

Recommendations

Status of Aquatic Life Uses

- Mill Creek and its tributaries were originally assigned aquatic life use designations in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. Therefore, because this study represents a first use of this type of biological data to evaluate and establish aquatic life use designations in the Mill Creek watershed, several revisions are recommended. While some of the changes may appear to constitute "downgrades" (*i.e.* EWH to WWH, WWH to MWH, etc.) or "upgrades" (*i.e.* LWH to WWH, WWH to EWH, etc.), any changes should not be construed as such because this constitutes the first use on Mill Creek of an objective and robust evaluation system and database. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use designations. Thus some of the following aquatic life use recommendations constitute a fulfillment of that obligation.

Mill Creek

- The main channel of Mill Creek can be subdivided into three segments: an upper unmodified reach (RM 27 to 24), a reach that experienced previous channel modifications, but which has undergone some recovery to natural conditions (RM 24 to 8) and the lower reach which has undergone permanent channel modification in several areas which will not be recoverable due to placement of concrete channels (RM 8 to 0).
- The recommended aquatic life use designation for Mill Creek from RM 27 to 8 (Center Hill Road) should be **Warmwater Habitat (WWH)**. This is a change in the previous use designation from RM 18 to 8 which was Limited Warmwater Habitat. Because the stream channel has shown sufficient recovery to its natural state through this section (RM 18 to 8), the previous LWH use designation is inappropriate and should be changed.
- The previous use designation for the lower reach (RM 8 to 0) of Mill Creek was Limited Warmwater Habitat. The recommended aquatic life use designation should be **Modified Warmwater Habitat (MWH)** because of the permanent modifications to the stream channel in this reach.

East Fork Mill Creek

- East Fork Mill Creek is presently designated Warmwater Habitat which is the appropriate designation. During low flow years, East Fork Mill Creek has been observed to turn interstitial upstream from Upper Mill Creek WWTP. East Fork Mill Creek enters Mill Creek at RM 17.95.

Town Run

- The tributary to which the of the Village of Glendale wastewater treatment plant discharges is officially unnamed. Through correspondence and regulatory documents, this tributary has been referenced as "Town Run" and should be documented as such in the Ohio Water Quality Standards, OAC, 3745-1. At this time, the recommended aquatic life use designation for Town Run is **Warmwater Habitat (WWH)**. No biological evaluation was conducted of Town Run during the 1992 survey, however based on the potential of the stream due to evaluation of the stream habitat it was determined WWH was the most appropriate use designation.

Sharon Creek

- Sharon Creek is presently designated Warmwater Habitat which is the appropriate use designation. The **State Resource Water** designation also is applicable from the headwaters to Sharon Lake because of the presence of Sharon Woods (a Hamilton County Park). Sharon Creek enters Mill Creek at RM 15.63.

Cooper Creek

- This tributary is unofficially named "Cooper Creek" for this survey and report. It receives the wastewater discharges from Steelcraft Manufacturing Company and Michelman, Inc. in the headwater region. The Steelcraft Manufacturing Company NPDES permit number IIC00042*AD refers to this creek as Rossmoyne Creek. The recommended use designation for this tributary is **Warmwater Habitat (WWH)** based on the habitat evaluation. Because the name Rossmoyne Creek is already in the permits processing system and the stream originates near the community of Rossmoyne, it is recommended this stream be officially named "Rossmoyne Creek". Cooper/Rossmoyne Creek enters Mill Creek at RM 14.05.

G.E. Tributary

- The tributary which flows through the property of General Electric in Evendale is presently unnamed. Although it originated upstream from the property, the name "G. E. tributary" has been unofficially assigned for use during this survey and report. The recommended use designation for this stream is **Limited Resource Water** due to the channel modifications and the extent of wastewater discharges; multiple stormwater and direct outfalls are located on G.E.'s property. The habitat of this tributary was evaluated downstream of the G.E. outfall at RM 0.10 and the Qualitative Habitat Evaluation Index (QHEI) value of 68 indicated the potential to attain WWH use, however this portion of the stream is atypical of the remainder of the stream habitat and the QHEI score should not apply. The G.E. tributary enters Mill Creek at RM 13.85.

West Fork Mill Creek

- The present WWH use designation for the entire length of the stream and State Resource Water from headwaters to Winton Lake should be retained. West Fork Mill Creek enters Mill Creek at RM 11.57.

Winton Ridge Tributary

- The Winton Ridge Tributary is the unofficial name assigned to this stream which enters Mill Creek at RM 6.85. It is recommended this tributary be officially named "Winton Ridge Tributary" in the Ohio Water Quality Standards. In Appendix 9 this tributary is referred to as Cape Creek in the Winton Ridge Dump preliminary assessment. Based on the habitat evaluation, it is recommended the stream be afforded a higher level of protection, such as **Warmwater Habitat** until the use designation of **Headwater Habitat** has been established.

Bloody Run

- "Bloody Run" is the unofficial name given to this tributary which enters Mill Creek at RM 7.63. This stream once received waste fluids from animal slaughter houses, hence the name. Due to industrial combined sewer overflows "Bloody Run" frequently continues to change colors (red and green). The recommended use designation for this stream is **Limited Resource Water** until it can be biologically assessed.

Ross Run

- The present use designation of Limited Warmwater Habitat should be change to **Limited Resource Water** based on the channel modifications and heavy industrial influence this stream experiences. Ross Run enters Mill Creek at RM 6.45.

West Fork

- West Fork is presently designated Limited Warmwater Habitat. The recommended designation should be **Warmwater Habitat** from headwaters to Montana Avenue and **Limited Resource Water** from Montana Avenue (RMs 2.1 to 0.0) to the mouth due to permanent channel modifications and the biological results from the 1991 survey (Ohio EPA 1992). The **State Resource Water** designation also applies for the section of stream which flows through Mount Airy Forest, part of the Cincinnati Park system. West Fork enters Mill Creek at river mile 3.45.

Status of Non-Aquatic Life Uses

The non-aquatic life use designations of water supply are based on existing types of water intakes or the potential for the types of activities to occur in the basin (Agricultural or Industrial). It does not necessarily mean that these uses are actually occurring. The recreational water designations are based on the size of the stream and its potential to support this activity (full or partial body contact). It does not indicate that it is advisable for these recreational activities to occur, only that the stream has the potential for them to occur. Due to the contamination detected in the lower reaches of Mill Creek (RM 17.6 to the Ohio River) as well as some of the tributaries, **it is not recommended that recreational activity occur in these reaches of the streams at this time.**

Mill Creek

- The entire length of Mill Creek should remain designated as Industrial Water Supply. Changes in the Agricultural Water Supply use should be as follows. Mill Creek from headwaters to I-275 should remain Agricultural Water Supply. Because the Mill Creek basin is heavily urbanized downstream from I-275, the Agricultural Water Supply use would not apply. The recommended recreational designation for Mill Creek based on the size of the stream should be Primary Contact Water, however based on contamination concerns in Mill Creek from RM 17.6 to the Ohio River, recreational contact by the public is strongly discouraged.

East Fork Mill Creek

- The entire length of East Fork Mill Creek should be designated both Industrial and Aricultural Water Supply. The Secondary Contact Recreation use should apply from the headwaters to the discharge of the Butler County Upper Mill Creek Wastewater Treatment Plant. From the Upper Mill Creek WWTP to the confluence with Mill Creek, the Primary Contact Recreation use should apply based on the depth of the stream.

Town Run

- It is recommended Town Run be designated as an Industrial Water Supply and have a Secondary Contact Recreation use. Based on the levels of fecal coliform contamination measured in Town Run, public contact is not recommended at this time.

Sharon Creek

- Sharon Creek is presently designated as Agricultural and Industrial Water Supply and has a Primary Contact Recreation use. Due to development in the basin, the Agricultural Water Supply use should be dropped. Based on the levels of fecal coliform contamination measured in

Sharon Creek downstream of the lake, public contact is not recommended at this time.

Cooper Creek

- It is recommended Cooper Creek be designated as an Industrial Water Supply and have a Secondary Contact Recreation use. Based on the levels of fecal coliform contamination measured in Cooper Creek, public contact is not recommended at this time.

G.E. Tributary

- It is recommended the G.E. tributary be designated as an Industrial Water Supply and have a Secondary Contact Recreation use. Based on the levels of PCB contamination measured in the tributary (REMCOR 1993), public contact is not recommended at this time.

West Fork Mill Creek

- The present non-aquatic life use designations of Agricultural and Industrial Water Supply and recreational Primary Contact Recreation are appropriate for West Fork Mill Creek. Due to elevated levels of fecal coliform contamination measured, public contact is not recommended at this time.

Winton Ridge Tributary

- The appropriate non-aquatic use designations for this tributary are Industrial Water Supply and Secondary Contact Recreation use.

Bloody Run

- It is recommended Bloody Run be designated as an Industrial Water Supply and have a Secondary Contact Recreation use. Based on the levels of fecal coliform contamination measured in Bloody Run, public contact is not recommended at this time.

Ross Run

- It is recommended Ross Run be designated as an Industrial Water Supply and have a Secondary Contact Recreation use. Based on the levels of fecal coliform contamination measured in Ross Run, public contact is not recommended at this time.

West Fork

- From the headwaters of West Fork to Montana Avenue (RM 2.1) the stream should be designated Industrial Water Supply and Secondary Contact. Downstream of Montana Avenue the channel has been modified so that the stream enters the combined sewer system through grates in the cement channel. Neither water supply nor recreational contact designations would be appropriate.

Other Recommendations

- Based on the chemical data from Town Run, the effectiveness of the Glendale WWTP should be evaluated with both chemical and biological monitoring.
- The recent expansion and upgrade of the Butler County Upper Mill Creek WWTP should be closely monitored. Results from the 1992 survey suggest the stream is at or over capacity for assimilation of wastewater.
- Areas of contamination have been identified in the Mill Creek basin and more definitive

evaluations must now occur to identify contamination sources. This does not commit Ohio EPA to identifying and evaluating all of these sources. State government resources are not available for a study of this magnitude. Local government, industry, property holders, and the community will have to be involved in the planning and funding of this effort.

- An evaluation should be conducted on the effect of additional wastewater contributions to the Mill Creek system due to new development occurring in Hamilton and Butler Counties. What impacts have these loadings caused to nonpoint source pollution, wastewater treatment plants and combined sewer overflow frequency?

Future Monitoring Concerns (to be addressed by Ohio EPA)

- A follow-up survey should be conducted on East Fork Mill Creek to evaluate the expansion and upgrade of the Butler County Upper Mill Creek WWTP. Another water quality survey is scheduled during the summer of 1997 by Ohio EPA.
- Town Run needs to be biologically evaluated to support the appropriate aquatic life use designation.
- The extremely elevated lead concentrations at RM 4.45 in West Fork Mill Creek need to be investigated as soon as possible since there are no known sources of contamination in the area.
- The sources of PCB aroclors 1248 and 1260 in Mill Creek should be further investigated.
- The expense of another comprehensive intensive stream survey should not be undertaken until some improvements are made in the watershed to address CSOs, industrial sites and old landfill contamination. Smaller surveys are recommended to address specific reaches of the stream as improvements are made.

Study Area Description

Mill Creek flows 28.1 miles from the headwaters in southeastern Butler County through central Hamilton County to a confluence with the Ohio River (Figure 1) and is located in the Interior Plateau Ecoregion. The Mill Creek watershed drains an area of 166.2 square miles. Along its course the stream has an average gradient of 11.9 feet per mile (ODNR, 1960). Most of Mill Creek flows atop a buried valley aquifer composed of highly permeable sands and gravel from past glacial deposits and outwash. Major tributaries include: West Fork, Ross Run, West Fork Mill Creek, Sharon Creek, and East Fork Mill Creek. These tributaries as well as several smaller ones enter Mill Creek from the hillsides that characterize the watershed. They are generally underlain by thinly inter-bedded shales and limestone bedrock except for the lower reaches at the confluences with Mill Creek. The average gradient for the major tributaries is 51.8 feet per mile (Table 3).

Aquatic life uses for streams in the basin reflect the high degree of urban/industrial development that has occurred. Mill Creek is currently designated Warmwater Habitat (WWH) for that portion upstream of I-275 and Limited Warmwater Habitat (LWH) for the remainder of its length. Variances to State of Ohio Water Quality Standards (OAC 3745-1) for some parameters have been established in portions of Mill Creek based on standards established in 1978. West Fork and Ross Run have also been designated LWH because of modifications to the streams and the number and density of discharges they receive. The rest of the major tributaries are designated WWH and West Fork Mill Creek is additionally listed in the water quality standards as State Resource Water (SRW) due to the presence of Winton Lake/West Fork Mill Creek Reservoir. Though not presently listed in the State of Ohio Water Quality Standards, Sharon Creek also qualifies for SRW from the headwaters to and including Sharon Lake. Streams and lakes encompassed in publicly owned park systems are by definition classified as State Resource Waters.

Land uses in the watershed have evolved over the time of development which began in the late 1700's. Cincinnati has always been a principal port for river transportation to the west and east along the Ohio and became a major industrial and transportation center as the United States expanded westward. The abundant surface and groundwater supplies of the Mill Creek made it an ideal location for industrial development beginning with the establishment of the water driven mills that gave it its name. Unfortunately the same characteristics made it a convenient conduit for the removal of wastes. Attempts to manage the wastes date from the construction of the Mill Creek interceptor in 1913. This sewer which is still in use has not been able to carry all of the wastes and stormwaters that were added to its flow as the area expanded and as a result raw sewage continues to enter Mill Creek especially during rain events (HCEAC 1993).

Most of the sewers in the basin were designed to carry combinations of domestic sewage, stormwater, and industrial wastes. Additions to the system have resulted in too much flow for the system to handle. Combined sewer overflows occur at 158 locations in the basin (R.D. Zande, 1991). These overflows contribute fecal bacteria, BOD, COD, nutrients and industrial wastes to the streamflow and are currently being studied by the Metropolitan Sewer District as part of the NPDES permit for the system.

Over time the City of Cincinnati and surrounding suburbs have expanded to cover almost all of the watershed. The only portion of the watershed which still contains significant areas of agricultural land is in the upper reaches in Butler County. Development pressure is very high in this area and much, if not all of it is likely to be developed for residential and related commercial uses. Most of the development has occurred without sufficient provisions for stormwater control or control of

erosion from the construction sites. As a result, all of the streams in the watershed have received significant quantities of sediment from construction. Without stormwater control the high gradient of the tributaries makes them especially susceptible to streambed erosion. All of these streams evolved under conditions of forested watersheds that reduced the volume and rate of runoff. Development removed the protective cover and permeable natural surface and replaced them with impermeable surfaces. As a result both the volume and rate of runoff combine to exceed the capacity of the streams.

Winton Lake in Greenhills shows the impacts of uncontrolled development on waterbodies. The lake watershed has been almost totally developed for residential and commercial uses. The runoff into the lake has deposited sediments from construction sites and from eroding streams as well as discharges from combined sewers. As a result more than 50% of the volume and nearly one third of the surface area have been lost to public use. The Hamilton County Park District and the Army Corps of Engineers are cooperating on a project to remove the accumulated sediment. Unfortunately opportunities to reduce the excess runoff and stream erosion are nearly nonexistent in the watershed so the process will have to be repeated on a regular interval. Sharon Lake suffered from similar problems and was cleaned of accumulated sediment by the Park District starting in 1987 and completed in 1989.

In response to flooding that occurred in 1959 the Mill Creek Valley Conservancy District was formed to develop a comprehensive flood control plan. The plan formulated in cooperation with the Army Corps of Engineers called for channelization and concrete lining of Mill Creek to speed water flow to the Ohio River. Construction of this project began in 1981 and by May 1992, 41.9% of the proposed length had been completed. The completed sections of the channelization project have completely removed the natural ecosystem and replaced it with an artificial (concrete and rip-rap) substrate that eliminates any potential for recovery of a natural diversity in the biological communities. In response to concerns about the costs of the project and environmental degradation the Corps of Engineers has begun to reevaluate the project with the possibility of not completing the original design.

More than one hundred years of industrial usage in the basin with emphasis on the mainstem of Mill Creek has left a legacy of contamination that has been detailed in studies by Ohio EPA, the Army Corps of Engineers, the Mill Creek Conservancy District, and the City of Cincinnati. Contaminated sediments, leaking landfills, and U.S. EPA Super Fund sites are all present along Mill Creek. Ohio EPA's Division of Emergency and Remedial Response has identified 31 different sites along Mill Creek and its tributaries that have the potential to adversely affect water quality due to possible hazardous waste (Figure 2, Appendix 9). The Corps of Engineers surveyed the areas adjacent to Mill Creek that could be affected by the flood control/channelization of Mill Creek. Approximately 1.2 miles of old municipal landfills border both sides of Mill Creek in Section 8 of the project and 16 other sites were identified in other portions. These sites have been described in the draft report Mill Creek Ohio LPP Contamination Reconnaissance Report (USACOE, November 1990).

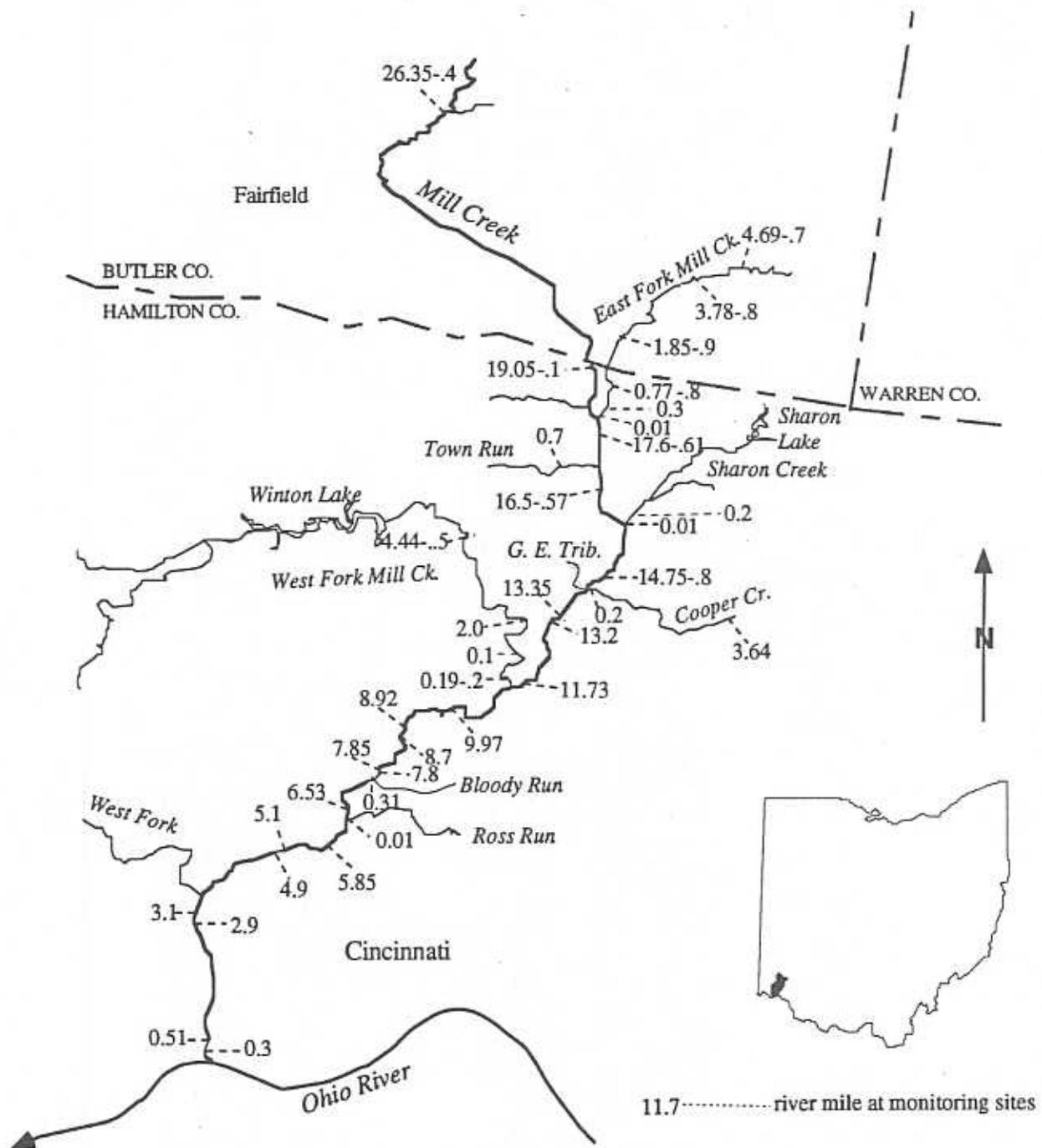


Figure 1. The Mill Creek study area showing principal streams and tributaries, and water quality monitoring sites.

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|--------------------------------------|---------------------------------|------------------------------|-----------------------------------|
| 1. B&O Dump | 9. Mill Creek Dump | 17. Lockland Works | 25. Ridgewood Arsenal |
| 2. Borden Chemical-Galbraith Plant | 10. CSX | 18. Manville Forest Products | 26. St. Bernard Dump |
| 3. Brighton Corp./Trinity Industries | 11. Elda Inc. | 19. MSD | 27. Sherwin Williams Co./PMC Inc. |
| 4. Brighton Yard | 12. Emery Chemicals | 20. North Bend Dump | 28. Skinner Landfill |
| 5. Canal Ridge Road Dump | 13. Este Ave. Dump | 21. Galbraith Rd. Landfill | 29. Techno-Adhesives |
| 6. Carstab/Morton International | 14. General Electric (Evendale) | 22. Pthalchem Inc. | 30. Vine Street Dump |
| 7. Carthage Ave. Landfill | 15. Highland Greens WWTP | 23. Premium Finishes, Inc. | 31. Winton Ridge Dump |
| 8. Celotex | 16. Laidlaw City Dump | 24. Pristine | |

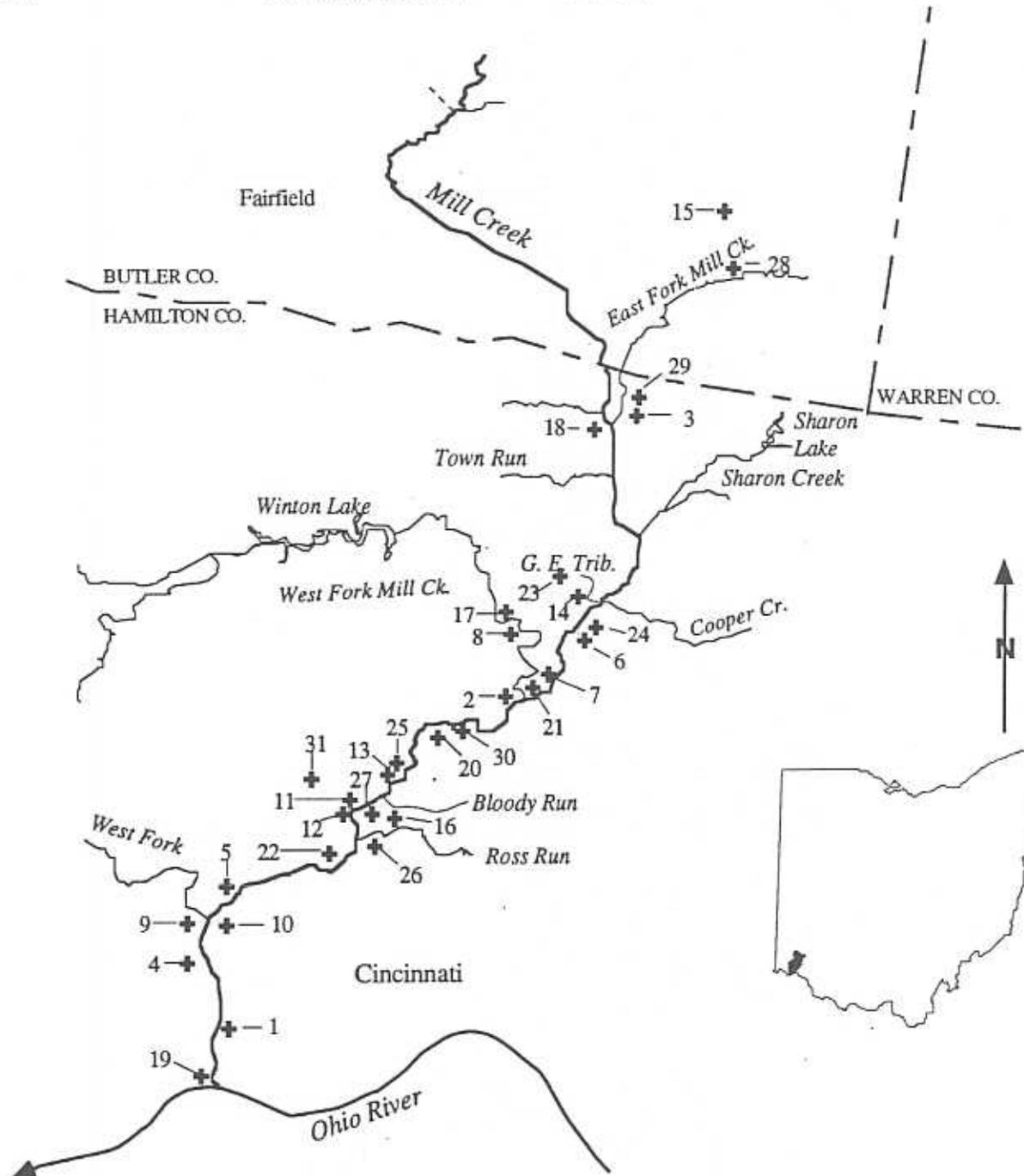


Figure 2. The Mill Creek study area showing principal streams and tributaries, and potential unregulated hazardous waste sites

Table 3. Stream characteristics and identified pollution sources in the Mill Creek study area.

Stream Name	Length (miles)	Average Fall (ft/mi)	Drainage Area (mi ²)	Nonpoint Pollution Categories	NPDES Point Sources:			
					Facility	River Mile	Latitude/Longitude	Design Flow (MGD)
Mill Creek	28.1	11.91	166.2	Land Disposal Agriculture				
					Parkway Nursing Ctr.+	25.97	39°22'33"/84°28'54"	Unknown
					Hoesch Suspension Inc.**	-	39°20'32"/84°30'54"	0.0238
					Avon+++	-	39°17'50"/84°28'21"	0.051
					Ryder Truck Rental Inc.	-	39°17'17"/84°26'26"	0.000415
					Xtek, Inc. (Reading Rd.)	16.91, 1.05	39°17'00"/84°25'00"	0.40
					Bedinghaus Business Communication Inc.	-	39°16'55"/84°26'50"	0.00144
					RJF International+++	-	39°16'41"/83°25'02"	0.000164
					National Starch & Chemical	15.6	39°15'26"/84°25'30"	0.001875
					Martest, Inc.	13.85, 2.25	39°15'10"/84°26'45"	0.03168
					Formica Corp.	14.59	39°14'40"/84°25'46"	1.525
					General Electric Aircraft Engines			
					001	13.85, 0.18	39°14'16"/84°26'34"	5.0
					002	13.30, 0.11	39°13'59"/84°26'34"	0.2
					Sawbrook Steel Castings++	13.15	39°13'42"/84°26'51"	0.014
					Liquid Carbonic Corp.	11.51, 0.60	39°12'26"/84°26'50"	0.009
					General Polymers	9.31, 0.21	39°12'22"/84°28'59"	0.017
					Proctor & Gamble (Winton Hill Tech. Ctr.)	8.25, 0.82	39°12'00"/84°30'15"	0.13
					Epcor+++	-	39°11'53"/84°29'15"	0.00012
					Proctor & Gamble			
					(Ivorydale) 001	6.76	39°10'48"/84°29'34"	0.052
					007	6.62	39°10'23"/84°30'20"	0.753

Table 3. (cont.) Stream characteristics and identified pollution sources in the Mill Creek study area.

Stream Name	Length (miles)	Average Fall (ft/mi)	Drainage Area (mi ²)	Nonpoint Source Pollution Categories	Facility	NPDES Point Sources:			Design Flow (MGD)
						River Mile	Latitude/Longitude		
East Fork Mill Creek	7.1	45.8	9.42	Suspected Unverified	Butler County Upper Mill Ck. Regional	0.90	39°18'00"/84°26'00"	8.0	
					Trinity Industries 001	0.48	39°17'26"/84°25'56"	0.026	
					003	0.41	39°17'25"/84°25'57"	0.078	
Town Run	1.9	51.4	2.9	Village of Glendale	0.92	39°16'20"/84°26'47"	0.43		
Sharon Creek	5.5	57.3	11.46	Northeast Knolls	3.45, 1.00	39°17'17"/84°22'18"	0.022		
				Timber Ridge Apts.	3.00, 1.05	39°16'52"/84°22'20"	0.08		
				Consolidated Rail Corp.	0.79	39°16'04"/84°25'03"	0.02		
Cooper Creek	3.9	70.3	5.1	Steelcraft 001	3.78	39°13'40"/84°23'30"	0.0274		
				002	3.78	39°13'40"/84°23'40"	0.0803		
				Michelman Inc.	3.78	39°13'27"/84°23'32"	0.018		
				Shell Oil+++	-	39°13'34"/84°23'40"	0.0072		
West Fork Mill Creek	15.2	23.8	36.42	Borden Packaging & Industrial Products	4.50, 0.50	39°15'27"/84°27'47"	0.01		
				City of Wyoming Waterworks	2.86	39°13'59"/84°27'53"	0.06		
				Lockland WTP+	2.75	39°14'03"/84°27'34"	Unknown		
Bloody Run	1.6	62.5	1.2	Xtek, Inc. (Township Rd.)	0.48	39°11'03"/84°29'14"	0.0378		

Table 3. (cont.) Stream characteristics and identified pollution sources in the Mill Creek study area.

Stream Name	Length (miles)	Average Drainage Fall Area (ft/mi)	Nonpoint Source Pollution Categories	Facility	NPDES Point Sources:			Design Flow (MGD)
					River Mile	Latitude/ Longitude		
Ross Run	4.9	51.1	5.92	Proctor & Gamble (Ivorydale) 002-006 Miami Margarine Co.	0.52	39° 10'34" / 84° 29'22"	0.005	
West Fork	5.0	81.1	9.74	Airy Pointe Condo Assoc.	4.45	39° 11'00" / 84° 35'40"	0.016	

+ Entity does not have a NPDES permit.

++ Discharge and NPDES permit eliminated subsequent to 1992 survey.

+++ Entity currently discharging without a NPDES permit; permit in process.

Methods and Materials

All chemical, physical, and biological field, laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989c) and Biological Criteria for the Protection of Aquatic Life, Volumes II-III (Ohio Environmental Protection Agency 1987b, 1989a, 1989b), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989) for aquatic habitat assessment.

Attainment/non-attainment of aquatic life uses is determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. The biological community performance measures that are used include the Index of Biotic Integrity (IBI) and the Modified Index of Well-being (MIwb), both of which are based on fish community characteristics.

The IBI is a multi-metric index patterned after an original IBI described by Karr (1981) and Fausch et al. (1984). The MIwb is a measure of fish community abundance and diversity using numbers and weight information; it is a modification of the original Index of Well-Being applied to fish community information from the Wabash River (Gammon 1976, Gammon et al. 1981). The macroinvertebrate community was evaluated based on qualitative sampling of all available aquatic habitat types. Qualitative macroinvertebrate sampling consists of an inventory of species with no attempt to quantify the populations and a measure of EPT (Ephemeroptera - mayfly, Plecoptera - stonefly, and Trichoptera - caddisfly) taxa richness - an indication of the prevalence of pollution sensitive organisms.

Performance expectations for the basic aquatic life uses (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes et al. 1986; Omernik 1988). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of an aquatic life use is FULL if all three indices (or those available) meet the applicable criteria, PARTIAL if at least one of the indexes does not attain and performance does not fall below the fair category, and NON if all indices either fail to attain or any index indicates poor or very poor performance.

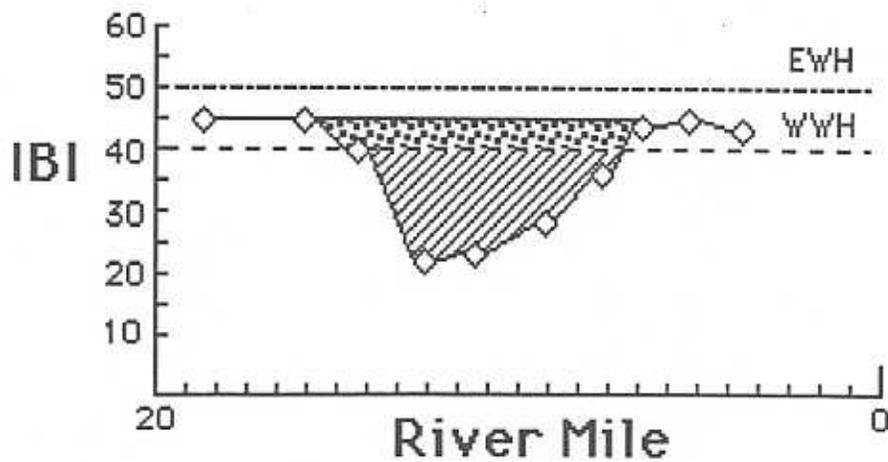
Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. 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 determine the QHEI score which generally ranges from 20 to 100. The QHEI is 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 are generally conducive to the establishment of warmwater faunas while those scores in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

Macroinvertebrate sites in the study area were also evaluated using an assessment tool currently in the developmental phase. This method utilizes the qualitative, natural substrate collections

available from each site and relies on tolerance values derived for each macroinvertebrate taxon collected. These tolerance values, unlike other tolerance values used in common indices (e.g., the Hilsenhoff Biotic Index), utilizes the abundance data for a given taxon collected with artificial substrates at sites around Ohio. To determine the tolerance value of a given taxon, ICI scores at all locations where the taxon has been collected with artificial substrates are weighted by the abundance data of that taxon at those sites. The mean of the weighted ICI scores for the taxon results in the tolerance value of that taxon. Thus, a taxon's tolerance value represents its relative level of tolerance on the ICI's 0 to 60 scale. High tolerance values are calculated for the more intolerant taxa which tend to reach their greatest abundance at undisturbed sites (i.e., sites with highest ICI scores). Conversely, the more pollution tolerant taxa attain their greatest abundances at highly disturbed sites with low ICI scores, which results in a lower tolerance value. For the qualitative macroinvertebrate collections in the Mill Creek study area, the median tolerance value, based on all tolerance values of the organisms collected at a site, resulted in what has been termed the Qualitative Community Tolerance Value (QCTV). Though only in the developmental stage, the QCTV shows potential as a method to supplement existing assessment methods using the qualitatively collected macroinvertebrate information. Its use in evaluating sites in the Mill Creek study area was restricted to relative comparisons between sites with no attempt to interpret quality of the sites or aquatic life use attainment status.

Fish were sampled 2-3 times using pulsed DC electrofishing gear using primarily the wading method (100 - 220 meter zones). The lower site on Mill Creek was sampled using the boat method (470 meter zone). The upper two sites on the East Fork Mill Creek were sampled using the backpack electrofishing method (150 meter zones). Chemical/physical and biological sampling locations are listed in Table EAS1 .

An Area Of Degradation Value (ADV; Rankin and Yoder 1991) was calculated for the study area based on the longitudinal performance of the biological communities. The ADV portrays the length or "extent" of degradation to aquatic communities and is simply the distance that the biological index (IBI and MIwb) departs from the stream criterion or the upstream level of performance. The magnitude of impact refers to the vertical departure of each index below the criterion. The total ADV is the area beneath the ecoregional criterion when the results for each index are plotted against river mile. This is also expressed as ADV/mile to normalize comparisons between segments and other areas.



 ADV Based on Upstream/Downstream Potential

 ADV Based on Minimum Criteria

Graphic illustration of the calculation of Area of Degradation Values (ADV) based on upstream potential and the ecoregion warmwater habitat use or minimum criteria (WWH). Criteria for exceptional warmwater habitat use (EWH) is provided for reference.

Results and Discussion

Pollutant Loadings

- Rapid population growth and development in the area has increased flows to the **Butler County Upper Mill Creek Regional WWTP** beyond the plant's capability to properly treat. Construction to expand capacity at the plant from 4.0 MGD to 8.0 MGD was completed September 1993.
- Generally, annual flows and loadings gradually and consistently increased at the Upper Mill Creek WWTP from 1983 through 1992. Ammonia-N loadings increased significantly in 1991 and 1992 after remaining fairly stable from 1983 through 1990. Phosphorous loadings peaked in 1987 and have generally decreased through 1992 (Figures 3A and 3B).
- Historically, an **excessive** number of **ammonia** NPDES violations have been recorded at the Upper Mill Creek WWTP (Appendix Table 1). In addition, the plant has periodically violated permit limitations for residual chlorine, oil and grease, fecal coliforms, CBOD₅, pH, and total suspended solids.
- Annual flows remained fairly stable from 1976 through 1989 at the **Village of Glendale WWTP** but increased sharply in 1990 and 1991 before dropping somewhat in 1992. Annual BOD₅ loadings generally increased from 1976 through 1985, dropped steadily from 1986 through 1989, and then increased significantly in 1990 and 1991 before dropping again in 1992. Total suspended solids loadings followed a similar pattern, peaking in 1990 after relatively stable levels from 1986 through 1989. Ammonia-N loadings dropped significantly in 1986 and remained relatively low through 1992 (Figure 3C).
- The **Village of Glendale WWTP's** self-monitoring monthly operating reports did not reveal any violations or elevated concentrations during the survey sampling period (July-September, 1992). However, this data and the loading data discussed above do *not* appear to adequately reflect the problems and generally poor chemical water quality found in Town Run.

Butler County Upper Mill Creek WWTP 001 Annual Effluent Loadings

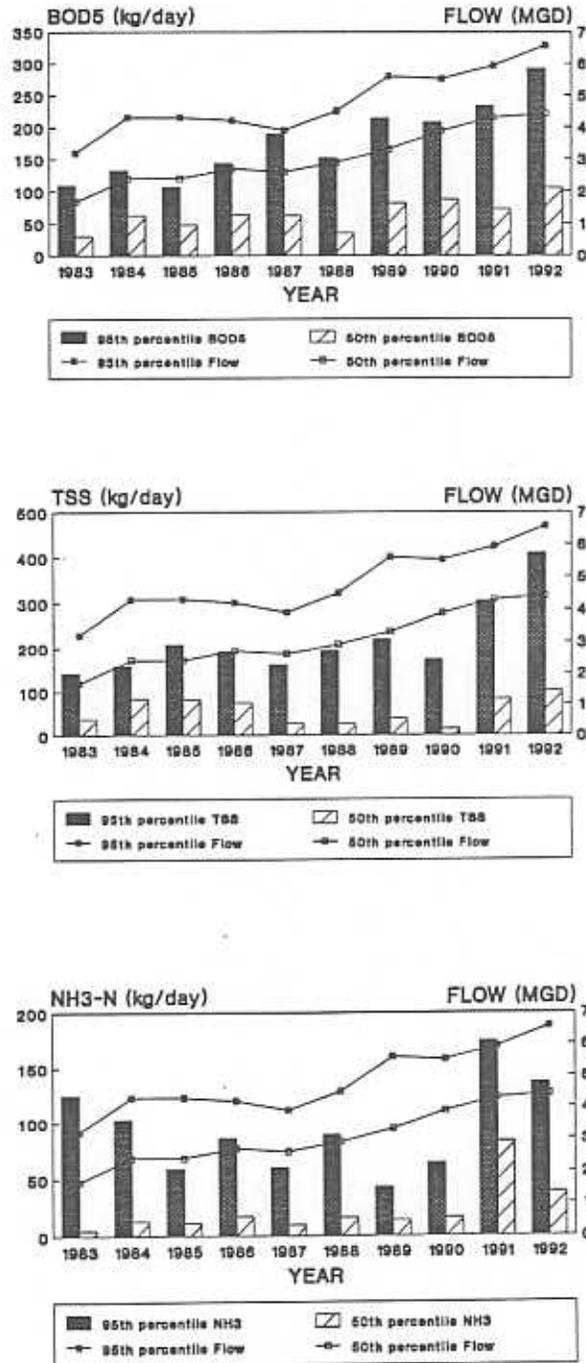


Figure 3A. Butler County Upper Mill Creek WWTP Annual Effluent Loadings (kg/day) of BOD₅, total suspended solids (TSS), and NH₃-N from 1983-1992.

Butler County Upper Mill Creek WWTP 001 Annual Effluent Loadings

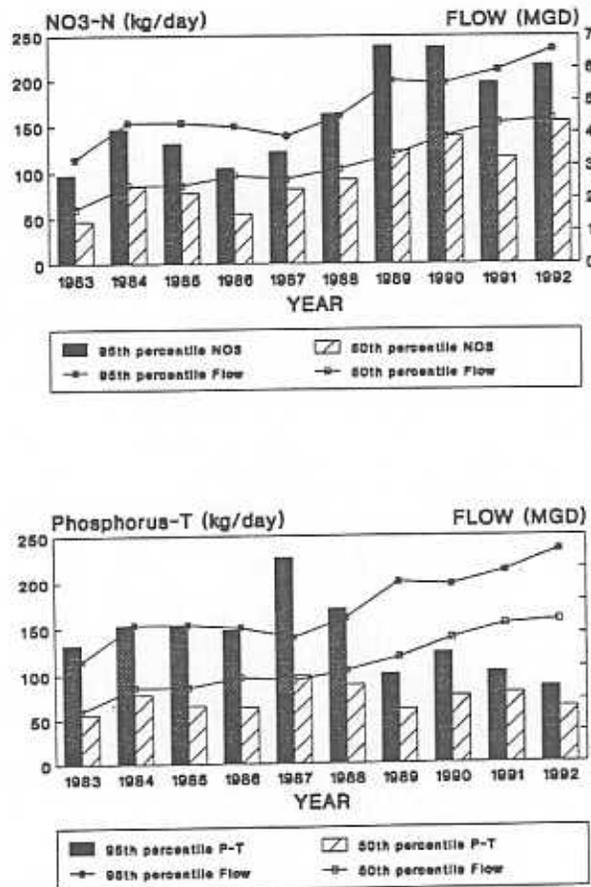


Figure 3B. Butler County Upper Mill Creek WWTP Annual Effluent Loadings (kg/day) of nitrate-N and total phosphorous from 1983-1992.

Village of Glendale WWTP 001 Annual Effluent Loadings

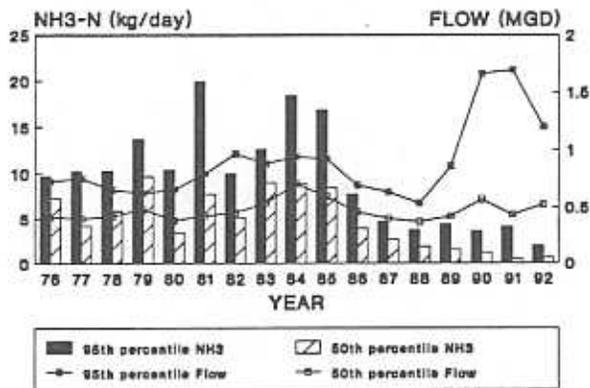
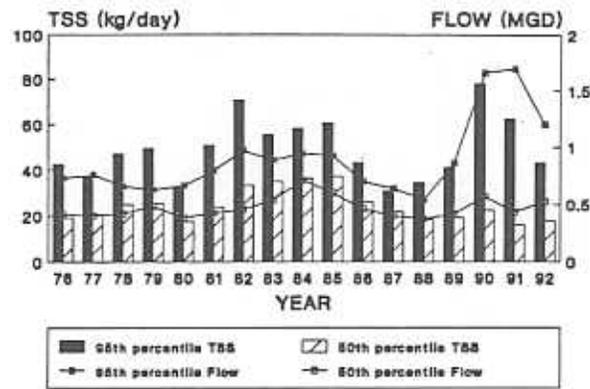
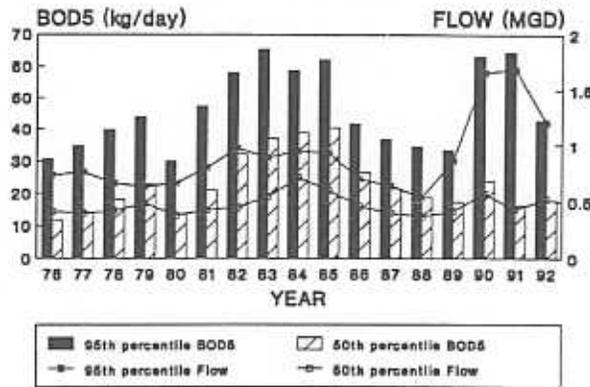


Figure 3C. Village of Glendale WWTP Annual Effluent Loadings (kg/day) of BOD₅, total suspended solids (TSS), and NH₃-N from 1976-1992.