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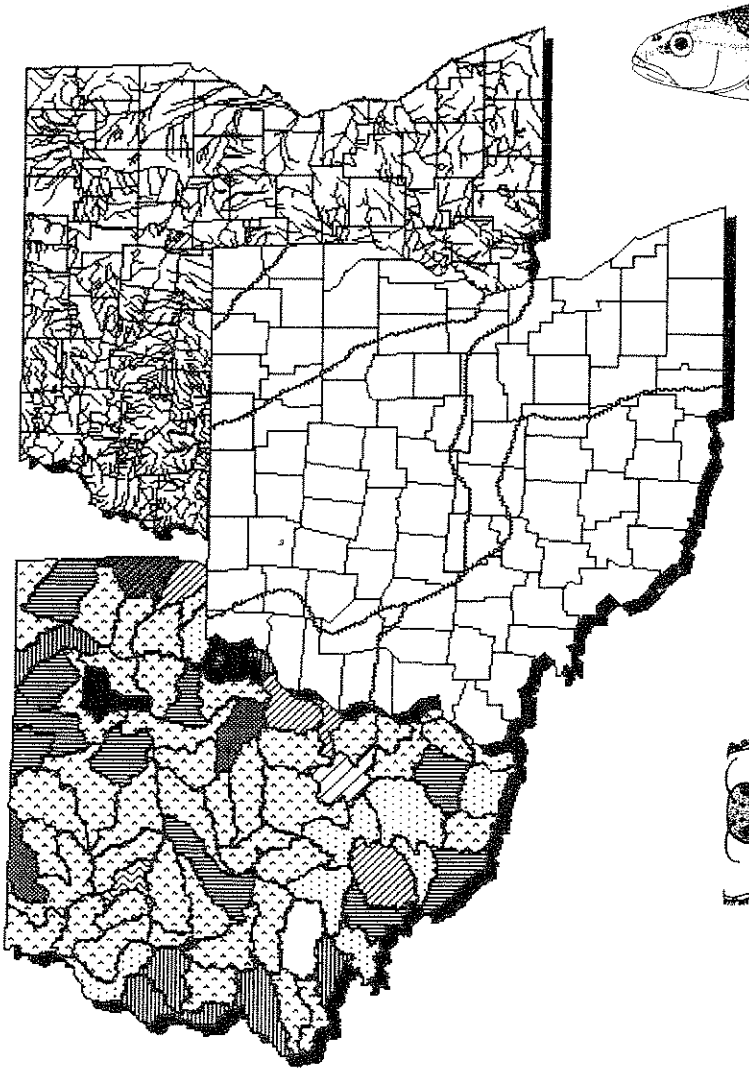
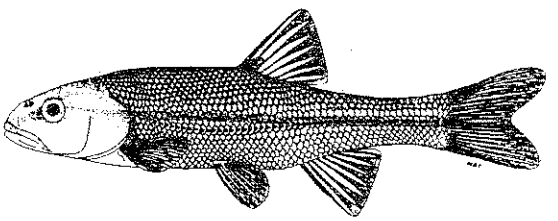
Ecological Assessment Section
Division of Surface Water

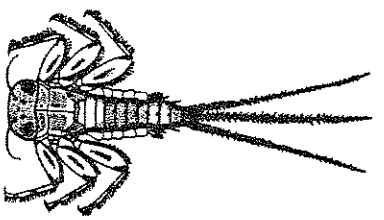
Biological and Water Quality Study of the Rocky Fork Mohican River

Richland County (Ohio)





Creek chub
(*Semotilis atromaculatus*)



Mayfly (*Stenonema*)

June 20, 1994

P.O. Box , 1800 WaterMark Dr. Columbus, Ohio 43266-3669

Biological and Water Quality Study of the Rocky Fork Mohican River

Richland County, Ohio

June 20, 1994

OEPA Technical Report EAS/1994-6-5

prepared by

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Division of Surface Water
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NOTICE TO USERS

Ohio EPA adopted biological criteria into the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (Effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish, and the Invertebrate Community Index (ICI), which is based on macroinvertebrates. Criteria for each index are specified for each of Ohio's five ecoregions, and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the chemical and whole effluent toxicity evaluation methods, figure prominently in the assessment of Ohio's surface water resources.

Several documents support the adoption of the biological criteria by outlining the rationale for using biological information, the specific methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results. These documents are:

Ohio Environmental Protection Agency. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989a. Addendum to biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990a. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale,methods, and application. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

These documents and this document can be obtained by writing to:

Ohio EPA - DSW
Ecological Assessment Section
1685 Westbelt Drive
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Acknowledgements

The following Ohio EPA staff are acknowledged for their significant contribution to this report.

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Biological Assessment:
  Macroinvertebrate Community - Jeff DeShon
  Fish Community - Charles Boucher
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Reviewer(s) - Chris Yoder, Jeff DeShon

This evaluation and report would not have been possible without the additional assistance of the study team, many full and part time staff in the field, and the chemistry analyses provided by the Ohio EPA Division of Environmental Services. Acknowledgment is also given to the property owners that allowed Ohio EPA personnel access to the Rocky Fork Mohican River and tributaries.

Biological and Water Quality Survey of the Rocky Fork Mohican River
(Richland County, Ohio)
Ohio Environmental Protection Agency
Division of Surface Water 1800 WaterMark Drive
Columbus, Ohio 43266-0149

Introduction

Specific objectives of this evaluation were to:

1) monitor and assess chemical, physical and biological integrity of the Rocky Fork Mohican River study area.

2) evaluate impacts from nonpoint source pollution, stormwater overflows (SSOs), habitat alterations and municipal and industrial wastewater treatment plants (WWTPs) on the receiving stream.

3) determine the attainment status of the current designated Warmwater Habitat (WWH) aquatic life use and other non-aquatic use designations and recommend changes in use where appropriate, and

4) conduct a water resource trend assessment where historical data exists.

The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (e.g., NPDES permits, Director's Orders), the Ohio Water Quality Standards (OAC 3745-1), and eventually be incorporated into the State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Water Resource Inventory (305[b] report).

Summary

Rocky Fork Mohican River
A total of 16.4 miles of the Rocky Fork Mohican River were assessed. Based on the performance of the biological communities and the ecoregional biocriteria, 3.2 miles of the Rocky Fork were in FULL attainment of the designated WWH aquatic life use (19.5% of the study area). An extensive area of **NON** attainment extended from near old Bowman Rd. (river mile [RM] 15.8) to RM 6.4, adjacent Mt. Zion Road. A total of 12.6 miles (76% of the surveyed reach) were **NON** attaining and 0.6 miles demonstrated PARTIAL attainment of the WWH use designation. Biological index scores and attainment status for the individual sampling locations are provided in Table 1.

Severe degradation of the Rocky Fork Mohican River in the Mansfield area was attributed to: 1) nonpoint source runoff from scrapyards in the adjacent watershed and 2) the Armco, Inc. 001-004 outfalls. Significant impacts were observed beginning near old Bowman Rd. (upstream from the Armco, Inc. outfalls). Abnormally high incidences of external anomalies on fish were recorded along with exceedences of the iron water quality standard and elevated levels of arsenic, chromium, and zinc in the sediments. Conditions further deteriorated downstream from the Armco, Inc. facility. Fish and macroinvertebrate communities were virtually eliminated for at least 1 mile downstream from the Armco outfalls and showed gradual improvement thereafter. It appeared that depressed dissolved oxygen levels in combination with elevated concentrations of oil and grease, metals, and elevated to extremely elevated levels of PCBs, DDT and PAHs in the

Table 1. Aquatic life use attainment status for the existing or recommended Warmwater Habitat (WWH) stream segments in the Rocky Fork Mohican River and tributaries based on data collected during June - October 1993.

RIVER MILE Fish/Invertebrate	IBI	Modified Iwb	ICI	QHEI[a]	Attainment Status[b]	Comment
Erie Ontario Lake Plain- WWH Use Designation (*Existing and Recommended*)						
Rocky Fork Mohican River						
16.4/16.3	31*	NA	50	56.5	PARTIAL	Wilging Rd.
- /16.1			42		(FULL)	
15.8/15.8	18*	NA	28*	38.0	**NON**	old Bowman Rd.
14.6/ -	14*	NA		47.5	**NON**	
14 .45/14.47	*12*	NA	*14*			Armco 002 Mixing Zone
14.2/14.2	12*[c]	NA	0*	56.5	**NON**	Longview Rd.
13.4/13.3	12*	2.5*	4*	48.5	**NON**	Orange Rd.
11.7/11.5	19*	3.9*	16*	67.0	**NON**	Illinois Ave.
11.10/11.10	*23*	*6.7*	*12*			Mansfield WWTP Mixing Zone
10.2/10.2	21*	5.2*	16*	81.5	**NON**	SR 39
6.4/6.4	26*	6.6*	46	76.5	**NON**	Mt. Zion Rd.
0.6/0.7	41	9.1	46	82.5	FULL	Applegate Rd.
Touby Run						
0.4/0.4	29*	NA	36	48.0	PARTIAL	Main St.
Clear Fork Mohican River						
35.7/35.7	43	NA	44	68.5	FULL	Marion Ave.

Ecoregional Biocriteria: *Erie Ontario Lake Plains (EOLP)*
(from OAC 3745-1-07, Table 7-17)

INDEX - Site Type	WWH	EWH	MWH[d]
IBI - Headwaters	40	50	24
IBI - Wading	38	50	24
Mod. Iwb - Wading	7.9	9.4	6.2
ICI	34	46	22

* - significant departure from biocriteria; poor and very poor results are underlined.
a - Qualitative Habitat Evaluation Index (QHEI) values based on the new version (Rankin 1989).
b - Attainment status based on one organism group is parenthetically expressed.
c - No fish were collected in either of two sampling passes.
d - Modified Warmwater Habitat for channel modified areas.
NA - Headwater station, MIwb is not applicable.

sediments were responsible for the classic toxic response exhibited by the biological indices. The presence of a severe toxic impact related to the Armco, Inc. facility has also been documented in bioassay tests. Between 1990 and 1993, 13 of 14 tests using outfall 002 effluent exhibited chronic toxicity. Eighteen of 27 tests demonstrated acute toxicity. Additionally, testing conducted by Ohio EPA in 1993 found the outfall 004 effluent to be acutely toxic.

Heavy metal concentrations documented in the sediments of the Rocky Fork Mohican River are some of the highest measured in the State of Ohio based on an Ohio EPA database which includes samples collected through 1992. Of these, the cadmium concentration at RM 10.13 (SR 39) is the highest and the chromium concentration at RM 14.47 (Armco 002 mixing zone) is the second highest recorded from a database of 777 samples over 14 years. Based on loadings and other source information, stormwater and treated process wastewater discharged through Armco, Inc. outfalls 001-004 and the Mansfield 001 discharge are the principal sources of these pollutants. Numerous violations of NPDES permit limits for copper and oil and grease were documented in 1993 for Armco, Inc. outfalls 001-004. Secondarily, latent impacts may remain from industrial sites which have been closed, such as White Consolidated Industries, Ohio Brass Co. and Globe Steel Abrasive Co.

Though applicable biological criteria were fully attained near the mouth of the Rocky Fork Mohican River, there appeared to be lingering impacts from the Mansfield area. Specifically, PCBs were detected at extremely to highly elevated levels in the sediments downstream from Armco, Inc. to near the mouth of the Rocky Fork (RM 0.62) as was the unusual incidence of external anomalies on fish. A single whole body composite sample of common carp collected at RM 6.4 contained elevated levels of total PCB (3.9 mg/kg). This result is another indication of the influence of the Mansfield area were having on the stream.

Significant effects on the biota attributable to discharges downstream from Armco, Inc. (*i.e.* Stone Container and the Mansfield WWTP) could not be completely discerned due to the overriding impacts which occurred upstream. At worst, Stone Container Corp. may have delayed the recovery process of the degraded fish assemblage. One concern that was made evident as a result of the 1993 sampling effort is the periodic discharge of chromium from the Mansfield WWTP. One such occurrence that was documented during the course of this survey exceeded the agricultural water supply limit and appeared to be due to inadequate pretreatment by an industry which is served by the plant.

Analysis of the Area of Degradation Value (ADV) results for the ICI, showed that the 5.8 mile segment upstream from the Mansfield WWTP accounted for 78% of the total ADV/ICI in 1993. Similarly, this segment accounted for 60 and 61%, respectively, of the total ADV statistic for the IBI and the MIwb.

The fish and macroinvertebrate communities in the Clear Fork Mohican River at RM 35.7 fully met the WWH biological criteria and performed above ecoregional expectations. Touby Run at RM 0.4 was apparently impacted as a result of an undocumented source and/or polluted runoff as a result of the urbanized land use. The biological community scores from Touby Run reflected PARTIAL

Based on available biological sampling data from the mid 70s to the early 80s it is evident that the condition of the Rocky Fork has remained relatively constant upstream from the Mansfield WWTP. Like the 1994 sampling results, the fish community was considered to be in fair condition and the macroinvertebrate community in good condition upstream from the industrial sources. Severely degraded and toxic conditions have persisted since 1974 in the vicinity of the

Armco, Inc. outfalls and may have worsened in the interim. The 1974 macroinvertebrate collections in this area, similar to 1993, produced assemblages that were predominated by toxic tolerant organisms, primarily dipterans and aquatic worms. External anomalies have remained elevated and sampling downstream from the Armco, Inc 002 outfall (RM 14.2) failed to produce any fish in 1993.

It is clear that improvements made to treatment processes at the Mansfield WWTP subsequent to 1977 have resulted in considerable positive changes to macroinvertebrate community condition in the lower reaches of the Rocky Fork as evidenced by very good quality faunas observed in the lower 6.5 miles in 1993. Similarly, longitudinal performance of recent and historic fish community data delineated considerable improvement of the Rocky Fork Mohican River downstream of Mansfield WWTP.

Conclusions

- The extremely poor condition and virtual absence of organized biological communities downstream from Armco, Inc. was the result of inadequate waste treatment, spills, and the accumulation of toxic compounds which have severely contaminated the sediment and degraded water quality. Previous habitat modification downstream from Armco, Inc. had little , if anything, to do with the severely degraded biological conditions encountered. Though physical habitat within this segment was generally poor, a severe and pervasive complex toxic impact far surpassed the limiting effects of habitat.

- Pollutant loadings from the Armco, Inc. facility have not declined significantly since 1976. The amount of metals and oil and grease discharged appears to be related to the volume of flow rather than any changes in the plant processes that may have occurred.

- Significant reductions in pollutant loadings from the Mansfield WWTP have occurred as a result of plant upgrades completed in 1987 and the implementation of an industrial pretreament program in 1984. These changes have resulted in significant improvement in the fish and macroinvertebrate communities compared to conditions encountered in the late 1970s. However, periodic loads of inadequately treated industrial wastewater, such as occurred during the 1993 sampling period, are of concern. Planned sanitary sewer extensions that will service approximately 2300 homes and take in a portion of the industrial wastes from Armco, Inc. will place an additional burden on the plant and bring the volume of flow close to design capacity. Consequently, good future plant operation will be important in realizing further gains in water quality once the impacts from upstream sources are reduced.

- Based on historic data, it was evident that water quality in 1993 upstream from the Mansfield WWTP was no better and may have been worse than in 1977. Downstream from the Mansfield WWTP conditions have improved, apparently as a result of plant upgrades and the implementation of pretreatment requirements.

- The large percentage of the Area Degradation Value (ADV) statistics accounted for in the stream segment upstream from the Mansfield WWTP reflected the major contribution of industrial facilities in the Mansfield area on the degraded condition of the Rocky Fork Mohican River.

- Past channelization and siltation was depressing the fish community in the headwaters of the Rocky Fork Mohican River even though acceptable water quality was documented.

- A significant decline in the condition of the Rocky Fork began in the vicinity of the metal scrapyards and Armco, Inc. apparently as a result of contaminated stormwater runoff from scrap and storage yards associated with these facilities.

- The principal impact to Touby Run appeared to be polluted runoff from the urbanized area that predominated the watershed. Habitat modification, another result of urbanization, was a secondary impact type but appeared to be less widespread.

Recommendations

Status of Aquatic Life Uses

Several of the streams evaluated during this study were originally designated for aquatic life uses 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. 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. Although most of the streams were evaluated in 1981, the numerical biocriteria were not adopted until 1990, thus use attainment status is also a reflection of this change as well.

- The existing Warmwater Habitat aquatic life use that applies to the Rocky Fork Mohican River should be maintained. Physical habitat conditions were adequate to support warmwater fish and macroinvertebrate faunas. If and when the anthropomorphic impacts documented during this study are remediated, typical warmwater communities can be expected to return.

- Based on the single sampling locations on the Clear Fork Mohican River and Touby Run no change is recommended to the currently designated WWH use assigned to each stream. The Touby Run sampling location exhibited a partially modified habitat and failed to fully meet the biological criteria; however, there appeared to be adequate physical habitats present in upstream reaches and the recovery potential is good. Consequently, a use change is not warranted.

Status of Non-Aquatic Life Uses

- The existing Primary Contact Recreation (PCR) designation for the Rocky Fork Mohican River upstream from the Mansfield WWTP should be retained. In addition, the PCR use is recommended downstream from the Mansfield WWTP to the mouth. Both stream segments have the requisite physical properties to qualify for primary contact (*i.e.* potential for full body contact based on the existence of pools with an average depth of at least 3 feet over an area of approximately 100 square feet).

Other Recommendations

- Alternate treatment technologies should be investigated to reduce oil and grease and metals loadings to the Rocky Fork Mohican River from Armco, Inc. outfalls 001-004. The natural substrates downstream from the facility were saturated with oil and grease, acute toxicity has been documented for outfall 002 and the limit for monthly average copper loading for outfall 002 was exceeded all twelve months of 1993.

- Currently, the Mansfield Foundry Corp. is required to monitor flow, pH, copper, and zinc once per month but has no discharge limits for outfall 002. This discharge is reportedly non-contact cooling water. However, copper in the effluent averaged 171 µg/l during 1993. Permit limits are needed to regulate this discharge unless the source of the metals in the effluent can be eliminated.

Future Monitoring Needs

- Armco, Inc. is currently undergoing a retooling and is not scheduled to recommence production until 1995. A biological survey in the vicinity of the plant during the 1994 sampling season would help to answer questions about impacts from contaminated sediments and provide background data with which to compare conditions when Armco resumes discharging.

- Additional and more frequent effluent toxicity testing (including both acute and chronic tests) should be made a priority for the major dischargers in the study area. Toxicity testing is particularly important for the Armco, Inc. outfall 002 effluent following the planned elimination of internal outfall 601.

- Due to extremely elevated levels of heavy metals in sediments of the Rocky Fork Mohican River, it is possible that these sediments could exhibit characteristic hazardous waste constituents. An evaluation of sediments for Resource Conservation and Recovery Act (RCRA) metals using the appropriate SW-846 Toxicity Characteristic Leaching Procedure (TCLP) test method in accordance with OAC 3745-51-24 is recommended. Additionally, an investigation of sediment toxicity and a study of how contaminated sediments could be remediated should be initiated.

- Additional fish tissue sampling is needed, so that, if it is warranted, an appropriate risk based advisory can be issued. The source of PCBs should also be identified and corrective measures investigated.

- A follow-up survey should be conducted in 1999 in accordance with the five year basin monitoring strategy to document changes in the water resource and provide updated information for the reissuance of NPDES permits. Additional evaluation of nonpoint source pollution resulting from metal scrapyards and projected improvements in water quality and biota resulting from the Madison Township sanitary sewer project and changes in waste treatment at Armco, Inc. will necessitate this reevaluation.

Study Area

The Rocky Fork Mohican River watershed is located entirely in Richland County in northcentral Ohio. It is a tributary of the Black Fork Mohican River which, in turn is a tributary of the Walhonding and Muskingum rivers. From its headwaters northwest of Mansfield, it flows southeast through Mansfield and Lucas before joining the Black Fork (Figure 1). The stream is 19.6 miles long, drains an area of 76.7 square miles, and has an average gradient of 14.5 feet per mile. Stream gradient varies over the length of the Rocky Fork, with gradients in excess of 30 feet per mile upstream from Mansfield, and less than 10 feet per mile in the vicinity of Mansfield. The Rocky Fork watershed lies in glaciated north central Ohio where glacial deposits overlay the predominant sandstone bedrock. The watershed is characterized by marshy uplands with low relief in the northwest portion, and moderately deep valleys with a well defined flood plain in the southeastern half of the watershed.

Land use in the upper half of the Rocky Fork watershed is dominated by urban and suburban development. The City of Mansfield covers approximately one third of the drainage area. The population of Mansfield is 50,622 . The other half of the watershed is mainly in agriculture and forest land. Permitted industrial and municipal dischargers in the Mansfield area are listed in Table 2.

The watershed is located in the Erie/Ontario Lake Plain (EOLP) ecoregion. This ecoregion is characterized by nearly level to strongly rolling terrain interspersed with glacial till ridges, till plains, and outwash terraces. Land use includes a mosaic of cropland, pasture, livestock and poultry production, and woodland and forest.

Soil associations found in the watershed include:

1. Shoals-Chili-Wheeling association: Deep, nearly level to moderately steep, somewhat poorly drained and well drained soils that have a medium textured to moderately coarse textured subsoil; on flood plains, terrace, and outwash deposits. This association is located in and along the valleys of the stream. The nearly flat soils are on the flood plain, and the gently sloping to moderately steep soils are on the stream terraces. The soils have been used for crop production (corn, soybeans, wheat, and hay) and as industrial sites in the Mansfield area.
2. Wooster-Canfield association: Deep, nearly level to very steep, well drained and moderately well drained soils that have a medium textured subsoil with a fragipan formed in glacial till. This association occurs in the headwaters and the southeast end of the watershed. It is characterized by gently sloping to moderately sloping soils on hilltops and moderately steep to very steep soils on hillsides that form the sides of narrow stream valleys. Slopes are generally long. About 50 percent of the soils in this association have been farmed.
3. Rittman-Wadsworth association: Deep, nearly level to moderately steep, moderately well drained and somewhat poorly drained soils that have a moderately fine textured subsoil with a fragipan formed in glacial till. Soils in this association have been used for urban expansion and transportation routes in the watershed. Erosion hazard on sloping areas of Rittman soils and wetness on Wadsworth soils are the major limitations.

The generally cleared, rolling to rugged hills of the watershed and the moderately steep profiles of the stream cause comparatively high peak discharges and short flood durations. Watershed runoff is highest during the winter months when storm rainfall may be augmented by melted snow and frozen or saturated ground results in low infiltration rates.

The channel of the Rocky Fork was modified in 1959 following very heavy rain and damaging flooding of the Mansfield urban area. About 2.8 miles of the stream from First Avenue in downtown Mansfield to the State Route 39 bridge were widened. The first 3,200 feet from downtown were enlarged to a 40 foot bottom width. The next 11,000 feet of channel were enlarged to a 60 feet bottom width. The remaining 800 feet, upstream from the State Route 39 bridge, were snagged and cleared.

The Ohio Nonpoint Source Assessment document (OEPA 1988) places the Rocky Fork Mohican River from its headwaters to its mouth as potentially impacted by nonpoint source pollution.

Table 2. Stream characteristics and significant identified pollution sources in the Rocky Fork Mohican River study area.

Stream Name	Length (Miles)	Average Fall (Feet/Mile)	Drainage Area (Squares Miles)	Nonpoint Source Pollution Categories	Point Sources Evaluated
Rocky Fork Mohican River					
	19.6	14.5	76.7	Urban runoff Channelization Storm sewers On-site septic systems	Stone Container Armco, Inc. Lantz Corporation Mansfield Foundry Corp. Mansfield WWTP
Touby Run					
	5.3	39.1	10.07	Urban runoff Storm sewers On-site septic systems	New Artesian Limited Partnership
Clear Fork Mohican River					
	36.6	11.0	218.5	Crop production	

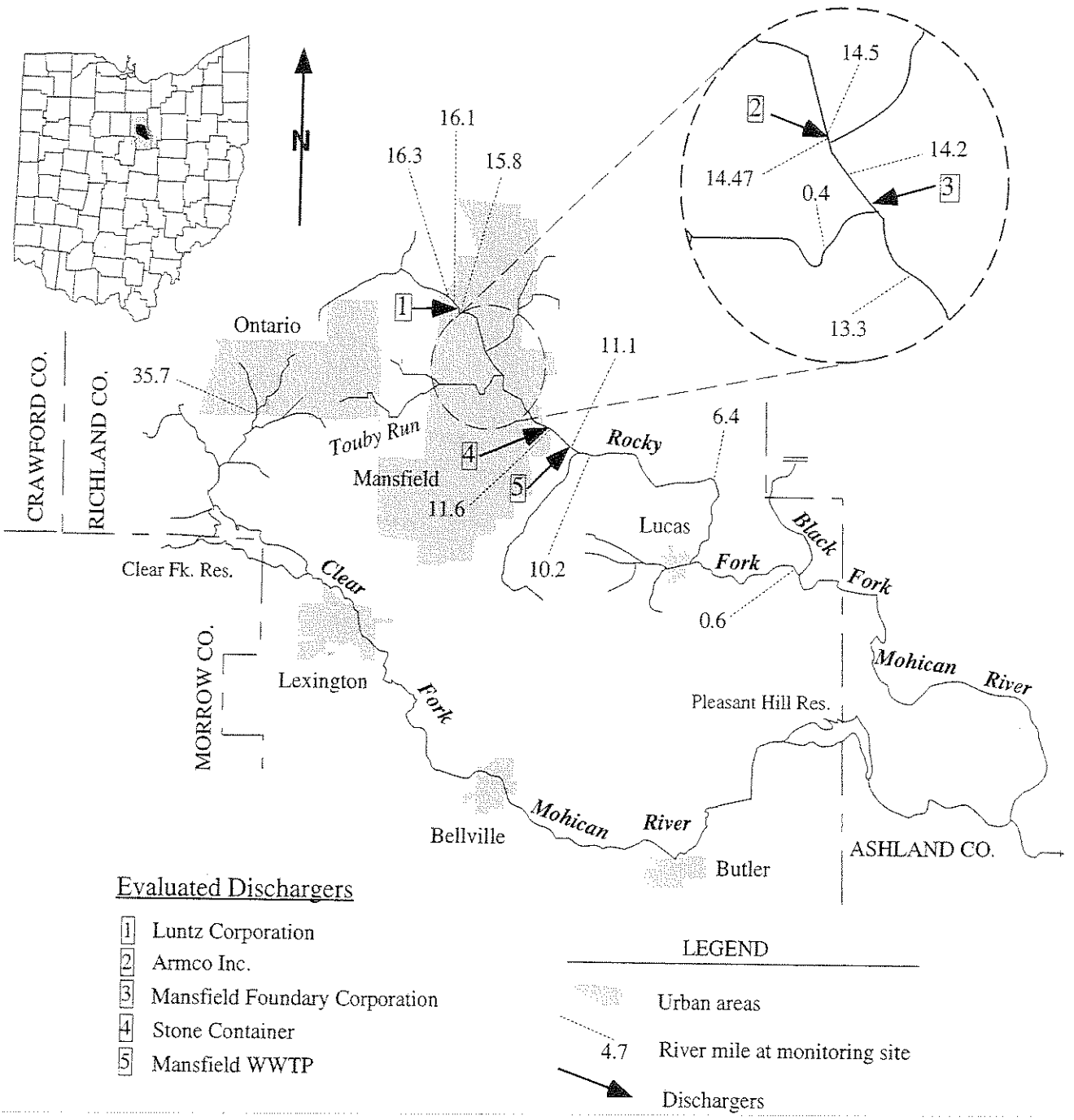

Figure 1. The Rocky Fork Mohican River study area showing principal streams and tributaries, population centers, pollution sources and sampling locations.

Methods

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 or nonattainment 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 were 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, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. IBI and ICI are multi-metric indices 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).

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 did not attain and performance did 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 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 were 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. During this survey, macroinvertebrates were sampled using modified Hester/Dendy multiple-plate artificial substrate samplers supplemented with a qualitative assessment of the available natural substrates. Fish were sampled 2-3 times using pulsed DC electrofishing gear using the wading method (150 meter zones). Chemical/physical and biological sampling locations are listed in Table 3.

An Area Of Degradation Value (ADV; Rankin and Yoder 1993) 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, MIwb, and ICI) departs from the stream criterion or the upstream level of performance (Figure 2). The amount 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 was plotted against river mile. This is also expressed as ADV/mile to normalize comparisons between segments and other areas. For the purpose of generating the ADV, ICI values may be assigned based on the narrative evaluation for sites that lack valid quantitative data due to loss or disturbance of the artificial substrates.

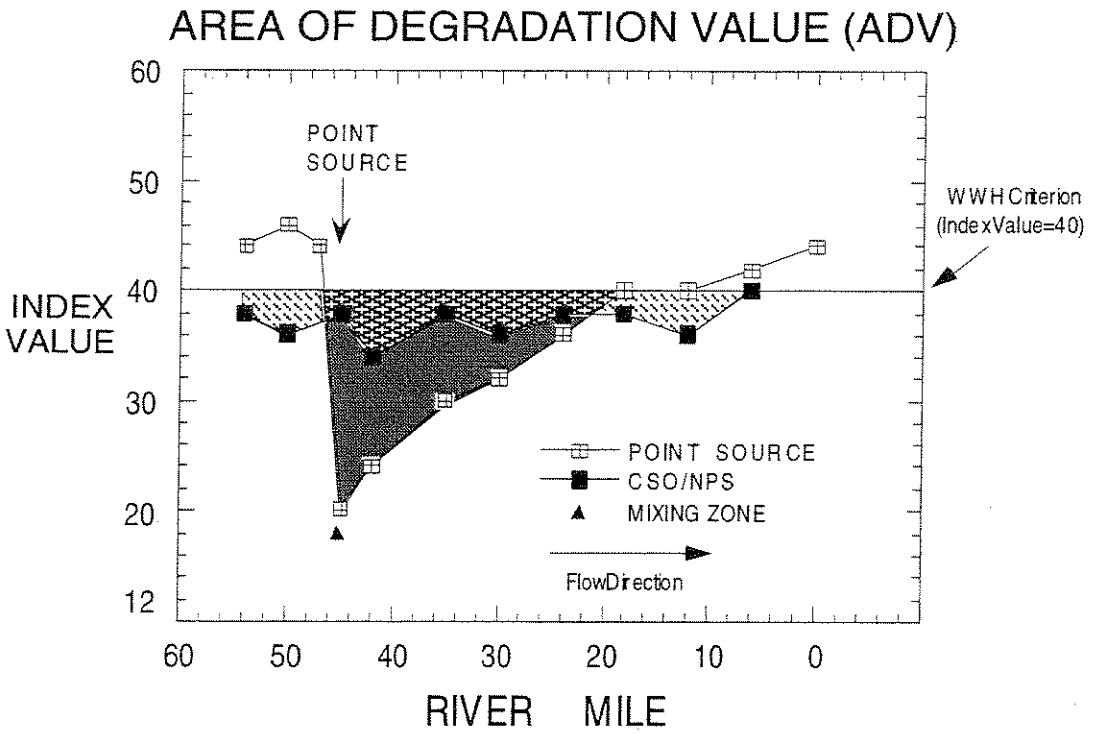

Figure 2. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). The index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears as a solid triangle); the filled boxes and dashed shading (area of departure) represent a typical response to a nonpoint source or combined sewer overflow impact. The blended shading represents the overlapping impact of the point and nonpoint sources.

Table 3. Sampling locations (effluent sample - E, water chemistry - C sediment chemistry - S, macroinvetebrates - M, fish - F, fish tissue - FT, continuous monitors- D) in the Rocky Fork Mohican River study area, 1993.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 min. Quad. Map
Rocky Fork Mohican River				
16.4	F,D	404759 /823220	Wilging Rd.	Mansfield North
16.3	M	404755 /823214	dst. Wilging Rd.	Mansfield North
16.29	C,S	404757 /823214	Wilging Rd.	Mansfield North
16.1	M	404747 /823208	ust. old Bowman Rd.	Mansfield North
15.86	C,S	404740 /823155	old Bowman Rd.	Mansfield North
15.8	M,F	404707 /823151	Dst. old Bowman Rd.	Mansfield North
14.6	F	404647 /823107	ust. Armco 002 mixing zone	Mansfield North
14.49	C	404649 /823109	ust.Armco 002 mixing zone	Mansfield North
14.47	M,F,C,E,S	404647 /823137	Armco 002 mixing zone	Mansfield North
14.24	C,S,D	404641 /823059	Longview Rd	Mansfield North
14.2	M,F	404635 823059	Ust. Longview Rd.	Mansfield North
13.4	F	404555 /823035	Orange Rd.	Mansfield North
13.31	C,S	404556 /823030	Orange Rd.	Mansfield North
13.3	M	404554 /823034	dst. Orange Rd.	Mansfield North
11.7	F	404502 /822908	Illinois Ave.	Povonia
11.59	C	404504 /822904	Illinois Ave.	Povonia
11.5	M	404505/822955	dst. Illinois Ave.	Povonia
11.17	C,E	404456 /822850	Mansfield WWTP mixing zone	Lucas
11.1	M,F	404448 /822845	Mansfield WWTP mixing zone	Lucas
10.2	M,F	404429 /822750	ust. SR 39	Lucas
10.13	C,S,D	404427 /822747	SR 39	Lucas
6.4	M,F,FT	404402 /822417	adj. Mt. Zion Rd.	Lucas
6.35	C	404402 /822414	adj. Mt. Zion Rd.	Lucas
0.7	M	404210 /822210	ust. Applegate Rd.	Perrysville
0.62	C,S,D	404209 /822201	Applegate Rd.	Perrysville
0.6	F	404210 /822107	Applegate Rd.	Perrysville
Touby Run				
0.4	M,F	404601 /823057	ust. Main St.	Mansfield North
0.38	C	404604 /823055	Main St.	Mansfield North
Clear Fork Mohican River				
35.7	M,F,C,S	404437 /823817	ust. Marion Ave.	Blooming Grove

Results and Discussion

Pollutant Loadings: 1976- 1993

Luntz Corporation

- The Luntz Corp., Ohio EPA permit number 2IN00076, located at 1344 Bowman Street, Mansfield, Ohio, 44905, collects, processes and separates scrap steel from manufacturing plants and sends this material to steel mills and foundries for remelting. Wastewater from the facility is discharged to the Rocky Fork Mohican River from one National Pollutant Discharge Elimination System (NPDES) permitted outfall.

- Outfall 001 discharges at river mile (RM) 15.85 and contains stormwater runoff from the scrap steel storage plant. Stormwater is diverted into a retention lagoon prior to discharge. Oil is skimmed and mixed with straw for disposal in a local landfill.

Armco, Inc.

- Armco, Inc. (a.k.a. Cyclops Corporation-Empire Detroit Steel Division), Ohio EPA permit number 2ID00003, located at 913 Bowman Street, Mansfield, Ohio, 44901, produces steel coils and sheets from scrap steel. Production operations include an electric arc furnace, blooming mill, roughing mill, hot strip mill, continuous pickling lines, tandem mill, reversing mill, and a temper mill. The raw water used at the plant includes well water supplied from company owned wells, Rocky Fork Mohican River water, and City of Mansfield municipal water supply. Most of the wastewater from the facility is discharged to the Rocky Fork Mohican River from four NPDES permitted outfalls. The pickling process wastewater is discharged to the City of Mansfield sanitary sewer system after pretreatment or is transported off site for deep well disposal.

- The current Armco, Inc. NPDES permit has been under appeal before the Environmental Board of Review since April 30, 1990. During 1993, 28 violations of monthly average loadings were recorded (Table 4). The monthly average loadings limit for copper was exceeded all twelve months. In an article published in the Mansfield News Journal dated March 29, 1994, an Armco, Inc. spokesman informed City of Mansfield officials that the facility would be shut down until February 1995 to allow for the installation of a new caster which will make the current blooming mill obsolete.

- Outfall 001 discharges at RM 14.95 and contains process wastewater from the hot strip mill, non-contact cooling water from the electric arc furnace (EAF), and stormwater runoff. Effluent is discharged from a lagoon system which allows approximately 24 hours of retention time. Wastewater from the hot strip mill first passes into an oil retention basin where a belt skimmer removes oil and transports it into a storage tank. The pretreated wastewater is then pumped into the lagoon system. The oil retention basin is not lined and the banks are oil soaked.

- In the Armco, Inc. NPDES permit, effective April 30, 1990, the entity was required to conduct quarterly acute/chronic (4) toxicity tests for one year with effluent from outfall 001 using *Ceriodaphnia dubia* and *Pimephales promelas* as test organisms. A summary of the test results are contained in Table A-6. Chronic toxicity was evident in 9 of 14 tests conducted.

- An acute screening bioassay of Armco, Inc. outfall 001 effluent was conducted by Ohio EPA in November, 1993 (Bioassay Number 93-1204-NW). The effluent was not acutely toxic at that time.

Table 4. Number of NPDES permit violations documented at the Armco, Inc., Stone Container, and Mansfield WWTP facilities from January-December 1993. Data evaluated was contained in monthly operating reports submitted to Ohio EPA by the entities.

		Type of Violation			
Outfall	Parameter	Daily maximum concentration	Daily maximum loading	Monthly average concentration	Monthly average loading
Armco Inc.					
001	oil & grease	6	11		
	T-copper	2	5	1	4
	phenolic	7	10	4	3
	TSS		1		1
	pH	1			
002	oil & grease	8	14		
	T-copper	12	15	11	12
	phenolic	3	8	1	3
	pH	1			
	silver				1
003	oil & grease	3			
	TSS	2			
	pH	2			
004	oil & grease	2			
	T-cadmium			1	
601	oil & grease	3	4	3	4
602	oil & grease		5		
	T-iron		3		
SUM OF NO. VIOLATIONS		46	76	21	28
Stone Container Corp.					
001	oil & grease	1			
	T-lead	1		2	1
	T-zinc	5		4	1
	cBOD5	1		1	
	fecal coliform			1	
	T-res. chlorine	1			
002	pH	1			
SUM OF NO. VIOLATIONS		10		8	2
Mansfield WWTP					
001	T-chromium	1	1	1	1
	Hex.-chromium	1	1	1	
SUM OF NO. VIOLATIONS		2	2	2	1
Total No. Violations		58	78	23	29

- Outfall 003 discharges at RM 14.73 and contains boiler blowdown and stormwater. Effluent from this outfall does not receive treatment prior to being discharged. Outfall 004 discharges at RM 14.70 and contains non-contact cooling water from the cold mill and air compressors and stormwater. Effluent from this outfall also does not receive treatment prior to being discharged.

- In the Armco, Inc. NPDES permit, effective April 30, 1990, the entity was required to conduct quarterly chronic (4) toxicity tests for one year with effluent from outfalls 003 and 004 using *Ceriodaphnia dubia* and *Pimephales promelas* as test organisms. A summary of the test results are contained in Table A-6. Chronic toxicity was evident in 12 of 14 tests conducted at outfall 004 and 4 of 14 tests at outfall 003.

- An acute screening bioassay of Armco, Inc. outfall 003 effluent was conducted by Ohio EPA in November 1993 (Bioassay Number 93-1206-NW). The effluent was not acutely toxic at that time. An acute screening bioassay of Armco, Inc. outfall 004 effluent was conducted by Ohio EPA in November 1993 (Bioassay Number 93-1207-NW). The effluent was acutely toxic during the test. The definitive toxicity test resulted in a *P. promelas* 96-hr. LC_{50} of 77.7 % effluent and a *C. dubia* 48-hr. LC_{50} of 72.0 % effluent.

- Outfall 002 discharges at RM 14.48 and contains blowdown from the oil cracking plant, non-contact cooling water from the DX, annealing furnace, and tandem mill, and stormwater. The oil cracking plant processes oily wastewater from the roughing and tandem mills. A wetting agent and flocculent are added to one of three 20,000 gallon tanks and aerated. Oil skimmed after the water settles is taken by tanker to the soaking pit waste oil tanks and retained prior to disposal by an oil recycler. During a Spill Prevention, Control, and Countermeasures (SPCC) inspection conducted by the Ohio EPA Division of Emergency and Remedial Response on March 15, 1990, the floor of the diked area surrounding these storage tanks was noted to be covered with an oily residue. The dike drain had no valve to prevent a spill from reaching an adjacent storm sewer. The remaining wastewater is discharged as interior outfall 601 into the outfall 002 treatment system. This system has a plate separator and pumps which remove waste oil to a 5000 gallon waste oil tank for recycling. The area surrounding outfall 002 has an oily residue covering the ground and facilities. The oil separator does not always function effectively, allowing oil to escape into outfall 002. Armco, Inc. is currently upgrading the internal outfall 601 treatment system to an evaporator type technology. After pretreatment, this waste stream will be discharged to the sanitary sewer system. The scheduled date of completion is April 1, 1994.

- In the Armco, Inc. NPDES permit effective April 30, 1990, the entity was required to conduct monthly acute (8) toxicity tests with effluent from outfall 002 and internal outfall 601 and quarterly (4) chronic toxicity tests with effluent from outfall 002 for a period of one year. A summary of the test results are contained in Tables A-5 and A-6. Chronic toxicity was evident in 13 of 14 tests conducted at outfall 002. Acute toxicity was evident in 18 of 27 tests conducted at outfall 002 and in 19 of 27 tests conducted at outfall 601. It should be noted that outfall 002 still exhibits toxicity even when toxicity from outfall 601 is reduced.

- An acute screening bioassay of Armco, Inc. outfall 002 effluent was conducted by Ohio EPA in November 1993 (Bioassay Number 93-1205-NW). The effluent was acutely toxic. All test organisms (*P. promelas* and a *C. dubia*) died during the first 24 hours of the test.

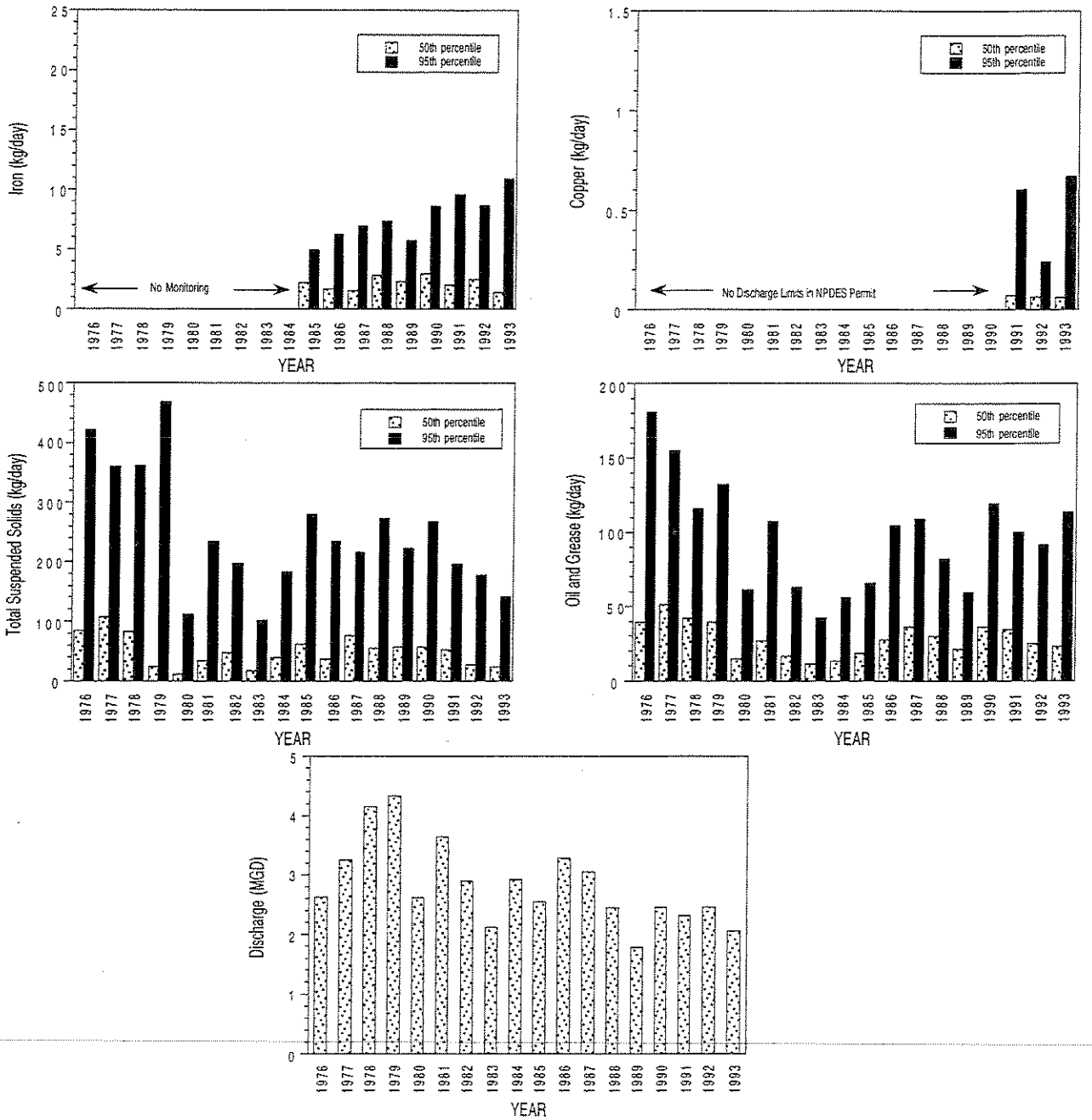

Figure 3. Average flow (MGD) and annual loadings (kg/day) of iron, copper, suspended solids, and oil and grease from Armco, Inc., 001-004 outfalls, 1976-1993.

- An evaluation of annual pollutant loadings from Armco, Inc. was conducted to determine trends in several pollutants of concern. Pollutant loadings and mean discharge from outfalls 001-004 were summed prior to the evaluation and are presented in Figure 3. Monitoring requirements for iron were not implemented until 1985. Annual loadings exhibit a slight increasing trend through 1993. Discharge limits for copper were not implemented until 1991, therefore, no discernible trend is evident. Annual loadings of total suspended solids and oil and grease are available from 1976 to present. Changes in annual loadings of these pollutants appear to respond to fluctuations in mean discharge and not to changes in treatment processes.

- Armco, Inc. is classified by the Ohio EPA Division of Hazardous Waste Management as a Large Quantity Generator (LQG) of hazardous waste and as a Treatment, Storage, and Disposal Facility (TSD). Some of the wastes either stored or generated at the facility include spent pickle liquor and acid filter cake, electric arc furnace baghouse dust, waste petroleum distillate from parts cleaners, and 1,1-dichloroethylene solvent. On February 18, 1993, the Ohio EPA conducted a hazardous waste compliance evaluation inspection to determine compliance with Ohio's generator and storage regulations. Several violations were documented during the inspection, including deficiencies in evaluating wastes generated at the facility and compliance with land disposal restriction requirements contained in their Waste Analysis Plan. As a result of the inspection, a Notice of Violation (NOV) letter was sent to the facility on March 2, 1993. Armco, Inc. addressed violations listed in the NOV with correspondence to Ohio EPA dated March 12, 1993 and April 22, 1993. In addition, the Ohio EPA conducted a follow-up inspection on March 31, 1993. Most violations have been corrected, although outstanding issues exist which have prevented the facility from receiving a Return to Compliance notice.

- Some analytical data of groundwater quality underlying the Armco, Inc. facility is available from the Ohio EPA Division of Drinking and Ground Waters (DDAGW). Prior to March 20, 1991, when city water was connected, Armco, Inc. used wells to supply potable water. As required under Ohio Administrative Code (OAC) Chapter 3745-81, water from all wells used for public water supply must have quarterly Volatile Organic Compound (VOC) analysis until four consecutive quarters of VOC free results were obtained. Results from samples collected in October 1990 indicated the presence of tetrachloroethylene, also known as perchloroethylene or PCE, (16.1 ppb) and chloroform (1.1 ppb) in well #10 and PCE (1.4 ppb) and chloroform (1.1 ppb) in well #5. Results from samples collected in January, 1991 indicated the presence of trichloroethylene, or TCE, (1.9 ppb) and PCE (21.0 ppb) in well # 10 and PCE (1.6 ppb) and chloroform (1.1 ppb) in well # 5. Of the compounds detected, only TCE has a Maximum Contaminant Level (MCL) of 5 ppb based on levels set in the Safe Drinking Water Act.

Mansfield Foundry Corporation

- The Mansfield Foundry Corp. facility (a.k.a. Mansfield Ferrous Casting Co.), Ohio EPA permit number 2IN00097, is located at 500 North Main Street, Mansfield, Ohio, 44903, and produces malleable and ductile iron castings. Processes used at the plant include induction melting, sand molding, grinding, cleaning, and galvanizing. The raw water used at the plant comes from the City of Mansfield municipal water supply. Wastewater from the facility is discharged to the Rocky Fork Mohican River from three NPDES permitted outfalls.

- Outfall 003 discharges at RM 13.84 and contains non-contact cooling water from the north end of the foundry and stormwater. Effluent from this outfall does not receive treatment prior to being discharged. Outfall 002 discharges at RM 13.80 and contains non-contact cooling water

from the center of the foundry and stormwater. Effluent from this outfall also does not receive treatment prior to being discharged. Outfall 001 discharges at RM 13.79 and contains non-contact cooling water and stormwater. Effluent from this outfall is discharged from a series of two cooling ponds.

Ideal Electric Company

- The Ideal Electric Co. facility, Ohio EPA permit number 2IN00058, located at 330 East First Street, Mansfield, Ohio, 44903, manufactures large electric motors (>200 h.p.), generators, and switchgear. Processes used at the plant include machining, grinding, and assembly. The raw water used at the plant comes from the City of Mansfield municipal water supply. Wastewater from the facility discharges to the Rocky Fork Mohican River via storm sewers from two NPDES permitted outfalls. Process and sanitary water is discharged to the City of Mansfield sanitary sewer.

- Outfall 001 discharges at RM 12.4 from the First Street catch basin and contains non-contact bearing cooling water and stormwater. Effluent from this outfall does not receive treatment prior to being discharged. Outfall 002 discharges at RM 12.4 from the Oak Street catch basin and contains non-contact compressor cooling water and stormwater. Effluent from this outfall also does not receive treatment prior to discharge.

Stone Container Corporation

- The Stone Container Corp. facility, Ohio EPA permit number 2IA00001, located at 288 South Illinois Avenue, Mansfield, Ohio, 44901, and produces corrugated containers from kraft linerboard and corrugating medium. Wastewater from the facility is discharged to the Rocky Fork Mohican River from two NPDES permitted outfalls.

- Outfall 001 discharges at RM 11.68 and contains pretreated printing and process washwater, boiler blowdown, sanitary wastewater, cooling water, and cleanup water. The combined wastewater is then treated by activated sludge and sand filtration prior to discharge.

- Outfall 002 also discharges at RM 11.68 and contains non-contact cooling water. Effluent from this outfall does not receive treatment prior to being discharged.

City of Mansfield Wastewater Treatment Plant

- The City of Mansfield WWTP, Ohio EPA permit number 2PE00001, located at 385 South Illinois Avenue, Mansfield, Ohio, 44905, and is a secondary wastewater treatment facility with single stage activated sludge. The plant was constructed in 1937 and upgraded in 1960 and 1987. Unit operations include flow equalization, screening, grit removal, preaeration, primary settling, biological treatment with sock aeration, final settling, chlorination, and dechlorination. Sludge generated in the treatment process is anaerobically digested and dewatered via belt press prior to disposal at an on-site stockpile area. Runoff from this area is collected and pumped to the WWTP headworks. The plant is designed for an average flow of 12 MGD and peak flows of 25 MGD. The mean annual discharge in 1993 was 10.5 MGD. Flows to the equalization basin in excess of five million gallons are discharged through outfall 001 after receiving primary treatment only. Bypasses are located at the plant headworks before the flow equalization basin and at the main lift station. Final effluent from the plant discharges to the Rocky Fork Mohican River at RM 11.18.

- In Mansfield's NPDES permit renewal effective June 8, 1989, the entity was required to

conduct monthly acute (8) and quarterly chronic (4) toxicity tests for a period of one year using effluent from outfall 001 and the test organisms, *Ceriodaphnia dubia* and *Pimephales promelas*. The calculated Allowable Effluent Toxicity (AET) value for Mansfield, based on the chronic toxicity criterion, discharge volume, and critical low flow of the Rocky Fork Mohican River, was determined to be 1.3 Toxic Units-chronic (TU_c). Results of the acute tests indicated that Mansfield's effluent was not acutely toxic to either test organism, but 3 of 4 chronic tests showed results exceeding the 1.3 AET value. As a result, Directors Final Findings and Orders issued November 13, 1991 required Mansfield to initiate a bimonthly biomonitoring program for one year to further define chronic toxicity of effluent from outfall 001. Results of the six 7-day static renewal tests conducted indicated no acute toxicity to either test organism (exposure periods of 48-hours for *C. dubia* and 96-hours for *P. promelas*). Chronic toxicity was exhibited in 4 of 6 tests. In the test initiated on March 23, 1993, significant chronic effects were exhibited for *C. dubia* with a TU_c value of 1.2, No Observed Effect Concentration (NOEC) of 75 % effluent, and Lowest Observed Effect Concentration (LOEC) of 100 % effluent. In the test initiated on February 9, 1993, chronic effects were exhibited for *P. promelas* with a TU_c value of 1.5 and NOEC of 56 % effluent. In the test initiated on November 17, 1992, chronic effects were exhibited for both *C. dubia* and *P. promelas*, with a TU_c value of 1.2 for both organisms. In the test initiated on September 22, 1992, chronic effects were exhibited for *C. dubia* with a TU_c value of 2.1.

- Acute bioassays of Mansfield's outfall 001 effluent were conducted by Ohio EPA in October 1974 (Bioassay Number 74-73-NW) and March 1993 (Bioassay Number 93-1064-NW). No acute toxicity was observed in either test.

- The City of Mansfield has an approved pretreatment program which became effective in August 1984. Annual and quarterly reports are submitted to Ohio EPA by the Industrial Pretreatment Coordinator. An annual report covering the period September 30, 1992 to September 30, 1993 was received by the Ohio EPA, Northwest District Office on November 16, 1993. Based on this report, the City of Mansfield has a total of twelve (12) significant industrial users, which are considered to contribute significant loadings of conventional pollutants (*i.e.*, BOD_5, suspended solids, and oil and grease) to the WWTP, with small quantities of toxic pollutants. Of the significant industrial users, four (4) are considered major industries, which are known or suspected to contribute large quantities of toxic pollutants (*i.e.*, heavy metals). During the reporting period, a total of seventeen (17) industries were documented as significant violators of the City of Mansfield's sewer user ordinance.

- A Permit To Install (application number 03-7123) was approved on March 29, 1993 for the Madison Township sanitary sewer project. This project involves the extension of existing sanitary sewers east of the City of Mansfield and will eliminate approximately 2,300 on-site sewage treatment systems, several package treatment plants which serve schools, mobile home parks, and commercial users, and the county operated Hillsdale WWTP. The Mansfield WWTP design capacity is sufficient to receive this additional flow, although some concern has been expressed that the additional flow may compromise effluent quality. Construction was initiated in October 1993 and is scheduled to be completed by April, 1995.

- An evaluation of annual pollutant loadings from the Mansfield WWTP outfall 001 was conducted to determine trends in several pollutants of concern (Figures 4 and 5). Mean annual discharge has varied from a low of 9.0 million gallons per day (MGD) in 1977 (note: the data for 1976 was not usable) to a high of 12.9 MGD in 1993. Annual loadings of total suspended

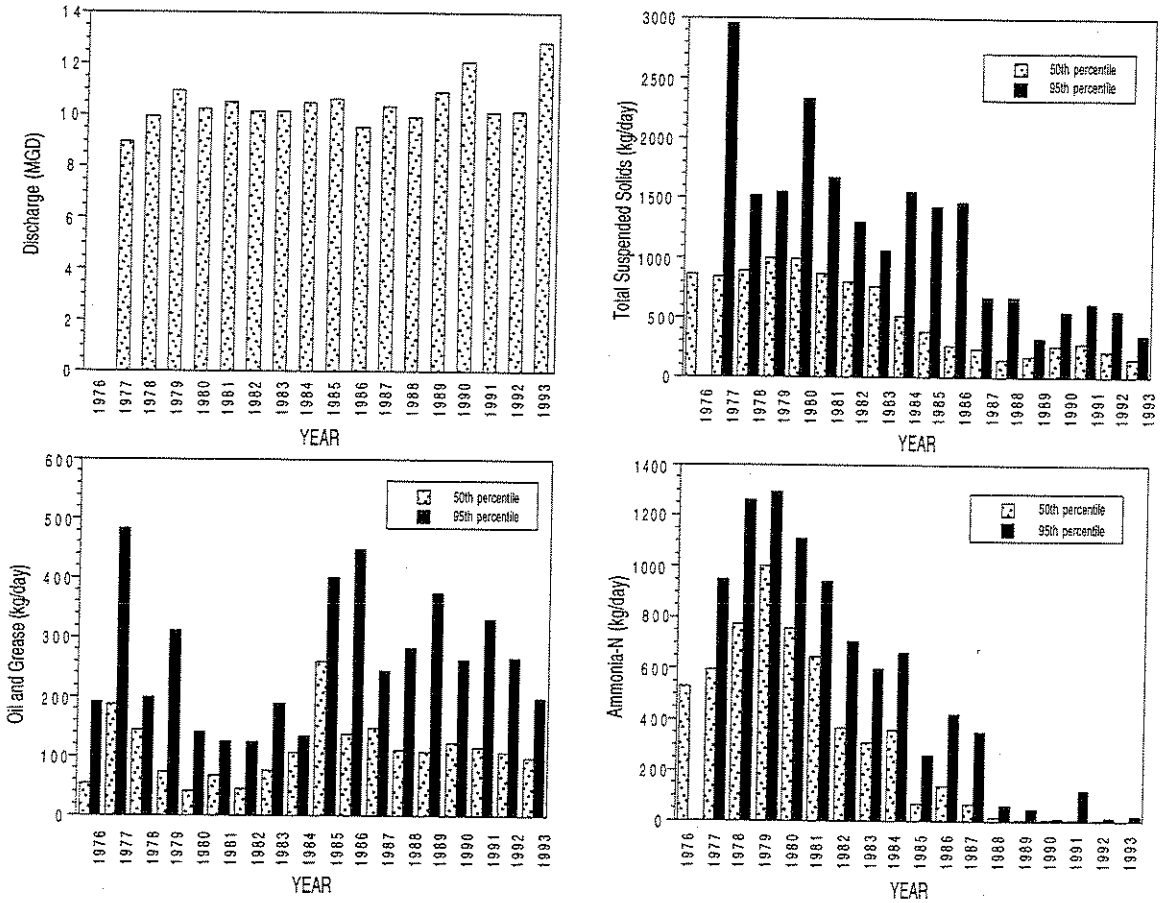

Figure 4. Average flow (MGD) and annual loadings (kg/day) of suspended solids, oil and grease, and ammonia from the Mansfield WWTP, 1976-1993.

solids exhibited a significant decline in 1987, most likely due to the completion of plant upgrades. Conversely, annual loadings of oil and grease exhibited an increasing trend beginning in 1985, possibly due to additional flows received by the WWTP from industrial dischargers following the initiation of an industrial pretreatment program in 1984. Annual loadings of ammonia-N exhibited a significant decline in 1988, again most likely due to the completion of plant upgrades. Monitoring requirements for nitrate+nitrite-N were not implemented until 1989; therefore, no discernible trend is evident. It is likely loadings of this pollutant increased significantly in response to plant upgrades which resulted in increased nitrification occurring within the WWTP. Annual loadings of BOD_5 also decrease in 1988 in response to plant upgrades Monitoring of 5-day biochemical oxygen demand (BOD_5) was changed to $cBOD_5$ in 1990. Annual loadings of heavy metals, such as copper and chromium have exhibited significant declines since about 1982, due primarily to the implementation of an industrial pretreatment program and completion of plant upgrades.

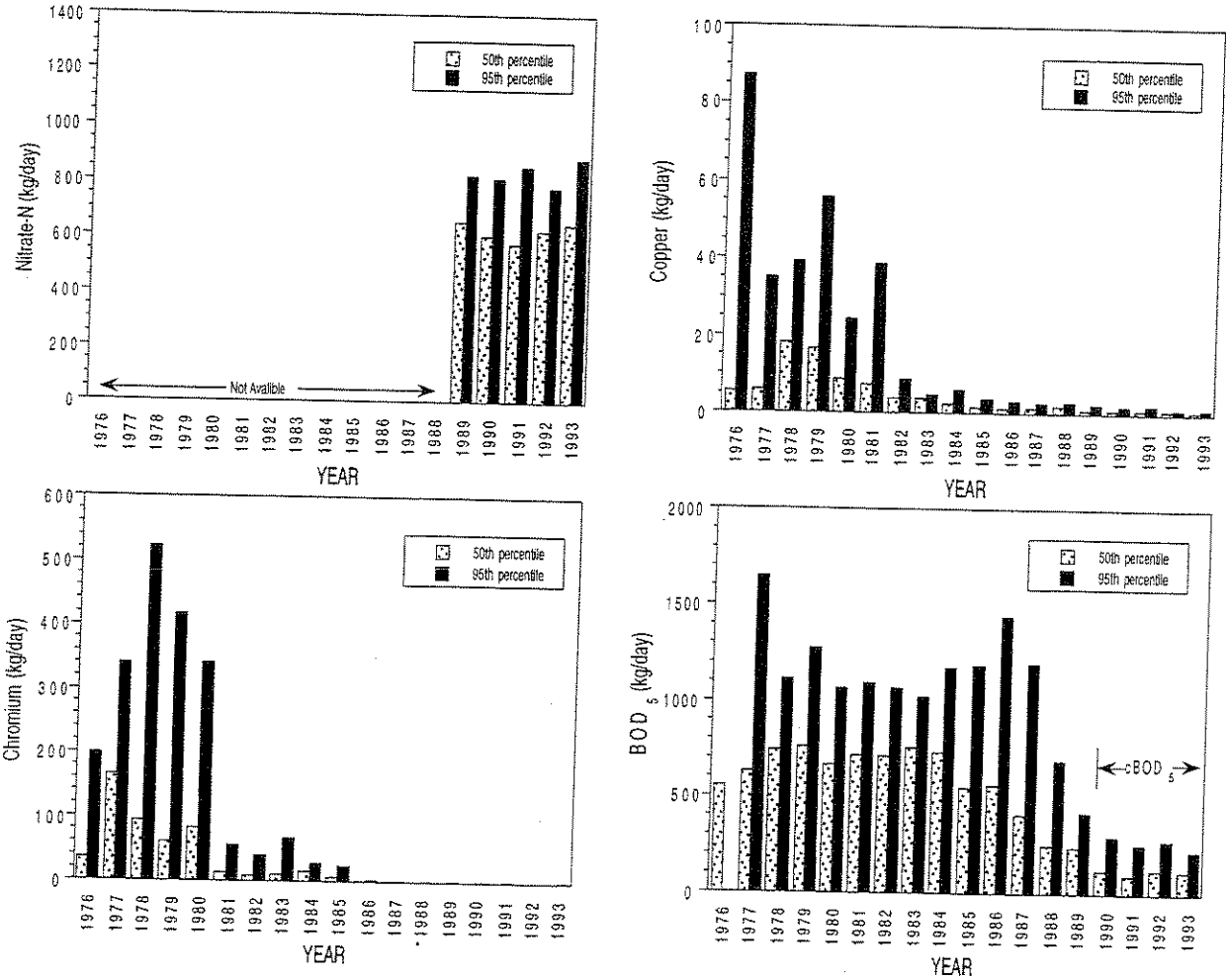

Figure 5. Annual loadings (kg/day) of nitrate, copper, chromium, and 5-day biochemical oxygen demand (BOD_5) from the Mansfield WWTP, 1976-1993. Five-day Carbonaceous biochemical oxygen demand ($cBOD_5$) is reported for 1990-1993 due to changes in monitoring requirements.

Village of Lucas Waste Water Treatment

- The Village of Lucas WWTP, Ohio EPA permit number 2PB00038, is located on Broad Street, Lucas, Ohio, 44843, and is a secondary wastewater treatment system with extended aeration constructed in 1987. The collection system consists of 100% separate sewers and includes two lift stations, one which contains a bypass. Final effluent from the plant discharges to the Rocky Fork Mohican River at RM 3.65.

Table 5. Summary of pollutants spilled into the Rocky Fork Mohican River and its tributaries reported to the Ohio EPA Division of Emergency and Remedial Response from January 1989 to December 1993.

Date	Entity	Material	Amount
9-1-89	Ohio Edison	Mineral Oil	25 gallons
10-31-89	Armco, Inc.	Oil	unknown
11-12-89	Armco, Inc.	Pickle Liquor	1,000 gallons
11-20-89	Armco, Inc.	Acid Rinse Water	2,000 gallons
2-2-90	City of Mansfield	Sewage	unknown
4-24-90	Armco, Inc.	Quench Oil	1,700 gallons
4-28-90	Armco, Inc.	Oil	75 gallons
11-8-90	Richland Co. Highway Dept.	#2 Fuel Oil	unknown
11-8-90	Richland Co. Highway Dept.	Asphalt Residue	unknown
6-18-91	Mansfield News Journal	Gasoline	12 gallons
11-30-91	BP Oil Co. Service Station	Gasoline	14 gallons
2-3-92	Therm-O-Disk	Oil and Grease	unknown
7-13-92	Stone Container Corp.	Wastewater	unknown
8-17-92	Stone Container Corp.	Wastewater	unknown
9-28-92	Stone Container Corp.	Wastewater	unknown
10-27-92	Stone Container Corp.	Wastewater	unknown
11-11-92	Daugherty Excavating	Diesel Fuel	10 gallons
1-19-93	BP Oil Co. Service Station	Gasoline	25 gallons
2-1-93	City of Mansfield	Sewage	unknown
3-8-93	Stone Container Corp.	Wastewater	unknown
5-3-93	Therm-O-Disk	Oil	1 gallon
6-9-93	Hillsdale Subdivision	Sewage	unknown
7-10-93	Ohio Brass	Chemicals	unknown
9-8-93	Stone Container Corp.	Wastewater	unknown
11-24-93	Stone Container Corp.	Wastewater	unknown

New Artesian Limited Partnership

- The New Artesian Limited Partnership facility, Ohio EPA permit number 2IN00063, is located at 1723 West Fourth Street, Mansfield, Ohio, 44906, and manufactures vitreous china plumbing fixtures. Processes used at the plant include molding, glazing, and firing. Wastewater from the facility discharges to Touby Run from one NPDES permitted outfall.

- Outfall 001 discharges at RM 4.8 and contains clay process water. Process wastewater enters a settling lagoon prior to discharge.

In addition to of discharge permit violations, a review of Ohio EPA Division of Emergency and Remedial Response spill records (Table 5) documented additional releases of toxic and/or oxygen demanding substances to the Rocky Fork Mohican River . It is likely that the reported spills comprised only a portion of the actual number of occurrences.

Chemical Water Quality

- Six sets of surface water grab samples were collected from the Rocky Fork Mohican River study area from July to September, 1993. An array of chemical analyses were performed on the samples including conventional (*i.e.* metals and nutrients), organic, and bacteriological pollutants. Results of the analyses conducted are presented in Tables 6 and 7 and Appendix Tables A-1 and A-2. Sampling stations (Table 3) were selected to provide information on ambient water quality and to assess impacts from major industrial and municipal dischargers. Analytical results were evaluated to determine exceedences of Ohio Water Quality Standards (OAC Chapter 3745-1) based on Warmwater Habitat (WWH) aquatic life, Primary and Secondary Contact Recreation (PCR and SCR, respectively), Agricultural Water Supply (AWS), and Public Water Supply (PWS) use designations. Although the Rocky Fork Mohican River is not designated as a public water supply, exceedences of the human health criterion for nitrate-N have been noted to emphasize elevated levels. Numerical criteria exist for the prevention of chronic toxicity (CAC), prevention of acute toxicity (AAC), and prevention of lethality (FAV) for several pollutants analyzed. Minimum and average criteria exist for dissolved oxygen (D.O.). Primary and Secondary Contact Recreation criteria relate to fecal coliform bacteria counts. At several sampling stations, Datasonde© continuous monitors were deployed to determine if diel fluctuations in D.O. concentration occurred. These measurements were useful in evaluating the presence of nuisance growths of algae and/or extensive oxidation of organic and inorganic matter.

- The sampling station located at Wilging Road (RM 16.29) was the most upstream site evaluated. This station was intended to provide information on ambient water quality, since there were few upstream sources of pollutants. One exceedence of the CAC for iron was documented (Table 6). The mean D.O. concentration (Figure 6) was above the Exceptional Warmwater Habitat (EWH) criterion of 6.0 mg/l. A Datasonde© continuous monitor was deployed at RM 16.41 on June 24 and recorded hourly measurements for a 24 hour period (Table A-4). Concentrations ranged from 7.51 to 8.93 mg/l; the low diel variation indicated normal algal populations (Figure 6). Other pollutants evaluated were near or below method detection limits and indicated good to exceptional water quality.

- The sampling station located at old Bowman Rd. (RM 15.86) was inside the Armco, Inc. facility, but upstream from NPDES permitted outfalls 001-004; it was also adjacent to the Luntz Corp. outfall 001. This station was intended to evaluate nonpoint source impacts from several metal scrapyards and impacts from the modified stream channel. Six exceedences of the CAC for iron were documented (Table 6). The mean D.O. concentration (Figure 6) declined somewhat, likely a result of the modified stream channel which results in reduced reaeration. The mean total suspended solids (TSS) concentration (Figure 6) increased significantly, probably due to poorly stabilized stream banks and nonpoint source runoff. A deep layer of fine silt was present and produced a slight oil sheen when disturbed. The mean total iron concentration (Figure 6) increased significantly, indicating a likely nonpoint source impact from the scrapyards. Water quality at this site was also evaluated for the presence of volatile and semi-volatile organic constituents (Table 7). On two of the three dates sampled, no priority organic pollutants were detected. On August 30, toluene was detected at a concentration of 0.9 µg/l, which was well below the CAC of 1,700 µg/l.

- The sampling station located at RM 14.49 was just upstream from the Armco, Inc. outfall 002 discharge and downstream from outfalls 001, 003, and 004. Five violations of the average D.O. criterion, one violation of the AAC for oil and grease, one violation of the AAC and one

Table 6. Exceedences of Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical, bacteriological and physical parameters measured in the Rocky Fork Mohican River study area during 1993 (units are µg/l for metals, # colonies/100 ml for fecal coliform, and mg/l for all others).

Stream Name	River Mile	Violation: Parameter (value)
Rocky Fork Mohican River		
	16.29	Fe (1440 *)
	15.86	Fe (1630 *, 1680 *, 1050 *, 1290 *, 1350 *, 1390 *)
	14.49	D.O. (4.7 ‡, 4.3 ‡, 4.0 ‡, 4.0 ‡, 4.9 ‡), Oil and Grease (40.7 **), Cu (191 ***, 90 **), Fe (1380 *, 1780 *, 1340 *, 1450 *, 3200 *), Cr (124 ∞)
	14.47	D.O. (4.6 ‡, 4.9 ‡, 4.6 ‡), Oil and Grease (13.9 **), Fe (4970 *, 2020 *, 1200 *, 1740 *, 2060 *, 1410 *)
	14.24	Oil and Grease (13.2 **, 15.6 **), Cu (47 *), Fe (2920 *, 1280 *, 1200 *, 1053 *)
	13.31	Cu (249 ***), Fe (1020 *, 1140 *)
	11.59	D.O. (4.8 ‡), Cu (32 *), Fe (1040 *)
	11.17	NO_3-NO_2 (15.6 †, 14.4 †, 13.7 †, 12.2 †, 18.1 †), Cr (390 ∞)
	10.13	NO_3-NO_2 (10.9 †, 10.9 †, 10.6 †, 14.2 †), Oil and Grease (14.4 **), Cr (423 ∞)
	6.35	NO_3-NO_2 (12.7 †, 11.8 †), Cr (541 **)
	0.62	Fe (1290 *)
Touby Run		
	0.38	Fecal Coliform (3800 ◊)
Armco, Inc. outfall 002 Effluent		
	14.48	Cu (138 Δ)
Mansfield WWTP outfall 001 Effluent		
	11.18	Cr (672 Δ)

* indicates an exceedence of numerical criterion for prevention of chronic toxicity (CAC).
** indicates an exceedence of numerical criterion for prevention of acute toxicity (AAC).
*** indicates an exceedence of numerical criterion for prevention of lethality (FAV).
‡ violation of the average dissolved oxygen (D.O.) criterion.
◊ exceedence of the Primary Contact Recreation criterion.
† exceedence of human health public water supply criterion.
∞ exceedence of agricultural water supply criterion.
Δ violation of NPDES permit daily maximum concentration limit.

Table 7. Surface water priority pollutant VOC (volitile organic compound) detections in the Rocky Fork Mohican River, 1993. Detection values for non-detected (ND) priority pollutants, taking into account method detection limits and sample dilution, are presented in parentheses.

PARAMETER	RM 15.86	RM 14.24	RM 11.59	RM 10.13
VOLATILE ORGANIC COMPOUNDS (µg/l)				
July 7, 1993				
Bromodichloromethane	ND (0.5)	ND (0.5)	ND (0.5)	1.5
Chloroform	ND (0.5)	1.5	0.8	1.8
1, 1 - Dichloroethane	ND (0.5)	ND (0.5)	1.0	ND (0.5)
Cis - 1, 2 - Dichloroethene	ND (0.5)	ND (0.5)	1.8	ND (0.5)
August 2, 1993				
Chloroform	ND (0.5)	1.6	ND (0.5)	1.9
Cis - 1, 2 - Dichloroethene	ND (0.5)	ND (0.5)	1.4	ND (0.5)
Naphthalene	ND (0.5)	ND (0.5)	0.6	ND (0.5)
August 30, 1993				
Bromodichloromethane	ND (0.5)	1.0	0.5	2.0
Chloroform	ND (0.5)	2.6	0.7	3.7
Dibromochloromethane	ND (0.5)	0.6	ND (0.5)	1.0
1, 4 - Dichlorobenzene	ND (0.5)	0.5	ND (0.5)	ND (0.5)
Cis - 1, 2 - Dichloroethene	ND (0.5)	ND (0.5)	1.5	ND (0.5)
Toluene	0.9	ND (0.5)	ND (0.5)	ND (0.5)
Trichloroethene	ND (0.5)	ND (0.5)	0.6	ND (0.5)

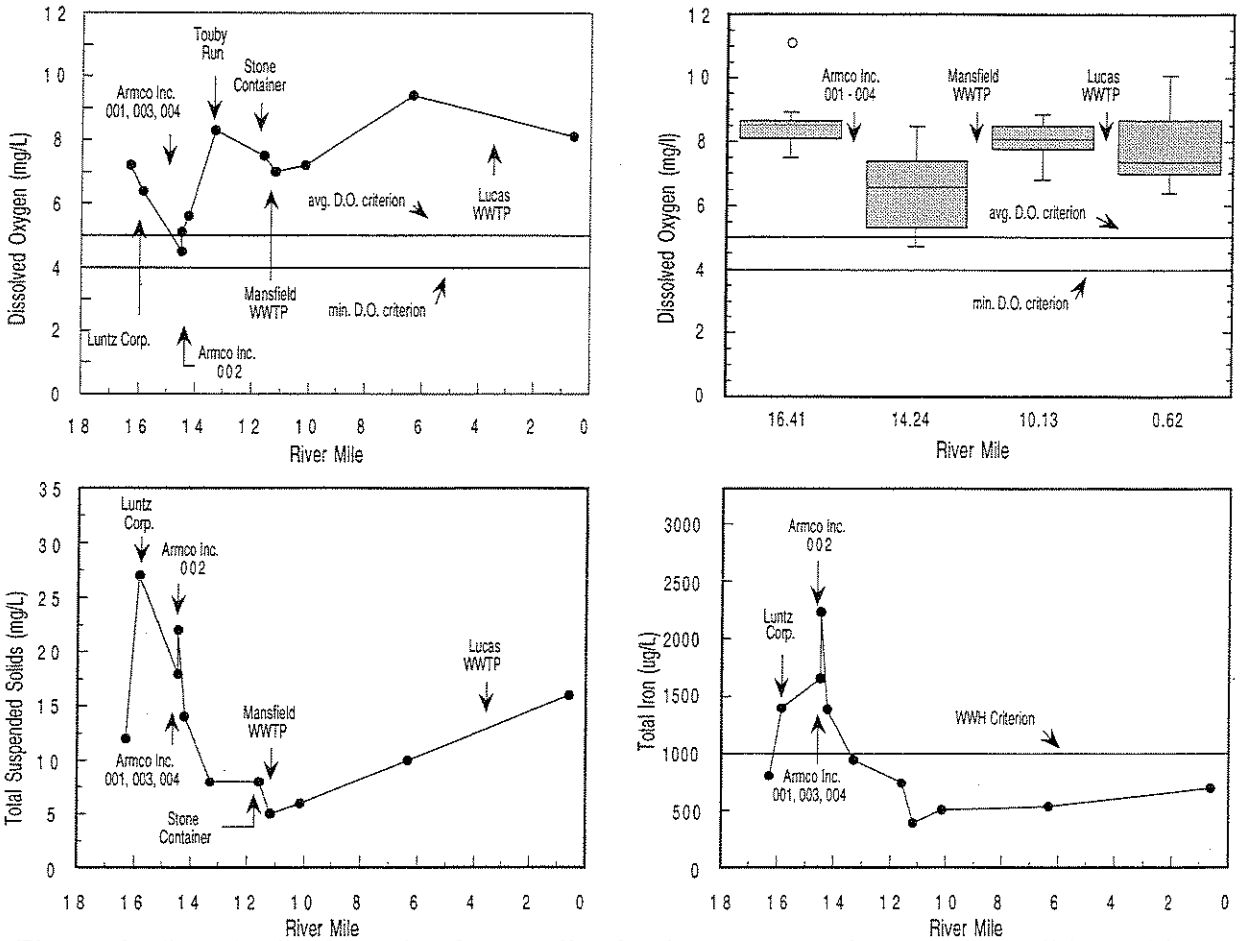

Figure 6. Longitudinal trends of mean dissolved oxygen, total suspended solids, and iron and box plots of dissolved oxygen from Datasonde© continuous monitors in the Rocky Fork Mohican River, 1993.

violation of the FAV for copper, five exceedences of the CAC for iron, and one exceedence of the AWS criterion for chromium were documented (Table 6). This sampling station was the only site in the Rocky Fork Mohican River study area where the mean D.O. concentration (Figure 6) was below the average WWH criterion. This results from a combination of impacts including an increase in loadings of demand pollutants, an increase in stream temperature, and a reduction in stream flow. Demand pollutants include biochemical oxygen demand (BOD_5), which measures the amount of D.O. a sample will consume due to organic material and microbial activity, carbonaceous biochemical oxygen demand (cBOD), which measures D.O. consumption while inhibiting the action of nitrogenous organisms, and chemical oxygen demand (COD), which included oxygen demand from substances resistant to biological oxidation. The mean BOD5, cBOD5, and COD concentrations (Figure 6) all show significant increases downstream from outfalls 001, 003, and 004. The increase in water temperature

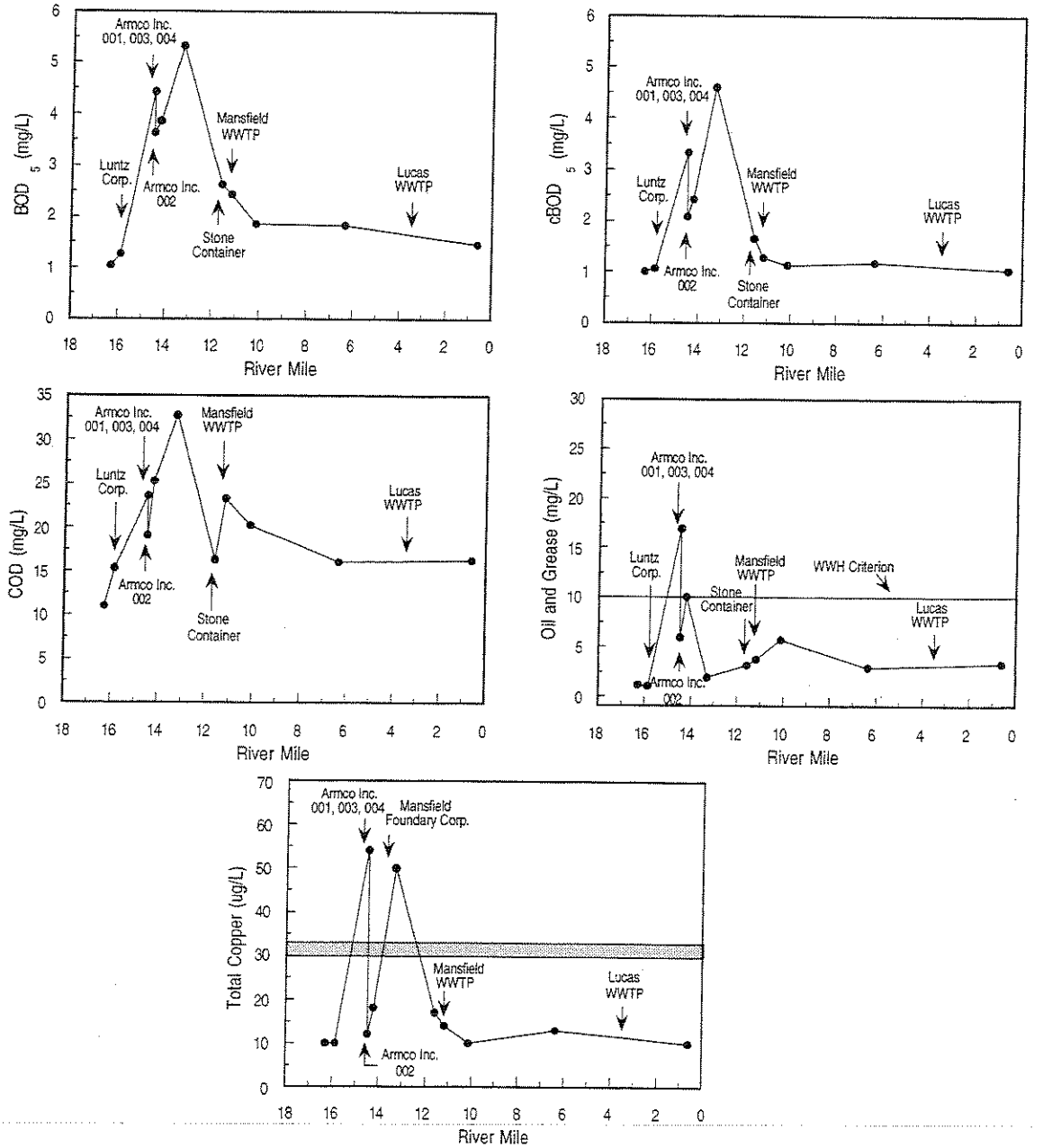

Figure 7. Longitudinal trends of mean biochemical oxygen demand (BOD_5), carbonaceous biochemical oxygen demand ($cBOD_5$), chemical oxygen demand (COD), oil and grease, and total copper in the Rocky Fork Mohican River, 1993. Shaded area in total copper graph represents the range of WQS criteria between the 90th and 25th percentile hardness values.

reduced oxygen solubility, since oxygen solubility is inversely proportional to temperature. The modified stream channel results in a reduction of stream gradient and minimizes the diffusion of atmospheric oxygen. The mean oil and grease and mean copper concentrations exhibited significant increases (Figure 7). These increases were likely due to loadings from outfalls 001, 003, and 004 and nonpoint source runoff from the scrapyards. Numerous NPDES permit violations were documented at these outfalls during calendar year 1993. A combined total of eleven daily maximum concentration limits for oil and grease and four monthly average loadings for copper at outfall 001 were violated (Table 4). Each of the outfalls have daily maximum discharge limits of 10.0 mg/l for oil and grease and 41 µg/l for copper. A severe oil sheen was visible at this site during each sampling event conducted, at times appearing as oil droplets. The mean iron concentration (Figure 6) continued to increase as a result of point and nonpoint source loadings. No discharge limits exist for iron, although routine monitoring is required.

- The sampling station located at RM 14.47 was in the Armco, Inc. outfall 002 mixing zone. Three violations of the average D.O. WWH criterion, one exceedence of the AAC for oil and grease, and six exceedences of the CAC for iron were documented (Table 6). An exceedence the of Armco, Inc. daily maximum discharge limit for copper was documented at outfall 002 on July 19. The mean D.O. concentration (Figure 6) improved slightly, likely due to an increase in stream gradient and decrease in demand pollutant concentrations. The mean oil and grease concentration continued to be elevated, while the mean copper concentration declined (Figure 7). No survey samples collected at outfall 002 violated the daily maximum discharge limit for oil and grease, although all samples submitted were above the method detection limit (Table A-1). A total of eight daily maximum concentration and fourteen daily maximum loading NPDES limits were violated for oil and grease during calendar year 1993 at outfall 002 (Table 4). A gross accumulation of oil was present in the outfall 002 mixing zone, primarily below the gravel substrate and along the river margins. No survey samples collected at outfall 002 exceeded the daily maximum discharge limit for copper, although three samples were above the method detection limit. The Armco, Inc. outfall 002 effluent violated the monthly average loading NPDES limit for copper during all twelve months in 1993 (Table 4). The mean iron concentration (Figure 6) was the highest in the Rocky Fork Mohican River study area.

- The sampling station located at Longview Avenue (RM 14.24) was intended to evaluate recovery of ambient water quality downstream from Armco, Inc. outfalls 001-004. Two violations of the AAC for oil and grease, one exceedence of the CAC for copper, and four exceedences of the CAC for iron were documented (Table 6). The mean D.O. concentration continued to exhibited a slight increasing trend (Figure 6). A Datasonde© continuous monitor was deployed on June 24 and recorded hourly measurements for a 26 hour period (Table A-4). Concentrations ranged from 4.71 mg/l to 8.49 mg/l (Figure 6), indicating an impact from oxidation of organic and inorganic material. The minimum reading was an excursion from the average D.O. criterion. The mean concentrations of oil and grease (Figure 7) continued to be elevated to near or above water quality standards. Water quality at this site was also evaluated for the presence of volatile and semi-volatile organic constituents (Table 7). Chloroform was detected on all three sampling dates and likely occurred as a result of the upstream use of chlorinated solvents. Little recovery in ambient water quality had occurred at this site.

- The sampling station located on Touby Run at Main Street (RM 0.38) was intended to evaluate ambient water quality. One exceedence of the PCR criterion for fecal coliform bacteria was documented (Table 6). Although no exceedences were documented for oil and grease, two of three samples analyzed were above the method detection limit. The mean D.O. concentration

was extremely elevated at this site (14.0 mg/l). Significant algal blooms were noted on several sampling dates which indicated a possible upstream nutrient source.

- The sampling station located at Orange Road (RM 13.31) was intended to evaluate impacts from Mansfield Foundry Corp. and the confluence of Touby Run. One violation of the FAV for copper and two exceedences of the CAC for iron were documented (Table 6). This station was located in a recently channelized section of stream where no riparian vegetation was present and channel development was poor with shallow glides predominating. Intense algal activity was noted during sampling events and was reflected by a significant increase in mean D.O. concentration (Figure 6). A major pollution event was detected at this site on August 17. The highest concentrations of BOD_5, $cBOD_5$, COD, and copper in the study area were documented (Table A-1, Figure 7). The suspected source of this event was non-contact cooling water from Mansfield Foundry Corp. outfall 002. Mansfield Foundry Corp. did not have discharge limits for outfall 002, but is required to monitor flow, pH, copper, and zinc once per month. The mean copper concentration calculated from monthly operating reports submitted to Ohio EPA from January, 1993 to December, 1993 was 171 µg/l. This is a major pollution source which should be regulated or eliminated.

- The sampling station located at Illinois Avenue (RM 11.59) was intended to evaluate impacts from Stone Container outfalls 001 and 002. One departure from the average D.O. criterion, one exceedence of the CAC for copper, and one exceedence of the CAC for iron were documented (Table 6). The mean D.O. concentration (Figure 6) declined but was not a concern due to the inordinately elevated levels at Orange Rd. The copper exceedence occurred on the same date as the daily maximum discharge limit violation from Armco, Inc. outfall 002 and was suspected to have been related to this event (Table 6). Water quality at this site was also evaluated for the presence of volatile and semi-volatile organic constituents (Table 7). Chloroform was detected on two of three dates sampled along with 1, 1-Dichloroethane, a breakdown product of trichloroethylene, which is used as a solvent.

- The sampling station located at RM 11.17 was located in the Mansfield WWTP outfall 001 mixing zone. One exceedence of the AWS criterion for chromium and five exceedences of the PWS criterion for nitrate-N were documented (Table 6). A violation of the Mansfield WWTP daily maximum discharge limit for chromium was documented on August 17 (Table 4). This violation was the result of an influent slug to the WWTP on August 16. The discharge was investigated by Mansfield pretreatment personnel, but a definite source was not identified. According to WWTP staff, Jay Plastics, Taylor Plating, and Armco, Inc. were the only dischargers currently in the pretreatment program to have the potential for a slug discharge of this magnitude. Chromium concentrations at this site were near or below the method detection limit on all other dates sampled (Figure 8). The mean nitrate+nitrite-N concentration (Figure 8) was elevated due to nitrification occurring during the waste treatment process, which converts ammonia-N to nitrate-N through aeration and bacterial action. All ammonia-N concentrations were below the method detection limit (Table A-1). The mean phosphorus concentration (Figure 8) was also elevated in the mixing zone, since no advanced tertiary treatment process was in operation at the WWTP.

- The sampling station located at S.R. 39 (RM 10.13) was intended to evaluate recovery of ambient water quality downstream from the Mansfield WWTP. One exceedence of the AAC for oil and grease, four exceedences of the PWS criterion for nitrate-N, and one exceedence of the AWS criterion for chromium were documented (Table 6). The chromium exceedence was a result of the slug discharge to the WWTP on August 16 (Figure 8). The mean nitrate+nitrite-N

and phosphorus concentrations (Figure 8) continued to be elevated although a declining trend was evident. This was an indication of assimilation of these nutrients by algae and bacteria. A Datasonde© continuous monitor was deployed on June 24 and recorded hourly measurements for a 28 hour period (Table A-4). Dissolved oxygen concentrations ranged from 6.80 to 8.86 mg/l, with a slight amount of diel variability (Figure 6). This indicated little, if any, nutrient enrichment and the resulting increased algal activity. Water quality at this site was also evaluated for the presence of volatile and semi-volatile organic constituents (Table 7). Chloroform was detected on all three dates, apparently as a result of an upstream source of solvents and/or the byproduct of residual chlorine used for disinfection at the WWTP.

- The sampling station located adjacent to Mt. Zion Road (RM 6.35) was also intended to evaluate recovery of ambient water quality downstream from the Mansfield WWTP. One exceedence of the AAC for chromium and two exceedences of the PWS criterion for nitrate-N were documented (Table 6). Although no exceedences were documented for oil and grease, two of three samples analyzed were above the method detection limit (Table A-1). The chromium exceedence resulted from the slug discharge to the Mansfield WWTP on August 16

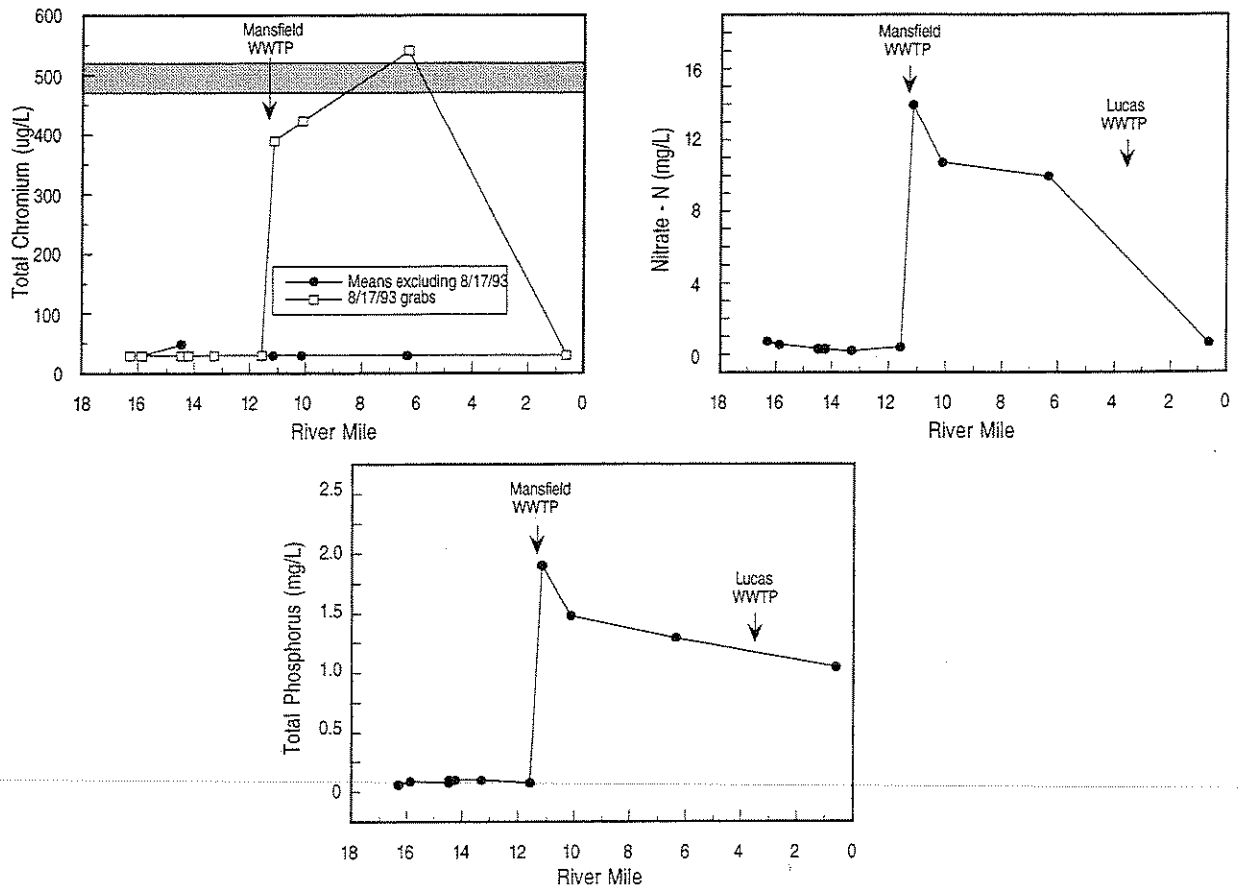

Figure 8. Longitudinal trends of mean total chromium, nitrate-N, and total phosphorus in the Rocky Fork Mohican River, 1993. Shaded area in total chromium graph represents the range of WQS criteria between the 90th and 25th percentile hardness values.

(Figure 8). The mean nitrate+nitrite-N and phosphorus concentrations (Figure 8) continued a declining trend. Other pollutants evaluated were near or below method detection limits and indicated fair to good water quality.

- The sampling station located at Applegate Road (RM 0.62) was the most downstream site evaluated. This site was intended to further monitor the recovery process of ambient water quality downstream from the Mansfield WWTP and also to evaluate potential impacts from the Lucas WWTP. One exceedence of the CAC for iron was documented (Table 6). Although no exceedences were documented for oil and grease, two of three samples analyzed were above the method detection limit (Table A-1). The slug discharge of chromium to the Mansfield WWTP on August 16 was not detected (Figure 8). The mean nitrate+nitrite-N and phosphorus concentrations (Figure 8) continued to decline. A Datasonde© continuous monitor was deployed on June 24 and recorded hourly measurements for a 26 hr. period. Concentrations ranged from 6.40 to 10.09 mg/l, with a significant amount of diel variability (Figure 5). This reflected an increase in algal activity as a result of nutrient enrichment. Other pollutants evaluated were near or below method detection limits and indicated fair to good water quality.

- The sampling station located on the Clear Fork Mohican River at Marion Avenue (RM 35.70) was intended to evaluate ambient water quality. This site was also evaluated to provide background water quality data for the Rocky Fork Mohican River survey area in the event the Wilging Road station was not appropriate for this purpose. No exceedences of Ohio Water Quality Standards were documented. All pollutants evaluated were near or below method detection limits which was an indication of exceptional water quality conditions.

Sediment Chemistry

- Pollutants present in sediment create the potential for continued environmental impact, even where water column pollutant levels are below established criteria, and may have a negative impact on water quality even if pollutant loadings have been eliminated. Certain pollutants have toxic impacts on aquatic life and may pose a threat to human health. To evaluate the extent of sediment contamination in the Rocky Fork Mohican River study area, eight sites were sampled to determine pollutant concentrations. Chemical analyses which were conducted included heavy metals (Table 8) and volatile and semi-volatile organic compounds (Table 9 and Table A-3). Selected parameters were ranked based on a stream sediment classification system described by Kelly and Hite (1984) and a toxicity based guideline described by Long and Morgan (1991). The Kelly and Hite classification system ranks pollutant concentrations from nonelevated to extremely elevated. Long and Morgan determined an effects range-low (ER-L) value which indicates the low end of the range of concentrations in which toxic effects were observed or predicted and an effects range-median (ER-M) value which indicated the concentration above which toxic effects were frequently or always observed or predicted among most organisms. Several pollutant concentrations are reported or evaluated as a total or sum of all isomers or species detected. These include the organochlorine pesticide DDT, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs).

Table 8. Dry weight concentrations of heavy metals (mg/kg or ppm) in sediments of the Rocky Fork Mohican River study area during 1993. All parameter concentrations (excluding nickel) were ranked based on a stream sediment classification system described by Kelly and Hite (1984). Concentrations preceded by an (*) exceeded the ER-M value described by Long and Morgan (1990).

River Mile	As	Cd	Cr	Cu	Fe	Pb	Ni	Zn
Rocky Fork Mohican River								
16.29	5.24[a]	0.280[a]	13.8[a]	12.3[a]	15000[a]	13.5[a]	9.14	72.5[a]
15.86	11.4[c]	0.470[a]	33.7[c]	18.6[a]	18400[b]	20.2[a]	13.8	145[c]
> *Armco Inc.*								
14.47	**22.7[d]**	1.20[c]	***1670[e]**	***711[e]**	**51300[e]**	**79.5[d]**	*54.9	***431[e]**
14.24	**18.6[d]**	**2.74[d]**	***712[e]**	**353[e]**	**45500[d]**	***182[e]**	*287	***549[e]**
13.31	**17.0[d]**	1.15[c]	**139[e]**	**224[e]**	**39000[d]**	**73.0[d]**	33.2	***422[e]**
> *Mansfield WWTP*								
10.13	12.8[c]	***49.1[e]**	***916[e]**	***462[e]**	**40400[d]**	***959[e]**	*83.5	***1170[e]**
0.62	9.93[b]	0.510[b]	**55.7[d]**	51.7[b]	18500[b]	41.0[c]	27.5	168[c]
Clear Fork Mohican River								
35.70	**17.4[d]**	0.177[a]	9.80[a]	9.81[a]	18100[b]	14.6[a]	9.84	64.1[a]
ER-M values (Long and Morgan, 1990)								
	85	9	145	390	NA	110	50	270

[a] Nonelevated; [b] Slightly elevated; [c] Elevated; [d] **Highly elevated**; [e] **Extremely elevated**
Note: The Kelly and Hite classification system addresses relative concentrations but did not directly assess toxicity.

- The sampling station located at Wilging Rd. (RM 16.29) was the most upstream site in the Rocky Fork Mohican River and was intended to evaluate ambient sediment quality. The only priority organic pollutant detected at this site was the organochlorine pesticide d-BHC at a concentration of 4.80 ppb (Table 9). All heavy metal concentrations were classified as nonelevated (Table 8).

- The sampling station located at old Bowman Rd. (RM 15.86) was intended to evaluate impacts from metal scrapyards. The only priority organic pollutants detected at this site were y-BHC at a concentration of 1.17 ppb and a total DDT concentration of 4.18 ppb (Table 9). The total DDT concentration was ranked as nonelevated and was above the ER-L value of 3 ppb. Heavy metal concentrations increase somewhat due to nonpoint source runoff (Table 8). Arsenic, chromium, and zinc were classified as elevated and iron as slightly elevated.

Table 9. Dry weight concentrations of priority organic pollutants detected in sediments of the Rocky Fork Mohican River study area, 1993. Corrected method detection limits, based on weight and dilutions of sample, for non-detected (ND) pollutants are presented in parentheses. Selected parameter concentrations were ranked based on a stream sediment classification system described by Kelly and Hite (1984). Concentrations preceded by an (*) exceeded the ER-M value described by Long and Morgan (1990). Those preceded by an (<) indicate interference from PCBs.

PARAMETER	Rocky Fork RM 16.29	Rocky Fork RM 15.86	Rocky Fork RM 14.47	Rocky Fork RM 14.24
VOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)				
Toluene	ND (0.06)	ND (0.06)	6.99	ND (0.18)
POLYNUCLEAR AROMATIC HYDROCARBONS (mg/kg or ppm)				
Benzo [B & K] Fluoranthene	ND (0.6)	ND (0.5)	ND (1.0)	3.6
Benzo [A] Pyrene	ND (0.6)	ND (0.5)	ND (1.0)	1.2
Benz [A] Anthracene	ND (0.6)	ND (0.5)	ND (1.0)	1.5
Chrysene	ND (0.6)	ND (0.5)	ND (1.0)	0.9
Fluoranthene	ND (0.6)	ND (0.5)	ND (1.0)	2.3
Phenanthrene	ND (0.6)	ND (0.5)	1.0	1.4
Pyrene	ND (0.6)	ND (0.5)	ND (1.0)	1.8
Total PAHs	ND	ND	1.0	12.7
PHTHALATES (mg/kg or ppm)				
Bis (2 - ethylhexyl) Phthalate	ND (0.6)	ND (0.5)	ND (1.0)	8.3
Butylbenzyl Phthalate	ND (0.6)	ND (0.5)	ND (1.0)	1.4
Di - N - Butyl Phthalate	ND (0.6)	ND (0.5)	ND (1.0)	2.6
ORGANOCHLORINE PESTICIDES and PCBs [1,2,3] (µg/kg or ppb)				
Aldrin	ND (0.56)	ND (0.60)	<46.75	ND (0.86)
a - BHC	ND (0.56)	ND (0.60)	4.88	ND (0.86)
b - BHC	ND (0.56)	ND (0.60)	42.74	ND (0.86)
d - BHC	4.80	ND (0.60)	<28.16	2.86
y - BHC	ND (0.56)	1.17	11.70	7.72
Total DDT	ND (0.56)	4.18[a]	<43.53	**74.15**[d]
Dieldrin	ND (0.56)	ND (0.60)	<11.32	3.37[a]
Endosulfan I	ND (0.56)	ND (0.60)	25.13	ND (0.86)
Endrin Aldehyde	ND (1.67)	ND (1.79)	6.84	ND (2.58)
Endosulfan II	ND (0.56)	ND (0.60)	ND (1.05)	2.19
Methoxychlor	ND (2.79)	ND (2.98)	8.24	15.59
Hexachlorobenzene	ND (0.56)	ND (0.60)	ND (1.05)	1.39
Total PCB	ND (27.88)	ND (29.79)	***2977.39**[e]	ND (43.00)

Table 9. Continued

PARAMETER	Rocky Fork RM 13.31	Rocky Fork RM 10.13	Rocky Fork RM 0.62	Clear Fork RM 35.70
POLYNUCLEAR AROMATIC HYDROCARBONS (mg/kg or ppm)				
Benzo [B & K] Fluoranthene	3.9	3.5	0.7	ND (0.5)
Benzo [A] Pyrene	1.4	1.5	0.7	ND (0.5)
Benzo [GHI] Perylene	2.4	2.4	ND (0.7)	ND (0.5)
Benz [A] Anthracene	1.4	1.5	ND (0.7)	ND (0.5)
Chrysene	1.4	1.3	ND (0.7)	ND (0.5)
Fluoranthene	3.3	2.9	1.0	ND (0.5)
Indeno [1, 2, 3 - CD] Pyrene	3.9	2.9	ND (0.7)	ND (0.5)
Phenanthrene	1.9	1.9	0.7	ND (0.5)
Pyrene	2.6	3.0	0.8	ND (0.5)
Total PAHs	22.2	20.9	3.9	ND
PHTHALATES (mg/kg or ppm)				
Bis (2 - ethylhexyl) Phthalate	3.3	1.1	1.1	ND (0.5)
Di - N - Butyl Phthalate	1.8	1.6	0.7	ND (0.5)
ORGANOCHLORINE PESTICIDES and PCBs [1, 2, 3] (µg/kg or ppb)				
Aldrin	<32.30	<12.03	<9.28	ND (0.52)
a - BHC	ND (0.91)	1.13	ND (0.68)	ND (0.52)
d - BHC	ND (0.91)	ND (0.72)	ND (0.68)	4.75
Total DDT	<18.79	<8.26	<10.01	ND (0.52)
Dieldrin	<5.00	<2.30	<1.86	ND (1.56)
Endosulfan I	ND (0.91)	2.67	2.17	ND (0.52)
Endosulfan II	<8.71	<8.58	<6.49	ND (0.52)
Endrin	<5.21	ND (0.72)	<1.02	ND (0.52)
Methoxychlor	32.37	21.22	10.45	ND (2.60)
Mirex	8.18	3.85	ND (3.41)	ND (2.60)
Total PCB	***1581.98**[e]	***581.97**[d]	***497.85**[d]	ND (26.04)

1. Pesticide concentrations indicated were ranked with the following stream sediment classification system described by Kelly and Hite (1984). [a] Non-elevated; [b] Slightly elevated; [c] Elevated; [d] **Highly elevated**; [e] **Extremely elevated**
2. Total DDT is the sum of 4, 4' - DDE, 4, 4' - DDD, and 4, 4' - DDT.
3. Total PCB is the sum of all isomers detected.

- The sampling station located in the Armco, Inc. outfall 002 mixing zone (RM 14.47) was intended to evaluate impacts from Armco outfalls 001-004. Several priority organic pollutants were detected, including the volatile organic compound toluene at a concentration of 6.99 ppm and a total PCB concentration of 3 ppm (Table 9). The total PCB concentration was the highest documented in the Rocky Fork Mohican River study area, was ranked as extremely elevated, and was above the ER-M value of 0.4 ppm. Heavy metal concentrations increased significantly (Table 8). Chromium, copper, iron, and zinc were classified as extremely elevated, arsenic and lead as highly elevated, and cadmium as elevated. The chromium, copper, nickel, and zinc concentrations exceeded ER-M values. The arsenic, chromium, copper, and iron concentrations were the highest documented in the study area.

- Several priority organic pollutants were detected at Longview Ave. (RM 14.24) including a total DDT concentration of 74.15 ppb and a total PAH concentration of 12.7 ppm (Table 9). The total DDT concentration was ranked as highly elevated. Heavy metal concentrations continued to be a concern (Table 8). Chromium, copper, lead, and zinc were classified as extremely elevated and arsenic, cadmium, and iron as highly elevated. The chromium, lead, nickel, and zinc concentrations exceeded ER-M values. The nickel concentration was the highest documented in the study area.

- Several priority organic pollutants were detected at Orange Rd. (RM 13.31) including a total PAH concentration of 22.2 ppm and a total PCB concentration of 1.6 ppm (Table 9). The total PCB concentration was ranked as extremely elevated and exceeded the ER-M value. Heavy metal concentrations declined somewhat, although they continued to be at levels of concern (Table 8). Chromium, copper, and zinc were classified as extremely elevated, arsenic, iron, and lead as highly elevated, and cadmium as elevated. The zinc concentration exceeded the ER-M value.

- The sampling station located at S.R. 39 (RM 10.13) was intended to evaluate impacts from the Mansfield WWTP. Several priority organic pollutants were detected including a total PAH concentration of 20.9 ppm and a total PCB concentration of 0.6 ppm (Table 9). The total PCB concentration was ranked as highly elevated and was above the ER-M value. Heavy metal concentrations exhibited an increase (Table 8). Cadmium, chromium, copper, lead, and zinc were classified as extremely elevated, iron as highly elevated, and arsenic as elevated. The cadmium, chromium, copper, lead, nickel, and zinc concentrations all exceeded ER-M values. The cadmium, lead, and zinc concentrations were the highest documented in the study area.

- Several priority organic pollutants were detected at Applegate Rd. (RM 0.62) including a total PAH concentration of 3.9 ppm and a total PCB concentration of 0.5 ppm (Table 9). The total PCB concentration was ranked as highly elevated and was above the ER-M value. Heavy metal concentrations exhibited a significant decline (Table 8). Chromium was classified as highly elevated, lead and zinc as elevated and arsenic, cadmium, copper, and iron as slightly elevated.

- The sampling station located on the Clear Fork Mohican River at Marion Avenue Rd. (RM 35.70) was intended to evaluate ambient sediment quality. The only priority organic pollutant detected was the organochlorine pesticide d-BHC at a concentration of 4.75 ppb (Table 9). Heavy metal concentrations declined somewhat (Table 8). Arsenic was classified as highly elevated, iron as slightly elevated and cadmium, chromium, copper, lead, and zinc as nonelevated.

Fish Tissue

- Fish tissue was collected from the Rocky Fork Mohican River at RM 6.4 (adjacent Mt. Zion Rd.) in 1993. A whole body composite sample of common carp was analyzed for priority pollutant pesticides (residues and metabolites), seven polychlorinated biphenyl (PCB) mixtures and three metals (Table 10). Dieldrin and DDT (residues and metabolites) were detected but at concentrations well below FDA action levels. The total PCB concentration was 3.9 mg/kg. Because the sample was whole body rather than skin-on fillets the U.S. Food and Drug Administration action level of 2 mg/kg is not directly applicable. However, the elevated total PCB concentration presents the need for additional fish tissue sampling, so that, if it is warranted, an appropriate risk based advisory can be issued. The source of PCBs should also be identified and corrective measures investigated.

Table 10. Concentrations of PCBs, pesticides, and metals collected from a whole body composite fish tissue sample of common carp from the Rocky Fork Mohican River adjacent Mt. Zion Rd. (RM 6.4), October 4, 1993.

Chemical	Concentration (mg/kg)
Total PCB (U.S. FDA Action Level = 2.0 mg/kg)	3.94656
PCB-1248	3.51956
PCB-1260	0.427
Total DDT (U.S. FDA Action Level = 5.0 mg/kg)	0.17757
4,4'-DDD	0.03523
4,4'-DDE	0.13014
4,4'-DDT	0.00553
Dieldrin	0.00667
Cadmium	0.0301
Lead	0.182
Mercury (U.S. FDA Action Level = 1.0 mg/kg)	0.0390

Physical Habitat for Aquatic Life

Rocky Fork Mohican River

- During the 1993 field sampling efforts the macrohabitats of the Rocky Fork Mohican River were evaluated at nine fish sampling stations. Qualitative Habitat Evaluation Index (QHEI) values ranged from 38.0 at RM 15.8 (old Bowman Rd) to 82.5 at RM 0.6 (Applegate Rd.); the mean QHEI value for the Rocky Fork was 61.6 (Table 11). A mean QHEI score greater than 60.0 suggested that near and instream physical habitats of the Rocky Fork Mohican River were generally of a sufficient quality to support and maintain a community of aquatic organisms consistent with the WWH aquatic life use designation (Rankin 1989). In order to elucidate stream reaches of relatively homogeneous habitat and to better evaluate habitat influences upon biological performance, the study area was divided into three segments (Table 12).

- The uppermost reach within the study area (**Segment 1**; RM 16.4) consisted of fair quality habitats. Moderate influence modified habitat attributes were predominant; however, minimum habitat quality was maintained as reflected in a QHEI score of 56.0. Positive aspects of stream habitat encountered within this reach included: extensive instream cover, high/moderate functional sinuosity, and a persistent wooded riparian corridor (including forested land use adjacent to the stream). Limiting aspects of stream habitat within this reach included: evidence of past channelization (though the recovery process was well underway), extensive siltation of pooled areas, and limited channel heterogeneity (likely related to past channel modifications). Though physical habitat for aquatic life within the upper segment of the study area was not optimal, significant habitat related impairment at this station did not appear likely.

- The middle reach of the study area between RM 15.8 (old Bowman Rd.) and RM 13.4 (Orange Rd.) represented **Segment 2**. This reach demonstrated an overwhelming predominance of moderate and high influence modified habitat attributes as reflected in a mean segment QHEI value of 47.6 (Table 11). All of the stations evaluated within this reach retained evidence of past channelization with little measurable recovery. Urban and industrial encroachment were pervasive and contributed to the abundance of negative habitat attributes. Limiting aspects of physical habitat included: low functional sinuosity, sparse instream cover, high degree of siltation, and poor channel development. A wooded riparian corridor was absent within this segment except for the reach between approximately RM 14.6 and RM14.45 (Armco, Inc. property). The overall lack of quality habitat could potentially exert a negative influence on biological potential if this segment was not already subject to severe chemical degradation.

- The lower reach of the study area between RM 11.7 (Illinois Rd.) and RM 0.6 (Applegate Rd.) represented **Segment 3**. The macrohabitats of this reach were considerably improved in comparison with the upper and middle segments of the study area as reflected in a mean QHEI value of 76.8. A mean reach QHEI value greater than 60 suggested that the macrohabitats within the lower reach of the study area were of a sufficient quality to support and maintain a community of aquatic organisms consistent with the WWH aquatic life use designation (Rankin 1989). Warmwater habitat attributes were predominant within this segment; at the same time, high influence and moderate influence modified habitat attributes occurred at a much lower frequency in comparison to the upstream segments. The station at RM 11.7 (Illinois Rd.) was the only station (within Segment 3) that demonstrated persistent evidence of previous channelization, though limited recovery was evident and minimal habitat integrity was maintained. The remaining stations within the lower reach exhibited considerable habitat heterogeneity. Positive habitat attributes found within this reach included: abundant coarse

Table 11. The Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for the Rocky Fork Mohican River study area, August-October, 1993.

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 Sinuousity*	*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 Sinuousity*	*Sparse/No Cover*	*Max Depth < 40 cm (WD,HW)*	**Total H.I. MWH Attributes**	*Recovering Channel*	*Heavy/Moderate Silt Cover*	*Sand Substrates (Boat)*	*Hardpan 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**
(17-733) – Rocky Fork Mohican River																																	
Year: 93																																	
16.4	56.5	8.2				■	■				■		3		●				1	▲	▲		▲				▲	▲	▲		6	.50	2.00
15.8	38.0	5.2									■		1	●	●	●	●		4		▲		▲	▲			▲	▲		▲	6	2.50	5.50
14.6	47.5	5.2	■				■				■		3	●		●	●		3		▲		▲	▲			▲	▲		▲	6	1.00	2.50
14.2	56.5	5.2	■				■	■			■		4	●		●			2	▲	▲		▲	▲				▲	▲		6	.60	1.80
13.4	48.5	6.0	■								■		2	●			●		2	▲	▲		▲	▲			▲	▲	▲		7	1.00	3.33
11.7	67.0	11.7	■				■	■			■		4	●			●		2	▲	▲		▲	▲			▲	▲	▲		7	.60	2.00
10.2	81.5	9.9	■	■		■	■	■	■	■	■	■	9						0		▲										1	.10	.20
6.4	76.5	11.9	■	■		■		■	■		■		7						0				▲					▲	▲		3	.13	.50
.6	82.5	19.8	■	■		■	■	■	■		■		7						0				▲					▲	▲		3	.13	.50
(17-734) – Touby Run																																	
Year: 93																																	
.4	48.0	12.2	■					■			■		4	●		●	●		3		▲		▲	▲	▲			▲	▲		6	.80	2.00
(17-750) – Clear Fork Mohican River																																	
Year: 93																																	
35.7	68.5	35.7	■	■		■	■				■		5			●	●		2				▲	▲			▲	▲	▲		5	.50	1.33

Table 12. Average QHEI values for three relatively homogeneous segments of the Rocky Fork Mohican River mainstem based on sampling conducted during August and October, 1993.

Sample Location: Segment Description				
Upstream River Mile	Downstream River Mile	Station River Mile	QHEI	Segment Average QHEI
Segment 1: Wilging Rd.				
16.4	16.4	16.4	56.5	56.5
Segment 2: Upstream Armco, Inc. to Orange Rd.				
15.8	13.4	15.8	38.0	47.6
		14.6	47.5	
		14.2	56.5	
		13.4	48.5	
Segment 3: Illinois Rd. to Applegate Rd.				
11.7	0.6	11.7	67.0	76.9
		10.2	81.5	
		6.4	76.5	
		0.6	82.5	

substrates, good/excellent channel development, abundant instream cover, mixed current velocities,and little evidence of past channelization. In addition, a mature wooded riparian corridor was fairly persistent within the lower reach. This segment of the study area contained the highest quality habitats encountered during the 1993 sampling effort.

- An additional aspect of physical habitat that likely influenced biological performance within the Rocky Fork Mohican River, though not directly measured by the QHEI, included the urban and industrial character of the middle segment of the watershed. Urbanization of a watershed leads to increased total runoff (and attendant urban/industrial nonpoint source pollution), higher peak discharge, and shorter duration of peak discharge (Gordon *et al.* 1992). The pervasive disturbances to the flow regime of impervious and well-drained urbanized catchments can adversely affect the ability of a river system to create and maintain habitats typically associated with less developed systems. Significant relationships have been found to exist between extent of urban land use and riparian condition, and biological performance within rivers and streams (Steedman 1988).

Touby Run

- The macrohabitats of Touby Run were evaluated at one fish sampling station (RM 0.4), where a QHEI value of 48.0 was scored. A QHEI value less than 60 suggested that near and instream habitats of Touby Run may have had a negative effect upon ambient biological performance (Rankin 1989). Moderate and high influence modified habitat attributes were predominant and reflected the urban and industrial character of the Touby Run subbasin (Table 11). The majority of this station was recently channelized and rip-rapped, which has resulted in fairly monotonous channel development and a near complete removal of woody riparian vegetation. Though this reach maintained a sinuous course, functional aspects of sinuosity were not evident. Positive aspects of physical habitat included pooled areas greater than 40 cm in depth, mixed current velocities, and coarse substrates, though these were mainly of concrete rip-rap

and other urban debris.

Clear Fork Mohican River

- The macrohabitats of the Clear Fork Mohican River were evaluated at one sampling station (RM 35.7), where a QHEI value of 68.5 was scored. A QHEI value greater than 60 suggested that the near and instream habitats encountered at this station were of a sufficient quality to support and maintain a community of aquatic organisms consistent with the WWH aquatic life use designation (Rankin 1989). The macrohabitats at this station appeared fairly typical of unmodified headwater streams within the Erie-Ontario Lake Plain (EOLP) ecoregion. Though high and moderate influence modified habitat attributes were present, these attributes appeared more reflective of the natural character of this stream, rather than anthropogenic modifications. The quality of physical habitat within this reach was characterized as good.

Biological Assessment: Macroinvertebrate Community

Rocky Fork Mohican River

- Invertebrate Community Index (ICI) scores from the Rocky Fork Mohican River ranged from 0 to 50 at the 11 locations sampled along a 16 mile reach from above Mansfield to the confluence with the Black Fork Mohican River (Table 13, Figure 9). The highest ICI value (50) was scored at the most upstream station at Wilging Rd. (RM 16.3); this score was indicative of a high quality macroinvertebrate community and reflected achievement of the Warmwater Habitat (WWH) aquatic life use biocriterion established for the Erie-Ontario Lake Plain ecoregion. Lowest scores and poorest macroinvertebrate community condition occurred in an approximate 2 mile stretch downstream from the four permitted Armco, Inc. wastewater outfalls (RMs 14.95-14.48). Values of 0 (very poor) and 4 (poor) were scored at Longview Rd. (RM 14.2) and Orange Rd. (RM 13.3), respectively. Subsequent recovery of the macroinvertebrate community progressed in a downstream direction with a moderate interruption observed in the vicinity of the Mansfield WWTP (RM 11.18). Near complete recovery to very good quality macroinvertebrate communities occurred by RM 6.4 at a site adjacent to Mt. Zion Rd. and about 7 downstream from below Mansfield. Community condition remained essentially the same from this location to the confluence with the Black Fork and reflected achievement of the WWH macroinvertebrate biocriterion in the lower 6.5 miles of the stream.

- Impacts to the macroinvertebrate community occurred rapidly at sites adjacent to the Armco facility and just downstream from the high quality background site at Wilging Rd. (RM 16.3). In a 0.5 mile stretch downstream from Wilging Rd., ICI scores declined to 42 (good) at RM 16.1 and then to 28 (fair) at RM 15.8 (old Bowman Rd. bridge). Macroinvertebrate community taxa richness underwent a similar sharp decline. Eighty-four total taxa, including 12 taxa of relatively pollution sensitive mayflies and caddisflies, were collected at Wilging Rd. while 76 total taxa (10 taxa of mayflies and caddisflies) and 60 total taxa (7 taxa of mayflies and caddisflies) were collected at RMs 16.1 and 15.8, respectively. The latter two sites were located on the Armco property proper but upstream from all wastewater outfalls. In this area, the Rocky Fork has been extensively modified over the years by steel plant activities. Stream bank riparian cover has been reduced to shrubs and weeds in some areas and was essentially nonexistent in the area around the old Bowman Rd. bridge. Adjacent land use is heavily industrial and consists of scrapyards and steel storage yards. The RM 15.8 site was additionally located downstream from and potentially impacted by a storm sewer draining a storm water lagoon at the nearby Luntz Corp. scrapyard.

Table 13. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Rocky Fork Mohican River study area, July-September, 1993. Stream uses indicated are those currently designated in the Ohio Water Quality Standards.

Quantitative Evaluation

Stream River Mile	Relative Density	Quant. Taxa	Qual. Taxa	Qual. EPT[a]	ICI	Evaluation
Rocky Fork Mohican River (WWH)						
16.3	2622	43	63	8	50	Exceptional
16.1	5327	44	56	8	42	Good
15.8	1851	53	25	1	28*	Fair
14.47	9335	15	3	0	14	Marginally Fair
14.2	1849	7	15	0	0*	Very Poor
13.3	17806	16	23	1	4*	Poor
11.5	2535	25	44	5	16*	Marginally Fair
11.10	2532	24	29	1	12	Poor
10.2	2507	30	43	4	16*	Low Fair
6.4	8010	38	49	9	46	Very Good
0.7	2732	33	43	12	46	Very Good
Touby Run (WWH)						
0.4	11414	32	43	7	36	Good
Clear Fork Mohican River (WWH)						
35.7	4548	35	48	14	44	Very Good

Ecoregional Biocriteria: Erie-Ontario Lake Plain (EOLP)
(from OAC 3745-1-07, Table 7-17)

INDEX	WWH	EWH	MWH[b]
ICI	34	46	22

a EPT= total Ephemeroptera (mayflies), Plectoptera (stoneflies) and Tricoptera (caddisflies).
b Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregional biocriterion (>4 ICI units); poor and very poor results are underlined.
ns Nonsignificant departure from ecoregional biocriterion (≤4 ICI units).

- Sampling of the macroinvertebrate communities at locations downstream from the Armco discharges reflected much more adverse water quality conditions. The ICI score in the Armco 002 mixing zone (RM 14.48) declined to 14 (low fair). Natural substrates at this site were covered with a thick layer of black oily solids and bacterial slime. The macroinvertebrate community collected from these substrates was extremely limited; only 3 taxa were found. The relatively high ICI score at this site was inflated by the presence of a few early instar mayflies and caddisflies collected from the artificial substrates. These organisms probably drifted in from better quality upstream areas; however, there was no evidence that any survived to later larval life stages. The ICI scores of 0 (very poor) and 4 (fair) at the next two downstream sites (Longview Rd. and Orange Rd., respectively) probably best reflected the true ambient biological conditions in this reach of the Rocky Fork. Both sites were physically similar in that habitat, though of good underlying quality, was saturated with oil; depositional areas were covered with layers of black solids and bacterial and blue-green algae slimes. Macroinvertebrate taxa richness was about 25% of background levels and the two sites were overwhelmingly predominated (> 90% of the individuals collected) by toxics tolerant aquatic worms and midges. It was readily apparent that macroinvertebrate biotas in this reach were far more impaired by existing sediment and water quality toxicity than any habitat limitations due to past channel alterations.

- Moderate recovery in the macroinvertebrate community occurred at the next downstream location downstream from Illinois Ave. (RM 11.5). This site was above the Mansfield WWTP outfall (RM 11.18) but below small discharges from Stone Container (RM 11.7) and a package WWTP (RM 11.6) serving the east side of Illinois Ave. The ICI score improved to 16 (low fair) at the site. Although numerically predominated by midges and tolerant organisms, the community consisted of a much higher diversity of total taxa (54) and included the

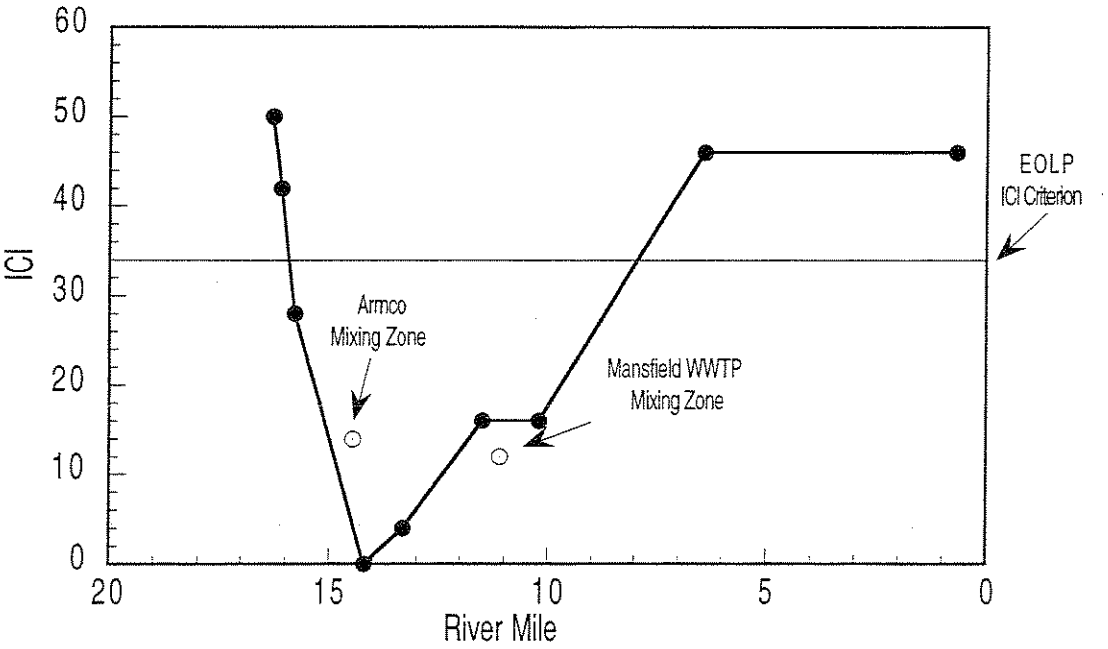

Figure 9. Longitudinal performance of the Invertebrate Community Index (ICI) within the 1993 Rocky Fork Mohican study area, 1993.

reappearance of a few types of mayflies and caddisflies. There was no distinguishable impact to the community which could be linked to either of the small upstream discharges although there was considerable foaming in both the effluent flow from the package WWTP and below riffle areas in the Rocky Fork.

- The recovery pattern of the macroinvertebrate community in the Rocky Fork appeared to be delayed for a short stretch below the Mansfield WWTP discharge (RM 11.18). Sampling in the mixing zone at RM 11.1 resulted in an ICI score of 12 (poor). Though not appreciably different than the community collected upstream from the discharge near Illinois Ave., there was a 20% reduction in total taxa diversity. Similar to the upstream site, toxics tolerant midges continued to numerically predominate. Macrohabitat within the mixing zone was restricted to a strong run with limited pooled conditions adjacent to well structured margins. Substrates were primarily gravel and sand. Evidence of a contributing toxic impact on the macroinvertebrates in the Mansfield WWTP effluent mixing zone included the substantial decline in diversity from the upstream site, the poor ICI score, and the field observation of low numbers of organisms inhabiting available natural substrates. Although community quality was not markedly lessened, the effect of the WWTP effluent noticeably interrupted the rather fragile recovery process that was occurring upstream from the outfall.

- Recovery of the macroinvertebrate community was again underway by the next downstream sampling location at SR 39 (RM 10.2) about one mile below the Mansfield WWTP. Though still very marginal in quality, the composition and structure of the community was comparable to the one collected at Illinois Ave. as evidenced by the same ICI score of 16 (low fair). Much like both the Illinois Ave. and the Mansfield mixing zone sites, the community at SR 39 continued to be numerically predominated by midges and toxics tolerant organisms, while a few taxa and individuals of more pollution sensitive mayflies and caddisflies made up a very minor proportion of the community. High quality macrohabitat and substrate conditions exist at SR 39 and certainly have the potential to support an equally high quality macroinvertebrate community if upstream sediment and water quality problems are addressed. As it was, the community at this location, though showing some limited recovery, was performing substantially below regionally based WWH expectations.

- Near complete recovery of the macroinvertebrate community to a level approaching the background condition was reached by RM 6.4 (adjacent to Mt. Zion Rd.) and sustained through the lower reaches of Rocky Fork downstream to near Applegate Rd. (RM 0.7). Though not quite the caliber of the most upstream Rocky Fork site at Wilging Rd. with respect to ICI score and taxa diversity and richness, ICI scores at both sites (46) clearly exceeded the WWH biocriterion for the Erie-Ontario Lake Plain ecoregion. Both sites were well populated with a number of mayfly and caddisfly taxa (10 at RM 6.4 and 12 at RM 0.7) which proportionately made up greater than 60% of the total number of organisms collected. The number of tolerant organisms declined substantially from over 45% or more of individuals collected at upstream sites to about 5% at these two locations.

Touby Run

- Touby Run, a small urban stream tributary to the Rocky Fork near downtown Mansfield (RM 13.7), was sampled at one location near Main St. (RM 0.4). The ICI score of 36 was just exceeding the WWH biocriterion and indicated an adequate level of macroinvertebrate community performance in this small urban tributary. Other than urban nonpoint sources of pollution (*e.g.*, storm water runoff), the only pollution source potentially affecting Touby Run

at this location was process wastewater from New Artesian Limited Partnership, a manufacturer of vitreous china plumbing fixtures discharging at RM 4.8. The high density of organisms collected with artificial substrates at this site along with field observations of high instream organism densities, moderate to heavy siltation, and moderate to heavy filamentous algal growths were indications of fairly significant nutrient enrichment. However, such conditions are fairly typical of small urban streams with substantial storm water runoff potential and little treed riparian cover. The effect of Touby Run on the Rocky Fork can only be considered beneficial from the perspective of providing dilution to the existing degraded water quality of the larger stream.

Clear Fork Mohican River

- The Clear Fork Mohican River was sampled near Marion Avenue Rd. (RM 35.7) just south of Ontario and upstream from Clear Fork Reservoir. The original intent of sampling this location was to provide an alternate background community assessment if the Wilging Rd. site, chosen as the Rocky Fork background, proved insufficient due to known or unknown upstream impacts. Macroinvertebrate results from the Clear Fork were fairly similar to those obtained from Wilging Rd. Though not having quite the taxa richness of the upstream Rocky Fork site, the community was still well populated by a variety of small headwater taxa including 16 taxa of mayflies and caddisflies and an unusual assemblage of some fairly uncommon midge species. The ICI value of 44 scored at Marion Avenue Rd. exceeded the WWH macroinvertebrate biocriterion and indicated that the Clear Fork was performing well above minimum ecoregional expectations at this location.

Biological Assessment: Fish Community

Rocky Fork Mohican River

- A total of 9,722 fish comprised of 35 species and three hybrids was collected from the Rocky Fork Mohican River mainstem between August 19 and October 5, 1993. The sampling effort included a total of 25.4 km at 11 sampling stations between RM 16.4 (Wilging Rd.) and RM 0.6 (Applegate Rd.).

- The numerically predominant fish species were: creek chub (23.4%), gizzard shad (16.8%), blacknose dace (15.4%), bluntnose minnow (10.2%), and white sucker (9.7%). Species that predominated in terms of biomass were: white sucker (38.1%), common carp (29.0%), creek chub (8.2%), gizzard shad (6.1%), and northern hog sucker (5.0%). Both in terms of relative abundance and biomass the fish assemblage of the Rocky Fork Mohican River was predominated by tolerant, omnivorous, and generalist feeding species and was indicative of the degraded condition generally found within the study area.

- The stream reach between RM 16.4 and RM 14.2 represented the headwater segment of the Rocky Fork Mohican River study area (*i.e.*. drainage area $\leq$ 20 sq. mile). In headwater areas the only the IBI community index is applicable. Wading criteria were applied within the lower reach of the study area between RM 13.4 and RM 0.6, where both the MIwb and IBI fish community indices were employed to evaluate ambient biological condition.

- Fish community indices and narrative evaluations ranged from good (IBI=41; MIwb=9.1) at RM 0.6 to very poor (IBI=12; MIwb=2.5) at RMs 13.4 and 14.2 (Table 14). Viewed in the

Table 14. Fish community indices based samples collected by Ohio State University and Ohio EPA in the Rocky Fork Mohican River study area, 1979 - 1993.

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel.No. (No./0.3 km)	Mean Rel.Wt. (Wt./0.3 km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Rocky Fork Mohican River (1993)								
Erie -Ontario Lake Plain - WWH Use Designation (Existing)								
16.4	14.0	14	1035.0	22.9	56.5	N/A	31*	Fair
15.8	11.5	14	598.5	32.5	38.0	N/A	18*	Poor
14.6	7.0	9	90.9	14.6	47.5	N/A	14*	V. Poor
14.47mz	*1.0*	*2*	*6.0*	*0.08*	-	*N/A*	*12**	*V. Poor*
14.2	0.0	0	0.0	0.00	56.5	N/A	12*	V. Poor
13.4	3.5	6	6.36	0.13	48.5	2.5*	12*	V. Poor
11.7	9.5	15	202.5	12.5	67.0	3.9*	19*	V. Poor/Poor
11.1mz	*11.5*	*14*	*3456.0*	*34.3*	-	*6.7**	*23**	*Fair/Poor*
10.2	11.0	13	703.5	38.9	81.5	5.2*	21*	Poor
6.4	17.5	19	1119.8	34.3	76.5	6.6*	26*	Fair/Poor
0.6	23.5	26	2676.0	57.7	82.5	9.1	41	Good
(1982)								
18.4	8.5	10	198.75	-	-	-	34*	Fair
16.4	9.0	10	217.5	-	-	-	34*	Fair
14.2	3.8	7	73.15	-	-	-	16*	Very Poor
12.5	5.5	8	195.4	-	-	-	19*	Poor
4.4	4.8	8	50.64	-	-	-	18*	Poor
(1979)								
11.6	7.0	11	291.7	-	-	-	21*	Very Poor
10.2	5.0	5	69.25	-	-	-	18*	Very Poor
4.4	6.0	7	147.8	-	-	-	20*	Poor
0.6	6.0	6	114.0	-	-	-	20*	Very Poor
Touby Run (1993)								
0.4	11.0	14	1229.3	20.3	48.0	N/A	29*	Fair
Clear Fork Mohican River (1993)								
35.7	14.5	17	2065.8	9.85	68.5	N/A	43	Good

Ecoregion Biocriteria: Erie Ontario Lake Plain

Index - Site Type	WWH	EWH	MWH[b]
IBI - Headwaters	40	50	24
IBI - Wading	38	50	24
MIwb - Wading	7.9	9.4	6.2

* - Significant departure from applicable criteria (>4 IBI units or >0.5 MIwb units); underlined values were in the poor or very poor range.
ns - Nonsignificant departure from biocriteria (≤4 IBI units or ≤0.5 MIwb units).
a - Narrative evaluation is based on applicable biocriteria.
b - Modified Warmwater Habitat for channel modified areas.
N/A - Headwater station, MIwb is not applicable.
mz - Mixing zone station.

aggregate (all stations) the fish assemblage was characterized as poor/fair. Community performance consistent with ecoregional expectations was observed at only one station (RM 0.6). The remainder of the study area failed to support fish assemblages consistent with the WWH biological criteria. Longitudinal performance of the fish community portrayed a clear and distinct impact associated with the Armco Inc. facility (Figure 10).

- The fish assemblage within the upper portion of the study area (RM 16.4) was characterized as fair (IBI=31). Though the community at this station was predominated by tolerant and omnivorous species and failed to fully achieve the WWH biological criterion, many functional and structural components were maintained. Simple lithophilic and insectivorous species were represented within the assemblage as well as two sensitive species (greenside darter and redside dace). A mean relative abundance of 1,035.0 fish/0.3 km and a relative weight of 22.9 kg/0.3 km indicated that this reach supported an abundance of fish. However, the functional organization within the assemblage was not quite consistent with that required to achieve the WWH criteria. The factors presently affecting the fish assemblage at this station appeared related, in part, to the locallly modified habitat.

- Performance of the fish community at RM 15.8 (upstream from the old Bowman Rd. bridge and Luntz Corp. storm sewer) declined to a poor level (IBI=18). In comparison to the station upstream, species richness (particularly native cyprinids) was diminished and the numbers of simple lithophilic, sensitive and headwater species were all reduced. An additional indication of sublethal stress within the fish assemblage at this station was an increase to 1.85% in the mean percent occurrence of deformities, eroded fins/barbels, lesions, and tumors (DELT) anomalies. Based upon ecoregional reference conditions, a mean percent occurrence of DELT anomalies greater than 1.3% (90th percentile) is considered highly elevated (Ohio EPA 1987[b]). An increase in the frequency of occurrence of DELT anomalies has been shown to be a reliable and consistent indicator of stream degradation (Leonard and Orth 1986; Ohio EPA 1987[b]). Though relative abundance was reduced to 598.5/0.3 km, in comparison to the upstream station, comparable biomass was maintained. The condition of near and instream physical habitat at this station, and the reach extending downstream to RM 13.4, was generally poor. Channel development was fairly monotonous and instream cover was sparse as a consequence of past channelization. The substrates were generally shifting and unstable sand and silts, and the reach lacked a mature wooded riparian corridor. The poor condition of physical habitat likely had a negative effect upon the ability of this segment to support as diverse and organized fish community as encountered upstream. An additional factor that likely contributed to diminished community performance was the heavy industrial land use immediately adjacent to the stream. Runoff from the industrialized area of the Armco, Inc. facility would likely introduce stressing agents. The observed shifts within the health and organization of the fish community were more indicative of impacts to water and/or sediment quality rather than poor habitat alone. The lack of quality habitat certainly had a negative influence; however, within Ohio, fish communities associated with impacts to physical habitat alone typically perform at a level no worse than fair. The condition of the community at RM 15.8 was poor and included elevated DELT anomalies. This condition was more indicative of impacts to chemical integrity of the water column and/or sediments of the Rocky Fork Mohican River.

- Downstream from Armco, Inc. outfalls 001, 003, and 004 (RM 14.6) longitudinal performance of the fish community portrayed toxic response. Every aspect of the fish assemblage was significantly diminished and resulted in a narrative evaluation of very poor (IBI=14). The most striking changes included a dramatic reduction in relative abundance

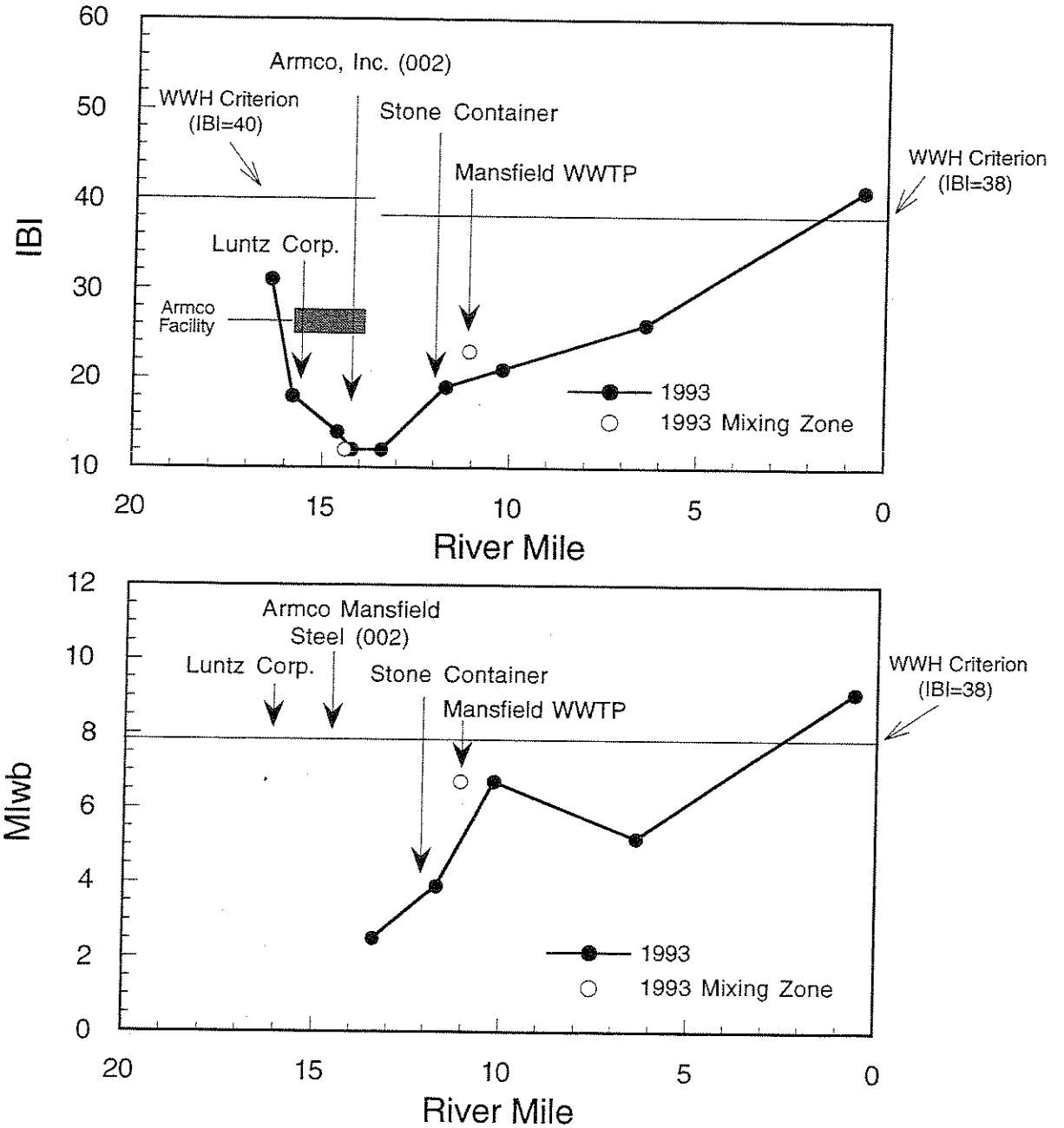

Figure 10. Longitudinal performance of the Index of Biotic Integrity (IBI, upper plot) and the Modified Index of Well-being (MIwb, lower plot) within the 1993 Rocky Fork Mohican study area, 1993.

(90.9/0.3 km), and an increase in the mean percent occurrence of DELT anomalies to 10.2% (Figure 11). The fish assemblage at this station was severely impaired. Though physical habitat within this reach was generally poor (given the mean QHEI of Segment 2) and likely had a negative effect on the ambient biological potential of this reach, the condition of the fish community was indicative of significantly degraded water and/or sediment quality.

- The fish assemblage within the reach between Armco, Inc. outfall 002 (RM 14.47) and Orange Rd. (RM 13.4) was severely impaired and nearly devoid of fish. Within this segment, only 13 individual fish were collected. This number is extremely low, given that this 1.05 mile (1.69 km) reach contained three sampling stations (one mixing zone and two standard zones) that were intensively sample twice during the summer field season. Only two fish were collected at RM 14.47 (002 mixing zone). The station at RM 14.2 (Longview Rd.) was found to be completely devoid of fish life, and only eleven fish were collected at RM 13.4 (Orange Rd.) ; both stations received IBI scores of 12. Though physical habitat within this segment was generally poor, the overall lack of fish was indicative of a severe and pervasive complex toxic impact which far surpassed the limiting effects of poor habitat alone (Figure 11). Rocky Fork sediments between RMs 14.47 and 13.4 appeared contaminated with oil and grease or other petroleum products. When the sediment within this segment was disturbed, a viscous black flocculent was suspended in the water column from which oil and grease were released along with a strong petroleum odor. The condition of the sediments described above was only observed downstream from the Armco, Inc. 002 outfall (RM 14.47) to Orange Rd (RM 13.4).

- Longitudinal performance of both the IBI and MIwb further downstream from the Armco, Inc. facility portrayed a trend of general recovery (Figure 10). The fish assemblage at RM 11.7 (Illinois Rd.), downstream of Stone Container, improved slightly; however the community was still characterized as very poor (IBI=19; MIwb=3.9). The most encouraging improvement was an increase in relative abundance to 202.5 fish/0.3 km. However, as the Rocky Fork Mohican River regained the ability to support fish life, the mean incidence of DELT anomalies rose to 20% (Figure 11). This observation indicated a continued chronic sublethal stress which was most likely the result the of Armco, Inc. discharges and sediment contamination. It was difficult to discern an influence from the Stone Container Corp. discharge on the fish community given the masking effects of the upstream point sources. At worst, Stone Container Corp. may have contributed to the degraded condition of the fish assemblage by delaying the recovery process. However, the magnitude of the impact from the Armco Mansfield facility, and the overiding influence of this facility within the middle and lower reaches of the study area virtually precluded a meaningful ambient biological assessment of the effect of the Stone Container Corp. discharge.

- The fish community showed a modest improvement downstream from the Mansfield WWTP, both within the mixing zone (RM 11.1) and at SR 39 (RM 10.2). Relative abundance continued to increase while the mean occurrence of DELT anomalies (10%) began to decline. Despite highly elevated DELT anomalies and assessment index values within the poor/fair range, the fish assemblage demonstrated incremental recovery. It appeared that treated wastewater discharged by the Mansfield WWTP had a dilutional effect on Rocky Fork water quality.

- The process of recovery within the fish community progressed downstream and appeared complete near the mouth. The fish assemblage at RM 6.4 (adjacent to Mt. Zion Rd.) was improved though performance was characterized as poor/fair (IBI=26; MIwb=6.6). Positive

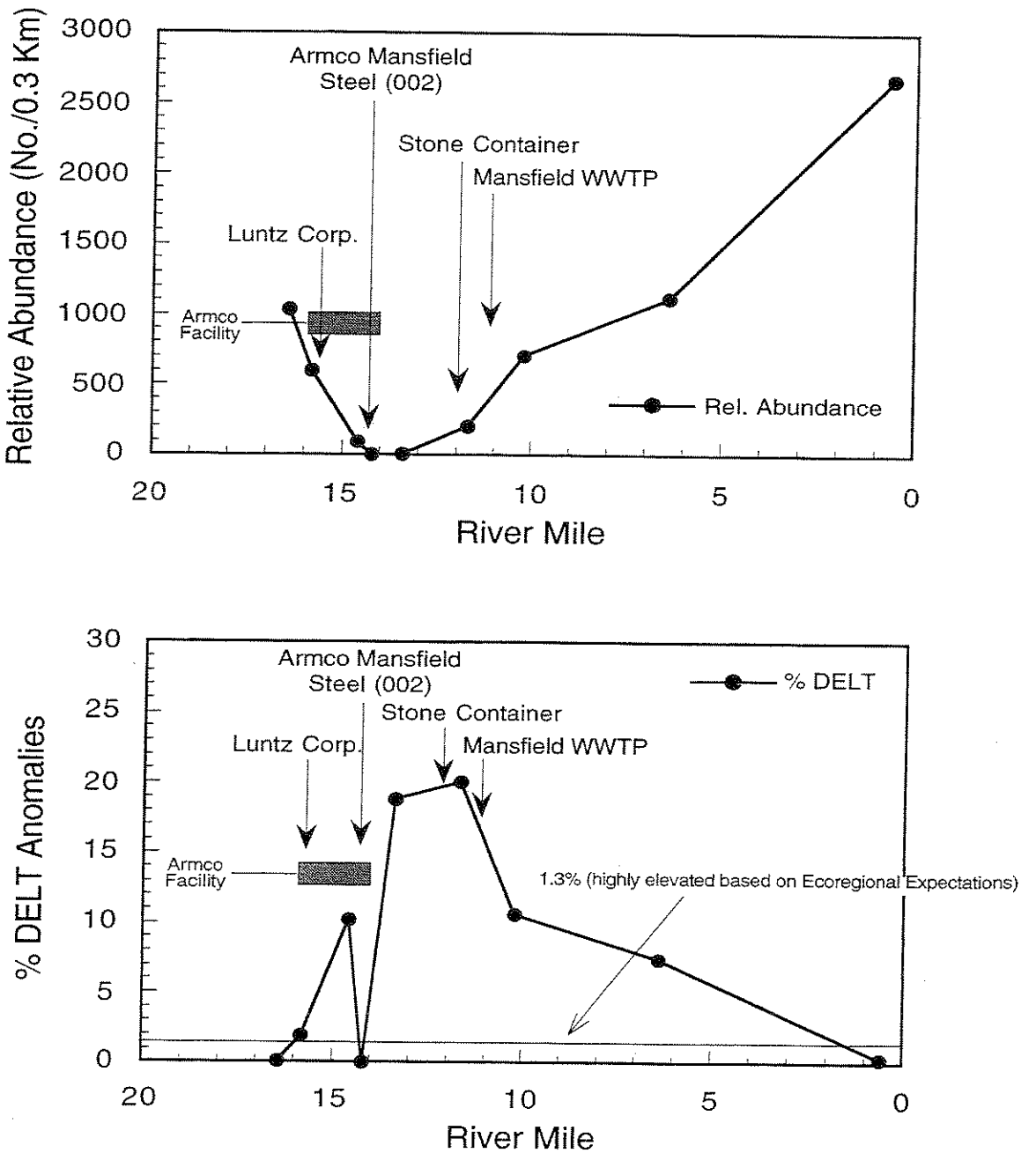

Figure 11. Longitudinal display of relative abundance (No./0.3 km)(upper plot) and the mean percent occurrence of deformities eroded fins/barbels lesions and tumors (DELT) anomalies (lower plot) within the 1993 Rocky Fork Mohican study area. (note: community samples from 50 meter mixing zones were excluded)

community attributes observed at this station included: an increase in relative abundance (1119.8 fish/0.3 km), and increased species richness, an additional decline in the mean occurrence of DELT anomalies to 7.4% (although still highly elevated), and the presence of an intolerant species (*e.g.* banded darter) within the assemblage. Full recovery of the fish community was observed at RM 0.6 (Applegate Rd). Community performance as measured by the IBI and MIwb exceeded the WWH biological criteria (IBI=41;MIwb=9.1). Species richness was high and the fish community was well organized. In addition, the mean incidence of DELT anomalies was reduced to 0.3%, and highly intolerant species (*e.g.* banded darter, black redhorse, rosyface shiner, and river chub) were well represented within the fish assemblage.

Touby Run

- A total of 1,639 fish comprised of 14 species was collected from Touby Run between August 24 and October 1, 1993. Fish community samples were collected from one station at RM 0.4 (SR 13). The numerically predominant fish species were: blacknose dace (45.2%), creek chub (36.2%), and bluntnose minnow (11.1%). Species predominating in terms of biomass were: blacknose dace (54.7%), creek chub (29.6%), and white sucker (12.6%). In terms of relative abundance and biomass, the fish community was predominated by tolerant, omnivorous, and feeding generalists.

- Community performance as measured by the IBI was characterized as fair (IBI=29) and failed to fully achieve the WWH biological criterion (Table 14). The condition of the fish assemblage at this station was likely reflective of the poor condition of physical habitat and the effect of urban and industrial polluted runoff.

Clear Fork Mohican River

- A total of 2,709 fish comprised of 17 species was collected from the Clear Fork Mohican River between August 25 and October 5, 1993. The numerically predominant fish species were: central stoneroller (32.6%), creek chub (20.7%), blacknose dace (19.6%), and white sucker (6.43%). Species predominating in terms of biomass were: creek chub (30.8%), white sucker (29.8%), central stoneroller (16.3%), and blacknose dace (12.4%). In terms of relative abundance and biomass, the fish assemblage was predominated by herbivorous, tolerant omnivorous, and generalist feeding species. The abundance of these species, particularly the herbivorous central stoneroller suggested modest nutrient enrichment.

- Community performance as measured by the IBI was characterized as good (IBI=43), consistent with the WWH use designation (Table 14). Although tolerant species were predominant, the functional organization within the fish community was maintained. Species richness, particularly the number of native cyprinids and darter/sculpin species, was reflective of ecoregional expectations, and sensitive species were represented within the fish community.

Trend Assessment

Chemical Water Quality Changes: 1977-1993.

- The following is an evaluation of changes in water quality which have occurred in the Rocky Fork Mohican River between 1977 and 1993. Historical data used in this evaluation was obtained from the Comprehensive Water Quality Report for the Rocky Fork of the Mohican River Subbasin (Ohio EPA 1983). Analytical results included in this report are from samples collected by the Ohio EPA between June, 1977 and October, 1979. Chemical analyses were

completed by the Ohio Department of Health laboratories located in Columbus, Ohio, and Bowling Green, Ohio using methods approved by U.S. EPA.

- A significant negative change in the D.O. regime has occurred in the upper Rocky Fork Mohican River. The mean D.O. concentrations (Figure 12) have declined significantly since 1979. In addition, the D.O. sag which occurred downstream from the Armco, Inc. facility was much more severe in 1993

- Due to the elimination of several significant industrial dischargers, a reduction in mean concentrations of heavy metals has occurred in the upper Rocky Fork Mohican River drainage. The mean copper concentration (Figure 12) at Illinois Ave. (RM 11.59) declined from 44 µg/l in 1977-79 (n=19) to 17 µg/l in 1993. In 1977-79, eleven samples were below the method detection limit (MDL) and four water quality standard exceedences documented. In 1993, four of six samples were below the MDL and only one water quality standard exceedence was documented. It should be noted that the MDL for copper was 30 µg/l in 1977-79 and in 1993 was 10 µg/l. In the calculation of mean concentrations, the MDL value is used for results below this limit. Therefore, the actual decline in mean concentration may be less than described above. The mean chromium concentration (Figure 12) at Illinois Ave. declined from 191 µg/l in 1977-79 (n=20) to 30 µg/l in 1993. In 1977-79, seven of 20 samples were below the MDL, and five water quality standard exceedences were documented. In 1993, all six samples were below the MDL.

- Water quality impacts in the lower Rocky Fork Mohican River drainage have historically occurred primarily due to the City of Mansfield WWTP outfall 001 discharge. The Mansfield WWTP completed a series of upgrades to its sewage treatment and collection systems in 1987. These upgrades included the change in design or addition of aeration tanks, secondary clarifiers, chlorination and dechlorination units, and the construction of a 4.9 million gallon capacity stormwater retention basin. The City of Mansfield also implemented an approved industrial pretreatment program in 1984. As a result, pollutant concentrations in the Rocky Fork Mohican River downstream from the Mansfield WWTP documented in 1993 have declined dramatically since the 1977-79 (Ohio EPA 1983) Further improvements in the sewage collection system are currently in progress including the initiation of the Madison Township sewer project.

- Due to upgrades at the WWTP, a significant change in the types and concentrations of nitrogenous compounds has occurred in the lower Rocky Fork Mohican River drainage. Influent entering the Mansfield WWTP is characteristically high in ammonia-N, which is known to be toxic to aquatic life at low concentrations. By increasing aeration and retention time, aerobic bacteria can more efficiently convert ammonia-N to nitrite-N and then nitrate-N. This increase in nitrification has reduced mean ammonia-N concentrations and increased mean nitrate+nitrite-N concentrations in the Rocky Fork Mohican River. The mean ammonia-N concentration (Figure 13) at S.R. 39 (RM 10.13) has decreased from 4.76 mg/l in 1977-79 (n=15) to 0.09 mg/l in 1993 (n=6). In 1977-79, no samples were below the MDL and four water quality standard exceedences were documented. In 1993, three samples were below the MDL and there were no water quality standard exceedences documented. Conversely, the mean nitrate+nitrite-N concentration (Figure 13) has increased from 1.11 mg/l in 1977-79 (n=11) to 10.7 mg/l in 1993 (n=6). This has reduced or eliminated near field toxic impacts from ammonia-N on aquatic life, but increased the risk of negative impacts resulting from nutrient enrichment. The increase in nutrient availability can lead to nuisance growths of algae

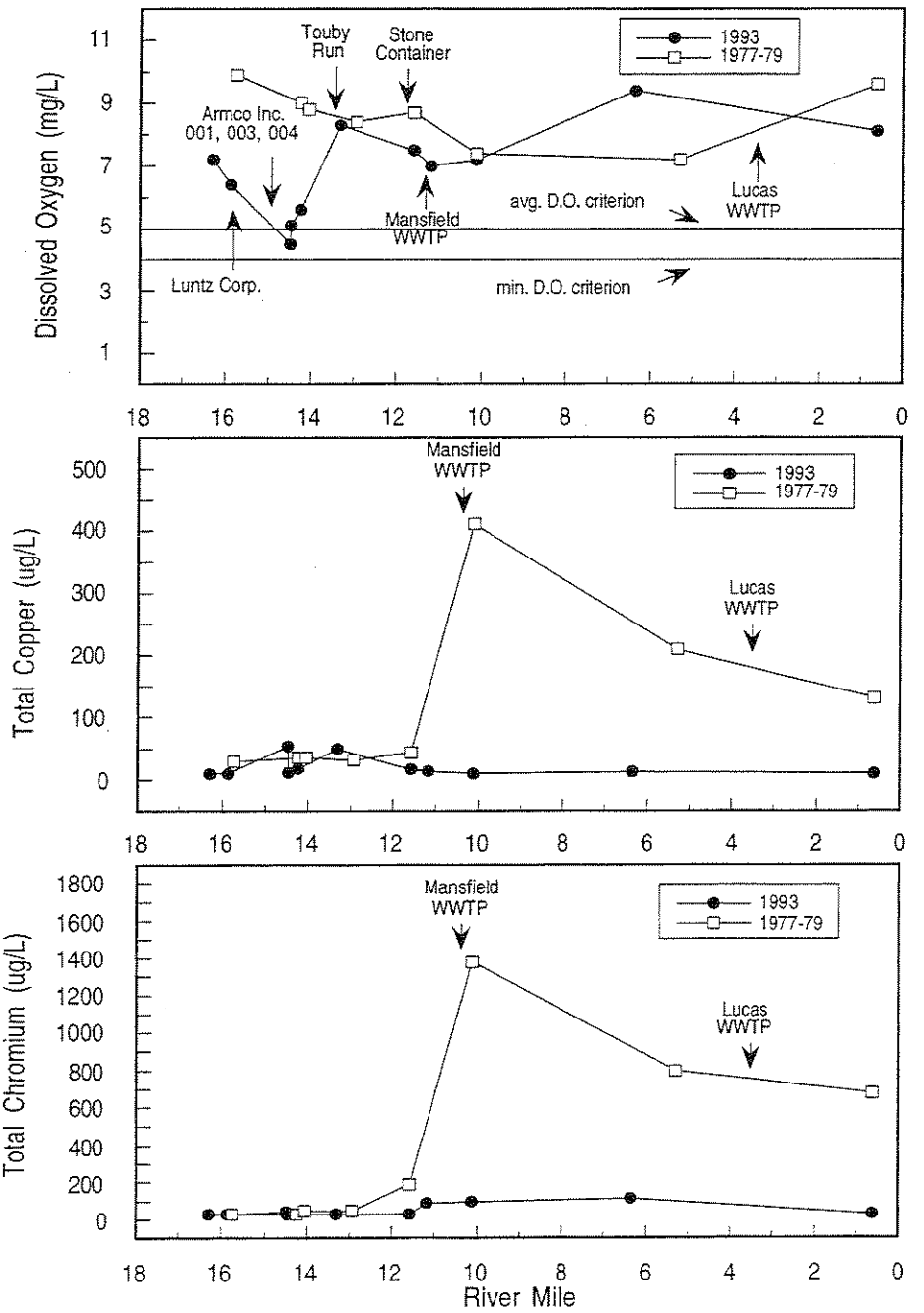

Figure 12. Longitudinal trend of mean dissolved oxygen, total copper, and total chromium in the Rocky Fork Mohican River study area, 1977-1993.

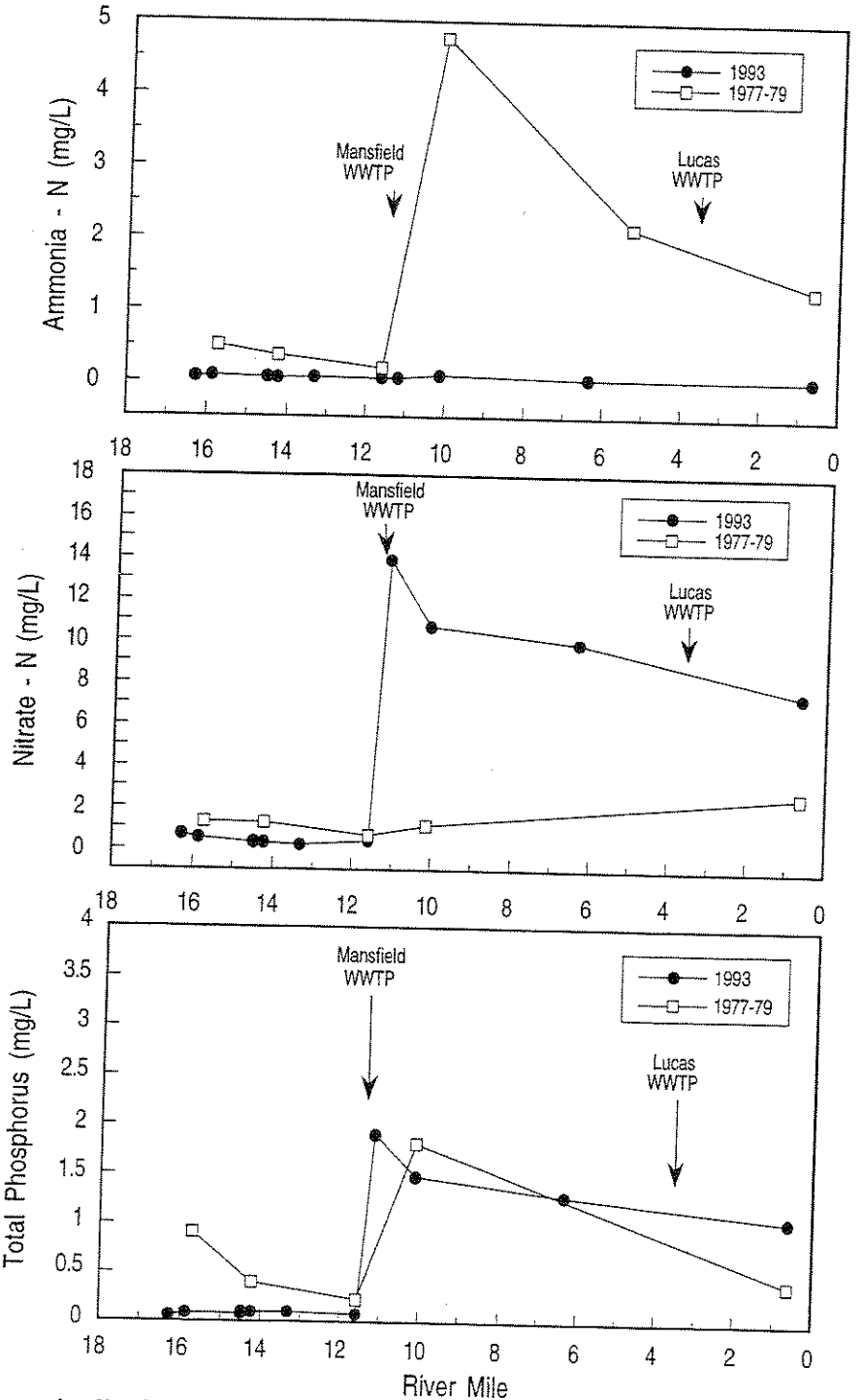

Figure 13. Longitudinal trend of mean ammonia-N, nitrate-N, and total phosphorus in the Rocky Fork Mohican River study area, 1977-1993.

which, in turn can result extremes in diel oxygen variability.

- WWTP upgrades and implementation of a pretreatment program have resulted in a dramatic reduction in mean concentrations of heavy metals has occurred in the lower Rocky Fork Mohican River drainage. The mean copper concentration at S.R. 39 has decreased from 410 µg/l in 1977-79 (n=20) to 10 µg/l in 1993 (Figure 12). In 1977-79, all twenty samples were documented as water quality standard exceedences. In 1993, four samples were below the MDL, with no water quality standard exceedences documented. The mean chromium concentration has decreased from 1,380 µg/l in 1977-79 (n=20) to 96 µg/l in 1993 (Figure 12). In 1977-79, all twenty samples were documented as water quality standard exceedences. In 1993, five samples were below the MDL, with one exceedence of the AWS criteria due to a slug discharge to the WWTP from a pretreatment industry.

- No change in mean phosphorus concentration has occurred since 1977-79 (Figure 13). Reduction in phosphorus is difficult to achieve and requires advanced tertiary treatment technologies. However, the Mansfield WWTP does add polymer to enhance phosphorus removal.

Changes in Biological Community Performance: Macroinvertebrate Community 1974- 1993

- Only a limited amount of historical macroinvertebrate data has been collected by the Ohio EPA from the Rocky Fork Mohican River. In 1974, two quantitative samples were obtained from sites just above the Armco Mansfield 002 wastewater outfall (RM 15.0) and in the 002 mixing zone (RM 14.47). In 1977, staff from the Northwest District Office made qualitative collections of macroinvertebrates from the Rocky Fork at five locations: Wilging Rd. (RM16.4), Longview Rd. (RM 14.2), Illinois Ave. (RM 11.6), SR 39 (RM 10.2), and Applegate Rd. (RM 0.6). Both years of information were assessed and reported in an Ohio EPA document entitled "Comprehensive Water Quality Report for the Rocky Fork of the Mohican River" (Ohio EPA 1983).

- Results from the 1974 quantitative macroinvertebrate sampling above and below the Armco 002 outfall were similar to those observed in the same general area in 1993. ICI values of 4 (poor) and 0 (very poor) were scored at the upstream and downstream sites, respectively. The macroinvertebrate communities were predominated by toxics tolerant organisms, primarily dipterans and aquatic worms. There were no mayflies or caddisflies collected at either site. There has been little change in aquatic resource quality in this area over the past 20 years.

- The qualitative macroinvertebrate sampling in 1977 corroborated and further defined the degree and longitudinal extent of the degradation in the Rocky Fork. A good macroinvertebrate community (at least 34 taxa) was collected at Wilging Rd., upstream from the Mansfield area discharges, while poor to very poor communities (fewer than 20 taxa) were collected at the four downstream sites. The results indicated that additional degradation to the macroinvertebrate community occurred below the Mansfield WWTP at SR 39 with little change in community quality noted even at the farthest downstream station at Applegate Rd (RM 0.6). It is clear that improvements made in watewater treatment at the Mansfield WWTP (subsequent to 1977) have resulted in considerable positive changes to macroinvertebrate community condition in the lower reaches of Rocky Fork as evidenced by very good community performance observed in the lower 6.5 miles in 1993.

- Analysis of the Area of Degradation Value results for the ICI (ADV/ICI) showed that the

segment upstream from the Mansfield WWTP accounted for 78% of the total ADV/ICI in 1993 (Table 15). This is yet another demonstration that the majority of the degradation remaining in the Rocky Fork Mohican River is the result of point and nonpoint sources upstream from the Mansfield WWTP.

Table 15. Area of Degradation (ADV) statistics for the Rocky Fork Mohican River study area, 1981 and 1993 ADVs are calculated using ecoregion biocriteria as the background community performance. The statistics include the entire mainstem and the segments upstream and downstream from the Mansfield WWTP.

Biological Index Scores			ADV Statistics					Attainment Status (miles)[a]			
Stream Index	Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV	ADV/ Mile	Poor/VP ADV	FULL	PARTIAL	**NON**	Poor/VP
Rocky Fork Mohican River (1979)											
IBI	11.6	0.6	18	24	1734	**143**	887	*0.0*	*0.0*	*12.1*	*12.1*
Rocky Fork Mohican River (1982)											
IBI	16.4	4.4	18	35	1540	**118**	665	*0.0*	*0.0*	*13.1*	*10.4*
Rocky Fork Mohican River (1993)											
IBI			12	39	1627	**96**	717				
MIwb	16.4	0.6	2.5	9.1	950	**56**	70	3.0	3.3	10.6	10.5
ICI			0	50	1173	**69**	178				
Rocky Fork Mohican River (1993) ust. Mansfield WWTP											
IBI			12	31	981	**169**	545				
MIwb	16.4	11.5	2.5	3.8	595	**103**	71	*0.0*	*0.6*	*5.2*	*5.1*
ICI			0	50	916	**158**	178				
Rocky Fork Mohican River (1982) ust. Mansfield WWTP											
IBI	16.4	12.5	19	35	480	**83**	172	*0.0*	*0.0*	*5.0*	*2.3*
Rocky Fork Mohican River (1993) dst. Mansfield WWTP											
IBI			21	39	667	**60**	186				
MIwb	11.1	0.6	5.2	9.1	365	**33**	5	3.0	2.7	5.5	5.5
ICI			16	46	201	**18**	0				
Rocky Fork Mohican River (1979) dst. Mansfield WWTP											
IBI	10.2	0.6	18	22	1546	**144**	797	*0.0*	*0.0*	*10.7*	*10.7*

a - Attainment status based on one organism group are in italics.

Changes in Biological Community Performance: Fish Community 1979-1993

- Fish community data were collected from the Rocky Fork Mohican study area in 1979, 1982, and 1993. The evaluation conducted in 1979 included the stream reach between RM 11.6 (Illinois Rd./upstream of Mansfield WWTP) and RM 0.6 (Applegate Rd.). The 1982 fish sampling effort was conducted in support of graduate research at the Ohio State University (Reash and Berra 1986, 1987, and 1989), and included the stream reach between RM 18.4 (Leppo Rd.) and RM 4.4 (Smart Rd.). The 1993 sampling effort included the reach between RM 16.4 (Wilging Rd.) and RM 0.6 (Applegate Rd.). The combined areas covered in both 1979 and 1982 was comparable with the 1993 study area, and allowed a near complete trend assessment of the ambient condition of the fish assemblage of the Rocky Fork Mohican River.

- The 1979 fish sampling effort was conducted between October 23-24, and employed both seining and electrofishing methodologies (sampler type G). Current Ohio EPA standardized ambient biological sampling protocols no longer encourage the use of sample type G (backpack elecro-fishing/seine combination), nor include community samples collected outside of the seasonal sampling window between mid-June and mid-October (Ohio EPA 1989b). Nevertheless, recent analysis determined the community data collected from the Rocky Fork Mohican River in 1979 to be sufficiently valid for trend purposes (Ohio EPA 1990b). The 1982 sampling effort was conducted from July to December and employed pulsed D.C. electrofishing methods. For the purpose of ambient biological assessment fish community samples collected in December and November were excluded from this analysis to conform with current Ohio EPA protocols (Ohio EPA 1989b). Due to the sampling methodologies employed in both 1979 and 1982, only the IBI was deemed applicable for trend assessment.

- Performance of the fish assemblage at Illinois Rd. (downstream Stone Container Corp./upstream Mansfield WWTP) has remained in the poor range since 1979 (Figure 14). The area that has demonstrated the greatest improvement was located between RM 10.2 (downstream from the Mansfield WWTP) and RM 0.6. In 1979, within this 9.6 mile segment, the fish community performed at a level no better than poor, and reflected a severe and pervasive impact from the Mansfield WWTP. Every component of the fish assemblage within this segment was significantly diminished in 1979. Relative abundance was very low (177/0.3 km), species richness was depressed (Twelve (12) species were recorded from this reach), and the assemblage lacked sensitive species.

- Though an impact was still evident in 1993 downstream of the Mansfield WWTP (and other point source dischargers upstream) significant improvement was evident (Figure 14). In 1993, substantial increases were demonstrated in relative abundance (1,632/0.3 km), species richness (twenty-nine (29) species were recorded from this reach), and the number of highly intolerant species (banded darter, rosyface shiner, black redhorse, and river chub) represented within the assemblage . Though the fish community did not perform at a level consistent with the WWH biological criteria at all stations downstream of the Mansfield WWTP, full recovery was evident at RM 0.6, and the overall structure and functional organization of the fish community within this segment was considerably improved in 1993. The significant improvement observed within the lower reach of the Rocky Fork Mohican River study area was commensurate with wastewater treatment upgrades at the Mansfield WWTP, and the fish community within the extreme lower reach of the study area met ecoregional expectations.

- Results from the 1982 sampling effort indicated that the fish assemblage performed at a fair level within the upper portion of the study area (upstream of Armco, Inc.). A precipitous decline was observed further downstream at RM 14.2 (downstream Armco, Inc. discharges)

in 1982 (Figure 14). Every attribute of the fish assemblage within the segment between RM 14.2 and RM 12.5 was significantly diminished. Species richness, abundance, and biomass were considerably reduced in comparison with upstream stations. The trophic structure was greatly simplified, and the assemblage consisted of a few, highly pollution tolerant species (Reash and Berra 1987). In addition, the incidence of gross external and internal fish anomalies were significantly elevated in 1982 (Reash and Berra 1989). Heavy metals were identified as the principle contaminants in the 1982 study. Though a direct causal link could not be demonstrated between the incidence of fish anomalies and heavy metal contamination in 1982, previous studies implicate these pollutants as the likely causal agents (Reash and Berra 1989).

- The results from the 1993 sampling effort indicated little change upstream from the urban/industrial impacts in comparison to the 1982 results (Figure 14). The fish assemblage within this area continued to perform at a fair level. The severely degraded conditions encountered in 1982 downstream from Armco, Inc. remained, and may have worsened in 1993.

- In summary, the upper portions of the Rocky Fork Mohican River study area appeared stable between 1979 and 1993. The significant impacts associated with Armco, Inc. recorded in 1982 were still persistent in 1993. The condition of the fish assemblage downstream of the Mansfield WWTP to the mouth, was no better than poor in both 1979 and 1982. Though an

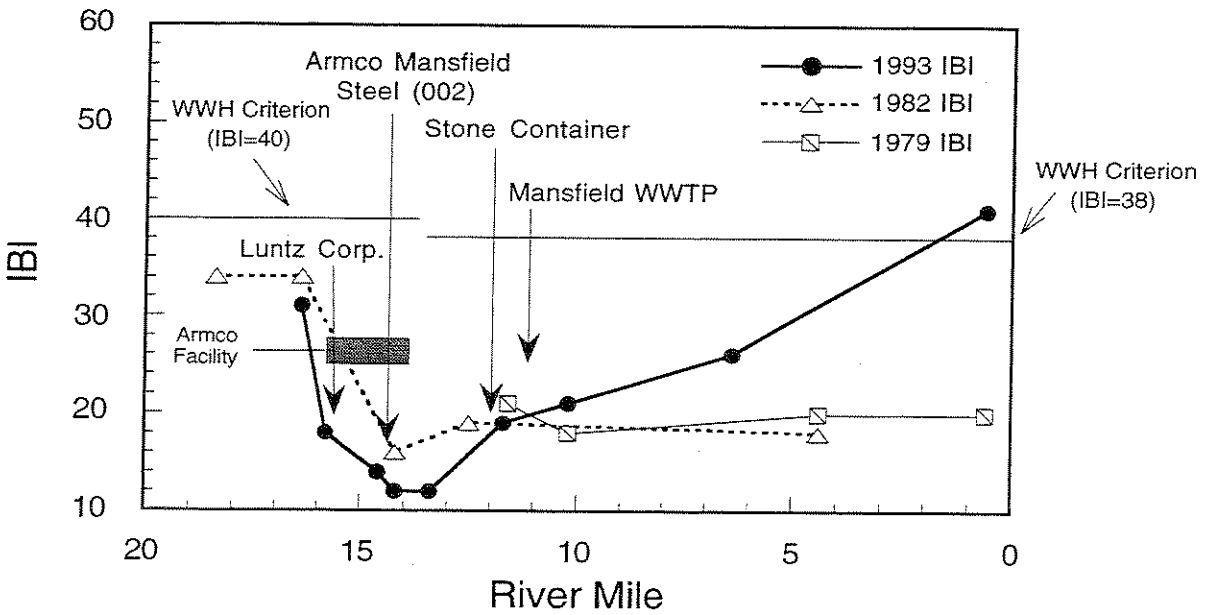

Figure 14. Longitudinal trend of the Index of Biotic Integrity (IBI) within the Rocky Fork Mohican River 1979-1993.

impact immediately downstream of the Mansfield WWTP was still apparent in 1993, considerable improvement was evident further downstream, with full recovery occurring near the mouth (RM 0.6). The stream reach downstream of the Mansfield WWTP was the only segment of the study area which exhibited biological improvement based on available historic data.

- The ADV statistics for the IBI and the MIwb for the 5.8 mile long stream segment upstream from the Mansfield WWTP accounted for 60 and 61%, respectively, of the IBI/ADV and MIwb/ADV for the entire 16.9 mile segment (Table 15). Differences in sampling method restricts comparison of ADV from previous surveys to the IBI. The Rocky Fork Mohican River ADV/mile for the IBI in stream segment upstream from the Mansfield WWTP increased from 83 in 1982 to 169 in 1993. Though sampling stations were not exact, this result reflects an increased severity of the impact on the fish community in 1993 compared to 1982. Conversely, the ADV/mile decreased in the stream segment downstream from the WWTP from 144 in 1979 to 60 in 1993, reflecting an improved though still impacted fish community.

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Appendix Tables

Table A-1. Results of chemical/physical sampling conducted in the Rocky Fork Mohican River study area during July-September, 1993. Results preceded by a less-than (<) indicate values below the method detection limit.

Rocky Fork Mohican River: RM 16.29 - Wilging Rd.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1035	22.0	8.5	7.5	8.01	<1.0	<1.0	12
930719	1025	20.6	6.2	7.8	8.03	<1.0	<1.0	10
930802	1100	19.5	6.8	8.0	8.01	1.1	<1.0	<10
930817	1045	21.3	6.4	8.0	8.05	1.2	<1.0	14
930830	1115	21.5	7.5	8.1	8.12	<1.0	<1.0	<10
930914	1120	18.4	7.8	8.1	8.20	<1.0	<1.0	<10

Rocky Fork Mohican River: RM 15.86 - old Bowman Rd.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1125	23.7	7.0	7.5	7.80	<1.0	<1.0	17
930719	1110	20.9	5.4	7.8	7.96	1.2	<1.0	15
930802	1150	21.0	7.9	8.2	8.08	1.1	<1.0	<10
930817	1130	22.6	5.3	7.9	7.98	2.3	1.4	10
930830	1200	23.2	5.2	8.1	7.99	<1.0	<1.0	19
930914	1150	19.4	7.4	8.2	8.16	<1.0	<1.0	21

Rocky Fork Mohican River: RM 14.49 - Upstream Armco, Inc. outfall 002 discharge

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1215	25.0	4.7	7.4	7.70	1.8	1.2	23
930719	1135	26.0	4.3	7.8	7.90	3.7	2.3	26
930802	1225	24.1	4.0	7.9	7.97	6.4	4.4	14
930817	1150	25.0	4.0	8.0	8.04	1.7	1.1	14
930830	1250	26.9	4.9	8.0	7.75	9.0	9.0	51
930914	1225	22.5	5.0	8.0	8.10	4.0	2.0	13

Table A-1. continued

Armco, Inc. (a.k.a. Cyclops Division Empire-Detroit Steel) Effluent at outfall 002: RM 14.48

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1205	28.0	5.9	7.1	7.09	6.4	4.1	31
930719	1140	23.3	6.0	7.7	NA	7.0	3.7	47
930802	1230	27.4	6.1	8.1	8.15	2.9	2.0	15
930817	1200	29.3	5.6	8.1	8.11	10	1.4	35
930830	1240	30.4	5.6	7.6	8.03	2.0	<1.0	18
930914	1215	27.7	5.8	8.1	8.01	1.0	<1.0	13

Rocky Fork Mohican River: RM 14.47 - Armco, Inc. outfall 002 mixing zone

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1155	25.7	6.0	7.1	7.56	5.5	3.7	29
930719	1130	26.1	4.6	7.7	7.92	4.9	2.3	27
930802	1225	24.7	4.9	7.9	8.01	2.8	1.5	11
930817	1155	25.7	4.6	7.8	7.95	3.5	2.0	20
930830	1230	27.5	5.1	7.9	8.02	3.0	2.0	17
930914	1210	23.4	5.5	8.0	8.06	2.0	1.0	<10

Rocky Fork Mohican River : RM 14.24 - Longview Ave.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1255	26.2	6.0	7.5	7.77	7.7	5.8	42
930719	1210	25.9	5.0	7.8	7.88	4.7	2.7	25
930802	1305	24.8	5.3	8.1	8.03	3.6	2.0	10
930817	1220	25.7	5.2	8.1	8.02	3.1	2.0	16
930830	1330	27.7	6.0	8.2	8.01	2.0	<1.0	48
930914	1250	23.6	6.2	8.0	8.07	2.0	<1.0	<10

Table A-1. continued

Rocky Fork Mohican River: RM 13.31 - Orange Rd.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1325	28.3	12.2	8.2	8.32	2.5	1.4	30
930719	1130	24.1	6.0	8.1	7.94	2.8	1.5	23
930802	1340	25.9	8.2	8.0	8.03	2.6	1.7	34
930817	1240	26.1	5.9	8.2	7.99	21	20	63
930830	1250	26.8	8.3	8.1	8.14	2.0	2.0	16
930914	1245	23.0	9.2	8.5	8.15	1.0	<1.0	30

Rocky Fork Mohican River: RM 11.59 - Illinois Ave.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1300	25.4	9.2	8.1	8.18	2.0	1.5	22
930719	1115	22.3	4.8	7.9	7.92	4.0	2.7	26
930802	1310	22.7	7.5	8.2	7.94	2.2	1.5	<10
930817	1210	23.9	7.3	7.9	7.88	3.5	2.2	18
930830	1230	24.0	7.8	8.0	8.05	2.0	1.0	12
930914	1230	20.6	8.2	8.2	8.04	2.0	1.0	<10

Mansfield WWTP Effluent at outfall 001: RM 11.18

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1230	21.4	6.9	7.2	7.22	1.4	<1.0	26
930719	1100	20.6	9.1	7.2	7.32	2.1	<1.0	26
930802	1245	21.2	6.8	7.3	7.22	1.6	1.0	16
930817	1200	22.2	7.0	7.2	7.21	3.0	1.2	38
930830	1215	22.8	7.2	7.3	7.27	1.0	<1.0	17
930914	1155	21.4	7.2	7.4	7.38	5.0	4.0	21

Table A-1. continued

Rocky Fork Mohican River: RM 11.17 - Mansfield WWTP outfall 001 mixing zone

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1215	21.4	7.2	7.2	7.36	1.3	<1.0	24
930719	1045	21.0	6.7	7.3	7.51	2.8	1.6	24
930802	1230	21.5	6.7	7.5	7.45	2.0	1.1	13
930817	1145	22.3	6.6	7.5	7.43	3.5	2.0	33
930830	1155	22.7	7.2	7.3	7.34	1.0	<1.0	25
930914	1210	20.8	7.4	7.5	7.50	4.0	1.0	20

Rocky Fork Mohican River: RM 10.13 - S.R. 39

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1135	21.7	7.1	7.5	7.55	1.4	1.0	22
930719	1025	21.3	7.5	7.7	7.63	2.2	1.1	23
930802	1200	21.0	6.7	7.6	7.64	1.8	<1.0	15
930817	1120	22.2	6.7	7.6	7.64	2.7	1.7	25
930830	1135	22.1	7.5	7.6	7.72	1.0	<1.0	24
930914	1140	20.1	7.4	7.7	7.69	2.0	<1.0	12

Rocky Fork Mohican River: RM 6.35 - Adjacent Mt. Zion Rd.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1100	22.6	9.1	8.0	8.16	1.2	<1.0	14
930719	1005	21.7	8.8	8.1	7.96	1.6	<1.0	23
930802	1135	21.2	8.4	8.2	8.05	2.1	1.1	<10
930817	1055	22.6	9.0	8.1	8.21	4.1	2.0	18
930830	1105	22.3	10.0	8.2	8.22	1.0	<1.0	21
930914	1125	19.8	11.2	8.5	8.34	1.0	<1.0	<10

Table A-1. continued

Rocky Fork Mohican River: RM 0.62 - Applegate Rd.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1015	22.5	8.6	8.2	8.30	1.1	<1.0	21
930719	0940	22.0	7.6	8.2	8.16	1.9	1.0	15
930802	1110	21.1	8.1	8.4	8.26	2.0	1.1	20
930817	1030	22.5	7.3	8.2	8.24	1.8	1.2	15
930830	1045	22.4	8.0	8.2	8.17	1.0	<1.0	16
930914	1105	19.0	8.9	8.4	8.34	<1.0	<1.0	10

Touby Run: RM 0.38 - Main St.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1355	27.3	14.3	8.6	8.46	1.9	<1.0	22
930719	1145	21.5	10.9	8.1	7.98	6.7	5.7	54
930802	1400	22.9	15.8	8.6	8.47	1.6	1.0	<10
930817	1300	23.1	15.1	8.4	8.35	1.8	1.7	12
930830	1305	23.0	13.6	8.4	8.38	1.0	1.0	11
930914	1255	20.0	14.0	8.5	8.34	<1.0	<1.0	15

Clear Fork Mohican River: RM 35.70 - Marion Ave.

Date	Time	Temp (°C)	D.O. (mg/l)	pH (field) (S.U.)	pH (lab) (S.U.)	BOD_5 (mg/l)	$cBOD_5$ (mg/l)	COD (mg/l)
930707	1000	20.2	10.6	7.3	8.04	<1.0	<1.0	12
930719	0955	19.3	9.1	7.9	8.08	8.3	8.5	16
930802	1030	18.9	8.8	8.0	8.11	<1.0	<1.0	<10
930817	1020	20.0	8.0	7.9	7.97	<1.0	<1.0	<10
930830	1025	19.8	9.2	7.9	8.03	2.0	<1.0	12
930914	1045	17.4	9.7	8.0	8.08	<1.0	<1.0	<10

Table A-1. continued

Rocky Fork Mohican River: RM 16.29 - Wilging Rd.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	675	<5	0.69	<0.02	<0.05	0.2	1.3
930719	681		0.65	<0.02	0.11	<0.2	
930802	657	<5	0.74	<0.02	<0.05	<0.2	<1.0
930817	663		0.62	<0.02	<0.05	<0.2	
930830	657	<5	0.75	0.02	<0.05	<0.2	<1.0
930914	647		0.73	<0.02	<0.05	0.2	

Rocky Fork Mohican River: RM 15.86 - old Bowman Rd.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	703	<5	0.63	0.04	0.11	0.3	<1.0
930719	712		0.53	0.04	0.13	<0.2	
930802	681	<5	0.51	0.04	<0.05	0.2	<1.0
930817	662		0.40	0.02	<0.05	<0.2	
930830	697	<5	0.49	0.04	<0.05	0.3	<1.0
930914	675		0.60	0.04	0.06	0.3	

Rocky Fork Mohican River: RM 14.49 - Upstream Armco, Inc. outfall 002 discharge

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	617	6	0.32	<0.02	0.06	0.4	1.7
930719	673		0.21	<0.02	<0.05	0.4	
930802	672	<5	0.21	<0.02	<0.05	0.4	40.7
930817	698		0.16	<0.02	<0.05	<0.2	
930830	598	<5	0.54	0.04	0.08	3.0	8.32
930914	619		0.60	0.02	<0.05	1.5	

Table A-1. continued

Armco, Inc. (a.k.a. Cyclops Division Empire-Detroit Steel) Effluent at outfall 002: RM 14.48

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	704	5	0.83	0.04	0.15	1.1	5.3
930719	669		0.75	0.03	0.09	1.8	
930802	650	<5	0.67	0.03	<0.05	1.0	2.7
930817	657		0.48	0.03	0.07	0.7	
930830	652	<5	0.22	0.02	<0.05	0.3	3.58
930914	626		0.22	0.02	<0.05	0.5	

Rocky Fork Mohican River: RM 14.47 - Armco, Inc. outfall 002 mixing zone

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	635	<5	0.46	0.02	0.08	0.6	2.8
930719	703		0.28	<0.02	<0.05	0.5	
930802	665	<5	0.26	<0.02	<0.05	0.5	13.9
930817	682		0.21	<0.02	0.06	0.3	
930830	649	<5	0.28	0.02	<0.05	0.5	<1.0
930914	631		0.29	0.02	<0.05	0.6	

Rocky Fork Mohican River : RM 14.24 - Longview Ave.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	653	<5	0.40	0.02	0.07	1.0	13.2
930719	822		0.39	0.02	<0.05	0.6	
930802	675	<5	0.26	<0.02	<0.05	0.4	15.6
930817	695		0.23	0.02	0.05	0.3	
930830	650	<5	0.26	0.03	0.05	0.5	1.17
930914	641		0.30	0.02	<0.05	0.6	

Table A-1. continued

Rocky Fork Mohican River: RM 13.31 - Orange Rd.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	684	<5	0.27	0.02	<0.05	0.5	3.0
930719	729		0.22	0.02	<0.05	0.4	
930802	701	<5	0.11	<0.02	<0.05	0.4	1.2
930817	674		0.11	<0.02	<0.05	2.6	
930830	666	<5	0.24	0.03	<0.05	0.5	1.5
930914	754		0.26	0.02	0.10	0.6	

Rocky Fork Mohican River: RM 11.59 - Illinois Ave.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	777	<5	0.49	0.04	<0.05	0.3	1.9
930719	777		0.31	0.03	<0.05	0.6	
930802	735	<5	0.25	<0.02	<0.05	0.5	5.5
930817	754		0.39	0.03	0.06	0.4	
930830	705	<5	0.62	0.02	0.06	0.5	2.0
930914	789		0.30	<0.02	0.05	1.0	

Mansfield WWTP Effluent at outfall 001: RM 11.18

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	1080	5	22.4	<0.02	0.05	1.3	<1.0
930719	1080		24.6	<0.02	<0.05	1.3	
930802	1040	<5	20.0	<0.02	<0.05	1.4	5.3
930817	1100		23.4	<0.02	<0.05	1.7	
930830	964	7	25.3	<0.02	<0.05	1.5	1.8
930914	1050		15.8	0.02	<0.05	1.7	

Table A-1. continued

Rocky Fork Mohican River: RM 11.17 - Mansfield WWTP outfall 001 mixing zone

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	982	6	15.6	0.02	<0.05	0.9	1.0
930719	990		14.4	0.02	<0.05	1.4	
930802	936	<5	13.7	<0.02	<0.05	1.4	6.7
930817	973		12.2	0.02	<0.05	1.5	
930830	887	<5	18.1	<0.02	<0.05	1.1	3.3
930914	930		9.59	0.02	<0.05	1.8	

Rocky Fork Mohican River: RM 10.13 - S.R. 39

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	861	5	9.63	0.04	0.25	0.8	<1.0
930719	778		10.9	0.04	<0.05	1.0	
930802	889	<5	10.9	0.02	<0.05	1.0	14.4
930817	904		10.6	0.02	0.07	1.3	
930830	837	<5	14.2	0.02	<0.05	1.1	1.8
930914	922		8.19	0.04	0.07	1.4	

Rocky Fork Mohican River: RM 6.35 - Adjacent Mt. Zion Rd.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	779	<5	7.21	0.07	<0.05	0.7	<1.0
930719	858		12.7	0.04	<0.05	0.9	
930802	880	<5	9.04	0.03	<0.05	0.9	5.8
930817	834		9.24	0.05	0.05	1.0	
930830	829	<5	11.8	0.03	<0.05	1.0	1.8
930914	853		9.54	0.05	<0.05	1.1	

Table A-1. continued

Rocky Fork Mohican River: RM 0.62 - Applegate Rd.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	788	<5	7.46	0.02	<0.05	0.5	<1.0
930719	786		7.82	0.04	<0.05	0.6	
930802	820	<5	6.86	0.03	<0.05	0.8	7.1
930817	827		6.97	0.03	<0.05	0.5	
930830	799	<5	9.21	0.03	<0.05	1.0	1.9
930914	763		6.27	<0.02	<0.05	0.9	

Touby Run: RM 0.38 - Main St.

Date	Conductivity (umhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	771	<5	0.27	<0.02	<0.05	0.3	<1.0
930719	666		0.65	0.04	<0.05	0.5	
930802	745	<5	0.49	0.02	<0.05	0.4	1.4
930817	797		0.69	0.04	0.08	0.2	
930830	730	<5	0.59	0.02	<0.05	0.3	1.5
930914	784		0.39	0.02	<0.05	0.4	

Clear Fork Mohican River: RM 35.70 - Marion Ave.

Date	Conductivity (µmhos/cm)	CN^- (µg/l)	NO_3-NO_2 (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	TKN (mg/l)	Oil&Grease (mg/l)
930707	666	<5	0.33	<0.02	<0.05	<0.2	1.0
930719	781		0.43	<0.02	<0.05	<0.2	
930802	570	<5	0.23	<0.02	<0.05	0.2	<1.0
930817	767		0.18	<0.02	<0.05	<0.2	
930830	742	<5	0.16	0.02	<0.05	0.2	<1.0
930914	733		0.18	<0.02	<0.05	0.2	

Table A-1. continued

Rocky Fork Mohican River: RM 16.29 - Wilging Rd.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	440	22	<2	<0.2	85
930719		0.08	456	13	<2	<0.2	88
930802	<10	<0.05	458	10	<2	<0.2	87
930817		<0.05	406	10	3	<0.2	84
930830	<10	<0.05	467	11	<2	<0.2	86
930914		<0.05	418	<5	<2	<0.2	89

Rocky Fork Mohican River: RM 15.86 - old Bowman Rd.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	467	24	<2	<0.2	94
930719		0.07	468	45	2	<0.2	92
930802	<10	<0.05	472	12	<2	<0.2	93
930817		0.13	412	22	2	<0.2	84
930830	<10	0.06	498	19	<2	<0.2	91
930914		0.18	434	40	<2	<0.2	93

Rocky Fork Mohican River: RM 14.49 - Upstream Armco, Inc. outfall 002 discharge

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	0.06	400	14	<2	<0.2	70
930719		0.12	448	32	5	<0.2	75
930802	<10	0.09	444	28	<2	<0.2	81
930817		0.10	418	14	4	<0.2	79
930830	<10	<0.05	422	16	<2	<0.2	69
930914		<0.05	384	<5	<2	<0.2	74

Table A-1. continued

Armco, Inc. (a.k.a. Cyclops Division Empire-Detroit Steel) Effluent at outfall 002: RM 14.48

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	0.09	458	34	<2	<0.2	83
930719		0.13	449	13	2	<0.2	79
930802	<10	<0.05	432	<5	<2	<0.2	82
930817		<0.05	396	12	<2	<0.2	79
930830	<10	0.15	434	22	4	<0.2	76
930914		0.10	392	20	3	<0.2	77

Rocky Fork Mohican River: RM 14.47 - Armco, Inc. outfall 002 mixing zone

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	0.12	430	25	<2	<0.2	82
930719		0.11	444	19	3	<0.2	77
930802	<10	0.07	442	21	2	<0.2	82
930817		0.11	408	21	3	<0.2	78
930830	<10	0.11	434	29	4	<0.2	76
930914		0.10	394	18	<2	<0.2	76

Rocky Fork Mohican River : RM 14.24 - Longview Ave.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	432	15	<2	<0.2	76
930719		0.11	486	15	3	<0.2	79
930802	<10	0.14	448	14	<2	<0.2	81
930817		0.09	416	9	4	<0.2	79
930830	<10	0.10	445	14	2	<0.2	75
930914		0.12	398	14	<2	<0.2	76

Table A-1. continued

Rocky Fork Mohican River: RM 13.31 - Orange Rd.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	440	10	<2	<0.2	82
930719		0.19	472	6	2	<0.2	82
930802	<10	0.07	466	<5	<2	<0.2	81
930817		0.15	422	14	4	<0.2	85
930830	<10	0.08	446	8	2	<0.2	77
930914		0.07	492	<5	<2	<0.2	85

Rocky Fork Mohican River: RM 11.59 - Illinois Ave.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	474	12	5	<0.2	84
930719		0.08	502	14	<2	<0.2	77
930802	<10	0.07	490	6	<2	<0.2	85
930817		0.09	494	8	3	<0.2	74
930830	<10	0.12	456	<5	<2	<0.2	79
930914		0.06	480	<5	<2	<0.2	85

Mansfield WWTP Effluent at outfall 001: RM 11.18

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	3.04	670	<5	<2	<0.2	76
930719		3.35	664	<5	<2	<0.2	76
930802	<10	3.70	626	<5	<2	<0.2	76
930817		2.39	680	8	<2	0.2	68
930830	<10	3.05	608	<5	<2	<0.2	67
930914		2.23	654	8	<2	<0.2	68

Table A-1. continued

Rocky Fork Mohican River: RM 11.17 - Mansfield WWTP outfall 001 mixing zone

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	2.06	600	<5	<2	<0.2	75
930719		2.00	590	6	<2	<0.2	80
930802	<10	2.40	578	<5	<2	<0.2	78
930817		1.45	615	6	2	<0.2	71
930830	<10	2.14	558	<5	<2	<0.2	70
930914		1.35	584	<5	<2	<0.2	74

Rocky Fork Mohican River: RM 10.13 - S.R. 39

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	1.24	526	8	<2	<0.2	77
930719		1.47	528	8	2	<0.2	74
930802	<10	1.94	554	6	<2	<0.2	78
930817		1.22	574	6	<2	<0.2	73
930830	<10	1.67	540	6	<2	<0.2	71
930914		1.31	554	<5	<2	<0.2	75

Rocky Fork Mohican River: RM 6.35 - Adjacent Mt. Zion Rd.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	0.82	468	7	<2	<0.2	72
930719		1.45	536	7	<2	<0.2	76
930802	<10	1.76	548	14	<2	<0.2	79
930817		1.06	528	16	4	<0.2	71
930830	<10	1.47	522	10	<2	<0.2	71
930914		1.17	530	<5	<2	<0.2	74

Table A-1. continued

Rocky Fork Mohican River: RM 0.62 - Applegate Rd.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	0.63	472	10	<2	<0.2	74
930719		1.00	480	13	2	<0.2	77
930802	<10	1.66	503	30	<2	<0.2	78
930817		0.99	512	21	3	<0.2	75
930830	<10	1.21	490	14	<2	<0.2	74
930914		0.83	472	<5	<2	<0.2	74

Touby Run: RM 0.38 - Main St.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	488	<5	<2	<0.2	93
930719		0.12	460	5	<2	<0.2	74
930802	<10	0.06	514	5	<2	<0.2	85
930817		0.97	484	<5	<2	<0.2	86
930830	<10	0.05	464	6	<2	<0.2	88
930914		0.06	528	<5	<2	<0.2	101

Clear Fork Mohican River: RM 35.70 - Marion Ave.

Date	Phenolics (µg/l)	T-Phosphorus (mg/l)	T-Flt Residue (mg/l)	T-Nflt Residue (mg/l)	T-As (µg/l)	T-Cd (µg/l)	T-Ca (mg/l)
930707	<10	<0.05	426	<5	<2	<0.2	68
930719		<0.05	498	<5	<2	<0.2	84
930802	<10	<0.05	368	<5	<2	<0.2	63
930817		0.06	480	<5	2	<0.2	89
930830	NA	<0.05	558	<5	<2	<0.2	90
930914		<0.05	468	<5	<2	<0.2	87

Table A-1. continued

Rocky Fork Mohican River: RM 16.29 - Wilging Rd.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	1440	<2	27	<40	<10	323	
930719	<30	<10	820	<2	29	<40	<10	339	380
930802	<30	<10	808	<2	29	<40	<10	337	
930817	<30	<10	809	<2	27	<40	24	321	400
930830	<30	<10	587	<2	29	<40	21	334	
930914	<30	<10	366	<2	29	<40	<10	342	60

Rocky Fork Mohican River: RM 15.86 - old Bowman Rd.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	1630	<2	28	<40	<10	350	
930719	<30	<10	1680	<2	30	<40	<10	353	350
930802	<30	<10	1050	3	29	<40	24	352	
930817	<30	<10	1290	<2	27	<40	17	321	390
930830	<30	<10	1350	2	31	<40	48	355	
930914	<30	<10	1390	<2	31	<40	<10	360	72

Rocky Fork Mohican River: RM 14.49 - Upstream Armco, Inc. outfall 002 discharge

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	1380	<2	19	<40	<10	253	
930719	<30	<10	1780	3	22	<40	14	278	660
930802	<30	<10	1340	3	25	<40	17	305	
930817	<30	<10	1450	<2	23	<40	41	292	170
930830	124	191	3200	<2	22	<40	<10	263	
930914	<30	90	780	<2	24	<40	<10	284	<2

Table A-1. continued

Armco, Inc. (a.k.a. Cyclops Division Empire-Detroit Steel) Effluent at outfall 002: RM 14.48

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	276	30	16100	<2	24	<40	54	306	
930719	97	138	1970	<2	25	<40	26	300	10
930802	34	<10	1522	<2	25	<40	<10	308	
930817	80	38	1650	<2	22	<40	17	288	4200
930830	<30	<10	1240	3	25	<40	<10	293	
930914	<30	<10	1460	2	23	<40	10	287	64

Rocky Fork Mohican River: RM 14.47 - Armco, Inc. outfall 002 mixing zone

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	4970	<2	21	44	<10	291	
930719	<30	<10	2020	3	23	<40	12	287	230
930802	<30	<10	1200	<2	25	<40	<10	308	
930817	<30	13	1740	3	24	<40	18	294	910
930830	<30	15	2060	3	24	<40	<10	289	
930914	<30	16	1410	<2	24	<40	13	289	62

Rocky Fork Mohican River : RM 14.24 - Longview Ave.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	36	47	2920	2	22	<40	10	280	
930719	<30	19	1280	<2	24	<40	16	296	550
930802	<30	<10	949	2	25	<40	<10	305	
930817	<30	<10	922	<2	23	<40	15	292	680
930830	<30	<10	1200	3	25	<40	<10	290	
930914	<30	<10	1053	<2	25	<40	<10	293	32

Table A-1. continued

Rocky Fork Mohican River: RM 13.31 - Orange Rd.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	1020	<2	22	<40	64	295	
930719	<30	<10	917	<2	25	<40	27	308	360
930802	<30	<10	895	<2	25	<40	15	305	
930817	<30	249	985	2	24	<40	30	311	350
930830	<30	<10	1140	<2	24	<40	10	291	
930914	<30	<10	742	<2	25	<40	<10	315	52

Rocky Fork Mohican River: RM 11.59 - Illinois Ave.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	939	<2	23	<40	15	304	
930719	<30	32	1040	<2	23	<40	33	287	1400
930802	<30	<10	742	<2	25	<40	<10	315	
930817	<30	<10	848	<2	21	<40	10	271	690
930830	<30	<10	507	<2	25	<40	<10	300	
930914	<30	31	389	<2	24	<40	<10	311	120

Mansfield WWTP Effluent at outfall 001: RM 11.18

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	176	<2	20	<40	50	272	
930719	<30	<10	159	<2	21	<40	49	276	10
930802	<30	<10	332	<2	23	<40	98	284	
930817	672	29	328	<2	19	<40	189	248	5
930830	<30	<10	181	<2	22	<40	71	258	
930914	<30	15	373	<2	19	<40	57	248	72

Table A-1. continued

Rocky Fork Mohican River: RM 11.17 - Mansfield WWTP outfall 001 mixing zone

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	405	<2	21	<40	40	274	
930719	<30	19	394	<2	23	<40	36	294	330
930802	<30	<10	440	<2	23	<40	112	289	
930817	390	17	476	<2	21	<40	52	264	530
930830	<30	<10	297	<2	23	<40	50	270	
930914	<30	21	343	<2	21	<40	41	271	150

Rocky Fork Mohican River: RM 10.13 - S.R. 39

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	615	<2	21	<40	41	279	
930719	<30	<10	559	<2	22	<40	32	275	340
930802	<30	<10	557	<2	24	<40	49	294	
930817	423	13	533	<2	21	<40	55	269	390
930830	<30	<10	377	<2	23	<40	36	272	
930914	<30	10	393	<2	21	<40	39	274	150

Rocky Fork Mohican River: RM 6.35 - Adjacent Mt. Zion Rd.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	502	<2	19	<40	17	258	
930719	<30	<10	402	<2	22	<40	32	280	220
930802	<30	29	938	<2	24	<40	51	296	
930817	541	11	690	<2	21	<40	50	264	410
930830	<30	10	415	<2	23	<40	38	272	
930914	<30	<10	287	<2	21	<40	33	271	140

Table A-1. continued

Rocky Fork Mohican River: RM 0.62 - Applegate Rd.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	524	<2	22	<40	15	275	
930719	<30	<10	633	<2	22	<40	24	283	340
930802	<30	<10	1290	2	22	<40	32	285	
930817	<30	10	867	<2	22	<40	23	278	140
930830	<30	<10	591	2	22	<40	37	275	
930914	<30	<10	274	<2	21	<40	21	271	62

Touby Run: RM 0.38 - Main St.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/l)	F.Coliform (#/100ml)
930707	<30	<10	141	<2	23	<40	<10	327	
930719	<30	15	397	7	20	<40	30	267	3800
930802	<30	<10	222	<2	27	<40	<10	323	
930817	<30	<10	140	<2	28	<40	<10	330	44
930830	<30	<10	156	<2	28	<40	<10	335	
930914	<30	<10	147	<2	29	<40	<10	372	27

Clear Fork Mohican River: RM 35.70 - Marion Ave.

Date	T-Cr (µg/l)	T-Cu (µg/l)	T-Fe (µg/l)	T-Pb (µg/l)	T-Mg (mg/l)	T-Ni (µg/l)	T-Zn (µg/l)	T-Hardness (mg/L)	F.Coliform (#/100ml)
930707	<30	<10	173	<2	21	<40	<10	256	
930719	<30	<10	214	<2	28	<40	<10	325	1400
930802	<30	<10	200	<2	20	<40	<10	240	
930817	<30	<10	248	3	31	<40	<10	350	19
930830	<30	<10	346	<2	31	<40	<10	352	
930914	<30	<10	276	<2	30	<40	<10	341	48

Table A-2. Surface water non-priority organic pollutant detections in the Rocky Fork Mohican River, 1993, listing tentatively identified compounds as determined by library computer match.

PARAMETER	RM 15.86	RM 14.24	RM 11.59	RM 10.13
SEMI - VOLATILE ORGANIC COMPOUNDS (µg/l or ppb)				
July 7, 1993				
Cis-1-bromo-2-chloro-Cyclohexane	5.6	ND	6.6	ND
2-ethyl-Hexanoic Acid	ND	547.6	ND	ND
N-propyl-Benzamide	ND	ND	3.6	ND
August 2, 1993				
Trans-2-bromo-Cyclohexanol	3.8	ND	ND	2.6
Cis-1-bromo-2-chloro-Cyclohexane	2.6	ND	2.8	ND
2-butyl-5-(2-methylpropyl)-Thiophene	ND	3.8	3.7	ND
2-Pentadecyn-1-Ol	ND	ND	5.3	ND
5-Dodecyldihydro-2(3H)-Furanone	ND	ND	ND	2.3
2, 6, 10, 15, 19, 23-hexamethyl-2, 6, 10, 14, 18, 22-Tetracosahexaene	ND	ND	ND	3.6
August 30, 1993				
Trans-2-bromo-Cyclohexanol	9.1	ND	4.7	6.6
O-[(methylamino) carbonyl] oxime 2-methyl-2 - (methylsulfonyl)-Propanal	2.7	ND	ND	ND
2-fluoro-4-nitrophenol	2.1	ND	ND	ND
1-Hydorxycyclohexanecarboxylic Acid	4.6	ND	5.7	6.4
Cis-1-bromo-2-chloro-Cyclohexane	3.1	8.9	5.6	2.4, 3.9
methyl ester-11, 14-Eicosadienoic Acid	ND	170.7	3.1	ND
Octadecanoic Acid	ND	20.3	ND	ND
(E)-3-Octadecene	ND	38.2	ND	ND
(E)-3-Eicosene	ND	16.7	ND	ND
Dehydromevalonic Lactone	ND	ND	3.7	ND
2-butyl-5-(2-methylpropyl)-Thiophene	ND	ND	7.8	ND
2-hydroxy-1-(hydroxymethyl) ethyl ester-9-Octadecenoic Acid (Z)	ND	ND	5.0	ND
5-methyl-2-benzylimino-1, 3-Thiazolidine	ND	ND	ND	5.2

Table A-3. Sediment non-priority organic pollutant detections in the Rocky Fork Mohican River study area, 1993, listing tentatively identified compounds as determined by library computer match.

PARAMETER	Rocky Fork RM 16.29	Rocky Fork RM 15.86	Rocky Fork RM 14.47	Rocky Fork RM 14.24
VOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)				
2-propanone	0.11	0.09	ND	ND
hexanol-4-D2	ND	ND	26.19	0.22
2-methyl-decane	ND	ND	4.19	ND
2, 2-dimethyl-undecane	ND	ND	12.57	ND
2, 2, 4, 6, 6-pentamethyl-heptane	ND	ND	9.43	0.49
2, 2, 5-trimethyl-hexane	ND	ND	4.19	ND
3, 7-dimethyl-nonane	ND	ND	27.23	ND
5-butyl-nonane	ND	ND	4.19	0.18
2, 2, 6-trimethyl-octane	ND	ND	ND	0.40
2-methyl-5-propyl-nonane	ND	ND	ND	0.62
5-methyl-decane	ND	ND	ND	0.18
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)				
molecular (S8) sulfur	2.8	3.5	ND	ND
6, 16-dimethyl-20-dione-pregn-4-ene-3	1.5	ND	ND	ND
hexadecanal	0.5	ND	ND	ND
nonacosane	1.3	1.5	ND	ND
triacontane	1.2	ND	ND	ND
2, 2, 4-trimethyl decane	ND	ND	53.6	ND
2, 5, 6-trimethyl-octane	ND	ND	24.8	ND
2, 2, 3-trimethyl-nonane	ND	ND	70.7	ND
6-ethyl-2-methyl-octane	ND	ND	115.2	ND
2, 6, 7-trimethyl-decane	ND	ND	105.6	18.7
2, 6, 8-trimethyl-decane	ND	ND	61.8	11.5
2, 5-dimethyl-nonane	ND	ND	48.8	ND
dodecane	ND	ND	29.8	ND
2, 5-dimethyl-undecane	ND	ND	41.1	ND
tetradecane	ND	ND	45.7	ND
2, 6, 10, 14-tetramethyl-heptadecane	ND	ND	31.1	17.9
2, 6, 10, 14-tetramethyl-heptadecane	ND	ND	34.1	ND
1-methyl-1-(2-methyl-2-propyl) cyclopentane	ND	ND	49.7	ND
hexadecane	ND	ND	33.1	ND
2, 6, 10, 14-tetramethyl-pentadecane	ND	ND	54.3	ND
17-pentatriacontene	ND	ND	33.8	ND
2, 6, 10, 14-tetramethyl-hexadecane	ND	ND	46.5	ND
hexadecanoic acid	ND	ND	50.9	ND
[1]benzothieno[3, 2-B][1]benzothiophene	ND	ND	25.4	ND
heptacosane	ND	ND	27.3	ND

Table A-3. continued

PARAMETER	Rocky Fork RM 16.29	Rocky Fork RM 15.86	Rocky Fork RM 14.47	Rocky Fork RM 14.24
2-hydroxy-propanamide	ND	ND	ND	40.9
2, 2, 6-trimethyl-octane	ND	ND	ND	10.9
2, 4, 6,-trimethyl-decane	ND	ND	ND	18.7
4-methyl-dodecane	ND	ND	ND	16.7
heptadecane	ND	ND	ND	21.2

PARAMETER	Rocky Fork RM 13.31	Rocky Fork RM 10.13	Rocky Fork RM 0.62	Clear Fork RM 35.70
VOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)				
hexanol-4-D2	0.13	ND	ND	ND
2, 2, 8-trimethyl-decane	0.17	ND	ND	ND
3, 7-dimethyl-nonane	0.26	ND	ND	ND
2-propanone	ND	ND	ND	0.06
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg or ppm)				
6-ethyl-2-methyl-octane	4.4	ND	ND	ND
2, 6, 7-trimethyl-decane	5.2	ND	ND	ND
2, 2-dimethyl-decane	3.7	ND	ND	ND
heptadecane	17.8	ND	ND	ND
molecular (S8) sulfur	20.1	40.7	2.4	2.2
[1]benzothieno[3, 2 - B][1] Benzothiophene	17.3	ND	ND	ND
nonacosane	ND	ND	1.9	1.4
(3.beta., 24S)-stigmast-5-en-3-ol	ND	ND	1.9	ND
octacosane	ND	ND	ND	1.2

Table A-4. Summary of dissolved oxygen measurements recorded with Datasonde© continuous monitors at 4 locations in the Rocky Fork Mohican River from June 24 to June 25, 1993.

River Mile	Total Hours	Mean (mg/l)	Median (mg/l)	Minimum (mg/l)	Maximum (mg/l)	25th %ile (mg/l)	75th %ile (mg/l)
16.41	24	8.47	8.51	7.51	11.11	8.11	8.65
14.24	26	6.42	6.58	4.71‡	8.49	5.30	7.38
10.13	28	8.09	8.10	6.80	8.86	7.82	8.42
0.62	26	7.84	7.36	6.40	10.09	6.99	8.68

‡ violation of the average WWH dissolved oxygen (D.O.) criterion.

Table A-5. Summary of acute bioassays conducted by Armco, Inc. using effluents from outfalls 002 and 601 to fulfill requirements contained in the NPDES permit effective April 30, 1990. Results presented include the median lethal concentration (LC_{50}), median effective concentration (EC_{50}), percent adversely affected (% A), and acute toxic units (TU_a) for the test organisms *Ceriodaphnia dubia* and Pimephales promelas.

EFFLUENT AT OUTFALL 002

	C. dubia 48-hr.				P. promelas 96-hr.			
test date	LC_{50}	EC_{50}	% A	TU_a	LC_{50}	EC_{50}	% A	TU_a
7-26-90	74	74	100	1.4	41	41	100	2.4
9-12-90	>100	>100	30	<1.0	>100	>100	3	<1.0
10-9-90	>100	>100	0	<1.0	>100	>100	0	<1.0
11-16-90	>100	>100	0	<1.0	>100	>100	0	<1.0
1-17-91	>100	>100	20	<1.0	98.6	98.6	50	1.0
2-5-91	>100	>100	40	<1.0	>100	>100	0	<1.0
4-26-91	7	7	100	14.3	10	10	100	10.0
5-23-91	>100	>100	5	<1.0	>100	>100	0	<1.0
7-18-91	>100	>100	0	<1.0	>100	>100	10	<1.0
9-25-91	69	69	100	1.5	68	68	100	1.5
10-10-91	75	75	100	1.3	62	62	100	1.6
11-27-91	12.2	12.2	100	8.2	13.5	13.5	100	7.4
1-21-92	63.5	63.5	100	1.6	64	64	100	1.6
2-25-92	72	72	100	1.4	>100	>100	40	<1.0
4-15-92	10	10	100	10.0	24	24	100	4.2
5-13-92	74	74	95	1.4	74.8	74.8	100	1.3
7-8-92	>100	>100	0	<1.0	>100	>100	0	<1.0
9-15-92	16.9	16.9	100	5.9	30.1	30.1	100	3.3
10-14-92	22.2	21.8	100	4.6	32.8	32.8	100	3.1
11-17-92	7.5	7.2	100	13.9	14.6	13.4	100	7.5
1-19-93	72.5	69.9	100	1.4	74.8	74.8	100	1.3
2-3-93	29.1	29.1	100	3.4	29.3	28.4	100	3.5
4-20-93	78	76.5	80	1.3	>100	>100	0	<1.0
5-12-93	3.2	3.2	100	31.3	3.2	3.2	100	31.3
7-20-93	>100	>100	30	<1.0	>100	>100	0	<1.0
9-14-93	100	78	65	1.3	90.8	90.8	60	1.1
10-19-93	>100	74.8	75	1.3	>100	>100	40	<1.0

Table A-5. continued

EFFLUENT AT OUTFALL 601

	C. dubia 48-hr.				P. promelas 96-hr.			
test date	LC_{50}	EC_{50}	% A	TU_a	LC_{50}	EC_{50}	% A	TU_a
7-26-90	24	15	100	6.7	34	34	100	2.9
9-12-90	19.5	19.5	100	5.1	23.5	23.5	100	4.3
10-9-90	3.1	3.1	100	32.3	3	3	100	33.3
11-16-90	11	5.1	100	19.6	3.1	3.1	100	32.3
1-17-91	38	38	100	2.6	35	35	100	2.9
2-5-91	4.5	4.5	100	23.3	1.9	1.9	100	52.6
4-26-91	>100	>100	0	<1.0	>100	>100	0	<1.0
5-23-91	>100	>100	0	<1.0	>100	>100	0	<1.0
7-18-91	22	8.9	100	11.2	19	19	100	5.3
9-25-91	75	75	100	1.3	85	85	70	1.2
10-10-91	33	15.5	100	6.5	1.5	1.5	100	66.7
11-27-91	82.5	82.5	65	1.2	>100	>100	0	<1.0
1-21-92	13	13	100	7.7	22	22	100	4.6
2-25-92	2.8	2.8	100	35.7	3.5	3.5	100	28.6
4-15-92	39.8	39.8	100	2.5	>100	>100	0	<1.0
5-13-92	37.2	37.2	100	2.7	74.8	74.8	100	1.3
7-8-92	>100	100	50	1.0	>100	>100	0	<1.0
9-15-92	>100	>100	5	<1.0	>100	>100	0	<1.0
10-14-92	37.7	37.7	100	2.7	72.7	72.7	100	1.4
11-17-92	44.8	43.5	100	2.3	72.7	72.7	100	1.4
1-19-93	51.2	42.5	100	2.4	64.9	64.9	100	1.5
2-3-93	38.9	36.7	100	2.7	24.0	24.9	100	4.2
4-20-93	>100	>100	10	<1.0	>100	>100	0	<1.0
5-12-93	59.6	59.6	100	1.7	42.3	42.3	10	2.4
7-20-93	>100	>100	10	<1.0	>100	>100	0	<1.0
9-14-93	>100	>100	0	<1.0	>100	>100	0	<1.0
10-19-93	>100	>100	5	<1.0	>100	>100	0	<1.0

Table A-6. Summary of chronic bioassays conducted by Armco, Inc. using effluents from outfalls 001-004 to fulfill requirements contained in the NPDES permit effective April 30, 1990. Results presented include the no observed effects concentration recorded as percent effluent (NOEC), lowest observed effects concentration recorded as percent effluent (LOEC), and chronic toxic units (TU_c) for the test organisms *Ceriodaphnia dubia* and *Pimephales promelas*. Note: In TU_c results listed as <1.0, the LOEC could not be determined since no significant effects were observed in 100 % effluent. Therefore, the LOEC can only be listed as >100 %.

EFFLUENT AT OUTFALL 001

	C. dubia 7-day					P. promelas 7-day				
	survival		reproduction			survival		reproduction		
test date	NOEC	LOEC	NOEC	LOEC	TU_c	NOEC	LOEC	NOEC	LOEC	TU_c
6-12-90	100	>100	100	>100	<1.0	100	>100	50	70	1.7
8-12-90	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
12-10-90 [a]	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
3-18-91	50	100	50	100	1.4	100	>100	100	>100	<1.0
6-27-91	25	50	25	50	2.8	100	>100	100	>100	<1.0
8-19-91	50	100	6	12	11.8	100	>100	100	>100	<1.0
12-10-91	100	>100	50	100	1.4	25	50	25	50	2.8
3-10-92	100	>100	50	100	1.4	100	>100	100	>100	<1.0
6-16-92 [a]	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
8-18-92	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
12-2-92	100	>100	25	50	2.8	100	>100	100	>100	<1.0
3-4-93	100	>100	50	100	1.4	100	>100	100	>100	<1.0
6-23-93	100	>100	25	50	2.8	100	>100	100	>100	<1.0
8-17-93	100	>100	50	100	1.4	100	>100	100	>100	<1.0

[a] unacceptable control mortality during Ceriodaphnia test. Used 100 % effluent results only.

Table A-6. continued

EFFLUENT AT OUTFALL 002

test date	C. dubia 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c	P. promelas 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c
6-12-90	30	60	10	30	5.8	1	10	1	10	31.6
8-12-90	30	60	30	60	2.4	<10	10	<10	10	>10.0
12-10-90 [a]	100	>100	100	>100	<1.0	<10	10	<10	10	>10.0
3-18-91	12	25	12	25	5.8	<6	6	<6	6	>16.7
6-27-91	50	100	25	50	2.8	25	50	<3	3	>33.3
8-19-91	3	6	<3	3	>33.3	<3	3	<3	3	>33.3
12-10-91	12	25	3	6	23.6	6	12	6	12	11.8
3-10-92	25	50	6	12	11.8	12	25	6	12	11.8
6-16-92 [a]	50	100	50	100	1.4	12	25	12	25	5.8
8-18-92	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
12-2-92	6	12	3	6	23.6	3	6	<3	3	>33.3
3-4-93	6	12	3	6	23.6	3	6	3	6	23.6
6-23-93	25	50	12	25	5.8	12	25	12	25	5.8
8-17-93	6	12	<3	3	>33.3	3	6	3	6	23.6

[a] unacceptable control mortality during Ceriodaphnia test. Used 100 % effluent results only.

Table A-6. continued

EFFLUENT AT OUTFALL 003

test date	C. dubia 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c	P. promelas 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c
6-12-90	100	>100	100	>100	<1.0	100	>100	70	100	1.2
8-12-90	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
12-10-90 [a]	100	>10	100	>100	<1.0	100	>100	100	>100	<1.0
3-18-91	100	>100	50	100	1.4	100	>100	50	100	1.4
6-27-91	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
8-19-91	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
12-10-91	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
3-10-92	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
6-16-92 [a]	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
8-18-92	100	>100	100	>100	<1.0	6	12	6	12	11.8
12-2-92	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
3-4-93	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
6-23-93	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
8-17-93	100	>100	100	>100	<1.0	100	>100	6	12	11.8

[a] unacceptable control mortality during Ceriodaphnia test. Used 100 % effluent results only.

Table A-6. continued

EFFLUENT AT OUTFALL 004

test date	C. dubia 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c	P. promelas 7-day survival NOEC	survival LOEC	reproduction NOEC	reproduction LOEC	TU_c
6-12-90	30	60	3	10	18.3	100	>100	70	100	1.2
8-12-90	100	>100	60	100	1.3	100	>100	100	>100	<1.0
12-10-90 [a]	70	100	70	100	1.2	100	>100	100	>100	<1.0
3-18-91	25	50	25	50	2.8	100	>100	100	>100	<1.0
6-27-91	100	>100	6	12	11.8	100	>100	100	>100	<1.0
8-19-91	25	50	12	25	5.8	50	100	50	100	1.4
12-10-91	25	50	12	25	5.8	25	50	25	50	2.8
3-10-92	25	50	25	50	2.8	50	100	50	100	1.4
6-16-92 [a]	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0
8-18-92	100	>100	6	12	11.8	100	>100	100	>100	<1.0
12-2-92	12	25	<6	6	>16.7	12	25	12	25	5.8
3-4-93	100	>100	25	50	2.8	100	>100	100	>100	<1.0
6-23-93	50	100	50	100	1.4	100	>100	100	>100	<1.0
8-17-93	100	>100	100	>100	<1.0	100	>100	100	>100	<1.0

[a] unacceptable control mortality during Ceriodaphnia test. Used 100 % effluent results only.

Table A-7. Invertebrate Community Index (ICI) metrics and scores (by RM) for locations sampled in the Rocky Fork Mohican Study area, 1993.

River Mile	Drainage Area (sq mi)	Number of: Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa	Qual. EPT	Eco-region	ICI
ROCKY FK. MOHICAN R. — 17-733													
Year: 93													
16.30	12.0	43(6)	5(4)	6(6)	25(6)	22.1(4)	7.0(6)	20.7(6)	48.7(2)	1.8(6)	8(4)	3	50
16.10	12.2	44(6)	5(4)	2(4)	24(6)	3.2(2)	0.9(2)	42.2(6)	53.0(2)	7.9(6)	8(4)	3	42
15.80	12.9	53(6)	4(2)	3(6)	32(6)	1.8(2)	0.2(2)	17.5(4)	75.5(0)	26.6(0)	1(0)	3	28
14.47	15.3	15(2)	3(2)	1(2)	8(2)	0.3(2)	0.1(2)	0.1(2)	99.0(0)	98.8(0)	0(0)	3	14
14.20	19.3	7(0)	0(0)	0(0)	6(0)	0.0(0)	0.0(0)	0.0(0)	99.9(0)	93.7(0)	0(0)	3	0
13.30	29.6	16(2)	0(0)	0(0)	11(2)	0.0(0)	0.0(0)	0.0(0)	99.4(0)	93.0(0)	1(0)	3	4
11.50	31.0	25(4)	1(0)	2(4)	13(2)	0.1(2)	1.6(2)	0.0(0)	98.1(0)	58.4(0)	5(2)	3	16
11.10	32.0	23(2)	2(0)	1(2)	15(4)	1.9(2)	0.1(2)	0.0(0)	96.4(0)	53.2(0)	1(0)	3	12
10.20	39.0	30(4)	0(0)	3(4)	19(4)	0.0(0)	2.4(2)	0.1(2)	96.3(0)	45.1(0)	4(0)	3	16
6.40	64.0	38(6)	3(2)	5(6)	26(6)	3.3(2)	62.3(6)	14.0(2)	20.3(6)	5.6(6)	9(4)	3	46
.70	76.0	33(4)	6(4)	2(4)	18(4)	20.4(4)	40.4(6)	18.5(4)	20.5(6)	5.6(6)	12(4)	3	46
TOUBY RUN — 17-734													
Year: 93													
.40	10.0	32(4)	3(2)	1(4)	15(4)	0.7(2)	1.5(6)	43.4(6)	54.3(2)	25.7(2)	7(4)	3	36
CLEAR FK. MOHICAN R. — 17-750													
Year: 93													
35.70	6.8	35(4)	6(4)	2(4)	24(6)	41.6(6)	0.1(2)	10.0(4)	48.1(2)	0.5(6)	14(6)	3	44

Table A-8. Macroinvertebrate collection summary (by RM) for locations in the Rocky Fork Mohican River study area, 1993.

Collection Date: 08/25/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 16.30

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	30
03600	*Oligochaeta*	4 +
05900	*Lirceus sp*	560 +
06201	*Hyalella azteca*	0 +
07860	*Cambarus (Puncticambarus) robustus*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	2 +
11120	*Baetis flavistriga*	264 +
11130	*Baetis intercalaris*	244 +
12200	*Isonychia sp*	0 +
13400	*Stenacron sp*	39 +
13521	*Stenonema femoratum*	13 +
15000	*Paraleptophlebia sp*	20
21200	*Calopteryx sp*	27 +
22001	*Coenagrionidae*	0 +
23600	*Aeshna sp*	0 +
23909	*Boyeria vinosa*	0 +
26100	*Cordulegaster sp*	0 +
45300	*Sigara sp*	0 +
45900	*Notonecta sp*	0 +
47600	*Sialis sp*	0 +
50804	*Lype diversa*	8
51400	*Nyctiophylax sp*	3
52200	*Cheumatopsyche sp*	102 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	7
52440	*Hydropsyche (Ceratopsyche) slossonae*	12 +
52530	*Hydropsyche (H.) depravata group*	52 +
60900	*Peltodytes sp*	0 +
63700	*Ilybius sp*	0 +
67500	*Laccobius sp*	0 +
68025	*Ectopria nervosa*	0 +
68601	*Ancyronyx variegata*	0 +
68708	*Dubiraphia vittata group*	0 +
68901	*Macronychus glabratus*	4
69225	*Optioservus fastiditus*	0 +
69400	*Stenelmis sp*	9 +
70600	*Antocha sp*	8
71100	*Hexatoma sp*	0 +
71700	*Pilaria sp*	0 +
71900	*Tipula sp*	0 +
72340	*Dixella sp*	0 +
72700	*Anopheles sp*	0 +
74100	*Simulium sp*	6 +
77120	*Ablabesmyia mallochi*	0 +
77500	*Conchapelopia sp*	117 +
77750	*Hayesomyia senata or Thienemannimyia norena*	0 +
77800	*Helopelopia sp*	0 +
78350	*Meropelopia sp*	15 +
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
78450	*Nilotanypus fimbriatus*	12
78650	*Procladius sp*	0 +
80204	*Brillia flavifrons group*	15
80370	*Corynoneura lobata*	164 +
80410	*Cricotopus (C.) sp*	15
80420	*Cricotopus (C.) bicinctus*	0 +
80430	*Cricotopus (C.) tremulus group*	15
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	15
81650	*Parametriocnemus sp*	0 +
81825	*Rheocricotopus (Psilocricotopus) robacki*	0 +
82141	*Thienemanniella xena*	32
82200	*Tvetenia bavarica group*	8
82770	*Chironomus (C.) riparius group*	0 +
82820	*Cryptochironomus sp*	0 +
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0 +
83840	*Microtendipes pedellus group*	58 +
84210	*Paratendipes albimanus or P. duplicatus*	15 +
84300	*Phaenopsectra obediens group*	0 +
84460	*Polypedilum (P.) fallax group*	44
84480	*Polypedilum (P.) n.sp. same as tuberculum (Maschwitz, 1976)*	0 +
84540	*Polypedilum (Tripodura) scalaenum group*	15
84700	*Stenochironomus sp*	29
84750	*Stictochironomus sp*	0 +
85500	*Paratanytarsus sp*	44 +
85501	*Paratanytarsus n.sp 1*	15
85615	*Rheotanytarsus distinctissimus group*	15
85625	*Rheotanytarsus exiguus group*	190 +
85700	*Stempellina sp*	0 +
85800	*Tanytarsus sp*	44
85802	*Tanytarsus curticornis group*	29
85814	*Tanytarsus glabrescens group*	205 +
86100	*Chrysops sp*	0 +
87501	*Empididae*	97 +

Table A-8. continued

Collection Date: 08/25/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 16.30

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
93900	*Elimia sp*	0 +			
95100	*Physella sp*	0 +			
98600	*Sphaerium sp*	0 +			

No. Quantitative Taxa: 43 Total Taxa: 84
No. Qualitative Taxa: 63 ICI: **50**

Table A-8. continued

Collection Date: 08/25/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 16.10

Taxa Code	Taxa	Quan/Qual
01320	*Hydra sp*	8
01801	*Turbellaria*	2
03360	*Plumatella sp*	0 +
03600	*Oligochaeta*	80 +
04935	*Erpobdella punctata punctata*	0 +
05900	*Lirceus sp*	460 +
06201	*Hyalella azteca*	0 +
06700	*Crangonyx sp*	1
07701	*Cambaridae*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	1 +
11120	*Baetis flavistriga*	36 +
11130	*Baetis intercalaris*	32 +
11200	*Callibaetis sp*	0 +
13400	*Stenacron sp*	84 +
13521	*Stenonema femoratum*	9 +
15000	*Paraleptophlebia sp*	8
21200	*Calopteryx sp*	14 +
22001	*Coenagrionidae*	0 +
45300	*Sigara sp*	0 +
47600	*Sialis sp*	0 +
52200	*Cheumatopsyche sp*	46 +
52530	*Hydropsyche (H.) depravata group*	3
53800	*Hydroptila sp*	0 +
57900	*Pycnopsyche sp*	0 +
63300	*Hydroporus sp*	0 +
63900	*Laccophilus sp*	0 +
66500	*Enochrus sp*	0 +
67000	*Helophorus sp*	0 +
67300	*Hydrochus sp*	0 +
67800	*Tropisternus sp*	0 +
68708	*Dubiraphia vittata group*	4 +
68901	*Macronychus glabratus*	8 +
69400	*Stenelmis sp*	10 +
71100	*Hexatoma sp*	0 +
71700	*Pilaria sp*	0 +
74100	*Simulium sp*	0 +
77120	*Ablabesmyia mallochi*	0 +
77500	*Conchapelopia sp*	105 +
77800	*Helopelopia sp*	52 +
78140	*Labrundinia pilosella*	157
78650	*Procladius sp*	0 +
80370	*Corynoneura lobata*	320
80410	*Cricotopus (C.) sp*	52
80420	*Cricotopus (C.) bicinctus*	0 +
81201	*Nanocladius (N.) sp*	52
81650	*Parametriocnemus sp*	52 +
82121	*Thienemanniella n.sp 3*	40
82141	*Thienemanniella xena*	40
82770	*Chironomus (C.) riparius group*	0 +
82820	*Cryptochironomus sp*	0 +
83040	*Dicrotendipes neomodestus*	52
83300	*Glyptotendipes (Phytotendipes) sp*	52
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	105 +
83840	*Microtendipes pedellus group*	472 +
84155	*Paralauterborniella nigrohalteralis*	52
84210	*Paratendipes albimanus or P. duplicatus*	52 +
84300	*Phaenopsectra obediens group*	157
84440	*Polypedilum (P.) aviceps*	0 +
84460	*Polypedilum (P.) fallax group*	209
84470	*Polypedilum (P.) illinoense*	0 +
84480	*Polypedilum (P.) n.sp. same as tuberculum (Maschwitz, 1976)*	0 +
84750	*Stictochironomus sp*	0 +
85400	*Micropsectra sp*	52
85500	*Paratanytarsus sp*	890 +
85615	*Rheotanytarsus distinctissimus group*	0 +
85625	*Rheotanytarsus exiguus group*	105
85800	*Tanytarsus sp*	262 +
85802	*Tanytarsus curticornis group*	52
85814	*Tanytarsus glabrescens group*	890 +
86100	*Chrysops sp*	0 +
87501	*Empididae*	117 +
93900	*Elimia sp*	2 +
95100	*Physella sp*	59 +
96900	*Ferrissia sp*	71
97601	*Corbicula fluminea*	0 +
98600	*Sphaerium sp*	0 +

No. Quantitative Taxa: 44 Total Taxa: 76
No. Qualitative Taxa: 56 ICI: 42

Table A-8. continued

Collection Date: 08/25/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 15.80

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	166
03600	*Oligochaeta*	160
05900	*Lirceus sp*	15 +
06201	*Hyalella azteca*	7 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	1 +
08601	*Hydracarina*	4
11200	*Callibaetis sp*	1 +
13400	*Stenacron sp*	3
13521	*Stenonema femoratum*	2
15000	*Paraleptophlebia sp*	28
21001	*Calopterygidae*	10
22001	*Coenagrionidae*	37 +
52200	*Cheumatopsyche sp*	1
52530	*Hydropsyche (H.) depravata group*	1
53501	*Hydroptilidae*	1
67000	*Helophorus sp*	0 +
67500	*Laccobius sp*	1
68708	*Dubiraphia vittata group*	5 +
68901	*Macronychus glabratus*	1 +
69225	*Optioservus fastiditus*	0 +
69400	*Stenelmis sp*	38
71100	*Hexatoma sp*	0 +
71900	*Tipula sp*	2 +
74501	*Ceratopogonidae*	27
77120	*Ablabesmyia mallochi*	12
77355	*Clinotanypus pinguis*	0 +
77500	*Conchapelopia sp*	180 +
77800	*Helopelopia sp*	84 +
78140	*Labrundinia pilosella*	4
78350	*Meropelopia sp*	12 +
78401	*Natarsia species A (sensu Roback, 1978)*	24
79085	*Telopelopia okoboji*	12
79400	*Zavrelimyia sp*	12
80204	*Brillia flavifrons group*	12
80370	*Corynoneura lobata*	4
80410	*Cricotopus (C.) sp*	72
80420	*Cricotopus (C.) bicinctus*	144 +
80430	*Cricotopus (C.) tremulus group*	12
80510	*Cricotopus (Isocladius) sylvestris group*	0 +
81690	*Paratrichocladius sp*	12
81825	*Rheocricotopus (Psilocricotopus) robacki*	12
82730	*Chironomus (C.) decorus group*	72
82820	*Cryptochironomus sp*	48
83003	*Dicrotendipes fumidus*	12 +
83040	*Dicrotendipes neomodestus*	48
84210	*Paratendipes albimanus or P. duplicatus*	12
84300	*Phaenopsectra obediens group*	48
84315	*Phaenopsectra flavipes*	12
84460	*Polypedilum (P.) fallax group*	84
84470	*Polypedilum (P.) illinoense*	12 +
84480	*Polypedilum (P.) n.sp. same as tuberculum (Maschwitz, 1976)*	12 +
84540	*Polypedilum (Tripodura) scalaenum group*	24
85500	*Paratanytarsus sp*	204
85800	*Tanytarsus sp*	24
85814	*Tanytarsus glabrescens group*	96
87400	*Stratiomys sp*	0 +
87501	*Empididae*	4 +
94400	*Fossaria sp*	0 +
95100	*Physella sp*	3 +
96900	*Ferrissia sp*	17

No. Quantitative Taxa: 53 Total Taxa: 60
No. Qualitative Taxa: 24 ICI: **28**

Table A-8. continued

Collection Date: 08/25/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 14.47

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	*Oligochaeta*	9220 +			
11001	*Baetidae*	5			
12501	*Heptageniidae*	24			
17200	*Caenis sp*	1			
22001	*Coenagrionidae*	1			
22300	*Argia sp*	59 +			
52001	*Hydropsychidae*	2			
77500	*Conchapelopia sp*	7 +			
77750	*Hayesomyia senata or Thienemannimyia norena*	1			
82101	*Thienemanniella n.sp 1*	1			
83300	*Glyptotendipes (Phytotendipes) sp*	4			
84450	*Polypedilum (P.) convictum*	3			
84470	*Polypedilum (P.) illinoense*	4			
85625	*Rheotanytarsus exiguus group*	2			
86100	*Chrysops sp*	1			

No. Quantitative Taxa: 15 Total Taxa: 15
No. Qualitative Taxa: 3 ICI: **14**

Table A-8. continued

Collection Date: 08/26/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 14.20

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	*Oligochaeta*	1724 +			
22001	*Coenagrionidae*	0 +			
63300	*Hydroporus sp*	0 +			
63700	*Ilybius sp*	0 +			
63900	*Laccophilus sp*	0 +			
64600	*Rhantus sp*	0 +			
65700	*Anacaena sp*	0 +			
66500	*Enochrus sp*	0 +			
67000	*Helophorus sp*	0 +			
67800	*Tropisternus sp*	0 +			
77500	*Conchapelopia sp*	92 +			
77750	*Hayesomyia senata or Thienemannimyia norena*	14			
77800	*Helopelopia sp*	1			
78350	*Meropelopia sp*	0 +			
78401	*Natarsia species A (sensu Roback, 1978)*	1			
80420	*Cricotopus (C.) bicinctus*	9			
84315	*Phaenopsectra flavipes*	8			
87400	*Stratiomys sp*	0 +			
89001	*Sciomyzidae*	0 +			
95100	*Physella sp*	0 +			

No. Quantitative Taxa: 7 Total Taxa: 20
No. Qualitative Taxa: 15 ICI: **0**

Table A-8. continued

Collection Date: 08/26/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 13.30

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	*Oligochaeta*	12928 +			
04964	*Mooreobdella microstoma*	3 +			
11200	*Callibaetis sp*	0 +			
22001	*Coenagrionidae*	69 +			
22300	*Argia sp*	37 +			
28001	*Libellulidae*	0 +			
28955	*Plathemis lydia*	0 +			
60900	*Peltodytes sp*	0 +			
67700	*Paracymus sp*	0 +			
67800	*Tropisternus sp*	0 +			
69400	*Stenelmis sp*	0 +			
74501	*Ceratopogonidae*	64 +			
77120	*Ablabesmyia mallochi*	93 +			
77500	*Conchapelopia sp*	416 +			
77750	*Hayesomyia senata or Thienemannimyia norena*	139			
77800	*Helopelopia sp*	46 +			
78401	*Natarsia species A (sensu Roback, 1978)*	0 +			
78650	*Procladius sp*	278 +			
78702	*Psectrotanypus dyari*	0 +			
79030	*Tanypus punctipennis*	46 +			
80420	*Cricotopus (C.) bicinctus*	3562 +			
83040	*Dicrotendipes neomodestus*	46			
84470	*Polypedilum (P.) illinoense*	46 +			
87501	*Empididae*	1			
89001	*Sciomyzidae*	0 +			
95100	*Physella sp*	0 +			
96900	*Ferrissia sp*	32			

No. Quantitative Taxa: 16 Total Taxa: 27
No. Qualitative Taxa: 23 ICI: 4

Table A-8. continued

Collection Date: 08/26/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 11.50

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	1 +
03600	*Oligochaeta*	67 +
04935	*Erpobdella punctata punctata*	0 +
04964	*Mooreobdella microstoma*	2 +
05800	*Caecidotea sp*	1 +
05900	*Lirceus sp*	0 +
06700	*Crangonyx sp*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
11120	*Baetis flavistriga*	3 +
11130	*Baetis intercalaris*	0 +
13400	*Stenacron sp*	0 +
13521	*Stenonema femoratum*	0 +
21200	*Calopteryx sp*	1 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	3 +
23909	*Boyeria vinosa*	1 +
27500	*Somatochlora sp*	0 +
48410	*Corydalus cornutus*	0 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	1
52530	*Hydropsyche (H.) depravata group*	40 +
60900	*Peltodytes sp*	0 +
63900	*Laccophilus sp*	0 +
65700	*Anacaena sp*	0 +
67000	*Helophorus sp*	0 +
69400	*Stenelmis sp*	0 +
74100	*Simulium sp*	163 +
74501	*Ceratopogonidae*	0 +
77120	*Ablabesmyia mallochi*	0 +
77500	*Conchapelopia sp*	251 +
77750	*Hayesomyia senata or Thienemannimyia norena*	17 +
77800	*Helopelopia sp*	17 +
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
78650	*Procladius sp*	0 +
80410	*Cricotopus (C.) sp*	34
80420	*Cricotopus (C.) bicinctus*	537 +
80430	*Cricotopus (C.) tremulus group*	0 +
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	34
81240	*Nanocladius (N.) distinctus*	84 +
81250	*Nanocladius (N.) minimus*	134
82730	*Chironomus (C.) decorus group*	0 +
84315	*Phaenopsectra flavipes*	17
84460	*Polypedilum (P.) fallax group*	201
84470	*Polypedilum (P.) illinoense*	251 +
87400	*Stratiomys sp*	0 +
87501	*Empididae*	334 +
89001	*Sciomyzidae*	0 +
95100	*Physella sp*	320 +
96002	*Helisoma anceps anceps*	0 +
96120	*Menetus (Micromenetus) dilatatus*	0 +
96900	*Ferrissia sp*	21
98200	*Pisidium sp*	0 +

No. Quantitative Taxa: 25 Total Taxa: 51
No. Qualitative Taxa: 44 ICI: 16

Table A-8. continued

Collection Date: 08/26/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 11.10

Taxa Code	Taxa	Quan/Qual
03600	*Oligochaeta*	48 +
04664	*Helobdella stagnalis*	0 +
04964	*Mooreobdella microstoma*	0 +
06700	*Crangonyx sp*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
11120	*Baetis flavistriga*	34
11130	*Baetis intercalaris*	13
13400	*Stenacron sp*	0 +
13521	*Stenonema femoratum*	0 +
21200	*Calopteryx sp*	0 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	41 +
23909	*Boyeria vinosa*	0 +
45900	*Notonecta sp*	0 +
52530	*Hydropsyche (H.) depravata group*	1
60900	*Peltodytes sp*	0 +
63300	*Hydroporus sp*	0 +
63900	*Laccophilus sp*	0 +
65800	*Berosus sp*	0 +
67000	*Helophorus sp*	0 +
74100	*Simulium sp*	33
77120	*Ablabesmyia mallochi*	29 +
77500	*Conchapelopia sp*	174 +
77800	*Helopelopia sp*	72 +
78650	*Procladius sp*	0 +
80204	*Brillia flavifrons group*	14
80410	*Cricotopus (C.) sp*	174
80420	*Cricotopus (C.) bicinctus*	449 +
80430	*Cricotopus (C.) tremulus group*	463 +
80510	*Cricotopus (Isocladius) sylvestris group*	14 +
81250	*Nanocladius (N.) minimus*	116
82730	*Chironomus (C.) decorus group*	0 +
82770	*Chironomus (C.) riparius group*	43 +
84315	*Phaenopsectra flavipes*	14
84460	*Polypedilum (P.) fallax group*	29
84470	*Polypedilum (P.) illinoense*	159 +
87501	*Empididae*	4
95100	*Physella sp*	450 +
96002	*Helisoma anceps anceps*	1 +
96900	*Ferrissia sp*	156 +

Taxa Code	Taxa	Quan/Qual

No. Quantitative Taxa:	23	Total Taxa:	40
No. Qualitative Taxa:	30	ICI:	**12**

Table A-8. continued

Collection Date: 08/27/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 10.20

Taxa Code	Taxa	Quan/Qual
00556	*Ephydatia fluviatilis*	0 +
01801	*Turbellaria*	1 +
03600	*Oligochaeta*	80 +
04964	*Mooreobdella microstoma*	0 +
05800	*Caecidotea sp*	0 +
05900	*Lirceus sp*	0 +
06700	*Crangonyx sp*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
08601	*Hydracarina*	8
11200	*Callibaetis sp*	0 +
13521	*Stenonema femoratum*	0 +
21200	*Calopteryx sp*	1 +
22001	*Coenagrionidae*	0 +
22300	*Argia sp*	0 +
23909	*Boyeria vinosa*	2 +
47600	*Sialis sp*	0 +
52440	*Hydropsyche (Ceratopsyche) slossonae*	4
52530	*Hydropsyche (H.) depravata group*	49 +
53800	*Hydroptila sp*	8 +
66500	*Enochrus sp*	0 +
67000	*Helophorus sp*	0 +
67700	*Paracymus sp*	0 +
67800	*Tropisternus sp*	0 +
69400	*Stenelmis sp*	26 +
71900	*Tipula sp*	1 +
72700	*Anopheles sp*	0 +
74100	*Simulium sp*	29 +
74501	*Ceratopogonidae*	0 +
77120	*Ablabesmyia mallochi*	0 +
77500	*Conchapelopia sp*	465 +
77750	*Hayesomyia senata or Thienemannimyia norena*	40 +
77800	*Helopelopia sp*	121 +
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
78450	*Nilotanypus fimbriatus*	20
78650	*Procladius sp*	0 +
80204	*Brillia flavifrons group*	20
80310	*Cardiocladius obscurus*	0 +
80410	*Cricotopus (C.) sp*	324 +
80420	*Cricotopus (C.) bicinctus*	202 +
80430	*Cricotopus (C.) tremulus group*	81 +
81240	*Nanocladius (N.) distinctus*	30
81250	*Nanocladius (N.) minimus*	30
81259	*Nanocladius (N.) rectinervis*	60
81825	*Rheocricotopus (Psilocricotopus) robacki*	20
82730	*Chironomus (C.) decorus group*	0 +
82820	*Cryptochironomus sp*	0 +
84315	*Phaenopsectra flavipes*	20
84460	*Polypedilum (P.) fallax group*	222
84470	*Polypedilum (P.) illinoense*	121 +
84540	*Polypedilum (Tripodura) scalaenum group*	0 +
85625	*Rheotanytarsus exiguus group*	4
87501	*Empididae*	42 +
95100	*Physella sp*	16 +
96900	*Ferrissia sp*	460 +

No. Quantitative Taxa: 30 Total Taxa: 54
No. Qualitative Taxa: 43 ICI: **16**

Table A-8. continued

Collection Date: 08/27/93 River Code: 17-733 River: Rocky Fork Mohican River RM: 6.40

Taxa Code	Taxa	Quan/Qual
00556	*Ephydatia fluviatilis*	0 +
01320	*Hydra sp*	8
01801	*Turbellaria*	0 +
03600	*Oligochaeta*	80
05800	*Caecidotea sp*	0 +
05900	*Lirceus sp*	0 +
06700	*Crangonyx sp*	0 +
08601	*Hydracarina*	136
11120	*Baetis flavistriga*	185 +
11130	*Baetis intercalaris*	78 +
13400	*Stenacron sp*	0 +
13521	*Stenonema femoratum*	0 +
13561	*Stenonema pulchellum*	5 +
21200	*Calopteryx sp*	0 +
22001	*Coenagrionidae*	0 +
23909	*Boyeria vinosa*	0 +
43300	*Ranatra sp*	0 +
45300	*Sigara sp*	0 +
47600	*Sialis sp*	0 +
52200	*Cheumatopsyche sp*	102 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	3300 +
52530	*Hydropsyche (H.) depravata group*	203 +
52540	*Hydropsyche (H.) dicantha*	1371 +
53800	*Hydroptila sp*	16
68708	*Dubiraphia vittata group*	0 +
69225	*Optioservus fastiditus*	0 +
69400	*Stenelmis sp*	0 +
70600	*Antocha sp*	8
71900	*Tipula sp*	4 +
77120	*Ablabesmyia mallochi*	0 +
77500	*Conchapelopia sp*	125 +
77750	*Hayesomyia senata or Thienemannimyia norena*	0 +
77800	*Helopelopia sp*	0 +
78350	*Meropelopia sp*	0 +
78450	*Nilotanypus fimbriatus*	50
78650	*Procladius sp*	0 +
80410	*Cricotopus (C.) sp*	150 +
80430	*Cricotopus (C.) tremulus group*	75 +
81229	*Nanocladius (N.) crassicornus*	50
81240	*Nanocladius (N.) distinctus*	50
81250	*Nanocladius (N.) minimus*	50
81270	*Nanocladius (N.) spiniplenus*	75
81825	*Rheocricotopus (Psilocricotopus) robacki*	100
82141	*Thienemanniella xena*	4
82220	*Tvetenia discoloripes group*	25
82730	*Chironomus (C.) decorus group*	0 +
82820	*Cryptochironomus sp*	0 +
83003	*Dicrotendipes fumidus*	25 +
83040	*Dicrotendipes neomodestus*	0 +
84210	*Paratendipes albimanus or P. duplicatus*	25
84300	*Phaenopsectra obediens group*	0 +
84315	*Phaenopsectra flavipes*	25
84450	*Polypedilum (P.) convictum*	75
84460	*Polypedilum (P.) fallax group*	100
84470	*Polypedilum (P.) illinoense*	0 +
84540	*Polypedilum (Tripodura) scalaenum group*	50 +
84700	*Stenochironomus sp*	25
84750	*Stictochironomus sp*	0 +
84888	*Xenochironomus xenolabis*	0 +
85500	*Paratanytarsus sp*	75 +
85625	*Rheotanytarsus exiguus group*	475
85800	*Tanytarsus sp*	100 +
85814	*Tanytarsus glabrescens group*	375 +
85840	*Tanytarsus guerlus group*	100 +
86401	*Atherix lantha*	0 +
87501	*Empididae*	90 +
95100	*Physella sp*	0 +
96900	*Ferrissia sp*	220 +

No. Quantitative Taxa: 38 Total Taxa: 68
No. Qualitative Taxa: 49 ICI: **46**

Table A-8. continued

Collection Date: 08/27/93 River Code: 17-733 River: Rocky Fork Mohican River RM: .70

Taxa Code	Taxa	Quan/Qual
00556	*Ephydatia fluviatilis*	0 +
01320	*Hydra sp*	1
01801	*Turbellaria*	1 +
03600	*Oligochaeta*	1
04964	*Mooreobdella microstoma*	0 +
05800	*Caecidotea sp*	0 +
05900	*Lirceus sp*	0 +
06201	*Hyalella azteca*	0 +
06700	*Crangonyx sp*	0 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
08601	*Hydracarina*	1
11120	*Baetis flavistriga*	25 +
11130	*Baetis intercalaris*	495 +
13400	*Stenacron sp*	1 +
13521	*Stenonema femoratum*	1 +
13540	*Stenonema mediopunctatum*	3 +
13561	*Stenonema pulchellum*	32 +
13590	*Stenonema vicarium*	0 +
17200	*Caenis sp*	0 +
23909	*Boyeria vinosa*	0 +
25510	*Stylogomphus albistylus*	0 +
42700	*Belostoma sp*	0 +
47600	*Sialis sp*	0 +
48410	*Corydalus cornutus*	2
52200	*Cheumatopsyche sp*	335 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	769 +
52540	*Hydropsyche (H.) dicantha*	0 +
53501	*Hydroptilidae*	0 +
69400	*Stenelmis sp*	2 +
70600	*Antocha sp*	9 +
74100	*Simulium sp*	0 +
77500	*Conchapelopia sp*	39 +
77750	*Hayesomyia senata or Thienemannimyia norena*	49
77800	*Helopelopia sp*	0 +
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
80310	*Cardiocladius obscurus*	0 +
80410	*Cricotopus (C.) sp*	10
80430	*Cricotopus (C.) tremulus group*	0 +
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	10
81270	*Nanocladius (N.) spiniplenus*	39
81825	*Rheocricotopus (Psilocricotopus) robacki*	20
82141	*Thienemanniella xena*	10
82770	*Chironomus (C.) riparius group*	0 +
82820	*Cryptochironomus sp*	0 +
82880	*Cryptotendipes sp*	0 +
83040	*Dicrotendipes neomodestus*	49
84300	*Phaenopsectra obediens group*	10 +
84450	*Polypedilum (P.) convictum*	137 +
84460	*Polypedilum (P.) fallax group*	127
84540	*Polypedilum (Tripodura) scalaenum group*	10 +
84700	*Stenochironomus sp*	10
84888	*Xenochironomus xenolabis*	0 +
85625	*Rheotanytarsus exiguus group*	185 +
85800	*Tanytarsus sp*	176
85814	*Tanytarsus glabrescens group*	146
86401	*Atherix lantha*	0 +
87501	*Empididae*	1
93900	*Elimia sp*	0 +
95100	*Physella sp*	0 +
96900	*Ferrissia sp*	26

No. Quantitative Taxa: 33 Total Taxa: 60
No. Qualitative Taxa: 43 ICI: **46**

Table A-8. continued

Collection Date: 08/26/93 River Code: 17-734 River: Touby Run RM: .40

Taxa Code	Taxa	Quan/Qual
01320	*Hydra sp*	36
01801	*Turbellaria*	44 +
03360	*Plumatella sp*	1
03600	*Oligochaeta*	426 +
04935	*Erpobdella punctata punctata*	0 +
04964	*Mooreobdella microstoma*	1 +
05900	*Lirceus sp*	97 +
06700	*Crangonyx sp*	1 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
08601	*Hydracarina*	12 +
11120	*Baetis flavistriga*	46 +
11130	*Baetis intercalaris*	11 +
11200	*Callibaetis sp*	0 +
13521	*Stenonema femoratum*	20 +
22001	*Coenagrionidae*	5 +
42700	*Belostoma sp*	0 +
43570	*Neoplea sp*	0 +
45300	*Sigara sp*	0 +
52200	*Cheumatopsyche sp*	0 +
52530	*Hydropsyche (H.) depravata group*	0 +
53800	*Hydroptila sp*	168 +
60900	*Peltodytes sp*	0 +
63900	*Laccophilus sp*	0 +
66500	*Enochrus sp*	0 +
67800	*Tropisternus sp*	0 +
68708	*Dubiraphia vittata group*	0 +
69400	*Stenelmis sp*	6 +
71900	*Tipula sp*	0 +
72700	*Anopheles sp*	0 +
72900	*Culex sp*	0 +
74100	*Simulium sp*	1 +
74650	*Atrichopogon sp*	4
77120	*Ablabesmyia mallochi*	441 +
77500	*Conchapelopia sp*	1542 +
77750	*Hayesomyia senata or Thienemannimyia norena*	220
77800	*Helopelopia sp*	0 +
78401	*Natarsia species A (sensu Roback, 1978)*	0 +
78450	*Nilotanypus fimbriatus*	110
79400	*Zavrelimyia sp*	0 +
80370	*Corynoneura lobata*	4
80420	*Cricotopus (C.) bicinctus*	881 +
83003	*Dicrotendipes fumidus*	220 +
84300	*Phaenopsectra obediens group*	0 +
84315	*Phaenopsectra flavipes*	110
84540	*Polypedilum (Tripodura) scalaenum group*	0 +
85500	*Paratanytarsus sp*	2533
85625	*Rheotanytarsus exiguus group*	110
85814	*Tanytarsus glabrescens group*	1762
85840	*Tanytarsus guerlus group*	551
87501	*Empididae*	421 +
89704	*Limnophora aequifrons*	0 +
94400	*Fossaria sp*	1
95100	*Physella sp*	587 +
96408	*Promenetus umbilicatellus*	0 +
96900	*Ferrissia sp*	1042 +

No. Quantitative Taxa: 32 Total Taxa: 55
No. Qualitative Taxa: 43 ICI: 36

Table A-8. continued

Collection Date: 08/25/93 River Code: 17-750 River: Clear Fork Mohican River RM: 35.70

Taxa Code	Taxa	Quan/Qual
01801	*Turbellaria*	24 +
03600	*Oligochaeta*	0 +
05900	*Lirceus sp*	1286 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	0 +
08601	*Hydracarina*	0 +
11120	*Baetis flavistriga*	12 +
11130	*Baetis intercalaris*	0 +
11430	*Diphetor hageni*	1
13400	*Stenacron sp*	5 +
13521	*Stenonema femoratum*	45 +
13590	*Stenonema vicarium*	0 +
15000	*Paraleptophlebia sp*	1820 +
15501	*Ephemerellidae*	10
17200	*Caenis sp*	0 +
18600	*Ephemera sp*	0 +
21200	*Calopteryx sp*	11
23909	*Boyeria vinosa*	0 +
47600	*Sialis sp*	0 +
50410	*Dolophilodes distinctus*	0 +
52200	*Cheumatopsyche sp*	0 +
52430	*Hydropsyche (Ceratopsyche) morosa group*	2 +
52440	*Hydropsyche (Ceratopsyche) slossonae*	2 +
52530	*Hydropsyche (H.) depravata group*	0 +
53800	*Hydroptila sp*	0 +
63300	*Hydroporus sp*	0 +
67000	*Helophorus sp*	0 +
67700	*Paracymus sp*	0 +
67800	*Tropisternus sp*	0 +
68708	*Dubiraphia vittata group*	0 +
69400	*Stenelmis sp*	0 +
71100	*Hexatoma sp*	0 +
71900	*Tipula sp*	0 +
74501	*Ceratopogonidae*	8
77120	*Ablabesmyia mallochi*	22 +
77500	*Conchapelopia sp*	55
77750	*Hayesomyia senata or Thienemannimyia norena*	0 +
77800	*Helopelopia sp*	0 +
78140	*Labrundinia pilosella*	3
78450	*Nilotanypus fimbriatus*	8
80204	*Brillia flavifrons group*	11
80370	*Corynoneura lobata*	402
80420	*Cricotopus (C.) bicinctus*	0 +
81650	*Parametriocnemus sp*	11 +
81690	*Paratrichocladius sp*	89 +
81825	*Rheocricotopus (Psilocricotopus) robacki*	11
82101	*Thienemanniella n.sp 1*	10
82141	*Thienemanniella xena*	38
83003	*Dicrotendipes fumidus*	0 +
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	0 +
83840	*Microtendipes pedellus group*	89 +
84210	*Paratendipes albimanus or P. duplicatus*	22
84300	*Phaenopsectra obediens group*	22 +
84440	*Polypedilum (P.) aviceps*	0 +
84460	*Polypedilum (P.) fallax group*	22
84480	*Polypedilum (P.) n.sp. same as tuberculum (Maschwitz, 1976)*	0 +
84750	*Stictochironomus sp*	0 +
85500	*Paratanytarsus sp*	177 +
85501	*Paratanytarsus n.sp 1*	22
85625	*Rheotanytarsus exiguus group*	111 +
85752	*Sublettea coffmani*	11
85800	*Tanytarsus sp*	11
85802	*Tanytarsus curticornis group*	22
85814	*Tanytarsus glabrescens group*	100
86100	*Chrysops sp*	0 +
87501	*Empididae*	53 +
89704	*Limnophora aequifrons*	0 +
94400	*Fossaria sp*	0 +

No. Quantitative Taxa: 35 Total Taxa: 67
No. Qualitative Taxa: 48 ICI: **44**

Table A-9. Catch summary for fish collected in the Rocky Fork Mohican River study area (by RM) in 1993.

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 16.40 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4679 SEC DATE RANGE: 08/26/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
40-016	WHITE SUCKER	110	82.50	7.97	10.950	47.74	132.72
43-001	COMMON CARP	5	3.75	.36	5.246	22.87	1,398.80
43-013	CREEK CHUB	116	87.00	8.40	.792	3.45	9.09
43-017	REDSIDE DACE	14	10.50	1.01	.016	.07	1.43
43-025	STRIPED SHINER	9	6.75	.65	.078	.34	11.44
43-026	COMMON SHINER	133	99.75	9.63	1.084	4.72	10.86
43-043	BLUNTNOSE MINNOW	596	447.00	43.16	1.873	8.17	4.19
43-044	CENTRAL STONEROLLER	13	9.75	.94	.069	.30	7.00
43-060	COMMON SH X STR. SH.	100	75.00	7.24	.824	3.59	10.99
77-003	ROCK BASS	23	17.25	1.67	.878	3.83	50.87
77-008	GREEN SUNFISH	54	40.50	3.91	.362	1.58	8.92
77-009	BLUEGILL SUNFISH	4	3.00	.29	.030	.13	9.75
77-015	GREEN SF X BLUEGILL	14	10.50	1.01	.596	2.60	56.71
80-014	JOHNNY DARTER	173	129.75	12.53	.119	.52	.92
80-015	GREENSIDE DARTER	9	6.75	.65	.018	.08	2.56
95-001	BROOK STICKLEBACK	8	6.00	.58	.006	.02	.87
	MILE TOTAL	1,381	1,035.75		22.941		
	NUMBER OF SPECIES	14					
	NUMBER OF HYBRIDS	2					

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 15.80 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 3417 SEC DATE RANGE: 08/25/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
01-006	LEAST BROOK LAMPREY	1	.75	.13	.006	.02	8.00
40-010	GOLDEN REDHORSE	2	1.50	.25	.102	.31	68.00
40-016	WHITE SUCKER	223	167.25	27.94	15.869	48.78	94.88
43-001	COMMON CARP	8	6.00	1.00	14.100	43.35	2,350.00
43-002	GOLDFISH	1	.75	.13	.015	.05	20.00
43-013	CREEK CHUB	62	46.50	7.77	.212	.65	4.56
43-025	STRIPED SHINER	5	3.75	.63	.061	.19	16.20
43-026	COMMON SHINER	32	24.00	4.01	.396	1.22	16.47
43-043	BLUNTNOSE MINNOW	258	193.50	32.33	.261	.80	1.35
43-060	COMMON SH X STR. SH.	6	4.50	.75	.074	.23	16.33
77-003	ROCK BASS	5	3.75	.63	.070	.22	18.60
77-008	GREEN SUNFISH	116	87.00	14.54	1.111	3.42	12.77
77-013	PUMPKINSEED SUNFISH	4	3.00	.50	.018	.06	6.00
77-015	GREEN SF X BLUEGILL	9	6.75	1.13	.197	.61	29.11
80-014	JOHNNY DARTER	64	48.00	8.02	.035	.11	.73
95-001	BROOK STICKLEBACK	2	1.50	.25	.002	.01	1.00
	MILE TOTAL	798	598.50		32.529		
	NUMBER OF SPECIES	14					
	NUMBER OF HYBRIDS	2					

Table A-9. continued

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 14.60 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 3718 SEC DATE RANGE: 08/25/93
SAMPLER TYPE: D DIST FISHED: 0.36 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	12	10.01	11.01	.394	2.69	39.42
40-016	WHITE SUCKER	58	48.34	53.21	1.932	13.20	39.95
43-001	COMMON CARP	6	5.00	5.50	11.919	81.46	2,383.34
43-003	GOLDEN SHINER	1	.84	.92	.025	.17	30.00
43-013	CREEK CHUB	3	2.50	2.75	.053	.36	21.00
43-042	FATHEAD MINNOW	2	1.67	1.83	.009	.06	5.50
43-043	BLUNTNOSE MINNOW	1	.84	.92	.008	.05	9.00
77-006	LARGEMOUTH BASS	4	3.34	3.67	.014	.10	4.25
77-008	GREEN SUNFISH	22	18.34	20.19	.280	1.91	15.27
	MILE TOTAL	109	90.88		14.634		
	NUMBER OF SPECIES	9					

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 14.45 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 1006 SEC DATE RANGE: 08/25/93
SAMPLER TYPE: D DIST FISHED: 0.10 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
40-016	WHITE SUCKER	1	3.00	50.00	.072	39.34	24.00
43-011	BLACKNOSE DACE	1	3.00	50.00	.009	4.92	3.00
	MILE TOTAL	2	6.00		.081		
	NUMBER OF SPECIES	2					

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 14.20 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 2562 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.42 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
	MILE TOTAL	0	.00				
	NUMBER OF SPECIES	0					

Table A-9. continued

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 13.40 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 2686 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.52 PASSES: 2 THRU: 09/30/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	2	1.16	18.22	.043	32.32	37.00
40-016	WHITE SUCKER	2	1.16	18.22	.024	18.25	21.00
43-013	CREEK CHUB	3	1.73	27.29	.023	17.49	13.33
43-032	SPOTFIN SHINER	1	.58	9.07	.003	1.90	4.00
77-006	LARGEMOUTH BASS	1	.58	9.07	.004	3.04	7.00
77-008	GREEN SUNFISH	2	1.15	18.14	.036	27.00	31.00
	MILE TOTAL	11	6.36		.133		
	NUMBER OF SPECIES	6					

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 11.70 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4164 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 10/01/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	18	13.50	6.67	.181	1.45	13.39
40-016	WHITE SUCKER	124	93.00	45.93	9.456	75.67	101.67
43-001	COMMON CARP	1	.75	.37	.938	7.50	1,250.00
43-003	GOLDEN SHINER	1	.75	.37	.005	.04	6.00
43-011	BLACKNOSE DACE	1	.75	.37	.001	.01	1.00
43-013	CREEK CHUB	60	45.00	22.22	1.150	9.20	25.55
43-025	STRIPED SHINER	4	3.00	1.48	.098	.78	32.50
43-032	SPOTFIN SHINER	5	3.75	1.85	.027	.22	7.20
43-043	BLUNTNOSE MINNOW	2	1.50	.74	.013	.10	8.50
43-044	CENTRAL STONEROLLER	2	1.50	.74	.003	.02	2.00
47-004	YELLOW BULLHEAD	2	1.50	.74	.132	1.06	88.00
77-006	LARGEMOUTH BASS	8	6.00	2.96	.057	.46	9.50
77-008	GREEN SUNFISH	37	27.75	13.70	.360	2.88	12.97
77-009	BLUEGILL SUNFISH	1	.75	.37	.029	.23	38.00
77-016	GR'N SF X PUMPKINS'D	1	.75	.37	.030	.24	40.00
80-015	GREENSIDE DARTER	3	2.25	1.11	.020	.16	8.67
	MILE TOTAL	270	202.50		12.500		
	NUMBER OF SPECIES	15					
	NUMBER OF HYBRIDS	1					

Table A-9. continued

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 11.10 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 1724 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.10 PASSES: 2 THRU: 10/01/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	9	27.00	.78	.570	1.66	21.11
40-016	WHITE SUCKER	39	117.00	3.39	5.774	16.83	49.35
43-001	COMMON CARP	1	3.00	.09	6.150	17.92	2,050.00
43-011	BLACKNOSE DACE	427	1,281.00	37.07	2.458	7.16	1.92
43-013	CREEK CHUB	534	1,602.00	46.35	11.916	34.73	7.44
43-016	SOUTH. REDBELLY DACE	4	12.00	.35	.012	.03	1.00
43-025	STRIPED SHINER	59	177.00	5.12	6.423	18.72	36.29
43-032	SPOTFIN SHINER	9	27.00	.78	.145	.42	5.38
43-043	BLUNTNOSE MINNOW	1	3.00	.09	.018	.05	6.00
43-044	CENTRAL STONEROLLER	47	141.00	4.08	.504	1.47	3.57
77-008	GREEN SUNFISH	6	18.00	.52	.204	.59	11.33
80-014	JOHNNY DARTER	4	12.00	.35	.012	.03	1.00
80-015	GREENSIDE DARTER	8	24.00	.69	.114	.33	4.75
95-001	BROOK STICKLEBACK	4	12.00	.35	.012	.03	1.00
	MILE TOTAL	1,152	3,456.00		34.312		
	NUMBER OF SPECIES	14					

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 10.20 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 3463 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 10/05/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
40-015	NORTHERN HOG SUCKER	3	2.25	.32	.129	.33	57.33
40-016	WHITE SUCKER	262	196.50	27.93	27.423	70.59	139.55
43-001	COMMON CARP	4	3.00	.43	5.757	14.82	1,918.75
43-011	BLACKNOSE DACE	96	72.00	10.23	.261	.67	3.62
43-013	CREEK CHUB	255	191.25	27.19	3.534	9.10	18.47
43-025	STRIPED SHINER	35	26.25	3.73	.701	1.80	26.69
43-032	SPOTFIN SHINER	1	.75	.11	.003	.01	4.00
43-043	BLUNTNOSE MINNOW	18	13.50	1.92	.065	.17	4.78
43-044	CENTRAL STONEROLLER	13	9.75	1.39	.033	.08	3.31
43-060	COMMON SH X STR. SH.	2	1.50	.21	.039	.10	26.00
77-008	GREEN SUNFISH	18	13.50	1.92	.219	.56	16.17
80-014	JOHNNY DARTER	2	1.50	.21	.002	.00	1.00
80-015	GREENSIDE DARTER	228	171.00	24.31	.687	1.77	4.02
95-001	BROOK STICKLEBACK	1	.75	.11	.001	.00	1.00
	MILE TOTAL	938	703.50		38.854		
	NUMBER OF SPECIES	13					
	NUMBER OF HYBRIDS	1					

Table A-9. continued

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 6.40 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4678 SEC DATE RANGE: 08/23/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 10/04/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	16	12.00	1.07	.089	.26	7.37
40-010	GOLDEN REDHORSE	1	.75	.07	.038	.11	50.00
40-015	NORTHERN HOG SUCKER	10	7.50	.67	.537	1.56	71.60
40-016	WHITE SUCKER	236	177.00	15.81	17.213	50.13	97.24
43-001	COMMON CARP	10	7.50	.67	11.534	33.59	1,537.80
43-011	BLACKNOSE DACE	136	102.00	9.11	.314	.91	3.08
43-013	CREEK CHUB	383	287.25	25.65	2.427	7.07	8.45
43-016	SOUTH. REDBELLY DACE	2	1.50	.13	.003	.01	1.50
43-025	STRIPED SHINER	68	51.00	4.55	.963	2.80	18.88
43-032	SPOTFIN SHINER	6	4.50	.40	.021	.06	4.50
43-034	SAND SHINER	18	13.50	1.21	.043	.13	3.17
43-043	BLUNTNOSE MINNOW	280	210.00	18.75	.217	.63	1.03
43-044	CENTRAL STONEROLLER	84	63.00	5.63	.291	.85	4.61
47-004	YELLOW BULLHEAD	2	1.50	.13	.032	.09	21.00
77-006	LARGEMOUTH BASS	1	.75	.07	.008	.02	10.00
77-008	GREEN SUNFISH	9	6.75	.60	.111	.32	16.44
80-014	JOHNNY DARTER	14	10.50	.94	.014	.04	1.29
80-015	GREENSIDE DARTER	214	160.50	14.33	.482	1.40	3.00
80-016	BANDED DARTER	3	2.25	.20	.004	.01	1.33
	MILE TOTAL	1,493	1,119.75		34.341		
	NUMBER OF SPECIES	19					

Table A-9. continued

RIVER CODE: 17-733 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 0.60 STREAM NAME: Rocky Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4644 SEC DATE RANGE: 08/19/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 10/04/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
20-003	GIZZARD SHAD	2,128	1,596.00	59.64	13.891	24.07	8.70
40-009	BLACK REDHORSE	1	.75	.03	.108	.19	143.00
40-010	GOLDEN REDHORSE	6	4.50	.17	1.559	2.70	346.42
40-015	NORTHERN HOG SUCKER	64	48.00	1.79	11.866	20.56	247.19
40-016	WHITE SUCKER	103	77.25	2.89	5.907	10.23	76.47
43-001	COMMON CARP	11	8.25	.31	16.317	28.27	1,977.76
43-005	RIVER CHUB	35	26.25	.98	.870	1.51	33.14
43-011	BLACKNOSE DACE	88	66.00	2.47	.255	.44	3.87
43-013	CREEK CHUB	72	54.00	2.02	.441	.76	8.17
43-022	ROSYFACE SHINER	13	9.75	.36	.017	.03	1.70
43-025	STRIPED SHINER	236	177.00	6.61	2.528	4.38	14.28
43-032	SPOTFIN SHINER	5	3.75	.14	.020	.03	5.26
43-034	SAND SHINER	27	20.25	.76	.077	.13	3.78
43-042	FATHEAD MINNOW	5	3.75	.14	.009	.01	2.20
43-043	BLUNTNOSE MINNOW	190	142.50	5.33	.567	.98	3.97
43-044	CENTRAL STONEROLLER	165	123.75	4.62	.978	1.69	7.90
43-060	COMMON SH X STR. SH.	4	3.00	.11	.043	.07	14.25
47-004	YELLOW BULLHEAD	4	3.00	.11	.333	.58	111.00
77-004	SMALLMOUTH BASS	1	.75	.03	.121	.21	161.00
77-006	LARGEMOUTH BASS	4	3.00	.11	.468	.81	156.00
77-008	GREEN SUNFISH	4	3.00	.11	.039	.07	13.00
77-009	BLUEGILL SUNFISH	1	.75	.03	.005	.01	6.00
80-011	LOGPERCH	2	1.50	.06	.013	.02	8.50
80-014	JOHNNY DARTER	16	12.00	.45	.014	.02	1.12
80-015	GREENSIDE DARTER	321	240.75	9.00	1.198	2.07	4.97
80-016	BANDED DARTER	59	44.25	1.65	.069	.12	1.56
80-022	RAINBOW DARTER	3	2.25	.08	.007	.01	3.00
	MILE TOTAL	3,568	2,676.00		57.720		
	NUMBER OF SPECIES	26					
	NUMBER OF HYBRIDS	1					

Table A-9. continued

RIVER CODE: 17-734 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 0.40 STREAM NAME: Touby Run PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4411 SEC DATE RANGE: 08/24/93
SAMPLER TYPE: D DIST FISHED: 0.40 PASSES: 2 THRU: 10/01/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
40-016	WHITE SUCKER	56	42.00	3.42	2.565	12.62	61.08
43-011	BLACKNOSE DACE	740	555.00	45.15	11.111	54.68	20.02
43-013	CREEK CHUB	593	444.75	36.18	6.010	29.58	13.51
43-016	SOUTH. REDBELLY DACE	4	3.00	.24	.015	.07	4.75
43-025	STRIPED SHINER	1	.75	.06	.001	.00	1.00
43-026	COMMON SHINER	3	2.25	.18	.027	.13	12.00
43-043	BLUNTNOSE MINNOW	182	136.50	11.10	.144	.71	1.06
43-044	CENTRAL STONEROLLER	36	27.00	2.20	.324	1.59	12.02
77-006	LARGEMOUTH BASS	2	1.50	.12	.015	.07	10.00
77-008	GREEN SUNFISH	1	.75	.06	.012	.06	16.00
77-009	BLUEGILL SUNFISH	1	.75	.06	.003	.01	3.00
80-014	JOHNNY DARTER	1	.75	.06	.002	.01	2.00
80-015	GREENSIDE DARTER	17	12.75	1.04	.090	.44	7.00
95-001	BROOK STICKLEBACK	2	1.50	.12	.003	.01	1.50
	MILE TOTAL	1,639	1,229.25		20.322		
	NUMBER OF SPECIES	14					

RIVER CODE: 17-750 BASIN NAME: Muskingum River DATA SOURCE: 01
RIVER MILE: 35.70 STREAM NAME: Clear Fork Mohican River PURPOSE:
SAMPLE DATE: 1993 TIME FISHED: 4472 SEC DATE RANGE: 08/25/93
SAMPLER TYPE: D DIST FISHED: 0.39 PASSES: 2 THRU: 10/05/93

SPECIES CODE	SPECIES NAME	NO FISH	REL NO	% BY NUMBER	REL WT	% BY WEIGHT	AVE(GM) WEIGHT
34-001	CENTRAL MUDMINNOW	5	3.79	.18	.028	.28	7.20
40-016	WHITE SUCKER	176	132.91	6.43	2.931	29.76	22.16
43-011	BLACKNOSE DACE	530	405.24	19.62	1.217	12.35	3.01
43-013	CREEK CHUB	554	428.50	20.74	3.031	30.77	7.09
43-016	SOUTH. REDBELLY DACE	64	49.35	2.39	.131	1.33	2.66
43-043	BLUNTNOSE MINNOW	1	.79	.04	.003	.03	3.00
43-044	CENTRAL STONEROLLER	890	674.02	32.63	1.601	16.26	2.37
47-004	YELLOW BULLHEAD	1	.75	.04	.009	.09	11.00
47-006	BLACK BULLHEAD	2	1.50	.07	.023	.23	15.00
77-006	LARGEMOUTH BASS	88	66.52	3.22	.278	2.82	4.18
77-008	GREEN SUNFISH	15	11.33	.55	.057	.57	4.93
77-009	BLUEGILL SUNFISH	1	.75	.04	.008	.08	10.00
80-011	LOGPERCH	1	.75	.04	.009	.09	11.00
80-014	JOHNNY DARTER	77	58.54	2.83	.085	.86	1.44
80-022	RAINBOW DARTER	51	38.61	1.87	.061	.61	1.57
80-024	FANTAIL DARTER	148	112.11	5.43	.170	1.73	1.52
90-002	MOTTLED SCULPIN	105	80.37	3.89	.212	2.15	2.64
	MILE TOTAL	2,709	2,065.83		9.854		
	NUMBER OF SPECIES	17					