2004 French and Quinebaug River Watersheds
Fish Population Assessment

Robert J. Maietta
Jane Ryder
Watershed Planning Program
Worcester, MA

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Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Ian Bowles, Secretary
Department of Environmental Protection
Laurie Burt, Commissioner
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

Introduction and Methods

Fish population surveys were conducted at twenty-one stations in the French and Quinebaug Watersheds using techniques similar to Rapid Bioassessment Protocol V as described originally by Plafkin et al. (1989) and later by Barbour et al. (1999) (See Figures 1 and 2). Standard Operating Procedures are described in *Fish Collection Procedures for Evaluation of Resident Fish Populations* (MassDEP 2006). Surveys also included a habitat assessment component modified from that described in the aforementioned document (Barbour et al 1999).

Fish populations in the French and Quinebaug watersheds were sampled during August and September of 2004 by electrofishing using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 80m and 100m was sampled by passing a pole mounted anode ring, side to side through the stream channel and in and around likely fish holding cover. All fish shocked were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, measured, and released. Results of the fish population surveys can be found in Tables 1 and 2. It should be noted that young of the year (yoy) fish from most species (with the exception of salmonids) are not targeted for collection. Young of the year fishes that are collected, either on purpose or inadvertently, are noted in Tables 1 and 2.

Habitat Assessment

An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2004 French and Quinebaug watershed fish population surveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and riparian area. Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover for fish, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and when appropriate compared to a reference station to provide relative habitat ranking (See Tables 3 and 4).

Fish Sample Processing and Analysis

The RBP V protocol (Plafkin et al. 1989 and Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below (See Tables 1 and 2).

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Meixler (2000) modified regionally following discussions between MassDEP and MA Division of Fish and Game (DFG) fishery biologists.

3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al.(1999).

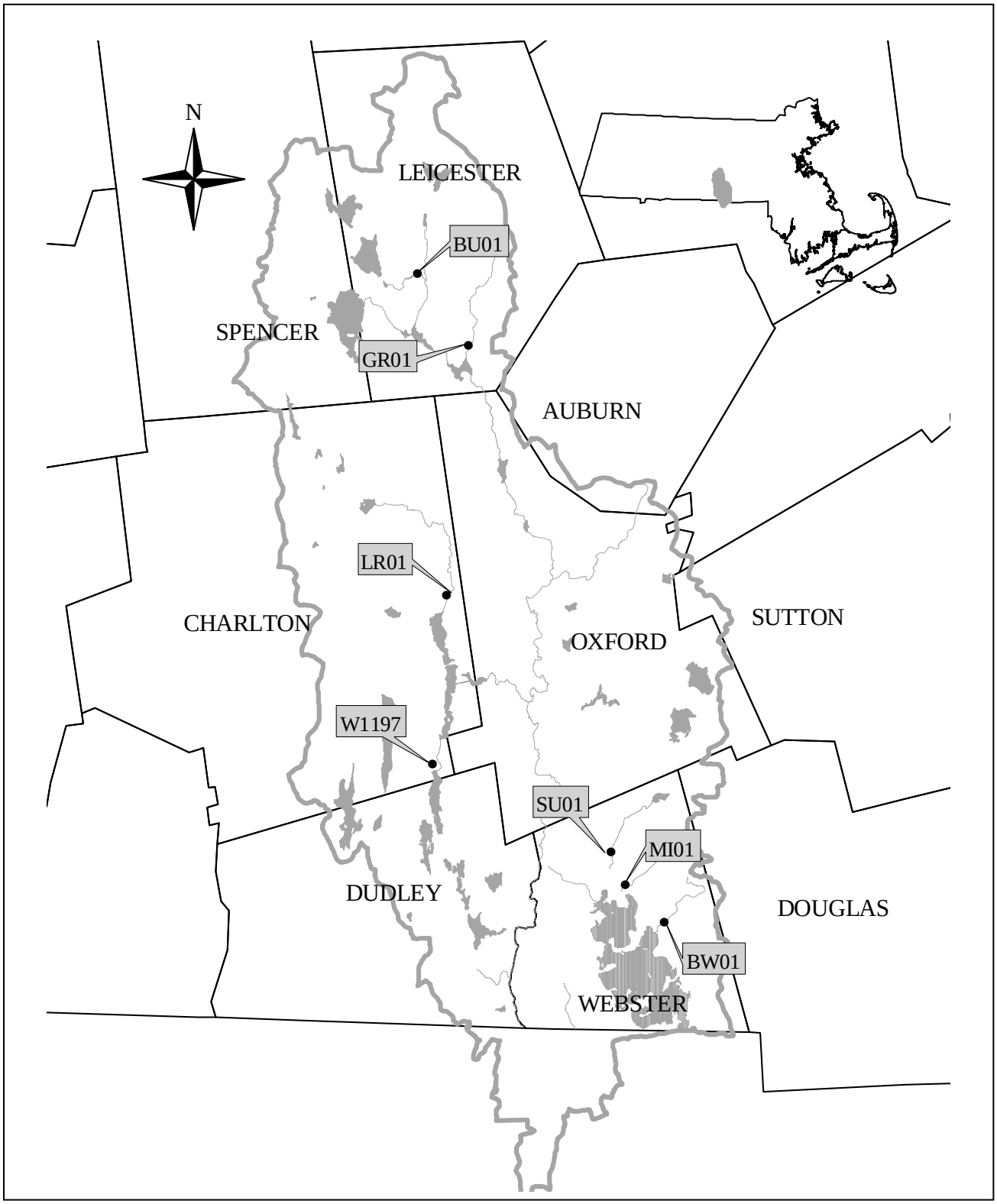

Figure 1. Locations of sampling stations in the French River Watershed

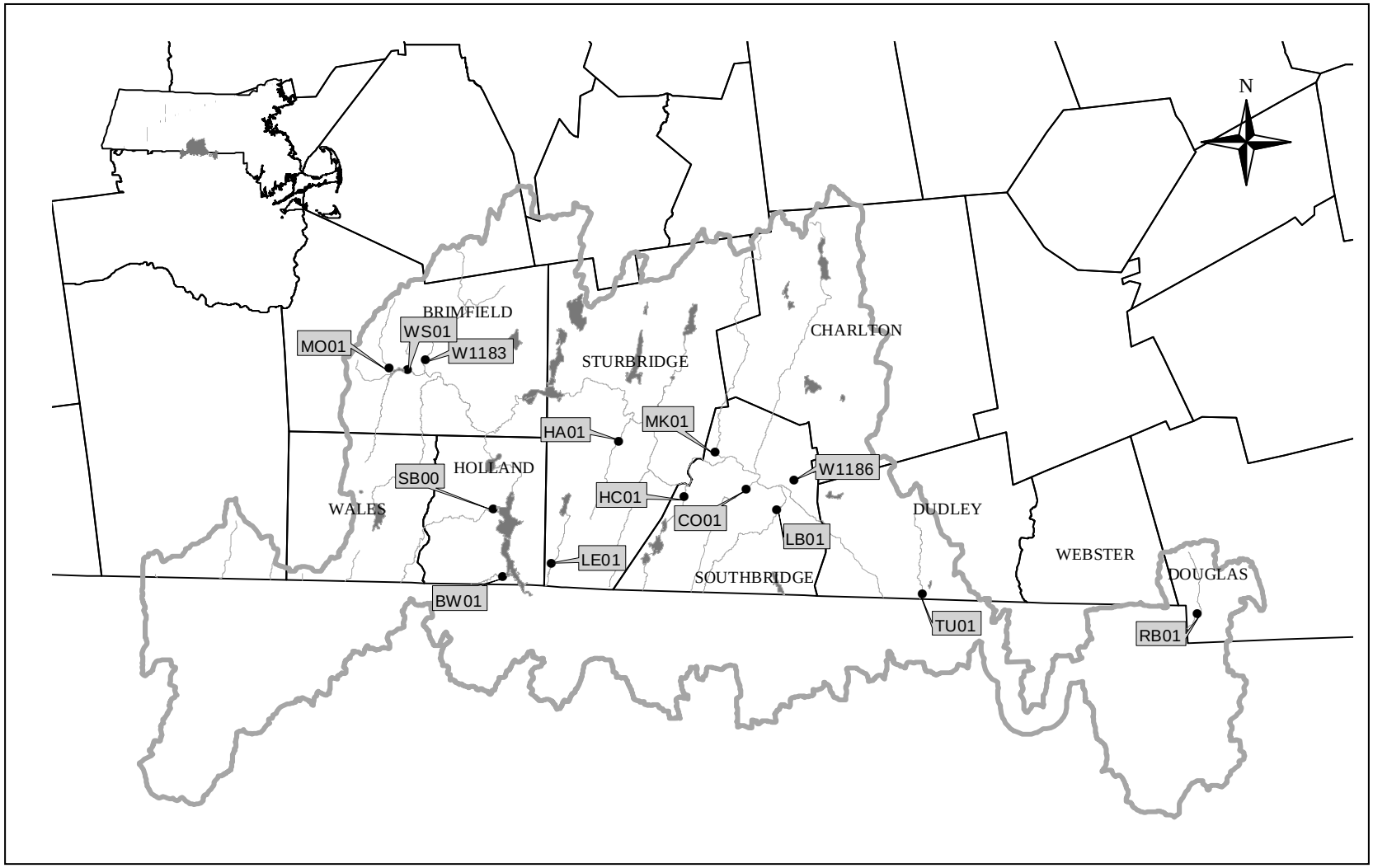

Figure 2. Locations of sampling stations in the Quinebaug River Watershed

Station Habitat Descriptions and Results

French River Watershed

Burncoat Brook adjacent to Pine Street in Leicester (BU01)

Burncoat Brook is a first-order stream with a drainage area of approximately 9.8 Km^2. It was sampled approximately 350 meters upstream of its confluence with Town Meadow Brook. The station was located in an active cow pasture just downstream from a small un-named impoundment. Six of the seven primary habitat parameters scored in the "optimal" category. Sediment deposition scored "suboptimal" due to the presence of what appeared to be new silt and sand deposits. For secondary parameters bank vegetative protection and bank stability scored "sub-optimal" on the right bank, and riparian vegetative zone width scored "marginal" and "poor" on the left and right bank respectively. Other secondary parameters scored optimal. The bank instability and compromised riparian zone can be attributed to the presence of livestock and the cow pasture. The final habitat score was 153 (See Table 3). The watershed upstream of the sampling station is primarily forested, however, the shorelines of Cedar Meadow Pond and the southern portion of Burncoat Pond are heavily developed with residences.

Fish species captured in order of abundance included fallfish *Semotilus corporalis*, white sucker *Catostomus commersonii*, brown bullhead *Ameiurus nebulosus*, Eastern blacknose dace *Rhinichthys atratulus*, and chain pickerel *Esox niger*. The large numbers of (n=140) and heavy dominance by fallfish, as well as the presence of white sucker and eastern blacknose dace (all fluvial dependants/specialists), are indicative of a stable flow regime. The impoundment located a short distance upstream is most likely the source of three brown bullhead and one chain pickerel which were also collected. All fish present are classified as being either tolerant or moderately tolerant of pollution, however, water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal and met Class B warmwater standards (MassDEP 1996 and 2005 and 2005). It should be noted that benthic macroinvertebrate assessment resulted in rating of "moderately impacted" with "habitat and water quality degradation" being noted as the probable causes. (Fiorentino 2007). In light of the three impoundments located upstream, the presence of a warm-water fish assemblage made up of tolerant to moderately tolerant species is not surprising. Future monitoring could include an additional station upstream of the small un-named impoundment (downstream of Bouchard Pond).

Grindstone Brook downstream of Route 56 in Leicester (GR01)

The sampled reach of this small second-order stream was of moderate gradient and contained a mix of riffles, pools, boulders, and undercut banks, with mostly shallow runs. The terminal end of the reach was located just downstream of the large pool at the Route 56 bridge. Six of the seven primary habitat parameters scored in the "optimal" category. Sediment deposition scored "suboptimal" due to the presence of some new bars and sandy sediments in pools. All secondary parameters also scored "optimal". The final habitat score was 174 (See Table 3).

The watershed upstream of the sampled reach is mostly forested or forested wetland with some agriculture and low - density residential land use mixed in. The upstream drainage area is approximately 7.3 Km^2.

Fish species captured in order of abundance included pumpkinseed *Lepomis gibbosus*, brown bullhead, bluegill *Lepomis macrochirus*, American eel *Anguilla rostrata*, yellow bullhead *Ameiurus natalis*, and chain pickerel. The presence of tolerant macrohabitat generalists suggests a compromised flow regime and possibly reflects the influence of Henshaw Pond and Great Cedar Swamp located upstream, as well as Rochdale Pond located downstream. Given the optimal fish habitat present, the overall low numbers of fish and relative absence of fluvial fishes (exception was a single American eel) is troubling. It is possible that periodic low flow events may have resulted in the loss of fluvial fishes with re-population being hindered due to the upstream and downstream impoundments. It should be noted that water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal and were well within Class B warmwater standards (MassDEP 1996 and 2005).

Little River downstream of Turner Road in Charlton (LR01)

The sampled reach of this third-order stream was of moderate gradient and contained a mix of boulder strewn small waterfalls, runs, and deep pools. Flows were high which made electrofishing difficult. Nine of the ten habitat parameters scored in the "optimal" category. Only riparian vegetative zone width on the left side of the stream scored

"sub-optimal". This was due to the presence of Buffum Road. The final habitat score was 183 (the highest score of the French River Watershed sites). (See Table 3). The watershed upstream of the sampled reach is mostly forested/forested wetland with some agriculture and low-density residential land use.

Fish species captured in order of abundance included Eastern blacknose dace, fallfish, yellow bullhead, brook trout *Salvelinus fontinalis*, brown bullhead, and pumpkinseed. The heavy dominance by blacknose dace and fallfish (both fluvial dependants) is indicative of a stable flow regime. Impoundments located upstream are most likely the source of the brown bullhead and pumpkinseed. The stream is also stocked seasonally with trout by MassWildlife (http://www.mass.gov/dfwele/dfw/dfw_trout_waters.htm#CENT) as is evidenced by the collection of three stocked brook trout. It is impossible to comment on total fish numbers and assemblage as sampling efficiency was estimated to be poor due to high flows and highly colored water. While the presence of holdover trout suggests excellent water quality and thermal refugia, it should be noted that water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 revealed low dissolved oxygen concentrations and percent saturations on all three sampling dates (ranges from 4.1 – 5.1 mg/l and 43 - 53%, respectively). Unless "naturally occurring" this is a violation of Class B warmwater standards for dissolved oxygen (MassDEP 1996 and 2005). Although it is unclear what may be causing the low dissolved oxygen levels, it is interesting to note that benthic macroinvertebrate assessment resulted in a rating of "moderately impacted" and suggested an "oxygen-stressed" community (Fiorentino 2007).

Un-named tributary to South Fork "Potter Brook" downstream of Potter Village Road in Charlton (W1197)

This un-named tributary (locally known as Potter Brook) to South Fork is the outlet of South Charlton Reservoir. South Fork then flows into Pierpoint Meadow Pond. Potter Brook drains approximately 36.26 Km^2 including South Charlton Reservoir, Baker Pond, and Shepherd Pond. The sampled reach is just upstream from Potter Brooks' confluence with South Fork. The reach was of moderate gradient and contained an excellent mix of riffle, pool, and run habitat with boulders, undercut banks and woody debris providing excellent habitat for fish.

Five of the seven primary habitat parameters scored in the "optimal" category. Velocity-depth combinations, and channel flow status scored "sub-optimal". For secondary parameters, bank vegetative protection scored "optimal", bank stability scored "sub-optimal", and riparian vegetative zone width scored "optimal" and "suboptimal" in the right and the left zones, respectively. The sub-optimal score in the left zone was due to the presence of a residence in this location. The final habitat score was 166 (out of 200). Fish sampling efficiency at "Potter Brook" was rated as good.

Fish species captured in order of abundance included yellow bullhead, Eastern blacknose dace, fallfish, largemouth bass *Micropterus salmoides*, pumpkinseed, and bluegill. Although two fluvial species (Eastern blacknose dace and fallfish) were present, their numbers were low (n=19) and the fish population was dominated by yellow bullhead, a macrohabitat generalist that is tolerant to pollution (including high temperatures and low dissolved oxygen). All macrohabitat generalists present are likely coming downstream from South Charlton Reservoir or migrating upstream from South Fork or Pierpoint Meadow Pond.

It should be noted that water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal and was well within Class B warmwater standards (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 18.5, 18.4, and 19.2 degrees C, respectively. It should also noted that, despite the fact that coldwater fish were not collected at this station (and the fact that its classified Class B warmwater by MassDEP), "Potter Brook" is designated as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007).

The watershed is largely forested, however, there is a large sand and gravel operation located just upstream from the sampling reach. Although there was no evidence of recent sedimentation, the moderately high gradient of the sampled reach and the very high gradient topography just upstream were not conducive to deposition. There is also a fair amount of development surrounding South Charlton Reservoir that may ultimately threaten the water quality of the Reservoir and un-named tributary. The presence of the impoundments (and their resident fish communities) both upstream and downstream of the un-named tributary and South Fork will most likely continue to impact the composition of the fish assemblage in these free-flowing reaches. Future monitoring should include an expanded search for coldwater fish species within this sub-watershed.

Sucker Brook downstream of Kingsbury Road in Webster (SU01)

Sucker Brook is a small-second order stream of moderate gradient containing mostly shallow riffles, runs and pools. Three of the ten habitat parameters scored in the "optimal" category and six others scored "sub-optimal". Riparian vegetative zone width scored "suboptimal" and "poor" on the left and right banks, respectively. Lawns that extend to the stream bank in the lower-most section of the sampling reach resulted in the aforementioned "poor" scoring. In addition, sedimentation was noted in the pools. The final habitat score was 144 (the lowest score of the French River Watershed sites) (See Table 3).

Although instream cover for fish was rated in the "optimal" category, flow was low on the day of the survey (resulting in some exposed stream bottom). Only three chain pickerel and one pumpkinseed were collected. A number of pumpkinseed were also observed in a large pool just downstream of the Kingsbury Road bridge, but this pool was not part of the sampled reach. All fish collected or observed were macrohabitat generalists that are classified as tolerant or moderately tolerant to pollution. A small impoundment located just upstream is most likely the source of all fish collected or observed. The absence of any fluvial dependants/specialists suggests an altered flow regime and possibly episodic low or no-flow events. It should be noted that the benthic macroinvertebrate assessment resulted in a rating of "moderately impacted" and suggested "organic pollution" as the main stressor. (Fiorentino 2007).

Mine Brook downstream of Mine Brook Road in Webster (MI01)

The sampled reach of this small second-order stream was of moderate to high gradient and contained a mix of riffles, runs, and pools. Eight of the ten habitat parameters scored in the "optimal" category. Velocity-depth combinations and channel flow status scored "sub-optimal" and "marginal", respectively due to the absence of deep pools and the amount of exposed channel substrate. Substrate appeared to be lightly covered in fine silt, however there was no appreciable deposition in pools or formation of point bars. This may be the result of flashy high flows pushing sediment further downstream. The final habitat score was 167 (See Table 3). The Mine Brook watershed upstream from the sampled reach is approximately 2.66 Km^2 and almost entirely forested.

Despite adequate instream cover for fish (mostly boulders), no fish were collected or observed in this reach of Mine Brook. Given the small drainage area and the flows encountered on the date of the survey it is certainly possible that Mine Brook periodically dries up. In light of the undeveloped watershed located upstream, episodic periodic low or no-flow events are most likely naturally occuring. Any future fish population monitoring should be concentrated further downstream.

Browns Brook upstream of Gore Road in Webster (BW01)

The sampled reach of this second-order stream was of moderate gradient and contained a mix of riffles, runs, and small pools. Eight of the ten habitat parameters scored in the "optimal" category. Velocity-depth combinations and channel flow status scored "sub-optimal" due mostly to the absence of deep pools and a small amount of exposed channel substrates. The final habitat score was 170 (See Table 3). Browns Brook originates in a small pond located approximately 0.6 Km to the north. It picks up additional flow from a small un-named tributary which flows from the south to it's confluence with Brown Brook just upstream of the sampled reach. In between these two streams lies LKQ Auto Parts an automobile salvage/recycling operation. The site is currently listed by the MassDEP BWSC as a 21E disposal site. (See http://db.state.ma.us/dep/cleanup/sites/Site_Info.asp?textfield_RTN=2-0012851). Aside from this one industrial/commercial operation, the watershed upstream of the sampled reach is a mix of mostly forested and low density residential land uses. During the reconnaissance survey, which was conducted in March of 2004, it was noted that there were a number of areas where runoff from the auto salvage yard was entering the stream. The nature of the runoff varied and included milky white discharges, reddish colored seeps, and rusty deposits.

Despite optimal instream cover for fish, no fish were collected or observed in this reach of Browns Brook. On the date of the survey all substrates were coated with what appeared to be algae and silt. It should be noted that the benthic macroinvertebrate community was rated as "moderately impacted" in the *2004 French and Quinebaug River Watershed 2004 Benthic Macroinvertebrate Assessment*. The total absence of fish from this second-order tributary is un-explainable and is most likely the result of either instream toxicity and/or flow problems such as dewatering.

Additional biomonitoring surveys within this and other reaches of Browns Brook (as well as the un-named tributary to the South) should be performed in the future. Elimination of runoff from the auto salvage/recycling yard needs to be part of any restoration effort in Browns Brook.

Quinebaug River Watershed

Mountain Brook downstream of Route 20 in Brimfield (MO01)

Located in the far northwestern corner of the Quinebaug River Watershed, and originating off the east side of West Mountain, Mountain Brook flows south to join an un-named impoundment which is tributary to Mill Brook. A first-order tributary with a drainage area of 3.5 Km^2, the sampled reach of Mountain Brook was of very low gradient and contained a mix of shallow runs and riffles. The end of the sampled reach was just downstream from Route 20. Only three (embeddedness, sediment deposition, and channel flow status) of the seven primary habitat parameters scored in the "optimal" category. The four other primary parameters scored "suboptimal" or "marginal". The velocity-depth combination "marginal" score was due mostly to the absence of deep water (fast or slow). Secondary parameters scored "optimal" except for riparian vegetative zone width, which scored "marginal" within the right zone. This was mostly due to the presence of a large grass lawn used in conjunction with a flea market. The final habitat score was 155 (See Table 4). The watershed upstream from the sampled reach is almost entirely forested and undeveloped. There was a beaver impoundment located just upstream from the sampled reach.

Fish species captured in order of abundance included yellow bullhead, white sucker, golden shiner *Notemigonus crysoleucas*, brown bullhead, and chain pickerel. Total fish numbers were very low (n=20) and many of the fish observed were young of the year. Only white sucker are considered "fluvial" species and two of the three suckers collected appeared to be young of the year. The relative absence of fluvial fish species may reflect a compromised flow regime. Given the relatively small watershed area upstream and the presence of beaver within the watershed it's possible that this reach of Mountain Brook has dried up in the past. The presence of many young of the year macrohabitat generalists suggests fish either migrating upstream from the impoundment, downstream from the beaver pond, or both.

Development within the Mountain Brook sub-watershed is very light and confined to that area just around Route 20 and one small road to the east. Water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal (MassDEP 1996 and 2005). Although the water temperature on July 13, 2004 was well below Class B coldwater fishery standards (19.4 degrees C), coldwater fish species were absent. Additional biomonitoring could be conducted in the higher gradient reaches of Mountain Brook but given the small watershed size these reaches may suffer from periodic severe low flow conditions.

West Brook approximately 0.4 Km downstream of Route 20 in Brimfield. (WS01)

West Brook is located in the far northwestern corner of the Quinebaug River Watershed, and originates just east of West Mountain (and Mountain Brook). West Brook begins as a high gradient stream flowing south through a couple of small un-named impoundments. It then enters a broad valley before joining Mill Brook just downstream of an un-named impoundment. A first-order tributary with an upstream drainage area of 3.5 Km^2, the sampled reach of West Brook was of very low gradient and contained a mix of shallow runs, riffles, and pools. Only three (instream cover for fish, embeddedness, and channel alteration) of the seven primary habitat parameters scored in the "optimal" category. Sediment deposition, channel flow status, and velocity-depth combinations scored "sub-optimal". Epifaunal substrate scored "marginal". For secondary habitat parameters, bank vegetative protection and bank stability scored "optimal". Riparian vegetative zone width scored "optimal" and "sub-optimal" in the right and left zones, respectively. The "sub optimal" scoring in the left riparian zone was mostly due to the presence of a large grass lawn used in conjunction with a flea market. The final habitat score was 156 (See Table 4). The watershed upstream from the sampled reach is a mix of forests and open fields.

Fish species captured in order of abundance included fallfish, yellow bullhead, central mudminnow *Umbra limi*, largemouth bass, tessellated darter *Etheostoma olmstedi*, and one each of blacknose dace, white sucker, brown bullhead, and chain pickerel. The sample was dominated by "fluvial" species, however, overall numbers of fluvial fishes were low (n=21). All fish present are classified as being either tolerant or moderately tolerant of pollution. Central mudminnow are considered to be extremely tolerant of low dissolved oxygen conditions and "able to breathe

atmospheric oxygen and survive in waters where other fish are excluded" (Hartel et. al. 2002). It should also be noted that, according to Hartel et.al. 2002, this species has never been documented in the Quinebaug River Watershed. In addition, many of the macrohabitat generalists were young-of-the-year fish. This suggests that these fishes are most likely being flushed downstream from the two aforementioned impoundments.

Water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal and met Class B warmwater standards (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 20.0, 19.0, and 17.2 degrees C, respectively. Future monitoring should include sampling a station upstream from the two un-named impoundments.

Un-named tributary to Mill Brook (East Brook) upstream of Route 20 in Brimfield (W1183)

This third-order stream is the combined flow of East and Sessions brooks. Both of these brooks initially flow through wetlands before merging and flowing through some agricultural land, and then into Sherman Pond. The un-named tributary (East Brook) leaves Sherman Pond and flows south through a low-gradient reach eventually merging with Mill Brook. The sampled reach was of low to moderate gradient with a mix of riffle, run, and pool habitats. This reach seemed fairly eutrophic as evidenced by moderate amounts of marcophytes, algae, and other organic matter. The sampled reach ended at an old beaver dam. Only three (channel alteration, sediment deposition, and channel flow status) of the seven primary habitat parameters scored in the "optimal" category. Instream cover for fish, epifaunal substrate, embeddedness, and velocity depth combinations scored "sub-optimal". For secondary habitat parameters, bank vegetative protection scored "optimal", bank stability scored "sub-optimal", and riparian vegetative zone width scored "marginal". The less than optimal scoring (bank stability and riparian vegetative zone width) is the result of erosional areas on both stream banks as well as the presence of lawns and a parking lot in the riparian zone. The final habitat score was 149 (See Table 4). The watershed upstream from the sampled reach is a mix of forests, agriculture, wetlands, and low density residential (except around the pond which is medium to high density residential).

Fish species captured in order of abundance included central mudminnow, common shiner, tessellated darter *Etheostoma olmstedi*, common shiner *Luxilus cornutus*, chain pickerel, white sucker, fallfish, yellow bullhead, creek chubsucker *Erimyzon oblongus*, and golden shiner. The sample was dominated by "fluvial" species and overall numbers were moderate (n=70). Macrohabitat generalists were most likely migrating from a large wetland located downstream or being flushed downstream from Sherman Pond. All fish present are classified as being either tolerant or moderately tolerant of pollution. The most dominant species, central mudminnow, is considered to be extremely tolerant of low dissolved oxygen conditions and "able to breathe atmospheric oxygen and survive in waters where other fish are excluded" (Hartel et.al. 2002). It should be noted that according to Hartel et al. (2002) this species has never been documented in the Quinebaug River Watershed. The presence and dominance by central mudminnow suggests the potential for low dissolved oxygen.

As a result of the benthic macroinvertebrate assessment, the biological condition was rated as "moderately impacted" and the macroinvertebrate assemblage is assessed as being "indicative of water quality impairment related to organic enrichment" (Fiorentino 2007). Water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 revealed low dissolved oxygen on all three sampling dates (range from 3.6 - 4.4 mg/l). The presence of wetlands may contribute to this condition. Unless "naturally occurring", this is a violation of Class B warmwater standards for oxygen (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 20.7, 19.7, and 18.9 degrees C, respectively. Although MassWildife lists an un-named tributary to Mill Brook as a coldwater fishery resource, it is unclear if this is the same waterbody which was sampled by MassDEP in 2004 (MassWildlife 2007). Inputs from agricultural lands and development around Sherman Pond are likely contributors of non-point sources of nutrients. Non-point source nutrient controls in the upper watershed need to be implemented in order to protect this un-named tributary to the Mill River. Future monitoring should include additional sampling upstream of Sherman Pond.

Stevens Brook upstream from Brimfield Road in Holland (SB00)

The sampled reach of this large second or small third-order stream was of moderate to low gradient and contained a diverse mix of riffles, runs and pools. Five of seven primary habitat parameters scored in the "optimal" category. Sediment deposition and channel flow status scored "sub-optimal". All secondary parameters scored "sub-optimal" due to the fact that the sampled reach flowed between two residential properties. The final habitat score was 156 (See Table

4). The watershed upstream of the sampled reach is mostly forested and relatively undeveloped. There are at least three small ponds and a large wetland located upstream and Hamilton Reservoir is located just downstream. Drainage area upstream from the sampling station is approximately 11 Km^2.

Fish species captured in order of abundance included yellow perch *Perca fleavescens*, yellow bullhead, blacknose dace, largemouth bass, pumpkinseed, white sucker and brown trout *Salmo trutta*. Total fish numbers were relatively low (n=36). Only six of the thirty-six fish collected are considered "fluvial specialists/dependants". It is unclear whether or not the brown trout that was collected was stocked or a "native" fish. The fish community present seemed to be more a reflection of the reservoir than it did a flowing stream.

Although the relative absence of fluvial fish species may reflect a compromised flow regime, it is possible that it is a reflection of the sampled reaches' proximity to Hamilton Reservoir. It should be noted that Mass Wildlife classifies Stevens Brook as a Coldwater Fishery Resource (CFR) (MassWildlife 2007) and that water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 appeared normal (MassDEP 1996 and 2005). Water temperature on July 13, 2004 was reported to be 18.7 degrees C. Additional fish population monitoring should be conducted in the higher gradient reaches of Stevens Brook to document the possible presence of naturally reproducing brook trout or other salmonids.

Brown Brook adjacent to intersection of May Brook Road and Stagecoach Road in Holland (BW01)

The sampled reach of this large second or small third-order stream was of moderately high gradient and contained a diverse mix of boulder strewn riffles, runs, and pools. All seven primary habitat parameters scored in the "optimal" category. Bank vegetative protection, bank stability scored "sub-optimal" and riparian vegetative zone width scored "optimal" and "marginal" on the right and left banks respectively. The presence of May Brook Road in the left riparian zone accounts for the "marginal" scoring within that zone. The final habitat score was 171 (out of a possible 200). The watershed upstream of the sampled reach is mostly forested and relatively undeveloped. There are at least three small ponds located a short distance upstream. Drainage area upstream from the sampling station is approximately 14.3 Km^2.

Fish species captured in order of abundance included white sucker, eastern blacknose dace, yellow bullhead, largemouth bass, yellow perch, common shiner, and golden shiner. Overall fish numbers were low given the amount and quality of fish habitat present. The slight dominance by fluvial species is indicative of a stable flow regime, however, the presence of four different macrohabitat generalists reflects the presence of small ponds located upstream and/or the presence of Hamilton Reservoir located a short distance downstream. In addition, most species collected (as well as the dominant fish present) are considered tolerant of pollution.

Although this stream was considered a least impacted "reference" site by the benthic macroinvertebrate biologists, the presence of small ponds located upstream and/or the presence of Hamilton Reservoir a short distance downstream appears to be negatively affecting the fish population with regard to species compostion and total numbers of fish. It should be noted that Brown Brook is classified as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007). Additional fish population monitoring should be conducted farther upstream to document the possible presence of naturally reproducing brook trout or other salmonids.

Leadmine Brook adjacent to the abandoned rest area off of Mashapaug Road in Sturbridge (LE01)

Originating as the outlet of Leadmine Pond in Sturbridge, Leadmine Brook flows south along and then under Route 84 before emptying into a small un-named impoundment which then flows into Hamilton Reservoir. The sampled reach of this small third-order stream was of moderate to high gradient and contained a mix of riffle, pool, and run habitat. All ten habitat parameters scored in the "optimal" category resulting in a final habitat score of 184 (the second highest score of the Quinebaug River Watershed sites).

The watershed upstream of the sampled reach is almost entirely forested. There is a fairly large wetland located just upstream to the west and 2005 orthophotos reveal what appear to be two beaver ponds just downstream (south) of this wetland. Development is limited to the area in the vicinity of Leadmine Pond. The total drainage area upstream from the sampling location is 6.4 Km^2. Fish species captured in order of abundance included largemouth bass, chain pickerel, yellow bullhead and white sucker. Total fish numbers were very low (n=17). The dominance by macrohabitat generalists and the presence of mostly young of the year or year two fishes leads one to believe that the flow regime of

Leadmine Brook may have been compromised in the past. This may have been a result of the damming of Leadmine Brook by beavers.

The benthic macroinvertebrate assessment scored Leadmine Brook as "slightly impacted", however no definitive reason for this scoring was suggested. Water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal (MassDEP 1996 and 2005). Given the excellent fisheries habitat present and what appears to be excellent water quality, flow issues (beaver dams or others) and/or impacts resulting from the macrohabitat generalists (pond species) migrating downstream from the beaver ponds (or Leadmine Pond) are two likely contributors to the relatively limited fish population encountered in Leadmine Brook.

Hamant Brook off of Shattuck Road in Sturbridge (HA01)

Topographical features of the southern portion of the Quinebaug River Watershed in the vicinity of Sturbridge and Southbridge result in a number of brooks and streams with long narrow sub-watersheds flowing south to north. Hamant is one such brook. A second-order tributary with moderate gradient and a drainage area of 6.5 Km^2 (upstream from the sampling station), the sampled reach of Hamant Brook was a mix of riffle, run, and pool habitat. Nine of the ten habitat parameters scored in the "optimal" category. Only bank stability scored "sub-optimal" due to small areas of erosion noted on each bank. The final habitat score of 182 was the third highest of the Quinebaug River watershed sites (See Table 4). The watershed upstream of the sampled reach is partly forested, however, Hamant Brook originates as an un-named pond outlet and flows parallel with Interstate 84 for much of it's length. There are a number of other ponds, as well as a few sand and gravel operations, scattered along it's course.

Fish species captured in order of abundance included Eastern blacknose dace, brook trout, white sucker, and largemouth bass. The presence of mostly fluvial specialist/dependant species is indicative of a stable flow regime. The large number and heavy dominance by Eastern blacknose dace suggests some degree of nutrient enrichment, however, the presence of reproducing brook trout, an intolerant coldwater fish species, is indicative of excellent water and habitat quality. It was noted that on the date of the survey, the water was slightly turbid and milky looking. In addition, water quality data collected during July, August, and September revealed elevated conductivity and total dissolved solids concentrations. Although Hamant Brook is classified as a Class B water without fishery designation, dissolved oxygen and temperatures met Class B coldwater criteria.

The presence of numerous sand and gravel operations and the proximity of Hamant Brook to the highway make this brook vulnerable to degradation from both point and non-point sources of pollution. Efforts to protect or enhance riparian areas along Hamant Brook should be pursued and future monitoring should include further documentation of the distribution of brook trout in this sub-watershed. It should be noted that Hamant Brook is classified as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007). In light of the presence of reproducing brook trout and data that suggest appropriate water quality, this segment should be considered for coldwater fishery designation.

Hatchet Brook upstream from South Street in Southbridge (HC01)

Located to the east of Hamant Brook, Hatchet Brook also flows south to north through a long narrow sub-watershed. The drainage area upstream from the sampling station is 9.3 Km^2. A small third order tributary to the Quinebaug River, Hatchet Brook originates as the outlet of Hatchet Pond and flows north through a series of three reservoir/ impoundments. The watershed upstream of the sampled reach is almost entirely forested and undeveloped. The sampled reach was of moderate to high gradient and contained a mix of riffle, run, and pool habitat. The reach included a very old breached boulder dam. Five of the seven primary habitat parameters scored in the "optimal" category. Velocity-depth combinations scored "suboptimal" due to a lack of deep fast habitat. Channel flow status scored "marginal" based on the amount of exposed substrate present on the day of the survey. For the secondary habitat parameters bank vegetative protection scored "optimal", bank stability scored "sub-optimal", and riparian vegetative zone width scored "optimal" and "sub-optimal" on the right and left sides of the brook, respectively. The final habitat score was 169 (See Table 4).

Fish species captured in order of abundance included Eastern blacknose dace and brook trout. The presence of two fluvial specialist/dependant species is indicative of a stable flow regime. While the dominance by Eastern blacknose dace can sometimes be indicative of nutrient enrichment the presence of a very robust reproducing population of brook trout, an intolerant coldwater fish species, is indicative of excellent water and habitat quality. Although Hatchet Brook

is currently classified as a Class B water without fishery designation, dissolved oxygen and temperatures were well below Class B coldwater criteria.

Responsible reservoir management practices that maintain year round flows in lower Hatchet Brook are necessary to protect this excellent cold water trout fishery. These flows should be reflective of seasonal flow fluctuations that could occur naturally (i.e. higher in the spring and fall). It should be noted that Hatchet Brook is classified as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007). In light of the presence of reproducing brook trout and data that suggest appropriate water quality, this segment should be considered for coldwater fishery designation.

Cohasse Brook downstream of culverts in Oak Ridge Cemetary in Southbridge (CO01)

Like Hatchet and Hamant Brooks, Cohasse Brook located further east, is another of the streams with long narrow sub-watersheds which flow south to north. A second-order tributary with a drainage area of 10.59 Km^2 , the sampled reach of Cohasse Brook was a mix of shallow runs and riffles with a large pool at the upper end of the reach just downstream of two culverts. Only one (epifaunal substrate) of the seven primary habitat parameters scored in the "optimal" category. Five others scored "suboptimal" and channel flow status scored "marginal". For the secondary parameters, bank vegetative protection scored "optimal", bank stability scored "sub-optimal" and riparian vegetative zone width scored "optimal" and "poor" in the right and left riparian zones, respectively. The presence of the Oak Ridge Cemetary in the left riparian zone accounts for the "poor" score. The final habitat score of 142 was the lowest of the Quinebaug River watershed sites (See Table 4). The watershed well upstream of the sampled reach is mostly forested and relatively undeveloped. There are two impoundments: Wells Pond and Cohasse Brook Reservoir located a short distance upstream. The watershed just upstream from the sampling station is mostly high-density residential.

Fish species captured in order of abundance included hundreds of Eastern blacknose dace, fallfish , white sucker, common shiner, longnose dace *Rhinichthys cataractae* and one largemouth bass. In addition, young-of-the-year (YOY) Eastern blacknose dace, fallfish, and common shiner were also collected. Eastern blacknnose dace YOY were too numerous to count while fallfish and common shiner YOY were mixed in much lower abundances. The presence of mostly fluvial specialist/dependant species is indicative of a stable flow regime. The large numbers of, and heavy dominance by, Eastern blacknose dace suggests some degree of nutrient enrichment. The shallow riffles and runs provided excellent habitat for YOY fishes as well as older age classes. Although the benthic macroinvertebrate crew reports observing "several salmonid fish", none were collected or observed during the fish population survey.

Water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 appeared normal and met Class B standards (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 19.3, 18.9, and 17.5 degrees C, respectively. As a result of the benthic macroinvertebrate assessment, the biological condition was rated as "moderately impacted" and the resident biota were assessed as being "structured in response to organic enrichment" (Fiorentino 2007). Non-point source nutrient controls in the lower more developed sections of the watershed need to be implemented in order to protect Cohasse Brook. It would also be interesting to conduct fish population further upstream above the influence of the residential development.

Lebanon Brook upstream of Route 131 in Southbridge (LB01)

Located to the east of Cohasse Brook, Lebanon Brook also flows south to north through a long narrow sub-watershed. The drainage area upstream from the sampling station is approximately 25 Km^2. This is much larger than the three watersheds (Cohasse, Hatchet, and Hamant brooks) located to the west. A large second or small third-order tributary to the Quinebaug River, Lebanon Brook originates as the outlet of Potter Pond in Woodstock, Connecticut. In the upper section of the watershed it flows through and drains wetlands and is twice impounded. The sampled reach was of moderate gradient and contained a mix of riffle, run, and pool habitat. The reach appeared to be at the upper end or just upstream from a drained beaver pond. Six of the seven primary habitat parameters scored in the "optimal" category. Channel flow status scored "sub-optimal" based on the amount of exposed substrate present on the day of the survey. All secondary habitat parameters scored "optimal". The final habitat score was 179 (See Table 4). The watershed upstream of the sampled reach is mostly forested with some low density residential. It appeared there had been beaver activity just downstream (north) of the sampling station.

Fish species captured in order of abundance included fallfish, white sucker, Eastern blacknose dace, common shiner, pumpkinseed, yellow bullhead, golden shiner, and chain pickerel. In addition, young-of-the-year (YOY) fallfish, eastern blacknose dace, common shiner, and white sucker were also identified. Fallfish YOY were too numerous to count while other YOY were mixed in much lower abundances. The dominace by fluvial specialist/dependant species is indicative of a stable flow regime. The shallow riffles and runs provided excellent habitat for YOY fishes as well as older age classes. The benthic macroinvertebrate crew used Lebanon Brook as a "reference" site for the larger streams sampled in the Quinebaug River watershed (Fiorentino 2007). Water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 appeared normal (MassDEP 1996 and 2005). Water temperature on July 13, 2004 was reported to be 20.3 degrees C.

The presence of a few macrohabitat generalist is not surprising given the impoundments located upstream and the amount of beaver activity which appears to be occurring within this watershed. Water temperatures in July were just above the Class B Coldwater Fishery criteria. It should be noted that Lebanon Brook is not considered a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007).

McKinstry Brook upstream of Pleasant Street in Southbridge (MK01)

Flowing south through the Town of Charlton, McKinstry Brook is a large second or small third-order stream with a drainage area (upstream from sampling station) of approximately 21.0 Km^2. Much of the sampled reach of McKinstry Brook was channelized. It contained a mix of shallow runs and riffles interspersed with limited pool habitat. The end of the sampled reach was downstream from a beaver dam. Only two of the seven primary habitat parameters (embeddedness and sediment deposition) scored in the "optimal" category. The five other primary parameters scored "suboptimal". Secondary parameters scored "optimal" except for riparian vegetative zone width, which scored "marginal" within the left zone. This was mostly due to the presence of lawns and an industrial parking lot. The final habitat score of 152 was the third lowest of the Quinebaug River watershed sites (See Table 4). The watershed upstream of the sampled reach is mostly forested with a small amount of low-density residential and agricultural land uses mixed in. Approximately 6.5 kilometers upstream, McKinstry Brook passes under the Massachusetts Turnpike and adjacent to the municipal airport. In addition the area in close proximity to the sampled reach is heavily developed residentially.

Fish species captured in order of abundance included fallfish, Eastern blacknose dace, white sucker, common shiner, longnose dace, tessellated darter, golden shiner, brown trout (presumed stocked), pumpkinseed, and largemouth bass. In addition, numerous (un-counted) young-of-the-year (YOY) fallfish, eastern blacknose dace, and white sucker were also present. Altough fish habitat was rated as "suboptimal" due to low flows, the high total numbers of fish and the dominance by fluvial specialist/dependant species is indicative of a stable flow regime. The shallow riffles and runs provided excellent habitat for YOY fishes as well as older age classes. Although water quality data (temperature, dissolved oxygen, and pH) collected by DWM during 2004 appeared normal (MassDEP 1996 and 2005), conductivity and total dissolved solids concentrations were slightly elevated. Non-point source nutrients may be enriching McKinstry Brook. It should be noted that McKinstry Brook is classified as a coldwater fishery resource by MassWildlife (Masswildlife 2007).

Non-point source nutrient controls in the McKinstry Brook watershed need to be implemented in order to protect the abundant and diverse fish community currently present in this location. It should be noted that the surveyed reach was full of trash and waste debris. A stream cleanup would go a long way towards improving the aesthetics of this reach. Future monitoring should include an upstream location to document the presence or absence of coldwater fishes.

Unamed tributary (Keenan Brook) to Quinebaug River off Route 31 in Southbridge (W1186).

The un-named tributary that is locally known as "Keenan Brook" is a third-order tributary to the Quinebaug River which originates in the Morseville section of Charlton. It receives the discharge from a small wastewater treatment plant located in it's headwaters and has a drainage area of 20.9 Km. The watershed is a mix of forested, agricultural, and low to medium density residential land uses. The sampled reach was a straight moderate gradient mix of riffle, run, and pool habitat with very rocky substrates that runs parallel and adjacent to Dresser Hill Road (Route 31). Four of the seven primary habitat parameters scored in the "optimal" category. Channel alteration and velocity-depth combinations scored "sub-optimal". Channel flow status only scored "marginal" due to the low flows which resulted in moderate amounts of exposed substrate. For secondary habitat parameters bank vegetative protection and bank stability scored

"optimal". Riparian vegetative zone width scored "optimal" and "sub-optimal" in the left and right zones respectively. The final habitat score was 161 (See Table 4).

Fish species captured in order of abundance included Eastern blacknose dace, white sucker, longnose dace, brown bullhead, common shiner, fallfish, yellow bullhead, and two each of tessellated darter, and largemouth bass. Sampling efficiency was rated as only fair at about fifty percent. This was primarily due to the presence of some very wide shallow pool and/or braided areas. Although flows were low on the date of the sampling, the presence and dominance by fluvial specialist/dependant species is usually indicative of a fairly stable flow regime. Non-point sources of nutrients may be enriching "Keenan Brook" resulting in the overall high numbers of fish. Water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 appeared normal (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 17.2, 16.3, and 15.6 degrees C, respectively. It should be noted that despite the fact that coldwater fish were not collected at this station (and the fact that it is classified Class B by MassDEP), "Keenan Brook" is designated as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007). In light of the cool temperatures documented in 2004, future monitoring should include an expanded search for coldwater fish species within this sub-watershed.

Tufts Branch downstream of Route 197 in Dudley (TU01)

The sampled reach of this large first or small second-order stream was of moderate gradient and contained a mix of riffles, runs and pools. Two of the seven primary habitat parameters scored in the "optimal" category. Instream cover for fish, channel alteration, sediment deposition, and velocity depth combinations scored "sub-optimal" and channel flow status scored "marginal". Although bank vegetative protection scored "optimal", bank stability scored "sub-optimal", and riparian vegetative zone width scored "sub-optimal" and "poor" in the right and left zone, respectively. Low flow conditions on the date of the survey and the fact that the stream flowed between two residential properties accounted for much of the "less than optimal" scoring. The final habitat score was 145 (See Table 4). The watershed upstream of the sampled reach is a mix of forested, agriculture, and low to medium density residential. Tufts Branch originates in a wetland and there are a few very small ponds located within the watershed upstream from the sampling station. Drainage area upstream from the sampling station is approximately 6.2 Km^2.

Fish species captured in order of abundance included pumpkinseed, white sucker, brook trout (native), brown bullhead, bluegill, largemouth bass and chain pickerel. Although the sample was dominated by macrohabitat generalists, four of the five macrohabitat generalists present (largemouth bass, bluegill, chain pickerel, and brown bullhead) were represented by a total of only six fish. The presence of white sucker and brook trout (both fluvial species) is indicative of a stable flow regime. The presence of "wild" brook trout indicates excellent water quality (supported by water quality survey data), however, overall numbers were low and young of the year fish were absent.

Low flow and habitat alteration (i.e. sedimentation) appear to be the largest threats to Tufts Branch. Water quality data (temperature, dissolved oxygen, and pH) collected by the DWM during 2004 appeared normal (MassDEP 1996 and 2005). Water temperatures on single dates in July, August and September were reported to be 18.5, 17.1, and 16.7 degrees C, respectively. It should be noted that Tufts Branch is classified as a Class B coldwater fishery and a Coldwater Fishery Resource (CFR) by MassDEP and MassWildlife (MassWildlife 2007), respectively. Future monitoring should include further documentation of the distribution of brook trout in this sub-watershed.

Rocky Brook downstream of dirt footpath off of Thompson Road adjacent to High Street in Douglas (RB01)

Located in the easternmost section of the Quinebaug River Watershed within Massachusetts, Rocky Brook originates within and just to the east of Douglas State Forest. A small second-order stream with a drainage area of approximately 11.8 Km^2 (upstream of sampling reach), Rocky Brook passes through a large beaver enhanced wetland just upstream of the sampling location. Just downstream from the sampling location the stream completely disappears beneath a section of heavy cobble and boulders and re-emerges a short distance downstream. The sampled reach was a mix of shallow riffle, run, and pool habitat. All ten primary habitat parameters scored in the "optimal" category resulting in a final habitat score of 188 (See Table 4). This was the highest score of the 2004 Quinebaug or French River Watershed sites. The watershed upstream of the sampled reach is entirely forested and undeveloped.

Fish species captured included mostly brook trout (n=13), plus two chain pickerel. Although the presence of a fluvial specialist/dependant species such as brook trout is indicative of a stable flow regime, overall numbers were low given

the amount of habitat present. In addition, the beaver pond located upstream and the area of sub-surface flow downstream, may be restricting migration into and out of this particular reach of Rocky Brook under low flow conditions. A reproducing population of brook trout, an intolerant coldwater fish species, is indicative of excellent water and habitat quality.

It is interesting to note that the benthic macroinvertebrate biologists classified Rocky Brook as “moderately impacted” and that dissolved oxygen was below Class B standards on all three dates that it was measured. This may be a natural condition resulting from the presence of the beaver enhanced wetland located just upstream. Water temperatures were well within the Class B standards (cold and warmwater) on the three occasions on which it was measured. The biggest threat to Rocky Brook appears to be habitat modification (and associated water quality conditions) caused by beavers. Although not specifically classified as a coldwater fishery in the water quality standards, Rocky Brook is classified as a Coldwater Fishery Resource (CFR) by MassWildlife (MassWildlife 2007).

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Table 1. List of fish population biomonitoring station locations and fish population data for the 2004 French River Watershed survey.

Station Description	Survey Date	Species Code[1]											Comments
		AE	BND	FF	WS	BB	YB	CP	EBT	B	LMB	P	
BU01 Burncoat Brook, Leicester, reach beginning downstream of Pine Street in cow pasture.	22 Sept 2004	-	2	140	14	3	-	1	-	-	-	-	
GR01 Grindstone Brook, Leicester, reach beginning approximately 80 m downstream of Rte 56 ending downstream of pool at road crossing .	22 Sept 2004	1	-	-	-	16	1	1	-	3	-	22	
LR01 Little River, Charlton, reach beginning downstream of Turner Road and upstream of Buffumville Lake.	16 Sept 2004	-	43	9	-	2	4	-	3*	-	-	2	Pick-up efficiency could not be estimated due to high flows and highly colored water.
W1197 Un-named tributary to South Fork Potter Brook, Charlton, reach downstream of Potter Village Road	16 Sept 2004	-	10	9	-	-	20	-	-	3	4	4	
SU01 Sucker Brook, Webster, reach beginning 200 m downstream of Kingsbury Road at block wall behind houses.	13 Sept 2004		-	-	-	-	-	3	-	-	-	1	There were a number of pumpkinseed observed in large pool just downstream of the road crossing but these fish were not within the sampling reach
MI01 Mine Brook, Webster, reach beginning 100 meters downstream of Mine Brook Road and ending at road crossing.	13 Sept 2004		-	-	-	-	-	-	-	-	-	-	No fish were collected or observed.
BW01 Browns Brook, Webster, reach beginning 150 m upstream of Gore Road and ending approximately 25 meters downstream of a small pond.	13 Sept 2004	-	-	-	-	-	-	-	-	-	-	-	No fish were collected or observed.

[1]SPECIES CODE — COMMON NAME — SCIENTIFIC NAME

AE	American eel	*Anguilla rostrata*
BND	blacknose dace	*Rhinichthys atratulus*
FF	fallfish	*Semotilus corporalis*
WS	white sucker	*Catostomus commersonii*
BB	brown bullhead	*Ameiurus nebulosus*
YB	yellow bullhead	*Ameiurus natalis*
CP	chain pickerel	*Esox niger*
EBT	brook trout	*Salvelinus fontinalis*
B	bluegill	*Lepomis macrochirus*
LMB	largemouth bass	*Micropterus salmoides*
P	pumpkinseed	*Lepomis gibbosus*

* stocked fish

Table 2. List of fish population biomonitoring station locations and fish population data for the 2004 Quinebaug River Watershed survey.

Station Description	Date	Species Code[1]																	Comments
		BND	CS	FF	GS	LND	CCS	WS	BB	YB	CP	CM	BT	EBT	B	LMB	P	YP	TD	
MO01, Mountain Brook, Brimfield, downstream of Route 20 adjacent to large flea market field	31 Aug 2004	-		-	3	-	-	3(2)[2]	(3)	5(2)	1	-	-	-	-	-	-	-	-	
WS01, West Brook, Brimfield, off of Mill Road approx. .4 km downstream from Route 20 adjacent to flea market field (SW corner).	31 Aug 2004	1		13	-	-	-	1	1	10	1	7	-	-	-	6	-	-	2	
W1183, Unnamed Tributary to Mill Brook, Brimfield, just upstream of Route 20 from bridge at old beaver dam.	31 Aug 2004	-	10	5	1	-	(2)	5	-	4	7	28	-	-	-	-	-	-	8	
SB00, Stevens Brook, Holland, reach beginning 50 m upstream from Brimfield Road	1 Sept 2004	5		-	-	-	-	1	-	6	-	-	1	-	-	3	3	17	-	BT appeared to be a stocked fish
BW01, Brown Brook, Holland, reach beginning adjacent to intersection of May Brook Road and Stagecoach Road and proceeding approximately 100 meters.	1 Sept 2004	13	4		2	-	-	33	-	12	-	-	-	-	-	10	-	6	-	
LE01, Leadmine Brook, Sturbridge, reach beginning about 1400m downstream of Vinton Road adjacent to the old abandoned rest area off of Mashapaug Road	1 Sept 2004	-	-		-	-	-	1	-	1	3(1)	-	-	-	-	(11)	-	-	-	Largemouth bass , and chain pickerel smaller than 80 and 60 mm respectively considered young of the year (yoy).
HA01, Hamant Brook, Sturbridge, off of Shattuck Road, reach beginning approximately 100m downstream of sand pit access road culvert and ending at the culvert.	1 Sept 2004	69	-		-	-	-	15	-	-	-	-	-	22	-	1 (1)	-	-	-	EBT appeared to be representative of a reproducing population Largemouth bass smaller than 50 mm considered young of the year (yoy).

Table 2 (continued). List of fish population biomonitoring station locations and fish population data for the 2004 Quinebaug River Watershed survey.

Station Description	Date	Species Code[1]																	Comments
		BND	CS	FF	GS	LND	CCS	WS	BB	YB	CP	CM	BT	EBT	B	LMB	P	YP	TD	
HC01, Hatchet Brook, Southbridge, upstream from South Street reach ending approximately 40 m upstream of old dam.	2 Sept 2004	68 (53)	-		-	-	-	-	-	-	-	-	-	33 (11)	-	-	-	-	-	Brook trout smaller than 71 mm and blacknose dace smaller than 46 mm considered young of the year (yoy)
CO01, Cohasse Brook, Southbridge, reach beginning approximately 100 m downstream of culverts in Oak Ridge Cemetary and ending at aforementioned culverts.	2 Sept 2004	316	6	25	-	2	-	9	-	-	-	-	-	-	-	1	-	-	-	Blacknose dace yoy to numerous to count, yoy fallfish and common shiner were also present in lower numbers
LB01, Lebanon Brook, Southbridge, reach beginning .4 km upstream of Route 131 road crossing.	2 Sept 2004	8	6	38	1	-	-	14	-	4	1	-	-	-	-	-	6	-	-	Young of the year FF (most abundant), CS, BND, and WS were too numerous to count. Evidence of recent beaver (impoundment) activity
MK01, McKinstry Brook, Southbridge, reach beginning .3 km upstream of Pleasant Street adjacent to industrial building.	7 Sept 2004	60	12	84	3	11	-	28	-	-	-	-	1	-	-	1	1	-	6 (4)	Young of the year FF, BND and WS were numerous. BT appeared to be a stocked fish. TD less than 44 mm considered young of the year
W1186, Unnamed Tributary, Keenan Brook Southbridge 0.5 km upstream of confluence with Quinebaug River.	7 Sept 2004	245	12	4	-	23	-	23	15	3	-	-	-	-	-	2	-	-	2	Shocking efficiency poor. Estimated pick-up 50%. A number of darters were missed during the start of the sampling run.
TU01, Tufts Branch, Dudley, reach beginning just downstream of Route 197 and extending 80 meters upstream.	7 Sept 2004	-		-	-	-	-	18	3	-	1	-	-	5	1	1	22	-		EBT appeared to be representative of a reproducing population

Table 2 (continued). List of fish population biomonitoring station locations and fish population data for the 2004 Quinebaug River Watershed survey.

Station Description	Date	Species Code[1]																	Comments
		BND	CS	FF	GS	LND	CCS	WS	BB	YB	CP	CM	BT	EBT	B	LMB	P	YP	TD	
RB01, Rocky Brook, Douglas, reach beginning 100 m downstream of dirt footpath in Douglas State Forest. Access located off of Thompson Road adjacent to High Street.	13 Sept 2004	-	-	-	-	-	-	-	-	-	2	-	-	13	-	-	-	-	-	EBT appeared to be representative of a reproducing population

[1] SPECIES CODE

COMMON NAME	SCIENTIFIC NAME
Eastern blacknose dace	*Rhinichthys atratulus*
common shiner	*Luxilus cornutus*
Fallfish	*Semotilus corporalis*
golden shiner	*Notemigonus crysoleucas*
longnose dace	*Rhinichthys cataractae*
creek chubsucker	*Erimyzon oblongus*
white sucker	*Catostomus commersonii*
brown bullhead	*Ameiurus nebulosus*
yellow bullhead	*Ameiurus natalis*
chain pickerel	*Esox niger*
central mudminnow	*Umbra limi*
brown trout	*Salmo trutta*
brook trout	*Salvelinus fontinalis*
Bluegill	*Lepomis macrochirus*
largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
yellow perch	*Perca flavescens*
tessellated darter	*Etheostoma olmstedi*

[2] number in parentheses indicate young-of-the-year

Table 3. Habitat assessment summary for fish population stations sampled during the 2004 French River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

Stations	Burncoat Brook	Grindstone Brook	Little River	Un-named Trib to Potter Brook	Sucker Brook	Mine Brook	Browns Brook
Primary Habitat Parameters	**Score (0-20)**						
INSTREAM COVER (for Fish)	18	19	19	18	17	18	18
EPIFAUNAL SUBSTRATE*	17	18	18	16	17	18	16
EMBEDDEDNESS	18	18	19	18	18	17	18
CHANNEL ALTERATION	16	19	19	18	11	19	18
SEDIMENT DEPOSITION	13	12	19	18	15	18	18
VELOCITY-DEPTH COMBINATIONS	18	18	18	15	14	14	15
CHANNEL FLOW STATUS	18	16	16	13	13	8	13
Secondary Habitat Parameters	**Score (0-10)**						
BANK VEGETATIVE PROTECTION left	9	9	10	9	8	10	9
BANK VEGETATIVE PROTECTION right	7	9	10	9	8	10	9
BANK STABILITY left	8	9	10	7	8	8	9
BANK STABILITY right	6	9	10	7	8	8	9
RIPARIAN VEGETATIVE ZONE WIDTH left	3	9	6	8	6	9	9
RIPARIAN VEGETATIVE ZONE WIDTH right	2	9	9	10	1	10	9
Total Score	**153**	**174**	**183**	**170**	**144**	**169**	**170**

* epifaunal substrate scores taken from benthic macroinvertebrate habitat assessment forms

Table 4. Habitat assessment summary for fish population stations sampled during the 2004 Quinebaug River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

Stations	Mountain Brook	West Brook	Un-named Trib Mill Brook	Stevens Brook	Brown Brook	Leadmine Brook	Hamant Brook	Hatchet Brook	Cohasse Brook	Lebanon Brook	McKinstry Brook	Un-named Trib Keenan Brook	Tufts Branch	Rocky Brook
Primary Habitat Parameters	**Score (0-20)**													
INSTREAM COVER (for Fish)	13	18	15	16	19	18	19	19	13	18	13	17	15	19
EPIFAUNAL SUBSTRATE	15	9	11	19	19	19	19	19	17	19	15	18	18	19
EMBEDDEDNESS	16	18	15	16	18	17	18	19	15	18	18	18	18	19
CHANNEL ALTERATION	15	19	18	17	18	20	19	18	14	19	12	15	14	18
SEDIMENT DEPOSITION	18	12	17	14	19	18	16	17	14	18	17	19	13	19
VELOCITY-DEPTH COMBINATIONS	10	14	14	18	18	19	20	15	14	16	13	12	15	18
CHANNEL FLOW STATUS	16	12	16	15	18	17	17	10	10	15	13	10	10	16
Secondary Habitat Parameters	**Score (0-10)**													
BANK VEGETATIVE PROTECTION left	10	10	9	6	6	9	9	9	9	9	9	9	9	10
BANK VEGETATIVE PROTECTION right	9	10	9	6	6	9	10	9	9	9	9	9	10	10
BANK STABILITY left	9	9	7	7	8	9	8	8	8	9	10	9	7	10
BANK STABILITY right	9	9	8	7	8	9	8	8	8	9	10	9	7	10
RIPARIAN VEGETATIVE ZONE WIDTH left	10	6	5	7	5	10	9	8	2	10	4	9	2	10
RIPARIAN VEGETATIVE ZONE WIDTH right	5	10	5	8	9	10	10	10	9	10	9	7	7	10
Total Score	**155**	**156**	**138***	**156**	**179**	**184**	**182**	**169**	**142**	**179**	**152**	**156**	**145**	**188**

N/A not assessed

* of a possible 180