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NEWS RELEASE

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Water quality in Ohio's rivers and streams has significantly improved in the last 10 years, according to a recent statewide study conducted by Ohio EPA. The study of 7,900 miles of rivers and streams proves that Ohio's investment in sewage treatment is paying off.

Half of the miles monitored now meet water quality standards, up from one-third just four years ago. Streams showing the most improvement include: the Scioto River downstream from Columbus, the lower 44 miles of the Tuscarawas River, the lower Great Miami River, the Hocking River downstream from Lancaster, and the Cuyahoga River downstream from Akron.

Much of the improvement can be attributed to upgraded wastewater treatment plants. Nearly $4 billion has been spent in Ohio to modernize municipal sewage treatment plants since 1972.

"After 12 years of comprehensive monitoring, we're able to measure the state's progress in improving water quality. The results are encouraging. As we gain more knowledge through continued monitoring, we can focus efforts on areas that still have problems. Reducing toxics and preventing water pollution are my priorities," Ohio EPA Director Donald R. Schregardus stated.

"Ohio EPA has invested in more than 12 years of comprehensive water quality monitoring. This investment has enabled us to assess the results of water pollution control efforts on Ohio's water resources."

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Ohio has been successful in controlling pollution from sewage plants and industry, but the impacts of nonpoint source pollution (agricultural and urban runoff, habitat modification, and siltation), may be worsening in some areas. For instance, more than 518 miles of streams presently meeting water quality standards are being threatened by nonpoint source pollution.

Ohio EPA also studied the health of lakes, ponds and reservoirs. Of those water bodies studied, only 0.2 percent were meeting water quality standards, 56 percent were partially meeting standards, 4.3 percent were not meeting standards, and 5.3 percent were meeting standards, but are considered to be threatened. Pollution usually resulted from agricultural runoff, discharges from wastewater treatment plants and industry, failing septic systems, storm water runoff, and habitat modifications.

The study also includes the first historical summary of Ohio's fish tissue monitoring program. Ohio EPA identified PCBs (polychlorinated biphenyls) and chlordane as the two most widespread contaminants found in Ohio's fish. PCBs were found in 360 of 369 samples and chlordane was detected in 75 of 313 samples. Both contaminants were found in fish in excess of FDA recommended limits.

Because harmful contaminants are found in fish, the Ohio Department of Health and/or local health departments issue fish consumption advisories. There currently are 19 sportfish advisories in Ohio.

Ohio EPA plans to study 33 additional rivers and streams during the next 10 years, if resources remain stable. Schregardus said the next five years are critical and will provide a fairly complete evaluation of major pollution control activities initiated in the 1980s.

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Forward

Section 305(b) of the Clean Water Act requires states to produce "Water Quality Inventories" that assess progress in achieving the objectives of the Act. Ohio changed the title of the 1990 report from "Water *Quality* Inventory" to "Water *Resource* Inventory". This is more than merely a semantic change and is in keeping with the theme and emphasis of the 1992 report: an ecosystem emphasis rather than reliance on water chemistry *alone*. The effects of human activities on aquatic ecosystems are broad, and extend beyond water chemistry to include physical and biological impacts. While chemical water quality remains an important component, it is necessary to consider additional impacts if we are truly interested in achieving the goals of the Clean Water Act by protecting and rehabilitating aquatic resources. Improved biological and habitat assessment tools have recently emerged and allow a more direct assessment of the biological integrity goals of the Clean Water Act (Section 101[a][2]). We hope that the information in this document will demonstrate the progress that Ohio has made towards improving water resource quality and the challenges that remain to protect and restore *all* aspects of Ohio's water resources.

Public and private entities in Ohio have invested several *billion* dollars in the control of point sources of pollution during the past 20 years. Ohio EPA has likewise invested in an intensive and integrated surface water monitoring program over the past 12 years in order to document the result of these economic expenditures. Because of this investment Ohio EPA is now able to begin a direct evaluation of the effectiveness of 20+ years of water pollution control efforts on a site specific basis. Thus, this cycle of the 305(b) report presents an appropriate opportunity to begin to review the effectiveness of Ohio's water resource management programs *from an environmental results perspective*. In this sense we can now initiate an environmental audit of Ohio's water resources using ambient environmental measures and indicators. The conclusions and recommendations that follow are an initial

endeavor towards this end. One result of this effort should be a re-examination of management strategies in order to more effectively protect high quality waters and rehabilitate degraded water resources by proportionately focusing water resource management and monitoring efforts on the sources most responsible for the observed impairments.

As water resource agencies have dealt with an increasing complexity of different and increasingly subtle and diffuse problems, the need for an integrated analysis quickly became apparent. Continued reliance on a technology, "end-of-pipe" approach and even water quality-based approaches *alone* will be inadequate for resolving many of the remaining environmental problems and in preventing new ones. Water resource management efforts in Ohio are maturing beyond a sole reliance on dilution based techniques for load allocations and surface water assessments. Integrated ambient monitoring is an indispensable component of the feedback needed to more effectively manage our pollution control and water resource restoration efforts. Monitoring must no longer be regarded as a "luxury" if these efforts are to truly succeed. This is increasingly important for relatively new areas such as nonpoint source management, urban stormwater management, habitat assessment, Natural Resource Damage Assessments (NRDA), and the assessment of unregulated hazardous waste sites, as well as the "established" water programs (Water Quality Standards, NPDES permits).

A carefully conceived monitoring approach, that includes cost-effective biosurveys integrated with other assessment tools (*i.e.* chemical, toxicological), can ensure that all sources are objectively judged on the basis of environmental results rather than prescriptive, administrative goals (*i.e.* number of permits issued, enforcement actions, etc.) for achieving water resource improvements. This approach relies on direct evidence of the attainment or non-attainment of water resource integrity and is a fundamentally more accurate portrayal of environmental conditions. This also ensures that pollution abatement dollars will be invested where needed the most.

Conclusions

√ Ohio is a water rich state with abundant flowing waters, lakes, ponds, and reservoirs, Lake Erie, and the Ohio River. The economic and social well-being of Ohioans is closely linked to the quantity and quality of these water resources and the services they provide.

√ An integrated monitoring framework that includes the use of ecoregional biological criteria, intensive biological, chemical, and physical surveys, habitat evaluations, and the use of ecoregions and a system of tiered aquatic life uses provides cost-effective, reproducible, and accurate assessments of the status of Ohio's surface waters. Some of the most useful aspects of the past 12 years of this type of monitoring is the discovery of previously unknown or poorly understood problems, and characterization of the water resource as a whole.

√ Our experience has demonstrated that a high density of sampling sites is needed in order to accurately detect impairment over space and time. This is especially true of concentrated, diverse, and interactive impacts within and downstream from urban areas. This is also important in the evaluation of large point sources located on medium to large streams and rivers where it is important to characterize the longitudinal response of the chemical, physical, and biological indicators in order to capture all of the major impacts and accurately assess the extent and severity of impairments.

√ For other more diffuse sources an adaptation of the U.S. EPA EMAP grid design seems offer the most cost-effective approach to assessing and characterizing these types of impacts. It is among the smaller watersheds (*i.e.* <20-50 sq. mi. drainage area) that our monitoring database presently lacks sufficient coverage. In addition, the EMAP design would be useful in further discriminating important "within ecoregion" heterogeneity which would provide a basis to extrapolate the results of pilot studies in the management of nonpoint source impacts.

√ Overall, water resource quality in Ohio streams and rivers is generally improving:

- The miles of streams and rivers that have impaired aquatic life uses in Ohio have decreased since 1988 (44% pre-1988 vs 29.1% post 1988). This estimate is the most accurate for larger streams and rivers (>100 sq. mi. drainage area) of which 67% have been sampled since 1980.

- Data from streams and rivers which have been monitored more than once (generally early 1980s vs late 1980s, early 1990s) shows a *statistically significant increase* in all of the biological indices which means that water resource integrity is improving overall..

√ However:

- For many waterbody types (*e.g.* lakes, ponds, and reservoirs, Lake Erie, and wetlands) the database is inadequate to assess the current status of these waters. Without adequate status information there can be no trend assessment for these water bodies.

√ On a statewide basis the degree of impact of domestic sewage (oxygen demanding substances, ammonia) discharges has been greatly reduced through upgraded treatment facilities. Nearly $4 billion has been spent on upgrades to publically owned treatment works in Ohio since 1972. However, localized dissolved oxygen and organic enrichment impacts, many of which are attributable to WWTPs, remain a major cause of impairment in streams and rivers.

√ Point source related toxic impacts still cause substantial impairment in Ohio streams and rivers. Problem areas exist in or near most of the larger urban centers. Key biological and chemical indicators (*e.g.* increased external anomalies, highly elevated metals in sediment) of toxic impacts are correlated with the concentrations of heavy industry (*e.g.* petroleum refining, rubber and plastics, electroplating, steel and glass making, etc.) across the state.

√ The impacts from other sources such as combined sewer overflows, urban storm water runoff, siltation of substrates, and habitat degradation are becoming increasingly evident as previously more prominent impacts (*e.g.* municipal WWTPs, some industrial effluents) are reduced. This has resulted in the "emergence" of these underlying problems. Multiple impacts are frequently "layered" in most areas which can result in the "masking" of an underlying problem by a more obvious and severe current problem. Periodic monitoring will be needed to track the emergence of the underlying problems as the present impacts are abated.

√ While there have been successes in the abatement of point sources of pollution, the impacts of less controlled sources (*e.g.* nonpoint source runoff, habitat degradation) may be worsening (see Section 4; Table 4-7, Maps 4-4 and 4-5) in some areas of the state. Siltation of substrates and habitat degradation are now the second and third leading causes of aquatic life impairment in Ohio streams and rivers. Besides the impacts from agricultural activities, these impairments are also the result of intensive urbanization and suburban development, the latter of which is emerging as one of the most significant threats to watersheds in the 1990s.

√ The trends in water resource quality differs between specific streams and rivers depending on the characteristics of the impacts. Overall, significant improvements have been observed in 11 rivers, no change in 7 rivers, and declines in 3 rivers based on follow-up monitoring done since 1989 (Tables 1 and 2). Assessments of trends in a minimum of 33 additional rivers and streams will occur during the next ten years, *provided monitoring resources remain stable.*

√ Although data on lakes, ponds, and reservoirs is insufficient to examine long term trends, the trophic status of 148 (out of 450 public lakes >5 acres) is known: using Carlson's Trophic State Index (TSI) 4 lakes are classified as oligotrophic, 31 are mesotrophic, 86 are eutrophic, and 27 are hypereutrophic. Although hypereutrophic lakes have a higher probability of having impaired beneficial uses (largely through nutrient related impacts) than other lakes, some eutrophic and mesotrophic lakes also exhibit impairments (*e.g.* volume loss, bacterial contamination, toxic chemicals, acid mine runoff, etc.)

√ Volume II of this report is the first statewide summary of Ohio's fish tissue contaminant monitoring program. Ohio has 20 tissue and/or primary contact advisories across the state mostly due to elevated PCBs and/or chlordane. The majority of the advisories and waters with high concentrations of contaminants are located in and downstream from urban areas.

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Table 1. Summary of aquatic community status and trends for the principal rivers and streams monitored by Ohio EPA between 1979 and 1991 in the lake Erie drainage basin. For study areas where before and after surveys have been performed, an indication of any significant change as greatly improved (▲▲), improved (▲), decline (▼), or no change (↔) was made under the Trends column (some areas are described as simultaneously improving, declining, etc. which reflects conditions in different segments of the study area). The years (e.g. 1995) indicates the next opportunity for a follow up survey within the Five-year Basin Approach schedule. A qualitative description of the nonpoint source and habitat conditions, and general highlights of major events in the study are also noted.

River/Stream	Earliest/ Latest Yr.	Trends	Nonpoint Status	Habitat Status	Comments/Observations
Lake Erie Drainage Basins					
Grand River	1987	1995	Good	Good	Upgraded to EWH; chromate lagoon impacts.
Maumee River	1984/86	1996/97	Poor	Good-Fair	NPS background impacts; WWTP/CSO impacts.
Auglaize	1985/1991	▲	Fair-Poor	Good-Fair	1985 agency enforcement Farm Services, Inc.
St. Marys	1991	1996	Fair-Poor	Fair-Poor	Silt/habitat impacts; HELP ecoregion effect.
Tiffin River	1984	1992	Fair	Fair	Significant NPS and habitat impacts.
Blanchard R.	1983/1991	▲	Fair	Fair	Findlay WWTP upgrade; CSO abatement eval.
Ottawa R.	1985/1991	▼↔▲	Good-Fair	Good-Fair	Historically improved; gross fish anomalies remain.
Sandusky River	1979/1990	▼▲	Fair-Poor	Good	WWTP upgrades; NPS impacts worsened.
Ashtabula River	1989	1995	Good	Good	Good quality ust. Ashtabula; toxics in harbor area.
Huron River	1982/84	1993	Good	Good	Generally good quality; localized WWTP impacts.
Rocky River	1981	1992	Good	Good	Many WWTP upgrades since 1981.
Chagrin River	1986/1991	1996	Good	Good	Industrial impacts evident in 1986 & 1991.
Portage River	1985	1994	Good-Poor	Good-Poor	NPS impacts; CSO impacts severe in E. Branch.
Cuyahoga River	1984/1991	▲▲	Good-Fair	Excell.-Fair	WWTP upgrades, pretreatment; CSO impacts.
Black River	1982	1992	Good/Fair	Good-Fair	WWTP, CSO, industrial impacts in 1982.
Vermilion River	1987	1997	Good-Fair	Excell.-Good	High quality in areas; NPS impacts in upper basin.

Table 2. Summary of aquatic community status and trends for the principal rivers and streams monitored by Ohio EPA between 1979 and 1991 in the Ohio River drainage basin. For study areas where before and after surveys have been performed, an indication of any significant change as greatly improved (▲▲), improved (▲), decline (▼), or no change (↔) was made under the Trends column (some areas are described as simultaneously improving, declining, etc. which reflects conditions in different segments of the study area). The years (e.g. 1995) indicates the next opportunity for a follow up survey within the Five-year Basin Approach schedule. A qualitative description of the nonpoint source and habitat conditions, and general highlights of major events in the study are also noted.

River/Stream	Earliest/ Latest Yr.	Trends	Nonpoint Status	Habitat Status	Comments/Observations
Ohio River Drainage Basins					
Hocking River	1982/1990	▲▲	Poor	Good-Poor	Lancaster WWTP upgraded; serious bank erosion.
Scioto River	1979/1991	▲▲	Fair	Good	WWTP upgrades; CSO, siltation impact remains.
Paint Cr	1989	1997	Fair-Poor	Excell.-Fair	Upgraded to EWH; NPS problems upstream.
Olentangy	1989	1996	Good	Excell.-Good	Upgraded to EWH; WWTP problems remain.

Table 2. (continued).

River/Stream	Earliest/ Latest Yr.	Trends	Nonpoint Status	Habitat Status	Comments/Observations
Ohio River Drainage Basins (cont'd)					
Big Darby Cr	1979/1989	↔	Good	Excellent	High quality waters; NPS impacts in upper basin.
Mill Creek	1978/1990	▼	Good-Fair	Excell.-Good	Declining despite WWTP upgrade; pesticides.
Central Ohio R. Tribs.					
Yellow Cr.	1983/1991	↔	Good-Poor	Good	Locally severe acid mine impacts.
Cross Cr.	1983	1996	Good-Poor	Good	Locally severe acid mine impacts.
Captina Cr.	1983/1991	↔	Good	Excellent	High quality (EWH); improvements in tribs.
McMahon Cr.	1983/1991	▲	Good-Poor	Good	Locally improved; acid mine impacts in tribs.
Sunfish Cr.	1983/1991	↔	Excell.-Good	Excellent	High quality (EWH).
L. Muskingum	1983/1991	↔	Good-Fair	Excell.-Good	High quality (EWH); some local NPS impacts.
Little Beaver Cr.	1985	1994	Excellent	Excellent	High quality (EWH).
Middle Fork	1985	1994	Good	Good	Fish tissue advisory; Nease Chem. site.
West Fork	1984	1988	Excellent	Excellent	Consistent EWH attainment.
Southeast Ohio R. Tribs.					
Symmes Cr.	1990	1995	Good-Fair	Excell.-Good	NPS sediment impacts from surface mining.
Raccoon Cr.	1990	1995	Good-Poor	Good-Fair	NPS sedimentation impacts from surface mining.
L. Scioto R.	1990	1995	Good-Fair	Good	NPS sediment and oil & gas well impacts.
Southwest Ohio R. Tribs.					
Ohio Brush Cr.	1987	1997	Good	Excell.-Good	High qual. (EWH); WWTP impacts to tribs.
Whiteoak Cr.	1987	1997	Good	Excellent	High qual. (EWH); some NPS in upper basin.
Little Miami River	1983	1993	Good	Excell.-Good	WWTP impacts in 1983; NPS in upper basin.
E. Fk. L. Miami	1982	1993	Good-Fair	Excell.-Good	High quality (EWH); NPS impacts upper basin.
Great Miami River	1980/1989	▲	Good	Excell.-Fair	Some improvements; WWTP impacts remain.
Twin Cr	1986	1995	Good	Excellent	High quality (EWH); NPS threats in upper basin.
Stillwater River	1982/1990	▲	Good-Fair	Excell.-Good	Improved since 1982; NPS impacts in upper basin.
Greenville Cr	1982/1990	▲	Good	Excellent	Improvements due to WWTP upgrade.
Mad River	1984	1993	Good	Good	WWTP upgrades since 1984.
Muskingum R	1988	1994	Good-Fair	Good-Fair	Lower part impounded; thermal impacts remain.
Upper Tusc	1983/1989	↔	Good-Fair	Good-Poor	Extensive channel mod., in-place contaminants.
Lower Tusc.	1983/1988	▲▲	Good	Excell.-Good	Upgraded to EWH due to point source improvements.
Nimishillen Cr.	1985	1993	Good-Fair	Excell.-Fair	Extensive industrial, WWTP, and CSO impacts.
Killbuck Cr.	1981/85	1993	Good-Fair	Good-Fair	WWTP, NPS impacts, channel mod., wetlands.
Rocky Fork	1979	1993	Good	Excell.-Good	Extensive industrial and WWTP impacts in 1979.
Black Fork	1984/1989	▼	Good-Fair	Fair-Poor	Decline due to worsening industrial impacts.
Kokosing R.	1987	1993	Excellent	Excellent	High quality (EWH); few impacts noted.
Licking River	1981	1993	Good	Excell.-Good	WWTP, CSO, industrial impacts; abated since 1981.
Wills Creek	1984	1994	Fair-Poor	Fair-Poor	Extensive sedimentation due to mine runoff.
Mahoning River	1980	1994	Good-Fair	Good-Fair	Historically very degraded by industry, WWTPs.
Mill Creek	1988	1992	Poor	Fair-Poor	Extensive channel mod., CSOs, urban, toxics.

Recommendations

√ The traditional theme of protecting and managing water *quality* should be revised to a theme which instead emphasizes the water *resource*. The latter term brings with it a broader focus beyond a concern with chemical pollutants and contamination of the water column *alone*, and emphasizes an integrated ecosystem approach to water *resource* management.

√ In 1990 Ohio EPA initiated the Five-year Basin Approach to NPDES Permit Reissuance and Monitoring. This orderly approach not only makes the utilization of limited monitoring resources more cost effective, but assures that monitoring information will be available to support water quality standards (WQS) use revisions and NPDES permit limit derivation *prior to* the drafting and reissuance. However, only 50% of the priority needs can be addressed every five years in each basin with current resources. In order to more effectively utilize all water program resources, the five-year cycle of permit reissuance, under certain restrictions, should be extended to 10 years. The benefits of this change would be:

1. better enable the orderly reevaluation of the impact of permitted sources on a once-every-ten year basis (high priority issues would be monitored more frequently); and
2. reduce the administrative resources required to reissue NPDES permits;
3. free-up both administrative and monitoring resources for the purpose of addressing previously neglected and under controlled impacts such as nonpoint source sedimentation, stormwater, combined sewer overflows, and habitat degradation.
4. more attention could be devoted to minor permit issues that have been shown to be significant environmental threats.
5. eliminate or substantially reduce the backlog of expired NPDES permits;

√ The criteria for determining whether a permit should be reissued on a five or 10 year basis should focus on the probable risk of impacts to the ambient environment. Criteria for a 10 year reissuance cycle could include::

1. sources of conventional pollutants and/or non-toxic constituents;
2. the absence of indications of significant impairment in the receiving water body, and/or,
3. a consistent compliance record.

Criteria for a five year reissuance cycle could include:

1. the discharge of a complex mixture of toxics;
2. significant impairment in the receiving water body that is related to the source in question;
3. significant effluent toxicity;
4. significant risk to human health and/or wildlife;
5. significant non-compliance; and/or,
6. a significant change in process and/or discharge volume that prompts a reevaluation.

Priorities for the remediation of unregulated hazardous waste sites should also be phased into the Five - year Basin Approach. Most of these sites will require the development of NPDES permit limits which means that water quality standards and Water Quality Based Effluent Limit (WQBEL) issues will need to be resolved at the same time that other issues are being addressed. This would also foster a watershed approach by all agency programs that have surface water management concerns.

√ Within the framework of the Five-year Basin approach, Ohio EPA needs to continue to conduct follow - up monitoring after pollution controls have been upgraded. The need to document the response of the receiving water body following treatment upgrades is justified by the need to document what was "purchased" for the public and private expenditures over the past 20 years. The next five years are of crucial importance and will provide a fairly complete evaluation of major treatment projects installed in the 1980s across Ohio (see Table A for schedule). The investment by Ohio EPA in 12 years of comprehensive basin monitoring has provided not only the baseline against which the results of follow - up studies can be compared and evaluated, but also the quantitative tools by which these assessments can be accomplished.

√ It is also recommended that the 305(b) report (Water Resource Inventory) be updated and revised on a 5 year cycle to more closely coincide with the Five-year Basin Approach and permit cycle. This report is becoming a major effort with an increasingly large information burden. The Water Body System (WBS) would continue to be updated annually with annual reporting of key Water Resource Inventory statistics.

√ The many non-chemical and non-toxic chemical impacts that continue to impair water resources need to be addressed. In order to successfully protect high quality waters and to rehabilitate waters impaired by these impacts, a much broader approach to water resource quality management is needed. This means incorporating strategies and techniques that go beyond steady-state, dilution oriented, pollutant focused approaches that presently consume the great majority of the water resource management efforts at the state, local, and federal levels. If we are to successfully deal with the leading causes of use impairment in Ohio waters, the focus of water programs must shift from a principal focus on controlling and eliminating pollutants (*i.e.* regulatory approach) to a broader focus on the water resource (*i.e.* systems approach) which includes new and innovative approaches to water resource problem solving. This will entail redirecting a significant portion of our resources to addressing the following problems:

1. **Habitat degradation:** The underlying causes of habitat degradation need to be addressed if we are to successfully protect and rehabilitate this important component of the water resource. Too often, the symptoms of habitat degradation are treated (*i.e.* mitigation) rather than the underlying causes. In many instances, long-term solutions will include land use set-backs, maintenance and/or restoration of the riparian vegetation, preservation or rehabilitation of instream habitat structure (*i.e.* large woody debris, root wads, large substrate, pool-run-riffle sequences), and maintenance of normal flow characteristics of the stream. Stream and river habitat needs to be considered as "wider than the wet part" which includes the immediate riparian zone. A rule of thumb for streams and rivers is for this area to extend two times the width of the normal low flow channel on either side. The use of grass "filter strips" or the installation of artificial habitat "structures" only treats symptoms and is not a replacement for stream channel and riparian zone protection. Some advantages of the long-term solutions described above are: (1) the habitat protection measures are relatively "low tech" requiring no design or construction of artificial structures, (2) instream manipulation and modification is minimized or eliminated, and (3) little or no external energy inputs are required for maintenance compared to symptomatic approaches. An important part of solving habitat problems is to initiate and expand cooperative education and outreach projects with state, county and federal agricultural agencies (*i.e.* SWCD, Cooperative Extension, SCS, etc.) and the agricultural community, county engineers, developers, and others while emphasizing ecological approaches to flooding and drainage problems.

2. **404/401 Program:** The 404 dredge and fill permit and 401 water quality certification program works well and is protective when it applies. However, there are too many exceptions of when a site-specific review and approval applies. Stream bank and instream activities affecting streams with an average annual flow of less than 5 cubic feet/second (cfs) and certain activities (*e.g.* utility lines, etc.) are permitted under a series of national permits. A more technically and environmentally sound criterion other than the 5 cfs threshold is needed. It is recommended that the water quality standards (WQS) use designations play a larger role as a decision criterion as to whether or not an activity falls under a national permit. For example, streams designated as exceptional warmwater habitat (EWH), cold water habitat (CWH), high quality warmwater habitat (WWH), or classified as a State Resource Water (SRW) should not be exempted under the national permits.

3. **PTI (Permit To Install) Reviews:** All of the potential environmental impacts of developments that require a permit to install (PTI) need to be integrated into what has traditionally been a review for engineering adequacy. The integration of an ecosystem concept in the PTI process should reduce the likelihood of irretrievable environmental impacts via the consideration of alternatives. An example of this is with the PTI review for the construction of interceptor sewers in the greater Cincinnati area (see Section 4).

4. **Water Diversions:** The long term environmental impacts of water use structures (*e.g.* reservoirs, water supply intakes) needs to be considered during the siting process. The recent technical literature indicates that the maintenance of high flows (within a regime of natural flows) can be as important as the concept of maintaining minimum flows for protecting aquatic ecosystem integrity. Presently, decisions regarding the ecological impacts of water withdrawals rely on the effects of minimum flows.

√ U.S. EPA requires states to provide a separate, annual list of waterbody segments impaired by toxics. This list is then used to establish priorities for water quality based permits to control toxics. We recommend that U.S. EPA also place a similar emphasis on developing lists of stream segments impaired by habitat degradation, sedimentation, and nutrient enrichment, with all lists (including the toxics list) being given *appropriate weight based on the extent and severity of impairment and on the proportion of waters impaired by each source.*

√ The use of tools which quantify damage to aquatic ecosystems need to be used in enforcement and environmental damage claim proceedings. The Area of Degradation Value (ADV), developed by Ohio EPA, is one such tool that can be used for this purpose. ADV can also be used to quantify the costs and benefits of water resource management efforts. The ADV may be able to provide a consistent framework across the state for prioritizing areas for further pollution control efforts and for the protection and maintenance of high quality resources. For example, investing in up front the use of biological data (*e.g.* ADVs) to prioritize impairment by CSOs in Ohio, along with innovative approaches to CSO characterization and identification, have the potential to save ***billions*** in CSO abatement costs statewide (see Section 4, ***Combined Sewer Overflows***).

√ There are some important sources of water resource impairment in Ohio that have not been addressed in proportion to their occurrence and impact. Two such sources are mine drainage and silviculture. For example, the rehabilitation of streams impacted by mine drainage will depend on the presence of "refuges" which contain the "seeds" of recovery in basins that have historically been severely impacted. Because these streams are likely sources of recolonization as mine drainage impacts are abated, they need to be identified and protected for this purpose.

- √ Consistent and regular monitoring of Lake Erie river mouth, nearshore, and open lake areas needs to be initiated and maintained in order to provide an accurate and comprehensive database for the purpose of tracking status and trends, problem discovery, and resource characterization. We have not been able to update the use attainment status of these areas since the 1988 305(b) report due primarily to a lack of accessible ambient information.

- √ A state funded monitoring effort for publically owned lakes, ponds, and reservoirs is needed to consistently assess status and trends. The development of additional indicators such as biological criteria are needed to broaden and make more accurate lake assessment and management throughout the state.

- √ Although laboratory capability has recently been expanded for fish tissue contaminant monitoring, the current effort is providing less information than is needed to address major Ohio water bodies. Monitoring needs to occur on a more regular basis for the purpose of evaluating Ohio's important fishery resources and as an additional assessment tool within the Five-year Basin Approach.

- √ The debate over the application of biological criteria needs to be continued and should include the consideration of the relative strength of the biosurvey tools and the underpinnings of the biological criteria derivation process. A hierarchy of bioassessment types is proposed in Section 2 (Table 2-7) and provides a potential framework for determining how policy restrictions should be applied to biological assessment and biological criteria. It is suggested that a similar framework be developed for the different levels of chemical-specific, physical (habitat), and toxicity assessment tools.

Executive Summary

Background

Ohio is a water rich state with over 29,000 miles of perennial streams and rivers (U.S. EPA 1991a), a 451 mile border on the Ohio River, more than 5000 lakes, ponds, and reservoirs greater than 1 acre in size, and 236 miles of Lake Erie shoreline (Figure 1-1). Ohio has 10 scenic river systems (ODNR Scenic Rivers Program) comprising over 629 river miles, the fourth largest total of any state in the nation. Ohio also has extensive, high quality ground water resources. Both the surface and ground water supplies are important to the economy, environment, and welfare of the people of Ohio. The purpose of this report is to summarize the present quality or integrity of these waters and describe the trends in the health of Ohio's water resources since the last report in 1990 (Ohio EPA 1990a).

Public and private entities in Ohio have invested several *billion* dollars on the control of point sources of pollution during the past 20 years. Ohio EPA has invested in an intensive and integrated surface water monitoring program over the past 12 years in order to document the result of these economic expenditures among the many objectives of this effort. Because of this investment Ohio EPA is now able to begin direct evaluation of the effectiveness of 20+ years of water pollution control efforts on a site specific basis. Thus, this cycle of the 305(b) report seems an appropriate opportunity to begin to review the effectiveness of the past 20 years of Ohio's water resource management programs from an *environmental results perspective* rather than an administrative oriented perspective (*i.e.* numbers of permits issued, compliance rates, enforcement actions, etc.) *alone*. In this sense it is now an appropriate time to initiate an environmental audit of Ohio's water resources *using ambient environmental measures and indicators*. The conclusions and recommendations that follow this executive summary are an initial endeavor towards this end. The result of this effort should be to re-examine the allocation of resources more effectively to protect high quality waters and rehabilitate degraded water resources by proportionately focusing water resource management and monitoring efforts on the sources responsible for the majority of the observed impairment.

The 1988 305(b) report (Ohio EPA 1988) was the first effort that relied on an integrated chemical, physical, and biological assessment approach to determine the attainment/non-attainment status of beneficial uses, and determine the major causes and sources of impairment on a statewide basis.

As water resource agencies deal with an increasing complexity of different and increasingly subtle and diffuse problems, the need for an integrated analysis quickly becomes apparent. Continued reliance on a technology, "end-of-pipe" approach and even water quality-based approaches *alone* will be inadequate for resolving many of the remaining environmental problems and in preventing new ones. Water resource management efforts are maturing beyond a sole reliance on dilution based techniques for load allocations and surface water assessments. Integrated ambient monitoring is an indispensable component of the feedback needed to manage our pollution control and water resource restoration efforts. It must no longer be regarded as a "luxury" if these efforts are to truly succeed. This will be increasingly important for relatively new areas such as nonpoint source management, urban stormwater management, habitat assessment, Natural Resource Damage Assessments (NRDA), and the assessment of unregulated hazardous waste sites, as well as the "established" water programs (Water Quality Standards, NPDES permits).

Section 305(b) of the Clean Water Act requires each state to submit a biennial report to U.S. EPA describing the quality of the nation's waters. Accomplishing this task requires the compilation, computerization, and integration of chemical, physical, and biological information for lakes, streams, rivers, and groundwater from numerous sources. This report includes:

(1) an analysis of the extent to which the Ohio's surface and ground waters provide for healthy and viable aquatic communities, recreation, water supply, and fish and wildlife that are virtually free from contaminants at concentrations of concern;
(2) an analysis of the extent to which previously impaired waters have improved;
(3) identification of water bodies where additional actions are needed ("long" and "medium" lists of impaired waterbodies as required by U.S. EPA [1991a] and Section 304[l] of the Clean Water Act);
(4) geographic portrayals of the major surface water problems throughout the state;
(5) an estimate of the economic expenditures for water pollution abatement;
(6) a description of the quality of Ohio's inland lakes, ponds, reservoirs, and Lake Erie;
(7) a description of the nature and extent of nonpoint sources of pollution;
(8) a brief history of water pollution and surface water degradation in Ohio;
(9) the first complete description of Ohio's fish tissue contaminant monitoring efforts and a preliminary analysis of the contaminant database; and,
(10) recommendations for possible adjustments in specific water resource management areas.

A carefully conceived monitoring approach, that includes cost-effective biosurveys integrated with other assessment tools (*i.e.* chemical, toxicological), can ensure that *all* sources are objectively judged on the basis of environmental results rather than prescriptive, administrative goals (*i.e.* "bean counting") for achieving water resource improvements. This approach relies on direct evidence of the attainment or non-attainment of water resource integrity and is a fundamentally more accurate portrayal of environmental conditions. This also ensures that pollution abatement dollars will be invested where needed the most. In fact, the monitoring data collected over the past 12 years by Ohio EPA strongly indicates that increased efforts are needed to protect stream, river, and lake habitats (particularly riparian zones and lake shorelines) and better control the impacts of suburban developments through better up front planning. This is becoming particularly evident as the impacts caused principally by conventional chemical agents (*i.e.* oxygen demanding wastes, ammonia, some metals and toxics) are beginning to abate. However, efforts to control nutrients, habitat degradation, and sedimentation leave substantial room for improvement.

Rivers and Streams

For this report 7,900 river miles in Ohio were assessed for aquatic life use attainment status. U.S. EPA (1991) estimates that there are just over 29,000 perennial stream miles in Ohio, thus, more than 27.1% of these waters have been assessed with monitored level (*i.e.* integrated surveys) information. Most of the unassessed streams, however, are in small watersheds (<20-50 sq. mi.). If only streams and rivers with drainage areas greater than 100 sq. mi. are considered, 67% of these waters have been assessed (Figure 1). A substantial fraction of these miles have been assessed two or more times in the past 12 years. Since the 1990 305 (b) report nearly 1,700 miles have been assessed. Of this total more than 1,300 miles were follow-up efforts to previous surveys. In keeping with the pattern established by the 1988 and 1990 305(b) reports, the 1992 effort concentrates on monitored level information and assessment results. A separate document, the Ohio Nonpoint Source Assessment (Ohio EPA 1990b), includes evaluated and survey level information, much of which was derived from a questionnaire of over 200 state, local, and federal agencies regarding suspected sources of nonpoint pollution.

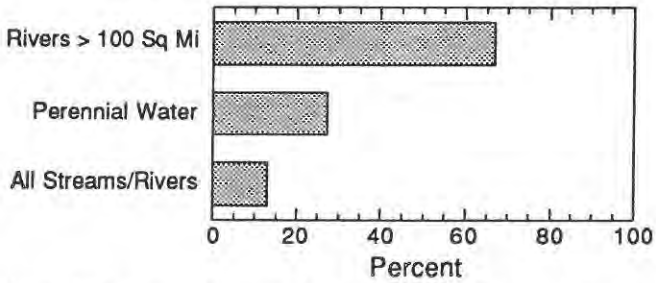


Figure 1. Percent of river and stream miles monitored for aquatic life use support in Ohio.

Of the total stream and river miles examined in this report, 33.1 percent (2,612 miles) are attaining their applicable aquatic life use designations; 6.6 percent (518 miles) are attaining their applicable aquatic life use designations, but are considered threatened; 21.4 percent (1,694 miles) are partially attaining their aquatic life use designations, and 38.9 percent (3,076 miles) are in non attainment (Figure 2). The coverage of the Ohio EPA sampling program is somewhat biased towards stream and river segments where the Ohio EPA has issued NPDES permits to point source dischargers. The actual percentage of total stream and river miles attaining their aquatic life uses in Ohio may be somewhat higher. This assessment of aquatic life use attainment status is, however, a good estimate of actual conditions in the larger streams and rivers (i.e. >50 - 100 sq. mi. drainage areas).

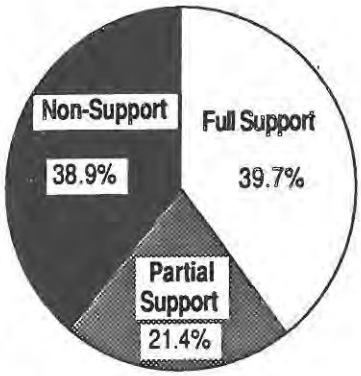


Figure 2. Current aquatic life use support status for Ohio's streams and rivers.

Another factor that influences these results is the "age" of the selected data; some of the information dates back to 1980. If data from the 1990 and 1992 assessment cycle (water years 1987-1990) only is compared to data from the 1988 assessment cycle (water years 1980-1986) the non-attaining fraction declines from 44% to 29.1%, and the attaining fraction increases from 34.5% to 44.8% (Figure 3). When the 1988 305(b) cycle results are compared to the 1992 305(b) assessment cycle alone, the non-attaining fraction declines even further to 24.1% and the attaining fraction increases to 48.8%. Although a sampling bias could exist because of the comparatively brief time period, these improvements are nevertheless encouraging.

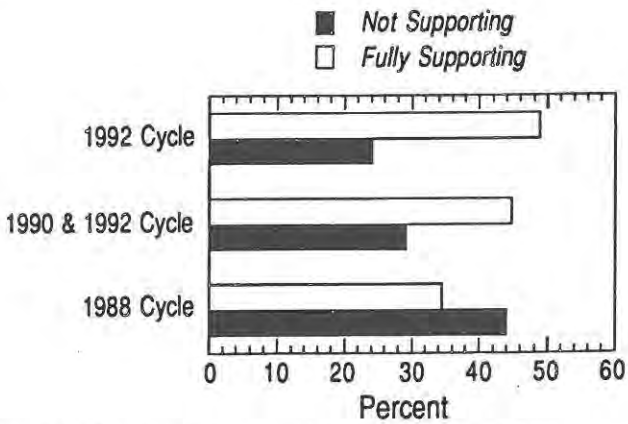


Figure 3. Change in percent of stream and river miles supporting aquatic life uses or having impaired aquatic life uses among 305(b) reporting cycles.

The above mentioned changes signify a substantial improvement in the aquatic life use attainment status of Ohio's surface waters,

much of which is attributable to improvements made by point source discharges. As the monitoring and evaluation of Ohio's surface waters continues, the threats to waters that are currently attaining aquatic life uses will likely become increasingly evident. More than 518 miles of streams that presently attain their applicable aquatic life use criteria are considered to be threatened by impacts that could develop into impairments in the near future. The principal threats are silt and sedimentation (193 miles), organic enrichment/dissolved oxygen (176 miles), and habitat degradation (140 miles), a substantial portion of which is attributable to increasing suburban development in high quality watersheds (97 miles). This is likely to be the threat that increases the most in the 1990s because of the increasing development of once rural watersheds. Other major sources of threats include agriculture (111 miles), mining (110 miles), point sources (64 miles), urban runoff (62 miles), and general habitat degradation (61 miles). Most of the threatened surface waters include streams and rivers designated as Exceptional Warmwater Habitat or classified as State Resource Waters It is clear that these threats are related to physical habitat, watershed manipulation, and nontoxic chemicals (*e.g.* nutrients).

Organic enrichment was by far the major cause responsible for aquatic life use impairment in streams and rivers (2,374 miles). Other significant causes of impairment include silt and sedimentation (720 miles), habitat modification (639 miles), ammonia (555 miles), heavy metals (501 miles), flow alterations (402), low pH (289 miles), unknown toxicity (199 miles), and priority organics (principally cyanide and PAHs; 103 miles). The major sources of impairment were point sources (2,182 miles), habitat modification (685 miles), agriculture (630 miles), mining (582 miles), urban runoff (209 miles), in-place contaminants and other miscellaneous sources (491 miles), and septic systems, landfills, and hazardous waste sites (117 miles). The predominance of organic enrichment as a major cause, and municipal and industrial point sources as the major sources of impairment reflects the extent of the impacts yet to be abated in Ohio.

Trend analyses of fish and macroinvertebrate results from sites with multiple years of data indicate substantial improvements in statewide water quality, especially where organic enrichment has been reduced and dissolved oxygen levels have improved. Streams with a combination of complex toxic and organic enrichment impacts have also generally improved, but to a lesser degree. No major stream or river with significant historical impairments has *completely* recovered to the point where all sites show full attainment of the applicable aquatic life uses. Streams and rivers showing

the most improvement include: the Scioto River downstream from Columbus, the lower 44 miles of the Tuscarawas River, the lower Great Miami River, the Hocking River downstream from Lancaster, and the Cuyahoga River downstream from Akron. Streams showing little or no improvement include the middle and upper Tuscarawas River, Mill Creek and tributaries (Marysville), Tinkers Creek, the upper Sandusky River downstream from Bucyrus, and the Ottawa River downstream from Lima. Within the next three years major reassessments of the Maumee River, Tiffin River, Black River, Mahoning River, Rocky Fork Mohican River, Little Miami River, Rocky River (many of which have historically had severe impairments of aquatic life uses), and numerous other smaller streams and rivers, will be accomplished provided the monitoring resources exist to support these efforts.

Inland Lakes and Reservoirs (Volume III)

Ohio has 118,849 acres (450) of public lakes, ponds, and reservoirs greater than 5 acres in surface area. Of this acreage, 78,527 acres (66.1%) were assessed for aquatic life use (EWH) support, 14,517 acres (12.2%) were assessed for fish tissue contaminants, 77,944 acres (67.3%) were assessed for public water supply uses, and 81,135 acres (68.3%) were assessed for recreational uses. For aquatic life uses there was full use support in 259 acres (0.2%), partial support in 66,835 acres (56%), and nonsupport in 5,168 acres (4.3)%. The remaining 6,265 acres (5.3%) were attaining, but considered to be threatened. For fish consumption, 14,337 acres supported this use; none were considered threatened; 180 acres were partially supporting (fish advisories); and, no lakes were impaired. For the public water supply use, 128 acres supported; 9,389 acres were considered threatened; 60,748 acres were partially supporting; and, 9,679 acres were impaired. For recreational uses 1,633 acres supported; 12,775 acres were considered threatened; 44,859 acres were partially supporting; and, 21,868 acres were impaired.

Important major and moderate magnitude sources of partial and non-attainment were, in order of affected acreage,agricultural nonpoint sources (30,128 acres), point sources (25,579 acres), on-lot septic systems (19,168 acres), urban runoff (10,691 acres), and habitat modifications (7,591 acres). Important major and moderate magnitude causes were identified as low dissolved oxygen in the hypolimnion (52,749 acres), algal/nutrients (31,546 acres), siltation (22,955 acres), flow alteration (8,008 acres), and metals/inorganics (6,639 acres).

Lake Erie

Lake Erie was likewise evaluated for aquatic life use support (the EWH use designation applies to the open lake; WWH applies to the river mouths). Recent data is sparse for Lake Erie nearshore areas and much of the aquatic life assessment was based largely on older data from the Lake Erie river mouth and harbor areas. None of the open lake was considered to be fully supporting the EWH use. All 231 shoreline miles were considered to be partially supporting the EWH use. This was due primarily to the lake wide fish consumption advisory for carp and channel catfish, and observed exceedences of criteria for copper and cadmium in the water column. Sources (major and moderate influence) included point sources (69%), nonpoint sources (19%), in-place pollutants (3.5%), and other (includes solid waste disposal, 8.5%). Causes of the partial attainment include toxics (mostly heavy metals[77%]), organic enrichment/D.O. (14%), and pH (9%).

Ohio EPA has initiated work on Remedial Action Plans in the four IJC Areas of Concern, of which Ohio has four (Maumee R., Black R., Cuyahoga R., and Ashtabula R.). Phase I RAP reports have been completed for three areas. Good progress is being made in all four areas with some proceeding to the point of making specific pollution abatement and water resource management recommendations.

Ohio River

Assessment of the Ohio River focused on the level of support of designated uses (warmwater habitat, public water supply, recreation) and fish consumption. For the warmwater aquatic life use (Ohio boundary waters only) there was 0 miles of full use support, partial support in 370 miles (82%), and non support in 80.9 miles (18%). For fish consumption all miles (450.9) were partially supporting (a fish consumption advisory exists for the entire Ohio segment). For the public water supply use 0 miles fully supported, 302 were partially supporting, and 148 miles were impaired. For recreation, no miles supported, 108.4 miles were partially supporting , 99.0 miles were impaired, and 243.5 miles of a total of 981 miles were not assessed.

The major cause affecting aquatic life use attainment in the Ohio River were heavy metals, particularly copper and cadmium. Fish community data from Ohio EPA and the Ohio River Valley Sanitation Commission (ORSANCO), however, show good biological communities which is somewhat at odds with the water column chemistry results. Metals in the water column of the

Ohio River may not be present in their most toxic form thus an assessment of chemical criteria violations *alone* may be misleading in the Ohio River.

Ohio's Fish Tissue Contaminant Monitoring Program (Volume II)

Volume II of this report is the first historical summary of the various fish tissue contaminant monitoring efforts in Ohio carried out over the past 15 years. The state of Ohio has not had a formal fish tissue monitoring program until recently. Previous efforts were fragmented, varied in the objectives, sample size, species sampled, and parameters analyzed. This volume also discusses the process for issuing fish consumption and human contact advisories in Ohio, lists current advisories, and projected sampling programs for 1992-1993. A preliminary analysis of the Ohio EPA PCB and pesticide database provides some insights into the pattern of contamination in fish flesh in Ohio. PCBs and chlordane appear to be the two most widespread contaminants in fish tissue in Ohio. PCBs were detected in 360 of 369 samples collected and chlordane was detected in 75 of 313 samples (whole body composites and fillets combined). Both parameters had the most values in excess of the FDA recommended action level as well.

Biocriteria in the Ohio Water Quality Standards

Ohio EPA adopted biocriteria (direct measures of fish and macroinvertebrate population and community characteristics) in February 1990. A process termed the regional reference site approach was used to develop these criteria. This simply means that biological community performance expectations are based on what a set of least impacted reference sites are "telling" us is possible in a given ecoregion and stream type. U.S. EPA has demonstrated their interest by producing guidance on Rapid Bioassessments (U.S. EPA 1989), national biocriteria program guidance (U.S. EPA 1990), and a policy statement on biocriteria in April 1990. A technical guidance manual for developing and using biological criteria in wadable streams is in progress. Efforts have also been initiated to develop biological criteria for lakes.

A key policy debate involving biological criteria is the U.S. EPA policy of independent application. This policy requires that biological survey information, chemical-specific data, and bioassay results be evaluated independently with no single method being viewed as superior or preemptive of another. Others (including Ohio) have proposed a weight-of-evidence approach in which the application of each tool is done on a more flexible case-specific basis. Ohio EPA has suggested

that the issue include a classification of the "strength" of the biological survey and underlying biological criteria development procedures as a way to regulate how much flexibility a state might be granted in the use of biological survey information (see Section 2, Table 2-7 of this volume). Based on analyses presented in the 1990 Ohio Water Resource Inventory (Ohio EPA 1990a) and elsewhere (Yoder 1991a, 1991b), there is little doubt that the addition of biological criteria and ambient biological monitoring significantly adds to the capability to detect and manage water resource impairments. Enhanced problem discovery and problem amplification would not be nearly as effective without an *integrated* chemical, physical, and biological approach to surface water monitoring. Aquatic life use impairments that we have identified and characterized during the past 12 years simply would not have been detected using chemical criteria and assessment tools *alone*. The three leading causes of aquatic life use impairment identified by this inventory would not have been possible without this type of approach, including the use of numerical biological criteria derived using the regional reference site approach.

Economic Assessment

A summary of Ohio EPA's economic assessment methodology for point sources is included in Volume I. An analysis of incremental wastewater treatment expenditures for Publically Owned Treatment Works (POTW) showed that approximately $3.7 billion was been invested between 1970 and 1987 to meet water quality based effluent limitations. Of this amount, $2.7 billion was awarded through the federal construction grants program. Total spending on pollution controls for all point sources is much higher when industrial and other treatment facilities are included. More than $1.5 billion has been invested in further point source pollution controls since 1987.

Wetlands/401 Water Quality Certifications

The total acreage of wetland areas in Ohio has not been quantified with any degree of accuracy because a complete inventory of the state's wetland resources does not exist. The most complete survey is the National Wetlands Inventory initiated by the U.S. Fish and Wildlife Service (U.S. FWS) in the late 1950s. The inventory is complete for only 42 of Ohio's 88 counties. These 42 counties account for approximately one third of Ohio land area and are located in the northern and eastern sections of the state. A Statewide inventory of wetlands is being conducted by the Remote Sensing Program in the Ohio Department of Natural Resources (Ohio DNR), Division of Soil and Water Conservation, the Ohio DNR, Division of Wildlife, and the U.S. Soil Conservation Service

(SCS). The wetland inventory is needed to implement the Swampbuster provision of the 1985 U.S. Farm Bill. The inventory also will provide planning information in wildlife management of both game and threatened species.

The 401 water quality certification program provides protection to wetlands threatened by projects which require a Section 404 permit. Ohio EPA presently lacks the authority to regulate projects that impact wetlands, but which do not require a 404 permit. Such projects include direct adverse impacts on wetlands such as drainage improvements, land clearing, peat mining and excavation (outside of Ohio's Northern Court District), and indirect impacts related to encroachment on wetlands from upland projects. The cumulative impacts of the historical practice of draining wetlands was been especially evident during the drought years of 1988 and 1991 in the form of stream intermittency and threatened public water supplies.

Specific examples of the use of biological criteria and habitat assessment in reviewing 401 certification applications have included stream channelization projects, surface mining, hydromodification (dam construction), and damage assessments for unauthorized activities. Biological criteria are especially useful in this process since habitat is a predominant factor in determining the ability of a lotic system to attain the use designations prescribed by the Ohio water quality standards. Furthermore, by using the results of the work that supported the development of the Qualitative Habitat Evaluation Index (QHEI; Rankin 1989), the biological consequences of projects involving the degradation of lotic habitat can be predicted. This allows Ohio EPA to prevent unnecessary degradation of aquatic habitat and communities where it has the authority to do so.

Exotic Species in Ohio Waters

The introduction of exotic (non-native) species in Ohio surface waters is a form of "biological pollution" that has posed a serious problem for Ohio's indigenous aquatic fauna for more than 100 years. Non-native species such as carp and goldfish are well established in Ohio waters. These species have their highest populations in areas with moderate to high degradation of habitat or water chemistry. Several recently introduced exotic species have become the focus of special concern in Lake Erie. Zebra mussels (*Dreissena polymorpha*), which are native to southern and central Asia, are believed to have entered the Great Lakes in 1986 via the discharge of ballast water

from ocean going ships. By 1989 the zebra mussel had spread throughout Lake Erie. It is known to have economic impacts by fouling water intake systems in Lake Erie. The effects of its large filtering capacity and high rate of colonization on other species in Lake Erie are unclear at this time. Thus, it will be important to monitor the effects of the zebra mussel especially given the economic importance of Lake Erie to Ohio. In addition, the zebra mussel has been collected in the Ohio River which may threaten populations of native naiad mollusks in this drainage.

In addition to the zebra mussel, other recently introduced exotic species may be of concern in Ohio. Two recent arrivals are the spiny water flea (*Bythotrephes cederstroemi*) and the river ruffe (*Gymnocephalus cernua*). It is unclear whether this species could disrupt the trophic relationships in Lake Erie or whether they will simply replace the zooplankton consumed as forage for fish. The river ruffe, like the zebra mussel, also arrived via the discharge of ballast water from ocean going ships. The concern with this species is that it could compete for forage with yellow perch. It has little or no sport or commercial appeal. Other recent exotic invaders of the Great Lakes are the tube-nosed goby and round goby. Both have been found in the St. Clair River between Lake St. Clair and Lake Huron. These fish species have the same Asian origins as the zebra mussel and are small, bottom dwelling species that also arrived via ocean freighter ballast water discharges. Because the effects of each of these exotic species are unknown they are of special concern to both the ecological and economic interests of Lake Erie.

Ground Water Quality *(Volume IV)*

Ground water quality monitoring activities for the 1990-1991 reporting period are described in Volume IV. This includes activities carried out by the Ohio EPA Divisions of Ground Water and Public Drinking Water. The ground water section includes a brief overview of Ohio's ground water resources, major aquifer systems, and a general discussion of program activities carried out by the Ohio EPA and other state agencies. These are followed by a summary of Ohio's Ground Water Monitoring Strategy completed in 1988 and a discussion of the common ground water pollution sources.

Many of the monitoring components and needs identified in Ohio's Ground Water Protection and Management Strategy (completed in 1986) are well on their way to being implemented. Ambient ground water and public drinking water supply monitoring have progressed the furthest with

regard to strategy implementation. Ohio's ambient monitoring stations have been increased by 10 over the previous reporting period and include selected industrial and municipal production wells which represent all of the major aquifer systems in the state. Over the past two years, most stations have been sampled annually or semi-annually for organic and inorganic parameters. A table of ambient monitoring locations identified by major aquifers is included. Ohio's public water supply systems which rely ground water sources have been monitored during the past two years as part of special water quality investigations and in compliance with requirements mandated by the Safe Drinking Water Act and state legislation. In particular, water supply testing of public systems has continued for radionuclides, pesticides, and volatile organic chemicals with approximately 300 to 400 systems tested annually.

Pollution source monitoring carried out by the Division of Ground Water involves the sampling and analysis of off-site and on-site wells in close proximity to various land disposal and storage facilities such as landfills, wastewater facilities, land application sites, and others. This program has been carried out at a moderate level with a total of 918 water samples tested over a two-year period. Most on-site monitoring wells at regulated facilities are tested by the facility as a condition of the operating or installation permits. Data collected by the Ground Water Division are limited largely to nearby water supply wells which may be susceptible to pollution impacts from these activities. Except for a few facilities, this program is not be conducted at a level where statistically significantly pollution impacts and trends can be clearly defined. The principal objective of this effort is to qualitatively identify public health threats in nearby drinking water supplies. In the area of nonpoint source monitoring, agency efforts continue to lag behind the milestones established in the various state strategic plans due to staffing limitations and other higher priority ground water monitoring activities. The number of samples collected as part of this program for the two-year reporting period are included in the pollution source monitoring total noted above.

Color Plates:

Plate 1: Contrasting stream habitat conditions in four Ohio streams.

Plate 2. Municipal and industrial point source discharges.

Plate 3. Nonpoint source and habitat impacts.

Plate 4. Two streams in the greater Cincinnati metropolitan area.

Plate 5. Electrofishing techniques used to assess the health of the fish communities in rivers and streams, and water chemistry sampling.

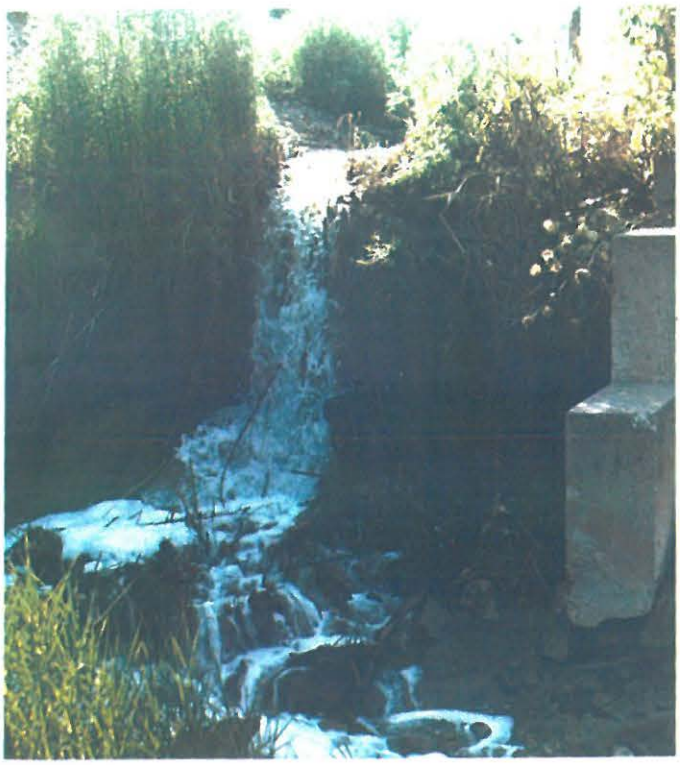
Plate 6. Macroinvertebrates and macroinvertebrate field sampling gear and techniques.

Plate 7: Ohio River mainstem and inland large river fish species.

Plate 8. Two important native Ohio nongame fish species.

Plate 9. External abnormalities on fish from the Ottawa River.

PLATE 1. Contrasting stream habitat conditions in four Ohio streams. ***Upper Left:*** The Kokosing River in eastern Knox County typifies an exceptional quality river in Ohio. This is a cross boundary stream which flows from the Erie/Ontario Lake Plain into the W. Allegheny Plateau ecoregion. ***Upper Right:*** Kokosing River upstream from Mt. Vernon in Knox County typifies the streams and rivers that flow out, over, and through glacial features. The glacial origin substrates of these streams are characteristic of certain stream types in the E. Corn Belt Plains ecoregion. ***Lower Right:*** Riparian encroachment and bank destabilization on Mad River (designated as a Cold Water Habitat [CWH]) just upstream from West Liberty (Logan Co.). This work was performed by a local land owner in an attempt to prevent surface flooding. Most of the beneficial habitat features have been removed. This activity is permitted under a Section 404 nationwide permit ***Lower Left:*** Moxahala Creek in Perry Co. east of New Lexington. This stream is severely impacted by acid mine runoff from unreclaimed strip mine lands. The orange color and extensive coal chunks and fines are characteristic of this type of impact which is prevalent in the sandstone geotype areas of the W. Allegheny Plateau ecoregion.



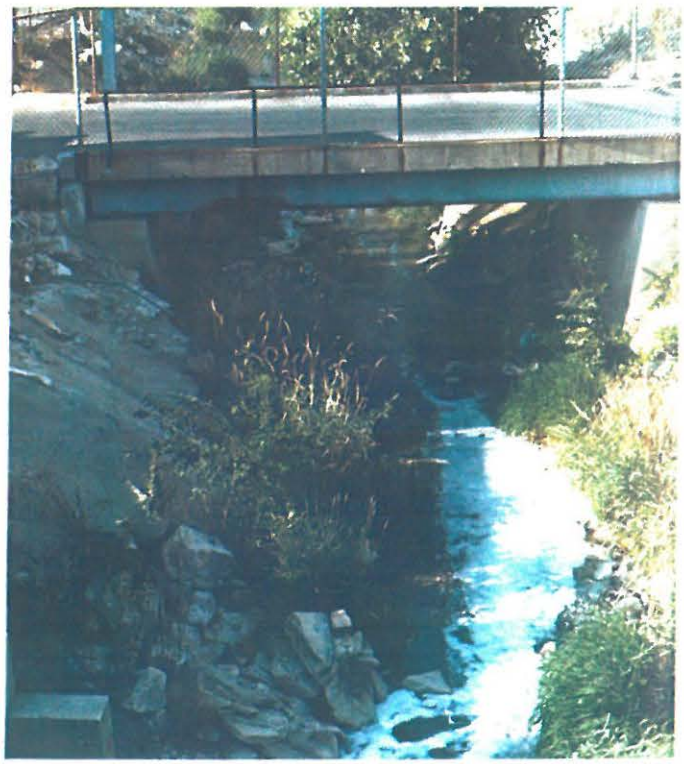


PLATE 2. Three point source discharges of treated and process wastewater. ***Upper Right:*** Municipal wastewater discharge from the Montgomery Co. E. Regional WWTP to Little Beaver Creek. The volume of discharge dominates the flow of the receiving stream. ***Upper Left:*** Industrial discharge of poorly treated electroplating effluent to Brush Creek in northwest Montgomery Co. ***Lower Left:*** Treated industrial process wastewater discharged by the Whirlpool Corp. in Clyde to Raccoon Creek. ***Lower Right:*** Whirpool effluent mixing with Raccoon Creek immediately downstream from the 001 discharge.

PLATE 3. Nonpoint source and habitat impacted streams. ***Upper Left:*** The impact of unrestricted livestock access to the upper section of L. Beaver Creek in eastern Montgomery Co. This is an example of a severe nonpoint source impact which has completely eliminated riparian and instream habitat. ***Upper Right:*** Lost Creek in Henry Co. near Holgate. This typifies headwater stream habitat in the extensively disturbed Huron/Erie Lake Plain (HELP) ecoregion. The conversion of land use to intensive row crop agriculture and the subsequent draining of wetlands results in most HELP streams going intermittent or completely dry during the summer and fall months. ***Lower Left:*** Extensive bank erosion along the Shade River in Meigs Co. This is an example of what happens when the mature woody vegetative riparian buffer is degraded or eliminated. The extensive amount of large woody debris in the stream channel is from trees that were cut or made susceptible to falling into the stream due to the original disturbance. Bank slumping is also evidence that grasses are not an adequate vegetative cover for stabilizing stream banks. This will contribute a significant amount of sandy sediment to the stream bedload which is a typical occurrence when streams of the W. Allegheny Plateau ecoregion are disturbed in this manner. ***Lower Right:*** Stream channel deepening in Cottonwood Ditch in southwest Hardin Co. This type of channel modification is performed to improve subsurface drainage of the base slope soils of the northern tier of the E. Corn Belt Plains ecoregion and commonly throughout the HELP ecoregion. Bank slumping is evident here as well.

PLATE 4. Two streams in the greater Cincinnati metropolitan area. ***Upper:*** Briarly Creek represents an example of the limestone and shale bedrock substrates that typify the undisturbed streams of the Interior Plateau ecoregion. These streams are perched on the surface layer of limestone which shields the stream habitat from the naturally erosive forces precipitated by high flow conditions. ***Lower:*** Rapid Run has been severely impacted by the construction and maintenance of gravity flow interceptor sewers. The intent of the interceptor sewer projects in this area are to improve chemical water quality by regionalizing flows from package WWTPs located in the headwaters to larger WWTPs located on the Ohio River and its major tributaries. These sewer systems require periodic maintenance and replacement because of the erosive forces caused by the disruption of the surface layer of limestone bedrock. The "torrent" of limestone and shale debris moves downstream with each high flow event.

PLATE 5. Electrofishing techniques used to assess the health of the fish communities in rivers and streams, and water chemistry sampling. ***Upper Left:*** Boat electrofishing is used in large streams and rivers that are too deep and/or wide to sample effectively with wading methods. Sampling zones are generally 500 meters in length and are sampled in a downstream direction three times during each field season (July-October). Most fish tissue contaminant samples are also collected with this method. ***Lower Left:*** Wading electrofishing method which is used in wadable streams. A three person crew samples in an upstream direction over a distance of 150-200 meters two or three times during the field season. Most of the fish sampling is performed by Ecological Assessment Section staff. ***Right:*** Taking field physical and chemical measurements with an oxygen/temperature meter. Water samples are also collected and preserved according to standard methods and procedures from three to eight times during the summer-fall field season. Fixed station monitoring sites are sampled monthly by Ohio EPA District Surface Water Unit staff.

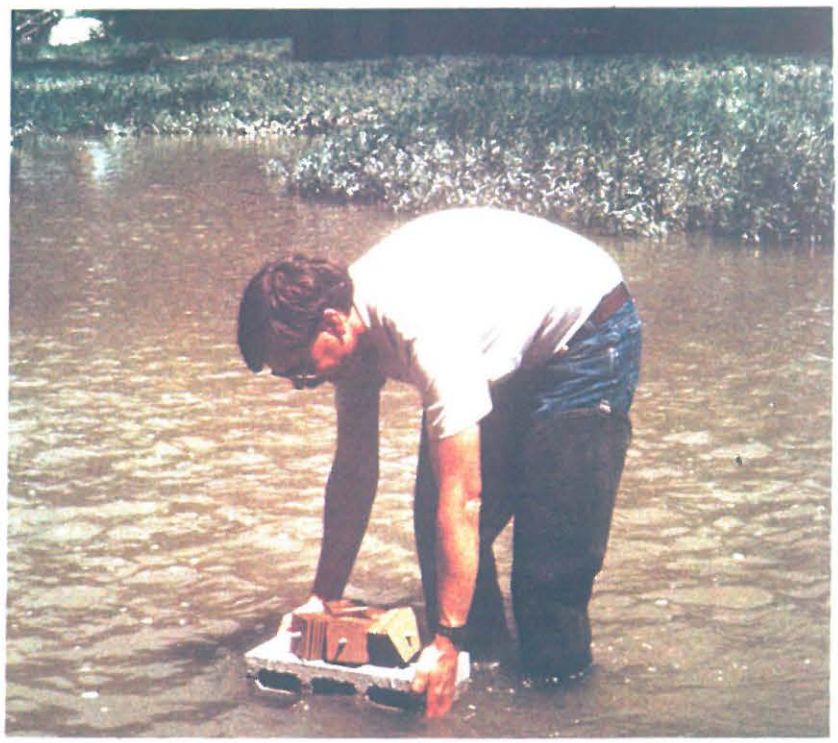


PLATE 6. Benthic macroinvertebrates and macroinvertebrate field sampling gear and techniques. ***Left:*** Triangular frame dipnet used to collect samples from the natural substrates and a set of modified Hester-Dendy multiple-plate artificial substrate samplers. Qualitative sampling from the natural substrates involves using the dipnet and sampling all available habitats. Sampling lasts at least 30 minutes and continues thereafter until no new taxa are observed. ***Upper Right:*** Benthic macroinvertebrates ready for detailed identification and sorting. Macroinvertebrates are predominated by the immature stages of insects, but also commonly include other arthropods, crustaceans (*e.g.* crayfish), annelids (segmented worms), and mollusks (clams, snails). Identifications are taken to the lowest taxonomic level practicable. ***Lower Right:*** Setting the artificial substrate samplers. Samplers are positioned in flowing water whenever possible and are retrieved after a six week colonization period during the period July-September. All macroinvertebrate sampling and analysis is conducted by the Ecological Assessment Section.

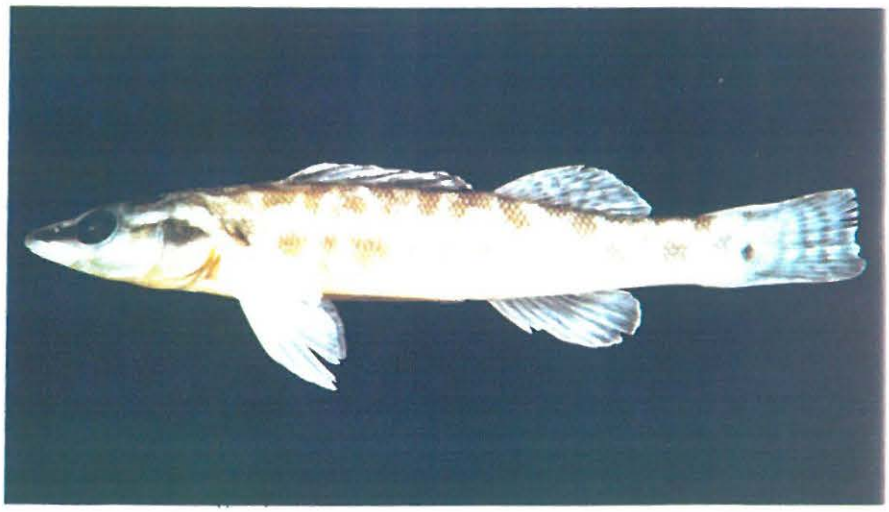


PLATE 7. Ohio River and large inland river fish species. ***Upper Right:*** A flathead catfish (*Pylodictis olivaris*) from the lower Muskingum River. This is common to the largest Ohio Rivers and is a sought after game fish in the eastern and southern parts of the state. ***Middle Right:*** The Ohio River downstream from Moundsville, W.Va. Ohio EPA has conducted night electrofishing surveys during the past three years along the Ohio shoreline. ***Lower Right:*** A slenderhead darter (*Percina phoxocephala*) which was collected from the Ohio River in 1991. This and several other large river darter species have been uncommon in the recent past. However, these species are being encountered more frequently by Ohio EPA fish sampling crews which is an indication of improving environmental conditions in our large rivers. ***Above:*** A freshwater drum (*Aplodinotus grunniens*) captured in the lower Muskingum River. This is a common species in large water bodies including rivers and Lake Erie. The pictured fish weighed 21 pounds which is one of the largest specimens recorded in the state.

PLATE 8. Two important native Ohio nongame fish species. ***Upper:*** A southern redbelly dace (*Phoxinus erythrogaster*) which is a signature species in high and moderate gradient headwater stream habitats. The range of this species has declined significantly in the past 10-20 years and is likely due to the increased direct and indirect degradation of headwater stream habitats. ***Lower:*** A variegate darter (*Etheostoma variatum*) which is part of a group of very colorful and sensitive species. Variegate darters are common to abundant in the exceptional Ohio streams and rivers in the Ohio River drainage. These include Big Darby Creek, Kokosing River, and several Ohio River tributaries of the Flushing Escarpment in eastern Ohio.

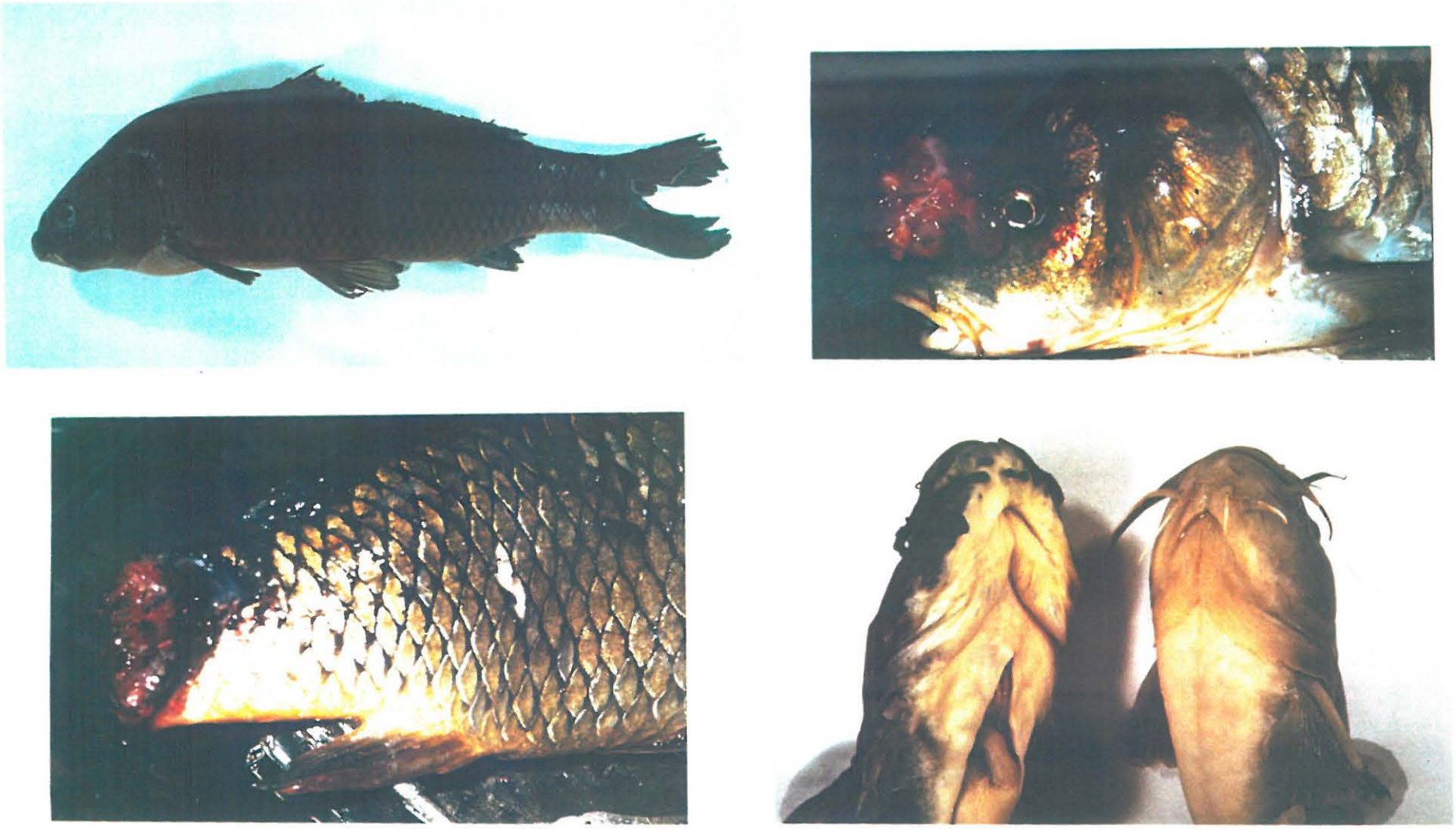


PLATE 9. Grossly disfigured common carp *(Cyprinus carpio)* and black bullhead *(Ameiurus melas)* captured in the Ottawa River downstream from major wastewater discharges. Specimens illustrate the DELT (Deformities, Eroded Fins, Lesions, and Tumors) external anomalies recorded by Ohio EPA. ***Upper Left:*** Common carp with a deformed head and heavily eroded fins. ***Upper Right:*** Common carp with a large nostril tumor. ***Lower Left:*** Common carp with a severely eroded caudal fin that has progressed into a lesion. ***Lower Right:*** A comparison of a black bullhead (*Ameiurus melas*, left fish) from the Ottawa River to a yellow bullhead (*Ameiurus natalis*, right fish) captured in the upper Cuyahoga River. The fish from the Ottawa River exhibits deformities, emaciation, eroded barbels, and increased melanism [Note: incisions were made for tissue study and preservation purposes].

1992 Ohio Water Resource Inventory: Questions and Answers

Q. Has stream quality improved in Ohio?

A. *Overall, yes (but there are site specific exceptions).*

Statistics

Overall Improvement in
Aquatic Life Uses[1]:
1979-1988: **34.5%** Attained Uses
1989-1991: **44.8%** Attained Uses
An overall increase in miles attaining
and a substantial decline in miles
of impaired streams & rivers
1979-1988: **44.0%** Impaired Uses
1989-1991: **29.1%** Impaired Uses

Q. Why have streams and rivers in Ohio improved?

A. *Much of the improvement reflected above is a result of improved municipal wastewater treatment. Ohio has invested more than 3 billion dollars in municipal wastewater treatment plants (WWTPs) since 1972.*

Statistics

Decline in miles impaired by WWTPs
Miles impaired 1978-1988: **2,002**
Miles impaired 1978-1991: **1,704**
Difference: **298 miles**

Q. What are the individual trends in water resource quality in the major Ohio river basins?

A. *Major trends in point source impacts are listed in Tables 1 and 2 and reflect changes between the early and mid 1980s to the late 1980s and 1990s. In addition, a general indication of the nonpoint source impacts and habitat conditions of these streams is indicated.. Some major river basins are scheduled to be monitored again in the near future thus trends will not be known until then:*

[1]The Ohio EPA monitoring program is biased somewhat towards sampling in areas where problems are known or suspected (*i.e.* point sources). Overall attainment may actually be somewhat higher in certain areas of the state where nonpoint impacts are low (*e.g.* parts of southeast Ohio), or lower where nonpoint and habitat impacts are more widespread (western and northwest Ohio).

Q. What are the major causes of the remaining problems in Ohio's streams and rivers?

A. *Low and marginal dissolved oxygen levels and organic enrichment is the leading cause of impairment. Sewage, urban runoff, and runoff from agriculture land uses are the main sources of this impairment. The 2nd and 3rd leading causes of aquatic life impairment are excess silt and sediment in runoff and habitat destruction. Thus, nonpoint source related problems are becoming increasingly significant threats to our surface waters.*

Statistics

Top 5 Major Causes of Aquatic Life Impairment

1. Organic Enrichment/ Low Dissolved Oxygen
2. Siltation
3. Habitat Destruction
4. Ammonia
5. Metals

Q. How much of Ohio's surface waters have been monitored for the impact of pollutants?

A. *Since 1978, Ohio EPA has monitored more than 7,900 miles of Ohio's streams and rivers. This represents 27.1 percent of all perennial streams. For larger streams (>100 sq mi drainage area), however, 67% of Ohio's streams and rivers have been monitored at least once. There are more than 118,000 acres of public lakes, ponds, and reservoirs in Ohio. Much of the data collected in these waters dates to the early 1970s; only in the last three years has Ohio EPA returned to an ambient sampling program for lakes in Ohio.*

Statistics

Streams & Rivers:
> **29,000** Miles of Perennial Streams
> **61,000** Miles of Perennial & Ephemeral Streams
> **7,900** miles monitored
1,700 miles monitored since 1990
305(b) report
Lakes:
450 Public Lakes > 5 Acres
23.8% Assessed for Aquatic Life Use Support

Q. What is the least protected aspect of Ohio stream and river quality.

A. *Stream and river habitat is the least protected attribute of surface water resources. Exceptions to rules protecting direct modification of stream habitat and extensive nonpoint related sedimentation of habitats both continue to contribute to the decline in aquatic resources in Ohio. While point sources of pollution have a mechanism to reduce problems (permits are required of all discharges) many nonpoint and habitat problems have no consistent and effective mechanism to reduce their impacts.*

Q. How can these nonpoint and habitat problems be addressed?

A. *Most habitat destruction could be avoided by simply avoiding impacts to the riparian zone[2] of streams and rivers. A rule-of-thumb guideline would be to leave 2 times the stream channel width on each side in forest or other natural vegetation.*

Both the Ohio EPA and ODNR have information on riparian habitat restoration and erosion control from construction sites, agriculture, etc. There are a series of voluntary "Best Management Practices" designed to minimize sediment, pesticides, and nutrients in runoff. Incorporation of ***both*** *riparian protection* ***and*** *widespread use of Best Management Practices would have substantial benefits to water resource quality and would likely preempt bureaucratic approaches to reducing these problems which are likely if voluntary approaches fail to produce results.*

Q. Are there any new or emerging problems in Ohio?

A. *One major problem emerging in the 1990s is the suburban development of once rural watersheds. This development could lead to severe degradation of streams and cause increased flooding problems if: 1) riparian zones are not protected, 2) erosion and sedimentation are not adequately controlled, and 3) stormwater and runoff problems are not attenuated. Streams need to be viewed as a resource and not a mere conveyance for "excess" water from lawns, parking lots, etc.*

[2]The riparian zone of a stream is the area of trees and vegetation in the immediate floodplain.

Q. Are toxic chemicals still a problem in Ohio?

A. *Yes, although certain groups of toxic compounds (e.g. metals, ammonia) are showing a declining trend in the amounts discharged and in their negative impacts on Ohio surface waters. Ohio EPA has developed a toxics reduction strategy and is participating in other initiatives (e.g. Great Lakes Initiative, pre-treatment and waste reduction programs) should continue to reduce toxic discharges to Ohio streams and rivers. There are areas of Ohio where significant evidence of toxicity (high rates of deformities, tumors, lesions, eroded fins in fish) is still found. The biological effects data collected by Ohio EPA are useful in identifying these areas so that abatement efforts can be focused on the worst toxic problems.*

Statistics

Pollutant	Decline in Miles Impaired (1978-1988 vs 1978-1990)
Metals	104.3
Priority Organics	14.7
Ammonia	107.4

Q. Are fish safe to eat in Ohio?

A. *Generally, yes. While there are lakes and rivers in Ohio where fish consumption should be limited (see Volume II of for details), fish from most streams and rivers in Ohio are relatively safe. In fact, for most people the addition of fish in the diet as a replacement for more fatty foods will reduce other health risks (e.g., heart disease). There are some general considerations, however, that will reduce the risk even lower:*

(1) omnivorous, bottom feeding fish (e.g. carp, catfish) generally have more contaminants than fish that have lower fat content and feed in the water column (e.g. walleye, bass, perch, panfish);
(2) most contaminants concentrate in fat tissue, so trimming fat from fish will reduce the risk of consuming contaminants;
(3) contaminated fish are more likely found in urban areas, thus rivers and lakes in rural areas not subject to urban runoff or pollution discharges have, in general, less contamination.
(4) become aware of the location of state or local fish consumption advisories (see Volume II) and follow any guidelines related to these advisories.

Unfortunately, fish contaminant monitoring has not received adequate funding to provide more detailed data on the areas of risk in Ohio.

Q. How is Lake water resource quality in Ohio? Is it improving?

A. *Unfortunately, not enough monitoring has been done to assess whether lake water quality has been improving or declining. Recently initiated monitoring needs to be continued and expanded to answer this question in the future.*

Unlike streams and rivers, few lakes are impaired by toxic impacts. The main problems in lakes are related to sediment and filling, and excess nutrients running into lakes from agricultural sources. Many of the solutions to reducing nonpoint runoff and habitat destruction in streams and rivers will lead to improvement in lake resources as well.

Q. How is Lake Erie water resource quality in Ohio? Is it improving?

A. *Little recent data has been collected in the nearshore or open lake areas of Lake Erie so trends cannot be ascertained. Many of the problems in Lake Erie (outside of nutrients and sediments delivered lakewide from nonpoint runoff) are found in the estuary areas near major cities. In these areas point source discharges are still a problem and areas of contaminated sediments remain. The worst of these areas are being addressed through Remedial Action Plans (RAPs) for the Maumee River, Black River, Cuyahoga River, and the Ashtabula River. In addition there is a lakewide consumption advisory for carp and channel catfish.*

Q. How can Ohio make good decisions between the environment and economic well-being?

A. *Usually what is good for the environment is, in the long term, good for the economy. There is a need to make sure, however, that dollars are spent where the environment can benefit. Neither the environment nor the economy benefit from misdirected dollars. Monitoring is the "engine in the machine" that implements plans for environmental improvements. The data in this report provide a mechanism for directing environmental spending. Without this type of monitoring we could not accurately set priorities nor know when environmental goals have been achieved. As an example, tertiary treatment of wastewater may provide little environmental benefit in some streams, but substantial benefits in others. Monitoring can discriminate between such situations.*

Q. What are "Threatened" Waters?

A. *Threatened waters are waters that are currently supporting their designated use, but the continued attainment of that use is threatened by some emerging source. For example, the upper Big Darby Creek watershed is currently attaining the Exceptional Warmwater Habitat aquatic life use criteria in many areas, but is threatened by rapid suburban development of tributary watersheds. This threat is real because construction sediment is already reaching some streams. Riparian zones, some already in poor shape, are not able to assimilate these impacts. Our experience from sampling over 4,000 sites across the state indicates that without intervention, these streams will decline in quality.*

Q. What basic surface water monitoring activities does Ohio EPA conduct?

A. *Ohio EPA conducts five main types of monitoring:*

1. Compliance: Ohio EPA district personnel sample the effluent of discharges across the state to ensure compliance with the requirements of NPDES permits
2. Complaints: Ohio EPA district personnel respond to citizen complaints and sample surface waters if necessary to determine the cause of any reported problems (e.g. chemical spills).
3. Basin Surveys: Ohio EPA district and central office personnel conduct intensive surveys of rivers, streams, and lakes across the state to gauge overall environmental quality and to support many of the surface water protection goals of the agency (permits, nonpoint pollution, etc.).
4. Long Term Monitoring. Ohio EPA district and Columbus office personnel conduct special sampling of ambient and reference (background) stations in rivers, streams, and lakes across the state to look for long terms trends in water resource quality. Some of these trends are discussed in this report.
5. Major Spill Response/Toxics Impacts. Ohio EPA responds to major spills in Ohio through the Division of Emergency and Remedial Response (DERR). DERR and other staff members also assess the ecological effects of hazardous waste sites in the State.

Q. How does Ohio EPA evaluate water resource quality and the overall quality of surface waters.

A. *Each year, primarily during the summer and early fall months, the Ohio EPA conducts intensive, integrated surveys in particular river basins across the state. During this Ohio EPA monitors the biological communities (fish and aquatic insects), water chemistry (toxic compounds, dissolved oxygen, metals, bacteria, etc.), the quality of the stream habitat, stream flow, and many other characteristics of surface waters. This data is compiled and analyzed and a report summarizing the results is completed, usually before the next field season. If a discharge is located on the river, the river assessment, along with data characterizing its effluent, is used by the Toxics & Standards section to recommend water quality based permit limits. The Five-year Basin Approach to monitoring is organized to address certain river basins each year on a consistent and rotating basis.*

Q. What streams, rivers, and lakes are in the best condition in Ohio?

A. *While this report focuses on many of the problem areas in Ohio surface waters there are many streams, rivers, and lakes of exceptionally high quality in Ohio. Big Darby Creek has been named one the "Last Great Places on Earth" by The Nature Conservancy. It is home to many rare and endangered fish and mollusk species, is a State Scenic River, and is under consideration for National Scenic River Status. In most medium and large rivers of high quality, streams that score high on our fish and macroinvertebrate community indices also contain sensitive and often threatened or endangered species of fish and other aquatic life. Not surprisingly, these waters invariably harbor the best fishing, recreational, and highest aesthetic qualities as well. Streams and rivers that rate as excellent under "habitat conditions" in Tables 1 and 2 all have the potential to rate among the best in Ohio.*