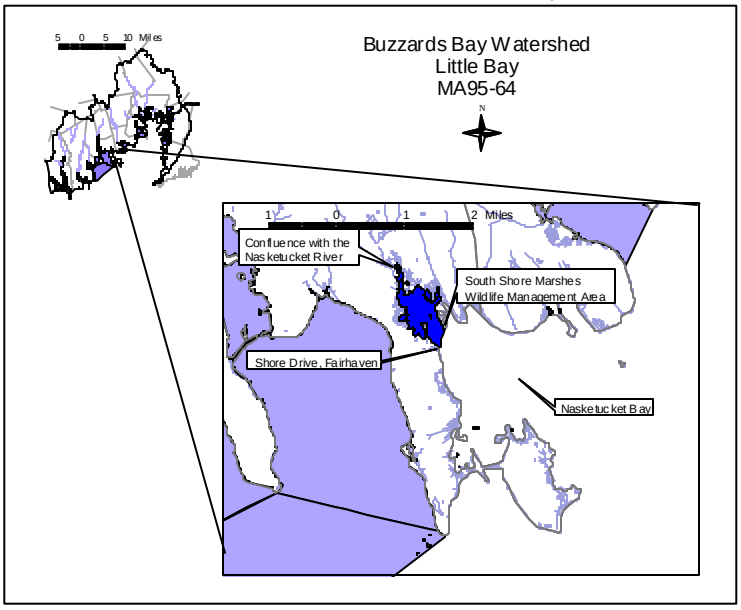
THE NASKETUCKET BAY DRAINAGE AREA

The Nasketucket Bay Drainage Area in Fairhaven and Mattapoisett includes the following two segments.

- Little Bay (Segment MA95-64)
- Nasketucket Bay (Segment MA95-65)

LITTLE BAY (SEGMENT MA95-64)

Location: From the confluence with the Nasketucket River to the mouth at Nasketucket Bay at a line drawn from the southern most point of land in the South Shore Marshes Wildlife Management Area (latitude: 41.625702; longitude: -70.854045) to a point of land near Shore Drive, Fairhaven (latitude: 41.621994; longitude: -70.855415).
Segment Area: 0.36 square miles
Classification: Class SA



Drainage area and land use estimates are not available for this segment.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in Little Bay between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at the three stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Two large dairy farms are located north of the embayment along Interstate 95. The Coalition noted that nitrogen and chlorophyll *a* concentrations are elevated and oxygen depletion is periodically below 60% saturation. The Coalition suggests that water quality degradation is due to inputs from residential dwellings and dairy farms (Howes *et al.* 1999). Little Bay received an average (1997-2001) Health Index Score of 46.8 (fair) (CBB undated b). It should be noted that the Coalition also monitors the Nasketucket River, which received an average (1997-2001) Health Index Score of 4.3 (poor), the worst score in the entire watershed (CBB undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Fairhaven Water Department**	4094000	9P42409401	42409401	4094000-01G	Registered = 1.07 Permitted = 0.52 (1999 & 2000) Permitted = 0.62 (2001)	1.37	1.42	1.42

* Excludes cranberry growers

**Fairhaven Water Department has six withdrawal points in the Buzzards Bay Watershed – one in Segment MA95-35, five in Segment MA95-36. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all six sources combined.

NPDES SURFACE WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges in this subwatershed. It should be noted, however, that Fairhaven and Mattapoisett are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Although the *Aquatic Life Use* is not assessed for Little Bay, this use is identified with an Alert Status due to the Coalition for Buzzards Bay's health index score and the poor health index score for the Nasketucket River, the major freshwater input to the bay.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB22.0 and BB22.3 are conditionally approved and BB22.1 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfish Harvesting Use* is assessed as impaired for this entire segment.

Little Bay (MA95-64) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED*			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status Issues identified—see details in use assessment section.

**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS LITTLE BAY (MA95-64)

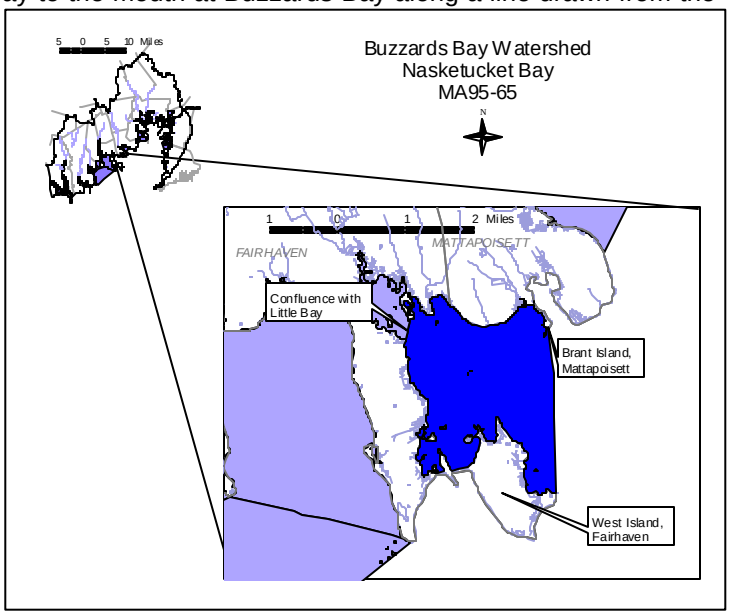
- Work with the Coalition for Buzzards Bay to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Develop a plan and conduct bacteria monitoring to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reopen shellfish beds. Continue to review the shellfish status report to assess the *Shellfish Harvesting Use.*

NASKETUCKET BAY (SEGMENT MA95-65)

Location: From the confluence with Little Bay to the mouth at Buzzards Bay along a line drawn from the southern most point of Brant Island, Mattapoisett to the western tip of West Island, Fairhaven
Segment Area: 3.7 square miles
Classification: Class SA



Drainage area and land use estimates are not available for this segment.

WMA WATER WITHDRAWAL SUMMARY

There are no regulated water withdrawals from this segment.

NPDES SURFACE WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges in this subwatershed. It should be noted, however, that Fairhaven and Mattapoisett are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Nasketucket Bay between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at the station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. The embayment supports recreational boating with 180 slips, primarily located at West Island (Howes *et al.* 1999). Nasketucket Bay received an average (1997-2001) Health Index Score of 61.1 (fair) (CBB undated b).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Nasketucket Bay from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Nasketucket Bay were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography revealed moderate to dense coverage of eelgrass along the northern shore between Shawn Cove and Brant Island and that the bed is fairly stable. Recent 2002 data is not available for the southern/western side of Nasketucket Bay. The beds identified in 1951 between Pea Island and White Rock, north of Round Island and Fish Island, and in North Cove appeared to have decline slightly between 1951 and 1994.

Due to the lack of recent (2002) data for the Fairhaven (western) portion of Nasketucket Bay, the *Aquatic Life Use* is currently not assessed.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB 18.0, BB18.1R, BB18.20, BB18.4R, BB21.0, BB21.20, and BB23.0 are approved and that areas B18.1, B22.0, BB22.3, and BB23.2 are conditionally approved (DFWELE 2000).

Based on the DMF shellfish growing area status, the *Shellfish Harvesting Use* is assessed as support for 3.2 mi^2 and impaired for 0.5 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 3.2 mi^2. The remaining 0.5 mi^2 are currently not assessed.

Nasketucket Bay (MA95-65) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		3.2 mi^2 SUPPORT 0.5 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	Marina/boat pumpout discharges, marina/boat on vessel discharges
Primary Contact		3.2 mi^2 SUPPORT 0.5 mi^2 NOT ASSESSED				
Secondary Contact		3.2 mi^2 SUPPORT 0.5 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS NASKETUCKET BAY (MA95-65)

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Develop a plan and conduct bacteria monitoring to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish survey program reports to reopen shellfish beds. Continue to review the DMF shellfish status report to assess the *Shellfish Harvesting Use*.

THE MATTAPOISETT RIVER DRAINAGE AREA

The Mattapoisett River Drainage Area in Mattapoisett and Rochester includes the following 4 segments.

- Mattapoisett River (Segment MA95-36)
- Mattapoisett River (Segment MA95-60)
- Eel Pond (Segment MA95-61)
- Mattapoisett Harbor (Segment MA95-35)

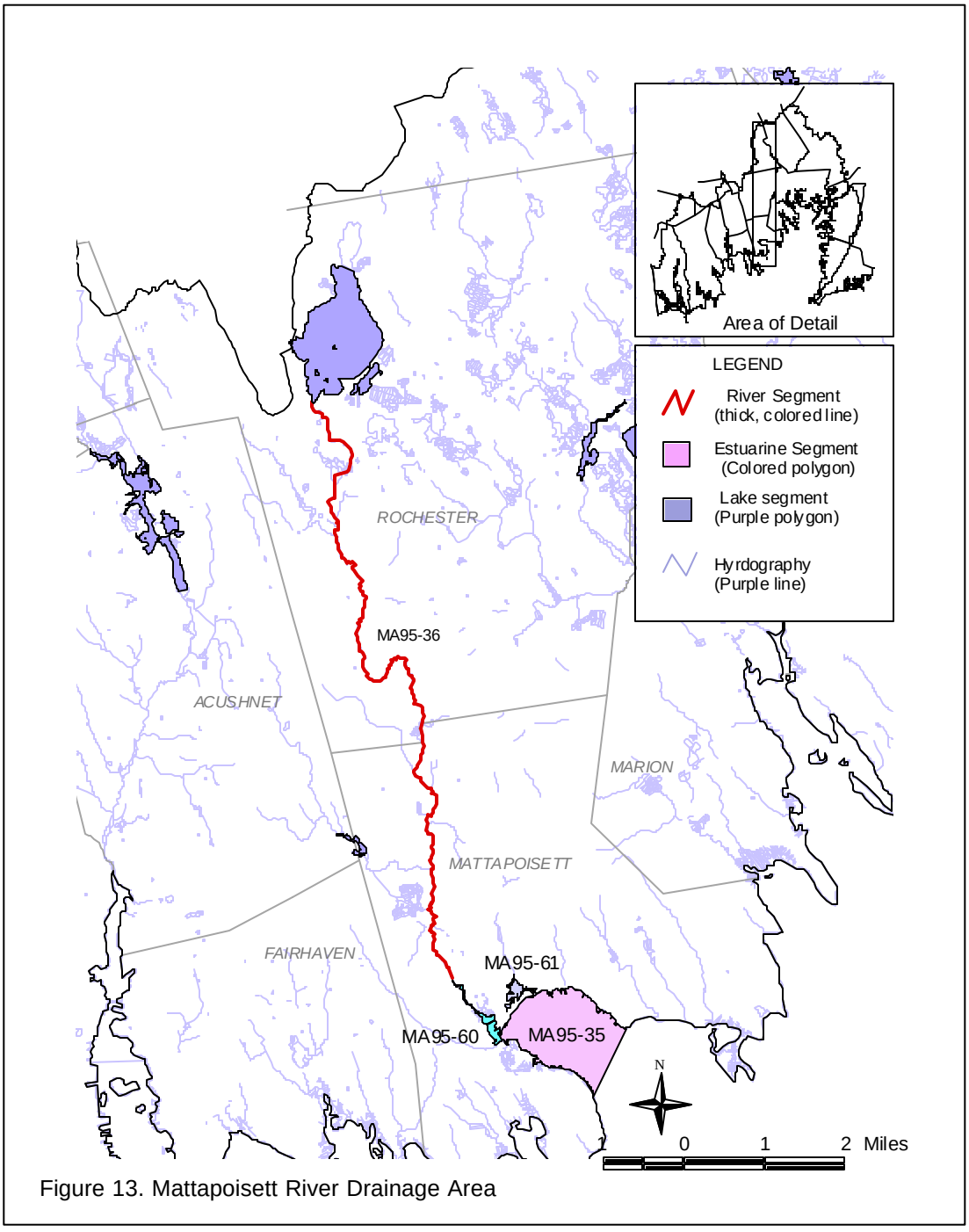
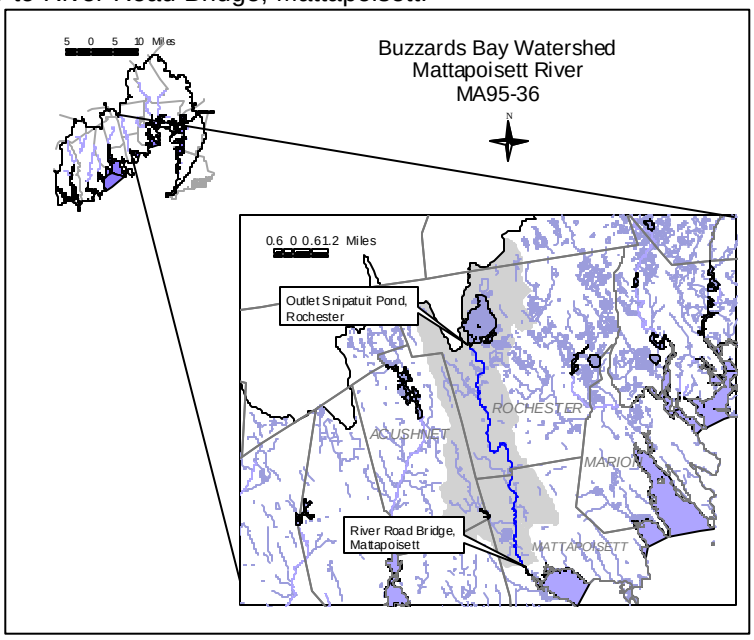


Figure 13. Mattapoisett River Drainage Area

MATTAPOISETT RIVER (SEGMENT MA95-36)

Location: Outlet Snipatuit Pond, Rochester to River Road Bridge, Mattapoisett.
Segment Length: 10.01 miles
Classification: Class B



The drainage area of this segment is approximately 24.1 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	68%
Residential	10%
Agriculture	8%

This segment is on the 1998 303(d) List Of Waters, needing confirmation, as not meeting the water quality standards for pathogens (MA DEP 1999).

In 2001 MassWildlife stocked trout in the Mattapoisett River for recreational fishing (DFWELE 24 September 2002).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Fairhaven Water Department**	4094000	9P42409401	42409401	4094000-03G 4094000-04G 4094000-05G 4094000-06G	Registered = 1.07 Permitted = 0.52 (1999 & 2000) Permitted = 0.62 (2001)	1.37	1.42	1.42
Marion Water Division***	4169000	9P42416901	42416910	4169000-05G 4169000-06G 4169000-07G	Registered = 0.56 Permitted = 0.15 (1999 & 2000) Permitted = 0.17 (2001)	0.71	0.62	0.72
Mattapoisett Water Department	4173000	9P42417301	42417301	4173000-01G 4173000-02G 4173000-03G 4173000-04G 4173000-05G	Registered = 0.42 Permitted = 0.29 (1999 & 2000) Permitted = 0.34 (2001)	0.56	0.51	0.52

* Excludes cranberry growers; ** Indicates system wide withdrawal, all sources not necessarily within this segment

**Fairhaven Water Department has six withdrawal points in the Buzzards Bay Watershed – one in Segment MA95-35, four in Segment MA95-36, and one (01G) in Segment MA95-64. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all six sources combined.

***Marion Water Division has seven withdrawal points in the Buzzards Bay Watershed – four in Segment MA95-06 and three in Segment MA95-36. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all seven sources combined. NOTE: Marion's sources in Segment MA95-06 are registered only.

The water suppliers (Marion, Fairhaven, and Mattapoisett) all work cooperatively to protect the resource through its Mattapoisett River Advisory Committee, established under Ch 92 of the Acts of 1997. It should be noted that Marion and Mattapoisett have implemented conservation measures in accordance with their WMA permit. The Town of Fairhaven is scheduled for its five-year WMA permit compliance review. The Town of Marion was found to be in compliance with its authorized withdrawals during its five-year permit compliance review in April of 2002 and the Town of Fairhaven has been found to be operating at well under their combined registered and permitted authorized withdrawals.

There are 524.370 acres of cranberry bog open space in the Mattapoisett River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 4.68 MGD.

NPDES SURFACE WASTEWATER DISCHARGE SUMMARY

There are no regulated wastewater discharges in this subwatershed. It should be noted, however, that Acushnet, Fairhaven, Mattapoisett and Rochester are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

According to the CBB the Mattapoisett River supports one of the more productive anadromous fish runs supporting both alewives and river herring (Howes *et al.* 1999). Fish passage is provided at the Route 6 bridge via a recently installed denil-type ladder.

A USGS study published in 1995 entitled *The Streamflow, Ground-Water Recharge and Discharge, and Characteristics of Surficial Deposits in Buzzards Bay Basin, Southeastern Massachusetts* indicated that major ground water withdrawals from shallow streamside public water supply wells may adversely impact streamflows in the Mattapoisett River (Bent 1995). A former fresh water mussel surveyor from the Natural Heritage and Endangered Species Program also documented low flow problems in the Mattapoisett River near the Route 6 bridge in September 1999 (DFWELE December 2002).

The wells along the Mattapoisett River in Rochester and downstream to the Wolf Island Rd wells draw from a sand and gravel deposit that underlies a semi-confining silt and clay layer. Over this semi-confining layer is a relatively thin surface layer of sand and gravel through which the narrow, shallow Mattapoisett River flows. The valley aquifer tracks back upstream to the Snipatuit Pond (Drake 2003).

DWM sampled (October 1996) the Mattapoisett River at the East End of Tinkham Lane (station NB13MAT) in Mattapoisett as part of the Biocriteria Development Project. The substrates in the sampled reach consisted of sand, silt, and clay mixed with detritus, and muck-mud. Flows were noted to be very slow and greater than 75% of the channel was full. Instream cover was lacking, although the water was sufficiently deep. Riffles or runs were virtually nonexistent. The banks were stable (less than five percent of the banks on both sides eroded) and well vegetated with native plants, trees, and shrubs. The riparian zone was greater than 18 meters with little human activities impacting the zone (MA DEP 1996b).

Biology

DWM conducted fish population sampling (8 October 1996) on the Mattapoisett River at the East End of Tinkham Lane (station NB13MAT) in Rochester as part of the Biocriteria Development Project. Four American eel (*Anguilla rostrata*), and one brown trout (*Salmo trutta*) were collected. A replicate reach was also sampled at this site and yielded four American eel and one redfin pickerel (*Esox americanus americanus*) (MA DEP 1996b).

DFWELE Southeast District conducted fish population sampling on the Mattapoisett River downstream of Route 105 (and the DWM site) on 19 September 2000 using backpack electroshocking gear. Fifty-three American eel, eight tesselated darters (*Etheostoma olmstedi*), seven brown trout, three redfin pickerel, two chain pickerel (*Esox niger*), one creek chubsucker (*Erimyzon oblongus*), one yellow perch (*Perca flavescens*), and one pumpkinseed (*Lepomis gibbosus*) were collected (Richards 2003).

Chemistry-water

DWM sampled the Mattapoisett River at the East End of Tinkham Lane (station NB13MAT) in Mattapoisett as part of the Biocriteria Development Project on 8 October 1996.

Parameter	Result
Measurement Depth (m)	0.1i
Time	08:55
Temperature (°C)	9.6
pH (SU)	5.5
Conductivity (µS/cm)	64
Total Dissolved Solids (mg/L)	41.2
Dissolved Oxygen (mg/L)	9.5
Percent Saturation (%)	83
Turbidity (NTU)	6i

i= inaccurate readings from Hydrolab likely

Too limited instream physicochemical/biological data are available so the *Aquatic Life Use* is currently not assessed for this segment of the Mattapoisett River. Potential effects of water withdrawals are of concern and, therefore, the *Aquatic Life Use* is identified with an Alert Status.

Mattapoisett River (MA95-36) Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status issues identified – see details in the use assessment section

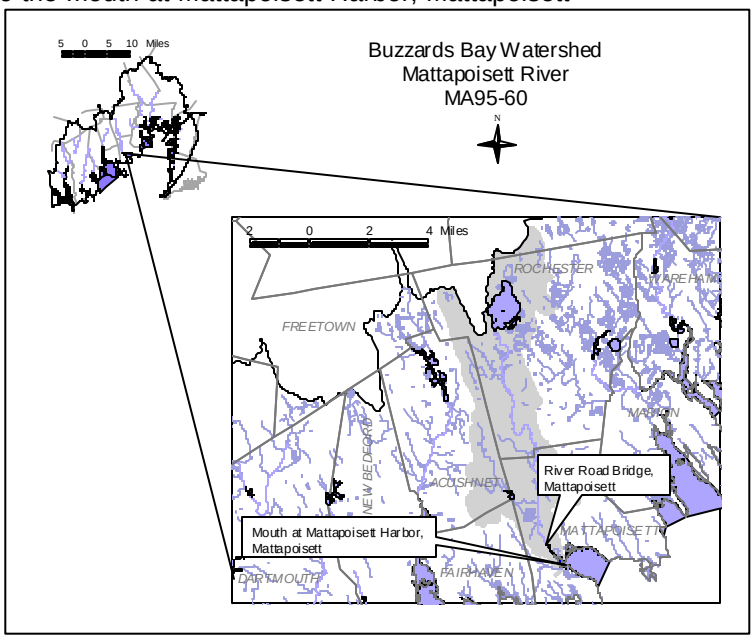
RECOMMENDATIONS MATTAPOISETT RIVER (MA95-36)

- Review and implement recommendations in the DMF anadromous fish assessment report when available for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data for use in determining the status of the *Aquatic Life Use.*

- Design and conduct a survey to determine the hydraulic relationship between Snipatuit Pond, the aquifer and the Mattapoisett River. Determine whether seasonal declines in flow are the result of natural fluctuations in the pond or water withdrawals. Determine if cranberry bog operations manipulate flows in Snipatuit Pond. Data from the survey could be used in the assessment of the *Aquatic Life Use*.

MATTAPOISETT RIVER (SEGMENT MA95-60)

Description: From the River Road Bridge to the mouth at Mattapoisett Harbor, Mattapoisett
Segment Area: 0.05 square miles
Classification: Class SA



The drainage area of this segment is approximately 24.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	67%
Residential	10%
Agriculture	8%

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Mattapoisett Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. The Mattapoisett River supports one of the productive anadromous fisheries runs with up to "120,000 alewives and river herring returning to spawn per year". Nitrogen and chlorophyll *a* concentrations are elevated. The mouth of the Mattapoisett River shows frequent oxygen depletion (defined by CBB as <60% saturation). The Coalition suggests that water quality degradation may be related to the physiography of the system and only partially influenced by watershed land use (Howes *et al* 1999). The Mattapoisett River received an average (1997-2001) Health Index Score of 51.5 (fair) (CBB undated b).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

There are no surface water discharges or authorized water withdrawals to this segment of the Mattapoisett River. It should be noted, however, that Fairhaven and Mattapoisett are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB26.1 is conditionally approved, and BB26.2 and 26.3 are restricted.

Based on the DMF Shellfish Status Report, this entire 0.05 mi^2 segment of the Mattapoisett River is assessed as impaired.

Mattapoisett River (MA95-60) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS MATTAPOISETT RIVER (MA95-60)

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, to improve water quality and increase habitat. If applicable, review data for use in determining the status of the *Aquatic Life Use.*

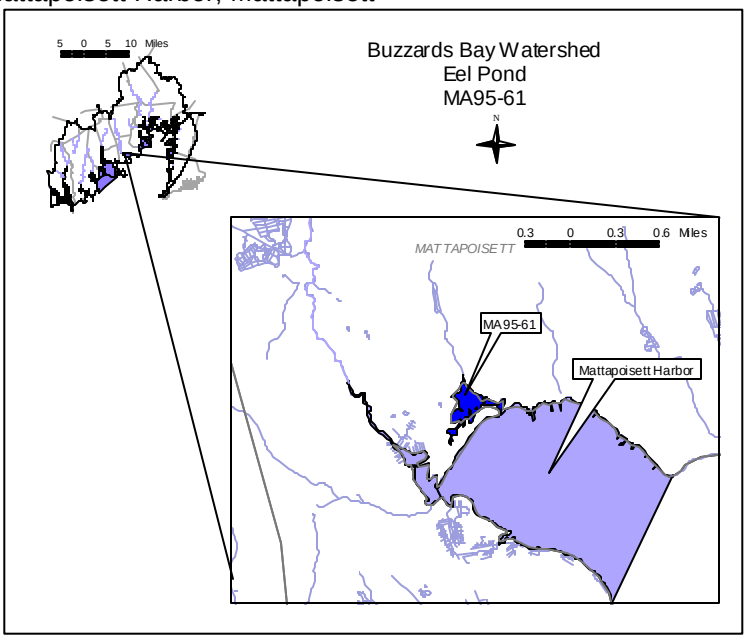
- Develop a plan and conduct a bacteria monitoring to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reopen shellfish beds. Continue to review the DMF shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the six salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MT07, MT08, MT18, MT19, MT31 and MT32. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

EEL POND (SEGMENT MA95-61)

Description: Coastal pond at the head of Mattapoisett Harbor, Mattapoisett
Segment Area: 0.04 square miles
CLASS: SB



Drainage area and land use estimates are not available for this segment.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in Eel Pond between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at the same two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. The Coalition noted that nitrogen and chlorophyll *a* concentrations are elevated, the pond is very turbid, with Secchi depths generally less than 80 cm, and, due to its shallow depth, water temperatures are elevated. Eel Pond shows frequent oxygen depletion (defined by CBB as <60% saturation). The Coalition suggests that water quality degradation is due to reduced tidal flushing, an adjacent golf course, lawn fertilizers, runoff, and storm water discharges (Howes *et al.* 1999). The culvert at the opening of Eel Pond (Site MT09) is considered a high priority site within the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* (BBP, 2002). The Eel Pond received an average (1997-2001) Health Index Score of 18 (poor) (CBB undated b).

WMA WATER WITHDRAWAL (APPENDIX F) AND NPDES SURFACE DISCHARGE SUMMARY

There are no authorized water withdrawals or regulated wastewater discharges to this segment of the Mattapoisett River. It should be noted, however, that Mattapoisett is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Too limited data are available so the *Aquatic Life Use* is not assessed for Eel Pond. The use is, however, identified with an Alert Status because of reduced tidal flushing, as well as the poor health index rating identified by the Coalition.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB27.0 is prohibited.

Based on the DMF shellfish growing area status this entire 0.04 mi^2 segment is assessed as impaired.

Eel Pond (MA95-61) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED*			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status issue identified-- see details in use assessment section

**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS EEL POND (MA95-61)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Develop and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to improve water quality and possible reopen shellfishing beds. Continue to review the shellfish status report to assess the *Shellfish Harvesting Use*.

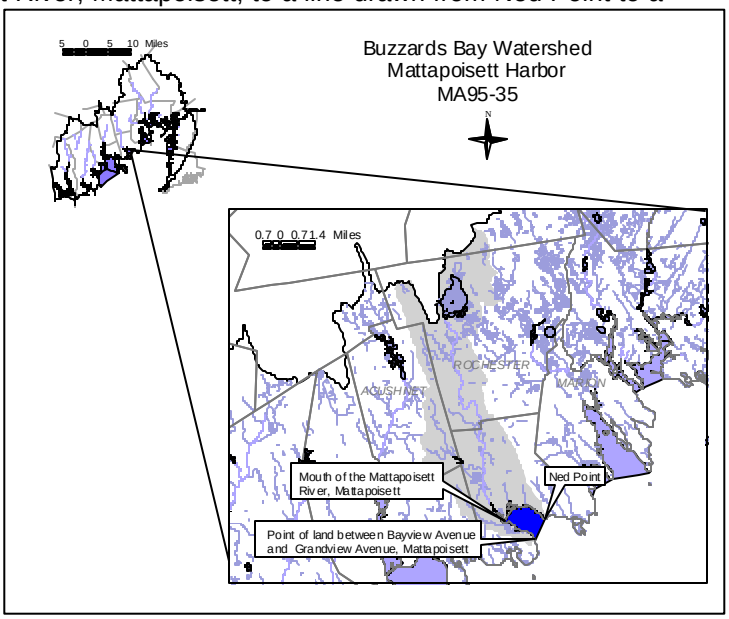
- Further investigate the two tidal restrictions to Eel Pond, including reviewing the BBP funded flushing study and the report entitled *Eel Pond Water Quality Analysis and Nitrogen Loading Evaluation*. If warranted, implement necessary measures to improve flushing for the benefit of water quality and aquatic life.

- Work with the Coalition for Buzzards Bay to promote stewardship and implement environmentally friendly practices that will help reduce the leaching of fertilizers, which negatively affects the aquatic life, from the Reservation Country Club and residential properties into Eel Pond.

- Implement the four salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MT09, MT20, MT21 and MT22. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

MATTAPOISETT HARBOR (SEGMENT MA95-35)

Location: From the mouth of the Mattapoisett River, Mattapoisett, to a line drawn from Ned Point to a point of land between Bayview Avenue and Grandview Avenue, Mattapoisett
Segment Area: 1.10 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 28.4 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	65%
Residential	12%
Agriculture	7%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

There is public access to Mattapoisett Harbor at Short Wharf. This site, maintained by the Town of Mattapoisett, has one asphalt boat launch with twenty-two parking spaces. A fee is charged and/or a sticker is required (DFWELE 2002). There is a vessel sewage pumpout boat and facility at the Mattapoisett Town Dock on Main Street and a vessel sewage pumpout boat at Mattapoisett Boat Yard (BBP Undated and DMF 29 January 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at three stations in Mattapoisett Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at five stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Eelgrass beds are found along the periphery of the Harbor at depths <12 feet. Shellfish resources are abundant and include oyster, quahogs, and soft shell clams (Howes *et al.* 1999). Mattapoisett inner harbor received an average Health Index Score of 72.6 and Mattapoisett outer harbor received a score of 84.2 (both good/excellent) (CBB Undated b).

Dr. Jefferson Turner, students, and research associates at UMass Dartmouth have conducted 141 monthly cruises of Buzzards Bay between October 1987 and October 1998 to establish temporal and spatial trends of hydrography, water quality, and plankton community structure. Station 1 in Mattapoisett Harbor was sampled for conductivity, temperature, depth, Secchi disk depth, salinity, nutrients, chlorophyll *a* and phytoplankton. Salinity was “almost uniformly 30 ppt throughout the study at virtually all times”. Mean surface temperatures at station 1 were below SWQS. Secchi disk depths at station 1 ranged from 1 to 7 m. Mean chlorophyll *a* concentrations at station 1 ranged between 0 µg/L and 14 µg/L. Mean ammonium concentrations ranged between 0 µM and 11 µM. Mean phosphate concentrations ranged between 0 µM and 3 µM (Turner *et al.* 2000).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Fairhaven Water Department**	4094000	9P42409401	42409401	4094000-02G	Registered = 1.07 Permitted = 0.52 (1999 & 2000) Permitted = 0.62 (2001)	1.37	1.42	1.42

*Excludes any authorized cranberry growers.

**Fairhaven Water Department has six withdrawal points in the Buzzards Bay Basin – one in Segment MA95-35, four in Segment MA95-36, and one in Segment MA95-64. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all six sources combined.

NPDES SURFACE DISCHARGE SUMMARY

Old Rochester Regional School District (MA0102318) is permitted (30 October 1998) to discharge 0.0225 MGD effluent to Coen Brook, a tributary to Mattapoisett Harbor, from POTW outfall 001. The facility's whole effluent toxicity limit is LC_{50}= 100% effluent and C-NOEC= 64%. The permit includes secondary limits: BOD= 30 mg/L, TSS=30 mg/L, fecal coliform bacteria= 200 cfu/100mL, TRC= 0.017 mg/L, and total ammonia= 2.7 mg/L. Old Rochester Regional School District tied in to the Mattapoisett sewer system in the summer of 2002 (Greenway 2003). Treated wastewater is ultimately discharged via the Fairhaven WWTF to New Bedford Inner Harbor.

It should also be noted that Mattapoisett is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

MA DEP identified the presence of eelgrass in Mattapoisett Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Mattapoisett Harbor were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography revealed moderate to dense coverage of eelgrass around the periphery of the bay. However, it appears that the beds may be declining slightly (no eelgrass found in the bed east of the outlet of Eel Pond in 2002). The condition of the eelgrass was identified as healthy with little to no drift algae and sparse epiphytes.

Based on the stable eelgrass bed habitat the *Aquatic Life Use* is assessed as support. This use is, however, identified with an Alert Status as the eelgrass bed habitat (especially east of Eel Pond) may be declining. Declining eelgrass bed habitat may be indicative of reduced water clarity or nutrient enrichment from anthropogenic activities (boating).

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB25.0 is approved and BB25.11 and BB25.7 are prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as support for 1.0 mi^2 and impaired for 0.1 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

According to the Mattapoisett Board of Health, there have been no closures at any public beaches in town since the sampling program began (Mattapoisett BOH 2003). Based on the more stringent shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 1.0 mi^2. The remaining 0.1 mi^2 are currently not assessed.

Mattapoisett Harbor (MA95-35) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		SUPPORT			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		1.0 mi^2 SUPPORT 0.1 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		1.0 mi^2 SUPPORT 0.1 mi^2 NOT ASSESSED			
Secondary Contact		1.0 mi^2 SUPPORT 0.1 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status Issues identified—see details in use assessment section.
**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS MATTAPOISETT HARBOR (MA95-35)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Develop and implement a bacteria monitoring program to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to improve water quality and possibly reopen shellfish beds. Continue to review the shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the ten (10) salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MT01, MT02, MT03, MT04, MT05, MT06, MT33, MT35, MT36, and MT38. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

THE SIPPICAN HARBOR COASTAL AREA

The Sippican Harbor Coastal Areas includes an inner cove and two adjacent open water estuaries in the following four segments.

- Hammett Cove (Segment MA95-56)
- Sippican Harbor (Segment MA95-08)
- Aucoot Cove (Segment MA95-09)
- Hiller Cove (Segment MA95-10)

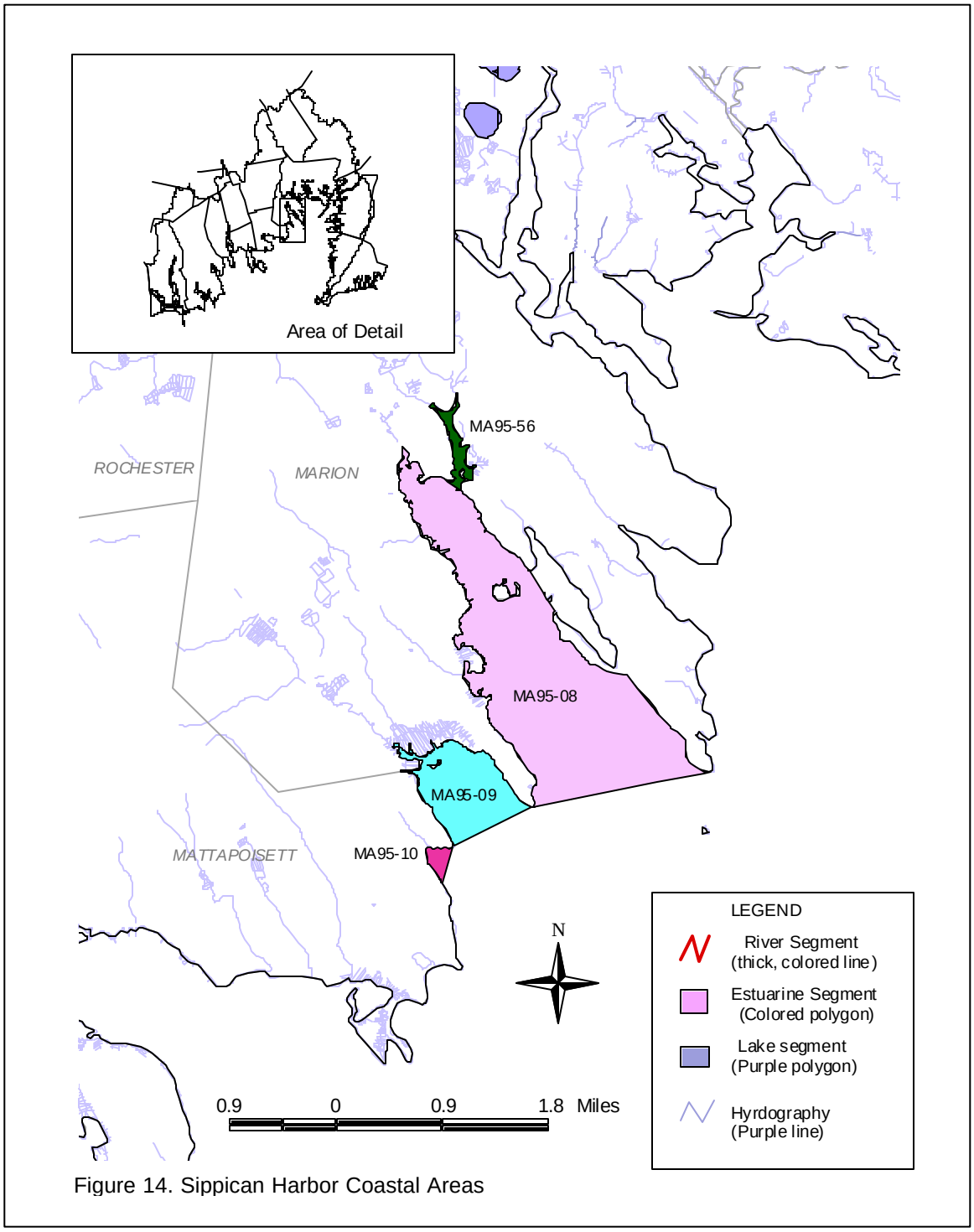
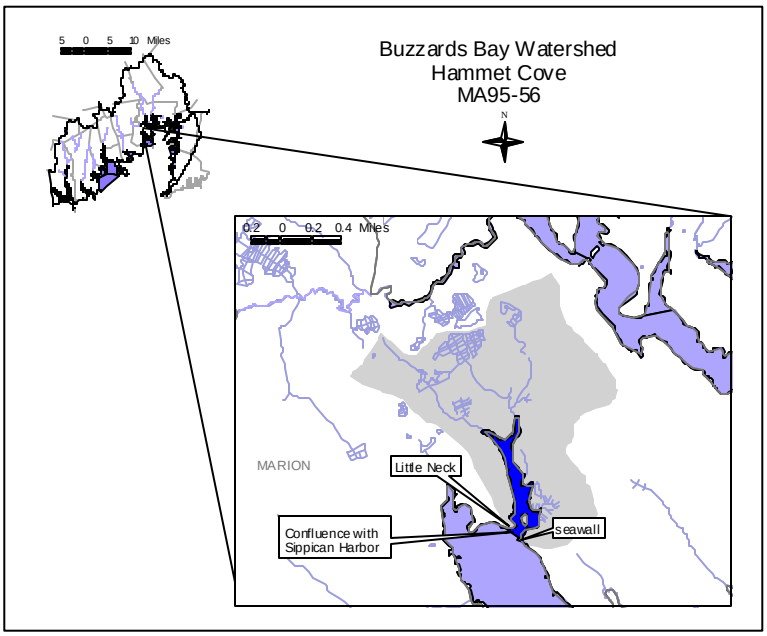


Figure 14. Sippican Harbor Coastal Areas

HAMMETT COVE (SEGMENT MA95-56)

Location: Hammet Cove, Marion to the confluence with Sippican Harbor along a line from the southwestern most point of Little Neck to the end of the seawall on the opposite point.
Segment Area: 0.07 square miles
Classification: Class SA



The drainage area of this segment is approximately 1.35 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	47%
Residential	25%
Open Land	11%

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Hammett Cove between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at all three stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Hammet Cove exhibits "poor nutrient related health"; with routine phytoplankton blooms and depleted oxygen levels below 60%. Chlorophyll *a*, particulate organic carbon, and total nitrogen are highest in the inner harbor/Hammets Cove region and suggest a eutrophic and moderately degraded habitat. The five-year (1997-2001) Health Index Score for Hammett Cove is 32.1, which is poor (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 34.709 acres of cranberry bog open space in the Hammett Cove subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.31 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated discharges to Hammet Cove, however, it should also be noted that Marion is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

Eelgrass beds in Hammett Cove were mapped by MA DEP from aerial photography and field verified in 1994 and 2002 (Costello 2003). Eelgrass bed habitat extended from the mouth of the cove to the mouth of an unnamed tributary on the east side of the cove in 1994. Eelgrass bed habitat had declined and was limited to a small area north of an unnamed island.

Because of the decline in eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired for Hammett Cove. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include septic systems and inputs from residential districts/lawns.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB32.0 and BB32.23 are approved and BB32.3 is prohibited (DFWELE 2000).

Based on the shellfish bed status 0.05 mi^2 are assessed as support and 0.02 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

There is one public beach in Hammett Cove. There have been no reported beach postings/closures during 2001 or 2002 (MDPH 2002b).

Based on the more stringent shellfish harvesting guidelines and because there have been no posting/closures, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.05 mi^2 of this segment. The remaining 0.02 mi^2 are currently not assessed.

Hammett Cove (MA95-56) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (decline of eelgrass bed habitat)	Total nitrogen		On-site treatment systems (septic systems), residential districts/lawns
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		0.05 mi2 SUPPORT 0.02 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	Municipal separate storm sewer systems
Primary Contact		0.05 mi^2 SUPPORT 0.02 mi^2 NOT ASSESSED				
Secondary Contact		0.05 mi^2 SUPPORT 0.02 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS HAMMETT COVE (MA95-56)

- Work with the Coalition for Buzzards Bay to implement their management recommendations for Hammet Cove including reducing fertilizer applications, treating storm water from Route 6, and encouraging the use of pumpout vessels/facilities.

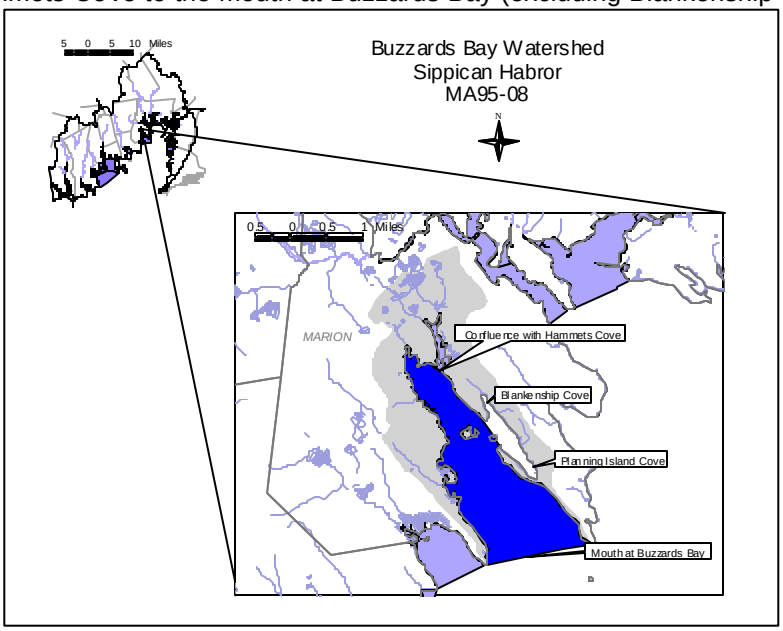
- Develop a monitoring plan and conduct bacteria monitoring to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement as appropriate recommendations from DMF shellfish sanitary survey and triennial reports to improve water quality and abate pollution causing the closures of the shellfish beds. Continue to review shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the three salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MN08, MN09 and MN10. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.
- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

SIPPICAN HARBOR (SEGMENT MA95-08)

Location: From the confluence with Hammets Cove to the mouth at Buzzards Bay (excluding Blankenship Cove and Planning Island Cove), Marion
Segment Area: 2.0 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 3.6 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	40%
Residential	33%
Open Land	12%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

There is a vessel sewage pumpout shoreside facility, pumpout boat, and porta-potty dump at Island Wharf located on Island Wharf Road, Marion (BBP Undated and DMF 29 January 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at three stations in Sippican Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at six stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. A roseate tern rookery on Bird Island supports approximately 1,000 nesting pairs in any given year. The flushing rate of inner Sippican Harbor is 8.6 days. Due to the depth of the Harbor, eelgrass beds are found only along the periphery. A "strong, increasing water quality gradient" exists from the inner to the outer harbor. Hammet Cove, not part of this segment, exhibits "poor nutrient related health" with routine phytoplankton blooms and depleted oxygen levels below 60%. Chlorophyll *a*, particulate organic carbon, and TN are highest in the inner harbor/Hammets Cove region and suggest a eutrophic moderately degraded habitat (Howes *et al* 1999). The five year (1997-2001) Health Index Score for Inner Sippican Harbor is 56.2 and for Outer Sippican Harbor is 72.0, which are fair and good/excellent, respectively (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 37.820 acres of cranberry bog open space in the Sippican Harbor subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.34 MGD.

NPDES SURFACE DISCHARGE SUMMARY

The following general storm water permits were issued by the EPA in October 2001 and will expire in October 2005:

Barden's Boat Yard Inc MAR05B624
Edey & Duff Ltd. MAR05B812

It should also be noted that Marion is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass beds in Sippican Harbor were mapped by MA DEP from field verified 1994 aerial photography (Costello 2003). MA DEP field verified 2002 aerial photography determined that the eelgrass beds identified in 1994 along the east and west sides of Ram Island had disappeared and that the remaining beds identified in 1994 around the periphery of Sippican Harbor remained stable/declined slightly.

Although eelgrass bed habitat data are available, the *Aquatic Life Use* is currently not assessed. This use is identified, however, with an Alert Status as the decline of eelgrass bed habitat may be indicative of reduced water clarity or nutrient enrichment from anthropogenic activities. Nitrogen thresholds and habitat quality guidelines are currently being developed by the Massachusetts Estuaries Project to better evaluate the status of the *Aquatic Life Use*.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB32.0 is approved, BB32.13 is conditionally approved, and BB32.1, BB32.4, BB32.5, BB32.9 and BB32.11 are prohibited (DFWELE 2000).

Based on the DMF shellfish status 1.7 mi^2 are assessed as support and 0.30 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

There are two public beaches in Sippican Harbor, Town Beach at Island Wharf and Silver Shell Beach. The beach at Island Wharf was closed to swimming on one occasion due to elevated *Enterococci* levels between July 12-13, 2001 (MDPH 2002b).

Based on the lack of beach posting/closures and the shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for this segment.

Sippican Harbor (MA95-08) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		1.7 mi^2 SUPPORT 0.30 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		SUPPORT			
Secondary Contact		SUPPORT			
Aesthetics		NOT ASSESSED			

* Alert Status Issues Identified—see details in use assessment section.

**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS SIPPICAN HARBOR (MA95-08)

- Work with the Coalition for Buzzards Bay to implement their management recommendations for Sippican Harbor including reducing fertilizer applications and treating storm water from Route 6, which will help to reduce nutrient and bacteria loading to Sippican Harbor.

- Continue to support the Town in its efforts to encourage the use of pumpout vessels/facilities to reduce bacteria inputs to this segment.

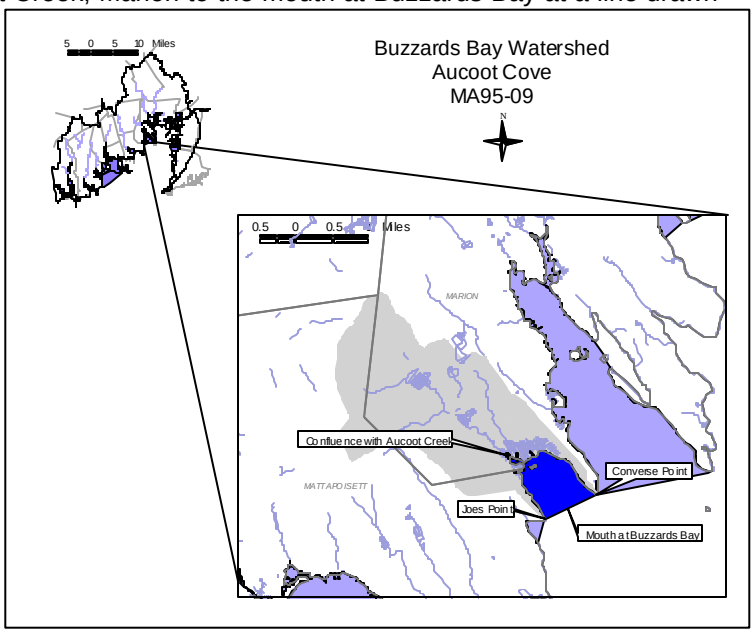
- Develop and implement a monitoring program for bacteria to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to mitigate pollution causing the closure of the shellfish beds. Continue to review the DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Implement the five salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MN30, MN31, MN05, MN06, and MN07. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

AUCOOT COVE (SEGMENT MA95-09)

Location: From the confluence with Aucoot Creek, Marion to the mouth at Buzzards Bay at a line drawn between Converse Point and Joes Point, Mattapoisett
Segment Area: 0.50 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 4.1 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	75%
Residential	8%
Wetlands	8%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

On 17 May 2000, at the request of EPA, DWM conducted benthic macroinvertebrate monitoring upstream and downstream from the Marion WWTP facility's discharge at three locations in an unnamed receiving stream known locally as "Effluent Brook". Monitoring was conducted using RBP I to discriminate obviously impacted and non-impacted areas from potentially affected areas. Upstream of the discharge a surprisingly diverse macroinvertebrate assemblage was observed. Fifteen taxa, four of which were pollution sensitive EPTs, were collected. Community composition and trophic structure changed abruptly at the Marion WWTP discharge point. Most trophic groups were displaced by more opportunistic gathering collectors, which are indicative of an aquatic community structured in response to organic enrichment and possibly low levels of dissolved oxygen. The return of additional trophic guilds and the addition of several macroinvertebrate taxa (including two EPT taxa) at the most downstream location suggest some recovery to the aquatic community. DWM recommended additional biomonitoring upstream and downstream of the discharge using more discriminating RBP methodology (Fiorentino 2000).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at three stations in Aucoot Cove between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at six stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al* 1999). Eelgrass beds are found only along the periphery of the Cove due to the depth (>12 feet). As a result of the Aucoot system circulation and bathymetry, Aucoot Cove "maintains a high level of water quality". The head of the cove, however, shows increased levels of nitrogen and chlorophyll *a*. The Macroalga (*Ulva lactuca*) was present in the region of the cove closest to the marsh and in the creek that receives the effluent from the Marion WWTP (Howes *et al* 1999). The average (1997-2001) Health Index Score for Inner Aucoot Cove was 53.9 (fair). Mid- and Outer Aucoot Cove received scores of 87.8 and 92.5 (good/excellent) respectively (CBB undated b). There is a gradient of nitrogen and chlorophyll *a* from the inner to the outer cove due mostly to the Marion WWTP. The waters at the head of Aucoot Cove showed "periodic depletions to levels less than 60% saturation, however, all sites were within or adjacent to wetlands" (Howes *et al* 1999).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 52.679 acres of cranberry bog open space in the Aucoot Cove subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.47 MGD.

NPDES SURFACE DISCHARGE SUMMARY

The Town of Marion Waste Water Treatment Plant is permitted (30 November 1998) to discharge 0.5 MGD of treated sanitary wastewater to an unnamed brook tributary to Aucoot Cove. The permit will expire in 2003. The facility's whole effluent toxicity limit is C-NOEC and LC_{50} >100% effluent. The Town received a State Revolving Fund Loan to upgrade the existing plant for ammonia removal and will reduce the nitrogen load to Aucoot Cove and Buzzards Bay. Proposed upgrades include the construction of a new headworks with screening, grit removal, inlet tanks for flow equalization, Sequencing Batch Reactor tanks, and post equalization flow measurement. Effluent will then go to the existing disk filters and UV disinfection. The current UV disinfection process is problematic and it may also be replaced. The effluent line will be modified by the use of pipe bursting to relieve some of the low spots. (It should be noted that there is a local petition to relocate the discharge.) The new plant will also have some chemical addition for treatment and odor control and the existing ponds will be used for high flow management with the effluent pumped to the new inlet tanks. Marion is also going to construct a laboratory, administration building and a Supervisory Control And Data Acquisition (SCADA) system for instrumentation. Many of the existing pump stations are going to be upgraded and/or replaced. In addition, the Town is sewering three areas of town where existing, dense housing cannot be adequately supported by on-site systems due to high groundwater and poor soils. Sewering these areas will reduce bacteria and nutrient loads to Sippican Harbor and the Weweantic River watershed. The goal is to meet the existing permit limits with some flexibility to meet lower nutrient limits. The plant construction began in August 2003 and the plant should begin startup in spring 2005.

It should also be noted that Marion is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Aucoot Cove from historic 1951 black and white aerial photography (Costello 2003). Field surveys conducted by MA DEP in 1994 and 2002 revealed moderate coverage of eelgrass. Additionally, the condition of the eelgrass was identified as healthy with little drift algae and sparse epiphytes (Costello 2003).

Toxicity

Effluent

Saltwater testing

The Town of Marion (MA0100030) conducted seven acute whole effluent toxicity tests between February 1996 and August 1997 using the test organisms *M. bahia* (mysid shrimp) and seven chronic tests using *M. berylinna* (inland silverside). No acute toxicity was detected (LC_{50}'s >100%effluent). C-NOEC's were below the permit limit in only one test (75%).

Freshwater testing

Marion also conducted 13 chronic whole effluent toxicity tests between 17 January 2000 and 28 January 2003 using the test organisms *C. dubia* (water flea) and *P. promelas* (fat head minnow). The effluent was not acutely toxic (LC_{50}>100% effluent) to the water flea or the fathead minnow, except in one test conducted on 23 January 2001 (*C dubia* LC_{50}= 30.5% effluent; *P. promelas* LC_{50}= 97.8%effluent). Chronic toxicity was detected in seven of the 11 valid test events with C-NOEC's ranging between 12.5% and 50%. The remaining tests had C-NOEC's=100%.

Ambient

Saltwater testing

Between February 1996 and August 1997 the Town of Marion collected dilution water from the unnamed tributary to Aucoot Cove for use as a diluent in their whole effluent toxicity testing. 48-hour survival of *M. bahia* was good (100%). 48-hour survival of *M. beryllina* was good (95-100%); chronic survival was good (87-98%).

Freshwater testing

Between 17 January 2000 and 28 January 2003 Marion also collected dilution water from the unnamed tributary to Aucoot Cove for use as a diluent in their whole effluent toxicity testing. Survival (48-hour and 7-day) of both *C. dubia* and *P. promelas* was good (90-100%). Toxicity in the unnamed tributary was documented on one occasion on 16 October 2000 with total mortality occurring.

Chemistry-water

Between 17 January 2000 and 28 January 2003, the Town of Marion collected water from the unnamed tributary to Aucoot Cove for use as dilution water in their whole effluent toxicity tests (n=7). Ambient chemical analysis included pH, TSS, hardness, alkalinity, conductivity, and ammonia.

pH

pH values ranged between 6.9 to 8.3 SU.

Total Suspended Solids

TSS concentrations ranged between <10 to 14 mg/L. Total solids concentrations ranged between 250 and 480 mg/L.

Conductivity

Conductivity ranged between 380 to 900 µmho/cm.

Hardness

Hardness values ranged between 40 and 102 mg/L as $CaCO_3$ (n=13).

Alkalinity

Alkalinity values reported in the Marion toxicity reports ranged between 16 and 110 (n=13).

Ammonia (as N)

Ammonia concentrations ranged between 0.9 and 11 mg/L. (No comparison to water quality criteria were conducted due to a lack of temperature data.)

Based on the stable eelgrass bed habitat the *Aquatic Life Use* is assessed as support. However, this use is identified with an Alert Status due to the chronic toxicity detected in the Town of Marion's whole effluent toxicity tests (discharge to an unnamed tributary to Aucoot Cove), elevated levels of nitrogen, and the presence of macroalgae reported by the Coalition for Buzzards Bay. It should be noted that planned upgrades to the WWTP would enhance ammonia removal and reduce nitrogen concentrations in the effluent.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB31.0 is approved and BB31.1 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status 0.46 mi^2 are assessed as support and 0.04 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.46 mi^2. The remaining 0.04 mi^2 are currently not assessed.

Aucoot Cove (MA95-09) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		SUPPORT			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		0.46 mi^2 SUPPORT 0.04 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		0.46 mi^2 SUPPORT 0.04 mi^2 NOT ASSESSED			
Secondary Contact		0.46 mi^2 SUPPORT 0.04 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status issues identified—see details in use assessment section.

** For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS AUCOOT COVE (MA95-09)

- Continue to monitor Marion's whole effluent toxicity testing data when evaluating the status of the *Aquatic Life Use*. If chronic toxicity continues to be problematic the need for a toxicity identification and reduction evaluation should be considered as part of their NPDES permit renewal.

- Conduct additional biomonitoring upstream and downstream of the Marion discharge using more discriminating RBP III methodology to assess the potential impacts from the discharge on the aquatic life.

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, upgrades to the Marion WWTP, and the Phase II community storm water management programs and to assess the recreational uses.

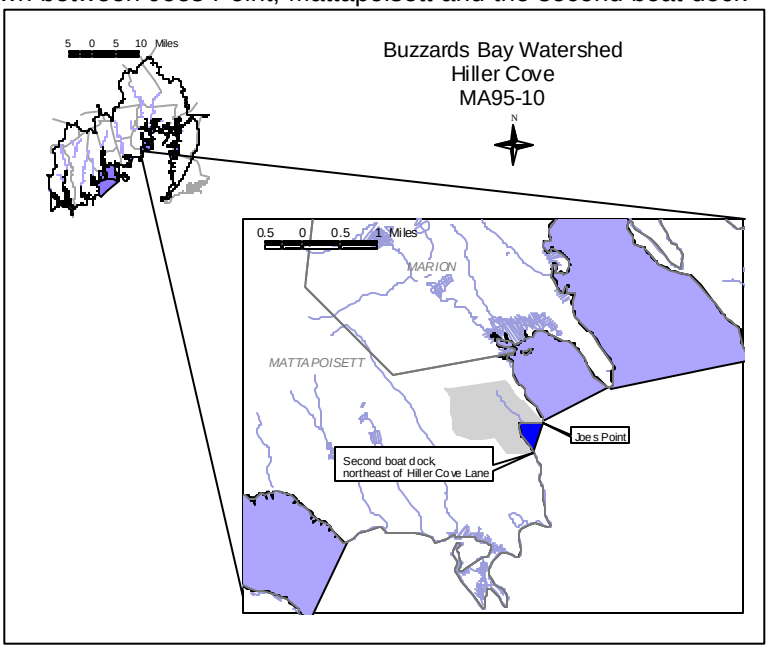
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports.

- Implement the one salt marsh restoration project identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that has been evaluated and prioritized by the Town (Site MN02). Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

HILLER COVE (SEGMENT MA95-10)

Location: The area landward of a line drawn between Joes Point, Mattapoisett and the second boat dock northeast of Hiller Cove Lane, Mattapoisett
Segment Area: 0.04 square miles
Classification: Class SA



The drainage area of this segment is approximately 0.4 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	75%
Residential	17%
Open land	5%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Hiller Cove between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al.* 1999). Eelgrass beds are found along the periphery of the cove due to the depth (>12 feet). As a result of the open well-flushed nature of the cove, Hiller Cove "maintains a high level of water quality" (Howes *et al.* 1999). The average (1997-2001) Health Index Score for Hiller Cove is 85.4 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

There are no regulated water withdrawals or wastewater discharges in this segment. It should be noted, however, that Mattapoisett is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Hiller Cove from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Hiller Cove were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 1999 aerial photography determined that the eelgrass bed identified in 1994 had declined.

Too limited data are available and, therefore, the *Aquatic Life Use* is not assessed for Hiller Cove. This use is, however, identified with an Alert Status due to the decline in eelgrass bed habitat, which may be indicative of declines in water quality (e.g., elevated nutrients, reduced clarity).

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB30.0 is classified as approved and BB30.1 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status 0.03 mi^2 are assessed as support and 0.01 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

There are no closures or postings at the public Harbor Beach according to the MDPH database. Based on the more stringent shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.03 mi^2. The remaining 0.01 mi^2 are currently not assessed.

Hiller Cove (MA95-10) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		0.03 mi^2 SUPPORT 0.01 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		0.03 mi^2 SUPPORT 0.01 mi^2 NOT ASSESSED			
Secondary Contact		0.03 mi^2 SUPPORT 0.01 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*Alert Status issues identified—see details in use assessment section

** For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS HILLER COVE (MA95-10)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs.

- Review and implement, as appropriate, recommendations from DMF shellfish survey program reports.

- Implement the three salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are MT15, MT16 and MT17. The latter, Site MT17, is a town owned rock wall that has sunk and is clearly overwashed. It is considered the fifth highest priority in Buzzards Bay.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality.

THE WEWEANTIC RIVER DRAINAGE AREA

The Weweantic River Drainage Area principally in Wareham and Marion has its headwaters located in Rochester, Middleborough, Carver, and Plymouth. It consists of the following five segments.

- Weweantic River (Segment MA95-04)
- Sippican River (Segment MA95-06)
- Sippican River (Segment MA95-07)
- Beaverdam Creek (Segment MA95-53)
- Weweantic River (Segment MA95-05)

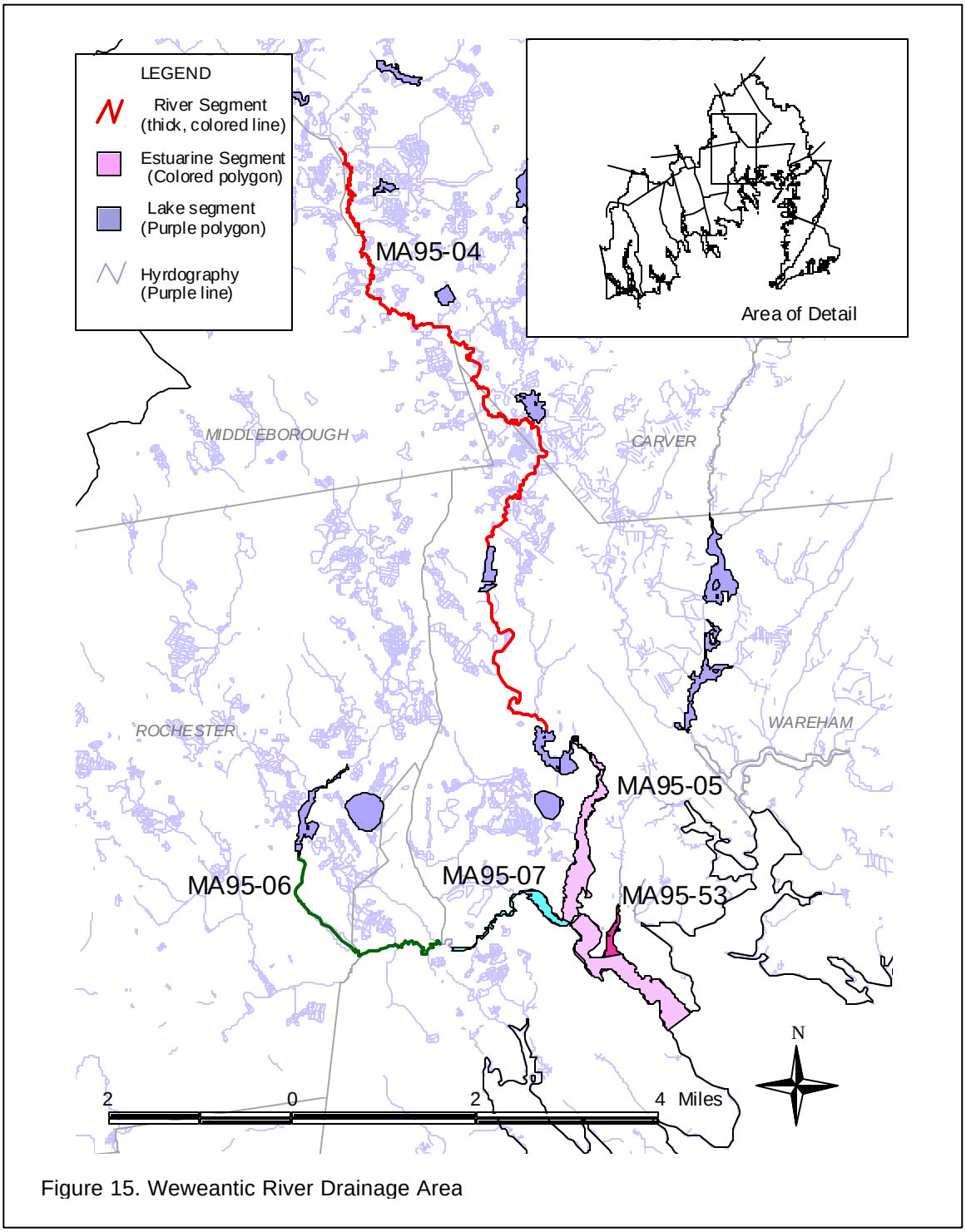
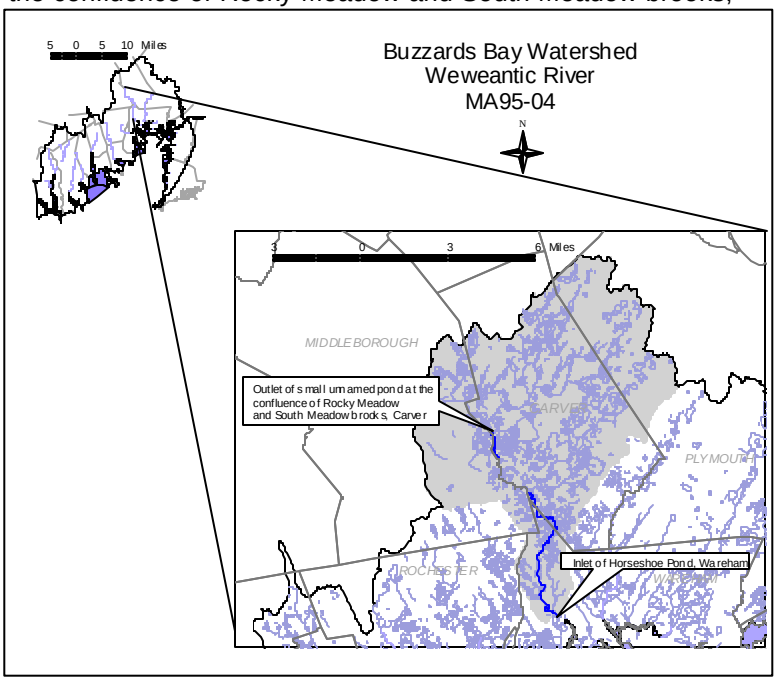


Figure 15. Weweantic River Drainage Area

WEWEANTIC RIVER (SEGMENT MA95-04)

Location: Outlet of small, unnamed pond at the confluence of Rocky Meadow and South Meadow brooks, Carver to the inlet of Horseshoe Pond, Wareham
Segment Length: 11.5 miles
Classification: Class B, Warm Water Fishery



The drainage area of this segment is approximately 56.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	52%
Open Land	22%
Residential	14%

This segment of the Weweantic River is on the Massachusetts 1998 303(d) List of Waters, needing confirmation, as not meeting water quality standards for pathogens (MA DEP 1999).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Lakeville Redi-Mix/ Lakeside Crushing, South Carver			42405216	Tremont St. Well Tremont St. Reservoir	Registered = 0.28	0.08	0.08	0.04
Plymouth DPW- Water Division, Plymouth	4239000	9P42423901		4239000-04G 4239000-08G	Permitted = 1.59**	1.28	1.34	1.49
South Meadow Village, Carver	4052001	9P42405202		4052001-01G	Permitted = 0.19	NR	0.15	0.09

*Excludes any authorized cranberry growers.

**This is the maximum daily volume that the Plymouth DPW-Water Division can withdraw from its Buzzard Bay sources. The average withdrawal volumes indicated are for the Buzzards Bay sources only. The Plymouth DPW-Water Division is permitted to withdraw 5.76 MGD in year 1999 and 6.06 MGD in years 2000 & 2001 from its South Coastal and Buzzards Bay sources combined.

NR – No report in file.

There are 6611.882 acres of cranberry bog open space in the Weweantic River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 59.04 MGD.

NPDES SURFACE DISCHARGE SUMMARY

Carver and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

FERC

The Town of Wareham owns a 300-Kilowatt FERC-exempt hydroelectric power facility at the Tremont Dam on this segment of the Weweantic River. The FERC license (FERC exempt # P-3894) was issued May 1981. There is no expiration date for an exempt license (Goggins 2001). The earth/stone masonry dam, built in 1845, is 1200 feet long, 15 feet high, and has a storage capacity of 200 acre feet (8,712,000 ft^3 or 246,696 m^3). There are two 12' high X 10' wide sluice gates in the dam. This facility has two underground concrete penstocks (7' X 10' x 18'), which convey water to two turbines that power a 75-KW capacity generator and a 125-KW generator (Cataldo 2003). The Tremont Dam facility has not operated since 1999 and both turbines are mothballed. This facility is required to release a minimum flow of 10 cfs. There are no fish passage requirements. It was noted in the last environmental inspection report that there was a large sinkhole on the left side of the dam along the overflow spillway. The Town maintains a public park downstream of the left embankment of the dam. There is no public access to the Weweantic River for boats or the general public downstream of the dam. Additionally, there is no formal access for boats or the public on Tremont Mill Pond, upstream of the dam (FERC 26 July 2001).

USE ASSESSMENT

AQUATIC LIFE

Although no instream water quality data are available to assess the status of the *Aquatic Life Use*, it is identified with an Alert Status because of the numerous cranberry bog operations in the subwatershed, which may affect instream flows and the lack of anadromous fish passage at the dams.

AESTHETICS

The Weweantic River Stream Team conducted a shoreline survey in May 2001. They did not report any objectionable trash, debris, oil sheens, etc. in this segment of the Weweantic River (WRST 2002).

The *Aesthetic Use* is assessed as support based on the high aesthetic quality (i.e., no objectionable conditions).

Weweantic River (MA95-04) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				SUPPORT

* Alert Status Issues identified—See details in use assessment section

RECOMMENDATIONS WEWEANTIC RIVER (MA95-04)

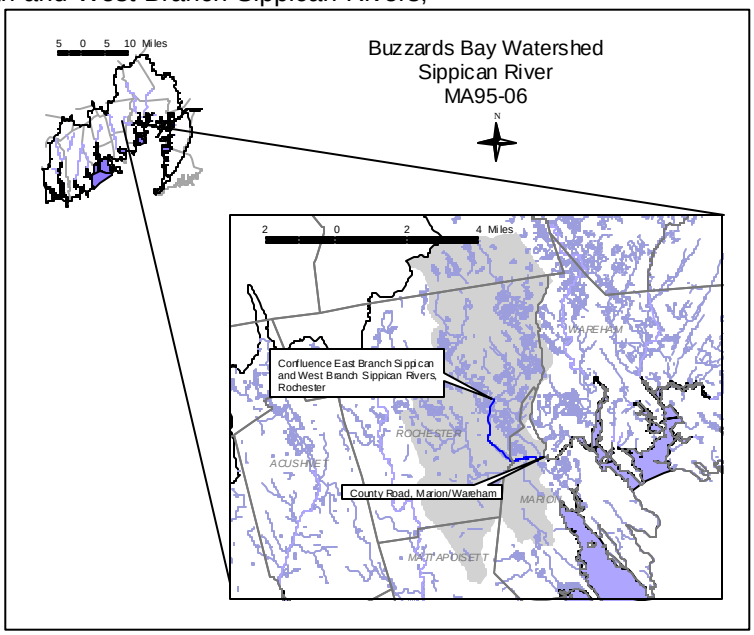
- Work with the Weweantic River Stream Team to implement their recommendations from their shoreline survey. Encourage the stream team to continue conducting surveys to assess the *Aesthetics Use*.
- Design and implement a bacteria monitoring program to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and/or the Phase II community storm water management programs and to assess the recreational uses.
- DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juveniles. DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of aquatic life.
- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data to assess the *Aquatic Life Use*.
- Inspect the sinkhole (identified during the last FERC inspection) on the left side of the dam spillway to determine if it is a source of sedimentation to the river and take actions to remediate if necessary.

SIPPICAN RIVER (SEGMENT MA95-06)

Location: Confluence East Branch Sippican and West Branch Sippican Rivers, Rochester to County Road, Marion/Wareham
Segment Length: 3.6 miles
Classification: Class B, Warm Water Fishery

The drainage area of this segment is approximately 28.1 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	65%
Open Land	16%
Residential	8%



WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Marion Water Division**	4169000	9P42416901	42416910	4169000-01G 4169000-02G 4169000-03G 4169000-04G	Registered = 0.56 Permitted = 0.15 (1999 & 2000) Permitted = 0.17 (2001)	0.71	0.62	0.72

*Excludes any authorized cranberry growers.

**Marion Water Division has seven withdrawal points in the Buzzards Bay Basin – four in Segment MA95-06 and three in Segment MA95-36. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all seven sources combined. NOTE: Marion's sources in Segment MA95-06 are registered only.

There are 1990.543 acres of cranberry bog open space in the Sippican River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 17.77 MGD.

NPDES SURFACE DISCHARGE SUMMARY

The following general storm water permit was issued by the EPA in October 2001 and will expire in October 2005:

Inshore Boat Shop Inc. MAR05B998

It should also be noted that Marion, Rochester and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

Although no instream water quality data are available to assess the status of the designated uses of this segment of the Sippican River, the *Aquatic Life Use* is identified with an Alert Status because of the numerous cranberry bog operations in the subwatershed, which may affect instream flows and the lack of anadromous fish passage at the dams.

Sippican River (MA95-06) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status issues identified – see details in the use assessment section

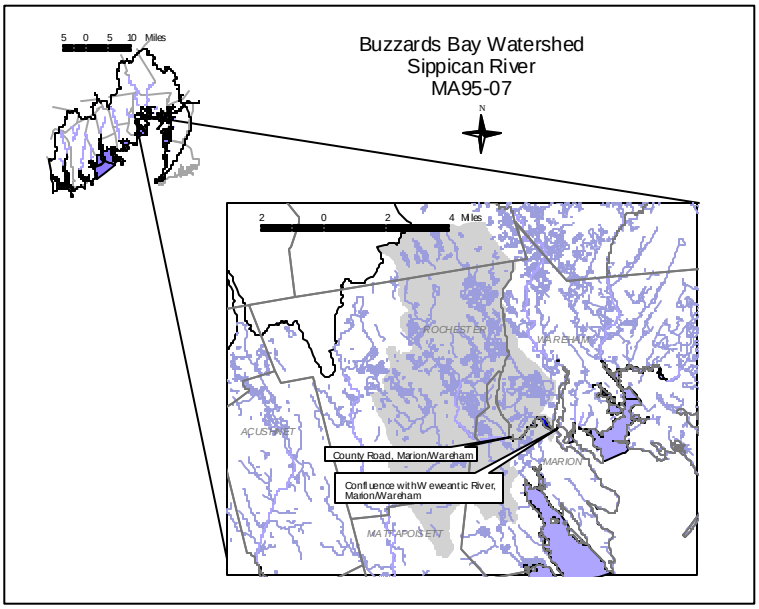
RECOMMENDATIONS SIPPICAN RIVER (MA95-06)

- DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juveniles. DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of the aquatic life.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and to increase habitat. If applicable, review data to assess the *Aquatic Life Use*.

SIPPICAN RIVER (SEGMENT MA95-07)

Location: County Road to confluence with Weweantic River, Marion/Wareham
Segment Area: 0.08 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 31.6 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	63%
Open Land	16%
Residential	9%

This segment of the Sippican River is on the 1998 303(d) List of Waters, needing confirmation, as not meeting water quality standards for pathogens (MA DEP 1999).

The Sippican Land Trust received a $4,650 Riverways Small Grant to support the Sippican River Access Project. The grant money will be used to help purchase land along the Sippican River to protect the river and its corridor by establishing public access to the river in the Town of Marion for passive recreation and monitoring of herring runs (Riverways 2002).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

There are 2313.124 acres of cranberry bog open space in the Sippican River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 20.65 MGD. This estimate includes the estimate of water use for the upstream segment MA95-06. An estimate of water use for the bog area contained exclusively in segment MA95-07 is 2.88 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated discharges to this subwatershed. It should be noted, however, that Marion and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that area BB35.4 is classified as prohibited (DFWELE 2000).

Based on the DMF shellfish status this entire segment (0.08 mi^2) is assessed as impaired.

Sippican River (MA95-07) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		0.08 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS SIPPICAN RIVER (MA95-07)

- Design and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

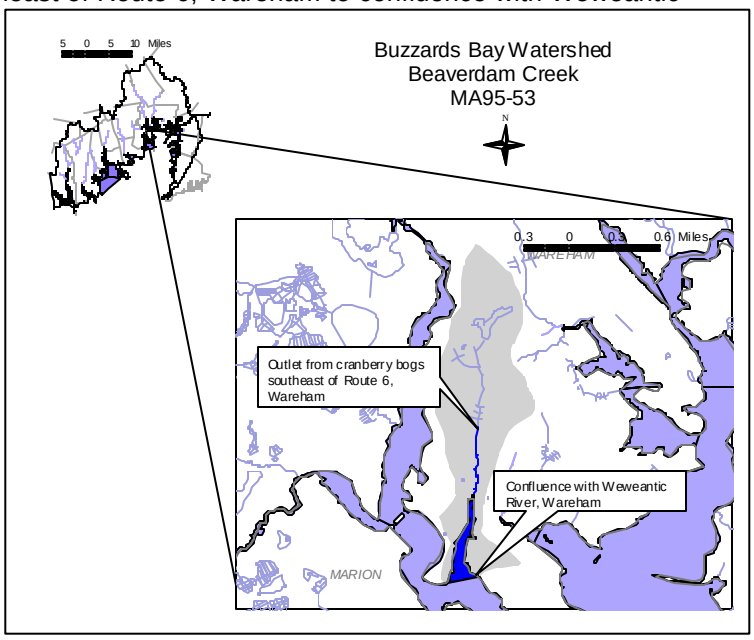
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to mitigate pollution causing shellfish bed closures. Continue to review the DMF shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the salt marsh restoration project identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that has been evaluated and prioritized by the Town (Site WH02). Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data to assess the *Aquatic Life Use*.

BEAVERDAM CREEK (SEGMENT MA95-53)

Location: Outlet from cranberry bogs southeast of Route 6, Wareham to confluence with Weweantic River, Wareham
Segment Area: 0.04 square miles
Classification: Class SA



The drainage area of this segment is approximately 0.7 miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Residential	40%
Forest	39%
Open Land	9%

WMA WATER WITHDRAWAL SUMMARY AND NPDES SURFACE DISCHARGE SUMMARY

There are 40.75 acres of cranberry bog open space in the Beaverdam Creek subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.36 MGD. It should be noted, however, that Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

Eelgrass beds in Beaverdam Creek mapped by MA DEP from field verified 1994 aerial photography extended from the mouth of the creek to just south of an imaginary line extended from Fillmore Street/Washington Street. MA DEP field verified 2002 aerial photography determined that the eelgrass bed identified in 1994 had declined and that moderate to dense algae was present in areas where eelgrass beds had been found previously.

Because of the decline of eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include operations related to cranberry bogs and septic systems.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB35.1 is prohibited (DFWELE 2000).

Based on the status of the DMF shellfish growing areas in Beaverdam Creek 0.04 mi^2 are assessed as impaired.

Beaverdam Creek (MA95-53) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (Decline of eelgrass bed habitat)	Total nitrogen	On-site treatment systems (septic systems), specialty crop production related to cranberry bogs
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS BEAVERDAM CREEK (MA95-53)

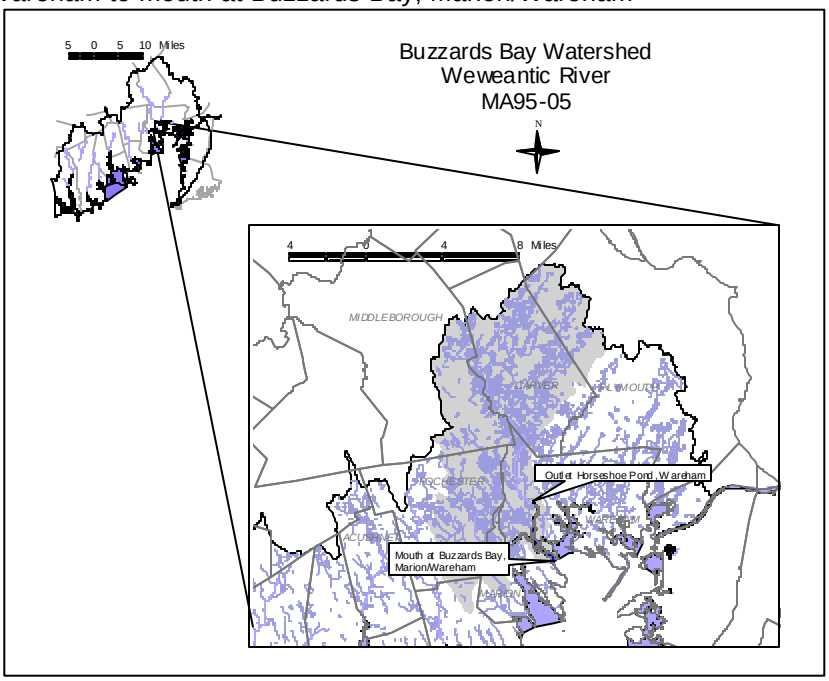
- Develop a plan to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to remediate sources of bacteria and reopen shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

WEWEANTIC RIVER (SEGMENT MA95-05)

Location: Outlet Horseshoe Pond, Wareham to mouth at Buzzards Bay, Marion/Wareham
Segment Area: 0.62 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 91.1 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	56%
Open Land	19%
Residential	13%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

There is a vessel sewage pumpout shoreside facility at Point Independence Yacht Club located on 7th Avenue, Wareham (BBP Undated and DMF 29 January 2003).

There is public access to the Weweantic River via an asphalt boat launch with two ramps and 36 parking spaces. The ramp is maintained by the Wareham DPW (DFWELE 2002).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in the Weweantic River between May and September from 1997 to the present. Samples were collected between 6 and 9 am. More intensive sampling of nutrients was conducted at five stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al.* 1999). The Weweantic River is home to a freshwater tidal marsh. Protected flora and fauna are associated with this rare habitat. Declines in anadromous fisheries have resulted from physical impediments. Efforts were underway in 1998 to install a fishway and make improvements to the dam at Horseshoe Pond. The Weweantic River was not monitored as intensively as other embayments and full-scale monitoring began in 1997 (Howes *et al.* 1999). The average Health Index Score (1997-2001) for the Inner Weweantic River is 34.8 and for the Outer Weweantic River is 50.8 (CBB Undated b). The Coalition states that the Weweantic River has “fair to poor water quality”. The Coalition believes that poor water quality has resulted in the loss of eelgrass beds from the inner region of the Weweantic River. The Coalition suggest that chlorophyll *a* levels indicate periodic blooms and a large phytoplankton community; that nitrogen levels are high; that turbidity is a major cause of eelgrass decline; and that oxygen levels were only “moderately depleted”. The Coalition identifies onsite septic systems, cranberry agriculture, and tidal recycling as potential sources of nitrogen (Howes *et al.* 1999).

WMA WATER WITHDRAWAL SUMMARY* (APPENIDX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source G = ground	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
SEMASS Partnership	4250007 4250008	9P42431001		4250007-01G 4250008-04G Industrial Well A Industrial Well B Industrial Well C	Permitted = 0.33	0.19	0.23	0.25

*Excludes any authorized cranberry growers.

There are 8969.409 acres of cranberry bog open space in the Weweantic River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 80.09 MGD. This estimate includes the estimates of water use for the upstream segments MA95-04 and MA95-07.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated wastewater discharges to this segment. Marion, Rochester and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

At the most upstream end of this segment the Weweantic River Stream Team noted sediment buildup near the Fearing Hill Road bridge in May 2001 and that the sluiceway at the dam was degraded, blocking fish migration and tidal flushing (WRST 2002). Launching of watercraft near Briarwood Beach Point has resulted in deterioration of the bank at that area (WRST 2002).

Eelgrass Bed Habitat

Eelgrass beds in this segment of the Weweantic River were mapped by MA DEP from field verified 1994 aerial photography (Costello 2003). MA DEP field verified 1999 aerial photography determined that the eelgrass bed identified in 1994 had declined between the Route 6 bridge and the mouth of Beaverdam Creek. A new eelgrass bed was found south of Beaverdam Creek along the west side of Cromeset Neck. Poor water clarity and the presence of sea lettuce (a macroalgae capable of creating nuisance conditions) have also been documented by the Weweantic River Stream Team.

Due to the decline of eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired for this segment of the Weweantic River. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include septic systems, recreational activities (boating), and operations associated with cranberry bogs.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB35.0 is approved, BB35.5 is conditionally approved, and BB35.2 is prohibited (DFWELE 2000).

Based on the status of the shellfish growing areas in this segment of the Weweantic River 0.17mi^2 are assessed as support, 0.45 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.17 mi^2. The remaining 0.45 mi^2 are currently not assessed.

AESTHETICS

During their May 2001 shoreline survey the Weweantic River Stream Team reported that there was “oily black mud” on the bottom of the river between 13th Avenue to the Route 6 bridge, Wareham. Water clarity downstream from the Route 6 bridge was estimated as less than two feet and sea lettuce was also evident throughout this area (WRST 2002).

Too limited data are available to assess the *Aesthetics Use*. The use, however, is identified with an Alert Status because of the noted poor water clarity and the presence of sea lettuce.

Weweantic River (MA95-05) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (decline of eelgrass bed habitat)	Total nitrogen		On-site treatment systems (septic systems), specialty crop production related to cranberry bogs, recreational activities (boat traffic)
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting**		0.17 mi^2 SUPPORT 0.45 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	Municipal separate storm sewer systems, on-site treatment systems (septic systems)
Primary Contact		0.17 mi^2 SUPPORT 0.45 mi^2 NOT ASSESSED				
Secondary Contact		0.17 mi^2 SUPPORT 0.45 mi^2 NOT ASSESSED				
Aesthetics*		NOT ASSESSED				

*Alert Status issues identified – see details in use assessment section.
**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS WEWEANTIC RIVER (MA95-05)

- The Weweantic River Stream Team identified sediment deposition in this segment of the Weweantic River near Horseshoe Pond Dam. As part of a shoreline survey, evaluate the extent of sedimentation problems in this subwatershed and determine the source of sediment buildup (most likely storm water related). Conduct biomonitoring in this subwatershed bracketing these nonpoint sources to determine if sedimentation and or other nutrient inputs negatively affect the aquatic life. Conduct bacteria monitoring to determine if road runoff is a source of bacteria to this segment and to assess the recreational uses. As a follow up to the survey(s), determine the need to implement erosion control measures and best management practices, remediate drains, and remove sediment buildup. Additionally, work to improve fish passage at the Horseshoe Pond Dam.

- Work with the Weweantic River Stream Team to implement their recommendations to improve the aesthetics of this subwatershed.

- Develop a bacteria monitoring program to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and/or the Phase II community storm water management programs.

- DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juveniles. DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of the aquatic life.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data for use in evaluating the status of the *Aquatic Life Use*.

- Evaluate and remedy bank erosion at the boat ramp near Briarwood Beach Point which may be detrimental to the aquatic life.

- Implement the five salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are WH21, WH01, WH01b, WH29, and WH33. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

THE WAREHAM RIVER DRAINAGE AREA

The Wareham River Drainage Area in Wareham includes two main freshwater tributaries (the Agawam and Wankinco Rivers), two smaller tributaries to the tidal portion (Broad Marsh and Crooked River) and a tributary to Marks Cove (Cedar Island Creek).

- Agawam River (Segment MA95-28)
- Agawam River (Segment MA95-29)
- Wankinco River (Segment MA95-30)
- Wankinco River (Segment MA95-50)
- Broad Marsh River (MA95-49)
- Crooked River (MA95-51)
- Cedar Island Creek (MA95-52)
- Wareham River (Segment MA95-03)

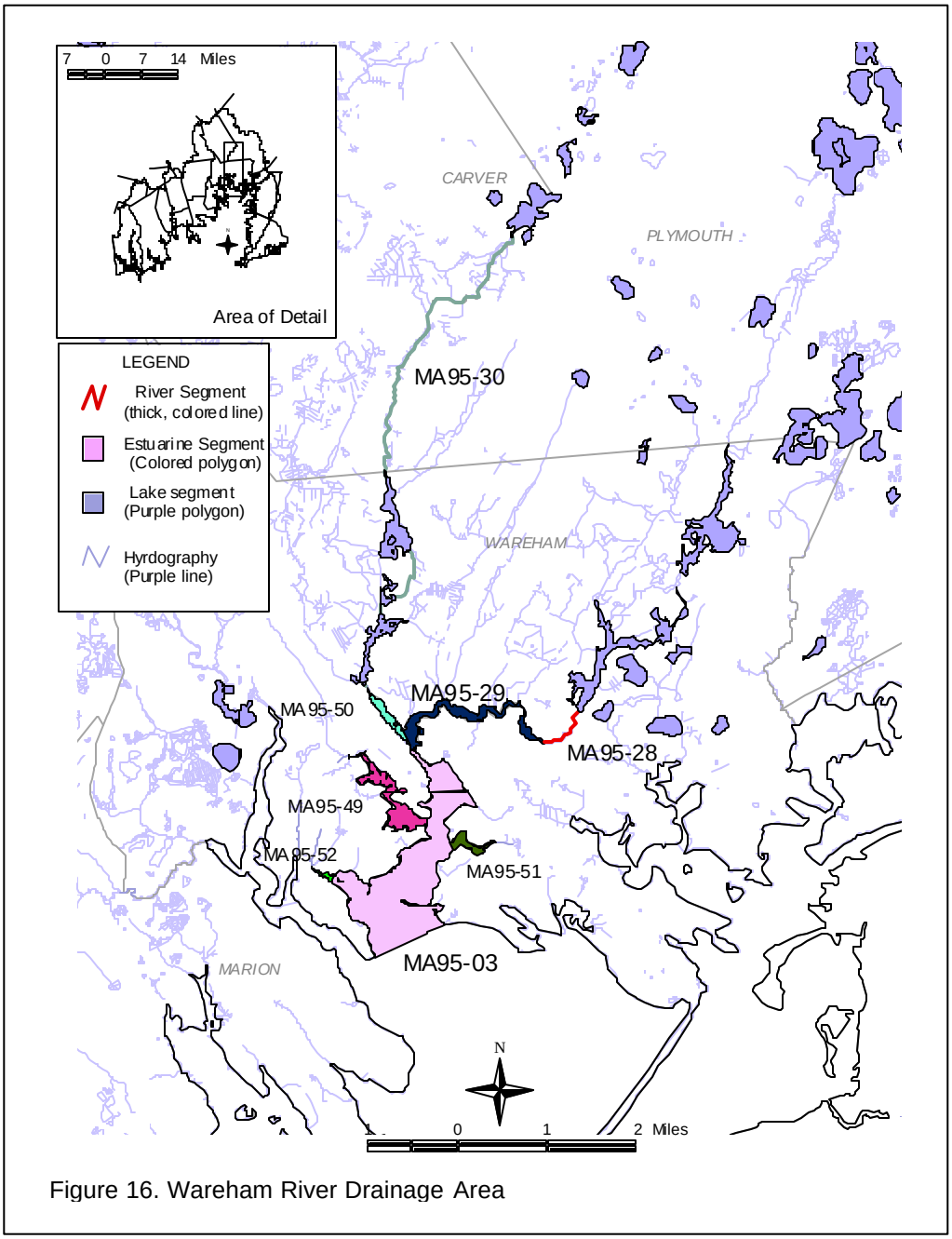
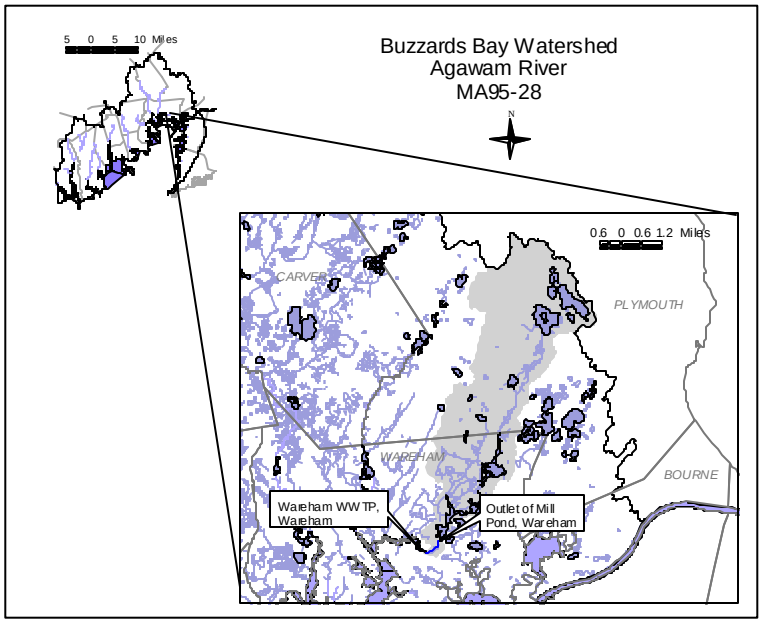


Figure 16. Wareham River Drainage Area

AGAWAM RIVER (SEGMENT MA95-28)

Location: Outlet Mill Pond, Wareham to Wareham WWTP, Wareham
Segment Length: 0.60 miles.
Classification: Class B, Warm Water Fishery



The drainage area of this segment is approximately 17.144 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	71%
Open Land	10%
Residential	7%

The use assessments of ten lakes located in this subwatershed (Little Long, Long, Gallows, Halfway, Round, Fawn, Abner, Five Mile, Glen Charlie, and Mill ponds) are provided in the Lakes Assessment section of this report.

In 2001 MassWildlife stocked trout in the Agawam River for recreational fishing (DFWELE 24 September 2002). On 25 August 1999 DFWELE conducted fish population sampling upstream of this segment (below Stump Pond Latitude: 41.8072059 Longitude: 70.6439405) using backpack electrofishing gear. Fish species collected in order of abundance included American eel, alewife, largemouth bass (*Micropterus salmoides)*, pumpkinseed (L*epomis gibbosus*), tesselated darter (*Etheostoma olmstedi)*, chain pickerel, bluegill, brown bullhead, black crappie, and yellow perch (Hurley 2003).

From 1997-2001 the Buzzards Bay Project conducted a 319 project to demonstrate that proactive land conservation is a viable tool for nitrogen management through the use of conservation restrictions, outright land purchase, and agricultural preservation restrictions. Thirteen acres in the upper portion of the Agawam River were placed under conservation restriction protecting rare damselflies habitat, freshwater mussel beds, and a quaking sphagnum bog. Additionally, four acres were protected for the public drinking water supply (BBP 1997-2001).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in this segment of the Agawam River between May and September from 1998 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al* 1999). (See segment MA95-29, the estuarine segment of the Agawam River, for more information.)

As part of the Town of Wareham WWTP Massachusetts Environmental Policy Act process, Camp Dresser & McKee (CDM) conducted a water quality investigation of the Wareham River Estuary Complex (CDM 2000). CDM collected river stage measurements in the Agawam River just downstream of the Mill Pond. Tide heights were recorded at four sites throughout the estuary complex. Nutrient sampling was conducted between 5 April and 5 November 1999 at one site in the Agawam River near the river stage transducer site “but on the branch associated with the herring run and one of the dam overflows” (CDM 2000). Conductivity, temperature, depth, and dissolved oxygen were also sampled *in situ* on four occasions between 11 August and 26 September 1999.

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Wareham Fire District**	4310000	9P42431002	42431012	4310000-01G 4310000-03G 4310000-04G 4310000-05G 4310000-06G	Registered = 1.31 Permitted = 0. 46 (1999 & 2000) Permitted = 0.56 (2001)	1.72	1.63	1.66

*Excludes any authorized cranberry growers.

**Wareham Fire District has seven withdrawal points in the Buzzards Bay Basin – five in Segment MA95-28 and two in Segment Ma95-29. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all seven sources combined.

There are 608.956 acres of cranberry bog open space in the Agawam River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 5.44 MGD.

NPDES SURFACE DISCHARGE SUMMARY

Based on the available information there are no regulated surface discharges to this segment of the Agawam River. Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Agawam River supports one of the most prolific herring runs within Buzzards Bay. A fish ladder (a weir pool) is maintained at the Mill Pond Dam to allow herring passage to the spawning grounds north of the dam to Halfway Pond in Plymouth.

AD Makepeace Company owns and operates a stop log station at the Route 12 bridge just downstream of Mill Pond on this segment of the Agawam River. Stop log activity occurs during the winter (December–March) when the cranberry bogs are flooded to avoid frost damage, thus reducing river flows. In mid-March stop logs are removed and excess water is released, increasing river flows. Between mid-May and August stop logs are installed to allow the application of pesticides and fertilizers and then removed. Between mid-September and early October the bogs are flooded for harvesting. Additionally, stop logs are manipulated following precipitation events. Stop log activity during 1999 in the Agawam River was not recorded by AD Makepeace (CDM 2001b).

Flows in the Agawam River as reported by CDM between 28 April and 4 November 1999 (a drought year [USGS 5 June 2001]) ranged between 5.12 and 70.77 cfs (n=382). The average annual flow in the Agawam River (extrapolated by CDM from their 7 months of monitoring) was 27.6 cfs and based on additional monitoring the average annual flow was 30.5 cfs. The 7Q10 for the Agawam River as calculated in the 1999 Wareham WWTP NPDES permit is 10.8 cfs (CDM 2000).

Too limited data are available, and, therefore, the *Aquatic Life Use* is not assessed for this segment of the Agawam River. This use is, however, identified with an Alert Status because of flow and fish passage concerns.

Agawam River (MA95-28) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status issues identified – see details in the use assessment section.

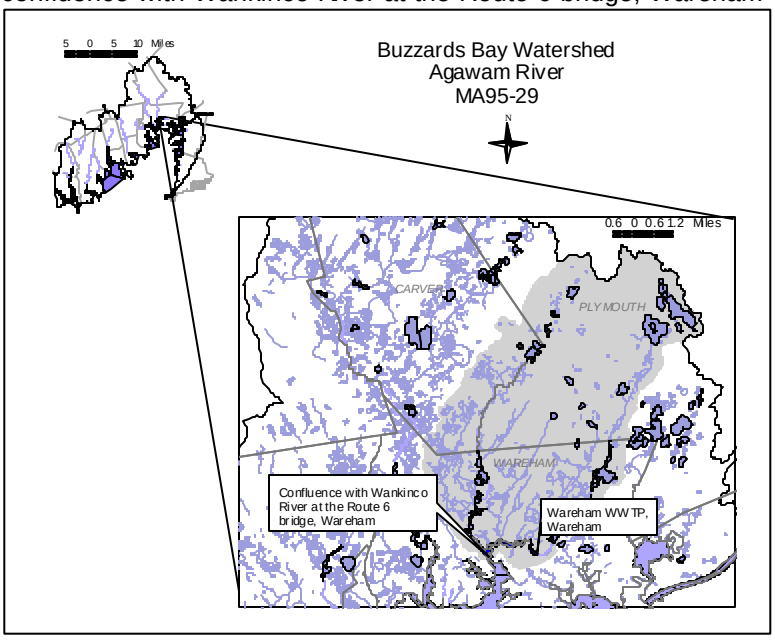
RECOMMENDATIONS AGAWAM RIVER (MA95-28)

- DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juveniles. DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of aquatic life.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

AGAWAM RIVER (SEGMENT MA95-29)

Location: From the Wareham WWTP to confluence with Wankinco River at the Route 6 bridge, Wareham
Segment Area: 0.16 square miles
Classification: Class SB, Shellfishing (Restricted)



The drainage area of this segment is approximately 41.4 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	69%
Open Land	16%
Residential	5%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens, nutrients, noxious aquatic plants and other habitat alterations (MA DEP 1999).

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

As part of the Massachusetts Environmental Policy Act process Camp Dresser & McKee (CDM) conducted a water quality investigation of the Wareham River Estuary Complex (CDM 2000). Tide heights were recorded at four sties throughout the estuary complex. Conductivity, temperature, depth, and dissolved oxygen were also sampled *in situ* on four occasions between 11 August and 26 September 1999.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in this segment of the Agawam River between May and September from 1998 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Marks Cove, included in this segment, was sampled for nutrients at three stations. The Agawam River "currently supports one of the most prolific herring runs within Buzzards Bay". The Agawam River is one of the most "heavily nutrient-loaded" estuaries in Buzzards Bay (Howes *et al* 1999). Health Index Scores for the Agawam River have consistently been in the "poor" category with an average score of 16.5. Water quality degradation in the Agawam River is attributed to nutrient discharges from the Wareham WWTP. Nitrogen and chlorophyll *a* concentrations are only elevated between the plant and the confluence with the Wankinco River. Dissolved oxygen concentrations consistently dropped to stressful conditions (defined by CCB as <60% saturation) within this segment of the Agawam River. The low DOs are associated with organic matter production stimulated by the high nutrients, oxidation of ammonium from the WWTF, and the decay of organic matter from the surrounding salt marshes (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Wareham Fire District**	4310000	9P42431002	42431012	4310000-02G 4310000-07G	Registered = 1.31 Permitted = 0.46 (1999 & 2000) Permitted = 0.56 (2001)	1.72	1.63	1.66

*Excludes any authorized cranberry growers.

**Wareham Fire District has seven withdrawal points in the Buzzards Bay Basin – five in Segment MA95-28 and two in Segment MA95-29. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all seven sources combined.

There are 2792.008 acres of cranberry bog open space in the Agawam River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 24.93 MGD. This estimate includes estimates of water use for the upstream segments MA95-28 and MA95-30. An estimate of water use for the bog area contained exclusively in segment MA95-29 is 3.68 MGD.

NPDES SURFACE DISCHARGE SUMMARY

The Town of Wareham (MA0101893) is permitted (30 October 1991) to discharge 1.8 MGD of treated sanitary wastewater via outfalls 001-004 to the Agawam River. The facility's whole effluent toxicity limit is $LC_{50} \geq$ 100% effluent and C-NOEC $\geq$ 14% effluent. This facility's permit is currently in the process of being renewed. EPA has issued the draft permit for public comment with a decrease in flow to 1.47 MGD and seasonal nitrogen limit of 4.0 mg/L. It is likely that the final permit will have a flow limit of 1.57 MGD, as the I/I calculation was incorrect. Wareham plans to upgrade the WPCF to include a new headworks facility with a new septage receiving system, two flow equalization basins, a new biological nutrient removal process, a UV disinfection system, a biofiltration odor control system, one new 18" outfall pipe, and a new solids thickening process. Additionally, the Town plans to extend the sewer to 12 "needs" areas. The facility, operational since 1972, currently provides secondary treatment through conventional activated sludge processes followed by disinfection and filtration (CDM 2001a and 2001b).

It should also be noted that Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Toxicity

Effluent

The Town of Wareham conducted 27 whole effluent toxicity tests using the mysid shrimp, *M. bahia* and the inland silverside, *M. berylinna* between April 1996 and August 2002. With the exception of one test (August 2001 LC_{50} = 85%) the effluent was not acutely toxic to the mysid. However, the effluent was acutely toxic to *M. berylinna* in ten of the 27 test events (LC_{50}'s ranged between 57.5 and >100% effluent). The facility did meet the C-NOEC permit limit of 14% effluent in all tests (range 14-100% effluent).

Ambient

The Town of Wareham collects Agawam River water downstream from the WWTP discharge at the Route 6 bridge (closest to their discharge) in Wareham for use as dilution water in their whole effluent toxicity tests. Between April 1996 and August 2002 survival of *M. bahia* exposed to the river water (48-hours) was good (not less than 90%) and *M. beryllina* was good (not less than 93% at 7-day exposure).

Chemistry-water

The Town of Wareham collects Agawam River water downstream from the WWTP discharge at the Route 6 bridge (closest to their discharge) in Wareham for use as dilution water in their whole effluent toxicity tests. Ambient chemical analysis included pH, TSS, and ammonia.

pH

pH values reported in the Wareham toxicity reports ranged between 6.4 and 9.0 SU (one less than 6.5; 14 greater than 8.5 SU) n=28.

Ammonia (as N)

Ammonia concentrations reported by Wareham ranged from BDL to 0.520 mg/L (n=27). A conservative total ammonia chronic criterion for this segment is 0.10 mg/L (estimated using a pH of 9.0 SU [Wareham TOXTD], a maximum temperature of 23.8°C and a low salinity of 10 ppt [CDM 2000]). Nineteen of 27 measurements exceeded this conservative criterion.

Total Suspended Solids

TSS concentrations in the samples collected by Wareham for their toxicity tests ranged from <2 to 27.50 mg/L (n=27). However, only one measurement exceeded 25 mg/L.

Based on elevated ammonia-nitrogen concentrations and the presence of acute toxicity in the Agawam WWTP discharge, the *Aquatic Life Use* is assessed as impaired in this segment of the Agawam River. This assessment is corroborated by the findings of the Coalition for Buzzards Bay, which claim this river is one of the most "heavily nutrient-loaded" estuaries in Buzzards Bay (Howes *et al* 1999). It should be noted, however, that the WWTP is undergoing a facility upgrade that will include a new biological nutrient removal process. Additional potential sources of nutrients include cranberry bog operations and on-site septic systems.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that area BB36.3 is prohibited (DFWELE 2000).

Because of the DMF shellfish growing area closure the *Shellfish Harvesting Use* for this segment ($0.16 mi^2$) is assessed as impaired.

Agawam River (MA95-29) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		IMPAIRED	Ammonia (unionized), whole effluent toxicity	Municipal point source discharge	Irrigated, specialty crop production related to cranberry bogs and on-site treatment systems (septic systems)
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems, municipal point source discharge
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

RECOMMENDATIONS AGAWAM RIVER (MA95-29)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring to continue to assess the *Aquatic Life Use*.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

- Continue to monitor nutrient levels to document effectiveness of source reduction activities including upgrade of the Wareham WWTP, treatment of storm water discharges, sewering, and the Phase II community storm water management programs. Continue to work with the cranberry bog growers association to improve best management practices to reduce nutrient loading from fertilizer applications. Review the results of the on-going nutrient study C*ranberry Bog Phosphorus Dynamics TMDL Project* (DeMoranville 2001).

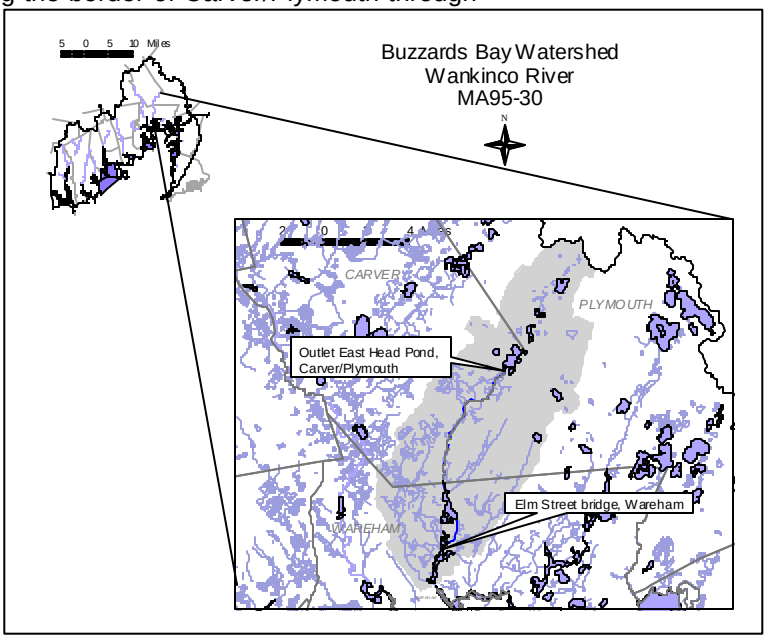
- If the Wareham WWTP continues to have problems meeting the whole effluent toxicity limits after the facility upgrade, the Town should be required to conduct a toxicity identification and reduction evaluation (TIE/TRE). Continue to review toxicity reports to evaluate the *Aquatic Life Use*.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacteria inputs and reopen shellfish beds.

- Implement the four salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are WH16, WH17, WH25, and WH26. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

WANKINCO RIVER (SEGMENT MA95-30)

Location: Outlet East Head Pond following the border of Carver/Plymouth through cranberry bogs to Elm Street bridge, Wareham
Segment Length: 6.40 miles
Classification: Class B



The drainage area of this segment is approximately 20.6 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	72%
Open Land	19 %
Commercial	1%

The use assessments of nine lakes (College, Three Cornered, New Long, East Head, Barrett, Fearing, Charge, Tihonet, and Parker Mills ponds) that are located in the drainage area of this segment are provided in the Lakes Assessment section of this report.

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

AD Makepeace will be constructing a 35-lot subdivision on 60 acres located between Farm-to-Market Road and Tihonet Pond. The proposed individual septic systems will include a "denitrification" removal system so the 35 lots should release 16 to 34 percent less nitrogen per acre than typical septic systems.

The Carver/Marion/Wareham Ash landfill is located along this segment of the Wankinco River (MA DEP BWP 2000).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 1770.557 acres of cranberry bog open space in the Wankinco River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 15.81 MGD.

NPDES SURFACE DISCHARGE SUMMARY

Tremont Nail Company (MA0005801) is permitted (18 February 1986) to discharge 60,000 gpd of contact cooling water from heat quench tanks via outfall 001 to the Wankinco River. The permit includes an 81°F temperature limit and also includes secondary limits for TSS= 20 mg/L, oil & grease = 15 mg/L and total iron =2.0 mg/L (dissolved iron = 1.0 mg/L).

It should also be noted that Carver, Plymouth, and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Wankinco River supports a herring run within Buzzards Bay. There are two denil fish ladders maintained at Tihonet and Parker Mill ponds to allow herring passage to the spawning grounds.

AD Makepeace Company owns and operates a stop log station on this segment of the Wankinco River. Stop log activity occurs during the winter (December –March) when the cranberry bogs are flooded and allowed to freeze, thus reducing river flows. In mid-March stop logs are removed and excess water is released, increasing river flows. Between mid-May and August stop logs are installed to allow the application of pesticides and fertilizers and then removed. Between mid-September and early October the bogs are flooded for harvesting. Additionally, stop logs are manipulated following precipitation events. During 1999 stop log activity in the Wanknico ranged from 14 per month to 5 per month (CDM 2001b).

Flows in the Wankinco River as reported by CDM between 28 April and 4 November 1999 (n=382) ranged between 1.89 and 133.49 cfs (CDM 2000). The average annual flow in the Wankinco River (extrapolated by CDM from their 7 months of monitoring) was 30.6 cfs. Based on additional monitoring the average annual flow was 29.3 cfs (CDM 2001b). It should be noted that 1999 was a drought year (USGS 5 June 2000). An estimated 7Q10 for the Wankinco River at Wareham, MA, 1000 feet below Parker Mills Pond is 8.0 cfs (Wandell and Morgan 1984).

Too limited data are available, and, therefore, the *Aquatic Life Use* is not assessed for this segment of the Wankinco River. The use is, however, identified with an Alert Status because of flow and fish passage concerns.

Wankinco River (MA95-30) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status issues identified – see details in the use assessment section

RECOMMENDATIONS WANKINCO RIVER (MA95-30)

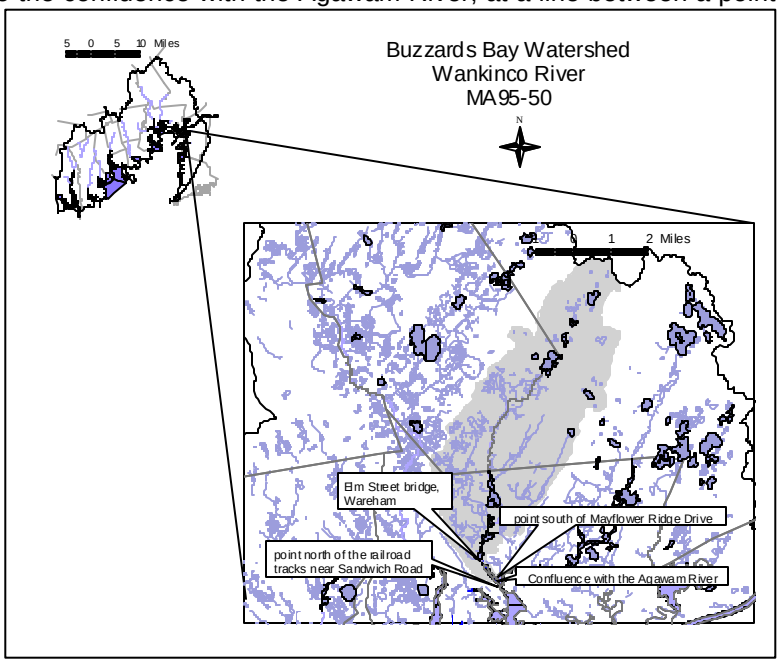
- DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juveniles. DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of aquatic life.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data for assessing the *Aquatic Life Use.*

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

WANKINCO RIVER (SEGMENT MA95-50)

Location: Elm Street bridge, Wareham to the confluence with the Agawam River, at a line between a point south of Mayflower Ridge Drive and a point north of the railroad tracks near Sandwich Road, Wareham
Segment Area: 0.05 square miles
Classification: Class SA



The drainage area of this segment is approximately 20.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	72%
Open Land	19%
Residential	2%

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

The Coalition for Buzzards Bay conducted weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in this segment of the Wankinco River between May and September 1992 to the present. Samples were collected between 6 and 9 am. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al.* 1999).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are no regulated water withdrawals from this subwatershed. There are, however, 1770.557 acres of cranberry bog open space located upstream from this segment in the subwatershed of segment MA95-30.

NPDES SURFACE DISCHARGE SUMMARY

There are no known surface NPDES discharges to this segment of the Wankinco River. It should be noted that Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISHING

The DMF Shellfish Status Report of July 2000 indicates that area BB36.3, which encompasses this entire segment, is prohibited (DFWELE 2000).

Based on the DMF shellfish status report the *Shellfish Harvesting Use* is assessed as impaired for this entire segment of the Wankinco River (0.05 mi^2).

Wankinco River (MA95-50) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

RECOMMENDATIONS WANKINCO RIVER (MA95-50)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

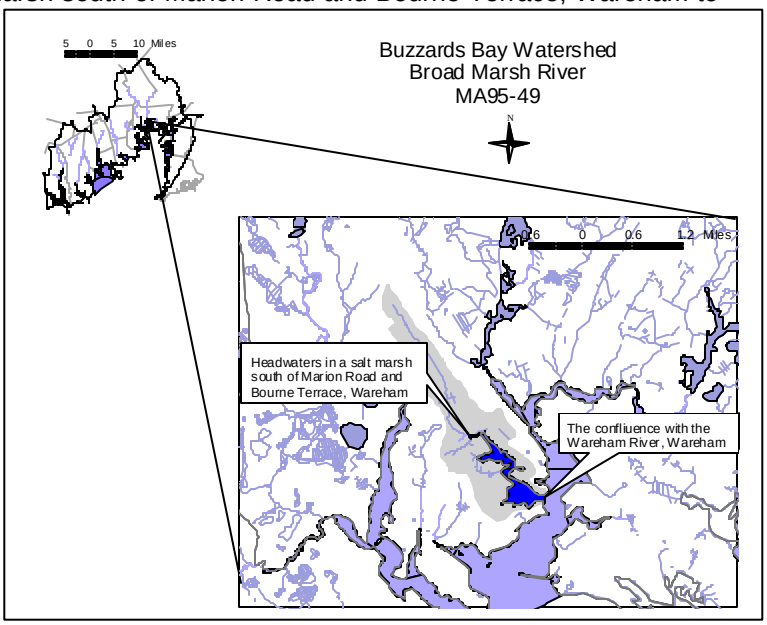
- Develop a plan to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to mitigate bacterial contamination and reopen shellfish beds. Continue to review the shellfish status report to assess the *Shellfish Harvesting Use*.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

BROAD MARSH RIVER (SSEGMENT MA95-49)

Location: From its headwaters in a salt marsh south of Marion Road and Bourne Terrace, Wareham to the confluence with the Wareham River, Wareham (at a line consistent with DMF DSGA BB36.8)
Segment Area: 0.16 square miles
Classification: Class SA



The drainage area of this segment is approximately 1.2 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	41%
Residential	29%
Wetlands	13%

The Broad Marsh River estuary is approximately 100 acres in size and contains large softshell clam and quahog resources. There is a Town owned and operated bathing beach as well as private beaches on the river's shore. Storm water runoff from 15 storm drain pipes discharges directly to the river resulting in the closure of shellfish growing areas and posing potential human health risks. In 1990 the Broad Marsh Stormwater Remediation Project was begun by the Town of Wareham utilizing MA DEP s.319 funds and assistance from BBP. The project installed subsurface concrete and plastic infiltration structures at 15 sites and was completed in April 1996. Post-project monitoring indicated that >99.99% of fecal coliform bacteria was removed from runoff and as a result, shellfish growing areas were reclassified as "conditionally approved" (EPA 31 December 2002).

The Coalition for Buzzards Bay have been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in Broad Marsh River between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at six stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll a (Howes *et al* 1999). The Broad Marsh River has been classified as having "fair" water quality based on the Health Index Scores. The average score for 1997-2001 is 50.9 (CBB Undated b). Eelgrass beds historically existed up to the mouth of Broad Marsh River. Upper and lower Broad Marsh River show elevated nitrogen and chlorophyll *a* levels. Dissolved oxygen concentrations in Broad Marsh River rarely showed moderately stressful oxygen levels (defined by CBB as less than 60% saturation). According to the Coalition, factors contributing to the fair health index are the relatively dense development in a small sub-watershed, extensive marsh area, and restricted tidal flushing (Howes *et al.* 1999).

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F) AND NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or discharges in this subwatershed. However, it should also be noted that Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB36.11 and BB36.9 are prohibited and BB36.8 is conditionally approved (DFWELE 2000).

Based on the status of the shellfish growing areas in Broad Marsh River this entire segment (0.16 mi^2) is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

There is a Town owned and operated bathing beach as well as private beaches on the river's shore. According to the Wareham Board of Health Office there have been no closures at the Broad Marsh River beach. (Wareham BOH 2003) The Broad Marsh Stormwater Remediation Project was completed in April 1996. Post project monitoring indicated that >99.99% of fecal coliform bacteria was removed from runoff.

Based on too limited data, the *Primary* and *Secondary Contact Recreational Uses* are not assessed.

Broad Marsh River (MA95-49) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS BROAD MARSH RIVER (MA95-49)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.
- Develop and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses. Continue to review the closure information/data from the beach bill to assess the recreational uses.
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to mitigate contaminants causing shellfish bed closures. Continue to review DMF shellfish status report to assess the *Shellfish Harvesting Use*.
- Implement the two salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town (Site WH28 and WH36). Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.
- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

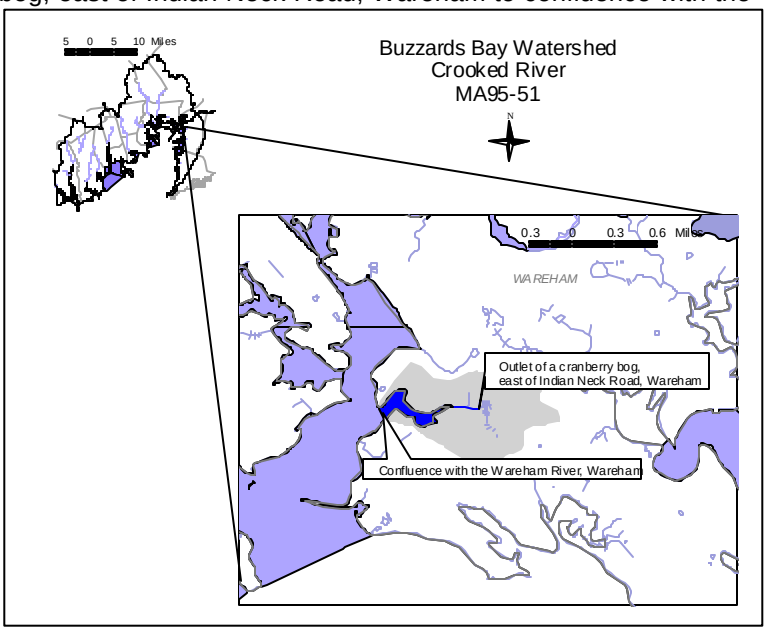
CROOKED RIVER (SEGMENT MA95-51)

Location: From the outlet of a cranberry bog, east of Indian Neck Road, Wareham to confluence with the Wareham River, Wareham
Segment Area: 0.04 square miles
Classification: Class SA

The drainage area of this segment is approximately 0.5 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	48%
Residential	33%
Open Land	711

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.



WMA WATER WITHDRAWAL SUMMARY (APPENDIX F) AND NPDES SURFACE DISCHARGE SUMMARY

There are no known regulated water withdrawals or NPDES discharges to Crooked River. Wareham, however, is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that area BB36.1 is prohibited (DFWELE 2000).

Based on the status of the shellfish growing areas in the Crooked River this entire segment (0.04 mi^2) is assessed as impaired.

Crooked River (MA95-51) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E

RECOMMENDATIONS CROOKED RIVER (MA95-51)

- Develop a plan to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs and possibly reopen shellfish beds. Continue to review the DMF shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the five salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are WH10, WH11, WH23, WH34 and WH35. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

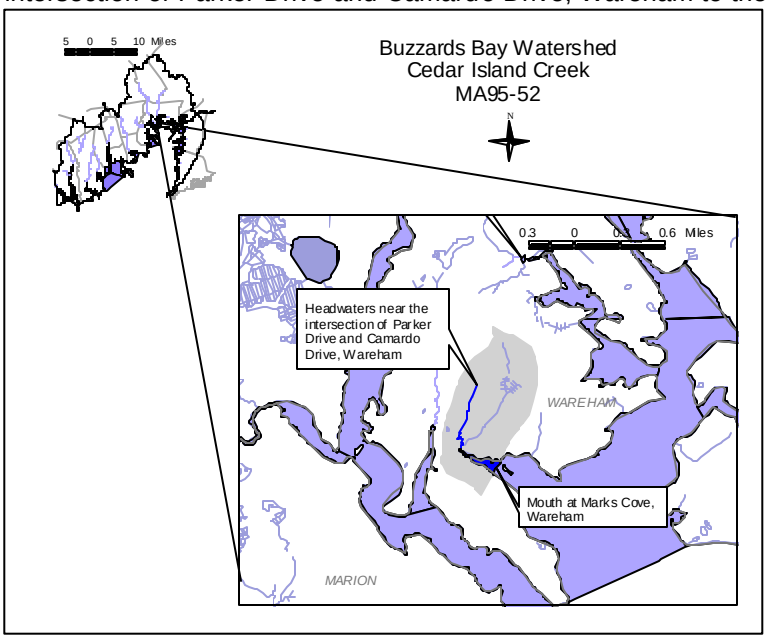
CEDAR ISLAND CREEK (MA95-52)

Location: From the headwaters near the intersection of Parker Drive and Camardo Drive, Wareham to the mouth at Marks Cove, Wareham (consistent with DMF DSGA BB36.7)
Segment Area: 0.01 square miles
Classification: Class SA

The drainage area of this segment is approximately 0.4 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	52%
Residential	20%
Wetlands	19%

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.



WMA WATER WITHDRAWAL SUMMARY AND NPDES SURFACE DISCHARGE SUMMARY

Based on available information there are no regulated water withdrawals or discharges to Cedar Island Creek. Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB36.7 and BB36.4 are prohibited and BB36.21 and BB36.0 are approved (DFWELE 2000).

Based on the status of the shellfish growing areas in the Cedar Island Creek, 0.006 mi^2 are assessed as impaired and 0.004 mi^2 are assessed as support. Therefore, this 0.01 mi^2 segment is reported as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.004 mi^2. The remaining 0.006 mi^2 are currently not assessed. Therefore, this 0.01 mi^2 segment is reported as not assessed.

Cedar Island Creek (MA95-52) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS CEDAR ISLAND CREEK (MA95-52)

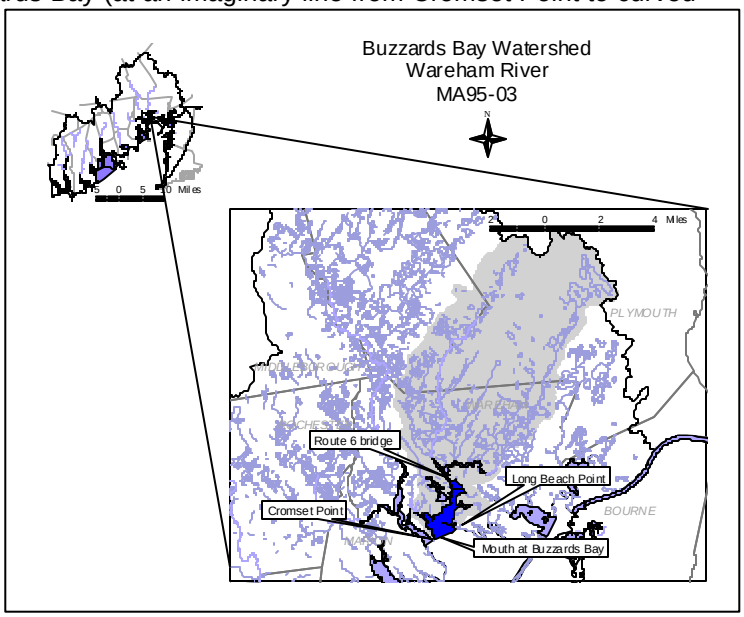
- Develop a plan to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs to Cedar Island Creek and possibly reopen closed shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

WAREHAM RIVER (SEGMENT MA95-03)

Location: Route 6 bridge to mouth at Buzzards Bay (at an imaginary line from Cromset Point to curved point east, southeast of Long Beach Point), Wareham. Includes Mark's Cove, Wareham
Segment Area: 1.18 square miles
Classification: Class SA, Shellfishing (Open)



The drainage area of this segment is approximately 44.8 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	67%
Open Land	15%
Residential	7%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

As part of the Massachusetts Estuaries Project a nutrient and bacteria TMDL will be developed by SMAST in the next few years for the Wareham River System, which encompasses this segment.

There is public access to the Wareham River at Tempest Knob. This site has one concrete boat launch with 36 parking spaces. A fee is charged and/or a sticker is required (DFWELE 2002). Additionally, the Wareham River Fishing Pier, maintained by the Town, offers anglers a chance to catch fluke, bluefish, and striped bass (DFWELE 2002). There is a vessel sewage pump-out facility, pump-out boat, and porta-potty dump at Warr's Marine located on Lower Main Street, Wareham (BBP Undated and DMF 29 January 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in this segment of the Wareham River between May and September from 1992 to the present. Samples were collected between 6 and 9 am. More intensive sampling of nutrients was conducted at seven stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Marks Cove was sampled for nutrients at three stations. The Wareham River Estuary receives the flow from the Agawam, Wankinco, and Weweantic rivers and is "subject to the greatest surface freshwater flows in all of the sub-embayments to Buzzards Bay" (Howes *et al.* 1999). The Health Index Scores for the Wareham River are Fair (35-65); the average score for the "inner river" between 1997 and 2001 was 40.8 and Wareham "outer river" was 47.1 (CBB Undated b). The Wareham River complex is "nitrogen enriched and experiencing moderate-high nutrient related water quality decline". The Coalition states that total nitrogen and chlorophyll *a* concentrations are moderately high and oxygen concentrations throughout the Wareham River Estuary were "only moderately depressed" (Howes *et al.* 1999).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 2842.489 acres of cranberry bog open space in the Wareham River subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for these bog areas is 25.38 MGD. This estimate includes the estimate of water use for the upstream segment MA95-29. An estimate of water use for the bog area contained exclusively in segment MA95-03 is 0.45 MGD.

NPDES SURFACE DISCHARGE SUMMARY

Based on available information there are no regulated discharges to this segment of the Wareham River. It should, however, be noted that Wareham is a Phase II community and has submitted their Notice Of Intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

Eelgrass beds in this segment of the Weweantic River were mapped by MA DEP from field verified 1994 aerial photography (Costello 2003). MA DEP field verified 2002 aerial photography determined that the eelgrass bed identified in 1994 along the eastern side of this segment near Oak Street had declined and that the beds were sparse with dense epiphytes. Costello also identified that algae was dense near Crab Cove and the Parkwood Beach area and a floating mat was identified near Wareham Neck.

Because of the decline of eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired for this segment of the Wareham River. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include recreational activities (boating) and septic systems.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB33.0, BB36.0, BB36.20, and BB36.21 are approved, and BB36.3, BB36.4 and BB36.5 are prohibited (DFWELE 2000).

Based on the status of the shellfish growing areas in the Wareham River 0.93 mi^2 are assessed as support and 0.25 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.93 mi^2. The remaining 0.25 mi^2 are currently not assessed.

Wareham River (MA95-03) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (decline of eelgrass bed habitat)	Total nitrogen	Municipal point source discharge	On-site treatment systems (septic systems), specialty crop production related to cranberry bogs
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		0.93 mi^2 SUPPORT 0.25 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	Municipal separate storm sewer systems
Primary Contact		0.93 mi^2 SUPPORT 0.25 mi^2 NOT ASSESSED				
Secondary Contact		0.93 mi^2 SUPPORT 0.25 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS WAREHAM RIVER (MA95-03)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollution inputs to this segment of the Wareham River. Continue to review the DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Implement the six salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are WH12, WH13, WH14, WH14b, WH15 and WH24. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

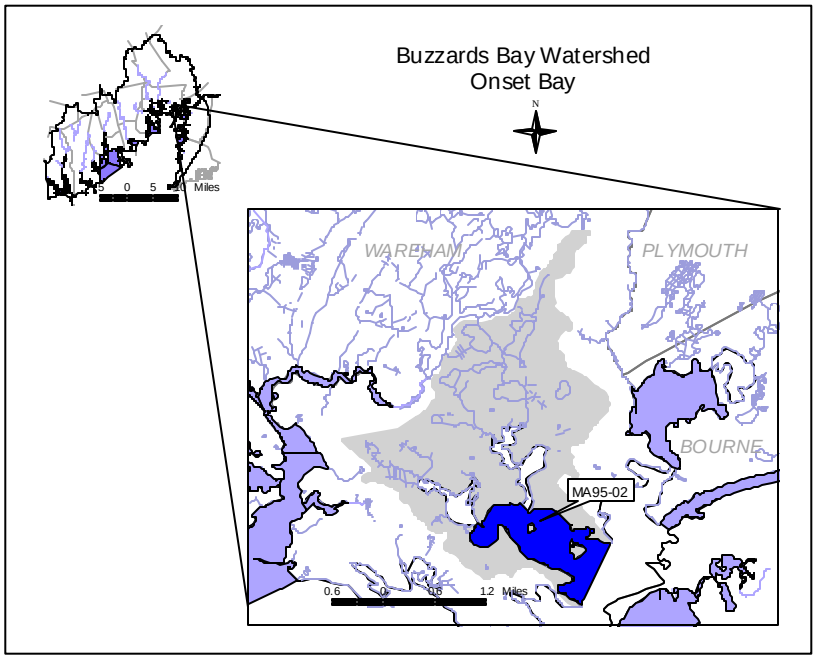
- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data for use in assessing the *Aquatic Life Use*.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Develop a nutrient/bacteria TMDL for the Wareham River system in accordance with the Massachusetts Estuaries Project.

ONSET BAY (SEGMENT MA95-02)

Location: Wareham
Segment Area: 0.78 square miles
Classification: Class SA



The drainage area of this segment is approximately 4.9 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	43%
Residential	26%
Open Land	11%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

The use assessments of Sandy, Spectacle, Union, Dicks, and Sand ponds, which are located in the subwatershed of Onset Bay, are provided in the Lakes Assessment section of this report.

There are three vessel sewage pumpout facilities located on Onset Bay; Onset Bay Marina at Green Onset, Stonebridge Marina at East Boulevard, and the Onset Town Pier at Onset Avenue (BBP undated and DMF 29 January 2003).

From 1997-2001 the Buzzards Bay Project conducted a 319 project to demonstrate proactive land conservation is a viable tool for nitrogen management through the use of conservation restrictions, outright land purchase, and agricultural preservation restrictions. In Onset Bay 13-acres along the Agawam River were placed under conservation restriction protecting rare damselflies habitat, freshwater mussel beds, and a quaking sphagnum bog. Additionally, 4-acres were protected for wellfield protection areas (BBP 1997-2001).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at three stations in Onset Bay between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at seven stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Marks Cove, included in this segment, was sampled for nutrients at three stations (Howes *et al.* 1999). The average depth of Onset Bay 2 m but there is a dredged channel that is 16 m deep. There are some restrictions to herring migration and runoff from Cranberry Highway may be a significant source of pollution. In 1997 the Town of Wareham began improvements to mitigate 14 discharges in the Point Independence Area and a surface water management facility to treat storm water runoff. In 1997 and 1998 the Town extended the sewers to many neighborhoods in the Broad Cove and Muddy Cove. The Health Index Scores for Onset Bay have been in the good to excellent category with an average score for the past five years (1997-2001) of 80.3 (good to excellent). The Coalition also sampled Shell Point Bay, Muddy Cove, Broad Cove, and the East River "tributaries" to Onset Bay. Shell Point Bay received a Health Index Score of 65.3 (fair); Onset Bay Inner received a score of 73.9; and Onset Bay, East River received a Health Index Score of 59.5. Shell Point Bay and the East River water quality degradation appears to be the result of elevated nitrogen and chlorophyll *a* concentrations associated with tidal wetlands and bathymetric/flushing characteristics (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source G = ground	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Onset Fire District, Wareham**	4310003	9P42431001	42431031	4310003-03G 4310003-04G	Registered = 0.49 Permitted = 0.60 (1999 & 2000) Permitted = 0.62 (2001)	0.6	0.57	0.57

*Excludes any authorized cranberry growers.

**Onset Fire District has four withdrawal points in the Buzzards Bay Basin – two in Segment MA95-01 and two in Segment MA95-02. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all four sources combined.

There are 162.792 acres of cranberry bog open space in the Onset Bay subwatershed (UMass Amherst 1999). For the purpose of this report, a conservative estimate of water use for this bog area is 1.45 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated wastewater discharges to this subwatershed. It should be noted, however, that Wareham is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

MA DEP identified the presence of eelgrass in Onset Bay from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Onset Bay were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography determined that the eelgrass bed identified in 1994 along the northwestern edge of the bay between Shell Point and the East River has declined (once continuous bed, now two smaller, segmented beds), the beds along the south/southwestern edge of the bay have declined (once continuous, now two separate smaller beds), the beds between Wicketts Island and Onset Island have declined, one bed between Onset Island and Sias Point has been lost, and the bed near the mouth of the bay appears to be stable/slightly declining.

Because of the loss/decline of eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired for Onset Bay. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include recreational activities (boating) and storm water.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that areas BB40.0, BB40.21, BB40.22 are approved and BB40.20 and BB40.3 are conditionally approved (DFWELE 2000).

Based on the status of the shellfish growing areas in Onset Bay 0.63 mi^2 are assessed as support and 0.15 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.63 mi^2. The remaining 0.15 mi^2 are currently not assessed.

Onset Bay (MA95-02) Use Summary Table

Designated Uses		Status	Causes		Sources
			Known	Suspected	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (loss/decline of eelgrass bed habitat)	Other anthropogenic substrate alterations, total nitrogen	Recreational activities (boat traffic), highway/road runoff, urbanized high density area, municipal separate storm sewer systems
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting		0.63 mi^2 SUPPORT 0.15 mi^2 IMPAIRED	Fecal coliform bacteria		Municipal separate storm sewer systems
Primary Contact		0.63 mi^2 SUPPORT 0.15 mi^2 NOT ASSESSED			
Secondary Contact		0.63 mi^2 SUPPORT 0.15 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS ONEST BAY (MA95-02)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management program and to assess the recreational uses.

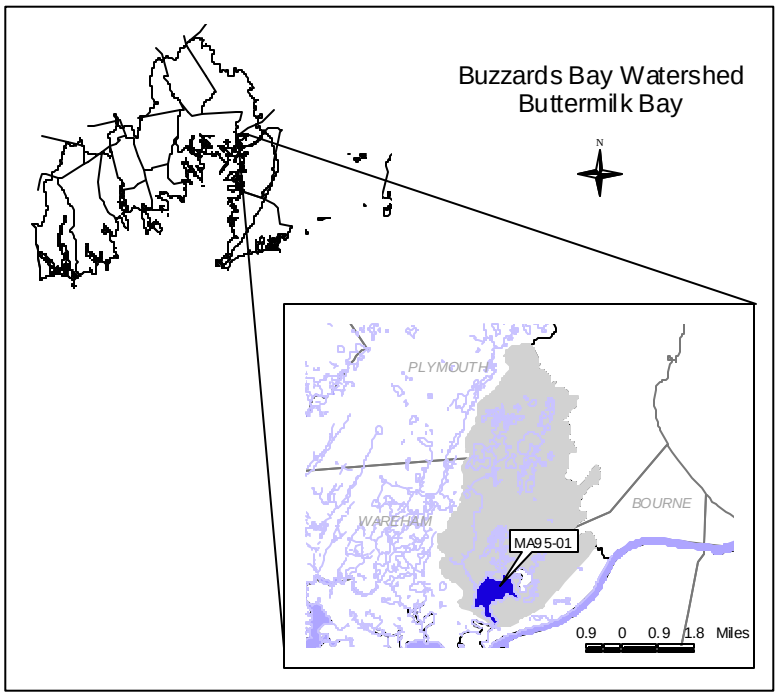
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs causing the closure of shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Implement the seven salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are WH30, WH31, WH05, WH06, WH07, WH08, and WH09. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data to assess the *Aquatic Life Use*.

BUTTERMILK BAY (SEGMENT MA95-01)

Location: Bourne/Wareham.
Segment Area: 0.67 square miles
Classification: Class SA



The drainage area of this segment is approximately 15.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	57%
Residential	20%
Open Land	11%

This segment is on the 1998 Massachusetts Section 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

The use assessments of Queen Sewell, Mare, and Sand ponds, which are located in the subwatershed of Buttermilk Bay, are provided in the Lakes Assessment section of this report.

There is a vessel sewage pump-out boat at Bevans/Continental Marina located on Cranberry Highway, Wareham (BBP Undated and DMF 29 January 2003).

In the Buttermilk Bay subwatershed the three towns of Bourne, Plymouth, and Wareham were the first to implement a holistic nitrogen management strategy based on growth management. In 1991 the three towns all adopted zoning changes to reduce the overall number of potential housing units that could be built in the watershed to ensure excess nutrients from future growth would not exceed what was believed at the time to be the critical nitrogen loading levels for the waterbody (Janik 2003).

The Army Corps of Engineers maintains a navigation channel in Buttermilk Bay that is 2,800-feet long, seven-feet deep and 100-feet wide. The ACOE dredges the natural channel of the bay that begins in the vicinity of Sears Point in Wareham and ends in an area between Taylor Point in Bourne and Peters Neck in Wareham. The original project was completed in 1953; in 1984, the channel was extended 2,500 feet to the site of a public marina. The extension is six feet deep and 80 feet wide (ACOE 1995).

The Coalition for Buzzards Bay conducted weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in this segment of Buttermilk Bay between May and September 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at five stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Little Buttermilk Bay, not part of this segment, was also sampled at one station. Little Buttermilk Bay, formerly a freshwater kettle pond, is now connected to Buttermilk Bay. Reduced tidal flushing is believed to contribute to the reduced water quality in Little Buttermilk Bay. Buttermilk Bay averages 1.5 m in depth (Howes *et al* 1999). The Health Index Scores from 1992-2001 for Buttermilk and Little Buttermilk bays have oscillated between fair and good/ excellent. The average Health Index Score for the past five years (1997-2001) for Little Buttermilk Bay is 62.8 (fair) and for Buttermilk Bay is 67.3 (good/excellent) with trends showing improvement. Elevated nitrogen and chlorophyll /pheophytin concentrations have been listed as the cause of water quality degradation. Remediation of 30 storm water discharges (see below) and sewering are believed to be major factors in the improved water quality (CBB Undated b).

EPA documented in 1985 that Buttermilk Bay had elevated fecal coliform bacteria due to storm water runoff. Thirty storm drain systems discharged directly to Buttermilk Bay in 1985. Numerous storm drain remediation projects have occurred between 1990 and 2000 in the towns of Wareham and Bourne. Most notable was the installation in September 2000 of storm water infiltration structures at six high priority sites around the bay to remove fecal coliform bacteria, sediments, nutrients, fertilizers, hydrocarbons, metals, and organics. This construction was funded in 1996 through a 319 grant to the Buzzards Bay Project and the Town of Bourne (BBP 1996-2000).

The Massachusetts Division of Fisheries and Wildlife conducted fish population sampling in Red Brook, a tributary to Buttermilk Bay, on 6 June 1997 using backpack electroshocking equipment. Species collected, in order of decreasing abundance, included American eel (*Anguilla rostrata*), brook trout (*Salvelinus fontinalsis*), golden shiner (*Notemigonus crysoleucas*), pumpkinseed (*Lepomis gibbosus*), river herring (*Alosa sp*), and one white perch (*Morone americana*). It was noted that trout were most abundant in the section above the last dam and that three trout (all in the same age class) had spinal deformities. DFW states that the survey "confirmed continued good reproduction of wild brook trout in Red Brook" (Hurley 2003).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source G = ground	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Atlantic Country Club, Plymouth		9P442423903		Well #1 Well #2	Permitted = 0.13	0.11	0.06	0.12
Buzzards Bay Water District, Bourne	4036001	9P42403601	42403606	4036001-01G 4036001-02G 4036001-03G 4036001-04G	Registered = 0.37 Permitted = 0.11(1999 & 2000) Permitted = 0.14 (2001)	0.52	0.47	0.48
Plymouth Water Company, Plymouth	4239045	9P442423905		4239045-01G 4239045-02G	Permitted = 0.16 (1999 & 2000) Permitted = 0.22 (2001)	0.14	0.14	0.23
Onset Fire District, Wareham**	4310003	9P42431001	42431031	4310003-01G 4310003-02G	Registered = 0.49 Permitted = 0.60 (1999 & 2000) Permitted = 0.62 (2001)	0.6	0.57	0.57

*Excludes any authorized cranberry growers.

**Onset Fire District has four withdrawal points in the Buzzards Bay Watershed – two in Segment MA95-01 and two in Segment MA95-02. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all four sources combined.

There are 515.01 acres of cranberry bog open space in the Buttermilk Bay subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 4.60 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated discharges to this subwatershed, however, Bourne and Wareham are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass beds in Clarks Cove were mapped by MA DEP from field verified 1994 aerial photography along the northern shore and in Millers Cove and Queen Sewell Cove (Costello 2003). MA DEP field verified 2002 aerial photography revealed no eelgrass beds.

Because of the loss of eelgrass bed habitat the *Aquatic Life Use* is assessed as impaired for Buttermilk Bay. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include storm water, recreational activities (boating), and highway road runoff.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that area BB44.0 is approved; BB44.8 is conditionally approved; and areas BB44.3, BB44.4, BB44.5, and BB44.7 are prohibited (DFWELE 2000).

Based on the status of the shellfish growing areas in Buttermilk Bay 0.51 mi^2 are assessed as support and 0.16 mi^2 are assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION

According to the Barnstable County Health Department, there were no closures at the Electric Avenue Beach in 2001 (Dowden 2003).

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.51 mi^2. The remaining 0.16 mi^2 are currently not assessed.

Buttermilk Bay (MA95-01) Use Summary Table

Designated Uses		Status	Causes		Sources
			Known	Suspected	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (loss/decline of eelgrass bed habitat)	Other anthropogenic substrate alterations, total nitrogen	Recreational activities (boat traffic), highway/road runoff, urbanized high density area, municipal separate storm sewer systems
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		0.51 mi^2 SUPPORT 0.16 mi^2 IMPAIRED	Fecal coliform bacteria		Municipal separate storm sewer systems
Primary Contact		0.51 mi^2 SUPPORT 0.16 mi^2 NOT ASSESSED			
Secondary Contact		0.51 mi^2 SUPPORT 0.16 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS BUTTERMILK BAY (MA95-01)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a bacteria monitoring plan to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

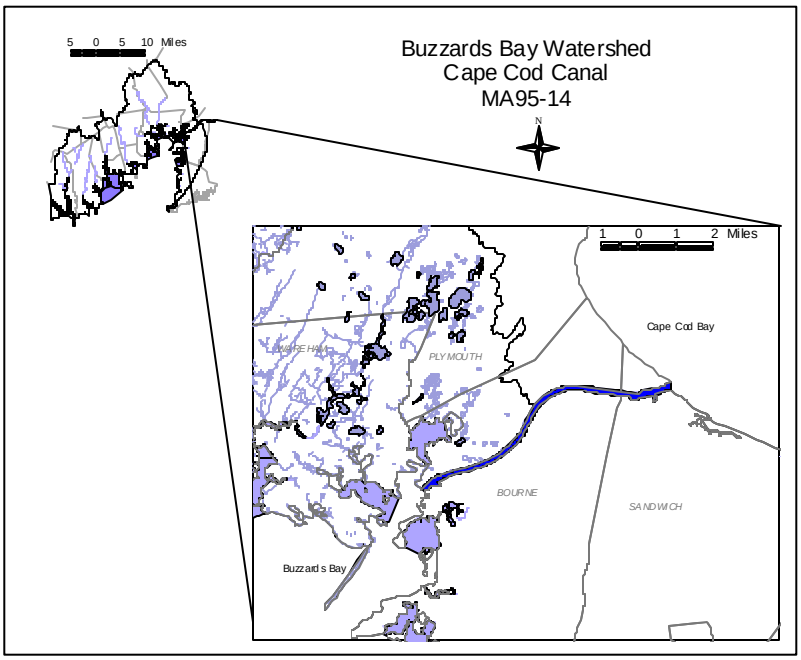
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs to Buttermilk Bay causing shellfish bed closures. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, for improving effectiveness of fish ladders in this segment and increasing habitat. If applicable, review data for use in assessing the *Aquatic Life Use*.

- Implement the two salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are BN03, BN04, BN39, BN40, WH40, and WH41. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

CAPE COD CANAL (SEGMENT MA95-14)

Location: Connection between Buzzards Bay and Cape Cod Bay in Bourne and Sandwich
Segment Area: 1.13 square miles
Classification: Class SB, Shellfishing (Restricted)



The drainage area of this segment is approximately 9.1 square miles. Much of the drainage area consists of a narrow strip of land that includes a vegetated buffer and service road on each side of the waterway.

This segment is on the Massachusetts 1998 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

The Cape Cod Canal is 32 feet deep, 700 feet wide and extends 7.4 miles across the narrow neck that joined Cape Cod to the mainland. Private interests sold the canal to the US in 1921 for $11.5 million. The US Army Corps of Engineers (ACOE) was charged with operation and maintenance. In 1933 the Sagamore, Bourne, and railroad bridges were authorized and constructed. Additional information on the history of the Cape Cod Canal may be obtained in the ACOE (1995) *Massachusetts Water Resources Development - Flood Damage Reduction, Shore & Bank Protection, Navigation Report publication NEDEP-360-1-34.*

Four million visitors annually enjoy the canal and adjacent land for outdoor recreation including saltwater fishing, biking, and hiking (ACOE 31 January 2002). Scusset Beach is located on Cape Cod Bay at the east end of the Cape Cod Canal. It is a popular swimming and camping area. The 98-site camping area is very popular with trailer campers. For salt water anglers the area offers a popular fish pier, a 3000 breakwater and 1.5 miles of frontage along the canal. A picnic area and bicycling along the service roads is also available (MA DEM Undated d). There are two vessel sewage pump-out boats and a shoreside facility at the Bourne Marina located on Academy Drive, Bourne. Additionally, there is a pump-out facility at the Sandwich Marina on Moffitt Avenue, Sandwich. Both pump-out facilities were funded by the Clean Vessel Act and are available free of charge (DMF 29 January 2003). ACOE planned to dredge the Cape Cod Canal and the West Mooring Basin in early fall 2002 removing approximately 300,000 yds^3 from shoal areas and placing it in the Cape Cod Canal Disposal Site or the Cleveland Ledge Disposal Site. Additionally two large boulders, one opposite Massachusetts Military Academy and one opposite Cleveland Ledge Light will be removed (ACOE 31 January 2002).

The National Marine Life Center in Bourne with support from EOEA's Wetlands Restoration Program has asked the ACOE to undertake a saltmarsh restoration project to re-establish tidal interaction to a degraded saltmarsh. The project seeks to modify an aging and undersized culvert to Cape Cod Canal. The Marine Life Center hopes that by restoring the saltmarsh and developing an open-water pond they will be able to rehabilitate recovering sea mammals (ACOE 31 January 2002).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Mirant Canal, LLC			42226109	Freezer Rd Well #1 Freezer Rd Well #2	0.45	0.47	0.45	0.5

NPDES SURFACE DISCHARGE SUMMARY

Mirant Canal, L.L.C. (formerly the Canal Electric Company) in Sandwich is permitted (MA0004928 issued 23 June 1989) to discharge the following stated maximum daily volumes via five outfalls to Cape Cod Canal.

Outfall 001: 518 MGD of condenser cooling water. Chlorine may be used as a biocide yet the Total Residual Chlorine allowed in the discharge is limited to a maximum concentration of 0.1 mg/l for no more than 2 hours per day. The temperature of the discharge is not to exceed 86^{o} F in the upper water column.

Outfall 002: 4.4 MGD of intake screen sluice and flume flushing water. Water temperature at the mouth of the former discharge flume of Unit No. 1 is to be maintained at or below 90^{o} F.

Outfall 010: 0.144 MGD of floor and equipment drains. Oil and grease discharged from this outfall may not exceed a maximum daily concentration of 15 mg/l.

Outfall 011: 0.4 MGD of waste system blowdown from the four waste ponds. The effluent may not exceed maximum daily concentrations of Total Copper (1.0 mg/l), Total Iron (1.0 mg/l),

Outfall 012: 0.12 MG (not to exceed 600 gpm) of demineralizer and condensate polisher waste. Maximum daily concentrations are stated for total suspended solids (100.0 mg/l) and oil and grease (15 mg/l).

A storm water runoff report was to be submitted. It requires regular monitoring at each storm water outfall within an hour after the start of a storm. No biological monitoring was required, however, the permittee should be providing notification of any incidence of fish mortality associated with the thermal plume or "unusual numbers of fish" impinged on the intake screens.

Massachusetts Maritime Academy (MA0024368) is permitted (20 April 2001) to discharge 0.14 MGD treated sanitary wastewater and untreated boiler water blow-down via outfall 001 and 10,000 GPD treated swimming pool discharge water via outfall 002 to the Cape Cod Canal. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent.

Bourne and Sandwich are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Toxicity

Effluent

Massachusetts Maritime Academy (MA0024368) conducted three whole effluent toxicity tests using the test organisms *M. bahia* and *M. beryllina* between June 2001 and June 2002. Acute toxicity was not detected (LC_{50}'s > 100% effluent).

Ambient

Between June 2001 and June 2002 Massachusetts Maritime Academy collected water from the Cape Cod Canal for use as dilution water in their whole effluent toxicity tests. Survival of *M. bahia* and *M. berylinna* (exposed 48-hours) was good (88-100%).

Too limited data are available, therefore, the *Aquatic Life Use* is not assessed.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB45.2 and BB45.3 are approved, and BB45.1, BB45.5, and BB45.4 (was restricted but recently changed) are prohibited (DFWELE 2000 and Whittaker 2003).

Based on the DMF shellfish status the *Shellfish Harvesting Use* is assessed as support for 0.49 mi^2 and impaired for 0.33 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

While swimming in the canal is not allowed there is a saltwater beach in Bourne Scenic Park Campground. According to the Barnstable County Department of Health records there was one elevated reading on July 11, 2001 the day after a rain event. The beach was resampled on July 12, 2001 and met water quality standards required under the Beach Bill (Dowden 2003).

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.49 mi^2. The remaining 0.33 mi^2 are currently not assessed.

Cape Cod Canal (MA95-14) Use Summary Table

Designated Uses		Status	Causes	Sources
			Known	Known
Aquatic Life		NOT ASSESSED		
Fish Consumption		NOT ASSESSED		
Shellfish Harvesting*		0.67 mi^2 SUPPORT 0.46 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown
Primary Contact		0.67 mi^2 SUPPORT 0.46 mi^2 NOT ASSESSED		
Secondary Contact		0.67 mi^2 SUPPORT 0.46 mi^2 NOT ASSESSED		
Aesthetics		NOT ASSESSED		

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS CAPE COD CANAL (MA95-14)

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce contaminants causing the closures of the shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Mirant Canal, L.L.C. discharges once through cooling water to Cape Cod Canal. Aquatic resources (fish, shellfish, etc.) within receiving waters may be susceptible to the impacts of the discharge. Additional monitoring should be implemented and results provided to the regulatory agencies to identify possible impacts. Mirant Canal LLC's NPDES discharge permit (MA0004928, issued 23 June 1989, expired 23 June 1994) should be reviewed and reissued with appropriate discharge limits and monitoring requirements.

  In general, MA DEP recommends that all power plant operators in the Commonwealth collect the following types of information:
  1. flow (cooling water use schematic, permit limits and location of intake(s) and discharge(s)):
  2. intake design (should include velocity across screens, mesh size, information as to the ability to rotate screens, mechanisms for removing impinged fish, fish return systems);
  3. discharge (thermal limit, discharge structure design);
  4. monitoring program (Discharge Monitoring Reports type and report frequency);
  5. biological monitoring (description of any biological monitoring programs required by permit);
  6. fish kill (description of any specific fish kill provisions included in permit);
  7. hydrological monitoring; and
  8. storm water management plan.

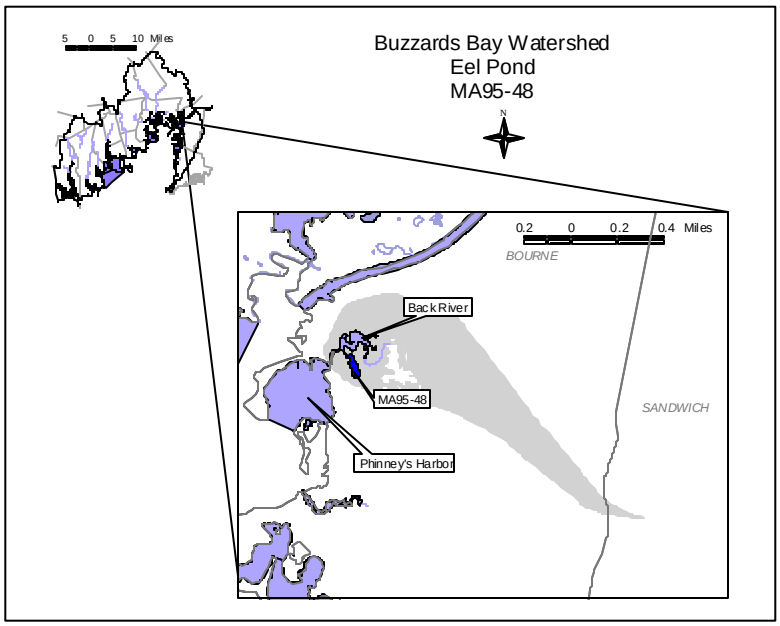
THE PHINNEYS HARBOR DRAINAGE AREA

The Phinneys Harbor Drainage Area in Bourne consists of the following three segments.

- Eel Pond (MA95-48)
- Back River (MA95-47)
- Phinneys Harbor (MA95-15)

EEL POND (SEGMENT MA95-48)

Location: Salt water pond that discharges to Back River, Bourne
Segment Area: 0.03 square miles
Classification: Class SA



A recharge area and, therefore, land use estimates, are not available for this segment.

Eel Pond is a salt water embayment that flows into Back River prior to discharging into Phinneys Harbor. It is shallow enough for some of the area to drain completely at low tide, leaving tidal flats (MA EOEA, 2003).

The Bourne Back River, including Eel Pond, was designated an Area of Critical Environmental Concern (ACEC) in 1989.

The Town has done storm water remediation work along Eel Pond (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in the Eel Pond between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al.* 1999). Chlorophyll *a* concentrations, phytoplankton blooms, and poor water transparency resulted in a Health Index Scores for Eel Pond (the average 1997-2001 score of 62.1 (fair) (CBB Undated b and Howes *et al.* 1999).

WMA WATER WITHDRAWAL (APPENDIX F) AND NPDES SURFACE DISCHARGE SUMMARY

There are no known regulated water withdrawals or discharges within this subwatershed. The Town of Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB47.2 is conditionally approved (DFWELE 2000).

Based on the DMF shellfish status the *Shellfish Harvesting Use* is assessed as impaired for this entire segment.

Eel Pond (MA95-48) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems, on-site treatment systems (septic systems)
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS EEL POND (MA95-48)

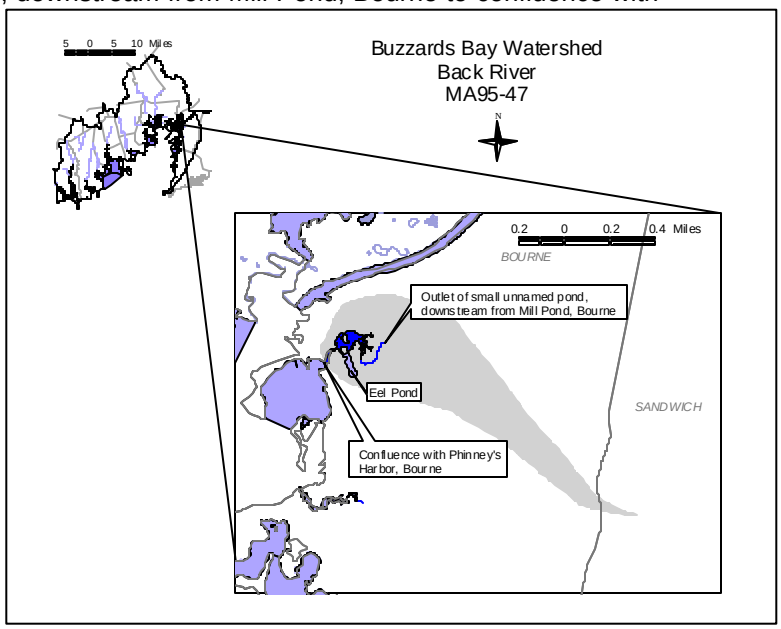
- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Develop and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, the Phase II community storm water management programs, and on-site septic system improvements and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce contaminant loadings that may result in the closure of the shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

BACK RIVER (SEGMENT MA95-47)

Location: Outlet of small unnamed pond, downstream from Mill Pond, Bourne to confluence with Phinneys Harbor, Bourne (excluding Eel Pond)
Segment Area: 0.08 square miles
Classification: Class SA



Back River is shallow and some of its area drains completely at low tide, leaving tidal flats. The recharge area of this segment is approximately 3.7 square miles. Land-use estimates (top three, excluding water), including land use of Segment MA95-48, for the recharge area (map inset, gray shaded area):

Forest	55%
Open land	17%
Residential	17%

The Bourne Back River was designated an Area of Critical Environmental Concern (ACEC) in 1989 and includes the Back River, Phinneys Harbor, Eel Pond, Clay Pond and Mill Pond. The Back River Estuary was designated an Estuary of National Significance by the US EPA in 1988 and is part of the Ocean Sanctuaries of Massachusetts. Most of the marshes, tidal flats, and freshwater wetlands within this area are undeveloped and serve as habitat to a large array of shellfish, finfish, amphibians, reptiles, birds, and mammals. The area contains at least three known state-listed rare and endangered species, including osprey, spotted turtle, and diamondback terrapin (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Back River between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Oxygen levels in Back River dropped below 60% saturation, however, due to the extensive wetland/saltmarsh in this watershed it is difficult to determine if these conditions are associated with anthropogenic sources or are natural conditions (Howes *et al.* 1999). The Back River 1997-2001 average Health Index Score was 66.8 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL

There are no known regulated water withdrawals within this subwatershed.

NPDES SURFACE DISCHARGE SUMMARY

The Lobster Trap Company is permitted (MA0029092, issued August 2, 1993) to discharge 7456 GPD treated wastewater from one outfall into the Back River. The permit includes the following secondary discharge limits: Total Suspended Solids =30 mg/l, BOD = 30 mg/l and, fecal coliform concentrations not exceeding the water quality standards for SA waters (geometric mean of 14 colonies per 100 mL nor shall more than 10% of the samples exceed a MPN of 43/100 mL).

Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB47.1, BB47.2, and BB47.20 are conditionally approved and BB47.3 is prohibited (DFWELE 2000).

Based on the DMF shellfish status the *Shellfish Harvesting Use* is assessed as impaired for this entire segment.

Back River (MA95-47) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems, on-site treatment systems (septic systems)
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS BACK RIVER (MA95-47)

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, to increase habitat. If applicable, review data for use in assessing the *Aquatic Life Use*.

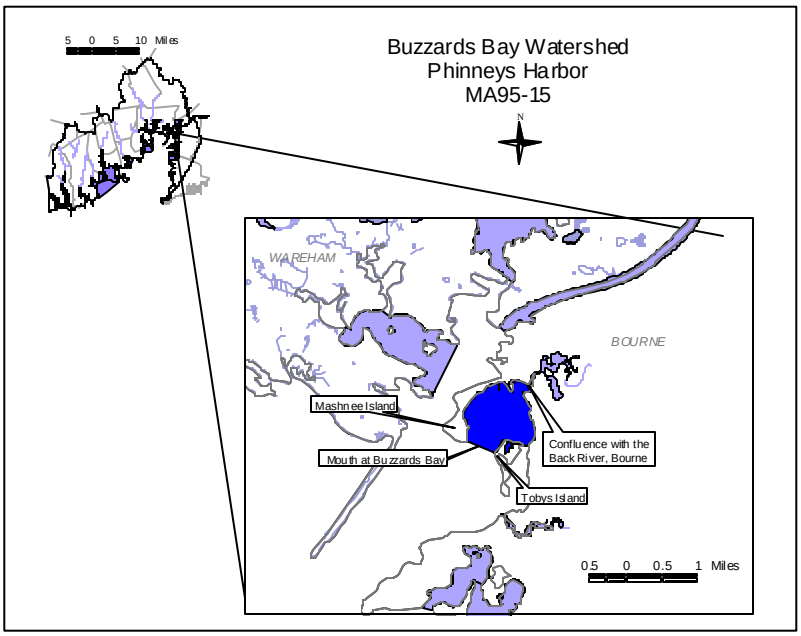
- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Develop and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce inputs of pathogens and possibly reopen shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

PHINNEYS HARBOR (SEGMENT MA95-15)

Location: From the confluence with the Back River, to its mouth at Buzzards Bay between Mashnee and Tobys Islands, Bourne
Segment Area: 0.73 square miles
Classification: Class SA



A recharge area and, therefore, land use estimates are not available for this segment.

This segment is on the Massachusetts 1998 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

Phinneys Harbor is semi-enclosed due to the construction of a long dike out to Hog and Mashnee Islands, but was completely open to the bay at the beginning of the last century. The harbor has a mean depth of 2 meters with shallow marginal areas and a depth of 5 meters in the central portion of the harbor. Although eelgrass is present in the system there are reports of some die-offs (Howes *et al.* 1999). The Bourne Back River, including Phinneys Harbor, was designated an Area of Critical Environmental Concern (ACEC) in 1989. The Back River Estuary also was designated an Estuary of National Significance by the US EPA in 1988. Most of the marshes, tidal flats, and freshwater wetlands within this area are undeveloped and serve as habitat to a large array of shellfish, finfish, amphibians, reptiles, birds, and mammals. The area contains at least three known state-listed rare and endangered species, including osprey, spotted turtle, and diamondback terrapin (MA EOEA 2003).

The Gray Gables Salt Marsh has a severe tidal restriction prioritized in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts.* Five other sites in this subwatershed have been evaluated and prioritized by the Town. The Massachusetts Wetlands Restoration Program has accepted this as a restoration project with the goal of helping to prevent the shoaling that is presently occurring at the culvert's inlet. The project sponsor, Town of Bourne, may begin the planning stage by the end of 2002 or after Wings Neck wetland restoration project is completed (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Phinneys Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at five stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* (Howes *et al.* 1999). The Phinneys Harbor 1997-2001 average Health Index Score was 73.0 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY AND NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or NPDES discharges in this segment. Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Phinneys Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Phinneys Harbor were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography determined that the eelgrass beds identified in 1994 near Tobys Island had declined.

Although the *Aquatic Life Use* is not assessed, it is identified with an Alert Status due to the decline of eelgrass beds. Eelgrass dies off from reduced water clarity that may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources including substandard septic systems, recreational uses, or other anthropogenic activities.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB46.0 is approved and BB46.1 and BB47.20 are conditionally approved (DFWELE 2000).

Based on the DMF shellfish status the *Shellfish Harvesting Use* is assessed as support for 0.58 mi^2 and impaired for 0.15 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

The village of Monument Beach has a public bathing beach. According to the Barnstable County Health Department there were no closures at Monument Beach in 2001 or 2002 (Barnstable County Department of Health 2003, Dowden 2003).

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary* Contact *Recreational Uses* are assessed as support for 0.58 mi^2. The remaining 0.15 mi^2 are currently not assessed.

Phinneys Harbor (MA95-15) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		0.58 mi^2 SUPPORT 0.15 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	On-site treatment systems (septic systems), highway/ road runoff
Primary Contact		0.58 mi^2 SUPPORT 0.15 mi^2 NOT ASSESSED			
Secondary Contact		0.58 mi^2 SUPPORT 0.15 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

*Alert Status issues identified-- see details in use assessment section.

**For watershed-wide shellfish growing area data see Appendix E

RECOMMENDATIONS PHINNEYS HARBOR (MA95-15)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Develop and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollutant loadings to shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

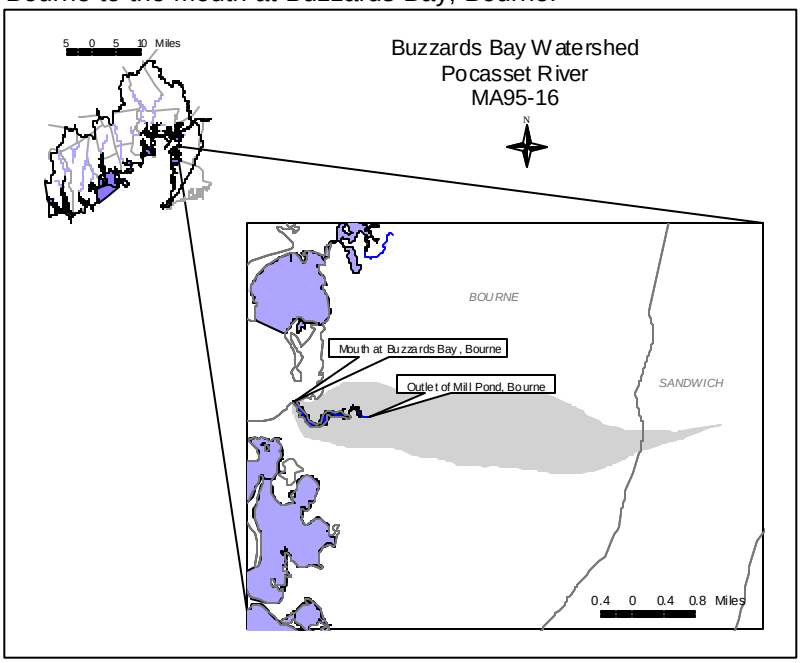
- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Implement the six salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are BN9, BN10, BN29, BN30, BN11, and BN6. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Implement the recommendations from the Cape Cod Watershed Team Watershed Action Plan (EOEA 2003) including:
  - conduct Gray Gables Salt Marsh Restoration Project to restore eight acres, and
  - examine water quality impacts due to birds at Mashnee Island.

POCASSET RIVER (SEGMENT MA95-16)

Location: From the outlet of Mill Pond, Bourne to the mouth at Buzzards Bay, Bourne.
Segment Area: 0.05 square miles
Classification: Class SA, Shellfishing (Open), ORW



The recharge area of this segment is approximately 3.3 square miles. Just over half of the land area is in the Mass. Military Reservation. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	65%
Residential	18%
Open Land	8%

This segment is on the Massachusetts 1998 303(d) List of Waters, in the Cape Cod Watershed, as not meeting the water quality standards for pathogens (MA DEP 1999).

The Pocasset River, from the Shore Road Bridge to its headwaters, was designated an Area of Critical Environmental Concern (ACEC) in 1980. The relatively small river and estuarine system contains diverse resources ranging from the saltmarsh, tidal lands, and floodplains of the estuary to the connecting freshwater wetlands, ponds, and streams. The estuary supports the town's most productive oyster crop. A comprehensive ecological inventory of the lower portions of this system has been made (MA EOEA 2003). There is one public landing in the Pocasset River and approximately 190 moorings and slips. A public beach is located in Tahanto (MA EOEA 2003).

Two of the public water supply wells located in this subwatershed have been contaminated from a plume emanating from the central impact area of the MMR. In June 2001 the military funded a pipeline linking the Bourne Water District water main to the Upper Cape Water Supply Cooperative supply to make up for the projected drinking water shortfalls (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in the Pocassett River between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Oxygen levels in Pocasset River dropped below 60% saturation. However, due to the extensive wetland/saltmarsh in this watershed it is difficult to determine if these conditions are associated with anthropogenic sources or are natural conditions (Howes *et al.* 1999). The Pocasset River 1997-2001 average Health Index Score was 67.7 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)*

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Bourne Water District**	4036000	9P42203601	42203602	036-01G 036-03G 036-04G 036-06G***	Registered =0.73 Permitted =0.64 (1999 & 2000) Permitted =0.67 (2001)	0.884	0.815	0.913

*Excludes registered cranberry growers

**Bourne Water District has nine withdrawal points in the Buzzards Bay Watershed – four in Segment MA95-16 and five in Segment MA95-18. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all sources combined.

*** Well No. 6 (06G) requires monitoring of wetland as part of permit

NPDES SURFACE DISCHARGE SUMMARY

Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB48.0 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* for this segment is assessed as impaired for 0.04 mi^2.

Pocasset River (MA95-16) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	On-site treatment systems, road runoff, municipal separate storm sewer systems
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS POCASSET RIVER (MA95-16)

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, and if necessary work to improve the effectiveness of fish ladders at Mill Pond, the headwaters of this segment. If applicable, review data to assess the *Aquatic Life Use.*

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system upgrades, and the Phase II community storm water management programs and to assess the recreational uses.

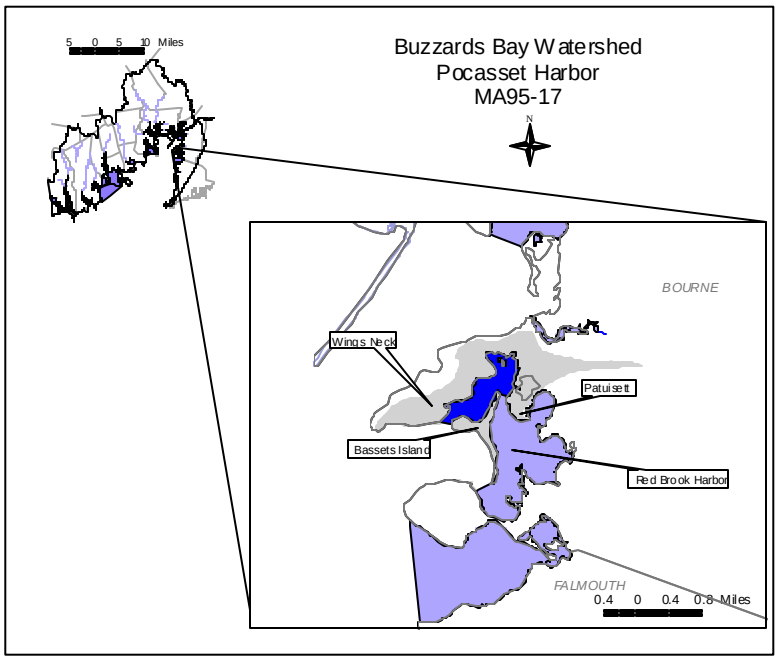
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollutant loadings to shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Implement the four salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites in this subwatershed are BN28, BN33, BN14 and BN26. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Implement the recommendations of the Cape Cod Watershed Team Watershed Action Plan (MA EOEA 2003) including:
  - determine the cause of the observed low oxygen conditions in Pocasset River,
  - maximize tidal exchanges between Pocasset River and Buzzards Bay through management to help maintain the water quality of the river system,
  - examine storm water discharge from Shore Road into Pocasset River. Develop BMP, and
  - examine remnant clay pipe south of Railroad Bridge.

POCASSET HARBOR (SEGMENT MA95-17)

Location: From the confluence with Red Brook Harbor near the northern portion of Bassetts Island and Patuisett to the mouth at Buzzards Bay between Bassetts Island and Wings Neck, Bourne
Segment Area: 0.33 square miles
Classification: Class SA



The recharge area of this segment is approximately 1.2 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Residential	41%
Forest	35%
Open Land	12%

This segment is on the 1998 Massachusetts 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

Pocasset Harbor has shallow margins but maintains a two meter channel with depths of seven meters in the channel between Bassetts Island and Wings Neck. Most of the eelgrass is located in the shallower inner Harbor region and bordering the main deep channel to the mouth. The beds are moderate in coverage. Pocasset Harbor has been designated as nitrogen sensitive by the Cape Cod Commission, ranking 14 out of 52 embayments. The new Cape Cod jail will be located on the Massachusetts Military Reservation in this subwatershed. Construction will begin in 2002 and last 18 months. The facility will have a wastewater hookup to the Otis sewage treatment plant (MA EOEA 2003).

There is one public beach and boat landing and pier at Barlow's Landing. There are a total of about 1,245 moorings and slips and three public boat landings in the Pocasset Harbor system including Red Brook Harbor (see segment MA95-18) (MA EOEA 2003).

Two significant salt marsh restoration projects were recently completed or are underway, one in Barlows Landing, the other in Wings Neck. At Barlows Landing, the Town of Bourne, the Massachusetts Wetlands Restoration Program, and the US Fish and Wildlife Service partnered to restore 13 acres of salt marsh by replacing a 48" culvert with an 8' box culvert to restore tidal flow and alleviate ponding of water that caused marsh deterioration. Work was completed in 1998. By 2002 the funding for the Wings Neck Salt Marsh Restoration Project was in place from the same partners as well as private organizations and corporate donors. Tidal flow will be enhanced by replacing a 24" culvert with two 3'x4' culverts, restoring 8 acres of salt marsh (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at three stations in Pocasset Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at six stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Significant improvement in water quality has occurred within the inner areas of Pocasset Harbor near Barlows Landing due to the implementation of storm water management practices (Howes *et al.* 1999). The average 1997-2001 Health Index Score for inner Pocasset Harbor was 68.6 and for outer Pocasset Harbor was 84.3 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Pocasset Golf Club**			42203601	Well #1 (G)	0.09	0.12	0.06	0.12

* Excludes registered cranberry growers
**Indicates average withdrawal over less than 365 days

There are 3.635 acres of cranberry bog open space in the Pocasset Harbor water recharge area (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.03 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no NPDES wastewater discharges to this subwatershed, however, Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Pocasset Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Pocasset Harbor were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 1999 aerial photography determined that eelgrass beds identified in 1951 had declined near Barlows Landing and Bassets Island. Between 1994 and 2002 the bed near Barlows landing had disappeared and additional decline had occurred near Bassets Island.

Because of the loss of eelgrass bed habitat near Barlows Landing and the decline of the remaining beds, the *Aquatic Life Use* is assessed as impaired for Pocasset Harbor. This loss may be attributed to recreational activities (i.e., boat traffic from landing and pier) and other anthropogenic activities that result in reduced water clarity and/or nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources including substandard septic systems and storm water runoff.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB49.0 is approved and BB49.20 and BB49.3 are conditionally approved (DFWELE 2000).

Based on the DMF shellfish growing area status the Shellfish Harvesting *Use* is assessed as support for 0.20 mi^2 and impaired for 0.13 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

According to the Barnstable County Health Department, there were no closures at Barlows Landing public beach in 2001 or 2002. (Barnstable County Department of Health 2003, Dowden 2003)

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.20 mi^2. The remaining 0.13 mi^2 are currently not assessed.

Pocasset Harbor (MA95-17) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (loss/decline of eelgrass bed habitat)	Other anthropogenic substrate alterations (resuspension of sediment), total nitrogen		Recreational activities (boat traffic), highway/ road runoff
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting		0.20 mi^2 SUPPORT 0.13 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), highway/ road runoff, municipal separate storm sewer systems
Primary Contact		0.20 mi^2 SUPPORT 0.13 NOT ASSESSED				
Secondary Contact		0.20 mi^2 SUPPORT 0.13 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS POCASSET HARBOR (MA95-17)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring so that the status of the *Aquatic Life Use* can be assessed.

- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system improvements and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs to Pocasset Harbor and possibly reopen shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

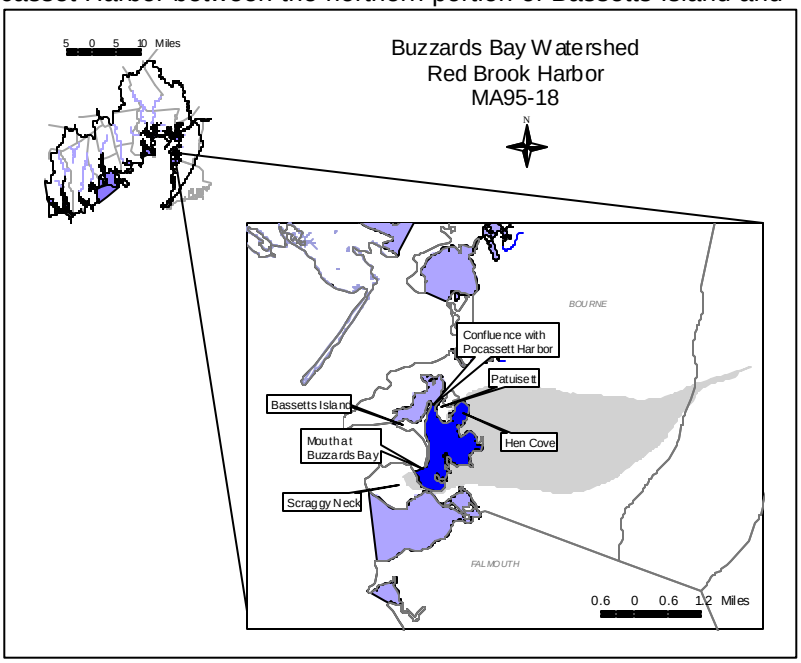
- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Towns, marinas, and harbormasters should encourage boat owners to make use of the pump-out facilities located in Red Brook Harbor to reduce bacterial inputs to Pocasset Harbor (Howes *et al.* 1999).

- Implement the recommendations from the EOEA Cape Cod Watershed Team Watershed Action Plan (MA EOEA 2003) including:
  - identify source of pollution into Wings Neck Creek and Barlows Landing.

RED BROOK HARBOR (SEGMENT MA95-18)

Location: From the confluence with Pocasset Harbor between the northern portion of Bassetts Island and Patuisett to its mouth at Buzzards Bay between Bassetts Island and Scraggy Neck, Bourne (including Hen Cove)
Segment Area: 0.91 square miles
Classification: Class SA



The recharge area of this segment is approximately 1.6 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	64%
Residential	15%
Open Land	12%

This segment is on the Massachusetts 1998 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

According to The Coalition of Buzzards Bay *Baywatchers II* report, Red Brook Harbor is one of the least developed watersheds in Buzzards Bay. The harbor itself has 14 acres of fringing salt marsh and has lost its eelgrass beds in recent years. Hen Cove has over 100 moorings and slips, a well used public beach, private beaches and a boat launch. There is a public beach in Hospital Cove (Merriam Beach). The harbor is heavily used for recreation with numerous slips and moorings and two marinas which both have pump-out facilities. The Red Brook Harbor subwatershed contains 92 acres of cranberry bogs (Howes *et al.* 1999). The new Cape Cod jail will be located on the Massachusetts Military Reservation in this subwatershed. Construction will begin in 2002 and last 18 months. The facility will have a wastewater hookup to the Otis sewage treatment plant (MA EOEA 2003).

The Cape Cod Commission included Red Brook Harbor in the Pocasset Harbor designation as nitrogen sensitive, ranked 14 out of 52 embayments. The Acid Rain Monitoring Project by the University of Massachusetts-Amherst (2001) studied Red Brook Pond. Samples are taken three times a year, in April, July, and October. The Acid Neutralizing Capacity of the pond was found to be in the “highly sensitive” range, meaning that the aquatic environment is highly sensitive to acid deposition (MA EOEA 2003).

A plume emanating from a former landfill (LF-1) on the MMR has contaminated 2 public water supply wells located in this drainage area and the northern of two lobes has reached the coast at Red Brook Harbor. The contaminants of concern include tetrachloroethene or perchloroethene (PCE), trichloroethene (TCE), and carbon tetrachloride. The public water supply wells were closed after traces of the chemical perchlorate, used in explosives, were found in both of them. The landfill has been capped and remediation efforts managed by the AFCEE have been underway since 1999 (AFCEE 2001). In June 2001 the military funded a pipeline linking the Bourne Water District water main to the Upper Cape Water Supply Cooperative supply to make up for the projected drinking water shortfalls (MA EOEA 2003). The AFCEE will continue monitoring at Red Brook and Squeteague Harbors.

Groundwater samples were collected along and beneath Red Brook Harbor by the U.S. Geological Survey in the summer of 2000 to investigate where freshwater discharges into the harbor and what concentrations of VOCs are present. TCE and PCE were detected from 68 to 176 feet below mean sea level at the Red Brook Harbor shoreline. The highest concentration (15 ppb of TCE) was detected at 176 feet below sea level. PCE was detected at less than 1 ppb. (The Federal and state maximum contaminant levels for drinking water is 5 ppb for both TCE and PCE.) TCE was also detected in several freshwater

locations (6 of 19 locations) beneath Red Brook Harbor, under the soft bottom sediments. Concentrations ranged from non-detect to 4.5 ppb at 500 feet from shore. The USGS concluded that even with TCE and PCE present in the groundwater just before it discharges to Red Brook Harbor it is unlikely that these compounds would be detected in the seawater due to dilution and tidal flushing. MDPH sampled shellfish from Red Brook Harbor in 1997. No VOCs were detected. In 2001 MDPH evaluated the risk associated with shellfish consumption based on the results of the 2000 USGS groundwater survey. They concluded that TCE bioconcentration in shellfish is unlikely to result in exposure levels that would present unusual health concerns (AFCEE 2001, MDPH 2002d).

The Red Brook Harbor/Pocasset Harbor/Hen Cove system was selected as a priority area for Year 2 of the Massachusetts Estuaries Project. The estuarine system will be evaluated in 2003.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Red Brook Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at four stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Occasional dissolved oxygen depletions indicate that this estuary is susceptible to hypoxia associated with warm temperatures, overcast and calm weather (Howes *et al.* 1999). The 1997-2001 Average Health Index Score for the inner Red Brook Harbor was 64.9 and the Outer Red Brook Harbor was 72.4 (both good/excellent) (CBB Undated b).

Two stations in Hen Cove (part of this segment) also are monitored by the Coalition for Buzzards Bay between May and September from 1992 to the present. A flushing study was conducted in Hen Cove in 1997. Fecal coliform bacteria contamination of the cove from the surface water inflow of a small fresh water pond is of concern. The Coalition states that eelgrass beds were present in the cove in 1985 but disappeared by 1996 (Howes *et al.* 1999). Residential development and on-site septic systems are cited as principle sources of nitrogen to Hen Cove. The 1997-2001 average Health Index Score for Hen Cove was 64.8 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Bourne Water District	4036000	9P42203601	42203602	036-02G 036-05G	Registered= 0.73** Permitted= 0.64 (1999 &2000) Permitted= 0.67** (2001)	0.316	0.281	0.349

*Excludes registered cranberry growers
**Bourne Water District has nine withdrawal points in the Buz zards Bay Watershed – four in Segment MA95-16 and five in Segment MA95-18. The Authorized Withdrawal and Average Withdrawal volumes indicated are system wide for all sources combined.

There are 91.116 acres of cranberry bog open space in the Red Brook Harbor water recharge area (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.81 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated NPDES wastewater discharges to this segment, however, Bourne is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of one small eelgrass bed in Red Brook Harbor along the western side of the harbor near Bassetts Island from historic 1951 black and white aerial photography (Costello 2003). Field surveys performed by MA DEP in 1998 and 2002 revealed no eelgrass in the entire harbor and the presence of macroalgae.

Although too limited data are currently available to assess the status of the *Aquatic Life Use*, this use is identified with an Alert Status because the USGS study (McCobb 2001) indicated that the northern lobe of the MMR landfill plume has entered the harbor. DMF has identified that flow manipulation associated with cranberry bog operations results in the loss of juvenile anadromous fish (Brady 2003). The loss of the eelgrass bed may also indicate a possible decline in water quality.

SHELLFISH HARVESTING

In September 1997 MDPH and DMF collected oysters, quahogs, soft-shell clams, and ribbed mussels from Red Brook Harbor. None of these samples had detections of VOCs associated with the Landfill #1 (LF-1) groundwater plume. MDPH planned to resample shellfish in the summer of 2001 at two sites at Red Brook Harbor and one in Squeteague Harbor in response to public concerns related to LF-1 plume contamination upwelling into the harbor in areas of shellfish beds (MDPH 2001b). They concluded that TCE bioconcentration in shellfish is unlikely to result in exposure levels that would present unusual health concerns (AFCEE 2001).

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB49.0 is approved, BB49.1is conditionally approved, and BB49.5 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as support for 0.80 mi^2 and impaired for 0.11 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

It should be noted that Patiusset Public Beach was closed infrequently during the 2001 and 2002 swimming season (8/1-2/2001, 8/22-24/2001, 6/7-10/2002 and 8/2-3/2002) based on elevated *Enterococccci* bacteria levels (MDPH 2002d, Dowden 2003). However, this swimming area and the Mirriam Beach (no reported closures) are both located within the DMF's approved shellfishing area.

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.80 mi^2. The remaining 0.11 mi^2 are currently not assessed.

Red Brook Harbor (MA95-18) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		0.80 mi^2 SUPPORT 0.11 mi^2 IMPAIRED	Fecal coliform bacteria	Unknown	On-site treatment systems (septic systems), highway/ road runoff, municipal separate storm sewer systems
Primary Contact		0.80 mi^2 SUPPORT 0.11 mi^2 NOT ASSESSED			
Secondary Contact		0.80 mi^2 SUPPORT 0.11 mi^2 NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status issue identified-- see details in use assessment section.

** For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS RED BROOK HARBOR (MA95-18)

- DMF and the Cape Cod Cranberry Growers (CCCG) developed BMPs for the protection of juvenile anadromous fish (Brady 2003). DMF and CCCG should continue to work together to educate growers and develop operating practices that maintain baseflows for the protection of the aquatic life.
- Review and implement recommendations in the DMF anadromous fish assessment report, when available, and if necessary improve the effectiveness of fish ladders in Red Brook Pond to increase habitat. If applicable, review data when assessing the *Aquatic Life Use*.
- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.
- Design and conduct a survey to monitor bacteria levels in Red Brook Harbor to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system upgrades, and the Phase II community storm water management programs and to assess the recreational uses.
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollutant loadings to Red Brook Harbor. Continue to review DMF shellfish status reports to assess the *Aquatic Life Use*.
- Monitor the progress of the MMR landfill plume (LF-1) remediation and the USGS investigation of its effect on Red Brook Harbor. Review reports and data when assessing the *Aquatic Life Use*.
- Encourage boat owners to make use of the pump-out facilities in Red Brook Harbor.
- Implement the salt marsh restoration projects identified in the 2002 *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* that have been evaluated and prioritized by the Town. Sites include BN13, BN17, BN24, BN27, and BN21. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.
- Implement the recommendations from the EOEA Cape Cod Watershed Team Watershed Action Plan (MA EOEA 2003) including:
  - implement BMP on storm drain off of Route 28 draining into Red Brook,
  - examine road runoff and flow from small pond at Island Drive for impacts to Hen Cove, and
  - conduct Hen Cove Salt Marsh Restoration Project.

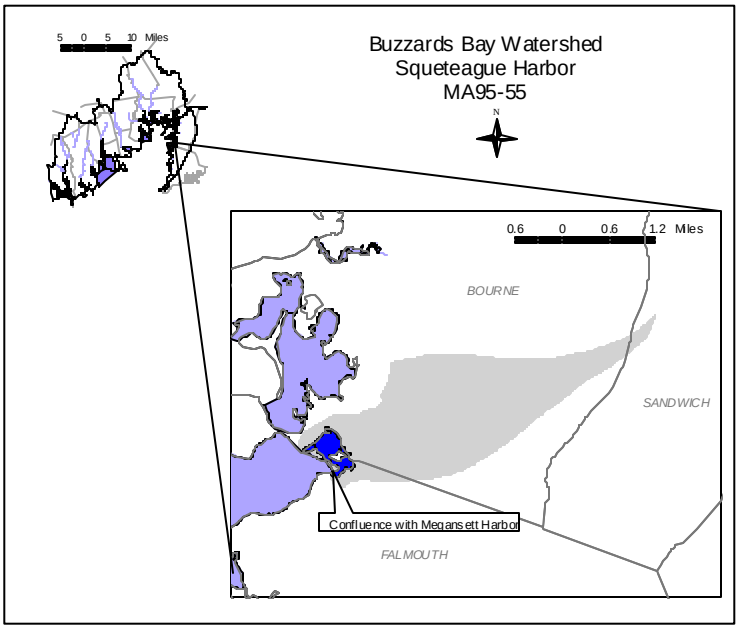
THE MEGANSETT HARBOR DRAINAGE AREA

The Megansett Harbor Drainage Basin is located along the border of Bourne and Falmouth and consists of two segments, the inner and outer harbor, identified as:

- Squeteague Harbor (MA95-55), and
- Megansett Harbor (MA95-19).

SQUETEAGUE HARBOR (SEGMENT MA95-55)

Location: Bourne/Falmouth to confluence with Megansett Harbor
Segment Area: 0.15 square miles
Classification: Class SA



The recharge area of this segment is approximately 3.8 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	63%
Residential	15%
Open Land	13%

The northern portion of the Squeteague Harbor drainage area falls within the Massachusetts Military Reservation. Past oil, fuel, chemical, and hazardous waste disposal activities have created a ground water pollution plume in this subwatershed. The southern lobe of LF-1 will likely be a consideration in future years. The Air Force Center For Environmental Excellence is investigating and addressing this groundwater pollution (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Squeteague Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Eelgrass beds in Squeteague Harbor have diminished. Squeteague Harbor is showing water quality degradation related to nutrient impacts (elevated total nitrogen, chlorophyll *a* concentrations and periodic oxygen depletion). The tidal flushing of Squeteague Harbor is reduced due to the deposition of a barrier spit from erosion and long-shore transport and sedimentation of the inlet. Sources of nitrogen identified by the Coalition include on-site septic systems, storm water, and groundwater from MMR (Howes *et al.* 1999). Squeteague Harbor received an average 1997-2001 Health Index Score of 57.3 (fair) (CBB Undated b and Howes *et al.* 1999).

WMA WATER WITHDRAWAL AND NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or wastewater discharges in this subwatershed. It should be noted, however, that Bourne and Falmouth are Phase II communities and have submitted their notices of intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of one eelgrass bed in Squeteague Harbor northwest of Amrita Island from historic 1951 black and white aerial photography (Costello 2003). A field survey performed by MA DEP in 1998 revealed the presence of macroalgae and no eelgrass in the entire harbor.

Although eelgrass bed habitat data are available there is low confidence in the 1951 data (Costello 2003), therefore, the *Aquatic Life Use* is currently not assessed. This use is identified, however, with an Alert Status as macroalgae may indicate a possible decline in water quality due to nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB50.0 is approved (DFWELE 2000).

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

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines, the *Primary* and *Secondary Contact Recreational uses* are assessed as support.

Squeteague Harbor (MA95-55) Use Summary Table

Aquatic Life*	Fish Consumption	Shellfish Harvesting**	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT	NOT ASSESSED

* Alert Status Issues identified—see details in use assessment section.

** For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS SQUETEAGUE HARBOR (MA95-55)

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Design and conduct a survey to monitor bacteria levels in Squeteague Harbor to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system improvements, and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollutants causing the closure of the shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

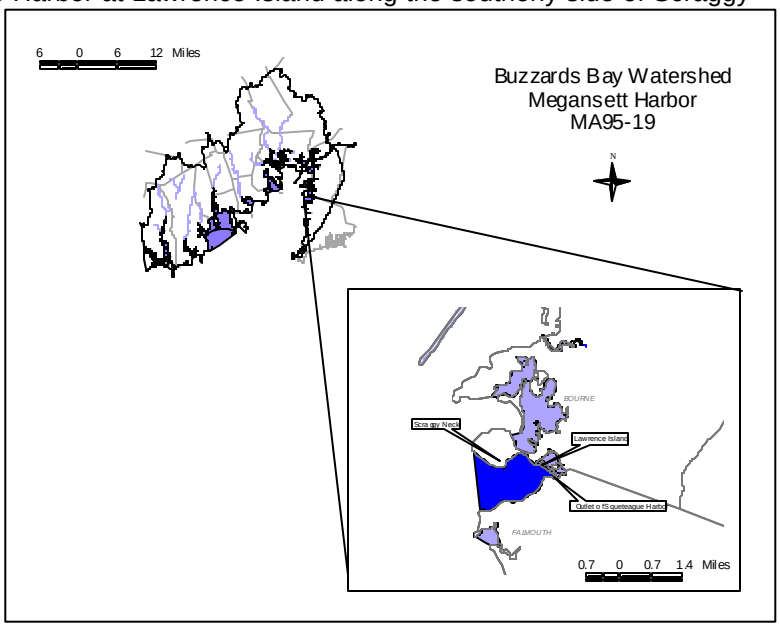
- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Monitor the progress of the MMR landfill plume (LF-1) remediation and the USGS investigation of its effect on Squeteague Harbor, particularly as it pertains to the aquatic life.

- Implement the recommendations from the EOEA Cape Cod Watershed Team Watershed Action Plan (MA EOEA 2003) including:
    - examine measures to discourage waterfowl around Squeteague Harbor or address bacteria and nitrogen impacts from waterfowl and consider DNA testing of the water to determine if waterfowl are a source of bacteria.

MEGANSETT HARBOR (SEGMENT MA95-19)

Location: From the outlet of Squeteague Harbor at Lawrence Island along the southerly side of Scraggy Neck, Bourne. The waters extend into Falmouth.
Segment Area: 1.26 square miles
Classification: Class SA



A recharge area and, therefore, land use estimates are not available for this segment.

There are only about 100 acres in this subwatershed that have not been developed but are available for development. Conversion of seasonal residences to year-round is a greater threat than new development (MA EOEA 2003). There is a vessel sewage pump-out boat and shoreside facility in the nearby Brewer's Fiddler Cove Marina on Fiddler's Cove Road, Falmouth (BBP Undated and DMF 29 January 2003)

Megansett Harbor is a large, well-flushed outer basin compared to the much smaller, shallower inner basin of Squeteague Harbor. A flushing study published in 1999 showed that large portions of the harbor exchange water freely with Buzzards Bay (less than 1 day flushing rate), but the more remote regions take longer (over 100 days) to exchange water with the Bay (Jachec and Hamilton 1999). The remote embayments do flush rapidly, however, with their adjacent water body. According to the Coalition for Buzzards Bay *Baywatchers II* report these basins are important recreational harbors with about 150 moorings and 75 slips. The system also has several beaches and a public boat ramp and pier (Howes *et al.* 1999).

Dr. Jefferson Turner, students, and research associates at UMass Dartmouth have conducted 141 monthly cruises of Buzzards Bay between October 1987 and October 1998 to establish temporal and spatial trends of hydrography, water quality, and plankton community structure. Station 3 in Megansett Harbor was sampled for conductivity, temperature, depth, Secchi disk depth, salinity, nutrients, chlorophyll *a* and phytoplankton. Salinity was "almost uniformly 30 ppt throughout the study at virtually all times". Mean surface temperatures at station 3 met SWQS. Secchi disk depths at station 3 ranged from 2 to 8.4 m. Mean chlorophyll *a* concentrations at station 3 ranged between 0 µg/L and 17 µg/L. Mean ammonium concentrations ranged between 0 µM and 12 µM. Mean phosphate concentrations ranged between 0 µM and 2 µM (Turner *et al.* 2000).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in Megansett Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at four stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Water quality in Megansett Harbor was among the best of those embayments monitored and is maintained by low watershed loadings and the deep open basin (Howes *et al.* 1999). Megansett Harbor received an average 1997-2001 Health Index Score of 81.0 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL AND NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or NPDES wastewater discharges in this subwatershed. It should be noted, however, that Bourne and Falmouth are Phase II communities and have submitted their Notices Of Intent for permit coverage for their NPDES Municipal (MS4) drainage systems. Their

coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their systems over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Megansett Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Megansett Harbor were mapped by MA DEP from field verified 1994 aerial photography eelgrass bed habitat near Eustis Beach and Sunrise Beach had declined. MA DEP field verified 2002 aerial photography determined that the eelgrass beds identified in the 1994 mapping along the southern portion of the harbor near Fiddlers Cove had declined, however, the beds along the northern portion of the harbor near Scraggy Neck appeared stable and two new beds appeared in the northeastern quadrant of the harbor near Eustis Beach and the Lawrence Island (Costello 2003).

Although the *Aquatic Life Use* is not assessed for Megansett Harbor, this use is identified with an Alert Status. Eelgrass bed loss is of concern and may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources including substandard septic systems, recreational uses, or other anthropogenic activities that result in reduced water clarity.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB50.0 and BB50.20 are approved (DFWELE 2000).

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

PRIMARY AND SECONDARY CONTACT RECREATION

According to the Barnstable County Health Department there were no closures at the Megansett Beach in 2001 or 2002 (Barnstable County Department of Health 2003 and Dowden, 2003).

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support.

Megansett Harbor (MA95-19) Use Summary Table

Aquatic Life*	Fish Consumption	Shellfish Harvesting	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT	NOT ASSESSED

* Alert Status issues identified see details in use assessment section.

** For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS MEGANSETT HARBOR (MA95-19)

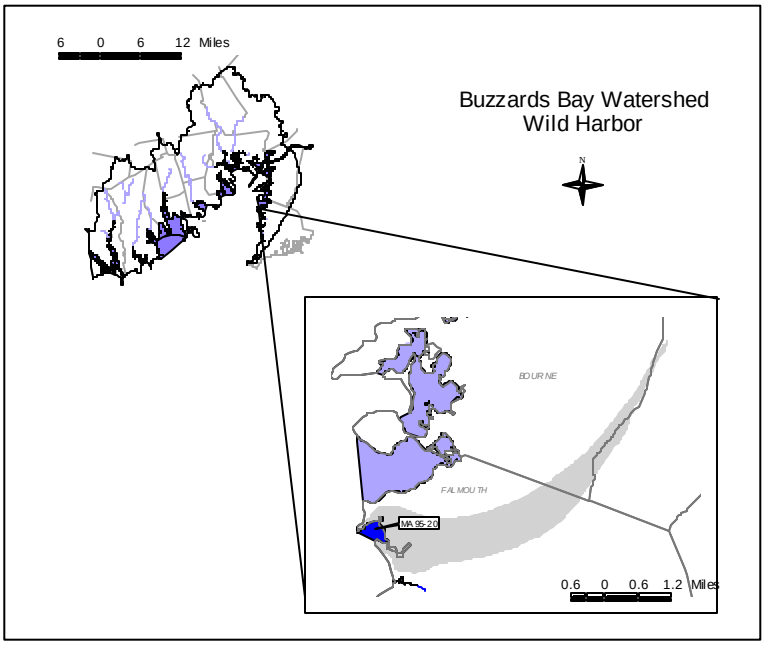
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacteria loadings to Megansett Harbor and possibly reopen shellfish beds. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when assessing the *Aquatic Life Use*.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

WILD HARBOR (SEGMENT MA95-20)

Location: Falmouth
Segment Area: 0. 14 square miles
Classification: Class SA



The recharge area of this segment is approximately 4.036 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	48%
Residential	27%
Open Land	19%

Wild Harbor is a well-flushed embayment with salt marsh ringing the edges and a predominantly sandy bottom in the outer regions. New Silver Beach is a popular public beach and there are 98 boat moorings and slips in the Harbor (MA EOEA 2003). The upper end of the subwatershed is largely undeveloped because 39% of the land area is preserved in either Massachusetts Military Reservation or Crane's Wildlife Management Area. The lower section of the watershed, below Route 28, is near buildout and the trend is to convert seasonal cottages to year round homes (Howes *et al* 1999).

Only about five percent of the Town of Falmouth is publicly sewered. The sewered areas are Main Street in Falmouth and nearly all of Woods Hole. Ninety to ninety-five percent of the town is on municipal water. There is one treatment plant in Falmouth, currently processing 0.5 MGD with a capacity of 0.81 MGD. A $14 million upgrade has been approved to bring the capacity up to 1 MGD in the next few years. This plant discharges to groundwater in the West Falmouth Harbor subwatershed (Segment MA95-22). In August 2001 the Town of Falmouth Department of Public Works submitted an ENF (August 2001) for a wastewater treatment plant that would serve the New Silver Beach area (two hundred new connections). The objective is to eliminate substandard individual onsite septic systems. The new collection system will gather and transmit wastewater to a new treatment facility located on Williams Road near the North Falmouth Elementary School that will discharge into the groundwater (MA EOEA 2003). Construction of this facility began in August 2003.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Wild Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at one station at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a* beginning in 1999. The harbor continues to support eelgrass beds with distribution limited by the water depth. Nitrogen loadings are associated with residential and commercial land uses including on-site septic system failures (Howes *et al.* 1999). The average 1997-2001 Health Index Score for Wild Harbor was 54.8 (fair) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX F)

There are 23.511 acres of cranberry bog open space in the Wild Harbor subwatershed (UMass Amherst 1999). For the purpose of this report a conservative estimate of water use for this bog area is 0.21 MGD.

NPDES SURFACE DISCHARGE SUMMARY

There are no known surface NPDES discharges to Wild Harbor, however, Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water

management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in Wild Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in Wild Harbor were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography determined that the eelgrass bed identified in 1994 had declined near the eastern inner shore in the vicinity of Silver Beach and Nye's Neck (Costello 2003).

Although the *Aquatic Life Use* is not assessed for Wild Harbor, this use is identified with an Alert Status. Eelgrass bed loss is of concern and may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources including substandard septic systems, recreational uses or other anthropogenic activities that result in reduced water clarity, and the residual affects of the 1969 oil spill.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that both shellfish growing areas (BB52.0 and BB52.2) are prohibited (area BB52.0 was approved in 2000 but was recently changed to prohibited) (DFWELE 2000 and Whittaker 2003).

Based on the DMF shellfish status the *Shellfish Harvesting Use* is assessed as impaired for this entire segment (0.14 mi^2). In 1969 a barge spilled 180,000 gallons of no. 2 fuel oil that washed into Wild Harbor. According to the EOEA Cape Cod Watershed Action Plan most of the effects of this spill have long since dissipated but since it is still detectable in the substrate in places it still affects the shellfish.

Wild Harbor (MA95-20) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting**		IMPAIRED	Fecal coliform bacteria	Unknown	On-site treatment systems (septic systems), other spill related impact (oil), highway/ road runoff
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* Alert Status issues identified-- see details in use assessment section

**For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS WILD HARBOR (MA95-20)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, sewering, and the Phase II community storm water management programs and assess the recreational uses.

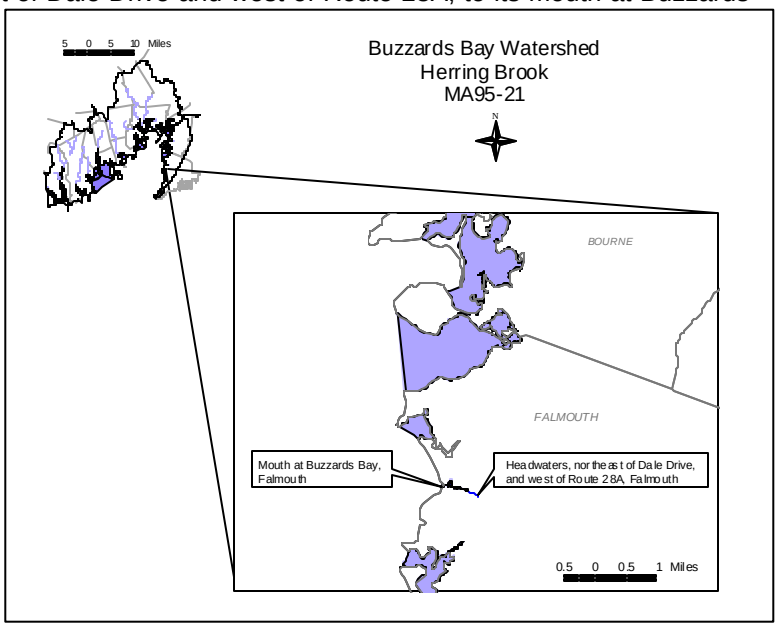
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacteria loadings to Wild Harbor. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.

- Implement the salt marsh restoration projects identified in the *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* (2002) that have been evaluated and prioritized by the Town. Sites in this subwatershed are FA11, FA12, FA13, FA35, FA36, FA37, and FA39. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

HERRING BROOK (SEGMENT MA95-21)

Location: From its headwaters, northeast of Dale Drive and west of Route 28A, to its mouth at Buzzards Bay, Falmouth
Segment Area: 0.01 square miles
Classification: Class SA



A recharge area and, therefore, land use estimates are not available for this segment.

This segment is on the Massachusetts 1998 303(d) List of Waters, in the Cape Cod Watershed, as not meeting the water quality standards for pathogens (MA DEP 1999).

WMA WATER WITHDRAWAL AND NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or NPDES surface discharges in this subwatershed. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB53.0 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* for this entire segment is assessed as impaired.

Herring Brook (MA95-21) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria	Unknown	On-site treatment systems (septic systems)
Primary Contact		NOT ASSESSED			
Secondary Contact		NOT ASSESSED			
Aesthetics		NOT ASSESSED			

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS HERRING BROOK (MA95-21)

- Review and implement recommendations in the DMF anadromous fish assessment report, when available, to increase habitat. If applicable, review data for assessing the *Aquatic Life Use*.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to remediate sources of bacteria causing shellfish bed closures. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use.*

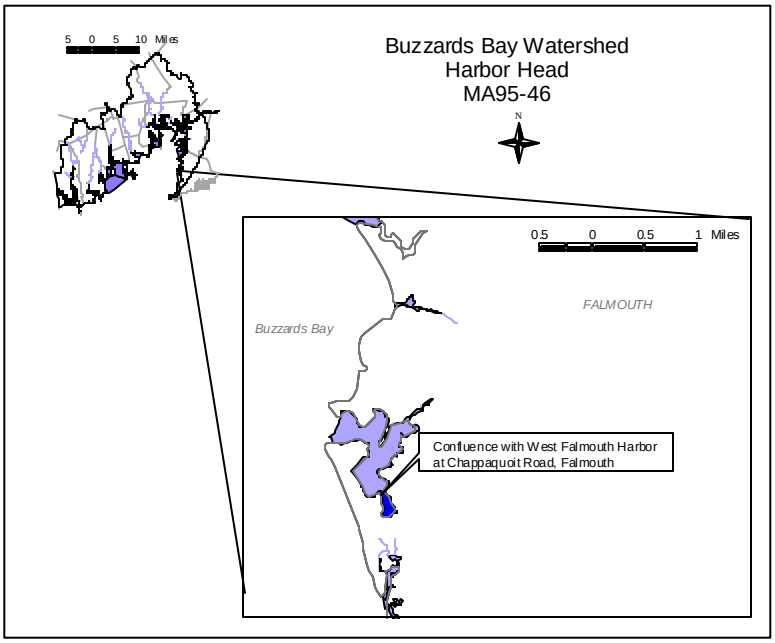
WEST FALMOUTH HARBOR DRAINAGE AREA

The West Falmouth Harbor Drainage Area in Falmouth consists of two segments:

- West Falmouth Harbor (MA95-22)
- Harbor Head (MA95-46)

HARBOR HEAD (SEGMENT MA95-46)

Location: The semi-enclosed body of water south of the confluence with West Falmouth Harbor at Chappaquoit Road, Falmouth
Segment Area: 0.02 square miles
Classification: Class SA



The West Falmouth Harbor recharge area includes this segment (see MA95-22).

This segment is on the Massachusetts 1998 303(d) List of Waters, a part of the formerly defined segment MA95-22 (West Falmouth Harbor), as not meeting the water quality standards for pathogens (MA DEP 1999). As part of the Estuaries Project a nutrient TMDL will be developed by SMAST in the next few years for West Falmouth Harbor system, which includes this segment.

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Harbor Head between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted by the Falmouth Pond Watchers at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Eelgrass communities are present in the Harbor, although it appears that some decline occurred within the inner areas. Nitrogen sources identified by the Coalition include the WWTF, storm water from road runoff and residential development, and the nitrogen enriched groundwater plume from the Falmouth Landfill and its former septage lagoons. Oxygen depletion (defined by CBB as <60% saturation) within the inner regions of the harbor is common and nitrogen levels are consistently higher and appear to coincide with the WWTF plume (Howes *et al.* 1999). The average 1997-2001 Health Index score for Harbor Head was 76.5 (good/excellent)(CBB Undated b).

WMA WATER WITHDRAWAL AND SURFACE NPDES DISCHARGE SUMMARY

There are no regulated water withdrawals or wastewater discharges in this segment. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB54.2 is restricted (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as impaired for this entire segment.

Harbor Head (MA95-46) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), highway/ road runoff, municipal separate storm sewer systems
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS HARBOR HEAD (MA95-46)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

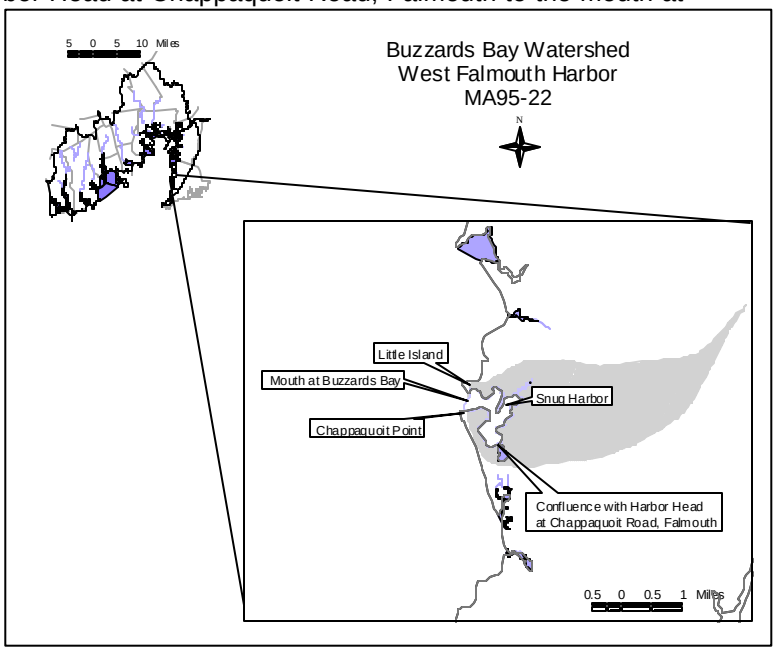
- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system improvements, sewering, and the Phase II community storm water management program and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacterial inputs to Harbor Head. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Develop a nutrient/bacteria TMDL for the West Falmouth Harbor system in accordance with the Massachusetts Estuaries Project.

WEST FALMOUTH HARBOR (SEGMENT MA95-22)

Location: From the confluence with Harbor Head at Chappaquoit Road, Falmouth to the mouth at Buzzards Bay at a line connecting the ends of the seawalls from Little Island and Chappaquoit Point, Falmouth (including Snug Harbor)
Segment Area: 0.29 square miles
Classification: Class SA



The recharge area of this segment is approximately 3.5 square miles and includes segment MA95-46. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	48%
Residential	27%
Industrial	15%

This segment is on the Massachusetts 1998 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999). As part of the Estuaries Project a nutrient/bacteria TMDL will be developed by SMAST in the next few years for the West Falmouth Harbor system.

According to the Coalition for Buzzards Bay *Baywatchers II* report, the harbor contains 356 moorings and is highly used by recreational boaters. The inner harbor (Snug Harbor) has both a Town Dock and public boat ramp. Boat fueling and pump out facilities at the Town Dock are no longer available (MA EOEA 2003).

West Falmouth Harbor is notable for its diversity of nitrogen sources, among them the Town's only Waste Water Treatment Facility (WWTF), its landfill, old septage lagoons, composting installations, runoff from roads and lawns, as well as effluent from a growing number of residential septic systems and from the Town's industrial park. The WWTF presents the largest source of nitrogen. It currently processes 0.55 MGD with a capacity of 0.81 MGD and discharges to groundwater. A $14 million upgrade has been approved to bring the capacity up to 1.0 MGD in the next few years. There is also a nitrogen enriched groundwater plume originating from the Falmouth Landfill and the now closed septage disposal lagoons at the landfill. The Harbor is projected to experience a more than 33% increase in total nitrogen load from 1998 to 2004 (Cape Cod Commission 1998).

The Town of Falmouth will install infiltration technology to treat storm water to reduce bacterial contamination to West Falmouth Harbor using funds awarded in 2000 by the MA CZM Coastal Remediation Program. Also, the West Falmouth Harbor Management Committee formed in 2000 is working on the development of a harbor management plan (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at five stations in West Falmouth Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted by the Falmouth Pond Watchers at nine stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Nitrogen sources identified by the Coalition include the WWTF, storm water from road runoff and residential development, and the nitrogen enriched groundwater plume from the Falmouth Landfill and its former septage lagoons. Oxygen depletion (defined by CBB as <60% saturation) within the inner regions of the harbor is common and nitrogen levels are consistently higher and appear to coincide with the WWTF plume (Howes *et al.* 1999). The average

1997-2001 Health Index scores for the two areas of West Falmouth Harbor were 75.1 mid and 81.8 outer (both good/excellent). Snug Harbor received a score of 49.7 (fair)(CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Falmouth Water Department	4096000	9P4220960	42209607	Crooked Pond Well 4096000-05G	Registered = 2.95** Permitted = 1.36**	NA	NA	NA

* Excludes registered cranberry growers ** Includes sources outside this subwatershed
The Crooked Pond Well has not yet been constructed.

NPDES SURFACE DISCHARGE SUMMARY

There are no surface wastewater discharges in this segment. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

AQUATIC LIFE

Eelgrass Bed Habitat

MA DEP identified the presence of eelgrass in West Falmouth Harbor from historic 1951 black and white aerial photography (Costello 2003). Eelgrass beds in West Falmouth Harbor were mapped by MA DEP from field verified 1994 aerial photography. MA DEP field verified 2002 aerial photography determined that the eelgrass beds identified in 1994 had declined throughout the harbor. Three beds, identified in 1951 (high confidence in data) along the southern shore near Nonamesset Road and Chappaquoit Road, have disappeared. The two remaining beds appear to be declining slightly.

Because of the decline/loss of the eelgrass bed habitat, the *Aquatic Life Use* is assessed as impaired for West Falmouth Harbor. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include septic systems and the wastewater treatment plant.

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB54.20 is approved, BB54.0 is conditionally approved, and BB54.1 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as support for 0.09 mi^2 and impaired for 0.20 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.09 mi^2. The remaining 0.20 mi^2 are currently not assessed.

West Falmouth Harbor (MA95-22) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		IMPAIRED	Estuarine bioassessment (decline of eelgrass bed habitat)	Total nitrogen	On-site treatment systems (septic systems), septage disposal (landfill lagoon), municipal point source discharge (groundwater)	
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		0.09 mi^2 SUPPORT 0.20 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), highway/ road runoff, municipal separate storm sewer systems
Primary Contact		0.09 mi^2 SUPPORT 0.20 mi^2 NOT ASSESSED				
Secondary Contact		0.09 mi^2 SUPPORT 0.20 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

* For watershed-wide shellfish growing area data see Appendix E

RECOMMENDATIONS WEST FALMOUTH HARBOR (MA95-22)

- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.

- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system improvements, sewering, and the Phase II community storm water management program and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacteria loading to West Falmouth Harbor. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

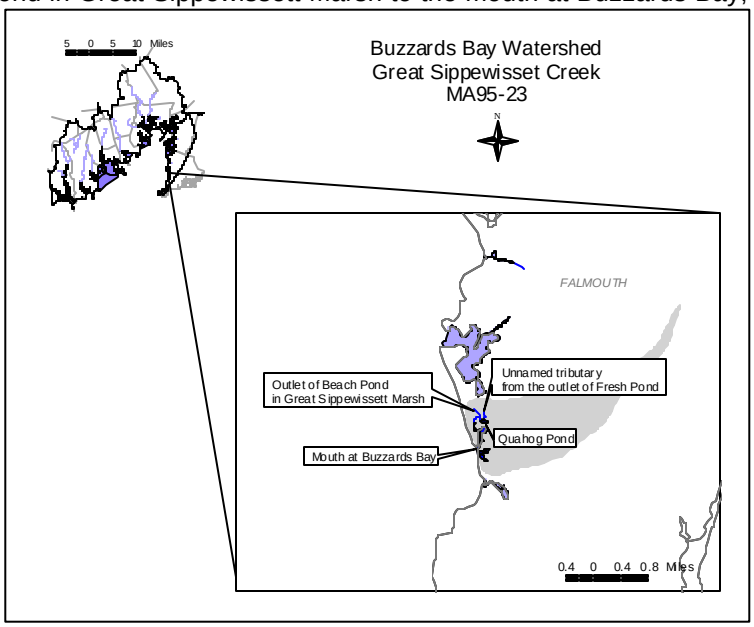
- Develop a nutrient/bacteria TMDL for the West Falmouth Harbor system in accordance with the Massachusetts Estuaries Project.

- Implement the salt marsh restoration projects identified in the *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* (2002) that have been evaluated and prioritized by the Town. Sites in this subwatershed are FA15, FA16, FA17, FA, FA19, FA29, FA30, FA31, FA32, FA33, and FA34. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

- Implement the recommendations from the EOEA Cape Cod Watershed Action Plan (MA EOEA 2003) including:
  - implement BMP for storm drain on Route 28A draining to West Falmouth Harbor, and
  - implement a storm water best management practice for the treatment of polluted roadway runoff contained in the Old Dock Road drainage system and discharging in West Falmouth Harbor.

GREAT SIPPEWISSET CREEK (SEGMENT MA95-23)

Location: From the outlet of Beach Pond in Great Sippewissett Marsh to the mouth at Buzzards Bay, Falmouth, including the unnamed tributary from the outlet of Fresh Pond, and Quahog Pond, Falmouth.
Segment Area: 0.03 square miles
Classification: Class SA



The recharge area of this segment is approximately 2.0 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	56%
Residential	20%
Wetlands	10%

This segment is on the Massachusetts 1998 303(d) List of Waters, in the Cape Cod Watershed, as not meeting the water quality standards for pathogens (MA DEP 1999).

The Great Sippewisset Creek Subwatershed is located in the town of Falmouth. Route 28 and 28A run through the area. The residential development is moderately dense, with very little commercial development. Long Pond, partially located in this subwatershed, is the source for Falmouth's municipal water. There is one hazardous waste 21E site located at Falmouth High School on Gifford Street (MA EOEA 2003).

The Cape Cod Commission designated the Black Beach/Great Sippewisset Marsh a *District of Critical Planning Concern* in 1996 to protect the 340 acres of sensitive marsh and barrier beach. The Town nominated the district to prevent flood damage, improve water quality, protect important plant and wildlife habitat, manage storm water runoff, protect finfish and shellfish, and minimize harmful effects of new development. The Town developed regulations that included clearing and grading limitations, prohibition of wetland alteration, increased wetland buffers, improvements to septic systems and storm water drainage, protections to flood zones and dunes, and other regulations (MA EOEA 2003).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Falmouth Water Department	4096000	9P4220960	42209607	Long Pond Reservoir 4096000-01S Mares Pond Well 4096000-004G	Registered = 2.95** Permitted = 1.36**	0.331	0.274	0.328

*Excludes registered cranberry growers ** Includes sources outside this subwatershed

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated NPDES wastewater discharges in this segment. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB56.0 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* for this entire segment is assessed as impaired.

Great Sippewisset Creek (MA95-23) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), highway/ road runoff
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

*For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS GREAT SIPPEWISSET CREEK (MA95-23)

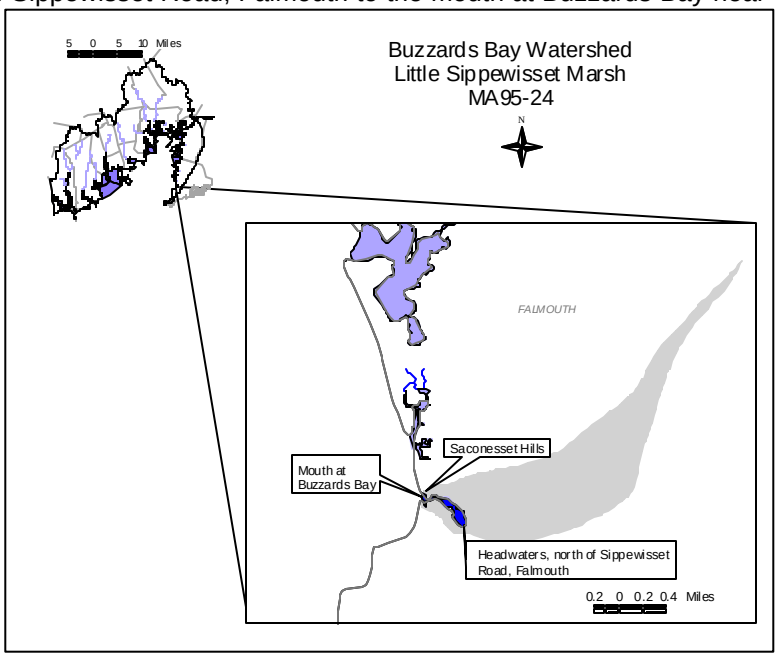
- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce bacteria inputs to Great Sippewisset Creek. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.

- Implement the salt marsh restoration projects identified in the *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* (2002) that have been evaluated and prioritized by the Town. Sites in this subwatershed are FA22, FA28, FA28A, FA20, FA21, FA27, and FA26. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

LITTLE SIPPEWISSET MARSH (SEGMENT MA95-24)

Location: From the headwaters north of Sippewisset Road, Falmouth to the mouth at Buzzards Bay near Saconesset Hills, Falmouth.
Segment Area: 0.02 square miles
Classification: Class SA



The drainage area of this segment is approximately 1.2 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest	56%
Residential	21%
Wetlands	5%

This segment is on the Massachusetts 1998 303(d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

Much of the drainage area is undeveloped though there is some residential development. Long Pond, the source for Falmouth's municipal water, is located in this drainage area (MA EOEA 2003).

In 2000 the Coalition for Buzzards Bay began conducting water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at one station in Little Sippewisset Marsh between May and September. Samples have been collected between 6 and 9 am.

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Falmouth Water Department	4096000	9P4220960	42209607	Long Pond Reservoir 4096000-01S	Registered = 2.95** Permitted = 1.36**	2.675	2.570	2.687

* Exclude registered cranberry growers **Includes sources outside this subwatershed

NPDES SURFACE DISCHARGE SUMMARY

There are no regulated water withdrawals or NPDES wastewater discharges in this segment. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB57.0 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as impaired for this entire segment.

Little Sippewisset Marsh (MA95-24) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), highway/ road runoff
Primary Contact		NOT ASSESSED				
Secondary Contact		NOT ASSESSED				
Aesthetics		NOT ASSESSED				

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS LITTLE SIPPEWISSET MARSH (MA95-24)

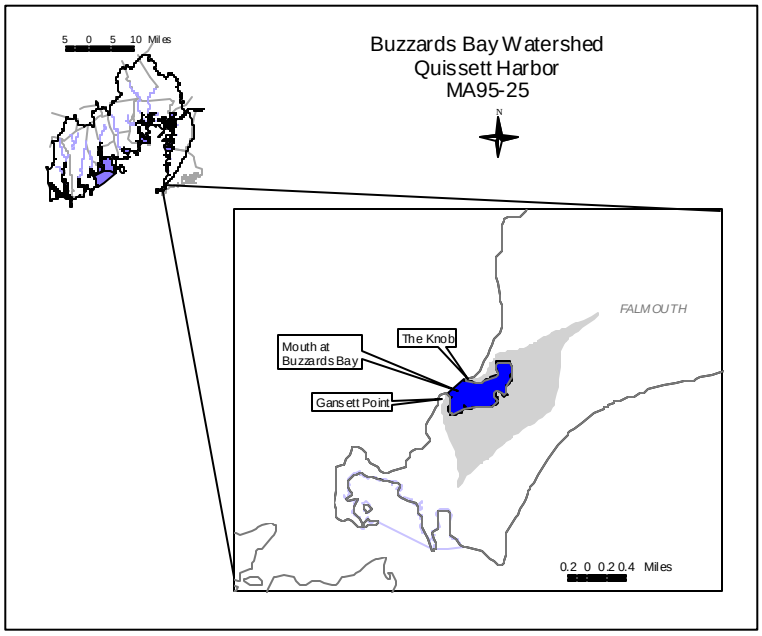
- Design and conduct a bacteria monitoring survey to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to mitigate bacterial inputs to Little Sippewisset Marsh. Continue to review DMF shellfish status report to assess the *Shellfish Harvesting Use*.

- Implement the salt marsh restoration project identified in the *Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts* (2002) that have been evaluated and prioritized by the Town. The one site in this subwatershed is FA10. Develop a plan to monitor the effectiveness of the restoration, improvements in water quality, and affects on aquatic life.

QUISSETT HARBOR (SEGMENT MA95-25)

Location: The semi-enclosed body of water landward of a line drawn between The Knob and Gansett Point, Falmouth
Segment Area: 0.17 square miles
Classification: Class SA



The recharge area of this segment is approximately 0.8 square miles. Land-use estimates (top three, excluding water) for the water recharge area (map inset, gray shaded area):

Forest	46%
Residential	35%
Open land	16%

This segment is on the Massachusetts 1998 303 (d) List of Waters as not meeting the water quality standards for pathogens (MA DEP 1999).

Quissett Harbor is one of the deepest embayments in Buzzards Bay. It has high tidal flushing, no freshwater inputs, and a healthy eelgrass population. The harbor supports beds of scallops, oysters, quahogs, and soft-shell clams (MA EOEA 2003).

The harbor receives a high volume of recreational boat use. A year round pump out facility is located at the Quissett Harbor Boatyard. In addition to the boat yard, there are 240 moorings and a public landing on northeast shore of the harbor. In January 1999 the Town approved a management plan for Quissett Harbor. There is a high demand for moorings but no room to accommodate more parking or a septic system for a bathhouse. The Harbor exceeds the number of commercial moorings recommended, but several moorings have been moved from the inner to the outer harbor to accommodate the number of private moorings needed in the inner harbor (MA EOEA 2003).

The Coalition for Buzzards Bay has been conducting weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at two stations in Quissett Harbor between May and September from 1992 to the present. Samples were collected between 6 and 9 AM. More intensive sampling of nutrients was conducted at two stations at two week intervals between July and August for organic nitrogen, particulate organic carbon, dissolved nitrogen, dissolved phosphorus, and chlorophyll *a*. Sources of nitrogen loading to the harbor include residential on-site septic systems and the Woods Hole Golf Club. The Harbor supports healthy eelgrass beds, especially in the outer areas, although historic beds have been lost in the inner areas south of Quissett Harbor Road (Howes *et al.* 1999). The average 1997-2001 Health Index Score for inner Quissett Harbor was 78.5 and for outer Quissett Harbor was 90.3 (good/excellent) (CBB Undated b).

WMA WATER WITHDRAWAL SUMMARY* (APPENDIX F)

Facility	PWS ID	WMA Permit Number	WMA Registration Number	Source (G = ground)	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)		
						1999	2000	2001
Woods Hole Golf Club**			42209606	Wells #1 and #2	0.08	0.07	0.06	0.08

* Excludes registered cranberry growers ** Indicates average withdrawal over less than 365 days

NPDES SURFACE DISCHARGE SUMMARY

There are no NPDES wastewater discharges in this segment. It should be noted, however, that Falmouth is a Phase II community and has submitted their notice of intent for permit coverage for their NPDES Municipal (MS4) drainage system. Their coverage requires that they develop, implement, and enforce a

storm water management program and reduce the discharge of pollutants from their system over the five-year permit term (Scarlet 2003).

USE ASSESSMENT

SHELLFISH HARVESTING

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB58.0 is approved and BB58.2 is conditionally approved (DFWELE 2000).

Based on the DMF shellfish growing area status the *Shellfish Harvesting Use* is assessed as support for 0.1 mi^2 and impaired for 0.05 mi^2.

PRIMARY AND SECONDARY CONTACT RECREATION

Based on the more stringent shellfish harvesting guidelines the *Primary* and *Secondary Contact Recreational Uses* are assessed as support for 0.1 mi^2. The remaining 0.05 mi^2 are currently not assessed.

Quissett Harbor (MA95-25) Use Summary Table

Designated Uses		Status	Causes		Sources	
			Known	Suspected	Known	Suspected
Aquatic Life		NOT ASSESSED				
Fish Consumption		NOT ASSESSED				
Shellfish Harvesting*		0.11 mi^2 SUPPORT 0.06 mi^2 IMPAIRED	Fecal coliform bacteria		Unknown	On-site treatment systems (septic systems), road runoff
Primary Contact		0.11 mi^2 SUPPORT 0.06 mi^2 NOT ASSESSED				
Secondary Contact		0.11 mi^2 SUPPORT 0.06 mi^2 NOT ASSESSED				
Aesthetics		NOT ASSESSED				

* For watershed-wide shellfish growing area data see Appendix E.

RECOMMENDATIONS FOR QUISSETT HARBOR (MA95-25)

- Work with the Coalition for Buzzards Bay to promote stewardship and implement environmentally friendly practices that will help reduce the leaching of fertilizers from the Woods Hole Golf Club and residential properties into Quissett Harbor.
- Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and, if deemed necessary, increase spatial and temporal coverage of *in-situ* monitoring. Review final reports when evaluating the status of the *Aquatic Life Use*.
- Design and conduct a survey to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, septic system improvements, and the Phase II community storm water management programs and to assess the recreational uses.
- Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to remediate sources of bacteria to Quissett Harbor. Continue to review DMF shellfish status reports to assess the *Shellfish Harvesting Use*.
- Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Continue to review data to assess the *Aquatic Life Use*.