

ASSABET RIVER WATERSHED

The Assabet River begins in Westborough at the George H. Nichols Dam which is the outlet on the Assabet River Reservoir, also known as the A1 site. The dam, which was created for “fish and wildlife development and flood prevention,” impounds approximately 0.6 mi². The river flows northeast through Northborough, Marlborough, Hudson, Stow, Maynard, and Concord. It is joined in Westborough by Hocomonco Stream. Hocomonco Stream drains Hocomonco Pond, a Superfund site. Below the confluence with Hocomonco Stream the Assabet River receives the discharge from the Westborough WWTP before receiving flow from Hop Brook. The river flows through a golf course and is again dammed in Northborough Center at the Route 20 dam (also known as the Aluminum City Dam). Before taking a 90-degree turn to be impounded by the Allen Street Dam the Assabet River receives the flows from Cold Harbor Brook. The river next receives the discharge from the Marlborough West WWTP and North Brook before it flows through the Hudson Street impoundment in downtown Hudson. After exiting Hudson Center the river receives the discharge from the Hudson WWTP just above the Gleasondale Dam. The Assabet continues its slow meandering into the Town of Stow where it receives freshwater inputs from the Elizabeth Brook/Assabet Brook subwatershed before it reaches the Ben Smith Dam. In Maynard center part of the river is diverted through the canal and mill pond at Clock Tower Place (the former American Woolen Mill), before rejoining the bypassed section downstream from the mill and just upstream from the USGS Assabet River gage. The river is channelized through Maynard, flows into Powder Mill Impoundment, and receives the discharge from the Maynard WWTP. The Assabet River continues toward its confluence with the Sudbury through the Town of Acton, where it receives the flows from the largest of its tributaries, Nashoba Brook, and then the discharge from the Massachusetts Correctional Institute-Concord facility. Just north of the center of historic Concord the Assabet River joins the Sudbury River to form the Concord River.

The Wild and Scenic Rivers Act provides for three possible classifications of eligible river segments: wild, scenic, and recreational. 4.4 miles of the Assabet River, from 1000 feet below the Damondale dam in West Concord to the confluence with the Sudbury River, have been designated as recreational by the National Park Service based on ecology, history, literature, and scenery (NPS 1996).

ISSUES

Historically, wastewater discharges and water withdrawals for public supply have deleteriously affected the Assabet River. A nutrient TMDL for the Assabet River was completed in 2004 (see the TMDL section for additional information). Implementation of the TMDL requires removal of total phosphorus to 0.1 mg/L in the effluent of the major municipal wastewater treatment plants and evaluation of the feasibility of sediment remediation to reduce phosphorus flux from the sediments.

As a result of degraded water quality from the municipal wastewater treatment plants the MA DEP required that each of the communities in the Assabet River Watershed prepare a Comprehensive Wastewater Management Plan/Environmental Impact Report (CWMP/EIR). To leverage resources and implement the study six communities (Hudson, Maynard, Northborough, Shrewsbury, Marlborough, and Westborough) formed the Assabet Consortium. The CWMP/EIR will study wastewater treatment issues and outline actions the Towns will take to manage and treat sanitary sewage for the next twenty years, reduce phosphorus loading to the Assabet River, and maintain/increase baseflows in the watershed. The CWMP/EIR will be developed in four phases: Phase I- existing conditions/needs analysis; Phase II- alternatives screening; Phase III- most feasible options evaluation and draft CWMP/EIR; Phase IV- Final CWMP/EIR. The CWMP/EIR process is directly linked to the Assabet TMDL. Water for municipal supply of the communities in the Assabet subwatershed is withdrawn via wells or direct surface water intake. Ground water for municipal supply is withdrawn from the “discontinuous glacial aquifers along the tributaries and main stem of the Assabet River...the aquifers are in direct hydraulic connection with surface waters... {and} typically reduce groundwater discharge to streams... and deplete streamflow” (DeSimone 2004). Wastewater is either transferred out of the basin via the MWRA and discharged to Boston Harbor or discharged via treatment plants downstream from the withdrawal. Information on the infrastructure of the six towns in the Consortium (summarized in the following paragraphs from upstream to downstream) is provided as background for readers unfamiliar with the subwatershed and to put withdrawals and discharges into context.

Shrewsbury

Water supply

Ninety-eight percent of the Town is served by the Town's public water supply system. The Town has six active and two inactive sources; all of the active wells are located in the Lake Quinsigamond aquifer in the Blackstone River Basin.

Wastewater

Prior to 1987 the Town of Shrewsbury owned and operated its own WWTP, which was physically located in the Town of Northborough. The former Shrewsbury plant discharged secondary treated effluent via a two-mile outfall to the Assabet River. The Town has owned and operated its own sewer system since 1960. The Town's system consists of approximately 145 miles of sewer with 37 pump stations. The system currently serves approximately 75% of the town's population. On-site septic systems (roughly 4,000) serve areas along Holden, Clinton, Sewall streets and in the southern portion of the town. In 1976 Westborough and Shrewsbury concluded Facilities Plans that determined that the most cost-effective alternative was to jointly treat wastewater. In 1981 the Westborough facility was expanded, upgraded, and regionalized to treat flows from Westborough, Shrewsbury, and part of Hopkinton. The Shrewsbury outfall was converted to a pressure sewer and diverted to the Westborough plant in 1987. The Town also pumps sewage from two areas to the Upper Blackstone Water Pollution Abatement District WWTP (4 million gallons per year). Since the mid-1970's the Town has been addressing significant Inflow/Infiltration (I/I) problems. Phase I of the CWMP process identified four areas (last remaining unsewered) that would need alternatives to on-site systems. (Fay, Spofford & Thorndike 2001b).

Westborough

Water supply

Water supply for the Town of Westborough consists of seven active wells, a surface water supply (Westborough Reservoir/Sandra Pond) and two inactive wells (one under construction, one being upgraded to a larger pump). The system serves about 15,977 of the 17,997 people (Earth Tech 2001b).

Wastewater

The Westborough WWTP receives flows from Westborough, Shrewsbury and Hopkinton. The collection system serves 80% of the town and includes 75 miles of sewer, 33 pump stations, and an interceptor to transport flow from Hopkinton. The facility is permitted to discharge 7.88 MGD of secondary treated effluent to the Assabet River, downstream from the majority of their water withdrawals (segment MA82B-02). Septage from the on-site systems is received at the WWTP along with septage from Shrewsbury and Hopkinton. Westborough also maintains a separate storm water collection system. Westborough continues its decades old program to mitigate I/I problems. Average infiltration was estimated to be 610,000 GPD and springtime I/I was estimated as 0.88 MGD. In 2001 Westborough estimated that 1,040 developed properties relied on on-site wastewater disposal systems with 600 of these considered to be pending connection to the sewer system. The Westborough Board of Health estimated that the failure rate of on-site systems in town was 23%. As part of the CWMP Earth Tech identified 17 needs areas where on-site septic systems are not recommended. These include areas around Westborough Reservoir, an area south of Nichols Reservoir, and an area east of Chauncy Lake (Earth Tech 2001b).

Northborough

Water supply

Eighty percent of the Town of Northborough obtains drinking water from municipal sources. The Town has four ground water supplies. The 24 -inch diameter gravel packed Brigham Street Well was dug to 60 feet deep in 1956 and has a safe yield of 0.35 MGD. The 24-inch gravel packed Crawford Street Well was dug to 52 feet deep in 1969 and has a safe yield of 0.35 MGD. The Howard Street Wells 1-3 were constructed in 1994 and have a combined safe yield of 0.10 MGD. The Lyman Street Well, constructed in 1963, has been offline since 1980 due to VOC contamination. The Town also obtains approximately 0.59 MGD from the MWRA Wachusett

Aqueduct (Fay, Spofford & Thorndike 2001a). For at least the past three years the Town has relied solely on MWRA supplies (Kickham 2004).

Wastewater

Approximately 20% (3,000 people) of the Town of Northborough is served by the municipal sewer system. The 25 miles of the separate sanitary system serve the central portion of the town, mostly areas adjacent to the Assabet River, and five pump stations currently send about 400,000 GPD to the Marlborough Westerly WWTP. Northborough has an agreement to send up to 800,000 GPD to the Marlborough Westerly WWTP, but has not yet reached their capacity. There are significant industrial users, such as Saint-Goban-Norton Company, Inc., that discharge to the Northborough sewer system. The Town commissioned an Infiltration and Inflow (I/I) study in 1996. The study determined that the Town does have a high I/I rate and the Town is actively trying to identify and address I/I sources. The remaining 80% of the population is served by on-site septic systems with an approximate failure rate of 10% (Fay, Spofford & Thorndike 2001a). Phase I of the CWMP/EIR process identified eight needs areas in the Town of Northborough (Fay, Spofford & Thorndike 2001a).

Marlborough

Water supply

The City of Marlborough obtains its drinking water from two surface water sources (Millham Reservoir and Lake Williams), which supply about 30%, and the MWRA. Water from the 200 million gallon Lake Williams flows by gravity to the 300 million gallon Millham Reservoir where it is treated at the Millham Water Treatment Facility and then distributed to almost all of the City's residents. Water is also withdrawn from the Wachusett Aqueduct at the Cedar Hill Pumping Station in the southwest corner of the City. The MWRA Walnut Hill Water Treatment Plant is also located in the southwest corner. In 2000 the City use was 1.67 MGD, however, 211 MG were unaccounted for. The City conducts regular maintenance that includes biannual system-wide leak detection (CDM 2001).

Wastewater

The Marlborough Westerly Plant serves the areas of the city adjacent to and west of Route I-495 (Segment MA82B-04) while the Easterly Plant serves the City's business district and the areas to the east in the Sudbury River Watershed. Approximately 86% of the population served by the Westerly Plant is sewered and 92% of the population in the Easterly service area has tied in to the sewer (overall 92%). The system is comprised of 200 miles of pipe and 18 pump stations. There are 13 significant industrial users; all discharging to the Westerly Plant- 12 in Marlborough and one in Northborough. It was estimated that on an average annual basis 36% to the Westerly Plant is I/I and 45% of the flow to the Easterly Plant is I/I. Eight percent of the City is still served by on-site systems. Sewer extension in the area tributary to the Westerly Plant will proceed. Additionally, an area along Red Spring Road has been identified in the CWMP as a needs area due to failing on-site systems. The CWMP noted the Westerly Plant is in need of upgrades and in the second phase of study will examine potential sites for discharging to groundwater or other surface waters. The antiquated Marlborough storm drain system in the central part of the City dates back to the early 1900's and discharges to Mowry Brook and South Brook, tributaries to the Sudbury Reservoir. Recently developed eastern and western systems discharge to numerous small tributaries to the North Branch of Millham Brook, Broad Meadow Brook, and Hop Brook. (CDM 2001).

Hudson

Water supply

There are several inactive bedrock faults underlying the Town of Hudson. Well drilling along the faults has shown that the fractured bedrock is an important aquifer, yielding several hundred gallons per minute. The southeast portion of the town, near Marlborough, is served by private wells. Hudson has five active water supply wells and one surface supply (Gates Pond) that serve 92% of the town's population. Four of the wells are located near the confluence of Fort Meadow Brook and the Assabet River (Kane Well, Chestnut Wells, 12 and 3). Water from the three Chestnut Wells is treated for excess levels of iron and manganese. The Cranberry Well is located

in the Sudbury River Watershed. Two other wells are currently inactive- the Rimkus Well, due to excessive levels of iron and manganese and close proximity to a surface waterbody (Assabet River) and the Cox Street wellfield, which has been inactive for decades. Intel Corporation is the single largest consumer using about 510,000 GPD, however, Intel has reduced their consumption by recycling and reuse. Intel also has reactivated a bedrock well with a capacity of 350,00 GPD (Earth Tech 2001a). The approved maximum daily rate (based on the capacity of the wells) is 0.45 MGD or 312.5 gallons per minute for the bedrock well and the back-up bedrock well. Based on industrial need, the facility was issued a WMA registration to withdraw 0.11 MGD and a permit to pump 0.24 for a total of 0.35 MGD. However, the permit is not valid until they build a storm water recharge basin to recharge 175,000 GPD. The recharge basin has been designed but not built, as Intel has changed operations internally and the extra water is not needed to expand operations at this time (Kickham 2004).

Wastewater

The Hudson sewer system, consisting of 51 miles of sewers, 14 pumping stations, and a 3 MGD advanced WWTP, serves approximately 80% of the town (15,000 people). The WWTP, upgraded in the mid-1980's, discharges to segment MA82B-05 of the Assabet River. The Hudson WWTP accepts septage from the town as well as from Stow. The Town has been addressing Infiltration/Inflow (I/I) problems since 1976 and has taken a number of steps to reduce I/I. Current estimated I/I was assumed to be on average 630,000 GPD and winter I/I was estimated as 1.22 MGD. A total of 1,170 properties (<20% of the population) are served by on-site septic systems. They are located along the eastern one-third of town, as well as in the southwest and northwest corners. The failure rate for these systems is about 16%. Two needs areas were identified in the CWMP for local or regional wastewater disposal, the area around Lake Boon and the area in southwestern Hudson west of the Assabet River. Ninety-one (91) percent of the properties abutting Lake Boon served by on-site septic systems have an estimated failure rate of 20% (Earth Tech 2001a). It was recommended that 11 other areas, including the area around White Pond, continue to be served by on-site systems. Hudson also has a separate storm water collection system (Earth Tech 2001a).

Maynard

Water supply

Approximately 100% of the Town of Maynard obtains its water from municipal sources. The Maynard water supply system contains seven active gravel-packed wells: Old Marlboro Road Wells #1, #2, #3; Well #4; and Rockland Avenue Wells #2, #3, #4 and #5. The Rockland Avenue Well #5 was scheduled to go online in 2002 after completion of the Rockland Avenue Water Treatment Plant. It is anticipated that the Rockland Well #3, which is not in service due to elevated levels of iron, will also be used after the completion of the WTP. Maynard also planned to construct a WTP off Great Road to service Well #4 by 2002. Backwash flow (0.02 MGD) from the Well #4 WTP will be collected and recharged to the ground while flow from the Rockland Avenue WTP (0.06 MGD) will be discharged to the WWTP. The Old Marlboro Road WTP treats the water from Wells #1, 2, and 3 for high levels of iron and manganese and discharges 0.04 MGD of backwash flow to the Maynard WWTP. White Pond Reservoir was a former surface water supply for the Town of Maynard; it is no longer used because it did not meet the Safe Drinking Water Act rules for treatment by filtration (Dufresne-Henry 2001).

Wastewater

On-site septic system failures have been documented in Maynard and a sewer extension program has been ongoing since 1980. Maynard plans to extend sewers to 100% of the town. By 2001, 93% of the town had been seweraged. The existing sewer system is 37.3 miles long with pipes ranging from 2-18" in diameter. The Maynard WWTP has a design capacity of 1.45 MGD. It does not accept septage at this time, although it could treat up to 8,000 gallons of sewage per day. Dufresne- Henry (2001) reported that inflow into the sewage system is 0.78 million gallons for the 1-year, 6-hour rainstorm of 1.72" and concluded that removal of inflow is not cost-effective. The peak infiltration is 0.46 MGD (1,570 GPD/ldm - gallons per day per inch diameter mile) (Dufresne-Henry 2001). GPD/ldm is calculated as follows: [reach length (in linear feet) X pipe

diameter (in inches) / 5,280] X GPD. MA DEP guidelines say that if I/I exceeds 4,000 GPD/idm then I/I is excessive and it is cost effective to remove.

Acton

The Town of Acton is also completing a *Comprehensive Water Resources Management Plan*. The Town currently receives all of its water supply through public and private wells. Wastewater from the Kelly Corner and South Acton areas (10% of the town) is processed at the Acton WWTP on Adams Street and discharged to the ground in the Assabet River Segment MA82B-06 subwatershed. The Town is also experiencing problems with malfunctioning on-site wastewater systems that affect surface water quality in the Fort Pond Brook and Nashoba Brook subwatersheds. Eighty percent of the town is serviced by individual on-site treatment systems and ten percent is serviced by private Title V package plants (Reagor 2005).

In the Assabet River Watershed the towns of Boylston, Hudson, Littleton, Maynard, Northborough, Shrewsbury, and Westford have participated in the Comprehensive Community Septic Management Program (Kasper-Dunne 2004 and Appendix F). The program provides betterment loans to communities to target known or suspected failures or to develop a community-wide management plan.

The communities of Shrewsbury, Westborough, Northborough, Berlin, Marlborough, Hudson, Bolton, Stow, Harvard, Maynard, Boxborough, Acton, Littleton, Concord, Westford, and Carlisle are Phase II storm water communities. Each community was issued a storm water general permit from EPA and MA DEP in 2003/2004 and is authorized to discharge storm water from their municipal drainage system. Over the five-year permit term the communities will develop, implement, and enforce a storm water management program to reduce the discharge of pollutants from the storm sewer system to protect water quality (Domizio 2004). Maynard and Shrewsbury are entirely regulated communities. With the exception of Berlin, Carlisle, Bolton, and Harvard, which received waivers, the remaining are partially regulated communities.

Hazardous waste sites could also potentially threaten water quality in the Assabet River Watershed. As of 8 March 2004 there are thirty-eight 21E Tier Classified Oil and HAZMAT Sites in the Assabet River Watershed (Appendix J). There are also four National Priority Listed Sites (Superfund Sites) in the Assabet River Watershed- Fort Deven-Sudbury Training Annex, Hocomonco Pond, WR Grace-Acton, and Starmet (Nuclear Metals). Additional information on these sites is provided in the Summary of Existing Conditions and Perceived Problems section and in the affected segment.

USGS is currently conducting a study to provide a more thorough description of the sediments within the Assabet River. The project will map the sediments and then the sediments will be chemically and physically analyzed. These data will be crucial in managing phosphorus in the watershed. As of February 2004 sediment depths and extent were mapped in six impoundments (Rt. 20 in Northborough; Allen Street in Northborough; Rt. 85/Washington Street in Hudson; Gleasondale in Stow; Ben Smith in Maynard; and Powdermill in Maynard/Acton) and hundreds of core sub-samples were collected, processed, and distributed to four laboratories, including the EPA's, for analysis. Sub-samples were analyzed for volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), extractable petroleum hydrocarbons (EPH), polychlorinated biphenols (PCBs), organochlorine pesticides, and metals. USGS is finalizing a report detailing the results and (Zimmerman 2004)

RECOMMENDATIONS

Throughout the Assabet River Watershed bacteria monitoring should be conducted to document the effectiveness of bacteria source reduction activities associated with the Phase II community storm water management program and to assess the status of the *Primary* and *Secondary Contact Recreational* uses.

The recommendations from the TMDL should be implemented including completing feasibility studies for dam removal and dredging of sediment for phosphorus removal.

Draft permits were issued to the major WWTPs in 2004 with total phosphorus limits of 0.1 mg/L between 1 April and 31 October. These limits are to be achieved by WWTPs by 2009.

A monitoring program should be developed to document the results of TMDL implementation.

When available, review the USGS sediment report for data to assess the status of the *Aquatic Life Use* as well as to implement options to manage concentrations of sediment phosphorus in the impoundments of the Assabet River.

The Organization for the Assabet River should continue to collect quality-assured water quality and quantity data and provide it to MA DEP for use in assessing the status of the *Aquatic Life* and *Aesthetics* uses. If possible, OAR should expand the monitoring program to include bacteria sampling to assess the *Primary* and *Secondary Contact Recreational* uses.

Work with interested parties to protect the core habitats associated with the Assabet River and critical supporting watershed identified in the Natural Heritage *Living Waters* report (2003) through land conservation measures and management practices.

Communities in the following subwatersheds should review the 2004 DeSimone simulation report (see summary on page 29) for guidance on decision-making related to the cumulative impacts of water withdrawals and wastewater management.

- Fort Meadow Brook
- Cold Harbor & Howard Brooks
- Hop Brook
- Stirrup Brook
- Taylor Brook
- Fort Pond Brook
- North Brook
- Danforth Brook
- Nashoba Brook

ASSABET RIVER WATERSHED- RIVER SEGMENT ASSESSMENTS

Assabet River (Segment MA82B-01)	49
Hop Brook (Segment MA82B-20).....	54
Assabet River (Segment MA82B-02)	57
Cold Harbor Brook (Segment MA82B-18).....	62
Assabet River (Segment MA82B-03)	65
Assabet River (Segment MA82B-04)	70
North Brook (Segment MA82B-21).....	77
Gates Pond Brook (Segment MA82B-10)	80
Danforth Brook (Segment MA82B-19).....	82
Assabet River (Segment MA82B-05)	85
Fort Meadow Brook (Segment MA82B-11)	94
Elizabeth Brook (Segment MA82B-12).....	98
Assabet Brook (Elizabeth Brook) (Segment MA82B-17).....	100
Taylor Brook (Segment MA82B-08)	103
Assabet River (Segment MA82B-06)	106
Assabet River (Segment MA82B-07)	111
Second Division Brook (Segment MA82B-09)	118
Fort Pond Brook (Segment MA82B-13).....	120
Nashoba Brook (Segment MA82B-14)	124
Spencer Brook (Segment MA82B-15)	129
Unnamed Tributary (Segment MA82B-16).....	131

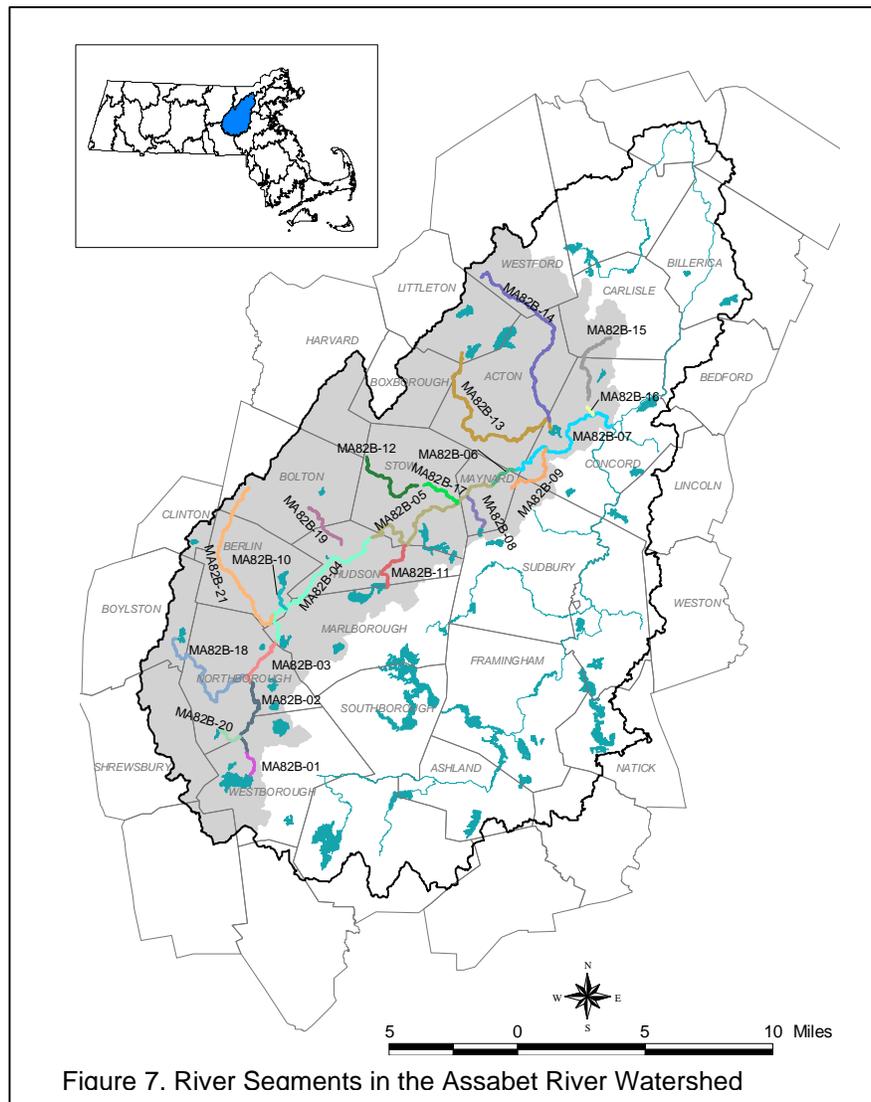


Figure 7. River Seaments in the Assabet River Watershed

ASSABET RIVER (SEGMENT MA82B-01)

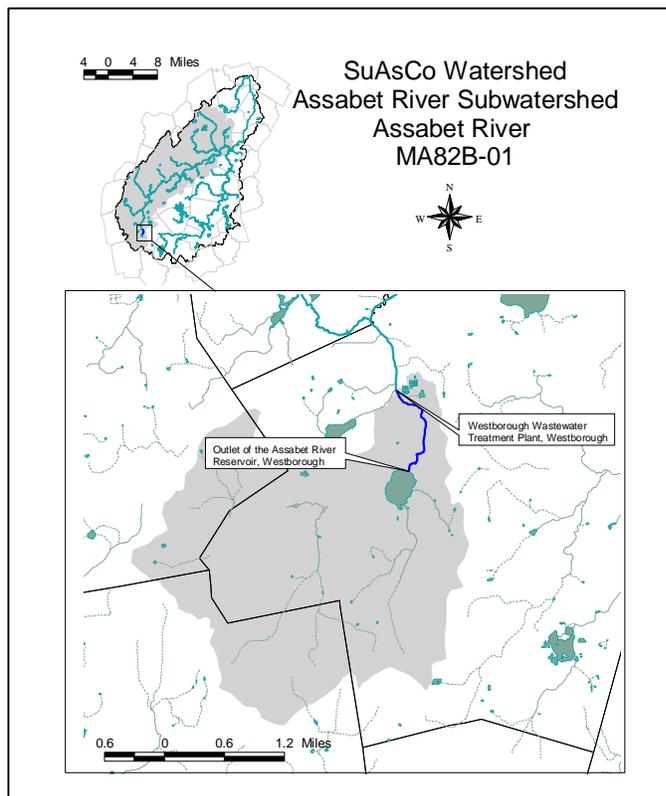
Location: Outlet of the Assabet River Reservoir, Westborough to the Westborough Wastewater Treatment Plant discharge, Westborough
 Segment Length: 1.2 miles
 Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 8.1 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.76 mi² and the percentage of the imperviousness is 9.3%.

- Forest..... 45%
- Residential 23%
- Agriculture..... 12%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for pathogens (MA DEP 2003a). A TMDL has been completed for nutrients (total phosphorus) and organic enrichment/low DO.

MDFW conducted fish population sampling at two unnamed tributaries to the Assabet River Reservoir (also known as the A1 Impoundment) on 4 June 2001 (Richards 2003a). The first station was east of the Old Nourse Street crossing (lat: 42.2566015/long: 71.6339457). The sample consisted of 14 brook trout and one individual pumpkinseed. The other station was south of the Glen Road crossing (lat: 42.24951/long: 71.65733). The sample consisted of five brook trout and two white sucker. Based on their sampling MDFW has proposed that these two unnamed tributaries be classified as cold water fisheries (Richards 2003b).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Westborough Water Department*	9P421432801	21432804	2328000-03G -04G -06G	1.92 (reg) <u>1.18 (perm)</u> 3.1*

* Indicates a system-wide withdrawal, all sources not necessarily located within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E1-E4)

MA0027189 Astra Pharmaceutical Products, now Astra Zeneca, connected to the Westborough WWTP and is considered a Significant Industrial User (SIU). As an SIU the effluent is monitored and limited by the Westborough WWTP. According to records at the Westborough WWTP Astra Zeneca has been discharging since at least 1990 (Webber 2004d).

Westborough Water Purification Facility (MAG640007) also discharges <1 MGD of filter backwash from sedimentation basins to Hocomonco Pond (See details in Lakes section).

LANDFILLS (APPENDIX K)

There is one landfill, which is inactive, located within this subwatershed.

SUPERFUND SITES

The 23-acre Hocomonco Pond (see also lake segment MA82060) site in this subwatershed of the Assabet River is contaminated with creosotes, carcinogenic compounds, and heavy metals including

arsenic and chromium. The Kettle Pond area, Hocomonco Pond, and a discharge stream were dredged and contaminated sediments were disposed of in an on-site lined landfill. Additional information is available in the Summary of Existing Conditions and Perceived Problems section of this report and from the EPA website:

http://yosemite.epa.gov/r1/npl_pad.nsf/51dc4f173ceef51d85256adf004c7ec8/ee9536bdef65eb8d8525691f0063f6ce?OpenDocument.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

There are competing water uses in the Assabet River Reservoir subwatershed that include municipal water supply, wildlife habitat (heron rookery), proposed flow augmentation for the Westborough WWTP discharge (has never happened), and golf course irrigation.

The summer of 1999 and the fall/winter/spring of 2001/2002 were documented to have below normal streamflows and precipitation (see Summary of Existing Conditions and Perceived Problems).

During dry/drought conditions the Assabet River has been documented to run dry for approximately one mile (the majority of this segment). When the Assabet River Reservoir (also known as the A-1 Impoundment) was built for flood control purposes in the early 1950's a minimum flow release of 3.5 cfs may have been required. This minimum flow requirement has not been met due to the shallowness, and subsequent lack of storage capacity, of the impoundment (DFWELE 2002). Using Stream Stats the estimated 7Q10 for this segment is 0.24 cfs. The August median flow is 1.35 cfs (USGS 2002).

The height of the A1 Impoundment varied over 3.7 feet during OAR's sampling work in the summers of 2001 and 2002 (OAR 2001 and 2002).

ENSR conducted streamflow monitoring at Maynard Street in Westborough in February, March, and August 2000 as part of a nutrient TMDL study (ENSR 2001). Flows ranged from 0.1 cfs during the summer month of August to 21 cfs in March (n=4).

USGS collected monthly flow data downstream of the bridge on Fisher Street in Westborough between November 2001 and December 2002 (n=13). Discharge ranged from a low of 0.02 cfs in August 2002 to a high of 33.1 cfs in December 2002. The drainage area size was calculated to be 6.72 mi². USGS also collected discharge measurements from the Maynard Street bridge in Westborough on 23 October 2001 (0.11 cfs), 17 July 2002 (0.10 cfs) and 7 August 2002 (0.03 cfs). The drainage area size was calculated to be 6.79 mi² at the Maynard Street bridge (Socolow *et al.* 2003).

DWM attempted to conduct biomonitoring along one reach of this segment between Mill Street and Fisher Street in Westborough on 18 July 2001. However, sampling this reach was impossible as the river was a "mostly dry streambed with shallow pools barely connected by very shallow, narrow bands of flowing water" (Appendix D). Barely a trickle of water was observed being released to the river from the Assabet River Reservoir (MA DEP 2001a). The survey was instead conducted downstream from Fisher Street (Station ARW (B0466)) where there was slightly more water and riffle habitat with sufficient depth to allow for the application of RBP kick sampling. The riparian zone was wooded and the reach was approximately 80% covered by canopy. Instream substrates were comprised mostly of cobble, however, sand deposits were noted and presumed to be from upstream sources. Instream cover for fish was considered poor and velocity/depth and channel flow status were considered marginal. The total habitat score for this reach (138/200) reflected the lack of water.

Biology

MDFW (Richards 2003a) conducted fish population sampling at one station south of Maynard Street, Westborough, on this segment of the Assabet River on 25 July 2001 using backpack electroshocking equipment. Twenty-three white sucker, 22 largemouth bass, 15 yellow bullhead, five chain pickerel, two bluegill, and one golden shiner were collected (68 fish total). Although the sample was

dominated by a fluvial dependant species (white sucker) all remaining fishes were macrohabitat generalists. In addition, all species collected are either tolerant or moderately tolerant to pollution.

The DWM RBP III analysis of the benthic survey conducted downstream from Fisher Street on 18 July 2001 (Station ARW) indicated a slightly impacted benthic community compared to the North Brook, Berlin reference station. The stress was considered likely a result from organic enrichment, poor habitat and flow fluctuations (Appendix D).

Toxicity

Ambient

Between November 1996 and March 2004 water from the Assabet River was collected approximately 20 feet upstream from the Westborough WWTP outfall for use as a diluent/control in their *Ceriodaphnia dubia* (n=28) and *Pimephales promelas* (n=16 conducted between November 1996 and November 2000) whole effluent toxicity tests. Survival of *C. dubia* exposed to the river water for seven days generally ranged between 80 and 100% with one exception in August 1999 (30% survival). *P. promelas* survival ranged between 20 and 98% and survival in six of the 16 tests was less than 75%.

Chemistry – water

OAR conducted monthly water quality monitoring at one station at the Maynard Street bridge in Westborough (Station 31.0) between June and September 2000, June and October 2001, and June and October 2002 (OAR 2001, OAR 2002, and OAR 2003). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for total suspended solids (TSS), total phosphorus, and ammonia-nitrogen. OAR also measured DO, saturation, and pH on two occasions off the end of Sassacus Drive in June and September 2000.

Assabet River water was collected approximately 20 feet upstream from the Westborough WWTP outfall for use as a diluent/control in their whole effluent toxicity tests. Data from these reports, which are maintained in the TOXTD database by DWM, are summarized below. The water was analyzed for pH, hardness, alkalinity, conductivity, ammonia, and suspended solids.

DO

Dissolved oxygen concentrations reported by OAR ranged from 7.2 to 10.1 mg/L and saturation ranged from 71.0 to 99.4% (n=14). The DO in the river near Sassacus Drive was 6.38 mg/L (72.4% saturation) and 6.2 mg/L (65.7 % saturation). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn (between 0500 and 0900).

Temperature

Temperatures reported by OAR ranged between 7. 7°C and 23.3°C (n=16).

pH

pH values recorded by OAR near Maynard Street ranged between 6.9 and 7.6 SU (n=14). The two pH measurements near Sassacus Drive were both 6.5 SU. Assabet River pH values reported in the Westborough toxicity tests ranged between 6.3 and 7.3 SU (n=28) with only one of the measurements less than 6.5 SU.

Conductivity

Conductivity reported by OAR ranged between 119 and 415 μ S/cm (n=14). Conductivity reported in the Westborough toxicity tests ranged between 135 and 313 μ S/cm (n=28).

Total Suspended Solids

Total suspended solids concentrations reported by OAR ranged between <1 and 19 mg/L (n=8). Suspended solids in Assabet River water collected for the Westborough toxicity tests ranged between <1 and 11 mg/L (n=28).

Total phosphorus

Total phosphorus concentrations reported by OAR were low ranging between <0.01 and 0.04 mg/L (n=11).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR ranged between <0.03 and 0.09 mg/L (n=10). Ammonia-nitrogen concentrations reported in the Westborough toxicity test reports ranged between <0.1 and 0.380 mg/L (n=28).

Total Residual Chlorine

None of the 28 measurements reported in the Westborough toxicity test reports were above the minimum quantification level of 0.05 mg/L.

The *Aquatic Life Use* for this segment of the Assabet River is assessed as impaired primarily as a result of flow limitations from the outlet control practices at the Assabet River Reservoir and the absence of intolerant and/or fluvial fish species (other than white sucker). Although the benthic macroinvertebrate community analysis indicated only slight impacts, evidence of flow fluctuations reduced instream habitat quality. Impacts associated with the ground water withdrawals, if any, are unknown. Enrichment associated with the A1 Impoundment is also likely affecting the benthic community. Poor survival of *P. promelas* exposed to river water is also a concern.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR collected one wet weather fecal coliform bacteria sample from the river at the Maynard Street bridge in Westborough (Station 31.0) on 20 August 2002. The concentration was >15,000 cfu/100 mL (OAR 2003).

With the exception of some trash in the river near the Fisher Street road crossing no other objectionable conditions (i.e., odor, color, turbidity or deposits) were noted in this segment of the Assabet River during either field reconnaissance or the DWM biomonitoring survey conducted on 18 July 2001. OAR volunteers described this section as clean, nicely shaded and beautiful (Flint 2004a).

Due to the limited amount of fecal coliform data (only one count) this segment of the Assabet River is currently not assessed for the *Primary* and *Secondary Contact Recreation* uses. However, the recreational uses are identified with an Alert Status because this bacteria count was extremely high. The *Aesthetics Use* is assessed as support based on the field observations of the DWM biologists and OAR volunteers.

Assabet River (MA82B-01) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Flow regime alterations, combined biota/habitat bioassessment (Suspected Source: Nutrient enrichment) Sources: Impacts from hydrostructure flow regulation/ modification
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED*
Aesthetics		SUPPORT

* Alert Status issues identified, see details in use assessment

RECOMMENDATIONS

- To the extent possible flows released from the Assabet River Reservoir should mimic natural hydrographs. Minimum flows should be released, particularly during low flow periods, to protect aquatic life and enhance habitat quality in this segment of the Assabet River.
- Continue to conduct water quality monitoring to better evaluate the status of the *Aquatic Life Use*. At a minimum continuous dissolved oxygen, pH, and total phosphorus data should be collected and biological (benthic macroinvertebrate, habitat assessment, and fish population) sampling should be conducted.
- Survival of *P. promelas* exposed to river water in the Westborough WWTP toxicity tests was less than 75% in six of 16 tests conducted. A shoreline survey of the river upstream from the Westborough outfall would be helpful to determine potential sources of toxicity. An instream toxicity test using caged minnows may also provide more insight into whether or not the river water is having negative effects on the biota.

HOP BROOK (SEGMENT MA82B-20)

Location: From the outlet of Smith Pond, Northborough to the confluence with the Assabet River, Northborough

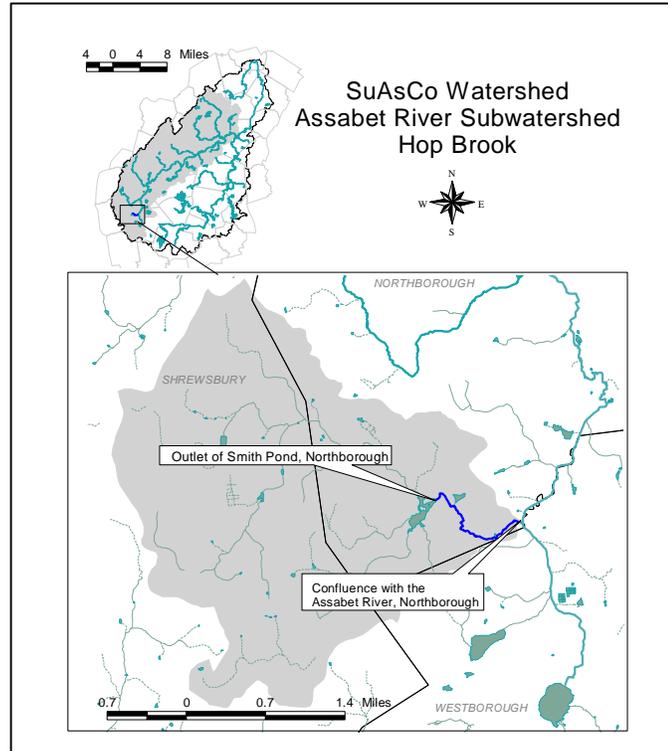
Segment Length: 1.3 miles

Classification: Class B

Land-use estimates (top 3, excluding water) for the 7.9 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 1.1 mi² and the percentage of the imperviousness is 14.5%.

- Forest..... 41%
- Residential 37%
- Open land 7%

MDFW (Richards 2003a) conducted fish population sampling upstream from this segment and Smith Pond, at two stations on 25 July 2001 (off Route 20, east of the sewage treatment plant road; and west of Route 20 near Davis Street) using backpack electroshocking equipment. The fish collected from the station east of the STP Road included 34 blacknose dace, nine white sucker, seven brook trout, seven fallfish, and one American eel (58 fish total). At the station west of Route 20 near Davis Street, 16 blacknose dace, three chain pickerel, two yellow bullhead, one American eel, one bluegill, and one banded sunfish were collected (24 fish total). Based on these data, MDFW has recommended that Hop Brook be protected as cold water fishery habitat (Richards 2003b).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Shrewsbury Water & Sewer Department*	9P21427101		2271000-01G	2.64 (reg) 1.01 (perm) 3.65
Bigelow Nurseries Inc.*		21421502	Well #1 (reservoir w/d)	0.15

*Shrewsbury has additional registered and permitted sources in the Blackstone Watershed. Shrewsbury no longer withdraws from this source (i.e., all withdrawals are now from the Blackstone Watershed). Their permit to withdraw 0.26 MGD (through 2009) will be rescinded (Kickham 2004).

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E1-E4)

The Friendship Inn applied for an NPDES permit (MA0039969) but a final permit was never issued. An alternative treatment system that discharges to groundwater was constructed and operational in 2004 (Firmin 2004).

LANDFILLS (APPENDIX K)

There are two landfills located within this subwatershed. One is still active.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

From the Smith Pond dam at Otis Street Hop Brook flows through an old stone mill sluice for about 50m before abruptly forming a pair of reflexed bends. In July 2001 sampling for aquatic macroinvertebrates was conducted by DWM in the riffles amid the initial pair of bends in the brook

downstream from Smith Pond (Station HB). The riparian zone was wooded with a canopy covering approximately 80% of the stream. Instream vegetation included moss, milfoil species, waterweed and duckweed. Hop Brook received a habitat score of 183 out of 200 (Appendix D).

USGS collected discharge measurements from Hop Brook at the downstream side of the bridge on Otis Street in Northborough on 17 July 2002 (2.33 cfs), 7 August 2002 (1.68 cfs), and 4 September 2002 (2.36 cfs). The drainage area size was calculated to be 7.45 mi² at the Otis Street bridge (Socolow *et al.* 2003).

In 2003, as part of the StreamWatch program, OAR collected weekly staff gage readings near Otis Street in Northborough and calculated stream flows based on rating curves developed with USGS. The flow ranged from 1.31 cfs in September to 30 cfs in June (OAR 2004). OAR noted that the dam at Smith Pond leaks and that the station has consistently good flow (Flint 2005).

USGS also collected monthly flow data in Hop Brook at the Indian Meadows Golf Course, upstream from the footbridge at hole #6 in Northborough, between July 2001 and December 2002 (n=17). Discharge ranged from a low of 0.55 cfs in August 2002 to a high of 35.0 cfs in December 2002. The drainage area size was calculated to be 7.74 mi² (Socolow *et al.* 2003).

ENSR measured in stream flows at one station near the mouth of Hop Brook in Westborough (T11) on six occasions between 1999 and 2000 (ENSR 2001). Flows ranged between 0.6 and 22 cfs.

Biology

DWM biomonitoring in Hop Brook in July 2001 downstream from Otis St., Northborough resulted in the benthos being classified as slightly impacted (52% comparable to the North Brook reference site), possibly as the result of the upstream impoundment and adjacent land uses (Appendix D). Filter-feeders (e.g., hydropsychid caddisflies) and algal scrapers (elmid beetles) were well represented in the macroinvertebrate assemblage observed at station HB (B0462). Their presence, when coupled with the excellent benthos habitat afforded them, suggests some degradation of water quality and an abundance of organic inputs in this portion of Hop Brook.

Chemistry – water

OAR conducted monthly water quality monitoring in Hop Brook near Otis Street in Northborough from June to October 2002 and from June to September 2003 (OAR 2003 and OAR 2004). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen.

DO

Dissolved oxygen concentrations reported by OAR ranged from 2.9 to 9.0 mg/L (n=8). Percent saturations reported for the 2002 surveys ranged from 37.1 to 88.6%. Two of the 8 readings were less than 5.0 mg/L (as were saturations below 60%) and were recorded during July and August 2002. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Temperature

Temperature ranged from a low of 14.4 to a high of 27.4°C (n=8).

pH

pH ranged between 6.6 and 7.1 SU (n=8).

Conductivity

Conductivity in Hop Brook in 2002 ranged between 366 and 831 µS/cm (n=4).

Total Suspended Solids

TSS concentrations ranged between <1 and 5.0 mg/L (n=7).

Total phosphorus

Total phosphorus concentrations ranged between <0.01 and 0.04 mg/L (n=7).

Ammonia-nitrogen

Ammonia-nitrogen concentrations were 0.14 and 0.22 mg/L (n=2).

The *Aquatic Life Use* for Hop Brook is assessed as support based primarily on the benthic macroinvertebrate community analysis and excellent habitat quality conditions. However, the use is identified with an Alert Status because of some indications of water quality degradation and the occasional low dissolved oxygen concentrations.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

With the exception of some woody debris in Hop Brook during the July 2001 biomonitoring survey no other objectionable odors, oils or other conditions were noted by DWM biologists (Appendix D, MA DEP 2001a). OAR volunteers noted that Hop Brook downstream from Smith Pond is free-flowing and pretty, with no objectionable deposits, sheens, or nuisance vegetation. They also note that the stream flows through a golf course (Flint 2004a).

Due to the lack of bacteria data Hop Brook is currently not assessed for the *Primary* and *Secondary Contact Recreational* uses. The *Aesthetics Use* is assessed as support based on observations by DWM biologists and OAR volunteers.

Hop Brook (MA82B-20) Use Summary Table

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

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

RECOMMENDATIONS

- Evaluate potential nonpoint sources of organic inputs to the Hop Brook subwatershed.
- Continue to monitor instream DO/ percent saturation in Hop Brook to evaluate the frequency/duration of low DO conditions.
- Continue to monitor the benthic community to assess the status of the *Aquatic Life Use*.
- MDFW has recommended that Hop Brook be protected as cold water fishery habitat. Additional monitoring of the fish population, DO, and temperature is needed to evaluate MDFW's proposal to list this segment as a cold water fishery in the next revision of the Surface Water Quality Standards.
- Work with the Indian Meadows Golf Course to educate staff at the facility on good stewardship and to implement best management practices (e.g., water conservation, fertilizer use, buffer zone, etc.).
- Conduct a shoreline survey to investigate sources of erosion, particularly examine the fallow fields bisecting Davis Street in Northborough.

ASSABET RIVER (SEGMENT MA82B-02)

Location: From the Westborough Wastewater Treatment Plant discharge, Westborough, to the Route 20 Dam, Northborough

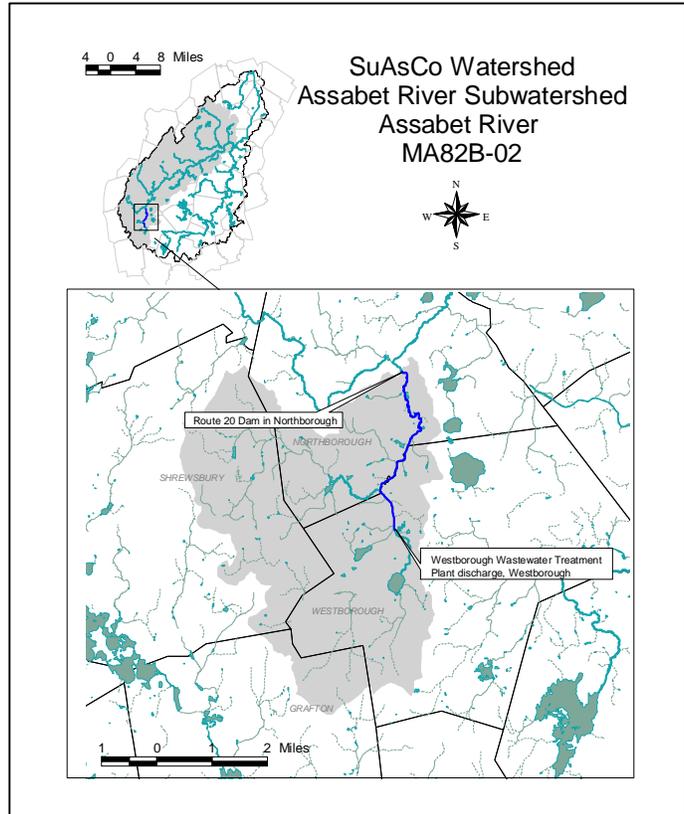
Segment Length: 3.8 miles

Classification: Class B, Warm Water Fishery

Land-use estimates (top 3, excluding water) for the 19.5 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 2.2 mi² and the percentage of the imperviousness is 11.4%.

- Forest..... 41%
- Residential 31%
- Agriculture..... 8%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for metals and pathogens (MA DEP 2003a). A TMDL has been completed for nutrients (total phosphorus) and organic enrichment/low DO.



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Westborough Water Department*	9P421432801	21432804	2328000-05G -10G	1.92 (reg) <u>1.18 (perm)</u> 3.1*
Northborough Water & Sewer Department*		21421503	2215000-01G	0.74*
Berberian Farms		21421504	Berberian Stream W/D	0.12 (92 days)
Juniper Hill Golf Course	9P21421501		01 S (Point A Assabet River) 02S (Point B)	0.15

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E1-E4)

The Town of Westborough (MA0100412) was permitted (12 February 2001) to discharge 7.68 MGD of treated sanitary wastewater via outfall 001 to the Assabet River. The permit expired in 2004. The facility's whole effluent toxicity limit is C-NOEC and LC₅₀ ≥ 100% effluent. (The prior permit limit for CNOEC was ≥77% effluent). The permit included seasonal limits for CBOD, BOD, TSS, total phosphorus, and ammonia-nitrogen. The season average monthly total phosphorus limit was 0.75 mg/L between 1 April and 30 October and for total ammonia-nitrogen was 1.0 mg/L between 1 June and 31 October. The total residual chlorine (TRC) limit (maximum daily concentration) was 0.019 mg/L. It should be noted that dechlorination was implemented at the facility in February 1992. The facility has not reported any violations of their TRC limit. The highest concentration of ammonia-nitrogen reported in the toxicity test reports was 0.81 mg/L. A draft permit was issued with new limits (see sources of information and Appendix D for more information.)

It should be noted that a TMDL (MA DEP undated) for the nutrient phosphorus as total phosphorus for the Assabet River has recently been approved by EPA. This TMDL was developed with special emphasis on reducing the extent of nuisance macrophyte growth, meeting minimum dissolved oxygen criteria, reducing extreme diurnal dissolved oxygen fluctuations and excessive dissolved oxygen supersaturation, and reducing ambient total phosphorus concentrations. The TMDL for meeting the water quality objectives, including a margin of safety, includes removal of total phosphorus from POTW effluents to 0.1 mg/L during the growing season (1 April and 31 October) and optimizing the removal of particulate phosphorus during the non-growing season (MA DEP undated). All POTWs are required to be upgraded to achieve 0.1 mg/l of effluent phosphorus by April 2009 and the design should be consistent with adding new technology in the future to achieve further reductions, if deemed necessary.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The estimated 7Q10 used to develop the Westborough WWTP NPDES permit is 0.01 cfs. During certain low flow conditions there is no flow in the Assabet River between the A-1 Impoundment and the Westborough WWTP discharge and the WWTP discharge accounts for most of the river flow below this point.

ENSR measured streamflow of the Assabet River at School Street in Northborough in July 1999. The flow was 5 cfs (ENSR 2001). The USGS conducted monthly flow monitoring on the downstream side of School Street in Northborough from June 2001 to October 2002. The flows ranged from a low of 5.27 cfs in June 2001 to a high of 66.9 cfs in April 2002. The drainage area was calculated to be 18.3 mi² (Socolow *et al.* 2003).

As part of the 18 July 2001 biomonitoring survey DWM conducted a habitat assessment in the Assabet River downstream from School Street in Northborough (ARN (B0359)). The reach was 80% covered by a canopy of deciduous trees and shrubs. The riparian zone was impacted by residential and recreational land uses. Sediment deposition and embeddedness were noted. This reach received a habitat score of 154 out of 200 (Appendix D).

The Juniper Hill Golf Course in Northborough withdraws water directly from the Assabet River between School Street and Brigham Street. The maximum permitted daily withdrawal is 0.15 MGD.

Biology

MDFW conducted fish population sampling at two stations in this segment of the Assabet River on 24 August 2001 using barge electroshocking equipment. The river was sampled north/downstream from Route 135 in Westborough and just upstream from the dam at Route 20 in Northborough (Richards 2003a).

At the station north of the Route 135 bridge a total of ten species were collected. Ninety-seven white sucker, 53 golden shiner, 30 redbfin pickerel, 14 pumpkinseed, seven chain pickerel, four fallfish, four brown bullhead, three bluegill, two largemouth bass, and two yellow bullhead were collected. The fish assemblage was dominated by a tolerant fluvial dependent species. While two other fluvial dependent/specialists (redfin pickerel and fallfish) were present, all other species (n=7) were macrohabitat generalists. All fish collected are considered moderately tolerant to tolerant of pollution.

DWM conducted biomonitoring along one reach downstream from School Street in Northborough in this segment of the Assabet River on 18 July 2001. When compared to the North Brook reference station the RBP III analysis indicated slight impairment (Appendix D).

A total of seven species were collected from the river just upstream from the dam at Route 20 in Northborough. Fourteen white sucker, seven yellow bullhead, five American eel, one brown bullhead, one chain pickerel, one pumpkinseed and one redbfin pickerel were collected at the station south of the dam at Route 20 in Northborough. Overall, the total number of fish collected (n=30) was very low compared to the upstream sampling location (n=216). It is unclear whether habitat differences may

account for this. All but one of the species collected are considered macrohabitat generalists, the exception being white sucker. Although white sucker is a fluvial dependant species they are also very tolerant of degraded conditions. All other species collected are also tolerant/moderately tolerant to pollution.

Toxicity

Effluent

Between 12 November 1996 and 9 March 2004 28 whole effluent toxicity tests were conducted on Town of Westborough WWTP effluent using the water flea, *Ceriodaphnia dubia*. A total of 16 whole effluent toxicity tests were conducted using the fathead minnow, *Pimephales promelas*, between 12 November 1996 and 7 November 2000. The LC₅₀s were all >100% effluent with the exception of the June 2002 *C. dubia* test (LC₅₀ = 70.7% effluent). The C-NOECs ranged from <6.25 to 100% effluent in 14 of the 27 valid *C. dubia* tests and only one of the valid *P. promelas* tests (September 1999 CNOEC<6.25% effluent) did not meet the current CNOEC permit limit of 100% effluent.

Chemistry – water

OAR conducted monthly water quality monitoring at four stations on this segment of the Assabet River between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen. In 2002 OAR only conducted water quality monitoring at two stations (OAR 2003).

- Station 30.1- by Rte 9 East bridge, Westborough (became Station ABT-301 in 2002)
- Station 29.0- Milk Street {Rte 135}, Westborough
- Station 28.0- by School Street bridge, Northborough (became Station ABT-280 in 2002)
- Station 26.3- above the dam at Rte 20, Northborough

As part of the SMART monitoring program, water quality sampling was conducted on five occasions between March and November of 2000 in the Assabet River (station AS04) approximately 20 meters upstream/south of School Street, Northborough (Appendix I). Parameters measured included temperature, pH, DO, specific conductivity, hardness, alkalinity, total phosphorus, and ammonia-nitrogen.

DO

Dissolved oxygen concentrations reported by OAR from their five stations ranged from 3.6 to 8.2 mg/L with seven of the 46 measurements (15%) less than 5.0 mg/L. These low concentrations occurred throughout the segment on 15 July 2000 and 11 August 2001. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Dissolved oxygen concentrations measured by the SMART monitoring program in 2000 ranged from 4.4 to 11.2 mg/L (n=5) with one of five measurements less than 5.0 mg/L. Percent saturation ranged between 48 and 88% (n=5) with two of the five measurements less than 60% saturation. None of these measurements were collected during worst-case, pre-dawn conditions although they were collected between 0830 and 0900h.

Temperature

None of the temperature measurements reported by either OAR or SMART exceeded 24°C.

pH

pH values recorded by OAR and the SMART monitoring programs ranged between 6.2 and 7.1 SU. Only seven of the 51 measurements were less than 6.5 SU.

Hardness

Hardness data ranged from 62 to 135 mg/L (n=6).

Alkalinity

Alkalinity ranged between 17 and 33 mg/L (n=6).

Conductivity

Conductivity reported by OAR throughout this reach ranged between 331 and 1031 $\mu\text{S}/\text{cm}$ (n=17). Conductivities measured by SMART in 2000 ranged from 373 to 879 $\mu\text{S}/\text{cm}$ (n=5).

Total Suspended Solids

Total suspended solids concentrations (n=33) reported by OAR ranged between <1 and 41 mg/L with three greater than 25 mg/L (all occurring on 15 July 2000). TSS concentrations measured by SMART ranged from <1.0 to 3.1 mg/L.

Turbidity

Turbidity in the Assabet River upstream from School Street ranged between 1.0 and 3.2 NTU (n=6).

Total phosphorus

Total phosphorus concentrations reported by OAR ranged between 0.16 and 0.90 mg/L (n=37). Total phosphorus concentrations reported by the SMART program in 2000 ranged between 0.15 and 0.69 mg/L (n=6).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR ranged between 0.09 and 0.24 mg/L (n=24). Ammonia-nitrogen concentrations reported by SMART in 2000 ranged between <0.02 and 0.06 mg/L.

Chemistry-sediments

USGS, with assistance from EPA, mapped the depth and extent of sediments in the Route 20 Northborough impoundment of the Assabet River. Cores were collected between September and October 2003 and analyzed for VOCs, PAHs, PCBs, extractable petroleum hydrocarbons (EPH), organochlorine pesticides, and metals. These data, however, are not yet available. Results from this study will be useful for implementing the recommendations of the Assabet nutrient TMDL (Zimmerman 2004).

The *Aquatic Life Use* is assessed as impaired for this segment of the Assabet River because of low dissolved oxygen/saturation, elevated levels of total phosphorus, and a slightly impacted benthic community indicative of enrichment related water quality degradation. Additionally, the fish community is dominated by tolerant/moderately tolerant species. Chronic toxicity in the Westborough WWTP is also of concern.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR's Northborough Stream Team conducted a shoreline survey in this segment of the Assabet River from Route 9 to Route 20. The Stream Team divided the survey into four sections. In section one, from Route 9 to Davis Street, they noted that the drainage system for the Indian Meadows Golf Course discharges to the river. In section two, from Davis Street to School Street, the sewer easement runs along the river, two pipes drain to this segment, and erosion from Route 135 was noted. In section three, from School Street through the Juniper Hills Golf Course to the railroad tracks, they noted pipes emitting suds and an oily film with sewage odors, discharges from the Juniper Hill Golf Course, and grass and leaf disposal along the riverbanks. In section four, from the railroad tracks to Route 20, excessive algae and weed growth were noted on top of the Route 20 dam. Sewage odors, clear cutting, and localized areas of trash were also noted in the Route 20 vicinity (NST 2002).

SMART field crews did not note any objectionable deposits of trash and debris, objectionable sheens or scum upstream from School Street in Northborough. On two occasions the water was noted to have a musty basement odor (MA DEP 2001b).

During the biomonitoring survey conducted on 18 July 2001 downstream from School Street, Northborough, DWM biologists noted the water had a "treated sewage" odor, was slightly turbid, and had a moderately dense greenish-brown color. No instream vascular plants or algae were observed within the sample reach (Appendix D).

Due to the lack of bacteria data this segment of the Assabet River is currently not assessed for the *Primary* and *Secondary Contact Recreational* uses. Although some effluent odors were noted throughout this reach there were no other objectionable deposits or other conditions prevalent through this segment; therefore, the *Aesthetics Use* is assessed as support. The use is identified with an Alert Status, however, because of the effluent odor and the discharge documented near the Juniper Hill Golf Course as well as localized areas of trash and algal growth near the Route 20 dam.

Assabet River (MA82B-02) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Total phosphorus, nutrient/ eutrophication biological indicators, combined biota/habitat bioassessments, dissolved oxygen saturation (Suspected Causes: Ambient bioassays- chronic Sources: Municipal point source discharge, impacts from Hydrostructure flow regulation/ modification) (Suspected Sources: Golf courses, yard maintenance, discharges from municipal separate storm sewer systems (MS4s), internal nutrient recycling)
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT*

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

RECOMMENDATIONS

- Continue to conduct biological monitoring (both fish population and benthic macroinvertebrate sampling) near School Street, Northborough, to evaluate the status of the *Aquatic Life Use* and to determine changes associated with upgrades and more stringent permit limits for the Westborough WWTP discharge and the effectiveness of implementation of the TMDL. Continue to conduct water quality monitoring including, at a minimum, continuous dissolved oxygen, pH, and total phosphorus collections to evaluate the frequency and duration of low DO conditions through this segment of the river.
- When it becomes available, review the USGS sediment report for appropriate data to assess the *Aquatic Life Use*.
- Work to educate the Juniper Hills Golf Course on good stewardship practices including implementing best management practices (e.g., water conservation, fertilizer use, buffer zone, etc.).
- Investigate the discharge identified by the stream team near the Juniper Hill Golf Course and remediate as deemed necessary.
- Conduct biological monitoring (fish population, habitat assessment, and benthic macroinvertebrate sampling) to evaluate potential impacts of the Juniper Hill Golf Course.
- Monitor the Westborough WWTP compliance with their total phosphorus permit limit.
- Implement the recommendations from the completed nutrient TMDL for the Assabet River.

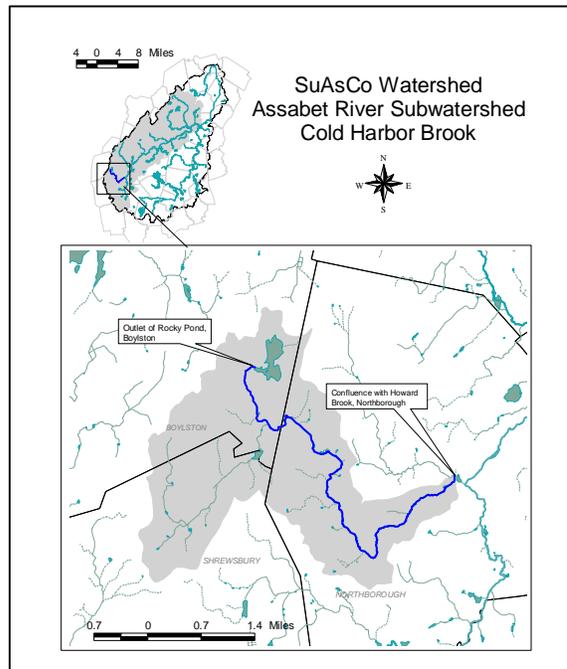
COLD HARBOR BROOK (SEGMENT MA82B-18)

Location: Headwaters, outlet of Rocky Pond, Boylston to confluence with Howard Brook, Northborough
 Segment Length: 6.1 miles
 Classification: Class B

Land-use estimates (top 3, excluding water) for the 6.9 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.7 mi² and the percentage of the imperviousness is 10.6%.

- Forest..... 49%
- Residential 32%
- Wetlands..... 5%

MA DCR maintains a large flood plain behind Cold Harbor Brook Dam, although hayfields are still mowed in the northern part of the area (OAR 2004).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Northborough Water & Sewer Department*		21421503	2215000-03G	0.74*
Bigelow Nurseries*		21421502	Well #2	0.15

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available data there are no NPDES regulated wastewater discharges to this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Between July and November 2002 USGS measured flow in Cold Harbor Brook in Northborough near the Cherry Street bridge (Station 01096701). The drainage area at this location is 5.06 mi². The flows (n=4) ranged from 0.66 to 7.49 cfs (Socolow *et al.* 2003). It is important to note that during the summer of 2002 the northeast portion of Massachusetts was under a drought advisory (Marler 2003).

The Organization for the Assabet River recorded stage measurements from the staff gage at the Cherry Street bridge in Northborough during June, July, August, September 2002 as part of their water quality monitoring program. In 2003 as part of the StreamWatch Project OAR also collected staff gage measurements at Cherry Street and converted the heights to streamflows based on rating curves developed with USGS. Flows ranged from 0.9 to 20 cfs (n=14).

The Cold Harbor Brook Stream Team noted a number of dams that are in disrepair and impact flow in the stream (CHBST 2002).

ENSR collected streamflow measurements near the mouth of Cold Harbor Brook in Northborough, (below the small impoundments) on four occasions in 2000 (ENSR 2001). Flows ranged from 0 to 23 cfs. It is possible that the two small impoundments ~100 meters upstream from the confluence with

the Assabet River were retaining water and that these flow measurements are not indicative of conditions upstream from the ENSR sampling location.

Biology

MDFW (Richards 2003a) conducted fish population sampling at one station east of Church Street, Northborough, in Cold Harbor Brook on 21 July 2000 using backpack electroshocking equipment. A total of four species were collected including 37 blacknose dace, nine white sucker, and seven bluegill, and three largemouth bass (56 fish total). A moderately tolerant fluvial specialist dominated the sample. The remainder of the fish present were tolerant species, two macrohabitat generalists and one fluvial dependant (white sucker).

Chemistry – water

OAR conducted monthly water quality monitoring at one station by the Cherry Street bridge in Northborough June and September 2002 and 2003 (OAR 2003 and OAR 2004). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia.

DO

Dissolved oxygen concentrations ranged from 3.6 to 8.1 mg/L (four of 11 measurements were less than 5.0 mg/L). Percent saturations were between 40.9 and 75.3% (six of 11 measurements were less than 60%). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900.

Temperature

Temperatures ranged from a low of 9.3 to a high of 21.7°C (n=11).

pH

pH ranged between 6.2 and 6.7 SU (n=11). Nine of the measurements were less than 6.5 SU.

Conductivity

Conductivity ranged between 350 and 704 µS/cm (n=11).

Total Suspended Solids

Total suspended solids concentrations ranged between <1 and 27.5 mg/L (n=9). Only one measurement was >25 mg/L.

Total phosphorus

Total phosphorus concentrations ranged between <0.01 and 0.045 mg/L (n=9).

Ammonia-nitrogen

Ammonia-nitrogen concentrations were <0.03 and 0.6 mg/L (n=9). None of these concentrations exceeded the chronic criterion for ammonia-nitrogen.

The *Aquatic Life Use* is assessed as support for Cold Harbor Brook based primarily on the water quality data and the fish community information. This use is identified with an Alert Status, however, because of low dissolved oxygen/saturations, low pHs, and the fish community. It is unclear whether the low dissolved oxygen and pH are naturally occurring conditions (there are contiguous wetlands in the lower section of Cold Harbor Brook) or the result of anthropogenic inputs. Although the fish community is dominated by fluvial specialists (indicative of a fairly stable flow regime) all species were moderately or tolerant to pollution. It is unclear if low flows in Cold Harbor Brook are impacting the Aquatic Life and additional flow monitoring would be useful.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

The Organization for the Assabet River Cold Harbor Brook Stream Team conducted a shoreline survey of Cold Harbor Brook on 4, 5, and 11 May 2002. The Stream Team noted occasional areas of trash and debris (mostly behind dam structures), improper disposal of lawn clippings, and occasional areas with algae blooms/objectionable odors. Storm drains, which discharged directly into the brook,

were also observed. Overall, the Stream Team generally described this brook as aesthetically pleasing with only minor problems that could be addressed by educating property owners, working with the Town DPW, and performing a minor stream cleanup (CHBST 2002).

Due to the lack of quality assured bacteria data the recreational uses are currently not assessed for Cold Harbor Brook. Based on the overall high aesthetic quality of Cold Harbor Brook the *Aesthetics Use* is assessed as support.

Cold Harbor Brook (MA82B-18) Use Summary Table

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

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

RECOMMENDATIONS

- Conduct water quality monitoring in Cold Harbor Brook to determine if the low dissolved oxygen/saturation and pH conditions are naturally occurring or anthropogenically induced.
- Evaluate the outlet control practices of the dams in this subwatershed. To the extent practical streamflows over the dams should mimic natural hydrographs/flow regimes for the protection of aquatic life. OAR should continue to conduct stream flow monitoring on this tributary. Flow monitoring at additional locations is also warranted given the zero flows recorded by ENSR in 2000.
- Continue to conduct biological monitoring (habitat quality, fish community) to evaluate the status of the *Aquatic Life Use*.
- Work with OAR and the stream team to educate abutters and promote stewardship, conduct stream cleanups, and continue to conduct shoreline surveys.

ASSABET RIVER (SEGMENT MA82B-03)

Location: From the Route 20 Dam in Northborough to the Marlborough West Wastewater Treatment Plant discharge, Marlborough

Segment Length: 2.4 miles

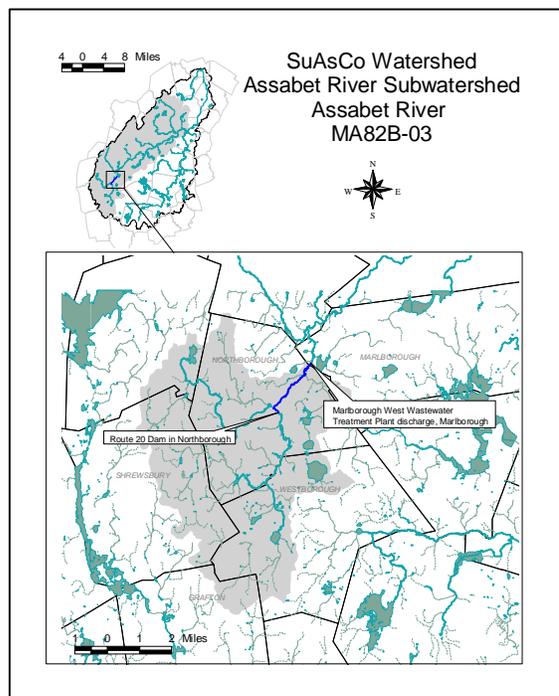
Classification: Class B, Warm Water Fishery

Land-use estimates (top 3, excluding water) for the 34.9 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 3.6 mi² and the percentage of the imperviousness is 10.3%.

Forest 43%
 Residential 29%
 Open land 7%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for pathogens (MA DEP 2003a). A TMDL for nutrients has been completed.

MDFW has proposed that Howard Brook, a tributary to this segment of the Assabet River, be protected as cold water fishery habitat (Richards 2003b). MDFW conducted fish population sampling in Howard Brook on 5 June 2000 at one station downstream from Green Street, Northborough (Richards 2003a). The sample consisted entirely of brook trout (n=12).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Northborough Water & Sewer Department*		21421503	2215000-02G -04G -05G -06G	0.74*
Westborough Water Department*	9P421432081	21432804	2328000-07G -08G	1.92 (reg) 1.18 (perm) 3.1*

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY

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

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

USGS measured discharge of the Assabet River at the River Street bridge in Northborough on 14 November 2001 (7.59 cfs). Flows were also measured by ENSR personnel at this location in February and March 2000. Discharge was 20 and 80 cfs, respectively (ENSR 2001). USGS also conducted bimonthly flow monitoring in the Assabet River downstream of the Woodside Mill dam/Allen Street in Northborough between June 2001 and October 2001. From November 2001 to December 2002 monthly flow measurements were taken. Discharges ranged from a low of 8.35 in October 2001 to a high of 102 in April 2002 (n=21). The drainage area at Allen Street is 29.5 mi² (Socolow *et al.* 2003). ENSR personnel also measured flow of the river at the Allen Street impoundment in August 2000; it was 11 cfs (ENSR 2001). Streamflows were also measured by ENSR at Boundary Street in Marlborough and were 40 and 87 cfs (ENSR 2001).

Biology

ENSR (2001) conducted macrophyte mapping in the Allen Street Impoundment in July 1999 and August 2000. The assemblage was dominated by filamentous green algae and the non-native *Potamogeton crispus* was identified. Water depth in the Allen Street impoundment ranged between two and six feet.

MDFW conducted fish population sampling at two stations in this segment of the Assabet River on 7 June 2001 using barge electroshocking equipment. The river was sampled near Yellick Park off Solomon Pond Road, Northborough, and near Boundary Street, Northborough/Marlborough (Richards 2003a).

At the Yellick Park station, a total of 14 species were collected. These included, in order of dominance, 72 blacknose dace, 46 white sucker, 42 bluegill, 13 rainbow trout, 12 fallfish, nine brown trout, eight American eel, six creek chubsucker, six yellow bullhead, five redbfin pickerel, four pumpkinseed, two brook trout, two chain pickerel, and one tiger trout. The fish population was dominated by fluvial dependants/specialists (five species excluding stocked trout). With the exception of the stocked trout most other species collected are considered moderately tolerant or tolerant of pollution. The presence of creek chubsucker an intolerant fluvial specialist should be noted.

Near Boundary Street a total of seven species were collected. These included, in order of dominance, 12 white sucker, nine American eel, nine bluegill, eight brown trout, six redbfin pickerel, three pumpkinseed and three rainbow trout. Overall numbers of fish were low (n=50) especially when compared to the upstream station (n=228). However, instream cover for fish at this sampling location was noted as being poor. All fish present, excluding stocked trout, were either moderately tolerant or tolerant of pollution.

Toxicity

Ambient

Between 11 November 1996 and 8 March 2003 water from the Assabet River was collected upstream from the Marlborough West WWTP's discharge for use as either the dilution water or site control in the facility's whole effluent toxicity tests. Survival of *C. dubia* exposed to the river water for seven days ranged from 60 to 100% and survival of *P. promelas* ranged between 43 and 100%. While survival was less than 75% in only two of the 28 *C. dubia* tests (February and May 1998), survival of *P. promelas* exposed to the river was less than 75% in six of 30 tests.

Chemistry – water

The USGS, as part of their mercury studies, collected DO, pH, conductivity, alkalinity, temperature, total and methyl mercury samples from the water column of the Assabet River near Allen Street in Northborough on 17 August 2000 (USGS 16 October 2003). USGS also collected water quality samples (DO, pH, turbidity, conductivity, temperature, ammonia-nitrogen, total phosphorus, chlorophyll a) from two stations in Northborough- at Allen Street in April and August 2000 and June through September 2001 and at Boundary Street from June through September 2001 as part of a NAWQA NECB nutrient and chlorophyll relation study (Socolow *et al.* 2002).

OAR conducted monthly water quality monitoring at four stations on this segment of the Assabet River between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for total suspended solids, total phosphorus, and ammonia-nitrogen. In 2002 OAR only conducted water quality monitoring at their Boundary Street sampling station (OAR 2003).

- Station 26.2- below the dam at Rte 20, Northborough
- Station 25.3- from Allen Street bridge, above dam, Northborough
- Station 25.2- below Allen Street dam, Northborough
- Station 24.2- by Boundary Street bridge, Northborough/Marlborough (became Station ABT-242 in 2002)

Water from the Assabet River was also collected upstream from the Marlborough West WWTP for use as either the diluent or site control in the facility's whole effluent toxicity tests. Data from these reports, which

are maintained in the TOXTD database by DWM, are summarized below. The water was analyzed for pH, hardness, alkalinity, conductivity, ammonia-nitrogen, and suspended solids.

DO

Dissolved oxygen concentrations reported by OAR from their four stations ranged from 4.9 to 10.3 mg/L (n=50). Only one measurement was less than 5.0 mg/L. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900.

The DO recorded by USGS in the river near Allen Street ranged between 8.0 and 10.8 mg/L (n=9) with reported saturations between 91 and 97% (n=5). The DO recorded by USGS in the river near Boundary Street ranged between 7.5 and 10.6 mg/L with saturations between 83 and 127% (n=5).

Temperature

Temperatures reported by OAR were all <28.3 (n=50). The maximum temperature of the river in this segment reported by USGS was 24.0 °C (n=14).

pH

pH values measured by OAR and USGS and as reported in the Marlborough West test reports in this segment of the Assabet River ranged between 6.6 and 8.1SU (n=93).

Alkalinity

Assabet River water, as reported in the Marlborough West toxicity tests, had alkalinities ranging between <10 and 80 mg/L (n=30).

Hardness

Hardness ranged from 37 to 124 mg/L in the Marlborough West toxicity tests (n=30).

Conductivity

Conductivity measured by OAR and USGS and as reported in the Marlborough West test reports in this segment of the Assabet River ranged between 206 and 961 µS/cm (n=93).

Turbidity

Turbidity measured by USGS NECB study ranged between 1.8 and 7.2 NTU (n=10).

Total suspended solids

Total suspended solids concentrations reported by OAR ranged between <1 and 19 mg/L (n=15). Suspended solid concentrations, as reported in the Marlborough West toxicity reports, ranged between <1 and 15 mg/L (n=30).

Total phosphorus

Total phosphorus concentrations reported by OAR ranged between 0.13 and 0.60 mg/L (n=27). Total phosphorus concentrations reported by USGS as part of the NECB study ranged between 0.145 and 0.782 mg/L (n=12).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR ranged between <0.04 and 0.15 mg/L (n=26). Ammonia-nitrogen concentrations reported by USGS as part of the NECB study ranged between <0.040 and 0.118 mg/L (n=12). Ammonia-nitrogen concentrations reported by Marlborough West ranged between <0.05 and 0.53 mg/L (n=30).

TRC

None of the 29 TRC measurements in the river as reported in the Marlborough West toxicity reports exceeded 0.05 mg/L.

Mercury

The total mercury concentrations in the water column of the Assabet River near Allen Street in Northborough was 1.68 ng/L (USGS 2003), which is below the EPA freshwater chronic criterion of 12 ng/L to protect aquatic life.

Chemistry – sediment

To support characterization of the Assabet River sediments ENSR collected sediment samples from the Allen Street Impoundment along this segment of the Assabet River in September 2000. Samples were analyzed for extractable phosphate and ammonia-nitrogen concentrations and total carbon (ENSR 2001).

USGS collected sediment from the Assabet River near Allen Street in Northborough in August 2000, as part of their mercury studies. The total mercury concentration was 1.5 ppm dry weight (USGS 2003), which exceeded the lowest-effect level (L-EL) of 0.2 ppm (Persuad *et al.* 1993).

USGS, with assistance from EPA, mapped the depth and extent of sediments in the Allen Street impoundments of the Assabet River. Cores were collected between September and October 2003 and analyzed for VOCs, PAHs, PCBs, extractable petroleum hydrocarbons (EPH), organochlorine pesticides, and metals. These data, however, are not yet available. Results from this study will be useful for implementing the recommendations of the Assabet nutrient TMDL (Zimmerman 2004).

Although the fish assemblage near Yellick Park is indicative of stable habitat and flow regimes, the large wetland immediately downstream and associated habitat changes appear to be reducing the diversity of the fish population in the downstream reach of this segment. Based on the elevated concentration of total phosphorus, dominance of filamentous green algae and the presence of the non-native aquatic macrophytes in the impoundment, occasional supersaturation, and frequency of the low survival of the minnows the *Aquatic Life Use* is assessed as impaired for this segment of the Assabet River.

FISH CONSUMPTION

Two edible fillet composite samples (scales off, skin on, five bluegills each) collected by USGS from this segment of the Assabet River in August 2000 were analyzed for total mercury. The concentrations of total mercury in the edible fillet samples were 0.14715 and 0.11721 ppm wet weight (USGS 2003).

The *Fish Consumption Use* is currently not assessed as MDPH has not issued a site-specific advisory for this segment of the Assabet River.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR's Northborough Stream Team conducted a shoreline survey of this segment of the Assabet River from Route 20 to Boundary Street in May 2002. They divided the survey into four sections. In section one an abundance of trash and debris was noted on the former Great Dane property and near Stone's Motorcycles, but most was not in the streambed. In section two, from River Street to Allen Street, thick algae (large green clumps) and foam, six pipes, heavy trash and debris, and a rotten egg smell were noted. In section three localized areas of trash and debris, two isolated oily sheens, and algae at the dam were noted. In section four the only major problem noted was clear-cutting near Boundary Street (NST 2002).

There was a strong effluent smell emanating from the Assabet River below the Allen Street Impoundment on 15 January 2004 (O'Brien-Clayton 2004). OAR noted that the effluent smell is present year round and for most of the length of the river, particularly during the low flow summer months (Flint 2005).

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for this segment of the Assabet River because of the objectionable deposits of trash and debris, odors, and growths of filamentous green algae.

Assabet River (MA82B-03) Use Summary Table

Designated Uses		Status
Aquatic Life		<p>IMPAIRED</p> <p>Causes: Total phosphorus, excess algal growth, non-native aquatic plants (Suspected Causes: Ambient bioassay-chronic aquatic toxicity)</p> <p>Sources: Municipal point source discharge, unknown (Suspected Sources: Discharges from municipal separate storm sewer systems (MS4s), internal nutrient recycling)</p>
Fish Consumption		NOT ASSESSED
Primary Contact		<p>IMPAIRED</p> <p>Causes: Debris/ floatables/trash, odor, excess algal growth</p> <p>Sources: Municipal point source discharge (Suspected Sources: Highway/ road/ bridge runoff (non -construction), residential districts, discharges from municipal separate storm sewers (MS4s), municipal urbanized high density areas, internal nutrient recycling)</p>
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

- Continue to evaluate the survival of minnows exposed to the Assabet River water collected upstream from the Marlborough West WWTP. Determine the need to conduct an instream toxicity evaluation.
- Conduct additional biological monitoring including benthic macroinvertebrate sampling in this segment of the Assabet River to evaluate the status of the *Aquatic Life Use* and to determine changes associated with upgrades and more stringent permit limits of the Westborough discharge and the effectiveness of implementation of the TMDL. Continue to conduct water quality monitoring including, at a minimum, continuous dissolved oxygen, pH, and total phosphorus collections to evaluate the frequency and duration of low DO conditions through this segment of the river.
- Work with OAR to continue to conduct quality assured water quality monitoring to assist in the evaluation of status of the *Aquatic Life Use*.
- When completed, review the USGS sediment report for appropriate data to assess the *Aquatic Life Use*.
- MDFW has proposed that Howard Brook, a tributary to this segment of the Assabet River, be protected as cold water fishery habitat. Additional monitoring of the fish population, DO, and temperature is needed to evaluate MDFW's proposal to list this brook as a cold water fishery in the next revision of the Surface Water Quality Standards.
- Work with OAR to continue conducting their annual river clean ups along this segment to improve the aesthetics.
- Implement the recommendations from the completed nutrient TMDL for the Assabet River.

ASSABET RIVER (SEGMENT MA82B-04)

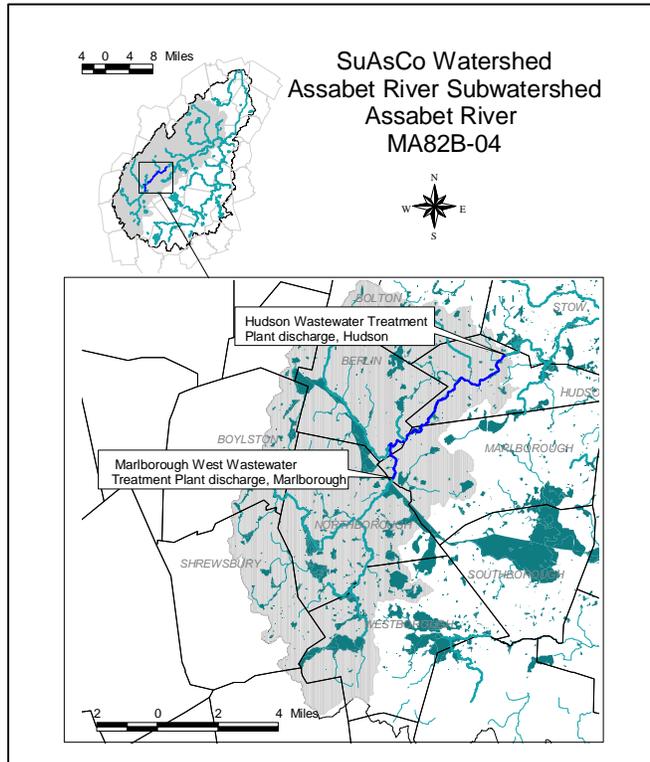
Location: From the Marlborough West Wastewater Treatment Plant discharge, Marlborough, to the Hudson Wastewater Treatment Plant discharge, Hudson
 Segment Length: 8.0 miles
 Classification: Class B, Warm Water Fishery

Land-use estimates (top 3, excluding water) for the 73.7 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 7.4 mi² and the percentage of the imperviousness is 10.0 %.

- Forest..... 48%
- Residential 26%
- Open land 7%
- Agriculture..... 7%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for unknown causes, metals, and pathogens (MA DEP 2003a). A TMDL was completed for nutrients and organic enrichment/low DO.

There is a Town maintained canoe access site on this segment of the Assabet River in Hudson.



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Intel Corp.	9P421414103	21414101	Hudson Well D-1 Hudson Well D-2	0.11 (reg) <u>0.24 (perm)</u> 0.35
Hudson Water Department*	9P21414102	21414102	2141000-01G	2 (reg) <u>0.95 (perm)</u> 2.95*
Concrete Service Inc.**		21402802	Pond 1	0.34

Lake Williams is an Emergency Water Supply.

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

**Concrete Service Inc. has ceased operations and the registration will be rescinded (Kickham 2004).

The MWRA was issued a temporary WMA permit/registration for the construction of the Wachusett Aqueduct. This has been rescinded as the aqueduct is complete and the withdrawal no longer needed (Kickham 2004).

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

The City of Marlborough was permitted (12 February 2001) to discharge 2.89 MGD of treated sanitary wastewater from the Marlborough Westerly Treatment Works via outfall 001 to the Assabet River. The permit expired in 2004. The facility’s whole effluent toxicity limits were LC₅₀ ≥ 100% and C-NOEC ≥ 40% effluent. The permit included seasonal limits for CBOD, BOD, TSS, total phosphorus and ammonia-nitrogen. The average monthly total phosphorus limit was 0.75 mg/L between 1 April and 30 October and for total ammonia-nitrogen was 2.0 mg/L between 1 June and 31 October. A draft permit has been issued with new limits (see sources of information section and Appendix D for additional details.) The facility uses chlorine gas and sulfur dioxide gas, which are both flow and residual based for

disinfection/dechlorination. The total residual chlorine (TRC) limit (maximum daily concentration) is 0.048 mg/L. Dechlorination was implemented in 1990.

Between 1997 and 1999 the Marlborough West WWTF had numerous violations of BOD, TSS, and ammonia-nitrogen (Webber 2004a). In 2000 the MA DEP issued an Administrative Consent Order ACO-CE-00-1001 (signed 10/26/00) to the City. The Order required the City to evaluate the high strength of influent BOD. The City has implemented a grease trap pumping program, conducts yearly I/I studies, stopped taking septage and found that Ken's Foods was the largest contributor of high strength BOD to the sewer system. The City required Ken's Foods to install a pretreatment facility prior to their discharge to the sewer system. A pretreatment facility was designed in 2001 and went on line in 2002. The pretreatment facility reduced the BOD strength of the wastewater from 2000 mg/l to 80 mg/l. Since implementation of Ken's Food pretreatment facility the Marlborough Westerly WWTF has been in compliance with its effluent limits and the Order has been closed out. The City has also implemented corrosion control in their water supply, which has helped reduce the copper concentrations (Webber 2004a).

It should be noted that a TMDL for the nutrient phosphorus as total phosphorus for the Assabet River has recently been approved by EPA (MA DEP undated). This TMDL was developed with special emphasis on reducing the extent of nuisance macrophyte growth, meeting minimum dissolved oxygen criteria, reducing extreme diurnal dissolved oxygen fluctuations and excessive dissolved oxygen supersaturation, and reducing ambient total phosphorus concentrations. The TMDL for meeting the water quality objectives, including a margin of safety, includes removal of total phosphorus from POTW effluents to 0.1 mg/L during the growing season 1 April and 31 October and to optimize the removal of particulate phosphorus during the non-growing season (MA DEP undated). All POTWs will be upgraded to achieve 0.1 mg/l of effluent phosphorus by April 2009 and the design should be consistent with adding new technology in the future to achieve further reductions if deemed necessary.

In January 2004 Hudson Lock LLC, which discharges to the Hudson WWTP, settled an administrative complaint with EPA for discharging zinc above the national metal finishers standards between December 1998 and May 2003. Additionally, the facility failed to apply for a storm water discharge permit in a "timely manner" and failed to conduct required site compliance evaluations and monitoring once the facility obtained the necessary permit coverage. Storm water from the facility ultimately discharges to Bruce's Pond (EPA 2004a). The outlet of Bruce's Pond discharges via an unnamed tributary to this segment of the Assabet River.

HAZARDOUS WASTE SITES AWAITING NPL DECISION

The Hudson Light and Power (HLP) property is located on Cherry Street in Hudson. The property consists of approximately 1.81 acres located on the northern bank of the Assabet River, within a commercial and residential area. The property is bordered to the north and east by industrial properties, to the south by the Assabet River, and to the west by a public playground. The property is owned by the Town of Hudson. HLP is a municipally-owned electricity generating plant for the Town of Hudson. The buildings on the property were constructed in 1897. In 1928 HLP converted the electrical equipment from coal to diesel power, which resulted in the removal of the coal-fired steam engines and the installation of diesel engines. Except for the engine changes, the HLP operations have not changed significantly since 1928. During the course of numerous investigations several groundwater, surface water, and sediment samples were collected. Selected samples collected during these sampling events were analyzed for volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons, and metals. VOCs, PAHs, and metals were detected above reference criteria in these samples. The HLP property is classified by MA DEP as a Tier 1A site and is currently in Phase V (Operation, Maintenance, and/or Monitoring) of the five phase Massachusetts Contingency Plan site cleanup process (EPA 2002c).

LANDFILLS (APPENDIX K)

There is one closed landfill located within this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The 7Q10 flow estimated as part of the Marlborough Westerly WWTP NPDES permit is 6.7 cfs.

Stream flow was measured by USGS on a monthly basis from June 2001 to December 2002 at three locations on this segment of the Assabet River (Socolow *et al.* 2003).

Location (number of samples)	Minimum streamflow (month recorded)	Maximum streamflow (month recorded)	Drainage area at sampling site
Downstream of the Donald Lynch Boulevard Bridge, Marlborough (n=17)	15.3 cfs (Nov 2001)	129 (April 2002)	39.5 mi ²
Downstream of the Chapin Road bridge, Hudson (n=18)	10.9 cfs (Aug 2002)	491 cfs (Dec 2002)	59.9 mi ²
Downstream of State Route 85, Hudson (n=17)	17.1 cfs (Aug 2002)	171 cfs (April 2002)	63.9 mi ²

ENSR conducted limited streamflow monitoring at three locations (Bigelow Road, Berlin- Station R19 (n=3), South Street, Hudson –Station R16 (n=2), and Cox Street, Hudson –Station R15 (n=4)) along this segment of the Assabet River between July 1999 and September 2000. Flows ranged between 13 and 136 cfs (ENSR 2001).

As part of the July 2001 biomonitoring survey DWM conducted a habitat assessment along a reach of the Assabet River downstream from Broad Street, Hudson (Station ARH (B0465)). The reach had an open canopy with substrates consisting primarily of sand and cobble. The overall habitat score was 136/200. Channelization, moderate sand deposition, and a human impacted riparian zone negatively affected the score (Appendix D).

Biology

ENSR (2001) conducted macrophyte mapping in the Hudson Center Impoundment in July 1999 and August 2000. The assemblage was dominated by coontail (*Ceratophyllum demersum*), although filamentous green algae, *Lemna* sp. and *Wolffia* sp., were also present. No non-natives were identified. Water depth in the Hudson Center Impoundment typically ranged between six and ten feet.

In July 2001 DWM conducted biomonitoring along one reach of this segment of the Assabet River (Station ARH) downstream from Broad Street, Hudson. The RBP III analysis indicated that the benthic community was moderately impacted when compared to the North Brook reference station (Appendix D). DWM noted that aquatic vegetation (*Potamogeton* sp., *Elodea* sp., *Myriophyllum* sp., and *Callitriche* sp.) covered approximately 70% of the stream bottom. Mosses, rooted emergent aquatic plants, duckweed, and watermeal were also present. Filamentous and a thin-film green algal growth covered about half the area of the reach (Appendix D).

A small number of largemouth bass collected by DWM from this impoundment during a fish toxics monitoring survey in 1997 had what appeared to be small skin lesions. In addition, a largemouth bass was also noted as having a skin pigmentation problem (black blotches). It was unclear what might be causing these anomalies (Appendix B).

MDFW conducted fish population sampling at three stations in this segment of the Assabet River using barge electros shocking equipment and at the Hudson Impoundment using gillnets (Richards 2003a). The results are summarized in the table below.

Table 3. MDFW fish population sampling data from the Assabet River (MA82A-04) in Berlin and Hudson (Richards 2003a).

Species	Sampling Location			
	Field across from Spooky World, Berlin (Sample ID 91) 31 August 1999 barge shocking	Hudson Impoundment (also called Theater Impoundment) off of Park Street, Hudson (Sample ID 498) 18 May 2001 gillnet	Small Park in Hudson Center, Hudson (Sample ID 306) 7 June 2001 barge shocking	North and South of Cox Street, Hudson (sample ID 500) 24 August 2001 barge shocking
T=tolerant M=moderately tolerant I = intolerant				
American eel (T)	17	--	20	12
Banded sunfish (I)	1	--	1	--
Black crappie (M)	--	5	6	--
Blacknose dace (T)	2	--	--	--
Bluegill (T)		50	14	9
Brown bullhead (T)	--	--	2	1
Brown trout (I)	2	--	--	--
Chain pickerel (M)	--	4	--	2
Creek chubsucker (I)	9	--	--	--
Fallfish (T)	7	--	21	5
Golden shiner (T)	4	--	12	4
Largemouth bass (M)	54	3	--	7
Pumpkinseed (T)	5	8	7	34
Redbreast sunfish (M)	11	--	17	16
Redfin pickerel (M)	14	--	--	3
White sucker (T)	66	11	30	5
Yellow bullhead (T)	17	--	6	19
Yellow perch (M)	--	--	--	1
Total number of fish	209	81	136	118

-- indicates species not collected

Of the 18 species collected from this segment of the Assabet River, only two species collected (banded sunfish and creek chubsucker) are considered intolerant (excluding the stocked brown trout) and only four are considered fluvial specialists/dependants (white sucker, fallfish, creek chubsucker, and blacknose dace). One half of the species collected are considered tolerant to pollution. The relative absence of fluvial specialists/dependants reflects the low gradient nature of this segment and the impoundment in Hudson.

Toxicity

Effluent

Between 18 November 1996 and 8 December 2003 twenty-eight whole effluent toxicity tests were conducted on the City of Marlborough Westerly WWTP effluent using *C. dubia* as a test organism and 30 tests were conducted using *P. promelas* as the test organism. With the exception of the 11 May 1998 test (LC₅₀= 34.9% effluent) the effluent was not acutely toxic to *C. dubia* or *P. promelas* (LC₅₀ > 100% effluent). C-NOECs for the *Ceriodaphnia* tests ranged from <6.25 to 100% effluent (three violations of the ≥40% effluent permit limit). C-NOECs for the *P. promelas* tests ranged from 25 to 100% effluent (only 1 violation in 1996).

Chemistry – water

OAR conducted monthly water quality monitoring at five stations on this segment of the Assabet River between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for total suspended solids, total phosphorus, and ammonia. In 2002 OAR only conducted water quality monitoring at two stations (OAR 2003).

- Station 23.8- above dam off Robin Hill Road, Marlborough (became Station ABT-238 in 2002)
- Station 22.0- by Bridge St bridge, Berlin
- Station 19.6- by Chapin Road bridge, Hudson
- Station 18.2- below Rte 85 bridge, Hudson center
- Station 16.2- by Cox Street bridge, Hudson (became Station ABT-162 in 2002)

DO

Dissolved oxygen concentrations from all five OAR stations ranged from 1.5 to 9.1 mg/L with ten of the 55 measurements less than 5.0 mg/L (18%). All but one station, the Rt. 85 station located downstream from the Hudson Impoundment, had low DO conditions at least once during the surveys. Three of the lowest DOs were measured in the river at Cox Street. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Temperature

None of the temperature measurements exceeded 26°C (n=55).

pH

pH measurements ranged between 6.3 and 7.3 SU (n=55). Only three measurements were less than 6.5 SU.

Conductivity

Conductivity measurements ranged between 321 and 920 µS/cm (n=53).

Total suspended solids

Total suspended solids concentrations ranged between <1 and 14 mg/L (n=31).

Total phosphorus

Total phosphorus concentrations ranged between <0.01 and 0.40 mg/L. Forty-four of the 46 samples (96%) had concentrations greater than 0.05 mg/L.

Ammonia-nitrogen

Ammonia-nitrogen concentrations ranged between 0.05 and 0.33 mg/L (n=44).

Chemistry – sediment

ENSR, in collaboration with OAR, conducted a sediment thickness survey in the Rt. 85/Hudson Center Impoundment in May and June 2000. Sediment thicknesses ranged from one to six feet with the greatest sediment thicknesses measured in the backwater and upstream reaches.

USGS, with assistance from EPA, mapped the depth and extent of sediments in the Rt. 85/Washington Street Impoundment of the Assabet River. Cores were collected between September and October 2003 and analyzed for VOCs, PAHs, PCBs, extractable petroleum hydrocarbons (EPH), organochlorine pesticides, and metals. These data, however, are not yet available. Results from this study will be useful for implementing the recommendations of the Assabet nutrient TMDL (Zimmerman 2004).

The *Aquatic Life Use* is assessed as impaired for this segment of the Assabet River because of moderately impacted benthic community indicative of enrichment-related water quality degradation, elevated levels of total phosphorus, presence of filamentous green algae/*Wolffia/Lemna*, and occasional low dissolved oxygen/saturation. Additionally, tolerant/moderately tolerant species and macrohabitat generalists dominate the fish community. Occasional chronic toxicity in the Marlborough West WWTP is also of concern.

FISH CONSUMPTION

Boat electrofishing conducted by DWM on 18 September 1997 resulted in the collection of three largemouth bass, three white suckers, three bluegills, two American eels, and one brown bullhead from the Hudson Center Impoundment of the Assabet River. Mercury concentrations in edible fillets ranged from 0.120 mg/kg in the individual brown bullhead to 0.47 mg/kg in the composite of largemouth bass. PCB Arochlor 1254 was detected in two of the five samples analyzed. The composites of white sucker and American eel contained 0.17 mg/kg and 0.32 mg/kg of PCB Arochlor 1254 respectively. All other PCB Arochlors and organochlorine pesticides were below detection in all samples analyzed. Although mercury concentrations in edible fillets of Assabet River (Hudson) fishes were below the MDPH trigger

level in all samples analyzed, the largemouth bass sample contained mercury just below the MDPH trigger level (0.5 mg/kg) and it is likely that larger bass contain mercury concentrations that exceed the “trigger level”. Although white sucker and American eel were found to contain detectable concentrations of PCB Arochlor 1254 these samples were well below the MDPH PCB trigger level of 1.0 mg/kg. Potential sources of PCBs to the Assabet River in Hudson include WWTPs as well as historic industrial discharges, however, no specific source has been identified at this time (Appendix B).

Since no site-specific advisory was issued by MDPH the *Fish Consumption Use* is not assessed. However, this use is identified with an “Alert Status” as DWM biologists noted that larger fish would likely contain mercury concentrations that exceed the MDPH trigger level.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable oils or odors were noted by DWM biologists as part of the biomonitoring survey downstream from Broad Street, Hudson, in July 2001, but the water color was described as murky and there were some deposits of trash in the reach sampled (Appendix D).

OAR reported that the section of the Assabet River from the Marlborough WWTP to Rt. 495 is free flowing and shaded with sand or gravel bottom and mainly free of heavy plant growth. Downstream from the Rt. 495 bridge the river becomes slower, winding through a marshy section. During the summer this lower section has heavy aquatic rooted plant growth and accumulations of floating duckweed (Flint 2004).

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for this segment of the Assabet River because of the objectionable growths of filamentous green algae, duckweed and watermeal along with areas of instream trash. It should be noted that objectionable conditions are more widespread in the section of the river downstream from the Hudson Impoundment.

Assabet River (MA82B-04) Use Summary Table

Designated Uses		Status
Aquatic Life		<p>IMPAIRED Causes: Combination benthic/fish bioassessment, total phosphorus, dissolved oxygen, oxygen saturation, excess algal growth (Suspected Causes: Ambient bioassay-chronic aquatic toxicity) Sources: Municipal point source discharge, impacts from hydrostructure flow regulation/modification, unknown (Suspected Sources: Internal nutrient recycling, discharges from municipal separate storm sewer systems (MS4s))</p>
Fish Consumption		NOT ASSESSED*
Primary Contact		<p>IMPAIRED Causes: Excess algal growth Sources: Municipal point source discharge (Suspected Sources: Highway/ road/ bridge runoff (non -construction, residential districts, discharges from municipal separate storm sewers (MS4s), municipal urbanized high density areas)</p>
Secondary Contact		
Aesthetics		

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

RECOMMENDATIONS

- Conduct an aquatic macrophyte survey to determine if non-native species are present in this segment of the Assabet River, especially since DWM biologists noted *Potamogeton* sp. and *Myriophyllum* sp., which could potentially be non-natives.
- Conduct biological monitoring (benthic macroinvertebrate and fish population) near Broad Street in Hudson and other locations to evaluate the status of the *Aquatic Life Use* and to determine changes associated with upgrades and more stringent permit limits of the Marlborough West WWTP discharge and the effectiveness of implementation of the TMDL. Continue to conduct water quality monitoring including at a minimum collecting continuous dissolved oxygen, pH, and total phosphorus data to evaluate the frequency and duration of low DO conditions through this segment of the river.
- Continue to review the results of the Marlborough West WWTP toxicity tests. If chronic toxicity persists evaluate the need to conduct a Toxicity Identification Evaluation/Toxicity Reduction Evaluation.
- Conduct additional fish toxics monitoring to determine if a site-specific fish consumption advisory is needed for the Assabet River. Prior sampling by DWM noted that, if collected, larger bass specimens would likely contain elevated concentrations of mercury.
- When available review the USGS (Zimmerman) sediment report for data to assess the *Aquatic Life Use*.
- Implement the recommendations from the Assabet River Nutrient TMDL.
- Monitor the Marlborough West WWTP compliance with their total phosphorus permit limit, as well as compliance by treatment plants upstream.

NORTH BROOK (SEGMENT MA82B-21)

Location: Headwaters east of Ballville Road and north of Wataquadock Hill Road, Bolton, to the confluence with the Assabet River, Berlin
Segment Length: 7.8 miles
Classification: Class B

Land-use estimates (top 3, excluding water) for the 16.9 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.8 mi² and the percentage of the imperviousness is 4.9%.

Forest	64%
Residential	17%
Agriculture.....	8%

WMA WATER WITHDRAWAL SUMMARY

Based on the available information there are no WMA registered or permitted water withdrawals from this subwatershed.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

The Massachusetts Water Resource Authority (MA0040134) is permitted (18 November 2002) to discharge intake screen wash water, reservoir foundation leakage, test water, pump seal water, non-contact cooling water, hydroelectric turbine bearing lubrication and cooling water, and storm water from the Cosgrove Intake Facility via outfall 001 to a wetland tributary to North Brook. This permit will expire in 2007. This facility began discharging in September 2004. The daily flows range from ~0.7 MGD to ~3.5 MGD, depending on precipitation (Keohane 2004).

LANDFILLS (APPENDIX K)

There are two landfills located within this subwatershed. One is still active.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

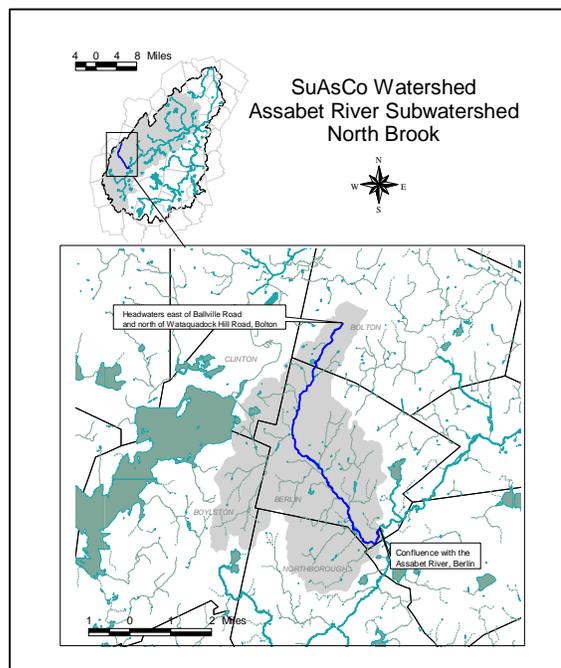
DWM conducted biomonitoring along one reach of North Brook, near Allen Road, Berlin, at Station NB (B0461) in July 2001. Habitat for the benthos in North Brook was classified by DWM biologists as optimal during the July 2001 benthic macroinvertebrate survey (Appendix D). The substrates were a boulder/cobble mix. No obvious erosion or nonpoint source pollution inputs were noted. The canopy covered 100% of the sampling reach. Instream vegetation covered half the reach but was dominated by moss with no algal species or non-native plants present.

USGS collected monthly flow data downstream of the bridge on Whitney Street in Berlin between May 2001 and December 2002 (n=15). Discharge ranged from a low of 0.88 cfs in September 2001 to a high of 57.8 cfs in December 2002. The drainage area size was calculated to be 15.5 mi² (Socolow *et al.* 2003). The estimated 7Q10 is 0.54 cfs (USGS 9 October 2002).

ENSR conducted limited streamflow monitoring near the mouth of North Brook in Berlin on five occasions in 2000. Flows ranged between 2 and 50 cfs (ENSR 2001).

Biology

MDFW (Richards 2003a) conducted fish population sampling at three stations on this segment in 2001 using backpack electroshocking equipment. Based on these data MDFW has proposed that North Brook be protected as cold water fishery habitat (Richards 2003b).



On 23 July 2001 seven species of fish were collected from North Brook (Sample ID 428) north of Lancaster Road, Berlin. A total of 116 fish were collected including, in order of abundance, 67 blacknose dace, 30 white sucker, eight brook trout, six fallfish, three pumpkinseed, one golden shiner, and one largemouth bass.

DWM conducted biomonitoring along one reach in North Brook, near Allen Road, Berlin at Station NB in July 2001. This brook was chosen as the reference station and the macroinvertebrate assemblage indicated a healthy aquatic community (pollution sensitive organisms dominated the well-balanced community -- high total richness, EPT taxa, and low HBI (Hilsenhoff Biotic Index) and dominance metric scores) (Appendix D).

On 5 June 2001 MDFW collected a total of 128 fish (four species) from North Brook off Lancaster Road (Sample ID 376) in Berlin, including, in order of abundance, 80 brook trout (multiple age classes), 32 blacknose dace, 15 pumpkinseed, and one white sucker.

On 23 July 2001 MDFW also collected five species of fish, in order of abundance including, six brook trout (multiple age classes), three white sucker, two chain pickerel, two American eel, and one brown bullhead from North Brook south of James Road (Sample ID 439) in Berlin. Only 14 fish were collected.

Chemistry – water

OAR conducted monthly water quality monitoring in North Brook near Whitney Street bridge in Berlin between June and September 2002 (OAR 2003). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen.

DO

Dissolved oxygen concentrations reported by OAR ranged from 4.8 to 8.9 mg/L (n=4). Percent saturations ranged from 57.2 to 87.9%. The August 2002 measurement was below 5 mg/L and 60% saturation. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Temperature

Temperatures reported by OAR ranged from a low of 14.8°C to a high of 24.3°C (n=4).

pH

pH values recorded by OAR ranged between 6.8 and 7.0 SU (n=4).

Conductivity

Conductivity reported by OAR ranged between 130 and 239 μ S/cm (n=4).

Total suspended solids

Total suspended solids concentrations reported by OAR were all <1 mg/L (n=3).

Total phosphorus

Total phosphorus concentrations reported by OAR were all <0.01 mg/L (n=3).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR were 0.06 and 0.08 mg/L (n=2).

The *Aquatic Life Use* for North Brook is assessed as support based primarily on the benthic macroinvertebrate community (used as reference station by DWM biologists) and the presence of reproducing brook trout.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable conditions (odors, oils, deposits, turbidity) were observed by DWM biologists in the North River near Allen Road in Berlin during either field reconnaissance or the biomonitoring survey

conducted on 2 July 2001 (MA DEP 2001a). OAR reported trash and debris in the brook downstream from Wheeler Pond (Flint 2004a).

Due to the lack of quality-assured bacteria data North Brook is currently not assessed for either the *Primary* or *Secondary Contact Recreational* uses. The *Aesthetics Use*, however, is assessed as support based on observations by DWM biologists. This use is identified with an alert status in the reach of the river downstream from Wheeler Pond because of the trash and debris observed by OAR volunteers.

North Brook (MA82B-21) Use Summary Table

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

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

RECOMMENDATIONS

- Continue to conduct biological and habitat quality monitoring in North Brook to evaluate the status of the *Aquatic Life Use* and document the effect(s), if any, from the MWRA Cosgrove Intake Facility (MA0040134) discharge of intake screen wash water, reservoir foundation leakage, test water, pump seal water, non-contact cooling water, hydroelectric turbine bearing lubrication and cooling water, and storm water.
- MDFW has proposed that North Brook be protected as cold water fishery habitat. Additional monitoring of the fish population, DO, and temperature is needed to evaluate MDFW’s proposal to list this brook as a cold water fishery in the next revision of the Surface Water Quality Standards.
- Work with OAR to conduct a shoreline survey of the entire North Brook, to conduct a cleanup in the lower section to remove trash and debris, and to promote local stewardship and educate local homeowners.

GATES POND BROOK (SEGMENT MA82B-10)

Description: From the outlet of Gates Pond, Berlin, to the confluence with the Assabet River, Berlin

Segment Length: 1.0 mile

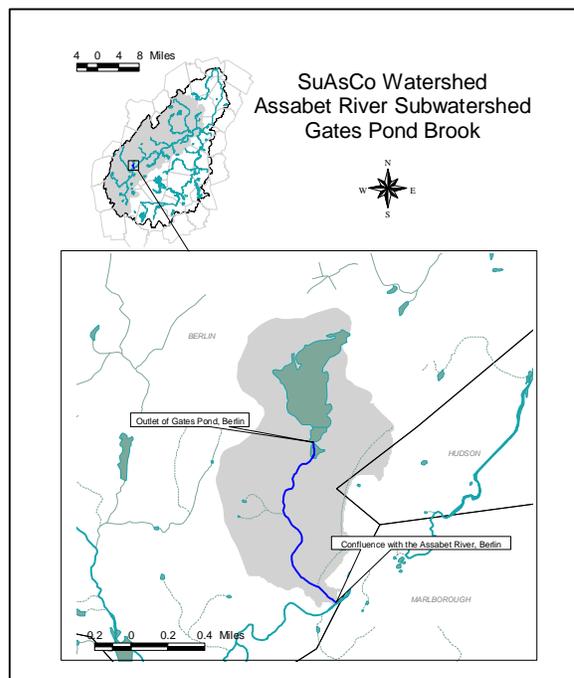
Classification: B

Land-use estimates (top 3, excluding water) for the 1.0 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.03 mi² and the percentage of the imperviousness is 3.1%.

- Forest 64%
- Open land 9%
- Agriculture..... 8%

There are orchards located northwest of the pond on Sawyer Hill.

Based on the last evaluation of water quality conditions Gates Pond Brook is listed on the 2002 Integrated List of Waters in Category 3. This segment was not assessed for any of the designated uses (MA DEP 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Gates Pond in Berlin is a surface public water supply for the Town of Hudson. The source was off line during the construction of the filtration plant. This source came back on-line in summer of 1997. The pond has a spillway at a fixed elevation (unknown).

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Hudson Water Department*	9P21414102	21414102	2141000-01S (Gates Pond)	2 (reg) 0.95 (perm) 2.95*

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed.

NPDES WASTEWATER DISCHARGE SUMMARY

Based on available information there are no regulated surface water discharges to this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

DWM conducted a habitat survey in Gates Pond Brook in 1996 as part of the benthic macroinvertebrate survey at two stations SAC03A and SAC03B, bracketing a dirt bike crossing that was contributing to erosion and sedimentation within the brook (Appendix H).

Biology

DWM conducted RBP II benthic macroinvertebrate sampling at two stations on Gates Pond Brook in 1996. Although these data are too old for assessment purposes it should be noted that the benthic community downstream from the dirt bike crossing was determined to be moderately impaired when compared to the upstream station (Appendix H).

Due to the lack of current biological, chemical, and toxicological data, Gates Pond Brook is currently not assessed for the *Aquatic Life Use*. This use is, however, identified with an "Alert Status" given the 1996 benthic assessment.

Gates Pond Brook (MA82B-10) Use Summary Table

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

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

RECOMMENDATIONS

- Conduct additional biological sampling (benthic macroinvertebrate, habitat assessment, fish population), water quality monitoring (pre-dawn dissolved oxygen, pH, temperature), bacteria sampling and conduct a shoreline survey of Gates Pond Brook to assess the designated uses.
- Determine the outlet practices of Gates Pond and the effects, if any, on the biota downstream in Gates Pond Brook. To the extent possible flow regimes should mimic a natural hydrograph to protect aquatic life in the brook.
- During the 1996 biological investigation dirt bikes crossed over the stream to access an abandoned gravel pit, causing erosion. At the time of the 1996 sampling the benthic community downstream from the “dirt bike crossing” was moderately impacted when compared to a site upstream from the crossing. Additional reconnaissance should be conducted in Gates Pond Brook to determine if erosion is still occurring. Additional benthic macroinvertebrate monitoring should be conducted to determine if the community has improved or degraded. Efforts should be made to educate local citizens about stream stewardship and to implement best management practices (BMPs) to reduce erosion to the stream.

DANFORTH BROOK (SEGMENT MA82B-19)

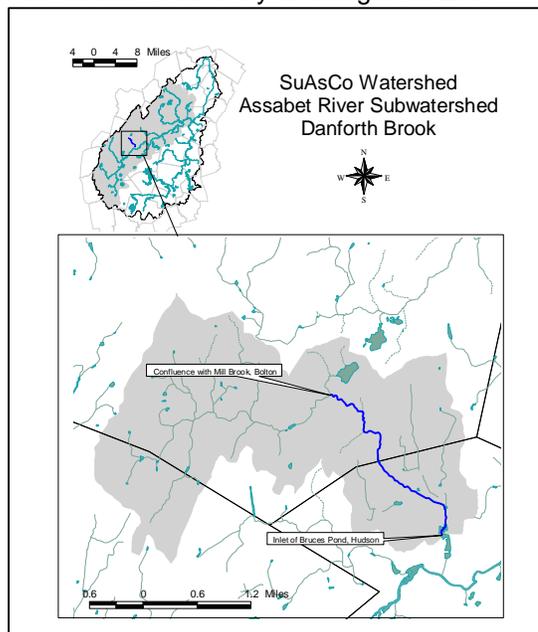
Description: Headwaters at the confluence of Mill Brook and an unnamed tributary draining from Little Pond, Bolton, to the inlet of Bruces Pond, Hudson

Segment Length: 2.4 miles

Classification: B

Land-use estimates (top 3, excluding water) for the 6.8 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.4 mi² and the percentage of the imperviousness is 6.2%.

- Forest 58%
- Residential 20%
- Agriculture..... 12%



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Great Oak Farm		21402801	Gr. Oak Farm Pond	0.07

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no NPDES discharges to this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The USGS began a habitat study in 2001 to determine stream flow requirements in the Assabet River Watershed and develop a ground-water modeling project. Parker and Armstrong (2002) provided preliminary estimates of streamflow necessary to maintain aquatic habitat for Danforth Brook based on sampling seven cross sections within a riffle/pool section about 300 ft upstream from the Route 85 culvert in a conservation area owned by the Town of Hudson. There were scattered trees and shrubs along both banks, the bed material was primarily cobble, and the bank material was a mixture of organic silt, sand, and cobble (Parker and Armstrong 2002). USGS measured flows in Danforth Brook between June 2001 and December 2002 upstream from the Route 85 bridge in Hudson (n=16). Flows ranged from a low of 0 cfs in October and November 2001 to a high of 63.9 cfs in December 2002. The drainage area was calculated to be 5.12 mi² (Socolow *et al.* 2003). Staff gage readings and percent wetted perimeter estimates were made near the Route 85 bridge in Hudson weekly from June to September 2002 by OAR volunteers as part of the Stream Watch project. Flows in Danforth Brook as calculated by Stream Watch ranged from a high of 1.7 cfs in June to <0.01 cfs by the third week in August. Flows increased slightly to 0.14 cfs in September (Flint 2003). It is important to note that during the summer of 2002 the northeast portion of Massachusetts was under a drought advisory due to below normal precipitation (Marler 2003). Flows in the brook as calculated by Stream Watch in 2003 were much higher ranging from 0.3 cfs to 28.5 cfs (n=15). The estimated 7Q10 for Danforth Brook at the Route 85 bridge is 0.16 cfs (USGS 2002). Streamflows in Danforth Brook were below the 7Q10 on three of the 16 occasions.

Biology

MDFW has proposed that Danforth Brook be protected as cold water fishery habitat (Richards 2003b). MDFW conducted fish population sampling in Danforth Brook on 23 July 2001 at one station north of Route 85 in Hudson using backpack electroshocking gear. A total of seven species of fish were collected including ten brown bullhead, six white sucker, three brown trout (two age classes), two eastern brook trout, two bluegill, one banded sunfish and one American eel were collected (Richards 2003a). Three of the seven species collected are considered fluvial dependants. Although overall numbers were low, trout and banded sunfish are intolerant to pollution and their presence is indicative of excellent water and habitat quality. The remainder of the fish present are considered to be tolerant to pollution and all except white sucker are macrohabitat generalists.

Chemistry – water

Water quality monitoring of Danforth Brook near the Route 85 bridge in Hudson was conducted by OAR volunteers as part of the Stream Watch pilot project. In 2002 and 2003 monthly sampling was conducted between June and September. All sampling occurred between 0400 and 0800h (Flint 2003, Flint 2004b and OAR 2003).

DO

Dissolved oxygen concentrations measured in 2002 ranged from 2.8 to 9.4 mg/L with two of the four measurements less than 5.0 mg/L and the percent saturations ranged from 27.9 to 92.2%. Both low DO measurements occurred during the drought when streamflow in Danforth Brook was less than the estimated 7Q10 condition. In 2003 DOs ranged between 8.1 and 9.7 mg/L (n=4).

Temperature

In-situ temperatures ranged from a low of 14.6 in June to a high of 21.9°C in August (n=8).

pH

pH values ranged between 6.3 and 7.3 SU with one of the eight measurements less than 6.5 SU.

Conductivity

Conductivity measured in 2002 ranged between 163 and 221 $\mu\text{S}/\text{cm}$ (n=4).

Total suspended solids

Total suspended solids concentrations ranged between <1 and 3 mg/L (n=7).

Total phosphorus

Total phosphorus concentrations were all $\leq 0.01\text{mg}/\text{L}$ (n=3) in 2002 and ranged from 0.03 to 0.086 mg/L (n=4) in 2003.

Ammonia-nitrogen

Ammonia-nitrogen concentrations in Danforth Brook in 2002 were 0.06 mg/L (n=2).

The *Aquatic Life Use* is assessed as support based primarily on the fish community information and best professional judgment. The use is identified with an Alert Status, however, due to low DOs, which seem to occur during low flow/drought conditions, the low numbers of fish present, and low flows.

AESTHETICS

Danforth Falls in the Danforth Lot Conservation Area is a scenic area along Danforth Brook (Flint 2004). OAR reported that Danforth Brook near the Route 85 bridge in Hudson was nice, shaded, and free-flowing with no objectionable deposits, sheens, or turbidity.

Based on observations by OAR volunteers Danforth Brook is assessed as support for the *Aesthetics Use*.

Danforth Brook (MA82B-19) Use Summary Table

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

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

RECOMMENDATIONS

- MDFW has recommended that Danforth Brook be protected as cold water fishery habitat. This recommendation should be evaluated further given the low dissolved oxygen concentrations, low flows, and low number of fish (25 total, only five trout in the sample). Fish population sampling should be conducted along multiple reaches of this segment. Continuous dissolved oxygen/temperature monitoring should be conducted at multiple locations to determine the frequency and duration of low dissolved oxygen concentrations and if the low dissolved oxygen concentrations are due to natural or anthropogenic causes. Additionally, causes of low flows in the brook should be investigated.
- Work with OAR to continue their water quality monitoring of Danforth Brook.

ASSABET RIVER (SEGMENT MA82B-05)

Description: From the Hudson Wastewater Treatment Plant discharge, Hudson, to the USGS gage at Routes 27/62, Maynard
 Segment Length: 8.2 miles
 Classification: Class B, Warm Water Fishery

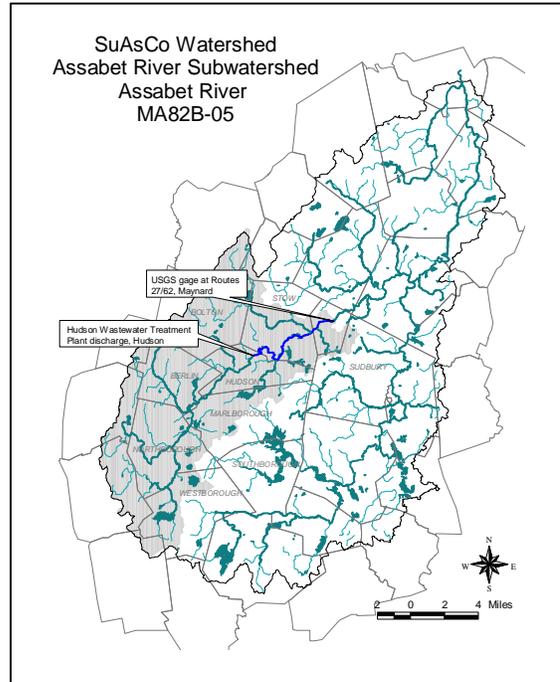
Land-use estimates (top 3, excluding water) for the 114.3 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 10.1 mi² and the percentage of the imperviousness is 8.8 %.

- Forest 49%
- Residential 25%
- Open land 8%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for pathogens (MA DEP 2003a). A TMDL has been completed for nutrients and organic enrichment/low DO.

The Organization for the Assabet River, in conjunction with Maynard High School students and the Riverways Adopt-A Stream Program, conducted a shoreline survey of Large Mill Pond, Small Mill Pond, and the canal that connects them to the Assabet River on 30 April 1998. The purpose of the survey was to provide data to the Town of Maynard and the new mill owner. The team identified three major threats to the waterbodies: polluted runoff from parking lots and roads entering through storm drains, nuisance plant growth, and inappropriate flow strategies. They noted numerous pipes and storm drains, trash and debris, and areas of erosion throughout this area. Resources noted by the team included overhanging vegetation for shading and cooling (Mill Pond 1998).

MDFW has proposed that an unnamed tributary to this segment of the Assabet River (SARIS # 8247260) be protected as cold water fishery habitat (Richards 2003b). MDFW sampled this unnamed tributary North of Randall Street in Stow on 1 August 2001. Twenty-one brook trout, three golden shiner, three redbfin pickerel, and one largemouth bass were collected (Richards 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Stow Acres Country Club		21428602	01G (Well #1) 01S (9 th Hole Pond) 04S (13 th Hole Pond)	0.14

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

The Town of Hudson (MA0101788) was permitted (14 January 2001) to discharge an average monthly flow of 2.65 MGD of treated sanitary wastewater from the Hudson Wastewater Treatment Facility via outfall 001 to the Assabet River. The permit expired in 2004. (It should be noted that more stringent permit limits were also included if the flow of the facility averaged 3.0 MGD. For the purpose of this report, however, the limits presented are based on an effluent discharge of 2.65 MGD). The facility's whole effluent toxicity limits were LC₅₀ ≥ 100% effluent and C-NOEC ≥ 29% effluent. The permit included seasonal limits for BOD, TSS, total phosphorus, and ammonia-nitrogen. The average monthly total phosphorus limit was 0.75 mg/L between 1 April and 31 October and for total ammonia-nitrogen was 3.0 mg/L between 1 May and 31 October. A draft permit has been issued with new permit limits (see sources of information and Appendix D for additional information). The facility is required to disinfect the wastewater on a year-round basis. The total residual chlorine (TRC) limit (maximum daily concentration) is 0.067 mg/L. Dechlorination was implemented May 1994. Both chlorine gas and sodium bisulfate are set

at manual set points (i.e., neither are flow or residual paced) (Webber 2004b). No detectable levels of TRC have been reported in the 33 whole effluent tests conducted between February 1996 and March 2004. In general, the facility has been meeting their NPDES permit limits, but there have been occasional high fecal coliform bacteria results and one mishap in October 2002 when pH of the effluent was 11 SU. As a result of the October incident more controls and alarms were installed at the facility (Webber 2004b). The highest concentration (14.07 mg/L) of ammonia-nitrogen reported was in June 2001. In 1997 MA DEP issued a moratorium on new connections to the sewer system requiring a 3:1 removal of I/I for every gallon of sewage connected to the system (Webber 2004b). The Town has been progressive in removing I/I and the peak I/I flows have decreased dramatically since the moratorium was imposed (Webber 2004b).

It should be noted that a TMDL for the nutrient phosphorus as total phosphorus for the Assabet River has recently been approved by EPA (MA DEP undated). This TMDL was developed with special emphasis on reducing the extent of nuisance macrophyte growth, meeting minimum dissolved oxygen criteria, reducing extreme diurnal dissolved oxygen fluctuations and excessive dissolved oxygen supersaturation, and reducing ambient total phosphorus concentrations. The TMDL for meeting the water quality objectives, including a margin of safety, includes removal of total phosphorus from POTW effluents to 0.1 mg/L during the growing season 1 April and 31 October and optimizing the removal of particulate phosphorus during the non-growing season (MA DEP undated). All POTWs are required to be upgraded to achieve 0.1 mg/l of effluent phosphorus by April 2009 and the design should be consistent with adding new technology in the future to achieve further reductions, if deemed necessary.

FERC

The Clock Tower Place/Mill Pond Project in Maynard (#P-5018-004) was originally constructed and installed in the mid 1800s. The Ben Smith Dam, which impounds 19 acres of water, was built just prior to 1900. The FERC exemption from licensing was originally granted to the Digital Equipment Corporation on 3 October 1983. Digital sold the complex to Franklin Lifecare Corporation in 1995 and Franklin subsequently sold the property to Wellesley Rosewood Maynard Mills L.P. in 1998. The project includes the Ben Smith Dam (170-foot long, 9.5-foot high, granite block dam), an 18.75 acre reservoir, a gatehouse approximately 1600 feet downstream from the entrance to the canal, consisting of two six-foot slide gates which are manually controlled, an 18.23-acre upper and lower mill pond system, an intake trashrack structure, a 49-foot long, 7-foot diameter steel penstock, a powerhouse containing a single 125-kilowatt turbine-generator, a 300-foot long tailrace canal, and appurtenant facilities (DEA 2003). The project originally operated in cycled mode, but reverted to run-of-the-river operation at flows between 64 and 128 cfs. The exemption required a conservation flow of 39 cfs or inflow to be released at the dam to protect habitat in the bypass reach. The project has an installed capacity of 125 kW but has not operated since 1998 (DEA 2003).

In 2002 the owners of Clock Tower Place in Maynard (Mill Pond) applied to FERC to surrender their "exemption from licensing for the existing, non-operational Project". Wellesley Rosewood Mills LLC determined that they have no need/desire to generate hydroelectric power. As part of the process the owners were required to submit a description of any physical work associated with the Ben Smith Dam, mill ponds, intake structures, etc. and develop a flow management plan that describes how flow would be managed through the Ben Smith Impoundment and mill ponds after the surrender under various water conditions. FERC developed a Draft Environmental Assessment (DEA) for the proposed surrendering. The DEA recommends that the canal gatehouse be modified to ensure a minimum flow of 39 cfs would remain in the river and allow surface flows during high flow periods into the mill ponds. The existing gate structures of the gatehouse would be removed and a fixed weir would be installed. The crest elevation of the weir would be greater than the crest elevation of the Ben Smith Dam (DEA 2003).

On 13 July 2004 FERC issued Wellesley Rosewood Maynard Mills, L.P. an "Order Accepting Surrender of Exemption." However, the surrender order is conditional and requires that "Within 270 days (9 months) from the date of issuance of this order, the exemptee shall file for Commission approval, a plan for the installation of a fixed weir at the Mill Pond Project's gatehouse." It further requires that the exemptee prepare the plan "in consultation with the U.S. Fish and Wildlife Service, Environmental Protection Agency, MA Historical Commission, MA Division of Fisheries and Wildlife, Maynard Conservation Commission and the Organization for the Assabet River."

SUPERFUND SITES

The Fort Devens-Sudbury Training Annex is a former U.S. Army military installation in the towns of Maynard, Stow, Hudson, and Sudbury. Contaminants at the site included VOCs, PCBs, pesticides, and inorganic compounds. All areas have been cleaned up. This site was deleted from the NPL on 29 January 2002. Most of the site (2205 acres) is now the US Fish and Wildlife Service Assabet River Wildlife Refuge, which is scheduled to open to the public in 2005 (EPA 2004f). Additional information is available in the Summary of Existing Conditions and Perceived Problems section of this report.

LANDFILLS (APPENDIX K)

There is one closed landfill located within this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

ENSR conducted limited streamflow monitoring at one station (below Gleasondale dam in Stow- Station R12) on this segment of the Assabet River in February and August 2000. Flows were 62 and 26 cfs.

Two time-of-travel studies were conducted by ENSR along this segment of the Assabet River. Rhodamine dye was released at Boon Road in Stow on 9 May 2000 under relatively high instream flows (average river flow = 266 cfs). The estimated time of travel through this reach of the river to the Rt. 17/62 bridge in Maynard was approximately 0.84 days (20 hours and 17 minutes) and the average velocity was estimated to be 0.20 ft/sec. On 28 September 2000 an additional time-of-travel study was conducted under average flow of 55 cfs. The estimated time of travel through this same reach was 3.4 days with an average velocity of 0.05 ft/sec (ENSR 2001). Flows in May were 19 times the 7Q10 (14 cfs) and in September flows were 3.9 times the 7Q10.

ENSR also measured water depths in the Gleasondale and Ben Smith impoundments in June 2000. Depths in the Gleasondale Impoundment ranged from four to ten feet. Depths in the Crow Island area of the Ben Smith Impoundment ranged between two to five feet while depths in the main channel ranged from eight to twelve feet (ENSR 2001).

As part of the biomonitoring survey in July 2001 DWM conducted a habitat assessment along a reach of the Assabet River upstream from Rt. 62 in Stow (Station ARS (B0389)). DWM biologists noted excellent habitat for aquatic macroinvertebrates. No evidence of erosion was detected. Along this reach the river was about 12 m wide and between 0.25 m and 0.5 m deep. The overall habitat score for this sampling site was 150/200 and was most limited by channelization and human impacts in the riparian zone (Appendix D).

Approximately 1.0 miles of the Assabet River can be bypassed downstream from the Ben Smith Dam by the hydropower project at Clock Tower Place/Mill Pond Project in Maynard (#P-5018-004). Currently a minimum flow of 39 cfs or inflow is supposed to be released at the dam to protect habitat in the bypass reach. The hydropower project, however, has not operated since 1998 (DEA 2003). Different alternatives are being explored that include modifying the canal gatehouse to allow some surface flow into the mill ponds under high flow conditions. According to the Mill Pond 2005 Shoreline Survey Report power generation for the mill would occasionally result in a dry section of the Assabet River (Mill Pond 1998). Currently the control structures are managed to try to maintain water quality in the mill ponds as well as to provide sufficient flow over the Ben Smith Dam to remove floating duckweed mats but they have been reportedly ineffective. Between 2 September and 14 September 2001 OAR observed that the water levels in the Ben Smith Impoundment were below the crest of the dam. The gates to the mill ponds at Clock Tower Place had been left open. The gates were closed on 6 September, but it took eight days for levels to return to the crest. Floating aquatic vegetation (duckweed) "accumulated over the entire surface of the impoundment" (OAR 2002).

Stream gaging data for the Assabet River are available from the USGS gage 01097000 located upstream from the bridge on State Highway 27 in Maynard from 1941 to the present. The drainage area at this gage is 116 mi² and the average annual discharge over the period of record is 189 cfs (Socolow

2004). According to USGS, occasional diurnal fluctuations occur during low flows due to regulation by mills upstream and the occasional low flow release by retarding reservoirs. High flows are also affected by retarding reservoirs (Socolow *et al.* 2003). The 7Q10 estimated at the Maynard gage (in the Maynard WWTP NPDES permit) is 14 cfs. The base flow is calculated to be 0.024 cfs/square mile.

Biology

In October 2002 the pH of the Hudson WWTF discharge was 11 SU causing a fish kill in the Assabet River (Webber 2004b).

MDFW set gillnets in the Assabet River in the Gleasondale Impoundment, Hudson (Sample 427), on 30 May 2001. Only three species (nine individuals) were collected including white sucker, largemouth bass, and one chain pickerel (Richards 2003a).

ENSR (2001) conducted macrophyte mapping in the Gleasondale Impoundment in July 1999 and August 2000. Coontail (*Ceratophyllum demersum*) was the dominant taxa, however, filamentous green algae, *Wolffia* sp., and *Lemna* sp. were also noted. In 2000 the non-native macrophyte *Cabomba caroliniana* was identified in the Gleasondale Impoundment. "The abundance of green algal mats, duckweed and watermeal is indicative of very high inorganic nitrogen concentrations" (ENSR 2001).

DWM conducted biomonitoring along one reach of the Assabet River (Station ARS (B0389)) upstream from Rt. 62 in Stow in July 2001. The RBP III analysis indicated that, when compared to the regional reference station (North Brook), the benthic community at ARS was moderately impacted with water quality, rather than instream habitat quality, limiting biological potential (Appendix D). The assemblage was hyperdominated by filter feeders (e.g., pisidiid clams and net spinning caddisflies) indicating high levels of fine suspended organic materials. While the Hudson WWTP probably contributes significant organic matter that is shaping the community at Station ARS, extensive upstream wetlands and the impounded nature of the Assabet system likely provide additional sources of organic loadings. That benthos metrics at Station ARS are comparable to the station upstream from the WWTP (ARH) suggests that water quality has not been degraded further in this portion of the river (Fiorentino 2004). Instream vegetation included arrow arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), *Potamogeton* sp., *Myriophyllum* sp., *Elodea* sp., and *Lemna* sp. Thin film green algae were also found in the sample reach (Appendix D).

ENSR (2001) conducted macrophyte mapping in the Ben Smith Impoundment in July 1999 and August 2000. The assemblage was dominated by filamentous green algae. Three non-native aquatic macrophytes were observed (*Trapa natans*, *Potamogeton crispus* and *Cabomba caroliniana*) in 1999 and 2000. *Wolffia* sp. and *Lemna* sp. were also noted.

MDFW conducted boat electrofishing in the Ben Smith Impoundment (Sample 307), (MDFW referred to the sampling location as the White Pond Road Impoundment) on 8 May 2001. A total of 351 fish were collected representing 13 species (Richards 2003a). The sample was heavily dominated by bluegill and pumpkinseed both tolerant, macrohabitat generalists. All remaining fish except for two white sucker are also considered macrohabitat generalists. With the exception of one banded sunfish, all species collected are classified as either moderately tolerant or tolerant to pollution. The fish community present is a reflection of the impounded nature of this section of the river.

Further downstream MDFW conducted barge shocking along another reach of the Assabet River north of Walnut Street, Maynard (Sample 497), on 11 July 2001. This sampling resulted in the collection of a total of 64 fish representing seven species (Richards 2003a). The assemblage was a mix of fluvial specialists/dependants (white sucker and fallfish) and macrohabitat generalists (American eel and redbreast sunfish). With the exception of an individual brown trout (likely stocked) all fish collected are classified as either moderately tolerant or tolerant to pollution. The sample also contained two bluegill and one yellow bullhead.

Table 4. MDFW fish population sampling data from the Assabet River (MA82B-05) in Hudson and Maynard (Richards 2003a).

Species T= tolerant M= moderately tolerant I= intolerant	Sampling Location and Sampling Technique		
	Gleasondale Impoundment, Hudson (Sample 427) 30 May 2001 gillnet	Ben Smith Impoundment, Maynard (Sample 307)* 8 May 2001 boat shocker	North of Walnut Street, Maynard (Sample 497) 11 July 2001 barge shocker
American eel (T)	--	14	14
Banded sunfish (I)	--	1	--
Black crappie (M)	--	15	--
Bluegill (T)	--	142	2
Brown bullhead (T)	--	8	--
Brown trout (I)	--	--	1
Chain pickerel (M)	1	12	--
Common carp (T)	--	11	--
Fallfish (T)	--	--	13
Golden shiner (T)	--	2	--
Largemouth bass (M)	2	27	--
Pumpkinseed (T)	--	110	--
Redbreast sunfish (M)	--	--	15
Redfin pickerel (M)	--	2	--
White sucker (T)	6	2	18
Yellow bullhead (T)	--	5	1
TOTAL NUMBER	9	351	64

* station referred to as White Pond Road Impoundment by MDFW.

Toxicity

Effluent

Between 12 February 1996 and 8 March 2004, 32 whole effluent toxicity tests were conducted on the Town of Hudson WWTP effluent using *C. dubia* while a total of 20 tests were conducted using *P. promelas* (up to February 2001). The LC₅₀s were less than the permit limit of 100% effluent on four occasions ranging from 47 to 90.6% effluent. The C-NOECs were less than the 29% effluent limit on four occasions ranging between 6.25 and 12.5% effluent. It should be noted, however, that in a 7-day chronic renewal test organisms are sequentially exposed to three separate composite effluent samples collected over the course of the test. For three of the four tests that exhibited chronic toxicity to *C. dubia* it was noted that the toxicity in these tests manifested very soon after the third renewal. That is, the chronic endpoints in these effluent evaluations appear to be caused by acute events within each test. The effluent was not acutely or chronically toxic to the minnows (LC₅₀s >100% effluent and C-NOECs =100% effluent) with the exception of one test in 1997(C-NOEC = 50% effluent).

Chemistry – water

OAR conducted monthly water quality monitoring at five stations on this segment of the Assabet River and at multiple sites within Ben Smith Impoundment between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia. In 2002 OAR only conducted water quality monitoring at two stations on this segment of the Assabet River (OAR 2003).

- Station 15.9- Hudson WWTP
- Station 14.4- Gleasondale dam at Rte 62, Stow (became Station ABT-144 in 2002)
- Station 13.4- by Sudbury Road bridge, Stow
- Station 9.5- by White Pond Road bridge, Stow
- multiple sites within Ben Smith Impoundment (*In-situ* profiles --top, middle, and bottom)
- Station 7.7- by USGS gage, Rte 62, Maynard (became Station ABT-077 in 2002)

As part of the SMART monitoring program, water quality sampling was conducted on five occasions between March and November of 2000 in the Assabet River (Station AS18) approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard (Appendix I).

DO

Dissolved oxygen concentrations reported by OAR from all five of their stations ranged from 3.5 to 11.1 mg/L with three of the 59 measurements less than 5.0 mg/L (5%). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Dissolved oxygen concentrations in the Ben Smith Impoundment, as reported by OAR, ranged from 0.1 to 10.5 mg/L with 26 of the 138 measurements less than 5.0 mg/L (19%). Percent saturation ranged from 0.1 to 104% with 37 of the 138 measurements less than 60%. It should be noted that most of the low dissolved oxygen readings were recorded at the bottom and/or middle depths indicative of oxygen demand from the sediments.

	Overall	Bottom	Middle	Top
DO < 5.0 mg/L	26/138 = 19%	16/46 = 35%	6/46 = 13%	4/46 = 9%
% Saturation < 60%	37/138 = 27%	19/46 = 41%	10/46 = 22%	8/46 = 17%

In August 2000 afternoon DO concentrations ranged from 2.5 to 14 mg/L with only one of the 30 measurements less than 5.0 mg/L in the bottom water. Percent saturation ranged between 26.8 and 159.4% with one measurement less than 60% and 13 of the 30 measurements greater than 115% (43%).

Dissolved oxygen concentrations measured by SMART in the river upstream from the Rt. 27/62 bridge ranged from 8.2 to 12.9 mg/L (n=5). Percent saturation ranged from 92 to 103 % (n=5). It should be noted that these measurements were not collected during worse case pre-dawn conditions.

Temperature

Temperatures measured by OAR were all less than 28.3°C (n=49). Measured temperatures in the Assabet River upstream of the Route 27/62 bridge by the SMART program ranged from a high of 23.5°C taken during the summer month of July to a low of 6.0° in March (n=5).

pH

pH values recorded by OAR ranged between 6.2 and 7.7 SU with three of the 49 measurements less than 6.5 SU. pH measured by SMART ranged from 6.7 to 7.4 SU (n=5).

Alkalinity

Alkalinity measured during the SMART monitoring ranged between 10 and 24 mg/L (n=9).

Hardness

Hardness of the Assabet River water upstream from Rt. 27/62 bridge ranged between 40 and 64 mg/L (n=9).

Conductivity

Conductivity measured by OAR ranged between 265 and 783 µS/cm (n=49). Measurements of specific conductance at 25°C during SMART monitoring ranged from a low of 289 to a high of 295 uS/cm (n=5).

Turbidity

Turbidity ranged from 0.8 to 2.5 NTU.

Total suspended solids

Total suspended solids concentrations ranged between <1 and 19.0 mg/L (n=24). Total dissolved solids concentrations measured *in situ* by SAMRT ranged between 185 and 295 mg/L (n=5) while suspended solids concentrations ranged between 1.2 and 7.3 mg/L (n=9).

Total phosphorus

Total phosphorus concentrations ranged between 0.04 and 0.32 mg/L with 37 of the 38 samples having concentrations greater than 0.05 mg/L. The concentration of total phosphorus in the Assabet River upstream from the Rt. 27/62 bridge as reported by the SMART program ranged from 0.09 to 0.20 mg/L.

Ammonia-nitrogen

Ammonia-nitrogen concentrations ranged between 0.04 and 0.54 mg/L (n=38). Ammonia-nitrogen concentrations reported by the SMART program were all <0.02 mg/L (n=7).

Chemistry – sediment

Sediment thicknesses in the Gleasondale Impoundment ranged from one to six feet with the greatest sediment thicknesses measured in the backwater areas. Sediment thickness in the Ben Smith Impoundment in the Crow Island reach ranged from four to eight feet, while the reach near the dam ranged from one to four feet. ENSR concluded from their nutrient flux study that dissolved oxygen and nitrate were being removed from the water column and ortho-phosphorus and ammonia-nitrogen were being released to the water column (ENSR 2001).

USGS, with assistance from EPA, mapped the depth and extent of sediments in the Gleasondale and Ben Smith Impoundments in Stow and Maynard. Cores were collected between September and October 2003 and analyzed for VOCs, PAHs, PCBs, extractable petroleum hydrocarbons (EPH), organochlorine pesticides, and metals. These data, however, are not yet available. Results from this study will be useful for implementing the recommendations of the Assabet nutrient TMDL (Zimmerman 2004).

The *Aquatic Life Use* is assessed as impaired for this segment of the Assabet River. In the upper reach of this segment acute toxicity in the Hudson WWTP effluent, a fish kill resulting from the discharge, and a moderately impacted benthic community downstream from the discharge were all documented. Elevated concentrations of total phosphorus, occasional incidences of both oxygen depletion and supersaturation, dominance of filamentous green algae, and noxious aquatic plants (*Wolffia* sp., *Lemna* sp. and *Ceratophyllum* sp.) were also found throughout the remainder of the segment. These are all indicators of a highly enriched system. The fish community was dominated by macrohabitat generalists and was reflective of the impounded nature of the majority of this segment. The presence of non-native macrophytes in the Ben Smith Impoundment is also of concern.

FISH CONSUMPTION

DWM conducted fish toxics monitoring in the Ben Smith Impoundment of the Assabet River downstream from White Pond Road, Maynard, using boat electroshocking gear on 18 September 1997 (station F0043). Three largemouth bass, three brown bullhead, three bluegill, and two black crappie were collected and analyzed for metals, PCBs, and organochlorine pesticides. Mercury concentrations ranged from 0.08 mg/kg in the composites of brown bullhead and bluegill to 0.41 mg/kg of mercury in the composite of largemouth bass. PCBs and organochlorine pesticides were below detection in all samples analyzed (Appendix B).

Since MDPH did not issue a site-specific advisory the *Fish Consumption Use* is currently not assessed for this segment of the Assabet River.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM conducted biomonitoring at one station of this section of the Assabet River upstream from Rt. 62 (Station ARS (B0389)) upstream from Rt. 62 in Stow on 18 July 2001. Biologists noted that there was no color to the water nor surface oils, but a sewage odor was present and the water was slightly turbid (Appendix D and MA DEP 2001a).

The SMART monitoring field crew noted occasional sparse areas of floating duckweed (*Lemna* sp.), trash and debris on the shore, and a septic/musty basement odor in the river approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard (MA DEP 2001b). OAR reported that this

segment of the Assabet River has heavy aquatic rooted plant growth and accumulations of floating duckweed over the course of the summer (Flint 2004). They also noted trash at all road crossings.

In 1996 the Maynard/ Assabet River Initiative volunteers conducted a shoreline survey of the Assabet River from White Pond Road to the Ben Smith Dam. Some trash and sedimentation were noted. The Maynard/Assabet River Initiative Action Plan was incorporated into Maynard's 1997 Open Space and Recreation Plan (Riverways 1999a).

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for this segment of the Assabet River because of the objectionable growths of filamentous green algae, duckweed and watermeal along with areas of instream trash and odor.

Assabet River (MA82B-05) Use Summary Table

Designated Uses		Status
Aquatic Life		<p>IMPAIRED</p> <p>Causes: Total phosphorus, low dissolved oxygen, excess algal growth, noxious aquatic plants, non-native aquatic plants, nutrient/ eutrophication biological indicators (Suspected Causes: Whole effluent toxicity)</p> <p>Sources: Municipal point source discharge (Suspected Sources: Impacts from hydrostructure/ flow regulation/ modification, internal nutrient recycling, discharges from municipal separate storm sewer systems (MS4s))</p>
Fish Consumption		NOT ASSESSED
Primary Contact		<p>IMPAIRED</p> <p>Causes: Excess algal growth, noxious aquatic plants, debris/floatables/ trash, odor</p> <p>Sources: Municipal point source discharge (Suspected Sources: Internal nutrient recycling, highway/ road/ bridge runoff (non - construction, residential districts, discharges from municipal separate storm sewers (MS4s), municipal urbanized high density areas)</p>
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

- Work with the Organization for the Assabet River and the Town of Maynard to encourage the new owner of Clock Tower Place to establish flow management protocols for the Ben Smith Impoundment, mill ponds, and canal that will protect the aquatic life and aesthetics of the area. This could include regularly monitoring and comparing canal outflow with USGS records for the Maynard gage and evaluating flow strategies with water quality information from the ponds and the Ben Smith Impoundment (Mill Pond 1998).
- Implement the Assabet Nutrient TMDL recommendations.
- Continue to evaluate the results of the Hudson WWTP whole effluent toxicity tests. If acute toxicity continues to be present the facility should be required to conduct a toxicity identification and toxicity reduction evaluation (TIE/TRE). Assabet River water should also be collected upstream from their discharge for use as diluent or at a minimum as a site control in their whole effluent toxicity tests.
- Biological monitoring should continue to be conducted in this segment of the Assabet River to evaluate impact(s) associated with the Hudson WWTF discharge and the effectiveness of implementation of the TMDL recommendations.
- Conduct continuous *in-situ* monitoring of DO, % saturation, temperature, and pH in the impounded sections of this segment of the Assabet River during the summer low flow period to determine frequency and duration of low DO conditions and the extent of diurnal fluctuations and better evaluate the status of the *Aquatic Life Use*.
- MDFW has recommended that an unnamed tributary to this segment of the Assabet River be protected as cold water fishery habitat. Additional monitoring of the fish population, DO, and

temperature is needed to evaluate MDFW's proposal to list this tributary as a cold water fishery in the next revision of the Surface Water Quality Standards.

- Review the results of the USGS sediment study when available for data to better evaluate the status of the *Aquatic Life Use*.

FORT MEADOW BROOK (SEGMENT MA82B-11)

Description: Outlet of Fort Meadow Reservoir, Marlborough/Hudson, to confluence with Assabet River, Hudson

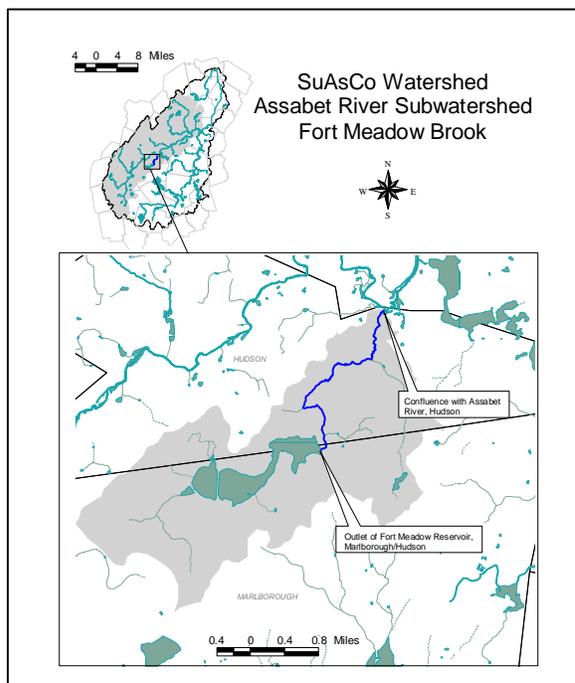
Segment Length: 2.7 miles

Classification: Class B

Land-use estimates (top 3, excluding water) for the 6.3 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.6 mi² and the percentage of the imperviousness is 9.8%.

- Residential 40%
- Forest..... 35%
- Open land 9%

Based on the last evaluation of water quality conditions Fort Meadow Brook is listed on the 2002 Integrated List of Waters in Category 2. This segment supported some designated uses (Aquatic Life, Aesthetics) and was not assessed for others (MA DEP 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Hudson Water Department*	9P21414102	21414102	2141000-03G -04G -05G	2 (reg) <u>0.95 (perm)</u> 2.95*

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

Arrow Automotive Industries (MA0036480) was permitted to discharge to this segment of the Assabet River. This permit was for an emergency exclusion and the site has been remediated. EPA terminated the permit in December 2002.

LANDFILLS (APPENDIX K)

There is one closed landfill located within this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

A spillway with removable slats controls the water level in Fort Meadow Reservoir. Water usually flows over the spillway except when the slats are lifted from the bottom of the reservoir to allow for drawdown. Drawdown has occurred approximately triennially for the past 11 years to control aquatic macrophyte species and conduct shoreline maintenance. The water level in the Reservoir is lowered roughly four feet. Drawdown begins at the end of September/early October. When the Reservoir is refilled in February no water passes over the spillway. This causes a 0.21-mile section of Fort Meadow Brook to be dewatered (Ryder 2004). Downstream from Causeway Street an unnamed tributary that drains a wetland augments flows to Fort Meadow Brook (Ryder 2004).

In July 2001 DWM conducted a habitat assessment as part of the biomonitoring survey along a reach of Fort Meadow Brook upstream from Shay Road in Hudson (Station FMB (B0198). The stream was about 4m wide and depths ranged from about 0.25 to 0.30m. Canopy cover (~95%) was provided by deciduous trees. At the head of the sampling reach three new homes were constructed. While signs of erosion (e.g., cut banks, sloughing of banks) were absent, instream deposits of sand were noted and

accounted for 50% of the substratum composition. Boulder, cobble, pebble, and gravel also provided good instream cover for macroinvertebrates. Fish cover was limited. Yard waste grooming/maintenance (i.e., disposed of improperly along the banks of the brook) negatively impacted the habitat score. The overall habitat score of 140 out of 200 also reflected the lack of bank vegetative protection and poor bank stability along the north bank where the residential development has taken place. DWM also conducted a habitat assessment upstream from Shay Street in 1996 (Appendix H).

USGS collected two stream flow measurements upstream of Shay Street in Hudson in July and August 2002. The flows were 1.56 cfs and 0.85 cfs, respectively. USGS also conducted monthly flow monitoring in Fort Meadow Brook downstream from Chestnut Street in Hudson between June 2001 and December 2002 (n=13). The lowest flow was recorded in September 2001 (0.67 cfs) and the highest flow occurred in December 2002 (30.5 cfs). The drainage area to Chestnut Street was calculated to be 5.23 mi² (Socolow *et al.* 2003).

ENSR conducted streamflow monitoring on four occasions near the mouth of Fort Meadow Brook in 2000. Flows ranged from 0.4 to 13 cfs (ENSR 2001).

It should also be noted that the Zone II's for the Hudson Water Departments wells encompass the lower 1.6 mile reach of this segment.

Stream flow model predictions (DeSimone 2004) for Fort Meadow Brook suggest that the maximization of water withdrawals and sewerage will reduce instream flows during the month of September by up to 96.5%.

Biology

DWM conducted biomonitoring along of Fort Meadow Brook upstream from Shay Road in Hudson (Station FMB (B0198)) on 3 July 2001. When compared to the North Brook reference station the RBP III analysis indicated the benthic community was slightly impacted (Appendix D). Algal scraping beetles were the dominant taxa and appeared to displace EPT taxa here. However, they are fairly sensitive to organic enrichment and indicate generally good water quality. Habitat degradation, specifically instream sediment deposition (the station received the lowest score in the survey) and riparian zone disturbances (yards to the stream, bank vegetation removal, reduced riparian vegetation, yard waste, and other NPS inputs) were most limiting to biological integrity (Fiorentino 2004). DWM also conducted biomonitoring upstream from Shay Street in Hudson in 1996 (Appendix H).

MDFW conducted fish population sampling at two stations in Fort Meadow Brook in Hudson in 2001 using backpack electroshocking equipment. The brook was sampled east of the Shay Street crossing on 6 June resulting in the collection of one fallfish and one American eel. The second station located west of Chestnut Street was sampled on 1 August (Richards 2003b). All fish (n=38) collected (chain pickerel, yellow bullhead, largemouth bass, pumpkinseed, brown bullhead, redbfin pickerel and American eel) were macrohabitat generalists classified as being moderately tolerant or tolerant of pollution.

Chemistry – water

OAR conducted monthly water quality monitoring of Fort Meadow Brook at Shay Road bridge in Hudson between June and October 2002 (n=5). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen (OAR 2003).

DO

Dissolved oxygen concentrations ranged from 7.9 to 10.7 mg/L. While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0530 and 0830h.

Temperature

Temperatures ranged from a low of 9.1°C in October to a high of 22.9°C in August.

pH

pH values ranged between 7.0 and 7.1 SU.

Conductivity

Conductivity reported by OAR ranged between 299 and 495 $\mu\text{S}/\text{cm}$.

Total suspended solids

Total suspended solids concentrations reported by OAR ranged between <1 and 6.0 mg/L (n=3).

Total phosphorus

Total phosphorus concentrations reported by OAR were all <0.01 mg/L (n=3).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR were 0.07 and 0.09 mg/L (n=2).

The *Aquatic Life Use* for Fort Meadow Brook is currently not assessed, but it is identified with an Alert Status. Although the benthic macroinvertebrate community was only slightly impacted it was the opinion of DWM biologists that both habitat degradation (embeddedness of substrates by sand) and riparian zone disturbances were problematic. Furthermore, only two fish were collected in the upstream reach and only macrohabitat generalists were collected in the downstream reach. The lack of any fluvial specialist or dependant species is of concern. The drawdown/refilling practices of Fort Meadow Reservoir, while not a yearly event, dewater 0.2 miles (8%) of this 2.7 mile brook resulting in the loss of habitat for aquatic life. The potential negative effect of maximizing of water withdrawals and centralization of wastewater treatment on instream flows also raises concerns.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR collected one wet weather fecal coliform sample from Fort Meadow Brook at Shay Road bridge in Hudson on 20 August 2002. The fecal coliform count was 3,300 cfu/100mL (OAR 2003).

During the 2001 biomonitoring survey DWM biologists noted that the water was free from odors, color, or turbidity and other objectionable conditions in the sampling reach upstream from Shay Road in Hudson. According to OAR staff, this stream is free from objectionable deposits or other conditions (Flint 2004).

Due to the lack of additional bacteria data the *Recreational uses* are currently not assessed for Fort Meadow Brook. These uses are identified with an Alert Status, however, because of an elevated fecal coliform bacteria count. The *Aesthetics Use* is assessed as support.

Fort Meadow Brook (MA82B-11) Use Summary Table

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

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

RECOMMENDATIONS

- Work with the Organization for the Assabet River to continue to monitor water quality in Fort Meadow Brook. It would be helpful if OAR could conduct additional bacteria sampling and a shoreline survey to identify potential sources of bacteria to Fort Meadow Brook.
- During the 2001 biomonitoring survey DWM biologists noted NPS pollution issues, particularly along the top of the sampling reach above Shay Street in Hudson. Sedimentation (the most deposition observed at any of the 2001 sites) and improper yard waste disposal practices negatively impacted the bioassessment and resulted in a slightly impacted community. Efforts should be made to educate homeowners about proper yard waste disposal practices and the use of fertilizers and pesticides. The source of the sedimentation should be investigated and mitigated to improve instream habitat quality.

- Determine the effects on instream habitat quality by evaluating the outlet control practices at Fort Meadow Reservoir and/or effects of induced infiltration from the Hudson Water Department wells. If deemed necessary, natural flow regimes should be restored in the Fort Meadow Brook.
- Continue to conduct flow monitoring, habitat quality and fish population sampling in Fort Meadow Brook to better evaluate the status of the *Aquatic Life Use*. *In-situ* monitoring of DO, saturation, pH, and temperature, including pre-dawn sampling during summer low flow conditions, is also recommended.

ELIZABETH BROOK (SEGMENT MA82B-12)

Description: From the outlet of an unnamed pond (the Delaney Project on Stow/Harvard border) west of Harvard Road, Stow, to the inlet of Fletchers Pond, Stow

Segment Length: 3.7 miles

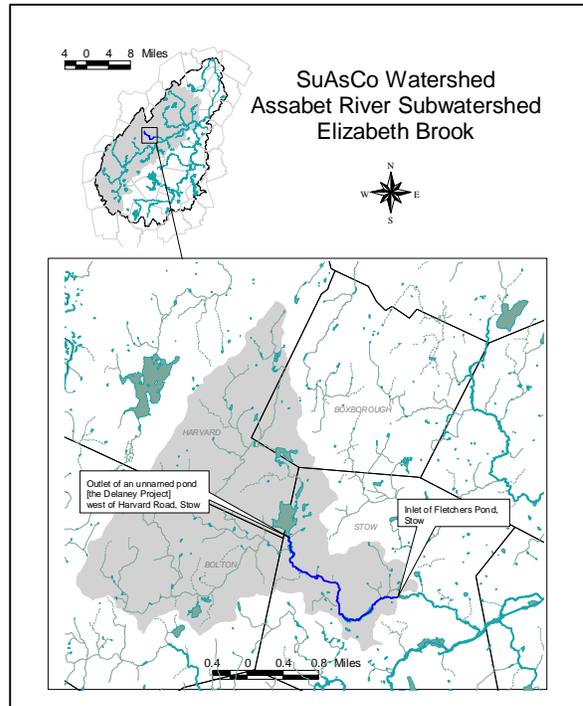
Classification: Class B

Land-use estimates (top 3, excluding water) for the 17.8 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 1.0 mi² and the percentage of the imperviousness is 5.5%.

- Forest 57%
- Residential 20%
- Open land 9%

Based on the last evaluation of water quality conditions Elizabeth Brook is listed on the 2002 Integrated List of Waters in Category 5. The cause of impairment for this segment is unknown (MA DEP 2003a).

This segment begins at the Delaney Project Dam. This dam was built as part of a flood control project to prevent the flooding of Elizabeth Brook and Great Brook. The area around Delaney Pond is now called the Delaney Complex and is maintained by MDFW as a conservation and recreation area (OAR 2004). There is fishing and boating access to Delaney Pond via an asphalt boat ramp (PAB 2003).



MDFW has proposed that Great Brook, a tributary to Elizabeth Brook, be protected as cold water fishery habitat (Richards 2003b). MDFW conducted fish population sampling in Great Brook on 5 June 2001 in the Conservation Area off Route 177, at Meadow Road in the Town of Bolton. The sample was dominated by cold water species: six brook trout, two brown trout, and two white sucker. Also collected were three redbfin pickerel, two blacknose dace, and one American eel (Richards 2003a).

A beaver exclusion device has been installed in Elizabeth Brook at the bridge on Delaney Street.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Stow Acres Country Club SSC Association		21428602	10th Hole Pond	0.14

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no regulated surface wastewater discharges to this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

Biology

MDFW conducted fish population sampling at two stations in Elizabeth Brook in Stow (Richards 2003a). The brook was sampled north of Route 117 (Station 372) on 1 August 2001 using backpack electroshocking equipment and west of Wheeler Road (Station 368) on 11 July using barge electroshocking equipment.

A total of ten species were collected in Elizabeth Brook near Route 117. The sample was comprised of nine American eel, seven redbfin pickerel, five chain pickerel, five creek chubsucker,

four pumpkinseed, three brown bullhead, three yellow bullhead, one fallfish, one largemouth bass, and one white sucker. MDFW noted that the presence of lots of weeds impaired the efficiency of sampling. Seven of the ten species are macrohabitat generalists, all of which are classified as moderately tolerant or tolerant to pollution. Of the three species that are fluvial specialists/dependants two were represented by single specimens. The other, creek chubsucker (n=5), is classified as an intolerant species.

Nine species were collected in Elizabeth Brook near Wheeler Road. The sample was comprised of 37 yellow bullhead, 30 pumpkinseed, 15 bluegill, 13 American eel, seven chain pickerel, six yellow perch, five largemouth bass, three brown bullhead, and two redbfin pickerel. The community at this site was comprised entirely of macrohabitat generalists and was dominated by a species that is extremely tolerant of low dissolved oxygen conditions.

In 1996, DWM conducted benthic macroinvertebrate sampling (RBP II) in Elizabeth Brook upstream from Rt. 117 in Stow (Appendix H).

The *Aquatic Life Use* for Elizabeth Brook is currently not assessed. This use is identified with an Alert Status because the fish assemblage was dominated by macrohabitat generalists, but sampling inefficiencies were cited by MDFW and must be taken into consideration. Additional data (e.g., benthic community, pre-dawn dissolved oxygen) are needed to assess this use.

Elizabeth Brook (MA82B-12) Use Summary Table

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

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

RECOMMENDATIONS

- Continue to conduct biological monitoring in Elizabeth Brook including benthic macroinvertebrate sampling, fish population sampling, and *in situ* water quality monitoring to assess the *Aquatic Life Use*. Benthic macroinvertebrate monitoring, pre-dawn DO and temperature monitoring, and bacteria monitoring should be conducted upstream and downstream from the Stow Acres Country Club to determine if it is impacting the aquatic life.
- Evaluate the outlet control practices at the Delaney Project Dam and determine if any impacts to the biota exist.
- Work with Stow Acres Country Club and other clubs in this subwatershed to promote good stewardship and implement BMPs to protect water quality (e.g., limiting fertilizer use, water withdrawals, stormwater management, maintenance of riparian buffer).
- Work with OAR and other interested parties to conduct a shoreline survey to promote stewardship and provide information to assess the *Aesthetics Use* and identify potential sources of pollution to the Elizabeth Brook.
- Great Brook, a tributary to Elizabeth Brook, should be protected as cold water fishery habitat as recommended by MDFW. Additional monitoring of the fish population, DO, and temperature is needed to evaluate MDFW's proposal to list this tributary as a cold water fishery in the next revision of the Surface Water Quality Standards.

ASSABET BROOK (ELIZABETH BROOK) (SEGMENT MA82B-17)

Description: Headwaters, outlet of Fletchers Pond, Stow, to the confluence with the Assabet River, Stow

Segment Length: 2.0 miles

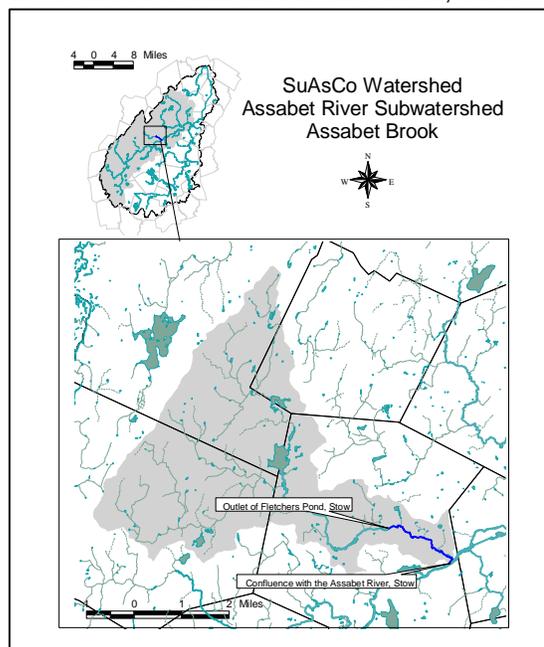
Classification: Class B

Land-use estimates (top 3, excluding water) for the 19.1 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 1.1 mi² and the percentage of the imperviousness is 5.5%.

Forest	57%
Residential	20%
Open land	9%

This segment was identified on USGS quadrangle sheets of 1969 and 1979 as Assabet Brook. On recent quads (1988) the stream is identified as Elizabeth Brook.

Fletcher Pond was described by OAR staff as being seriously eutrophied with heavy plant growth including water chestnut and having a cloudy water column in the summer (Flint 2004).



WMA WATER WITHDRAWAL SUMMARY

Based on the available information there are no WMA registered or permitted withdrawals from this subwatershed.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

The NPDES permit for Mobil Oil Corporation in Stow (MA0033669) was terminated by EPA in February 2004 (Vergara 2004). A vapor extraction system is being used instead (Rapp 2004).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

On at least one occasion in 2002 no flow was being released to Assabet Brook downstream from the Fletcher Pond Dam (OAR 2004).

The USGS began a habitat study in 2001 to determine stream flow requirements in the Assabet River Watershed. Three tributaries to the Assabet River were sampled including Assabet Brook (Elizabeth Brook). Parker and Armstrong (2002) provided preliminary estimates of streamflow necessary to maintain aquatic habitat for Assabet Brook (Elizabeth Brook) based on sampling six cross sections within a riffle section 0.7 miles upstream from the brook's mouth in Stow (Parker and Armstrong 2002). USGS measured stream discharge at this site between May 2001 and December 2002 (n=20). Flows ranged from a low of 0.67 cfs in August 2002, when the northeast portion of Massachusetts was under a drought advisory (Marler 2003), to a high of 161 cfs in December 2002 (Socolow *et al.* 2003). ENSR also conducted limited stream flow monitoring near the mouth of Assabet Brook (Elizabeth Brook) in 2000. Flows ranged from four to 77 cfs (ENSR 2001).

Chemistry – water

OAR conducted monthly water quality monitoring at one station (ELZ-004, near White Pond Road, Stow) approximately 0.7 miles upstream from the mouth of Assabet Brook (Elizabeth Brook) between June and October 2002. *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen (OAR 2003).

The USGS, as part of their mercury studies, also collected DO, pH, conductivity, alkalinity, temperature, total and methyl mercury samples from this location on 15 August 2000 (USGS 2003) and on 7 April and 17 August 2000 as part of the NECB NAWQA nutrient study (Socolow *et al.* 2001).

DO

Dissolved oxygen concentrations reported by OAR in 2002 ranged from 1.0 to 7.2 mg/L (n=5). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0530 and 0830. Concerned by the low DOs OAR visually surveyed this segment on 20 August and 25 September 2002. They found a beaver dam approximately 0.6 miles upstream from their sampling station in the Stow Town Forest. The dam had been partially breached in August and by September the dam was completely removed and grating was installed at the culvert. On 25 September OAR measured high DO (9.0 mg/L) in the brook upstream of Fletcher Pond but low DO in this segment of the brook (3 mg/L and 4 mg/L). In 2003 DO concentrations ranged between 3.9 and 6.2 mg/L with two of the four measurements less than 5.0 mg/L (OAR 2004).

The DO reported by USGS on 15 August 2000 was 3.7 mg/L. The DOs reported by USGS on 7 April and 17 August 2000 were 6 and 11.6 mg/L, respectively.

Temperature

Temperatures reported by OAR ranged from a low of 9.1°C in October to a high of 24.3°C in August (n=5). The temperature reported by USGS as part of the mercury study was 19.3°C. Temperatures reported in the NECB study were 20.6 and 21.1°C.

pH

pH values recorded by OAR ranged between 6.5 and 6.6 SU (n=5). The pH reported by USGS for the mercury study was 6.5 SU. The NECB study reported pHs of 6.5 and 7.0 SU.

Conductivity

Conductivity reported by OAR ranged between 208 and 374 µS/cm (n=5). The conductivity reported by USGS as part of the mercury study was 238 µS/cm while the conductivities reported as part of the NECB study were 238 and 289 µS/cm.

Total suspended solids

Total suspended solids concentrations reported by OAR ranged between <1.0 and 18.0 mg/L (n=3).

Total phosphorus

Total phosphorus concentrations reported by OAR ranged between 0.05 and 0.47 mg/L (n=3). Total phosphorous concentrations reported as part of the NECB study were 0.32 and 0.35 mg/L.

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR were 0.05 and 0.70 mg/L (n=2).
Ammonia-nitrogen concentrations reported in the NECB study were 0.25 and 0.41 mg/L.

Mercury

The concentration of total mercury as reported by USGS was 1.36 ng/L.

Chemistry – sediment

USGS collected sediment from Assabet Brook (Elizabeth Brook) near Stow in August 2000, as part of their mercury studies. The total mercury concentration was 0.147 ppm dry weight (USGS 2003), which did not exceed the L-EL of 0.2 ppm (Persuad *et. al.* 1993).

The *Aquatic Life Use* is not assessed for Assabet Brook (Elizabeth Brook) but is identified with an Alert Status because of low DOs and elevated total phosphorus. Additional data are needed to assess this use.

FISH CONSUMPTION

Two edible fillet composite samples (scales off, skin on, five pumpkinseed each) collected by USGS from Assabet Brook (Elizabeth Brook) in August 2000 were analyzed for total mercury. The concentration of total mercury in the edible fillet samples were 190.78 ng/g wet weight and 165.21 ng/g wet weight.

The *Fish Consumption Use* is currently not assessed for Assabet Brook (Elizabeth Brook) since MDPH has not issued a site-specific fish consumption advisory.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR collected one wet-weather fecal coliform bacteria sample from Elizabeth/Assabet Brook on 20 August 2000. The sample had a concentration of 800 cfu/100mL. No aesthetically objectionable deposits or other conditions (except that naturally associated with beaver activity) in Assabet Brook were documented by OAR volunteers (Flint 2004).

Too limited data are available and, therefore, the *Primary* and *Secondary Contact Recreational Uses* for Assabet Brook (Elizabeth Brook) are currently not assessed. The *Aesthetics Use* is assessed as support.

Assabet Brook (Elizabeth Brook) (MA82B-17) 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

- Benthic macroinvertebrate sampling, habitat assessment, fish population sampling as well as pre-dawn *in situ* sampling for dissolved oxygen, and total phosphorus monitoring should be conducted in Assabet Brook (Elizabeth Brook) upstream and downstream from the Stow Acres Country Club to determine if it is impacting water quality and to assess the *Aquatic Life Use*.
- The outlet control practices at Fletcher Pond should be evaluated to determine if they are having any impacts on instream habitat quality. To the extent practical, releases should mimic a natural hydrograph to protect the biota.
- Work with Stow Acres Country Club, other clubs, and gravel operations in this subwatershed to promote good stewardship and implement BMPs to protect water quality (e.g., limiting fertilizer use, water withdrawals, stormwater management, maintenance of riparian buffer).
- Work with OAR and other interested parties to conduct a shoreline survey to promote stewardship and provide information to assess the *Aesthetics Use* and identify potential sources of pollution to Elizabeth Brook.

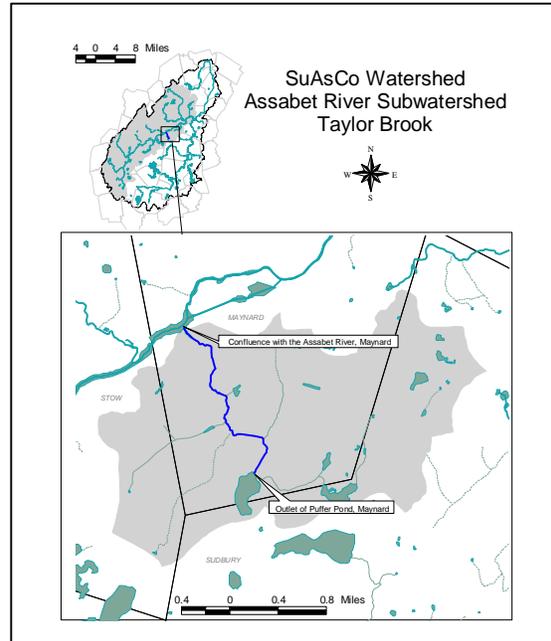
TAYLOR BROOK (SEGMENT MA82B-08)

Description: From the outlet of Puffer Pond, Maynard, to the confluence with the Assabet River, Maynard
 Segment Length: 1.8 miles
 Classification: Class B

Land-use estimates (top 3, excluding water) for the 4.2 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.3 mi² and the percentage of the imperviousness is 5.9%.

- Forest 58%
- Residential 23%
- Open land 7%

Based on the last evaluation of water quality conditions Taylor Brook is listed on the 2002 Integrated List of Waters in Category 3. This segment was not assessed for any of the designated uses (MA DEP 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Maynard Department of Public Works*	9P2147401	21417401	217400-01G -02G -03G -04G	1.09 (reg)

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

The Town of Maynard wells #1-4 are located in this subwatershed. These wells are located in sand and gravel deposits that overlie bedrock between 40 and 60 feet deep. One million gallons per day from wells 1-3 is disinfected and run through sand filters at the Old Marlboro Road Treatment Facility. The Green Meadow Treatment Facility treats 0.65 MGD of water from Well #4 and is expandable to 1 MGD. The sand filters remove iron and manganese. Old Marlboro Road and Green Meadow facilities add potassium hydroxide to control corrosion in household plumbing. The Green Meadow Facility went online in the fall of 2002. Maynard pumped 339.1 MG in 2002 with an average daily water use of 0.93 MGD servicing 3,800 people (The Maynard Web 2003). Wastewater from the Old Marlboro Road Water Treatment Facility (0.04 MGD) is discharged to the Maynard WWTP for treatment (Dufrense-Henry 2001). Backwash flow (0.02 MGD) from the Green Meadow Facility is discharged to the ground.

NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no regulated surface water NPDES discharges to this subwatershed.

SUPERFUND SITES

The Fort Devens-Sudbury Training Annex is a former U.S. Army military installation in the towns of Maynard, Stow, Hudson, and Sudbury. Contaminants at the site included VOCs, PCBs, pesticides, and inorganic compounds. All areas have been cleaned up. This site was deleted from the NPL on 29 January 2002. Most of the site (2205 acres) is now the US Fish and Wildlife Service Assabet River Wildlife Refuge, which is scheduled to open to the public in May 2005. Additional information is available in the Summary of Existing Conditions and Perceived Problems section of this report and from the EPA website: http://yosemite.epa.gov/r1/npl_pad.nsf/51dc4f173ceef51d85256adf004c7ec8/a4350eb2d816bcd68525691f0063f6ca?OpenDocument.

USE ASSESSMENT

AQUATIC LIFE

Chemistry – water

OAR conducted monthly water quality monitoring at one station on Taylor Brook (TAY-005, at Taylor Road) between June and October 2002. *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia (OAR 2003).

DO

Dissolved oxygen concentrations reported by OAR ranged from 0.7 to 10.2 mg/L (n=5). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0530 and 0830h. OAR noted that the Taylor Brook sampling site is just downstream from a beaver dam blocking a culvert under Old Patrol Road in the Assabet River Wildlife Refuge. This dam has not been breached and there was little flow through or over it. Taylor Brook was not sampled in 2003 or 2004 due to beaver activity (OAR 2004).

Temperature

Temperatures reported by OAR ranged from a low of 10.2 in October to a high of 22.9 in August (n=5).

pH

pH values recorded by OAR ranged between 5.9 and 6.7 SU (n=5). Three of the five measurements were <6.5 SU.

Conductivity

Conductivity reported by OAR ranged between 43 and 154 μ S/cm (n=5).

Total suspended solids

Total suspended solids concentrations reported by OAR ranged between 3 and 51 mg/L (n=3). Only one measurement (September) exceeded 25 mg/L.

Total phosphorus

Total phosphorus concentrations reported by OAR ranged from <0.01 to 0.08 mg/L (n=3).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR were 0.05 and 0.09 mg/L (n=2).

Too limited water quality data are available so the *Aquatic Life Use* is not assessed. This use is identified with an Alert Status, however, because of the small size of the watershed and the presence of municipal water supply withdrawals (out of subbasin transfer of water).

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR collected one wet-weather fecal coliform bacteria sample from Taylor Brook on 20 August 2002. The concentration in the sample was 200 cfu/100mL (OAR 2003). DWM collected one fecal coliform bacteria sample from Taylor Brook on 25 June 1996 (Appendix G, Table G2).

No aesthetically objectionable deposits or other conditions (except that naturally associated with beaver activity) in Taylor Brook were documented by OAR volunteers (Flint 2004).

Too limited data are available so the *Primary* and *Secondary Contact Recreational Uses* for Taylor Brook are currently not assessed. The *Aesthetics Use* is assessed as support based on the observations of OAR volunteers.

Taylor Brook (MA82B-08) Use Summary Table

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

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

RECOMMENDATIONS

- Investigate whether or not low DOs are occurring as a result of the beaver dam and natural low gradient wetland nature of the stream.
- Benthic macroinvertebrate, habitat, and fish population sampling should be conducted to evaluate whether or not there are any instream impacts associated with water withdrawals. If deemed necessary, conduct an inflow/outflow analysis for Taylor Brook.
- Work with interested parties to protect the core habitats and critical supporting watershed identified in this subwatershed by the Natural Heritage *Living Waters* report (2003) through land conservation measures and management practices.
- Establish a stream team or have volunteers conduct a shoreline survey to obtain additional data and to encourage local stewardship.

ASSABET RIVER (SEGMENT MA82B-06)

Description: From the USGS Gage at Routes 27/62, Maynard, to the Powdermill Dam, Acton

Segment Length: 1.2 miles

Classification: Class B, Warm Water Fishery

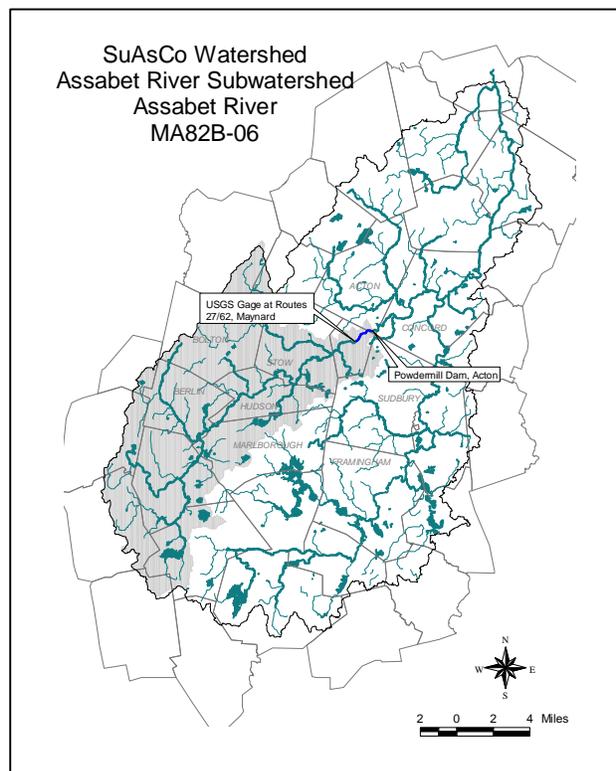
Land-use estimates (top 3, excluding water) for the 115.6 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 10.4 mi² and the percentage of the imperviousness is 9.0%.

Forest	49%
Residential	25%
Open land	8%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for priority organics, metals, thermal modifications, taste, odor and color, and suspended solids (MA DEP 2003a). A TMDL was completed for nutrients, organic enrichment/low DO, and noxious aquatic plants.

WMA WATER WITHDRAWAL SUMMARY

Based on the available data there are no regulated water withdrawals from this subwatershed.



NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

The Town of Maynard (MA0101001) was permitted (12 February 2001) to discharge 1.45 MGD of treated sanitary wastewater via outfall 001 to the Assabet River. The permit expired in 2004. The permit included seasonal limits for total phosphorus (April 1- October 31 = 0.75 mg/L and November 1-March 31 = report) and ammonia-nitrogen (November 1- April 30 = report and May 1- October 31 = 12 mg/L). Ferrous sulfate is used for phosphorus removal. The highest total ammonia-nitrogen concentration reported in their whole effluent toxicity testing reports was in February 2000 (12.7 mg/L). The facility's whole effluent toxicity limit was C-NOEC \geq 14% effluent and LC₅₀ \geq 100% effluent. A draft permit was issued with new permit limits (see sources of information and Appendix D for more information). The facility utilizes chlorine for disinfection and sodium dioxide for dechlorination (flow-paced). The TRC limit was 0.079 mg/L. Total residual chlorine concentrations measured in the effluent, as part of the facilities whole effluent toxicity tests conducted between November 1996 and September 2004, ranged between <0.01 and 0.9 mg/L (n=35) with five measurements exceeding the TRC limit of 0.079 mg/L – three of which occurred in 2003/early 2004. The facility has made some repairs to the dechlorination system and the problem appears to have been resolved (Webber 2004c). In April 2003 the Department gave final approval to the upgraded pump station and main sewer trunk and in December 2003 they had completed upgrades of all pump stations in Town. These two events were key events within the Town and now there are no more sewer overflows (Webber 2004c). Improvements have also been noted in the operations at the facility since the fall of 2003 although they have recently (2004) had problems meeting their TSS limit. Additionally, in September 2004 the pH of the effluent was 4.9 SU (Webber 2004c).

It should be noted that a TMDL for the nutrient phosphorus as total phosphorus for the Assabet River has recently been approved by EPA (MA DEP undated). This TMDL was developed with special emphasis on reducing the extent of nuisance macrophyte growth, meeting minimum dissolved oxygen criteria, reducing extreme diurnal dissolved oxygen fluctuations and excessive dissolved oxygen supersaturation, and reducing ambient total phosphorus concentrations. The TMDL for meeting the water quality objectives, including a margin of safety, includes removal of total phosphorus from POTW effluents to 0.1 mg/L during the growing season 1 April and 31 October and to optimize the removal of particulate

phosphorus during the non-growing season (MA DEP undated). All POTWs are required to be upgraded to achieve 0.1 mg/L of effluent phosphorus by April 2009 and the design should be consistent with adding new technology in the future to achieve further reductions if deemed necessary.

OTHER

The Town of Acton (0-656) is authorized (7 January 2000) to discharge 0.25 MGD of sanitary wastewater to the ground from the Action WWTP located on Adams Street. The permit includes limits for BOD (20mg/L), TSS (20mg/L), oil & grease (15 mg/L), fecal coliform (200 mg/L), total nitrate –nitrogen (10 mg/L), total nitrogen (10 mg/L), and total phosphorus (maximum daily of 0.5 mg/L until flow is >125,000 GPD or 1 March 2004 whereby the limit is a weekly average of 0.2 mg/L). The sewers are located in the South Acton and Kelly Corner sections of town. The Town is also required to conduct monthly monitoring of total phosphorus, dissolved phosphorus, and nitrate-nitrogen concentrations in Powdermill Impoundment (Reagor 2005). From April 2002 through January 2005 samples were collected monthly in the Impoundment in the vicinity of the Acton WWTP. While these data did not meet MA DEP requirements for external data submissions it should be noted that total phosphorus concentrations were elevated (reported range: <MDL to 2.9 mg/L with 28 out of 31 greater than 0.05 mg/L).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The 7Q10 estimated at the Maynard gage (in the Maynard WWTP NPDES permit) is 14 cfs. Water levels in Powder Mill Impoundment were very low in September 2001 as a result of the gate manipulations at Clock Tower Place.

Biology

MDFW conducted fish population sampling at one station on this segment of the Assabet River on 16 May 2001 near the Maynard Elks Club parking lot in Maynard (Station 499) using a boat electroshocking equipment (Richards 2003a). Twenty-six white sucker, 15 common carp, 13 largemouth bass, 11 redbreast sunfish, nine bluegill, five American eel, five pumpkinseed, two yellow perch and one yellow bullhead were collected. With the exception of the white sucker, which is considered a fluvial dependent species, all species can be classified as macrohabitat generalists that are either moderately tolerant or tolerant to pollution. The fish community is reflective of the impounded nature of this segment.

ENSR (2001) conducted macrophyte mapping in the Powder Mill Impoundment in July 1999 and August 2000. The macrophyte community was dominated by *Ceratophyllum* sp., but filamentous green algae, *Wolffia* sp., *Lemna* sp., and the non-natives *Trapa natans*, *Potamogeton crispus*, and *Cabomba caroliniana* were also identified. Water depths in the impoundment ranged from two to ten feet.

Toxicity

Effluent

Between 4 November 1996 and 8 September 2004, 33 whole effluent toxicity tests were conducted on the Town of Maynard WWTP effluent using *C. dubia* and 17 toxicity tests were conducted using *P. promelas* (4 November 1996 to 6 November 2000). The effluent was not acutely toxic to either *P. promelas* or *C. dubia* with the exception of the June 2003 test (LC₅₀ = 36.3% effluent to *C. dubia*). The effluent did exhibit some chronic toxicity to both test species. The C-NOECs for the 31 valid *C. dubia* tests ranged between 25 and 100% effluent, but none were reported less than the permit limit of 14% effluent. Of the 17 chronic tests conducted with *P. promelas* the C-NOECs ranged between 12.5 and 100% effluent with one test violating the permit limit of 14% effluent. However, it should be noted that three tests were invalid and a poor dose-response relationship was observed in three other test events with reduced survivals noted in the lower test concentrations although the CNOECs were reported as 100% effluent. Since the instream waste concentration of the Maynard WWTP discharge is estimated to be 14% the effects on survival of *P. promelas* noted in the lower dilution series is of concern.

Ambient

The Town of Maynard collects water from this segment of the Assabet River from the Waltham Street bridge near the USGS gaging station for use as a diluent in their whole effluent toxicity tests. Survival of

C. dubia exposed to river water for seven days in the 33 tests conducted was good ($\geq 90\%$) with the exception of the March 2001 test (60%). Survival of *P. promelas* exposed to Assabet River water for seven days in the 17 tests conducted between November 1996 and November 2000 ranged between 60 and 100% with survival less than 75% in four test events.

Chemistry – water

The Town of Maynard collected water from Assabet River at the Waltham Street bridge for use as diluent in their whole effluent toxicity tests. The water was analyzed for pH, hardness, alkalinity, conductivity, ammonia-nitrogen, and suspended solids. The results are maintained in the TOXTD database and summarized below.

In-situ profiles (top, middle, and bottom) for dissolved oxygen, temperature, conductivity, and pH were collected from five sites within Powder Mill Impoundment by OAR in July and August 2000. In August 2000 OAR also collected *in-situ* measurements in the impoundment in the afternoon hours to document diurnal variations. Additionally, OAR conducted monthly water quality monitoring at the Powdermill Dam (referred to as Old High Street dam) between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured (top, middle, and bottom) included temperature, DO, conductivity, and pH. Results from all of these stations are combined and summarized below.

DO

Dissolved oxygen concentrations in the Powder Mill Impoundment section of the Assabet River ranged from 4.2 to 11.9 mg/L with only two of the 62 measurements less than 5.0 mg/L. Percent saturations ranged between 43.0 and 148.5% with only three of the 62 measurements less than 60% and eight of the 62 measurements greater than 115%. It should be noted that these data were collected between 0430 and 0900h, not during worst-case, pre-dawn conditions.

Temperature

Temperatures in the Powder Mill Impoundment ranged between 14.4°C and 27.5°C (n=62).

pH

The pH of the Assabet River reported in the Maynard toxicity tests ranged between 6.3 and 7.6 SU (n=36) with only one measurement less than 6.5 SU. pH of Assabet River reported by OAR ranged from 6.5 to 8.6 SU with two of the 62 measurements less than 6.5 SU and two measurements greater than 8.3 SU.

Alkalinity

The alkalinity of the Assabet River, as reported in the Maynard toxicity tests, ranged between <10 and 52 mg/L (n=35).

Hardness

Hardness of the river ranged from 32.9 to 102 mg/L in the Maynard toxicity tests (n=36).

Conductivity

Conductivity in Assabet River water, measured as part of the Maynard toxicity tests, ranged between 222 and 664 $\mu\text{S}/\text{cm}$. OAR measured the conductivity of Assabet River water to be between 263 and 626 $\mu\text{S}/\text{cm}$ (n=62).

Total Suspended Solids

Suspended solids concentrations, as reported in the Maynard toxicity tests, ranged between <1 and 12 mg/L (n=36).

TRC

According to the Maynard toxicity test reports no detectable levels of TRC have been reported in the river (n=36).

Ammonia-nitrogen

Concentrations of ammonia-nitrogen in the Assabet River, as measured during the Maynard toxicity tests, ranged between <0.1 and 0.6 mg/L (n=36). These data do not exceed the chronic criterion for ammonia.

Chemistry – sediment

ENSR, in collaboration with OAR, conducted a sediment thickness survey in the Powder Mill Impoundment in May and June 2000. Sediment thicknesses ranged from two to ten feet with the greatest sediment thicknesses measured near the dam (ENSR 2001). ENSR concluded from their nutrient flux study that dissolved oxygen and nitrate were being removed from the water column and ortho-phosphorus and ammonia were being released to the water column (ENSR 2001).

USGS, with assistance from EPA, mapped the depth and extent of sediments in the Powdermill Impoundment in Maynard/Acton. Cores were collected between September and October 2003 and analyzed for VOCs, PAHs, PCBs, extractable petroleum hydrocarbons (EPH), organochlorine pesticides, and metals. These data, however, are not yet available. Results from this study will be useful for implementing the recommendations of the Assabet nutrient TMDL (Zimmerman 2004).

The *Aquatic Life Use* is assessed as impaired for this segment of the Assabet River based on occasional incidences of both oxygen depletion and supersaturation, dominance of filamentous green algae, and noxious aquatic plants (*Wolffia* sp., *Lemna* sp., and *Ceratophyllum* sp.); all indicators of a highly enriched system. The fish community was dominated by species that are highly tolerant of low dissolved oxygen conditions. The majority of the fish species present are macrohabitat generalists reflecting the impounded nature of this segment. Chronic toxicity (decreased survival of *P. promelas*) was occasionally present in low concentrations (6.25 to 50% effluent) of the Maynard effluent and, since the instream waste concentration of the discharge is estimated to be 14% at low flow, the effect of the discharge is of concern. The presence of non-native macrophytes in the Ben Smith Impoundment is also of concern.

FISH CONSUMPTION

Fish toxics monitoring (screening of metals in a composite sample of edible filets from five yellow bullheads) was conducted by DWM in this segment of the Assabet River in the Powder Mill Impoundment (upstream of the dam at High Street in Acton) in July 1985 (Maietta 1986).

MDPH did not issue a site-specific fish consumption advisory for this segment of the Assabet River so the *Fish Consumption Use* is not assessed.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

The Town of Maynard used to have a sewer overflow every spring during high flows to the Assabet River near the Elk's parking lot. In 2002 MA DEP issued a consent order to increase the size of the sewer main and make the pumps at the pump station larger. In April 2003 MA DEP gave final approval to the upgraded pump station and main sewer trunk. As of December 2003 upgrades of all pump stations in town were completed and the sewer overflows were eliminated (Webber 2004c).

According to OAR staff the free-flowing sections of the Assabet River from the gage to the Powder Mill Impoundment occasionally have objectionable conditions but the impounded section behind the Powder Mill dam is severely eutrophic with rooted aquatic plants, algal mats, and accumulations of floating duckweed completely covering the impounded section at times. Strong decaying plant odors are present in the late summer and strong smelling sediments are exposed when the water is low. Trash was also observed at most road crossings (Flint 2004).

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for this segment of the Assabet River because of the objectionable growths of filamentous green algae, duckweed, and watermeal along with areas of instream trash and odor. Additionally, prior to upgrades of the Maynard sewer main and pump stations in 2003 untreated sewage overflowed into the river near the Elks parking lot during high stream flows in the spring.

Assabet River (MA82B-06) Use Summary Table

Designated Uses		Status
Aquatic Life		<p>IMPAIRED</p> <p>Causes: Total phosphorus, low dissolved oxygen, excess algal growth, noxious aquatic plants, non-native aquatic plants, nutrient/ eutrophication biological indicators, fish bioassessment (Suspected Causes: Whole effluent toxicity)</p> <p>Sources: Municipal point source discharge, sanitary sewer overflows (collection system failure), unknown (Suspected Sources: Impacts from hydrostructure /flow regulation/ modification, internal nutrient recycling, discharges from municipal separate storm sewer systems (MS4s))</p>
Fish Consumption		NOT ASSESSED
Primary Contact		<p>IMPAIRED</p> <p>Causes: Excess algal growth, noxious aquatic plants, trash and debris, odor</p> <p>Sources: Municipal point source discharge, sanitary sewer overflows (collection system failure) (Suspected Sources: Impacts from hydrostructure/ flow regulation/ modification, internal nutrient recycling, discharges from municipal separate storm sewer systems (MS4s))</p>
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

- Biological monitoring should continue to be conducted in this segment of the Assabet River to evaluate impact(s) associated with the Maynard WWTP discharge and the effectiveness of implementation of the TMDL recommendations.
- Whole effluent toxicity testing for the Maynard WWTP should include testing with *P. promelas*. Since a pattern of a poor dose-response relationship was noted in prior toxicity tests and the instream waste concentration of the Maynard WWTP discharge is estimated to be 14% careful attention should be given when evaluating the results of the whole effluent toxicity tests. The facility should also be required to use Assabet River water as dilution water or at a minimum as a site water control for the toxicity tests.
- If it is determined that Assabet River water used as dilution water or as a site control water results in reduced/poor survival then the need for an instream toxicity investigation should be evaluated.
- Conduct continuous *in-situ* monitoring of DO, %saturation, temperature, and pH in the impounded sections of this segment of the Assabet River during the summer low flow period to determine frequency and duration of low DO conditions and the extent of diurnal fluctuations.
- Work with the Town of Acton to develop a QAPP and collect quality-assured total phosphorus data for use in the assessment of the *Aquatic Life Use* and in the evaluation of the effectiveness of TMDL implementation.
- Review results of the USGS sediment study, when available, for data to continue to evaluate the status of the *Aquatic Life Use*.
- Implement the Assabet Nutrient TMDL recommendations.

ASSABET RIVER (SEGMENT MA82B-07)

Description: From the Powdermill Dam, Acton, to the confluence with the Sudbury River, Concord

Segment Length: 6.4 miles

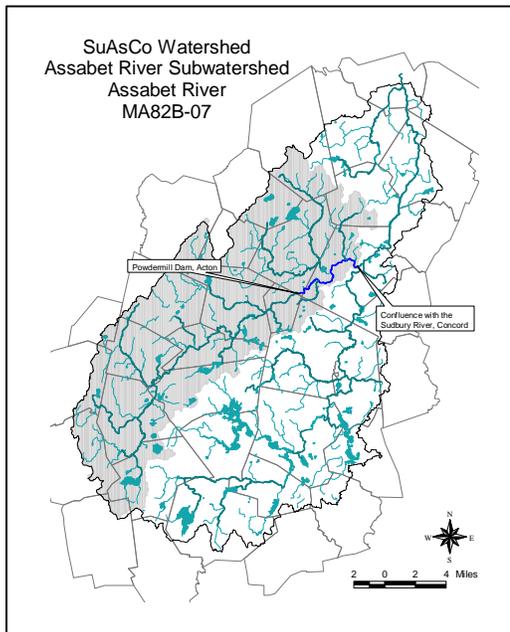
Classification: Class B, Warm Water Fishery

Land-use estimates (top 3, excluding water) for the 177.8 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 15.8 mi² and the percentage of the imperviousness is 8.9%.

- Forest 49%
- Residential 27%
- Open land 7%

Based on the last evaluation of water quality conditions this segment of the Assabet River is listed on the 2002 Integrated List of Waters in Category 5. This segment was assessed as impaired and requires a TMDL for pathogens (MA DEP 2003a). A TMDL was completed for nutrients and organic enrichment/low DO.

As part of the WR Grace Superfund Site Investigations, Menzie-Cura & Associates, Inc. conducted benthic macroinvertebrate sampling along three transects in this segment of the Assabet River. The purpose of this study was to evaluate whether VOC's (vinylidene chloride) in groundwater discharging to the Assabet River adversely affect the abundance and diversity of the benthic invertebrates in the river. The results of this study were inconclusive (Menzie-Cura & Associates Inc. 2004)



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Assabet Sand and Gravel Company Inc.		21400205	Assabet River w/d	0.17
Acton Water Department**	9P421400201	21400203	2002000-05G -06G -19G	1.56 (reg) <u>0.38 (perm)</u> 1.94*

* Indicates system-wide withdrawal, all sources not necessarily in this subwatershed

**As part of an agreement and settlement with W.R. Grace, the Acton Water District (AWD) installed, operates, and maintains air stripper units to remove any volatile organic compounds that may be present in groundwater pumped from Assabet 1, Assabet 2, Scribner, Lawsbrook and Christofferson Town wells. The AWD routinely treats and samples the water they provide to their users to assure that all safe drinking water quality standards are met.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

S/P Acton Realty Trust (MA0028835) is permitted (29 June 1984) to discharge treated sanitary wastewater from the Powder Mill Plaza WWTP via outfall 001 to this segment of the Assabet River. The permit expired in 1989. The permit includes limits for oil & grease (15.0 mg/L), TSS (30 mg/L), BOD (30 mg/L) and fecal coliform bacteria (200 cfu/100mL). This facility will be tying in to the Acton sewer system. The Acton wastewater is treated at the Acton WWTP off Adams Street and discharged to ground in the Nashoba Brook subwatershed (MA82B-14).

W.R. Grace & Co (MA0027421) is permitted (28 April 1982) to discharge 0.5 MGD from groundwater remediation at the Acton Water Supply District Assabet Municipal Well Number 1 to this segment of the Assabet River. WR Grace-Acton is an active Superfund Site (See below and Summary of Existing Conditions and Perceived Problems).

The Massachusetts Correctional Institute- Concord Wastewater Treatment Plant (MA0102245) is permitted (11 January 1978) to discharge 0.162 MGD of treated sanitary wastewater via outfall 001 to this

segment of the Assabet River. This permit, which included secondary limits for TSS, BOD, fecal coliform bacteria, expired 11 January 1983. EPA released a draft permit (public comment period ended 12 February 2005) for the facility that includes a seasonal total phosphorous limit of 0.2 mg/L from April to October (to be implemented by 30 April 2009). This April to October seasonal limit is expressed as a 60 day rolling average. From November through March the total phosphorous limit is 1.0 mg/L. A new design flow of 0.31 MGD has been incorporated into the draft permit with an accompanying adjustment in ammonia-nitrogen based upon the new flow limit (Casella 2005).

FERC

Acton Hydro Inc. Project Number: P-7148. The Assabet Dam Hydroelectric Project formerly owned by A&D Hydro Inc. and Acton Turbo Electric is currently owned by Acton Hydro Company. The FERC exemption was filed on 15 March 1983 and was granted on 16 March 1983. The Project is located on the Assabet River at the outlet of Powdermill Impoundment in the Town of Acton (the hydropower company identifies the impoundment as "Ripple Pond"). The Project, built in the early 1920's to produce power for the manufacture of gunpowder, includes a stone and timber dam that is 13 feet high and 78 feet long. The impounded area behind the dam is approximately 25 acres with negligible storage capacity. The flow of water to two 40-foot long, 6-foot diameter steel penstocks is controlled by three timber, head gates. The brick powerhouse is 18 feet by 22 feet and houses one generating unit that would have a generating capacity of 178 kilowatts. At the time of the application for FERC exemption it was estimated that the Project would produce about 79,700 kilowatts. The Project is to be operated as run-of-the river. The USFWS requires that an instantaneous discharge from the Project of 40 cfs or inflow, whichever is less, be maintained to protect downstream habitat and that if future fisheries management plans call to restore migratory fish to the Assabet the Project must provide fish passage facilities (FERC 1983).

The Project's single generating unit has been out of service since December 2000. During the last FERC inspection no deficiencies or dam safety concerns were observed. During 2001 and through September 2002 the intake gates and the floodgates have remained closed with the exception of two days in May 2002 when inflow exceeded 550 cfs. Flow over the spillway was never less than 100 cfs and Acton Hydro Company has complied with the minimum flow requirements (FERC undated). Concord Municipal Light Plant agreed to buy 500,000 kilowatt hours (the entire yearly output) from the plant in November 2003 for customers interested in using green power. The plant will operate seasonally in fall and spring (Heaney 2003, Levinson 2003).

NOTE: In April of 2004 storm flows partially breached the Powdermill Dam and the impoundment has been drawdown since. Acton Hyrdo has applied to the Maynard Conservation Commission for approval to conduct work to repair the dam (Flint 2005).

SUPERFUND SITES

The Nuclear Metals, Inc. (NMI) site, also known as the Starmet Corporation, is located on a 46.4-acre parcel located at 2229 Main Street in Concord, Massachusetts. The soil, sediment, and surface water are contaminated with radioactive materials (including uranium), VOCs and heavy metals. The site was listed on the NPL on 14 June 2001. In June 2002 EPA assumed the semi-annual groundwater monitoring program previously performed by Starmet. During the June 2002 sampling event EPA also sampled sediment and surface water on-site and in the Assabet River. Starmet is currently in violation of its MDPH radioactive materials license because it has failed to remove the stored drums of depleted uranium materials from the site. Starmet filed for Chapter 11 bankruptcy protection on 3 April 2002. EPA is currently negotiating for the performance of a Remedial Investigation/Feasibility Study (RI/FS) and an Engineering Evaluation and Cost Analysis (EPA 2004g). Additional information is available in the Summary of Existing Conditions and Perceived Problems section of this report.

The W. R. Grace Acton Plant Site is located in the towns of Acton and Concord, Massachusetts, off of Independence Road and covers approximately 260 acres. Investigations in 1978 indicated that two municipal wells, Assabet #1 and #2, were contaminated with volatile organic compounds and heavy metals, including iron, manganese, lead, arsenic, chromium, and nickel. As a result of these findings the Town took precautionary action and closed the two wells. The Acton Water District operates and maintains air strippers to remove any volatile organic compounds that may be present in groundwater pumped from Assabet 1, Assabet 2, Scribner, Lawsbrook and Christofferson town wells. The Acton Water

District routinely samples and treats the water they provide to users to assure that safe quality standards are met. The soil and sludge in the disposal areas are contaminated primarily with arsenic and VOCs, including vinyl chloride, ethyl benzene, benzene, 1,1-dichlorethylene, and bis(2-ethylhexyl)phthalate. The potentially responsible parties have been performing a Remedial Investigation/Feasibility Investigation of on and off site groundwater, surface water and sediments to determine the nature, extent and levels of contamination. A Final Remedial Investigation/Feasibility Study will be prepared and submitted under EPA and MA DEP oversight. The study includes the preparation of ecological & human health risk assessments to determine if there are any unacceptable risks to the environment or people (EPA 2004d). Sediment and surface water samples were collected from the Assabet River and Fort Pond Brook as part of the ecological and human health risk assessments (LeBlanc 2003). The final document is not yet available.

Additionally, the W. R. Grace Daramic Plant, adjacent to the W.R. Grace Superfund Site, is currently in Phase V of the five-phase Massachusetts Contingency Plan due to an oil release from an underground storage tank and a surface release of hexane. A Response Action Outcome (RAO) Statement had been submitted to MA DEP but was retracted (MA DEP 2004a).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The FERC exempt Project Number: P-7148 is operated by the Acton Hydro Company at the outlet of Powdermill Dam. The exemption for this project was issued in 1983 and includes the following requirements.

- The facility must be operated in a true run-of-river manner, whereby outflow equals inflow instantaneously.
- There is a very small bypass reach (<0.1 mile) below the dam at the hydropower project (water is conveyed from the impoundment to a powerhouse located downstream from the dam and, thus, a small portion of the natural stream channel is bypassed by the hydropower facility). The exemption requires an instantaneous minimum release of 40 cfs or inflow, whichever is less, in the bypass reach be maintained to protect downstream habitat.
- In the event that fisheries management plans call to restore migratory fish to the Assabet the project must provide fish passage facilities.

The single generating unit has been out of service since December 2000. Beginning again in late 2003/early 2004 the plant is expected to operate seasonally in fall and spring (Heaney 2003, Levinson 2003).

USGS conducted monthly stream flow monitoring at Pine Street in Concord in this segment of the Assabet River between May 2001 and December 2002 (n=20). Flows ranged between 23.1 cfs in September 2002 to 358 cfs in April 2002. The drainage area was calculated to be 119 mi². USGS also conducted stream flow monitoring at the Main Street bridge in Concord between May and August 2001 as well as in May 2002. Flows here ranged from 32.8 cfs to 179 cfs (Socolow *et al.* 2003).

Downstream from Route 2 in Concord the Assabet River is comprised of both wide shallow reaches containing sand and gravel riffles as well as deeper slow moving pool type habitats containing snags in the form of downed trees and large boulders (Appendix B).

ENSR conducted limited streamflow monitoring along this segment of the Assabet River in 1999 and 2000 at three stations (below Powdermill Dam, Rt. 62 in Concord, and Park Street in Concord) as part of the Assabet River Nutrient TMDL assessment study. Flows throughout the segment ranged between 18 and 95 cfs.

ENSR conducted stream flow monitoring near the mouth of the Assabet River near Nashawtuc Hill in Concord on 23 July and 11 September 2001 as part of the Concord River nutrient TMDL assessment study. Flows were 45.3 and 19.5 cfs, respectively.

Biology

MDFW conducted fish population sampling at one station on this segment of the Assabet River east of Route 62 in Concord (Station 496) on 11 July 2001 using barge electroshocking equipment (Richards 2003a). A total of 11 species were collected and included, in order of abundance, 21 fallfish, 13 white sucker, 12 redbreast sunfish, 11 spottail shiner, nine yellow bullhead, eight yellow perch, seven American eel, five bluegill, four largemouth bass, two chain pickerel, and one golden shiner were collected. Fluvial specialists/dependants were numerically dominant (fallfish, white sucker and spottail shiner), although many macrohabitat generalists were also present. All species present are considered moderately tolerant or tolerant to pollution.

Chemistry – water

OAR conducted monthly water quality monitoring at six stations on this segment of the Assabet River between June and September 2000 and June and October 2001 (OAR 2001 and 2002). *In situ* parameters measured included temperature, DO, conductivity, and pH. Grab samples were collected and analyzed for TSS, total phosphorus, and ammonia-nitrogen. In 2002 OAR only conducted water quality monitoring at four stations on this segment of the Assabet River (OAR 2003).

- Station 6.3- above Rt. 62 near Acton Ford, Acton (became Station ABT-063 in 2002)
- Station 4.7- above old dam at Damon Mill, Concord (only June 2000)
- Station 4.4- from Rt. 62 bridge at Damon Mill, Concord
- Station 3.3- by Rt. 62 bridge near Donut Shoppe, Concord (became Station ABT-033 in 2002)
- Station 2.6- by Rt. 2 bridge east of Assabet Avenue, Concord (became Station ABT-026 in 2002)
- Station 1.0- below Dakins Brook, off Lowell Road, Concord (became Station ABT-010 in 2002)

In 2001 DWM conducted water quality monitoring of the Assabet River at one location (Station AS01) at Rt. 2/2A bridge in Concord on three occasions. Measurements were collected *in situ* for dissolved oxygen, percent saturation, temperature, pH, conductivity, and total dissolved solids, while grab samples were collected and analyzed for turbidity, alkalinity, hardness, ammonia-nitrogen, total phosphorus, and suspended solids (Appendix A).

As part of the Concord River nutrient TMDL assessment study ENSR collected water quality samples near the mouth of the Assabet River near Nashawtuc Hill in Concord between June 2001 and September 2002. *In situ* parameters included DO, % saturation, temperature, pH, and conductivity. Grab samples were collected and analyzed for TP, ammonia-nitrogen, and TSS (ENSR 2003). ENSR also conducted two continuous *in situ* studies 23- 25 July 2001 and 11-13 September 2001.

As part of the Sudbury River bacteria survey ENSR also collected *in situ* water quality samples at one site (Station AR01) on the Assabet River, upstream from the confluence with the Sudbury River. Samples were collected between 29-30 July, 22-24 August, and 16 September 2003. *In situ* parameters included pH, specific conductivity, DO, % saturation, and temperature. Grab samples were also collected and analysis included ammonia-nitrogen, total phosphorus, and TSS.

DO

Dissolved oxygen concentrations reported by OAR from all six of their stations in this segment of the Assabet River ranged from 5.1 to 9.5 mg/L (n=62). While these measurements were not recorded during worst-case, pre-dawn conditions they were collected very close to pre-dawn between 0500 and 0900h.

Pre-dawn dissolved oxygen concentrations recorded by DWM at the Rt. 2/2A bridge ranged from 5.2 to 7.0 mg/L (n=3) with percent saturations ranging between 60 and 81%.

DO concentrations near the mouth of the Assabet River reported by ENSR as part of the Concord River TMDL study ranged between 7.8 and 9.3 mg/L (n=7 excluding two dry intensive surveys). Percent saturations ranged from 87.1 to 109.7%. DO concentrations measured by ENSR as part of the Sudbury survey ranged between 6.9 and 8.4 mg/L, while percent saturations ranged between 83.2 and 102.1% (n=3). These data were collected between 1131 and 1344h, not during worst-case, pre-dawn conditions.

Temperature

Temperatures reported by OAR, DWM and ENSR were all below MA SWQS.

pH

pH values reported by OAR, DWM and ENSR ranged between recorded by OAR ranged between 6.4 and 7.6 SU with only two the 75 measurements < 6.5 SU.

Hardness

Hardness of the river near Route 2/2A in Concord ranged from 52 to 78 mg/L (n=3).

Alkalinity

Alkalinity ranged between 22 and 53 mg/L (n=3).

Turbidity

Turbidity data ranged from 0.08 to 2.9 NTU (n=3).

Conductivity

Conductivity reported by OAR, DWM and ENSR ranged between 246 and 773 μ S/cm (n=74).

Total Suspended Solids

None of the total suspended solids concentrations reported by OAR, DWM and ENSR exceeded 25 mg/L. They ranged between <1 and 21.0 mg/L (n=59).

Total phosphorus

Total phosphorus concentrations reported by OAR ranged between 0.01 and 0.17 mg/L with 45 of the 52 samples having concentrations greater than 0.05 mg/L (87%). Total phosphorus concentrations in the Assabet River near Rt. 2/2A ranged between 0.074 and 0.16 mg/L (n=3). Total phosphorus concentrations near the mouth of the Assabet River reported by ENSR as part of the Concord study ranged between 0.03 and 0.11 mg/L with five of the six samples having concentrations greater than 0.05 mg/L. Total phosphorus concentrations in the Assabet River water reported by ENSR as part of the Sudbury bacteria survey ranged from 0.04 to 0.05 mg/L (n=3).

Ammonia-nitrogen

Ammonia-nitrogen concentrations reported by OAR ranged between 0.03 and 0.30 mg/L (n=48). Concentrations of ammonia-nitrogen in the Assabet River near Rte 2/2A were <0.02 mg/L (n=3). Ammonia-nitrogen concentrations near the mouth of the Assabet River reported as part of the Concord River TMDL study ranged from <0.03 to 0.11 mg/L. Ammonia-nitrogen concentrations reported by ENSR as part of the Sudbury study ranged from <0.03 to 0.06 mg/L (n=3). All of these are below the Chronic Criteria Concentration (CCC) for ammonia-nitrogen.

The *Aquatic Life Use* is assessed as support for this segment of the Assabet River based primarily on the fish community information and, with the exception of elevated total phosphorus concentrations, the other water quality data. It should be noted that DOs measured in the Assabet River at the Rt. 2/2A bridge in Concord during worse-case (pre-dawn) and low-flow (at and below 7Q10) conditions met water quality standards. The fish sample was comprised of 48% fish classified as fluvial specialists/dependants (three species). However, due to the presence of a large number of macrohabitat generalists and all species being classified as moderately tolerant or tolerant of pollution, combined with elevated total phosphorus concentrations, the *Aquatic Life Use* is identified with an Alert Status. (The elevated total phosphorus concentrations will be addressed as the TMDL is implemented.)

FISH CONSUMPTION

DWM conducted fish toxics monitoring in the Assabet River downstream from Route 2 in Concord on 17 September 1997 using boat-mounted electroshocking gear (Appendix B). Three white sucker, three yellow perch, three bluegill, three largemouth bass, and one yellow bullhead were collected and analyzed for metals, PCBs, and organochlorine pesticides. The composite of largemouth bass contained 0.47 mg/kg of mercury and the individual yellow bullhead contained 0.64 mg/kg of mercury. Although mercury in the yellow bullhead sample exceeded the MDPH trigger level, the MDPH does not

issue an advisory as the result of a data point from an individual fish sample. While it is not surprising to see largemouth bass containing mercury approaching the MDPH trigger level of 0.5 mg/kg, it is surprising to see bullhead in excess of this trigger level. It should be noted that the downstream end of this segment is located fairly close to the confluence with the Concord and Sudbury rivers and that both have site-specific fish consumption advisories due to mercury contamination. It is possible that this particular bullhead migrated into the Assabet from a downstream area of the Concord River or from the Sudbury River. PCB concentrations were below the MDPH trigger level of 1.0 mg/kg and organochlorine pesticides were not detected in any sample (Appendix B).

The *Fish Consumption Use* is currently not assessed for this segment of the Assabet River since MDPH did not issue a site-specific advisory. However, this use is identified with an Alert Status because of the potential for fish from the Concord and/or Sudbury rivers to easily migrate into this segment. Both the Concord and Sudbury rivers have MDPH site-specific fish consumption advisories due to elevated mercury.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected samples from the Assabet River near the Rt. 2/2A bridge in Concord on three occasions. The samples were analyzed for fecal coliform bacteria and *E. coli* bacteria. Sample holding times were exceeded so the data from one survey were censored. The dry weather fecal coliform bacteria counts for the other samples were 400 cfu/100mL on 18 July 2001 and 250 cfu/100mL on 30 July 2001 (Appendix A).

ENSR also collected *E. coli* and fecal coliform bacteria samples near the mouth of the Assabet River near Nashawtuc Hill in Concord as part of the Concord River TMDL assessment study. Samples were collected between 28 June and 7 September 2001. Fecal coliform bacteria counts ranged between 190 and 1250 colonies/100 mL (n=5). Four counts exceeded 200 cfu/100 mL and two counts exceeded 400 cfu/100 mL.

Additionally, ENSR collected fecal coliform and *E. coli* samples from the Assabet River at one station upstream from the confluence with the Sudbury River, as part of the Sudbury River Water Quality Study. Samples were collected on 29 July 2003 (dry weather) and 16 September 2003 (wet weather). The dry weather fecal coliform bacteria count was 100 cfu/100 mL. The wet weather fecal coliform bacteria count was 29,200 cfu/100 mL.

The geometric mean of the fecal coliform bacteria data collected from this segment of the Assabet River in the summer of 2001 was calculated to be 363 cfu/100 mL and 29% of the samples exceeded 400 cfu/100mL. Only one sample exceeded 2000 cfu/100 mL.

According to OAR staff this segment of the Assabet River is largely unimpaired by plant growth. They noted some trash at road crossings. Occasionally, duckweed washes downstream and some odor is present (Flint 2004a).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated fecal coliform bacteria counts. The *Secondary Contact Recreational Use* is assessed as support but is identified with an Alert Status because of the single extremely high bacteria count during wet weather in 2003. The *Aesthetics Use* is also assessed as support but is identified with an Alert Status because of objectionable amounts of duckweed and trash and debris near the road crossings.

Assabet River (MA82B-07) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED*
Primary Contact		IMPAIRED Causes: Fecal coliform Sources: Unknown (Suspected Sources: Discharges from municipal separate storm sewer systems (MS4s))
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

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

RECOMMENDATIONS

- Review any available data from the two superfund sites for pertinent information for this segment of the Assabet River. If appropriate, utilize the data to continue to evaluate the status of the *Aquatic Life Use*.
- Additional fish toxics monitoring should be conducted in this segment of the Assabet River, with particular emphasis on capturing yellow bullhead, to determine if the edible portions of fish from this waterbody contain mercury levels above the MDPH trigger level. The Starmet (Nuclear Metals, Inc.) Superfund site and the W.R. Grace Superfund site have also contaminated the Assabet River and other surface waters in this subwatershed with heavy metals and additional fish toxics monitoring also should be conducted near these sites.
- S/P Acton Realty Trust (MA0028835) is predicted to be tied into the Acton WWTP. If this does not occur the NPDES permit should be reissued with the appropriate limits and monitoring requirements to protect water quality. The W. R. Grace groundwater remediation permit has expired. The operations at the facility should be reviewed. If still actively discharging a new permit should be issued with appropriate limits and monitoring requirements.
- Work with interested parties to protect the core habitats and critical supporting watershed identified in this subwatershed by the Natural Heritage *Living Waters* report (2003) through land conservation measures and management practices.
- Implement the Assabet Nutrient TMDL recommendations.

SECOND DIVISION BROOK (SEGMENT MA82B-09)

Description: From the headwaters at the outlet of small unnamed pond north of Waltham Street, Maynard to the confluence with the Assabet River, Concord

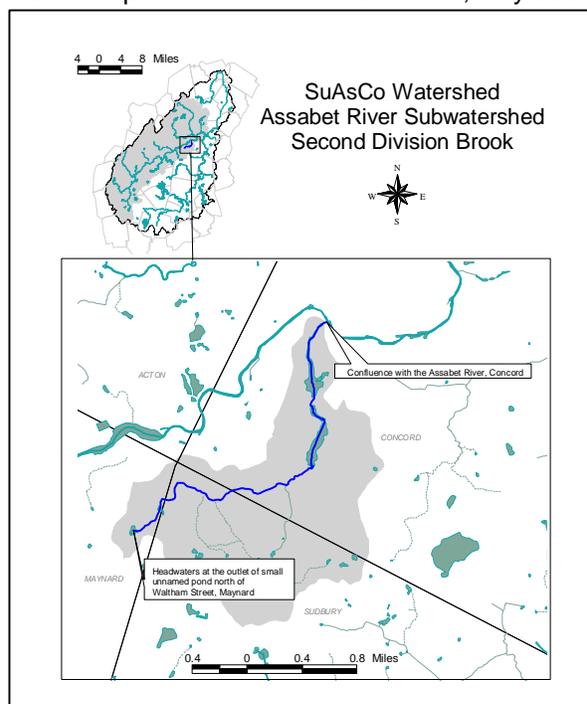
Segment Length: 2.9 miles

Classification: Class B

Land-use estimates (top 3, excluding water) for the 2.0 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.1 mi² and the percentage of the imperviousness is 7.7%.

Residential 50%
 Forest..... 37%
 Open land 3%
 Wetlands..... 3%

Based on the last evaluation of water quality conditions Second Division Brook is listed on the 2002 Integrated List of Waters in Category 3. This segment was not assessed for any of the designated uses (MA DEP 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Concord Water Department*			3067000-05G	2.52*
Verrill Farm**		31406707	Rte 117 #2w/d (s)	0.06 (184 days)

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

** This facility's withdrawals have been under the WMA threshold and they have initiated discussion with MA DEP to give up their registration (Peters 2004).

NPDES WASTEWATER DISCHARGE SUMMARY

Based on available information there are no regulated surface water discharges to this subwatershed.

LANDFILLS (APPENDIX K)

There are two landfills located within this subwatershed.

USE ASSESSMENT

Too limited data are available so all uses for Second Division Brook are currently not assessed. It should be noted, however, that because of the small size of the drainage area and the presence of the water withdrawals the *Aquatic Life Use* is identified with an Alert Status. While Kennedy Pond, an impoundment of Second Division Brook, was closed to swimming due to elevated counts of *E. coli* between 11 July and 12 July 2002 (MDPH 2002b). No additional information was provided by the Town of Concord as to the frequency of testing/length of swimming season. One of the recommendations in the Town's Comprehensive Wastewater Management Plan (CWMP) suggested that on-site wastewater disposal systems be examined in the Second Division Brook subwatershed (Weston and Sampson 2003).

Second Division Brook (MA82B-09) Use Summary Table

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

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

RECOMMENDATIONS

- Conduct instream monitoring (water quality, habitat, biological) in Second Division Brook to assess the status of the *Aquatic Life Use* and determine the impacts, if any, of the water withdrawals.
- Continue to evaluate beaches bill data for Kennedy’s Pond to assess the status of the *Primary and Secondary Contact Recreational Uses*.
- A shoreline survey should be conducted to identify potential nonpoint sources of pollution to the brook and to provide data to evaluate the *Aesthetics Use*.
- Implement recommendations from the Town of Concord CWMP.

FORT POND BROOK (SEGMENT MA82B-13)

Description: From source in a wetland just west of Fort Pond, Littleton, to the inlet of Warners Pond, Concord

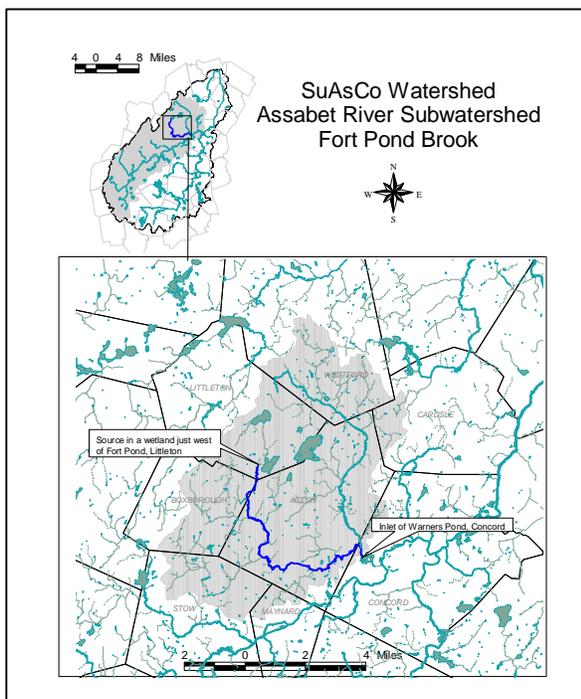
Segment Length: 10.2 miles

Classification: Class B

Land-use estimates (top 3, excluding water) for the 47.4 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 4.1 mi² and the percentage of the imperviousness is 8.6%.

- Forest 50%
- Residential 30%
- Agriculture..... 6%

Based on the last evaluation of water quality conditions Fort Pond Brook is listed on the 2002 Integrated List of Waters in Category 2. This segment supported some designated uses (Aquatic Life) and was not assessed for others (MA DEP 2003a).



The Acton Board of Health has conducted quarterly fecal coliform bacteria monitoring at ten stations along Fort Pond Brook since 1988 (Reagor 2005). This dataset is too limited temporally (i.e., only four counts per year) and was not used for assessment purposes.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Idylwilde Farm Inc.		V21400202	Fort Pond Brook	0.03
W. R. Grace & Co. – CONN		31415501	Well #1 Well #2 Well #3	0.58
Maynard Department of Public Works*	9P421417401	21417401	2174000-05G -06G -07G	1.09 (reg)
Acton Water Department*	9P421400201	21400203	2002000-01G -03G -04G -20G -21G -22G -23G -24G -25G	1.56 (reg) <u>0.38 (perm)</u> 1.94

* Indicates system-wide withdrawal, all sources not necessarily in this subwatershed

As part of an agreement and settlement with W.R. Grace, the Acton Water District (AWD) installed, operates and maintains air stripper units, which remove any volatile organic compounds that may be present in groundwater pumped from Assabet 1, Assabet 2, Scribner, Lawsbrook (03G), and Christofferson (04G) Town wells. The AWD routinely treats and samples the water they provide to their users to assure that all safe drinking water quality standards are met.

The Town of Maynard wells #5-7 are located in this subwatershed. These are bedrock wells that are approximately 400 feet deep. Up to 1.1 MGD from wells 5-7 are disinfected and run through green sand

filters as well as an air stripper to remove radon at the Rockland Avenue Treatment Facility. The green sand filters remove iron and manganese. The Rockland Avenue Facility went online in the fall of 2002. Maynard pumped 339.1 MGD in 2002 with an average daily water use of 0.93 MGD servicing 3,800 (The Maynard Web 2003). Wastewater from the Rockland Avenue Treatment Facility (0.06 MGD) is discharged to the Maynard WWTP for treatment (Dufrense-Henry 2001).

NPDES WASTEWATER DISCHARGE SUMMARY

Based on available information there are no regulated surface water discharges to this subwatershed.

SUPERFUND SITES

In preparation for conducting an Ecological Risk Assessment of the W.R. Grace Superfund Site, Menzie-Cura & Associates Inc., under contract to EPA, collected limited water quality and sediment samples from Fort Pond Brook. *In situ* measurements were collected on 12 August 2002 from three locations within the brook. Dissolved oxygen concentrations ranged from 6.8 to 10.2 (n=3). Temperature ranged from 19.5 to 23.4°C. pH ranged from 7.3 to 8.3 SU and conductivity ranged from 345 to 384 µS/cm. Sediment samples were also collected and analyzed for Target Analyte List (TAL) metals, TOC, SVOCs, and VOCs. No VOCs or SVOCs were detected. Additional information on the W.R. Grace Superfund Site is available in the Summary of Existing Conditions and Perceived Problems section of this report.

HAZARDOUS WASTE SITES AWAITING NPL DECISION

Acton Landfill: The Town of Acton has owned and operated the property located at 14 Forest Road as a landfill since 1927. Between 1927 and 1969 the property was used as a burning dump. From 1969 until 1985 the property was used as a municipal landfill. Municipal and industrial wastes, the exact types and quantities of which are unknown, have been disposed of in the landfill. The landfill was closed and capped in 1985. Analytical results of groundwater samples collected from the property between 1985 and 1995 indicated the presence of chlorinated and non-chlorinated volatile organic compounds and metals (including lead and mercury). Analytical results of surface water samples collected from the unnamed stream between 1985 and 1995 do not indicate the presence of any contaminants attributable to the Acton Landfill property. No impacts to downstream fisheries or sensitive environments are known or suspected. MA DEP currently does not consider the property to be a disposal site that requires action under the Massachusetts Contingency Plan (EPA 2002b).

LANDFILLS (APPENDIX K)

There are two landfills (Acton Landfill and the Fletcher Landfill) located within this subwatershed. The Fletcher Landfill is inactive. The former Acton Landfill is no longer active and was replaced by the Acton Transfer Station (Reagor 2005).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

USGS measured stream flows in Fort Pond Brook downstream of River Street bridge in Acton between May 2001 and December 2002 (n=17). Flows ranged from a low of 0.30 cfs in September 2002 to a high of 75.1 cfs in April 2002 (Socolow *et al* 2001).

In 1996 DWM conducted a habitat assessment as part of the benthic macroinvertebrate sampling site in Fort Pond Brook near Parker Street in Acton (Appendix H).

Biology

In 1996 DWM conducted benthic macroinvertebrate sampling (RBP II) in Fort Pond Brook near Parker Street in Acton (Station SAC06). This station was chosen as the watershed reference (Appendix H).

Chemistry – water

The USGS, as part of their mercury studies, collected DO, pH, conductivity, alkalinity, temperature, total and methyl mercury samples from the water column of Fort Pond Brook near South Acton on 15 August 2000 (USGS 16 October 2003). USGS also collected water quality data from Fort Pond Brook near South Acton as part of the NECB nutrient study on 4 April and 15 August 2000 (Socolow *et al.* 2001).

DO

The DO in Fort Pond Brook in April was 11.1 and in August was 8.7 mg/L. These data were not collected during worst-case, pre-dawn conditions.

pH

The pH of Fort Pond Brook in April was 6.8 and in August was 7.0 SU.

Conductivity

The conductivity was 228 μ S/cm in April and was 214 μ S/cm in August.

Temperature

The temperature was 11.2°C in April and was 18.8°C in August.

Alkalinity

The alkalinity was 14 and 26 mg/L in April and August, respectively.

Total Phosphorus

Total phosphorus concentrations in Fort Pond Brook were 0.019 and 0.070 mg/L in April and August, respectively.

Ammonia-nitrogen

Ammonia-nitrogen concentrations were 0.34 and 0.72 mg/L in April and August, respectively.

Mercury

The concentration of methylmercury in Fort Pond Brook in August was 1.82 ng/L and the concentration of total mercury was 6.66 ng/L.

Chemistry – sediment

USGS collected sediment from Fort Pond Brook near South Acton in August 2000, as part of their mercury studies. The total mercury concentration was 0.672 ppm dry weight (USGS 2003) which exceeded the L-EL of 0.2 ppm.

Due to the lack of additional data (biological, pre-dawn DO) the *Aquatic Life Use* is currently not assessed for Fort Pond Brook.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected bacteria samples in Fort Pond Brook at one station (at Laws Brook Road) on 25 June 1996 and at two stations (at River Street and at Central Street) on 18 July 1996 (Appendix G, Table G2). Additionally, DWM collected samples from the outlet of Warners Pond, just upstream from Commonwealth Ave. on 25 June 1996; from a formerly unnamed tributary known as Coles Brook on 18 July 1996; and from a formerly unnamed tributary known as Pratts Brook on 18 July 1996 (Appendix G, Table G2).

Between 22 April and 7 May 1998 volunteers conducted a shoreline survey of Fort Pond Brook. The stream team noted areas of sedimentation, particularly around storm drains, improper yard waste disposal practices, and isolated areas of algae and trash. Septic odors were noted in one section, possibly emanating from an unnamed tributary at Stow Road. It should be noted that a stream cleanup took place in September 1998 (Acton Stream Teams 1998).

Too limited data are available so the *Recreational* and *Aesthetic* uses are currently not assessed for Fort Pond Brook.

Fort Pond Brook (MA82B-13) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

- Benthic macroinvertebrate, habitat, and fish population sampling should be conducted to evaluate whether or not there are any instream impacts associated with water withdrawals and to assess the *Aquatic Life Use*. If deemed necessary conduct an inflow/outflow analysis for Fort Pond Brook. Additionally, *in situ* monitoring of pre-dawn dissolved oxygen should also be conducted to aid in the assessment of the *Aquatic Life Use*.
- Evaluate additional data collected as part of the WR Grace-Acton Superfund Site Remedial Investigation/Feasibility Study for Fort Pond Brook. When complete review the Ecological Risk Assessment report for data and recommendations to assess the *Aquatic Life Use*.
- Work with the Acton Board of Health to continue to collect quality assured bacteria data from Fort Pond Brook and to expand the monitoring program to include additional sampling dates, particularly during the Primary Contact season. Data collected could be used to assess the status of the *Primary* and *Secondary Contact Recreational* uses.
- Support the efforts of the stream team to update their shoreline survey, to obtain additional data, to encourage local stewardship, and to provide data to evaluate the status of the *Aesthetics Use*.

NASHOBA BROOK (SEGMENT MA82B-14)

Description: From source, just south of Route 110 in Westford, to confluence with Fort Pond Brook, Concord

Segment Length: 9.4 miles

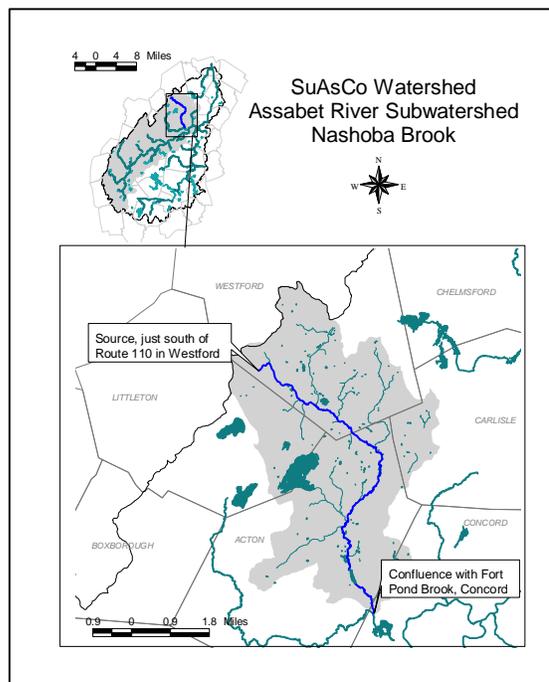
Classification: Class B

Land-use estimates (top 3, excluding water) for the 21.5 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 2.1 mi² and the percentage of the imperviousness is 9.8%.

- Forest 51%
- Residential 27%
- Agriculture..... 6%

Based on the last evaluation of water quality conditions Nashoba Brook is listed on the 2002 Integrated List of Waters in Category 3. This segment was not assessed for any of the designated uses (MA DEP 2003a).

MDFW has proposed that Nagog Brook, a tributary to Nashoba Brook, be protected as cold water fishery habitat (Richards 2003b). MDFW conducted fish population sampling in Nagog Brook on 8 June 2001 west of Route 27 in Concord. Four redfin pickerel, one banded sunfish, and one brook trout were collected (Richards 2003a).



WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E5)

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)
Acton Water Department*	9P421400201	21400203	2002000-02G -09G 10G -11G -12G -13G -14G -15G -16G -17G -18G	1.56 (reg) <u>0.38 (perm)</u> 1.94
Concord Water Department*	9P31406701	31406704	3067000-01S (Nagog Pond)	2.1 (reg) <u>0.42 (perm)</u> 2.52*

* Indicates a system wide withdrawal, all sources not necessarily within this subwatershed

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

Haartz Corporation (MAG25006) is permitted (27 October 2000) to discharge 0.004 MGD of NCCW to Conant Brook, a tributary to Nashoba Brook. This permit will expire in 2005. The Haartz Corporation (MAR05B612) was also issued a multi-sector general storm water permit (expires October 2005) by the EPA.

The Deck House Inc. permit (MA0036820) was terminated in September 2003 by EPA because the wells were shut down in July.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The USGS maintains a stream gaging station (01097300) on Nashoba Brook downstream from the dam in North Acton. The period of record for this gage is July 1963 to present with occasional low-flow

records from 1962-1963. Also, since 1967 USGS notes that a pond upstream has occasionally affected Nashoba Brook. The average discharge for the period of record is 20.1 cfs (Socolow *et al.* 2003). The estimated 7Q10 is 0.12 cfs (Wandle and Fontaine 1984). This gage may be discontinued due to the presence of several beaver dams, which cause impounding of Nashoba Brook at the gage.

Table 5. Monthly mean discharge data for USGS Gage 01097300 Nashoba Brook near Acton, MA. Excerpted from Socolow *et al.* 2003, 2002, 2001, 2000, 1999.

	May	June	July	August	September
WY 2002*	32.8	19.2	6.04	0.19	0.74
WY 2001	9.28	19.9	6.82	3.53	0.66
WY 2000	26.4	24.4	4.45	6.65	6.02
WY1999	8.76	1.37	0.52	0.076	6.57
WY1998	35.6	56.7	13.3	2.04	0.94

*USGS notes that the records for water year October 2001 to September 2002 are poor due to backwater from a beaver dam.

During the drought year of 1999 flows were below the calculated 7Q10 at the USGS gage for 41 out of 92 days (45%) during the months of July, August, and September.

In 1996 DWM conducted a habitat assessment of Nashoba Brook as part of benthic macroinvertebrate sampling (Appendix H).

USGS also measured flows downstream from the Commonwealth Avenue bridge in Concord (the outlet of Warners Pond) between May 2001 and December 2002 (n=21). Flows ranged from a low of 0.54 cfs in August 2002 to a high of 172 cfs in April 2002 (Socolow *et al.* 2003).

In 1999 and 2000 ENSR conducted limited streamflow monitoring near the mouth of Nashoba Brook as part of the assessment phase of the Assabet River Nutrient TMDL. Flows ranged between 2 and 163 cfs (ENSR 2001).

It should be noted that the Nashoba Brook watershed is classified by MA DCR as a "high stressed basin" (MWRC 2001).

Ice House Pond, an impoundment of Nashoba Brook in Acton, was dredged in 1995 as a result of siltation and infestation of the pond by *Trapa natans* (water chestnut). Nutrient loading from malfunctioning on-site wastewater systems, stormwater and non-point source pollution sources upstream contributed to conditions in the pond. There has been no recurrence of the non-native infestation, which once covered the entire surface of the pond (Tidman 2005).

Biology

In 2000 the MDFW conducted fish population sampling using backpack electroshocking equipment at two stations in Nashoba Brook in Acton. On 21 June 2000 four species were collected near Carlisle Road bridge off Route 27 including two chain pickerel, two American eel, and one golden shiner (Richards 2003a). On 22 June 2000, a total of six species were collected near Wheeler Road (off Route 27) including 14 chain pickerel, ten pumpkinseed, four bluegill, two creek chubsucker, one American eel, and one golden shiner (32 fish total).

At the Carlisle Road site fish numbers were extremely low (n=5). All fish collected were macrohabitat generalists. It is unclear what is causing the low numbers of fish. At Wheeler Road, with the exception of the creek chubsucker, all species can be classified as macrohabitat generalists and moderately tolerant/tolerant of pollution. The creek chubsucker (n=2) is considered a fluvial specialist and pollution intolerant. The low numbers of fish and the dominance by macrohabitat generalists may be related to the proximity of this station to Robbins Mill Pond (located just downstream) and the increase of ponding by recent beaver activities in these locations.

Between 22 April and 7 May 1998 volunteers from Acton conducted a shoreline survey of Nashoba Brook. It was noted that the stream near Robbins Mill Pond "is almost dry in the summer and gets

completely choked off with water chestnuts". Dams are noted throughout the stream. Duckweed covered sections of the stream (Acton Stream Team 1998).

In 1996 DWM conducted benthic macroinvertebrate sampling (RBP II) at one station on Nashoba Brook, off Route 2A between Wetherbee Street and Keefe Road (Appendix H).

Toxicity

Effluent

The Haartz Corporation conducted one whole effluent toxicity test on 2 April 2001 using the water flea (*Ceriodaphnia dubia*). No acute ($LC_{50} > 100\%$ effluent) or chronic toxicity (C-NOEC = 100% effluent) was detected (TOXTD).

Chemistry – water

As part of the SMART monitoring program, water quality sampling was conducted on five occasions between March and November of 2000 in Nashoba Brook (station NA01) upstream/north of footbridge in Nashoba Brook Conservation Area southeast of Wheeler Lane, Acton (Appendix I). Parameters measured included temperature, pH, specific conductivity, DO, TSS, turbidity, total phosphorus, ammonia-N, alkalinity, and hardness.

The Organization for the Assabet River conducted water quality monitoring in Nashoba Brook at one station T2.9, Nashoba Brook, by Commonwealth Ave. Bridge, Concord between 2001 and 2003. *In situ* parameters measured included temperature, dissolved oxygen, pH, and conductivity. Grab samples were collected and analyzed for total suspended solids, total phosphorus, Total Kjeldahl Nitrogen, and nitrate concentrations.

DO

DO measurements (n=5) ranged from a low of 5.1 mg/L in August to a high of 11.5 mg/L in March during the SMART surveys. Percent saturation (n=5) ranged from 55% (August) to 90% (March). It should be noted that these data do not represent the worst-case, pre-dawn conditions.

DO concentrations reported by OAR ranged between 4.7 and 11.5 mg/L (n=14) with only two measurements less than 5.0 mg/L in August. Percent saturations ranged between 58.4 and 92.8 (n=10) with only the August 2002 measurement less than 60% saturation. These data were not collected during worst-case, pre-dawn conditions, but they were collected close to pre-dawn, between 0530 and 0830h.

Temperature

Temperatures reported by the SMART program ranged from a high of 19.8°C taken during the summer month of August to a low of 5.6° in March. Temperatures reported by OAR ranged from a low of 11.5°C in October to a high of 25.8°C in August (n=14).

pH

Instream pH had a narrow range between 6.3 and 6.6 SU during the SMART monitoring (n=5) with four out of the five measurements less than 6.5 SU. pH reported by OAR ranged between 6.4 and 7.25 SU (n=14) with only one measurement less than 6.5 SU.

Alkalinity

Alkalinity ranged from 10 to 30 mg/L (n=5).

Hardness

Hardness data ranged from 37 to 55 mg/L (n=5).

Conductivity

Measurements of specific conductance at 25°C by SMART ranged from a low of 249 to a high of 341 $\mu\text{S}/\text{cm}$. Conductivity measured by OAR ranged between 258 and 544 $\mu\text{S}/\text{cm}$ (n=10).

Turbidity

Turbidity ranged from 0.80 to 2.5 NTU (n=5).

Total Suspended Solids

The concentration of total suspended solids ranged between <1 and 1.4 mg/L during the SMART survey (n=5). TSS concentrations reported by OAR ranged between <1.0 and 6.0 mg/L (n=11)

Total Phosphorus

Total phosphorus concentrations reported by the SMART program ranged between 0.023 and 0.073 mg/L with three of the five measurements greater than 0.05. Total phosphorus concentrations reported by OAR ranged from <0.01 and 0.06 with only one of the 11 samples having a concentration greater than 0.05 mg/L.

Ammonia-nitrogen

Ammonia-nitrogen concentrations ranged from <0.02 to a high of 0.20 mg/L during the SMART survey (n=5). Ammonia-nitrogen concentrations reported by OAR were 0.03 and 0.08 mg/L (n=2). None of these exceed the chronic criterion for ammonia.

The *Aquatic Life Use* is assessed as impaired based on reported frequency and duration of low flow conditions and the fish community information. Additionally, low DO/saturation and slightly elevated levels of total phosphorus are also of concern. The influence of the beaver dams in this subwatershed is unknown at this time.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample from Nashoba Brook on 25 June 1996 (Appendix G, Table G2).

The Acton Board of Health has collected quarterly fecal coliform bacteria samples from six sites along Nashoba Brook since 1988 (Reagor 2005). According to the Board swimming standards were exceeded in Ice House Pond, an impoundment of Nashoba Brook, in approximately 25% of the samples. The most likely source of bacteria is septic systems up gradient from Ice House Pond and the brook (Halley 2004).

Between 22 April and 7 May 1998 volunteers from Acton conducted a shoreline survey of Nashoba Brook. There was a piggery, which appeared to be contributing to instream turbidity, that was identified as a concern in the vicinity of South Street. Some trash and debris and odors were noted along the stream. Duckweed covered sections of the stream. Storm drains and sedimentation were also noted (Acton Stream Team 1998). OAR volunteers have conducted stream cleanups in Nashoba Brook.

The SMART monitoring field crew did not note any objectionable conditions during their bimonthly water quality sampling between February and December 2001 (MA DEP 2001b).

Too limited data are available so the *Recreational* and *Aesthetic* uses are currently not assessed for Nashoba Brook. The *Primary Contact Recreational Use* is identified with an Alert Status, however, because of concerns identified by the Acton Board of Health regarding septic system failures upstream of Ice House Pond.

Nashoba Brook (MA82B-14) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low flow alterations, fish bioassessment (Suspected Causes: Low dissolved oxygen, total phosphorus) Sources: Unknown (Suspected Sources: Baseflow depletion from groundwater withdrawals, on-site septic systems)
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

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

RECOMMENDATIONS

- Additional monitoring (habitat, benthic macroinvertebrate, fish community, and water quality including pre-dawn DO sampling) should be conducted to document effects of water withdrawals, if possible, and to better assess the status of the *Aquatic Life Use* for Nashoba Brook.
- The Acton Board of Health identified failing septic systems up-gradient of Ice House Pond as probable sources of bacterial contamination in Nashoba Brook and is implementing projects under the Comprehensive Community Septic Management Program and/or the Homeowner Septic Loan Program to improve water quality. Bacterial monitoring should be continued in Ice House Pond and Nashoba Brook to document improved water quality following the system upgrades and to assess the status of the *Primary* and *Secondary Contact Recreational* uses.
- Implement the recommendations identified in the Acton CWMP.
- Work with the Acton Stream Teams to implement their action plan including conducting stream cleanups, educating abutters about proper yard waste disposal practices, and working with the Town Conservation Commission, Board of Health and Highway Department to investigate potential sources of pollution and implement best management practices.

SPENCER BROOK (SEGMENT MA82B-15)

Description: From the outlet of an unnamed pond in Concord, north of Bellows Hill, to the inlet of Angiers Pond, Concord

Segment Length: 3.8 miles

Classification: Class B

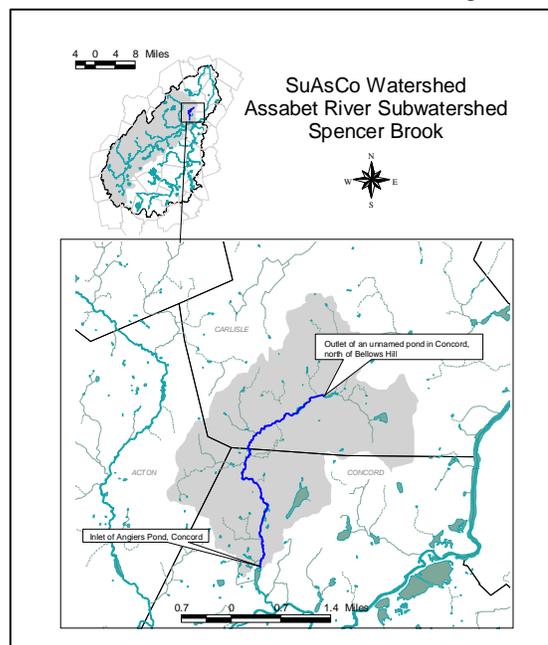
Land-use estimates (top 3, excluding water) for the 6.8 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.4 mi² and the percentage of the imperviousness is 5.9%.

Forest	57%
Residential	27%
Agriculture.....	9%

Based on the last evaluation of water quality conditions Spencer Brook is listed on the 2002 Integrated List of Waters in Category 3. This segment was not assessed for any of the designated uses (MA DEP 2003a).

WMA WATER WITHDRAWAL SUMMARY

Based on the available data there are no WMA regulated water withdrawals from this subwatershed.



NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1-E4)

Middlesex School Wastewater Treatment Plant (MA0102466) is permitted (4 February 1988, modified 28 Sept 1989) to discharge 0.052 MGD of treated sanitary wastewater via outfall 001 to an unnamed tributary to Spencer Brook when flow exists. When flow in the unnamed tributary ceases, the effluent is discharged directly to Spencer Brook. The permit expired 3 February 1993 and EPA/MA DEP issued a new permit on 3 March 2005 that includes seasonal limits on total phosphorus (Firman 2004). The facility was upgraded to achieve phosphorus removal to 0.2 mg/L and is under construction to utilize UV for disinfection (Firmin 2004).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

In 1999 and 2000 ENSR conducted limited streamflow monitoring near the mouth of Spencer Brook as part of the assessment phase of the Assabet River Nutrient TMDL. Flows ranged between 0.1 and 21 cfs (ENSR 2001).

Biology

MDFW conducted fish population sampling at one station in Spencer Brook in Carlisle on 8 June 2001 using backpack electroshocking equipment (Richards 2003a). Fifteen redbfin pickerel, five pumpkinseed, and five golden shiners were collected (25 fish total). All three species can be classified as macrohabitat generalists and are considered to be moderately pollution tolerant or tolerant species. The low numbers of fish and the absence of fluvial species may be due to instream flow issues.

Due to the lack of additional data (benthic macroinvertebrate, habitat, chemical including pre-dawn DO) Spencer Brook is currently not assessed for the *Aquatic Life Use*. However, the *Aquatic Life Use* is identified with an Alert Status because of the fish community information.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

Although OAR staff reported that heavy rooted and floating plant growth and algal mats were observed in the summer in Spencer Brook (Flint 2004) the spatial extent and the frequency and duration of these conditions are unknown at this time. Therefore, the *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed for Spencer Brook, but are identified with an Alert Status.

Spencer Brook (MA82B-15) Use Summary Table

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

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

RECOMMENDATIONS

- Conduct water quality monitoring (habitat, biological and physicochemical sampling) in Spencer Brook to evaluate the status of the *Aquatic Life Use* and to evaluate the effects, if any, of the Middlesex School Wastewater Treatment Plant (MA0102466) discharge.
- A shoreline survey along Spencer Brook is recommended to document potential nonpoint sources of pollution to the brook and document the spatial extent, frequency, and duration of plant growth and algal blooms in the brook.

UNNAMED TRIBUTARY (SEGMENT MA82B-16)

Description: From the outlet of Angiers Pond, Concord, to confluence with the Assabet River, Concord

(This segment is locally known as part of Spencer Brook)

Segment Length: 0.5 miles

Classification: Class B

Land-use estimates (top 3, excluding water) for the 7.1 mi² watershed (map inset, gray shaded area) are presented below. An estimate of the impervious area within this subwatershed is 0.3 mi² and the percentage of the imperviousness is 3.8%.

Forest 56%

Residential 28%

Agriculture..... 9%

Based on the last evaluation of water quality conditions this unnamed tributary is listed on the 2002 Integrated List of Waters in Category 4c. This segment was assessed as impaired or threatened due to flow alteration which is not a pollutant requiring calculations of a TMDL (MA DEP 2003a).

WMA WATER WITHDRAWAL SUMMARY AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on available information there are no regulated WMA withdrawals or surface water discharges in this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

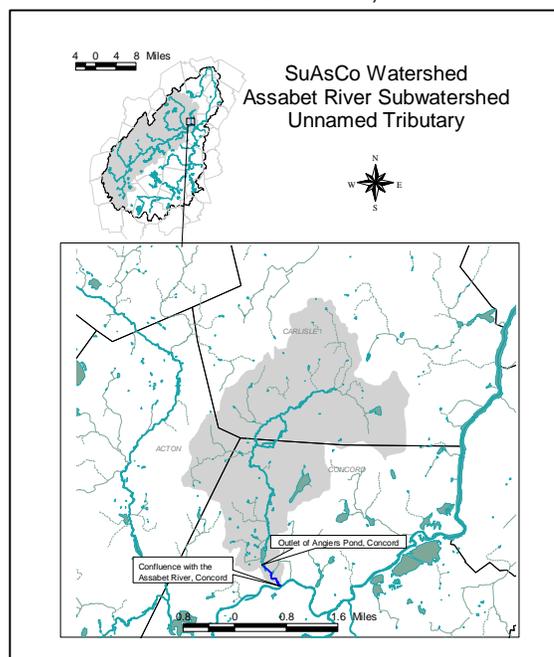
Habitat and Flow

DWM attempted to conduct benthic macroinvertebrate sampling in this reach of "Spencer Brook" in 1996. During reconnaissance in May 1996 biologists noted that Angiers Pond has two side-by-side spillways. The bulk of the flow from Angiers Pond to the brook was via the easterly channel. In July, when biologists returned to sample, the easterly spillway had very little water flowing over it and the channel below (~300 m) was virtually dry. The water flowed out of Angiers Pond via the westerly channel to a small pond, through a dug channel to the former "Bartlett's Mill", underground, and then back into the brook downstream of Barrett's Mill Road bridge (Appendix H).

When sampled on 3 July 2001 by DWM biologists upstream from Barrett's Mill Road (Station SB) there was sufficient water to cover the 4 m wide channel and provide a depth of 0.5 m to 0.75 m. The streambed in the reach was dominated by cobble and boulder (together 75-80% of the composition) and large woody snags contributed notably to available fish cover. A canopy covered the stream. About 60% of the reach had aquatic vegetation. Most of the aquatic vegetation was moss but water milfoil (*Myriophyllum* sp.) and duckweed (*Lemna* sp.) were also present. No algae were seen. The habitat ranking for this site was one of the two best encountered during the 2001 survey of the upper Concord Watershed. The overall habitat score was 184/200 (Appendix D).

Between May 2001 and December 2002 USGS conducted flow monitoring in this unnamed tributary downstream from Barretts Mill Road in Concord (n=18). Flows ranged from a low of 0.02 cfs in August 2002 to a high of 41.1 in April 2002. The calculated drainage area was 7.12 mi² (Socolow *et al.* 2003). Flows were below the 7Q10 for two of the sampling events in 2001 (September and October) and one event in 2002 (August).

This unnamed tributary was reported to be dry by OAR during their September 2002 water quality sampling (OAR 2003). OAR attributes this to the mild drought in the area and not manipulations at Angier's Pond (Flint 2005).



Biology

On 3 July 2001 DWM conducted biomonitoring in Spencer Brook upstream from Barretts Mill Road in Concord. When compared to the regional reference station (North Brook) the RBP III ranking for this site was *Slightly Impacted*. This is likely the result of degraded water quality/organic enrichment. Not one mayfly (Ephemeroptera) or stonefly (Plecoptera) was present in the assemblage and the dominant taxa were filter-feeding organisms (Appendix D).

As noted in the habitat and flow section DWM attempted to conduct benthic macroinvertebrate monitoring in Spencer Brook in 1996 (Appendix H) but the reach was dry.

Chemistry-water

OAR volunteers conducted water quality monitoring in Spencer Brook at one station (SPN-003), near Barrett's Mill Road bridge in Concord in 2002 and 2003. *In situ* parameters measured included temperature, dissolved oxygen, pH, and conductivity. Grab samples were collected and analyzed for total suspended solids, total phosphorus and ammonia-nitrogen (OAR 2003, OAR 2004, and Flint 2004b).

DO

DO concentrations in Spencer Brook ranged between 5 and 9.8 mg/L (n=10) with only one measurement less than 5.0 mg/L in August 2002. Percent saturations ranged between 57.7 and 93.9 (n=10) with only the August 2002 measurement less than 60% saturation. These data were not collected during worst-case, pre-dawn conditions, but they were collected close to pre-dawn, between 0530 and 0830h.

Temperature

Temperatures ranged from a low of 9.3°C in October to a high of 23.0°C in August (n=10).

pH

pH reported by OAR ranged between 6.3 and 7.5 SU (n=10) with only two measurements less than 6.5 SU.

Specific Conductance

Conductivity measured by OAR ranged between 92 and 147 $\mu\text{S}/\text{cm}$ (n=10).

Total Suspended Solids

The concentration of total suspended solids reported by OAR ranged between <1.0 and 17.0 mg/L (n=8).

Total Phosphorus

Total phosphorus concentrations reported by OAR ranged from <0.01 and 0.1 with four of the 8 samples having a concentration greater than 0.05 mg/L.

Ammonia-nitrogen

Ammonia-nitrogen concentrations ranged from <0.03 to a high of 0.17 mg/L (n=8). None of these exceed the chronic criterion for ammonia-nitrogen.

The *Aquatic Life Use* is assessed as support based primarily on the RBP III analysis, which indicated a slightly impacted benthic community. This use is identified with an Alert Status, however, because of flow issues and the slightly elevated total phosphorus concentrations.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

OAR collected one wet-weather fecal coliform sample from this unnamed tributary on 20 August 2002. The concentration was 2500 cfu/100 mL (OAR 2003).

No objectionable odors, oils, deposits or other conditions were noted by DWM biologists in this segment on 3 July 2001 near Barretts Mill Road, Concord (MA DEP 2001a). The water was tea-stained and slightly turbid (Appendix D). No aesthetic impairments were reported by OAR staff either (Flint 2004).

Although the *Primary* and *Secondary Contact Recreational* uses are not assessed due to the lack of bacteria data the *Aesthetics Use* is assessed as support. The *Primary Contact Recreational Use* is identified with an Alert Status due to the elevated bacteria count measured by OAR.

Unnamed Tributary (MA82B-16) Use Summary Table

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

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

RECOMMENDATIONS

- Evaluate the outlet control practices at Angiers Pond and to the extent possible stream flow conditions in the brook should be allowed to mimic natural conditions.
- Continue to conduct biological monitoring near Barretts Mill Road, Concord, to evaluate the status of the *Aquatic Life Use*. Continue to conduct water quality monitoring including at a minimum collecting continuous dissolved oxygen, pH, and total phosphorus data, to evaluate the frequency and duration of low DO conditions through this segment of the river.
- Investigate and remediate the source(s) of total phosphorus to the brook.