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INDIANA 305(b) REPORT
1994 - 95

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

OFFICE OF WATER MANAGEMENT
100 NORTH SENATE AVENUE
INDIANAPOLIS, IN 46206

INDIANA 305(b) REPORT
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INDIANA DEPARTMENT
OF ENVIRONMENTAL
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OFFICE OF WATER MANAGEMENT
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EXECUTIVE SUMMARY

The 1994-95 305 (b) Report is organized into four major sections, and Indiana's activities and concerns in each area are summarized or discussed as follows:

1. **Surface Water Quality** - This section includes a discussion of the present status of water quality in Indiana rivers, lakes and streams that were assessed during this reporting period as well as any water quality trends that were apparent, a discussion of the toxics information which has been compiled, a discussion of the lake and nonpoint source assessments, and a summary discussion of the waters assessed in each major river basin.

2. **Water Pollution Control Program** - This section includes a discussion of the point source control programs including the construction grants, NPDES permitting, pretreatment, compliance, and enforcement programs; the nonpoint source control program; and the various monitoring programs used to obtain water quality data.

3. **Ground Water Quality** - This section describes Indiana's ground water resources; ground water quality; nonpoint source impacts; and geographic areas of concern.

4. **Special Concerns and Recommendations** - This section highlights Indiana's special concerns and includes proposed recommendations for future actions by the state and the federal government.

There are about 90,000 miles of rivers, streams, ditches and drainage ways in Indiana of which 35,673 miles are listed in EPAs River Reach File 3 (RF3). Of these, approximately 21,094 miles have sufficient all weather flow and other physical characteristics necessary to support both the fishable and swimmable uses year around.

There are approximately 575 publicly owned inland lakes and reservoirs in Indiana with a combined surface area of some 106,203 acres. Indiana also controls 154,000 acres (43 shoreline miles) of Lake Michigan. Some assessment was made for nearly all of these waters.

Although much of Indiana's wetland resource has been lost, there are an estimated 813,000 acres of wetlands remaining, mostly in the northern part of the state. No formal water quality assessment has been made of these areas. However, the state is unaware of any wetland problems related to point source discharges. The main concern of the state regarding wetlands is preventing the future loss of these areas through draining and filling.

Of the stream miles assessed it was estimated that the recreational use was supported in 18% and the aquatic life was supported in 85%. Although both the aquatic life and recreational uses were supported in more than 99% of the total lake and reservoir acres assessed, many are considered threatened by point and/or nonpoint sources of pollution. All of Lake Michigan governed by Indiana supported the recreational and aquatic life uses but only partially supported the fish consumption use due to the lakewide fish consumption advisory.

The major causes of nonsupport of uses were E. coli bacteria, priority organic compounds, organic enrichment, pesticides, and metals. The sources of substances most often contributing to nonsupport of uses were: agricultural nonpoint sources, municipal/semi-public point sources, urban runoff; industrial point sources, and combined sewer overflows.

In the past two years, the Indiana Department of Environmental Management has monitored toxic substances in fish tissue and sediments. Most of the 8,355 stream miles and approximately 47,892 inland lake and reservoir acres assessed during this reporting period were monitored in some way for toxics. Of the river and stream miles monitored, about 6% were considered to have elevated levels of toxic substances. Most of these miles were due to sediment contamination or the occurrence of fish consumption advisories. Pesticides, PCB's, mercury, and metals were the substances most often responsible for these problems.

Approximately 76,080 inland lake and reservoir acres have been sampled for toxics since 1985. Data indicate that less than 1% of these acres monitored were found to have toxic substances in sediments at levels of concern. All of Indiana's portion of Lake Michigan is considered to be affected by PCBs and mercury and is also included in a lakewide fish consumption advisory. Approximately 47,892 acres of lakes and reservoirs were tested for PCB's and mercury in fish tissue. All of these acres have a specific advisory for fish consumption.

In order to improve water quality, an increased level of wastewater treatment has been provided by both municipalities and industries throughout the state. The percentage of the population served by primary treatment facilities decreased from 6% to 0% from 1972 to 1993, while the percentage served by advanced treatment facilities increased from 0% to 53% in the same time period. About 90% of Indiana's population not served by publicly owned treatment facility have adequate individual septic tank disposal systems or is served by semi-public facilities. Since 1972, Indiana has received more than $1.4 billion in federal construction grants' money and has spent more than $207 million in state money and $190 million in local matching funds for new or upgraded municipal wastewater treatment plants and sewer systems. There is no precise information on the amount of money spent for industrial waste treatment control, but there were 373 claims for more than $1,491,447,202 in tax exemptions for industrial wastewater treatment or control facilities in 1994. There were only 102 claims for $369,187,000 in 1978.

Indiana has a plentiful ground water resource serving 60 percent of its population for drinking water and filling many of the water needs of business, industry and agriculture. Although most of Indiana's ground water has not been shown to have been adversely impacted by man's activities, more than 1,200 sites of groundwater contamination have been documented.

The substances most frequently detected as drinking water well contaminants in the state are nitrates, volatile organic chemicals, and heavy metals. Monitoring wells at waste disposal sites most often indicate ground water pollution from inorganic chemicals such as heavy metals. Based on the ground water data regarding agricultural chemicals, about 7-10 percent of rural drinking water wells tested are expected to contain unacceptably high nitrate levels and some detectable concentration of a pesticide.

The sources of ground water contamination most commonly reported in the state are hazardous materials' spills, underground storage tanks and waste disposal activities. However, there are a wide variety of both contamination sources and their associated chemical pollutants which have been documented in Indiana's ground water.

In 1987, the Indiana Ground Water Protection and Management Strategy was developed as a comprehensive guide to improve and protect the state's ground water supply. Subsequently, the Indiana Ground Water Protection Act of 1989 established the Governor's Ground Water Task Force, with appointees representing private industry and government, to coordinate the implementation of the Strategy. The Act authorizes a number of ground water protection activities and mandates the accomplishments of several key initiatives from the Ground Water Strategy. In 1995, Indiana's Wellhead Protection Program was contingently approved by the EPA. The Wellhead Protection Program is a proactive program developed to protect public water supplies from contamination. Also in 1995, a Memorandum of Understanding was signed, outlining the responsibilities of IDEM and the Indiana Office of State Chemist (IOSC) in the implementation of the Generic State Management Plan for Pesticides in Ground water. This plan takes a comprehensive approach to preventing, monitoring and correcting ground water contamination resulting from the use of pesticides. Efforts continue in the establishment of ground water quality standards which will ultimately result in a comprehensive set of qualitative and quantitative standards that will be used to evaluate effectiveness of ground water protection programs.

I. INTRODUCTION

The State of Indiana, with a surface area of 36,532 square miles, has approximately 5.5 million inhabitants. Although nearly 70 percent of the land in the state (16 million acres) is still devoted to agriculture, Indiana also has a diverse manufacturing economy. Most of these economic pursuits in some way depend on or affect Indiana's water resources. Also, much of the waste produced by Indiana's inhabitants is ultimately discharged to surface waterways after receiving wastewater treatment.

In addition to the demands placed on the water resource by agriculture, industry, utilities and municipalities, the increased leisure time available to Indiana residents as a result of the many technological advances over the last few decades has produced a rapid growth in recreational usage of Indiana's waters. Boating, fishing, swimming, water skiing, and "enjoying nature" are recreational activities which have recently placed heavier demands for a share of the water resource. There is now much greater concern for the preservation of some of Indiana's waterways in their natural state and to protect the waters and riparian habitat for fish, other aquatic life forms, and wildlife.

Although the population of Indiana and its demands on the water resource have increased greatly since the turn of the century, the extent of the water resource remains essentially the same. Of the estimated 90,000 total miles of water courses in Indiana, only 21,094 miles of streams and rivers are large enough to support all designated uses throughout the year (see Section II). These miles include 356 miles of the Ohio River, which forms the border between Indiana and Kentucky, and approximately 200 miles of the lower Wabash River, which forms the border between Indiana and Illinois. For purposes of this report, Indiana waterways have been divided into seven drainage basins. Assessment of the mainstream Ohio River is done by the Ohio River Valley Water Sanitation Commission (ORSANCO) and these miles are not included in Indiana's report.

Indiana has approximately 575 public lakes and reservoirs with a total area of 106,203 acres. Three of these are over 5,000 acres in size (24,890 total acres) and have a gross storage capacity of all public lakes and reservoirs of over 606 billion gallons. Indiana also controls some 241 square miles (154,240 acres) of Lake Michigan and has approximately 43 miles of Lake Michigan shoreline.

Indiana has other wetland areas that are also a part of the water resource. These are commonly described as marshes, swamps, bogs, potholes, sloughs, and shallow ponds or remnant lakes. Wetlands are considered to be the most productive aquatic habitats for both plants and animals as they provide breeding and nesting areas, abundant food sources, and excellent protection or cover. They also serve as sediment and nutrient traps and provide flood control. Inventories indicate that most of Indiana's wetlands have been filled or drained and are now utilized for other purposes. Of the non-open water wetlands remaining (estimated at a little over 813,000 acres) most are located in the northern two tiers of counties and along the Ohio River. Wetlands in the remaining part of the state consist of small widely scattered pockets or narrow bands along rivers and streams.

Ground water in Indiana is readily available in the northern and central areas of the state with availability decreasing toward the southern one-third of the state. Ground water is obtained primarily from unconsolidated deposits (many originating from Wisconsin Age glaciation); however, it can also be obtained from bedrock. Approximately 60 percent of the state's population use ground water for drinking water and other household uses. Industry and agriculture also rely heavily on ground water as a resource. Ground water protection programs are imperative as demands on ground water are increased.

Section 305 (b) of the Clean Water Act requires the states to report to Congress every two years on their activities and the progress they have made toward meeting the goals of the Act. This report discusses Indiana's activities and progress in 1994-95.

II. SURFACE WATER QUALITY

Current Status and Designated Use Support

In this 1994-95 305 (b) Report the water resource's information was modified to incorporate the current guidelines from U.S. EPA for estimating stream miles. Total stream miles were based on perennial stream miles in River Reach File 3 (RF3). RF3 was derived from computerized databases which list streams shown on the 1:100,000 USGS hydrologic maps which are greater than one mile in length. The use of RF3 has decreased Indiana total stream miles from the 90,000 listed in previous reports to 35,673. The computerized databases will produce consistent estimates for reporting purposes. However, all streams, ditches, and waterways are "Waters of the State" protected by the Indiana Water Pollution Control Laws. Table 1 shows the total size of various types of waterbodies classified for various uses under the revised estimates.

Utilizing this format, there are 35,673 miles of surface waterways in Indiana greater than one mile in length. This total includes some ditches, canals, and intermittent streams as well as permanent streams. An estimated 21,094 miles of these flowing streams in Indiana are assumed to have enough depth and habitat the year around to be "fishable and swimmable." The remaining 14,579 could be considered only intermittently flowing. Of this total, 8,429 miles are intermittent streams and 6,149 are ditches and canals. Many of these miles of intermittent surface drainage probably hold water only periodically following heavy rainfalls.

The goal of all water pollution control programs is to provide water quality sufficient to protect designated uses. For example, recreation (e.g., swimming and wading) and the propagation of aquatic life are designated uses for waters of Indiana. These waterbodies are often spoken of as having "swimmable" and "fishable" uses. To determine whether these uses are supported, a variety of physical, chemical and biological information must be assembled and applied with a degree of professional judgment. Table 2 summarizes how such information was used in this report to assess water quality. In addition, a "threatened" category was applied when a water body supports designated uses but had anticipated new sources or adverse trends of pollution.

For this report, waterbody uses of aquatic life and recreation are evaluated separately for two reasons for this decision:

1. Not as many miles of waterways were assessed to support recreation as for support of aquatic life uses.

2. Nearly all field monitoring data were for E. coli; however, many NPDES permits in effect for this two year period were based on fecal coliform.

If the state evaluated the waters for aquatic life support and recreational use support in a single assessment, many waters would be placed in partial or non-support categories due only to the failure to meet the whole body recreational use criteria. Actual water quality may be the same or better than previously reported when most waters were evaluated at the partial body contact level.

The state is currently investigating the possible causes of the bacteriological problems affecting a major portion of the assessed streams. All NPDES permit holders that have a

Table 1. *Summary of Classified Uses for Indiana Waterbodies*, 1994-95.

TOTAL SIZE CLASSIFIED FOR USE

CLASSIFIED USE	RIVERS (MILES)	LAKES (ACRES)	LAKE MICHIGAN (SHORELINE MILES)
Aq. Fish and Wildlife	35,673*	106,203	43
Domestic Water Supply	***	32.000	43
Recreation	35,673*	106.203	43
Industrial	35,673*	106,203	43
Navigation	–	–	43
Nondegradation	35,673*	106,203	43
Other (Specify)	00	–	–
Unclassified	–	–	–

* Although it has been estimated that there are approximately 90,000 miles of streams, ditches, and drainageways in Indiana, these figures represent estimate totals of the U.S. Geological Survey (USGS) 1:100,000 Digital Line Graph (DLG) and U.S. EPA Reach File 3 (RF3) databases which project a consistent computerized method for summing State Waters.

** Standards for domestic water supply apply at the point of withdrawal for use. Approximately 20 different rivers and streams have domestic water supply intakes.

Table 2. *Criteria for evaluating support of designated uses.*

ASSESSMENT BASIS	ASSESSMENT DESCRIPTION	SUPPORT OF DESIGNATED USE		
		FULLY SUPPORTING	PARTIALLY SUPPORTING	NOT SUPPORT
Evaluated	No site-specific ambient data or data more than five years old. Assessment is based on land use, location of sources, citizen complaints, etc. Predictive models use estimated inputs.	No sources (point or nonpoint) are present that could interfere with the use Data indicates or it is predicated that criteria are attained.	Sources are present but may not affect use or no sources present but complaints on record.	Magnitude of sources indicated use is likely to be impaired. Criteria exceedences predicted.
Monitored (Chemistry)	Fixed state sampling or survey sampling. Chemical analysis of water, sediment, or biota.	For conventional pollutants, criteria exceeded in ≤ 10% of measurements and mean of measurements is less than criteria. No fish consumption advisory exists. For toxicants no more than 1 violation of acute criteria in 3 years data.	For a conventional pollutant, criteria exceeded 11-25% and mean of measurements is less than criteria; or criteria exceeded ≤ 10% and means is greater than criteria.	For a conventional pollutant, criteria exceeded > 25% or criteria exceeded 11-15% and means of measurements is greater than criteria. For toxicant no more than 1 violation of acute criteria in 3 years data.
Monitored (Biology)	Site visit by qualified biological personnel. Rapid bioassessment protocols may be used.	Use fully supported; no evidence of modification of community (within natural range of control/ecoregion).	Some uncertainty about use support; some modification of community noted.	Use clearly not supported; definite modification of community.

CLASSIFICATION GUIDELINES FOR MULTIPLE USE WATERBODIES

Fully Supporting = All uses are fully supported.
Partially Supporting = One or more uses partially supported and remaining uses are fully supported.
Not Supporting = One or more uses not supported.

disinfection requirement in their permits are required to meet limits to support recreational/swimmable uses. However, for some permit holders these limits are still in terms of fecal coliform bacteria, i.e., 200/100 ml as a monthly geometric means versus 125/100 ml E. coli as a geometric mean and 400/100 ml fecal coliform versus 235/100 ml as a maximum for whole body contact. While some of the bacteriological problems may result from facilities not properly disinfecting the water, it is likely that most of the problems arise from combined sewer overflows (CSOs), storm water runoff, and/or nonpoint sources such as agricultural feedlots, poor septic tank disposal systems, urban runoff, etc. Little data are currently available that would allow the state to assess the relative contributions from these various sources.

When data from the fixed station Water Quality Monitoring Network were examined, arsenic concentrations were found to be rather high in all state waters sampled for this parameter. Every sample taken containing arsenic has concentrations above the detection level of 0.2 μg/L and thus above the human health criteria of 0.175 μg/L (to provide protection at the 10^{-5} cancer risk level for consumption of aquatic life) adopted in the water quality standards. Some of these values ranged up to 4 or 5 μg/L in certain waters. These values probably represent background levels of arsenic for the most part, since point sources which discharge arsenic are quite limited and these high values occur throughout the state. No arsenic samples collected exceeded the chronic aquatic life criterion (190 μg/L) or the drinking water criterion (50 μg/L).

Indiana waterbodies, including streams, inland lakes, and Lake Michigan, were assessed for the degree of individual use support. These individual uses have replaced the fishable/swimmable Clean Water Act goals used in previous reporting cycles. Individual uses include fish consumption, aquatic life, swimming, secondary contact, drinking water supply, and industrial water supplies whose uses apply to defined waterbodies. The degree of designated use support is described in terms of full support/full support threatened, partial support, non-support and unassessed. However, not all of these uses were assessed in all waters.

During the 305(b) reporting cycle, Indiana went from a Food and Drug Administration (FDA) action level approach for poisonous and deleterious substance in fish, as was evaluated during 1994, to a risk based approach for evaluating PCB and mercury contamination during 1995. Under this risk based approach, all waters in the state are under a limited fish consumption advisory for carp 15 to 25 inches in length includes for PCB's and mercury. Carp over 25 inches long should not be consumed. Approximately 164 miles of streams in the state are under a complete fish consumption advisory and no fish from these waters should be consumed. The streams affected and health risks involved will be detailed in Section II, Fish Tissue Contamination Monitoring Program. The waters where there is a "Do not consume any species of fish" advisory are considered to be non-supportive of fish consumption. A more detailed description of the advisory, health and safety risks, and locations of affected rivers, streams, lakes and reservoirs (including Lake Michigan, it's tributaries and the Ohio River) can be found in the 1996 it's tributaries and the Ohio River) can be found in the 1996 Indiana Fish Consumption Advisory available from the Indiana Department of Health.

Tables 3 and 4 summarize the current status of individual and overall use support, respectively, in the waterbodies of Indiana. Table 5 summarizes the degree of use support for

Table 3. *Individual use support summary*

Rivers (Miles)

USE	SUPPORTING	SUPPORTING BUT THREATENED	PARTIALLY SUPPORTING	NOT SUPPORTING	NOT ATTAINABLE	UNASSESSED
Fish Consumption		–	35,509	164	–	–
Shellfishing	–	–	–	–	–	–
Aquatic Life Support	6,510	613	296	935	77*	–
Swimming	1,170	–	22	5,259	–	
Secondary Contact						
Drinking Water Supply						
Non Point Source	21	142	49	205		
Agriculture	35,673					
Industrial	35,673					
Nondegradation	35.673					

* Includes all streams designated as "limited use"613 in state water quality standards.

Lake (Acres)

USE	SUPPORTING	SUPPORTING BUT THREATENED	PARTIALLY SUPPORTING	NOT SUPPORTING	NOT ATTAINABLE	UNASSESSED
Fish Consumption		–	106.203	12	–	–
Shellfishing	–	–	–	–	–	–
Aquatic Life Support	106,014	–	88	101	–	
Swimming	106,014	–	88	101	–	
Secondary Contact						
Drinking Water Supply	32,000					
Non Point Source						
Agriculture	106,203					
Industrial	106,203					
Nondegradation	106.203					

Lake Michigan (Shoreline Miles)

USE	SUPPORTING	SUPPORTING BUT THREATENED	PARTIALLY SUPPORTING	NOT SUPPORTING	NOT ATTAINABLE	UNASSESSED
Fish Consumption			43			
Shellfishing						
Aquatic Life Support	43					
Swimming	43					
Secondary Contact						
Drinking Water Supply	43					
Non Point Source						
Agriculture	43					
Industrial	43					
Nondegradation	43					

Table 4. *Overall use support summary*

RECREATIONAL RIVERS

DEGREE OF USE SUPPORT	ASSESSMENT BASIS		TOTAL ASSESSED
	EVALUATED	MONITORED	
Size Fully Supporting	8	1,162	1,170
Size Threatened	0	0	0
Size Partially Supporting	5	17	22
Size not Supporting	663	4,596	5,259
TOTAL	676	5,775	6,451

AQUATIC LIFE RIVERS

DEGREE OF USE SUPPORT	ASSESSMENT BASIS		TOTAL ASSESSED
	EVALUATED	MONITORED	
Size Fully Supporting	1,134	5,376	6,510
Size Threatened	300	313	613
Size Partially Supporting	127	169	296
Size not Supporting	68	867	935
TOTAL	1629	6726	8,335

DEGREE OF USE SUPPORT	LAKES (ACRES)						LAKE MICHIGAN (SHORELINE MILES)					
	EVALUATED		MONITORED		TOTAL ASSESSED		EVALUATED		MONITORED		TOTAL ASSESSED	
	AQU. LIFE	REC.	AQU. LIFE	REC.	AQU. LIFE	REC.	AQU. LIFE	REC.	AQU. LIFE	REC.	AQU. LIFE	REC.
Size Fully Supporting	96,035	106,014	9,979	0	106,014	106,014	–	–	–	43	–	43
Size Threatened			*			–	–	–	–	–	–	–
Size Partially Supporting	88	88	–	–	88	88	–	–	43	–	43	–
Size Not Supporting	101	101	–	–	101	101	–	–	–	–	–	–
TOTAL	96,224	106,203	9,979		106,203	106,203	–	–	43	43	43	43

* All lakes are considered threatened to some extent by non-point urban and agricultural sources.

Table 5. *Summary of river and stream miles fully supporting, threatened, and impaired for Aquatic life uses*

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE (MILES)
	Evaluated	Monitored	
Size Fully Supporting All Assessed Uses	1,134	5,376	6,510
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	300	313	613
Size Impaired for One or More Uses	195	1,162	935
TOTAL ASSESSED	1,629	6,726	8,355

Summary of river and stream miles fully supporting, threatened, and impaired for recreational uses

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE (MILES)
	Evaluated	Monitored	
Size Fully Supporting All Assessed Uses	8	1,162	1,170
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	0	0	0
Size Impaired for One or More Uses	668	4,613	5,282
TOTAL ASSESSED	676	5,775	6,452

fully supporting, threatened, and impaired rivers and streams. There are 21,094 miles of rivers and streams in Indiana which are potentially both "fishable" and "swimmable" throughout the year. Approximately 40% of these miles were assessed for support of aquatic life uses. Of those miles assessed, 78% were judged to be fully supporting of aquatic life uses, but another 7% of these miles were considered threatened. Another 4% were partially supporting these uses, while 11% did not support these uses.

Approximately 31% of these 21,094 miles were assessed for attainment of whole body contact recreational uses. About 18% of the waters assessed fully supported this use designation, 0.3% partially supported it, and 81% did not support this use due to frequent high E. coli levels. Of the river and stream miles assessed, 164 miles are currently under some type of "Do not consume any species of fish" advisory and do not fully support the fish consumption use.

For the 1994-95 305 (b) Report a total of 8,355 river miles was assessed for the degree of aquatic life use support. This was an increase of 495 miles assessed when compared to the 1992-1993 reporting period.

Based on Digital Line Graph computerized databases, U.S. EPA estimates that there are 142,871 acres of lakes and reservoirs in Indiana. Of those acres, 106,203 are public. Enough information was available to assess nearly all of the state's public lakes and reservoirs. Less than 0.2% of the lake and reservoir acreage assessed failed to support designated uses. The number of acres considered not meeting the aquatic life or fishable goal was roughly equal to the number not meeting the recreational goals. No lakes in Indiana are designated for less than "swimmable" and "fishable" use.

A more complete discussion of the trophic classification, current status, trends and support of designated uses of Indiana lakes and reservoirs can be found in the Lake Information and Assessment Section.

There are 43 shoreline miles (154,240 acres) of Lake Michigan in Indiana. All of these miles were assessed by using a combination of physical, chemical and biological information. Because of the consumption advisory in effect for some fish species in Lake Michigan, all 43 miles were judged to be only partially supporting the fish consumption use. All 43 miles fully supported recreational and aquatic life uses. None of the lake has been designated for less than "fishable" and "swimmable" uses.

Tables 6 and 7 summarize the causes and sources of non-support of uses in Indiana waterbodies, respectively. The major pollutant categories contributing to non-support of uses, in descending order of importance, were E. coli bacteria, organic enrichment, priority organic (PCBs), organochlorine pesticides, metals, and ammonia. Nonpoint runoff from agricultural practices and municipal or semi-public discharges were the sources which accounted for the largest number of miles or acres impacted, although many of these impacts only affected bacteriological concerns. Other important sources contributing to use impairment were combined sewer overflows, industrial discharges, urban runoff, and land disposal practices. The

Table 6. *Rivers and stream miles not fully supporting uses by various cause categories*

CAUSE CATEGORY	MILES OF WATERS BY CONTRIBUTION TO IMPAIRMENT	
	Major	Moderate/Minor
Cause unknown	297	67
Unknown toxicity		
Pesticides	195	89
Priority organics cyanide. PCB's	322	118
Nonpriority organics		1.3
Metals	111	155
Ammonia	81	64
Chlorine		
Other inorganics		
Nutrients	53	38
pH	12	7
Siltation	12	23
Organic enrichment/low D.O.	468	331
Salinity/TDS/chlorides		
Thermal modifications		2
Flow alterations	17	
Other habitat alterations	119	119
Pathogen indicators (Rec.)	3949	8
Radiation		
Oil and grease	13	2
Taste and odor		
Suspended solids TSS	16	36
Noxious aquatic plants	4	14
Filling and draining		
Total toxics		
Turbidity		20
Filling and draining		
Exotic species		
Other (specify) shaded area/algae	6	26

Table 7. *Rivers and stream miles not fully supporting uses affected by various source categories*

SOURCE CATEGORY	MILES OF WATERS BY CONTRIBUTION TO IMPAIRMENT	
	Major	Moderate/Minor
Industrial Point Sources	244	9
Municipal Point Sources	551	376
Combined Sewer Overflows	161	26
Agriculture	475	265
Silviculture		
Construction	18	
Urban Runoff/Storm Sewers	64	5
Resource Extraction	28	142
Land Disposal	99	48
Hydromodification/Habitat Modification	71	27
Marinas	3	
Atmospheric Deposition		
Contaminated Sediments	60	6
Unknown Source		
Other (specify) Groundwater loadings (iron & temp.)	2	

causes and sources of the non-support of uses are discussed in more detail in the basin by basin summaries.

In 1991, the Indiana Department of Natural Resources (IDNR) used its Geographic Information System (GIS) to combine individual digital wetland maps with the U.S. Geological Survey's 1:250,000 digital county boundaries. Through this combination, the IDNR was able to determine that from the early-to-mid 1980's Indiana contained approximately 813,000 acres of wetlands and an additional 194,000 acres of deep-water habitat, excluding Lake Michigan (see Section III "Indiana Section 401 Water Quality Certification Program.") Until the IDNR GIS project, the amount of wetlands in Indiana was based upon the best professional estimates of IDNR field staff. These estimates were as low as 100,000 acres.

Wetland acreage was further classified into type of wetland. Forested wetland is the most common type of wetland in Indiana with 504,000 acres or 77% of the total wetland acreage. Forested wetland is followed by shallow marsh - 65,000 acres (8%), wet meadow - 57,000 acres (7%), shrub-scrub- 41,000 acres (5%) and deep marsh - 24,000 (3%).

Palustrine wetlands were also classified according to duration of flooding. "Temporarily flooded" was the most common duration of flooding. Approximately 460,000 acres of 55% of palustrine habitats were classified as temporarily flooded. "Seasonally flooded" was the next most common - 220,000 acres (27%), followed by "intermittently exposed" - 80,000 acres (10%), "semi-permanently flooded" - 40,000 acres (5%), and "saturated" - 24,000 acres (3%).

The IDNR project confirmed that the major concentration of wetlands was in the northeastern portion of Indiana, along river floodplains in southwestern Indiana, and in the Lake Michigan shoreline region in northwestern Indiana. Noble County contained the greatest number of wetland acres with approximately 27,500 acres of 3.38% of the state's total wetland acreage. Noble County was followed by Kosciusko County - 27,000 acres (3.32%), Lagrange County - 25,708 acres (3.16%), LaPorte County - 25,000 acres (3.07%), Jackson County - 24,000 acres (2.95%), Gibson County - 23,500 acres (2.89%), Steuben County - 22,000 acres (2.71%), Pike County - 20,500 acres (2.52%), Posey County - 20,000 acres (2.46%), and Warrick County - 19,957 acres (2.45%). The remaining 82 counties contained the remaining 71% of the wetland areas. Ohio County contained the least amount of wetland area with 633 acres or only 0.08% of the states total wetland acreage. Forested wetlands were the most common type of wetland in all 92 counties.

The discharge of fill material into the waters of the United States requires a Section 404 permit from the U.S. Army Corps of Engineers and subsequently Section 401 Water Quality Certification from the state in which the discharge is to occur. The Section 401 Water Quality Certification is to insure that the project will not violate state water quality standards. If a state determines that a discharge of fill material will violate state water quality standards, Section 401 Water Quality Certification can be denied. If a state denies Section 401 Water Quality Certification then the Corps of Engineers must deny the Section 404 permit. In Indiana, the Department of Environmental Management is responsible for review of projects requiring Section 401 Water Quality Certification.

Public Health/Aquatic Life Concerns

The release of toxic materials into the aquatic environment can produce effects in several ways: 1) when present in sufficient amounts to be acutely toxic, they may directly kill fish and other aquatic organisms; 2) when present in lesser amounts, these substances can reduce densities and growth rates of aquatic organisms and/or bioaccumulate in their tissues until they are unsafe for human consumption; and 3) toxic materials in the water could potentially affect human health by contaminating public water supplies. At this time, we have no data to indicate that there have been any adverse human health effects from contaminated water supplies or primary contact recreation activities (e.g., swimming) due to toxic substances in surface waters.

In the last several years, advances in analytical capabilities and techniques, and the generation of more and better information as to the toxicity of these substances, have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. The following portion of this report focuses primarily on the studies Indiana completed in 1994 - 1995 to discover the scope of problems caused by toxic substances and possible solutions to these problems.

Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column, much of the data on toxic substances was obtained through the fish tissue and in-place sediment monitoring programs as well as the bioassay data and biosurvey studies. Other than specific metals, cyanide, and a few other substances, most priority pollutants were not found in detectable amounts in surface water samples.

Indiana decided to separate aquatic life use from fish consumption use due to the recent general fish consumption advisory applicable to all states waters. The aquatic life use is considered to be supported or not supported based on chemical or biological data indicating that the waters should support diverse aquatic communicates consisting of expected species and population sizes.

Support of the fish consumption designated uses is based on fish consumption advisories. The criteria for placing waters and fish species on the Indiana Fish Consumption Advisory have changed from using the Food and Drug Administration guidelines, to using the Great Lakes Sport Fish Risk Based Approach.

The recently issued 1996 advisory is based on levels of Polychlorinated Biphenl (PCB) and Mercury found in fish tissue and all waters of the state are under some level of consumption restriction for at least some species. (i.e., carps).

While not all species of fish found in Indiana lakes, rivers, and streams nor all waters have been tested, carp have generally been found to be contaminated with both PCB's and mercury at levels of concern.

The total size of the various types of waterbodies that were determined to have elevated levels of toxics is shown in Table 8. Toxic substances are impairing the uses of all waters of the state to some extent due to the latest fish consumption advisory which places at least some restriction on consumption of some species for all waters due to PCBs and/or mercury.

Of the total river and stream miles actually monitored for toxics during this reporting period, 470 miles were determined to have substantial impairment due to elected levels of toxics. Nearly 35% of the 470 river and stream miles determined to have elevated levels of toxic substances were placed in this category, at least in part, due to fish consumption advisories advocating no consumption of any fish caught in these waterways. (see Section II Fish Tissue Contamination Monitoring Program). Most of the remaining affected river and stream miles had metals or other contaminants in the sediment at levels of concern.

Table 8. *Total size of waterbodies affected by toxics* - 1994-1995

WATER BODY	SIZE MONITORED FOR TOXICANTS	SIZE WITH ELEVATED LEVELS OF TOXICANTS
Rivers (miles)	8,355	470
Lakes (acres)	47,892	12
Great Lakes (shoreline) (miles)	43	43
Freshwater Wetlands (acres)	—	—

Fishkill Reports

A diverse healthy fish population is considered an indication of good water quality. Serious public concern is generated when dead and dying fish are noted in the aquatic environment since this is usually evidence of a severe water quality problem and may indicate the long-term loss of use of affected waters for a fishery.

A fishkill can result from the accidental or intentional spill of a toxic compound or oxygen-depleting material into the aquatic environment. Fishkills may also occur downstream of a continuous industrial or municipal discharge which may release, due to a system upset, an atypical effluent containing high concentrations of pollutants.

A total of 79 fishkills was reported in 1994 and 95 (Table 9), an increase of two (2) kills the 1991-1992 reporting period. Many of these fishkills were agricultural related such as confined feeding operational problems and misapplication of livestock waste; runoff of animal manure; fertilizer, herbicides or pesticides applied prior to rainfall events; and intentional dumping of fertilizer or livestock manure. Enforcement efforts in these areas have been increased in an effort to reduce these problems.

Although many of the causes of fishkills were unknown (28%), municipal sewer/sludge (12%), livestock manure from feeding operations (10%), and other sources (27%) were responsible for most of the fishkills reported (Figure 1). The causes grouped in the "other"

Table 9. *Fish kills reported in 1994-95*

County	Receiving Water	Material	No. Killed	Area Affected
Adams	unnamed state water	unknown	2	unknown
Allen	unnamed state water	Jp-4 jet fuel	4	4 sq ft
Boone	Rogers Ditch	animal waste (hog)	200	1 mile
	Sims/Rogers Ditch	hog waste	146	unknown
Carroll	Wabash & Erie	thermal	100	unknown
Cass	Wabash River	unknown	36	unknown
Clark	Ohio River	low dissolved oxygen	200	500 sq ft
	unnamed state water	suspect diesel fuel	1	unknown
Clay	unnamed state water	fish kill	400	7 acres
Clinton	Pog Run	unknown material	600	150 linear ft
	Swamp Creek	unknown	90	2 miles
Delaware	Green Farm Ditch	low dissolved oxygen	1800	½ mile
Dubois	Beaver Cam Lake	low dissolved oxygen	300	unknown
Gibson	Toops Ditch	coal burner blowout	2000	1/4 mile
	unnamed state water	fish kill	20	2700 sq ft
Hamilton	unnamed state water	low dissolved oxygen	100	unknown
	Cool Creek	chlorinated pool water	613	1 mile

Table 9. *Fish kills reported in 1994-95 (cont.)*

County	Receiving Water	Material	No. Killed	Area Affected
Hamilton (cont.)	Cool Creek Ditch	unknown	10	creek
Hancock	Six Mile Creek	hog waste	108	60,000 sq ft
Hendricks	Danville Cons. Lake	unknown	400	8 acre lake
	Charles Creek	probable natural fish kill	40	30 sq ft
	White Lick Creek	unknown	300	1 mile
	White Lick Creek	low dissolved oxygen	36	100 ft
Henry	Blue River	chlorine	200	½ mile
Howard	Kokomo Creek	potassium permanganate	14	unknown
	unnamed state water	gasoline	4	300 sq ft
Jefferson	unnamed state water	gramalt zone	200	unknown
Johnson	Lakeview	low dissolved oxygen	8	5 acres
	Pleasant Run Creek	unknown	200	1/4 mile
Kosciusko	Jacob Maish Ditch	fish kill	100	undetermined
	Jacob Maish Ditch	unknown	25	undetermined
Lake	Grand Calumet	sodium hypochlorite	300	retention pond
	White River	low dissolved oxygen	12	unknown
	unnamed state water	acrylide	9	900 sq ft

Table 9. *Fish kills reported in 1994-95 (cont.)*

County	Receiving Water	Material	No. Killed	Area Affected
Lake (cont.)	unnamed state water	carbon monoxide	30	unknown
Lawrence	Spring Mill Lake	sewage	2	unknown
Madison	unnamed state water	unknown	10	undetermined
	Big Duck Creek	brown green gray (septic)	50	1/4 mile
Marion	unnamed state water	private pond fish kill	12	unknown
	White River	municipal waste	10000	½ mile
	White River	primary effluent	300	unknown
	White River	unknown	10	300 yds
	White River	unknown	30	unknown
	White River	STP bypass/overflow	500,000	5 miles
	unnamed state water	suspect methane gas	6	21 sq ft
	McFarland Creek	unknown	100	unknown
	unnamed state water	fish kill & mallard duck	2	unknown
	unnamed state water	low dissolved oxygen	70	5 acre pond
	White River	primary effluent	21	unknown
	Buck Creek	unleaded gasoline	25	1 mile
	10 acre lake	sheen	2	100 yds

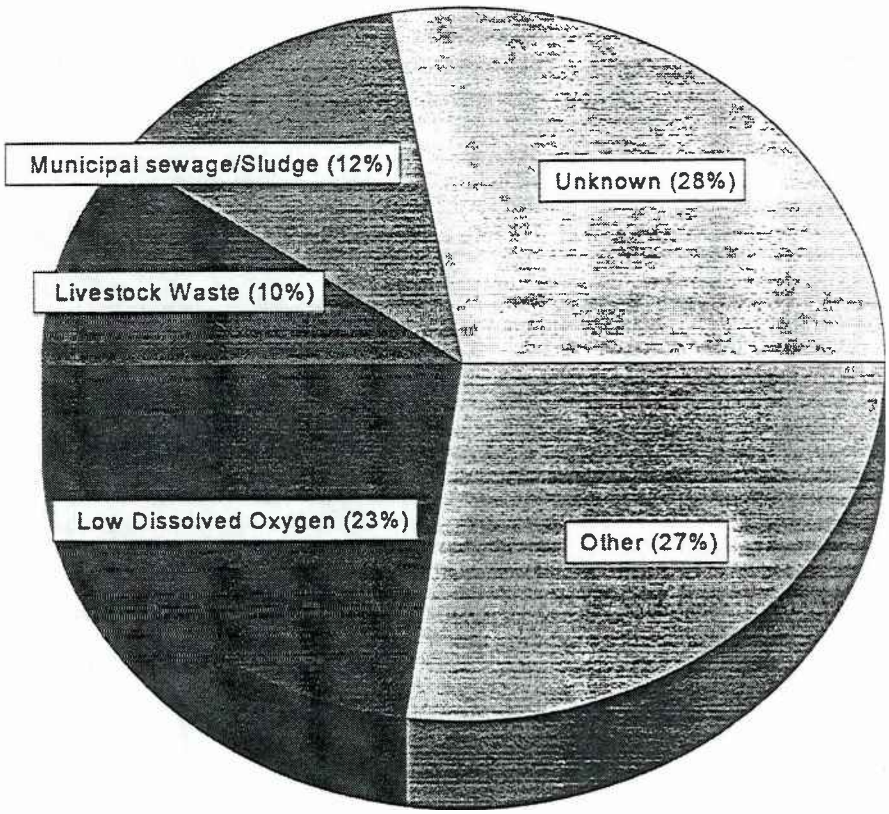
Table 9. *Fish kills reported in 1994-95 (cont.)*

County	Receiving Water	Material	No. Killed	Area Affected
Marion (cont.)	Crooked Creek	unknown	12	unknown
Miami	Washonis Creek	hog waste	1	unknown
Monroe	Jack Defeat	unknown	150	1/4 mile
Morgan	unnamed state water	unknown	9	unknown
Owen	Elliston Creek	fish kill	50	unknown
Parke	Rockville Lake	algae	71	25 x 50 ft
Porter	unnamed state water	raw sewage	4	50 sq ft
	unnamed state water	coke oven condensate	30	8 sq ft
	unnamed state water	sewage	10	9 sq feet
Putnam	unnamed state water	unknown	100	unknown
Randolph	unnamed state water	fish kill	20	unknown
	White River	low dissovled oxygen	100	2000 sq ft
	White River	unknown	600	unknown
Ripley	Ripley Creek	unknown	300	Riley Creek
	Buffalo Creek	chlorpyrifos	160	creek
	Pleasant Run Creek	chlorine	874	water
Shelby	Little Blue River	fish kill	2700	2 miles

Table 9. *Fish kills reported in 1994-95 (cont.)*

County	Receiving Water	Material	No. Killed	Area Affected
Spencer	Chrisney Lake	unknown	200	unknown
Steuben	Crooked Lake	sick fish	2	unknown
Tippecanoe	Laramie Creek	hog waste	25	1/4 mile
	unnamed state water	diesel	445	1 & 1/4 miles
Vanderburgh	Ohio River	low dissolved oxygen	300	1/4 mile
Vigo	unnamed state water	hydraulic oil	9	100 sq ft
	Prairie Creek	hog waste	1500	2 mi
Wabash	Paw Paw Creek	hog waste	5	unknown
Warrick	Ohio River	turbin oil - mineral oil	2	undetermined
	Cypress Creek	manure	100	1 mile approx
Wayne	Clear Creek	milk waste/municip sewage	200	½ mile

Figure 1. *Causes of 1994-95 fishkills*



category include industrial chemicals, chlorine, and thermal. "Natural" cause, primarily low dissolved oxygen, accounted for 23% of the reported kills.

There were approximately 527,227 fish killed in the 79 fishkills reported in 1994-95. Table 10 categorizes the reported 1994-1995 fish kills as to size (number of fish killed) and the number of kills in each size category. Marion County reported fourteen (14) fishkills during this period. Hendricks and Lake counties reported four (4) fishkills during this period. Four counties each reported three (3) kills and eleven counties reported two (2) each.

Several other fishkill events were reported, but are not listed in this study because the supplied information was incomplete, or the waterbodies were private ponds.

Table 10. *Size categories (number of fish killed) and number of fishkills reported per category in 1994-95.*

NUMBER OF FISH KILLED	NUMBER OF FISHKILLS REPORTED
Unknown	0
0 - 500	69
500 - 1,000	3
1,000 - 10,000	5
10,000 - 100,000	1
More than 100,000	1
TOTAL	79

FISH TISSUE CONTAMINATION MONITORING PROGRAM

The recreational sport of fishing and resulting fish consumption is an important activity for citizens participation. Health studies have shown fish to be good for people to eat being high in protein and low in saturated fats. However, some fish may accumulate contaminants from the water and from the foods they eat. Some of these contaminants can actually build up in the muscle tissues of the fish, the very part of the fish that we like to eat. Exposure to these contaminants through consumption can cause build up of the contaminants in humans also.

A portion of the fish tissue contaminant monitoring program has become a very important and highly profiled program in the state of Indiana. It is a widely used method of monitoring and assessing environmental contaminants and their bioavailability. It is known that concentrations of some contaminants may be greater in tissues than in water because of bioconcentration, bioaccumulation, or biomagnification. Tissue contaminant monitoring provides us with a tool that measures contaminants in Indiana's environment that are not measured in water or air. It also provides us with information on bioavailability of compounds that bioaccumulate. Tissue contaminant monitoring, when part of an integrated multimedia monitoring program, gives insight into exposure levels and allows the Indiana Department of Environmental Management (IDEM) to better develop its understanding into the complexities of contaminant distribution, fate, and effects.

One of the objectives of Indiana's fish tissue monitoring program is to provide the recreational fisher with information as to the risks associated with the consumption of potentially contaminated fish. A "Fish Consumption Advisory" (FCA) helps consumers to make personal decisions regarding the size and type of fish and how often to eat freshwater fish. Historically, Indiana's Fish Consumption Advisory Program has issued advisories based primarily on a U.S. Food and Drug Administration levels for poisonous and deleterious substances in fish and shellfish for human food (Table 11). The FDA Action Levels are based on edible portions (i.e. fillets). Starting in 1995, a risk-based approach was adopted for evaluating PCB contamination in fish tissue based on the protocols developed by the Great Lakes Sport Fish Consumption Advisory Task Force. This approach will become effective with the 1996 Fish Consumption Advisory. In 1986, the Great Lakes Sport Fish Consumption Advisory Task Force was created. This task force was charged with developing a uniform sport fish consumption advisory protocol applicable to all Great Lakes. The advisory goals were to: 1) maintain the health benefit of fish consumption, 2) minimize the potential for angler toxic chemical exposure, 3) use credible and understandable science and, 4) present the information in a manner conducive to maximal voluntary compliance. The task force spent considerable time reviewing and discussing the risk of adverse health effects from consumption of contaminated sport fish. They chose to focus advisory protocol on PCBs, the chemical contaminant most frequently encountered in Great Lakes fish which necessitated guidance. Their advisory approach (Anderson, et al 1993) utilizes a weight-of-evidence derived individual health protection value (HPV) of 0.05ug/kg/day for PCBs residue ingested from fish tissue. The HPV is intended to encompass acceptable reproductive/developmental risks as well as cancer.

Indiana's advisories are not intended to discourage the general eating of freshwater fish, but they should be used as a guide to eating fish low in contaminants. Some contaminants can cause cancer in animals. The risk of cancer to consumers (from eating contaminated fish) cannot be predicted with certainty. Exposure to contaminants in fish eaten may not increase one's cancer risk at all. Following the advisory over a lifetime will minimize exposure and reduce whatever cancer risk is associated with those contaminants.

Table 11. *Food and Drug Administration (FDA) Action levels for poisonous and deleterious substances in fish and shellfish for human food and its tolerance level for PCBs.*

Substance	Action/Tolerance Level[b]
Metals	
Methyl Mercury (expressed as Mercury)	1.0 ppm
Pesticides	
Chlordane (total)	0.3 ppm
DDT + DDE + DDD	5.0 ppm
Dieldrin + Aldrin	0.3 ppm
Endrin	0.3 ppm
Heptachlor + Heptachlor epoxide	0.3 ppm
Tosaphene	5.0 ppm
Industrial Chemicals	
PCBs	2.0 ppm

b

ppm = parts per million

Long lasting contaminants such as PCBs, DDT, and mercury build up in your body over time. It may take years of regularly eating contaminated fish to build up amounts which are a health concern. Health problems which may result from the contaminants found in fish range from small changes in health that are hard to detect to birth defects and cancer. Females who eat highly contaminated fish for many years before becoming pregnant may have children who are slower to develop and learn. The meal advice advisory is intended to protect children from these potential developmental problems. Adults are less likely to have health problems at the low levels that affect children.

Many contaminants such as PCBs and organochorine pesticides are found at higher levels in the fat of fish. Consumers can reduce the amount of these contaminants in a fish meal by properly trimming, skinning, and cooking the catch. It is recommended that the skin be removed and all fat trimmed away from the belly flap, the line along the sides of the fish, along the back, and under the skin.

Cooking does not destroy contaminants in fish, but heat from cooking melts some of the fat in the fish and allows some of the contaminated fat to drip away. It is recommended to broil, grill, or bake the trimmed, skinned fish on a rack so the fat drips away. Mercury is distributed through a fish's muscle tissue and not in the fat. Therefore, the only way to reduce your mercury exposure from fish is to reduce the amount of contaminated fish you eat.

The primary organic pollutants of concern (PCBs and certain organochlorine pesticides) for fish in Indiana waters are persistent substances that, for the most part, are no longer used to any extent in agriculture or industry. The persistent nature of these substances has made them available to the aquatic life over a long period of time and they have bioconcentrated in the fish to levels which sometimes warrants a fish consumption advisory.

Program Summary

During the period of 1994 through 1995 the state compiled data on contaminants in the tissue of fish collected from Lake Michigan, and 33 unique river locations in 17 counties on 15 different streams or rivers. Table 12 lists the locations where 203 fish tissue samples were collected during these two sampling years (also see Figure 2). In addition there were some tissue samples collected from Pigeon Creek in Vanderburgh County in 1993 that were not analyzed until 1994 because of insufficient funds for analysis at the time of collection. Tissue samples were submitted to a contract analytical laboratory (Hazleton Environmental Services, Inc. of Madison, WI) for determination of contaminant levels in fish samples. All fish tissue samples were analyzed for percent lipid, percent moisture, organochlorine pesticides, total polychlorinated biphenyls (PCBs), cadmium, lead, and mercury. In addition, 78% were analyzed for specific polycyclic aromatic hydrocarbons (PAH) by high pressure liquid chromatography (HPLC) methodology; 75% were analyzed for a more complete spectrum of metals; and 9% were analyzed for semivolatile and volatile organic compounds (Table 13). Large size scaled fish were analyzed as skin-on scaleless fillets. Catfish were analyzed as skin-off fillets. Small samples or small sized fish such as some sunfish or creek chub were analyzed as whole fish. The analytical results for the 1995 collected samples, 1994 Grand Calumet River samples for PAH contaminants, and 1994 collected South Fork of Wildcat Creek are not included within this report, as they have not been completed nor the results evaluated.

Twenty-one locations, as well as Lake Michigan, have historically been monitored on a biennial basis (Table 12). For Lake Michigan both non-salmonid and salmonid species tissue samples were analyzed. These samples were collected by the Indiana Department of Natural Resources' (IDNR) Division of Fish and Wildlife personnel. Some salmonid samples were submitted to the U.S. FDA lab in Minneapolis, Minnesota as part of the U.S. EPA Great Lakes National Program Office's Coho/Chinook monitoring program.

Fish tissue contaminant results are presented to the Indiana Fish Advisory Task Force consisting of representatives from the Indiana State Department of Health (ISDH), IDEM, and

Table 12. *Locations where fish tissue was collected for contaminant analysis during the period from 1994 through 1995.*

NO.	BODY OF WATER / LOCATION	COUNTY	COLLECTION DATE	HYDROLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI
	BURNS DITCH	PORTER CO.						
1[b]	U/S LEFTY'S COHO LANDING		08/24/94	4040001050	41 36' 31.5"/87 10' 53.0"	54G	3	2B
	EAST FORK WHITE RIVER	LAWRENCE CO.						
2[b]	D/S WILLIAMS DAM		12/01/95	5120208110	38 47' 44.0"/86 38' 30.0"	71G	85	9A
	GRAND CALUMET RIVER	LAKE CO.						
3	BRIDGE ST.		09/21/94	4040001020	41 36' 32.5"/87 22' 16.0"	54G	1	2B
4	CLINE AVE.		09/21/94	4040001020	41 36' 45.0"/87 25' 48.5"	54G	1	2B
5	INDIANAPOLIS BLVD.		09/28/94	4040001020	41 36' 53.5"/87 28' 54.5"	54G	1	2B
6	KENNEDY AVE.		09/28/94	4040001020	41 36' 54.0"/87 27' 38.5"	54G	1	2B
	INDIANA HARBOR CANAL	LAKE CO.						
7[b]	DICKEY RD.		08/25/94	4040001020	41 39' 8.0"/87 27' 47.0"	54G	1	2B
	KANKAKEE RIVER	LAKE CO.						
8[b]	LASALLE F. & W. AREA		08/18/94	7120001170	41 9' 59.0"/87 31' 32.0"	54G	14	3C
	KANKAKEE RIVER	LAPORTE CO.						
9[b]	KINGSBURY F. & W. AREA		08/19/94	7120001010	41 29' 25.0"/86 34' 51.0"	54G	14	3C
	LAKE MICHIGAN	LAPORTE CO.						
10[a]	EAST		10/20/94	4060200	0 0' 0.0"/0 0' 0.0"	1	1	
11[a]	OPEN WATERS		09/05/95	4060200	0 0' 0.0"/0 0' 0.0"	1	1	
	MAUMEE RIVER	ALLEN CO.						
12[b]	1 MILE U/S LANDIN RD.		08/10/94	4100005010	41 5' 13.0"/85 2' 45.0"	55G	19	6
	OHIO RIVER	PERRY CO.						
13	CANNELTON LOCK		09/28/95	5140202140	37 53' 58.0"/86 42' 26.0"	72M	94	12
	OHIO RIVER	POSEY CO.						
14	UNIONTOWN LOCK		09/29/95	5140202140	37 47' 41.5"/87 59' 33.0"	72M	94	12
	PIGEON CREEK	VANDERBURGH CO.						
15	KLEYMEYER PARK, EVANSVILLE		09/23/93	5140202060	37 59' 54.0"/87 33' 52.0"	72M	94	8

Table 12. *Locations where fish tissue was collected for contaminant analysis during the period from 1994 through 1995 (cont.)*

NO.	BODY OF WATER / LOCATION	COUNTY	COLLECTION DATE	HYDROLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI
16	U/S STRINGTOWN RD, EVANSVILLE		09/23/93	5140202060	37 59' 52.5"/87 30' 35.0"	72M	94	8
	PLEASANT RUN CREEK	LAWRENCE CO.						
17	D/S GMC, PEERLESS RD.		12/05/95	5120208090	38 54' 12.0"/86 29' 20.5"	71G	84	10A
18	U/S GMC, MT. PLEASANT RD.		12/05/95	5120208090	38 54' 2.5"/86 78' 15.5"	71G	84	10A
	SOUTH FORK WILDCAT CREEK	CLINTON CO.						
19	C.R. 0E/W		10/12/94	5120107040	40 18' 54.5"/86 30' 21.5"	55G	23	5B
20	C.R. 300W		10/12/94	5120107040	40 19' 23.0"/86 33' 44.0"	55G	23	5B
	ST. JOSEPH RIVER	ALLEN CO.						
21[b]	U/S DAM @ JOHNNY APPLESEED PRK		08/10/94	4100003100	41 7' 2.0"/85 6' 55.5"	55G	20	5C
	ST. JOSEPH RIVER	ELKHART CO.						
22[b]	BRISTOL, IN		08/12/94	4050001240	41 43' 46.0"/85 48' 45.0"	56G	8	4
	ST. JOSEPH RIVER	ST. JOSEPH CO.						
23[b]	D/S SOUTH BEND,ST PATRICK PARK		08/11/94	4050001340	41 45' 38.0"/86 16' 20.0"	56G	8	4
	ST. MARY'S RIVER	ALLEN CO.						
24[b]	FORT MIAMIS PARK		08/09/94	4100004060	41 4' 58.0"/85 9' 4.0"	55G	21	5C
	TRAIL CREEK	LAPORTE CO.						
25[b]	D/S MICHIGAN CITY STP		08/23/94	4040001070	41 43' 5.5"/86 53' 11.0"	56G	4	2C
	WABASH RIVER	POSEY CO.						
26[b]	NEW HARMONY, IN		09/26/95	5120113110	38 8' 26.0"/87 56' 6.0"	72G	53	8
	WABASH RIVER	TIPPECANOE CO.						
27[b]	D/S LAFAYETTE, IN		09/20/95	5120108020	40 24' 37.0"/87 0' 51.0"	55G	43	5A
28[b]	U/S LAFAYETTE, IN		09/19/95	5120108020	40 26' 31.0"/86 53' 43.0"	55G	43	5A
	WABASH RIVER	VIGO CO.						
29[b]	D/S TERRE HAUTE, IN @ DARWIN		09/21/95	5120111101	39 17' 3.0"/87 36' 33.0"	72G	51	12
30[b]	FAIRBANKS PARK, TERRE HAUTE		09/22/95	5120111060	39 27' 10.0"/87 25' 23.0"	72G	51	12
	WABASH RIVER	WELLS CO.						

Table 12. *Locations where fish tissue was collected for contaminant analysis during the period from 1994 through 1995 (cont.)*

NO.	BODY OF WATER / LOCATION	COUNTY	COLLECTION DATE	HYDROLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI
31[b]	U/S BLUFFTON, IN		10/25/95	5120101050	40 43' 43.0"/85 8' 14.0"	57G	36	5C
32[b]	WEST FORK WHITE RIVER / BROAD RIPPLE PARK	MARION CO.	11/01/95	5120201090	39 52' 23.0"/86 7' 58.0"	55G	65	5B
33[b]	WEST FORK WHITE RIVER / HENDERSON FORD	MORGAN CO.	10/06/95	5020201140	39 29' 56.0"/86 21' 26.0"	55G	64	5B
34[b]	WEST FORK WHITE RIVER / PETERSBURG, IN	PIKE CO.	09/29/95	5120202100	38 30' 44.0"/87 17' 12.0"	72G	70	8
35[b]	WEST FORK WHITE RIVER / U/S WINCHESTER, IN	RANDOLPH CO.	09/18/95	5120201010	40 11' 0.0"/84 58' 15.0"	55M	62	5B

IASNRI = Indiana Academy of Science Natural Retion Index (Homoya, 1985)
Drainage Segment is an internal IDEM-OWM code for dividing sampling areas
Ecoregion is the U.S. EPA Ecoregion of The United States Code.
Hydrologic Unit is the U.S.G.S. Hydrologic Unit Code based on discrete drainage basins.
(b)=Locations sampled biennially
(a)=Location sampled annually for salmonids or nonsalmonids in alternating years
U/S=Upstream
D/S=Downstream
C.R.=County Road
F.&W.=IDNR Fish & Wildlife Area

Figure 2. *Locations where fish tissue was collected for contaminant analysis during the period from 1994 through 1995*

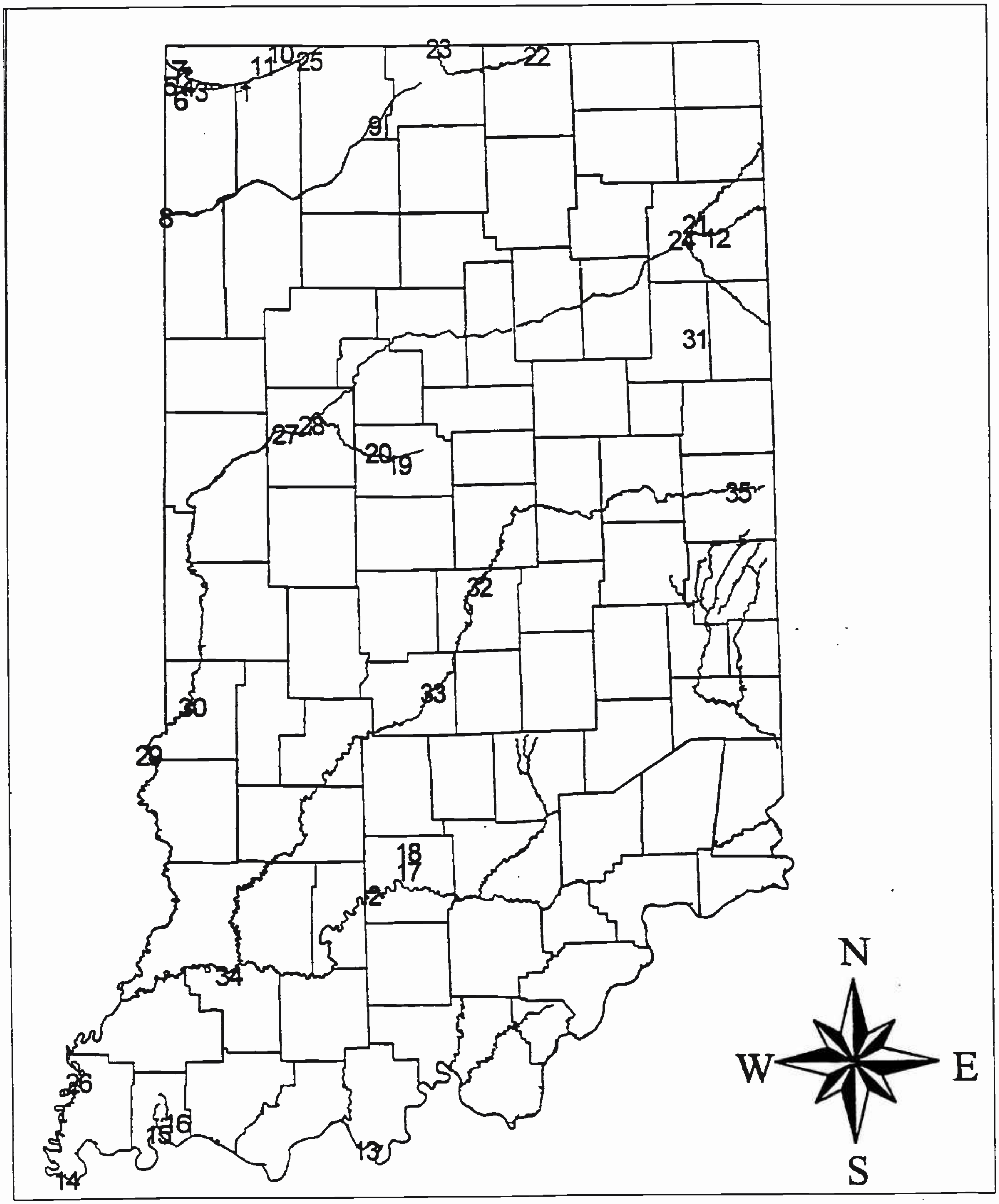


Table 13. *List of chemicals for which fish tissue samples are analyzed by the State of Indiana.*

METALS
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium/*
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead/*
- Magnesium
- Manganese
- Mercury/*
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

ACID EXTRACTABLES[@]
- Benzoic acid
- Phenol
- 2-Chlorophenol
- 2,4-Chlorophenol
- 2,4,5-Trichlorophenol

PESTICIDES
- Aldrin/*
- alpha-BHC/*
- beta-BHC/*
- delta-BHC/*
- gamma-BHC (Lindane)/*
- alpha-Chlordane/*
- gamma-Chlordane/*
- cis-Nonachlor/*
- trans-Nonachlor/*
- Oxychlordane/*
- p,p'-DDD/*
- o,p'-DDD/*
- p,p'-DDE/*
- o,p'-DDE/*
- p,p'-DDT/*
- o,p'-DDT/*
- Dieldrin/*
- Endosulfan I/*
- Endosulfan II/*
- Endosulfan sulfate/*
- Endrin/*
- Endrin aldehyde/*
- Endrin ketone/*
- Heptachlor/*
- Heptachlor epoxide/*
- Hexachlorobenzene/*
- Methoxychlor/*
- Pentachloroanisole/*
- Toxaphene/*

PCBs
- PCBs/Total/*

VOLATILE ORGANICS
- Acetone
- Benzene
- Chlorobenzene
- Ethyl benzene
- 2-Butanone (MEK)
- Carbon disulfide
- Chloroethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- 1,1,2,2-Tetrachlorethane
- 1,1-Dichloroethylene
- 1,2-Dichloroethylene/Total
- Trichloroethylene
- Tetrachloroethylene
- 2-Hexanone
- Bromomethane
- Tribromomethane (Bromoform)
- Bromodichloromethane
- Dibromochloromethane
- Chloromethane
- Dichloromethane (Methylene chloride)
- Trichloromethane (Chloroform)
- Tetrachloromethane (Carbon tetrachloride)
- 4-methyl-2-Pentanone
- 1,2-Dichloropropane
- cis-1,3-Dichloropropylene
- trans-1,3-Dichloropropylene

BASE/NEUTRAL EXTRACTABLES[@]
- Acenaphthylene
- Acenaphthene
- 4-Chloroaniline
- 2-Nitroaniline
- 3-Nitroaniline
- 4-Nitroaniline
- Anthracene
- Benzo (a) anthracene
- Dibenzo (a,h) anthracene
- 3,3'-Dichlorobenzidene
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobezene
- Nitrobenzene
- Benzyl alcohol
- Chrysene
- n-nitro-di-phenylamine
- n-nitroso-di-n-Propylamine
- Hexachloroethane
- Bis (2-chloroethyl) ether
- Bis (2-chloroisopropyl) ether
- 4-Bromophenyl-phenylether
- 4-Chlorophenyl-phenylether
- Fluoranthene
- Fluorene
- Benzo (beta) fluoranthene
- Benzo (kappa) fluoranthene
- Dibenzofuran
- Bis (2-chloroethoxy) methane
- Isophorone
- Naphthalene
- 2-Chloronaphthalene
- 2-Methylnaphthalene
- Hexachlorocyclopentadiene

PAHs by HPLC[a]
- Naphthalene
- 1-Methyl naphthalene
- 2-Methyl naphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pyrene
- Benzo(a) anthracene
- Chrysene
- Benzo(b) fluoranthene
- Benzo(k) fluoranthene
- Benzo(a) pyrene
- Dibenzo(a,h) anthracene
- Benzo(g,h,i) perylene
- Indeno(1,2,3-c,d) pyrene

Table 13. List of chemicals (cont.)

ACID EXTRACTABLES[@]	VOLATILE ORGANICS	BASE/NEUTRAL EXTRACTABLES[@]
2,4,6-Trichlorophenol	Styrene	Benzo (ghi) perylene
Pentachlorophenol	Toluene	Phenanthrene
2-Methylphenol	Vinyl acetate	di-n-Butylphthalate
4-Methylphenol	Vinyl chloride	Diethylphthalate
2,4-Dimethylphenol	Xylene/Total	Dimethylphthalate
4-Chloro-3-methylphenol		di-n-Octylphthalate
4,6-Dinitro-2-methylphenol		Bis (2-ethylhexyl) phthalate (BEHP)
2-Nitrophenol		Butylbenzylphthalate
4-Nitrophenol		Pyrene
2,4-Dinitrophenol		Benzo(alpha) pyrene
		Indeno (1,2,3-c,d) pyrene
		2,4-Dinitrotoluene
		2,6-Dinitrotoluene
		Hexachlorotoluene
		Carbazole

/* Indicates minimum analyte set
a=PAH by HPLC-Polycyclic Aromatic Hydrocarbons quantitated by high pressure liquid chromatography.
@=Acid and base/neutral extractables are semivolatile organic compounds.

IDNR. The committee develops the fish consumption advisory which is issued officially by ISDH.

Table 14 lists a summary of waterbodies for the most current fish consumption advisory (1996). This new advisory is based also on data from previous years of fish tissue sampling. Previously there had been 669 miles of streams in and bordering the state (including the Ohio River) not meeting water qualty goals of the Clean Water Act because of fish consumption advisories. The new risk based approach advisory (using PCBs and mercury) increaseses the number of stream miles under advisory. This, however is not a reflection of worsening conditions in Indiana rivers, streams, and lakes but of more protective guidances for human health. In fact, levels of persistent bioaccumulating organic contaminants such as PCBs, DDT, and dieldrin have been shown to generally be on a decling trend (IDEM, 1994). Also, the number of streams and streams miles under a **no consumption** advisory has actually decreased. Most all of the current **no consumption** fish advisory locations have been of the list for a number of years.

The 1996 fish consumption advisories in Indiana occur due to the presence of total PCBs and mercury. However, organochlorine pesticides continue to be detected in fish tissue. Some of these compounds such as chlordane, dieldrin, and DDT have been the cause of fish consumption advisories in the past. Although still detected in lesser quantities these compounds have also been shown to be on a generally declining trend as a fish tissue contaminant (IDEM, 1994).

The Indiana Lake Michigan advisory extends for 241 square miles which is the southern most waters of the lake. The fish consumption advisory for Lake Michigan is the result of efforts from all of the great lakes states for a consistent and uniform fish consumption advisory. Data used includes salmonid species tissue samples collected and prepared by IDNR. These samples are submitted to the U.S. Food and Drug Adminsitation (FDA) as part of any interagency agreement in which the U.S. Environmental Protection Agency (EPA) arranges sample collection and the FDA analyzes the samples for a number of pesticides and PCBs. This is the seventeenth year of the agreement.

There are species specific consumption advisories recommended for specific sites. However, not all species are necessarily sampled at all sites visited and it is not possible nor feasible to visit all fishable streams, rivers, and lakes. Normally fish are tested regularly only in areas where there is suspected or known contamination. For the 1996 fish consumption advisory all fish from sites not listed should be assumed to be in a group 2 advisory category, i.e., consume in more than one meal per week.

Table 14. 1996 Fish Consumption Advisory Summary for Indiana waters released by the Indiana State Department of Health.

The new advisory use five fish advisory groups:

Group 1 - unrestricted consumption
Group 2 - One meal a week 952 meals/years)
Group 3 - one meal a month (12 meals/year)
Group 4 - One meal every 2 months (6 meals/year)
Group 5 - **No consumption (Do Not Eat)**

Statewide COMMON CARP Advisory for all rivers and streams:

15 - 20 inches	one meal per month (Group 3)
21 - 25 inches	one meal every 2 months (Group 4)
over 25 inches	**do not eat (Group 5)**

Carp are generally contaminated with both PCBs and Mercury. Carp in all Indiana rivers and streams fall under the following risk groups.

One meal is considered to be eight ounces (weight before cooking) of trimmed, skinned fish for a 150 pound person. This meal advise is equally protective for larger people who eat larger meals and smaller people who eat smaller meals. Generally a consumer should subtract or add 1 ounce of fish for every 20 pounds of body weight above or below the standard 150 pound person to stay within the protection guidelines.

GROUP 5 WATERWAYS:

All fish from the following waters are under a group 5 (no consumption) advisory. **Do not eat any fish caught from these waters due to high levels of contamination.**

- Elliot Ditch, Tippecanoe County (PCBs)
- Grant Calumet River/Indiana Harbor Canal, Lake County (PCBs)
- Kokomo Creek, Howrad County (PCBs)
- Litle Mississinewa River, Randolph County (PCBs)
- Little Sugar Creek, Montgomery County (PCBs)
- Pleasant Run Creek, Lawrence County (PCBs)
- Stoney Creek, Hamilton County (PCBs)
- Clear Creek, Monroe County
- Salt Creek, Lawrence County
- Wea Creek, Tippecanoe County (PCBs)
- Wildcat Creek in Howard, Carroll, and Tippecanoe counties (PCBs)

Table 14. Current fish consumption advisory for Lake Michigan and tributaries

LOCATION	SPECIES	FISH SIZE	GROUP
Lake, LaPorte, & Porter County	Brook Trout	All	3
	Brown Trout	up to 18"	3
		18 - 27"	4
		27+"	5
	Commom Carp	**All**	**5**
	Catfish	**All**	**5**
	Chinook Salmon	up to 26"	3
		26+"	4
	Coho Salmon	17 - 28"	3
		28+"	4
	Lake Trout	up to 21"	3
		21 - 26'	4
		26+"	**5**
	Longnose Sucker	14 - 23"	4
		23+"	**5**
	Pink Salmon	All	3
	Rainbow Trout	up to 22"	3
		22+"	4
	Walleye	17 - 26"	3
		26+"	4
	Whitefish	17 - 23"	3
		23+"	4
	White Sucker	14 - 23"	3
		23+"	4

Polychlorinated biphenyls (PCBs) are a family of 209 individual chlorinated hydrocarbon compounds each referred to as a congener. The major U.S. producer, Monsanto Corporation, marketed PCBs under the trade name Aroclor from 1930 to 1977. The only other known manufacturer of PCBs in the U.S was Geneva Industries of Houston, Texas, which operated from 1972 to 1974. Chemical and physical stability and electrical insulating properties led to the commercial utility of PCBs. PCBs were made for use in closed electrical and heat transfer fluids (approximately 60% of total use), plasticizers (25%), hydraulic fluids and lubricants (10%), printing inks, paints, dusting agents, pesticides, carbonless copy papers, and many other applications (USEPA, 1987).

Their ubiquitous past use has led to widespread distribution of PCBs in the environment, causing great environmental concern due to their extreme persistence, bioaccumulation and adverse health effects (IJC, 1991). PCBs are known to cause reproductive and developmental effects in laboratory animals. Human investigations have confirmed that PCBs present in maternal blood cross the placenta and enter the fetal circulation. The PCB contamination of fish is often correlated with identifiable sources. Specific sources have been identified as contributory to PCB contamination. However, because of the wide occurrence of PCBs in fish tissue samples, contamination is thought to be contributed from nonpoint and atmospheric sources as well. Total PCB was detected in 82% of the fish tissue samples analyzed for the reporting period (See Table 15). Total PCB was detected in 86% of the fish tissue samples analyzed for the reporting period 1990-1993 (IDEM, 1994).

Lake Michigan fish have been exposed to PCBs from both point and non-point sources, many of which are in other states bordering the lake. PCB contaminated non-salmonids collected in the past from Burns Ditch and Trail Creek, which are direct tributaries to Lake Michigan, were thought to receive their exposures to PCBs in these tributaries, while the salmonids that migrated into these tributaries received exposure in the lake. The most recent fish tissue samples from these tributaries exceeded 2.0 ppm for PCBs.

Two non-salmonid samples collected in 1992 had PCB concentrations exceeding 2.0 ppm and PCBs were deleted in all but one sample (yellow perch) including those from 1990. Also, most Lake Michigan fish samples collected in Indiana waters still contained low but measurable levels of residues of chlordane, DDT, DDD, DDE, dieldrin, and endrin, as well as mercury.

The Indiana Harbor Canal and the Grand Calumet River are known to have highly contaminated sediments. Every 1994 fish tissue sample from the Indiana Harbor Canal analyzed had concentrations that exceeded 2.0 ppm total PCBs. All fish tissue samples collected from four locations in the Grand Calumet River show a continued high level of contamination. Historically, nearly every sample analyzed, whether whole fish or fillets, had total PCB concentrations in excess of 2.0 ppm. In fact, the Grand Calumet River/Indiana Harbor Canal fish rank as the most contaminated fish in the state of Indiana.

To date, there are no known point sources which have contributed to PCB contamination in fish from the St. Joseph River near South Bend, IN. Sediment testing in several tributaries of the river in 1985 indicated some evidence of contamination. Collections in 1988 revealed some

Table 15. *Percent detections of organochlorine pesticides and total PCBs in 1994 fish tissue samples analyzed (also 1993 Pigeon Creek, Vanderburgh Co. samples).*

COMPOUND	%DETECTION	# OF SAMPLES ANALYZED	GENERAL DETECTION LIMITS
Aldrin	3.4	87	8.0 ug/kg
alpha-BHC	0.0	87	8.0 ug/kg
beta-BHC	0.0	87	8.0 ug/kg
delta-BHC	0.0	87	8.0 ug/kg
gamma-BHC	4.6	87	8.0 ug/kg
alpha-Chlordane	52	87	8.0 ug/kg
gamma-Chlordane	31	87	8.0 ug/kg
cis-Nonachlor	33	87	8.0 ug/kg
trans-Nonachlor	36	87	8.0 ug/kg
Oxychlordane	1.1	87	8.0 ug/kg
Total Chlordane*	53	87	*
p,p'-DDD	52	87	10.0 ug/kg
o,p'-DDD	13	87	10.0 ug/kg
p,p'-DDE	71	87	10.0 ug/kg
o,p'-DDE	3.4	87	10.0 ug/kg
p,p'-DDT	2.3	87	10.0 ug/kg
o,p'-DDT	1.1	87	10.0 ug/kg
Total DDT*	67	87	*
Dieldrin	49	87	10.0 ug/kg
Endosulfan I	0.0	87	20.0 ug/kg
Endosulfan II	0.0	87	20.0 ug/kg
Endosulfan Sulfate	1.1	87	20.0 ug/kg
Endrin	0.0	87	10.0 ug/kg
Endrin Aldehyde	0.0	87	10.0 ug/kg
Endrin Ketone	0.0	87	10.0 ug/kg
Heptachlor	0.0	87	8.0 ug/kg
Heptachlor epoxide	6.9	87	8.0 ug/kg
Hexachlorobenzene	2.3	87	10.0 ug/kg
Methoxychlor	0.0	87	20.0 ug/kg
Pentachloroanisole	0.0	87	8.0 ug/kg
Toxaphene	0.0	87	10.0 ug/kg
Total PCB	82	87	50.0 ug/kg

PCBs in sediment upstream of Mishawaka, IN. Some of the fish tissue samples collected in 1990 and 1992 had PCB concentrations above 2.0 ppm. The 1994 samples did also.

Although private, state and/or federal cleanups have occurred near some of the state's "PCB hot spot" locations, fish tissue continues to be highly contaminated. The total PCB levels in the fish tissue from these locations are some of the highest levels found in any stream in the state sampled to date. Samples collected from Pleasant Run Creek, north of Bedford in Lawrence County had concentrations of total PCB in creek chubs as high as 330 ppm. A spotted bass tissue sample at 220 ppm total PCB, and a white sucker tissue sample at 260 ppm total PCB were also collected at this site. This site is downstream of GM Central Foundry in Bedford, IN. It was monitored again in 1995 but the analysis of these samples is not yet complete. The most recent samples collected from Little Mississinewa River in Randolph County (1993) had PCBs in creek chub at 23 ppm and in green sunfish at 13 ppm. Little Sugar Creek in Montgomery County (Wabash basin) had a creek chub sample collected with 10 ppm, a rock bass sample at 7.5 ppm, and a white sucker sample at 16 ppm. This is, however, a marked reduction from the previous sampling before clean up (1987) in which creek chub had 170 ppm, rock bass had 300 ppm, and white sucker had 250 ppm. Samples collected in Clear Creek in Monroe County continue to have PCBs above 2.0 ppm.

No "human protection value" has been developed or accepted yet for calculating and evaluating the following compounds on a risk based approach as with PCB and mercury so comparisons are made based on FDA Action/Tolerance Levels. DDT, dieldrin, and chlordane were widely used, environmentally persistent organochlorine pesticides banned from general agricultural use in 1969, 1972, and 1980, respectively. They have also been common contaminants in fish. These compounds are toxicants with long-term persistence in soil and water, and are highly lipophilic (affinity for fatty tissue). Dieldrin, chlordane isomers, DDT, DDD, and DDE, like PCBs, are found ubiquitously, occurring in small amounts at least in most fish tissue samples analyzed (see Table 15). Table 16 lists 5 river sites where fish tissue samples collected in 1994 equaled or exceeded FDA Action/Tolerance Levels.

Because of the agricultural use bans, the incidence of DDT, dieldrin, and chlordane contamination in fish flesh has declined over the years in response to decreasing exposure from non-point sources such as farm field runoff. Chlordane was the only one of the three that has exceeded the FDA Action Level (0.3 ppm) in the reporting period. Elevated chlordane in excess of FDA Action Levels was confirmed at Pigeon Creek at Kleymeyer City Park in Evansville, IN (Vanderburgh County). Samples collected and analyzed in 1992 first detected the elevated chlordane concentrations. Pigeon Creek in Evansville is thought to be surrounded by some abandoned landfills of unknown contents. Kleymeyer Park may be one of these.

Total DDT was quantitated in 67% of the fish tissue samples analyzed for 1994 with p,p'-DDE being the primarily detected breakdown isomer at 71% occurrence. Total chlordane was quantitated in 53% of fish tissue samples with trans-nonachlor (36%) and alpha chlordane (52%) being the two most highly detected (out of five) isomers.

Heptachlor epoxide was detected in 6.9% of the fish tissue samples analyzed for 1994. However, none of these quantities exceeded the FDA Action Level for this compound.

Heptachlor epoxide is a microbially converted metabolite of heptachlor in the environment. Heptachlor is a broad spectrum insecticide introduced in 1948 as a contact insecticide under the trade names R

Table 16. *River sites where fish tissue samples collected in 1994 (and Pigeon Creek, Vanderburgh Co. 1993) equaled or exceeded FDA action/tolerance levels.**

PCB=Polychlorinated Biphenyl
*FDA Action Levels: total PCB=2.0 ppm, Total FDA Chlordane=0.3 ppm

STREAM	COUNTY	CONTAMINANT EXCEEDED	SPECIES
Burns Ditch	Porter	PCB	Carp
Grand Calumet River	Lake	PCB	Carp, Goldfish
Indiana Harbor Canal	Lake	PCB	Carp
Pigeon Creek	Vanderburgh	Total Chlordane	Carp
St. Joseph River	St. Joseph	PCB	Carp
St. Mary's River	Allen	Mercury	Carp
Trail Creek	LaPorte	PCB	Carp

3314 and Velsicol 104. It was suspended for use on food crops and home use in 1976. Significant commercial use of heptachlor for termite control or in nonfood plants continues. Both heptachlor and heptachlor epoxide have been shown to be toxic to aquatic life, to accumulate in plant and animal tissues, and to persist in aquatic ecosystems (USEPA, 1980). Heptachlor is also contained in chlordane. All of the other organochlorine pesticides were detected in 1994 fish tissue samples at a rate of less than 4% or not at all.

In addition to pesticides and PCBs, all 1994 fish tissue samples were analyzed for 21 different compounds or elements including polycyclic aromatic hydrocarbons, cadmium, lead, and mercury. Additional metals and organics are analyzed only in a limited number of selected samples.

Mercury can exist in a number of forms in the environment. Mercury is found in insecticides, fungicides, bactericides, pharmaceuticals, paint additives, tanning, batteries, electrical equipment, applications in metallurgy and dental fillings, thermometers, and barometers. It is also released from fossil fuel combustion. Use of mercury in pesticides is now banned except for some limited use in fungicides or preservatives (IJC, 1987). Natural emissions of mercury include release from soils and vegetation, from forest fires, and from water surfaces (IJC, 1987). Very small amounts of the emissions are contributed to by the latter two. Mercury released in this century through human activities is almost ten times the calculated amount released due to natural weathering (Moore and Ramamoorthy, 1984). However the International Joint Commission (1987) estimated manmade emissions of mercury to be less than half the natural mercury emissions. Consumer use and disposal of products containing mercury eventually release more mercury to the overall environment than do manufacturing processes (U.S. EPA, 1986). About 60% of mercury consumed in the United States goes to landfills (IJC, 1987). Total human contribution of mercury into the environment in the United States is estimated to be 650 metric tons (IJC, 1987) with the most important sector being the combustion of fossil fuels.

Mercury is detected ubiquitously in fish tissue samples from Indiana waters. Mercury was detected in 98% of all 1994 fish tissue samples analyzed, and one of these samples contained 1.0 ppm. The levels of mercury found in fish tissue and the concern for human health protection from exposure to mercury prompted the issuance of the 1996 Indiana Fish Consumption Advisory. Specific information on locations for mercury-based fish consumption advisories is available in the 1996 Fish Consumption Advisory released by the ISDH.

Lead is another of the metals of environmental concern. It is ubiquitous in nature. Lead has been in use for many centuries and is found in piping, building materials, solders, paint, and ammunition as well as other things. Today its main use has been in lead-acid storage batteries, metal products, chemicals (such as anti-knock agents that used to be found in gasoline), and pigments. Important sources of lead in the environment include automobile exhaust (with leaded gasoline), smelting smoke and lead base paints (Moore and Ramamoorthy, 1984) (USEPA, 1978). Lead today is ubiquitous in air, water, and soil, in both rural and urban environments, in far above background concentrations (Beyer et al, 1996).

The U.S. EPA reported that ingestion constitutes the major source of lead in people (USEPA, 1980b). There is little evidence of biomagnification in the food chain and fish consumption, which indicates there is not an unusually significant source of lead in the human diet. High levels in fish tissue samples are usually associated with point source contamination. Lead tends to accumulate equally in both organs and muscle tissue of fish. Lead was quantitated above the laboratory detection in 85% of the 1994 fish tissue samples analyzed and ranged from 0.05 ppm to 1.5 ppm (Grand Calument River). The hazard of lead to children is of considerable concern. Further evaluation is needed to interpret what these concentrations of lead in fish tissue mean for human health and wildlife health.

Cadmium is also found in low levels throughout the environment. The major routes of exposure of humans to cadmium are through food and tobacco smoke. Major uses of cadmium include electroplating, pigments, plastic stabilizers, batteries, and as cadmium phosphors for tubes in TVs, fluorescent lamps, x-ray screens, etc. (USEPA, 1980c). Cadmium is accumulated mainly in the organ tissues of fish rather than in muscle. Because levels are normally low in edible muscle, accumulation does not appear to be a threat to most of Indiana's fishery resources. In fact only 20% of the fish tissue samples analyzed had detectable amounts of cadmium with a detected range of 0.010-0.050 ppm. Most of these were at or just above the detection limit of 0.010 ppm.

Copper, like lead is known to only bioaccumulate in muscle under conditions of moderate to extreme pollution and although it can accumulate in the muscle tissue it has been shown to accumulate at a much higher level in the liver and the gut wall (Moore and Ramamoorthy, 1984). Also, toxicity to fish is the more important problem before accumulation begins to occur. No separate organ analysis studies have been undertaken in the fish tissue contaminant monitoring program although organ studies may provide a better indication of metals bioaccumulation than fillet samples can provide. Copper was quantifiable in all of the 1994 fish tissue samples. The range of values was 0.18-0.81 ppm.

Starting in 1987, tissue analysis for semi-volatile and volatile compounds was performed on some fish samples. Table 17 lists those locations where fish tissue samples had detections of semivolatile or volatile organic compounds. A number of these compounds were detected in fish tissue samples from the Indiana Harbor Canal (IHC) in Lake County and Burns Ditch in Porter County (see Table 17). Most of these compounds are classed as monocyclic and polycyclic aromatic hydrocarbons (MAHs and PAHs). Although generally not considered very acutely toxic to forms of life (except in high concentrations), several are either known or suspected carcinogens and all are priority pollutants (USEPA, 1991) (Beyer, et. al. 1996). Both MAHs and PAHs are not very polar in physical nature (sparingly to insoluble in water) and are strongly adsorbed to the organic component of suspended solids and sediments.

Table 17. *Semi-volatile and/or volatile organic compound detections in fish tissue at locations sampled (1994).*

SITE	COUNTY	COMPOUNDS DETECTED
Burns Ditch	Porter	fluoranthene, acenaphthylene, trichlorethylene, tetrachloroethylene, bromodichoromethane, trichloromethane
Indiana Harbor Canal	Lake	benzene, 2-methyl naphthalene, acenaphthylene, acenaphthene, fluorene, phananthrene, anthracene, fluoranthene, pyrene, dibenzofuran, naphthalene, tetrachloroethylene, trichloromethane
Kankakee River	Lake	acenaphthylene, fluorene
Kankakee River	LaPorte	acenaphthylene, fluorene, phenanthrene
Maumee River	Allen	acenaphthylene, fluorene, phenanthrene, anthracene
Pigeon Creek	Vanderburgh	acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene
St. Joseph River	Allen	acenaphthylene, fluorene
St. Joseph River	Elkhart	acenaphthylene, fluorene
St. Joseph River	St. Joseph	acenaphthylene, fluorene, trichloroethylene, tetrachloroethylene
St. Mary's River	Allen	acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene
Trail Creek	LaPorte	acenaphthylene, fluorene, phenanthrene, dichloromethane, trichloromethane

PAHs originate from both natural and anthropogenic sources and are generally distributed in plant and animal tissues, surface waters, sediments, soils, and air. They can be formed as a result of incomplete combustion of organic compounds with insufficient oxygen. Many PAHs can be found in smoked food, cigarette smoke, vegetable oils, and margarines as well as surface waters and fish. Residues in tissues from other studies have been observed to be very low except at site specific discharge points (Moore and Ramamoorthy, 1984). Naphthalene is used in the manufacture of chemicals such as solvents, lubricants, dyes, moth repellents, insecticides, vermicides, antihelmintics, and intestinal antiseptics. Acenaphthene is used in the manufacture of dyestuff, plastics, and pesticides. Phenanthrene is also used as an intermediate in these production uses. Polycyclics such as chrysene, pyrene, perylene, benzopyrene, dibenzoanthracene, and benzo(a)anthracene have few industrial uses. Crude oil contains high levels of various PAHs and MAHs. Oil contamination and heavy industry is the most probable source for these contaminants found in aquatic sediments and fish tissue from the IHC. Because of a shortage of funds, PAHs were not analyzed on Grand Calumet River samples in 1994. Samples were saved and these compounds are being analyzed along with the 1995 fish tissue samples. Results are pending.

Some of the more commonly produced monocyclic aromatic hydrocarbons include benzene, toluene, xylene, ethyl benzene, and chlorobenzenes. These compounds are used in the synthesis of pharmaceuticals and other chemicals such as styrene, detergents, pesticides, and cyclohexane in addition to being used as degreasers, antiknock fuel additives and solvents. Although there are no FDA Action Levels or human protection values for these compounds, upper limit values in water are given for some of these as well as other toxic chemicals for the "protection of human health from the toxic affects which may result from the consumption of aquatic organisms and/or drinking water from a waterbody" in the Indiana State Water Quality Standards (327 IAC 2-1-6).

Fluorene and acenaphthylene were the most widely detected polycyclic aromatic compounds followed by phenanthrene, anthracene, and fluoranthene (Table 18). Some PAH compounds were detected at all locations where tissue was analyzed for PAHs. Benzene (a volatile organic compound known to be highly carcinogenic) was found in an Indiana Harbor Canal carp sample at 7.0 ppb (parts per billion). It was found in another IHC carp sample at 61 ppb but there was also associated blank contamination in the quality control sample. Acenaphthylene was detected in at least one fish tissue sample from every 1994 site monitored.

The primary objective of the fish contaminant monitoring program is to provide supporting data for the issuance of fish consumption advisories for Indiana rivers, streams, and lakes. What we have not explored is the possible effects that these contaminants can have on the health of the individual organisms within and associated with the waterbodies. Research has demonstrated physiological stresses from contaminants can be placed on fish, waterfowl, and

Table 18. *Percent detections of polycyclic aromatic hydrocarbon (PAH) compounds by HPLC detection method in fish tissue samples collected (1994). (All other PAH compounds analyzed for had no detections in 1994 fish tissue samples.)*

Compound	% Detection	Standard Detection Limit
2-Methyl Naphthalene	3.1	100 ug/kg
Acenaphthene	4.7	50 ug/kg
Acenaphthylene	61	125 ug/kg
Anthracene	19	7.5 ug/kg
Fluoranthene	17	7.5 ug/kg
Fluorene	63	10 ug/kg
Phenanthrene	41	5.0 ug/kg
Pyrene	6.3	7.5 ug/kg

(All other PAH compounds analyzed had no detections in 1994 fish tissue samples.)

a whole. Effects can include cancer (to the reproductive system and other body tissue), as well as developmental and behavioral abnormalities. Toxicological effects of high concentrations of contaminants can have a very visible effect. Low concentrations of some contaminants may have a much more insidious effect. In fact contaminant uptake from the aquatic environment can affect all communities that come in contact with it. Disruption of ecological balance (or biological integrity) can occur. The difficulty is in determining the level of various contaminants or the invertebrate species which can in turn have profound effects on the quality of the communities as compounds were detected at all locations where tissue was analyzed for PAHs. Benzene (a volatile organic compound known to be highly carcinogenic) was found in an Indiana Harbor Canal carp sample at 7.0 ppb (parts per billion). It was found in another IHC carp sample at 61 ppb but there was also associated blank contamination in the quality control sample. Acenaphthylene was detected in at least one fish tissue sample from every 1994 site monitored.

The primary objective of the fish contaminant monitoring program is to provide supporting data for the issuance of fish consumption advisories for Indiana rivers, streams, and lakes. What we have not explored is the possible effects that these contaminants can have on the health of the individual organisms within and associated with the waterbodies. Research has demonstrated physiological stresses from contaminants can be placed on fish, waterfowl, and invertebrate species which can in turn have profound effects on the quality of the communities as a whole. Effects can include cancer (to the reproductive system and other body tissue), as well as developmental and behavioral abnormalities. Toxicological effects of high concentrations of contaminants can have a very visible effect. Low concentrations of some contaminants may have a much more insidious effect. In fact contaminant uptake from the aquatic environment can affect all communities that come in contact with it. Disruption of ecological balance (or biological integrity) can occur. The difficulty is in determining the level of various contaminants or the mixture of contaminants that will cause harm not only to the individuals but to the interrelated communities as a whole.

LAKE INFORMATION AND ASSESSMENT

Indiana has 575 public lakes and reservoirs with a combined surface area of 106,203 acres. Three of these are reservoirs over 5,000 acres in size with a combined surface area of 24,890 acres. Although all of these water bodies are important and must be protected, Indiana's 404 natural, public lakes are irreplaceable resources and are in need of exceptional protection.

A fish consumption advisory exists for all lakes and reservoirs in Indiana became effective in 1996. This advisory is based on levels of PCBs and mercury found in fish tissue. Although there are 106,203 acres of lakes and reservoirs in Indiana, only 47,892 acres were tested to develop the new consumption advisory. At a minimum, adult males and felmales should consume no more than one meal per week (52 meals per year) of fish from these waters. Please consult the 1996 Indiana Fish Consumption Advisory for specific advisory groups and fish species.

Although scientific investigation of Indiana lakes began before the end of the 19th century, probably less than 100 had been studied prior to 1970. At that time, the State recognized the need to generate physical, chemical, and biological data from all of its public lakes and reservoirs. A concerted effort was made to standardize lake study methods and to develop a system for comparing one lake to another. This allowed lakes and reservoirs to be organized and prioritized according to their need for protection and/or renovation.

While a variety of lake classification schemes have been developed over the years, the msot commonly-used ones are based on nutrient concentrations and associated levels of lake productivity. Eutrophication is a natural process in which lakes age and gradually fill in. Unfortunately, this process is often accelerated, as man's activities distrub and "over nourish" lake systems. Terms such as oligrotrphic, mestorphic, eutrophic, and hypereutrophic are used to describe the nourishment or enrichment level of lakes, from the lowest to the highest utrophy level.

The *Indiana Lake Classification System and Management Plan* of the Indiana Department of Environmental Management (1986) describes the system used to classify Indiana lakes and reservoirs. Water quality data, collected statewide in the mid-1970s, were used to separate lakes and reservoirs into one of three classes using the Indiana Trophic State Index (TSI) (Table 19). A fourth class for remnant natural and oxbow lakes has since dropped out of use.

The Indiana TSI assigns eutrophy points for different concentrations of ten common water quality parameters. The total of all of these points for a particular lake is that lake's trophic or TSI score, which ranges from 0 (oligotrophic) to 75 (hypereutrophic) points. Since nutrient levels (and subsequent levels of productivity) can fluctuate from season to season and year to year, the lines of demarcation between the different lake classes are not as sharp as they appear. Further description of these classes follows.

Class I lakes are mostly oligotrophic in nature. They have the highest water quality, the lowest levels of nutrients and primary production, and score between 0 and 25 points on Indiana's eutrophication index. They rarely support concentrated plant or algae growth or display other impairment which interfere with any designated uses.

Class II lakes are of intermediate quality, scoring from 26 to 50 eutrophy points. The term mesotrophic has been applied to these moderately productive lakes. While often noticeably affected by man's activities, the process of aging within these lakes can be subtle. Such lakes frequently support plant and algae growth, but seldom to the extent that one or more designated uses are impaired. The majority of Indiana lakes and reservoirs fall into this category.

Class III lakes have the poorest quality, scoring 51 to 75 points on the Indiana index. These lakes and reservoirs are rich in nutrients and are the most productive in the state. While termed eutrophic for purposes of this classification, several of these waterbodies actually border on being hypereutrophic. In addition to other degradation, these lakes support extensive

Table 19. *Calculation of the IDEM lake trophic state index*

	PARAMETER AND RANGE	EUTROPHY POINTS
I.	Total Phosphorus (ppm)	
	A. At least 0.03	1
	B. 0.04 to 0.05	2
	C. 0.06 to 0.19	3
	D 0.2 to 0.99	4
	E. 1.0 or more	5
II.	Soluble Phosphorus (ppm)	
	A. At least 0.03	1
	B. 0.04 to 0.05	2
	C. 0.06 to 0.19	3
	D. 0.2 to 0.99	4
	E. 1.0 or more	5
III.	Organic Nitrogen (ppm)	
	A. At least 0.5	1
	B. 0.6 to 0.8	2
	C. 0.9 to 1.9	3
	D. 2.0 or more	4
IV.	Nitrate (ppm)	
	A. At least 0.3	1
	B. 0.4 to 0.8	2
	C. 0.9 to 1.9	3
	D. 2.0 or more	4
V.	Ammonia (ppm)	
	A. At least 0.3	1
	B. 0.4 to 0.5	2
	C. 0.6 to 0.9	3
	D. 1.0 or more	4
VI.	Dissolved Oxygen Percent Saturation at 5 feet from surface	
	A. 114% or less	0
	B. 115% to 119%	1
	C. 120% to 129%	2
	D. 130% or more	3
	E. 150% or more	4
VII.	Dissolved Oxygen Percent of measured water column with at least 0.1 ppm dissolved oxygen	
	A. 28% or less	4
	B. 29% to 49%	3
	C. 50% to 65%	2
	D. 66% or 75%	1
	E. 76% to 100%	0
VIII.	Light Penetration (Secchi Disk)	
	A. Five feet or under (1.52 meters or less)	6
	B. Greater than five feet (or greater than 1.52 meters)	0
IX.	Light Transmission (Photocell) Percent of light transmission at a depth of 3 feet	
	A. 0 to 30%	4
	B. 31% to 50%	3
	C. 51 % to 70%	2
	D. 71% and up	0

Table 19. *Calculation of the IDEM lake trophic state index (cont.)*

	PARAMETER AND RANGE		EUTROPHY POINTS
X.	Total Plankton per liter of water sampled from a single vertical tow between the 1% light level and the surface:		
	A.	Less than 3,000 organisms/L	0
	B.	3,000 to 6,000 organisms/L	1
	C.	6,001 to 16,000 organisms/L	2
	D.	16,001 to 26.000 organisms/L	3
	E.	26,001 to 36,000 organisms/L	4
	F.	36.001 to 60,000 organisms/L	5
	G.	60,001 to 95,000 organisms/L	10
	H.	95,001 to 150,000 organisms/L	15
	I.	150,001 to 500,000 organisms/L	20
	J.	Greater than 500,000 organisms/L	25
	K.	Blue-Green Dominance (additional points)	10

concentrations of aquatic plants and algae during the summer, often requiring artificial control efforts. Nuisance blooms of blue-green algae commonly occur in Class III lakes and reservoirs, as do fish kills during extended periods of hot weather or ice and snow cover. One or more lake uses are commonly impaired on these lakes.

IDEM's Indiana Clean Lakes Program monitored water quality on a total of 176 Indiana lakes and reservoirs during the 1994 and 1995 summer seasons. The samples were collected by staff and graduate students at Indiana University's School of Public and Environmental Affairs (SPEA). Sampling consisted of a single set of water samples from each lake, taken from the deepest basin during stratification in July and August. Sampling during these months facilitated comparison to past results and represented worst-case water quality conditions.

Analysis of water samples for chemical parameters was completed at the SPEA laboratory in Bloomington using methods outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA, 1992). Dissolved oxygen and water clarity values were determined in situ, and plankton counts were completed using a Sedgewick-Rafter counting cell, as recommended by *Standard Methods*. Data collected for the 96 lakes sampled in 1994 are given in Table 20. These data were used to calculate trophic scores for these 96 lakes. Additional information or data collected during the 1994 season included: lake area, maximum depth, the depth at which the light level is only 1%, pH, alkalinity, conductivity, and chlorophyll *a*. The 1% light level depth is the depth from which the vertical tow begins when collecting plankton samples. These data will not be presented nor discussed here.

Due to the lack of Section 314 federal funds, analysis of the 1995 samples ceased in October of that year. Following a six-month hiatus, SPEA has resumed collecting and analyzing 1996-season lake samples under Section 319 funding. Indiana University plans to complete the plankton and chlorophyll *a* analysis for the 1995 samples, so that TSI scores can be calculated for the 80 lakes sampled in this season. Table 21 lists the lakes visited during the 1995 season. Analytical results of those which were sampled will be included in a subsequent 305(b) report.

Trophic state index results for the 1994 survey are presented in Table 22. TSI scores ranged from a low of 4 for Axel Lake in Noble County to a high of 61 for Black Lake in Whitley County. Several lakes appear to have had trophic gains or losses when compared to past lake survey results. Lakes with the largest TSI increases (worsening water quality) include Lower Long Lake in Noble County (+16 points in 5 years), and Port Mitchell in Noble County (+21 in 20 years). The lakes with the largest TSI decreases (improving water quality) include Wabee Lake in Kosciusko County (-47 in 20 years), Palestine in Kosciusko County (-23 in 10 years), and Bartley Lake in Noble County and Little Crooked Lake in Whitley County with (-29) and (-26), respectively in 5 years.

For the lakes sampled in 1994, thirty (31%) were in Class I, sixty (63%) were in Class II, and six (6%) were in Class III. Of the 96 lakes sampled in 1994, 62 had been sampled before, allowing for some comparisons. Table 21 also presents trophic scores resulting from previous

Table 20. *Indiana lake water quality data: 1994*

COUNTY	LAKE	Secchi (m)	% Trans. @ 3 ft.	%DO Sat.	%DO Oxic	NO3 (mg/L)	NH4 (mg/L)	Org-N (mg/L)	Sol-P (mg/L)	Tot-P (mg/L)	Plankton (1000/L)	% Blue-Green
Dekalb	Dunten	0.9	15	94.4	29	0.022	2.126	0.564	0.455	0.535	3249	56
Dekalb	Indian	1.3	35	116	33	0.022	0.273	0.23	0.007	0.069	9864	73.2
Dekalb	Lower Story	2	42	110	56	0.022	0.076	0.326	0.081	0.156	63790	60.4
Dekalb	Upper Story	1.9	43	103.6	60	0.022	1.952	0.23	0.582	0.028	21352	88.9
Dekalb	Wiley	1	24	106	41	0.022	1.932	0.23	0.368	0.435	21310	33.7
Fulton	Lukens	2.6	19	96	52	0.022	2.391	0.234	0.484	0.415	2825	76.6
Kosciusko	Allen	2.3	40	104	39	0.022	1.297	0.496	0.227	0.284	39830	74.2
Kosciusko	Backwater	1	25	127	100	0.05	0.018	0.437	0.005	0.068	12955	5.7
Kosciusko	Banning	1.5	12	65	100	0.022	0.051	0.504	0.001	0.042	5011	72.5
Kosciusko	Barrel and ½	2.4	45	109	32	0.022	1.961	0.23	0.524	0.644	79664	95
Kosciusko	Beaver Dam	1	17	110	25	0.022	1.971	0.517	0.297	0.313	9188	58.1
Kosciusko	Big Barbee	1.05	16	83	40	0.022	1.218	0.357	0.206	0.272	28119	65.5
Kosciusko	Big Chapman	2.7	54	95	85	0.022	0.260	0.484	0.000	0.035	8603	32
Kosciusko	Black Pond	0.5	0	90	100	0.022	0.023	0.831	0.002	0.053	8380	70.8
Kosciusko	Boner	3.2	53	100	90	0.022	0.018	0.579	0.003	0.036	21021	59.7
Kosciusko	Caldwell	1.7	19	117	64	0.022	0.576	0.804	0.005	0.056	200547	94.8
Kosciusko	Carr	1.5	14	96	43	0.022	1.846	0.937	0.453	0.460	63271	84.8
Kosciusko	Center	2.2	45	94	53	0.022	0.670	0.387	0.108	0.124	11568	33.8
Kosciusko	Crystal	3.3	72	94	65	0.026	1.515	0.632	0.009	0.032	2238	41.4
Kosciusko	Goose	3.7	48	100	56	0.026	1.549	0.688	0.192	0.256	9312	81.6
Kosciusko	Hill	2.9	28	110	69	0.022	1.527	0.33	0.058	0.086	7053	83.3
Kosciusko	Hoffman	1.4	40	135	66	0.595	1.159	0.638	0.026	0.068	8725	37.1

Table 20. *Indiana lake water quality data: 1994* (cont.)

COUNTY	LAKE	Secchi (m)	% Trans. @ 3 ft.	%DO Sat.	%DO Oxic	NO3 (mg/L)	NH4 (mg/L)	Org-N (mg/L)	Sol-P (mg/L)	Tot-P (mg/L)	Plankton (1000/L)	% Blue-Green
Kosciusko	Irish	1	13	84	63	0.022	1.024	0.297	0.054	0.098	50971	76.8
Kosciusko	James	1.35	18	104	35.9	0.022	0.018	1.076	0.065	0.08	2920	84.6
Kosciusko	Kiser	1.7	33	83	82	0.022	0.048	0.264	0.003	0.028	4070	51.3
Kosciusko	Kuhn	1.9	11	93	100	0.022	0.073	0.230	0.002	0.030	*	*
Kosciusko	Little Barbee	0.9	5	80	57.1	0.022	1.683	0.357	0.256	0.373	30840	72.4
Kosciusko	Little Chapman	1.4	23	106	65	0.022	1.004	0.522	0.128	0.185	18563	35.3
Kosciusko	Little Pike	0.6	12	95	100	0.056	0.018	0.971	0.003	0.079	34437	22.4
Kosciusko	Long	4.6	31	100	82	0.050	0.672	0.551	0.004	0.072	40990	92.1
Kosciusko	Loon	1.5	17	101	38	0.022	2.686	0.688	0.359	0.370	2316	30.4
Kosciusko	McClures	1.4	22	108	55	0.031	2.912	0.489	0.118	0.145	4251	25.4
Kosciusko	North Little	0.8	5	90	32	0.022	2.431	0.613	0.537	0.573	14162	68.6
Kosciusko	Palestine	0.8	5	92	6	0.022	2.496	0.849	0.603	0.790	27447	23.2
Kosciusko	Pke	0.8	12	112	59	0.150	1.864	1.234	0.196	0.345	9221	31.8
Kosciusko	Price	3.1	16	50	60	0.022	2.562	0.301	0.060	0.130	29499	71.4
Kosciusko	Rothenberger	1.5	36	131	46	0.022	0.018	0.791	0.008	0.045	10589	70.6
Kosciusko	Sawmill	0.8	13	88	60	0.022	1.490	0.554	0.126	0.192	18906	44.1
Kosciusko	Sechrist	2.9	29	98	49	0.022	0.684	0.285	0.043	0.066	44772	91.3
Kosciusko	Shock	4.4	44	99	27.8	0.022	1.244	0.349	0.385	0.411	21873	89.9
Kosciusko	Shoe	4.7	63	88	82	0.022	0.018	0.230	0.001	0.073	6412	71.9
Kosciusko	Stanton	5.1	61	84	100	0.022	0.018	0.597	0.004	0.016	6874	23.1
Kosciusko	Tippecanoe	1.7	40	95	54.1	0.329	0.050	0.230	0.060	0.069	7880	73.8

Table 20. *Indiana lake water quality data: 1994 (cont.)*

COUNTY	LAKE	Secchi (m)	% Trans. @ 3 ft.	%DO Sat.	%DO Oxic	NO3 (mg/L)	NH4 (mg/L)	Org-N (mg/L)	Sol-P (mg/L)	Tot-P (mg/L)	Plankton (1000/L)	% Blue-Green
Kosciusko	Wabee	2.5	62	129	49	0.685	0.988	0.230	0.006	0.028	4084	44.5
Kosciusko	Wawasee	2.4	62	106	36.4	0.022	0.167	0.230	0.015	0.032	3126	66.5
Kosciusko	Webster	1.3	38	99	50	0.022	1.764	0.370	0.128	0.150	33825	34.5
Kosciusko	Winona	2.3	38	89	28	0.185	0.585	0.490	0.155	0.198	111776	75.1
LaGrange	Cline	1.4	43	67	100	0.592	0.175	0.344	0.002	0.025	1100	77.5
LaGrange	Dollar	2.4	25	86	100	0.030	2.258	0.900	0.154	0.226	14685	84.6
LaGrange	Eve	2.5	58	92	100	0.022	0.654	0.397	0.002	0.055	3750	40.6
LaGrange	Weir	2.3	55	58	100	0.538	0.055	0.475	0.000	0.049	1362	54.6
Noble	Axel	3.7	54	78	100	0.025	0.020	0.372	0.001	0.038	5125	40.7
Noble	Bartley	1.4	33	131	46	0.151	0.626	0.253	0.033	0.096	58401	20.1
Noble	Baugher	1.2	37	132	45	0.022	1.763	0.230	0.345	0.412	51224	63.2
Noble	Big	2.8	38	115	60	0.430	0.211	0.259	0.118	0.166	19512	69.4
Noble	Bowen	3.1	60	101	38	0.031	1.797	1.173	0.537	0.401	39347	74.9
Noble	Bristol	1.7	22	137	100	1.385	0.697	0.230	0.331	0.337	57107	67
Noble	Bushong	0.8	10	142	100	0.022	1.853	0.600	0.325	0.431	52722	95.2
Noble	Crane	1.3	25	191	100	1.015	1.309	1.328	0.665	0.534	184095	7.7
Noble	Dock	1.1	26	126	70	0.056	0.197	0.357	0.055	0.130	119183	88.7
Noble	Finster	3	45	97	100	0.022	11.248	2.434	0.530	0.674	892	25.4
Noble	Grannis	2.2	65	120	86	0.022	0.156	0.230	0.002	0.072	18855	36
Noble	Green	0.9	3	14	35	0.666	0.492	1.714	0.165	0.252	503176	2.6
Noble	Indian (Ligonier)	1.8	28	103	100	0.063	0.083	0.496	0.002	0.033	3156	7.9
Noble	Keister	1.7	26	125	100	0.022	2.890	1.387	0.529	0.555	16203	50.4

Table 20. *Indiana lake water quality data: 1994 (cont.)*

COUNTY	LAKE	Secchi (m)	% Trans. @ 3 ft.	%DO Sat.	%DO Oxic	NO3 (mg/L)	NH4 (mg/L)	Org-N (mg/L)	Sol-P (mg/L)	Tot-P (mg/L)	Plankton (1000/L)	% Blue-Green
Noble	Lindsey	1.7	37	126	35	0.451	2.601	0.319	0.424	0.502	159050	97.4
Noble	Long (Chain)	2.4	48	127	56	0.496	1.664	0.230	0.153	0.312	23372	67.9
Noble	Lower Long	3.4	35	104	34	0.022	0.835	0.230	0.128	0.268	61027	85.5
Noble	Miller (Chain)	2.2	46	81	59	0.022	0.775	0.230	0.148	0.293	266715	8.1
Noble	Mud (Chain)	2	32	37	100	0.022	3.579	0.858	0.581	0.029	67130	30.5
Noble	Muncie	1.2	37	129	52	0.500	0.784	0.230	0.016	0.087	229734	46
Noble	Norman	2.1	45	99	39	0.022	0.828	0.230	0.281	0.340	94232	50.1
Noble	Pleasant	4	45	100	34	0.022	0.219	0.242	0.123	0.155	69782	78.1
Noble	Port Mitchell	1.3	32	148	51	0.071	1.023	0.230	0.005	0.098	220508	76
Noble	Rivir (Chain)	2	40	136	48	0.041	0.769	0.230	0.328	0.378	131296	20.6
Noble	Sand (Chain)	4.4	62	99	43	0.022	0.637	0.230	0.213	0.253	17434	41.9
Noble	Silver	1.7	70	98	67	0.096	0.055	0.230	0.005	0.060	18041	72.5
Noble	Summit	2.1	33	110	100	0.022	1.072	0.230	0.352	0.403	77588	97.4
Noble	Sweet	1.5	42	130	78	0.022	0.995	0.236	0.067	0.104	5340	53.8
Noble	Upper Long	2.1	31	114	39	0.022	0.780	0.230	0.275	0.310	66333	75.2
Noble	Whitford	0.95	40	154	100	0.196	1.407	0.230	0.198	0.224	33968	67.5
Noble	Williams	1.4	37	142	34	0.345	1.297	0.283	0.312	0.375	92225	28.8
Noble	Wilmot Pond	1.8	24	53	100	0.022	0.020	0.601	0.036	0.097	11508	26.9
Whitley	Black	0.5	20	106	27	0.416	2.010	1.038	0.378	0.473	218925	76.9
Whitley	Crooked	4.5	50	103	85	0.066	0.204	0.230	0.103	0.142	7183	21.9

Table 20. *Indiana lake water quality data: 1994 (cont.)*

COUNTY	LAKE	Secchi (m)	% Trans. @ 3 ft.	%DO Sat.	%DO Oxic	NO3 (mg/L)	NH4 (mg/L)	Org-N (mg/L)	Sol-P (mg/L)	Tot-P (mg/L)	Plankton (1000/L)	% Blue-Green
Whitley	Dewart	2.3	40	108	37	0.022	0.392	0.230	0.038	0.056	7213	70.3
Whitley	Goose	1.1	34	117	22	0.022	0.856	0.230	0.273	0.324	10114	83.1
Whitley	Hammond	2	33	112	49	0.022	1.298	0.264	0.233	0.288	31822	79.3
Whitley	Larwill	1.6	43	78	22	0.022	0.979	0.486	0.139	0.166	187272	91.2
Whitley	Little Crooked	3.5	44	105	56	0.179	2.905	0.279	0.612	0.934	17892	71.8
Whitley	Little Wilson	3.4	54	74	83	0.022	0.391	0.286	0.032	0.087	14875	50.1
Whitley	Loon	1.7	47	112	22	0.022	0.573	0.345	0.195	0.251	76172	94.5
Whitley	Old	2.4	50	128	38	0.051	1.924	0.384	0.389	0.347	223667	96.7
Whitley	Spear	2.3	39	122	55	0.022	1.817	0.338	0.294	0.335	13375	50.1
Whitley	Troy Cedar	0.9	15	100	19	0.031	0.555	0.581	0.197	0.249	17668	80.5
Whitley	Wilson	3.1	45	85	67	0.022	1.025	0.230	0.177	0.197	141331	93.9

* = value not reported

Table 21. *Indiana lakes sampled in 1995*

COUNTY	LAKE	AREA (ACRES)	MAX. DEPTH (FEET)	DATE SAMPLED
Allen	Cedar Shores	7	8	no access
Allen	Cedarville Res.	245	15	8/14/95
Allen	Hurshtown Reservoir	265	35	8/14/95
Allen	St. Joseph Reservoir	30	nr	8/14/95
Boone	Boones Pond	8	28	8/21/95
Carroll	Freeman	1547	40	8/21/95
Carroll	Knop	10	20	8/21/95
Cass	France Park	20	21	8/21/95
Cass	Cicott	65	50	8/21/95
Elkhart	Boot	80	12	no acess
Elkhart	Butts	35	nr	wetland
Elkhart	Cooley	9	8	no acess
Elkhart	Dock	30	5	private
Elkhart	Goshen Pond	142	11	8/7/95
Elkhart	Heaton	87	22	7/5/95
Elkhart	Indiana	122	68	7/5/95
Elkhart	Norton	35	nr	wetland
Elkhart	Round	30	12	no acess
Elkhart	Simonton	282	24	7/5/95
Elkhart	Wolf	18	40	7/5/95
Elkhart	Yellow Creek	16	20	7/5/95
Fulton	Bruce	245	28	8/7/95
Fulton	Fletcher	45	40	8/7/95
Fulton	Kings	19	35	8/7/95
Fulton	Manitou	713	44	8/7/95
Fulton	Nyona	104	32	8/7/95
Fulton	Rock	56	12	8/21/95
Fulton	South Mud	94	20	8/21/95
Hsmilton	Clare	54	7	8/21/95
Huntington	Clair	43	54	8/14/95
Huntington	Huntington Res.	900	24	8/14/95
Huntington	Salamonie Res.	2800	60	8/14/95
Kosciusko	Beigh	40	40	7/5/95

Table 21: *Indiana Lakes Sampled in 1995 (cont.)*

COUNTY	LAKE	AREA (ACRES)	MAX. DEPTH (FEET)	DATE SAMPLED
Kosciusko	Heron	22	30	7/31/95
Kosciusko	Mud	68	45	no access
Kosciusko	Muskelonge	32	21	unable to access
Kosciusko	Silver	102	33	7/5/95
Kosciusko	Tibbetts	nr	nr	no acess
Kosciusko	Yellow Creek	151	60	7/5/95
LaGrange	Pond Lil	21	15	no access
Lake	Bingo	10	nr	no access
Lake	Cedar	781	16	7/10/95
Lake	Dalecarlia	193	8	private
Lake	Fancher	10	40	7/31/95
Lake	Hermit	21	nr	private
Lake	George (Hammond)	78	12	7/10/95
Lake	George (Hobart)	270	14	7/10/95
Lake	Redwing	75	nr	private
Lake	Wolf	385	8	7/10/95
LaPorte	Clear	17	33	7/31/95
LaPorter	Clear (Hudson)	50	nr	wetland
LaPorter	Clear (LaPorte)	106	12	7/10/95
LaPorte	Finger	50	nr	wetland
LaPorte	Fish (Lower)	134	16	7/17/95
LaPorte	Fish (Upper)	139	24	7/17/95
LaPorte	Hog	59	52	no access
LaPorte	Hudson	432	42	7/17/95
LaPorte	Hunt	50	nr	wetland
LaPorte	Lee	10	nr	private
LaPorte	Lily	16	22	7/10/95
LaPorte	Pine	564	71	7/10/95
LaPorte	Saugany	74	66	7/17/95
LaPorte	Silver	50	nr	private
LaPorte	Stone	125	36	7/10/95
LaPorte	Walton	21	12	7/10/95
Marion	Eagle Creek Res.	1510	40	8/21/95

Table 21: *Indiana Lakes Sampled in 1995 (cont.)*

COUNTY	LAKE	AREA (ACRES)	MAX. DEPTH (FEET)	DATE SAMPLED
Marshall	Cook	84	51	7/31/95
Marshall	Dixon	27	33	7/31/95
Marshall	Flat	23	24	7/31/95
Marshall	Gilbert	35	28	7/31/95
Marshall	Holem	30	28	7/31/95
Marshall	Kreighbaum	20	32	7/31/95
Marshall	Maxinkuckee	1854	88	8/7/95
Marshall	Lake of the Woods	416	48	7/24/95
Marshall	Lawrence	69	63	7/31/95
Marshall	Mill Pond	168	16	7/31/95
Marshall	Myers	96	59	7/31/95
Marshall	Pretty	97	40	7/31/95
Marshall	Thomas	16	43	7/31/95
Miami	Mississinewa Res.	3180	65	8/21/95
Newton	J. C. Murphy	1200	8	7/10/95
Noble	Millers	28	34	no access
Porter	Chestnut	11	nr	private wetland
Porter	Deep	7	7	no access
Porter	Eliza	45	21	7/10/95
Porter	Flint	89	67	7/10/95
Porter	Long	65	27	7/10/95
Porter	Loomis	62	55	7/10/95
Porter	Mink	35	24	private
Porter	Rice	38	nr	no access
Porter	Spectacle	62	5	7/31/95
Porter	Wauhob	21	48	7/31/95
St. Joseph	Bass	88	32	7/17/95
St. Joseph	Chamberlin	51	27	no access
St. Joseph	Dipper	10	6	7/24/95
St. Joseph	Kale	10	15	no access
St. Joseph	Pinhook	45	21	7/17/95
St. Joseph	Pleasant	29	39	7/17/95
St. Joseph	Riddles	77	20	7/17/95

Table 21: *Indiana Lakes Sampled in 1995 (cont.)*

COUNTY	LAKE	AREA (ACRES)	MAX. DEPTH (FEET)	DATE SAMPLED
St. Joseph	Rupel	25	18	private
St. Joseph	Sously	40	19	no access
St. Joseph	South Clear	51	15	wetland
St. Joseph	Worster	327	25	7/17/95
Starke	Bass	1345	30	8/7/95
Starke	Hartz	28	31	8/7/95
Starke	Langenbaum	48	19	8/7/95
Starke	Round	30	15	no access
Starke	Skitz	140	6	wetland
Steuben	Tamarack	47	14	9/7/95
Wabash	Hominy Ridge	11	16	8/14/95
White	Shaffer	1281	30	8/21/95
Whitley	Big Cedar	144	75	8/14/95
Whitley	Blue	239	43	8/14/95
Whitley	Little Cedar	45	62	8/14/95
Whitley	Round	131	63	8/14/95
Whitley	Shriner	120	74	8/14/95

nr - value was not reported

Table 22. *Trophic state and lake classification results of the 1994 Indiana lake survey*

COUNTY	LAKE	AREA (acres)	MAX. DEPTH (feet)	TSI (LAKE CLASS) c. 1975	TSI (LAKE CLASS) c. 1985	TSI (LAKE CLASS) c. 1990	TSI (LAKE CLASS) 1994
Dekalb	Dunten	21	28				37 (II)
Dekalb	Indian	56	55			24 (I)	28 (II)
Dekalb	Lower Story	77	26	60 (III)		24 (I)	31 (II)
Dekalb	Upper Story	nr	30				26 (II)
Dekalb	Wiley	9	44				28 (II)
Fulton	Lukens	nr	41				28 (II)
Kosciusko	Allen	nr	46				33 (II)
Kosciusko	Backwater	nr	5				17 (I)
Kosciusko	Banning	12	14			10 (I)	24 (I)
Kosciusko	Barrel & ½	7	46	46 (II)			38 (II)
Kosciusko	Beaver Dam	146	60	56 (III)			39 (II)
Kosciusko	Big Barbee	296	41	38 (II)		35 (II)	39 (II)
Kosciusko	Big Chapman	415	33	18 (I)			5 (I)
Kosciusko	Black Pond	nr	3				26 (II)
Kosciusko	Boner	40	20	43 (II)		8 (I)	17 (I)
Kosciusko	Caldwell	45	23	46 (II)		66 (III)	43 (II)
Kosciusko	Carr	64	34	50 (II)		36 (II)	48 (II)
Kosciusko	Center	120	40	31 (II)		23 (I)	16 (I)
Kosciusko	Crystal	76	38	10 (I)		25 (I)	9 (I)
Kosciusko	Goose	27	44	15 (I)			30 (II)
Kosciusko	Hill	67	31	31 (II)			26 (II)
Kosciusko	Hoffman	187	32	23 (I)		36 (II)	26 (II)
Kosciusko	Irish	143	34	45 (II)		33 (II)	36 (II)
Kosciusko	James	267	55	39 (II)		40 (II)	32 (II)
Kosciusko	Kiser	nr	18				14 (I)
Kosciusko	Kuhn	118	23	15 (I)		24 (I)	30 (II)
Kosciusko	Little Barbee	68	23	56 (III)		40 (II)	38 (II)
Kosciusko	Little Chapman	120	29	25 (II)		24 (I)	26 (II)
Kosciusko	Little Pike	25	10	31 (II)			20 (I)
Kosciusko	Long	nr	26				25 (I)
Kosciusko	Loon	40	39	52 (III)		31 (II)	27 (II)
Kosciusko	McClures	32	27	51 (III)		32 (II)	23 (I)
Kosciusko	North Little	12	26		52 (III)	43 (II)	39 (II)
Kosciusko	Palestine	232	25		55 (III)		32 (II)
Kosciusko	Pike	203	31	37 (II)	45 (II)		28 (II)
Kosciusko	Price	12	41	50 (II)		27 (II)	29 (II)

Table 22. *Trophic state and lake classification results of the 1994 Indiana lake survey (cont)*

COUNTY	LAKE	AREA (acres)	MAX. DEPTH (feet)	TSI (LAKE CLASS) c. 1975	TSI (LAKE CLASS) c. 1985	TSI (LAKE CLASS) c. 1990	TSI (LAKE CLASS) 1994
Kosciusko	Rothenberger	nr	25				44 (II)
Kosciusko	Sawmill	27	25	33 (II)		40 (II)	26 (II)
Kosciusko	Sechrist	99	57	24 (I)		27 (II)	30 (II)
Kosciusko	Shock	37	59	28 (II)		29 (II)	32 (II)
Kosciusko	Shoe	40	26	14 (I)			17 (I)
Kosciusko	Stanton	32	22	20 (I)		15 (I)	5 (I)
Kosciusko	Tippecanoe	706	115	12 (I)		22 (I)	23 (I)
Kosciusko	Wabee	117	50	60 (III)		19 (I)	13 (I)
Kosciusko	Wawasee	2618	72	16 (I)			17 (I)
Kosciusko	Webster	773	43	37 (II)		41 (II)	25 (I)
Kosciusko	Winona	447	76	56 (III)		34 (II)	40 (II)
LaGrange	Cline	20	26	9 (I)		9 (I)	21 (I)
LaGrange	Dollar	15	30				30 (II)
LaGrange	Weir	10	16	10 (I)			16 (I)
Noble	Axel	8	23				4 (I)
Noble	Bartley	34	32	35 (II)		56 (III)	27 (II)
Noble	Baugher	32	33	54 (III)		56 (III)	42 (II)
Noble	Big	228	69	38 (II)		52 (III)	27 (II)
Noble	Bowen	30	57	41 (II)		34 (II)	35 (II)
Noble	Bristol	27	52				36 (II)
Noble	Bushong	10	25				42 (II)
Noble	Crane	28	33	45 (II)		47 (II)	52 (III)
Noble	Dock	16	21	38 (II)		35 (II)	43 (II)
Noble	Finster	nr	44				19 (I)
Noble	Grannis	nr	21				10 (I)
Noble	Green	5	16				52 (III)
Noble	Indian (Ligonier)	5	13				6 (I)
Noble	Keister	12	24				34 (II)
Noble	Lindsey	12	33				52 (III)
Noble	Long (Chain)	40	32	33 (II)		41 (II)	33 (II)
Noble	Lower Long	66	52	32 (II)		34 (II)	36 (II)
Noble	Miller (Chain)	11	7	35 (II)			35 (II)
Noble	Mud (Chain)	8	26				23 (I)
Noble	Muncie	47	22	46 (II)			41 (II)
Noble	Norman	14	38	39 (II)		26 (II)	37 (II)
Noble	Pleasant	20	62	29 (II)			32 (II)

Table 22. *Trophic state and lake classification results of the 1994 Indiana lake survey (cont)*

COUNTY	LAKE	AREA (acres)	MAX. DEPTH (feet)	TSI (LAKE CLASS) c. 1975	TSI (LAKE CLASS) c. 1985	TSI (LAKE CLASS) c. 1990	TSI (LAKE CLASS) 1994
Noble	Port Mitchell	15	29	30 (II)		55 (III)	51 (III)
Noble	Rivir (Chain)	24	31	38 (II)		32 (II)	35 (II)
Noble	Sand (Chain)	47	49	23 (I)		16 (I)	19 (I)
Noble	Silver	34	17				19 (I)
Noble	Summit	18	39				35 (II)
Noble	Sweet	20	19				32 (II)
Noble	Upper Long	86	54	32 (II)		31 (II)	37 (II)
Noble	Whitford	nr	27				38 (II)
Noble	Williams	46	44			63 (III)	38 (II)
Noble	Wilmot Pond	16	11				12 (I)
Whitley	Black	24	39				61 (III)
Whitley	Dewart	358	84				22 (I)
Whitley	Goose	84	68	61 (III)		40 (II)	37 (II)
Whitley	Hammond	5	30				32 (II)
Whitley	Larwill	10	37				46 (II)
Whitley	Little Crooked	nr	50	32 (II)		56 (III)	30 (II)
Whitley	Little Wilson	nr	30				19 (I)
Whitley	Loon	222	82	46 (II)			36 (II)
Whitley	Old	32	39	48 (II)		55 (III)	50 (II)
Whitley	Spear	18	39				31 (II)
Whitley	Troy Cedar	93	80	60 (III)		34 (II)	37 (II)
Whitley	Wilson	29	27				39 (II)

Note: Area and Depth results were originally reported in metric units
(nr = not reported)

surveys. Note that not all of the 1994 lakes were included in the earlier surveys. The distribution of lake classes varies little through the years; with the exception of the 1985 survey which had only three lakes in common with the 1994 survey. There seems to be little variation between the means of the trophic scores for the 1975, 1990, and 1994 surveys; which are 36, 34, and 30, respectively. Data will need to be collected more often during each summer stratification season, or more consistently over several seasons, to validly determine if lake water quality in Indiana remains unchanged or is actually improving.

Note in Table 22 that a lake can switch classes with very little change in trophic score. Conversely, a large swing in trophic score may not result in a shift of lake class for a particular lake. This relates back to the demarcation lines being drawn, necessarily, through the rather gray areas between lake classes. Relatively large swings in lake trophic scores in the intermediate surveys could be indicative of some anomaly during those sampling events, such as unusually heavy rainfall or plankton blooms. As stated above, insufficient data is available at this time to conduct trend analyses of these lakes.

The IDEM embarked on a new, watershed-based monitoring of its rivers and streams early in 1996. This should allow for better assessment of the impacts of nonpoint, as well as point, source pollution problems. It will be interesting in the future to analyze lake trophic data in light of other surface water information for a given watershed.

During 1994 and 1995, the Volunteer Lake Monitoring Program marked its sixth and seventh years as part of the Indiana Clean Lakes Program. Each volunteer monitor was equipped and trained to measure Secchi disk transparencies at their lake as a low-cost, high-volume lake monitoring tool. In addition to contributing useful information to assist in monitoring the longterm trends of lake water quality, the Volunteer Lake Monitoring Program also provides information to volunteers about lake science, and helps to promote a sense of direct citizen involvement with lake management issues.

Secchi disk measurement of water transparency can assist in evaluating lake water quality. The transparency of natural waters is decreased by suspended sediments and organic matter, such as algae, in the water column. While the Secchi disk technique alone cannot distinguish among the potential causes of low transparencies, the data suggest that lakes with highly variable transparencies have been affected by sudden, transient events, as indicated earlier. Management efforts at these lakes may be more successful in identifying and correcting the specific problem causing low transparencies.

A total of 75 lakes were monitored by volunteers during the 1994 summer season. In 1995 the number of lakes being monitored increased to 83 lakes. Seven new lakes were recruited into the volunteer monitoring program in 1994, with nine more joining in 1995. Volunteers at two lakes in 1994, and five in 1995, also returned to the program after lengthy absences. A total of sixteen lakes have maintained a consistently active volunteer in the program since its inception I 1989. With the need for lake and watershed information and the demands placed on agency budgets always on the rise, the role of volunteer monitors in environmental protection is as crucial as ever.

Table 23 shows the results of Secchi disk monitoring for 1994 and 1995. Included are the maximum and minimum Secchi disk measurements, plus the July-August average transparencies. Calculating a July-August average is preferable to an annual average because these readings are taken during the summer stratification period, when water transparency is likely to be at its worst due to higher concentrations of suspended organic and inorganic matter.

Also included in Table 23 is the water clarity category into which each lake fell. The Secchi depth ranges for these four categories, used in the U.S. EPA's National Eutrophication Survey, are as follows: very poor (3 ft. or less); poor (3 - 6.5 ft.); good (6.5 -13 ft.); and very good (>13 ft.). These data indicate what the most consistent transparency readings were from May to October for each Lake. In 1994, 53% of the lakes monitored were in either the good or very good categories, and 37% wee classified as either poor or very poor. Insufficient information was available to accurately determine the water clarity category for the remaining 10% of the lakes sampled in 1994. In 1995, the occurrence of lakes in the good or very good categories dropped to 40%, while 43% were classified as poor to very poor. Unfortunately, 14 (17%) of the lakes monitored in 1995 could not be classified due to insufficient data. Of these lakes, five were new to the program and three had rejoined the program following a period of inactivity. With encouragement, training, and feedback volunteer monitoring efforts at these lakes should be more successful in subsequent years.

In 1994, Saugany Lake (21.17ft.), Yellowwood Lake (19.06 ft.), and Clear Lake, Steuben Co. (18.50 ft.) Showed the greatest (best) Secchi disk transparencies for the July/August mean. Conversely, Lake of the Woods, Marshall Co. (1.88 ft.) Had the lowest (worst) transparency. Saugany Lake (21.6 ft.) Again had the greatest transparency in 1995, with Clear Lake, Steuben Co. (19.0 ft.) Not far behind. Little Pike Lake (1.5 ft.) And Pike Lake (1.8 ft.), both I Kosciusko co., had the lowest July/August average transparencies for 1995.

The volunteer monitoring program was expanded in 1992 to include the collection of phosporous and chlorphyll samples on some of the lakes. Volunteers collected samples for the expanded program on 24 lakes in 1994 and 27 lakes in 1995. Table 24 summarizes these results using the July/August mean values.

In 1994 Goose Lake had the highest mean total phosphorous (TP) concentration, 102.0 parts per billion (ppb). Lemon Lake had the lowest mean TP at 16.1 ppb. The highest mean TP value in 1995 was 85.3 ppb at Little Pike Lake. Chapman Lake had the lowest mean TP concentration at 9.0 ppb. Overall, the sampled lakes showed a net decrease in mean TP. The largest decrease (-53.9 ppb) occurred at Goose Lake. While most lakes reflected the overall decrease, a few showed an increase in mean TP during this two-year period. The greatest such increase (43.9 ppb) occurred at Lake Lemon.

Table 23. *1994-95 summary results - volunteer secchi monitoring program*

COUNTY	LAKE	YEAR	ANNUAL MAX. (FEET)	ANNUAL MIN. (FEET)	JUL/AUG MEAN (FEET)	NUMBER OF OBSERV.	WATER CLARITY (MAY-OCT)
Brown	Yellowwood	1994 1995	21.25 14.8	10.50 4.8	19.06 12.8	7 5	very good good
Carroll	Freeman	1995	2.8	2.3	2.6	4	very poor
Daviess	Dogwood	1994	10.80	7.00	7.38	7	good
Dekalb	Indian	1994	7.20	7.10	7.15	3	good
Elkhart	Heaton	1994	13.25	10.50	na	2	na
Elkhart	Indiana	1994 1995	22.00 20.5	10.50 8.5	15.21 9.9	18 15	very good very good
Elkhart	Simonton	1995	6.5	6.5	na	1	na
Fulton	Manitou	1994 1995	6.00 5.5	3.00 3.0	4.50 3.2	3 8	poor poor*
Fulton	Millark Mill Pond	1994 1995	4.00 3.3	2.50 2.6	3.25 3.0	7 6	poor very poor
Fulton	Mt. Zion Mill Pond	1994 1995	6.75 6.5	4.00 3.5	5.92 4.9	6 6	poor poor
Fulton	Nyona	1994 1995	4.20 7.5	2.60 2.0	3.51 2.6	14 19	poor poor
Henry	Summit	1994 1995	15.25 15.0	7.50 7.0	12.50 13.6	9 8	very good good
Kosciusko	Banning	1994 1995	9.25 9.5	3.50 4.0	4.25 4.7	7 10	poor poor
Kosciusko	Big Barbee	1995	4.0	2.3	2.9	6	very poor
Kosciusko	Caldwell	1994 1995	8.50 8.3	1.75 2.5	4.30 3.9	12 18	good poor
Kosciusko	Center	1994 1995	9.75 12.0	3.75 4.5	6.45 5.3	12 11	poor poor
Kosciusko	Chapman	1994 1995	13.00 12.0	8.00 8.00	8.50 9.1	11 6	good good
Kosciusko	Dewart	1994 1995	15.50 20.8	8.50 8.0	10.00 9.3	10 11	good good
Kosciusko	Irish	1994 1995	8.50 8.0	83.25 3.0	na 3.4	5 10	good poor
Kosciukso	Kuhn	1995	11.0	6.0	8.0	6	good
Kosciusko	Little Barbee	1994 1995	6.75 6.8	4.50 2.5	5.8 2.9	3 8	poor poor
Kosciusko	Little Pike	1994 1995	3.50 3.0	1.75 1.0	2.25 1.5	10 11	very poor very poor

Table 23. *1994-95 summary results - volunteer secchi monitoring program (cont.)*

COUNTY	LAKE	YEAR	ANNUAL MAX. (FEET)	ANNUAL MIN. (FEET)	JUL/AUG MEAN (FEET)	NUMBER OF OBSERV.	WATER CLARITY (MAY-OCT)
Kosciukso	Pike	1994 1995	4.8 3.0	2.0 1.3	2.5 1.8	10 11	very poor very poor
Kosciusko	Sawmill	1995	4.8	3.0	na	2	na
Kosciusko	Sechrist	1995	10.3	7.0	na	2	na
Kosciusko	Stanton	1994 1995	19.00 15.0	10.50 11.5	14.89 12.6	17 12	very good good
Kosciusko	Tippecanoe	1994 1995	13.50 13.8	4.50 3.5	5.36 4.9	17 16	poor good
Kosciusko	Waubee	1995	32.5	7.0	11.4	7	good
Kosciusko	Wawasee	1994 1995	24.50 18.0	7.00 5.3	8.21 7.5	16 18	good good
Koscusko	Webster	1995	7.0	7.0	na	2	na
Kosciusko	Winona	1994 1995	8.50 6.0	3.80 3.0	4.13 3.1	9 7	poor poor
Koscuisko	Silver	1994 1995	11.00 11.0	2.00 8.0	2.50 na	6 2	very poor na
LaGrange	Big Turkey	1994 1995	12.00 9.5	3.00 2.5	3.67 3.6	10 10	poor poor
LaGrange	Big Long (NW Basin)	1994 1995	18.50 15.0	12.50 10.3	14.93 13.0	10 10	very good very good
LaGrange	Fish	1994	11.50	11.50	na	1	na
LaGrange	Lake of the Woods	1994 1995	17.0 13.0	5.0 5.8	6.9 7.5	10 7	good good
LaGrange	Little Turkey	1994 1995	12.50 3.3	2.75 2.3	3.38 2.4	5 3	poor very poor
LaGrange	Martin	1994 1995	16.00 15.0	7.25 4.5	13.00 11.9	14 17	very good good
LaGrange	Olin	1994 1995	22.50 16.3	8.00 6.0	8.90 7.3	15 17	good good
LaGrange	Oliver	1994 1995	23.25 22.3	7.00 4.8	8.20 7.3	15 17	good good
LaGrange	Royer	1994	13.00	13.00	na	1	na
Lake	George (Hammond)	1995	2.0	2.0	na	1	na
Lake	Wolf	1995	3.0	3.0	na	1	na
LaPorte	Lower Fish	1994 1995	12.00 7.0	3.75 5.0	5.8 6.4	8 5	poor poor
LaPorte	Saugany	1994 1995	23.50 25.0	18.50 18.0	21.17 21.6	6 7	very good very good

Table 23. *1994-95 summary results - volunteer secchi monitoring program (cont.)*

COUNTY	LAKE	YEAR	ANNUAL MAX. (FEET)	ANNUAL MIN. (FEET)	JUL/AUG MEAN (FEET)	NUMBER OF OBSERV.	WATER CLARITY (MAY-OCT)
Marshall	Dixon	1994 1995	5.50 6.5	3.00 3.0	3.42 3.4	10 8	poor poor
Marshall	Lake of the Woods	1994 1995	6.50 4.5	1.50 3.0	1.88 3.2	10 8	very poor poor
Marshall	Maxinkuckee	1995	11.0	7.3	7.9	6	good
Marshall	Myers	1994 1995	13.00 10.0	7.00 7.0	9.43 9.5	12 11	good good
Monroe	Griffy	1994 1995	15.00 14.3	5.50 8.3	10.50 12.7	9 5	good good
Monroe	Lemon	1994 1994	3.75 3.3	3.66 2.8	3.75 2.9	7 10	poor very poor
Monroe	Monroe (Lower Basin)	1994 1995	9.25 7.0	4.25 4.3	5.88 5.5	6 6	poor poor
Noble	Bear	1994 1995	13.25 11.8	4.25 3.0	5.13 3.6	12 10	poor poor
Noble	Big	1994 1995	14.00 12.0	4.00 5.0	6.8 6.2	16 7	good poor
Noble	Bixler	1994 1995	9.25 6.0	4.00 2.0	6.92 3.0	4 7	good* poor
Noble/Whitley	Crooked	1994 1995	27.50 14.5	10.50 9.5	13.60 11.5	8 7	very good good
Noble	High	1994 1995	11.25 8.3	3.25 2.0	4.46 2.3	12 10	poor very poor
Noble	Little Long	1994	8.50	5.00	7.00	6	good
Noble	Long	1994 1995	8.00 6.3	8.00 2.5	na 5.2	1 6	na poor
Noble	Round	1994	8.00	5.00	7.33	6	good
Noble	Skinner	1994 1995	11.50 15.0	3.00 9.0	4.00 na	8 4	poor poor
Noble	Upper Long	1995	17.0	5.5	7.4	7	good
Porter	Big Bass	1994 1995	3.00 3.3	2.25 1.5	2.44 2.0	7 8	very poor very poor
Porter	Flint	1994 1995	13.75 10.3	9.00 4.5	9.5 8.9	4 6	good good
Porter	Wauhob	1994 1995	10.00 12.0	10.00 12.00	na na	1 1	na na
Ripley	Versailles	1995	1.5	1.5	na	1	na
Starke	Koontz	1994 1995	8.00 7.0	3.00 2.8	3.69 3.2	31 15	poor poor

Table 23. *1994-95 summary results - volunteer secchi monitoring program (cont.)*

COUNTY	LAKE	YEAR	ANNUAL MAX. (FEET)	ANNUAL MIN. (FEET)	JUL/AUG MEAN (FEET)	NUMBER OF OBSERV.	WATER CLARITY (MAY-OCT)
Steuben	Ball	1994 1995	11.60 7.0	4.00 4.0	na na	5 2	good na
Steuben	Barton	1994 1995	12.00 8.0	7.00 7.0	9.33 7.7	6 5	good good
Steuben	Bass	1995	13.5	8.0	8.2	11	good
Steuben	Big Otter	1994 1995	16.00 19.0	6.33 6.8	8.33 8.4	11 11	good good
Steuben	Clear	1994 1995	33.00 32.0	16.00 15.0	18.50 19.0	4 8	very good very good
Steuben	Golden	1994 1995	5.50 5.0	3.00 3.3	4.50 3.8	8 9	poor poor
Steuben	Hamilton	1994 1995	17.00 7.8	3.75 3.0	6.50 3.5	11 10	good poor
Steuben	Hogback	1994 1995	4.25 5.0	2.75 2.5	3.18 2.9	11 5	poor very poor
Steuben	James	1994 1995	9.13 10.8	8.13 7.8	na 8.7	2 3	na good
Steuben	Jimmerson	1994 1995	18.3 12.0	5.5 8.5	7.3 9.9	11 7	good good
Steuben	Little Otter	1994 1995	16.00 14.0	7.00 6.0	9.35 6.4	11 11	good good
Steuben	Long	1994 1995	7.00 5.5	2.60 2.5	2.85 3.0	12 8	very poor poor*
Steuben	McClish	1994 1995	22.50 18.0	5.50 5.5	16.00 10.9	11 11	very good good
Steuben	Pleasant	1995	16.3	16.3	na	1	na
Steuben	Silver	1994 1995	12.50 10.0	6.25 8.0	6.58 9.6	9 9	good good
Steuben	Snow	1995	15.0	9.0	na	4	good
Steuben	West Otter	1994 1995	9.00 19.3	4.00 4.3	4.88 6.3	4 5	good* good
Wabash	Long	1994 1995	9.00 8.3	4.00 3.5	8.15 5.2	9 8	good good
Wabash	Lukens	1994	9.00	4.60	7.15	9	good
Wells	Kunkel	1994 1995	5.25 2.3	2.30 1.8	3.50 na	8 2	poor na
Whitley	Big Cedar	1994 1995	16.00 17.00	10.00 13.0	14.00 15.5	5 6	very good very good

Table 23. *1994-95 summary results - volunteer secchi monitoring program (cont.)*

COUNTY	LAKE	YEAR	ANNUAL MAX. (FEET)	ANNUAL MIN. (FEET)	JUL/AUG MEAN (FEET)	NUMBER OF OBSERV.	WATER CLARITY (MAY-OCT)
Whtiley	Goose	1994 1995	11.00 8.0	4.00 2.5	5.00 3.9	8 7	good poor
Whitley	Little Cedar	1994 1995	10.00 9.0	4.00 6.0	7.33 na	7 2	good na
Whitley	Little Cedar	1995	8.0	5.0	6.4	7	poor
Whitley	Round	1994 1995	17.00 13.0	12.00 11.0	14.33 na	7 2	very good na

na = insufficient data
** - observations split 50/50 between two classes were reported as the better of the two*

Table 24. *Results of the expanded lake volunteer monitoring program. 1994-95.*

COUNTY	LAKE	TOT-P 1994	TOT-P 1995	TP CHANGE 94 TO 95	CHL.A 1994	CHL.A 1995	CHLA. CHANGE 94 TO 95
Elkhart	Indiana	22.8	12.0	-10.8	1.1	1.0	-0.1
Fulton	Manitou	69.5	77.8	8.3	7.6	24.7	17.1
Kosciusko	Center	40.5	25.5	-15.0	4.7	5.0	0.3
Kosciusko	Chapman	23.8	9.0	-14.8	2.6	1.8	-0.8
Kosciusko	Dewart	30.6	24.8	-5.8	3.4	3.1	-0.3
Kosciusko	Little Pike	na	85.3	na	na	53.5	na
Kosciusko	Pike	81.0	81.8	0.8	31.7	62.2	30.5
Kosciusko	Tippecanoe	30.8	60.8	30.0	4.4	4.7	0.3
Kosciusko	Wawasee	32.0	16.0	-16.0	0.5	2.5	2.0
LaGrange	Lk. Of the Wds.	85.0	50.9	-34.1	5.6	2.9	-2.7
LaGrange	Little Turkey	35.8	42.3	6.5	12.2	0.5	-11.7
LaGrange	Martin	34.0	60.5	26.5	3.0	1.8	-1.2
LaGrange	Oliver	37.0	23.0	-14.0	3.0	1.1	-1.9
Marshall	Lk. Of the Wds.	668	54.3	-12.5	24.6	1.9	-22.7
Monroe	Lemon	16.1	60.0	43.9	6.7	1.9	-4.8
Noble	Big	30.3	35.0	4.7	3.9	8.4	4.5
Noble	Crooked	32.3	18.3	-14.0	1.0	1.2	0.2
Porter	Flint	39.5	20.8	-18.7	5.1	1.9	-3.2
Starke	Koontz	67.7	43.0	-24.7	7.2	10.1	2.9
Steuben	Barton	35.5	15.7	-19.8	1.1	1.1	0
Steuben	Big Otter	24.5	20.0	-4.5	3.8	2.0	-1.8
Steuben	Hamilton	43.0	44.3	1.3	4.6	13.1	8.5
Steuben	Long	82.5	72.3	-10.2	35.4	22.7	-12.7
Steuben	McClish	35.0	20.5	-14.5	0.7	1.1	0.4
Steuben	Silver	38.0	13.3	-24.7	3.1	0.5	-2.6
Steuben	West Otter	42.3	25.7	-16.6	2.0	2.9	0.9
Whitley	Goose	102.0	48.1	-53.9	10.9	9.3	-1.6

All results are in parts per billion (ppb)

A number of factors can influence total phosphorous concentrations in lakes. Precipitation can very greatly from watershed to watershed and season to season. Intense rainfall can cause increased surface runoff, carrying soil and nutrients into lakes and resulting in higher concentrations of phosphorous and chlorophyll. New construction activities can have the same effect if proper safeguards are in place. Activities such as aquatic plant harvesting or the addition of sewers, on the other hand, can result in lower phosphorous concentrations in individual lakes.

The highest 1994 July/August mean chlorophyll a (Chl a) concentrations were 35.4 and 31.7 ppb at Long and Pike Lakes, respectively. The lowest Chl a means were 0.5 ppb at Wawasee Lake and 0.7 ppb at McClish Lake. For 1995, Pike Lake had the highest Chl a value of 62.2 ppb, and Little Turkey and Silver lakes had the lowest concentrations at 0.5 ppb each. Chlorphyll a barely shows a net decrease from 1995 to 1995. The greatest change, an increase of 30.5 ppb, occurred in Pike Lane. No change at all was observed at Barton Lake.

Chlorophyll concentrations in lakes are influenced by factors which affect algae growth including: phosphorous availability, light intensity and penetration, water temperature, and algal predation. High Chl a concentrations reflect an increase in algae, often as a direct result of increased TP concentrations. Such factors as increased turbidity from heavy runoff or boating activity may keep Chl a concentrations low, despite high TP concentrations, since high turbidity results in less light available for algae growth.

It should be noted that the three parameters collected in the volunteer monitoring program are those used in the Trophic State Index (TSI) developed by Bob Carlson in the late 1970s. This TSI--developed from statistically significant mathematical relationships between Secchi disk transparency, total phosphorous, and chlorophyll a--is widely accepted and used today. According to Carlson, five or more years of data are ideally needed to conduct trend analysis with his TSI. Results generated during the upcoming 305(b) reporting period should allow some excellent analysis of water quality trends on Indiana lakes.

BASIN INFORMATION AND SUMMARIES

Lake Michigan Basin

The Lake Michigan drainage basin includes four major waterways in Indiana: the Grand Calumet River-Indiana Harbor Ship Canal (GCR/IHC), the Little Calumet River, Trail Creek and the St. Joseph River. The first three compose what is referred to as the Lake Michigan Basin - Northwest in this report, and empty into Lake Michigan within the boundaries of Indiana (Figure 3). The St. Joseph River and its tributaries will be referred to as the Lake Michigan Basin-Northeast in this report (Figure 4). The St. Joseph River flows into Lake Michigan approximately 25 miles north (downstream) of the state line at the towns of St. Joseph-Benton Harbor, Michigan.

Five major Indiana municipalities (Michigan City, East Chicago, Gary, Hammond, and

Figure 3. *Lake Michigan basin - northwest*

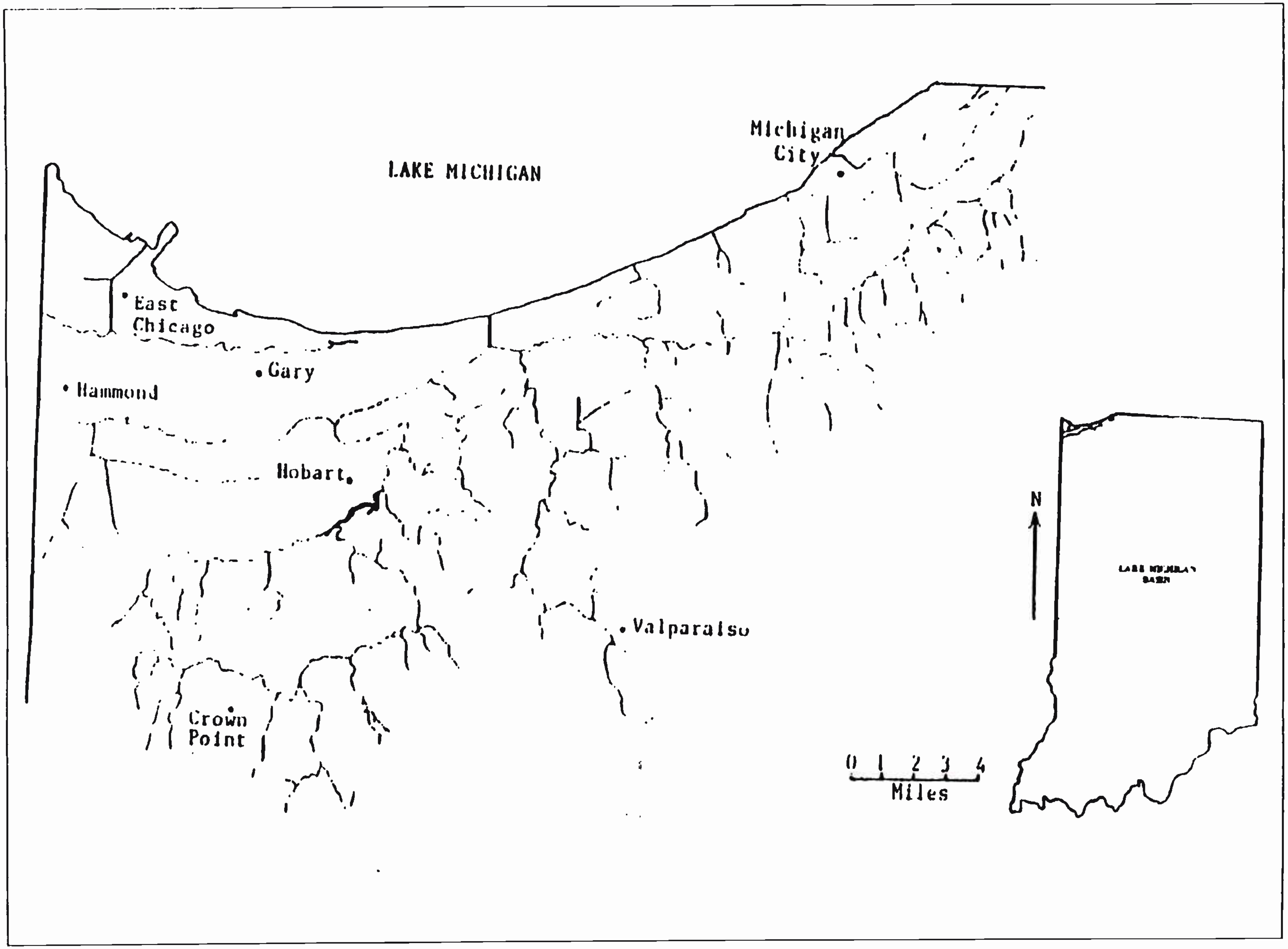
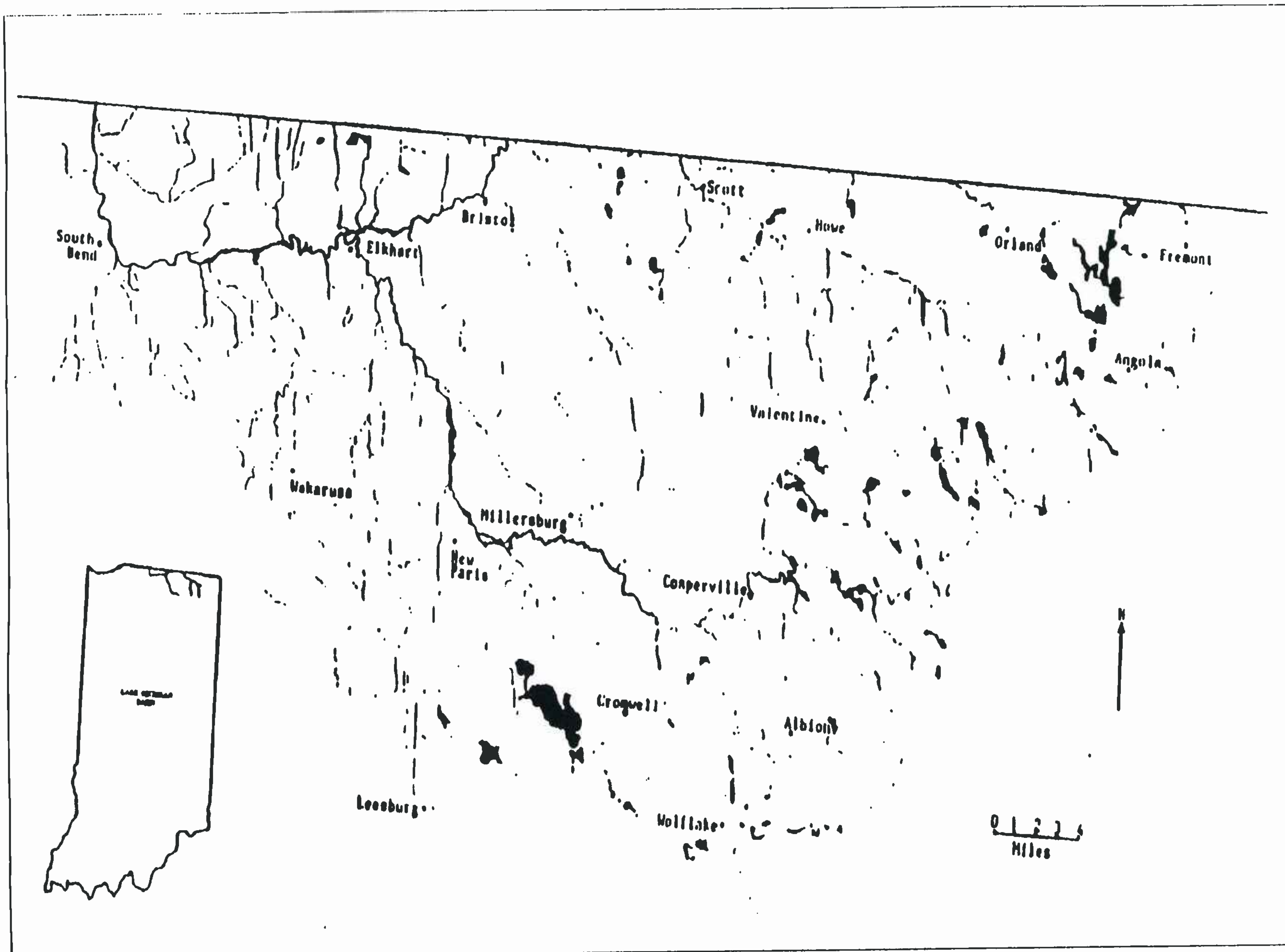


Figure 4. *Lake Michigan basin - northeast*



Whiting) use Lake Michigan for their potable water supply and several return treated municipal wastewater to the lake via a tributary. In addition, a number of industries also use the lake as a raw water source. Lake Michigan and its contiguous harbor areas have been designated for multiple uses including recreation, aquatic life, potable water supply, and industrial water supply in regulation 327 IAC 2-1. This regulation outlines the criteria and minimum standards of water quality that must be maintained in the lake.

Water quality in Lake Michigan does vary in the Indiana portion. Concentrations of substances in the nearshore zone reflect the effects of wastewater and tributary contributions from the watershed and are nearly always higher than in the "open water" lake samples.

Tissue from some species of fish in Lake Michigan has contained concentrations of contaminants in excess of FDA Action Levels since testing began in the early 1970's. Fish samples are collected for metals, pesticide and PCB analyses in the fall of each year by the Indiana Department of Natural Resources (IDNR) and analyzed by the Indiana State Department of Health (ISDH). PCBs, chlordane, dieldrin, and DDT are found in excess of their FDA Action Levels in certain sizes and species of fish on a lakewide basis although no fish collected from Indiana waters over this two-year period exceeded these levels. A revised lakewide fish consumption advisory for fishermen and consumers of these fish is issued each spring. The most current advisory is shown in Table 14. Due to this consumption advisory, Lake Michigan (43 shoreline miles) is considered only partially supportive of its fish consumption use. Recreational uses have been fully supported.

Lake Michigan Basin - Northwest

An assessment of designated aquatic life use support was made for 219 stream miles in this subbasin and 107 miles were assessed for recreational use. The waters assessed, support status, miles affected, and probable causes of impairment are shown in Table 25. Additional information for certain stream reaches is also provided. No major surveys occurred in this basin during this reporting period.

The major streams in the basin are the Grand Calumet River, Trail Creek, the Little Calumet River, and Lake Michigan tributaries, including Kintzele Ditch and the Indiana Harbor Canal. Fish tissue samples collected from four locations within this basin during 1994 (Burns Ditch, the Grand Calumet River, the Indiana Harbor Canal, and Trail Creek) exceeded the FDA Action Levels for PCB's in carp. No fish caught in the Grand Calumet River/Indiana Harbor Ship Canal should be eaten.

Trail Creek is located in LaPorte County in the northwest corner of the state and flows into Lake Michigan at Michigan City. The drainage area is 59.1 square miles, with an approximate average annual flow of 75 cfs. It is Indiana's most noted salmonid stream due to an IDNR stocking program that began in the early 1970s. It is designated for whole body contact recreation and protection of cold water fish.

Table 25. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Lake Michigan Basin - Northwest*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Coffee Creek and its Tributaries	Chesterton	NS (Aquatic Life)	Monitored (b)		10	Biological Assessment "Poor".
Coffee Creek	Chesterton	NS (Aquatic Life)	Monitored (b)	Urban Runoff	2	Biological Assessment "Poor".
Damon Run	Chesterton	NS (Aquatic Life)	monitored (b)	D.O.	7	Biological Assessment "Poor".
Upper Salt Creek	Valparaiso	NS (Aquatic Life) NS (Recreational)	Monitored (b)	D.O. E. coli	4	Valparaiso STP plans to initiate a Land Application Program. Salmonid Stream.
Lower Salt Creek	McCool Portage	NS (Aquatic Life) NS (recreational)	Monitored (b) (c)	D.O. E. coli	4	Biological Assessment "Poor"
Sager Creek	Valparaiso	NS (Aquatic Life)	Monitored (b)		2	Biological Assessment "Very Poor".
Dunes Creek	Tremont	NS (Aquatic Life)	Monitored (b)	Channelization E. coli	5	Biological Assessment "Poor".
Kintzele Ditch and its Tributaries	Michigan City	FS (Aquatic Life)	Evaluated	Channelization PCB's Pesticides	5	
Upper Trail Creek and its Tributaries	Michigan City	NS NS(Recreational)	Monitored (c)	E. coli PCB's Agricultural Run-Off Pesticides Cyanide	42	
Lower Trail Creek	Michigan City	NS(Recreational)	Monitored (c)	E. coli PCB's Pesticides Cyanide	3	Michigan City STP effluent, discharged into Trail Creek, is clear and Bluegill, Large-mouth Bass, Steelhead, and Chinook are observed in outfall. Trail Creek water quality reflects improvements in waste-water treatment.
Willow Creek	Michigan City	NS(Aquatic Life)	Monitored (b)		3.7	Biological Assessment "Poor".

Table 25. *Water assessed, status of designated use support, probable causes of impairment and miles affected in the Lake Michigan Basin - NW (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Galena River and its Tributaries	Heston Lalimere	FS(Aquatic Life)	Evaluated		13	
Burns Ditch	Lake Station Portage	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli PCB's Pesticides	8	a) Well operated facility. Some bypassing during wet weather. Portage and IDEM working on alternatives to bypassing. b) Burns Harbor developing an operational control program to eliminate violations to NIPSCO facility. c) Biological Assessment "Poor".
Little Calumet River	Gary	NS(Aquatic Life) NS(Recreational)	Monitored (b) (c)	Cyanide PCB's E. coli Pesticides	7	
Little Calumet River	Porter Chesterton	NS(Aquatic Life) NS(Recreational)	Monitored (b) (c)	E. coli PCB's Cyanide Pesticides	6	
Little Calumet River	Hammond	NS(Aquatic Life) NS(Recreational)	Monitored (b) ©	E. coli PCB's Cyanide Pesticides	10	CSO problems occasionally.
Unnamed Trib of Little Calumet River	Pine	FS(Aquatic Life)	Monitored (b)		3	Biological Assessment "Fair".
Kemper Ditch	Pine	NS(Aquatic Life)	Monitored (b)		3.4	Biological Assessment, "Poor".
Deep River	Hobart	NS(Aquatic Life)	Monitored (b)	Run-off Hobart POTW Poor Habitat	4	Biological Assessment, "Poor".
Deep River	Lake Station	NS(Aquatic Life)	Monitored (b)	Sewage	4	Severe bypassing. Biological Assessment, "Poor".

1994 - 95

Table 25. *Water assessed, status of designated use support, probable causes of impairment and miles affected in the Lake Michigan Basin - NW (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Deer Creek	Merrillville	NS(Aquatic Life)	Monitored (b)		4	Biological Assessment, "Poor".
Turkey Creek	Hobart	NS(Aquatic Life)	Monitored (b)	D.O. Run-off Channelization	10	
Indiana Harbor Canal	Whiting E. Chicago	NS (Aquatic Life) NS(Recreational)	Monitored (b) (c)	PCB Pesticides D.O. Mercury E. coli	4	a) Biological Assessment, "Very Poor"
Lake George Branch of Indiana Harbor Canal	East Chicago	NS (Aquatic Life) NS(Recreational)	Monitored (c)	Oil & Grease E. coli PCB's D.O. Pesticides	1	a) Multiple Sources b) Oil Leachate from Amoco Oil and ECI property.
Turkey Creek	Hobart	NS(Aquatic Life)	Monitored (b)	D.O. Run-off Channelization	10	
E. Branch Grand Calumet River	Gary East Chicago	NS(Aquatic Life) NS(Recreational)	Monitored (b) (c)	Oil & Grease E. coli Lead Cyanide PCB Pesticides	10	a) Biological Assessment, "Very Poor"
W. Branch Grand Calumet River	Hammond East Chicago	NS(Aquatic Life) NS(Recreational)	Monitored (b) (c)	E. coli D.O. Cyanide PCB's Lead Ammonia CSO's Pesticides	3	a) The Hammond Sanitary District has caused severe degradation of the river in the past. b) Biological Assessment, "Poor".

Table 25. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Lake Michigan Basin - NW (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Plum Creek	Dyer	FS(Aquatic Life)	Evaluated		4	
Hart Ditch	Munster Highland	FS(Aquatic Life)	Evaluated		2	
Dyer Ditch	Dyer	NS(Aquatic Life)	Monitored (b)	Ammonia	2	a) New facility in chronic violation of NPDES TSS criteria. b) Biological Assessment, "Very Poor".
Kaiser Ditch	Lincoln Village	FS(Aquatic Life)	Evaluated		1	
Beaver Dam Ditch	Crown Point	NS(Aquatic Life)	Monitored (b)	Poor Habitat D.O.	7	Biological Assessment, "Very Poor".
Niles Ditch	Crown Point	NS(Aquatic Life)	Monitored (b)	D.O.	5.6	Biological Assessment, "Poor".
Carver Ditch	Pine	NS(Aquatic Life)	Monitored (b)		3.0	Biological Assessment, "Poor".
Reynolds Creek	Pine	FS(Aquatic Life)	Monitored (b)		1	Biological Assessment, "Fair".
Reynolds Creek	LaPorte	NS(Aquatic Life)	Monitored (b)		2	Biological Assessment, "Poor".
Sand Creek	Chesterton	NS(Aquatic Life)	Monitored (b)		4.5	Biological Assessment, "Poor".

FS = Fully Supported; PS = Partially Supported; NS = Not Supported. If a use is not listed, it was not monitored or evaluated
b = Biological; c = Chemical.

Historically, many water quality problems have been associated with Trail Creek. Inadequately treated sewage, combined sewer overflows (CSOs), industrial discharges and chemical spills have contributed to its poor condition and resulted in periodic fish kills. In 1986 and 1987, four fish kills occurred due to low dissolved oxygen, high temperature, and ammonia. No fish kills, however, were reported from 1988 through 1995. Significant modifications to the Michigan City sewage treatment plant (STP) were recently completed to prevent the plant from discharging raw or inadequately treated waste water into Trail Creek. The Michigan City sanitary District has plugged many CSOs and has built a storage basin for stormwater which will reduce the amount of raw sewage entering Trail Creek.

Because Trail Creek is designated as a salmonid stream, a more stringent set of water quality standards applies than for general use streams. None of the stations monitored during 1995 showed any violations of the dissolved oxygen criteria. Cyanide concentrations above the chronic aquatic criteria were found in 14% of the samples taken at Michigan City. Chlordane, dieldrin, and DDT are still found in some fish tissue samples collected in Trail Creek as a result of past agricultural use. The E. coli bacteria criteria were violated often enough during 1990-95 that the designated recreational uses were not supported. No violations of unionized ammonia standards occurred during this five-year period. Temperature criteria are lower than background or ambient temperatures much of the time.

The Little Calumet River flows through Lake and Porter counties in northwest Indiana. This river basin is a highly populated urban area. The steel industry is the major economic provider in the basin, with the large plant of Bethlehem Steel the most visible. Supportive industries and the population base that subsequently developed encompass most of the watershed. Urban runoff, combined sewer overflows, and municipal and industrial wastewater effluents are common, especially in the West Branch of the Little Calumet River.

A portion of the West Branch of the Little Calumet River drains to Lake Michigan via Burns Ditch, while a flow divide near Griffith directs a portion of the flow into Illinois and eventually to the Illinois River. Deep River is the major tributary to the portion of the West Branch that drains to Lake Michigan. The section that flows into Illinois includes Hart Ditch.

Samples from the portion of the Little Calumet River that flows west into Illinois have shown violations of water quality standards for a number of years. Poor treatment at Schereville and Dyer, as well as CSOs from Hammond, provided major problems in this reach. Dissolved oxygen (D.O.) violations at the fixed water quality station at Holman Avenue have gone from less than 4.0 mg/L more than 50% of the time during 1984-85 to fewer violations in 1988-89 and none in the 1990 to 1993 period. However, during 1994-1995 dissolved oxygen violations were found in 42% of the seven samples taken. Cyanide was found at levels above the chronic criterion in 33% of the samples during 1994-95 in this portion of the river. This portion of the Little Calumet River is not supportive of the aquatic life use, due to frequent high cyanide concentrations and low dissolved oxygen. Whole body contact recreational uses were also not supported due to high E. coli counts in 75% of the samples taken.

In the past, the Dyer sewage treatment plant was experiencing some bypassing to Plum Creek (Hart Ditch). The bypassing was due to excessive rainfall-induced flow which backed up the treatment facility and threatened property damage. As of December 1993, plant construction plans included changes to the design flow which will be increased from 1.5 to 1.8 mgd with peak flow of 5.0 mgd. This project, completed in February 1994, should alleviate the exceedances for TSS and TBOD. The Dyer facility and IDEM have entered into an Agreed Order to limit TSS parameters and this facility will be under increased scrutiny.

The East Branch of the Little Calumet River and its tributaries drain the cities of Porter, Chesterton and Valparaiso in Porter County. This portion of the Little Calumet River and Salt Creek are designated as salmonid streams.

Salt Creek receives the effluent of the Valparaiso sewage treatment facility. Chronic violations of the Facility's NPDES permit in the past have caused poor water quality in this salmonid stream. Bacteriological standards were exceeded often enough that the stream does not support the recreational use designation. Additionally, recent fish community sampling indicates that the biological integrity of Salt Creek is poor due to dissolved oxygen. These results cause the stream to be considered non supportive of the aquatic life use.

Improved water quality in Beaver Dam Ditch and Deep River is partly attributable to the improvements at the treatment plant in Crown Point. Current ammonia levels have been low. Regionalization of the Hobart wastewater treatment plant with Gary has been completed, and the elimination of this discharge to Deep River has further improved water quality in this stream. The biological integrity of Deep River is poor, however, based on fish community sampling.

Sewage related problems exist in the Little Calumet River in the Black Oak area of Gary, which is served by antiquated sewers. These sewers frequently discharge raw sewage to the Little Calumet River.

A fish community sampling survey conducted in 1990 on Burns Ditch produced a "poor" Index of Biotic Integrity score, also indicating non support of aquatic life uses due in part to past wastewater discharges from local steel industries and traces of pesticides found in the water.

The Grand Calumet River (GCR) in Lake County consists of an East and West Branch, with the two branches meeting to form the Indiana Harbor Ship Canal (IHSC). The East Branch originates in Gary at the outlet of the Marquette Park Lagoons just upstream from the outfalls of the U.S.X. Corporation mill. It flows west and empties into Lake Michigan via the Indiana Harbor Ship Canal. The west portion, like the Little Calumet River, flows both east and west, with the divide located just west of Indianapolis Boulevard. The western flow into Illinois eventually reaches the Illinois River Basin and the Mississippi River.

The Grand Calumet River Basin is small, but includes some of the most industrialized and populated areas of the state. While problems have existed in these waters for many years, some past pollutant problems have been resolved, and the concentrations of many substances have been reduced even though criteria violations still occasionally occur. A summary of environmental problems affecting this area of concern is found in Table 26.

As a result of these water quality problems and the designation of this area as a Class A Area of Concern (AOC) by the IJC, a concerted effort was begun to address these problems. The "Master Plan for Improving Water Quality in the Grand Calumet River and Indiana Harbor Canal" was prepared in 1985 by the U.S. EPA with cooperation from the State of Indiana. The Master Plan calls for programs which will focus U.S. EPA and State of Indiana water quality control efforts on problems related to these streams. These programs include tightening NPDES permit limits, pretreatment program development and compliance actions (both municipal and industrial) to ensure that permit limits are met. Longer term investigations to evaluate the effectiveness of existing and new control programs for enhancing water quality conditions in the GCR/IHC system will be conducted. A status report on the implementation of this plan was issued in 1986. Intensive biological and sediment sampling was conducted in 1986, 1987 and 1988, and sampling of effluents and surface waters in the GCR was done in 1988.

In order to address the more widespread environmental concerns of this area, the Indiana Department of Environmental Management (IDEM) and the Region 5 U.S. EPA decided to expand the scope of the original "Master Plan" to include air quality and solid and hazardous waste issues as well as water quality. In 1986, a draft titled "Northwest Indiana Environmental Action Plan" (EAP) was prepared.

As a result of the designation of this area as a Great Lakes AOC, a Remedial Action Plan (RAP) was needed to address the water quality, aquatic habitat, and use impairment issues of the nearshore area of Lake Michigan.

The Indiana Department of Environmental Management (IDEM) is responsible for the coordination of this Remedial Action Plan (RAP). The RAP must address the impairments to the 14 beneficial uses of the surface waters of the AOC as defined by the International Joint Commission (IJC). IDEM confirmed all of these uses are considered impaired in the Grand Calumet River/Indiana Harbor ship Canal and its surrounding ecosystem in the RAP Stage I document published in 1991. All impairments must be addressed in a written and IJC approved Stage II Remedial Action Plan document. The 14 beneficial use impairments are as follows:

1) Restrictions on fish and wildlife consumption;
2) Tainting of fish and wildlife flavor;
3) Degradation of fish and wildlife population;
4) Fish tumors or other deformities;
5) Bird or animal deformities or reproduction problems;
6) Degradation of benthos;
7) Restrictions on dredging activities;
8) Eutrophication or undesirable algae;

Table 26. *Summary of environmental problems affecting the Indiana Harbor and Canal, the Grand Calumet River and the Nearshore Lake Michigan area of concern*

IMPAIRED USE EVALUATION	EXISTING CONDITIONS	SOURCE OF CAUSE OF THE PROBLEM
i) Restriction on Fish and Wildlife Consumption Use impairment confirmed	No fish should be eaten from the Grand Calumet River or the Indiana Harbor and Canal. In Lake Michigan, Brown Trout and Lake Trout over 23", Chinook over 32", Catfish and Carp should not be eaten. Chinook Salmon over 21", Lake Trout between 20 to 23 inches, Coho Salmon over 26 and Brown Trout up to 23" should not be eaten by children age 15 or under, pregnant women. women who may be pregnant, or nursing mothers. All others should limit their consumption to one meal per week. No known restriction on wildlife consumption.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination
ii) Tainting of fish and wildlife flavor Use impairment confirmed	IDEM staff have identified degraded fish populations. Tainting of the fish has occurred.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination
iii) Degradation of fish and wildlife populations Use of impairment confirmed	Extremely pollution tolerant forms of fish such as Carp and Oligochaetes are dominant. There is a lack of a stable fish community in the river and harbor. As of yet, wildlife surveys have not been conducted.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination

Table 26. *Summary of environmental problems affecting the Indiana Harbor and Canal, the Grand Calumet River and the Nearshore Lake Michigan area of concern (cont.)*

IMPAIRED USE EVALUATION	EXISTING CONDITIONS	SOURCE OF CAUSE OF THE PROBLEM
iv) Fish tumors or other deformities Use impairment confirmed	IDEM Environmental scientist have discovered river and canal carp (bottom dwellers) with eroded fins, swollen eyes, swollen abdomens, deformed lower jaws and bloody fins. The bloody fins may be caused by internal hemorrhage.	- Contaminated Sediments - Input from Industries
v) Bird or animal deformities or reproduction problems Use impairment likely	The U.S. Fish and Wildlife will be conducting wildlife studies in this area in the near future. Great Lakes Studies have found deformities in migratory birds. The area of concern has been migratory species. Although it is not known if these birds were contaminated in this areas, bird and animal deformities or reproduction problems are likely.	- Toxics - Contaminated Fish Tissue - Degraded Water Quality - Contaminated Sediments - Combined Sewer Overflows - Input - Urban Runoff - Groundwater - Air Toxics
vi) Degradation of Benthos Use impairment confirmed	A sampling of benthic organisms showed that only sludge worms inhabited the Indiana Harbor, suggesting that severe pollution exist. Studies concluded that sediments were toxic or avoided by other benthic organisms.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination
vii) Restrictions on dredging activities Use impairment confirmed	Due to the concern of contaminated sediments and the disposal concerns, no dredging activities have occurred in several years.	- Contaminated Sediments

Table 26. *Summary of environmental problems affecting the Indiana Harbor and Canal, the Grand Calumet River and the Nearshore Lake Michigan area of concern (cont.)*

IMPAIRED USE EVALUATION	EXISTING CONDITIONS	SOURCE OF CAUSE OF THE PROBLEM
viii) Eutrophibication or undesirable algae Use impairment confirmed	Species of diatoms, which favor eutrophic conditions, have increased in abundance in the nearshore Lake Michigan waters. The waters of the Grand Calumet River and the Indiana Harbor and Canal have persistent water quality problems leave in and the near shore Lake Michigan and the river and the harbor have decreased water clarity.	- Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities
ix) Restrictions on drinking water consumption, or taste and odor problems Use impairment likely	The area of concern is serviced by public drinking water supply from Lake Michigan waters. There appears to be no public safety problems with this water. The CARE committee anonymously voted that there were restrictions with drinking water from the Grand Calumet River and the Indiana Harbor, although this is not a public water supply.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination
x) Beach Closings Use impairment confirmed	Due to poor water quality, swimming is not recommended in the river or canal. Along the nearshore waters of Lake Michigan, the Hammond beach has been closed for several years. In 1990, Chicago beaches and the Indiana Dunes National Lakeshore were closed due to high coliform counts, but the source may be or may not have been from the area of concern.	- Combined Sewer Overflows
xi) Degradation of astheti Use impairment confirmed	Debris litter the Banks of the Grand Calumet River and the Canal. The banks of the harbor appear to be saturated with petroleum. The river and the harbor often have an oily sheen. The nearshore Lake Michigan waters often appear murky.	- Contaminated Sewer Overflows - Groundwater Contamination - Spills

Table 26. *Summary of environmental problems affecting the Indiana Harbor and Canal, the Grand Calumet River and the Nearshore Lake Michigan area of concern (cont.)*

IMPAIRED USE EVALUATION	EXISTING CONDITIONS	SOURCE OF CAUSE OF THE PROBLEM
xii) Added cost to agriculture or industry Use impairment confirmed	Due to the accumulation of sediments in the harbor, and restrictions for removal of the sediment due to environmental concerns, industry reports shipping capacity is reduced by 15% and therefore has a substantial increase in shipping cost.	- Contaminated Sediments
xiii) Degradation of phytoplakton and zooplankton populations Use impairment confirmed	The lack of suitable habitat results in a scarcity of aquatic and terrestrial organisms associated with the Grand Calumet River and the Indiana Harbor Canal. Phytoplaton counts are very low in the Nearshore Lake Michigan waters in the area of concern.	- Contaminated Sediments - Industrial and Municipal Effluent - Combined Sewer Overflows - Urban Runoff - Input from Industries and Municipalities - Spills - Groundwater Contamination
xiv) Loss of fish and wildlife habitat Use impairment confirmed	A combination of lack of food reserves, low dissolved oxygen and toxic stress have resulted in the lack of a stable resident fish community in the Indiana Harbor and Canal and the Grand Calumet River. The wildlife has greatly diminished this century.	- Industrialization - Draining and Filling of Wetlands - Degraded Water Quality - Contaminated Sediments

9) Restrictions on drinking water consumption, or taste and odor problems;
10) Degradation of aesthetics;
11) Added costs to agriculture or industry;
12) Degradation or phytoplankton and zooplankton populations;
13) Loss of fish and wildlife habitat; and
14) Ambient water quality standards for Lake Michigan and its tributaries.

The Grand Calumet AOC is among the largest and is certainly the most complex of the 43 designated AOCs on the Great Lakes. In order to identify and implement solutions needed to restore these 14 beneficial uses in this AOC, IDEM has broken down the problem into more manageable components. This increases the ability of all parties to understand the technical nature of the problems and to identify the practical steps needed to solve them. These components also generally follow the programmatic divisions of the federal and state governments.

A total of seven RAP teams was formed in the topical areas of water, sediments, and air to develop plans to remove the 14 area-wide impairments. To facilitate the completion and multimedia coordination of the Stage II RAP document, a RAP Coordinating Committee (RAPCC) was formed to direct these IDEM-led program teams involving program managers, external agencies and major stakeholders within the AOC. The RAPCC developed seven goals to remove the identified impairments in the AOC. The Goals include:

1) Achieving water quality standards;
2) Eliminating sediment contamination;
3) Reducing non point source pollution;
4) Preserving and restoring fish and wildlife habitat;
5) Preventing and remediating land and groundwater contamination;
6) Achieving ambient air standards; and
7) Achieving multimedia data coordination.

Each RAP team was then charged with the responsibility of producing a Stage II document that determines the remediation necessary to achieve that team's respective goal.

Each of the seven teams elected a team leader to serve on the RAPCC. In addition to coordinating team meetings and document preparation, the leader presents regular presentations to the Commissioner's public advisory committee, Citizens Advisory for the Remediation of the Environment (CARE). The leader can then provide feedback for use in team deliberations. The guidelines for each team's document direct that it provides a historical context of the AOC relative to that team's goal. The documents should also define the environmental, managerial and communication problems associated with meeting each goal, and propose solutions to overcome each problem. Since consistency is important, the multimedia data coordination team compiles data provided to them in a specified format in a separate Geographical Information

System (GIS) layer.

The Water Quality Component establishes a goal to restore the ecological integrity of the Grand Calumet River and the Indiana Harbor Ship Canal (the River system), with anticipated water quality improvements by the year 2000. The Water Quality team is charged with developing a document based upon this goal and the following objectives:

1) Reduce point source discharges;
2) Reduce combined Sewer Overflows currently allowed in permits;
3) Reduce runoff from those sites covered by General Permit Rules 5 & 6; and
4) Restore lakes.

In addition to describing the water quality goals and objectives, this Water Quality component identifies current regulatory controls and efforts being implemented by the IDEM Office of Water Management (OWM). It also describes how OWM plans to eliminate or reduce, to the maximum extent practicable, both point and non point source pollution within the AOC. More specifically, it describes how OWM plans to prevent the discharges of toxic substances in toxic amounts and virtually eliminate the discharge of all persistent, bioaccumulative toxic substances to the Grand Calumet River Watershed. Implementation of this portion of the RAP will reduce the discharge of pollutants harmful to human, animal or aquatic life to Lake Michigan from all AOC sources.

Because many AOC residents and technical personnel are cooperating in the RAP development, the Water Quality component establishes a goal to make information about the AOC available to these people. This information will be used to encourage an ecosystem approach to all permitting affecting the AOC ecosystem, to evaluate RAP programs, and to accelerate RAP progress. The information will also be used to update the description of the AOC's pollution problems which constitutes Stage I of the RAP and to regularly revise the Water Quality Component. Ultimately, the Stage II document will propose the most effective, workable solutions to restoring the AOC and specify practical remedial action to be implemented in the Stage III, or Implementation, phase of RAP.

Three major sewage treatment plants, Gary, Hammond, and East Chicago, as well as several industries, discharge to the Grand Calumet River.

Although discharges from the major industries and municipalities affect the quality of the Grand Calumet River, additional inputs are found along the river. Although they may not be as great in magnitude as those previously mentioned, they do contribute to the degradation of the waterway. Sources of these inputs are not only from point sources, but include ship traffic in the IHC, parking lot runoff, and other non point sources.

Data from samples collected from the seven fixed water quality monitoring stations on the GCR/IHC system were examined. Cyanide concentrations exceeded the chronic criterion for this substance at three of the stations 15% of the time. One D.O. violation was found at the Grand Calumet River/Indiana Harbor Canal station and a 1990 fish community sampling assessment indicates that D.O. levels may be of concern. Unionized ammonia did not meet the chronic criteria in 28% of the samples taken. The E. coli bacteriological criterion was exceeded up to 71% of the time at each of the monitoring stations. Thus, concentrations of cyanide, unionized ammonia and E. coli appeared to be of concern throughout much of the GCR/IHC system.

Although the water quality is far from desirable, it is showing improvement. Resident fish populations are evident. Carp, goldfish, golden shiners, fathead minnow, central mudminnow, black bullhead, pumpkinseed and green sunfish were collected in 1986, 1987, and 1988, and even some salmonids are found in the river in the autumn.

Macro invertebrate sampling (Hester-Dendy samplers) in the past has shown that five main groups of organisms were present at nearly every site. The most obvious characteristic of this assemblage of organisms is that each group is tolerant to moderate organic pollution and reduced dissolved oxygen concentrations. The presence of many "facultative" organisms (especially odonates, certain midges and snails) and a few intolerant species indicated that severe oxygen depletions do not occur frequently. Stresses associated with toxic chemicals were indicated by most samples.

IDEM and U.S. EPA Region V staff completed fish community sampling in the Lake Michigan Basin Northwest in 1990. Water quality trends as assessed by this sampling in the Lake Michigan basin will be categorized into two stream divisions (East Branch Little Calumet River and Other Lake Michigan Tributaries) in order to facilitate presentation.

The East Branch of the Little Calumet River division of the Lake Michigan drainage includes Burns Ditch, the East Branch of the Little Calumet River and its tributaries (e.g., Salt Creek, Reynold's Creek and the unnamed tributary in the river's headwater). A total of 28 headwater and wading sites were sampled for fish community structure analyses in the East Branch Little Calumet River division during Central Corn Belt Plain Ecoregion sampling in 1990. A total of 48 species were collected and were numerically dominated by centrarchid species (black bass and sunfish). The headwaters of the East Branch of the Little Calumet River, Reynold's Creek and the unnamed tributary, possessed high biological integrity comprised of many salmonid species and more tolerant species from Lake Michigan. These areas were the best observed in this basin although they only achieved a "fair" evaluation for water resource classification.

The overall water quality of the East Branch Little Calumet River division ranged between a low of 12 (very poor) to a high of 45 (fair) based on Index of Biotic Integrity (IBI) scoring criteria developed during the current investigation. The biotic integrity of the East Branch Little Calumet River division declined with increasing drainage area. The number of sites approximated a highly skewed curve (toward degraded conditions) with respect to water quality as determined from index scores. The following was the percent occurrence of total East Branch Little Calumet River Division stations (28) within each index classification: fair 14.29% (four stations); poor 46.43% (13 stations); very poor 39.29% (11 stations). Consequently, 86% of the sample sites in this basin failed to achieve attainment standards for biologically assessed water quality. Fish were collected at all sites in the division. Sites which had low index values were primarily because of poor habitat and anthropogenic influences from industrial and municipal dischargers. The low flows of some tributaries caused the accumulation of soft substrates in adjacent riffle and pools, effectively reducing available habitat, and dredged streams reduced habitat complexity. Reynold's Creek was an exceptional stream in the East Branch division. An unnamed tributary in the Little Calumet headwaters, and the Little Calumet headwaters near the Indiana Dunes National Lakeshore's Heron Rookery had relatively high index of biotic integrity scores.

The Other Lake Michigan Tributaries division of the Lake Michigan drainage includes the Grand Calumet river basin and the West branch of the Little Calumet River and its tributaries (e.g., Deep River, Turkey Creek and Hart Ditch).

A total of 20 headwater and wading sites were sampled for fish community structure analyses in the Lake Michigan division during Central Corn Belt Plain Ecoregion sampling in 1990. A total of 36 species was collected and numerically dominated by centrarchid (black bass and sunfish) species. There were no outstanding reference locations in this division. However, the single location which scored the highest was on the Little Calumet River at Cline Avenue. This area was the best observed in this basin segment although it only received a fair evaluation with respect to its water resource classification.

The overall water quality of the Lake Michigan division ranged between a low of 12 (very poor) to a high of 44 (fair), based on Index of Biotic Integrity scoring criteria developed during the current investigation. The biotic integrity of the Lake Michigan division was relatively degraded throughout, but a declining trend was evident with increasing drainage area. The number of sites approximated a highly skewed curve (toward degraded conditions) with respect to water quality. The following was the percent occurrence of total Lake Michigan Division stations (20) within each index classification: fair 5.0% (one station); poor 10.0% (two stations); very poor 85.0% (17 stations). This basin division produced the lowest IBI scores of those sampled. Within the Lake Michigan Division basin, 95% of the sample sites failed to meet use attainment standards for biologically assessed water quality. Fish were collected at all sites in the division. Sites which had low index values were due to poor habitat and toxic influences caused by industrial and urban land uses. The low flows of some tributaries caused the accumulation of soft substrates effectively reducing available habitat, and dredged streams reduced habitat complexity.

The West Branch of the Little Calumet River has a peculiar flow regime with a portion of the River flowing eastward toward Burns Ditch and a westward flowing segment toward Illinois. The hydrologic division between the two occurs near Indianapolis Boulevard depending on Lake

Michigan level. The eastward flowing segment has relatively better quality potential than the westward flowing segment. The barriers to overall improvements in water resource quality include the presence of landfills and frequent oil and hazardous waste spills into the river. Waste diversions from municipalities also are quite frequent, resulting in only the most tolerant taxa existing as a resident community. The headwaters of Deep River are extremely degraded and can be attributed to municipalities along the upper portions of Niles Ditch, Main Beaver Dam Ditch, and Turkey Creek.

The Grand Calumet River has been a well-studied basin with numerous investigations conducted over the past three decades. The overall quality of the river is very poor even though a high proportion of cattail marsh wetland lies along the basins margins. Overall, habitat is not the limiting factor in the improvement of this basin since enough refuges exist to facilitate the colonization of impacted areas after the perturbations have been removed. The high degree of industrialization along the river's banks is the principal cause of toxic influence impacting the aquatic community.

The Grand Calumet River and the Indiana Harbor Ship Canal (GCR/IHC) receive 90% of their flow from municipal and industrial point sources. Treated industrial process water and effluent from municipal wastewater treatment facilities have been identified as major contributors to poor water quality in the GCR/IHC.

Effluent controls of point source discharges are being put in place to improve water quality as part of the National Pollution Discharge Elimination System (NPDES). However, at the present time there are two chronic problems which are not adequately addressed by the NPDES Program. They are (1) discharges from combined sewer overflows (CSOs) that remain uncontrolled, and (2) non point source discharges, including urban and industrial runoff, that contain pollutants.

Recent data suggest that the CSO discharges into the GCR are somewhat of a greater problem than the stormwater discharges. In addition, the CSO discharges were significantly greater in volume than the stormwater discharges. The CSOs thus discharge more pollution and have more input on particular sections of the Grand Calumet River than others.

Neither treatment nor control of all stormwater discharges into the Grand Calumet river (GCR) appears practical, as efforts to treat toxicity or control stormwater discharges would involve significant amounts of money. A more practical approach would be to locate and remove the source of the toxicity.

Pollution impact by discharges to the Grand Calumet River can be relative to the current stream quality of the river. Therefore, further toxicity testing as well as a benthic study on the river could help IDEM determine if the discharges further exacerbate the stream quality.

It is recommended that an evaluation of actual flows treated at the STPs versus the design peak flows be conducted. STPs should begin to characterize their CSO systems and/or maximize flows to STPs for treatment.

In summary, 219 stream miles were assessed for aquatic life uses in the Lake Michigan Basin - Northwest. Of these assessed waters, 28 miles (11%) fully supported this use, and 191 miles (87%) did not this use. Of the 107 stream miles assessed for recreational uses, none supported this use. In addition, all 43 shoreline miles (241 square miles) of Lake Michigan are considered supportive of the aquatic life and recreational.

Lake Michigan Basin - Northeast

In the Lake Michigan Basin - Northeast approximately 684 miles were monitored and/or evaluated to determine support of use designations. Table 27 summarizes the waters assessed, support status, miles affected, and probable causes of impairment. Additional information on certain stream reaches is also provided in this table.

No major surveys occurred in this basin during this reporting period. Stream sampling during 1992 consisted of sampling the entire length of the St. Joseph River and its tributaries in Indiana from the Michigan/Indiana line north of Bristol, Indiana, to the Indiana/Michigan state line north of South Bend. The most recent water quality monitoring was conducted at fixed stations in this area. In addition to the St. Joseph River, other major rivers in this basin include Turkey Creek, Pigeon Creek, Little Elkhart River and the Elkhart River.

The St. Joseph River enters Indiana from Michigan near Bristol in Elkhart County. From there it flows west through Elkhart and South Bend (St. Joseph County) where it turns north and returns to Michigan. The cities of Bristol, Elkhart, Mishawaka, and South Bend operate wastewater treatment plants with direct discharges to the St. Joseph River. The largest industry which discharges to the St. Joseph is Uniroyal, Inc. of Mishawaka. ConRail in Elkhart discharges to Crawford Ditch, which flows into the St. Joseph River. Four dams are located in the river and are used to generate power during periods of peak demand.

Although the St. Joseph River segment in Indiana is less than 40 miles long, the Indiana drainage basin covers 1,778 square miles and six counties. Water quality data from fixed water quality monitoring stations at Bristol, Mishawaka, and South Bend show almost no violations of water quality standards except for E. coli.

A portion of the St. Joseph River, from the Twin Branch Dam near Mishawaka to the Indiana/Michigan state line, has been designated as a salmonid stream. Through a cooperative effort between Indiana and Michigan, fish ladders were built at dams in South Bend, Mishawaka, and in Michigan, and a cold water hatchery is in operation at Mishawaka, Indiana. The Salmonid stocking program and the removal of migration barriers will enable trout and salmon to move up the river from Lake Michigan to Mishawaka.

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin-Northeast*

WATERBODY	NEAREST TOW N(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Turkey Creek	Lake Village	FS(Aquatic Life) FS(Recreational)	Monitored (c)		9.0	
Turkey Creek	Syracuse	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.0	
Turkey Creek	Milford	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.3	High suspended solids as results of algae bloom.
Turkey Creek	Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.0	
Skinner Ditch	Syracuse	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.8	Ditch choked with lily pads and heavy algae. Limited access.
Coppes Ditch (Lower reach)	Leesburg Milford	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Sewage Discharge	1.5	
Coppes Ditch	Leesburg Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		8.5	
Hoopingarner Ditch	Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.5	
Preston Miles Ditch	Milford Junction	FS(Aquatic Life)	Evaluated		4.2	
Kiefer Ditch	Milford Junction	FS(Aquatic Life)	Evaluated		6.1	
Dausman Ditch	Milford	FS(Aquatic Life)	Monitored (c) (b)		8.8	Biological Assessment "Fair".
Swoveland Ditch	New Paris	FS(Aquatic Life) FS(Recreational)	Evaluated		7.0	
Wisler Ditch and Tributaries	Wakarusa	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	17.8	
Werntz Ditch	Wakarusa	PS(Aquatic Life)	Monitored (c)		4.0	Lack of dilution water for Wakarusa STP lagoon waters. Stream also impacted by cattle operations. Limited use stream.
Grimes/Barkley Ditches	Wakarusa	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	25.0	Recreational uses impaired due to nearby cattle operations.

Table 27. *Water assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin -Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Baugo Creek	Wakurasa	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	10	
Baugo Creek	Jamestown	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.7	
Uhl Ditch	South Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.5	
Little Elkhart Creek	South Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		0.3	
Little Elkhart Creek	South Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2.2	
Little Elkhart Creek	South Milford	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.5	
Little Elkhart Creek	Wolcottville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.6	
Little Elkhart Creek	Wolcotville	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli	0.7	Wolcottville STP should be upgraded to alleviate treatment problems.
Little Elkhart River and tributaries	Topeka Middlebury	FS(Aquatic Life) NS(Recreational)	Monitored ©	E. coli	30.0	Farm areas, Middlebury STP impact stream.
Tributary from Blackman Lake including trib from unnamed pond toAdams Lake	South Milford	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.2	
Bixler Lake Ditch	Kendallville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2.0	Cadmium slightly high but not affecting water quality.
Henderson Lake Ditch	Kendallville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.96	
Tributary to Round Lake	Kendallville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.9	

Table 27. *Water assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin -Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Waterhouse Ditch	Albion	NS(Aquatic Life) FS(Recreational)	Monitored (c)	D.O. Iron	1.7	
Oviatt Ditch	Rome City	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.7	
Oliver Lake Outlet Tributary	Eddy	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.5	
North Branch Elkhart River	Eddy	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.8	
North Branch Elkhart River	Cosperville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. Coli	5.1	
North Branch Elkhart River	Cosperville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.1	
Tributary to Jones Lake	Rome City	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.0	
Branch from Little Lake to Lake Jones	Rome City	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.4	
Gretzinger Ditch	Brimfield	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.1	Insignificant flow. Bordered by farmland.
Tributary from Munk Lake to Clock Creek	Brimfield	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.9	
Clock Creek	Brimfield	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.65	Marsh/muddy conditions.
Dry Run	Brimfield	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.0	
Boyd Ditch	Cosperville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1	

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin -Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Huston Ditch	Wawaka	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.2	
Jacobs Ditch	Cosperville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.0	
Thumma-Rousch Ditch	Bakerstown	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.0	
Forker Creek	Burr Oak	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.36	Occasional low D.O. due to heavy duckweed cover in areas.
Brown Ditch/Parker Ditch	Burr Oak	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.6	
Winebreemer Branch	Merriam	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.0	
Carrol Creek	Wolflake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.0	
South Branch Elkhart River	Albion	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.9	
South Branch Elkhart River	Albion	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.9	
South Branch Elkhart River	Albion	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.9	
South Branch Elkhart River	Wawaka	FS(Aquatic Life) FS(Recreational)	Monitored (c)		13.2	Some low D.O. values due to Marshland.
Rimmell Branch	Bakertown	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.3	
Croft Ditch	Albion	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	D.O. Ammonia E. coli	1.7	
Croft Ditch	Albion	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.7	Heavy algae growth.

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin - Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Long Ditch	Albion	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.0	
Tributary from Lower Long Lake	Port Mitchell	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.4	
Elkhart River	Ligonier	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.75	Variety of fish found; bass, pike bluegill, etc.
Elkhart River	Ligonier	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.2	
Elkhart River	Goshen	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	10.0	
Elkhart River	Goshen	FS(Aquatic Life) (Threatened) FS(Recreational)	Monitored (c)		7	
Eaton Creek	Fremont	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.4	
Unnamed tributary from Fremont STP	Fremont	NS(Aquatic Life) FS(Recreational)	Monitored (c)	pH Chlorides Copper	3.0	
Toll Road Rest Stop Tributary	Fremont	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.0	
Follette Creek	Jamestown	FS(Aquatic Life) FS(Recreational)	Monitored (c)		.05	
Follette Creek	Glen Eden	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2.2	
Unnamed tributary from Walters Lake	Angola	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.6	
Crooked Creek	Jamestown	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.4	
Crooked Creek	Nevada Mills	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.7	
Crooked Creek from Tamarack Lake	Orland	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.3	

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin - Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Bell Lake Ditch	Nevada Mills	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.4	
Unnamed tributary from Lime Lake	Nevada Mills	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.5	
Orland Tributary	Orland	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Low D.O, E. coli	1.0	
Fawn River from Fawn River Fish Hatchery	Greenfield Mills	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.8	
South tributary to Lake James	Crooked Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	0.4	
Lake James/Lake Jimmerson Channel	Lake James	FS(Aquatic Life) FS(Recreational)	Monitored (c)		.1	
Ditch to Little Center Lake	Angola	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.5	Metals in sediment. Dana Corporation effluent discharges into this ditch.
East tributary to Crooked Lake	Glen Eden	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.9	
Southeast tributary to Crooked Lake	Crooked Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.7	E. coli counts of 940/100 ml.
South tributary to Crooked Lake	Crooked Lake	PS(Aquatic Life) PS(Recreational)	Monitored (c)	E. coli	1.1	
Tributary between the Third Basin of Crooked Lake and Lake Loon	Iverness	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.4	
Lake Gage/Lime Lake Channel	Panama	FS(Aquatic Life) FS(Recreational)	Monitored (c)		0.3	
Pigeon Creek	Angola	FS(Aquatic Life) FS(Recreational)	Monitored (c)		8.0	
Pigeon Creek from Pigeon Lake	Angola	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.0	E. coli counts of 420/100 ml.

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in Lake Michigan Basin -Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Pigeon Creek from Mud Creek	Angola	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Ammonia E. coli	1.5	Continuation of problems with ammonia and E. coli from Mud Creek. Also poor treatment from Angola STP.
Pigeon Creek from CR 400	Pleasant Lake	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.5	
Pigeon Creek from Golden Lake	Angola	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.3	
Pigeon Creek from Hogback Lake	Flint	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.4	
Pigeon Creek from Otter Lake	Flint	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2.6	
Ewing Ditch	Angola	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.6	E. coli counts of 1600/100 ml.
Berlin Court Ditch	Berlin	PS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O.	3.9	
Mud Creek from Angola STP Discharge	Angola	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Ammonia Low D.O. E. coli	3.0	Poor treatment from Angola STP.
Johnson Ditch	Hudson	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli TSS Low D.O. Ammonia	5,7	Impairments from Pigeon Creek Rest. Area.
Trout Creek	Bristol	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.0	
St. Joseph River	Bristol	FS(Aquatic Life) NS(Recreational)	Monitored(b) (c)	E. coli	7.6	
St. Joseph River	Elkhart	FS(Aquatic Life) NS(Recreational)	Monitored (b)	E. coli	5.9	
St. Joseph River	Elkhart	FS(Aquatic Life) FS(Recreational)	Monitored (c)		12.3	

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin-Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
St. Joseph River	Mishawaka	FS (Aquatic Life) NS(Recreational)	Monitored (c)	PCB's E. coli	3.2	Salmonid classification.
St. Joseph River	South Bend	FS(Aquatic Life) NS(Recreational)	Monitored (c)	PCB's E. coli	2.6	
Sheep Creek	Bristol	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.0	
Pine Creek	Bristol	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	18.0	
Peterbaugh Creek	Elkhart	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.0	
Christianna Creek	Elkhart	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.0	
Osborn-Manning Ditch	Elkhart	PS(Aquatic Life)	Monitored (c)		3.8	
Cobus Creek	Elkhart	FS(Aquatic Life) FS(Recreational)	Monitored (c)		11.0	
Crawford Ditch	Elkhart	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Metals Oil E. coli	.75	
Auten Ditch	South Bend	PS (Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Ammonia	1.5	Impacts from two mobile home parks and Berliner-Maux industry.
Juday Creek	South Bend	FS(Aquatic Life)	Monitored (c)		24.6	
Solomon Creek	Cromwell	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Non point source	3.7	Cromwell STP adds to E. coli count.
Cromwell Ditch	Cromwell	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.7	Intermittent stream.

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin-Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Meyer Ditch	Cromwell	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	20	Channelized drainage ditch with no point sources, but E. coli exceeds standard.
Stoney Creek	Millersburg	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2	
Long Ditch/Dry Run	Millersburg	FS(Aquatic Life) FS(Recreational)	Monitored (c)		8.0	
Rock Run Creek and tributaries	Goshen	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	42.0	
Turkey Creek	Bushy Prairie	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.0	
Pigeon River	Mongo	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2.3	
Pigeon River	Howe	FS(Aquatic Life) PS(Recreational)	Monitored (c)	E. coli	1.7	
Pigeon River	Scott	FS(Aquatic Life) NS(Recreational)	Monitor ed (c)	E. coli	6.0	
Pigeon River	Scott to State Line	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.0	
Fly Creek	LaGrange	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	10.1	
E. Fly Creek	LaGrange	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.8	
Rowe Ditch	Howe	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.3	
West Buck Creek	Valentine	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Low D.O. E. coli	4.0	Low D.O. from lack of stream aeration after going through wetlands.

Table 27. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the Lake Michigan Basin-Northeast (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Van Netta Ditch	Seyberts	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.0	
Page Ditch	Shipshewana	FS(Aquatic Life) NS(Recreational)	Monitored (c)	TSS E. coli	6.0	Impacts from Shipshewana Lake and STP.
Buck Creek	Seyberts	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.5	
Unnamed tributary	Shipshewana	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Ammonia TSS D.O. E. coli	2.1	Impacts from Shipshewana STP.
Fawn River	Scott	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.5	
Wagner Ditch	Nappanee	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.5	
Nunemaker-Township Ditch	Nappanee	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1	
Rogers Ditch	Nappanee	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1	
Mather's Ditch	Middlebury	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O. Endrin	10	

1 PS = Partial Support; NS = Non Support; FS = Full Support. If a use is not listed, it was not monitored or evaluated
2 b = biological; c = chemical.

A diverse fish community exists along the entire length of the St. Joseph River, making it fully supportive for aquatic life. All rivers, stems, and lakes in this river basin are under some advisory for fish consumption. Please refer to the 1996 Indiana Fish Consumption Advisory for the specific waterways and fish species involved. Due to the frequency of high E. coli levels the designated recreational use is not supported throughout the river. A possible source of some of these high E. coli levels could be dry weather bypassing at the Elkhart wastewater treatment plant, caused by a series of mechanical failures and electrical outages. There were also nearly 100 combined sewer overflows (CSOs) found along much of the river which may contribute to this problem.

The majority of the streams in this basin fully supported aquatic life. Eleven streams were assessed as non supportive of aquatic life. The main causes of non support were ammonia and low dissolved oxygen. Low dissolved oxygen could be attributed to wastewater treatment plant's impacts and large diurnal fluctuations caused by heavy algae growth present in some of the streams.

Mather Ditch was impacted by point sources which discharge process waters into the streams. Crawford Ditch, a St. Joseph River tributary, has sediment saturated with oil from surface runoff and leaking around the ConRail Railroad yard. Water samples indicated copper values at one sampling site were below the acute aquatic life criteria but above the chronic criteria level. Sediment analysis taken at this same site shows copper levels being slightly less than 10 times the maximum state background level. PCB's (Aroclor 1260) were found at 500 ug/kg in the sediment, which is 20 times the maximum state background level.

At least 40% of the stream miles sampled were fully supportive for recreational full body contact uses. High E. coli concentrations are the reason recreational uses are not being met. The concentrations ranged from 360 cfu/100 ml to 18,000 cfu/100 ml. The major sources of the E. coli causing impairment of recreational uses are agricultural practices, livestock operations, and farm runoff.

IDEM and U.S. EPA Region V staff collected fish community samples in the Lake Michigan Basin - Northeast during the 1991 field season. The results of this study can be found in the Index of Biotic Integrity Expectations for Ecoregions of Indiana and were discussed in the 1992-93 305(b) report.

In summary, 684 miles of streams were assessed to determine the extent of support of aquatic life uses in the Northeast Lake Michigan basin. Of these assessed waters, 626 miles (92%) fully supported this designated use, 9 miles (1%) are fully supportive but threatened, 14 miles (2%) only partially support this use and 34 miles (5%) are considered not supportive. Six hundred thirty seven (637) miles were assessed as to support of recreational use. Of these miles 220 (35%) were fully supporting, 3 miles (0.4%) were partially supportive and 414 (65%) were non supporting of the recreational use designation.

Kankakee River Basin

The Kankakee River Basin (Figure 5) drains about 3000 square miles of northern Indiana before flowing westward into Illinois. Major tributaries in Indiana include the Iroquois and Yellow rivers. Other major streams in the basin include Cedar Creek and Kingsbury Creek/Travis Ditch.

Those water bodies assessed, the status of designated use support, probable causes of non support, and miles affected are shown in Table 28. No major surveys were conducted in this basin during this reporting period, and a more detailed description of the most recent basin survey can be found in the 1992-93 305 (b) Report. Additional comments concerning certain reaches are also given in this table.

A fish consumption advisory is in effect for all waters in the basin and includes the Kankakee River in LaPorte and Lake counties, and the Irogquois River in Jasper and Newton counties. Consult the 1996 Indiana Fish Consumption Advisory for the fish species affected and the risk group the species are in.

The origin of the Kankakee River consists of the accumulated flow of several irrigation ditches and the outflow of a South Bend storm sewer detention pond. These ditches flow together to form Dixon West Place Ditch, which then becomes the Kankakee River approximately 7.76 miles downstream.

Water quality is generally good throughout the Upper and Lower Kankakee River. The main concern was high E. coli concentrations, which measured up to 8900 cfu/100 ml in several sample locations in the basin. Several ditches drain towns which are on septic systems within the basin. This is one probable source of the E. coli problem; other sources include feedlot and pasture land runoff. Travis Ditch and Kingsbury Creek, major tributaries to the Kankakee, have a high concentration of metals and priority pollutants in the sediment. These streams run through the Kingsbury Industrial Park where two industrial discharges have their outfalls. The metal concentration levels decline downstream and priority pollutants drop to below the detection limits.

Several substandard dissolved oxygen (D.O.) values were noted throughout the basin, especially in ditches where no point sources are located. Possible causes of these low D.O. valves include a lack of stream reaeration and algae induced diurnal variations. During this survey, water that had stood in fields for days was being drained or purged into some streams. This water had very low D.O. concentrations. Ammonia levels ranging from 2.3 mg/L to 5.9 mg/L are attributed to poor treatment from wastewater treatment facilities.

A total of 112 sites was sampled for fish community structure analysis in the Kankakee River Basin during Central Corn Belt Plain Ecoregion sampling in 1990. A total of 82 species was collected.

Figure 5. *Kankakee River basin*

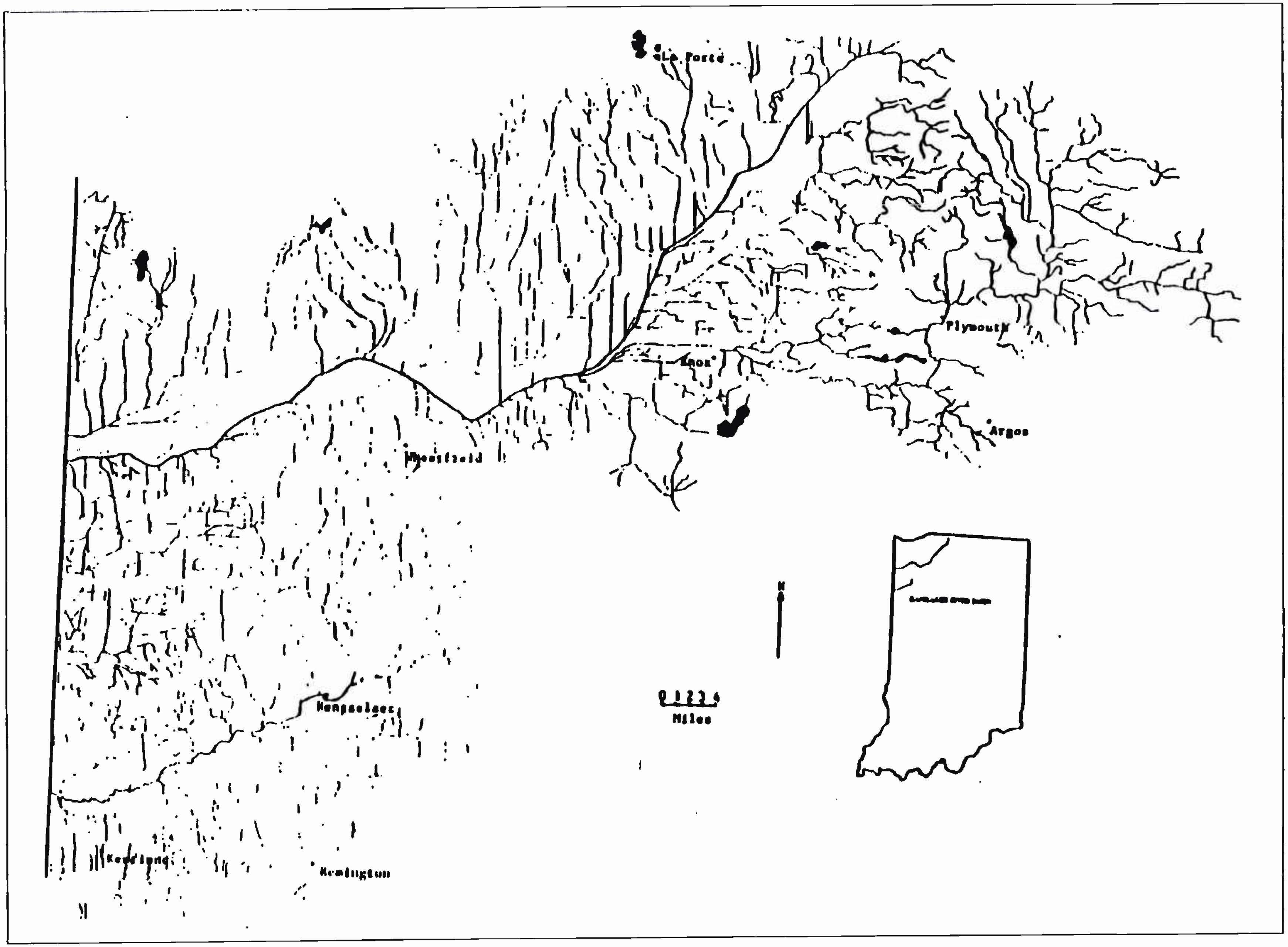


Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Travis Ditch	Kingsbury LaPorte	NS (Aquatic Life) PS(Recreational)	Monitored (c) (b)	E. coli	13.2	Biological Assessment "very Poor" 3 miles south of LaPorte.
Kingsbury Creek	Kingsbury	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	9.3	Biological Assessment, "Poor".
Kankakee River	Crumstown	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	15.8	
Kankakee River	English Lake	FS(Aquatic Life)	Monitored (c)		5.0	Alachlor found above detection level at .12 ug/l.
Kankakee River	Shelby	FS(Aquatic Life)	Monitored (c)		23.0	
Kankakee River	Hamlet	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.4	
Kankakee River	Knox	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.5	
Barringer Ditch	Mill Creek	FS(Aquatic Life)	Monitored (c)		0.7	
Dixon West Place Ditch	South Bend	FS(Aquatic Life)	Monitored (c)		8.0	
Little Kankakee	LaPorte	NS(Aquatic Life)	Monitored (b)		3.0	Biological Assessment "very Poor" near headwaters
Little Kankakee	Fish Lake	FS(Aquatic Life)	Monitored (c) (b)		7.0	
Pine Creek	Walkerton	NS(Aquatic Life)	Monitored (c) (b)		29.0	Biological Assessment "Poor".
Geyer Ditch	New Carlisle	NS(Aquatic Life)	Monitored (c) (b)		11.2	Biological Assessment, "Poor".
Laskowski Ditch	Crumstown	FS(Aquatic Life)	Monitored (c)		6.0	
County Line Ditch	Crumstown	PS(Aquatic Life)	Monitored (c)	Ammonia TSS	11.5	
Niespodziany Ditch	Crumstown	PS(Aquatic Life)	Monitored (c)	Ammonia D.O.	6.0	New Carlisle STP
Mill Creek	Union Mills	FS(Aquatic Life)	Monitored (c) (b)		8.0	High BOD no significant impacts to stream.
Potato Creek	North Liberty	NS(Aquatic Life)	Monitored (c) (b)		7.0	Biological Assessment, "Poor".
Sherman Emmans Ditch	LaPaz	FS(Aquatic Life)	Monitored (c)		5.0	
Peter Sarber Ditch	LaPaz	FS(Aquatic Life)	Monitored (c) (b)		5.0	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Peter Sarber Ditch	Walkerton	NS(Aquatic Life)	Monitored (b)		12.0	Biological Assessment, "Poor"
Breckenridge Ditch	Kingsbury	FS(Aquatic Life)	Monitored (c)		11.0	
Breckenridge Ditch	Stillwell	NS(Aquatic Life)	Monitored (b)		6.0	Biological Assessment, "Poor".
Yellow Bank Creek	Teegarden	FS(Aquatic Life)	Monitored (c)		9.0	
Yellow River	Bremen	FS(Aquatic Life)	Monitored (c) (b)		4.0	Includes Run-off from Prairie View Landfill. Biological Assessment "Poor" north of Bremen.
Yellow River	Bremen	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	7.0	Biological Assessment "Poor".
Yellow River	Inwood	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	6.4	
Yellow River	Plymouth	FS(Aquatic Life)	Monitored (b)		13.0	Biological Assessment "Excellent" 4.5 miles south of Plymouth.
Yellow River	Plymouth	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	4.5	
Yellow River	Plymouth	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	7.5	
Yellow River	Knox	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	29.8	
Yellow River	Knox	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli D.O. Bypassing	11.2	Knox STP under Agreed Order for new construction.
Newcomer, Anthony Gross, Lehman-Brink Ditches	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		24.0	
Sara Hershberger Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.3	
Kline Rouch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.2	
Army Ditch	Bremen	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli CSO's	10.0	Biological Assessment, "Poor".
Heston Ditch	Lakeville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.8	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Kehman Ditch	LaPaz	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.9	Includes Laville High School STP discharge.
Shidler-Hoffman Ditch	Wyatt	FS(Aquatic Life) FS(Recreational)	Monitored (c)		3.8	
W. Branch Bunch Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.5	Includes Lakeville STP Lagoon Discharge.
E. Branch Bunch Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		13.6	
Stock Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.7	
Dausman Ditch	Bremen	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c) (b)	E. coli D.O.	30.7	Mikel Mobile Home Park STP poorly operated and maintained.
Lemler Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.2	
Brook Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.8	
Border Ditch	Bremen	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1	
Martin & Walt Kimble Ditches	Linkville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.4	
Isaac Sells Ditch	Linkville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.1	
Crews Ditch	Inwood	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	20.2	Biological Assessment, "Poor". Located 5 mile east of Plymouth.
Elmer Seltenright Ditch	LaPaz	NS(Aquatic Life)	Monitored (b)		2.0	Biological Assessment "Poor".
Elmer Seltenright Ditch	Plymouth	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c) (b)	E. coli	9.6	Gatewood Mobile Home Park STP poorly operated and maintained.
Schuh Ditch	Plymouth	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.4	
Bogus Run	English Lake	FS(Aquatic Life)	Monitored (c) (b)		30.0	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Bogus Run	Denham	NS(Aquatic Life)	Monitored (b)		6.0	Biological Assessment, "Poor".
Pine Creek	Denham	FS(Aquatic Life)	Monitored (c)		4.7	
Pine Creek	N. Judson	PS(Aquatic Life) FS(Recreational)	Monitored (c)	D.O.	3.9	
Pitner Ditch and tributaries	LaCrosse	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	60.1	
Origer Ditch	English Lake	FS(Aquatic Life)	Monitored (c)		10.8	
Payne Ditch	English Lake	FS(Aquatic Life) FS(Recreational)	Monitored (c)		13.2	
Keller Arm and tributaries	English Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.0	Only Lawton Ditch Sampled.
Davis Ditch	Wheatfield	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.2	
Cook Ditch	LaCrosse Kotus	FS(Aquatic Life) FS(Recreational)	Monitored (c)		23.6	
Reeves Ditch	Kouts	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		9.7	
Slocum/Topper Ditch	Wanatah	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	23.0	
Topper Ditch	Wanatah	NS(Aquatic Life)	Monitored (c) (b)		12.0	Biological Assessment, "Poor".
Topper Ditch	Wanatah	NS(Aquatic Life)	Monitored (b)		4.0	Biological Assessment, "Poor".
Geiger Ditch	LaCrosse	FS(Aquatic Life)	Monitored (c)		19.4	
Geiser Ditch	Kouts	NS(Aquatic Life) NS(Recreational)	Monitored (b)	D.O. E. coli	2.0	Biological Assessment, "Poor".
Crumpacker Arm/Wright Arm	Westville	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Ammonia D.O.	1.0	No Sample from Wright Arm, Degradation Due to Westville STP and Westville Correctional STP. Occasional low D.O.

Table 28. *Waters assessed, status designated use support, probable causes impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Forbes Ditch	Westville	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. E. coli	1.5	
Crooked Creek	Westville	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli D.O.	1.5	Biological Assessment, "Very poor".
Crooked Creek	Valparaiso	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli D.O.	3.2	Biological Assessment, "Poor".
Crooked Creek, West Branch	Valparaiso	PS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli D.O.	4.1	Biological Assessment, "Fair".
Crooked Creek, West Branch	Kouts	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c) (b)	E. coli Non point source	47.4	
Pleasant Township Ditch	Kouts	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli	10.3	Threatened due to bypassing from Kouts STP.
Sandy Hook/Ahlgrim Ditch	Kouts	NS(Aquatic Life)	Monitored (b)	D.O.	3.0	Biological Assessment, "Poor".
Sandy Hook/Cobb Ditches	Kouts	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.0	
Phillips Ditch	Kouts	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.0	
Cornell Ditch	Hobron	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	D.O. E. coli	5.0	Low D.O. at time of sampling
Cobb Creek	Hebron	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Non point source	4.7	
Cobb Creek	Hebron	FS(Aquatic Life)	Monitored (c) (b)		5.9	
Cobb Creek/Breyfogel	Hebron	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	Ammonia Low D.O. E. coli	3.4	Hebron STP impacts stream with low D.O. E. coli and occasional ammonia violations. Biological Assessment, "Poor".
Hodge Ditch	Wheatfield	NS(Aquatic Life)	Monitored (c) (b)	Low D.O.	4.0	Biological Assessment, "Very Poor".
Hodge Ditch and tributaries	DeMotte	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		70.4	
DeHean and Tyler Ditches	DeMotte	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli D.O.	11.2	DeMotte STP impacts stream. Biological Assessment, "Poor" on Tyler Ditch.

Table 28. *Waters assessed, status of designated use support, probable cause of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Brent Ditch	DeMotte	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.0	
Evers Ditch	DeMotte	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.0	
Otis Ditch	DeMotte	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.6	
Knight Ditch	Lake Village	NS(Aquatic Life)	Monitored (b)		7.0	Biological Assessment "Very Poor" near Lake Village, "Fair" further upstream.
Beaver Lake Ditch and tributaries	Lake Village	FS(Aquatic Life) NS(Recreational)	Monitored (b) (c)	E. coli Non point source	30.5	
Lawlet Ditch and tributaries	Lake Village	FS(Aquatic Life) FS(Recreational)	Monitored (c)		22.4	
Best Ditch and tributaries	Lake Village	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	10.6	Biological Assessment, "Poor".
Beaver Creek and tributaries	Eros	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	47.0	
Beaver Creek	Morocco	NS(Aquatic Life) PS(Recreational)	Monitored (c) (b)	D.O. E. coli	1.2	Morocco sewer system impacts stream. Biological Assessment, "Poor".
Beaver Creek	Morocco	FS(Aquatic Life)	Monitored (b)		2.4	1 mile east of Illinois border.
Singleton Creek	Schneider	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	D.O. E. coli	44.7	
Bryant Ditch	LeRoy	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.2	Apply Valley Mobile Home Park impacts stream.
Brown Ditch	Hebron	FS(Aquatic Life)	Monitored (b)		3.0	
Brown/Tully Ditch	Shelby	NS(Aquatic Life) FS(Recreational)	Monitored (c) (b)	Low D.O.	32.2	Biological Assessment was "Poor" for Tully Ditch near Shelby.
West Creek	St. John	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		21.2	
Craigmile Ditch	Knox	FS(Aquatic Life)	Monitored (b)		2.0	
Bessler Ditch	LaCrosse	FS(Aquatic Life)	Monitored (b)		0.5	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Cedar Lake Ditch	N. Judson	NS(Aquatic Life)	Monitored (b)		4.0	Biological Assessment rate, "Poor".
Delehanfy Ditch	Wheatfield	NS(Aquatic Life)	Monitored (b)		4.1	Biological Assessment rate, "Poor".
Stony Run E. Branch	LeRoy	NS(Aquatic Life)	Monitored (b)		5.0	Biological Assessment rated, "Poor".
Eagle Creek	Knox	FS(Aquatic Life)	Monitored (b)		6.8	
Eagle Creek	Knox	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	18.4	
Tuesburg Ditch (Hanna Arm)	Hanna	FS(Aquatic Life)	Monitored (b)		9.0	
Jordan Creek	Walkerton	FS(Aquatic Life)	Monitored (b)		1.0	
Kuehn Ditch	LaCrosse	FS(Aquatic Life)	Monitored (b)		1.5	
Long Ditch	Kingsford Hts.	NS(Aquatic Life)	Monitored (b)		4.0	Biological Assessment, "Poor".
Whitham Ditch	Kingsford Hts.	NS(Aquatic Life)	Monitored (b)		2.0	Biological Assessment, "Poor".
Whaley Ditch	Kentland	FS(Aquatic Life)	Monitored (b)		3.0	
Whitham Ditch	Hanna	FS(Aquatic Life)	Monitored (b)		2.0	
Richman Ditch	Hanna	FS(Aquatic Life)	Monitored (b)		6.8	
Rice Ditch	Hanna	NS(Aquatic Life)	Monitored (b)		2.2	Biological Assessment, "Poor".
Salisbury Ditch	Kingsford hts. .	NS(Aquatic Life)	Monitored (b) (c)		2.0	Biological Assessment, "Very Poor".
Iroquois River	Rensselaer	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		51.4	
Iroquois River	Parr	NS(Aquatic Life)	Monitored (b)		5.0	Biological Assessment "Very Poor", but "Good" further downstream.
Carpenter Creek	Remmington	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		18.1	
Carpenter Creek	Egypt	NS(Aquatic Life)	Monitored (b)		7.0	Biological Assessment, "Poor".
Hunter Ditch	Goodland	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	3.1	
Darroach Ditch	Kentland	FS(Aquatic Life)	Monitored (b)		3.4	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Montgomery Ditch	Kentland	FS(Aquatic Life)	Monitored (b)		20.1	
Cedar Creek	Lowell	NS(Aquatic Life)	Monitored (b) (c)	E. coli	3.0	Biological Assessment, "Poor".
Foss Ditch	Lake Dalecarlia	FS(Aquatic Life) (Threatened)	Monitored (c)	D.O.	4.5	Occasional low D.O. Center utilities STP.
Lost Creek	Nappanee	FS(Aquatic Life)	Monitored (b)		1.5	
Yellow Creek	Nappanee	NS(Aquatic Life)	Monitored (b)		1.8	Biological Assessment, "Poor".
Moffit Ditch	DeMotte	NS(Aquatic Life)	Monitored (b)		1.0	Biological Assessment, "Poor".
Unnamed Tributary of English Lake	N. Judson	NS(Aquatic Life)	Monitored (b)		1.3	Biological Assessment, "Poor".
Geisel Ditch (Spring Run)	Lowell	FS(Aquatic Life)	Monitored (b)		2.0	
Hunsley Ditch (Sheldon Amm)	Hanna	FS(Aquatic Life)	Monitored (b)		1.5	
Bice Ditch	Rensselaer	FS(Aquatic Life)	Monitored (b)		10.2	
Banham Ditch	Earl Park	NS(Aquatic Life)	Monitored (b)		3.7	Biological Assessment, "Poor".
Bruner Ditch	Rensselaer	FS(Aquatic Life)	Monitored (b)		2.7	
Curtis Creek	Rensselaer	NS(Aquatic Life)	Monitored (b)		7.0	
Curtis Creek	Rensselaer	NS(Aquatic Life)	Monitored (b)		7.0	Biological Assessment, "Poor".
Dexter Ditch	DeMotte	FS(Aquatic Life)	Monitored (b)		5.0	
Finigan Ditch	Benton	FS(Aquatic Life)	Monitored (c)		1.0	
Goshwa Ditch	Remmington	FS(Aquatic Life)	Monitored (c)		8.7	
Hickory Branch	Newton	FS(Aquatic Life)	Monitored (c)		3.0	
Lateral Ditch #77	Lewiston	FS(Aquatic Life)	Monitored (c)		3.0	
Leuck Ditch	Fowler	FS(Aquatic Life)	Monitored (c)		9.4	
Leuck Ditch	Ambia	FS(Aquatic Life)	Monitored (b)		9.4	
Mud Creek	Earl Park	FS(Aquatic Life)	Monitored (c)		14.0	
Mud Lake Ditch	Enos	NS(Aquatic Life)	Monitored (b)		3.7	Biological Assessment, "Poor".

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Narrows Ditch	Morocco	FS(Aquatic Life)	Monitored (b)		2.4	
Oliver Ditch	Rensselaer	NS(Aquatic Life)	Monitored (b)		5.2	Biological Assessment, "Poor".
Oliver Ditch	Lewiston	FS(Aquatic Life)	Monitored (b)		1.1	
Oliver Ditch	Wheatfield	NS(Aquatic Life)	Monitored (b)		1.0	Biological Assessment, "Poor".
Ryan Ditch	Lewiston	FS(Aquatic Life)	Monitored (b)		0.5	Biological Assessment, "Poor".
Slough Creek	Rensselaer	FS(Aquatic Life)	Monitored (b)		1.5	
Slough Creek	Rensselaer	NS(Aquatic Life)	Monitored (b)		1.0	Biological Assessment, "Poor".
Sugar Creek	Earl Park	FS(Aquatic Life)	Monitored (b)		6.0	
Thompson Ditch	Brooke	FS(Aquatic Life)	Monitored (b)		1.5	
Whaley Ditch	Kentland	FS(Aquatic Life)	Monitored (b)		0.5	
Lawrence Pontius Ditch	Koontz Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.4	
Robbins Ditch	Koontz Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.1	
Robbins Ditch	Hamlet	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	26.2	Biological Assessment, "Poor".
Robbins Ditch	Hamlet	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	1.3	
Blad Ditch	Hamlet	FS(Aquatic Life) NS(Recreational)	Monitored ©	Low D.O. Ammonia E. coli Phosphorous	1.4	Jellystone Park STP having operational problems.
Blad Ditch	Hamlet	FS(Aquatic Life)	Monitored (c)		3.5	
Jain Ditch	Hamlet	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	27.2	Biological Assessment, "Poor".
Danielson Ditch	Hamlet	FS(Aquatic Life) FS(Recreational)	Monitored (c)		12.5	

Table 28. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Kankakee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Bailey Ditch	Hamlet	FS(Aquatic Life) (Threatened) FS(Recreational)	Monitored ©	Low D.O.	33.5	
Laramore Ditch	Knox	FS(Aquatic Life) FS(Recreational)	Monitored (c)		19.0	
Wolf Creek	Argos	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)		5.4	
Wolf Creek	Argos	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	6.9	
Meyers Ditch	Argos	PS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Low D.O.	15.9	Argos STP permit violations causing degradation in streams.
Clifton Ditch	Hibbard	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.4	
Lowry/Listenberger Ditch	Burr Oak	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.4	
Harry Cool Ditch	Twin Lakes	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	6.0	Biological Assessment, "Poor".
Gunnard Anderson Ditch	Ancilla Domini	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.4	Ancilla Domini: STP discharge to Gilbert Lake which affects ditch.
Earl Gjemere Ditch	Ancilla Domini	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.8	
Cavanaugh Ditch	Knox	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.4	Low level toxic parameters in sediment.

1 PS = Partial Support; NS = Non Support; FS = Full Support. If a use is not listed, it was not monitored or evaluated.
2 b = biological; c = chemical.

The overall quality of the Kankakee River fish community ranges between a low of very poor (score of 12; numerous sites) to excellent (score of 57; Yellow River), based on Index of Biotic Integrity (IBI) scoring criteria. Sites classified as fair, good or excellent were considered to attain their biological uses and those classified as poor, very poor or no fish were considered not to attain their uses. In this basin, 55% of the stations attained their uses and 45% did not. The sites which had low index values were primarily attributed to poor habitat and, to a limited extent, low dissolved oxygen levels. The Yellow River, a main tributary component of the Upper Kankakee River, had very high Index of Biotic Integrity scores for almost all sites sampled.

Water quality in the Iroquois River appears to be very good in most areas. However, a biological assessment of the fish community in the reach of the river near the Town of Parr produced a poor Index of Biotic Integrity score. Biological assessments of other portions of the river were good.

In summary, 1,638 stream miles were assessed in the Kankakee River Basin. With regard to aquatic life uses, 1,074 miles (65%) fully support this use, 142 miles (9%) fully support this use but are threatened, 26 miles (2%) are partially supportive and 396 miles (24%) were not supportive. There were 1,117 miles assessed for recreational uses. Of those miles, 445 (40%) were supportive, 14 miles (1%) were partially supporting and 658 miles (59%) did not support recreational uses. Metals and sewage related problems accounted for the large majority of stream miles not supporting their designed uses.

Maumee River Basin

The Maumee River Basin is located in the northeastern portion of Indiana, and drains portions of Adams, Allen, DeKalb, Noble, and Wells counties (Figure 6). The Maumee River drainage area within the borders of Indiana is approximately 1,216 square miles. The land use is approximately 80% agriculture, 10% urban, with the remaining 10% being either forested or of other classifications. This region is one of the major livestock and corn producing areas of Indiana.

Water Quality Standards for the Maumee River basin are covered under Regulation 327 IAC 2-1 of the Indiana Water Pollution Control Board. Cedar Creek is designated as an Outstanding State Resource Water (OSRW), from DeKalb County to its confluence with the St. Joseph River in Allen County. All streams in the basin are now designated for warm water aquatic life and whole-body contact recreational use. The waters assessed, the status of designated use support, probable causes of impairment, and miles affected in the Maumee River Basin are shown in Table 29. Additional comments are also given for certain reaches. No major surveys occurred in this basin during the reporting period.

All waters in the Maumee River Basin are under a general fish consumption advisory for

Figure 6. *Maumee River basin*

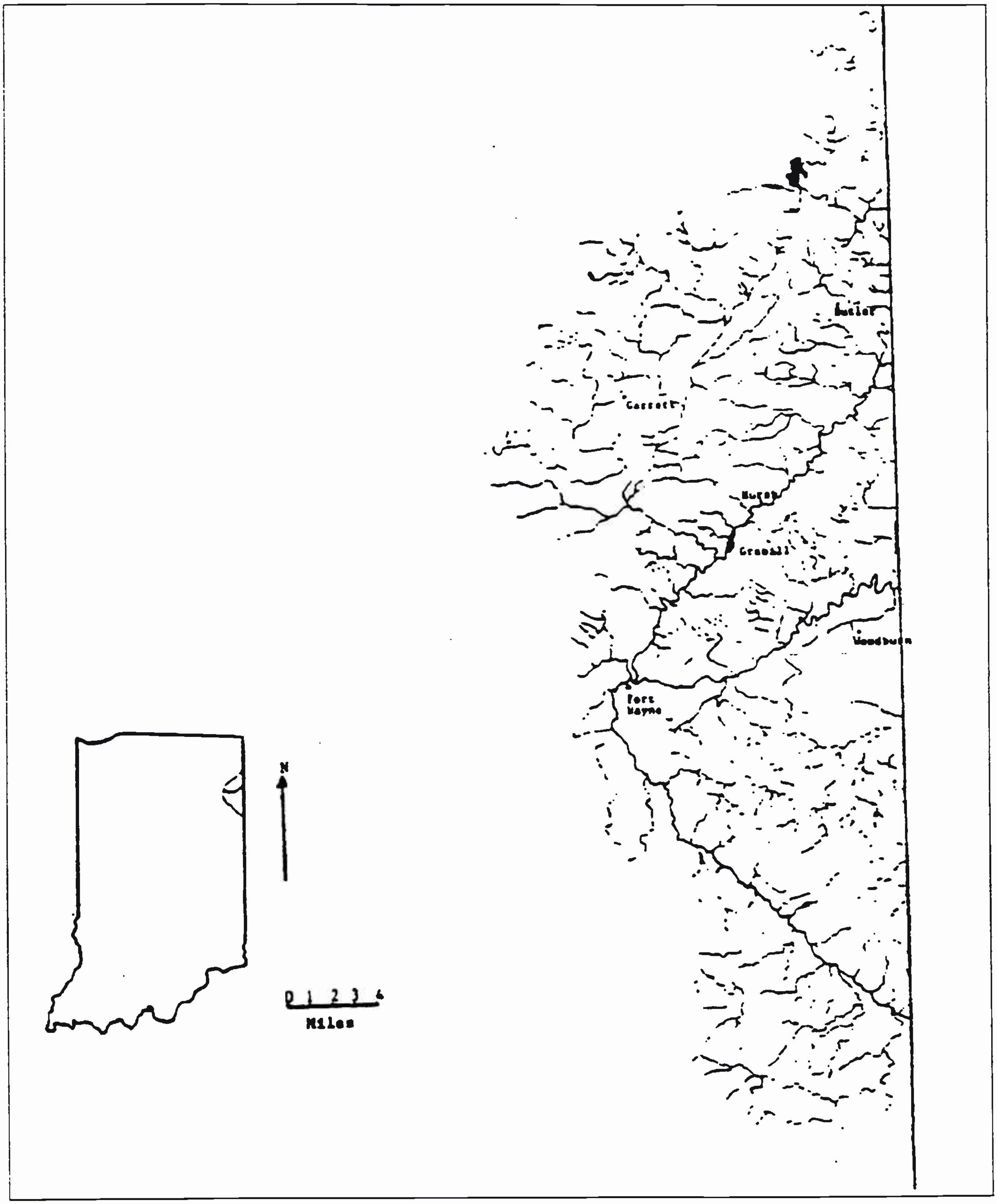


Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
St. Mary's River	State Line to Near Fort Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	11.2	CSO problems and submergence of outlying septic systems during flooding. Decatur sewage problems.
St. Mary's River	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	7.5	Pesticide (dieldrin) found in sediment at low level of concern.
St. Mary's River	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	14.8	Copper found at low levels of concern in sediment
St. Mary's River	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.2	Pesticides in sediment is low level of concern. Poly-nuclear Aromatic Hydrocarbons(PAH's) in sediment at low level of concern. Copper and zinc found at medium concern levels in sediment. 4, menthylphenol found at low levels of concern in sediment.
Yellow Creek	Monroe	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O.	14.3	Residential septic discharges. Sewage contamination. Agricultural run-off.
Blue Creek	Adams County	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O.	14.9	D.O. <4.0
Habegger Ditch	Berne	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Ammonia D.O.	10.4	Agricultural run-off. CSO activity. Cadmium in sediment.
Little Blue Creek	Southeastern Adams County	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.8	Flooding and landwash contamination.
Blue Creek	Adams County	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	12.6	Agricultural run-off.
Twenty-Seven Mile Creek	Monroe	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.5	Agricultural run-off.
Borum Run	Southwest Decatur	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.3	Whitehorse Mobile Home Park violating NPDES permit.
Koss Ditch	Decatur	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.3	
Holthouse Ditch	Decatur	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	20.4	Agricultural run-off.

Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Gerke Ditch	Decatur	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O. Ammonia	8.5	Slaughter house, Septic Tanks, Pasture land.
Bulhman Ditch	Decatur	PS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Ammonia D.O.	8.9	D.O. ranged from 11.7 mg/l to 3.4 mg/l.
Nickelson Creek	Preble	FS(Aquatic Life) FS(Recreational)	Monitored (c)		13.8	
Houk Ditch	Hoagland	FS(Aquatic Life) (Threatened) FS(Recreational)	Monitored (c)	D.O.	2.6	D.O. level at 3.7 mg/l.
Houk Ditch	Hoagland	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.6	
Unnamed Tributary	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.2	Antimony found at medium concern levels in sediment.
Harber Ditch	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	11.8	
Harber-Fairfield Ditch	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.8	
Snyder Ditch	Ft. Wayne	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. E. coli	6.4	
Junk Ditch	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.9	Copper and zinc found in sediment at a level of low concern.
Newhaus Ditch	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.4	Diedrin and chloroform were found in sediment samples at low levels of concern.
Spy Run	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.2	
St. Joseph River	State Line to Allen County	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	18	TSS impact from non point source.

Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
St. Joseph River	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c) (b)	E. coli	23	TSS impact from non point source.
Fish Creek	Hamilton	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	48.6	Farming practices.
Black Creek	Hamilton	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4	Farming practices.
Teutsch Ditch	Butler	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.2	
Big Run Drain	Butler	FS(aquatic Life) FS(Recreational)	Monitored (c)		1.3	
Big Run Drain	Butler	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli Ammonia	6.7	Ammonia from Butler STP.
Ayford Ditch	Butler	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2.7	
Buck Creek	Butler	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3	Agricultural run-off.
Sol Shank Ditch	Newville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	15.6	Agricultural sources.
Swartz, Matson, & Smith Ditches	Waterloo	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	20.4	
McCullough Ditch	Waterloo	FS(Aquatic Life) FS(Recreational)	Monitored (c)		4.05	
Leins Ditch	Waterloo	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7	
Dibbling Ditch Hoffelder Ditch	Waterloo	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8	
John Diehl Ditch	Auburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	14.5	
Peckhart/Ober Ditch	Auburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.9	

Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Grandstaff Ditch	Auburn	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.5	
Dosch/Schnadel Ditch	Auburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.8	
Garrett City Ditch	Garrett	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. Ammonia E. coli	3.7	Garrett STP.
Bear Creek	St. Joseph	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	15.2	Possible septic leaks from town of St. Joseph
Hindman Ditch	St. Joseph	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.7	
Swartz-Carnahan Ditch	St. Joseph	NS(Aquatic Life) FS(Recreational)	Monitored (c)	D.O.	3.8	D.O. < 4.0
Metcalf- Davis Ditch	Leo	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.7	
Fisher Ditch	Spencerville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		1.7	
Haifly Ditch	Grabil	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.1	
Ely Run	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.5	
Tiernan Ditch	Ft. Wayne	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. E. coli	4	
Becketts Run	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		6.6	
Cedar Creek	Cedarville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	28.6	
Little Cedar Creek	Cedarville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	32.5	

Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Willow Creek	Huntertown	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli	13.5	Possible septic discharges.
Willow Creek Branch	Huntertown	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	E. coli D.O.	7	Septic tanks
Willow Creek Ditch	Huntertown	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O.	7.3	Septic tanks
Black Creek, Bilger Ditch	LaOtto	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	14	
King Lake Ditch	Avilla	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. Ammonia E. coli	1	Avilla STP.
King Lake Ditch	Avilla	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2	
Maumee River	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		20.7	
Maumee River	Woodburn	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	7.9	Fort Wayne CSO's wet weather bypasses
Harvester Ditch	Ft. Wayne	FS(Aquatic Life) (Threatened) FS(Recreational)	Monitored (c)	Organics Metals	1.3	PAH's and metals in sediments.
Trier/Bender Doctor Ditch	Ft. Wayne	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.5	
Cochoit Ditch	Ft. Wayne	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.1	
Bullerman Ditch	New Haven	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7	
Martin Ditch	New Haven	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.1	
Six Mile Creek	New Haven	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3	Livestock.

Table 29. *Waters assessed, status of designated use support, probable causes of impairment and miles affected in the Maumee River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT	METHOD OF ASSESSMENT	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Gar Creek	New Haven	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	11.4	Possibly from septic tank.
Summers Ditch	New Haven	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	1.9	Livestock.
Wilbur/Bottern Ditch	Woodburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	12.3	Non point source run-off.
Black Creek	Woodburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	23.1	Possibly septic tanks.
Marsh Ditch/Edgerton-Carson Ditch	Woodburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.7	Woodburn STP wet weather bypasses.
Viland Ditch	Woodburn	FS(Aquatic Life) FS(Recreational)	Monitored (c)		7.4	
Hamm Interceptor Ditch	Woodburn	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	15.72	Non point source.
Grover Ditch	Harlan	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7.6	Non point source run-off.
Flatrock Creek	Monroeville	FS(Aquatic Life) FS(Recreational)	Monitored (c)		5.45	
Flatrock Creek	Monroeville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.0	
Adam-Shlemmer-Baker Ditch	Monroeville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.3	
Hoffman/Lepper/McHenry/B Bohnke Ditch	Monroeville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	27.5	Residual from recent flooding.

PS = Partial Support; NS = Non Support; FS = Full Support. If a use is not listed, it was not monitored or evaluated.
b = biological; c = chemical

PCB's and mercury. Please refer to the 1996 Indiana Fish Consumption Advisory for the listed waterways and the level of risks associated with some fish species.

The Maumee River Basin consists of three major rivers; the St. Joseph, the St. Mary's, and the Maumee. The Maumee River originates in Fort Wayne at the confluence of the St. Joseph and St. Mary's Rivers. It then flows east into Ohio where it crosses the northern portion of the state toward Toledo and empties into Lake Erie.

The St. Mary's River originates near New Bremen, Ohio and passes through five small towns before entering Indiana near Pleasant Mills in Adams County. Upon entering Indiana, the St. Mary's River follows a northwesterly course through the town of Decatur in Adams County and on into Allen County and metropolitan Ft. Wayne, where it meets with the St. Joseph River to form the beginning of the Maumee River. Major tributaries include Blue Creek, Yellow Creek, Borum Run, Holthouse Ditch, Gerke Ditch, Buhlman Ditch, Nickelsen Creek, Houk Ditch, Snyder Ditch, Harber/Fairfield Ditch, Junk ditch and Newhaus Ditch/Spy Run. The total drainage area of the basin is approximately 400 square miles. Land use in the St. Mary's River segment is predominantly agricultural, which is divided nearly equally among cropland, pasture, and untitled or wooded areas.

There has been significant industrial development in and around incorporated communities in the basin. These include municipal, industrial and semi-public facilities. Most of the public water utilities in this segment use groundwater as a source of supply. Ft. Wayne obtains water from the St. Joseph River, Cedarville Reservoir, and Hurshtown Reservoir.

Water quality in this basin was generally good except for ammonia, low dissolved oxygen (D.O.), and E. coli. Most of the D.O. violations occurred in small ditches which have algae growth in almost stagnant streams with poor reaeration. Dissolved oxygen values in this basin are significantly improved from values evident during the 1970's surveys. The average D.O. value in 1992 was the approximate equivalent of the highest value recorded during a 1976 survey. Evidence indicates that improvements to collection systems and sewage treatment works contributed to the reduction of many dissolved oxygen problems.

Ammonia violations were only marginally above the water quality standards. The highest value (3.2 mg/l) was found in a tributary to Cedar Creek. There is no known source for this value. The majority of stream samples were less than 0.1 mg/l. Streams with marginal violations were recorded downstream of local wastewater treatment plants.

Sediment samples collected downstream of Phelps Dodge Magnet/Wire outfall revealed relatively high concentrations of heavy metals and polynuclear aromatic hydrocarbons (PAHs) in Harvester Ditch, a tributary to the Maumee River. There was, however, minimal degradation of the Maumee River from this discharge.

The most significant water quality problems in the Maumee River basin were E. coli concentrations. The Indiana Water Quality standards require that E. coli concentrations not exceed 235 cfu/100 ml on a single grab sample. While most samples had concentrations from 236-500 cfu/100 ml, 17% had concentrations greater than 1,000 cfu/100 ml. Many of the higher concentrations were found in Willow Creek Ditch and Black Creek. Willow Creek Ditch and Black Creek, where many of the higher concentrations occurred, drain areas of high residential populations where septic tanks are still in use. E. coli concentrations ranged up to 15,800 cfu/100 ml along the St. Mary's River.

IDEM and U.S. EPA Region V staff sampled 21 sites in the Maumee River Basin during the 1991 field season, as part of an ongoing fish community survey. A total of 54 species was collected. These species were numerically dominated by cyprinid, catostomid, and centrarchid species. Based on an Index of Biotic Integrity, fish species diversity was used as an indicator of water quality at various points in the watershed.

The fish community survey showed that the fish assemblages of the Maumee River Basin ranged from a low of no fish (score of 0; 1 site) to good-excellent (score of 55; 1 site), based on the Index of Biotic Integrity scoring criteria. Increasing biological integrity was observed from upstream to downstream, with declining conditions observed in the headwaters of the minor tributaries. The sites with low biological integrity were primarily headwater and mid-reach rivers. The highest biotic integrity was associated with the Maumee River, at the SR 24 bridge in New Haven (IBI=55). This River segment deseves protection to ensure that the quality of the resource continues. Some of the northern tributaries are intermittent and were dry during the investigations in 1991.

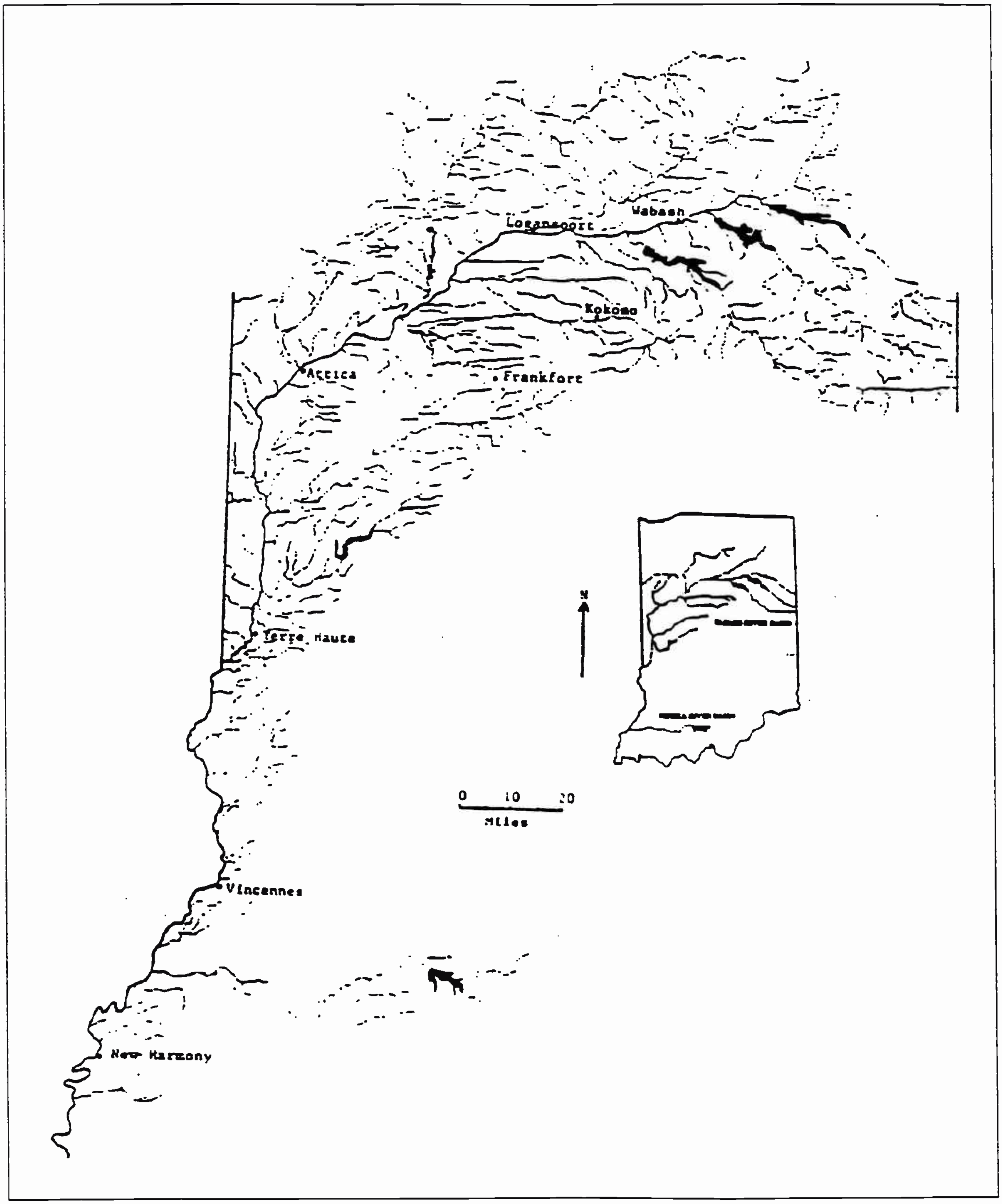
In summary, 764 miles were assessed for aquatic life uses in the Maumee River Basin. Of these total miles, 649 miles (85%) support the aquatic life designated use; another 31 miles (5%) were fully supporting, but threatened; 9 miles (1%) were only partially supportive; and 75 miles (9%) did not support the aquatic life use. Of the 764 miles assessed for recreational use, 110 miles (14%) fully supported this use while the remaining 654 miles (86%) were not supportive.

Wabash River Basin

The Wabash River Basin provides drainage for approximately 33,000 square miles of the surface area of Indiana, Illinois, and Ohio. The greatest portion of the basin is in Indiana where it drains two-thirds of the state's surface area (Figure 7). The portion of the river system addressed in this section excludes the White River Basin and is, therefore, limited to about 21,000 square miles. The Wabash, Patoka, Tippecanoe, Eel, Mississinewa and Salamonie rivers, Wildcat Creek and Sugar Creek are the major streams in this basin.

There is one large Corps of Engineers (C.O.E.) impoundment on the 450 mile river mainstream and four on its tributaries. Two narrow lakes, Freeman and Shafer, were created on

Figure 7. *Wabash River basin (including Patroka River basin)*



the Tippecanoe River by construction of hydroelectric power facility dams. All of these water bodies provide a variety of uses which require a high degree of protection.

Regulation 327 IAC 2-1 establishes the water quality standards for the Wabash River Basin. The river and its tributaries are now designated for whole body contact recreation and maintenance of a warm water fish community. In the Wabash River Basin, stretches of Wildcat Creek and the South Fork of Wildcat Creek are designated as Outstanding State Resource Waters.

Eight stream reaches within the basin have been designated as exceptional use waters and their quality must be maintained without degradation. (Table 30))

Limited use streams are those watercourses which, because of their shallow depths, lack of flow, or lack of habitat, cannot support a well-balanced aquatic community. The limited use streams in the Wabash River Basin are listed in Table 31. Surface water intakes for public water supplies are located on the waters shown in Table 32.

This basin covers a large portion of the state and is subjected to a wide array of uses, some of which have more adverse impacts on water quality than others. Waters in this basin receive a diversity of wastes from municipal sewage treatment facilities, cropland runoff, chemical manufacturing facilities, coal fired electricity generating stations, steel processing plants, and coal mines.

During this reporting period, an intensive survey of Wildcat Creek was conducted. The waters assessed, the status of designated use support, probable cause of impairment, and affected miles are shown in Table 33. Additional information is also provided in this table for certain reaches.

All waters in the Wabash River Basin are under a general fish consumption advisory for PCB's and mercury. Please refer to the 1996 Indiana Fish Consumption Advisory for the listed waterways and the level of risks associated with some fish species.

Fish tissue samples collected during 1994 from Elliott Ditch and Wea Creek downstream of the Elliott Ditch confluence in Tippecanoe County exceeded Food and Drug Administration (FDA) Action Levels for PCB's. These areas are included in the 1994 Fish Consumption Advisory (FCA). No fish species from these streams should be consumed to high levels of contamination. The source of PCB contamination is the Aluminum Company of America (ALCOA) facility which is known to have discharged low levels of PCB'S to Elliott Ditch in the past.

The Little Mississinewa River does not support the fish consumption use due to PCB'S and chlordane found in fish tissue samples. A consumption advisory for all fish from the Little Mississinewa River is currently in effect. The PCB'S apparently came from a Westinghouse

Table 30. *Exceptional use streams in Wabash River Basin*

STREAM	COUNTY	SPECIFIC PORTION
Big Pine Creek	Warren	Downstream State Road 55 to Wabash River
Mud Pine Creek	Warren	County Road between Brisco and Ridgeville to confluence with Big Pine Creek
Fall Creek	Warren	One-half mile downstream from US 41 to confluence with Big Pine Creek
Indian Creek	Montgomery	From County Road 650 West downstream to confluence with Sugar Creek
Clifty Creek	Montgomery	Within Pine Hills Nature Reserve
Bear Creek	Fountain	From County Road 450 North to confluence with Wabash River
Rattlesnake Creek	Fountain	From County Road 450 North to confluence with Bear Creek
Unnamed tributary to Bear Creek	Fountain	Within Portland Arch Nature Reserve

Table 31. *Limited use streams in Wabash River Basin*

STREAM	COUNTY	SPECIFIC PORTION
Redkey Run and Halfway Creek	Jay	From Redkey POTW to a point 2 miles downstream
Buck Creek	Sullivan	From the Sullivan South POTW to 2.25 miles downstream
Jefferson Ditch	Grant	From the Upland POTW to its confluence with Lake Branch
Unnamed Stream	Dubois	From Huntingburg City Lake Dam downstream to the Wabash River.
Spring Creek	Vigo	From Hercules, Inc. , outfall downstream to the Wabash River
Francis Dutro Ditch	Blackford	From the Blackford Canning Company discharge downstream to its confluence with Prairie Creek

Table 32. *Public water supply surface water intakes in Wabash River basin*

WABASH RIVER BASIN	
Logansport	Eel River
Kokomo	Wildcat Creek (plus wells)
Terre Haute	Wabash River (plus wells)
Turkey Run State Park	Sugar Creek
Warsaw	Center Lake
Montpelier	Salamonie River
Huntington	Wabash River
PATOKA RIVER BASIN	
Huntingburg	Huntingburg Lake
Jasper	Patoka River
Lynnville	Lynnville Lake (strip mine)
Oakland City	Oakland City Lake
Winslow	Patoka River (plus purchases)

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Wabash River	Geneva	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	16	
Wabash River	Markle	FS (Aquatic Life) NS (Recreational)	Monitored (c) (b)	E. coli	3	
Wabash River	Huntington	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	6	
Wabash River	Andrews	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli Cyanide	16	a) Some infrequent by passing at Andrews STP but normal operating is good. b) Awarded 1990 IDEM Operation and Maintenance award.
Wabash River	Wabash Peru	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	28	a) No effluent violations due to overall recycling of wate streams by Container Corporation of America. Major problem in past. b) Plans underway to build new Wabash STP plant. c) Wastewater treatment plant improvement project underway at Peru.
Wabash River	Georgetown	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	27	
Wabash River	Upstream Lafayette	FS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	E. coli	30	
Wabash River	Lafayette Terre Haute Darwin	FS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	E. coli	73	
Wabash River	Darwin to Mouth	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	185	
Salamonie River	Portland	PS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli Cyanide	23	
Salmonie River	Upstream Lancaster to Mouth	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	54	
Little Mississenewa River	Union City	FS (Aquatic Life)	Monitored (c)	PCB's Chlordane	7	PCBs and chlordane in fish tissue. Fish Consumption Advisory. No fish should be eaten.
Mississenewa River	Union City to Ridgeville	FS (Aquatic Life)	Monitored (c)		9	

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Mississenewa River	Ridgeville to Marion	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	20	Ridgeville has applied for grant for WWTP improvements.
Mississenewa River	Marion	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	36	
Mississenewa River	Jalapa to Mouth	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	37	
Eel River	Headwaters Near Churusubso	FS (Aquatic Life) (Threatened) FS (Recreational)	Monitored (c)	Nonpoint Source	5	
Eel River	Near Headwaters to Upstream South Whitney	FS (Aquatic Life) (Threatened) FS (Recreational)	Monitored (b) (c)	Nonpoint Source	20	
Eel River	South Whitney	FS (Aquatic Life) (Threatened) FS (Recreational)	Monitored (b) (c)	Nonpoint Source	2	
Eel River	2 Miles D/S South Whitley to Roann	FS (Aquatic Life) FS (Recreational)	Monitored (b) (c)	Nonpoint Source	24	
Eel River	Roann to Mouth	PS (Aquatic Life) (Threatened) NS (Recreational)	Monitored (b) (c)	E. coli Nonpoint Source Cyanide	41	
Williamson Ditch	Upstream Palestine Lake	FS (Aquatic Life) (Threatened)	Evaluated	Metals	2	
Tippecanoe River	Headwater to Rochester	FS (Aquatic Life) (Threatened) FS (Recreational)	Evaluated	Nonpoint Source	53	
Tippecanoe River	Rochester	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli Cyanide	5	Flooding caused problems with compliance due to occasional bypassing.
Tippecanoe River	Downstream Rochester to Lake Shafer	FS (Aqutic Life) NS (Recreatonal)	Monitored (c)	E. coli	102	

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Mud Creek	Sharpsville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	21.9	E. coli > 235/100 ml
North Creek and Tributaries	Sharpsville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	2.5	E. coli > 235/100 ml
Irvin Creek	Sharpsville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.3	
Turkey Creek	Windfall	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	15.1	E. coli > 235/100 ml
Askren Ditch	Windfall	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	1.9	E. coli > 235/100 ml
Cottingham Dtich	Windfall	FS (Aquaic Life) FS (Recreatioal)	Monitored (c)		2.9	
Round Prairie Dtich	Windfall	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	3.8	E. coli > 235/100 ml
Middle Fork River	West Liberty	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	7.6	E. coli > 235/100 ml
Waters Ditch	West Library	FS (Aquatic Life) FS (Recreational)	Monitored (c)		1.5	
Paley Walk	West Liberty	FS (Aquatic Life) NS (Recreational)	Monitored (c)		4.7	E. coli > 235/100 ml
Hutcherson Ditch	Point Lisabel	FS (Aquatic Life) FS (Recreational)	Monitored (c)		3.2	
Grass Fork	Point Isable	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	9.4	E. coli > 235/100 ml
Prairie Run	Point	FS (Aquatic Life) NS (Recreational)	Monitorored (c)	E. coli	2.8	E. coli > 235/100 ml
Wildcat Creek	Kokomo	FS (Aquatic Life) NS (Recreational0	Monitored (c)	E. coli	6.2	E. coli > 235/100 ml. PCBs in fish tissue. Fish Consumption Advisory. No fish should be eaten.
Wildcat Creek	Kokomo	FS (Aquaic Life) FS (Recreational)	Monitored (c)		5.3	PCBs in fish tissue. Fish Consumption Advisory. No fish should be eaten.

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Wildcat Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c) (b)	E. coli D. O. CN Lead	2.9	E. coli > 235/100 ml D.O. < 4.0 mg/l CN above CAC of .0052 mg/l Lead above CAC of 8.9 mg/l Fish Consumption Advisory. No fish should be eaten.
Wildcat Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c) (b)	E. coli CN NH3	5.4	E. coli > 235/100 ml CN > CAC of .0052 mg/l NH3 > CCC of .5 mg/l Fish Consumption Advisory. No fish should be eaten.
Wildcat Creek	Kokomo	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	14.9	E. coli > 235/100 ml. Fish Consumption Advisory. PCBs in fish tissue. No fish should be eaten.
Wildcat Creek	Burlington	FS (Aquatic Life) FS (Recreational)	Monitored (c)		35.5	Fish Consumption Advisory. PCBs in fish tissue. No fish should be eaten.
Roberts Ditch/Moon - Barclay Ditch	Burlington	FS (Aquatic Life) FS (Recreational)	Evaluated		5.5	
Shambaugh Run	Burlington	FS (Aquatic Life) NS (Recreational)		E. coli	.5	Sewage from Kokomo STP
Edwards Ditch	Burlington	FS (Aquatic Life) FS (Recreational)	Evaluated		.5	
Kokomo Reservoir	Greentown	FS (Aquatic Life) FS (Recreational)	Monitored (c)		380 Acres	
Prairie Creek Ditch	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli D.O.	2.3	E. coli > 235/100 ml D.O. of 1.5 mg./
Connon - Goyer Ditch	Kokomo	NS (Aquatic Life) NS (Rectreatinal)	Monitored (c)		1.5	E. coli > 235/100 ml D. O. <4.0 mg/l
Kokomo Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli D.O. PCB's	5.2	E. coli > 235/100 D.O. < 4.0 mg/l No fish should be eaten. Fish Consumption Advisory
Kokomo Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli D.O. Ammonia PCB's	4.2	E. coli > 235/100 ml D.O. <4.0 mg/l NH3 high No fish should be eaten. Fish Consumption Advisory

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Zauss/Finn Ditch	Kokomo	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	3.5	
Tolle Dtich	Kokomo	FS (Aquatic Life) FS (Recreational)	Evaluated		1.2	
Pickering Dtich	Kokomo	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	1.2	
Muggs - Ingels Ditch	Kokomo	FS (Aquatic Life) FS (Recretational)	Evaluated		2.4	
Martin - Youngman Scott - Youngman	Kokomo	FS (Aquatic Life) FS (Recreational)	Evalauted		2.7	
Little Wildcat Creek East Fork/Kelly West Ditch	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli CBOD D.O.	6	E. coli at 180,000/100 ml D. O. < 4.0 mg/l CBOD from facility discharging to Kelly West Ditch
Little Wildcat Creek West Fork	Kokomo	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.7	E. coli > 235/100 ml
Little Wildcat Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli D.O.	6.1	E. coli > 235/100 ml
Claus Creek	Kokomo	FS (Aquatic Life) FS (Recreaional)	Evaluated		.5	
William Vogus Ditch	Kokomo	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	2.9	E. coli > 235/100 ml
Butler Dtich	Kokomo	FS (Aquatic Life) FS (Recreational)	Evaluated		1.3	
Honey Creek	Kokomo	NS (Aquatic Life) NS (Recreational)	Monitored (c)	D.O. E. coli	7.4	D.O. of 3.0 mg/l
West Honey Creek	Russiaville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	4.1	E. coli > 235/100 ml
Walnut Fork	Russiaville	FS (Aquatic Life)	Evaluated		1.7	
Petes Run/Burchard Division Ditch	Burlington	FS (Aquatic Life) NS (Recreational)	Monitored (c)		5.8	E. coli > 235/100 ml

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Hurricane Creek/Unamed Tributary	Burlington	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	3.3	
South Fork Wildcat Creek	Entire Length	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	41	
Middle Fork Wildcat Creek	Hillsburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	33	Agricultural activity.
Silverthorn Tributary	Rossville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	2.6	Agricultural acitivity. Limited use stream.
Cambells Run	Rossvile	FS (Aquatic Life) NS (Recereational)	Monitored (c)	E. coli	14	Agricultural activity.
Elliot Ditch and Wea Creek	Lafayette	FS (Aquatic Life) NS (Recreational)	Monitored (c)	PCB's E. coli	27	Contaminated sediments from Alcoa have been removed from Elliot Ditch. Fish Consumption Advisory. PCBs in fish tissue. No fish should be eaten.
Big Pine Creek	Pine Village	FS (Aquatic Life) NS (Recreational)	Monitored (b)(c)	E. coli	77	Exceptional use stream.
Vermillion River	Cayuga	FS (Aquactic Life) NS (Recreation)	Monitored (c)	E. coli	8	
Black Creek	Crawfordsville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	11.5	
Dry Branch	Crawfordsville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	3.0	
Walnut Fork	Cawfordsville	FS (Aquatic Life)	Monitored (c)		22	
Lye Creek	Darlington	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	6.5	Lower reaches used as warm water fishery.
Honey Creek	Darlington STP	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	3.1	E. coli > 1,200/100 Darlington STP
Withe Creek	Colfax STP	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	7.7	Highest E. coli upstream of Colfax STP. Wide variety of msall fish and aquatic life.
Goldberry Creek	Colfax	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.8	E. coli > 3,200/100

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Golberry Creek	Colfax	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.8	E. coli > 3,200/100
Wolf Creek	Colfax	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	12.5	Pastureland
Prairie Creek	Lebanon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	24.1	Septic systems.
Brush Creek	Lebanon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	9.1	Pastureland
Spring Creek	Lebanon	FS (Aquatic Life) FS (Recreational)	Monitored (c)		6.3	Limited use stream.
Sugar Creek	Above Crawfordsville	FS (Aquatic Life)	Monitored (c)		35	
Sugar Creek	Near Crawfordsville	NS (Aquatic Life)	Monitored (c)	PCB's	7	
Sugar Creek	Downstream Crawfordsville to Mouth	FS (Aquatic Life) FS (Recreational)	Monitored (c)		30	
Little Sugar Creek	Near Crawfordsville	FS (Aquatic Life)	Monitored (c)	PCB's	10	Fish Consumption Advisory. No fish should be eaten.
Rattlesnake Creek	New Market	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	23.7	
Corner Creek	New Market	FS (Aquatic Life)	Evaluated		6.2	
Indiana Creek	New Market	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	15.2	
Sugar Mill Creek	Wallace	FS (Aquatic Life) FS (Recreational)	Monitored (c)		36.6	
Roaring Creek	West Union	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	8.1	
Rush Creek	West Union	FS (Aquatic Life) FS (Recreational)	Monitored (c)		10.7	
Big Raccoon Creek	Entire length (except for 1 mile)	FS (Aquatic Life)	Monitored (b)		82	Based on DePauw University fish population study.

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Big Raccoon Creek	Coxville	FS (Aquatic Life) (Threatened)	Evaluated	Acid Mine Darinage	1	
Otter Creek (Upper)	Vigo and Clay Counties	FS (Aquatic Life) (Threatened)	Monitored (b)	Acid Mine Drainage	11	
Otter Creek (Lower)	Vigo County	FS (Aquatic Life)	Monitored (b)		9	
Philipps Ditch	Walton	PS (Aquatic Life)	Evluated	Ammonia	2	Some violations from Walton STP may have impacted Phillips Ditch to a Minor degree
Coal Creek	Vigo County	PS (Aquatic Life)	Evaluated	Acid Mine Darinage, Silt	7	
Blue River	Columbia City	FS (Aquatic Life) FS (Recreational)	Evaluated		3	
Flack Ditch	Laketon	FS (Aquatic Life)	Evaluated		1	
Brouilletts Creek	Vigo and Vermillion Counties	FS (Aquatic Life) (Threatnened)	Evaluated	Acid Mine Drainage	2	
Honey Creek and Tributary	Terre Haute	PS (Aquatic Life)	Evaluated	Acid Mine Drainage	27	
Busseron Creek	Sullivan County	PS (Aquatic Life)	Evaluated	Acid Mine Darinage	23	
Mud Creek	Sullivan County	NS (Aquatic Life)	Evaluated	Acid Mine Drainage	7	Heavy coal fine deposition observed.
Sulphur Creek	Sullivan County	NS (Aquatic Life)	Evaluated	Acid Mine Drainage	7	Deposits of unknown origin observed and an effluent odor detected
Patoka River	Jasper to Mouth	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli TSS	86	Minor grease and oil desposits in storm ditches add to a TSS problem
South Fork of Patoka River	Pike, Warrick, and Gibson Counties	FS (Aquatic Life) (Threatened)	Evaluated	Acid Mine Drainage	40	Oakland City STP has severe bypassing problems to tributary
South Fork Smalls Creek	Bruceville	NS (Aquatic Life)	Evaluated	Acid Mine Drainage	8	Iron precipitate observed downstream of Smalls Creek to mouth
Sugar Creek	Vigo County	NS (Aquatic Life)	Evaluated	Acid Mine Drainage	9	

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Turman Creek	Sullivan County	FS (Aquatic Life) (Threatened)	Evaluated	Acid Mine Drainage	3	
Big Shawnee Creek	Attica	FS (Aquatic Life)	Evaluated		26	
Little Wabash River	Roanoke	FS (Aquatic Life) (Threatened)	Evaluated	Metals in Roanoke STP Lagoons	21	
Humbert Ditch	Fowler	FS (Aquatic Life)	Evaluated		1	
Round Prairie Creek	Wndfall	FS (Aquatic Life)	Evaluated		1	
Towns and Lucas Ditch	Shamrock Lakes	FS (Aquatic Life)	Evaluated		6	
Hoagland Ditch	Wolcott	FS (Aquatic Life)	Evaluated		12	
Chippewanuk Creek	Akron	FS (Aquatic Life)	Evaluated		2	
Walnut Creek	Warsaw	FS (Aquatic Life)	Evluated		5	a) Warasaw STP in excess of cyanide limits. A dozen volatile organic compounds were fond in influent/effluent (small concentrations) b) High volume of metals concentrations found
Danner Ditch	Etna Creek	FS (Aquatic Life)	Evaluated		5	
Little Pipe Creek	Converse	PS (Aquatic Life)	Evaluated		2	
Grant Creek	LaFontaine	FS (Aquatic Life)	Evaluated		3	
Burnetts Creek	Burnettsville	FS (Aquatic Life)	Evaluated		5	
Rock Creek	West lebanon	FS (Aquatic Life)	Evaluated		4	
Mill Creek	Kingman	FS (Aquatic Life)	Evaluated		8	
N. Fork Coal Creek	Winagate	FS (Aquatic Life)	Evaluated		4	
Roaring Creek	Marshall	FS (Aquatic Life)	Evaluated		4	
East Fork Coal Crek	Waynetown	FS (Aquatic Life)	Evluated		10	
Withe Creek	Colfax	FS (Aquatic Life)	Evaluated		5	

Table 33. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the Wabash River Basin (including Patoka River) (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
North Branch Otter Creek	Carbon	FS (Aquatic Life)	Evaluated		10	
Little Raccoon Creek	Russellville	FS (Aquatic Life)	Evaluated		16	
West Fork Busseron Creek	Farmersburg	FS (Aquatic Life)	Evaluated		7	
Bond Ditch	Oaktown	FS (Aquatic Life)	Evaluated		3	
Lost Creek	Francisco	FS (Aquatic Life)	Evaluated		2	
Little Pine Creek	Green Hill	FS (Aquatic Life) (Threatened)	Evaluated	Nonpoint Source	16.2	
Indian Creek	Klondike	FS (Aquatic Life) (Threatened)	Evaluated	Nonpoint Source	9.4	
Trimble Creek	Mentone	PS (Aquatic Life) PS (Recreational)	Evaluated	BOD TSS Ammonia E. coli	4	Problems from past procedures remain. Poultry plant is now closed
Yellow Creek	Mentone	FS (Aquatic Life)	Evaluated		1	Mentone completed an STP

PS = Partial Support; NS - Non Support; FS = Full Support. If a use is not listed, it was not monitored or evaluated
b = biological; c = chemical.

facility which discharged to the Union City STP. This, in turn, discharged to the Little Mississinewa River, which is a tributary of the Mississinewa River. A.O. Smith purchased the Westinghouse facility in 1986 and began cleaning the site and the sewers leading to the Union City STP. In the course of the cleanup, additional PCB contaminated areas were found. At this time, A.O. Smith exercised an option in the purchase contract that required Westinghouse to repurchase the site if contamination was found. Westinghouse then did additional cleaning in 1989, but the effectiveness of the cleanup remains in question. Additional sampling is now being done and the site is currently being scored for CERCLA. Some samples indicate levels above 5 parts per million (ppm), 12 inches below the soil. The Union City STP has been cleaned and PCB'S are no longer being discharged from this facility.

Little Sugar Creek does not support fish consumption use and has a fish consumption advisory for all species due to PCB concentrations in fish tissue. The Mallory Landfill site is the source of the PCB contamination. This site has now been cleaned up. Recent fish tissue and sediment samples from these streams show reduced PCB concentration, but fish tissue concentrations are still high.

The Patoka River receives acid mine drainage and organic loading from the Jasper and Oakland City STPs, but aquatic life uses are supported. The South Fork of the Patoka and it's tributaries have a large percentage of abandoned coal mined area. Acid mine drainage from mining operations causes an accumulation of heavy metals and acid which could impact fish survival.

While most of the Wabash River fully supports aquatic life, 16 miles are non supportive due to cyanide. Fixed station water monitoring results taken near the town of Andrews also indicated that cyanide levels were high enough to violate the chronic criteria (5.2 μg/L) 27% of the time, but were less than the acute criteria (22 μg/L). The source of the cyanide is unknown. Cyanide concentrations of 6.0 and 11.5 mg/kg were noted in sediment samples. Pesticide sampling was also conducted during 1993 in six tributaries to the Wabash. Five pesticide compounds (Atrazine, Alachlor, Cyanazine, Metolachlor, and Metribuzine) were noted above detection limits. These pesticides are commonly used by farmers and are present due to agricultural run off.

Five miles of the Tippecanoe River do not support aquatic life due to cyanide levels which violate the chronic aquatic criteria. Nonpoint source impacts, specifically erosion and agricultural run off, threaten the recovery and maintenance of the type of fish community which could exist in the river. Both the Eel and Salamonie Rivers were impacted by cyanide concentrations above the chronic level, making portions of these rivers only partially supportive of aquatic life.

A comprehensive survey of Wildcat Creek and its South Fork was conducted in June 1994. Some of the major streams in this segment include Mud Creek, Turkey Creek, Kokomo Creek, and Honey Creek. The initial reach of Wildcat Creek begins in southwestern Howard

County and follows a northwestern path to the headwaters of Kokomo Reservoir, just south of Greentown.

The headwaters of Mud Creek begin in northwestern Tipton County and follow a northeasterly course to a confluence with Wildcat Creek in Howard County. The stream is situated in a predominately agricultural area with a short portion skirting the southern edge of Sharpsville. Two small livestock operations are located along this stream reach.

Water quality appeared good at the time of sampling with some algae and aquatic plants present. Minnows were observed at a majority of the sampling sites with small fish, crayfish and turtles observed at a few sites.

E.coli was the only stream standard violation found in the waterbody. E. coli exceeded the standard of 235cfu/100 ml for ten of thirteen samples taken. The highest count, 1500cfu/100ml was found just downstream of the livestock operations. Specific sources for the remaining sample sites are undetermined other than a livestock operation at C.R. 600 North. Some possible explanations may be runoff, livestock, wildlife, or septic tank seepage. All other parameters were found to be well within stream criteria.

Turkey Creek, much like Mud Creek, originates in northwestern Tipton County and meanders in a northeastern direction to its confluence with Mud Creek a few miles north of Windfall. Similarly, Turkey Creek is bordered by agriculture and has steep banks with tall grass and a few trees.

The water appearance is good except for an occasional, slow-moving pool where floating weed seeds and algae were creating a surface scum. Aquatic plants and minnows can be observed along this stream. Large carp were also seen. There was no visual evidence of degradation along this reach of the stream.

Field and laboratory analyses showed four out of five sample sites exceeded the E. coli stream standard of 235cfu/100ml. The highest level found was 830cfu/100ml. The sources for these counts are unidentified and, as determined with Mud Creek, could originate from a variety of sources.

Round Prairie Ditch begins southeast of Windfall and follows a northwesterly course which skirts the southern and southwestern edges of Windfall. The Windfall STP and a seed processing plant (Voorhis Seed), discharge to this stream and could impact water quality.

This slow moving low gradient stream is pooled over much of its length and channelized for roughly half its total reach. Except for the Windfall area the stream is surrounded by cropland, has steep grassy banks, and very few trees overhanging the stream. The pooled effect had promoted algae growth, some duckweed, and turbidity, making sediment and aquatic life observations difficult.

During pre-survey work in 1993, a fish kill was discovered in progress from a few hundred yards downstream of SR 213 to a point near the confluence with Turkey Creek. The source of degradation was traced to Voorhis Seeds which had recently washed down a soybean bin and discharged the contents to the creek. The rotting and decaying beans were depleting the stream oxygen and thereby causing the kill.

This facility subsequently entered into an agreed order and paid a substantial fine. The discharge pipe was blocked off to effectively prevent future deleterious discharges. There were no problems related to this facility during the 1994 intensive survey work.

The survey data for 1994 showed E. coli to be the only stream standard violation for this water body. The highest count was 1200 cfu/100 ml. Sources of this contamination were unidentified and could encompass a myriad of possibilities such as livestock, wildlife, or runoff.

The Windfall STP violated permit limits for suspended solids and ammonia during the 1994 survey. These violations were not impacting downstream water quality as observed by data at any downstream sampling locations.

Based strictly on the more recent water quality data collected in 1994, this water body can be assessed as being supportive of aquatic life but non supportive of full body recreational contact. The STP violations represent a threat to the support designation for aquatic life.

Middle Fork River, including Waters Ditch, Paley Walk, Hutcherson Ditch, Grassy Fork, and Prairie Run have similar geography and physical stream characteristics. The majority of these tributaries are located in western Grant County and generally follow a northwesterly path where Middle Fork and Grassy Fork meet to form the beginning of Wildcat Creek.

These water bodies are situated in an agricultural area with only the small communities of Point Isabel and West Liberty existing within the drainage area. The tributaries are meandering and most appeared to have good re-aeration. The riparian zones varied from grassy (and open to sunlight) to wooded with significant shading. Most of these waters are in good condition with clear water, some algae, and no sources of degradation. The exceptions were where livestock operations were having some aesthetic and erosion impacts but very little analytical water quality impact. Minnows and some larger fish were seen throughout this stream reach.

Water quality analyses showed several samples exceeding the stream standard for E. coli (235cfu/100ml). The highest count was 910cfu/100ml. Other than livestock around the area, there were no specific sources for the E.coli counts.

The initial reach of Wildcat Creek begins in southwestern Howard County and follows a northwestern path to the headwater of Kokomo Reservoir just south of Greentown. This reach of Wildcat Creek is located in an agricultural area with a short reach skirting the southwestern edge of the small community of Jerome. This is a very scenic and pretty reach of Wildcat Creek.

The reach of Wildcat Creek that flows through the heart of Kokomo is bordered by various industrial and commercial facilities as well as some residential areas. Large carp and small-mouth bass are regularly observed throughout the stream.

Some of the facilities in this area have the potential to impact the creek. These include the Kokomo Waterworks Plant, Mervis Industries (metal scrap yard), the defunct Cuneo Printing Press operation, and the lone NPDES discharger, Syndicate Sales, which discharges through a CSO. Additionally, a total of 19 CSO's and a multitude of unidentified discharge pipes exist within this reach.

Due to the myriad of commercial and industrial activity and historical problems documented on this reach of the Wildcat, metals and total toxic organics (full priority pollutant scan) were collected during a 1993-94 intensive survey. In addition to a complete fish consumption advisory, numerous stream standard violations were found from the laboratory and field data which also prohibits this water body from achieving support status for both aquatic life and full body contact. E. coli exceeded the stream standard at several sample sites with the highest being 3500cfu/100ml. These levels are probably attributed to the plethora of CSO's in this reach.

Dissolved oxygen (D.O.)was below the state stream standard (<4.0mg/L) in this reach. The cumulative impact of all CSO's and discharge pipes may be a plausible explanation for the D.O. sags. Cyanide levels throughout this reach would exceed the chronic aquatic criteria (CAC) should the levels found in the twenty-four hour sampling period persist for a four-day average. Cyanide levels were 0.007 μg/L at two sampling sites and exceeded the CAC of 0.0052 μg/L. Additionally, lead was found at 19.0 μg/L at one of the same sites which would exceed the CAC of 8.9 μg/L should that level persist for a four-day average. The sample sites where these levels were found are situated in an industrial and commercial area where any number of possibilities may have contributed the pollutants. The lead level may be due to the high number of vehicles using this area with numerous parking lots and US 31 just upstream, and the runoff from the previous day's precipitation. Three CSO points just upstream of this area may also have contributed to these levels.

Total toxic organic analyses revealed numerous priority pollutant parameters above detection limits in three sediment samples collected from this water body. Most significantly, the group of compounds classified as polynuclear aromatic hydrocarbons (PAH) were prevalent at all three of the sampling locations. Of the PAH's, flouranthene was found at the highest concentrations at all three sampling sites. Benzopyrene was also found at one site. Considering the industrial history of Kokomo, these compounds have probably accumulated from air emissions. None of the PAH'S were found above detection limits in any of the water samples. The only toxic organic compound found above detection limits in the stream samples was tetrachloroethane (TCE), a volatile organic compound (VOC).

Another six mile segment of Wildcat Creek begins in the heart of Kokomo and flows in a westerly direction through industrial and suburban residential areas. Aquatic life was not readily apparent along this reach of Wildcat Creek, but some turtles were observed.

Potentially significant nonpoint sources of runoff include the abandoned Continental Steel grounds, which includes a Super fund site, two landfills at Hayes International which have undergone closure certifications under RCRA, and a Continental Steel slag disposal site which drains into a Martin Marietta gravel pit. Various sizes of metal parts and severely rusted and deteriorated metal drums were observed at the slag disposal site.

Three NPDES dischargers to this reach of Wildcat Creek, Kokomo STP, Devon Woods Subdivision, and Four Mile Subdivision were sampled in 1993 with all found to be meeting permit limits. Facility sampling during the 1994 survey revealed the Kokomo STP and Devon Woods Subdivision would violate permit limits should levels of certain parameters continue for a week or a month. The STP cyanide level of 0.029 mg/L would exceed the weekly and monthly averages of 0.01mg/L and 0.02 mg/L, respectively. There was not a known source for the influent cyanide level of 0.045 mg/L. The Devon Woods BOD5 level of 40 mg/L would exceed the monthly limitation of 30mg/L. Although not permitted, an elevated ammonia level of (11 mg/L) was also observed in the Devon Woods outfall. Bacteriological analyses of the Four Mile Subdivision effluent showed E.coli at a very high level of 7600cfu/100ml. The permit has limits set for Fecal coliform at 400cfu/100ml (weekly average) and 200cfu/100ml (monthly average).

Although Haynes International was not discharging contact cooling water at the time of sampling, flows were passing through their outfalls in the form of storm water. This water was sampled for general chemistry, nutrients, metals, and total toxic organics as a scan for potential runoff impact upon the stream. Cyanide was analyzed at 0.006 mg/L in outfall 003 which compares with the CAC stream standard of 0.0052 mg/L. Additionally, four volatile organic compounds were found slightly above the method detection. The highest parameter found was cis-1,2-dicloroethene at 5.5 μg/L.

Total toxic analyses on a Martin Marietta outfall disclosed no parameters above detection limits. Significantly, this appears to indicate the drainage from the slag disposal site was not having a deleterious impact on the gravel pit and thence the discharge to Wildcat Creek.

Stream data indicate this six mile reach of Wildcat Creek to be non supportive of both aquatic life and full body contact. All sample sites were found to exceed the E. coli stream standard of 235 cfu/100 ml. The highest level found was 6600 cfu/100 ml which was on the tributary of Shambaugh Run and downstream of where raw sewage was observed flowing into the creek during a pre-survey. The highest level observed on the main stem of Wildcat Creek was 1100 cfu/100 ml downstream of the Shambaugh Run confluence.

Cyanide, as was the case of the upstream water body, was again found to be a threat to aquatic life should the level of 0.011 mg/L at a site near the Norfolk & Western railroad bridge persist for a four-day average. This level exceeds the CAC stream standard of 0.0052 mg/L. As mentioned in the facilities discussion of this water body, possible contributing sources include the Kokomo STP (0.029 mg/L) and Haynes International (0.006 mg/L).

Ammonia was also found to pose a threat to aquatic life as observed by a level of 1.0 mg/L at the same site. The chronic aquatic criteria level (CAC) would have been exceeded should the pH and temperature levels remained static as found during one of the composting intervals. A pH of 8.29 S.U. and a temperature of 24.06°C at 6.45 P.M. correlates to a CAC stream standard of 0.51 mg/L. The Kokomo STP and Haynes International discharges were the likely sources with levels of 4.1 mg/L and 1.0 mg/L analyzed in their respective outfalls.

Sediment samples indicated numerous toxic organic compounds to be present in the sediment. Most significantly, PAH'S were present at all sediment collection sites. The highest levels were observed at the Norfolk & Western railroad bridge site where fluoranthene (3200 μg/L), pyrene (2300 μg/L), cyrsene (1700 μg/L), benzo(b)fluoranthene (1500 μg/L), benzo(a)anthracene (1300 μg/L) and benzo(a)pyrene (920 μg/L) were found.

A defoliant, 2,4,5-trichlorophenol was found in the sediment at 720 μg/L. Most significantly, as cited in the *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, this compound will break down in an alkaline medium at high temperatures to form dioxin. Other compounds found included a relatively high level (24 μg/L) of the pesticide Beta BHC. Numerous phthalate compounds were found above detection limits.

Green Acres Subdivision was sampled during both intensive surveys in 1993 and 1994. The 1993 data showed the facility was meeting all permit parameters. Sampling in 1994 indicated the facility was experiencing numerous problems which were causing permit violations. $CBOD_5$ was found at 57 mg/L, which would exceed the monthly and weekly averages of 30 mg/L and 45 mg/L, respectively. Additionally, suspended solids were found at 57 mg/L which would exceed the monthly and weekly averages of 30 mg/L and 45 mg/L, respectively. Although not permitted, ammonia and E. coli were found at high levels. Ammonia was analyzed at 7.2 mg/L and E. coli was found at an extremely high count of 190,000 cfu/100 ml. This plant obviously had many problems due to poor operation and maintenance.

Prairie Creek Ditch is a small tributary of Wildcat Creek which has unusual physical characteristics and degraded water quality. This ditch originates northeast of Kokomo and is fed by agricultural tiles which make up a majority of the headwater flow. Much of the stream length is channelized and has a nominal gradient causing slow moving and pooled conditions. One of the tributaries is fed by a large drainage pipe and was observed to have an unexplainable dark amber hue during the time of the survey. Algae were abundant in areas where the flow was barely detectable. Stately Manor Mobile Home Park discharges to a farm ditch which is pumped up to an underground tile which eventually finds its way to Prairie Creek Ditch.

The upper half of Prairie Creek Ditch is situated in an agricultural area with the lower half bordered by industrial, commercial, and finally Delco Park at the mouth. Carp and minnows were observed in the stream.

Sample data indicate this water body is not supportive of aquatic life or full body contact recreation. E. coli violations were found and low D.O. (dissolved oxygen) of 1.5 mg/L were found where an extreme diurnal fluctuation was observed due to the algae growth. The fish observed at this site appeared lethargic and sluggish. Field and laboratory data from the small tributary with the amber hue met all water quality criteria.

The Stately Manor Mobile Home Park sewage treatment plant did not appear well maintained at the time of the survey. Sample data, however, showed the facility to be meeting permit limits.

Cannon-Goyer Ditch is a small tributary of Wildcat Creek which flows in a northwesterly direction through residential neighborhoods on the east side of Kokomo. Some commercial establishments border the stream near the mouth. The upper two-thirds of this stream is meandering and follows a natural course whereas the lower one-third has been channelized. A wooded area along the riparian corridor was causing extreme shading of the stream. The water appeared muddy and turbid, which effectively prevented observation of aquatic life and sediment.

This water body is assessed as non supportive of aquatic life and full body contact based on laboratory and field analyses. E. coli was found at 3300 cfu/100 ml which exceeded the stream standard of 235 cfu/100 ml. Some D.O. concentrations were below the stream standard of 4.0 mg/L. There was not an observed point source which could be causing these violations.

The headwater of Kokomo Creek begins as a network of tributaries southeast of Kokomo and initially flows northeast, then north, and finally due west to its ending point. Land usage is predominately agricultural with a few residences dotting the length of the reach. The stream has been channelized in places and for the most part appeared as a continuous pool. The riparian zone had various amounts of vegetative growth but most of the stream was exposed to sunlight. The water appeared muddy and turbid with moderate algae growth. Minnows were observed. There was no visual degradation observed in this water body. Laboratory and field analyses showed this water body to be non supportive of both aquatic life and full body contact recreation. E. coli was found in excess of the stream standard with a high value of 3500 cfu/100 ml. Some D.O. values were found to be below the minimum stream standard of 4.0 mg/L. Values found were 3.7 mg/L and 3.6 mg/L, respectively. Algae were causing a moderate diurnal fluctuation where the high D.O. was 9.36 mg/L.

The next nine mile reach of Kokomo Creek is situated southeast of Kokomo and follows a western course to an ending point on the southern edge of Kokomo. Much of this reach is shaded with the two upstream sites bordered by woodland and the downstream riparian zones being tree lined. This reach was typically a pool-riffle-pool type flow. Water was turbid and slightly muddy. Sediment varied from mud and sand at the upstream sites to rock, gravel, and silt at the downstream site. The only aquatic life observed was a school of minnows at the upstream location.

Sampling of four semi-public facilities in the area revealed marginal suspended solids permit violations at Regency Mobile Home Park, Taylor High School, and Timbernest Apartments. More significantly, ammonia was analyzed at 5.4 mg/L in the Regency effluent and 3.4 mg/L in the Taylor High School effluent for the 1993 sampling survey. Ammonia was again found in the Regency Mobile Home Park effluent in 1994 at a relatively high level of 6.9 mg/L. Ammonia is not a permit parameter for either of these facilities. Center Meadows Apartments was found to be meeting permit limits for both the 1993 and 1994 sampling surveys.

Laboratory and field data showed this water body to be non supportive of both aquatic life and full body contact recreation. E. coli levels prohibited full body contact for this stream. Some D.O. concentrations were below the minimum allowable stream standard of 4.0 mg/L. A low reading of 3.4 mg/L was observed. Diurnal fluctuation was not a factor at this location. The elevated ammonia discharges from the two semi-public facilities did not cause a stream standard exceedence for ammonia at any downstream locations.

Total toxic organic sampling showed a few parameters above detection in the sediment. The most significant findings were the defoliant 2,4,5-trichlorophenol at 730 μg/L and a PAH, fluoranthene, at 290 μg/L. There were no toxic parameters above detection in the water samples at this location.

In the lower 3 miles, Kokomo Creek travels a meandering course through residential, commercial, and industrial areas, in addition to a city park en route to the confluence with Wildcat Creek. The riparian zone varies from weeds, shrubs, and trees along the majority of this reach to open mowed grassy areas in Highland Park. The water varied from clear in riffle areas to turbid and greenish-brown in a small lake area created by a spillway in the city park. Minnows were observed in this reach and several fishermen along the Highland Park Walk Bridge related that rock bass, bluegill, smallmouth bass, and catfish had been caught at this location.

Stream sampling showed this water body to be non supportive of full body contact recreation. E. coli concentrations were found above stream standards, the highest value found being 4100 cfu/100 ml at Lafountain Street. A cyanide level of 0.006 mg/L was found at a Delco Electronics outfall which would exceed the CAC stream standard of 0.0052 mg/L should this level persist for a four-day average. There is not a known source for this cyanide level.

Sediments were collected in this reach of the stream and results disclosed numerous and relatively elevated levels of toxic organic compounds. As has been found in other water bodies in the Kokomo area, the PAH group of compounds was the most common. Some differences with the highest concentrations found in this reach include fluoranthene (9,100 μg/L), pyrene (7,400 μg/L), cyrsene (4,500 μg/L), benzo(b)fluoranthene (4,200 μg/L), benzo(a)anthracene (4,100 μg/L), benzo(a)pyrene (2,900 μg/L), phenanthrene (1,600 μg/L), and anthracene (1,600 μg/L). Some toxic parameters other than PAH'S found in the sediment were carbazole (1,400 μg/L), 2-nitrophenol (960 μg/L), 2,4,5-trichlorophenol (780 μg/L), and dibenzofuran (390 μg/L). All of these compounds were found along US 31. Elevated levels of numerous phthalate compounds appear to be from more than just background contamination which is common with these plasticizer compounds.

PCB contamination has been a documented problem in Kokomo Creek as well as Wildcat Creek. A sediment sampling study conducted in October of 1988 revealed PCB's concentrations as high as 12,000 μg/L. This most recent intensive survey did not reveal PCB's above detection at any stream or sediment collection location. However, a fish consumption advisory indicating no consumption of fish from these streams is now in effect.

The East Fork of Little Wildcat Creek is a headwater stream which originates south of Kokomo and is initially bordered by an agricultural area. The stream follows a course to suburban Kokomo and is bordered by residential areas for the final half of the reach. The stream was observed to be channelized and pooled in most locations with algae prevalent. At the County Line Road site portions of this creek are very marshy, stagnant, and wide due to beaver activity which has dammed the stream. Riparian zones varied from grassy banks in the agricultural areas to wooded reaches causing considerable stream cover. Schools of minnows have been observed in this reach.

Two mobile home park facilities' effluent combine into a common effluent pipe which discharges to and helps form a very short unnamed tributary (40 yards in length). Sampling of this ditch indicated an elevated level of E. coli contamination at 86,000 cfu/100ml.

Stream sampling of the main stem and Kelly West Ditch showed this water body to be non supportive of aquatic life and full body contact recreation. E. coli counts exceeded the stream standard at all seven sample sites. D.O. values below the water quality criteria were also found at several sites.

The West Fork of Little Wildcat Creek originates southwest of Kokomo and flows in a northern direction to a confluence with the East Fork of Little Wildcat Creek. The stream is bordered by intermittent residential areas located within an agricultural area. Laboratory and field analyses showed this stream to be supportive of aquatic life but non supportive of full body contact recreation. E. coli was found to exceed the stream standard.

The next seven mile reach of Little Wildcat Creek is located southwest of Kokomo and flows in a general westerly direction before turning north to a confluence with Wildcat Creek. This reach was interspersed with residences which were situated in a larger agricultural area. Large carp and minnows were observed.

Field and laboratory data indicated this water body to be non supportive of both aquatic life and full body contact. E. coli exceeded the stream standard with the highest level found being 1300 cfu/100 ml. The D.O. levels were also below standards within this reach.

William Vogus Ditch is a small tributary located east of Russiaville. It follows a northern course to a confluence with Little Wildcat Creek. This stream is situated in an agricultural area with a few residences interspersed along the reach. Analyses of this water body showed conditions to be supportive of aquatic life but non supportive of full body contact. E. coli was inordinately high in this water body but did not appear to be due to the Western High School discharge.

Honey Creek follows a northwesterly course and skirts the western edge of Russiaville to a confluence with Wildcat Creek. Land usage is predominately agricultural with some residences located within it. Algae growth was prevalent at most locations. The sediment varied from sand to gravel and large rock. Minnows were observed.

Field analyses showed this water body to be non supportive of both aquatic life and full body contact. A low D.O. reading of 3.0 mg/L was due to algae growth and a high diurnal fluctuation. The highest D.O. at this location was 17.0 mg/L. Additionally, E. coli exceeded the stream standard at four of the five sample sites. The highest site had a count of 890 cfu/100 ml.

West Honey Creek originates southwest of Russiaville and follows a northern course which skirts the western edge of Russiaville and eventually turns east to a confluence with Honey Creek just north of the small town of New London. Most of the stream reach is situated in agricultural areas except for residences which are on the western edge of Russiaville. A farm with pasture land and cattle having access to the stream was located just downstream from the Russiaville STP. The riparian zone was primarily wooded with a few cleared areas having tall grasses and shrubs. Pool/riffle/pool effects were common which appeared to indicate good re-aeration. Algae were prevalent at most sample locations. Stream sediment varied from sand and mud to rock and gravel. A peculiar odor was noticed upstream where an orange tint to one side of the stream indicated a high iron content spring seepage with resultant iron bacteria growth. The only aquatic life observed was small fish.

The Russiaville STP was sampled for both intensive surveys conducted in September 1993 and June 1994. Compliance sampling inspections (CSI) showed this facility to be hydraulically overloaded and experiencing operation and maintenance problems. These problems caused permit violations and a degraded effluent for both surveys. The 1993 CSI indicated ammonia (8.9 mg/L), suspended solids (207 mg/L), D.O. (4.5 mg/L) and E. coli (370,000 cfu/100 ml) would violate permit limits if these values continued. These same parameters would violate permit limits for the 1994 CSI should the levels continue for a week or month. Values found were 11 mg/L, 144 mg/L, 4.5 mg/L, and 130,000 cfu/100 ml for ammonia, suspended solids, D.O. and E. coli, respectively.

Despite the problems and threat to aquatic life from the Russiaville STP, this water body was found to be meeting aquatic life criteria. High E. coli counts, rendered this water body non supportive of full body contact recreation. The highest value found was 6,400 cfu/100 ml downstream from the STP where cattle had access to the stream.

Petes Run/Burchard Davison Ditch is a tributary of Wildcat Creek and drains a network of small streams east of Burlington. The stream flows generally in a southwestern and then a southern direction to a confluence with Wildcat Creek. The drainage area is agricultural with some livestock grazing upstream of the lone sample site, located at SR 22. The stream banks were wooded causing some shading of the stream. The water appeared very clear with minnows abundant. The bottom sediment was sand and gravel. Field and laboratory data showed this tributary to be supportive of aquatic life but non supportive of full body contact recreation. An inordinately high E. coli count for a rural location was found. A count of 10,000 cfu/100 ml was observed at the sample site, which may have been due in part to the livestock activity upstream.

Field and laboratory data indicated that Hurricane Creek and an unnamed tributary to Wildcat Creek are supportive of both aquatic life and full body contact. One sample site, at Prince William Road, showed an E. coli (250 cfu/100 ml) count just slightly above the stream standard of 235 cfu/100 ml. This was a very marginal exceedence which wasn't deemed sufficient to classify this tributary as non supportive of full body contact. Sediment samples taken at periodic locations did not show a significant presence of total toxic organic compounds. A few phthalate compounds (a common sampling and laboratory contaminant) were found at three sites, and the pesticide dieldrin (6.1 μg/L) was found at the last sample site of immediately upstream of the confluence with the South Fork of Wildcat Creek.

The most frequent water quality problem in this basin is E. coli. Causes of these E. coli concentrations may be the result of run off from this primarily agricultural area.

In summary 2,105 miles of stream were assessed in the Wabash River Basin as to the support of designated aquatic life uses. Of this total 1,530 miles (73%) fully supported this use, 210 miles (10%) were fully supportive but threatened, 157 miles (7%)were only partially supportive, and 208 miles (10%) did not support this use. Only 1,380 of these miles were assessed as to support of recreational uses. Of these miles, 183 (13%) fully supported, and the remaining 1,197 miles (87%) did not support the recreational use.

East Fork of the White River Basin

The East Fork of the White River drains approximately 5,600 square miles of southern Indiana (Figure 8). Sugar Creek, Big Blue River, Driftwood River, Flatrock River, the Muscatatuck River, and Salt Creek are the river's major tributaries. The largest cities in the watershed (populations greater than 15,000) are Columbus, Seymour, Bloomington, New Castle, Shelbyville and Bedford.

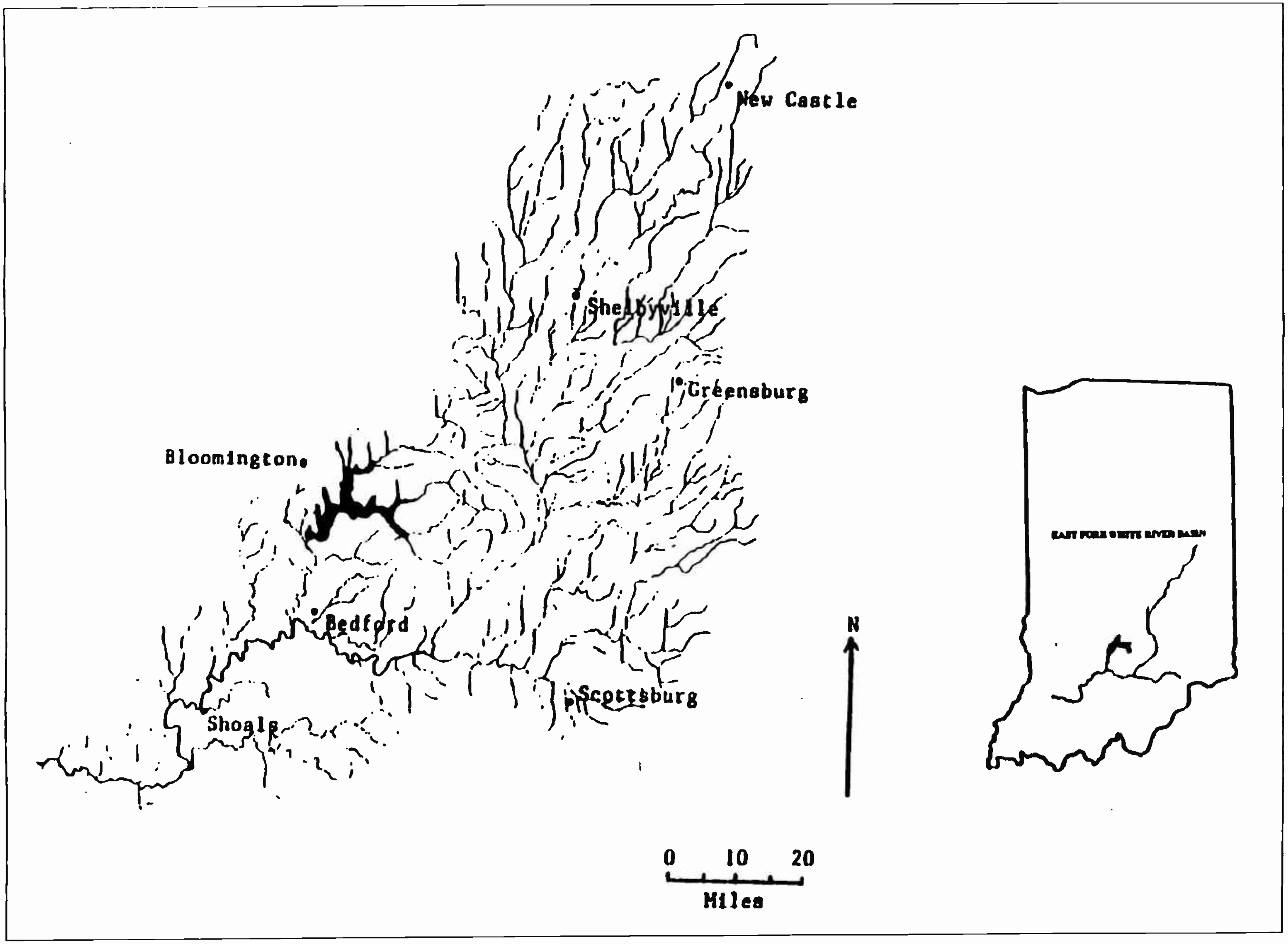


Figure 8. *East Fork of White River basin*

The topography of this basin ranges from flat to rugged as it crosses seven of southern Indiana's eight physiographic regions. The basin also includes unique underground streams in the karst region of Orange and Lawrence counties. Agriculture is important in this region, but much of the watershed is forested. The groundwater contribution to stream flow in the basin as a whole is low, so flow depends largely on rainfall and variations can be considerable. Compared to other basins, stream channelization projects in the East Fork of the White River Basin have been minimal.

There are municipal drinking water supply intakes on the East Fork of the White River at Bedford, Mitchell, and Seymour. Surface water supplies for drinking are also found at Greensburg, Paoli, West Baden, Bloomington, Westport, North Vernon, and Scottsburg on various tributaries of the river. Therefore, the water in this basin must meet the raw water standards for potable water supply at the municipal intakes.

The Lost River and many of its tributaries in Orange and Martin counties have been designated for exceptional use. This designation should help preserve the water quality in the watershed and help protect several unusual aquatic animals, including blind cavefish which inhabit the underground portion of the river.

Several streams in the basin have been designated for limited use, based on their lack of sufficient habitat to support a well-balanced aquatic community. These include Plasterers Creek at Loogootee, a portion of Brewer's Ditch at Whiteland, Huntingburg Lake Outlet Stream at Huntingburg, and a portion of Ackerman branch and Mill Creek at Jasper.

No major surveys were done in this basin during this reporting period. Those waters assessed, the status of designated use support, the method of assessment, probable causes of non support, and miles affected are shown in Table 34. Additional comments on certain reaches are also given in this table.

Tissue analysis of fish collected in 1983 from Big Blue River, Driftwood River, Sand Creek, Muddy Fork Sand Creek, Clear Creek, Richland Creek, Salt Creek, Pleasant Run, and the East Fork of the White River indicated a potentially serious PCB and pesticide contamination problem in the streams. As a result, fish consumption advisories were issued for certain reaches of these streams.

The 1996 fish consumption advisory (Table 14) included Clear Creek in Monroe County, Pleasant Run Creek near Bedford and Salt Creek downstream of Monroe Reservoir Dam in Monroe and Lawrence counties. No fish species from these streams should be consumed.

The PCB'S in Clear Creek, Salt Creek, Pleasant Run Creek and portions of the East Fork of the White River were associated with identified industrial inputs. Westinghouse Corporation in Bloomington began court-ordered hydro vacuuming of contaminated sediments in Clear Creek and Salt Creek during 1987. This clean up has helped to reduce the PCB contamination of fish in

Table 34. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the East Fork of White River Basin*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Plasterers Creek/Friends Creek	Loogootee	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	4	Severe overloads at Loogottee WWTP impacts stream. Limited use stream.
Big Blue River	New Castle	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli Cyanide	10	Allegeny - Ludlum Steel has had past problems meeting permit limits for chromium, iron, nickel, copper. Not causing water quality violations.
Big Blue River	Carthage Shelbyville Edinburg Knightstown	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli BOD	60	Some bypassing from Shelbyville STP. Edinburg STP hadles two hardwood lumber and veneer processing plants very well. Knightstown has a much improved facility since construction was compelted. Control of treatment process during rainfall still a problem. Carthage's STP and the Container Corporation of America have oil grease problems. The town is investigating it's sewer ordinance to include greage traps in response to grease and oil going to Big Blue River.
Monroe Reservoir	Bedford Bloomington	FS (Aquatic Life) (Threatened)	Evaluated	Nonpoint Source	10,750 (acres)	Sedimenatation and nutrient loading affect recreational uses in upper end.
Pleasant Run	Bedford	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli PCBs	4	Good water treatment in area by Central Foundary. No fish should be eaten due to PCBs.
Gas Creek/Sand Creek/Muddy Fork	Greensburg	FS (Aquatic Life) NS (Recreational)	Monitored (c0	E. coli	15	New Greensburg STP. Some bypassing still occurs.
Sand Creek	Below Greensburg	FS (Aquatic Life)	Monitored (c)	TSS	15	
Muscatatuck River	Austin Scottsburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	25	New facility. Good treatment is achieved.
Lick Creek	Paoli	PS (Aquatic Life) PS (Recreational)	Evluated	TSS D. O. E. coli	5	Solids often lost to Creek from STP.

Table 34. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the East Fork of White River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Underground Lost River	Orleans	PS (Aquatic Life)	Evaluated	D.O. Ammonia	5	
Rock Lick Branch	Mitchell	FS (Aquatic Life)	Evalauted		4	
E. Fork White River (Lawrence County Line to Mouth)	Shoals Petersburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	75	
East Fork White River Bedford to Williams	Bedford	FS (Aquatic Life) NS (Recrctional)	Monitored	E. coli	3.4	
E. Fork White River (Williams to Lawrence County Line)	Williams	NS (Aquatic Life) NS (Recreational)	Monitored (c)	PCBs E. coli Metals	5	
Clear Creek/Salt Creek	Bloomington Bedford Williams	NS (Aquatic Life) NS (Recreational)	Monotored (c)	PCB's D.O. E. coli	37	Sediment samples revealed PCB in upstream samples. Downstream samples are still considered low as documented in past 305(B) reports. Presence is there but no increase in contamination No fish should be eaten due to PCBs.
E. Fork White River	Seymour Brownstown Medora	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	74	a) Medora plant under construction. No evidence of contamination of E. Fork White River from town STP.
E. Fork White River	Columbus	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	71	a) New sludge pumps at Columbus STP. Head works construction started.
Leary Dtich/Little Sugar Creek	Greenfield	PS (Aquatic Life)	Monitored (c)	Ammonia	4	
Underground Carter's Creek	Cambellsburg	PS (Aquatic Life)	Evaluated	Ammonia D.O.	3	
Millstone Creek	Westport	PS (Aquatic Life)	Evaluated	D.O.	3	
Pee Dee Ditch	Wilkenson	FS (Aquatic Life)	Evaluated		2	
Brock Bezor Ditch	Spiceland	FS (Aquatic Life)	Evaluated		2	
Hominy Ditch	Crothersville	FS (Aquatic Life)	Evaluated		1	

Table 34. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the East Fork of White River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
North Fork of Salt Creek	Nashville	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	3	
Heddy Run	Seymour	PS (Aquatic Life)	Evalauted	Metals Pesticides	1	
Sugar Creek	Edinburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5	
Slate Creek	Alfordsville	PS (Aquatic Life)	Evalated	Abandoned Mine Drainage (pH, metals)	7	
Little Blue River	Mays, Shelbyville	FS (Aquatic Life) (Threatened)	Evaluated		25	
Bradnywine Creek	Greenfield	FS (Aquatic Life) (Threatened)	Evaluated		25	Greenfield STP currwntly experimenting with innovative sludge reduction technology.
Clifty Creek	Hartville	FS (Aquatic Life) (Threatened)	Evaluated	BOD TSS Ammonia	10	
Boggs Creek	Martin County	FS (Aquatic Life) (Threatened)	Evaluated		15	
Lost River	Orange and Martin Countires	FS (Aquatic Life)	Evaluated		40	
Montgomery Creek	Kennard	FS (Aquatic Life)	Evaluated		8	
Little Sugar Creek	Greenfield	FS (Aquatic Life)	Evaluated		10	
Six MilesCreek	Shirley	FS (Aquatic Life)	Evaluated		10	
Sulphur Creek	Martin County	FS (Aquatic Life)	Evaluated		10	
South Fork Salt Creek	Freetown	FS (Aquatic Life)	Evaluated		15	
Town Creek	Lexington	FS (Aquatic Life)	Evaluated		5	

Table 34. *Waters assessed, status of designated use support, probable cause of impairment, and miles affected in the East Fork of White River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Luther McDonald Ditch	Seymour	FS (Aquatic Life)	Evaluated		3	
Goose Creek	Oolitic	FS (Aquatic Life)	Evalauted		2	
Six Mile Creek	Jennings County	FS (Aquatic Life)	Evalauted		6	
Youngs Creek	Franklin	FS (Aquatic Life) (Threatened)	Evaluated	Ammonia	10	Franklin STP has repeatedly been in violations of ammonia limit. Fish kill.
Cooks Creek/ Little Sand Creek	Elizabethtown	FS (Aquatic Life)	Evaluated		5	
Flatrock River	Columbus, Rusville	FS (Aquatic Life) (Threatened) NS (Recreational)	Monitored (c)	E. coli Pesticides	40	
Grassy Creek	New Whiteland	FS (Aquatic Life)	Evaluated		3	
Coons Creek	Waldron	FS (Aquatic Life)	Evaluated		3	
Little Flatrock River	Milroy	FS (Aquatic Life)	Evaluated		7	
Sourth Fork Otter Creek	Holton	FS (Aquatic Life)	Evaluated		10	
Haw Creek	Hope	FS (Aquatic Life)	Evaluated		10	Pesticides from over applications and run off.
Sugar Creek	New Palestine To Edinburgh	FS (Aquatic Life) (Threatened)	Evaluated		25	Pesticides from over application and run off.
Driftwood River	Edinburg Columbus	FS (Aquatic Life)	Evaluated		15	
Sand Creek	Brewersburg	FS (Aquatic Life)	Evaluated		10	

PS = Partial Support; NS = Non Support; FS = Fully Support. If a use is not listed it was not monitored or evaluated.
b = biological; c = chemical.

these streams and in the East Fork of the White River below Bedford. However, the PCB content of fish tissue in these streams is still high enough that no fish should be consumed.

Of 17 sites sampled for pesticides in the East Fork White River Basin in May and June of 1991, thirteen sites in this basin had concentrations of Alachlor and Atrazine over maximum contaminant levels (MCL's). In addition, three sites had more than 6 pesticides which were found above detection levels. These were Sand Creek at Brewersville (12 chemicals), Sugar Creek at New Palestine (6 chemicals) and Clifty Creek at Hartsville (6 chemicals). These samples were taken soon after pesticide application by farmers and reflect runoff from these operations. Additional samples taken in the fall of 1991 and the spring of 1992 showed fewer detections of these pesticides and none at levels above the MCL's.

Several municipal waste water treatment facilities in this basin have contributed to water quality impairments by not meeting permit limits for D.O. and ammonia. Two steel mills near New Castle appear to have been responsible for metals contamination found in water and sediments. Cyanide from existing sediment problems, is also believed to have originated from the same source and has impaired 10 miles of the Big Blue River near New Castle. There are also seven miles of Slate Creek in Daviess County which were partially impaired by drainage from 2.0 acres of unreclaimed barren mine spoil.

E. coli concentrations are also a water quality problem throughout the basin. Most of the bacterial problems are from undetermined sources.

In summary, 758 miles of stream were assessed as to meeting aquatic life uses in the East Fork of White River Basin in 1994 and 1995. Of these, 540 miles (71%) fully supported designated uses, 140 miles (18%) were fully supportive but threatened, 21 miles (3%) partially supported its uses, and 57 miles (8%) did not support the designated uses. Accumulation of high levels of PCBs and pesticides in fish accounted for 15% of the stream miles not meeting or only partially meeting the designated uses. In terms of recreational uses, 432 miles were assessed. None of the miles assessed fully supported the recreational use, only 5 miles (1%) were partially supportive, and 427 miles (99%) failed to support the designated full body contact use.

West Fork of White River Basin

The West Fork of White River, which begins near Winchester in Randolph County, Indiana, flows through eleven counties and is joined by the East Fork of White River near Petersburg. The main stem of White River then flows about 48 miles and joins the Wabash River. In total, the West Fork flows about 356 river miles and drains 5,600 square miles of Indiana watershed (Figure 9). The main tributaries to the West Fork of White River are White Lick Creek, Eagle Creek, Fall Creek, Eel River and Mill Creek. A water quality survey was conducted on White Lick Creek and West Fork of White River (from Perkinsville to Martinsville) during this reporting period. Table 35 shows the waters assessed in this basin, the

Figure 9. *West fork of White River basin*

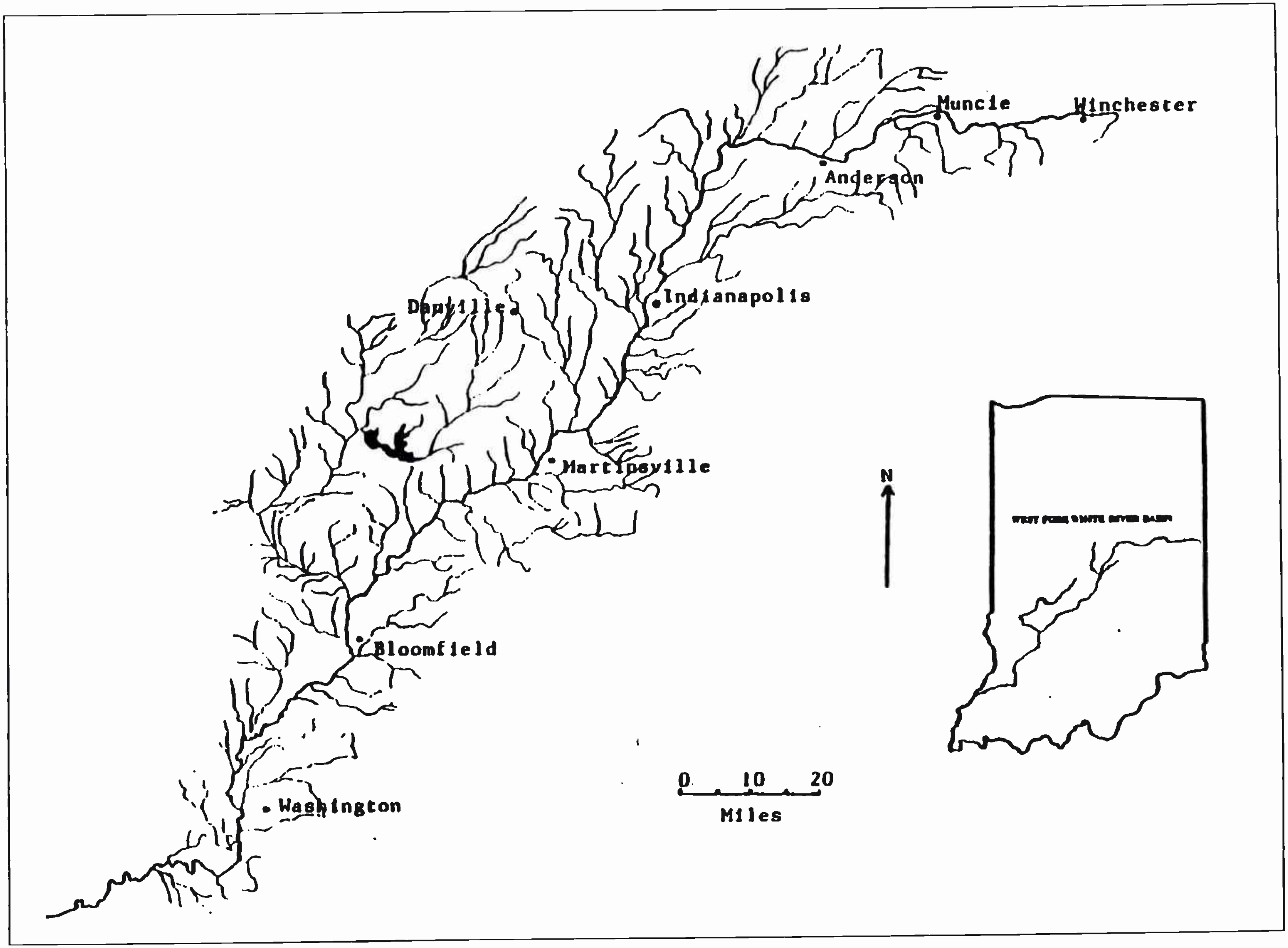


Table 35. *Water assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
W.F. White River	Winchester to Yorktown Bridge	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	32	
W.F. White River	Delaware County downstream of Yorktown Bridge	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	7	After its upgrading and construction Muncie STP is achieving a clean, quality effluent.
W.F. White River	Delaware County line to 10 mile upstream of Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	30	New system for solids handling at the Anderson facility
W.F. White River IN65-001	Upstream Noblesville to Potters Bridge	FS(Aquatic Life) (Threatened) FS(Recreational)	Monitored (c)	D.O. Ammonia	6	D.O. < 4.0 mg/L
W.F. White River IN 65-003	Potters Bridge to U.S. 32	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	D.O. E. coli Ammonia	2	D.O. < 4.0. mg/L Average > 5.0 mg/L
W.F. White River IN65-004	Noblesville/U.S. 32 to Stony Creek	NS(Aquatic Life) NS(Recreational)	Monitored (c)	D.O. E. coli	2	D.O. < 4.0. mg/L
W.F. White River IN65-010	Noblesville/Stony Creek to 126th St.	FS(Aquatic Life) (Threatened) NS(Recreational)	Monitored (c)	D.O. E. coli	6	E. coli > 235/100 ml D.O. < 4.0 mg/l
W.F. White River IN65-011	Fishers/126th St. to 116th St.	FS(Aquatic Life) FS(Recreational)	Monitored (c)		2	
W.F. White River IN65-014	Carmel/116th St. to I-465 Bridge	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4	
W.F. White River IN65-018	Nora/I-465 to Fall Creek	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	17	
W.F. White River IN64-001	Indianapolis Washington St. to Harding St.	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3.5	CSO's
W.F. White River IN64-005	Indianapolis Harding St. Bridge toDollar Hide Creek	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Mercury	8.6	Mercury > 0.012 ug/L

Table 35. *Water assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
W.F. White River IN64-012	Indianapolis/Little Buck Creek to Pleasant Run Creek	NS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	Cyanide D.O. E. coli	6.3	Cyanide > 5.2 ug/L D.O. < 4.0. mg/L
W.F. White River/Travis Creek IN64-015	Waverly/Confluence of Pleasant Run Creek to S.R. 144	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6	
W.F. White River/Bluff Creek IN64-018	Brooklyn/S.R. 144 to Blue Bluff Road	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	13	
W.F. White River IN64-031	Martinsville/Blue Bluff Rd. To S.R. 39	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.3	
W.F. White River	Martinsville to confluence of the West Fork of White River and the East Fork of White River near Petersburg	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	142	Possible septic system seepage, field runoff or wildlife contact with river.
White River (Main Stem)	Petersburg to Wabash River	FS(Aquatic Life) NS(Recreational)	Monitored (c) (b)	E. coli	48	
Buck Creek	Yorktown	FS(Aquatic Life)	Monitored (c)		10	Solids handling at STP addressed. Plants runs more efficiently.
Bell Creek	Yorktown	FS(Aquatic Life)	Monitored (c)		10	
York Prairie Creek	Muncie	FS(Aquatic Life)	Monitored (c)		5	
Killbuck Creek	Anderson	FS(Aquatic Life)	Monitored (c)		20	
Cicero Creek	Cicero	FS(Aquatic Life) (Threatened) FS(Recreational)	Evaluated		7	Improvements made in sludge disposal prgm. at Cicero, with the construction of drying beds. Non point run-off threatens this stream.
Little Cicero Creek	Cicero	FS(Aquatic Life)	Evaluated		16	
Stony Creek	Lapel	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	12	Confined feeding operations Mobile home impacts.
Ingerman Ditch IN65-002	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	3	

Table 35. *Water assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN (S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Stony Creek IN65-005/008	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli PCB's	9	Complete Fish Consumption Advisory due to PCBs. No fish should be eaten.
William Lock Ditch	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5	
Vestal Ditch/Kirkendall Creek IN65-009	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9	
Wilson Ditch IN65-007	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2	
Mitchner Ditch IN65-012	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4	
Cool Creek/Grassy Branch IN65-013	Noblesville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	16	
Blue Woods Creek	Carmel	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	2	
Wheeler Beals Drain	Carmel	FS(Aquatic Life) FS(Recreational)	Monitored (c)		0.5	
Carmel Creek IN65-015	Carmel	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.0	E. coli above 235 mg/L
Williams Creek IN65-016	Carmel	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	20	
Crooked Creek IN65-017	Carmel	FS(Aquatic Life) FS(Recreational)	Monitored (c)		15	
Fall Creek	Immediately Downstream Geist Reservoir	FS(Aquatic Life) NS(Recreational)	Evaluated	E. coli	6	
Fall Creek (Headwaters to Geist Reservoir)	Pendleton	FS(Aquatic Life) NS(Recreational)	Monitored (b)	E. coli Non point Source	17	Nutrients and sediments may be causing some impact to reservoir
Fall Creek (the last 7 miles before joining W.F. White River)	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	CSO E. coli	5	

Table 35. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Eagle Creek	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli Non point Source	4	
Eagle Creek	Zionsville Headwater to Eagle Creek Reservoir	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	25	
Pogues Run-All tributaries IN64-002	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	8.9	
Pleasant Run-All tributaries IN64-003	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	10.4	
Bean Creek-All tributaries IN64-004	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	6.2	
Haveisen Ditch	Indianapolis	FS(Aquatic Life) FS(Recreational)	Monitored (c)		N/A	Headwaters in gravel pit
Lick Creek 64-006	Indianapolis/ Headwater to I-465 Bridge	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	13.3	
Lick Creek IN64-008	Indianapolis/ I-465 Bridge to White River	NS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli D.O.	4.5	D.O. < 4.0. mg/L
Indianapolis Waterway Canal	Indianapolis	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	4.5	
State Ditch/Mars Ditch IN64-009	Indianapolis	NS(Aquatic Life) NS(Recreational)	Monitored (c)	Cyanide pH E. coli	8.2	Cyanide > 5.2 ug/l pH > 9.0
Little Buck Creek IN64-010	Indianapolis/ Headwaters to I-465 Bridge	FS(Aquatic Life) FS(Recreational)	Evaluated		5.5	
Little Buck Creek IN64-011	Indianapolis/ Toon Hendricks Ditch to White River.	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	9.9	
Beech Creek/Churchman Creek/Sloan Ditch IN64-007	Beech Grove	FS(Aquatic Life)	Monitored (c)		3.8	Low flow at time of sampling

Table 35. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT [1]	METHOD OF ASSESSMENT [2]	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Pleasant Run Creek/ Buffalo Creek IN64-013	Greenwood/ Headwaters to Buffalo Creek	FS (Aquatic Life) NS (Recreational)	Monitored	E. coli	20.8	
Pleasant Run Creek IN64-014	Geenwood/ Buffalo Creek to White River	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	4	E. coli >235/100 ml
Honey Creek/Turkey Pen Creek/Messer Smith Creek IN64-016	Greenwood	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	11.3	E. coli > 235/100 ml
Goose Creek/Sinking Creek-all tributaries IN64-017	Mooresville	FS(Aquatic Life)	Evaluated		13.4	Low flow during sampling
Crooked Creek & tributaries/Banta Creek IN64-019	Bargersville	FS(Aquatic Life)	Evaluated		12.9	
North Prong Stotts Creek IN64-020	Bargersville	FS(Aquatic Life)	Evaluated		1.2	Limited use stream
North Prong Stotts Creek IN64-021	Trafalgar	FS(Aquatic Life)	Evaluated		12.9	Low flow
Henderson Creek	Trafalgar	FS(Aquatic Life)	Evaluated		4.4	
South Prong Stotts Creek and Unnamed Ditch IN64-022	Trafalgar	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	5.6	E. coli >235/100 ml
South Prong Stotts Creek/Koots Fork/Lost Creek IN64-023	Trafalgar	FS(Aquatic Life)	Evaluated		26.7	
Stotts Creek IN64-024	Adams	FS(Aquatic Life) NS(Recreational)	Monitored	E. coli	3	E. coli > 235/100 ml
Unnamed Ditch IN64-026	Monrovia	FS(Aquatic Life)	Evaluated		2.5	Low flow at time of sampling
Clear Creek and tributaries IN64-025	Martinsville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	15	
Clear Creek East/West, Grassy Forks	Martinsville	FS(Aquatic Life)	Evaluated		13.7	Low flow at time of sampling

Table 35. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Sycamore Creek/Dry Fork/Gold Creek IN64-027	Martinsville	FS(Aquatic Life)	Evaluated		11.2	Low flow at time of sampling
Sycamore Creek IN64-029	Martinsville	FS(Aquatic Life) FS(Recreational)	Evaluated		1	
Highland Creek/Mill Hollow Branch/Unnamed tributary IN64-030	Centerton	FS(Aquatic Life) FS(Recreational)	Evaluated		9	Low flow at time of sampling
Lilly Creek	Orestes	FS(Aquatic Life) NS(Recreational)	Evaluated	E. coli	1	
Duck Creek	Elwood	NS(Aquatic Life) NS(Recreational)	Evaluated	E. coli CSO's Bypassing	3	Remediation plans to correct bypasses discussed with facility
Duck Creek (lower 8 miles)	Strawtown	FS(Aquatic Life) (Threatened)	Evaluated	Bypassing	8	Periodic bypassing from Elwood POTW threatens this reach of stream.
Williams Creek	Indianapolis	FS(Aquatic Life)	Evaluated		6	
Little Eagle Creek	Indianapolis	FS(Aquatic Life) (Threatened)	Evaluated		5	Urban non point run-off periodically threatens this stream.
White Lick Creek IN56-001	Pittsboro	FS(Aquatic Life) (Threaatened) NS(Recreational)	Monitored (c)	D.O. E. coli	17	D.O. < 4.0. mg/L (Daily average D.O. > 5.0 mg/l) E. coli > 235/100 ml
White Lick Creek IN56-002/009	Pittsboro Danville	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	121.5	E. coli >235/100 ml
McCracken Creek IN56-010		FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	12	E. coli > 235/100 ml
Julia Creek	Indianapolis	NS(Aquatic Life)	Evaluated	Metals	1	
Richland Creek	Whitehall, Monroe Cnty. to confluence with White River in Greene County	FS(Aquatic Life)	Monitored (c) (b)		19	

Table 35. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Stouts Creek	Bloomington	FS(Aquatic Life)	Monitored (c)		2	PCB Sediment contamination may still be present.
Beehunter Ditch	Linton	PS(Aquatic Life)	Monitored (c)	Copper Ammonia	4	Bypassing problems with Linton POTW
Indian Creek	Bicknell	NS(Aquatic Life)	Evaluated	Acid Mine Drainage	4	
Hawkins Creek	Washington	NS(Aquatic Life) NS(Recreational)	Evaluated	Low D.O. Ammonia High BOD E. coli CSO	4	Bypassing problems. Some sewer improvements include grit removal system. Three sanitary sewers eliminated. One CSO closed.
Pipe Creek	Alexandria	FS(Aquatic Life) (Threatened)	Evaluated	CSO	20	Sludge handling and storage problems occur at Alexandria Municipal Treatment Plant. CSO's to Pipe Creek.
Jacks Defeat Creek	Elletsville	FS(Aquatic Life)	Evaluated		6	Working with Northern Richland Sewer Dist. to limit amount of inflow and infiltration to correct the problem. Caused fish kill.
Bean Blossom Creek	Bloomington to confluence with W.F. White River	FS(Aquatic Life) (Threatened)	Monitored (c)		12	
Latta Creek	Switz City	FS(Aquatic Life)	Evaluated		12	New facility to be constructed in 1991 or will hook up with Lyons STP.
Mill Creek	Stilesville to Cataract Lake	FS(Aquatic Life) NS(Recreational)	Monitored (c)	E. coli	17	
Four Mile Creek	Lyons	FS(Aquatic Life)	Evaluated		4	
Black Creek	Sandborn	FS(Aquatic Life)	Evaluated		5	
Vertress Ditch	Elnora	FS(Aquatic Life)	Evaluated		3	
Kane Ditch	Odon	FS(Aquatic Life)	Evaluated		4	Funds for renovation approved. Plant under OATS program.
Smothers Creek	Plainsville	FS(Aquatic Life)	Evaluated		4	
South Fork Prairie Creek	Montgomery	FS(Aquatic Life)	Evaluated		5	

Table 35. *Waters assessed, status of designated use support, probable causes of impairment, and miles affected in the West Fork of White River Basin (cont.)*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT 1	METHOD OF ASSESSMENT 2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Wilson Creek	Monroe City	FS(Aquatic Life)	Evaluated		6	
Lick Creek	Ingalls	FS(Aquatic Life)	Evaluated		13	
Mud Creek	Summitville	NS(Aquatic Life)	Monitored (c)	D.O. TSS <u>E. coli</u>	8	Waste water bypassed into Mud Creek. Enforcement against violations pursued to correct CSO structures.
Arbogast Ditch	Park City	FS(Aquatic Life)	Evaluated		1	
Cabin Creek	Farmland	FS(Aquatic Life)	Monitored (c)		10	
Mud Creek	Clayton	FS(Aquatic Life)	Evaluated		6	
East Fork Big Walnut Creek	North Salem	FS(Aquatic Life)	Evaluated		8	
West Fork Big Walnut Creek	North Salem	FS(Aquatic Life)	Evaluated		10	
Big Walnut Creek	Roachdale to Reelsville	FS(Aquatic Life)	Evaluated		35	
Eel River	Worthington	FS(Aquatic Life) NS(Recreational)	Monitored (c)	<u>E. coli</u>	10	Renovation to Worthington Packing Plant almost completed; will reduce NH_3-N.
North Prong Stotts Creek	Centerton	FS(Aquatic Life)	Evaluated		3	
Indian Creek	Morgantown	FS(Aquatic Life)	Evaluated		12	
Sycamore	Centerton	FS(Aquatic Life)	Evaluated		7	
Plass Ditch	Decker	FS(Aquatic Life)	Evaluated		5	

PS = Partial Support; NS = Non Support; FS = Full Support. If a use is not listed, it was not monitored or evaluated.
b = Biological; c = Chemical

status of their support of designated uses, the probable causes of impairment, and the miles effected. Additional comments on some reaches are also provided.

A fish consumption advisory due to PCB's or mercury exists for all waters in the basin. While this report may list several waters under the fish consumption advisory, fish species, risk levels and a complete list of waters can be found in the 1996 Indiana Fish Consumption Advisory.

All 9 miles of Stoney Creek in Hamilton County are under a complete fish consumption advisory for all species due to PCB's. Also both Geist and Morse Reservoir have advisories for Largemouth Bass due to mercury.

Two intensive watershed surveys were conducted on the West Fork of White River from Perkinsville to Martinsville during August 1994. The drainage basin of the area from Perkinsville to Indianapolis is mainly agricultural and residential with some industrial base. The residential areas along with the industrial base are mostly serviced by wastewater treatment facilities.

A 6 mile stretch of the West Fork of White River (Strawtown Avenue to Potters Bridge), approximately seven river miles upstream of Noblesville, meets full body contact recreation and aquatic life usages, but is threatened. A dissolved oxygen value of 3.3 mg/L occurred at Potters Bridge, which is below the minimum allowable dissolved oxygen standard of 4.0 mg/L. However, the 24-hour average dissolved oxygen content was above the minimum standard of 5.0 mg/L. The extreme diurnal fluctuations observed in dissolved oxygen and pH were due to very high concentrations of algae present in the water. Also, ammonia results indicated high levels at three sampling sites. Flow measurements were obtained using a Marsh-McBirney current flow meter. The flow was determined to be approximately 114 cubic feet per second (cfs). The Q_{7-10} for this station is 66 cfs.

The analysis of a sediment sample taken at the Strawtown Avenue site indicated a level of 6200 μg/L of bis (2-ethylhexyl) phthalate. The detection limit of this compound was 300 μg/L. Also found was Di-n-octylphthalate at a level of 1600 μg/L. The detection limit for this compound was 300 μg/L.

P.S.I. Energy was the only NPDES discharger in this waterbody. All permit parameters for outfall 001 and 002 were sampled and no violations were found. However, an E. coli sample result of 51,000 mg/L was found in the cooling water discharge. E. coli samples taken downstream on the White River did not indicate any impact from this discharge. Aquatic life observed in this area included minnows, sunfish and carp.

A 2 mile stretch of the White River, from the north side of Noblesville to near the mid section of town (Potters Bridge to U.S.32), drains approximately 13 square miles. A large algae bloom was present in the river. The riparian habitat varies slightly throughout this area. The banks are lined with mature trees, wild grasses and sandy banks. The uppermost segment of this waterbody's outlying area consists of cropland and pasture area. The mid-range area has outlying areas of both cropland and residential/park area. The lower area of the waterbody is surrounded by a business district. Aquatic life was abundant within this waterbody and included both fish and turtles. Wild ducks also inhabit this area. During the segment survey, a minor fish kill did occur. This affected mainly suckers and a few game species. Field analyses were run extensively throughout this stretch. It was determined that low dissolved oxygen and ammonia were the cause. Dissolved oxygen levels were low due mainly to the high water temperature and increased algae growth. The presence of high ammonia levels is believed to be caused by the decomposition of algae releasing ammonia. The dead fish were spotted in several upstream sites.

This section of the river is considered to meet the aquatic life designation, but is threatened, and does not meet full body contact standards. Minimum dissolved oxygen results for some sites were 3.3 mg/L and 3.4 mg/L respectively. This violates the minimum required 4.0 mg/L dissolved oxygen level. These sites, however, met the average 5.0 mg/L of dissolved oxygen for any calendar day. Sample results indicated the E. coli levels to be 460/100 ml.

A sediment sample taken from this reach, at a U.S. 32 site, contained 1000 μg/L of Di-n-octylphthalate and 7.0 μg/L of delta BHC (benzene hexachloride). No other organic substances were found above detection levels.

Another 2 mile stretch of the West Fork of White River, from U.S. 32 to Stony Creek, drains approximately 284 square miles. A compliance sampling inspection was conducted in this reach at the Noblesville STP. Samples were taken for priority pollutants and all permit parameters. Results indicated that all permit parameters were being met at this time, however VOA samples indicated levels above detection limits. Three individual VOA samples were taken, and all contained chloroform. Also, one VOA sample contained bromodichloromethane. The detection limit for chloroform was 2.5 μg/L and the samples contained from 9.3 to 13.0 μg/L. Bromodichloromethane had a detection limit of 2.5 μg/L and was detected at the level of 6.3 μg/L. A possible source for both of these compounds is the breakdown of chlorine from chlorination at the STP and chlorinated city water used in the plant.

This section of the river does not meet aquatic life or full body contact recreation uses. Dissolved oxygen levels of 1.6 mg/L and 3.0 mg/L were found at two sampling points. These violate the minimum required 4.0 mg/L dissolved oxygen level. The average of all dissolved oxygen tests taken at these sites also violates the average of 5.0 mg/L of dissolved oxygen required for any calendar day. All dissolved oxygen results were low due to the high amounts of algae present in the river during sampling. Several E. coli samples taken also violated water quality criteria for this parameter.

An eight mile portion of the West Fork of White River, from the confluence of Stoney Creek to 116th Street, does not meet aquatic life nor whole body contact recreation uses. Water sample results indicated that E. coli levels of 440/100 ml, 550/100 ml, and 780/100 ml were present. Dissolved oxygen tests were obtained during sampling and one site had a dissolved oxygen reading of 3.8 mg/L. The daily average for this station was 4.5 mg/L. Both of these results violated the stream standards.

In a 17 river mile stretch of the West Fork of White River, from I-465 to its confluence with Fall Creek at Indianapolis, aquatic life was abundant, including fish, turtles, and wild ducks. The stream bed is composed of sand and rock. A sediment sample was obtained at a site located near the 86th Street Bridge. Sample results indicated levels above detection limits for Di-n-butylphthalate (530 μg/L) and bis(2-Ethylhexyl)phthalate (1400 μg/L).

This reach of the river meets aquatic life uses but does not meet full body contact recreation uses. E. coli levels from samples obtained at all stations ranged from 800/100 ml to 2800/100 ml.

The West Fork of White River from Indianapolis to Martinsville flows southwesterly for about 39 miles and drains an area of 851 square miles in parts of Marion, Johnson, and Morgan counties. The land use is equally divided between densely populated and relatively unpopulated areas. In the less populated areas, agriculture is the largest portion of land use but there are woodland areas, untilled pasture and golf courses.

Throughout Indianapolis there are numerous combined sewer overflows (CSOs), commercial or industrial properties and ten of the twenty National Pollutant Discharge Elimination System (NPDES) permit holders in the segment. The other ten permit holders were scattered throughout Johnson and Morgan counties. The waterbodies in this watershed are utilized for industrial, recreational, and agricultural uses. Some of the areas are supplied with potable water from Geist or Eagle Creek reservoirs and others are supplied with ground waters.

The reach of White River from old Washington Street to Harding Street flows through Indianapolis for about 3.5 stream miles. The Marion County Health Department reported sixteen combined sewer overflows (CSOs) in this corridor. Three of these were flowing and sampled but did not significantly impact the water quality. There were four NPDES permit holders: Hebrew National Kosher Foods, IPL Perry K., Diamond Chain, and Eli Lilly. E. coli counts and the possibility of contamination by CSOs during rainfall events caused this waterbody to be non-supportive of full body contact recreational uses.

The first sample site in this reach was at the old Washington Street bridge (river mile 231.4), just upstream of the White River Canal overflow in Indianapolis. The river has concrete levees in some areas. Downstream, both banks are slightly sloped and grassy. The Indianapolis Zoo is to the west and the city is to the east. No visible water quality problems were observed. A local fisherman reported carp, blue gill, smallmouth bass, and turtles in the area. The water was clear with a rock and sand riverbed. National Starch, Eli Lilly and commercial properties were upstream. The E. coli concentration was 260/100 ml.

The next 8.6 miles of White River flows past commercial properties and rural/farmland areas. This reach collects the runoff of 9.7 square miles. There were two sampling sites on the river and three NPDES permit holders: Belmont STP, IPL Stout Generating Station, and American Aggregates.

White River was sampled at Harding Street just upstream of the raw bypass for the Belmont STP. The surrounding area is wooded and isolated from the population. The river bed was sandy with some large rocks. Fish were observed. The E. coli concentration was 300/100 ml and mercury was found in this sample at a concentration of 0.30 μg/L.

Another sample site in this reach was a wade station upstream of Interstate 465 at approximately river mile 224.4. White River widens significantly and its depth decreases. The bed was sandy, the water clear and large groups of minnows were observed. The west bank changes from almost vertical, rip-rap lined sections to steep grassy areas as the river bends toward the bridge. The east bank has very little slope and is mainly sand with some weeds. The vegetation on both banks changes to heavy brush and trees. Upstream, farmland borders the west bank and American Aggregates Gravel Company borders the east bank. The E. coli concentration was 1140/100 ml. This waterbody did not support aquatic life or full body contact standards due to mercury levels above 0.012 μg/L and E. coli counts above 235/100 ml.

This same reach of White River, at mile 221.1, was very shallow and wide. The underlying material was sand and gravel with a bedrock base causing riffles. The water was clear with minnows and turtles present. Heavy vegetation was present on both banks but the west bank was significantly steeper than the east. The vegetation began with trees and underbrush on both banks and turned into floodplain grasses on the east and farmland on the west. The E. coli concentration was 1000/100 ml.

White River from Little Buck Creek in Marion County to Pleasant Run Creek in Johnson County did not meet aquatic life or full body contact recreational uses due to cyanide levels above 5.2 μg/L, dissolved oxygen below 4.0 mg/L, and E. coli counts above 235/100 ml. This waterbody contains one NPDES permit holder, Southport STP, as well as two sampling sites.

Within this 6.3 mile reach, the first sampling site downstream of Southport STP on White River revealed an E. coli concentration of 2700/100 ml and a cyanide concentration of 21 μg/L. Cyanide samples were taken on May 12, 1995, from upstream and downstream of the Southport STP, and the cyanide concentrations had dropped to <5.0 μg/L and 7.0 μg/L, respectively. Just two miles east at a second sampling point, the E. coli concentration was 3500/100 ml and the dissolved oxygen concentration was 3.8 mg/L.

Another 6.0 miles of White River, from the confluence of Pleasant Run Creek to State Road 144, flow southwest through farmland and undeveloped areas. Just past the Marion/Johnson County line, the river returns to a meandering path and a more pristine wildlife area where Goose Creek confluences. Farm land borders a riparian corridor consisting of thick brush and various sizes of trees. E. coli counts caused this waterbody to be non-supportive of full body contact. There are two NPDES permit holders, Bargersville Water Utility and Oak Meadows MHP, in this reach.

A site in the reach of White River was sampled by boat upstream of the Bargersville Water outfall near mile point 217.5. The north bank of the river had very shallow slope and was heavily covered in forest vegetation. The south bank was extremely steep and undercut. A farm field is on the flatland above this bank. The water was cloudy and no aquatic life was observed. E. coli concentration was 2400/100 ml.

The reach of the White River beginning at State Road 144 includes Bluff Creek and an unnamed creek beginning in Waverly and ends at Blue Bluff Road downstream of White Lick Creek. White River flows in a southwesterly direction, meandering across the floodplain through fields and wildlife areas. This waterbody drains 21.9 square miles. From upstream to downstream, Sinking Creek, Bluff Creek, Crooked Creek, an unnamed tributary, Stotts Creek and White Lick Creek flow into White River. E. coli counts caused this waterbody to be non-supportive of full body contact recreational uses.

Samples were also taken on the White River approximately halfway between State Road 144 and the other sampling sites downstream. A farm field road winds west to the river from Old State Road 37. The west bank was undercut to the point of being vertical. The east bank was gradually sloped. Both banks were composed of sand and gravel. Beyond the west bank was farmland. The floodplain area of the east bank consisted of dense ragweed which becomes farmland. The water was clear but contained a number of fallen trees. Jumping fish were observed, and the E. coli concentration was 7500/100 ml. On March 16, 1995, the site was resampled and the E. coli concentration was 360/100 ml.

Henderson Ford bridge was the next sampling site for the White River at mile point 202.6. In this area, the river bed was composed of sand and gravel and the water was clear. The banks were gradually sloping and were heavily wooded. The uplands eventually shift into farmland and pasture. Local fishermen mentioned that several varieties of fish were present in this area. The E. coli concentration at this site was 3600/100 ml.

The final sampling site in this reach was at Blue Bluff Road (mile point 199.3) and is the location of the Centerton gauging station. This area of White River was much wider and shallower but still maintained the sand and gravel bed. Parts of a stove or furnace littered the river bed and there was a noticeable oil sheen. The banks were thinly lined with trees and had approximately 35% minimum slope. To the north of the site was primarily farmland but on the south side was a large residential subdivision surrounded by thick woods. The E. coli concentration was 2000/100 ml.

White River, from Blue Bluff Road to State Road 39 west of Martinsville, is 7.9 stream miles and drains an area of 15.4 square miles. The river begins flowing west but as it passes IPL

Pritchard Generating Station it turns south. On this southward leg, floodplain farmland borders the east bank of the White River while State Road 67 and steep hills border the west bank. Flow into this waterbody comes from Sycamore Creek, Highland Creek, Susan's Branch and Lake Edgewood. The E. coli count caused this waterbody to be non-supportive of full body contact recreation.

Fish tissue samples collected from Buck Creek in Delaware County during 1990 - 1993 indicated that PCB levels in carp exceeded FDA Action Levels. Buck Creek was added to the Fish Consumption Advisory list in 1993. Although fully supportive for aquatic life, Buck Creek remains under a gerard advisory for some species due to PCB's and mercury.

Ingerman Ditch flows approximately 3 miles from its headwaters near Noblesville to its confluence with the White River. The surrounding area was cropland and pasture with a cattle operation at approximately river mile 0.5 upstream of the confluence with White River. The streamed was composed mainly of sand. The aquatic life observed at this site included minnows and small sunfish.

Suburban Estates is the only NPDES discharger in this waterbody. This facility discharges approximately 2 river miles upstream of the confluence with White River. Samples were taken on both the raw influent and final effluent for permit parameters. All permit parameters were met with the exception of total suspended solids. A total suspended solid result of 21 mg/L was found in the final effluent which violates the allowed discharge of 15 mg/L daily maximum or 10 mg/L monthly maximum. The effluent was clear and caused no visible impact on the receiving stream. No upstream samples were taken, but visual examination revealed a rich riparian habitat and many small fish. Approximately 0.1 river mile upstream of the confluence with White River, water sample results indicated E. coli of 1800/100 ml.

The upper portion of Stony Creek encompasses a 19 mile stretch of stream and has a total drainage area of approximately 15.5 square miles. The average flow for this waterbody was < 1 cubic foot per second. Aquatic life noted in this waterbody consisted of minnows and small fish. The surrounding area is mainly grassy fields and cropland with a cattle operation upstream of the sampling sites.

A 9 mile portion of Stony Creek near Noblesville does not support the fish consumption use as a fish consumption advisory exists for all species. The fish are contaminated with PCB'S from the Firestone Industrial Products facility which has a discharge to Wilson Ditch.

Stony Creek in this reach also fails to meet the full body contact recreational use. E. coli results for two sampling points were 750/100 ml and 4400/100 ml, respectively. The probable causes are contamination from the hog lot and cattle operation upstream of the sampling sites.

Another 12 mile reach of Stoney Creek begins upstream of the Lapel Municipal STP and continues to the confluence with White River. The total drainage for Stony Creek is approximately 57.2 square miles with approximately 41.7 square miles drained by this waterbody. The flow in this waterbody ranged from 0.3 cubic feet per second (cfs) to 6.4 cfs at the confluence with White River. Aquatic life noted include minnows and small fish. Wild ducks also inhabit this area.

The riparian habitat in the upper half of the waterbody was mainly cropland and pasture, with cattle and hog operations present. The lower portions of this waterbody are surrounded by residential areas.

The first NPDES discharger to this waterbody is the Lapel Municipal STP. A compliance sampling inspection was conducted at this facility during the sampling survey. This facility has a design flow of 0.36 million gallons per day (mgd). Samples were taken for all permit parameters. Results indicated that all parameters were being met at this time with the exception of dissolved oxygen levels which ranged from 3.4 mg/L to 3.8 mg/L, well below the permit limit of 5.0 mg/L daily minimum average.

Tall Timbers Mobile Home Park is the next downstream NPDES discharger on Stony Creek. The outfall is located on an unnamed tributary that flows into Stony Creek. The design flow for this facility is 0.0126 million gallons per day (mgd) and the approximate flow during the sampling event was 0.007 mgd. Samples were obtained as a two-part composite and field tests were conducted at both times of sampling. Field observations indicated sludge in the clarifier and sludge pooled on the plant grounds. Also, sludge was observed in the receiving stream. Analyses were conducted for all permit parameters and results indicated no permit violations. However, no E. coli samples were obtained.

This waterbody meets aquatic life use but does not meet whole body contact recreational uses. E. coli violations occurred at 8 of the 9 stream stations within this reach. The violations ranged from 340/100 ml to 6100/100 ml. Two possible sources for these high E. coli counts are the confined feeding operations and the impact on the stream from Tall Timbers Mobile Home Park.

William Lock Ditch flows approximately 5 river miles from its headwaters to the confluence with Stony Creek, and drains approximately 11.2 square miles. The water was clear with algae present along the banks and on the sediments. The sediment was mainly sand and rock.

This waterbody meets aquatic life standards, but does not meet whole body contact regulations. Water sample results indicated E. coli concentrations of 460/100 ml. Tests showed dissolved oxygen levels of 7.2 mg/L to 8.3 mg/L.

Wilson Ditch is approximately 2.0 stream miles from headwaters to its confluence with Stony Creek. The water in this stream was clear with heavy algae growth along the banks and stream bottom. Mowed grass and a few small trees and shrubs covered the stream bank. This waterbody runs through downtown Noblesville, which includes both industrial and residential areas. Aquatic life was minimal and included only minnows at one site.

Three stream stations and one NPDES discharger, Firestone/Bridgestone Industrial, were sampled. The first station, the uppermost station sampled on Wilson Ditch, is upstream of Firestone/Bridgestone. The other two stream stations sampled are both downstream of Firestone/Bridgestone. The water at all sites was clear with periphyton present along the banks and bottom of the stream.

This waterbody supports the aquatic life use but does not support the whole body recreational use due to high E. coli levels. Sample results indicated E. coli concentrations of 570/100 ml and 490/100 ml, respectively. Dissolved oxygen tests indicated a range of 6.4 mg/L to 11.0 mg/L. The first site downstream of Firestone/Bridgestone showed dissolved oxygen levels from 9.5 mg/L to 10.2 mg/L. The last stream station had dissolved oxygen readings from 8.6 mg/L to 12.0 mg/L. The diurnal fluctuations observed were probably due to the high concentration of algae present in the stream.

Firestone/Bridgestone has long been a source for PCB contamination in sediment and fish tissue. In 1988, U.S. EPA, IDEM, and Firestone/Bridgestone began working toward an agreement to clean up stream sediments and plant sludges which contain high PCB levels. An agreement was made in 1989 and amended in 1992. Firestone now has an outfall, 003, that is used exclusively for the discharge of treated groundwater. During the sampling of this waterbody, sampling upstream from Firestone/Bridgestone was conducted. At this site, general water chemistry, volatile organic aromatics (VOA), and sediment samples were obtained. The only stream standard violation was for E. coli. The liquid VOA samples resulted in bis(2-Ethylhexyl)phthalate at a level of 12 μg/L. The detection limit for this compound was 1.5 μg/L. The sediment sample obtained contained the following compounds:

Parameter	Detection limit (μg/L)	Result (μg/L)
Phenanthrene	200	370
Anthracene	200	370
Flouranthene	200	730
Pyrene	200	650
bis(2-Ethylhexyl)phthalate	300	720

Water samples for general water chemistry, metals, and vas were also taken from the Firestone/Bridgestone outfall during samples. All permit parameters were met. In addition, metals parameters not included in the permit and all VOA sample results indicated no problems. Dissolved oxygen, pH, and temperature tests were preformed on site. The results were 9.5 mg/L, 8.1 standard units, and 24°C, respectively.

At the first station located downstream of Firestone/Bridgestone, water chemistry, metals, VOA, and sediment samples were obtained. All liquid matrix samples met minimum stream standards. Dissolved oxygen test results range from 9.5 mg/L to 10.2 mg/L. The sediment samples showed the following compounds:

Parameter	Detection Limit (μg/L)	Result (μg/L)
Phenanthrene	200	920
Anthracene	200	920
Di-n-butylphthalate	200	550
Flouranthene	200	1300
Pyrene	200	1200
bis(2-Ethylhexyl)phthalate	300	2900

All water chemistry and metals results indicated no water quality standard violations. VOA and sediment samples were not taken at this site. Dissolved oxygen levels ranged from 8.6 mg/L to 12.0 mg/L. The diurnal fluctuation was due mainly to large algal concentrations present in the stream during the survey.

Vestal Ditch is approximately 5 miles long and drains approximately 6.2 square miles. A tributary to Vestal Ditch, Kirkendall Creek, flows approximately 4.0 stream miles and drains approximately 4.62 square miles. The total drainage area for these two streams is approximately 10.8 square miles.

The water in Vestal Ditch was clear with large concentrations of periphyton present along the banks and stream bottom. The average stream area directly exposed to sunlight was approximately 20 to 40%. The streamed was consistently sand and small rock. The flow for this creek was 1.7 cubic feet per second (cfs). This included an NPDES discharger, but did not include Kirkendall Creek. Aquatic life was abundant and included minnows and small fish. The riparian habitat consisted of shallow sand banks, with trees and wild grasses. The outlying areas were, for the most part, cropland and pasture.

Kirkendall Creek was slightly turbid with algae present along the banks and stream bottom. There was a cattle operation upstream of the sampling site. The stream was approximately 30-40% exposed to direct sunlight. The streamed was composed mainly of sand and rock. The riparian habitat consisted of sand banks lined with trees and wild grasses, with cropland and pasture outlying areas. Aquatic life included minnows and small fish. The average flow for this creek was < 1.0 cfs.

Two stream stations and one NPDES discharger, Martin Marietta Aggregates, were sampled within this waterbody. The uppermost stream station on Vestal Ditch was located downstream of Martin Marietta Aggregates. The other stream station, which was located at Hazeldale Road was on Kirkendall Creek.

Martin Marietta Aggregates is a facility that quarries and processes limestone and discharges into an unnamed tributary of Vestal Ditch. All permit limits were met in the samples obtained. The flow from this facility was estimated to be 1.49 million gallons per day (mgd).

These streams meet aquatic life uses but do not meet full body contact recreational uses. Samples obtained during the survey indicated E. coli levels in Vestal Ditch were 320/100 ml and Kirkendall Creek contained E. coli levels of 8400/100 ml. The latter is likely due to cattle access to the stream.

Mitchner Ditch is approximately 4.0 stream miles in length. Flow for this creek was estimated to be <1.0 cubic foot per second. The water was a red/brown color due to an algae bloom and algae were also present along the sides and bottom of the stream. The riparian vegetation lining this waterbody was mature and small trees with wild grasses on sandy banks. A few sandbars are scattered about the waterbody. The outlying areas in the upper reaches were mainly cropland, while the lower reaches were lined by residential neighborhoods. The streamed is composed of sand and rock throughout. The areas exposed to direct sunlight ranges from approximately 40-80% of the total area. Aquatic life noted included minnows and small fish.

This water body meets aquatic life stream standards but does not meet the minimum full body contact recreation standards. E. coli results from a sample obtained were 370/100 ml. A possible source for this value would be a field tile or septic tank seepage.

Cool Creek, from the headwaters to its confluence with White River, contains three individual streams. The largest, Cool Creek, flows directly into the White River and the other two, Grassy Branch and Wheeler Beals Drain, drain into Cool Creek. The total drainage area for Cool Creek is approximately 23.7 square miles which would include both Grassy Branch and Wheeler Beals Drain. Aquatic life in this reach consisted of minnows and small fish. The outlying area was mainly cropland with few residential areas.

This waterbody does meet aquatic life uses but not full body contact recreational uses. E. coli samples from Grassy Branch and all four Cool Creek stations were above the standard of 235/100 ml for a grab sample.

Carmel Creek is an approximately 6.0 mile long stream draining approximately 5.47 square miles. This stream meets aquatic life uses but not full body contact recreational uses. Sample results showed E. coli levels of 2000/100 ml.

Williams Creek from the headwaters to its confluence with White River flows about 20 stream miles and drains approximately 22.2 square miles at its mouth. This waterbody meets aquatic life uses but does not meet the full body contact recreational uses. Sample results indicated E. coli levels of 240/100 ml and 1000/100 ml.

Eagle Creek, which flows into White River, is in an area that is industrialized with some residences upstream. Levees surround the creek as it flows through the city of Indianapolis. The stream bed was sandy. Fishermen noted the presence of catfish, bluegill and sunfish. The waterbody had a visible oily sheen on its surface and did not meet full body contact recreational uses due to E. coli concentrations of 540/100 ml at a Kentucky Avenue site.

Eagle Creek was sampled again at the White River confluence, downstream of the Belmont STP outfall. This site had gently sloping grassy banks and a sandy bed. No aquatic life was observed, and the E. coli concentrations were 260/100 ml.

Travis Creek was sampled at stream mile 0.5 from County Road 700 N. The creek had shallow sloping banks and the bed was lined with silt and sand. Upstream of the bridge was farmland and some residential homes. The trees provided about 10% cover over the clear water; minnows were observed. The E. coli concentrations were 3200/100 ml.

Pogues Run flows 8.9 stream miles and drains an area of approximately 9.0 square miles. As reported by the Marion County Board of Health, there are 15 combined sewer overflows (CSOs) along the creek. None were flowing during the survey. No NPDES dischargers are present on this tributary. E. coli counts caused this waterbody to be non-supportive of full body contact or recreational uses.

Pleasant Run and its tributaries drain an area of 15.6 square miles. The Marion County Board of Health reported 19 CSOs on Pleasant Run, but none were flowing during sampling. E. coli counts caused this waterbody to be non-supportive of full body contact.

Bean Creek and its tributaries drain 5.5 square miles. The only NPDES permittee on this creek is Navistar International which constitutes 80% of the creek's flow. They are currently applying for a storm water permit. Bean Creek flows under the Hawthorn Railyard which may account for the oil and grease contamination (a problem in the past). E. coli counts caused this waterbody to be non-supportive of full body contact. Two stream samples were taken.

Lick Creek from its headwaters to the I-465 bridge, drains 13.3 stream miles and has a watershed area of 12.4 square miles. Lick Creek flows under the Conrail Railyards, through Beech Grove, and through a city park. From the confluence with Beech Creek, the creek flows west. This waterbody did not contain any NPDES permit holders. E. coli counts caused this waterbody to be non-supportive of full body contact.

Lick Creek meets White River just south of Indianapolis Power and Light's (IPL) Stout Generating Station. The Stout Plant is permitted for the two NPDES discharge points on the creek. This reach flows through sparsely populated residential, commercial and farm properties for approximately 4.5 stream miles and drains an area of 8.4 square miles. This waterbody did not support aquatic life or full body contact due to dissolved oxygen below 4.0 mg/L and E. coli counts above 235/100 ml. Three sites were sampled.

State Ditch and its associated tributaries, Mars Ditch and Seerley Creek, enter White River at mile 223.6. Both Mars Ditch and Seerley Creek originate on Indianapolis International Airport property and flow eastward to State Ditch. Both streams join State Ditch north of Mooresville Road. The main stem continues south to the river. This waterbody did not support aquatic life or full body contact due to cyanide levels above 5.2 μg/L and E. coli counts above 235/100 ml. Another sampling site on Mars Ditch was just downstream of the Indianapolis International Airport's East Lagoon. This lagoon collects runoff from airport runways and the surrounding area. This runoff may contain de-icing fluids and ammonia-based fertilizer that are used to prevent icing of planes and runways. The stream bed consisted of rip-rap and some pasture grass. The bed was coated with dead algae, although the water itself was clear. No aquatic life was noticed. E. coli concentration was 1100/100 ml and cyanide concentration was 34 μg/L.

Little Buck Creek from its headwaters and including all tributaries downstream to Toon Hendricks Ditch (9.9 miles from the mouth) is a meandering creek which was not sampled. It drains an area of 8.3 square miles.

Little Buck Creek downstream from Toon Hendricks Ditch and several tributaries comprise this waterbody. The creek flows through residential areas, commercial property and farmland for 9.9 stream miles. Little Buck Creek, in this reach, drains 8.5 square miles of area. E. coli counts caused this waterbody to be non-supportive of full body contact. The waterbody was sampled at five locations.

Another sample point was further upstream on Little Buck Creek at Combs Street or stream mile 8.5. This area is residential with 40% tree cover and steep banks. Upstream, there are trees lining both banks. Spotted Bass and other minnows were observed. The E. coli concentration was 680/100 ml.

Little Buck Creek was sampled next at Shelby Street and mile 6.9. The banks are gently sloping with light underbrush, grass and trees. In this area the stream tree cover is about 75%.

Both up and downstream of the bridge, there are grassy areas before the cover begins. On the southwest bank there are two tile lines that appear to be CSOs. Minnows and a brown banded water snake were observed. The E. coli concentration was 1700/100 ml.

Banta Road was the next sample site at mile 3.6 on Little Buck Creek. The surrounding area upland of the steep banks was residential. Upstream of the bridge, there was approximately 20% cover. The stream flowed over a bed of sand and rocks and contained minnows and some larger fish. The E. coli concentration was 850/100 ml.

Stream mile 1.1 marked the last site on Little Buck Creek before the White River confluence. Here at Tibbs Street, the creekbed was primarily silt and sand. The banks were slightly sloped, and forests provided 80% canopy cover. The surrounding area was farmland. In this area there was a large minnow population. The E. coli concentration was 1300/100 ml.

Pleasant Run Creek begins at the headwaters of Buffalo Creek and Pleasant Run Creek in Johnson County and flows westward. This stream drains an area of 20.3 square miles and flows 15.4 stream miles through residential properties. No NPDES permittees are present on the stream and two sites were sampled. The E. coli counts caused this waterbody to be non-supportive of full body contact. Crayfish and minnows were observed in the stream. A sampling site in Greenwood near a farmlot was found to be highly contaminated with E. coli concentrations of 55,000/100 ml. The next day the E. coli concentration was 300/100 ml and the serious problem seemed to have abated.

Buffalo Creek at County Road 400 W was the other site sampled on this waterbody. Upstream and south of the bridge is pasture land. The north bank is pasture, woods and residential. The woods provide about 30% cover. The bed was rocky and sandy but there was also some metal debris. There were minnows observed in the creek. The E. coli concentration was 1500/100 ml.

Another lower 4 miles of Pleasant Run Creek flow through areas that are approximately one half residential and one half farmland. The E. coli count caused this waterbody to be non-supportive of full body contact.

The pastures near the creek are grazing land for cattle and horses that have direct access to the water. Although the water appears slightly cloudy, minnows were observed.

Honey Creek flows 8.5 stream miles and meets the White River after passing through farmland, developing residential areas, and a wildlife area. The stream drains 18.5 square miles. The one NPDES permittee on the main stem, Center Grove Schools, connected to a sanitary sewer system as of January 1995. The E. coli count caused this waterbody to be non-supportive for full body contact recreation. Minnows were observed in the creek.

The first 1.25 miles of the North Prong Stotts Creek from the headwaters at the Bargarsville STP are considered a limited use stream (327 IAC 2-1-11 (11)) and do not support full body contact recreation.

An unnamed ditch which flows 2.9 miles from the south side of Trafalgar to the South Prong of Stotts Creek and the first 2.7 miles of the South Prong of Stotts Creek form one waterbody. The Trafalgar STP is located 1.6 miles from the mouth of the ditch. This waterbody and the STP were sampled. The E. coli counts caused this waterbody to be rated as non-supportive of full body contact.

South Prong Stotts Creek, from the confluence with an unnamed ditch at stream mile 11.3 to the confluence with the North Prong and all associated tributaries, is included in this waterbody. The South Prong drains southwesterly to where it meets the ditch. No locations were sampled due to minimal stream flow.

The Stotts Creek waterbody includes the South and North Prongs of Stotts Creek, as well as all the tributaries from the confluence of the South and North Prongs of Stotts Creek to the White River. Stotts Creek meets White River at mile 203.9 and drains 4.5 square miles and 3.0 stream miles. The topography becomes less contoured farmland but the creek still cuts into high limestone banks at some points. The stream flow was at or below the Q_{7-10} level of 0.1 cfs. Two sites were sampled. High E. coli counts caused this waterbody to be non-supportive of full body contact recreation.

The Clear Creek waterbody includes West Fork, East Fork and Grassy Fork with a drainage area of 22.9 square miles and 15.0 stream miles. The East Fork flows north through farmland areas. Grassy Fork begins at a fish hatchery just north of Martinsville and flows northeasterly. Two manmade lakes at Fox Cliff Estates drain into the main stem approximately 0.7 miles from the mouth. The E. coli count caused this waterbody to be non-supportive of full body contact. There were no NPDES permit holders in this waterbody and only one site was sampled.

The portion of Sycamore Creek north of Old Swimming Hole Lake and all tributaries make up this waterbody. Clear Brook, an unnamed tributary, Dry Fork, and Gold Creek feed into the main stem. This waterbody covers 9.2 stream miles and drains 17.1 square miles of area. Sycamore Creek flows through very steep topography. The area is densely forested and has no population near the stream. The main stem flows to the west, joins Clear Brook at mile 7.8, turns to the south, then flows east from the unnamed tributary (mile 6.5), then flows south after meeting Dry Fork (mile 5.7). As flow was low no stream samples were taken. No NPDES permit holders are located in this waterbody.

Old Swimmin Hole Lake is a 20.7 acre lake that lies in north central Morgan County. Sycamore Creek feeds the lake and is the outlet stream past a spillway. The lake was not sampled but is used for recreational purposes as part of Bradford Woods.

Sycamore Creek continues for 1.1 miles from Old Swimmin Hole Lake and meets White River at mile 196.2. This small reach of creek includes Bradford Woods STP. No tributaries feed this watershed. Both the creek and the STP were sampled.

The sampling site on Sycamore Creek was in Bradford Woods downstream of the treatment plant. There was approximately 85% tree cover over the clear water. The banks were sloped and covered with grass and undergrowth. This site is 0.8 miles from the White River confluence. Samples indicated that both the aquatic life and recreational uses were supported.

Highland Creek and all tributaries make up this waterbody. The main stem, an unnamed tributary, and Mill Hollow Branch combine to make 6.6 total stream miles. These creeks drain areas of steep topography bordered by thick forest and very sparse population. Mill Hollow Branch flows parallel to State Road 142. The other creeks are quite distant from the local residents. As flow was low, this waterbody was not sampled.

White Lick Creek originates in the lower quarter of Boone County and flows generally south to the West Fork of White River. The White Lick Creek Watershed drains approximately 291 square miles and includes East Fork White Lick Creek, West Fork White Lick Creek, and several other tributaries. A water quality survey was conducted in this watershed during July 1994.

Land use in the segment is a mixture of agricultural, residential, and commercial. Riparian vegetation in these areas consists of weeds, grasses and trees. Aquatic life, such as frogs, fishes, and insects were visible at most sampling stations. Aquatic plant life such as duckweed, and algae were also not uncommon.

Facilities in this area are decreasing in number. Currently, there are 28 NPDES permitted facilities. Four of these facilities were to be routed to a new facility, Eastern Hendricks Regional Sewer District, by the summer of 1995. Eastern Hendricks Regional Sewer District is a new facility and was not completed or discharging at the time of the survey.

All waters in this watershed met aquatic life criteria. White Lick Creek from the headwaters to the confluence with the West Fork of White Lick Creek near Pittsboro is considered to be threatened as some two sampling points in this waterbody violated the 4.0 mg/L dissolved oxygen minimum. However, the minimum daily average of 5.0 mg/L was not violated. These stations had high daily maximum values of 16.2 mg/L and 9.2 mg/L, respectively. The large fluctuations in dissolved oxygen may be attributed to diurnal fluctuations caused by large amounts of algae being present in the stream at the time of the survey. This algae growth may be attributed to nutrient enriched runoff from upstream and surrounding farmland and nutrient rich effluent from the Brownsburg STP.

All waters in the White Lick Creek watershed exceeded the bacteriological requirements for full body contact recreation. Thirty-five of the fifty-five stations sampled for E. coli did not meet the minimum requirement. The E. coli results for the entire segment ranged from 60 /100 ml to 4200/100 ml. The cause of these violations is unknown.

Four sampling sites had priority pollutants analyzed on water and/or sediment. These sites were upstream and downstream of landfills in Hendricks County. Phthalates were found in all samples in low concentrations.

Chlordane and PCBs in fish tissue, occasional to frequent high levels of ammonia, and E. coli seemed to be the major problems in this basin. The exact sources of these pollutants are hard to determine, but are probably spread across point, non point source, and CSO problems. Nearly all the tributaries to the West Fork of White River receive agricultural non point runoff which results in some degree of siltation, nutrient enrichment, and exposure to pesticides. The streams of the lower part of this basin are more severely channelized for drainage than the streams of the upper basin. However, nearly all streams in the basin have undergone some type of habitat alteration. The severely channelized waterways usually support only low diversity aquatic life communities and are not attractive recreation resources.

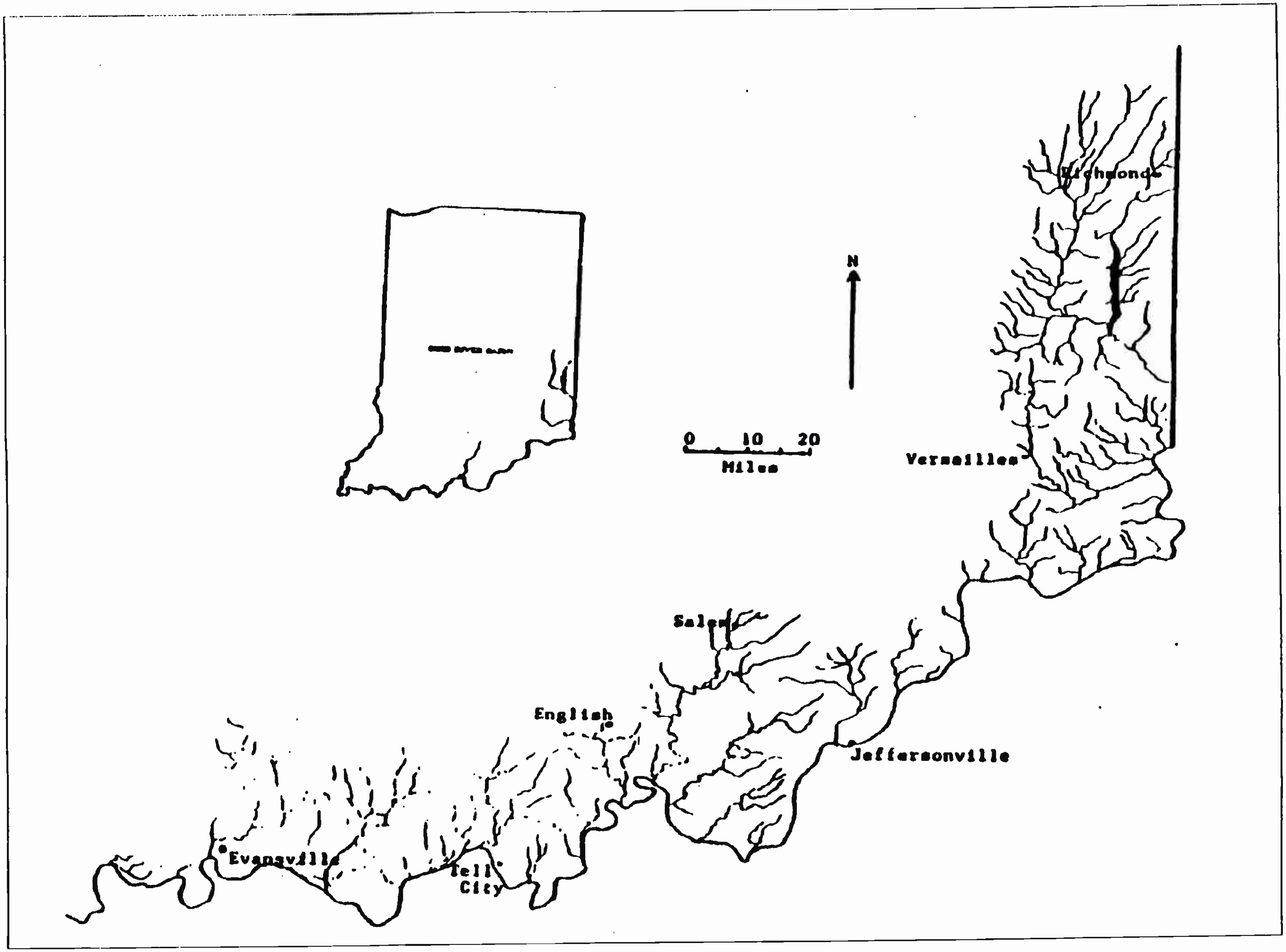
In summary, 1,236 miles of stream were assessed in the West Fork of White River for support of designated aquatic life uses. Of this total, 1,121 miles (91%) fully supported this use, 64 miles (5%) were fully supportive but threatened; 4 miles (0.3%) partially supported this use, and 47 (4%) did not support aquatic life uses. Only 815 miles were assessed for recreational use. Of these miles, 28 miles (3%) were fully supportive and the remaining 788 miles (97%) did not support the recreational use designation.

Ohio River Basin

The Ohio River and its Indiana tributaries (excluding the Wabash River) drain approximately 5,800 square miles in Indiana (Figure 10). The major Indiana tributaries in the basin are the Whitewater River (via the Great Miami River in Ohio), the Blue River, the Little Blue River, the Anderson River, Laughery Creek, Big Indian Creek, and Pigeon Creek. The major land use in the basin is agricultural, but a large portion of the land is hilly and rolling, and much is still heavily forested. Strip-mining operations are important in certain portions of the basin.

Water quality monitoring of the Ohio River itself, which forms the southern boundary of 13 Indiana counties from about river mile 492 to 848 (356 miles), is done by the Ohio River Valley Water Sanitation Commission (ORSANCO), a consortium composed of eight states, six of which border the Ohio River main stem. ORSANCO maintains eight fixed water quality monitoring stations on the portion of the Ohio River which border Indiana. The State of Indiana maintains fixed water quality monitoring stations on the Whitewater and Blue Rivers and the Indiana Department of Environmental Management (IDEM) personnel conduct compliance sampling inspections and other water quality monitoring activities on Indiana facilities and waterbodies that discharge to the Ohio River.

Figure 10. *Ohio River basin*



A detailed discussion of the water quality conditions in the Ohio River main stem can be found in the 1994-1995 ORSANCO 305 (b) report. Therefore, this report will not address these waters.

The U.S. Army Corps of Engineers operates a series of 20 locks and dams on the Ohio River to allow year round navigation. Four of these are located along Indiana's southern boundary, and these dams create slowly flowing pools in the Ohio River which are similar to reservoirs.

Indiana Regulation 327 IAC 2-1 designates the Ohio River for general uses and whole body contact recreation. The Ohio River has also been designated by the Ohio River Valley Water Sanitation Commission as "available for safe and satisfactory use of public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life and adaptable to such other uses as may be legitimate." Such other uses would include navigation and power generation.

Recreational uses occur all along the river. There are no designated swimming beaches, and whole body contact recreation consists mainly of water skiing and swimming from boats. The main stem of the Ohio River and especially the tributary embayments created by the dams are extensively used for sport and commercial fishing. These recreational uses have increased in recent years due to increased leisure time, increased interest in water-based recreation, and to improved water quality.

Indiana has 14 municipal water supply intakes on the Ohio River, three of which are greater than two million gallons per day (MGD): Indiana Cities Water Corporation at mile point (MP) 609, Evansville at MP 702.53 and Mount Vernon at MP 829.2. There are 17 municipal discharges and 13 industrial discharges to the Ohio River from Indiana, but only five are 2 MGD or greater (Jeffersonville, New Albany, Evansville, ALCOA-Warrick, and Newburg). There are three electrical generating stations and 13 Indiana river terminals that handle petroleum products or hazardous wastes.

Several Indiana streams tributary to the Ohio River, have been assessed. Table 36 shows the waters assessed, the status of designated use support, the probable causes or impairment, and the number of miles affected in the Ohio River Basin. Additional comments are also provided for certain reaches. In addition, a comprehensive stream survey was conducted on the West Fork-Blue River, the Blue River and its tributaries, Indian Creek, Mosquito Creek, Buck Creek, and the Little Blue River.

The Ohio River which borders southern Indiana for 356 miles is currently under a fish consumption advisory for several species. Approximately 1.8 miles of the Great Miami River flow through southeastern Indiana from Ohio. Although it is fully supportive of aquatic life, this portion of the river is currently under a fish consumption advisory for channel catfish due to PCB

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin*

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
W. F. Whitewater River	Connersville	FS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	E. coli	40	The Connersville STP has continued to operate within its permit limits but has I & I problems which impact stream.
E. F. Whitewater River	Richmond	PS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	E. coli Cyanide	48	Richmond's STP experiences difficulties during wet weather.
Whitewater River	Brookville	FS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	E. coli	16	New facility in operation.
Pipe Creek	Brooksville	FS (Aquatic Life)	Evaluated		10	
Nolands Fork	Centerville	FS (Aquatic Life)	Monitored (b)		20	
Greens Fork	Greens Fork	FS (Aqautic Life)	Evaluated		20	
Martindale Creek	German town	FS (Aquatic Life)	Evaluated		15	
Williams Creek	Connersville	FS (Aquatic Life)	Evaluated		10	
Salt Creek	Oldenburg	FS (Aquatic Life)	Monitored (b)		12	OATS helping to train staff. New Facility
Big Cedar Creek	Cedar Grove	FS (Aquatic Life)	Evaluated		4	
Village Creek	Alquina	FS (Aquatic Life)	Evaluated		6	
Richland Creek	Cedar Grove	FS (Aquatic Life)	Evaluated		1	Limited use stream.
Silver Creek	Liberty	FS (Aquatic Life)	Monitored (b)		12	
N. F. Tanner Creek	Lawrenceburg	FS (Aquatic Life)	Evluated		16	
S. F. Tanner Creek	Lawrenceburg	FS (Aquatic Life)	Evaluated		4	
Great Miami River	Lawrenceburg	FS (Aquatic Life)	Monitored (b)	PCBs	1.6	
North Hogan Creek	Aurora	FS (Aquatic Life)	Evaluated		10	
South Hogan Creek	Aurora	FS (Aquatic Life)	Evaluated		10	
Laughrey Creek	Ripley/Ohio County	FS (Aquatic Life)	Evaluated		30	Three miles of this stream in Ripley County downstream of Napoleon are designed for limited use.
Indian Creek	Vevay	FS (Aquatic Life)	Evaluated		5	
Plum Creek	Vevay	FS (Aquatic Life)	Evaluated		21	

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Indiana Kentucky Creek	Brooksburg	FS (Aquatic Life)	Evaluated		21	
Peter Creek	Dillsboro	FS (Aquatic Life)	Evaluated		3	New system running well since construction. Installatin of 3 stage lagoon completed.
Coles Creek	Tennyson	FS (Aquatic Life)	Evaluated		5	
Tributary of Laughrey Creek	Osgood	PS (Aquatic Life)	Evaluated	Municipal STP Organics E. coli	2	State working with town on new treatment processes.
Otter Creek	Boonville	NS (Aquatic Life)	Evaluated	Acid Mine Drainage	8	
Cypress Creek	Boonville	NS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	CSO's Nonpoint Acid Mine Drainage Chlordane E. coli	10	Boonville STP has been upgraded but CSO's discharge to creek.
Pigeon Creek	Evansville	NS (Aquatic Life)	Monitored (c) (b)	Municipal STP Organics Habitat alteration Nonpoint Chlordane	31.9	Pigeon Creek NS due to chlordane
Tributary of Ripley Creek	Sunman	NS (Aquatic Life)	Evaluated	Municipal STP Organics Low D.O.	2	State working with Sunman on new treatment system.
Little Pigeon Creek	Dale	NS (Aquatic Life) NS (Recreational)	Monitoed (b) (c)	Municipal STP Organics Low D.O. Ammonia E. coli	5	Construction completd on new plant but bypassing still occurs.
Oil Creek	Perry County	PS (Aquatic Life)	Evaluated	Institutional Treatment Plant Organic unknowns	7	

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Cain Run	Clarksville Jeffersonville	NS (Aquatic Life)	Evaluated	Municipal STP Organics Low D.O. Ammonia E. coli	1	The City of Clarksville STP now discharges to the Ohio River. Both of the old treatment facilities that used to serve the city have been closed down. The City of Jeffersonville STP still has inflow and filtration problems.
West Fork Pigeon Creek	Fort branch	FS (Aquatic Life)	Evaluated		5	New STP began operation Spring 1990.
Stollberg Ditch	Chandler	FS (Aquatic Life) (Threatened)	Evaluated	Sludge depositis Dump run-off	2	Chandler has completed construction advanced treatment, expansion, and ammonia removal.
Mosquito Creek	New Boston	FS (Aquatic Life) FS (Recreational)	Monitored (c)		10.5	
West Branch Mosquito Creek	New Boston	FS (Aquatic Life) FS (Recreational)	Monitored (c)		6.4	
Little Mosquito Creek	New Boston	FS (Aquatic Life) FS (Recreational)	Monitored (c)		4.4	
Buck Creek	New Middletown	FS (Aquatic Life) FS (Recreational)	Monitored (c)		7.9	
Middle Fork Buck Creek	Seven Springs	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	7.3	
Buck Creek	Dogwood	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.2	
Little Blue River	English	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	9.5	
Little Blue River	Sulphur	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	13.9	
Little Blue River	Alton	FS (Aquatic Life) FS (Recreational)	Monitored (c)		12.3	
Camp Fork Creek	English	FS (Aquatic Life)	Monitored (c)	E. coli	4.4	
Otter Creek	Grantsburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.7	

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Bogard Creek/ Brush Creek	Granesburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	11.7	
Stinking Fork	Sulphur Springs	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	8.9	
Turkey Fork	Fredonia	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	11.7	
Mill Creek	Alton	FS (Aquatic Life)	Monitored (c)		5.3	
Anderson River	Troy	FS (Aquatic Life)	Evaluated		25	
Middle Fork Anderson River	Troy	FS (Aquatic Life)	Evaluated		12	
Deer Creek	Cannelton	FS (Aquatic Life)	Evaluated		5	
Holey Run	Ferdinand	FS (Aquatic Life)	Evaluated		2	
Fourteen Mile Creek	New Market	FS (Aquatic Life)	Evaluated		10	
Silver Creek	Sellersburg/Clarksville	FS (Aquatic Life) (Threatened)	Evaluated	Sellerburg STP	20	Sellersburg constuction of new STP in June 1990 delayed.
Middle Fork	Sellersburg	FS (Aquatic Life)	Evaluated		10	
Indian Creek	Lanesville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	11	
Indian Creek	Lanesville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	15	
Indian Creek	Lanesville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	25.5	
Little Indian Creek	Lanesville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	2.3	
Little Indian Creek	Lanesville	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	13	
Little Indian Creek	Corydon	NS (Aquatic Life) NS (Recretional)	Monitored (c)	D.O. E. coli	10	

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Little Indian Creek	Corydon	NS (Aquatic Life) NS (Recreational)	Monitored (c)	D.O. E. coli	1.25	
Little Indian Creek Middle Fork/Bannon Creek/Thompson Creek	Corydon	FS (Aquatic Life) FS (Recreational)	Monitored (c)		4.3	
Georgetown Creek	Corydon	FS (Aquatic Life)	Evaluated		5.2	
Richland Creek	Corydon	FS (Aquatic Life) NS (Recretaonal)	Monitored (c)	E. coli	5.6	
Corn Creek	Corydon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.26	
Crandall Branch	Corydon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	4.32	
Racoon Branch	Corydon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	4.26	
Brush Heap Creek	Corydon	FS (Aquatic Life) NS (Recreational)	Evaluated	E. coli	4.13	E. coli present in upstream/downstream samples.
Panther Creek	Corydon	FS (Aquatic Life) NS (Recretional)	Monitored (c)	E. coli	1.05	
Smith Creek	Corydon	FS (Aquatic Life)	Evaluated		1.73	
Woertz Creek	Corydon	FS (Aquatic Life) FS (Recreational)	Evaluated		1.44	
Jersey Park Creek/Campbell Branch Miller Branch	Corydon	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	5.2	
Yellow Fork	Lanesville/Crandall	FS (Aquatic Life) FS (Recreational)	Monitored (c)		2	
Middle Fork Blue River	South Boston Salem	FS (Aquatic Life) FS (Recretional)	Monitored (c)		17.9	
Mill Creek	Becks Mill	FS (Aquatic Life) NS (Recretional)	Monitored (c)	E. coli	7.7	

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Blue River	Salem Fredricksburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	18.6	
Blue River, South Fork/Dry Run Tributories	New Pekin	FS (Aquatic Life)	Evaluated		25.5	
Blue River South Fork	Palmyra	FS (Aquatic Life) FS (Recreational)	Monitored (c)		8.8	
Dutch Creek	Palmyra	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	3.8	
Bear Creek/Little Bear Creek	Palmyra	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	9.4	
Blue River South Fork	Fredricksburg	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	13.10	
Blue River	Fredricksburg Milltown	FS (Aquatic Life) FS (Recreational)	Monitored (c) (b)		24.1	
Blue River	Milltown White Cloud	FS (Aquatic Life) FS (Recreational)	Monitored (c)		18.75	
Blue River	Leavenworth	FS (Aquatic Life) FS (Recreational)	Monitored (c)		15.26	
Dry Run/Texas Creek	Leavenworth	NS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	10.5	No dry weather flow.
Whiskey Run	Marengo	FS (Aquatic Life) FS (Recreational)	Monitored (c)		8.1	
Slick Run	Milltown	FS (Aquatic Life)	Evaluated		2.7	No flow during survey.
Blue River West Fork	Salem	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	9.6	E. coli 3,500 - 18,000 CFU/100 ml
Blue River West Fork	Salem	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	6.14	E. coli 36,500 - 137,600 CFU/100 ml
Brock Creek	Salem	FS (Aquatic Life) NS (Recreational)	Monitored (c)	E. coli	4.6	E. coli 120,000 CFU/100 ml

Table 36. *Indiana tributary waters assessed, status of designated use support, probable causes of impairment and miles affected in the Ohio River Basin* (cont.)

WATERBODY	NEAREST TOWN(S)	STATUS OF DESIGNATED USE SUPPORT1	METHOD OF ASSESSMENTS2	PROBABLE CAUSE OF IMPAIRMENT	MILES AFFECTED	COMMENTS
Highland Creek	Salem	FS (Aquatic Life) NS (Recreational)	Monitored	E. coli	4.6	E. coli 16,000 CFU/100 ml.
Georgetown Creek	Georgetown	FS (Aquatic Life)	Evaluated		2	
Havey Branch	Oldenburg	NS (Aquatic Life) NS (Recreational)	Monitored (b) (c)	Municipal STP Low D.O. Ammonia E. coli Organics	2	Severe hydralic overloads. Working with IDEM.
Barr Creek	Kassor	PS (Aquatic Life)	Evaluated	Nonpoint Source	8	a) Stream bank erosion. b) Excess nutrients from animal waste and flooding.

PS = Partial Support; NS = Non Support; FS = Full Support. If a use is not listed it was not monitored or evaluated.
b = Biological; c = Chemical.

and mercury concentrations. Most of the Great Miami River originates from and flows through Ohio. The source of these contaminants is in that state.

All waters in the Ohio River Basin are assumed to be under some fish consumption advisory for PCB's and mercury. Please refer to the 1996 Indiana Fish Consumption Advisory to get a list of these waters and the risk levels associated with fish consumption.

Currently, the portion of Pigeon Creek in Vanderburg County is under a fish consumption advisory recommending no fish consumption due to chlordane which was found above FDA Action/Tolerance levels in carp and channel catfish. Past agricultural usage and the many old abandoned landfills near the stream in this area may be the sources of this pollutant.

Pigeon Creek has been severely channelized and also receives a large volume of agricultural nonpoint run off. The combined effects of the high chlordane levels, channelization, nonpoint runoff, and various STP effluents cause Pigeon Creek to be non supportive of its designated uses for about 32 miles.

Approximately ten miles of Cypress Creek near Boonville in Warrick County do not support designated uses. The Boonville STP discharges to Cypress Creek which flows to the Ohio River. This is a newly renovated facility but it is still providing poor treatment and permit limit violations occur. In addition to plant problems, CSO discharges were causing degradation to Cypress Creek. The discharge from the south CSO showed a D.O. of 0.1 mg/L, BOD_5 of 57 mg/L, total ammonia of 15 mg/L, suspended solids of 48 mg/L, and E. coli of 2,600,000/100 ml. Impacts to the Ohio River are probably minor due to its distance from the Boonville discharge (approximately ten miles). Acid mine drainage and agricultural nonpoint run off also contribute to the degradation of Cypress Creek. Elevated PCB and chlordane levels have been found in the sludge drying beds of the Boonville STP and in the sediments of Cypress Creek.

The Blue River in Washington, Harrison and Crawford counties is a high quality stream that seldom experiences pollution problems. This river, from the confluence of its West and Middle Forks in Washington County downstream to the Ohio River, as well as a portion of the South Fork of the Blue River, are designated as "Exceptional Use" streams.

The West Fork of Blue River originates several miles northeast of Salem and flows generally southwest to its confluence with the Middle Fork of Blue River. Downstream of this confluence the river is called Blue River. Total length of the West Fork is approximately 15.2 miles with a drainage area of 49.5 square miles. (Stream miles are measured moving upstream from a designated point. In this case that point is the confluence of the West Fork and Middle Fork).

Land use in the region is approximately 50% agricultural, 40% wooded, and 10% urban or miscellaneous. Livestock related activities comprise a major part of the agricultural base. The topography varies from rolling sinkhole dotted plains to steep hills.

As the West Fork of Blue River flows toward and through Salem it is joined by four tributaries. The first tributary (unnamed) just northeast of town originates in a rural, pasture, and wooded area. Brock Creek is approximately 4.6 miles in length with a drainage area of 9.78 square miles and includes both urban and rural areas. Highland Creek is approximately 5 miles in length. This tributary is the receiving stream for Jean's Extrusions wastewater discharge, as well as rural and urban run off. Hoggatt Branch is the overflow from Lake Salida, a public water supply reservoir on the south side of Salem. The city of Salem municipal wastewater treatment plant and Hoosier Stone Company effluents are discharged to the West Fork of Blue River.

The city of Salem has been placed on a sewer ban due to hydraulic overloads at the sewage treatment plant and dry weather bypassing from the combined sewer system. During the survey one combined sewer was discharging a small amount of flow. After a storm which occurred later, the volume of the discharge increased dramatically. The final effluent at the sewage treatment plant was cloudy due to bulking in the final clarifiers. This condition abated during survey set up, and the plant was within their suspended solids limits. However, the plant effluent did not meet the permit limits for ammonia-N.

Hoosier Stone company pumps clear water from a stone quarry into the West Fork of Blue River. This augments the flow downstream of the sewage treatment plant and provides dilution water for the effluent. Jean's Extrusions discharges non-contact cooling water to Highland Creek, a tributary of the West Fork of Blue River.

Water quality in the West Fork of Blue River and its tributaries was satisfactory except for bacteriological concentrations. Extremely high E. coli counts were detected at all stream sites, except Hoggatt Branch and the Middle Fork of Blue River, which are not in the general drainage pattern of the other streams. These high values are attributed both to the Salem sewer system and to nonpoint sources such as farm runoff. Septic systems which are outside the sewer system service area are also suspect, especially along Brock and Highland Creeks. There was no definite pattern. High counts were noted at sites far removed from the city as well as within the city confines. Agricultural activities include many livestock operations along the river and tributaries.

Indian Creek is located in southern Indiana and flows through Floyd and Harrison counties before entering the Ohio River. The topography of this area is hilly and the stream bed is primarily made up of limestone. This stretch of stream is considered to be in a karst area, which has sinkholes, underground streams, caverns and springs. Indian Creek and its tributaries are all slow moving bodies of water.

Indian Creek has eleven tributaries that meet the main stem along its 68-mile meandering course. The creek's headwaters start in Floyd County above Floyd Knobs; the creek travels southwest into Harrison County and meets the Ohio River north of New Amsterdam. Most of the land use in this area is primarily agricultural with some residential areas throughout. The agricultural uses range from beans, corn and tobacco fields to pastures for livestock. There is no major industry located in this stream reach.

There are thirteen NPDES dischargers in this area. Only one of the six sampled, the Chimney Woods Estates STP, had any problems. This plant was discharging sludge into the creek and had high levels for total suspended solids and ammonia. There are six semi-public facilities that have a history of problems in the area but all downstream sampling sites indicated no stream water quality problems.

The largest town in this segment is Corydon, the first state capital. The next largest towns are Lanesville and Floyd Knobs. There are a lot of little towns in this reach including Bryneville, Crandall, Galena, and Navilleton. Stream uses for these towns range from NPDES discharges to recreation and irrigation. There are some undisturbed natural areas throughout this area, especially southwest of Corydon.

Most of the waterbodies in this area are supportive of aquatic life but not full body recreational contact. There were two segments of Indian Creek, one near Corydon and one in Lanesville, that did not support the aquatic life or full body contact designations. High E. coli and low D. O. concentrations were the cause of the non support in this reach.

The waterbody that had the highest concentration of E. coli was Little Indian Creek in Lanesville, an area which has had problems in the past. Old sewer tiles that have been left open are still draining into Little Indian Creek and continue to have an impact on the stream. This waterbody accounts for three of the five sampling sites that were above 2000 cfu/100 ml for E. coli, and also had violations of the daily minimum dissolved oxygen criteria.

The Mosquito Creek watershed drains approximately 27 square miles and is located approximately 14 miles southeast of Corydon in Harrison County. The Buck Creek watershed drains about 114 square miles in Harrison County and is bordered by Lanesville in the far upstream portion and the Ohio River in the downstream portion. The Little Blue River watershed drains about 172 square miles in Crawford County and is bordered by English in the upstream portion and the Ohio River in the downstream portion. The land use for all of these drainage areas is predominately agricultural/pasture land with areas of dense woodland. Karst topography characterizes this area which includes many sinkholes and spring fed streams.

Overall water quality in these streams was very good, with the exception of some elevated E. coli concentrations. All of these streams were assessed as "supportive of aquatic life." Several reaches in these streams were assessed as "non supportive of full body contact" due to high E. coli concentrations. No correlation with any known point sources can be established at these sites. Pasture land run off is suspected because of a rain event prior to sampling.

Most Indiana tributary streams to the Ohio River fully support aquatic life and recreational uses. Although most Indiana dischargers do not appear to be causing problems in the Ohio River, some facilities which discharge directly to the river have recently had problems meeting permit limits for various organics and cyanide. The tributaries which do not fully support their uses are most often impaired by municipal discharges. Impaired waters in this basin frequently contained ammonia, organics, low D.O., and E. coli, which were often discharged due to poor water treatment.

In summary, 910 miles of Indiana tributaries to the Ohio River were assessed for aquatic life use in this report. Of these miles, 798 (88%) fully support the aquatic life use, 12 miles (1%) are considered threatened, 65 miles (7%) are only partially supportive, and 35 miles (4%) did not support the aquatic life use. Recreational uses were assessed for 514 miles. Of these miles, 142 (28%) were supportive of these uses, and the remaining 372 miles (72%) were not considered to support the recreational use designation.

III. WATER POLLUTION CONTROL PROGRAM

Point Source Control Program

The point source control program in Indiana primarily involves discharges from municipal or industrial wastewater treatment facilities. In order to meet the goals of the Clean Water Act, federal state, and local governments, as well as industry, have spent considerable monies to improve the degree of wastewater treatment they provide and, in turn, the water quality of Indiana's lakes, rivers and streams. The concentrations of polluting materials in these discharges are regulated by the National Pollutant Discharge Elimination System (NPDES) permit program. All facilities which discharge to Indiana waters must apply for and receive an NPDES permit. The limits, set in the permit, are designed to protect all designated uses of the river, lake or stream into which the discharge flows.

Municipal Facilities

Table 37 depicts the changes in the degree of wastewater treatment provided by municipal facilities in Indiana in the period from 1972 to 1995. During this time, percentage of people who are served by municipal treatment plants has changed slightly, but the degree of treatment has improved considerably. There are no more primary treatment plants in the state. The percentage of the population served only by secondary treatment plants has also decreased, whereas, the percentage served by advanced waste treatment facilities of some type has increased dramatically.

In 1972, there were no advanced wastewater treatment facilities operating in Indiana. In 1995, over half the population was being served by these types of systems. Of the 31% of the population not served by municipal wastewater treatment plants, the great majority (about 90%) have been determined to have adequate individual spectic tank disposal systems or are served by

Table 37. *Changes in degree of wastewater treatment provided by municipal facilities to the population in the period 1972-1995*

	1972	1982	1985	1988	1989
Pop. Size	5,195,000	5,490,000	5,500,000	5,510,000	5,556,000
No Municipal Treatment	40%	40%	38%	38%	37%
Primary Treatment	6%	0.4%	0.4%	0%	0%
Secondary Treatment	54%	41%	17%	11%	10%
Advanced Treatment	0%	18%	45%	51%	53%

	1991	1993	1995
Pop. Size	5,551,795	5,662,000	5,625,600
No Municipal Treatment	37%	36%	35%
Primary Treatment	0%	0%	0%
Secondary Treatment	10%	11%	12%
Advanced Treatment	53%	53%	53%

semi-public facilities. The effect of this increased level of wastewater treatment has been an improvement in the water quality of many of Indiana's lakes, rivers and streams.

Since the passage of the Federal Water Pollution Control Act in 1972, Indiana has processed more than 351 grants under the federal construction grants program involving approximately 1.4 billion dollars. Each of these grants has also been "matched" with state monies totaling approximately 230 million dollars. In addition local governments have provided addtional funds for construction of wastewater treatment facilities. This program is now being phased out, and Indiana issued the last federal grant in September of 1991. There are currently 21 construction grants that are not administratively completed in Indiana.

In place of the construction grants program, Indiana is now participating in the State Revolving Fund Program. This program makes low interest loans to qualified entities for water pollution control projects. As the principal and interest on these loans are repaid, they become available to lend for other projects. Table 38 shows the state revolving loans made in 1992-1995.

Industrial Facilities

By July 1, 1977, industrial discharges were required to meet Best Practicable Control Technology Currently Available (BPT) or achieve water quality standards, whichever was more stringent. Nearly all Indiana industries met BPT by this time. For those which did not comply, enforcement action was initiated and eventually resolved to achieve compliance. However, there was a concern that toxic pollutants, which are the primary focus of Best Available Technology Economically Achievable (BAT), were not sufficiently addressed. Many permittees now have installed treatment that can meet BAT, primarily because of an overriding site-specific water quality issue. Applicants for permit reissuance are required to specifically identify toxic substances which are or may be discharged to the waters of the state from their facility. The permit reissuance process involves the detailed review of these applications, and toxic pollutants are limited to safe levels. If there is a question as to the presence of a particular substance in sufficient quantities to be of concern, a monitoring requirement is established in the permit. A final permit limit is based on these additional monitoring data.

Although the total amount of money expended by industry for wastewater treatment has not been reported, it has been considerable. Data from claims for tax exemptions for wastewater treatment equipment provide some idea of these expenditures. The number of claims and total amounts claimed for each year from 1978-1994 by Indiana industries are shown in Table 39. This amount has more than tripled in this time period.

In the past, industrial wastewaters have caused water quality problems even though they were discharged to a municipal sewage treatment facility. These waters would often "upset" the various treatment processes at the municipal sewage treatment facility to the extent that little or no wastewater treatment would occur. Also, some of these pollutants can pass through a wastewater treatment facility and remain at levels that are still toxic to the aquatic life in the

Table 38. *Loans supplied by the State Revolving Loan Fund (1994-95)*

COMMUNITY	DATE	AMOUNT ($)	STATUS
Auburn Edit Corp.	05/31/95	3,360,000	FP[1] Done
City of Auburn	07/10/95	6,600,000	FP[1] Done
Crown Point	12/27/94	11,030,000	P&S[2] In
Dyer S.D.	02/05/93	4,950,000	Complete
Town of Dyer	5/28/93	4,136,000	Complete
Evansville	07/26/93	2,247,000	Complete
Farmersburg	12/05/94	1,725,000	P&S[2] In
Farmland	12/07/94	720,000	In Construction
Franklin (sewers)	05/10/93	2,283,000	Complete
Franklin (WWTP)	09/15/94	860,000	In Construction
" " (WWTP)	12/23/94	8,060,000	" "
Gary S.D.	05/03/93	15,082,000	In Construction
Goshen	03/03/93	9,300,000	Complete
Hammond S.D. (WWTP)	05/03/93	23,304,000	In Construction
Kouts	04/15/94	1,600,000	In Construction
" "	05/04/95	600,000	" "
LaCrosse	09/15/94	2,546,497	In Construction
Lake George RSD	12/22/93	5,337,000	P&S[2] In
Lake of the Woods	02/17/93	4,126,479	Complete
" "	6/30/94	732,521	" "
Medaryville	12/28/94	700,000	In Construction
New Paris C.D.	06/09/94	5,945,000	In Construction
Parker City	08/19/94	805,000	In Construction
Riley	01/31/94	453,000	In Construction
St. Joe/Spencerville	09/22/94	2,210,000	In Construction
Wanatah	09/24/91	3,495,000	Complete
West Lafayette	04/15/94	19,950,000	In Construction
Zanesville	07/10/95	2,345,000	P&S[2] In
TOTAL		**$144,592,497**	

[1] FP=Facility Plan
[2] P&S=Plans and Specifications

Table 39. *The number of tax exemption claims and the total dollars claimed by Indiana industries for wastewater treatment facilities from 1978 to 1995*

YEAR	NUMBER OF CLAIMS	AMOUNT CLAIMED
1978	102	$369,186,717
1979	123	394,712,641
1980	113	400,895,352
1981	124	518,478,055
1982	126	607,093,628
1983	139	633,443,520
1984	145	797,153,029
1985	159	803,676,180
1986	184	867,057,770
1987	176	1,045,182,501
1988	188	1,055,619,253
1989	230	1,061677,161
1990	241	1,111,971,008
1991	280	1,217,244,746
1992	297	1,311,708,561
1993	322	1,334,466,191
1994	323	1,491,447,202
1995	*	*

* Indiana has changed from an annual certification program to a once every 5 years-certification program. Accurate figures are not available for 1995, due to Industry's confusion over the new law.

receiving stream. Toxic substances can also accumulate in the municipal sludge at levels which make disposal much more expensive. Pass-through and interference at STP's can be caused by excessive quantities of conventional pollutants as well as toxic pollutants.

To prevent these occurrences, Indiana has developed a pretreatment program that requires industries to reduce concentrations of toxic or harmful substances to "safe" levels before releasing them to the sewer system. Municipalities with sewage treatment facilities which are designed to treat 1.0 million gallons per day (MGD) (majors) or more and have an adequate industrial base are required to develop their own pretreatment to control these discharges. In general, the state works with the smaller municipalities and their associated industries to develop their pretreatment programs. Certain minor municipalities with significant industrial users are being required to develop partial or "hybid" pretreatment programs.

Indiana has identified 45 municipalities that need to have direct control of their industrial users (IUs). Approximately 800 IUs are controlled by these 45 municipalities, and their pretreatment programs are audited annually by the state. Also, there are approximately 150 IUs that discharge into smaller municipal sewage plants that are controlled directly by the state.

Compliance and Enforcement

In order to assure compliance with NPDES permit limits and water quality standards for pollutants in wastewater, a variety of data is reviewed. These data include self monitoring reports including, Discharge Monitoring Reports (DMRs) and Monthly Reports of Operation (MROs), written correspondence, the permit (i.e., effluent limitations, compliance schedules), and inspection reports. The data reported on the DMR's is entered into the Permit Compliance System (PCS) which is an EPA automated national NPDES data base. Through PCS, the Office of Water Management (OWM) maintains a comprehensive source inventory of all discharges holding NPDES permits. The source inventory includes basic information concerning each NPDES permit holder. Information includes name, location permit number, discharge limits,compliance dates, other permit requirements, and effluent data. The source inventory also includes any enforcement actions which may be in effect. This ensures that enforcement actions against permitted and unpermitted discharges are tracked. When NPDES effluent limitation violations or unpermitted discharges are found, measures to gain compliance are initiated by the inspector or other OWM staff person. If this intervention is ineffectual, then a referral to the Office of Enforcement (OE) is made. An enforcement action is then initiated. The enforcement action will ensure a return to compliance by the violator.

In Indiana, compliance with NPDES permit effluent limitations is tracked with the assistance of computers. Reports are generated which routinely used to identify violations. One such report is the Quarterly Noncompliance Report (QNCR). The QNCR summarizes certain types of noncompliance information for all major and some minor facilities violating the terms of their NPDES permits, enforcement actions, or pretreatment programs. This noncompliance information is used to manage and implement the NPDES and pretreatment programs. The report contains the name, location, and NPDES permit number of each of the permitted facilities, the instances of Reportable Noncompliance (RNC), and the enforcement actions that have been taken in response to the instances of RNC. A similar report for minor facilities is also generated for use by the SNC (Significant Noncompliance) review committee. A Significant Noncompliance report from instances of RNC, is generated monthly for internal use, and is retrieved by EPA from PCS quarterly in the form of the QNCR.

The SNC review committee is an interoffice committee composed of Permits Section, Water Enforcement Section, Inspection Section, Pretreatment Group, Compliance Section, Operator Assistance and Training Section (OATS), Modeling Section, Facility Construction Section, and Special Projects Section which has been established to discuss facilities in Significant Noncompliance. Major, minor, and pretreatment facilities are included. The purpose of the committee is to determine the problem causing the noncompliance and the action required for the facility to return to compliance. In some instances, noncompliance may be the result of poor laboratory procedures and a visit from the OATS staff to discuss proper procedures brings the facility back into compliance. For the Water Enforcement Section, this information allows the focus to be on those facilities which truly require an enforcement action to come into compliance. A better use of all resources is gained by this method, a testimony to total quality management.

The Compliance Section of the Office of Water Management is responsible for follow-up and updates involving compliance issues of the QNCR. The Compliance Section also uses flow data from PCS to manage the Sewer Ban Program (327-IAC 4-1) for municipal and semi-public facilities.

Not every violation of an NPDES permit is required to appear on the QNCR. Significant Noncompliance (SNC) is not a regulatory distinction; it is a program definition used for management purposes and serves to classify those violations EPA believes merit priority and enforcement attention. SNC is a subset of RNC.

Source inventory for industrial discharges holding Industrial Waste Pretreatment (IWP) permits is tracked and screened on PCS in the same manner as NPDES permits.

The Inspection Section, now a part of the OWM Compliance Branch, conducts routine inspections based upon a systematic plan as well as complaint investigations. If compliance is not achieved through the regular inspection program, the inspection section may make a referral for enforcement action. The Inspection Section also provides copies of letters sent to facilities in noncompliance for information purposes. These serve as advance information and allow OE staff to remain updated on problem facilities. The reports supplement the PCS reports in that they contain operation and maintenance details, sampling and reporting adequacy, and general plant conditions. During 1994, 152 major facilities and 623 minor facilities (775 total) were inspected by staff of the Inspection Section. In 1995, these staff inspected 155 major and 718 minor (873 total) facilities.

The Office of Enforcement (OE) utilizes two types of enforcement action, "formal" and "informal." Informal actions range from phone calls, inspector notification, site investigation, and meetings, to the first written step by the OE, a Warning of Noncompliance (WONC). In many instances of noncompliance, a return to compliance can be achieved by these informal means.

When the OE accepts a referral which warrants informal action, a WONC is issued. The WONC specifies the violation of the NPDES permit, statute, or rule and further requests immediate attention to return to compliance. The violator must provide a written response as to the reasons for the noncompliance and the corrective measures which will be instituted to return to compliance. It also states that further enforcement action may be pursued for failure to act. If no response or an unsatisfactory response is received, the action may escalate to formal enforcement status.

Formal enforcement action includes the issuance of administrative orders and, if unable to gain compliance through administrative action, the case may be referred to the Office of the Attorney General for judicial action.

Administrative orders include Agreed Orders (AO) or Interlocutory Agreed Orders (IAO) each of which are preceded by a Notice of Violation (NOV). A Commissioner's Order (CO) may be issued after the 60-day settlement period, following the issuance of a NOV, has expired. This procedure is prescribed by Indiana statute. An Emergency Order of the Commissioner (EO) may be issued whenever it is determined that contamination has reached a point where it constitutes an immediate danger to human health or the environment.

A Civil Penalty Policy has been developed to address certain common violations and is used by all enforcement staff in determining penalties. This Policy is intended to assist enforcement staff in establishing base civil penalties. The authority for IDEM to assess civil penalties is provided for by the Indiana Environmental Management Act, IC 13-7-13-1. The violator may be liable for a civil penalty not to exceed twenty-five thousand dollars ($25,000) per day on any violation. The Policy is intended to standardize penalty calculations based on the extent of deviation from the requirement, the potential for harm, the economic benefit gained by the noncompliance, and various mitigating or aggravating factors in the assessment of an appropriate civil penalty. IDEM imposes civil penalties with the intent of encouraging future compliance by specific deterrence for the violator and as a general deterrence to others, and to provide a level playing field for all by removing the economic benefit of noncompliance.

In addition to compliance tracking, which focuses on significant noncompliance at all types of facilities holding NPDES permits, a considerable effort is being made to address a wide variety of other violations of state rules. Many violations of state rules do not result in identification of noncompliance by PCS. These violations may include improper operation and maintenance, improper sampling and reporting, bypassing, and operator misconduct. Non-NPDES violations involve inadequate spill reporting and/or cleanup response, land application issues, confined feeding issues, septic waste hauler issues, storm water discharges, and unpermitted discharges. The enforcement staff has worked closely with the Indiana Department of Natural Resources (IDNR) in conducting enforcement actions against facilities which have had spills resulting in fish kills. This has resulted in the assessment of civil penalties under IDEM rules and compensation for natural resources damages under IDNR rules. Enforcement staff has been working closely with U.S. EPA Region V on number of enforcement cases on the Grand Calumet River/Indiana Harbor Ship Canal (GCR/IHC). This comprehensive effort is aimed at achieving compliance with the NPDES permits and associated rules, and establishing a foundation for the GCR/IHC remedial action plan for removal of contaminated sediment from this waterbody.

NONPOINT SOURCE (NPS) WATER POLLUTION CONTROL PROGRAM

In the last two years, there have been numerous activities which have aided the state's progress in its efforts to control NPS water pollution. The acquisition of Section 319 grant funds has had a significant impact in controlling NPS pollution, however, the program has also acquired Section 314, 604(b), and 104(b)(3) grant funds as well to expand on these efforts. The figures below show the amounts of funding for NPS projects and activities that have been administered by the Indiana Department of Environmental Management's (IDEM's) NPS Section.

Program	1994-95	Since the Initial Funding of Section 319 (1990)
Section 319	$3,578,814	$6,951,598
Section 314	$ 50,000	$ 460,000
Section 104(b)(3)	$ 356,400	$ 356,400
Section 604(b)	$ 60,000	$ 128,593

Assessment and monitoring activities as well as other contributions from the IDEM Office of Water Management (OWM) and other federal, state, and local agencies have also provided valuable information and assistance in the state's NPS pollution control efforts. The projects listed below briefly describe the NPS activities that are taking place throughout the state through this program and through other organizations/agencies around the state.

The 1994 year of the Section 319 program was funded with $2,904,019 of federal/state funds, $1,742,411 being provided by federal funds. Besides providing staffing and equipment for the IDEM's OWM, it funded the following projects, with the amounts shown representing the federal funding for the projects:

Indian/Pine Watershed

Purdue University is utilizing $100,000 to study Indian Creek and Pine Creek watersheds which include parts of Tippecanoe, Warren, and Benton counties. This project is determining the quality of the water system and the impacts made on it by the historic and continuing changes in land use. Informational and educational materials are being published and distributed, as well as a presentation developed for the state workshop.

Lake Monroe Watershed

Indiana University is utilizing $91,077 to study the watershed of Lake Monroe which includes parts of Monroe, Lawrence, Brown, and Jackson counties. This project is being conducted using the same parameters as the Indian/Pine Watershed project. The results of the two projects will be compared to determine the differences in watershed characteristics and how they are affected by NPS water pollution. This information will help to illustrate the potential need for specific land treatments for the various characteristics found throughout Indiana.

Forestry Best Management Practices

Utilizing $57,400 to develop best management practices (BMPs) for forestry application, the Indiana Department of Natural Resources (IDNR) Division of Forestry is conducting training sessions and field days using demonstration projects. A manual, informational/educational materials, and video, plus various news publications, are being produced and published. Once the BMPs are determined, the project will shift to an implementation and monitoring mode.

Under the coordination of the Woodland Steward Institute, a 15 member steering committee was established representing a wide variety of potentially affected interests. A technical training session was sponsored by the Indiana Society of American Foresters to provide forestry and NPS background information to the steering group members. The steering group operates under the "Forest Practices Working Group" of the Woodland Stewart Institute. In addition to defining forestry BMPs, the group also defined Nonpoint Source Pollution/Water Quality Goals and developed criteria to judge the BMP guidelines to be developed and implemented.

Initial work has been completed in identifying the types of training programs needed. It has also been identified as to who should be involved in developing these programs and the intended audiences. Project updates and articles have appeared in several Association publications, and two general mailings to interested parties has been conducted. Articles will continue to be developed every few months.

Wabash Watershed Management

The Friends of the Limberlost is utilizing $51,650 for the reduction of sediment and nutrient loading in the Wabash River by applying best management practices. A 70 percent/30 percent cost-share program has been established for landowners interested in installing vegetative filter strips, riparian forest buffers along open streams, and fencing to exclude livestock from critical areas.

In early 1995, 31 landowners were contacted followed by another 24 in the spring. Of those contacted, five have agreed to participate in the cost-share program for vegetative filter strip installation and one was interested in installing fencing to exclude livestock from an adjacent open stream. Another three sites have been chosen to serve as permanent demonstration projects and construction was completed on them in the late spring. Photographs of the areas were taken before and after construction.

Public participation was good in the development of the watershed plan as represented by approximately 30 area residents that attended the first public meeting held in March of 1995. More landowners have expressed interest in participating in this process in the future. The first of the three demonstration days was held in June 1995. The demonstration prototype of the self-guided tour map has been completed which will provide area residents with a chance to explore the area without having to wait until an organized demonstration day.

In working with the U.S. Fish and Wildlife Service, two wetlands have been surveyed and one restored thus far. Also, 543 acres have been inventoried as critical areas for permanent protection. This acreage will be signed in the Wetland Reserve Program Sign-Up.

Upper Wabash River Restoration

The Bloomington Office of the U.S. Fish and Wildlife Service is utilizing $75,000 to determine how restoration of native habitats can be used to enhance water quality. Through a cooperative effort with local Soil and Water Conservation Districts (SWCDs), Ducks Unlimited, the IDNR Division of Forestry, the U.S. Department of Agriculture (USDA), the Wabash River Heritage Corridor Commission, and private landowners, up to 500 acres of wetlands, bottomland hardwood forest, and native prairie will be restored within the upper Wabash River watershed.

1995 Farm Progress Show/State Fair

Purdue University has utilized $35,000 for the building of a mini-watershed at the 1995 Farm Progress Show and the enhancement of an already existing mini-watershed located at the Indiana State Fairgrounds. The project helped to educate land users on what a watershed is and how residents and land users within a watershed affect the quality of water. Assistance and resource information was also provided on the control of NPS pollution.

Crop Nutrient Training

Utilizing $71,897, the Purdue University Cooperative Extension Service (CES) is educating producers, fertilizer dealers, consultants and agency personnel on crop nutrient and manure management in the Patoka River and White River watersheds. The CES is also going to demonstrate various best management practices and provide resource information and assistance on BMPs and nutrient management to interested participants that will enhance the utilization of crop nutrients, manure, and yard waste in cropping systems.

Quality of Precipitation

The USGS is using $209,695 to monitor the quality of wet deposition at a monitoring site located at the Gary Regional Airport. This is a continuation of a project that provided 52 weeks of monitoring at this site. The data will be collected over a period of two years. The data is needed to evaluate possible sources of atmospheric NPS pollution in northwest Indiana.

West Boggs Lake

The Joint Daviess-Martin County Park and Recreation Board has used $38,900 for the construction of two wetlands at the park and to sponsor educational tours of the site. The structures will serve as sediment and nutrient traps, preventing the majority of these contaminants from reaching the main body of the lake.

The two wetland sites were constructed in November and December of 1994. Both of the project sites are now functioning and serving their intended purpose. A public tour was held during the construction of the sites and again in June of 1995 to show the finished work and resulting water quality improvements. Participating in the tour were representatives of the Daviess County Board of Commissioners, the Daviess County Council, the Daviess County SWCD, the Martin County Board of Commissioners, the Martin County Council, the Martin County SWCD, and the West Boggs Lake Conservation Association. The participants were able to see the project from a lake-wide perspective. Articles were written and published in the local newspaper discussing the first two demonstration tours and another was produced for the final tour scheduled in June of 1995.

Filter Strip Project

Utilizing $25,050, the Kosciusko County SWCD has hired a person to promote the benefits of vegetative filter strips. This person has begun to undertake the campaign of disseminating information and making numerous personal contacts in an effort to promote the use of filter strip BMPs. Cost-share payments have been offered for grass, legume, and tree plantings that will be maintained for a minimum of five years.

Air observation of the Upper Tippecanoe River watershed via an IDNR helicopter helped to identify problem areas. Vegetative buffers were observed along streams, ditches, and riverbanks. Areas of gully erosion were also observed. This information was used to develop the list of potential landowners to contact. The observations were reviewed with the landowners in an effort to get them interested in participating in the cost-share program.

During the spring of 1995, many landowners were contacted and six of them with the greatest erosion problems agreed to participate in the cost-share program. Filter strips were installed on these properties. Site visits were made by the project manager to check on the growth of the plant materials. Other potential landowners have been contacted and their properties reviewed. More filter strips were installed in the fall of 1995. An article was placed in the Upper Tippecanoe Water Quality Project Exchange to update the public on the Filter Strip Program. An article was also placed in the Kosciusko County SWCD Newsletter Resource Report. The newsletter circulation is 24,000.

Augusta Lake Remediation

The U.S. Fish and Wildlife Service is utilizing $75,000 to plan, implement, and complete a plan using anoxic limestone drains and constructed wetlands to abate the effects of acid mine drainage on Augusta Lake. This is a continuation of a previous project started in 1993.

Nonpoint Source Training Seminars

The USDA Natural Resources Conservation Service (NRCS) is utilizing $22,000 to prepare and conduct seminars and participate in conferences on NPS best management practice issues related to watershed management. The seminars that are using the Coordinated Resource Management (CRM) concept are being held at different locations around the state in an effort to reach the widest range of citizens and professionals that are involved with or concerned watershed management.

Five CRM workshops were conducted for citizen groups which were organizing to address their watershed concerns. The watersheds were selected upon request for the workshop from a project steering committee or sponsoring SWCD. The NRCS contracted the services of Mr. Dennis Phillippi of Resource Options, Inc. Of Bozeman, Montana, to conduct the workshops and advise other Indiana CRM instructors. The workshops were held in late 1994 and early 1995 in the Flatrock River watershed, the Pigeon Creek watershed in Evansville, the Salt Creek/Lake Monroe watershed, the Cedar Creek watershed, and the Upper Eel River watershed. Participant surveys were completed for the Salt Creek/Lake Monroe and the Upper Eel River sessions.

The development of ideas for the NPS conferences began in the fall of 1995. Initial planning by IDEM and NRCS staff has grown to include other interested parties to form a planning committee. The committee has been discussing dates, format, and topics. The conferences will be held in the Summer of 1996.

NPS Information Project

The Indiana Association of Soil and Water Conservation Districts is utilizing $75,000 to fund the salary of a NPS Information Specialist to provide information and resources to all local SWCDs and other groups so that they can be more effective in guiding local NPS water pollution prevention efforts. Since the start of this project, the Specialist has been researching and reporting on NPS activities and issues from around the state in the monthly newsletter, Nonpoint Notes which has over 850 contacts on the distribution list. The Specialist has also developed brochures, fliers, and other handouts for the "Pathway to Water Quality" Communications Committee to be distributed at the Indiana State Fair and other public events and conferences.

The Specialist has attended many meetings, workshops, and conferences including the water quality database training workshops, the Indiana Water Resource Association Conference, the National Association of Conservation Districts Conference, and the Association's annual conference. The Specialist assists in the planning and operations of the Association's Executive Committee and Board and the planning of the next Association's annual conference. Other activities that the Specialist has been doing include tracking clean water legislation and gleaning information from USEPA guidance documents pertaining to water quality and NPS pollution.

Know Your Watershed

The Conservation Technology Information Center is utilizing $25,000 to develop a citizen outreach component of its current "Know Your Watershed" program. This component will assist citizen groups in the formation of local partnerships.

Groundwater Monitoring Network

The Indiana Geological Survey is utilizing funds in the amount of $50,000 to develop a statistically valid basis for extrapolating pesticide data from wells in the Indiana Baseline Monitoring Program to aquifers throughout the state.

Comprehensive Resource Planning System (CROPS) Development

The NRCS, using $100,000, is developing software adaptable to Indiana for CROPS, a decision-making model to assist farmers to plan and implement economically sound, multi-year crop production systems while complying with applicable environmental criteria and standards. The NRCS is implementing the CROPS project in Indiana in order to respond to site-specific environmental and economic constraints relative to NPS water quality conditions. The CROPS is needed to enhance the existing delivery system to solve NPS problems for both surface and groundwater.

The 1995 year of the Section 319 program was funded with $3,060,671 of federal/state funds, $1,836,403 being provided by federal funds. Besides providing staffing for the IDEM's

Ground Water Section and Special Projects/Standards Section, it funded the following projects, with the amounts shown representing the federal funding for the projects:

NRCS Nonpoint Source Liaison

The USDA/NRCS is utilizing $94,484 to staff a liaison position with an experienced USDA/NRCS employee to provide technical assistance and knowledge to the Office of Water Management/IDEM on a daily basis for two years. This is a continuation of a Section 319 funded liaison position started in 1992.

Restoration of Juday Creek

Utilizing $106,100, the Michiana Area Council of Governments is implementing a public awareness program and incentive program to encourage riparian landowners to install BMPs along the Juday Creek corridor.

Yard Maintenance Practices Impact on Water Quality

The Purdue University is utilizing $29,318 to produce and distribute a pilot educational publication that will outline the BMPs for lawn and garden care throughout Indiana.

Geographic Information System Technical Support

The U.S. Geological Survey is using $150,400 to develop a large-scale, 14-digit HUA, digital database of drainage basin boundaries for approximately 47 counties throughout Indiana.

Friar Tuck Acid Mine Drainage Wetland

Utilizing $105,000, the IDNR is developing a subsurface wetland treatment system to treat acid mine drainage at the Friar Tuck reclamation site in Sullivan County, Indiana.

Public Information/Education Program

The Historic Hoosier Hills Resource Conservation and Development Council is utilizing $63,730 to hire an information/education coordinator on the NPS activities occurring in the Versailles Lake and upper Laughery Creek watershed. The coordinator will develop informational booklets and brochures to be made available to the public and develop educational materials to be used in elementary school classrooms. This person will also coordinate an Integrated Crop Management Clinic, field days, and other public outreach events within the watershed area, as requested by interested parties.

Upper Eel River Water Quality Project

Utilizing $97,250, the Whitley County SWCD is developing an incentive program for landowners for the installation of BMPs, such as filter strips, fencing to exclude livestock from streams, willow post installations along stream banks, and rip-rap (if necessary) in the Eel River watershed.

Lakes Shafer and Freeman Restoration Sediment Trap Basin Implementation

The Shafer-Freeman Environment Conservation Corporation is utilizing $112,300 to develop sediment trap basins in the tributaries contributing the largest volume of sediment to Lake Shafer. Monitoring of the basins for sedimentation rates and volumes will provide important data in establishing a program of BMP installations throughout the watershed.

Lite-On-The-Land (Forestry Best Management Practices)

The IDNR Division of Forestry is utilizing $27,530 to provide an economic incentive for landowners and timber producers to implement BMPs for forestry in the Lake Monroe watershed. This project is a continuation of a Section 319 project started in 1994.

Wabash Watershed Management Project

Utilizing $56,750, the Friends of the Limberlost is developing a program for the installation of BMPs that will include vegetative filter strips, riparian forest buffers along open streams, and fencing to exclude livestock from critical water quality areas. The group is also conducting weekly tours for public awareness, providing photographic documentation of critical areas and project progress, and producing educational/informational materials and self-guided tour maps of BMP installations.

Monroe Lake Watershed Land Treatment

Utilizing $110,563, the SWCDs of Monroe, Brown, and Jackson counties are beginning to comprehensively address water quality concerns within the watershed by developing a watershed management plan. BMPs to reduce NPS pollution in the watershed will be implemented based on the management plan recommendations.

Application of the National Agricultural Pesticide Risk Analysis (NAPRA) for Protection of Indiana's Groundwater

The Office of the Indiana State Chemist is utilizing $202,880 in this pilot project involving six Indiana counties to create databases on multiple issues affecting groundwater pollution from agri-chemicals. The project will run Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model scenarios to determine pesticide leaching potential and complete comparative risk analysis on different agricultural scenarios in order to determine effects of different agricultural management strategies. The application of this project in the six pilot counties will be used throughout Indiana.

The 1994 year of the Section 104(b)(3) program provided $153,900 of federal funds to be administered by the IDEM NPS Section for the implementation of the following three projects:

Eel River Watershed Project

Utilizing $70,000 of Section 104(b)(3) Watershed management funds, the SWCDs of Whitley, Allen, Noble, Huntington, Kosciusko, and Wabash counties are providing a cost-share program for the installation of filter strips and animal waste systems for the land owners in the upper Eel River watershed.

The steering committee began to organize in 1995. The filter strip program and animal waste systems have been presented, along with other farm programs. The steering committee was involved with a CRM workshop in early 1995 where consensus planning was the focus and a watershed tour was held. This helped to get the group familiar with the watershed as a whole. Recently constructed filter strips and animal waste systems were a part of the tour. Comments from land owners about problems and benefits aided in the understanding acquired by the group.

There have been a number of participants in the filter strip program. One of the farmers is going to seed a strip 66' wide to be used as forage while the others will be seeding 33' wide strips to be used as set-aside acreage. There have also been three participants in the animal waste system program. The planning of the systems has been completed and installation is to begin.

A field day was held at the Northeast Purdue Agricultural Center and was put on by the County Extension Service. A filter strip presentation was provided. A canoe trip is being planned by the steering committee to assess the river and become familiar with some of its characteristics. Also this project area was featured in the Land and Water magazine, May/June 1995 issue providing national exposure and increasing local interest in the project.

Mobile Education Unit

Utilizing $38,900 of Section 104(b)(3) Watershed Management funds, the LaGrange County Soil and Water Conservation District is developing a mobile education unit that will be available to the county and adjacent counties within the Lake Michigan watershed for public outreach at special events and field days. The county purchased a used 1987 Chevrolet step van to be utilized as the unit.

The committee of county representatives from the watershed met and began planning and developing material for such components as rivers and streams, wetlands and marshes, lakes and ponds, and groundwater. The coordinator began researching various library and display material, such as Choice Farm Activity, Terrene Institute material, Enviroscape information (on the development of wetland's scenarios), Water Resources Education Program, various videos, and computer programs. Development of the education stations continues. Material requests relating to each station are being considered and reviewed for purchase. Several contacts with various companies have been made for the purchase of these materials.

Initial publicity on the project provided information on the grant and the mobile education unit. The committee also reviewed ways to market the unit once completed. The development of a brochure has been started and a teacher training program is being considered. Promotion of the unit continues through newsletters and word-of-mouth.

Fish Creek in Hamilton County

Utilizing $45,000 of Section 104(b)(3) Watershed Management funds, The Nature Conservancy (TNC) will be addressing the threats to the Fish Creek watershed by collecting information on the potential point and nonpoint source water pollution and accident sites throughout the watershed. The TNC will inventory local responders to determine the need for equipment to adequately address emergency situations. The TNC will also provide for the conversion of the Hamilton Wastewater Treatment Plant to an ultraviolet light disinfection system.

The inventory of point sources include six livestock operations and one discharge site at the Hamilton Wastewater Treatment Plant. The Agricultural NPS Sediment Modeling Program for the entire watershed is nearing completion. Also, all pipelines, highways, and railroads have been identified. Contact has been made with the owners of the most severe livestock damaged areas of Fish Creek. Negotiations are underway to solve the problem. Additionally, the agreement with the Hamilton Wastewater Treatment Plant has been executed for the installation of the ultraviolet light disinfection system and construction will start.

A letter has been sent to all local fire departments covering the Fish Creek watershed. The letter is to inform them of the project and for them to determine their equipment needs. Three of the four fire departments have responded to the letter by sending an inventory of equipment needed and costs. A meeting will be held with the fire departments to further coordinate equipment identification and purchase. Local officials have been identified for the inventory of local emergency response plans and officials. A meeting was held with them to discuss the importance of the Fish Creek watershed.

The 1995 year of the Section 104(b)(3) program provided $202,500 of federal funds to implement the following projects that are being administered by the IDEM NPS Section:

Pigeon Creek in Gibson County

The Gibson County SWCD is utilizing $30,000 of Section 104(b)(3) Watershed Management funds to develop a cost-share program of voluntary participation that will improve water quality by applying best management practices (BMPs) to the land. This project will also focus on protecting topsoil, improving and increasing wildlife habitat for a variety of species (including some listed as threatened and endangered), and improving overall water quality of Pigeon Creek through a public awareness campaign. The campaign will include information about the BMP implementation program. In addition, the SWCD will compile an inventory of confined feeding operations within the Pigeon Creek watershed.

Pigeon Creek in Vanderburgh County

The Vanderburgh County SWCD is utilizing $21,900 of Section 104(b)(3) Watershed Management funds to develop a cost-share program to demonstrate BMPs for agricultural land, previously mined land, and developing urban land. The SWCD will also focus of education through a multimedia information campaign and a program to educate youth about the importance of water quality in their watershed.

Cedar Creek

The Allen County SWCD is utilizing $35,000 of Section 104(b)(3) Watershed Management funds to monitor surface water in the Cedar Creek watershed for pesticide level fluctuation both seasonally and in conjunction with high flow times. This information will be used to identify problem sub-watersheds and target them for BMPs.

Nonpoint Chloride

Keramida Environmental, Inc. is utilizing $26,550 of Section 104(b)(3) Watershed Management funds to study nonpoint sources of chlorides impacting Lake Michigan, quantify the releases from these sources, and recommend available strategies to further reduce NPS releases of chlorides into Lake Michigan.

GIS/Patoka River

The Four Rivers Resource Conservation and Development Council, Inc. is utilizing $28,500 of Section 104(b)(3) Watershed Management funds to create a Geographic Information System (GIS) coverage of the South Fork of the Patoka River watershed that will allow for identification and modeling of environmental and economic resources in the pursuit of stream restoration. The project will provide a valuable tool in the planning and implementation of NPS and other water quality improvement activities coordinated by the South Fork Patoka Watershed Partnership.

Definition and Digitizing

The U.S. Geological Survey (USGS) is utilizing $60,550 of Section 104(b)(3) Watershed Management funds to define and digitize drainage basin boundaries for 18 counties in Indiana using 14-digit hydrologic unit code (HUC) for each of the sub-watershed units on the existing USGS boundary delineations. The USGS will be working with the NRCS to develop the 14-digit HUCs according to NRCS guidelines. These maps will be available for distribution upon completion of the project.

The 1993-94 year of the Section 604(b) program provided $60,000 of federal funds to implement the LaGrange County Project that is being administered by the IDEM NPS Section. Utilizing $60,000 of Section 604(b) Water Quality Planning funds, the LaGrange County Health Department will be developing a nitrate management plan. They will also be developing a brochure explaining the dangers of nitrates to pregnant women and other women of child bearing years to be distributed throughout the county.

Other IDEM NPS programs/activities include the following:

Surface Water Pesticide Study

The final report of this study is now about to be published and will be available through the IDEM, Office of Water Management, Assessment Branch upon request.

IDEM Permits

The IDEM continues to process permits for confined animal feeding facilities. There is still significant activity to process the remaining backlog of applications for confined feeding approvals. It is estimated that by the end of the federal fiscal year, IDEM will have processed 420 applications for existing and proposed facilities. It is anticipated that all backlogged applications for existing facilities will be processed by fiscal year 1997.

The permitting activities for land application permits has decreased since the backlog of applications has been reduced to only those applications where significant deficiencies exist or administrative actions are being considered. The focus of attention has been drawn to compliance monitoring and technical assistance. In this regard, eighteen Warnings of Non-Compliance (WONCs) have been issued in one month alone as part of IDEM's initial efforts.

The Land Application Group now has full responsibility for the annual processing of permits for Wastewater Management Businesses (septage waste haulers). This permit program involves 378 business permits, 570 truck licenses, and 105 land disposal site approvals. Significant effort is being made to correlate non-compliance activities with the processing of requests for permit renewal.

Agricultural Outreach Activities

An Indiana State Representative sponsored an exchange meeting between the IDEM and the agricultural community for the three counties in southeastern Indiana which she represents in the State Legislature. The purpose of the meeting was for IDEM staff to answer questions on such environmental issues as wetlands, nonpoint source, confined feeding, land application, spill reporting, and voluntary compliance and outreach. Other environmental topics discussed which did not directly relate to water pollution included air and solid and hazardous waste pollution issues. It proved to be a helpful interchange between the public and the agency.

Other NPS programs occurring throughout the state include:

Soil and Water Conservation Districts

The Indiana Association of Soil and Water Conservation Districts (IASWCD) continues to operate under the three-year grant award from the W.K. Kellogg Foundation to provide a facilitator for Indiana's new Leadership 2000 (L-2000) program. Co-sponsored by the IASWCD, the Purdue Extension, the Farm Bureau, and the League of Resource Conservation and Development (RC&D) Councils, L-2000 is a locally initiated leadership development experience designed for those who represent agricultural, renewable resource management and rural community interests. A portion of the grant funds fifty percent of a full-time IASWCD executive director to function as state L-2000 program coordinator. The other fifty percent of the executive director's time is funded through the IASWCD's treasury. As coordinator, the executive director assists local sponsors in organizing, promoting, recruiting for, and conducting the four-session workshops. T-by-2000 education specialists assist SWCDs in improving leadership skills. Education specialists often serve as facilitators in conducting L-2000 programs and they provide assistance in directing area L-2000 programs. In the past year, seven adult and youth programs have been scheduled throughout Indiana.

Hoosier Heartland Resource Conservation and Development Council, Inc.

The Hoosier Heartland Resource Conservation & Development (HHRC&D) Council represents ten central Indiana counties. Its 30 member Board of Directors is appointed by the SWCDs, the County Extension Boards, and the Boards of Commissioners of each county. As with many RC&D Councils, the Hoosier Heartland is concerned with the environmental effects of urbanization. The Urban Committee of the HHRC&D conducted a three-hour program called "Sediment Control in Homebuilding - An Industry Perspective" which focused on urban erosion and sedimentation reduction. It was held on the Indiana University/Purdue University Indianapolis campus in early 1995. While the target audience was intended to be home builders, the approximately 50 attendees included government agencies, as well as industry. Topics covered such things as laws and liability, roles and responsibilities of developers, erosion control plans, and construction best management practices.

The Urban Committee also held two retention pond management seminars in June of 1995 and two NRCS Technical Release (TR) Workshops in the winter of 1994-95. The retention pond seminars were offered free of charge to homeowners, homeowner associations, apartment managers, commercial developers and managers, etc. The topics included purpose, design and construction, maintenance, erosion and pest control, use of aquatic plants, and safety issues. The December 1994 TR-55 workshop was taught by NRCS instructors. TR-55 presents simplified procedures that estimate runoff and peak discharges in small watersheds. Attendees receive both training and DOS-based software. The February 1995 workshop featured the TR-20 computer model for predicting the effects of various storm events on runoff. However, it can be used to predict downstream effects of alternative development and controls in watersheds of various sizes. Both of these TR-55 workshops provided excellent hands-on training for engineering firms involved in the planning and development of urban areas.

Other committees of the HHRC&D include the Education Committee and Forestry Committee. The Education Committee held a basic Grant Writing Workshop in December of 1994 to educate groups in locating and securing financial assistance. Several other educational events were held in 1995 to promote the use of improved management techniques and empower groups to find the financial resources needed to help solve area problems and realize opportunities. The Forestry Committee co-sponsored a Forestry Field Day. Among the sites/topics covered on the tour were a visit to a woodland/wetland habitat area and a session on erosion control measures. Other activities of the HHRC&D included: 1) developing a symposium entitled "Preserving Agricultural Lands and Open Spaces in Urbanizing Counties"; 2) working with "Citizens for Greenspace" to produce educational and informational materials; and 3) reprinting the NRCS's Midwestern Wetland Flora field guide which is an excellent reference for determining wetland areas, and offering the National List of Plant Species that Occur in Wetlands: Indiana as a companion book.

State Soil Conservation Board

The Chief of the NPS Section has been appointed as the IDEM's representative to the State Soil Conservation Board which is comprised of representatives from the farming community, from non-farming backgrounds, and includes the director of the IDNR, the commissioner of the Department of Agriculture, and the director of the Purdue University Cooperative Extension Service. A report is given at each meeting on NPS activities taking place within the IDEM. The NRCS Specialist housed at the IDEM, and partially paid with Section 319 funds, also attends many of the State Soil Conservation Board meetings.

In 1995, the Board assisted in the development and execution of the Rule 5 Memorandum of Agreement. This agreement provides for the operating procedures in regulating erosion/sediment controls by the SWCDs, the IDNR, the IDEM, and the Board. Also the Board has been providing guidance through the IDNR in the training of over 800 Indiana Department of Transportation (INDOT) staff and contractors in environmental awareness. An erosion control committee has been meeting to develop standards that are being implemented into new projects.

INDOT has reevaluated and improved its ditch engineering, spraying alternatives, roadway runoff, salt storage, salt alternatives, etc. INDOT may have approximately 3,400 projects underway at any one time, with a budget of $1 billion. INDOT now has a division for preliminary engineering and environmental assessment.

Reported to the Board was information on the cutbacks in federal funds to the NRCS and the SWCDs. The Indiana State Legislature approved an additional $10,000 to be awarded to each SWCD in the State to compensate this reduction. This is in addition to the previously awarded $3,000 to be given to each SWCD by the Legislature.

Other activities presented to the Board include reports on Lake and River Enhancement (LARE) activities, the T-by-2000 program, and the Build Indiana Fund. $200,000 of the Build Indiana Fund money has been released by the State Budget Agency to IDNR for watershed land treatment in the Lake Manitou watershed. These funds will be used in the watershed in ways such as conservation practices and sensitive land purchases to protect the watershed. Further information on the reports from LARE and T-by-2000 are below.

T-by-2000 Soil Conservation Education Program

T-by-2000 is a comprehensive, state-funded program aimed at significantly reducing soil erosion and resulting sedimentation throughout Indiana by the year 2000. The name is derived from the program's goals, which are to reduce annual erosion on each acre of land to its tolerable limit or T (the maximum level at which soil loss can occur without impairing crop productivity), and to control all off-site sedimentation using the best practical technology. The program was authorized by the Indiana General Assembly in 1986 and given start-up funding in 1987. The focus of T-by-2000 has expanded to include understanding and lessening the impacts of soil erosion on water bodies and the resulting water quality consequences.

The Soil Conservation Education program is one of four components of the T-by-2000 program. It provides educational, technical, and financial assistance to deal with erosion and sedimentation problems occurring on the land and in public waters. It is administered at the state level by the IDNR, Division of Soil Conservation under guidelines set by the State Soil Conservation Board. It is carried out at the local level through the county Soil and Water Conservation Districts. Since 1987 the program has installed 888 practices throughout the state. Ninety-six percent of the landowners who participated in the program were satisfied with their practices.

The T-by-2000 education specialists sent a four-page survey to the SWCDs seeking information regarding the educational needs of districts and their "customers". The survey asked about the district's mission statement, conservation concerns, educational goals and activities, priority customers, partnership roles in district efforts, educational tools used, value of present programs, and needs for other programs. The results have helped the education specialists better identify and address the educational program needs of SWCDs.

There was also a project coordinated with many of the Future Farmers of America chapters to assist in estimating post-harvest residue cover and the regional seminars that focused on residue management, no-till, manure management, and water quality. The T-by-2000 program also developed procedures for cropland transect surveys and published it for use by individuals and organizations interested in conducting cropland surveys. Other activities organized by the education staff included watershed alliance organization meetings, field day and Envirothon presentations, grant proposal preparations, and outdoor lab construction.

Conservation Tillage

Conservation tillage is now being used on over 30 percent of annually planted cropland in Indiana. This compares to 13 percent in 1990. No-till farming for all crops increased from seven percent in 1990 to 30 percent in 1995. This is over a four-fold increase from 1990. Most of this increase is due to no-till soybeans which increased from eight percent in 1990 to 52 percent in 1995. No-till corn stayed the same as 1994 at 22 percent. There has been a decrease in the other conservation tillage practices with the ridge till practice dropping to less than one percent in Indiana.

The data collected for 1995 by the T-by-2000 program included information on approximately 26,000 fields of various crops, such as corn, soybeans, small grains, hay, fallow, conservation reserve program, etc. Slope was also a factor as well as row widths. In 1994, over 65 percent of no-till crop production was on soils with 0-2 percent slope. Twenty to 25 percent were on 2-6 percent slope. By crop, approximately 64 percent of no-till corn and 73 percent of no-till soybeans were on 0-2 percent slope and 20 to 25 percent of both no-till corn and soybeans was on 2-6 percent slope. For soybeans, approximately 80 percent were planted in narrow rows (less than 15-inch row width) with the remainder planted in rows measuring 15-inches or wider. With a slight increase from 1994, nearly 62 percent of narrow-row soybeans were no-tilled. However, only eight percent of wide-row soybeans were planted using a no-till system. Overall, 97 percent of all no-till soybean fields were planted in narrow rows.

Since 1993, no-till corn adoption has leveled off. Since 1990, however, there has been a dramatic shift in rotations used for no-till corn production. The following table indicates the move toward more no-till corn after soybean rotations as well as other crop rotations.

Table 40.

No-till Corn After...
(Figures are in percent of no-till corn fields)

Year	Corn	Soybean	Wheat	Forage	Other
1990	31	44	11	8	5
1993	26	64	6	3	1
1995	17	75	4	2	2

Similar data for soybeans indicates that since 1993 over 85 percent of all no-till soybeans have been planted into corn stalks.

No-till Soybeans After...
(Figures are in percent of no-till soybean fields)

Year	Corn	Soybean	Wheat	Forage	Other
1990	65	14	14	2	4
1993	85	11	3	1	1
1995	88	9	2	0	1

Farming for Maximum Efficiency (MAX) Program

The MAX program has been designed to help farmers track and compare economic returns in the production of corn, soybean, and wheat. This program also provides a look at the bottom line in determining what practices could be improved while reducing negative water quality impacts. In Indiana, over 200 farmers from over forty counties participate each year, providing production information on fields averaging forty acres in size. In 1994, the program was expanded to include barley, cotton, dry edible beans, oats, rice, sorghum, sunflowers, and sugar beets. Also two new features were added to the computer program to further clarify agricultural impacts on water quality.

The MAX '95 program now allows farmers to track their nutrient and pesticide management practices. The pesticide and nutrient data gathered from this year's participating farmers will provide important information regarding improved water quality. The information provided by the MAX program participants is used in the evaluation and annual reports for this program.

In early 1995, T-by-2000 education specialists distributed copies of the 1994 Indiana MAX Program Summary to the SWCDs in the participating areas and the IDEM. The report presents the statewide results and individual ranking summaries plus selected MAX farmer/Purdue research profiles, work sheets of the highest-profit entries and a list of input costs used.

Lake and River Enhancement Program

The Lake and River Enhancement (LARE) Program is part of the T-by-2000 program. Its goal is to ensure the continued viability of Indiana's public-access lakes by controlling sediment and associated nutrient inflows by forestalling or reducing the impacts of such inflows, where appropriate, through remedial actions. To accomplish this goal, the IDNR provides technical and financial help for selected projects which involve Indiana water bodies. The watershed land treatment program focuses on the watershed as a whole and encourages SWCDs to work together, and sharing information and employees when needed.

Through action of the State Legislature, the IDEM and the IDNR are working together with surveyors, drainage boards, and legislators to determine the best practices to be used by the surveyors and drainage boards that are compatible with the environment. The Water Resources Study Committee will be forming a work group that will focus on gathering this information into a guidance handbook. The work group will be supported through funding from the state legislature to produce this handbook for surveyors and drainage boards statewide.

Lake and River Enhancement (LARE) funds are being used by the Friends of White River for the Kingfisher Water Quality Monitoring Education Program. Fourteen schools are participating in the program. A program manager visited each school to distribute test kits and curriculum, while providing beginning guidance for collecting and recording data. The Indianapolis Rotary has contributed additional funds for equipment. Members of the Indianapolis Flycasters has provided people to act as program mentors. Newsletters are being published to publicize the findings and a computer database will be available and accessible to other schools, agencies, and water quality networks. Consistency in sampling and data reporting is being monitored by trained staff and members of the Friends of the White River.

A complete list of the LARE projects from September 1994 to August 1995 and a brief summary of each project's status is available through the IDNR LARE Office. For the next fiscal year, the State Soil Conservation Board has awarded $830,000 for the implementation of more LARE projects.

Agricultural Water Quality Program

The USDA has two major NPS hydrologic unit area (HUA) projects in Indiana, the Upper Tippecanoe River HUA and the Upper Kankakee (Tri-County) HUA. The projects are led by the NRCS, assisted by the Farm Services Agency, the Purdue University Cooperative Extension Service, the IDNR, the IDEM, the U.S. Fish and Wildlife Service, and local agri-chemical dealers. Local land owners guide the effort of the program.

The Upper Tippecanoe Project is a program that promotes soil and water conservation practices and education in a 209,000 acre watershed. All programs are voluntary. Currently the water quality project is doing the following:

- An irrigation scheduling program for ten farmers is being sponsored. This computer program determines when water is needed on specific crops for specific soils to sustain a high yield without allowing excess leaching and runoff. Crops that are being studied include potatoes, corn, soybeans, dry beans, and alfalfa.
- The IDNR Division of Fish and Wildlife is investigating and evaluating release sites for river otter along the Tippecanoe River in Marshall and Kosciusko Counties. Once common in Indiana, the river otter is more associated with the rivers and marshes of the southern United States. Otter are sensitive to environmental stresses such as air pollution

and poor water quality. The Upper Tippecanoe Project has had a dramatic effect on improving water quality for human use and recreation as well as these "river wanderers".

- A private well test program is being promoted by the watershed project in partnership with many state, county and federal agencies. This provides a low-cost but wide range test for common pollutants in the drinking water. Over 300 wells are expected to be sampled.
- Vegetated filter strips are being promoted along ditches in the watershed through an NPS 319 grant from the IDEM. Land owners are compensated by installing 20 to 80 foot wide grass strips to slow runoff and capture any sediment or chemicals.
- A prairie restoration was planted inside the watershed in partnership with the Kosciusko County Soil and Water Conservation District, the U.S. Fish and Wildlife Service, and the Koinonia Environmental and Retreat Center. The project is approximately three acres in size.
- Earthwatch '95 - "In Our Own Backyard" was a program held on Earth Day, April 22, 1995 at an area discount store to inform non-traditional customers of the services available through various conservation and environmental organizations in the county.
- An animal waste management wetland system in the watershed was featured in June 1995 in a program and field trip that discussed planning, management, design, maintenance and results. Approximately 75 people attended.

Know Your Watershed

The National Association of Conservation District's Conservation Technology Information Center (CTIC) continues to work on the Know Your Watershed campaign. This campaign is geared toward helping local agricultural leaders join with appropriate rural and urban partners to prevent pollution within their watersheds. Some of the campaign activities that have been taking place throughout this year include:

- The duplication and distribution of the "Partnerships for Watersheds" video as provided by the USEPA and the NRCS;
- The development, duplication and distribution of the "What is a Watershed Partnership?" brochure to go with the video;
- The development, duplication and distribution of seven guides for watershed partners to use in organizing and developing watershed management and implementation plans;
- The development of media kits to use for area tours that would demonstrate the many different management practices as they are developed;
- The development of a NPS Water Quality Contact Directory that would include national as well as regional contacts. The Water Quality Project Directory includes a list of active national and state watershed projects that is updated annually.
- The organization of the workshops using the guides to bring together watershed partnerships;

- The participation in and development of various conferences on water quality, agricultural ecosystem management, groundwater protection, and the activities of the Soil and Water Conservation Districts;
- The development of a National Watershed Network database of local watershed groups nationwide, and
- The organization of the first train-the-trainer Know Your Watershed workshop that was held at the Indiana Lake Management Association annual conference in April of 1995. Two more of these workshops are scheduled for later in the year.

The National Forum on NPS Pollution announced that the Know Your Watershed campaign has been selected as one of 25 demonstration projects to assist Americans in efforts to protect water quality. Further funding for this campaign is being provided through the FFY 1994 Section 319 Nonpoint Source Program.

Kosciusko County Private Well Water Supply Testing Program

The Kosciusko County Soil and Water Conservation District has developed the Private Well Water Supply Testing Program that will allow individuals to test their well water for possible contamination. Through the use of well testing kits, this program offers the opportunity of testing drinking water for nitrates, triazines and Lasso/Dual herbicides. Optional tests will be available for Volatile Organic Chemicals, metals, and E. coli at an additional charge. Water tests will be performed at Turner Technologies, Inc., Warsaw and Heidelburg College's Water Quality Laboratory in Tiffin, Ohio.

The water testing kits were distributed in August of 1995 throughout the county. Private well owners will be responsible for monitoring the quality of their water. The collection of the kits will all be done at one time to be forwarded to the labs. The results of the testing will be confidential and the SWCD will work with the well owners needing further assistance.

Indiana Farm Forum

Lieutenant Governor Frank O'Bannon, who also serves as the Commissioner of Agriculture, sponsored a Farm Forum in two locations in Indiana during the month of July, 1995. They were held in Tippecanoe County and Miami County. The forums brought together representatives from the local agricultural community and state and federal agencies regulating or governing agriculture programs. The meetings were structured around the local agricultural representatives giving a short presentation and requesting a response from the appropriate governmental representatives. Agricultural interests represented included livestock producers, grain producers, the fertilizer industry, sustainable agriculture, agribusiness, and a local elected official. The panel of governmental agencies attending included the Farm Services Agency, the Office of State Chemist and Seed Commissioner, the IDEM, the NRCS, the Tax Commissioners Board, the IDNR, the Indiana State Department of Health, the Rural Economic Community Development Agency, the State Board of Animal Health, and the Indiana Commodities

Warehouse Licensing Agency. A staff person from the NPS Section served as the IDEM representative. This proved to be a valuable forum for interaction between the agricultural community and state and federal agencies.

Groundwater Task Force

The Groundwater Task Force was instituted by the 1989 Indiana General Assembly's passage of the Groundwater Protection Act to manage Indiana's groundwater resources. This legislation provides authority for the establishment of programs and activities to facilitate the implementation of Indiana's Groundwater Protection and Management Strategy which was adopted in 1987. A key provision of the Groundwater Protection Act was the establishment of a Groundwater Task Force (GWTF) to oversee and facilitate the implementation of Indiana's groundwater strategy. Although the GWTF has not met since September 1994, work on projects initiated under its direction has been completed or have significantly progressed toward completion.

The groundwater quality standards issue brief was published in the July 1, 1994 Indiana Register. That publication started the process of rule making for the standards. The first public comment period has ended and the next step is for the agency to compile and respond to first-round public comments. Those comments and responses have been published in the Indiana Register along with a technical draft of the rule. Round two of public comment was collected and the rule-making on groundwater quality standards continues to mark the final stages of a long-lived process of meetings, debates, input and collaboration among many diverse interested parties.

The Task Force continued to track to completion the progress of the Wellhead Protection Program as it is implemented in the state. The IDNR has reported to the Task Force that it is nearing completion of the database of private well log records for the state. Current information on new wells has been entered as it is received. Historical data has been entered on a schedule basis. With the completed collection of historical and new well data a much more accurate and complete picture of the status of private wells in Indiana. A preliminary report has been compiled and sent to the U.S. Environmental Protection Agency for review and approval.

A document, entitled "Groundwater Education Compendium" was produced in 1994 by the IDEM Groundwater Section with assistance from the Groundwater Education work group. This document provides information on available Groundwater education materials and organizations and a directory of organizations involved in groundwater education. Other recommendations made by the GWTF, such as the rule adoption and promulgation for hazardous waste and underground storage tanks, have been completed.

Interagency Watershed Management Coordinating Committee

The USDA Natural Resources Conservation Service (NRCS) initiated the formation of an interagency watershed group which meets every other month. The group assists with coordination among various agencies with respect to water and related resource projects and studies. Groups represented include the IDNR, the U.S. Army Corps of Engineers, the Purdue Cooperative Extension Service, the U.S. Fish and Wildlife Service, the Indiana Department of Transportation, the Indiana Association of SWCDs, the Office of the Indiana State Chemist, and the IDEM.

The major discussions center around the role of each agency in water resource projects in Indiana, and discussions of projects which each agency is implementing related to watershed management. A number of presentations have been given to the group in order to make everyone fully aware of some of the water-related resources which are available in the state. Examples are discussion of the WETnet, overviews of pilot watershed management projects that are being conducted in the state, and a presentation on the Know Your Watershed campaign being done by the Conservation Technology and Information Center.

There have also been discussions of the reorganization of the NRCS and of how this will affect the participating agencies. The group is also committed to having an Executive Order issued by the Governor to appoint the group as an official body called WATER.

Site Erosion Control Regulations

In September 1992, Rule 5, the state's regulations governing storm water runoff from construction activity on parcels five acres or larger, became effective. The Rule 5 Memorandum of Agreement (MOA) between local SWCDs, the State Soil Conservation Board, the IDNR, and the IDEM has been executed. Many SWCD offices are now routinely reviewing and commenting on plans, providing on-site technical assistance, evaluating sites for effectiveness of installed practices, and referring projects to the IDEM. The IDEM is reviewing all Notice of Intent (NOI) letters for deficiencies, sending notification when necessary, sending compliance letters to those violating Rule 5 regulations, and investigating projects in violation where corrective action is not being taken.

In 1994 IDNR urban conservation specialists reviewed 480 Rule 5 plans for a total of 1,235 plans reviewed by IDNR and SWCD staff. On-site technical reviews totaled 1,426. The IDNR and the IDEM have also been cooperating on enforcement action.

Indiana's WETnet

Since early 1994, the Indiana Water Resource Research Center at Purdue University has been working toward developing a WETnet prototype server to enhance and improve communication and information sharing among water resources professionals and organizations in the state. The concept of the WETnet is being designed to provide a better understanding of the state's water environment.

The World Wide Web was chosen for the development of the WETnet prototype because it contains most of the base level inter-networking functionalities that the WETnet concept needed. It was chosen because it is the single fastest growing tool on the Internet allowing for wide and easy accessibility.

The future of the WETnet concept rests with the user community and in the development of other funding sources to continue with the exploration of other potential uses of the WETnet. For the WETnet to be successful, the content must be developed and maintained by interested users. The current developments are focusing on educating these users in the development of content. Once the WETnet community starts to publish and consume information, then advanced tools will be built for such things as collaborative modeling, the development of atomic hypermedia modules for education, and other resources that may be determined once users get more involved.

CLEAN LAKES PROGRAM

The IDEM has contracted with the Indiana University, School of Public and Environmental Affairs (SPEA) to administer certain elements of the Clean Lakes program. This ongoing program utilized approximately $50,000 per year of Sectin 314 funds, with funding to be provided for the 1996 year by Section 319. Dissemination of information and education regarding lakes is being accomplished through distribution of a quarterly newsletter, the publication of technical fact sheets, and the implementation of the annual Indiana Lake Management Conference.

The 1995 Indiana Lake Management Conference was held in Warsaw in April. The SPEA arranged publicity, facility accommodations, registration, the progam, and exhibits. The conference was attended by 120 participants and included the results of research on several Indiana lakes and watersheds, updates on state and federal lake programs, the annual meeting of the Indiana Lakes Management Society, and a large exhibit area.

The quarterly issues of the Water Column newsletter continue to be published by SPEA providing valuable information on the projects and topics being addressed by the Indiana Clean Lakes Program. Also staff members continue to be available to provide technical assistance to lake associations or groups interested in initiating lake studies, interpreting water quality data, and identifying lake management techniques.

Additionally, the SPEA conducts the ongoing Volunteer Lake monitoring program, which was begun in 1989. From a beginning of 53 lakes monitored in that year, 176 lakes and reservoirs were monitored in the 1994 and 1995 summer seasons. See the "Lake Information and Assessment" portion of this report for more information on the monitoring program. The SPEA and volunteers also assisted in the Kent State University 1995 Great American Secchi Dip-IN by helping with the planning, providing addresses of the volunteers, and by encouraging the volunteers to participate in the July 4th weekend event.

The SPEA has also produced the Lake Water Quality Assessment Report which analyzes trends between the Indiana trophic status index (TSI) and time, ecoregion, glaciated regions, lake morphometry, and Carlson's TSI. Synthesis/analysis of the data collected for 1994 has been completed and plankton data and water quality data has been entered into a spreadsheet data management system. From this information, one-page summaries of each lake monitored has been produced and sent out to the volunteers in April of 1995.

INDIANA'S SECTION 401 WATER QUALITY CERTIFICATION (WQC) PROGRAM

Scope of activities

Section 404, 33 U.S.C. §1344, of the Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq., otherwise known as the Clean Water Act (CWA), requires an individual to obtain a permit from the U.S. Army Corps of Engineers (COE) for dredging and filling in "waters of the United States," which includes wetlands. Section 401 of the CWA requires the applicant to obtain certification from the state that the discharge of dredged or fill materials will not violate the water quality standards of the state. The COE cannot complete their processing of the permit until the State provides Section 401 Water Quality Certification (WQC) or waives this right. Denial of Section 401 WQC prohibits the COE from granting a Section 404 permit; thus the 404 permit will be denied without prejudice and returned to the applicant. Under Indiana Code (IC) 13-7-2-15 IDEM is designated as the water pollution control agency for all purposes of the CWA and, therefore, gives it the responsibility to provide Section 401 WQC of Section 404 permit applications. Under IC 13-1-3-7(d), the Commissioner of IDEM may take appropriate steps to prevent any pollution determined to be unreasonable and against the public interest in view of the conditions in any stream or any other waters of the state.

Section 401 of the CWA grants authority to the State to administer a program designed to review federally permitted or licensed activities that may result in a discharge to waters of the United States. The State certifies that there is a reasonable assurance that the activity will be conducted in a way that will not violate applicable water quality standards (40 C.F.R. §121.11(a)(3)). Thus, Indiana uses the Section 401 WQC to grant or deny certification for these types of projects based on whether a given project is or is not in violation of Indiana's water quality standards, which are found at 327 Indiana Administrative Code (IAC) 2. Indiana's water quality standards include policies of maintenance of existing uses and nondegradation of water quality in waters of the state. Projects whose impacts will cause or contribute to a polluted condition or will adversely affect water quality will be considered in violation of the following state laws and regulations.

IC 13-1-3-8 states in part:

> It is unlawful for any person to throw, run, drain or otherwise dispose into any of the streams or waters of this State . . . any organic or inorganic matter that shall cause or contribute to a polluted condition of any waters . . . or whereby any fish life or any beneficial animal or vegetable life in any waters may be destroyed or the growth or propagation thereof prevented or injuriously affected.

327 IAC 2-1-2(1) states:

> For all waters of the state, existing instream beneficial uses shall be maintained and protected. No degradation of water quality shall be permitted which would interfere with or become injurious to existing and potential uses.

IDEM's granting of Section 401 WQC to an applicant for a federal license or permit indicates that the project in question will comply with Indiana's water quality standards. Section 401 provides that compliance with these standards may include limitations, conditions or any other provisions on the certification deemed necessary by IDEM to assure that the project is carried out according to all appropriate state laws.

The denial of Section 401 WQC to an applicant for a federal license or permit indicates that the project in question will not comply with Indiana's water quality standards. IDEM's denial of Section 401 WQC prohibits the issuance of the relevant federal permit or license. All IDEM final decisions relevant to Section 401 WQC are subject to an administrative appeal, with review in state courts designated for appeal of agency decisions (IC 4-21.5-3-5).

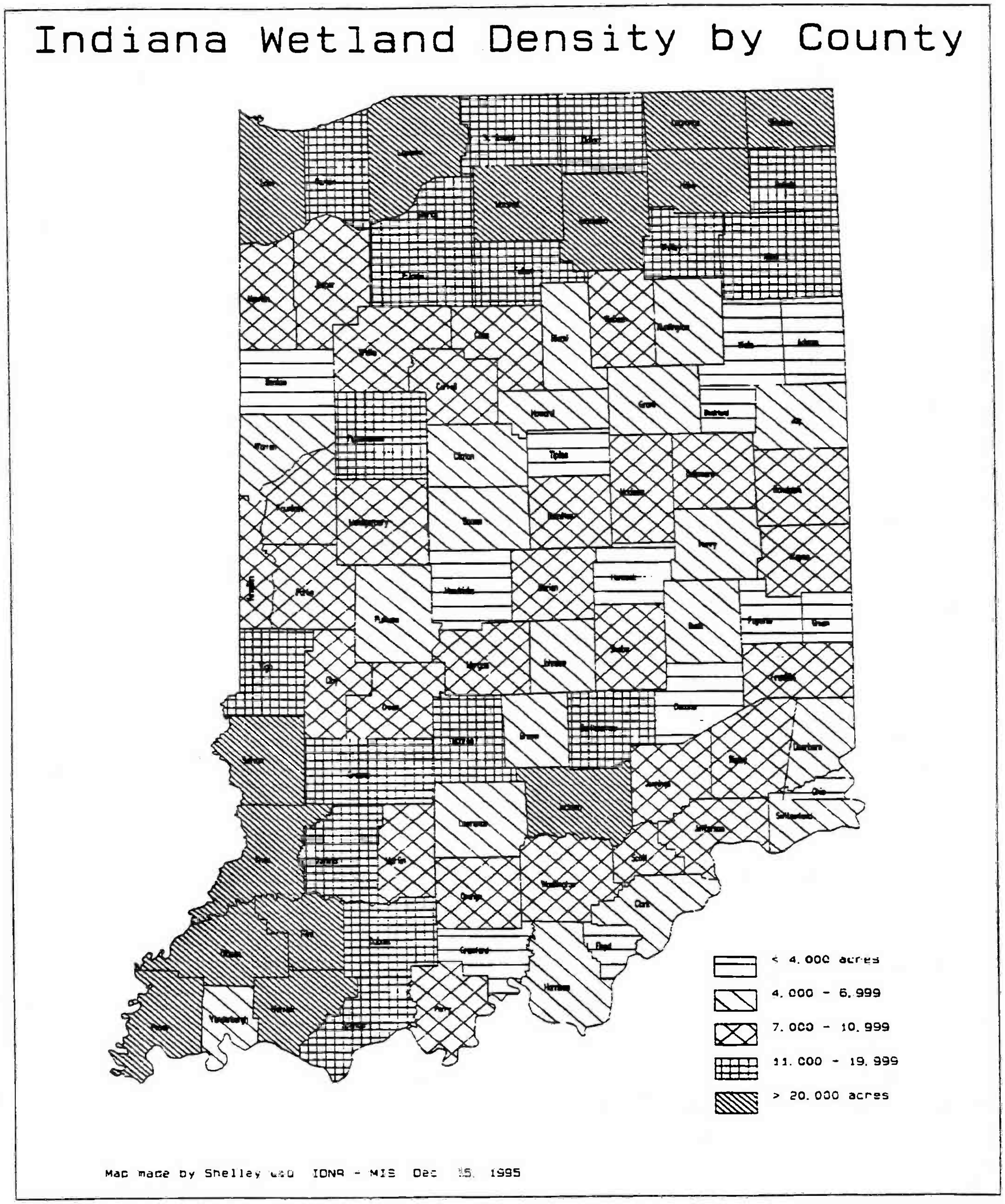
Section 401 WQC decisions also may be waived by the state, either affirmatively or involuntarily. Under Section 401 of the CWA, if the state fails to act on a certification request "within a reasonable time (which shall not exceed one year)" after receipt of an application, the state forfeits its authority to grant conditionally or to deny certification (33 U.S.C. §1341(a)(1)). The "reasonable time" for review of Section 401 WQC in Indiana is 60 calendar days from the receipt of a completed application (40 C.F.R. §121.16(b)).

Extent of wetland resources

Wetlands occur in and provide benefits to every county in Indiana (Figure 11). The lack of quantitative information on some aspects of Indiana's wetland resources is a major obstacle to improving wetland conservation efforts.

The most extensive database on wetland resources in Indiana is the National Wetlands Inventory developed by the U.S. Fish & Wildlife Service. In 1985, the Indiana Department of Natural Resources, Division of Fish and Wildlife entered into a cooperative agreement with the U.S. Fish and Wildlife Service to share the costs of mapping Indiana's wetlands.

Figure 11. *Indiana wetland density by county*



Indiana's National Wetlands Inventory maps were produced primarily from interpretation of high-altitude color infrared aerial photographs (scale of 1:58,000) taken of Indiana during spring and fall 1980-87. Map production also included field investigations, reviews of existing information, quality assurance, draft map production, interagency review of draft maps, and final map production.

National Wetland Inventory maps indicate wetlands by type, using the Cowardin *et al.* classification scheme (1979, Classification of wetland and deepwater habitats of the United States, U.S. Fish and Wildlife Service FWS/OBS-79/31). The minimum size of a given wetland on National Wetland Inventory maps is typically one to three acres. Very narrow wetlands in river corridors and wetlands under cultivation at the time of mapping are generally not depicted, and forested wetlands are poorly discriminated.

The most recent and complete analysis of this database was conducted in 1991 by the Indiana Department of Natural Resources. According to the report, Indiana had approximately 813,000 acres of wetland habitat in the mid-1980s when the data were collected. Wetland loss or gain since then is unknown.

The following figures are from the Indiana Department of Natural Resources report:

Wetland habitats	*Acres*	*% of total*
scrub-shrub	42,131	5.2%
forested	504,336	62.0%
wet meadow	55,071	6.8%
shallow marsh	67,564	8.3%
deep marsh	20,730	2.5%
open water	98,565	12.1%
other	24,633	3.0%
Total wetland habitats	813,032	100%

Palustrine wetlands were also classified according to duration of flooding. "Temporarily flooded" was the most common duration of flooding. Approximately 460,000 acres or 57% of palustrine habitats were classified as temporarily flooded. "Seasonally flooded" was the next most common - 220,000 acres (27%), followed by "intermittently exposed" - 80,000 acres (10%), "semi-permanently flooded" - 40,000 acres (5%), and "saturated" - 24,000 acres (3%).

The IDNR project confirmed that the major concentration of wetlands was in the northeastern portion of Indiana, along river floodplains in southwestern Indiana, and in the Lake Michigan shoreline region in northwestern Indiana. Noble County contained the greatest number of wetland acres with approximately 27,500 acres or 3.38% of the state's total wetland acreage. Noble County was followed by Kosciusko County 27,000 acres (3.32%), LaGrange County - 25,708 acres (3.16%), LaPorte County - 25,000 acres (3.07%), Jackson County - 24,000 acres

(2.95%), Gibson County - 23,500 acres (2.89%), Steuben County - 22,000 acres (2.71%), Pike County - 20,500 acres (2.52%), Posey County - 20,000 acres (2.46%), and Warrick County - 19,957 acres (2.45%). The remaining 82 counties contained the remaining 71% of the wetland area. Ohio County contained the least amount of wetland area with 633 acres or only 0.08% of the states total wetland acreage. Forested wetlands were the most common type of wetland in all 92 counties (Table 41).

Integrity of wetland resources

The best estimate of the wetlands in Indiana before settlement 200 years ago is an assessment based on hydric soils (soils indicative of wetlands) conducted by the USDA Soil Conservation Service (now the Natural Resource Conservation Service). Based on an analysis of this data by the Indiana Department of Natural Resources, Division of Outdoor Recreation in 1989, there were approximately 5.6 million acres of wetlands in Indiana 200 years ago. Combining the information from the National Wetlands Inventory and the Division of Outdoor Recreation yields the following summary:

Estimated wetlands circa 1780s	5,600,000 acres
Percent of surface area in wetlands circa 1780s	24.1%
Existing wetlands	813,000 acres
Percent of surface area in wetlands today	3.5 %
Percent of wetlands lost	85%

Indiana's wetlands are being lost or affected today in a variety of ways, including agricultural activities, commercial and residential development, road building, water development projects, groundwater withdrawal, loss of instream flows, water pollution, and vegetation removal. Comprehensive data for the current extent and causes of wetland loss at the state level are not available.

Program accomplishments

IDEM's Section 401 Water Quality Certification Program continues to play an active role in wetlands regulation and protection of water quality throughout all of Indiana. Within the 1994/1995 reporting period, staff levels within the program doubled, permits reviewed each year increased by almost 20%, and impacts to wetlands and other waters were offset by compensatory mitigation at an average ratio of 1.5 acres of mitigation for every acre impacted by regulated activities. In addition, staff has increased public outreach through participation in numerous conferences, seminars, inter-agency workgroups, and involvement with the Indiana Wetland Conservation Plan, organized by IDNR.

IDEM staff reviewed 973 applications for Section 401 Water Quality Certification during the 1994/1995 reporting period. Of those projects, the following summarizes permitting activities:

Table 41. *Area (acres) of wetland and deep-water habitats in Indiana counties during 1980-87*

COUNTY	WETLAND HABITATS							TOTAL WETLAND HABITATS	DEEP WATER HABITATS			
	Scrub-shrub	Forested	Wet meadow	Shallow marsh	Deep marsh	Open water	Other		Limnetic lake	Perennial riverine	Total deep water	Total
Adams	103	1,913	121	128	21	451		2,737	199	185	384	3,121
Allen	317	8,082	666	786	177	1,540	694	12,262	921	1,233	2,154	14,416
Bartholomew	486	10,436	188	128	21	1,316	80	12,654	877	750	1,627	14,281
Benton	80	467	474	312	19	123	1	1,475		114	114	1,589
Blackford	54	1,433	317	274	61	342		2,480		9	9	2,489
Boone	143	3,460	610	195	25	552	1	4,985	128	201	329	5,314
Brown	58	2,132	177	72	75	1,546	939	4,999	1,513	25	1,538	6,538
Carroll	322	4,085	928	380	40	355	154	6,264	574	1,784	2,358	8,622
Cass	395	4,600	1,460	957	145	436		7,993	210	1,435	1,644	9,637
Clark	112	3,377	153	98	16	1,315	11	5,082	1,459	136	1,594	6,676
Clay	78	4,657	239	183	21	3,260	16	8,453	337	622	958	9,412
Clinton	256	4,591	677	196	44	342		6,106	80	119	199	6,305
Crawford	50	654	11	56	38	485	9	1,303	2,505	167	2,672	3,975
Daviess	235	8,866	424	324	42	1,658	160	11,709	2,153	962	3,115	14,824
Dearborn	171	1,859	244	71	19	1,214	70	3,649	1,024	512	1,536	5,185
Decatur	48	2,494	68	27	16	683	9	3,345	361	19	380	3,724
Dekalb	455	6,710	1,557	2,137	216	1,069	879	13,023	316	104	420	13,443
Delaware	185	3,709	310	553	98	803		5,657	1,259	431	1,690	7,347
Dubois	584	8,256	322	303	261	1,752		11,478	2,499	797	3,297	14,774
Elkhart	1,318	7,522	1,053	1,979	837	1,065	1,013	14,786	1,332	917	2,249	17,035
Fayette	43	1,823	33	8	7	247	47	2,208	22	236	258	2,466
Floyd	25	446	48	60	27	558	36	1,200	378	28	406	1,696

Table 41. *Area (acres) of wetland and deep-water habitats in Indiana counties during 1980-87 (cont.)*

COUNTY	WETLAND HABITATS							TOTAL WETLAND HABITATS	DEEP WATER HABITATS			
	Scrub-shrub	Forested	Wet meadow	Shallow marsh	Deep marsh	Open water	Other		Limnetic lake	Perennial riverine	Total deep water	Total
Franklin	93	2,276	77	26	4	721	128	3,325	3,051	645	3,696	7,021
Fulton	944	4,982	2,012	2,685	579	694	95	11,990	1,427	438	1.865	13.855
Gibson	1.251	18,182	682	552	597	1.868	369	23,500	3,483	3,494	6,977	30,477
Grant	190	2.384	475	254	62	846		4.212	80	603	683	4,895
Greene	178	5,876	295	212	29	3.014	242	9.847	755	1,229	1,983	11,831
Hamilton	109	5,240	302	445	96	651	7	6,848	2.389	545	2,934	9,782
Hancock	37	2,447	117	138	36	404	3	3,182	112	11	123	3,305
Harrison	106	1,389	39	177	74	1.502	40	3,328	3,050	355	3.405	6,733
Hendricks	23	1,793	63	46	20	782	37	2,763	151	9	160	2,923
Henry	104	2,446	274	239	56	603	2	3,723	601	2	603	4,326
Howard	154	4,065	360	353	22	261	7	5,222	586	220	806	6,028
Huntington	160	2,042	290	353	55	566	59	3,524	2,519	587	3,106	6,630
Jackson	477	21,015	605	404	25	1,409	158	24,093	593	1,369	1,962	26,055
Jasper	582	3,256	1,249	1,960	322	574	364	8,307	431	305	736	9,043
Jay	115	4,235	195	267	41	440		5,293				5,293
Jefferson	1,041	5,585	117	40	28	859	112	7,782	1,226	142	1,368	9,150
Jennings	656	5,132	167	54	19	1,256	103	7,386	462	337	798	8,184
Johnson	65	2,847	106	83	35	1,095	15	4,246	420	360	779	5,025
Knox	291	13,512	928	942	74	1,947	125	17,818	790	3,418	4,208	22,026
Kosciusko	3,104	11,332	3,042	3,706	1,942	1,350	2,706	27,172	10,574	261	10,835	38,007
LaGrange	2,704	11,356	2,660	4,684	1,224	1,090	1,988	25,708	4,286	245	4,532	30,239
Lake	1,408	5,856	1,618	5,052	2,477	2,578	772	19,760	2,584	793	3,377	23,137

Table 41. *Area (acres) of wetland and deep-water habitats in Indiana counties during 1980-87 (cont.)*

COUNTY	WETLAND HABITATS							TOTAL WETLAND HABITATS	DEEP WATER HABITATS			
	Scrub-shrub	Forested	Wet meadow	Shallow marsh	Deep marsh	Open water	Other		Limnetic lake	Perennial riverine	Total deep water	Total
LaPorte	1,648	13,402	2,872	3,147	1,775	1,849	690	25,383	2,028	241	2,269	27,652
Lawrence	59	3,166	265	219	14	857	6	4,587	1,101	729	1,830	6,417
Madison	225	5,155	472	393	73	696		7,014	158	289	447	7,461
Marion	55	1,622	74	151	11	1,629	18	3,560	3,899	976	4,875	8,435
Marshall	574	10,598	1,732	3,246	559	1,166	166	18,039	2,998	194	3,192	21,231
Martin	72	3,904	137	161	49	558		4,882	969	1,481	2,450	7,332
Miami	192	2,729	567	713	53	417	100	4,771	454	910	1,364	6,135
Monroe	132	2,225	55	172	56	670	11	3,323	10,982	111	11,093	14,416
Montgomery	292	4,417	764	407	21	323	32	6,255	428	526	953	7,209
Morgan	116	4,606	465	368	22	2,085	172	7,832	610	1,249	1,859	9,691
Newton	484	4,807	682	1,093	716	646	538	8,965	28	462	491	9,456
Noble	3,651	11,389	2,109	4,829	776	1,359	3,354	27,467	3,723	103	3,827	31,294
Ohio	8153	153	72	66		305	30	633	1,021	206	1,227	1,860
Orange	129	1,284	129	416	59	617	237	2,871	4,519		4,519	7,389
Owen	143	3,709	450	136	15	1,936	113	6,501	1,010	897	1,906	8,408
Parke	196	4,205	164	139	5	762	98	5,568	2,524	756	3,279	8,848
Perry	147	1,361	48	88	28	742		2,414	4,472	121	4,594	7,007
Pike	1,693	13,362	446	541	421	3,915	130	20,510	721	1,717	2,438	22,948
Porter	1,414	9,791	1,034	2,519	1,365	1,445	532	18,100	672	285	956	19,056
Posey	966	16,155	465	232	88	1,181	950	20,036	3,014	2,965	5,979	26,015
Pulaski	374	7,241	2,204	1,383	123	335	65	11,725	40	827	867	12,592
Putnam	83	3,058	48	68	7	1,025	77	4,366	1,209	171	1,380	5,746

Table 41. *Area (acres) of wetland and deep-water habitats in Indiana counties during 1980-87 (cont.)*

COUNTY	WETLAND HABITATS							TOTAL WETLAND HABITATS	DEEP WATER HABITATS			
	Scrub-shrub	Forested	Wet meadow	Shallow marsh	Deep marsh	Open water	Other		Limnetic lake	Perennial riverine	Total deep water	Total
Randolph	125	5,996	264	122	23	428	4	6,962	74	28	102	7,063
Ripley	795	4,416	51	19	16	1,507	35	6,839	783	225	1,008	7,846
Rush	172	4,639	217	91	12	343	3	5,476	69	22	91	5,566
St. Joseph	577	6,279	1,064	1,139	747	925	219	1,095	1,502	264	1,766	12,716
Scott	221	5,673	99	121	5	1,121	276	7,515	953	62	1,016	8,530
Shelby	90	5,822	196	133	18	400	28	6,686	190	391	581	7,267
Spencer	396	7,845	350	188	29	1,993	27	10,829	1,398	260	1,657	12,486
Starke	312	7,940	1,187	1,312	254	414		11,419	1,847	185	2,032	13,450
Steuben	1,928	7,051	2,433	5,058	1,901	2,088	1,394	21,851	7,411	7	7,418	29,269
Sullivan	403	14,175	452	374	127	2,862	73	18,466	3,959	514	4,474	22,940
Switzerland	74	838	45	44	1	687	23	1,712	2,467	1	2,469	4,180
Tippecanoe	300	7,521	1,317	902	220	471	150	10,880	91	2,211	2,301	13,181
Tipton	96	3,103	201	144	9	103		3,656		1	1	3,657
Union	106	1,408	54	41	8	132	201	1,951	2,015	9	2,024	3,975
Vanderburgh	121	2,650	110	145	8	1,319	38	4,391	1,250	93	1,344	5,735
Vermillion	129	3,909	205	225	53	847	105	5,473	367	2,109	2,476	7,949
Vigo	233	11,902	228	358	25	2,406	25	15,176	1,397	1,797	3,194	18,369
Wabash	492	2,224	1,133	465	59	685	771	5,829	3,549	859	4,408	10,237
Warren	99	3,891	359	503	95	247	245	5,439	29	735	764	6,203
Warrick	1,522	11,618	364	417	433	5,473	130	19,957	2,780	192	2,972	22,929
Washington	140	5,999	192	194	20	1,086	8	7,639	500	415	915	8,554
Wayne	218	5,717	166	107	38	676	39	6,961	282	51	334	7,295

Table 41. *Area (acres) of wetland and deep-water habitats in Indiana counties during 1980-87 (cont.)*

COUNTY	WETLAND HABITATS							TOTAL WETLAND HABITATS	DEEP WATER HABITATS			
	Scrub-shrub	Forested	Wet meadow	Shallow marsh	Deep marsh	Open water	Other		Limnetic lake	Perennial riverine	Total deep water	Total
Wells	40	2,083	169	189	83	538		3,102	37	390	428	3,530
White	539	2,270	2,265	1,057	35	344	536	7,046	1,779	64	1,842	8,889
Whitley	634	4,923	561	1,328	158	870	1,465	9,939	1,376	42	1,418	11,357
TOTAL	42,131	504,336	55,071	67,564	20,730	98,565	24,633	813,032	140,532	53,630	194,162	1,007,194
	5.2%	62.0%	6.8%	8.3%	2.5%	12.1%	3.0%	100%	72.4%	27.6%	100.0%	

* NWI habitat types were combined based on a scheme developed by the Illinois Natural History Survey.

** Includes palustrine emergent with undetermined water regime, littorial lake, and reverine unconsolidated shore.

Projects by permit type:

INDIVIDUAL	194
NATIONWIDE	779

Projects by Corps District:

CHICAGO	5
DETROIT	376
LOUISVILLE	592

Projects involving violations (After-the-fact applications):

NO	902
YES	71

Projects by final decision:

DENY	44
GRANT	902
WAIVE	27

Other important facts involve the types of projects reviewed and the types of aquatic ecosystems impacted. During the 1994/1995 reporting period, 47% of all projects reviewed involved the replacement or reconstruction of bridges, culverts, or other structures crossing rivers, streams, and ditches. These projects typically involve minimal or temporary impacts to riverine wetlands, but do involve impacts to riparian corridor vegetation and increased sedimentation of downstream areas often occurs as a result of the construction of temporary crossings, poorly maintained erosion control devices, and construction equipment entering the stream. Of all projects involving impacts to wetlands (emergent, scrub/shrub, forested, and open water), 49% of Section 401 Water Quality Certification projects impact emergent ecosystems. Of these projects, almost 50% involve impacts to wetland areas of 1/4 of an acre or less. This observation is consistent with the fact that over half of Indiana's wetlands are less than 1 acre in size and most of these wetlands exist as remnants and pockets within agricultural, urban, and suburban areas. In addition, many applicants site projects so as to avoid significant or diverse wetland areas, and impacts are typically minimized to reduce mitigation costs and to insure project approval.

Table 42 presents a summary of Section 401 permitting activities by wetland type. The wetland types "Greater than 5 CFS" and "Less than 5 CFS" refer to streams, rivers, and ditches, with CFS denoting cubic feet per second of water flow. Open water wetlands are defined as lakes, ponds, and other large bodies of water, such as the Ohio River, where regulated activities typically involve dredging to remove accumulated sediment. The majority of projects reviewed during the reporting period involved impacts to streams, rivers, and ditches. Typically, regulated activities included bridge replacement and rehabilitation, and maintenance of agricultural drainage ditches. Bridge construction and repair is the single largest project class of all project types reviewed under Indiana's Section 401 authority. Of the projects which involve wetland

Table 42. *Summary of Section 401 permitting activities by wetland type (1994/1995)*

WETLAND TYPE	# OF PROJECTS	ACRES PROPOSED	ACRES FILLED	ACRES DREDGED	WETLAND MITIGATION (acres)
Emergent	251	151.85	90.22	44.06	231.19
Forested	60	80.08	65.53	2.80	232.88
Greater Than 5 CFS	281	129.67	5.76	21.87	15.90
Less Than 5 CRS	178	5.29	2.48	2.41	0.47
Open Water	152	90.19	34.66	55.52	15.55
Scrub/Shrub	51	73.88	29.02	12.76	62.38
TOTAL	973	530.96	227.66	139.41	558.37

impacts, emergent wetlands are most often impacted. Wetland mitigation is high for this class, but little data exist to substantiate that IDEM is achieving positive results with its Section 401 WQC program. Lack of resources has hampered serious attempts to perform structured post-permit monitoring and data analysis, although monitoring reports supplied by applicants indicate that some mitigation projects produce developing ecosystems.

Figure 12 presents a comparison of proposed impacts versus permit type issued by the U.S. Army Corps of Engineers. In general, the majority of projects reviewed by IDEM involve proposed impacts to wetlands averaging 0.25 acres or less in size. Data reveals that IDEM receives an average of 2:1 (acres of mitigation: acres of impact) mitigation for projects of this size and greater. Few projects are proposed with wetland impacts greater than one acre. This may be due to the lack of large, contiguous wetlands within Indiana, the high cost of mitigation for large wetland impacts, and the probability that projects which have large impacts to wetlands will not be considered to be in compliance with Indiana's water quality standards.

Comparison to last reporting period

Table 43 compares this reporting period with information reported in previous years. Project approval rates have remained relatively consistent, but after-the fact applications have increased significantly since the last report. Increased awareness of regulatory programs, coupled with more aggressive inspection efforts by all agencies, have had an impact on this number. IDEM needs to target the section of the population which is engaged or intends to engage in activities which are regulated by Section 404 and 401 of the Clean Water Act with increased public information and awareness seminars on the importance of wetlands and the need to obtain permits before starting construction within regulated water bodies

Development of wetland water quality standards

During the 1993/1994 305(b) reporting period, IDEM assessed Indiana's water quality standards to determine if wetlands are conferred protection under state law and if further revision to these standards was needed to enhance protection for wetland ecosystems. As a part of work completed in fulfillment of USEPA Grant Number X995137-01-0 "Wetlands Protection," IDEM analyzed the state's current definition of "waters of the state" to determine if wetlands are covered by this definition. As listed below, waters of the state of Indiana are defined as:

> "Waters of the state" means such accumulations of water, surface and underground, natural and artificial, public and private, or parts thereof, which are wholly or partially within, flow through, or border upon this state, but the term does not include any private pond, or any pond, reservoir, or facility built for reduction or control of pollution or cooling of water prior to discharge unless the discharge therefrom causes or threatens to cause water pollution (327 IAC 2-1-9; See also, IC 13-7-1-27).

Figure 12. *Comparison of impact acreage of proposed projects and permit type*

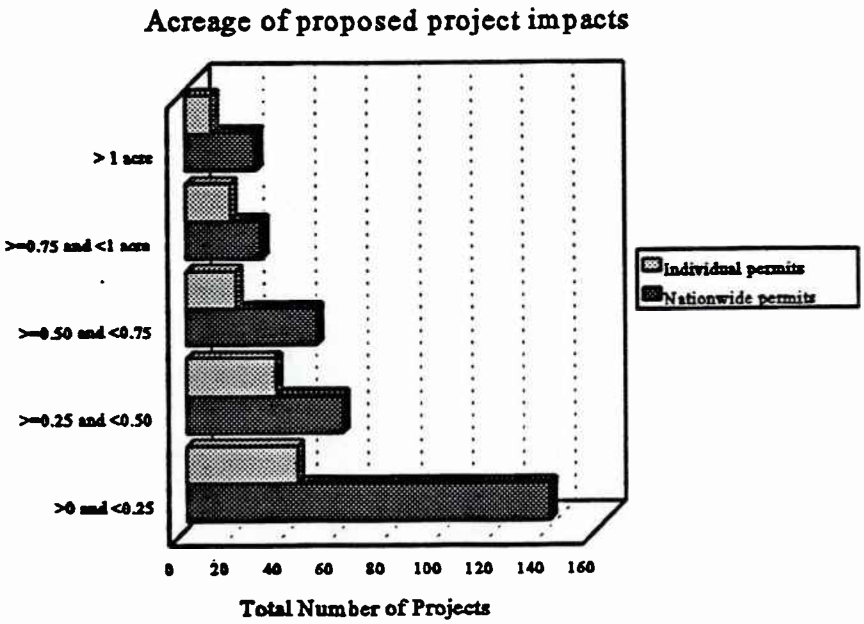


Table 43. *Summary of IDEM's Section 401 Water Quality Certification Program Activities from 1986 - 1995*

	01/01/86 TO 01/20/92	01/21/92 TO 05/11/94	01/01/94 TO 12/31/95
Number of permits reviewed	664	893	973
Monthly average reviewed	8	22	41
Percent NW	0	82	80
Percent IND granted	78	72	85
Percent NW granted	NA	95	98
Total proposed IND impacts*	622	186	177
Total proposed NW impacts*	NA	90	354
Total proposed impact*	622	276	531
Total ATF IND impacts*	111	37	67
Total ATF NW impacts*	NA	33	90
Total ATF impacts*	111	70	157
Total granted IND impacts*	156	15	169
Total granted NW impacts*	NA	58	198
Total permitted impccts*	156	73	367
Total IND mitigation*	536	53	209
Total NW mitigation*	NA	173	349
Total mitigation*	536	226	558

NW = U.S. Army Corps of Engineers Section 404 Nationwide General permit
IND = U.S. Army Corps of Engineers Section 404 Individual permit
NA = Not applicable (Prior to January 20, 1992. IDEM had approved all existing nationwide permits and performed no Section 401 Water Quality Certification review for projects which qualified for this class of Corps of Engineers' permit)

** Units are expressed in acres*

This definition includes all types and forms of water, including but not limited to such bodies of water, commonly called rivers, streams, and lakes, and all types of wetlands. Legal analysis of this definition confirmed that wetlands are conferred the same protection under the water quality standards as other surface waters.

Currently, IDEM has not assessed the viability of developing narrative and numeric biological criteria for Indiana's wetlands, in part due to lack of staff, funding for research activities, and political opposition to revisions of the water quality standards. The antidegradation policy found within the water quality standards confers broad but general protection for wetlands, and does not address the specific characteristics of any exceptional aquatic ecosystem. Wetlands currently support the same designated uses as all other Indiana surface waters. IDEM has not begun to integrate wetland protection through Section 401 Certification and the NPDES stormwater program, although the NPDES program processes were recently revised and funding increased to improve efficiency. It is hoped within the next reporting period that IDEM can make efforts to increase wetlands protection through these avenues.

Additional wetland protection activities

The following presents an overview of projects within IDEM's Section 401 Water Quality Certification program and within the state which are designed to enhance wetland protection activities, both on a regulatory and resource management level.

Development of application forms

IDEM staff is developing a standardized application form for the Section 401 Water Quality Certification Program. Currently, applicants submit information to IDEM utilizing a variety of forms, letters, checklists of required information, etc., which result in permit applications submitted with inadequate, incomplete, or illegible information. Standardized forms will improve permit review efficiency by decreasing the time needed to review applications and ease confusion regarding information needed for Section 401 review. Staff has been working on an application form since December of 1995 and has produced multiple drafts. It is the desire of the program to have an officially adopted application form by the end of calendar year 1996.

Revision of the Section 401 Water Quality Certification permit database

IDEM staff is updating the current computerized Section 401 Water Quality Certification database. The present database, which was designed on software which provided limited data storage capacity, cannot track the data needed to accurately assess permitted wetland impacts and evaluate trends in permitting. The revised database will utilize Paradox 6.0 on a local area network, provide an interactive user interface for ease of data entry and improved data error checking, and will allow for greater depth in reporting, querying, and data assessment. Standardized data entry procedures will also be implemented concurrent with the database upgrade. Project development began in late 1995, and completion is slated for the end of calendar year 1996.

Legislation

In 1995, the Indiana legislature passed two bills which addressed concerns within the agricultural community regarding regulations affecting the implementation of county drainage ditch maintenance projects. The need for early coordinated responses to drainage project applications from the IDNR and IDEM and the need for a "Best Management Practices Handbook" were cited by all involved parties as methods of providing useful input to county surveyors conducting drainage projects.

Senate Enrolled Act 368 requires that when a county drainage board or surveyor undertakes a project which requires authorization from IDEM through a Section 401 Water Quality Certification and an IDNR Construction in a Floodway permit that an onsite meeting take place. From this meeting both agencies draw up comments and draft language which will appear in the respective permits for the project. The meetings and the early environmental coordination document allow all parties to examine the project at an early stage, voice concerns and ask questions, as well as work collaboratively toward a project which meets the goals and needs of the county and the affected landowners, as well as meets the requirements and needs for water quality as set forth by the agencies. Currently, more than 36 projects have had early environmental coordination meetings, and the response from all parties has been largely positive. This process has facilitated education of both surveyors and regulators on the unique aspects of each others job, and has shown that there is common ground between the two interests. This allows for sound drainage projects that can be executed in an environmentally sound manner.

Senate Enrolled Act 303 establishes funds and procedures for the creation of a technical manual, whose development will be diverted by a multifaceted group composed of county surveyors, regulatory agencies, environmental groups, and farming agencies. The manual will set forth project techniques, best management practices for construction, explanations of the permitting process, lists of contacts within permitting agencies, descriptions of compensatory measures for unavoidable impacts, a list of projects exempt from regulations, and methods to discuss and work out solutions to project concerns in a timely and collaborative manner. Currently, the team has a draft manual available for public review, and several public meetings have been scheduled by the private contractor hired to develop the manual. Further input and refinement is needed, but a final document should be available by late 1996.

Wetland Conservation Plan

The Indiana Wetlands Conservation Plan is a comprehensive planning process by which the Indiana Department of Natural Resources (DNR) will plot a course for statewide wetlands conservation into the next century. The DNR has secured a grant from the U.S. Environmental Protection Agency which fully funds this 2-year project. In the past 200 years, Indiana has lost more than 80% of its original wetland acreage, and this trend continues today. Currently, there is no comprehensive plan to address this important issue.

Technical expertise will be provided by the **Technical Advisory Team** - experts from various divisions within the DNR as well as representatives from the Indiana Department of Environmental Management, Indiana Department of Transportation, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and U.S. Natural Resources Conservation Service. In addition, the DNR will actively seek input from all stakeholders in Indiana wetlands issues - from environmentalists to county surveyors, from farmers to coal mine operators. Agencies, organizations, and individuals from around the state have been participating in the **Wetlands Advisory Group**, providing input and guidance throughout the project's duration. Finally, as the plan begins to take shape based on the input of stakeholder groups, it will be placed into the public input process so all Hoosiers have an opportunity to comment and make recommendations.

This planning process has been approached as a partnership effort. The DNR has no preconceived notions about what will be included in the plan or how the plan will take shape. A private contractor was hired to collect input from stakeholders and to facilitate the planning process. The facilitator has gathered existing information on Indiana's wetlands and has requested the participation of stakeholders who impact or are impacted by wetland issues. The final plan will be completed by June 30, 1996.

Challenges and Goals

IDEM's Section 401 Water Quality Certification Program has made great efforts to maintain and protect water quality by careful review of projects which involve dredge, fill, or excavation activities within Indiana's lakes, streams, rivers, ditches, and wetlands. Emphasis has been consistently placed on careful project design and planning, with a focus on avoidance of impacts to water bodies, minimization of unavoidable impacts, and lastly mitigation in carefully selected cases. Mitigation of impacts to wetlands or other water bodies stresses in-kind replacement, restoration of wetlands as a preferable option to creation or enhancement, and placement of mitigation areas within the same watershed as project impacts. Certain projects are not granted Section 401 Water Quality Certification regardless of proposed mitigation due to the quality of the water body or due to the impracticality of viable mitigation for project impacts. Nevertheless, faced with limited resources, pressures from special interest groups, and a rapidly dwindling resource, Indiana's Section 401 Water Quality Program has several key challenges and goals for improving the program and improving water resource management within the state.

Challenges

- Improve education and public outreach with citizens and special interest groups regarding water quality, the importance of Indiana's wetlands, and the requirements of various regulatory programs which restrict work within waters of the state. Increased awareness of this information will improve compliance with existing regulations, increase public understanding of water quality issues, and aid in sound project planning.

- Balance sound management and regulation of Indiana's wetland resources with the needs to improve agricultural, developmental, and recreational needs within these areas.

- Work with IDNR, the U.S. Fish and Wildlife Service (USFWS), USEPA, and the Corps of Engineers to improve the regulatory process (Section 404 and 401 permitting). Address key issues in Indiana such as mitigation banking, mitigation requirements, and permit conditions for projects which have minimal impact on water resources such as bridge replacements.

- Work with special interest groups to address regulatory concerns and environmental impacts of specific projects, such as housing development, shoreline stabilization along lakes and rivers, drainage ditch improvements, and agricultural development of wetland areas.

Goals

- Expand program resources to improve wetland mitigation monitoring, increase inspections of potential violations, provide educational seminars to the public, improve certification review, and assess Indiana's wetland resource (through inventory of ecological integrity).

- Develop and implement water quality standards for wetlands, including unique aquatic ecosystems such as sphagnum bogs and calcareous fens.

- Develop and implement wetland bioassessment criteria.

- Improve the Section 401 Water Quality Certification permitting process by developing application materials, expanding staff to increase efficiency of all aspects of the certification review process, produce and distribute educational materials, and update and revise IDEM's Section 401 Water Quality Certification database.

Monitoring Programs

Fixed Station Water Quality Monitoring Network

In April 1957, the Indiana State Board of Health established 49 stream sites for the biweekly collection of water samples for physical, chemical, and bacteriological analysis. Since 1957, various changes and improvements have been made and several stations have been added. Locations of historical stations for data collection may be found in the annual "Water Quality Monitoring of Rivers and Streams" publication of the Indiana Department of Environmental Management (IDEM).

The Fixed Station Water Quality Monitoring Network was established to provide basic information which would reveal pollution trends and provide water quality data for the many existing and potential users of surface water in Indiana. The monitoring program has these specific objectives:

1. To determine the chemical, physical, bacteriological, and biological characteristics of Indiana's water under changing conditions.

2. To indicate, when possible, the areas where pollution is entering a stream.

3. To compile data for future pollution abatement activities.

4. To obtain background data on certain types of wastes, such as sewage, industrial wastes, and radioactive materials, and to detect critical changes.

5. To obtain data useful for municipal, industrial, agricultural, and recreational users.

6. To compile data necessary to support enforcement action intended to preserve streams for all beneficial uses.

One hundred and four (104) stations were sampled during 1994 - 1995, monitoring approximately 2,055 stream miles in Indiana. Of the 104 stations, 89 are sampled once each month, and 15 are sampled quarterly. These stations and their descriptions are listed in Table 44 and in Figures 13 and 14. A list of the parameters for which analyses are run is given in Table 45.

Toxic Monitoring and Control Programs

The State uses a combination of chemical and biological monitoring to identify discharges of toxic pollutants. Chemical methods include toxicants identified by (1) EPA Form 3510-2C for permit application, (2) effluent sampling in compliance sampling inspections, (3) sludge sampling in land application permits and compliance sampling inspection, and (4) sediment and fish tissue sampling in receiving streams. Biological methods include the use of biosurveys and effluent toxicity tests.

Regular monitoring for toxic substances is conducted by the IDEM through analysis of the fish tissue and sediments collected once biennially at the 23 CORE program stations (Table 44 and Figure 15). These stations are also part of the Fixed Station Water Quality Monitoring Network. The stations are divided into two groups which are sampled on alternate years.

Three sets of fish samples (3 samples, 5 fish each, if possible) are collected at each station. Skin-on, scaleless fish fillet (skin-off for catfish) samples are submitted to the laboratory for analysis. A list of the parameters for which fish samples are analyzed is shown in Table 13.

Table 44. *Indiana's fixed station water quality monitoring network*

STATION	NAME	LAT/LONG	LOCATION
BD-1(C) ★	Burns Ditch at Portage	41 37 20.5/87 10 34.4	Midwest Steel Truck Bridge, Portage
BD-2E	Burns Ditch At Portage	41 36 45/87 10 25	State Highway 249 Bridge (Chrisman Road)
BD-3W	Burns Ditch at Portage	41 36 9.3/87 11 37	Portage Boat Yard Dock, Portage
BL-.7(BL-.1) (Q)	Big Blue River at Edinburgh	39 21 29/85 59 01	U.S. Highway 31 Bridge, Edinburgh
BL-64 (BL-61) (Q)	Big Blue River near Spiceland	39 52 256/85 26 20	County Road 450S Bridge
BLW-57 (BLW-53) (Q)	Blue River, West Fork-Fredericksburg	38 26 02/86 11 31	U.S. Highway 150, Fredericksburg
BS-O	Blue Springs Caverns		At Opening - Lawrence Co.
EC-1★	Eagle Creek at Indianapolis	39 44 11/86 11 48	Raymond Street, East of State Highway 67
EC-7	Eagle Creek at Speedway	39 46 41/86/15 02	Lynhurst Bridge near West 10th Street
EC-21★	Eagle Creek at Zionsville	39 54 37/86 17 08	State Highway 100, South of Zionsville
EEL-1 (Q)	Eel River at Worthington	39 07 26/86 58 10	S.R. 67 Bridge, Worthington
ELL-7	Eel River near Logansport	40 46 55/86 15 50	C.R. 125N Bridge, NE of Logansport
ELL-41	Eel River near Roann	40 56 53/85 53 28	S.R. 15 NE of Roann
ER-.3★	Elkhart River at Elkhart	41 41 16/85 58 18	East Jackson Street Bridge, Elkhart
EW-1	East Fork, White River-Petersburg	38 32 22/87 13 22	S.R. 57 bridge NE of Petersburg
EW-79 (EW-77) (C)★	East Fork, White River-Williams	38 48 07/86 38 44	County Road South of State Highway 450
EW-94	East Fork, White River-Bedford	38 49 33/86 30 47	U.S. Highway 50 Bridge, Sth. of Bedford
EW-168 (EW-167)★	East Fork, White River-Seymour	38 59 12/85 53 56	Seymour Waterworks Intake
EW-239	East Fork, White River-Columbus	39 12 02/85 55 35	S.R. 46 Bridge, Columbus
FC-.6★	Fall Creek-Indianapolis	39 46 54/86 10 36	Stadium Driver Bridge, Indianapolis
FC-7	Fall Creek-Indianapolis	39 50 05/86 07 19	Keystone Avenue near Water intake
CGR-34★	Grand Calumet River-Hammond	41 37 12/87 30 31	Hohman Avenue Bridge at Hammond
GCR-37★	Grand Calumet River-East Chicago	41 36 50/87 27 41 4	Bridge on Kennedy Avenue, East Chicago
GCR-42★	Grand Calumet-Gary	41 36 33/87 22 20	Bridge Street Bridge, Gary
IHC-0	Indiana Harbor Canal at East Chicago	41 40 23/87 26 25	At Mouth of Ship Canal
IHC-2 (IHC-1) (C)★	Indiana Harbor Canal at East Chicago	41 39 18/87 27 33	Bridge on Dickey Road, East Chicago
IHC-3S	Indiana Harbor Canal at East Chicago	41 38 22/87 28 16	Bridge on Columbus Drive, East Chicago
IHC-3W	Indiana Harbor Canal at East Chicago	41 38 48/87 28 51	Bridge on Indianapolis Boulevard, East Chicago
IWC-9 (IWC-6.6) (C)★	Indianapolis Waterway Canal at Indpls.	39 52 07/86 08 30	Confluence of Canal and White River
KR-68 (KR-65) (C)★	Kankakee River at Shelby	41 10 57/87 20 26	S.R. 55 Bridge, 1 Mile South of Shelby
KR-118 (KR-125) (C)★	Kankakee River-Kingsbury Wildlife	41 28 39/86 36 16	U.S. 6 Bridge, Sth. of Kingsbury Wildlife
LCR-13	Little Calumet River at Hammond	41 34 39/87 31 19	Hohman Avenue Bridge, Hammond
LCR-39	Little Calumet River-Porter 41	37 04/87 07 32	S.R. 149, South of U.S. Highway 12, NW of Porter
LM-EC	Lake Michigan at East Chicago	41 39 09/87 26 17	Raw Water, East Chicago Waterworks
LM-G	Lake Michigan at Gary	41 38 58/87 20 32	Raw Water, Gary Waterworks
LM-H	Lake Michigan at Hammond	41 42 00/87 29 00	Raw Water, Hammond Waterworks
LM-M (C)	Lake Michigan at Michigan City	41 44 07/86 54 00	Raw Water, Michigan City Waterworks

Table 44. *Indiana's fixed station water quality monitoring network (cont.)*

STATION	NAME	LAT/LONG	LOCATION
LM-W (C)★	Lake Michigan at Whiting	41 40 45/87 29 17	Raw Water, Whiting Waterworks
M-114(M-95)★	Maumee River at Woodburn	41 10 11/84 50 57	S.R. 101 Bridge, 3 Miles Nrth. of Woodburn
M-129 (M-110) (C)★	Maumee River at New Haven	41 05 06/85 01 14	Land in Road, .5 Mile Nrth. of New Haven
MC-18 (MC-17) (Q)	Mill Creek at Devore	39 26 00/86 45 47	U.S. Highway 231 Bridge, Near Devore
MC-35 (Q)	Mill Creek at Stilesville	39 38 12/86 38 25	U.S. Highway 40 Bridge at Stilesville
MS-1	Mississinewa River at Peru	40 45 14/86 01 23	State Highway 124, East of Peru
MS-28 ★	Mississinewa River at Jalapa	40 37 32/85 43 52	Izaak Walton Lodge
MS-36 (MS-35)	Mississinewa at Marion	40 34 34/85 39 34	Highland Aveunue Bridge, Marion
MS-99 (MS-100)	Mississinewa River at Ridgeville	40 16 48/84 59 43	County Road 134E, 2 Miles East of City
MU-20 (MU-25)	Muscatatuck River near Austin	38 45/46/85 56 11	S.R. 39 bridge West of Austin
P-35 (P-33) (Q)	Patoka River near Oakland City	38 22 57/87 20 00	
P-76 (Q)★	Patoka River at Jasper	38 19 40/86 57 59	US 231 Bridge
PC-21(Q)	Big Pine Creek, Pine Village	40 25 19/87 20 30	S.R. 55 Bridge, Pine Village
S-O	Salamonie River-Lagro	40 49 46.5/85 43 06	Division Road, near Lagro
S-25★	Salamonie River-Lancaster	40 43 45/85 30 26	IN 124, South of Lancaster
S-71	Salamonie River-Portland	40 25 42/85 02 17	106 South Road Bridge, Portland
SC-25 (SC-30)	Sugar Creek at Shades State Park	39 56 46/87 03 33	S.R. 234 Bridge, above Shades State Park
SGR-1(Q)	Sugar Creek at Edinburg	39 21 39/85 59 51	Road to Atterbury from Edinburg
SJR-51 (SJR-460 (C)★	St. Joseph River at South Bend	41 44 40/86 16 22	Auten Road Bridge, South Bend
SJR-64★	St. Joseph River at Mishawaka	41 40 16.5/86 09 08	Petro Park Bridge, Mishawaka
SJR-87 (SJR-76) (C)★	St. Joseph River at Bristol	41 43 20/85 49 03	County Road through Bristol
SLC-1	Salt Creek, Portage	41 35 50/87 08 43	U.S. Highway 20 Bridge, Portage
SLC-17 (SLC-12)★	Salt Creek near Valparaiso	41 29 56/87 08 29	S.R. 130 Bridge, below Sewage Treatment Plant
SLT-12 (SLT-11)	Salt Creek near Oolitic	38 53 18/86 30 31	State Highway 37 Bridge
STJ-.5 (STJ-0) (C)★	St. Joseph River at Fort Wayne	41 45 21.5/85 07 42	Tennessee Street Bridge
STM-.2 (C)★	St. Mary's River at Fort Wayne	41 45 21.5/85 07 42	Spy Run Bridge over St. Mary's
STM-11 (STM-12)	St. Mary's River at Fort Wayne	40 59 17/85 06 01	Anthony Boulevard Bridge, South of Hwy. 27-33
STM-37 (STM-33)	St. Mary's River at Pleasant Mills	40 46 45/84 50 32	S.R. 101 Bridge, Nrth. of Pleasant Mill
TC-.5 (TC-.3) (C)	Trail Creek at Michigan City	41 43 21/86 54 16	Franklin Street Bridge, Michigan City
TC-1★	Trail Creek at Michigan City	41 43 18/86 53 49	U.S. Hwy. 12 Bridge, Michigan City
TC-2	Trail Creek at Michigan City	41 43 21/86 52 32	Bridge Upstream STP at Krueger Park
TR-9 (TR-6)	Tippecanoe River near Rochester	41 06 21/86 13 12	U.S. 31 Bridge, North of Rochester
TC	Twin Caves		At outlet in Spring Mill State Park
V-.8★	Vermillion River at Cayuga	39 57 40/87 27 07	State Highway 63 Bridge, Cayuga
WB-52 (#)	Wabash River at New Harmony	38 07 52/85 56 33	U.S. Highway 460 Bridge, New Harmony
WB-130 (WB-128)	Wabash River at Vincennes	38 42 26/87 31 09	U.S. Highway 50 Bridge, NW Edge of Vincennes
WB-183 (WB-175) (C)	Wabash River, West of Fairbanks	39 13 39/87 34 21	I & M Breed Generating Station

Table 44. *Indiana's fixed station water quality monitoring network (cont.)*

STATION	NAME	LAT/LONG	LOCATION
WB-205	Wabash River, South of West Terre Haute	39 24 07/87 39 02	Dresser Sub-Station
WB-218 (WB-207) (C)★	Wabash River near Terre Haute	39 30 24/87 24 50	Fort Harrison Boat Club
WB-230 (WC-219)★	Wabash River at Clinton	39 39 26/87 23 42	S.R. 163 Bridge at Clinton
WB-240 (WB-228)	Wabash River at Montezuma	39 47 33/87 22 26	U.S. Hwy. 36 Bridge, West Edge of Montezuma
WB-256 (WB-245)	Wabash River at Cayuga	39 50 08/87 25 11	State Highway 234 Bridge, Cayuga
WB-303 (WB-292) (C)★	Wabash River near Lafayette	40 24 43/87 02 11	Granville Bridge, SW of Lafayette on Road 700W
WB-316 (C)★	Wabash River North of Lafayette	40 25 10/86 53 50	S.R. 225 (East Street) Bridge, Battleground
WB-347 (WB-336)★	Wabash River at Georgetown	40 44 19/86 30 10	C.R. 675, West of Georgetown
WB-370 (WB-360)	Wabash River at Peru	40 44 32/86 05 48	Business U.S. Highway 31 Bridge, Peru
WB-402 (WB-390)	Wabash River at Andrews	40 52 08/85 36 06	S.R. 105 Bridge, North of Andrews
WB-409	Wabash River at Huntington		
WB-420 (WB-409)	Wabash River at Markle	40 49 26/85 20 22	State Highway 3 Bridge
WB-452★	Wabash River at Geneva	40 37 00/84 57 15	U.S. 27 Bridge, 1.5 Miles North of Geneva
WC-3 (WC-1)★	Wildcat Creek at Lafayette	40 27 12/86 51 05	S.R. 25 Bridge, NE of Lafayette
WC-60 (WC-63)★	Wildcat Creek at Kokomo	40 28 26/86 11 02	County Road 300W, 1 mile west of Kokomo
WC-66 (WC-690	Wildcat Creek at Kokomo	40 29 10/86 06 37	U.S. Highway 31 Bypass Bridge
WCS-34 (Q)★	Wildcat Creek, South Fork-Frankfort	40 18 59/86 32 48	Highway 38 - 39 Bridge NW of Frankfort
WHE-27 (Q)★	East Fork, Whitewater River-Abington	39 43 57/84 57 35	Pottershop Road Bridge, East Edge of Abington
WHW-22 (Q)	West Fork, Whitewater River, Cedar Grove	39 21 12/85 56 36	S.R. 1 Bridge, Cedar Grove
WLSL★	Wolf Lake at Hammond	41 39 42/87 31 30	Culvert, South Edge of Dike W. of Calumet Avenue
WR-19 (Q)	West Fork White River at Hazelton	38 29 24/87 33 00	Old 41 Bridge, Hazelton
WR-46 (WR-48) (C)★	West Fork White River at Petersburg	38 330 42/87 17 16	State Highway 61 Bridge, Petersburg
WR-81 (WR-80)	West Fork White River at Edwardsport	38 42 42/87 14 26	S.R. 358 Bridge, 1 Mile below Generating Station
WR-162 (WR-166)	West Fork White River at Spencer	39 17 16/86 44 45	S.R. 43 & 46 Bridge, South Edge of Spencer
WR-192	★West Fork White River, Martinsville	39 26 02/86 26 55	S.R. 39 Bridge West of Martinsville
WR-219 (C)★	West Fork White River at Waverly	39 33 35/86 16 28	S.R. 144 Bridge, Waverly
WR-248 (WR-249)	West Fork White River at Nora	39 54 35/86 06 19	86th Street, East of Nora
WR-279 (WR-280)★	West Fork White River, Perskinsville	40 08 30/85 52 48	State Highway 13 Bridge
WR-293 (WR-295)	West Fork White River at Anderson	40 06 22/85 40 22	10th Street at Waterworks
WR-309 (WR-310)★	West Fork White River at Yorktown	40 10 42/85 29/40	County Road Bridge, North of Yorktown H.S.
Wr-319	West Fork White River at Muncie	40 10 41/85 20 32	Memorial Drive, East Edge of Muncie
WR-348 (WR-3500 (C)★	West Fork White River, Winchester	4-10 56/85 58 10	At U.S. 27 Bridge, East of Winchester

(C) CORE Station

(Q) Quarterly Sampling Station

★ Quarterly Toxics Scan

(#) Tissue, Sediment & Biological Only

Figure 13. *Locations of Indiana's fixed station water quality monitoring network stations (except Northwest Indiana)*

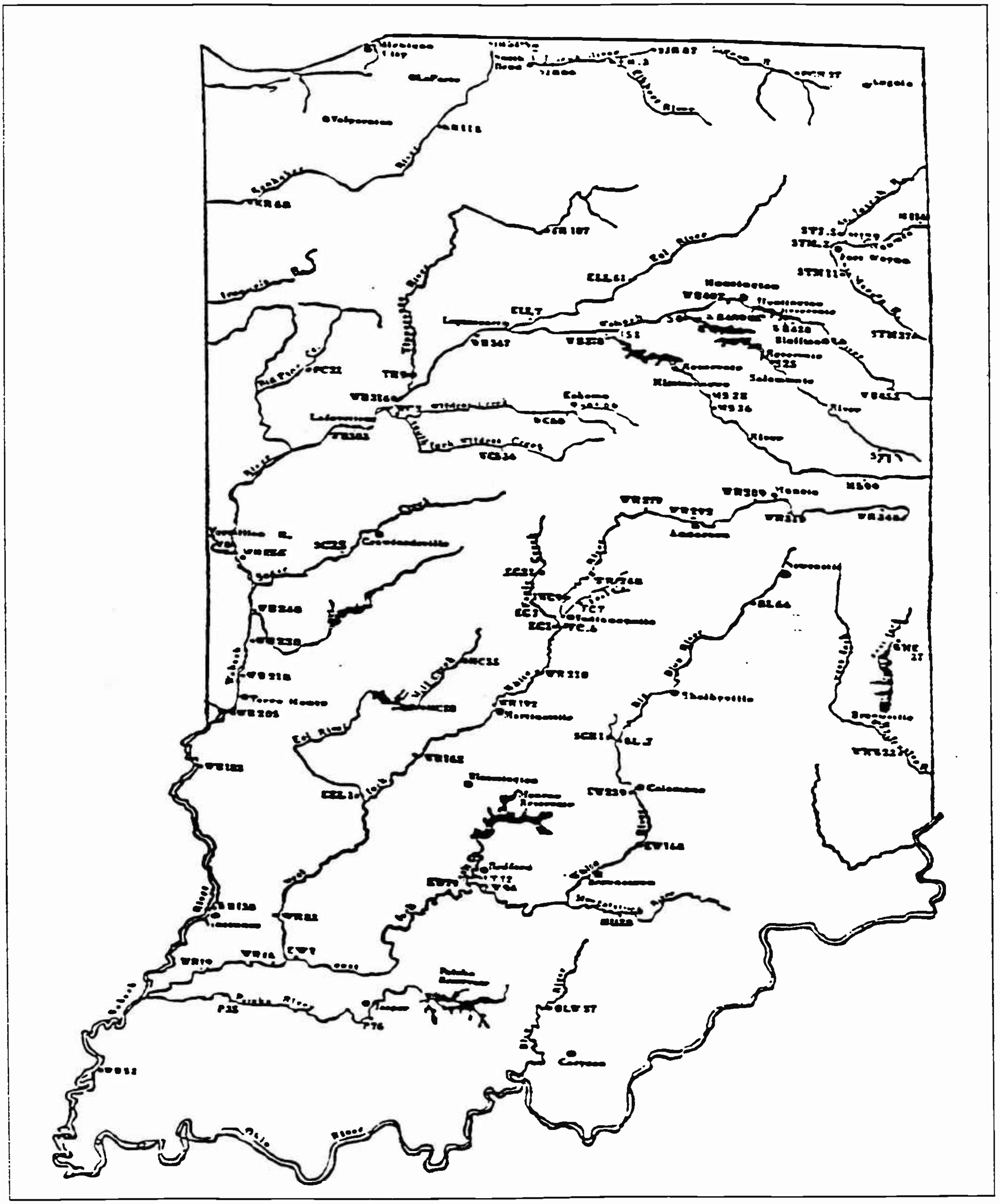


Figure 14. *Locations of Indiana's fixed station water quality monitoring network stations in Northwest Indiana*

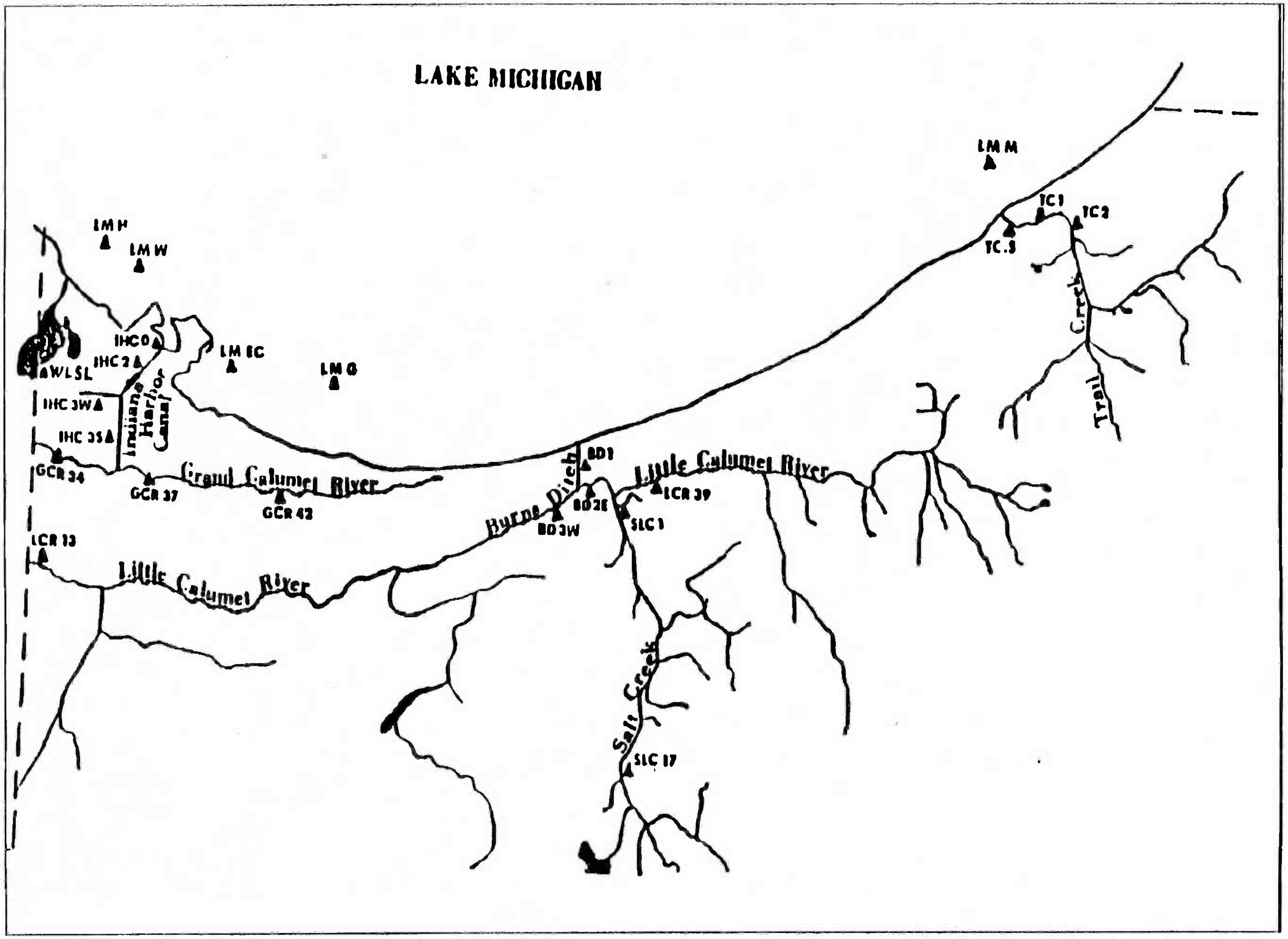
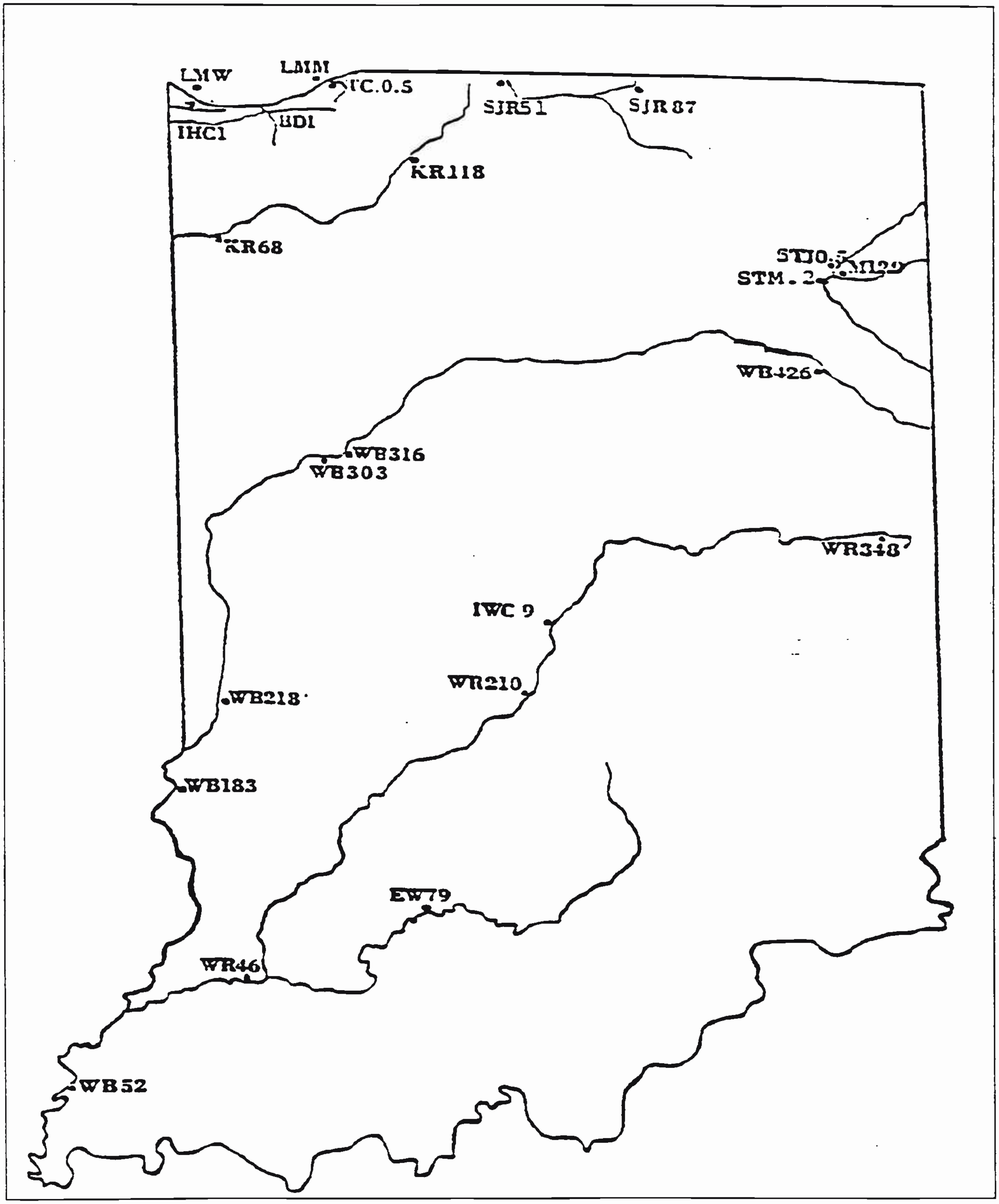


Table 45. *Analyses conducted at Indiana's fixed water quality monitoring(not all parameters are sampled and analyzed at each station)*

Alkalinity (total)	Mercury as Hg↑
Ammonia as NH_3-N	Nichel as Ni (total Recoverable)
Barium	Nitrogen, TKN (total)
Biochemical Oxygen Demand (BOD)	Oil and Grease
Calcium as CaCO3	Polychlorinate biphenyls (PCBs) see below
Chemical Oxygen Demand (COD)	pH
Cadmium as Cd	Phenol
Chloride as Cl	Phosphorus as P (total)
Chromium as Cr_{+6} (hexavalent)	Phthalates see below
Chromuym as Cr (total)	Selenium
Coliform (E. coli)	Silica as SiO_2
Copper as Cu (total recoverable0	Silver as Ag
Cyanide (total) as Cn	Suspended Residue (nonfilterable reside)
Dissolved Iron	Voltile Suspnded Matter
Dissolved Oxygen (DO)	Total Residue
Fluoride as F	Dissovled Residue (filterable residue)
Hardness as CaCO3	Specific Conductance as micromhos/cm
Iron as Fe (total)	Sulfate asSO_4
Lead as Pb (total recoverable)	Total Organic Carbon (TOC)
Magnesium as $MgCO_3$	Turbidity as NTU
Manganese as Mn (total)	Zinc as ZN (total recoverable)

Figure 15. *Location of Indiana's CORE monitoring stations*



Sediment samples collected are analyzed for 150 pollutants (Table 46). In addition to the more routine monitoring, special studies of fish, turtles, crayfish, aquatic vegetation, sediment and in some cases, water may be conducted to monitor for toxic substances.

When waterbodies potentially affected by in-place pollutants are identified by sediment and/or fish tissue analysis, the site can be further evaluated by sediment toxicity testing, pollutant transport modeling, sediment criteria, caged fish bioaccumulation studies, or additional sampling. Remedial actions, if appropriate to reduce or remove in place toxicants, could include additional point source controls, dredging sediments, sealing contaminated sediments or leaking landfills, or construction of sediment traps.

Water quality is routinely sampled for a limited number of toxic parameters (mostly metals) at the fixed water quality monitoring stations (Table 45). Effluents from dischargers known or suspected to contain toxic materials are analyzed for these materials when compliance sampling is conducted at these localities. Toxicity tests are used by the State to screen wastewater for potentially toxic effects. These tests can measure both acute (short-term) and chronic (long-term) effects on aquatic life.

The elimination of the discharge of toxic substances in toxic amounts is accomplished for the most part through the NPDES permits program. After a potentially toxic discharge is identified, its toxicity is controlled by issuing water quality based discharge permits for individual toxicants identified in the effluent. Numerical criteria for approximately 90 substances and procedures for determining criteria for others were included in the State's water quality standards revisions which went into effect in 1990. When it is uncertain if toxic substances are present in a discharge, when site specific conditions are suspected to possibly increase or modify the toxic effects of a discharge, or when more than one toxicant may create additive or antagonistic effects, the permit may include a toxicity testing requirement.

The State also requires toxicity reduction evaluations (TREs) in the cases where toxicity requirements are not met. A TRE is used to determine what measures are necessary to control effluent toxicity. This could include bench scale treatability studies, spill control procedures or process modifications in which the identification of specific toxicants is not necessary.

Biological Monitoring Program

Biological monitoring involves the intermittent sampling of the biological resources of Indiana lakes, rivers, and streams to assess and monitor the various components of the biological community including fish, aquatic invertebrates, algae, and bacteria. These biological measurements are used to assess and monitor the long-term temporal changes of the ecological condition of our lakes, rivers and streams. Biological community data, by its nature integrates the cumulative effects of all successive environmental perturbations and stressors.

Table 46: *Complete list of sediment analytes for 1990 - 1993*

Metals
Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper/
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc
Cyanide

Acid
Extractables

Benzoic acid
Phenol
2-Chlorophenol
2,4-dichlorophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Pentachlorophenol
2-Methylphenol
4-methylphenol
2,4-Dimethylphenol
4-chloro-3-Methylphenol
4,6-dinitro-2-Methylphenol
2-Nitrophenol
4-Nitrophenol
2,4-Dinitrophenol

PCBs
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260
Aroclor-1262

Pesticides

Aldrin
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
alpha-Chlordane
gamma-Chlordane
cis-Nonachlor
trans-Nonachlor
Oxychlordane
Total Chlordane
p,p'-DDD
o,p-DDD
p,p'-DDE
o,p'-DDE
p,p'-DDT
o,p'- DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Edrin ketone
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Methoxychlor
Pentachloroanisole
Toxaphene

Base/Neutral Extractable
di-n-Octylphthalate
Acenaphthylene
Acenaphthene
Aniline
4-Chloroaniline
2-Nitronaniline
3-Nitroaniline
4-Nitroaniline
Anthracene
Benzo(a)anthracene
Dibenzo(a.h) anthracene
3,3-Dichlorobenzidene
1,2-Dichlorobezene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2,4-Trichlorobenzene
Hexachlorobenzene
Benzyl alcohol
Carbazole
Chrysene
n-nitro-di-phenylamine
n-nitroso-di-n-Propylamine
Hesachloroethane
Bis(2-choroethyl)ether
Bis(2-chloroisoprovl)ether
4-Bromophenyl-phenylether
4-Chlorophenyl-phenylether
Fluoranthene
Fluorene
Benzo(beta)fluoranthene
Benzo (kappa)fluoranthene
Dibenzofuran
Bis(2-chloroethoxy)methane
Isophorone
Naphthalene
2-Chloronaphthalene
2-Methylnaphthalene
Hexachlorocyclopentadiene
Benzo(g,h,i) perylene
Phenanthrene
di-n-Butylhthalate
Diethylphthalate
Dimethylphthalate

Pyrene
Bis (2-ethylhexyl)
phthalate
Buthylbenzyl-phthalate

Benzo (alpha) pyrene

Indeno 91,2,3-c,d) pyrene

1,2-Diphenylhydrazine

Hexachlorobutadiene
2,4-dinitrotoluene
2,6-dinitrotoluene

General Chemistry

Total Organic Carbon
Acid Volatile Sulfide
Ammonia-N
Percent Moisture
Percent Total Solids

Volaitle Organics
Acetone
Benzene
Chlorobenzene
Ethylbenzene
2-Butanone (MEK)
Carbon disulfide
Chloroethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1-Dichloroethylene
1,2-Dichloroethylene
trichloroethylene
2-Hexanone
Bromomethane
Tribromomethane (Bromoform)
Bromodichloromethane
Dibromochloromethane
Dichloromethane (Methylene Chloride)
Xylene (total)
Trichloromethane (Chloroform)
Tetrachloromethane
4-methyl-2-Pentanone
1,2-Dichloropopane
cis-1,3-Dichloropropylene
trans-1,3-Dichloroproylene
Styrene
Toluene
Vinyl acetate
Vinyl Chloride
Fuel oil
Gasoline

Biological data has been collected and analyzed by this agency and its predecessor for many years. Above and below comparisons of the actual effects point source discharges were having on the extant biological communities have been instrumental in providing the necessary data to have such point sources either removed or their effluent quality increased to an acceptable level. The agency has also been collecting and analyzing fish tissue samples to test for the presence of toxic substances for over 15 years. Periodic comprehensive studies of entire watersheds have been conducted, as needed, to evaluate the status of the complete cross section of biological communities. The state of Indiana has addressed and included narrative biological criteria in its water quality standards to prevent degradation of these biological resources for many years.

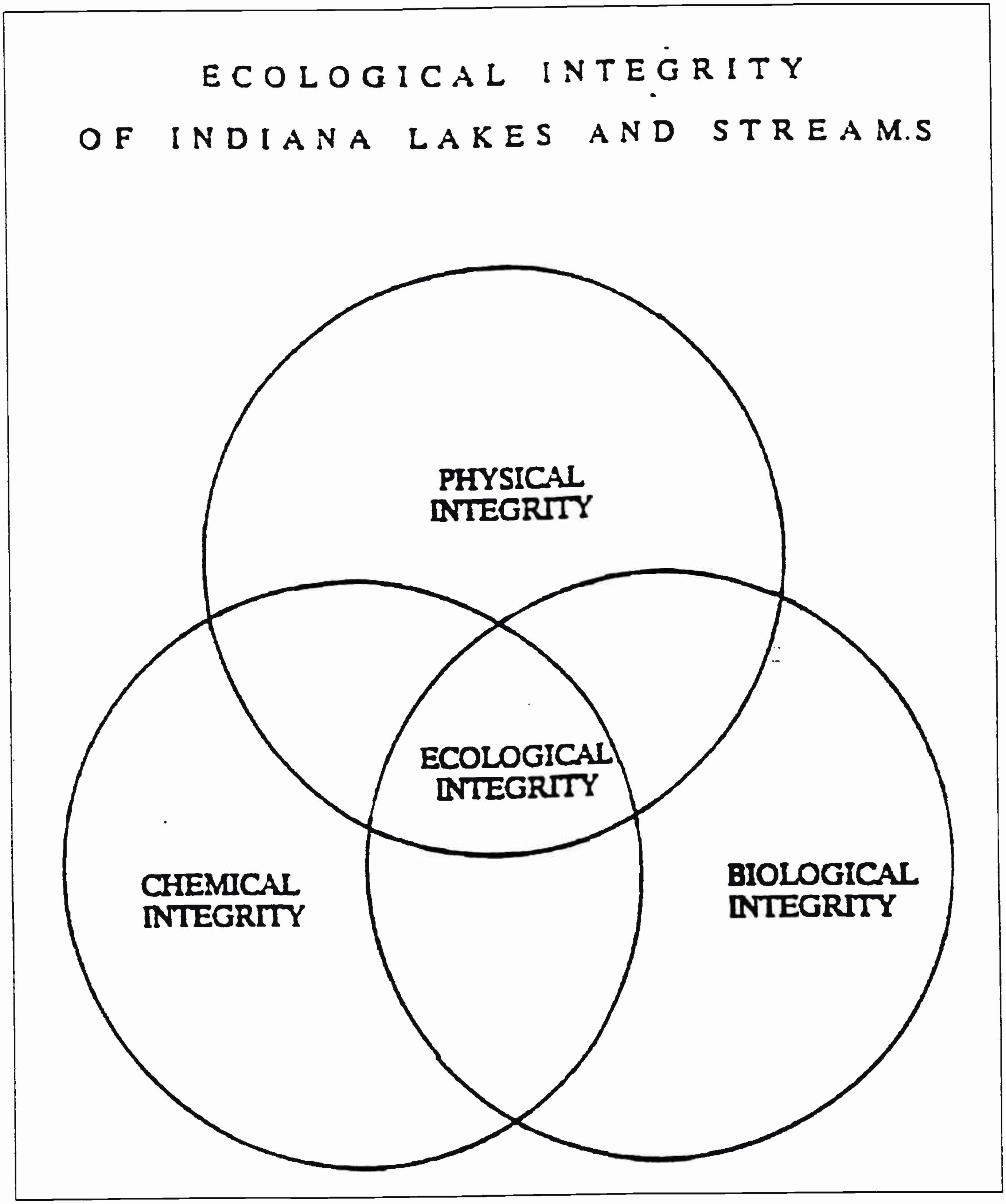
The Indiana Water Quality Standards (WQS) protect the surface waters of the state with regulations and policies of non-degradation. These non-degradation policies require that existing beneficial uses be maintained and protected and that no degradation be permitted which would interfere with, or become injurious to existing and potential uses of our surface waters. Specific surface waters of the state have also been designated for specific multiple uses. If a particular body of water has several designated multiple uses then the most protective of all the simultaneously applicable standards are applied to protect the water body. Both the warm water and cold water aquatic communities are recognized within the multiple use classification system and protected under Indiana's narrative biological criteria.

Indiana has an "Exceptional Use" classification to provide more stringent protection to waters which possess unusual aquatic habitat, which are an integral feature of an area of exceptional natural beauty or character, or support unique assemblages of aquatic organisms. Historically some streams have been found incapable of supporting diverse communities of fish and other aquatic life during much of the year simply because there is not enough water, food, or suitable habitat present to support them, no matter how high the water quality might be. The state has established a "Limited Use" designation for some of these streams. At present, 34 stream reaches (77 stream miles) are designated for "Limited Use" and 11 are designated for "Exceptional Use" (181 stream miles).

The biological monitoring program begins with a comprehensive habitat assessment component using two different numerical assessments. These assessments are performed at all sites where biological sampling and/or evaluations are carried out. During these habitat assessments numerical evaluations are made regarding the physical, chemical, and riparian/watershed character of the stream. These habitat assessments are used with the biological assessments to determine the overall ecological integrity of a stream or stream segment.

Biological monitoring, when used with chemical and physical assessments, provides a holistic and complete picture of the ecological integrity of the lotic or flowing water system. "Ecological Integrity" is the condition of an unimpaired ecosystem, as measured by combined chemical, physical, and biological attributes (Figure 16). An ecological assessment is an

Figure 16. *Conceptual model of the ecological integrity of Indiana lakes and streams*



evaluation of the condition of a water body using biological, water quality, and physical habitat evaluations. It should be noted that water quality is only one element of this complete picture.

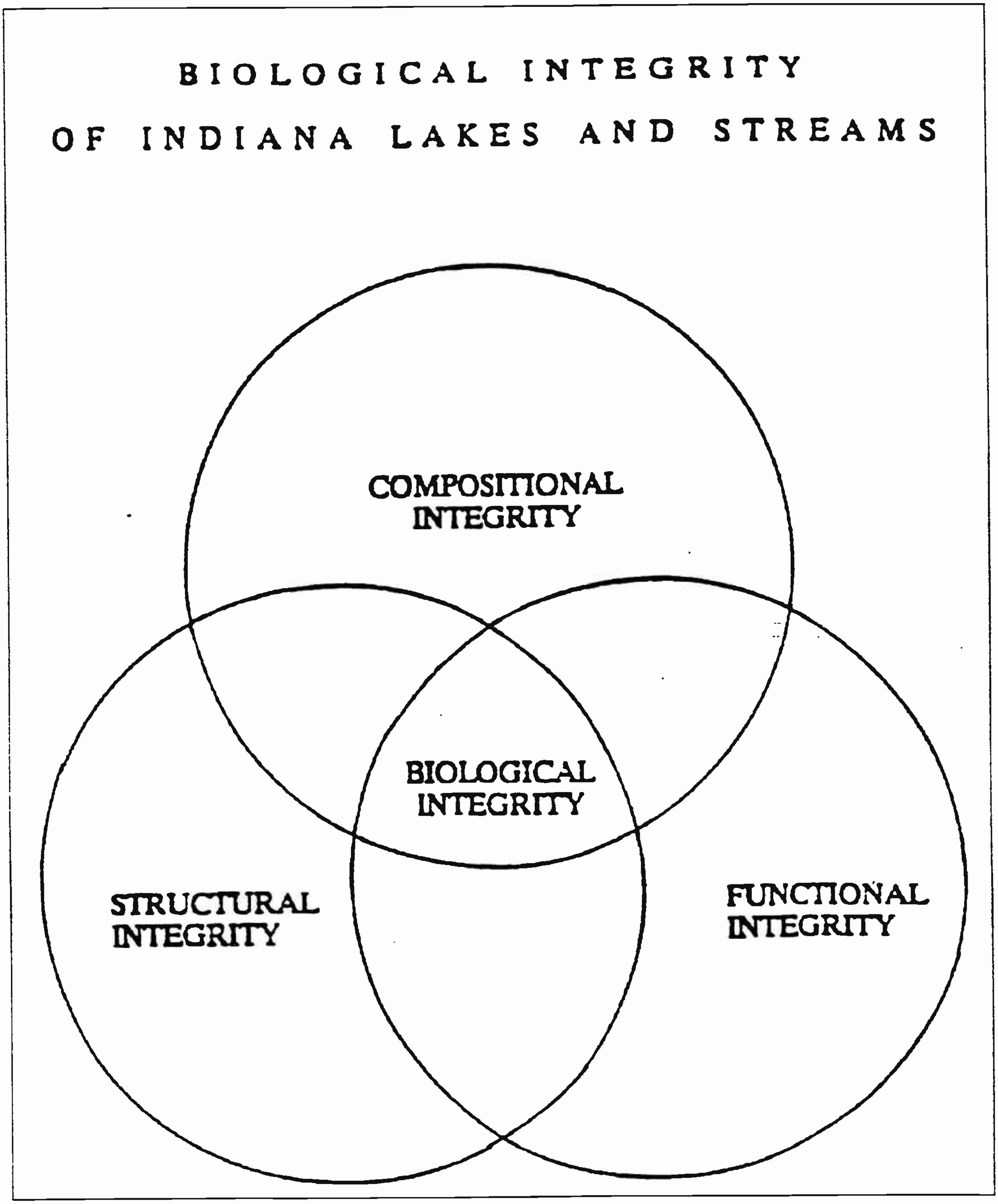
In terms of measuring biological integrity the task becomes the collecting and interpreting of biological information in such a way as to be useful in evaluating the overall biological integrity of some defined segment of the aquatic community. The two aquatic communities typically used in biological assessments are the fish community (201 species within Indiana) and the benthic macroinvertebrate community. While the fish community is well known to the general public, the benthic macroinvertebrate community provides a much more diverse group of animals from which monitoring of ecological integrity can be made. The macroinvertebrate segment of the aquatic community live sedentary lives on the stream bottom and are exposed to all the chemical, physical, and biological stresses imposed on the aquatic system upstream of where they live. Biological integrity also integrates the effects of these stressors over an entire year since the compositional components of the invertebrate community complete their lifecycle under the degree of impairment imposed on them over their lifecycle, which is typically one year.

By their nature, biological measurements are a collective measurement of all stresses on Ecological Integrity. The biological community imprints into its compositional, structural, and functional organization all stresses, not only reflecting the stresses at the immediate site sampled but the collective "ecological integrity" of all aspects of the system upstream. Biological integrity therefore has three community components from which measurements can be made (Figure 17). These three components include: compositional integrity, which is the species composition of the biological community; structural integrity, which is a description of how the numerical abundances of those species are arranged within the community; and functional integrity which is the organizational structure of groups of species having similar functional roles within the biological community. A numerical evaluation of biological community and its biological condition would best be served by incorporating numerical characteristics from each of these three components.

As we approach and enter the 21st century, and as we continue to achieve improvements in the quality of point source discharges within the state, the overall ecological integrity of our streams and rivers will be controlled by more subtle sources of pollution such as non-point pollution. Biological monitoring; which, by its nature integrates the cumulative effects of all environmental stressors, provides an appropriate and timely tool to measure and detect such forms of pollution.

The biological monitoring program also includes the bioassay testing of effluent by this agency, which will be further discussed in the Toxic Monitoring Programs Section.

Figure 17. *Conceptual model of the three components of biodiversity used in deriving metrics for assessing biological integrity of Indiana lakes, rivers, and streams*



Fish Monitoring Program

During the past four year period our agency has been working with USEPA-Region V to establish an extensive and unified effort to evaluate the biological integrity of Indiana rivers and streams using the fish communities which are living within the various waterbodies. The fish communities of the state's rivers and streams are being sampled and a fish community Index of Biotic Integrity (IBI) is being calculated and calibrated specifically for our state (Simon, T.P. 1991, 1992, 1994). This data network will supplement chemical information to document and better understand the long term and cumulative effects of successive perturbations on Indiana waterbodies.

The agency entered into a REMAP project with USEPA, Ohio EPA, and Mich. DNR to evaluate standard sampling methods and site selection to a USEPA REMAP type random sample site selection process using the Eastern Corn Belt Plains of the tri-state area. Indiana's portion of this project included sampling and assessing the fish community at 191 randomly selected sites. The final report for this project is due in 1996. A map of these 1995 sample sites is included (Figure 18) and a corresponding list of the sites sampled can be found in Table 47.

Benthic Macroinvertebrate Program

IDEM personnel have been sampling the benthic macroinvertebrate communities living within Indiana rivers and streams using Rapid Bioassessment Protocols (RBP's) (Plafkin, J.L., et al 1989). These data will be used to provide a long term database to determine and establish a level-of-expectation data set, as well as provide a database from which changes in the biological integrity of our streams can be monitored.

In the last six years, over 3000 benthic macroinvertebrate samples have been collected at 704 different sites on 465 different rivers and streams in Indiana. These sampling sites are presented in Figure 19. At this time over 84 of the state's 92 counties (91%) have been sampled.

This six year project entails a long term commitment of IDEM to accumulating an extensive unified database from which comparisons of ecological integrity can be made at this time and in the future. Constraints on resources, including staffing, necessitates a multi-phase program to provide a scientifically defensible database from which enforcement actions can be made in the future.

Figure 20 presents the stages of an observational ecological study such as this present project (Noy-Meir 1970). Such studies are multivariate and rely heavily on mathematical methods to elucidate and describe patterns in the data with the ultimate goal of correlating these patterns with environmental relationships. As can be seen by their nature, such studies are complex and require a long term commitment to obtain the data which are necessary for acceptable data quality objectives. Data Quality Objectives (DQO's) are qualitative and quantitative statements developed by data users to specify the quality of data needed to support

Figure 18. *Collection sites for the regional environmental monitoring assessment program (REMAP) fish community study 1995*

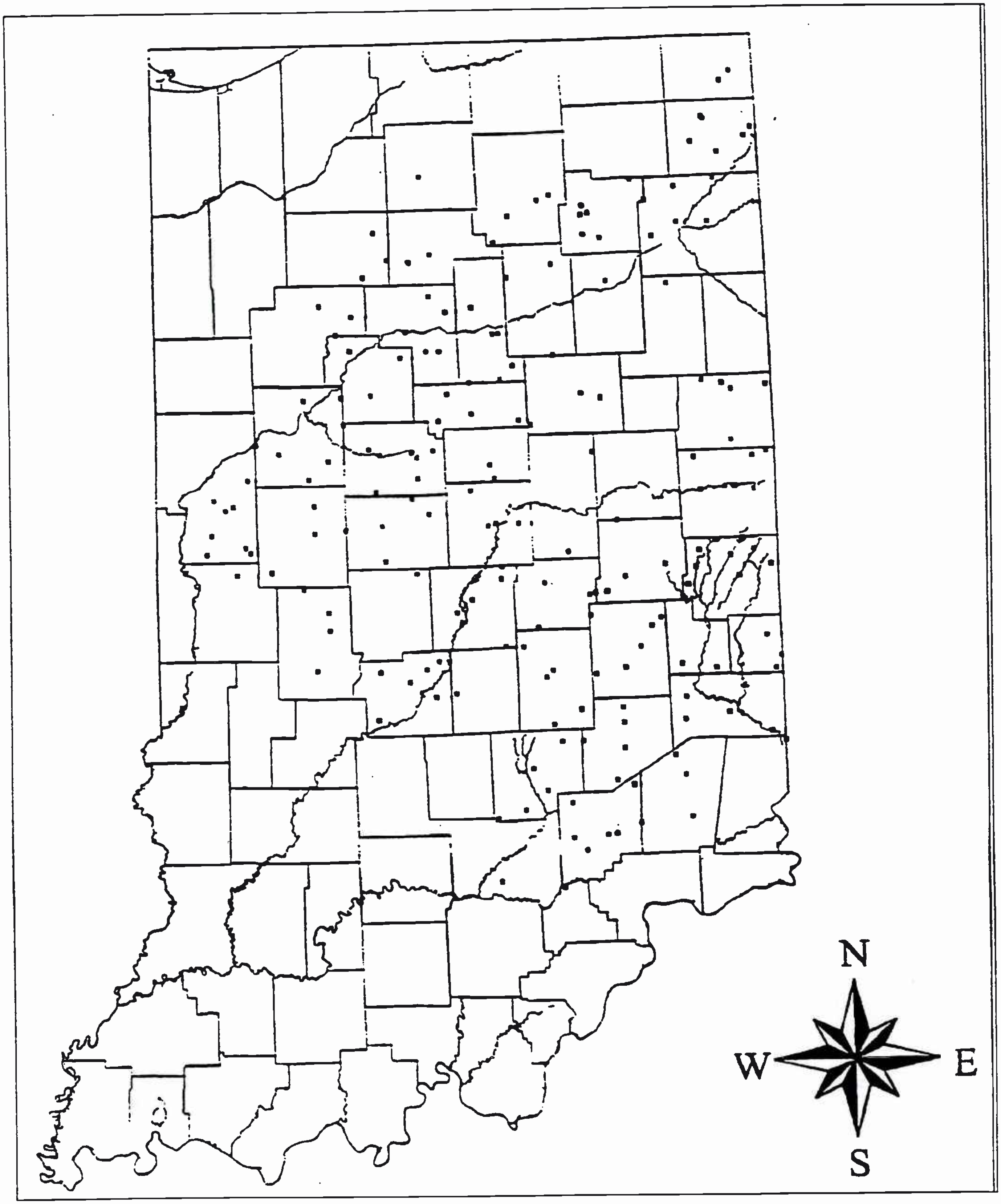


Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995.*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
Adams	Trib. Wabash River	C.R. 400W (200 m D/S)	13Sept95	5120101050	41°6'6.1"/85°2"18.6"	55G	36	5c	6.0
Allen	Bullerman Ditch	Maysville Rd. (300m D/S)	30Aug95	4100005010	41°6"6.1"/85°2"18.6"	55G	19	6	6.0
	Lowther-Neuhaus Ditch	Bulter Rd. (75m U/S)	30Aug95	4100003100	41°6'8.4"/85°10'31"	55G	20	5c	5.0
	Swartz-Carnahan Ditch	Lochner Rd.	30Aug95	4100003070	41°15'12.5"/85°0'20"	55G	20	5c	7.6
	Trib. Aboite Creek	Homestead Rd. (200m D/S)	31Aug95	5120104100	41°3'28"/85°17'12"	55G	35	5c	2.0
	Willow Creek Ditch	Malcolm Rd. (100m D/S)	30Aug95	4100003080	41°13'21.1"/85°10'50"	55G	18	5c	8.5
Bartholonew	East Fork White Creek	C.R 800S (1300m D/S)	29Sep95	5120206040	39°4'19.6"/85°56'16"	55G	84	11b	0.0
	Haw Creek	Columbus Hosp. (D/S Waterworks)	20Jul95	5120205040	39°12'57.9"/85°53'51.2"	55G	74	11a	54.9
	Little Haw Creek	S.R. 9 (75m U/S)	20Jul95	5120205040	39°18'30.9"/85°46'14.1"	55G	74	11b	6.2
	Little Sand Creek	U.S. 31 (300m D/S)	14Jul95	5120206030	39°8'24.4"/85°50'30.1"	55G	74	11a	25.0
	South Fork Creek	S.R. 58 (425m U/S)	20Jul95	5120206040	39°2'44.8"/86°3'43.7"	55G	84	10b	4.8
Boone	Campbell Ditch	C.R. 500N (500m U/S)	20Jul95	5120110010	40°6'31.8"/86°19'28"	55M	48	5b	1.0
	Deer Creek	C.R. 200N (100m D/S)	20Jul95	5120110010	40°4'12.3"/86°32'19.3"	55G	48	5b	7.3
	Grassy Branch	C.R.300W (200m D/S)	20Jul95	5120203010	39°56'45.4"/86°31'38.7"	55M	66	5b	6.0
	Mud Creek	West St. (261 St.) (120m U/S)	22July95	5120110010	40°9'48.6"/86°24'9.4"	55M	48	5b	25.3
Carroll	Rattlesnake Creek	C.R. 700W (95m U/S)	23Jul95	5120105030	40°40'50.4"/86°39'34.4"	55G	40	5B	9.0
	Rock Creek	C.R. 500E (250m D/S)	23Jul95	5120105020	40°39'10.8"/86°26'0"	55M	40	5b	60.0
	Sugar Creek	C.R. 250W (25m D/S)	23Jul95	5120105070	40°31'27.9"/86°34'21.9"	55G	45	5b	2.0
Cass	Rock Creek	C.R. 300E (275m U/S)	26Jul95	5120105020	40°40'29.7"/86°18'46.9"	55M	40	5b	16.1
	Rock Creek	C.R.600E (450m U/S)	26Jul95	5120105020	40°40'27.2"/86°15'10.1"	55M	40	5b	4.0
Cass	Twelve Mile Creek	400m U/S Confl. Goose Creek	26Jul95	5120104070	40°48'44.2"/86°13'5.2"	55G	31	4	46.3

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
	Trib. Wabash River	Longcliff Hospital (400m D/S)	26Jul95	5120104070	40°48'44.2"/86°13'5.2"	55G	31	4	46.3
	W. Branch Twelve Mile Creek	S. R. 16 (50m U/S)	26Jul95	5120104070	40°51'59.9"/86°24'14.4"	55G	31	4	9.0
Clinton	Brush Creek	1-65 (25m U/S)	13Jul95	5120110020	40°11'14.8"/86°17'33.7"	55G	48	5b	13.0
	Kilmore Creek	C.R. 400W (1500m D/S)	13Jul95	5120107040	40°20'12.1"/86°35'19.1"	55M	23	5b	74.6
	Scott Wincoop Ditch	C.R. 400S (450m U/S)	13Jul95	5120110010	40°13'54.9"/86°22'14.3"	55G	48	5b	10.5
	South Fork Wildcat Creek	C.R. 200N (225m U/S)	12Jul95	5120107040	40°18'50.4"/86°32'29.6"	55M	23	5b	74.1
	South Fork Wildcat Creek	C.R.730W (100m U/S)	13Jul95	5120107040	40°18'16.8"/86°22'17.5"	55M	23	5b	12.5
	South Fork Wildcat Creek	Michigantown Rd. (290m U/S)	13Jul95	5120107040	40°19'18.9"/86°23'38.5"	55M	23	5b	21.5
	Swamp Creek	C.R. 1100E (510m D/S)	13Jul95	5120107040	40°19.43.6"/86°17'44.1"	55M	23	5b	16.0
	Trib. Middle Fork Wildcat Creek	Count Line Rd. W. (40m U/S)	13Jul95	5120107030	40°25'24.8"/86°41'37.6"	55G	42	5b	1.2
Dearborn	Kolb Creek	State Line	29Jun95	50800003060	39°17'28.5"/84°49'10"	55G	89	11c	0.2
Decatur	Clifty Creek	C.R. 1050W (500m U/S)	31Jul95	5120206010	39°18'32.3"/85°40'48.7"	55M	74	11b	83.3
	Clifty Creek	C.R. 600N (1500m D/S Kick Site)	19Jul95	5120206010	39°25'13.4"/85°30'7.2"	55M	74	11b	54.4
	Muddy Fork	C.R. 150W (800m U/S)	18Jul95	5120206020	39°22'4/85°30'3.2"	55M	82	11b	11.0
	Panther Creek	C.R. 110S (550m U/S)	13Jul95	5120206020	39°10'14.7"/85°32'19.2"	55M	82	11b	8.0
	Sand Creek	C.R. SW 60 (100m D/S)	18Jul95	5120206020	39°16'51"/85°30'11.5"	55M	82	11b	30.0
Dekalb	Carper Ditch	C.R. 50 (350m D/S0	01Aug95	4100003070	41°20'40.7"/84°58'51.2"	55G	20	5c	1.5
	Dibbling Ditch	C.R. 18	29Aug95	4100003080	41°27'43.9"/85°2'4.3"	55M	18	5c	15.0
	Dibbling Ditch	C.R. 31 (400m D/S)	29Aug95	4100003080	41°28'8.3"/85°2'34.7"	55M	18	5c	16.0
Dekalb	Metcalf Ditch	S.R. 1 (900m D/S)	02Aug95	4100003060	41°23'56.9"/84°51'40.8"	55M	20	5c	9.0

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
	Peckhart Ditch	S.R. 1 (900m D/S)	02Aug95	4100003060	41°23'56.9"/84°51'40.8"	55M	20	5c	9.0
	Trib. Big Run	C.R. 28 (250m D/S)	01Aug95	4100003080	41°25'44.1"/84°49'51.2"	55M	18	5c	1.0
Fayette	S. Branch Garrison Creek	Garrison Rd. (60m off Road)	20Jul95	5080003020	39°33'51.7"/85°14'27.8"	55G	88	11c	10.2
	Trib. Bear Creek	C.R. 725S (1300m U/S)	24Jul95	5080003020	39°32'49.7"/85°5/38.4"	55G	88	11c	0.4
Fountain	Dry Run	C.R. 150N (37m D/S)	24Jul95	5120108090	40°8'46.1"/87°12'1.2"	55G	46	5a	15.0
	Dry Run	East Division Rd (900m U/S)	24Jul95	5120108090	40°7'56.4"/87°14'3.8"	55G	46	5a	17.0
	Flint Creek	County Line Rd. (370m D/S)	24Jul95	5120108020	40°21'265"/87°5'32.7"	55G	43	5a	38.0
	Mill Creek	C.R. 1000S (175m D/S)	25Jul95	5120108120	39°58'50.1"/87°19'10.9"	55G	45	5a	26.4
	Prairie Creek	S.R. 32 (550m U/S)	25Jul95	5120108110	40°2'46.5"/87°17'54.3"	55G	46	5a	5.0
	Trib. Coal Creek	C.R. 140W (100m U/S)	25Jul95	5120108090	40°10'7.2"/87°17'15"	55G	46	5a	0.5
	Trib. Shawnee Creek	C.R. 700E (160m D/S)	24Jul95	5120108090	40°14'0.6"/87°7'54.5"	55G	44	5a	5.3
	Trib. Stillwater Creek	Goff Rd. (500m D/S)	25Jul95	5120110040	39°59'0.3"/87°7'27.2"	55G	47	5a	6.0
	Trib. Sugar Mill Creek	C.R. 800S (1000m D/S)	25Jul95	5120110040	40°0'8.8"/87°8'48.4"	55G	47	5a	7.0
Franklin	Little Salt Creek	Frazer Rd. (50m Off)	30Jun95	5080003030	39°26'57.3"/85°13'45"	55G	88	11c	10.3
	Salt Creek	Stockpike Rd. (1100m U/S)	12Jul95	5080003030	39°22'19.5"/85°14'13"	55G	88	11c	43.4
	Trib. Cranes Run	Seeley Rd. (550m D/S)	11Jul95	5080003060	39°19'23.1"/84°52'37.2"	55G	89	11c	0.2
	Wolf Creek	Wolf Creek Rd.	11Jul95	5080003060	39°23'34.5"/85°2'54.5"	55G	89	11c	4.3
Fulton	Callahan Ditch	175M U/S Confl. Mill Creek	31Jul95	5120106070	40°59'15.8"/86°22/44.3"	55G	28	4	3.5
	Mud Creek	C.R. 325S (325M D/S)	31Jul95	5120106050	40°0'45.7"/86°16'56.3"	55G	29	4	25.5
Grant	Middle Fork	C.R. 1000S (700m D/S)	12Sep95	5120107010	40°24'41.5"/85°51'14.2"	55m	23	5b	11.4

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
	Mississinewa River	Garthwaite Rd. (Imi Gravel Co)	24 Oct95	5120103050	40°31'2.6"/85°37'45"	55M	24	5c	587.0
Grant	Walnut Creek	C.R. 700E (400m D/S)	12Sep95	5120103050	40°29'59.5'/85°32/37.6'	55M	24	5c	27.0
Hamilton	Little Cicero Creek	Dunbar Rd. (180m U/S)	22Jul95	5120201080	40°11'16.6"/86°8'6.9"	55M	58	5b	13.2
	Mallory Granger Ditch	196th St. (175m U/S)	22Jul95	5120201050	40°4'27.2"/86°8'6.9"	55M	63	5b	1.9
	Sly Run	Mill Creek Rd. (40m U/S)	22Jul95	5120201080	40°3'54.9"/86°3'43"	55M	58	5b	7.2
	Stony Creek	Pilgrim Rd. (600m D/S)	22Jul95	5120201050	40°4'81.1"/85°55'17.4"	55M	65	5b	20.8
Hancock	Anthony Creek	Garrison Rd. (200m D/S)	18Sep95	5120204020	39°49'3.1"/85°37'40.1"	55M	79	5b	4.0
	Sixmile Creek	I-70 (420m D/S)	17Aug95	5120204020	39°49'26.2"/85°36'2.2"	55M	79	5b	10.0
	Sugar Creek	Btwn 600N & 500N (100m off)	19Sep95	5120204060	39°51'46"/85°49'11.4"	55M	78	5b	66.0
	Thompson Ditch	C.R. 300W (600m U/S)	06Oct95	5120204060	39°42'16.7"/85°23'15.2"	55M	78	6	6.3
Hendirkcs	White Lick Creek	C.R.1000N (950m U/S)	19Jul95	5120201150	39°54'6.8"/86°23'15.2"	55M	56	5b	21.8
Henry	Duck Creek	C.R. 350S	23Aug95	5120204010	39°52'37.1"/85°28'3.3"	55M	71	5b	26.0
	Fall Creek	C.R. 950N (700m U/S)	03Aug95	5120201100	40°4'27.8"/85°29'30.1"	55M	63	5b	4.9
	Flatrock River	S.R. 38 (50m D/S)	22Aug95	5120201010	39°54'58.9"/85°17'35.7"	55m	71	5b	13.4
	Montgomery Creek	U/S C.R. 750S	21Aug95	5120204010	39°49'36.3"/85°32'55.2"	55M	79	5b	19.9
	Symons Creek	C.R. 950S (90m D/S)	24Aug95	5080003010	39°48'1.9"/85°13'25.7	55M	87	5b	21.0
Howard	Harrison-Harlan Ditch	C.R. 500W (290m D/S)	11Jul95	5120105050	40°31'26.1"/86°13'32.1"	55M	41	5b	6.3
	Honey Creek	C.R. 320S (350m D/S)	12Jul95	5120107020	40°25'48.3"/86°15'58.6"	55M	23	5b	3.8
	Kokomo Creek	U.S. 31 (350M D/S)	11Jul95	5120107010	40°27'15.8"/86°7'8.2"	55M	23	5b	30.1
	Mud Creek	C.R. 300S (910M U/S)	12Jul95	5120107010	40°25'42.1"/85°54'22.3"	55M	23	5b	94.6
Huntington	Flint Creek	S.R. 9/37/24 Bypass (50m Off)	31Aug95	5120104110	40°54'17.2"/85°29/46.1"	55G	35	5c	5.1
Jackson	Mill Creek	Starve Hollow Lake (1100m U/S)	17Jul95	5120207120	38°49'19.8"/86°3'15.5"	55G	83	11c	3.0

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
Jay	Bear Creek	S.R.67/27 (200m D/S)	13Sep95	5120101045	40°30'56"/84°58'30.9"	55M	36	5b	14.5
Jay	Haskins Run	C.R. 75E (600m D/S)	13Sep95	5120102045	40°33'1"/85°5'59.6"	55G	36	5c	4.0
	Trib. Butternut Creek	C.R. 650S (350m D/S)	13Sep95	5120102010	40°20/24.7"/84°59'6.8"	55M	37	5c	0.5
	Trib. Wabash River	C.R. 40S (400m D/S)	13Sep95	5120101040	40°31'51.5"/84°49'39.4"	55G	36	5c	1.0
	Wolf Creek	C.R. 30S (775m D/S)	19Oct95	5120101045	40°32'22"/85°0'49.8"	55G	36	5c	4.0
Jennings	Crooked Creek	C.R. 20N	11May95	5120207020	38°59'7"/85°32'56.5"	55G	76	11b	7.5
	Little Otter Fork	1km D/S Schaped Charged Rd. Jefferson Proving Ground	12Jul95	5120207020	39°1/14.2"/85°26'43.1"	55G	83	11b	8.0
	Nettie Creek	U/S C.R. 750N	11Jul95	5120206030	39°5'43.5"/85°44'15.8"	55M	82	11a	4.5
	North Fork Vernon Fork	C.R. 1225N (1400m D/S)	19Jul95	5120207010	39°9'10.4"/85°28'6.4"	55G	83	11b	38.0
	Otter Creek	C.R. 75E	13Jul95	5120207020	38°58'51"/85°35'24.7"	55G	83	11b	82.5
	Powder Creek	C.R. 400S (800m D/S)	13Jul95	5120207040	38°55'45.2"/85°41'4.3"	55G	83	11a	2.0
	Sixmile Creek	S.R. 50 (30m D/S)	11Jul95	5120207040	38°58'21.4/85°44'8"	55G	83	11b	22.5
Johnson	North Prong Stotts Creek	C.R.700W (140m U/S)	17Jul95	5120201140	39°28'46.4"/86°13'43.3"	55G	64	5b	2.8
Kosciusko	Chippewanuck Creek	C.R. 1250S (200m D/S)	27Jul95	5120104040	41°3'0.9"/85°59'22.1"	55G	30	4	2.5
	Deeds Ditch	Van Ness Rd. (200m D/S)	26Jul95	5120106020	41°12'46.3"/85°43'51.4"	55G	30	4	11.5
	Sloan Ditch	C.R. 450W (225m U/S)	27Jul95	5120106030	41°8'31.7"/85°55'11.8"	55G	30	4	2.0
	Wyland Ditch	C.R. 275E (250m U/S)	27Jul95	5120106020	41°11'42.9"/85°47'10.8"	55G	30	4	11.0
Madison	Lick Creek	C.R. 950S (200m D/S)	05Sep95	512020110	39°58'41.4'/85°35'34.2"	55M	63	5b	15.0
	Pipe Creek	C.R. 1540N (250m D/S)	23Oct95	5120201060	40°18'41.4"/85°35'34.2"	55M	60	5b	31.0
Marion	Eagle Creek	300m U/S Mouth	15Sept95	5120201130	39°43'18.6"/86°11'45.9"	55M	64	5b	210.0
	Fall Creek	College Ave. (120m D/S)	15Aug95	5120201110	39°48'25.1"/86°8'45"	55M	63	5b	310.0
	Fall Creek	Fall Creek Rd. (300m Off)	08Aug95	5120201110	39°52'45.1"/86°0'32.6"	55M	63	5b	243.0

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
Marion	Flat Branch	Maze Rd. (320m D/S)	16Aug95	5120204070	39°38'28.7"/86°0'1.5"	55M	78	5b	2.0
	Little Eagle Creek	S. Of W. Washington St. (200m)	14Aug95	5120201120	39°45'24.6"/86°12'48.7"	55M	57	5b	26.9
	Mud Creek	E. 96th St. (670m D/S)	15Sep95	5120201110	39°55'16.9"/86°0'11.5"	55M	63	5b	39.0
Marshall	Yellow River	W. 13th Rd (300m D/S)	02Aug95	7120001050	41°17'10.3"/86°19'5.1"	55G	13	4	317.8
Miami	Deer Creek	S.R. 18 (850m U/S)	11Jul95	5120105040	40°34'19.3"/85°58'57.6"	55M	41	5c	8.9
	Honey Creek	C.R. 1050S (390m U/S)	11Jul95	5120101160	40°37'6.1"/85°55'26.8"	55M	32	5c	26.9
	Mississinewa River	C.R. 300 (50m off to East)	10Jul95	5120103060	40°43'51.6"/86°0'34.3"	55G	33	5c	812.5
	Mississinewa River	C.R. 340E (350m U/S)	10Jul95	5120103060	40°43'59.8"/85°58'.1"	55G	33	5c	803.4
	South Fork Deer Creek	Cassville, IN (50m Off)	11Jul95	5120105040	40°33'47.6"/86°7'24"	55M	41	5c	22.9
	Trib Eel River	C.R. 100W (700m D/S)	10Jul.95	5120104060	40°49'35.6"/86°6'2.4"	55G	31	5c	1.6
Montgomery	Little Sugar Creek	N.W. of Smartsubrg, IN	20Jul95	5120110020	40°3'3.7"/86°50'9"	55G	48	5a	43.9
	Little Sugar Creek	Terri Ave, Shannondale, 100m D/S	20Jul95	5120110020	40°3'30.3"/86°41'50.5"	55G	48	5b	17.3
	Spencer Branch	C.R. 850S (400m D/S)	20Jul95	5120110030	39°54'52.3"/87°1'57.9"	55M	47	5c	0.3
	Trib. Armentrut D.	Sec 26, Union Twp.	20Jul95	5120110015	40°8'40.8"/86°50'7.9"	55G	48	5b	2.3
Morgan	Fall Creek	Old 67 (100m D/S)	18Jul95	512201170	39°23'32.7"/86°34'48.4"	55G	68	10b	11.5
	Lake Ditch	C.R. 900N (75m U/S)	18Jul95	5120203050	39°33'28.5"/86°34'0.5"	55G	66	5b	15.3
	Stotts Creek	C.R. 250N (300m D/S)	18Jul95	5120201140	39°28'5.5'/86°19'1.1"	55G	64	5b	22.5
	Sycamore Creek	Hill Rd. (850m U/S)	18Jul95	5120201170	39°31'18.7"/86°26'5.1"	55G	64	10b	16.9
	Trib. Sinking Creek	C.R. 1100N (Btwn Pair of Lakes)	18Jul95	5120201140	39°35'32.5"/86°18'4.2"	55G	64	5b	6.0
	White Lick Creek	C.R. 900N (950 U/S)	18Jul95	5120201150	39°33'57.3"/86°21'33.8"	55G	56	5b	280.2
Parke	Trib. Sugar Creek	C.R. 280E (700m Off0	20Jul95	5120110040	39°54'23.9"/87°11'14.7"	55G	47	5a	0.8

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
Pulaski	Bruce Lake Outlet	C.R. 300E (375m U/S)	31Jul95	5120106061	41°5'38.4"/86°32'25.9"	55G	29	3b	18.0
	Dickey Creek	C.R. 100E (600m D/S)	31Jul95	5120106080	40°56'12"/86°35'30.2"	55G	28	3b	2.3
	Mill Creek	C.R. 625E (175m U/S)	31Jul95	5120106070	40°59'48.8"/86°28'49.1"	55G	28	3b	43.9
Putnam	Big Raccoon Creek	S.R. 43/231 (400m U/S)	19Jul95	5120108160	39°51'11.5"/86°53'26.7"	55G	50	5a	126.3
	Big Walnut Creek	C.R. 300N (1050m U/S)	19Jul95	5120203020	39°42'31.6"/86°46'53.5"	55G	66	5a	155.0
	Big Walnut Creek	Rolling Stone Rd. (400m D/S)	19Jul95	5120203020	39°46'16.2"/86°47'7.3"	55M	66	5a	137.4
	Upper Limestone Creek	100m U/S Confl. Lower Lime Creek	20Jul95	5120203040	39°34'2.5"/86°50'24.7"	55G	66	5a	5.4
Randolph	Jordon Creek	C.R. 950N (400m D/S)	19Oct95	5120103010	40°17'57.9'/84°50'23.7"	55M	39	5c	7.5
	Mississinewa River	C.R. 400E (50m D/S)	07Sep95	5120103010	40°17'5"/84°54'5.8"	55M	39	5c	84.2
	Mississinewa River	S.R. 1 (325m D/S)	31Aug95	5120103020	40°17'1.8"/85°8'59.3"	55M	39	5c	212.0
	Salt Creek	D/S 4th Street	02Aug95	5120201010	40°10-44.4"/84°58'39.1"	55M	62	5b	6.8
	West Fork White River	C.R. 200W (450m D/S)	06Sep95	5120201010	40°10'49.2"/85°1'20.2"	55M	62	5b	62.0
	West Fork White River	C.R. 400E (975m D/S)	06Sep95	5120201010	40°10'1.1"/84°54'2.1"	55M	62	5b	13.5
	West Fork White River	S.R. 1 (50m U/S)	02Aug95	5120201010	40°10'13.9"/85°7'37.6"	55M	39	5b	52.0
Ripley	Laughery Creek	C.R. 250S	17Jul95	5090203110	39°2'11.3"/85°13'30.2"	55G	93	11c	172.0
	Laughery Creek	C.R. 650N (2200m U/S)	18Jul95	5090203110	39°10'55.8"/85°14'47.4"	55G	93	11c	117.0
	Walnut Fork	220m U/S Confl. Laughery Creek	18Jul95	5090203110	39°15'5"/85°17'16.3"	55G	93	11c	5.1
Rush	Conns Creek	C.R. 900W	12Oct95	5120205020	39°32'11.9"/85°36'46.8"	55M	81	5b	50.0
	Flatrock River	C.R. 150N (440m D/S)	13Oct95	5120205020	39°37'45.4"/85°24'59.7"	55M	80	5b	158.0
	Flatrock River	C.R. 200N (320m D/S)	17Oct95	5120205020	39°33'29.4"/85°29'3.7"	55M	72	5b	186.0
	Flatrock River	C.R. 650N (>600m D/S0	14Sep95	5120205010	39°42'8.1"/85°21'53.1"	55M	80	5b	64.5
	Shawnee Creek	C.R.800N (200m U/S)	13Oct95	5120205010	39°43'48.3"/85°19'23.8"	55m	80	5b	14.0

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
Rush	Sixmile Creek	C.R. 900N (200m Off)	18Sep95	5120209010	39°44'37"/85°37'35.8"	55M	79	5b	32.5
Scott	White Oak Branch	C.R. 50W (175m U/S)	10Jul95	5120207070	38°47'54.8"/85°47'3"	55G	76	11a	22.0
Shelby	Deprez Ditch	Boggstown Rd. (700m D/S)	12Oct95	5120204050	39°31'482"/85°49'37.1"	55G	79	5b	6.9
	Deprez Ditch	C.R. 200N (75m U/S)	21Jul95	5120204050	39°33'13.7"/85°47'50.7"	55G	79	5b	4.5
	Flatrock River	River Rd. (50m Off)	27Jul95	5120205040	39°24'59.2"/85°41'2.6"	55M	81	11b	388.0
	Sugar Creek	C.R. 750W & 800N (200m Off)	29Sep95	5120204060	39°38'15.5"/85°55'18.5"	55M	78	5b	133.0
	Sydney Branch	C.R. 125W (130m U/S)	21Jul95	5120205040	39°21/52.5"/85°48'8.1"	55M	81	11a	1.5
Steuben	Jack Ditch	US 20 (700m U/S)	01Aug95	40500001080	41°37'489"/84°54'27.4"	55G	7	4	1.0
	Pigeon Creek	Hanselman Rd. (1450m D/S)	02Aug95	40500003080	41°35'41.6"/84°57'6.1"	55G	20	4	42.0
Tippecanoe	Burntt Creek	S.R. 43 (400m D/S)	27Jul95	5120108020	40°30'39.1"/86°52'18.3"	55G	43	5b	26.1
	Lauramie Creek	8S Rd. (425m D/S)	27Jul95	5120107040	40°17'54"/86°46'6"	55G	23	5b	7.2
	Sugar Creek	C.R. 700N (50m Off)	27Jul95	5120105070	40°31'5.2"/86°42'5.6"	55G	43	5b	18.4
	Trib. Of Flint Creek	South Rd. (700m D/S)	27Jul95	5120108020	40°19'28.7"/86°59'20.1"	55G	43	5b	2.3
	U.N. Trib. Stock Farm D.	C.R.? (900m D/S)		5120108010	40°14'5.1"/86°51'23.5"	55G	43	5b	0.5
Tipton	Buscher Ditch	C.R. 50W (270m U/S)	12Jul95	5120201080	40°13'38.4"/86°1/31.9"	55M	58	5b	5.3
	Cicero Creek	S.R. 19 (City Park, 30m Off)	12Jul95	5120201080	40°16'23,8".86°2'38.4"	55M	58	5b	80.3
Union	Charlottsville Creek	N.E. Charlottsville (>500m U/S)	28Aug95	5080003100	39°32'25.1"/84°50'51.9"	55G	89	5b	0.1
	Little Four Mile Creek	State Line (1200m U/S)	25Jul95	5080003090	39°35'4.5"/84°52'40.5"	55G	89	5b	24.2
	Nutter Creek	C.R. 250E (300m U/S)	25Jul95	5080003050	39°39'22.3"/84°52'40.5"	55G	86	5b	6.6
Wabash	Metochinah Creek	County Line Rd. (600m D/S)	12Sep95	5120103060	40°39'9.9"/85°44'34.4"	55M	33	5c	15.5

Table 47. *Collection sites for the Regional Environmental Monitoring Assessment Program (REMAP) fish community study 1995 (cont.)*

COUNTY	STTE	LOCATION	DATE OF COLECTION	HYDROLOGIC UNIT	LATITUDE/ LONGITUDE	ECO-RETION	DRAINAGE SEMENT	IASNRI	DRAINAGE AREA (SQ. MI.)
	Pony Creek	C.R. 1000N	11Sep95	5120104040	40°58'13.4"/85°44'8.6"	55G	34	5c	22.7
	Squirrel Creek	Harman Rd. (200m D/S)	12Sep95	5120104050	40°55'37.6"/85°56'3.7"	55G	31	5c	31.9
Wayne	Boro Brook	Inke Rd. (40m D/S)	29Aug95	51080003050	39°54'20.8"/84°50'38.9"	55M	86	5b	0.4
	Greens Fork	Lewis Road (100m Off)	01Aug95	5080003010	39°56'24.7"/85°0'39.5"	55M	87	5b	50.4
	Lick Branch	Goose Haven Rd (300m D/S)	30Aug95	5080003010	39°50'30.2"/85°11'48.3"	55M	87	5b	8.7
	Nettle Creek	D/S Washington Street	27Jul95	5080003010	39°54'9"/85°9'40.7"	55M	87	5b	20.9
	Nolands Fork	King Road (90m D/S)	29Aug95	5080003020	39°52/9.6"/84°58'40.8"	55G	87	5b	40.0
	Slow Run	900W Aka North Street	26Jul95	5080003020	39°57'39.5"/84°54'51.8"	55M	87	5b	6.2
	Symons Creek	Heacock Rd. (100m U/S)	30Aug95	5080003010	39°47'35.1"/85°12'56.7"	55M	87	5b	22.1
	Whitewater River	U/S Cheesman Road	26Jul95	5080003010	39°57'35.5'/85°8/40.9"	55M	87	5b	20.0
Wells	Eightmile Creek	C.R. 1000N (450m D/S)	13Sep95	5120101110	40°53'27.7"/85°13'59"	55G	35	5c	40.0
White	Pike Creek	C.R. 1150E (50m U/S)	28Jul95	5120105021	40°48'3.2"/86°38'57.1"	55G	28	3b	23.0
	Rattlesnake Creek	C.R. 100S (230m U/S0	28Jul95	5120105021	40°44'18.7"/86°43'8.1"	55G	40	3b	4.7
	Trib.Tippicanoe R.	C.R. 650N (800m U/S)	28Jul95	5120105090	40°50'28.4"/86°47/20.2"	55G	28	3b	3.2
Whitley	Betzner Branch	Trail Rd. (700m U/S)	26Jul95	5120104030	41°8'50.6"/85°33'58"	55G	34	5c	1.0
	Blue River	US 33 (150m D/S)	25Jul95	4100003020	41°15'25.9"/85°22'21.2"	55G	34	5c	20.0
	Eel River	County Line Raod East (350m D/S)	25Jul95	4100003010	41°11'4.8"/85°18'49.3"	55G	34	5c	44.0
	King Branch	C.R. 150S/5.75qw (50m U/S Confl.	25Jul95	5120104030	41°8'20"/85°35'47.5"	55G	34	5c	1.5
	Schuman Ditch	S.R. 30 (1320m D/S)	25Jul95	5120104030	41°10'17.1"/85°35'23.9"	55G	34	5c	5.5
	Sugar Creek	S.R. 14 (850m D/S)	26Jul95	5120104030	41°4'13.6"/85°35'25.6"	55G	34	5c	31.0
	Sugar Creek	Washington Road (600m D/S)	26Jul95	5120104030	41°3'18.5"/85°30'55.6"	55G	34	5c	27.0

Figure 19. *Benthic macroinvertebrate sampling sites sampled from 1990 - 1995*

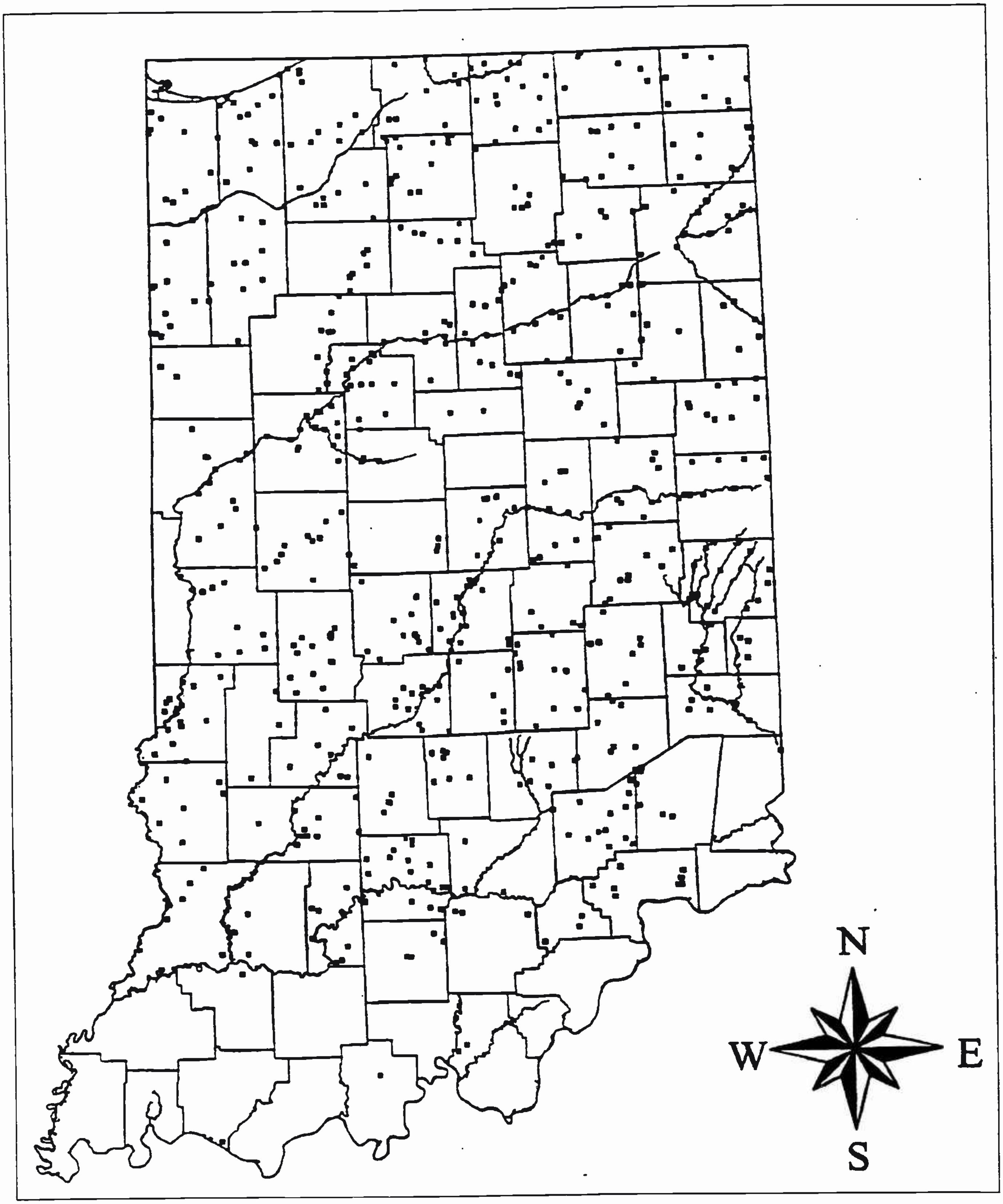
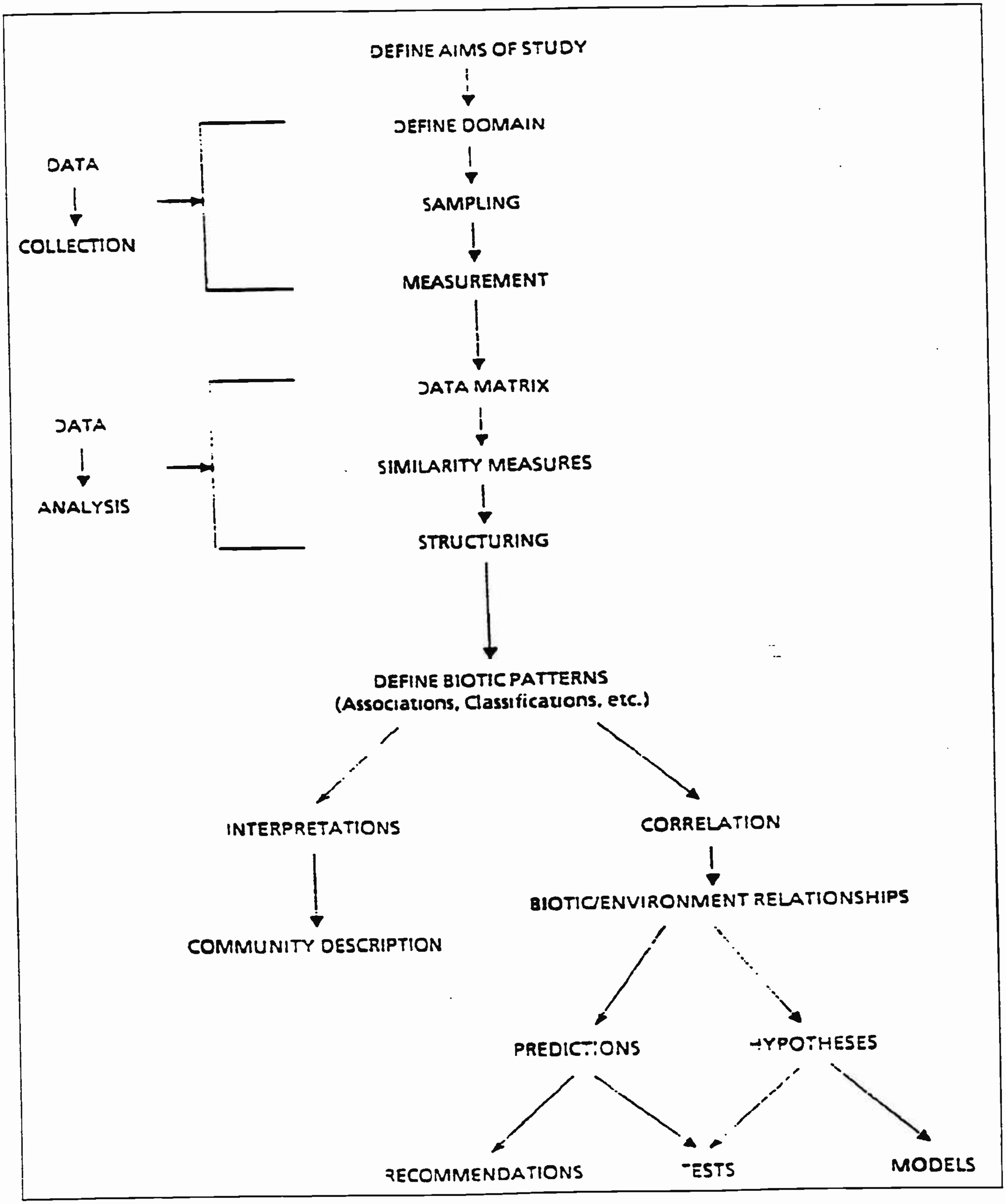


Figure 20. *IDEM biocreiteria development stages*



specific decisions. The IDEM macroinvertebrate program, as stated earlier, is a six year project just to complete the field sampling. The collections made each year, once these samples are enumerated and taxonomically processed and entered into our computer database, stand as an independent data set allowing analysis to proceed at multiple levels. This results in useable data for enforcement and management decision making; once each year's data set has been collected, processed and analyzed. Applicability and refinement of this data set, and thus its usability, increases as the project progresses.

The RBP III study utilizes the benthic macroinvertebrate communities which live within Indiana rivers and streams. Only a general overview of the experimental design and standard operating procedures (SOP's) being used in this project can be presented here. Biological samples, which require several thousand fragmentations of each original sample result in a QA/QC challenge and rely heavily on strict sample labeling and tracking protocols. Only a general overview of these protocols can be addressed in this report. A complete QA/QC overview can be found in the project Quality Assurance Project Plan (QAPP) (IDEM 1994a).

Data collection consists of sampling streams or rivers to obtain a representative benthic macroinvertebrate riffle-community sample using a standard kick-screen sampling device. Two 1 square meter samples are composited into one sample, which is preserved in the field. A second sample of the Coarse Particulate Organic Matter (CPOM) community is also obtained at each site and preserved. These two samples are returned to the laboratory for sorting and processing. Quality control procedures require a 10% field duplicate rate, so for every ten sites duplicate KICK and CPOM samples are collected.

Samples are logged into a data tracking, labeling, and report-generating computer system designed for this project called MACROTRAK. Samples are logged into the system as soon as the field notebook is returned to the laboratory. Laboratory processing consists of sub-sampling each field sample. This sub-sampling results in two sub-samples for each field sample, which are designated 100-ORG and 15-MIN sub-samples. Laboratory duplicates are also carried out on 10% of the field samples and are flagged with the addition of 0.5 on the MACROTRAK sample number. The complete descriptions and methods can be found in the Biological Studies Section Standard Operating Procedures Manual (IDEM 1992).

As stated earlier, this procedure has resulted in over 3,000 sub-samples for the 465 sites sampled to-date. These sub-samples are further fragmented within a two phase taxonomic identification and enumeration procedure. Phase I processing consists of curation of sub-samples into 15 artificial groups; roughly along ordinal level taxonomic lines. Identifications and enumerations are made at the family taxonomic level. These family level identifications and counts are entered into a database for a preliminary round of community and biotic integrity metrics for preliminary site classification and analysis. Phase II involves the completion of all identifications to the lowest taxonomic level possible for all specimens collected. This two phase approach to specimen identification allows the greatest control over the QA/QC problems associated with non-continuity of taxonomic identification. This problem is minimized since all identifications within a homogeneous taxonomic group are completed by one taxonomist.

Family level identifications (Phase I) has provided data, in the course of the development of this program, usable for preliminary assessment, classification, and screening of sites to detect biological impairment. Figures 21 and 22 summarize the results of this project to-date and demonstrate how biological integrity measurements, in this case a provisional Macroinvertebrate Index of Biotic Integrity (mIBI), can be used to evaluate "ecological integrity" of the 704 sites sampled on the 465 rivers and streams sampled so far.

The provisional mIBI is a provisional index developed to evaluate the condition of the sites sampled to-date and to evaluate a series of ten preliminary sub-metrics prior to the completion of a statewide classificatory database. The provisional mIBI allows the classification of the family level information collected at each site to be evaluated on a 0-8, scale with 0 representing a severely impaired biological condition and 8 representing an unimpaired biological condition. The scoring criteria for each of the ten family level metrics were derived by using pentasection (Metric Scores= 0, 2, 4, 6, or 8) of the 95th percentile and the minimum value range (using nlog x or nlog x+1) of the individual metrics for the 1990-1992 riffle kick samples. The mIBI is the average score of the sum of the ten family level metrics using these derived scoring criteria. The complete derivation and explanation of this procedure is presented in IDEM 1994b. The four impairment categories (Figures 21 and 22) were determined after scoring each sample relative to its mIBI. The horizontal categorical lines in Figure 21 delimit the four impairment categories for biological condition and the vertical lines delimit these categories in Figure 22. Figure 21 shows the extant database for Indiana, showing the QHEI habitat assessment as a function of the biological condition of the site as represented by the mIBI.

Barbour and Stribling (1990) propose a theoretical relationship between ambient stream biological communities when compared to reference condition. The statistical nature of the IDEM data set has allowed us to use this relationship and examine Indiana data. The proposed relationship (Barbour and Stribling 1990) suggests that a sigmoid relationship defines three general outcomes when measuring ambient biological condition when examined against habitat condition: 1) no biological effects, or effects due to habitat degradation, on the curve; 2) effects due to water quality, below the curve or 3) an artificial elevation of the perceived condition of the community beyond the expected relationship because of mild enrichment effects, above the curve. The relationship expressed in Figure 21 allows all biological samples and sites to be classified relative to this model. It results in four possible biologically measurable impairment categories and three habitat categories:

Biological Categories

1. Nonimpaired
2. Slightly Impaired
3. Moderately Impaired
4. Severely Impaired

Figure 21. *The QHEI habitat score versus the provisional mIBI classification categories and theoretical relationship of biotic condition and habitat quality using the 1990 - 1992 benthic macroinvertebrate data*

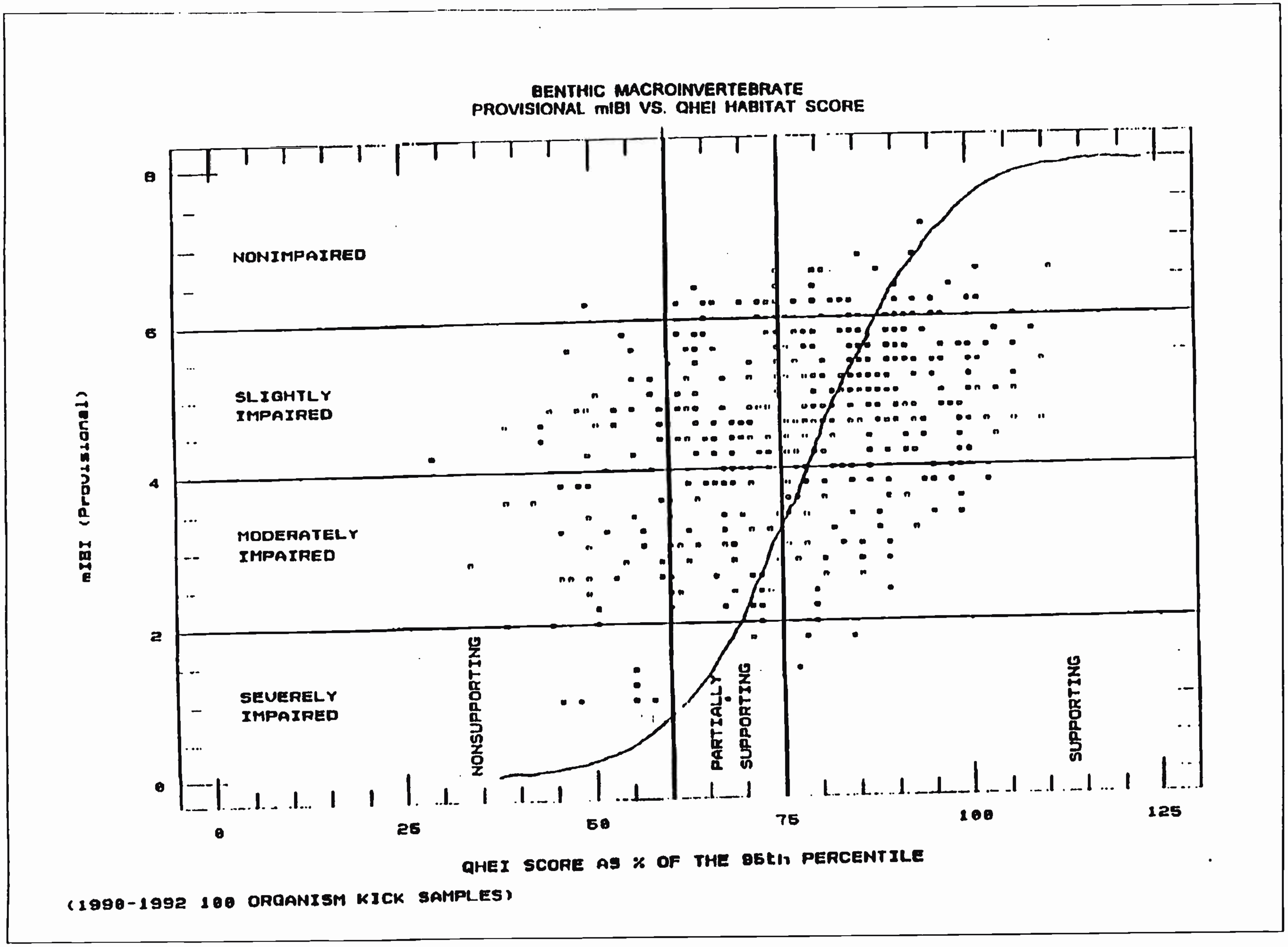
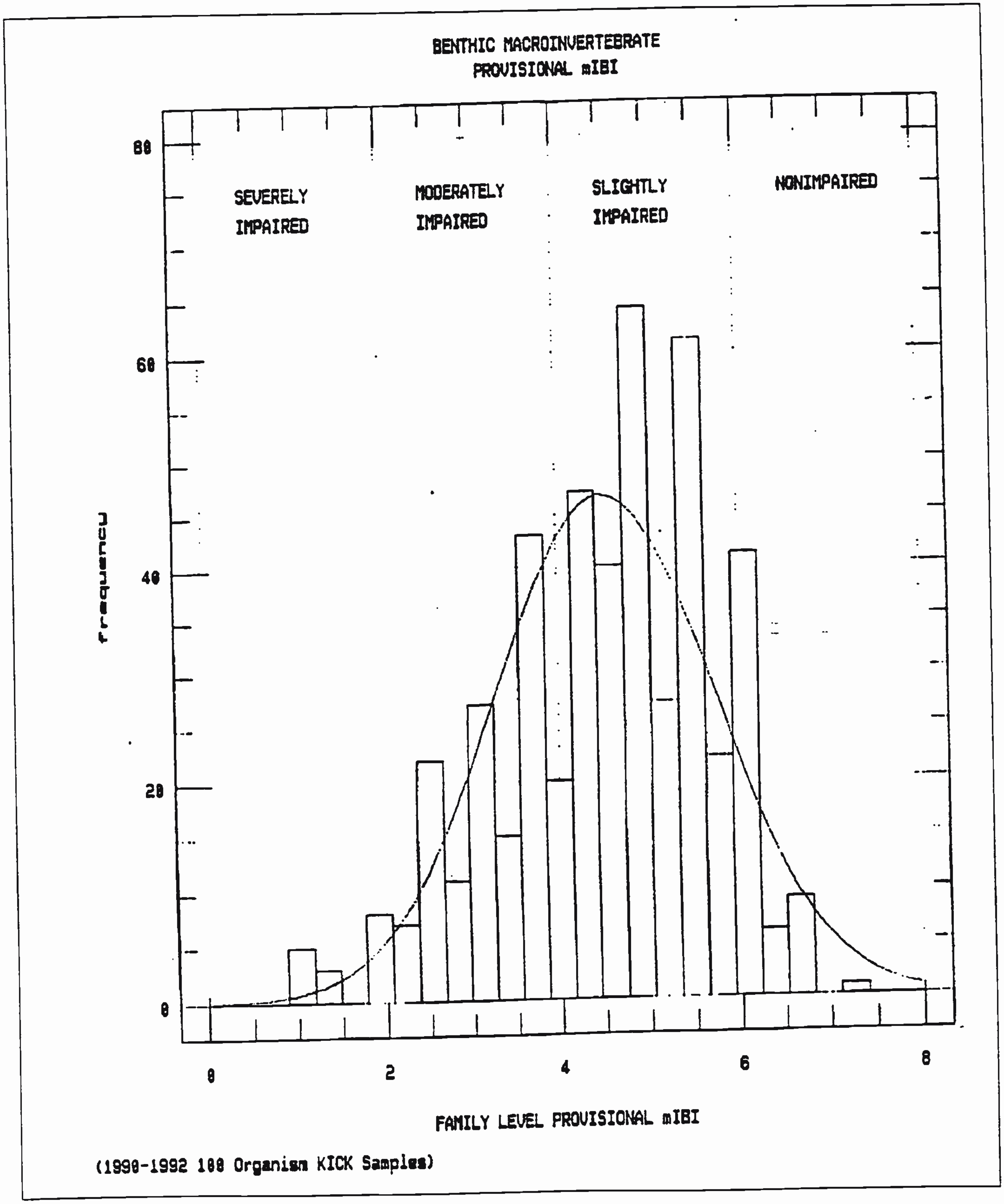


Figure 22. *The distribution of the biotic condition of Indiana benthic macroinvertebrate samples using a provisional mIBI multimetric and the 1990 - 1992 100 organism kick samples*



Habitat Categories

1. Supporting
2. Partially Supporting
3. Nonsupporting

For comparative purposes the QHEI habitat score in Figure 21 is expressed as percent of reference condition which, in this case, is the 95th percentile of the QHEI (QHEI=83). The "theoretical" sigmoid curve in this figure was determined by deriving the empirical ratio of the mIBI/QHEI, expressed as a cumulative frequency curve and positioned relative to the geometric mean of the QHEI. The QHEI classification categories are bounded by the geometric mean of the QHEI scores and less one log-normal standard deviation below the mean. This range is designated as "partially supporting," while the area above is designated "supporting" and the area below as "nonsupporting" relative to habitat. As can be seen in Figure 22, the "typical" sample found within the state to-date presents a "slightly impaired" condition. The habitat score or condition is then used to modify and/or explain the biological condition. Those sites which are "moderately" and "severely impaired" biologically are of concern. The sites which are in these two categories are of particular concern if the habitat quality is "partially supporting" to "supporting"; since the Barbour and Stribling model (1990) would suggest that they are biologically impaired due to water quality impairment such as toxicant(s) or organic pollution effects.

Using this technique, it is possible to screen those samples and sites which are biologically impaired and target these watersheds for further investigation. It is important to remember that a biological measurement is a collective measurement of all aspects of the "ecological integrity" (Figure 16), not only of the site sampled but to some degree as reflection of the collective ecological integrity of all stressors upstream of the site being evaluated. The sites sampled in 1993, due to staffing and other priorities, are yet to be processed within the laboratory, though they have been sampled. Figure 23 presents the benthic macroinvertebrate sites sampled during 1994-1995. Table 48 provides a list of all sites and samples collected during the period of this report (1994-1995).

It should be noted that in using a family level provisional mIBI, "cold water" effects can theoretically reflect a toxic type impairment signature. Thus, sites screened by this method, and showing impairment, should be evaluated for the possibility of an in-stream coldwater biological community effect due to natural groundwater or spring fed habitat. Future sub-metrics or lower level taxonomic considerations should isolate these "false positive" signatures.

Family level identifications (Phase I) have been shown to provide biological data adequately sensitive for the detection of gross biological perturbations in the biological community. Phase II identifications will provide the data sensitivity to identify subtle differences in the biological integrity of the sites and systems sampled. Final metric development from which correlations and predictive relationships, among all

Figure 23. *Macroinvertebrate sampling sites sampled from 1994 - 1995*

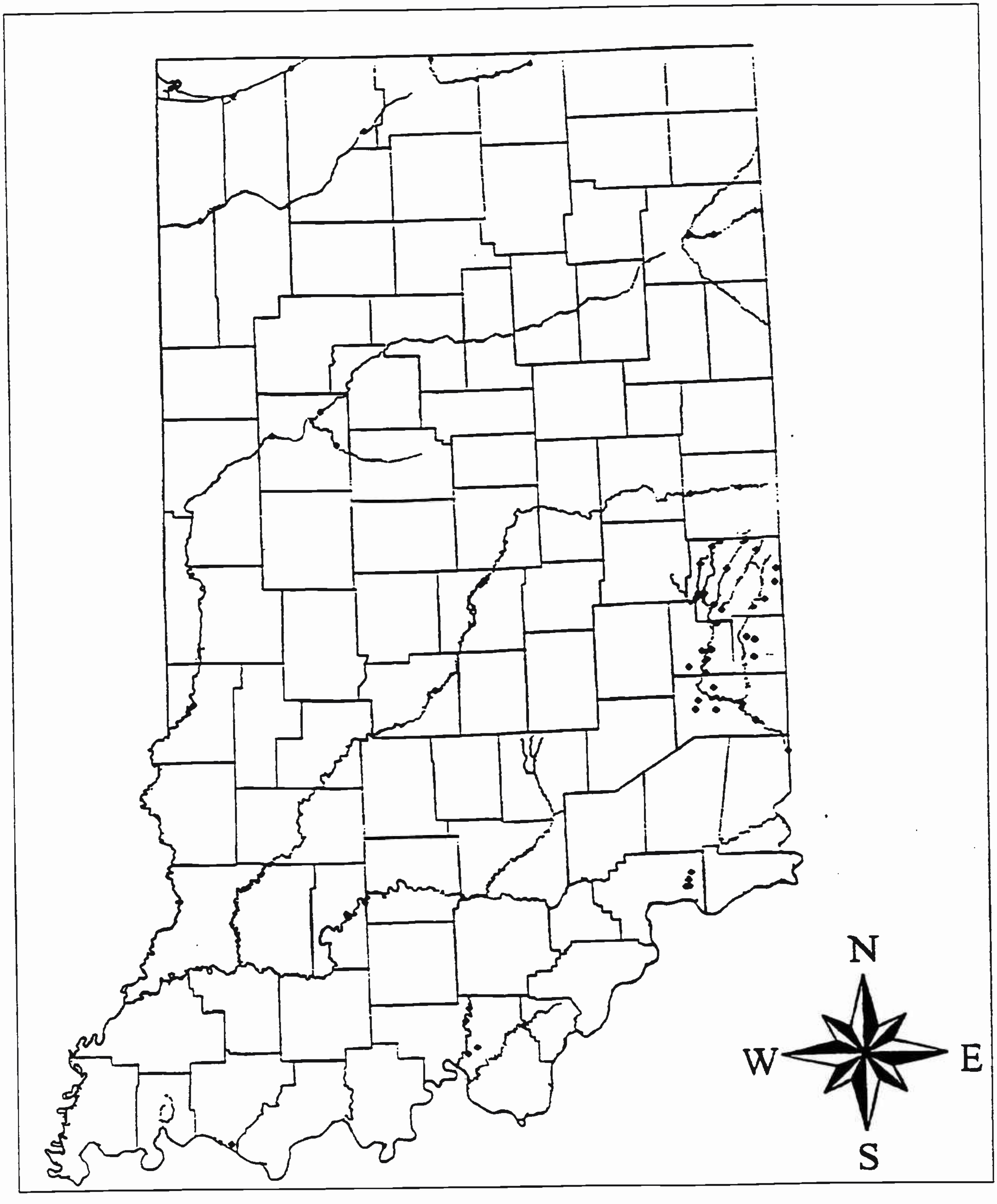


Table 48. *Aquatic macroinvertebrate sampling locations for 1994 - 95*

COUNTY SITE LOCATION	DATE OF COLLECTION	HYDOLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI	DRAINAGE AREA (sq. mi.)
Allen Co. Maumee River U/S Landin Rd.	14-Sept-1994	04100005010	41° 5' 5.0"/ 85° 1' 19.0"	55G	19	6	1967.0
St. Joseph River Tennessee Ave. Bridge	14-Sep-1994	04100003100	41° 5' 21.0"/ 85° 7' 46.0"	55G	20	5C	1086.0
St. Mary's River Spy Run Bridge	14-Sep-1994	04100004060	41° 5' 2.0"/ 85° 8' 9.0"	55G	21	5C	839.0
Crawford Co. Blue River U/S Milltown (Totten Ford Brg)	17-Oct-1995	05140104130	38° 22' 38.0"/ 86° 15' 35.5"	71M	96	9B	358.0
Dearborn Co. Whitewater River Harrison Rd.	26-Aug-1994	05080003060	39° 15'5.0"/ 84° 49' 25.0"	55G	89	11C	1368.8
Elkhart Co. St. Joseph River Congdon Park, Bristol, In	15-Sep-1994	04050001240	41° 43'20.0"/ 85°49' 6.0"	56G	8	4	2444.0
Fayette Co. Bear Creek Ott Rd.	01-Aug-1994	05080003020	39° 31'56.0"/ 85° 9'23.0"	55G	88	11C	542.0
South Fork Garrison Cr. James Rd.	03-Aug-1994	05080003020	39° 33' 12.0"/ 85° 13' 47.0"	55G	88	11C	8.0
Village Creek S.R. 1	03-Aug-1994	05080003020	39° 36' 55.0"/ 85° 7' 41.0"	55G	88	11C	16.1
Whitewater River C.R. 440N C.R. 480S	01-Aug-1994 01-Aug-1994	05080003020 05080003020	39° 42'19.0"/ 85° 5' 53.0" 39° 34'24.0"/ 85° 9'23.0"	54G 55G	87 88	11C 11C	310.0 528.0
Williams Creek C.R. 225S	01-Aug-1994	05080003020	39° 36' 36.0'/ 85° 10' 2.0"	55G	88	11C	44.9
Wilson Creek C.R. 50W	03-Aug-1994	05080003020	39° 34'48.0"/ 85° 8' 51.0"	55G	88	11C	5.1
Franklin Co. Duck Creek @ Jim Run	02-Aug-1994	05080003040	39° 28'45.0"/ 85° 7' 37.0"	55G	88	11C	22.1

Table 48. *Aquatic macroinvertebrate sampling locations for 1994 - 95* (cont.)

COUNTY SITE LOCATION	DATE OF COLLECTION	HYDOLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI	DRAINAGE AREA (sq. mi.)
East Fork Whitewater River S.R. 252	25-Aug-1994	05080003050	39° 25' 3.0"/ 85° 0' 18.0"	55G	86	11C	381.8
Little Salt Creek Bridge U/S Confluence Salt Cr.	02-Aug-1994	05080003040	39° 26' 12.0"/ 85° 11' 40.0"	55G	88	11C	24.8
Pipe Creek Pipe Cr. Rd. (Sec 18 T11N R 13E)	02-Aug-1994	05080003040	39° 24' 3.0"/ 85° 7' 9.0"	55G	88	11C	56.5
Salt Creek Bull Fork Rd.	02-Aug-1994	05080003040	39° 24' 15.0"/ 85° 12' 25.0"	55G	88	11C	79.1
Whitewater River 6th St Bridge, Brooksville,In Franklin Co. Conservation Club S.R.1	02-Aug-1994 26-Aug-1994 26-Aug-1994	05080003060 05080003040 05080003060	39° 25' 24.0"/ 85° 0' 56.0" 39° 24' 21.0"/ 85° 0' 43.0" 39° 21' 38.0"/ 84° 57' 13.0"	55G 55G 45G	88 89 89	11C 11C 11c	837.0 1283.5 22.7
Harrison Co. Blue River D/S Confluence Harrison Spring D/S Milltown, In D/S WWTP State Stop Compground	12-Oct-1995 12-Oct-1995 12-Oct-1995	05140104140 05140104130 05140104140	38° 14' 17.0"/ 86° 13' 46.0" 38° 20' 6.5"/ 86° 16' 30.0" 38° 12' 54.0"/ 86° 16' 12.0"	71M 71M 71M	96 96 96	9B 9B 9B	475.0 412.0 490.0
Jefferson Co Brushy Fork Bridge at Mouth	08-Sep-1994	05140101030	38° 47' 25.0"/ 85° 16' 9.0"	71G	98	11C	15.3
Indian Kentucky Creek E. Prong Rd. Ford Lonnis Hill Rd.	08-Sep-1994 08-Sep-1994	05140101030 05140101030	38° 48' 45.0"/ 85° 16' 13.0' 38° 50' 21.0"/ 85° 15' 37.0"	71G 71G	98 98	11C 11C	56.0 50.0
W.F. Indiana Kentucky Cr. Manville, IN	08-Sept-1994	05140101030	38° 47' 19.0"/ 85° 16' 59.0"	71G	98	11C	46.0
Lake Co Indiana Harbor Canal Dickey Rd. Bridge	16-Sep-1994	04040001020	41° 39' 17.0"/ 87° 27' 31.0"	54G	1	2B	30.0
Kankakee River U/S S.R. 55, Shelby, IN	16-Sep-1994	07120001160	41° 10' 57.0"/ 87° 20' 24.0"	54G	14	3C	1779.0

Table 48. *Aquatic macroinvertebrate sampling locations for 1994 - 95* (cont.)

COUNTY SITE LOCATION	DATE OF COLLECTION	HYDOLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI	DRAINAGE AREA (sq. mi.)
LaPorte Co. Kankakee River U/S Kingsbury F&W Boat Ramp	15-Sep-1994	07120001010	41° 29' 25.0"/ 86° 34' 52.0"	54G	12	3C	354.0
Trail Creek IDNR Ramp, Michigan City, IN	15-Sep-1994	04040001070	41°43' 18.0"/ 86° 54' 22.0"	56G	4	2C	59.1
Marion Co. Indianapolis Water Canal Broad Ripple	13-Oct-1995	05120201110	39° 52' 16.0"/ 86° 8' 32.0"	55G	65	5B	1230.0
Morgan Co. West Fork White River D/S Henderson Ford Bridge	13-Oct-1995	05120201140	39° 29' 56.0"/ 86° 21' 20.0"	55G	64	5B	2123.0
Porter Co. Burns Ditch Midwest Trucking Bridge	16-Sep-1994	04040001050	41° 37' 20.0"/ 87° 10' 34.0"	56G	3	2C	331.0
Randolph Co. West Fork White River C.R. 1100W, 120M U/S S.R. 27	13-Jul-1995 10-Oct-1995	05120201010 05120201010	40° 9' 59.0"/ 85° 11' 1.5" 40° 10' 55.5"/ 84° 58' 8.0"	55G 55M	62 62	5B 5B	118.0 35.6
Spencer Co. Anderson River Sec. 18 T5S, R3W	13-Sept-1994	05140201100	38° 42' 33.0"/ 86° 45' 44.0"	71G	95	7C	5.9
St. Joseph Co. St. Joseph River U/S Auten Rd., South Bend, IN	15-Sep-1994	04050001340	41° 44' 40.0"/ 86° 16' 20.0"	54G	8	4	3659.0
Tippecanoe Co. South Fork Wildcat Creek S.R. 38	16-Jun-1995	05120107040	40° 22' 32.0"/ 86° 45' 7.5"	55G	23	5B	230.0
Wabash River D/S Granville Bridge S.R. 225	11-Oct-1995 11-Oct-1995	051200108020 051200105070	40° 24' 40.0"/ 87° 2' 14.0" 40° 29'42.5"/ 86° 49' 20.0"	55G 55G	43 43	5B 5A	7489.0 6398.0
Union Co. Hanna Creek S.R. 101	25-Aug-1994	05080003050	39° 34' 59.0"/ 84° 56' 47.0"	55G	86	5B	160.2

Table 48. *Aquatic macroinvertebrate sampling locations for 1994 - 95* (cont.)

COUNTY SITE LOCATION	DATE OF COLLECTION	HYDOLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI	DRAINAGE AREA (sq. mi.)
Hanna Creek S.R. 101	25-Aug-1994	05080003050	39°34' 59.0"/ 84° 56' 47.0"	55G	86	5B	160.2
Richland Creek Brownsville Rd.	25-Aug-1994	04040001070	39° 39' 12.0"/ 84°58' 26.0"	55G	86	5B	12.4
Silver Creek Bronwsville Rd.	25-Aug-1994	05080003050	39° 38' 30.0"/ 84° 56' 24.0"	55G	86	5B	14.2
Vigo Co. Wabash River Fairbanks Park Dock	11-Oct-1995	05120111061	39° 27' 35.0"/ 87° 25' 9.0"	72G	49	7B	12266.0
Warick Co. Little Pigeon Creek U/S IDNR Boat Ramp, Yankeetown	12-Oct-1995	05140201270	37° 54'36.0"/ 87° 17' 44.0"	72M	95	8	357.0
Wayne Co. East Fork Whitewater River Beelor Rd Hayes Arboretum Rd.	24-Aug-1994 24-Aug-1994	05080003050 05080003050	39° 45' 36.0"/ 84° 56' 22.0" 39° 50' 48.0"/ 84° 50' 31.0"	55G 55G	86 86	5B 5B	152.0 46.1
Greens Fork Mineral Springs Rd. Pennvile Rd.	20-Jul-1994 21-Jul- 1994	05080003010 05080003010	39° 53' 53.0"/ 85° 2' 34.5" 39° 46' 18.0"/ 85° 6' 31.0"	55G 55G	87 87	5B 5B	58.4 85.5
M.F. E.F. Whitewater River Middleboro, IN	24-Aug-1994	05080003050	39°53' 42.0"/ 84° 49' 57.0"	55G	86	5B	37.3
Martindale Creek U.S. 35 U.S. 40	20-Jul-1994 21-Jul-1994	05080003010 05080003010	39° 58' 38.0"/ 85° 6' 8.0" 39° 48' 47.0"/ 85° 8' 51.0"	55M 55G	87 87	5B 5B	7.2 59.0
Nolands Fork Chapel Rd. Scott Rd. Fountain City	21-Jul-1994 20-Jul-1994	05080003020 05080003020	39° 45' 7.0"/ 85° 4' 32.0" 39° 57' 42.0"/ 84° 54' 45.0"	55G 55M	87 87	5B 5B	76.3 14.0
Short Creek Straightline Rd.	24-Aug-1994	05080003020	39° 47' 12.0"/ 84° 53' 22.0"	55G	86	5B	6.3
Simon Creek Paul Rd.	21-Jul-1994	05080003010	39° 47' 50.0"/ 85° 11' 1.0"	55M	87	5B	24.3

Table 48. *Aquatic macroinvertebrate sampling locations for 1994 - 95* (cont.)

COUNTY SITE LOCATION	DATE OF COLLECTION	HYDOLOGIC UNIT	LATITUDE/LONGITUDE	ECOREGION	DRAINAGE SEGMENT	IASNRI	DRAINAGE AREA (sq. mi.)
Whitewater River							
Crietz Park, Cambridge, City, IN	21-Jul-1994	05080003010	39° 48' 44.0'/ 85° 10' 16.0"	55M	87	5B	91.5
Jones Rd. Hagerstown, IN	20-Jul-1994	05080003010	39° 55' 3.5"/ 85° 9' 23.0"	55M	87	5B	29.3

IASNRI - Indiana Adacemy of Science Nautral Regiona Index (Homoya. 1985) biotic/environmental parameters can be optimally made is pending completion of both phases of this project.

THE INDIANA SURFACE WATER MONITORING STRATEGY 1996-2001

The Assessment Branch has prepared a new monitoring strategy for the surface waters of Indiana. Early in 1995 the Water Quality Surveillance and Standards Branch (now the Assessment Branch) of the Office of Water Management (OWM) initiated a revision of the surface water monitoring program of the Indiana Department of Environmental Management (IDEM). A Monitoring Strategy Committee was formed using personnel from all branch sections to review and formulate a new strategy. Three working subcommittees were formed to expedite this process. A fourth one was subsequently formed. These subcommittees are: 1) Planning; 2) Sampling; 3) Information Management and Reporting; and 4) Volunteer Monitoring and Outreach. These working subcommittees brought before the Branch Chief and the overall Monitoring Strategy Committee their recommendations for review and adoption.

Historically, the state's surface water assessment program was "reactive" in its approach to data collection which has led to information gaps. Information gaps make it difficult to assess the overall physical, chemical and biological integrity of Indiana surface waters. The proposed strategy provides a "proactive" assessment program which is more ideally suited to meeting the variety of data and information needs for assessing Indiana surface waters. The following are the goals of the overall assessment branch monitoring strategy:

1. To understand the physical, chemical, bacteriological, and biological quality of the aquatic environment in each watershed and the factors responsible for impairment.

2. To assess the impact of human or other activities that occur in each watershed and the probable effects of these activities on the quality of the dynamic system.

3. To identify and make recommendations for the protection of high quality water resources of the State.

4. To determine how to mitigate for any adverse effects which are unavoidable.

5. To coordinate point and nonpoint source program activities in targeted watersheds to ensure that maximum environmental benefits are realized.

6. To evaluate the effectiveness of the coordinated efforts of our program to determine if additional measures are required.

7. To provide environmental quality assessment reports to support the water quality management program in partnership with communities, industry, and government.

The Biological Studies Section will provide biological assessments as part of this new monitoring strategy. The macroinvertebrate program as described in this 305(b) Report will serve as a foundation for the biological component of the Assessment Branch, Surface Water

Monitoring Strategy for 1996-2001. The five years of ecoregional fish community assessments along with the REMAP investigation of the fish communities of the Eastern Corn Belt Plain (Figure 24), represented by approximately 1000 sites; will provide the foundation for the fish community assessment component of the new surface water monitoring strategy.

The biological monitoring program will incorporate both fish community work and benthic invertebrate community work as well as habitat assessment into the overall surface water monitoring strategy. The state has been divided into 5 watersheds which will be monitored on an overlapping 2 year schedule. The first year will be a synoptic survey of the watershed followed by an intensive "microscopic" problem oriented type investigation of the watershed. The first year will have a random sampling component and an intensive sampling component. Specific indicator type parameters will be utilized each year. The Biological Studies Section will use their six years of evaluating reference condition at 704 Indiana sites, as earlier described, from which to make comparisons as part of the new monitoring strategy. The macroinvertebrate component of the synoptic survey will consist of random subsampling of a subset of sites previously sampled. More intensive Hester Dendy Multiplate samples will also be undertaken. Fish community assessments will utilize the random site selection sampling method (USEPA, EMAP Selected Sites) to pick sites for community assessment. The overall biological assessment results will be incorporated into synoptic and final watershed assessment reports for the agency.

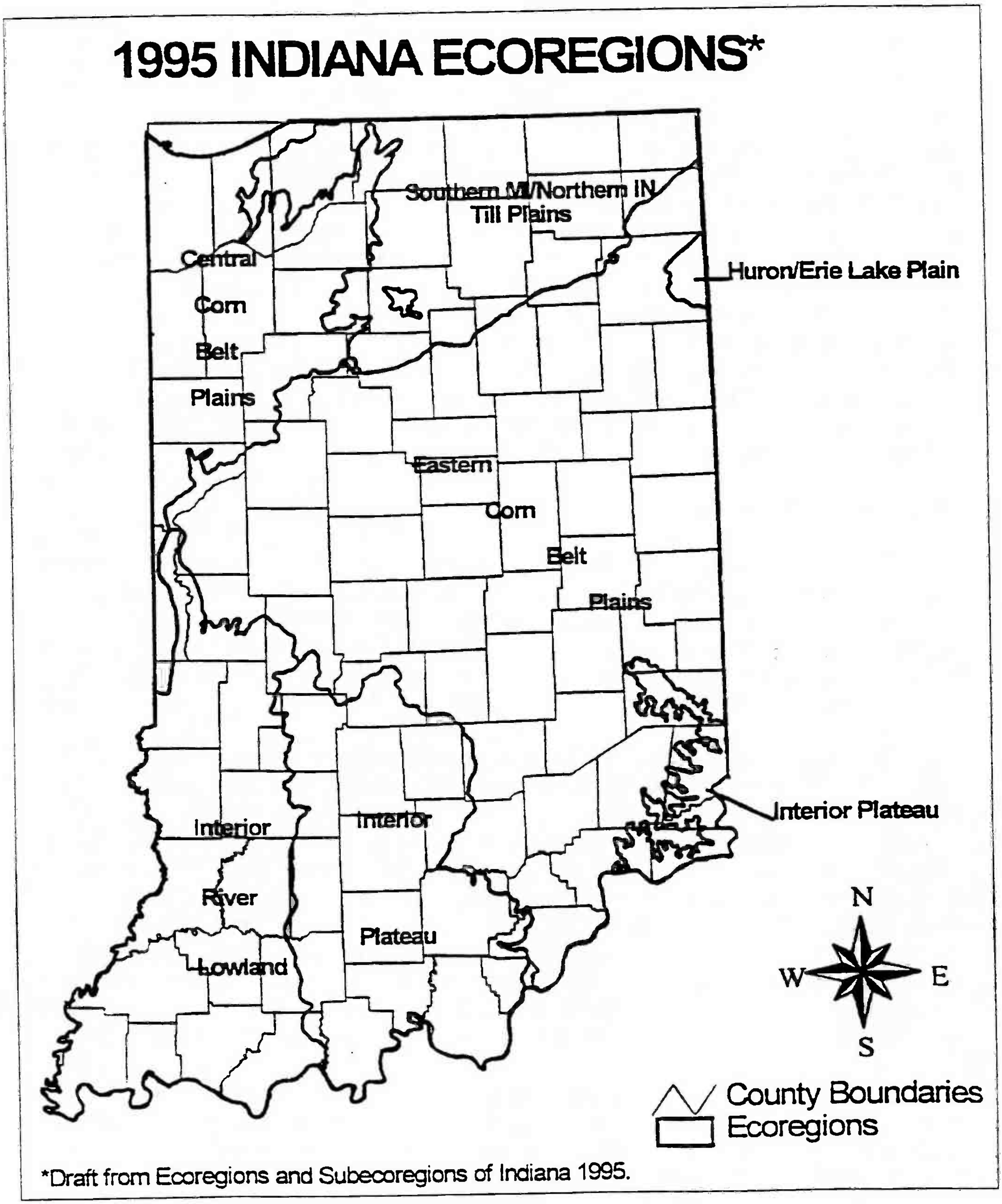
IV. GROUND WATER QUALITY OVERVIEW

Introduction to Indiana Groundwater

Ground water is a very important resource for Indiana citizens, agriculture, and industry. Nearly 60 percent of the state's population uses ground water for drinking water and other household uses. Approximately half of the population served by public water supplies depend on ground water as its source of water. Approximately thirty-three hundred public water supply systems are supplied solely by ground water and over one-half million Indiana homes have private wells for their water supply. Ground water is also an integral component in Indiana's economy. Industry withdraws an average 190 million gallons per day, irrigation consumes 200 million gallons per day during the crop production season, and livestock depend on an average of 45 million gallons per day.

Ground water in Indiana occurs in both unconsolidated and bedrock aquifer systems that yield potable water in sufficient quantity to serve as a source of supply. The most productive aquifers are associated with glacially derived outwash sand and gravel deposits that occur in the major river valleys. Large diameter wells in these areas can produce up to 2,000 gallons per minute (gpm). Other good unconsolidated aquifers are found in the thick, inter-till sand and gravel deposits and outwashes of central and northern Indiana. The withdrawal potential for properly constructed wells in unconsolidated aquifers ranges from 400 to 2,000 gpm. The major bedrock aquifers include the Pennsylvanian Age sandstones of southwest Indiana, Mississippian Age limestones in the south central area, Devonian Age limestones and dolomites across northern and central Indiana, and Silurian Age limestones and dolomites in the north and central portions of the state. Well yields of the major bedrock aquifers can vary from 200 to 600 gpm.

Figure 24. *The ecoregions of Indiana*



The ambient ground water quality throughout Indiana is variable and dependent on the aquifer system, geologic setting, and depth of geologic formation. In general, the incidence of mineralized or even saline ground water increases at bedrock depths below 300 feet. The majority of private and public wells in Indiana occur at depths less than 200 feet. The chemical quality of the potable water is generally adequate to meet the basic needs for household, municipal, industrial, and irrigation uses. However, the waters are generally very hard, with hardness often exceeding 180 parts per million (ppm) as calcium carbonate. Other constituents of importance to natural water quality are iron, manganese, sulfate, fluoride, and hydrogen-sulfide. The majority of Indiana's ground water exceeds the 0.3 ppm aesthetic threshold for iron, a level that may cause staining and may impart a metallic taste to water. Manganese concentrations are often a nuisance associated with iron, causing black staining and deposits. Manganese concentrations are lowest along the Wabash and Whitewater River and in Mississippian age limestone aquifers. Sulfate levels are dependent on the geologic deposits. Concentrations exceeding 600 ppm sulfate have been noted in Allen, Harrison, Orange, Vermillion and Lake counties. Hydrogen-sulfide, which has an objectionable odor at low concentrations, is produced from sulfate by oxidation-reduction reactions or biologic reduction of anaerobic bacteria and is present in the ground water in northwestern regions of Indiana underlain by limestone bedrock.

Ground Water Protection Programs

Several state programs and activities are being implemented or are in the implementation process to protect Indiana's ground water resources from contamination. Table 49 encompasses the state's ground water protection programs and lists the agency or agencies responsible for implementation and enforcement of the protection activity. Developmental stage of the program or activity is given and include programs ranging from the initial planning stage to fully developed and operational programs.

Major strides in the protection of Indiana ground water have occurred within the past decade. In 1987, the Indiana Ground Water Protection and Management Strategy was developed as a comprehensive guide to improve and protect the state's ground water supply, addressing issues that cross program and agency jurisdictions. Subsequently, the Indiana Ground Water Protection Act of 1989 (IC 13-7-26-7) established the Governor's Ground Water Task Force, with appointees representing private industry and government, to coordinate the implementation of the strategy. On October 23, 1992, the Task Force adopted the Policy Framework for the Protection of Indiana's Ground Water to guide the implementation of the strategy. Since then, Indiana has retained the improvement and protection of its ground water resources as a priority, and substantial progress has been made in realizing the directives set forth in the strategy with a number of important objectives being met within the last couple of years.

During 1994 and 1995, significant progress was made in several ground water protection programs and activities. In 1994, the "Hydrogeologic Atlas of Aquifers in Indiana," which maps aquifers at a scale of 1:500,000 and hydrogeologic sections at a horizontal scale of 1:250,000, was completed by the U.S. Geological Survey. Completed in 1995 was the Indiana Geological Survey's "Atlas of Hydrogeologic Terrains and Settings of Indiana." This document maps areas for aquifer sensitivity at a scale of 1:100,000. Additionally, characterization of the relative

Table 49. *Summary of state ground water protection programs (through 12/31/95)*

PROGRAMS OR ACTIVITIES	STATUS	STATE AGENCY
Active SARA Title III Program	fully established	IDEM-OER
Ambient ground water monitoring system	pending	OISC/IDEM-OWM
Aquifer vulnerability assessment	fully established	IGS/IDNR/OISC/IDEM-OWM
Aquifer mapping/basin studies	under development	USGS/IDNR/IDEM-OWM
Aquifer characterization/hydrogeologic setting	fully established	IGS/IDNR/IDEM-OWM
Bulk storage program for agricultural chemicals	fully established	OISC
Comprehensive data management system	pending	IDEM-OWM
Complaint response for private wells	fully established	IDEM-OWM
Confined feeding	fully established	IDEM-OWM
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)	under development	Governor's Ground Water Task Force/IDEM-OWM
Ground water discharge permits	not applicable	
Ground water Best Management Practices	under development	OISC/IDEM-OWM
Ground water legislation	fully established	IDNR/OISC/ISDH/IDEM
Ground water classification	under development	IDEM-OWM
Ground water quality standards	under development	IDEM-OWM
Interagency coordination for ground water protection initiatives	pending	Governor's Ground Water Task Force
Land application of domestic and industrial residuals	fully established	IDEM-OWM
Nonpoint source controls	under development	IDEM-OWM
Nutrient Management	under development	IDEM-OWM
Oil and Gas	fully established	IDNR
Pesticide State Management Plan	under development	OISC/IDEM-OWM
Pollution Prevention Program	fully established	IDEM-OPPTA
Reclamation	fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	fully established	IDEM-OSHWM
Spill Monitoring	fully established	IDEM-OWM
State Superfund	fully established	IDEM-OSHWM/OER
State RCRA Program incorporating more stringent requirements than RCRA primacy	fully established	IDEM-OSHWM
State septic system regulations	fully established	ISDH
Underground storage tank installation requirements	fully established	IDEM-OER
Underground Storage Tank Remediation Fund	fully established	IDEM-OER
Underground Storage Tank Permit Program	fully established	IDEM-OER
Underground Injection Control Program	fully established for Class II wells	IDNR

Table 49. *Summary of state ground water protection programs (through 12/31/95) (cont.)*

PROGRAMS OR ACTIVITIES	STATUS	STATE AGENCY
Vulnerability assessment for drinking water/wellhead protection	under development	IGS/IDEM-OWM
Well abandonment regulations	fully established	IDNR
Wellhead Protection program (EPA- approved)	continuing efforts	IDEM-OWM
Well installation regulations	fully established	IDNR

Acronyms Used:

IDEM *Indiana Department of Environmental Management*
IDNR *Indiana Department of Natural Resources*
IGS *Indiana Geological Survey*
ISDH *Indiana State Department of Health*
OER *Office of Environmental Response (IDEM)*
OISC *Office of the Indiana State Chemist*
OPPTA *Office of Pollution Prevention and Technical Assistance (IDEM)*
OSHWM *Office of Solid and Hazardous Waste Management (IDEM)*
OWM *Office of Water Management (IDEM)*
USGS *United States Geological Survey*

Definitions:

"pending" is used to describe those programs that have a written, draft policy

"under development" is used to describe those programs still in the planning stages

susceptibility to contamination for public water supply wells was completed in 1995. These geologic maps will serve as useful tools in the further development and implementation of the state's ground water protection projects including the Indiana Wellhead Protection Program and the generic State Management Plan for Pesticides.

On November 13, 1995, Indiana's Wellhead Protection Program was contingently approved by the Environmental Protection Agency (EPA). This document was written to fulfill the requirements of Section 1428 of the federal Safe Drinking Water Act, which directs States to develop proactive programs that protect public water supplies from contamination. The Wellhead Rule, which outlines the minimum program requirements that community public water supply systems must meet, was preliminarily adopted by the Indiana Water Pollution Control Board on December 13, 1995.

In July of 1995, a Memorandum of Understanding was signed between the Indiana Department of Environmental Management (IDEM) and the Office of the Indiana State Chemist and Seed Commissioner (IOSC). This agreement outlines the respective responsibilities of IDEM and IOSC in regards to the Generic State Management Plan for Pesticides in Ground Water. This plan takes a comprehensive look at contamination resulting from the use of pesticides. A major component of the draft plan includes the establishment of an extensive ground water monitoring network which will be used to collect water quality data to determine not only the extent of pesticide contamination, but also the presence of other indicator compounds and chemicals of concern. The data collected from the ground water monitoring network will be integrated into the Indiana Department of Environmental Management's comprehensive Ground Water Database as it comes online. This database will store data collected and reported by state agencies on any wellsite throughout the state. It will serve as the basis of the state's central clearinghouse for information pertaining to ground water in Indiana.

Efforts continue in the establishment of Ground Water Quality Standards. Extra effort has gone into this rule development process to ensure private and public sector concerns and interests are addressed. Extensive research has been done to identify valid risk-based numbers for protective purposes. It is anticipated that the extra time taken will result in a comprehensive set of qualitative and quantitative standards that will include a ground water classification system. Once established, these standards can be used to evaluate the effectiveness of nonpoint source controls and other best management practices designed to protect ground water quality and will serve as guidance in establishing ground water discharge limits and cleanup targets for identified contaminated sites.

The Indiana Department of Environmental Management, Ground Water Section, plans to utilize the EPA guidelines for developing a Comprehensive State Ground Water Protection Program (CSGWPP). Along with stressing the importance of the inclusion of all relative policies The Indiana Department of Environmental Management, Ground Water Section, plans to utilize the EPA guidelines for developing a Comprehensive State Ground Water Protection Program (CSGWPP). Along with stressing the importance of the inclusion of all relative policies

required to carry out Indiana's Wellhead Protection Program, the ground water monitoring network component of the Generic State Management Plan for Pesticides, the comprehensive Ground Water Database, and Ground Water Quality Standards.

Successful Ground Water Protection: Indiana's Land Application and Confined Feeding Programs

IDEM's Office of Water Management (OWM) regulates the land application of wastewaters, wastewater residuals, and other byproducts resulting from water treatment facilities, industrial processes and the treatment of municipal and industrial wastewaters. Maintaining soil productivity and protecting surface and ground water are priority concerns of OWM while administering this program. Land application activities are dictated by the need to dispose of enormous quantities of residuals resulting from the purification of waters prior to the discharge to receiving streams. There are also waste products generated from processes unrelated to water treatment processes. The concept of OWM's land application permit program is based on extensive scientific research showing that land application of these waste products can be done in a beneficial manner with no detrimental effects on the environment. Rates of application are specified through the evaluation of the waste material and utilizing the knowledge of soil science and crop production to minimize any effect to the ground water. OWM'S land application section recorded that during 1995 approximately 80,000 dry tons of residuals returned 2,000,000 pounds of nitrogen to over 20,000 acres of farmland.

Another OWM program relative to the protection of Indiana's ground water is the Confined Feeding approval program. This program requires large livestock and poultry producers to gain approval for construction and operation of their facilities. The design of the waste storage facilities must meet certain specifications assuring stability and protection of surface and groundwaters.

Best management practices (BMPs) for manure disposal activities have been developed and are recommended within each approval letter. Over one thousand confined feeding operations have been inspected and received approval in the last two years. Efforts to stress the importance of following the BMPs include public presentations, the distribution of leaflets and newsletters pertaining to manure management and water quality concerns, and continued communication with industry representatives and the Purdue Agricultural Extension and Education Service. The size and diversity of the industry dictates that extensive education efforts be utilized to garner voluntary compliance with using best management practices. This technique stresses the environmental liability of handling manure and the benefits of proper manure and nutrient management.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 50. Those contaminant sources that are considered to be the greatest

Table 50. *Major sources of ground water contamination*

CONTAMINANT SOURCE		HIGHEST PRIORITY	FACTORS[1]	TYPE OF CONTAMINANT[2]
Agricultural Activities				
Agrichemical facilities		/	A, D, E, F	A, B, E
Animal feedlots		/	A, D, E, F	E, J
Domestic and industrial residual applications			A, D, E, F	E, H, J
Commercial fertilizer applications			A, D, E, F	E
Irrigation practices		/	A, D, E, F	A, B, E
Manure applications			A, D, E, F	E, J
Pesticide applications			A, D, E, F	A, B
Storage and Treatment Activities				
Land application			A, E, F	C, D, E, H, J
Material stockpiles			A, E, F	A, B, C, D, E, G, H, J
Storage tanks (above ground)		/	A, D, E, F	A, B, C, D, E
Storage tanks (below ground) placed prior to 1988?		/	A, B, C, D, E, F	B, C, D
Surface impoundments		/	A, B, C, D, E, F	A, B, C, D, E, G, H, J
Waste piles			A, B, C, D, E, F	A, B, C, D, E, G, H, J
Disposal Activities				
Deep injection wells			A, F, G	B, C, G, H, I
Landfills (closed, pre-19xx)		/	A, E, F	A, B, C, D, E, G, H, I, J
Permitted landfills			A, E, F	A, B, C, D, E, G, H, J
Septic systems			A, D, E, F	A, B, C, D, E, H, J
Shallow injection wells			A, D, E, F	A, B, C, D, E, H, J
Other				
Hazardous waste generators			A, B, C, D, E, F	A, B, C, D, E, H, I, J
Hazardous waste sites			A, B, C, D, E, F	A, B, C, D, E, H, I, J
Industrial facilities		/	A, B, C, D, E, F	A, B, C, D, E, H, I, J
Material transfer operations			A, B, C, D, E, F	A, B, C, D, E, H
Mining and mine drainage			A, E, F, G	H, I
Liquid transport pipelines (including sewer)		/	A, B, C, D, E, F	A, C, D, E, H, J
Road salting			A, D, E, F	G
Salt storage	State facilities		A, E, F	G
	Nonstate facilities			

Table 50. *Major sources of ground water contamination (cont.)*

CONTAMINANT SOURCE	HIGHEST PRIORITY	FACTORS[1]	TYPE OF CONTAMINANT[2]
Materials spills (including during transport)	/	A, D, E, F	A, B, C, D, E H, I, J
Urban runoff		A,B D, E, F, G	A, B, C, D. E, G, H, J

[1] *Factors considered in selecting the contaminant source:*

- *(A) human health and/or environmental risk (toxicity)*
- *(B) size of the population at risk*
- *(C) location of source relative to drinking water source*
- *(D) number and/or size of contaminant sources*
- *(E) hydrogeologic sensitivity*
- *(F) documented State findings*
- *(G) high to very high priority in localized areas, but not over majority of Indiana*

[2] *Classes of contaminants associated with contamination source:*

- *(A) Inorganic pesticides*
- *(B) Organic pesticides*
- *(C) Halogenated solvents*
- *(D) Petroleum compounds*
- *(E) Nitrate*
- *(G) Salinity/ brine*
- *(H) Metals*
- *(I) Radionuclides*
- *(J) Bacteria*

threat to ground water are identified and have been determined based on various risk factors described in the table. Contaminants commonly associated with each contaminant source are also given. Approximately half of the contamination sources of greatest concern to groundwater are due to practices or activities occurring prior to construction standards and legislation established for the protection of ground water. Current containment and use standards for landfills, storage tanks, pesticide and fertilizer storage facilities adequately protect groundwater, although it must be noted that surface impoundments with discharge to ground water are not regulated.

Animal feedlots have been identified by Purdue University as potential major contributors to groundwater contamination via ammonia which is converted to nitrate. Although determinations of nitrate quantity added to groundwater by confined feedlot operations vs. land application vs. septic discharge is open to interpretation, nitrate contamination of groundwater is the most common and pervasive form of groundwater contamination in rural areas. The nitrate contamination problem is exacerbated by the high solubility and mobility of nitrates. For the first time in Indiana, banks are refusing togive loans to prospective buyers of farmsteads whose wells exhibit nitrate contamination. The IDEM recognizes and promotes overall farm nutrient management planning to address this situation. The Natural Resource Conservation Service has gained approval to require farm nutrient management through their overall farm planning and management programs. Continued emphasis and promotion of nutrient management are priorities with the State.

Irrigation practices in Indiana often withdraw large quantities of water and predominantly occur in sandy soil areas of the state. Water which is drawn from the ground is used to irrigate land in which fertilizers and pesticides have been applied. Often, fertilizers and pesticides are applied as irrigation occurs. These irrigation processes accelerate leaching of pesticides and fertilizers to the groundwater through macropores or pore infiltration.

Surface impoundments can be local discharge areas; however, almost all manmade surface impoundments discharge to groundwater. In the highly vulnerable hydrogeologic setting areas identified in this report, many surface impoundments do not ever discharge or even have designed outfalls. Surface impoundments, many of them industrial, in the aforementioned hydrogeologic settings have a surface water to groundwater discharge relationship that is close to 100 percent. Many of these surface impoundments discharge metals, volatile organic compounds (VOC's), and synthetic organic compounds (SOC's) to groundwater.

Liquid transport pipelines, including sewers, tend to leak, or in some cases where the groundwater table is close to the surface, tend to take in contaminants to the sewer system. Pipelines under pressure tend to discharge to groundwater. It has been estimated that up to20 percent of all fluids in sewers and up to10 percent of pipelines leak fluids to groundwater. This phenomena is related to the type of construction materials or the age of the system involved. Even though sewers and pipelines are usually made of durable materials, the type of seals between joints and the occurrence of construction accidents lead to apparent discharge of contaminants to the groundwater systems of Indiana.

Over fifty spills are reported on the average to IDEM per week. In 1992, nearly 5 million gallons of chemicals, industrial wastes and agricultural products spills were reported. Spills are one of the major contributors to ground water contamination. Most spills can be avoided or minimized in terms of impacting ground water. Outreach efforts are mitigating the number of spill incidents and environmental impact from spills; however, spill prevention efforts need to continue.

Industrial facilities or their ancillary operations are responsible for more than 60 percent of contamination of groundwater. Although many incidents occurred prior to development of regulations or reporting requirements, many incidents occurred as results of either accidents or intentional dumping of waste, and the lack of knowledge that reporting requirements existed. The ferreting-out process is the responsibility of many different program areas within the IDEM. Outreach and education programs have alleviated the majority of problems; however, these activities continue to be a major source of contamination to groundwater of Indiana.

Hydrogeologic Settings in Indiana

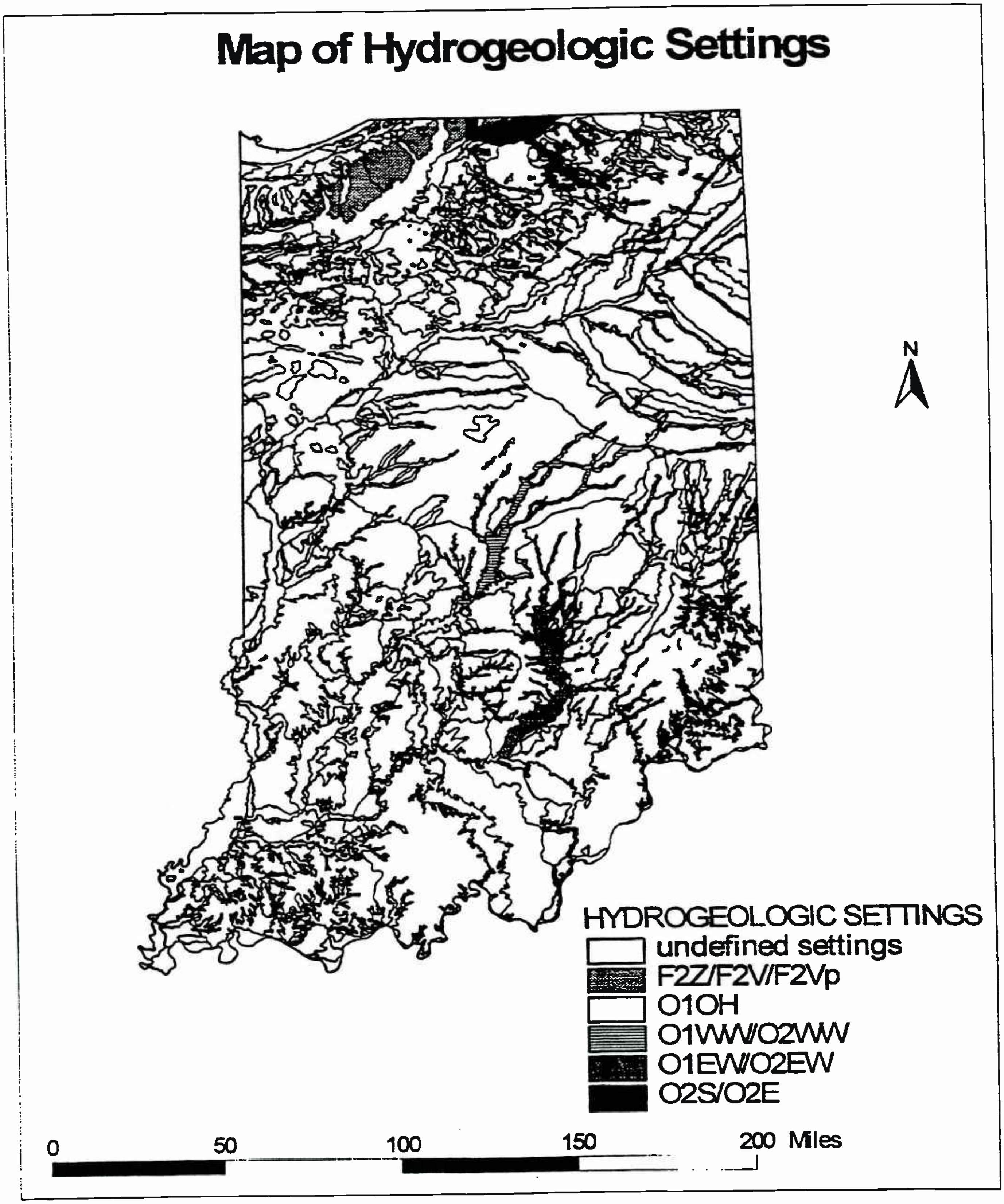
Ground water quality data can be better assessed and interpreted when data are analyzed according to similar surface and subsurface environments rather than similar political boundaries. In this report, ground water quality data and contamination source site data have been correlated to hydrogeologic settings that are the most vulnerable to contamination and occur in largely populated areas (i.e., areas of greatest ground water demand) using the Indiana Geological Survey hydrogeologic settings for Indiana (Figure 25).

In 1995, the Indiana Geological Survey (IGS) produced a document that describes the hydrogeologic settings found in Indiana. The hydrogeologic settings provide a conceptual model to interpret the sensitivity to contamination of groundwater in relation to the surface and subsurface environment (Fleming, et.al., 1995). Included in the analysis are the composition and geometry of the aquifers, thickness and variability of the confining units, surface and groundwater interactions, and recharge/discharge relationships. The resulting framework provides a conceptual and practical hierarchy to evaluate and forecast the effect of aquifer sensitivity to contamination.

A set of 1:100,000 maps was compiled for 35 different quadrangles in Indiana, and show the "distributions of hydrogeologic terrains, settings, and subsettings; generalize thickness of large sand and gravel aquifers; generalized thickness of glacial tills and other confining or capping units in areas of predominately confined aquifers; generalized depth to the water table, chiefly in areas of unconfined sand and gravel or alluvial aquifers; and depth to bedrock where it is less than 50 feet deep" (Fleming, et.al., 1995).

Hydrogeologic settings are made up of a number of sequences (the aquifers themselves)

Figure 25. *Map of hydrogeologic settings*



that describe the sensitivity of the aquifers in question. For the purposes of this report, individual map units with similar geologic history, hydrogeologic terrains and settings, and identical vulnerability indices have been combined. These describe mappable units analogous to sequences that have a common geologic history, and as aforementioned, identical vulnerability indices.

The Ground Water Section and the Drinking Water Branch have chosen to identify the occurrence of contamination of aquifers that are the most susceptible to contamination as found in Tables 51a-51e and Tables 52a-52e. These units include OS2/O2E, O1OH, O1EW/O2EW, O1WW/O2WW, and F2Z/F2V/F2Vp. These units are principally outwash deposits or fans of glacial origin. These units and their relation to various hydrogeologic settings are described below:

O2S/O2E - The sequence O2S, the St. Joseph River Outwash Plain, comprises a large outwash plain and glacial sluiceway that encompasses more than 250 square miles of northern Indiana and is contiguous to the Elkhart River Outwash system (O2E). The glacial sluiceway is a meltwater channel that is up to 100 feet thick whereas the outwash plain ranges from 25 to 50 feet in thickness. The combined total sequence can be more than 350 feet in thickness. The water table commonly ranges between five and fifteen feet below the land surface and many wells are hand driven. This sand and gravel outwash system forms an unconfined aquifer that is highly susceptible to contamination. Because of the degree of industrial development in the cities of Elkhart and South Bend, and areas between, this aquifer system exhibits more documented contamination per sampling event than any other in Indiana.

F2Z/F2V/F2Vp - The sequence F2Z is an exposed outwash fan that is present north of the St. Joseph River in Elkhart and St. Joseph counties. The unit is more than 100 feet thick and well depths are commonly less than 70 feet deep. The water table in this unconfined unit is 15 to 30 feet below the land surface. This sequence is part of the larger Kalamazoo Morainal System that covers hundreds of square miles in southern Michigan. The sequence's F2V/F2Vp also represents exposed glacial fans in LaPorte and Porter counties that formed as part of the Valparaiso Moraine derived from Michigan Lobe glacial events. These units were not deposited at the same time as the fan deposits of the Kalamazoo Morainal System, but do share similar geologic histories and structures. The sequence F2V and the previously noted sequence F2Z are exposed glacial fans that are composed of sand and gravel deposits that can be in excess of 100 feet thick. The sequence F2Vp represents a pitted surface of sand and gravel deposits and peat and muck that formed from collapse of buried melting ice blocks. Valparaiso Moraine fan deposits have a shallow water table that is less than 40 feet, and in many areas less than 15 feet, below the land surface. These sequences are highly susceptible to contamination; however, because of less industrial development, less contamination per sampling event is noted as compared to outwash and sluiceways of northern Indiana.

O1WW/O2WW - These sequences were formed as part of an anastomosing outwash system in which northeast to southwest trending outwash channels (O1WW) that reside between

Table 51a. *Summary of ground water contamination sites*

Hydrogeologic Setting(s): exposed outer fan of Valparaiso Moraine and exposed outwash fan of Kalamazoo Morainal System

Map Unit(s): F2Z, F2V, F2Vp

Counties included: southeastern Lake, LaPorte, eastcentral and southeastern Porter, northern St. Joseph

SOURCE TYPE		NUMBER OF SITES IN AREA THAT ARE LISTED AND/OR HAVE CONFIRMED RELEASES	NUMBER OF SITES WITH CONFIRMED GROUND WATER CONTAMINATION	CONTAMINANTS
Superfund		1	1	VOC's
CERCLIS (non-NPL)		32	*	VOC's, SOC's Metals
DOD/ DOE		1	1	VOC's
LUST		80	19	VOC's
RCRA Corrective Action		3	2**	VOC'S, SOC's, Metals
UIW	Class I	1	N/A	Ammonia, Metals, Chloride
	Class II	0	0	N/A
	Class III	0	0	N/A
	Class V	23	23	VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		0	0	N/A
Voluntary Cleanup		2	*	VOC's, Metals
Material spills		24	*	VOC's, SOC's, Nutrients, Metals, Pesticides Hazardous Materials
Total		166	46	

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Energy
DOE= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
** only sites with "high priority" listing included, the total unknown
UIW= Underground Injection Wells
* information not available
N/A = not applicable

Table 51b. *Summary of ground water contamination sites*

Hydrogeologic Setting(s): St. Joseph River outwash plain, Elkhart River outwash system

Map Unit(s): O2S, O2E

Counties included: northern and central Elkhart, northeastern Kosciusko, northwestern Noble, northwestern and northcentral St. Joseph

SOURCE TYPE		NUMBER OF SITES IN AREA THAT ARE LISTED AND/OR HAVE CONFIRMED RELEASES	NUMBER OF SITES WITH CONFIRMED GROUND WATER CONTAMINATION	CONTAMINANTS
Superfund		3	3	VOC's, Metals
CERCLIS (non-NPL)		88	*	VOC's, SOC's, Metals
DOD/ DOE		0	N/A	N/A
LUST		211	44	VOC's
RCRA Corrective Action		12	2**	VOC's, SOC's, Metals
UIW	Class I	1	1	Acids, Metals
	Class II	0	N/A	N/A
	Class III	0	N/A	N/A
	Class V	760	760	VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		1	1	VOC's
Voluntary Cleanup		10	*	VOC's
Material spills		57	*	VOC's, SOC's, Nutrients, Metals, Pesticides, Hazardous Materials
Total		1143	811	

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Energy
DOE= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
** *only sites with "high priority" listing included, therefore the total is unknown*
UIW= Underground Injection Wells
* *information not available*
N/A = not applicable

Table 51c. *Summary of ground water contamination sites*

Hydrogeologic Setting(s): White River West Fork outwash system and outwash plain

Map Unit(s): O1WW, O2WW

Counties included: southeastern Boone, southwestern Delaware, eastcentral Hamilton, northwestern Johnson, central and southwestern Madison, Marion, northeastern Morgan

SOURCE TYPE		NUMBER OF SITES IN AREA THAT ARE LISTED AND/OR HAVE CONFIRMED RELEASES	NUMBER OF SITES WITH CONFIRMED GROUND WATER CONTAMINATION	CONTAMINANTS
Superfund		4	4	VOC'S, SOC's, Metals
CERCLIS (non-NPL)		178	*	VOC's, SOC's Metals
DOD/ DOE		2	1*	VOC's
LUST		886	207	VOC's
RCRA Corrective Action		21	4**	VOC's, SOC's, Metals
UIW	Class I	0	N/A	N/A
	Class II	0	N/A	N/A
	Class III	0	N/A	N/A
	Class V	55	55	VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		2	2	Metals
Voluntary Cleanup		11	*	VOC's, Metals
Material spills		98	*	VOC's, SOC's, Nutrients Metals, Pesticides Hazardous Materials
Total		1257	273	

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Energy
DOE= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA =Resource Conservation and Recovery Act
** only sites with "high priority" listing included, therefore the total is unknown*
UIW= Underground Injection Wells
** information not available*
N/A = not applicable

Table 51d. *Summary of ground water contamination sites*

Hydrogeologic Setting(s): White River Upper East Fork sluiceway and outwash plain

Map Unit(s): O1EW, O2EW

Counties included: southeatern Lake, LaPorte, eastcentral and southeastern Porter, Northern St. Joseph

SOURCE TYPE		NUMBER OF SITES IN AREA THAT ARE LISTED AND/OR HAVE CONFIRMED RELEASES	NUMBE OF SITES WITH CONFIRMED GROUND WATER CONTAMINATION	CONTAMINANTS
Superfund		3	3	VOC's, Metals
CERCLIS (non-NPL)		48	*	VOC's, SOC's, Metals
DOD/ DOE		1	*	*
LUST		72	23	VOC's
RCRA Corrective Action		2	2	VOC's
UIW	Class I	0	N/A	N/A
	Class II	0	N/A	N/A
	Class III	0	N/A	N/A
	Class V	16	16	VOC,s Nutrients, Metals, Pesticides, Septic
State Cleanup		1	1	VOC's
Voluntary Cleanup		3	*	VOC's
Material spills		30	*	VOC's, SOC's, Nutrients, Metals, Pesticides, Hazardous Materials
Total		176	45	

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Energy
DOE= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA =Resource Conservation and Recovery Act
** only sites with "high priority" listing included, therefore the total is unknown*
UIW= Underground Injection Wells
** information not available*
N/A = not applicable

Table 51e. *Summary of ground water contamination sites*

Hydrogeologic Setting(s): Ohio River Valley

Map Unit(s): O1OH

Counties included: southern edges of the following: Clark, Crawford, Floyd, Harrison, Jefferson, Perry, Posey, Spencer, Switzerland, Vanderburgh, Warrick

SOURCE TYPE		NUMBER OF SITES IN AREA THAT ARE LISTED AND/OR HAVE CONFIRMED RELEASES	NUMBER OF SITES WITH CONFIRMED GROUND WATER CONTAMINATION	CONTAMINANTS
Superfund		0	N/A	N/A
CERCLIS (non-NPL)		98	*	VOC's, SOC's Metals
DOD/ DOE		1	1	VOC's, Ordinance
LUST		308	64	VOC's
RCRA Corrective Action		4	4**	VOC's, SOC's Metals
UIW	Class I	0	N/A	N/A
	Class II	125	N/A	N/A
	Class III	0	N/A	N/A
	Class V	5	5	VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		0	N/A	N/A
Voluntary Cleanup		3	*	VOC'S
Material spills		36	*	VOC's. SOC's, Nutrients Metals, Pesticides, Hazardous Materials
Total		580	74	

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response. Compensation. and Liability Information System
DOD= Department of Energy
DOE= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
*** only sites with "high priority" listing included. therefore the total is unknown*
UIW= Underground Injection Wells
** information not available*
N/A = not applicable

Table 52a. *Summary of ground water for drinking water monitoring data*

Hydrogeologic Setting(s): exposed outer fan of Valparaiso Moraine and exposed outwash fan of Kalamazoo Morainal System

Map Unit(s): F2Z, F2V, F2Vp

Counties included: southeastern Lake, LaPorte, eastcentral and southeastern Porter, northern St. Joseph

MONITORING DATA TYPE	TOTAL NO. OF ENTRY POINTS[1] OR WELLS[2] USED IN ASSESS-MENT	PARAMETER GROUPS	NUMBER OF ENTRY POINTS[1] OR WELLS[2]					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS[4]	31	VOC	22	8	1	0	0	0
	31	SOC	22	9	0	0	0	0
	31	IOC	NOT TRACKED			0	0	0
	35	NO_3	26	8	1	0	0	0
	26	Radionuclides	0	26	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[5] and non-transient PWS[4]	45	VOC	45	0	0	0	0	12
	44	SOC	42	2	0	0	0	0
	45	IOC	NOT TRACKED			0	0	0
	171	NO_3	118	26	17	10	0	0
		Radionuclides[6]						
Ground Water Quality Data from private wells and PWS wells selected in 319 study[7]	27	VOC	10	4	1	12	0	0
	15	SOC	0	2	0	1	0	0
	20	Metals	18	1	0	1	0	0
	15	NO_3	13	1	0	1	0	0
	0	Radionuclides	0	0	0	0	0	0

1 *PWS system data collected per entry point (narrative)*
2 *Data collected per well or sampling site for private well and 319 PWS study*
3 *Action due to contaminated ground water (source water)*
4 *Reporting period: 1/1/93-12/31/95*
5 *Transient communities only required to monitor for* NO_3
6 *Radionuclides not required for noncommunity systems*
7 *Reporting period: all parameters for private wells, 1/1/80- 10/1/95; all parameters for 319 PWS, 1/1/93-12/31/94*

Table 52b. *Summary of ground water for drinking water monitoring data*

Hydrogeologic Setting(s): St. Joseph River outwash plain, Elkhart River outwash system

Map Unit(s): O2S, O2E

Counties included: northern and central Elkhart, northeastern Kosciusko, northwestern Noble, northwestern and northcentral St. Joseph

MONITORING DATA TYPE	TOTAL NO. OF ENTRY POINTS[1] OR WELLS[2] USED IN ASSESS-MENT	PARAMETER GROUPS	NUMBER OF ENTRY POINTS[1] OR WELLS[2]					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS[4]	30	VOC	23	4	3	0	0	1
	29	SOC	23	6	0	0	0	0
	30	IOC	NOT TRACKED			0	0	0
	24	NO_3	19	2	2	1	0	0
	31	Radionuclides	0	31	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[5] and non-transient PWS[4]	77	VOC	52	15	6	4	0	0
	78	SOC	77	1	0	0	0	0
	77	IOC	NOT TRACKED			0	0	0
	245	NO_3	178	48	17	2	0	0
		Radionuclides[6]						
Ground Water Quality Data from private wells and PWS wells selected in 319 study[7]	80	VOC	12	8	8	52	0	0
	38	SOC	33	0	3	2	0	0
	40	Metals	32	1	4	3	0	0
	33	NO_3	24	0	2	7	0	0
	0	Radionuclides	0	0	0	0	0	0

1 *PWS system data collected per entry point (see narrative)*
2 *Data collected per well or sampling site for private well and 319 PWS study*
3 *Action due to contaminated ground water (source water)*
4 *Reporting period: 1/1/93-12/31/95*
5 *Transient communities only required to monitor for NO_3*
6 *Radionuclides not required for noncommunity systems*
7 *Reporting period: all parameters for private wells, 1/1/80- 10/1/95; all parameters for 319 PWS, 1/1/93-12/31/94*

Table 52c. *Summary of ground water for drinking water monitoring data*

Hydrogeologic Setting(s): White River West Fork outwash system and outwash plain

Map Unit(s): O1WW, O2WW

Counties included: southeastern Boone, southwestern Delaware, eastcentral Hamilton, northwestern Johnson, central and southwestern Madison, Marion, northeastern Morgan

MONITORING DATA TYPE	TOTAL NO. OF ENTRY POINTS[1] OR WELLS[2] USED IN ASSESSMENT	PARAMETER GROUPS	NUMBER OF ENTRY POINTS[1] OR WELLS[2]					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS[4]	39	VOC	34	5	0	0	0	0
	36	SOC	35	1	0	0	0	0
	39	IOC	NOT TRACKED			0	0	0
	43	NO_3	39	3	1	0	0	0
	39	Radionuclides	0	39	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[5] and non-transient PWS[4]	46	VOC	39	7	0	0	0	0
	45	SOC	45	0	0	0	0	0
	46	IOC	NOT TRACKED			0	0	0
	292	NO_3	267	22	3	0	0	0
		Radionuclides[6]						
Ground Water Quality Data from private wells and PWS wells selected in 319 study[7]	62	VOC	22	3	10	27	0	0
	27	SOC	20	5	0	2	0	0
	45	Metals	32	0	10	3	0	0
	10	NO_3	7	3	0	0	0	0
	3	Radionuclides	0	0	0	3	0	0

1 *PWS system data collected per entry point (see narrative)*
2 *Data collected per well or sampling site for private well and 319 PWS study*
3 *Action due to contaminated ground water (source water)*
4 *Reporting period: 1/1/93-12/31/95*
5 *Transient communities only required to monitor for NO_3*
6 *Radionuclides not required for noncommunity systems*
7 *Reporting period: all parameters for private wells, 1/1/80-10/1/95; all parameters for 319 PWS, 1/1/93-12/31/94*

Table 52d. *Summary of ground water for drinking water monitoring data*

Hydrogeologic Setting(s): White River Upper East Fork sluiceway and outwash plain

Map Unit(s): O1EW, O2EW

Counties included: central and western Bartholomew; central and western Jackson; southeastern Johnson; western Shelby

MONITORING DATA TYPE	TOTAL NO. OF ENTRY POINTS[1] OR WELLS[2] USED IN ASSESS-MENT	PARAMETER GROUPS	NUMBER OF ENTRY POINTS[1] OR WELLS[2]					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS[4]	18	VOC	13	4	1	0	0	0
	18	SOC	17	1	0	0	0	0
	18	IOC	NOT TRACKED			0	0	0
	19	NO_3	7	10	2	0	0	0
	15	Radionuclides	0	15	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[5] and non-transient PWS[4]	10	VOC	9	1	0	0	0	0
	10	SOC	9	1	0	0	0	0
	10	IOC	NOT TRACKED			0	0	0
	35	NO_3	14	13	5	3	0	0
		Radionuclides[6]						
Ground Water Quality Data from private wells and PWS wells selected in 319 study[7]	31	VOC	21	0	4	6	0	0
	20	SOC	20	0	0	0	0	0
	26	Metals	15	4	4	7	0	0
	20	NO_3	7	2	2	9	0	0
	0	Radionuclides	0	0	0	0	0	0

[1] *PWS system data collected per entry point (narrative)*
[2] *Data collected per well or sampling site for private well and 319 PWS study*
[3] *Action due to contaminated ground water (source water)*
[4] *Reporting period: 1/1/93-12/31/95*
[5] *Transient communities only required to monitor for NO_3*
[6] *Radionuclides not required for noncommunity systems*
[7] *Reporting period: all parameters for private wells, 1/1/80- 10/1/95; all parameters for 319 PWS, 1/1/93-12/31/94*

Table 52e. *Summary of ground water for drinking water monitoring data*

Hydrogeologic Setting(s): Ohio River Valley

Map Unit(s): O1OH

Counties included: southern edges of the following: Clark, Crawford, Floyd, Harrison, Jefferson, Perry, Posey, Spencer, Switzerland, Vanderburgh, Warrick

MONITORING DATA TYPE	TOTAL NO. OF ENTRY POINTS[1] OR WELLS[2] USED IN ASSESS-MENT	PARAMETER GROUPS	NUMBER OF ENTRY POINTS[1] OR WELLS[2]					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS[4]	26	VOC	18	7	0	1	1	0
	26	SOC	23	3	0	0	0	0
	26	IOC	NOT TRACKED			0	0	0
	28	NO_3	10	16	2	0	0	0
	16	Radionuclides	0	16	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[5] and non-transient PWS[4]	7	VOC	5	2	0	0	0	0
	7	SOC	7	0	0	0	0	0
	7	IOC	NOT TRACKED			0	0	0
	29	NO_3	20	9	0	0	0	0
		Radionuclides[6]						
Ground Water Quality Data from private wells and PWS wells selected in 319 study[7]	28	VOC	10	9	0	9	0	0
	10	SOC	3	0	0	0	0	0
	10	Metals	7	3	0	0	0	0
	12	NO_3	12	0	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0

1 *PWS system data collected per entry point (narrative)*
2 *Data collected per well or sampling site for private well and 319 PWS study*
3 *Action due to contaminated ground water (source water)*
4 *Reporting period: 1/1/93-12/31/95*
5 *Transient communities only required to monitor for* NO_3
6 *Radionuclides not required for noncommunity systems*
7 *Reporting period: all parameters for private wells, 1/1/80- 10/1/95; all parameters for 319 PWS, 1/1/93-12/31/94*

Muncie and Indianapolis coalesce to form a broad outwash plain (O2WW) between Indianapolis and the Wisconsin glacial margin north of Martinsville. The West Fork of the White River roughly parallels these sequences and contains episodic fan deposits that may be more than 100 feet thick. These sequences are regionally extensive unconfined sand and gravel aquifers with a water table that is typically less than 20 feet below the land surface. Limestone and dolomite are below and hydraulically connected to the outwash. Because these units are unconfined and industrialized they exhibit a high ration of contamination detected per sampling event.

O1EW/O2EW -The East Fork of the White River is underlain by a broad outwash plain (O2EW) that is twelve miles wide and is commonly more than 100 feet thick. In addition, this sequence may contain small fan deposits. It originated as several smaller glacial sluiceways (O1EW) north of the outwash in the central till plain. These sequences begin near Columbus and continue for 30 miles southward. The water table is shallow in this unconfined system and ranges from five to twenty feet below the land surface in the outwash. Because these sequences are vulnerable to contamination and are in areas of agricultural production, more contamination related to farming practices was noted per sampling event than in other areas.

O1OH - The Ohio River Outwash sequence is more than 200 miles long in Indiana and is up to 12 miles wide near Mt. Vernon. This sequence formed as a result of carrying meltwater for pre-Wisconsin and late Wisconsin glaciation. The outwash is up to 200 feet thick and is capped by ten to twenty feet of alluvium. The water table ranges from five feet below the land surface to as much as fifty feet under the sand and gravel terraces that flank the valley walls. This highly vulnerable sequence exhibited contamination in the industrialized areas of Jeffersonville and Evansville whereas the relatively unpopulated areas between have not been documented as contaminated.

Summary of Ground Water Contamination Sites

Type and frequency of contamination sites occurring in each selected hydrogeologic setting are reported in Tables 51a-51e. Organization of this data per setting permits a better understanding of the stress occurring to the individual hydrogeologic setting. Several trends in the data are noted as follows:

1. Industrialized areas exhibit the highest degree of contamination.

2. VOC's are the primary constituent of groundwater contamination.

3. O2S/O2E exhibits the highest degree of contamination of the environments indicated because of the high number of injection wells. The principal contaminants are chlorinated solvents that are used in the construction of recreational vehicles (RV's), or other manufacturing processes.

4. O1EW/O2EW followed by O1WW/O2WW exhibit the highest degree of

contamination by LUST sites (31 percent and 23 percent, respectively) principally because these areas were major development centers for the automobile industry or were chosen as targets in the enforcement of environmental compliance programs for LUST sites.

5. More than 90 percent of contamination occurs in large population centers.

Ground Water for Drinking Water Monitoring Data

Ground water quality data are summarized per hydrogeologic setting in Tables 49a-49e and separated according to data source. Data obtained from community and noncommunity public water supplies (PWS) were collected from Indiana's "Standardized Monitoring Framework" (SMF) compliance results. Community and noncommunity nontransient systems are required to test for 12 inorganic chemicals (IOCs), 31 synthetic organic compounds (SOCs), and 21 volatile organic compounds (VOCs). All public water supply systems including noncommunity transient are required to test for nitrates. Only community systems are required to monitor for radionuclides. Radionuclide monitoring consists of analysis for gross alpha particle activity. Samples collected by PWS are from entry points which occur after treatment and before the distribution system. Entry point data can be from a single well or blended from two or more wells. Table 49a-49e includes a separate summary of ground water quality data originating from private wells. Private well water samples were taken before treatment and from a single well source. Included with the private well summary are those wells sampled from public water supplies (per well and prior to treatment) in a pilot 319 PWS wellhead study. A more extensive list of parameters was analyzed for private wells including more than 100 VOCs, 60 SOCs and 30 metals. The most frequent exceedance of a Maximum Contaminant Level (MCL) for PWS occurred with nitrates, and the most frequent MCL exceedance for private wells was in the VOC parameter group.

DISCUSSION/ CONCLUSION

Ground water is a very important resource for Indiana citizens, business, industry and agriculture. Approximately 60 percent of the state's population uses ground water for drinking water and other household uses. Several ground water protection programs and rules are being developed or have been developed in Indiana to prevent ground water contamination, including the Wellhead Protection Program, Pesticide State Management Plan and ground water quality standards. The major sources of ground water contamination include agrichemical facilities, animal feedlots, irrigation practices, above and below ground storage tanks, closed landfills, industrial facilities, surface impoundments, liquid transport pipelines and materials spills. Several contamination sources are due to practices or activities occurring prior to construction standards and legislation established for the protection of ground water.

Ground water contamination site data were summarized for hydrogeologic settings characterized as highly sensitive to ground water contamination, located within densely populated geographic areas. The five geographic areas summarized were as follows: (1) St. Joseph River Outwash Plain (O2S) and Elkhart River Outwash System (O2E); (2) Exposed outer fan of Valparaiso Moraine (F2Z) and exposed outwash fan of Kalamazoo Morainal System (F2V, F2Vp); (3) White River West Fork outwash system and outwash plain (O1WW, O2WW, respectively); (4) White River Upper East Fork sluiceway and outwash plain (O1EW, O2EW, respectively); and (5) Ohio River Valley (O1OH). The trends identified in ground water contamination site summaries were: (1) industrialized areas exhibited the highest degree of contamination; (2) VOC's were the primary class of contaminants in all hydrogeologic settings; (3) the St. Joseph River Outwash Plain and Elkhart River Outwash System exhibited the largest amount of contamination due to the high number of injection wells and uncontrolled releases. The principal contaminants in this setting were chlorinated solvents used in manufacturing processes; (4) the White River Upper East Fork sluiceway and outwash plain followed by the White River West Fork outwash system and outwash plain exhibit the highest degree of contamination by leaking underground storage tanks and (5) over 90 percent of contamination occurred in major cities.

Ground water quality data from public and private drinking water supplies was summarized within the hydrogeologic settings described above. The most frequent ground water contaminant detected above a Maximum Contaminant Level at Public Water Supplies was nitrate, and the most frequent ground water contaminant detected above a Maximum Contaminant Level in private wells was a volatile organic compound.

Continued emphasis of ground water protection is essential to prevent occurrence of ground water contamination. Ground water protection must continue to be a priority in Indiana.

V. SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Although the discharge of inadequately treated conventional pollutants (BOD, ammonia, solids, etc.), in the past often resulted in highly visible evidence of water pollution, much has been done in the last 10-15 years to greatly reduce or eliminate these problems. This includes the construction of an increasing number of advanced wastewater treatment plants; the regular monitoring for toxic substances through fish tissue and sediment analysis; implementation of the Municipal Compliance Strategy (MCS) which required all municipalities to be in compliance with water quality standards by 1988 regardless of the availability of construction grant funding; and the implementation of an operator training assistance program to help assure better operation of these wastewater treatment facilities. However, other problems or concerns continue, and new ones arise. Some of these concerns will be briefly listed below.

Combined Sewer Overflows and Stormwater

For the past several years, the state has been concerned about the effects of combined sewer overflows (CSOs) and stormwater runoff on surface water and how to best deal with these problems. Since that time, the state has developed strategies to effectively handle these problems.

Indiana developed a Final CSO Strategy which was published in the Indiana Register on May 17, 1996. There are about 116 municipalities that have combined sewer systems. As the NPDES permits for these municipalities expire, they will be reissued permits that include requirements for CSO control based on the approved strategy. The strategy is aimed at identifying and eliminating all non-stormwater discharges (dry weather flow) and minimizing water quality impacts from CSO discharges. Also, municipalities are required to accurately characterize their collection systems and understand the dose/response relationships to precipitation events as well as sample and analyze the receiving stream above and below the CSO points to identify the water quality impacts caused by the CSO events and develop Long Term Control Plans to correct them.

Regulation 327 IAC Article 15, contains the NPDES General Permit Rules. Rules 5 and 6 in Article 15 are the stormwater general permits-by-rule. A Memorandum of Agreement between the IDEM, the IDNR, and local Soil and Water Conservation Districts (SWCDs) is currently being executed by all SWCD's in order to formalize the Rule 5 implementation process. All point source dischargers of stormwater are automatically regulated by these permits-by-rule unless a facility applies for an individual permit or is included in a group application. Existing point source dischargers had until December 29, 1992, to submit the Notice of Intent (NOI) letter required by Article 15.

Semi-Public Facilities

There are many semi-public wastewater treatment facilities in the state. Many of these are not properly maintained and operated. With the limited staff available, the required monitoring of the major and significant minor dischargers does not leave enough time available to adequately monitor these smaller facilities. However, what monitoring has been done would indicate that many of these facilities may have significant impacts on receiving waters. In addition, there have been several instances where these facilities have been constructed to serve subdivisions or housing developments and then abandoned once all the available lots have been sold and major repairs are needed. IDEM is increasing the number of it's inspectors and is developing a strategy to allow for these facilities to be inspected and monitored on a more frequent basis.

Criteria for Contaminants in Fish Tissue and Sediment

The state has gathered considerable data on contaminants in fish tissue and sediments over the last several decades. Indiana currently uses FDA Action Levels for poisonous and deleterious substances in interpreting fish tissue data as to potential health effects. These action levels are only available for relatively few toxic pollutants. Health effect's criteria for substances in fish tissue are being developed using a risk-based approach for Great Lakes sport fish, to allow the states to adequately assess the effect to the public of consuming contaminated fish tissue.

This criteria will be in place in 1996. The U.S. EPA is in the process of developing sediment criteria for some substances. These efforts need to be enhanced and expanded.

Great Lakes Water Quality Guidance (GLWQG)

Although the state has been actively involved in the process of developing the GLWQG, there are still concerns about the impacts that this guidance may have on the state. This guidance became final in March 1995, and the state now has two years to get this guidance, or criteria and procedures "consistent with" the guidance, and incorporated into the states water quality regulations. The state has begun this process by forming a workgroup consisting of representatives from all potential stakeholders (industry, municipalities, environmental and citizen groups, other federal and state agencies, and universities) to provide input to IDEM on the content of these new regulations. The GLWQG criteria and provisions will only apply to the Great Lakes Basin area in Indiana initially, but some of these criteria and implementation procedures may be appropriate for application to the rest of the state during the triennial review for these waters. The state is currently on schedule to get the GLWQG incorporated into the state regulations within the allowed time frames. The workgroup has provided considerable input and guidance to the state and the process seems to be working well, although consensus may not be reached on all issues. There is concern that some of these unresolved issues will cause delays in getting the regulations promulgated by the Water Pollution Control Board.

Biocriteria

The state is generating information necessary to develop numeric biocriteria based on both fish and macroinvertebrate community data to compliment existing narrative biocriteria. However, due to past personnel shortages, this process has fallen behind schedule, and the process may take longer than originally planned. Currently, we are at the same staffing levels as during the previous 305 (b) reporting period. These constraints need to be understood by EPA.

Data Analysis and Report Writing

The state is developing a strategy which will place more emphasis on data review, analysis, interpretation and reporting. Due to lack of adequate personnel, most staff time has been spent in the gathering of data and not in processing and reporting. New staff is being added to assist in QA/QC and data analysis.

Nonpoint Source Pollution Program

The control of nonpoint source (NPS) pollution still poses a concern for the state. However, Indiana has developed several programs which are attempting to alleviate various NPS problems. Particularly active in this area are programs implemented on the local level by county planning and development groups and local soil and water conservation district (SWCD) offices. On the state level these programs are implemented by the IDEM and the Indiana Department of

Natural Resources (IDNR). And, on the federal level these programs are implemented by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service, the U.S. Department of the Interior's Fish and Wildlife Service and the Geological Survey. Volunteer cleanup efforts are also gaining importance. Indiana will continue these various programs with a particular emphasis being placed on education and demonstration projects which are focused at the local level. Regulatory efforts will be greatly enhanced by the proposed rules providing for permit requirements for stormwater runoff from construction and industrial activities. Indiana's Department of Environmental Management also is in the process of updating the State's NPS Water Pollution Management Program Plan and the State's NPS Assessment Report. The updating of these two documents will help in alleviating NPS problems in the State.

Ground Water Protection

A principal objective is to establish a comprehensive state ground water protection program for Indiana. The development of the state ground water protection program framework will build on Indiana's Ground Water Protection and Management Strategy and Implementation Plan of 1987.

One of the major components of the comprehensive ground water protection program is a data management strategy. This strategy should provide for coordination and collection of ground water data among all program areas and agencies which have the responsibility for protecting and remediating ground water. This will allow the state to measure progress, identify problems, and set priorities.

Another important component of a comprehensive ground water protection program is improved public participation, education and awareness. Such a program should coordinate the efforts of all program areas and agencies which have the responsibility for protecting and remediating ground water and involve other organizations and departments which oversee public and higher education.

The State of Indiana is in the process of establishing a wellhead protection program for the protection of public water supply well fields from known sources of contamination. This program will provide technical assistance to local wellhead protection program development and implementation. The wellhead protection program is an excellent example of comprehensive ground water protection because every type of facility within the wellhead protection area must place ground water protection as their highest environmental priority.

Indiana 401 Water Quality Certification Program (Wetlands)

Our wetlands program has evolved over the last 15 years in a way intended to provide the maximum protection possible with the limited staff available. Although there have been some recent staff increases, the workload has also become much greater with our denial of water quality certification for several nationwide permits that the U.S. Army Corps of Engineers had proposed to renew.

There are several modifications or additions to the program that will be considered in the near future, but the direction we take will depend upon the level of staffing provided for this program.

One of the first changes that will be made is the implementation of formal review procedures for projects requiring Section 401 Water Quality Certification. We will also recommend standard mitigation goals for various categories of projects.

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