SURFACE WATER ASSESSMENT

Current Surface Water Monitoring Program

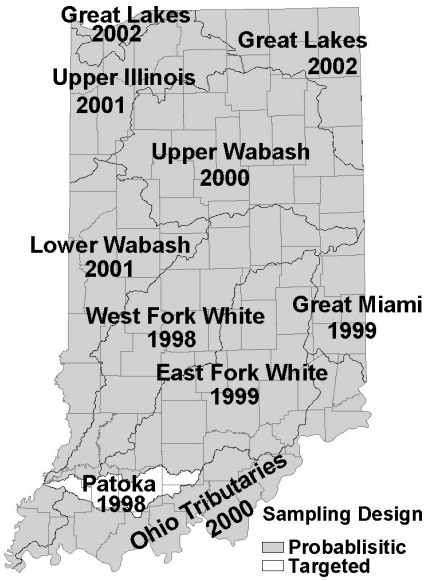
The Office of Water Quality implemented a new surface water monitoring strategy in 1996 to assess the quality of Indiana waters within five years using a rotating basin approach. The monitoring strategy was revised and updated in 1998 and again in 2001. The strategy is designed to provide technical data and information in support of:

- The annual update and biennial Report of Indiana Water Quality (305[b] Report)
- National Pollutant Discharge Elimination System permitting program
- The annual Fish Consumption Advisory (issued by the Indiana State Department of Health in cooperation with IDEM and the Indiana Department of Natural Resources)
- Drinking water source assessment
- Identifying past and emergent water quality trends

Approximately one-fifth of the state is scheduled for monitoring each year for five years (Figure 4). The monitoring results are analyzed and each waterbody is assessed in the second year. Waterbody impairments are generally reported in the third year. This report provides comprehensive assessments for all state surface watersheds. See Appendix C. Watersheds that were previously reported are included in this report:

- 1998 White River, West Fork Basin and Patoka River Basin
- 1999 White River, East Fork Basin and Whitewater River Basin
- 2000 Upper Wabash River Basin
- 2001 Lower Wabash River Basin and Kankakee River Basin
- 2002 Great Lakes Basins and Ohio River Basin

Figure 4 Basin Report Year



The Office of Water Quality's surface water quality monitoring strategy is designed to describe the overall environmental quality of each major river basin and to identify monitored waterbodies that do not fully support designated uses. The surface water monitoring strategy was revised in 2001 to continue to meet the goal of assessing all waters of the state within five years while enhancing support of other Office of Water Quality programs. Four goals of the monitoring program are:

- Measure the physical, chemical, bacteriological, and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment.
- Assess the impact of human or other activities that occur in all river basins and the probable effects of these activities on the quality of the dynamic ecosystem and drinking water source protection.
- Identify trends through analysis of environmental data from a variety of sources and make recommendations for the protection of designated uses of the water resources of the state.
- Provide environmental quality assessment reports to support the water quality management program in partnership with customers and stakeholders.

The monitoring strategy encompasses various monitoring networks staffed by the Office of Water Quality or managed by the Office of Water Quality through contractors. Elements of the sampling program include: fixed station monitoring; computer generated random sites sampled for fish community biotic integrity (IBI), benthic aquatic macroinvertebrate community biotic integrity (mIBI), fish tissue contaminants, surficial aquatic sediment contaminants, and water chemistry; pesticide water monitoring; *E. coli* sampling; National Pollutant Discharge Elimination System permitting support; total maximum daily load (TMDL) development; and targeted fish tissue and surficial aquatic sediment sites. The monitoring strategy and fact sheets with detailed descriptions of the monitoring programs are available on the IDEM Internet web site: www.IN.gov/idem.water.assessbr.swqms2001flndoc.html (IDEM 2001).

Quality assurance project plans covering the major surface water sampling programs were prepared and forwarded to EPA Region 5 in June 1998 and June 1999. A quality assurance project plan revision is planned this year. The Office of Water Quality follows a rigorous and well-defined data quality assessment process for reviewing analytical results presented to the Assessment Branch. This allows the Assessment Branch staff to immediately categorize analytical results for appropriate use and to plan analytical requirements to meet the intended data quality objectives and usage. Four data quality assessment levels have been defined.

The IDEM Assessment Branch stores sampling results in several file formats at this time. A new database that links data from different media and will be accessible to other IDEM staff is under construction. Results from the fixed station monitoring program have been stored in USEPA's storage and retrieval system (STORET) for samples collected through 1995. STORET is not available for batch upload at this time, and it appears that data stored in the system will only be available locally to IDEM.

The 305(b) Assessment Database (version 1.1.3) has been implemented by the IDEM Office of Water Quality. Waterbody assessments for all hydrologic unit areas are now stored in the database. See Appendix A for Assessment Database Metadata. All eight-digit watersheds (USGS cataloging units) in the state have been monitored and are included in this report (See Table 4.). Site-specific results are listed by basin in Appendix B. Comprehensive results for each basin are listed in Appendix C.

Table 4 Indiana Watersheds and Basins

USGS HYDRLOGIC UNIT CODE	NAME	BASIN
04040001	LITTLE CALUMET-GALIEN	GREAT LAKES
04050001	ST. JOSEPH-ELKHART	GREAT LAKES
04100003	ST. JOSEPH-FISH	GREAT LAKES
04100004	ST. MARYS	GREAT LAKES
04100005	UPPER MAUMEE	GREAT LAKES
04100007	AUGLAIZE	GREAT LAKES
05080001	UPPER GREAT MIAMI	GREAT MIAMI
05080002	LOWER GREAT MIAMI	GREAT MIAMI
05080003	WHITEWATER	GREAT MIAMI
05090203	MIDDLE OHIO-LAUGHERY	OHIO RIVER TRIBUTARIES
05120101	UPPER WABASH	UPPER WABASH
05120102	SALAMONIE	UPPER WABASH
05120103	MISSISSINEWA	UPPER WABASH
05120104	EEL-BLUE	UPPER WABASH
05120105	MIDDLE WABASH-DEER	UPPER WABASH
05120106	TIPPECANOE	UPPER WABASH
05120107	WILDCAT	UPPER WABASH
05120108	MIDDLE WABASH-LITTLE VERMILION	LOWER WABASH
05120109	VERMILION	LOWER WABASH
05120110	SUGAR	LOWER WABASH
05120111	MIDDLE WABASH-BUSSERON	LOWER WABASH
05120113	LOWER WABASH	LOWER WABASH
05120201	UPPER WHITE	WEST FORK WHITE
05120202	LOWER WHITE	WEST FORK WHITE
05120203	EEL-BIG WALNUT	WEST FORK WHITE
05120204	DRIFTWOOD	EAST FORK WHITE
05120205	FLATROCK-HAW	EAST FORK WHITE
05120206	UPPER EAST FORK WHITE	EAST FORK WHITE
05120207	MUSCATATUCK	EAST FORK WHITE
05120208	LOWER EAST FORK WHITE	EAST FORK WHITE
05120209	PATOKA	PATOKA
05140101	SILVER-LITTLE KENTUCKY	OHIO RIVER TRIBUTARIES
05140104	BLUE-SINKING	OHIO RIVER TRIBUTARIES
05140201	LOWER OHIO-LITTLE PIGEON	OHIO RIVER TRIBUTARIES
05140202	HIGHLAND-PIGEON	OHIO RIVER TRIBUTARIES
07120001	KANKAKEE	UPPER ILLINOIS
07120002	IROQUOIS	UPPER ILLINOIS
07120003	CHICAGO	UPPER ILLINOIS
NONE	OHIO RIVER MAINSTEM	OHIO RIVER

Source: USEPA Total Waters File and Indiana 305(b) Assessment Database

The Office of Water Quality has georeferenced waterbody segments in the 305(b) Assessment Database to the National Hydrography Dataset version provided by USEPA. Each lake and stream segment has it's own unique identifier in the 305(b) Assessment Database (ADB), and the same unique identifier in the Indiana Reach Index Georeference. A geographical information system coverage of Indiana 14-digit hydrologic unit areas was recently finalized; each waterbody 14-digit hydrologic unit code in the ADB corresponds to the Indiana 14-digit hydrologic unit polygon geographical information system coverage. The interactive data analysis capabilities are expected to be extremely useful for watershed monitoring, assessment, reporting, planning, and management.

Plan for Achieving Comprehensive Assessments

IDEM adopted a new surface water quality monitoring strategy in 1995 with the goal of assessing and reporting all streams for aquatic life use support by 2003. To date, 99.3 percent of Indiana stream miles have been assessed for aquatic life use. A five-year rotating basin plan was chosen which would result in reporting on assessment of approximately 20% of the state's surface water streams each year using this process. Reporting began with the West Fork White River and Patoka River watersheds in 1998. The East Fork White River and Whitewater River watersheds were reported in 1999 as an electronic update. Indiana's portion of the Upper Wabash basin was reported in Indiana Water Quality 2000. The Lower Wabash and Upper Illinois basins were reported for the 2001 electronic update. This report adds the Great Lakes basin, Ohio River tributaries, and mainstem Ohio River, providing a comprehensive assessment of Indiana streams for aquatic life use support. (See Figure 4.) Comprehensive assessment results for each basin appear in Appendix C.

Lake assessments are rotated on a five-year plan, generally north to south across the state. Assessments were rescheduled beginning with the 1998 sampling rotation. The new schedule more closely resembles the stream monitoring schedule. Since lake distribution is denser in the northern area of the state, the schedules do not match exactly. Lake monitoring results are generally available at the end of each monitoring year.

Ground water updates are provided as monitoring of Indiana's hydrogeologic settings progresses each year. The hydrogeologic settings that are assessed are added to the groundwater report, and new assessments replace older assessments.

The five-year rotating basin approach provides reports of comprehensive assessments of approximately 20% of Indiana watersheds each year. Watersheds have been assessed and reported for the entire state this year using this approach. A combination of probabilistic and targeted monitoring designs are used to provide data for waterbody assessment and to support other IDEM Office of Water Quality goals and programs.

Assessment Methodology and Summary Data

Use support status was determined for each stream waterbody using the assessment guidelines provided by USEPA (1997b). Available results from six monitoring result types were integrated to provide an assessment for each stream waterbody reported here.

- Physical/chemical water results.
- Fish community assessment.
- Benthic aquatic macroinvertebrate community assessments.
- Fish tissue and surficial aquatic sediment contaminant results.
- Habitat evaluation.
- *E. coli* monitoring results.

Lake assessments were based on the Indiana Trophic State (or eutrophication) Index, a modified version of the BonHomme Index developed for Indiana lakes in 1972. This multi-metric index combines chemical, physical, and biological data into one overall trophic score for each public lake and reservoir sampled. Scores range from 0 to 75. Lower values reflect more oligotrophic lakes and higher values represent more eutrophic lakes. This information is useful in evaluating watershed impacts on a lake.

Waterbodies are identified based on watershed areas known as 14- digit hydrologic unit areas (HUAs). These watersheds range from about 5,000 to 20,000 acres in Indiana. The average 14-digit hydrologic unit area in Indiana is about 12,000 acres or 20 square miles. River miles in a watershed appear as one waterbody with smaller segments designated when assessments for stream reaches differ. Each lake in a watershed is reported as a separate waterbody.

Large rivers with over 1,000 square miles of drainage area are tracked by reach of the mainstem within hydrologic unit areas. This way the wadeable streams and nonwadeable streams are separated so that issues, such as sampling techniques, which might bias results can be considered within a class of streams.

Lakes, reservoirs, and wetlands are tracked individually. They are reported with the hydrologic unit area in which they are located whether or not the lake or reservoir is also included as a linear stream feature in the National Hydrography Dataset.

Lake Michigan is tracked both as Great Lake shoreline miles and as a lake with its own USGS cataloging unit (eight-digit hydrologic unit code). The shoreline is assigned mileage units. Lake Michigan as a separate lake waterbody is assigned acreage units; it is not included in the lake acre assessment values in this report. Hopefully, separate tracking will lead to better assessment and understanding of the water quality of the Indiana waters of Lake Michigan.

The assessment process was applied to each data sampling program. Then the individual assessments were integrated into a comprehensive assessment for each waterbody by use designation: aquatic life support, fish consumption, drinking water supply, and recreational use. Each unique waterbody segment received it's own assessment. When the assessment for a segment was not homogeneous, the segment was split. Each smaller segment then received it's own assessment. Each segment in the 305(b) assessment database corresponds to a linear,

polygonal, or point feature in the Indiana Reach Index georeferenced to the National Hydrography Dataset.

Physical/chemical data for toxicants (total recoverable or dissolved metals, polynuclear aromatic hydrocarbons [PAHs], pesticides, ammonia, and cyanide), conventional water chemistry parameters (dissolved oxygen, pH, temperature, and anions), and bacteria (*E. coli*) were evaluated for exceedance of the Indiana Water Quality Standards (327 IAC 2-1-6 and 327 IAC 2-1.5-8). USEPA 305(b) Guidelines were applied to sample results as indicated in Table 5 (USEPA 1997b).

Table 5 Criteria for Use Support Assessment

Parameter	Fully Supporting	Partially Supporting	Not Supporting
Aquatic Life Use Support			
Toxicants	Metals,pesticides, PAHs, cyanide, ammonia were evaluated on a site by site basis and judged according to magnitude of exceedance and the number of times exceedances occurred using USEPA guidelines.		
Conventional inorganics	Dissolved oxygen, pH, total dissolved solids, specific conductance, sulfate, chloride were evaluated for exceedance of Indiana water quality standards using USEPA guidelines.		
Nutrients	Presence of some stream response dissolved oxygen, pH, algae, field observations with corresponding high inorganic and/or organic nutrient parameters combined with possible nutrient source(s).		
Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI)	mIBI $\geq$ 4.	mIBI < 4 and $\geq$ 2.	mIBI < 2.
Qualitative habitat use evaluation (QHEI)	QHEI $\geq$ 64.	QHEI < 64 and $\geq$ 51.	QHEI < 51.
Fish community (IBI) (Lower White River, West Fork)	IBI $\geq$ 44.	IBI < 44 and $\geq$ 22	IBI < 22.
Fish community (IBI) (White, East Fork; Whitewater; and Upper Wabash basins)	IBI > 34	IBI $\leq$ 34 and $\geq$ 32	IBI < 32
Fish community (IBI) (Lower Wabash, Upper Illinois, Great Lakes, basin, Ohio River tributaries)	IBI $\geq$ 32		IBI < 32
Sediment 1998 - 1999 (PAHs = polynuclear aromatic hydrocarbons. AVS/SEM = acid volatile sulfide/ simultaneously extracted metals.)	All PAHs $\leq$ 75th percentile. All AVS/SEMs $\leq$ 75th percentile. All other parameters $\leq$ 95th percentile.	PAHs or AVS/SEMs > 75th percentile. (Includes Grand Calumet River and Indiana Harbor Canal sediment results, and so is a conservative number.)	Parameters > 95th percentile as derived from IDEM Sediment Contaminants Database.

Table 5 Criteria for Use Support Assessment

Parameter	Fully Supporting	Partially Supporting	Not Supporting
Sediment (Upper Wabash, Lower Wabash, Great Lakes basin)	In addition: Locations with results above probable effects concentration and some indication of adverse biological or toxic response were classified as not supporting. Other locations identified for further biological or toxicity assessment (Ingersoll and MacDonald 1999).		
Indiana Trophic State Index (lakes only)	Nutrients, dissolved oxygen, turbidity, algae growth, and sometimes pH were evaluated on a lake-by-lake basis. Each parameter judged according to magnitude.		
Lake sport fishery survey by Indiana Department of Natural Resources	Supports cold water fishery, including native cisco and/or put and take trout.	Native cisco population are gone or lake unable to support put and take trout fishing.	Lake attributes appear to contribute to warm water fishery condition.
Fish Consumption			
Fish tissue	Group 1- Unlimited consumption*	Groups 2 - 4 – Limited consumption*	Group 5 – Do not eat*
* Indiana fish consumption Advisory, 2001, includes a state wide advisory for carp consumption for rivers and streams. Only site specific fish consumption advisories were considered in determining use support status.			
Drinking Water (Surface water intake before treatment)			
Pesticide application to surface drinking water reservoir	Drinking water reservoirs or lakes that received pesticide (algicide) application for taste and odor caused by algae were classified as not fully supporting drinking water because of the additional treatment required to prepare the water for drinking.		
Recreational Use Support (Swimmable)			
Bacteria: at least 5 equally spaced samples over 30 days.	Meets both geometric mean and no more than one sample substantially > single sample maximum	Meets geometric mean. More than one sample substantially > single sample maximum.	Exceeds geometric mean.
Bacteria: grab samples (cfu = colony forming units)	No more than one grab sample (no more than 10% if 10 or more samples) substantially > single sample maximum	More than 10% of samples substantially > single sample maximum. No more than one sample > 2,400 cfu/100ml	More than 25% of samples substantially > single sample maximum or more than one sample > 2,400 cfu/100ml

Source: IDEM Office of Water Quality

List of Impaired Waters

Waterbodies that require total maximum daily load calculations are reported to USEPA periodically as required by Section 303(d) of the Clean Water Act. The last report was in April 1998.

A draft list for 2002 was prepared and published in the Indiana Register, March 1, 2002. Public comments on the draft list were accepted through May 29, 2002.

Indiana's Listing Methodology describes the process used to place water bodies into the five Integrated List categories. See Appendix E.

The final 2002 Section 303(d) List of Impaired Waters is Category 5 of the Consolidated List of Indiana Waters, Appendix F. The list is available on the Office of Water Quality internet site: (http://www.IN.gov/idem/water/planbr/wqs/303d.html). Waters in Category 5 require TMDLs.

Rivers and Streams Water Quality Assessment

Designated Use Support

Rivers and streams in all watersheds were assessed for uses designated in Indiana water quality standards (Indiana Legislative Services Agency, 1997). The standards have both narrative and numeric requirements that are used to evaluate designated use support. Indiana has several designated uses for surface water. The ability of waterbodies to support aquatic life use and recreational use were assessed for this report. Individual waterbody assessment results may be found in Appendix B or on the IDEM Internet site at: (http://www.IN.gov/idem/water/planbr/wqs/quality.html).

Fish consumption advisories are based on data resulting from the bioaccumulation of pollutants in fish tissues and are tracked separately from other aquatic life use support parameters (USEPA 1997b). Fish consumption use was evaluated by using the Indiana Fish Consumption Advisory to indicate specific waterbodies that have limited fish consumption advisories. This report makes no assumptions regarding the relationship between the fish body burden of a contaminant and the state water quality standard for that contaminant developed and promulgated to provide for acceptable levels of human health protection under the Clean Water Act.

Assessed waters are those waterbodies that were evaluated or monitored and classified for use support based on the assessment results. Waterbodies with monitoring data over five years old are evaluated. Streams that have been assessed with probabilistic monitoring results that do not correspond to specific stream reaches are also classified as evaluated (Table 6). See the Special State Concerns and Recommendations section. Waterbodies that have been monitored within the past five years are classified as monitored. Some monitored waterbodies include supplemental monitoring data mostly from fish tissue samples collected as early as 1987 (USEPA 1997b).

Table 6 summarizes the division of assessed stream miles into evaluated and monitored categories. Ninety-nine and three tenths percent of Indiana stream miles have been assessed since 1998. The probabilistic monitoring program precludes relating every stream mile assessed for aquatic life use to the specific stream miles assessed for other uses at this time. In addition, the conversion from the Waterbody System Database to the 305(b) Assessment Database resulted in insufficient information in the new database for the streams reported in 1998. Therefore, an estimate of the total assessed stream miles that have been reported 1998 – 2002 are presented in the table.

Table 6 Summary of Fully Supporting, Threatened and Impaired Waters - Streams

National and State Uses (rounded to the nearest ten miles)

Degree of Use Support	Evaluated	Monitored	Total Assessed
Size filly supporting all assessed uses	13720	9280	23000
Size impaired for one or more uses	5790	6640	12430
TOTAL ASSESSED	19510	15920	35430

Source: Indiana 305(b) Assessment Database and IDEM Biological Studies Section

Waterbodies are classified for designated use support as described in the Assessment Methodology Section. Individual use support for the state is determined by adding the stream miles assessed for each use individually. Table 7 summarizes use support for the stream miles in the state. See Appendix B for site-specific assessments.

Table 7 Individual Use Support Summary - Streams

National and State Uses (rounded to the nearest ten miles)

Use	Size Assessed	Size fully supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic life support	35430	23000			12430	14
Fish Consumption	3470			3250	220	
Drinking Water Supply	3	3				
Primary Contact (RECR)	8450	5500		70	2890	

Source: Indiana 305(b) Assessment Database and IDEM Biological Studies Section.

IDEM Office of Water Quality believes that the most consistent way to evaluate overall use support is best represented by the stream miles supporting aquatic life use, which is a designated use in the Indiana Administrative Code. Representative samples for fish community assessment have been used to determine overall aquatic life use support this year as part of the rotating basin watershed approach. Sampling locations randomly generated from Reach File 3 by USEPA's computer in Corvallis, Oregon were assessed by IDEM staff for fish community index of biotic integrity as part of the probabilistic monitoring program. The results of each year's sample data set were analyzed to determine the estimated aquatic life use support for the basin represented. A small number of samples were used to represent and estimate aquatic life use support for a large watershed area as shown in Table 8. Previous assessments required large numbers of individual samples each representing a specific location and stream mileage.

Table 8 Comprehensive Aquatic Life Use Support – Streams

PROJECT ID	PROJECT NAME	SUPPORT (miles)	NON SUPPORT (miles)	NOT ASSESSED (miles)	TOTAL (miles)
IN-GL00	GREAT LAKES TRIBUTARIES	999	2997		
IN-GM97	GREAT MIAMI BASIN	1463	163		
IN-UW98	UPPER WABASH BASIN	4776	1857		
IN-RW99	LOWER WABASH BASIN	4086	1221		
IN-WF96	WEST FORK WHITE BASIN	3120	1154		
IN-EF97	EAST FORK WHITE BASIN	3885	971		
IN-UN99	UPPER ILLINOIS BASIN	2528	1484		
IN-HT00	OHIO TRIBUTARY BASINS	1262	2563		
	PATOKA BASIN**	531	16	250	
	OHIO RIVER**	347			
	TOTAL STREAM MILES	22997	12426		35673
	PERCENT TOTAL	64.5	34.8		

Source: IDEM Biological Studies Section. **Indiana 305(b) Assessment Database

Causes/Stressors and Sources of Impairment of Designated Uses

Causes/ stressors are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. Toxic substances listed in the state water quality numeric standards and conditions such as habitat alterations, presence of exotic species, etc. are all examples of causes or stressors. The stressor inhibits the waterbody from providing a habitat that can support aquatic life or creates a situation that is hazardous to human health or animal life.

Table 9 represents the total miles of streams affected by each cause/stressor in Indiana. A waterbody may be impaired by several different causes/stressors so that the total stream miles affected may actually be less than the total number of miles listed in the table.

Biotic community status represents streams where the cause of impairment is not identified. The fish and/or benthic macroinvertebrate community at sampling sites in the watershed have responded to as yet unidentified stressors. The category corresponds to national code "unknown". See Appendix A for cause definitions.

Table 9 Summary of National and State Causes Impairing Waters – Streams

(Rounded to the nearest mile)

Cause/ Stressor	Size (miles)
Cause unknown	2128
Biotic community status	2128
Pesticides	54
Atrazine	6
Priority organics	64
PAHs	22
PCBs	3007
Dioxins	154
Metals	2734
Cadmium	17
Copper	29
Lead	90
Mercury	2678
Nickel	13
Zinc	31
Unionized Ammonia	70
Cyanide	65
Sulfates	106
Nutrients	277

Cause/ Stressor	Size (miles)
PH	60
Siltation	16
Organic enrichment/Low DO	335
Organic enrichment	31
Low dissolved oxygen	301
Salinity/TDS/chlorides	205
Total dissolved solids	186
Chlorides	19
Thermal modifications	15
Other habitat alterations	55
Pathogens (*E. coli* indicator)	2952
Oil and grease	11
Algal Growth	55

Source: Indiana 305(b) Assessment Database.

Sources are the activities that contribute pollutants or stressors to surface water resulting in impairment of designated uses in a waterbody. The activities listed in Table 10 represent the total stream miles impaired due to each possible source. Several sources may contribute to impairment of a stream or stream reach, so the total miles in the table may be greater than the actual stream miles impaired.

Table 10 provides more information than was available for the previous report in 2000. Since 1998, 32 potential sources of pollutants have been added to Table 10 including agricultural categories and additional sources resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters without any treatment. Contaminated sediments are largely due to PCBs that correlate with elevated PCB levels in fish tissue resulting in group 5 (do not eat) fish consumption advisories. See Appendix A for source definitions.

Table 10 Summary of National and State Sources Impairing Waters – Streams

(Rounded to the nearest mile)

Source	Size (miles)
Industrial Point Sources	287
Municipal Point Sources	263
Package Plants (Small Flows)	55
Combined Sewer Overflow	174
Collection System Failure	2
Agriculture	540

Source	Size (miles)
Crop-related Sources	132
Livestock	284
Intensive animal feeding operations	3
Construction	2
Highway/road/bridge construction	2
Land development	2
Urban Runoff/Storm Sewers	452
Other Urban Runoff	254
Illicit connections/illegal hook-ups/dry weather flows	167
Erosion and sedimentation	18
Resource Extraction	87
Acid Mine Drainage	63
Abandoned Mining	24
Land Disposal	189
Landfills	7
Inappropriate waste disposal/wildcat dumping	35
Onsite Wastewater Systems (Septic Tanks)	144
Hydromodification	201
Channelization	175
Dredging	46
Dam construction	16
Flow regulation/modification	10
Habitat Modification (other than Hydromodification)	228
Removal of riparian vegetation	83
Bank or shoreline modification/destabilization	14
Contaminated Sediments	176
Debris and bottom deposits	18
Natural Sources	43
Salt storage sites	26
Other	2569
Nonpoint source/ unknown origin	2569
Source Unknown	2135

Source: Indiana 305(b) Assessment Database

Great Lakes Shoreline Water Quality Assessment

The Indiana portion of Lake Michigan is under a limited fish consumption advisory issued by the Indiana State Department of Health. The Lake Michigan shoreline miles represented in Table 11 are under the same limited consumption advisory. Lake Michigan shoreline is also classified as partially supporting recreational use. The shoreline miles reported in Tables 11 through 14 represent linear shoreline miles from the National Hydrography Dataset.

Table 11 Summary of Fully Supporting, Threatened and Impaired Great Lakes Shoreline

National and State Uses (shoreline miles)

Degree of Use Support	Evaluated	Monitored	Total Assessed
Size fully supporting all assessed uses			
Size fully supporting all assessed uses but threatened for at least one use			
Size impaired for one or more uses	6	53	59
Size not attainable for any use and not included in the line items above			
TOTAL ASSESSED	6	53	59

Source: Indiana 305(b) Assessment Database

Lakes are classified for support of designated uses as described in the Assessment Methodology section. Indiana's entire portion of the Lake Michigan shoreline was assessed in 2001. See Appendix B for site-specific assessments.

Table 12 Individual Use Support Summary – Great Lakes Shoreline

National and State Uses (in miles)

Use	Size Assessed	Size fully supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic life support	59	58			1	
Fish Consumption	59			59		
Drinking Water Supply	33	33				
Primary Contact (RECR)	59	1			58	

Source: Indiana 305(b) Assessment Database

Causes/ stressors are pollutants or other stressors that adversely impact the designated uses of a lake. PCBs and mercury are the fish tissue contaminants identified in fish consumption advisories. Pathogens (*E. coli* is the indicator measured.) identify recreational use impairment for Indiana's Lake Michigan shoreline (Table 13). See Appendix A for cause definitions.

Table 13 Summary of National and State Causes Impairing Great Lakes Shoreline

Cause/ Stressor	Size (miles)
PCBs	59
Metals	59
Mercury	59
Cyanide	1
Pathogens	58

Source: Indiana 305(b) Assessment Database

Sources are the activities that contribute pollutants or stressors to lakes resulting in impairment of designated uses. Six possible activities contributing to impairment of the Lake Michigan shoreline have been added as a result of the 2001 assessments (Table 14). See Appendix A for source definitions.

Table 14 Summary of National and State Sources Impairing Great Lakes Shoreline

Source	Size (miles)
Urban runoff/storm sewers	18
Illicit connections/illegal hook-ups/dry weather flows	18
Land Disposal	18
Onsite wastewater systems (septic tanks)	18
Other	6
Nonpoint source/unknown origin	6
Source Unknown	59

Source: Indiana 305(b) Assessment Database

Great Lake Water Quality Assessment – Lake Michigan

The Indiana waters of Lake Michigan have been assessed for fish consumption. Tables 15 and 16 reflect the fish consumption advisory for Lake Michigan issued by the Indiana State Department of Health.

Table 15 Summary of Fully Supporting, Threatened and Impaired Great Lake

National and State Uses (acres)

Degree of Use Support	Evaluated	Monitored	Total Assessed
Size fully supporting all assessed uses			
Size fully supporting all assessed uses but threatened for at least one use			
Size impaired for one or more uses		154,176	154,176
Size not attainable for any use and not included in the line items above			
TOTAL ASSESSED		154,176	154,176

Source: Indiana 305(b) Assessment Database

Table 16 Individual Use Support Summary – Great Lake

National and State Uses (in acres)

Use	Size Assessed	Size fully supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic life support						
Fish Consumption	154,176			154,176		
Drinking Water Supply						
Primary Contact (RECR)						

Source: Indiana 305(b) Assessment Database

Lake Water Quality Assessment

Designated Use Support

AQUATIC LIFE USE SUPPORT (ALUS) of lakes and reservoirs has not been frequently monitored in Indiana, owing to the fact that the majority of State resources have gone toward assessing the trophic status of lakes in the state. Since Indiana's Trophic State Index (TSI) focuses on such water quality components as nutrients, dissolved oxygen, water clarity, and plankton; trophic information alone is considered insufficient for judging the exact condition of biological communities such as fish, macroinvertebrates, and rooted plants. Although the State has long used biological indicators of river and stream health, it has only recently begun looking at the potential for such indicators within lake settings.

In 1999 and 2000, the State utilized Section 319 monies to fund a study to determine if fish and macroinvertebrate IBIs (Index of Biotic Integrity) could be developed for natural lakes and reservoirs in the Indiana portion of the Central and Eastern Corn Belt Plains ecoregions. Additional funding has been awarded to conduct a similar study on the fish communities of oxbow and fluvial lakes found in the southern parts of the state. Preliminary findings from the fish portion of this study appear very promising in this regard. Macroinvertebrate data collected during this study are still being quality checked prior to statistical analysis, although the initial numbers and diversity of organisms collected also appear to be promising.

For purposes of this Report, assessments of ALUS for lakes was determined using current and historical information gathered by fishery biologists with the Indiana Department of Natural Resources (IDNR or DNR). While monitoring the status of sport fish communities in lakes and reservoirs around the state, DNR biologists have noted the distribution and abundance of native cisco (*Coregonus artedi*) populations. This native salmonid (fish) is sensitive to environmental conditions within the layer of water that is their domain. Their requirements for cool temperatures and adequate dissolved oxygen in this layer makes them susceptible to the effects of increased nutrients and turbidity; which can lead to shading out of deeper plants and/or oxygen depletion below the thermocline during periods of summer stratification. Although other stressors--such as over-fishing, being out-competed or preyed upon--may also be impacting these populations; DNR reports are often unclear as to which of these causes is affecting any given lake. A more thorough investigation of various data from these lakes and their watersheds will be needed to make such determinations.

Lakes which have--at some point in recorded history--lost their native cisco population have been listed here as partially supporting for ALUS, since it is assumed that the warmwater fish community may still be thriving in those lakes. Lakes whose heretofore thriving cisco populations are now considered rare or probably extirpated have been listed here as threatened. Lakes where cisco are still commonly found have been listed as fully supporting, since it is assumed that warm water fishes are also being sustained where their cold water counterparts are thriving. All other lakes (those where Cisco have always been and still are rare, or those beyond the ciscoes natural range) have been left as unassessed at this time.

FISH CONSUMPTION USE SUPPORT assessments were made in the recent past using the currently published Indiana Fish Consumption Advisory (FCA). The same was done here using the 2001

Indiana FCA, which currently lists 69 lakes for mercury and/or PCB contamination. Lakes and reservoirs where fish consumption advisories have been issued for contaminant of any fish species are listed as partially supporting for fish consumption use.

RECREATIONAL USE SUPPORT has also been rarely monitored for in Indiana lakes and reservoirs, except at swimming beaches. Historically, if persons were utilizing a given lake, it was considered to be supporting of that use--despite any knowledge (or lack thereof) of its bacteriological component. Past difficulties in collecting and transporting bacteriological samples to a state laboratory within the required time frame was one of several hindrances to monitoring of this type. Funding from a Section 319 grant, however, has allowed the State to a) initially contract out some *E. coli* testing, and b) purchase a cargo van and outfit it as a mobile *E.coli* laboratory for more long-term monitoring benefit. In 2000, the mobile van followed routes throughout the Great Lakes watersheds. About a dozen lakes, in addition to the many river and stream sites, had statistically valid bacteriological sampling done on them for at least a month during the recreational season of April through October. Unfortunately, for ease of access, these samples were typically taken at a boat ramp and may or may not be indicative of bacteria counts elsewhere in the lake. During the 2001 sampling season, mobile lab routes included only one lake within each of the West Fork White River and Patoka River watersheds. The results for all were found to be well-within State guidelines for recreational use support.

As indicated above, swimming beach managers have long been major players in monitoring the bacteriological quality of waters around the state. It is hoped that access to beach monitoring information, be it raw data or information on beach closures, will be more readily available for future assessments. Much effort will be needed on the part of the State, however, to gather and assess this information each year, since reporting to a centralized location is no longer a requirement in Indiana. Still, as mentioned previously, swimming beach information may or may not be a good indication of water quality conditions elsewhere in the lake, where wading or water skiing may be occurring.

DRINKING WATER USE SUPPORT has been assessed within the lakes program for the first time this year. Reservoirs and lakes used directly or indirectly for drinking water supplies (as a withdrawal point or for upstream storage) were taken into consideration for this assessment. Water utilities are not currently required to report data on raw water sources, only on finished water quality. Key information used here included drinking water lakes for which pesticide application permits have been issued within the past five to six years. This information was available from both the IDNR Division of Fish and Wildlife (which regulates and approves such permit applications) and IDEM's Drinking Water Branch.

As mentioned above for aquatic life use support, recent discoveries of an exotic bluegreen algae came into play with assessments of drinking water use support. One or two drinking water lakes have been classified as threatened if the presence of this algae has been confirmed there. Long-term ramifications of this algae within these lakes is currently under study by a panel of professionals from around the state.

Cumulative lake assessment data are presented in Tables 17 through 20. Eight additional causes and five additional possible source activities were identified in 2001 assessments. See appendix B for site-specific assessments. Cause and source definitions may be found in appendix A.

Table 17 Summary of Fully Supporting, Threatened and Impaired Lakes, Reservoirs

National and State Uses (Rounded to nearest 10 acres)

Degree of Use Support	Evaluated	Monitored	Total Assessed
Size fully supporting all assessed uses	490	2180	2,670
Size fully supporting all assessed uses but threatened for at least one use	0	0	0
Size impaired for one or more uses	540	68,550	69,090
Size not attainable for any use and not included in the line items above	0	0	0
TOTAL ASSESSED	1030	70,730	71,760

Source: Indiana 305(b) Assessment Database

Table 18 Individual Use Support Summary – Lakes, Reservoirs

National and State Uses (Rounded to nearest 10 acres)

Use	Size Assessed	Size fully supporting	Size Fully Supporting but Threatened	Size Partially Supporting	Size Not Supporting	Size Not Attainable
Aquatic life support	13,720	5,740		6,310	1,670	
Fish Consumption	65,190			65,190		
Drinking Water Supply	25,460		9,110	15,870	480	
Primary Contact (RECR)	7,170	7,170				

Source: Indiana 305(b) Assessment Database and IDEM Biological Studies Section.

Table 19 Summary of National and State Causes Impairing Lakes, Reservoirs

Cause/ Stressor	Size (Rounded to nearest 10 acres)
Cause Unknown	4960
Biotic community status	4960
PCBs	19,230
Metals	55,140
Mercury	55,140
Nutrients	1350
pH	110
Thermal modifications	1560
Taste and odor	9330
Noxious aquatic plants	3280
Algal Growth/chlorophyll a	13,080

Source: Indiana 305(b) Assessment Database

Table 20 Summary of National and State Sources Impairing Lakes, Reservoirs

Source	Size (Rounded to nearest 10 acres)
Industrial Point Sources	1,560
Resource Extraction	110
Acid mine Drainage	110
Other	210
Source Unknown	63,470

Source: Indiana Water Quality Report 1998 and Indiana Fish Consumption Advisory

Indiana Clean Lakes Program

The Indiana Trophic State Index (TSI) is used to assign points for each of ten common water quality parameters. The total of these points for a particular lake is that lake's trophic or TSI score. Scores range from 0 to 75 points, with lower numbers indicating more oligotrophic conditions and higher numbers indication more eutrophic conditions.

During the 1970s, Indiana lakes and reservoirs were divided into three classes based on trophic scores determined for them at the time. Class I lakes were least impacted by nutrients, scoring

between 0 and 25 points on the Indiana Trophic State Index. Class II lakes (26-50 points) showed an intermediate amount of nutrient enrichment. Class III lakes scored 51 to 75 points and demonstrated the highest level of enrichment or eutrophication. A fourth lake class, which included remnant and oxbow lakes, ceased to be utilized in the lakes program since waterbodies listed in this class are more typically recognized and/or regulated as wetlands.

In 1998, Indiana lakes were divided into five classes consistent with USEPA guidelines (USEPA 1997b), whose methodology appears consistent with the original lake classification scheme described above for Indiana. The lake classes used in this report, in order of increasing eutrophication, are:

- oligotrophic less than 15 points on the Indiana TSI scale;
- mesotrophic 16-31 TSI points;
- eutrophic 32-46 TSI points;
- hypereutrophic greater than 47 TSI points;
- dystrophic lakes with little plant growth despite the presence of nutrients; usually due to high humic conditions.

Staff and students at Indiana University's School of Public and Environmental Affairs (SPEA), funded by a Section 319 grant, monitored 403 lakes during the summers of 1996 through 2000. Data for seven (7) of these lakes was considered unusable for this assessment, due to technical difficulties in the laboratory.

In keeping with past practices and university class schedules, the lake samples are collected during July and August of each year since this is when the water column in the lakes naturally stratify. The results, then, are expected to represent worst-case conditions for lake water quality, consistent with past monitoring efforts in the state and elsewhere.

Sampling protocol calls for a single set of water samples to be collected from the deepest portion of each lake and analyzed at the SPEA laboratory in Bloomington, Indiana using standard methods (APHA 1992). All other chemical analyses and plankton counts are also completed in the SPEA lab in Bloomington, Indiana. Dissolved oxygen, pH, and water clarity readings are taken in the field.

During the past five years, TSI scores ranged from a low of 0 points for Pump Lake in Sullivan County to a high of 68 points on Black Lake, Whitley County. The average trophic score during this five-year period (1996-2000) was 27 points, which is the upper half of the mesotrophic class (or the lower end of Class II in the original Indiana lake classification scheme).

Of the lakes sampled from 1996 to 2000, approximately 21% fell into the oligotrophic category, 42% were classified as mesotrophic, 28% as eutrophic, and 8% as hypereutrophic. One percent of the lakes with data older than five years were listed as unknown (Table 21).

Looking at acreage for each classification shows us that 13% fell into the oligotrophic category. The next three classes–in order–contained 71%, 13%, and 3% of the lake acres monitored from 1996-2000. Less than one percent of the lake acres were classified as unknown.

A summary of trophic status for lakes sampled throughout the state between 1996 and 2000 is presented in Table 21. "Significant public lakes" means all lakes monitored regardless of ownership or access. See Appendix D for individual lake classification.

Table 21 Trophic Status of Significant Public Lakes Assessed 1996-2000

	Number of Lakes	Lake Acres
Total assessed for Trophic Status	371	100,815
Oligotrophic	77	13,194
Mesotrophic	157	71,517
Eutrophic	104	12,846
Hypereutrophic	29	3,108
Unknown	4	150

Source: Indiana 305(b) Assessment Database

Based on lake monitoring efforts to date, Indiana is still just beginning to have enough data points collected to do some cursory trend analysis (Table 22). Of the lakes sampled during this period, approximately 43% (39% of the acreage) appear to be stable; they are neither losing nor gaining with respect to eutrophication status. Twelve percent of the lakes (eight % of the acres) show some water quality improvement due to decreasing eutrophication. Six percent of the lakes sampled between 1996 and 2000 (11 % of the acreage) show degraded water quality due to increasing eutrophication. The water quality trend is fluctuating or unknown for 38% of the lakes (42% of the acreage). A lack of trend detection here may be due to insufficient data points for a particular lake (i.e. it is new or was never sampled in the past). Lack of detectable trends can also be due to sampling error, methodology, abnormal seasonal effects, or changing activities in the surrounding watershed.

Table 22 Trends in Trophic Status of Significant Public Lakes - 1996-2000

	Number of Lakes	Lake Acres
Assessed for trends	371	100,815
Improving	46	8,086
Stable	161	39,181
Fluctuating	86	37,007
Degrading	23	10,825
Trend Unknown	55	5,716

Source: IDEM Biological Studies Section

Efforts were made to more closely align the five-year rotation of lake assessments with IDEM's current surface water monitoring strategy. The goal was to enable a temporal comparison of the assessed water quality of lakes with that of adjoining rivers and streams. The difficulty with such an approach lies in the fact that lakes are not distributed as equally around the state as rivers and streams are. While some basins contain few lakes, others contain more than can feasibly be sampled in a given year. Therefore, switching from a sampling regime that includes all lakes and reservoirs to one with a probabilistic sampling design might be preferable in the future.

Wetlands Assessment

The Indiana Department of Environmental Management (IDEM) administers the Clean Water Act Section 401 Water Quality Certification (WQC) Program. IDEM regulates the placement of fill materials, excavation (in certain cases), and mechanical clearing of wetlands and other waterbodies. IDEM draws its authority from the federal Clean Water Act and from Indiana's water quality standards. IDEM regulates activities in conjunction with the U.S. Army Corps of Engineers.

Any person who wishes to place fill materials, excavate or dredge, or mechanically clear (use heavy equipment) within a wetland, lake, river, or stream must first apply to the Corps of Engineers for a Clean Water Act Section 404 permit. If the Corps of Engineers decides a permit is needed, then the person must also obtain a Clean Water Act Section 401 water quality certification from IDEM. Section 401 water quality certification information is available on the IDEM Internet page (http://www.in.gov/idem/water/planbr/401/wqs/401home.html).

Under Clean Water Act Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's water quality standards. The applicant may be required to avoid impacts, minimize impacts, or mitigate for impacts to wetlands and other waters. IDEM will deny water quality certification if the activity will cause adverse impacts to water quality. A person may not proceed with a project until they have received a certification from IDEM. A key goal of the program is to insure that all activities regulated by IDEM meet the no net loss of wetlands policy.

Development of Wetland Water Quality Standards

Rulemaking efforts are underway to help guide state wetland regulatory efforts. Additionally, wetland issues are being discussed by legislative subcommittees. These discussions will provide additional guidance to the state on wetland regulatory responsibilities.

Integrity and Extent of Wetland Resources

Wetlands occur in and provide benefits to every county in Indiana. 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 of wetland resources in Indiana is the National Wetlands Inventory developed by the U.S. Fish and Wildlife Service. 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. The maps indicate wetlands to type, using the Cowardin *et al.* classification scheme. 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. Forested wetlands are poorly described.

The Indiana Department of Natural Resources conducted the most recent and complete analysis of this database in 1991. According to the report, Indiana had approximately 813,000 acres of wetland habitat in the mid-1980s when the data were collected (Table 23). Wetland loss or gain since then is not known at this time. (Rolley 1991)

Table 23 Extent of Wetlands by Type

(rounded to nearest thousand acres)

Wetland type (Cowardin et al. 1979)	Historical extent (acres)	Most recent acreage (1991)
Palustrine scrub/shrub (PSS)		42,000
Palustrine forested (PFO)		504,000
Palustrine emergent (PEMB)		55,000
Palustrine emergent seasonally flooded (PEMC)		68,000
Palustrine emergent semi-permanently flooded (PEMF)		21,000
Palustrine open water (POW)		99,000
Lacustrine limnetic open water (L10W)		141,000
Riverine (R)		53,000
Total	5,600,000	813,000

Source: Rolley 1991.

Wetland Protection Activities

In addition to the review of applications for Section 401 Water Quality Certification, the program worked on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, USEPA, and the Indiana Department of Natural Resources to evaluate projects in planning and to coordinate requirements for various state and federal permits related to wetlands.
- IDEM maintains a web page devoted to wetlands and water quality issues. This page is under development and is expected to include information on the status of Indiana's wetlands, current laws and rules, conservation programs, and links to other regulatory and non-regulatory wetland programs. The Water Quality Certification staff conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations protecting wetlands.
- IDEM is working closely with other regulatory agencies on the development of an interagency agreement that addresses key issues governing the use of wetland mitigation banks in Indiana.
- IDEM continues to work closely with all partners in the Indiana Wetland Conservation Plan. Part of the implementation phase of the plan calls for the development of an Indiana-focused

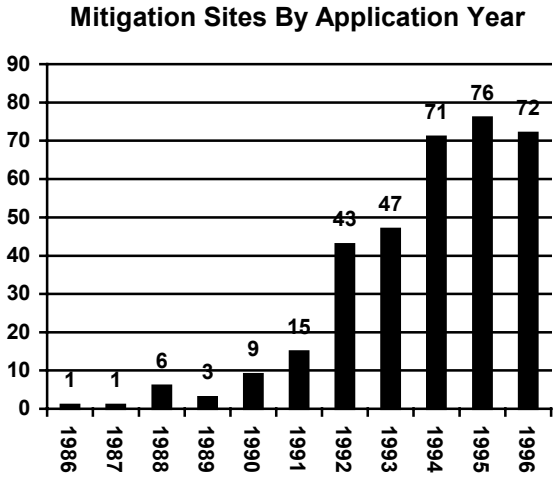
assessment protocol, which was field tested during the summer of 1999 by IDEM and other regulatory agencies.

- IDEM is implementing grant funds obtained from a USEPA Wetlands Protection grant to evaluate regulatory activities on wetland acreage. Anticipated products include a revised certification database, which will be web-accessible, and a revised estimate of historic and current wetland losses.
- IDEM is implementing grant funds obtained from a USEPA Wetlands Protection grant to develop wetland outreach materials targeted to potential permittees, school-age children, and citizens interested in wetland protection. Materials will include a set of brochures, an application guidebook, and a wetland video to be produced by the end of 2000.

Wetland Compensatory Mitigation: An Ongoing Study

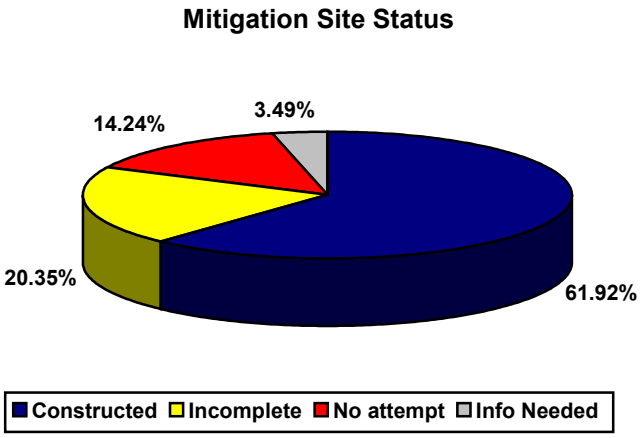
Over the course of the last four years IDEM has undertaken a review of wetland compensatory mitigation in Indiana. Wetland compensatory mitigation is the replacement of wetlands lost through the permitting process. Since its inception in 1986 IDEM has increasingly required the restoration, creation or enhancement of wetlands as compensation for wetland losses before it will issue a Water Quality Certification. The study revealed this increase in the number of mitigation sites required over the life of Water Quality Certification program (Figure 6).

Figure 5 Mitigation Sites by Application Year



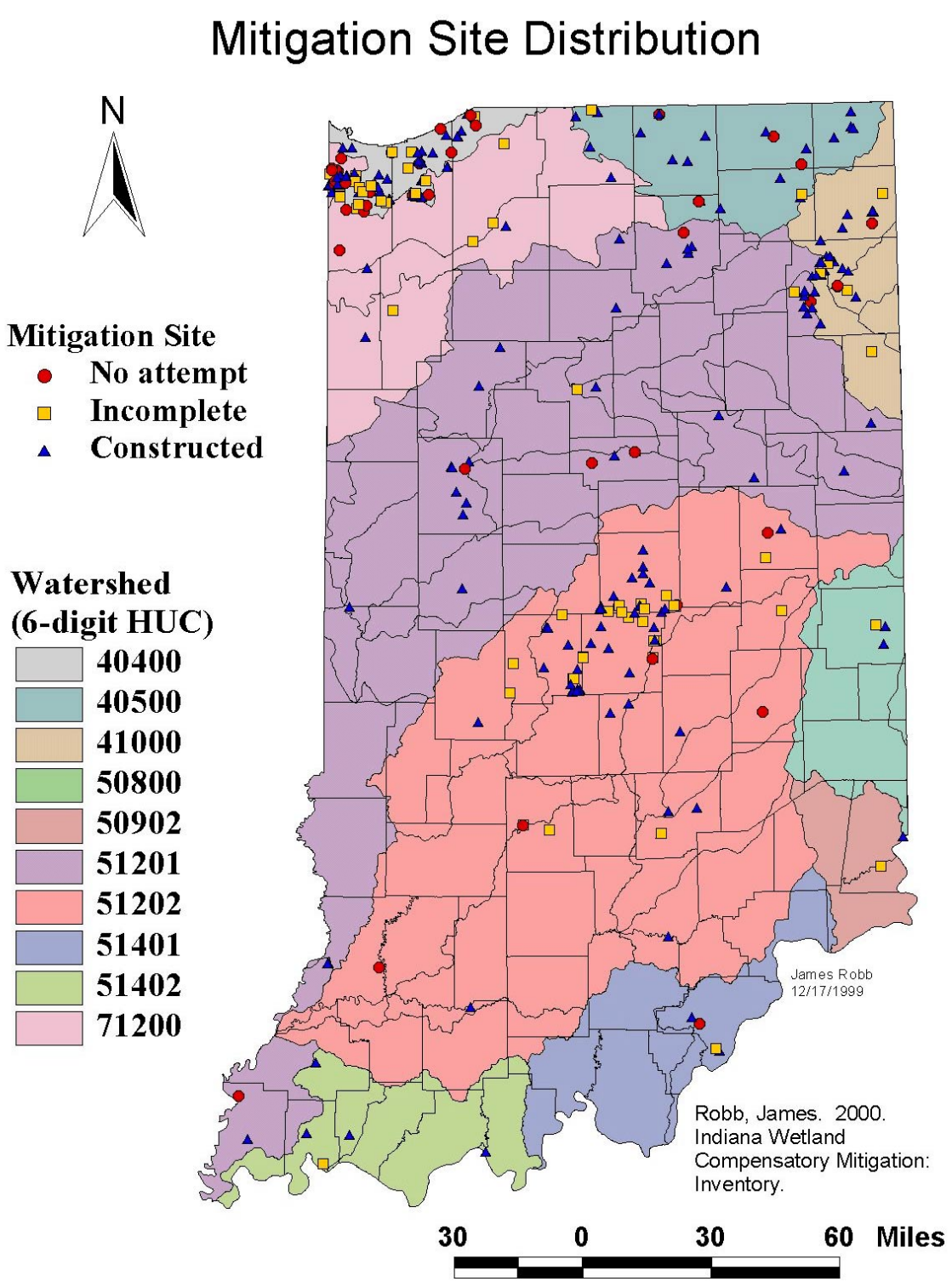
It also revealed significant compliance problems. The study inventoried 344 sites during the summer and fall of 1998 and the spring of 1999. Nearly 35% of the sites had not been completed. Applicants had made no attempt on 49 of the sites. Another 70 sites showed some signs of construction activity but had not been completed (Figure 7).

Figure 6 Mitigation Site Status



Over a third of the mitigation sites lie within watersheds feeding the Great Lakes. Nearly one-fifth of the mitigation sites lie in the Little Calumet-Galien watershed, the watershed directly abutting Lake Michigan (Figure 8).

Figure 7 Mitigation Site Distribution



During the summer of 1999 IDEM measured the wetland acreage and mapped the vegetation community in 31 randomly selected constructed mitigation sites. The purpose of this study was to gauge the performance of compensatory mitigation effort in Indiana by measuring the area of wetland established as a result of these efforts. This study used Global Positioning System (GPS) techniques to map the total area of wetland and the area of each established wetland vegetation community. IDEM required 34.31 hectares (ha) [84.7 acres] in compensation for the 13.72 ha (33.9 acres) of state waters lost through the permit actions associated with these sites. The mapping effort demonstrated that a total of 15.21 ha (37.6 acres) of wetland and other waters had established at these sites, a net gain of 1.49 ha (3.7 acres). Mapping of each vegetation community at these sites revealed that forested areas, which had a failure rate of 71 percent, and wet meadow areas (87% failure) were harder to establish than shallow emergent areas (17% failure) and open water areas (4% failure). Compensation for this risk of failure would require minimum mitigation ratios of 3.4:1 for forested, 7.6:1 for wet meadow, 1.2:1 for shallow emergent, and 1:1 for open water. Additional mitigation may be needed to offset the effects of temporal loss of wetland function. Although there was a net gain in area over all, forested wetlands experienced a net loss of 4.15 ha (10.3 acres) raising concerns that forested areas are being replaced with shallow emergent and open water community types. Visit the IDEM Wetlands web site: http://www.in.gov/idem/owm/planbr/401/mitigation_monitoring.html for more information.

Public Health/ Aquatic Life Concerns

The release of toxic materials into the aquatic environment can produce effects in several ways:

- Contaminants present in acutely toxic amounts may kill fish or other aquatic organisms directly.
- Substances present in lesser, chronically toxic, amounts can reduce densities and growth rates of aquatic organisms and/or bioaccumulate in their tissues that are consumed by humans.
- Toxic materials in the water could potentially affect human health by contaminating public water supplies; although, at this time IDEM has no data to indicate that there have been any adverse human health effects due to toxic substances in surface water supplies.

In the last several years, advances in analytical capabilities and techniques, and the generation of more and better toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water, much of the data on toxic substances used for fish consumption assessments in this report was obtained through the fish tissue and surficial aquatic sediment monitoring program.

The Indiana Fish Consumption Advisory identifies fish species, which contain toxicants at levels of concern for human consumption, using the Great Lakes Task Force risk-based approach. The 2001 advisory is based on levels of polychlorinated biphenyl compounds and mercury found in fish tissue. While not all species of fish found in Indiana lakes and streams nor all waters have been tested, carp have generally been found to be contaminated with both polychlorinated biphenyls and mercury at levels of concern. All waters of the state are under some limited consumption advisory for at least some species (i.e. carp). For fish caught in waters not

specifically listed in the Indiana Fish Consumption Advisory, a general Group 2 advisory has been issued (one meal/week for general population and one meal/ month for women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15). (ISDH 2001)

Fish consumption use is reported separately from aquatic life use in order to provide more information about each individual use. Concerns related to fish consumption advisories can be evaluated independently of the impact of other parameters affecting the support of aquatic communities. It is expected that as more lakes and streams are monitored, toxicants will be found at levels of concern in the new samples (i.e., mercury and/or PCBs). The measured miles of streams and acres of lakes affected by toxicants are expected to increase in the near term due to additional lakes and streams with specific fish consumption advisories.

A diverse and healthy fish community 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 sometimes evidence of a severe water quality problem and may indicate the long-term loss of use of affected water as a fishery. A fish kill can result from:

- The accidental or intentional spill of a toxic compound or oxygen-depleting substance into the aquatic environment.
- Continuous industrial or municipal discharge which may release, due to a system upset, an atypical effluent containing high concentration of pollutants.
- Natural causes such as disease, extreme draught, or depletion of dissolved oxygen from extreme weather conditions.

Spills recorded by the IDEM Office of Land Quality for 1996 through 1999 are listed in Table 24.

Table 24 Spills 1996 - 1999

Year	Spills	Fish Kills
1996	2,381	25
1997	2,268	24
1998	2,675	27
1999	2,588	39

Source: IDEM Office of Land Quality

Drinking Water Source Assessment

Source water assessment stakeholders, as part of a source water assessment advisory panel, participated with IDEM in the development of a source water assessment plan. IDEM with stakeholders has developed a source water assessment plan that will identify or delineate the areas (watersheds and wellheads) in Indiana that supply public drinking water. In the delineated source water areas, IDEM will inventory the potential sources of contamination from regulated facilities and assess water system susceptibility to contamination. IDEM submitted a source water assessment plan to the USEPA on February 4, 1999 and has requested an 18-month extension in addition to the initial two-year implementation period. Approximately 4300 source water assessments of Indiana's public water systems are projected to be completed by May 2003.

Implementation of Indiana's source water assessment plan will require contractual agreements to conduct source water assessments. It is anticipated that contractual agreements will be used for most aspects of the source water assessment plan. Agreements with other state and federal agencies such as the Indiana Geological Survey and the United States Geological Survey may be used to obtain or develop information about Indiana's ground water and surface water utilized as a water source by public water systems.

To assess Indiana's source water areas will require an inventory of potential contaminants and a determination of water system susceptibility to contamination. IDEM will use elements from the existing Wellhead Protection Program as tools for assessing the surface and ground water used as a source by public water systems. Assessing source water in Indiana will include delineating ground water within a 5 year time of travel or within a 3,000 feet radius of designated community public water system wells and for non-community ground water system wells, a fixed radius of 300 or 3000 feet will be used. Assessments of surface water public water systems will include delineating watershed boundaries upstream of the water system intakes. For both wellheads and watersheds, inventories of potential sources of contamination within source water areas will be developed within the guidelines of the Source Water Assessment Plan.

Existing information about Indiana's surface water and ground water that will be useful in assessing the source waters of public water systems will be obtained from both state and federal agencies such as the Indiana Department of Natural Resources and the United States Geological Survey. Public water system sanitary surveys, vulnerability assessments, water well logs, and existing monitoring data will also be used in assessing public water system susceptibility to contamination. In addition to using existing information, on-site visits will be made to public water systems to identify the location and proximity of potential sources of contamination and to accurately locate public water supply wells using a global positioning system.

Based on contaminant inventories, information obtained on-site from public water systems and from various state and federal water agencies, the susceptibility of public water systems to possible contamination will be determined. To manage and access the information generated by a state-wide assessment of Indiana's public water supply sources, the use of geographical information systems is proposed. To integrate data and information from a wide variety of sources, a geographical information system will be needed and will be used to describe source water assessment areas. Geographical information systems developed for source water assessment can also be used to communicate source water assessment findings to the public in electronic and graphic formats. Education and community outreach activities will also be used to disseminate source water assessment results.