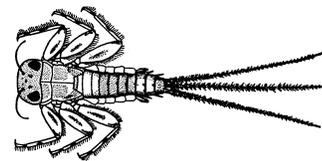
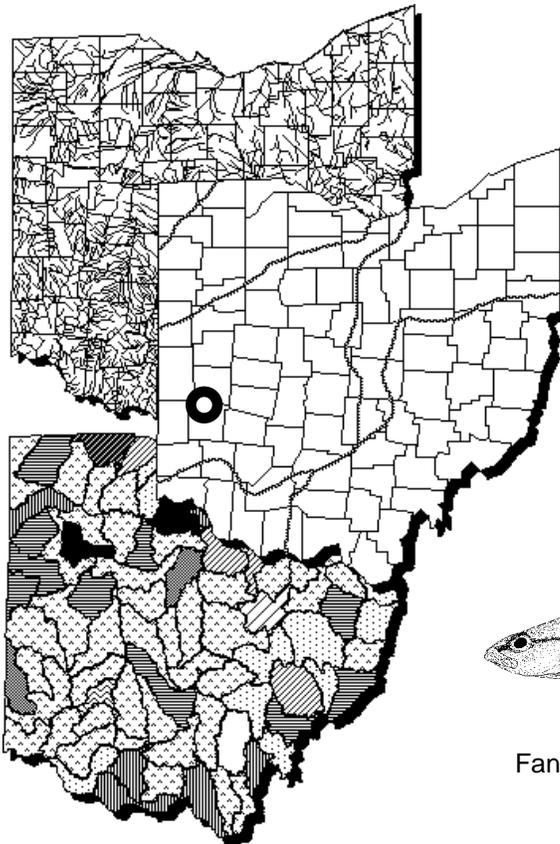
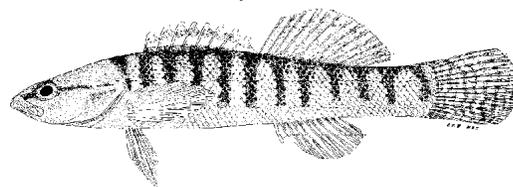


# Biological and Water Quality Study of Mill Creek

**Dayton International Airport  
Miami and Montgomery Counties, Ohio**



Mayfly (*Stenonema*)



Fantail Darter (*Etheostoma flabellare*)

February 20, 1995

**Biological and Water Quality Study  
of  
Mill Creek  
1994**

Miami and Montgomery Counties, Ohio

February 20, 1995

OEPA Technical Report MAS/1995-2-2

prepared by

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## TABLE OF CONTENTS

	<u>Page</u>
Acknowledgements	3
Introduction/ Methods	4
Summary/ Conclusions	6
Physical Habitat For Aquatic Life	10
Macroinvertebrate Community	11
Fish Community	13
Fish Kills/ Chemical Spills/ Surface Water	16
References	20
Appendix Tables	21

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## Introduction and Methods

Fish and macroinvertebrate communities were sampled during the summer of 1994 at four locations in Mill Creek from river mile (RM) 3.9 to the mouth (Table 1). Sampling was conducted to assess the condition of fish and macroinvertebrate communities following the discharge of contaminated retention basin water from the Dayton Airport into Mill Creek during March 1994. Fish collections were made at each site on August 2 and September 13 using pulsed DC electrofishing gear, with sampling distances varying between 180 and 200 meter zones. Qualitative macroinvertebrate collections were made at each site on August 9 and September 13 by sampling all available natural substrates in the near vicinity of the sampling site. Fish and macroinvertebrate field work, laboratory, data processing and data analysis methods and procedures conducted by Ohio EPA were consistent with those specified in Ohio EPA manuals (1987, 1989b, 1989c). Evaluation of aquatic life uses was determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. The Index of Biotic Integrity (IBI) was used to evaluate the performance of the fish community. The IBI is a multi-metric index patterned after an original IBI described by Karr (1981) and Fausch *et al.* (1984). Qualitative macroinvertebrate sampling consisted of an inventory of taxa at a sampling station with an attempt to field estimate predominant populations. An assessment of the status of the designated aquatic life use was made based on best professional judgement utilizing sample attributes such as taxa richness and EPT (Ephemeroptera - mayfly, Plecoptera - stonefly, and Trichoptera -caddisfly) richness - an indication of the prevalence of pollution sensitive organisms.

Physical habitat was evaluated by Ohio EPA using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989). Various attributes of the available habitat were scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

Surface water grab samples were collected in Mill Creek on three different occasions by Ohio EPA between March 15 and April 28, 1994 and in the Stillwater River on April 28, 1994. In addition, a water sample was collected from the Dayton Airport retention basin discharge on March 15, 1994. All chemical and physical, field and laboratory methods and procedures adhered to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 1989a).

Mill Creek, a tributary of the Stillwater River, is located in the Eastern Corn Belt Plains ecoregion and is currently assigned the Warmwater Habitat (WWH) aquatic life use.

Table 1. Fish, macroinvertebrate, and surface water sampling locations in the Mill Creek study area, 1994.

Stream/ River Mile	Type	Latitude	Longitude	Landmark	County	USGS 7.5 min. Quad. Map
<b><i>Mill Creek</i></b>						
3.9	F,M,W	39°54'33"	84°14'18"	Upstream Dayton Airport Retention Basin	Montgomery	Tipp City, OH
2.6	F,M	39°55'20"	84°15'00"	County Line Rd.	Miami/ Montgomery	West Milton, OH
1.2	F,M,W	39°55'21"	84°16'30"	Frederick Rd.	Miami	West Milton, OH
0.5	F,M	39°55'36"	84°17'14"	Karns Rd.	Miami	West Milton, OH
0.1	W	39°55'32"	84°17'34"	Near the mouth	Miami	West Milton, OH
<b><i>Stillwater River</i></b>						
14.0	W	39°55'28"	84°17'42"	Dst. Mill Cr.	Miami	West Milton, OH

## Summary and Conclusions

From August to September, 1994 Ohio EPA's Division of Surface Water staff conducted biological community sampling of Mill Creek upstream and downstream from the Dayton Airport retention basin discharge. In addition, Ohio EPA Southwest District Office staff collected surface water samples during March and April, 1994. Sampling was conducted in response to reported releases of contaminated retention basin water into Mill Creek during March and April, 1994. The results of these sampling events are summarized below.

- Biological and water quality sampling results from Mill Creek during 1994 indicated that severe biological degradation and chemical impairment has occurred in Mill Creek associated with water discharged from the Dayton Airport retention basin. Biological communities were reflective of poor water quality conditions both upstream and downstream from the retention basin; however, there was a detectable decline in biological condition downstream from the retention basin discharge.
- The fish community in Mill Creek had not fully recovered as of the sampling dates from the repeated releases of contaminated retention basin water. Fish communities at RM 2.6 (County Line Rd.) and RM 1.2 (Frederick Rd.) were severely degraded, with results indicative of very poor water quality. Sampling results at RM 1.2 suggest that acutely toxic conditions have occurred in the stream, as evidenced by the near complete absence of fish (one fish collected on August 2 and 6 fish collected on September 13, 1994). Re-invasion of fish from the Stillwater River into Mill Creek in the Frederick area is precluded by several low-head dams, thus recovery will need to emanate from upstream. The fish community upstream from the retention basin is reduced in diversity, a condition largely attributed to reduced habitat conditions.
- Macroinvertebrate communities in Mill Creek reflected a wide range of conditions, from poor both upstream and downstream from the retention basin, to very good near the mouth. Macroinvertebrate communities in the poor range were associated with limited habitat upstream from the retention basin (RM 3.9) and low stream flows (RM 2.6 - County Line Rd.). Marginally good to good macroinvertebrate communities were recorded at RM 2.6 (August sampling) and RM 1.2 (Frederick Rd.). The macroinvertebrate communities downstream from the retention basin exhibited a rapid recovery from any deleterious effects caused by the March and April 1994 spills of highly elevated concentrations of ammonia-N and oxygen demanding water.
- Biological communities were in NON attainment of the Warmwater Habitat (WWH) aquatic life use designation at the three uppermost sampling locations - one upstream from the Dayton Airport retention basin, and two downstream from the retention basin discharge (Table 2). FULL biological attainment of the WWH use occurred near the mouth of Mill Creek (RM 0.5). Overall 1994 biological results for Mill Creek indicate that at least 3.1 miles of stream were not meeting the WWH use designation, and 0.6 miles were fully attaining the WWH use designation.
- Sampling in Mill Creek upstream from the retention basin revealed ammonia-N at less than laboratory detection limits (<0.05 mg/l). However, ammonia-N levels measured in Mill Creek downstream from the Dayton Airport retention basin discharge were at levels considered acutely and chronically toxic to aquatic life. Of the four ammonia-N samples collected in Mill

Creek downstream from the retention basin, two were in violation of the maximum Ohio Water Quality Standard for ammonia-N. The maximum ammonia-N value reported instream (330 mg/l) was one of the highest values recorded in the Ohio EPA statewide database.

- Measurements of oxygen demand (5 day biochemical oxygen demand - BOD<sub>5</sub>, 5 day carbonaceous biochemical oxygen demand - cBOD<sub>5</sub>, and chemical oxygen demand - COD) instream were highly elevated in Mill Creek downstream from the retention basin discharge. Maximum cBOD<sub>5</sub>, BOD<sub>5</sub>, and COD concentrations measured in Mill Creek were >104 mg/l, >100 mg/l, and 1,720 mg/l, respectively. These values are among some of the highest stream measurements recorded in the Ohio EPA statewide database. Ethylene glycol, a de-icing chemical used at the Dayton Airport, can exert a high oxygen demand during biodegradation in surface water.
- Extremely elevated levels of ammonia-N, cBOD<sub>5</sub>, and COD in Mill Creek were commensurate with results reported from the Dayton Airport retention basin discharge on March 15, 1994.
- Dayton Airport self-monitoring data reported for 1994 at the retention basin indicated highly elevated concentrations of ammonia-N (161 mg/l - maximum), total recoverable lead (1080 ug/l - maximum), cBOD<sub>5</sub> (547 mg/l - maximum), and COD (1530 mg/l - maximum).
- Thirteen spills were reported in Mill Creek between 1989 and January, 1995, with 11 of these associated with the Dayton Airport facility. The majority of spilled material has been identified as glycol or ethylene glycol, de-icing agents used at the Dayton Airport. In most of the reported spills, the amount of material spilled into Mill Creek was unknown. A total of two wildlife kills associated with the retention basin discharge were reported between 1986 and 1994. These resulted in 2,267 organisms killed.
- The stream morphology of Mill Creek upstream from the retention basin consisted of only fair pool and riffle development. This section of Mill Creek has been previously modified, although the channel has begun to show signs of recovery. Stream habitat was considered fair.
- Physical habitat in Mill Creek from RM 2.6 to the mouth was of good quality, with bottom substrates predominated by sand and gravel in the upper section, exposed limestone in the Frederick area (RM 1.2), and a predominance of cobble and gravel in the lower section. Overall stream development from RM 2.6 to the mouth was considered good.
- Recovery of nearly 3-3.5 miles of Mill Creek is dependent on controlling large releases of retention basin water. While full attainment of the WWH use may be precluded by other factors in the immediate vicinity of the discharge, most of the stream has a WWH potential. Thus, water quality based limitations should be based on meeting WWH criteria in accordance with Ohio EPA Wasteload Allocation policies and procedures.

Table 2. Aquatic life use attainment status for Mill Creek based upon sampling conducted in August and September, 1994. August results for the IBI, ICI and attainment status are listed first/ September is listed second. Attainment status is based on biocriteria for the Eastern Corn Belt Plains ecoregion of Ohio (OAC Chapter 3745-1-07, Table 7-17).

<b>RIVER MILE Fish/ Invert.</b>	<b>IBI</b>	<b>ICI<sup>a</sup></b>	<b>QHEI</b>	<b>Attainment Status</b>	<b>Comment</b>
<i>Mill Creek Eastern Corn Belt Plains Ecoregion - WWH Use Designation</i>					
3.9	30*/30*	<u>P*</u> / <u>P*</u>	57.0	<b>NON/NON</b>	Background WQ/ channelized
2.6	<u>14*</u> / <u>18*</u>	MG/ <u>P*</u>	62.0	<b>NON/NON</b>	Dst. Dayton Airport
1.2	<u>12*</u> / <u>12*</u>	G/MG	65.5	<b>NON/NON</b>	Fish kill area/ high ammonia
0.5	38 <sup>ns</sup> /46	VG/VG	67.0	<b>FULL/FULL</b>	Near mouth

**Ecoregion Biocriteria:** Eastern Corn Belt Plains (ECBP)

<b>INDEX</b>	<b>WWH</b>	<b>EWH</b>	<b>MWH<sup>b</sup></b>
IBI - Headwaters	40	50	24
ICI	36	46	22

\* Significant departure from ecoregion biocriterion (>4 IBI units); poor and very poor results are underlined.

<sup>a</sup> Narrative evaluation used in lieu of ICI (E=Exceptional, V=Very good, G=Good, MG=Marginally good, F=Fair, P=Poor, VP=Very poor).

<sup>b</sup> Modified Warmwater Habitat for channel modified areas.

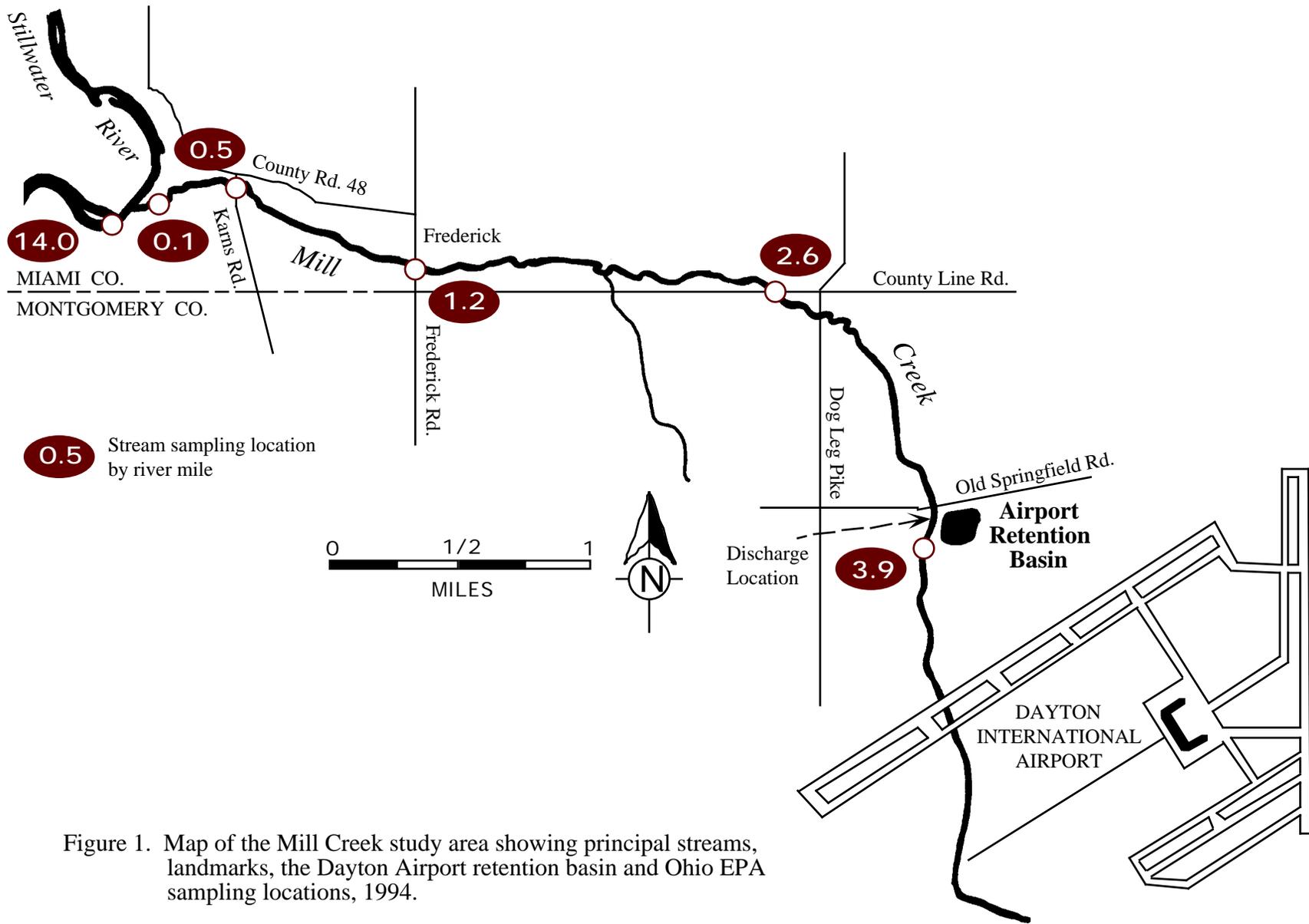


Figure 1. Map of the Mill Creek study area showing principal streams, landmarks, the Dayton Airport retention basin and Ohio EPA sampling locations, 1994.

### Physical Habitat for Aquatic Life

Physical habitat was evaluated in Mill Creek at each biological sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 3.

- Stream morphology at the upper most sampling location (RM 3.9 - upstream from the retention basin) consisted of only fair pool and riffle development. Bottom substrates were predominated by gravel and sand, with lesser amounts of boulders, cobble and muck. This section of Mill Creek has been previously modified, although the channel has begun to show signs of recovery. One side of the riparian corridor was completely devoid of woody vegetation. The QHEI score at RM 3.9 was 57.0 and the relatively high number of modified habitat attributes (Table 3) was reflective of fair quality stream habitat.
- Physical habitat in Mill Creek at RM 2.6 (County Line Road) was of good quality, with bottom substrates predominated by sand and gravel, adequate amounts of instream cover, and good pool and riffle development. The QHEI score of 62.0 and a predominance by warmwater habitat attributes was indicative of good quality stream habitat.
- Mill Creek in the vicinity of Frederick (RM 1.2 - Frederick Rd.) consisted of different physical habitats compared with the other three sampling locations. Exposed limestone bedrock, along with cobble, were the two predominant bottom substrates. The stream gradient in this area was the highest in the study area (71.4 ft./ mile). A lowhead dam was located within the sampling zone, and another was located within 200 meters downstream from the zone (adjacent Mills Grove pool). These dams are effective barriers to re-invasion of fish species from the lower Mill Creek to its middle and upper sections. The QHEI score of 65.5 and a predominance by warmwater habitat attributes was indicative of good quality stream habitat.
- The most downstream sampling site in Mill Creek (RM 0.5 - Karns Rd.) exhibited good instream physical habitat, with bottom substrates predominated by cobble and gravel, and extensive areas of riffle and run habitats. Woody riparian cover was sparse along Mill Creek at RM 0.5 and livestock had unrestricted access to the stream channel. Overall stream development was considered good, as represented by a QHEI score of 67.0 and a predominance by warmwater habitat attributes.

Table 3. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for Mill Creek, 1994.

**Key  
QHEI  
Components**

WWH Attributes

MWH Attributes

*High Influence*

*Moderate Influence*

River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current Eddies	Low/Normal Embeddedness	Max Depth > 40 cm	Low/No Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD/HW)	Total H.I. MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Harapan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Moderate Embeddedness	Ext./Moderate Riffle Embed.	No Riffle	Total M.I. MWH Attributes	MWH H.I./WWH Ratio	MWH M.I./WWH Ratio
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(14-202) – Mill Creek

Year: 94

3.9	57.0	18.8	■		■				■			4	● ●					2	▲ ▲		▲ ▲				▲ ▲ ▲					7	.60	2.00
2.6	62.0	10.8	■ ■		■ ■ ■			■ ■	■ ■			8		●				1	▲						▲ ▲ ▲					4	.22	.67
1.2	65.5	71.4	■ ■ ■		■ ■ ■			■ ■ ■	■ ■ ■			8		●				1							▲					1	.22	.33
.5	67.0	47.6	■ ■ ■		■ ■ ■			■ ■	■ ■			8						0							▲ ▲ ▲					3	.11	.44

## Macroinvertebrate Community

Macroinvertebrate communities were qualitatively sampled on two occasions at four locations in Mill Creek during August and September, 1994 (Table 4). Sampling consisted of using kicknets and hand picking all available habitat types and substrates in accordance with Ohio EPA standard methods (Ohio EPA 1989c). The macroinvertebrate collections provided an inventory of taxa in Mill Creek (Appendix Table 1).

- The macroinvertebrate community at the upstream site (RM 3.9 - upstream retention basin) was evaluated as poor and reflected the limited habitat available, a condition which tended to exclude many pollution sensitive taxa such as mayflies and caddisflies. The August 9 sample included 31 taxa with two EPT (Ephemeroptera - mayfly, Plecoptera - stonefly, and Trichoptera - caddisfly) taxa; EPT taxa are used as an indication of the prevalence of pollution sensitive organisms. The September 13 sample included 28 taxa with an EPT taxa richness of one. The community was predominated by flatworms, damselflies, beetles, midges, and leeches.
- The first site downstream from the Dayton Airport retention pond (RM 2.6 - County Line Rd.) exhibited a marginally good macroinvertebrate community in August and a poor quality community in September. The decline in the September sample was most likely due to low stream flow conditions with the stream consisting mostly of isolated pools and very restricted habitats. The August 9 sample included 39 taxa with an EPT taxa richness of seven. The September 13 sample included 24 taxa with an EPT taxa richness of one. The community was predominated by midges, damselflies, and beetles in August; however, by September the community consisted primarily of midges and the dragonfly species *Libellula lydia*.
- Macroinvertebrates at RM 1.2 (Frederick Rd.) were evaluated as marginally good to good. The August 9 sample included 30 taxa with an EPT taxa richness of 11 (EPT taxa number is very good for this size stream). The September 13 sample consisted of 29 total taxa and an EPT taxa richness of seven (EPT taxa numbers were reflective of good conditions). The decline between August and September was again most likely attributable to low stream flow conditions. There were extremely high numbers of midges and predators (e.g., dragonflies, alderflies, and damselflies).
- The site near the mouth at RM 0.5 (Karns Rd.) had a macroinvertebrate community in the very good range. Both samples included 43 total taxa and had EPT taxa richnesses of 14 in August and 13 in September. There were large numbers of blackfly larva (a recovery zone organism) but also large numbers of more pollution sensitive mayflies and caddisflies.

Table 4. Summary of macroinvertebrate data collected from natural substrates (qualitative sampling) in Mill Creek, August and September 1994. Mill Creek has a WWH aquatic life use designation in the Ohio Water Quality Standards.

Stream/ River Mile	No. Qual. Taxa	QCTV <sup>b</sup>	Qual. EPT <sup>a</sup>	Relative Density	Predominant Organisms	Narrative Evaluation <sup>c</sup>
<b><i>Mill Creek - August 9, 1994</i></b>						
3.9	31	25.4	2	Low	Damselflies, Beetles	Poor
2.6	39	32.7	7	Low	Midges, Damselflies	Marginally Good
1.2	30	38.7	11	Moderate - Low	Blackflies, Caddisflies	Good
0.5	43	36.8	14	Moderate	Blackflies, Caddisflies	Very Good
<b><i>Mill Creek - September 13, 1994</i></b>						
3.9	28	29.2	1	Low	Flatworms, Damselflies	Poor
2.6	24	26.1	1	Low	Midges, Dragonflies	Poor
1.2	29	35.1	7	Moderate	Midges, Isopods	Marginally Good
0.5	43	35.1	13	Moderate	Caddisflies, Midges	Very Good

<sup>a</sup> EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa richness.

<sup>b</sup> Qualitative Community Tolerance Value (QCTV) derived as the median of the tolerance values calculated for each qualitative taxon present.

<sup>c</sup> The qualitative narrative evaluation is based on best professional judgement utilizing sample attributes such as taxa richness, EPT richness, and QCTV score and is used when quantitative data is not available to calculate the Invertebrate Community Index (ICI) scores.

<sup>d</sup> Modified Warmwater Habitat for channel modified areas.

## Fish Community

A total of 2,152 fish representing 20 species and one hybrid were collected from Mill Creek between August and September, 1994. The sampling effort included a cumulative distance electrofished of 1.51 km at four locations. IBI metrics and scores and relative numbers and species collected per location are presented in Appendix Tables 2 and 3, respectively.

- Creek chub (37.9%) and fathead minnow (20.2%), two pollution tolerant species, predominated the catch numerically. These two species, combined with central stoneroller (10.7%), smallmouth bass young-of-year (8.5%), and southern redbelly dace (8.4%) made up 85.7% of the fish collected in Mill Creek. Seventy-seven (77) percent of the fish from the study area were collected at the site located upstream from the retention pond discharge pipe.
- The fish community at the upstream Mill Creek sampling location (RM 3.9 - upstream retention basin) was evaluated as fair, with a large proportion of pollution tolerant species present (Table 5, Figure 2). The upstream section of Mill Creek has previously been channelized, which along with the maintenance of a degraded riparian corridor, has contributed to the reduced fish community. The IBI score of 30 was not achieving the WWH ecoregional biocriterion upstream from the retention pond discharge.
- Fish communities at RM 2.6 (County Line Rd.) and RM 1.2 (Frederick Rd.) were severely degraded. IBI scores ranged between 12 and 16. Both of these IBI scores are in the very poor range, showing significant departure from the WWH ecoregion biocriterion. Sampling results at both sites suggested that acutely toxic conditions have occurred in the stream, as evidenced by the near complete absence of fish (one fish collected on August 2 and 6 fish collected on September 13, 1994) at RM 1.2. Only incremental recovery of the fish community was evident at RM 2.6, where an increase in numbers of fish was recorded between August and September (from 33 to 101). Ninety-one (91) percent of the fish collected at RM 2.6 and all of the fish collected at RM 1.2 are classified as highly tolerant of pollution.
- A significant improvement in the fish community was documented at the most downstream sampling location (RM 0.5 - Karns Rd.). The cumulative number of fish species collected increased substantially at RM 0.5 (16 species) compared with RM 1.2 (2 species). The mean IBI score of 42 was representative of good water quality conditions and achieved the WWH ecoregion biocriterion. Based on ammonia-N levels (85.9 mg/l) recorded near the mouth of Mill Creek in April 1994, acutely toxic conditions probably existed for a short time at RM 0.5. The fish community sampled in August likely represents fish which re-invaded Mill Creek from the nearby Stillwater River. Larger fish species collected at RM 0.5 (northern hog sucker, golden redhorse, white sucker, yellow bullhead, smallmouth bass, largemouth bass, green sunfish and longear sunfish) were all young-of-year size; with no adults observed. Some recovery of the fish community was observed at RM 0.5 between August and September, where the number of species increased from 11 to 16 and the IBI increased from 38 to 46, respectively.

Table 5. Fish community indices from Mill Creek, 1994 based on pulsed D.C. electrofishing at sites sampled by Ohio EPA. Sites were sampled using wading methods.

Stream/ River Mile	Mean Number of Species	Cumulative Species	Relative Number (No./0.3 km)	QHEI	Index of Biotic Integrity	Narrative Evaluation <sup>a</sup>
<b>Mill Creek</b> (Summary of two sampling passes, 1994)						
3.9	6	6	1384	57.0	30*	Fair
2.6	5	6	105	62.0	<u>16*</u>	Very Poor
1.2	1.5	2	5	65.5	<u>12*</u>	Very Poor
0.5	13.5	16	277	67.0	42	Good
<b>Mill Creek</b> (September 13, 1994)						
3.9	-	6	1492	-	30*	Fair
2.6	-	5	159	-	<u>18*</u>	Poor
1.2	-	2	9	-	<u>12*</u>	Very Poor
0.5	-	16	268	-	46	Very Good
<b>Mill Creek</b> (August 2, 1994)						
3.9	-	6	1275	-	30*	Fair
2.6	-	5	49	-	<u>14*</u>	Very Poor
1.2	-	1	2	-	<u>12*</u>	Very Poor
0.5	-	11	286	-	38 <sup>ns</sup>	Marginally Good

**Ecoregion Biocriteria:** Eastern Corn Belt Plains (ECBP)

<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>	<u>MWH</u> <sup>b</sup>
IBI - Headwaters	40	50	24

\* Significant departure from ecoregion biocriterion (>4 IBI units); poor and very poor results are underlined.

<sup>ns</sup> Nonsignificant departure from WWH biocriterion (≤4 IBI units).

<sup>a</sup> Narrative evaluation is based on IBI scores.

<sup>b</sup> Modified Warmwater Habitat for channel modified areas.

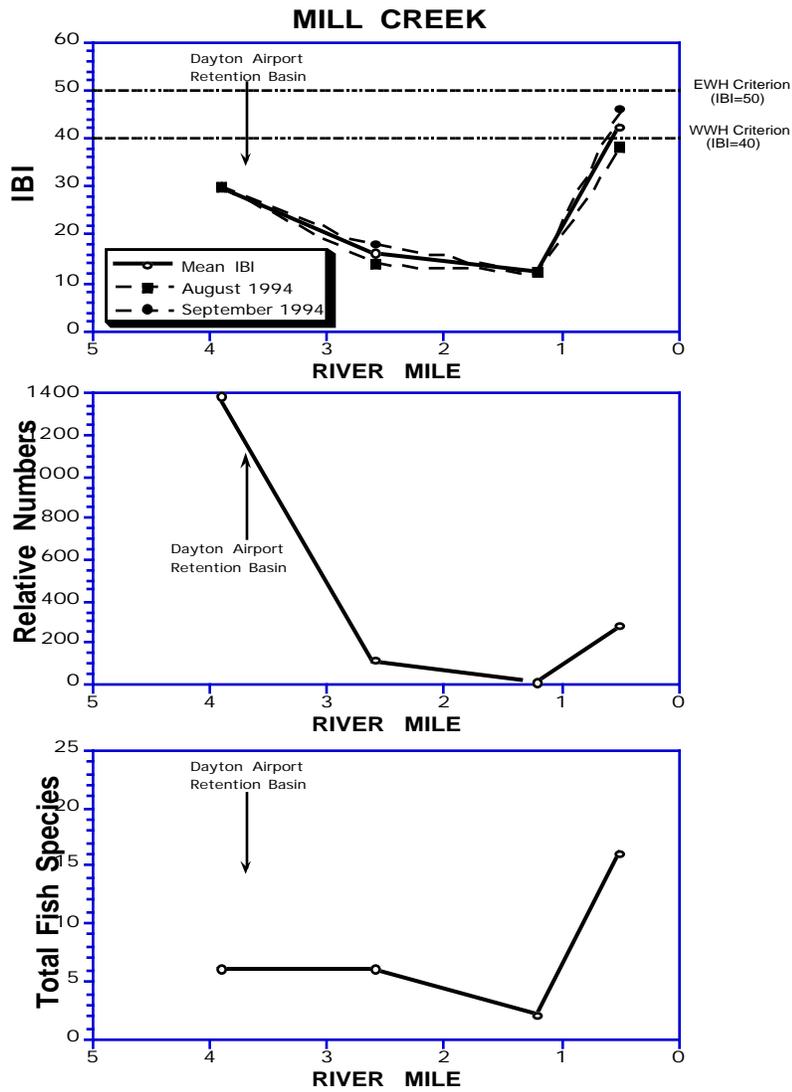


Figure 2. Longitudinal performance of the Index of Biotic Integrity (IBI), total number of fish species, and relative number of fish in Mill Creek, 1994.

### Chemical Spills/Wildlife Kills/Surface Water Quality

Surface water samples were collected by Ohio EPA from Mill Creek on March 15, April 12 and April 28, 1994. One surface water sample from the Stillwater River downstream from Mill Creek was collected on April 28, 1994. One effluent sample from the Dayton Airport retention basin discharge to Mill Creek was collected on March 15, 1994. Chemical analyses of these samples are presented in Table 6.

- Ammonia-N levels measured in Mill Creek downstream from the Dayton Airport retention basin discharge ranged between 6.29 mg/l and 330 mg/l. Of the four ammonia-N samples collected in Mill Creek downstream from the retention basin, two were in violation of the maximum Ohio Water Quality Standard for ammonia-N and the other two exceeded chronic WWH criteria. Numerous stream and toxicity studies (Roseboom and Richey 1977, Lewis *et al.* 1981, U.S. EPA 1983) have documented acutely toxic conditions and severe biological degradation associated with ammonia-N levels which were reported in Mill Creek during 1994. The maximum ammonia-N value reported instream (330 mg/l) was one of the highest values recorded in the Ohio EPA statewide database. Sampling in Mill Creek upstream from the retention basin revealed ammonia-N at less than laboratory detection limits (<0.05 mg/l). Ammonia is produced largely by deamination of organic nitrogen containing compounds and by hydrolysis of urea (APHA *et al.* 1992).
- Measurements of oxygen demand (biochemical oxygen demand - BOD and chemical oxygen demand - COD) instream were extremely elevated in Mill Creek downstream from the retention basin discharge. Carbonaceous biochemical oxygen demand (cBOD<sub>5</sub>) measurements in Mill Creek on several days were greater than 100 mg/l downstream from the retention basin. The maximum cBOD values were greater than the BOD 99th percentile value for stream samples reported throughout Ohio. Chemical oxygen demand measurements were extremely elevated, with three of five samples downstream from the retention basin at or greater than 138 mg/l. The maximum instream COD concentration of 1,720 mg/l was documented at RM 1.2 (Frederick Rd.) on March 15, 1994. The 99th percentile COD concentration for streams in Ohio is 133 mg/l. The Mill Creek sampling station located upstream from the retention basin discharge had relatively low concentrations of cBOD<sub>5</sub> (1.7 mg/l) and COD (22 mg/l). Ethylene glycol, a de-icing chemical used at the Dayton Airport, can exert a high oxygen demand as a result of biodegradation in surface water.
- Extremely elevated levels of ammonia-N, cBOD<sub>5</sub>, and COD in Mill Creek were commensurate with results reported from the Dayton Airport retention basin discharge on March 15, 1994.
- The Dayton Airport currently has an NPDES permit to discharge wastewater into Mill Creek via permit number III00029, outfall 003. Final permit limits, which are to become effective within 36 months of the effective date of the permit, regulate the discharge levels of ammonia-N, BOD, metals and organic chemical compounds. Self-monitoring data reported for 1994 at outfall 003 included highly elevated concentrations of ammonia-N (161 mg/l - maximum), total recoverable lead (1080 ug/l - maximum), cBOD<sub>5</sub> (547 mg/l - maximum), and COD (1530 mg/l - maximum).
- Chemical spills and wild animal kills are additional indications of impacts due to excessive pollutant loadings. Reviews were conducted for discharges and kills in Mill Creek for Miami and Montgomery Counties as reported by the Ohio EPA Division of Emergency and Remedial

Response and the Ohio DNR Division of Wildlife. Spills and kills results are listed in Tables 7 and 8, respectively. Thirteen spills were reported in Mill Creek between 1989 and January, 1995, with 11 of these associated with the Dayton Airport facility. The majority of spilled material has been identified as glycol or ethylene glycol, de-icing agents used at the Dayton Airport. In most of the reported spills, the amount of material discharged into Mill Creek was unknown. Of the four Ohio DNR investigations of pollution described, two reported wildlife killed (total of 2267 individuals) and two did not report any dead animals. The latter may be an indication of the completeness of previous kills and the effect of the low-head dams in preventing a more rapid recovery.

Table 6. Surface water chemical sampling results from Mill Creek and the Stillwater River collected between March 15 and April 28, 1994. The retention basin discharge results are listed under the effluent column. Exceedances of applicable Ohio Water Quality Standards are indicated with asterisks. ND = not detected.

Parameter	Concentration						
	Upstream	Effluent	RM 1.2		RM 0.1		Stillwater R.
	RM 3.9 4/28/94	RM 3.73 3/15/94	RM 1.2 4/12/94	RM 1.2 3/15/94	RM 0.1 4/28/94	RM 0.1 4/12/94	RM 14.0 4/28/94
Dissolve Oxygen (mg/l)	15.2	5.0	10.6	10.8	8.4	10.0	11.3
Temperature °C	15.5	7.0	12.0	9.0	16.5	12.0	18
Ammonia-N (mg/l)	<0.05	487	7.52**	330*	85.9*	6.29**	32.0*
BOD <sub>5</sub> (mg/l)	1.9	-	-	-	>100	-	98
cBOD <sub>5</sub> (mg/l)	1.7	>414	23	>104	>100	17	91
TOC (mg/l)	6	810	17	19	109	14	46
COD (mg/l)	22	2500	48	1720	299	34	138
Conductivity (umhos/cm)	889	3220	610	2480	1100	580	830
Nitrate-Nitrite,N (mg/l)	0.10	<0.1	5.04	1.78	1.31	4.78	1.79
Nitrite-N (mg/l)	<0.02	0.04	0.08	0.62	0.12	0.10	0.06
TKN (mg/l)	0.7	560	8.4	380	82.0	7.1	30.3
pH (SU)	8.36	8.88	8.07	8.80	8.27	8.12	8.33
Phenolics (ug/l)	<10	-	<10	-	<10	<10	<10
Phosphorus, T (mg/l)	-	0.67	0.14	0.37	-	0.12	-
Residue, T. Nflt. (mg/l)	<5	16	24	80	26	16	19
Chloride (mg/l)	-	51	41	72	-	39	-
Aluminum, T (ug/l)	-	-	1360	-	-	1360	-
Arsenic, T (ug/l)	-	-	<2	-	<4	<2	<4
Barium, T (ug/l)	-	-	52	-	-	55	-
Cadmium, T. (ug/l)	-	-	<0.4	-	-	<0.4	-
Calcium, T (mg/l)	-	-	60	-	-	58	-
Chromium, T. (ug/l)	-	-	<30	-	-	<30	-
Copper, T. (ug/l)	-	-	<10	-	-	24	-
Iron, T. (ug/l)	-	-	1960**	-	-	1820**	-
Lead, T. (ug/l)	-	-	2	-	-	2	-
Magnesium, T. (mg)	-	-	21	-	-	21	-
Manganese, T. (ug/l)	-	-	43	-	-	37	-
Nickel, T. (ug/l)	-	-	<40	-	-	<40	-
Selenium, T. (ug/l)	-	-	<2	-	-	<2	-
Zinc, T. (ug/l)	-	-	10	-	-	17	-
Hardness, T. (mg/l)	-	-	236	-	-	231	-
Cyanide, T. (ug/l)	-	-	-	-	-	<10	-
Volatile Organic Compounds	-	-	ND	-	-	ND	-
Semivolatile Organic Compounds	-	-	-	-	-	ND	-
- Bis(2-ethylhexyl) phthalate	-	-	28.2**	-	-	ND	-

\* - exceedance of warmwater habitat outside mixing zone maximum criteria.

\*\* - exceedance of warmwater habitat outside mixing zone 30-day average criteria.

Table 7. Summary of pollutant discharges to Mill Creek and tributaries reported to the Ohio EPA, Division of Emergency and Remedial Response from January 1989 - December 1994.

Date	Stream	Entity	Material	Amount
01/15/95	Mill Creek	Dayton Airport	White foam/ odor	Unknown
06/14/94	Mill Creek	Dayton Airport	White foam	Unknown
04/27/94	Mill Creek	Dayton Airport	Jet fuel, ethylene glycol, urea, potassium	Unknown
03/14/94	Mill Creek	Dayton Airport	Ethylene glycol, urea	Unknown
04/27/93	Mill Creek	Unknown	White milky stuff	Unknown
09/07/92	Mill Creek	Unknown	Foam	Unknown
08/20/92	Mill Creek	Emery Worldwide	Glycol wastewater	150 gallons
10/03/91	Mill Creek	Emery Worldwide	Ethylene glycol	150 gallons
02/04/91	Mill Creek	Dayton Airport	Ethylene glycol	Unknown
01/03/91	Ditch-Mill Cr.	Wright Brothers, Inc.	Jet fuel A	1000 gallons
09/04/90	Trib. to Mill Cr.	Unknown	Gasoline	Unknown
03/30/90	Mill Creek	Dayton Airport	Ethylene glycol	Unknown
02/28/90	Mill Creek	Dayton Airport	De-icer fluid	Unknown
12/29/89	Mill Creek	Emery Worldwide	Ethylene glycol	Unknown
03/10/89	Mill Creek	Dayton Airport	Pesticide	Unknown

Table 8. Summary of wildlife kills and water pollution investigations for Mill Creek between 1980 and 1994, as reported by the Ohio DNR, Division of Wildlife and Ohio EPA.

Date	Stream	County	Number Reported Killed	Cause
3/16/94	Mill Creek	Montgomery/ Miami	0	Urea/ antifreeze
8/25/92	Mill Creek	Miami	24	Ethylene glycol
12/31/86	Mill Creek	Montgomery	2,243	Antifreeze
1/24/86	Mill Creek	Miami	0	Jet fuel

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**Appendix Table 1. Raw macroinvertebrate data by river mile for Mill Creek, 1994.**

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 08/09/94 River Code: 14-202 River: Mill Creek

RM: 3.90 A

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +			
03600	<i>Oligochaeta</i>	0 +			
04664	<i>Helobdella stagnalis</i>	0 +			
04685	<i>Placobdella ornata</i>	0 +			
05900	<i>Lirceus sp</i>	0 +			
08250	<i>Orconectes (Procericambarus) rusticus</i>	0 +			
11200	<i>Callibaetis sp</i>	0 +			
13521	<i>Stenonema femoratum</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
23600	<i>Aeshna sp</i>	0 +			
23618	<i>Aeshna umbrosa</i>	0 +			
23704	<i>Anax junius</i>	0 +			
28516	<i>Libellula pulchella</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
42700	<i>Belostoma sp</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
65700	<i>Anacaena sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
67000	<i>Helophorus sp</i>	0 +			
68702	<i>Dubiraphia bivittata</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
80510	<i>Cricotopus (Isocladius) sylvestris group</i>	0 +			
83003	<i>Dicrotendipes fumidus</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	0 +			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	0 +			
95100	<i>Physella sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 31

No. Qualitative Taxa: 31 ICI:

Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 09/13/94 River Code: 14-202 River: Mill Creek

RM: 3.90 B

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01301	<i>Hydridae</i>	0 +			
01801	<i>Turbellaria</i>	0 +			
03360	<i>Plumatella sp</i>	0 +			
03600	<i>Oligochaeta</i>	0 +			
04664	<i>Helobdella stagnalis</i>	0 +			
04685	<i>Placobdella ornata</i>	0 +			
05900	<i>Lirceus sp</i>	0 +			
08250	<i>Orconectes (Procericambarus) rusticus</i>	0 +			
11200	<i>Callibaetis sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
28516	<i>Libellula pulchella</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
42700	<i>Belostoma sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
63600	<i>Hygrotus sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	0 +			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	0 +			
84302	<i>Phaenopsectra punctipes</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
86100	<i>Chrysops sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			
95501	<i>Planorbidae</i>	0 +			
98200	<i>Pisidium sp</i>	0 +			

No. Quantitative Taxa: 0      Total Taxa: 28  
 No. Qualitative Taxa: 28      ICI:  
 Number of Organisms: 0      Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 08/09/94 River Code: 14-202 River: Mill Creek

RM: 2.60 A

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +			
05900	<i>Lirceus sp</i>	0 +	No. Quantitative Taxa:	0	Total Taxa: 39
07875	<i>Cambarus (Tubericambarus) sp A</i>	0 +	No. Qualitative Taxa:	39	ICI:
11130	<i>Baetis intercalaris</i>	0 +	Number of Organisms:	0	Qual EPT:
11200	<i>Callibaetis sp</i>	0 +			
13521	<i>Stenonema femoratum</i>	0 +			
21604	<i>Archilestes grandis</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
23610	<i>Aeshna interrupta</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
42700	<i>Belostoma sp</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
45900	<i>Notonecta sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52430	<i>Ceratopsyche morosa group</i>	0 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
63700	<i>Ilybius sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
68201	<i>Scirtidae</i>	0 +			
68707	<i>Dubiraphia quadrinotata</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77001	<i>Tanypodinae</i>	0 +			
77250	<i>Alotanypus venusta</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
78401	<i>Natarsia species A (sensu Roback, 1978)</i>	0 +			
78650	<i>Procladius sp</i>	0 +			
80370	<i>Corynoneura lobata</i>	0 +			
82820	<i>Cryptochironomus sp</i>	0 +			
83040	<i>Dicrotendipes neomodestus</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
85500	<i>Paratanytarsus sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 09/13/94 River Code: 14-202 River: Mill Creek

RM: 2.60 B

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +			
04685	<i>Placobdella ornata</i>	0 +			
07875	<i>Cambarus (Tubericambarus) sp A</i>	0 +			
11200	<i>Callibaetis sp</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
22300	<i>Argia sp</i>	0 +			
23610	<i>Aeshna interrupta</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
45700	<i>Buenoa sp</i>	0 +			
45900	<i>Notonecta sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
77250	<i>Alotanypus venusta</i>	0 +			
78650	<i>Procladius sp</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
86200	<i>Tabanus sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 24

No. Qualitative Taxa: 24 ICI:

Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 08/09/94 River Code: 14-202 River: Mill Creek

RM: 1.20 A

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +			
04666	<i>Helobdella triserialis</i>	0 +			
05900	<i>Lirceus sp</i>	0 +			
11120	<i>Baetis flavistriga</i>	0 +			
11130	<i>Baetis intercalaris</i>	0 +			
11430	<i>Dipheter hageni</i>	0 +			
13400	<i>Stenacron sp</i>	0 +			
13521	<i>Stenonema femoratum</i>	0 +			
13560	<i>Stenonema pulchellum group</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
21604	<i>Archilestes grandis</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
23909	<i>Boyeria vinosa</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52430	<i>Ceratopsyche morosa group</i>	0 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
58505	<i>Helicopsyche borealis</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
81650	<i>Parametriocnemus sp</i>	0 +			
82200	<i>Tvetenia bavarica group</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	0 +			
84460	<i>Polypedilum (P.) fallax group</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
87540	<i>Hemerodromia sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 30

No. Qualitative Taxa: 30 ICI:

Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 09/13/94 River Code: 14-202 River: Mill Creek

RM: 1.20 B

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +			
04666	<i>Helobdella triserialis</i>	0 +			
05900	<i>Lirceus sp</i>	0 +			
11115	<i>Baetis brunneicolor</i>	0 +			
11120	<i>Baetis flavistriga</i>	0 +			
11200	<i>Callibaetis sp</i>	0 +			
13521	<i>Stenonema femoratum</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
23909	<i>Boyeria vinosa</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
58505	<i>Helicopsyche borealis</i>	0 +			
59500	<i>Oecetis sp</i>	0 +			
61400	<i>Agabus sp</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
77800	<i>Helopelopia sp</i>	0 +			
78650	<i>Procladius sp</i>	0 +			
82820	<i>Cryptochironomus sp</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
85800	<i>Tanytarsus sp</i>	0 +			
94400	<i>Fossaria sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 29

No. Qualitative Taxa: 29 ICI:

Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 08/09/94 River Code: 14-202 River: Mill Creek

RM: 0.50 A

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +	87540	<i>Hemerodromia sp</i>	0 +
04666	<i>Helobdella triserialis</i>	0 +	95100	<i>Physella sp</i>	0 +
05800	<i>Caecidotea sp</i>	0 +	95501	<i>Planorbidae</i>	0 +
05900	<i>Lirceus sp</i>	0 +			
11120	<i>Baetis flavistriga</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 43
11130	<i>Baetis intercalaris</i>	0 +	No. Qualitative Taxa: 43		ICI:
11200	<i>Callibaetis sp</i>	0 +	Number of Organisms: 0		Qual EPT:
12200	<i>Isonychia sp</i>	0 +			
13400	<i>Stenacron sp</i>	0 +			
13521	<i>Stenonema femoratum</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
23610	<i>Aeshna interrupta</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
50315	<i>Chimarra obscura</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52430	<i>Ceratopsyche morosa group</i>	0 +			
52530	<i>Hydropsyche depravata group</i>	0 +			
53800	<i>Hydroptila sp</i>	0 +			
58505	<i>Helicopsyche borealis</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
77800	<i>Helopelopia sp</i>	0 +			
78401	<i>Natarsia species A (sensu Roback, 1978)</i>	0 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +			
83820	<i>Microtendipes "caelum" (sensu Simpson &amp; Bode, 1980)</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	0 +			
84460	<i>Polypedilum (P.) fallax group</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
85814	<i>Tanytarsus glabrescens group</i>	0 +			
86200	<i>Tabanus sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section  
Macroinvertebrate Collection**

Collection Date: 09/13/94 River Code: 14-202 River: Mill Creek

RM: 0.50 B

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +	95100	<i>Physella sp</i>	0 +
05900	<i>Lirceus sp</i>	0 +	95907	<i>Gyraulus (Torquis) parvus</i>	0 +
11120	<i>Baetis flavistriga</i>	0 +	97601	<i>Corbicula fluminea</i>	0 +
11130	<i>Baetis intercalaris</i>	0 +			
11200	<i>Callibaetis sp</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 43
13521	<i>Stenonema femoratum</i>	0 +	No. Qualitative Taxa: 43		ICI:
13570	<i>Stenonema terminatum</i>	0 +	Number of Organisms: 0		Qual EPT:
17200	<i>Caenis sp</i>	0 +			
21300	<i>Hetaerina sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
23704	<i>Anax junius</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
48410	<i>Corydalus cornutus</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
50315	<i>Chimarra obscura</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52430	<i>Ceratopsyche morosa group</i>	0 +			
53800	<i>Hydroptila sp</i>	0 +			
58505	<i>Helicopsyche borealis</i>	0 +			
59970	<i>Petrophila sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
65800	<i>Berosus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
74650	<i>Atrichopogon sp</i>	0 +			
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	0 +			
78600	<i>Pentaneura inconspicua</i>	0 +			
80370	<i>Corynoneura lobata</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	0 +			
83040	<i>Dicrotendipes neomodestus</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
84960	<i>Pseudochironomus sp</i>	0 +			
85500	<i>Paratanytarsus sp</i>	0 +			
85800	<i>Tanytarsus sp</i>	0 +			
85814	<i>Tanytarsus glabrescens group</i>	0 +			
87540	<i>Hemerodromia sp</i>	0 +			

**Appendix Table 2. IBI metrics and scores for Mill Creek, 1994.**

Appendix Table 2. IBI metrics and scores for Mill Creek, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants / (0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omnivores	Pioneering fishes	Insectivores	DELT anomalies		
Mill Creek - (14-202)																
Year: 94																
3.90	E	08/02/94	2.7	6(3)	5(5)	2(3)	0(1)	0(1)	2(3)	79(1)	21(1)	73(1)	3(1)	0.0(5)	265(5)	30
3.90	E	09/13/94	2.7	6(3)	5(5)	2(3)	0(1)	0(1)	2(3)	75(1)	21(1)	72(1)	5(1)	0.0(5)	367(5)	30
2.60	E	08/02/94	3.1	5(1)	4(3)	1(1)	0(1)	0(1)	1(1)	100(1)	55(1)	82(1)	6(1)	0.0(1)	0(1)* *	14
2.60	E	09/13/94	3.1	5(1)	4(3)	2(3)	0(1)	0(1)	2(3)	88(1)	67(1)	77(1)	3(1)	0.0(1)	19(1)* *	18
1.20	E	08/02/94	5.5	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	100(1)	100(1)	0.0(1)	0(1)* *	12
1.20	E	09/13/94	5.5	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	100(1)	67(1)	100(1)	33(1)	0.0(1)	0(1)* *	12
0.50	E	08/02/94	6.0	6(1)	4(3)	0(1)	3(3)	2(3)	2(1)	4(5)	0(5)	4(5)	59(5)	0.0(5)	41(1)* *	38
0.50	E	09/13/94	6.0	11(3)	5(3)	2(3)	5(5)	3(3)	3(3)	18(5)	0(5)	6(5)	69(5)	0.0(5)	101(1)* *	46

**Appendix Table 3. Summary of relative numbers of fish and species collected at each location (by river mile) sampled in Mill Creek, 1994. Relative numbers are per 0.3 km.**

# Species List

River Code: <b>14-202</b>	Stream: <b>Mill Creek</b>	Sample Date: <b>1994</b>
River Mile: <b>3.90</b>	Basin: Great Miami River	Date Range: 08/02/94
Data Source: 01	Time Fished: 6458 sec    Drain Area: 2.7 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 0.36 km    No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI	Feed Grp	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACKNOSE DACE (C)	N	G	S	T	78	65.00	4.70			
CREEK CHUB (C)	N	G	N	T	788	656.67	47.47			
SOUTH. REDBELLY DACE (C)	N	H	S		168	140.00	10.12			
FATHEAD MINNOW (C)	N	O	C	T	349	290.83	21.02			
CENTRAL STONEROLLER (C)	N	H	N		211	175.83	12.71			
GREEN SUNFISH (C)	S	I	C	T	66	55.00	3.98			
	<i>Mile Total</i>				1,660	1,383.33				
	<i>Number of Species</i>				6					
	<i>Number of Hybrids</i>				0					

# Species List

River Code: <b>14-202</b>	Stream: <b>Mill Creek</b>	Sample Date: <b>1994</b>
River Mile: <b>2.60</b>	Basin: Great Miami River	Date Range: 08/02/94
Data Source: 01	Time Fished: 3904 sec    Drain Area: 3.1 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 0.39 km    No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACKNOSE DACE (C)	N	G	S	T	17	13.18	12.62			
CREEK CHUB (C)	N	G	N	T	14	10.78	10.31			
SOUTH. REDBELLY DACE (C)	N	H	S		12	9.47	9.07			
FATHEAD MINNOW (C)	N	O	C	T	82	64.18	61.43			
BLUNTNOSSE MINNOW (C)	N	O	C	T	4	3.00	2.87			
GREEN SUNFISH (C)	S	I	C	T	5	3.87	3.70			
<i>Mile Total</i>					134	104.49				
<i>Number of Species</i>					6					
<i>Number of Hybrids</i>					0					

# Species List

River Code: <b>14-202</b>	Stream: <b>Mill Creek</b>	Sample Date: <b>1994</b>
River Mile: <b>1.20</b>	Basin: Great Miami River	Date Range: 08/02/94
Data Source: 01	Time Fished: 3703 sec    Drain Area: 5.5 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 0.38 km    No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
FATHEAD MINNOW (C)	N	O	C	T	4	3.16	57.14			
GREEN SUNFISH (C)	S	I	C	T	3	2.37	42.86			
	<i>Mile Total</i>				7	5.53				
	<i>Number of Species</i>				2					
	<i>Number of Hybrids</i>				0					

# Species List

River Code: <b>14-202</b>	Stream: <b>Mill Creek</b>	Sample Date: <b>1994</b>
River Mile: <b>0.50</b>	Basin: Great Miami River	Date Range: 08/02/94
Data Source: 01	Time Fished: 5351 sec    Drain Area: 6.0 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 0.38 km    No of Passes: 2	Sampler Type: E

Species Name / Stage / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GOLDEN REDHORSE (B)	R	I	S	M	1	0.79	0.28			
NORTHERN HOG SUCKER (B)	R	I	S	M	3	2.37	0.85			
WHITE SUCKER (B)	W	O	S	T	44	34.74	12.54			
COMMON CARP (B)	G	O	M	T	1	0.79	0.28			
RIVER CHUB (C)	N	I	N	I	3	2.37	0.85			
BLACKNOSE DACE (C)	N	G	S	T	9	7.11	2.56			
CREEK CHUB (C)	N	G	N	T	4	3.16	1.14			
SPOTFIN SHINER (C)	N	I	M		15	11.84	4.27			
CENTRAL STONEROLLER (C)	N	H	N		18	14.21	5.13			
YELLOW BULLHEAD (B)		I	C	T	3	2.37	0.85			
SMALLMOUTH BASS (A)	F	C	C	M	3	2.37	0.85			
SMALLMOUTH BASS (B)	F	C	C	M	188	148.42	53.56			
LARGEMOUTH BASS (B)	F	C	C		6	4.74	1.71			
GREEN SUNFISH (C)	S	I	C	T	2	1.58	0.57			
LONGEAR SUNFISH (C)	S	I	C	M	4	3.16	1.14			
GREEN SF X BLUEGILL (C)					1	0.79	0.28			
GREENSIDE DARTER (C)	D	I	S	M	17	13.42	4.84			
RAINBOW DARTER (C)	D	I	S	M	21	16.58	5.98			
FANTAIL DARTER (C)	D	I	C		8	6.32	2.28			
<i>Mile Total</i>					351	277.11				
<i>Number of Species</i>					17					
<i>Number of Hybrids</i>					1					