									
JPF99-9	6/8/99	WP	26.9	280									
JPF99-10	6/8/99	YP	28.0	220	99227 (L990212-4)	<0.02	<0.20	0.57	<0.04	0.22	0.15	ND	ND
JPF99-11	6/8/99	YP	21.1	110									
JPF99-12	6/8/99	YP	18.6	70									
JPF99-13	6/8/99	B	23.3	210	99228 (L990212-5)	<0.02	<0.20	0.31	<0.04	0.32	0.16	ND	ND
JPF99-14	6/8/99	B	22.3	220									
JPF99-15	6/8/99	B	22.6	230									
JPF99-16	6/8/99	BB	32.3	420	99229 (L990212-6)	<0.02	<0.20	0.20	<0.04	0.09	0.45	ND	ND
JPF99-17	6/8/99	BB	31.0	430									
JPF99-18	6/8/99	BB	34.7	520									

[1]Species: B = bluegill (Lepomis macrochirus) BB = brown bullhead (Ameiurus nebulosus) LMB = largemouth bass (Micropterus salmoides)
SMB = smallmouth bass (Micropterus dolomieu) WP = white perch (Morone americana) YP = yellow perch (Perca flavescens)

ND - not detected or the analytical result is at or below the established detection limit (MDL). See Appendix A for MDL.
*Note: Analytes listed in Appendix A and not appearing in the table were included in the analysis and were not detected

Table B7. 1994 DEP OWM fish toxics monitoring data for the Mashpee Pond, Mashpee (part of Mashpee / Wakeby Ponds, Mashpee/Sandwich). Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species[1] Code	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	As (mg/kg)	Se (mg/kg)	Lipids (%)	PCB (µg/g)	Pesticides (µg/g)
Mwf94-01	10/5/94	LMB	32.9	570	94038 (94-4636)	<0.20	0.357	<1.00	<0.04	0.169	0.06	ND	ND
Mwf94-02	10/5/94	LMB	36.8	680									
Mwf94-03	10/5/94	LMB	31.0	400									
Mwf94-04	10/5/94	LMB	33.8	570									
Mwf94-05	10/5/94	LMB	35.1	580									
Mwf94-06	10/5/94	YP	25.4	160	94039 (94-4638)	<0.20	0.154	<1.00	<0.04	0.145	0.27	ND	ND
Mwf94-07	10/5/94	YP	20.3	70									
Mwf94-08	10/5/94	YP	24.0	130									
Mwf94-09	10/5/94	YP	22.9	80									
Mwf94-10	10/5/94	YP	22.3	140									
Mwf94-11	10/5/94	WP	28.0	290	94040 (94-4640)	<0.20	0.406	<1.00	0.041	0.247	0.49	ND	ND
Mwf94-12	10/5/94	WP	26.0	230									
Mwf94-13	10/5/94	WP	27.9	300									
Mwf94-14	10/5/94	WP	26.9	280									
Mwf94-15	10/5/94	WP	27.6	250									
Mwf94-16	10/5/94	WB	36.6	660	94041 (96-4642) (96-4643)	<0.20	0.107	<1.00	<0.04	0.068	1.9	ND	ND
Mwf94-17	10/5/94	WB	32.6	440									
Mwf94-18	10/5/94	WB	34.1	580									
Mwf94-19	10/5/94	SMB	40.0	86.0	94042 (96-4644)	<0.20	0.529	<1.00	<0.04	0.156	0.43	ND	ND
Mwf94-20	10/5/94	SMB	35.8	620									
Mwf94-21	10/5/94	SMB	36.9	600									

[1]Species: LMB = largemouth bass (Micropterus salmoides) SMB = smallmouth bass (Micropterus dolomieu)
WB = white catfish (Ameriurus Catus) WP = white perch (Morone Americana) YP = yellow perch (Perca flavescens)

ND = not detected or the analytical result is at or below the established detection limit (MDL). See Appendix A for MDL.
NOTE: mg/kg = µg/g = ppm= mg/L

Table B8. 1994 DEP OWM fish toxics monitoring data for Wequaquet Lake, Barnstable. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species[1] Code	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	As (mg/kg)	Se (mg/kg)	Lipids (%)	PCB (µg/g)	Pesticides (µg/g)
Wqf94-01	10/5/94	BB	31.1	430	94035 (94-4646) (94-4647)	<0.20	0.385	<1.00	<0.04	0.223	1.4	ND	ND
Wqf94-02	10/5/94	BB	32.1	460									
Wqf94-03	10/5/94	BB	34.5	640									
Wqf94-04	10/5/94	BB	34.4	620									
Wqf94-05	10/5/94	LMB	38.5	880	94036 (94-4648)	<0.20	0.544	<1.00	<0.04	0.232	0.11	ND	ND
Wqf94-06	10/5/94	LMB	42.0	1120									
Wqf94-07	10/5/94	LMB	39.7	860									
Wqf94-08	10/5/94	LMB	36.7	850									
Wqf94-09	10/5/94	LMB	38.0	800									
Wqf94-10	10/5/94	YP	25.2	200	94037 (94-4650) (94-4651)	<0.20	0.103	<1.00	<0.04	0.072	0.08	ND	ND
Wqf94-11	10/5/94	YP	23.1	140									
Wqf94-12	10/5/94	YP	24.5	170									
Wqf94-13	10/5/94	YP	22.5	130									
Wqf94-14	10/5/94	YP	21.8	110									

[1]Species BB = brown bullhead (Ameiurus nebulosus)
LMB = largemouth bass (Micropterus salmoides)
YP = yellow perch (Perca flavescens)

ND = not detected or the analytical result is at or below the established detection limit (MDL). See Appendix A for MDL.
NOTE: mg/kg = µg/g = ppm= mg/l

Table B9. 1994 DEP OWM fish toxics monitoring data for Great Pond, Eastham. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species[1] Code	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	As (mg/kg)	Se (mg/kg)	Lipids (%)	PCB (µg/g)	Pesticides (µg/g)
Gpf94-01	10/6/94	WP	25.4	270									
Gpf94-02	10/6/94	WP	26.9	300	94043								
Gpf94-03	10/6/94	WP	26.1	240	(94-4652)	<0.20	0.146	<1.00	<0.04	0.209	0.68	ND	ND
Gpf94-04	10/6/94	WP	26.6	280	(94-4653)*						0.49*	ND*	ND*
Gpf94-05	10/6/94	WP	27.0	330									
Gpf94-06	10/6/94	BB	33.2	500									
Gpf94-07	10/6/94	BB	34.1	500									
Gpf94-08	10/6/94	BB	31.9	440	94044 (94-4654)	<0.20	0.067	<1.00	<0.04	0.069	0.41	ND	ND
Gpf94-09	10/6/94	BB	30.9	370									
Gpf94-10	10/6/94	BB	31.8	430									
Gpf94-11	10/6/94	CP	46.6	620									
Gpf94-12	10/6/94	CP	41.9	450	94045 (94-4656)	<0.20	0.212	<1.00	<0.04	0.157	0.13	ND	ND
Gpf94-13	10/6/94	CP	34.6	240									
Gpf94-14	10/6/94	YP	23.0	150									
Gpf94-15	10/6/94	YP	18.4	70									
Gpf94-16	10/6/94	YP	28.3	230	94046 (94-4658)	<0.20	0.161	<1.00	<0.04	0.130	0.19	ND	ND
Gpf94-17	10/6/94	YP	22.5	130									
Gpf94-18	10/6/94	YP	19.8	80									

[1]Species: BB = brown bullhead (Ameiurus nebulosus)
CP = chain pickerel (Esox niger)
WP = white perch (Morone Americana)
YP = yellow perch (Perca flavescens)

ND = not detected or the analytical result is at or below the established detection limit (MDL). See Appendix A for MDL.
* = duplicate sample
NOTE: mg/kg = µg/g = ppm= mg/l

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APPENDIX C – CAPE COD WATERSHED NPDES AND WMA TABLES

TABLE C1. Cape Cod Watershed NPDES surface water discharges.

PERMITTEE	NPDES #	Issuance	Flow (average daily)	Receiving Water
Aquaculture Research Corporation	MA0005576	1975	*	Chase Garden Creek (MA96-35)
Woods Hole Oceanographic Institution	MA0005916	1988	0.72 MGD	Vineyard Sound
The Lobster Trap Company	MA0029092	1998	7456 gallons per day	Back River
Henry T. Wing School	MA0101656	1987	0.0144 MGD	Dock Creek
Massachusetts Division of Fisheries and Wildlife	MA0110027	1990	1.4 MGD	Dock Creek

*permit expired – no discharge information available

Table C2. List of WMA registered and permitted water withdrawers in the Cape Cod Watershed (Levangie 2000).

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
9P42226102			The Ridge Club	0.12			G	Ridge Club Well	Sandwich
9P42217201			Willowbend Development Corporation*	0.27			S G	Willowbend Pond Willowbend Well #1	Mashpee Mashpee
9P42235104			King's Way Golf Course*	0.1			G		
9P42235103			Bayberry Hills Golf Course*	0.12			G		
9P42202005			Barnstable Municipal GC*	0.28			G		
9P42202001	42202001	4020002	Centerville-Osterville/Marston FD	1.59	1.98	020C01G 020C02G 020C03G 020C04G 020C05G 020C06G 020C07G 020C08G 020C09G 020C10G 020C11G 020C12G 020C13G	G G G G G G G G G G G G G	McShane (1 & 2) Arena (3 & 4) Lumbert Mill (#5) Craigville (#7) Lumbert Mill (#9) Davis (#10) Craigville (#8) Craigville (#11) Murray (#12) Murray (#13) Hayden (#14) Hayden (#15) Harrison (#16)	Osterville Osterville Centerville West Hyannisport Centerville Osterville West Hyannisport West Hyannisport Marston Mills Marston Mills Marston Mills Marstons Mills Marstons Mills
	42202002		Geoffrey Lenk		0.07		S	Santuit Pond	Mashpee
	42202004		Henry H. Lampi-c/o Jennie Rustici		0.08		S S	Mystic Lake Little Pond	Marston Mills Marston Mills
	42202005		Newtown Cranberries		0.2		S S	Newtown Bog Newtown Bog	Mashpee Mashpee
	42202006		J.A. Jenkins & Son Cranberry Co.		0.68		S S S S S S G G G	C-1 C-2 C-3 C-4 Hinkley Bog Hinkley Bog Parker Road Well Bumps River Rd Well Bumps River Rd Well	West Barnstable West Barnstable Centerville Centerville West Barnstable Marston Mills West Barnstable Centerville Centerville
	42202008		Hyannisport Club*		0.1		S	Golf Course Pond	Hyannisport
	42202009		Oyster Harbors Golf Club*		0.11		S	#9 Pond	Osterville
	42202010		Wianno Club, Inc.*		0.15		S S G	Neck Pond Parker Pond Parker Pond Well #1	Osterville Osterville Osterville
	42202012		Mystic Cranberry Company		0.32		S	C-1	Yarmouth

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
9P42202004	42202013	4020004	Barnstable Water Company	0.71	2.71	020D01G 020D02G 020D03G 020D04G 020D05G 020D06G 020D07G 020D08G 020D09G 020D10G 020D11G 0200004-12G	G G G G G S G G G G G G	Straightway Maher Electric #2 Hyannisport Mary Dunn #1 Mary Dunn #2 Simmons Pond Maher Electric #1 Mary Dunn #3 Mary Dunn #4 Airport #1 Station Maher Electric #3 Straightway #2	Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis Hyannis
9P42202002	42202014	4020003	Cotuit Water Department	0.21	0.27	020B05G 020B04G 020B03G 020B02G	G G G G G	ES #4 ES #2-Old King's Road ES #3-Diesel Sub Station ES #1-Old King's Road ES #5	Cotuit Cotuit Cotuit Cotuit Cotuit
9P242202001	42202015	4020000	Barnstable Fire District	0.32	0.34	020-01G 020-02G 020-03G	G G G	G.P. Well #1 G.P. Well #2 G.P. Well #3	Barnstable Barnstable Barnstable
	42202016		Donald H. Coombs	0	0.09		S S S G	C-3 C-2 Micah Pond Well #1	Centerville Osterville Osterville Osterville
	42202017		Cape Cod Cranberry Realty Trust	0	0.07		G S G	B-2 C-1 B-1	East Sandwich East Sandwich West Barnstable
	42202018		Richard J. Ojala	0	0.04		S	C-1	Centerville
	42202019		Quaker Run Cranberries	0	0.17		S S	C-2 John's Pond	Mashpee Mashpee
	42202020		Perry Cranberry Company	0	0.16		S		
	42202021		Sweet Briar Cranberry Bogs	0	0.06		G G	C-1 C-2	West Barnstable West Barnstable
	42202022		Iyanough Hills Golf Course*	0	0.1		G	Iyanough Hills G C Well	Hyannis
	42202024		Seth Hamblin	0	0.04		S	C-1	Marston Mills
	42202025		Mystic Realty Trust; c/o B. Cuddy	0	0.37		G	C-1	Marston Mills
	42202026		Cranberry Cove Farm	0	0.12		S S S S	C-1 C-2 C-3 C-4	Marston Mills Marston Mills Santail Marston Mills

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42202028		Hamblin & Lampi Cranberry Bogs	0	0.13		S	Marston Mills River	Marston Mills
	42203601		Pocasset Golf Club*	0	0.09		G	Well #1	Pocasset
9P42203601	42203602	4036000	Bourne Water District	0.67	0.73	036-01G	G	Pump Sta. #1(has 4 wells)	Monument Beach
						036-02G	G	Pump Station #2	Cataumet
						036-03G	G	Pump Sta. #3 State forest	Monument Beach
						036-04G	G	Pump Station #4	Monument Beach
						036-05G	G	Pump Station #5	Cataumet
						036-06G	G	Pump Station #6	Pocasset
	42203603	4036003	South Sagamore Water District	0	0.09		G	Tubular Well Field #1	Sagamore
	42203604		John M. Alden	0	0.12		S	C-1	Monument Beach
9P42204101	42204101	4041000	Brewster Water Department	0.94	0.63	041-01G	G	Gravel Pack Well #1	Brewster
						041-02G	G	Gravel Packed Well #2	Brewster
						041-03G	G	Well #3	Brewster
						041-04G	G	Well #4	Brewster
						041-05G	G	Well #5	Brewster
	42204103		Namskaket Farm*	0	0.11		S	C-1	Brewster
	42204104		Ocean Edge Golf Club*	0	0.09		G	Well #1	Brewster
							G	Well #2	Brewster
	42204105		The Captain's Golf Course*	0.7	0.1		G	Well #1 (Reg and Perm)	Brewster
				0	0.1		G	Well #2 (Reg only)	Brewster
9P42205501	42205501	4055000	Chatham Water Department	0.47	0.7	055-01G	G	S. Chatham Well #1	Chatham
						055-02G	G	S. Chatham Well #2	Chatham
						055-03G	G	S.Chatham Well #3	Chatham
						055-04G	G	Indian Hill Well #4	Chatham
						055-05G	G	Well #5	Chatham
						055-06G	G	Well #6	Chatham
						055-07G	G	Well #7	Chatham
						4055000-08G	G	Well #8	Chatham
	42205502		Raymond D. Murphy	0	0.22		S	C-4	Harwich
							S	C-5	Harwich
							S	C-6	Harwich
							S	Halls Pond	Orleans
							S	Goose Pond	Chatham
							S	Emery Pond	Chatham
	42205503		Eastward Ho Country Club, Inc.*	0	0.11		G	Eastward Ho Well #1	Chatham
							G	Eastward Ho Well #2	Chatham
							G	Eastward Ho Well #3	Chatham

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42207501		Dennis Pines Golf Course*	0	0.08	0	G S	Well #1 Pump Station #1	East Dennis East Dennis
9P42207501	42207502	4075000	Dennis Water District	1.16	2.1	075-01G 075-01G 075-01G 075-01G 075-01G 075-02G 075-03G 075-04G 075-05G 075-06G 075-07G 075-08G 075-09G 075-10G 075-11G 075-12G 075-13G 075-14G 075-15G 075-16G 075-17G 075-18G 075-19G	G G G G G G G G G G G G G G G G G G G G G G G	Main Station Well #1 Main Station Well #2 Main Street Well #3 Main Station Well #4 Main Station Well #5 Pumping Station #1 Pumping Station #2 Pumping Station #3 Pumping Station #4 Pumping Station #5 Pumping Station #6 Pumping Station #7 Pumping Station #8 Pumping Station #9 Pumping Station #10 Pumping Station #11 Pumping Station #12 Pumping Station #13 Pumping Station #14 Pumping Station #15 Pumping Station #16 Well #18 Well #19	South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis South Dennis Dennis Dennis Dennis Dennis South Dennis Dennis Dennis Dennis South Dennis South Dennis
	42207503		Harwich Reservoir Bog/Rob Cottrell	0	0.09		S	C-1	Harwich
	42207504		Dennis Highlands Golf Course*	0	0.14		G S	Well #1 Pump Sta #1	Dennis Dennis
	42209601		Paul Harney Golf Club*	0	0.1		G	Well #1	North Falmouth
	42209604		Cape Cod C.C./Green Meadow G.C.,Inc*	0	0.1		G S	Green Meadow G C Well C-1	Hatchville Hatchville
	42209605		Falmouth Inn & Country Club Inc*	0	0.13		G S	Well #1 C-1	Falmouth Falmouth
	42209606		Woods Hole Golf Club*	0	0.08		G G	Well #2 Well #1	Woods Hole Woods Hole
9P42209601	42209607	4096000	Falmouth Water Department	1.36	2.95	4096000-01S 4096000-02G 4096000-03G 4096000-04G 4096000-05G	S G G G G	Long Pond Reservoir Fresh Pond Well Coonamesset Well Mares Pond Well Crooked Pond Well	Falmouth Falmouth Falmouth Falmouth Falmouth

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42209608		Ralph S. Tupper	0	0.04		G S	Owl Pond Road Well	Brewster Brewster
	42209609		Handy Cranberry Trust	0	2.08		S S S S S S S S S S S S S G G G G G G G G G	C-1 C-2 C-3 C-4 C-5 C-6 C-7 C-8 C-9 C-10 C-11 C-12 C-13 Well #1 Well #2 Well #3 Well #4 Well #5 Well #6 Well #7 Well #8 Well #9	Cataumet Cataumet Cataumet West Falmouth West Falmouth West Falmouth Falmouth Falmouth Falmouth Falmouth Falmouth Falmouth Falmouth Cataumet Cataumet Falmouth Falmouth Falmouth Falmouth Falmouth Falmouth Falmouth
9P42209601	42212601	4126000	Harwich Water Department	0.96	1.2	126-01G 126-02G 126-03G 126-04G 126-05G 126-06G 126-07G 126-08G 126-09G 126-10G 126-11G 126-12G	G G G G G G G G G G G G	GPW #1 GPW #2 GPW #3 Main Pumping Sta. GPW #4 GPW #5 GPW #6 GPW #7 GPW #8 GPW #9 GPW #10 GP Well #11	Harwich Harwich Harwich Harwich Harwich Harwich Harwich Harwich Harwich Harwich Harwich Harwich
	42212602		Raymond L. Thacher	0	0.39		G S S S	Thacher Bog Well Sand Pond Hinkly Pond Long Pond	No. Harwich No. Harwich Brewster Brewster
	42212603		O'Brien Cranberries	0	0.19		S S	C-2 C-1	Chatham Dennis

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42212604		Latham Bog	0	0.05		S	C-1	Brewster
	42212605		Cleveland B. Smith	0	0.1		S S	C-1 C-2	North Harwich North Harwich
	42212606		Flax Pond Bogs - John Sarkes	0	0.1		S S	Dodge Bog Flax Pond	Harwich Harwich
	42212607		Cranberry Valley Golf Course*	0	0.11		G G	Well #1 C-1	Harwich Harwich
	42212608		Cedar Swamp Bogs, Inc.	0	0.06		S	Grass Pond	Harwichport
	42212609		Aaron Gingras	0	0.04		S	C-1	Harwich
	42212610		John E. Hall	0	0.07		S	Herring Dam Res.	No. Harwich
	42212611		Chatham Cranberry Company	0	0.12		S	Robbins Pond	Harwich
	42212615		Carver Crowell & Son Cranberry Co.	0	0.87		G		
9P42217202	42217201	4172000	Mashpee Water District	1.16	0.14	tba 4172039-01G 4172039-02G 4172039-03G 4172039-04G 4172039-05G 4172039-06G	G G G G G G G	P-1 Site G.P. Well #1 G.P. Well #2 G.P. Well #3 Quaker Run #4 Turner Road Well Mashpee Village Well	Mashpee Mashpee Mashpee Mashpee Mashpee Mashpee Mashpee
	42217202		Quashnet Valley Golf Course*	0	0.09		S	Quashnet Valley G C Pond	Mashpee
	42217203		New Seabury Golf Course*	0	0.22		G G G	Well #2 Well #1 Golf Course Well#3	Mashpee Mashpee Mashpee
	42217204		Chop Chaque Cranberries, Inc.	0	0.06		S	Santuit Pond	Mashpee
	42217205		Town of Mashpee Con. Com.		0.11		S S	Johns Pond John's Pond	Mashpee Mashpee
9P42222401	42222401	4224000	Orleans Water Department	1.12	0.86	224-01G 224-02G 224-03G 224-04G 224-05G 224-06G 224-07G	G G G G G G G	Pumping Station #1 Pumping Station #2 Pumping Station #3 Pumping Station #4 Pumping Station #5 Pumping Station #6 Pumping Station #7	Orleans Orleans Orleans Orleans Orleans Orleans Orleans
	V42222501		USCG Golf Course, Otis ANGB	0	0.02		G	Well B	Otis ANGB
	42222502	4066001	Otis ANG Base		0.54	Well #2 Well #1	G G	Well J Well G	Otis ANG BASE Otis ANG BASE

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42224201	4242000	Provincetown Water Department	0	0.85		G	North Truro Air Fo Well#5	North Truro
							G	Knowles Crossing Wellfield	North Truro
							G	South Hollow Wellfield	No. Truro
							G	National Park #4	North Truro
	42226102		Wakly Bog and Sandwich Bog	0	0.16		S	Wakby Pond	S. Sandwich
							S	Lily Pond	E. Sandwich
	42226103		Sagamore Cranberry Corporation	0	0.28		S	Muddy Pond	Marsons Mills
							S	Lovells Pond	Cotuit
							S	Hamblin Pond	Marsons Mills
	42226106		Discovery Hill Cranberry Company	0	0.06		G	Discovery Hill pump	E. Sandwich
9P42226101	42226108	4261000	Sandwich Water District	1.87	0.77	261-02G	G	Boiling Springs	Sandwich
						261-03G	G	Boiling Springs	Sandwich
						261-04G	G	Pinkham Road	East Sandwich
						261-05G	G	Weeks Pond Well	East Sandwich
						261-06G	G	Well #6	Forestdale
						261-07G	G	Well #7	Sandwich
						261-09G	G	Well #8	Sandwich
						261-09G	G	Well #9	Sandwich
						261-10G	G	Well #10	Sandwich
						261-11G	G	Well #11	East Sandwich
	42226109		Mirant Canal, LLC	0	0.45		G	Freezer Rd Well #2	Sandwich
							G	Freezer Rd Well #1	Sandwich
	42226110		The Scorton Company	0	0.31		G	Well #1	E. Sandwich
							G	Well #2	E. Sandwich
							S	Hoxie Pond	E. Sandwich
							S	Hoxie Pond	E. Sandwich
							S	Nye Pond	E. Sandwich
							S	Scorton Neck Bog	E. Sandwich
	42226111		Gelsthorpe & Middleton Cranberry Co	0	0.23		S	C-1	Yarmouthport
							S	C-1	E. Sandwich
							S	Cows River	E. Sandwich
							G	Well #1	E. Sandwich
							G	Well #2	Yarmouthport
							G	Well #3	Yarmouthport
	42226112		Round Hill Country Club, Corp.*	0	0.07		G	Round Hill Well	Sandwich

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
	42226113		Massachusetts DFW	0	2.77		S	Nye Pond-E. Sandwich	E. Sandwich
							G	E. Sandwich Fish Hatchery	E. Sandwich
							G	Sandwich State Hatchery	Sandwich
							G	E. Sandwich Fish Hatchery	E. Sandwich
	42231001		Baptiste Cranberry Realty Trust	0	0.2		S	C-1	Bourne
	42235101		Blue Rock Golf Course*	0	0.16		G	Well-Blue Rock G.C.	Yarmouth
							S	Cat Swamp Pond	Yarmouth
	42235102		Cummaquid Golf Club*	0	0.1		G	Well #2	Barnstable
							G	Well #3	Barnstable
	42235103		Rocky Bog Cranberry Company	0	0.21		S	Griffiths Pond	Brewster
							S	Elbow Pond	Brewster
							S	Marston Mills Bog	Marston Mills
							S	C-3	Yarmouth
	42235104		Russell Gallagher	0	0.06		S	Robbins Pond	Harwich
	42235105		Bass River Golf Course*	0	0.12		S	Turtle Pond	S. Yarmouth
							G	Bass River G C Well	S. Yarmouth Road
P42235101	42235106	4351000	Yarmouth Water Department	1.92	3.03	4351000-01G	G	Main Station	Yarmouthport
						351-02G	G	G.P. Well #1	West Yarmouth
						351-03G	G	G.P. Well #2	West Yarmouth
						351-04G	G	G.P. Well #3	West Yarmouth
						351-05G	G	G.P. Well #4	South Yarmouth
						351-06G	G	G.P. Well #5	South Yarmouth
						351-07G	G	G.P. Well #6	South Yarmouth
						351-08G	G	G.P. Well #7	South Yarmouth
						351-09G	G	G.P. Well #8	South Yarmouth
						351-10G	G	G.P. #9	South Yarmouth
						351-11G	G	G.P. Well #10	South Yarmouth
						351-12G	G	G.P. Well #11	South Yarmouth
						351-13G	G	G.P. Well #13	West Yarmouth
						351-14G	G	G.P. Well #14	West Yarmouth
						351-15G	G	G.P. Well #15	South Yarmouth
						351-16G	G	G.P. Well #16	South Yarmouth
						351-17G	G	G.P. Well #17	West Yarmouth
						351-18G	G	G.P. Well #18	West Yarmouth
						351-19G	G	G.P. Well #19	West Yarmouth
						351-20G	G	G.P. Well #20	West Yarmouth
						351-21G	G	G.P. Well #21	Yarmouthport

Permit	Registration	PWSID	Name	20 Year Permitted Volume (mgd)	Registered Volume (mgd)	Source	G or S	Well/Source Name	Withdrawal location
continued from previous page			Yarmouth Water Department	1.92	3.03	351-22G 351-23G 351-24G	G G G G	G.P. Well #22 Well #23 Well #24 Willow St. Interceptor	Yarmouthport Yarmouthport Yarmouthport West Yarmouth
	42235107		Mello-Wilson Cranberry Corporation	0	0.52		G S S	Buck Island Rd Well West Yarmouth Rd Buck Island Rd	Yarmouth Yarmouth Yarmouth
	42235108		Thomas Powers	0	0.04		S	5 acre bog – Big Sandy	Yarmouth
	V42202003		Sheraton Hyannis Resort-Twin Brooks*	0	0.07		G	Golf Course Well	Hyannis
	V42207505		Dean P. Emery	0	0.04		S	Whig Street Bog	Dennis
	V42209602		Carleton H. Collins	0	0.03		G	Carlton Collins	Falmouth
	V42212616		Alan McClennen(Three Town Bog)	0	0.03		S	Three Town Bog	Brewster
	V42226105		John Ahonen Bogs	0	0.02		S	John W. Ahonen Bogs	Sandwich

*indicates average withdrawal over less than 365 days
G – ground water
S – surface water

APPENDIX D – MA DEP 1999 GRANT AND LOAN PROGRAMS

Excerpted from the MA DEP World Wide Web sites, http://www.state.ma.us/dep/brp/mf/files/glprgm.pdf and http://www.state.ma.us/dep/brp/mf/othergrt.htm.

604(b) WATER QUALITY MANAGEMENT PLANNING GRANT PROGRAM

This grant program is authorized under the federal Clean Water Act Section 604(b) for water quality assessment and management planning. 604(b) projects in the Cape Cod Watershed include:

- 97-01/604 *Priority Land Acquisition Assessment for Cape Cod: Protecting Suitable Land for Future Water Supply Needs* (Cape Cod Commission). This project proposes to conduct a regional assessment of suitable parcels for potential water supply sites and water supply source protection in the Cape Cod Watershed. The method proposed will serve as a rational, cost effective planning tool for identifying potential future well sites and guidance for parcel acquisition. The project will consist of the development and application of an innovative parcel-based GIS methodology to refine efforts to identify priority water supply related land parcels for immediate protection and eventual acquisition. Prioritization of parcels will be conducted cooperatively with water supply purveyors and town planners.

- 99-01/604 *Priority Land Acquisition Assessment for Cape Cod: Phase 2* (Cape Cod Commission). This project is the second phase of a priority land rating project initiated under a previous 604(b) grant. This phase of the project will provide guidance to eleven Cape Cod towns towards securing new land for water supply. Project tasks will include providing detailed GIS maps of the most suitable parcels for potential acquisition. These GIS maps will provide surficial topography and depth to water table information. A detailed analysis of relevant water development factors including funding options, groundwater protection measures, withdrawal permitting issues, and identification of local concerns affecting site selection will be prepared for each recommended site. A series of Public meetings will be conducted to distribute project information.

- 99-03/604 *Cape Cod Coastal Nitrogen Loading Studies* (Cape Cod Commission). The Cape Cod Commission will complete the nitrogen loading assessments for three embayments – Centerville River, Nauset Marsh and Town Cove, and Herring River systems initiated under previous grants. Development of nitrogen limits/TMDLs, determination of nitrogen loads, and recommendations for potential pollution controls will be prepared. In addition, recent water quality and revised tidal flushing in the Popponesset Bay system, including the Mashpee River, will be used to produce nitrogen management options for this system.

- 2000-01/604 *Surface Water Nutrient Management* (Cape Cod Commission). This project will address two Massachusetts Watershed Initiative Priority Projects: 1) Long Pond; and 2) Barnstable and Red Brook Harbor. Nitrogen loading and management options will be prepared for the Barnstable Harbor and Red Brook Harbor Coastal embayment systems. This includes watershed delineations, critical nitrogen loads, existing and buildout nitrogen loads, comparison of nitrogen loads to nitrogen limits, and developing management options. For Long Pond, data needs will be identified and if necessary additional data collected (a QAPP will be prepared if necessary), an Advisory Committee will be established, nutrient management options will be prepared and a preferred set of options identified

104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM

This Grant Program is authorized under Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. The Water Quality proposals received by MA DEP under this National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency is a results oriented approach that will focus attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are to: 1) achieve clean air, 2) achieve clean water, 3) protect wetlands, 4) reduce waste generation, and 5) clean up waste sites. 104(B)(3) projects in the Cape Cod Watershed include:

- 99-02/104 *Biomonitoring Support for the BRP Watershed Management Program* (Department of Environmental Protection) This project will provide reconnaissance and freshwater biomonitoring support, as needed, to watershed teams during year 2 of the river basin schedule including the Merrimack, Parker, French and Quinebaug, Boston Harbor, Narragansett, and Cape Cod teams. Biomonitoring activities may include Rapid Bioassessement Protocols (RBP) for macroinvertebrate or fish populations, fish toxics monitoring, primary production studies, or other efforts aimed at assessing aquatic life use support. Habitat assessment and biomonitoring functions will be carried out according to the terms of the respective project plans. Results will be presented to the watershed teams in the form of technical memoranda, or incorporated into comprehensive assessment reports, as dictated by the magnitude and extent of other monitoring and assessment activities that may have been performed. Assessments will be used to focus "individual control strategies" (ICS) in the form of wastewater discharge or other necessary permits, and implementation of best management practices (BMP) for controlling nonpoint pollution. Aquatic life use assessments will be stored in the Waterbody System database for future reference by watershed teams, and for generating state-wide reports to EPA as required by sections 305(b) and 303(d) of theClean Water Act.

319 NONPOINT SOURCE GRANT PROGRAM

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan. 319 projects in the Cape Cod Watershed include:

- 97-02/319 *Red Lily Pond Rejuvenation* (Town of Barnstable). The purpose of this project is to restore the Red Lily Pond complex and return it to its former function as a valuable fish habitat and migratory fish spawning reverse relayering in order to deepen the pond and seal off the nutrients that have accumulated on the bottom of the pond. The existing weed growth in the pond will be removed by hydroraking the pond prior to dredging. Storm drainage from an adjacent road will be infiltrated to eliminate a direct discharge to the pond.

- 97-03/319 *Protecting Nitrogen Sensitive Coastal Embayments through Land Conservation*. This project will demonstrate the use of conservation restrictions and other land protection tools at Best Management Practices to protect sensitive coastal embayments from nitrogen inputs from increased development. The conservation restrictions and land protection tools will be implemented in two watersheds, Slocums River and Onset Bay.

- 97-03/319 *Technical Outreach to Communities Regarding Alternative On-Site Septic Systems* (Barnstable County Department of Health & the Environment). The proposed project will supply ongoing technical assistance to communities relative to alternative on-site septic system technologies. The emphasis of the information will be performance data, permitting procedures and requirements, treatment efficacy, design specifications, monitoring and maintenance requirements, cost effectiveness and installation requirements. Outreach primarily will be focused toward Boards of Health and the design and engineering communities.

- 97-05/319 *Leak Prevention for Heating Oil Storage Systems* (Barnstable County Department of Health & the Environment). With the goal of protecting Cape Cod's sole source aquifer, the purpose of this project is to increase compliance with existing regulations on underground heating oil storage tanks (USTs). In addition, low cost effective containment methods for above ground fuel tanks (AGTs) and underground feed lines will be developed and distributed to interested parties.

- 97-09/319 *Three Bay Area - Ropes Beach Subwatershed* (Town of Barnstable). The purpose of this project is to capture and treat road runoff that is contributing to the contamination of Cotuit Bay, a prime shellfish location and gateway to two herring runs. Under this project a series of rock filled

pools and channels will be installed. The pools will be preceded by sediment removal tanks and followed by an infiltration system. The net effect will be removal of sediment, bacteria and nitrogen.

- 98-01/319 *Determining the Effectiveness of On-Site Septic Systems for the Removal of Viruses* (Barnstable County Department of Health & the Environment). The proposed project seeks to determine the removal efficiencies of standard Title 5 systems for viruses and provide a benchmark against which alternative on-site septic system technologies can be compared. In addition, this study endeavors to clarify some of the mechanisms of virus removal and suggest guidelines that Boards of Health can use in their review of variance requests from setback requirements of the regulations.

- 98-03/319 *Coastal Embayment/Title 5 Training Video* (Cape Cod Commission). The proposed project will produce a video on methods to identify nitrogen-sensitive coastal embayments and to develop water quality protection and remediation strategies within their watersheds. This video can be utilized in training agency staff, local Boards of Health and other community-based watershed groups.

- 01-12/319 *Cranberry Bog Phosphorus Dynamics for TMDL Development* (University of Massachusetts Cranberry Experiment Station). This project will study phosphorus dynamics in Massachusetts cranberry bogs to assist the MA DEP in formulating Total Maximum Daily Load performance standards. Specifically, the objectives of this project are (1) determine phosphorus and nitrogen import and export from representative cranberry beds associated with water management, including floods, irrigation, and rain events; (2) determine nitrogen and phosphorus export from a natural freshwater wetland; (3) determine phosphorus and nitrogen export from beds where phosphorus fertilizer rates are reduced to less than 20 pounds of phosphorus per acre; and (4) determined the impact of reduction in phosphorus fertilization on cranberry sustainability.

RESEARCH AND DEMONSTRATION GRANT PROGRAM

The Research and Demonstration Program (R&D) is authorized by section 38 of Chapter 21 of the Massachusetts General Laws and is funded by proceeds from the sale of Massachusetts bonds. Specifically, the R&D Program was established to enable the Department to conduct a program of study and research and demonstration relating to water pollution control and other scientific and engineering studies "...so as to insure cleaner waters in the coastal waters, rivers, streams, lakes and ponds of the Commonwealth." R&D projects in the Cape Cod Watershed include:

- 00-06/R&D *Orleans Septage Treatment Facility Groundwater and Coastal Marsh Study*. This project will continue to investigate the transport and impact of a plume of nutrient-rich groundwater from the Tri-Town Septage Treatment Facility in Orleans on the Namskaket River and salt marsh. (The Namskaket River and adjoining salt marsh are designated Outstanding Resource Waters (ORW's) and Areas of Critical Environmental Concern (ACEC). The results of this study will be useful in evaluating waste disposal alternatives and assist the Department in it's efforts to develop nitrogen control policies for coastal waters of Massachusetts.

- 02-06/R&D *Cape Cod Coastal Embayments Delineations*. For this project the United States Geological Survey will develop a regional understanding of the ground-water flow and the sources of water to ecologically sensitive coastal embayments throughout Cape Cod. The delineation of the contributing areas, the determination of time-of-travel distributions, and the calculation of groundwater fluxes to the natural receptors will be completed for current pumping and recharge conditions. Ground-water flow models previously developed for the delineation of the source of water to public-supply wells will be used to: delineate areas that contribute water to coastal embayments, upgradient ponds and streams, and wetlands greater than 16 acres in area; determine time-of-travel distributions within the embayment contributing areas; and determine steady-state ground-water fluxes to coastal embayments as well as the ponds and streams within the contributing areas to these.

SOURCE WATER PROTECTION TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to third party technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies. Source Water Protection projects in the Cape Cod Watershed include:

- 99-14/SWT *Resource Planning for Cranberry Bogs within Drinking Water Supply Areas*. This project will provide direct technical assistance with farm planning to cranberry growers in the Cape Cod, Buzzards Bay, Taunton, South Coastal, and Nantucket Basins in an effort to conserve and protect water resources. Resource planning for cranberry bogs located within or adjacent to public drinking water supply areas will provide cranberry growers with the information necessary for the protection of public surface and groundwater drinking water supplies in Southeastern Massachusetts.

- 00-13/SWT *Cape Cod Source Water Protection Project*. This project will support Groundwater Guardian education and outreach activities in all fifteen Cape Cod Communities. Specific tasks will include: 1. Conduct Groundwater Guardian activities in Cape Cod Communities to address water supply protection and safe drinking water issues. Organize Groundwater Guardian meetings, including mailings, minutes and follow-up; coordinate Groundwater Guardian events including water festivals and school events; distribute Groundwater Guardian water conservation materials; and, be available to water suppliers for ongoing assistance with education and outreach. 2. Submit final report to MA DEP.

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education. Wellhead Protection Grants in the Cape Cod Watershed include the following:

- 99-01/WHP *Brewster Wellhead Protection Project* (Town of Brewster). This Project will install security fencing in an effort to protect the town's wells #1 and #2 from vandalism and entrance by unauthorized persons or animals. These two wells are located in a wooded area close to recreation areas and accessible by road. New fencing will prevent access to the Zone I area and will provide additional security to the pump station and wells.

- 01-05/WHP *Truro Wellhead Protection Project*. This project will conduct three town wide hazardous waste collection events and distribute public educational information to area residents and businesses. The educational effort will focus on three areas: groundwater and wells; hazardous materials and hazardous materials collections; and alternative products and practices that can reduce contaminants in the groundwater. This project targets the protection of the Provincetown Water Department's wells located in highly susceptible soils within the Town of Truro.

CLEAN WATER STATE REVOLVING LOAN FUND (CWSRF) PROGRAM

The Massachusetts State Revolving Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. The SRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection and the Massachusetts Water Pollution Abatement Trust. Each year the Department solicits projects from Massachusetts municipalities and wastewater districts to be considered for subsidized loans, which are currently offered at 50% grant equivalency (approximates a no-interest loan). In recent years the program has operated at an annual capacity of $150 to $200 million per year, representing the financing of 40 to 50 projects annually. The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed. CWSRF Projects in the Cape Cod Watershed include the following:

- 98-67/SRF *Asher's Path Landfill Closure*. Mashpee
- 98-76/SRF *Landfill Closure*. Falmouth

- 00-50/SRF *CWMP.* Mashpee
- 00-60/SRF *WWFP Phase IIIA*. Barnstable

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems. The law appropriated $30 million to the MA DEP to assist homeowners. The Department will use the appropriation to fund loans through the Massachusetts Water Pollution Abatement Trust. The fund will provide a permanent state/local administered revolving fund to assist income-eligible homeowners in financing necessary Title 5 repairs. Working together, the MA DEP and the Trust have created the Community Septic Management Program to help Massachusetts' communities protect threatened ground and surface waters while making it easier to comply with Title 5. This loan program offers three options from which a local governmental unit can choose.

MASSACHUSETTS DRINKING WATER STATE REVOLVING FUND PROGRAM

The Massachusetts Drinking Water State Revolving Fund (DWSRF) provides low-cost financing to help community public water suppliers comply with federal and state drinking water requirements. The DWSRF Program's goals are to protect public health and strengthen compliance with drinking water requirements, while addressing the Commonwealth's drinking water needs. The Program incorporates affordability and watershed management priorities. The DWSRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection (MA DEP) and the Massachusetts Water Pollution Abatement Trust (Trust). The current subsidy level is equivalent to a 50% grant, which approximates a two percent interest loan. The Program will initially operate with approximately $50 million in financing capacity. For calendar years 1999 through 2003, up to $400 million may be available through the loan program. DWSRF projects in the Cape Cod Watershed include the following:

- 01-01/SRF *Mid-Cape Hydrologic Modeling*. The objective of this USGS investigation is to develop a regional understanding of groundwater flow and the sources of water to public water supple wells and ecologically sensitive natural receptors on Inner Cape Cod for current and future stress conditions. A regional groundwater flow model will be developed to evaluate the effects of (1) future groundwater withdrawals, (2) seasonal changes in groundwater pumping and aquifer recharge, and (3) extended periods of drought and high groundwater on the groundwater flow system, and, more specifically, the sources of water to public supply wells and natural receptors, such as ponds, streams, and coastal embayments. The benefits of this project will include an improved understanding of the groundwater flow system, which will assist State and local regulators in managing the current water resources of Inner Cape Cod and enable them to evaluate the effects of future groundwater withdrawals on these resources. The flow model developed as part of this investigation will be a valuable tool for determining the sources of water to existing and proposed public water supply wells and it can be used to determine the source of water to natural receptors. such as the coastal embayments identified as Areas of Critical Environmental Concern under the Cape Cod Coastal Embayment project. In addition to determining the sources of water to natural receptors, groundwater discharge rates to these receptors can be calculated for current and future stress conditions.

MASSACHUSETTS WATERSHED INITIATIVE GRANT FUNDING PROGRAM

Annually, EOEA Watershed Team Leaders, in conjunction with State and Federal agencies, municipal governments and regional planning agencies, universities, local watershed associations, businesses and other groups develop transitional work plans that identify the most important goals for each watershed and the specific projects and programs which will be needed to meet those goals.

The Massachusetts Department of Environmental Protection is designated as a "Lead Agency" to implement some of these MWI priority projects identified by the Teams. The watershed priority projects administered by MA DEP address issues relating to water quality, open space and growth planning, and technical assistance and outreach. MWI projects in the Cape Cod Watershed include the following:

- 01-03/MWI *Cape Cod Nutrient Loading Studies* (Tetra Tech, Inc.). This project will conduct nutrient loading studies for Back River, Lewis Bay, Parker River and Swan Pond on Cape Cod. Specific

tasks include; review and summarize available hydrologic and nutrient data for each waterbody, delineate the watersheds/subwatershed, conduct flushing studies of selected waterbodies, develop critical nitrogen loads for each waterbody, develop watershed nitrogen management options, conduct public participation and information transfer to stakeholders groups, and prepare final project report.

- 02-04/MWI *Cape Cod Comprehensive Regional Wastewater Management Strategy*. This project will compile existing data and develop an outreach plan to help facilitate community involvement and interest in regional wastewater planning and implementation on Cape Cod by identifying lakes, ponds, rivers and coastal embayments; public water supply wells, their watersheds and their sensitivity to wastewater contaminants, and reviewing available projections of wastewater flows with the potential to impact these resources; reviewing potential centralized and community wastewater discharge locations region-wide, identify down-gradient sensitive receptors and potential discharge capacity; facilitating community involvement and transfer findings through regulating, technical and planning discussions, and other means.

- 01-03/WRP *Namskaket Marsh Restoration,* Brewster/Orleans. MA DEM and the Cape Cod Conservation District are the project sponsors for this 8-acre salt marsh restoration on the Cape Cod Rail Trail. MWRP contracted out the restoration design and now has final construction plans. A CWRP partner is in the process of preparing all of the necessary permits. MA DEM applied for, and received, a $45,000 National Coastal Wetlands Conservation Grant from the USFWS. The remainder of the funding required for construction will likely come from MA DEM and other CWRP partners. Anticipated construction is in late 2002.

- 01-05/WRP *South Cape Beach Wetlands Restoration, Mashpee*. MA DEM is the project sponsor. In FY '01, MWRP contracted out the initial feasibility study. MWRP hired the same contractor in FY '02 to complete this 16+ acre salt marsh restoration design plan and should have full construction plans for this project by July 2002.

- EOEA funded Watershed Stewardship Program *Cape Cod Lake and Pond Stewardship Strategy 2000 – 2001* (Barnstable County through the Cape Cod Commission). The project will compile and update existing data, initiate lake and pond monitoring groups and develop an outline for a comprehensive strategy for pond stewardship and protection. Specific tasks include: 1) Update atlas and digital record of information on Cape Cod Ponds and Lakes; 2) Recruit pond advocacy groups and organize pond and lake workshops to educate on environmental issues; 3) Select and develop lake and pond sustainability indicator(s); 4) Develop outline for a pond Stewardship strategy; and 5) Produce quarterly and final reports of project activities, findings and improvements.

- EOEA funded Massachusetts Communities Connected By Water Program *Cape Cod Outreach for Protection of Water Quality and Quantity 1999 - 2001* (Association for the Preservation of Cape Cod). This project will identify, organize and activate watershed stakeholders into a Watershed Advocacy Network, and pursue the adoption of model bylaws to manage growth and protect water resources. Tasks include: 1) Identify and engage existing watershed stakeholder groups on Cape Cod; 2) Organize, educate, and motivate the participating groups to bring information back to their constituents that results in action; 3) Pursue adoption of growth management and resource protection bylaws in each Cape town, with the goal that by the year 2008 all of the towns will have the complete array of available protections in place; 4) Accomplish broader use of Districts of Critical Planning Concerns (DCPCs) to protect key resource areas; and 5) Develop model nitrogen and phosphorous management programs including development of model bylaws to control nutrient inputs, and to provide education/outreach on these issues.

APPENDIX E – DMF SHELLFISH DATA, CAPE COD WATERSHED

It is the mission of the Massachusetts Division of Marine Fisheries (DMF) to manage, develop, and protect the Commonwealth's renewable living marine resources to provide the greatest public benefit. DMF fosters protection of the marine environment by cooperating with other state and federal agencies on pollution abatement, coastal wetlands protection and other programs concerning coastal waters and marine life. DMF monitors coastal contaminant levels in fish and shellfish, operates a shellfish depuration facility, and evaluates the impacts of coastal development on marine fish and their habitats. DMF provides assistance to local shellfish officers on matters affecting the management of shellfish, and provides expertise on anadromous fish and construction assistance on fishways. Other DMF programs assist commercial and recreational fishermen and educate the public on marine resource issues and values.

The DMF Shellfish Management Program manages shellfish growing areas in compliance with the National Shellfish Sanitation Program (NSSP). The NSSP is a federal/state cooperative program recognized by the U.S. Food and Drug Administration (USFDA) and the Interstate Shellfish Sanitation Conference (ISSC). One goal of this program is the sanitary control of shellfish harvested and sold for human consumption. Growing areas are managed with respect to shellfish harvest for direct human consumption and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (six different classification types in all) with respect to shellfish harvest (Tables E1 and E2).

Table E1. DMF Shellfish Management Program Managed Shellfish Growing Area Classifications.

Classification Type	**Definition**
Approved	A classification used to identify a growing area where harvest for direct marketing is allowed. The area is shown to be free of bacterial contaminants under a variety of climatological and hydrographical situations (i.e. assumed adverse pollution conditions). Average fecal coliform concentrations may not exceed 14 fc/100mL H_20 and no more than 10% of the samples may not exceed a value of 28 fc/100mL H_20. Open for harvest of shellfish for direct human consumption.
Conditionally Approved	A classification used to identify a growing area which meets the criteria for the approved classification except under certain conditions described in a management plan. This classification category may be assigned for growing areas subject to intermittent and predictable microbiological contamination that may be present due to operation of a sewage treatment plant, rainfall, and/or season. Use of the conditionally approved classification is strictly a voluntary option due to the considerable investment in time and resources demanded by the NSSP to establish and maintain the classification. The returns are worth the effort and costs only for growing areas with abundant shellfish assets. During the time the area is approved, it is open for harvest of shellfish for direct human consumption subject to local rules and state regulations.
Conditionally Restricted	A classification used to identify a growing area that meets the criteria for the restricted classification except under certain conditions described in a management plan. During the time the area is restricted, it is only open for the harvest of shellfish with depuration subject to local rules and state regulations.

Classification Type	Definition
Restricted	A classification used to identify where harvesting shall be by special license and the shellstock, following harvest, is subject to a suitable and effective treatment process through relaying or depuration. Restricted growing areas are mildly or moderately contaminated only with bacteria. Average fecal coliform concentrations may not exceed 88 fc/100mL H_20 and no more than 10% of the samples not may exceed a value of 173 fc/100mL H_20. Open for harvest of shellfish with depuration subject to local rules and state regulations for the relay of shellfish.
Management Closure	Closed for the harvest of shellfish. Not enough testing has been done in the area to determine whether it is fit for shellfish harvest or not.
Prohibited	A classification used to identify a growing area where the harvest of shellstock is not permitted. Growing area waters are so badly contaminated that no reasonable amount of treatment will make the shellfish safe for human consumption. Growing areas must also be classified as Prohibited if there is no or insufficient information available to make a classification decision. Closed for the harvest of shellfish.

Classification area codes and town names identify each DMF shellfish area. The Cape Cod Watershed 1999 Water Quality Assessment Report describes each shellfishing area by its classification area code and the assessed region is defined in square miles within the MA DEP/DWM water body system segment. Areas not specifically included in this assessment report and appendix are the Town of Bourne and the western shore of Falmouth as these areas are included in the Buzzards Bay Watershed.
As of July 2000 DMF classified a total of 395641.79 acres in the Cape Cod Watershed (Table E2).

Table E2. Summary Shellfish Classification Area Information as of July 2000.

Classification Type	Area (acres)
Approved	389326.142
Conditionally Approved	4280.407
Restricted	182.406
Conditionally Restricted	0.000
Prohibited	1809.923
Management Closure	42.912
Total	**395641.79**

Table E3. DMF - Shellfish Project Classification Area Information as of July 2000.

Town	Classification Area Code	Classification Type	Area (acres)
Barnstable	CCB29.0	Prohibited	24.001
Barnstable	CCB30.0	Approved	11214.609
Barnstable	CCB30.0	Approved	2615.431
Barnstable	CCB31.0	Approved	1695.468
Barnstable	CCB31.1	Conditionally Approved	280.217
Barnstable	CCB31.2	Conditionally Approved	81.106
Barnstable	CCB31.20	Approved	35.431
Barnstable	CCB32.0	Prohibited	27.596
Barnstable	CCB33.0	Conditionally Approved	181.174
Barnstable	CCB34.0	Approved	169.396
Barnstable	NS1.0	Approved	885.886

Town	Classification Area Code	Classification Type	Area (acres)
Barnstable	NS4.0	Approved	1861.285
Barnstable	SC18.0	Approved	18362.299
Barnstable	SC19.0	Approved	174.51
Barnstable	SC20.2	Prohibited	46.493
Barnstable	SC20.3	Prohibited	50.427
Barnstable	SC21.0	Approved	518.279
Barnstable	SC21.1	Conditionally Approved	26.806
Barnstable	SC21.2	Conditionally Approved	21.223
Barnstable	SC21.20	Approved	7.89
Barnstable	SC21.21	Approved	7.218
Barnstable	SC21.22	Approved	2.598
Barnstable	SC22.0	Approved	304.2
Barnstable	SC22.21	Approved	15.664
Barnstable	SC22.22	Approved	10.643
Barnstable	SC22.23	Approved	1.556
Barnstable	SC23.1	Conditionally Approved	58.81
Barnstable	SC23.2	Conditionally Approved	290.506
Barnstable	SC23.20	Conditionally Approved	8.961
Barnstable	SC23.21	Conditionally Approved	0.675
Barnstable	SC23.22	Conditionally Approved	2.654
Barnstable	SC23.3	Conditionally Approved	30.184
Barnstable	SC24.0	Restricted	114.221
Barnstable	SC24.2	Prohibited	42.912
Barnstable	SC25.0	Restricted	13.641
Barnstable	SC25.1	Prohibited	35.647
Barnstable	SC26.0	Prohibited	42.345
Barnstable	SC27.0	Approved	479.624
Barnstable	SC27.0	Approved	71.424
Barnstable	SC27.1	Prohibited	1.54
Barnstable	SC27.2	Prohibited	8.925
Barnstable	SC27.22	Approved	5.942
Barnstable	SC27.3	Conditionally Approved	80.395
Barnstable	SC27.3	Conditionally Approved	2.437
Barnstable	SC28.0	Approved	298.436
Barnstable	SC28.1	Prohibited	31.142
Barnstable	SC28.2	Conditionally Approved	16.74
Barnstable	SC28.20	Approved	4.149
Barnstable	SC28.8	Conditionally Approved	16.986
Barnstable	SC28.9	Prohibited	1.189
Brewster	CCB17.0	Approved	0.01
Brewster	CCB20.0	Approved	2115.212
Brewster	CCB21.0	Prohibited	11.89
Brewster	CCB22.0	Prohibited	4.611
Brewster	CCB24.0	Prohibited	8.381
Brewster	CCB20.0	Approved	8649.959
Chatham	OC1.0	Approved	5956.801
Chatham	SC42.0	Approved	1247.251
Chatham	SC42.1	Prohibited	3.774
Chatham	SC43.0	Prohibited	0.568
Chatham	SC44.0	Conditionally Approved	19.658
Chatham	SC45.0	Conditionally Approved	11.131

Town	Classification Area Code	Classification Type	Area (acres)
Chatham	SC46.0	Conditionally Approved	53.094
Chatham	SC47.0	Approved	4083.46
Chatham	SC48.0	Approved	347.925
Chatham	SC48.4	Conditionally Approved	2.343
Chatham	SC49.0	Approved	88.825
Chatham	SC49.1	Conditionally Approved	0.335
Chatham	SC49.2	Conditionally Approved	2.741
Chatham	SC50.0	Approved	20.532
Chatham	SC50.1	Conditionally Approved	95.244
Chatham	SC50.2	Prohibited	18.562
Chatham	SC51.0	Approved	58.416
Chatham	SC52.0	Approved	2687.801
Chatham	SC52.1	Conditionally Approved	0.768
Chatham	SC53.0	Approved	713.037
Chatham	SC54.0	Approved	85.008
Chatham	SC55.0	Approved	122.972
Chatham	SC56.0	Approved	109.528
Chatham	SC56.2	Conditionally Approved	1.839
Chatham	SC57.0	Prohibited	12.792
Chatham	SC58.1	Conditionally Approved	0.414
Chatham	SC58.2	Prohibited	16.677
Chatham	SC61.0	Approved	0.306
Chatham	NS1.0	Approved	194.967
Chatham	OC1.0	Approved	28397.349
Chatham	SC42.0	Approved	3482.502
Chatham	SC47.0	Approved	19614.294
Dennis	CCB23.0	Approved	2280.755
Dennis	CCB23.2	Conditionally Approved	385.423
Dennis	CCB24.0	Prohibited	7.42
Dennis	CCB25.0	Conditionally Approved	43.584
Dennis	CCB26.1	Approved	1.063
Dennis	CCB27.0	Conditionally Approved	55.398
Dennis	SC32.1	Approved	1419.59
Dennis	SC32.2	Conditionally Approved	158.948
Dennis	SC33.1	Conditionally Approved	137.214
Dennis	SC34.1	Conditionally Approved	163.452
Dennis	SC34.20	Conditionally Approved	43.87
Dennis	SC34.3	Prohibited	5.815
Dennis	SC34.7R	Conditionally Approved	32.664
Dennis	SC35.4	Conditionally Approved	4.142
Dennis	SC35.7	Conditionally Approved	99.891
Dennis	SC36.0	Prohibited	163.697
Dennis	CCB23.0	Approved	12359.566
Dennis	CCB23.2	Conditionally Approved	20.244
Dennis	NS1.0	Approved	838.931
Dennis	SC32.1	Approved	7198.946
Eastham	CCB10.0	Prohibited	7.88
Eastham	CCB11.0	Approved	0.707
Eastham	CCB15.0	Prohibited	38.151
Eastham	CCB16.0	Prohibited	35.243
Eastham	CCB18.0	Prohibited	4.684

Town	Classification Area Code	Classification Type	Area (acres)
Eastham	CCB9.0	Approved	2253.708
Eastham	OC1.0	Approved	87.66
Eastham	OC2.0	Approved	33.476
Eastham	OC4.0	Approved	139.902
Eastham	OC4.1	Prohibited	5.225
Eastham	OC4.2	Conditionally Approved	0.5
Eastham	OC5.0	Approved	535.526
Eastham	OC5.1	Conditionally Approved	23.882
Eastham	OC6.0	Approved	22.392
Eastham	OC7.0	Approved	1934.881
Eastham	OC8.0	Approved	33.689
Eastham	CCB9.0	Approved	13794.328
Eastham	OC1.0	Approved	78.277
Eastham	OC7.0	Approved	8246.605
Eastham	OC8.0	Approved	939.418
Falmouth	SC1.0	Approved	201.615
Falmouth	SC10.0	Management Closure	42.912
Falmouth	SC11.0	Conditionally Approved	61.041
Falmouth	SC11.20	Approved	142.588
Falmouth	SC11.21	Approved	69.722
Falmouth	SC11.22	Conditionally Approved	1.252
Falmouth	SC12.0	Conditionally Approved	136.542
Falmouth	SC13.0	Approved	88.219
Falmouth	SC13.1	Conditionally Approved	38.846
Falmouth	SC13.20	Approved	25.859
Falmouth	SC14.0	Approved	163.776
Falmouth	SC14.2	Conditionally Approved	51.117
Falmouth	SC14.3	Conditionally Approved	29.076
Falmouth	SC15.0	Approved	718.388
Falmouth	SC15.2	Prohibited	42.004
Falmouth	SC16.0	Approved	33.766
Falmouth	SC17.0	Approved	69.439
Falmouth	SC2.0	Approved	220.418
Falmouth	SC2.1	Prohibited	40.943
Falmouth	SC3.0	Approved	367.232
Falmouth	SC4.0	Approved	52.877
Falmouth	SC4.1	Conditionally Approved	16.022
Falmouth	SC4.2	Prohibited	5.922
Falmouth	SC5.0	Approved	1283.691
Falmouth	SC6.0	Prohibited	65.975
Falmouth	SC7.0	Prohibited	60.673
Falmouth	SC8.0	Approved	1627.36
Falmouth	SC8.1	Prohibited	7.445
Falmouth	SC9.0	Conditionally Approved	33.302
Falmouth	SC17.0	Approved	792.31
Falmouth	SC3.0	Approved	780.474
Falmouth	SC5.0	Approved	2175.899
Falmouth	SC8.0	Approved	4844.237
Harwich	SC32.1	Approved	0.036
Harwich	SC32.2	Conditionally Approved	0.006
Harwich	SC37.0	Approved	1693.644

Town	Classification Area Code	Classification Type	Area (acres)
Harwich	SC38.1	Conditionally Approved	19.204
Harwich	SC38.2	Prohibited	21.043
Harwich	SC39.1	Conditionally Approved	13.591
Harwich	SC39.2	Prohibited	5.462
Harwich	SC40.0	Conditionally Approved	13.793
Harwich	SC41.1	Conditionally Approved	9.264
Harwich	SC41.2	Prohibited	5.137
Harwich	SC42.0	Approved	0.095
Harwich	SC53.0	Approved	139.302
Harwich	SC58.1	Conditionally Approved	1.071
Harwich	SC58.2	Prohibited	12.643
Harwich	SC59.0	Conditionally Approved	13.039
Harwich	NS1.0	Approved	221.921
Harwich	SC32.1	Approved	0.041
Harwich	SC37.0	Approved	5355.048
Harwich	SC42.0	Approved	0.219
Mashpee	SC15.0	Approved	242.101
Mashpee	SC15.3	Prohibited	33.056
Mashpee	SC16.0	Approved	252.602
Mashpee	SC16.1	Conditionally Approved	7.902
Mashpee	SC16.2	Prohibited	8.459
Mashpee	SC17.0	Approved	1952.012
Mashpee	SC18.0	Approved	359.621
Mashpee	SC19.0	Approved	273.599
Mashpee	SC19.1	Conditionally Approved	10.241
Mashpee	SC20.1	Conditionally Approved	22.099
Mashpee	SC20.2	Prohibited	45.552
Mashpee	SC20.3	Prohibited	60.346
Mashpee	SC20.4	Prohibited	32.505
Mashpee	NS4.0	Approved	2166.947
Mashpee	SC17.0	Approved	7301.053
Mashpee	SC18.0	Approved	4676.386
Orleans	CCB17.0	Approved	446.459
Orleans	CCB18.0	Prohibited	4.879
Orleans	CCB19.0	Prohibited	3.819
Orleans	CCB21.0	Prohibited	10.451
Orleans	OC1.0	Approved	2464.373
Orleans	OC2.0	Approved	326.075
Orleans	OC3.0	Approved	86.061
Orleans	OC4.0	Approved	269.81
Orleans	OC4.2	Conditionally Approved	0.702
Orleans	OC5.0	Approved	0.165
Orleans	SC52.0	Approved	0.001
Orleans	SC53.0	Approved	988.129
Orleans	SC60.0	Approved	14.082
Orleans	SC61.0	Approved	2087.927
Orleans	SC62.1	Prohibited	5.319
Orleans	SC62.2	Approved	149.768
Orleans	SC63.0	Approved	313.1
Orleans	SC63.4	Conditionally Approved	0.924
Orleans	SC64.0	Approved	5.073

Town	Classification Area Code	Classification Type	Area (acres)
Orleans	SC64.1	Prohibited	0.29
Orleans	CCB17.0	Approved	2814.027
Orleans	OC1.0	Approved	11621.606
Orleans	OC7.0	Approved	46.195
Provincetown	CCB1.0	Approved	2428.657
Provincetown	CCB2.1	Prohibited	17.137
Provincetown	CCB2.2	Conditionally Approved	135.796
Provincetown	CCB3.0	Approved	306.478
Provincetown	CCB4.0	Approved	1976.217
Provincetown	CCB4.1	Prohibited	283.508
Provincetown	CCB4.2	Conditionally Approved	41.036
Provincetown	CCB4.20	Approved	41.099
Provincetown	CCB4.3	Prohibited	3.24
Provincetown	CCB4.4	Conditionally Approved	161.597
Provincetown	CCB5.0	Approved	129.568
Provincetown	CCB5.1	Prohibited	1.92
Provincetown	OC10.0	Approved	2332.489
Provincetown	CCB1.0	Approved	15821.658
Provincetown	CCB3.0	Approved	1058.036
Provincetown	CCB4.0	Approved	384.243
Provincetown	CCB49.0	Approved	0.002
Provincetown	CCB6.0	Approved	1275.199
Provincetown	OC10.0	Approved	16748.028
Sandwich	CCB30.0	Approved	0.002
Sandwich	CCB35.0	Approved	2396.32
Sandwich	CCB35.2	Prohibited	56.016
Sandwich	CCB36.0	Prohibited	26.176
Sandwich	CCB37.0	Prohibited	87.656
Sandwich	CCB35.0	Approved	11865.387
Truro	CCB3.0	Approved	828.949
Truro	CCB4.0	Approved	1068.248
Truro	CCB4.4	Conditionally Approved	130.241
Truro	CCB6.0	Approved	1233.369
Truro	CCB7.1	Conditionally Approved	60.731
Truro	CCB7.2	Conditionally Approved	8.529
Truro	CCB7.3	Prohibited	20.937
Truro	CCB8.0	Approved	35.21
Truro	OC10.0	Approved	1.939
Truro	OC9.0	Approved	4771.294
Truro	CCB1.0	Approved	424.744
Truro	CCB3.0	Approved	3271.537
Truro	CCB4.0	Approved	928.173
Truro	CCB6.0	Approved	6646.482
Truro	CCB8.0	Approved	1716.932
Truro	OC10.0	Approved	3.876
Truro	OC9.0	Approved	25382.227
Wellfleet	CCB10.0	Prohibited	2.263
Wellfleet	CCB11.0	Approved	2851.839
Wellfleet	CCB12.1	Conditionally Approved	150.669
Wellfleet	CCB12.2	Restricted	54.544
Wellfleet	CCB12.20	Conditionally Approved	0.601

Town	Classification Area Code	Classification Type	Area (acres)
Wellfleet	CCB12.4	Prohibited	45.903
Wellfleet	CCB12.5	Prohibited	2.225
Wellfleet	CCB13.0	Approved	172.975
Wellfleet	CCB13.1	Prohibited	3.923
Wellfleet	CCB13.2	Conditionally Approved	69.548
Wellfleet	CCB13.3	Conditionally Approved	0.964
Wellfleet	CCB14.0	Approved	572.722
Wellfleet	CCB8.0	Approved	2207.278
Wellfleet	CCB9.0	Approved	291.364
Wellfleet	OC8.0	Approved	2513.427
Wellfleet	OC9.0	Approved	60.996
Wellfleet	CCB11.0	Approved	2296.965
Wellfleet	CCB8.0	Approved	10023.528
Wellfleet	CCB9.0	Approved	1945.043
Wellfleet	OC8.0	Approved	10264.319
Wellfleet	OC9.0	Approved	1787.939
Yarmouth	C-49.2	Prohibited	2.813
Yarmouth	CCB26.1	Approved	620.748
Yarmouth	CCB26.2	Prohibited	4.455
Yarmouth	CCB27.0	Conditionally Approved	50.552
Yarmouth	CCB28.0	Prohibited	29.367
Yarmouth	CCB29.0	Prohibited	38.149
Yarmouth	SC18.0	Approved	330.804
Yarmouth	SC27.0	Approved	334.148
Yarmouth	SC28.0	Approved	790.382
Yarmouth	SC28.1	Prohibited	0.207
Yarmouth	SC28.10	Conditionally Approved	3.8
Yarmouth	SC28.2	Conditionally Approved	5.532
Yarmouth	SC28.4	Conditionally Approved	1.532
Yarmouth	SC28.5	Conditionally Approved	9.995
Yarmouth	SC28.6	Prohibited	33.965
Yarmouth	SC28.7	Conditionally Approved	47.645
Yarmouth	SC29.0	Approved	2057.884
Yarmouth	SC30.0	Approved	6.697
Yarmouth	SC30.2	Prohibited	11.915
Yarmouth	SC30.3	Conditionally Approved	12.881
Yarmouth	SC30.4	Conditionally Approved	76.351
Yarmouth	SC30.5	Prohibited	3.123
Yarmouth	SC31.0	Approved	46.143
Yarmouth	SC33.1	Conditionally Approved	66.405
Yarmouth	SC34.1	Conditionally Approved	123.09
Yarmouth	SC35.6	Prohibited	5.515
Yarmouth	SC35.7	Conditionally Approved	188.225
Yarmouth	CCB26.1	Approved	3274.582
Yarmouth	NS1.0	Approved	1737.928
Yarmouth	SC18.0	Approved	3086.564
Yarmouth	SC27.0	Approved	28.938
Yarmouth	SC29.0	Approved	10103.705